Ground-based microwave radiometry and 1DVAR for atmospheric thermodynamic profiling and nowcasting

Domenico Cimini
IMAA-CNR, Italy

Ground-based passive microwave observations exhibit a high potential for observing essential meteorological and climate variables related to atmospheric temperature, humidity, and clouds. These observations prove very useful in augmenting upper air soundings towards a high temporal resolution profiling of the troposphere with special emphasis on the boundary layer. In this respect they are valuable for climate applications as well as for weather forecasting and data assimilation.

Ground-based microwave radiometer profilers (MWRP) are operational at numerous worldwide sites. Despite their high potential for weather and climate, there is currently lack of coordination, standardization, and data harmonization and sharing, causing underutilization of the MWRP potential.

Continuous thermodynamic profiles are traditionally retrieved from ground-based MWRP observations using neural network or regression methods. In the last few years, it has been demonstrated that a One-Dimensional Variational (1DVAR) technique, coupling radiometric observations with a numerical weather prediction model output, may outperform other temperature and humidity profiling retrieval methods. This approach avoids error inherent errors in neural network or regression retrieval methods and benefits from recent surface, radiosonde, satellite, radar and other data residing in the local analysis and/or forecast.

The 1DVAR technique has been applied to MWRP observations in the 60-200 GHz range during the Radiative Heating in Underexplored Bands Campaign (RHUBC, February-March 2007), held during the Artic winter at the Atmospheric Radiation Measurement (ARM) Program’s site in Barrow, Alaska.

More recently, the 1DVAR technique has been applied to 20-60 GHz observations from the MWRP deployed at Whistler, British Columbia, operated by the Meteorological Service of Canada (MSC) in support to the 2010 Vancouver Winter Olympic Nowcasting and short term weather forecasting.

This presentation will show the all-weather 1DVAR results obtained during RHUBC and the 2010 Winter Olympics, including comparison with radiosonde and other sensors to quantify the achieved retrieval accuracy. Moreover, the presentation will introduce the current efforts towards the establishment of an international network of ground-based microwave radiometers (MWRnet), whose objective is to coordinate the exchange of science knowledge, state-of-the-art technology, measurement practices, and data in the MWRP manufacturer, operator, and user community.