

Preview of Award 1226983 - Annual Project Report

Cover

Federal Agency and Organization Element to Which Report is Submitted:	4900
Federal Grant or Other Identifying Number Assigned by Agency:	1226983
Project Title:	Near-Real Time Data Streaming from the Coweeta LTER Environmental Sensor Network
PD/PI Name:	Theodore L Gragson, Principal Investigator John Chamblee, Co-Principal Investigator
Submitting Official (if other than PD\PI):	Theodore L Gragson Principal Investigator
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Reporting Period:	08/15/2012 - 07/31/2013
Signature of Submitting Official (signature shall be submitted in accordance with agency specific instructions)	Theodore L Gragson

Accomplishments

* What are the major goals of the project?

The goal of this project is to improve and expand the existing network of Coweeta LTER weather, streamflow, and terrestrial microclimate sensors by upgrading existing equipment and adding additional stations until we have a total of 28 stations operating across west-to-east elevational, hydrologic, and climatic gradients. The improvements will make it possible to wirelessly transmit data from individual sensor sites by a combination of satellite, cellular, radio, and WLAN transmitters. The network will rely on the GCE Data Toolbox for Matlab to provide metadata-based analysis, quality control / quality assurance (QA / QC), transformation, management, and delivery of the data sets. These data will support site, regional, and comparative research by LTER scientists both within the Coweeta LTER project and from across the LTER Network as well as by non-LTER scientists.

* What was accomplished under these goals (you must provide information for at least one of the 4 categories below)?

Major Activities: There were three major activities this year:

1. Deploying new and upgraded equipment for the existing microclimate and regional climate stations within the Coweeta Basin, the Upper Little Tennessee River basin, and the French Broad River basin.
2. Developing and documenting protocols and GCE Data Toolbox scripts for near-real time streaming of data to the web.
3. Locating suitable sites for expansion of the regional network according to our identified need to track climatic variation along longitudinal and elevational gradients.

Specific Objectives: To date, we have replaced or upgraded equipment for 14 stations, including all

stations within the Coweeta Basin, as well as stations in the French Broad River Basin. We have also deployed our southernmost station, near the University of Georgia's Athens, GA, campus and have identified suitable high elevation sites to expand the regional network within the Upper Little Tennessee River basin.

Significant Results: By developing protocols to automatically retrieve data, flag them for QA / QC, and publish them on the internet, we identified variances in data management practices across comparative data sets and addressed these inconsistencies in such a way that investigators will no longer have to spend time rectifying data sets from multiple stations for comparative analyses. In addition, we have increased the frequency with which data sets are updated for publication.

Key outcomes or Other achievements: Our development of a streaming sensor network has greatly enhanced our ability to contribute to LTER Network-Wide efforts to establish common practices and standards for the use of streaming sensor data transmission networks.

*** What opportunities for training and professional development has the project provided?**

We provided a summer internship for an advanced, gifted high school student who assisted us with the configuration and deployment of these field stations.

*** How have the results been disseminated to communities of interest?**

We published an article in Databits, the LTER Network newsletter for Information Management. We also contributed materials to a Wiki on Environmental Sensor Networks developed as part of the ESIP Federation's EnviroSensing Cluster.

*** What do you plan to do during the next reporting period to accomplish the goals?**

In the coming year, we will deploy the remaining 14 sites, focusing on stream stage sensors, as well as high-elevation and regional climate stations.

Products

Journals

Books

Book Chapters

Thesis/Dissertations

Conference Papers and Presentations

Other Publications

Cary, Richard Chamblee, John Sheldon, Wade M., Jr. (2013). *Coweeta LTER Upgrades Sensor Stations by Implementing the GCE Data Toolbox for Matlab to Stream Data*. Databits. Spring 2013 Issue. (<http://databits.lternet.edu/spring-2013/coweeta-lter-upgrades-sensor-stations-implementing-gce-data-toolbox-matlab-stream-data>).

Status = OTHER; Acknowledgement of Federal Support = Yes

Cary, Richard Chamblee, John F. Sheldon, Wade M., Jr. (2013). *Overview Guide for the GCE Data Toolbox for MATLAB*. This guide covers various methods of importing data files into the GCE Data Toolbox for MATLAB software, working with the data, creating a metadata template for the file, joining multiple data sets, QA/QC processing and

exporting documented data products. It is designed to be used with sample data sets provided on the GCE Data Toolbox development site. (https://gce-svn.marsci.uga.edu/trac/GCE_Toolbox/chrome/site/gce_toolbox_user_guide.pdf).

Status = OTHER; Acknowledgement of Federal Support = Yes

Technologies or Techniques

Nothing to report.

Patents

Nothing to report.

Inventions

Nothing to report.

Licenses

Nothing to report.

Websites

Title: Continuously measured forest soil moisture at four sites in the Coweeta basin.

URL: <http://coweeta.uga.edu/cwtstream/soilmoisture/data/index.xml>

Description: Volumetric soil water content is measured at four locations in the Coweeta Basin across a range of elevations. At each location, soil water content was measured from 0 to 30 cm and from 30 to 60 cm. In addition, air temperature was measured at 100 cm above ground and soil temperature was measured at 5 and 20 cm depth. Data are available at hourly time scales.

Title: Terrestrial Gradient Microclimate Measurements.

URL: <http://coweeta.uga.edu/cwtstream/gradient/data/index.xml>

Description: The terrestrial gradient study at Coweeta compares vegetation, soils, and understory microclimate at five sites: 118 low elevation (782 m) pine-oak, 218 low elevation (795 m) cove hardwood, 318 low elevation (865 m) mixed oak, 427 high elevation (1001 m) mixed oak, 527 high elevation (1347 m) northern hardwood. Understory microclimate stations were installed in representative locations at the downslope margin of each 20 x 40 m gradient plot (within the 80 x 80 m plot). At each location, soil water content is measured from 0 to 30 cm and from 30 to 60 cm at both an upper and lower plot. Soil temperature is measured at 5, 20, and 50 cm below the surface, while air temperature is measured at 1 meter above the surface.

Title: Mars Hill Climate and Soil Moisture.

URL: <http://coweeta.uga.edu/cwtstream/marshill/data/index.xml>

Description: These sites expand the regional coverage of the Coweeta LTER sensor network by providing climate and soil moisture and soil temperature data from the campus of Mars Hill College, in Buncombe County, North Carolina (near Asheville). Microclimate and weather data are collected at a central open site. Soil moisture, soil temperature, and air temperature data are collected at two other sites -- one near the college's Maintenance Facility one near the college President's house. Data collected include reference temperature, air temperature, air humidity, solar radiation, wind speed, wind direction, soil moisture, and soil temperature. Air temperature, PAR, wind speed, soil moisture, and soil temperature are measured once a minute and then averaged and saved to the output table every hour. Wind direction and relative humidity are sampled and data are recorded at the top of the

hour, and total rainfall is recorded every hour.

Other Products

Product Type: Instruments or Equipment

Description: We have deployed 14 climate and microclimate stations that are streaming data in near-real-time to the websites listed in this report.

Other:

Participants

Research Experience for Undergraduates (REU) funding

What individuals have worked on the project?

Name	Most Senior Project Role	Nearest Person Month Worked
Theodore L Gragson	PD/PI	1
Scott M Pearson	Faculty	1
Joseph Davis	Technician	2
John Chamblee	Co PD/PI	2
Richard Cary	Technician	6
Katherine Bower	Technician	1
Wade C Sheldon	High School Student	1
Joel Scott	Technician	1

What other organizations have been involved as partners?

Name	Location
Mars Hill College	Mars Hill, North Carolina

Have other collaborators or contacts been involved? N

Impacts

What is the impact on the development of the principal discipline(s) of the project?

Investigators have long known that sensor data must be treated with care and subjected to post-processing prior to analysis. However, by developing documentation and protocols for the rapid and systematic deployment of new field sensor stations, we have enhanced the ability of researchers to respond to dynamic conditions and major changes that could have an impact on ecological systems. This rapid-response ability may be relevant to studies of resilience and resistance both in the short- and long-term.

What is the impact on other disciplines?

The ability to collect near real-time data across basin-level elevational, hydrologic, and climatic gradients is providing an empirical foundation for addressing theoretically significant regional-scale ecological questions. In addition, we have increased the potential for cross-site comparisons by adopting a widely shared tool to address data processing and post-processing challenges that are common across the LTER network.

What is the impact on the development of human resources?

Software-driven approaches to field sensor station management enhances protocol-based management approaches by allowing a central management unit to check data from field stations against one another for consistency. The standardization required for automated streaming thereby provides opportunities for field personnel to increase their technical capacity.

What is the impact on physical resources that form infrastructure?

The addition of new sensor stations allows for more systematic comparisons across elevational and longitudinal gradients.

What is the impact on institutional resources that form infrastructure?

The documentation accompanying automated software-based station management provides continuity across changes in personnel.

What is the impact on information resources that form infrastructure?

By upgrading our sensor network and using a systems approach to provide consistently formatted and constantly maintained streaming sensor stations, we have essentially created a “wall plug” that any CWT LTER investigator can use to their advantage when integrating sensor data into their research. Rather than having to begin anew each time remotely collected sensor data are required, investigators can leverage both our infrastructure and our protocols.

What is the impact on technology transfer?

Our deployment of a near-real time sensor network for the Coweeta LTER enabled us to partner with the GCE LTER in hosting a workshop on the GCE Data Toolbox for 14 LTER Information Managers. This workshop contributed to an increased user base for the GCE Data Toolbox, both within and beyond the LTER community. It also resulted in on-line documentation that allows anyone with a Matlab license to download the GCE Data Toolbox and begin using it to process their environmental data.

What is the impact on society beyond science and technology?

The near real-time delivery of sensor data through a public website is a direct contribution to making federally funded research results available in a format that is both useful and minimally constrained.

Changes

Changes in approach and reason for change

Nothing to report.

Actual or Anticipated problems or delays and actions or plans to resolve them

Nothing to report.

Changes that have a significant impact on expenditures

Nothing to report.

Significant changes in use or care of human subjects

Nothing to report.

Significant changes in use or care of vertebrate animals

Nothing to report.

Significant changes in use or care of biohazards

Nothing to report.

Special Requirements

Responses to any special reporting requirements specified in the award terms and conditions, as well as any award specific reporting requirements.