EMS Annual Meeting Abstracts
Vol. 16, EMS2019-239-1, 2019

Advanced use of scatterometer observations in mesoscale Arctic data assimilation: the supermodding method

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Nowadays, satellite observations are providing primary information for initial conditions of state-of-the-art numerical weather prediction (NWP) systems and the amount of remote sensing data in the Global Observing System increases rapidly. However, the way such data are assimilated is usually conservative and suboptimal especially in high resolution limited-area models. Our objective is to improve the use of scatterometer observations from polar-orbiting satellites by taking into account the observation footprint and reducing the observation representativeness error in the observation operator.

The variational assimilation system (including 3D and 4D-Var) of HARMONIE-AROME is widely used for research and operational NWP purposes by many European countries. In most cases, the HARMONIE-AROME model and its data assimilation are run on higher resolution (corresponding to around 2.5km grid or smaller) than the effective resolution of satellite observations i.e. the effective resolution of scatterometer instruments. Therefore, a new observation operator is developed and studied to calculate model equivalent of satellite observations and innovations on those scales which can be accurately determined by satellite measurements. This method would target the reduction of spatial representativeness error, therefore it can be called as supermodding (similarly to superobbing). The use of ASCAT scatterometer observations is evaluated and studied in AROME-Arctic data assimilation. While applying the 3D-Var with different supermodding size would give the impact on reduction of the spatial representativeness error, 4D-Var with the same strategy would show the impact on reduction of the temporal representativeness error. This AROME-Arctic model configuration highly relies on satellite data assimilation over high latitude region. The results are demonstrated through data assimilation diagnostics, observing system experiments and case studies.