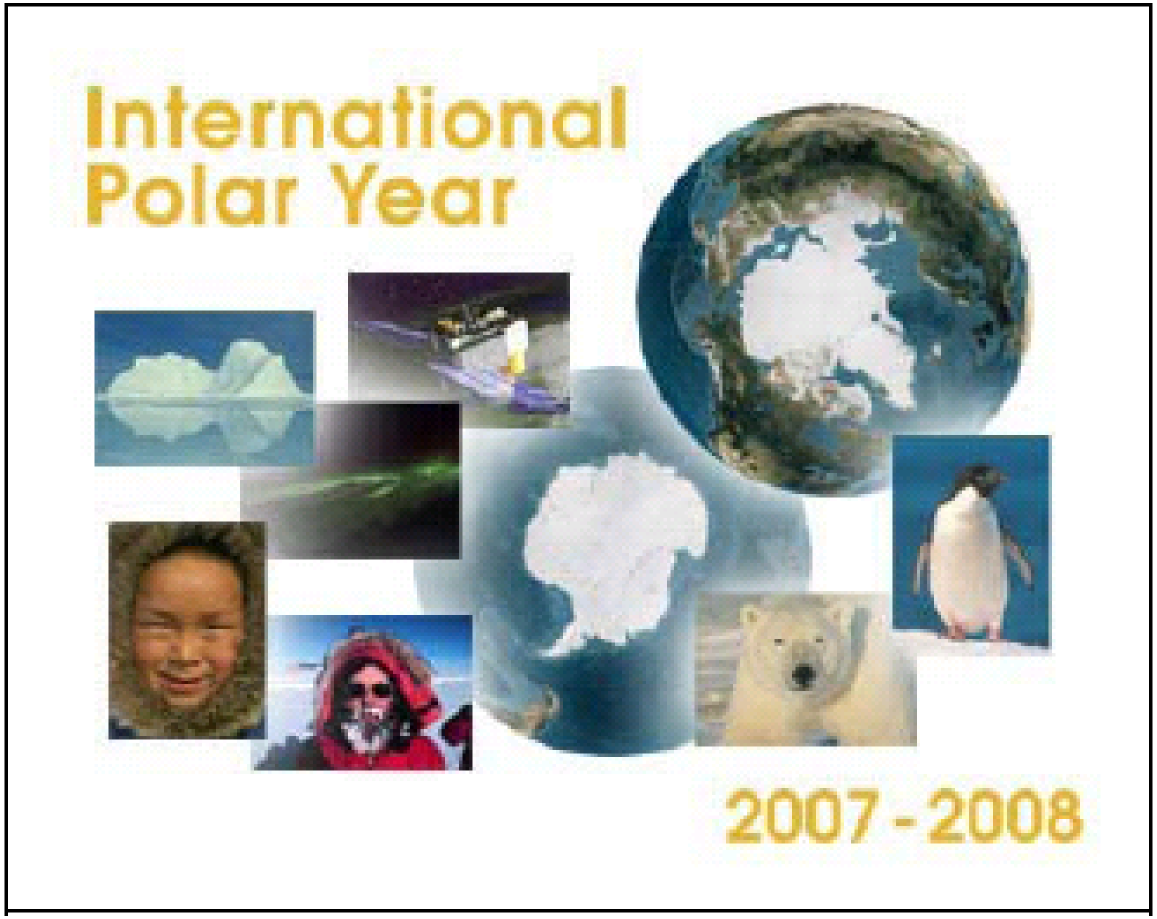


By Thor Erik Nordeng

(with more than a little help from my friends…. .)

Polar years

First International Polar Year, 1882-1883:
a precedent for international science cooperation established

Second International Polar Year, 1932-1933:
investigate the global implications of the newly discovered “Jet Stream

The International Geophysical Year, 1957-1958:
continental drift confirmed, Van Allen Radiation Belt discovered, new technology (satellites, radars, rockets…..)

The International Polar Year, 2007-2008 is an international programme of coordinated, interdisciplinary scientific research and observations in the Earth's polar regions:

- to explore new scientific frontiers
- to deepen our understanding of polar processes and their global linkages
- to increase our ability to detect changes, to attract and develop the next generation of polar scientists, engineers and logistics experts
- to capture the interest of schoolchildren, the public and decision-makers.

The Vision!

FGGE associated with a distinct leap forward in predictive skill

The Global Atmospheric Research Programme, GARP, led to the Global Weather Experiment called FGGE in 1979.

Recent advances (e.g. data assimilation, ensemble prediction & targeting) suggest that another leap forward is possible now.

In concept this is a "Second GARP Global Experiment"

FGGE + 30 years

IPY Themes

1. To determine the present environmental status of the polar regions by quantifying their spatial and temporal variability.

2. To quantify, and understand, past and present environmental and human change in the polar regions in order to improve predictions.

3. To advance our understanding of polar - global interactions by studying teleconnections on all scales.

4. To investigate the unknowns at the frontiers of science in the polar regions.

5. To use the unique vantage point of the polar regions to develop and enhance observatories studying the Earth's inner core, the Earth's magnetic field, geospace, the Sun and beyond.

6. To investigate the cultural, historical, and social processes that shape the resilience and sustainability of circumpolar human societies, and to identify their unique contributions to global cultural diversity and citizenship

THORPEX and IPY

Under the International Polar Year, THORPEX will

a) assess and seek to improve the quality of operational analyses and research reanalyses products in the Polar Regions
b) address improving data assimilation techniques for Polar Regions
c) assess the skill in the prediction of polar to global high impact weather events for different observing strategies in higher latitudes
d) demonstrate the utility of improved utilization of ensemble weather forecast products for high impact weather events and for IPY operations, when applicable
e) result in recommendations on the design of the Global Observing System in polar regions for weather prediction
f) To assist in accomplishing these research goals, THORPEX/IPY will conduct field campaigns during the IPY intensive observing period
g) address two-way interactions between polar and sub-polar weather regimes

(THORPEX International Research Implementation Plan, Version I, 2005)

THORPEX has also a climate dimension

THORPEX will play a major role in partnering with the climate forecast community to bridge the gap between weather and climate forecasting, leading to better understanding, improved forecast techniques, and more skilful forecasts for the often neglected, 10-60 day range between the weather and climate time scales.

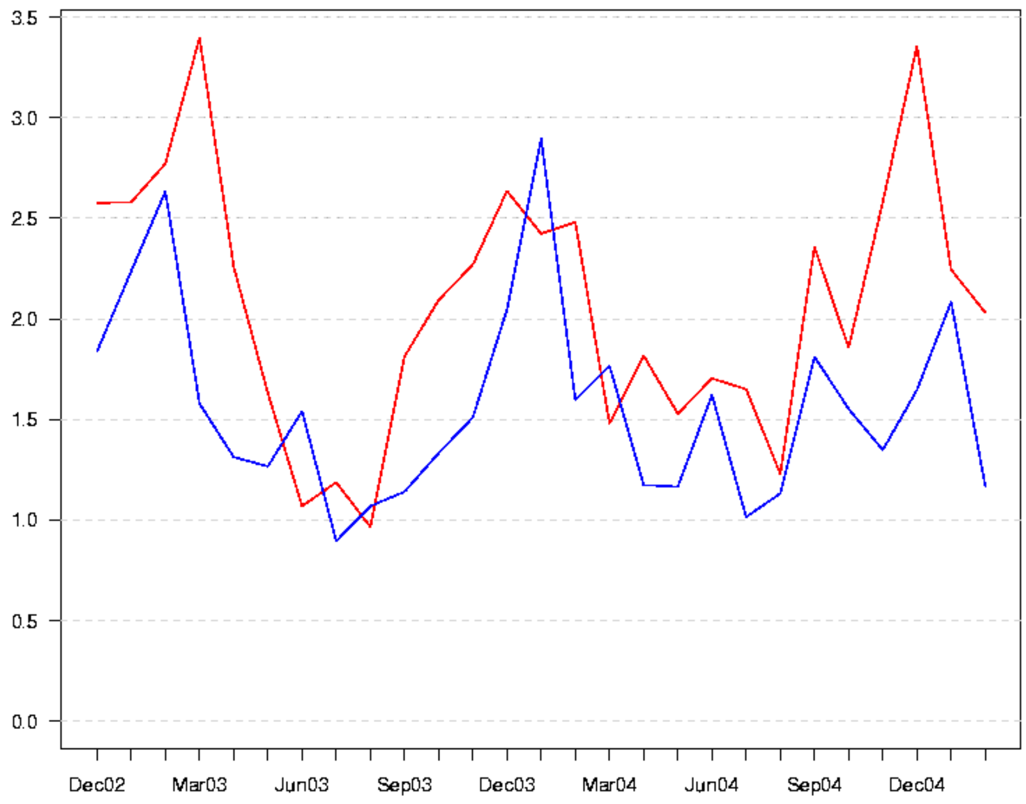
(THORPEX International Research Implementation Plan, Version I, 2005)

What is special about polar regions?

- ”No one” lives there! i.e. data sparse
- Low troposphere
- Strong contrasts in stability and temperatures
- Small scale systems
- Rapid developments
- Extratropical surprises!
- Strong influence on global climate (?) (thermohaline circulation)

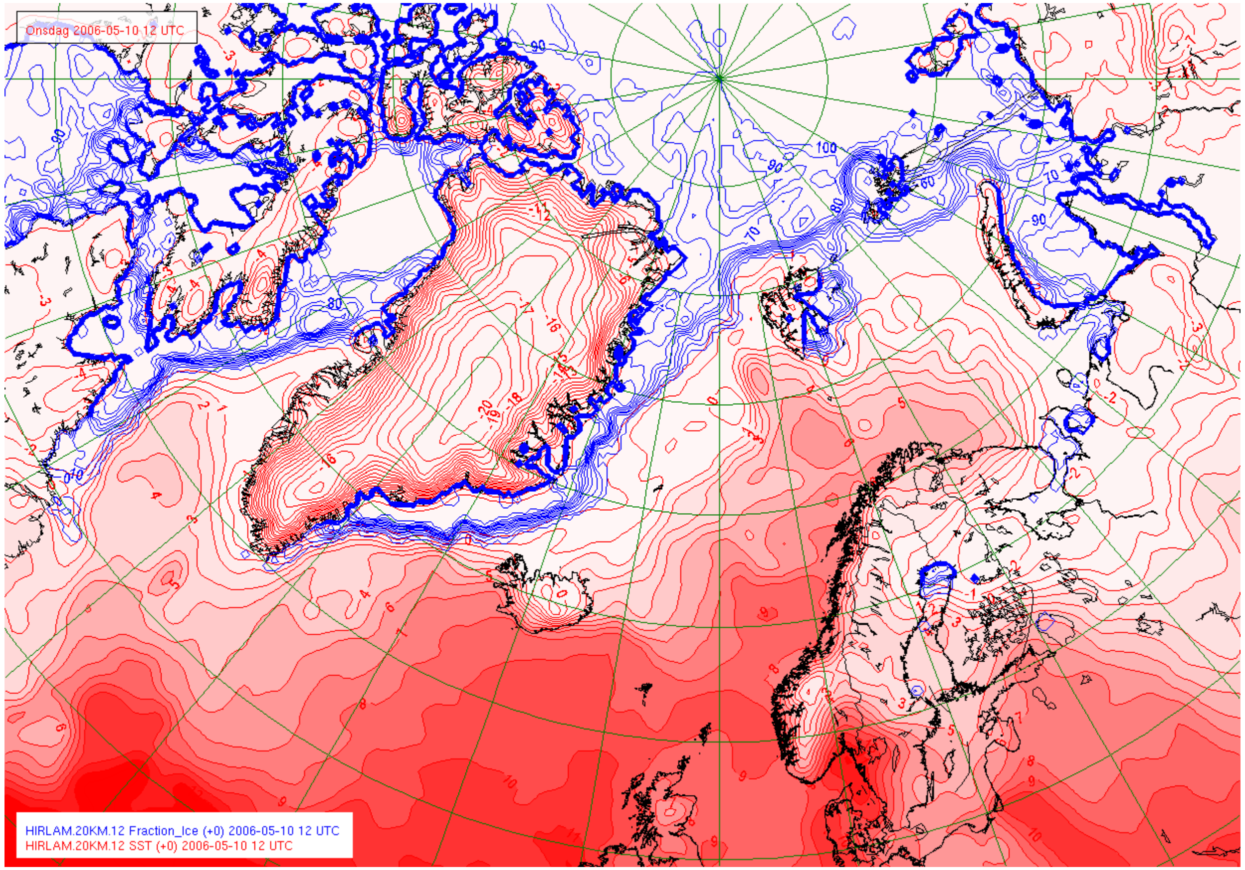
poorer NWP performance

rms error of mslp forecasts for the North Sea (blue) and for the Barents Sea (red)
Norwegian LAM (HIRLAM 20km res.)



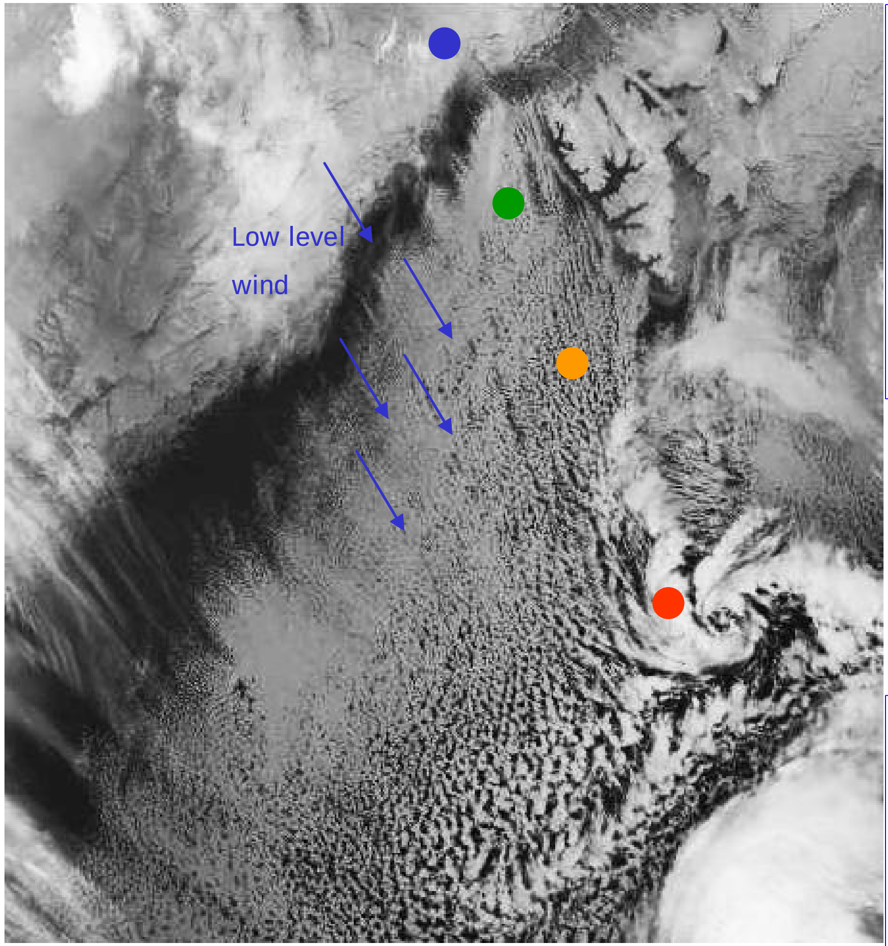
Surface contrasts
(ice, warm sea, snow covered land..)

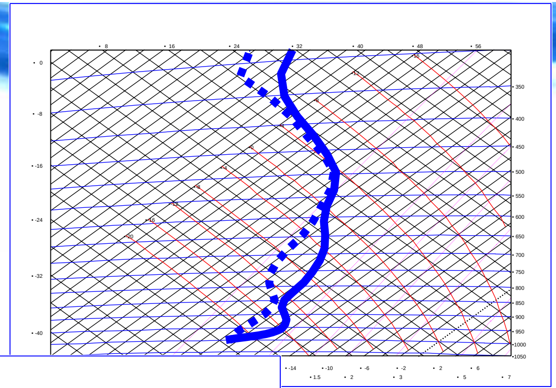
SST and ice in the North Atlantic

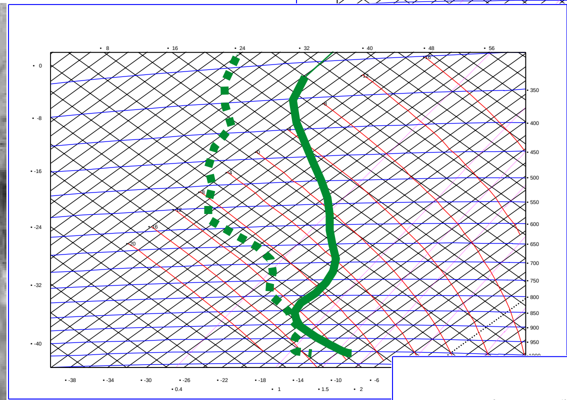


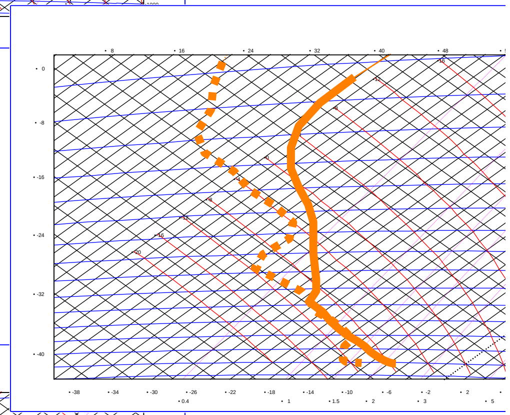
topography and destabilisation
Cold air outbreaks

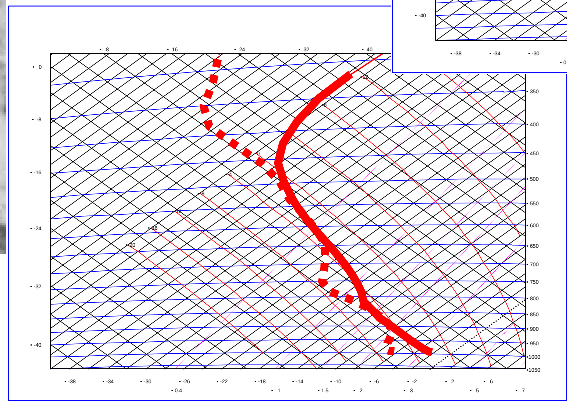
Sensible and latent heat:











Cold air outbreak and arctic fronts (Shapiro and Fedor, 1989)

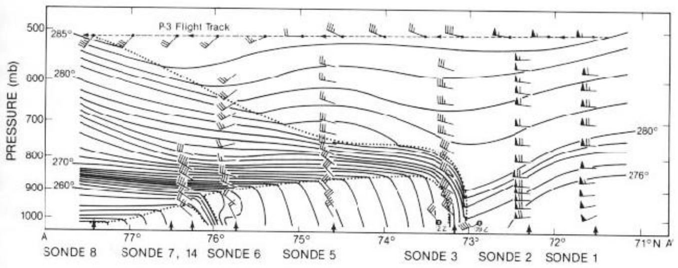


Figure 5. Cross-section analysis of potential temperature (K, solid lines) through the arctic front on 14 February 1984 along the line AA' of Figure 4. Dropwindsonde locations are indicated by heavy arrows with identifying numbers from Figure 4 plotted below. The dashed line with flight direction arrows and selected flight-level wind vectors shows the research aircraft flight track. Wind vectors without dotted heads indicate dropwindsonde wind profiles; wind vectors with flag=25 m s^{-1}, at full barb=5 m s^{-1}, and at half barb=2.5 m s^{-1}. Dotted lines show frontal boundaries.

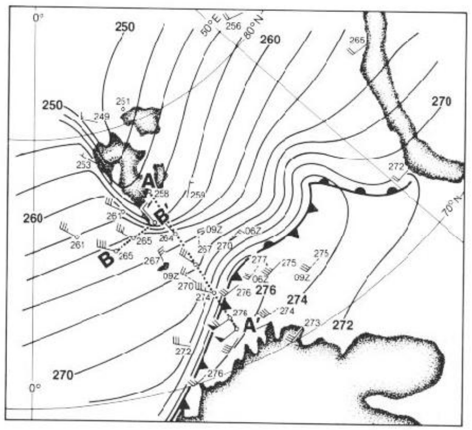
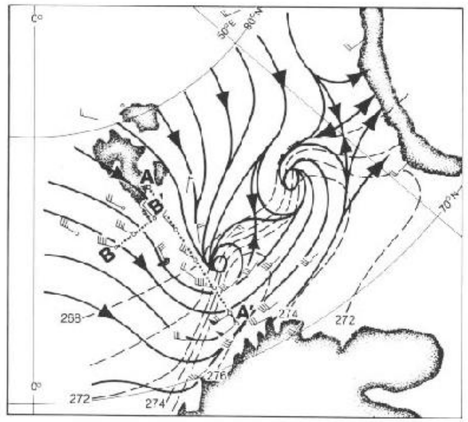
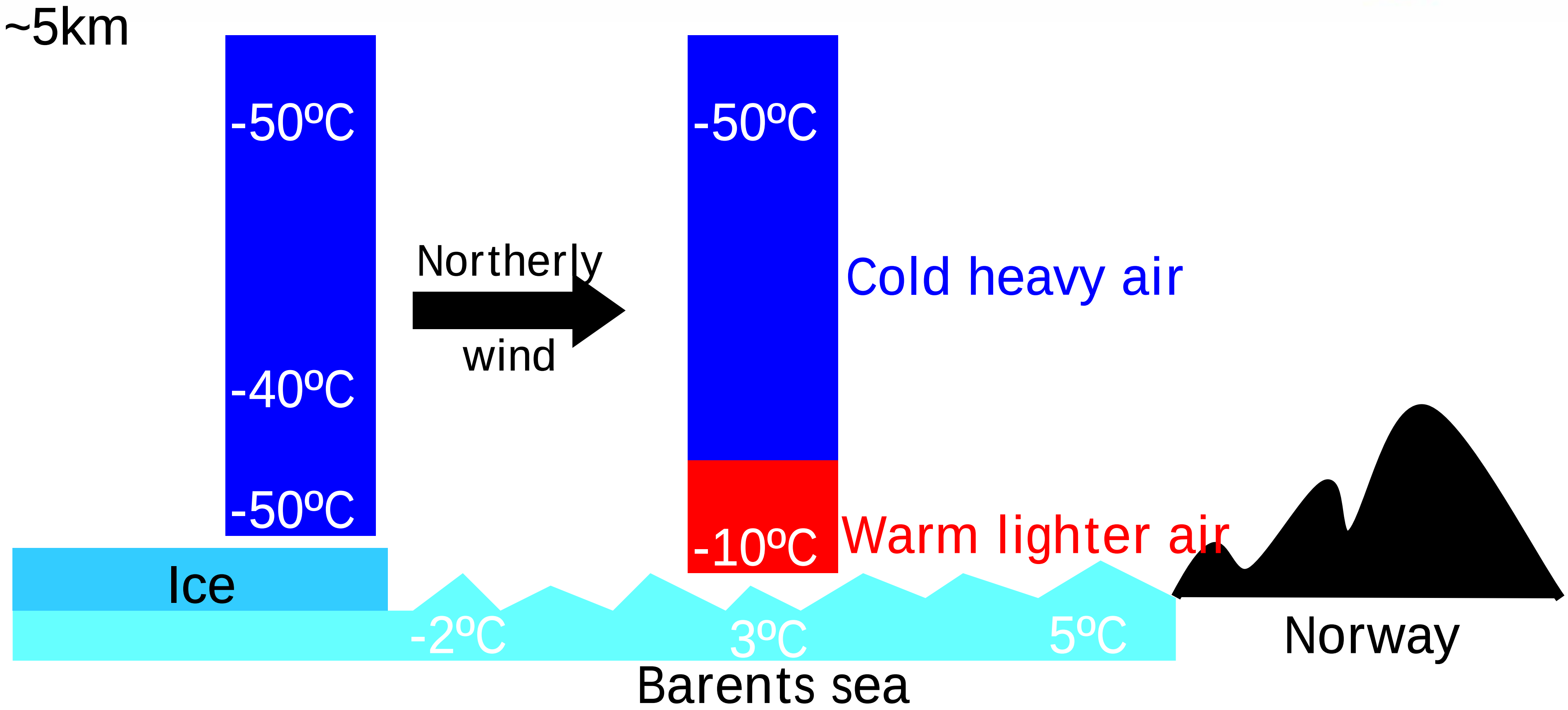


Figure 7. Surface potential temperature (K, solid lines) analysis at 1200 GMT 14 February 1984, prepared from a composite of land and ship observations (wind vectors without circle heads), and dropwindsondes (wind vectors with circle heads). Cross-section projection lines AA' and BB' (dotted lines) are for Figures 5 and 6, respectively. The observations were taken between 0400 and 1200 GMT and were space-time adjusted to 1200 GMT. Heavy solid lines indicate the arctic front.



COLD AIR OUTBREAK



Arctic air blowing south and above warm water will be heated from below. The result is often very heavy convection or small instability lows.

COLD AIR OUTBREAK

Fair

N

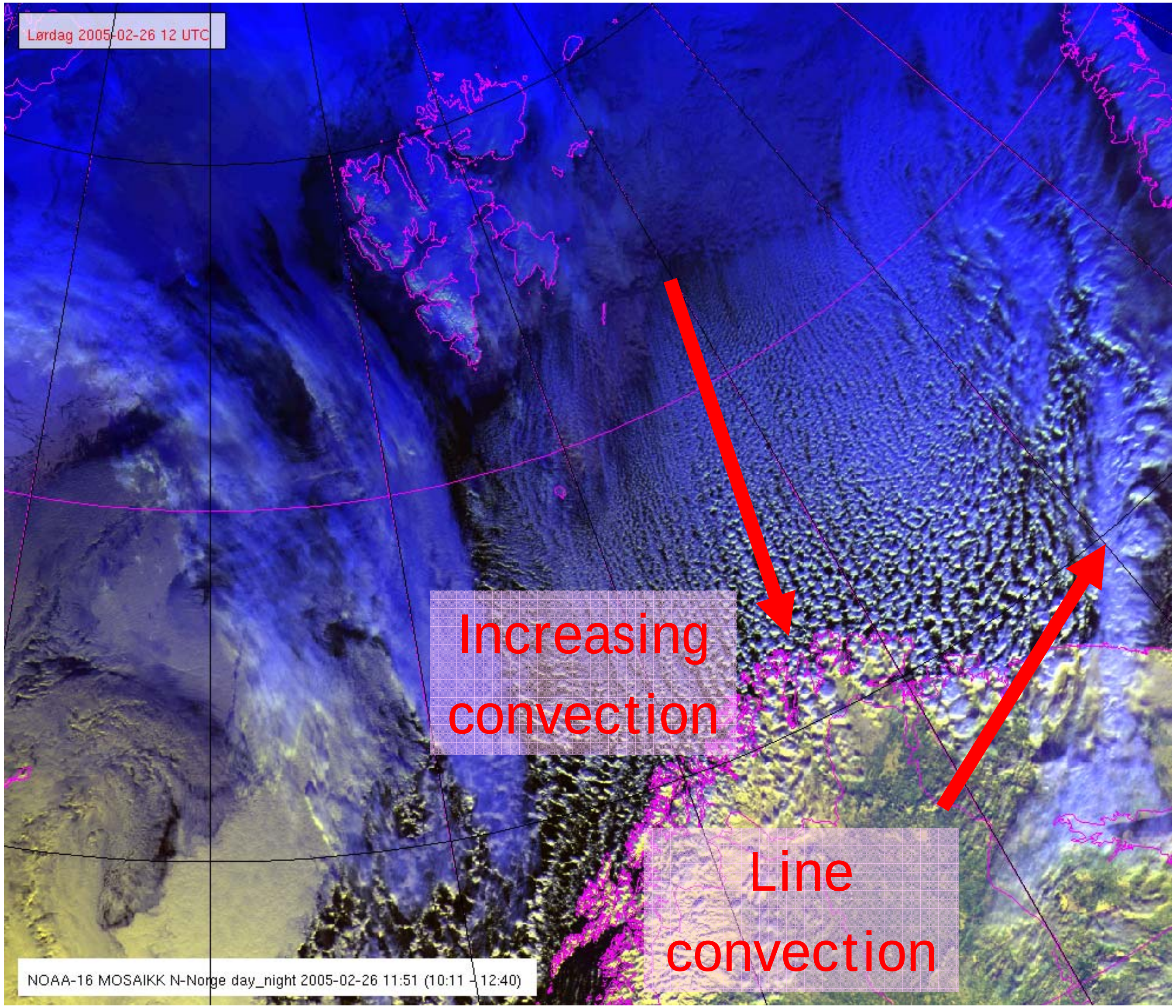
This kind of heavy convection is a winter phenomenon only!

y

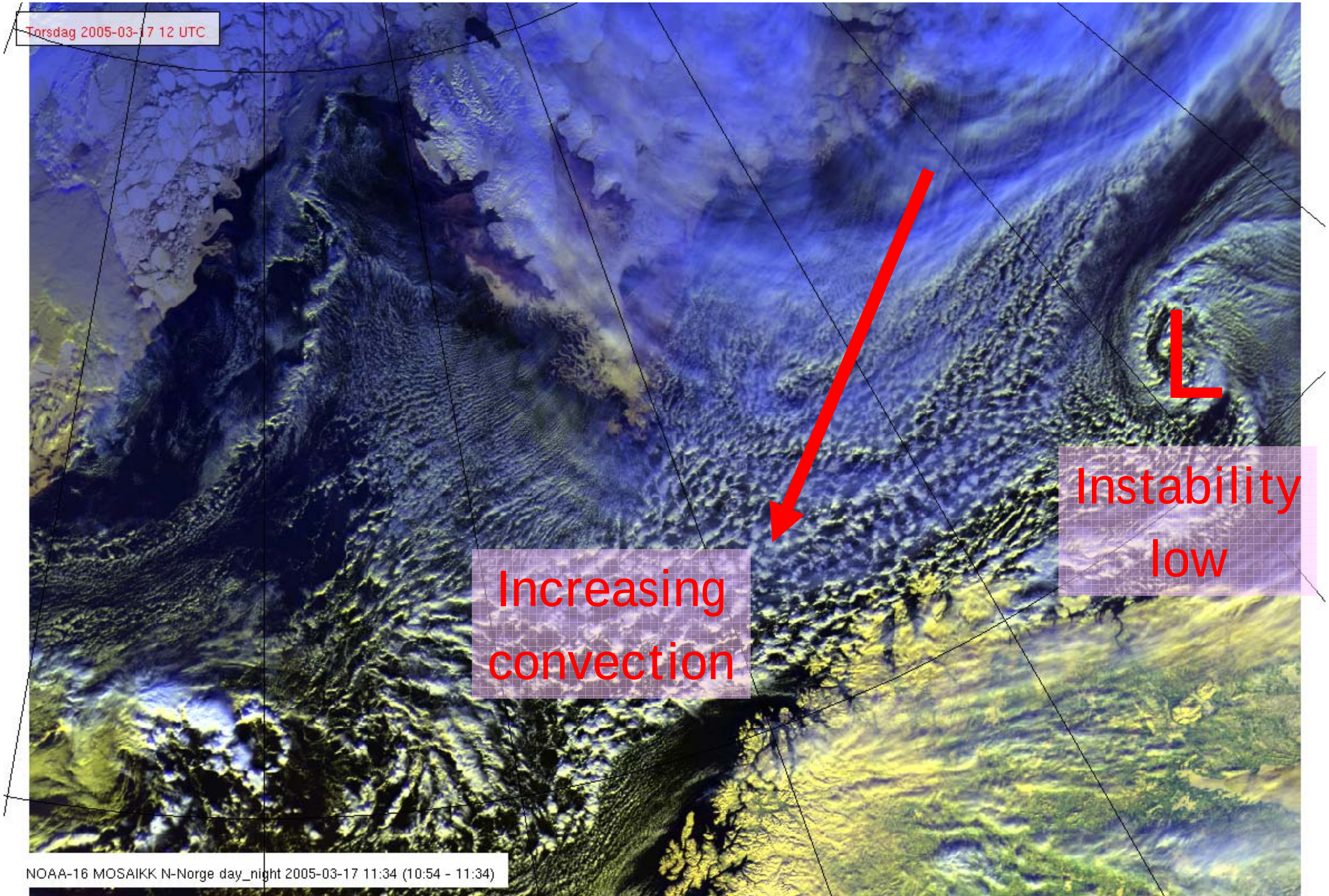
Barents sea

The convection usually get more intense with increasing distance from the ice edge.

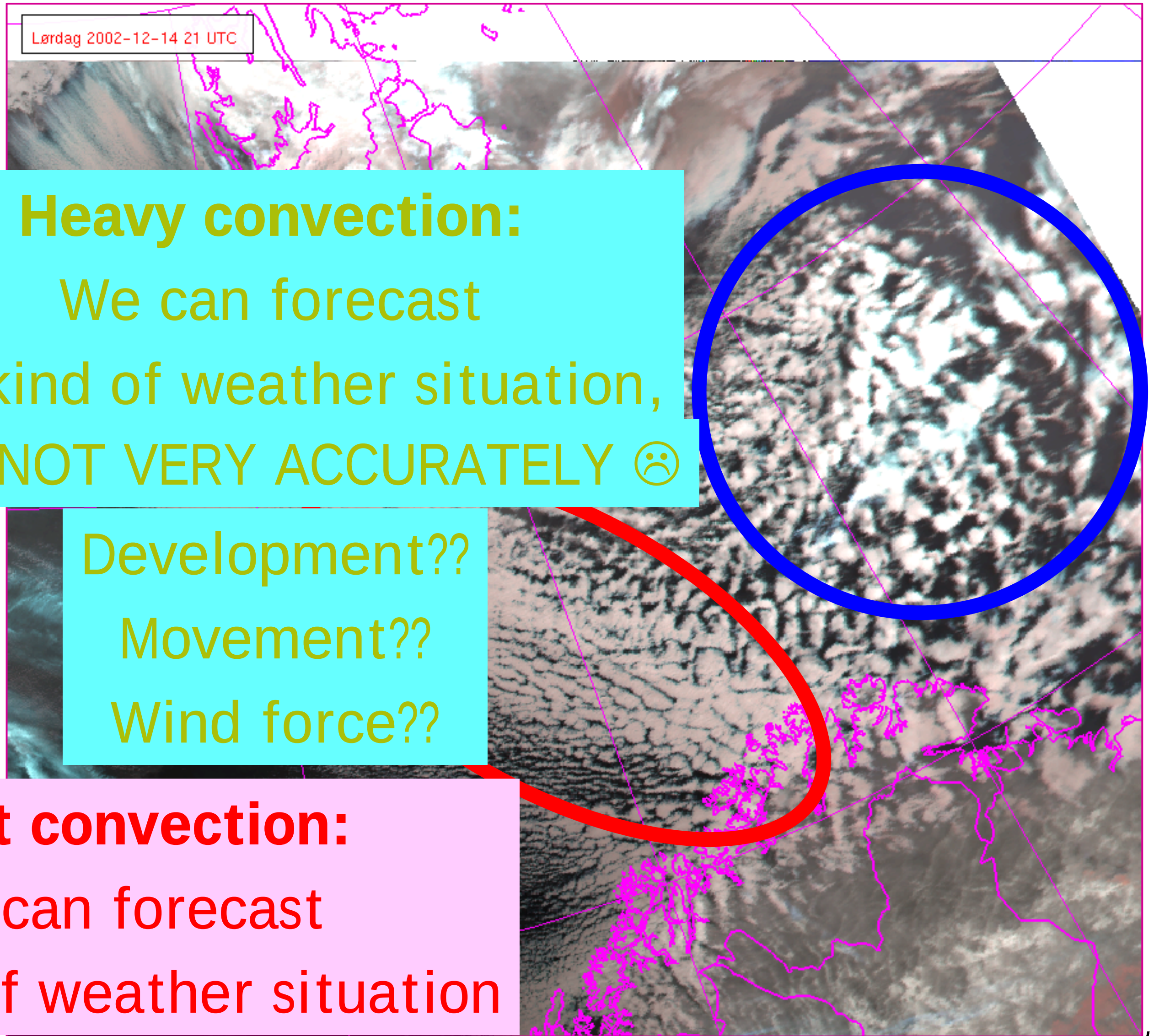
COLD AIR OUTBREAK



COLD AIR OUTBREAK



COLD AIR OUTBREAK



Heavy convection:

We can forecast

the kind of weather situation,

BUT NOT VERY ACCURATELY ☹

Development??

Movement??

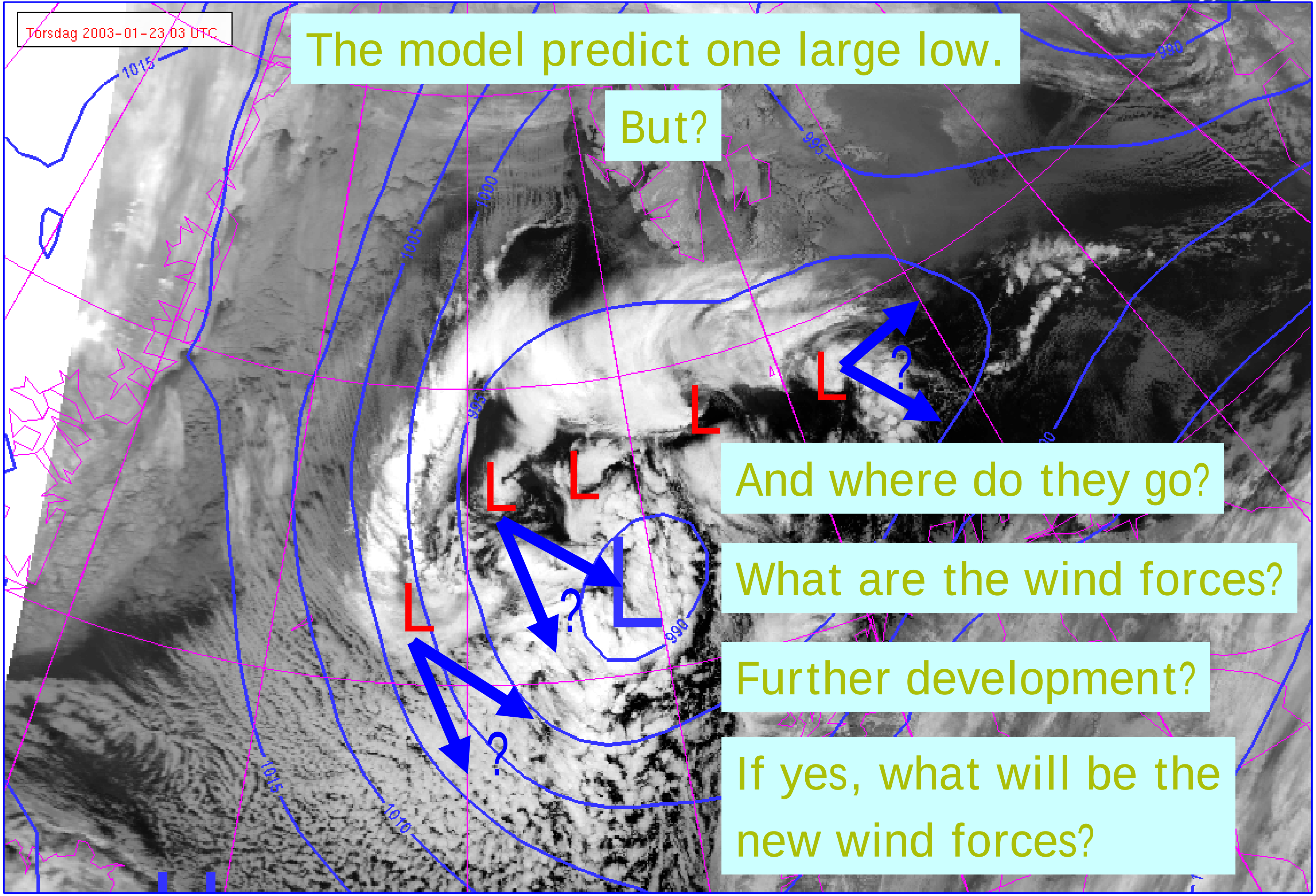
Wind force??

Light convection:

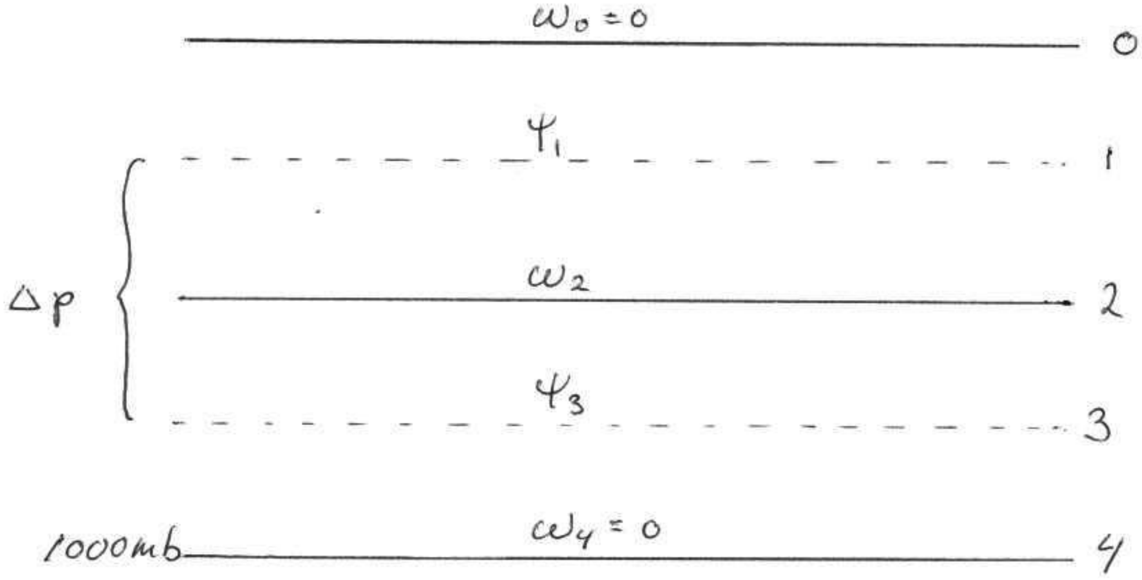
We can forecast

this kind of weather situation

INSTABILITY LOW(S?)



the two-parameter model



Baroclinic developments

perturbations on a basic flow

Geostrophic streamfunction:

$$\vec{v}_\psi = \vec{k} \times \nabla \psi, \quad \zeta = \nabla^2 \psi, \quad \psi = \Phi / f$$

Quasi-geostrophic vorticity equation:

$$\frac{\partial}{\partial t} \nabla^2 \psi + \vec{v}_\psi \bullet \nabla (\nabla^2 \psi + f) - f \frac{\partial \omega}{\partial p} = 0$$

Thermodynamic energy equation:

$$\frac{\partial}{\partial t} \left(\frac{\partial \varphi}{\partial p} \right) + \vec{v}_\psi \bullet \nabla \left(\frac{\partial \varphi}{\partial p} \right) + \sigma \omega = 0$$

typical middle latitude conditions - (L_c~3000 km)

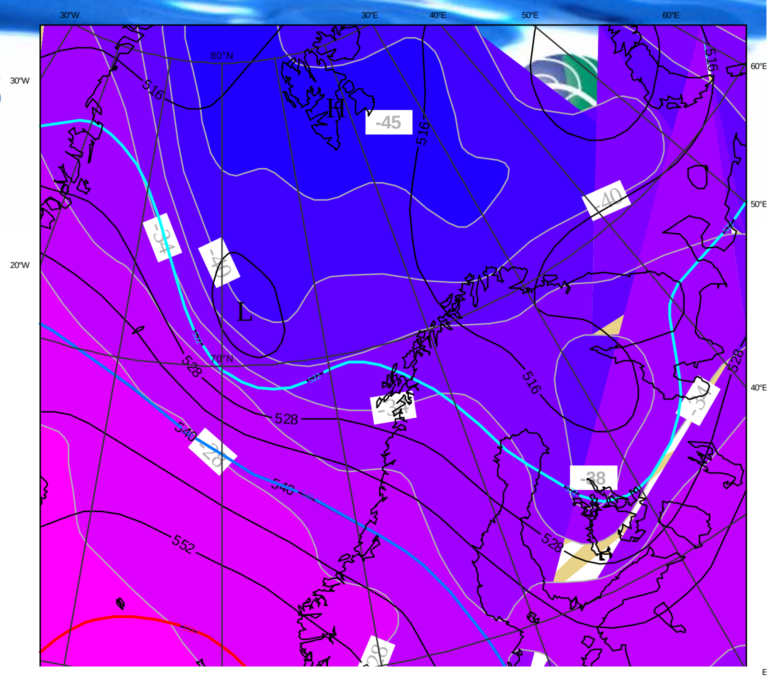
typical polar conditions - (L_c~600 km)

because of

- low tropopause, ~600 hPa
- small static stability), ~half its extratropical value
- far north => larger f

Maximum growth for L ~1.6L_c (650-900 km)

Formation mechanisms



Upper level:

-Cold upper trough or closed, cold-core upper vortex

-Approach of a jet maximum

-PV anomaly and positive vorticity advection

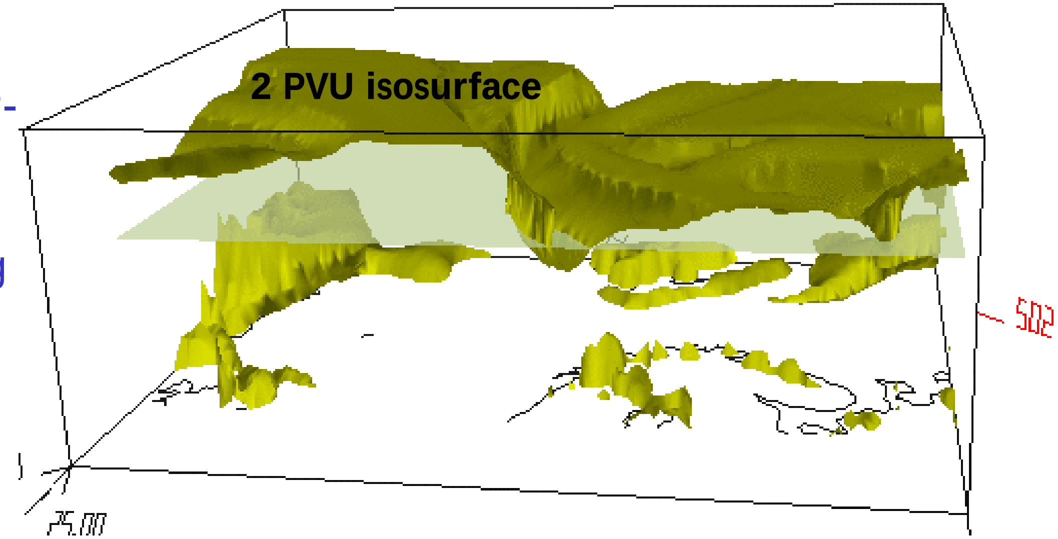
Low-level favourable environment

+

Dynamic forcing associated with upper-level system

+

Initiation of deep convection resulting from decreased mid- and high-level stability



Convective feedback

↓

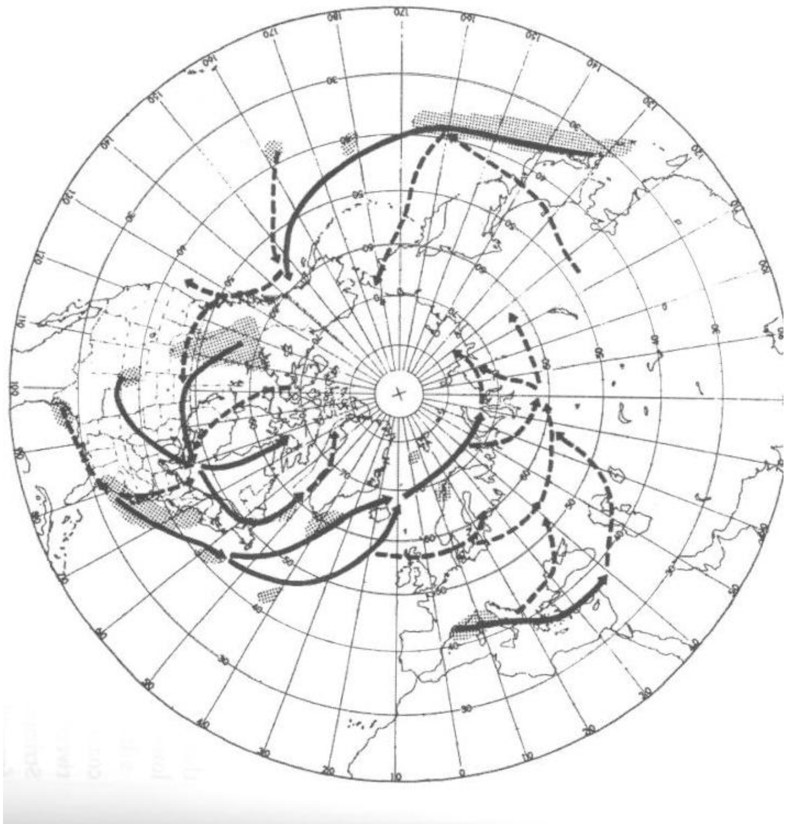
Rapid development

Preconditioning

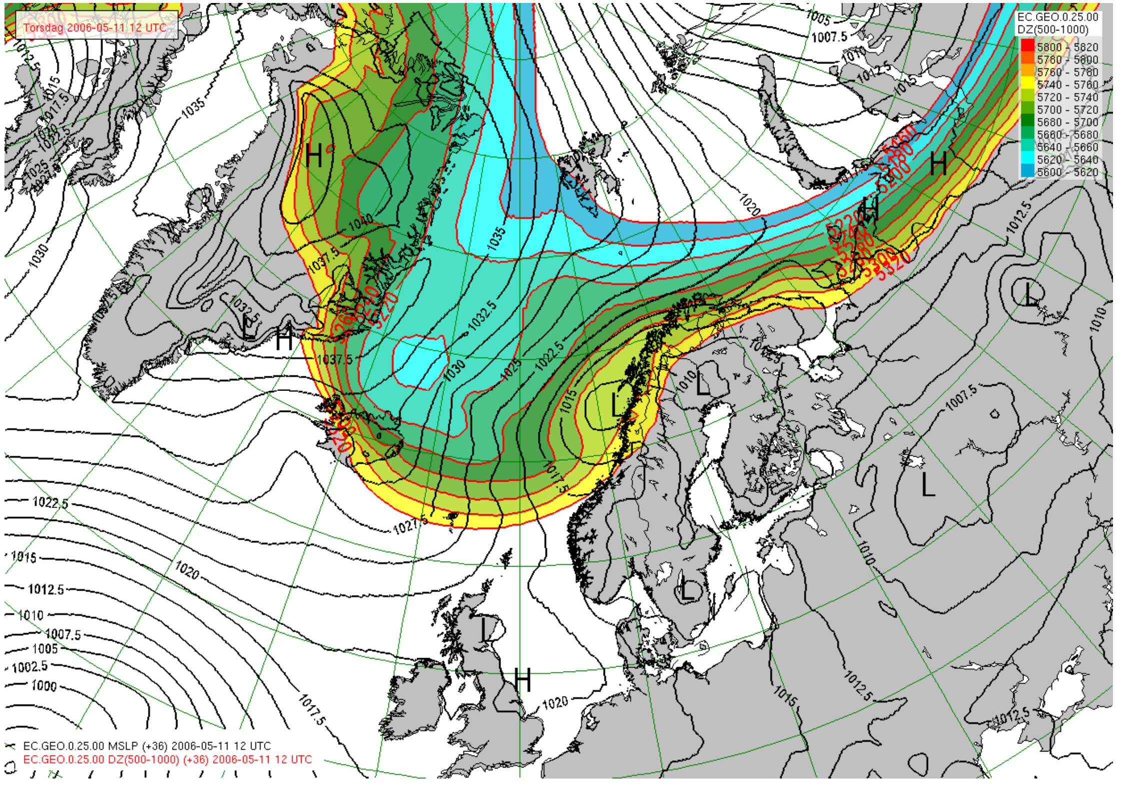
- Baroclinic zones and reversed shear flow
- Frontal dynamics (shear, deformation.....)
- Geographical conditions
    - Warm/cold ('fixed') surfaces
    - topography
- Low level air temperature contrasts due to large scale dynamics
- Large scale destabilization
- Upper air disturbances

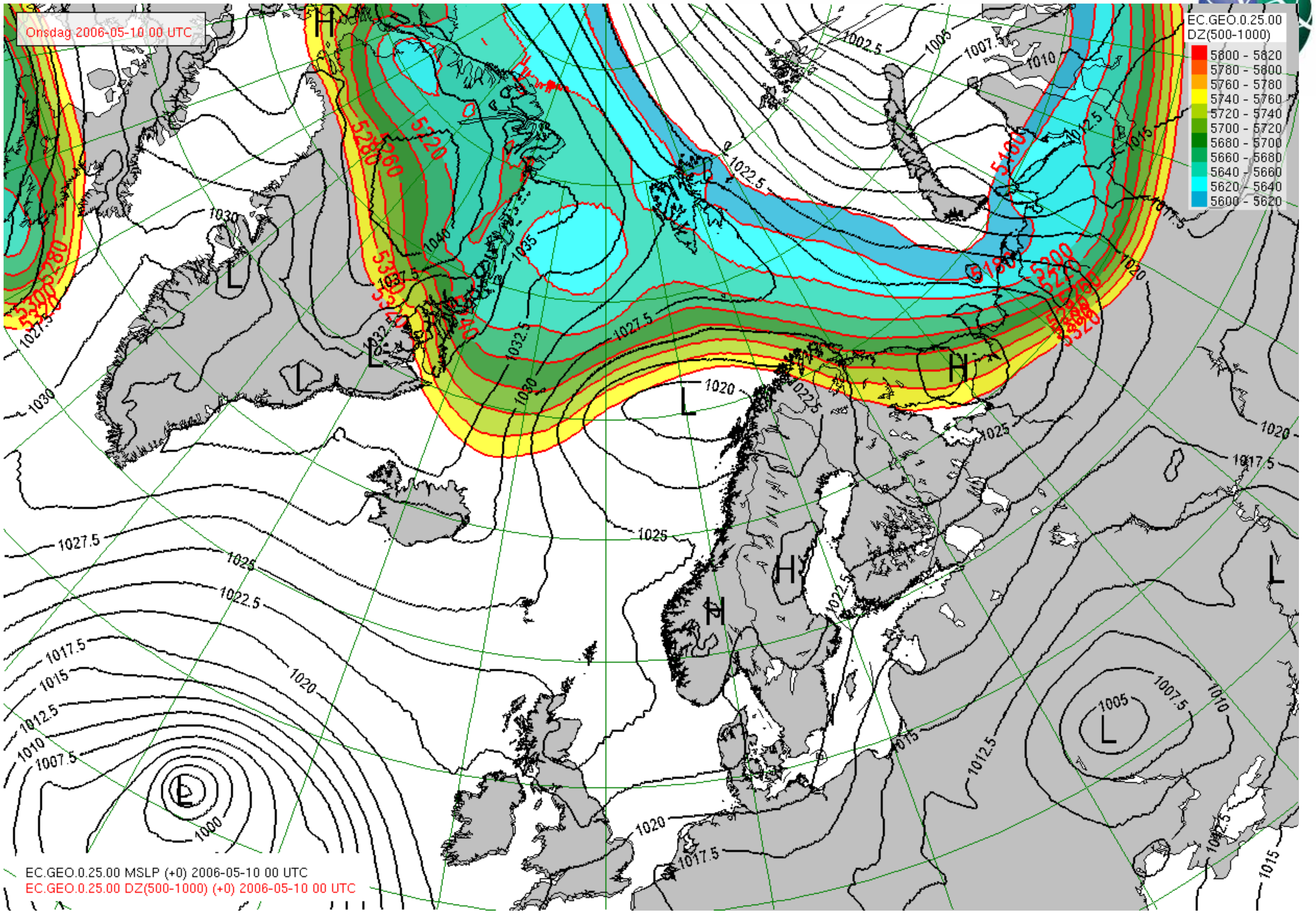
Reversed shear

NH stormtracks in January (Whittaker and Horn, 1984)



Synoptic scale lows following the 'standard' cyclone track become quasi-stationary over Northern Scandinavia and set up a northerly flow (cold air advection) in the Norwegian Sea




Onsdag 2006-05-10 00 UTC
EC.GEO.0.25.00
DZ(500-1000)
5800 - 5820
5780 - 5800
5760 - 5780
5740 - 5760
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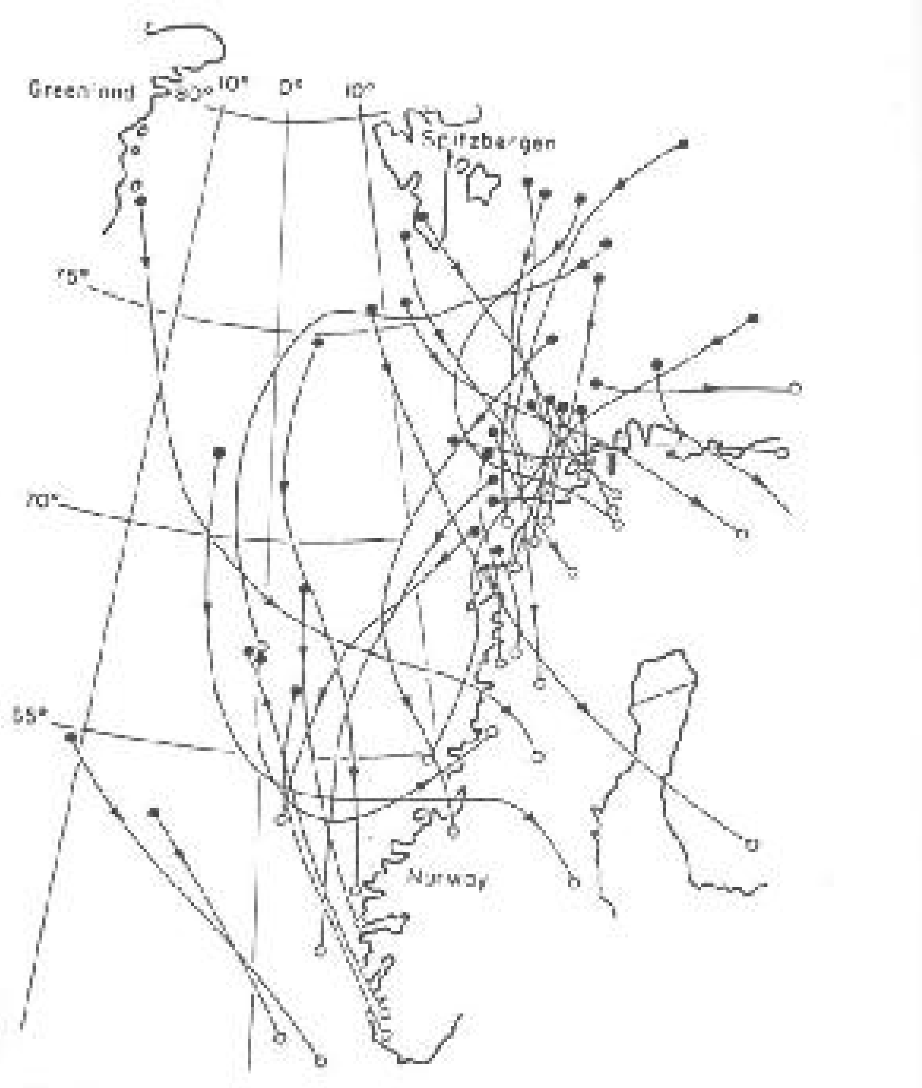
5700 - 5720
5680 - 5700
5660 - 5680
5640 - 5660
5620 - 5640
5600 - 5620
EC.GEO.0.25.00 MSLP (+0) 2006-05-10 00 UTC
EC.GEO.0.25.00 DZ(500-1000) (+0) 2006-05-10 00 UTC

Polar low tracks 1978-1982 (Wilhelmsen, 1985)



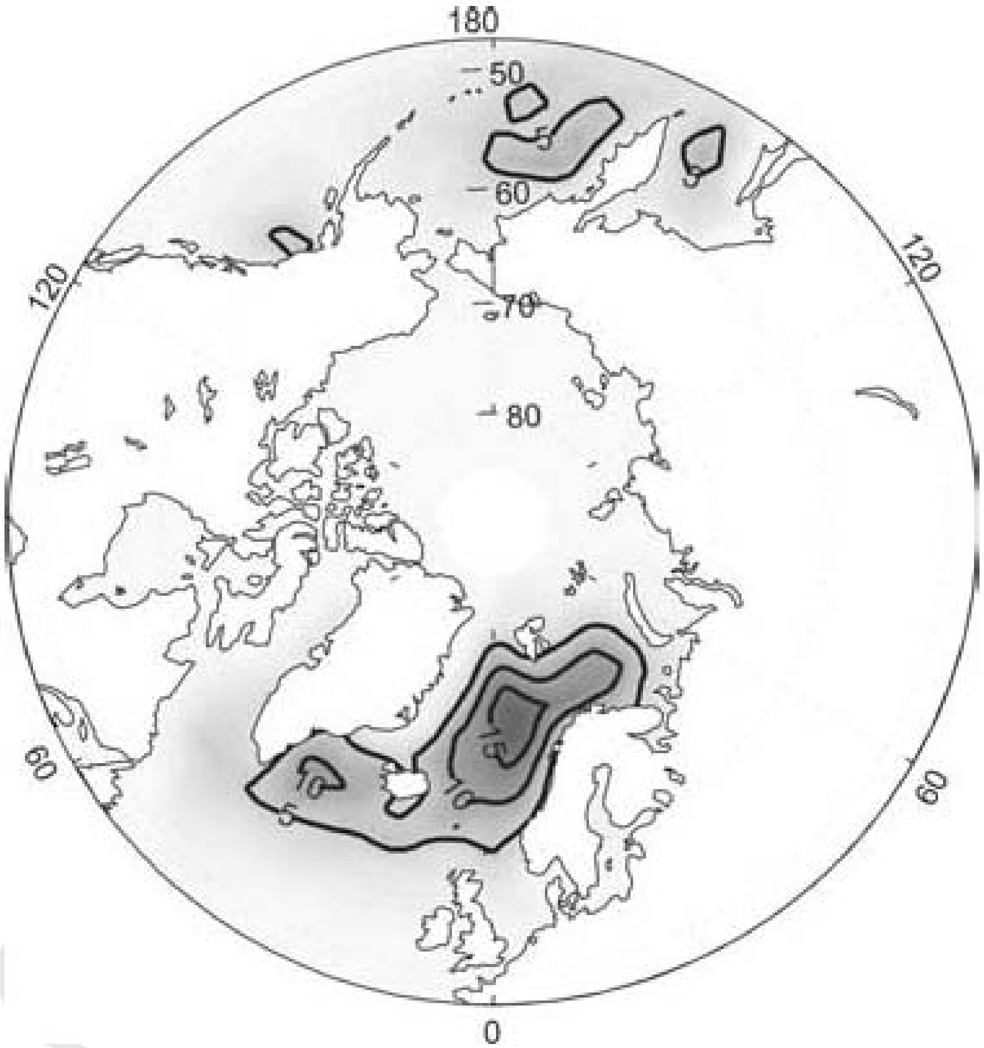
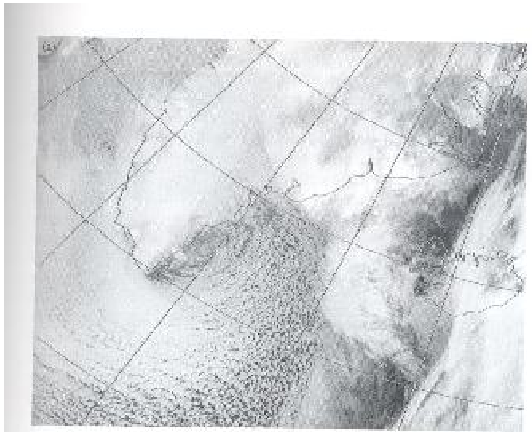
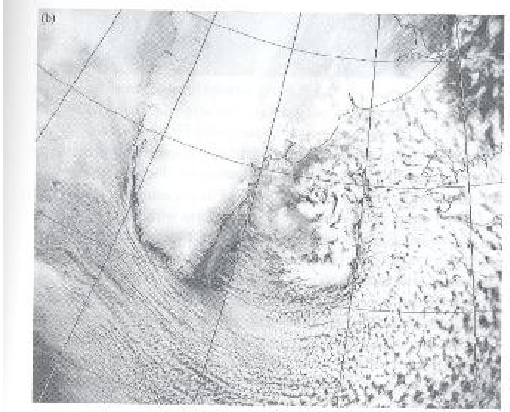
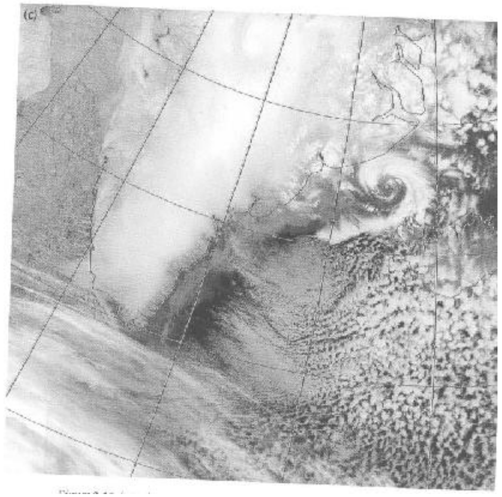


Fig. 13. The mean percentage of the time during NDJFM 1960–61 to 1999–2000 for each grid point with reverse thermal shear and low static stability according to our constraints.

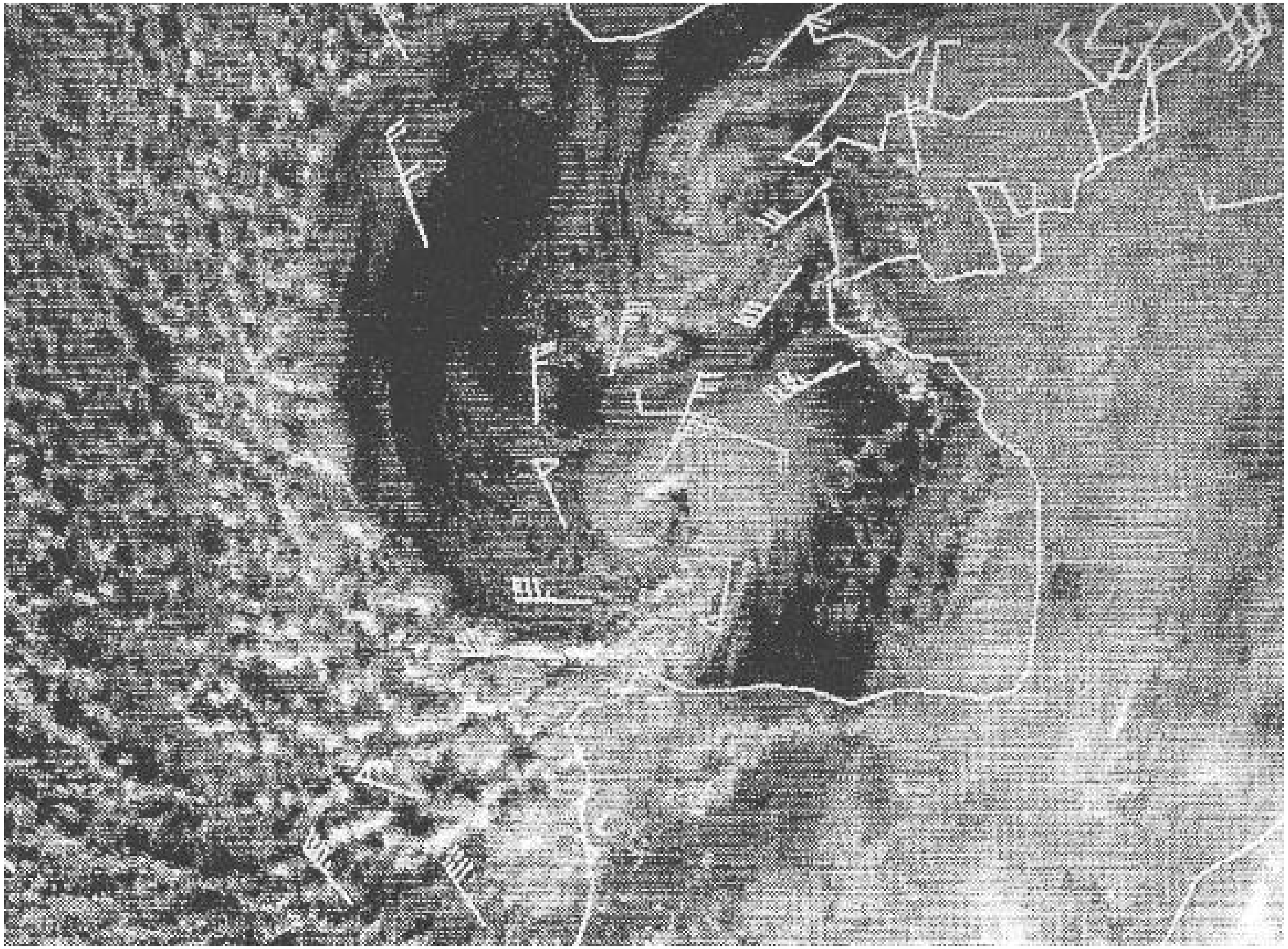


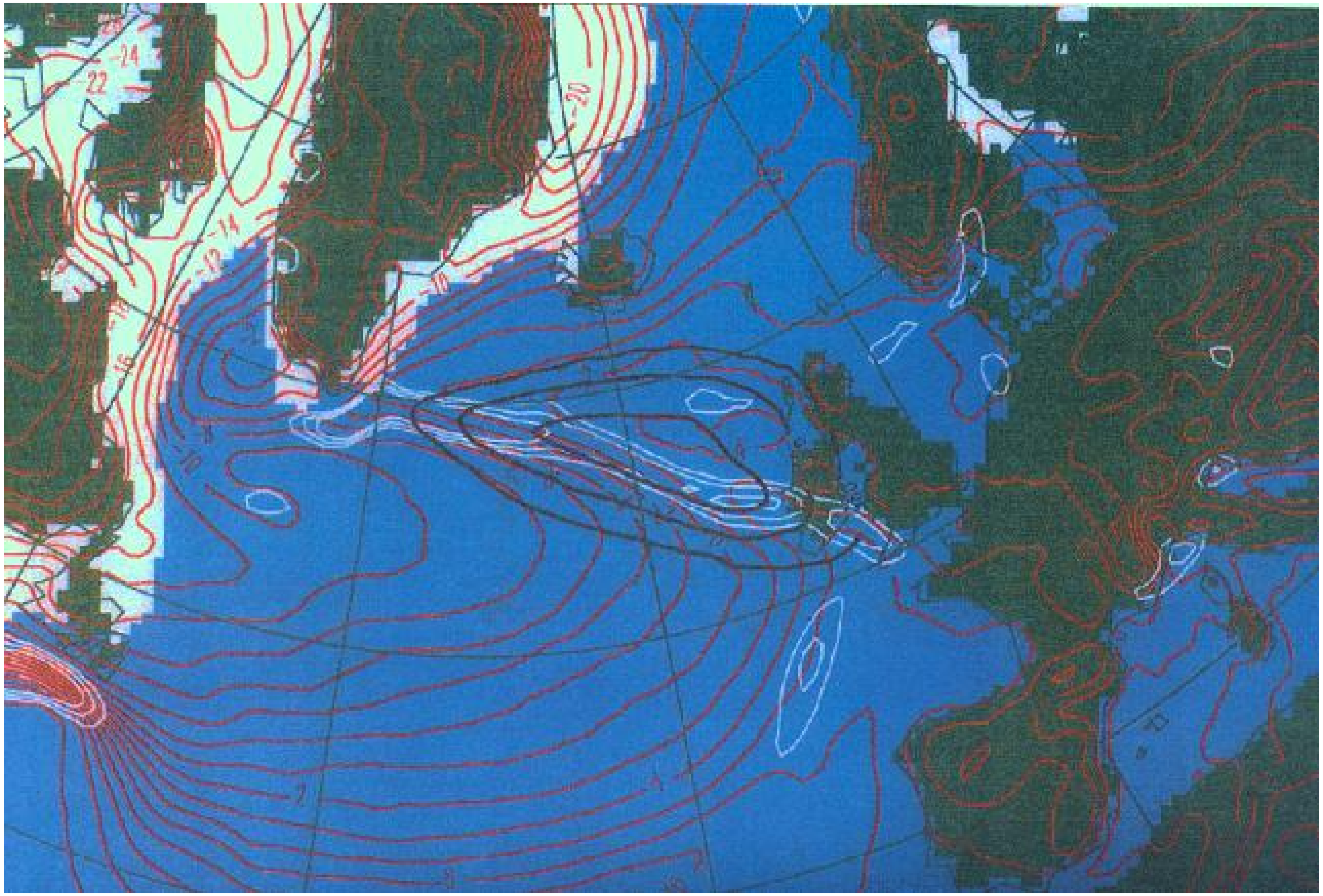


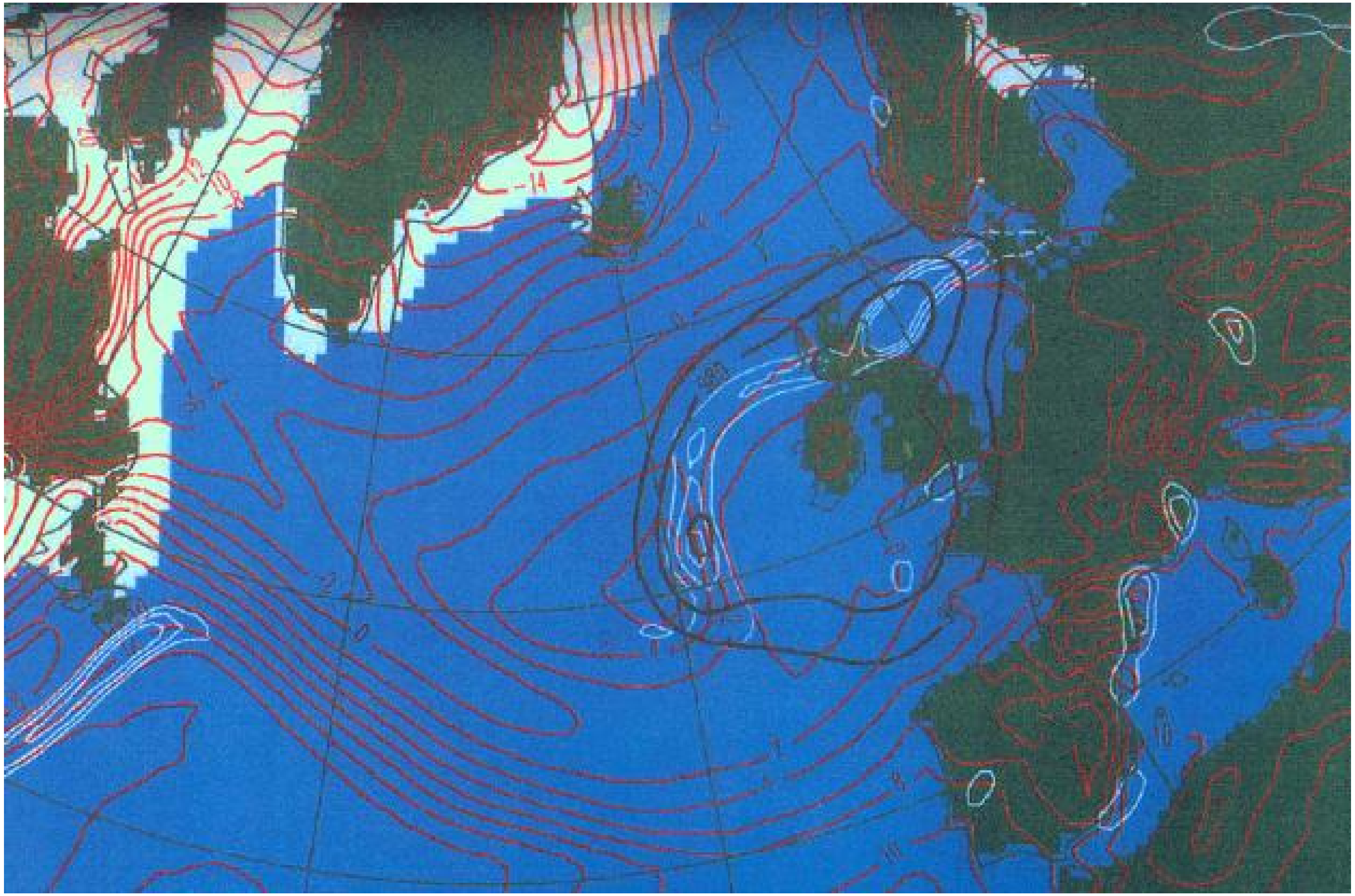


Greenland Tip Jet

Large scale dynamics



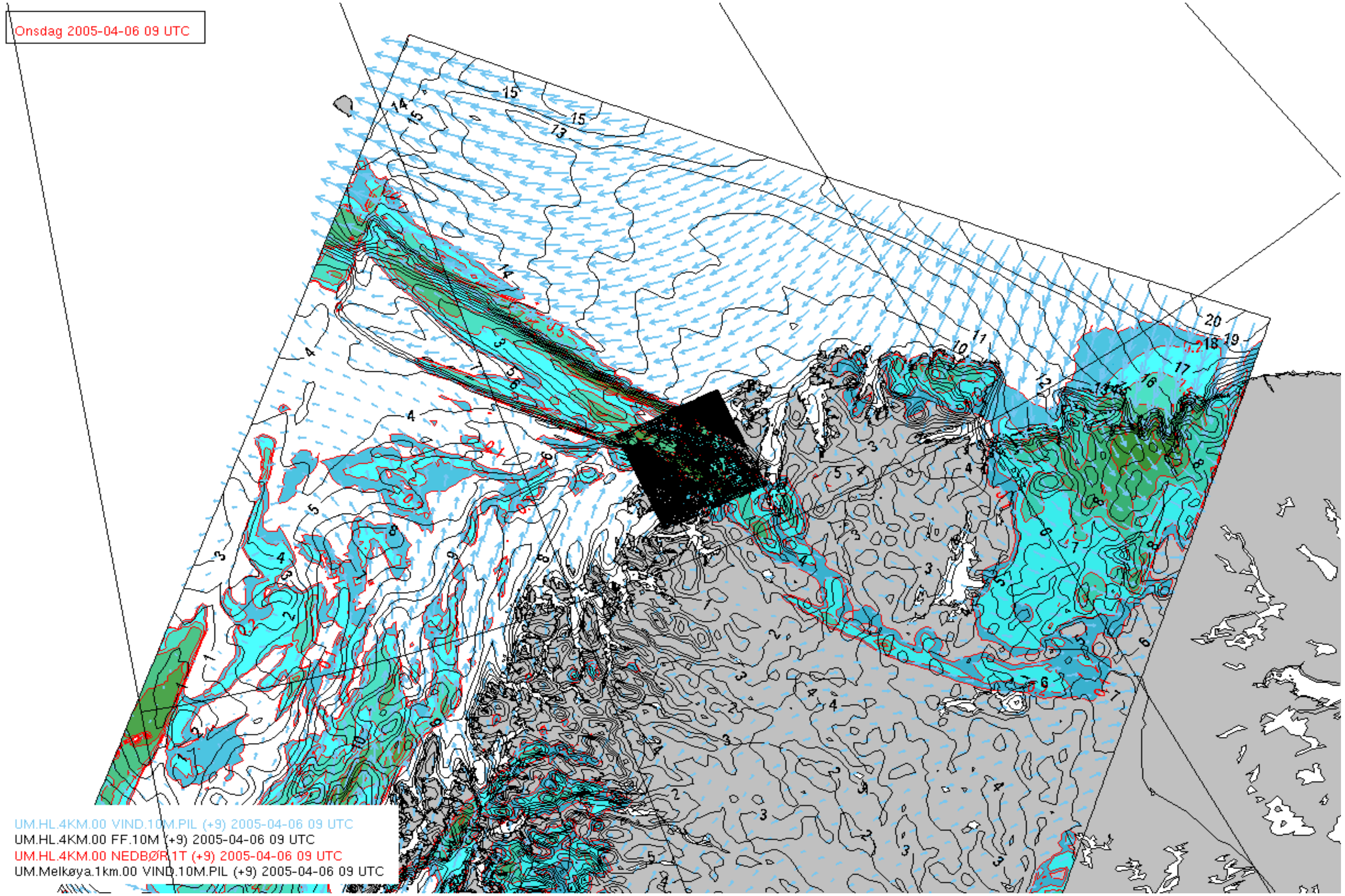




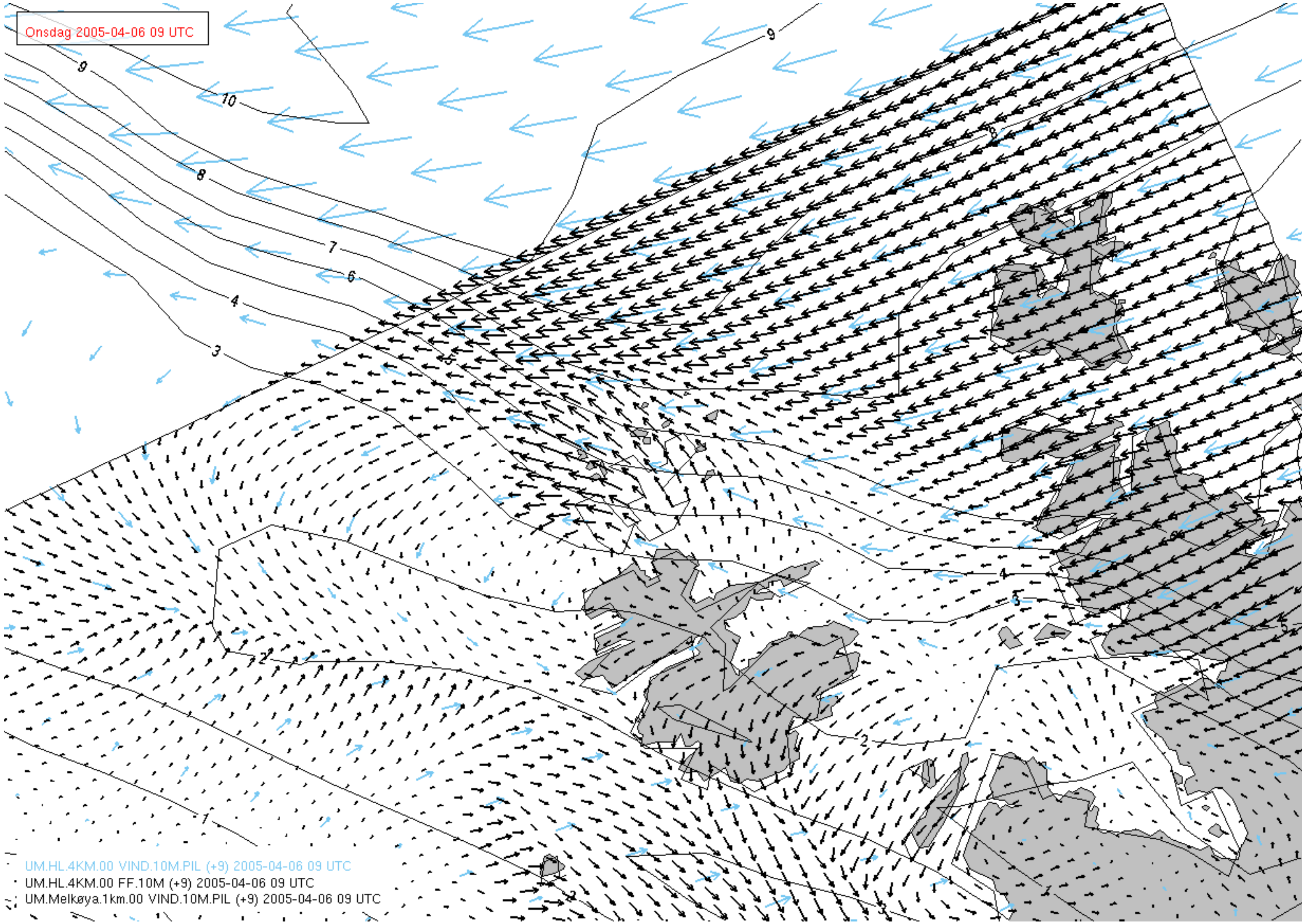
Where do we have to improve

- **Higher resolution models (1-4 km)**
- **Combine with LAM-EPS**
- **Initial conditions - better use of observations (satellites in particular)**

9 hour forecasts of precipitation and wind with the UM-model with horisontal resolution 4 km; only the northern part of the integration area is shown



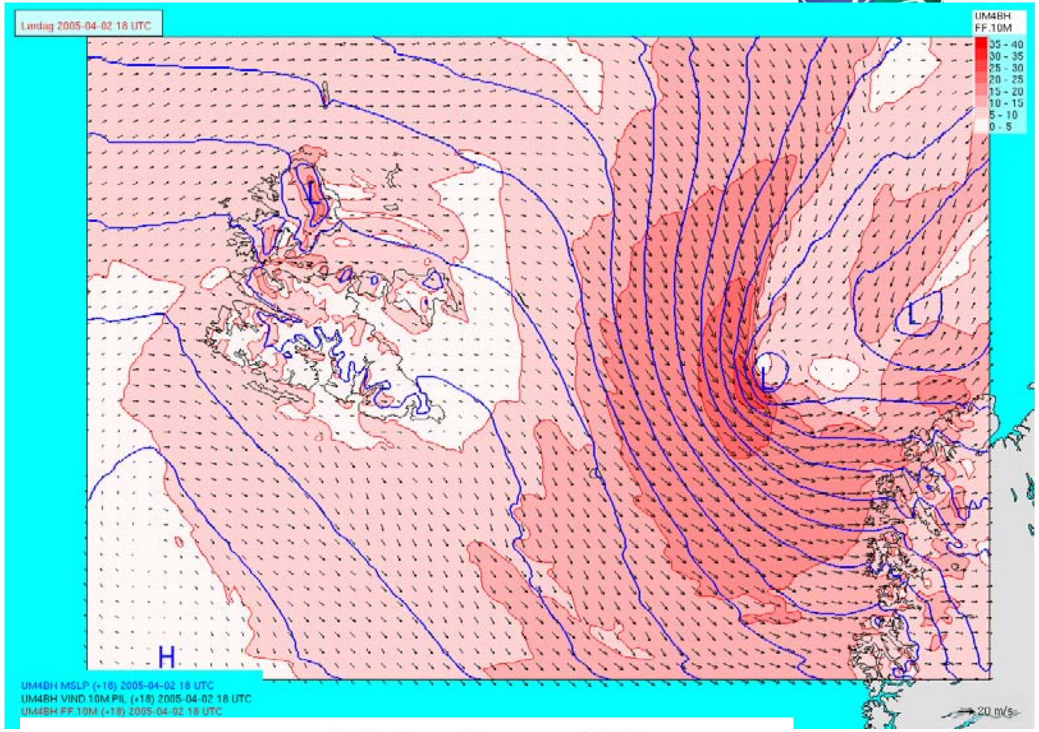
Very high resolution simulations for selected areas (1 km resolution).



Models and observations

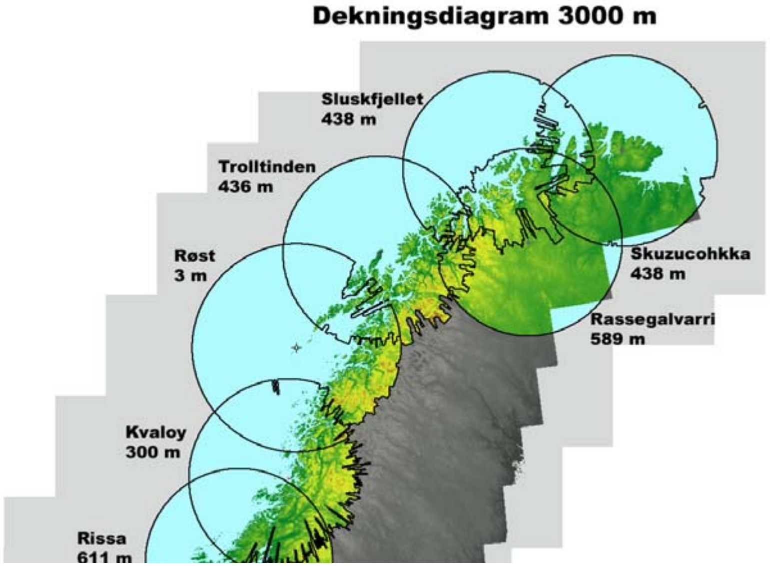
- More details and more correct physical description, when using high resolution models

  (a forecasted polar low with a state of the art high resolution nonhydrostatic model)



- more observations and better use of these observations

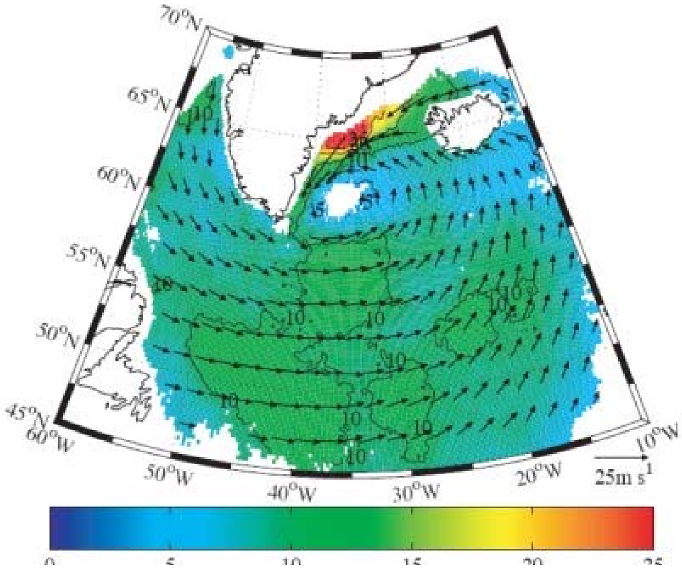
  (assimilate radar and satellite information into numerical models)

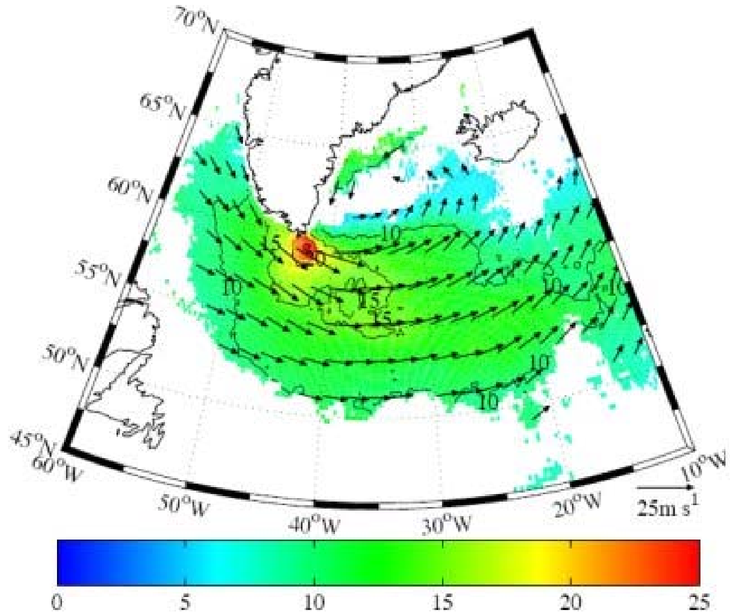


Greenland Flow Distortion experiment (GFDex), EOI #146

(GFDex) is an international fieldwork and modelling based project to investigate the role that Greenland plays in distorting atmospheric flow over and around it: affecting local and remote weather systems and, via air-sea interaction processes, the coupled climate system

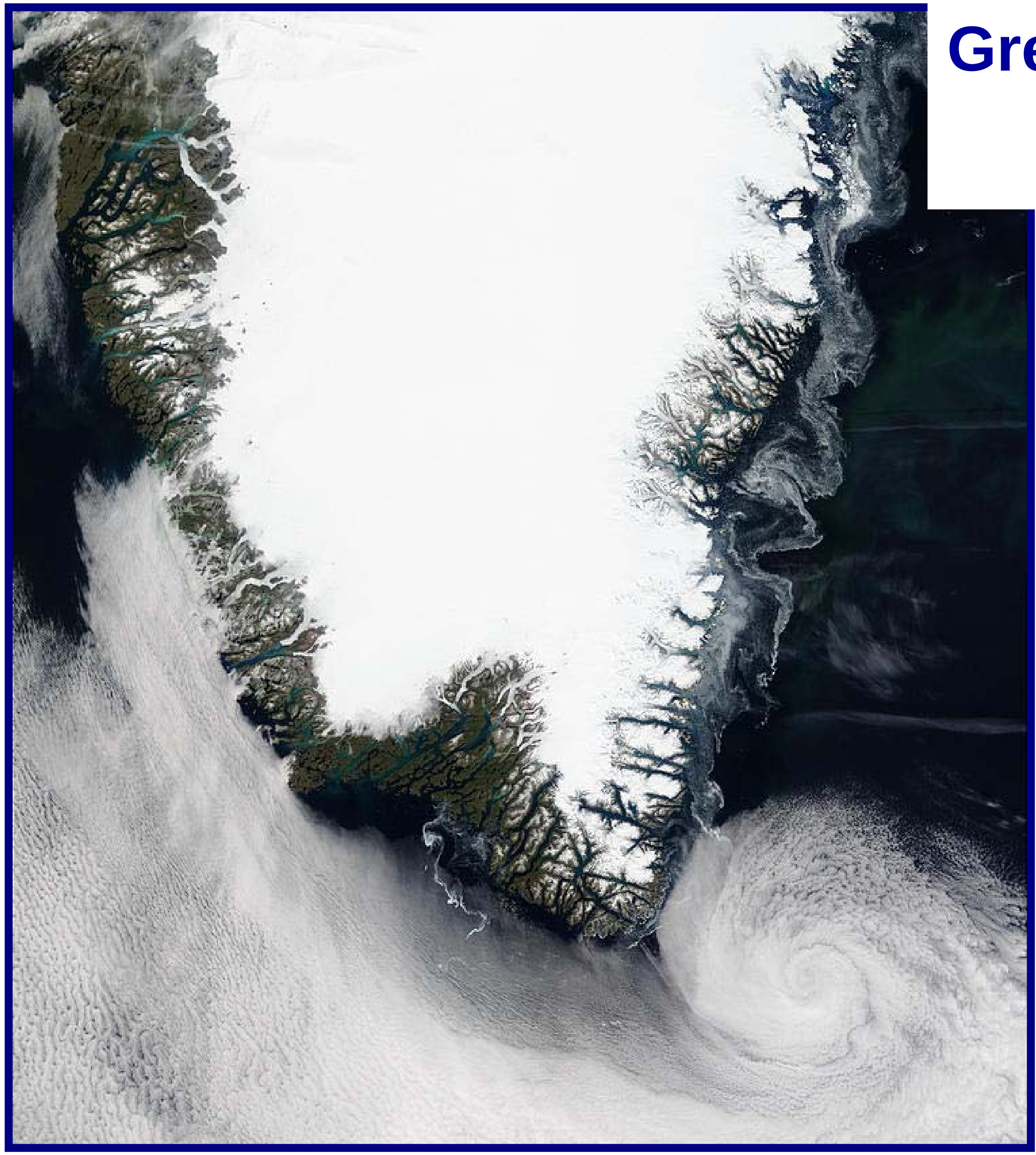
(Dr. Ian Renfrew, Univ. of East Anglia, UK)





Greenland Jets

EOI #394



27 July 2002 1425 UTC (MODIS Terra

(Dr. Andreas Dörnbrack, DLR, Germany)

TAWEPI's Polar-Gem (EOI #638)
(The Arctic Weather and Environment Prediction Initiative)

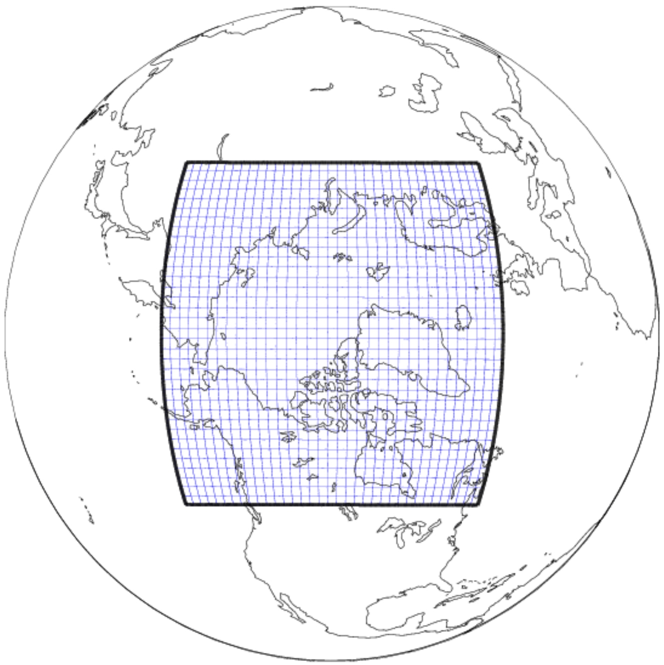
- An important component of this proposal is to develop a regional Numerical Weather Prediction (NWP) system (10-15km horizontal resolution) over the Arctic in support of the IPY projects, like THORPEX and field measurement campaigns.

- EXPECTED ADVANCES:

  - Improvement of environmental forecasting from few hours to two days for warning, health, transport, planning and security.

  - Unprecedented high resolution time series of analyses of environment parameters for miscellaneous studies (impact, adaptation, health, …)

(Dr. Gilbert Brunet, Proposal Lead (Meterological Research Division, Canada)



The Concordiasi Project (EOI #888)

Participating Institutes

Météo-France, CNES, LGGE, LMD	France
NCAR	USA
ECMWF	International
Bureau of Meteorology Research Centre	Australia

Main goal

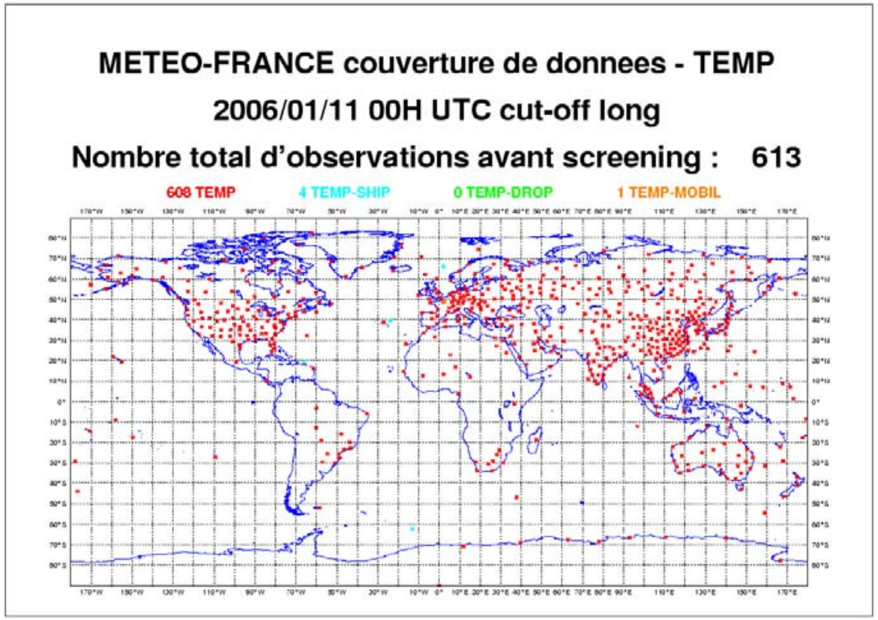
Validate the assimilation of advanced sounders (AIRS, IASI) over Antarctica

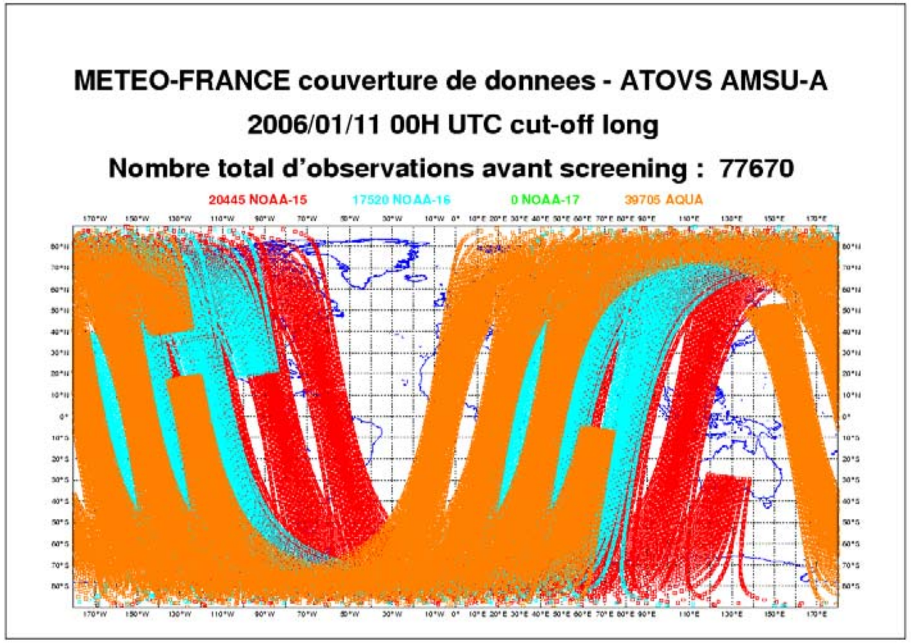
Using both models and additional observations (RS in Concordia, drifsondes)

In Sept-Oct 2008. To be coordinated with RIME.

Scientific objectives

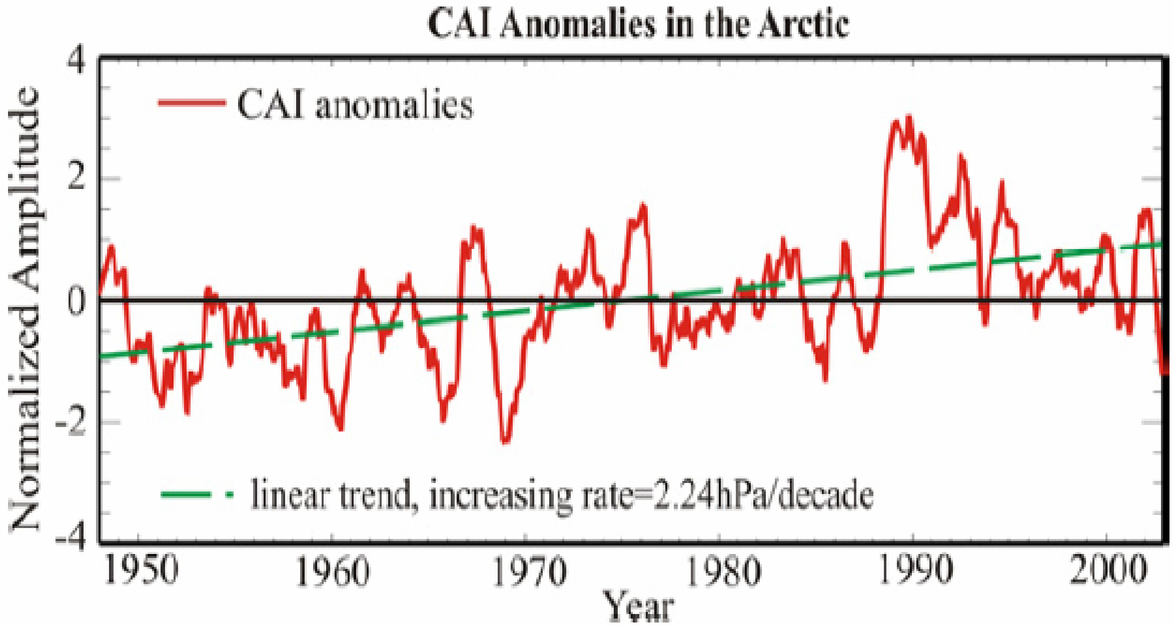
- Validate and improve the assimilation of AIRS/IASI in numerical models.





Impacts of Surface Fluxes on Arctic Climate, EOI #990
(Dr Will Perrie,Bedford Institute of Oceanography – DFO Canada)

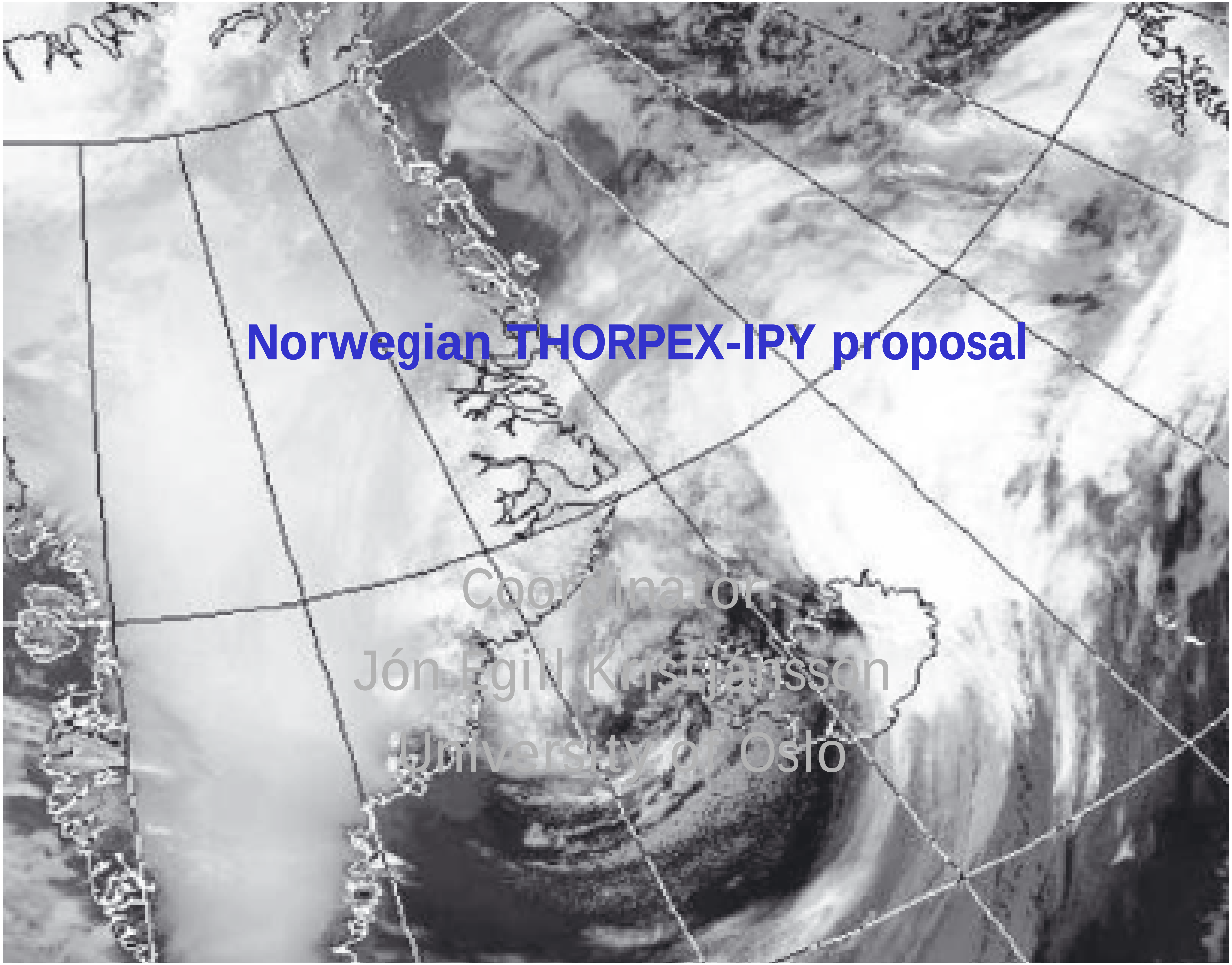
Arctic cyclone activity intensified:



ï The Arctic cyclone activity apparently intensified in the second half of the 20th century.

ï The dramatic increase of cyclone activity around 1990 corresponds well to the AO amplification.

Change in Arctic Storms climate – Zhang et al. 2004 J. Climate



Norwegian THORPEX-IPY proposal

Coordinator:

Jón Egill Kristjánsson

University of Oslo

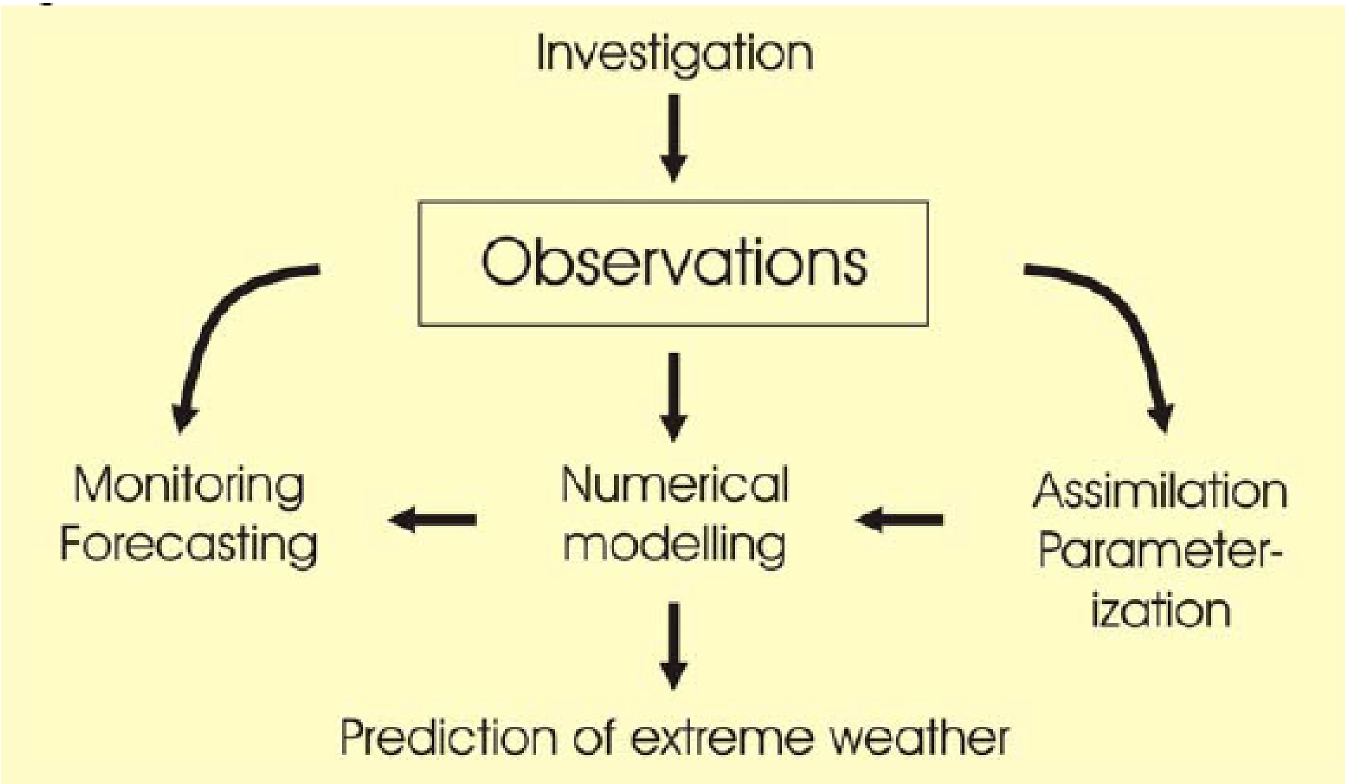
Outline

- Title: **THORPEX-IPY: Improved forecasting of adverse weather in the Arctic region – present and future**
- Overall Objective: *To improve the accuracy of high-impact weather forecasts in the Arctic region, for the benefit of society, the economy and the environment*
- Active participants: Approx. 20 institutions, including 3 Russian institutions

Work Packages

- **WP1**: Field experiments, data handling. *Leaders: I. Barstad (UiB), Ø. Hov (met.no)*
- **WP2**: Physics and dynamics of Arctic Weather Extremes. *Leader: Ø. Sætra (met.no)*
- **WP3**: Physical processes of Arctic clouds and sea ice. *Leaders: A. Sandvik (BCCR), J. Stamnes (UiB)*
- **WP4**: Synoptic influence on mesoscale Arctic weather extremes. *Leaders: A. Sorteberg (BCCR), E. Kolstad (UiB)*
- **WP5**: Operational modeling capability of adverse Arctic weather. *Leaders: L.-A. Breivik (met.no), T. Iversen (met.no)*
- **WP6**: International co-operation. *Leader: T.-E. Nordeng (met.no)*

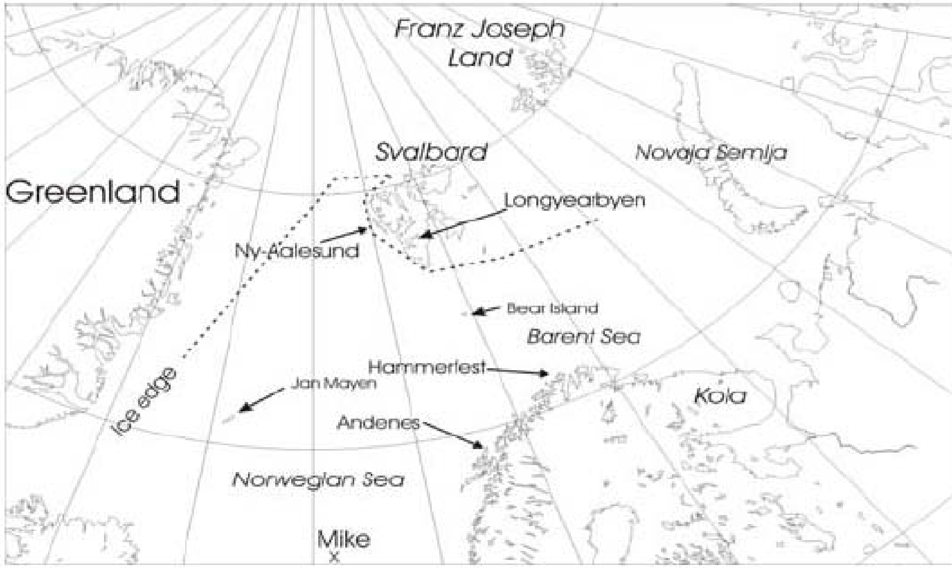
Links between the different activities



WP1: Planned field campaign February-March 2008

- Focus on Weather Extremes in the Barents Sea region
- Operations centre: Andenes, N-Norway (daily commercial flights, military air base, weather radar, LIDARs)
- Existing and new observational platforms

Observational platforms during field campaign 2008



- DLR Falcon from Andenes
- UAV at Longyearbyen
- New radiosondes at Franz Joseph Land, Hammerfest
- Tethered balloon system at Ny-Ålesund
- New wind and temperature profiler at Bear Island
- Flux mast at Spitzbergen
- Radiosondes from two ships near Bear Island

Field campaign – Orographic influence of Spitzbergen

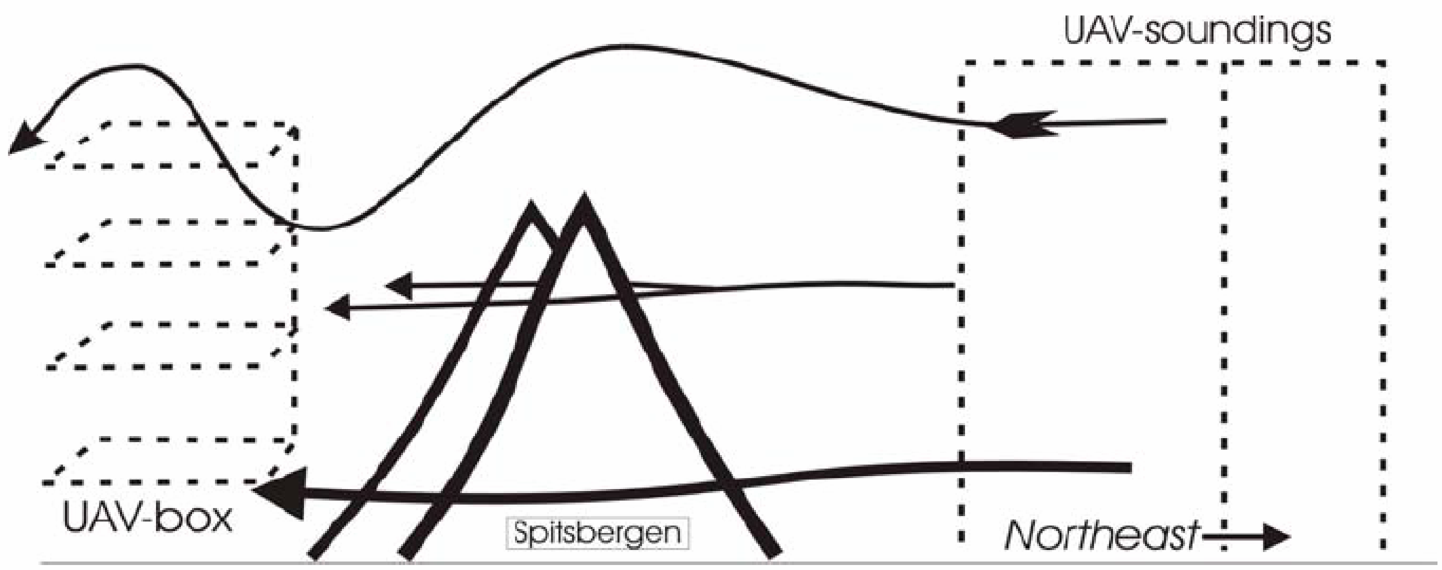


Figure 3: Schematic illustration of mesoscale features (left-side jet, gap-flow and gravity wave) typical for northeasterly flows over Spitsbergen.

Field campaign – Arctic fronts

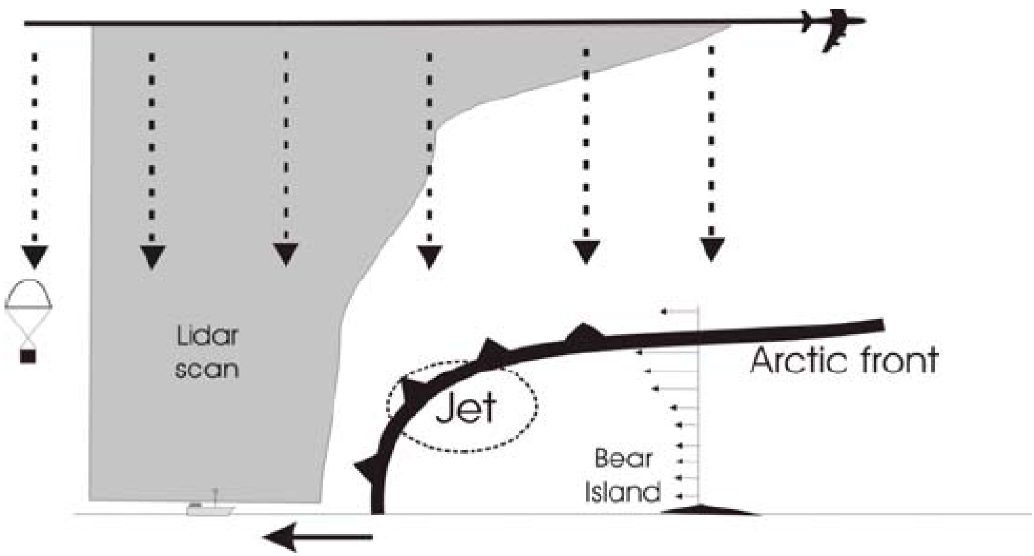
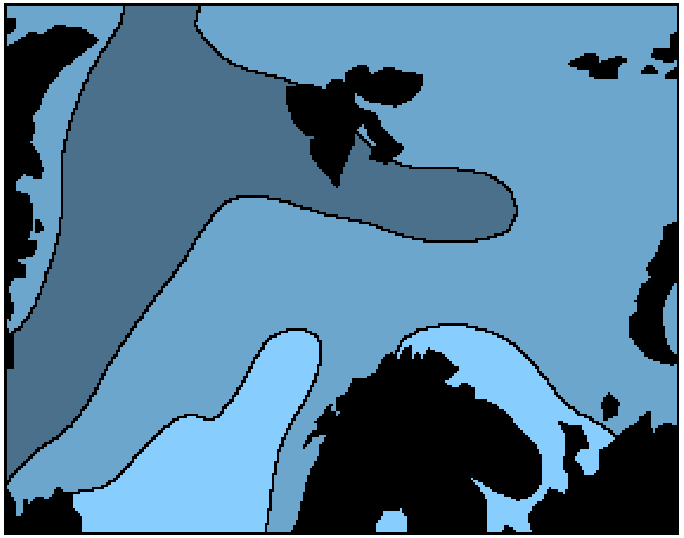


Figure 2: Schematic illustration of an Arctic front and planned measurements, the Falcon-DLR dropping sondes and scanning downward with its LIDAR platform, ship measurements and wind profiler measurements.

Arctic Fronts and Polar Lows

Areas where low-level large-scale temperature gradients are largest



Areas of high climatological probability for polar low formation

Kolstad (2006)

WP1: Participation in Ian Renfrew's GFDex in February-March 2007

- Builds on previous modeling activities at the University of Oslo
- Seeks to understand the orographic influence of Greenland on air flow and cyclone developments – PV structures; mesocyclones
- The impact of campaign data for forecast skill
- Support from EUFAR has been granted (9 flight hours with FAAM aircraft)

WP2: The physics and dynamics of Arctic weather extremes

- Parameterizations of the influence of sea state on air-sea fluxes
- The southward extent of Arctic fronts
- Interactions between Arctic fronts and polar lows
- Physical processes in polar lows – mechanisms, parameterization issues
- Modeling simulations of cyclone developments under the influence of Greenland's orography (collaboration with GFDex and WP1)

WP3: Parameterization of physical processes connected to arctic clouds and sea ice: Feedbacks with climate change

- Improved parameterizations of ice cloud optical properties, based on CPI and LIDAR measurements (WP1)
- Model studies of the impact of changes in sea ice cover on the radiative budget and interactions with Arctic clouds

WP4: The synoptic influence on mesoscale Arctic weather extremes

- Investigation and synthesis of existing case studies and data base for polar lows and Arctic fronts
- Dynamical downscaling of known polar low (and Arctic front) events
- High-resolution simulations of future climate scenarios for the Arctic, using a global model with stretching

WP5: Operational modeling capability of adverse Arctic weather

- Assimilation of new satellite data: Upper-level winds (IASI, wind LIDAR), humidity (MODIS, VIIRS)
- Assimilation of weather radar data (radial winds, precipitation)
- Adjustment and fitting of LAMEPS to a target domain in the Arctic
- Exploit developments in WP2, to improve operational predictions of Arctic fronts, polar lows, etc.

Milestones of the IPY JC activities

- ✓ ICSU and WMO have established IPY Joint Committee (JC) – November 2004;
- ✓ ICSU and WMO have established IPY International Programme Office (IPO) at BAS, UK – Nov. 2004;
- ✓ ICSU and WMO have issued call for Expressions of Intent (EOI)- Nov. 2004

  - by14 January 2005 more than 1000 Expressions of Intent (EOI) were collected;
- ✓ IPY JC First session, Paris, 7-9 March 2005

  - JC identified EOI of category 1 that may become "cluster" full proposal projects for IPY, and EOI of category 2 that should be grouped around "cluster" full proposal;
- ✓ IPY JC and IPO has sent out letters to all proponents on 30 March 2005 with JC guidance on clustering of EOI and preparation of full proposals with three deadlines: 30 June 2005, 30 September 2005, 31January 2006;

Milestones of the IPY JC activities

- ✓ Intercommission Task Group on IPY established by WMO EC developed a set of recommendations on role of technical commissions and NMSs in the IPY preparation and implementation (April, 2005)

- Technical commissions (CBS, CCL, CAS, JCOMM) have developed plans of actions for IPY on the basis of ITG recommendations;

- ✓ IPY JC Second session, Geneva (15-17 Nov. 2005) and JC teleconference (2 March 2006)

- JC evaluated of more than 400 full proposals that were received at IPY IPO by 30 June, 30 September 2005 and 31 January 2006;

- ✓ IPY JC Third session, Cambridge (20-22 April 2006)

- JC endorsed 160 IPY scientific projects proposals and 46 proposal on education and outreach; JC reviewed reports of Subcommittees on Observations, on Data Policy and Management, on Education,Outreach and Communications and endorsed the recommendations

THORPEX and the IPY

CAS- XIV (February,2006) welcomed the decision of THORPEX ICSC on coordinating role of the THORPEX in respect to all other proposals and projects from IPY national committees and other entities falling into THORPEX scientific objectives, including those in the Southern Hemisphere. It recommended that THORPEX Subcommittee for IPY should play this role and keep close contacts with IPY JC and IPO regarding THORPEX objectives and plans for the IPY.

THORPEX IPY Cluster proposal

The objectives of the THORPEX IPY Cluster proposal:

- Explore use of satellite data and optimised observations to improve high impact weather forecasts <u>(form a Polar Trec and/or provide additional observations in real time to the WMO GTS)</u>
- Better understand physical/dynamical processes in polar regions
- Achieve a better understanding of small scale weather phenomena
- Utilise improved forecasts to the benefit of society, the economy and the environment
- Utilise of TIGGE for polar prediction

What is EUCOS?

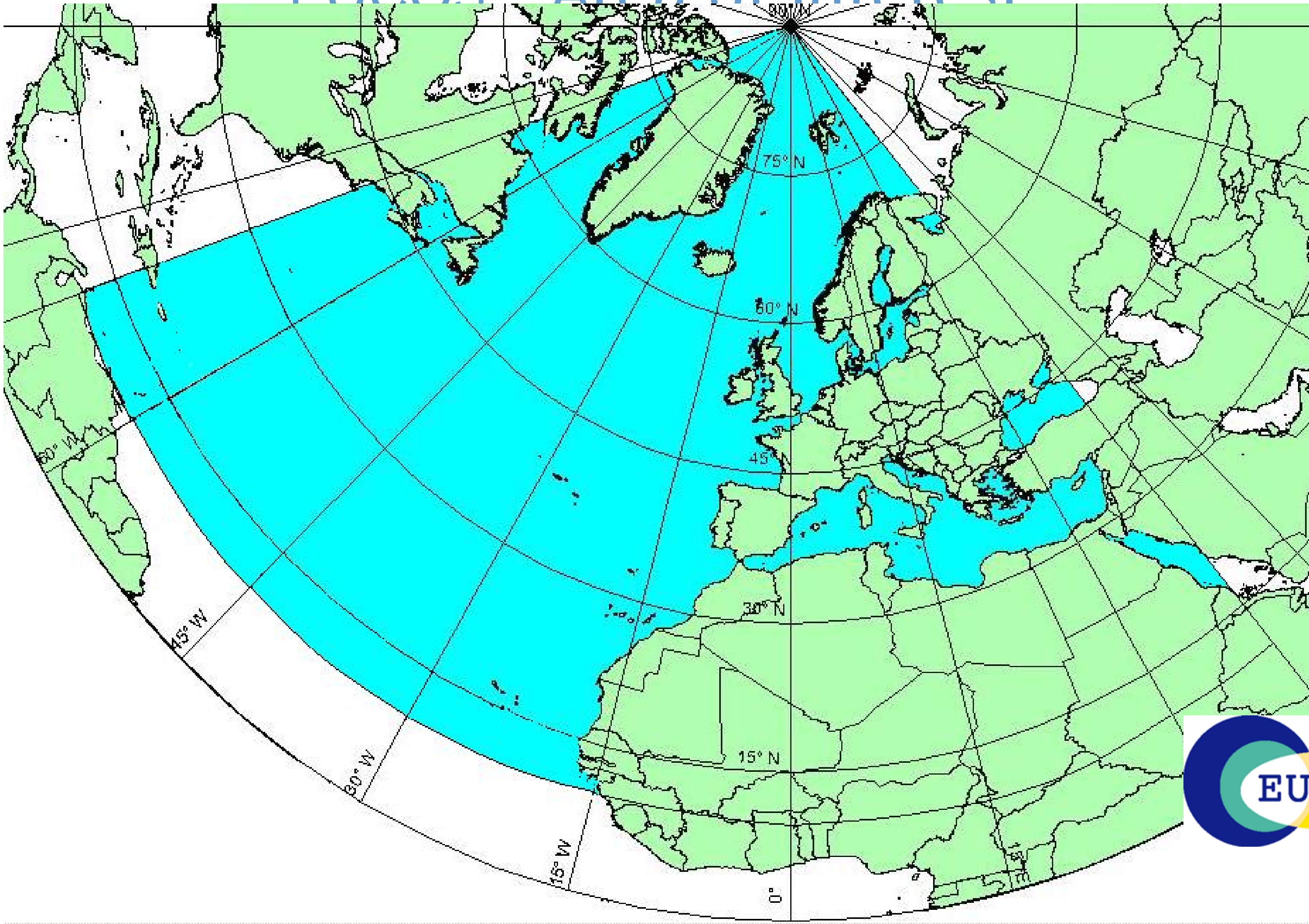
- **EU**METNET **C**omposite **O**bserving **S**ystem

- Current remit to cover regional NWP requirements providing terrestrially based observational capability that spans individual national capabilities

- Definition of 'regional' not fixed as the requirements evolve with time but focussed on 1 to 3 day forecast requirements considering synoptic scale meteorology

- Operational elements of EUCOS include aircraft based measurement (E-AMDAR), ship borne radiosonde systems (E-A and oceanic surface measurements (E-SURFMAR)

EUCOS – Area of Interest



EUCOS

et.no

EUCOS involvement in the IPY

- EUMETNET Council have approved the involvement of EUCOS and its operational programmes to support IPY activities.

- Our involvement must support the goals of EUCOS in terms of improving regional NWP in the European domain and by implication information on how to improve observing networks so that regional NWP can be improved.

- Approximately 120k€ of additional money has been allocated to support observing related activities over and above the continued operational delivery of observations from the EUCOS Programme in the northern IPY region

Observing Resources Available

- The nature of the EUCOS Programme is such that the infrastructure of the operational observing programmes can be used to support IPY.

- This could include
  - Additional AMDAR data from E-AMDAR aircraft crossing the IPY region
  - Additional radiosonde ascents from the E-ASAP fleet in the area, predominately from the Danish and Icelandic ships
  - Additional radiosondes from the land based radiosonde networks of the Members of EUMET
  - Data quality monitoring services

- To develop a data targeting service within the framework of the EC sponsored EURORISK PREVIEW Programme to deliver additional meteorological observations over key sensitive regions to better understand issues surrounding data targeting and facilitate future services that might aid:
  - Accurate prediction and early warning of high impact weather events over Europe
  - Reduce forecast uncertainties should ensemble products show differing predictions

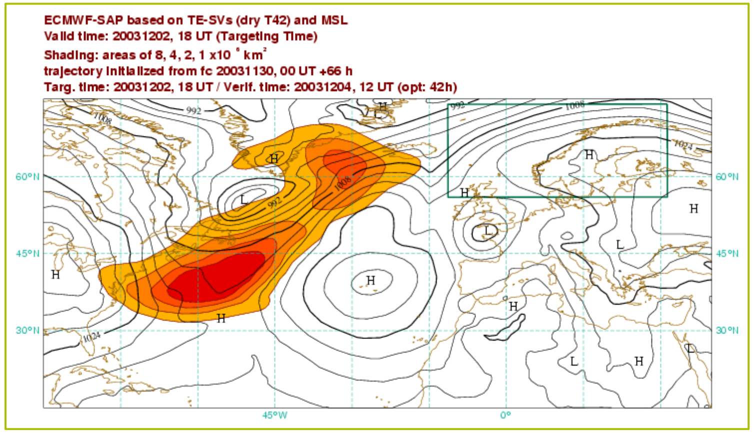
- A-TReC was manually intensive; under PREVIEW semi-automatic processes will be implemented making data targeting possible over an extended duration

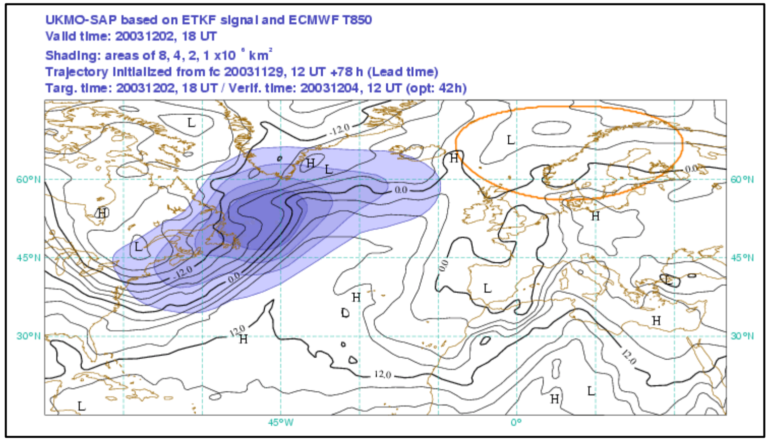
- This will require the development of efficient processes in order to:
  - Identify ‘cases’ that might benefit from improvement (in terms of geographical region and forecast time)
  - Run forecast sensitivity calculations for each case to identify the ‘target regions’ where additional observations will have most impact
  - Deliver additional observations within these target regions
  - Monitor data provision and resource availability

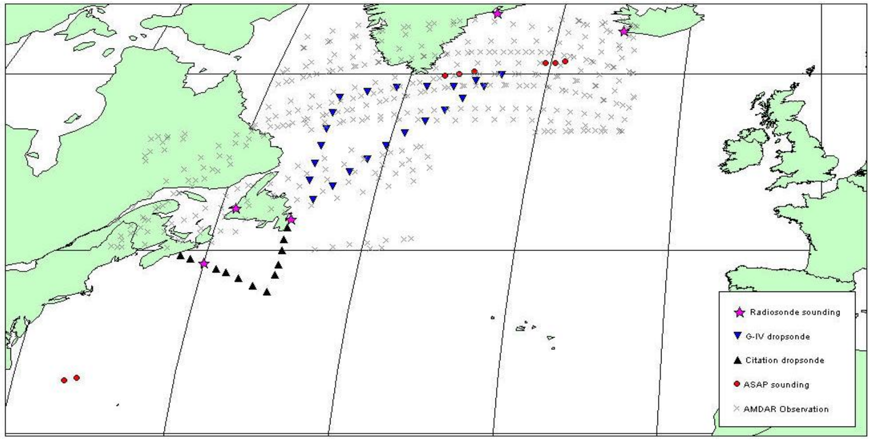
ATReC (Oct 15 - Dec 17 2003)

- The Atlantic THORPEX Regional Campaign (ATREC) was a collaborative effort between EUCOS (EUMETNET Composite Observing System) program and THORPEX to test the targeting ability of a wide range of observational platforms in a real-time quasi-operational environment. It involved high degree of coordination and collaboration among UK Met office, ECMWF, Meteo-France, NRL, NASA, U of North Dakota, Meteorological Service of Canada, NCEP, FSL, NCAR and U of Miami
- Two methods were used to identify the areas where supplemental observations might help to mitigate forecast errors in regions selected for verification over Europe and the eastern US.
- A variety of observing platforms were deployed where data were collected from instruments aboard or released from these platforms. They include aircraft, AMDAR, ASAP ships, GOES rapid-scan winds and radiosondes to supplement the routine observational network.

Examples of Sensitivity Calculations







Sensitive Area Predictions and the observational Response

(A-TReC Case 24)

IPY Observational Initiatives

1. A synoptic set of multidisciplinary observations to establish the status of the polar environment in 2007-2008
2. The acquisition of key data sets necessary to understand factors controlling change in the polar environment
3. The establishment of a legacy of multidisciplinary observational networks
4. The launch of internationally-coordinated, multidisciplinary investigations into new scientific frontiers
5. The implementation of polar observatories to study important facets of Planet Earth and beyond
6. The creation of datasets on the changing conditions of circumpolar human societies

What is necessary?

In order to extend our knowledge on the variability of the processes in the Arctic and Antarctic environment and to develop more sophisticated techniques for weather forecasting and climate prediction to improve the hydro-meteorological services of socio-economic activity in Polar Regions <u>it is necessary to obtain long-term series of observational data on the state of atmosphere, ocean, cryosphere and other components of climate system as well as on the changing conditions of circumpolar human societies</u>

At present global observing systems provide satellite and in-situ data on the Arctic environment, however, as one can see from next slides the data coverage by in-situ observations is far from adequate.

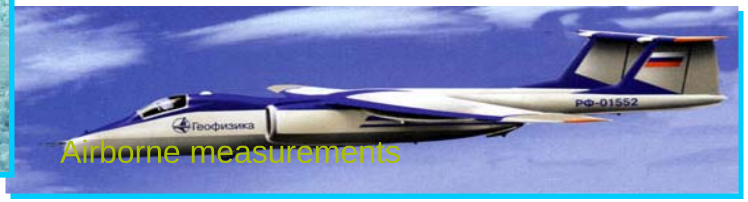
Global Observing Systems

At present WMO is operating or co-sponsoring the following observing systems:

- **Global Observing System of the World Weather Watch (GOS/WWW)** - physical parameters of the atmosphere;
- **Global Atmosphere Watch (GAW)** - chemical parameters of atmosphere, including ozone;
- **Global Ocean Observing System (GOOS)** - physical, chemical and biological parameters of the ocean;
- **World Hydrological Cycle Observing System (WHYCOS)** as part of Global Terrestrial Observing System (GTOS) - hydrological cycle parameters;
- **GCOS Terrestrial Network for Permafrost (GTN-P) and GCOS Terrestrial Network for Glaciers (GTN-G)** - parameters of cryosphere

WWW Global Observing System

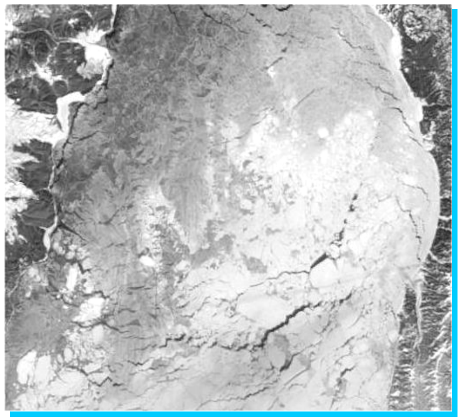
Meteorological ice drifting buoy
using for IABP and IPAB



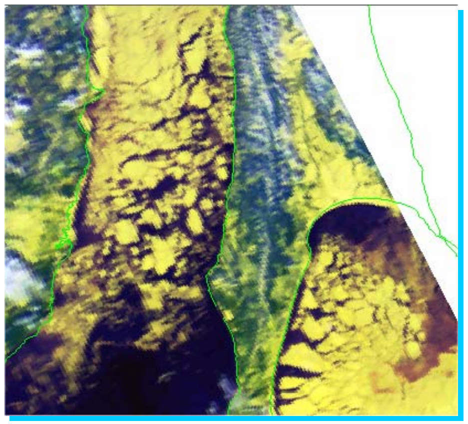
Airborne measurements

Automatic
weather station

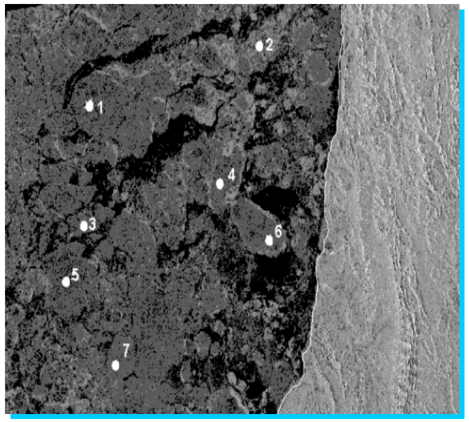
Satellite images



MODIS (TERRA)

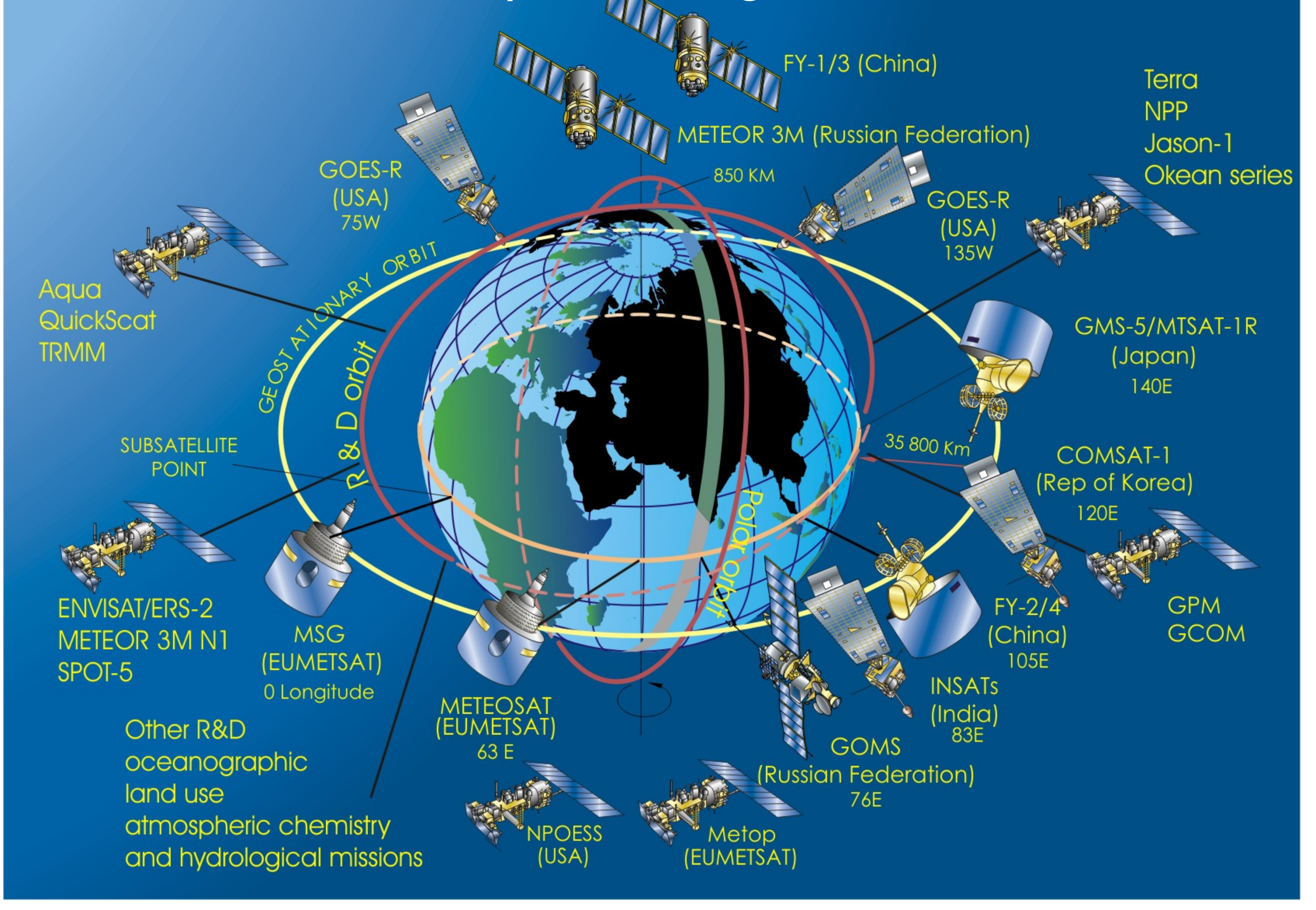


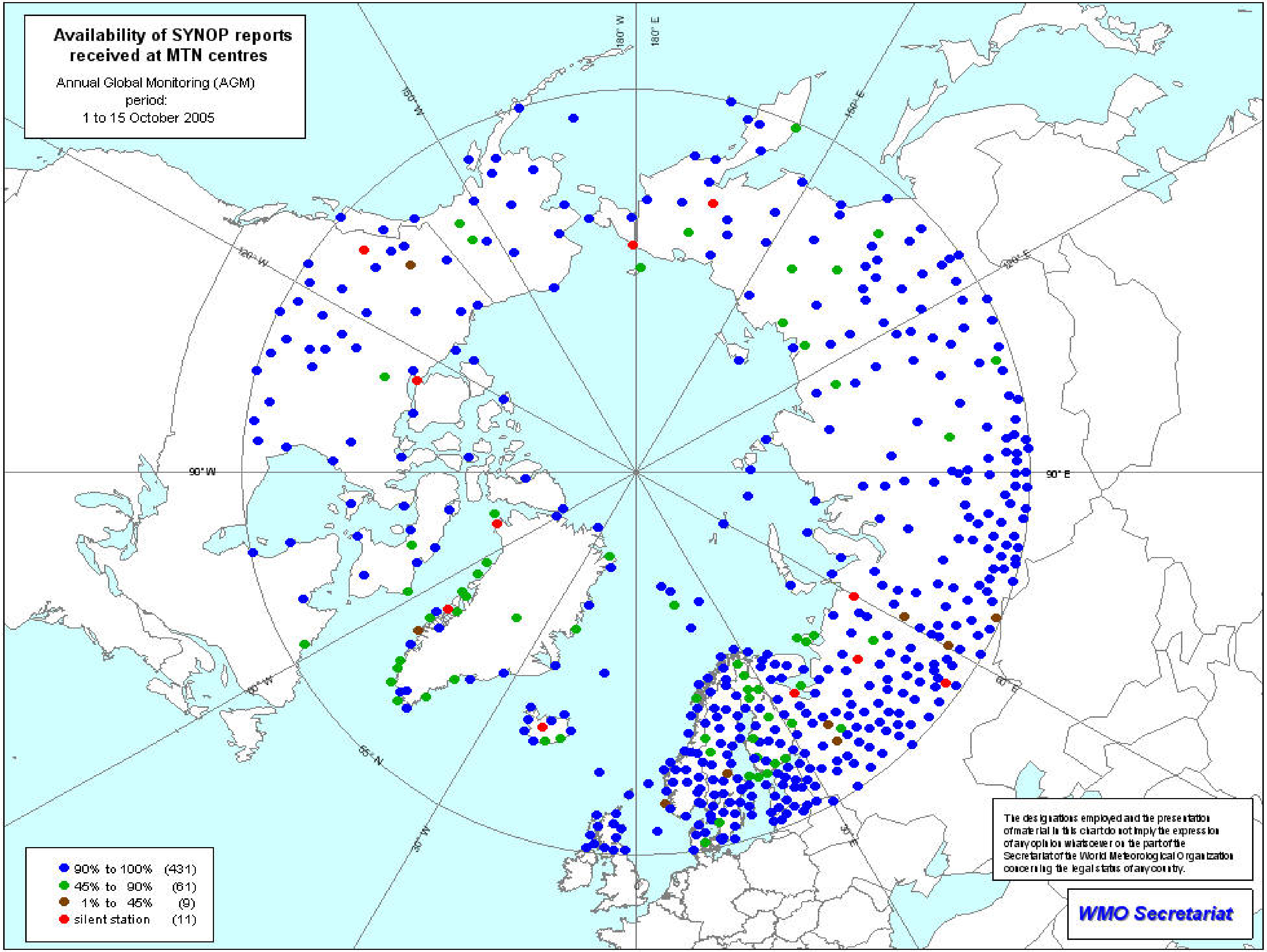
AVHRR (NOAA)



SAR (RADARSAT)

WMO Space Programme




Availability of SYNOP reports
received at MTN centres
Annual Global Monitoring (AGM)
period:
1 to 15 October 2005
180° W
180° E
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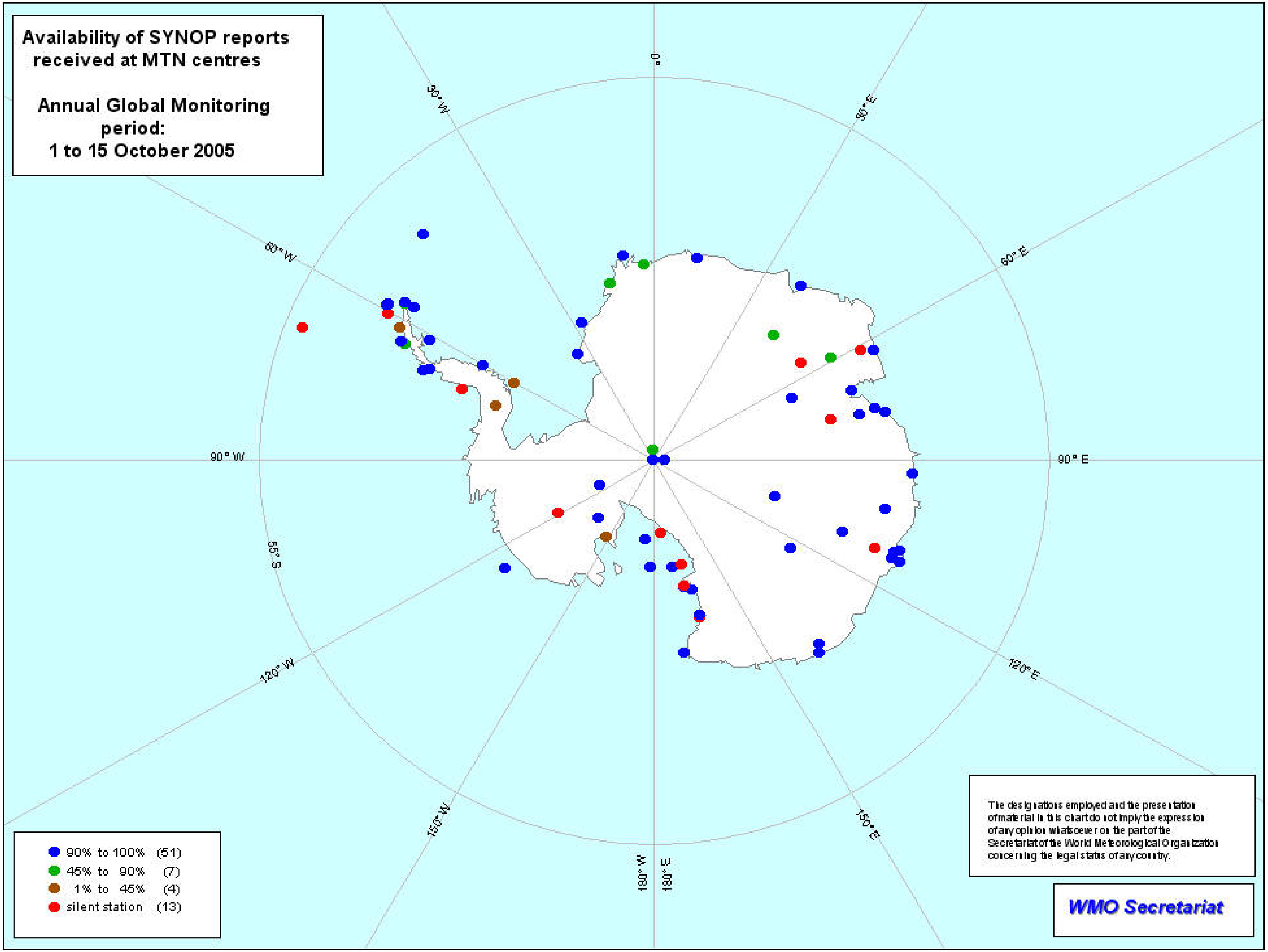
90% to 100% (431)
45% to 90% (61)
1% to 45% (9)
silent station (11)
The designations employed and the presentation of material in this chart do not imply the expression of any opinion whatsoever on the part of the Secretariat of the World Meteorological Organization concerning the legal status of any country.
WMO Secretariat


Availability of SYNOP reports
received at MTN centres
Annual Global Monitoring
period:
1 to 15 October 2005
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120° E
150° E
180° E
180° W
150° W
120° W
90° W
60° W
30° W
55° S
90% to 100% (51)
45% to 90% (7)
1% to 45% (4)
silent station (13)
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of material in this chart do not imply the expression
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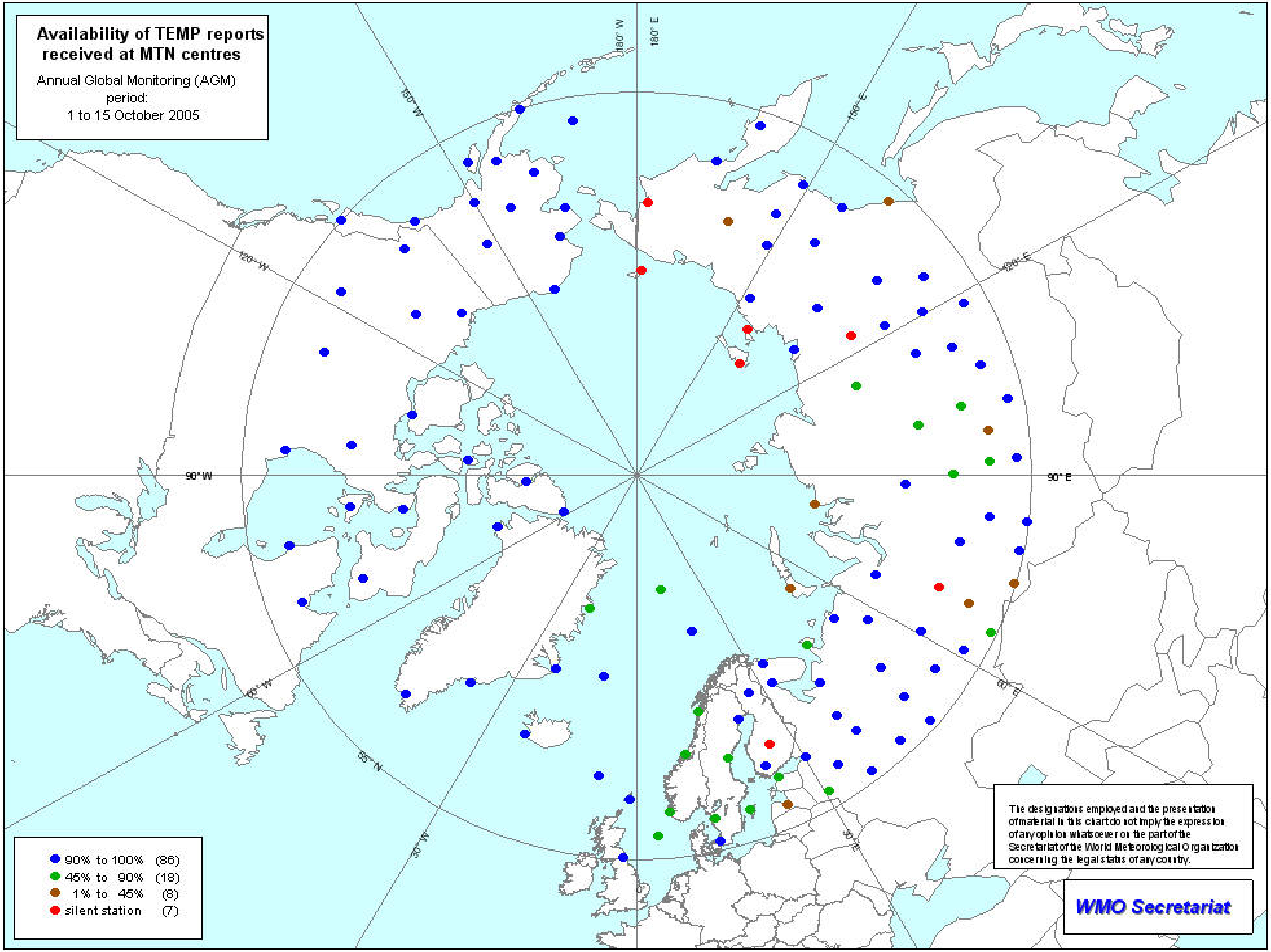
WMO Secretariat


Availability of TEMP reports received at MTN centres
Annual Global Monitoring (AGM) period:
1 to 15 October 2005
180° W
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150° W
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120° W
120° E
90° W
90° E
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60° E
30° W
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55° N
90% to 100% (86)
45% to 90% (18)
1% to 45% (8)
silent station (7)
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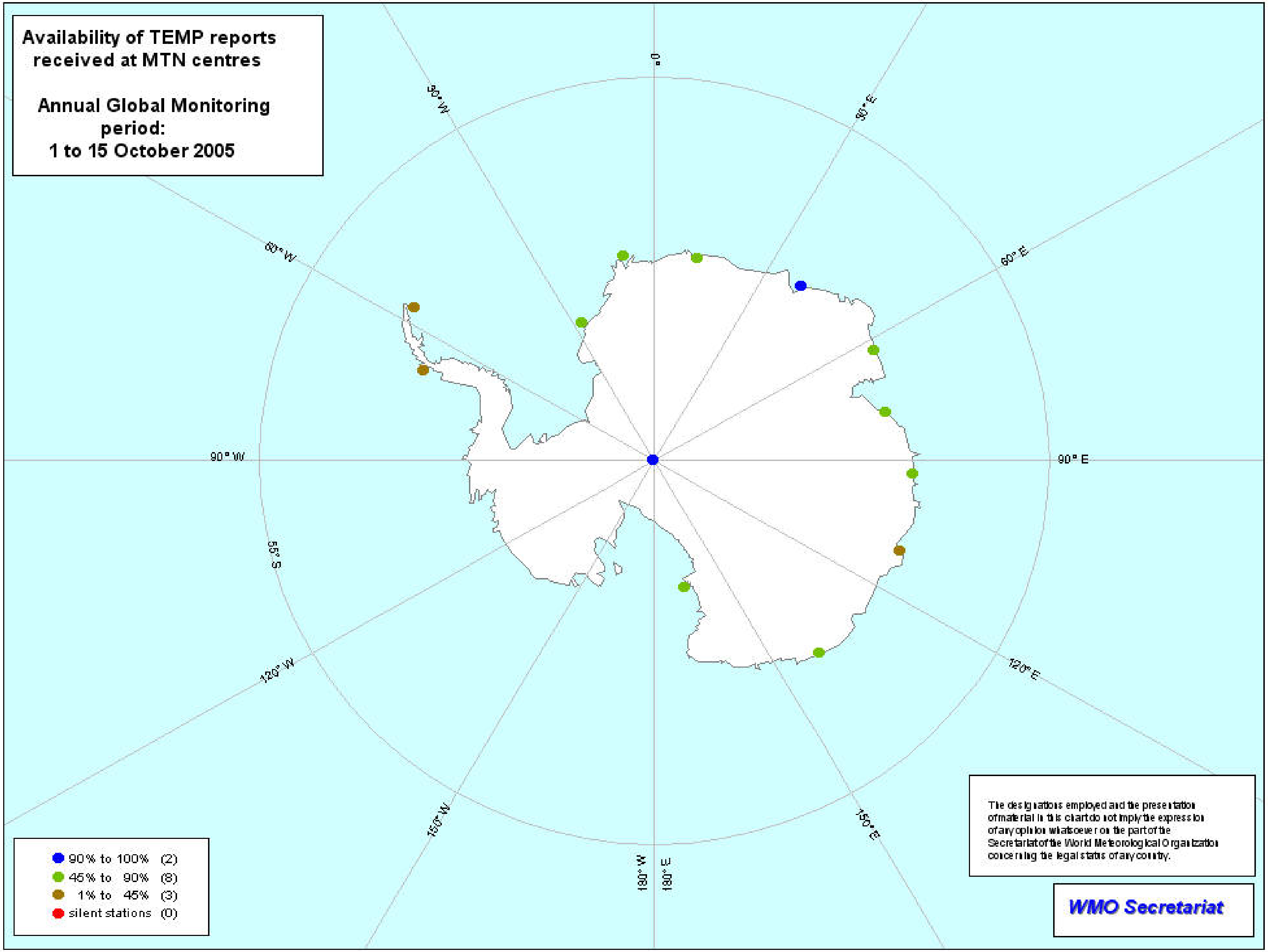
WMO Secretariat



Availability of TEMP reports
received at MTN centres
Annual Global Monitoring
period:
1 to 15 October 2005
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30° E
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60° E
90° W
90° E
55° S
120° W
120° E
150° W
150° E
180° W
180° E
90% to 100% (2)
45% to 90% (8)
1% to 45% (3)
silent stations (0)
The designations employed and the presentation
of material in this chart do not imply the expression
of any opinion whatsoever on the part of the
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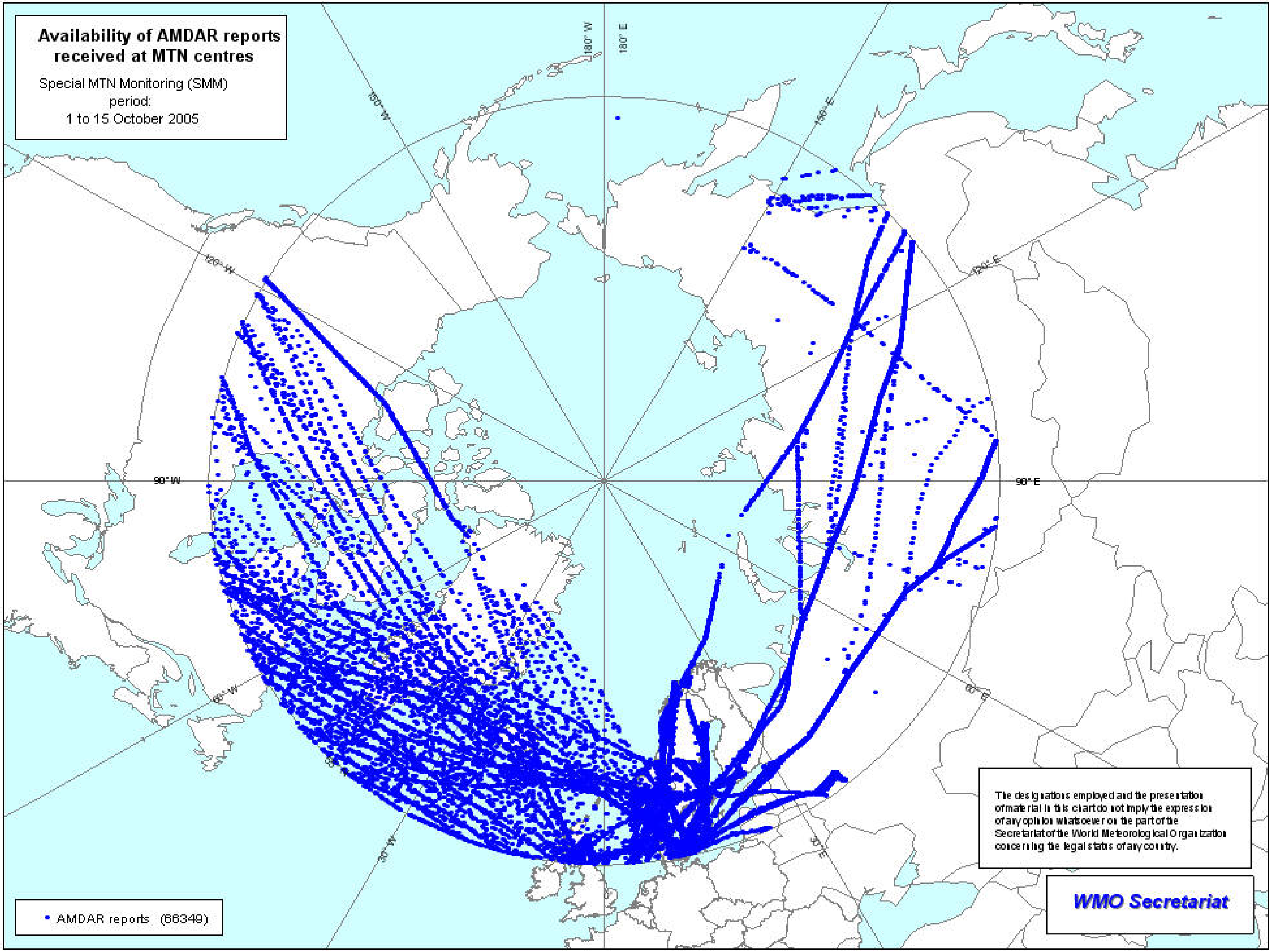
WMO Secretariat


Availability of AMDAR reports
received at MTN centres
Special MTN Monitoring (SMM)
period:
1 to 15 October 2005
180° W
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90° W
90° E
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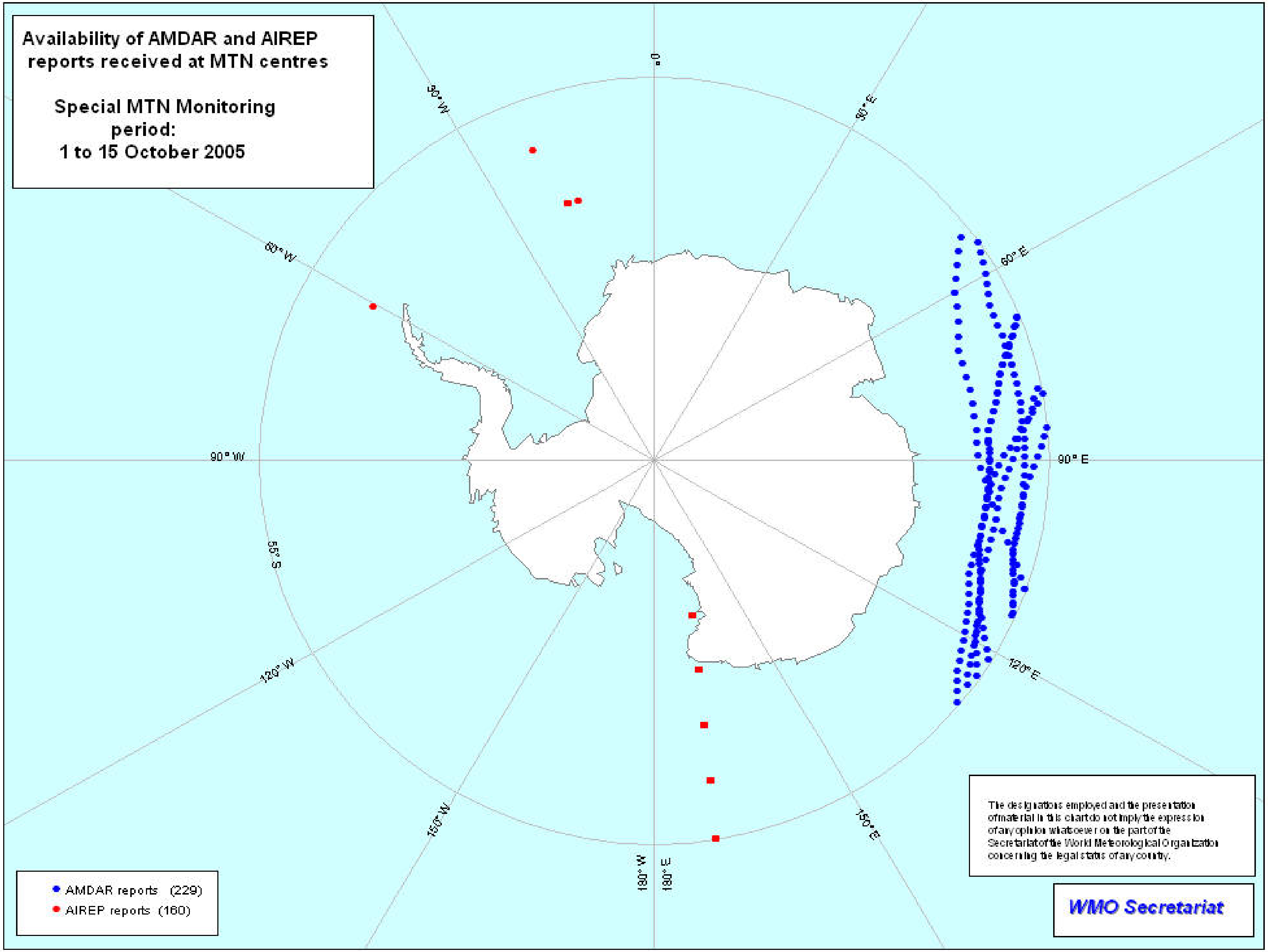
30° E
The designations employed and the presentation of material in this chart do not imply the expression of any opinion whatsoever on the part of the Secretariat of the World Meteorological Organization concerning the legal status of any country.
WMO Secretariat
AMDAR reports (66349)


Availability of AMDAR and AIREP reports received at MTN centres
Special MTN Monitoring period:
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90° E
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150° W
150° E
180° W
180° E
AMDAR reports (229)
AIREP reports (160)
The designations employed and the presentation of material in this chart do not imply the expression of any opinion whatsoever on the part of the Secretariat of the World Meteorological Organization concerning the legal status of any country.
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WWW Global Observing System during the IPY (main tasks):

Re-activate existing and establish new surface and upper-air stations, increase the number of drifting buoys, Voluntary Observing Ships, Aircraft Meteorological Data Relay flights;

Use existing and new operational polar-orbiting satellite series, especially satellites with capabilities for polar regions

Some IPY project proposals related to Global Observing System

- **Global Inter-agency IPY Polar Snapshot Year (GIIPSY, ID 91)**
- **International Arctic System for Observing of the Atmosphere (IASOA, ID 196)**
- **Polar Weather Forecasting (THORPEX-IPY, ID 121)**
- **COmprehensive Meteorological dataset of active IPY Antarctic measurement PhAse for Scientific and applied Studies (COMPASS, ID 267)**

Global Atmosphere Watch during the IPY (main tasks)

- **Measurement and modeling of the transport of greenhouse gases and aerosols to minimize the impact of chemicals on the polar ecosystems;**
- **Integrated monitoring of the ozone layer, using ground-based optical remote sensing instrumentation and ozone sondes, aircraft and satellites consistent with the Integrated Global Atmospheric Chemistry Observation system of IGOS led by WMO.**

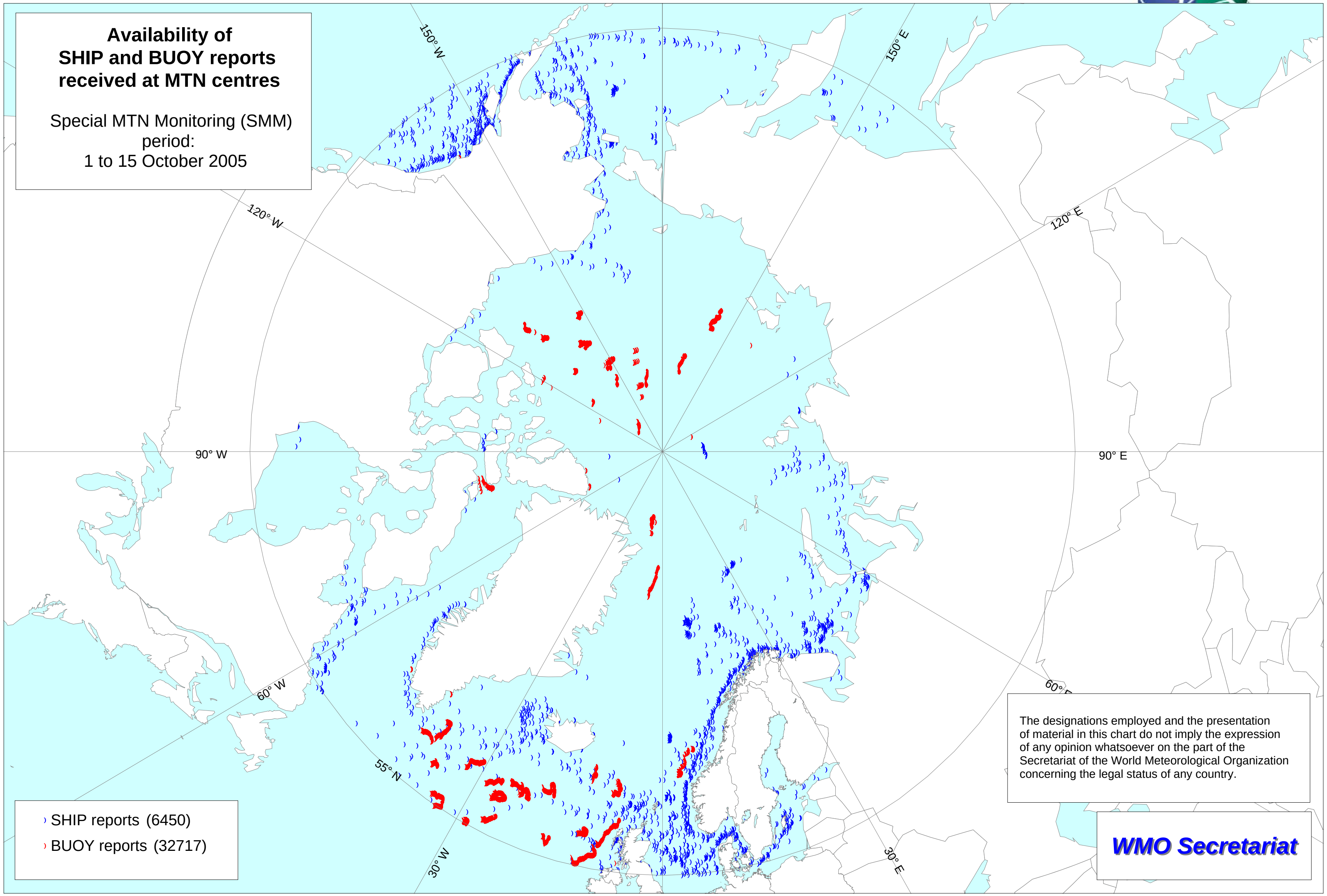
Some IPY project proposals related to Global Atmosphere Watch

- **Polar Study using aircraft, remote sensing, surface measurements and modeling of climate, chemistry, aerosols and transport (POLARCAT, ID 32)**
- **Ozone layer and UV radiation in changing climate evaluated during IPY (ORACLE-O3, ID 99)**
- **Ocean-Atmosphere-Sea Ice-Snowpack Interactions (OASIS, ID 38)**

Global Ocean Observing System
(ice-covered areas)

Drifting research ice camp for Central Arctic ocean investigations

Multipurpose research vessel for ice covered ocean investigations and supply operations in the Arctic and Antarctic



Availability of
SHIP and BUOY reports
received at MTN centres
Special MTN Monitoring (SMM)
period:
1 to 15 October 2005
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120° E
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60° W
55° N
30° W
30° E
SHIP reports (6450)
BUOY reports (32717)
The designations employed and the presentation of material in this chart do not imply the expression of any opinion whatsoever on the part of the Secretariat of the World Meteorological Organization concerning the legal status of any country.
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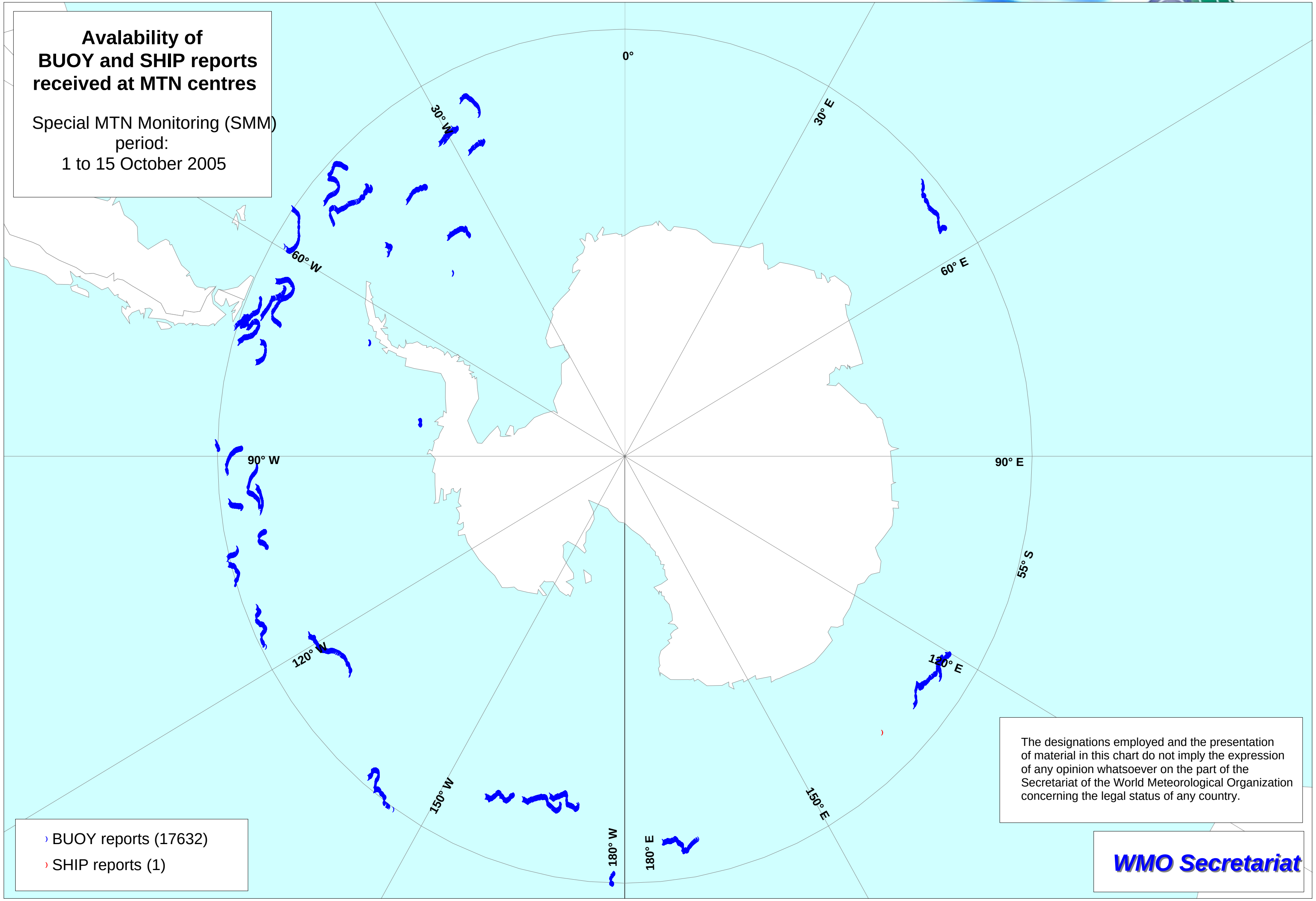
Avalability of
BUOY and SHIP reports
received at MTN centres
Special MTN Monitoring (SMM)
period:
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BUOY reports (17632)
SHIP reports (1)
The designations employed and the presentation of material in this chart do not imply the expression of any opinion whatsoever on the part of the Secretariat of the World Meteorological Organization concerning the legal status of any country.
WMO Secretariat

Global Ocean Observing System during the IPY (main tasks):

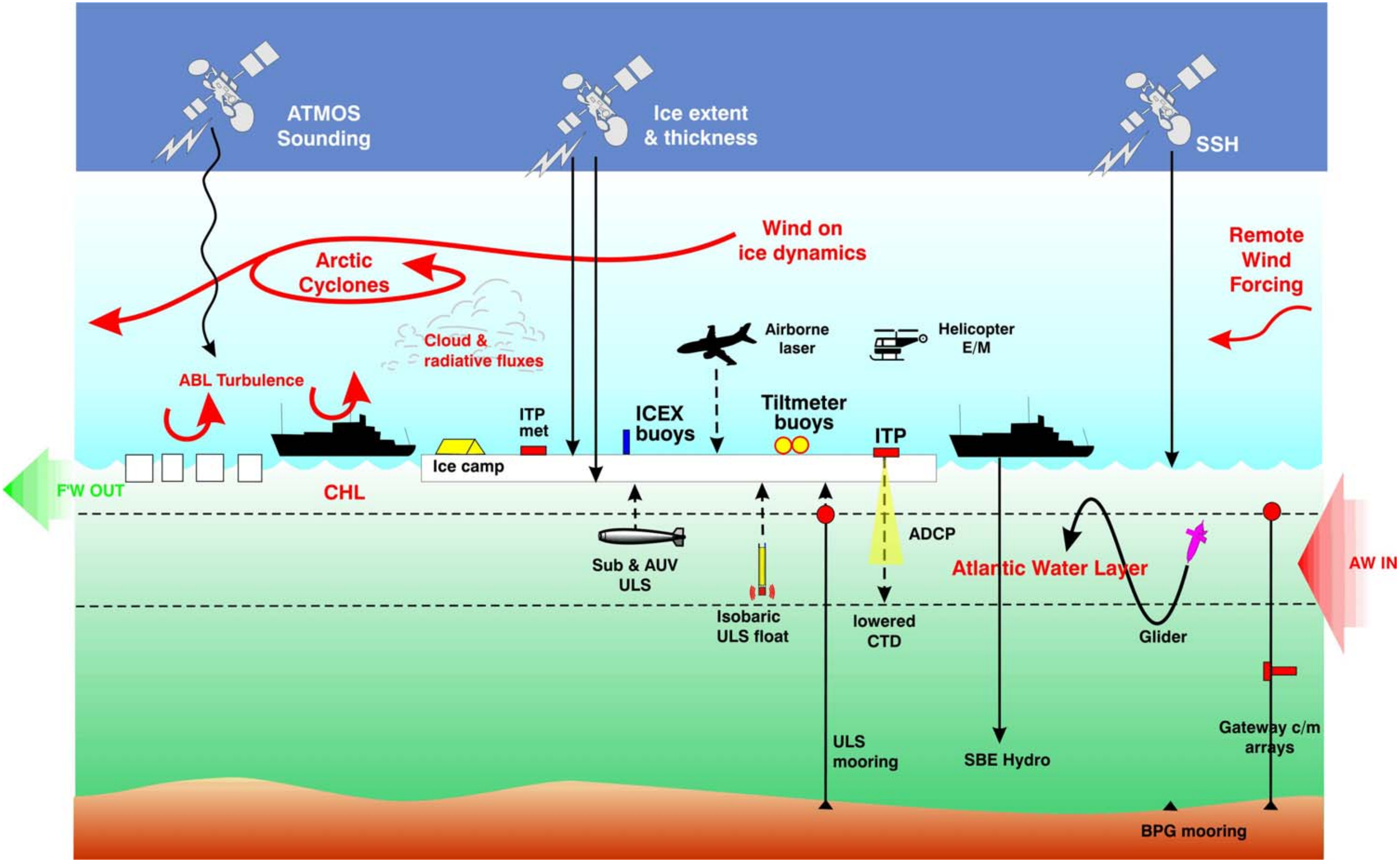
- **To investigate physical processes in polar oceans, as well as the role of polar oceans in climate change.**
- **To establish the Arctic Ocean and the Southern Ocean Observing Systems, including:**
  - **Reactivation of existing and the establishment new sea level measurements stations,**
  - **Strengthening of the ice drifter networks,**
  - **Deployment of ocean mooring buoys and Argo floats**
  - **Establishing of research stations on drifting ice and conducting marine expeditions**

Some IPY project proposals related to Global Ocean Observing System

- **Integrated Arctic Ocean Observing System (iAOOS, ID 14) –***see next slide*

- **Climate of the Antarctic and Southern Ocean (CASO, ID 132)**

- **Sea level and Tidal Science in Polar Oceans (ID 13)**



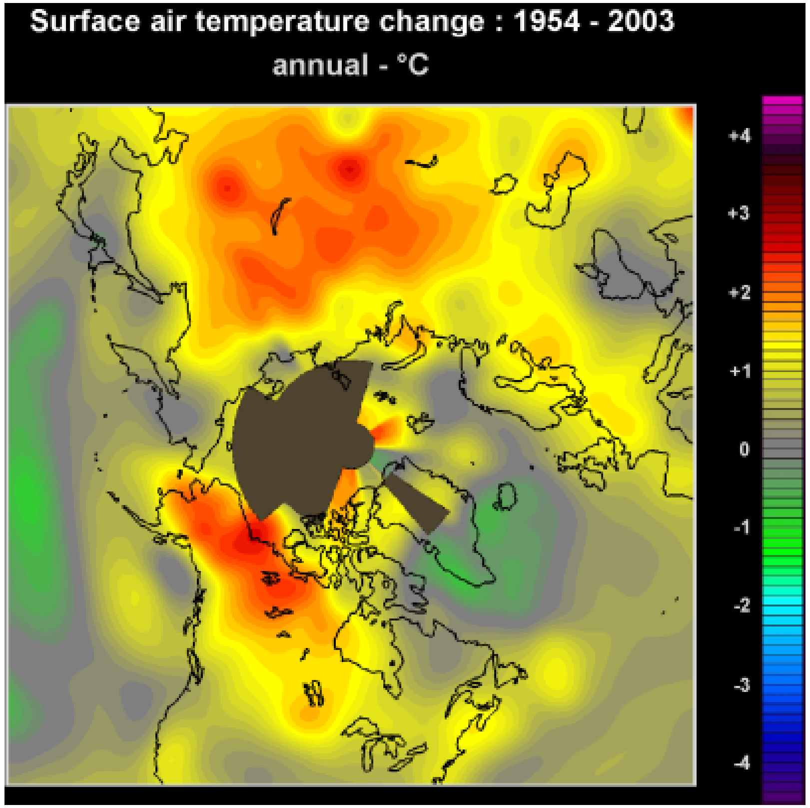
Schematic of the vertical stack of observations from satellites to seabed that would be necessary to inform an iAOOS study focused on the present state and future fate of the Arctic perennial sea-ice (by R.Dixson).

Some IPY project proposals related to climate (CCL)

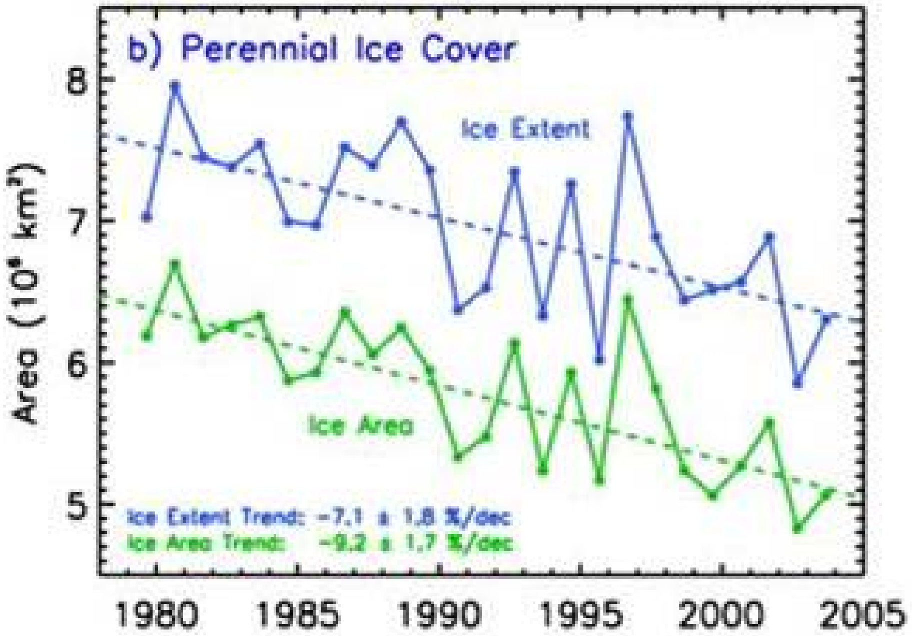
- **Climate of the Arctic and its role for the Europe (CARE, ID 28) –** *see next slide*
- **Past Arctic Climate Variability (WARMPAST, ID 36)**
- **Antarctic Climate and Atmospheric Circulation (AC, ID 180)**
- **Norwegian THORPEX-IPY proposal (ID 294)**

Climate of the Arctic and its Role for Europe (CARE)

17 nations: supported by European Union

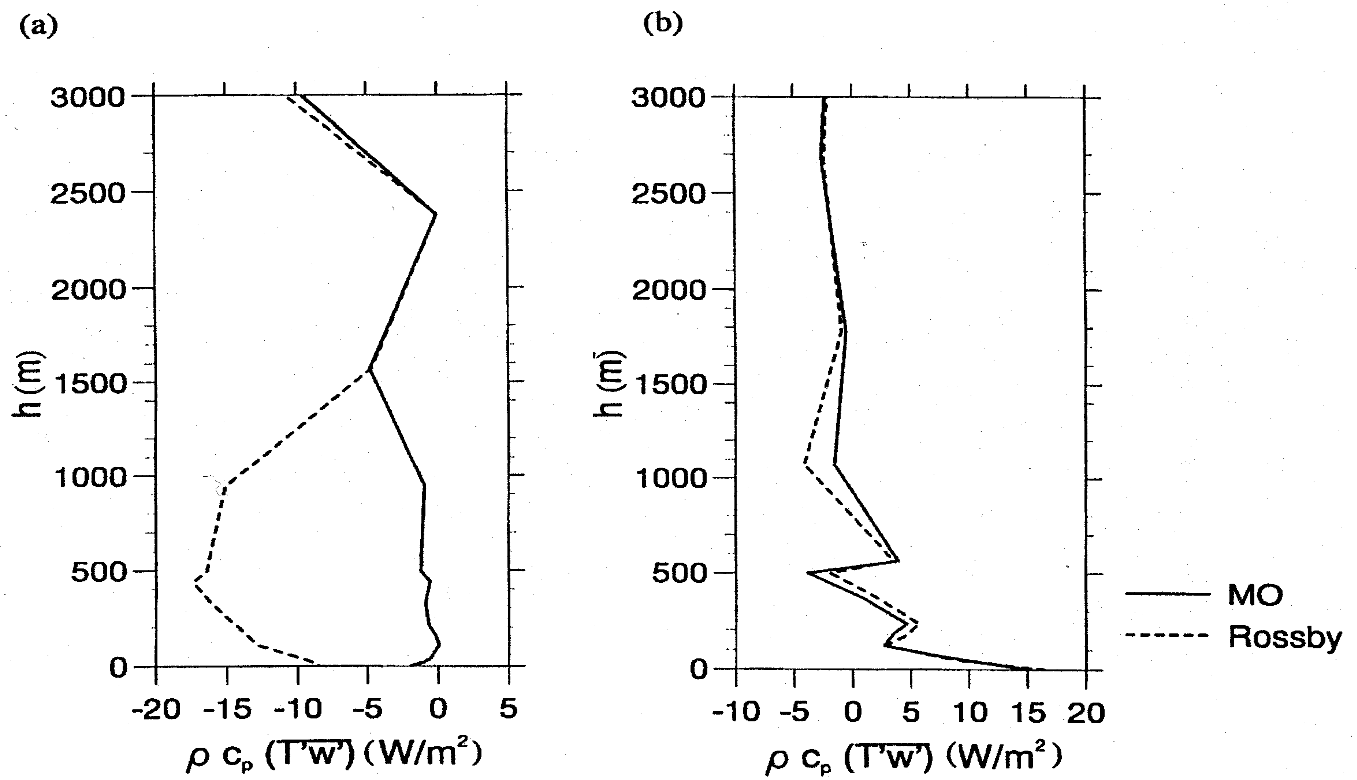


Arctic sea ice change 1979-2004



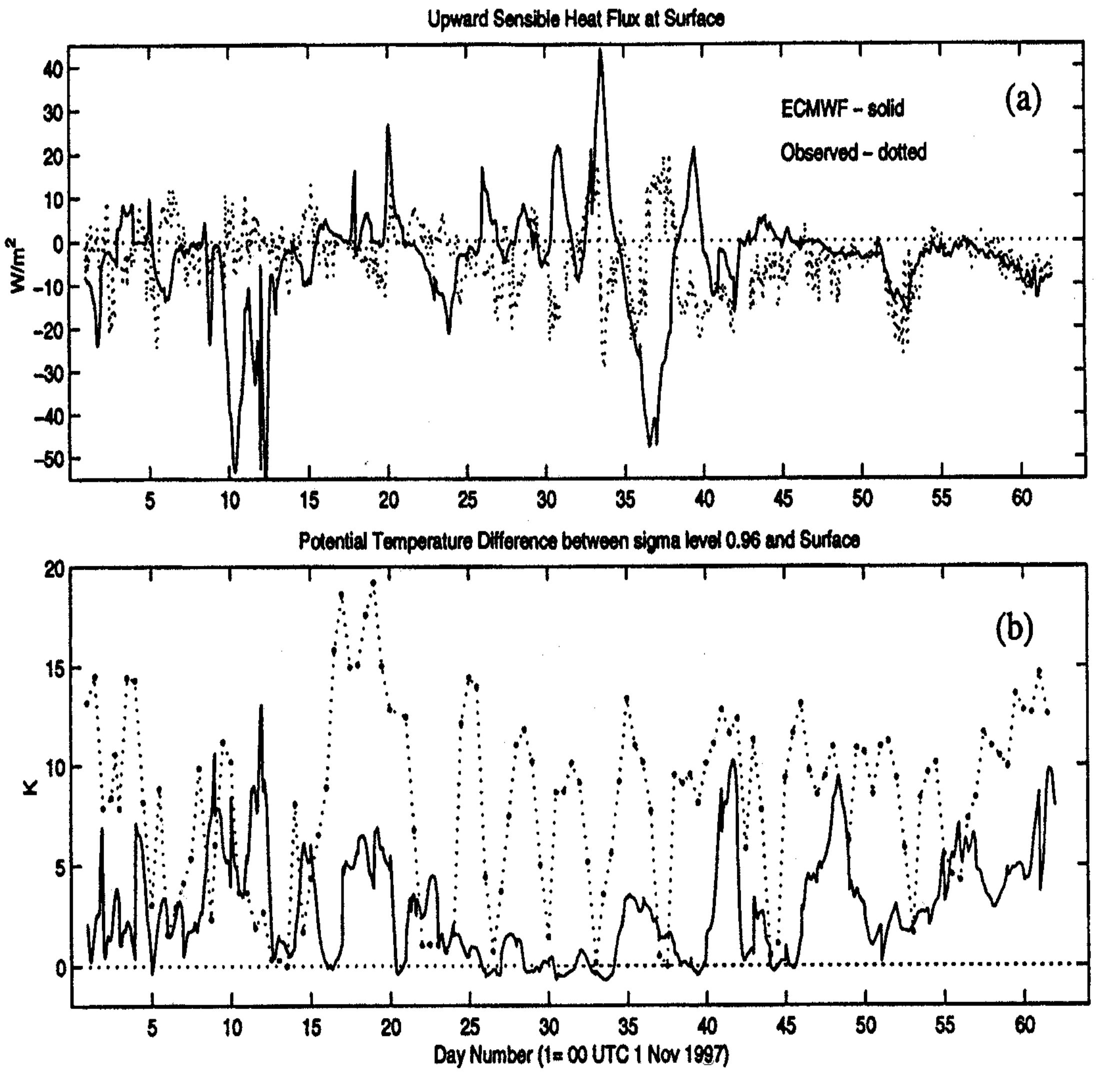
Source: ACIA

Modeled heat flux sensitive to choice of parameterisation scheme



Monthly mean profiles of sensible heat flux simulated with a climate model by using two different parameterisation schemes for the boundary layer.
(a) January 1991, (b) July 1990. From Dethloff et al. 2001

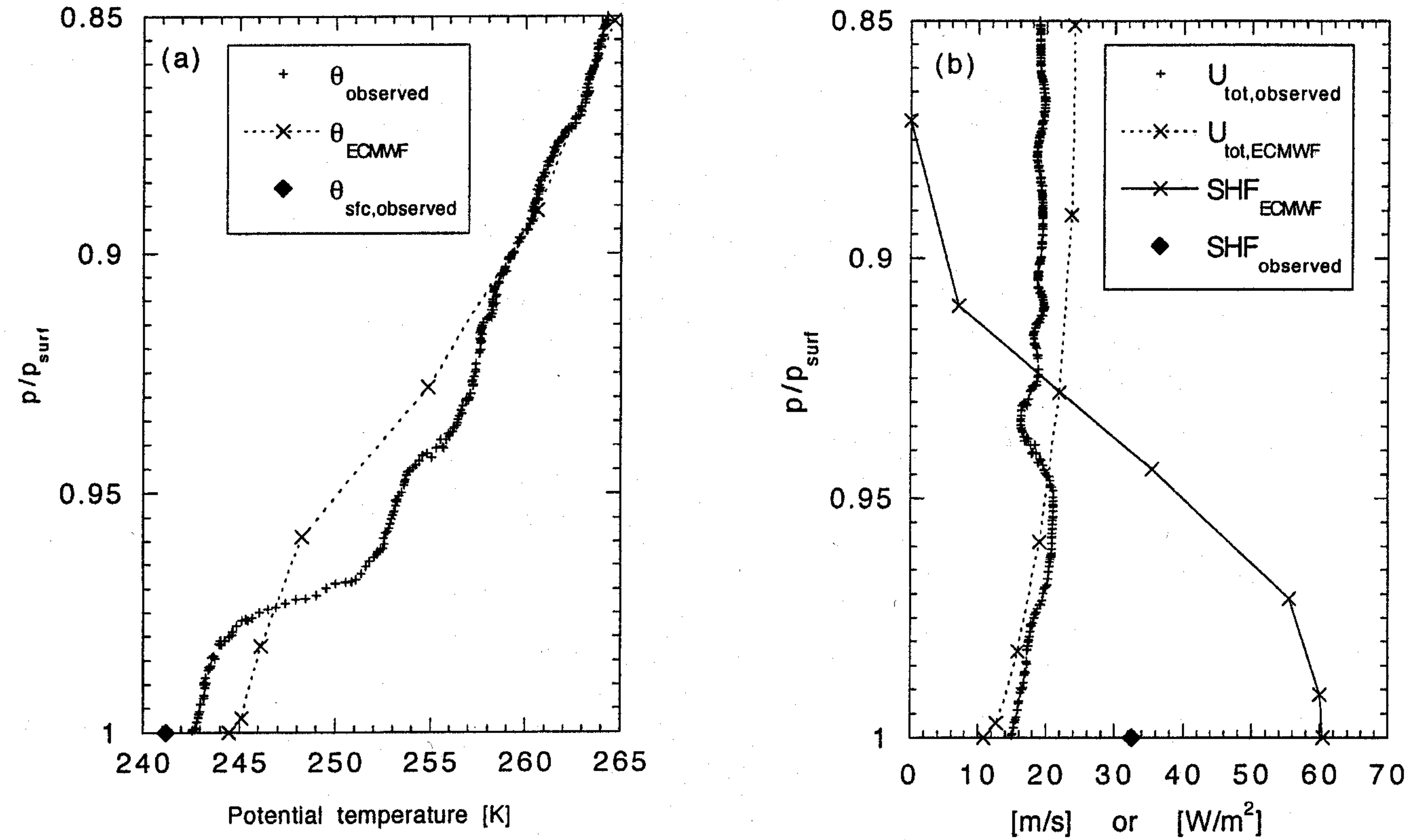
Observed and modelled heat flux and stability for the Arctic ocean



Heat flux (a) and stability (b) in Nov-Des 1997 from the SHEBA-program.

Stability is defined as difference in potential temperature between 300m og 2m.
From Beesley et al. 2000.

Observed and modelled wind, heat flux and stability for the Arctic ocean

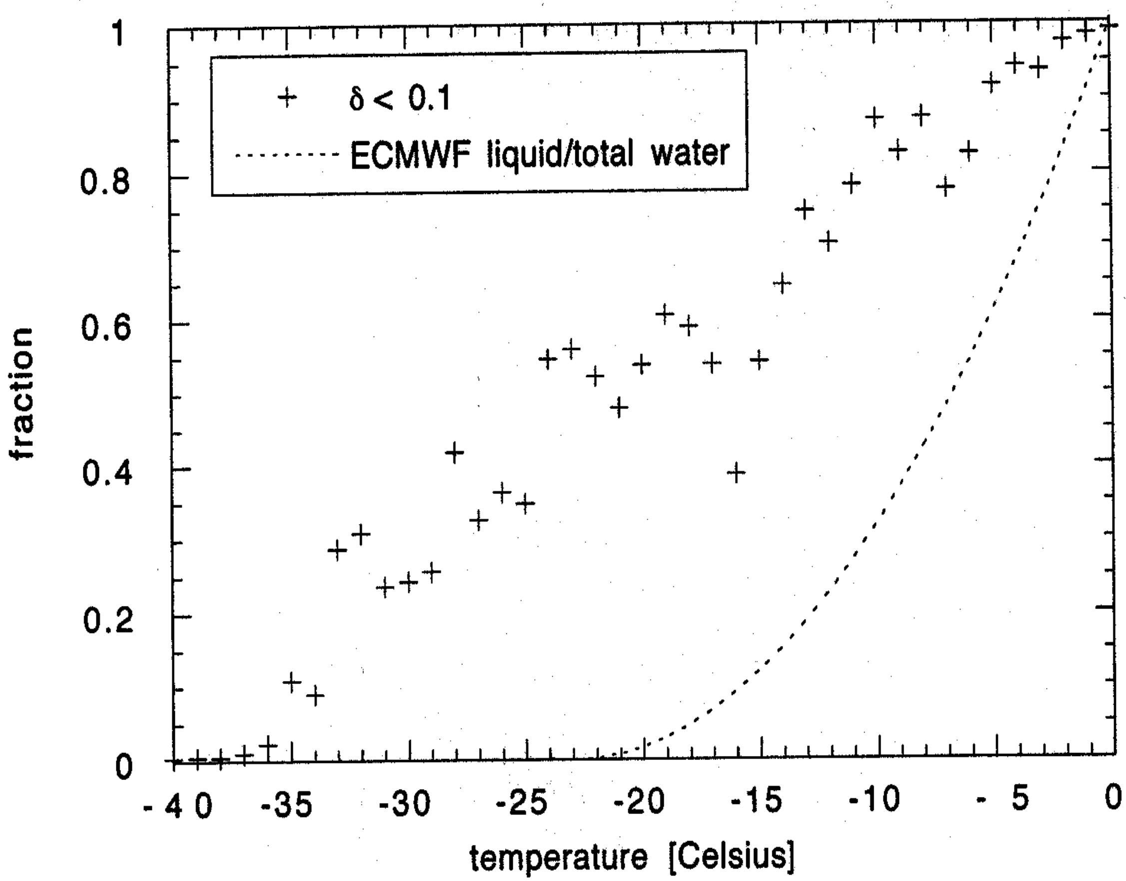


Profiles from SHEBA February 1998: (a) Modelled and observed potential temperature and (b) modelled and observed wind and heat flux. From Bretherton et al. 2002.

Clouds

- Low clouds are an important factor for the Arctic climate :
  - low latitudes: low clouds have a cooling effect. high latitudes: When low clouds appear over snow- or ice covered surfaces with high albedo their effect can be different
  - In addition, special radiation properties alter their role as compared to low latitudes
- Parameterisation of clouds is difficult in general. In the Arctic there are additional problems:
  - The poor description/understanding of the boundary layer causes wrong heat- and humidity fluxes and this as an effect on the parameterisation of clouds.
  - Low temperatures, low absolute humidity and stable conditions give conditions which current parameterisation schemes are not tuned for.
- *===> Need for observations/measurements to improve an test parameterisation schemes.*

Measured and modelled fraction liquid water in Arctic clouds



lidar depolarisation δ<0.1 (indicating liquid cloud water) and parameterised cloud liquid water in the ECMWF model as a function of cloud base temperature

From Bretherton et al. 2002.

Some IPY project proposals related to social sciences

- **International Study of Arctic Change (ISAC, ID 48)**
- **Sea Ice Knowledge and Use: Assessing Arctic Environmental and Social Change (SIKU, ID 166)**
- **Community Adaptation and Vulnerability in Arctic Region (ID 157)**

Future activities on IPY preparation

- Call for IPY proposals to be funded by funding agencies (March, 2006);
- Preparation and publication of a Science Plan for IPY (January, 2007);
- IPY Consultative Forum, Hobart, Australia, 8 July, 2006;
- JC Fourth session, Svalbard, 25-28 September 2006
- JC and Coordinators Meeting (November, 2006)
- Science Symposium highlighting the IPY planned work (March, 2007).


Thank you!