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

New Objectives for BALTEX Phase II

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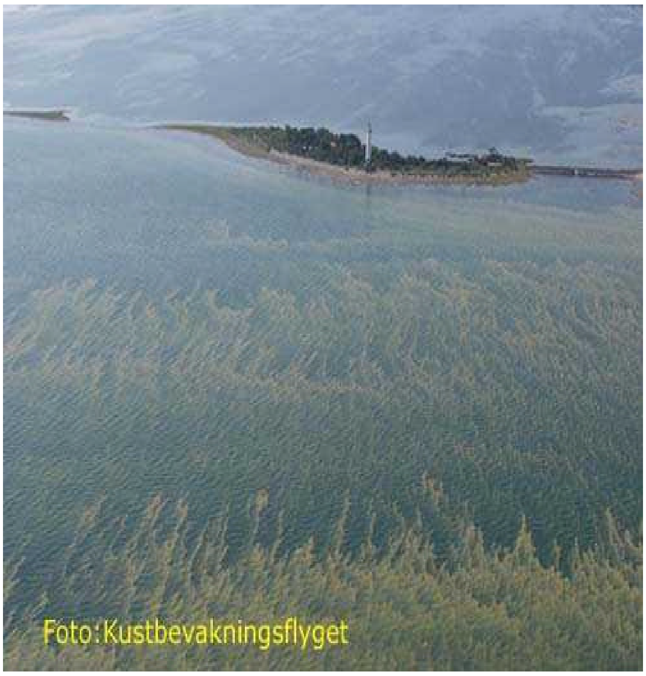
At its 14th meeting in Lund, Sweden, the BALTEX Science Steering Group has unanimously approved the following new general objectives for BALTEX Phase II:

1) Better understanding of the energy and water cycles over the Baltic Sea catchment;
2) Analysis of climate variability and change since 1800, and provision of regional climate projections over the Baltic Sea catchment for the 21st century;
3) Provision of improved tools for water management, with an emphasis on more accurate forecasts of extreme events and long-term changes;
4) Gradual extension of BALTEX methodologies to air and water quality studies;
5) Strengthened interaction with decision-makers, with emphasis on global change impact assessments;
6) Education and outreach at the international level.

The energy and the water cycles are intricately linked and dominate climate variability. They have been the focus of BALTEX Phase I and continue to do so in Phase II. The first objective for Phase II may seem to have an insufficiently innovative character, however, if one looks at all the fields benefiting from smaller error bars for energy and water flux profiles in the atmosphere, e.g. weather forecasting, seasonal climate anomaly predictions and water resource management, it becomes clear that this prime goal of GEWEX has to be continued. This is in particular true, because we can use now a suite of new sensors on NASA's AQUA and TERRA satellites, ESA's ENVISAT and NASDA's ADEOS II for cloud, water vapour and surface flux observations with higher precision and resolution. Also, Objective 1 clearly indicate that further basic understanding and model improvements are needed.

Objective 2 is building on the achievements of BALTEX Phase I in the area of advanced modelling of the energy and water cycle for the present climate over large catchments like the entire Baltic Sea basin. Its main foci are firstly the assessment and realistic modelling of changes in climate parameters since 1800, in this area of denser meteorological and hydrological observations than in nearly all other large catchments, and secondly the provision of regional climate change projections using validated coupled regional atmosphere/ocean/sea ice/land/hydrology models that have been developed within BALTEX.



The aim of Objective 4 is to gradually improve the modelling capability on transport and deposition of nutrients and pollutants and to identify today's scientific shortcomings and limitations for climate predictions and on present day assessment of the environment. The photo shows extended algal blooms in the Baltic Sea at the northern tip of Öland during July 2002. Courtesy of The Swedish Coast Guard Air Patrol.

The proper management of water resources is a prime interest of all countries. As climate change has become obvious we have to re-adapt our infrastructure (such as reservoirs, dams, dykes, sewers, harbours) to changing extreme meteorological events as a consequence of ongoing and anticipated further climate change. Therefore, following its third objective, BALTEX aims at delivering tools for improved predictions and projections of extreme meteorological, oceanographical and hydrological events on time scales of days to decades using both the long-term trend analyses and state-of-the-art coupled models.

With growing skill of predictions on shorter and projections on longer time-scales these BALTEX tools, among them statistical and dynamical downscaling of atmospheric, land surface and Baltic Sea processes, are a new basis for more advanced air and water quality studies (Objective 4). However, this enlargement concerning the disciplines involved and the complexity of scientific questions should not be done too fast in order to fully adapt the research network, including the representation of the new disciplines in the BALTEX SSG and working groups. It should be kept in mind that eutrophication of the Baltic Sea by river and atmospheric input is a key environmental problem and sound strategies for its reduction are urgently needed.

Any research improving the understanding of any facet of regional or global environmental change has an immediate application; this is especially true for water cycle components. Therefore, the 5th BALTEX Phase II objective puts special emphasis on linking research to the needs of the many users, especially decision makers in politics, administration, national services, private companies, etc. An example for such an enhanced interaction is invitation of user representatives into BALTEX projects that deal with groundwater level and quality changes as a consequence of ongoing and future climate change and EU agricultural policies.

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

BALTEX is a truly international research endeavour, encompassing countries in various stages of development speaking about 10 different languages. Therefore we need a strong education and outreach programme at the international level. BALTEX will, for example, include its research results into courses of international university programmes such as the Baltic University Programme, but will also address the general public through e.g. a teacher education section at BALTEX conferences, open days at research centres and universities, and web-sites contributing to e-learning.

Our plans will come true only if national environmental research programmes continue or start funding the research necessary to meeting our objectives and – above all – if we scientists are enthusiastic about our goals.

Radiation Budget of the BALTEX Area Derived from ISCCP-Data: Differences Between the Baltic Sea and its Environmental Land

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The scientific goal of BALTEX is to improve our knowledge of the water and energy cycles over the Baltic Sea and its catchment area (BALTEX, 1995; Raschke et al., 2001). In order to understand the cycles the question has to be answered how much of the energy and water is imported to the area through its lateral boundaries and how much is supplied through the upper and lower boundaries. The latter net influx will be defined as local sources in contrast to the horizontal fluxes, which represent an external source. For the mid-latitudes in general advection processes i.e. external sources are dominant but local sources can have a large effect on weather and climate of a certain area.

The specialty of the BALTEX area is its geographical characteristic with a semi-enclosed sea in the centre. This configuration should have a remarkable influence on the radiation, too. The radiation fluxes at the top of the atmosphere and at the surface are determined in this study to understand the local sources. In particular we are interested in the differences between the Baltic Sea and its environmental land.

Data and Method

The calculations are performed with the radiation transfer model "Streamer" (Key, 1996). The parameters and variables, which are needed as input for the radiation model, are derived from the ISCCP cloud and atmospheric parameters as for example cloud top height, cloud thickness, surface albedo and vertical profiles of temperature and humidity. We used the daily DX data of the years 1986-1993 which have a spatial resolution of 30 km. To derive the input cloud parameters for "Streamer", observations in the visible and IR-channel are necessary. Since such observations are not available during the whole day and in the winter season at best during noon we used here only the 12 UTC data to calculate the radiative fluxes. The calculation was performed pixel by pixel and then temporarily averaged to produce monthly means for the whole BALTEX area, the Baltic Sea and for its environmental land.

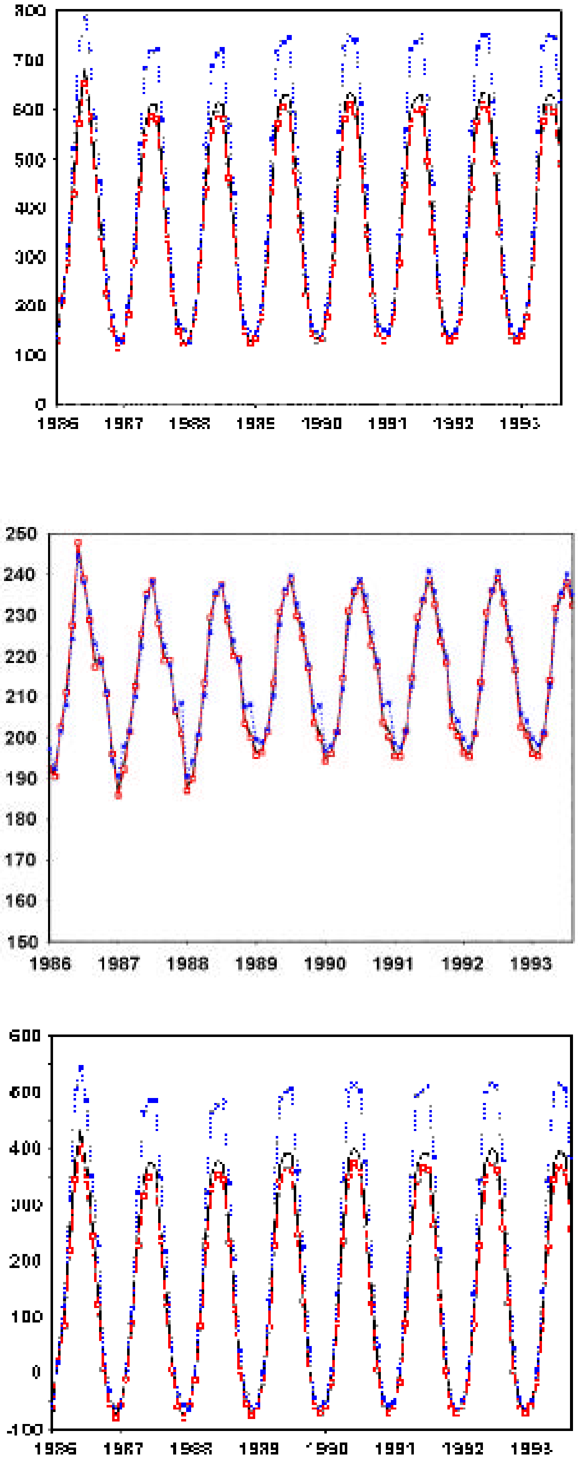

Figure 1: *Monthly mean values of the daytime radiation budget at the top of the atmosphere during 1986 to 1993 over the BALTEX area (black), over the Baltic Sea (dashed blue) and over the environmental land (red) for the solar radiation (top), the longwave radiation (middle), and the net radiation budget (bottom) in W/m².*

Results

The mean annual cloud coverage shows a distinct difference between the Baltic Sea and its land environment. The cloud cover over sea is about one tenth less than cloud cover over land. During summer the difference is even larger (about two tenths). This fact together with the difference in surface albedo is the cause that the absorbed solar radiation at the top of the atmosphere is larger over the Baltic Sea than over the environmental land (Fig. 1a). The time series show for the summer month an excess of 120 W/m² of the absorbed solar radiation of the Baltic Sea. The outgoing longwave radiation is, however, almost homogeneous over the whole BALTEX area. Fig. 1b shows nearly no differences between the different regions that means the surface conditions have only very small effects on the outgoing radiation. Thus, the variations of the resultant net budget are similar to those of the solar budget (Fig. 1c). During the summer months an atmospheric column over the Baltic Sea receives about 100 W/ m² more radiation energy than the atmosphere over the environmental land. This result is more clearly demonstrated in Fig. 2, which shows the spatial distribution of the 8-year annual mean of the total budget. The Baltic Sea stands out very clearly.

The parameters, which determine the fluxes at the top of the atmosphere, also affect the radiation budget at the surface. During summer the excess of radiation over the Baltic Sea compared to the environmental land is of the same magnitude at the surface as at the top of the atmosphere (Fig. 3). In addition the figure shows that the budget at the surface is positive during the whole year. This is in contrast to the budget at the top of atmosphere, which is negative during 4 months (November – February) at least. From these results one can conclude about the energetic conditions of the BALTEX area: During daytime in winter the local energy source at the top of the atmosphere is negative, that means energy must be imported through the lateral boundaries. The budget between the Baltic Sea and its environmental land is not significantly different. During summer radiation provides a large energy source, significant more radiation is received over the Baltic Sea than over the environmental land. The excess is transported through the lateral boundaries in the environment of the BALTEX area. That means during winter the area depends energy-wise on the large-scale environment and during summer the BALTEX area influences its surrounding.

The results indicate the importance of the fluxes through the lateral boundaries. Thus, limited area models, which need the description of the conditions at the lateral boundaries, can correctly simulate the processes within the BALTEX area only when the transports through the lateral boundaries are well known.

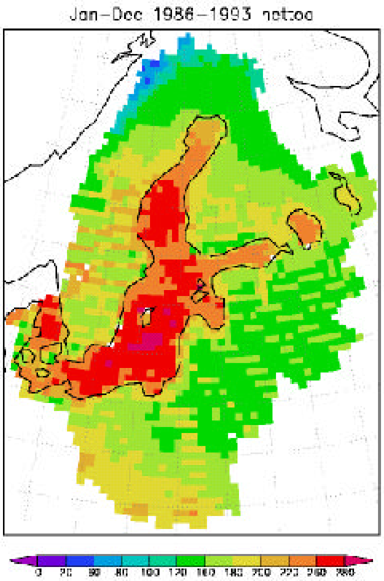

Figure 2: *Annual mean (1986-1993) of the daytime net radiation budget at the top of the atmosphere over the BALTEX area.*

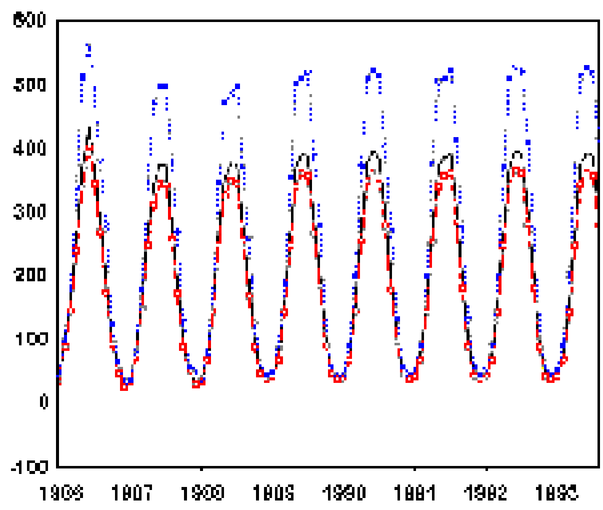

Figure 3: *Monthly mean values of the daytime net radiation budget during 1986 to 1993 at the surface of the BALTEX area (black), the Baltic Sea (dashed blue), and the environmental land (red) in W/m².*

References:

BALTEX, 1995: Baltic Sea Experiment BALTEX. Initial Implementation Plan. Intern. BALTEX Secretariat, Publ. No. 2, 84 pp.

Key, J., 1996: Streamer User's Guide. Technical Report 96-01. Dept. Geogr. Boston Univ., 85 pp.

Raschke, E. and Co-authors, 2001: The Baltic Sea Experiment (BALTEX): A European Contribution of the Investigation of the Energy and Water Cycle over a Large Drainage Basin. Bull. Amer. Meteor. Soc., 82(11), 2383-2413.

Lindenberg: One of the BALTEX Reference Sites for CEOP

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The Meteorological Observatory Lindenberg (MOL) performs a comprehensive operational monitoring program of the physical structure of the atmosphere including in-situ and remote sensing vertical soundings and the operation of a special boundary layer field site. The complex data sets resulting from these measurements are particularly suited to fulfil the requirements of a reference site for CEOP, the prototype project for a future global earth observing system.

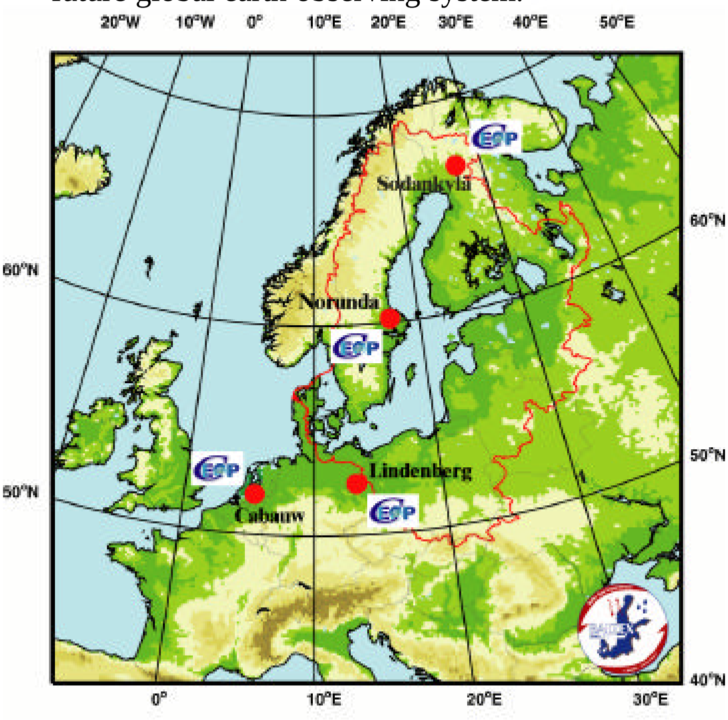

***Figure 1:** Locations of BALTEX Reference Sites for CEOP*

Lindenberg is situated about 65 km to the south-east of Berlin within a rural landscape. The topography has been formed by the inland glaciers during the last ice age and exhibits a slightly undulating surface with height differences between about 40 m and 130 m above sea level, and with a number of small and medium-sized lakes embedded. The land use in the area around Lindenberg is dominated by a mixture of forest and agricultural farmland. This type of landscape is rather typical for the whole region in the north-east of Germany and even for large parts of northern Central Europe south of the Baltic Sea. Figure 2 gives an impression on the type of landscape around Lindenberg with the L-shaped boundary layer field site in the centre of the photo. Lindenberg represents moderate mid-latitude climate conditions at the transition between marine and continental influences. Monthly mean temperatures vary between -1.2 deg C (January) and 17.9 deg C (July), and the mean annual precipitation sum (1961-1990) is 563 mm.

***Figure 2:** Aerial view at the heterogeneous landscape of the LITFASS area with the L-shaped GM Falkenberg (marked by the arrow) in the centre of the photo.*

The Meteorological Observatory Lindenberg (MOL) has a nearly 100-years-old tradition in experimental scientific and technological research in the field of measurements on the vertical structure of the atmosphere. It was founded as "Königlich Preußisches Aeronautisches Observatorium Lindenberg" (Royal Prussian Aeronautical Observatory Lindenberg) by R. Assmann in 1905. Systematic operational aerological soundings have been performed at Lindenberg since that time, starting with kites and tethered balloons, which were - at the beginning of the 1930ies -

replaced by free-flying balloons carrying radiosondes.

At present, the Lindenberg upper air station is equipped with the Vaisala PTU standard aero logical system and a Gematronics wind-finding Radar. Radiosoundings are performed operationally four times per day (00, 06, 12, 18 UTC). Over the last decade, research has been done in order to essentially improve the quality of humidity measurements from standard radiosondes (see Leiterer et al., 2000).

Since the beginning of the 1990ies, new ground-based remote sensing systems were successively introduced into the operational practice at Lindenberg. This development was motivated by the increasing need for continuous high-resolution data on the vertical structure of the atmosphere to be used in nowcasting and data assimilation for NWP models. Today, the remote sensing activities at MOL include the operation of two wind profiler / RASS systems, one sodar / RASS system, a microwave radiometer profiler, and a micro-rain radar (see e.g. Engelbart and Steinhagen, 2001). Further extensions of the remote sensing facilities by a cloud radar, a water vapour Raman lidar and infrared (Fourier-) spectroscopy are planned.

CEOP Reference Site Data on Internet:
http://www.joss.ucar.edu/ghp/ceopdm/

In 1994, experimental boundary layer research has been defined as an additional focus of the measurement program at MOL. This decision was based on the increasing demand for data on land surface and boundary layer processes originating from recent developments in NWP and climate research, namely

- the increasing resolution in time and space of NWP and climate models (resolving the meso-γ scale) and the need to adapt the boundary layer model parameterisations to the smaller resolved scales taking into account the heterogeneity of the land surface,
- the increasingly integrative description of the climate system with special focus on the interaction processes between the atmosphere, hydrosphere, and biosphere, and
- the growing use of in-situ measurements as a ground truth for land surface parameters derived from satellite data.

Two basic infrastructure elements have been created at MOL during the period 1994 to 2000 for the experimental investigation of boundary layer processes over the heterogeneous landscape around Lindenberg, namely the boundary layer field site (in German: Grenzschichtmessfeld = GM) at Falkenberg and the LITFASS networks (mesoscale networks of micrometeorological stations, rain gauges and radiation sensors). The installation of these systems has been greatly supported by the LITFASS project, an internal research project of DWD launched in 1995 (see Beyrich et al., 2002). LITFASS stands for Lindenberg Inhomogeneous Terrain - Fluxes between the Atmosphere and the Surface: a long-term Study. An overview on the actual basic installation at the Falkenberg boundary layer field site is given in Table 1, and a view at the tower is shown in Figure 3.

A second permanent micrometeorological measurement site has been set up in a pine forest about 10 km west of Falkenberg, representing the second major type of land use in the area. A 30m profile mast as well as radiation ~, soil ~ and turbulence sensors are in operation at this site. Thus, from the combination of the grassland and forest sites, simultaneously measured data of the basic energy budget components over the two main land-use classes within one grid cell of a state-of-the-art regional NWP or climate model and at the pixel scale of a satellite image are available allowing for studies of area-averaging of energy flux measurements for modelling and satellite data interpretation applications.

A comprehensive radiation monitoring program, including operational measurements of integral and spectral components of atmospheric radiation, forms a fourth basic activity of experimental meteorological research at Lindenberg. This concept to create a comprehensive reference data set of the atmospheric structure from the ground up to the lower stratosphere over a heterogeneous land surface in Central Europe has been called "The Lindenberg Column".

Figure 3: *View across the boundary layer field site GM Falkenberg with the 99m tower.*

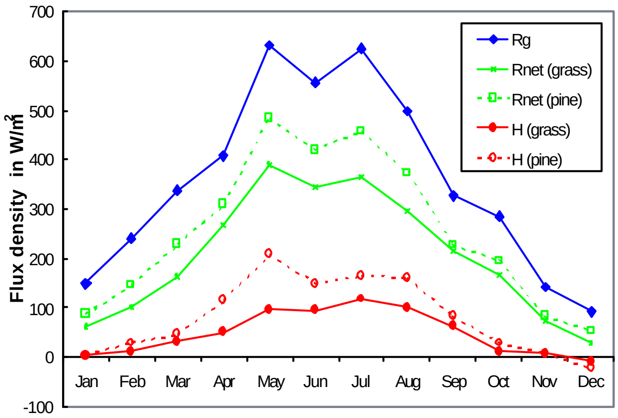

Figure 4: *Annual cycle of the monthly mean values of global radiation (Rg) and of net radiation (Rnet) and sensible heat flux (H) over two different types of landuse at around noontime (1100-1200 UTC) during the year 2001.*

measurement complex	installed in	measured parameters	height (range) in m
99m tower	1998	temperature, humidity, wind	10 .. 98
12m mast	1998	temperature, humidity, wind	0.5 .. 10
soil measurements	1998 / 1999	soil temperature soil moisture soil heat flux	-0.05 .. -1.5 -0.07 .. -0.9 -0.05 .. -0.1
radiation	1998 / 1999 2001	short-/longwave radiation (up / down) PAR (up / down) surface temperature	2, 98 2 2
flux complex (eddy covariance)	1999 (2003)	turbulent heat / momentum flux water vapour flux	2.4 2.4
sodar / RASS	1998	wind speed, virtual temperature	40 .. max. 400
laser scintillometer	2001	turbulent heat / momentum flux	2
ceilometer	1999	cloud base height	25 .. 13000
rain gauge	1998	precipitation	1

Table 1: *Basic installation at the MOL boundary layer field site (GM) Falkenberg.*

Lindenberg on Internet:
http://www.dwd.de/de/FundE/Observator/MOL/MOL.htm

An example of results from the micrometeorological measurements is presented in Figure 4. It shows the variation of the monthly mean values of the noontime radiation budget and sensible heat flux during the year 2001 at the grassland (GM Falkenberg) and forest sites. During most of the year, the sensible heat flux into the atmosphere is higher over the pine forest than over the low vegetation. This is partly explained by the larger values of net radiation over the forest, which basically result from lower albedo values. The differences in the heat flux are most pronounced in spring (April / May) during the period of most active vegetation growth of the grass suggesting a different partitioning of available energy into sensible and latent heat fluxes.

First CEOP EOP1 results on Internet:
http://www.gewex.org/reports/ceop03_2.pdf.

Due to its comprehensiveness, data from the "Lindenberg Column" are of special interest for several of the atmospheric and climate monitoring programs of WMO - WCRP, and, besides CEOP, Lindenberg has been defined as a reference site for, e.g., GCOS (the Global Climate Observing System), BSRN (the Baseline Surface Radiation Network), and GVaP (the Global water Vapour Project). The Lindenberg facilities also form an ideal technical, logistical and climatological background for the performance of intensive field campaigns within national and international research projects. This has been demonstrated, e.g., during the LITFASS-98 field experiment (Beyrich et al., 2002). A new field experiment (LITFASS-2003) is currently under preparation within the frame of the atmospheric and climate research programs (AFO-2000, DEKLIM) of the BMBF (the German Federal Ministry on Education and Research).

Most recently (Tamagawa et al., 2003), a comparison of Lindenberg data and CEOP Model Location Time Series (MOLTS) output shows large differences in net radiation for the CEOP-EOP1 phase (July to September 2001).

References

Beyrich F., Herzog H.-J., and J. Neisser (2002): The LITFASS project of DWD and the LITFASS-98 experiment: The project strategy and the experimental setup. *Theor. Appl. Climatol.* **73**, 3-18

Engelbart, D.A.M., and H. Steinhagen (2001): Ground-based remote sensing of atmospheric parameters using integrated profiling stations. *Phys. Chem. Earth* **26**, 219-223

Leiterer,U., Dier, H., Nagel, D., Naebert, T., Althausen, D., and K. Franke (2000): Correction method for RS80A-Humicap Humidity Profiles. Report for WMO Working Group on Upper-Air Observing Systems (available from the authors)

Neisser J., Adam W., Beyrich F., Leiterer U, and H. Steinhagen (2002): Atmospheric boundary layer monitoring at the Meteorological Observatory Lindenberg as a part of the "Lindenberg Column": Facilities and selected results. *Meteorol. Z. (N.F.)* **11**, 241-253

Tamagawa K., T. Koike and S. Williams (2003): Comprehensive CEOP Intercomparisons of in-situ data, satellite products and model outputs are underway. GEWEX Newsletter 13 (2), 5, May 2003

INTAS project (2002-2005): Snow Cover Changes Over Northern Eurasia during the Last Century: Circulation Consideration and Hydrological Consequences (SCCONE)

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Institute of Geography, Russian Academy of Sciences, Moscow, Russia; participant of the INTAS-SCCONE project

The SCCONE project is supported by INTAS, an independent International Association formed by the European Community, European Union's Member States and like minded countries acting to preserve and promote the valuable scientific potential of the NIS (New Independent States) partner countries through East-West Scientific co-operation.

The general objective of the project is to assess the trends, climatic causes and hydrological consequences of the snow cover changes in Northern Eurasia during the 20th century. This objective could be accomplished through the extraction and comparison of surface data that are at the disposal of all the participating teams. Especially valuable will be the significant enlargement of the data for the FSU (Former Soviet Union) territory, made accessible to the scientific community. The comparison of these data with the archive of satellite images will bring added value to these unique databases.

The specific objectives are:
- to quantify the trends in snow cover;
- to identify the main snow cover regions of Northern Eurasia;
- to estimate the covariation in snow cover between regions;
- to investigate the relation between snow cover variability and variations in atmospheric circulation patterns;
- to investigate the impact of snow cover changes on basin-scale run-off.
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The SCCONE project has obvious relation to BALTEX because snow is an important component of the water cycle in the climate system. SCCONE will also look into northern parts of the Baltic Sea catchment and has therefore quite some regional overlap with the BALTEX area.

SCCONE kick-off meeting participants in Helsinki, Finland, August 2002: From left: O-E.Tveito, E.Forland, A. & G.Krenke, V & L.Razuvaev, R.Solantie, A.Drebs, I.Seversky, V.Radionov. R. Heino behind the camera.

Research teams:

INTAS Teams:
- Finnish Meteorological Institute (FMI), Helsinki, Finland (overall co-ordination);
- Norwegian Meteorological Institute (DNMI), Oslo, Norway;
- Global Precipitation Climatology Centre (GPCC), Offenbach, Germany;
- Max Planck Institute for Meteorology (MPI), Hamburg, Germany.

NIS-Teams:
- Institute of Geography, Russian Academy of Sciences (IGRAS), Moscow, Russia (NIS - co ordination);
- All-Russia Research Institute of Hydrometeorological Information (RIHMI-WDC), Obninsk, Russia;
- Arctic and Antarctic Research Institute (AARI), St. Petersburg, Russia;
- Institute of Geography, Kazakhstan Academy of Sciences (IGKAS), Almaty, Kazakhstan.

Soil Moisture Fluctuations from TDR Measurements

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Introduction

Soil moisture content considered as the hydrologic variable represents water retention in the top soil layers. Acting as the interface between the solid earth surface and the atmosphere, it integrates much of the surface hydrology. Playing a significant role in the soil-vegetation-atmosphere interactions, its estimates are necessary in anticipating the effects of climate change. Due to the large temporal and spatial variability of soil moisture in the environment it is very difficult to be measured on a consistent and spatially comprehensive basis. Current knowledge of the time and space distribution of soil moisture is still inadequate. Recent developments in remote sensing techniques are promising, however these techniques do not solve all problems of inadequacy of soil moisture estimates on the operational basis. One reason is the limited availability of ground data for calibration of electromagnetic signals in hydrological terms.

The traditional way of acquisition of soil moisture data is the collection of point measurements in the field. Conventionally applied laboratory procedures are often substituted by widely used soil moisture field meters working with the TDR (Time-Domain-Reflectometry) method. Usual high heterogeneity of physical characteristics of soils requires large number of measurements to build reliable data sets. This makes ground measurements data collection slow, time consuming and non-cost-effective. However in-situ observations of soil moisture are still of primary importance.

Figure 1: *Location of the study area.*

The in-situ data collected from reference sites are an integral component of the long-term research strategy for better understanding and assessment of physical processes leading to managing water resources in the face of climate change.

The research reported here aims at the assessment of the soil moisture variability in the region of special ecological importance (Somorowska 2002a, b). The study area is located in central Poland, on the Mazovian Lowland (Figure 1). An extensive set of the soil moisture data being collected through ground in-situ measurements has been incorporated into this research. The results can serve as background values in simulating and predicting soil moisture.

Soil moisture data set

Field measurements of soil moisture have been conducted along three transects during the period 1995-2002 (Figure 2). The measurements have been taken at depths of 5 and 10 cm, and then with the increment of 20 cm, down to the first saturated layer.

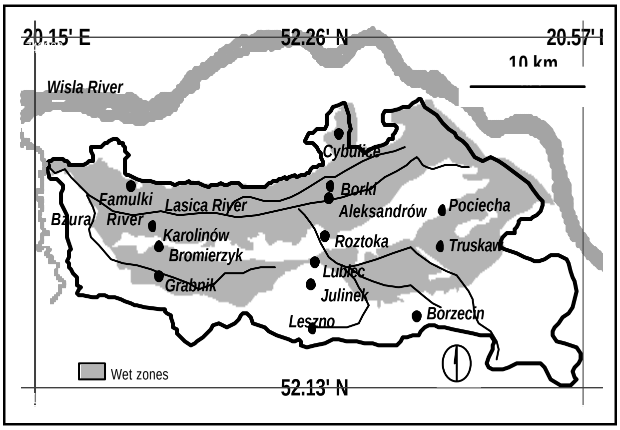

Figure 2: *Location of the moisture measurement sites in the study area.*

The TDR Field Operating Meter produced by Easy Test, Poland, was used for the determination of the volumetric soil moisture content in the field.

Soil moisture fluctuations

From the soil moisture data set for each location the volumetric soil moisture profiles have been derived for each measurement period. Selected soil moisture profiles are shown in Figure 3. The range of the soil moisture variability is determined by the edge curves representing extreme stages of the soil moisture content.

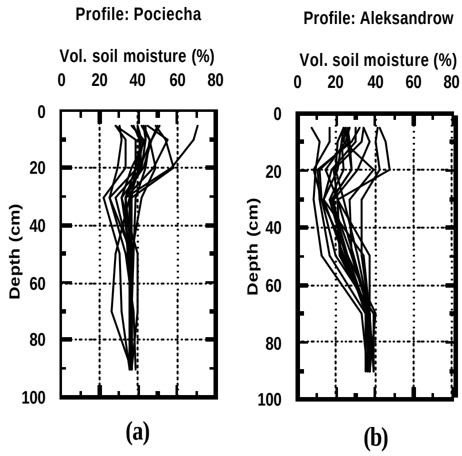

Figure 3: *Volumetric soil moisture profiles of selected sites: Profile with very shallow groundwater level (a), profile with shallow groundwater level (b).*

The soil water storage has been calculated from volumetric soil moisture data for the 0-100cm layer. The temporal fluctuations of the water storage in the years 1995-2002 are shown in Figure 4. Two series of the

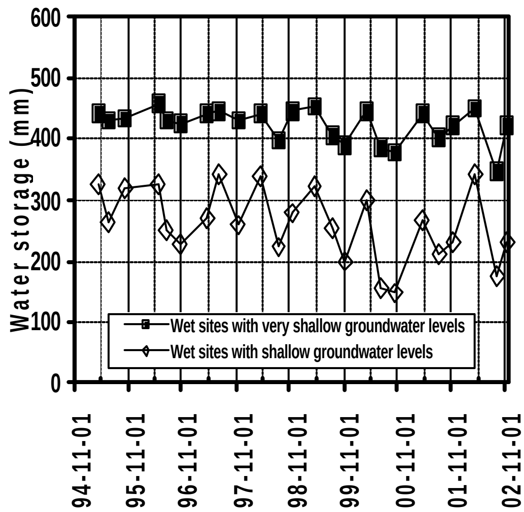

Figure 4: *Temporal fluctuations of the soil water storage in the 0-100 cm soil layer during 1995-2002.*

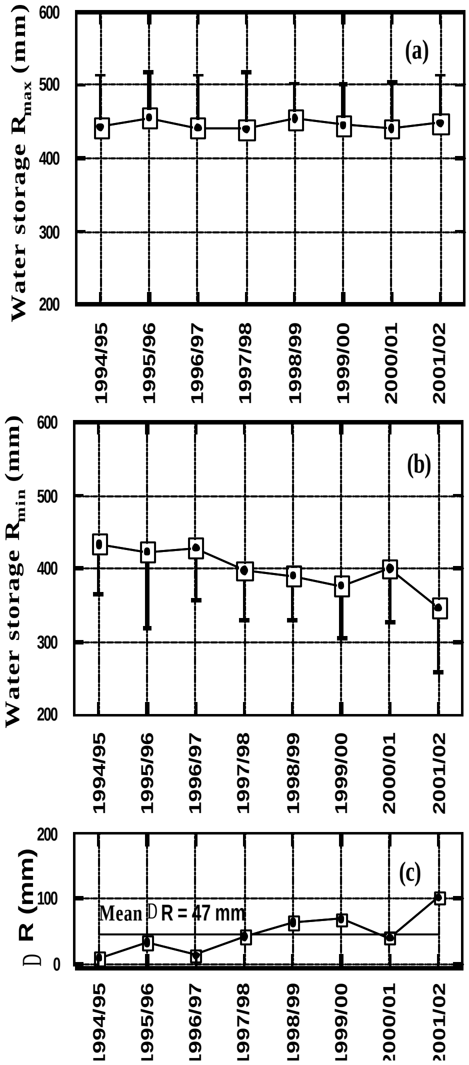

Figure 5: *Extreme stages of the water storage in the 0-100 cm layer at sites with very shallow groundwater level: Maximum values with upper range (a), minimum values with lower range (b), annual differences in water storage with the 8-year average value (c).*

water storage fluctuations are displayed to represent two different regimes of the soil moisture fields; sites with very shallow groundwater levels are considered separately from sites with shallow groundwater levels. In both cases fluctuations observed are formed by the wetting and drying cycles. In spring, after the winter which is the wetting season, the water content is often found at a maximum level. During the spring-summer period which is usually the drying season, a considerable decrease in water storage is observed that leads to the appearance of the lowest moisture content at the end of summer and beginning of autumn. In extreme situations volumetric moisture content has been found at wilting point.

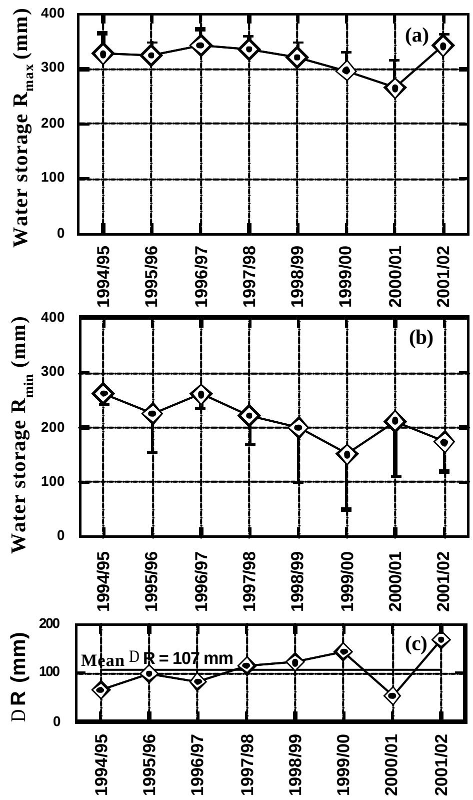

Figure 6: *Extreme stages of the water storage in the 0-100 cm layer at sites with shallow groundwater level: Maximum values with upper range (a), minimum values with lower range (b), annual differences in water storage with the 8-year average value (c).*

From the 8-year-long course of the water storage, the extreme stages of the water storage have been extracted for two types of soil moisture fields (Figures 5a,b and 6a,b). Then the observed differences between extreme water storage values in each year were derived for both types of moisture fields (Figures 5c and 6c). The results obtained indicate that significant differences appear between different seasons within one hydrological year as well as between different years. The average difference in temporal water storage was calculated as an eight-years average. This value was 47 mm at sites with very shallow groundwater level and 107 mm at the remaining sites.

Conclusions

The research presented here provides ground truth information on the soil moisture content and water storage in the top soil layers. The soil moisture fluctuations have been detected based on field measurements that were conducted at 14 representative sites along three transects during eight years of observation (1995-2002). Fluctuations are presented for two different regimes of the soil moisture fields, separately for sites with very shallow and shallow groundwater levels. Average differences in water storage between dry and wet periods were approximately 47 mm for sites with very shallow groundwater levels, and 107 mm for sites with deeper groundwater levels. These average differences characterize the dynamics of soil water storage that are the result of site-specific characteristics and recharge by precipitation. The range of possible temporal variation of water storage detected in this study might be helpful in soil moisture simulation and prediction.

Acknowledgment
Soil moisture research has been supported by the Department of Environmental Sciences and Policy of the Central European University, Budapest by a grant no. 92-14.

References

Somorowska, U., 2002a, *Extreme stages of the basin wetness conditions. Variability of the soil moisture in a lowland basin*. [In]: FRIEND2002 Bridging the gap between research and practice. Proc. FRIEND2002 Conference, Cape Town, South Africa, March 2002, IAHS Publication no.274, pp.389-395.

Somorowska, U., 2002b: *Simulation of the soil water storage in risk situations. Management framework of the wetness conditions at a basin scale.* [In:] Risk Analysis III, Ed. C.A. Brebbia. Third International Conference on Computer Simulations in Risk Analysis and Hazard Mitigation, WIT Press, Southampton, pp. 573-582.

Simulation of Bottom Water Inflow in the Baltic Sea

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The Baltic Sea consists of some deep basins connected by shallow and narrow channels. Spreading of the bottom saline water into the Baltic Sea looks like episodically successive dense water overflows from one basin to another. The inflowing dense water moves into a basin as a bottom gravity current until it reaches a level with equal water density. Then it spreads as interpicnocline intrusion.

The process of bottom dense water penetration plays a very important role in the formation of the Baltic Sea climate. For this reason the development of the Baltic Sea climate should be accompanied by investigation of bottom gravity currents. In spite of a long history of investigation of these processes there are some features, which are not understood. The latter include for example the role of nonhydrostatic effects in bottom water dynamics, and the structure of the interaction of the bottom water with upper layers.

To investigate non-hydrostatic effects the Poisson equation of pressure was used in this study. This equation is obtained from the non-hydrostatic equation of motion and includes - in its right side - the divergence of different forces such as gravitational force, Coriolis force etc. Using this equation the pressure disturbance caused by lenses was calculated (Tsarev, 2001a) for different types of dense water lenses. Results were compared with those obtained by using equations with the hydrostatic approximation. For example, it was found that for a lens on inclined bottom, the pressure disturbance gradient was not directed vertically but aligned normal to the bottom. At the same time the gravity component directed along the bottom was unbalanced.

The interaction of the bottom dense water with an upper layer was also considered (Tsarev, 2001a). For this purpose an integral two layer model was used. It was shown that the mechanism of such interaction is connected with the transformation of vorticity caused by lens deformation and its motion near the bottom. It takes place not only at a stage of geostrophic adjustment but also at the stage of the collapse of the lens. The influence of such interaction on the bottom lens dynamics depends on the alignment of the thickness of lens and the thickness of the upper water layer.

These results together with known theoretical results were used in a three-dimensional non-hydrostatic model of bottom water gravity flow (Tsarev, 2001b). The model governing equations included three-dimensional non-stationary nonlinear equations of motion for the horizontal and vertical directions, equations of mass and salinity conservation, and the equation of state. Equations of motion and mass conservation were transformed with the method of vector potential to three-dimensional equations of vector vorticity, vector and scalar potentials.

The model was applied for the simulation of lens transformation and motions for the case of horizontal bottom, for the case of inclined bottom (Tsarev, 1998, 2000), and for the case of a lens moving along the boundary between horizontal and inclined bottom parts (Tsarev,1999). Results indicate that the model represents all main features known from laboratory investigations. Additionally, the model application made it possible to investigate the connection between vorticity transformation and lens motion.

The division of a bottom dense flow into two streames was considered also (Tsarev, 2001c). For this purpose the bottom flow from the Stolpe Channel into the Central Baltic Sea was simulated. The calculations were carried out for a rectangular area located in the central part of the Baltic Sea, including the Gotland and Gdansk Deeps (fig. 1a, 1b). The lateral border was considered as solid except for the small part of the Stolpe Channel, where the bottom water inflow occurs. As initial condition a homogeneous salinity and vorticity distribution was set to 10‰ and zero, respectively. The salinity of the dense water at the Stolpe Channel was set to 16‰. The salinity at the free surface was kept constant equal to 10‰ during the entire model run. The domain was covered by 25x59grid cells in the horizontal with 5 km spacing, and 30 levels in the vertical direction. The grid point distance in the vertical direction was 2 m for the first ten steps from the bottom, and (H-20)/19 elsewhere where H denotes the bottom depth in meters. The model run shows that bottom water motion is strongly controlled by bottom topography.(inflowing saline bottom water moves along the right sea slope.) It reaches the watershed, separating the Gotland and Gdansk Deeps (fig. 2a) as a single flow. After that the bottom flow is divided into two branches. The right branch moves to the Gdansk Deep, spreading along its right slope. After 10 days it reaches the deepest part of the Gdansk Deep and partially moves to its opposite slope. The left branch goes to the Gotland Deep reaching its maximal depths approximately after one month. During the following 40 days the bottom salinity distribution does not change significantly and is characterized by the bottom water storage in the Gotland Deep (fig.2b). The main bottom water flow is found over the right Gotland Deep bottom slope (fig.3). The direction of the bottom water currents follows the main isobaths. The flow velocity and the current width depend on the bottom inclination with decreasing current width but increasing velocity over areas with high bottom inclination. The maximum velocity is reached near the Stolpe Channel where it reaches 60 cm/s. In the upper layer the opposite directed currents (fig. 4) are formed with velocities sometimes lower then in the bottom current.

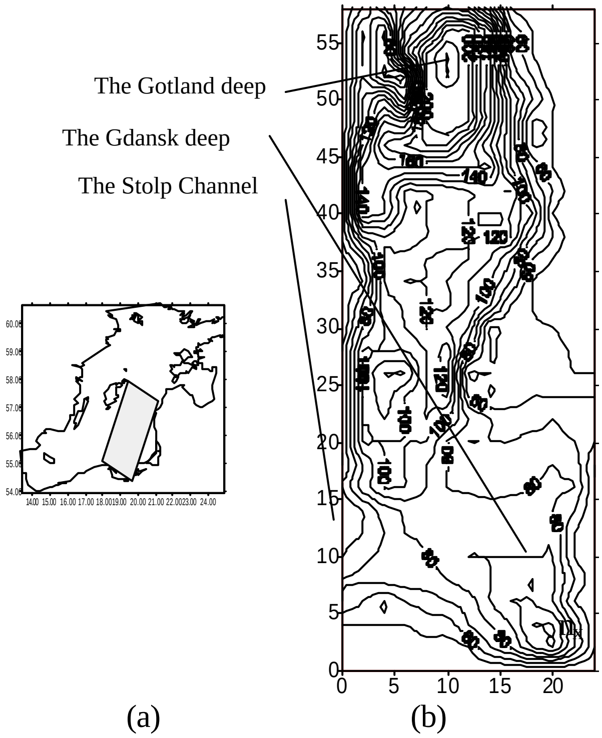

Figure 1: *Model area location(a) and bottom depth distribution(b). (nx, ny denote grid node numbers along x and y axises)*

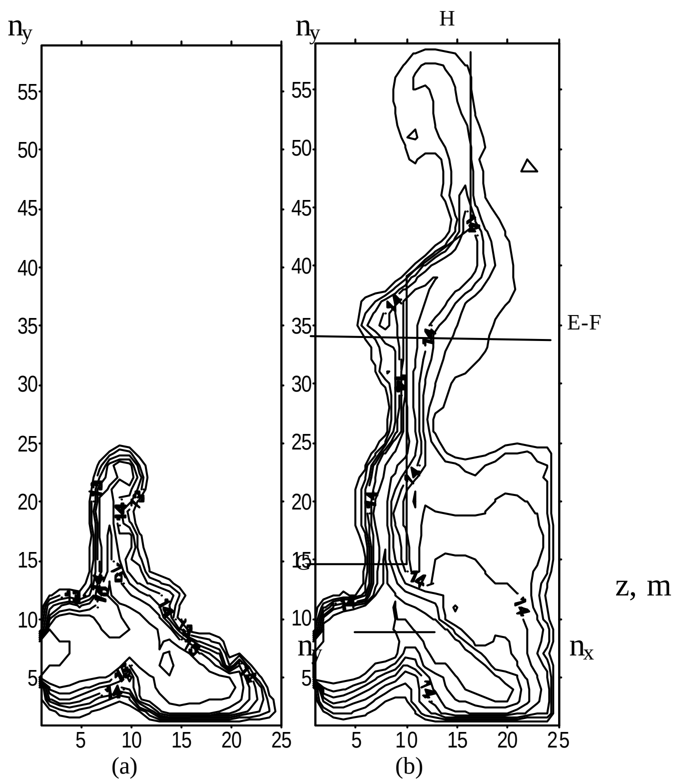

Figure 2: *Bottom salinity distribution calculated after 10 (a) and 70 (b) days.*

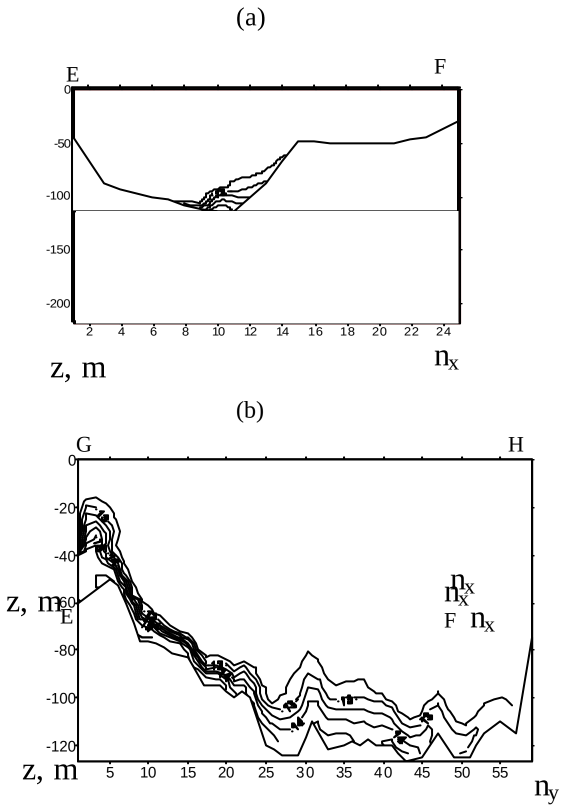

Figure 3: *Computed salinity distribution along section E-F (a) and section G-H (b), see figure 2b for section locations.*

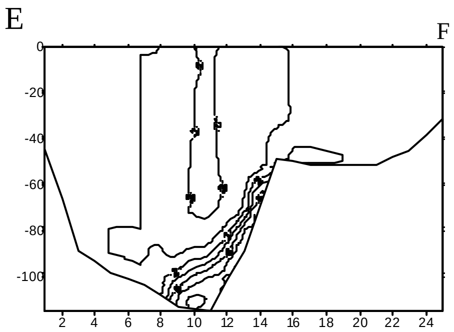

Figure 4: *Computed longitudinal current velocity component distribution at section E-F after 70 days, see figure 2b for section location.*

In future it is planed to consider the following questions

- influence of canyons and sills on bottom water motion;
- influence of surrounding density stratification on bottom water flow;
- transformation of bottom gravity currents to intrusion flow;
- dilution of bottom water because of salt exchange with upper layer.

References

Tsarev V., 1998: Three-dimensional modeling of bottom dense lens evolution. Proc. Of Int. Symp.*"Oceanic fronts and related phenomena*", Saint-Petersburg, P.542-546.

Tsarev V., 1999: Dense water translation along boundary between inclined and horizontal bottom. Proc. of Int. Conf. "Fluxes and structures in fluids", Saint-Petersburg, P.81-82.

Tsarev V., 2000: Evolution of bottom lens based on numerical simulation *Oceanologia*, V.40. N.6. P.833-839.(in Russian)

Tsarev V., 2001a: Theory and modelling of bottom density currents in a sea. Saint-Petersburg, RSHU, 297p., Doctor dissertation. (in Russian)

Tsarev V., 2001b: Theory and simulation of bottom density currents in a sea. Saint Petersburg, RSHU, 60p.(in Russian)

Tsarev V., 2001c: Simulation of bottom water spreading into the Baltic sea.. *Oceanologia*, V.41 N.4, P.510-514 (in Russian)

German Climate Research Programme DEKLIM

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In the year 2000, the Federal Ministry of Education and Research (BMBF) in Germany has launched a new Climate Research Programme, supporting the National Climate Protection Programme and the Federal Government's Sustainability Strategy: DEKLIM. It pursues the following key objectives.

- To improve the understanding of the climate system and the possible human influence on it.
- To reduce uncertainties in analysis and forecasting.
- To derive strategies for dealing with climate change (adaptation and mitigation).

DEKLIM's key major aims are the increased integration of the results of German research in the international assessment of climate development and providing basic know-how and guidance in the field of practical climate protection measures. In consequence DEKLIM sets out to incorporate national contributions to a greater extent in international research programmes and in the assessment reports of the IPCC.

DEKLIM research activities started in 2001 with a runtime of up to 5 years. More than 100 individual projects co-operate in 37 joint projects, forming 4 major areas of research. Within these areas DEKLIM offers young scientists an opportunity to gain experience in heading a research group (in total 6 research groups) or in interdisciplinary co-operation between different research institutions (in total 2 joint research groups). The entire financial volume of all DEKLIM projects amounts to € 37 million.

The climate system responds in a complex interaction between extremely variable natural processes and human influences. Thus, DEKLIM primarily supports larger integrated networks in which scientists from various disciplines co-operate, ensuring close links between the developments in climate modelling and data survey. Research topics range from the examination of tree rings to satellite-based observation of land use changes, from climate simulation using numerical models to the development of strategies for a rainforest margin area (e.g. remote sensing or paleoclimate data from different archives).

Selected spokespersons guarantee intensive communication, co-ordination and co-operation in the following 4 major areas of research, which –especially in the first two cases- offer a strong link to CLIVAR activities:

1. Climate Variability and Predictability

This area provides greater insight into the variability of today's climate, which is an essential requirement for predicting the future climate and possible abrupt climate changes, and for estimating the role of humankind in this respect. In view of the fact that only intensive international co-operation can offer the optimum preconditions for tackling global challenges it is closely linked to the WCRP programme CLIVAR and especially the German contribution CLIVAR/marin, which comprises 11 projects funded by BMBF.

DEKLIM project websites at
http://www.deklim.de
BALTIMOS website at
http://www.baltimos.de

DEKLIM is funding integrated research projects which study the relevant climate subsystems (e.g. in connection with decadic climate variability in northern Europe) or the climate system as a whole. In this connection, further development of climate models plays an important role aiming at a more precise reproduction of large-area climate processes in order to improve climate prognoses for smaller regions.

As a first highlight scientists at the Potsdam Institute for Climate Impact Research (PIK) together with colleagues from Jena (Germany), Boston (USA), Paris (France) and Lund (Sweden), have discovered the reason why satellites have been observing an earlier greening of northern vegetation since the beginning of the 1980s. Results of computer simulations relating climate to the growth of plants showed, that only climate change can explain this change in vegetation. Despite some fluctuations from year to year, the onset of spring now occurs earlier in Canada, Northern Eurasia and Siberia than it did twenty years ago.

On-line information on this work and the other projects can be found at the DEKLIM homepage www.deklim.de

2. Regional Process Studies in the Baltic Sea Area

DEKLIM is funding 8 research groups working in the catchment area of the Baltic Sea in order to investigate the influence of global climate changes on limited areas. Multidisciplinary research networks are investigating how changes in the atmosphere, the sea and the land surface affect the climate in the Baltic Sea region. Climate predictions in the Baltic are of practical significance for all the Baltic states, e.g. in terms of the annual variability of the ice cover. The DEKLIM projects are providing an important contribution towards the evaluation phase of Phase I of the Baltic Sea Experiment (BALTEX), a continental-scale experiment of the Global Energy and Water Cycle Experiment (GEWEX) of the World Climate Research Programme (WCRP) .

Since the two BMBF programmes DEKLIM and AFO2000 (German Atmospheric Research Programme 2000) focus on potentials of synergy and at the same time emphasise on contributions towards global sustainable development, the following co-operation of two projects is cited as an example. The directors of the projects EVA-GRIPS (part of this DEKLIM research area) and VERTIKO (AFO2000) started the co-operation on regional evaporation at grid/pixel scale over heterogeneous land surfaces and the vertical transports in the atmospheric boundary layer over heterogeneous terrain.

3. Paleoclimate Research

In order to ascertain the variability of natural climate, researchers must look back into the earth's past and investigate earlier climate periods and developments. By studying proxy data (ice cores, corals, ocean sediments, tree rings) scientists can trace climate variations as well as extreme occurrences such as drought periods.

The principal objectives of paleoclimate research are:

- to understand the mechanisms how and why climate and ecosystems have varied in the past;
- to assess how climate change and variability have affected natural ecosystems and human society in the past;
- to provide a basis both for developing and testing climate models that are needed to forecast climate change in the future.

For these reasons it is understandable that the DEKLIM projects in this area are closely linked to the IGBP programme PAGES. For example the project EEM (Climate change at the very end of a warm Stage) is using high resolution geo-archives that allow annual time resolution. Eolian dust, pollen or stable isotope data are serving as indicators of past atmospheric temperature and precipitation. The time series from the geo-archives are compared with insolation forced climate time series generated by ocean-atmosphere general circulation models (GCMs). Any deviation between the environmental history from the geo-archives and the computer model will be used to test whether the dynamics of GCMs are adequate to simulate the magnitude and speed of natural climate change during a warm-cold transition. Climate simulations will be used to detect the physical parameters determining the length and structure of an interglacial and its subsequent end. The synthesis of all nine participating research groups results will allow to assess the climate variability and availability of water during the end of the ongoing warmstage. Finally both the paleoclimate and the modelling groups should be able to predict when our ongoing Holocene interglacial is likely to come to its natural end and what mankind will have to expect during the transition phase with respect to climate variability and water availability.

4. Climate Impact Research

This area studies the interaction between climate changes, natural systems, and socio-economic systems. The aim is to provide a scientific basis for concrete measures to adapt to climate changes and/or - in the long term - to control human influence on the climate system, thus offering well considered options for decision makers. DEKLIM projects do not cover areas only in Europe but also, for example in the project IMPENSO, in Indonesia. The overall objectives of IMPENSO (http://www.gwdg.de/~impenso/Overview/framover.htm) are

- to quantify the local and regional manifestations of global climate variability,
- to analyse their implications for water resources and agricultural land use,
- to assess the socio-economic impact of ENSO on rural communities living in agro-ecologically sensitive regions, and
- to develop in a participatory approach strategies and policy recommendations that help improve the capacity of developing regions to cope with ENSO.

One of the most important projects in this research area is the project KRIM, which is going to analyse the consequences of an accelerated sea-level rise and intensified extreme incidents and of adaptation options for the natural and the social structures within the Weser-Jade-Region. Modern coastal protection management schemes will be developed based on the results. This analysis will include aspects of the individual and social perception and communication of the possible consequences of a sea-level rise and the rising risk of dike failure as well as the analysis of the implicit conflict potentials, decision making structures and possible solutions.
Inter alia scientists are studying the effects in the fields of fisheries, agriculture and society as well as options for measures to be taken in these fields.

CEOP Reference Site Managers Workshop 31 March – 1 April 2003 Berlin, Germany

Sam Benedict *(seb@netra1.wmo.ch)*
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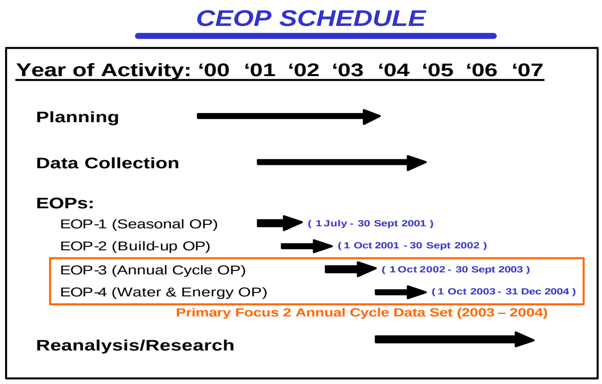
The Workshop was held at the Institute for Space Sciences at the Free University of Berlin in conjunction with the second formal CEOP Implementation Planning Meeting. It was organized by Drs Steve Williams and Hans-Jörg Isemer, Co-Chairs of the Coordinated Enhanced Observing Period (CEOP) Data Management Working Group, with support of the head of the host institution, Prof. Jürgen Fischer. The focus of the Workshop was on the reference site contributions to the assembly and timely delivery of the CEOP annual cycle data sets. The reference site representatives were asked to collectively assist in defining the format for future CEOP data sets and to discuss individually their plans to deliver data that meet the established criteria.

The *in situ* data gathered from the CEOP reference sites and reference hydrological basins from the GEWEX Continental Scale Experiments (CSE) located around the world are the most fundamental component of the CEOP strategy. The Enhanced Observing Period-1 (EOP-1) (July to October 2001) uniformly formatted hourly reference site data sets are available now on the Internet. Collection of the data from the CSE sites for this first CEOP seasonal data has shown that adherence by the reference sites, to a consistent format is especially important to ensure an efficient continuation of the CEOP data set development and delivery process.

CEOP Reference Site Data for EOP-1 on Internet:
http://www.joss.ucar.edu/ghp/ceopdm/archive/eop1_data/index.html

An important part of the discussion included the current status of the Prototype CEOP EOP-1 Reference Site Data Set that was developed by the CEOP Data Archive (CDA) at the University Corporation for Atmospheric Research/Joint Office for Scientific Support. Several changes were suggested and approved. All Reference Site spokespersons agreed to be responsible for immediate submittal and continued maintenance of complete site documentation. The required information includes: on-line site links, location(s) [latitude, longitude, and elevation], maps and photos, land characterization, canopy height, measurements (parameters, frequency, instrumentation and specifications, exposure).



Another outcome of the Workshop was the interchange of information related to critically important data from the CEOP reference sites that had not been provided earlier. The CEOP Reference Site Table at: **http://www.joss.ucar.edu/ghp/ceopdm/rsite.html** has been updated with the newest information obtained at the meeting. The CSE spokespersons from the five most mature GEWEX CSEs (Baltic Sea Experiment; Large-Scale Biosphere- Atmosphere Experiment in Amazonia; Mackenzie GEWEX Study, GEWEX Asian Monsoon Experiment; and the GEWEX Americas Prediction Project) were asked to undertake another review of the CEOP Reference Site characteristics table for completeness. This action has become more important as the data for the CEOP annual cycle data sets are about to be received and fashioned into appropriate composited sets.

It was agreed that a detailed document containing the complete “composite” data set description was necessary for reference by the in situ data site managers by the end of July 2003. It was decided that the report would include the details associated with the standard format for continued submission of Reference Site data (ASCII column) and notes that all data submitted must be accompanied by a corresponding Metadata file(s) and that the data Quality Check (QC) will be exthat the data Quality Check (QC) will be expected to have been performed by the individual Reference Sites prior to data submission to CDA. It was agreed that the CDA will be funded to perform a "gross" and visual QC on the entire data set to ensure completeness and consistency once all data sets have been submitted.

In response to this request for action **a CEOP Reference Site Data Report** has been produced. The report is based on the feedback received so far on the EOP-1 Prototype Data Set and the discussions that had taken place at the Workshop and the CEOP Implementation Planning Meeting.

CEOP Reference Site Data Report available on Internet:
http://www.joss.ucar.edu/ghp/ceopdm/refdata_report

The report forms the basis for provision of future in situ data for CEOP. The agreement reached at the meeting that directly impacts CEOP's ability to meet its commitment to produce an initial composited annual cycle data set in line with the previously documented CEOP data policy was that EOP-3 data collected during the first half of the first annual cycle (October 2002 through March 2003) will be submitted to the CDA, in the agreed-to format, so that Category 1 data (e.g. Rawinsonde, surface standard meteorology) would arrive on or before 1 October 2003 and Category 2 data (e.g. flux or tower data, soil profile data, wind profiler) would follow on or before 1 June 2004. This commitment by the reference site managers ensures that CEOP will meet its delivery milestones as reflected in the CEOP Schedule.

The CEOP Reference Site Data Report has been endorsed by the CEOP Science Steering Committee in July 2003 and forms now the approved document on CEOP Reference Site Data details, such as type, units, formats, meta data etc; and is currently been used as a working document at the various sites for establishing EOP3 data.

Participants at the CEOP Managers Reference Site Workshop in Berlin, Germany, 31 March – 1 April 2003.

Special Issue on BALTEX in *Boreal Environment Research*

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Head International BALTEX Secretariat;
GKSS Research Centre, Geesthacht, Germany

The second special journal issue dedicated to the 3rd Study Conference on BALTEX is now available in Boreal Environment Research (BER) 2002, Vol. 7, No 4. The volume contains 18 conference papers, which passed the BER review process. Together with the preceding BER issue (Vol.7, No 3), a total of 34 per-reviewed articles originated from BALTEX results presented at the 3rd BALTEX Conference. More than 60 authors from 12 countries contributed to the articles and 20 articles have at least three ore more authors indicating strong cooperation and group-building among BALTEX scientists at both national and the international levels. I would like to take this opportunity again to heartily thank the BER editorial board and several special editors and numerous reviewers, who did a great job in organising a two-volume special issue on BALTEX. This appreciation is expressed herewith on behalf of the entire BALTEX research community.

The following papers appear in Boreal Environment Research Vol.7, No 4:

1. Roads, J.; E. Raschke and B. Rockel: BALTEX water and energy budgets in the NCEP/DOE reanalysis II, pages 307-318

2. Maslowski, W. and W. Walczowski: Circulation of the Baltic Sea and its connection to the Pan-Arctic region - a large scale and high-resolution modeling approach, pages 319-326

3. Meier, H.E.M. and R. Döscher: Simulated water and heat cycles of the Baltic Sea using a 3D coupled atmosphere-ice-ocean model, pages 327-334

4th Study Conference on BALTEX

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information, online-registration form, 1st announcement available on Internet:

http://www.gkss.de/baltex/

4. Stipa, T. and J. Vepsäläinen: The fragile climatological niche of the Baltic Sea, pages 335-342

5. Berger, F.H.: Surface radiant and energy flux densities inferred from satellite data for the BALTEX watershed, pages 343-352

6. Peters, G.; B. Fischer and T. Andersson: Rain observations with a vertically looking Micro Rain Radar (MRR), pages 353-362

7. Stigebrandt, A.; H.U. Lass, B. Liljebladh, P. Alenius, J. Piechura, R. Hietala and A. Beszczynska DIAMIX - An experimental study of diapycnal deepwater mixing in the virtually tideless Baltic Sea, pages 363-370

8. Brümmer, B.; A. Kirchgäßner, G. Müller, D. Schröder, J. Launiainen and T. Vihma: The BALTIMOS (BALTEX Integrated Model System) field experiments: A comprehensive atmospheric boundary layer data set for model validation over the open and ice-covered Baltic Sea, pages 371-378

9. Gryning, S.-E.; S. Halldin and A. Lindroth: Area averaging of land surface-atmosphere fluxes in NOPEX: challenges, results and perspectives, pages 379-388

10. Oltchev, A.; J. Cermak, N. Nadezhdina, F. Tatarinov, A. Tishenko, A. Ibrom and G. Gravenhorst: Transpiration of a mixed forest stand: field measurements and simulation using SVAT models, pages 389-398

11. Malinin,V.N.; A. Nekrasov and S. Gordeeva: Inter-annual variability of the Baltic Sea water balance components and sea level, pages 399-404

12. Lehmann, A. and H.-H. Hinrichsen: Water, heat and salt exchange between the deep basins of the Baltic Sea, pages 405-416

13. Lindau, R.: Energy and water balance of the Baltic Sea derived from merchant ship observations, pages 417-424

14. Clemens, M. and K. Bumke: Precipitation fields over the Baltic Sea derived from ship rain gauge measurements on merchant ships, pages 425-436

15. Kitaev, L.; A. Kislov, A. Krenke, V. Razuvaev, R. Martuganov and I. Konstantinov: The snow cover characteristics of northern Eurasia and their relationship to climatic parameters, pages 437-446

16. Klavins, M.; A.Briede, V.Rodinov, I.Kokorite and T.Frisk: Long-term changes of the river runoff in Latvia, pages 447-456

17. Rimkus, E. and G. Stankunavichius: Snow water equivalent variability and forecast in Lithuania, pages 457-462

18. Tomingas, O.: Relationship between atmospheric circulation indices and climate variability in Estonia, pages 463-469.

Next issue of the BALTEX *Newsletter* (# 6)

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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 guidance of the BALTEX Science Steering Group, chaired by Professor 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 Scientific and Initial Implementation Plans for BALTEX.
The editor invites the scientific community to submit BALTEX - related contributions 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.
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