BALTEX Newsletter

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

BALTIC GRID Pilot Study

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BALTIC GRID

One of the major objectives of BALTEX Phase I was the development of coupled atmosphere-land-ocean-models for the Baltic Sea basin. This aim has been achieved and at least two coupled systems have been developed, the *Regional Coupled Atmosphere-Ocean Model (RCAO)* at the Rossby Center in Sweden and the *BALTEX-Integrated-Model-System BALTIMOS* at the Max-Planck-Institute for Meteorology in Germany. For BALTEX Phase II, these models will be further developed and applied for BALTEX research, and will produce an enormous amount of data. These data are of very high scientific potential, and the analysis, validation and improvement of the models need international collaboration of different scientists, not only modellers. These models can be seen as nuclei for the development of Earth System Models (ESM) of the Baltic region. Regional Earth system modelling belongs to the group of grand challenge problems with long model runs on supercomputers and high data storage requirements. Regional Earth system modelling of the BALTEX region requires an infrastructure for which BALTEX with its international cooperation and contacts has created an ideal basis. The BALTEX region constitutes an ideal test bed not only for model development and validation as well as developments in satellite techniques, but also for grid technologies - the BALTIC GRID. In the near future, scientific experiments (models and observations) will become more detailed and complex via improved modelling tools and new observational techniques such as new satellite sensors. This will cause a tremendous increase in information and data. The emphasis for BALTIC GRID until 2012 will be directed to the extension and intensification of the BALTEX communication network to share expertise and databases rather than distributed computing.

BALTIC GRID Pilot Study

As a first step to BALTIC GRID, the BALTEX SSG initiated a Working Group on BALTIC GRID to coordinate activities and promote a BALTIC GRID Pilot Study. The intention of the pilot study is to intensively utilize the BALTEX community network to initiate the formation of international research groups to start important research

Announcement:
Assessment of Climate Change for the Baltic Sea Basin
International Conference
Göteborg, Sweden, 22-23 May 2006
For details see page 30

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within BALTEX Phase II. Furthermore, the research groups will be ideally suited as core groups to initiate funding proposals directed to both the EU and national funding agencies.

The target period for the pilot study will be 1999 to 2005. This period includes the BRIDGE period and recent extreme inflows to the Baltic Sea as well as extreme hot summers and flooding. Thus, this period is extraordinarily suited to study extreme events in the Baltic catchment. A synthesis of BALTEX BRIDGE is up to now missing. With modelled data and corresponding observations including satellite data, a synthesis would be possible including a detailed quantification of the energy and water cycles of the Baltic Sea basin. The BALTIC GRID Pilot Study should last for about 2 years. Participating research groups should take advantage of existing observations and satellite data in conjunction with model simulations of the target period. Thus, data needed include model data from process models and coupled atmosphere-land-ocean models, and observations consisting of basic measurements of atmosphere, land and ocean, flux-measurements and satellite data. The general objectives with focus on the target period are:

- determining the energy and water budgets of the Baltic Sea catchment
- quantification of fluxes between atmosphere and land, as well as between atmosphere and the ocean including sea ice
- quantification of uncertainties
- study of extreme events

The following projects or case studies have been identified as a framework of potential sub-projects (SPs) within the BALTIC GRID Pilot Study:

SP BRIDGE Synthesis (Quantification of the Energy and Water Cycle including P-E)
This subproject focuses on the quantification of the energy and water cycle of the Baltic Sea catchment with the intention to determine river runoff, P-E, in- and outflow through the Danish Straits, as well as im- and export of heat and water vapour to the BALTEX area as accurate as possible. For the target period, the mean conditions and their variability should be determined also as reference for further studies. Thus, projects should be grouped around the following items:

- inventory of observations and satellite data
- budgets and uncertainties
- climate variability

SP Coastal Regions
The atmospheric boundary layer (ABL) over the Baltic Sea is typically not entirely in balance with the local sea surface, but there is a certain coastal influence. This influence might reach as far as 100 km off the coast, thus, major parts of the ABL over the Baltic Sea are under coastal influence. Furthermore, coastal waters are the important transition zone between the coast and the deep basins of the Baltic Sea, and there is still little knowledge whether fluxes of heat and material (salt, nutrients and toxic substances) are directed from the coastal area to the open sea or vice versa. Projects should be grouped around the following items:

- atmospheric boundary layer, atmosphere-ocean and atmosphere-sea ice-ocean fluxes
- coastal mesoscale features
- coastal seas and transports including up- and downwelling
- sea ice dynamics and ice thickness distribution

SP Wind, Water Vapour and Cloud Properties
This subproject aims at the comparison of the representation of wind, water vapour and clouds in coupled atmosphere-land-ocean models with corresponding measurements by mainly using satellite data. Wind, water vapour and clouds strongly affect the air-sea and air-sea ice fluxes. Thus, this SP is strongly related to SP Coastal Regions.

- wind over water
- detailed analysis of clouds and water vapour

SP Großwetterlagen and Extreme Events (Forcing and Response)
Large scale and mesoscale weather patterns should be investigated in relation to extreme events. As the target period includes extremes such as hot summers, flooding and major inflows, typical weather patterns (classification) might be identified as responsible for extreme situations.

- classification, probability and extreme events
- convective Großwetterlagen and precipitation

BALTIC GRID - Proposals wanted

We like to encourage scientists of the BALTEX community who are interested to take part in the BALTIC GRID Pilot Study (see front page) to send in a single page proposal to the BALTEX Secretariat (baltex@gkss.de), not later than 28 February 2006 with the following specifications:

- relation to the subprojects (SPs)
- name of the project
- scientific objectives and aims
- data needs
- responsible scientist and partners
- time plan

Some ideas have already been received in response to an earlier e-mail announcement. These are already a part of BALTIC GRID and do not need to be re-submitted.

The Baltic Sea Climate: Today, Yesterday and Tomorrow - Part 2

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This is the second of three articles related to Baltic Sea research. The first one was published in BALTEX Newsletter, No. 7, 2005.

The Baltic Sea yesterday – A puzzle to piece

The Baltic is one of the most studied seas in the world and still we know far too little about it. How do the climate systems work and how do they affect our large inland sea? The answer may lie in the past. To understand what is happening today, we must find out what happened yesterday. Only then will it be possible to say anything about the future.

Dramatic past

The history of the Baltic Sea is one of major and dramatic changes. In the last 20,000 years, the Baltic Sea has been both the Baltic Glacier Lake with currents of fresh glacier water from the inland ice and the Litorina Sea, fed by inflows of saline ocean water. Our understanding of this is based on studies of shorelines and sediment. There are no modern climate archives available, no measurements of temperature, pressure, humidity and wind strength, and for that matter no eye-witness accounts. In light of the dramatic prehistory, it seems reasonable to believe that climate changes during the historical era have been rather minor. Is that true? Do we have any evidence to support the claim? And why is it so important to know how the climate has varied over, let's say, the last thousand years?

A misused curve

A few years ago, American scientist Michael Mann launched his thesis on global temperature variations during the past millennium. Using indirect observations from earlier times and measurement series from 1850 and onwards, he showed that the variations were small until a hundred years ago, when there was a steep rise in the curve. Many have used Mann's curve to support the theory that the higher quantity of greenhouse gases impacted the climate in the 20th century. Others, with some justification, have questioned both Mann's method and his results.

Mann's conclusions are based on a skewed distribution of data. While the mass of information certainly becomes denser when we gain access to instrumental data, its reliability is inadequate. Data on temperature in the sea are few. The measurements were taken on land and frequently in areas of strong population growth. Sites and instruments were often changed.

From the majority of the period, we have only sparse, indirect observations of tree rings, sediments, and drill cores; observations that have been translated to temperature. These are reinterpretations that entail a large measure of uncertainty. Nor is ground temperature alone sufficient to characterize something as complex as the climate. Our studies of the Baltic Sea show that the total heat balance must be taken into account (Omstedt and Nohr, 2004). Such an analysis will perhaps not become reliable for the entire Earth's heat content until we can combine instrumental and global satellite data. Here, there is a great deal for future GEWEX/BALTEX research to do.

Climate archives must be supplemented

Mann's thousand-year curve should not be taken as gospel. The conclusion that the 20th century was unique may be a hasty one. What if the deviation is only an expression of longer and better measurement series, or constitutes a normal variation that becomes apparent only when longer periods of time are studied in detail? What was the situation in the 1930s…the early 1700s…the Middle Ages?

If anything, Mann's work emphasizes the need for more in-depth studies. Existing climate archives must be supplemented with new ones. Let me give one example. One of the most intriguing long climate series shows how the Baltic Sea has frozen year by year from the early 1700s to the present day, Figure 1. The bar chart shows the ice cover extent every year. The greatest climate change in the period takes place in the late 1800s. The breakpoint marks the end of the "Little Ice Age" and the beginning of the

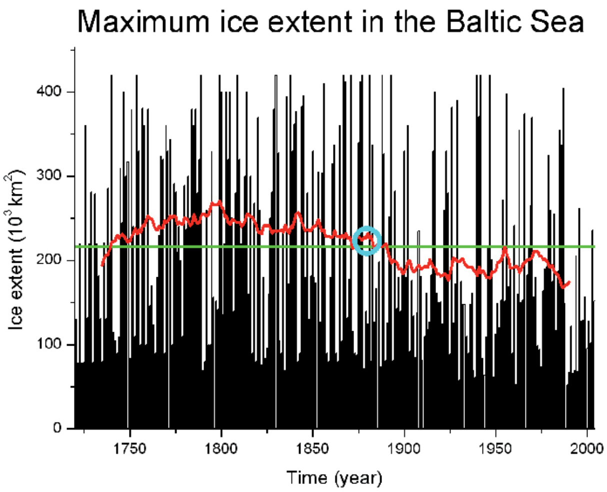

Figure 1. *Baltic Sea ice cover extent. Annual size of the Baltic Sea ice cover extent since the 1700s based on various types of observations. The annual variation is large, but the variations are considerably smaller when illustrated as 30-year mean values (red curve). The green line shows the average size of the ice for the entire period and the circle marks a breakpoint where the climate changed and the Little Ice Age ended.*

milder period we are in today. What caused the climate change is uncertain, but our studies show that many low-pressure fronts moved in over the Baltic Sea during this phase (Omstedt et al., 2004).

Our understanding of the distribution of the ice is based on various types of information. In modern times, data are provided by weather stations, ice-breakers, the coast guard, and satellites. Earlier observations are based on information found in newspapers, lightship logs, other log-books, travelogues, and similar sources. But that kind of information is becoming increasingly thin. To find out about the distribution of the ice before 1720, we must employ other methods.

Invasion across the Great Belt

Our research team analyzed the correlation between winds and ice (Omstedt and Chen, 2001). Using reconstructed atmospheric pressure, we could connect to how the winds blew and the ice distribution. As usual, it involved a combination of measuring data and indirect methods. There are only a few indirect measurement series available for Northern Europe before 1720. Unevenly distributed information of varying quality is a problem. Despite that, we believe our model can tell us something about how the climate has varied in the Baltic Sea, Figure 2.

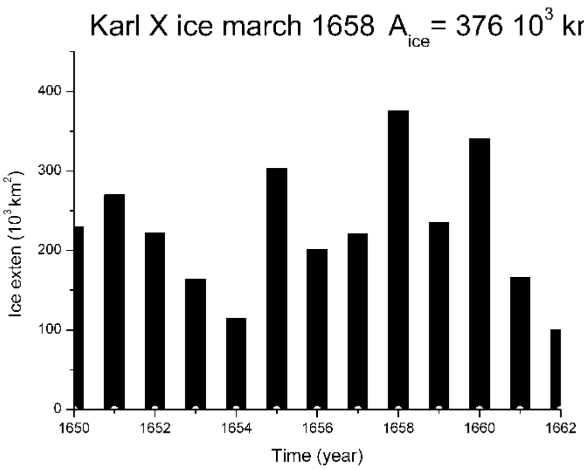

Figure 2. *Model calculation of the Baltic Sea ice cover extent. The climate model calculations of the ice cover extent in the 1650s. The model indicates that there was a great deal of ice in 1658, which is consistent with the historical fact that King Carl X Gustaf and his army walked across the Little Belt and the Great Belt that year.*

We also got help from an unexpected source: the old Swedish monarch Carl X Gustaf (Figure 3), who walked with his army across the ice in the Little Belt and the Great Belt in 1658. Our model calculations (Figure 2) also indicate that it was cold that year. A documented historical event thus supports our calculations and shows how historical archives can be meaningful to climate research.

Figure 3. *The painting. Carl X Gustaf studies the battle at Little Belt, 1658. Artist: J.P. Lemke. Photo: The Swedish National Museum, Stockholm.*

Piecing a puzzle

Swedish researchers have formed a network aimed at mapping the climate of Sweden for the past two thousand years (MUSCAD: http://www.geol.lu.se/proxy/). One of the subjects of discussion is the value of historical documents as sources of knowledge about the climate. Sweden has unique documents that have never been examined in this context. Working together, humanist researchers and scientists can piece together a picture of past seas and ancient climates.

Wanted: Young scientists gifted with patience and imagination.

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New Scenario Simulations for the Baltic Sea

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Introduction

In several publications, the added value of Regional Climate Models (RCMs) for climate change studies has been demonstrated. A review of existing literature concerning climate change for the Baltic Sea basin is currently in preparation (von Storch, 2005). Applying data of global atmosphere-ocean General Circulation Models (GCMs) at their lateral boundaries, RCMs may provide useful information of the impact of anthropogenically induced climate change on the regional scale. Recently, a fully coupled atmosphere-ocean RCM, the Rossby Centre Atmosphere Ocean Model (RCAO) was utilized to carry out a series of four time slice scenario simulations for Europe including the Baltic Sea region for the period 2071-2100 (Räisänen et al., 2004). At the lateral boundaries of the RCM, data of two GCMs (HadAM3H from the Hadley Centre, U.K., and ECHAM4/OPYC3 from the Max Planck Institute for Meteorology, Germany) were used. For each of the two driving GCMs, two scenarios with different greenhouse gas emissions were calculated. The two so-called A2 and B2 scenarios follow the IPCC Special Report on Emission Scenarios (SRES).

The results suggest that river runoff to the Baltic Sea may dramatically increase in future due to increased precipitation in northern Europe. Graham (2004) calculated that the total mean annual river flow to the Baltic Sea changes in the four particular scenarios between -2 and +15% of present-day flow. In addition, the monthly mean wind speed over sea during winter and spring increases in two of the scenarios significantly, with up to 30% (Räisänen et al., 2004). Both increased freshwater inflow and increased mean wind speeds could cause the Baltic Sea to drift into a new state with significant lower salinity (Meier, 2005a). However, it was impossible to perform projections for salinity because the long internal response time scale of the Baltic Sea of about 20-30 years requires a spin-up period much longer than the 30-year long time slices of the scenario simulations. Furthermore, precipitation biases of control simulations using state-of-the-art RCMs and lateral boundary data from GCMs tend towards overestimation for northern Europe (Hagemann et al., 2004).

Hence, new scenario simulations using the so-called Δ-change approach were performed at the Rossby Centre to reduce model biases and to spin up future salinity. From the previous RCAO time slice experiments, 30-year monthly mean changes of atmospheric surface data and river discharge into the Baltic Sea were calculated. These changes were added to reconstructed atmospheric surface fields and runoff for 1903-1998 (Kauker and Meier, 2003; Meier and Kauker, 2003). Assuming that the variability of the 20th century will not change in future climate, four 96-year long scenario simulations using the ocean component of RCAO (RCO) and the modified atmospheric and hydrological forcing were performed. For wind speed, the assumption of unchanged variability is approximately true (Räisänen et al., 2004), allowing the calculation of changing sea level extremes.

There is another advantage of the new scenario simulations compared to earlier studies. The statistical uncertainty of simulated changes of extremes (e.g. sea level extremes) due to natural variability is reduced because the new scenario simulations are more than three times longer than the previous runs. To project storm surges at the end of the 21st century relative to the mean sea level of present climate, the global sea level rise and land uplift need to be considered in addition to storm surge changes caused by changing regional wind fields. The global average sea level is projected to rise from 1990 to 2100 by 9 to 88 cm (Church et al., 2001). Absolute land uplift rates were calculated from the station data for the apparent land uplift relative to the mean sea level 1892-1991 presented by Ekman (1996) adding an eustatic sea level rise of 1.5 mm/yr (Church et al., 2001).

Results for salinity

According to the four new projections performed at the Rossby Centre, the average salinity of the Baltic Sea in 2071-2100 will decrease between 7 and 47% (Figure 1). Although the results of the scenario simulations differ considerably, all changes are larger than simulated natural variability. Both factors, increased freshwater inflow and increased monthly mean wind speed, explain the calculated reductions. However, even with the highest projected freshwater inflow, the Baltic Sea will not be transformed

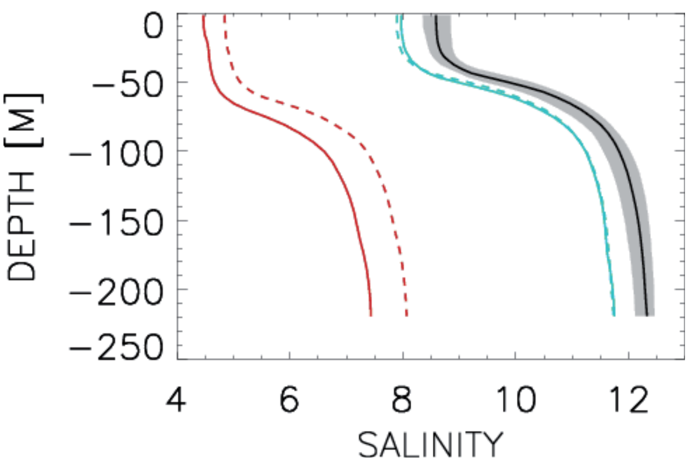

Figure 1. *Median profiles of salinity (in psu) for 1961-1990 and 2071-2100 at Gotland Deep. Present climate (black solid line, shaded areas indicate the range between the first and third quartiles) and four scenarios using two driving global models and two emission scenarios (blue and red lines).*

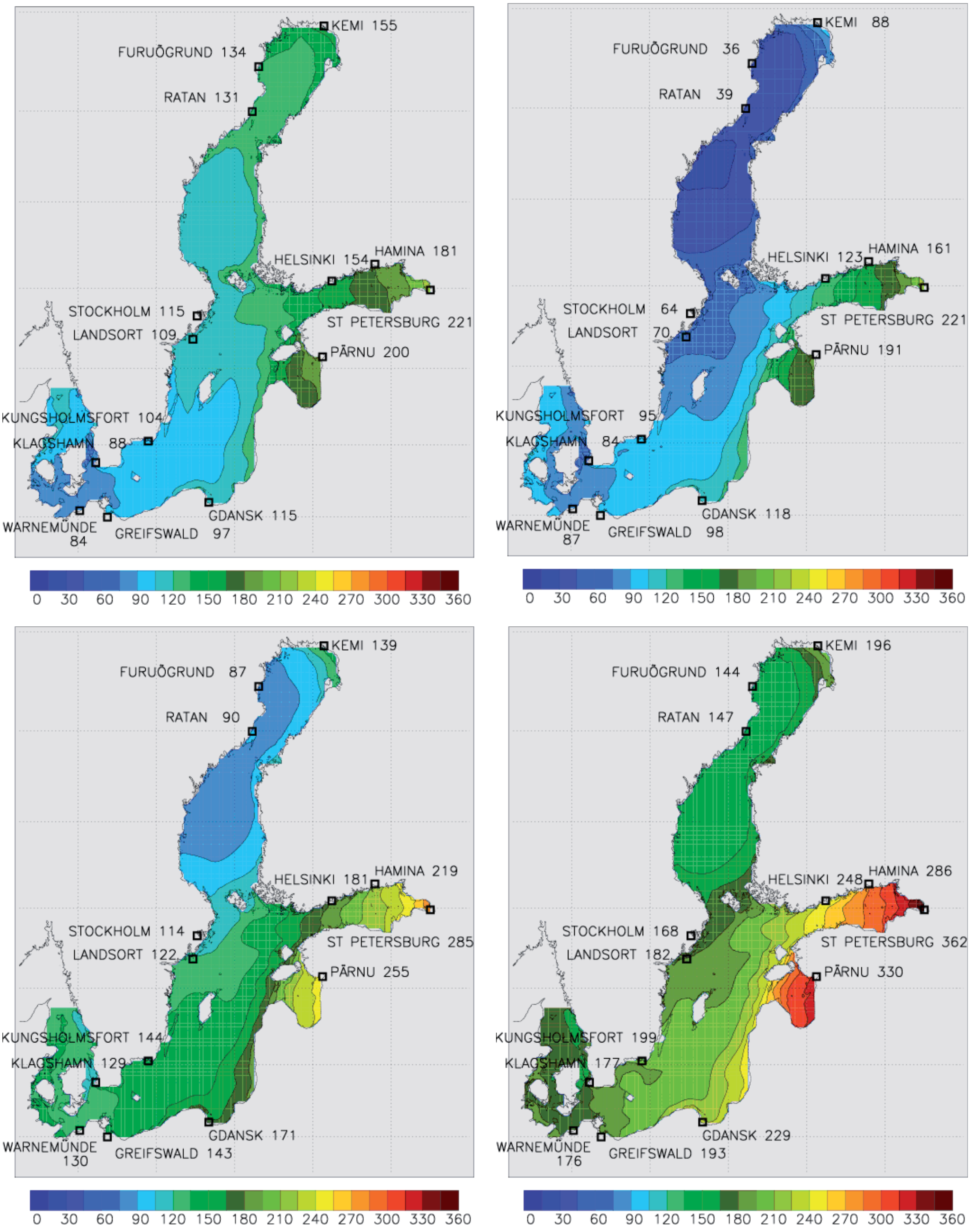

Figure 2. *Simulated 100-year surges (in cm) in present climate (upper left panel) and in three selected regional scenarios relative to the mean sea level 1903-1998: `low case´ scenario assuming a global average sea level rise of 9 cm (upper right panel), `ensemble average´ scenario assuming a global average sea level rise of 48 cm (lower left panel), and `high case´ scenario assuming a global average sea level rise of 88 cm (lower right panel). Land uplift is considered.*

into a freshwater lake because the relationship between freshwater supply and average salinity of the final steady state is found to be nonlinear. A pronounced halocline still separates the upper and lower layers in the Baltic proper, limiting the impact of direct wind induced mixing to the surface layer. Although changes of freshwater inflow and wind speed may cause the Baltic Sea to drift into a new state with considerable lower salinity, the ventilation of the deep water will not significantly change because the vertical overturning circulation will partially recover (Meier, 2005b).

Results for sea level extremes

To estimate the impact of the uncertainties of the global and regional model results and of the emission scenarios of anthropogenic greenhouse gases, three sea level scenarios were calculated. Firstly, a \`low case´ scenario is estimated, using the regional model with the smallest changes of the 100-year surge together with the lower limit for the global average sea level rise of 9 cm. Secondly, an \`ensemble average´ is calculated from the results of the four regional projections (including two forcing GCMs and two emission scenarios, A2 and B2), assuming a global average sea level rise of 48 cm, which is the central value for all scenarios (not only A2 and B2) presented by Church et al. (2001). Thirdly, a \`high case´ scenario is estimated using the regional model results with the largest changes of the 100-year surge together with the upper limit for the global average sea level rise of 88 cm. 100-year surges of the three selected scenarios relative to the mean sea level 1903-1998 are shown in Figure 2.

In general, land uplift and the global average sea level rise are the dominant contributions to the future changes of the mean sea level in the Baltic. This is not necessarily the case for changes of sea level extremes because in the \`high case´ scenario, 100-year surges will increase significantly more than the mean sea level. To illustrate this effect, the Estonian station Pärnu is selected where the simulated 100-year surge (200 cm) is in very good agreement to observations (196 cm). A simple method to estimate future 100-year surges would be to add the results of the mean sea level and observed 100-year surges. According to the simple method the \`low case´, \`ensemble average´, and \`high case´ scenarios for the 100-year surges would result in 190, 237, and 289 cm, respectively. Taking into account that sea level extremes will increase significantly more than the mean sea level the corresponding figures for Pärnu are 191, 255, and 330 cm (Figure 2). Thus, in the \`low case´ scenario, about the same changes are found, but for the \`high case´ scenario the difference of the changes amounts to 41 cm which is larger than the land uplift in Pärnu according to Ekman (1996). For further details the reader is referred to Meier (2005b).

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DEKLIM: Regional Process Studies Wrap-Up

The regional process studies in the Baltic Sea area of the German Climate Research Programme DEKLIM have come to a finalisation in 2005. The final symposium in Leipzig in May has been highlighted already in the last issue (# 7) of this newsletter; but we feel that a concluding presentation of these projects which have been at the core of BALTEX is worthwhile. The following 17 pages show summary articles of the projects: what was intended, what was achieved.

APOLAS - More Accurate Areal Precipitation over Land and Sea

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Abstract
Long term field comparisons of four progressive precipitation sensors demonstrate their superior performance. Measurements yield differences in cloud micro physics between land and sea and between surface and higher altitudes. A pattern recognition algorithm based on CAPPI-fields of Rostock weather radar was developed to separate convective from stratiform rain areas.

Introduction
All efforts in modelling precipitation necessitate reliable data bases, highly resolved in space and time. Unfortunately, standard instruments as used at synoptic stations show a number of systematic errors especially at high wind exposure as it is typical for a marine environment. Weather radar networks like NORDRAD (Michelson and Koistinen, 2000) or other remote sensing techniques may provide such precipitation fields, but a sufficient accuracy can be achieved only by making use of auxiliary in-situ measurements of both, precipitation rate and precipitation micro physics. The main goal of APOLAS was therefore to investigate the performance of novel sensors and to demonstrate the usefulness of these sensor data for an improved radar based precipitation measuring concept.

Results
Ship rain gauges (SRG, Hasse et al., 1998), optical disdrometers (OD, Großklaus et al., 1998), a prototype of a mini sodar (MS, Pang and Graßl, 2005), and micro rain radars (MRR, Peters et al., 2002) were tested against classical Joss Waldvogel (JW) disdrometers. While SRG gives rates only, all other instruments provide also drop number densities (DSD) as a function of drop diameter. The OD is an in-situ instrument like the JW, sampling volumes are of comparable size. The MS and MRR are vertical sounding remote sensors, with sounding ranges up to a few decametres (MS) to some kilometres (MRR) and much larger sampling volumes than in-situ sensors. Measurements were performed at several sites at the German coast of the Baltic Sea and onboard of RV ALKOR.

Measurements were classified according to the kind of precipitation, stratiform or convective, rain rate, and wind speed including moderate and extreme conditions. To separate precipitation events in convective and stratiform ones, a new procedure based on weather radar measurements has been developed.

During moderate conditions, all sensors show satisfying performance with some differences in drop size densities of smallest and largest measured drops. Under extreme weather conditions the sensors' performance differ considerably. The JW shows a systematic underestimation of the number of small drops under both, high winds and heavy rain (Figure 1). In contrast, the MRR and the OD show nearly no influence of wind speed on the shape of measured spectra. Measured rain rates of the MS prototype correlate well with those measured by other sensors, correlation coefficients reach from 0.82 (JW) to 0.96 (OD). However, for heavy showers with strong winds, the MS gives higher rain rates than all other devices. Radar reflectivities of the MRR and Rostock radar show unexpectedly high correlations.

A statistical analysis of OD data classified in rain rates show that almost all mean DSDs measured over land contain smaller drops than DSDs derived over sea. Since artefacts due to measurement techniques can be excluded, the differences are real and reflect different meteorological conditions over land and sea, e.g. stability. Profile measurements of MRRs support these results; for all rainfall classes the velocity jump at the height of the melting layer is significantly higher over Christiansø (close to conditions over sea) than over Zingst (conditions over land), indicating larger drops over Christiansø.

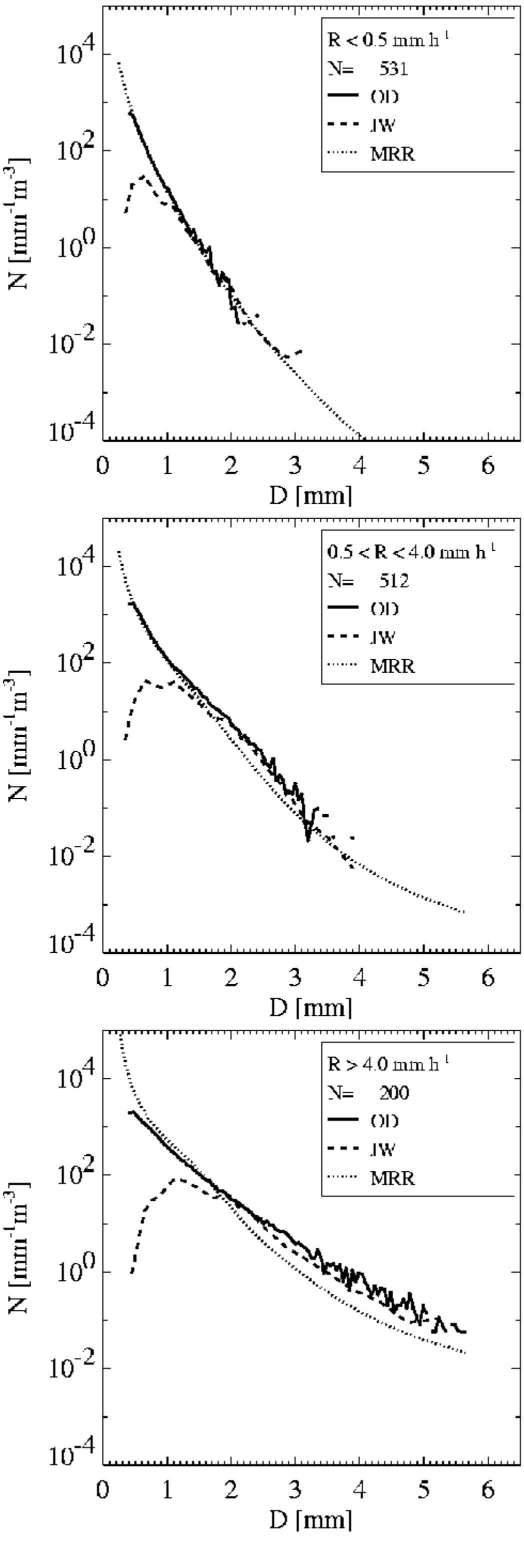

__Figure 1.__ Average drop size densities as a function of drop diameter for light, moderate, and heavy rain (from top to bottom), as measured by the OD, JW, and MRR in Westermarkelsdorf at wind speeds exceeding 5ms^{-1}

For estimating areal precipitation, an advanced CAPPI (Constant Altitude Plan Position Indicator) has been developed (Figure 2). Unlike conventional CAPPIs, all radar range bins intersecting a grid pixel are used with appropriate weighting. Corrupted pixels are effectively reduced by filtering. The pattern recognition algorithm, mentioned

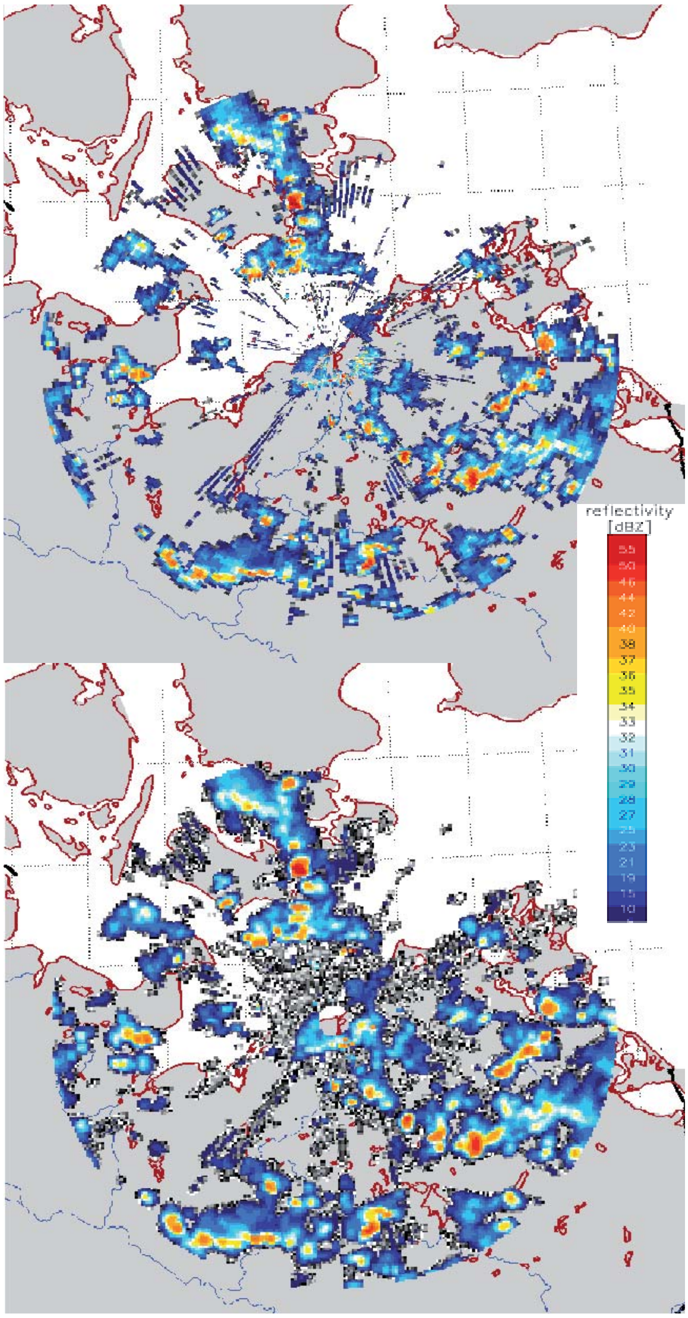

__Figure 2:__ Lowest PPI of a precipitation event from September 2003 (upper) and lowest CAPPI of the same event (lower), derived from Rostock weather radar reflectivities

above, is based on these CAPPIs. Two characteristics of convective cells (the higher vertical extent and higher maximum reflectivity) are used to detect the cell core. Several control mechanisms including temperature data from radiosondes are part of the algorithm.

Seasonal precipitation fields, estimated from SRG measurements over the Baltic Sea on merchant ships and RV ALKOR (Clemens and Bumke, 2002) were compared to synoptic rain gauge data, corrected for systematic errors (Rubel and Hantel, 1999) and the regional climate model output as part of BALTIMOS (Jacob et al., 2005). While SRG measurements compare well with synoptic rain gauge data at coastal sites and on islands, REMO overestimates precipitation especially in autumn along all coasts with mainly onshore wind conditions (Ober-Bloibaum, 2005).

Conclusions

Although precipitation is one of the most important of all weather elements, it is predicted with lowest quality. The combination of novel in-situ instruments, vertically sounding instruments, and a weather radar gives promising prospects to improve precipitation fields from weather radar reflectivities. Such improved areal precipitation fields are a prerequisite to improve precipitation forecast, important also for water management or agriculture and at least important for climate modelling.

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BALTIMOS - Development and Validation of a Coupled Model - System in the Baltic Region

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In the frame of BALTEX, a fully coupled model system for the Baltic Sea region, called BALTIMOS (http://www.baltimos.de), was developed by linking existing model components for the atmosphere (REMO, Jacob 2001), the ocean including sea ice (BSIOM, Lehmann and Hinrichsen, 2000, 2002) and for hydrology (LARSIM, Bremicker, 2000), as well as for lakes and vegetation (Figure 1). This investigation was funded by DEKLIM (German Climate Research Programme 2001-2006; http://www.deklim.de) as a combined effort of 10 different German institutions, coordinated by the Max Planck Institute for Meteorology in Hamburg.

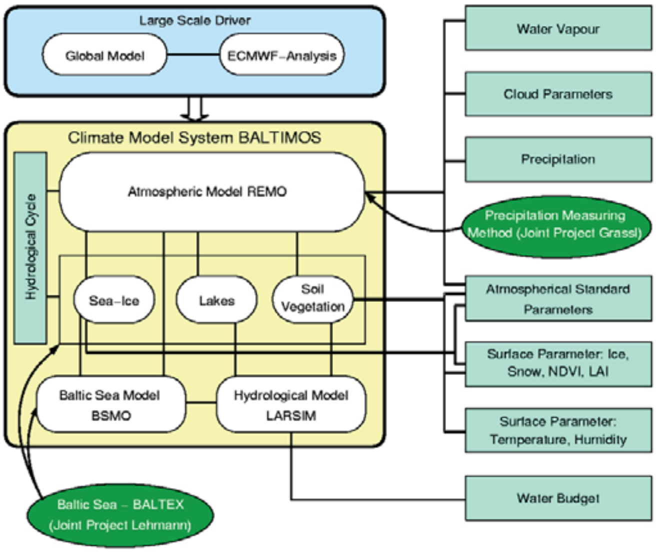

Figure 1. *BALTIMOS including the validation parameters*

The focus of the development was on model validation rather than on long-term climate simulations (which will be performed later). Thus, the simulated water and energy budget of the Baltic Sea area undergoes a comprehensive validation, including means as well as extremes like the salt water inflow 2003 (Lehmann et al., 2004).

With BALTIMOS, the energy and water budgets in the period from 1999 to 2003 have successfully been recalculated and a detailed inter comparison against available observations of the water cycle components on different time and space scales has been carried out (for more details see www.baltimos.de). The results of the coupled model BALTIMOS demonstrate the powerful applicability of coupled numerical simulations. The strategy behind BALTIMOS is to develop a model system which can be utilized for present day simulations of the Baltic area with the focus to understand present day climate variability, and which can also be used to study possible changes in the water and energy budgets under climate change scenarios.

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BASEWECS - Influence of the Baltic Sea and its Annual Ice Coverage on the Water and Energy Budget of the Baltic Area

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BASEWECS is a contribution to the German Climate Research Program DEKLIM. The project started in May 2001 and lasted until December 2004. BASEWECS aimed at the investigation of the influence of the Baltic Sea and its annual ice coverage on the water and energy budget of the BALTEX area.

Aim of the research in the framework of DEKLIM

The computation of the energy and water budget is a milestone in controlling the quality of numerical models, which later can be used for studies of extreme events and climate change in the Baltic area. Improved knowledge of the energy and water budgets can only be obtained from sophisticated numerical models, including data assimilation and model validation. The consortium used a 3 dimensional coupled sea ice-ocean model (BSIOM) driven by observed meteorological input fields and runoff data, in order to obtain the most accurate response of the Baltic Sea. The results have been compared to the results of an interactively coupled model of atmosphere, land surfaces, the Baltic Sea and sea ice (BALTIMOS).

Main conclusions

Three-dimensional ocean circulation models of the Baltic Sea (including ice) have reached a sufficient state of accuracy, so that a coherent picture of the circulation and the water mass exchange within the Baltic Sea can be described. The energy and water cycle can be determined for the Baltic Sea, but uncertainties remain mainly in the forcing functions, by unresolved processes such as turbulent mixing and the limited resolution of the hydrodynamic model. Improved atmospheric forcing data and river runoff are urgently needed. The flux parameterisation needs to be revised and further studies with respect to turbulent mixing and the effects of waves on mixing and fluxes need to be investigated. The improved understanding of the dynamics of the surface layer of the ocean is crucial for turbulent processes which control the exchange of momentum, heat, dissolved and particular matter. Subproject B contributed to this issue and improved the understanding of the energy transport within the mixed layer by complex measurements of dissipation and turbulence. The parameterization of turbulence in ocean circulation models should mirror the observed relations between the wind and surface turbulence regime with respect to both intensity and vertical scale. Subproject C has shown that the water transport through the Fehmarn Belt can be described with good accuracy by the combination of transport measurements at only one position and BSIOM. However, the accurate measurement of heat and salt fluxes need, because of the high variability, more measurement sites across the Fehmarn Belt. Subproject D has demonstrated that sea level variations are satisfactorily described by BSIOM with good accuracy for high frequency variations and some underestimation at seasonal and inter-annual time scales. An improvement can be achieved if observed sea level observations of the North Sea are applied as western boundary of BSIOM.

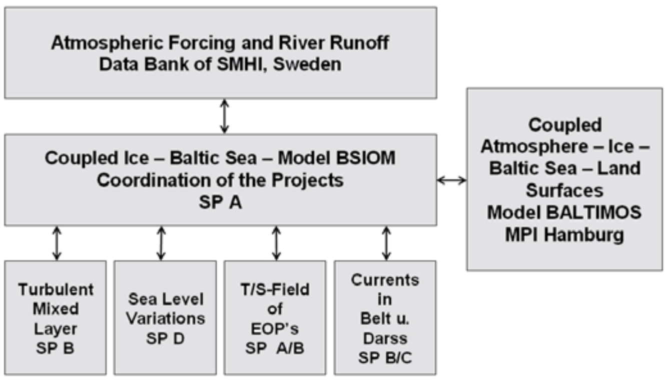

Figure 1. *Cooperation within BASEWECS*

BSIOM has become the ocean model component of BALTIMOS, a regional climate model of the Baltic area. Simulations show that this model system is able to realistically describe extreme inflow events. A model system has been developed which proved to be suitable for regional climate change studies. Such sophisticated model systems are the basis for regional earth system models.

BASEWECS - Subproject A : Energy, Water, Salt and Sea Ice Cycle of the Baltic Sea *(IFM-GEOMAR)*

The main goal of the project was the accurate determination of the energy, water, salt and sea ice budget of the Baltic Sea by utilizing a high resolution coupled sea-ice ocean model (BSIOM, Lehmann and Hinrichsen, 2000). Beside this, the focus of the research was directed to the general circulation, extreme inflow events and up- and downwelling. Results of the subprojects B, C and D have been directly incorporated for model improvement, validation and assimilation. The period from January 1979 to December 2004 has been simulated and analyzed with respect to the energy and water cycle of the Baltic Sea. The water heat and salt exchange between the deep basins of the Baltic Sea has been determined (Lehmann and Hinrichsen, 2002). Extreme inflow events to the Baltic Sea have been modeled and validated with corresponding observations (Lehmann et al., 2004). BSIOM has become the ocean- sea ice- component of the regional climate model BALTIMOS, a coupled atmosphere-land-ocean model system for the Baltic region.

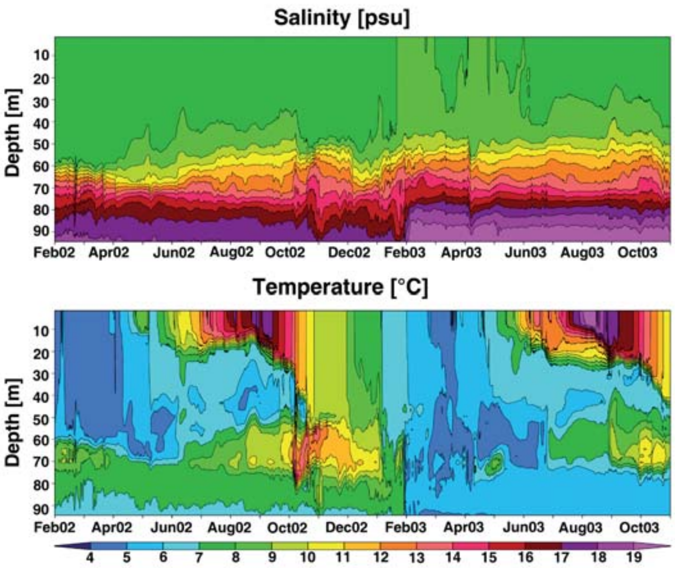

Figure 2. *Time series of vertical profiles of salinity [PSU] (upper panel) and temperature [°C] at Bornholm Deep vs. Time from February 2002 until October 2003.*

Main conclusions

BSIOM has become an accurate and sophisticated tool to model the Baltic Sea. A coherent picture of the circulation and the water mass exchange with the North Sea could be achieved. Thus, the energy and water cycle of the Baltic Sea can be described with high level of accuracy. Furthermore, BALTIMOS has demonstrated that extreme inflow events can be simulated realistically (Figure 2). Thus, not only the causal conditions for extreme inflow events could be described with the regional climate model, but also the complicated in- and outflow regime and the corresponding salt and heat fluxes have been simulated in high agreement with the observations. A model system has been developed suitable for regional climate change studies.

BASEWECS - Subproject B: On the Vertical Structure of the Turbulent Mixed Layer in the Baltic Sea
(Institute for Baltic Sea Research Warnemünde)

The understanding of turbulence in the dynamic surface layer of the ocean is a key goal since turbulent processes are crucial in controlling the exchange of momentum, heat, dissolved and particulate matter between atmosphere and ocean. Until recently our knowledge of turbulence in the surface mixed layer has been severely limited by the difficulties to make measurements of the fluctuating velocity components near the sea surface remote from a disturbing platform (ship), carrying the necessary equipment. There are different conceptual models of the ocean mixed layer which differ even in the causal relation between turbulence and mean current. However, proving a conceptual model by field observations remains a challenging task because both the superposition of wave motion and turbulence as well as the highly intermittent nature of the turbulence impede the access to statistically reliable results. In this project, we attempted to study the relations of the dissipation of turbulent kinetic energy and the surface wind-waves in the upper surface mixed layer of the sea by means of a rising dissipation profiler (MSS). Emphasis was given on the evaluation of the relation between the thickness of the transition layer and the wavelength of the peak of the wind-wave spectrum, as well as on the depth dependence of the dissipation from the sea surface down to the shear production layer.

A layer of extreme high turbulence dissipation was observed with a thickness of one significant wave height Hs right beneath the sea surface. Below this, another layer of enhanced turbulence dissipation was found whose thickness Hp was related to the wave length of the peak of the surface wave spectrum. Turbulent dissipation in the interior of the water column was independent of the surface waves and related to the mean current shear.

Main conclusions

The results of the non-linear regression of the decay of dissipation with depth imply that the turbulence regime in the surface layer is closely correlated with surface wave regime. It consists of an injection layer with a thickness of the significant wave height. Nearly one third of the turbulent energy flow from the atmosphere to the ocean is dissipated within this injection layer. Below the injection layer, a transport layer is located which has a variable thickness determined by the wave length associated with the peak frequency of the wind wave spectrum. Dissipation decays with depth according to an exponential law within this layer. A smooth transition exists from the transport layer to the underneath laying classical law of the wall layer (Figure 3). The parameterisation of turbulence in ocean circulation models should mirror the observed relations between the wind and the surface turbulence regime with respect to both intensity and vertical scale.

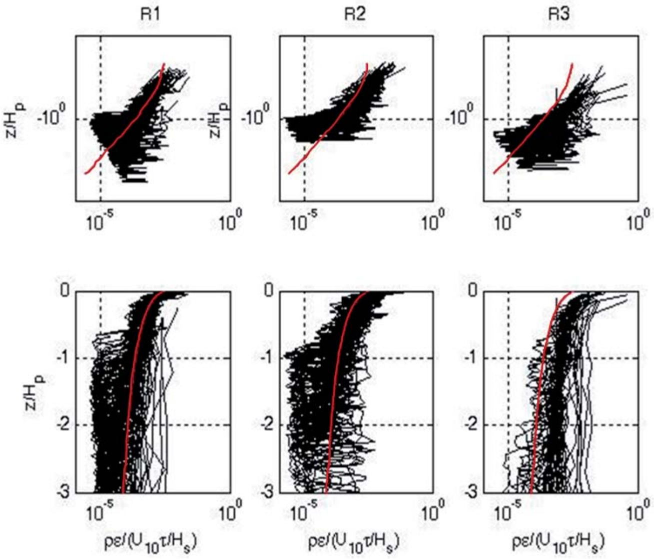

Figure 3. Normalised dissipation versus normalised depth in log-log and semi-log coordinates. The red line indicates the wall-layer dissipation profile.

BASEWECS - Subproject C: Water Mass Exchange through the Fehmarn Belt *(IFM-GEOMAR)*
The key question to answer within the project was to which accuracy it is possible to estimate the total transport through the Fehmarn Belt and thus one of the two major components of the total water mass exchange, from vertical profiles of moored current measurements at a single position. From May 2002, an Acoustic Current Doppler Profiler (ADCP) has been moored at the southeastern entry of the Baltic Sea to the Fehmarn Belt, providing time series of vertical current profiles at a resolution of better than 1 day in time and 2 m in the vertical. As part of a detailed correlation analysis, König (2004) has used low pass filtered daily averages of in-situ currents from the year 2003 for comparison with current data output from the model of Lehmann and Hinrichsen (2002). The major result is that the vertically integrated in-situ current component, which is parallel to the main axis of the belt, correlates highly (r=0.92) with the amplitude of first Empirical Orthogonal Function (EOF) from the model transport, normalized to the section area. This shows that the vertically integrated current at that position indeed is a measure for the total transport, and thus can be taken as such.

Main conclusions
Measurements of vertical current profiles at the southeastern entry of the Fehmarn Belt can be used to estimate the total transport through the Fehmarn Belt, and model simulations performed well to describe the net flow through the Fehmarn Belt, which gives confidence also to its outputs where comparisons with direct measurements are not possible.

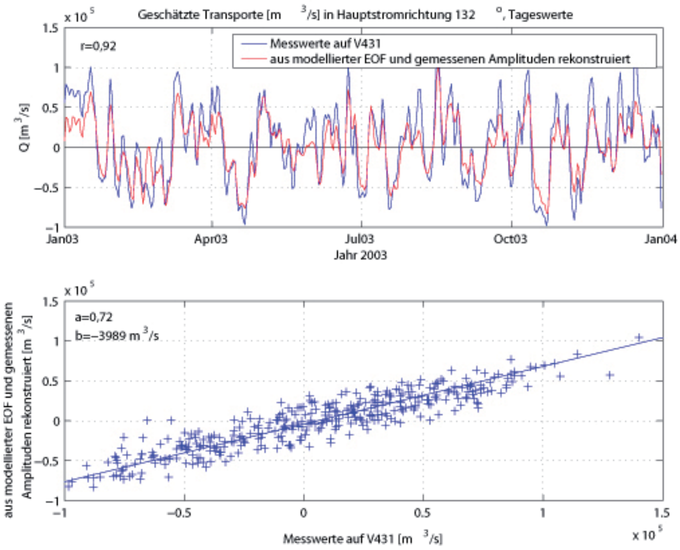

Figure 4. Upper panel: Comparison of observed and modelled transport through the Fehmarn Belt. The simulated transport was constructed out of the 1st EOF of the modelled transport and observed amplitudes. Lower panel: correlation between observed and modelled transports.

BASEWECS - Subproject D: Validation of Modelled Sea-Surface Elevations by Comparison with Observed Sea-Levels *(Dresden University of Technology)*
The main task of the project was the validation of the Baltic Sea sea-ice-ocean model (BSIOM; Lehmann und Hinrichsen 2000) in terms of its sea-surface elevations by comparing them with observed sea-level heights obtained from tide gauges, satellite altimetry and GPS. An off-shore, multi-sensor sea level monitoring system was developed at the Dresden University of Technology, that provides precise sea-surface heights with short temporal lags (Eberlein et al. 2004). The system, which is composed of a GPS receiver, a tide gauge, an inclinometer and a data logger, was installed on two MARNET stations (Figure 5) in co-operation with the Bundesamt für Seeschifffahrt und Hydrografie and the Institut für Ostseeforschung Warnemünde, and became operational in 2003.

Main conclusions
The comparison of modelled and observed sea-level heights show the high quality of BSIOM. The model reproduces all main sea-level variations within the Baltic Sea (Novotny et al. 2002). High frequency variations and Baltic Sea internal effects are well reflected by the model, and the differences of observed and modelled sea-level heights are on average 10 to 15 cm. Low frequency va-

riations, which are mainly caused by external effects, are somewhat underestimated. However, it was shown that the model can be improved when observed sea-level observations in the North Sea are applied as western boundary (Novotny et al. 2004).

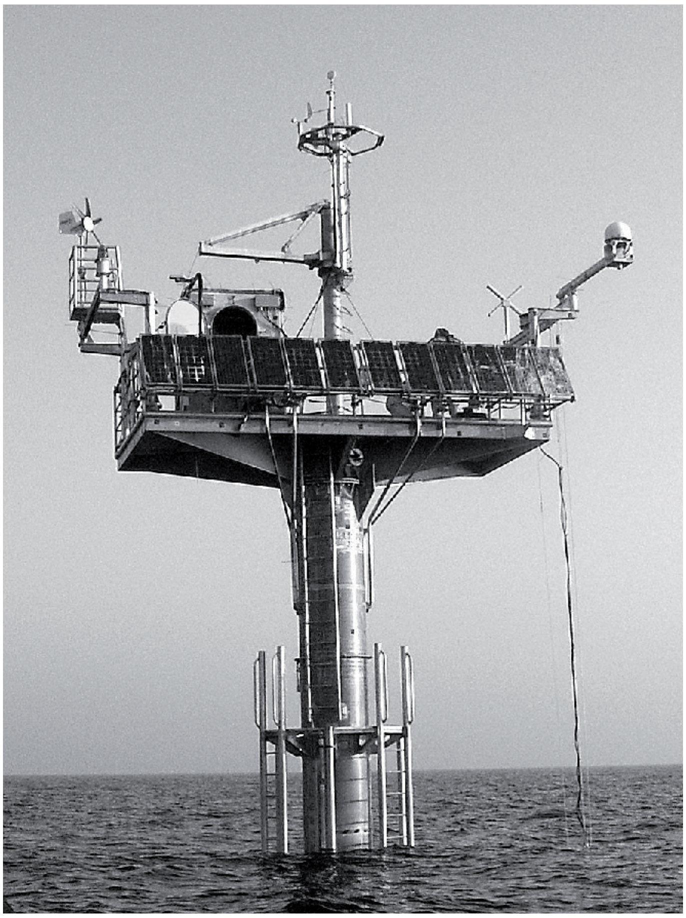

Figure 5*. MARNET station Arkona Sea. At the right hand side of the platform, the GPS antenna and the radar gauge can be seen.*

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BOBA - A 4D-Var Data Assimilation System for the Hydro-Thermodynamic Soil-Vegetation Scheme (HTSVS)

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Introduction

In the Baltic region, frozen ground and snow are frequent conditions that affect the exchange of heat, water, and trace gases at the land surface-atmosphere interface. To simulate these fluxes without prior-calibration - an important goal within GEWEX – frozen ground and snow metamorphism processes have to be treated in detail and the distributions of soil and snow temperature, snow height, volumetric water and ice content have to be reasonably well predicted. Herein a major difficulty is to consistently initialize the soil and snow state with the ceaseless interaction between soil, snow and atmosphere. As shown by Douville et al. (2000) for soil moisture, forecasts can be significantly improved by assimilating soil moisture data in a physically consistent way. Advanced spatio-temporal data assimilation algorithms that have the theoretical potential to provide a Best Linear Unbiased Estimator, like the four dimensional variational (4D-var) method are able to exploit consistently sequences of observations and the physical laws inherent in the model. Therefore, tangent-linear and adjoint components were developed for the Hydro-Thermodynamic Soil-Vegetation Scheme (HTSVS) coupled to the Penn/State NCAR mesoscale model generation 5 (MM5), i.e. the HTSVS was completed by a soil and snow assimilation system.

Brief description of the method

HTSVS consists of a one layer canopy model, a multi-layer soil model (Kramm et al., 1996) with inclusion of freezing and thawing, the related release and consumption of latent heat energy, effects of frozen soil layers on vertical fluxes of heat and moisture, water uptake by vertically variable root distributions (Mölders et al., 2003), a temporal variation of soil and snow albedo and snow emissivity, and a multi-layer snow metamorphism model (Mölders and Walsh, 2004).

The suite of state variables of the underlying model include soil temperature, volumetric water and ice content of the layers, snow height and snow temperatures, and the exchange parameters of the soil vegetation scheme. The task is to minimize a cost function, scoring the discrepancies between the model and observations scattered in space and time on the one hand, and the model and some other climatological or prior forecast state, on the other hand. Doing this in a spatio-temporal domain with adjoint modeling for gradient calculation, a complex variational minimization problem is solved, a procedure commonly referred to as 4D-var data assimilation. It requires the knowledge of the local gradient with respect to the initial state, which is supplied by the adjoint of the tangent linear version of the model. By taking the initial values as "control parameters", a scalar distance function (cost function) is defined that provides a measure of weighted distances between observations available and the values of the corresponding state variables predicted by the model during a predefined so-called "assimilation window" (Figure 1). This cost function J0, valid for the assimilation window, depends on the observations, the valued state variable x, the background fields xb, and its estimated background error covariance matrix.

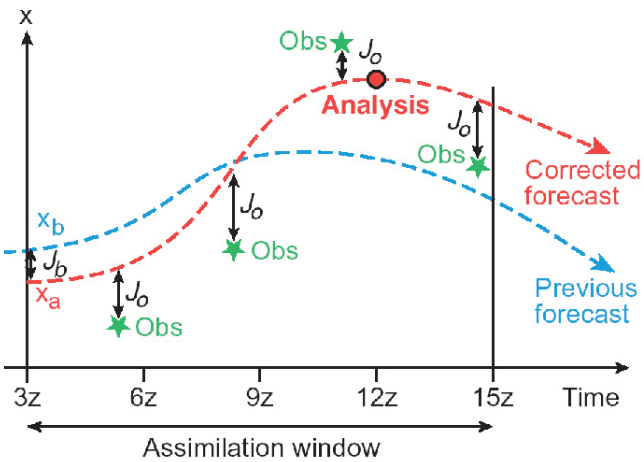

Figure 1. *Basic concept of 4D-var: Improvement of the model trajectory fit to the data starting from the first guess (previous forecast) to the final analysis*

The assimilation works as follows. A preceding MM5 run supplies HTSVS and its adjoint with the required parameters, which then iteratively and column wise estimate the optimal soil state and, if snow exists, snow state. In practice, the cost function is minimized via its gradient with respect to the soil temperature and volumetric water content and snow height as optimization parameters.

Results

Our case study describes a major melt event in the Baltic basin on April, 21 2000. This episode was selected (1) because of the inflow of warm southerly air masses and associated triggering of a distinctive melting during the afternoon, and (2) because soil temperature and snow height records were available from the BALTEX data base for 25 and 355 locations, respectively.

Assimilation of soil state

Figure 2 exemplarily illustrates how the compliance with observations is significantly improved after the assimilation, while thermodynamic consistency is maintained. Soil temperature observations are available for the upper three layers three times a day. These observations are assimilated during a 24 hours assimilation interval, yielding optimized estimates not only for the three upper most layers, but also for the two deeper layers, for which no observations exist. The assimilation removed the 2 K/d warming tendency in layers 3 (at 0.543 m depth), and 2 (at 0.233 m depth) that cannot be sustained by the observations, and enforced higher temperatures in the fourth layer. The depicted situation is typical in showing the property of 4D-var data assimilation of approximation to observations, while, at the same time, physical consistency is maintained in the spatio-temporal domain, and unobserved features are modified accordingly.

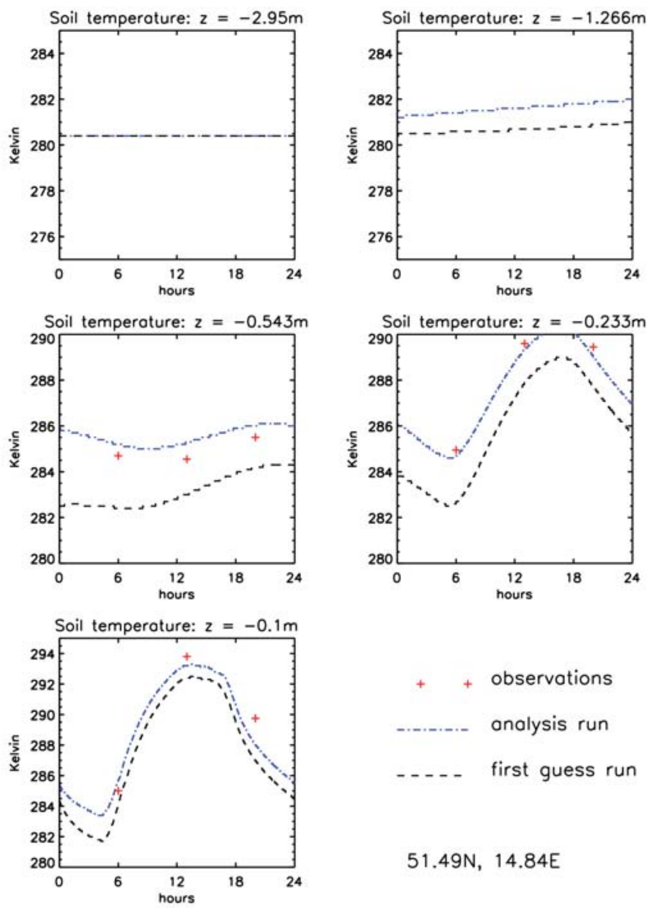

Figure 2. *Soil temperature evolution for April 21st, 2000. Assimilation interval 00h to 24h for all five model layers*

Physical consistency in HTSVS is also maintained between soil temperature and volumetric water and ice content. Hence, soil volumetric water content can be expected to be modified by the appreciable corrections of soil temperature performed in the assimilation procedure. In some cases, where the assimilation procedure accounts for (up to 3 K) too low model first guesses in soil temperatures in the two upper layers, soil volumetric water content diminishes (up to 0.05 m^3/m^3). Note that no simultaneous soil water content observations were available at locations with temperature profiles.

Assimilation of snow state

Snow height observations were available once per day. Thus, to achieve a reasonable temporal control, the assimilation interval was defined by two framing observations. Snow temperatures are rarely available, especially as vertical profiles of the snow cover are required. The HTSVS employs five equidistant model layers in the snow. The coupling of the related quantities by the model makes it feasible; at least to consistently correct for the vertical snow temperatures by given observations of snow height and near-surface air temperature.

Especially during snow melt events, the assimilation has to bridge a variety of possible discrepancies between the first guess and observations. If the MM5 simulation has a slight offset in warm air advection, snow melt may be overestimated in some locations. At 65.1°N, 29.4°E, for instance, a moderate decrease of snow height was observed, but a decrease of nearly 30 cm was predicted prior to assimilation. After the assimilation, the decrease is only 20 cm and onset of melting is delayed by about 2 h (Figure 3). The assimilation of snow height and temperature also yields more exposed diurnal snow temperature cycles that, as expected, decrease with depth. Minimised discrepancies between observations and post assimilation simulations in terms of the cost function can be claimed throughout the integration domain.

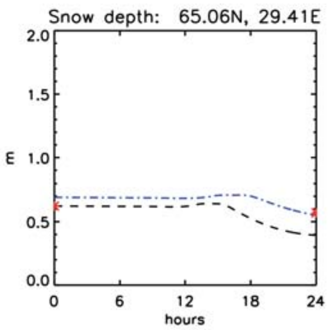

Figure 3. *Like Figure 2 but for snow depth*

A more difficult case occurs when the simulation without assimilation predicts a complete melting event, while, following observations, temperature does not enforce this to happen. The 4D-var assimilation system now has to bridge the gap between modeled melting and sustained persistence of the snow pack. Typically, in this case all snow temperature layers exhibit extremely strong diurnal cycles, which are damped with snow depth. The assimilation result correctly changes from the melting scenario to preserve the frost case, and snow temperatures exhibit a less pronounced diurnal cycle at all layers (Figure 4).

An intermediate situation is given when warm air advection only resumes slight melting during the last hours. Again the assimilation results in full agreement with observations, enforcing a reduced diurnal cycle for the layer snow temperatures, and an appreciable delay in time (not shown).

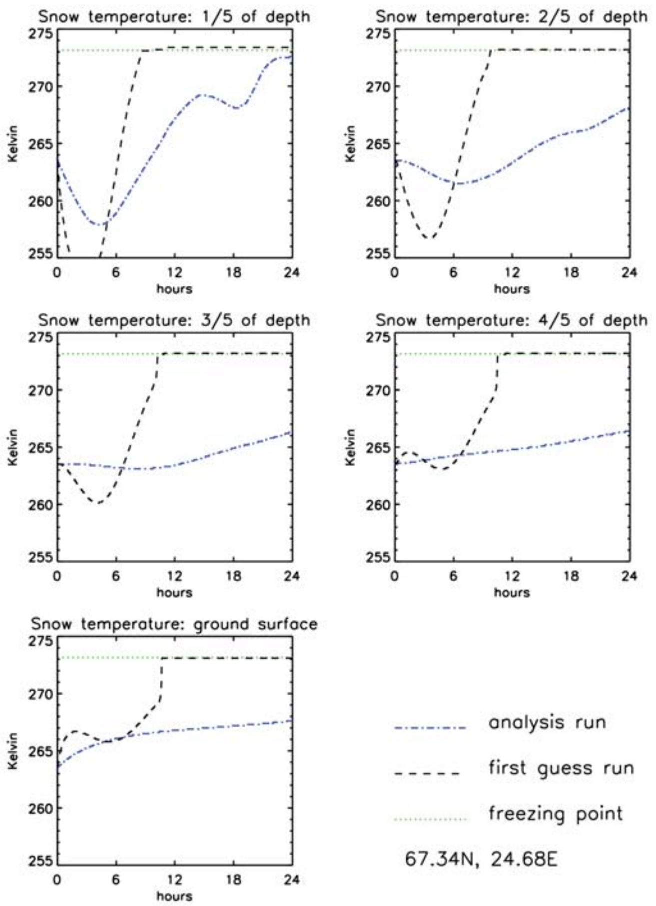

Figure 4. *Like Figure 2, but for snow temperature and snow depth*

Conclusions

The 4D-var data assimilation component permits to derive the maximum benefit from the few available measurements of soil temperatures and snow height for improved initialization of HTSVS. Despite presence of phase transitions from solid to liquid water, the 4D-var assimilation with the snow metamorphosis model has been successful even in difficult cases of full scenario discrepancies between the model and observations. The method proved itself as fully suitable and robust and its performance as excellent. In view of its importance for both regional and global climate studies, the costly 4D-var pays the effort. This fact will especially be true in future with expected new space borne sensors that will provide a drastic improvement in the spatio-temporal availability of observations.

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CANIBALT - Inclusion of Carbon and Nitrogen into a Land Surface Model

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In this century, global anthropogenic climate change will start to affect significantly the development of ecosystems and agriculture in Europe. Since the landscape impact on weather and climate increases with decreasing scale, it is essential to study the combined carbon, nitrogen, water and energy fluxes at the land surface at the regional scale. The following research questions are still of fundamental interest for understanding the processes. Of which order of magnitude is the interaction between the carbon and nitrogen cycle at the land surface and the water fluxes? How large are the regional changes of the nitrogen cycle at the land surface that are associated with changes in the components of the water cycle? To which extent does this influence the vegetation? The Baltic Sea itself is impacted by nitrogen transports from the rivers. Since nitrogen accumulates in the soil and and is partly flushed non-linearly from the land surface into the rivers, mainly during periods of snow melt and strong rainfall events, high frequent measurements in the river system and sophisticated regional models are of need for nitrogen transport budgets (e.g. McHale et al., 2002). The DEKLIM funded project "Interaction of carbon and nitrogen fluxes and the water and energy budget of the terrestrial biosphere" aimed at providing a physical-biogeochemical land surface model for regional atmospheric models. Furthermore, the model's validation and application were subject of the project.

The model

The soil-plant-land-atmosphere-TOPMODEL model (SPLAT, e.g. Engel et al., 2002) serves as the baseline model for partitioning and allocating GPP (gross primary productivity) to plant tissues in both amongst lowland and upland trees. As the canopy model of SPLAT determines only GPP and foliar respiration, a scheme for carbon allocation and respiration for the non-foliage parts of the vegetation was added (Warrach et al., 2005). Following Scanlon et al. (2001) and Waelbroeck and Louis (1995) a soil nitrogen module was developed and added to SPLAT.

Validation and application

The validation of such a model demands a great deal of data, i.e. many vegetation and soil parameters and long time series of meteorological data. The model requires diurnal cycles of atmospheric variables for multi year periods. Furthermore, its validation in forests requires at least time series of tree inventories including alive and dead trees. Soil carbon and nitrogen data and atmospheric nitrogen deposition are needed as well as at least daily runoff measurements including nitrogen loads.

In the Baltic Sea drainage area, high resolution, long-term, quality checked data for validation of such a model are rare. The EUROFLUX station data from 1996-1998 (Falge et al., 2001 a and b) e.g. still include errors such as wrong wind speed and radiation (Hyytiälä) or no measured precipitation data in winter (Flakaliden and Norunda). Furthermore, the EUROFLUX data set does not contain plant parameters such as leaf nitrogen at Flakaliden and Norunda. Also the EUROFLUX station data does not contain soil nitrogen and runoff data.

Black Rock Forest

In the project the model SPLAT and its carbon module were validated and applied at the Red Oak dominated Black Rock Forest (BRF) in the northeastern USA. BRF is a secondary growth forest and is a natural preserve since the 1930s, the tree inventory is updated since then every 5 years, and annualy since 1990. Extended plant parameter sets are collected since the 1990s and meteorological data are available from nearby stations. Warrach et al. (2005) describe the data, the model and its validation at BRF in detail. A linear relationship between NPP (net primary productivity) and GPP was found for Red Oaks, however the relationship depends on climatic conditions. A major result is the significant correlation (R^2=0.66, 99% level) between summer precipitation and the NPP/GPP ratio, a measure of the carbon storage capability of the trees.

Hyytiälä
Within the Baltic Sea drainage basin, the model was applied to the pine forest at Hyytiälä (61°51'N, 24°17'E) for 2001 and 2002. Plant parameters if not measured at Hyytiälä were calibrated applying the SCE-UA method (Duan et al., 1992) for 2001 comparing the simulated and measured latent heat flux. The latent heat flux data from 2002 were used for validation (Figure 1).

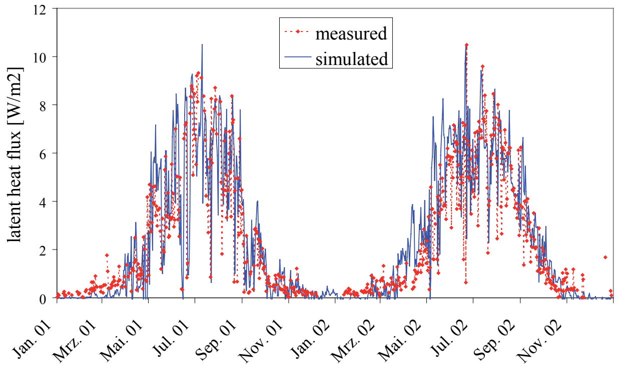

***Figure 1.** Measured (data provided by Timo Vesala) and simulated (SPLAT) latent heat flux at Hyytiälä (Finnland)*

Tree inventory data from Hyytiälä were available from 1926 onwards but since it only includes living trees and since the forest is also used for timber extraction, the carbon module of SPLAT cannot be validated at Hyytiälä. However, annual growth rates may be calculated and compared well with about 10 m^3/ha/year in the 1990s.

Ovre Lansjarv
In the project, a soil nitrogen module for regional application was added to SPLAT. The module allows for the simulation of rapid nitrogen outflow during strong precipitation events and during snow melt as it is described e.g. by McHale et al. (2002). Since there were no daily or more frequent nitrogen measurements available to the project, a validation is not possible.

However, a preliminary qualitative study was carried out for the Ovre Lansjarv catchment in northern Sweden. For this 1340 km^2 sub-basin of the Torneälv extended meteorological and hydrological data are therefore available on a 0.25° grid resolution for the 1980s and '90s (Bowling et al., 2003). Tree inventory data were purchased, the inventories do not include dead trees and natural preserves and national parks. Annual atmospheric nitrogen deposition in the Ovre Lansjarv region is 138 mg/m^2 (EMEP). The model simulation was started in 1988. Figure 2a shows simulated and observed runoff in 1992 and 1993. Figure 2b shows the simulated runoff and nitrogen outflow. Note the nitrogen outflow can only demonstrate the qualitative simulation since no data for validation was available. However, the simulation shows the nitrogen outflow mainly during runoff events due to snow melt and strong precipitation.

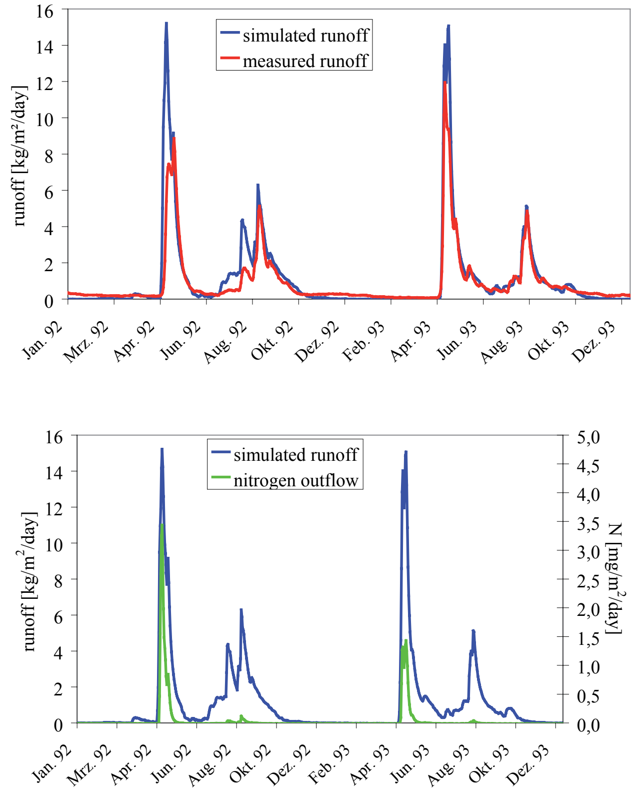

***Figure 2.** a) Measured and simulated runoff, and b) simulated runoff and nitrogen outflow of the Ovre Lansjarv*

Discussion and outlook
During the project, carbon and nitrogen were included into a land surface model for regional model applications in the Baltic Sea drainage basin. The project revealed the importance of complete quality tested data sets with respect to meteorological, hydrological, plant, soil, carbon and nitrogen data. The compilation of such quality tested data sets would be valuable for further studies of this complex issue in BALTEX.

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DEKLIM

EVA-GRIPS - Evaporation over a Heterogeneous Land Surface

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The Earth's surface is characterized by spatial heterogeneity over a wide range of scales as can be seen by examining soil and topographic maps. This heterogeneity affects the exchange of momentum, heat and water between the land surface and the atmosphere. Specification of these processes is vital for climate and weather forecast models. Despite a quite noticable increase in complexity and sophistication of land-surface schemes in recent years, the horizontal resolution of present-day numerical atmospheric models is still too coarse to explicitly capture the effects of surface heterogeneity. This problem of considering subgrid-scale variability is particularly relevant in modeling evapotranspiration because soil moisture may vary on scales as small as a few meters. In combination with the natural heterogeneity of vegetation, orography and non-uniform precipitation on larger scales this may result in a relationship between regional evapotranspiration and area-averaged soil moisture that is fundamentally different from the relationship at a particular point (Wetzel and Chang, 1988).

Since long-term data sets on the interaction between heterogeneous land surfaces and the atmosphere are indispensable for improving the parameterisation in coupled climate models, the BALTEX implementation and BRIDGE design plan (Raschke et al. 2001, Mengelkamp 2004) contain a special research task on land surface - atmosphere interaction. This aim was also formulated in the German Climate Research Program (DEKLIM) and in particular in its cluster „Regional Process Studies in the Baltic Sea Area" under which EVA-GRIPS was funded for the period 2002 to 2004. EVA-GRIPS combines model studies of various spatial resolution with a comprehensive field campaign over a heterogeneous landscape and with satellite data analysis in order to investigate strategies for considering subgrid-scale heterogeneities in atmospheric models.

The activities of the EVA-GRIPS project focused on an area of about 20 x 20 km^2 around the Meteorological Observatory Lindenberg (MOL) of the Deutscher Wetterdienst (DWD, German Meteorological Service), roughly 65 km south-east of Berlin. The landscape in this area was formed by the inland glaciers during the last ice age, exhibiting a slightly undulating surface with height differences of about 80 to 100 m over distances of about 10 to 15 km, and a number of small and medium-sized lakes embedded. The land use is dominated by forest and agricultural fields (40 - 45 % each), lakes cover 6-7 %, villages and traffic roads less than 4 %. The forest is mainly situated in the western part of the area, while agriculture is dominant in the eastern part (Figure 1). This mixture of surface types is

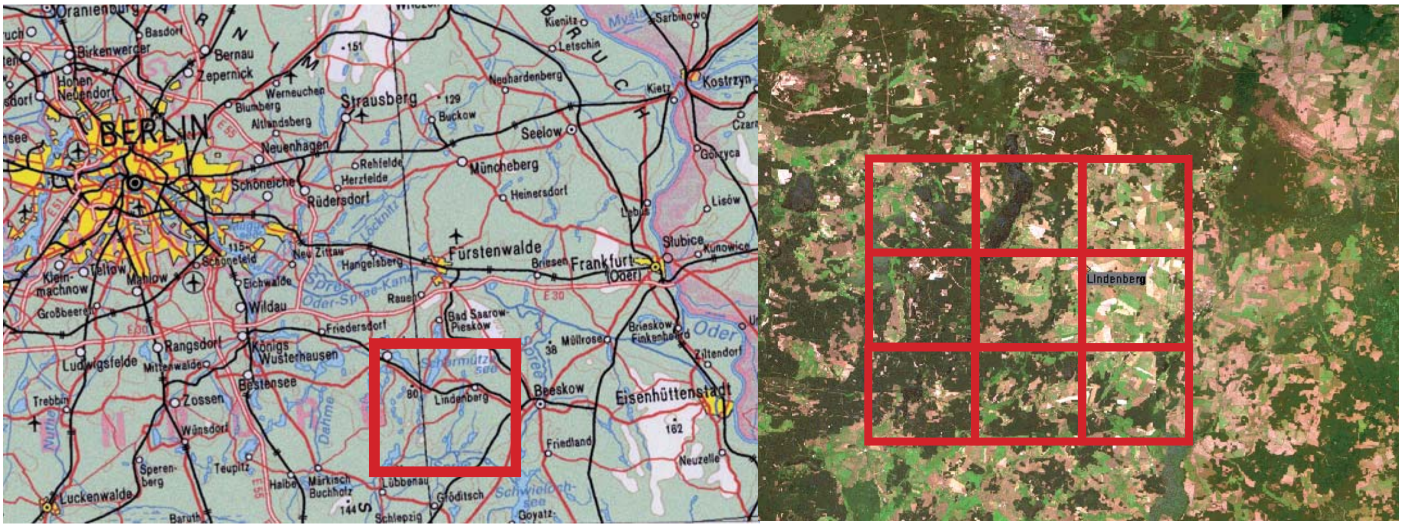

Figure 1. *Location of the experimental area roughly 65 km southeast of Berlin. The LANDSAT picture (right, copyright GEOSPACE Herold, 1997 Herold Business Data AG/GEOSPACE Beckel Satellitenbilddaten GmbH) gives an impression of the landscape heterogeneity inside 9 grid cells of the weather forecast model of DWD (LM). Each grid cell covers an area of 7x7 km*^{2}.

rather typical for the whole region and even for larger parts of northern Central Europe.

The LITFASS-2003 Experiment

As the major field activity in the EVA-GRIPS project, the LITFASS-2003 experiment took place between May 19 and June 17, 2003, during the main growing season as part of the ongoing boundary layer measurements at the Lindenberg Observartory (Beyrich, et al., 2002. The instrumentation comprised 13 micrometeorological stations over 8 land-use types with eddy-correlation sensors for the turbulent fluxes, standard equipment for common synoptic variables and sensors to measure vertical profiles of soil parameters, three large aperture optical scintillometers and a microwave scintillometer set up along three different paths over distances of 3 to 10 km. Vertical profiles of water vapor and vertical velocity were measured by a combination of a differential absorption lidar and a wind lidar (Bösenberg et al., 1998). Turbulent structures of temperature, humidity and wind in the boundary layer were measured by the helicopter borne HELIPOD probe (Bange and Roth 1999). An infrared camera for surface temperature mapping was operated on board of a Tornado aircraft of the German Air Force. Satellite images (Landsat-7 ETM+ and NOAA-AVHRR) completed the set of observations. The spatial scales of this suite of measurement systems covered five orders of magnitude (10^{-1} .. 10^4 m) for the sampling scale and three orders of magnitude (10^1 .. 10^4 m) for the footprint scale, respectively.

Combined flights of the Tornado aircraft and the HELIPOD took place at 6 days. The grey-scale pictures taken with the infrared camera on board the tornado aircraft were calibrated with surface temperatures measured with the HELIPOD on a grid-like flight pattern and with those measured directly at the micrometeorological stations. High-resolution (1 m) surface temperature maps indicate a large heterogeneity regarding the surface temperature even across fields which appeared to be homogeneous in the visible (Figure 2). This is basically due to the large variation in soil moisture even at homogeneously vegetated surfaces and may explain differences in the fluxes over similar vegetation and soil types and even at different locations on the same field.

Special attention was given to quality assurance and quality control issues. This included, e.g., sensor intercomparisons of the turbulence-, radiation- and soil sensors during a pre-experiment, the calibration of all fast-response hygrometers with a unified procedure before and after the experiment, and a regular control of the humidity profiling systems (radiosonde, DIAL, microwave radiometer profiler) against each other (Foken and Wichura, 1996).

Water vapor (latent heat) flux measurements are illustrated for May 25 (Figure 3). Significant differences occur between the major land use classes (forest and low vegetation farmland).

A large variation was also found between the different types of agricultural farmland. Flux composites for the different surface types were derived by suitably averaging the data from all stations over the same type of crops thereby accounting for the data quality of the individual measurements. An overall farmland composite was then constructed taking into account the respective fractional area of the four major crop types. In order to validate this averaging strategy, the farmland composites were compared to area-representative flux values derived directly from the long-range scintillometers and from the HELIPOD measurements. While the three different flux estimates appeared to be widely consistent in case of the sensible heat flux (not shown here), larger differences were found between the

Figure 2. Infrared image (center) of the LITFASS area taken from a Tornado RECCE aircraft of the German airforce and surface temperatures from the HELIPOD (left) which were used to calibrate the infrared images and the calibrated infrared surface temperature from the combination of Tornado and Helipod measurements (right). The reverse "L" shaped central experimental field can be identified in the center picture and in the lower left quadrant of the right picture. Temperatures range from 20 °C (blue) to 55 °C (red).

different types of measurements for the latent heat flux. Systematically higher latent heat fluxes were derived from the microwave scintillometer data when compared to the composite of the eddy covariance measurements, and quite some scatter had to be noticed in the HELIPOD fluxes. Interpretation of these differences will be subject of further data analysis.

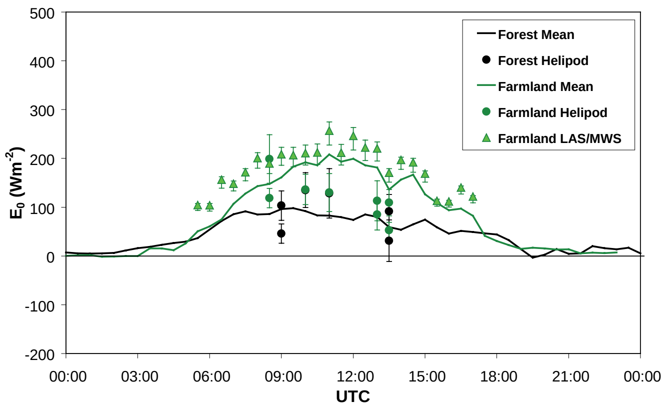

***Figure 3.** Diurnal cycle of the latent heat fluxes above farmland and forest for May 25 measured by surface based eddy-correlation instrumentation, the combination of an optical large-aperture and a microwave scintillometer, and the HELIPOD.*

A complete quality-controlled data set of area-averaged surface fluxes from the four-weeks period of the LITFASS-2003 experiment (with a data coverage of more than 80 %) is now available for the forcing and validation of numerical models and flux-averaging strategies, and also for investigating algorithms to derive surface energy fluxes from satellite data.

Numerical studies

The ABL structure for the LITFASS-2003 experiment was simulated using a suite of models ranging in resolution from the mesoscale to the large eddy size. In particular, the regional climate model REMO (18 km grid), the Lokal-Modell (LM) of DWD (7 and 1 km grid), the FOOT3DK model of the University Cologne (1 km and 250 m grid, Heinemann et al., 2005), and a LES model of the University Hannover were used.

Figure 4 shows the daily course (5-17 UTC) of the net radiation (Q0) and latent (E0) heat flux simulated by the different mesoscale models for the whole LITFASS area for May 30, 2003. Net radiation is almost identical for all three models with a slight tendency to lower values for the LM. Despite of this the turbulent heat fluxes show large differences among the different models. The latent heat flux in REMO peaks at about 350 Wm-2, while the measurements show values of 100 Wm-2 during daytime. The operational LM version 'LM op' tends to overestimate the latent heat flux. With the area-averaged means of LAI and plant cover derived from NOAA AVHRR data (Tittebrand et al., 2005) a significant improvement for the simulated latent heat flux is obtained ('LM NOAA'), yet still significantly overestimating the latent heat flux. The best agreement with the measurements is achieved by the FOOT3DK model with 250 m resolution and by 'LM mosaic'. While the F250 resolves most of the surface heterogeneities, the 'LM mosaic' uses the mosaic approach with a resolution of 7 km in atmosphere and 1 km at the surface.

With respect to the whole LITFASS period the operational LM (LM op) generally tends to overestimate the latent heat flux while the modified version with satellite-derived vegetation parameters (LM NOAA, LAI and plant cover, Tittebrand et al., 2005)) shows a significant improvement. With the mosaic approach implemented in the LM land-surface scheme based on 1 km resolution subgrid-scale information for the albedo, stomatal resistance and soil moisture, the agreement with the observed composite is much better. The quality of the 'LM mosaic' run is comparable to the simulations of the FOOT3DK model with a resolution of 1 km.

Large eddy simulation studies also showed that mesoscale circulations contribute significantly to the area-averaged evaporation. This means that the local flux profile measurements as performed with remote sensing systems during LITFASS-2003 might not necessarily be representative for the mean ABL flux profiles. It seems advisable to perform a model study on mesoscale circulations during the design phase of the measurement strategy for future field experiments.

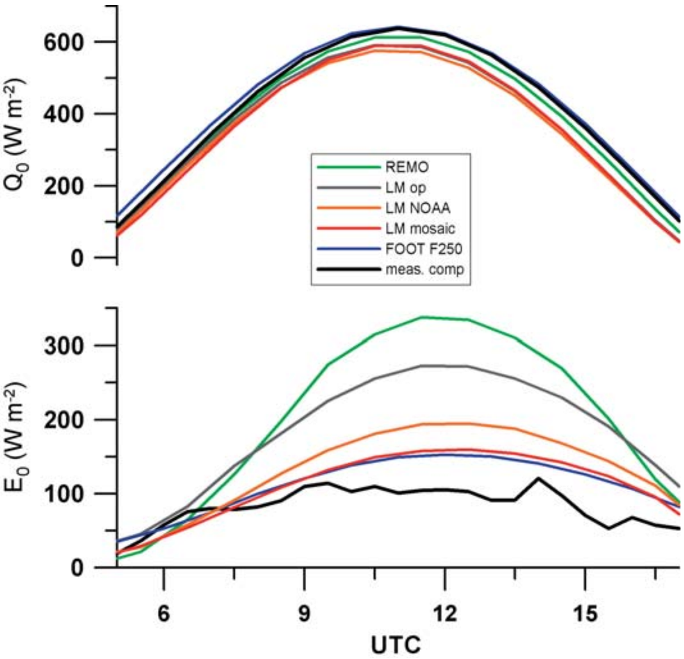

Figure 4. *Daily course of Q_0 and E_0 computed by different mesoscale models for the whole LITFASS area for May 30, 2003: REMO (18 km resolution), different LM versions (7 km resolution), FOOT3DK (250 m resolution), and area-averaged flux composite from the surface stations. The curves for the LM denote three different model runs: 'LM op' is the operational run, 'LM NOAA' uses LAI and vegetation cover derived from AVHRR, 'LM mosaic' uses the mosaic method with 1 km resolution of the surface parameters.*

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HyperSatAn - Hyperspectral Satellite Data Analysis over Land Surfaces

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Introduction

The accuracy and applicability of current numerical weather prediction (NWP) models and climate models are limited by the insufficient representation of the initial conditions of the land surface and uncertainties in the parameterization of land surface processes. Especially the effects of the dynamics of the variability of the surface parameters on the water and energy budgets have not yet been quantified for varying temporal and spatial scales. Therefore, it remains unclear how the terrestrial hydrosphere-biosphere controls the distribution of energy and water and how changes in land surface parameters affect weather parameters and the climate.

Satellite remote sensing data exhibit a tremendous potential for global validation, calibration, and assimilation applications in NWP and climate modelling. However, it is challenging to combine the information from different satellite instruments and numerical models since the land surface is heterogeneous, radiative transfer is a non-linear process, and the spatial resolution of the individual data sets is different.

The key objectives of the project were: (1) the development of a hyperspectral radiative transfer model, which can be used as an observation operator for data assimilation applications and inverted for parameter retrievals. (2) Research on the optimal combination of remotely sensed observations and output from numerical models and (3) the analysis of scale effects in assimilation and retrieval processes.

Main results

The following paragraphs summarize the main results. Firstly, retrieval studies and the assimilation of satellite retrieved geophysical parameters are addressed. The second part focuses on the direct assimilation of satellite observations. Details on the results can be found in the corresponding publications.

Inverse modelling and parameter retrieval

The underlying theory for the land surface emission model has been described in Drusch and Crewell (2005). To quantify the potential of passive microwave remote sensing for soil moisture retrieval, operational soil moisture data sets (ECMWF's operational analysis and ERA 40) were compared against in-situ observations and remotely sensed observations (Drusch et al. 2004). For the Southern Great Plains region the following results were obtained: (1) the quality of the atmospheric forcing data determines the accuracy of modelled soil moisture. (2) L-band (1.4 GHz) observations have the largest potential for soil moisture retrievals. However, measurements at C- and X-band contain useful information on soil moisture, which can be used to initialize and validate numerical models. (3) Soil moisture fields from different data sources are characterized by different statistical distributions. Consequently, absolute values can hardly be compared.

The radiative transfer model was then used to derive the TRMM Microwave Imager (TMI) Pathfinder soil moisture product (Gao et al. 2005). The data set is entirely based on products, which are available operationally through the North American Land Data Assimilation Study (NLDAS). Preliminary comparisons within-situ observations, modelled fields, and the Advanced Microwave Scanning Radiometer (AMSR) soil moisture data set are very promising (Gao et al. 2005). However, it has to be noted that the satellite derived soil moisture data sets tend to exhibit a higher dynamical range and a low bias when compared to modelled values and in-situ observations.

Assimilation techniques, which are based on the BLUE (Best Linear Unbiased Estimate) theory (i.e. 4DVar, Kalman filters), result in statistically optimal analyses when there are no systematic differences between the (modelled) first guess and the observations. To use satellite derived soil moisture in the surface analysis the cumulative distribution function (CDF) matching technique has been applied to derive observation operators for the TMI pathfinder data set. It was found that CDF matching is an effective method to correct for systematic differences (Drusch et al. 2005). Observation operators for the Southern US showed a considerable amount of spatial and temporal variability. Currently, assimilation experiments are performed at ECMWF to quantify the impact of satellite derived soil moisture on the analysis, local weather parameters, and consequently the forecast quality.

Assimilation of brightness temperatures

Satellite observations, e.g. brightness temperatures, can be used directly in the surface analysis. Radiative transfer models are used as observation operators to translate a variable from model space (e.g. first guess soil moisture) to observation space (first guess brightness temperatures).

Currently, operational NWP soil moisture analyses are based on the modelled first guess and the screen level variables 2 m temperature and relative humidity. This pragmatic approach has been taken since direct observations of soil moisture are not available on large spatial scales and since NWP centres are traditionally more interested in the turbulent atmospheric fluxes of sensible and latent heat (which of course can depend on soil moisture) than in soil moisture itself. However, for applications like flood forecasting, crop growth modelling, carbon studies and water management soil moisture is of particular importance. Within the European Land Data Assimilation Study (ELDAS) a series of assimilation experiments based on L-band (1.4 GHz) brightness temperatures, screen level variables, the single column version of ECMWF's NWP model, and the radiative transfer model was performed for the Little Washita area (Seuffert et al. 2003, Seuffert et al. 2004). The meteorological forcing data for the analysis were obtained from in-situ observations.

The reference experiment without any data assimilation resulted in accurate soil moisture values but a poor description of the turbulent fluxes. When screen level parameters were assimilated, the resulting fluxes improved considerably but analysed soil moisture was less accurate when compared against in-situ measurements. The highest accuracy for analysed soil moisture was obtained when only satellite data were assimilated. The best overall analysis of soil moisture and turbulent fluxes was computed when screen-level variables and satellite information were used in the analysis.

Again, systematic differences between the first guess and the observations have to be minimized. Since operational land surface models can hardly represent the dry down and saturation dynamics of the top 3 centimetre layer of the soil, Wilker et al. (2005) developed a statistical bias correction scheme. The parameterization is based on the antecedent amount of precipitation and results from a radiative transfer model for a stratified dielectric medium at very high vertical resolution. Applying the correction scheme for the assimilation experiments described in Seuffert et al. (2004) resulted in higher accuracies for the soil moisture analysis.

Outlook

Recently, global surface soil moisture data sets have become available from ERS1/2 scatterometer data and AMSR. In 2007 and 2010 ESA's Soil Moisture and Ocean Salinity (SMOS) and NASA's HYDROS missions will provide global information on soil moisture with an accuracy of ~ 4%. A new surface analysis system based on the land surface emission model and the ELDAS Kalman filter is currently being implemented in ECMWF's forecast system to use these new data sets. The work started on the snow analysis (Drusch et al. 2004) will be continued and eventually integrated in the Kalman filter surface analysis.

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BONUS and BONUS-169: Future Funding Options for BALTEX?

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ERA-NET

The ERA-NET (European Research Area Network) of the 6th EU Framework programme (2002-2006), FP6, was designed to contribute to realizing the European Research Area (ERA) by transborder networking and cooperation of national and regional programmes across Europe. As such, the ERA-NET scheme aims at the national and regional programme makers and managers of either the national Ministries or other national and regional funding agencies, which implement programmes on behalf of their governments. The ERA-NET Scheme has been implemented via open calls for proposals, welcoming proposals for coordination actions in any field of science and technology, i.e. using a bottom-up approach. The Commission will pay all additional costs related to the coordination of such programmes up to 100%. The long term goal is the collaboration of different national and regional funding agencies across Europe, leading to the implementation of transnational programmes.

The open call for ERA-NET proposals was published in December 2002 and involved a budget of 148 Million Euro. By the end of FP6 in 2006, 75 ERA-NET projects are expected to be established. Some ERA-NET projects are currently about to start their transnational programmes and to publish own calls for proposals.

FP6: BONUS

One of the first approved ERA-NET projects was „BONUS for the Baltic Sea science - Network of funding agencies", coordinated by the Finnish Academy of Science with a total funding of 3 M € for the years 2004-2007. The BONUS consortium includes 11 national key funding agencies in all EU member states around the Baltic Sea and Russia, and also the International Council for the Exploration of the Sea (ICES).

The idea of BONUS is to foster sustainable development and utilization of the Baltic Sea, justified through sound scientific research. Its general aim is therefore to warrant the high quality and efficiency of Baltic Sea research through international collaboration, considering political and economic issues for the benefit of the people living in the Baltic Sea area. The central aim of BONUS is to suggest and – if possible - take steps towards a harmonization of national funding programmes dedicated to Baltic Sea research. BONUS is considered to be among the successful FP6 ERA-NET projects.

FP7: BONUS-169

The EU Commission has recently suggested to bring the BONUS project to a higher level of integration as had been originally intended. An additional future option would be the establishment of one European funding scheme, instead of – or in parallel to – several national schemes. The legal basis for this is Article 169 of the EU Treaty, which states that the EU may contribute to common research and development programmes of several member states, if they agree. A proposal for an Article-169-project following BONUS (BONUS-169) to be implemented in the 7th EU framework programme (2007-2013), FP7, is currently being discussed at the European level. The common budget for BONUS-169 is presently estimated to be up to 200 M €: The national agencies' contribution could be up to 100 M €; an additional 100 M € may be provided by the European Commission. BONUS-169 is planned to offer common calls for proposals and a common evaluation procedure. A basic requirement for an international funding programme is a common science programme, which needs to be agreed upon by the supporting national agencies and the EU. Such a science programme for BONUS-169 was drafted and opened for discussion in summer 2005. At present, this programme draft is thoroughly discussed at the national level in the countries contributing to BONUS. In order for BONUS-169 to be implemented in FP7, the related science programme will have to be approved already in spring 2006. Additionally, a number of questions concerning funding, financial and legal procedures and regulations must be settled, allowing for the different legislative systems in the contributing countries.

The draft BONUS-169 science programme (version as of September 2005) includes the following work packages:

1. Natural forcing and climate change
2. Eutrophication
3. Sustainability of living resources
4. Biodiversity
5. Pollution and ecosystem health
6. Socio- and ecological economics
7. Synthesis and dissemination
8. Management and infrastructure

A revised science programme is currently being compiled and is scheduled to be available in January 2006. The draft document and a questionnaire for feedback and discussion, as well as extensive information on BONUS is available at www.bonusportal.org.

Relevance for BALTEX

Although the focus of BONUS-169 is apparently maritime, research issues related to the entire water catchment of the Baltic Sea – and even beyond, such as hydrology, atmosphere, land surface, and others are expected to be included at least in some work packages of the BONUS-169 programme. A particular potential candidate for the above is work package 1 in the present BONUS-169 draft programme, entitled "Natural forcing and climate change". If BONUS-169 will materialize, it may be the primary, if not the only major EU funding source for Baltic Sea research in the coming years. Thus, input from BALTEX concerning the formulation of both the science programme and also the call-specific work programmes of BONUS-169 seems highly advisable.

BONUS Web Site:

www.bonusportal.org

A new BALTEX Web Site for Everybody

Marcus Reckermann (reckermann@gkss.de)
International BALTEX Secretariat,
GKSS Research Centre, Geesthacht, Germany

Environmental research programmes like BALTEX produce results and insights which are generally of high interest to the public. Examples are an improved process understanding of the climate system in the Baltic Sea basin, which was the core of BALTEX Phase I, or an improved understanding of the past and future climate in the region, which is more related to Phase II of BALTEX, including scenarios and projections of for example air temperature, precipitation and runoff, as well as the occurrence of extreme events. Related information has rarely been disseminated to the general public in a comprehensible and consumable way.

A new objective of BALTEX Phase II under the headline „Education and Outreach" is the dissemination of information to stakeholders, students and the general public. The internet as a basic information platform is of particular relevance in this aspect. Chapter 7.1 of the BALTEX II Science Plan states that *"the BALTEX web site will be complemented by a particular dissimination part dedicated to the general public, which will need specific amendments to the present web site content and language. This initiative will contribute to the general concept of e-learning."*

The present BALTEX web site (www.gkss.de/baltex) has been designed and used mainly as a communication platform for scientists involved in the research programme. It is now planned to extend the BALTEX web site with a section dedicated to the non-scientific community. This new section for interested laymen, students and teachers is envisaged to disseminate BALTEX results and related basic information in a comprehensible way. A special download section may provide presentations, graphic and media files and other documents; film clips or animated GIFs to visualize model results could be a highlight of the site. An extensive collection of relevant Baltic Sea links and general information about the geological history as well as the climatic, oceanographic and biological characteristics of the Baltic Sea may also be provided.

Easy access by the general public including teachers and children in all BALTEX countries will only be accomplished if the contents is available in the national languages. This will be hard to achieve in the next future, so the entire content will be compiled in English for the time being, until a translation into the respective languages is feasible.

The main challenge will be the „translation" of hard science talk into a language the average educated laymen can understand and relate to. It should be exciting for everybody to browse through the BALTEX pages. To achieve this, we are looking for BALTEX scientists who think they have the touch to present the complicated matter in an easily accessible and exciting way, and who are willing to participate in this interesting project and join the new Baltex Working Group on BALTEX Web Site Content. Also wanted: translators into the BALTEX languages!

For the new Working Group on BALTEX Web Site content, we are looking for

- scientists who are able to describe BALTEX research in an understandable and interesting way, and
- scientists in the BALTEX countries who are willing to translate articles from English to their national languages.

Please contact the BALTEX Secretariat (marcus.reckermann@gkss.de)

BALTEX SSG Meeting 2005: SSG Membership

Hans-Jörg Isemer (isemer@gkss.de)
International BALTEX Secretariat;
GKSS Research Centre, Geesthacht, Germany

The 18th BALTEX Science Steering Group (BSSG) meeting was held 18 to 20 October 2005 at the Richard Aßmann Observatory of the German Weather Service in Lindenberg, Germany. The meeting started with a scientific workshop which was dedicated to results of BALTEX-related projects funded through the German DEKLIM programme, see some project summaries above in this Newsletter.

***Figure 1**. Participants at the 18th BSSG meeting in front of the radiosonde launch hall at Richard Aßmann Observatory of DWD.*

Several topics important for the present and future development of BALTEX were discussed in detail and related conclusions were drawn and action items defined. Topics discussed included the BALTIC GRID and BACC (BALTEX Assessment of Climate Change for the Baltic Sea Basin) initiatives, the final approval of the BALTEX Phase II implementation document, as well as future funding options at the EU level. The establishment of four new working groups was either approved or suggested (see short descriptions below). Also, new BSSG members were approved, as follows:

Hans von Storch is director at the Institute of Coastal Research at GKSS Research Centre Geesthacht and Professor at the Meteorological Institute of the University of Hamburg. His scientific interests are statistical analysis, simulation of regional climates and pathways of matter, paleoclimatic modelling, and transfer of knowledge from natural sciences to the public arena, in cooperation with social and cultural scientists (http://w3g.gkss.de/staff/storch/). He has recently become actively involved in BALTEX by chairing the BACC initiative and contributing to establishing the BALTEX Phase II implementation document.

Daniela Jacob is head of the Regional Climate Modelling Group at Max-Plank-Institute for Meteorology in Hamburg, Germany (http://www.mpimet.mpg.de/en/depts/dep1/reg/index.php). Her scientific interests cover the understanding, modelling and validation of water and energy cycles in drainage basins, regional climate changes and impact assessment, uncertainties related to regional modelling, and fully coupled regional systems. She is the responsible scientist for the model systems REMO and BALTIMOS. Daniela has actively contributed to BALTEX since years and, among other activities, chaired the BALTEX Working Group on Energy and Water Cycles.

BALTEX Working Group on Data Management

Jörgen Nilsson (jorgen.nilsson@smhi.se)
Swedish Meteorological and Hydrological Institute, Norrköping, Sweden

The BALTEX SSG (BSSG) has recently approved the establishment of a new BALTEX Working Group on Data Management (BWGD), which I have the pleasure to chair. At the dawn of Phase II of BALTEX, the need for a detailed review of future data requirements and possible related organisational actions is obvious, and the BWGD will be the major forum to discuss and conduct the above. The following terms of reference, as well as the initial membership of the new working group were approved at the recent BSSG meeting.

- to serve as the principal advisory group in all matters pertaining to BALTEX data management activities and issues and the coordination and exchange of BALTEX data among data providers, data centres and data users;
- to establish and periodically review both the terms of reference and the membership of the BGWD, to be finally approved by the BSSG;
- to revise and propose updates of the BALTEX data policy including individual data exchange restrictions and access procedures, to be finally approved by the BSSG. Such propositions should be in compliance with regulations of major international relevant organisations such as WMO, ECOMET ,and the EU directives.
- to undertake appropriate action for the implementation and continuous monitoring of the BALTEX data policy;
- to establish and maintain an inventory of BALTEX data requirements for BALTEX research;
- to facilitate the access to data for BALTEX researchers by
  a. getting the BALTEX data policy known and accepted by data owners,
  b. establishing and maintaining an inventory of available and new data archives and data sources,
  c. developing ideas for specific data sets;
  d. monitoring the performance of the BALTEX Data Centres;
- to develop and draft a BALTEX Data Management Plan, as a detailed extension to the BALTEX Phase II Implementation Plan, to be finally approved by the BSSG;

- to initiate the establishment of and continuously review a BALTEX data management WWW website, preferably linked to the BALTEX "homepage" on WWW. This website is expected to inform on relevant data management issues for BALTEX data providers, BALTEX Data Centres and archives, as well as BALTEX data users.

The present members of BWGD include:
Franz Berger, *German Weather Service*
Andreas Lehmann, *Leibniz Institute for Marine Research, Germany*
Jörgen Nilsson (chair), *Swedish Meteorological and Hydrological Institute*
Timo Vihma, *Finnish Meteorological Institute*
Valery Vuglinsky, *State Russian Hydrological Institute*

As a first accomplishment of the group, the BALTEX data policy was revised and already approved by the BSSG. The forthcoming issue of the BALTEX Newsletter will report on the revised policy in detail.

BALTEX Working Group on Budgets

Daniela Jacob (jacob@dkrz.de)
Max-Planck-Institute for Meteorology, Hamburg, Germany

During BALTEX phase I, major effort was contributed to understand the physical processes determining the water and energy budgets of the Baltic Sea and its drainage basin. Observations have been analysed, unfortunately they are not continuous in space and time. In addition, two fully coupled regional modelling systems simulating the water and the energy cycles have been developed, and successfully validated against observations.

In BALTEX phase II these systems can now be utilized in several ways: they can recalculate the past for example to determine the impact of the large scale circulation on the regional climate, or to analyse the decadal variability of the water and energy budget. For future periods the systems can be used to downscale dynamically global climate change effect to investigate possible changes in means and extremes in the Baltic Sea region (as an example see fig. 1). The systems can also be used as intelligent interpolators to create climatological information on the budgets in times and regions were observations are sparse.

The new working group can be seen as a core groups to initiate, collect and synthesise studies of budgets like water and energy in BALTEX. A first focus can be attributed to the analyses and understanding of the variability of the water and energy budgets on different time periods: 1999-2003, 1980-2005, 1960-2000, 1900-2100.

Besides this activity the new WG could establish close links to GEWEX/GHP and contribute with results from BALTEX to the global assessment of the water and energy budgets. Here one topic could be to identify the role of the process understanding, which has been achieved within BALTEX , in the GEWEX activities.

Additional activities of the WG could be to stimulate proposals and to actively look to research funding within the BALTEX area.

BALTEX Working Group on BALTIC GRID

Andreas Lehmann (alehmann@ifm-geomar.de)
Leibniz Institute of Marine Sciences at the University of Kiel, Germany

The main task of the Working Group on BALTIC GRID will be the initiation and conduction of the pilot study. Members will be the leading scientists of the different subprojects plus one representative of the BALTEX Secretariat. The draft terms of reference are as follows:

- conduction of the BALTIC GRID Pilot study
- setting up international collaborations
- initiating and conducting (interdisciplinary) research within BALTEX Phase II
- initiating resources sharing (expertise, observations including satellite and model data)
- promote scientific core groups to initiate projects funded by the EU and national funding agencies

See also lead article of this issue.

BALTEX Working Group on Web Site Content

See article on page 26.

Special Issue on BALTEX in *Nordic Hydrology*

Hans-Jörg Isemer (isemer@gkss.de)
International BALTEX Secretariat;
GKSS Research Centre, Geesthacht, Germany

A special journal issue dedicated to the 4th Study Conference on BALTEX is now available in Nordic Hydrology 2005, Vol. 36, No 4. The volume contains 10 conference papers, which passed the Nordic Hydrology review process. The Nordic Hydrology editorial board did a great job in organising a two-volume special issue on BALTEX, which I herewith like to appreciate thankfully on behalf of the BALTEX research community.

The following papers appear in Nordic Hydrology 2005, Vol. 36, No 4.:

Special issue of Nordic Hydrology – 4th Study Conference on BALTEX
H.-J. Isemer, S.-E. Gryning and D. Rosbjerg

Long-term changes in the frequency of cyclones and their trajectories in Central and Northern Europe
M. Sepp, P. Post and J. Jaagus

Distribution of snow cover over Northern Eurasia
L. Kitaev, E. Førland, V. Razuvaev, O. E. Tveito and O. Krueger

Expected changes in water resources availability and water quality with respect to climate change in the Elbe River basin (Germany)
V. Krysanova, F. Hattermann and A. Habeck

Derivation of a root zone soil moisture algorithm and its application to validate model data
R. Lindau and C. Simmer

The realism of the ECHAM5 models to simulate the hydrological cycle in the Arctic and North European area
K. Arpe, S. Hagemann, D. Jacob and E. Roeckner

A comparison between the ERA40 and the SMHI gridded meteorological databases as applied to Baltic Sea modelling
A. Omstedt, Y. Chen and K. Wesslander

Evaluation of the heat balance components over the Baltic Sea using four gridded meteorological databases and direct observations
A. Rutgersson, A. Omstedt and Y. Chen

Atmospheric response to different sea surface temperatures in the Baltic Sea: coupled versus uncoupled regional climate model experiments
E. Kjellström, R. Döscher and H.E. M. Meier

Operational hydrodynamic model for forecasting extreme hydrographic events in the Oder Estuary
H. Kowalewska-Kalkowska and M. Kowalewski

Variability of radiosonde-observed precipitable water in the Baltic region
E. Jakobson, H. Ohvril, O. Okulov and N. Laulainen

New International BALTEX Secretariat staff member

Hans-Jörg Isemer (isemer@gkss.de)
International BALTEX Secretariat,
GKSS Research Centre, Geesthacht, Germany

As of 15 September 2005, the International BALTEX Secretariat has been reinforced by Dr. Marcus Reckermann as a new full-time staff member. Marcus is a Biological Oceanographer by education. He has worked in various research projects and participated in research cruises in the North Sea, the Baltic Sea, the North Atlantic and the Indian Ocean. His primary field of research has been the microbial food web dynamics in the sea.

Marcus received his Diploma at the Institut für Meereskunde Kiel in 1991 ("On the production and release of organic substances by phytoplankton in the Baltic Sea") in the research group of Prof. Bernt Zeitzschel. From 1991 to 1993, he was affiliated with the Royal Netherlands Institute for Sea Research (NIOZ), where he worked in an EU-project dedicated to the foam-building alga Phaeocystis, and participated in the "Netherland´s Indian Ocean Programme", a JGOFS pilot study on food web dynamics in response to the monsoonal circulation in the Arabian Sea. He joined two Dutch research cruises to the Indian Ocean to carry out specific food web experiments on phytoplankton that flourishes primarily in oligotrophic oceans.

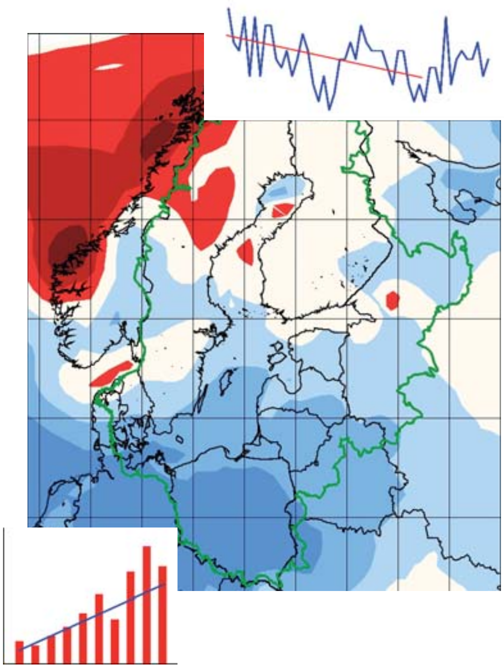
In 1996, Marcus received his Ph.D. at the Institut für Ostseeforschung Warnemünde (IOW) supervised by Prof. Bodo von Bodungen. In his thesis, he compared food web dynamics in the different ecosystems of the Baltic Sea and the Indian Ocean ("Ultraphytoplankton and protozoan communities and their interactions in different marine pelagic ecosystems: Arabian Sea and Baltic Sea"). Afterwards, he worked in Prof. Franciscus Colijn´s group at the Research and Technology Centre Westcoast of Kiel University (FTZ), where he was responsible for a large flow cytometer, an instrument to count and characterize phytoplankton cells in sea water by their optical characteristics. While at FTZ, he also contributed to the EU project BEQUALM (Biological Effects Quality Assurance in Monitoring Programmes), which was dedicated to an intercalibration of biological monitoring methods across Europe. During the last 2 years, Marcus coordinated a Master of Science programme on "Coastal Geosciences and Engineering" at Kiel University.

The International BALTEX Secretariat (IBS) is entirely financed by GKSS Research Centre Geesthacht GmbH. With Dr. Reckermann's full-time employment, in addition to the continued support for both Silke Köppen and myself, the engagement of GKSS for the BALTEX Secretariat is significantly increased, and I am particularly grateful for this support. The BALTEX programme is in an important transition period towards Phase II. Marcus will add important background knowledge to aspects of the new BALTEX Phase II objectives.

Conference Announcements

Assessment of Climate Change for the Baltic Sea Basin

- The BACC Project -



International Conference
Göteborg, Sweden
22 - 23 May 2006

The BACC Project

Objective
BACC (BALTEX Assessment of Climate Change for the Baltic Sea Basin) will assemble, integrate and assess available knowledge of historical, current, and expected future climate change, and related changes and impacts on marine, freshwater and terrestrial ecosystems in the Baltic Sea Basin. The combination and synthesis of evidence on both climate change and related impacts on ecosystems is a unique feature of BACC.

Cooperation
BACC has established close cooperation with the Helsinki Commission (HELCOM).

BACC aims at publishing a comprehensive assessment book and will contribute to related HELCOM thematic reports. BACC is an initiative within BALTEX, the Baltic Sea Experiment, and therefore a contribution to GEWEX (Global Energy and Water Cycle Experiment) and the World Climate Research Programme (WCRP).

Goals of the conference
- to discuss the scientific results of the BACC project with the scientific community, and
- to create awareness of the BACC results and related possible societal implications at relevant stakeholders and at the public at large.

Scientists as well as the interested public and stakeholders are invited to attend.

Location
Conference Centre Wallenberg, Göteborg, Sweden
www.konferensbokning.gu.se

Registration deadline is 31 March 2006

Further information
Details on registration procedures and the Conference in general will be available at the BACC website:

www.gkss.de/BACC

Conference Announcements

European Geosciences Union
General Assembly 2006
Vienna, Austria
2 - 7 April 2006

The General Assembly 2006 of the European Geosciences Union (EGU) is held at the Austria Center Vienna (ACV) in Vienna, Austria, during 2 - 7 April 2006. The assembly is open to scientists of all nations.

The conference programme is subdivided into thematic sections which span the entire field of Geosciences. There are various programme sections with relevance to GEWEX and BALTEX, e.g. „Climate: Past, Present, Future“, Atmospheric Sciences“, „Energy, Resources and the Environment“, and „Ocean Sciences“.

We would like to draw your particular attention to two sessions of this conference:

HS22: Coupling hydrology and atmosphere from catchment to global scales

Convener: Dan Rosbjerg (dr@er.dtu.dk)
Co-conveners: John Roads (jroads@ucsd.edu), Harald Kunstmann (harald.kunstmann@imk.fzk.de), Daniela Jacob (jacob@dkrz.de), Petra Döll (P.Doell@em.uni-frankfurt.de)

CL015: Generality of Climate Models and their Components

Convener: Ray Arritt (rwarritt@iastate.edu)
Co-Conveners: Burkhardt Rockel (rockel@gkss.de) and Michael Bosilovich (Michael.Bosilovich@nasa.gov)

These sessions are of particular relevance to GEWEX CSEs such as BALTEX. The conveners would like to enourage suitable contributions - from BALTEX and beyond - to be submitted to these EGS sessions.

For a detailed description of these and other sessions which might be of relevance for BALTEX, please visit the conference web site *http://meetings.copernicus.org/egu2006/*. The thematic sections and associated sessions can be viewed under the Programme menu > Call-for-papers.

Contributions outside of these specific topics but fitting into the general theme of the conference are welcome as well. The presentations will be organized into suitable thematic subsessions. Note that high quality submissions of broader scope will be candidates for upgrade to solicited papers.

Deadline for abstract submission: 13 January 2006

First Announcement

5th Study Conference
on BALTEX
Island of Saaremaa, Estonia,
4 - 8 June 2007

The Conference will be a forum to both summarize achievements of the BALTEX programme and discuss visions and options for its future development. The Conference will cover research themes where knowledge on the water and energy cycles in the climate system are relevant, such as past and future climate, water resource management, and water quality issues in marine, terrestrial and freshwater ecosystems. The target region is the Baltic Sea Basin, but contributions dealing with other GEWEX Continental-scale Experiments – and beyond – are very welcome.

Please, mark the dates for the Conference in your calendar. More details will be circulated soon with an extended first announcement. Details of the Conference will also be available at the BALTEX homepage at

www.gkss.de/baltex

From the BALTEX Secretariat

Merry Christmas
and a
Happy New Year!

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, chaired by Prof. Hartmut Graßl, Max-Planck-Institute for Meteorology, Hamburg, Germany. 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.

The editor invites the scientific community to submit BALTEX-related contibutions to be published in this *Newsletter.* Submitted contributions will not be peer-reviewed and do not necessarily reflect the majority's view of the BALTEX research community. Scientific material published in this *Newsletter* should not be used without permission of the authors.

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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