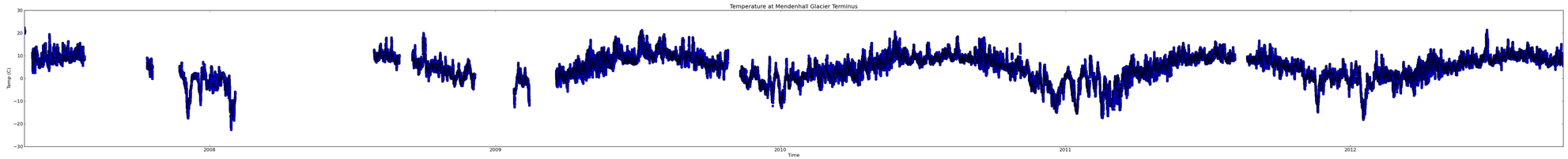
AGU FALL MEETING
San Francisco | 3–7 December 2012



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Four+ Years of Measurements from the Mendenhall Glacier Terminus

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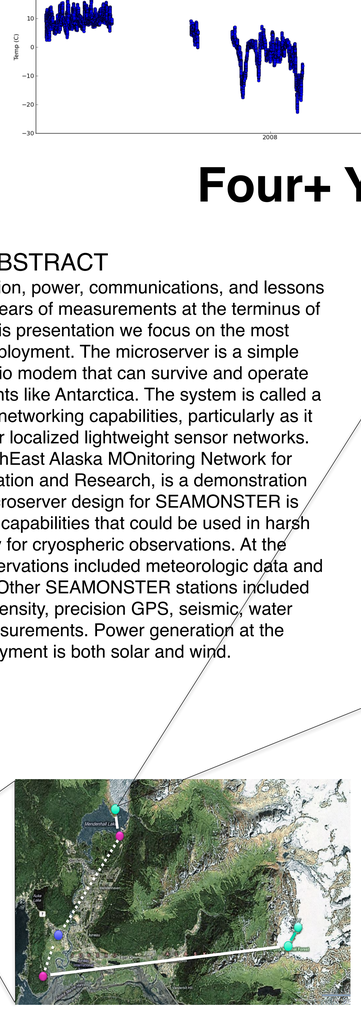
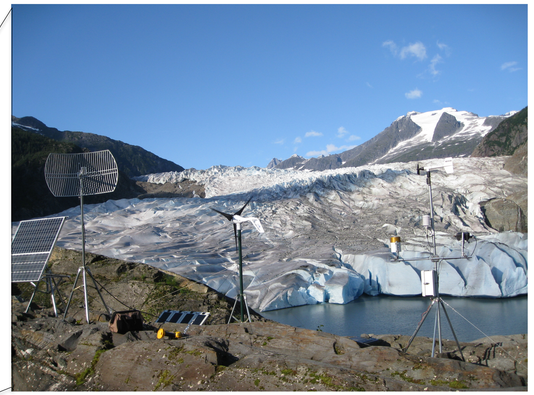
ABSTRACT

We describe the instrumentation, power, communications, and lessons learned from ongoing four+ years of measurements at the terminus of Mendenhall Glacier. In this presentation we focus on the most successful microserver deployment. The microserver is a simple rugged computer with a radio modem that can survive and operate outdoors in harsh environments like Antarctica. The system is called a microserver because of the networking capabilities, particularly as it may act as anchor points for localized lightweight sensor networks. SEAMONSTER, the SouthEast Alaska MOnitoring Network for Science, Technology, Education and Research, is a demonstration sensor web effort. The microserver design for SEAMONSTER is intended to provide general capabilities that could be used in harsh environments specifically for cryospheric observations. At the Mendenhall terminus the observations included meteorologic data and repeat digital photography. Other SEAMONSTER stations included snow accumulation and density, precision GPS, seismic, water pressure, and other measurements. Power generation at the Mendenhall deployment is both solar and wind.



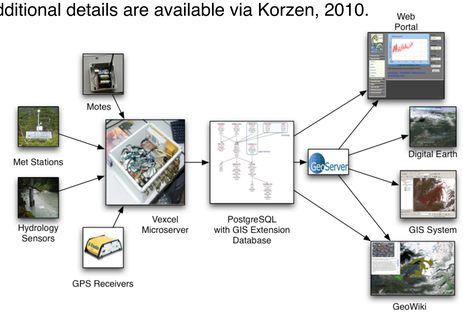
BACKGROUND

The South East Alaska MOnitoring Network for Science,Telecommunications, Education, and Research is a collaborative environmental research program centered at the University of Alaska Southeast in Juneau. The emphasis in SEAMONSTER during its three-year initial run was terrestrial hydrology in glacier-covered watersheds, and in particular on near-real-time data recovery from sensors by means of radio telemetry and related sensor network technology. The biggest technological success story from SEAMONSTER is the continuous operation of a field computer at the base of Mendenhall Glacier over four years (including through the winters).



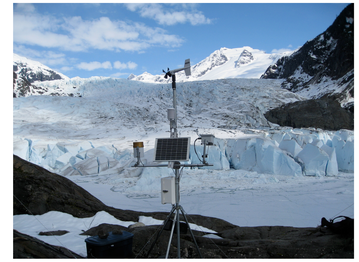
POWER

Power supplied to station is from both solar and wind technology. For the solar part of the system, two different panels are wired together in parallel. The solar panels used are Kyocera (kc85t) 85 watt panel and Sunwise (sw55) 55 watt for a total of 145 rated watts of solar energy going into the system. The solar panels are mounted on a tripod that is roughly 1 meter off the ground; orientation of the panels is due south mounted at a 60 degree angle. The wind turbine used for the system is an AirX Marine Wind Turbine from Southwest Windpower. This turbine is rated at 400 Watts at a wind speed of 12.5 m/s. Power storage for this system uses two marine deep cycle flooded lead acid (wet) batteries. The batteries are rated at 85 Ah for a total of 170 Ah. The Campbell Scientific Data Logger system has separate solar and battery. The camera has been operated with separate solar and batteries as well. Additional details are available via Korzen, 2010.



CONCLUSIONS & LESSONS LEARNED

The key design philosophy allowing the longer duration deployment of the MGT system is modular power and station components with redundant data storage. With this design, the greatest point of failure has been flash memory corruption. This has occurred twice during the total deployment time from 2007-present.



SENSORS

Weather stations, based on Campbell Scientific data loggers, have been deployed near the terminus of the glacier to measure parameters such as air temperature, precipitation, solar radiation, wind speed and direction, snow depth, etc. The station includes a high-resolution digital camera.

POWER MANAGEMENT

The main computer ("micro server") has a a power conditioning system (PCS) custom circuit board--including a microcontroller that operates for 3 years on internal batteries. The PCS monitors the operational power, an external 12 V power system with solar and wind charging and regulates the micro server operation based on charge state. The Campbell Scientific data logger and camera both have independent battery and charging systems so they can operate independently of the

COMMUNICATIONS

The Mendenhall Glacier Terminus station uses 802.11b/g with a directional antenna to deliver data ~1.8 km. Because this is a "high power" use, there is redundant local data storage at the MGT site.

SOFTWARE

The SEAMONSTER project generates heterogeneous data sets at irregular time intervals. Managing the data with ease of access, public outreach, and easy of comparison between the different instruments for researchers motivated our use of a single SQL database for final storage of all data. (In situ data is typically stored as ASCII files within the Microserver filesystem.) As illustrated in the figure to the left, all the data streams through sensors to the microservers and into a postgreSQL database with GIS extensions enabled, called PostGIS. Coupling the PostGIS database with the Open Geospatial Consortium (OGC) GeoServer automatically provides the ability to disseminate the data streams through a web portal as raw data, kml for 4-D Geobrowsers (such as Google Earth or Microsoft Virtual Earth), services to more traditional GIS systems (such as the ESRI suite of Arc* software), and through the geowiki.

RESOURCES

The SEAMONSTER development effort has been done in an open environment, coordinated through a project wiki, with all code stored in a publicly accessible subversion (SVN) code repository. The SEAMONSTER data browser, SVN repository, project wiki, and data streams are all accessible from

http://seamonsterak.com/

The SEAMONSTER project wiki at
http://robfatland.net/seamonster

is used to document the development efforts and technologies used with sufficient detail to replicate the sensor web and virtual globe efforts. All code developed by SEAMONSTER (from assembly code used for power control boards to SQL database design and php code for the data browser) is available through the SEAMONSTER SVN.

Heavner MJ, DR Fatland, E Hood, C Connor, SEAMONSTER: A Demonstration Sensor Web Operating in Virtual Globes, Computers & Geosciences (2010), 10.1016/j.cageo.2010.05.011, arXiv:0906.2611v2 [physics.geo-ph].

Korzen, N, Mendenhall Terminus Meteorological Station: Power Budget, Wind and Solar Power Independent Study, UAS, 2010.

ACKNOWLEDGEMENTS

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Note: The aspect ratio of the image below is distorted by approximately 3x horizontally.