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Deutscher Wetterdienst
Wetter und Klima aus einer Hand

Influence of Assimilating Altimeter Data into WAM

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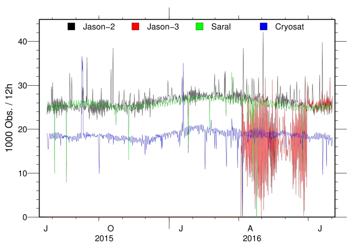
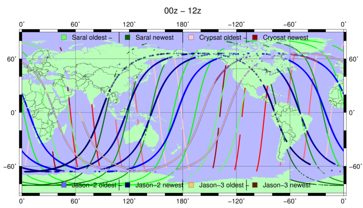
Since 1995, the DWD operates a version of the WAM wave model (WAMDI, 1988), today in the version 4.5.4 with a spatial resolution of 0.25° global, 30 frequencies and 36 directions. In 2008, an assimilation scheme including usage of altimeter data as introduced by de las Heras et al (1995) become operational. However, the effect of using data of several altimeter has not been quantified yet at DWD what should be changed with this study.

Setup of the study

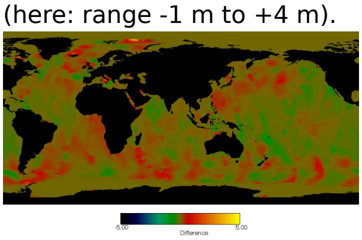
For the time frame Aug 2015 to Jul 2016 every 12 hours model runs over 72 hours forecast time were started with different initial fields, based on 12-h-assimilation runs with different combinations of altimeter used. Available altimeter were Jason-2, Cryosat, SARAL, and temporarily Jason-3, with the observation frequency shown below. All data were unmodified L2 as received by EUMETSAT. Verification was done against the buoy data that were available in GTS, with the known concentration on Northern Hemisphere, near coastal areas.



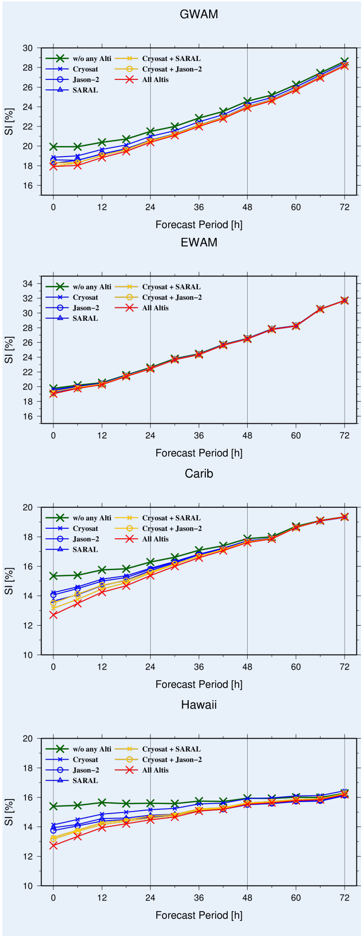
Daily altimeter effect to modelled SWH



Single instruments show significant gaps on earth during a 12-h-assimilation run (see above, example of 13-Jun-2016). A combination of three altimeters is able to fill these gaps. Most of the modifications (example below, 25-Nov-2015, 00z) are smaller than 0.5m (red colors indicates increase of SWH due to altimeter), but there is a significant shift towards increasing the initial state (here: range -1 m to +4 m).



Statistics

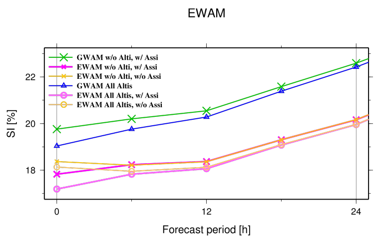


Concentrating on the scatter index (standard deviation of forecast error normalized by mean observation), the diagrams above show the influence of assimilating different altimeter data in some regions (from top to bottom: global, area of the European regional model, Caribbean area and Hawaii), from initial state until forecast step 72 hours. While in small basins (Europe) the effect is small even for all altimeters, influence grows with the basin's size.

Results

Depending on the region, assimilation of a single altimeter can reduce the scatter index by up to 10% (e.g. Hawaii). Combination of more altimeter data can increase this improvement to almost 20%. In regions with small basins (e.g. Europe) the improvement is much smaller. On the global scale the effect is reduced to about 10% improvement when using all altimeter data available, and even after 72 h forecast time a 1.5%-improvement can be detected.

When running a regional model, to operate a separate assimilation scheme will improve the initial state by 5% as well, but the effect will vanish almost after 12 hours forecast time (see below). After that, only the influence of the improved boundary conditions become noticeable.



References

M.M. de las Heras, G. Burgers, P.A.E.M. Jansen, 1995: Wave data assimilation in the WAM wave model. Journal of Marine Systems, 6: 77-85

The WAMDI Group, 1988: The WAM Model - A third generation ocean wave prediction model. J. Phys. Oceanogr., 18:1775-1810.

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