BALTEX Assessment of Climate Change for the Baltic Sea Basin (BACC II)

International Conference in Tallinn 6-7 September 2012

Summary

Leading scientists from the BACC II community presented their first assessment results in Tallinn 6-7 September 2012. The aim of the assessment is to make an effort to establish which scientifically legitimized knowledge about anthropogenic climate change is available for the Baltic Sea catchment. The assessment is a synthesis of material drawn comprehensively from the available scientifically legitimate literature (e.g. peer reviewed literature, conference proceedings, reports of scientific institutes). Influence or funding from groups with a political, economical or ideological agenda is not being allowed; however, questions from such groups are welcome. If a consensus view cannot be found in the above defined literature, this will be clearly stated and the differing views will be documented. The assessment will thus encompass the knowledge about what scientists agree on but also identify cases of disagreement or knowledge gaps.

The assessment is evaluated by independent scientific reviewers and the results are communicated in close contact with the inter-governmental HELCOM commission as a basis for its future deliberations. The assessment results will be published in late 2013.

The assessment finds results of BACC I, published in 2008, valid. In short this means:

- The presently a warming is going on in the Baltic Sea region, and will continue throughout the 21st century.
- The importance to stress the high inter-annual and inter-decadal variability in most variables, and that the variability is much higher than long-term trends, and that the trends depend very much on the selected period.
- BACC I considered it plausible that this warming is at least partly related to anthropogenic factors.
- So far, and in the next few decades, the signal is limited to temperature and directly related variables, such as ice conditions.
- Later, changes in the water cycle are expected to become obvious.
- This regional warming will have a variety of effects on terrestrial and marine ecosystems – some predictable such as the changes in the phenology others so far hardly predictable.

In addition to these results, significant detail and additional material has been found and assessed. Some contested issues have been reconciled (e.g. sea surface temperature and sea level trends). Also the ability to run multi-model ensembles seems a major addition. In the literature we find a first signs of detection studies, but attribution studies are still

weak. The regional climate models need further development with regard to the water and heat cycles, as well as the impact of man-made aerosols and the dynamical coupling to the Baltic Sea. In the analyses of time series, homogeneity is still a problem and not taken seriously enough in some scientific quarters. The issue of multiple drivers on ecosystems and socio-economy is recognized, but more efforts to deal with are needed. Climate change is a serious issue in the region, but in some cases it needs to be determined if it is a dominant factor. A frequent misunderstanding of BACC I was that the Baltic Sea salinity would decline even though BACC I did not make such a statement. The assessment of BACC II is unchanged with this respect?

The assessment is in progress and some significant findings are listed below:

- The Baltic Sea region has seen remarkable changes since the end of last ice age (last 10 – 12,000 years). During this time, externally forced climate variability in the Baltic Sea basin is most likely attributable to orbital forcing at millennial time scales, to changes in solar irradiance at multi-decadal or centennial timescales, and to volcanic activity at multi-decadal timescales. In addition to the external climate drivers' factors, non-linear high-dimensional dynamics in the different components of the climate system and within each subsystem give rise to internal climate variability at all timescales.
- In the last few decades, temperature changes have emerged which cannot be explained by natural factors alone, and are consistent with simulated effects of elevated greenhouse gas levels (detection and consistency); the relative role of a reduced presence of man-made aerosols is not known. The strongest warming took place in spring, whereas winter showed little change.
- Historical climatic periods such as the medieval warm period and the Little Ice Age are real for Northern Europe. But as expected also for future warming, the warmings/coolings were not uniform but represent a shift of the frequency of warm/cool periods. The effect of these historical changes on regional ecosystems, which may serve as an analogue for future changes, seems not to have been studied in detail.
- More extensive results are available for several parameters, in particularly on sea level. The main signal is the isostatic change; the observations do not show a recent acceleration beyond what was observed earlier.
- Future warming is expected to be associated with less runoff in southern regions and more runoff in northern regions. This is connected to an expected precipitation change pattern, with less rainfall in summer in the southern part, and increased precipitation in the Northern Part (as in BACC-1).
- Terrestrial ecosystems near the coast are most prone to climate change; a significant increase in spruce growth is expected in the North.
- Climate change affects directly vulnerability and productivity of agricultural and forestry systems, predominantly by changes in precipitation and temperature

patterns. Indirect impacts are altered risks for damage, such as increased stress periods (droughts etc.)

- In the northern boreal forests, temperature is the dominant driving climate force with generally positive effects on coniferous tree growth, whereas in the temperate forests in the southern part of the Baltic Sea basin precipitation becomes more important. Thus, forest management in the north may face more favorable conditions, but unfavorable impacts in the south.
- Coastal areas play a key role in the interaction between the terrestrial and aquatic ecosystems. These areas and archipelago ecosystems are sensitive to environmental changes like human impacts, climate or related changes.
- Models point to accelerating Baltic Sea marine acidification due to rising atmospheric CO_2 but this is not yet confirmed in observations.
- Future main changes in air pollution in the Baltic Sea region are expected to be due to changes in emissions rather than climate-change itself.
- More dissolved organic matter is transported by rivers and both positive and negative feedbacks on nutrient fluxes are expected, but effects of climate on cultivated watersheds are unknown. Cultural practices are expected to adopt fast.
- Higher turnover of algal biomass may lead to larger anoxic areas; pH is expected to decrease.
- Climate variability has led to regime shifts in the Baltic Sea ecosystem; lower salinity will lead to less marine benthic species; the effect is unknown for pelagic groups (more nutrients and dissolved organic matter may result in opposite effects).
- Climate change impacts on cities will differ due to specifics of urban complexes. Every urban complex is a unique mixture of infrastructure and urban services, inhabitants, natural resources and green spaces, built structures, economic and societal factors - hardly possible to generalize potential extent of climate change impacts from single-case studies. Urban complexes are subject to other change processes as well (demographic, economic, social, political, technological, land-use) which might interact with climate change impacts.
- Because of many natural and human influences on coasts, specific climate change impacts on coastal erosion and coastline changes are difficult to be identified. Key climatic factors for coastal development are wind driven factors and diminishing sea ice. Seasonal climate change (high water level, storm events, ice periods, heavy rain) can cause erosion, landslides, flooding.
- Detection and determination of consistency of expected and observed changes have made progress, but serious efforts for accounting of the effects of regional land use changes (including urbanization) and changing man-made aerosol loads are missing.

- Regional climate models still suffer from partly severe biases; the effect of certain drivers (aerosols, land use change) on regional climate statistics cannot be described by these models.

What is new in BACC II compared with BACC I?

1. The warming of the sea surface temperature (SST) in the Baltic Sea, which was a contested issue in BACC I, is now confirmed.
2. The question whether storminess is intensified in recent years, has received new attention, with contradictory evidence.
3. The issue of sea level change is contested – as in case of global sea level. Evidence points not to a regionally accelerated sea level rise.
4. Model calculations indicate that pH levels are expected to be lowered, anoxic regions to increase.
5. The question if and how regime shifts in the Baltic Sea ecosystem are favored by man-made climate change is contested.
6. The topics of impacts on urban complexes, agricultural and forest management as well as coastline issues (erosion) have been considered first time; research is ongoing, but little consensus has emerged about longer term past and possible future development and the role of climate change in this process.
7. First efforts for detecting non-natural climate change have been made, but knowledge about other drivers is insufficient for doing formal attribution studies. Observed decadal trends in temperature are most consistent with model scenarios, but precipitation trends are not.