

4D-LETKF Data Assimilation in a WAVEWATCH III® Wave Model Ensemble

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Challenges in wave data assimilation into models are diverse. The evolution of wave energy spectra under wind forcing quickly loses memory of initial conditions [1]. The aim of this work is to build a system that efficiently performs a wave height assimilation cycle in a global wave model ensemble, including the joint use of wave and wind observations, and an improved sea surface wind analysis. The most widely available wave data provide a measure of total energy. Global data coverage is provided by satellite altimeters, which small number and lack of swath conspire against an even spatial distribution. We explore here how flow-dependent uncertainties contribute to overcome this drawback. Conventional wave observations from buoys are usually too near the coast to be relevant in global assimilation. They are used here as an independent source of information for validation.

The NOAA/NCEP GEFS fields drive a global WAVEWATCH III® [2] wave model ensemble. We get observed significant wave heights from satellite altimeters on Jason 1 and Jason 2 and vector winds from the ASCAT scatterometer on MetOp-A. A 4D-LETKF assimilation system based on T. Miyoshi's code [3] produces analyzed significant wave height and surface wind fields. The latter enhance the driving wind fields in the wave hindcasts, while the significant wave height analyses scale the initial wave energy spectra in the wave model, with no further considerations.

We developed an object-oriented system to handle observations, which main skill is to easily add new sources of data. Following current trends, we worked with python, an updated and versatile language, with friendly graphics, date management, encoding/decoding libraries (matplotlib, matplotlib.basemap, datetime, netcdf4-python). We succeeded in implementing an efficient and feasible in computing time, wave data assimilation system.

References

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- [3] Miyoshi, T. "The Gaussian Approach to Adaptive Covariance Inflation and Its Implementation with the Local Ensemble Transform Kalman Filter". *Mon. Wea. Rev.*, pp 1519-1535, May 2011.