Climate Sensor Poles

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www.las.ch

Purpose

LAS is instituting a long-term student-based inquiry into climate and ecology that will monitor plants at various altitudes and observe how they are changing over time.

To understand plant ecology, one needs to know the exact temperature that plants are actually growing in, rather than regional averages. To understand the effects of a changing climate, you also need to know those same highly localized temperatures. This can only be done with sensors in the field that continuously record temperatures. The standard approach is with 2-meter poles that have temperature sensors at fixed heights. The data from these poles are collected by scientists (in our case, student-scientists) who then analyze those temperature patterns and correlate them with species and change.

Collaborators

- Chris Leonard - GLOBE teacher 11th and 12th grades
- Dan Patton - GLOBE teacher 8th and 9th grades
- Bill Tihen - information technology and data analysis expert
- John Harlin - coordinator of GLOBE and local field science investigations
- Dr. Christophe Randin - Swiss ecologist, climate scientist, and LAS Visiting Scholar
- Irene Alvarez - Program director of Center for Research of Alpine Ecosystems (CREA), based in Chamonix, France

Progress & Questions

Preliminary research has been done by Dr. Randin and his colleagues at several universities and at CREA. They developed protocols for measuring temperatures at standardized heights: -5 cm, ground, +30 cm, and +2 m. They also developed an inexpensive thermal protection system utilizing a doubled set of plastic plant growing pots attached to a pole. Also attached to many of their poles is an NDVI camera (Normalized Difference Vegetation Index), which records in near-infrared to indicate plant production/health. These highly local NDVI photos are then compared with satellite imagery.

As used by CREA and others, these four temperature sensors and the NDVI camera transmit their data via GSM (cell phone), powered by a solar panel.

The mission at LAS is a combination of collecting this vital scientific data and of developing a way for students themselves to build the technology cheaply out of available parts. We will

then share the DIY process so that schools worldwide can replicate it for their own ecological/climate work. With this in mind, we will use more complicated and pricier solar panels and GSM data transmitters for truly remote locations, but will first focus on developing simple, cheap, reliable systems that store data to SD cards and use batteries for power. These will be manually serviced, but are more easily replicated by non-affluent schools.

These Sensor Poles will be placed at each of the plots established for the Leysin Local Elevation Transect Survey (LETS) study from the village of Aigle below Leysin at 500 m, through Leysin (1,400 m + and -) to the summit of our local Tour d'Ai at 2,330 m. To date this totals 20 plots at 10 elevations, and this may increase.

Before deploying Sensor Poles at all the LETS plot locations, we will test prototypes nearby: one next to the LAS weather station on the roof of our Beau Reveil building, one in the forest next to the Beau Reveil, and one in the meadow on the northeast side of the Beau Reveil. These locations are being studied anyway, they allow students to reach them during a normal class period, and they can be carefully monitored and calibrated to sophisticated instruments (like our Davis weather station on top of Beau Reveil).

NDVI cameras can be purchased off the shelf, but can also be built for 1/10th the cost from used digital cameras donated or bought online. The LAS approach will be to develop a system where students can DIY modify these used cameras to record NDVI. They will record the process and share it with schools worldwide. Satellite NDVI imagery is already available free to anyone.

Observations

Scientists at the University of Basel recently determined that ground temperature is the primary limiting factor at the upper altitude limit of many plant species - especially treeline. Our student-based research will follow-up on these studies. It will also connect into CREA's Phenoclim project, where students (and other citizens) around France, Spain, and Italy are investigating phenology (when plants wake up in spring and go to sleep in the fall). To date their sensor poles are located in only the most "professional" plots. With our innovations in student-built inexpensive systems, we expect these poles to be deployed more widely, which will greatly benefit ecological and climate research.

We have not yet built any Sensor Poles, but we've experimented with all the components except the NDVI camera. We feel confident that our systems will work and/or that we can continue to engineer them to success. Widespread remote deployment won't take place until the local prototypes are fully functioning.