Minutes of

15^{th} Meeting
of the
BALTEX Science Steering Group

held at

Risø National Laboratory
Wind Energy Department
Roskilde, Denmark
8 - 10 September 2003

edited by
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Participants at the 15th BALTEX Science Steering Group Meeting

Front row, left to right: S. Meyer, S. Keevallik, D. Jacob, H. Graßl, S. Crewell.
Back row, left to right: R. Preusker, S.-E. Gryning, M. Rummukainen, P. Kowalczak, D. Rosbjerg, H.-J. Isemer, J. Piechura, J. Hesselbjerg Christensen, A. Omstedt, A. van Ulden, P. Axe, A. Lehmann. Missing: A. Lindroth, D. Michelson

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Summary of Action Items

Action #1: Daniela Jacob to assemble all parts of the BALTEX state-of-the-art-review by the end of November and distribute a concise draft report to all contributors for final mutual adjustments and improvements (see item 3 of this meeting's agenda).

Action #2: Hans-Jörg Isemer, Dan Rosbjerg and Sven-Erik Gryning to continue the timely preparation of the 4th Study Conference on BALTEX with the following suggested major milestones, if possible: Circulation of the 2nd Announcement during November 2003, deadline for abstract submission prior to 31 January 2004, registration deadline prior to 15 March 2004 (see item 3 of this meeting's agenda).

Action #3: Sven-Erik Gryning to approach the Nordic Council of Ministers for support of the 4th Study Conference on BALTEX (see item 3 of this meeting's agenda).

Action #4: The science plan drafting team (Hartmut Graßl, Anders Omstedt, Markku Rummukainen, Dan Rosbjerg, Sven-Erik Gryning, Hans-Jörg Isemer) with the support of **Aad van Ulden and Anders Lindroth** to finalize the Science Plan for BALTEX Phase II following suggestions and decisions made at this meeting, in due time for the plan to be print-ready before the end of 2003 (see item 4 of this meeting's agenda).

Action #5: Dan Rosbjerg to organize additional reviews of the draft science plan by colleagues of the hydrological community (see item 4 of this meeting's agenda).

Action #6: Andreas Lehmann to constitute the "BALTEX Phase II Implementation Plan Drafting Group" and organize a meeting of this group in mid-winter 2003/2004 with the objective to establish an Implementation Plan draft until May 2004 (see item 5 of this meeting's agenda).

Action #7: Aad van Ulden and Daniela Jacob to further explore possibilities for proposal submission to the ESF-EuroCLIMATE programme and, if appropriate, write a draft proposal for the ESF-EuroCLIMATE call, with the support of Hans-Jörg Isemer (see item 6 of this meeting's agenda).

Action #8: Daniela Jacob, together with **Hartmut Graßl and Hans-Jörg Isemer** to test the operativeness of the BMDC at MPIFM in Hamburg and hold close contact to Dr. Lautenschlager at BMDC for feedback on possible further requirements to BMDC (see item 7 of this meeting's agenda).

Action #9: Hartmut Graßl to discuss with Michel Jarraud, the designated future Secretary General of WMO (as of 2004), possible support actions of WMO to convince Eastern European National Services to continue free-of-charge data delivery to BALTEX Data Centres. The option of a support letter of Dr Jarraud to these Services was in particular mentioned (see item 7 of this meeting's agenda).

Action #10: **Hans-Jörg Isemer and Bengt Carlsson** to establish a critical BHDC inventory and take necessary steps to fill data gaps in the BHDC archive, if necessary (see item 7 of this meeting's agenda).

Action #11: The BALTEX Secretariat to establish a link from the BALTEX homepage to the ODCB webpage (see item 7 of this meeting's agenda).

Action #12: Hans-Jörg Isemer and Piotr Kowalczak to prepare for the 17th BSSG meeting in Poznan, Poland during November 2004 (see item 8 of this meeting's agenda).

Introduction

The 15th meeting of the BALTEX Science Steering Group (BSSG) was hosted by the Wind Energy Department at Risø National Laboratory, Denmark. Prior to the BSSG meeting a science workshop on "The BALTEX/BRIDGE Period 1999 to 2002 – Selected Results" was held on Monday, 8 September 2003, 14:00 to 18:30 hours. The agenda of the science workshop is given in Appendix 1. Summaries of workshop presentations are collected in Appendix 2.

Hartmut Graßl, the chairman of the BSSG, opened the BSSG meeting on Tuesday, 9 September at 9:00 hours. The meeting was closed on Wednesday, 10 September at 12:00 hours. The agenda of the BSSG meeting and the list of BSSG meeting participants including their full addresses may be found in Appendix 3 and Appendix 4 respectively.

The structure of the minutes follows chronologically the items numbered as given in the meeting agenda (see Appendix 3).

Item 1: Welcome by the Host and the Chairman

Sven-Erik Gryning welcomed all participants and expressed his pleasure about the lively discussion at the workshop the day before. He continued with a short presentation on Risø National Laboratory, which is a national laboratory under the Danish Ministry for Science, Technology and Innovation. It was established in 1956 for the peaceful exploitation of nuclear energy. 1986 it was firstly named "Risø" and the general objective was broadened to conduct research in the field of energy as a whole. In 2000 the D3 Research reactor was closed down and the decommissioning of all Risø's nuclear facilities began. Today, Risø performs research in the natural sciences and technologies, with the overall aim to give Danish industry and society new opportunities for technological development.

In his opening address, Hartmut Graßl, the BSSG chairman, welcomed the participants and emphasized the importance of this meeting in the light of the revised Science Plan for BALTEX Phase II to be discussed and approved. In the context of important decisions for BALTEX to be made the BALTEX bodies and their terms of reference were reviewed. Hartmut Graßl remarked that the BSSG is one of the largest Science Steering Groups within the various programmes of the World Climate Research Program (WCRP). In most cases the SSGs have a size of up to 12 members. It is a specialty in BALTEX that, for good reasons, almost all national meteorological and hydrological Services in the Baltic Sea basin are represented in the BSSG, which brings the group to a rather large size. In view of the extended science topics envisaged for BALTEX Phase 2, the Chairman suggested, that the BSSG should review the terms of reference for and the size of the BSSG. He suggested introducing "membership to the BSSG" as a permanent topic on agendas of future BSSG meetings.

Item 2: Amendment and Approval of the Agenda

Two additions were made to the agenda: Susanne Crewell, who substituted Clemens Simmer within this BSSG meeting, will present an overview about the EurAT funding proposal as item 4.3. Aad van Ulden put forward to discuss possibilities for a proposal to the European Science Foundation (ESF) EuroCLIMATE call. This item will be discussed as item 6.10.

Item 3: Review of Important Action Items of the Previous SSG Meeting

3.1 Funding proposal MOVE to the EU's 6th Framework Programme (FP6)

Hartmut Graßl reported that MOVE (An Integrated Project proposal, entitled: Modelling of Observed and Future Variability of European Water Cycles) unfortunately failed to get high enough points in the evaluation procedure, and was hence not retained for funding. Major criticism raised in the evaluation report for MOVE were: (i) MOVE`s regional focus on northern and mid-Europe was considered too limited and not Pan-European; (ii) a bias towards climate research and a concurrent lack of hydrological research components. Graßl continued to note that no other proposal for the FP6 work programme topic, MOVE had been submitted to, was retained for funding. There is, hence, a possibility that the EU might issue an additional call for this topic, which, however, might not be opened before autumn 2004.

It was discussed controversially within the BSSG whether the 10K2008[1] proposal consortium should be contacted for discussions on a possible joint preparation of a future proposal. But as no opportunity to hand in a proposal was directly open, and the number of partners would have to be reduced anyway, the decision was shifted. However, some BSSG members also claimed that thoughts, how to get money should not dominate BSSG meetings and discussions.

3.2 State-of-the-art-review for BALTEX

Daniela Jacob collected several still heterogeneous text contributions so far, with still some parts missing. It was decided that the intensive observation periods during BALTEX (such as PIDCAP and BRIDGE) shall not be subject of dedicated paragraphs in this report. Hans-Jörg Isemer agreed to write a summary paragraph about BRIDGE activities including first results such as those presented at the workshop the day before. It was further suggested to ask Lennart Bengtsson, the former BSSG Chair to write the section on atmospheric research results. For the introductory chapter on the BALTEX history Erhard Raschke, the former vice-chairman of the BSSG, should be approached. Susanne Crewell accepted to write a short paragraph about precipitation.

This state-of-the-art-review shall not cover more than 40 pages and should be published as an International BALTEX Secretariat Series report first. Afterwards, it should be re-written suitable to be submitted to a journal. **Action #1** was given to **Daniela Jacob** to assemble all parts of the State-of-the-art-review by the end of November and distribute a concise draft report to all contributors for final mutual adjustments and improvements.

3.3 4th Study Conference on BALTEX 2004

Hans-Jörg Isemer briefly reported on preparations for the Conference accomplished so far under guidance of the BALTEX Secretariat. He noted the 1st Conference Announcement which included all information on the sessions planned, Conference venue, hotels pre-booked and travel possibilities. All preparations, which are done together with DTU (Dan Rosbjerg), Risø National Laboratory (Sven-Erik Gryning) and the *Bornholm Tourist Booking Centre* are running smoothly and in time. The following Conference issues were discussed at this meeting:

The contents of the Conference's scientific sessions were discussed and approved as follows:

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[1] 10K2008 was an FP6 IP proposal submitted in direct competition to MOVE.

1. Improved understanding of water and energy cycle processes using diagnostic studies, field experiments, remote sensing applications and numerical modelling, including results from BALTEX/BRIDGE and CEOP;
2. Trends and variability in the regional climate, water and energy cycles, and the climate-water interactions during the past two centuries; Development and validation of advanced modelling tools, e.g. coupled models, for regional climate studies;
4. Projection of future climate change at river catchment and basin scales during the 21st century;
5. Applications for water resources management, including extreme events, long-term changes and studies on air and water quality.

These sessions shall be included in the 2nd announcement to be circulated during November 2003. It was further agreed upon that the length of each Conference presentation should be limited to 15 minutes plus 5 minutes time for discussion.

Further, financial issues of the Conference were discussed. It was stated that support money is needed not only generally for the whole Conference, but may in particular be needed for support of the invited speakers. Hartmut Graßl proposed and agreed that the Max-Planck-Institute for Meteorology (MPIfM) might help with money for the invited speakers. Sven-Erik Gryning proposed and agreed to approach the Nordic Council of Ministers for additional support. The Conference fee was debated. The fee for full delegates should not exceed € 200 including the Conference dinner, and should not be made dependent on how long individual participants stay at the Conference. The central Conference room in Gudhjem, Bornholm is, for security reasons, limited to 160 participants. Technical means for a video transmission to another room are foreseen in case of more participants wishing to attend a specific session. Means of generally limiting the total number of Conference participants were discussed controversially.

Action #2 was given to **Hans-Jörg Isemer, Dan Rosbjerg and Sven-Erik Gryning** to continue the timely preparation for the 4th Study Conference on BALTEX with the following suggested major milestones, if possible: Circulation of the 2nd Announcement during November 2003, deadline for abstract submission prior to 31 January 2004, registration deadline prior to 15 March 2004. **Sven-Erik Gryning** accepted **Action #3** to approach the Nordic Council of Ministers for support of the 4th Study Conference on BALTEX.

Item 4: Science Plan for BALTEX Phase II

Before going into detailed discussion on the Draft Science Plan for BALTEX Phase II three major international initiatives with possible relevance for BALTEX were shortly presented and discussed in the context of the revised objectives of BALTEX Phase II.

4.1 The Global Water System Project (GWSP)

Hartmut Graßl summarised recent developments of the Global Water System Project (GWSP), which is a joint project of all Global Change Research Programmes WCRP, IGBP, IHDP and DIVERSITAS. A draft scoping document has been established during recent months, which shall now be condensed into a science plan for GWSP. A group of four scientists (Joe Alcamo, Pavel Kabat, Robert Naiman, Hartmut Graßl) has recently been established for this purpose. The group met once recently and will have to be in contact with members of the GWSP scoping team for finalising a science plan draft for GWSP by the end of the year 2003.

4.2 Prediction of regional scenarios and uncertainties for defining European climate change risks and effects (PRUDENCE).

PRUDENCE is a comprehensive EU FP5 project with 21 participating institutions, including major modelling centres and BALTEX partner organisations (e.g. MPIFM, SMHI, KNMI and GKSS are participants to PRUDENCE). Jens Hesselbjerg Christensen, the PRUDENCE co-ordinator, reported upon results and future plans of the project. It started the 1st of November 2001. Its major goals are in short: (1) to address and reduce deficiencies in projections of future climate change; (2) to quantify the uncertainties in predictions of future climate change and its impacts; (3) to interpret the results gained in relation to European policies for adapting to or mitigating climate change. See Appendix 5 for an overview text on PRUDENCE. The BSSG encouraged PRUDENCE to perform a central validation and to figure out, what the shortcomings are and which other questions are coming up. Therefore communication with BALTEX is encouraged for these issues. Daniela Jacob added that a study upon the summertime precipitation for the area over the open Baltic Sea will be performed and suggested to use outputs of PRUDENCE model runs for forcing a Baltic Sea Ocean Model to find out, which regimes evolve. Furthermore, budget studies for the entire Baltic Sea basin should be given a higher priority within BALTEX. Such studies are now possible also with the ECMWF 40 Years Re-Analysis data (ERA40) which have just been made available since August 2003 and are available in an easy way.

4.3 EurAT Observatory proposal

Susanne Crewell reported on the EurAT Observatory (“Towards an Integrated European Atmospheric Observatory for Climate and Weather Studies”) proposal which was submitted to the EU FP6 call for Infrastructures in April 2003. It was unfortunately not successful in getting funding, but it should be submitted again, taking into account the advices of the evaluators. The main focus of this proposal is on measurements, but these measurements should also be applied for model evaluation within the proposed project. The proposal suggests networking existing advanced ground-based observatories, harmonizing important instrument infrastructure and co-ordinating both measurement details and the archival of data (model and measured ones). The major gap of this proposal is to be found in Eastern Europe. The BSSG highly values and supports the monitoring activities proposed in the EURAT proposal. These monitoring activities will deliver data useful for a number of activities (e.g. process studies, model evaluation) within BALTEX. The BSSG encourages the revised submission of the proposal in 2004.

4.4 The Science Plan for BALTEX Phase II

Following action items of the previous BSSG meetings a Draft Science Plan for BALTEX Phase II was written by a drafting team and distributed to BSSG members prior to this meeting. In an in-depth discussion of this Draft Science Plan comments and constructive criticism were expressed for each chapter. These should serve as guiding notes for the revision for the authors of each chapter. It was generally agreed that summary bullets should be added at the end of each chapter under the heading “Major Scientific Issues”. The titles should also be reshaped and a generally more homogeneous outfit should be given to all chapters. Furthermore, the number of references should be kept down to the really needed key references like official ones from e.g. the World Meteorological Organisation (WMO), major summary papers and conference proceedings. Acronyms should be explained immediately in the text.

In the following, chapters of the Draft Science Plan are discussed individually.

Chapter 2 – "Better Understanding of the Energy and Water Cycles over the Baltic Sea Basin": BSSG members stated that this chapter describes nicely, what is still missing from BALTEX phase 1, but criticisms were mentioned that more emphasize should be put on concrete future challenges than on past issues. Anders Lindroth was asked to provide input on land use and vegetation issues. It was also suggested to include a figure of e.g. the anomalous salt water inflow into the Baltic Sea of 2002/2003 as a new exciting observation. Coming along with this issue it was put forward to enlarge the model area because e.g. the Danish straits are at the very edge of the Baltic Sea region and computer facilities that allow computations of an enlarged area are available now.

Chapter 3 – "Analysis of Climate Variability and Change since 1800, and Provision of Regional Climate Projections over the Baltic Sea Basin for the 21st Century": Some BSSG members missed a highlighted, BALTEX-specific and outstanding 10 years perspective, noting that much of the topics envisaged in this chapter are currently investigated in the context of other programmes or projects and will just be continued for the next couple of years. A challenging goal of a time horizon of 10 years was considered to be missing. Suggestions made include having the land use change from 1800 to 2000 highlighted specifically, together with irrigation and ground water issues.

Chapter 4 – "Provision of Improved Tools for Water Management, with an Emphasis on more Accurate Forecasts of Extreme Events and Long-term Changes": BSSG members noted that this is a chapter with a pronounced focus on engineering issues and it was suggested to mention this more clearly in the introduction. Lakes and sea level change were found to be missing in this chapter. Additionally the question was raised if Coastal Zone Management should be included in this chapter. Markku Rummukainen suggested that Markus Meier (Rossby Centre, Sweden) can be asked for comments on sea level change. Hans von Storch and co-workers at GKSS Research Centre were suggested to consider adding text parts in the context of Coastal Zone Management.

Chapter 5 – "Gradual Extension of BALTEX Methodologies to Air and Water Quality Studies": This chapter was considered critical, because its scientific issues addressed are not core investigations of the BALTEX community so far. Also, BALTEX will not open up entire new research fields which may already be well covered by other programmes. It was however agreed upon that information is needed from other environmental related research fields to better understand the climate system. It was suggested to focus on a subset of most important issues and processes which are relevant for the climate system to better understand the water and energy cycles. Therefore, the chapter was renamed to "Exploring linkages between the climate system and environmental issues". Sven-Erik Gryning together with Anders Lindroth, Markku Rummukainen and Aad van Ulden agreed to rewrite this chapter along the lines discussed. Furthermore, BSSG generally suggested establishing closer contacts to researchers working on water and air quality with the aim to jointly establish further details of the goals of BALTEX Phase II.

Chapter 6 – "Strengthened Interaction with Decision Makers, with Emphasize on Global Change Impact Assessments": BSSG suggested shortening chapter 6 and avoiding in particular repetitions between sections 6.2 and 6.3. Furthermore "by decision makers" should be removed from the title of section 6.2 and the term "immediately" should be avoided.

Chapter 7 – "Education and Outreach at the International Level": BSSG agreed to condense the contents of this chapter into 2 pages. The question was raised if journalists and media should explicitly be included in a science plan. As journalists are very supportive of environmental research it was finally the prevailing conclusion to include them within 7.1.

Chapter 8 – "Data Management": As with chapter 7, suggestions were made to shorten this chapter significantly to about 2 pages. Anders Omstedt noted that access to long climate data sets of e.g. ice data is difficult at present, and he therefore suggested building up a new climate data centre with a specific regional focus to meet the objectives of BALTEX Phase II covering the period data for 1800 to 2000. It was argued that BALTEX should establish a new data centre only, if no other data centre provides the necessary data and that a data centre function would be more feasible to realize. The BSSG left this topic open for further future discussion. Sirje Keevallik noted that BALTRAD (BALTEX ground-based weather radar network) consists also of a station in Estonia, which was missing in the text.

Chapter 9 – "Links to Other Research Projects and Programmes" was accepted without opposition.

Chapter 10 – "Time Plan for BALTEX, 2003 – 2012": The duration of BALTEX phase II was intensively discussed. While several BSSG members estimated the presently suggested science plan to cover a time horizon of about 5 years, others noted 10 years to be a suitable time period for BALTEX Phase II. Suggestions were made to add milestones to the science plan and to link the science plan to e.g. the duration of satellite missions and/or world wide observational periods.

In summary, **Action #4** is for **the science plan drafting team (Hartmut Graßl, Anders Omstedt, Markku Rummukainen, Dan Rosbjerg, Sven-Erik Gryning, Hans-Jörg Isemer) with the support of Aad van Ulden and Anders Lindroth** to finalize the Science Plan for BALTEX Phase II following suggestions and decisions made at this meeting, in due time for the Plan to be print-ready before the end of 2003.

Further, the BSSG asked **Dan Rosbjerg (Action #5)** to organize additional reviews of the science draft plan by colleagues of the hydrological community.

Item 5: Towards Implementing BALTEX Phase II

The BSSG decided that a specific group shall set up a general outline of the implementation plan for BALTEX Phase II until the next BSSG meeting on Bornholm. This "BALTEX Phase II Implementation Plan Drafting Group" will be chaired by Andreas Lehmann and shall be built around the Science Plan Drafting Group (Hartmut Graßl, Anders Omstedt, Markku Rummukainen, Dan Rosbjerg, Sven-Erik Gryning and Hans-Jörg Isemer). Daniela Jacob will be a member of the group, thus bringing in additional contributions from the BALTEX Working Group on Energy and Water Cycles. Hans von Storch (GKSS Research Centre) was suggested to contribute, among others to be determined. It was suggested that the life time of the implementation plan might cover only 3-4 years with several implementation plans for the time of one science plan.

Action #6: Andreas Lehmann to constitute the "BALTEX Phase II Implementation Plan Drafting Group" and organize a meeting of the Group in mid-winter 2003/2004 with the objective to establish an Implementation Plan draft until May 2004.

Item 6: How "European" is BALTEX?

A recently submitted major EU funding proposal for BALTEX (MOVE, see item 3 above) failed to be retained for funding. The major objective of this item was to analyse the present state of BALTEX as a European Research Programme and to critical review existing and future national funding sources for BALTEX. Brief summaries on the present and future national funding sources and options for BALTEX were given as summarized below. BSSG members noted that several activities may be dedicated to BALTEX and its objectives, but may not be named as such. It may depend upon how individual scientists commit themselves to BALTEX - which itself depends on the activeness of communication within the BALTEX programme, and beyond.

6.1 In **Denmark** the National Science Foundation and the National Council of Ministers are possibilities of receiving financial support for BALTEX-related studies. Currently, CO_2 flux and nutrient measurements as well as the development of new measurement techniques directly contribute to BALTEX. In addition, the EU project PRUDENCE, co-ordinated by DMI (Danish Meteorological Institute), contributes to BALTEX although it is not explicitly directed towards it, and funding for PRUDENCE is mainly through the EU and partners in other European countries.

6.2 Within **Sweden** BALTEX-related work has foci at the universities of Gothenburg, Lund, Uppsala and at the measurement site at Norunda. SMHI is a major national centre of activities for BALTEX by (i) being the holder of three dedicated BALTEX data centres, (ii) providing essential support for BALTRAD, and (iii) having science contributions through its Research and Development Division including the Rossby Centre. Anders Omstedt noted that SMHI will thoroughly investigate its future contributions to BALTEX upon completion of the Science Plan for BALTEX Phase II. Omstedt continued to state that climate research – focussing on time scales of centuries to millennium - is also becoming important in Sweden. As an example, a new network program – the MUSCAD program (Multi-proxy Studies of Climate Anno Domini) - has been established, with the objective to explore relations between and integrate instrumental measurements and proxies for the time span from the Vikings up to now. The address of its homepage is: http://www.geol.lu.se/proxy/.

6.3 Written reports on the situation in **Finland** were submitted prior to the meeting and are given in Appendix 6.

6.4 Within **Estonia**, there are 3 institutes, the Marine Systems Institute, Tartu University and Tartu Observatory, with research activities contributing to BALTEX, but they do not always put the BALTEX label on their projects. Apart from this the contracts with the Meteorological Services of all three Baltic countries, including **Latvia** and **Lithuania**, expire at the end of this year. Thus, this is the last year that these Services are contractually obliged to give in data into the BALTEX data centres.

6.6 At the Institute of Oceanology, Polish Academy of Sciences in **Poland** the research dedicated to BALTEX consists mostly of process-oriented studies and monitoring activities in the Baltic Sea. Most of these activities are being conducted in the frame of five EU projects, but nevertheless money is still lacking to explore all measured data. Piotr Kowalczak reported that the Polish Hydrometeorological Service (Institute for Meteorology and Water Management, IMGW) has just undergone an internal re-organisation. IMGW has established four new meteorological radars, whose operational work will start soon. The data are stored at IMGW. Kowalczak announced to send a letter to the BSSG Chair containing detailed information on how to improve activities in support of BALTEX in due time after the meeting.

6.7 In **Germany** several ongoing projects are funded by the National Federal Research Ministery (BMBF) through the national DEKLIM and AFO2000 programmes. In particular the DEKLIM projects cover a major part of the research spectrum in BALTEX. Most of these projects will be concluded by the year 2005. Furthermore, the Lindenberg observatory of the German Weather Service (DWD) will continue to deliver data to CEOP, and institutional support is available and will be continued for the BALTEX Meteorological Data Centre (by MPIfM) and the BALTEX Secretariat (by GKSS).

6.8 In the **Netherlands** KNMI is the major organisation contributing to BALTEX. Cabauw as one of the Coordinated Enhanced Observing Period (CEOP) stations will be continued. A weather radar is connected as well and it will be continued to analyse all the data gained. Furthermore both data and model studies of climate variability and change will be performed. In November 2003 decisions are expected whether substantial financial support for climate related research will be allocated within a national programme.

6.9 While several projects with direct relevance for BALTEX were funded by the **European Commission** (EC) in both the 4th and 5th Research Framework Programmes (FP4 and FP5), no BALTEX research proposal to FP6 has been successful so far in being retained for funding by the EC. With the CLIWANET project having been concluded in early 2003, there is at present no running BALTEX project funded by the EC.

6.10 ESF – EuroCLIMATE:
The European Science Foundation (ESF) launched a first call for outline proposals for research projects to be funded through the EUROCORES programme EuroCLIMATE with a deadline for submission on 31 October 2003. EuroCLIMATE calls for basic research addressing climate variability and the carbon cycle (past, present and future), and in particular their interrelationship, in a European framework. Multi-proxy reconstructions from all available archives will bring the marine, the terrestrial and the ice-core communities together on cross-cutting issues, such as obtaining a common timeframe, and will allow coupled climate models used for global warming scenarios to be validated on European and regional scales. The programme is divided into two main sections entitled 1. Reconstructing past climate, and 2. Modelling and understanding processes of past climate; both sessions containing several subsections (see www.esf.org for details). In particular session 2 was expected to offer funding possibilities for climate modelling aspects in BALTEX, although only a subset of all nations contributing to BALTEX are eligible for funding through this ESF call.

The BSSG suggested investigating funding possibilities for BALTEX research and **Action #7** was given to **Aad van Ulden and Daniela Jacob** to further explore possibilities for proposal submission to the ESF-EuroCLIMATE programme and, if appropriate, write a draft proposal for the ESF-EuroCLIMATE call, circulate and submit with the support of Hans-Jörg Isemer.

Item 7: Important Other Issues

7.1 GEWEX Hydrometeorology Panel (GHP) Meeting

GHP meetings are held annually and are hosted in turn by one of the GEWEX CSEs (Continental Scale Experiments). The 2003 GHP meeting will be hosted by BALTEX and will be held in Lüneburg, Germany, during 22 to 26 September 2003. Local arrangements for this meeting have been organised by the BALTEX Secretariat. GHP is a forum for representatives of the individual CSEs and other organisations and projects contributing to hydrometeorological research in GEWEX.

An overview on the suit of individual sessions to be held at the forthcoming GHP meeting was given. A major discussion point was the review of BALTEX representation and contribution to GHP and its sub-panels and working groups. In the following, groups and workshops which are presently implemented within GHP and have relevance for BALTEX are listed together with past and suggested future BALTEX representatives:

- GHP: Sten Bergstrøm recently resigned, BALTEX representation is through Hartmut Graßl at present. Hans-Jörg Isemer attended several previous GHP meetings and provided overview presentations for BALTEX.
- WEBS (Water Energy Budget Studies): Daniela Jacob will take part at the 2003 meeting and perhaps also for following ones.
- WRAP (Water Resources and Application Project): Phil Graham recently resigned. Theo Mengelkamp (GKSS Research Centre) will be asked, if he would participate for BALTEX.
- CEOP (Coordinated Enhanced Observing Period): Hartmut Graßl, Hans-Jörg Isemer and Jürgen Fischer are actively contributing to CEOP in different functions and will continue these activities. Both Graßl and Isemer will participate at the 2003 meeting.
- Predictability Workshop: Daniela Jacob will take part at the 2003 meeting and inform the BALTEX SSG members if interesting issues come up.
- Sources and Cycling of Water Workshop: Hans-Jörg Isemer will participate in this workshop in the upcoming meeting.
- Extremes Workshop: Tido Semmler from the group of Daniela Jacob at MPIFM, Hamburg will be asked to give a short presentation at this workshop because he is doing studies on extremes within the Baltic region.

Perceiving difficulties for BALTEX to participate in some of the groups, the usefulness of GHP for BALTEX altogether was considered. The BALTEX SSG members concluded that active participation of BALTEX representatives at GHP activities and bodies is mutually valuable for BALTEX and GHP, in particular looking at e.g. CEOP, performed model intercomparisons and the Global Precipitation Climatology Project (GPCP). Nevertheless, BALTEX does not necessarily have to take part in any group of GHP. BSSG members noted that information on the 2003 GHP meeting was circulated on rather short notice and suggested to circulate information on future GHP activities in due time.

7.2 CEOP and BALTEX Contributions

Hartmut Graßl reported that CEOP (Coordinated Enhanced Observing Period) is developing into a real success story. An update of new developments concerning CEOP may be found at www.gewex.org/ceop. Based on its contributions so far BALTEX has a high reputation in CEOP. Data from four reference sites (Sodankylä, Norunda, Lindenberg and Cabauw), preparation and archival of ENVISAT data (Jürgen Fischer and his group at FU Berlin) and a data centre for CEOP-MOLTS data (established at MPIfM in Hamburg) form the backbone of BALTEX contribution. As the infrastructure for three of the four reference sites is maintained by National Meteorological Services (FMI, DWD and KNMI), the continuation of future data delivery is very likely.

7.3 BALTEX Data Centres

- BALTEX Meteorological Data Centre (BMDC)

The German Weather Service (DWD) finished maintaining the BMDC at the end of 2002. The BMDC archive is now stored in Hamburg at MPIFM as part of the World Data Centre for Climate (WDCC) headed by Dr. Michael Lautenschlager. Details on both adding new data to the existing archive and extraction of specific data subsets upon data user request are at present not fully solved and need action. Additional workload for MPIFM is expected for conducting data quality checks, details of which are not solved yet. The BSSG stressed the importance of the BMDC and suggested test data requests to BMDC to be generated for inspection of its full operability.

Action #8: Daniela Jacob, together with **Hartmut Graßl and Hans-Jörg Isemer** to test the operativeness of the BMDC at MPIFM in Hamburg and hold close contact to Dr. Lautenschlager at BMDC for feedback on possible further requirements to BMDC.

The continuation of the data delivery from Eastern European countries to the BALTEX Data Centres was discussed already at previous BSSG meetings. It is still an open problem, again mentioned and discussed at this BSSG meeting. **Hartmut Graßl** offered and accepted **Action #9** to discuss with Michel Jarraud, the designated future Secretary General of WMO (as of 2004), possible support actions of WMO to convince Eastern European National Services to continue free-of-charge data delivery to BALTEX Data Centres. The option of a support letter of Dr Jarraud to these Services was in particular mentioned.

- BALTEX Hydrological Data Centre (BHDC)

Markku Rummukainen reviewed the status of and the present data contents of BHDC for Bengt Carlsson, head of BHDC, who was unable to attend. The BHDC delivered data to data users at Swedish, Finish and German institutes within the last 1.5 years. Receiving data from Russia is the most burning problem at present for BHDC; no Russian data have been received for the last four years.

During the discussion on BHDC’s status, conflicting evidence on the available data contents was presented. Data users reported that data gaps spanning over several recent years in some catchments exist, although agreements and even contracts exist which should guarantee a continuous data delivery from national Hydrological Services to BHDC. Examples of gaps in the archive seem to include data from Estonia, but also other countries. Hans-Jörg Isemer noted that GKSS had concluded funded contracts with most of the Eastern European National Hydrometeorological Services holding runoff data relevant for BALTEX with the objective of a continuous data delivery covering periods prior to 2003. **Action #10** was given to **Hans-Jörg Isemer and Bengt Carlsson** to establish a critical BHDC inventory and take necessary steps to fill data gaps in the BHDC archive, if necessary. As part of this action, Isemer will again check whether existing contracts between GKSS and national Services have been completely fulfilled.

For Polish data, Piotr Kowalczak suggested to approach the central IMGW office in Warsaw in the future for any data requests.

BSSG discussed the necessity of collecting and archiving ground water, soil moisture and snow cover data, and concluded that these data are important, requested by users, and well defined, and, hence, shall be archived.

- BALTEX Satellite Data Centre Function (BSDCF)
A BALTEX Satellite Data Centre Function had been designed at previous BSSG meetings and preliminary implementation steps had been reported. BSDCF was planned to be a distributed archive with contributions from several institutions. One contributing participant to BSDCF is the Institute for Space Sciences at the Free University of Berlin (FUB), and Rene Preusker (for Jürgen Fischer, who was unable to attend) reported about recent developments in this context at FUB. MODIS (Medium Resolution Imaging Spectroradiometer) data from four instruments will be available even beyond January 2004, Preusker reported. MERIS (Medium Resolution Imaging Spectrometer) data will be continued, as well as MSG (Meteosat Second Generation) data, which will be continued as long as EUMETSAT (European Organisation for the Exploitation of Meteorological Satellites) will deliver data, expected for the next two to three years. The data storage for MSG data is being paid from own resources at FUB. Data delivery of retrieved MSG data is expected to be started by January 2004. METEOSAT data can be delivered for a limited future period, whereas for the AVHRR (Advanced Very High Resolution Radiometer) data additional support and staff is needed to properly receive and archive these data. Satellite data mentioned are easily accessible on an http-server (http://www.fu-berlin.de/iss/research.html) with a self explanatory data format. However, data users are advised to contact the group in Berlin first, before downloading the data.

The BSSG appreciated the progress made. In order to further proceed towards establishing a visible data centre function for satellite data, it was suggested to build-up a specific website to bring together the links to FUB and other institutions offering satellite data in a manner equal or similar to FUB.

Daniela Jacob reported that GPS (Global Positioning System) based data are currently worked on in a network of Swedish and German institutes. Integrated water vapour data are available for yearly and half yearly data, with an accuracy of less than 1 cm per column for monthly mean data. The data cover almost all Europe with an area from Norway down to Spain and therefore also the entire Baltic basin. Nevertheless, the accuracy is going down for more southerly data because of higher temperatures. 68 stations contribute to this data set of which about 28 to 32 are situated within the Baltic area. Daniela Jacob offered to distribute a related report, which lists institutions and individuals to be contacted for information on these data.

- BALTEX Oceanographic Data Centre (ODCB)
Philip Axe reported that one new user was registered since the last BSSG meeting and more CTD data have been received. All data provided by Anders Omstedt are included now in the archive and metadata are available on the internet homepage of ODCB, see http://www.smhi.se/sgn0102/nodc/datahost/datahost.html#BALTEX. **Action #11** was given to **the BALTEX Secretariat** to establish a link from the BALTEX homepage to the ODCB webpage. Axe continued noting that the transfer of the ODCB contents at its former host (FIMR in Finland) to SMHI has been completed.

Jan Piechura reported that Polish data should be delivered by the maritime branch of IGMW. Currently, the establishment of oceanographic metadata including the Baltic Sea is ongoing in Poland as part of an EU project. Andreas Lehmann reported on data from IfM Kiel which he delivered to the ODCB data bank. Sea ice information will also be gathered by the ODCB in the future, but nobody within BALTEX is responsible for the collection of lake ice data at the moment. Another future aim is to connect long time data sets (> 50 years) from the Baltic Sea and its interior to the ODCB, as well as to include the BEART and SHARK data archives.

- BALTEX Radar Data Centre (BRDC)
Daniel Michelson, who is responsible for the BRDC, had to leave before this item of the agenda was discussed. A status report about the BRDC is attached as Appendix 7. It also includes notes about other radar related activities. Hartmut Graßl resumed that the workshop presentation showed that calibration and validation is ongoing and that the network has even been enlarged and extended to research radars. The major radar event will be the Gotland 2004 radar conference (ERAD 2004), it is largely organised by the BRDC and may include a special session about BALTEX. The 1st announcement for this conference should still be published this year (2003), the 2nd early 2004.

7.4 BALTEX Working Group on Radar (BWGR)

Jarmo Koistinen, chair of the the BALTEX Working Group on Radar (BWGR) was unable to attend. The group met for its 8th meeting on 26 and 27 June 2003 in the Netherlands. The minutes of this meeting were established during the preparation of the BSSG meeting minutes and are attached as Appendix 8.

Item 8: Date and Place of the Next Meetings

The BSSG accepted to have the 16th BSSG meeting in conjunction with the 4th Study Conference on BALTEX scheduled for 24 to 28 May 2004 in Gudhjem on Bornholm. It should be a half day meeting on Sunday afternoon, 23 May 2003. This meeting will cover only major issues and Hans-Jörg Isemer, in close co-operation with the BSSG co-chairs, was asked to prepare for this meeting in due time.

The next full annual meeting is envisaged to be held in Poland and Piotr Kowalczak preliminarily offered to host the 17th BSSG meeting at IMGW's facilities in Poznan during November 2004. Anders Omsted suggested that the workshop theme might focus on long climate data series 1800 to 2000.

Action #12: Hans-Jörg Isemer and Piotr Kowalczak to prepare for the 17th BSSG meeting in Poznan, Poland, during November 2004.

Item 9: Any Other Business

9.1 Funding and Function of the BALTEX Secretariat
Hans-Jörg Isemer noted that since 2002 the International BALTEX Secretariat is fully funded only by the GKSS Research Centre. He further recalled that with the retirement of Ehrhard Raschke in 2001 and the parallel re-organisation of environmental research at GKSS, the research profile of GKSS in BALTEX declined substantially. A co-ordination office for an international research programme, such as the International BALTEX Secretariat, however benefits substantially, if active research contributions originate from the host institution of the office, Isemer continued. He emphasized that the revised objectives for BALTEX Phase II may offer GKSS, in particular the group headed by Hans von Storch, again a stronger participation profile in BALTEX, which in turn will be instrumental to approve GKSS's further engagement in supporting the BALTEX Secretariat. Isemer finished by confirming both Hans von Storch's intention to contribute with his group to BALTEX Phase II and his preparedness to participate in steering activities for the programme.

The function of the BALTEX Secretariat was discussed, based on a statement by Hans-Jörg Isemer that the communication between BALTEX research groups on the one side and the Secretariat on the other side has lost momentum during recent months, compared to earlier periods in the 1990s. Isemer appealed to the BALTEX community members to continue to be responsive and, in particular, report on achievements of BALTEX research more frequently and on own initiative. BSSG members suggested that the Secretariat might be additionally active in informing on data centre functions for BALTEX, but also beyond at the European level, to increase the Secretariat's outreach. A possible means would be the installation of a related internet portal.

9.2 Hydrology in BALTEX

BSSG members noted that the number of contributions from hydrology research groups to BALTEX seems to have decreased in recent times. So does regrettably the number of active hydrologists in the BSSG and other BALTEX bodies, members noted. As examples, Sten Bergstrøm (resigned from GHP representation and with a somewhat lower profile in BSSG activities) and Phil Graham (resigned from WRAP) were mentioned. BSSG members added that in Phase 2 even additional contributions e.g. from the groundwater community is needed for research efforts on the sub-basin scale. This issue may need further discussion and action which were postponed to the next BSSG meeting.

Item 10: Closing of the BSSG Meeting

The chairman thanked Sven-Erik Gryning for all arrangements made at Risø for this meeting, especially the nice meeting rooms and the good preparation of the meeting.

Acronyms and Abbreviations

AFO 2000	The German Program on Atmospheric Research
AVHRR	Advanced Very High Resolution Radiometer
BALTEX	Baltic Sea Experiment
BALTRAD	BALTEX ground-based weather radar network
BHDC	BALTEX Hydrological Data Centre
BMBF	Bundesministerium für Forschung und Technologie, Bonn, Germany
BMDC	BALTEX Meteorological Data Centre
BRDC	BALTEX Radar Data Centre
BRIDGE	The Main BALTEX Experiment, 1999-2002
BWGR	BALTEX Working Group on Radar
BSDCF	BALTEX Satellite Data Centre Function
BSSG	BALTEX Science Steering Group
CEOP	Coordinated Enhanced Observing Period
CLIWANET	EU FP5 project: "Cloud Liquid Water Network"
CSE	Continental Scale Experiment
DEKLIM	German Climate Research Programme
DIVERSITAS	An International Program of Biodiversity Science
DMI	Danish Meteorological Institute
DTU	Technical University of Denmark
DWD	Deutscher Wetterdienst, Offenbach / Germany
ECMWF	European Centre for Medium Range Weather Forecast, Reading / UK
ENVISAT	ESA Earth Observation Satellite
ERA 40	ECMWF 40 Years Re-Analysis
ERAD	Third European Conference on Radar in Meteorology and Hydrology
ESF	European Science Foundation
EU	European Union
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
EurAT	EU FP6 proposal: "Towards an Integrated European ATmospheric Observatory for Climate and Weather Studies"
EuroCLIMATE	A EUROCORES Program for basic science addressing Climate Variability and the Carbon Cycle
EUROCORES	A Scientific Program of the ESF for basic research complementary to the Framework Programme
FIMR	Finnish Institute of Marine Research
FMI	Finnish Meteorological Institute
FP4/5/6	Fourth/Fifth/Sixth Framework Programme of the EU
FUB	Freie Universität Berlin, Germany
GEWEX	Global Energy and Water Cycle Experiment
GHP	GEWEX Hydrometeorological Panel
GKSS	GKSS Research Centre, Geesthacht / Germany
GPCP	Global Precipitation Climatology Project
GPS	Global Positioning System
GWSP	Global Water System Project
IGBP	International Geosphere Biosphere Programme
IMGW	Institute for Meteorology and Water Management, Poland
KNMI	Royal Netherlands Meteorological Institute, De Bilt / The Netherlands
MERIS	Medium Resolution Imaging Spectrometer onboard TERRA
MPIfM	Max-Planck Institute for Meteorology, Hamburg, Germany
MODIS	Medium Resolution Imaging Spectroradiometer

MOLTS	Model Output Location Time Series (data type of CEOP)
MOVE	EU FP6 proposal: "Modelling of Observed and Future Variability of European Water Cycles"
MSG	METEOSAT Second Generation
MUSCAD	Multi-proxy Studies of Climate Anno Domini
NRT	Near-Real-Time
ODCB	Oceanographic Data Centre BALTEX
PIDCAP	Pilot Study for Intensive Data Collection and Analysis of Precipitation
PROMED	EU FP6 proposal
PRUDENCE	EU FP5 project: "Prediction of regional scenarios and uncertainties for defining European climate change risks and effects"
SMHI	Swedish Meteorological and Hydrological Institute, Norrköping/Sweden
SSG	Science Steering Group
SST	Sea Surface Temperature
WCRP	World Climate Research Program
WDCC	World Data Centre for Climate
WEBS	Water Energy Budget Studies
WMO	World Meteorological Organisation
WRAP	Water Resources Application Project
4DWolken	German BMBF/AFO2000 project: „4D Clouds of the Lower Atmosphere“

Appendix 1: Workshop Agenda

Results of the BALTEX/BRIDGE Period 1999-2002

A workshop prior to the 15th BALTEX SSG Meeting
Risø National Laboratory, Roskilde, Denmark

Monday, 8 September 2003

The workshop venue at Risø National Laboratory is the Niels Bohr Auditorium, building 112.

Chair: Sven-Erik Gryning, Risø National Laboratory, Roskilde, Denmark

14.00 ***Introduction***
Hartmut Graßl, Max-Planck-Institute for Meteorology, Hamburg, Germany

14.10 ***Long-term trends in near-surface flow over the Baltic***
Rebecca Barthelmie and Sara Pryor, Risø National Laboratory, Roskilde, Denmark

14.35 ***MIKE SHE / ARPS - A fully coupled modelling system***
Dan Rosbjerg, Technical University of Denmark, Kongens Lyngby, Denmark

15.00 ***CLIWA-NET: BALTEX/BRIDGE cloud liquid water network***
Susanne Crewell, Meteorological Institute, University of Bonn, Germany

15.25 ***BALTRAD activities during BRIDGE and beyond***
Daniel Michelson, Swedish Meteorological and Hydrological Institute, Norrköping, Sweden

15.50 *Break*

16.15 ***Remote sensing of atmospheric properties for BRIDGE***
Jürgen Fischer, René Preusker, Peter Albert, Max Reuter, Andy Walther, Institute of Space Science, Free University Berlin, Germany; Ralf Bennartz, University of Wisconsin, Madison, USA

16.40 ***Rain spectra and radar calibration with a ground-based micro rain radar***
Gerhard Peters, Meteorological Institute, University of Hamburg, Germany

17.05 ***The BALTEX/Bridge water and heat balances calculated from Baltic Sea modelling and available meteorological, hydrological and ocean data***
Anders Omstedt and Christian Nohr, Göteborg University, Sweden

17.30 ***The eight BALTIMOS Field Experiments 1998 - 2001 over the Baltic Sea***
Burghard Brümmer, Amélie Kirchgäßner, Gerd Müller, David Schröder, Meteorological Institute, University of Hamburg, Germany; Jouko Launiainen and Timo Vihma, Finnish Institute of Marine Research, Helsinki, Finland

17.55 ***The 2002/2003 salt water inflow to the Baltic Sea***
Jan Piechura, Institute of Oceanology, Polish Academy of Sciences, Sopot, Poland

18.20 Concluding discussion and closing of the workshop

Appendix 2: Workshop Presentation Abstracts

Long-term trends in near-surface flow over the Baltic

R.J. Barthelmie (1), S.C. Pryor (2);
(1) Department of Wind Energy and Atmospheric Physics, Risoe National Laboratory, Dk4000 Roskilde, Denmark
(2) Atmospheric Science Program, Geography, Indiana University, Bloomington, IN47405, USA

Introduction

Offshore wind resources are typically characterised by relating short-term on-site measurements with longer term records from nearby land sites. However, few truly climatological records of near surface wind speeds exist and observational data sets of surface wind speeds are subject to large inhomogeneities, are short-term relative to modes of climate variability and are strongly influenced by local land surface characteristics. Wind farms have typical lifetimes on the order of 30 years, so questions arise regarding the average expected annual energy production. Alternatively stated, over the lifetime of the wind farm what is the average expected energy production ('what is a normal wind year?') and how will non-stationarities in the global climate system be manifest as evolution of a 'normal wind year' on timescales relevant to wind energy developments. The research presented herein, is an attempt to address these considerations in the geographic context of the Baltic Sea. Here we use wind speeds at 850 mb as an indicator of regional, lower atmosphere flow.

Analysis of 850 mb flow during the twentieth century

The NCEP/NCAR reanalysis project was designed to provide homogenized records of atmospheric fields to support climate research. The project drew data from a range of sources, which were then quality controlled and assimilated with a consistent data simulation system for the entire record. Herein we use twice daily (00 ZULU and 12 ZULU) 850 mb wind speeds calculated from the data set wind components (u and v) for each 2.5° x 2.5° grid shown in Figure 1 for 1953-1999.

Application of multiple linear regression to NCEP/NCAR reanalysis fields of 850 mb wind speeds over the Baltic region indicates annual mean wind speeds significantly increased over the period 1953-1999 (annual mean wind speed = c1*year +cons). The trends in annual and seasonal mean wind speeds are greatest in relative and absolute sense in the southwest of the Baltic basin where they are in excess of 0.25 m s-1/decade for the annual mean (Figure 2). The majority of this increase is associated with increases in the upper quartile of the wind speed distribution (see Figure 3). Accordingly much of the change is focused on the winter season. The extremes of the wind speed distribution have also increased by up to 5 m s-1 for the 50 year wind, again with the largest magnitude changes in the southwestern Baltic. These changes in wind speed are strongly linked to changes in the synoptic scale circulation. Over half of the trend in winter mean wind speed over the entire domain is explicable by increases in the frequency of westerly anticyclonic, westerly cyclonic and north-westerly cyclonic circulation types as manifest in the Grosswetterlagen catalogue. These circulations changes are in turn related to the recent prevalence of positive phase North Atlantic Oscillation (NAO) during the latter portion of the twentieth century.

Implications

Analyses presented herein suggest long-term changes in climate at the synoptic scale (and larger) directly and profoundly impacted the near-surface wind resource in the Baltic region during the latter portion of the twentieth century. If the current prevalence of positive phase NAO is sustained under an increasingly greenhouse warmed climate it will have a profound impact on the viability of offshore wind energy developments. At the very least, the results presented here re-emphasize that the resource predicted depends on the length and period of data used from the predictor site, and that care should be taken in developing climatologically representative wind climates for use in resource prediction.

Acknowledgements

Financial support for this research was given in part by the European Commission's Fifth Framework Programme under the Energy, Environment and Sustainable Development Programme. Project Reference: ERK6-1999- 00001 ENDOW (Efficient Development of Offshore Windfarms).

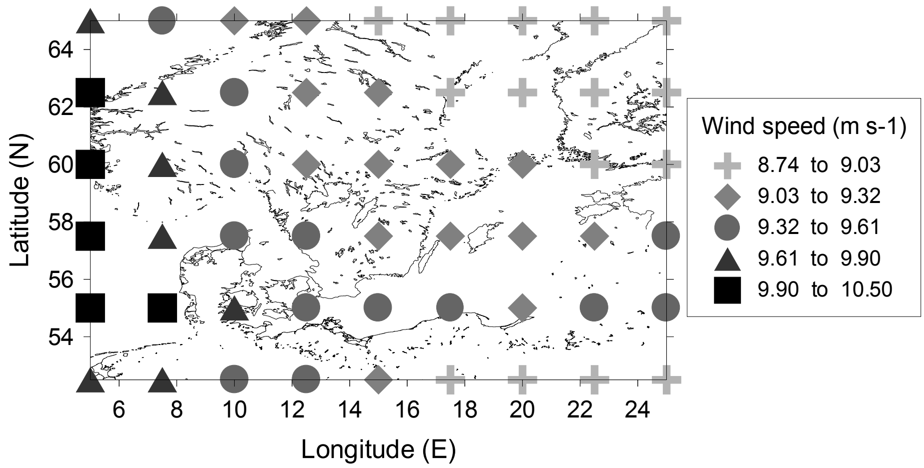


Figure 1. Map depicting the study domain, coastline and annual mean wind speeds at 850 mb over the period 1953-1999. It should be noted that the domain is depicted as rectangular. This introduces distortion due to the high latitudes under study.

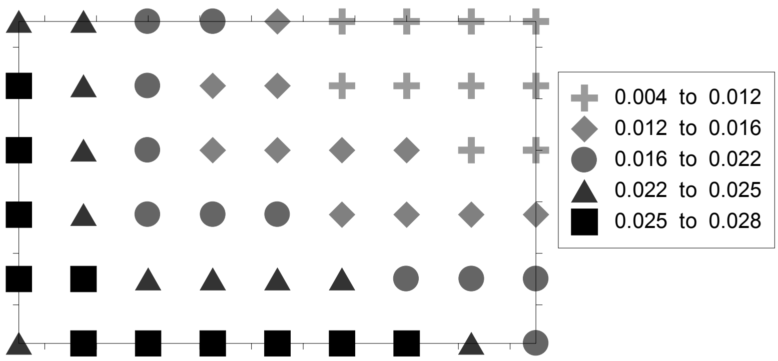


Figure 2. Trends in annual mean 850 mb wind speeds computed for each grid cell for the period 1953-1999 expressed as the regression coefficient, c1. Note: this analysis relies upon repeated application of ordinary linear regression and coefficients are examined for significance at the 95 % confidence level. Hence, based purely on random chance five out every one hundred analyses will result in a coefficient that is statistically significantly different to 0. Hence we place greatest emphasis on the spatial coherence rather than the absolute magnitude of the regression coefficients.

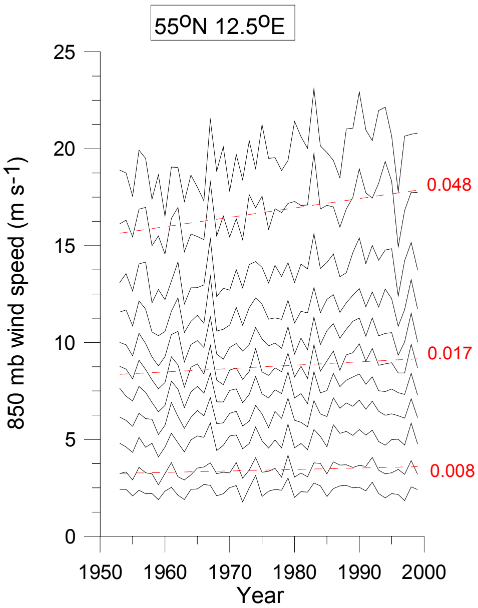


Figure 3. Percentiles (5th, 10th, 20th, 30th, 40th, 50th, 60th, 70th, 80th, 90th and 95th) of the twice daily 850 mb level wind speed from the at one sample NCEP/NCAR grid cell located over the western Baltic. The dashed lines and numbers indicate the linear trends for the 10th, 50th and 90th percentiles.

MIKE SHE/ARPS – A Fully Coupled Atmospheric and Hydrological Modeling System

D.Rosbjerg,
Technical University of Denmark, Kongens Lyngby, Denmark

Recognizing the need for coupled hydrological and atmospheric models for impact assessment of climate- and land use changes, the Advanced Regional Prediction System (ARPS) has been coupled to the integrated, hydrological model MIKE SHE through a shared SVAT. MIKE SHE simulates all major processes in the land phase of the hydrological cycle, and for most processes there are several options of varying complexity. The ability to change complexity of the process parameterizations is the makes MIKE SHE applicable at spatial scales ranging from single soil profiles to regional watershed studies. The coupled model provides a unique framework for investigation of the interaction and feedback mechanisms between the land-surface and atmosphere.

The new modeling system was presented, as well as the results from a validation study of the modeling system in both coupled and uncoupled mode.

CLIWA-NET: BALTEX/BRIDGE cloud liquid water network

Susanne Crewell, Meteorological Institute, University of Bonn, Germany
Erik van Meijgaard, KNMI, De Bilt, The Netherlands
and the CLIWA-NET Team

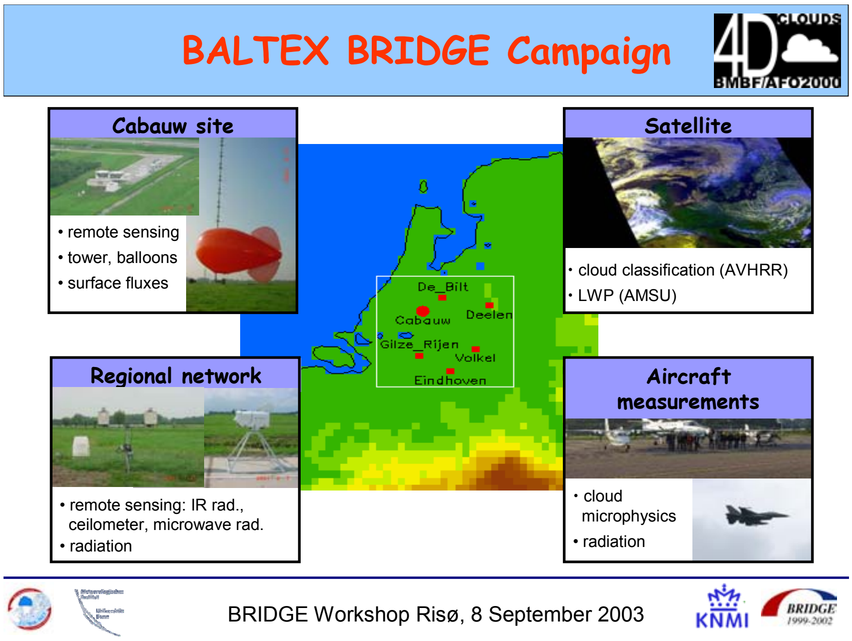
CLIWA-NET (www.knmi.nl/samenw/cliwa-net) was the major European activity within BRIDGE concerning cloud observations and modeling studies. Within CLIWA-NET a prototype European cloud observing system was established during three campaigns by co-ordinating the use of existing, ground-based passive microwave radiometers and active profiling instruments. In parallel satellite observations of clouds from the Advanced Very High Resolution Radiometer (AVHRR) series and the Advanced Microwave Sounding Unit (AMSU) were analyzed. The first two campaigns (CNNI and II) were conducted on the continental scale covering the Baltic catchment while the BALTEX BRIDGE Campaign (BBC) focused on the regional scale. Four European NWP/climate models (ECMWF, RCA, RACMO and HIRLAM) were involved in the activities and it was the aim of CLIWA-NET to perform an objective evaluation of their short-term cloud forecasts and to improve the parameterization of cloud processes in these models. Focus was on vertically integrated cloud liquid water and the vertical structure of clouds. Furthermore, for a future operational network a low-cost microwave radiometer was designed. An overview of the measurement program can be found in Crewell et al. (2002).

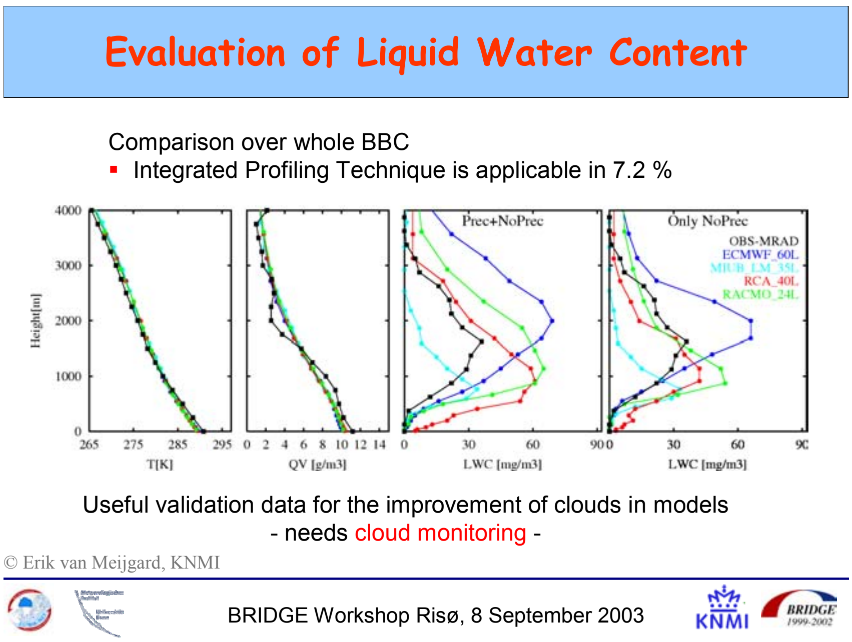
Here, we present one example how the CLIWA-NET data can be used for model evaluation. For that purpose ground-based observations from the BBC central measurement facility Cabauw was used to evaluate the model predicted vertical structure of cloud liquid water. The synergy of microwave radiometer, cloud radar and lidar ceilometer measurements allows the simultaneous retrieval of temperature, humidity and cloud liquid water profiles using the integrated profiling technique (IPT) (Löhnert and Crewell, 2002). Owing to the required presence of three instruments and given the fact that, like in the evaluation of LWP, a meaningful retrieval is only possible in non-precipitating conditions including the absence of drizzle, the relative number of retrievals turned out to be rather limited. In the present analysis retrievals are available for 7 % of the BBC campaign, always confined to the daylight period in correspondence to the operational hours of the GKSS clouds radar.
The model predictions are confined to the time slots for which profile information was successfully retrieved from the measurements. Furthermore, to indicate the effect of precipitation the figure on the cloud liquid water profile is duplicated with respect to the occurrence of precipitation at the surface in either of the model predictions. The result is consistent with an earlier finding in the evaluation of liquid water path, i.e. ECMWF and RACMO have similar amounts of LWP, RCA somewhat smaller, and LM much smaller. A significant difference can be seen in the position of the maximum liquid water content. RCA and RACMO predict this height to occur at about 1000 m, whereas the ECMWF model puts the position of maximum LWC at almost 2000 m, which is somewhat closer to the observed height of about 1600 m. LM, on the other hand is below 1000 m. If we restrict to non-precipitative events the main characteristics remain, but the details change. LWP reduces, the position of maximum LWC tends to come down somewhat, and the amount of LWC above the maximum reduces. Interestingly, for temperature and humidity all four models are mutually very comparable, but fail to reproduce the observed vertical structure in humidity related to the position of the boundary-layer height.

Both, observational analysis and model evaluation performed within CLIWA-NET have enormously benefited from the close collaboration between the modeling and measurement community. In conclusion, we can say that a large measurement program has been executed quite cost effectively within CLIWA-NET. Quicklooks of all data are available from the project web site. The data set is used for many applications including the validation of coupled models, satellite validation (CLOUDMAP) and retrieval development. We invite everybody to use this wealth of observations for these and other research efforts.

Crewell, S, M. Drusch, E. Van Meijgaard and A. Van Lammeren, 2002:
Cloud Observations and Modelling within the European BALTEX Cloud Liquid Water Network, Boreal Environment Research, 7, 235-245.

Löhnert U., and S. Crewell, 2002:
Profiling cloud liquid by combination of multi-channel ground-based passive microwave and cloud radar measurements, Workshop on COST Action 720: "Integrated Ground-Based Remote Sensing Stations for Atmospheric Profiling", L'Aquila, Italy, June 18-21, 2002, Symposium Proceedings

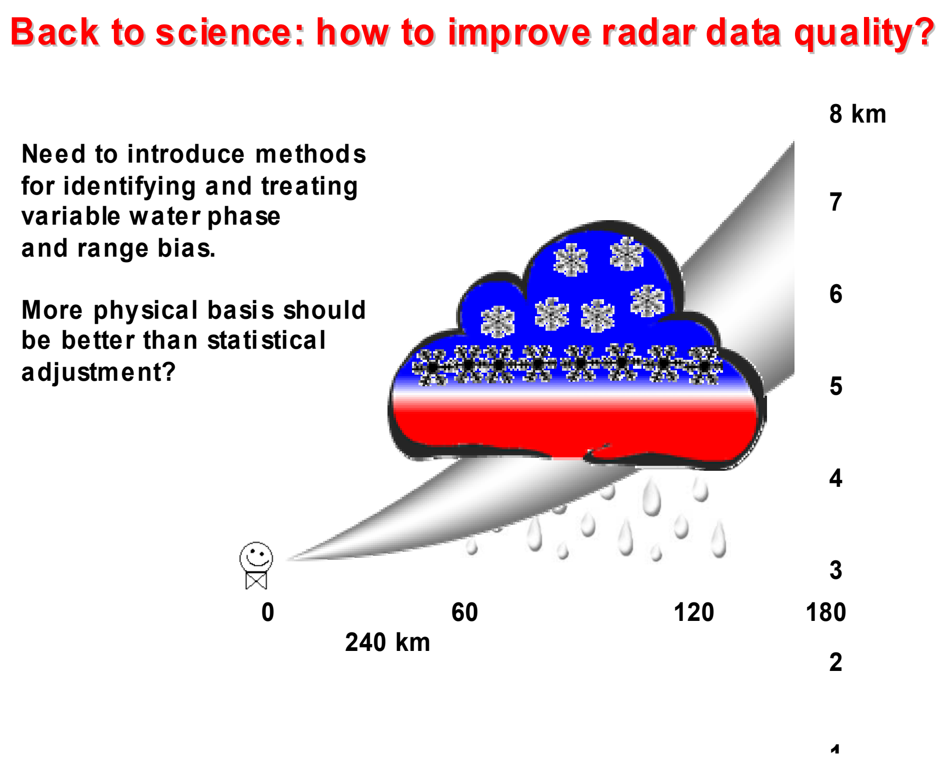




BALTRAD Activities during BRIDGE and Beyond

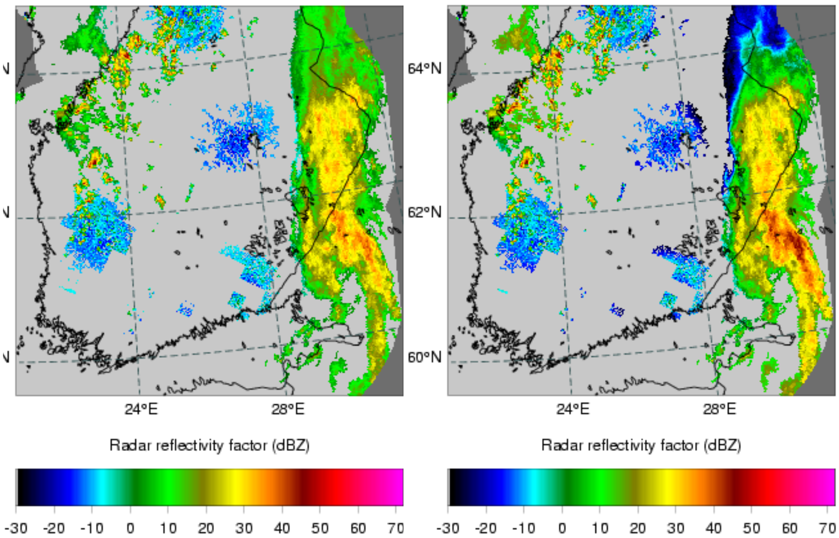
Daniel Michelson
SMHI
Norrköping, Sweden

The status of the BALTEX Working Group on Radar (WGR), the BALTRAD network, the Radar Data Centre (BRDC), and the BRDC products and datasets are presented and discussed in this presentation. The quality control algorithms are highlighted. One such algorithm combines analyzed 2 m temperatures and Meteosat IR data to identify and remove non-precipitation echoes in BALTRAD composite imagery. Improved accuracy using the BALTRAD gauge adjustment technique is also demonstrated within the context of NWP by comparing with HIRLAM forecasted precipitation from setups in Finland and Sweden. A new dealiasing technique for use with ambiguous radar radial winds is also touched upon within the context of variational assimilation in HIRLAM, as are the first serious attempts at integrating radar-based precipitation estimates in the HBV hydrological model at SMHI. New research efforts on implementing vertical reflectivity profile correction techniques, intended to further improve radar-based precipitation estimates, are presented along with their evaluations. Finally, the expected direction which the WGR and BRDC will take is outlined. Examples of enhanced collaboration surrounding commonly prioritized topics are provided, and (E)GPM is given as an example where the application of BALTRAD datasets can be valuable.
A few selected slides from the presentation are following:



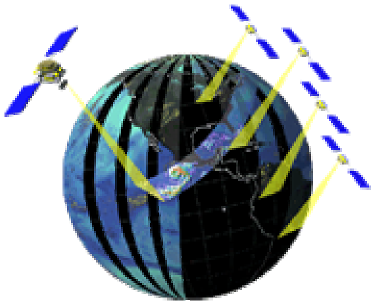
"Down-to-Earth" physical VPR correction

Uncorrected composite — Corrected composite



Global Precipitation Mission (GPM)

Spacebourne weather radar based on TRMM



Passive radiometers similar to AQUA

Data from polar orbiting sensors need ground validation.
For high latitudes and cold climates: **BALTRAD**
combined with <u>well-instrumented supersites!</u>

ERAD 2004

WHEN
September 6-10, 2004

WHERE
Visby, Sweden
Island of Gotland

TOGETHER WITH
COST 717 Final Seminar

Initiative of
BALTEX WGR

Calls made by
EMS
with assistance from AMS

Local organizer
SMHI

Remote Sensing of atmospheric properties for BRIDGE

Jürgen Fischer, Rene Preusker, Peter Albert, Andi Walther, Max Reuter
Freie Universität Berlin, Institut für Weltraumwissenschaften

Ralf Bennartz
University of Madison

The Institut für Weltraumwissenschaften at the Freie Universität Berlin (FUB) is working within two DEKLIM projects which contribute to BALTEX: i) "Cloud observations from Satellites" and ii) "Precipitation statistics in the Baltic region". The aim of both projects is the validation of the coupled regional climate model BALTIMOS. Special attention has been turned to the BRIDGE phase between April 1999 and March 2001 to obtain, together with all other BALTEX contributions, a complete dataset of atmospheric and hydrologic properties. Within the first project cloud properties (fraction, height, thickness, droplet concentration, albedo) and columnar water vapour are retrieved from satellite measurements, namely from MODIS (Moderate Resolution Imaging Spectroradiometer) onboard the TERRA and the AQUA platform, MERIS (Medium Resolution Imaging Spectrometer) onboard ENVISAT, Meteosat and finally MSG (Meteosat Second Generation). MODIS, MERIS and MSG have bands in the near and thermal infrared which are perfectly suited to the remote sensing of cloud properties and water vapour. The remote sensing algorithms are validated (MODIS and MERIS) or are in the process of validation (MSG), and their specific error characteristics are known. Figure 1 exemplarily shows the mean water vapour column for the year 2002 measured by MODIS and simulated by BALTIMOS. The used satellite instruments have mutual supplementary spatial and temporal resolutions making their combination highly valuable for the Baltic region. MERIS and MODIS have a very high spatial resolution (0.25km-1km) but a low temporal coverage of 1-6 over-paths per day (depending on the latitude). In contrary, the geo-stationary MSG has coarse spatial resolution in the northern latitudes (4km-20km) but a high temporal resolution of 15 minutes. However, MERIS and MSG were launched after and MODIS was launched at the end of the bridge period, thus apart from Meteosat none of the foreseen instruments fills the bridge period. The availability of remote sensed data is summarized in the following table. A double "+" indicates a very good availability of the data. MERIS has always a single "+" only, since the ESA has some problems with and restrictions for the dissemination of ENVISAT data, MODIS has a single "+" for the bridge phase where only the end could be covered. A "0" indicates data, which is in principle available but not yet processed, a "--" indicates data that is not available.
The second project is about the discrimination between and registration of frontal and convective precipitation in the Baltic region using radar data. The algorithm is working reliable and allows due to the high temporal resolution of 15 minutes the creation of high level precipitation and rain rate statistics like the combined diurnal and annual cycle of frontal and non-frontal precipitation events and rain rates. Figure 2 exemplarily shows the average non-frontal rain rate for the year 2000 as a function of the local time and the season. Additionally process studies can be made to investigate for example the speed of cloud systems related frontal precipitation. The data situation in this project is very good, the Bridge phase is completely covered.

Product	CTP			CER		COT			CDNC		WV		CM				CTT
Sensor	MODIS	MERIS	SEVIRI	MODIS	SEVIRI	MODIS	MERIS	SEVIRI	MODIS	SEVIRI	MODIS	MERIS	MODIS	MERIS	SEVIRI	METEOS	MODIS
Data	++	+	0	++	0	++	+	0	++	0	++	+	++	+	0	++	++
Data during Bridge	0	-	-	0	-	+	-	-	0	-	+	-	+	-	-	++	0

Table 1: Data availability for the different sensors and products.

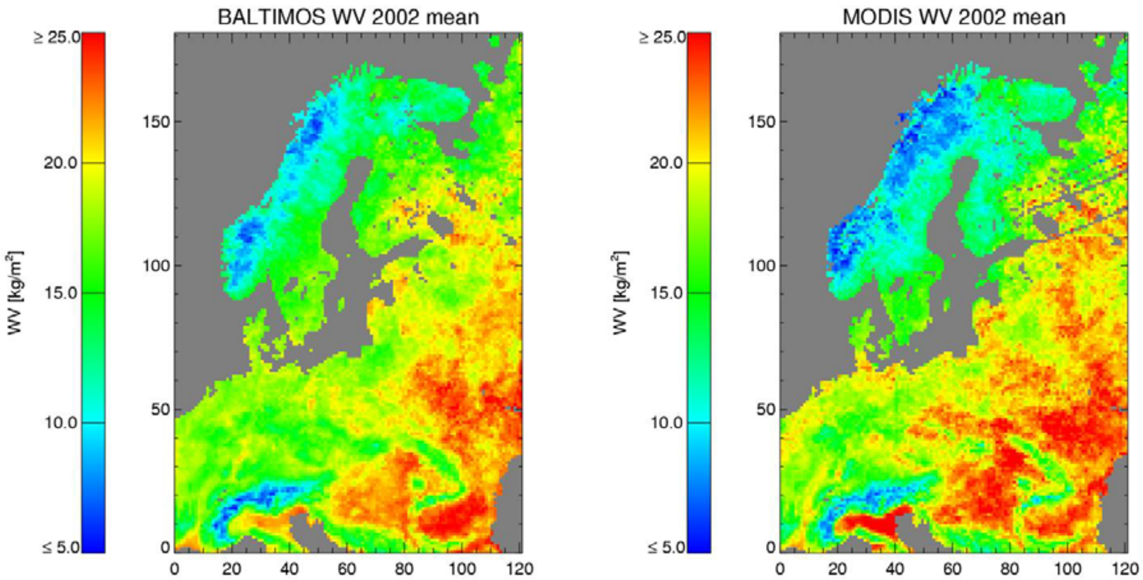


Figure 1: Mean water vapour column for year 2002 measured by MODIS (right) and simulated by BALTIMOS (left).

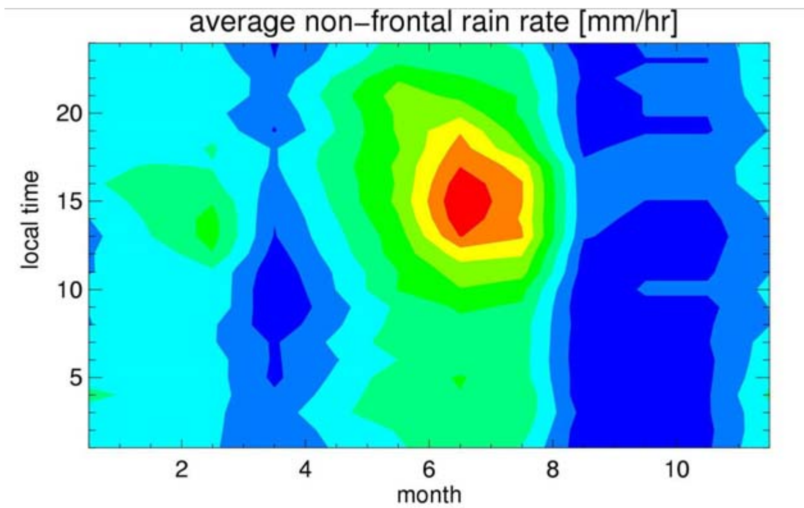


Figure 2: Average non-frontal rain rate in mm/hr for year 2000 as a function of local time and season.

Rain Spectra and Radar Calibration with a ground based micro rain radar

Gerhard Peters, Meteorological Institute, University Hamburg

Abstract
Data of a vertically pointing K-band Doppler micro rain radar were analyzed for a period of 3 years. From the Doppler spectra profiles of rain rate *R* and radar reflectivity *Z* are derived, which would be seen by conventional (X-C-S-band) weather radars. A significant height dependence of the shape of the DSDs - and thus of the *Z* - *R* relations - is observed, particularly at high rain rates. From this observation follows that rain rates derived by a height independent *Z* - *R*-relation, which is adjusted (as usual) to surface conditions, are significantly underestimated at high rain rates - even in lower weather radar measuring heights.

The Micro Rain Radar "MRR-2"
The MRR-2 is a low power (50 mW) FMCW Doppler radar with 24 GHz transmit frequency. It is operated at vertical incidence, which provides the possibility to convert the Doppler spectra of rain echoes into drop size distributions (DSDs) using the relation between terminal fall velocity of rain drops and drop diameter. The radar is located on the peninsula Zingst at the German Baltic coast (54.43°N, 12.67°E). It is operated continuously with a range resolution of 1 min and a height resolution of 100 meters up to 3000 m. In order to stay free from the ice phase the data analysis was restricted to the warmer season (May to September) and to the lower 1500 m. Further details of the system and of the retrieval procedure are described in Peters et al., 2002.

Aim of the observations
The MRR-2 is operated in about 50 km distance from the Rostock weather radar, which belongs to the German DWD Radar network. Both, the MRR2 and the weather radar have common observation volumes located in a vertical column above the MRR-2 site. As first comparisons of radar reflectivity show a high correlation (Peters et al., 2002), we expect to reveal potential synergies between profiling measurements with MRR-2 and weather radar measurements for improvement of quantitative rain retrievals. The extra information provided by the MRR-2 is the actual drop size distribution and its variability with height, which should be useful to mitigate various ambiguities inherent in the retrieval of surface rain rates from radar reflectivity data obtained aloft.

Profiles of spectral moments
In a recent analysis MRR-2-data, obtained in 2000, 2001 and 2002, were stratified according to the mean rain rate, where "mean" refers to the spatial average observed within the analyzed height range (100-1500 m). Each class of rain rates comprises one decade with the limits 0.02, 0.2, 2, 20 and 200 mm/h. Within each class the mean profiles of various spectral moments were calculated. The number of observations falling into each class is given in table 1.

Year	2000	2001	2002
Rain Rate mm/h			
0.02-0.2	6478	7068	4383
0.2-2	7841	9262	5246
2-20	2422	3742	2354
20-200	96	249	213

Table 1: Number of observations in each rain rate class in each year

The upper row in figure 1 shows the radar reflectivity *Z* which would be observed at typical weather radar wave lengths. As the MRR-2 wave length is so short, that the Rayleigh approximation does not hold for larger drops, Z was calculated here from the drop size distribution according

$$Z = \Sigma_i N(D_i) D_i^6 \Delta D(D_i) \quad (1)$$

with D_i = drop diameter of drops corresponding to the i^{th} line of the Doppler spectrum, $N(D_i)$ = number density of drops with diameter D_i, and $\Delta D(D_i)$ = width of i^{th} diameter bin (not a constant but a function of D_i due to the non-linear relation between drop size and terminal fall velocity).

Generally Z decreases slightly with increasing height. The reasons for this common behaviour are probably different in the different rain rate classes. The lowest rain rate class represents drizzle, which typically originates in shallow clouds. Thus the decrease of Z is caused in this case by the upper cloud boundary, which was often observed to be below 1500 m. In the highest rain rate class the upper cloud boundary is certainly always far above 1500m m. Here we found evidence that the variability of Z with height is mainly due to a transformation of the drop size distribution on the fall path. One indicator for this process is the mean fall velocity shown in the second row of figure 1. "v_1.moment" is the first moment of the Doppler spectrum. At high rain rates v_1.moment decreases drastically with increasing height at high rain rates. We explain these small values aloft by the predominance of smaller (slower) drops close to the melting level. On their fall path they disappear probably mainly due to coalescence. The fact that such transformation processes are only evident at high rain rates is in qualitative agreement with the theoretical argument, that the probability of drop-drop-interaction increases with increasing number density (e.g. Hu and Srivastava, 1994). This transformation of drop size distribution implies of course a corresponding height dependence of the Z - R relation, employed for rain rate retrievals from radar reflectivity. The third row of figure 1 shows the ratio of rain rates obtained using the drop-size analysis of the MRR-2 divided by the corresponding rain rate, which follows from a fixed $Z - R$ relation and which is adjusted for surface conditions. (Here $Z = 350 \cdot R^{1.42}$ was used). One recognizes that the use of a fixed $Z - R$ relation leads particularly at high rain rates to a height dependent deviation between both estimates. According to these findings high rain rates would be significantly underestimated by employing $Z - R$ relations (established at the surface) for rain retrievals at typical radar measuring heights aloft.

References:

Hu, Z., and R.C. Srivastava, 1994: Evolution of rain drop size distribution by coalescence, breakup, and evaporation, theory and observations, J. Atmos. Sci., 52, 1761-1783.

Peters, G., B. Fischer, T. Andersson, 2002: Rain observations with a vertically looking Micro Rain Radar, Boreal Env. Res. 7, 353-362.

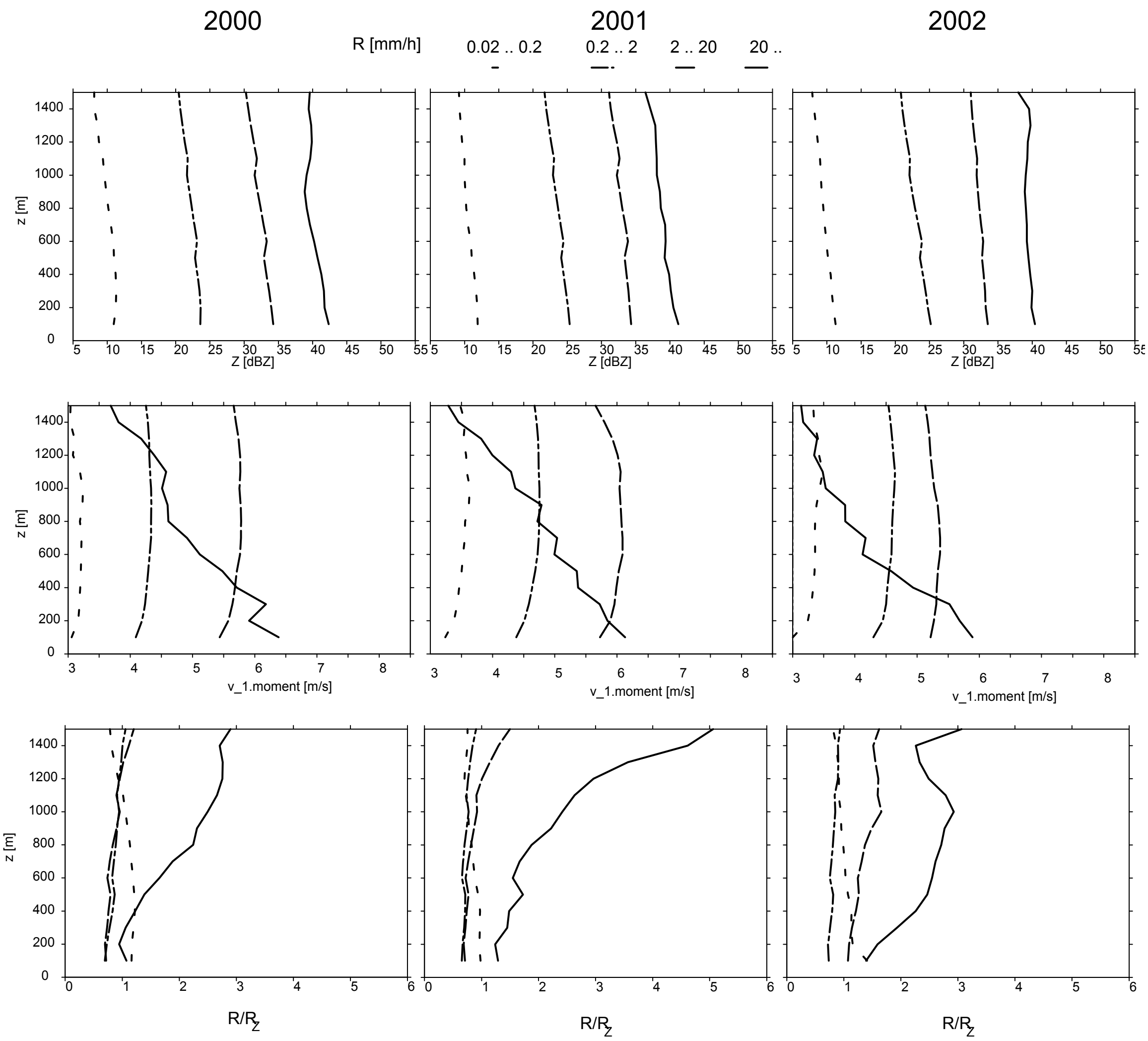


Figure 1: Mean profiles of various rain parameters, stratified in 4 rain rate classes for 3 consecutive years. 1st row: Radar reflectivity, 2nd row: Mean fall velocity, 3rd row: Rain rate divided by rain rate as derived from *Z-R* relation.

The BALTEX/Bridge water budget and heat balances calculated from Baltic Sea modelling and available meteorological, hydrological and ocean data

Omstedt, Anders (1) and Nohr, Christian (2)
Workshop at the 15th BALTEX SSG Meeting, Risö National Laboratory, Denmark

The Main BALTEX Experiment (BRIDGE) is the central element in the BALTEX program and is concentrated to the period October 1999 to March 2002. Through enhanced observations and improved modelling the main aim was to increase our understanding of the water and energy cycles in the Baltic Sea drainage basin. In the presentation we analyse the BRIDGE three year period and put it in perspective to a longer time period. The work extend earlier studies using Baltic Sea modelling (Ref 1,2 and 3) as our tool for integrating and analysing a large amount of atmosphere, river runoff and ocean data. Major questions raised in the study are:
What are the values for the individual- terms in the BALTEX/Bridge water and heat balances and do they stand out from present climate conditions? How accurate can the water and heat balances of the Baltic Sea be estimated? And, can detection of climate change signals be done easier in the water and heat balances compared to parameters such as e.g. temperature, cloudiness and precipitation?

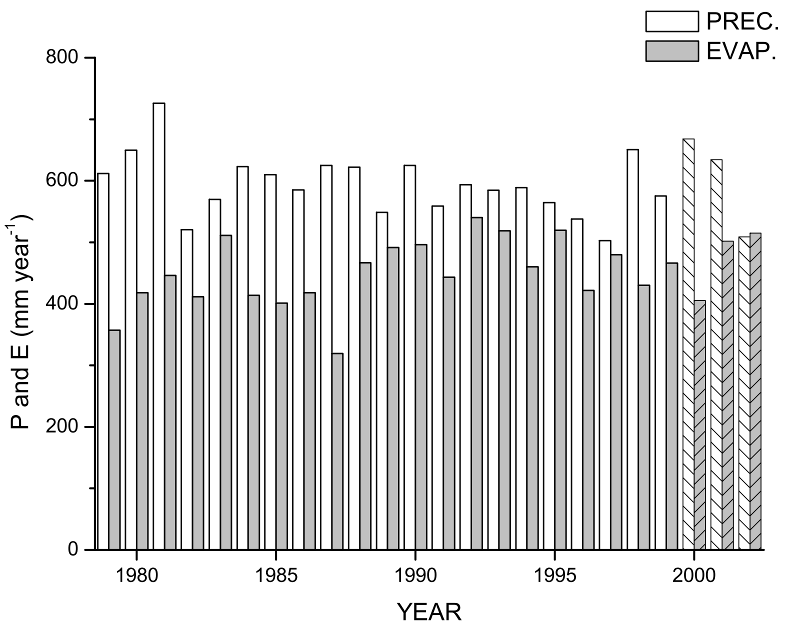


Fig. 1. Annuals means of precipitation and evaporation for the Baltic Sea (excluding the Kattegat and the Danish Sounds) from 1979 – 2002. The BALTEX/Bridge period is market out.

Some results:

Present Baltic Sea modelling and data available from the BALTEX data centres indicate that the net water balance and the net heat flux can be estimated with good accuracy. The accuracy of the individual terms is still unknown.

The study indicates that the surface heat balance in the HIRLAM-BALTEX system needs improvements, particularly the treatment of clouds which strongly influence the calculated short and long wave radiation.

Negative net precipitation rates on annual time scales were estimated for the year 2002, this stand out from last 30 years period, Figure 1. The inter-annual variation of the net heat loss at the atmosphere-water interface seems to have increased?

Water and heat balances studies add important information to the detection of climate change signals and should be used together with trend analysis of observed parameters.

(Ref.1): Omstedt, A. and L., Axell (2003). Modeling the variations of salinity and temperature in the large Gulfs of the Baltic Sea. Continental Shelf Research, 23, 265-294
(Ref. 2) Omstedt, A. and A., Rutgersson (2000). Closing the water and heat cycles of the Baltic Sea. Meteorol. Z., 9, 57-64.
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The eight BALTIMOS Field Experiments 1998-2001 over the Baltic Sea

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Coupled regional models of the Baltic Sea and its catchment area have recently been developed or are in the stage of development. They have to be validated against observations. In order to test the models' accuracy over the Baltic Sea itself, there are only very few data. The Baltic Sea is a data-sparse region. To improve this situation, a comprehensive atmospheric boundary layer (ABL) data set including the surface conditions was collected in eight field experiments (two during each season) over open water and sea ice in the Baltic Sea (Fig. 1) during 1998-2001 with the primary objective to validate the coupled ice-ocean-land surface model BALTIMOS (BALTEX Integrated Model System). Measurements were taken by aircraft, ships and surface stations and cover the mean and turbulent structure of the ABL including turbulent fluxes, radiation fluxes, cloud conditions and precipitation (Table 1). In total, measurements were taken on 76 days (46 days over open water, 30 days over sea ice). On 16 days the 3-dimensional ABL structure over sea ice was monitored by aircraft measurements in boxes of typically 100 km times 50 km x 3 km and in total 460 radiosondes were launched. The measurements represent the typical range of synoptic conditions for present day climate. Details of the BALTIMOS field experiments are given in Brümmer et al. (2002) and Brümmer et al. (2003).

References:

Brümmer, B., A., Kirchgäßner, G. Müller, D. Schröder, J. Launiainen and T. Vihma, 2002: The BALTIMOS field experiments: A comprehensive atmospheric boundary layer data set for model validation over the open and ice-covered Baltic Sea. Boreal Environ. Res. 7, 371-378.

Brümmer, B., G. Müller, D. Schröder, A. Kirchgäßner, J. Launiainen and T. Vihma, 2003: The eight BALTIMOS field experiments 1998-2001 over the Baltic Sea: Field reports and examples of measurements. Internat. BALTEX Secretariat, Publ. No. 24, 138 pp.

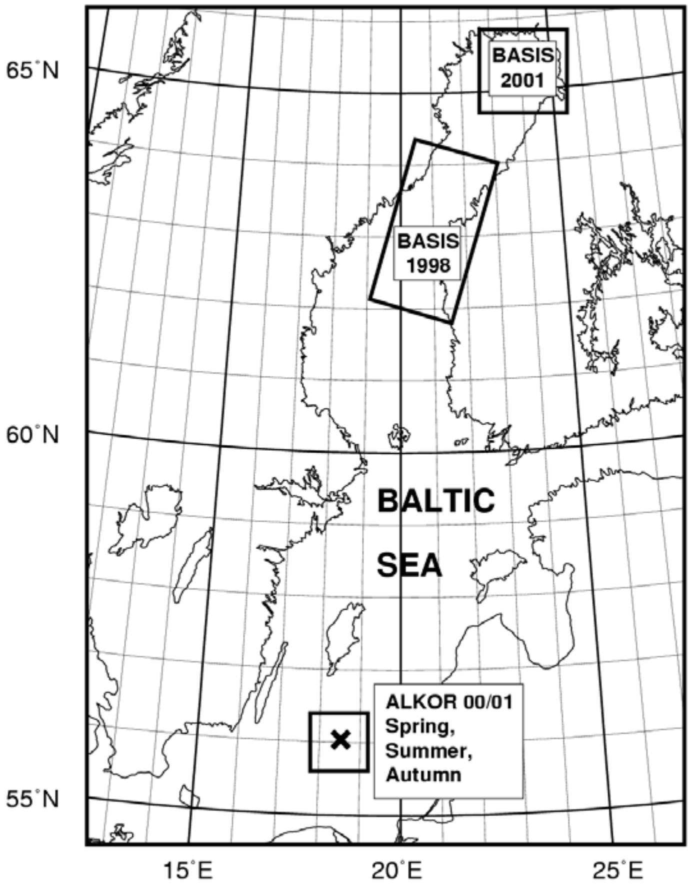


Fig. 1: Locations of the eight BALTIMOS field campaigns: two BASIS winter experiments in 1998 and 2001 and six Alkor cruises in spring, summer and autumn 2000 and 2001.

Table 1: The eight BALTIMOS field experiments: names, times, involved platforms and measurements (overview):

BASIS 1998: 17 February – 06 March

- Ship in land-fast sea ice (Aranda): 6-hourly radiosounding (0-15 km). Continuous surface measurements including turbulent and radiation fluxes. Sea ice measurements.
- Radiosonde and surface stations at ice-covered shore (Kokkola, Umeå, Merikarvia): Measurements as at Aranda except sea ice measurements.
- Aircraft (Falcon-20 operating from air base Kokkola): 6 flight missions in mesoscale box (appr. 100 km x 50 km x 3 km) over sea ice and open water with vertical profiles and horizontal flight legs including turbulent and radiation fluxes.

BASIS 2001: 12 – 23 February

- Ship in land-fast sea ice (Aranda): Measurements as in BASIS 1998.
- Sfc station on land-fast ice (Marjaniemi): Continuous surface measurements including turbulent and radiation fluxes, clouds (base, coverage), and precipitation.
- Automatic Argos surface station at ice-covered shore (Kuivaniemi, Haparanda): Hourly meteorological surface measurements.
- Aircraft (Dornier-128 operating from air base Oulu): 10 flight missions in mesoscale box (appr. 60 km x 60 km x 3 km) over sea ice and open water. Measurements as Falcon-20 (see above).

Six Alkor cruises: Year 2000: 05 – 11 April, 14 – 20 June, 25 – 31 October. Year 2001: 01 – 11 April, 12 – 20 June, 20 October – 07 November

- Ship in Baltic Sea Proper (Alkor): 3-6 hourly radiosoundings (0-15 km). Continuous meteorological surface measurements including radiation fluxes, clouds (base, coverage), and precipitation.

Salt Water Inflow winter 2002/2003

by Jan Piechura and Agnieszka Beszczyńska-Möller

Abstract

Medium size inflow (about 200 km^3 according to IOW data, - personal communication) of saline water occurred during January 2003. Not like any previously observed inflow this one brought very cold water - about 1-2^{o}C or even below. Since the temperature of deep water in the Southern Baltic Sea was exceptionally high (11-12^{o}C) before the inflow, inflowing waters created dramatic changes and high gradients of temperature. The movement of inflowing waters through the deep basins and channels of the Baltic Sea from the Arkona Basin to the Gdańsk Deep during the next 4-8 month is described. Frequent mesoscale structures and intensive mixing accompanied the inflow water transport to the east, particularly in the Bornholm Deep and Słupsk Furrow.
Paper is based on data collected by R.V. Oceania's 6 cruises in the period from December 2002 to April 2003. The last cruise in August was made to check out the long term consequences of the inflow.

1. Introduction
Water exchange through the Danish Straits is a process crucial for the Baltic Sea hydrography, environment and ecosystem. Special role is prescribed to a rapid, inflow bringing hundreds of cubic kilometers of salty, well oxygenated waters into the Baltic Sea in a time scale of days. Temperature of inflowing waters depends on time of the year of inflow but usually it is few degrees higher than the temperature of deep waters inside the Southern Baltic Sea. Occurrence of inflows depends mainly on atmospheric circulation and requires proper sequence of wind forcing and sea level changes. It is an irregular phenomenon, but over 90% of such events were observed during late autumn - winter time, every 4-5 years on average, until 1980 times. Since that time large inflow are much less frequent (1983, 1993, 2003), about 10 years apart.
The last inflow and its consequences inside the Baltic Sea for the first time were very well investigated, 15 cruises of research vessels from Sweden, Germany, Poland, Russia & Finland were performed during the time from December 2002 until August 2003. This gives us good opportunity to learn more about phenomena itself and its consequences inside the Baltic Sea. So far we can talk about changes of physical/chemical environment; changes in biology take time and will be seen later.

2. Data
Data of 7 cruises made by R.V. Oceania in the area of Gdańsk Deep - Słupsk Furrow - Bornholm Deep - Bornholm Gate - Arkona Basin were used in this paper. The dates of cruises were as follows: 3-4 December, 21-26 January; 4-6 February, 17-18 February, 16-16 March, 26-27 April and 16-17 August 2003.
Temperature and salinity were measured by towed CTD (Sea Bird SB49); Depending on bottom depth CTD cast were made 100-300m apart and as close as 1-2 m above the bottom. Currents were recorded continuously by ship mounted ADCP (RDI 150 kHz). Standard oceanographic processing technics were applied. The location of the transects are shown in Fig.1.

3. History of the inflow

The inflow, over the Drogden Sill look place from Jan. 11 to Jan. 18 (SMHI data) and over the Darss Sill from Jan. 16 to Jan. 25 (IOW data). Before we start to describe the inflow and its consequences inside the Baltic Sea lets have a look at the situation before it happened. Fortunately we have data collected by R.V. Oceania at the beginning of December 2002.

December 3-4, 2002

Striking feature of December's conditions in the deep regions of the Southern Baltic Sea is extremely high water temperature (fig.2): about 7°C in upper layer and up to 11-12°C in deep layer. Probably this was the record high value ever recorded. Detailed description and explanation of this phenomenon was given in previous paper by Rainer Feistel et al. At the same time distribution of salinity was rather normal: about 7.5 psu in the mixed upper layer, halocline at the depth below 40-60m and increase to 17 psu near bottom of the Bornholm Deep and 13.5 psu of the Słupsk Furrow.

January 21-26, 2003

In January (23.01.03) inflow waters were noticed already in Arkona Basin, Bornholm Gate and the northern part of Bornholm Deep. In Arkona Basin (fig.3) temperature dropped to below 2°C (in thin layer at about 30m depth even below 1.5°C) and salinity increased to over 20 psu near bottom. In deepest part of the Basin – narrow trench at northern part – value over 22.5 psu was measured.

The shapes of the isopycnics suggest a cyclonic eddy below 20m depth of the Arkona Basin, with the dimension of the Basin.

In the Bornholm Gate (fig. 3 perpendicular transect) inflowing water is seen in near bottom layer of deep channels at the southern slope. The upper layers of the inflow climb the southern slope, pushing the bottom layer to rise on northern slope. The lowest temperature, below 2°C, with the minimum below 1°C was observed at 30-40m depth. The highest salinity – over 23 psu was recorded at the bottom of the northern slope.

In the Bornholm Deep (fig.4) in its central and western part the usually met layering of temperature is completely destroyed. Instead we observe chaotic distribution of patches of old-warm (>10°C) and new-cold (<2°C) water.

This could indicate that inflow water came here recently, most probably the process is in development, and there was no time for mixing, we observe very high temperature gradients, especially in the horizontal plane. Inflow water did not come here directly from the Bornholm Gate but it flows along the western slope and into central part of Bornholm Deep in the cyclonic eddie. Confirmation of this assumption can be found in ADCP data (fig. 5) at depth of 50m and 60m.

Salinity/density distributions indicate many mesoscale eddies, both cyclonic and anticyclonic types. Like that with the centers at about 80 km line. There we have cyclonic circulation in the upper part of deep layer and anticyclonic below. Such combination has been observed few times before e.g. in the Gotland Deep (DIAMIX data) and in the Słupsk Channel. In another place (at 56 km line) we can see the apposite configuration: anticyclonic rotation on top of cyclonic one. Their dimentions varied between 20 and 40 km in horizontal plane and 20-30m in vertical. The inflow water lifted halocline in the Bornholm Deep by 10-20m pushing the old-warm and mixed water upward and on the eastern slope.

In Słupsk Channel there is no signals of the inflow water yet; temperature of the deep layer is still very high >10°C.

But the deep layer it self is now by about 20 m of depth sinner, the negative thermocline and the halocline is now at the depth of about 60 m while in December they were at about 40m depth. Also salinity of deep layer decrease by about 1 psu. Such changes could not be caused by vertical mixing; advection has to be considered as a main player.

February 4-7, 2003
In the Arkona Basin cooling from the surface and low temperature of inflow make the whole layer thermally homogeneous with the temperature about 2°C. Salinity in bottom layer decreased by 2-4 psu during last 10-12 days (fig. 6). In the Bornholm Gate cold (≈2°C) and fresh (≈10 psu) water is found, so we can assume that there is no salt water flow at this particular moment. But on the slope to the Bornholm Deep we can sea cold and saline water cascading down the slope, pushing the remaining warmer water away. Distribution of temperature, salinity and density can suggest that water is moving in portions and the bottom topography influence the movement.
Very intensive mixing is going on in the Bornholm Deep (fig. 7). The body of old warm water was fragmented into small patches concentrated in two layers: 60-70m with temperature 6-7°C and 45-55m with temperature 4-5°C. More details can be seen at the next picture (fig. 8). Cold water below 4°C occupied bottom layer below 70m depth and sin layer separating mentioned warmer layers.
The idea could come to mind that this two cold-inflow water layers could come from different sources; upper, less saline from the Oresund and lower, more saline from the Belts or another way around?
The deep layer was farther extended upwards but only by 5-10m.
The large body of the old-warm saline water is still climbing the eastern slope of the Bornholm Deep; at the top of Słupsk Sill we have now the water with 7-8°C and 16 psu.
On the other side of the sill we can see brake in the salty water flow some time before and start of flow of a new partion of such water.
In the Słupsk Furrow effects of the inflow are already seen, but mainly by the inflow of the old waters from the intermediate layers of the Bornholm Deep. As a consequence the warm waters in the Furrow are pushed to the east, and upwards (deep layer was extended upwards by about 10m) and salinity increased by about 1 psu.
Partions of warm waters are cascading down hill to the Gdańsk Deep.

February 16-18, 2003
No dramatic changes were observed in the Arkona Basin and the Bornholm Gate (fig. 9). A bit warmer water appeared on the slope of the Bornholm Gate and salinity in the deepest trench increased again up to over 20 psu. In the Bornholm Deep (fig. 10) mixing is going on all the time, lenses of wormer and cold water became more numerous and smaller.
General decrease of temperature is observed, now patches of warm water have temperature 5-6°C only.
The larges body of warm water remains at the eastern slope, but it is now smaller its fragmentation already standard.
Salinity of deep layer father slightly increased and the layer itself extended father upwards to the shallowest depth of 26-28m only in the center of the Bornholm Deep.
Salinity/density distributions suggest one huge cyclonic eddy there, about 80-90 km in diameter.
Movement of old –mixed and inflow waters to the east continues along the Słupsk Channel, but seems to be a bit slower. The highest temperature (over 6°C) was measured at the eastern end of the Channel. Remains of the old waters from intermediate layers of the Bornholm Deep continue to move along the eastern slope of the Słupsk Sill into Słupsk Furrow. The upper boundary of the deep layer here remains at the depth of 50-60m, its temperature decrase to 5-6°C and salinity increase maximum to over 14 psu near bottom.

March 15-17, 2003
In the Arkona Basin-Bornholm Gate are a (fig. 11) temperature of near bottom layer slightly increase (2-3°C) and salinity decrease to 15-16 psu. We can say that there is no more any sig-

nals of January inflow in this area and the situation become “normal” (whatever this means). Body of warmer and saline water can be seen on the slope towards the Bornholm Deep.
In the Bornholm Deep the mixing is goin on all the time and now the whole deep layer contains mixed water; the largest influence of the old water are seen in the upper part of this layer, where lenses of warmer water (up to 5°C) are seen at depth about 60m and thin layer with temperature over 4°C at depth 40-50m. Salinity of deep layer slightly decreases here and the signals of cyclonic circulation in the lower part are seen.
The upper boundary of the deep layer was lowered down to average depth of about 40-45m what can be taken as the end of inflow’s influence here.
The deep layer shrank in the Słupsk Furrow as well, its upper boundary was located at 50-60m depth now, and except the eastern part over the sill here this boundary was pushed upward again (to 45-50m). Deep layer in Słupsk Furrow became more saline (maximum over 14 psu in larger volume near bottom) and cooler (4-5.5°C). Mixed water from intermediate layers of the Bornholm Deep continues to overflow the Słupsk Sill.

<u>April 22-24, 2003</u>
There is no sign of the inflow in Arkona Basin and Bornholm Gate any more. Temperature of sin deep layer started to rise (3-4°C) and salinity increase to 14 psu at the bottom (fig. 12). In the deep layer of the Bornholm Basin temperature finally become nearly homogeneous: a-bout 3°C. Vertical gradients of salinity and density remain high all the tame, what suggest that the temperature uniformity was reached by thermal conductivity mainly.
A body of little warmer water (over 4°C) was notices at the depth 50-60m above the Słupsk Sill and in Słupsk Furrow, where deep layer was further cooled to 3-4°C. Salinity of a deep layer decrease slightly in the Bornholm Deep but increased considerably in the Słupsk Channel – to over 15 psu. Since March cruise the deep layer slightly extended upwards here. Distribution of salinity in the Słupsk Furrow suggests that in the mean time quite large body of salty water splashed from intermediate layers of Bornholm Deep over Słupsk Sill into the Channel.

<u>August 16-17, 2003</u>
Signs of January inflow seen in the bottom layer of the Bornholm Basin, Słupsk Furrow and Gdańsk Deep as a low temperature 4-5°C layer (fig. 13). Additionally in Słupsk Channel and Gdańsk Deep salinity remains high as well (>14.5 psu). Another intrusion of warmer water 10-12°C seen in Arkona Basin near bottom and in Bornholm Gate and Basin at intermediate depth of 30 - 60m in from of separated lenses of different dimensions. Their salinity varies around 10-12 psu. Above this layer remain patches of cold water (5-6°C).

Discussion
Midium size inflow started to cross sills at the western limits of the Baltic Sea in second decode of January and brought more saline and very cold waters. Very low temperature of the inflow waters (close to 1°C) is a very exceptional feature; previously observed inflows were bringing waters distinctly warmer then local waters in the Baltic Sea. This coincide with another exceptional feature: very high temperature of deep waters inside the Baltic Sea (11-12°C) what Created big difference of at least temperature between inflow and ambient waters. This gave us unique opportunity to follow the inflow water movement inside the Baltic Sea and to learn more about the mixing. There is also another exceptional feature of this particular, inflowing waters moved very fast in the first stage of a process: they covered distance of about 140 Miles from the sills of Droden and Darss to the middle of the Bornholm Basin in less then 12 days, what makes their speed about 30 cm/s at least.
First disturbance of the smooth flow was noticed already in the Arkona Basin, cyclonic eddy with the diameter of the Basin and down stream in flow on the southern edge with maximum

speed of 45 cm/sand downstream, measured transport of 129 x 103 m^3/s (fig. 14). In the Bornholm Gate inflowing waters were pressed to and climbed on the southern slope (fig. 15).
But the most interesting processes were going on in the Bornholm Deep itself. Due to complicated circulation transport of more or less pure inflow waters ends here, intensive mixing with the ambient waters, causes transformation of it and farther to the east into the Słupsk Channel only this mixed water enters.
Longitudal section across the northern edge of the Bornholm Basin in January 2003 (fig. 16) shows near-bottom gravity-driven current of inflow water with maximum salinity of 21 psu, extremely low temperature (down to 1.5°C) and measured velocity up to 75 cm/s enters the Bornholm Basin along the southern rim, suggesting the cyclonical circulation.

Another cyclonical structure in the northern part of basin with radius ca 10 km and maximum rotational speed to 20 cm/s is probably related to local circulation in old stagnating deep waters.

Net volume transport across the whole section is ca 81·103 m^3/s directed eastward while volume transport of waters (S>8.5psu) within dense plume reaches 107.3 ·103 m^3/s.

Section across the central part of the Bornholm Basin measured twicely in January 2003 (fig.17) shows strong anticyclonic lens-like eddy with diameter 35 km and rotational speed up to 50 cm/s is filled up with cold waters of inflow origin (minimum T 1.8°C);
ca 5 km^3 of cold water (T<4 °C) contained within eddy core, total eddy volume ca 9 km^3 (assuming the eddy symmetry);
Development of baroclinic eddy in result of meandering of dense bottom current flowing along the southern slope of the Bornholm Basin;
Strong interleaving at the edges of the eddy;
Presence of lens-like eddy can slow progress of the most saline waters in near-bottom layer in downstream direction;
Cold water comprised within the core of lens-like eddy in January 2003, mixing with ambient waters at the edges of the eddy;
Cooling in deep layer of Słupsk Channel is going on 4 months after inflow remains of warm water (T>7°C) are visible in the Gdansk Deep only.

The overflow above Słupsk Sill contains mostly mixed water which comes from the intermediate layer of the Bornholm Deep; but due to additional forcing usually overflowing waters come from much deeper than the depth of the sill layers- nearly permanently seen process of climbing of deep waters on the sill slope and deep inflow - mixed waters from below the sill level were forced over it. Some amount of "inflow" waters was coming to the Słupsk Channel already in Feb. & March, but the larges volume came here in March - April period only. Evolution of waters above the Słupsk Sill is shown at fig.18.
Section across the central part of the Słupsk Channel in April 2003 (fig. 19) show inflow waters with salinity over 15 psu carried on by near-bottom density driven current;
Westward flow dominating in the whole water column, only in deep layer core of eastward current is visible.
Similar structure of calculated baroclinic flow field and ADCP measured current suggest that the flow in the Słupsk Channel is mainly baroclinic with weak barotropic component directed to the West.

Section across the eastern part of the Słupsk Channel in April 2003 (fig. 20) show indicate downstream transport of inflow waters (with max S ca. 14.5 psu) shifted towards the northern slope of channel and confined only to the deep layer;

Westward flow is prevailing in the channel resulting in significant upstream transport. Transformation of deep waters in the Bornholm Basin and Słupsk Furrow is shown at fig. 21 & 22. Dramatic changes of TS relation are seen in the Bornholm Deep.
December: very high temperature, prevailing portion of Water is in the range of 8-13°C of temperature and 8-15 psu of salinity, Body of bottom water is distinguish by 9-11°C and 14-18.0 psu.
January: Chaos very broad range of temperature and salinity within the deep layer is observed 2-11°C and 9-21 psu respectively. Generally, strong cooling and increase salinity is observed.
February, March, April: Further coolong is in progress, range of measured of temperature become more narrow (2-10°C beginning of Feb. and 2-8°C in mid Feb. 2-7°C in March and 3-5°C in April) range, of salinity remains nearly the same.
Cumulative TS for Słupsk Furrow show similar but less dramatic changes caused by the inflow: cooling is much slower as well as a growth of salinity.

Conclusions
In January 2003 we have witnessed **exceptionally** interesting feature: the medium size inflow bringing about 200 km3 of highly saline and **exceptionally** cold water into the deep layer of **exceptionally** warm waters.
Inflow waters moved **exceptionally** fast into the Arkona Basin and through the Bornholm Gate into the Bornholm Basin: estimated speed would be about 30 cm/s.
Flow of inflow waters was disturbed by frequent baroclinic eddies, particularly numerous in the Bornholm Deep.
Bornholm Basin was the main are of mixing of cold inflow waters with the local warm waters
To the east of Bornholm Basin no "pure" inflow waters were seen, mixed waters only.
Inflow pushed ambient waters upwards by 20-30m, thus the volume of the inflow grew considerably by entrainment and mixing.
As a consequence of the inflow more saline and colder, mixed waters from the intermediate layers of the Bornholm Deep were flowing to the Słupsk Furrow over the Słupsk Sill
Intensive heat exchange through the thermal conductivity was observed in spite of strong density stratification.

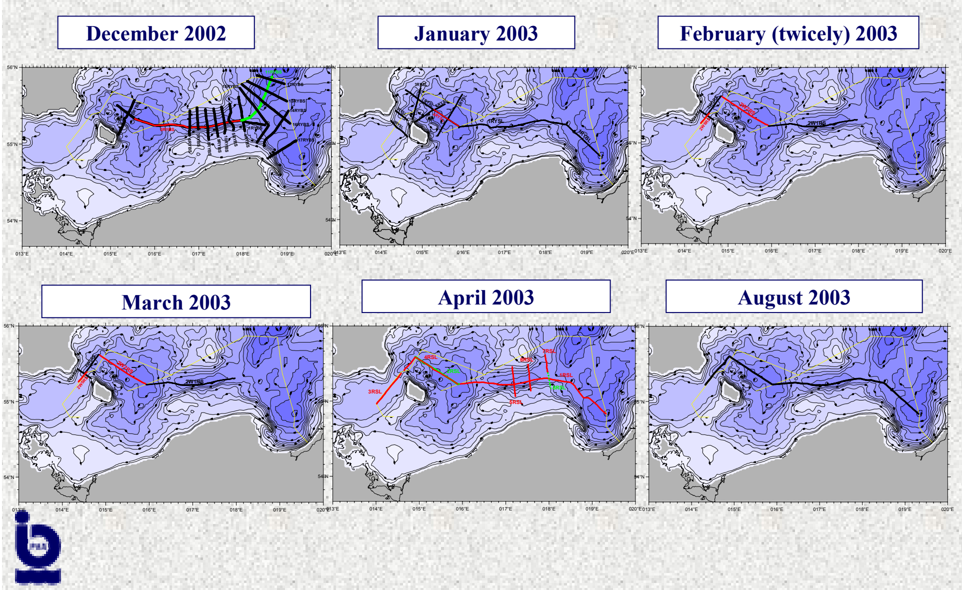


Fig. 1. Maps of investigations during the main inflow in winter, spring and summer 2003.

Fig. 2. Temperature (°C), salinity (psu). December 3-4, 2002.

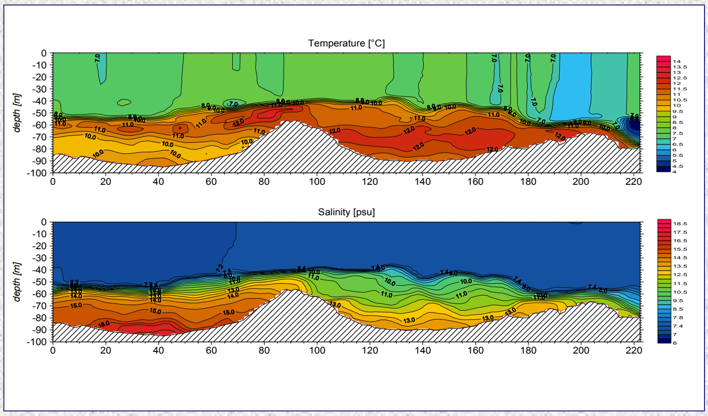


Fig. 3. Temperature (°C), salinity (psu) and currents. January 25-26, 2003. Arcona Basin and Bornholm Gate.

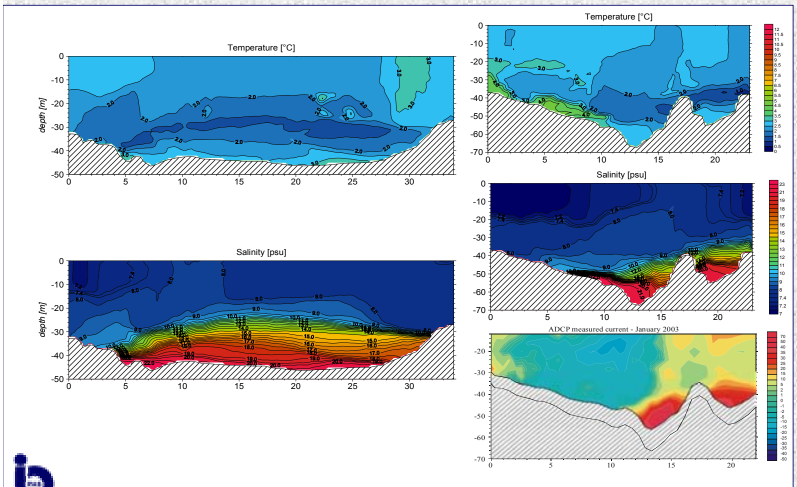


Fig. 4. Temperature (°C), salinity (psu) along the Main Transect. January 25-26, 2003.

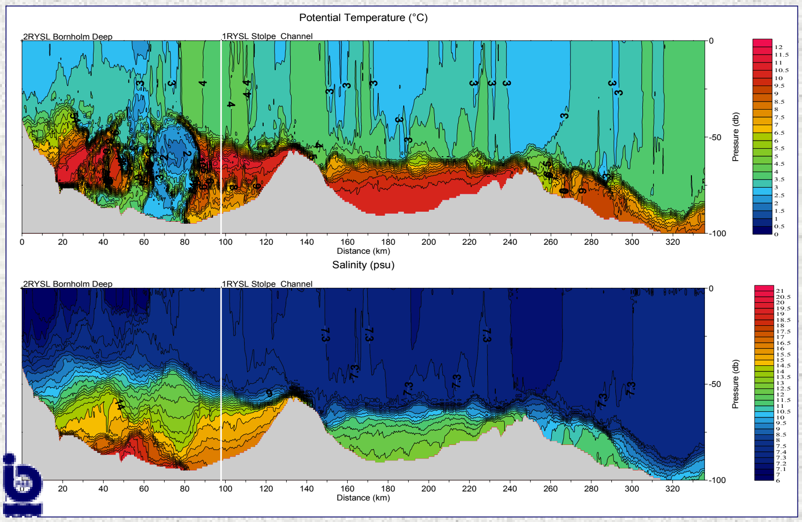


Fig. 5. Currents, 50 and 60 m level. ADCP data, (VM BB 150 kHz). January 2003.

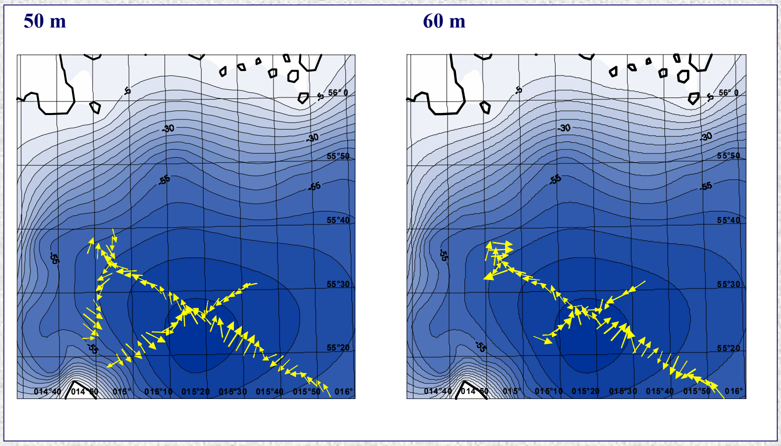


Fig. 6. Temperature (°C), salinity (psu) in the Bornholm Gate. February 07, 2003.

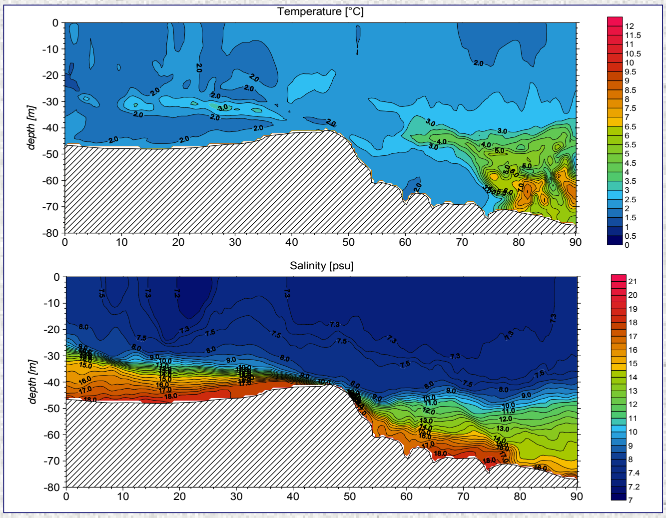


Fig. 7. Temperature (°C), salinity (psu) along the Main Transect. February 04-07, 2003.

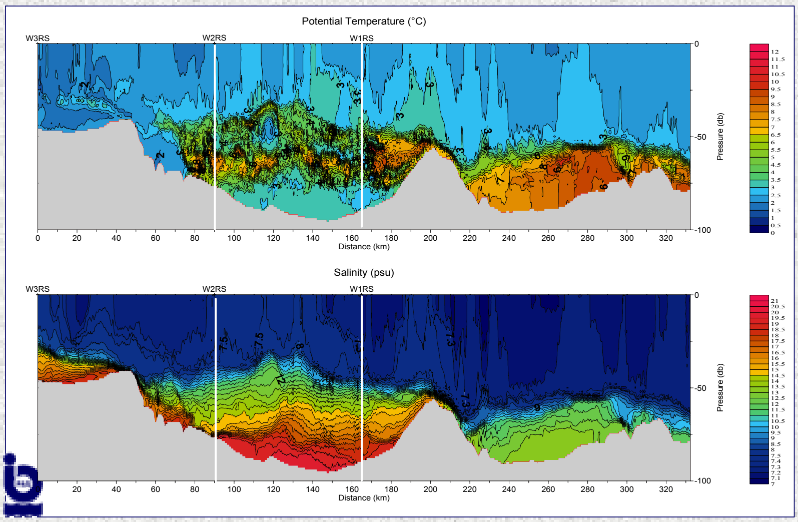


Fig. 8. Temperature (°C), salinity (psu) in the Bornholm Deep. February 06-07, 2003.

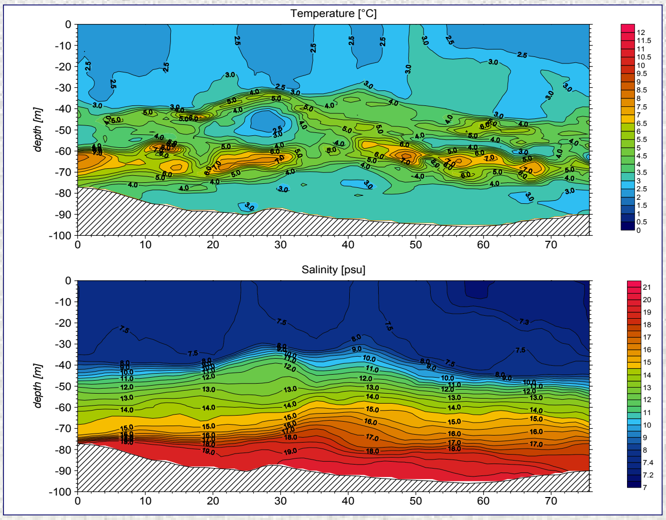


Fig. 9. Temperature (°C), salinity (psu) across the Bornholm Gate. February 16-18, 2003.

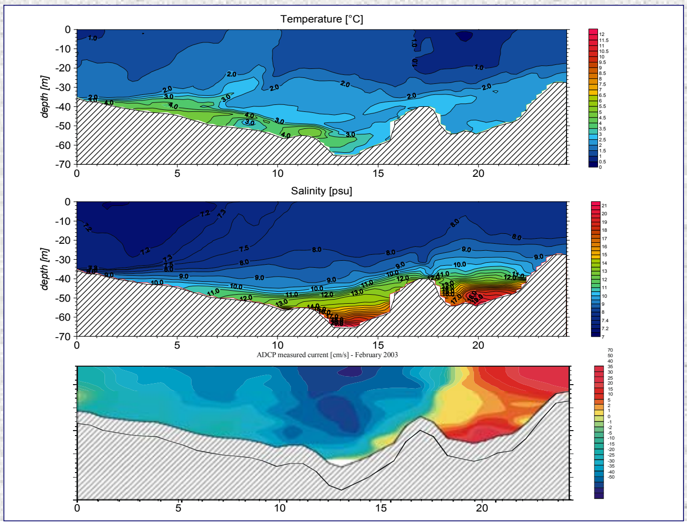


Fig. 10. Temperature (°C), salinity (psu) along the Main Transect. February 16-18, 2003.

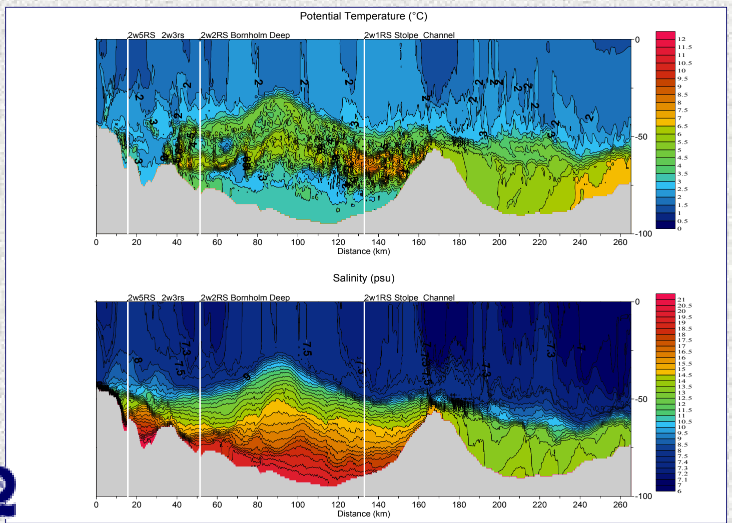


Fig. 11. Temperature (°C), salinity (psu) along the Main Transect. March 15-17, 2003.

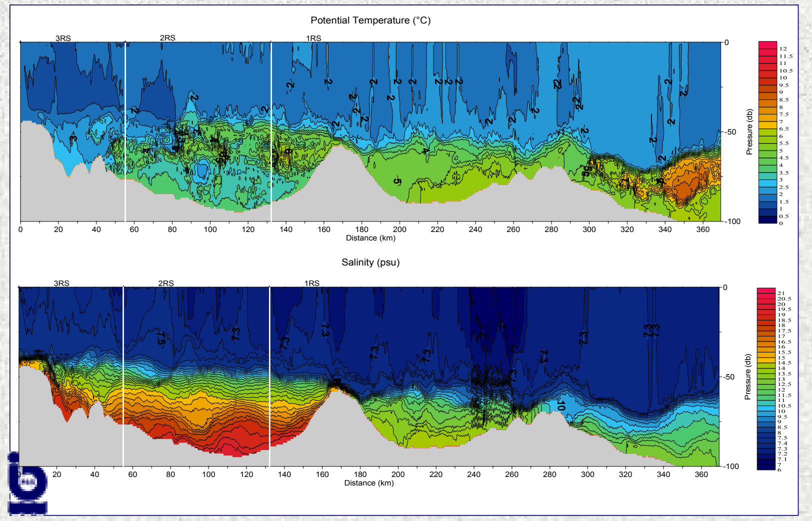


Fig. 12. Temperature (°C), salinity (psu) along the Main Transect. April 22-26, 2003.

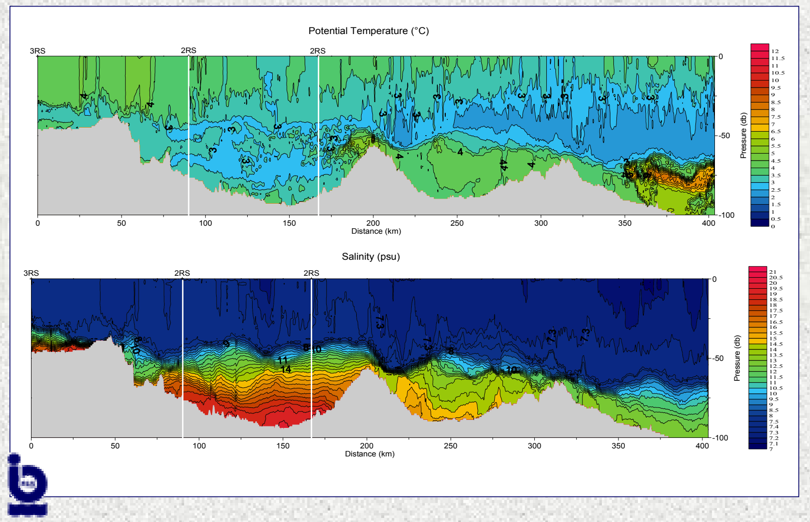


Fig. 13. Temperature (°C), salinity (psu) along the Main Transect. August 15-17, 2003.

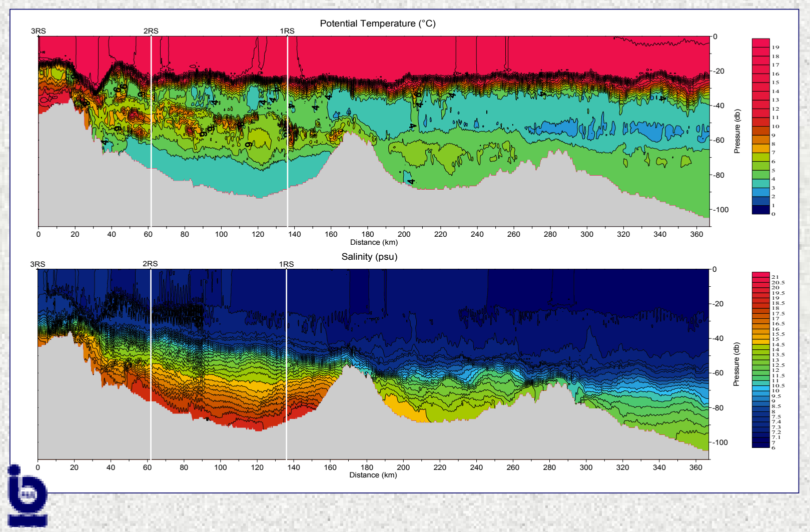


Fig. 14. Pool of the inflow waters in the Arkona Basin. January 26, 2003.

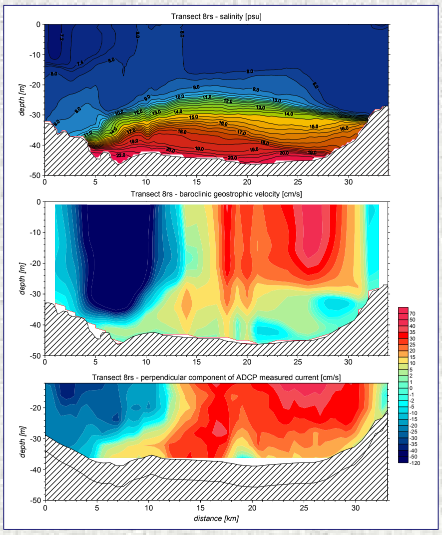


Fig. 15. Transportation of the inflow waters through the Bornholm Channel.

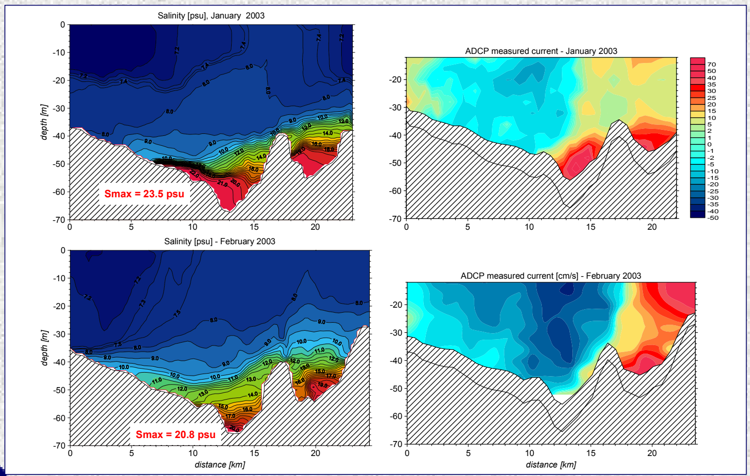


Fig. 16. Dense bottom current entering into the Bornholm Basin. January 2003.

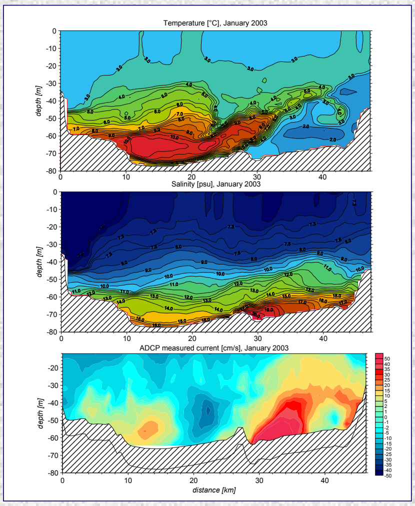
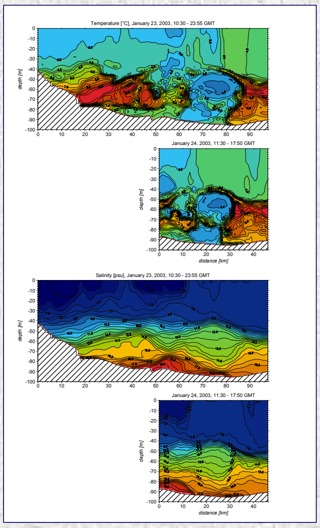


Fig. 17. Eddies and meandering of slope current in the Bornholm Basin. January 2003.



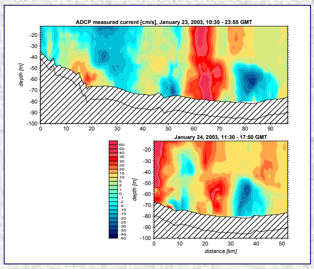
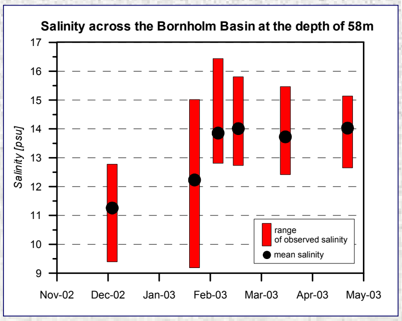
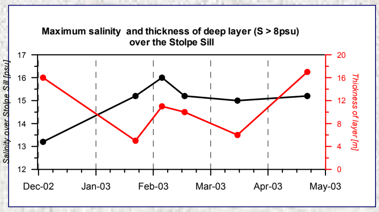


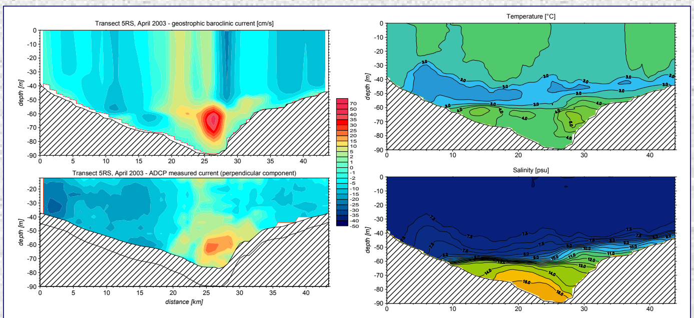
Fig. 18. Transport of the inflow waters over the Slupsk Sill.





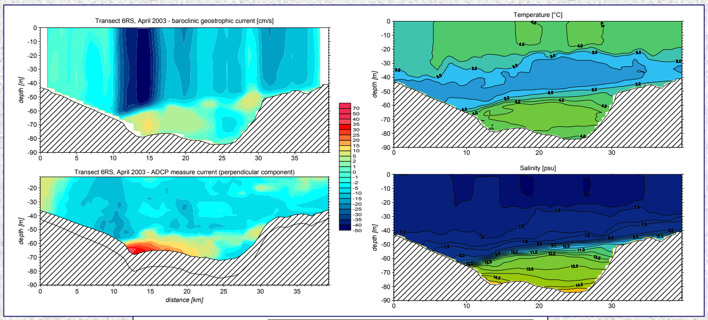
	Halocline depth in Bornholm Basin			
	Mean H_d [m]	*Min H_d [m]*	*Max H_d [m]*	*STD H_d [m]*
December 2002	48.9	40.4	54.8	5.1
January 2003	43.3	31.6	54.6	7.3
February 2003 (beg)	41.0	25.5	53.8	6.5
February 2003 (mid)	40.5	26.2	49.6	6.9
March 2003	44.1	37.6	51.8	3.3
April 2003	41.5	36.9	47.7	2.4

Fig. 19. Transport of the inflow waters in the Slupsk Channel. April 2003.



	Baroclinic geostrophic calculations	ADCP measured transport
	Entire water column	
Eastward transport	47.1 x 10^3 m^3/s	29.3 x 10^3 m^3/s
Westward transport	132.6 x 10^3 m^3/s	176.3 x 10^3 m^3/s
Net transport	- 85.5 x 10^3 m^3/s	- 147.0 x 10^3 m^3/s
Mean current	-3.1 cm/s (westward)	-6.5 cm/s (westward)
	Deep layer with S>8psu	
Eastward transport	35.7 x 10^3 m^3/s	24.0 x 10^3 m^3/s
Westward transport	11.7 x 10^3 m^3/s	21.6 x 10^3 m^3/s
Net transport	24.0 x 10^3 m^3/s	2.4 x 10^3 m^3/s
Mean current	3.8 cm/s (eastward)	0.5 cm/s (eastward)

Fig. 20. Transport of the inflow waters in the Slupsk Channel. April 2003.



	Baroclinic geostrophic calculations	ADCP measured transport
Entire water column		
Eastward transport	$9.7 \times 10^3\ m^3/s$	$50.8 \times 0^3\ m^3/s$
Westward transport	$260.3 \times 10^3\ m^3/s$	$111.2 \times 10^3\ m^3/s$
Net transport	$-250.6 \times 10^3\ m^3/s$	$-60.3 \times 10^3\ m^3/s$
Mean current	-10.1 cm/s (westward)	-2.5 cm/s (westward)
Deep layer with S>8psu		
Eastward transport	$9.6 \times 10^3\ m^3/s$	$37.3 \times 10^3\ m^3/s$
Westward transport	$16.3 \times 10^3\ m^3/s$	$8.3 \times 10^3\ m^3/s$
Net transport	$-6.7 \times 10^3\ m^3/s$	$30.3 \times 10^3\ m^3/s$
Mean current	-1.1 cm/s (westward)	6.6 cm/s (eastward)

Fig. 21. Transformation of water masses during succeeding stages of inflow in 2003 – Borbholm Basin.

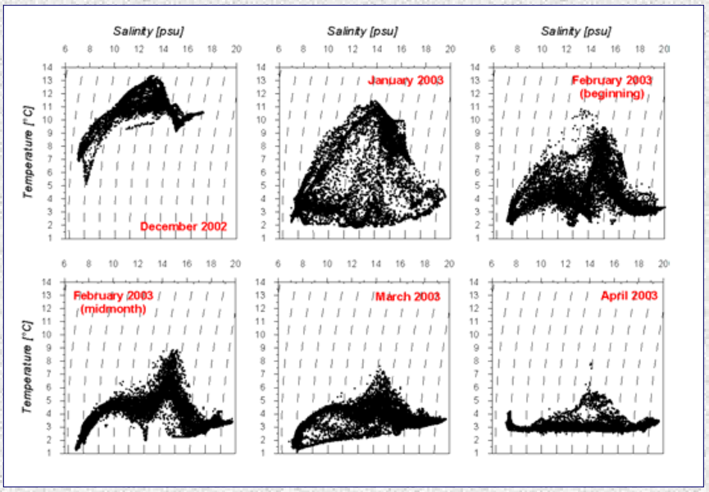
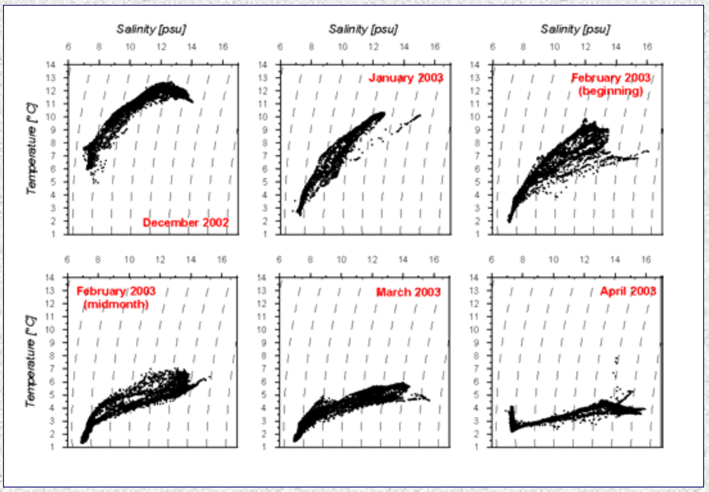


Fig. 22. Transformation of water masses during succeeding stages of inflow in 2003 – Slupsk Channel.



Appendix 3: BSSG Meeting Agenda

15th BALTEX SSG Meeting

at

Risø National Laboratory

Wind Energy Department
Roskilde, Denmark
8 – 10 September 2003

Note: The workshop and the BSSG meeting will take place at different locations!

The workshop venue on Monday will be at the Niels Bohr Auditorium, building 112.

The SSG meeting venue on Tuesday will be at the H.H.Kock Auditorium, building 112.

The SSG meeting venue on Wednesday will be at the Poul la Cour Auditorium in building 114.

PROVISIONAL AGENDA AND EXPLANATORY MEMORANDUM

The major objectives of the 15th BALTEX SSG meeting are:

1) to improve and finally approve the BALTEX Phase II Science Plan,
2) to initiate actions to establish a revised Implementation Plan for BALTEX,
3) to analyse the present state of BALTEX as an European Research Programme and options for support of its programme implementation and infrastructure originating from European and national sources.

The latter are to be discussed under items 4, 5 and 6 of the agenda. Item 7 includes several other important issues, which need to be addressed by the BALTEX SSG, for which however only limited time will be allocated. On the second meeting day, items 4, 5 and 6 will be taken up again to the extent necessary for concluding the meeting with final decisions.

Monday, 8 September 2003

14.00 **„The BALTEX/BRIDGE Period 1999 to 2002 – Selected Results"**
The workshop prior to the official BSSG meeting includes presentations on research activities, which are exploiting BALTEX/BRIDGE data or are related to the BRIDGE period. See separate workshop agenda.

18.30 Closing of the workshop

Tuesday, 9 September 2003

9.00

Item 1: Welcome by the Host and the Chairman (S.-E. Gryning, H. Graßl)
Introduction to Risø National Laboratory (**S.-E. Gryning**)

Item 2: Amendment and Approval of the Agenda

Item 3: Review of Important Action Items of the Previous SSG Meeting.
Most of the action items of the previous SSG meeting were alluding to the following issues:

3.1: Funding proposal MOVE to the European Union's 6th Framework Programme FP6 (**H. Graßl**)
3.2: State-of-the-art-review for BALTEX (**D. Jacob**)
3.3: 4th Study Conference on BALTEX 2004 (**H.-J. Isemer**)
3.4: Science and Implementation Plans for BALTEX Phase II (see item 4)

Action items 3.1, 3.2 and 3.3 will be reviewed briefly by speakers indicated with a follow-up discussion on future implications and steps by participants, if required. 3.4 will be subject of a broader discussion, see item 4 of the agenda.

Break

10.30 **Item 4: Science Plan for BALTEX Phase II**
A draft Science Plan for BALTEX Phase II, established by the Science Plan Core Group (SPCG), has been brought to the attention of BALTEX SSG (BSSG) members prior to the meeting. The draft will briefly be reviewed by members of the SPCG. BSSG members and guests are expected to comment on the draft and discuss improvements, if required. This discussion is expected to conclude with a final approval of a BALTEX Phase II Science Plan including a list of possible improvements and related action items.
Additionally, as contributions to this item, the following two reports (each 15 minutes) are scheduled:

4.1 *The Global Water System Project of all Global Change Research Programmes*. Introduction by **H. Graßl**.

4.2 *Prediction of regional scenarios and uncertainties for defining European climate change risks and effects (PRUDENCE).* PRUDENCE is an EU-FP5-funded research project.
Overview on results and future plans by **J. Hesselbjerg Christensen**[2].

Time allocated to item 4 at this part of the meeting is 2 hours at maximum. Item 4 may be taken up again Wednesday morning, in case that time is too short for final and conclusive decisions.

[2] J. Hesselbjerg Christensen is the PRUDENCE co-ordinatior and will attend the meeting as a representative for Leif Laursen, who is unfortunately unable to attend.

Lunch break

Tuesday, 9 September 2003 *(continued)*

14.00 Item 5: Towards Implementing BALTEX Phase II
Based on decisions made for item 4, item 5 includes discussions and decisions on how to implement the revised objectives for BALTEX Phase 2. In particular, steps to revise BALTEX documents, in particular the BALTEX Implementation Plan for the new objectives of BALTEX phase 2 need to be agreed upon.

Time allocated to item 5 at this part of the meeting is 1 hour at maximum. Discussion in the context of item 6 (see below) may be important for item 5 as well. Item 5 may be taken up again Wednesday morning, in case that time is too short for final and conclusive decisions.

Break

15.30 Item 6: How "European" is BALTEX ?
This somehow provocative question relates to the fact that a recently submitted major EU funding proposal (MOVE, see item 3 above) failed to be retained for funding. Consequences need to be discussed and conclusions to be drawn. The objective of this item is to analyse the present state of BALTEX as an European Research Programme and options for support of its future programme implementation and infrastructure originating from European, national and other sources. This topic will include a brief and critical review of the existing and future national funding sources for BALTEX.
Brief summaries on the present and future national funding sources and options for BALTEX shall be given as follows:
6.1 Denmark (**S.-E. Gryning**)
6.2 Sweden (**A. Omstedt**)
6.3 Finland (**P. Seuna**)
6.4 Estonia, Latvia, Lithuania (**S. Keevallik**)
6.5 Russia (**V. Vuglinski**)
6.6 Poland (**J. Piechura**)
6.7 Germany (**D. Jacob**)
6.8 The Netherlands (**A. van Ulden**)
6.9 European Commission (**D. Jacob, H.-J. Isemer**)
It is envisaged that the SSG members mentioned review the entire national situation in their respective country (or countries), and not just the situation in their own home institution. Each report shall be short with a maximum duration of 5 minutes each.
Time allocated to item 6 at this part of the meeting is 1 hour 30 minutes.

Item 7: Important Other Issues

This item will include important present other issues with relevance to BALTEX. It is expected that both an introductory report or statement and a related discussion of the group shall be confined to 15 minutes each on average. Issues to be discussed will include:

<u>Tuesday, 9 September 2003</u> *(continued)*

7.1: GEWEX Hydrometeorology Panel (GHP) Meeting 2003
GHP meetings are held annually and are hosted in turn by one of the GEWEX CSEs (Continental Scale Experiments). The 2003 GHP meeting will be hosted by BALTEX and will be held in Lüneburg, Germany, during 22 to 26 September 2003. Local arrangements for this meeting have been organised by the BALTEX Secretariat. An overview on the suit of individual meetings will be given and further possible contributions by BSSG members or BALTEX scientists to GHP shall be discussed. Introduction by **H.-J. Isemer**.

7.2: CEOP and BALTEX Contributions
Overview by **H. Graßl.**

7.3: BALTEX Data Centres
Short reports on the status of all BALTEX Data Centres or Data Centre Functions are expected, as follows:
- BALTEX Meteorological Data Centre (**H. Graßl**)
- BALTEX Hydrological Data Centre (**M. Rummukainen**)
- BALTEX Radar Data Centre (**D. Michelson**)
- Oceanographic Data Centre for BALTEX (**P. Axe**)
- BALTEX Satellite Data Centre Function (**J. Fischer**)

7.4: BALTEX Radar Working Group (BRWG)
A report on the status of the BRWG is expected to be given (**J. Koistinen**).

Time allocated to item 7 is 1 hour 30 minutes.

18.30 **Closing of day 1 of the meeting**

<u>Wednesday, 10 September 2003</u>

9.00 **Item 4: Science Plan for BALTEX Phase II** *(continued)*
Wrap-up and conclusions

10.00 Item 5: Towards Implementing BALTEX Phase II ***(continued)***
Wrap-up and conclusions

Break

11.30 **Item 6: How "European" is BALTEX ?** *(continued)*
Wrap-up and conclusions

12.30 **Item 8: Date and Place of the Next Meeting**

Item 9: Any Other Business

13.00 **Closing of the BSSG meeting**

Appendix 4: Participants List

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Appendix 5: PRUDENCE

Prediction of Regional scenarios and Uncertainties for Defining EuropeaN Climate change risks and Effects – PRUDENCE

Problem to be solved:
European decision-makers in government, non-governmental organisations (NGOs), and industry as well as the general public need detailed information on future climate. In this way it becomes possible to evaluate the risks of climate change due to anthropogenic emissions of greenhouse gases. Projections of future climate change already exist, but are deficient both in terms of the characterisation of their uncertainties and in terms of their regional detail. To date, the assessment of potential impacts of climate change has generally relied on projections from simple climate models or coarse resolution Atmospheric-Ocean General Circulation Models (AOGCMs), neither capable of resolving spatial scales of less than ~300km. This coarse resolution precludes the simulation of realistic extreme events and the detailed spatial structure of variables like temperature and precipitation over heterogeneous surfaces e.g. the Alps, the Mediterranean or Scandinavia. Simple models include, at best, a limited physical representation of the climate system.

Scientific objectives and approach:
PRUDENCE is a European-scale investigation with the following objectives:
a) to address and reduce the above-mentioned deficiencies in projections;
b) to quantify our confidence and the uncertainties in predictions of future climate and its impacts, using an array of climate models and impact models and expert judgement on their performance;
c) to interpret these results in relation to European policies for adapting to or mitigating climate change.

Climate change is expected to affect the frequency and magnitude of extreme weather events, due to higher temperatures, an intensified hydrological cycle or more vigorous atmospheric motions. A major limitation in previous studies of extremes has been the lack of: appropriate computational resolution - obscures or precludes analysis of the events;
long-term climate model integrations - drastically reduces their statistical significance;
co-ordination between modelling groups - limits the ability to compare different studies.
These three issues are all thoroughly addressed in PRUDENCE, by using state-of-the-art high resolution climate models, by co-ordinating the project goals to address critical aspects of uncertainty, and by applying impact models and impact assessment methodologies to provide the link between the provision of climate information and its likely application to serve the needs of European society and economy.

Expected impacts:
PRUDENCE will provide a series of high-resolution climate change scenarios for 2071-2100 for Europe, characterising the variability and level of confidence in these scenarios as a function of uncertainties in model formulation, natural/internal climate variability, and alternative scenarios of future atmospheric composition. The project will provide a quantitative assessment of the risks arising from changes in regional weather and climate in different parts of Europe, by estimating future changes in extreme events such as flooding and windstorms and by providing a robust estimation of the likelihood and magnitude of such changes. The project will also examine the uncertainties in potential impacts induced by the range of climate scenarios developed from the climate modelling results. This will provide useful information for climate modellers on the levels of accuracy in climate scenarios required by impact analysts. Furthermore, a better appreciation of the uncertainty range in calculations of future impacts

from climate change may offer new insights into the scope for adaptation and mitigation responses to climate change. In order to facilitate this exchange of new information, the PRUDENCE workplan places emphasis on the wide dissemination of results and preparation of a non-technical project summary aimed at policy makers and other interested parties.

Appendix 6: Status Report Finland

BALTEX activities in the Finnish Institute of Marine Research in 2002-2003
by Timo Vihma

Air-sea-ice exchange processes over sea ice
The studies are based on mesoscale modelling and analyses of field data from the recent BASIS and BALTIMOS field expeditions in winters 1997-1999 and 2001. A new field expediton was made in the Bay of Bothnia in February 2003 focusing on sea ice thermodynamics, air-ice interaction, and validation of ENVISAT data. The modelling studies address the structure of the atmospheric boundary layer in the ice-edge zone in various synoptic situations. The data are compared with results of mesoscale models and HIRLAM. In addition, the role of subsurface melting and super-imposed ice formation on sea ice thermodynamics are modelled.

Coastal meteorology and air-sea interaction
An analyses on marine meteorological conditions over the northern Baltic Sea in 1990s was completed in 2002. The ongoing studies focus on the dependence of wind, air-sea momentum flux, and wave conditions on the fetch from the coast. Data are analysed from R/V Aranda field expeditions made in autumns 2001 and 2002. Two new field expeditions are carried out in September and October 2003. The analyses of field data are supported by mesoscale modelling: 2D modelling studies have been made and an application of the 3D non-hydrostatic mesoscale model MM5 is under work.

BALTEX-related publications in 2002-2003:

Brümmer, B., D. Schröder, J. Launiainen, T. Vihma, A.-S. Smedman, and M. Magnusson, Temporal and spatial variability of surface fluxes over the ice edge zone in the northern Baltic Sea, *J. Geophys. Res.,* 107(C8), 3096, doi:10.1029/2001JC000884, 2002.

Pirazzini, R., T. Vihma, J. Launiainen, and P. Tisler, Validation of HIRLAM boundary-layer structures over the Baltic Sea *Boreal Env. Res.*, 7, 211-218, 2002.

Vihma, T. and B. Brümmer, Observations and modelling of on-ice and off-ice flows in the northern Baltic Sea, *Bound.-Layer Meteorol.,* 103, 1-27, 2002.

Niros, A., T. Vihma and J. Launiainen, Marine meteorological conditions and air-sea exchange processes over the Baltic Sea in 1990s, *Geophysica*, 38, 59-88, 2002.

Brümmer, B., A. Kirchgässner, G. Müller, D. Schröder, J. Launiainen, and T. Vihma, The BALTIMOS field campaigns over the Baltic Sea during all four seasons, *Boreal Env. Res.*, 7, 371-378, 2002.

Schröder, D., T. Vihma, A. Kerber, and B. Brümmer, On the parameterization of turbulent surface fluxes over the marginal sea ice zone, *J. Geophys. Res.,* 108, C6, 3195, 2003.

Finnish Meteorological Institute (FMI) Report
by Mikko Alestalo

1. HIRLAM modelling versus BALTEX (responsible person Carl Fortelius)
FMI coordinates a new Baltic HIRLAM cooperation project funded by the Nordic Council of Ministers, aiming at coordinated research and education in order to develope and apply in the participating institutes a fine scale numerical weather prediction and atmospheric research model. (See the project web site http://hirlam.fmi.fi/Baltic/ for details)

FMI cooperates with the universities of Helsinki (Sami NiemelÃ¤) and Tartu (Aarne MÃ¤nnik) for developing a fine-scale non-hydrostatic NWP model. Extensive use is made of radar data in evaluating parameterisations of convection and precipitation processes.

2. Special measurements (responsible person Bengt Tammelin)
FMI is operating two meteorological mast stations in connection to the BALTEX research.

Kopparnäs 35 m mast is located in the archipelago at the southern coast of Finland on a small island just outside the shore line and also prone to open sea winds. At this site the sea is ice covered every winter. This mast was also part of our contribution to the EU/PEP in a BALTEX related project.

Sodankylä 48 m mast is located some 100 kilometers north of the Polar Circle at the FMI Arctic Research Centre. For this site ground inversions and wintertime permanent snow cover are very typical features. The mast is part of the FMI´s contribution to the GEWEX/CEOP project.

At both mast stations vertical wind, temperature and humidity profiles, heat fluxes and evaporation are measured using different types of sensortechniques.

3. Radar data (responsible person Jarmo Koistinen)
The operational production of high resolution Doppler radar data for most of the BALTEX area is continued. Data are stored in the BALTEX Radar Data Center in SMHI. FMI is responsible for the chairmanship of the BALTEX Radar Data working group. A separate Status Report from WGR/BRDC will highlight the radar work in detail.

Finnish Environmental Institute (FEI) Report
by Pertti Seuna

As to the future national funding options, the data supply from FEI will work in the same way, as it has been, also in the future. There should not be any serious problems in that. More complex is the input for the real research of BALTEX. We were looking forward to have an opportunity to be more active in the MOVE concept, but without the EU financiation our chances for direct BALTEX research are, unfortunately very limited. Most likely those activities mentioned for us in the MOVE will not be started now. There are, however, some other projects, which have clear links with the activities planned in the MOVE. One of these is Climate and Energy (CE formerly CWE), which is going on on the Nordic basis. It is known well by Markku Rummukainen and Sten Bergström, who might be at the SSG meeting.

In the agenda PRUDENCE was already mentioned.

Appendix 7: Status Report on Radar Activities

Status Report: BALTEX Working Group on Radar (WGR), BALTRAD, and BALTEX Radar Data Centre (BRDC)

Daniel Michelson, SMHI

WGR Membership

Over the past year or so, the WGR has expanded to include new countries and new concepts. The group now includes active members from Estonia (EMHI) and The Netherlands (KNMI). The WGR was originally created as a forum for consolidating operational weather radar activities, with little contact with research radars and groups. This has now changed. The group now welcomes such groups, and the first one is that led by Markus Quante at GKSS.

Johann Riedl at DWD-Hohenpeissenberg has recently retired, handing over his responsibilities to his successor Jörg Seltzmann. Johann, like Tage Andersson (also retired), will nevertheless enjoy membership in the WGR for the rest of his life, according to the principle "once you're in, you never get out". BALTEX radar activities have gained much through Johann's involvement.

BALTRAD and NORDRAD

At the WGR's annual meeting in De Bilt (KNMI, NL), a few significant strategic decisions were made which affect how the WGR, BALTRAD, and the BRDC will operate in the future. BALTRAD and NORDRAD will work much more intimately, concentrating together on common R&D and quality control issues. There will also be a move towards BALTRAD operating in real-time. The data availability policy will remain unchanged, with all BALTRAD-specific data and products being freely available for R&D purposes only.

The move towards a tighter link with NORDRAD will rationalize activities, since a common software system is in use in several BALTRAD countries. This move also highlights a major success: the software system designed and developed for the BRDC has been integrated into the second generation NORDRAD software system. This is an example of how R&D activities can lead to improvements in operational environments.

BRDC

Dataset production has been continuous since October 1, 1999. Data from new Norwegian radars Rissa and Bømlo have been integrated into the BALTRAD products. Wind profiles from KNMI have also been integrated. The Norrköping radar has been moved south to Vilebo and data from it are also being integrated. The radar in Tallinn has been poorly sited, unfortunately, and so intergrating data from it is more complicated; this activity is pending. An acceptable solution for integrating data from St. Petersburg is also pending.

The BRDC host computer platform has reached the end of its lifetime. Production has been disrupted since early August. A modern replacement platform was planned for 2003, but it has not yet materialized. The continued generation of BALTRAD datasets is at risk unless this new platform is made available soon.

ERAD 2004

ERAD has emerged as the primary conference series for European weather radar activities. The first event was held in 2000 in Bologna and the second last year in Delft. ERAD 2004 will be held in Visby, Island of Gotland, Sweden, 6-10 September. This event will be combined with the COST 717 Final Seminar. The BALTEX WGR has taken the initiative to invite the various communities to ERAD. SMHI is the local organizer. Daniel Michelson chairs the Programme Committee. The EMS is expected to make the official call.

ERAD 2004 will provide an excellent opportunity to showcase research related to BALTEX. One of the focusses may be on preparations for the Global Precipitation Mission, which would give the radar and satellite communities, not to mention all GEWEX experiments, an good opportunity to interact. The same holds true for the link to the hydrological and NWP modelling communities. Such groups are expected to participate because of the COST 717 Final Seminar.

The BALTEX community is urged to help raise awareness of this event, and to encourage participation from relevant research communities. Logistical support may be requested from the BALTEX Secretariat, although it is not yet clear what this may involve.

Appendix 8: Minutes of 8th BWGR Meeting

Minutes of the 8th BALTEX WGR Meeting at KNMI, De Bilt, The Netherlands

June 26-27, 2003

1 Practical arrangements

1.1 Opening and participants

Jarmo opened the meeting with a summary of the WGR's place in BALTEX and the world.

Attendees:

Sylvia Barlag, KNMI, The Netherlands (in part)
Uta Gjertsen, met.no, Norway
Iwan Holleman, KNMI, The Netherlands
Tarmo Kaldma, EMHI, Estonia
Jarmo Koistinen, FMI, Finland
Elena Maltseva, EMHI, Estonia
Daniel Michelson, SMHI, Sweden
Jörg Seltmann, DWD, Germany

1.2 WGR membership and addresses

The address list was circulated and updated. The latest version is appended to these minutes.

1.3 Schedule

Iwan briefly presented KNMI and the logistics of this meeting.

2 Minutes from 7th WGR meeting in St. Petersburg and matters arising from the minutes and from the short meeting at ERAD 2002

Jarmo summarized the 7th WGR meeting and some of the interesting Russian activities which were presented then. Exchange of Russian data was briefly touched upon and this topic would be revisited later on in the meeting.

There was a short and informal meeting held at ERAD 2002 in Delft. This meeting only really served to update the WGR members on recent activities, and it provided a pleasant social event.

3 Radar networks and data (status and plans)

3.1 National reports

3.1.1 The Netherlands

KNMI still operates two radars at De Bilt and Den Helder. They plan a major upgrading of the radar hardware and processing, to commence in 2005. They will get digital receivers and the ability to perform custom scan strategies with sophisticated configurations. The OS9-based Gematronik system will be replaced.

Hydrological application of gauge-adjusted radar has recently been introduced. Wind profile quality studies have been performed. The wind profiles available to BALTEX will be made fully operational later during 2003. The hail warning product is operationally available and deemed useful by several users.

All new systems will make full use of the HDF5 file format.

International exchange is performed with Germany, Belgium and the UK. Composites are received from France, the UK, and Germany.

3.1.2 Norway

Two new radars have been introduced this year, both located on the west coast: Bømlo outside Bergen and Rissa outside Trondheim. Sea clutter is a problem with Bømlo. Rissa provides high quality data. A systematic error of 0.3 degreees in the Gematronik antenna system means that the lowest elevation is programed at 0.8 degrees in order to get the actual angle at 0.5 degrees.

A new radar is planned for the island of Røst in spring 2004. This will be an installation at around 17 m a s l, which might give similar results to those experienced at Bømlo.

The old Ericsson radar at Oslo will receive a new host platform, similarly to the Swedish radars (see below).

3.1.3. Estonia

The Tallinn radar will be upgraded with a new version of Rainbow software. EMHI plans on introducing compositing with Finnish radar data and buying Rainbow precipitation and wind products which are not part of the standard Rainbow system.

A new radar is planned. Potential sites are the southeast and the southwest. Jarmo recommended that EMHI liase with their Latvian collegues in order to optimize the potential international network coverage. The Tallinn site is not optimal due to many blockages from the city buildings and its proximity to Vantaa in Finland. Moving this radar may not be politically feasible, but it would be an advantage in order to achieve good data quality and a better balance compared to the Finnish and other international radars.

EMHI is officially an observer in NORDRAD. This enables them to exchange data but not use any software. Estonian data is transmitted to FMI via Rainbow

NORDRAD API in the (old) NORDRAD format. At FMI they are readily converted in the old NORDRAD to IRIS and to NORDRAD2 (HDF5) formats and are thus available to BRDC, but have not been read from SMHI! The availability at FMI has been relatively low due to telecommunication problems, e.g. 80 % in August 2003.

Gematronik has offered EMHI a so-called ``NORDRAD2'' converter. This makes it possible to export Rainbow data to HDF5. According to the If EMHI orders this feature, it should be specified that Rainbow data should be exported in HDF5 according to version 1.2 of the COST 717 specification on how to encode data in HDF5. This document is available in the documetation section of the COST 717 website (http://www.smhi.se/cost717/).

The group recognized the usefullness of having a programmer available to evaluate commercial software and to provide the potential to implement some in-house software that performs some tasks better and/or less expensively.

3.1.4. Germany

RADRUM is a project designed to migrate the product generation from RMV (VMS) to FROG (Linux) developed by GAMIC. Tests are ongoing and the system is planned to be operational in 2004. No new algorithms are included in the initial version, but it will be possible to add new functionality in the future.

NEUWERG is a project for introducing new weather radar hardware. It is still in the planning stage. It includes introducing Doppler to non-Doppler systems and the opportunity to evaluate polarisation diversity techniques with a prototype system (Hohenpeißenberg) for potential future operational application. The major manufacturers seem to have adopted a new hardware strategy for polarisation, where critical hardware components are physically located in the antenna system in order to minimize error sources.

Johann Riedl will retire in August and Jörg Seltmann will replace him. The WGR expresses sincere thanks to Johann of his significant contribution in the group and elsewhere in the radar community and wishes him relaxing days of retirement.

3.1.5 Finland

Finland is considering establishing a prototype radar for testing new technology. Vaisala company will build the new hardware and they plan on making a prototype dual polarisation radar available in 2004 or 2005.
A Finnish consortium consisting of Vaisala, FMI and the University of Helsinki will be addressing issues associated with this radar. Vaisala will not be building their signal processor and software themselves; the supplier will be Sigmet with possible additional modules from other suppliers e.g. FMI.

Nothing new about the operational Finnish radars. FMI is still requesting money for procuring a new radar as a gap-filler in Western Finland (Kauhava), but so far decisions have been negative. Product availability has increased so that all radars now have figures above 98 % monthly, including telecommunications and regular maintenance.

Polar volume exchange with St. Petersburg is ongoing. There is no mechanism for informing FMI when there is no Russian data due to lack of hydrometeors (scanning is then ceased), which is an integral element of the Russian system. For example in August 2003 the availability of the data was only 23 % and no information exists of the relative proportions of radar in standby or system failures.

3.1.6 Sweden

The Swedish radars will replace the host platforms for the Ericsson systems. The (Open)VMS systems are being replaced with a Windows 2000 industrial PC host which is designed to operate the radar only. Product generation will be conducted on-site at the military radars, and centrally at SMHI using Sigmet IRIS and the new NORDRAD2 system. All dataflow will be based on HDF5 and the NORDRAD2 distribution functionality.

An extended Doppler capability has been adopted by the Swedish Air Force for their 7 radars, but SMHI has not accepted the quality of this solution and will therefore not introduce it.

During 2002 the Göteborg radar was moved to Vara, and in 2003 the Norrköping radar was moved to Vilebo. In both cases, the umodified radar provided higher quality data simply due to the better siting.

Telecommunications quality for transfer of radar data is low in Sweden and the most important factor explaining the poor availability statistics. Hopefully this issue will be resolved in the relatively near future.

3.2. NORDRAD2

Daniel summarized the status of the NORDRAD2 system. This system will, whenaccepted, provide a natural platform for joint development work within the NORDRAD collaboration. The product generation software in NORDRAD2 is the RAVE system originally developed for use at the BRDC.

There was a discussion on the relationship between dedicated product generation systems and equivalent functionality available from systems based on commercial databases like Oracle and Informix, as well as visualization systems referred to as ”meteorological workstations". There was widespread agreement that such databases are entirely inappropriate for generating basic radar-based products, and that the use of databases in general is expensive, complicated and slow. Meteorological workstations work better if their input data are organized into file systems.

3.3 EUMETNET OPERA and its successor

Iwan summarized the status of the present and future OPERA programmes. The present OPERA will end at the end of 2003 and the new OPERA will start at the beginning of 2004 (the proposal was accepted by EUMETNET Council in September). The new OPERA will provide an excellent forum for addressing radar issues at the European level, with a high level of variable scientific and practical activities.

The dependency of OPERA on BUFR only is broken and the issue of new data representation formats will be addressed. The prospects of the new OPERA adding value to European radar activities are excellent.

4 BALTRAD: BALTEX radar cooperation and the BRDC

Daniel summarized the BRDC activities and the status of the datasets and their availability. Availability is high although there are no specific statistics.

Action on SMHI to resume data transfer with as many of the POLRAD radar as possible.

Action on FMI to make St. Petersburg data available to the BRDC.

Denmark and Sweden have agreed that data from all Danish radars will be exchanged with Sweden. These will be made available to the BRDC.

A DEKLIM project is designed to create an 8-bit German pseudo-CAPPI which can be made available to the BRDC.

BALTEX Phase II is forthcoming. An EC Framework VI proposal MOVE was recently rejected. Chris Collier leads a Network of Excellence called EDIFICATION designed to address drought and floods. CEOP is ongoing but with a fairly low BALTEX profile. Specific funding for BALTEX and BALTRAD appears to be unlikely as there are no self-evident channels where it might be found.

Jarmo and Daniel both presented ideas on how to continue the BRDC activities. The first generation BRDC hardware is deteriorating and there is no strong awareness at SMHI for ensuring that the BRDC is continued. There is a distinct risk that the BRDC will reach the point where it can no longer continue unless a second generation technical solution is made available. Within the satellite community, decadal datasets are common and natural. Within the weather radar community, such datasets are extremely rare. BALTRAD has the potential to provide unique datasets over a long preiod of time which can be extremely valuable for a multitude of applications.

Outcome: There was strong agreement to keep the BALTEX WGR as it is, with its terms of reference, yet move towards utilizing the NORDRAD infrastructure in order to preserve operations which are sustainable in the long term.

In terms of the issue of real-time exchange of data, there is a strong interest in enhancing the degree of true exchange. In the future, activitites should approach real-time as closely as possible. This will enhance the applied research process, since it will facilitate the implementation of new algorithms which must work in real-time.

The concept of an Internet-based BALTRAD Atlas was earlier presented by Jarmo (see WGR Information letter 4, 2000) and this could be an effective means of raising the profile both of NORDRAD and BALTRAD.

The BRDC will no longer provide datasets on CD-ROM. Instead, ISO images will be created and placed on the BRDC website and/or FTP site at SMHI. The COST 717 HDF5 information model will be followed. Also, there are no longer any rules governing availability of datasets, as long as they are subject to a delay of at least two days for commercial reasons.

Action on Jarmo and Daniel to write a short paper containing the way in which SMHI, FMI and met.no will proceed to arrange the integration of NORDRAD and BALTRAD. Daniel will provide the first draft.

5 Ongoing and planned radar research and papers related to BALTRAD

The issue of reruns of BALTRAD datasets was raised, as was the feasibility of performing them. Reruns would provide the ability to produce gauge-adjusted radar accumulations using climate station data, which has been an impossibility in ordinary BRDC operations. Yet, reruns consume tremendous resources which can only be available through dedicated funding. It might be more valuable to concentrate on improving the regular real-time operations and focus on improving the algorithms used there.

Ways in which existing product algorithms can be improved, starting with a single-site reflectivity image:

- Calibration errors (radar constant, power level and antenna angles)
- DSP averaging, Doppler clutter filtering and signal thresholding
- Removal of non-meteorological bins (sea clutter, insects, birds, chaff, emitters)
- Beam blockage correction
- Attenuation corrections (along the path and in the radome)

Attenuation due to precipitation should include 3D-phase. It would be more intelligent to perform this correction after removal of non-meteorological targets, since AP does not cause attenuation. Yet, this is a task which is typically performed on single-site data at the national level. Perhaps a national filter could applied before attenuation correction, and this would reduce the need for such correction at the BRDC.

Single site Doppler data
- Aliasing methods
- Compressed Doppler data: polar volume -> VVP/VAD/VPR -> Superobs

2-3D compositing

- Compositing algorithms
- Removal of overhanging precipitation (NWP, satellite, VPR, ceilometers)
- Phase-dependent lower Z-cutoff threshold
- Z-R, Ze - S (with phase analysis at ground)

Integration with other data

- Gauge adjustment (SYNOP, climate station obs)
- Satellite IR thresholding (clutter)

Jarmo urged each member to describe its national product flow and that such metadata should be available in the product headers sent to the BRDC. Uta pointed out that all of us have no sophisticated product quality control used operationally.

Jarmo urged each institute to provide VPRs as part of their wind profile products.

Superobs are desirable as well, and generating them required access to polar volumes. Accomodating their generation at the BRDC is not prioritized, although future interest from the NWP communities might provide the necessary pressure required to raise this priority.

Is it possible to generate a gauge adjusted product using climate station gauge observations? The WGR noted that there is no BMDC any more, which means that it is up to us to try to find these data. They may not be readily available from all of us. Timing synchronization issues between countries cause additional problems. This task may be too difficult to realize properly but must be investigated.

Action on everyone to investigate the availability of climate station observations.

Action on everyone to investigate the availability of visibility measurements. These could be valuable for determining precipitation phase and could add value to our radar estimates once they have been subjected to a VPR correction.

It might be desirable to include a partitioning of reflectivity into convective and non-convective types, where different Z-R relations are applied for each.

There was widespread agreement that a VPR correction should be added to the BRDC product chain. Jarmo presented the method used to validate the Finnish VPR correction technique. The validations results show excellent performance of the method, given that only cases where precipitation reaching the surface were considered. The method is successful in almost completely eliminating the range bias in both summer and winter conditions, without increasing the random error. The method does not work if the measured long range precipitation is overhanging, i.e. never reaches the ground, or the actual measurement elevation angles differ too much from the nominal pointing angles in the datasets.

Daniel presented the "Down to Earth" method of physically modelling an equivalent VPR correction. The method evaluation revealed an ambiguous result, since a bias is introduced at close ranges. However, the method includes a specific evaporation scheme which could be combined with the Finnish VPR correction technique to enable the treatment of overhanging precipitation.

A discussion on beam blocking correction techniques took place and each institute was urged to include such techniques where possible.

Jörg mentioned the problems caused by windmills.

Outcome: A new BALTEX report will collect envisaged enhancements and additions to the BALTRAD quality control and product generation algorithms.

All will document their national production chain at present.
Jarmo will document the VPR correction technique. He and Daniel will consider if/how to include an evaporation scheme.
Daniel and Uta will address the gauge adjustment technique.
Tarmo and Elena will describe how the visibility measurements can be used.
Jörg, Uta and Daniel will look into the beam blockage issue.
Daniel will address the centralized non-meteorological echo identification and correction.
Jarmo will look into how NORDRAD QA might be applied.
Jarmo will ask Harri Hohti to see how quality weights for various targets (like windmills) can be included in the 3-D compositing algorithm.
Iwan can look into quality control of wind profiles.
Jörg will report on the German variable Z-R relation scheme, and Iwan will add information on hail detection. Jarmo will be included and add information on the Finnish phase analysis experiences.

We should try to estimate when these kinds of enhancements and additions can be realized in time.

One A4 paper is expected for each of these items by September 30, 2003. This will provide the basis for continued discussion at the next meeting (see below).

6 Important meetings related to WGR

The latest BSSG meeting was held in November, 2002 on the same days as ERAD, and Jarmo reported on a positive attitude from them regarding the WGR.

The GPM Workshop held earlier this week (see http://www.estec.esa.nl/conferences/03C06/) planned the ground validation (GV) of the new satellite based K-band precipitation radars and passive radiometers, which will measure precipitation up to the latitudes of 83 degrees. Weather radars at ground will be an important component in this work. Fore example, vertical profile measurements could be used to validate latent heat release distributions. The potential of using BALTRAD datasets were pointed out at this event through a poster. In the discussion it was pointed out (together with the Canadians, who are full ESA members) that the measured snowfall reflectivity probability distributions (PDF) suggest that the sensitivity of the K-band radars may not be good enough to detect major part of snowfall at high latitudes. Jarmo has sent a specific letter based on the Finnish PDF to NASA of this concern and the same data was presented in ESA by Paul Joe with a parallel result from Canada. The work will continue in the 1st International GPM GV Requirements Workshop, 4-7 November in Abingdon, UK (at least Jarmo will participate), see http://www.rcru.rl.ac.uk/GPMGV.

The AMS 31st International Radar Conference will be held in Seattle, 6-12 August, and at least Daniel, Iwan and Jarmo will give a presentation there.

The 4th BALTEX study conference will be held 24-28 May, 2004 on the island of Bornholm, Denmark.

ERAD 2004 will be held together with the COST 717 Final Seminar 6-10 September, 2004 in Visby on the Swedish island of Gotland. Since the WGR is inviting the various communities to this event, we should contact the BALTEX Secretariat to see whether they can help us with the proceedings volume. Action on Jarmo to contact Hans-Jörg Isemer to determine how the Secretariat can assist us.

7 Next WGR meeting

Possibly in conjunction with the Nordic Weather Radar Workshop to be held in Norrköping preliminarily 27-28 November, 2003.

8 Any other business

None.

9 Closing of the meeting

Jarmo officially closed the meeting and thanked everyone for their contributions.

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No. 1: Minutes of First Meeting of the BALTEX Science Steering Group held at GKSS Research Center in Geesthacht, Germany, 16-17 May, 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 Second Meeting of the BALTEX Science Steering Group held at Finnish Institute of Marine Research in Helsinki, Finland, 25-27 January, 1995. October 1995

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

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

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

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