

# The Met Office Weakly-Coupled Atmosphere/Land/Ocean/Sea-Ice Data Assimilation System

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The Met Office has developed a weakly-coupled data assimilation (DA) system around the global coupled model HADGEM3 (Hadley Centre Global Environment Model, version 3). This model combines the atmospheric model UM (Unified Model) at 60 km horizontal resolution on 85 vertical levels, with the ocean model NEMO (Nucleus for European Modeling of the Ocean) at 25 km (at the equator) horizontal resolution on 75 vertical levels, and with the sea-ice model CICE at the same resolution as NEMO. The atmosphere and the ocean/sea-ice are coupled every 1-hour using the OASIS coupler. The initial condition of the coupled model is corrected using two separate 6-hour window data assimilation systems: a 4D-Var for the atmosphere with associated soil moisture content nudging and snow analysis schemes on the one hand, and a 3D-VarFGAT for the ocean and sea-ice on the other hand. The background information in the DA systems comes from a previous 6-hour forecast of the coupled model.

To assess the benefit of the weakly-coupled DA, one-month experiments have been carried out, including 1) a full atmosphere/land/ocean/sea-ice coupled DA run, 2) an atmosphere-only run forced by OSTIA SSTs and sea-ice with atmosphere and land DA, and 3) an ocean-only run forced by atmospheric fields from run 2 with ocean and sea-ice DA. Moreover, 15-day forecast runs, started once per day, have been produced from initial conditions generated by either run 1 or a combination of runs 2 and 3. The different results have been compared to each other and, whenever possible, to other references such as the Met Office atmosphere and ocean operational analyses or the OSTIA data. Evidence of imbalances and initialisation shocks has also been searched for.

The weakly-coupled data assimilation system will be described, and results from these assessments will be presented in order to provide some insight into whether the weakly-coupled DA system offers improvements over starting from separate atmosphere/ocean initial conditions.