Projects at DMI supported by the European Commission

Projects initiated after autumn 1998

Introduction

Institute profile

The Danish Meteorological Institute (DMI) was founded in 1872. The main objectives of DMI are forecasting and warning services as well as continuous monitoring of weather, climate, and related environmental conditions in the atmosphere, on land and in the sea, in order to safeguard life and property as well as to provide a basis for economic and environmental planning in the community (air navigation, shipping, defence, agriculture, sport and leisure activities etc.). Special forecasts and services are provided for agriculture, energy and environmental agencies, and DMI also provides a World Wide Weather Routeing Service for shipping on the high seas.

DMI provides meteorological and related services for the community within the large geographical area of Denmark, the Faroe Islands and Greenland, including surrounding waters and airspace. DMI has a staff of about 400 employees and 650 associated observers.

Applied research and development and use of information technology is an integral part of the DMI strategy. The research/development focus on

Meteorology including further development of the DMI-HIRLAM (**H**igh **R**esolution **L**imited **A**rea **M**odel) system for numerical weather forecasting and modelling of road conditions;

Air Quality involving modelling of air pollution (ground-level ozone etc.), atmospheric dispersion of harmful material in the atmosphere (radioactive material, foot-and-mouth disease virus, biological warfare agents etc.), and pollen forecasting;

Oceanography focusing on stormsurge, waves, 3D-ocean modelling, sea ice monitoring and forecasting, and ship routing to the benefit of safety on land and at sea, as well as for environmental assessment and protection purposes. DMI participates in the EUMETSAT **S**atellite **A**pplication **F**acility (SAF) for ocean and sea ice monitoring;

Climate with main emphasis on climate variability and climate change, global and regional climate modelling, and seasonal prediction. Climate scenarios from DMI are used by other groups for studies of impacts of climate change;

Middle atmosphere physics including ozone and UV monitoring and forecasting, polar stratospheric clouds and aerosols, and the role of ozone as a climate gas. DMI participates in the development of the EUMETSAT SAF on ozone and UV radiation;

Solar-terrestrial physics including effects of the Solar magnetic activity on the Earth's environment and climate and scientific leadership of the Danish Ørsted Satellite

Mission which includes geomagnetic instruments and a GPS-instrument for atmospheric weather and climate monitoring;

Atmosphere ionosphere remote sensing focusing on atmospheric profiling based on the global navigation satellites (GPS). The Ørsted satellite carries a GPS instrument and DMI is leading the development of the EUMETSAT SAF on GPS.

DMI is the national data focal point for meteorology (including the upper atmosphere, climatology, hydrology) and DMI is the institute within the European Union that has the best data coverage of the European polar regions (Greenland and its surrounding waters). DMI possesses extensive expertise in EDP-systems, including data bases, data communication, and supercomputer systems for advanced numerical modelling.

The activities of DMI are carried out noting international obligations due to Denmark's membership of international organizations. At the same time, these memberships ensure coordination of data collection and exchange of data and products etc.

The international organizations are first and foremost **WMO** (World Meteorological Organization), a specialized agency of the United Nations, **ECMWF** (European Centre for Medium-Range Weather Forecasts) established by 17 Western European countries, **EUMETSAT** (European Organisation for the Exploitation of Meteorological Satellites) established by 16 Western European Countries, **ICWED** (the Informal Conference of Western European Directors of Meteorological Services), **EUMETNET** (the Network of European Meteorological Services) and **EuroGOOS**, the European component of the Global Ocean Observing System (GOOS).

DMI is a member of **ESA** (European Space Agency) Earth Observation Programme Board, and through the Danish Civil Aviation Administration, DMI is represented as meteorological authority in **ICAO** (the International Civil Aviation Organization, a specialized UN agency).

Furthermore, DMI participates in the **IPCC** (Intergovernmental Panel on Climate Change) established by WMO and the United Nations Environmental Programme (UNEP). DMI is represented in the Danish National Committees under **IUGG** (International Union of Geodesy and Geophysics), **ICSU** (International Council of Scientific Unions), **IAGA** (International Association of Geomagnetism and Aeronomy), and **IGBP** (International Geosphere-Biosphere Programme). DMI is also represented in the **Nordic Hydrologic Union**, in **URSI** (Union Radio Scientific Internationale), and in the Steering Group of **NDSC** (Network for Detection of Stratospheric Change).

The research and development projects are carried out in collaboration with research groups in Denmark and other countries and supported by research councils and programmes, inter alia the European Commission's Framework Programmes on Research and Technological Development, and ESA and EUMETSAT programmes. This report describes the projects supported by the European Commission (EC), initiated after autumn 1998. Previous projects are described in DMI Technical Reports 94-12 and 98-3.

EC supported projects, summary

The EC supported projects at DMI described in this report primarily comes under the thematic programme on Energy, Environment and Sustainable Development of the Fifth (EC) RTD Framework Programme (1998-2002), but DMI is also involved in projects in other thematic areas.

One group of projects deals with **meteorological forecasting**, including forecasting of natural disasters and forecasting of wind energy for advanced management of wind farms (energy saving), air quality monitoring, and environmental protection. These projects are:

- Evaluation of the Climatic Impact of Dimethyl sulphide (EL-CID)
- Methods to reconcile disparate national forecasts of medium and long-range atmospheric dispersion (ENSEMBLE)
- Integrated systems for Forecasting Urban Meteorology, Air Pollution and population EXposure (FUMAPEX)
- An European Flood Forecasting System (EFFS)
- Advanced management and surveillance of wind farms (CLEVERFARM)
- Targeting Optimal use of GPS Humidity measurements in meteorology (TOUGH)
- a High resOlution Numerical wind EnergY Model for On- and Offshore ForecastiNg using ensemble predictions (HONEYMOON)

A number of projects deal with the depletion of the **stratospheric ozone layer**. There is unequivocal evidence that ozone loss in polar regions arises from chemical reactions involving chlorine compounds from man-made sources, but ozone depletion has been observed over most of the globe. In a series of European Arctic and mid-latitude stratospheric ozone experiments and campaigns, extensive measurements from ground based and balloon borne instruments are carried out over Northern Europe and Greenland and the processes involved in the ozone depletion are studied. DMI participates in these campaigns. Other ozone projects deal with the evolution of stratospheric aerosol and the formation of polar stratospheric clouds which are important for the ozone depletion processes.

The ozone projects in which DMI participates (or participated) are the following:

- Spring-to-Autumn Measurements and Modellling of Ozone and Active species (SAMMOA)
- Improved understanding of stratospheric ozone loss by collaboration with the SAGE III ozone loss and validation experiment (EUROSOLVE)
- Comprehensive Investigations of Polar stratospheric Aerosols (CIPA)
- MAPping of polar Stratospheric Clouds and Ozone levels relevant to the Region of Europe (MAPSCORE)

- Impact of tropIcal Convection on the Upper tropospHere and lower Stratosphere at gloBal Scale (HIBISCUS)
- Quantitative Understanding of Ozone losses by Bipolar Investigations (QUOBI)
- Chemical ANd Dynamical Influences on Decadal OZone changes (CANDIDOZ)
- Compilation of atmospheric Observations in support of Satellite measurements over Europe (COSE)
- Radiometer for Atmospheric Measurements At Summit (RAMAS)

A relatively large group of projects deals with **climate variations and climate changes**. These projects include analysis of observed data as well as development and use of dynamical and empirical models. The overall objectives reflected in the projects are to improve the understanding of the climate system, its variations and interactions between its components. There is special emphasis on the importance of external climatic forcing such as the greenhouse effect and ozone layer depletion on both global and regional/local European scale.

EC supported climate projects with DMI participation are the following:

- Mechanisms and PREDICtability of decadal fluctuations in ATlantic-European climate (PREDICATE)
- PRogramme for Integrated earth System Modelling (PRISM)
- DETECTion of changing radiative forcing over the recent decades (DETECT)
- Predictability and variability of monsoons, and the agricultural and hydrological impacts of climate change (PROMISE)
- Development of a European Multi-model Ensemble system for seasonal To interannual prediction (DEMETER)
- Prediction of Regional scenarios and Uncertainties for Defining EuropeaN Climate change risks and Effects (PRUDENCE)
- STAtistical and Regional Dynamical downscaling of EXtremes for European regions (STARDEX)
- Coupling of Atmospheric Layers (CAL)
- GLobal IMPlications of Arctic climate procesSEs and feedbacks (GLIMPSE)

DMI participates in a number of projects in the field of **oceanography, sea ice and climate**. These projects are:

- Integrated Observing and Modelling of the Arctic Sea ice and Atmosphere (IOMASA)
- GREENland arctic shelf ICE and climate experiment (GREENICE)
- Programme for A Baltic network to Assess and upgrade an oPerational observing and forecasting system in the region (PAPA)
- Optimal Design of Observational Networks (ODON)
- Meridional Overturning Exchange with Nordic Seas (MOEN)

- European shelf Seas Ocean Data Assimilation and forecast Experiment (ESODAE)
- Development and implementation of a generic marine SAR analysis and interpretation system for application to the coastal zones (MERSEA STRAND-1)
- Integrated Weather, Sea Ice and Ocean Service System (IWICOS)
- Greenland Sea Convection Mechanisms and their Climatic Implications (CONVECTION)

More detailed and technical descriptions of each project are given on the following pages.

Meteorological Forecasting

EvaLuation of the Climatic Impact of Dimethyl Sulphide (EL CID)

Contract EVK2-CT-1999-00033

Participants

Abbreviation	Name of Institute/Country
UWUPP.9N2.PC	Bergische Universität, Germany (Coordinator)
CNRS.LCSR	Centre National de la Recherche Scientifique, France
JRC.EI	EC Joint Research Centre, Environment Institute, Ispra, Italy
UCM.DQF	Universidad de Castilla-La Mancha, Spain
SFHG.ITA	Fraunhofer-Gesellschaft zur Förderung der Angewandten Forschung e.V., Germany
CEAM.EPRL	Fundacion Centro de Estudios Ambientales del Mediterráneo, Spain
ECRE.DC	University of Crete, Greece
CNRS.LSCE	Entre National de la Recherche Scientifique, France
UHEI.IU	Ruprecht-Karls-Universität, Germany
NILU	Norwegian Institute for Air Research, Norway
DMI	The Danish Meteorological Institute, Denmark

Project period

1 March 2000 – 28 February 2003

Objectives

The main goal with the EL CID project is to improve the understanding of the gas-phase oxidation of DMS, and the liquid-phase chemistry of DMS and DMS's oxidation products.

1) to put constrains on the large uncertainties associated with current photochemical models by providing more accurate gas-phase kinetic and photochemical data on DMS oxidation chemistry;
2) Investigate particle formation from both DMS and DMSO;
3) Simultaneous high-time resolution measurements of dimethyl sulphide, oxidation products, halogen oxides, NO;
4) Radical, and aerosol number/size distribution in three campaigns at sites with different geographical locations reflecting distinct aspects of DMS chemistry;
5) Use the data to determine the relative importance of the oxidants OH, NO(3) and halogen oxides under different atmospheric conditions;
6) Use the laboratory data to construct a DMS chemistry module for CT-models capable of describing both the remote and polluted marine atmosphere and test of the models

against the field data. The objectives will be achieved by a closely co-ordinated amalgamation of laboratory, field and modelling investigations.

Role and Responsibility of DMI

The role and responsibility of DMI in the ELCID project are to develop a general DiMethylSulphide (DMS) mechanism for atmospheric chemical transport modelling, and perform model studies on the chemical transformations and depositions of gases and aerosols in the marine atmosphere. The investigations will only be applied for the clean marine atmosphere. The goals will be achieved using results from laboratory experiments and field measurements.

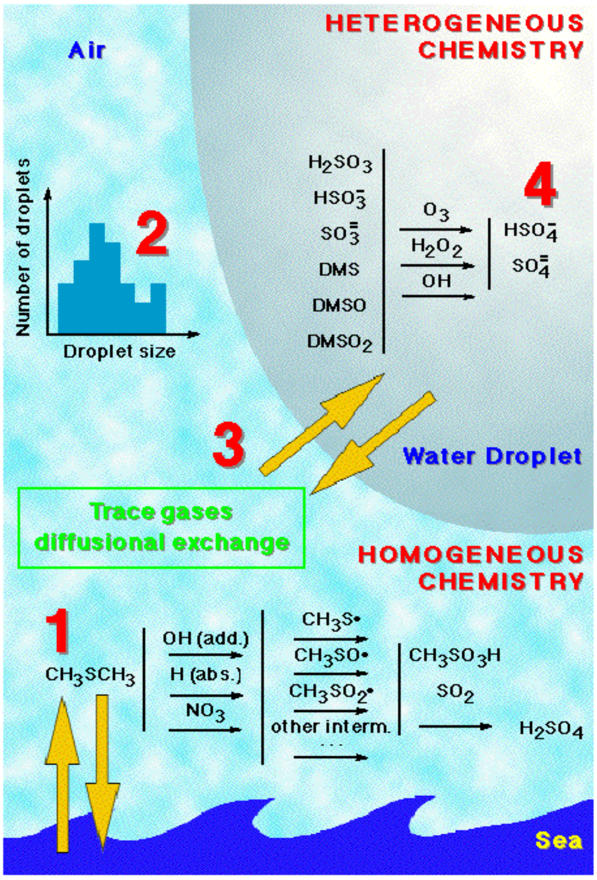


Illustration of the oxidation of CH3SCH3 (DMS) and the transfer of DMS and other oxidation products of DMS into water droplets.

1: Describes roughly the gas-phase oxidation of DMS to H2SO4 in the atmosphere (other DMS oxidation products are e.g. CH3SOCH3 (DMSO)and CH3SO2CH3 (DMSO2)). DMS, DMSO, DMSO2 and H2SO4 can be absorbed into atmospheric water droplets 2: shows an example of an atmospheric water droplet size distribution. This process is illustrated in 3. It is observed that the gas-phase and aqueous-phase are in an equilibrium. When DMS and the oxidation products of DMS are absorbed in the water droplet they can be subjected to different chemical reactions as shown in 4.

Methods to Reconcile Disparate National Forecasts of Medium and Long Range Dispersion (ENSEMBLE)

Contract FIKR-CT-2000-00038

Participants

Abbreviation	Name of Institute/Country
RISO.VEA	Risoe National Laboratory , Denmark (Coordinator)
JRC	EC, Institute for Environment and Sustainability, Ispra, Italy
UMNC.MBS	The Victoria University of Manchester, UK
DEWE.F.ADM	Deutscher Wetterdienst, Germany
KNMI.OMD	Royal Netherlands Meteorological Institute, The Netherlands
RIVM.LRR	National Institute of Public Health and Environment, The Netherlands
IRM.OSSU	Institut Royal Météorologique de Belgique, Belgium
CNRM.CEM	Centre National de Recherche Météorologique, France
MOD.MET.AD	Secretary of State for Defence, Ministry of Defence, UK
FIMI.AQD	Finnish Meteorological Institute, Finland
SMHI	Swedish Meteorological and Hydrological Institute, Sweden
DMI.RDD.M	Danish Meteorological Institute, Denmark
ZMG.EM	Zentralanstalt für Meteorologie und Geodynamik, Austria
ENVIROWARE	Enviroware Srl, Italy
IEA.IRA	National Institute of Atomic Energy Agency, Poland
DNMI.M	Norwegian Meteorological Institute, Norway
NRCSD.NTRP.E	National Centre for Scientific Research, Greece

Project period
1 October 2000 – 30 September 2003

Objctives
The ENSEMBLE project addresses the problem of achieving a common coherent strategy across European national nuclear emergency management. New decision-making procedures and Web based tools are developed which, corresponding to accidental atmospheric radioactive releases, utilize real-time long-range atmospheric dispersion model results obtained from national meteorological services and emergency centres. Using ensemble statistics methodology the dispersion results are employed to derive estimates of the most probable dispersion scenario and the associated uncertainties. A number of exercises are carried out, to which DMI contributes with results of the DERMA model using forecast and analysed data from the DMI-HIRLAM model versions. Additionally, in order to enable the Risø National Laboratory as partner

in the ENSEMBLE project to use the RODOS system within the exercises conducted, real-time delivery of DMI-HIRLAM data for local-scale and long-range atmospheric dispersion modelling are provided by DMI to Risø.

Role and Responsibility of DMI

Within the ENSEMBLE project a number of nuclear emergency preparedness exercises are carried out in which hypothetical large releases of radioactivity to the atmosphere are assumed. DMI contributes with corresponding results from its atmospheric long-range dispersion model, the Danish Emergency Response Model of the Atmosphere (DERMA), using forecast and analysed data from the various DMI-HIRLAM model versions. Additionally, in order to enable the Risø National Laboratory as partner in the project to employ the RODOS nuclear emergency decision support system within the exercises conducted, real-time delivery of DMI-HIRLAM data for local-scale and long-range atmospheric dispersion modelling are provided by DMI to Risø.

Integrated System for Forecasting Urban Meteorology, Air Pollution and Population Exposure (FUMAPEX)

Contract EVK2-CT-2002-00097

Participants

Abbreviation	Name of Institute/Country
DMI.RDD.M	Danish Meteorological Institute, Denmark (Coordinator)
DEWE.F.ADM	Deutscher Wetterdienst, Germany
UHAM.MI	Universität Hamburg, Germany
CEAM	Fundacion Centro de Estudios Ambientales del Mediterraneo, Spain
ECNA.LMF	Ecole Centrale de Nantes, France
FIMI.ADQ	Finnish Meteorological Institute, Finland
ARIANET	Arianet srl, Italy
ARPA.SMR	Agenzia Regionale Prevenzione e Ambientale dell'Emilia-Romagna, Italy
DNMI.RDD	Norwegian Meteorological Institute, Norway
NILU	Norwegian Institute for Air Research, Norway
UHER.DES	University of Hertfordshire, UK
CNRS.CORIA	Centre National de la Recherche Scientifique, France
NPHI.DEH.LAH	National Public Health Institute, Helsinki, Finland
EPFL.DRG.PAS	Swiss Federal Institute of Technology, Switzerland
JRC.EI	EC Joint Research Centre, Environment Institute, Ispra, Italy
ARPAP	Agenzia Regionale per la Protezione Ambientale del Piemonte, Italy

Project period

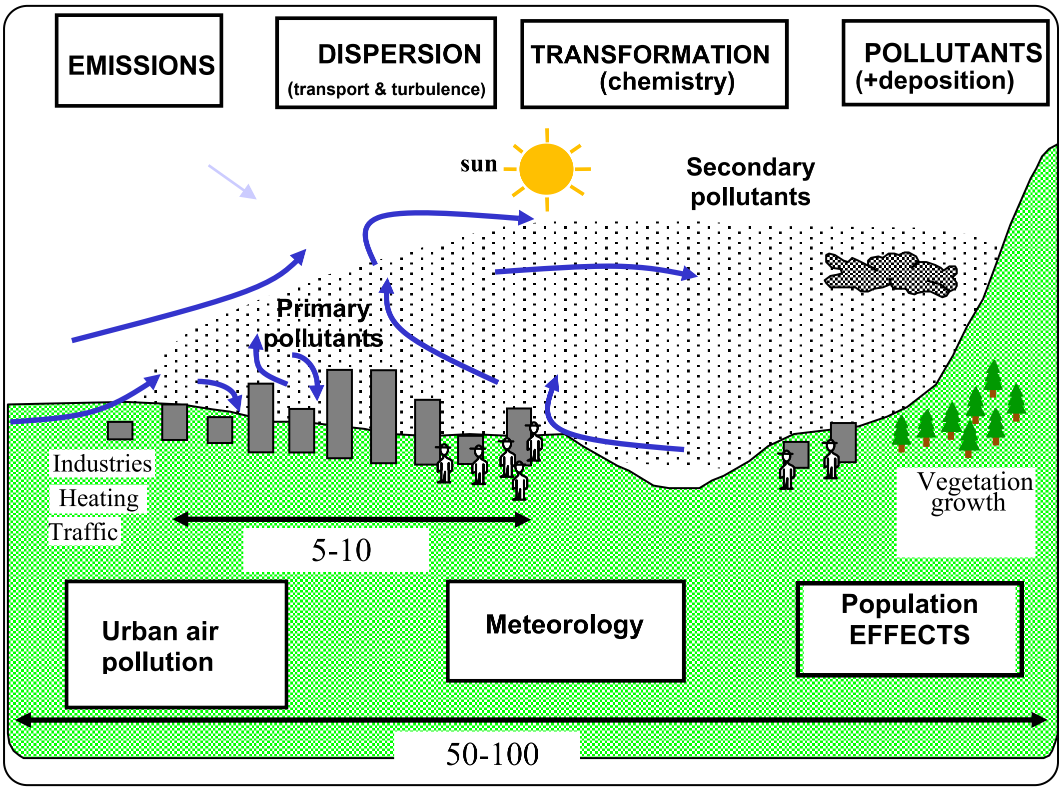
1 November 2002 – 30 October 2005

Objectives

The quality of the urban air pollution forecast critically depends on the mapping of emissions, the urban air pollution (UAP) models, and the meteorological data. The quality of the meteorological data should be largely enhanced by using downscaled data from advanced numerical weather prediction (NWP) models. These different topics, as well as the application of population exposure models, have traditionally been treated in distinct scientific and administrative communities whose expertise needs to be combined to enhance the possibilities of forecasting air pollution episodes in European cities. The main objectives of the project are thus the improvement of meteorological forecasts for urban areas, the connection of NWP models to UAP and exposure models, the building of improved urban air quality information and forecasting systems (UAQIFS), and their application in cities in various European climates. The necessary steps will evolve in ten separate but inter-linked Workpackages realised by 16 participants and 6 subcontractors. They represent leading NWP centres, research organisations, and organisations responsible for urban air quality, population exposure forecast and control, and local/city authorities from ten European countries.

Role and Responsibility of DMI

DMI is the project co-ordinator and co-ordinates Workpackages WP4 and WP10. In addition DMI will contribute to WP3, WP5, WP6 and WP8. The main tasks for DMI will be to contribute: (WP3) to the validation of the DMI-HIRLAM model analysis and forecasts during urban air pollution episodes in Europe; (WP4) to improve the urban effects and boundary layer parameterisations in the DMI-HIRLAM model with a higher resolution; and (WP5) to develop different elements of an interface from urban NWP to urban air pollution (UAP) models (estimation of mixing height, surface fluxes, velocity fields, cloud and precipitation parameters). DMI-HIRLAM will be coupled with an air pollution model. DMI will participate (WP6) in a substantial uncertainty analysis of meteorological parameters important in urban air-pollution episodes for NWP models, and an estimation of the importance of the uncertainty of the meteorological input to the total uncertainty of the UAP models. The improved high-resolution NWP forecasting will be provided to demonstrate the ARGOS emergency preparedness system for the target city of Copenhagen (WP8).



In Fumapex the overall main objective will be to improve the meteorological forecasts for urban areas and to improve urban air quality information and forecasting systems (UAQIFS).

European Flood Forecasting System (EFFS)

Contract EVG1-CT-1999-00011

Participants

Abbreviation	Name of Institute/Country
WL Delft	Delft Hydraulics, The Netherlands (Coordinator)
GRDC	Global Runoff Data Centre, Germany
LANC	University of Lancaster, UK
DMI	Danish Meteorological Institute, Denmark
UNIBOL	Universitá degli Studi di Bologna, Italy
SMHI	Swedish Meteorological and Hydrological Institute, Sweden
DWD	Deutscher Wetterdienst, Germany
RIZA	Institute for Inland Water Management and Waste Water Treatment, The Netherlands
BRISTOL	University of Bristol, UK
NIMH-Romania	National Institute of Meteorology and Hydrology, Romania
GGI	Institute of Geology and Geography, Lithuania
IMGW	Institute of Meteorological and Water Management, Poland
EA-Slovenia	University of Ljubljana, Slovenia
NIMH-Bulgaria	National Institute of Meteorology and Hydrology – Bulgarian Academy of Sciences, Bulgaria
VITUKI	Water Resources Research Centre PLC, Hungary
GRDC	Federal Institute of Hydrology, Germany
CEC	Agricultural & Regional Information System Unit Space Applications Institute, CEC, Italy
ECMWF	European Centre for Medium Range Weather Forecasts, UK

Project period

1 March 2000 – 1 October 2003

Objectives

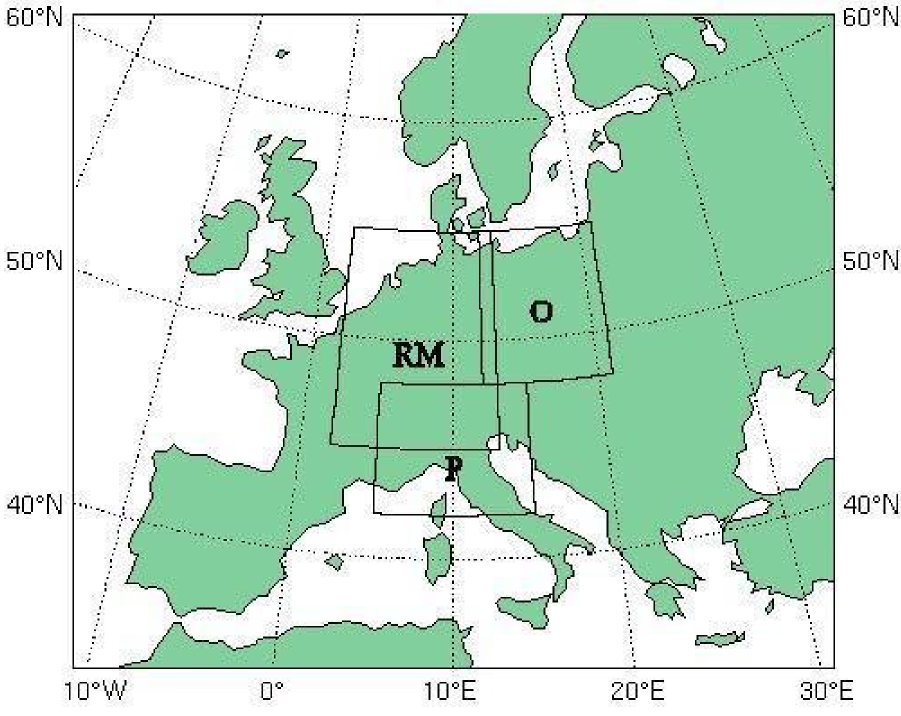
National water authorities are normally able to provide flood warnings between one and four days in advance of flood events. These warnings are usually based on weather forecasts in combination with knowledge of the actual hydrologic conditions in the river basins concerned. However, the emergency civil and water management agencies would benefit from an increase in lead-time, to effectively implement their plans in downstream areas. Therefore there exists a need for improved flood forecasting to extend the flood-warning period. Improved flood forecasting should enable more effective evacuation of people from high-risk areas or the controlled release of water from reservoirs in upstream areas to create temporary retention basins to reduce flood volumes and peaks. EFFS aims at developing a prototype of 4-10 days in advance European flood forecasting system. This system aims at providing daily information on potential floods for the large rivers Rhine and Oder as well as flash floods in small basins. The framework of the system will allow incorporation of both detailed models for specific basins as well as a broad scale for entire Europe.

Role and Responsibility of DMI

DMI's role and responsibilities in the FP5 EU project "An European Flood Forecasting System" (EFFS) are twofold.

Firstly, DMI has been one of the providers of meteorological data for use in water level prediction with hydrological models. Hindcasts using the DMI numerical weather prediction system DMI-HIRLAM in an adapted set-up have been provided for four periods, each of several weeks length, which contain historical events of large precipitation, that led to a major river flooding over European rivers.

Secondly, DMI has been leader of the work package "Downscaling and Validating Meteorological Forecasts", where studies to address uncertainty in high-resolution precipitation prediction were performed by experimenting with short-range LAM ensembles. For three of the four historical events, two different ensemble designs have been applied using DMI-HIRLAM based on the ECMWF-EPS. The DMI-HIRLAM ensembles have also been provided for use in the hydrological models.



The EFFS project includes a study on uncertainty in rainfall forecasts, in which historical floods have been investigated using HIRLAM ensembles. The areas outline the target domains of HIRLAM selection ensemble simulations for the Rhine/Meause region (RM), the Odra basin (O) and the river Po basin (P).

Advanced management and surveillance of wind farms (CLEVERFARM)

Contract ERK6-CT-1999-00006

Participants

Abbreviation	Name of Institute/Country
RISO.VEA	Risoe National Laboratory, Denmark (Coordinator)
DMI.RDD.MOR	Danish Meteorological Institute, Denmark
ISET.DCE	Institut für Solare Energieversorgungstechnik e.V., Germany
RES	Renewable Energy Systems Ltd., UK
UOLD.AP.ESR	Carl von Ossietzky University of Oldenburg, Germany
SEASDIS.WE	SEAS Distribution Cooperative Limited Society, Denmark
GRAMJUHL	Gram & Juhl Aps, Denmark

Project period

1 April 2000 – 31 March 2003

Objectives

Objectives and problems to be solved:

The idea behind this project is to take the by now many very advanced techniques developed for optimising and enhancing the performance of wind farms, integrate them into one system and implement the system at a number of wind farms. The techniques include remote measuring of the status and production of the wind farm, short-term prediction of the expected power output from the wind farm, models for wake calculations, remote control of wind farm production and so on. By combining these techniques we will make the wind farm seem intelligent to an outside viewer. For example, the wind farm will send immediate warnings to the maintenance crew if something goes wrong. It will also send e-mail to the electrical utility (and power brokers) containing its expected production over the next two days, it will suggest optimal periods for preventive maintenance, it will reduce its production if it experiences an extreme weather condition or if the power quality drops, it will give the wind farm operator real time images from the wind farm and so on.

Role and Responsibility of DMI

DMI will for the entire duration of the implementation, testing and evaluation phase deliver Numerical Weather Prediction (NWP) model output for the selected wind farms. DMI will use the newest version of it's operational NWP model DMI-HIRLAM and will provide data automatically via the Internet to the project partners and to the selected wind farms.

Targeting Optimal use of GPS Humídity measurements in meteorology (TOUGH)

Contract EVG1-CT-2002-00080

Participants

Abbreviation	Name of Institute/Country
DMI.RDD	Danish Meteorological Institute, Denmark (Coordinator)
SMHI.RD	Swedish Meteorological and Hydrological Institute, Sweden
MetO MetOffice	Secretary of State for Defence, Ministry of Defence, UK
INM	Instituto Nacional de Meteorologia, Spain
ULAQ.DF.EX	Universita degli Studi – L'Aquila, Italy
KNMI.OMD	Royal Netherlands Meteorological Institute, The Netherlands
FIMI.MR	Finnish Meteorological Institute, Finland
ACRI-ST	Mecanique Appliquee et Sciences de l'Environment - Acri SA, France
CUT	Chalmers University of Technology, Sweden
ASI	Agenzia Spaziale Italiana, Italy
TUDT.CTG.GEO.MGP	Delft University of Technology, The Netherlands
NMA.GI	Norwegian Mapping Authority, Norway
IEEC	Institut d'Estudis Espacials de Catalunya, Spain
SFOT.GEO	Swiss Federal Office of Topography, Switzerland
GOP-RIGTC.DGG	Research Institute of Geodesy, Topography and Cartography, Chech Republic

Project period

1 February 2003 – 31 January 2006

Objectives

The GENERAL OBJECTIVES for the project are to improve the use of GPS data for numerical weather prediction and climate monitoring. This shall be done by innovation of new techniques and methodologies enabling proper correction of error sources identified in previous work, as well as by initiating use of the more detailed information available in the form of the individual delays between each receiver and the GPS satellites visible to it, rather than the single average type delay used by current methods. In the project we will:

- Carry out research to optimise the assimilation of ground-based GPS in numerical weather prediction models. This research will include a proper modelling of the GPS measurement errors and application of more advanced assimilation techniques. Each step/component in the optimisation of the assimilation techniques will be verified by impact studies.

- Develop methods for use of GPS slant delays in numerical weather prediction. Use of slants will enhance the amount of information available from each ground station.
- Running a research mode data collection, by co-ordinated pre-processing and distribution of ground-based GPS measurements from Europe through a few European processing centres in support of the proposed data assimilation research efforts. The data processing centres will provide pre-processed data from subsets of the total European network, and each subset of the data should have comparable error characteristics. These error characteristics will be documented through comparisons of data from stations included in several of the network subsets (network overlap).
- Investigate the benefit of using ground-based GPS-data in numerical weather prediction using the improved assimilation software through extended parallel data assimilation and forecast experiments, with and without ground-based GPS measurements, covering all four seasons.

Role and Responsibility of DMI

DMI is the coordinator of the TOUGH project. As such DMI has the overall responsibility of ensuring the project develops according to the scientific plan and the budget, which are parts of the contract with the EC.

Besides coordinating, DMI will contribute directly to a number of scientific workpackages. This work will include: Error modelling, impact studies using 3DVar for seasons and selected cases, impact studies using 4DVar, assimilation of slant delays, tests of effect of GPS in combination with EUCOS data, production of met. data for validation of GPS (and met) products.

a High resOlution Numerical wind EnergY Model for On- and Offshore ForecastiNg using ensemble predictions (HONEYMOON)

Contract ENK5-CT-2002-00606

Participants

Abbreviation	Name of Institute/Country
UCCORK.DCE	National University of Irland, Cork, Ireland
UOLD.AP.ESR	Carl Von Ossietzky University Oldenburg, Germany
INM. PEIC	Instituto Nacional de Meteorologia, Spain
POWERGEN.DPT	PowerGen PLC, United Kingdom
DMI.RDD	Danish Meteorological Institut, Denmark
EED	Espace Eolien Developpement SARL, France
EDF.DOP	Electricité de France, France
EWE	EWE AG, Germany
POWREN	Powergen Renewables Development Limited, UK
ELTRA	I/S Eltra, Denmark

Project period

1 January 2003 – 31 December 2004

Objectives

The aim of this project is to introduce a wind energy forecasting system that is compatible with future needs of on- and offshore wind energy, and demonstrate it in real-time. The general objectives of the project are

- merging of meteorology and wind energy towards an interdisciplinary science
- tackling the main deficiencies of today's wind power prediction systems
- including future prediction techniques for offshore wind energy forecasting
- preserving high quality of real-time forecasting through continuous development and maintenance.

Role and Responsibility of DMI

HONEYMOON - A high resolution numerical wind energy model for on- and offshore forecasting using ensemble predictions. The role and responsibility of DMI is

- to provide DMI-HIRLAM forecasts to the project during a four months demonstration period
- to develop a direction dependent roughness parameterization
- to improve the coupling between WAM and DMI-HIRLAM
- to participate in the verification of the multi-model weather forecasts and wind power predictions.

An inter- operable Suite of European HPCN Tools (SEP-TOOLS)

Contract EP26276

Participants

Abbreviation	Name of Institute / Country
Pallas	Pallas Gesellschaft für Parallele Anwendungen und Systeme MbH, Germany (Coordinator)
CEDRA	Universidad Politecnica de Cataluna, Spain
FECIT	Fujitsu European Centre for Information Technology Ltd
NEC	C & C Research Laboratories Nec Europe, Germany
UoG	University of Greenwich, School Office of Computing Science and Mathematics, UK

Project period:
1 June 1998 – 30 November1999

Objectives
The European Commission (EC) commissioned a survey of High Performance Computing and Networking (HPCN) and followed up with a number of recommendations. The SEP-Tools project seeked to address the recommendations of the EC by forming close collaborations between software tool developers and Japanese HPC platform vendors, supporting the later stages of tool development, and encouraging the international uptake of European software tools.

The starting point of SEP-Tools is:

- CAPTools, a semi-automatic code parallelisation tool capable of complex code dependency analysis,
- vampir, a performance visualization tool for message-passing applications,
- dimemas, a performance prediction of message-passing applications.

The primary focus will be to develop the interfaces necessary between the tools to ensure interoperability.

Role and Responsibility of DMI
DMI's role in the project is, as a software developer, to perform an in-depth assessment of the tools suite. In order to do this, we will compare the performance of the operational DMI-HIRLAM code, put through the tool suite, with an existing hand-coded MPI version of HIRLAM, namely PARLAM.

Stratospheric Ozone Layer

Spring-to-Autumn Measurements and Modelling of Ozone and Active species (SAMMOA)

Contract EVK2-CT-1999-00049

Participants

Abbreviation	Name of Institute/Country
NILU	Norwegian Institute for Air Research, Norway (Coordinator)
DMI	Danish Meteorological Institute, Denmark
UOX	University of Oxford, UK
ULEEDS	University of Leeds, UK
FZJ	Forschungszentrum Jülich, Germany
AWI	Alfred Wegener Institute – Potsdam, Germany
UCAM	Centre for Atmospheric Science, University of Cambridge, UK
IRF	Swedish Institute of Space Physics, Sweden
KNMI	Royal Netherlands Meteorological Institute, The Netherlands

Project period

1 March 2000 – 28 February 2002

Objectives

The objective is the quantification of ozone loss in the stratosphere, a key science priority in support of the Montreal protocol. There are still discrepancies between model prediction and observations of the ozone depletion. The mid-latitude ozone decline is observed year-round. It has not been modelled quantitatively in springtime. In the summer, current models still severely overestimate ozone in the polar regions, and this appears as a major deficiency in our ability to model the complete ozone seasonal cycle. This proposal hence aims at improving our understanding and modelling of ozone loss processes throughout spring and summer, in the northern, mid and high latitudes. This is the time of year when human exposure to UV radiation is the largest in mid-latitudes.

The goal is to acquire a quantitative understanding of

- The mid-latitude ozone depletion accompanying the breakdown of the wintertime polar vortex, especially over Europe
- The Arctic summer ozone deficit and its linkage to mid-latitudes

Modelling improvements shall result in better assessment and prediction of the ozone trend and recovery in support of regulatory protocols.

Role and Responsibility of DMI

DMI coordinates workpackage 3: Dilution and ozone depletion in spring. The dilution will be calculated using vortex ozone losses derived by others. The calculations will use high-resolution 3-D RDF calculations in a 111 km equal area grid to follow the ozone depleted air inside the vortex during spring. Photochemistry will be included by running a photochemical box model along lower resolution domain-filling trajectory calculations. Further, realistic mixing will be introduced by a regridding procedure every 8th day, and the mixing properties will be investigated. It is only planned to look at the dilution after the PSC-processing stops, because the dilution prior to this is usually limited due to the weakness of the vortex erosion. The mid-latitude dilution will be quantified and the influence on the ozone trend will be assessed. Special attention will be given to the results for Europe.

For the 1997 spring the modelling will also be done meticulously and the results will be compared to the normal approach mentioned above. A new photochemical box model using a highly vectorized gear algorithm will be used. The initialisations are as used in the photochemical box model mentioned above. The new photochemical box model is run along the high-resolution RDF calculations. The calculations undergo the following steps repeatedly:

1. 8-day 3-D RDF calculations in a 1° equal area grid are done for the whole Northern Hemisphere. The heating rates are calculated using the interactively computed ozone field (from the previous step).
2. Photochemical calculations along each trajectory will be done.
3. All species will be regridded (to introduce realistic mixing).

Improved understanding of stratospheric ozone loss by collaboration with the SAGE III Ozone Loss and Validation Experiment (Euro-SOLVE)

Contract EVK2-CT-1999-00047

Participants

Abbreviation	Name of Institute/Country
NILU	Norwegian Institute for Air Research, Norway (Coordinator)
CNRS-AERO	Centre National de la Recherche Scientifique, France
DLR	Deutches Zentrum für Luft- und Raumfart, Germany
FZJ	Forschungszentrum Jülich, Germany
ULEEDS	University of Leeds, UK
AWI	Alfred Wegener Institute – Potsdam, Germany
UCWA	University College of Wales Aberystwyth, UK
UB	University of Bremen, Germany
UVSQ	Université de Versailles Saint-Quentin en Yvelines, France
DMI	Danish Meteorological Institute, Denmark
CNRS-LOA	Centre National de la Recherche Scientifique, France
URFW	Rheinische Friedrich-Wilhelms-Universität Bonn, Germany
UHEI	Ruphecht-Karls-Universität Heidelberg, Germany
CNRS-LPMA	Centre National de la Recherche Scientifique, France
CNRS-LPCE	Centre National de la Recherche Scientifique, France
SISP	Swedish Institute of Space Physics, Sweden
ETH	Eidgenössische Technische Hochschule, Switzerland
UBern	Universität Bern, Switzerland
UKARL	Universität Karlsruhe, Germany
FMI	Finnish Meteorological Institute, Finland

Project period

1 January 2000 – 31 December 2000

Objectives

The main objective is to obtain a better understanding of the processes that lead to stratospheric ozone loss in the Arctic during winter and spring. More specifically THESEO 2000-EuroSOLVE aims at:

1. Quantifying the degree and geographical extent of chemically-induced (anthropogenic) ozone loss in the Arctic vortex during the 1999-2000 winter.

2. Improving our knowledge on the role of lee-wave induced polar stratospheric clouds in the activation of passive reservoir compounds into active forms that destroy ozone.
3. Obtaining a more complete picture of the most important chemical species involved in chemical ozone destruction.
4. Closing the gap between measured and theoretically calculated ozone loss.
5. Creating the best possible synergy between THESEO 2000 and the US SOLVE campaign.

THESEO 2000 and SOLVE will be coordinated so that one gets the best possible coverage in measured species, and temporal and spatial coverage. For the first time one will get information on key chemical and physical parameters throughout the lifetime of the polar vortex from autumn to spring.

Role and Responsibility of DMI

For campaign planning and post-campaign analyses, fields of potential vorticity and temperature on several isentropes have been calculated, using both analyses and forecast data (up to 8 days of forecast). Further isentropic trajectories ending at most measurement sites have been calculated daily.

Analysed temperatures of several numerical weather prediction centres will be compared to observed temperatures to assess their accuracy.

The DMI Brewer spectrometer at Kangerlussuaq, Greenland. The observatories at Kangerlussuaq and Pituffik are part of the Network for Detection of Stratospheric Change (NDSC).

Comprehensive investigations of polar stratospheric aerosols (CIPA)

Contract EVK2-2000-00095

Participants

Abbreviation	Name of Institute/Country
DMI	Danish Meteorological Institute, Denmark (coordinator)
MPI	Max-Planck-Institut für Kernphysik, Germany
FZK	Forschungszentrum Karlsruhe, Germany
CNR-IFA	Istituto di Fisica Atmosferica di CNR, Italy
CNRS-LMD	Laboratoire de Meteorologie Dynamique, France
ENEA	Ente Per le Nuevo Tecnologie, Italy
UW	University of Wyoming, USA
ENSUP	Ecole Normale Superieure, France

Project period

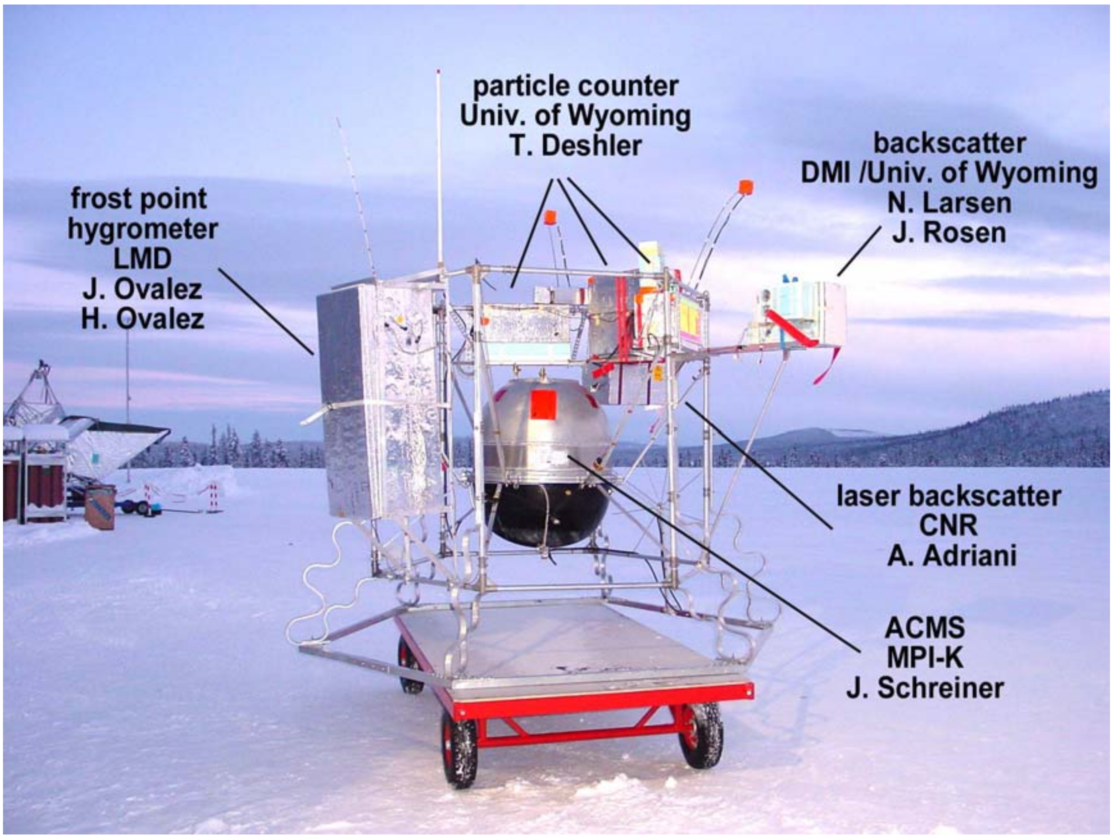
1 October 2000 – 30 June 2003

Objectives

The objective is to obtain a detailed knowledge of the pathways to formation of different types of PSCs. This is accomplished by balloonborne measurements of particle chemical composition, size distributions, phase, and optical properties in combination with large-scale cryo-chamber experiments. The investigation combines three activities as an integrated research project: Field measurements, large-scale laboratory simulations, and microphysical and optical modelling. Balloon-borne experiments will be performed from Kiruna in winters 2000/2001, 2001/2002, and 2002/2003 using multi-instrument payloads to measure the chemical and physical characteristics of PSC particles and their gas phase environment. The payloads consist of an aerodynamic focusing lens and a mass spectrometer for measurements of condensed H_2O and HNO_3, together with detection of dissolved trace gases. Optical particle counters provide particle concentration and size distributions, and backscatter sondes measure the backscatter ratio at four wavelengths and depolarisation. Physical phase and refractive indices of the particles are derived from these measurements. Finally, observations are made of near-gondola environment, especially temperature and water vapour. Nearly identical instrumentation will be used within a large cryo-chamber to perform simulations of PSC particle formation over a wide temperature and gas phase range. Temperature and the gas environment of the chamber will be monitored and changed, both systematically and in a way to simulate the particle evolution in connection with the balloon-borne observations. Over periods of hours and days, composition, size distribution, and phase of aerosols will be continuously measured. The meteorological conditions in connection with the balloonborne field measurements will be analysed by non-hydrostatic meteorological mesoscale model calculations, providing high-resolution temperature histories of the observed air parcels. Microphysical and optical models will be used to calculate the chemical compositions, physical phase, size distributions, and optical properties of PSC particles, which can be compared directly to the field and laboratory measurements.

Role and responsibilities of DMI

The responsibility of the Danish Meteorological Institute lies in co-ordination of the project and in the work concerning the meteorological temperature forecasting and mesoscale analysis of the mountain leewave situation in connection with the balloonborne experiments. DMI will also be responsible for the microphysical model simulations of polar stratospheric clouds and analysis of experimental data.



Balloon-borne gondola used within the CIPA project for measurements of chemical and physical properties of polar stratospheric clouds. In the centre of the gondola is located an aerosol mass spectrometer for chemical analyses of the micro-meter sized particles. At the upper level are installed several instruments for measurements of particles size distributions, physical phase, and optical backscatter. The gondola is also equipped with a frost point hygrometer (left) for measurements of water vapour concentrations. The gondola is launched from Esrange, Sweden, with a 250.000 m3 balloon and the fight duration is typically 3-4 hours. Within the CIPA project and in collaboration with the German POSTA project, 4 flights of this type have been performed.

Mapping of Polar Stratospheric Clouds and Ozone Levels relevant to the region of Europe (MAPSCORE)

Contract EVK2-2000-00072

Participants

Abbreviation	Name of Institute/Country
ULE	University of Leicester, UK
NILU	Norwegian Institute for Air Research, Norway
DMI	Danish Meteorological Institute, Denmark
DLR	Deuche Zentrum für Luft- und Raumfarht, Germany
UNIVLEEDS	University of Leeds, UK
CCLRC	Rutherford-Appelton Laboratory, UK
ETHZ	Swiss Federal Institute of Technology, Switzerland
CNR-IFA	Istituto di Fisica Atmosferica di CNR, Italy
BISA	Belgian Institute for Space Aeronomy, Belgium
BUGHW	Bergische universitaet – gesamthochschule, Germany
CNRS-SA	Service d'Aeronomie, France
AWI	Alfred Wegener Institut, Germany

Project period

1 January 2001 – 31 December 2003

Objectives

The objectives of the MAPSCORE project are (1) To enable European scientists to fully exploit existing datasets from field and satellite campaigns by providing validated maps of PSC behaviour and denitrification, calculated from sub-grid scale microphysical models, in the stratosphere over Europe; (2) To provide validated maps of chlorine activation and polar ozone depletion rates,from chemical assimilation models integrated with detailed sub-grid scale microphysical models, to support European scientists engaged in characterising ozone trends on short term and on climatic timescales; (3) To provide added-value products to the European stratospheric ozone observing system by deriving new information on PSCs from atmospheric data interpreted by novel laboratory measurements of optical properties, and by employing the chemical assimilation model to describe the hemispheric behaviour of ozone and related species.

Role and responsibilities of DMI

A systematic study to investigate the effects from localised leewave cooling events on PSC properties on a hemispheric scale. Domain filling trajectories will be calculated for selected past NH winters. The trajectories are initialised on a dense regular grid in mid-winter inside the polar vortex. The trajectories are calculated in a backward and forward model, spanning the whole PSC season. The temperature histories are used as input to a microphysical box model. Effects of mountain leewave events will be investigated in two ways. First, a parameterisation of mountain wave cooling, using NH orography and surface winds will be applied to trace those trajectories which could have been exposed mountain wave temperature depressions, possibly holding signatures of freezing and solid type PSC formation. Second, radiosonde data will be used to correct analysed temperatures like ECMWFs. It is planned to correct ECMWF temperatures according to the nearest radiosonde to quantify the effect on calculated PSC surface areas. Finally, the uncertainties of the used temperatures will be estimated and the effects of the modelled PSC occurrences are assessed. Validation of PSC fields against lidars/-SAOZ/satellite data fields will be performed including critical tests of PSC composition and physical phase identification from observational data.

Impact of tropical convection on the upper troposphere and lower stratosphere at global scale (HIBISCUS)

Contract EVK-CT-2001-00055

Participants

Abbreviation	Name of Institute/Country
CNRS-SA	Service d'Aeronomie, France (Coordinator)
CNRS-LMD	Laboratoire de Meteorologie Dynamique, France
UCAM	Centre for Atmospheric Science, University of Cambridge, UK
NPL	National Physical Laboratory, UK
DMI	Danish Meteorological Institute, Denmark
CNR-IFA	Istituto di Fisica Atmosferica di CNR, Italy
CNRS-LPCE	Lab. de Physique et Chimie de l'Environnement, France
UMIST	University of Manchester, UK
NILU	Norwegian Institute for Air Research, Norway
ENEA	Ente Per le Nuevo Tecnologie, Italy
ENSUP	Ecole Normale Superieure, France
UVSQ	Université de Versailles Saint Quentin en Yveline, France

Project period

1 February 2002 – 31 January 2005

Objectives

The source of chemical species involved in stratospheric ozone depletion at global scale, lies in the tropics where they are transported vertically from surface level to the tropopause by deep convection. Among most important species and aerosols specific to the tropics which could have an impact on ozone and climate in the future are: the still unknown volume of NOx production by lightning, a prerequisite to evaluate the impact of aircraft, and the chemical impact of biomass burning, change of agricultural practices and pollution from fast growing population in tropical developing countries on the upper troposphere and the lower stratosphere.

Within this frame, HIBISCUS is to study the vertical and horizontal transport from the upper troposphere to the lower stratosphere including the contribution of meso- and small scale waves associated to deep convection, to assess the quality of current operational global meteorological models in the tropics, and to explore the mechanism which controls the amount of water vapour reaching the stratosphere and the possible causes of its trend in the stratosphere, the impact on chemistry of short lived active chemical species lifted by convection, as well as of aerosols on the formation of thin cirrus at tropopause levels and their impact on chemistry and radiation transfer. The approach, based on successful techniques developed for the Arctic European campaigns in the 90's, is to combine in situ measurements by a variety of instruments flown on small balloons for few hours in Brazil during the summer convective season and on long duration balloons for several weeks around the world at the tropics, with state of the art transport, microphysical, radiative and chemical modelling. Long duration balloons planned combine in situ measurements of meteorology, ozone and water vapour on constant level superpressure balloons at and immediately above the tropopause (80 and 60 hPa) and remote sensing in the upper troposphere and the lower stratosphere of temperature, aerosol and of chemical composition from IR Montgolfier flying above, at 24-27 km.

Specific anticipated deliverables are: a validation of satellite (particularly ENVISAT) measurements at the tropics and the determination of the altitude down to which their measurements could be reliable; a study of the accuracy of global operational meteorological models (particularly ECMWF) in the tropics and of possible causes of deviations (i.e. mesoscale waves); an evaluation of the amplitude of NOx production by lightning and alternatively lifting from biomass burning and urban pollution needed to better understanding the relative impact of aircraft exhaust, the measurement of the frequency and geographic distribution of sub-visible cirrus at global scale.

Role and responsibilities of DMI

Analysed temperatures and winds in the tropics will be evaluated against the balloon observations. This will be done for both future flights within the present project, as well as past long-duration flights in the tropics of IR Montgolfier as well as Superpressure constant level balloons whose data are available at participants 01 and 02. More than 16 flights lasting from 3 to 39 days were launched near the equator from 1991-2000, and 19 flights in the tropics launched from South Africa (25S) from 1985-89, which might be used also. Further, calculated trajectories will be compared to the balloon trajectories to assess their accuracy.

A microphysical model will be used to investigate aerosol and cirrus cloud properties, performing analysis of in-situ optical measurements, obtained by balloon-borne microlidar and backscattersonde, in combination with simultaneous water vapour and temperature measurements. In focus of the investigations will be those meteorological conditions and microphysical processes, which lead to large-scale sub-visible cirrus formation near the tropical tropopause. This could be in connection with deep convective systems, lifting lower tropospheric air and aerosols to the upper troposphere and the lower stratosphere. Outflow from such systems may lead to extended cirrus formation. It will be investigated how aerosol properties, water vapour, and temperature conditions will effect the processes of homogeneous aerosol freezing, activation of cloud condensation nuclei, and sub-visible cirrus formation. Microphysical simulations will be performed in connection with specific cloud formation events observed during the balloon flights. The aerosol and cirrus particle size distributions, calculated by the microphysical model, will serve as input for calculations of radiative and chemical properties of the clouds and will be compared with observations.

Quantitative Understanding of Ozone losses by Bipolar Investigations (QUOBI)

Contract EVK2-2001-00132

Participants

Abbreviation	Name of Institute/Country
AWI	Alfred Wegener Institute – Potsdam, Germany (Coordinator)
CAO	Central Aerological Observatory, Russia
BAS	British Antarctic Survey, UK
UPMC	Université Pierre et Marie Curie, France
DMI	Danish Meteorological Institute, Denmark
FMI	Finnish Meteorological Institute, Finland
FUB	Free University of Berlin, Germany
FZJ	Forschungszentrum Jülich, Germany
INTA	Instituto Nacional de Técnica Aerospatial, Spain
NILU	Norwegian Institute for Air Research, Norway
UWA	University of Wales Aberystwyth, UK
UCAMB	University of Cambridge, UK
ULEEDS	University of Leeds, UK
AUTH	University of Thessaloniki, Greece
CNRS	Centre National de la Recherche Scienfitique, France

Project period

1 January 2002 – 31 December 2004

Objectives

The main objective of the proposed work is to test our quantitative understanding of the chemical mechanisms that destroy ozone in the wintertime Arctic stratosphere and to improve the representation of these processes in chemical models of the atmosphere. Chemical ozone destruction rates in two polar winter/spring periods will be determined in different ways.

Firstly, ozone profile data will be gathered by the use of ozonesondes. Within two campaigns, one in the Arctic and one in the Antarctic, several hundred ozonesondes will be launched in a co-ordinated manner such that single air-parcels will be probed twice (Match method).

Secondly, data from several satellite-borne instruments (POAM III, OSIRIS, SAGE III, ILAS II and instruments on board of ENVISAT) will be used in the same way as the ozonesonde measurements.

In order to validate the Match results, comparisons with other experimental techniques, i.e. a vortex average method and a tracer correlation method, will be performed. An important part of the project is the critical comparison of the Match results with several box/trajectory models as well as state-of-the-art 3-D chemical transport models. Discrepancies between measured and modelled ozone loss rates will be identified and attributed to different meteorological conditions. As the latter differ significantly between Arctic and Antarctic, the proposed bipolar approach improves the chance of identifying the reasons of possible discrepancies.

Role and Responsibility of DMI

Due to the rather homogenous distribution of ozone within the vortex, the temporal development of the vortex averaged mixing ratios usually gives a good estimate of the ozone depletion. On short terms this method is not as accurate as the Match method, but for the total depletion over the whole winter, it might be comparable, and provides a more or less independent check of the match results. Some degree of inhomogeneity of the vortex ozone mixing rations could be dealt with by dividing the vortex into different parts (by PV) and average each part individually. At the bottom of the vortex transport into the vortex might affect the calculations, but well above the bottom this is negligible. The radiative cooling, which is a necessary prerequisite for calculating the ozone depletion correctly, will be determined independently from the cooling used by Match, using the Morcrette radiation scheme. The effect of using actual ozone in the radiation calculations instead of climatological ozone will be quantified. The results of the different heating rate calculations will be compared.

Chemical and Dynamical Influences on Decadal ozone change (CANDIDOZ)

Contract EVK2-2001-00024

Participants

Abbreviation	Name of Institute/Country
FMI	Finnish Meteorological Institute, Finland (Coordinator)
ETH	Eidgenössische Technische Hochschule, Switzerland
UCAMB	University of Cambridge, UK
UPMC	Université Pierre et Marie Curie, France
AUTH	University of Thessaloniki, Greece
ASCR	Institute of Atmospheric Physics, Czech republic
CHMI	Czech Hydro-Meteorological Institute, Czech republic
DMI	Danish Meteorological Institute, Denmark
AWI	Alfred Wegener Institute – Potsdam, Germany
UoO	University of Oslo, Norway
NILU	Norwegian Institute for Air Research, Norway
UB	University of Bremen, Germany
CNRS	Centre Nationale de la Recherche Scientifique, France
UoA	National and Kapodistrian University of Athens, Greece

Project period
1 April 2002 – 31 March 2005

Objectives
The main objective is to establish a scientific basis for the detection of the earliest signs of ozone recovery due to Montreal protocol and its amendments. We use two approaches to achieve our main objectives. First, we will advance the capabilities of trend models to capture dynamical/chemical forcings to corresponding terms in the model and apply the refined model to the longest homogenized ozone data series. The second approach relies to comprehensive global data analysis and global modeling involving most recent long-term data sets of meteorological analysis. The two approaches are complementary and interactive. A significant input is expected from the global analyses and modeling exercises in refining the trend models. Technically, the work is arranged in five work packages. WP1 is devoted to trend studies exploiting selected ground based data sets from mid-latitudes and satellite data sets. In WP2 mid-latitude trends are supplemented by similar analyses from polar observations. Polar vortex is analyzed in the context of global dynamics and interactions between polar and mid-latitudes are studied. In WP3, changes in residual circulation will be quantified, their role in redistribution of ozone in mid and high latitudes are assessed and the coupling of stratosphere and troposphere is studied in the light of known atmospheric

variations such as Arctic Oscillation (AO) or North Atlantic Oscillation (NAO). In WP4 long duration integrations are performed with a set of four complementary chemical transport models and a mechanistic model all forced by long-term meteorological data. The mechanistic model is also run in several experiments with different emission scenarios and greenhouse gas forcing 50 years into future to study the responses of ozone recovery to climate change. The resulting global fields of various models are subsequently compared and analyzed to find different aspects of the role of chemistry and dynamics. Finally, we link these two approaches together in a synthesis work package WP5.

Role and Responsibility of DMI

Satellite measurements have shown that the mid-latitude ozone depletion has been worst over the European area. It is well known that decadal variations in the structure of the planetary waves explain about half the existing longitudinal differences in the ozone trends. Recently, Knudsen and Andersen (Nature, 2001) have shown that transport of the ozone depletion inside the polar vortex plays an important role in spring. In the last decade massive ozone depletions inside the polar vortex have often taken place. Now, it turns out that the vortex and its remnants have preferred locations, where they increase the magnitude of the ozone trend. The effect on ozone of the long-term changes in the structure of the planetary waves is quantified through a regression analyses. The influence of the polar vortex depletions on the mid-latitude ozone in spring is determined by following the vortex air with room filling trajectory calculations. Further we want to test whether this a robust feature, which is likely to continue in the future. This might be very important for Europe and Russia in the future, if, as some climate models suggest, the Arctic vortex depletion will increase in the future. The calculations are dependent on the availability of accurate total column vortex ozone depletion, which only exist for a few years. Therefore we also want to look at the longitudinal differences in occurrence frequency of the vortex and its remnant, which can be calculated for a greater number of years.

The trend calculations in Knudsen and Andersen (Nature, 2001) use the transported vortex ozone depletions as explanatory variables, which take part in the regression. This is unphysical, however, since the transported vortex ozone depletions are known. In this project we want to take this into account in the trend calculations. The crucial calculations of the transport of ozone depleted air from the vortex will be validated against measurements.

Compilation of atmospheric Observations in support of Satellite measurements over Europe (COSE)

Contract ENV4-CT98-0750

Participants

Abbreviation	Name of Institute/Country
AWI	Alfred-Wegener-Institut für Polar- und Meeresforschung, Germany
DMI	The Danish Meteorological Institute, Denmark
BIRA/IASB	Belgian Institute for Space Aeronomy, Belgium
FIMI	Finnish Meteorological Institute, Finland
UBE	University of Berne, Switzerland
NILU	Norwegian Institute for Air Research, Norway
UBx1	Université de Bordeaux , France
IVL	Swedish Environmental Research Institute Ltd., Sweden
UNI-Bremen	Universität Bremen, Germany
ULG	Université de Liège, Belgium
GKSS	Forschungszentrum Geesthacht GmbH, Germany
CNRS	Centre National de la Recherche Scientifique, France
FhG	Fraunhofer-Gesellshcaft zur Förderungen der angewandten Forschung e.V., Germany

Project period

1 October 1998 – 30 September 2000

Objectives

The ***COSE*** proposal is based on reliable and demonstrated ground-based instruments deployed in networks, for monitoring of atmospheric species. The global objective of ***COSE*** is to co-ordinate the ground-based observations mainly performed in Europe, in order to provide the Earth Observation community with a validated, consistent and well-documented data set of atmospheric compounds, columns and/or profiles, that builds on past time series, and that will be archived in a data base for immediate and future exploitation.

The project is driven by several customer requirements, namely, (i) the satellite validation product needs for GOME, ODIN, MOPITT, (ii) the THESEO campaign co-ordinated by the EC, including data that are needed to develop data assimilation, (iii) the necessary data base to collect qualified data, including those needed for upcoming ENVISAT validation and for international programmes like NDSC and SPARC. The methodology consist of (i) an observational phase to acquire data needed to meet the customers requirements, (ii) a so-called consolidation phase to transform the data into products and information directly supporting the customer applications and (iii) a demonstration related to the actual and upcoming satellite validation requests; all three will be running in parallel. After consolidation of products with the customer, they will be archived in dedicated database for further application. A contribution to User Support and Enabling Sources is also included in the project.

Role and Responsibility of DMI

To provide the following data from Pituffik, Greenland, to the database at NILU:

1. Ozone profiles
2. Total ozone column data from UV-VIS (DOAS) instruments
3. NO2 column data from UV-VIS (DOAS) instruments
4. Backscatter sonde data

An ozone sonde is prepared for launch at Pituffik, Greenland.

Radiometer for Atmospheric Measurements at SUMMIT (RAMAS)

Contract EVK-CT-2001-00097

Participants

Abbreviation	Name of Institute/Country
UHB	University of Bremen, Germany (Coordinator)
OBX	Observatoire de Bordeaux, France
DMI	Danish Meteorological Institute, Denmark
UNIVLEEDS	University of Leeds, UK

Project period

1 August 2001 – 31 July 2004

Objectives

The maximum loading of the stratosphere with chlorine (Cl) is expected around year 2000, and consequently also the maximum ozone depletion. How long the recovery of the ozone layer will take place is unclear. State-of-the-art models predict 10 to 50 years; however, these models are incomplete, and they cannot reproduce the presently established ozone decline. Therefore it is an absolute requirement to continuously observe the ozone layer and key constituents of ozone destruction. Polar regions where the largest ozone decline has been observed can be used as an indicator for the recovery of the ozone layer. Therefore the projects will imply the installation of a microwave sensor at the SUMMIT station in Greenland as part of the Network for the Detection of Stratospheric Change (NDSC). SUMMIT provides the only high altitude site available in the Arctic necessary for such a sensor. Microwave radiometry is the only proven technique to observe simultaneously profiles of ozone and the key Cl species ClO.

Role and responsibilities of DMI

Coordinate the validation of data collected by RAMAS at SUMMIT, in particular for the key-parameters such as ozone and ClO. Lead the analysis and interpretation of retrieved parameters and coordinate the data-exchange between partners. Organise the dissemination of results, in particular supervise the proper archiving of the data in appropriate databases.

Mechanisms and Predictability of Decadal Fluctuations in Atlantic-European Climate (PREDICATE)

Contract EVK2-CT-1999-00020

Participants

Abbriviation	Name of Institute/Country
UREAD.DMHA	Centre for Global Atmospheric Modelling, Univ. of Reading, UK (Coordinator)
UKMO	Hadley Centre for Climate Prediction and Research, UK
MPG.IMET	Max-Planck Institut für Meteorologie, Germany
UPMC.LODYC	Université Pierre et Marie Curie, Laboratoire d'Oceanographie Dynamique et de Climatologie, France
NERSC	Nansen Environment and Remote Sensing Centre, Norway
ING	Istituto Nazionale di Geofisica, Roma, Italy
DMI	Danish Meteorological Institute, Copenhagen, Denmark
CERFACS	Centre Européen de Recherche et de Formation Avancée en Calcul Scientifique, Toulouse, France

Project period
1 March 2000 – 28 February 2003

Objectives
PREDICATE has the following objectives:

- To assess the predictability of decadal fluctuations in Atlantic-European climate.
- To improve understanding and simulation of mechanisms via which ocean-atmosphere interactions cause decadal fluctuations in Atlantic-European climate.
- To improve the European capability for forecasting decadal fluctuations in Atlantic-European climate by developing forecasting systems based on coupled ocean-atmosphere models.
- To work with targeted user groups to assess the potential benefits from possible future decadal forecasts for selected sensitive industries.

The work programme is divided into four workpackages:

WP1: Mechanisms and predictability of decadal fluctuations in the atmosphere of the Atlantic-European region

WP2: Mechanisms of decadal fluctuations in the Atlantic ocean

WP3: Decadal climate prediction for the Atlantic-European region.

WP4: Project management, interaction with users and dissemination of results

Role and Responsibility of DMI

DMI is involved in workpackage 1 dealing with mechanisms and predictability of decadal fluctuations in the atmosphere of the Atlantic-European region. In this workpackage, we have

- elucidated the mechanisms through which fluctuations in SST force fluctuations in the atmosphere of the Atlantic-European region:

We have conducted multidecadal ensemble simulations with the ECHAM5 model. We have analyzed potential predictability and the most predictable component (i.e., time-space pattern).

- investigated how and why the atmospheric response to decadal changes in SST varies with season:

We have conducted multidecadal simulations where the atmosphere is forced by idealized positive or negative SST anomalies. With this approach, it is possible to identify the SST patterns that have most influence on Atlantic-European climate and their temporal evolution.

- investigated how the atmospheric response to decadal changes in SST depends on the mean atmospheric state and the model formulation:

We have conducted multidecadal simulations as outlined above, but with a model version which is weakly empirically forced to reduce the systematic errors of the model. This forcing was obtained via assimilation ("nudging") of observed data (in our case ECMWF reanalyses).

Programme for integrated Earth system modelling (PRISM)

Contract EVR1-CT-2001-40012

Participants

Abbreviation	Name of Institute/Country
MPG.IMET	Max Planck Institute for Meteorology, Germany (Coordinator)
KNMI	Royal Netherlands Meteorological Institute, The Netherlands
MPG.MDG	MPI Model & Data Group, Germany
UKMO	Hadley Centre for Climate Prediction and Research, United Kingdom
UREAD.MET	University of Reading, United Kingdom
CNRS.IPSL	Centre Nationale de Recherche Scientifique, Institut Pierre Simon Laplace, France
DMN.CNRM	Météo France, France
CERFACS	Centre Européen de Recherche et de Formation Avancée en Calcul Scientifique, Toulouse, France
DMI	Danish Meteorological Institute, Copenhagen, Denmark
SMHI	Swedish Meteorological and Hydrological Institute, Sweden
NRSC	Nansen Environmental and Remote Sensing Centre, Norway
ETH.CSCS	Swiss Centre for Scientific Computing, Zurich, Switzerland
NI	National Institute of Geophysics, Italy
MPG.BGC	Max Planck Institute for Biogeochemistry, Germany
PIK	Potsdam Institute for Climate Impact Research, Germany
ECMRWF	European Centre for Medium Range Weather Forecast, UK
UCL.DP.ASTR	Université Catholique de Louvain, Belgium
NECDE.ESS	NEC Deutschland Gmbh, Germany
FECIT	Fujitsu European Centre for Information Technology, France
SGIDE	Silicon Graphics GmbH, Germany
SUNMIC	Sun Microsystems GmbH, Germany
NECCE.CCRL	NEC Europe, London, UK

Project period
1 December 2001 – 30 November 2004

Objectives
The "Programme for integrated Earth system modelling" will, in form of a pilot infrastructure project, establish a climate research network in Europe. The project was proposed because the real and potential expertise in climate modelling in Europe is widely distributed. This is basically healthy, but implies that a successful European climate modelling initiative must develop mechanisms for effectively combining this expertise in a coordinated scientific framework.

The overall objective of PRISM is to undertake a pilot infrastructure towards the establishment of a distributed European network for Earth system modelling.

To reach this objective, PRISM will

- create a European service and management infrastructure for developing, coordinating and executing a long-term programme of European-wide, multi-institutional climate and Earth system simulations
- develop a European system of portable, efficient and user-friendly Earth system/climate community models and associated diagnostic/visualisation software under standardised coding conventions that can be accessed by all European scientists.

Role and Responsibility of DMI

DMI is coordinating the workpackage dealing with the system specification and scientific layout of the PRISM system. DMI is further involved with the inclusion of regional models into a common PRISM coupling system and in the conduction of demonstration simulations that will be run when the system has been set up completely.

The system specification workpackage is of particular importance for the whole project. A number of documents have been created which define in detail how the components, such as atmosphere, ocean, land surface etc. can communicate with each other via the coupler, thus enabling us to create truly integrated models of the Earth system. These documents are being circulated in the scientific community.

Detection of Changing Radiative Forcing over the Recent Decades (DETECT)

Contract EVK2-CT-1999-00048

Participants

Abbreviation	Name of Institute/Country
DMI	Danish Meteorological Institute, Denmark (Coordinator)
MPI.MET	Max Planck Institute for Meteorology, Germany
UTA.DSRC.DGP	University of Tel-Aviv, Israel

Project period

1 July 2000 – 30 June 2003 (an extension to 31 December 2003 applied for).

Objectives

The EC-project DETECT will estimate temporal variations in AGCM estimates of systematic (running decadal mean) initial temperature tendencies (SITTs) due to observed and calculated radiative forcings of the Earth climate system over the last four decades. The SITTs, due to different kinds of modelled processes, will be calculated during assimilation in the AGCM of data, i.e. the ERA-40 data and concentrations (and / or observed emissions) of gasses and aerosols. The preliminary determined total SITTs will be compared with observed changes using systematic initial temperature tendency errors (SITTEs), the calculated minus the observed SITTs. This may facilitate consideration of processes not included in the AGCM and give conservative estimates of the SITTEs for individual forcings, although in general the SITTEs cannot be distributed on the different processes. The forcings to be analysed separately are those related to well mixed greenhouse gases, ozone, water vapour, clouds, stratospheric (volcanic) and tropospheric (e.g. sulphates and desert dust) aerosols, solar irradiation, and surface albedo. A final task is to set up a heat budget, for different parts of the Earth climate system, as a function of time. It should facilitate a detection of climate variations over the recent decades and an attribution of the causes of these variations.

Role and Responsibility of DMI

DMI is coordinating the project and is responsible for the preparation of the assimilating AGCM and for establishing a data base for the diagnostic output. In addition DMI is the principal investigator in the work packages on "ozone forcing" and on "heat budget studies".

PRedictability and variability Of Monsoons and the agricultural and hydrological ImpactS of climate changeE (PROMISE)

Contract EVK2-CT-1999-00022

Participants

Abbreviation	Name of Institute / Country
UREAD.MET	Department of Meteorology, University of Reading, UK (Coordinator)
CIRAD.AMIS.AG	Centre de Cooperation Internationale en Recherche Agronomique pour le Development, France
DMN.CNRM.MGREC	Météo France, Paris, France
DMI.CD	Danish Meteorological Institute, Copenhagen, Denmark
UNESCO.ICTP.PWC	The Abdus Salam International Centre for Theoretical Physics, Italy
NERC.IH	Centre for Ecology and Hydrology, Wallingford, UK
CNRS.LMD	Centre Nationale de la Recherche Scientifique, Laboratoire de Meteorologie Dynamique, France
MPG.IMET	Max-Planck-Institut für Meteorologie, Germany
MOD.MET.HC	Hadley Centre for Climate Prediction and Research, UK
UREAD.DA	Department of Agriculture, University of Reading, UK
ECMRWF	European Centre for Medium-Range Weather Forecasts, UK
ENSUP.LMD	Ecole Normale Supérieure, Paris, France
UBOU.CRM	Centre de Recherches de Climatologie, Université de Bourgogne, France

Project period
1 April 2000 – 31 March 2003

Objectives
PROMISE is a three-year (2000-2003) research project funded by the European Commission with a total budget of 1.6 million Euros. It brings together state-of-the-art climate and seasonal prediction models with sophisticated models of ground hydrology, water balance for large river catchments, land use changes, crop development and productivity to attack the following issues:

- the potential for seasonal prediction and the benefits that would accrue in terms of the management of water resources and agriculture

- the impacts of anthropogenic climate change on tropical countries, in particular on the availability of water resources for human use, and on the productivity of crops and the potential changes in the natural vegetation

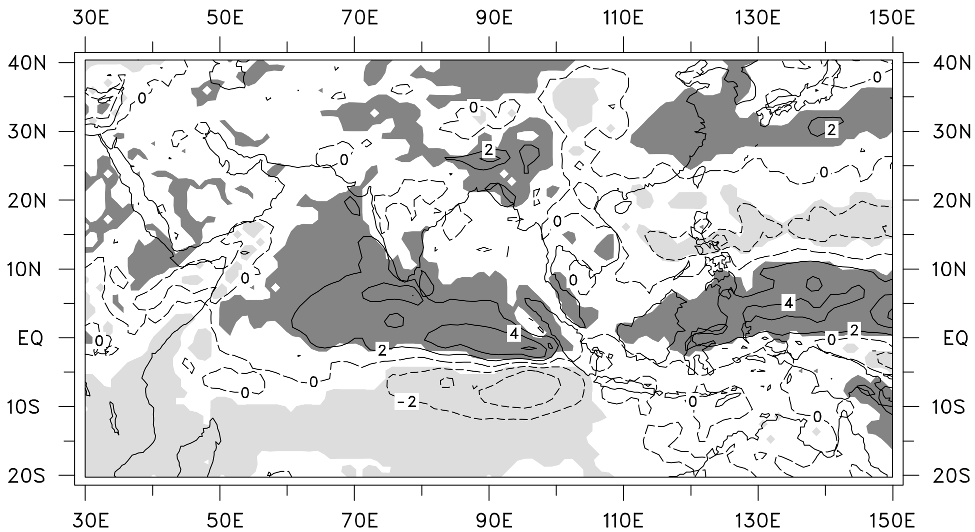
In the past, the agricultural and hydrological impacts of the monsoon have generally been considered separately from the predictability and variability of climate. A key objective of PROMISE is therefore the development of an integrated approach towards seasonal and climate change modelling which incorporates local hydrology and agriculture in the prediction process.

Part of PROMISE is the creation of a data archive, which scientists from monsoon-affected countries will both contribute to and benefit from. This will help to foster pro-active links between European and non-European partners - one of the aims of PROMISE.

Role and Responsibility of DMI

DMI contributes to both of the issues mentioned above. DMI investigates the possible climatic changes affecting the Indian summer monsoon due to the anticipated increase in the concentrations of the important greenhouse gases. This is done on the basis of a global time-slice experiment with a high-resolution global atmospheric GCM covering two periods: one representing the present-day climate (1970-1999) and one presenting the future climate (2060-2089). Special emphasis is given to the hydrological aspects of the Indian summer monsoon, including extreme daily rainfall events.

Further, DMI investigates the possibility of predicting seasonal variations of the strength of the Indian summer monsoon with coupled GCMs. This is done on the basis of multi-model ensemble predictions originating from the DEMETER project (described on the next page) over the period 1959-2001.



Simulated change in the seasonal mean (June, July, August and September) daily precipitation between 1970-1999 and 2060-2089. The shading indicates the significance of the differences at the 95% level. Units are [mm/d]. The contour interval is 2 mm/d.

Development of a European multi-model ensemble system for seasonal to interannual prediction (DEMETER)

Contract EVK2-CT-1999-00024

Participants

Abbreviation	Name of Institute / Country
ECMRWF	European Centre for Medium-Range Weather Forecasts, UK (Coord.)
MOD.MET	Secretary of State For Defence – Ministry of Defence, UK
DMN.CNRM	Météo-France, France
MPG.IMET	Max-Planck-Gesellschaft zur Förderung der Wissenschaften e.V., Germany
ING	Istituto Nazionale di Geofisica, Roma, Italy
UPMC.LODYC	Université Pierre et Marie Curie, Paris, France
CERFACS.CMT	Centre Européen de Recherche et de Formation Avancée en Calcul Scientifique, Toulouse, France
DMI	Danish Meteorological Institute, Denmark
LSTM.PVB	Liverpool School of Tropical Medicine, UK
INM.PEIC	Instituto Nacional de Meteorologia, Madrid, Spain
ARPA-SMR	Agenzia Regionale Prevenzione Ambiente dell'Emilia Romagna, Italy
JRC	Land Management Unit from the Institute for Environment and Sustainability, Joint Research Centre, European Commission, Italy

Project period
1 February 2000 – 30 September 2003

Objectives
The overall objective of DEMETER is the development of a European coupled multi-model ensemble forecast system for real-time seasonal to interannual prediction. This objective will be achieved by installing a number of coupled ocean/atmosphere models on a single supercomputer. The DEMETER system will be tested through the production of an extensive set of hindcast ensemble integrations. Data to initialise and validate the ensembles will be taken from the ECMWF 40-year reanalysis project. The utility of the DEMETER system will be assessed by potential seasonal forecast user-partners from the agriculture and health sectors. In order to increase utility at regional and local scales bias correction and downscaling will be developed and applied as part of the DEMETER system.

Role and Responsibility of DMI
DMI's role in the project is to develop a method for statistical downscaling, so that the sesonal predictions can be used as input to the fine grid crop yield models. Futhermore DMI will apply model-dependent bias corrections to the ensemble members.

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

Contract EVK2-CT-2001-00132

Participants

Abbreviation	Institutes / Country
DMI	Danish Meteorological Institute, Denmark (Coordinator)
CINECA	CINECA High Performance Systems Division, Italy
DMN.CNRM	Météo-France,Toulouse, France
DLR.IPA	Deutsches Zentrum für Luft- und Raumfahrt, Germany
UKMO	Hadley Centre for Climate Prediction and Research, UK
ETH.AS	Swiss Federal Institute of Technology, ETH, Switzerland
GKSS.IC	GKSS Forschungszentrum Geesthacht GmbH, Germany
MPG.IMET	Max-Planck-Institut für Meteorologie, Germany
SMHI	Swedish Meteorological and Hydrological Institute, Sweden
UCMAD.FC.TAA	Universidad Complutense de Madrid, Toledo, Spain
UPMAD.EIAG.PFV	Universidad Politécnica de Madrid, Spain
UNESCO.ICTP.PWC	The Abdus Salam Intl. Centre for Theoretical Physics, Trieste, Italy
SPFDK.DSS	Danish Institute of Agricultural Sciences, Denmark
RISO.SAD	Risø National Laboratory, Denmark
UFRI.FS.DGS	University of Fribourg, Switzerland
FEA.IRD	Finnish Environmental Institute, Finland
UREAD.MET	University of Reading, United Kingdom
ULUND.DPE.PE.CIG	Lund Universitet, Sweden
SMASH.CIRED	Centre International de Recherche sur l'Environment et le Dévelopment, France
UEANG.CRU	University of East Anglia, United Kingdom
FMI.MR	Finnish Meteorological Institute, Finland
KNMI	The Royal Netherland Meteorological Institute, The Netherlands
DNMI	The Norwegian Meteorological Institute, Norway

Project period

1 November 2001 – 31 October 2004

Objectives

PRUDENCE is a European-scale investigation with the following objectives:

1. to address and reduce deficiencies in climate change projections;
2. 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;
3. 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.

Role and Responsibility of DMI

DMI is coordinating this project, which means that we have the responsibility for ascertaining that everything is carried out as specified in the contract, and for reporting the project progress to the EC.

We are maintaining a web site as the primary information gateway within the project. As part of this site, a data distribution centre will be built up for distribution of model output to the participating impact model groups. After the conclusion of the project this data centre will become public.

With the regional climate model HIRHAM we are taking an active part in the intensive modelling effort in the project, which aims at collecting model output from a number of models and driving conditions. At the DMI we will be carrying out experiments with a total of about 300 model years over Europe in 50km resolution and 60 years in 25km resolution.

STAtistical and Regional Dynamical downscaling of Extremes for European regions (STARDEX)

Contract EVK2-CT-2001-00115

Participants

Abbreviation	Name of Institute / Country
UEA	University of East Anglia, UK (Coordinator)
KCL	King's College London, UK
FIC	Fundación para la Investigación del Clima, Spain
UNIBE	University of Bern, Switzerland
CNRS	Centre National de la Recherche Scientifique, France
ARPA-SMR	Servizio Meteorologico Regional, ARPA-Emilia Romagna, Italy
ADGB	Atmospheric Dynamics Group, University of Bologna, Italy
DMI	Danish Meteorological Institute, Denmark
ETH	Eidgenössische Technische Hochschule, Switzerland
FTS	Fachhochschule Stuttgart - Hochschule für Technik, Germany
USTUTT-IWS	Institut für Wasserbau, Germany
AUTH	University of Thessaloniki, Greece
DNMI	Norwegian Meteorological Institute, Norway
SMHI	Swedish Meteorological and Hydrological Institute

Project period

1 February 2002 – 31 July 2005

Objectives

General objectives

- To rigorously and systematically inter-compare and evaluate statistical, dynamical and statistical-dynamical downscaling methods for the reconstruction of observed extremes and the construction of scenarios of extremes for selected European regions.
- To identify the more robust downscaling techniques and to apply them to provide reliable and plausible future scenarios of temperature and precipitation-based extremes for selected European regions.

Measurable objectives

1. Development of standard observed and climate model simulated data sets, and a diagnostic software tool for calculating a standard set of extreme event statistics, for use by all partners.

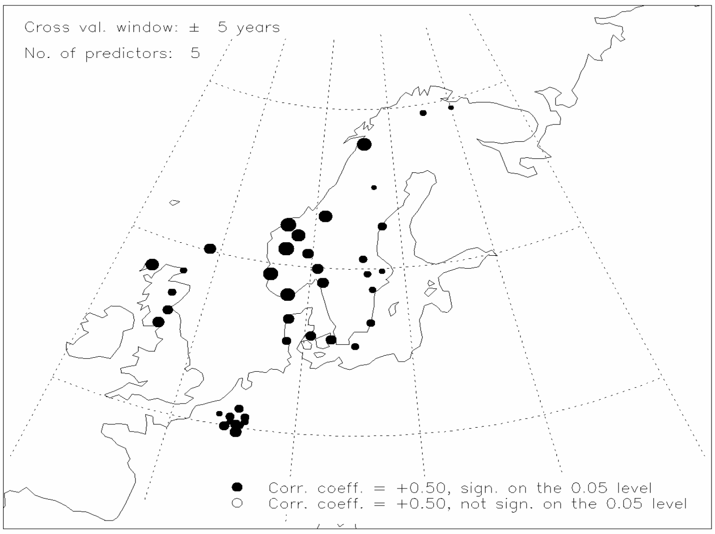
2. Analysis of recent trends in extremes, and their causes and impacts, over a wide variety of European regions.
3. Validation of HadCM3 and ECHAM4/OPYC3 climate model integrations, particularly for extremes.
4. Inter-comparison of improved statistical, dynamical and statistic-dynamical downscaling methods using data from the second half of the 20th century and identification of the more robust methods.

Development of scenarios, particularly for extremes, for the late 21st century using the more robust statistical, dynamical and/or statistical-dynamical downscaling methods.

Role and Responsibility of DMI

The main responsibility of DMI is being leader of the workpackage entitled "Inter-comparison of improved downscaling methods with emphasis on extremes" and will therefore coordinate the validation part of the project. Most groups have developed their downscaling method in their particular region. For independent validation, each method should therefore be applied to at least one other region. Two groups (including DMI) will apply their method to the entire European region and will therefore form a kind of benchmark for the other methods. Also comparison with dynamical will be carried out (in co-operation with the PRUDENCE project).

DMI will also continue the development of our statistical downscaling method based on local vorticity. Particular emphasis will be on identification of additional predictors, such as static stability or humidity.



Correlation coefficient between winter (ONDJFM) precipitation and the atmospheric circulation for 38 northwestern European stations. Such correlations are used and further developed in the STARDEX project for estimating precipitation in future climate.

Coupling of Atmospheric Layers (CAL)

Contract HPRN-CT-2002-00216

Participants

Abbreviation	Name of Institute/Country
DSRI	Danish Space Research Institute, Denmark (Coordinator)
BIRA	Belgian Institute for Space Aeronomy, Belgium
UPST.LA	Université Paul Sabatier de Toulouse III, France
CEA.DASE.LDG	Commissariat a l'Energie Atomique, France
UOULU.DG.GO	University of Oulo, Finland
UFRANK.IMG	Johann Wolfgang Goethe Universität, Frankfurt, Germany
ULEIC.DPA	University of Leicester, UK
UMON.CSE	De Monfort University, UK
FIMI.GEO	Finnish Meteorological Institute, Finland
UCRE.DP.AIP	University of Crete, Greece
DMI.RDD.STP	Danish Meteorological Institute, Denmark

Project period
1 November 2002 – 30 October 2006

Objectives
The research training network "Coupling of Atmospheric Layers" CAL concerns thunderstorms, electrical- and space radiation effects in the stratosphere, mesosphere and lower thermosphere. The network will study unanswered questions relating to discharges in the stratosphere and mesosphere, also termed "high-altitude lightning", their relation to various aspects of the atmospheric system and the overall dynamic response of the atmospheric layers to forcing of the mesosphere and lower thermosphere regions by thunderstorm and solar activity.

Role and Responsibility of DMI
DMI will in cooperation with the University of Leicester implement thermospheric physics in an existing climate model and study the dynamical coupling between the upper atmosphere and the troposphere. Such a coupling may link solar activity to climate.

Global Implications of Arctic climate Processes and feedbacks (GLIMPSE)

Contract EVK2-CT-2002-00164

Participants

Abbreviation	Name of Institute/Country
AWI.FP	Alfred-Wegerner-Institut für Polar und Meeresforschung, Germany (Coordinator)
DNMI.RDD	Norwegian Meteorological Office, Norway
SMHI	Swedish Meteorological and Hydrological Institute, Sweden
DMI	Danish Meteorological Institute, Denmark
ULAP.AC	University of Lapland, Finland
UTROM.NCFS	University of Tromsoe, Norway
GKSS.IC	Forshungszentrum Geestacht, Germany

Project period
1 November 2002 – 30 October 2005

Objectives
The target of GLIMPSE is to better identify and model the important key processes of the climate system in the Arctic, including natural variability, than has been done so far using coarse resolution AOGCMs. This will be carried out by introducing a better description of physical processes in the oceans, cryosphere, atmosphere, land and biosphere including their interactions in high-resolution regional climate models (RCMs). This will be based on identifying and modelling of the key processes and through an assessment of the improved understanding in the light of analysis of instrumental as well as paleoclimatic and paleoenvironmental records.

GLIMPSE aims to:

- address and reduce the mentioned deficiencies in the Arctic by developing improved physical descriptions, understanding and parameterizations of regional Arctic climate feedbacks (stable Arctic planetary boundary layer parameterization, cloud-water-vapour-radiation parameterization, land surface and permafrost parameterization, Precipitation minus Evaporation (P-E) feedbacks on Arctic Oceans sea-ice distribution and influence on ecosystems) in regional climate models with high horizontal and vertical resolution;

- apply improved parameterizations of regional Arctic climate feedbacks into coarser resolution coupled AOGCMs and to determine and understand their global influences via atmospheric and oceanic teleconnections and consequences for decadal scale climate variability.

- assess the implications of these results for abrupt climate changes on decadal time scales in the past and in the future, important for adapting to and mitigating climate changes.

Role and Responsibility of DMI

DMI will participate mainly with global model simulations:

- Simulations with a global atmosphere-ice-ocean global model (ECHAM4/OPYC) 50 years simulation for validation and comparison purpose with the results from the regional models
- 500 years simulation for determining the low frequency variability and possible abrupt changes
- Application of a grid-point based ice sheet mass balance model providing run-off data for Greenland's ice margins
- Leading of the WP4 work package

The work package (WP4) "Global consequences of improved description of Arctic climate processes and feedbacks in free AOGCM runs" will estimate the implications and global consequences of the improved physical Arctic process parameterizations and feedbacks in two coupled AOGCM's by carrying out 500 year free simulations with constant external forcing parameters. This allows to determine abrupt changes as a result of multiple equilibria in the unforced climate system as e.g. the two states of the thermohaline circulation under the influence of atmospheric and sea-ice feedbacks.

Integrated Observing and Modelling of the Arctic Sea Ice and Atmosphere (IOMASA)

Contract EVK3-CT-2000-00067

Participants

Abbreviation	Name of Institute/Country
IUP	University of Bremen, Institute of Environmental Physics, Germany (Coordinator)
DTU-DCRS	Danish Centre for Remote Sensing, Ørsted*DTU, Technical University of Denmark, Denmark
DNMI	Norwegian Meteorological Institute, Norway
SMHI	Swedish Meteorological and Hydrological Institute, Sweden
DMI	Danish Meteorological Institute, Denmark

Project period

1 November 2002 – 31 October 2005

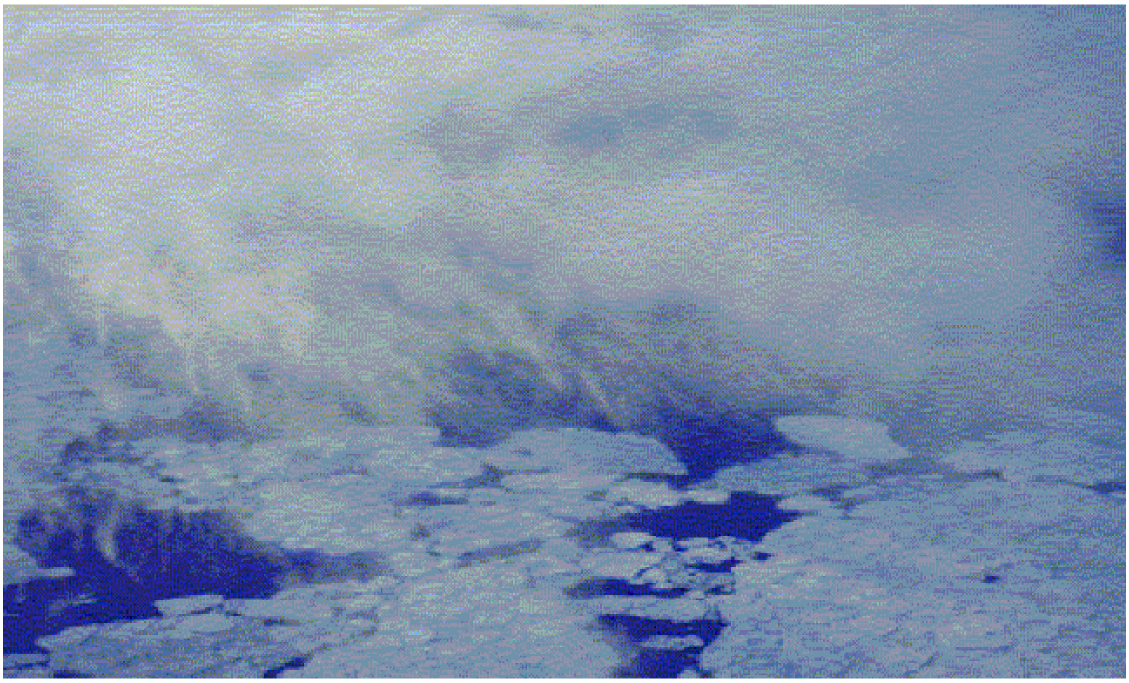
Objectives

At present, the polar regions belong to the regions of which the least information is available about the current and predicted states of surface and atmosphere. ***IOMASA*** contributes to the activity of extending the European capacity in Earth observation technology within ice monitoring and meteorology by promoting, in general, the utilisation of EO data. There is a need to improve our knowledge and monitoring and forecasting capabilities for Arctic regions - The ***IOMASA*** project aims to contribute to this by developing new validated earth observation products, and to transform them into higher-order products by integrating them with other data sources to demonstrate the feasibility of a near real time forecasting and monitoring system for the Arctic weather and sea ice.

Role and Responsibility of DMI

DMI will be responsible for the development of sea ice retrieval algorithms. DMI has a long experience in sea ice retrieval using optical as well as active and passive microwave sensors through its operational obligations and in addition has participated in a number recent projects in the field. Having observed the ice around Greenland systematically since 1959, DMI is in possession of considerable expertise and observations in the fields of ice properties and processes and will assist DTU in the development of the sea ice emissivity and backscatter model. DMI's archive of remote

sensing data spans several years of SSM/I, ERS scatterometer and SAR, Quikscat, Radarsat and AVHRR data. These data as well as real time observations and remote sensing data will be at the projects disposal.
DMI will participate in the work on improving surface flux modelling to help optimise the use of the developed ice concentration algorithm.



Picture of sea ice and broken clouds taken during a measurement campaign near Svalbard.

Greenland Arctic Shelf Ice and Climate Experiment (GreenICE)

Contract EVK2-2001-00280

Participants

Abbreviation	Name of Institute/Country
UCAM.SPRI	University of Cambridge, Scott Polar Research Institute, UK (Coordinator)
DTU.DCRS	Danish Centre for Remote Sensing, Ørsted*DTU, Technical University of Denmark, Denmark
GEUS	Geological Survey of Denmark and Greenland, Denmark
MGP	Alfred-Wegener-Institut für Polar- und Meeresforschung, Germany
DMI	Danish Meteorological Institute, Denmark
NSC	National Survey and Cadastre, Denmark

Project period
1 November 2002 – 31 October 2005

Objectives
A radical change occurred a decade ago in Arctic atmospheric circulation associated with a reversal of the Arctic Oscillation (AO). This resulted in changes of sea ice-motion and characteristics, most manifest in the critical region north of Greenland. Green ICE takes advantage of winter ice camps in this region. Sea-bed sediment cores will map the climatic record, and a multilevel study of sea ice - in situ thickness and roughness measurements; buoys for ice dynamics, and satellite coverage - will be performed. An existing sea ice model will be improved and used to extend regional results to basin scales. The aim is to form a complete picture of ice response to an AO reversal, matching this to concurrent climate change. By reference to the regional climatic record for the past 2000+ years, we thus aim to understand the nature and magnitude of Arctic sea ice response to observed climate variability.

Role and Responsibility of DMI
The role of DMI, as an associate partner to DTU, shall be to analyse ENVISAT ASAR, RADARSAT and QuickSCAT Seawinds data from the region. The ENVISAT data shall be acquired through previously accepted AO's while RADARSAT data shall be commercially purchased (~20 scenes).

DMI shall study the changes in the SAR and Seawinds signature due to the different snow properties and surface weather conditions. A very important study will be to compare the backscatter signals from different types of ice (which is used indirectly to infer ice thickness in SAR data) in both the SAR and the scatterometer data, with the ice thickness (freeboard) maps made using the aircraft laser profilemeter.

DMI shall also undertake the evaluation of a number of in-house developed ice edge and icebergs detection and ice type classification algorithms using SAR and scatterometer data. Some of these algorithms, those based on statistical parameters and probability distributions, have been developed within the last 5-6 years and have been published in the open literature, while others, those based in fuzzy logic data fusion techniques are still under development. These algorithms shall be further improved using both the unique aircraft laser profile and in-situ ground measurements mentioned above from these high latitudes.

Sea ice north of Greenland. The aircraft shadow is 15 m long.

Programme for a Baltic network to asses and upgrade an operational observing and forecasting system in the region (PAPA)

Contract EVR1-CT-2002-20012

Participants

Abbreviation	Name of Institute/Country
DMI	The Danish Meteorological Institute, Denmark (Coordinator)
BSHM	Bundesamt für Seeschifffahrt und Hydrographie, Germany
CMRLT.HYD	Centre for Marine Research, Lithuania
TUTAL.EEMI	Tallin Technical University, Estonia
FIRM.DPO	Finnish Institute of Marine Research, Finland
FEA.RD.PP	Finnish Environmental Institute, Finland
IMWM.MAR	Institute of Meteorological and Water Management, Poland
PLIO-MH	Institute of Oceanology, Poland
IOSF	Institut für Ostseeforshung Warnemünde, Germany
LHA	Latvian Hydrometeorological Agency, Latvia
MIGPL.OPOC	Maritime Institute Gdansk, Poland
NWAH.STP	North-West Regional Administration for Hydrometeorological and Environmental Monitoring, Russia
RDANH.OC	Royal Danish Administration of Navigation and Hydrography, Denmark
SMHI.OS	Swedish Meteorological and Hydrological Institute, Sweden
ULAT.LME	University of Latvia, Latvia

Project period
1 November 2002 – 31 October 2005

Objectives
PAPA will plan the implementation of a Baltic Operational Oceanographic System which aims at: 1) building a basin-wide network for ocean monitoring and forecasting. Linking all Baltic countries, broadening and strengthening the existing network of national institutions already established by PAPA partners; 2) identify gaps in the monitoring systems in the region and in the capacity to measure, model and forecast the ecosystem; 3) build capacities for expertise in the setting up and running observing platforms, data management, modelling and forecasting; 4) design the initial observing and forecasting system; 5) raise awareness on the benefits of ocean forecasting at local, regional and global scales, involving stakeholders and disseminate PAPA results and products.

Role and Responsibility of DMI

DMI is the coordinator of PAPA and are additionally responsible for leading the work package on awareness. DMI takes an active part in all components and activities of PAPA.

German oceanographic measuring platform in the Arkona Basin contribution to the PAPA project.

Optimal Design of Observational Network (ODON)

Contract EVK3-CT-2002-00082

Participants

Abbreviation	Name of Institute/Country
DMI.RDD.SOO	The Danish Meteorological Institute, Denmark (Coordinator)
IRSNB.MUMM.N	Royal Belgian Institute for Natural Sciences, Belgium
NERC.POL	Natural Environment Research Council, UK
SMHI.RD	Swedish Meteorological and Hydrological Institute, Sweden
BSHM	Bundesamt für Seeschifffahrt und Hydrographie, Germany

Project period

1 January 2003 – 31 December 2005

Objectives

ODON is a pilot project in optimal ocean observing system design. ODON will:
1) investigate/develop techniques in optimal observing system design;
2) design adhoc and rational sampling strategies for SST and temperature/salinity (T/S)profile monitoring in the Baltic & North Sea by using statistical analysis(including synergy among satellite, buoy, floating profiler, ferry and XBT sections);
3) demonstrate improvements in ocean now casts/forecasts due to improvements in the observing networks by using Observing System Simulation Experiment (OSSE) and;
4) perform cost-benefit analysis of the designed observing networks. ODON meets challenges, explores new fields and improves capacity building in quantitative ocean observing system studies in Europe, and justifies implementation of new observing systems in coastal/shelf seas.

Role and Responsibility of DMI

DMI is the coordinator of ODON and are additionally responsible for

- Leading a number of work packages
- Provide one-year meteorological forcing, bathymetry and validation data
- Perform scale and sampling error analysis in the Baltic Sea and assist in information analysis, design SST and T/S profile monitoring networks.
- Perform SST OSSE's and evaluate SST sampling strategies
- Estimate costs of observing networks and perform cost benefit analysis

Meridional Overturning Exchange with Nordic Seas (MOEN)

Contract EVR2-CT-2002-00141

Participants

Abbriviation	Name of Institute/Country
UIB.BCC	University of Bergen, Norway (Coordinator)
WSCL.WRI	Westlakes Scientific Consulting Limited, UK
MRINST	The Marine Research Institute of Iceland, Iceland
DMI	The Danish Meteorological Institute, Denmark
UHAM.IM	Universität Hamburg, Germany
USTOCK.DM	Stockholm University, Denmark
UKBH.NBI.GD	Copenhagen University, Denmark

Project period

1 December 2002 – 30 November 2005

Objectives

Using a combination of different observational techniques and model experiments, MOEN will monitor the total Atlantic inflow to the Nordic Seas and the Ireland-Scotland return overflow of dense water into the Atlantic during a two-year field phase and will study trends and variations of the fluxes on longer time scales. MOEN is a self-contained project but also acts as a component of the Arctic-Subarctic Ocean Flux (ASOF) study.

Role and Responsibility of DMI

DMI is leader of the modelling work package within the project. DMI will carry out socalled hindcast runs, which are experiments with an ocean model forced by atmospheric reanalysis fields. The ocean model used will be C-HOPE. The purpose of this is to determine which factors controls the water mass exchange between the North Atlantic and the Nordic Seas.

Two classes of experiments will be carried out, namely experiments covering the period 1958-2002, where reanalysis forcing fields are available, and extended experiments, covering the period 1900-2002, where pseudo-forcing fields have to be constructed from the available data, using statistical techniques.

European Shelf Seas Ocean Data Assimilation and Forecast Experiment (ESODAE)

Contract no. MAS3-CT98-0187

Participants

Abbreviation	Name of Institute / Country
MOD.MET.OA	Ministry of Defence, Meteorological Office, Ocean Applications, UK (Coordinator)
RIKZ	Netherlands National Institute for Coastal and Marine Management, Netherlands
IRSNB.MUMM	Institute Royal de Sciences Naturelles de Belgique, Belgium
KNMI	Royal Netherlands Meteorological Institute, Netherlands
DNMI	Norwegian Meteorological Institute, Norway
DMI	Danish Meteorological Institute, Denmark
ULG.GHER	GeoHydrodynamics and Environment Research University of Liege, Belgium

Project period

1 February 2000 – 31 January 2001

Objectives

ABSTRACT

This Concerted Action has as its objective the development of a plan for a European shelf Seas Ocean Data Assimilation and forecast Experiment (ESODAE). The Concerted Action forms ESODAE Phase 1, whilst the actual experiment will constitute ESODAE Phase 2.

The specific objective of the Concerted Action is to design a framework to carry out an experiment so as to:

- develop models for the North West European Shelf which analyse and forecast the ocean in depth (temperature, salinity and current structure) to include data assimilation

- run a selection of available models for the North West European Shelf in a consistent framework (with regards to area, boundary, tidal and meteorological forcing and, where possible, observational input) at the various participating institutes for a period of at least 3 months

- exchange model products between the various participants involved in such an experiment and to jointly assess performance

  - carry out model sensitivity studies to boundary and meteorological forcing and impacts of data assimilation.

The Concerted Action will contribute towards networking and exchange of data, models and assimilation schemes between institutes involved in development of ocean forecasting in Europe. It will also increase awareness of current developments in preoperational modelling of the area of interest. The overall goal will be to design an experiment to provide a practical demonstration of the overall capabilities of ocean analysis/assimilation and forecasting models for the North West European Shelf. The Concerted Action is aimed at fostering a spirit of cooperation in developing improved ocean forecasting services for the North West European Shelf region.

OBJECTIVES AND METHODOLOGY

Under this Concerted Action, a plan for a European shelf Seas Ocean Data Assimilation and forecast Experiment (ESODAE) will be developed. The European Shelf Seas are taken to include all the shallow seas from Norway, round the Shetland Islands, Scotland, Ireland, south west of the UK to southern Brittany and including the North Sea.

The primary objective of the Concerted Action is to design a framework to carry out an experiment so as to:

- develop models for the North West European Shelf which analyse and forecast the ocean in depth (temperature, salinity and current structure) to include data assimilation

- run a selection of available models for the North West European Shelf in a consistent framework (with regards to area, boundary, tidal and meteorological forcing and, where possible, observational input) at the various participating institutes for a period of at least 3 months

- exchange model products between the various participants involved in such an experiment and to jointly assess performance

- carry out model sensitivity studies to boundary and meteorological forcing and impacts of data assimilation.

Other objectives of the Concerted Action are:

- to encourage networking and exchange of data and models between institutes involved in development of ocean forecasting in Europe

- to increase awareness of current developments in pre-operational modelling of the area of interest

- to foster a spirit of cooperation in **developing improved ocean forecasting services** for the North West European Shelf region.

The overall goal is to design an experiment to provide a practical demonstration of the overall capabilities of ocean analysis and forecasting models for the North West European Shelf.

Particular issues that will be addressed are:

- the performance of different model systems in analysing and forecasting conditions on the North West European Shelf, including the shelf break;

- the needs of the various modelling systems for boundary and forcing data;

- the application of techniques of data assimilation in shelf models so as to maximise the use of available data;

- planning for exchange of model products and, in collaboration with EU-funded SeaNet initiative for the fixed station network, for data exchange.

Role and Responsibility of DMI

DMI will bring into the project its experience with operational storm surge forecasting and model validation procedures, identification and use of meteorological surface forcing, and experience gained in participation in the Nordic Model Intercomparison Study and other applications of 3-D ocean models.

DMI is will host one Workshop or Task team Meeting and will contribute to ESODAE Meeting and Workshop Reports. It will also contribute to the ESODAE Web Page and Development and Writing of the Plan for ESODAE Phase 2.

Marine EnviRonment and Security in the European Area – Strand 1 (MERSEA-STRAND 1)

Contract EVK3-CT-2002-00089

Participants

Abbreviation	Name of Institute/Country
NERSC	Nansen Environmental and Remote Sensing Centre, Norway (Coordinator)
DMI	Danish Meteorological Institute, Denmark
NERC.POL	Natural Environment Research Council, Proudman Oceanographic Laboratory, UK
FIMR	Finnish Institute of Marine Research, Finland
CLS.SOC	Collecte Localisation Satellites Sa , France
MOD.MET.OA	Hadley Centre, Ocean Applications Meteorological Office, UK
USOU.SOES	University of Southampton, UK
NCMRG.IO	National Centre for Marine Research, Greece
IMR.DME	Institute of Marine Research, Norway
DNMI.RDD	Norwegian Meteorological Office, Norway
UPST.LEGOS	Université Paul Sabatier de Toulouse III, France
CNRS.LEGOS	Centre National de la Recherche Scientifique, France
INGV	Istituto Nazionale di Geofisica E Vulcanologia, Italy
DLR.RST	German Aerospace Centre, Germany
MANR.DF.LPO.OS	Ministry of Agricultural and Natural Resources, Cyprus
PLYMAR	Plymouth Marine Laboratory, UK
IFREMER	Institut Français de Recherche pour l'Exploitation de la Mer, France
CNRM.PROD	Meteo-France, France
MERCOCEA	Groupement D'intérêt Public Mercator Ocean, France
DEFRA.CLL	Department For Environment, Food and Rural Affairs, UK

Project period
1 January 2003 – 30 June 2004

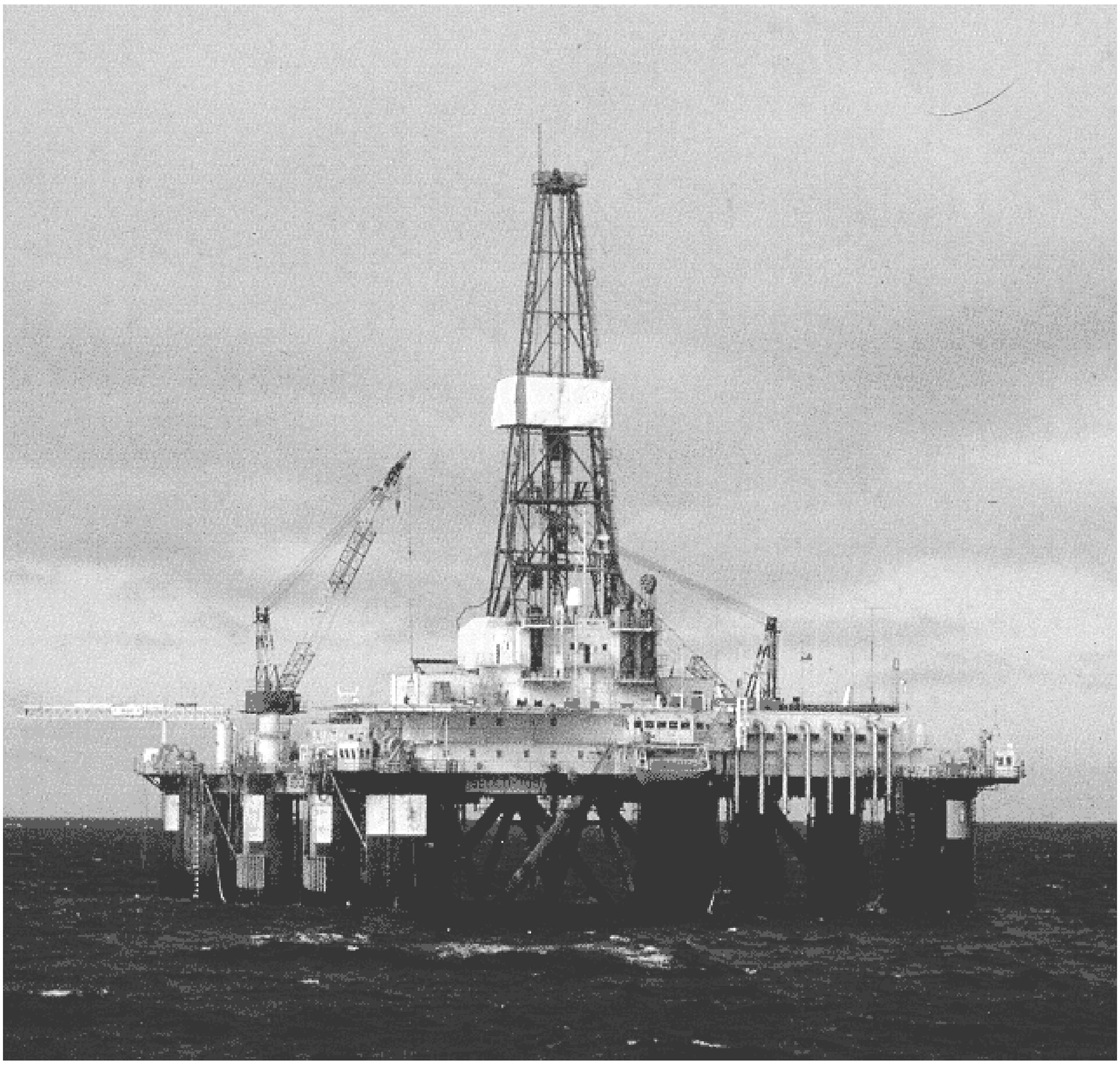
Objectives
In spite of the considerable advances in the integration of numerical models and observing systems, their provision of information products to support the assessment of the state of European marine environments and ecosystems is currently fragmented, regionally inconsistent and very often incomplete. Until this deficiency and its causes are properly documented, it will not be feasible to identify the important knowledge

gaps that, in turn should be prioritised and filled via targeted research and monitoring as stated in the GMES call. In this context the MERSEA Strand-1 project will consequently analyse the strength and weaknesses with existing European operational oceanography and data assimilation systems, in particular regarding:

- modelling capabilities and
- data observations, integration and data flow

Role and Responsibility of DMI

DMI contributes to 3 work packages which all primarily are concerned with Baltic Sea conditions. DMI are specifically going to perform a demonstration on setup of oil spill alert system in the Baltic region with special focus on the oil drift facility operated by DMI.



Oil platform in the North Sea. Oil at sea is of great danger to the marine environment and DMI has a task in the MERSEA project to demonstrate the capability to forecast oil drift in the North Sea - Baltic Sea region.

Integrated Weather, Ice and Ocean Service for High Latitudes (IWICOS)

Contract IST-1999-11129

Participants

Abbreviation	Name of Institute/Country
NERSC	Nansen Environmental and Remote Sensing Centre, Norway (Coordinator)
FIMR	Finnish Institute of Marine Research, Finland
VTT	Technical Research Centre of Finland, Finland
DCRS	Danish Centre for Remote Sensing, Denmark
DMI	Danish Meteorological Institute, Denmark
IMO	Icelandic Meteorological Office, Vedurstofa, Iceland

Project period

1 January 2000 - 31 December 2002

Objectives

The ***IWICOS*** project aims to increase the safety and cost-effectiveness of fisheries, sea transport and exploitation of marine resources in Northern European waters. The project will develop a marine information system, which will provide a single-entry access to meteorological, sea ice and oceanographic (met-ice-ocean) data and products. The system will be based on data provided by weather forecasting, ice and research centres.

Objectives:
The objective of ***IWICOS*** is to develop a prototype marine information system which will provide a single-entry access to meteorological, sea ice and oceanographic (met-ice-ocean) data and products.
The prototype will include an end user system which allows users to select, order and retrieve products offered by the consortium and to pay electronically. Innovative met-ice-ocean products will be developed which combine satellite, weather, ice and ocean data and are suitable for transmission via the Internet or other communication channels.

Role and Responsibility of DMI

In overall DMI will implement the Decision Support and Information System under IWICOS for users navigating in ice infested Greenland waters. Furthermore DMI will act as data provider. More specifically DMI will:

- Be responsible for completing the design report.
- Establish off line and real time meteorological data sets, ice charts and satellite data sets for Greenland waters.
- Develop an information system related to Greenland and Icelandic Waters for use both on ships and by land based users. The system will be able to efficiently present both stationary as well as temporal and spatial varying data sets and it will use a set of well defined symbolisation schemes for optimum interpretation (e.g. during day and night). A wide range of tools will enable the user to merge and combine data sets to promote the synergy effect.
- Test the baseline version on one or two ships, i.e. baseline system functionality and data communication.
- Develop an add-on route planning module to the baseline system which will enable the users to have a detailed display of the sea ice and meteorological data along the planned route.
- Explore and test new met-ice-ocean products for the Greenland and Icelandic waters which can be used in ice forecasting.
- Demonstration and validation of the prototype system in Greenland waters.

Greenland Sea Convection Mechanisms and their Climatic Implications (CONVECTION)

Contract EVK2-CT-2000-00058

Participants

Abbreviation	Name of Institute/Country
UCAM-SPRI	University of Cambridge, Scott Polar Research Institute, UK (Coordinator)
DTU	Danish Technical University, Denmark
UCAM-DAMTP	Department of Applied Mathematics and Theoretical Physics, University of Cambridge, UK
IFM	Institut für Meereskunde, Universität Hamburg, Germany
ISAO	Istituto di Scienze dell'Atmosfera e del'Oceano, Consiglio ISAO-CNR Nazionale delle Ricerche, Italy
DMI	Danish Meteorological Institute, Denmark
AWI	Alfred-Wegener-Institut für Polar-und Meeresforschung, Germany
NPI	Norsk Polarinstitut, Norway
IFREMER	Institut Français de Recherche pour l'Exploitation de la Mer, France
UI	University of Iceland, Iceland

Project period

1 November 2000 – 31 December 2003

Objectives

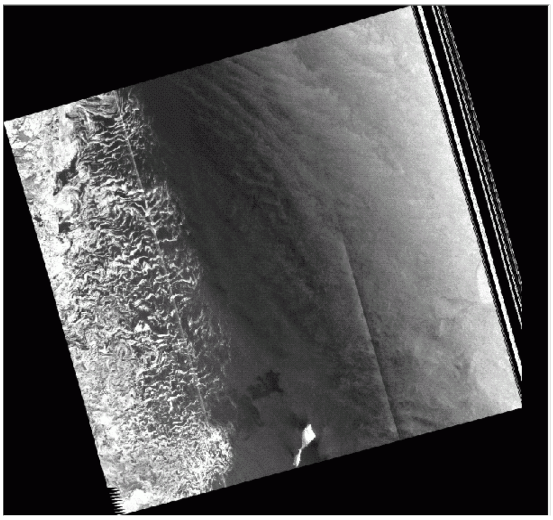
Convection aims to assess open ocean deep-water production in the Greenland Sea by a combination of operational remote sensing, modelling, and field requirements. We seek to understand the physics underlying convection and how this process links with global climatic factors. The field measurements comprise work in two winter and three summer cruises. Winter convection will be mapped by an acoustic shadowgraph array, moored yo-yo CTDs and transects by an AUV, while ice production and movement will be mapped by in situ measurements and buoy deployments, with support from ice tank experiments. Passive microwave, SAR, wind scatter meter and airborne data will be combined with in situ data to feed a model which calculates salt flux distribution over the region. When combined with a large-scale ice-ocean model and a small-scale convection model the final package will explain the convection process and its variability under extremes of forcing.

Role and Responsibility of DMI

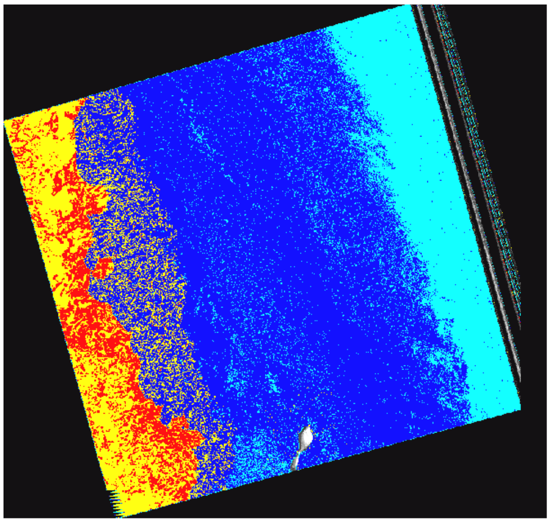
DMI is participating in two work packages in the CONVECTION project: WP 6 and 8 with total numbers of 3 and 4 man months, respectively.

WP 6 includes among other things, the generation of support data for salt flux model parameterisation. The task of DMI is to carry out an airborne validation campaign over first winter field study comprising 30 hours of flight time (Narsarsuaq - Jan Mayen and back plus 1 -2 flights over ship).

WP 8 deals with, among other things the generation of validation data of ice parameters for the salt flux model using high-resolution SAR data. In particular, this involved the production of a limited set of RADARSAT SAR based digital ice charts classified in terms of different stages of frazil and pancake ice.



RADARSAT image of the Odden, 2nd March 2002



Automatic classification. Water (blue: calm; turquoise: turbulent). Sea ice (red: low concentration, yellow: high concentration).