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Applications of the Hotplate Snow Gauge

Matthew L. Tryhane*, Scott D. Landolt, Roy M. Rasmussen

National Center for Atmospheric Research
Research Applications Laboratory
Boulder, CO

1. INTRODUCTION

In many situations, end-users of meteorological data require real-time precipitation rates to support decision making for different applications. The Hotplate snow gauge (Fig. 1) is a new meteorological instrument that provides 1-minute real-time liquid equivalent snowfall rates (Rasmussen et al., 2005). The Hotplate is currently available from Yankee Environmental Services, Inc. (YES) and is marketed as the TPS-3100. The ability of the Hotplate to measure real-time liquid equivalent snowfall rates exceeds other snow gauges with its compact design, no moving parts, no fluids to change, and its capability to correct for wind speed variations without the use of wind shielding. Other instrumentation, such as weighing snow gauges, continuously provide accumulation information but often require five to ten minutes of data to derive the corresponding precipitation rate. Requiring this much time for computing the rate will delay timely reporting of rapid variations in snowfall rates.

In addition to measuring snowfall rates and accumulation, the Hotplate also measures ambient temperature and wind speed. The wind speed measurement derived by the Hotplate can be used in situations where severe icing conditions occur due to the Hotplate remaining naturally ice free. (Rasmussen et al., 2005). This paper will discuss the Hotplate snow gauge as it is applied to airport and road weather systems.

2. COMPARISONS AGAINST OTHER GAUGES

Hotplate snow gauges can be used in any application where a measurement of liquid equivalent snowfall rate and accumulation is needed. Due to the high frequency of observations, the Hotplate snow gauge can be added to an observation system and easily displayed at any user-defined temporal resolution. Figures 2 and 3 show hourly accumulations of liquid equivalent snow from two TPS-3100 Hotplates and a truth gauge (a GEONOR in a Double Fenced Intercomparison Reference (DFIR) Shield) during a rain/snow event on April 27-29, 2005 at Marshall, CO. Each Hotplate shows a high correlation with the truth gauge. During this event, the propeller anemometer at the site froze due to ice accretion for a large portion of the event. Figure 4 shows the comparison of the Hotplate snow gauges deployed at the site with the propeller anemometer. Before the anemometer froze, the wind speeds were nearly identical. During the period when the anemometer was frozen, the hotplate continued to calculate wind speeds providing an alternative data source for winds until the anemometer de-iced.

Figure 1 - The Hotplate snow gauge deployed at the NCAR Marshall Field Site just south of Boulder, CO.

3. AIRPORT WEATHER SYSTEMS

The Hotplate snow gauge has undergone testing at Denver International Airport (DIA) as part of the Weather Support to Decision Making (WSDM) system (Fig. 5) (Rasmussen et al, 2001). For this application, the liquid equivalent snowfall rate and accumulation data from the Hotplate is used to support aircraft de/anti-icing operations. Aircrafts are de/anti-iced base on the current meteorological conditions; temperature, precipitation type and severity (light, moderate and heavy). All these conditions play a role in determining how long an aircraft can sit in winter weather conditions before requiring additional de/anti-

* Corresponding author address: Matthew L. Tryhane, NCAR, P.O. Box 3000, Boulder, CO 80307;
Email: mtryhane@ucar.edu

icing procedures. Since deicing operations are expensive, accurate, real-time measurements of the precipitation rate allows airport operations to proceed more efficiently. When used in conjunction with the rest of the WSDM system (Rasmussen et al. 2001), airport operations personnel are able to make decisions on what procedures are necessary to continue operating aircraft in adverse weather conditions.

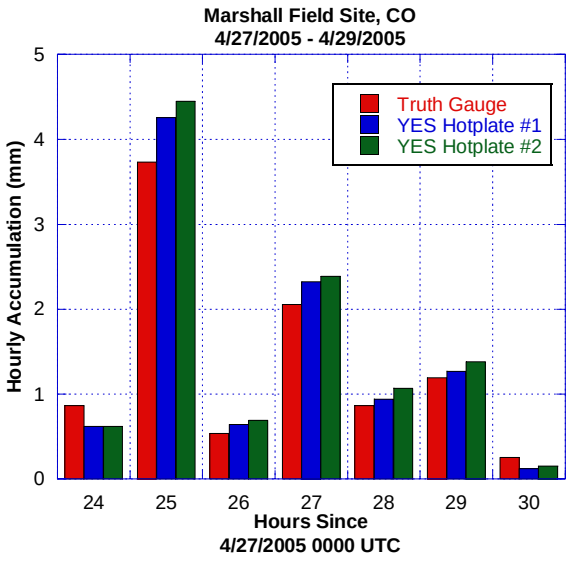

Figure 2 - Hourly accumulation from two Hotplates compared against a truth gauge during a rain/snow event on April 27-29, 2005. Accumulations shown are for the period ending at the corresponding times.

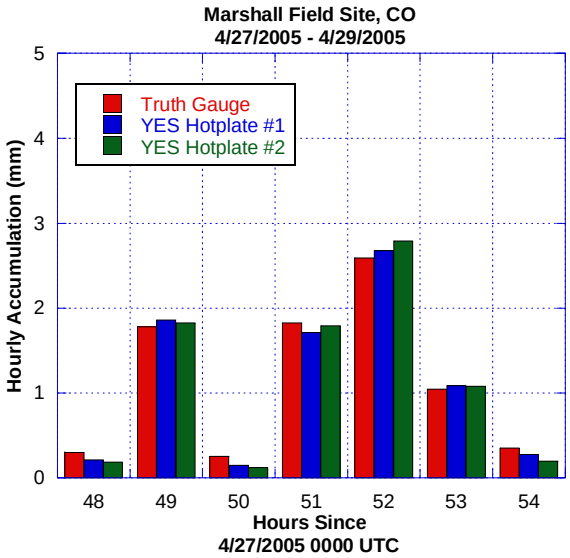

Figure 3 - Hourly accumulation from two Hotplates compared against a truth gauge during a rain/snow event on April 27-29, 2005. Accumulations shown are for the period ending at the corresponding times.

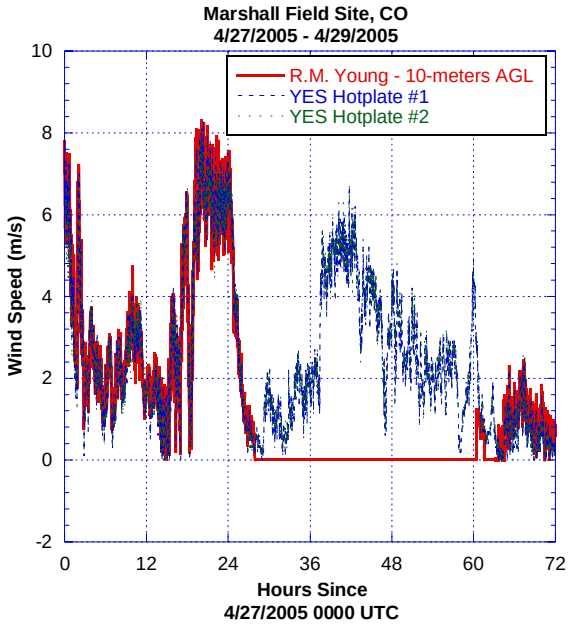

Figure 4 - Time Series of Wind Speed measured by a propeller anemometer and two Hotplates. The propeller anemometer froze up for over 30 hours during this event while the Hotplates continued to report the wind speed.

4. ROAD WEATHER SYSTEMS

Road weather concerns are of high interest as state Department of Transportations (DOT's) realized the need for real-time snowfall rates and accumulations during winter events. This information allows them to accurately determine the type of road treatment to use (sand, salt, magnesium chloride, etc), how much to apply to the road, and where along the road to apply the treatments. Hotplate snow gauges were deployed in Worthington, MN and Ames, IA during the winter of 2004-05. A modified WSDM system was developed for use during this period and was similar to the display shown in Figure 5. By giving the DOT's real-time snowfall information during winter events, DOT personnel were able to make better decisions on when to plow and apply road treatments. Due to the lack of snowfall events and relatively low snowfall amounts during those events, a more extensive project is being planned for the upcoming winter.

5. SUMMARY

In situations where measurements of liquid equivalent snowfall rates are necessary, the Hotplate snow gauge can provide real-time observations. The Hotplate can be deployed as a stand alone product providing real-time measurements of snowfall rates, accumulation, temperature and wind speed or it can be integrated into a system as a component in

decision making processes. Several systems (including WSDM) are already integrating the Hotplate into their instrumentation packages.

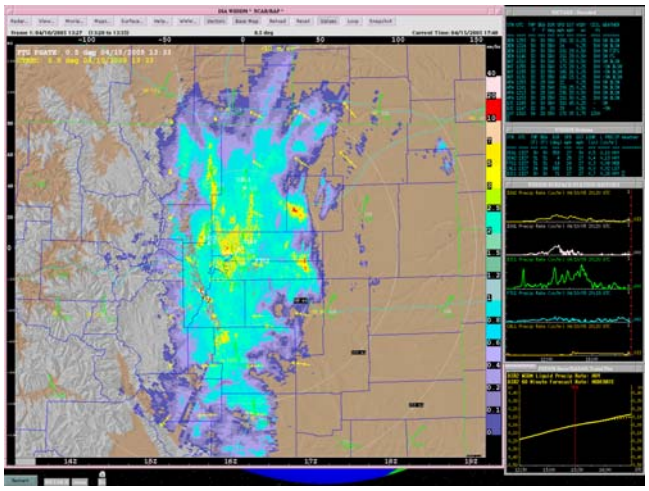

Figure 5 - Example of the WSDM system display.

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