Antarctic Extremes: Support for the Next Generation Polar Weather and Climate Station

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Introduction

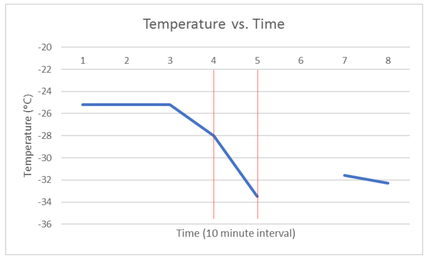
The Antarctic climate and weather is one of the most extreme on Earth, and has been the focal point of study for decades. As time has passed by, more advanced technology needs to be put into place to improve the observations of that extreme environment. In order to capture those observations, the Automatic Weather Stations (AWS) have been built to withstand the intensely harsh environment. UW-Madison is one of several AWS networks on the Antarctic continent, and it is also one of the earliest installed that dates back to the 1980's (Lazzara et al. 2012). Today, the original homemade manufactured electronic core from that original network can no longer be manufactured and is outdated. While the widespread use of commercial off the shelf (COTS) stations has been a good replacement for the homemade electronics, these COTS systems are not made for polar climates and have their quirks. This poster presentation goes through the extreme weather conditions that different AWS have observed around the continent, including record high and low temperatures, and wind speed (highs); long durations of cold temperatures, high relative humidity, and high wind speeds; and dramatically rapid changes in temperature, relative humidity, and wind speed. This information will be applied toward the electronic design of the next generation AWS so that these polar climate and weather stations can last longer and work better in this harsh environment.

Temperature

(Norton et al. in prep)

Byrd

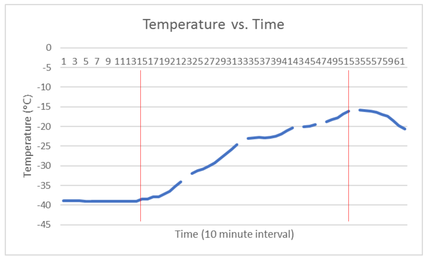
ΔT=5.5°C in 10 min.



April 28, 2003
7:00-7:10 UTC

Gill

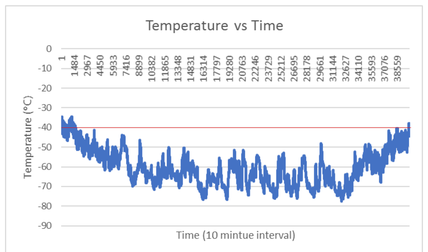
ΔT=21.2°C in 6 hours



October 10, 2002
15:20-21:20 UTC

AGO-4

265 days, 16 hrs., 20 min.
T< -40°C



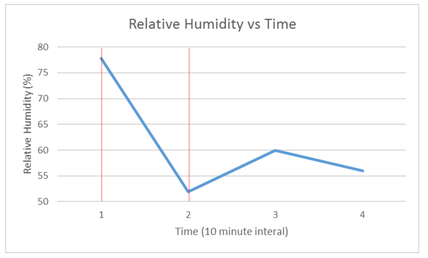
February 12, 2012 (11:30 UTC)-
November 4, 2012 (3:50 UTC)

Relative Humidity

(Norton et al. in prep)

D-10

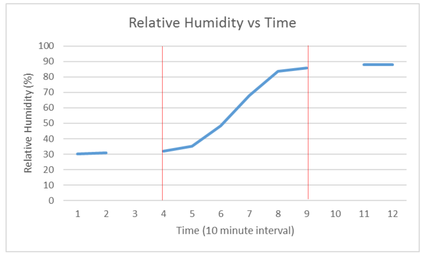
ΔRH= 25.9% in 10 min.



March 19, 2009
10:40-10:50 UTC

D-10

ΔRH= 54.0% in 50 min.

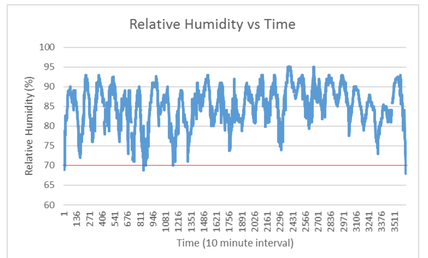


July 13, 2011
17:50-18:40 UTC

Gill

26 days, 4 hrs., 20 min.
RH> 70.0%

*1 exception



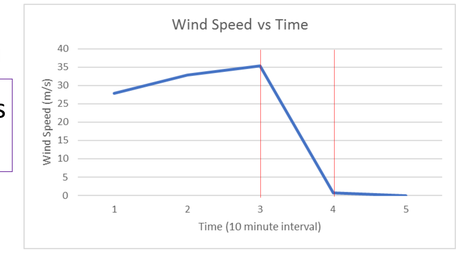
December 29, 2012 (23:30 UTC)-
January 24, 2013 (3:50 UTC)

Wind Speed

(Norton et al. in prep)

Manuela

ΔV= 34.6m/s in 10 min.

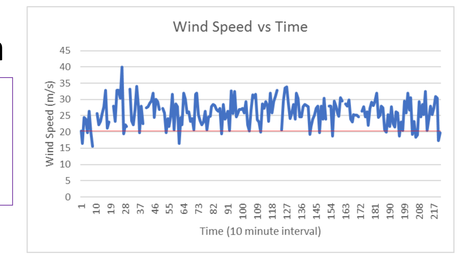


April 24, 2003
12:30-12:40 UTC

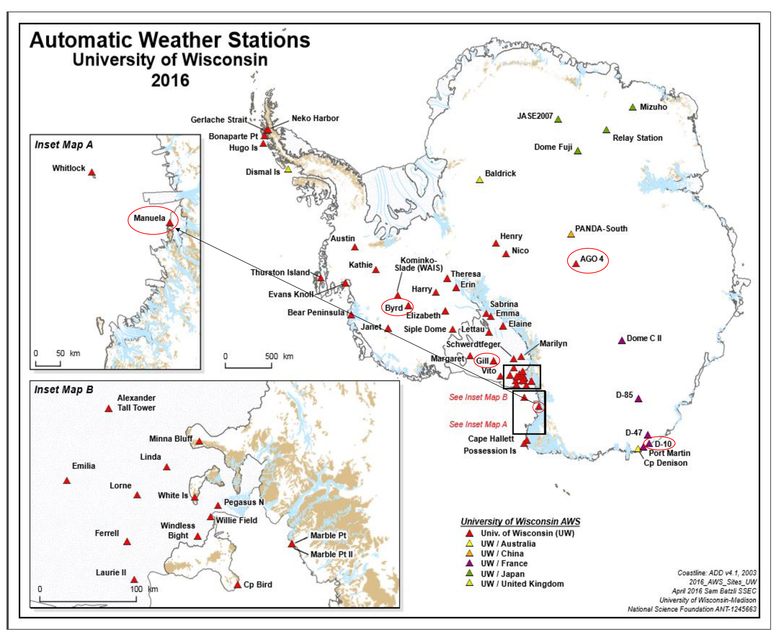
Manuela

34 hrs. 40 min.
V> 20m/s

*11 exceptions



June 7, 2003 (11:50 UTC) –
June 8, 2003 (22:30 UTC)



Extremes

Station	Max. Temp. (°C)	Date	Min. Temp. (°C)	Date	Max. Wind Speed (m/s)	Date
Gill	3.9	12/25/2005	-65.4	8/14/2001	25	6/12/2007
D-10	11.9	12/11/2010	-42.3	9/1/1992	41.8	7/11/2002
AGO-4	-21.7	1/3/2014	-77.4	9/11/2012	16.8	3/31/2014
Byrd	1.6	1/6/2005	-64.4	7/18/1985	33.2	8/8/1997
Manuela	7.3	1/6/2014	-42.4	9/1/1992	48.8	3/28/2013

(Norton et al. in prep)

Antarctic Maximum Temperatures

Region: 19.8°C
Continent: 17.5°C
Plateau: -7.0°C

(Skansi et al. 2017)

Antarctic Minimum Temperature

Plateau: -89.2°C

(Turner et al. 2009)

Conclusion

- Some extremes have been found
  - ΔT= 21.2°C/ 6 hrs.
  - Duration T < -40 °C for 265 days
  - ΔRH= 54.0%/ 50 min.
  - Duration RH > 70% for 26 days
  - ΔV= 34.6m/s /10 min.
  - Duration V > 20 m/s for 34 hrs.
- Work is ongoing, need to look through
  - More years
  - More stations
- Learn what the electronics need to withstand in order to build next generation AWS

References

Lazzara, M.A., G.A. Weidner, L.M. Keller, J.E. Thom, J.J. Cassano, 2012: Antarctic automatic weather station program: 30 years of polar observations. *Bull. Amer. Meteor. Soc.*, **93**, 1519-1537, doi:10.1175/BAMS-D-11-00015.1.

Skansi, M. d. L. M., et al. (2017), Evaluating highest-temperature extremes in the Antarctic, *Eos, 98,* https://doi.org/10.1029/2017EO068325. Published on 01 March 2017.

Turner, J., et al. (2009), Record low surface air temperature at Vostok station, Antarctica, J. Geophys. Res., 114, D24102, doi:10.1029/2009JD012104.

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