

Managing sensor networks and data: Best practices working group Report to the LTER Network Office, September 26, 2013

Meeting: Albuquerque, NM, April 2 - 4, 2013

Participants: Don Henshaw (AND-co-organizer), Corinna Gries (NTL – co-organizer), Renee Brown (SEV), Adam Kennedy (AND), Richard Cary (CWT), Mary Martin (HBR), Christine Laney (UTEP, JRN), Jennifer Morse (NWT), Chris Jones (DataONE), Branko Zdravkovic (University of Saskatchewan), and Scotty Strachan (University of Nevada-Reno) attended in person. Jordan Read (USGS) and Wade Sheldon (GCE) attended some sessions of the meeting remotely.

Meeting: H.J. Andrews Experimental Forest, OR, September 4-6, 2013

Participants: Don Henshaw (AND-co-organizer), Corinna Gries (NTL – co-organizer), Renee Brown (SEV), Adam Kennedy (AND), Chris Jones (DataONE), and Scotty Strachan (University of Nevada-Reno) attended.

Summary: A working group of LTER information managers and representatives from other groups with experience in sensor networks have assembled to develop a best practices guide for LTER and the wider environmental community on managing sensor networks and data. The working group met on two occasions (Albuquerque, NM and Andrews Forest, OR) and shared their collective experiences and various sensor network strategies and applications. This working group builds on past LTER-initiated workshops (i.e., Hubbard Brook sensor workshop 2011, trainings at the LNO and Sevilleta in both 2012 and 2013, and the LTER ASM 2012 sensor workshop). Six outlined topics that emerged from the earlier meetings representing many aspects of sensor networks are used as the basis for detailed discussion and document development. The working group continues to teleconference monthly and editors are assigned and lead document creation for each of the topical areas. The resulting best practices documents and products will be shared online with LTER and the broader environmental sensor community on the Earth Science Information Partners (ESIP) Federation wiki page (http://wiki.esipfed.org/index.php/EnviroSensing_Cluster). A short publication describing our work and introducing the materials posted to the wiki pages is planned. An Environmental Sensor User Group (EnviroSensing Cluster) has been formed and provides a forum for this work within the ESIP commons allowing for a wider impact.

Albuquerque workshop activities: Each participant presented a brief introduction into sensor network development at their respective sites, and additionally shared a related problem statement that was relevant to their current work. Other presentations included a review of past work, the DataONE perspective on streaming data, streaming sensor data management within the USGS, and CUAHSI's new observational data model (ODM2). The general goal, audience and scope of final products were discussed. Over the next two days, sessions were held to discuss each of the following best practice sections:

- **Introduction** provides the scope and executive summary of the best practices document and describes the planning process, implementation feasibility, and team assembly with necessary personnel roles and expertise to establish and maintain sensor networks.
- **Sensor Site and Platform Selection** considers environmental concerns, site accessibility, system specifications, site layout, and common points of failure.
- **Remote Data Acquisition** is concerned with data security, integrity and remote control of the system.
- **Sensor Management Tracking and Documentation** outlines the importance of communication between field and data management personnel in tracking and documenting field events that may alter the data streams.
- **Streaming Data Management Middleware** discusses software features for managing streaming sensor data.
- **Sensor Data Quality** discusses different ways sensor data may be compromised and how to automatically control for it in the data stream.
- **Sensor Data Archiving** introduces different approaches and repositories for archiving and publishing data sets of sensor data.

Andrews Forest workshop activities: Documents are in preparation for each of the listed sections. Each section of the best practices document was reviewed for status, content, and consistency in presentation at this workshop. A general outline for each section was agreed upon as follows:

- **Overview** includes scope and problem statement
- **Introduction** discusses specific considerations
- **Methods** details descriptions of all options
- **Best practices** refers to successful methods or examines why one strategy may work better than another
- **Case studies** provides real world examples in terrestrial and aquatic ecosystems
- **Resources** provide links to resources such as existing standards, protocols, products, etc.
- **References** provide citations for materials presented in each section

Status and next steps: The working group and other interested parties continue to meet regularly via teleconference to review content and completeness for one section at a time with each section editor. The plan is for all best practice sections to be completed and placed into the ESIP wiki pages by the end of 2013. A short publication has been outlined as a means of introducing this effort and the resulting wiki pages and will be developed once the wiki pages are ready. The primary intent is to provide and allow the use of these best practices materials as a guide for environmental research teams in establishing and managing sensor networks. We intend to involve further community participation in improving and refining these working documents and periodically archive and release new versions of the wiki-based materials. The broader community will be essential in adding new materials such as use cases and resource links, and participating in ongoing forums on topics of interest.