balt adapt

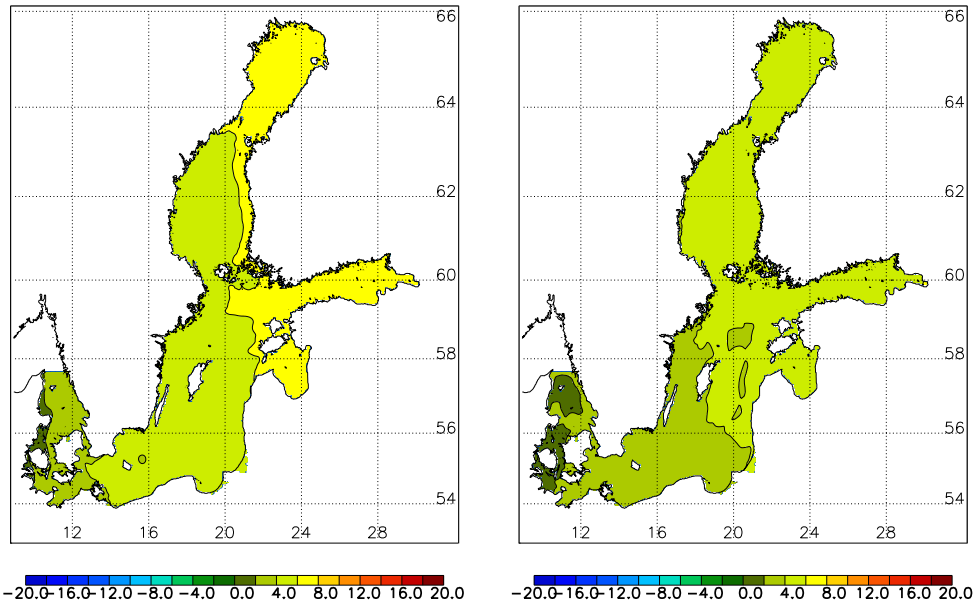
Baltic Sea Region
Climate Change Adaptation Strategy

Climate Change in the Baltic Sea Region: Sea Level Rise

BALTADAPT CLIMATE INFO # 4

Sea level rise in the Baltic Sea

The future sea level in the Baltic Sea depends on several factors. The mean sea level is determined by the local postglacial Fennoscandian uplift and the global sea level change. The uplift is larger in the northern part of the Baltic Sea than in the southern and south-eastern. The global sea level change is governed by the thermal expansion of the oceans and the melting of glaciers and icecaps. When the oceans get warmer the volume increases (thermal expansion) and if the summer melting of icecaps and glaciers is larger than the accumulation of snow in winter there will be a net gain of water to the ocean. A long-term change of the prevailing wind conditions in the Baltic Sea area may also affect the sea level.



Current Situation

When comparing the predicted sea level change in the Baltic Sea due to uplift with those observed one may conclude that for the past 100 years the change is smaller than expected (BACC, 2008). This difference may be attributed to climate change. The rise also seems to have accelerated during the past 20–30 years.

Figure 1:

Left panel: The mean change in annual sea surface height between the periods 2070–2099 and 1969–1998 (in cm).

Right panel: The range of the changes. (in cm, from Meier et al., 2011)

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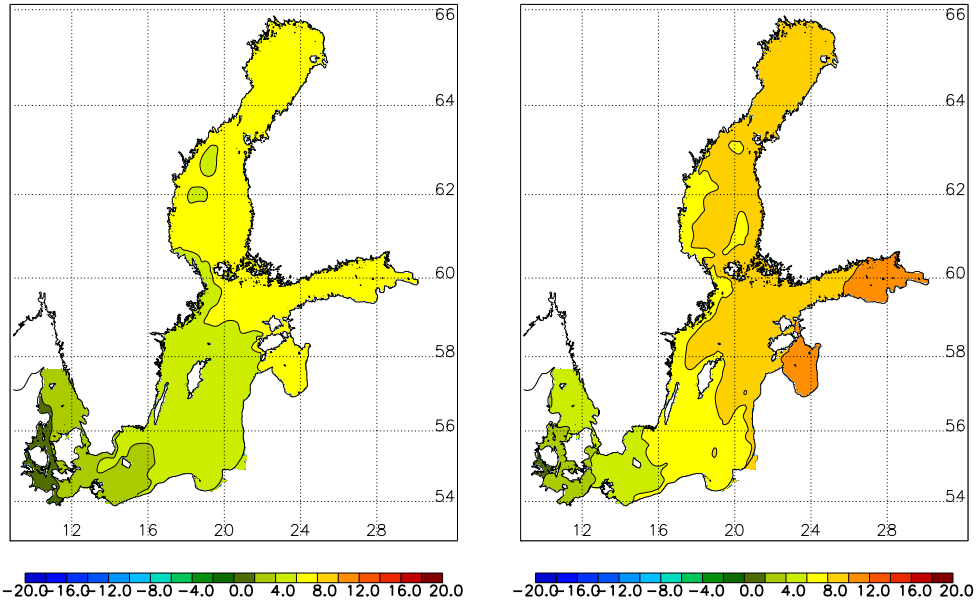

Figure 2:

Left panel: The mean change in winter sea surface height between the periods 2070–2099 and 1969–1998 (in cm).

Right panel: The range of the changes. (in cm, from Meier et al., 2011)

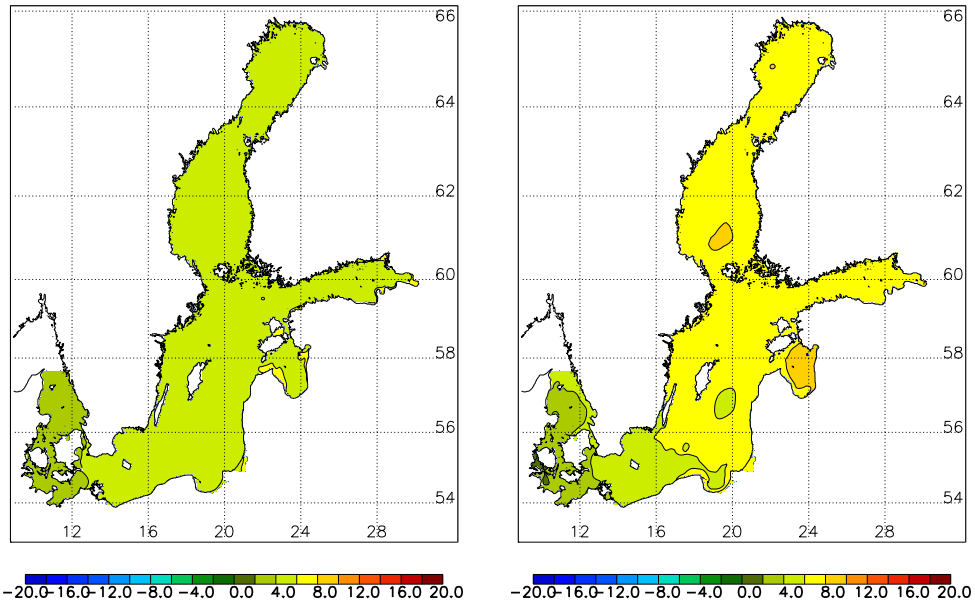

Figure 3:

Left panel: The mean change in spring sea surface height between the periods 2070–2099 and 1969–1998 (in cm).

Right panel: The range of the changes. (in cm, from Meier et al., 2011)

Climate Change Impacts

In the IPPC Report (2007) the future global sea level rise was estimated to 18–59 cm. However, ice transport from Greenland and Antarctica was not included and later reports suggest that the rise may be twice as high.

Here the effect of regional climate change on sea surface height is discussed, i.e. the effect of land lift and global sea level rise is not included. The results from four different scenario simulations of sea surface height changes between the periods 2070–2099 and 1969–1998 are presented in a set of maps. The seasonal and annual means of the simulations have been calculated as well as the difference between the maximum and minimum values obtained among them. This latter quantity, the range, is a measure of the spread of the results from the four simulations where a large value indicates a larger uncertainty. More information about the scenario simulations is given on the back of this bulletin. (Note that other climate scenarios, and other models, may give different results.)

- The change in the annual sea surface height is largest in the Gulf of Finland, the Gulf of Riga, and the Bothnian Bay and along the Finnish coast in the Bothnian Sea, see Figure 1.
- When looking at the different seasons highest values are found in autumn (Figure 5), when the winds are strongest, followed by winter (Figure 2) while spring and summer (Figures 3 and 4) are less affected. Especially spring shows very small geographical variations.

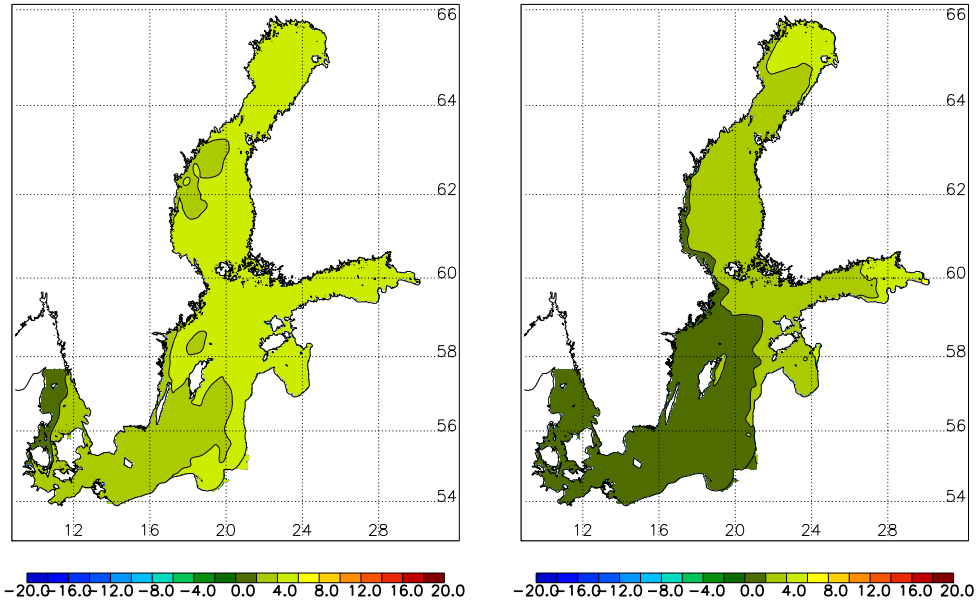

Figure 4:

Left panel: The mean change in summer sea surface height between the periods 2070–2099 and 1969–1998 (in cm).

Right panel: The range of the changes. (in cm, from Meier et al., 2011)

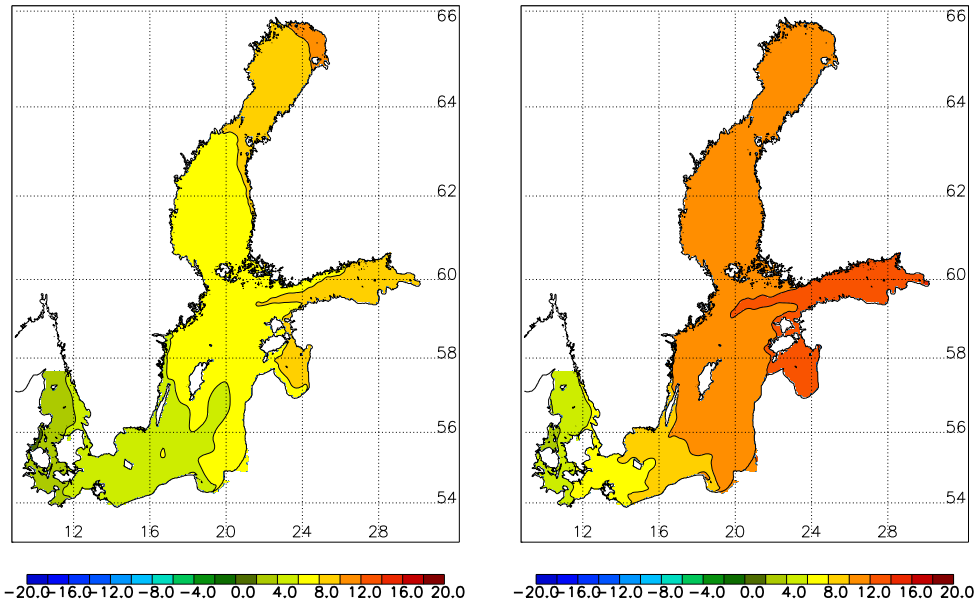

Figure 5:

Left panel: The mean change in autumn sea surface height between the periods 2070–2099 and 1969–1998 (in cm).

Right panel: The range of the changes. (in cm, from Meier et al., 2011)

- The range of the four scenario simulations is largest in autumn (Figure 5, right panel) with the highest values for the Gulf of Finland and the Gulf of Riga. The uncertainty is, however, quite large for the whole area except for the south-western parts and Kattegat. A similar pattern is found in winter (Figure 2, right panel) but with somewhat lower values.
- Summer is the season for which the spread of the simulations is smallest. Although the mean change in spring does not show any geographical variations the spread does.

Conclusion

The projected regional climate change between the periods 2070–2099 and 1969–1998 will have the largest effects on the sea level in the Bothnian Bay, the Gulf of Finland and the Gulf of Riga. To get the total rise one has to add the global sea level rise and subtract the uplift. Accordingly, the total rise will be much larger in the southern and south-eastern parts of the Baltic Sea while the northern part will be less affected.

The consequences of rising sea levels will differ along the coastline where lowland areas and densely populated regions are more exposed. On shorter time-scales the sea level in the Baltic Sea is affected by the local meteorological conditions which may give rise to extreme sea level rise and flooding. The frequency of such events may also change in a future climate.

Climate scenario data

Four simulations of the changing conditions in the Baltic Sea between the periods 2070–2099 and 1969–1998 have been carried out using a coupled physical-biogeochemical model, RCO-SCOBI. The scenarios cover the Baltic Sea region and have a spatial resolution of 3.7 km.

The model is forced by a regional climate model which, in turn, obtains data on its boundaries from a General Circulation Model (GCM), see more in Baltadapt Climate Info #1. Two different GCMs and two different emission scenarios have been combined to form the four climate simulations.

The emission scenarios chosen are A1B and A2 which are characterized by the following storylines:

- A1B: "a future world of very rapid economic growth, global population that peaks in mid-century and declines thereafter, and rapid introduction of new and more efficient technologies with a balance across energy sources".
- A2: "a very heterogeneous world with continuously increasing global population and regionally oriented economic growth that is more fragmented and slower than in other storylines".

One should note that other combinations of GCMs and emission scenarios, and other regional models, may give different results.

References and further reading

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The Baltadapt project in a nutshell

The Baltic Sea and its coastlines face challenges due to climate change …
Climate change will influence precipitation amounts and patterns, and lead to an increase in terrestrial and sea temperatures and a rise in sea level. The resulting changes will jeopardize the integrity of the ecosystem and increase risks caused by natural disasters.

… it is time to adapt now!
Adaptation strategies are needed to cope with the inevitable consequences of climate change. This is also highlighted in the EU Baltic Sea Region Strategy. Baltadapt is developing a transnational climate change adaptation strategy for the Baltic Sea Region, which focuses on the sea and the coastline.
Baltadapt can't stop climate change but it will help to adapt to its impacts. The project facilitates a knowledge-brokerage process on climate change adaptation between research and policy, thus contributing to improved institutional capacity. This will help decision makers in the Baltic Sea Region to tackle the consequences of climate change.
The project was approved under the Baltic Sea Region Programme 2007–2013 and has a total budget of € 2.86 m. Its partner consortium is led by the Danish Meteorological Institute. Baltadapt is a flagship project under the EU Strategy for the Baltic Sea Region and has been awarded the Baltic 21 Lighthouse Project quality label.

www.baltadapt.eu