Scuola universitaria professionale della Svizzera italiana
Dipartimento ambiente costruzioni e design
Istituto scienze della Terra

open science

SUPSI

RISULTATI DELLO SVILUPPO DI UN SISTEMA DI MONITORAGGIO BASATO SU COMPONENTI OPEN

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SUPSI

FNSNF
SWISS NATIONAL SCIENCE FOUNDATION

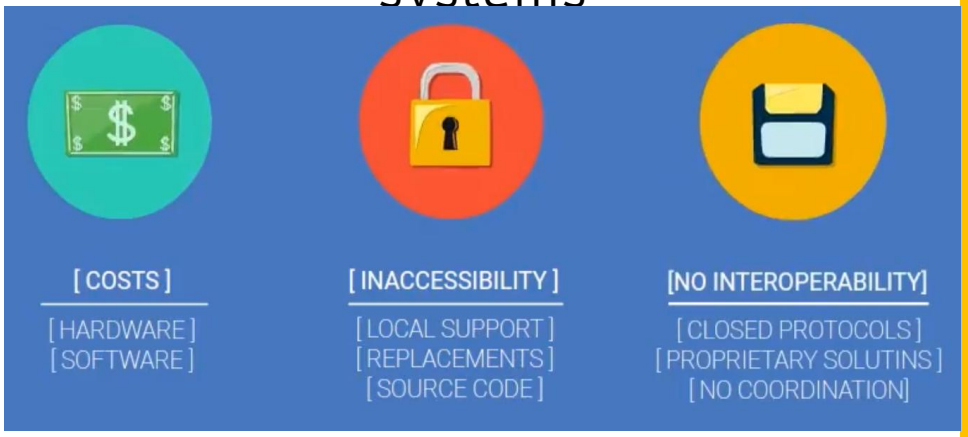
Swiss Programme for Research on Global Issues for Development

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Agency for Development and Cooperation SDC

Problem

missing hydro-met monitoring systems



Solution

4 open & low-cost technologies

STATE OF THE ART

State of play in many countries

Few data

Low quality control

No real time

For purchase only

Can we rely on these open technologies to fill the data gap and cope with climate change impacts?

Quality

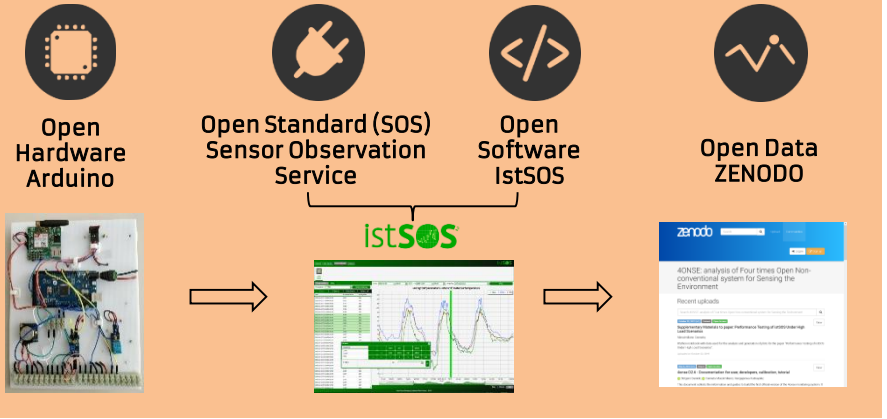
Durability

Costs

Sustainability

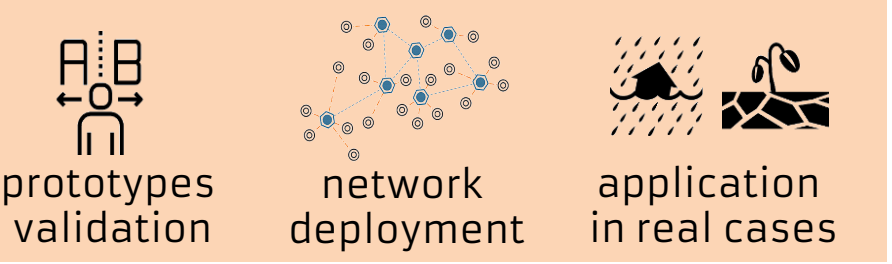
Development

ntegrated open-monitoring-system



Findings

quality, applicability, sustainability

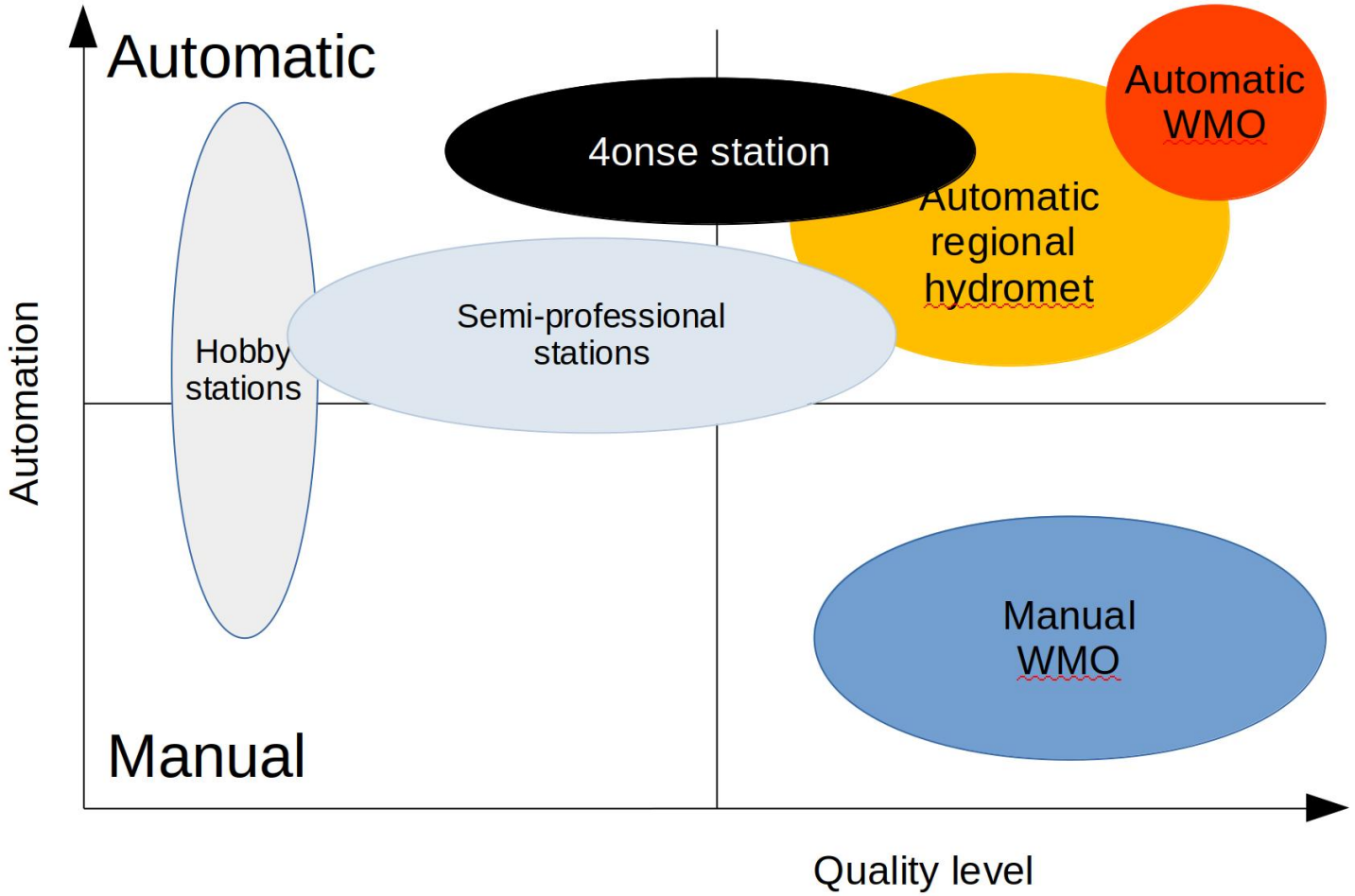


RESEARCH

The research question

4nse

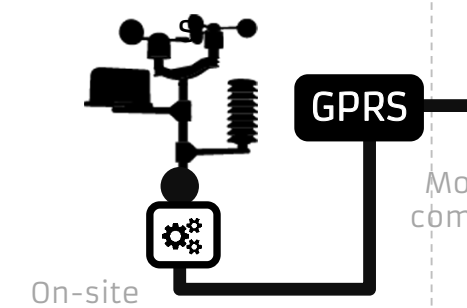
Target network type



support the implementation of management actions

System Design

FIELD | CLOUD | APPLICATIONS | USERS



Measure

GPRS

Mobile communication

On-site processing & QC

Data archiving

Data quality

Data serving

Open & Standard data

Data reports

Drought alert

Heavy rain alert

Hydrological model

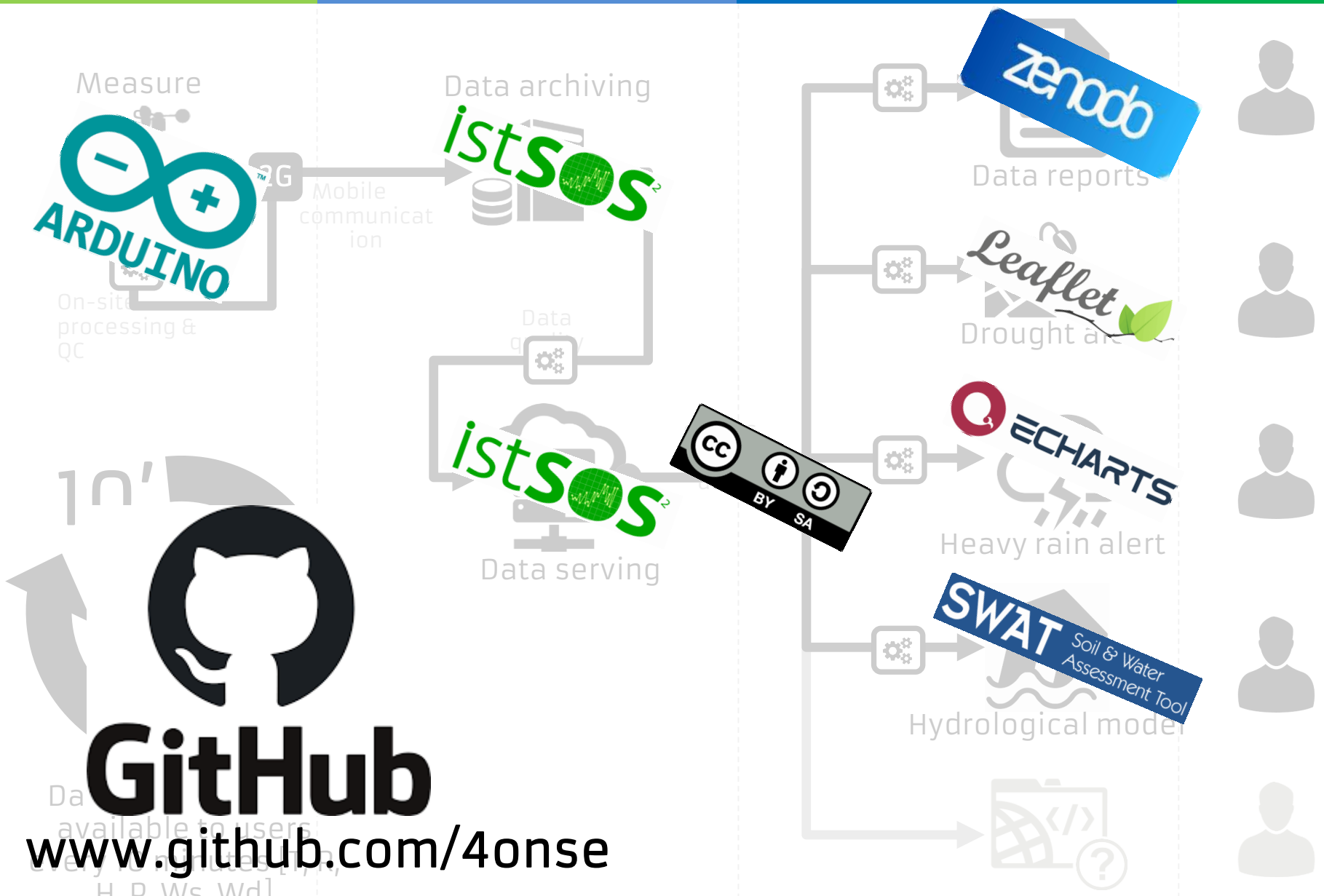
10'

Data automatically available to users every 10 minutes [T, R, H, P, Ws, Wd]

Open technologies

4nse

FIELD | CLOUD | APPLICATIONS | USERS



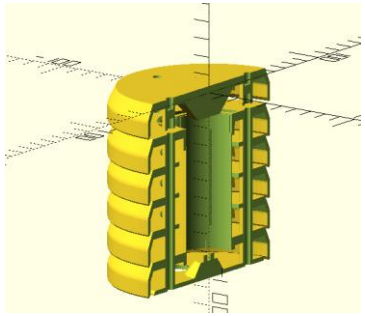
GitHub

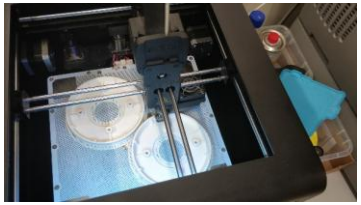
www.github.com/4onse

Sensing

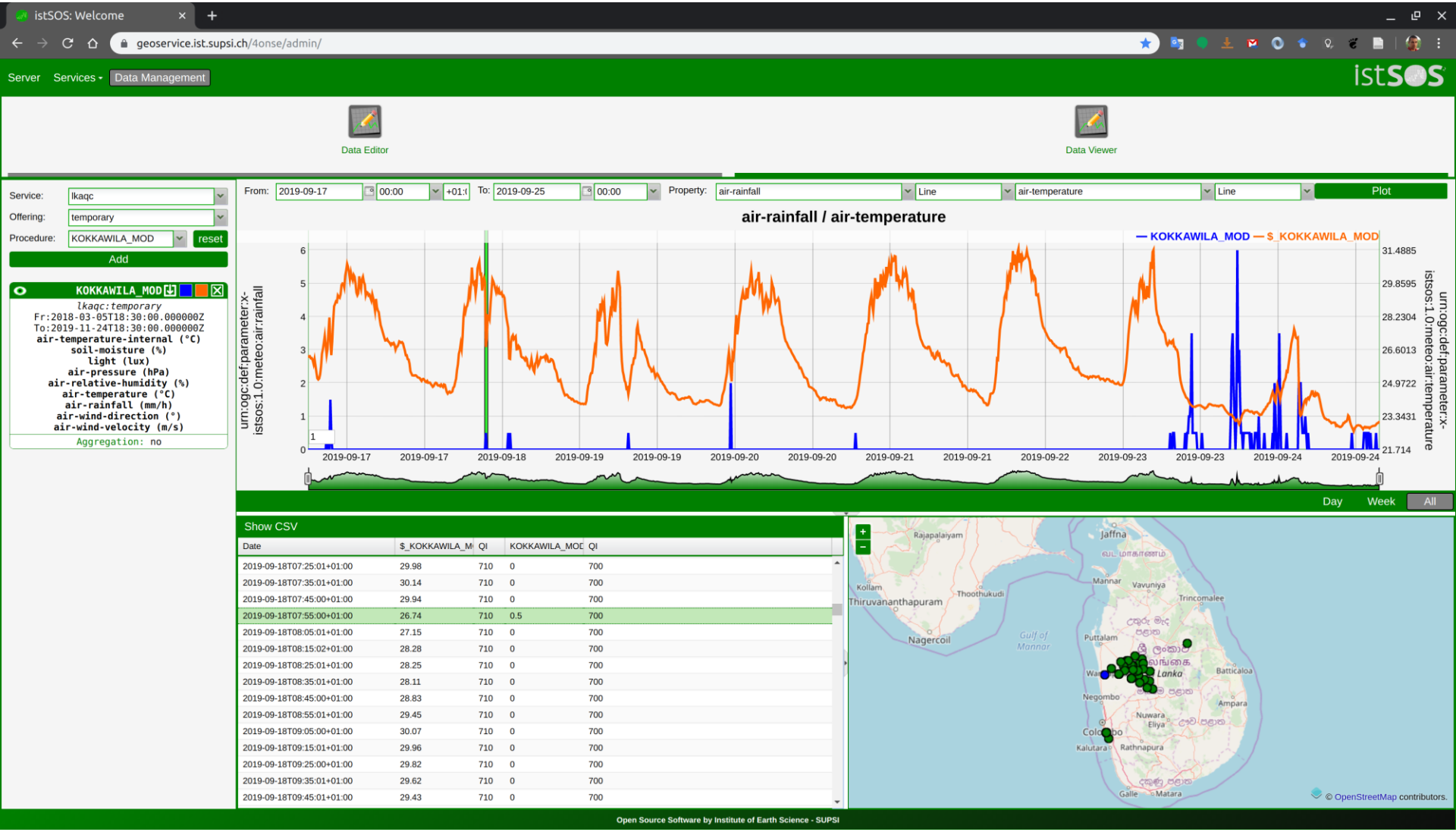
4onse-mod

4onse-pcb

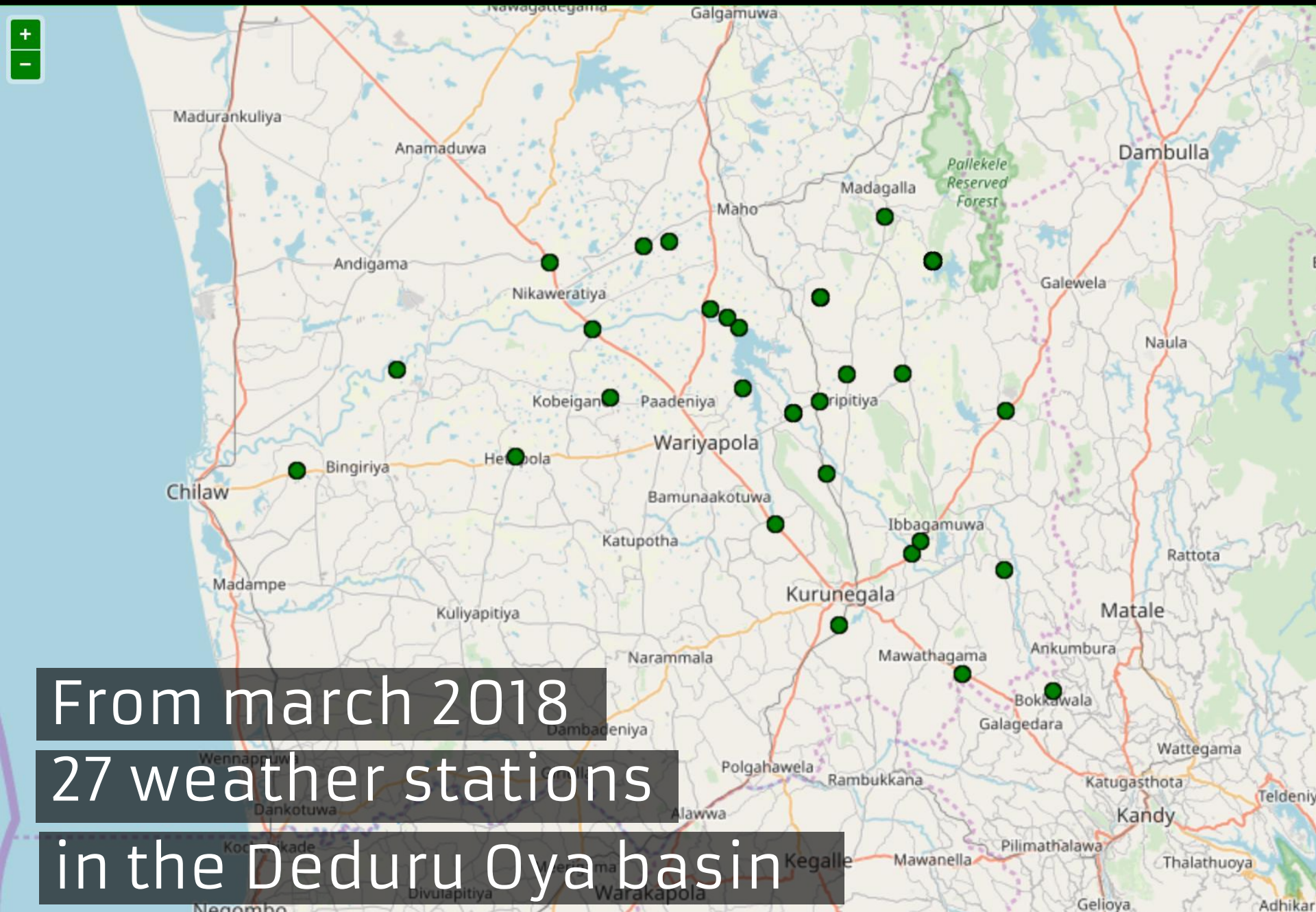




Data archiving and serving



Monitoring network



From march 2018

27 weather stations

in the Deduru Oya basin

Data Quality

Accuracy: how data fit real values?

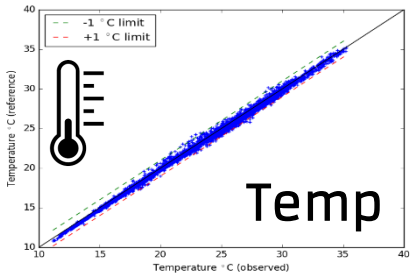
6 months data: official vs 4onse station (CH)

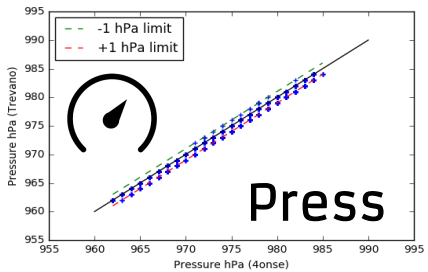
±0.2°C
Air Temperature

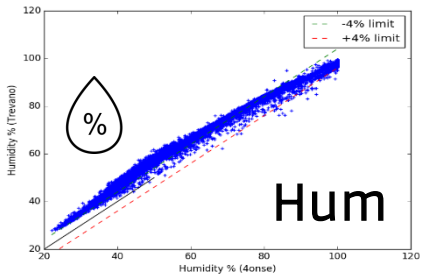
±3.8%
Rel. Humidity

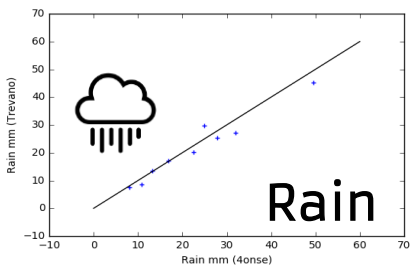
±0.5hPa
Air Pressure

±9.8%
Precipitation





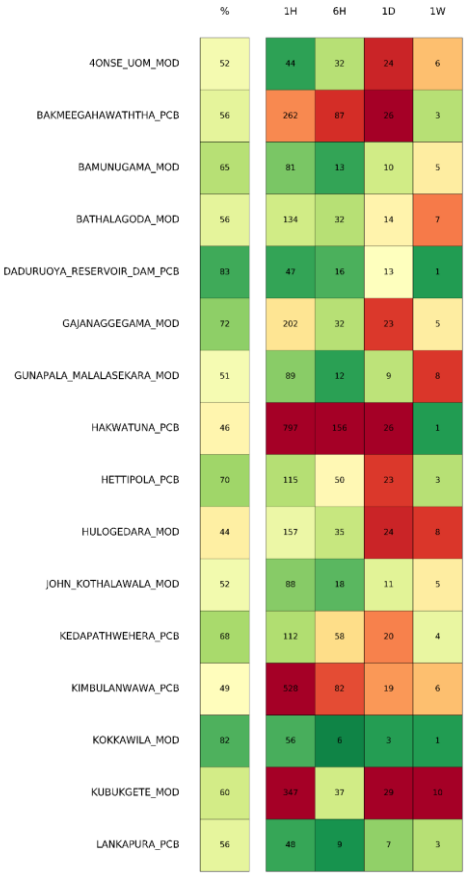




How frequent data gap?

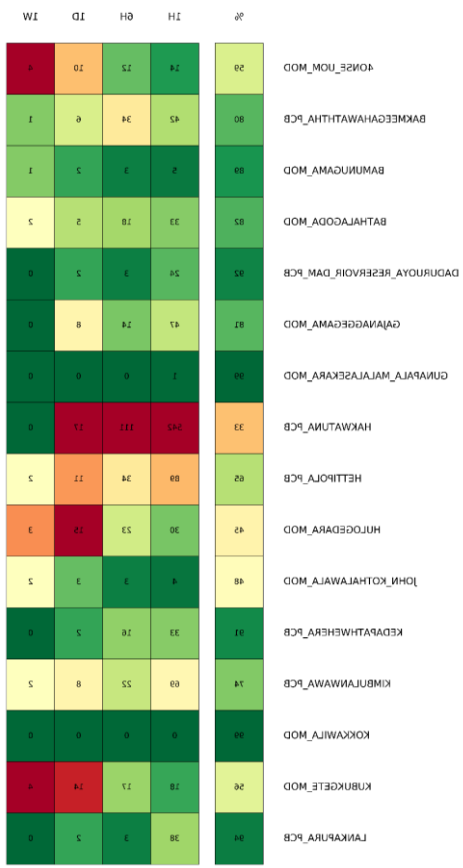
60%

Completeness
with sporadic maintenance



80%

Completeness
with proper maintenance



Timeliness: how late are data?

0.000 0 days
00:00:12.421393
0.100 0 days
00:00:20.643247
0.200 0 days
00:00:23.942705
0.300 0 days
00:00:28.746212
0.400 0 days
00:00:31.121794
0.500 0 days
00:00:33.659747
0.600 0 days
00:00:35.450307
0.700 0 days
00:00:41.982987

93% 

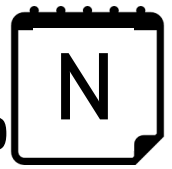
Within 10 minute

5.3% 

From 10m to 1h

1.4% 

From 1h to 1d

0.3% 

More than 1d

Service Quality

Service availability: 2019

99.246%

Availability

3 days

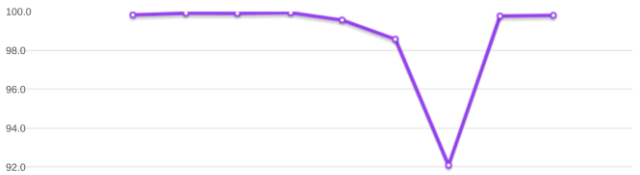
Downtime

811ms

Response Time

98.827%

Responsiveness



Database: 03/2018 – 11/2019

16Mio
Observations 

6GB
Size

19
Observed properties

43
Procedures

Service performance

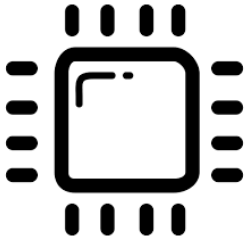
18Mic

Served requests

0

Failed requests

140ksec



Processing time

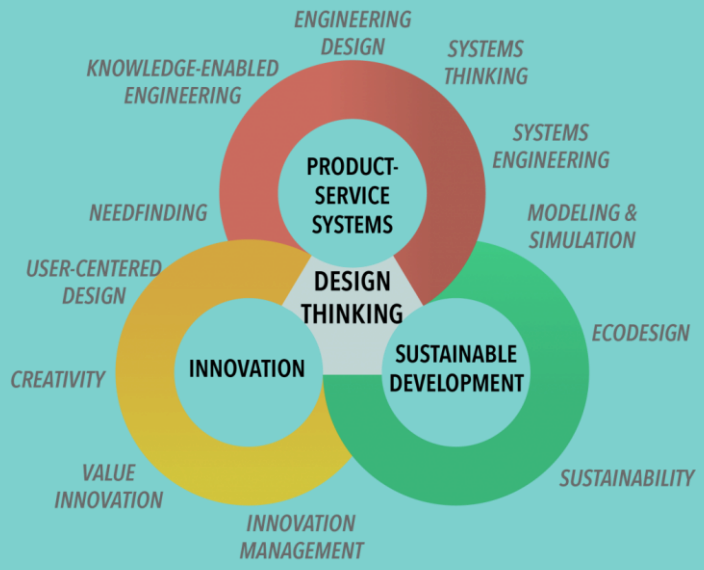
150

Unique visitors

35GB

Served data

Sustainability



Costs

750 USD/station

Total costs of deploy

(including taxers, batteries, installation & communication)

Similar stations purchasing costs

Vantage Pro Plus Station 1,670USD
MetPak RG Weather Station 2,735USD
Rainwise PORTLOG 805-1018 5,036USD

54 USD/station

Monthly maintenance cost

(including personnel 31USD and replacements 7USD)

9USD replacements

Station's replacements parts

14USD travels

From Kurunegala to stations

31USD personnel

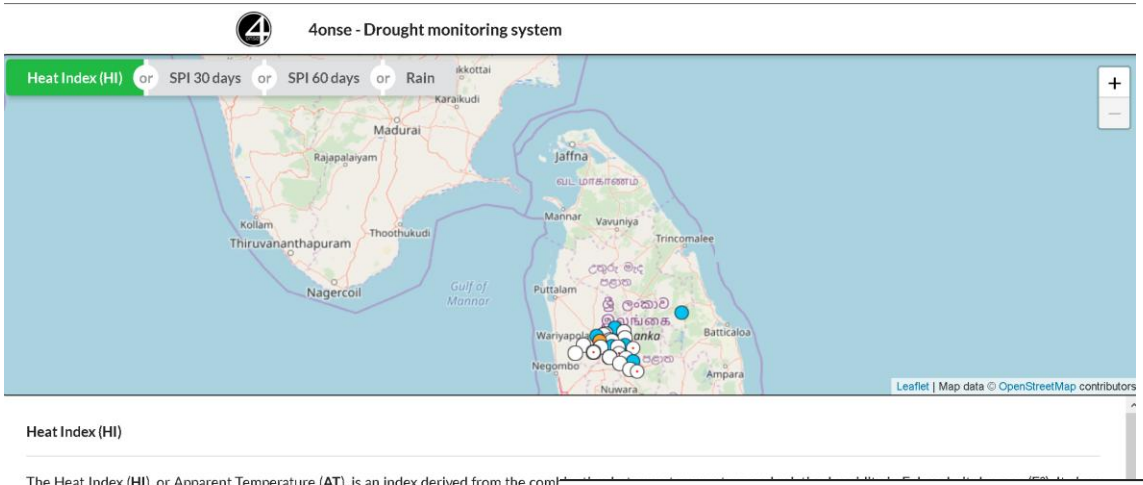
2 people 100% for 30 stations

Durability of components

>>1y Solar panel	>>1y Temperature (DS18B20)	>>1y SD card
>>1y Solar charger	3.3y Board	1.3y Battery
>>1y RTC	6y Wind (S,D)	1.5y BME (P, H)

Applicability

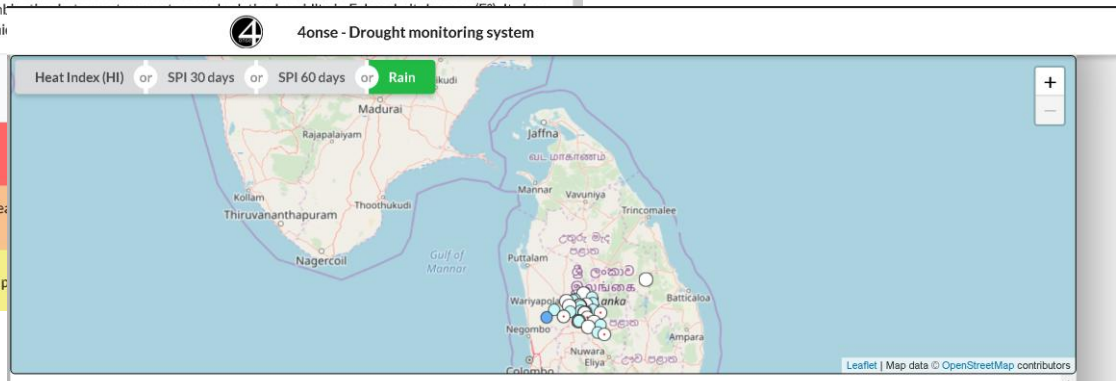
Droughts and rain events



Heat Index (HI)

The Heat Index (**HI**), or Apparent Temperature (**AT**), is an index derived from the comb
information about the physiological disconfort due to high temperatures and high humi

Intensity level	Heat Index	Dangers
Very high	Higher than 53°C	Heat stroke highly likely
High	40-53°C	Heat cramps or heat exhaustion likely, and hea activity
Medium	32-40°C	Heat stroke, heat cramps or heat exhaustion p

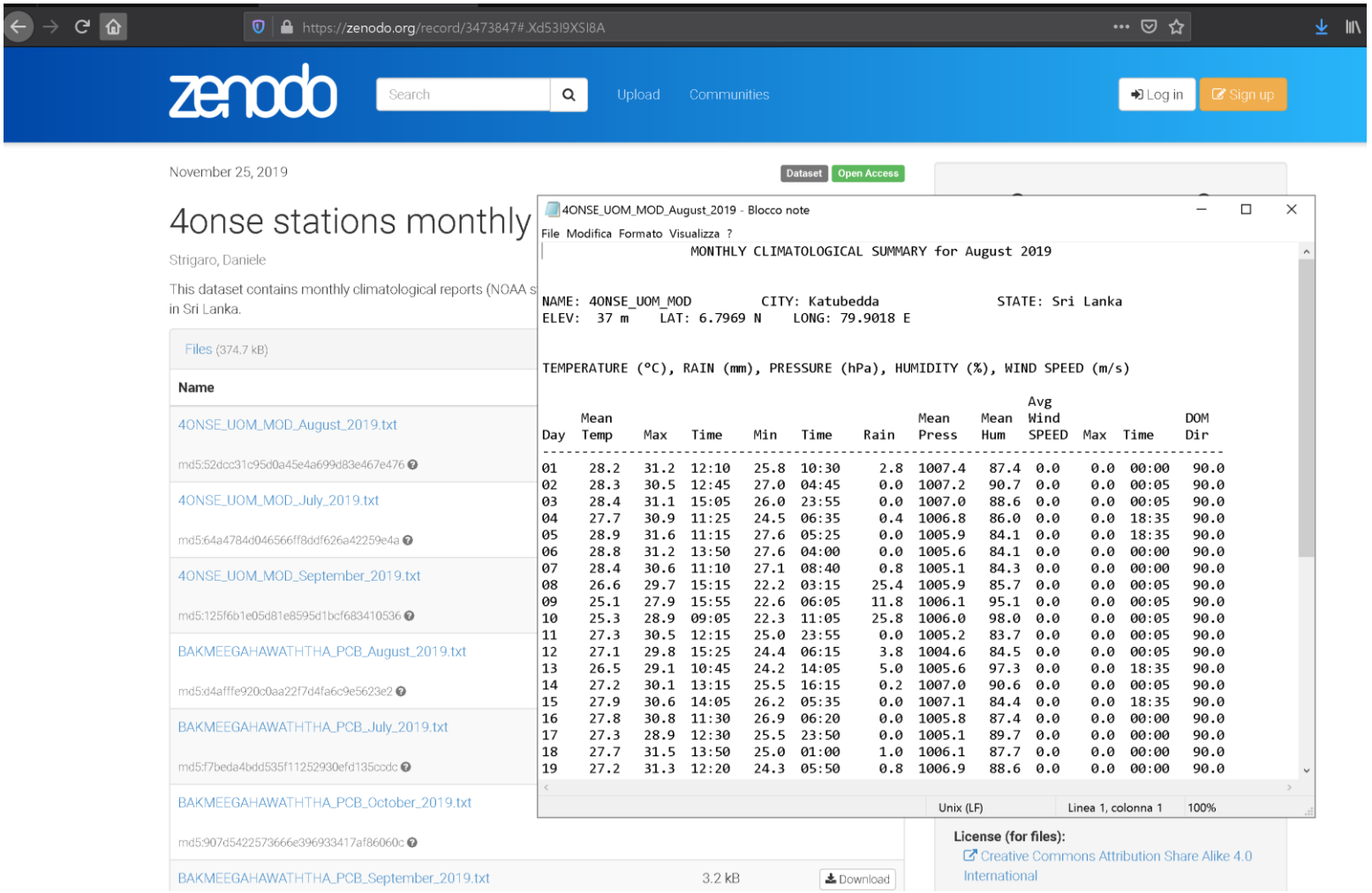


Rain daily data

The daily sum of the **rain** amount daily rain data , is a simple statistical anaylsis that is useful to highlight particular heavy rain events. The map shows the rain data marked in different colours based on the amount of the rain caollected by the 4onse weather staitons. The last data collected is shown and by clicking on the points the last seven days data are plotted. In Table 1, the rainfall classification based on daily rainfall of a station is proposed.

Classification of rainfall event	Rainfall (R) in a day (mm)
Very heavy rain event	R > 120.0
Heavy rain event	60.0 < R ≤ 120.0
Rather heavy rain event	35.0 < R ≤ 60.0
Moderate rain event	10.0 < R ≤ 35.0

Monthly statistical report



Hydrological model

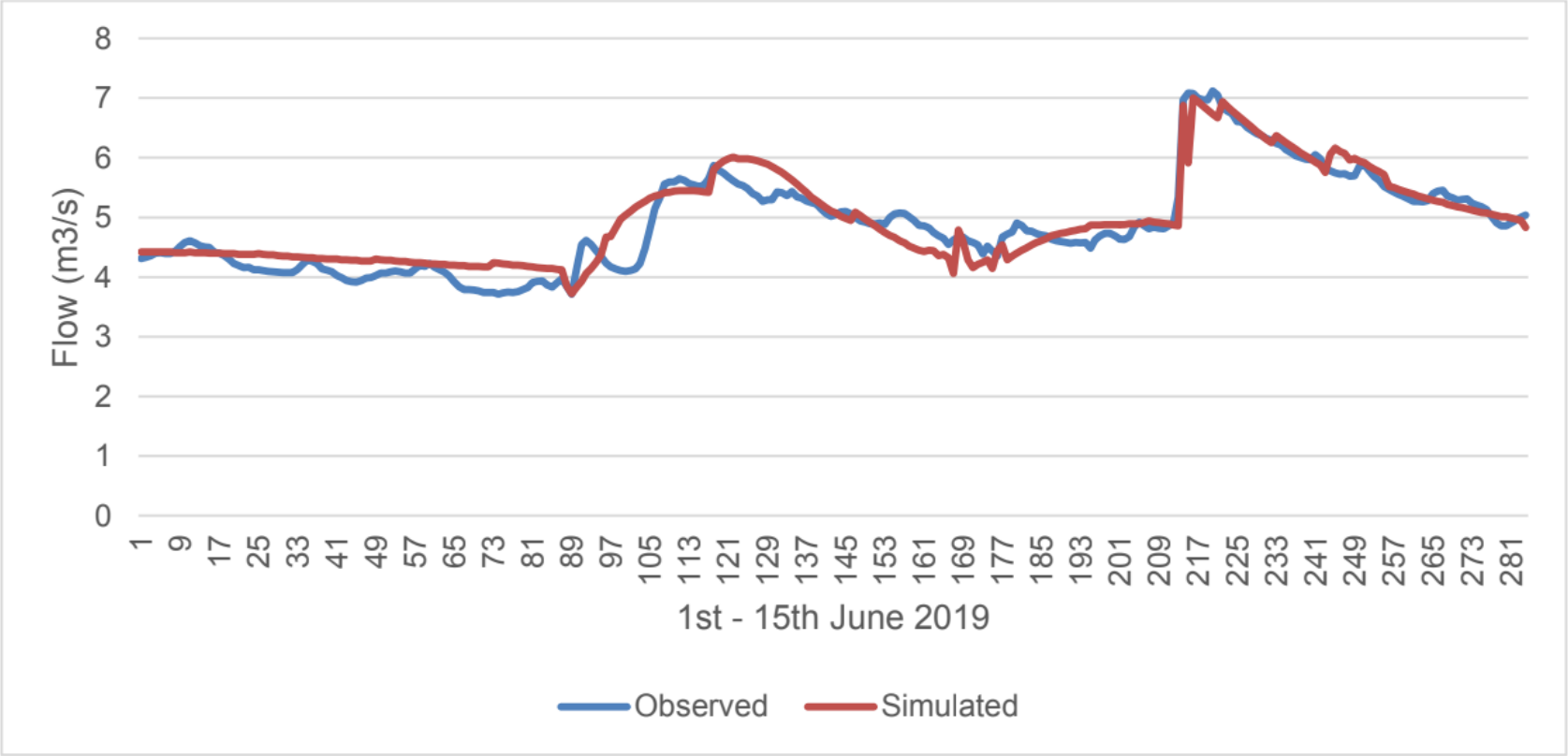


Figure 24: Observed and Simulated hourly flow for Deduru Oya sub-catchment during the period of 1st to 15th June 2019 – applied data of 4 stations

Summary

In summary

- Good data quality of data
  - Good for modelling, alert, etc.
  - Failures in power -> data gaps

- Good data service
  - Stability
  - Availability
  - Performance -> max 500 concurrent users

- Good sustainability
  - Independence
  - Durability
  - Costs

- Good applicability
  - Data tested in 4 applications

Thank you


Swiss Programme for Research
on Global Issues for Development
In light of global challenges, the Swiss Agency for Development and Cooperation (SDC) and the Swiss National Science Foundation (SNSF) launched in 2012 the joint «Swiss Programme for Research on Global Issues for Development» (r4d programme). The main goal of the r4d programme is the generation of new knowledge and the application of research results that contribute to solving global problems and securing public goods in low- and middle-income countries within the framework of global sustainable development. The r4d programme consists of six modules, five with thematic priorities and one for thematically open calls.
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