Comparison of Sea Surface Temperatures and Sea Ice Concentrations from ERA-Interim and BSH

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1 Introduction & Methods

We compare the sea surface temperatures (SSTs) and the sea ice concentrations (SICs) of the ERA-Interim reanalysis to a dataset from the German Federal Maritime and Hydrographic Agency, Hamburg (BSH) in order to assess its quality to drive and validate regional climate models. The SSTs and SICs of ERA-Interim are taken from ERA-40 until 2001 (using the NCEP 2DVAR and OISSTv2 products) and the ECMWF operational data (using NCEP RTG product until 2008 and Met Office's OSTIA dataset from 2009 on) afterward. The products from NCEP are derived from AVHRR satellite data and in-situ measurements, whereas the BSH data are only based on the AVHRR data.

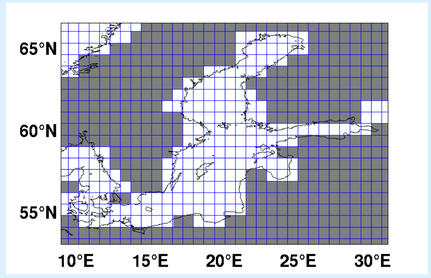

Figure 1: *Coast line of the Baltic Sea (black lines). The grid of ERA-Interim is shown as blue lines and the land sea mask is indicated by the gray area.*

Methods:

For this study monthly means of the SSTs and SICs for the period from 1990 to 2009 were used.

ERA-Interim data are bilinearly remapped from its reduced gaussian grid (T255 resolution, ~80km) to a rotated grid with 0.088º resolution (~10km) and then conservatively to the grid of the BSH data (1.2km).

For the BSH data sea ice is assumed when missing values occur from December to May. The SST is then set to the approximated freezing point of -0.3ºC. However the missing values could also result from a persistent cloud cover, which is not unusual in autumn and winter.

2 Seasonal differences

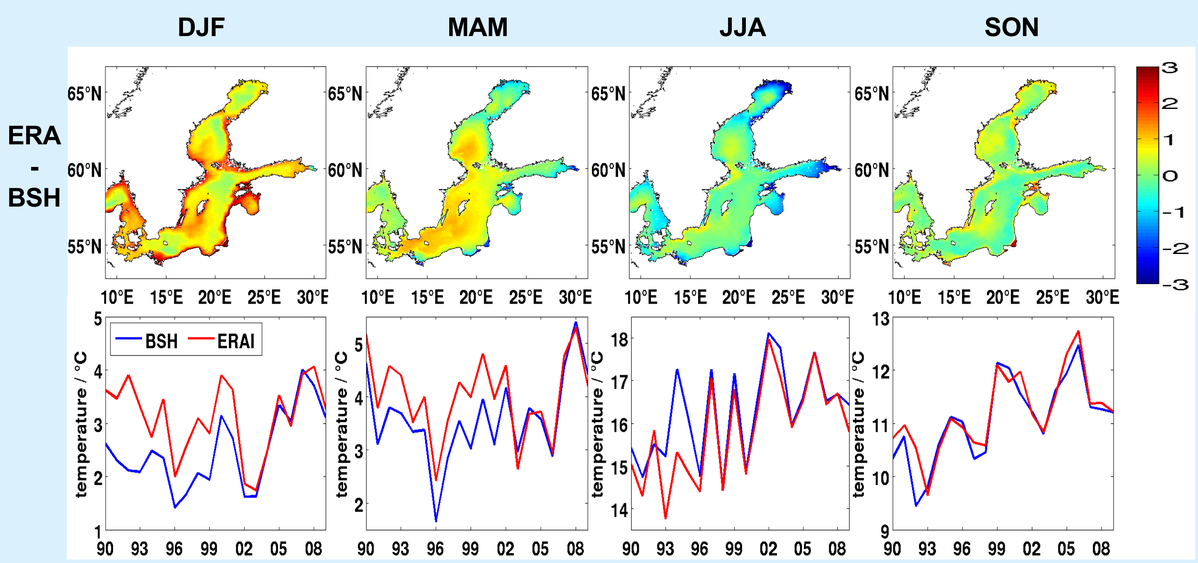

Figure 2: *Differences of the SSTs from ERA-Interim and BSH for the four seasons in space (1st row) and in time (2nd row).*

The SSTs of ERA-Interim are lower in winter and spring compared to BSH, especially near the coast. In summer there is a cold bias, particularly in the Gulf of Bothnia and the Gulf of Finland. This difference is mainly caused by the colder summers in the mid-90s. In autumn the temperatures agree quite well. The differences generally become weaker from around 2003 on.

3 Annual cycle

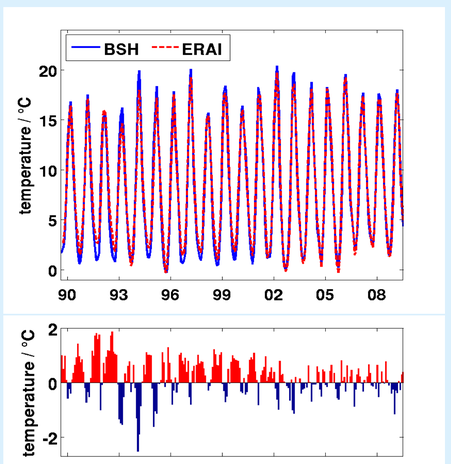

Figure 3: *Time series of the monthly means averaged over the whole area (top) and differences ERAI – BSH (bottom).*

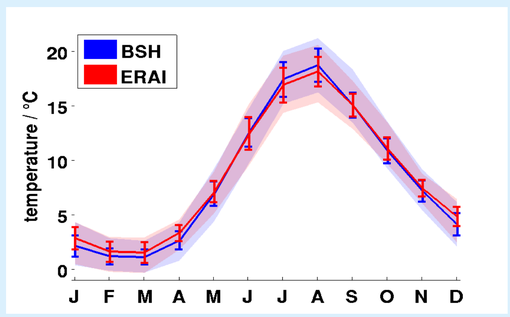

Figure 4: *Mean annual cycle. Errorbars show standard deviation, shading indicates the total range.*

The temporal characteristics agree well in both datasets as can be seen in Figure 4. However the SSTs of ERA-Interim exhibit a weaker annual cycle compared to the BSH data (Figure 3). There is a large improvement for the last third of the period, due to the change in the datasets used in ERA-Interim.

4 Trend analysis

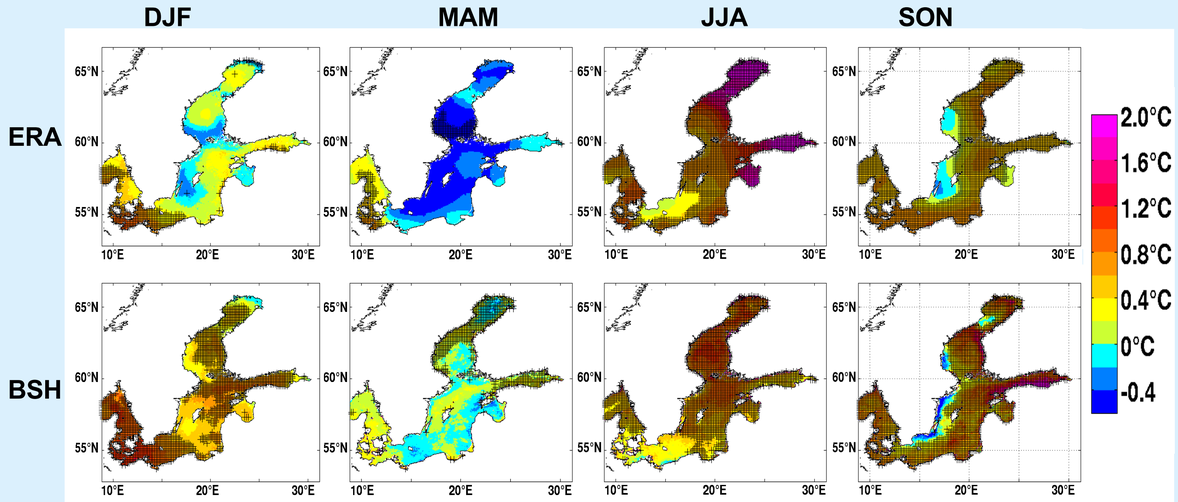

Figure 5: *SST trends in ºC/10y for the period 1990 – 2009. Significance above 90% is indicated by hatching.*

In summer and autumn the SSTs increase in both ERA-Interim and BSH over almost the whole area. The warming in ERA-Interim is stronger in the Gulf of Bothnia and the Gulf of Finland. The pattern in autumn might be due to changing winds and therefore altered occurrence of upwelling events.
In winter there is a significant positive trend only in the BSH data.
A cooling occurs on the average in spring in ERA-Interim (however not significant) and there is no trend in the BSH data.

5 Comparison of sea ice concentrations

There is a systematically higher sea ice concentration in ERA-Interim compared to the BSH data (Figure 6). However the results have to be taken with care due to the method to determine the sea ice content of BSH. Therefore we also included the SICs from the AMSR-E (started in June 2002). There are no values available for a some ten kilometers wide band along the coastline. The values agree quite well with the data from BSH and tend to confirm the overestimation in ERA-Interim.
Figure 7 shows the sea ice extend in March 2006, after a relatively strong winter.

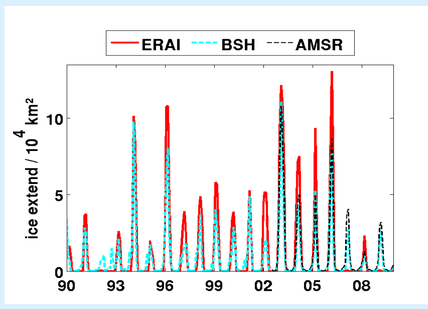

Figure 6: *Time series of sea ice extend.*

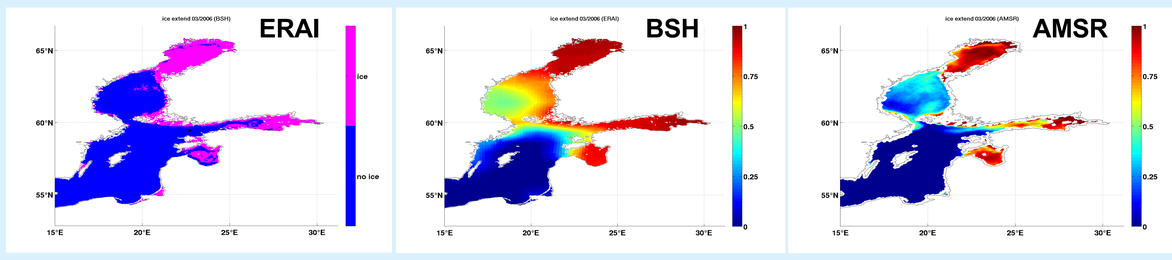

Figure 7: *Sea ice extend in March 2006.*

6 Conclusion & Outlook

- The SSTs and SICs from ERA-Interim and BSH exhibit quite large differences, particularly in winter and spring. This was at least partly expected due to the coarse resolution of the bias correction methods of the NCEP datasets used in ERA-Interim (Fiorino 2004).
- We also can clearly see the convergence in the two data sets due to the change of the NCEP datasets used after 2001.
- There is a significant warming in summer and autumn in both datasets.
- A deficiency of our study is that the two datasets are both based on the AVHRR satellite data. A comparison to independent data is desirable.
- As next steps we will further investigate the possible reasons for these differences, for example by analyzing the correction of the SST for grid boxes with sea ice.

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