2023 ILUS

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ABSTRACT BOOK

Leibniz Institute of Ecological Urban and Regional Development
CAG CENTER FOR APPLIED GEOMATICS
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ABOUT ILUS 2023

The biennial International Land Use Symposium (ILUS) is an interdisciplinary conference with an objective to advance the understanding of built-up areas and to develop new ideas for sustainable urbanization. ILUS brings together leading international academics and interested attendees for presentation, discussion, and collaborative networking in the fields of spatial sciences, environmental studies, geography, cartography, GIScience, urban planning, architecture, which relate to investigations of settlements and infrastructure.

Under the umbrella of the thematic area, “Urban Analytics for Transforming Cities and Regions”, ILUS 2023 is dedicated to give answers to the question how interdisciplinary concepts in spatial analysis and data modelling can contribute and support sustainable urban and regional development. To this end, the symposium covers the major topics: Urban Dynamics, Resilient urban and regional systems, Open data in planning and urban management, and Big Data Analytics and Land Use.

The symposium includes original contributions from researchers with an objective to advance the knowledge on urban dynamics towards sustainability in the Global South and Global North.

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Resilient urban and regional systems
Keywords: Urban Heat, Environmental Justice, Satellite Data

Mapping the (un)equal distribution of urban heat

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Abstract:

The Universal Declaration of Human Rights recognizes the equal rights of all members of the human family. However, the environmental burden caused by industrialization and urbanization is often not shared equally. Even within a single municipality, communities with lower income are often exposed to higher environmental burdens than their wealthy neighbors and therefore experience more severe risks to health and productivity. Particularly the impact that urban heat has on different communities has so far been understudied on the large scale, particularly outside the US.

By combining a global dataset of summertime urban land surface temperature anomalies, derived from MODIS data with a 1 km x 1 km resolution, along with census data, we have conducted an assessment focusing on the US and select parts of Europe. Our findings reveal significant disparities in urban heat distribution. For the US, we observed that within 76% of the counties analyzed (and 54% concerning education levels), the poorest communities and the ones with lower average education levels experience significantly higher temperatures compared to the wealthier and/or more educated neighborhoods. Additionally, we identified a pattern where neighborhoods with higher shares of Black, Hispanic, and Asian populations tend to have higher temperatures compared to predominantly White and non-Hispanic areas in each county. This trend persists regardless of whether the counties have large or small variations in these population shares. We are able to link these disparities to the unequal distribution of vegetation and built-up areas.

ID: 121 / **A OD: 4**
Open data in planning and urban management
Keywords: Open Data, Geodata infrastructures, Participation system

An open source, cloud-supported and lightweight participation system for the support of spatial and urban planning processes.

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Abstract:

Urban sprawl and its negative consequences on biodiversity, climate, water and agriculture are one of the greatest challenges of the 21st century. That is why the United Nations calls for sustainable, socially and ecologically compatible urban development in its Sustainable Development Goal (SDG) 11 . Open data and modern land use models offer a great opportunity to investigate the consequences of planning and to show planning alternatives.

Until now, such data and the results of land use models have only been available to experts. This is not in line with SDG 4 and 16 which call for a public participation in spatial and urban planning processes. Online information systems are used toprovide access to the underlying data, and to ease involvement of interested citizens in the planning processes including the opportunity to make their own suggestions. two classes of such systems have become established, especially in Europe. The first class comprises specially developed systems that are often tailored to the needs of a planning authority, such as DIPAS of the Free and Hanseatic City of Hamburg. The second class comprises applications based on digital twins. Both systems require a high level of configuration and maintenance, which makes them very cost-intensive to run. In addition, digital twins in particular require high computing power on both the

server and the client side due to the massive use of 3D data and orthophotos. The high computational effort on the client side is an access barrier for interested people with not powerful hardware. Through a smart combination of different open source software components and cloud services , very lightweight and cost-effective participation systems can be developed. Using the example of a suburban railway extension west of Cologne, the development of such a system based on QGIS, QFIELD, Felt.com and Postgis will be presented. As a basis for the data, the free and open source geodata of the German federal state of North Rhine-Westphalia and the research results of the project Nachwuchs will be used. The research project Nachwuchs deals with the possibilities of a sustainable settlement development in the western part of the metropolitan region of Cologne. The project included the modeling of various scenarios for future settlement development and the development of a system of indicators that can be used to examine the effects of infrastructure projects on agriculture, ecology, housing and commerce.

First results show that the applicability of the presented model. On the client side, so little computing effort is required that a third-generation Rasberry PI is sufficient as a client. Particularly noteworthy is that through the close integration of QGIS and Felt interested citizens can be easily involved, for example by importing data from citizen research projects directly into the planning process. Citizens are also provided with the oportunity to analyze stored data by themselves and, based on this, to develop and introduce their own planning proposals.

ID: 236 / F UD: 1

Urban dynamics

Keywords: Semantic segmentation, land cover, foundation model

Optimised Neural Architecture Search Algorithm for Semantic Segmentation of Satellite Imagery

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Abstract:

Semantic segmentation of satellite imagery plays a crucial role in various urban planning applications. This abstract presents a novel algorithm specifically tailored for discovering optimal neural architectures to perform semantic segmentation on overhead imagery. The proposed algorithm capitalizes on the distinctive characteristics of overhead imagery, taking advantage of domain-specific biases while addressing its challenges.

The algorithm's distinct advantages lie in its ability to address key hurdles in satellite image segmentation:

1. Progressive Field-of-View (FoV) Increments: The algorithm introduces a strategic approach to progressively increase the Field-of-View (FoV) in segmentation models. This addresses the trade-off between capturing context and avoiding overfitting. By iteratively expanding the FoV and retaining subnetwork weights and structures, the algorithm achieves improved validation accuracy without necessitating training from scratch.
2. Flexible Capacity Tuning: Instead of employing a fixed filter multiplier for each block, the algorithm innovatively introduces capacity tuning at various scales. This is achieved through the inclusion of parallel blocks with identical downsampling rates, facilitating effective adaptation to different levels of detail in satellite imagery.
3. Adaptation to Wide and Shallow Architectures: The algorithm demonstrates a unique capability to model a wide range of network architectures, including shallow and wide structures. These architectures prove advantageous in handling satellite imagery due to their inherent capacity to preserve information across low and medium resolutions. The algorithm accommodates diverse connectivity patterns, optimizing adaptability to specific domain requirements.

By tailoring the search process to the idiosyncrasies of satellite imagery data, our algorithm showcases superior performance in discovering optimal neural architectures for semantic segmentation. We demonstrate automatic discovery of semantic segmentation models for built-up mapping using LISS-IV sensor imagery and building footprint mapping using Cartosat-2 imagery, which outperform previously developed models which were designed and tuned manually. Ultimately, the proposed algorithm opens avenues for enhanced semantic segmentation accuracy and efficiency in satellite imagery analysis.

Keywords: Neural Architecture Search, Semantic Segmentation, Satellite Imagery, Field-of-View, Capacity Tuning, Wide and Shallow Networks.

ID: 171 / B RU: 2

Resilient urban and regional systems

Keywords: urban flood, urban heat, adaptation, green infrastructure, numerical analysis, global south

Urban Heat Adaptation and Green Infrastructure: A Synthesis with Urban Flood Adaptation Perspectives

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Abstract:

Cities worldwide face the dual challenges of urban heat and flooding brought about by various factors such as urbanization, vegetation changes, and prevailing climate conditions. These factors contribute to the formation of urban heat islands and increased runoff during heavy rainfall events. Impervious surfaces like roads and sidewalks in certain cities intensify surface temperatures and exacerbate flooding. Addressing these interlinked challenges necessitates integrated strategies that encompass both urban heat and flood adaptation. In the case of world heritage cities like Ahmedabad, preserving historical significance and emotional value restricts structural modifications to existing buildings. Consequently, the limitations of space and resources require a strategic approach to climate adaptation, effectively managing both heat and flood extremes. Though various studies explore thermal comfort and mitigation strategies concerning urban morphology and vegetation, there remains a gap in connecting urban heat adaptation with urban flood adaptation. Urban heat mitigation through the lens of non-structural GI modifications, specifically stormwater management, remains an underexplored area of research. By studying how a specific GI strategy can simultaneously address urban heat and flood challenges, we can adopt a synergistic approach to urban planning and design. Little is known about the cooling potential of green infrastructures engineered for urban flood reduction, particularly in systematically disadvantaged cities in the global south. Urban areas often have limited resources for implementing adaptation measures. Studying the co-benefits of GI strategies for urban heat and flood adaptation allows us to optimize resource allocation and achieve multiple outcomes with a single intervention which helps maximize the efficiency of limited resources.

We propose to assess the urban heat mitigation benefits of specific GI practices designed for stormwater management in Ahmedabad. By simulating the urban heat for various GI strategies (e.g., Infiltration-based GI, Retention-based GI, and Evapotranspiration-based GI) in an area of approximately 1 km2 using ENVI-met v.5.5, we aim to gain insights into their effectiveness. We obtain urban heat mitigation efficiencies of the GI strategies adopted in our study in terms of Physiological Equivalent Temperature (PET), Mean Radiant Temperature (MRT), and Reduction in Air Temperature (Ta). We then transform the efficiencies by using a normalized scale which helps us rank the efficiencies of various strategies without being biased by the differences in measurement units. While the urban heat mitigation efficiencies are obtained at a finer scale, allowing us to pinpoint critical areas that could benefit the most from specific GI practices, we perform the flood analysis at an urban sub-catchment scale and obtain the effectiveness of various GI strategies in reducing runoff. Our initial results show that permeable pavements exhibit higher effectiveness in urban flood reduction. However, the thermal comfort benefits of permeable pavements are found to be contingent upon the surrounding urban environment. While showing limited impact on flood reduction, green roofs display substantial improvements in thermal comfort, particularly in areas characterized by low-rise buildings and higher

density. Our study takes into account the influence of site characteristics, such as building density and height, on the effectiveness of GI practices.

ID: 120 / C UD: 1

Urban dynamics

Keywords: Urban growth, Regional planning, Rural-urban migration, Urban densification, Stepwise regression analysis

Unraveling the Complexities of Urban Densification: Stepwise Regression Insights for Regional Planning on Belgium

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Abstract:

Since the advent of the 19th century, the phenomenon of rural-urban migration has propelled the rapid expansion of urban areas, necessitating innovative regional planning strategies. A crucial aspect of effective regional planning lies in identifying the pivotal variables that either stimulate or impede urban growth. Our prior research utilized a sophisticated multidensity multinomial logistic regression model to scrutinize the influence of various controlling factors, acting as explanatory variables, on urban densification, the dependent variable. However, it remains imperative to address the issue of variable (un)certainty. Consequently, we endeavor to enhance our comprehension of the intricate interrelationships among these explanatory variables and their level of certainty for inclusion in a comprehensive multiple regression model. To accomplish this, we undertake a sensitivity analysis utilizing backward stepwise regression(BSWR) techniques. Our study encompasses a thoroughly curated dataset comprising ten variables, encompassing geophysical, accessibility, and socio-economic factors, renowned for their impact on urban densification in the regions of Brussels capital, Flemish Brabant, and Walloon Brabant in Belgium. In order to maintain data homogeneity, our study focuses exclusively on the aforementioned regions. The findings of our analysis reveal that BSWR approach highlights the high significance of variables such as Zoning, number of Household, number of Jobs, Population density, Station, Local roads, and Residential Roads. Notably, the variables number of Jobs , residential Roads, Local roads ,Population density consistently emerge as imperative factors in both methodologies, demonstrating their vital role in urban densification modelling. This knowledge can guide policymakers in formulating targeted interventions to enhance job opportunities and manage population growth effectively. It also underscores the importance of considering factors like zoning regulations, household numbers, and transportation infrastructure in urban planning policies to ensure efficient land use, sustainable development, and the creation of liveable urban environments. While stepwise regression possesses certain limitations, it remains a powerful tool for effective model and variable selection, particularly adept at handling complex, large-scale datasets and streamlining the identification of key input variables, thus filling a void in conventional land use change models. By leveraging these findings, policymakers can make informed choices, adapt their policies to changing urban dynamics, and work towards a sustainable future, especially in the context of increasingly available data. Overall, our research contributes to advancing the understanding of urban growth patterns and provides practical implications for urban planning policies, empowering decision-makers to navigate the complexities of urban development and create resilient, liveable cities.

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ID: 244 / B OD: 1
Resilient urban and regional systems
Keywords: Fog, INSAT-3DR

Effect of urbanisation on fog over cities in Indo-Gangetic Plains using INSAT-3DR observations

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Abstract:

The Indo-Gangetic Plains (IGP) of India is among the most densely populated regions in the world, which observes dense fog condition during every winter. Urbanisation has increased the occurrence of fog in the IGP in the past two decades by adding pollutants and increased levels of aerosols as the condensation nuclei. Along with the increased number of condensation nuclei and favourable meteorological conditions, large-scale fog prevails during winter for a considerable period over this region. However, due to urbanisation the cities in the IG plains are observing less fog condition in comparison to the nearby rural or semi urban region with the presence of vegetation. INSAT-3DR data has been analysed for 2022-2023 wintertime to study this scenario in detail. It is observed that for most of the cases the city are going through less fog events as well as the dissipation of fog is rapid over these regions. Due to urbanisation the cities are mostly wormer than the nearby rural and semi urban regions. The low vegetation cover over the city region also results low humidity, which leads to reduction in fog over the cities. This event is very prominent over Delhi in comparison to nearby places like Faridabad and Gurgaon.

ID: 222 / F RU: 2
Urban dynamics
Keywords: Continental Polluted Aerosols, Lidar Ratio, Relative Humidity, Urban Aerosols

Lidar Ratio – Optical Property of Continental Aerosols at 355 nm with respect to Size Distribution of Continental Aerosols

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Abstract:

The extinction-to-backscattering ratio, popularly known as lidar (light detection and ranging) ratio of atmospheric aerosols is an important optical property, which is essential to retrieve the extinction profiles of atmospheric aerosols. The single scattering lidar equation is solved in order to determine extinction and backscatter profiles of aerosols using ground based as well as satellite based lidar observations. Thus, lidar ratio is an important optical property of aerosols to utilise the range-resolved lidar observations for atmospheric studies. Raman lidar can retrieve the extinction and backscatter profiles of atmospheric aerosols without estimating the lidar ratio. However, elastic backscatter lidar needs prior estimation of lidar ratio to retrieve extinction profiles of atmospheric aerosols. Thus, a physics-based methodology is developed to retrieve lidar ratio for continental aerosols. The wavelength considered in the present study to estimate lidar ratio is 355 nm; a third harmonic of an Nd:YAG laser. This important to understand particle sizes of the atmospheric aerosols.

Aerosols are compositions of various particles present in the atmosphere. The continental aerosol model as described by OPAC (Optical Properties by Aerosols and Clouds) package is considered in the present study to estimate the lidar ratio at 355 nm. Continental aerosol types are distinguished between desert and non-desert types and non-desert types are further subcategorised with respect to

amount of soot. The categories clean continental, continental average, continental polluted and urban along with maritime polluted aerosols are considered which are comprised of mainly water soluble and soot particles. Water soluble particles consist mainly of nitrate and sulfate particles whereas soot particles are generated in all kinds of combustion activities. Soot particles are supposed to be graphitic carbon. Clean continental aerosols represent areas with low anthropogenic activities whereas continental polluted and urban aerosols represent areas with highly polluted by man-made activities. Maritime polluted refers to a maritime environment under anthropogenic influence with high amount of soot particles.

The effect of relative humidity on the lidar ratio is also studied for each of these aerosol categories, as the lidar ratio is a function of refractive index of the aerosol, which depends upon the composition of aerosol. The lidar ratio at 355 nm for each of these aerosol type is observed to vary with respect to the size distribution of the aerosol. The radius of aerosol particle is considered between 0.07 μm to 0.6 μm where significant backscattering and extinction due to particles is observed. The lidar ratio is observed to decrease with relative humidity varying from 0% to 80% whereas lidar ratio is observed to increase with relative humidity varying between 90% to 99% for each of these aerosol models. The lidar ratio is observed to increase with increase in number mixing ratio of soot particles in the aerosol models ranging from clean continental to urban. In case of polluted maritime aerosols the lidar ratio decreased from 73.96 sr to 64.71 sr with relative humidity varying between 0% to 90% whereas lidar ratio increased from 64.71 sr to 68.98 sr when relative humidity further increased to 99%.

ID: 156 / F BD: 4

Open data in planning and urban management

Keywords: Land use, Remote sensing, User-generated Big Data, Open Data

A Review of Essential Urban Land Use Mapping Techniques: The Role of Remote Sensing and User-Generated Big Data

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Abstract:

Land use mapping is an essential tool to achieve sustainable urban planning, management, and growth. However, traditional land use mapping methods only rely on surveys, which presents several problems, including time, capital, use of incompatible categorisation systems and changing category definitions and data-gathering techniques by various organisations. With significant developments in Remote sensing (RS) in the mid-20th century, land use mapping has become easier to obtain with open data. However, Open RS data alone cannot effectively reflect the richness and diversity of urban land use. Recently, User-generated big data (UGBD) have been increasingly applied to map urban land use. Users create UGBD via interactions with various digital platforms and devices. Therefore, it can offer detailed information on people's activity and preferences in urban areas.

UGBD can be social media, web browsing, mobile device, sensor, and transaction data. These data may only be open data in some cases. Finding open data sources and employing suitable ones for the studies can be critical. Physical (RS) and socioeconomic (UGBD) factors can combine and improve urban land use mapping accuracy and quality. Previous studies have used various approaches and developed methodologies for mapping essential urban land use (EULU), a category in classifying urban functional areas by integrating RS and UGBD.

The paper aims to critically review EULU, its technical applications and identify its benefits and drawbacks as a mapping tool. First, the study will discuss sound open sources of RS and UGBD. Then, we examine the currently used techniques and applications for merging RS and UGBD for mapping essential urban land use, concentrating on the feature-level and decision-level ways of integration. RS and UGBD features are combined into a single feature set for categorisation through feature-level integration. In contrast, decision-level integration combines the categorisation findings from RS and UGBD independently using decision rules. We contrast the effectiveness and drawbacks of various integration techniques and offer examples of the maps of urban land use they produce. After considering

the suitable UGBD source and integrating it with RS, we also discuss some critical issues and challenges in the process of essential urban land use mapping at various stages, such as analysis unit setting, parcel segmentation, data availability, data privacy, data quality, parcel labelling, classification algorithms, and validation method. Integrating RS with UGBD is a promising and creative technique to map EULU accurately and with high resolution. As the final output, the paper aims to provide a methodology for EULU mapping from open RS and UGBD data sources. The output will cast light on further studies to solve technical and practical issues that are associated with this study and studies focusing on land use predictions.

ID: 146 / D RU: 4

Urban dynamics

Keywords: Flash floods, Geospatial framework, Resilient urban planning, Climate change adaptation, Sustainable urbanization

Integrated Geospatial Framework for Assessing and Mitigating Flash Flood Risks in Guwahati: Advancing Resilient Urban Planning in the Context of Climate Change

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Abstract:

The escalating incidence of flash floods in urban areas presents a pressing challenge for sustainable urban planning, particularly in Guwahati - a rapidly expanding city in India's North-Eastern Region (NER). The intensification of unplanned urbanization, coupled with changing weather patterns and natural drainage alterations, has amplified the city's vulnerability to flash floods that pose significant challenges to its urban infrastructure, public safety, and socio-economic well-being. This study examines the causes and impacts of flash floods in the city through a multi-dimensional analysis of various contributing factors, encompassing hydrological, meteorological, and socio-spatial aspects. The research assesses flood-prone areas by employing high-resolution geospatial data, including remote sensing imagery, digital elevation models, and land-use data. It identifies patterns of rapid urban growth, densification, and suburbanization that may exacerbate flash flood vulnerabilities. The study incorporates decadal data to analyse the long-term trends and patterns of the phenomenon under investigation.

The proposed geospatial framework in this paper aims to offer a comprehensive and integrated solution to enhance urban resilience and promote sustainable urban and regional systems in the face of increasing flash flood risks in Guwahati. A comprehensive climate change adaptation component shall be integrated into the framework to evaluate how changing weather patterns and extreme precipitation events influence flash flood occurrences in the city. The research will also explore the implications of climate change projections and their potential impacts on urban flood risks, providing valuable data for informed decision-making in resilient urban planning. To address the socio-spatial inequalities exacerbated by flash floods, an in-depth examination of vulnerable communities and areas at heightened risk shall be conducted. This analysis will involve a socio-economic assessment of the exposure, sensitivity, and adaptive capacity of the population, enabling the formulation of inclusive and equitable strategies for resilience enhancement. The findings of the research will be of significance to urban scientists, city planners, and policymakers seeking evidence-based approaches to foster climate change adaptation strategies to address the impending flash flood challenges. The research shall contribute to the advancement of knowledge on urban dynamics towards sustainability through a robust geospatial framework to comprehensively address the flash flood problems in Guwahati.

ID: 250 / A RU: 3

Resilient urban and regional systems

Keywords: Urbanization, Development Authorities, Suatainable Urban Development, Local Area Plan, Environment

Enabling Integrated Land use Plan through differential Planning Mechanism

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Abstract:

Gujarat's urbanization level was 43% as per census 2011, which is much higher than the national average of 31.16%. It is estimated, urbanisation will reach around 47% in 2021. To ensure sustainable urban development, State of Gujarat has put in place Gujarat Town Planning & Urban Development (GUTP&UD) Act, 1976. It empowers State Government for declaration of Development Authorities, entrust authorities for preparation of development plans, town planning schemes, local area plans, design general development control regulations, bye-laws for planned urbanization and other tools required for ensuring integrated urban development. Further, this legislation facilitates the availability of land for infrastructure, utilities, and public spaces, fostering livable cities with enhanced environmental and social-economic conditions.

With an approach to keep evolving and swiftly responding to the changing times and needs, State of Gujarat has demonstrated its readiness to keep amending existing laws and enacting new ones from time to time such as, introduction of Local Area Plans (LAP) in 2014, statutory backing for Transfer Development Rights (TDR) in 2014, and Comprehensive General Development Control Regulations (GDCR) in 2017. Customized legislative initiatives like the Statue of Unity Area Development & Tourism Governance (SUAD&TG) Act, 2019, and Ambaji Area Development & Pilgrimage Governance (AAD&PG) Act, 2022, address specific area development needs.

Ahmedabad Urban Development Authority (AUDA) prepares Development Plan under GTPUD Act at regular interval as per provisions in the Act. Development Plan is a macro level planning which broadly focuses on city level interventions in planning. These plans encompass zoning proposals, development regulations, transportation and infrastructure planning. Serving as a vital framework for regeneration and private sector investment, Development Plans influence decision-making and resource allocation and also conceptualises and shapes the three dimensional urban environment.

This paper focuses on how beautifully differential FSI (Floor Space Index) can be planned and implemented for land use by private developers. It discusses Gujarat's experience and highlights the importance of continuous legislative evolution how it manages pace with changing urban dynamics. The state's readiness to amend existing laws and enact new ones reflects a forward-looking approach that prioritizes the well-being of its citizens and the environment. By embracing innovative mechanisms and enabling policies, how the State exemplifies a model for fostering sustainable, integrated, and resilient urban development that can serve as an inspiration for other regions facing similar urbanization challenges.

ID: 253 / E BD: 5

Big Data Analytics and Land Use

Keywords: Urban heat islands, Land Surface Temperature

Development of Artificial Neural Network Model to Retrieve Land Surface Temperature using SLSTR Sentinel-3A TIR Observations

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Abstract:

Over the past few decades, the urbanisation has been increasing in the global cities. The combination of rapid urbanization and massive infrastructural development affects the urban environment and

exacerbates climate change at a regional or global scale. Therefore, extreme heat wave, floods, hazards and various catastrophic events have increased significantly in urban regions. In climate change, the predominant influencing factor is the Urban Heat Island (UHI) effect. A few studies demonstrate that urban temperatures have experienced recent increases attributable to the UHI effect. Since the Land Surface Temperature (LST) drives the land-surface energy interaction and water balance, it is one of the essential parameters in the study of UHI. Satellite-derived LST offers superior spatial and temporal resolution as it covers larger geographical areas. Since many decades, satellite derived LST has been extensively utilized in the study and modelling of the UHI cities. In present study, we are proposing newly developed Artificial Neural Network (ANN) model for the purpose of the LST retrieval using Sea and Land Surface Temperature Retrieval (SLSTR) TIR bands 1&2 onboard Sentinel-3A observations. The model has been built by the collection of the atmospheric Radiative Transfer (RT) methodology and Deep Learning (DL) modelling, which provides effective results with the high precision by the DL data driven capabilities. At-sensor radiance simulations obtained from the MODTRAN 5.3 RT model were used for ANN modelling. Substantially, nearly five lakh simulations have been obtained for the tropical region. Among them, 80% dataset are used for the model training and remained dataset are used in the analyses of the accuracy assessment of the ANN model. The theoretical accuracy assessment results of the ANN model show remarkable accuracy with <0.5 K RMSE and R2 value of 0.99. Substantially, the developed ANN model has been applied over the SLSTR TIR observations over the western part of India. The retrieved LST is conventionally compared with the standard LST product of the SLSTR for the validation purpose. The high correlation between the retrieved LST results and the standard LST is shown with the <1 K RMSE and 0.98 R2. Consistent findings underscore the efficacy of the ANN model in LST retrieval. The proposed ANN model represents a significant advancement in the historical progression of LST retrieval through satellite remote sensing observations. The obtained results indicate that the proposed model is feasible and reliable in the model development as well as LST retrieval with high precision.

ID: 109 / F RU: 1

Urban dynamics

Keywords: Urban form, Morphology, Air quality, Dispersion.

Between Urban Form and its Air Quality at the Local Scale

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Abstract:

In today's world India has gained much attention because of its air pollution, and to combat this, India has developed a few action plans for the city to collect the pollution sources for further analysis. However, with this as a base, countries have moved forward and have established a relation between the urban form and air pollution stating that "the air pollution concentration is described as the rate of emission and the rate of Dispersion. The emission rate is the effect of the pollution source, while natural components like relative humidity, temperature, and wind speed affect the rate of Dispersion. Urban morphology acts as a barrier to these natural components resulting in accumulation, venturi, and fugitive air pollution, and creates microclimates within the city. It states that the distinctive spatial form of a neighbourhood creates its unique wind environment, which is responsible for trapping and dispersing pollutants".

This hypothesis examines the relationship between urban form and urban air quality at a local level by taking the dispersion study approach. It was conducted in two stages by taking Nagpur, Maharashtra, India as a case. The first stage focuses on the city-level analysis, where air quality and sources of pollution were identified using kriging and inverse distance weightage in ArcGIS, which provide details on the distribution of emissions within the city for various pollutants. The urban form was explained by quantifying the shape, size, compactness ratio, and sprawl. The pollution concentration levels were

further integrated with the population density map and local climate zone map to understand "what spatial configuration lies underneath the different pollution levels."

In the second stage, four different zones were formulated based on the pollution concentration scenario at the local scale for comparison by integrating pollution, people, and urban form. The zones were categorized as High Pollution-High Density, High Pollution-Low Density, Low Pollution-High Density, and Low Pollution-Low Density, mentioning the source apportionment. Here the spatial configuration at the local level was also quantified based on three indicators: Canyon aspect ratio, Building volume density, and Plan area fraction. To further understand, CFD simulations in Autodesk Flow Design were carried out through these zones assessing the accumulation or Dispersion of wind between these zones, which can be responsible for trapping or dissipating the pollution.

The results show that the areas with high emissions and high density have low ventilation conditions, confirmed by simulations. The ventilation conditions were good in low pollution – low density because the distances between buildings were greater. The street canyons have a ratio of less than one, resulting in less turbulence and high wind velocity. Therefore, the complete analysis and the hypothesis testing indicated a significant relationship between urban form and air quality at the local spatial scale. This study highlights the need for tactful land use planning and rethinking local urban morphology by considering dispersion studies to create a suitable microclimate.

ID: 106 / C LT: 1
Submission for Posters
Keywords: Urbanization, LST, NDVI

Analysis of Urban Expansion and its Impacts on Land Surface Temperature and Vegetation Using RS and GIS, A Case Study in Metro Cities of Gujarat

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Abstract:

The present study aims to explain the impacts of urban expansion on land surface temperature and vegetation of Ahmedabad, Gujarat using integrated techniques of remote sensing (RS) and geographic information system (GIS). Urbanization is one of the potential driving factors for land use/land cover (LULC) change, vegetation decrease, and land surface temperature (LST) increase. To access information about the spatial and temporal land cover change, the use of two essential sources RS and GIS is indispensable. This study focuses on LULC changes in Metro cities of Gujarat for the last three decades (1987-2018) using Landsat satellite images. The images from Thematic Mapper (TM), Enhanced Thematic Mapper (ETM+), and Operational Land Imager (OLI) of Landsat satellite are utilized. The results are as follows: (1) Most metro cities experienced strong urbanization over the last 30 years with an increase of 72.3% in the urban area. The urban expansion pattern from 1985 to 2004 is alternate infilling and edge expansion in interior region, while from 2004 to 2022 is dominantly edge expansion toward outer region (2) Urbanization has negative effects on normalized difference vegetation index (NDVI); from 2004 to 2018 vegetation cover has decreased sharply in outer districts of Gujarat. (3) There is a synergetic relationship between urban expansion and LST. (4) The correlation between LST and NDVI is strongly negative, which indicates vegetation can relieve the effects of LST to some extent.

ID: 168 / C UD: 2
Urban dynamics
Keywords: Soft densification, vacant lots, residential infill, regression

Determinants for soft densification – understanding processes of residential infill on vacant lots

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Abstract:

Although urban densification is a widely adopted strategy to reduce urban sprawl and to promote sustainable urban transformation, there are still substantial amounts of untapped infill potentials within urban areas. While larger infill potentials like brownfields are typically developed with the involvement of local planning authorities and project developers, small-scale potentials like vacant or underused lots receive little attention by planning. Hence, densification in suburban areas or on vacant lots often happens unplanned, driven by multiple private owner decisions. Many lots stay vacant for decades while in other areas a high amount of densification takes place. For an evidence-based discussion on strategies to facilitate or regulate future infill, research on these decentralized processes of soft densification is needed. In this contribution we thus suggest an empirical approach to evaluate under which conditions residential infill on vacant lots is more likely and which factors are important for the realization of different densities in the case of a development. Based on highly detailed data on development on vacant lots from 2011-2021 at the level of individual parcels, we test logistic regression and random forest classification to predict a) if a vacant lot remains vacant or not and b) if it is built-up, whether low-density housing or housing with higher densities is developed. As explanatory variables we use land prices and accessibility as well as parcel- and neighbourhood characteristics, which we expect to be good predictors for the individual owners' decision. We apply the approach to a study area in Germany, covering an area of 11,000 km² with 3.3 million inhabitants and urban as well as rural areas. The results can support preliminary assessments for steering and managing densification processes, particularly in suburban areas where still a lot of vacant lots exist.

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Mapping soft densification: a geospatial approach for identifying residential infill potentials
In: Buildings and Cities 4 (2023) 1, S.193-211
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Ehrhardt, Denise; Eichhorn, Sebastian; Behnisch, Martin; Jehling, Mathias; Münter, Angelika; Schünemann, Christoph; Siedentop, Stefan
Stadtregionen im Spannungsfeld zwischen Wohnungsfrage und Flächensparen. Trends, Strategien und Lösungsansätze in Kernstädten und ihrem Umland
In: Raumforschung und Raumordnung | Spatial Research and Planning 80 (2022) 5, S.522-541
https://doi.org/10.14512/rur.216

ID: 227 / D UD: 4

Open data in planning and urban management

Keywords: inner urban development, residential construction activity, GIS analysis, Global Human Settlement (GHSL), Census

Inner urban development in Germany. Estimating the extent of inner urban development in German municipalities between 1979 and 2011

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Abstract:

Inner urban development is a guiding principle for sustainable settlement development and is considered a key to achieving reduced respectively zero net land take. At its core, inner urban development aims at mobilising development potential in already-developed urban areas. As a multi-dimensional approach, it can take place on urban green spaces, gaps between buildings, sites with suboptimal land use available for restructuring or densification, brownfields formerly used for commercial / industrial purposes, former road or rail facilities or airports, and ex-military sites, as well as through the conversion or reuse of existing buildings.

To date, however, it is challenging to retrospectively determine the share of residential construction activity realised as inner urban development. This is due, on the one hand, to the legal and physical fuzziness of what constitutes an urban area and, on the other hand, to the lack of small-scale data on building activity necessary to determine the share of inner urban development.

Against this background, this study presents for the first time - on the basis of the open data of the Global Human Settlement Layer (GHSL) and small-scale data from the Building and Housing survey of the Census - a methodological approach with which the relevance of inner urban development can be measured and evaluated for large study areas over an extended period of time. By overlaying both data sets, the approach makes it possible to differentiate residential construction activity according to inner urban and greenfield development. The method is applied to Germany and a total of 9,438,010 newly built housing units between 1979 and 2011.

The results show that with 5,381,407 newly built housing units between 1979 and 2011, about 60 % of the residential construction activity was realised as inner urban development. Results also show a positive trend, indicating that the cities and municipalities have succeeded in building more housing units in already-developed urban areas over time. At the same time, major differences between urban and rural areas become apparent, with urban and more central regions being more successful in directing residential construction activity towards existing settlements and already-developed urban areas. Therefore, a key recommendation is to encourage and support especially smaller municipalities in their infilling efforts.

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ID: 164 / C RU: 1

Resilient urban and regional systems

Keywords: Urban land-use planning, Blue-Green Infrastructure, Climate change action, Geospatial analysis, Policy analysis

Integrating Blue-Green Infrastructure into Urban Land Use Planning: A Comparative Assessment of Indian Cities

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Abstract:

Urban centres comprise man-made infrastructure and natural elements vital to city growth. Among them, blue-green infrastructure (BGI) has emerged as a multi-benefit solution to address the challenges of globalization, urbanization, and climate change. Urban land use planning is pivotal in developing and safeguarding BGI in cities. As Indian cities experience rapid growth led by the private sector, integrating BGI into land use planning becomes increasingly crucial to balance the preservation of green spaces and water bodies with economic goals. The non-coherent functioning of multiple organizations and the lack of alignment between urban planning instruments such as master plans, development control regulations, and climate action plans pose challenges for Indian cities and city regions undergoing rapid urbanization.

While existing research often focuses on either spatio-temporal analysis of urban development or policy analyses of land use plans and climate action plans, this study investigates both urban development and land use transformations, and land use planning policies. It particularly explores the effects of differences in land-use policies on the development and protection of BGI in Indian cities facing rapid population growth and climate-induced disasters like flooding and heat stress.

The research uses two broad types of methods - (i) Geospatial analysis and (ii) Policy analysis. This study involves geospatial analysis of the built-up area, BGI, and climate variables for the past two decades using open-access secondary datasets and software. Concurrently, a policy analysis examines the temporal evolution of land use planning approaches that integrate BGI and climate change policies in the Indian context based on content analysis of policy documents and action plans published by public institutions. The investigation is conducted in selected Indian cities, based on criteria such as population growth, frequency/intensity of urban flooding, and heat stress.

This research examines plans and policies focusing on BGI integration to understand their vision and implementation in urban land use planning and management. Using spatio-temporal analysis aligns with India's National Geospatial Policy (2022), emphasizing citizen-centric geospatial development and information management. The research presents spatio-temporal visualizations illustrating urban land use transformations and their correlation with land use and BGI planning policies, impacting the city's resilience to climate change. Moreover, it provides a comprehensive understanding of the relationship between land use and urban development policy and the integration of blue-green infrastructure in Indian cities. These insights can inform urban planners and policymakers in formulating effective strategies to create sustainable, resilient, and ecologically balanced urban areas facing ongoing urbanization and climate change challenges.

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ID: 139 / D OD: 3

Open data in planning and urban management

Keywords: Community Participation; Data Driven Insights; Sustainable Neighbourhood; Inclusive Planning, NMT and PT; Capacity Building

Engaging with communities in data-based planning: Case study of Sustainable Mobility Accords Project, Bengaluru, India

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Abstract:

Community participation in data collection not only helps to improve the quality of data collected for planning but it also makes the process engaging, inclusive and transparent. As the community plays a role in data collection and analysis, it is more open to the interventions suggested based on insights derived from analysis of the data. Sustainable Mobility Accords (SuMA) is a programme being implemented in Bengaluru in India, by the Directorate of Urban Land Transport (DULT) in partnership with community-based organisations (CBOs) in seven selected neighbourhoods. The objective of the programme is to nudge increased use of sustainable mobility modes like walking, cycling and public transport. In SuMA, the selected CBOs prepared proposals for improving the infrastructure for sustainable mobility modes based on the key insights arrived from household surveys, Focus Group Discussions (FGDs) and Local Area Mobility parameters (LAMP) audit. DULT earmarked Rs 50 lakhs for each neighbourhood for implementation of the selected proposals.

Data relating to demographics, socio-economic profile, travel diary, issues, and concerns with respect to mobility were collected in the household surveys through volunteers identified by the CBOs. FGDs, facilitated by the CBOs, were conducted with selected senior citizens, women, children, people with disabilities, people from lower income strata and individuals commuting to the neighbourhood for work. LAMP audit being of highly technical nature and time-consuming was done by the DULT, but the results in the form of report were shared with the communities. Overall, the process was fruitful, and helped DULT and the communities to understand the neighbourhoods, their mobility patterns, and the challenges better. Based on the insights gained from this process, the CBOs formulated proposals for implementing interventions to promote sustainable mobility in their neighbourhoods. The results of data analysis, infrastructure audit and draft proposals were then exhibited for the larger community to give

their feedback. The proposals which received the most votes from the community were taken up for implementation.

This research paper shares the approach followed by DULT, Government of Karnataka, India in engaging with communities in data-based planning under SuMA, and the learnings gained in the process.

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ID: 187 / C LT: 4

Submission for Posters

Keywords: m-governance, citizen-centric phase, digital urban infrastructure, design-thinking, user experience

The Interface of Governance: Assessing the Design of Civic Apps in Indian Cities

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Abstract:

It is estimated that 71% of India's population owns a smartphone in 2023. This rapid adoption, coupled with India's Digital India initiative, has led to a surge in governance through mobile applications or m-governance, aiming to bring civic services to citizens' fingertips. The centrally-sponsored Smart Cities Mission aims for finding smart solutions to urban development, but there are challenges in meeting the objectives of good governance like efficiency, effectiveness, and citizen participation due to flaws in the product development cycle and user experience (UX). This study aims to critically analyze the m-governance tools provided by selected Indian cities to assess design, quality, inclusivity, and overall citizen experience by examining:

1. The possibility and potential of an open design environment to ensure standardizationa across these applications.
2. The basic standards, guidelines and quality parameters followed by Urban Local Bodies (ULBs) for developing efficient m-governance applications
3. The m-governance apps are efficient and usable ensuring a positive citizen experience regardless of digital literacy.

This study aims to assess the different mobile applications provided by select 3 to 5 cities in India, based on their design, development, quality and range of services provided, and inclusivity and accessibility of these applications to assess the overall experience provided to the citizens.

A design-thinking (DT) approach has the potential to strengthen collaborative structures in smart cities and thus aid in building resilient urban systems. This is because the principles of DT, such as radical collaboration, experimentation, prototyping and iterative design, align with the citizen-centered, problem-solving perspective of collaborative innovation, which is the underlying objective of Smart Cities Mission.

Hence, for this study, we would adopt an interdisciplinary approach by leveraging the design thinking process and thus conduct the following activities to assess the m-governance tools provided by the selected ULBs:

1. UX Audit - analyzing the products and services and the experience they offer to citizens based on tenets to identify shortfalls pertaining to branding, ease of first use, navigation, usage of normalized patterns, ethical design, feedback loops, system statuses, grievance redressal, contextual help, task lifecycle, and range and quality of available micro-services. This assessment will help gauge inclusivity and accessibility for both, digital natives and digital immigrants.

2. Generalisation & Standardisation - identifying opportunities to establish certain standards that can be followed to make the ecosystem of apps seem cohesive and interconnected.
3. Identifying Global Benchmarks - identifying standards, guidelines or best practices followed by other countries worldwide and learning from them.

The objective of this study is to formulate recommendations for government bodies to create better m-governance tools to facilitate urban development. The findings of this study would be of interest and importance to any government or private institutions that are eager to transform cities by improving or developing m-governance tools.

ID: 208 / C UD: 4

Resilient urban and regional systems

Keywords: policy analysis, urban densification, Switzerland, ground lease, zoning

Shifting planning approaches and their effect on urban development in Bern, Switzerland

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Abstract:

To reduce land take from urban development, governments worldwide promote construction within the already built-up area. However, unlike greenfield development, such urban densification takes place within a web of existing ownership rights, requiring local governments to adopt new planning approaches that extend beyond their conventional zoning practices. In Switzerland, this shift in urban planning challenges has led to a renewed interest in the alternative instruments of long-term ground leases and so-called special land use zones, which allow for deviations from existing zoning regulations, thereby granting both municipality and landowner more leeway of action. The question arises, how these instruments affect urban development. Therefore, the aim of this contribution is (1) to measure how the use of alternative instruments develops over time, what kind of municipalities make use of them and what kind of projects they apply these instruments to; and (2) to explore differences between the resulting projects in terms of building morphology, provision of green spaces and population density. For this, we develop a GIS-based approach that automatically detects construction projects and divides them by transformation type (i.e. greenfield development or densification, where densification is further divided into residential redevelopment, infill, and brownfield redevelopment). We then characterise construction projects regarding their ground coverage and building and population density. Ultimately, we perform an ANOVA to test for siginificant differences between the three planning approaches – standard zoning, special zoning and ground lease. We find that especially the most urbanised municipalities have transferred almost entirely to the use of special land use plans. Since 2020, all larger-scale densification projects have been completed with a special land-use plan. Overall, compared to projects without special land-use plans, these developments show significantly higher building densities, but the measured effects vary between municipalities of different sizes. Thereby, our study provides an important empirical contribution to debates on the effects different planning approaches on urban development.

ID: 245 / E BD: 4

Big Data Analytics and Land Use

Keywords: Data analytics, Artificial Intelligence, Machine Leanring, High-resolution, Image Processing

Data Analytics and Artificial Intelligence for High Resolution Data Processing

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Abstract:

Modern urban studies invariably include multi-modal high-resolution datasets to focus on microscopic aspects that affect the region of interest. In the realm of high-resolution satellite data processing, Data Analytics powered by Artificial Intelligence (AI) and Machine Learning (ML) has emerged as a transformative force, revolutionizing how we extract actionable insights from intricate and voluminous datasets. By leveraging AI and ML, data analytics can autonomously identify intricate patterns, classify land cover types, detect subtle changes over time, and predict trends with unprecedented accuracy. These technologies not only enable rapid and efficient processing of massive datasets but also enhance our ability to understand complex geospatial relationships that might otherwise go unnoticed.

While high-resolution data is desirable, the implementation complexity of high-resolution imaging systems has grown many fold in last few years, mainly due to requirements on high spatial resolution, spectral resolution as well as swath. Most high-resolution sensors produce raw data affected from aberrations, making them unsuitable for use in applications directly. Images obtained from such sensors often contain time-varying artifacts such as blur, noise, atmospheric interference, data loss, and variations in lighting conditions. Owing to these complex design and realization procedures, and due to limits of imaging, it is difficult to remove them completely from system development perspective. Ground systems have tried to traditionally alleviate the issue to some extent by applying sophisticated signal and image processing techniques. However, due to their parametric nature, the techniques have their own set of limitations such as incosistent output quality and inability to understand complex patterns of such aberrations.

In this work, First, we present a survey style qualitative and quantitative comparison of some key AI/ML based Data Analytics techniques which have surpassed the power of classical techniques to harvest the power of high-resolution raw data. Additionally, we present results from AI models developed at Space Applications Centre, Indian Space Research Organization (ISRO), which play crucial role in enabling information extraction from the data obtained from ISRO's high resolution sensors. Specifically, state-of-the-art algorithms related to image restoration, super-resolution, image fusion, image-to-image translation, image stitching, and semantic segmentation are comared and discussed. We show that these advanced techniques, which harness the capabilities of AI and ML algorithms, offer opportunities to unlock the full potential of high-resolution satellite imagery. The presented work will provide useful insights about the scope and applicability AI/ML models to tackle real world problems related to high-resolution imagery, to the geospatial data processing audience.

ID: 246 / A OD: 3

Open data in planning and urban management

Keywords: Open data, FAIR policy, Blockchain, Geospatial data, Hyperledger

BEGNET: A Blockchain Enabled Decentralized Geospatial Data Sharing Platform for Promoting Open Data

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Abstract:

Timely, multi-modal data at appropriate resolution is a critical driver for the planning and management of urban projects. Most agencies implementing such projects find it difficult to discover the data kept in individual silos distributed across the globe. While the FAIR (Findable, Accessible, Interoperable, and Reusable) policy from the Open Geospatial Consortium (OGC) alleviates this issue to some extent, the nature of the underlying technology stacks still requires that the data is far from discoverable. For example, while cloud-based systems and geospatial portals distribute the data faster than ever, non-technical users are expected to know the technical details to fetch the data from across these portals for their purpose. Also, the user finds it difficult to automatically discover the availability of a new source of data which is relvant to the their project without the need for explicit advertisement. Additionally, current systems don't allow data acquired by individuals or independent small-scale organizations to be shared easily in a peer-to-peer, easy-to-integrate manner with large portals.

To solve this, in this work, we conceptualize and detail the prototype of BEGNet- a peer-to-peer Blockchain-Enabled Geospatial data sharing Network which allows secure, trustless, and large-scale sharing of geospatial data amongst its users. The proposed system has three key components - Blockchain, Transaction Processor (TP), and Web-interface. While the Blockchain subsystem is responsible for securely storing the Geospatial metadata in a peer-to-peer network, the Transaction Processor subsytem enables smart-contracts that ensure that the raster and vector data uploaded to the chain is validated as per on-chain rules. The web-based system is runs at every node and acts as a local browser for the data stored in the blockchain. A reputation and voting mechanism built into the system ensures its usefulness over time.
We also outline a prototype implemented using the Hyperledger framework, based on these concepts. Our developed system enables cross-sensor, multi-platform, complex queries directly on individual nodes without browsing multiple portals. At the end, we discuss some implementation aspects and limitations that exist in the current system.

ID: 160 / B OD: 2

Open data in planning and urban management

Keywords: Open data, Geospatial, Democratization, Data for all, Geospatial Revolution

Open Geospatial Data: A Revolution in Making

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Abstract:

Geospatial data essentially includes information about the surface of the earth and features above it. Since long time we are using such information for navigation, trade, planning, military, administration, decision-making, engineering and planning purposes.

Geospatial technology thrives on geospatial data, the more accessible the quality data, the more robust will be its outcomes and subsequently applications in the real word. Availability constraints of remote sensing and GIS data always posed challenges to the intended users. There were several issues regarding proprietary rights, ownership, high cost, accessibility and restriction on usage of geospatial data which hampered the growth of Geospatial domains and its applications for societal benefits.

Geospatial technology is directly benefitting us in several ways, whether it is urban planning, infrastructure planning, environmental issues, disaster management, community health, demographics, agriculture or businesses, GIS is contributing its own bit in significant manner. The geospatial technology has changed the way we live. Therefore, opening up free usage of geospatial data is of paramount importance for analysis, developing models and coming out with meaningful inferences which can be beneficial to all. The more we democratize the data, the more we will be benefitted by it.

There have been continued efforts at international level by many agencies to make data available in public domains without restrictions. Such data are in the form of satellite images, vector data & associated non-spatial data, maps. Apart from this, there are also many open platforms available for geospatial analysis.

There are several authentic and reliable sources of open geospatial data available globally for common use. These open datasets can be utilized by planners, researchers, domain experts etc. for their assignments. Some of the major sources of open geospatial data are- Open Street Maps, NASA's Earth Science Data Systems Program, United State Geological Survey, European Space Agency, Natural Earth, Global Forest Watch, Humanitarian Data Exchange, United Nations, OpenDEM, Global Administrative Areas and NRSC's Bhuvan.

In present time, due to availability of enormous amount of open geospatial data students, researchers, small private organizations are able to utilize it without worrying about financial constraints and licensing issues.

Democratization of geospatial data is revolutionizing evidence-based decision-making, urban planning (smart cities are the best example), disaster preparedness & management, precision agriculture,

governance, epidemiology (it helped a lot during COVID pandemic) and environmental-societal initiatives. These are just among a few resultants of the transformative potential of the open data revolution. The possibilities are endless and opportunities are innumerable.

However, there is still reluctancy in many organizations regarding data sharing which lead to duplicity of efforts, wastages of resources and inconsistency. Therefore, it is important for governments to understand that this is the age of sharing and collaborations, so they have to come forward to facilitate data availability to the geospatial community for common use.

Embracing and promoting open geospatial data not only empower individuals and organizations but also drives sustainable development addressing many global issues while ensuring a more equitable and secure future for the mankind and life forms.

ID: 228 / C LT: 6
Submission for Posters
Urban dynamics
Keywords: wetlands and type, urban, remote sensing, spatial resolution

Spatial resolution and urban wetlands dynamics using Resourcesat-2/2A satellite data

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Abstract:

Wetlands are very diverse and most productive eco-system. Wetlands are serving as critical components of urban ecosystems, understanding their changes is imperative for sustainable urban development and conservation efforts. This study focuses on evaluating changes in wetland distribution and extent in the urban setup using two satellite datasets viz. LISS-III and LISS-IV having distinct spatial resolutions. The study area is taken up within the Ahmedabad district utilizing moderate spatial resolution LISS-III (24 m) and high spatial resolution LISS-IV (5.8 m) satellite datasets covering the periods of 2017-18 (L3) and 2017-19 (L4), respectively. Wetland mapping of 20 types of wetlands was carried out using spectral indices and visual interpretation. Using the LISS-III data, 872 wetlands were mapped (>= 2.25 ha) covering an area of 62,275 hectares over Ahmedabad district. In contrast, remarkably 8,798 wetlands (>= 0.1 ha) were identified using finer resolution LISS-IV data with total area of 81,485 ha. This substantial increase in both wetlands count and coverage highlights the significance of advance imaging technology in detecting wetland areas more accurately in urban setup where wetlands are small in size but large in numbers.

Comparative analysis of the wetland datasets reveals a substantial rise of 7,926 wetlands and an expansion of wetland area by 19,210 hectares. Notably, the "tank/pond" and "waterlogged" wetland categories exhibit the most significant alterations, indicating dynamic changes in distribution in these wetland types. The study's findings have farreaching implications for urban planning, environmental management, and wetland conservation. Urban planners can utilize this information to guide sustainable development practices, while policymakers can make informed decisions to preserve wetland ecosystems. These insights are particularly relevant in a rapidly urbanizing context like Ahmedabad. Further investigation is recommended to discern the drivers of these changes, contributing to a more holistic understanding of urban wetland dynamics.

In conclusion, the study underscores the utility of satellite data and advanced technology in monitoring and assessing complex urban wetland ecosystem. By revealing the changes in wetland distribution and extent, the study contributes to the broader discourse on urban sustainability and resilience.

ID: 234 / **C RU: 4**
Resilient urban and regional systems
Keywords: NbS, water, social, spatial

Nature-based Solutions for Urban Water Security: A Socio-spatial Perspective

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Abstract:

Growing urban water crisis in conjunction with urbanization and climate change impacts has exacerbated drought and flooding risks. Currently, nature-based solutions (NbS) are being promoted globally as just and equitable strategies to build sustainable and resilient cities for the environmental risks and societal challenges. While now greater stress is laid on both problem and solution side to understand the issues and evolve relevant strategies respectively, there is still a considerable gap in synchronizing socio-spatial integration to understand the cumulative impacts of environmental risks. In this regard, spatial scale plays a critical role in understanding the phenomena and evolving 'just' solutions.

Taking the case of Dehradun, India, this study examines urban water security from two facets of drought and flooding risks at city scale which is then explored further at local scale in one of the identified hotspots through social surveys. The surveys attempt to supplement the understanding of urban water risks while also considering the type of solutions that are suited to the community to address their woes. Various types of NbS based on their social, economic and environmental benefits were presented to the respondents to record their preferences. The scale of type of NbS were also taken in to account to bring a socio-spatial perspective in understanding the problem and consideration of solutions.

Three distinct observations can be made from the results. First, the modifiable areal unit problem, the scalar unit of available biophysical earth observation datasets, which were used for drought and flood risks assessment, may not always share a similar scale leading to a mismatch in overlaps of different risks. This may lead to misinterpretation and disaggregation eventually impacting the decision-making process. Hence, integrated assessment was undertaken at city level while aggregating them at sub-divisional administrative wards to associate related hotspots with respective wards. This also enabled focused interviews with the residents and their local leaders at the selected hotspot to bring social perceptions better. This point towards the second result where it was observed that though the ward was identified as more prone to flooding risks by various studies in the region. The social surveys revealed drought as the major concern in the locality. Thus, highlighting a differential understanding of urban water risks at different scales of investigation. Form the third result, with respect to the preferences for various NbS types (classified at various scales), it was found that smaller scale NbS were most preferred by the respondents in comparison to large scale solutions. Again, indicating the association of scale with social factors for both risk perceptions and relevant adaptations.

Hence from the study it can be concluded that while scale plays a critical role in successful integrated risk assessments, they cannot be looked in silos without considering the social factors. The results at a particular scale needs to be harmonized from macro to meso to micro levels embedding both spatial and social factors to contextualize both the problem and solutions, and to eventually evolve strategies that can be scaled-up to achieve sustainable transformation in cities.

ID: 108 / **D OD: 2**
Open data in planning and urban management
Keywords: Citizen Science, Machine Learning, Building Data

Semantic enrichment of building data using Citizen Science and AI

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Abstract:

Buildings are of central importance socially, culturally, economically and ecologically. People spend most of their lives in buildings and also invest large sums of money in them. Buildings exist over epochs and shape our cityscape. Their construction consumes resources and impacts the environment. Whether building material, energy and thus CO2 emissions in general - buildings offer enormous potential for savings. This makes them particularly important in the context of climate protection and mitigation. Preserving existing buildings in the long term, constructing new buildings in such a way that existing materials are recycled and reused wherever possible - this is how building culture can be preserved on the one hand and a contribution can be made to decarbonize the building stock on the other. In order to further develop the building stock in a climate-friendly and resource-saving way, basic information is required, for example on the age, construction, material, specific use or the renovation status of the buildings in order to assess the resilience to climate change-related risks (such as heat, heavy rainfall or flooding), expected lifetime, and the potential for reuse of building materials and components as well as retrofitting.

Building geometry data is now available as open data for many cities all over the world. However, important semantic information about building characteristics is often missing or not accessible, or only accessible to a very limited extent, in order to perform such an assessment. Collecting these data through on-site inspections or manual evaluation of plans and aerial photographs is therefore still often common practice and only possible for small study areas. Another way to automatically generate this information is to use GeoAI. However, training data is also needed to train the AI-based models. In this context, we see a great opportunity to obtain the training data via Volunteered Geographic Information (VGI) platforms.

In this paper, we focus on the introduction to the web based VGI platform Colouring Cities to collectively map building attributes in cities. Using the example of the Colouring Dresden initiative and platform in Germany, the collection of data and the motivation of contributors using a Citizen Science approach will be presented. We address both data quantity and quality with respect to selected basic characteristics such as number of stories, type, building age and building usage. We then show examples of how Citizen Science observations can be used as training data to make inferences about the entire building stock using AI-based models. Finally, we discuss the possibilities and perspectives of using AI methods for semantic enrichment of building footprints and the role for the Colouring Cities platform.

ID: 140 / F BD: 3

Resilient urban and regional systems

Keywords: local UHI, land use, sensor network, deep learning, co-design

Land use and local urban heat islands – empirical evidence and AI-supported simulation of mitigation measures

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Abstract:

Summer heatwaves increasingly pose a serious health risk to urban populations worldwide. In the view of global warming, cities face the challenge of counteracting the overheating of their densely built centres. While the Urban Heat Island (UHI) effect at city level is well documented and understood, little evidence exists on the intra-urban variations and the efficacy of local mitigation measures. The frequently used land surface temperature (LST), which is derived from remote sensing data, overestimates the air temperature differences between land use classes and does neither provide evidence of the perceived temperatures nor the efficacy of mitigation measures.

To fill the gap, we co-design and employ dense medium-cost sensor networks, which are distributed throughout the two pilot cities of Dresden and Langenfeld, Germany. The collected sensor

measurements on air temperature and relative humidity are made available to the public as open data via a web portal. The data provide detailed information on the inner-city variations of the temperature distribution given the urban layout and influence of different land uses. In a second step, we use the collected data to train a deep learning model against various data from the environment of the sensors, such as land use and land cover, built-up density, building heights, and urban greenery. The trained model is subsequently applied to city-wide available land use data to enable spatially high-resolution mapping and prediction of local UHIs. We test the prediction accuracy of the model against different sensor network layouts. To inform municipal administrations and urban planners for better decision making on efficient heat adaption measures, we demonstrate the possibilities of simulating the impact of alternative urban configurations.

ID: 199 / Poster Session cont.: 5

Resilient urban and regional systems

Keywords: spatio-temporal analysis, LULC, population growth, Land Surface Temperature (LST), urbanization

Temporal Analysis of Green Cover Conversion and its Impact on Environment in Ahmedabad District, India: A Spatio-Temporal Study (2001-2021)

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Abstract:

This study presents a detailed temporal analysis of land use changes in Ahmedabad district, Gujarat, India, spanning two decades (2001-2021), focusing on the conversion of green cover and its environmental implications. The research utilizes satellite imagery from the USGS Earth Explorer. It employs Land Use Land Classification (LULC) supervised classification techniques to assess the transformation of the study area over the specified time frame. The study reveals a significant decline in green vegetation area, with Ahmedabad district losing approximately 2100 sqm of green cover, equivalent to around 40% of its green area, during the study period. This reduction has mainly resulted from converting agricultural land (vegetation land) to built-up areas. The built-up area experienced an overall increment of nearly one hundred fifty percent, emphasizing the magnitude of the land conversion issue. Furthermore, the study examines the impact of these land use changes on the environment, particularly in terms of temperature variation. It was observed that the Land Surface Temperature (LST) rose by 11°C during the two decades under consideration, indicating significant warming trends in the district. A parallel decrease in green vegetation was also detected, signifying a correlation between land conversion and environmental temperature changes. A spatio-temporal analysis was conducted by superimposing population census data on the LULC data, revealing a positive correlation between population growth and the dynamic rate of land conversion in the Ahmedabad district. The rapidly expanding urban areas and increasing population have intensified the land transformation process, contributing to the loss of green cover. Considering the implications of these findings, e-governance initiatives have the potential to play a key role in addressing the challenges posed by land use changes. Departments such as Planning Authorities, Urban Development Authorities and Agriculture and Forest Department can leverage the study's insights to develop and implement targeted policies for sustainable land management and environmental conservation. This study assesses the temporal changes in land use patterns and their impact on the environment in Ahmedabad district, India. The research underscores the urgency of adopting sustainable land use practices to mitigate the loss of green cover and curb rising temperatures. The findings are of immense significance for policymakers, urban planners, and environmental agencies seeking effective strategies to address the intricate challenges of rapid urbanization and its consequences on the ecosystem.

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ID: 184 / Poster Session cont.: 4

Resilient urban and regional systems

Keywords: Multi-Criteria Decision Analysis (MCDA), Rest Points, Food Courts, Local Markets, Site Suitability Analysis

A Multi-Criteria Decision Analysis for Locating Optimal Food Zones, Rest Points and Local Markets in Rajkot: Enhancing Urban Livability and Efficiency for the Gig Economic Sector.

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Abstract:

Rajkot, a bustling industrial city in Gujarat, is home to a diverse population engaged in various occupations. The city's economic landscape thrives, and among its dynamic sectors is the unstructured segment, housing street vendors and delivery agents who play vital roles in the daily hustle. With a strong focus on nurturing Rajkot Smart City's local economic ecosystem, this study aims to leverage the city's unused land to create spaces for thriving local businesses. Three interventions have been proposed: Rest Points, Food Courts, and Local Markets. The Gig Economic Sector, known for its temporary and part-time jobs occupied by freelancers and independent organizations, forms a key area of concern. Delivery agents from food delivery giants like Zomato and Swiggy and e-commerce platforms like Amazon, Myntra, and Flipkart traverse the city tirelessly without proper facilities to rest and recharge. Understanding their challenges was crucial, and a survey involving over 40 delivery agents provided essential insights, including daily travel distances, prime locations for maximum orders, and the availability of amenities like drinking water and sanitation facilities. Another focal point of this study involves identifying suitable sites for Food Courts and Local Markets. These spaces serve as golden opportunities for local entrepreneurs to launch or expand new ventures. The study capitalizes on the untapped potential of existing vacant lands owned by the Rajkot Municipal Corporation (RMC) instead of resorting to new acquisitions. A site suitability analysis was conducted using the Multi-Criteria Decision-Making process to ensure strategic and sophisticated land use planning. The Analytical Hierarchy Process (AHP), a robust Multi-Criteria Decision Analysis (MCDA) approach, played a pivotal role in this process. Accessibility, public amenities, and demographic profiling were weighed to pinpoint the most suitable locations. Additionally, land utilization patterns and transportation accessibility were considered to enhance precision in location identification. Locations of over 350 food joints across Rajkot were geocoded based on Google ratings to identify areas with booming eateries and epicentres for gig economic workers. Locations of other amenities, such as public toilets and parking facilities, along with population, among others, were obtained and mapped. Market values for land parcels were mapped from trusted online sources and interpolated to paint a picture of Market Values for the entire city. Land having higher market values was given a higher preference. The interventions were proposed in three phases based on the economic feasibility of the selected sites. Rest Points, Food Courts, and Local Markets are envisioned to enhance urban liveability, foster sustainable development, and empower the thriving gig economy workforce. This study has the potential for further enhancement through the implementation of simulations, predictive modelling, and replication in similar cities across the country under comparable economic conditions.

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ID: 131 / E UD: 3
Urban dynamics
Keywords: Burglary crime, Permeability, Residential environment, Space syntax, Urban form

Residential Environment and Burglary Crime Risk: A Space Syntax Analysis of Crime Areas

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Abstract:

Environmental criminologists and urban design researchers believe that the built environment plays a crucial role in shaping the spatial distribution of crime. There is, however, a discrepancy between their views regarding the relationship between neighbourhood characteristics and crime. This paper intends to investigate the different morphological features of residential neighbourhood spaces to understand the factors that constitute burglary crime risk in the area. The methods used for data collection include field survey, and Block Environmental Inventory from two residential neighbourhoods in Penang, Malaysia, while inferential statistics, Geographic Information System (GIS) and space syntax analytical tools were used for data analysis. The crime data used was acquired from the Royal Malaysian Police between 2015-2020. By comparing burglary indices to syntactical spatial attributes in two residential layouts of Bayan Baru (Perumahan Mahsuri and Perumahan Sunway Tunas), the findings indicated the influence of neighbourhood-built features on burglary crime and the vulnerability of areas to future crime risk. The analysis indicated the spatial variation of crime risk factors across the study areas and how that shaped the understanding of burglary activities in the area. The study showed how the permeability of grid iron-like layouts may have affected vulnerability and explains high crime rates in the areas of Perumahan Mahsuri and lower crime rates in the areas of Perumahan Sunway Tunas. In conclusion, the paper suggests further research to correlate these spatial explanations with the socio-demographics of the areas studied to draw up an effective crime-prevention mechanism for Penang and Malaysian cities at large.

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ID: 128 / E RU: 1
Resilient urban and regional systems
Keywords: Resettlement, displacement, socio-spatial segregation, exclusion, spatial design

Understanding Socio-Spatial Segregation and Exclusion in Resettlement Colonies: Through the study of two resettlement colonies in Chennai

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Abstract:

Resettlement colonies, often created to address issues of displacement and slum clearance, have been intended to provide housing and improved living conditions for marginalized populations. However, in many instances, these colonies face challenges that perpetuate socio-spatial segregation and exclusion, hindering the intended positive outcomes.

This paper examines the socio-spatial segregation and exclusion of the resettlement colonies from the city's Urban Fabric, through the study of two resettlement colonies in Chennai, namely Kannagi Nagar and Semmancheri.

The study focuses on understanding the complex interplay between social factors, spatial design, and exclusionary processes that perpetuate the marginalization of disadvantaged communities in these areas.

The study involves analysing the identified urban area through site visits, empirical data gathering, observations and surveys. Utilizing a mixed-methods approach, including qualitative interviews, spatial analysis, and documentary analysis, the research examines the markers of spatial segregation. The paper puts forth a framework for analysing spatial segregation based on the Defensible spaces theory by Oscar Newman. The framework includes the study of physical parameters of the two neighbourhoods such as urban grain, densities, Access control as well as the non-physical aspects such as territoriality, Surveillance, lifestyle markers and symbolic barriers.

The findings reveal that the resettlement colonies in Chennai exhibit high levels of socio-spatial segregation and exclusion from the city's fabric. The physical design of these areas, combined with discriminatory practices and stigmatization, contribute to the exclusion of the urban poor from mainstream urban life. The paper highlights the need for comprehensive and inclusive urban planning strategies that address the socio-spatial exclusion of the urban poor by addressing the Planning practices contributing to socio-spatial segregation and exclusion of the resettlement colonies of Chennai.

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ID: 202 / C UD: 3

Open data in planning and urban management

Keywords: Commons, Natural Resources, Urbanisation, Bangalore, India

Rural to Urban Transitions: The case of Anekal Taluk in Bangalore

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Abstract:

Cities in India are rapidly growing. While major cities have been studied many times over, the effects of rapid urbanisation on the peripheries of major urban agglomerations has only picked up momentum in recent years. In this context, this paper on Anekal Taluk in Bangalore examines how the urban-driven shift in land use patterns in the southern edges of Bangalore has affected community-led governance and management of natural resources. Further, it captures the changing livelihood scenarios where a major agricultural landscape has transformed to make space for real estate and enclaves for conspicuous consumption, while traditional seasonal migration has been replaced by perennial cyclical forms of migration. This case study illustrates a grim picture of how unfettered urbanisation, multiplicity of governance institutions and shifting relationships between people and nature lead to socio ecological challenges like depleting natural resources and lack of green spaces in contemporary urban landscapes. By departing from conventional emphasis on growth, we seek to raise pertinent questions on the consequences of such rapid urbanisation on urban and environmental governance, and offer sustainable pathways through capacities around human capital and data which integrate political, economic, social, and cultural dimensions of these urban areas.

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ID: 230 / D UD: 3
Urban dynamics
Keywords: Landscape Fragmentation, Urban Dynamics, Sprawl, Ahmedabad, Remote Sensing, GIS

Assessing Landscape Fragmentation in Ahmedabad using Multi-date Remote Sensing Data

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Abstract:

Landscape fragmentation is one of the major consequence of low-density, unplanned and haphazard development, often termed as urban sprawl. The waste of land that landscape fragmentation entails, becomes a major challenge for authorities and citizens alike in land use and infrastructure planning. Ahmedabad, which is the largest city of Gujarat, and is part of the seventh largest urban agglomeration in India, is witnessing rapid expansion exceeding much beyond its defined limits. It is one of the cities identified under the Smart Cities Mission of Government of India, and has seen tremendous investment and economic growth in recent years.

This study attempts to understand urban dynamics of Ahmedabad city using multi-date remote sensing data. Unlike studies that have relied on moderate to coarse resolution data from Landsat series satellites, which have 30 m spatial resolution, and the Sentinel-2 data, which has 10 m spatial resolution, this study uses data acquired by LISS-4 sensor onboard Indian Remote Sensing Satellites, Resourcesat-2 and 2A having 5.8 m spatial resolution. This enables mapping of small scattered structures in the peripheral areas of the city as well. The built-up area of multiple years was extracted from these images using a combination of semi-automatic object-based classification approaches, Artificial Intelligence / Machine Learning (AI/ML) based automatic feature extraction techniques and visual interpretation.

The built-up area of multiple years was used to understand the type of new development that has occurred within the city in each subsequent period. The new development was categorized as infill, extension and leapfrog development. Shannon's entropy was used to demarcate the influence area of city beyond the identified Central Business District (CBD). The proportion of developed area beyond the influence zone was also used to understand the pattern of scattered growth in the city. Additionally other spatial indices such as scatter index, compactness index and largest patch index were used to define urban morphology and its trend over the study area. It was observed that the city recorded 14% of new growth as leapfrog development during 2011-2015 time period, which increased to 26% during 2015-2019 time-period indicating cycles of coalescences and diffusion in its evolution respectively, a trend reminiscent of the other major cities of Gujarat as well.

The results of the study enhance current understanding of urban dynamics of the city. They will help urban planners and concerned authorities in making policies for minimizing the waste of land and managing landscape fragmentation effectively. This can also enable development of accurate models for forecasting growth of cities, as required in several applications such as climate resilience, infrastructure planning and environmental studies. The study provides a valuable input for sustainable settlement planning as envisaged under the Sustainable Development Goal (SDG) 11 for sustainable cities and communities.

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ID: 257 / E BD: 3

Big Data Analytics and Land Use

Keywords: Urban Surveillance, High-Resolution Imagery, Deep Learning

Comprehensive Urban Surveillance through Space: Leveraging High-Resolution Imagery and Deep Learning

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Abstract:

Urban areas are dynamic environments characterized by rapid growth, infrastructure development, and constant change. Urbanization continues to expand at an unprecedented rate, bringing both opportunities and challenges. Effective urban planning is essential to prevent disasters such as urban floods and traffic congestion resulting from illegal constructions and inadequate monitoring during building stages in case of new cities development and the existing cities expansion. Continuous monitoring of urban areas presents a formidable challenge for human observation alone. However, with the aid of remote sensing technologies, the potential to achieve unparalleled levels of precision and comprehensiveness in urban monitoring can be unlocked. In this study, we propose a comprehensive approach to urban monitoring using deep learning techniques, focusing on building and road detection, as well as their change detection with high resolution data.

Our approach begins with the utilization of high-resolution satellite or aerial imagery, which captures urban landscapes in intricate detail. Convolutional neural networks (CNNs) are employed to analyze these high resolution images, enabling precise identification and segmentation of buildings and road networks by extracting the fine-grained features. The trained models achieve high accuracy even in complex urban environments, providing a foundation for informed city planning. In addition to building and road detection, our methodology incorporates change detection using temporal data. By extracting the urban elements from high-resolution imagery acquired at different time points with deep learning algorithms, we employ change detection analysis to detect changes in buildings and road layouts. Our change detection model is capable of discerning both subtle and significant changes, providing critical insights for urban planners and disaster management teams. This temporal analysis allows not only to monitor the growth but also helps for the early detection of illegal constructions and other unauthorized changes, minimizing the risk of disasters and congestion.

In summary, our research presents a holistic framework for high-resolution urban monitoring, employing deep learning techniques for building and road detection and change detection. The combination of fine-grained spatial data and temporal analysis offers valuable insights into the ever-evolving urban landscape, supporting sustainable urban planning and enhancing disaster resilience in urban areas.

ID: 210 / E UD: 1

Urban dynamics

Keywords: comparative urban analytics, urban density, cross-national spatial data, urban types

Sustainable urbanisation through suburban densification in European agglomerations

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Abstract:

As more and more people move to cities, urban areas become denser and space more scarce, as policies in Europe and world-wide seek to tame urban expansion. As a consequence, especially urban centres experience house prices increase, gentrification and displacement through densification. At the same time, there is untapped potential for densification in suburban areas characterised by single family houses. Suburban densification appears to face strong barriers through multiple private land owners, strong binding public land use planning and diverse stakeholders' interests. However, little is known about ongoing processes of suburban densification and, hence, empirical knowledge is lacking on the potentials of suburban areas to contribute to sustainable urbanisation.

It is the aim of this contribution to present an approach that makes suburban densification visible through identifying patterns. As we seek to understand these patterns across individual states, we develop and apply an approach to comparatively analyse six urban agglomerations in three European countries, i.e. England, France and Germany. To cover for the incremental change in density, we use a building and land parcel based approach. Therefore, national 3D building (LOD1) and plot data sets need to me harmonised for two time steps t1 and t2. Further, locational information to derive non-central, i.e. suburban residential areas is required. Population (GHSL) and land use information needs to be included as well as a comparative delimitation of the study areas.

The analytical results allow for a comparative description of the six regions with central and polycentral urban settlement structures. Liverpool shows the highest mean population density, while Toulouse has the lowest. Interestingly, the logarithmic distribution of the population shows a negative skew, indicating for a abrupt fall in population densities beyond a specific threshold. Across all regions, the change in building density on land parcels between 2011 and 2021 shows a trend from high total change in the peripheral locations to lower change in the central locations, as is it is typical for suburban expansion. Further a k-proto cluster analysis is applied to identify an urban typology across the six regions, which leads to the suggestion of a common definition of suburban areas.

In the presentation, we further elaborate on the strategies applied to compare the regions, while considering differences in the national data through metadata analysis and distributions. As we present first results, further insights in the complementary analysis of national land policies facilitating suburban densification are discussed and general insights on working with national data sets for comparative research are given.

ID: 135 / A RU: 4

Resilient urban and regional systems

Keywords: riverfront development, landscape patterns, river ecology, analytical methods, sustainable, blue-green infrastructure

Living Riverfront: A planning strategy for riverfronts based on a qualitative analytic framework

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Abstract:

The global environmental crisis underscores the urgency of preserving and restoring natural ecosystems in the context of increasing urbanization. In today's urban areas, the role of designers expedites maximizing ecological, social, and economic benefits by navigating a renewed focus on theoretical and empirical studies of landscape patterns. More so in cases of riverfront development projects, where there is an urgent need for approaches that prioritize safeguarding natural ecosystems. This paper explores the concept of optimizing coexistence with a resilient natural river system through design - the case of the *Vishwamitri* river, flowing across Vadodara city in Gujarat. *Vishwamitri,* a non-perennial river, primarily consists of stormwater drainage mixed with the city's sewer waste for most of the year. It becomes an outcast *'nala'* due to the city's inadequate urban planning. An analytical framework monitors and documents existing landscape conditions and generates site-based design options. A comprehensive three-step process created these treatments. First, the river's history and ecology are examined. Second, a city-level master plan is carefully constructed, considering existing

infrastructure. Finally, green infrastructure and cleanup are suggested with a deadline. This interdisciplinary approach creates sustainable, inclusive, and accommodating urban places by integrating ecology, urban planning, and climate science. This design methodologically helped highlight the importance of dynamic, adaptive, and resilient riverfronts for long-term urban well-being. The design proposal brings forth a sample emphasizing protecting and restoring the river's edge by addressing natural and artificial stressors in this multifunctional environmental urban system. This paper positively demonstrated the possibility of design interventions along all scales: restoring riparian ecosystems and increasing water quality levels through the integration of green and blue infrastructure at the regional scale, as well as developing public spaces and walkways along land-water mediation. Aiming to comprehend how urban habitats influence the environment rather than vice versa, the suggestion seeks to enhance and treat the natural drainage along *Vishwamitri* while maintaining the river continuum. All this while also addressing socio-spatial inequalities and contributing to climate change adaptation results in an urban river where the patterns and processes along its ravines continue to be a complex resolution area amongst urban designers, landscape architects, and ecologists for riverfront development.

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ID: 249 / E RU: 3

Urban dynamics

Keywords: Spatial configuration, Socio spatial segregation, Bypass urbanism, Space syntax, Urban transformation

Dynamics of Socio-spatial & Configurational segregation in Kolkata

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Abstract:

In Kolkata, bypass urbanism has resulted in the creation of new centralities as well as a reciprocal interaction with existing centralities. Important public institutions and governmental services were transferred to Salt Lake and Rajarhat, while the inner-existing city's centralities faced disinvestment. Contribution of integrated urban mega projects to bypass urbanism has already been established as a major role. These are integrated development projects at the city or urban district scale that were created on a for-profit basis, by a single developer, consortium, or government infrastructure projects. Even though these projects' specifics differ, they have a few things in common. They range in size from a few dozen to thousands of hectares. In the case of Kolkata Eastern Metropolitan bypass is one such example. Bypass urbanism initiates the process of peripheralization, and commercialization and this development instigate changes at the periphery which has unequal benefits for its residents and aggravates gender disparity in works. This also represents a model of urban expansion in developing countries with segregation in configuration as well as in society. This segregation is the notion of change in centrality and policies, development approaches, land uses adopted diachronically in Kolkata. These changes have not yet been studied in morphological language. Analysis of configurational changes will help us understand the spatial planning and space design part of it. This research paper dwells on the research question – is socio spatial segregation associated with configurational segregation? This study

explores the changes in spatial configuration of Kolkata due to integrated Urban Mega projects through Global integration, Local Integration, Choice measures of space syntax analysis developed by Bill Hillier. Along with configurational change study, the spatial distribution of income and land use changes will be analyzed to answer the research question. The outcome of research will provide a basis for decision making in the future spatial planning process.

ID: 206 / E BD: 1

Open data in planning and urban management

Keywords: Remote Sensing, Remote places, Poles of inaccesibility, Settlement footprint

Where are the remotest places on earth?

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Abstract:

The project “Landscape Criticality in the Anthropocene – Biodiversity, Renewables and Settlements (CriticaL)” investigates the permeability of built-up areas at the global scale.

Poles of inaccessibility refer to areas that have a minimum distance from any kind of settlement activity in order to provide extensive habitats for large fauna, especially large mammals, without disturbance by anthropogenic influences.

In recent years, settlement construction has developed an unprecedented dynamic. Between 1975 and 2014, the settled area was doubled globally, i.e. in four decades as much built-up area has been created as since the beginning of urban development several thousand years ago.

Modern remote sensing data sets allow the worldwide identification of areas remote from settlements. The basis for the approach presented here and initial results is the question of the existence of poles of inaccessibility, taking into account incremental minimum distances as well as their distribution on the Earth's surface or by continent and country. The World Settlement Footprint 2019, a global settlement area dataset with a spatial resolution of 10 metres, was used as the input dataset. The timeliness of the dataset is very high with the specified reference year 2019. The data is collected by the German Aerospace Center and made available as Open Data.

Through global analysis of the data, the remaining distant areas could be determined for the minimum distances in the range of 1000 kilometres to 1000 metres.

Most poles of inaccessibility with very large minimum distances of more than 100 km are located near the polar regions and on remote islands in the great oceans. With a minimum distance of 100 km, the first distant poles appear on continental mainlands: some in northern Canada, the Amazon-region, North Africa, East Asia and Australia. In Europe, distant areas are only found when reduced to smaller minimum distances of 25 km or less.

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ID: 119 / B OD: 3

Open data in planning and urban management

Keywords: Research Data Centre, Open Data, Decision Support

Data, Models and Tools for spatial sustainability Science: The new IOER Research Data Centre

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Abstract:

Establishing the Leibniz Institute for Ecological Urban and Regional Development's (IOER) new research data centre (RDC) is a significant milestone towards supporting sustainable land transition and transformative urban and regional development. The IOER RDC aims to provide essential spatial data, analysis, and digital tools that enable interdisciplinary research, support policy and planning practices, and aid decision-making for spatial sustainability transformations to happen. The IOER RDC activities respond to pressing societal challenges, including rapid urbanization, environmental degradation, climate change, and social inequality.

To address these issues, the IOER RDC focuses on spatial data science and artificial intelligence to process and analyse heterogeneous data sources, make sense of complex spatial relationships and dynamics, and visualize the results in an easy accessible way. In addition to pure research data, which will be made available FAIR and as open data, the RDC will also offer a product range consisting of models, simulations, tools and services to provide stakeholders with decision-supporting information bases. These products should help policymakers and planners to understand the potential impacts of different development scenarios, identify trade-offs, and make informed decisions that support sustainable urban and regional development.

The IOER RDC aims to bundle the data-driven work of all research departments of the IOER and make the results available to the public. The RDC integrates several information systems and data infrastructures developed at the IOER such as the "Monitor of Settlement and Open Space Development (IOER Monitor")", a well-established research data infrastructure which has been operating since 2009 and is interactively providing indicators on land use, ecosystems, settlement structures, building stocks, for instance. In this way, the activities and research fields of the various Research Departments of the IOER are integrated and made accessible to the public under a common uniform data concept which in progress of development.

One of the unique selling points of the IOER RDC will be supply of spatially explicit models and scenarios with respect to future developments regarding land use, land-use change, or land using conflicts, for instance. The IOER will conduct specific research in that field in order to provide the RDC with input that can be distributed as outcome. Approaches of measuring the impact of the RDC products will be developed.

The centre aims to improve data literacy by making data and information more accessible and comprehensible. The centre will organize regular training and collaborative educational events, workshops, and webinars to enhance the thematic data literacy of researchers, policymakers, and planning practitioners. Moreover, interdisciplinary cooperation and knowledge exchange will be facilitated between research areas, political decision-makers, and planning practitioners.

The IOER-RDC is well-integrated into the National Research Data Infrastructure of Germany consisting of 26 different consortia, five of them IOER is being attached as institutional partner.

The IOER 'RDC's interdisciplinary approach focuses on spatial data science and dedication to improving competence in understanding and performing knowledge generation during the societal shift to digital culture.

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ID: 213 / B UD: 3

Urban dynamics

Keywords: urban sprawl, Land surface temperature, Tier -II cities, land cover change, environmental impact

Assessing Machine Learning Classifiers for Tropical Land Use/Land Cover Mapping: A Study in Kochi Urban Agglomeration, India

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Abstract:

The rapid and uncontrolled growth of the world's population, coupled with economic and industrial development, has significantly sped up land use/land cover (LULC) change, particularly among developing countries. LULC classification is often used for predictive analytics purposes where it helps identify patterns within a landscape that could indicate future trends or behaviors. There are a wide variety of classifiers for mapping LULC patterns from satellite observations, and each classifier has its features. The complexity of the study area and the types of data used for classification often led to controversial results. Recently, the application of machine-learning algorithms on remotely-sensed imageries for LULC mapping has attracted considerable attention. This study aims to find a suitable machine-learning-based classifier for classifying tropical land covers composed of real-world objects that vary in spectral characteristics, shapes, and densities. Five classifiers – Mahalanobis distance (MD), maximum likelihood classifier (MLC), support vector machine (SVM), random tree (RT), and neural network (NN)– were tested using Landsat-8 data in the Kochi urban agglomeration (KUA), Kerala, India using the same training sample data sets. Five land cover classes were classified: built-up, waterbody, bare land, vegetation, and cultivated land. From the results, it was inferred that the overall accuracies of MD, MLC, SVM, RT, and NN are 80%, 86.4%, 90%, 91.2%, and 89.6%, respectively. SVM produced results close to reality with better user and producer accuracy in classifying built-up features and was identified as the optimum classification method for a tropical setting with a different land cover mix. Finally, the changes in LULC for the Kochi City Region (KCR) from 1992 to 2022 were also analyzed by SVM.

The results of this study will provide the scientific basis for selecting the best machine-learning-based remote sensing classifier to develop accurate LULC maps.

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ID: 254 / F UD: 2

Big Data Analytics and Land Use

Keywords: LUIS, Satellite Imagery, Land Administrations, AI/ML, Geo-visualization, Sustainable city, Smart City Management, Sustainable Development

Land use Intelligent System: From Autonomous to Autonomy in Smart and Sustainable Cities

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Abstract:

Sustainability is taking the centre stage with every technological innovation that is being served to the global markets, along with-it rapid growth in urbanization, population, livelihood and consumption calls for land administration systems that empowers key users in basing out decisions on the latest data and monitor the progress that puts forward value impact in strategies and plans. The mechanics and materiality of smart-city efforts are continually evolving due to technological advancement. Unauthorised land use possess a problem for planned growth in developing cities because there is no formal method for identifying changes, therefore the majority of them go unnoticed under the pretext of revenue loss. Understanding the need, Vassar Labs developed the Land Use Intelligence System (LUIS), which protects land with near real-time monitoring and automates the process of identification. The system uses combination of AI/ML and satellite imagery, generates land use and land-use change maps using current and historical satellite images, allowing users to base planning decisions on the most recent information and track the development and impact of those decisions. The system fetches the high-resolution (HR) satellite imagery on desired frequency, deep neural network system and other disruptive technologies to build a framework. The technology enables geo-visualization and timeline comparisons of any changes in land use without the need for manual intervention, saving both time and resources. LUIS leverages varied use cases which includes; assessing suitable land for sustainable developments, un-authorized land use, major infrastructure project progress monitoring, utilities, monitors land use in cities/Urban areas, sensitive zones (high security, high risk, mining, etc), urban wetland, green/forest cover, habitat expansion, geological pattern identification, river shores, water bodies, catchment areas, environment and any other custom analysis including linear constructions like roads, bridges works in the area of interest. A smart workflow integration ensures auto-alert is generated till removal of unauthorized constructions through Web and Mobile App. Finally, the outcomes of the developed machine learning model enable the deployment of various strategies for policymakers and investors at many levels, including the ward and micro level, to identify, analyse, and understand changes in urban land use.

ID: 217 / F RU: 4

Resilient urban and regional systems

Keywords: WRF, ML, Ground measurements

A Hybrid Weather Forecasting System for City Weather Forecast

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Abstract:

The city scale weather forecasts are performed in general using the dynamical model that is based on the physics of the atmosphere. The accuracy of the dynamical weather predictions are restricted due to large surface heterogeneity, cloud physics, surface and boundary layer processes, initial conditions and many others. In this study, a hybrid model is developed, a combination of dynamical and machine-

learning (ML) model, for short-range weather prediction over the state of Bihar. To perform the hybrid model prediction, the dynamical model predictions are improved using ML based models.

The weather research and forecasting (WRF) model developed by National Center for Atmospheric Research (NCAR) is utilized here as a dynamical model. The station specific temperature and moisture forecasts from the WRF model have biases that are minimized here using the ML models. Various ML algorithms were explored and based on their performance, the best ML algorithm has been selected for hybrid model development.

The results suggest that the biases and root-mean-square errors are improved significantly in the developed hybrid model as compared to WRF model predictions. These improvements are over different land types with complex orography. Around 10-20 % improvements are seen in the short-range temperature and relative humidity forecasts. These results suggest that the WRF model predictions can be improved further with the help of ML algorithms.

ID: 162 / D UD: 1

Resilient urban and regional systems

Keywords: Landuse, Ecosystem Services Valuation, Landuse modeling

An Extensive Literature Review on the Role of Ecosystem Services Valuation in Anticipating impacts of Urban Sprawl in Future Land Use Scenarios

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Abstract:

The declining ecosystem services from poor land use management is a growing concern, especially for developing countries, with the most vulnerable ones being those with a rising population. The growing population drives higher demands for food and infrastructure, resulting in converting forests and wetlands to agriculture and agricultural lands to developed areas. Forests and wetlands are particularly valuable for their ecosystem services. Despite their significance, these essential ecosystems are experiencing rapid depletion, with wetlands disappearing at a rate nearly three times higher than that of forests. To address this critical issue and minimize ecological loss during development, an essential approach is adopting optimum land use modeling coupled with ecosystem services valuation. Ecosystem services valuation is a process that accounts for the natural capital and helps in informed decision-making when it comes to changing land uses. By employing this strategy, we can balance the needs of development while preserving and protecting crucial ecosystems and their services. History of land use modeling dates back to the pre-20th century, when land was zoned and allocated for different sectors as per the suitability in ancient European cities. Later, the need for organized land use planning became evident when urbanization and industrialization stepped to the fore. When the world entered the digital era, computer-based models such as cellular automata stepped in and it has been an ascent from there. Research on land use change and its impact on ecosystem services reduction has been published for two decades, but existing studies have certain limitations.This includes regional variations, lack of integrated aspects that considered both societal and ecological functions, and not considering socio-economic factors for study and landscape level studies.

Ecosystem services valuation gained prominence after the Millenium Ecosystem Assessment Report in the 2000s. Many comprehensive studies exist worldwide, with China, the USA, and the UK leading research on land use change's impact on ecosystem services. A total of 202 papers have been identified based on search criteria using keywords “Landuse" + "Ecosystem services” OR “Landuse" + "Ecological loss" in the Scopus research database. Researchers have studied the impact of land use on ecosystem services, ecological loss, and optimum land use scenarios and models that can minimize the ecological loss and maximize the ecosystem services value. This paper presents a comprehensive review of the 202 papers, starting with a bibliometric analysis in the first part and followed by a detailed review of papers that are crucial for further research in the domain in the second part. Unlike previous reviews, this paper will concentrate on studying the key literature on mainly four heads (regional variation, context

of the area, indicators used, and models followed), which would systematically derive the research gap. Future research directions and limitations of the study will be brought out for discussion as the third part. The document would prove a one-stop destination for delving into the history of the impacts of land use change on ecosystem services in an urban context.

Bibliography

Nil

ID: 218 / A RU: 1

Open data in planning and urban management

Keywords: climate change adaptation, routing, heat stress

Heat avoiding routing as a tool for climate adaptation and urban planning

Sven Lautenbach[1,2], Johannes Fürle[2], Christina Ludwig[1,2], Mohammed Rizwan Khan[1], Sascha Fendrich[1], Anton Eberhardt[2], Kathrin Foshag[3], Nicole Aeschbach[3], Alexander Zipf[1,2]

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Abstract:

Heat waves are predicted to increase in frequency and severity as an effect of anthropogenic climate change, posing severe stress on human health and well-being. This affects especially vulnerable groups such as elderly, pregnant women, families with small kids and people with pre-existing conditions. Severity of heat stress inside of urban areas is likely to be moderated by characteristics of urban structure: building density, presence of water bodies and green elements, availability of shade and micro-climatic conditions vary spatially and partially also temporally. This variability can be used to partially adapt to heat stress by better planning of necessary walking activities.

We used information on heat stress as routing weights at a case study for the city of Heidelberg, Germany (160,000 inhabitants). Heat stress has been modeled by time-dependent sunlight exposure based on a 2.5D model of terrain, buildings and trees. The routing weights were used as input for the openrouteservice which allows the generation of routes for individual users but also the calculation of accessibility information for urban planers.

Work on the heat avoiding routing application were complemented by a transdisciplinary approach which involved interaction with municipal stakeholders, representatives of the vulnerable groups as well as with the general public. These activities covered an assessment of the quality of urban space, an evaluation of personal heat stress risk and the derivation of parameters for the routing algorithm. Two-thirds of respondents of an online survey stated that summer heat affected their daily lives in a negative way. Reported individual adaptation strategies included information seeking, changes in mobility behavior and adaptation of daily and social life. This is in line with the strategy of the heat avoiding routing smart phone app which offers support in respect to these mentioned adaptation strategies. Participants indicated a willingness to accept a detour of 5 to 10 minutes for a route that offers lower heat stress exposure.

An analysis of four-hundred routes for a typical heat day at four periods across the day showed as preliminary results that heat avoiding routes offered on average 10% less sun light exposure compared to normal pedestrian routes for detours clearly inside the reported detour-factors. Heat stress avoidance was on average strongest for evening and to a lower degree for morning routes. This is caused by the lower sun angle which increases differences in shading at the road network. Start and endpoints were chosen randomly but restricted to realistic walking distance and inside urban areas.

Ongoing activities involve the incorporation of real time temperature measurements through sensors in the routing weights. Analysis of the sensor data indicates clear (elevation corrected) temperature differences across the city in the range of 2.5 Kelvin. Incorporating this information should offer further heat stress avoidance potential. Further ongoing activities involve the analysis of different neighborhoods with respect to their potential to access points of interest by heat avoiding routing and tests of transfer to other cities.

ID: 251 / E BD: 2

Big Data Analytics and Land Use

Keywords: GeoAI, Machine Learning, Deep Learning, and Graph Intelligence - Illuminating the path to advanced geospatial insights

Navigating New Frontiers in Spatial Analysis

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Abstract:

Navigating New Frontiers in Spatial Analysis

The convergence of location intelligence and AI technologies such as machine learning and deep learning is becoming known as GeoAI—advanced geospatial data analytics made possible by GIS software. GeoAI empowers organizations to answer complex and high-value questions at scales and frequencies never achieved before. Esri is the leader in location intelligence and GIS, helping customers integrate GeoAI into operations and workflows.

During this session, we will delve into the following topics:

1. Analysing spatial distributions, patterns, and relationships using robust statistical and machine learning techniques. While parallels can be drawn between conventional and spatial statistics, the latter directly incorporates spatial elements and their diverse relationships into mathematical computations.
2. Harnessing geospatial data, science, and technology in conjunction with artificial intelligence (AI). How GeoAI helps in automated data generation and user-friendly spatial tools and algorithms are being deployed to modernize operations.
3. Organizations are looking for ways to bring all several data together—spatial and nonspatial, structured and unstructured—so they can better understand what is happening, where it's happening, and why. This is where a knowledge graph can help. Graph analysis combines data from a variety of sources to generate a network of interactions between entities that can reveal patterns we might not otherwise be able to see. ArcGIS Knowledge allows you to discover how parts of the system are connected, which factors in the system have the biggest impact, and which hidden connections have more influence than expected.

Bibliography

Saranya M is working as an Assistant Manager for Presales and leads the Data Science team. She has been with Esri India since 2019. She is a certified Desktop Associate & ArcGIS Online Administrator with master's in environmental engineering & management and PGD in RS & GIS. She is focused on helping users better understand GeoAI in ArcGIS. She leads the Data Science vertical for various sectors such as Utilities, Defence, Transportation, etc.

ID: 233 / A UD: 2

Urban dynamics

Keywords: anthropocene, photovoltaics, climate neutrality, virtual reality

Employing Virtual Reality to enable for climate mitigation and adaption

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Abstract:

Human-induced greenhouse gas emissions are driving climate change and characterizing the intricate interplay between the Earth's system and societies in the Anthropocene. This is forcing governments to address the twin challenges of climate change: Mitigation and Adaptation. With this paper we provide examples for the implementation of mitigation and adaptation measures in Virtual Reality (VR).

Climate neutrality, crucial in this effort for mitigation, requires harnessing the potential of renewable energy, especially in urban areas. Building integrated photovoltaics (BIPV) plays a central role in the energy transition and requires quantification of its technical feasibility. The key questions are: Which building categories offer significant potential for standardized BIPV facade integration? How does solar radiation modelling help to assess the BIPV potential on site? The German building landscape, encompassing design and energy demand, requires a comprehensive understanding. Similarly, assessing national BIPV capacity is critical. Therefore, we applied a virtual 3D city model, calculated solar radiation on roofs and facades and combined those with thematic GIS data. This approach allows for detailed assessment across building categories and use types, identification of areas with high potential, and consideration of historic preservation and ownership. To further improve adoption of BIPV, the results of the solar potential calculation are translated into a virtual reality (VR) experience. VR promotes awareness among decision makers and homeowners and supports resilience through urban planning.

In addition to climate mitigation, adaptations to climate impacts, such as increasing risks, also need to be undertaken to deal with climate change. For Europe, an increase in extreme rainfall and flooding is predicted. Complex flood risk simulations involving climate ensembles, hydrological and hydrodynamic modeling, and hazard assessment generate complex datasets and pose significant challenges to decision makers. VR supports to visualize potential flood risks under climate change. The virtual environment improves user perception and engagement, enables an understanding of risk dynamics, and fosters a sense of presence. This allows users to interact with data, explore temporal trends and compare scenarios, identify structures at risk, and track hourly flooding processes. Evaluations confirm VR's effectiveness in communicating flood risk data, influencing decisions, and raising awareness.

VR applications enable the presentation of complex content and thus promote decisions to take action against climate change. The VR approach harmonizes climate change mitigation and adaptation efforts promoting future resilience and sustainability transformation.

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DOI: 10.5194/egusphere-egu22-8085

Mapping the urban forest in detail: From LiDAR point clouds to 3D tree models
https://doi.org/10.1016/j.ufug.2022.127637

ID: 186 / E UD: 4

Urban dynamics

Keywords: Urban Neighborhood, Commercial Development, Mixed-Use Streets, Informal Activity

A Commercial Attractiveness Model for Self-Organised Mixed-Use Streets in Delhi

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Abstract:

To maintain a delicate balance between growth and sustainability in the face of increasing urbanization, our cities need effective planning strategies and infrastructure upgrades. As a result, mixed-use development has become a crucial part of numerous planning trends like ‘Smart Growth’ and ‘New Urbanism’ and has a big impact on how land use and transportation interact. Higher level of mixedness results in shorter travel distances with increased access to retail and services in proximity, increased cycling and walking, reduction in vehicular travel and boosting local economy which includes informal activities. From the standpoint of urban dynamics, mixed use development has taken place in incremental ways in Indian cities due to people converting and using their residential properties in

commercial developments, creating multifunctional areas hosting various economic activities, including informal activities. Such self-organized development is primarily influenced by high network accessibility levels and local neighbourhood consumption needs for retail and services.

Till recently, the development authorities in Delhi have declared more than 6000 streets as mixed-use streets, however an empirical study of such economic activities and their influencing factors is missing. To fill this gap, this study focuses on both planned and unplanned residential areas of North-West Delhi, where survey of selected mixed-use streets is conducted, and statistical model is developed to understand the relationship between commercial attractiveness and type of commercial activities, clustering of commercial activities, mixed-use characteristics, and road network accessibility indices. The study applies Ordinal Logistic Regression model to predict average number of customers visiting these commercial establishments and demonstrates a significant relationship with economic performance, mixed-use characteristics, higher network connectivity, presence of informal activities and type of commercial activities.

This research contributes by developing better understanding at neighbourhood level about the factors which influence mixed-use streets and its commercial attractiveness. The model aims to predict the number of people visiting these shops based on several predictor variables which in return will aid in determining requirements of transport and pedestrian infrastructure and formulating planning policy interventions addressing self-sufficient neighbourhoods, diversifying economic activities and management of informal activities.

ID: 122 / C LT: 9
Submission for Posters
Urban dynamics
Keywords: Spatial Impact Assessment, Transit Oriented Development, Data-Driven Planning, Statistical Analysis, Public Transport

Assessing Impact of Metro on the Spatial Characteristics – Case of Rajajinagar, Bengaluru

Sushmita Mudhol, Navabharathi T N, Monica Kashkari, Manjula Vinjamuri
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Abstract:

The introduction of mass transit system in a city is expected to influence the spatial characteristics of the neighborhoods surrounding transit stations as it catalyzes economic growth and urban regeneration. A thorough exploration of impact on land use, built form and land value may facilitate successful implementation of transit-supportive development in the influence zone of the mass transit. Hence, it is critical to understand the impact of a mass transit system on the built fabric of a predominantly brown-field development. This analysis further helps explore strategies for optimizing limited urban space and creating more livable neighborhoods. This research paper is an effort on the part of the Directorate of Urban Land Transport, Government of Karnataka to document the methodology and approach used for assessing the spatial impact of a mass rapid transit system on a neighbourhood in its influence area so as to derive insights for developing appropriate regulations to encourage transit-oriented development. This study focuses on assessing the impact of metro on the spatial character of the core Transit-Oriented Development (TOD) zone, which refers to the 500-meter walking catchment area around the Rajajinagar neighborhood in the city of Bengaluru. It aims to evaluate and quantify the spatial transformations occurring in the immediate vicinity of the metro station, within its walkshed, and explore the factors influencing these changes.

The study captures plot level data on land use, building heights, plot areas, and floor-wise uses through detailed on-site and household surveys. The dataset collected was analyzed and compared to the developments recorded in 2014 when the metro system was first operationalized. The recorded spatial transformations were further validated through statistical analysis. The study helped in understanding the impact of mass transit stations on spatial transformation and its dynamics. Furthermore, it provides a detailed methodology for conducting spatial assessments facilitating the development of TOD zone

plans. Building on the learnings from this research, the methodology and approach have been fine-tuned for application in similarly placed transit zones.

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ID: 235 / D OD: 4

Open data in planning and urban management

Keywords: Community-based adaptation, decision-making, climate change, under-resourced communities, information and communication technology

Enabling Collective Decision-Making for Community-based Climate Change Adaptation via a Web-Based Tool

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Abstract:

Community-based climate change adaptation (CbA) has been acclaimed to facilitate adaptation and has the potential to bring transformative resilience in under-resourced communities. However, extant barriers like lack of access to comprehensible and relevant information, capacities to translate information into actionable knowledge, gathering long-term funding, and most challenging of all, the complex interplay of community power dynamics, constrain its potential by limiting collective decision-making – a foundational tenet of CbA. However, the advancement and widespread adoption of information and communication technology, even within under-resourced communities, coupled with the availability of open-source urban and climate data, present an opportunity to enhance capabilities and overcome barriers like lack of access to information. This paper hypothesises that by leveraging such surmountable barriers like lack of information, adaptation decision-making processes can be restructured and therefore, empower communities. To test this hypothesis, a smartphone-compatible web-based application is designed and two pivotal characteristics are explored. Firstly, the application visually represents climate data spatially, employing simulations to illustrate the potential impacts of various adaptation measures on the community's built environment. This facilitates comprehension and informs decision-making. The contention is that decisions collectively reached by the community and relevant stakeholders, grounded in this shared climate information obtained from reliable sources, are more likely to garner legitimacy in the eyes of government agencies and funding entities, thus facilitating implementation. Secondly, the application facilitates online voting through a comprehensive evaluation matrix for each adaptation measure. This enabled individuals to anonymously vote for pertinent adaptation strategies from the convenience and privacy of their homes, reducing the influence of power dynamics on decision-making and encouraging participation. Therefore, the paper argues that integrating this tool within a reflexive adaptation planning process would alleviate socio-spatial inequalities – a core contributor to the climate vulnerability under-resourced communities face.

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ID: 144 / **D RU: 2**

Open data in planning and urban management

Keywords: STP, Urban planning, GIS, Remote Sensing, Kochi

Application of Geoinformatics in Optimal Site Selection for a Sewage Treatment Plant – A case study of Kochi City, Kerala, India

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Abstract:

In the present era of sustainable development, environmental protection has emerged as the utmost priority. The extensive urbanization has led to a severe threat to public health and safety through the contamination of drinking water sources by sewage and septage. The unrestricted discharge of sewage into water courses in areas without proper sewer systems, as well as the release of septic tank effluents into streams and canals, has resulted in widespread pollution throughout these water bodies. In the developing world, sanitation has consistently lagged behind its counterpart, water supply, in terms of advancements and provision. It is crucial to recognize that the positive impact of water supply on public health can only be achieved if it is coupled with adequate sanitation facilities. Given the current circumstances, there is a pressing need to identify suitable sites for the establishment of Sewage Treatment Plants (STPs). The objective of this study is to develop a robust decision-making model that leverages remote sensing, GIS data, and analysis, along with the implementation of Multi-Criteria Analysis (MCA), to select the most optimal STP sites. To achieve this goal, publicly available open source datasets are utilized as valuable resources for the study. The study area chosen for this research is Kochi city, widely recognized as the commercial capital of the state of Kerala. As a city experiencing a steady growth in population, Kochi necessitates the establishment of sewage treatment plants (STPs) with substantial capacity. In the planning stage, the conventional approach for selecting a site for a Sewage Treatment Plant (STP) typically entails the collection and analysis of various data sets encompassing topography, environment, economics, and sociopolitical factors. This conventional method is known to be time-consuming, labor-intensive, and expensive. However, the integration of Geographic Information System (GIS) and Remote Sensing Technologies (RS) presents a viable alternative, enabling the identification of suitable STP locations with a satisfactory level of accuracy during the planning phase. By leveraging the capabilities of GIS and RS, the process becomes more efficient and cost-effective while still ensuring the identification of appropriate STP sites. Specifying the locations of the treatment units is very important from environmental, social and technical aspects. The optimal sites for STP are delineated from 11 thematic parameters such as elevation, slope, levels of roads at 10m intervals, building footprints, distance from building footprints, distance from roads, drainage density, soil, Normalized Difference Vegetation Index (NDVI), NDWI (Normalized Difference Water Index) and NDBI (Normalized Difference Buildings Index) using multi criteria evaluation method. Different classes of thematic maps have been assigned weights based on the influence on STP site suitability and finally factor ranks are applied. The best suitable site is validated by field investigation. The findings of this study demonstrate the feasibility and effectiveness of employing GIS-based Multi-Criteria Analysis (MCA) for the selection of sewage treatment plant sites. Furthermore, this research highlights the significant benefits of integrating GIS and remote sensing technologies in the field of site selection and urban planning, allowing for a more efficient and scientifically driven approach.

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ID: 153 / **Poster Session cont.: 2**

Resilient urban and regional systems

Keywords: Rooftop Photovoltaic Potential, Solar, Renewable Energy, Carbon emission, Sustainable development.

Assessment of Rooftop Photovoltaic Potential For Rajkot Smart City

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Abstract:

The significant migration of the majority population is causing the rapid growth of cities. As cities grow the demand for necessary resources also increases, and one of which is energy. Urban development without continuous supply of energy is impossible. The conventional methods for the generation of energy require burning of fossil fuel of different types, as a result a large amount of emission occurs, which eventually contributes to climate change. As the global temperature is rising annually, most cities are experiencing record high temperatures in the summer and heat waves are causing the population to depend largely on cooling systems. For most air conditioners used to be a luxury but now it is becoming a necessity. Which results in higher consumption of energy to run these cooling systems and being an strong emitter, it leads to higher pollution levels.

Including renewable and lean energy sources like solar, wind and energy from waves etc. in the urban development projects could help in solving this problem by a lot. The advantage India has in terms of renewable energy is the ample amount of solar radiation. Rooftops of Indian buildings can generate enough green energy through solar photovoltaic systems throughout the year, excluding monsoon season. Harvesting this possibility could help in lowering the global emissions by a lot. The current study aims to determine the potential of solar rooftop utilisation over a smart city - Rajkot. Three parameters

which have a strong influence towards energy potential were identified as Land Surface Temperature, Global Horizontal Irradiance and Electricity Consumption. Through methods like Multi Criteria Decision Analysis (MCDA) and Analytical Hierarchical Process (AHP), by computing different weightages, suitable locations in the city were identified. The findings suggest that the city has the potential to be sustainable in terms of energy and minimize the use of conventional sources of energy and reduce the carbon footprint left by the city to a much lower level. Using 3D models of the building footprints, shadows of each building were derived and such regions were removed from consideration. From the unshaded area and suitability data buildings which hold photovoltaic potential were identified. The results showed that most of the buildings in the city hold photovoltaic potential providing 21.4 km² area for Solar panel installation. From the area available for installation of solar panels the study was able to calculate the energy that can be produced by installing solar panels is 19.9 petajoules. Such a huge amount of energy can decrease about 4.9 million tonnes of CO_2 Emission.

ID: 204 / F UD: 4

Open data in planning and urban management

Keywords: geodata, data management, postgis, POI

Distributed POI data management framework using version-control

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Abstract:

Points of Interest (POIs) are one of the most widely used geospatial data sets. While commercial data sources generally provide good quality on various POI categories, their high cost and strict usage policies can significantly limit their usefulness. In addition, non-commercial POI categories (e.g., childcare, public schools) tend to be of lower quality than POIs maintained by service owners.

Maintaining your database of up-to-date Points of Interest (POIs) is a challenging and resource-intensive task. The integration of diverse data sources presents significant complexity. In addition, data structures tend to vary, particularly in terms of semantic information. Therefore, keeping POIs data up-to-date requires a well-coordinated strategy. This strategy involves identifying suitable data sources, assessing data quality, and integrating the data into a pre-defined schema. Meanwhile, it is essential to consider the versioning of the collected data and establish a review process, which requires a systematic approach to track changes and updates over time.

This work presents a data management framework for distributed data collection and integration, utilizing widely used geo tools and software development techniques. The core component is "Kart," an open-source tool developed by the company Koordinates. Kart functions as a geospatial version control system built on top of Git, with either a PostGIS or a Geopackage database serving as the working data store.

This framework enables the use of remote git hosting services, such as GitHub, to synchronize different versions of the dataset among various contributors. Additionally, it supports a review process similar to those found in software development, utilizing issues, pull requests, releases, and branching to coordinate the collaborative efforts and secure high data quality through a review process. This approach utilizes a pre-defined table schema for the POIs, accompanied by tables listing related data such as data sources and POI categories.

To interact with the data, contributors can use QGIS for spatial revisions and the SQL client DBeaver to query and insert the data. For data integration, the datasets are first imported into a temporary schema within the database to avoid conflicts with the existing POI data. Subsequently, this data is integrated into the target schema using a SQL script.

In the scope of the development of the tool GOAT, data from several hundred sources, mostly open source, was integrated using the framework and subsequently utilized for accessibility analyses in

Germany, the United Kingdom, Belgium, and the Netherlands. Overall, this contribution highlights a scalable method for handling POI data under version control, enhancing the accuracy and usability of the data in geospatial applications. Although the framework was effective and cost-efficient, challenges were identified in managing conflicting changes and performance issues with larger data sets occurred. We recommend enhancing Kart through open-source contributions and implementing semi-automated data validation strategies to elevate data quality further.

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ID: 231 / **C LT: 7**
Submission for Posters
Resilient urban and regional systems
Keywords: Carbon monOxide (CO), Sentinel – 5P Tropomi, Remote Sensing, Air Quality

Temporal measurements and mapping of carbon monoxide through in situ and satellite platforms over a metro city of Ahmedabad, India

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Abstract:

Carbon monOxide (CO) is the third most abundant carbon-based trace gas in the atmosphere, after CO_2 and CH_4. It is susceptible to atmospheric transport, but it will not get completely mixed in air due to its short lifetime. Thus, changes in CO sources and sinks generally have regional as well as global effects. Uneven distribution of the sources causes large spatial and temporal variations of CO. Hence, CO could be used as a tracer of anthropogenic pollution. CO emitted to the atmosphere both naturally and anthropogenically. CO natural sources include contributions from marine and fresh-water environments; forest fires, photochemical reactions involving naturally-emitted methane and other organic HCs, volcanic gases, natural gases, soils and plants, fungi, insects and animals (including

humans), rain water during lightning storms etc. More than half of all CO emissions are considered to be man-made. Such sources include incomplete combustion of fossil fuels used in transport, power generation, industries (foundry & petroleum refining), domestic and commercial heating. Other man-made sources include biomass burning, oxidation of anthropogenically-emitted methane & other HCs in air, use of explosives and as a result of cigarette smoking.

In this study in-situ measurements of CO were collected throughout the year 2021, to understand the temporal characteristics of the trace gas over Ahmedabad. An attempt has also been made to view the concentration of CO using satellite data of Sentinel – 5p TROPOMI. For year 2021 the variation of CO at ground is in the range 0.3 ppm to 0.8 ppm while the variation of CO using satellite is in the range of 0.044 mol/m^2 to 0.032 mol/m^2. For ground observation the maximum concentration observed is 0.8 ppm in winter season in the month of January and minimum value observed is 0.3 ppm in summer season in the month of March. Similar trend is also observed in satellite data. Beside it is also observed that the concentration of CO increases with decrease in temperature. Ahmedabad's CO concentration is below the threshold limit because as per WORLD HEALTH ORGANIZATION (WHO), the acceptable limit of carbon monoxide is 9 ppm for residential area. CO is also an important parameter in overall AQI calculation as per National Ambient Air Quality Standards (NAAQS) so understanding its variation and continuous monitoring is necessary. The result of this study will further be useful in downscaling satellite data to ground data points and in developing an automated approach or application which can perform better for Air pollution monitoring using open-source datasets.

ID: 163 / B UD: 2
Urban dynamics
Keywords: Neoliberal policies, Hyderabad, spatial polarization, Landscape Expansion Index (LEI)

Comprehending Spatial Polarization in Hyderabad's Urban Geography using Landscape Expansion Index(LEI)

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Abstract:

Neoliberal efforts have significantly transformed the spatial landscape of cities across the world. Cities are increasingly experiencing large-scale migration from different socioeconomic classes, and this growing social polarization manifests itself in the city's urbanscape by concentrating people with low incomes and the affluent to varying locations in the cityscape, often referred to as spatial polarization. While there is a growing scholarship on this phenomenon in European and American settings, spatial polarization remains a question in an Indian city context.

After 1991, Hyderabad introduced several neoliberal policy initiatives. On the one hand, these policies intensified the growth of specialized enclaves along the urban peripheries; on the other, they encouraged the development of separate IT parks and allied enclaves. These initiatives have articulated the urbanscape of Hyderabad in two significant ways. Firstly, the restrictive nature of the urban enclaves and their inclination towards the elite's needs have made the urban peripheries unaffordable to the lower economic class, pushing them towards the relatively affordable inner city areas. Secondly, the concentration of slums is also happening outside these specialized enclaves' boundaries because of their growing interdependencies. Hyderabad is, therefore, experiencing spatial polarization at two scales: A city-scale polarization between affluent peripheries and a degrading inner city area and an inter-neighborhood scale polarization showcasing the growth of slums beside residential enclaves.

Due to the unavailability of micro-scale income data, it is challenging to perceive this polarization visually in Indian cities like Hyderabad. Therefore, this paper addresses an important research question: Can spatial polarization be comprehended using spatial metrics when data availability is a major concern? The paper's objectives are: a) to understand the emerging polarization trend in Hyderabad through a comprehensive literature review and b) to appreciate Hyderabad's evolving landscape patterns and its translation into polarization by using Landscape Expansion Index (LEI). The study applies LEI on the built-up patches of HMR across four years, 1991,2001, 2011, and 2021 considering 1991 as the base

year. It highlights that during 1991-2001, the HITEC city area emerged as an outlying cluster to the city but observed edge-expansion type growth in the subsequent years. However, the areas just outside the CDA boundary observed extensive infill growth until 2011, followed by edge-expansion type growth in 2021. The analysis also shows that the urban core has experienced infill growth throughout these years, which portrays the densification of the inner city area in contrast to the sparsely developed urban peripheries that are becoming more economically vibrant. The LEI is unable to detect whether these extensive infill growths are due to the development of slums or due to real estate activities, but the literature confirms that this densification of urban core and densification outside newly developed enclaves like CDA has majorly happened due to the restrictive attitude of the enclaves and the growth of informal settlements imparting polarization trends both at city-scale and at neighborhood-scale. Therefore, spatial metrics like LEI only help to conform to the emerging city-scale and neighborhood-scale polarization found in the literature by detecting spatial variations across the cityscape.

ID: 126 / B UD: 1

Urban dynamics

Keywords: Continuity Index, Impervious Surfaces, Normalized Difference Impervious Index, Shannon's Entropy, Unplanned spatial growth

Spatio-Temporal analysis of the Impact of Urban Growth in the Ahmedabad city

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Abstract:

Urban growth is characterized by an increase in population and built-up area. Urbanization provides opportunities for holistic development, but it also has many negative impacts on the environment. One of the major concerns is the rise in impervious surfaces due to unplanned spatial growth in urban areas. Impervious surfaces are surfaces that restrict the infiltration of water into the ground. This study aims to identify the growth pattern and assess the increase in impervious surfaces due to urban growth in Ahmedabad city. Ahmedabad is the seventh largest metro city in India. To analyze the urban growth and rise in impervious surfaces, Landsat-8 data was used for the years 2011 and 2021.

Supervised classification was performed to extract the built-up area from the satellite imagery. Indices like Shannon's entropy and Continuity index were used to identify the growth pattern of the city. For extracting the impervious surfaces, Normalized Difference Impervious Index (NDII) was calculated. Shannon's entropy was used to identify dispersed sections in the study area. For this, the study area was divided into three buffer zones at five-kilometer interval from the Central Business District. Continuity index was used to identify that the built-up growth has occurred in a leapfrog manner or not. Results showed that the growth was mainly in the periphery of the city. The entropy values turned out to be 0.75 and 0.76 for 2011 and 2021, respectively. The increase in entropy value was observed in the fringes of the city, indicating the dispersed development pattern of urban growth over the years in the periphery. Continuity index values for 2011 and 2021 were 1.05 and 1.17, respectively. The results show that the development has occurred in a continuous manner based on the increase in the value of the index. By overlaying the road network on the built-up area, it was observed that the development had occurred along the major roads in a ribbon pattern in the fringes of the city. Normalized Difference Impervious Index increased from 0.84 to 0.94, showing an increase in impervious surfaces from 2011 to 2021, respectively. Image difference of both images was performed to identify the change in impervious surfaces over the decade. This highlighted the impervious surfaces that increased during this timeframe. To compare the rise in impervious surfaces and growth areas spatially, a spatio-temporal analysis was conducted to identify the change in the impervious surfaces that had increased in the same areas of built-up growth. The present study uses remote sensing and GIS technology to provide an efficient way to monitor and analyze the growth patterns of cities that have grown in an unplanned manner.

ID: 166 / Poster Session cont.: 3
Resilient urban and regional systems
Keywords: Environment, Green cover, Air Quality Index, Land Surface Temperature, Land use

Suggestive improvements to the city's green cover for a sustainable future of Rajkot.

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Abstract:

Environment refers to everything surrounding us, including man-made and natural components such as air, water, and soil. Sustainable urban planning and environmentally responsible practices in cities are essential for preserving natural resources, reducing pollution, and creating a resilient and habitable environment for current and future generations. Rajkot is a city encompassed by a semi-arid meteorological environment. The city of Rajkot intends to transform the city's character by adding more green networks and increasing tree cover to address the rising population and pollution problems. The city plans to preserve waterbodies, ravines, and eco-sensitive areas to address environmental issues like degraded air quality due to high vehicular growth, industrialization, and heat effect in urbanized areas. This study aims to develop a phase-wise suggestive plan for the city's green cover implementation by analyzing monthly dynamics for the years 2018, 2019, 2021, and 2022 of land surface temperature and air quality index in co-relation with land use/land cover to understand their impacts on the city's green cover. The land surface temperature was derived using mono window algorithm of Landsat 8 consisting of 46 different time observations post-removal of nonusable periods. Air quality index was collected from in situ deployed environmental sensors spread throughout the city. The data were interpolated for all the time periods individually to understand their spatial distribution and change in trend throughout the years. Supervised land use/land cover classification of 4 classes Built-up, water, bare soil, and vegetation, was prepared using high-resolution 10m Sentinel 2 satellite data, taking more than 300 training samples. The derived classification generated an average accuracy of 89.2% through confusion matrices. By understanding the influences of these and other environmental parameters, the level of influence was defined within the Analytical hierarchy process to define which spaces within the Rajkot municipal corporation's reserved land can provide higher importance within the phase-wise implementation while ignoring and rejecting modifications within existing structures. Phase-1 recommends a possibility of approximately 0.65 square kms. of land for green cover, with phase-2 of approximately 3.26 square kms. in reserved lands of Rajkot for faster implementation, while phases 3 and 4 for the rest of the city. Collectively this process was developed into a model to provide a semi-automated approach-based workflow for faster computations in future samples. This study can be further developed by doing simulations, predictions, and replication to other semi-arid regions of the country under similar environmental conditions.

ID: 142 / Poster Session cont.: 1
Resilient urban and regional systems
Keywords: Climate Change, Flood Vulnerability, Urban Floods, Multi-Criteria Assessment, Hazard Risk

Socioeconomic Flood Vulnerability Assessment for Ahmedabad City

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Abstract:

Cities worldwide are experiencing the effects of extreme climate events. Urban floods have emerged as a direct consequence of climate change in cities. Understanding the vulnerability to flooding would help policy actions to reduce the impacts due to flooding. This paper targets Ahmedabad, one of the major cities in India witnessing rapid urbanization and frequently struggling with floods. The study utilizes flood vulnerability indicators, quantifying and establishing a flood vulnerability index for

Ahmedabad. The index links social, environmental, infrastructure, economic, and building-level indicators to define flood vulnerability. The relative importance of the indicators is arrived at by using experts' inputs and merged with the indicator to spatially analyze the patterns of vulnerability in the city comprising the four dimensions. The study finding suggests the city's eastern side is most vulnerable to floods. Twenty-four percent of the Ahmedabad population lives in highly vulnerable areas and seventy-four percent in moderately vulnerable areas, while a mere two percent of Ahmedabad's population resides in low-vulnerable areas. Lambha ward is the most vulnerable for the social dimension, while Dani Limda ward is the most vulnerable for the economic dimension. Kadi ward performs poorly in the environmental and infrastructure dimension. Sarkhej emerges as the most vulnerable ward in building conditions. Combing the dimensions, Shahpur is the most vulnerable ward when considering overall flood vulnerability.

Bibliography

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ID: 240 / C LT: 8

Submission for Posters

Urban dynamics

Keywords: Key Words: Local Area Plan, compact city, forms & regulations

Local Area Planning – A tool to transform city (Case study of Ahmedabad)

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Abstract:

Local Area Planning (LAP), also known as ward level planning is a statutory planning mechanism that is devised to improve and enhance the existing developed areas. It is prepared for improving, retrofitting and/or solving issues in these currently developed areas.

The LAP mechanism allows the cities and urban authorities to re-plan, revive and regenerate the existing developed inner city areas. The LAP mechanism is a micro-level planning tool used to implement the larger vision embedded in the DP on the specific areas. It involves elements of plot reconstitution, Master Planning, designing of urban realm and regulating the private realm through form based regulations. Additionally, the LAP process involves consultation with multiple stakeholders and plot-owners and therefore requires to be conceptualized to incentivize and promote redevelopment for ease of its implementation.

Local area planning is adopted in many cities globally & also in India but Gujarat is the first state to adopt Local Area Planning as a *Statutory Planning Mechanism.* The Government of Gujarat (GoG) in 2014 and 2017 amended the GTPUD (Gujarat Town Planning & Urban Development) Act 1976 to include Special provisions for preparing Local Area Plans.

Currently, section 76A of GTPUD Act provides for preparation of Local Area Plan. In the short duration of its inception through amendment in the GTPUD Act, in 2014, the current LAP mechanism provides a strong statement of intent from the Government of Gujarat and the Urban Development &Urban Housing Development.

Currently under the LAP mechanism there are total three overlay zones in Development Plan of Ahmedabad in which LAP mechanism has been adopted. Firstly “Transit Oriented Zone” which is conceptualized to enhance Public Transport through LAP mechanism. Secondly “Central Business District” (CBD) to enhance central area (Ashram Road) of Ahmedabad by proposing densification of low density mixed use areas. Thirdly “Residential Affordable Housing” (R-AH) zone which is proposed for housing development of low income and middle income groups.

This paper will emphasize how Local Area Planning mechanism is acting as a tool to bring a transformation in development pattern of Ahmedabad. The findings on this paper will include different characteristics of all three Local Area Plans demarcated in Ahmedabad Development Plan 2013 and how this mechanism supports to bring compactness for rapidly growing Ahmedabad as a city by giving some incentives in Development Control Regulations in terms of FSI and margins.

ID: 130 / E RU: 2

Resilient urban and regional systems

Keywords: Urban Poor, Livelihood, Vulnerability, Livelihood Capital, Vulnerability framework

Understanding Urban Livelihood Vulnerability: What Role Livelihood Capital Plays

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Abstract:

The urban poor residing in informal settlements face various vulnerabilities as they try to secure their livelihood. Vulnerabilities are local, complex and dynamic over which people have limited or no control. Vulnerability is closely linked to their livelihood capital: Natural, Social, Human, Physical and Financial. The urban poor are the active managers of their livelihood capitals. People's livelihoods and the wider availability of livelihood capital are fundamentally affected by vulnerability. Despite recent attempts to assess and measure vulnerability, the assumption that the increased availability of these livelihood capitals confers greater adaptive capacity among urban poor households remains largely untested. Therefore, the paper aims to identify the neglected dimensions and indicators for analysing the livelihood vulnerability in the urban poor context. The paper explores **29** dimension with **174** indicators through the literature review, which will be further established by conducting expert opinion. Integrating the livelihood capital can help to develop an urban livelihood vulnerability framework.

ID: 211 / Poster Session cont.: 10

Open data in planning and urban management

Keywords: Capital City, Land Pooling, Remote Sensing and GIS

Amaravati: A Visionary Transformation of a Capital City

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Abstract:

Amaravati is the new capital city of Andhra Pradesh, India. It is being built on a grand scale, with a master plan that includes a number of iconic buildings and infrastructure projects. The city is being designed to be a hub for economic development, tourism, and culture.

Amaravati was founded in 2014 by former Andhra Pradesh Chief Minister N. Chandrababu Naidu. The city is located in the Guntur district, about 200 kilometers from the former capital, Hyderabad. The name Amaravati comes from the Sanskrit word "Amara," meaning "immortal."

The master plan for Amaravati was developed by the Singapore government. The plan calls for the city to be built in three phases. The first phase is currently underway and includes the construction of the legislative assembly complex, the high court complex, and the financial district. The second phase will focus on the development of the IT hub and the sports complex. The third phase will see the construction of the cultural center and the greenfield airport.

Amaravati is expected to be a major economic driver for the state of Andhra Pradesh. It is estimated that the city will create millions of jobs and generate billions of dollars in revenue. Amaravati is also expected to attract tourists from all over the world.

The construction of Amaravati is a major undertaking. However, the city is well on its way to becoming a reality. The foundation stone for the city was laid in 2015, and construction is progressing rapidly. It is expected that Amaravati will be completed in the next few years.

ID: 216 / **F RU: 3**

Resilient urban and regional systems

Keywords: Remote Sensing, Air Quality Index, Google Earth Engine, Central Pollution Control Board, Sentinel-5P

Urban Air Quality Assessment Using Remote Sensing and GIS

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Abstract:

Air quality plays a very significant role for all types of life in the biosphere. Humans alter the environment through various anthropogenic activities, which in turn get affected adversely by its consequences. The rising pollution level in the atmosphere has become a strong insulator, prohibiting heat from slipping away from earth, back into space, and contributing to an increase in overall average temperatures globally. In India, in the last few decades, air pollution has become a critical environmental issue as an outcome of enhanced anthropogenic activities, economic development, industrial development, and growing energy demands. The key factor of spreading air pollution in the nation are toxic gases emitted from industry, thermal power plant emissions, and vehicular emissions. In 2019, 99% of the world's population was living in places where the WHO air quality guidelines levels were not met. Ambient (outdoor) air pollution is estimated to have caused 4.2 million premature deaths worldwide in 2019.

The study experiments these methods and strategies to measure air quality, mainly in urban areas, with the evidence of past impact on human health in addition to regional and local environmental consequences. The usability of in-situ ground-level measurements are inadequate to reflect both the quality of air and the dispersion of pollution accurately fully. Satellites grant the unusual and unique ability to detect greenhouse gas emissions (GHGs) and air pollutants in the 'Space-Time' or 'Spatio-Temporal' domain and help people understand their atmospheric concentrations and distribution at local, national, and international scales. Observations from the satellite imagery are valuable for event detection, transport, model forecasts, and emission assessment. For the study of different air pollutants, it is essential to map Air Quality. The study aims at assessing the suitability of Tropomi, Sentinel-5P products based on Google Earth Engine (GEE) to monitor air pollutants, including NO2, SO2, O3, CO and Aerosol Optical Depth for Ahmedabad city, India. Our process involved feeding satellite images to a cloud free GEE platform that identifies pollutant affected areas monthly, seasonally, and annually. JavaScript language is used to code the application in the GEE, five pollution parameters of Tropomi, Sentinel-5P satellite images were used with cloud filtered Images and the mean values were used. The Air Quality Index was calculated as per Central Pollution Control Board Guidelines. Whole calculation was employed in the model, which used Sentinel-5P and MODIS satellite data products using the GEE user-friendly Air Quality Index real time application. The application shows the time series of various pollutants; it has a time slider that allows the user to set a suitable date for the calculation of the AQI, start date and end date can be set as per the user's requirement to calculate daily, weekly, monthly, and yearly. Application shows overall AQI for the selected pollutant and legend in the application helps in the understanding of the colour code for the user as per CPCB standards. The result of this study is to develop an automated approach using GEE, which can perform better for Air pollution mapping monitoring using open datasets.

ID: 141 / **D RU: 1**

Resilient urban and regional systems

Keywords: energy demands, urban mobility, VAWT, GIS, sustainability

Use of Vertical Axis Wind Turbine (VAWT) as a Sustainable Energy Solution for the Metro Lines of Mumbai City, India

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Abstract:

As urbanization continues to surge, cities face escalating energy demands and environmental challenges. The rapid expansion of metro line projects in Mumbai city has become a vital catalyst for enhancing urban mobility, but it also intensifies the need for sustainable energy solutions to mitigate the associated ecological impacts. This abstract explores the potential of utilizing Vertical Axis Wind Turbines (VAWTs) as a sustainable energy solution to address the energy demands along the metro line projects of Mumbai city.

The conventional reliance on fossil fuels and grid-supplied electricity has demonstrated its limitations, contributing to pollution, carbon emissions, and resource depletion. To counter these adverse effects and achieve the ambitious targets set for sustainable development, integrating renewable energy sources such as VAWTs into urban infrastructures has gained prominence.

This study investigates the applicability of VAWTs within the context of Mumbai's metro line projects. Geographic Information System (GIS) is used to map the wind velocity profiles for Mumbai city along an existing metro line, Versova-Andheri-Ghatkopar (VAG) corridor, from which the net wind velocity, relative to the speed of the metro train, is extracted as a design wind velocity for the proposed design of Vertical Axis Wind Turbine (VAWT). The design of VAWT is carried out by an established method developed by Khandagale et al. (2017). The design analysis considers various factors, including the net wind speed, wind power, aspect ratio, overlap ratio, solidity, and the number of blades. The number of VAWTs required and the best suitable locations for the proposed VAWTs along the VAG corridor are identified. The material for the VAWT is also selected by using the TOPSIS method with fuzzy linguistic variables.

It was analyzed that when the speed of the metro is around 18m/s, 1.69kW of output power is generated from one VAWT. Thus, if 4 VAWTs each having area of 1.5sq.m with 4 blades on each VAWT is placed between two stations, there is a power output of 6.77 kW. In addition, if the VAWT are placed in series, it is observed that the output efficiency can be increased.

The findings reveal that VAWTs offer several advantages in the urban context, such as compact design, reduced noise, and omnidirectional wind capture capabilities, and energy generation at low wind speeds which make them suitable for densely populated areas and complex urban landscapes. Moreover, their vertical orientation enables harnessing wind from various directions, without yaw mechanism, making them adaptable to the changing wind patterns encountered in urban environments.

Additionally, the integration of VAWTs along Mumbai's metro lines can serve a dual purpose. Not only do they provide a clean and reliable energy source to power the transportation infrastructure, but they also act as iconic symbols of the city's commitment to sustainability, raising public awareness and support for renewable energy initiatives. As Mumbai strides towards a cleaner and more sustainable future, embracing innovative solutions like VAWTs becomes imperative to transform its metro infrastructure into a shining example of sustainability for other cities to follow.

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ID: 221 / B RU: 4

Resilient urban and regional systems

Keywords: Urban Heat Island, MODIS, Urban areas, SUHI intensities, Megacities

Monitoring urban heat stress for megacities of India using remote sensing data

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Abstract:

Warmer global climate and urban heat islands (UHIs) interact, by exacerbating heatwaves and increasing the extreme heat nights in cities. The implications of added heat stress in urban environments due to intensifying surface UHIs (SUHIs) is of utmost concern. The remote sensing satellite data of night time from MODIS Land surface temperature product is used for seasonal, annual and decadal nighttime SUHI intensities (SUHIIs), from 2001 to 2021, for seven major populated cities of India. This includes five megacities- Delhi, Mumbai, Kolkata, Bangalore, and Chennai, and two incipient megacities Hyderabad, Ahmedabad. For all cities either pre-monsoon (MAM) or winter (December-February; DJF) seasons show the strongest SUHII development. During the 2001–2011, and the 2011–2021 decade, a nighttime SUHII maxima of respectively (i) 2.1°C and 2.5°C for Delhi, (ii) 1.3°C and 1.5°C for Mumbai, (iii) 1.3°C and 1.5°C for Kolkata, (iv) 0.6°C and 1.0°C Bangalore, (v) 1.7°C and 1.9°C for Chennai, (vi) 1.8°C and 2.3°C for Hyderabad, (vii) 2.8°C and 3.1°C for Ahmedabad is noted. High SUHII magnitudes, greater growth rates of SUHII, and huge populations, increasing desnse urban development in these cities severely compounds the vulnerability of Indian cities to excessive heat exposure risk, especially during MAM heatwaves. The study of nighttime SUHII help to localize hotspots within urban areas and simultenously helps the decision makers to take measures to cool down the identified areas.

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ID: 220 / **F BD: 2**
Urban dynamics
Keywords: SMART cities, Deep learning, Remote Sensing, Image Segmentation

Artificial Intelligence based urban areas mapping of SMART cities using remote sensing data

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Abstract:

Mapping of urban built-up areas plays a vital role in urban planning and development of the proposed SMART cities of India. With the availability of high resolution satellite data and Artificial Intelligence computer vision techniques, automating the process of extracting built-up areas is possible. It allows the continuous monitoring of urban development in all the SMART cities in much less time in contrast to manual digitization of urban built-up areas. In this study, Indian remote sensing Resourcesat-2 LISS IV satellite data with 5.8m spatial resolution and three spectral bands Red, Green and Near Infrared are used. The image segmentation deep learning hybrid model called U-ASPP Network is used for extracting built-up areas in small, medium and large SMART cities spread across the country. The model is the combination of state-of-art UNet model and atrous spatial pyramid pooling (ASSP) with the advantage of including contextual information in the complex urban environment. It is an encoder-decoder network with last layer of ASPP having varied field of view for delineating the exact boundaries of the man-made structures. The model is trained and validated on the manually digitized 20 cities having varied terrain conditions situated in plane, coastal areas, mountaineous regions with both compact and scattered built-up areas. Using the stratified accuracy assessment techniques, it is found that the mean accuracy and Intersection over union obtained over the cities are 94.2% and 85% respectively. The proposed model able to classify the urban areas for all the proposed SMART cities and aids in monitoring urban development within these cities.

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ID: 183 / **C RU: 2**
Resilient urban and regional systems
Keywords: Blue-green infrastructure (BGI), Urban flood, resilience, community participation, wetland restoration

Blue-green Infrastructure for Urban Resilience of Developing Indian Cities: Wetland and Water network Restoration as a Tool to Mitigate Urban flood in Guwahati, Assam

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Abstract:

Climate change is increasing flood risk in India. Increased exposure due to rapid urbanization, makes adaptation a key strategy for reducing adverse impacts. Nature-based solutions (NbS) such as wetland restoration and water network restoration as a part of urban blue-green infrastructure (BGI) can help fill the adaptation gap and reduce flood risk at low-cost.

In this context, Guwahati the capital of Assam and the gateway to the north east India presents an interesting case. Because of its potential connectivity to the south east Asia in the purview of the Act east policy it is suddenly and abruptly subjected to enormous infrastructure developmental pressure.

Deepor Beel a wetland on the southern edge of the city of Guwahati and river Brahmaputra on the northern edge is connected to various water bodies and man made tanks spread over the city through channels creating a water network. The settlements though started at the valley areas, with increasing population it has spread everywhere. This growth is disturbing the natural landscape and the Man made water network resulting in flash urban flood. Though Assam always had an intimate relation with riverrine floods, Guwahati was not in that flood map. This change in climate makes it difficult for the capital city to cope and it is almost every time on the verge of total infrastructure collapse.

This study tries to analyze if restoration of the wetland and the water network can contribute to the urban flood mitigation. It outlines a scientific and applicable approach to identifying areas of high urban risk focusing on urban flooding. Hotspots in Guwahati are identified, and a Participatory-GeoSM-NatE approach is implemented. A community survey following the desk-based analysis throws light into identifying real issues and feasible solutions both in terms of urban planning principles as well urban design guidelines.

ID: 205 / A OD: 1

Open data in planning and urban management

Keywords: OpenStreetMap, Data Quality, Accessibility, Open Data, 15-Minute City

Towards Reliable Accessibility Analysis: Assessing OpenStreetMap Data Quality in Germany

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Abstract:

Proximity-centred planning concepts, exemplified by the 15-Minute City, have garnered considerable attention in recent years as a means to create sustainable urban spaces. Scholars have increasingly analyzed urban areas using these concepts to measure walking access to crucial destinations such as schools, parks, and healthcare facilities. Concurrently, the availability of extensive open geodata, particularly through OpenStreetMap, has enabled researchers to extend these analyses from single cities to continental and worldwide comparisons.

However, it is well-known that OpenStreetMap data has limitations in terms of completeness, thematic accuracy, and other data quality criteria. Only limited attention has been given to the data quality of points of interest and its impact on accessibility evaluations. Subpar data quality may undermine the validity of studies assessing access inequity and spatial patterns of accessibility. Understanding the extent of data quality variation across different areas and its effects on accessibility analyses is thus crucial to assess the reliability of studies utilizing OpenStreetMap data.

This contribution focuses on comparing the data quality of OpenStreetMap's points of interest to reference datasets concerning completeness and usability. The analysis centers on three distinct German regions - Munich, the Rhine-Neckar metropolitan region, and the county of Görlitz. The reference datasets were sourced from official authorities and provider websites and encompass essential amenities such as (elementary) schools, kindergartens, nurseries, general practitioners, pharmacies, and supermarkets. Accessibility is evaluated through three distinct measures: gravity-based, cumulative opportunities, and travel time to the nearest destination. A comparison is made between these measures using OpenStreetMap data and the reference datasets to assess usability.

The hypotheses guiding this study are as follows: 1) data quality tends to be higher in more central areas, 2) Points of Interest more visibly represented in public spaces (e.g., schools, pharmacies, supermarkets) tend to have higher data quality, and 3) spatial patterns of cumulative opportunity and gravity-based accessibility measures are less influenced by data quality compared to travel time to the closest destination.

Preliminary analysis in Munich revealed considerable disparities in data quality across different destination types. While pharmacies and supermarkets were reasonably well-mapped in OpenStreetMap, substantial discrepancies were found between reference datasets and OpenStreetMap data for kindergartens, nurseries, and general practitioners. Further exacerbating this issue was the frequent lack of semantic information to differentiate between different types of healthcare centers and child daycare facilities. Accessibility analyses with the different measures exhibited similar spatial patterns with the different data sets.

This study contributes critical insights into data quality variations in OpenStreetMap, particularly concerning points of interest and their implications for assessing urban accessibility. The findings can inform the development of more robust and reliable measures of proximity-based accessibility to foster sustainable and equitable urban environments.

ID: 243 / A OD: 2
Open data in planning and urban management
Keywords: MOSDAC, INSAT, Satellite, GIS, weather

Weather Information Services from MOSDAC for Urban Management

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Abstract:

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Meteorological and Oceanographic Satellite Data Archival Centre (MOSDAC) (https://mosdac.gov.in) is a data repository for all Indian Met and Ocean Satellite missions launched by ISRO. These satellite datsets are disseminated to the national and international scientific user community as well as operational agency in NRT mode through MOSDAC.MOSDAC geo-portal also provides weather information services on a Geospatial platform related to weather forecasts at different prediction lead times ranging from immediate short range (nowcast), medium range to seasonal time scales.

This paper outlines the design and development of a WebGIS based Decision Support System (DSS) for Near Real Time dissemination of weather information services over Indian Landmask at different temporal and spatial resolutions. WebGIS based decision support system can help government agencies, NGO's etc. in planning mitigation activities to save lives and properties due to damages caused by extreme weather events like heavy rainfall, flash floods, etc. Weather information service using GIS technology can be useful for decision making to reduce economic and material loss and thereby contribute to the Disaster Management Program.
Weather information services on MOSDAC include high resolution Numerical Weather Prediction based forecasts of different weather parameters, very short range prediction (upto next 3 hours) of all India heavy rainfall and cloud bursts over Uttarakhand and Himachal Pradesh, as well as seasonal prediction of All India summer monsoon rainfall. MOSDAC also provides regular observations of all India heavy rain using the near real-time observations from operational geostationary satellite NSAT-3D at every half hour intervals.

ID: 115 / E UD: 2
Urban dynamics
Keywords: Infrastructure, Satellite Images, Change Detection

Study of Infrastructural Upgrade of Ahmedabad City using Satellite Imagery

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Abstract:

In today's era satellite imaging systems have revolutionized the way in which urban development is comprehensively and continuosly observed and analyzed. The availability of satellite images over a period of time and at regular intervals helps in monitoring the changes occurring due to different activities. The study of these changes in time-space domain helps in analyzing and understanding the pattern of growth of modern cities. This paper presents the transformation of Ahmedabad, one of India's fastest-growing cities over time, using the satellite imagery, highlighting the key developments, geo-spatial patterns and urban growth. Ahmedabad, located in the western state of Gujarat, has experienced rapid urbanization and transformation over the past few decades. The major growth factors of Ahmedabad have been industrialization, increase in population, real-estate development, infrastructure growth and upliftment of civic facilities in eastern and western part of the city as evident from different image sources. By harnessing the power of satellite imagery, this paper aims to provide valuable insights into the urbanization process and its implications for urban planning, infrastructure development and sustainable growth. To conduct this study the earth observation remote sensing data from high and medium resolution satellite images from ISRO satellites IRS-1C/1D, Resourcesat-1/2/2A, Cartosat Missions, and geo-spatial platforms hosting the satellite datasets such as Bhuvan and Google Maps are utilized to capture the changes in city from infrastructural point of view. The method of evaluation is detecting changes between satellite images of Ahmedabad corrected using reference images to acheive higher geo-spatial accuracy. The change detection technique using the feature extraction and evaluation method effectively details the new roads and buildings in different areas of Ahmedabad. By comparing images acquired at different days, land cover usage reveals the transformation of agricultural land into residential, commercial, and industrial areas. The analysis also identifies the growth of transportation networks, including roads and highways and the impact of urbanization on natural landscapes. This provides a clear picture of Ahmedabad's urban expansion and land use changes over time. The evolution of Ahmedabad's infrastructure is a key aspect of this study. By analyzing satellite imagery, the expansion and upgrades of infrastructure elements such as transportation networks, airports, railway lines and major public facilities has been detected. This examination provides insights into the city's investment in transportation, utilities, and other essential amenities to meet the demands of a growing population.The preservation of green spaces is also a crucial aspect for sustainable urban development and the study of satellite images has provided an overview of the distribution and changes in green spaces within Ahmedabad. This also highlights the city’s efforts to maintain a balance between urbanization and environmental sustainability. By examining the land use changes, infrastructure development and green spaces, this study provides a comprehensive understanding of the Ahmedabad's growth dynamics. Presently Ahmedabad city is envisaged as the future commercial capital of India and the pace of infrastructural improvements support this fact. With this the vitality of satellite imagery’s role in monitoring and managing urban growth also gets highlighted.

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ID: 195 / **C LT: 5**
Submission for Posters
Open data in planning and urban management
Keywords: Technology for developments; Open data; site selection; criteria decision making

Methodology challenges in Spatially locating Smart Beehive in tribal areas

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Abstract:

Communities living in Tribal areas like Kanha National Park in Madhya Pradesh are one of the most sensitive tribal communities known as Baiga.They are hunter gatherer and are nature-dependent for their livelihoods and food. Collecting non-timber forest products (NTFPs) including honey collection has been one of the livelihood options for the tribes. Bees are crucial in helping pollination and providing ecosystem stability. Conserving native bee species is also an important nature-based ecology and landscape conservation initiatives. However, tribals often get into human-animal conflict while going into the designated core and buffer areas boundary of Tiger and wild animals habitations thus leading to injuries and death. An IoT (internet of Things) based Smarthive has been designed and prototyped in the project using Arduinos and four sensors to remotely collect data regarding weight of bee box, humidity, motion and temperature. In this ongoing research project, a smarthive is proposed as a technology intervention to help tribals do honey collection in a safer manner and continue NTFP-based livelihoods.

Currently tribes with their traditional knowledge access specific forest areas for checking the growth of bee hives and to evaluate its readiness for honey collection. With risks of human-animal conflicts, there is decline in honey collection as a livelihood among tribes and also in conserving the bee population. In this project, a systematic multi-criteria methodology is proposed for site selection strategies by combining open data (Forest area maps), community settlements (census, spatial data), potential locations of existing bee hives (oral history and participatory GIS), path from settlement villages to natural bee hives (Field observations), etc. In order to collect the current honey collection practice, methods such as social mapping, oral history and participatory GIS approach were used to locate 20 pilot testing locations in two case study villages. Tribals who have been engaging in honey collection will be participants in this project by sharing their knowledge about honey collection, challenges involved and the effort. In this participatory GIS approach, community elders prepare a social map showing settlements, key points of interests, nature hive locations, and path to it. This will be triangulated with the GIS based maps to identify the geographical features shared by honey collecting tribals. The presentation will focus on methodology challenges of combining diverse data sources – open map, census, field observations, oral history, etc- for site selection of SmartHive.

An experimental approach is proposed with two honey collection groups–namely control group (who will continue their routine practice) and then smarthive group (who will participate in pilot testing SmartHives). An activity diary will be recorded by participants in both the group with timestamp, effort in honey collection, amount of honey collected, field challenges (if any). The efficacy of Smarthives will be evaluated in pilot phase about its functional performance (remotely monitor beehive growth), incremental reduction in effort for honey collection, changes in migration patterns and income. The impact of this proposed project is to provide safer honey collection livelihood to these tribes and thereby reducing their economic migration to urban areas.

Bibliography

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(Aston Business School, UK) in Disaster Management. He has published in European Journal of Operational Research, International Journal of Disaster Risk Reduction, Water Resources Management, Urban Climate, Nature climate Change etc. His email address is magesh@iimnagpur.ac.in.

Author-2- Mr. Prasoon Shrivastava comes with a Techno-social background with a Bachelor's in Mechanical engineering from Govt Engineering College, Ujjain and a Master's degree in Rural Development from Tata Institute of Social Sciences. started my career as a conservation specialist in one of the most ecologically sensitive areas of Kanha National Park, working with an ecologically rich cultured tribal community known as 'Baiga" of Madhya Pradesh, which recently got their habitat rights too.He also worked on sustainable land use management, ecological restoration and soil water conservation as his work. Later he worked with various governments at the central and state levels and government think tanks as a Public Policy researcher on multiple short- and long-term assignments on Environment Health, Agriculture, Forest and Livelihood. Currently working as program manager landscape restoration program at World resource institute in Bhopal. apart from that he has been part of many renowned research project like "Kumbh Mela Experiment" with University of Amsterdam and IISC , ICRISAT , Potsdam University , IIM Nagpur and IFRI.

ID: 241 / F UD: 3

Resilient urban and regional systems

Keywords: Severe rainfall, Flooding in urban domain, Satellite based nowcasting

Satellite based rainfall nowcasting for an urban domain

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Abstract:

Recent studies have shown that there is an increase in heavy rainfall events, and this is especially disastrous for urban domains. Continuous and intense rain can lead to urban flooding, water logging, traffic congestion and toppling of the entire fabric of city life for hours. The ability to nowcast (very short term forecast upto 3 hours) rainfall in realtime is crucial for decision-making and disaster rapid response in this regard. Such a system would provide valuable information for disaster preparedness, as well as improve the efficiency of mitigation and rescue operations. Satellite based model Hydro-estimator (H-E) Nowcaster has thus been developed using INSAT-3DR data to provide predicted precipitation fields upto next three hours. The algorithm is based on optical flow technique, which advects precipitation fields. In conjunction with Cloud Top Cooling rate (CTCR) information, the model is able to identify and give estimates of precipitating systems. This has been operationalized on mosdac.gov.in to display the nowcasted Hydro estimator precipitation data for Indian subcontinent on a web-GIS platform. The developed real-time system has shown promising results in predicting rainfall and gives higher skill scores for initial stages with error for the rainfall range <5 mm/hr and lead-time 60 minutes is less than 10 %

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ID: 154 / **A UD: 4**

Open data in planning and urban management

Keywords: Open Data, Global Human Settlement Layer, Evidence based policy making, Urban Development, Global South

Open data for tackling urban data poverty in the Global South: A review on Global Human Settlement Layer (GHSL)

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Abstract:

This study presents a comprehensive analysis of the applicability and usage trends of Global Human Settlement Layer (GHSL) products for local-level urban development policies in the Global South. Despite the much talked-about explosion in data generation, it is alarming that high-quality local data sources for urban areas in the Global South are largely lacking. Most of these areas in the Global South are growing rapidly owing to higher rates of urbanization and economic development, and their urban growth is concentrated in irregular and informal settlements with an acute shortage of basic infrastructure and services. Above all, such data poverty may be addressed through the potential adoption of global Open Data products.

This research adopts a bibliometric analysis approach, conducting a systematic and critical literature review to explore the existing knowledge on GHSL products and their utilization patterns within the context of the Global South. The findings of the study highlight a significant limitation of existing population grids, such as WorldPop and GHS-Pop, in terms of their coarse spatial resolution. Numerous studies have reported their poor performance, particularly when applied at local scales. The coarse resolution (~100m and ~1km) of these grids hinders their effectiveness in local-level application studies, posing challenges for urban development policies in the Global South. Consequently, this study emphasizes the necessity of incorporating additional field-level data collection efforts and engaging stakeholders for validation purposes when utilizing GHSL products for local policy-making. The integration of on-the-ground data collection activities and collaboration with local stakeholders is crucial to supplement the limitations imposed by the coarse spatial resolution of existing population grids. While GHSL products demonstrate their value in global-scale analyses and broader urban development policies, caution should be exercised when applying them at the local level in the Global South. Other authors have highlighted concerns related to GHSL data quality, accessibility, relevance, and privacy, and issues such as underestimating the population in densely populated regions, and overestimating the area of the depopulated zone.

In order to ensure the reliability and accuracy of GHSL products for local policy-making, it is imperative to bridge the gap between remote sensing data and ground-level reality by collecting field-level data and involving stakeholders in the validation process. This research sheds light on the existing knowledge gaps and emphasizes the importance of addressing these limitations to enhance the applicability of GHSL products for local-level urban development policies in the Global South. It serves as a valuable resource for researchers, practitioners, and policymakers seeking to leverage remote sensing data for effective and context-specific urban planning and policy formulation in the Global South.

ID: 223 / **D UD: 2**
Urban dynamics
Keywords: Urban forestry, LiDAR, Physiognomy, Phenology, Remote Sensing

Urban Forestry Monitoring through Satellite Remote Sensing and Terrestrial LiDAR: An integrated approach

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Abstract:

Urban forestry plays a vital role in enhancing the quality of urban environments by providing numerous ecosystem services, ecological, social, and economic benefits. Effective management of urban forests necessitates accurate and up-to-date information on their composition, structure, and health. This abstract introduces an integrated approach to urban forestry monitoring that combines space based satellite remote sensing observation data and terrestrial LiDAR (Light Detection and Ranging) System (TLS). Satellite remote sensing offers a broad-scale view of urban forests, enabling the assessment of canopy cover, species distribution, and phenological changes over time. High spatial resolution satellite imagery having multispectral and hyperspectral channels, delivers valuable insights into vegetation health and stress indicators. Furthermore, synthetic aperture radar (SAR) data aids in penetrating cloud cover and assessing structural characteristics of tree canopies. However, Terrestrial LiDAR complements satellite remote sensing by providing detailed, three-dimensional data at a local scale. LiDAR captures fine-grained physiognomic information on tree architecture, individual tree heights, tree trunk diameter, canopy structure, canopy diameter, branching pattern and vertical vegetation profiles. Integration of these remote sensing techniques supports large-area coverage and enhances our capability of monitoring urban forests. When combined with ground-based measurements, accurate estimation of biomass, carbon sequestration, tree growth patterns and phenological dynamics can be done.

The proposed integrated monitoring framework combines the strengths of both satellite remote sensing and terrestrial LiDAR which enhances the precision of urban forestry assessments and facilitates the development of targeted management strategies. The benefits of this integrated approach are manifold. Urban planners, policymakers, and arborists gain access to timely and accurate information to make informed decisions regarding tree management and urban development. This approach aids in quantifying the impacts of urbanization on tree cover, facilitating sustainable urban planning and green space management. Additionally, the framework contributes to our understanding of urban forests' role in mitigating climate change impacts, urban heat island effect and supporting urban resilience. In conclusion, the integration of satellite remote sensing and terrestrial LiDAR point cloud data presents a powerful solution for comprehensive urban forestry monitoring. This approach bridges the gap between large-scale landscape analysis and detailed local assessments, enabling effective management of urban forests for a more sustainable and bio-climatically more comfortable urban environment.

ID: 197 / **E RU: 4**
Urban dynamics
Keywords: Migrants, Proximity, Affordability, Urban Growth & Housing

Allocating Space to the Migrants using Geo-informatics

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Abstract:

Migration has been the main component of urbanisation. According to the Census 2011, about one third of the population in India lives in urban areas (31 per cent). Migration is a form of mobility in which

people change their residential location across defined administrative boundaries for a variety of reasons. The research has been performed to identify the housing needs and choices of migrants. There is a need to analyse the problems of the poor urban migrants separately from the problems of the urban poor. This research first provides a brief review of migration trends, patterns and types in India. Further, an overview of migrants' characteristics and housing conditions in Bhopal and Mumbai has been studied to assess the current economic background in meeting their housing needs and security. The study analyses various parameters and factors that affect the choice of a migrant through Affordability and Proximity criteria. Location intelligence and geospatial analysis with network analysis enhances the moulding of Rental housing sites for migrants more efficiently. For analyzing though the lens of affordability price valuation of rental properties will be done for the case study areas whereas for evaluating proximity criteria the minimum walkable distance from public transport nodes by buffer analysis will be performed. As distance from work is also preferred by migrants a study of major industrial and commercial nodes has been done from land use plan of study area. Migrants have poor access to housing and basic amenities, have poorer entitlements, and suffer from poor working conditions and labour market discrimination. The paper establishes a relationship between residential rental price, location, availability of amenities and the existence of facilities within a particular piece of accommodation. The study tried to understand the reasons why people prefer one type of apartment over another and in particular locations. Understanding the impact of certain characteristics on residential rental prices provides important information for rent regulations and policy making to guide the rental market. Poorer migrant workers who enter urban job markets face large uncertainties in the potential job market. The paper establishes a relationship between residential rental price, location, availability of amenities and the existence of facilities within a particular piece of accommodation. The study tried to understand the reasons why people prefer one type of apartment over another and in particular locations. Understanding the impact of certain characteristics on residential rental prices provides important information for rent regulations and policy making to guide the rental market.

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ID: 124 / **C LT: 10**
Submission for Posters
Resilient urban and regional systems
Keywords: Bioswales, Digital Elevation Model (DEM), Groundwater Recharge wells, Multicriteria Decision analysis (MCDA), Surface Runoff

Improving Stormwater Infrastructure using Geospatial Techniques in Rajkot Smart City

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Abstract:

Due to climate change and unpredictable weather conditions, Indian cities are majorly facing issues like urban flooding and depleting fresh water resources. Key factor behind these issues is unstructured water infrastructure. Majority of cities in India are managing stormwater with traditional approaches which are insufficient to handle extreme weather conditions. However, providing robust and sustainable water infrastructure is one of the key components for planning smart cities. Geospatial Technology driven solutions can be used to mitigate such situations with data driven decision making.

Rajkot is one of the cities under Smart Cities Mission which is also trying to incorporate sustainability as one of the major criteria in their infrastructure solutions. There are issues of water scarcity and the city has an improper stormwater infrastructure due to which it is affected by flash floods in monsoon. The two major reasons for flooding in the city are the blocked natural drains and increase in impervious pavements throughout the city leading to decrease in infiltration of excess surface runoff. The present study focuses on improving and augmenting the existing stormwater infrastructure of Rajkot and proposes smart, sustainable and green infrastructure solutions using geospatial techniques. Furthermore, it will help to alleviate the water logging issues and also rejuvenate the groundwater table. In order to conduct this study, satellite imageries and water utilities datasets were used. Topographic characteristics and natural flow of drainage were understood using indices like Topographic Position Index and Topographic Wetness Index, generated from Alos-Palsar DEM. These terrain indices and land use were considered to identify potential areas suitable for groundwater recharge wells using Multicriteria Decision analysis. This resulted in the delineation of eighteen new locations for groundwater recharge wells. To assess the stormwater issue at a granular level, surface runoff was calculated based on watersheds generated from existing stormwater drain points in the city. Based on that, twelve locations for green infrastructure practices which include bio-swales and permeable pavements, were identified. These interventions were proposed by prioritizing areas with higher surface runoff, existing water-logging incidents and availability of space at that location.

These proposed interventions will help in tackling the water stress issue and will mitigate the impacts of flash floods. These practices are cost-effective methods to capture the excess runoff and reduce the rate of stormwater, which will in turn benefit the recharging of groundwater.

This study provides geospatial solutions for resolving the critical stormwater and groundwater issues by integration of smart geospatial techniques.

ID: 219 / **A UD: 1**
Urban dynamics
Keywords: 3D modelling, Digital twin, sustainable development

3D Mapping and Digital Twin for sustainable development

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Abstract:

3D mapping of the city is need of the hour for effectively managing the vast city areas and resources in Indian context. 3D mapping of a city can be very well performed with the help of aerial photogrammetry

using aerial drones and LiDAR as well as with the help of satellite photogrammetry. With the launch of very high-resolution remote sensing satellites (15-30cm resolution) namely Cartosat-3 series, World view- 4, Pleiades and many upcoming contemporary missions, it is now feasible to reconstruct very accurate and precise 3D city models over any part of the world using satellite data. Accurate representation of city models mainly depends on extraction of highly accurate Digital Elevation Models (DEM), Digital Terrain Model (DTM), and buildings shapes and precision of the collected Ground Control Points (GCP). It is convincing to generate ~1m absolute accuracy DEM using in-track / across- track stereo acquisitions made by above-mentioned payloads while using precise GCPs. Automatic extraction of precise building shapes from raster data is also a reality because of deep learning, convolutional neural networks and high end computer systems. Representation of physical cities in digital world at large scale (national level) lays foundation for various new applications of 3D change detection, population estimation, resources estimation, visibility analysis, disaster management, airflow analysis, strategic planning and solar energy calculations at building level etc. Digital city models are serving as an important asset in smart city planning and effective management.
Static virtual 3D city models have allowed users to visualize and analyses city areas visually. However, recently the evolution of digital technologies, sensors and IoT have taken virtual 3D modelling to the next level. With the introduction of these nascent technologies, real time data of air quality, water quality, noise pollution, bridge monitoring, traffic monitoring and energy sensors, over precise locations can be captured and analyzed. By exploiting smart city technologies, including digital twins, cities may enhance the design and planning of urban metabolism by simulating various unknown and difficult scenarios before actual implementation. Continuous steam of data is very useful for understanding the complex relations among various environmental parameters and also for performing the predictive analysis using data analytics. Digital twin of a city is proving as an indispensable technique for efficient management and sustainable development of an urban city.

Bibliography

Two-Dimensional and 3D Change Detection in Urban Area Using Very High-Resolution Satellite Data and Impact of Urbanization over LST and NDVI.
DOI:10.1007/s12524-023-01737-6

ID: 242 / D RU: 3

Urban dynamics

Keywords: sustainable finance, land use, urban planning, climate risk

Development of an interdisciplinary indicator assessment approach for climate risk standards

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Abstract:

Growing concerns about natural disasters and extreme weather events have increased the urgency to develop standards and indicators for climate risk assessments in the financial sector. This approach differentiates between physical and transitional risk. Whereas the former refers to the physical vulnerability to hazards like drought or flooding in a specific area, the latter adresses legal risks stemming from regulatory changes in reaction to climate change. While in theory a spatial approach, both risk assessments do not take into account the risk mitigation potential of local and regional institutions and infrastructures. Furthermore, the performative impact of financial risk assessments on regions have not been investigated yet. Indicator design entails a decision making process guided by a transformation theory based on systemic knowledge, target knowledge and assumptions of the qualitative change necessary.

This paper spotlights indicators and standards of different sectors (finance, building sector and urban planning) referring to the built environment. While they adress the same infrastructure they might not define the same object classification, actors, targets and system boundaries. Consequently, their concurrence in spatial areas might enforce and measure different and sometimes unintentionally

interacting climate strategies. This paper develops a framework to identify designs and potential effects of sustainability indicators and targets in land use planning, building sector and sustainable finance on a conceptual base. The paper investigates sustainability metrics indicators of residential buildings and areas from the private and public sector. It links three dimensions. It begins with the socio-technical analysis of orders of worth, values and norms inscribed into indicator design, data infrastructures and the legal, technical, administrational practices within data value chains. It adresses the potential of network analysis of policy discourses and actors revolving around risk assessment, ratings and sustainability reporting standards in green finance and investigating spatial and institutional dimensions as well as themes like impact orientation or sustuainable (de)growth. The potential of earth oberservation and spatial science methods is discussed to investigate environmental impacts of the housing sector and validating sustainability targets, strategies and indicators as well as testing new indicators designed with data sets and methods based on the critical conceptual analysis and collaboration with partners from regional planning and city administration. The concept of indicator analysis covers the translational steps from abstract concepts and ideals to data and administrational or financial practices to spatial objects and impacts. This framework can be used for analysing sustainability standards and indicators by comparing their questions, concepts and metrics. Spatial science methods can help to understand unintended effects, relations and interdependencies with local environment, social science can investigate social drivers and create access to additional data with interviews and administrational data and network analysis can assess connections between spaces and actors, that otherwise would not be seen. This results in more meaningful research questions and tools to validate and understand sustainability targets, data and indicators from multiple perspectives while at the same time adressing the values, concepts and visions inscribed in these perspectives.

ID: 226 / Poster Session cont.: 7

Resilient urban and regional systems

Keywords: Healthcare facilities, Urban Health Centers (UHCs), Air quality, Vector borne, Geospatial assessment

Geo-Analytical Approach to diseases vulnerability and high-risk space in Rajkot

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Abstract:

Healthcare facilities stand at the forefront of a city's progress, and in pursuit of advancing its medical sector, Rajkot has demonstrated unwavering dedication. Currently, Rajkot Municipal Corporation (RMC) operates 21 Urban Health Centers (UHCs), with eight of them having received the prestigious National Quality Assurance Standards (NQAS) accreditation, and Nana Maua UHC achieving accreditation from the National Accreditation Board for Hospital and Healthcare Providers (NABH). Committed to providing inclusive healthcare services for all, Rajkot also targeted to offer specialized treatments through its UHCs, as outlined in the RUDA Development Plan of 2015.

The study primarily focuses on analysing the prevalence of different diseases in Rajkot, with particular attention to its occurrence due to environmental factors. Diseases like Asthma and Pulmonary diseases, has strong correlation with air quality and Vector-borne diseases like Malaria and Dengue, which become more prominent during the monsoon seasons and subsequent water logging areas

Rajkot has installed 20 environmental sensors, strategically positioned across the city which aid in monitoring concentrations of PM_{10}, $PM_{2.5}$, SO_2, NO_x, CO_2, etc., These sensors continually record air quality data every hour, which are critical indicators for air pollution-based diseases, pulmonary diseases and Asthma. By observing and analysing over different temporal resolutions of the level of these pollutants, the study identifies vulnerable sites using Multi-Criteria Decision Analysis (MCDA) and these findings are subsequently validated by correlating them with reported cases of the respective diseases. For vector-borne diseases, the study explores various factors that contribute to the breeding of mosquitoes in close proximity to human habitation. Land Surface Temperature, Humidity, Rainfall,

and Lower elevation play pivotal roles in promoting mosquito breeding sites. By employing MCDA, high-risk locations are identified, and the results are corroborated with actual reported cases of vector-borne diseases.

Areas which are near water bodies and where the PM_{10} and $PM_{2.5}$ concentrations are the most vulnerable areas for diseases. This study suggests ward no. 3 is the most vulnerable zone to air pollution-based diseases. There are 10 UHCs present within 500 meters radius of the highly vulnerable zones which may require preparedness.

The implications of this comprehensive geospatial assessment extend far beyond Rajkot, offering vital insights and methodologies for enhancing healthcare infrastructure planning in other regions. By prioritizing inclusivity and specialized care, Rajkot aims to pave the way for a healthier, resilient, and thriving community. This research, grounded in the power of geospatial technology, presents a momentous step forward in achieving Rajkot's vision of a robust and accessible healthcare system for all its residents.

ID: 247 / C RU: 3

Urban dynamics

Keywords: Urbanization, Kole Wetlands, Thrissur District, Land Use and Land Cover (LULC) change detection, Random Forest / Tree Classification

Spatio-Temporal Analysis of Urban Growth and its Impact on Kole Wetlands of Thrissur District

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Abstract:

Urbanization, driven by industrialization and globalization, leads to rapid urban growth and altered land use, with environmental consequences. The rapid expansion of urban areas presents challenges to both human societies and natural ecosystems. Over half of the world lives in cities, impacting ecosystems. Remote sensing and GIS help to track changes for effective management. This study is done to address the limited information on recent spatio-temporal changes including urban growth and their repercussions on the Kole Wetlands of Thrissur District, Kerala. The Thrissur district is a region of cultural significance and ecological diversity. The Kole Wetlands part of the Vembanad-Kole wetland system, was designated as a Ramsar site in 2002. It is the largest brackish, humid tropical wetland environment on the Southwest coast of India. The Kole Wetlands are low-lying areas, covering about 168.67km^2 and play a crucial role in flood regulation and ecological/environmental balance, yet face ecological threats. These wetlands have long been cultivated for traditional agricultural practices, primarily paddy cultivation, using methods that adapt to changing water levels. They support a rich array of flora and fauna which are under constant threats from land transformations and pollution from urbanization. The primary objectives of the study were twofold: firstly, to assess the pattern of urbanization in Thrissur District over the past two decades, and secondly, to analyze the temporal changes in land use and land cover (LULC) and their impact on the Kole Wetlands using satellite imagery. Multi-temporal Landsat images from 2000, 2014, and 2023 were employed with remote sensing and GIS techniques, specifically the random forest/tree supervised classification, to classify LULC categories such as built-up, agriculture, vegetation, water bodies, and fallow/barren land. ArcMap and QGIS software were used to conduct the research. The findings reveal significant shifts in LULC, notably the decrease in barren/fallow land (109.63km^2), agriculture (22.63km^2), water bodies (12.25km^2) and vegetation (10.04km^2), coupled with an increase in built-up areas (154.55km^2). The built-up class shows the greatest decadal change, primarily at the expense of 108km^2 vegetation area, reflecting the expanding urbanization around Thrissur City. The expansion is particularly evident in the south, west, and east directions, encroaching upon the Kole Wetlands. Additionally, the Kole wetlands were delineated and changes specifically within the Kole Wetlands showed a reduction in barren/fallow

land (11.869km^2), water bodies (5.427km^2) and agriculture (0.344km^2), with an increase in built-up (2.214 km^2) and vegetation (15.428km^2). Urbanization encroachments are especially noticeable in the Puzhakkal area along state highway 69. The accuracy assessment of the LULC classification reveals satisfactory results, with overall accuracy ranging from 79% to 85% for different years. The research underscores the potential of high-resolution data to enhance accuracy and classification outcomes. The research highlights the importance of continuous remote sensing monitoring for assessing urbanization and urban encroachment, particularly in ecologically and internationally significant areas like the Kole Wetlands. By shedding light on the evolving dynamics between urbanization and the natural landscape, this study contributes valuable insights for policymakers, researchers, and officers involved in the sustainable development and preservation of these vital ecosystems.

ID: 167 / B UD: 4

Open data in planning and urban management

Keywords: Traffic Flow, Visualization of traffic, Traffic congestion analysis

Multiple layers method of transportation analysis

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Abstract:

This is an abstract for International Land Use Symposium 2023. I had the Indian and Japanese joint research “SATREPS” or Science and Technology Partnership for Sustainable developments from 2017 to 2022. In the project, we have transportation analysis in Ahmedabad city. This research used a unique approach for traffic analysis among multiple layers method, let’s say such as 3D printing technology. 3D Printing technology helps to develop and create products structure easily from human’s imagination. In general, transportation analysis uses 2D design approach such as road network analysis, traffic flow analysis, and sometimes environment condition such as road quality. In order to study transportation, 2D analysis is useful for current people movement in a city. To understand transportation, it is necessary to consider the reasons why the transportation is required such as a purpose of travel, choice of transportation, environment condition, and social reason etc.
In our transportation study, we took 3D printing design thinking. The objective of our research is visualization of traffic and reduction of CO2 emission. Therefore, there are several aspects of transportation analysis. At first, we started to develop traffic measurement equipment test in a test field where we developed the testbed in a campus of Indian Institute of Technology Hyderabad who is our counter partner research in this project and measure real CO2 emission of Rickshaw for example. And then, we collected actual traffic flow data from the CCTVs in Ahmedabad city. Second, we compared its data based on traffic flow theory. This surface analysis is to find out Indian specific traffic flow algorism including environmental condition including CO2 emission data. Third, we studied individual personal transport choice reasons based on personal accepted ideas such as why this person takes public transportation or not.
By using the above multiple layers research approach, it becomes more clear understanding about Indian traffic condition and issues. We would like to show analysis research case study as an example of Urban Analytics for Transforming Cities and Regions.

Bibliography

Tsutomu Tsuboi joined Hitachi from 1979 and worked as industrial motors designer until 1985, then Network product management of Semiconductor Div. from 1986 to 1997. He was manager of Hitachi Semiconductor America Inc. from 1997 to 2000. He was senior manager of Renesas Technology from 2003 to 2010. He was senior manager of Smart City Div. of Hitachi Ltd. from 2010 to 2012. He was Project Director of Hamamatsu Agency for Innovation from 2012 to 2014. He is currently general manager of Global Business Development office in Nagoya Electric Works since 2014. He is pricipal researcher for government funded project “SATREPS” Science and Techonology Research Partnershi for Sustainable Development for Low Carbon Urban Transproation Designe in India from 2016 to 2022. He rounched EVQ Technology Japan from 2017 until now and support mobile EV charging

system busisness “Hopcharge” with EVQ Technoloy India Pvt. He is IPSJ (Information Processing Society of Japan) member and IEEE (Institute of Electrical and Electronics Engineers) senior member.

ID: 232 / Poster Session cont.: 8

Resilient urban and regional systems

Keywords: Temporal Variation, Particulate Matter, Ambient Air Quality, PM ratio

Monthly and Seasonal behaviour of Ambient air particle mass concentrations in the urban area of Ahmedabad city (Gujarat, India)

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Abstract:

The city of Ahmedabad is ranked in the top 10 most urban ambient air polluted location within the country due to high Particulate Matter (PM) concentrations. As per National Ambient Air Quality Standards (NAAQS) the acceptable limit of 24 hours averaged PM_{10} and $PM_{2.5}$ for residential and industrial areas are 100 µg/m³ and 60 µg/m³ respectively. The main objective of this work is to analyze comprehensively the temporal (seasonal, and monthly) trends of PM_{10} and $PM_{2.5}$ collected using portable MINI Wide Range Aerosol Spectrometer simultaneously at four different sub-zones (Rural, Industrial, Traffic and Mix (Urban)) of Ahmedabad city for the duration September 2020 - March 2022. The average concentration observed over rural, industrial, traffic and mix regions for PM_{10} is approximately 124, 188, 185 and 110 µg/m³ while for $PM_{2.5}$ it is 52, 83, 58 and 56 µg/m³ respectively. The values shows that PM_{10} concentration is still above the acceptable limits while for $PM_{2.5}$ it is at the margin except at industrial region. The PM data analysis showed clear diurnal cycles at the study site with minimum value in afternoon and maximum during night and morning during peak hours. Due to poor dispersion conditions and suspension of fine particles remains in the ambient air for longer hours. The data analysis indicates that the areas with high PM concentration are the industrial and traffic regions of Ahmedabad, while lower values of PM concentration are obtained in the rural area for $PM_{2.5}$ and mix regions for PM_{10}. The high concentration of PM can be resulted due to resuspension of dust particles due to vehicle movements, biomass burning low temperature resulting in less boundary layer height and continuous construction activities within the vicinity. The highest monthly average level of the PM fractions was observed in the Winter season. Particularly in the month of October and November. The Lowest is observed in the monsoon season because of the washout effect. From the fine to coarse particles ratio analysis, it is observed that the concentration of coarser particles is dominating in the city. Throughout the measurement period a drop in mass concentration is observed indicating the decrease in the PM concentration. The data collected can be used in future for validation of air quality parameters retrieved through satellite observations. It can also be used as a background value for modelling and estimation of radiative budget. Other than these, in future, the data collected will be utilized as a appropriate background values to use for modeling analyses for locations in the state not having its own monitoring station can be determined.

ID: 212 / Poster Session cont.: 11

Urban dynamics

Keywords: Metropolitan region, urban planning, land use, governance, projections

Dynamics of Metropolitan Regional Planning: A case of Ahmedabad Metropolitan Region.

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Abstract:

Metropolitan planning in India is a complex process in nature as it revolves around the different dynamics of socio, cultural, economic and ecological systems. Up-gradation of those sectors to which inadequate attention was paid. Growth factors of different regions, cross-scale interactions of various sectors like agriculture, manufacturing, service etc. The complexity of this process increase when all these paradigms are tried to bring under one umbrella of spatial planning, governance and administration.

The aim of this paper is to find rural and urban elements as elemental environment on that must be considered in developing metropolitan area and not merely form the structure and pattern of urban spaces. The problem statement of the study is what kind of approach of strategic rural urban linkage, context setting and local assessment, strategic community investment can be taken up for the planning of Ahmedabad Metropolitan Region.

This paper explores a different forefront of Ahmedabad Metropolitan Region and it's planning through various perspectives and tries to deliver a more resilient regional plan for 2051 based on the analysis of various sectors taken in count like landuse, topography, geography, ecology, policy incentives, facilitating infrastructures, regional features, potentiality and resources. It provides a research findings from an intensive data analysis and field based exploratory exercise and tries to draw out the insights from planner's interpretation. The findings of the study show the areas identified that can be considered for metropolitan region may become an addition to value chain of urban activities. Networking of urban areas and why metropolitan region must promote the realization of growth centers and connect the interregional activities of metropolitan area for providing sustainable economic growth.

The paper captures the detailed process of formulating metropolitan regional plan accompanied by various fundamental characteristics and opportunities. It concludes with a proposal for Ahmedabad metropolitan regional plan 2051 for sustainable governance with a specific emphasis on trends, patterns and respective future growth. Keywords: Metropolitan region, resources, infrastructure, economic growth.

ID: 239 / Poster Session cont.: 12

Open data in planning and urban management

Keywords: public spaces, climate change, resilience, sustainability

Parks & Climate Change in India: An Essay on Public Spaces

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Abstract:

Public spaces play a crucial role in creating a healthy and vibrant society.

They serve as places for social interaction, physical activity, and relaxation. In the larger Asian context, the usage pattern of public parks is different from the Western context due to a difference in social-economic status, culture, and geo-climatic conditions (Jogdande & Bandyopadhyay, 2023). In a developing country like India, parks are mostly used for recreation, physical exercise, and social gatherings (Jogdande & Bandyopadhyay, 2023). They provide a space for individuals and communities to come together, share experiences, build relationships, and foster a sense of belonging.

However, in recent years, public spaces in India have faced significant challenges due to the impacts of climate change. Rising temperatures, erratic rainfall patterns, and extreme weather events have led to changes in the way public parks are used and maintained. These climate-related changes have a direct impact on the quality and accessibility of public spaces, affecting the well-being of individuals and communities. For instance, as temperatures continue to rise, public parks may become less desirable for outdoor activities due to excessive heat. This can discourage people from utilizing these spaces for physical exercise and recreation, leading to a decline in overall health and well-being. Additionally, changes in rainfall patterns can lead to flooding or droughts, which can damage park infrastructure and make it unsafe for public use. Furthermore, the increased frequency and intensity of extreme weather

events such as storms and cyclones pose a threat to the safety of public park users. Therefore, it is crucial for public spaces in India to adapt to the challenges of climate change in order to continue serving as valuable resources for communities. To address these challenges, several steps can be taken. Firstly, it is important to integrate climate resilience into the design and maintenance of public parks. This can include implementing strategies such as using heat-resistant materials for park infrastructure, creating shaded areas, and planting climate-resistant vegetation. In addition, incorporating green infrastructure techniques such as rain gardens and permeable surfaces can help manage storm water and reduce the risk of flooding. Furthermore, community involvement and participation are key in ensuring the long-term sustainability of public spaces. Local communities should be engaged in the planning and decision-making process to ensure that their perspectives and needs are taken into account. This can be done through community consultations, workshops, and public forums where individuals can voice their opinions and contribute to the design and management of public parks.

Their research paper will aim at the understanding the issue of environmental concerns affecting urban parks and its usage. The partnerships and collaborations with relevant stakeholders such as meteorological departments, urban planning agencies, and environmental organizations can further enhance the effectiveness of climate adaptation strategies and the resilience of public spaces. By working together and implementing these measures, public spaces in India can become resilient to the impacts of climate change and continue to be valuable resources for communities.

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Towards Efficient Management of Street Market – Ahmedabad in IJERT Thesis-2020, registration number-IJERTTH0020

ID: 189 / Poster Session cont.: 9

Urban dynamics

Keywords: change of land use, lifestyle, preference, identity, Chandigarh

Change of Land use and its impact - A Case of Planned city of Chandigarh

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Abstract:

Development is an inevitable part of an economy and a nation. Development essentially relates to urbanization, economic growth, literacy rate, life expectancy, and urban growth along with the growth of infrastructure. Due to rapid urbanization, there is a high demand for housing and infrastructure. Also due to Liberalization, Globalization, and Privatization, there is a boom in real estate. Economic changes further affect social, cultural, and lifestyle changes.

The changes are at two levels one is inside the city which is re-densification and the other is outside the city, which is known as sprawl. Urban settings must be reorganized to provide the optimum quality of living because urban usage evolves with time. Urban expansion needs to be viewed as both a spatial and temporal phenomenon. Urban areas have a certain rhythm that is determined by how people use them and form an identity about it.

As suggested by Relf,1996 identity is made by physical form and perception. The identity of the place shifts with any change brought to the form and activity of a place (Balki, 2017).

Chandigarh is a planned city and has a mark on the face of the globe. It is one of the finest example of neighborhood planning. However, the brunt of urbanization has been experienced here also. It is experienced both within the periphery and outside the periphery of the “city beautiful”. The change of economy changes the lifestyle and preferences of people, which causes the change in land usage. The other reason of the changes may also be given to the fact that Chandigarh did not cater to the real Indian system which is based on multi-use of spaces.

Policy decisions, changing economy, changing lifestyle, preferences, globalization etc. lead to land conversions. It is important to comprehend the necessity and its impact. The researcher investigates all

the possible reasons which have led to conversions of land use in a planned city and its effect on place identity.

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ID: 252 / A UD: 3

Big Data Analytics and Land Use

Keywords: Landfill, TROPOspheric Monitoring Instrument, shortwave infrared, urban environment

Estimation of Landfills Methane Emission Using Radiative Transfer Modelling and High-Resolution Satellite Data Over India

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Abstract:

Managing waste in megacities is essential for the sustainability and livability of densely populated urban areas. Landfills are a common issue for any municipality related to land use management. Additionally, landfills are a significant source of methane (CH4) emissions in urban environments. It emits an average of 30-70 million tonnes of CH4 annually, which causes serious health issues and increases temperature by altering the urban climate. Landfills produce CH4 when organic waste decomposes through anaerobic decomposition. In India, megacities like Delhi, Mumbai, Bengaluru, and Ahmedabad are already suffering from CH4 emissions from mountainous landfills, which are responsible for more than 25% of CH4 emissions in the country. The first step towards mitigating this emission is to detect and monitor the large emission sites. High-resolution satellite data can be a valuable tool for detecting CH4 emissions due to its ample area coverage and higher spectral resolution. TROPOMI (TROPOspheric Monitoring Instrument) on board the Copernicus Sentinel-5 Precursor (S-5P) satellite CH4 product has been used to monitor urban CH4 concentration with higher temporal coverage. Still, the 7 km spatial resolution cannot detect the exact pinpoint location of the emission. Spaceborne hyperspectral satellites such as PRISMA (Hyperspectral Precursor of the Application Mission) and EMIT (Earth surface Mineral dust source InvesTigation) provide data in shortwave infrared (SWIR) regions with 10 nm and 7.4 nm spectral resolution, and 30-meter and 60-meter spatial resolution, respectively, which is further used to identify the exact location of the emission. In this study, hyperspectral remote sensing data have been used to uncover significant CH4 emissions from landfills. A physics-based matched filter algorithm can effectually detect emissions from point sources. The matched filter method uses radiative transfer (RT) simulations to generate target spectra of CH4 and match them with satellite image pixels to estimate column CH4 enhancements emerging from the landfills. MODTRAN (MODerate resolution atmospheric TRANsmission) RT model is extensively used here for at-sensor radiance simulations to develop a detection algorithm with reasonable accuracy. Highly dense urban areas have a heterogeneous land cover, which introduces errors in detection. However, a matched filter algorithm provides accurate results even on spatially cluttered surfaces. Estimating CH4 emissions can be helpful to government agencies working for urban environment management to plan strategies to mitigate CH4 emissions from landfills and regulate the urban environment.

ID: 176 / **F BD: 1**
Resilient urban and regional systems
Keywords: Urban Heat Island, Land Surface Temperature, Deep Learning, Climate Change Adaptation, Urban Planning

Modeling the Surface Urban Heat Island Effect in Ahmedabad City Using Deep Learning Techniques

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Abstract:

Rapid urbanization over the world's dense urban centers can lead to an enormous change in the land use land cover (LULC) over a metropolitan area. This can adversely affect the land surface temperature (LST) and intensify the urban heat island (UHI) phenomena. The UHI effect occurs when an urban area is significantly warmer than its surrounding rural areas. This is due to a number of factors, including the replacement of vegetation with impervious surfaces, such as roads and buildings, which trap heat.

The change in LULC can also lead to an increase in LST, as impervious surfaces absorb more heat from the sun than vegetation. Ahmedabad is one of the hottest cities in India, with average annual temperatures reaching 33 degrees Celsius, with the summers being particularly hot and humid. As a result, the city becomes warmer, which can have a number of negative impacts, such as increased energy use for cooling, decreased air quality, and heat stress.

This study, given the context, intends to understand this relationship that land use land cover has with UHI through use of various remote sensing-based indicators for vegetation, built cover, water extent and so forth through use of Deep Learning algorithms such as Artificial Neural Networks (ANN) and thus enable the model to predict the heat island effect for the future years.

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ID: 174 / **C LT: 3**
Submission for Posters
Urban dynamics
Keywords: Air Pollution, Climate Change, Particulate Matter, Machine Learning, Artificial Neural Network

Modeling PM 2.5 concentrations using Machine and Deep Learning: Case of Delhi City

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Abstract:

Air is one of the most essential natural resources for life on Earth. Good air quality is essential for human health and well-being. However, air pollution is a serious problem that has been linked to millions of deaths each year. Urban land use, along with the increase in population, growth in transportation, and industrial sectors and so forth have contributed greatly to the rise in air pollution levels.

Delhi is one of the most polluted cities in the world, with air pollution levels that far exceed World Health Organization (WHO) guidelines, in particular the PM2.5 concentrations. PM2.5 is a type of particulate matter that is small enough to enter the lungs and bloodstream, and it has been linked to a number of health problems. The high levels of air pollution in Delhi have a significant impact on public health.

In this context, this study aims to model the concentrations of Particulate Matter 2.5 (PM2.5) in Delhi using various remote sensing-based land use indicators, such as the normalized difference vegetation index (NDVI), the Normalized difference built-up index (NDBI), and land surface temperature (LST), along with indicators such as Aerosol Optical Depth (AOD). The modeling is done using machine learning algorithms, such as support vector machines (SVMs), random forests (RFs), and long short-term memory (LSTM) models. The best performing model will be selected based on the evaluations on the validation set and the evaluation metrics.

ID: 180 / Poster Session cont.: 6

Urban dynamics

Keywords: urbanization, sustainability, urban forms, urban morphology and land use

Towards Sustainable Planning: A Multi-Criteria Assessment of Urban Forms & Morphology

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Abstract:

As urbanization accelerates worldwide, cities face increasing challenges in managing their growth sustainably. Ahmedabad, a rapidly growing city in India, is no exception. This research aims to develop a multi-criteria assessment framework to evaluate urban form and morphology in Ahmedabad with a focus on sustainability. By examining various aspects, such as land use patterns, transportation networks, green spaces, and building density, this study seeks to inform urban planners and policymakers on effective strategies for fostering sustainable development.

Initiating the research by Introducing sustainable urban planning and its significance with respect to urban forms and morphology of the city. Succeeding the same by identifying the key criteria and indicators whilst land use, transportation, heritage and culture & social equity that will be used to assess the form and morphology of Ahmedabad.

Reviewing and justifying the key criteria and indicators with the help of literature reviews and finding the ways to measure and prioritize the urban forms. Accompanied with the research papers study based on different cities' urban forms and morphology.

Gathering the relevant spatial data for each indicator for the Ahmedabad municipal corporation – macro level by using GIS – Geographic information system tool to create maps that visualize the distribution of different features and indicators across Ahmedabad. Getting deeper into it by analyzing wards – micro level like Paldi (first developed ward on the west after the construction of Ellise bridge in 1893) & Jamalpur (heritage rich ward and ward with first laid town planning scheme in 1925) through mapping the spatial data and analyzing the morphological factors that shaped their existing land use.

Concluding the research by Comparing both wards i.e. differing from modern to traditional and strategizing the parameters & suggesting actionable and realistic recommendations that will guide urban planning decisions and create more resilient, equitable, and liveable cities for the future.

ID: 182 / B OD: 4

Open data in planning and urban management

Keywords: Land Registry / Land Registration, Digitizing & Documenting Transaction Details, Peer-to-peer Decentralized Network, Democratic, Increase Liquidity.

Smart Land Registry Management: A Blockchain Approach

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Abstract:

Land is an immovable property that is owned by an individual, group or a community, institutions or a government. Ownership of land is evidenced by possessing land title, legal document that protects the rights of the title-holder. They may be known with different names as per the State that land falls in; for example, it may be generally called ROR (Record of Right), 7/12 or 8A.

Land registration involves details of a particular land: owner's name, location, size of the property, etc. The process is too tedious as it involves safekeeping of large volumes of records and registers, mostly found in a written form which makes it hectic to refer to any required documents for transaction. This system is opaque and not secure. The processes are long, slow, time consuming, labour intensive and expensive. It includes intricate and complex processes while transacting of a property, an accurate recording still essential and important. The elimination of the manual process is done by digitalizing the records. But the possibility of data contents may be breached, data tampering may happen easily. This paper learns the importance of the Blockchain system, adopts and applies to the current land registry process.

Blockchain functions as a distributed ledger technology that keeps records of all transactions that have taken place across peer-to-peer network. The system is made more secure. It is immutable. Contracts and details of ownership are stored in a decentralized method. Transactions are easily tracked. Strong sense of digital identity is created. Details like property ID, property number, owner details, transaction amount, mode of payment and last transaction details are being stored. Moreover, for data that is confidential, a password or key based accessing is approached. Public key is used for authentications with identity verifications. Transactions are performed using private keys. This data, possible to link with the maps, has potential to increase liquidity, mitigate risk and reduce costs, making property investment a more attractive prospect. It also excludes the presence of the middlemen. The registration officers and third party are eliminated and mitigates many interferences.

Blockchain based smart contracts ensures recording sequential transactions which eradicates intermediaries, brokerage charges and loss of time. For property transaction: Chain of things includes – previous owner – present owner – actual price – selling price – property details like location, size and others. Data collection, data confidentiality, authenticity of ownership details, other form of connections to financial institutions for banking or insurances all can be linked with the transaction. There are many tangible and intangible benefits in the Smart Land Registry Management, lead to a transparent, efficient and trustworthy Land Market.

This paper is an outcome of a research study, establishes and demonstrates that 'blockchain enabled future in the smart Land Registry Management', can be formalized and monetized. The result reveals the process, showcases the benefit of opening up a new way of land registry management, helps in enhancing the economy by tapping the potential of land as a resource or a commodity, in a true democratic way.

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ID: 178 / A RU: 2

Resilient urban and regional systems

Keywords: Urbanisation, UHI, Remote Sensing, Planning Techniques, Policy & Governance

Towards mitigating UHI using Planning Tools and Techniques

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Abstract:

Ahmedabad, like many rapidly urbanizing cities, faces the pressing challenge of the Urban Heat Islands (UHI) effect, where parts of urban area experiences higher temperatures than surrounding area. This phenomenon is increasing with the increase in urbanization. It poses significant environmental, social, and economic implications, necessitating actions to mitigate the impacts. This paper emphasizes on exploring the measures and implementing those with appropriate urban planning tools as a strategic approach to combat UHI effects. Ahmedabad is considered as a case study city.

The research initiated with understanding and identifying UHI, analysis of the reasons of formation of UHI with respect to the surrounding land use, such as the percentage of the built-up area, roads, vegetation coverage, pervious and impervious areas, etc. Use of various satellite imagery helped in identification of land use, Land-surface temperature (LST) and calculating of the Normalized Differential Vegetation Index (NDVI). Spatial statistics was opted for identifying the correlation between Land use, LST and NDVI. Spatial Regression analysis too was carried out and identified potential heat hotspots and vulnerable area.

A literature was carried out at length including international and national level publications for understanding the mechanics/procedure for identifying and implementing appropriate mitigation measures at local city level.

Accordingly, the city‘s characteristics, dividing those into categories, factors and criteria, and choosing those that can be lessened with the aid of planning tools and approaches. It was considered that policy directives promote the incorporation of UHI mitigation within the urban planning framework. This includes incorporating urban form, vegetation, and cool material.

A conclusion of this study may offer useful direction regarding reducing UHI's effects with a workable model for other cities across India. It may serve as a guiding resource for policymakers and urban planners for preparation of the master plans.

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