COMBINING ACTIVE AND PASSIVE MICROWAVE DATA FOR SNOW PARAMETERS RETRIEVAL WITH MULTI-SENSOR SNOW PROPERTIES MEASUREMENTS: THE GAPS09 AND GAPS10 EXPERIMENTS

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Abstract.

Seasonal snow is a fundamental element of the water and energy cycles and its monitoring is crucial for estimates of freshwater storage, quantifying land-atmosphere albedo feedback mechanisms and flashflood forecasts, among other things. Space-borne passive microwave instruments can be used to map snow parameters at large scales and with a high temporal resolution such as snow water equivalent (SWE), which describes the amount of water stored within a snowpack. Recent studies show that the combination of passive and active microwave data can improve the retrieval of snow parameters. Preliminary results at regional and global spatial scales in the case of SWE show that the combined active/passive retrieval accuracy is better than a passive only retrieval [1, 2].

In this talk we report results from a field campaign conceived for supporting the refinement and development of a multi-sensor physically-based algorithm for the retrieval of key snow parameters (such as SWE, snow depth, snow cover area (SCA) and onset/end of snow melt) by using combined active and passive microwave data.
To this aim, on February 11th – 17th, 2009 a multi-sensor experiment, the Ground Passive and Active Snow (GAPS09) Experiment, was carried out nearby Stanley, Idaho. The aims of the

experiment was to collect concurrent ground-based active (Ku-band) and passive (Ka-band) data over snow covered terrain for improving models of active/passive microwave data, refining retrieval approaches based on passive microwave (PMW) data from satellite data (e.g., AMSR-E), developing and refining combined active/passive retrieval of snow parameters (in particular SWE, snow depth and grain size) from MW observations, also for supporting algorithms applied to data collected from currently orbiting satellite sensors and potential future missions (e.g., COREH2O, SCLP). Beside microwave data, other activities were carried out, such as: analysis of snow startigraphic properties through conventional techniques (observation and measurement of snow density, grain size, temperature, layer properties along the vertical profile); NIR photographs of snowpit for studying layers distribution and the retrieval of specific surface area (SSA) and grain size; visible macroscope photography of grain size along the vertical direction for comparison with grain size retrieved from NIR photography and refinement of the technique; micropenetrometer measurements and density measurements by means of a snow fork probe. GAPS10 is planned for February 2010. The planned location for this experiment is Colorado. A major planned change to GPAS10 with respect to GAPS09 is the overlap in time of ground observations with airborne active microwave data. Also, differently from GAPS09, active and passive microwave data will be collected along transects, rather than at single selected locations. This approach will help understanding how both active and passive microwave data vary at small spatial scales, their relationship with snow parameters and how they can be scaled up to airborne and satellite footprint spatial scales. Snow parameters will be sampled at selected locations along the transect. We are planning to present both GAPS09 and GAPS10 results.

[1] M. Tedesco and J. Miller, Observations and statistical analysis of combined active–passive microwave space-borne data and snow depth at large spatial scales., Remote Sensing of Environment, Volume 111, Issues 2-3, 30 November 2007, Pages 382-397

[2]- M. Tedesco and J. Miller, Northern Hemisphere Snow-Covered Area Mapping: Optical Versus Active and Passive Microwave Data, Geoscience and Remote Sensing Letters, April 2007 Volume: 4, 221 – 225

[3] Hallikainen M., P. Halme, P. Lahtinen and J. Pulliainen, Combined active and passive microwave remote sensing in Finland, Proc. Of IEEE Geoscience and Remote Sensing Symposium, IGARSS 2003, Toulouse, France