New Mexico EPSCoR Innovation Working Group

Topic: Applications of Distributed Temperature Sensing for Climate Change Research in New Mexico

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Problem Statement

In environmental research, there is a persistent need for high-resolution, reliable data. Indeed, the need for better observational data was a key point in the NM EPSCoR RII3 proposal which noted that "the hydrologic system is inadequately monitored at high elevations" and also that, "NM needs a more robust hydrologic infrastructure to fill in critical gaps needed to develop a better understanding of the relationship of high elevation events to downstream water supplies." Recognizing the importance of distributed temperature sensing (DTS) for monitoring and data collection in these critical areas, NM EPSCoR funded New Mexico Tech's purchase of a DTS system through their research infrastructure initiative.

Because of its applicability to so many aspects of research, from stream monitoring to meteorology, DTS is a promising technology for NM climate change research. Distributed temperature sensing is a powerful tool that can provide the kind of monitoring data necessary for validating climate and other environmental models. Fortunately, access to this technology has been greatly simplified by way of the NM EPSCoR instrument at New Mexico Tech and also through the DTS-lending program (CTEMPS) run by NSF through University of Nevada – Reno (www.ctemps.org). However, these resources cannot be used to their full potential unless NM EPSCoR researchers are aware of the applications and availability of this technology. Potential users must also be trained to operate the system and design appropriate field implementation.

Goals

This IWG was designed to insure that DTS technology was introduced to NM researchers in such a way that it will be incorporated into ongoing and future NM climate change and hydrology research in the most productive and beneficial way possible. To accomplish this, therefore, the goal of this workshop was four-fold:

1) To introduce DTS technology and its applications to NM researchers.
2) To train participants in the use of DTS with hands-on training exercises
3) To apply DTS during the workshop to a field project that contributes to NM EPSCoR research in the Valles Caldera.
4) To discuss and brainstorm potential collaborations using DTS.

Approach & Results
By maintaining focus on these objectives, the IWG was able to accomplish its goals with great success. The following is an elaboration on the approach taken during the IWG to address each of these specific issues.

Introducing DTS technology and its applications During the course of the workshop, participants learned about DTS technology through lectures from experts in the field, including a representative from the NSF-funded Center for Transformative Environmental Monitoring Programs (CTEMPS) as well as a representative from AP Sensing, a manufacturer of DTS systems. Lectures ranged in subject from "The Physics of Fiber Optic Sensing" to "Past Earth Science Applications of DTS."

Hands-on training exercises Participants were divided into teams, with each team expected to design and implement a field experiment on La Jara Creek in Valles Caldera National Preserve. Each team then deployed fiber optic cable in their individual field sites and collected data using one or more of three different DTS systems available. Afterwards, participants analyzed and presented their findings to the entire group. This gave all participants the opportunity to troubleshoot a real field deployment as well as the experience of analyzing the data collected from a DTS system. During another session of the IWG, everyone also had the opportunity to learn fiber splicing, an important repair technique.

Applying DTS to ongoing NM EPSCoR research The site for the field experiments- La Jara Creek in Valles Caldera - was chosen because New Mexico Tech has already instrumented this drainage as part of an ongoing NM EPSCoR research project. The data collected from the field deployment will therefore contribute to a hydrological research project already being conducted in the Valles Caldera.

Brainstorming potential projects & collaborations Most importantly, the workshop aimed to inspire technology-driven research collaborations between New Mexico institutions and others. During the brainstorming session, participants discussed how to apply their new-found knowledge of DTS technology to ongoing projects and potential future collaborative research focused on hydrology and climate change. As a result, several promising ideas emerged including applications with the potential for immediate implementation:

- locating return flows in NM acequia systems (NMSU & NMT)
- characterizing thermal variations of ice caves in Antarctica (NMT)
- observing wetting fronts in the vadose zone (UNR & NMSU)
- down-hole monitoring of geothermal wells in New Mexico (NMT)
- assessing return flow below NM dams (ISC)
- ground-truthing of remote sensing for lake fluctuations & ET (UofA)
- streamflow generation in paired, managed watersheds (City of Sante Fe)

Details of IWG meeting

The IWG was held from Oct 1-3, 2010 at the Valles Caldera National Preserve in Jemez Springs, NM. The majority of participants were from New Mexico with 1 participant from a non-NM EPSCoR state (Nevada) and 1 participant from a non-EPSCoR state (Arizona).

Participants	Institution	Area of Expertise
Scott Tyler	University of Nevada, Reno	Hydrogeology
John Wilson	New Mexico Tech	Groundwater hydrology
Jevon Harding	New Mexico Tech	Hydrology
Aaron Curtis	New Mexico Tech	Snow/Ice Hydrology
Amanda White	New Mexico Tech	Ecohydrology
Amy Lewis	Amy C. Lewis, Consultant	Hydrology
Carlos Ochoa	New Mexico State University	Agricultural Engineering
Colin Kikuchi	University of Arizona	Hydrology
Greg Lewis	NM Interstate Stream Commission	Hydrology
Emile Sawyer	NM Interstate Stream Commission	Hydrology
Greg McElyea	AP Sensing	Distributed Temperature Sensing
Jesus Gomez	New Mexico Tech	Hydrology
Katrina Koski	New Mexico Tech	Karst Hydrology
Kristin Green	NM Interstate Stream Commission	Hydrology
Phil Kyle	New Mexico Tech	Geochemistry
Roxanne Candelaria-Ley	University of New Mexico	Stream Ecology
Scott Compton	Valles Caldera National Preserve	Ecology
Trevor Schlossnagle	New Mexico Tech	Geothermal Energy
Virginia Thompson	University of New Mexico	Stream Ecology

Lectures on DTS Technology

Hands-on Training with DTS Instruments

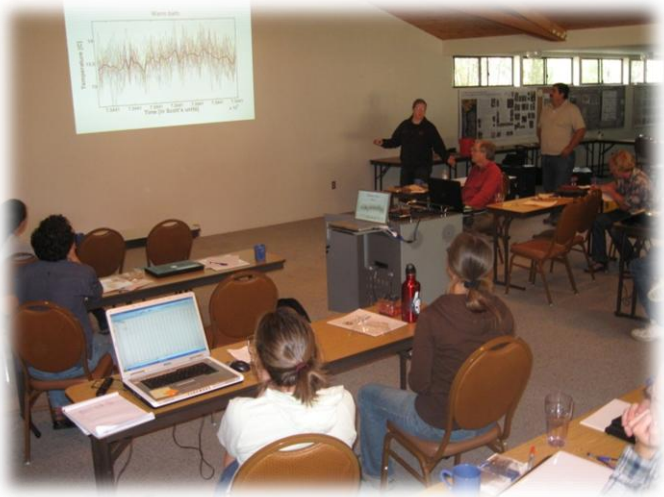
Field Deployments in Valles Caldera National Preserve

Team 1 : Upstream La Jara Creek

Team 2 : La Jara Pond

Team 3: Downstream La Jara Creek

Data Analysis & Presentations



Brainstorming Session