BALTEX *Newsletter*

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

How is BALTEX embedded into the World Climate Research Program?

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The Goal

The World Climate Research Program (WCRP) is one of four components of the World Climate Program (WCP) which has been initiated by the First World Climate Conference in Geneva, organised by WMO in 1979. As the most active of these components WCRP has now reached a mature stage encompassing many of the facets of climate research which need or depend on international co-ordination. The simple but demanding goal of WCRP is *to understand climate variability and to predict - to the extent possible - climate variability and change on time scales to centuries, including human influence.*

First Achievements

During the first 15 years WCRP has made already major steps. The first now successfully completed project Tropical Ocean/Global Atmosphere (TOGA) has brought physically based skill in predicting sea surface temperature and related climate anomalies a season or up to a year ahead for the areas affected by the El Niño/Southern Oscillation (ENSO) phenomenon. Thus some tropical and sub-tropical countries do get for example hints for changed agricultural practice and many more could in principle get it, if infrastructures for dissemination of predictions and improved responses were in place.
The improvement of climate forecast skill needs both better initial fields, especially in the upper ocean and on the land surface, and more sophisticated coupled ocean-atmosphere-land models. Therefore, WCRP has started two other major global projects, the World Ocean Circulation Experiment (WOCE) which has given since 1991 the first global survey of the physical and partly the chemical status of the world ocean and its circulation as a prerequisite for ocean circulation model improvement, and the Global Energy and Water Cycle Experiment (GEWEX) aiming since 1989 at a better understanding of cloud - radiation and soil - vegetation - atmosphere interactions, which largely determine the energy fluxes at the Earth's surface and the global water cycle and their reaction to changed atmospheric composi-

tion and land use. GEWEX thus also tries to exploit the soils' memory for improved long-range weather forecasting and climate variability prediction, what also requires concomitant improvements of the handling of clouds and precipitation in the atmospheric circulation models. GEWEX is most advanced at present in its global climate parameter time series for cloudiness, but has also given first global data sets for precipitation and water vapour as well as surface radiation fluxes.

Continental Scale Experiments

The approach chosen by GEWEX for the understanding of soil - vegetation - atmosphere interaction and thus energy and water fluxes at the surface is the implementation of so-called Continental Scale Experiments (CSEs), which should from the beginning aim at transferability to other less well observed areas. One out of formally five accepted CSEs for eight areas (catchments of single large rivers or a marginal sea, see Table 1) is the Baltic Sea Experiment (BALTEX). These experiments are charged with the fulfilment of the following criteria (for more information see the contribution by Ehrhard Raschke in BALTEX Newsletter No. 1):

i) Co-operation with a numerical weather prediction centre,
ii) development of coupled atmospheric-hydrological models including run-off,
iii) intensified observation networks, where needed, and unified data management for coupled model validation,
iv) free and open exchange of data and scientific information,
v) agreements with water resource agencies and other clients for better applications of research results.

While the first should guarantee the rapid use of better parameterisations of, for example, soil moisture in long-range weather prediction, the second is the major scientific challenge of CSEs, since it involves the interactive coupling of soil, vegetation and atmosphere including ground-water and run-off. This coupling is at least as demanding as ocean-atmosphere coupling because of the vegetation's response to both changes in atmospheric and soil parameters. The third criterion may be the most costly one, because it calls for intensified observations and new technologies. Examples for BALTEX are: Full precipitation radar coverage, water vapour profiling by differential absorption lidar, and possibly stable water isotope studies ($\delta^{18}0$, δD) in precipitation, river flow, ground-water and atmospheric water vapour useful for constraining the water budget. The fourth criterion seems superfluous at a first glance, but is normally difficult to be achieved especially for hydrological data, which often do not cross borders. The fifth criterion is a major challenge, since it goes beyond the routine clients/users of hydro-meteorological services. It asks for collaborative agreements with for example hydro-power companies, insurance companies and water resource managers of large cities.

Uniqueness of BALTEX

BALTEX is an atmospheric, hydrological and oceanic field experiment and thus needs the co-operation of meteorologists, hydrologists and oceanographers unlike any other CSE approved so far by the Joint Scientific Committee for the WCRP.

Another unique feature of BALTEX in comparison to other CSEs (see Table 1) is the involvement of 10 countries with larger territories in the catchment of the Baltic Sea. Other CSEs are organised predominantly by one country like GCIP for the Mississippi by the United States of America or MAGS for the Mackenzie by Canada. LBA for the Amazon is confined largely to the catchment portion within one country, Brazil, but has strong international participation. GAME, although strongly international as a whole, is again conducting its experiments in several single countries (China, Russian Federation and Thailand).

A further uniqueness of BALTEX as a CSE is its involvement in sea-ice studies which links it to another WCRP project, the Arctic Climate System Study (ACSYS), started in 1994, whose first main goal is the understanding of the Arctic Ocean circulation together with sea-ice formation and the freshwater export from the Arctic, mainly through Fram Strait, into the Atlantic.

Outlook

The era of climate prediction, started within TOGA and continued within CLIVAR (Climate Variability and Predictability), the newest WCRP component, needs for a success strongly improved parameterisation of cloud and land surface processes. Thus GEWEX, and its successful CSEs, are a prerequisite for an extended global weather and climate prediction and its rapid application for the benefit of all societies. The large differences in economic strength of the countries participating in BALTEX are a grand challenge for Europe. Therefore, one of my desires as director of the WCRP is a strong and joint funding of BALTEX as a good example for intensified European co-operation, leading to an immediate benefit for all participants, guaranteed only when the criteria, laid down for the continental scale experiments within GEWEX, are fulfilled. •

Table 1 (Graßl):
Continental Scale Experiments within GEWEX
(in alphabetical order)

	Name	Catchment
i)	BALTEX Baltic Sea Experiment	Entire Baltic Sea catchment
ii)	GAME GEWEX Asian Monsoon Experiment consisting of the following components	
	GAME - Tibet	Highland of Tibet
	GAME - Tropics	Chao-Praya-River in Thailand
	GAME - Siberia	Lena river basin in the Russian Federation
	HUBEX	Huai-he river basin in China
iii)	GCIP GEWEX Continental International Project	Mississippi Basin
iv)	LBA Large-scale Biosphere Atmosphere Interaction in Amazonia	Amazon Basin
v)	MAGS Mackenzie River GEWEX Study	Mackenzie river basin in Canada

The Contribution of BALTEX to the Goals of GEWEX and WCRP

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The Global Energy and Water Cycle Experiment (GEWEX) program brings together the resources of the international scientific community and the World's space agencies to improve the measurement, modelling and prediction of hydrological processes in climate. To achieve this GEWEX has focused on two major categories of processes: Determining the global radiation budget and fluxes in the atmosphere and at the surface and prediction of precipitation, changes in water resources, and changes in soil moisture over continental regions. Improvement in both areas is essential for progress in meeting WCRP's (World Climate Research Program) goals in seasonal-to-interannual prediction and understanding the response of the climate system on decadal-to-centennial time scales to changes in anthropogenic forcing.

The GEWEX radiation studies address the radiative interactions and feedbacks of clouds, water vapour, aerosols, and the land/ocean surface.

Information on GEWEX is available on the Internet at
http://www.cais.com/gewex/gewex.html

Global data sets of important cloud, surface and atmospheric parameters have been assembled and cloud-resolving models and cloud-system parameterisations are being employed to bridge the gap between process studies and GCM parameterisations.

To address the land-surface hydrometeorological questions; and to develop coupled land-surface atmospheric models, GEWEX has undertaken regional studies located in the Baltic sea region (BALTEX), the U.S. Mississippi River basin (GCIP), the Canadian Mackenzie River basin (MAGS), the Amazon River basin (LBA) and the Asian monsoon region (GAME). These regional studies aim to answer a broad range of scientific questions such as:

1. What are the residual uncertainties in closing the energy budget and the hydrological cycle over a large continental area with the best state-of-the art observations? Is the achievable accuracy compatible with the precision requirements for predicting the evolution of seasonal or interannual climatic variations and long-term climate trends?

2. What are the contributions of land surface processes and soil moisture to the maintenance of persistent weather regimes over periods of weeks to months or seasons? What is the impact of the memory induced by variations in ground water storage and evaporation on the predictability of wet or dry spells?

3. How well can the diurnal cycle and seasonal variations be modelled over continental areas? What are the corresponding roles of mesoscale-resolving models and weather forecasting models with full-scale data assimilation?

The GEWEX five continental-scale regional projects are designed to address these questions under different climate and terrain conditions. However, these diverse research activities are closely co-ordinated through a special panel within the GEWEX program to insure transferability and validation of results. The unique features of the Baltic region include unusual topography and orographic effects, a strong oceanographic component, the influence of sea-ice processes, and intense (although poorly-predicted) meso-scale storms.

BALTEX has made rapid progress in developing its observing network and developing the modelling and process studies. A full organisational structure has been established and working group activities are well underway. An intensive data collection activity has already taken place and preliminary scientific results are already being analysed. The BALTEX Science Steering Group and the supporting meteorological agencies are working together to improve the assimilation of atmospheric, hydrological and oceanographic data into numerical weather models, with the promise of exciting results soon. •

PIDCAP

Hans-Jörg Isemer
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The Initial Implementation Plan for BALTEX foresees Intensive Observation Periods in order to provide basic data sets for the analysis and diagnosis of synoptic-scale systems and extreme events in the BALTEX region. The first of such an Intensive Observation Period is PIDCAP, *the BALTEX Pilot Study for Intensive Data Collection and Analysis of Precipitation.* The objectives of PIDCAP include

- the collection, analysis and intercomparison of measured and estimated precipitation from different data sources in order to identify and establish reliable standards for model validation,
- the validation of the output of different regional models against such precipitation data sets,
- to develop, test and establish necessary data management and analysis procedures for future comprehensive studies in the frame of BALTEX.

The observational period of PIDCAP was August to November 1995, the area of interest is the entire catchment region of the Baltic Sea. Precipitation data sets to be compared include standard data (e.g. from gauge land stations) and non-standard data (e.g. from research vessel, specially equipped ships of opportunity, from SSM/I and radar stations). Modelling groups at e.g. MPIfM, GKSS, DMI and SMHI are currently performing model runs with different regional models for the PIDCAP period. At present, more than 15 different research projects are defined for PIDCAP.

For a PIDCAP project description and a preliminary PIDCAP progress report see the BALTEX Secretariats Report No.7. •

Information on BALTEX is available on the Internet at
http://w3.gkss.de/baltex/baltex_home.html

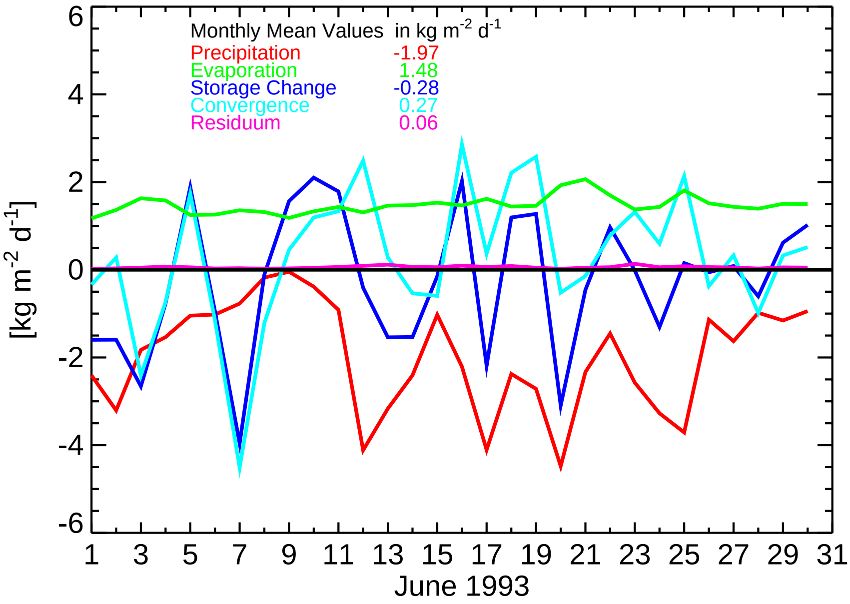

***Figure 1 (Rockel et al.):** Atmospheric components of the water cycle over the catchment area of the Baltic Sea for June 1993. The daily values refer to the time span from 06 UTC to 06 UTC on the following day, corresponding to hours 6 to 30 after model start at 00 UTC. All components are calculated explicitly, the residuum $R=\Delta W - (E - P + C)$ has only numerical character.*

Regional-scale Modelling and Validation of the Water and Energy Cycle in the BALTEX Region

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Our goal is to quantify the energy and water cycle components over the BALTEX area using a regional atmospheric model, and to validate the results by measurements. In the following we will give a short overview over the model and some selected results. More detailed information can be found in Karstens et al. (1996), and Nolte-Holube et al. (1996).

The regional model REMO as used here is essentially the same code as the regional weather forecast model „Europa-Modell“ EM (workstation version 1.14) of the German Weather Service (Majewski, 1991). The model uses the hydrostatic approximation with 20 vertical levels in a hybrid co-ordinate system. The horizontal resolution is approximately 18518 km^2. The EM grid refers to the same co-ordinate system but with 1/2^o horizontal resolution. Thus every third REMO grid point coincides with an EM grid point.

The EM has two prognostic equations for total water content $q = q_v + q_c$ and total heat $h = c_pT + Lq$. For REMO these equations were splitted into three prognostic equations for water vapour q_v, cloud water q_c, and temperature T. A prognostic equation for ice water was added. Extended diagnostics and pre-processing was implemented. Both REMO 1/2° and REMO 1/6° are started for each day of June 1993 at 00 UTC using analyses on the EM grid obtained from DWD as initial conditions. Sea surface temperature is analysed daily using ship and buoy data and is kept constant during each forecast. No analysis of the prognostic variables of the soil model (temperature and moisture) is performed. Their values are taken from the 6h first guess of the EM data assimilation procedure (Majewski 1991). A 30 h forecast is computed by both models. EM uses analyses of 00, 06, 12, 18 UTC as boundary

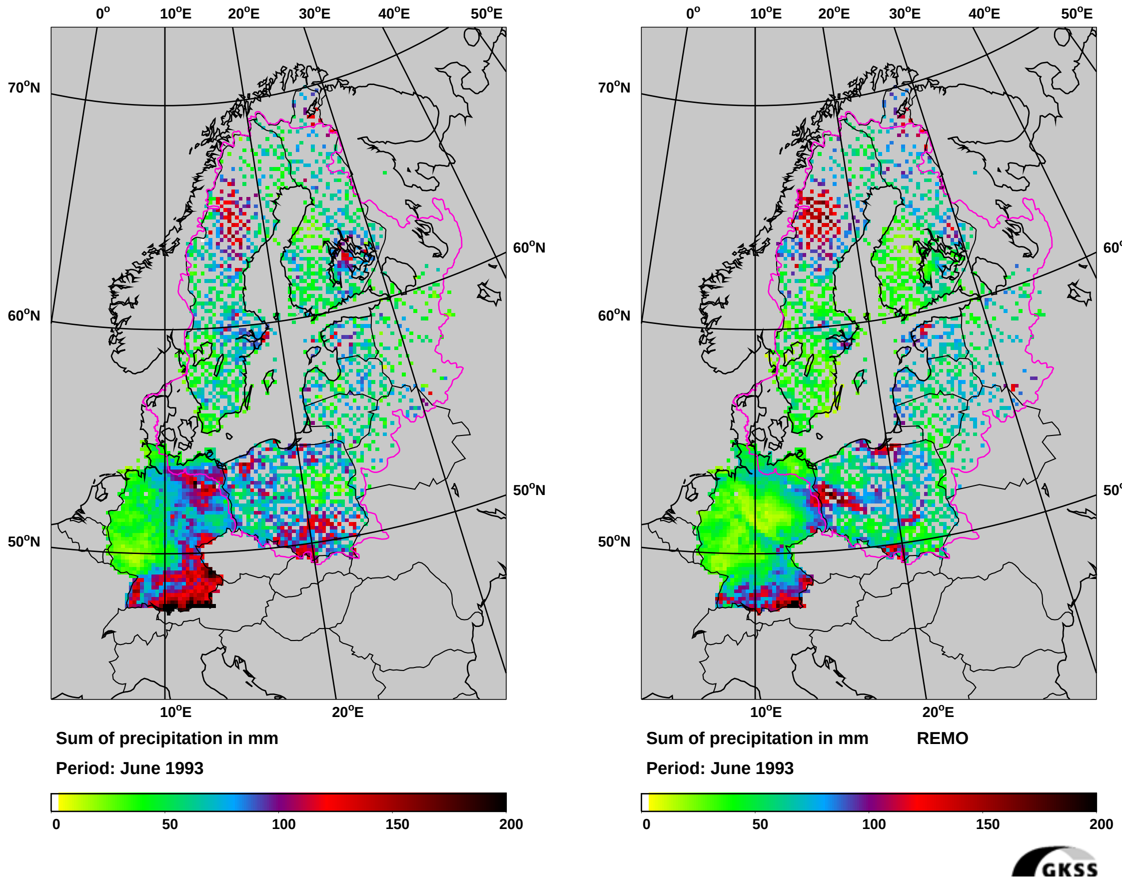

Figure 2 (Rockel et at.): *Measured (left) and calculated (right) precipitation in June 1993. Only grid boxes with available measurements are coloured, all others are shown in grey. The boundary of the Baltic Sea catchment area is marked by the pink line.*

conditions. REMO's boundary conditions are provided by hourly data from the EM run. To account for a spin-up time, only REMO results obtained after the first 6 hours of the forecast are taken into account. By re-starting the model every day with analyses the model state is forced to stay close to the real weather situation. This facilitates a comparison with measurements with high spatio-temporal resolution. However, small scale features which develop during the forecast period are destroyed at the next re-start, because the initial conditions are interpolated from a coarser grid.

Model Results

The total atmospheric water storage changes due to precipitation, evapotranspiration, and horizontal water transport convergence. Daily mean values over the whole catchment area are shown in Figure 1 (see previous page). Also shown is the small residuum R in the water balance which is due to numerical errors. There is, however, another source of error which has to be considered. Due to the daily re-initialisation of the model, all variables are discontinuous in time at 6 UTC on every day but the first. Thus adding water storage changes which occur during each day of the month is not equivalent to calculating the storage change as difference of the two contents at the beginning and at the end of the month.

In the daily balance plot it can be seen that the first 10 days of June 1993 were comparatively dry over the BALTEX region. Major precipitation events of about 4 kg $m^{-2}d^{-1}$ occur later on June 12, 17, 20 and 25. Daily mean evapotranspiration remains nearly constant near its mean value of 1.5 kg m^{-2} d^{-1} during the month. From day 3 to 8 the change in water content is mainly determined by horizontal transport. Precipitation and evapotranspiration approximately balance each other. In contrast to this, water storage and horizontal transport follow the strong precipitation in the period from day 17 to 20. On the monthly time scale precipitation and evaporation are the dominant components of the water budget. In June 1993 the excess of precipitation over evapotranspiration is balanced by a transport of water into the region and a decrease of water content.

The calculated energy budget shows that in the daily mean the atmosphere looses energy in form of radiation, the daily values deviate only slightly from the monthly mean of -57.9 Wm^{-2}. Sensible heat also does not show strong variations, an average of 46.2 Wm^{-2} are transferred from the ground to the atmosphere. Precipitation results in a gain of 57.2 Wm^{-2} when averaged over the whole month.

Comparison with Measurements
The validation of the individual components of the water cycle is necessary to assure reliable estimates of the balance. It will also indicate possible deficiencies in the physical parameterisations and their feedbacks in the model. A main objective is the validation of the precipitation field because this is a critical input parameter for hydrological models.

REMO model precipitation is compared with measurements from the operational rain gauge network of several meteorological services within the Baltic Sea region (data collection of the International BALTEX Secretariat and the BALTEX Data Centre). Observations from 7775 stations were used. The measurements are converted to the model grid by taking the average of the values of all stations situated in a grid box. Figure 2 (see previous page) shows accumulated measured and calculated precipitation for June 1993 at those grid boxes where measurements were available. In some regions the model underestimates the amount of precipitation significantly. The differences are mainly due to a mismatch in location of the precipitation regions and to a lesser extent to a general underestimation. This is also confirmed by a comparison of daily sums because even on days when the areal averages over the whole catchment area are quite close to the observed values, a large RMS of the difference reflects errors in the geographical distribution. The measured and calculated amount of precipitation in June 1993 are 71.4 mm and 60.6 mm, respectively.

Satellite data are particularly well suited for model validation because of the possibility to cover the whole model area. Data from the International Satellite Cloud Climatology Project (ISCCP) with spatial and temporal resolutions of 30 km and 3 h, respectively, are used for this purpose. First comparisons of cloud cover and cloud liquid water with model results show good agreement.

References

Karstens, U., R. Nolte-Holube and B. Rockel, 1996: Calculation of the Water Budget over the Baltic Sea Catchment Area using the Regional Forecast Model REMO for June 1993. *Tellus*, **48A**, 684-692.

Majewski, D., 1991: The Europamodell of the Deutscher Wetterdienst. ECMWF Course "Numerical methods in atmospheric models", Vol. 2, pp. 147-191.

Nolte-Holube, R., U. Karstens, D. Lohmann, B. Rockel and R. Stuhlmann, 1996: Regional Scale Atmospheric and Hydrological Modelling: Results and Validation for the Baltic Sea and Weser Catchments. GKSS Report 96/E/54, pp. 40. •

Atmospheric Modelling of the Water and Energy Budget of the Baltic Sea and its Drainage Basin

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The hydrological and energy cycles over the Baltic Sea and its drainage basin are influenced by meteorological phenomena on a variety of scales. Small meso-scale cyclones as well as synoptic scale features determine the interannual variability and the long term climate. Therefore an intense study of a variety of weather events on a wide range of spatial and temporal scales will be carried out.
For regional studies the regional-scale model REMO based on the operational forecast model of the DWD (Deutscher Wetterdienst) was used. In close co-operation with the Deutsche Klimarechenzentrum (DKRZ) an additional physical parameterisation scheme, identical to the one of the global MPI (Max-Planck-Institute) climate model (ECHAM4) for the atmosphere was suc-

cessfully implemented. The REMO model can now be used with two complete physical parameterisation schemes, the original one (DWD-physics) and the new one (ECHAM4-physics).

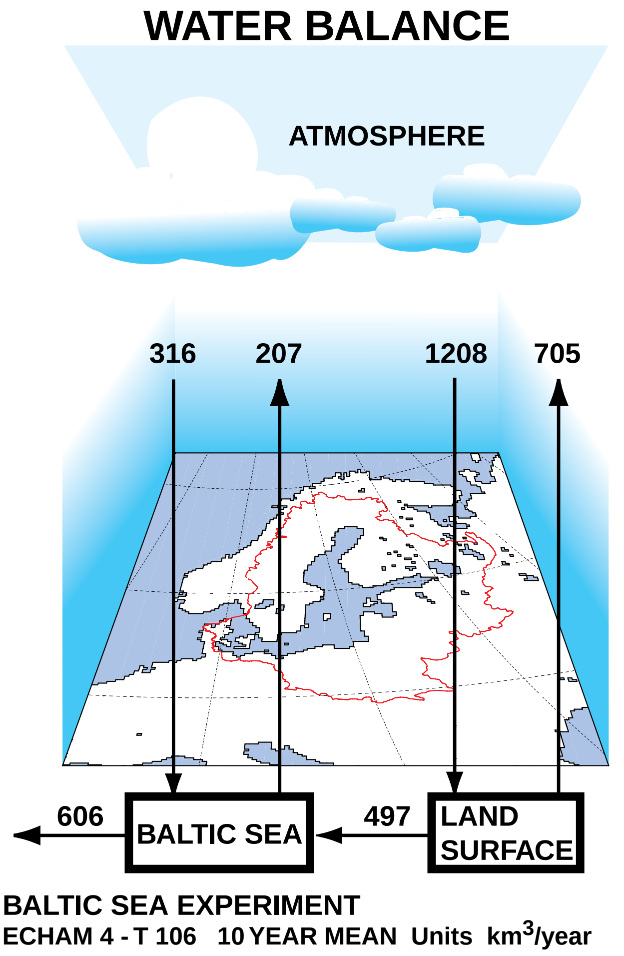

Figure 1 (Jacob and Windelband)

The simulated climatology of the Baltic region has been analysed for land and ocean, separately. In particular two 10 year long simulations of the global climate model ECHAM4 in T42 and T106 resolution for the years 1979 - 1988 have been used to study the spatial distribution, vertical profiles, interannual variability and the 10 year mean for the drainage basin. As an example the water budget for a 10 year mean is shown in Figure 1. The total amount of water running from the land surfaces into the Baltic Sea sums up to 497 km^3 per year. This is in broad agreement with the long term average runoff from the rivers into the Baltic Sea. Together with an input of 316 km^3 /year due to precipitation and a loss of 207 km^3 /year due to evaporation from the water surface the outflow from the Baltic Sea through the Kattegat amounts in 606 km^3 /year as a 10 year mean.

A restriction to T106 is necessary since the ratio between land and sea points on T42 and T106 is so different. Due to the too coarse resolution of T42, the errors in area size are dominating the T42 budgets.

A number of sensibility experiments have been performed on the regional scale to study the influence of:

- boundary conditions
- horizontal and vertical resolution
- integration area size
- physical parameterisation schemes

For each physical parameterisation scheme two simulations have been performed, one with 50 km and a second one with 18 km resolution on the horizontal scale.

During this period REMO was driven by analysis data provided by the DWD as lateral boundary conditions. Therefore it was possible to compare the performance of the two different physical parameterisation schemes against each other and in addition against observed rainfall data. The observations were taken during the BALTEX PIDCAP period (see page 4).

The spatial distribution of precipitation is very similar in all simulations and agrees well with the observed data. In particular, the relatively dry regions over south-east Sweden and northern Denmark and the increase of precipitation (close to the long term climatology) over Poland are realistically simulated. In general, the ECHAM4 physics simulates more precipitation than the DWD physics for the case study. Much more details are shown on the 18 km resolution and the amount of precipitation is in better agreement with the observations.

After the detailed validation of the REMO simulations against observations taken during PIDCAP, long term simulations with REMO are planned. •

The Role of Ocean Models in BALTEX and Implications for Future Work

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The strong need for better understanding of the water and energy cycles in the atmosphere/land/ ocean climate system requires the development of high resolution coupled atmosphere/land/ocean models. This is one of the main goals of the BALTEX research, and several important initiatives are now undertaken within the BALTEX program to achieve this goal. In this note I would like to give my view on the role of ocean models in the BALTEX research and some implications for future work.

In a recent paper (Omstedt et al. 1997) we have investigated the meteorological freshwater inflow (precipitation minus evaporation rates) to the Baltic Sea. The precipitation rates were based upon available meteorological data interpolated to grid points using a two-dimensional objective analysis scheme. The evaporation rates were calculated using an ocean model, in which the Baltic Sea was treated as thirteen sub-basins with high vertical resolution (Omstedt and Nyberg 1996). Calculated sea surface temperatures (SST) and sea-ice were extensively verified against temperature and ice charts.

According to this study the long term difference between precipitation and evaporation rates is positive but shows large interannual, seasonal and regional differences. These variations are illustrated in Figures 1 - 3. From this study it is obvious that when comparing different results from models or observations we always need to use the same time period as well as the same region. In many studies we try to support our own estimates by comparing results from other studies, but if not the same period or the same region are used we will not learn much. Also, as the interannual variations are large we need to integrate over a rather long period, say 10 years, to be able to estimate a reasonable long term mean.

From the study by Omstedt et al. (1997) it was also concluded that an ocean model is a most useful tool when calculating evaporation from the sea. This is partly due to the fact that consistent estimates of heat fluxes and SST can be calculated, and also to the fact that SST and sea-ice can be calculated with high resolution in time and space. Both SST and sea-ice data constitute information that is not easily reproduced from charts with often rather coarse information. The application of an ocean model to estimate fluxes between atmosphere and ocean can also be regarded as one important step in the development of coupled models.

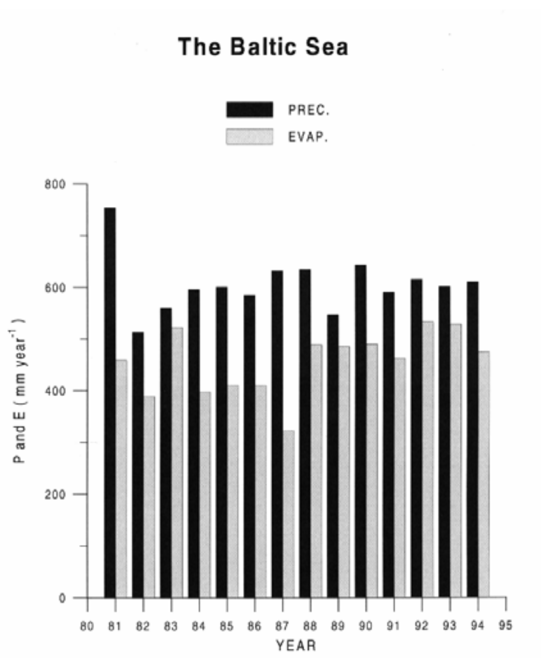

Figure 1 (Omstedt): *Annual means of precipitation and evaporation rates [mm per year] for the Baltic Sea (including the Kategatt) during 1981 to 1994.*

The ocean models within the BALTEX research can thus provide the boundary condition to the meteorological models with high resolution in time and space with respect to SST and sea-ice. But the ocean models will also serve as an important component for the verification of the atmosphere and river runoff models, as the modelled salinity can be used as a constraint on the quality of meteorological inflow and the river runoff as well as the in- and outflows trough the Baltic Sea entrance area. The ocean models will therefore serve as important verification tools for our understanding of the water and energy cycles. If the modelling efforts with coupled models will

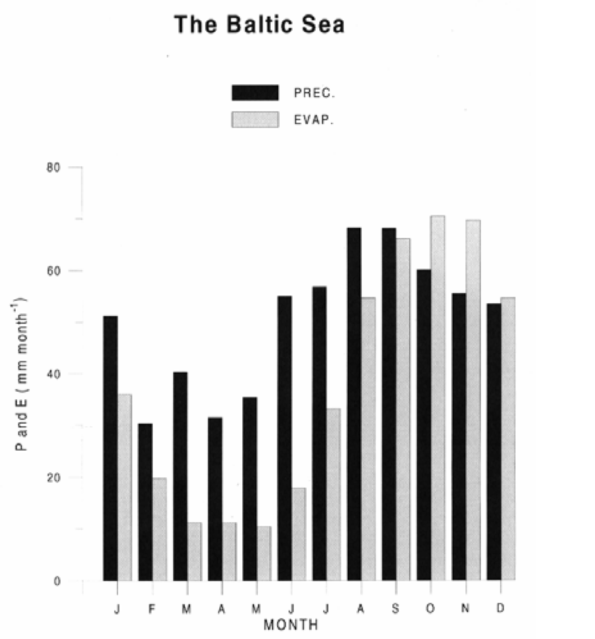

Figure 2 (Omstedt): *Monthly long term means of precipitation and evaporation rates [mm per year] for the Baltic Sea (including the Kategatt) during 1981 to 1994.*

not be able to calculate the salinity in the Baltic Sea correctly, we have not understood the energy and water cycles of the Baltic drainage basin!

To achieve the goals in the BALTEX program we need to develop coupled atmosphere/land/ocean models. The planned process oriented field experiments during the coming three years (see e.g. BALTEX Newsletter No.1) will provide us with important modelling input. During the BALTEX Main Experiment which is planned now for the years 1999 - 2001 we should be in a good position for putting coupled models in pre-operational use and making diagnostic model studies. After that we need to make a consistent re-analysis of a time period over at least 10 years, using coupled models.

This will need large efforts, but will provide us with a consistent data set, from which the BALTEX energy and water budgets can be calculated. The program can then, with good planning and co-ordination, come to an end in say the year 2006. The BALTEX energy and budgets study will then replace the HELCOM (1986) study as the state of art. If we are successful, we have been able to achieve our BALTEX goals within almost the same time period as in the HELCOM study. The achievements will then be a really strong contribution to our knowledge, partly as we treat the water and energy budgets in a consistent way and partly because we have developed coupled atmosphere/land/ocean models that can be used in numerical atmosphere / land / ocean predictions.

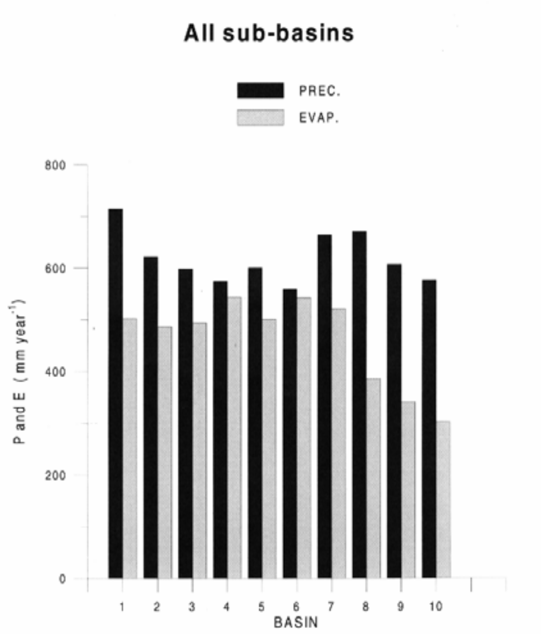

Figure 3 (Omstedt): *Regional long term means of precipitation and evaporation rates [mm per year] for 10 Baltic Sea sub-basins during 1981 to 1994. The numbers denote: 1=Kattegat, 2=Belt Sea, 3=Arkona Basin, 4=Bornholm Basin, 5=Eastern Gotland Basin, 6=North Western Gotland Basin, 7=Gulf of Riga, 8=Gulf of Finland, 9 =Bothnian Sea, 10=Bothnian Bay.*

References

HELCOM, 1986: Water Balance of the Baltic Sea. Baltic Sea Environment Proceedings 16, Helsinki, Finland.

Omstedt, A. L. Meuller and L. Nyberg, 1997: Interannual, seasonal and regional variations of precipitation and evaporation over the Baltic Sea. *Ambio*, in press.

Omstedt,A. and L., Nyberg, 1996: Response of Baltic Sea ice to seasonal, inter-annual forcing and climate change. *Tellus*, **48A**, 644-662. •

Special BALTEX Issue of *Tellus*

The First Study Conference on BALTEX was held at Visby, Sweden 28 August - 1 September 1995. The following 15 papers which were presented at this Conference have recently been published as Volume 48A, No.5 in a special BALTEX issue of *Tellus*:

Ljungemyr, P., N. Gustafsson and A. Omstedt: Parameterisation of lake thermodynamics in a high-resolution weather forecasting model.
Haapala, J. and M. Leppäranta: Simulating the Baltic Sea ice season with a coupled ice-ocean model.
Omstedt, A. and L. Nyberg: Response of Baltic Sea ice to seasonal, inter-annual forcing and climate change.
Lass, H.U. and W. Matthäus: On temporal wind variations forcing salt water inflows into the Baltic Sea.
Samuelsson, M. and A. Stigebrandt: Main characteristics of the long-term sea level variability in the Baltic Sea.
Karstens, U., R. Nolte-Holube and B. Rockel: Calculation of the water budget over the Baltic Sea catchment area using the regional forecast model REMO for June 1993.
Heise, E.: An investigation of water and energy budgets for the BALTEX region based on short-range numerical weather predictions.
Lohmann, D., R. Nolte-Holube and E. Raschke: A large-scale horizontal routing model to be coupled to land surface parametrization schemes.
Tooming, H.: Changes in surface albedo and air temperature at Tartu, Estonia.
Keevallik, S. and H. Tooming: Relationships between surface albedo and spring heat accumulation.
Mölders, N., A. Raabe and G. Tetzlaff: A comparison of two strategies on land surface heterogeneity used in a mesoscale β meteorological model.
Holopainen, E.: Diagnostic studies on atmospheric budgets of water and energy based on aerological data.
Calanca, P. and C. Fortelius: Representation of model data and evaluation of diagnostic equations in pressure coordinates.
Karlsson, K.-G.: Validation of modelled cloudiness using satellite-estimated cloud climatologies.
Russak, V.: Atmospheric aerosol variability in Estonia calculated from solar radiation measurements.

For the comprehensive Conference Proceedings see the BALTEX Secretariats Report No.3.

Hans-Jörg Isemer
International BALTEX Secretariat. •

International BALTEX Secretariat Publication Series

No. 1: Minutes of 1st Meeting of the BALTEX Science Steering Group at GKSS Research Centre in Geesthacht, Germany, May 16-17, 1994. August 1994.

No. 2: Baltic Sea Experiment BALTEX - Initial Implementation Plan. March 1995, 84 pages.

No. 3: First Study Conference on BALTEX, Visby, Sweden, August 28 - September 1, 1995. Conference Proceedings. Editor: A. Omstedt, SMHI Norrköping, Sweden. August 1995, 190 pages.

No. 4: Minutes of 2nd Meeting of the BALTEX Science Steering Group at Finnish Institute of Marine Research in Helsinki, Finland, January 25-27, 1995. October 1995.

No. 5: Minutes of 3rd Meeting of the BALTEX Science Steering Group at Strand Hotel in Visby, Sweden, September 2, 1995. March 1996.

No. 6: BALTEX Radar Research - A Plan for Future Action. October 1996, 46 pages.

No.7: Minutes of 4th Meeting of the BALTEX Science Steering Group at Institute of Oceanology PAS in Sopot, Poland, June 3-5, 1996. February 1997.

Also available:

Minutes of the 1st BALTEX Hydrology Workshop at Polish Academy of Sciences, Warsaw, Poland, September 9-11, 1996. March 1996.

BALTEX is an European regional project within the Global Energy and Water Cycle Experiment (GEWEX), with contributions of 10 countries in the Baltic Sea drainage basin. GEWEX has been launched by the World Meteorological Organisation (WMO), the International Council of Scientific Union (ICSU) and the Intergovernmental Oceanographic Commission (IOC), as part of the World Climate Research Programme (WCRP).
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