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# Newsletter

## Open Environmental Monitoring: data for all

Assembly of one out of 30 *4onse* monitoring stations in the Deduru Oya basin, Sri Lanka

## What's Inside



## Welcome again...

and thank you for following the latest *4onse* developments. Read about the progress made in the last months on the field and about the newest technical developments. *4onse* became more international since the first monitoring station in Islamabad, Pakistan, has been switched on and connected online to the *istSOS* data storage at SUPSI in Lugano, Switzerland.

**Analysis of four times Open, Non-conventional, Sustainable and Effective monitoring systems**

a project fund within the Research for Development program with decision IZ07Z0_160906 / 1

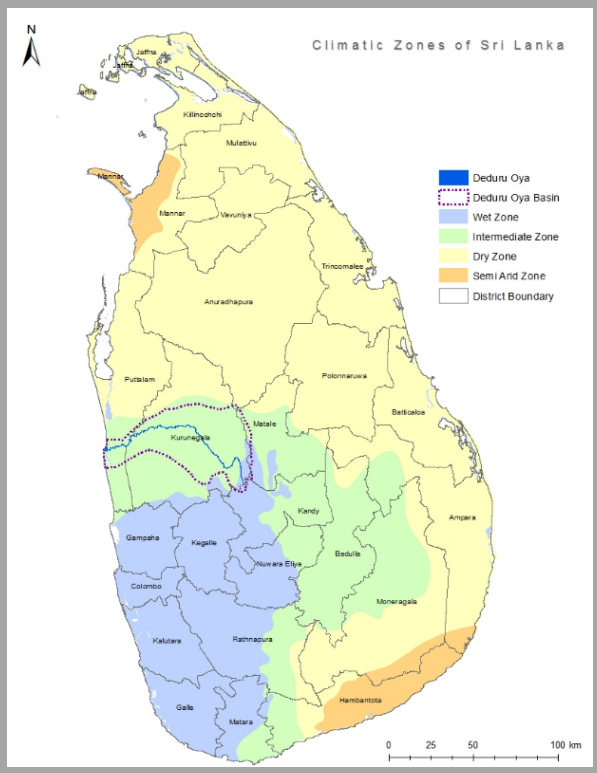
Chapter 1

# Sensor network deployment

The project case study, where the *4onse* system will be deployed and investigated is the Deduru Oya basin. It is the fourth largest river basin in Sri Lanka and is located within the highly vulnerable areas due to climate change according to recent studies (Katupotha, 2009). The Deduru Oya is 115km long and covers 2623km$^2$ of catchment area. 97% of the basin's area covered by the North Western Province (Kurunegala and Puttalam Districts) and 3% by the Central Province (Kandy and Matale Districts). The basin area falls under two climatic zones, wet and intermediate.

The annual average rainfall of the basin area is about 1628mm. The hydrometric network in the basin consists of several meteorological stations and two gauging stations. The major sources of water available in the basin include direct rainfall, stream flow, surface water storage and groundwater storage. These available water resources vary spatially and temporally across the basin, significantly.

The Deduru Oya is affected by flash floods in some periods and also suffers from long periods of low flows which occurs in the months of February, March, June, July, August, and September (Samarasinghe, et.al, 2000). More runoffs available at upper basin which is located in the Wet Zone. Middle and tail end parts of the basin locate in the Intermediate Zone, face water shortage problems in dry periods. Sometimes the Drought period endure in the area for nearly 7 to 9 months creating an acute water shortage (Katupotha, 2009).




| Total stations | 30 |
|---|---|
| Near selected schools | 18 |
| Near selected temples | 2 |
| Other places | 10 |

Project case study area (within the dotted line) in the Kurunegala district, Sri Lanka. The *4onse* monitoring stations were mainly positioned in the vicinity of schools for educational reasons (see next page).

## Chapter 2

# Young students discover applied science

Great interest and enthusiasm by the students were encountered during an assembly of a monitoring station in the vicinity of a school in the Kurunegala district. The promotion of the project, its technologies and deployment, is essential for the overall long term success. Especially the future generation has to be involved.

## Chapter 3

# Maintenance using *ODK Collect*

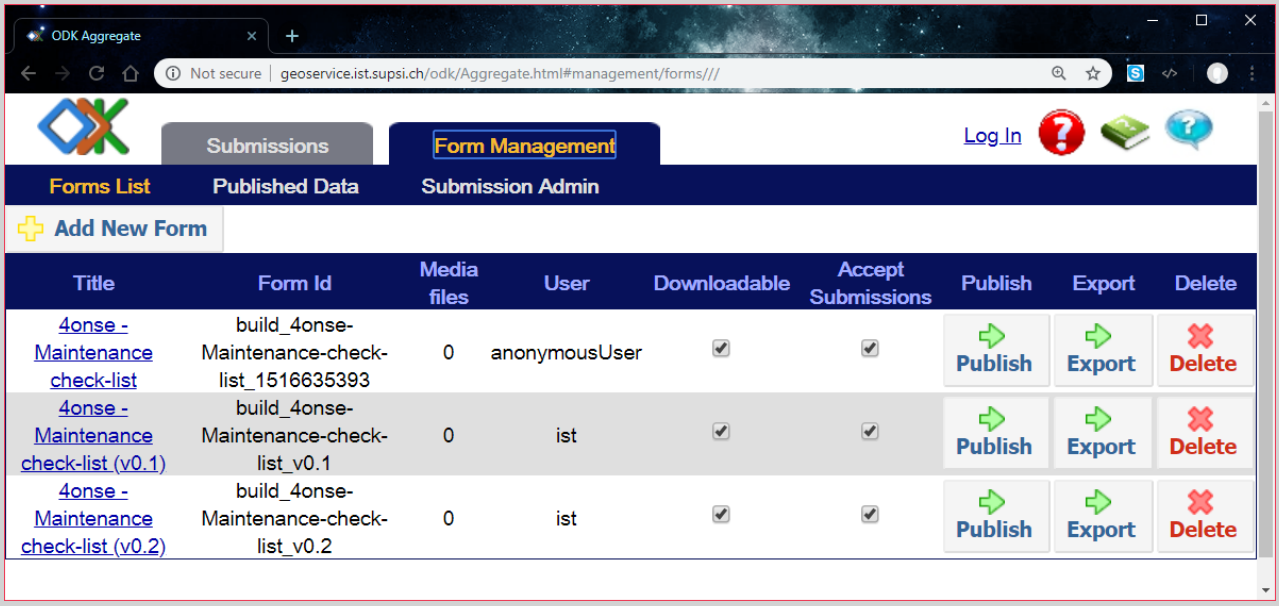
The open source Android app *ODK Collect* [1] is a tool that substitutes classical paper forms, often used in survey-based data gathering. The app supports a wide range of question and answer types and is designed to work well even without network connectivity. *ODK Collect* renders forms into a sequence of input prompts that apply form logic, entry constraints and repeating sub-structures. Users work through the prompts and can save the submission at any point. Finalized submissions can be sent to (and new forms downloaded from) a server any time.

For project purposes a specific monitoring station management form has been designed to guarantee consistent data collection. When the system has been deployed and is operative, maintenance data can be collected in the field using a mobile device and sent to a remote server for archiving. The same server supplies the above mentioned form (i.e. a checklist to be answered) to the Android smartphone or tablet.

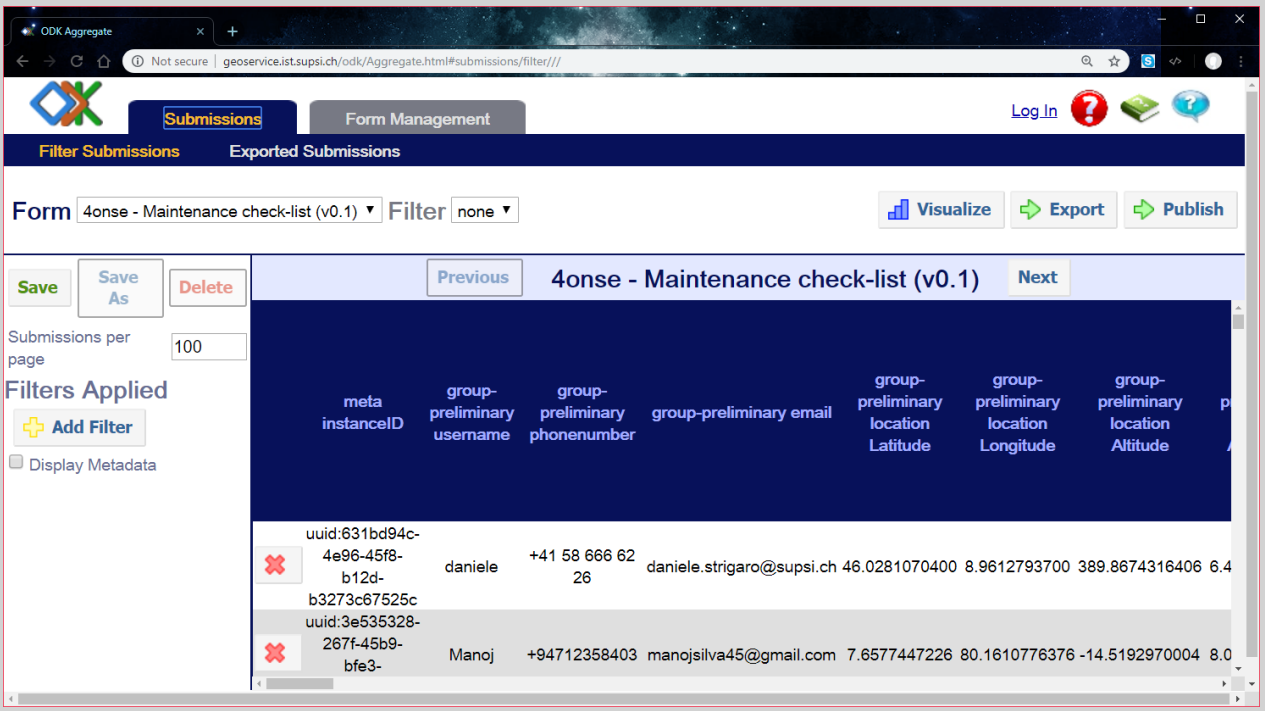
Every station is equipped with a QR code which can be read and identified by the device.

[1] https://docs.opendatakit.org/collect-intro/

# Chapter 3




*ODK Collect* Web interface showing the form management:

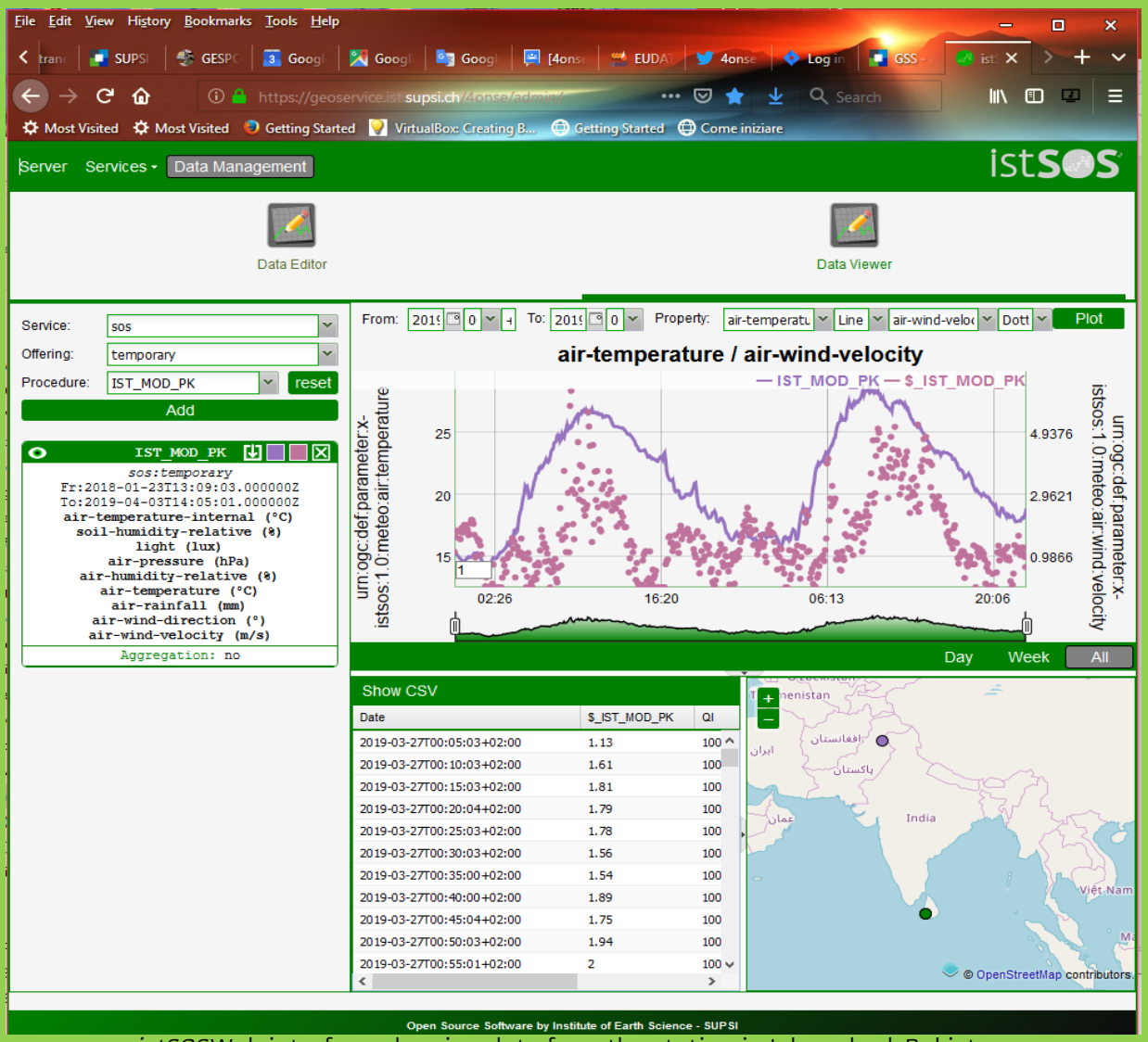



*ODK Collect* Web interface showing the gathered status data.

Chapter 4

# First Results from Pakistan

In January 2018 the first *4onse* monitoring station in Pakistan has been put to operation in the vicinity of the capital Islamabad. Other five stations have been sent to Pakistan in spring 2019. The *Institute of Space Technology* as local partner, represented by Prof. Imran Sahid, is responsible for the full functionality and maintenance of these stations.



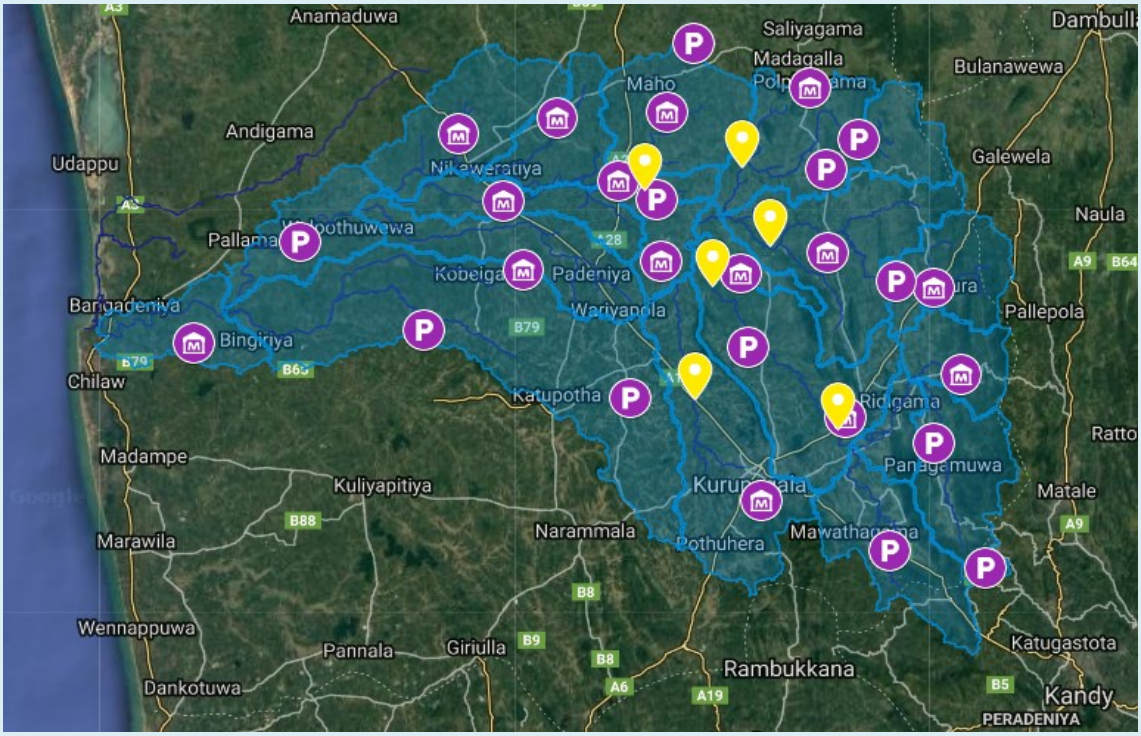

*istSOS* Web interface showing data from the station in Islamabad, Pakistan.

Chapter 5

# News from Sri Lanka

## The tank management model

The selected case study area in Sri Lanka to deploy the *4onse* systems is Deduru Oya basin, which is the 4th largest river basin of Sri Lanka. It covers nearly 2687km$^2$ of catchment area. There are 8 major reservoirs / tanks in the basin. Out of them, Deduru Oya reservoir is the largest tank in the basin which has a capacity of 75,000,000 m$^3$. In this project, the Deduru Oya reservoir have been selected to develop the tank management model, since it is the largest tank in the area, which merged the stream network of the upper basin and the main determinant of controlling the floods in the lower basin. In here the term "tank management" refers to the "process of dealing with or controlling the operation of releasing water from tanks". The existing hydro-meteorological network of Deduru Oya river basin consists only several stations, which operate manually. Most of the time the decision to open the reservoir gate for water release is hard to make.




27 weather stations and 6 river gauges have been installed in the Deduru Oya basin area.

Chapter 5

This is due to the unavailability of a proper decision support system for flow forecast with real-time weather data. A late decision might cause overflow at the downstream areas and might affect the dam's structure.

Currently, the reservoir managers of Deduru Oya reservoir release water at the rainy periods, once it comes to a particular level. This creates floods in the downstream areas due to intolerable quantity of water. Therefore, the flood risk in the downstream areas can be reduced to a considerable level, if the reservoir mangers take prior judgments about the water quantity that should be released time to time. Hence, there is a strong need to reduce the flood risk in the downstream areas by means of establishing a suitable decision support system. Accordingly, tank management inevitably leads to regulating the flood risk at the downstream areas. The main objectives of developing the tank management are:

- to forecast the runoff generated in the sub-basins
- to forecast the temporal variation of tank capacity with respect to the runoff coming from the upper sub basins

### Workshop on building 4ONSE weather station

The project team has organized a workshop at the FOSSS4G-Asia 2018 event, which was held on 2nd December 2018 at the Department of Town & Country Planning University of Moratuwa. The overall aim of conducting this workshop is to share the theoretical and practical skills in building a 4ONSE Weather Station with stakeholders. The 4ONSE Project Team from the University of Applied Sciences and Arts of Southern Switzerland (SUPSI) also participated at the workshop to share their expertise and knowledge with stakeholders.
The stakeholders from the following institutions and organizations took part in the workshop:

- Department of Irrigation – Kurunegala District Office
- Department of Meteorology, Sri Lanka
- Urban Development Authority
- Department of Mechanical Engineering, University of Moratuwa
- Department of Computer Science and Engineering, University of Moratuwa
- Department of Information Technology, University of Moratuwa
- Department of Town and Country Planning, University of Moratuwa
- I-bitz Company, Thailand

## Chapter 5

The agenda of the workshop was:

Workshop commenced with Dr. Rangajeewa Ratnayake welcoming the audience and introducing the project. Then, Professor Massimiliano Cannata further briefed about the *4onse* project and istSOS open source application. Dr Daniele Strigaro presented data evaluation part of the *4onse* non-conventional solution. Mr Athula Priyantha of Meteorological Department presented the state of the art of weather monitoring of Sri Lanka. Then, Prof Imran Shahid shared his experience about the *4onse* weather stations installed in Pakistan. The stakeholders visited the 4ONSE-PCB and 4ONSE-MOD weather stations at the university premises. Finally Mr B.H. Sudantha, explained the systems architecture of the 4ONSE station and commenced the hands on session on building the 4ONSE station.

Workshop on building 4ONSE weather station

## Upcoming Events 2019

| | |
|---|---|
| 7-12 Apr | **EGU General Assembly, Vienna, Austria**<br>M. Antonovic, M. Cannata, D. Strigaro |
| 6-8 May | **Sustainability workshop, UoM, Sri Lanka**<br>M. Antonovic, M. Cannata, D. Strigaro |
| 8-14 July | **Euro-Python 2019, Basel Switzerland**<br>M. Antonovic, M. Cannata, D. Strigaro |

## Past Events 2018

| | |
|---|---|
| 9-11 October | **OGRS 2018 Lugano, Switzerland**<br>The project team has presented a paper at the OGRS 2018 conference (Open Source Geospatial Research & Education Symposium) which was held on 9-11 October 2018 at SUPSI Lugano. The title of the paper is "Appropriateness of low cost sensor network for environmental monitoring in a tropical country: Experience and lessons learnt from real world deployment" |
| 15-19 October | **ACRS 2018 Kuala Lumpur, Malaysia**<br>The project team has presented a paper at the ACRS 2018 conference (Asian Conference on Remote Sensing) which was held on 15-19 October 2018 at Kuala Lumpur Malaysia. The title of the paper is "An approach to determine the optimum spatial distribution of weather station network for hydrological modelling: 4ONSE deployment" |
| 2-5 December | **FOSS4G-ASIA Moratuwa, Sri Lanka**<br>The project team has presented a paper at the FOSS4G Asia 2018 conference (Free and Open Source Software for Geospatial) which was held on 02-05 December 2018 at University of Moratuwa, Sri Lanka. The title of the paper is "Is non-conventional low cost weather station a sustainable monitoring solution?" |
| 6-7 December | **ICITR 2018**<br>The project team has presented a paper at the ICITR 2018 conference (International Conference on Information Technology Research) which was held on 06-07 December 2018 at University of Moratuwa, Sri Lanka. The title of the paper is "Building an open-source environmental monitoring system – A review of state of the art and directions for future research" |