Preliminary report on the installation and operation of a
CR1000 Campbell Scientific Climate Station

August 2012

ISEN funding supported the acquisition of a certified, expandable, and research grade Campbell Scientific climate station based on the CR1000 data logger system in 2011. The multiple missions of this station include:

- support of climate research based on the Northwestern campus in the Evanston community. The closest certified meteorological station reporting to the National Climate Data Centre (NCDC) of NOAA is O’Hare, some 13 miles inland. The lack of lake-side meteorological data has proven to be a limitation in the evaluation of the proposed off-shore wind farm. Over the coming 2 years, the goal is to accumulate the necessary 24 months of data passing quality assurance / quality control (QA/QC) requirement for the station data to be ascended by NCDC, and over 15 years establish a new climate standard based at Northwestern;
- support teaching (e.g. Earth 360 – Instrumentation and Field Methods), and also associated programs at the Chicago Botanic Gardens and the University of Chicago;
- support educational outreach at Northwestern University and the broader community;
- support the ongoing NU CO2 Urban Footprint project, headed by Dr. Jacobson, with real time paired climate data needed for robust interpretation of the CO2 concentration and isotope chemistry using the Picarro Cavity Ring Down mass spectrometer;
- provide research opportunities for undergraduate students, which may include stable isotope climatology by analysis of precipitation samples;
- provide an iconic demonstration of the long-term commitment to the sustainability and energy mandate at Northwestern.

Installation - The installation of the roof-top station proved to be much more challenging than expected. The selection process of a roof top spanned many months and was undertaken in collaboration with Dr. Joel Moore (who was co-citing the NU CO2 station). Scott Hall was selected due to its proximity to a high traffic intersection at the Arch beneficial to the NU CO2 effort, and importantly for the climate station, without obstructing structures and ventilation stacks such as from fume hoods. Scott Hall is a historic building, and installation of the climate station tower was deemed to require an aesthetically acceptable full building lightening grounding system. The cost was significant, but has been overcome through cost sharing with the university, and reallocation of the balance of funds on the initial climate station grant from ISEN (originally slatted in support of isotopic analysis of precipitation samples; reallocation approved by ISEN directors). Full physical installation was achieved during the Christmas holidays 2011.

From January through to May 2012, work focussed on improving the station programming, and establishing the essential data stream arriving from the station to a server with full offline backups set up for this purpose in Hogan building (in the Integrated Laboratories for Earth and Planetary Sciences – ILEPS). A rudimentary data feed can be viewed at http://129.105.139.55/. Significant setbacks include the failure of 3 sensors. These sensors were returned to Northwestern from the manufacturer on May 3rd and promptly reinstalled. It is a pleasure to report that the data recovery since May has now been 100%.

To date, 1.4 million observations have been accumulated at minute intervals, with parallel hourly data streams, in support of high frequency and synoptic meteorological analysis.

Data from the 4th of July, 2012, a memorable sweltering summer day of 2012
The analysis to correlate the Evanston weather conditions to those of the surrounding area has begun, using the O’Hare data of record archived with the National Climate Data Centre. Early results are showing distinct offsets, including consistently lower precipitation at the NU station compared to O’Hare. An undergraduate research student will be recruited to undertake synoptic meteorological analysis, potentially as a senior thesis.

**Correlation of days with precipitation over 3.5 months from May to August 2012. O’Hare data from the National Climate Data Centre (NCDC) archives.**

**Outreach and Data Sharing**

Current effort to expand the visibility of the data to the NU and broader community focuses on providing a live and graphical internet feed, which can be incorporated into NU webpages, including potentially on the ISEN webpage. The initial effort is based on the standard software provided with the Campbell Scientific station. This will be followed by custom integration into the live NU-CO₂ webpage (http://nuco2.earth.northwestern.edu/), although additional resources for customization of the interface will be required.

Fall 2012 effort will include extending the use of the station data throughout all of the missions listed above, specifically with site visits by students, dissemination and use of data packages in classes in support of teaching and outreach, and seeking undergraduate students with research foci on the special opportunities afforded by having this research grade station on campus. Early success in the outreach efforts are demonstrated through the summer activities:

- Sharing expertise gained during this project with the Northwestern Engineers for a Sustainable World effort to install a network of anemometers on the Northwestern Campus to assess wind generation potential.
- Planning is advancing for the climate station data to form the foundation of a multi-month AP Environmental Science course enhancement, led by PhD Student Jessica Lodewyk, in her capacity as a “Reach for the Stars” NSF funded fellow placed at Niles North High School. Jessica aims to increase the analytical and modelling skills of the students using the data, supplemented by student collection of meteorological data and rain water samples from their high school campus. The class will benefit from site visit to the NU campus station, as well the potential to analyze the stable isotopes of their personally collected rain water samples (see below – GNIP).

**Research**

A specific research goal here forward is to begin the collection of precipitation prior to the winter with the aim of establishing this ISEN funded station as a member in the UN-IAEA Global Network for Isotopes in Precipitation (GNIP - www-naweb.iaea.org/napc/ih/IHS_resources_gnip.html). Such an effort allows for the tracking of storm paths and chemical evolution of precipitation through the heart of the North American continent. This is a necessary understanding of modern processes in support of robust paleoclimate reconstructions, as this precipitation isotopic chemistry is preserved in earth materials including vegetation and sediments.

Sincerely,
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Street view of the climate station on the roof of Scott Hall.

Roof top installation of the principal instrument tower. A second portion of the station is the rain gauge located on a lower roof accessible without ladders allowing for regular collection of precipitation samples for isotopic analysis.