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Evaluation of decadal hindcasts using satellite simulators

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The evaluation of dynamical ensemble forecast systems requires a solid validation of basic processes such as the global atmospheric water and energy cycle. The value of any validation approach strongly depends on the quality of the observational data records used. Current approaches utilize in situ measurements, remote sensing data and reanalyses. Related data records are subject to a number of uncertainties and limitations such as representativeness, spatial and temporal resolution and homogeneity. However, recently several climate data records with known and sufficient quality became available. In particular, the satellite data records offer the opportunity to obtain reference information on global scales including the oceans. Here we consider the simulation of satellite radiances from the climate model output enabling an evaluation in the instrument's parameter space to avoid uncertainties stemming from the application of retrieval schemes in order to minimise uncertainties on the reference side.

Utilizing the CFMIP Observation Simulator Package (COSP) we develop satellite simulators for the Tropical Rainfall Measuring Mission precipitation radar (TRMM PR) and the Infrared Atmospheric Sounding Interferometer (IASI). The simulators are applied within the MiKlip project funded by BMBF (German Federal Ministry of Education and Research) to evaluate decadal climate predictions performed with the MPI-ESM developed at the Max Planck Institute for Meteorology. While TRMM PR enables the evaluation of the vertical structure of precipitation over tropical and sub-tropical areas, IASI is used to support the global evaluation of clouds and radiation.

In a first step the reliability of the developed simulators needs to be explored. The simulation of radiances in the instrument space requires the generation of sub-grid scale variability from the climate model output. Furthermore, assumptions are made to simulate radiances such as, for example, the distribution of different hydrometeor types. Therefore, testing is performed to determine the extent to which the quality of the simulator results depends on the applied methods used to generate sub-grid variability (e.g. sub-grid resolution). Moreover, the sensitivity of results to the choice of different distributions of hydrometeors is explored.

The model evaluation is carried out in a statistical manner using histograms of radar reflectivities (TRMM PR) and brightness temperatures (IASI). Finally, methods to deduce data suitable for probabilistic evaluation of decadal hindcasts such as simple indices are discussed.