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### SUPSI

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### 40NSE PROJECT RESULTS: QUALITY AND COSTS EVALUATION OF AN OPEN AND LOW-COST MONITORING NETWORK OF 30 STATIONS IN SRI LANKA

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The issue

In most of the world it is difficult to cope with natural hazards and implement natural resources management due to missing or inaccessible data

impacts on Water / Food / Society / Health





### **Problem** missing hydro-met monitoring systems



## State of play in many countries

Few data

#### Solution 4 open & low-cost technologies



### Low quality control

No real time

### For purchase only



### The motivation

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



The research question

### Development integrated open-monitoring-system







Quality level

## support the implementation of management actions

### System Design





### Open technologies





Sensing



#### 4onse-mod



- Modular solution
- Common materials (screws, boxes, Plexiglass board, etc.)
- Easy to replace each component
- More time to build
- Connections by wires
- More space required

#### 4onse-pcb



- PCB based
- Easy to install
- Open PCB schema
- Less space required
- Hard to change components
- 4onse PCB is not widely available
- More expensive





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Open Source Software by Institute of Earth Science - SUPSI

### Monitoring network





## Data Quality





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





















### Completeness: how frequent data gap?



### 60% Completeness with sporadic maintenance



## 80%

### Completeness with proper maintenance



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0 days 00:00:12.421393 0.000 0 days 00:00:20.643247 0.100 0 days 00:00:23.942705 0.200 0 days 00:00:28.746212 0.300 0 days 00:00:31.121794 0.400 0 days 00:00:33.659747 0.500 0 days 00:00:35.450307 0.600 0 days 00:00:41.982987 0.700 0 days 00:01:08.378276 0.800 0 days 00:05:29.853662 0.900 0 days 00:10:47.267438 0.930 0 days 00:15:41.010492 0.950 0.983 0 days 01:01:07.204712 0 days 23:32:40.093877 0.997 7 days 19:12:40.124288 1.000



More than 1d

### Service Quality





## **99.246**% Availability



## **3 days** Downtime

July

## **811**ms Response Time



## 98.827%

August September October November December

### Responsiveness





## 16Mio Observations

**6GB** Size

## $19 \approx \approx 430$ Observed properties Procedures

Service performance



## 18Mic 约 Servced requests Failed requests





**35**<sub>GB</sub> **€** Served data







### Sustainability





## 750<sub>USD/station</sub>

### Similar stations purchasing costs

Vantage Pro Plus Station MetPak RG Weather Station Rainwise PORTLOG 805-1018

1,670USD 2,735USD 5,036USD

### Total costs of deploy

**54** USD/station

(including taxers, batteries, installation & communication)



## **9**USD **replacements** Station's replacements parts



### 14USD travels

From Kurunegala to stations



**31**USD **personnel** 2 people 100% for 30 stations

### Monthly maintenance cost

(including personnel 31usp and replacements 7usp)

### Durability of components



<b>&gt;&gt;ly</b> Solar panel	<b>Solution</b> <b>Solution</b> <b>Solution</b> <b>Solution</b> <b>Solution</b>	>>ly SD card
<b>&gt;&gt;ly</b>	<b>3.3y</b>	<b>1.3</b>
Solar charger	Board	Battery
<b>&gt;&gt;1y</b>	<b>6</b>	<b>1.5у</b>
RTC	Wind (S,D)	вме (р, н)

### Sustainability of technology





## Applicability



### Droughts





#### Heat Index (HI)

The Heat Index (HI), or Apparent Temperature (AT), is an index derived from the combination between temperature and relative humidity in Fahrenheit degrees (F°). It gives information about the physiological disconfort due to high temperatures and high humidity rates. In table 1, the heat index classification is described:

Intensity level	Heat Index	Dangers	Category
Very high	Higher than 53°C	Heat stroke highly likely	Extreme danger
High	40-53℃	Heat cramps or heat exhaustion likely, and heat stroke possible with prolongued exposure and/or physical activity	Danger
Medium	32-40°C	Heat stroke, heat cramps or heat exhaustion possible with prolonged exposure and/or physical activity	Extreme caution





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 × P < 35 0						



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	in Sri Lanka.	NAME: ELEV:	40NSE_ 37 m	UOM_MC	D : 6.796	CITY 9 N	: Katub LONG: 7	edda 19.9018 E		STA %) wt	TE: Sri	i Lanka	a			
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	md5:125f6b1e05d81e8595d1bcf683410536	08 09 10 11 12	25.0 25.1 25.3 27.3 27.1	29.7 27.9 28.9 30.5 29.8	15:15 15:55 09:05 12:15 15:25	22.2 22.6 22.3 25.0 24.4	05:15 06:05 11:05 23:55 06:15	25.4 11.8 25.8 0.0 3.8	1005.9 1006.1 1006.0 1005.2 1004.6	95.1 98.0 83.7 84.5	0.0 0.0 0.0 0.0	0.0 0.0 0.0 0.0	00:05 00:05 00:05 00:05	90.0 90.0 90.0 90.0 90.0		
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### Hydrological model





Figure 24: Observed and Simulated hourly flow for Deduru Oya sub-catchment during the period of 1<sup>st</sup> to 15<sup>th</sup> 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

## 40nse

enable open, accessible and quality data for

climatic based services supporting policymakers and managers



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#### 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. www.r4d.ch



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