BALTEX Newsletter

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BALTEX, the Baltic Sea Experiment

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Introduction

The Baltic Sea region covers an area of 2.1 mill. km^2 including the drainage basin of 1.7 mill. km^2. The annual net drainage discharge is 470 km^3 per year, with an interannual variation of some 25%. The total discharge out of the Baltic Sea through the Danish Straits is about the same as for Mississippi and the largest from the European continent.

The Baltic Sea area is an excellent region for a major geophysical experiment and will no doubt contribute significantly to the scientific objectives of GEWEX. It is primarily a cage experiment including process studies, numerical modelling, long term data analysis and application of remote sensing.

The first phase of BALTEX is now well on its way, including planning work and preparatory numerical modelling. A pilot observational study was organised in the autumn 1995 to explore and validate precipitation measurements over the BALTEX area. The BALTEX project is supported by the European Community. It is also actively supported by the meteorological services in the area, several of them operating advanced limited area models and data assimilation systems.

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When GEWEX developed first activities, it became quite clear that still fundamental questions have to be solved which are related to hydrometeorological processes over all continents. Serious errors occur in modelling and measuring regionally representative statistics of such quantities as the surface radiation budget components, precipitation, areal evapotranspiration and water transports in the atmosphere and at the ground, but also of all cloud fields and their properties, and finally of the atmospheric dynamics itself.

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BALTEX has a strong oceanographic component, including studies of water exchange processes with the Skagerrak and detailed studies of sea-ice processes in the Baltic Sea. Other areas of interest are investigations of intense weather systems over the Baltic Sea such as intense cyclogenesis and other kinds of extreme weather.

An improved understanding of the hydrological and energy cycle for the Baltic region will not only be of considerable benefit for the region itself but for weather- and climate modelling in general and create a sound scientific basis for environmental investigations. Several aspects of the BALTEX programme would be transferable to other regions such as hydrological investigations of the large Russian rivers and sea-ice investigations in the Arctic Ocean.

A successful research programme will provide benefits within a large number of areas. Some of them are discussed below.

Short range weather prediction

The Baltic Sea plays a central role for trade and shipping. The shipping requires more reliable forecasts in particular for adverse weather conditions, for the state of the sea and for the sea-ice situation. A particularly serious problem is icing on ships which can grow rapidly in stormy conditions at low temperatures.

Severe storm surges do occur especially at the inner parts and end of bays. This is particularly serious in rapidly moving systems when the water level can change critically in a few hours. Many cases causing casualties have been reported, even so in recent years.

The Baltic Sea is also playing an increasingly important role for leisure activities, presently mainly in the coastal regions, but gradually over larger regions as sailing with more advanced boats is becoming more common. Accidents due to sudden development of small scale weather systems causing loss of life and property are not unusual. Improved monitoring of the weather through satellite observations and radar, in situ observations and more realistic and reliable numerical modelling will be necessary for the provision of a better service.

Many of the deficiencies in the weather information are due to insufficient knowledge of the hydrological cycle and many intense small scale weather systems are driven by the release of latent heat and strong surface fluxes. It is anticipated that the BALTEX programme will provide increased understanding of the physical mechanisms of intense meso-scale systems and contribute to more reliable forecasts of such features in the future. Similarly a more systematic use of satellite and other remote sensing data, explored under the BALTEX programme, will contribute by providing a better specified initial state.

Long term prediction

The sea-surface temperature, sea-ice and the thermal stratification of the Baltic Sea requires improvements in the numerical modelling for the ocean component together with good forecasts for the state of the atmosphere. Important phenomena to predict are e.g. i) massive influx of salt-water from the North Sea, which takes place under certain but rare meteorological conditions, ii) catastrophic increase in algae blooming and iii) serious and rapid sea-ice development. Accurate and detailed ocean modelling requiring high resolution is essential here since the vertical stratification of temperature and salt, particularly in the mixed layer, must be well described. It is expected that the ocean component of BALTEX will strongly contribute towards a better handling of these important processes.

Climate monitoring and impact

The BALTEX programme will provide increased understanding of energy and water fluxes over a large and climatologically significant high-latitude region of the Northern Hemisphere. In particular the interaction with a huge inland sea and surrounding land areas will be explored, including intense meso-scale features. Other aspects are the huge river runoff, totalling that of the Mississippi river and occasional very strong ice and air-sea interaction situations during the winter, similar to what happens in Arctic and Antarctic waters. Development of climate monitoring methods, including the development of satellite and radar observing and processing systems, will contribute to a better understanding of climate relevant processes of the Baltic region.

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BALTEX - one out of five GEWEX Continental-Scale Experiments

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Therefore, simultaneous plans arose for regional-scale experiments whose areas cover the drainage area of larger river basins to obtain a possibility for the closure of the water budget. There are now five such experiments: the GEWEX Continental Scale International Project (GCIP) covers the entire Mississippi-Basin, the Mackenzie-River GEWEX Study (MAGS) the basin of this river system, and the Large-Scale Biosphere-Atmosphere Experiment in Amazonia (LBA) the Amazon-Basin. BALTEX - the Baltic Sea Experiment - covers the entire drainage area of the Baltic Sea with multiple river systems, and finally the GEWEX Asian Monsoon Experiment (GAME) concentrates its research interests on two larger regions in Asia (the highland of Tibet and South East Asia) and the drainage area of the Lena-River in Sibiria. Each of these areas covers more than 1.5 million km^2; they discharge into the oceans more than 300 km^3 fresh water each year.

The research for MAGS, BALTEX and GAME (Sibiria) is also related to the goals of ACSYS, the Arctic Climate System Study.

All these experiments whose representatives form a special panel within the GEWEX structure (GHP, the GEWEX Hydrometeorology Panel) have to fulfil the following criteria:

(i) The co-operation of a NWP centre which has implemented a state-of-the art atmospheric and surface data assimilation procedure, and will deliver estimates of hydro-meteorological properties in a form directly comparable to observables.

(ii) A commitment of resources and personnel to pursue the development of suitable atmospheric-hydrological models, develop an atmospheric-hydrological data management and assimilation system, and to conduct an appropriate programme of numerical experimentation and climate change studies.

(iii) A regional scientific co-operation mechanism for collecting basis hydrometeorological data sets, including satellite observations, for supporting and validating the above model developments.

(iv) A commitment to participate in the international exchange of scientific information and data in conformity with the general practice of WCRP.

(v) Collaborative agreements with water resource agencies or related client/user groups to better utilise improved continental-scale information with the objective of addressing the problem of assessment of impacts on regional water resources.

BALTEX meets them, where the last one is in particular met by all clients of the hydrometeorological services of ten countries, who are partners in BALTEX. •

The BALTEX *Newsletter*

This first issue of the BALTEX *Newsletter* is published while BALTEX is already in its major planning stage with important organisational aspects being implemented and a number of individual research projects successfully started in different countries. The focus of this issue is on the four major BALTEX field campaigns and a summary of their present experiment plans. Detailed information on the development and present status of other BALTEX components will be given step-by-step in the following issues of the BALTEX *Newsletter*. The interested reader may find information on BALTEX in the BALTEX Secretariat Reports. See page 11 for a list.

The future issues will contain both organisational aspects of BALTEX and contributions on preliminary scientific results. The editor invites the scientific community to submit BALTEX-related contributions for publication in future issues of this *Newsletter*. See the last page for further information.

Hans-Jörg Isemer
BALTEX Secretariat

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Environmental aspects

The increase in environmental pollution in the Baltic has reached critical levels which already has lead to the destruction of aquatic life in some areas. Of particular concern is industrial waste including discharges from nuclear power stations along the Baltic and leakage of low and medium active waste dumps. In recent years several environmental studies in the Baltic have addressed issues which have put the main emphasis on chemical and biological measurements. It is clear from these investigations that the physical and dynamical processes in the Baltic and associated interactions and feedback with the atmosphere and surrounding land areas are very complex. Such an example is the enforced upwelling from the huge reservoir of nutrients below the primary halocline leading to a rapid increase in both the primary and secondary biological activity. It is thus difficult to draw any general conclusions from such observational programmes without any strong supportive modelling programme of the physical system. Consequently, a programme like BALTEX, which incorporates comprehensive three-dimensional data-assimilation and modelling both in the ocean and in the atmosphere will provide a solid framework for environmental investigations and make it possible for more realistic environmental predictions and scenario calculations.

Present status

An initial implementation plan for BALTEX was approved by its Steering Committee in January 1995 and a full organisational structure for the experiment has been established. The Steering Committee has established working groups on numerical experimentation, process studies and radar meteorology. Three data centres for atmospheric data at the German Meteorological Service in Offenbach, for oceanographic data at the Institute for Marine Research in Helsinki, and for hydrological data at the Swedish Meteorological and Hydrological Institute in Norrköping have also been set up.

The research programme is actively supported by the meteorological services of the BALTEX states (Belarus, Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland, Russia and Sweden) as well as by a number of research institutes of the participating countries. An international secretariat has been set up at GKSS Research Centre in Geesthacht near Hamburg.

The European Community is presently supporting two subprogrammes on atmospheric and oceanograpy and a third programme on the preparation of data not normally available through the routine meteorological channels. In addition to the original BALTEX states United Kingdom and Austria are also taking part in the research programme.

Scientific achievements so far

BALTEX constitutes almost ideal conditions for the determination of the energy - and the hydrological cycle for the Baltic Sea as well as for the drainage basin. Preliminary results indicate that high resolution forecasting models reproduce the large scale accumulated precipitation in overall agreement with river run-off measurements, while the distribution of precipitation in time and space may differ. The simulation of clouds, convective precipitation and radiation are strongly resolution-dependent and shows clearly that present coarse resolution models have pronounced deficiencies to reproduce how cloudiness and radiation are modulated by the diurnal cycle and by the differences between land and sea.

The modelling work is oriented towards the building of very high resolution coupled models incorporating the interaction between the atmosphere, sea and sea-ice as well as the design of more advanced land surface models to better handle river hydrology. Such models will be used for a more accurate calculation of the energy and water balance of the BALTEX area. The meteorological services are actively involved in this work with the expectation that this research will provide more accurate forecasting systems.

Improved observations is a *sine qua non* for BALTEX. An intensive data collection and precipitation analysis exercise, PIDCAP, took place in August - November 1995 where high resolution precipitation data were systematically collected for the whole area. The amount of precipitation data were roughly ten times as many as the standard WWW observations. Special measurements of precipitation were organised from ferries in the Baltic Sea, and the integrated tropospheric water vapour was measured by a dense net of GPS receiving stations. The data from PIDCAP is presently in an active validation phase.

Four major field campaigns are presently being planned for BALTEX, and preliminary preparato-

ry work has already started. The purpose here is to explore characteristic regions in the area with generally different physical conditions and belonging to different climatic regimes. Cloud and precipitation processes over land and sea will be evaluated, one area over the Gotland Basin and another one in eastern Germany. The interaction atmosphere/sea/sea-ice will be investigated in the Gulf of Bothnia and the vertical advection and mixing in the Baltic Sea will provide useful data for the high resolution models. More detailed descriptions of the planned BALTEX field campaigns are given in the second part of this newsletter. BALTEX will also work closely with NOPEX in evaluating earlier experiments and the planning of new ones. The scientific community is invited to participate in this work.

Finally, a major central experiment for the whole Baltic Sea area is being planned for the period 1999 - 2001. A special task force has been set up to prepare this work. Key issues to be considered here are the role of the Baltic Sea area in the overall climate and environment of northern Europe. Improved observations such as a fully integrated radar network will be a necessity. It is anticipated that this study will provide scientific results which will be crucial for the detailed environmental future studies of the Baltic Sea and its land and river basin.

Importance for other WCRP programmes

Several aspects of the BALTEX observational programmes are unique. The integration of atmospheric, hydrological and oceanographic observations in both operational and research mode will provide important experience in future data-handling and data-assimilation systems. This will be beneficial for other aspect of the GEWEX programme and for the new CLIVAR programme.

Ice observation and ice modelling in the Baltic Sea is presently being done with advanced methods, and further advancements in this area will be an important aspect of the BALTEX programme. This will be most beneficial for ACSYS, in particular for ice dynamics investigations in narrow straits which will have to be treated on scales typical for the Baltic Sea.

There exist presently long and accurate hydrological records for the many Baltic rivers, and further comprehensive data studies and modelling will be an important part of BALTEX. Future hydrological studies, in particular in arctic conditions where water flow interacts with the ice processes, such as for the large Russian rivers, will no doubt benefit from similar aspects of the BALTEX programme. •

BALTEX Field Campaigns

Hans-Jörg Isemer, BALTEX Secretariat, GKSS Research Centre, Germany

An important component of the BALTEX research strategy (see the BALTEX Initial Implementation Plan 1995) constitutes the conduction of observational experiments and studies. BALTEX plans for two types of observational activities:

- Field Campaigns for process studies of small- and meso-scale processes. These activities are confined to individual locations or limited areas with the emphasis on specific, non-operational instrumentation.
- Intensive Observation Periods for e.g. the study of catchment-wide phenomena and processes, extreme events and modification of synoptic-scale systems. Here the emphasis is on enhanced observations, mainly from operational networks.

At present four field campaigns are intensively discussed and planned in the BALTEX community:

1. ASCAP, the Air-Sea Interaction, Cloud and Precipitation experiment over the Baltic Sea,
2. BALTEX Land Surface Experiment,
3. BASIS, the Baltic Air-Sea-Ice Study,
4. BAVAMEX, the Baltic Sea Vertical Mixing and Advection Experiment.

The BALTEX Working Group on Process Studies (WGP) is in charge of the general planning of BALTEX field experiments. A co-ordinator has been assigned to each field campaign who prepares detailed planning, monitors the overall development of the campaign and looks for promotion and support for realisation of the campaign. Planning efforts include the preparation of funding applications to be submitted to national and international funding agencies.

In the following short descriptions of the field campaigns are announced to the scientific community. They have been condensed from the current versions of the campaign plans. The purpose is to stimulate interested research groups to participate in the campaigns or give input for improvements of the current plans. Further details may be obtained through the BALTEX Secre-

tariat or directly at the individual field campaign co-ordinators. •

1 ASCAP, the Air-Sea Interaction, Cloud and Precipitation Experiment over the Baltic Sea

Ann-Sofi Smedman, Uppsala University, Sweden

1.1 Objectives of ASCAP

ASCAP is a comprehensive plan for an air-sea interaction field campaign in the Baltic Sea. The central aim of ASCAP is to improve model parameterization schemes through a better understanding of the physical mechanisms involved and to validate algorithms applied to remote sensing data. The specific scientific objectives of ASCAP include

- measurements of parameters, which determine air-sea interaction processes (e.g. wind stress and evaporation), the sea state and wave spectra,
- in-situ measurements (ground based and aircraft soundings) and observation of clouds and water vapour,
- in-situ measurements of precipitation by advanced methods on ships,
- parameterization of air-sea interaction processes in regional models over the Baltic Sea area,
- validation of algorithms to estimate cloud parameters and water vapour content from satellite data,
- validation of algorithms to estimate precipitation from radar data (NORDRAD) and satellite data,
- use of optimised parameterizations and algorithms to improve regional models,
- validation of numerical models against long term measurements over the Baltic Sea area.

1.2 General Experiment Set-up

ASCAP will include two components: 1) continuous measurements (monitoring component) and 2) Concentrated Field Efforts (CFEs).

The monitoring component include

- air-sea interaction measurements on the small island Östergarnsholm situated about 4 kilometres east of Gotland,
- radar measurements and satellite measurements,
- precipitation measurements on ferries running between Lübeck and Helsinki.

These measurements have already begun in 1995 and are expected to be continued at least until 1997.

The main impetus will be on two CFEs, one in early summer (15 May - 15 June 1997), when the surface of the Baltic Sea is likely to be much colder than the surrounding land areas (stable boundary conditions), and one autumn campaign (4 weeks during September and October 1996), with the likelihood of unstable conditions over the sea.

Information on BALTEX is available on the Internet at the BALTEX Home Page

http://w3.gkss.de/baltex/baltex_home.html

1.3 Continuous Measurements

The field station at Östergarnsholm has been chosen to represent undisturbed off-shore Baltic Sea conditions for winds from a wide sector, ranging from Northeast to South. Here, the sea fetch is of the order 100 - 200 km and includes the Gotland Basin. With winds from other directions, effects of limited fetch on wave characteristics and hence on air-sea exchange processes will be studied in a systematic way. The field station consists of an instrumented 30 m tower placed on a very low cliff at the extreme south end of Östergarnsholm and of a directional wave rider buoy deployed about one kilometre south of the island. Turbulent fluctuations of wind and temperature will be recorded at four levels on the tower and humidity fluctuations at one level. In addition, slow response ('profile') measurements of wind, temperature and humidity will be recorded at several levels as well as radiation and other relevant meteorological data.

Further continuous measurement activities during ASCAP include e.g. Doppler radar to determine the 3-dimensional wind field. A Micro Rain Radar (MRR) will be installed at Östergarnsholm and will provide rain-rates and drop spectra at a site where conventional gauges suffer because of

wind exposure and sea spray. This MRR will be installed on RV *ALKOR* during the CFEs.

1.4 CFE activities during ASCAP

CFEs include measurements with a Differential Absorption Lidar (DLAL) operated side by side with a UHF RADAR/RASS. These instruments will be deployed on Gotland just 4 kilometres west of the Östergarnsholm station. This combined measuring system will provide profiles of the mean quantities of wind, water vapour mixing ratio and temperature, and - by combined high resolution measurements - also profiles of turbulence parameters as dissipation rate, turbulent fluxes of water vapour and momentum. Other measurements on Östergarnsholm include tethered balloon soundings, frequent high resolution radio soundings and pilot balloon trackings as well as constant level balloons. Turbulent flux measurements and measurements of the vertically integrated atmospheric water vapour content will also be provided on board of the research vessel RV *Alkor*, which will be cruising east of Östergarnsholm during the CFEs. RV *ALKOR* will also carry different rain measurement devices. A detailed dataset from weather radars and satellites will be compiled during CFEs. Cloud parameters will be provided by a laser ceilometer operated at Östergarnsholm and by a 3-channel microwave radiometer operated on RV *ALKOR.*

Airborne flux measurements will be performed onboard a C-130 aircraft, which can fly as low as 17 m above the surface of the sea. The C-130 will provide a wide range of thermodynamic and kinematic parameters, microphysical data as well as radiation measurements. Part of the flights will be co-ordinated with satellite overpasses (e.g. the DMSP, NOAA-K and ERS-2) and launches of radiosondes from RV *Alkor*.

1.5 Contributions and Co-ordination

At present the following institutions are planning contributions to ASCAP: Uppsala University and SMHI, Sweden, IfM Kiel and MPIfM Hamburg, Germany, Risö National Laboratory, Denmark and the Meteorological Office, England.

ASCAP is co-ordinated by Prof. Ann-Sofi Smedman, Department of Meteorology, Uppsala University, Box 516, S-75120 Uppsala, Sweden, Phone: +46 18 542792, Fax:+46 18 544706, e-mail: annsofi@big.met.uu.se. •

2 BALTEX Land Surface Experiment

Gerd Tetzlaff, Leipzig University, Germany

2.1 The Problem

Previous field experiments showed that the vertical turbulent energy fluxes at the surface usually fall short of the radiation fluxes to be redistributed by these turbulent fluxes. Magnitudes of this bias of 100 to 200 W/m^2 are rather common in clear sky, noon conditions. Field measurements (e.g. FIFE and others) showed a systematic relation between the inhomogeneity of the land surfaces and the observed deficit. However, no systematic investigation was performed allowing to relate the deficit to any physical property of measured parameters. The parameterizations applied in models contain these systematic deficits in the turbulent fluxes at the surface of inhomogeneous terrain and thus model results based on these parameterizations are likely to contain the effects of this bias. Therefore, it has been considered a comprehensive key question to address the problem of the accuracy of the experimental methods of these turbulent fluxes as part of the land surface experiments within BALTEX.

2.2 The Experimental Approach

The first BALTEX land surface experiment will basically contain two components:

- a long-term, multi-year monitoring campaign, and
- one or several Concentrated Field Efforts (CFEs).

The measurement site will be around the observatory Lindenberg (located south-east of Berlin) of the German Weather Service (DWD). The Lindenberg region represents a landscape typical for large parts of the Baltic catchment south of the Baltic Sea, showing wide lowlands extending from Germany to the east including parts of Poland, Belarus, Russia, and of the Baltic States. This landscape is typically rather flat, slightly hilly in parts with lakes and rivers being quite common.

The long-term monitoring component of the BALTEX land surface experiment will be closely connected to the DWD measuring programme LITFASS which is planned for the years 1996 until at least 2000. The scientific objectives of LITFASS include the determination and modelling of the fluxes of momentum, heat, water and other substances, representative for the horizontal scale of the order of 10 km (which is the grid length of the operational NWP model DM pres-

ently in use at DWD) over heterogeneous land surfaces. The primary focus is on the investigation of sub-grid scale heterogeneity in the characteristics of the land surface, in the forcing conditions and the resulting fluxes. The measuring site covers an area of about 20 by 20 kilometres. The full equipment will be deployed finally by 1998. The routine measurements will comprise area-covering data on the basic parameters such as air temperature, humidity, wind, radiation, soil temperature, soil moisture, runoff in several places, rain gauges, and data such as the leaf area index. In addition, more detailed measurements will be taken at a 100 m tower including vertical profiles and fluxes measured by covariance techniques, as well as profiling work into the atmosphere up to several 100 m height with ground-based remote sensing methods. The infrastructure of the measuring site is designed to host guest equipment. For a more detailed description of the LITFASS plan and the Lindenberg measurement site contact Dr. Foken at Lindenberg observatory (address see below).

The CFE will extend over a shorter period of approximately four weeks. The surface energy budget measured at several fully equipped energy budget stations is one of the main parameters under concern. Aircraft measurements and measurements with ground-based acoustic or optical systems (e.g. scintillometers) will be performed to provide area-covering information of the fluxes. Measurements to determine the soil moisture budget are also panned.

A first pilot field experiment is planned for the summer months of 1997. A major CFE is scheduled for the summer 1998.

2.3 Co-ordination

The BALTEX land surface experiment is co-ordinated by Prof. Gerd Tetzlaff at Leipzig University, LIM, Stephanstr.3, D-04103 Leipzig, Germany, Phone: +49 341 9732850, e-mail: gppnm@convex.rz.uni-leipzig.de.

For information on the LITFASS experiment contact Dr. Thomas Foken, Observatorium Lindenberg, D-15864 Lindenberg, Germany,
Phone: +49 33677 60228, fax: +49 33677 60280, e-mail: foken@mol.dwd.d400.de. •

3 BASIS, the Baltic Air-Sea-Ice Study

Jouko Launiainen, Finnish Institute of Marine Research, Helsinki, Finland

3.1 Background and General Objective

The Baltic Sea is located in the seasonal sea-ice region with an ice cover forming and melting each year. By acting as a thermal insulator and a mechanical cover, the sea-ice influences the exchange of energy, water and momentum between the atmosphere and the sea in a dramatic way. Considering the winter navigation, sea-ice is of practical importance to various Baltic Sea countries. Numerical modelling of the dynamics and thermodynamics of sea-ice need verification and optimisation by observations. A detailed and multi-disciplinary observational data set of various physical processes in the wintertime atmosphere, ice and the sea is still lacking.

BASIS aims at an improved understanding and modelling of the energy and water cycles during winter conditions by conducting a winter field experiment in the marginal ice zone (MIZ) of the Baltic Sea. The overall objective of BASIS is to create and analyse an experimental data set for optimisation and verification of coupled atmosphere-ice-ocean models. Modelling studies will be associated with the BASIS field experiments, providing for a close link between observational strategy and modelling requirements in BALTEX.

3.2 Specific Objectives

The specific objectives of BASIS include the

- Investigation of water budget and momentum and thermal interaction at the air-ice, air-sea and sea-ice boundaries,
- Investigation of the atmospheric boundary layer (ABL), especially close to the sea-ice margin,
- Investigation of the ocean boundary layer (OBL),
- Validation of coupled atmosphere-ice-ocean models.

3.3 Measurement Plans

The Concentrated Field Effort (CFE) of BASIS is planned to be carried out during February and March 1998 in the Gulf of Bothnia. The location of the experimental area is preliminary planned between Umea and Vaasa, however, will have to be exactly determined later in accordance with the actual ice situation. The intensive period will last for three weeks and the experiment covers pre- and post-intensive period monitoring of weather and ice conditions. The central working platform is the Finnish ice breaking RV *Aranda*

around which measuring grids for hydrographic, ice, and meteorological studies will be located, and airborne measurements will be made. Contribution from another research vessel is planned, and automatic stations, helicopters and aircraft, and snow scooters will be used. Experiments are concentrated in the region of the marginal ice zone (MIZ). The scale of the various experiments varies from micro-scale to meso-scale, i.e. the spatial and time scale range from 100 m to 100 km and from hours to days, respectively.

3.3.1 Atmospheric Boundary Layer

The aerological method will be used to calculate flux divergence of heat and moisture on the scale of the entire MIZ experimental region. Additional radiosonde stations with specific launching programmes will be installed for BASIS at some coastal locations and onboard of participating RVs. Subgrid-scale fluxes will be determined from measurements of an aircraft (FALCON of DFLR Oberpfaffenhofen Germany) and two helicopters (HELIPOD system of University Hannover and FIMR Helsinki). The FALCON will operate in a box of about 200 km x 200 km side-length while helicopter missions will be concentrated in an area of 50 km radius around RV *Aranda*. Tower measurements on the ice and close to the shore line will give local near-surface flux measurements. A combination of meteorological and turbulence data from aircraft, HELIPOD and surface measurements has not been gained previously and is expected to yield good estimates of e.g. the area-averaged vertical flux divergence.

3.3.2 Ice and Surface Properties

An important goal is to quantify the role of the surface properties in the air-ice-sea exchange of momentum, heat, and moisture. Information on ice concentration, ice roughness and ice kinematics will be obtained using SAR imagery from Radarsat and ERS-2, covering the experimental area at the ice edge zone. NOAA-AVHRR imagery will be used when cloud coverage is low. Ice drift is intended to be measured with several GPS equipped buoys, ARGOS buoys and radiosondes for location tracking deployed on ice. The vertical temperature profile in the sea water will be measured with thermistor chains connected to ARGOS buoys. Detailed ground measurements of ice surface roughness, ice salinity and temperature, and ice and snow thickness will be carried out directly on the sea-ice.

3.3.3 Ocean Boundary Layer (OBL)

Hydrographic sections crossing the experimental region will be performed by the research vessels and ship- and helicopter-based CTD profiles will be measured during the CFE. Thermistor chains and current meters will be deployed beneath the sea-ice. At least one ADCP will be operated at the central base station from RV *Aranda*. The OBL turbulence structure will be measured by acoustic devices and small fast-responding propellers using eddy-flux and energy dissipation techniques.

3.4 Contributions and Co-ordination

At present BASIS will be carried out in co-operation of five institutes in Finland, Sweden, and Germany including the Finnish Institute of Marine Research (FIMR), Hannover University, Hamburg University, Swedish Meteorological and Hydrological Institute (SMHI), and Uppsala University. BASIS has co-operation and co-ordination with the Northern Hemisphere Climate Land Surface Processes Experiment (NOPEX), which will organise a winter field experiment in northern Finland. A funding proposal for BASIS is currently prepared to be submitted to EU during October 1996. BASIS is co-ordinated by Prof. Jouko Launiainen at FIMR, P.O.Box 33,
FIN-00931 Helsinki, Finland, Phone: +358 9 61394472, Fax: +358 9 61394494, e-mail: jouko.launi@fimr.fi. •

4 BAVAMEX, the Baltic Sea Vertical Mixing and Advection Experiment

Anders Stigebrandt, Göteborg University, Sweden

4.1 Processes in the Baltic Sea

The major components of the vertical advection and mixing system of the Baltic Sea include the following processes: i) the inflow of new deepwater and outflow of Baltic proper surface water through the Belts and Öresund, ii) mixing and advection of new deepwater as it flows through the system of dense bottom pools and bottom currents in the south-western Baltic proper, and iii) vertical mixing and advection in the major basins of the Baltic Sea.

The present planning of BAVAMEX foresees to concentrate on the latter process. The in- and outflow are subject of the ongoing DYNOCS programme, and the process mentioned under ii) above is very difficult and expensive to observe

because of the ephemeral character of bottom currents.

4.2 Measurement Plan

It is intended to estimate the distribution of kinetic and potential energy in an experimental box extending from the shoreline to the maximum depth of a deep basin. The experiment should cover scales ranging in space from the size of the experimental box and in time from the length of the experiment down to the space and time scales of molecular dissipation and diapycnal mixing. BAVAMEX foresees the conduction of a summer experiment with a seasonal, essentially thermal stratification in the surface layers, and a winter experiment when the water is homogeneous down to the halocline at about 60 m depth. Each of the experiments should last for about 2 weeks.

The area east of Gotland is a good site for such an experiment. Here the bottom slope is typical of the Baltic Proper and the experimental box includes parts of one of the major deep Baltic Sea basins. The experimental box will be about 30 by 30 nautical miles with one border at the coast of Gotland. A further benefit of this location is that the meteorological measurements obtained during field phases of ASCAP at Östergarnsholm will be available. Four ships are expected to participate. Two of these will do continuous CTD (Conductivity-Temperature-Depth) and ADCP (Acoustic Doppler Current Profiler) measurements along transects perpendicular to the coast (about 30 nautical miles in length). Vessel-mounted ADCP and a vertically undulating vehicle carrying the CTD will be used. The distance between transects will be about 4 nautical miles. Each ship will cover four transects a day. The other ships will take CTD profiles and profiles of turbulent dissipation from the sea surface to the sea bed in many verticals each day.

At the start of an experiment moorings with current meters and CT (Conductivity-Temperature)-sensors will be deployed along the borders of the experimental box. These measurements will be used to compute fluxes of energy across the open boundaries of the box. Moorings with similar equipment will also be deployed inside the experimental area for studies of the frequency domain.

The meteorological mast at Östergarnsholm will provide high-quality meteorological data and independent estimates of the air-sea exchange of heat and moisture.

4.3 Expected Results

Besides more traditional descriptions of experimental data in terms of coastal dynamics, mixed layer dynamics, internal waves and mixing an evaluation of the distribution of kinetic and potential energy on all space and time scales down to dissipation scales is planned. This will include the quantification of the transfer of energy between different scales of motion. Investigation of the meteorological forcing, including buoyancy fluxes through the sea surface is a pre-requisite. Finally, parameterizations will be developed for diapycnal mixing as function of e.g. wind speed (meteorological forcing), stratification, horizontal and vertical distances to the sea bottom and possibly other important parameters to be detected.

The BAVAMEX data sets will also be quite useful for testing circulation models with respect to, e.g. meso-scale dynamics. Circulation models are instrumental for the interpretation of motions on larger spatial scales in the experiment. There are several suitable models available, particularly the 3-dimensional circulation model at IFM Kiel, or at other research institutions (e.g. SMHI, FIMR and IOW) presently participating in BALTEX.

4.4 Participation and Co-ordination

Participants at BAVAMEX presently include groups at Göteborg University, SMHI, FIMR and IOW. BAVAMEX is co-ordinated by Prof. Anders Stigebrandt at University of Göteborg, Departement of Oceanography, Box 4038,
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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

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 Organization (WMO), the International Council of Scientific Union (ICSU) and the Intergovernmental Oceanographic Commission (IOC), as part of the World Climate Research Programme (WCRP).

The scientific planning and development of BALTEX is under the guidance of the BALTEX Science Steering Group, chaired by Professor Lennart Bengtsson, Max-Planck-Institut für Meteorologie, Hamburg, Germany.

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The editor invites the scientific community to submit BALTEX - related contributions in the field. Scientific contributions will not be reviewed, scientific material published in this newsletter should not be used without agreement of the author.

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

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