Using Soil Moisture Sensors in Environmental Sensing Networks

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THE RECENT EMERGENCE of small, inexpensive wireless sensor platforms is fundamentally changing the way we approach many scientific problems. This technology is particularly well suited for environmental monitoring where high-resolution, continuous measurements are needed in a heterogeneous habitat [1]. Low-power wireless devices allow an affordable, non-invasive, easily deployable, scalable design for large-scale monitoring systems. At last, we have the means to study not only the gross effects of the environmental parameters, but detect subtle relations between gradients and small temporal changes.

We are currently deploying a system of 200 Tmote Sky wireless modules [2], each connected to two to three Decagon ECH2O-5 moisture sensors and a self-designed soil temperature sensor. The motes form a hierarchical network with an on-line Internet connection. Data are uploaded into an on-line SQL Server database where they are calibrated and reorganized. Spatial and temporal tags are stored with each measurement. Other related data sets (weather, soil biota, land cover, land management) are also loaded into the database for analyzing crosscorrelations. Various interfaces, based on webservices provide an easy visual and tabular access to the data[3]. The database design enables us to have a summary of the data on various spatial and temporal scales, while still retaining the ability to look at every bit of raw data as well.

The main objective of this deployment is to gain insight on how belowground physical conditions vary across several spatial and temporal scales. This data set, combined with our sampling and observations on soil fauna abundances, activity and biogeochemical processes will enable us to a much better understanding of the patterns and processes in the soil ecosystem.

The project is an integral part of the Baltimore Ecosystem Study (BES) monitoring activities. BES is one of the recent additions of the NSF funded LTER (Long-Term Ecological Network) sites [3]. One of the BES central questions is how urbanization alters relationships between ecosystem structure and function. Several ongoing projects, such as invasive species ecology and patterns of soil nutrient cycling, will greatly benefit from the data provided by the sensor network The network will also provide input data for urban hydrology models. Further details of the prototype system can be found at [4].

[1] http://www.nature.com/news/2006/060320/full/440402a.html
[2] http://moteiv.com/
[3] http://lifeunderyourfeet.org/
[4] http://www.beslter.org/}

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