U.S. DEPARTMENT OF ENERGY | Office of Science

DOE/SC-ARM-16-049

Marine ARM GPCI Investigation of Clouds Psychrometer Field Campaign Report

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September 2016

ARM
CLIMATE RESEARCH FACILITY

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Work supported by the U.S. Department of Energy,
Office of Science, Office of Biological and Environmental Research

Acronyms and Abbreviations

ARM	Atmospheric Radiation Measurement Climate Research Facility
DOE	U.S. Department of Energy
GCSS	GEWEX Cloud System Study
GEWEX	Global Energy and Water Experiment
GPCI	GEWEX Pacific Cross-Section Intercomparison
MAGIC	Marine ARM GPCI Investigation of Clouds
RH	relative humidity

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Figures

1.0 Summary

Figure 1. Assmann psychrometer, Model 430101, used in the MAGIC field campaign.

One of the most critical measurements in the suite of meteorological measurements used for the calculation of evaporation and latent heat flux is the relative humidity (RH). In order to achieve an overall net flux uncertainty < 10 W/m^2 (Bradley and Fairall, 2006), the RH must be accurate to < 2 %RH. Anyone experienced in shipboard meteorological measurements will recognize that this is a tough specification.

During the U.S. Department of Energy (DOE) Marine Atmospheric Radiation Measurement (ARM) Climate Research Facility Global Energy and Water Experiment (GEWEX) Cloud System Study (GCSS) Pacific Cross-Section Intercomparison (GPCI) Investigation of Clouds (MAGIC) experiment, the meteorological package used three different RH sensors. We found approximately 3-4 % differences between units. To arbitrate the differences and to track calibration drift over the months of exposure, we used a precision psychrometer.

The Assmann Psychrometer, Model 430101 is a classic, mercury-in-glass instrument that gives a precise measure of the wet and dry bulb temperatures from which atmospheric humidity and RH are computed. On a regular basis, typically after each balloon launch, a technician took the psychrometer to an exposed location on the bridge roof. That was just below the instruments on the mast and high enough into the mixed layer that the difference is negligible.

2.0 Results

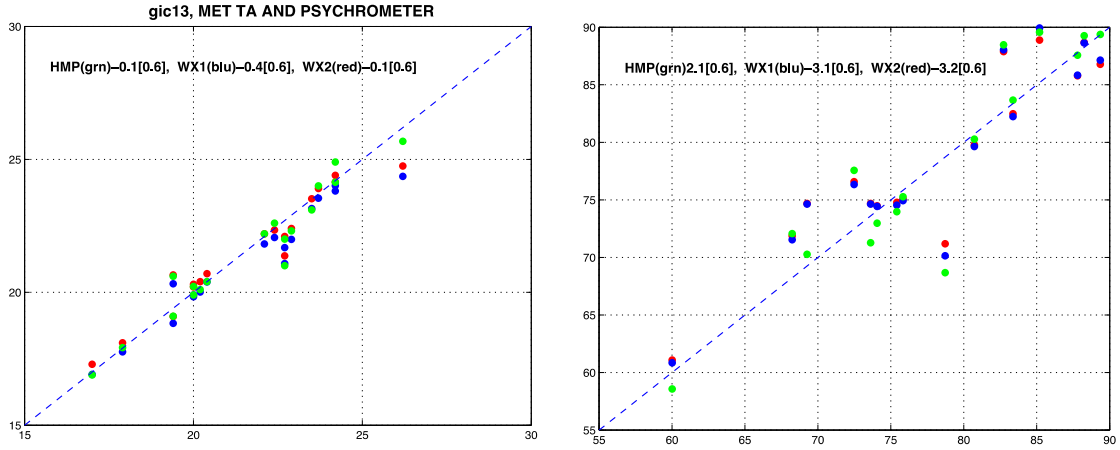

Figure 2. Example of psychrometer measurements of air temperature and RH during cruise 13.

At the end of each leg a summary plot is drawn and the mean and standard deviation of each sensor is considered. Then, for that leg a sensor and calibration adjustment is derived.

With the psychrometer technique, we are confident that the air temperature and RH are within specification.

3.0 Publications and References

Bradley, Frank and Chris Fairall, 2006. *A Guide to Making Climate Quality Meteorological and Flux Measurements at Sea*. NOAA, Boulder, CO. Available at http://rmrco.com/prod/samos/doc/bradley06_shipbpardmeasurements.pdf

Description of the MAGIC Experiment: https://www.bnl.gov/envsci/cloud/campaigns/MAGIC/index.php

Review of MAGIC data processing for flux computation: http://rmrco.com/cruise/magic/data/OnDataProcessing/index.html

Overview of the MAGIC met instrumentation: http://rmrco.com/docs/m1212_MagicMet.pdf

4.0 Lesson Learned

This project was a complete success. Any time a climate-quality air-sea flux data set is required at sea, a psychrometer should be used to quality-control the air temperature and RH instrumentation.


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