MEETINGS

Taking the Temperature of Ecological Systems With Fiber Optics

Fiber Optic Distributed Temperature Sensing for Ecological Characterization; Blue River, Oregon, 10–15 September 2007

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Fiber-optic distributed temperature sensing (DTS) is emerging as a powerful tool for hydrological and ecological observation over wide spatial and temporal scales. DTS installations allow for the precise observation of temperature at each meter of fiber-optic cables, with a precision of up to 0.01°C. The temperature is computed from the light backscattered following an intense laser pulse, and the location of each reading is determined by the arrival time of the pulse back to the central recording station. Because cables can exceed 10,000 meters in length, DTS holds the potential for transformative observation of diverse Earth processes.

However, the technique involves many nonstandard applications of component technologies that have not been previously used within the Earth science communities, presenting challenges in equipment selection, installation, and data analysis. The Hydrologic Measurement Facility (HMF) of the Consortium of Universities for the Advancement of Hydrologic Science, Inc. (CUAHSI), is presenting a series of workshops to aid successful DTS application. Here we report on the first U.S. National Science Foundation (NSF) supported CUAHSI DTS workshop, which took place in the H. J. Andrews Experimental Forest, in Oregon.

Instructors of the new technique were John Selker (Oregon State University, Corvallis), Scott Tyler (University of Nevada, Reno), and Fred Day-Lewis and John Lane (Branch of Geophysicists, U.S. Geological Survey Office of Ground Water, Storrs, Conn.). There were 30 enrollees in the workshop. The hands-on instruction included cable and instrument selection, cable deployment, power requirements, fiber repair, data acquisition, measurement calibration, quality assurance/quality control, and data visualization and analysis. Participants designed, installed, and analyzed the data from three field experiments using DTS systems from three leading DTS manufacturers. The workshop included a poster session with 16 contributions presenting a diversity of current and planned deployments.

During the workshop, participants conducted two field installations, which focused on stream temperatures at research watersheds within the Long Term Ecological Research (LTER) Network. In one installation, cable was laid over contrasting bedrock and alluvial reaches, demonstrating how such a technique can collect data on the dynamics between groundwater and surface water beneath and lateral to the streambed. Cable for a unique airshed fiber-optic array, designed to monitor nocturnal cold-air valley drainage (see supplementary material, at http://www.agu.org/eos_elec), was also established. The greatest logistical challenge for this deployment was threading 11 cable crossings through the dense forest canopy. This was achieved by emplacing guide strings using biodegradable potatoes launched from a high-pressure device fitted with bow-fishing line. Notably, there were no field injuries through the course of the workshop.

Many technical issues were discussed during the course of the workshop, including whether and why to use DTS, comparisons between different types of fiber-optic cable, the need for additional test and repair tools (e.g., optical time domain reflectometers and fusion splicers), and the cost-benefit comparison of fiber-optic and conventional point measurements. Cable selection received special attention, as costs (from less than $0.20 to more than $10 per meter), loss rate, flexibility, tensile strength, resistance to crushing, resistance to animals (e.g., squirrels, beavers, muskrats), weight, and even the durability of meter marks along the cable vary greatly between products.

DTS has great promise for efficiently gathering precise, high-resolution environmental temperature data. The workshop provided participants with practical on-the-
A coordinated, concerted action between Europe and China in ocean monitoring kicked off with its first meeting, held in Beijing. The project, named DRAGONESS (DRAGON in support of harmonizing European and Chinese marine monitoring for Environment and Security System), is funded by the European Union’s (EU) Framework Programme for 3 years. Researchers from the two continents will establish an inventory of Chinese and European capacities in marine monitoring for environment and security in the framework of challenges identified within international programs such as Global Ocean Observing System, Global Earth Observing System of Systems, and Global Monitoring for Environment and Security. In particular, the DRAGONESS project is both benefiting from and complementing the joint European Space Agency (ESA) and China’s Ministry of Science and Technology (MOST) DRAGON collaboration, with a focus on Earth observations from satellites. DRAGON will run until 2012.

More than 30 participants from five European research institutes and eight Chinese institutes attended the kickoff meeting, which was hosted by MOST and the Ocean University of China. An official welcome was provided by the director of the National Remote Sensing Center of China, Guocheng Zhang. A detailed revision and discussion of the project background, objectives, tasks, and milestones followed (see http://dragoness.nersc.no).

In particular, meeting participants agreed that monitoring the marine environment is urgently needed to advance understanding of mesoscale and submesoscale processes and physical and biogeochemical interaction. Monitoring the marine environment is also crucial to tracking pollution, forecasting and tracking extreme events, understanding climate change, and aiding operational oceanography. Because of the myriad of important applications, sustainable monitoring of the ocean is necessary, speakers stressed. In this context, the five work packages in the project (review of in situ observing systems, review of spaceborne observing systems, specification of data integration and information management, specification of ocean and coastal information products and services, and capacity building) are therefore highly relevant.

The project is now evolving around these work packages, with the first progress report delivered in April 2008. This will be followed by the first annual meeting, to be held in Bergen, Norway, in the autumn of 2008. The second and third annual meetings and a final symposium will be coordinated with the DRAGON program to secure a wider promotion of the DRAGONESS achievements.

For more information, contact the program coordinator, Johnny Johannessen (johnny.johannessen@nersc.no), and the Chinese coordinator, Ming-Xia He (mxhe@orsi.ouc.edu.cn).

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The full text of this meeting report can be found in the electronic supplement to this Eos issue (http://www.agu.org/eos_elec).

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