



Contribution ID : 34

Type : not specified

## Enabling Virtual Research and Education in Environment monitoring - The role of research and education networks

*Friday, 18 March 2016 09:40 (20)*

### **1. Motivations and awareness about the need for environment monitoring:**

We present ongoing research and education in environment monitoring targeting several African countries and discuss how RENs could support the emerging virtual research and education communities involved in environment oriented research with large socio-economic impact.

The need for environment monitoring is well documented in International, regional and national strategies and implementation plans including several of the UN Goals for Sustainable Development. Stakeholders in environment information can be found in all sectors of society. Examples of applications include weather research and forecasting, climate research, adaptation and mitigation, farmers' decision-making in agriculture, monitoring of drinking water quality, pollution of air, water or land, all sorts of early warnings, environment impact assessment, etc.

Most African countries have considerably more sparse observation networks than other parts of the world. The key challenges include access to affordable and robust observation stations and communication links to transport data from remote observation stations to central repositories and human vandalism.

These facts are known by decision makers and funds are increasingly allocated to act upon this awareness.

### **2. Ongoing research exploring new technologies for environment monitoring:**

There are emerging technologies under the Internet of Things umbrella that promise to make massive monitoring affordable. There are projects in progress that explore their potential.

One such project is WIMEA-ICT, a NORAD funded project aiming at capacity building at some East African Universities while improving the accuracy of and access to weather information by the communities in the East African region through suitable ICTs for increased productivity and safety (<http://www.cis.mak.ac.ug/wimea/>).

The project is organized in four research components (RC1-4): The design and deployment of an affordable and dependable weather station (RC3), Secure and integrated storage of the weather data (RC2), Analyses and forecasting based on the collected data (RC1), Dissemination of weather data adapted to end-user needs (RC4). A first generation prototype developed by WIMEA-ICT RC3 has been under field test since early March 2015 (<http://wimea-ict.gfi.uib.no/>). Three copies of a 2nd generation prototype will be deployed in Uganda, Tanzania and South Sudan over the next few months.

The architecture of the prototypes replaces the traditional centralized architecture of environment monitoring station with a distributed system consisting of local wireless sensor networks having a few sensor nodes reporting readings from connected sensors to a sink node connected to a gateway with buffer storage and uplinks to Internet. This distributed model facilitates putting sensor nodes at appropriate locations within an observation station without wiring problems. The distributed model also facilitates having redundant nodes reporting the most essential parameters independently, some distance apart, to improve data quality and dependability.

The stakeholders in the WIMEA-ICT project form a research community that has been adopted as a Community of Practice supported by the EU Sci-GaIA project developing components enhancing the e-infrastructure of Africa in close cooperation with AfricaConnect and the regional academic networks, Ubuntunet and WACREN.

Researchers in other countries than those targeted by NORAD have expressed an interest in the WIMEA-ICT project, currently including Kenya, Mozambique, Nigeria and Somalia, who also signed an MoU as a research partner with both Sci-GaIA and WIMEA-ICT. Discussions are under way to fund extra stations to be deployed in these countries. There is reason to believe that researchers in other countries would also be interested if information about the project is disseminated more widely.

### **3. The role of RENs and what they can contribute to environment monitoring**

The mission of Research and Education Networks is to support research and higher education in all academic areas.

One of the main challenges in the automation and densification of the environment observation networks in African countries is affordable and dependable communications between the sensor networks and the data reception centers is an absolute necessity for sustainable operations.

What RENs can contribute is

- Facilitating the deployment of access points wherever they can be deployed to which remote wireless sensor network gateways can connect.
- Host science gateways, repositories and other e-infrastructure components serving the communities of practice involved in environment oriented research and education.

How to organise this will be elaborated in the full paper.

Plans in this directions are already discussed with TERNET, RENU, the emerging NREN of South Sudan, SomaliREN and ngREN. Examples of similar agreements in Europe and North America will be described.

## **Summary**

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**Session Classification :** PLENARY SESSION IV – Paper Presentations

**Track Classification :** Innovation in Research and Education Networks