Merging observations and Earth system models

Coupled ensemble data assimilation for Earth system models

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In Short

- Earth system models simulate different compartments like the ocean or the atmosphere
- Data assimilation merger models with real observations to improve the model predictions
- Of particular interest is the question of how to optimally transfer the information in data assimilation between different compartments
- Ensemble data assimilation methods use an ensemble of model state realizations to estimate the uncertainty but also the cross-correlations between different compartments

This project considers the problem of data assimilation in coupled models of Earth system compartments. These model systems usually consist of separate models for different compartments, like the ocean and the atmosphere, which are coupled through a coupler software that performs the information exchanges at the interface of the compartments and can interpolate between different model grids. While the data assimilation into single compartment models, in particular ocean or atmospheric circulation models, is well established, the assimilation into coupled models is at a rather early stage. Of particular interest is the so-called 'strongly coupled data assimilation' in which the assimilation of observations of one compartment are directly used to correct the model state of another compartment. For example, this concerns satellite observations of the ocean like sea surface temperature.

In the project we use the coupled atmosphere-ocean model ECHAM6-FESOM (AWI-CM, Sidorenko et al., 2015) to examine data assimilation for a coupled atmosphere-ocean model. The data assimilation is implemented using the Parallel Data Assimilation Framework (PDAF, Nerger et al., 2005, Nerger and Hiller 2013), which is an open-source software for ensemble data assimilation developed at the Alfred Wegener Institute. A particular focus of the project is the strongly-coupled data assimilation, i.e. we focus on the question of how we can utilize, e.g., oceanic observations to directly improve the model state in the atmosphere.

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More Information

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[2] L. Nerger, W. Hiller, J. Schröter. PDAF - The Parallel Data Assimilation Framework: Experiences with Kalman Filtering, in *Use of high performance computing in meteorology : proceedings of the Eleventh ECMWF Workshop on the Use of High Performance Computing in Meteorology, Reading, UK, 25–29 October 2004*, Eds.: Walter Zwieflhofer; George Mozdzynski, Singapore: World Scientific, 63–83 (2005).

[3] L. Nerger, W. Hiller. Software for ensemble-based data assimilation systems - implementation strategies and scalability. *Computers & Geosciences*, **55**, 110–118.

[4] http://pdaf.awi.de

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