The Development of the Polar Climate Weather Station (PCWS) System

Josh Thorsland¹, Matthew A. Lazzara¹,², Andy Kurth¹, Forbes Filip¹, Ben Andersen¹, John McGreevey¹, Joey Miller¹, Sean Lynch¹, Amy Limberg-Dzukute¹, George Weidner², Lee J. Welhouse¹,², David E. Mikolajczyk², Claudette Zweifel¹, Taylor P. Norton¹,², Joel Shoemaker¹, and Tristan L’Ecyuer²

¹Madison Area Technical College, Madison, WI        ²University of Wisconsin-Madison, Madison, WI

https://madisoncollege.edu/antarctic-meteorology-project

Introduction and Overview

The PCWS is a student-developed embedded weather & climate observation system based on 8-bit CMOS microprocessor technology. The system has been designed with the goal to operate in the extreme weather conditions of polar climates. Through years of revisions, the team at Madison College has made significant progress in the PCWS systems hardware & software implementation. The PCWS system employs 24-bit analog-to-digital conversion technology, paired with instrumentation amplifiers, ensuring analog sensor precision. At the systems heart, a temperature-compensated-crystal-oscillator provides accurate timing & the ability to capture accurate frequency measurements in frigid environments. On January 14th, 2020, the team successfully installed the first working and transmitting PCWS at Sarah site near the University of Wisconsin-Madison Willie Automatic Weather Station (AWS) near Williams Airfield, Antarctica. Successful platinum resistance thermometer & thermistor temperatures, relative humidity, wind speed & direction values were recorded. In future field seasons, additional installations of the PCWS will be compared against existing Antarctic AWS technology. The team will continue to develop a final revision of the PCWS through the end of this summer. Future goals are to improve power system efficiency, conduct more comprehensive testing, and expand the software capabilities of the PCWS.

Advantages:
- Generation of a new electronic core system
- Cost

Climate and Weather Applications:
- First AWS for “Climate” – Following US Climate Reference Network and multi-temperature sensors “at level” along with an internal check to try to reduce post observation quality control issues
- Expanded basic observational suite

Students involved in the project:
- One-of-a-kind experiences
- Students involved at EVERY level of the project

Impact in the Classroom:
- Unique data and observations to study weather and climate

The Community:
- The AWS network - a community asset

The authors wish to thank the NSF Geoscience Directorate, Office of Polar Programs and Office of Integrative Activities, Major Research Instrumentation Program - Grant #1625904 for their support of this project.

First Generation
PCWS Version 1.0

Sample Data from Sarah AWS in real-time

First Generation
PCWS Version 0.1

The Madison PCWS

Advantages:
- Generation of a new electronic core system
- Cost

Climate and Weather Applications:
- First AWS for “Climate” – Following US Climate Reference Network and multi-temperature sensors “at level” along with an internal check to try to reduce post observation quality control issues
- Expanded basic observational suite

Students involved in the project:
- One-of-a-kind experiences
- Students involved at EVERY level of the project

Impact in the Classroom:
- Unique data and observations to study weather and climate

The Community:
- The AWS network - a community asset

The authors wish to thank the NSF Geoscience Directorate, Office of Polar Programs and Office of Integrative Activities, Major Research Instrumentation Program - Grant #1625904 for their support of this project.