

**Spectroscopy and remote sensing studies with the Atmospheric Radiation Measurement (ARM) ground-based microwave and millimeter-wave radiometers: A review of accomplishments and recent challenges.**

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The ARM program operates several ground-based microwave radiometers located in diverse climatic regions. The radiometers are used to provide continuous information on atmospheric water vapor and liquid water path as well as temperature and humidity profiles. The estimation of physically important atmospheric variables from radiometric measurements of sky radiances is often referred to as 'retrieval'. An essential part of the retrieval process is the forward model that represents the propagation of the radiation through the atmosphere. The forward model describes the gaseous absorption as well as the absorption and scattering by liquid and ice hydrometeors present in the radiation field. Using an accurate forward model is essential to ensure that microwave and millimeter wave retrievals are not affected by unaccounted uncertainties, however the formulation of spectroscopy line parameters is in continuous evolution and molecular absorption databases are continuously updated as new laboratory measurements and new calculations are available.

In the first part of the talk we will show how throughout the years, the scientific need to improve the understanding of atmospheric processes as well as the exploration of new challenging climatic regions such as the Arctic and Antarctic has driven the quest to improve the quality of ground-based microwave and millimeter wave retrievals. This has been accomplished by adding new frequencies and by devoting continuous effort to validating and improving the propagation models. It will be shown how ARM ground-based radiometers have been used to validate and sometime improve the spectroscopy of gaseous and liquid water absorption in the microwave and millimeter-wave region and will discuss the advantages as well as the challenges associated with the use of field data for this purpose.

In the second part of the talk we will review recent research developments on the application of ground-based microwave remote sensing to drizzling and ice clouds when scattering effects from hydrometeors are non-negligible. In particular, we will focus on recent results on the use of the 90 GHz frequency to separate cloud from drizzle liquid water path in marine stratocumulus clouds at the ARM Easter North Atlantic site and on the effect of ice scattering on frequencies above 90 GHz at the Greenland Summit station.

## BIOGRAPHY:

Maria P. Cadeddu received the Ph.D. degree in physics from Heriot-Watt University, Edinburgh, U.K., in 2002. Since 2005, she has been with the Argonne National Laboratory where her primary duty has been as the Instrument Mentor for the U.S. Department of Energy Atmospheric Radiation Measurement Program microwave radiometer instrumentation. In this role she has overseen the development and deployment of 18 microwave and millimeter radiometers that are now operational in the ARM network. Her research interests include inversion and retrieval theory and application of remote sensing to atmospheric research.

