Progress in ground-based millimeter-wave observations in the Arctic winter

Domenico Cimini[(1)], Ed R. Westwater[(2)], Francesco Nasir[(1)], Al J. Gasiewski[(2)], Marian Klein[(2)], Vladimir Leuski[(2)], Dave Turner[(3)], Vivienne Payne[(4)], Eli Mlawer[(4)], Mike Exner[(5)], Maria Cadeddu[(6)]
(1) CETEMPS, University of L'Aquila, Italy.
(2) CET/ECE, University of Colorado, Boulder, USA.
(3) SSEC, University of Wisconsin, Madison, WI, USA.
(4) AER Inc., Lexington, Massachusetts, USA.
(5) Radiometrics Corporation, Boulder, CO, USA.
(6) Argonne National Laboratory, Argonne, IL 60439, USA.

Radiometers operating at millimeter and submillimeter wavelengths show enhanced sensitivity to low water vapor and liquid contents relative to conventional microwave radiometers operating below 30 GHz (1 cm). This sensitivity makes the higher frequency radiometers particularly appealing for accurate observations in the extremely dry and cold conditions typical of the Arctic. For this reason, the Center for Environmental Research (CET) of University of Colorado designed a 27-channel instrument, called the Ground-based Scanning Radiometer (GSR), spanning the millimeter- and submillimeter-wave spectrum (from 50 to 380 GHz). The set of frequencies was selected for the simultaneous retrieval of atmospheric temperature and humidity profiles, precipitable water vapor, cloud liquid path, and cloud depolarization ratio.

The GSR was first deployed in 2004 and more recently took part of the Radiative Heating in Underexplored Bands Campaign (RHUBC, February-March 2007) held at the Atmospheric Radiation Measurement (ARM) Program's site in Barrow, Alaska. The GSR joined the resident ARM instrumentation, including a dual channel Microwave Radiometer (MWR) and a 12-channel Microwave Radiometer Profiler; additionally, two other millimeterwave radiometers were deployed by ARM during RHUBC, namely the 15-channel MP-183A manufactured by Radiometrics Co., and the 4-channel G-band Water Vapor Radiometer (GVR) manufactured by ProSensing. From the same site, the ARM operational radiosonde were routinely launched twice a day. These operational radiosondes were complemented by a large number of additional radiosondes that were released during very dry conditions with very low water vapor content (<= 1 mm), as detected by near real-time GSR retrievals.

In this presentation, we discuss the method used to make the GSR, GVR, and MP-183A observations directly comparable and quantify the overall agreement obtained during the experiment. In addition, we present the retrieval technique applied to GSR data, based on optimal estimation method initialized with Numerical Weather Prediction model forecast. Examples of GSR-based retrievals will be presented and compared with ARM operational products.