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An ensemble methodology to estimate precipitation overland from passive microwave observations

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Precipitation retrieval from satellite passive microwave observations is an ill-posed problem, i.e. multiple solutions are possible. This is especially true overland where the warm background significantly limits the information provided by microwave brightness temperatures. To make the problem well posed, it is customary to incorporate a priori information into retrievals. This information can be derived from independent observations and/or physically-based models. While information derived directly from observations is desirable, in some instances (e.g. high latitude precipitation) such information does not exist to the extent to which unbiased statistical retrievals are possible. In such instances, the information needed for the retrievals may be provided by cloud-resolving numerical models. Although cloud-resolving models may be deficient in describing the vertical distribution of precipitation, there are nevertheless synoptic situations when high-resolution simulations provide realistic results appropriate for satellite passive microwave precipitation retrievals. As opposed to observation derived information, which is often not available, the cloud-model derived information can be dynamically produced, which may have a positive impact on the retrieval accuracy.

In this study, we investigate an ensemble based methodology to estimate precipitation overland from passive microwave observations. An ensemble consisting of parallel runs of a cloud resolving model is produced and the corresponding microwave brightness temperatures are simulated. The ensemble is generated by including random perturbations into the model's initial conditions. A Kalman Filter formulation is used to determine the model's state variables most consistent with the satellite observations. The methodology is tested on a flash-flooding producing storm that occurred in Romania in September 2007. The Weather Research and Forecasting (WRF) model is used in the study to produce the ensemble needed to investigate the relationships between precipitation and brightness temperatures. Initial and boundary conditions for WRF are derived from Global Forecasting Model (GFS) analyses. Results indicate the feasibility of the approach. General implications on global precipitation retrievals will be discussed during the presentation.