Propagating non linearities of the observation operator formicrowave radiances within an all-sky data assimilation system

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Microwave observations are becoming more and more useful for numerical weather prediction (NWP); in particular in an all-sky context within which they can bring highly relevant information content on the vertical distribution of water vapour and hydrometeors.

The method currently operational for assimilating those observations in the global model ARPEGE is : 'the 1D-Bay+4D-Var' scheme (Duruisseau et al., 2019). It is planned to be replaced by a direct assimilation system to extract more optimally the observation information content. The 1D-Bay+4D-Var scheme corresponds to a two step process: (i) a Bayesian inversion to retrieve atmospheric profiles from microwave radiances, (ii) the 4D-Var assimilation of these retrieved profiles.

In their current implementations, both schemes use the RTTOV-SCATT V12 forward model with a single set of radiative properties for hydrometeors. This means that the same properties are used for all weather situations over the globe. This rather common assumption in NWP context is somewhat unsatisfactory when considering the variability of hydrometeors habits in nature. The '1D-Bay+4D-Var' methodology offers an interesting test-bed in order to examine how this variability can be taken into account and propagated to the analysis through the inversion.

In this presentation, we first explore a unique feature of the 1D-Bay which consists of using several radiative properties together within the inversion step. And afterwards we present a scenario running ensembles of inversions with different radiative properties within a direct 4D-Var assimilation system. These two novel methods will be illustrated and discussed.