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Urban Cross-cutting Applications Sample Dataset

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CONTENTS

LIST OF TABLES

1 INTRODUCTION

1.1 Purpose of this document

The deliverable D3.3: "Urban Cross-cutting Applications Sample Dataset" is the third deliverable of WP3: "Cross-cutting Applications Development". It constitutes a digital collection of all sample products from the developed cross-cutting applications (as specified in Table 1).

The complete Urban Cross-cutting Applications Sample Dataset can be found in https://doi.org/10.5281/zenodo.5812049.

The purpose of this document is to describe the database of sample products from the cross-cutting applications developed in CURE and to define the data specifications for Deliverable 3.3.

Table 1. CURE Applications study sites.

AP	Cross-cutting applications	Berlin	Copenhagen	Sofia	Heraklion	Bristol	Ostrava	Basel	Munich	Vitoria-Gasteiz	San Sebastian
01	Local Scale Surface Temperature Dynamics (FORTH)	•	•	•	•	•	•	•	•	•	•
02	Surface Urban Heat Island Assessment (DLR)	•	•	•	•	•	•	•	•	•	•
03	Urban Heat Emissions Monitoring (UNIBAS)				•			•			
04	Urban CO_2 Emissions Monitoring (UNIBAS)				•			•			
05	Urban Flood Risk (GISAT)				•		•				
06	Urban Subsidence, Movements and Deformation Risk (GISAT)				•		•				
07	Urban Air Quality (VITO)			•		•	•				
08	Urban Thermal Comfort (VITO)		•	•			•				•
09	Urban Heat Storage Monitoring (FORTH)				•			•			
10	Nature Based Solutions (TECNALIA)			•						•	•
11	Health Impacts (socioeconomic perspective) (ApHER)		•	•		•					

1.2 Definitions and acronyms

Acronyms

CURE	Copernicus for Urban Resilience in Europe
WP	Work Package
APP	Application
LST	Land Surface Temperature
SUHII	Surface Urban Heat Island Index
QH	Sensible heat flux
NaN	Not a number
PS	Permanent scatterer
AOI	Area of interest
WBGT	Wet Bulb Globe Temperature
DQS	

2 DATA SPECIFICATION

In particular, the products are organised in folders specific for each APP.

For each file, the following naming convention applies (see Table 2):

"CityName_APXX_ProductID_YYYYMMDDThhmmss_version_SpatialResolution.extension"

Table 2: Explanation of file name parts

CityName	Berlin, Copenhagen, Sofia, Heraklion, Bristol, Ostrava, Basel, Munich, Vitoria-Gasteiz or San Sebastian	required
APXX	Application identifier	required
ProductID	Name of the Product, either in full or acronym	required
YYYYMMDD	Year Month Day	required if applicable if applicable
Thhmmss	Time	if applicable
SpatialResolution	Spatial Resolution in m	if applicable
extension	File extension, e.g., .tif, .csv	required

Examples:

Berlin_AP02_SUHII_2019_v1.json

SanSebastian_AP01_LSTDayTime_20180104T105746_v1_100m.tif

3 DATA OVERVIEW

In the following, a generic overview of the delivered data is given. Specifically, all necessary information has been added for each product to properly interpret each file e.g., bands and their meaning, scale of output data, attributes in shapefiles and their meaning.

3.1 AP01 - Local Scale Surface Temperature Dynamics

Product	Description
CityName_**AP01_LSTDayTime_** YYYYMMDDThhmmss_**v1_100m.tif**	The tif files contain the machine-readable output of AP01. Each entry corresponds to a single LST estimation in Kelvin for a specific daytime at 100m spatial resolution for each available city. Masked Pixels are depicted with NaN values.
CityName_**AP01_LSTNightTime_** YYYYMMDDThhmmss_**v1_100m.tif**	The tif files contain the machine-readable output of AP01. Each entry corresponds to a single LST estimation

	in Kelvin for a specific nighttime at 100m spatial resolution for each available city. Masked Pixels are depicted with NaN values.

3.2 AP02 - Surface Urban Heat Island Assessment

Product	Description

CityName_**AP02_SUHII**_YYYY_**v1.json**	The JSON file contains the machine-readable output of AP02. Each entry corresponds to a single SUHII estimate at a given reference time-period.
	
	The following slots are available:
	• [**city**]: Location
	• [**filters**]: defines the time-period of LST data considered
	• [**number_of_scenes**]: number of LST acquisition dates considered
	• [**suhii**]: SUHII point estimate
	• [**suhii_ci**]: SUHII 95% confidence interval (lower and upper)
	
	The following example entry shows the results for Sofia, calculated over the months September and October of the years 2018 and 2019 during daytime (resulting in 61 LST products). The SUHII was estimated as 0.02 (0.018, 0.020).
	
	{
	"city": "Sofia",
	"filters": {
	"years": [
	2018,
	2019
	],
	"months": [
	9,
	10
	],
	"daytimes": [
	"Day"
	]
	},
	"number_of_scenes": 61,
	"suhii": 0.01904810053785863,
	"suhii_ci": [
	0.017760741169068384,
	0.020176750881793496
	]

	}
CityName_**AP02_SUHII_YYYY_v1.pdf**	The data outputs are accompanied by a high-level report, providing a summary of the SUHII analysis.

3.3 AP03 - Urban Heat Emissions Monitoring

Product	Description
CityName_**AP03_QH_** YYYYMMDDThhmmss_**v1_100m.tif**	The tif files contain the machine-readable output of AP03. Each entry corresponds to a single **QH (sensible heat flux) estimation** in W m^{-2} **for a specific daytime** at 100m spatial resolution for each available city. Masked Pixels are depicted with NaN values.
ERA5\CityName_**AP03_QH_** YYYYMMDDThhmmss_**v1_100m.tif**	Same as above but processed with ERA5 meteorological input data.

3.4 AP04 - Urban CO2 Emissions Monitoring

Place holders	description	values
SSS	season	**DJF** (winter), **MAM** (spring), **JJA** (summer), **SON** (autumn)
WW	weekday	**WD** (workdays), **WE** (weekends)
source	source of emission	**build** (buildings), **pop** (human metabolism), **traffic** (transport), **veg** (biogenic), **total** (total emissions)
HH	Hour	01..24

Product	Description
YYYY\CityName_**AP04_CO2_** YYYY_SSS_WW_source_**v1_100m.tif**	The tif files contain the machine-readable output of AP04. Each entry corresponds to the **mean daily CO2 emission** in g CO^2 m^{-2} d^{-1} **for the respective season, weekday and emission source** at 100m spatial resolution for each available city.
YYYY\hourly\CityName_**AP04_CO2_** YYYY_SSS_WW_HH_source_**v1_100m .tif**	The tif files contain the machine-readable output of AP04. Each entry corresponds to the **mean hourly CO2 emission** in g CO^2 m^{-2} d^{-1} **for the respective season, weekday, hour and emission source** at 100m spatial resolution for each available city.

3.5 AP05 - Urban Flood Risk

Product	Description
CityName_**AP05_FloodExtentHAND_** 2021_**25m_v1.tif**	This raster file contains information about presence of flood hazard per 25m pixel. The flood hazard calculated

	as a result of AP05 is quantified by a scale from 1 (highest) to 5 (lowest) for each pixel.
CityName_**AP05_06_UrbanAtlas_ Flood_Subsidence_Hazard**_2018_ 2021_**v1.shp**	This vector file provides a flood hazard estimation for each polygon of Copernicus Urban Atlas layer (as of 2018). This information about flood hazard is calculated from the flood hazard raster *(CityName_AP05_FloodExtentHAND_2021_25m_v1.tif).* This layer also contains information about the subsidence hazard for each urban block, calculated in AP06 (from *CityName_AP06_SubsidencePS_2021_v1.shp*) and about city development taken from World Settlement Footprint layer. This layer represents integrated result of both AP05 and AP06. Attributes: AP05 – related to flood hazard: - floodcount: nr. of pixels with flood hazard per urban block - floodmax: minimum level (but hazard still present > 0) of flood hazard in urban block - floodmax: maximum level of flood hazard in urban block - floodmajor: the most frequent level of flood hazard in urban block AP06 – related to subsidence hazard: average annual subsidence velocity in millimeters – aggregated from all permanent scatterer points inside urban block: - Vel_avg_me: mean value per urban block - Vel_avg_mi: minimum value (but hazard still present > 0) per urban block - Vel_avg_ma: maximum value per urban block - Vel_avg_st: standard deviation per urban block - Vel_avg_co: number of PS points inside block Additional attributes: From Urban Atlas: - Coder/L4_code: block land use according to Urban Atlas nomenclature From World Settlement Footprint layer: - Wsfmin: earliest year of built-up in urban block - Wsfmax: most recent built-up in urban block - Wsfcount: nr. of built-up pixels inside urban block - Wsfmajorit: most frequent year of built-up inside block

	- Wsf_1985: nr. Of pixels built-up in 1985 in urban block
CityName_**AP05_06_ UrbanAtlasChange_Flood_ Subsidence_Hazard**_2018_2021_ **v1.shp**	This vector file provides a flood hazard estimation for each polygon of Copernicus Urban Atlas change layer (2012-2018). This information about flood hazard is calculated from the flood hazard raster *(CityName_AP05_FloodExtentHAND_2021_25m_v1.tif)*. This layer also contains information about the subsidence hazard for each urban block, calculated in AP06 (from *CityName_AP06_SubsidencePS_2021_v1.shp*) and about city development taken from World Settlement Footprint layer. This layer represents integrated result of both AP05 and AP06. Attributes are the same as for the previous layer. Additional attributes – consumption and formation of land use from Urban Atlas: - Code1: Urban Atlas code 2012 - Code2: Urban Atlas code 2018
CityName_**AP05_06_Buildings_ Flood_Subsidence_Hazard**_2121_ **v1.shp**	This vector file provides a flood hazard estimation for each building in the city (layer is only available for Heraklion city area). This layer also contains information about the subsidence hazard for each building, calculated in AP06 and about city development taken from World Settlement Footprint layer. This layer represents integrated result of both AP05 and AP06. Attributes are of the same naming convention and calculated from the same layers as in case of previous Urban Atlas based vector layers.

3.6 AP06 - Urban Subsidence, Movements and Deformation Risk

Product	Description
CityName_**AP06_SubsidencePS_** 2021_v1.shp	This vector file contains information about subsidence hazard as measure for each permanent scatterer (PS) point in the AOI. Average annual velocity of subsidence in millimeters is calculated for each point.
CityName_**AP05_06_UrbanAtlas_ Flood_Subsidence_Hazard**_2018_ 2021_**v1.shp**	This vector file provides a subsidence hazard estimation for each polygon of Copernicus Urban Atlas layer (as of 2018). This layer also contains information about the flood hazard for each urban block, calculated in AP05 and about city development taken from World Settlement Footprint layer. This layer represents integrated result of both AP05 and AP06. Attributes are listed in the AP05 table.

CityName_**AP05_06_ UrbanAtlasChange_Flood_ Subsidence_Hazard**_2018_ 2021_v1.shp	This vector file provides a subsidence hazard estimation for each polygon of Copernicus Urban Atlas change layer (2012-2018). This layer also contains information about the flood hazard for each urban block, calculated in AP05 and about city development taken from World Settlement Footprint layer. This layer represents integrated result of both AP05 and AP06. Attributes are listed in the AP05 table.
CityName_**AP05_06_ Buildings_Flood_ Subsidence_Hazard_** 2121_**v1.shp**	This vector file provides a subsidence hazard estimation for each building in the city (layer is only available for Heraklion city area). This layer also contains information about the flood hazard for each building, calculated in AP05 and about city development taken from World Settlement Footprint layer. This layer represents integrated result of both AP05 and AP06. Attributes are listed in the AP05 table.
Ostrava_POHO_AP006_ SurfaceFaultingHazard_ 2021_100m_v1.shp	This vector layer contains information about subsidence related surface faulting hazard per 100m grid cell (layer is only available for Ostrava-POHO area). Attributes are of same naming convention as in case of previous layers, with "vel-up" representing velocity of vertical and "vel_ew" velocity of horizontal movements detected, measured in [mm/year].

3.7 AP07 - Urban Air Quality

Product	Description

CityName_ **AP07_** ProductID_ **2018_v1_ 10m.tif**	The GeoTiff files contain various indices describing the air pollution in the cities. All maps provide the annual mean air pollutant concentration for a specific pollutant and a specific emission sector in µg/m^3, at a resolution of 10m x 10m.
	
	The filenames are structured as follows:
	• **CityName**: Name of the city. The following options are available:
	  o Bristol
	  o Ostrava
	  o Sofia-Copernicus: Results for Sofia in which only the Copernicus data is used (see details in Report D3.2)
	  o Sofia-CoperncuisPlusLocal: Results for Sofia in which the Copernicus data is supplemented with local data to improve the accuracy of the downscaling (see details in Report D3.2).

	• **ProductID**: Combination of the air pollution and the sector. The ProductID key is actual the combination of two keys, with the logic: ProductID = **Pollutant-Sector** with the following options for ○ **Pollutant**: Air quality pollutant: ▪ NO_2 ▪ PM_{10} ▪ PM_{25} ○ **Sector:** GNFR emission sectors ▪ TotalAnnualMeanConcentration: total concentration (all sectors included) ▪ Industry: Industrial emissions ▪ PublicPower: Emissions of power plants ▪ Residential: Emissions of households ▪ Traffic: Traffic emissions ▪ Background: Concentrations due to emissions emitted outside the domain, or emissions that are not directly taken into account

3.8 AP08 - Urban Thermal Comfort

Product	Description
CityName_**AP08_MEAN_WBGT_** YYYYMMDD_**v1_2m.tif**	The GeoTiff files contain daily mean Wet Bulb Globe Temperature values in °C for a particular city (CityName). The maps are calculated for a specific hot summer day (YYYYMMDD) and have a spatial resolution of 2m.
CityName_**AP08_MAX_WBGT_** YYYYMMDD_**v1_2m.tif**	The GeoTiff files contain daily maximum Wet Bulb Globe Temperature values in °C for a particular city (CityName). The maps are calculated for a specific hot summer day (YYYYMMDD) and have a spatial resolution of 2m.

3.9 AP09 - Urban Heat Storage Monitoring

Product	Description
CityName_**AP09_DQSDayTime_** YYYYMMDDThhmmss_**v1_** **100m.tif**	The tif files contain the machine-readable output of AP09. Each entry corresponds to a single Storage heat flux estimation in W/m^2 for a specific daytime at 100m spatial

	resolution for each available city. Masked Pixels are depicted with NaN values.
CityName_**AP09_DQSNightTime_**YYYYMMDDThhmmss_**v1_100m.tif**	The tif files contain the machine-readable output of AP09. Each entry corresponds to a single Storage heat flux estimation in W/m^2 for a specific nighttime at 100m spatial resolution for each available city. Masked Pixels are depicted with NaN values.

3.10 AP10 - Nature Based Solutions

Product	Description
CityName_**AP10_GreenRoofPriority_**YYYY_**v1.gpkg**	The vector file is in geopackage format. It contains the results for the cities to implement nature-based solutions. The following fields are provided: • fid: automatically generated field for identifying single features. • id_building: building's identification field specified by the user from original building layer. • max_green_roof_pot: maximum green roof potential for each building in square meters. • priority: for each building, the green roof priority is provided in a range from 0 to 1 based on zone priority and building priority.

3.11 AP11 - Health Impact

All input files, the air quality maps (one file per city) have the exact same format. Files are in standard asci format (i.e. text-files).

Data output is delivered as excel file and will be presented in an online interface.

Product	Description
CityName_**App11_healthandcostsofairpollution_**YYYY**.xlsx**	The results of the EVA model on health and costs of air pollution based on maps of air quality from Copernicus and local data, see details of air pollution maps under Ap07, which are used for this application as input. The health effects in the EVA model look specifically at: - Acute premature deaths from short term exposure of O3 and PM2.5 - Chronic premature deaths from long-term exposure to PM2.5 - Respiratory hospital admissions

	- Cardiovascular hospital admissions - Asthma symptoms - Chronic bronchitis (adults and children) - Work loss days due to health concerns - Restricted activity days - Minor restricted activity days - Lung cancer - Infant mortality The economic impacts are calculated for health impacts and related external costs based on information about the sources of pollution and their location, the dispersion of air pollution as well as exposure of the population, the dose-response relationship between exposure and health effects, and the valuation of health effects, also referred to as external costs related to health effects from air pollution. The external costs are given in MEUR in local prices and in mean EU27 prices.