BALTEX Newsletter

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World Climate Research Programme / Global Energy and Water Cycle Experiment
WCRP GEWEX

Review of BALTEX Phase II Objectives

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At its 22nd meeting held 24 and 25 January 2008 at the Swedish Meteorological and Hydrological Institute (SMHI) in Norrköping, Sweden, the BALTEX Science Steering Group (BSSG) initiated a review of the present objectives defined for Phase II of BALTEX as detailed in the implementation document for 2003 to 2012 (BALTEX 2006). A discussion on the need of changes or amendments to BALTEX Phase II objectives, potential activities and milestones was opened, also motivated by the fact that new BSSG members (see page 18 in this newsletter for the present BSSG membership) have recently suggested adjustments to the

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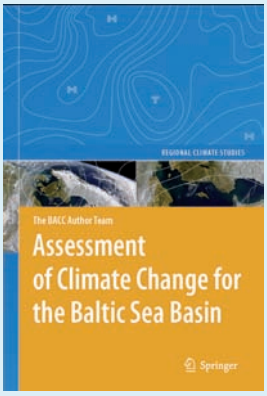
Participants of BSSG #22 in front of the SMHI building



BACC Book Published

After 3 years of preparation, the BALTEX Assessment of Climate Change for the Baltic Sea Basin ("the BACC Report") was published in January 2008 (BACC Author Team 2008). This is a milestone for BALTEX, and, as we believe, also for the climate research community in northern Europe. For the first time, a comprehensive assessment of the published knowledge on climate change in the Baltic Sea region is available in one text book.

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Mildest Baltic Sea Ice Winter Ever Recorded

The winter 2007/2008 showed the smallest sea ice extent in the Baltic Sea since the beginnings of recordings in 1720.

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BALTEX Proposals Recommended by BONUS

The BONUS EEIG Steering Committee announced on their web site (www.bonusportal.org) that 2 proposals from the BALTEX community are among those recommended for funding: BALTIC-C (coordinator: Anders Omstedt of Göteborg University), and ECOSUPPORT (coordinator: Markus Meier of SMHI).

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Obituary

Professor

Zdzisław Kaczmarek

(1928 – 2008)

The BALTEX community learnt with deep regret that Professor Dr. Zdzisław Kaczmarek left us forever. He was one of the pioneers in founding the BALTEX programme during the early 1990s, when the decay of the Iron Curtain smoothed considerably the establishment of international research projects between former "West" and "East" research groups in Europe. At that time BALTEX was scheduled to enable a complete water budget for the entire water catchment area of the Baltic Sea as a control experiment for the Global Energy and Water Cycle Experiment (GEWEX) and for studies of all aspects of Global Change within this area.

When the first planning steps were initiated, Professor Kaczmarek immediately joined the BALTEX planning group with his enormous skill of all hydrological processes and never-ending enthusiasm. He was a founding member of the BALTEX Science Steering Group, BSSG, and acted as vice-chairman of the BSSG during 1994 to 2001. Professor Kaczmarek was among the few key hydrologists who shaped the profile of BALTEX in these years. He helped opening doors for cooperation with the Polish Hydro-Meteorological Service as well as other research institutions in Poland and further countries of the former Eastern Europe. Professor Kaczmarek supported actively the build up of a unique hydrological data base on river runoff to the Baltic Sea – a key element for investigating the water cycle of the basin. This data base has been central to many projects of BALTEX Phase I and was also used in a range of related environmental studies beyond BALTEX.

We had the honour and privilege working together with Professor Kaczmarek for quite some time and met him at various occasions. We will always remember him as a personality of highest professionalism in science and also diplomacy as well as of utmost integrity and warmth.

For the BALTEX Science Steering Group

Ehrhard Raschke and Hans-Jörg Isemer

Review of BALTEX Phase II Objectives

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BALTEX Phase II science and implementation plans. Emphasis was on the rationale and feasibility of research to be conducted in the next 4 to 5 years ahead of us in BALTEX Phase II. This article shortly summarizes suggestions for main changes discussed at the BSSG meeting. An extended document with detailed suggestions of revised goals and activities for the continuation of BALTEX Phase II is available at the BALTEX web page. We encourage comments and discussion on this document over the coming three months before we prepare a final set of objectives to be approved at the next BSSG meeting.

The plenary discussion at BSSG #22 centred on the identity of BALTEX, where a range of opinions were voiced related to the extent of how far BALTEX should deviate from the original objectives as defined in strong alignment with those of the Global Energy and Water Cycle Experiment (GEWEX). While some BSSG members stressed the necessity for BALTEX to comply as closely as possible with the basic GEWEX objectives, others supported a more flexible opening of the programme to other areas with particular regional relevance. In the latter context, Objectives 2 and also 4 of BALTEX Phase II were considered potential candidates to successfully merge the traditional BALTEX science with new challenges in climate, hydrological and environmental research in a broader context. It was argued that the relevant regional questions and problems apparently call for a cross-cutting rather than monothematic approach. A re-definition of some research goals was considered to be potentially necessary. For this purpose, three breakout groups were established to initiate a revision of Objectives 1, 3 and 4 research goals, potential activities and milestones, respectively. Objective 2 was excluded from this exercise because the majority of the group felt no obvious need for modifications at this time.

Objective 1 of BALTEX Phase II is entitled *Better understanding of the energy and water cycles over the Baltic Sea Basin*. In practice, Objective 1 is a follow-up of the main objectives of BALTEX Phase I. The breakout group concluded that the goals set up under Objective 1 were still valid with many challenges remaining and recommended adjustments to the potential activities defined in the implementation plan of 2006. The main challenges are not only in closing of the budgets, but also in the quantification and reliability of them. Uncertainties remain in estimates of precipitation minus evaporation over the Baltic Sea and only few studies have analyzed the energy balance.

The group noted the progress on re-analysis for the atmosphere and stressed the need for production and validation of regional re-analysis for the better understanding of en-

ergy and water cycles over the Baltic Sea basin. Re-analysis on the temperature, salinity and current fields in the sea are particularly needed. Model validation is a continuous activity with several relevant challenges still remaining related among others to in- and outflows and dense bottom currents, sea ice diversity, precipitation, effects of land-surface heterogeneity, as well as generation of ground-water and runoff. Considering model evaluation, new ground-based remote sensing methods to measure vertical profiles of atmospheric variables with a high temporal and spatial resolution offer new methods and approaches for validation. There is potential for increased collaboration between BALTEX and EUMETSAT. National Meteorological Services in the BALTEX countries have ongoing activities in the field of combined application of radar data, mesoscale analysis techniques, and mesoscale modeling that should lead to improved products for water management.

Objective 3 of BALTEX Pase II concerns the *Provision of improved tools for water management, with an emphasis on more accurate forecasts of extreme events and long-term changes*. Management decisions of river basins (such as e.g. reservoir dimensions, flood protection measures and the like) are taken largely at local, regional or national levels. Thus, BALTEX may be faced with a scale mismatch between the research dimension so far mainly addressed in BALTEX, being basically of continental dimension, and the needs of decision makers, being of river basin scale, local to regional. Numerous regional and national projects dedicated to particular river catchments, sub-catchments, and lagoons are going on, however, few of them relate their work to BALTEX. It needs to be critically assessed which potential benefits and input BALTEX may offer, and is indeed offering, to decision makers, or more generally, to projects targeted to local or regional issues in the field of water management.

Contribute to discussions on the further implementation of BALTEX Phase II objectives at *www.baltex-research.eu/BP2*

While the goal 3.2.1 under Objective 3 *Development and Validation of Coupled Hydrological-Atmospheric Models* seems well defined and on track, it was noted that no initiatives related to the goal on *BALTEX Selected River Basins* have been initiated so far. It was suggested to concentrate future activities jointly with goal 3.2.4 *Improvement of Flood forecasting*. The latter area has been the subject of several both concluded and ongoing EU-funded research projects, where an inventory on results targeted for river basins in the BALTEX region should be undertaken in the frame of BALTEX. A BALTEX workshop is proposed to be held in Poland in early 2009 with focus on the river Oder basin. This could lead to new efforts on basin-scale hydrological modelling aiming at improved flood forecasting methods and systems. As to 3.2.3 *Studies of Climate Change Impacts on Water Resources Availability and Extreme Events*, an apparent weakness is that little effort is visible related to extreme events.

Objective 4 *Gradual extension of BALTEX methodologies to air and water quality studies* was introduced in BALTEX Phase II as an entirely new component to BALTEX research, recognizing the need to integrate biogeochemical processes to arrive at a true Earth System approach. The objective was suggested to be re-phrased to *Biogeochemical cycles and transport processes within the regional Earth system under anthropogenic influence* to better focus on the challenges of this objective. Emphasis was put on biogeochemical process understanding and modelling in a changing environment under anthropogenic pressure.

Biogeochemistry is defined as the integrative study of interactions between the living and the non-living environment which govern the fluxes and reservoirs of the Earth´s elements such as carbon, nitrogen, phosphorus, silicate, sulphur, oxygen, calcium, iron, etc. The expertise of BALTEX in describing the water and energy cycle and the development of coupled regional climate models embracing the atmosphere, the Baltic Sea with sea ice, and the land surface with rivers and lakes, calls for an application in biogeochemical matter flux estimations under anthropogenic pressure.

While biogeochemical research in the Baltic Sea area has a long tradition, and many research groups exist, BALTEX has the unique approach to integrate the Baltic Sea and the hydrological cycle in the atmosphere and on land. In other words, the holistic description of the Baltic Sea basin is a BALTEX domain. Also there is strong expertise in (coupled) regional climate modelling.

The research goals and potential activities were re-defined to account for the above considerations. The aspects of understanding biogeochemical processes, quantifying the fluxes, and the integration into coupled regional climate models are explicitly addressed. New aspects are a stronger integration of terrestrial processes (in the existing version of the implementation plan the focus is on processes in the Baltic Sea) and a stronger reference to climate change.

References

BALTEX (2006) BALTEX Phase II 2003-2012 Science Framework and Implementation Strategy. International BALTEX Secretariat Publications 34, 92 p.

BACC Book Published

Marcus Reckermann *(marcus.reckermann@gkss.de),* ***Hans-Jörg Isemer*** *(isemer@gkss.de), International BALTEX Secretariat at GKSS Research Centre*

Continued from page 1. Several aspects of the BACC process are worth mentioning. Firstly, this is an example for dedicated regional climate change assessments which are urgently needed to complement the global picture given by the IPCC Reports with regional results and scenarios of higher resolution, which local decision-makers and stakeholders can use (Visbeck 2008, von Storch and Meinke 2008). Secondly, the report not only gives an overview over past and future modeled climate conditions in the area, but also summarizes ecological changes in marine and terrestrial ecosystems in the recent past, and, wherever possible, gives an outlook on possible future developments in these ecosystems. Thirdly, a remarkable effort was made to include results published in non-English literature, which is likely to be not accessible or known to the broad science community. Fourthly, the entire process was a peer-reviewed joint effort of 84 scientists from 13 countries, aiming to bring together consolidated knowledge which has broad consensus in the scientific community, rather than portraying the opinion of one or few authors. Finally, the close and fruitful collaboration with HELCOM, the Baltic Sea Environment Protection Commission, can serve as an example for a successful linkage between scientists and policy makers. This was demonstrated by the presence of several national and EU politicians at the International BACC Conference in Göteborg in May 2006 (see BALTEX Newsletter #9, p.3).

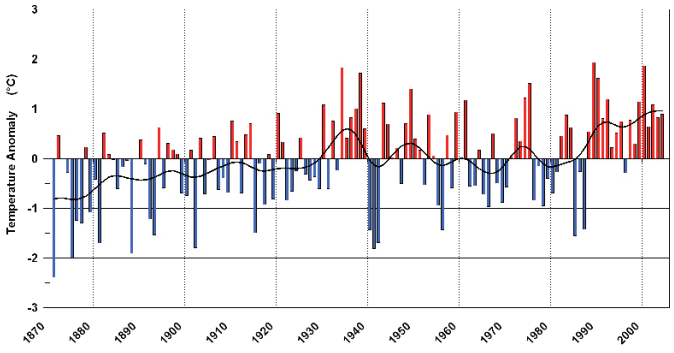

Fig. 1. Air temperature changes for the Baltic Sea basin from 1871-2004, shown as deviation from the 1961-1990 mean value. Bars represent annual values, the black curve shows the smoothed data. Figure from BACC (2008), modified.

The work was organized in four main chapters (Past and current climate change; Projections of future anthropogenic climate change; Climate-related change in terrestrial and freshwater ecosystems; Climate-related marine ecosystem change); a number of Annexes providing relevant

background information; and an introductory chapter, which places the initiative in context, clarifies key analytical and modelling concepts, and provides a summary of the assessment.

Main results

During the period 1871-2004, there were significant positive trends in the annual mean near-surface air temperature for the northern (0.1 °C per decade to the north of 60 °N) and southern Baltic Sea basin (0.07°C per decade to the south of 60 °N).

Climate scenarios for the period leading up to the year 2100 suggest that air temperatures could rise by 4-6 °C in northern areas such as Sweden, Finland, and western Russia, and by 3-5 °C in southern areas such as Poland and northern Germany. Water surface temperature in the Baltic Sea could increase by 2-4 °C. Higher water temperatures and decreased salinity would have a great impact on the Baltic Sea's flora and fauna, affecting the different organisms in the aquatic ecosystem in various ways, including creating altered growth conditions for bacteria and plankton (e.g. possibly leading to increased nuisance cyanobacterial blooms), and changed survival rates of commercially important fish species such as cod. Ecosystems on land - including managed forests - could benefit from an extended growing season, but land ecosystems may also become increasingly vulnerable to damage by insect and fungal pests as well as other stresses.

While the northern parts of the Baltic Sea are usually mostly ice-covered in today´s winters, a milder climate could by 2100 reduce the ice cover by 50 to 80 %. While these conditions would be beneficial for shipping in the Baltic Sea, they would threaten species which depend on sea ic such as populations of the Baltic ringed seal, which needs ice surfaces in order to reproduce.

Precipitation is expected to change as well, with possible increases of 20 - 75 % during the winter season over the entire basin. During summer, the northern areas would ex-

perience a slight increase (- 5% to + 35%), while a strong decrease of up to 45 % is expected for the southern areas. The combination of reduced rainfall and increased temperatures in summer could threaten water supplies, food production and forestry in the countries along the southern coast of the Baltic Sea. Another possibility is that increased overall precipitation and freshwater inflow, especially in the winter season, could lead to a decrease in the Baltic Sea's mean salinity, with consequences for the Baltic Sea flora and fauna.

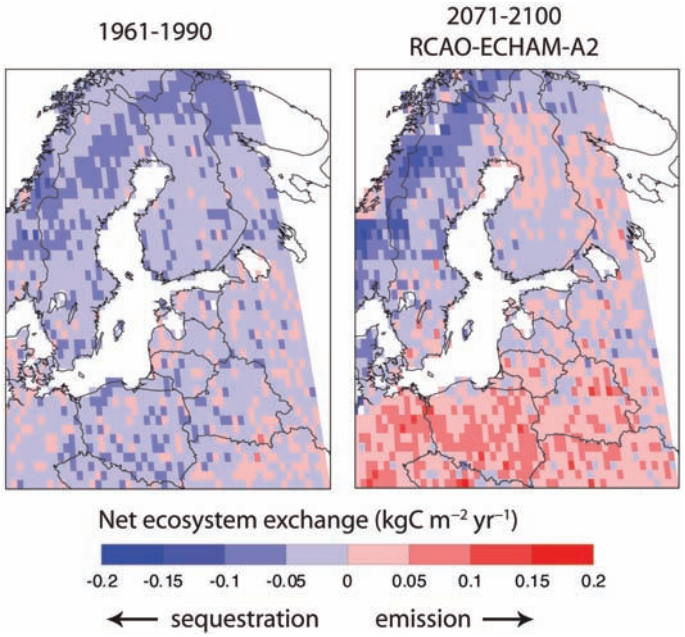

Fig. 2. Rising temperatures and an increased CO_2 availability may result in higher productivity in the future but not necessarily in a higher carbon sequestration rate. Figure from BACC (2008).

Storm activity in the past has shown decadal-scale variability, and the regional assessment detected no long-term trends towards more or less storminess. Also, the various scenarios for future wind conditions differ considerably so that no robust outlook can be given at this time, but very strong changes seem to be unlikely.

According to IPCC (2007), global sea levels are expected to rise by 20 to 60 centimeters by the end of the century. As the Baltic Sea is connected to the World Ocean, a similar sea level rise can be expected here. Still, no consensual perspectives for regional sea levels are available for the Baltic Sea. However, a postglacial land uplift (in the north) and lowering (in the south) is well documented for the Baltic Sea basin. This means that the northern coasts will be less affected by global sea level rise, as they also rise due to postglacial land uplift, while the southern coasts may be more vulnerable to flooding in the future.

BACC is an ongoing project within BALTEX and has led to the launch of other, similar initiatives, including, for example, climate reports for the greater Hamburg area in Germany, for the Yellow Sea, or for the Laptev Sea north of Russia. Work on a second BACC report is currently being taken up by the newly installed BALTEX Working Group on BACC II; the report is due in 2012.

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BACC Author Team (2008), Assessment of Climate Change for the Baltic Sea Basin, 474 pp., Regional Climate Studies, Springer Heidelberg.

IPCC (2007), Fourth Assessment Report. (Available at http://www.ipcc.ch/ipccreports/ar4-syr.htm)

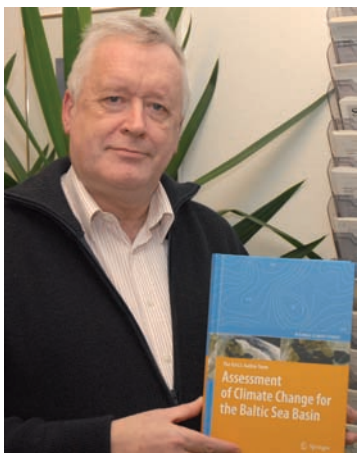
Visbeck M. (2008), From climate assessment to climate services, Nature Geoscience, 1, 2-3.

von Storch H. and I. Meinke (2008), Regional climate offices and regional assessment reports needed, Nature Geoscience, 1, 78-78.

www.baltex-research.eu/BACC

Academic Tribute to Hans von Storch

The University of Gothenburg through its Faculty of Science has recently conferred the degree of *Doctor Honoris Causa* on Hans von Storch, Director at the Institute of Coastal Research at GKSS, Geesthacht, Germany, and member of the BALTEX SSG. This honour recognizes Hans's various outstanding contributions to climate research, *inter alia* contributions "to climate diagnostics and statistical climatology, specifically detection and attribution of anthropogenic climate change, variability and change in storminess and related marine variables (storm surges, ocean waves), regional climate change; use of paleo proxy data to study climate variability and change". The University particularly alludes to "his contributions within the international research program BALTEX", where Hans leads the BALTEX Assessment of Climate Change for the Baltic Sea Basin project, which recently published the comprehensive BACC book. (see article on the opposite page). The official promotion ceremony is scheduled for 24 October 2008 in Gothenburg.



The editors congratulate Hans for this award, and we take the liberty to do so in the name of the BALTEX community!

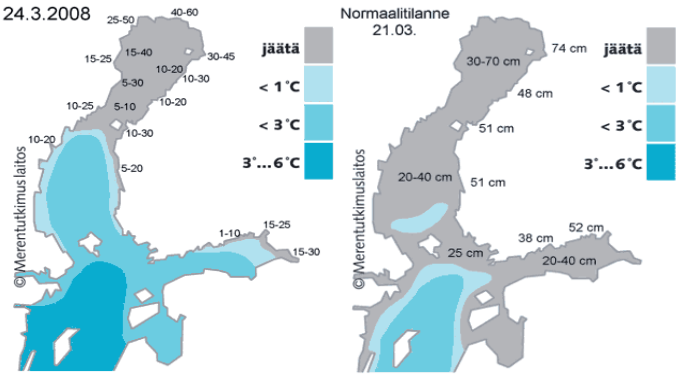
Mildest Ice Winter Ever in the Baltic Sea

Jouni Vainio *(jouni.vainio@fimr.fi), Ice Service, Finnish Institute of Marine Research, Helsinki, Finland, and* ***Hans-Jörg Isemer*** *(isemer@gkss.de), International BALTEX Secretariat, GKSS Research Centre Geesthacht, Germany*

The past ice winter 2007/2008 was recorded in statistics as the mildest ever, when measured by the extent of ice cover. Related press releases were issued by the ice services of the Bundesanstalt für Seeschiffahrt und Hydrographie (BSH), Germany (www.bsh.de) and the Finnish Institute of Marine Research (FIMR), Finland (www.fimr.fi). FIMR has assessed ice winters by keeping statistics in this way since the year 1720.

The peak of the ice winter was reached as late as March 24 this year, when the ice cover extended over an area of 49,000 km². The previous record was in the winter of 1989, when there was ice covering an area of 52,000 km², the total area of the Baltic Sea being 422,000 km².

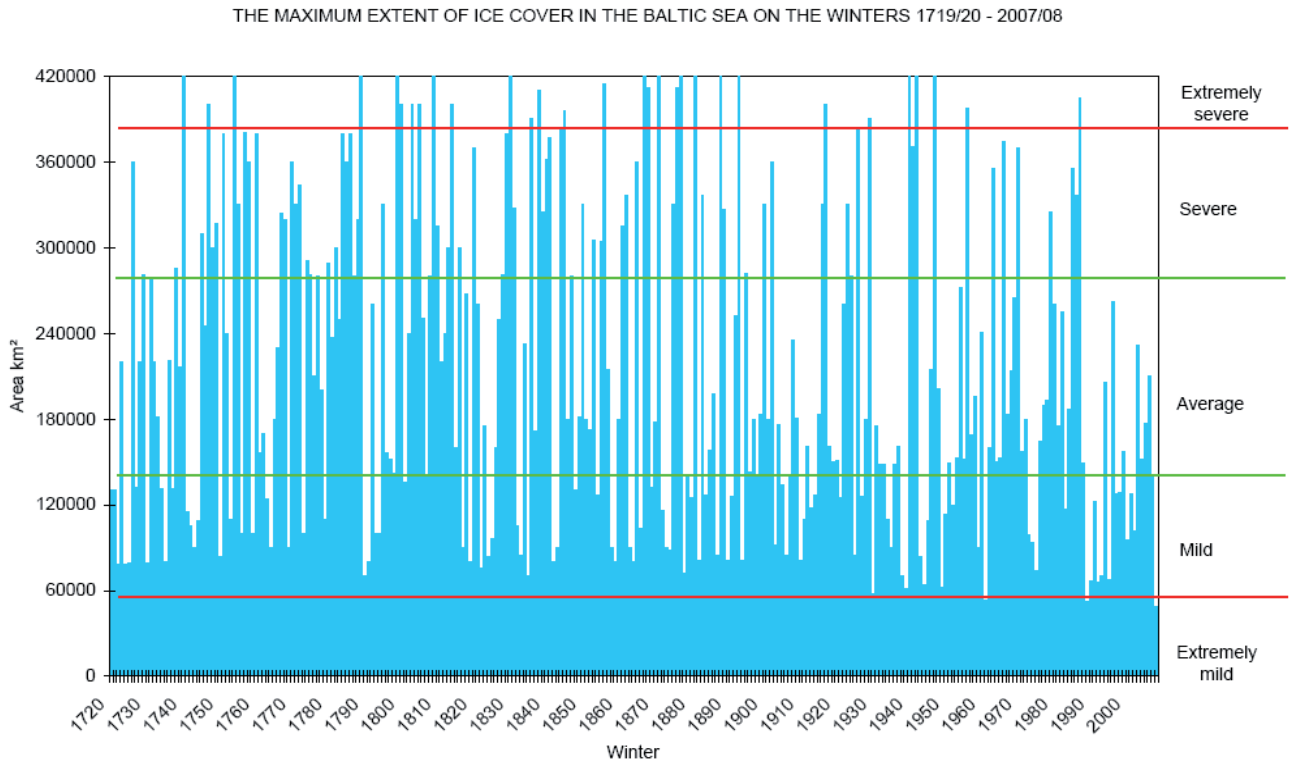
For a long time it seemed as though the northernmost part of the Baltic Sea, the Bay of Bothnia, would not freeze over completely this winter. However, with the colder weather at Easter, new ice formed on the southern parts of the Bay of Bothnia and the Quark. Thus so far the Bay of Bothnia has frozen over every winter, but for how long remains to be seen.



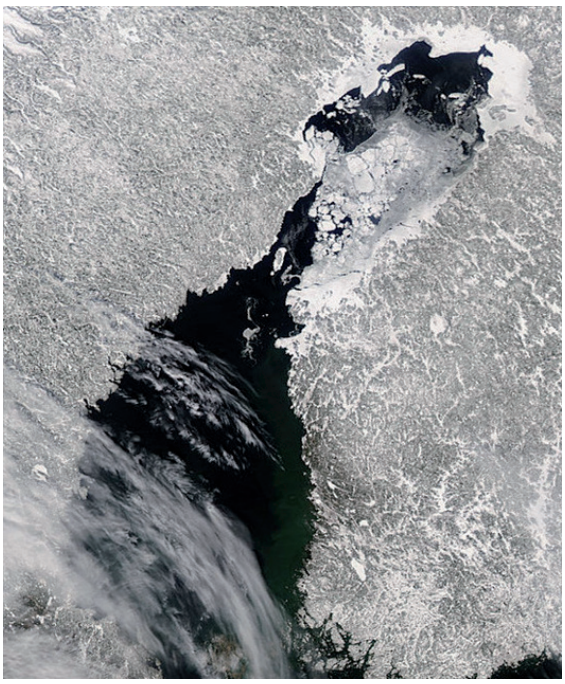
Left: Sea ice cover map for 24 March 2008, as delivered by the Ice Service of FIMR; Right:Average sea ice map for 21 March based on the years 1966 – 1986 (source: Ice Service of FIMR).

The past winter began very late in the Baltic Sea area, and the first FIMR daily ice charts and bulletins were not published until early 2008. Usually the daily publication of ice charts begins at the end of November or beginning of December.

The mild winter for seafaring has also been reflected in the fact that there has been exceptionally little need for icebreakers. When the ice cover was at its peak, there were three Finnish and three Swedish icebreakers working in the Bay of Bothnia and three Russian icebreakers in the Gulf of Finland. Finnish icebreakers were not needed for a single day in the Gulf of Finland – that has



The maximum extent of ice cover in the Baltic Sea 1720 – 2008 (based on Seinä and Palosuo, 1996; updated by Ice Service of FIMR 2008) and ice winter classification thresholds as used by FIMR.



Sea ice coverage in the Bay of Bothnia on 25 March 2008, seen by MODIS (Moderate Resolution Imaging Spectroradiometer on Terra and Aqua satellites). Source: FIMR Ice Service at veps.fma.fi/portal/page/portal/baltice/satellite-images

never happened before. Similarly, the high speed ferry service between Helsinki and Tallinn continued late at the end of the year and traffic began again exceptionally early after the winter.

Effects on the marine ecosystem of the Baltic Sea remain to be assessed. For species dependent on sea ice *e.g.* for breeding, such as the Baltic ringed seal, the recent winter may have caused adverse conditions for reproduction. Also, effects and causes related to water and energy cycles, both internally and externally for the Baltic Sea drainage basin may have to be explored in detail.

www.fimr.fi/en/tietoa/jaa/jaatalvi/en_GB/jaatalvi/

BALTEX Reference Site Data Managers Discussed Further Contribution to CEOP

Frank Beyrich *(frank.beyrich@dwd.de), Meteorological Observatory Lindenberg - Richard Aßmann-Observatory, German Meteorological Service, Lindenberg, Germany*

Representatives from the three BALTEX *in-situ* reference sites (Cabauw – The Netherlands, Lindenberg – Germany, and Sodankylä – Finland) contributing to the Coordinated Energy and Water Cycle Observations Project (CEOP) within the frame of the WCRP-GEWEX programme met at the Meteorological Observatory Lindenberg (Richard-Aßmann-Observatory) of the German Meteorological Service (DWD) from April 21 to April 23, 2008. They discussed a number of general issues of the data provision during CEOP Phase II (data collection period will cover the full annual cycles 2007-2010). Within CEOP, *in-situ* reference site data from more than 30 sites, representing all major Regional Hydroclimate Projects in GEWEX, are collected, quality-checked and made accessible for climate researchers in a unified format via a Central Data Archive (CDA) at NCAR in Boulder (http://www.eol.ucar.edu/projects/ceop/dm/).

Fred Bosveld (KNMI), Frank Beyrich (DWD) and Jani Poutiainen (FMI) at the DWD boundary layer field site in Lindenberg – Falkenberg.

In addition, numerical model output time series from a number of global climate and weather prediction models and selected satellite data for the regions around the CEOP *in-situ* sites are collected and archived at the World Data Centre for Climate in Hamburg and at Tokyo University for the same time period. So far, up to four years (from the period 2002-2006) of near-surface meteorological and hydrological data (including radiative and turbulent energy fluxes, soil moisture and temperature profiles) and also high-resolution radiosonde profiles are available at the CDA. The scientists from KNMI, DWD and FMI informed each other about qualifications and recent developments of their measurements programmes and intensively discussed quality assurance and quality control procedures applied at the three sites. Moreover, the representatives from the three weather services agreed on principles to initiate a close-to-real-time exchange of selected data from the observatory sites in order to support the operational validation of the model output of the HIRLAM- and COSMO NWP systems.

www.eol.ucar.edu/projects/ceop/dm/

www.ceop.net

BALTEX Workshop on the Utility of Regional Climate Models Well Received

Marcus Reckermann *(marcus.reckermann@gkss.de) International BALTEX Secretariat);* ***Markus Meier*** *(markus.meier@smhi.se), SMHI and Chairman of the BALTEX Working Group on the Utility of Regional Climate Models*

A workshop on the Utility of Regional Climate Models was organized as the start-up event of the recently approved new BALTEX Working Group on the Utility of Regional Climate Models (RCM). It was held in conjunction with the 22nd BALTEX Science Steering Group meeting at the SMHI in Norrköping, Sweden. The open workshop was attended by more than 50 scientists from Sweden, Germany, Denmark, Poland, Estonia, Russia and Belarus. This demonstrated the wide resonance in the research community and the interest in the key objective of the new BALTEX Working Group on the Utility of Regional Climate Models, namely to infer added value from regional climate models as compared to global climate models.

The presentations showed the state of the art in regional climate modelling in Northern Europe, with examples from SMHI´s Rossby Centre, and from recent international projects like PRUDENCE and ENSEMBLES and other international initiatives like CEOP/GEWEX and ERAMESAN. Added value for RCMs was reflected in the presentations focussing on coupling wave physics to RCMs, on the use for hydrological applications, and particularly on coupling marine and terrestrial biogeochemical models to RCMs. Most of the presentations are available at www.baltex-research.eu/organisation/bwg_rcm.html.

A lively discussion evolved around the question what the added value of RCMs are and could be. The coupling of different components of the Earth system into the RCMs was considered to be a challenge for the future. The integration of biogeochemical processes into RCMs was shown to be a good example in the attempt to arrive at a regional Earth System Model. This was demonstrated by the fact that 3 presentations dealt with the extension of RCMs to biogeochemical (resp. ecological) processes.

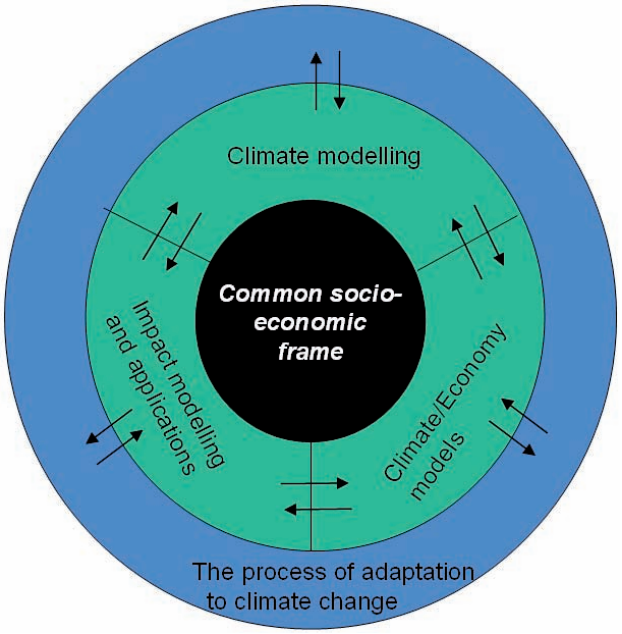
More information about the Working Group on the Utility of Regional Climate Models is available on the BALTEX web site.

www.baltex-research.eu/organisation/bwg_rcm.html

Mistra-SWECIA: A Swedish Climate Change Impacts and Adaptations Programme

Markku Rummukainen *(Markku.Rummukainen@smhi.se), Programme Director Mistra-SWECIA, Swedish Meteorological and Hydrological Institute, Core Services, Norrköping, Sweden*

Mistra-SWECIA (SWEdish research programme on Climate, Impacts and Adaptation) is a new Swedish initiative (see www.mistra-swecia.se) focusing on climate adaptation. The programme builds on research both for and on adaptation. We pursue climate system science (incl. advanced global and regional modelling), climate/economy modelling, impact research (e.g. ecosystems and ecosystem services, hydrology) and land use, as well as research on the adaptation process in society. The programme brings together different disciplines as well as researchers and users. The main funding agency of the programme is Mistra, the Foundation for Strategic Environmental Research (www.mistra.org). The programme is a collaboration between SMHI (the Swedish Meteorological and Hydrological Institute), Stockholm and Lund Universities and the Stockholm Environment Institute. Effort is also provided by the Swedish Agricultural University, Edinburgh University and the Centre for Climate Science and Policy at Linköping University.



The Mistra-SWECIA programme has four interacting research projects that all build on common scenarios of future socioeconomic development, the Common socioeconomic frame

The programme is focused on regional change within a global context. Knowledge of the global climate change and its consequences for ecosystems and society is needed to assess regional and even local changes, impacts and adaptation needs. Global mitigation efforts with the eco-

nomic and climatic conditions they impose are taken into account, as are some of the global adaptation mechanisms, such as international trade and insurance. Many of the programme activities target Sweden, but are relevant also to the Nordic and the Baltic region. On both the global and the regional/local scale, climate, impacts, economy and adaptation processes will be considered.

The programme regards regional and local climate adaptation as measures both for dealing with risks, but also with opportunities. In addition, climate adaptation is seen as a continuous process responding to new information, insights, rounds of planning, execution and monitoring of decisions, but also constrained by institutional, sociological and economic barriers to adaptation. Thus, there is a role for improved research on information supporting climate adaptation, and on the adaptation process itself.

Mistra-SWECIA aims at an improved capacity for advanced analysis and assessment that combines understanding of climate, economy and impacts. The starting point is state-of-the-art process understanding and models, such as global and regional climate and impact models, economic modelling, and impact modelling on especially water resources, ecosystems and ecosystem services. In the course of the research, new interdisciplinary approaches will be forged and integrated within models and researcher networks. Throughout the programme, participatory efforts combining modelling and assessment on climate, impacts and economy with stakeholder knowledge and feedback will contribute information to real-world adaptation decisions within climate-relevant sectors such as the water, forestry and energy sectors in Sweden.

Some of the main lines of research as to our research for adaptation are:

- global and regional Earth System Models encompassing the physical climate system, vegetation and ecosystems and also feedback due to human action and decisions in response to the changes
- capturing extreme events, such as storm track changes and heat waves, heavy precipitation events and prolonged dry spells and extreme wind speeds, in climate models. This in turn encompasses studies of possible changes of the large-scale circulation patterns due to global climate change, including the influence of aerosol changes
- provision of relevant climate change and impact information on appropriate temporal and spatial scales to users, including the overall uncertainties in global and regional climate change, impacts and economy and the interaction between climate change and economic development
- the possibility of climate and economic activity to lead to such major changes in ecosystems and land use that would significantly feed back to climate
- the potential for changes in soil respiration and the liberation of frozen carbon in arctic and boreal soils to accentuate greenhouse forcing and climate change
- the potential of adaptation, through global or regional market and adjustment mechanisms, to diminish the future costs of climate change, such as endogenous response by sectorial actors to perceived risks and opportunities
- the role and drivers of technical change in climate adaptation

Mistra-SWECIA will, however, not just be a natural sciences' modelling programme. It will take on the adaptation process itself, focusing on learning from success stories and on identifying hinders to adaptation (cf. research on adaptation). These issues are relevant as such, but they will also help to keep the overall research relevant to users and make the results useful for anticipatory adaptation.

Main lines of research as to our research on adaptation are:

- the current preparedness and ability of actors to incorporate climate adaptation into their long term policies and strategies
- the perception of climate scenarios and how such information leads (or not) to action, including the "worst case" outcomes, their likelihood, and role in the perception of the risks. What contributes to climate risk awareness and the barriers and opportunities to the implementation of adaptation?
- conditions that facilitate learning on climate adaptation, how social learning on adaptation happens and its effect on risk perception, such as institutional, cultural and policy factors that influence climate adaptation capacity
- generic sets of policy and institutional requirements for managing the integration of adaptation to climatic stress

In short, the programme has a scientific agenda and ambition covering a range of challenging issues on climate change, climate change impacts, adaptation processes, costs of action and inaction, and feedback between climate change and socio-economic development. Possible connections to BALTEX include advanced climate, coupled and impact modelling, the relationships between regional and global changes, and the communication between the scientific and user communities. We encourage the BALTEX community to keep an eye on the Mistra-SWECIA programme. We will in turn keep an eye on the BALTEX activities.

www.mistra-swecia.se

KALME – The National Research Programme on Climate Change Impacts on the Waters of Latvia

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In Latvian, „Kalme“ is the name of a popular wetland plant – the sweet flag (*Acorus calamus* L.). Prized for its delicate smell and medical properties, the sweet flag is often used in traditional medicine and is a popular element of the Midsummer Festival decorations in Latvia. The national research programme “Climate Change Impact on the Aquatic Environment of Latvia” borrowed the name as an acronym of the five important key-words relevant to the subject of the study: Klimats – climate, Adaptācija – adaptation, Līdzsvars – equilibrium, Mainība – variability, Ekosistēmas – ecosystems.

The programme officially started on 30 October 2006. Generic goal of the Programme is to assess the short-, medium-, and long-term impact of climate change on the environment and ecosystems of the inner waters of Latvia and the Baltic Sea, and to create a scientific basis for adaptation of the environmental and sectorial policies to climate change. Several more specific goals have been formulated to achieve this goal, e.g.:

a) to create several mutually non-controversial scenarios of the regime-determining parameters that could be further utilized for the forecasts of the development of aquatic environment;
b) to assess possible climate change impacts on the quality of inland waters of Latvia, their availability, flood and drought regime, to facilitate adaptation of the drainage basin management and secure protection and sustainable use of water resources;
c) to forecast possible climate change impacts on the physical regime, coastal dynamics, biogeochemical regime, and ecosystems of the Baltic Sea, to facilitate the protection of marine environmental quality, biological diversity, and sustainable use of its resources and services.

Specific tasks and achievements of the WPs

To cover the variety of tasks, the Programme is organized in nine work-packages (WPs) – mostly in accordance with the specific disciplines: hydrological modelling, soil and freshwater biogeochemistry, ecology of the inland waters, marine biogeochemistry, and marine ecology including fisheries research. Two of the WPs are charged with overarching tasks: WP7 is responsible for the investigation of stakeholder needs and for translating the research findings into useful products, while WP8 takes care of the overall scientific governance, everyday management and dissemination to the broad public. A crucial step there is to investigate what content and form of scientific advice would be best perceived by the policy-makers and to achieve cooperation across various sectors and institutional frameworks.

Each of the work packages is linked to others by important flows of information. WP1, for example, is responsible for supplying the other WPs with climate change scenarios including water flows in different compartments of the drainage basin. Assessments and predictions of possible precipitation levels and river run-off are essential for WP2, which works on nutrient load changes in drainage basins. In turn, WP3, dealing with ecosystem and biodiversity changes in freshwater, and WP9, investigating the impact of climate change on runoff extremes and areas influenced by floods and droughts, are dependent on the outputs of WP2. Climate change forecasts are important also for WP4, focusing on geological processes on Latvia’s Baltic Sea coasts, and two marine work packages – WP5 and WP6. WP5 studies biogeochemical processes and primary production in the Baltic Sea, WP6 will look into marine ecosystem and biodiversity dynamics.

WP1: Models and Scenarios (coordinator Dr. Uldis Bethers) - The core of the work package team is the Laboratory of Mathematical Modelling of Environmental and Technological Processes at University of Latvia. To fulfil their task, modellers have to assess regional climate change scenarios in relation to conditions in Latvia, forecast the impact of climate change on river runoff and the physical properties of the Baltic Sea, including salinity, temperature, water stratification, currents, wave regime and water level, by modelling processes in the Baltic Sea and its drainage basin, and to provide modelling support to other work packages of the Programme.

Outputs of 20 available RCMs have been statistically assessed by comparing with the series of the observed climate data (1961 – 1990) from the territory of Latvia, and series of the forecasts were generated by use of the best fit RCM. A comparison with historic data also revealed that even negligible differences in air temperature and precipitation cause significant changes in the runoff. Therefore, a specific statistical method to minimize the deviation of the RCM output from the local data has been proposed. Finally, the model calculations for the pilot basin (Aiviekste river) have been performed according to the SRES storylines A2 and B2. As a separate WP1 task performed by climatologists of the Faculty of Geography and Soil Science, University of Latvia, an analysis of the Daugava river runoff (1881–2001) has been performed. While the summer runoff remained virtually on the same level during the 120 years of observation, a statistically

evident increasing trend (ca 1 m^3/s per year) of the winter runoff has been demonstrated on the background of multi-annual cycles.

WP2: Nutrient Fluxes (coordinator Prof. Viesturs Jansons) This workpackage aims to assess the impact of climate change on nutrient fluxes in runoff discharge and is teamed mainly by the researchers of the Faculty of Rural Engineering, Latvia University of Agriculture, assisted by load modelling experts of the Faculty of Geography and Soil Science, University of Latvia. Their task is to collect and analyse monitoring data of nutrient export from agricultural land and forests, evaluate the background emission and nutrient retention in the water bodies under conditions of climate change, and finally, to estimate the possible development of the nutrient loading from the territory of Latvia into the Baltic Sea. The water quality simulation in the medium size drainage basin is based on the FYRIS model developed at Swedish University of Agricultural Science. The complexity of the task is determined by the variety of necessary input data, scarcely covered by field observations, the necessity to make the digital drainage basin maps more accurate, and also by uncertainties of future alternations of the land use.

WP3: Freshwater Ecosystems (coordinator Dr. Gunta Spriņģe) - A team of freshwater biologists of the Institute of Biology, University of Latvia, supported by inland fisheries scientists of the Latvian Fish Resources Agency assumed an objective to assess the impact of climate change on the ecosystems of inland waters and their biological diversity. Their first task is to characterize and predict climate change impacts on the chemical properties of water (together with WP2) and investigate how these changes may affect the ecosystems of inland waters. When the predictions of the climatic properties, hydrological regime and chemical quality of the water are at hand, an attempt will be made to clarify how climate change might influence biological diversity, composition of fish communities and the structure of fish populations in the rivers and lakes of Latvia. Recognizing that the uncertainty of predictions increases dramatically with each ecological level, researchers are currently involved mostly in collecting and analyzing data on the historical variability of the biodiversity of inland waters. Along with the predictions of development of the freshwater ecosystems, the work of WP3 will also help to select species of aquatic plants and animals suitable for bio-indication under conditions of climate change.

WP9: Floods and droughts (coordinator Prof. Arturs Škute) A research team seated in the eastern part of the country, at the Institute of Ecology, Daugavpils University, has undertaken an objective to predict the impact of

The January 2005 storm on the open Baltic coast of Latvia. WP 4 has produced detailed maps of the potential risk of erosion. Photo by J. Lapinskis

climate change on extremes of runoff regimes (floods and low-water periods), and aims to identify the impact of these phenomena on flood-plain ecosystems. The ecology of the flood-plain lakes and the impact of runoff properties on the ecosystem of the middle Daugava river has been a focus of this group since the last 10 years. Their complex tasks include an assessment of the intensity and frequency of extreme runoff events in the context of climate change; a prediction of changes in the regimes of floods and droughts (together with WP1); identification of the role of flood-plains in the stabilization of hydrological regimes, using the example of flood-plain lakes on the middle reaches of the Daugava; an assessment of the impact of the extreme events on the ecosystems of the flood-plain lakes themselves; and finally proposing adaptation measures to mitigate the risks associated with floods and droughts.

WP4: Coastal Processes (coordinator Prof. Guntis Egerhards) - A group of geo-morphologists of the Faculty of Geography and Soil Science, University of Latvia, has been involved in the monitoring of coastal erosion along Latvia's 500 km long sandy shores already since the 1960ies. Participation in the KALME programme gives this group an opportunity to summarize their findings on the historical and present-day dynamics of the Baltic Sea coast and to forecast the impact of climate change on coastal processes. The work already done includes digital maps of the coastal geological processes since the beginning of the 20th century. These maps will be published as an Atlas of Coastal Process in 2008. In several sections of the Latvian coast, erosion has already taken a more than 100 m wide strip of land, therefore it is not surprising that governmental and municipal authorities express a lot of interest in the WP4 outputs. Furthermore, the group will focus on predictions of the future coastal dynamics in support to the spatial planning and coastal management.

WP5: Marine Biogeochemistry (coordinator Dr. Juris Aigars) - Due to a possible modification of North Sea water inflows, fresh water runoff and nutrient loading from the drainage basin, climate change will most possibly cause massive shifts in the biogeochemistry of the Baltic Sea. WP5 focuses on the changes that may affect the turnover of nutrients in the Gulf of Riga. Marine biogeochemists and modellers of the Latvian Institute of Aquatic Ecology look into the processes occurring in the water column, and especially in the water-sediment boundary layer. By series of laboratory experiments, they will identify the boundary conditions which, when exceeded, would lead to abrupt changes in the fluxes of matter in the water-sediment interface. The team will identify how climate change will influence the sedimentation regime of biogenic matter by field experiments and by modelling efforts simultaneously. Finally, a predictive biogeochemical model for the Gulf of Riga will be developed and calibrated. This will allow to predict changes in environmental quality and productivity of the Gulf of Riga until 2100 under different scenarios of climate development. Forecasts of water temperature, salinity, surface currents and wave height, as well as the pattern of water stratification necessary for these predictions, are being delivered by WP1.

WP6: Marine Ecosystems (coordinator Dr. Anda Ikauniece) - Marine biologists in Latvia are mostly affiliated with the Latvian Institute of Aquatic Ecology. To assess the impact of climate change on the Baltic Sea ecosystems and biological diversity off the coasts of Latvia, they cooperate with experts from the Latvian Fish Resources Agency and the Institute of Biology, University of Latvia. As in the other work packages, during the initial phase, marine biologists are mostly focusing on the collection of scattered information into data series and analysis of relationships among various physicochemical and biological parameters. For example, a historical series of anomalies in cod reproduction volume during the last 50 years has been assessed. Also a firm relationship between the herring recruitment and spring biomass of copepod *Eurytemora affinis* has been demonstrated. Both these features directly relate to the Baltic Sea regime shifts caused by climate variability. In the fisheries part, the ultimate goal is to develop a model for the long term prediction of fish growth, stock dynamics and changes in the structure of fish communities, to propose measures to protect and maintain marine biological diversity, to manage the marine environment, and to develop and implement policies for the sustainable management of fisheries.

WP7: Adaptation (coordinator Dr. Kristīne Āboliņa) Although the awareness of the reality and potential effects of climate change has increased enormously during the recent years, the weakness of the link between science and policy is recognized as a main factor hampering the development of effective adaptation measures. Scientists of the KALME Programme have taken an initiative to make the first step towards policy-makers. Although each of the natural science WPs has assumed a task to produce practical advice in their field of expertise, WP7 is specifically designed as an interface between the research team of the Programme and its stakeholders. Socio-economists of the University of Latvia and Daugavpils University investigate the concerns and needs at different administrative levels in the climate change context, and analyse to what degree current environmental and sector policies address possible impacts related to climate change in the context of the aquatic environment. Based on the outputs of the Programme, science-based advice for the adaptation of national development strategies and environmental and sector policies to the impacts of climate change will be developed.

WP8: Programme management and dissemination (co-directors Dr. Andris Andrušaitis and Prof. Maris Kļaviņš, PM Ineta Plikša) - The KALME Programme is led by two co-directors, representing the research expertise in two domains of the aquatic environment – freshwater and marine. Together with the Programme Manager, they constitute the small central coordination unit that steers the whole programme, involving 8 partner institutions, about 95 researchers and research assistants, with an indicative workload of 1260 person-months and funds of almost EUR 2 mill. until the end of 2009.

In addition to the scientific supervision and everyday management, the coordination unit is responsible also for the Programme's joint activities (e.g. publications, conferences, study courses) and dissemination of the results and general knowledge about climate change to the broad public. The Programme has arranged two annual national conferences and an international conference "Climate Change and Waters" (Riga, May 2007, together with the INTERREG IIIB project ASTRA). A collection of articles "Climate Change in Latvia" (Ed. M.Kļaviņš, 2007), and a text book "Climate change and Global Warming" (Eds. M.Kļaviņš and A.Andrušaitis, 2008, in Latvian) has been published so far. A useful instrument to maintain the Programme´s scientific quality and to improve its visibility among similar programmes and projects in the Baltic region and beyond, is the International Advisory Panel. Composed of reputable scientists and coordinators of climate change research programmes, the International Advisory Panel meets annually to discuss the progress and refine the plans for future work.

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Research Articles

Mnemiopsis leidyi, a New Invader to the Baltic Sea: Possible Pathways of Distribution

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The ctenophore ("comb jelly") *Mnemiopsis leidyi* (Fig.1), native of the US east coast, is widely recognized as a harmful invader and is ranked among the world's 100 worst invasive species (www.issg.org/). It became particularly infamous for causing major ecological and economic damage to the Black Sea ecosystem after its introduction in the 1980s . The strong ecological impact of *M. leidyi* on marine food webs stems from both direct feeding on fish larvae and eggs, and resource competition with zooplanktivours fish due to voracious feeding on mesozooplankton. Its presence in northern European waters has been reported for some estuaries in the Netherlands where it probably had existed already for several years, and recent records indicate a progressive northward and eastward spread.

M. leidyi was observed in 2005 from Oslofjorden, Norway (Oliveira 2007), then later in the North Sea, off the western coast of the Netherlands (Fasse and Bayha 2006) and the Swedish west coast, in the Kattegat region and in the southwestern Baltic Sea in autumn 2006 (Javidpour et al. 2006). In 2006-2007, it was widely distributed in Danish waters (Tendal et al. 2007), and has further been observed in the Pommeranian Bay, in the Arkona and Bornholm basins, the Bay of Gdansk and in the Åland Sea and Bothnian Sea (Kube et al. 2007, Haslob et al. 2007, Lehtiniemi et al. 2007, Janas and Zgrundo 2007).

Fig. 1. The American comb jelly Mnemiopsis leidyi. *Body length can be up to 10 cm.*

Typically, potential invaders to the Baltic Sea must be able to tolerance a wide range of salinities and temperatures, with a prevalence to cold water. The ability to live and reproduce in low saline waters is a key factor for survival success in the Baltic Sea. The strong salinity gradients from nearly fresh water conditions in the north and east to ocean water conditions in the Kattegat makes the Baltic Sea susceptible for invasions of fresh water, brackish and marine species. Additionally, vertical temperature and salinity gradients provide a broad range of conditions inhabitable by alien species of different biogeographical origin. Furthermore, climate warming increases the risk that warm-water species become established in the Baltic Sea. Concerns about such invasions have led to the systematic monitoring of population density variations and the physical factors that determine such variations.

Approximately 120 invasive species have been recorded in the brackish waters of the Baltic Sea during the last 100 years, most of them introduced by shipping (ballast water) as the most important individual vector (about 80 species; Gollasch and Leppäkoski 2007). It is likely that organisms once introduced into a Baltic port may subsequently spread and reach other Baltic Sea regions (secondary introduction), either by natural drift or by internal ship traffic. In the Baltic Sea (including the Kattegat), about 76 ports handle more than 1 million t of cargo per year. The busiest port is St. Petersburg with more than 14,500 ship operations per year. The number of ship operations (passages, excluding ferry traffic) in the Baltic Sea is estimated at 150,000 per year (Gollasch and Leppäkoski 2007), and it is assumed that the shipping activities will considerably increase in the future.

Seasonal temperature development

As reported by Lehmann and Hinrichsen (2007), there is a warming trend in the Baltic Sea of 0.52°C/decade for the period 1985-2005. This warming probably favors the establishment of invasive species. *M. leidyi* tolerates a wide range of salinity (4-38 psu) and temperature (4-32°C), so that there is no physical limitation to the establishment in the brackish Baltic Sea. However, surface water temperatures can drop significantly below 4°C during winter. If temperature is a constraint for the development and distribution, *M. leidyi* would be limited to coastal and shallow areas with weak saline stratification during severe winters. For the deep basins of the Baltic Sea where a permanent halocline exists, winter water temperatures are normally not below 4°C. If *M. leidyi* is already established in the deep basins, there is no limitation or temperature threshold for further development, even in winter. It seems that *M. leidyi* can survive at low temperature and salinity conditions, but for reproduction, higher temperatures may be necessary (>12°C, Purcell et al. 2001). However, Lehtinie-

mi et al. (2007) observed eggs and larvae of *M. leidyi* in the Åland Sea in September at depths of 155 to 50 m, with water temperatures between 4.5 and 5°C.

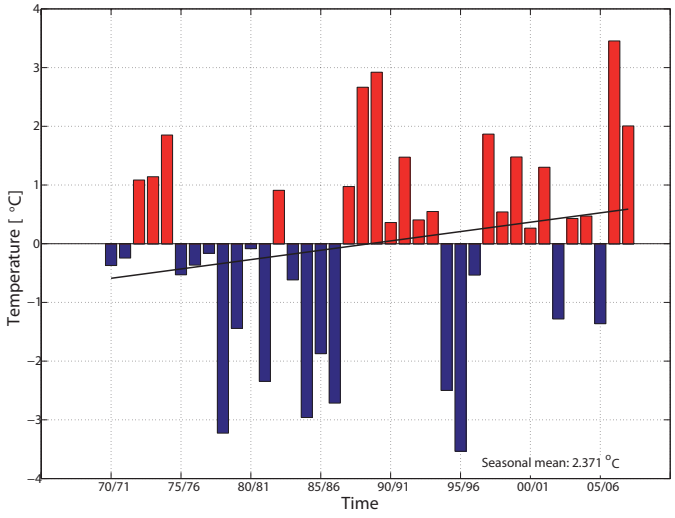

Fig 2. Air temperature anomalies at Kiel lighthouse with respect to the seasonal means (DJFM=2.37°C) for the period 1970-2008

In 2006, *M. leidyi* was first observed in the Kattagat/Skagerrak and the southwestern Baltic Sea. If this area is a source region for further spreading of *Mnemiopsis*, it is interesting to analyze the temperature evolution during winter over the recent years. We choose Kiel Bight as a representative area for the southwestern Baltic Sea. To classify different winters over the period 1970-2008 we calculated the seasonal winter air temperature anomalies for the months December to March (DJFM) at Kiel Lighthouse (54°30‘N, 10°16.5‘E).

The long term seasonal mean over the period 1970-2008 is 2.37°C. Air temperature anomalies at Kiel Lighthouse (Fig. 2) reveal that since 1998, the seasonal mean winter temperature (DJFM) was well below 4°C. However, the winters of 2006/2007 and 2007/2008 were exceptional. For the winter 2005/2006, the seasonal mean air temperature was 1.06°C (minimum sea surface temperature SST = 0.1°C); for 2006/2007 it was 5.87°C (min. SST = 4.0°C), and for 2007/2008 it was 4.46°C (min. SST = 4.0°C). Thus, favourable conditions for overwintering (survival) of *M. leidyi* have prevailed since the winter 2006/2007.

The recent two winters were not only mild in the southwestern Baltic Sea. The maximum sea ice extent in these years was also extraordinarily small: for 2006/2007, it was 139,000 km², and for 2007/2008, a new low ice extent record was documented, the ice cover being only about 49,000 km² which is the smallest sea ice extent since 1720 (see article on page 6).

Drift tracking

The years 2005 and 2006 were simulated using the Kiel Baltic Sea model (BSIOM). A Lagrangian particle tracking model provided main drift routes of *M. leidyi*. The drift model allows a tracking, as well as a back-tracking of individual drifters to calculate starting and end positions of drift routes with respect to time. Once released, drifters can freely move through the 3-dimensional model flow field. Drifters were released from the surface to the bottom along several sections through the main basins of the Baltic Sea (Fig. 3). Different areas were chosen to investigate main drift routes or possible pathways of invasion, specific for the different areas of the Baltic Sea. Drifters were released in January 2005 (white circles), and end positions reached in December 2006 were marked in different colors, specifying the sub-basins in which the drifters were released.

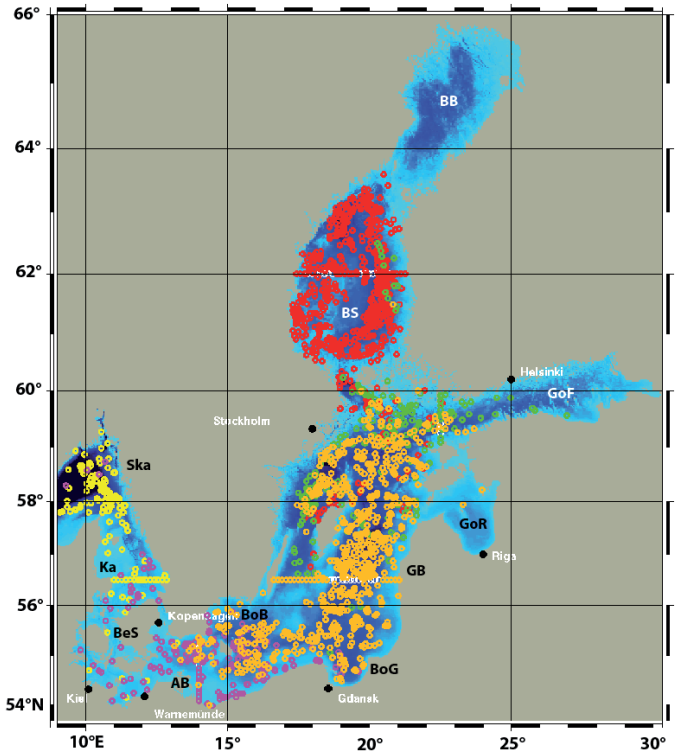

Fig 3. Start positions (white circles) of drifters released in January 2005 and end positions (colored circles; colours denote sub-basins of origin) in December 2006. Sub-basins: Ska-Skagerrak, Ka-Kattegat, BeS-Belt Sea, AB-Arkona Basin, BoB-Bornholm Basin, GB-Gotland Basin, GoF-Gulf of Finland, BS-Bothnian Sea, BB-Bothnian Bay

The end positions depended not only on the specific weather conditions and the starting points, but also on the time of release. However, similar pictures were obtained for different launching dates for the period January until March 2005. It can be seen that drifters launched in the Kattegat (yellow circles) reached Kiel Bight and Mecklenburg Bight during 2006. Principally, an invasion of *M. leidyi* from the Kattegat to the western Baltic Sea could

explain the detection records in autumn 2006 (Javidpour et al. 2006, Kube et al. 2007). However, drifters were not able to reach Mecklenburg Bight, when released in early 2006. Drifters launched in the Arkona Basin (cyan circles) were found in the Belt Sea and along the southern coast of the Baltic Sea to the Bay of Gdansk.If we assume that *M. leidyi* was introduced to the Arkona Basin already in 2005, all observations in the Mecklenburg and Kiel Bights, as well as in Danish waters, could be explained.

Drifters released in the Gotland Basin (orange circles) were distributed from the Baltic Proper to the western Baltic Sea. Some of them reached the Gulf of Riga and the Bothnian Sea, as well as the entrance to the Gulf of Finland. Drifters launched there (green circles), mainly reached the eastern Gotland Basin, the inner Gulf of Finland and the Bothnian Sea. Drifters launched in the Bothnian Sea (red circles) strongly circulated in the Bothnian Sea or were distributed further south in the eastern Gotland Basin, and none of them reached the Bothnian Bay.

Drift routes reveal potential pathways of invasion. The more or less complete spread of *M. leidyi* over the Baltic Sea in 2007 can partly be explained by the circulation patterns within the Baltic Sea basins. However, it seems unlikely that the only source of invasion was the Kattegat area. The release of ballast water in different harbors and the subsequent distribution by internal circulation could be an optional pathway. Further drift calculations, especially for 2007, might lead to a clearer picture of the different distribution mechanisms of *M. leidyi* in the Baltic Sea.

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Recent and Future Changes of Snow Accumulation over Northern Europe

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Recent changes in snow storage in North America and northern Eurasia show distinct regional differences. This process is connected to atmospheric patterns and is illustrated by changes of the North Atlantic and Arctic Oscillation indices, respectively (Fig. 1; Barnston and Livezey 1987, Zhou et al. 2001).

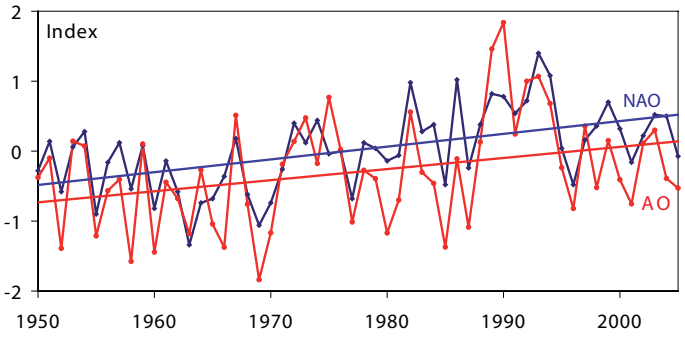

Fig. 1. Long-term variability and trends of indices of the North Atlantic Oscillation (NAO) and the Arctic Oscillation (AO)

Global warming has not directly affected snow accumulation in northern Eurasia to date, due to the low prevailing air temperatures during the winter period. On the contrary, the increase in precipitation has even led to an increase in snow storage here (Fig. 2).

This long-term increase of maximum snow storage in northern Europe is primarily due to snow gains in January, which is the coldest month (Fig. 3). Thus, two principal factors de-

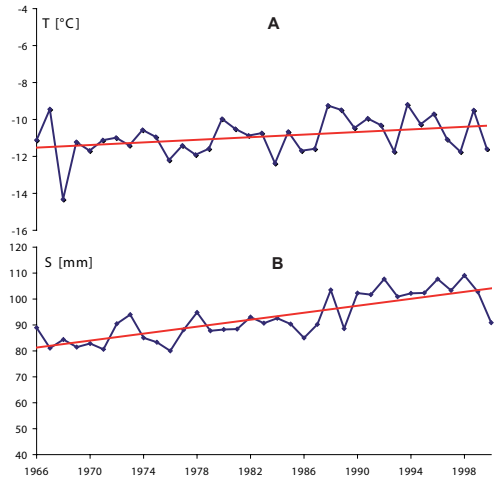

Fig. 2. Trends and long-term variability of mean air temperature (A) and snow water equivalent (B) in the northern part (>60° N) of the Eastern European plain in November-February.

fine the changes in snow storage: the atmospheric oscillation patterns, and the regional meteorological regimes.

Nevertheless, the process of snow storage increase cannot persist under the conditions of progressing global warming. The snow depth in Scandinavia, for example, has already been reduced (trend in January is -0.35 cm/yr for 1936-2004), while the duration of snow cover is still increasing. The cold winters in the northern part of the East European plain still constrain a decrease in snow depth (trend in January is +0.24 cm/yr for 1936-2004). However, this occurs against the background of a warming trend: Regional temperatures have increased by +0.14°C/yr (Kitaev et al. 2006; BACC Author Team 2008).

Table 1. Global climate models used for this analysis. Models printed in italic are not used for data calculation and averaging, because they failed to produce realistic results of snow water equivalent (Kitaev and Kislov, 2007) compared to data from the validation period 1961-1989.

NN	Model	Country	NN	Model	Country
1	*BCCR-BCM2.0*	*Norway*	9	GFDL-CM2.1	USA
2	CCSM3, NCAR	USA	*10*	*GISS-ER*	*USA*
3	CGCM3.1 (T47)	Canada	*11*	*IPSL-CM4*	*France*
4	*CNRM-CM3*	*France*	*12*	*MIROC3.2*	*Japan*
5	*CSIRO-Mk3.0*	*Australia*	13	MRI-CGCM 2.3.2	Japan
6	*ECHAM5/ MPI-OM*	*Germany*	14	PCM	USA
7	*ECHO-G (MIUB)*	*Germany*	15	INM	Russia
8	GFDL-CM2.0`	USA			

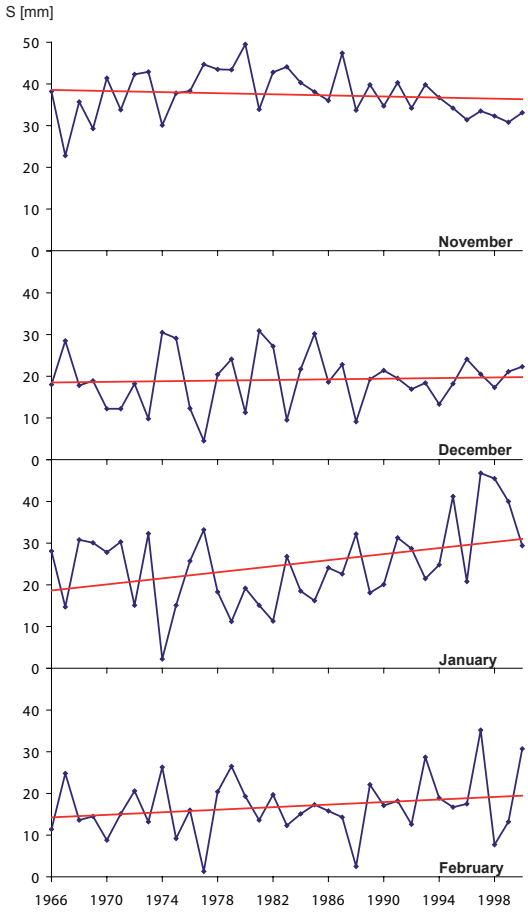

Fig. 3. Long-term variability and trends of monthly gains of snow water equivalent

For an estimation of the future changes of snow storage in the East European plain, we used the results of global climate model calculations (Table 1). The projections of snow water equivalents were based on recalculations of water equivalents from winter precipitation by means of a special algorithm (Kitaev and Kislov 2007). Seven models were selected after validating the modeled against measured values of snow water equivalents for the base period 1961-1989 (Table 1).

Regional variations of snow gains versus temperature increases in February are shown in Fig. 4 for three periods: For recent conditions (base period 1961-1989), and for two scenario periods in the 21st century, 2047-2065 and 2083-2099. During 1961-1989, areas where snow water equivalent continues to increase in conditions of warming (positive values in Fig. 4) are located north of 60°N over the East European plain. This region is displaced almost 1000 km to the north east, to the foothills of the Ural, at the end of the 21st century (Fig. 4).

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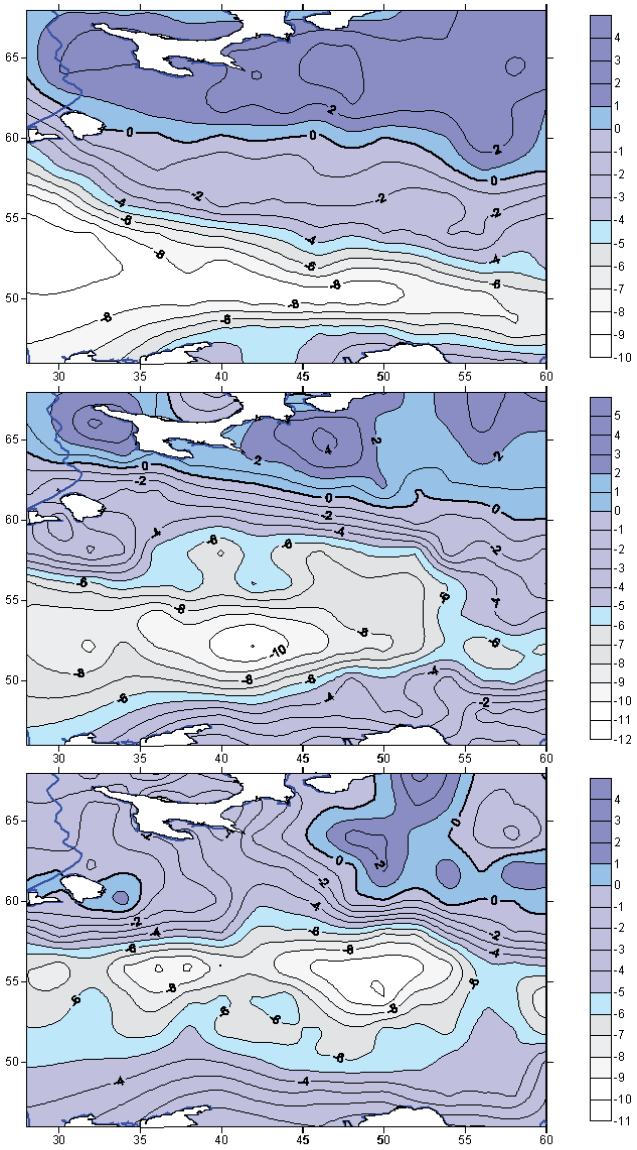

Fig. 4. Regional variation of the regression coefficient of gains of snow water equivalent versus changes of air temperature in February over the East European plain for(from top to bottom) recent conditions in the base period 1961-1989, and for two projected periods 2047-2065 and 2083-2099

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Lead Author: Sofia Hjalmarsson, sofia@chem.gu.se

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Lead Author: Birgit Hünicke, birgit.huenicke@gkss.de

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Conference Announcements

First Announcement for the

TELLUS - BALTEX Workshop on

Biogeochemical Land and Baltic Sea Interactions driven by Climate and Land Use

1 - 2 December 2008
Göteborg University, Sweden

The workshop aims to bring together the terrestrial and marine biogeochemistry research communities, emphasizing on potential impacts due to climate and land use change.

Tellus is a comprehensive research programme at the University of Gothenburg, dedicated to Earth systems science.

More infos and programme available soon at

www.tellus.science.gu.se/
www.baltex-research.eu/

UNIVERSITY OF GOTHENBURG

2nd International Lund RCM Workshop
21st Century Challenges in Regional Climate Modelling
Lund, Sweden 4 - 8 May 2009

Developments and progress achieved in the last five years since the first RCM Workshop in Lund 2004 will be presented and discussed along with open issues and expected future challenges related to regional climate modelling. The meeting will cover a wide range of RCM-related topics from basic research from basic research - such as theoretical aspects of numerics and parameterisations - to applications such as impact studies in the context of climate variability and change. Topics include dynamical downscaling, new developments in numerics and physical parameterisations, regional observational data and re-analysis, results from large projects, impact studies, and the future of RCMs.

GEOCENTRE, Lund University
GeoBiosphere Science Centre
Sölvegatan 12
223 62 Lund
Sweden

For more information and registration, see
www.baltex-research.eu/RCM2009

Can we save the Baltic Sea? Eutrophication in future climate

Workshop at the SMHI, Norrköping, Sweden
SMHI Lecture Hall, Tuesday 21 October 2008, 10-16

The aim of this workshop is to bring scientists and stakeholders together and to discuss the latest results of climate change impact studies. A vision of an advanced modelling tool for scenario simulations of the whole marine ecosystem that can underpin and inform management strategies to ensure water quality standards, biodiversity and fish stocks will be presented and discussed.

Please register until 13 October with gunn.persson@smhi.se
www.smhi.se/content/1/c6/03/51/49/attatchments/can_we_save_the_baltic_sea_SMHI.pdf

BALTEX is the European continental-scale experiment within the Global Energy and Water Cycle Experiment (GEWEX). It constitutes a research programme focussing on water and energy cycles in the climate system of the entire Baltic Sea basin with contributions of more than 10 countries. GEWEX has been launched by the World Meteorological Organisation (WMO), the International Council for Science (ICSU) and UNESCO's Intergovernmental Oceanographic Commission (IOC), as part of the World Climate Research Programme (WCRP). The scientific planning of BALTEX is under the guidence of the BALTEX Science Steering Group. The BALTEX *Newsletter* is edited and printed at the International BALTEX Secretariat with financial support through the GKSS Research Centre Geesthacht, Germany. It is the hope that the BALTEX *Newsletter* is accepted as a means of reporting on plans, meetings and work in progress, which are relevant to the goals of BALTEX, as outlined in the Science and Implementation Plans for BALTEX.

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Please, send contributions to the BALTEX *Newsletter,* requests for BALTEX - related documents, suggestions or questions to the International BALTEX Secretariat via

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