



## **4onse: a modular open, non-conventional and low-cost weather station & monitoring system**

Daniele Strigaro, Massimiliano Cannata, Milan Antonovic, Mirko Cardoso, and Marcus Hoffmann  
Institute of Earth Sciences, SUPSI, Canobbio, Switzerland (daniele.strigaro@supsi.ch)

An Environmental Monitoring System (EMS) is one of the possible measures which helps to prevent and mitigate natural disasters and manage the water resources. Unfortunately low-income and developing countries has a lack of these systems due to high costs related to the conventional systems. The 4onse project (analysis of Open, Non-conventional, Sustainable and Effective monitoring systems), funded by the Swiss National Science Foundation (SNSF), aims to evaluate “non-conventional” EMS based on open technologies both hardware and software. A fully open solution (for hardware, software, standard and data), if scientifically validated, can be an effective opportunity to offer a low-cost, collaborative, accessible, modifiable solution. On the wave of the Internet of Things and the ubiquitous of Internet, the solution proposed can potentially increase the capacity of these countries to fast react against hazardous events and better understand natural phenomena.

The 4onse EMS is composed by sensor nodes which transmit data using GPRS wireless technology. Each node is a weather station which uses Arduino as core component to collect the signal measurements of air temperature, air pressure, air humidity, rain and other environmental parameters thanks to low-cost sensors components. Once the prototype has been built, it has been tested during the system prototyping activities. The preliminary results, concerning the accuracy of the system, are performed by means of the comparison between the 4onse prototype and other authoritative weather stations of the hydro-meteorological network of Canton Ticino (Southern Switzerland). Two additional prototypes has been installed to check the durability, reproducibility and stability of the system respectively in Sri Lanka and Indonesia.

Together with the hardware component, a data warehouse software is used in a monitoring system to validate and manage data and metadata. Thus, the istSOS software ([www.istsos.org](http://www.istsos.org)) has been selected due to four main reasons: according to Cannata et al. 2015 it showed good stability in the management of the hydrological and weather data; it is fully compliant to the Sensor Observation Service (SOS) of the Open Geospatial Consortium (OGC); it integrates a data quality control system; and it is open source (published under the GNU GPL v2 license). During the research project, it has been further developed thanks to some new features needed to increase the capability of a fast and secure communication between the nodes and the server. To provide a data control system and to take advantage of the istSOS features, an algorithm to control the quality of raw data has been studied on the node level. As a result of the first part of the project, about 20 stations are installed in a Sri Lankan basin to scientific test and validate a real open EMS.

### References

Cannata, M., Antonovic, M., Molinari, M., & Pozzoni, M. (2015). istSOS, a new sensor observation management system: software architecture and a real-case application for flood protection. *Geomatics, Natural Hazards and Risk*, 6(8), 635-650.