DMI
Center for Ocean and Ice

Operational satellite altimetry in shelf and coastal seas

Satellite altimetry science plans at the Danish Meteorological Institute 2009

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Introduction

The northwestern European shelf and the Baltic Sea are densely populated regions of the world oceans. These shallow water regions experience very large variations in sea level due to tides and storm surges. Yet the application of altimetry observations is limited in this region, especially within the operational oceanographic community.

In the coming year, we will focus on the application of operational satellite altimetry in shelf sea/coastal sea, the validation of the satellite observations in the study regions and the near real time determination of sea level, using a combination of in situ and satellite observations.

Real time sea level from satellite altimetry

DMI has access to a large number of historical and real time tide gauge observations from the North Sea and the Baltic Sea, and together with the satellite altimetry observations they provide the basis for this study.

We will calculate error statistics for the identical orbit and the interleaved Jason-1 and Jason-2/Ocean Surface Topography Mission, with special focus on the improvement in the near coastal data retrieval.

A statistical model that combines the altimetry and tide gauge observations has proven to perform similar to the hydrodynamic storm surge model when describing the real time sea level variability in the region. The statistical model has previously been applied to test cases. It will be run in pre-operational mode, using the Jason-2 OGDR and IGDR observations.

We will assess the impact of the increased number of SSH observations near the coast as well as the difference between using OGDR and IGDR observations in the statistical model. Also we will evaluate the effect of including observations from multiple satellite missions (e.g. Jason-1) observations.

Figure 1: Study area with the North Sea, Inner Danish Waters (IDW) and Baltic Sea. The lines show satellite observations for Jason-1 cycle 37 and TOPEX/Poseidon cycle 380. The data return with the radiometer landmask is shown in green and without the mask in red. Triangles mark the tide gauges used for the statistical model and squares mark tide gauges used for validation (figure 1 from Madsen et al., 2007).

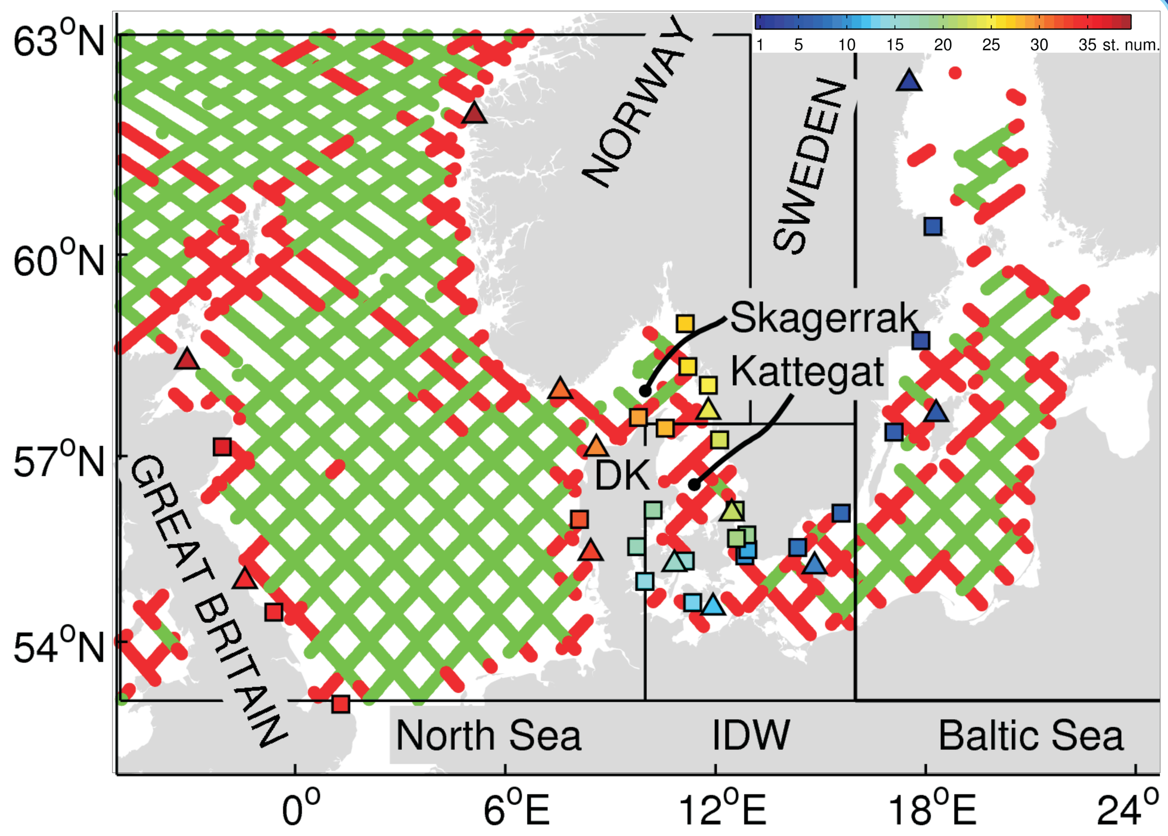
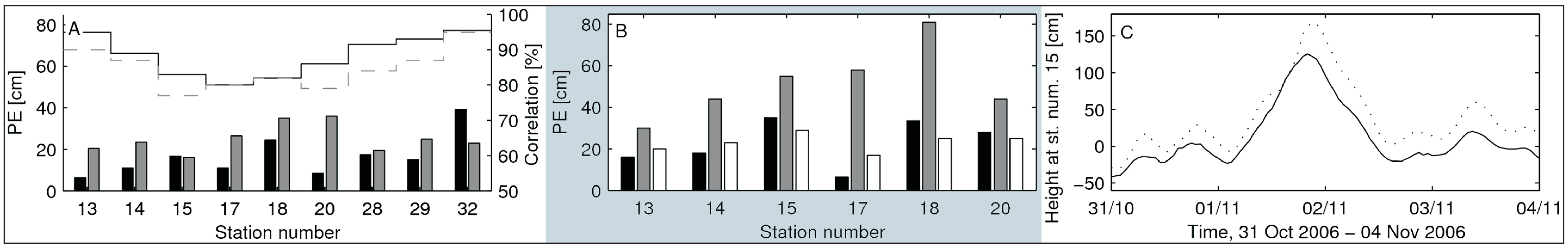


Figure 2 (below): (a) Mean peak error and mean correlation of the statistical model and the DMI storm surge model against tide gauge observations not used in the statistical model. (b) Peak Error for the 1 November 2006 storm surge of the statistical model (black), DMI 2-D storm surge model (gray) and DMI 3-D storm surge model (white) for the stations above located in the Inner Danish Waters. (c) Example of the statistical model prediction at station number 15 (Korsør). Dotted curve shows the observations, solid curve shows the statistical model estimation (figure 4 from Madsen et al., 2007).



Online validation of significant wave height

DMI run an operational wave model covering the North Atlantic, North Sea and the Baltic Sea. The model provides 60 hours forecasts of significant wave height (SWH) 4 times a day. Until now the SWH observations from satellite altimetry in the North Sea/Baltic Sea have been used to perform off-line validation of the wave model in the coastal seas.

We will use Jason-2 OGDR SWH observations to perform an near-real time valida-tion of the wave model performance, using the real time observations obtained from EUMETSAT. The validation includes assessment of the satellite errors on SWH and an evaluation of the timeliness of the EUMETCAST data delivery. The study will prepare for assimilation of wave observations in coastal models.

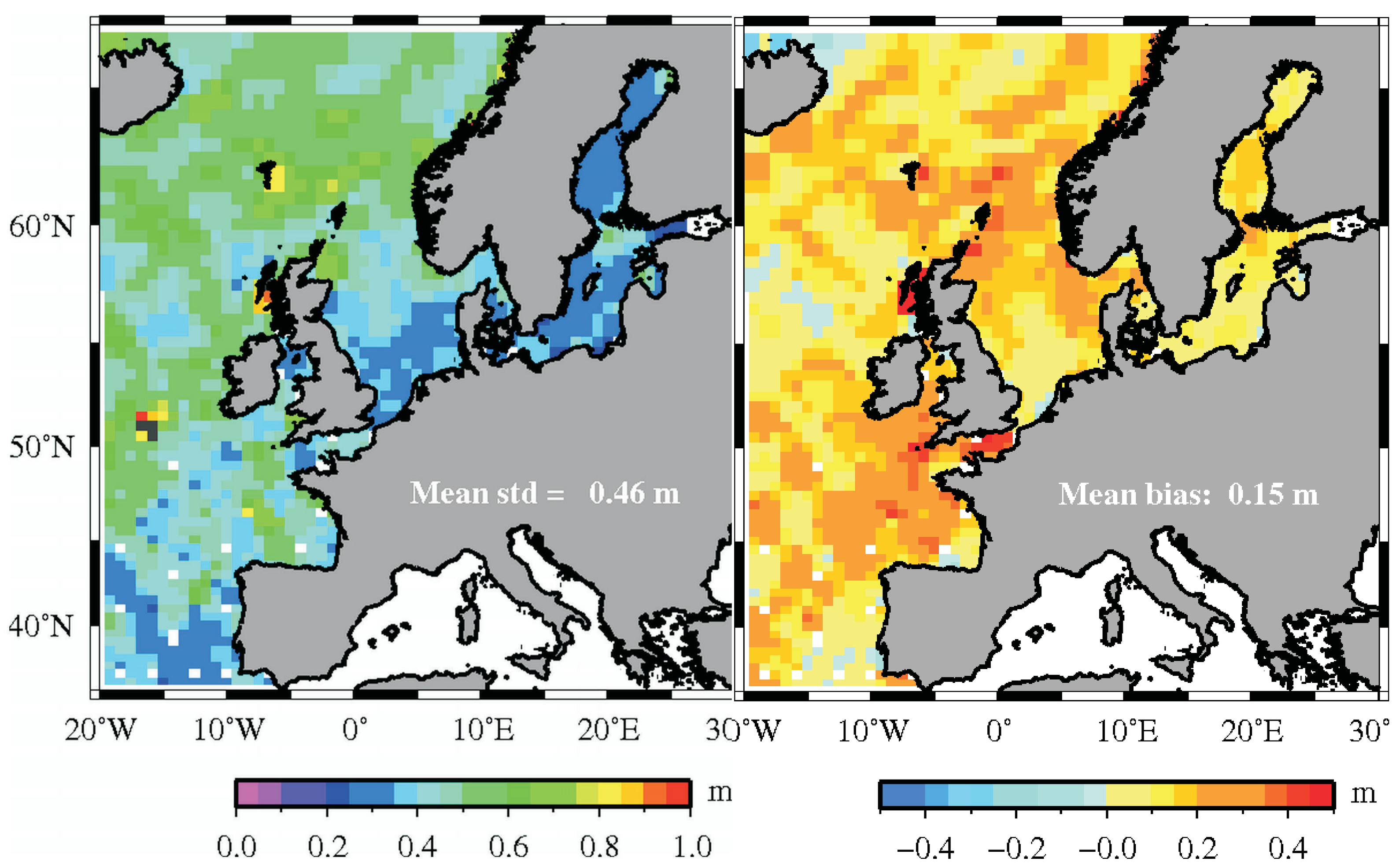


Figure 3: Mean standard deviation and bias between wave model output of significant wave height and observations from the Jason-1 satellite for the period January-June, 2007. More validation results are found at: ocean.dmi.dk/waves/verify/.

Eddy kinetic energy and deep water formation off Greenland

Southwest of Greenland, a region with large mixing is important for the formation and spreading of Labrador Sea Water and the transport of fish larvae.

We will use a regional hydrodynamic model and a large set of observations (satellite altimetry, CTD sections, and surface float drifters) to gain new detailed insight of the spatial and temporal characteristics of the eddy kinetic energy in the region, and perform a comparative study between the different representations of eddy kinetic energy.

Temporal changes in the mixing may affect the formation of Labrador Sea Water and the regional transport of fish larvae, and the study will thus be valuable to both fisheries management and scientific colleagues.

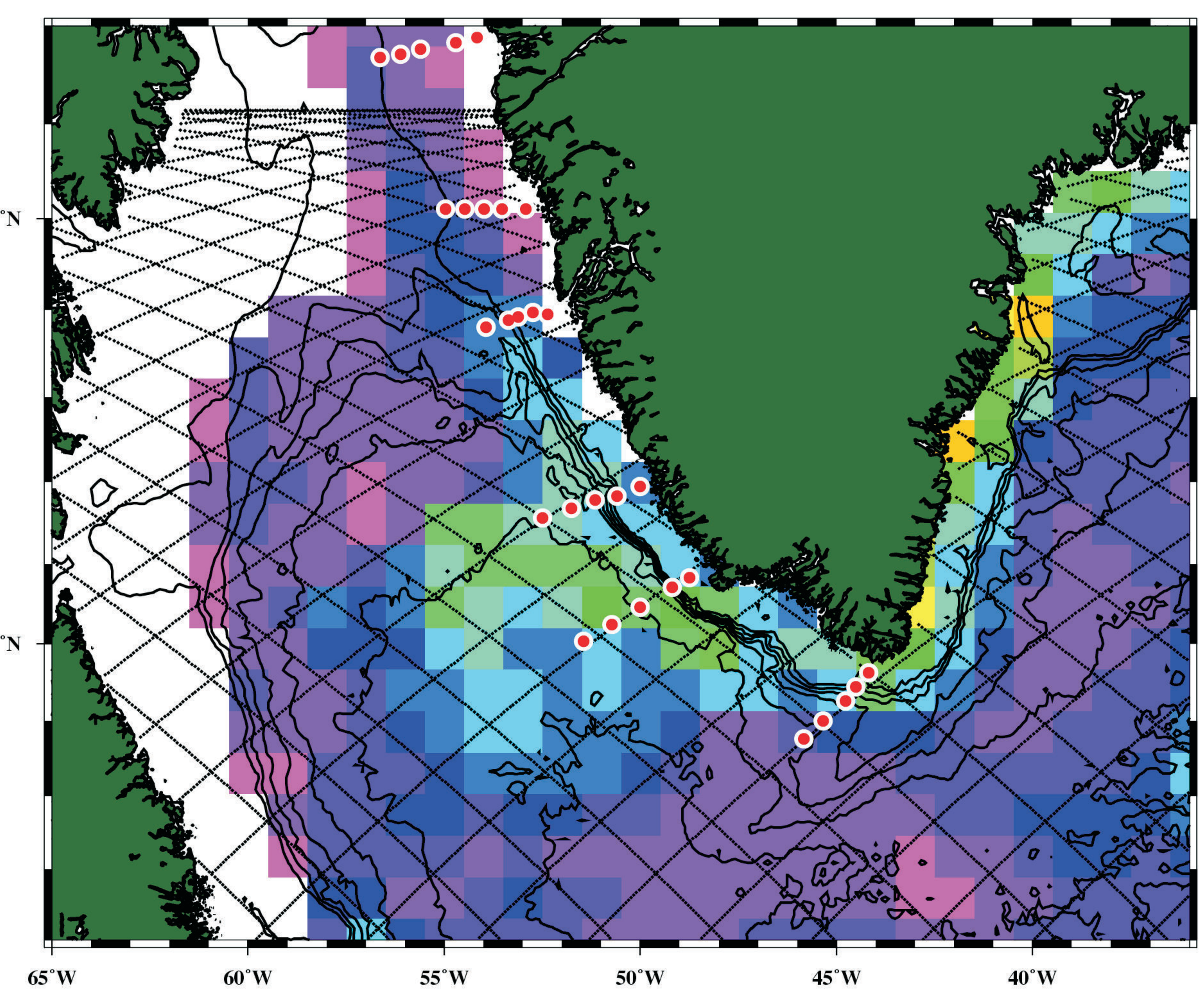


Figure 4: Position of repeated CTD casts (filled red circles) southwest of Greenland. The mean eddy kinetic energy calculated from surface drifters is shown in colors. The Jason-1 ground tracks are overlaid and the bathymetry is contoured.