

**THORPEX**

***Jim Caughey***

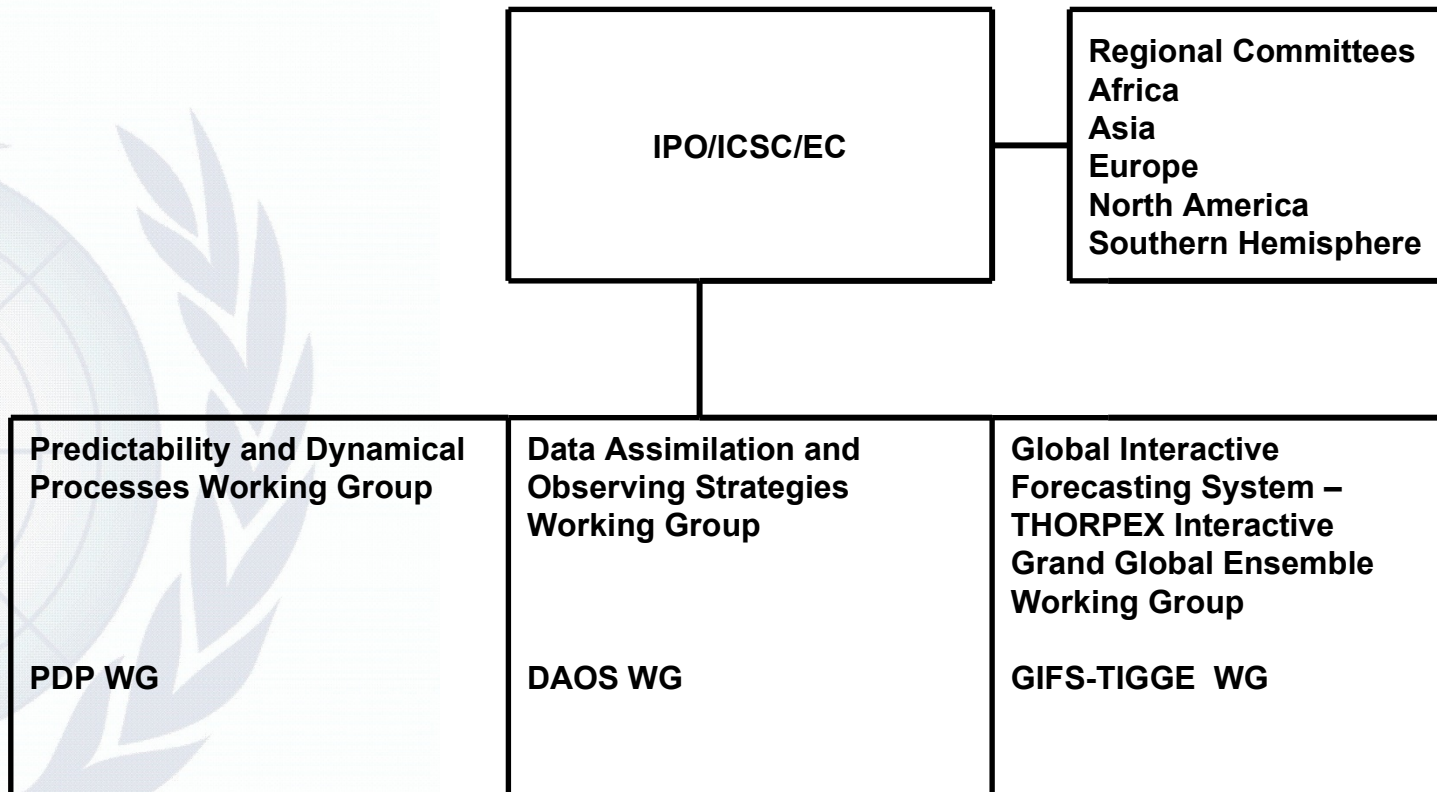
***WMO, Geneva***

*THORPEX International Programme Office*

# THORPEX - research priorities

- Global-to-regional influences on the evolution and predictability of weather systems
- Global observing-system design and demonstration
- Targeting and assimilation of observations
- Societal, economic, and environmental benefits of improved forecasts

# THORPEX Current Organisational Structure



# The THORPEX Interactive Grand Global Ensemble (TIGGE)

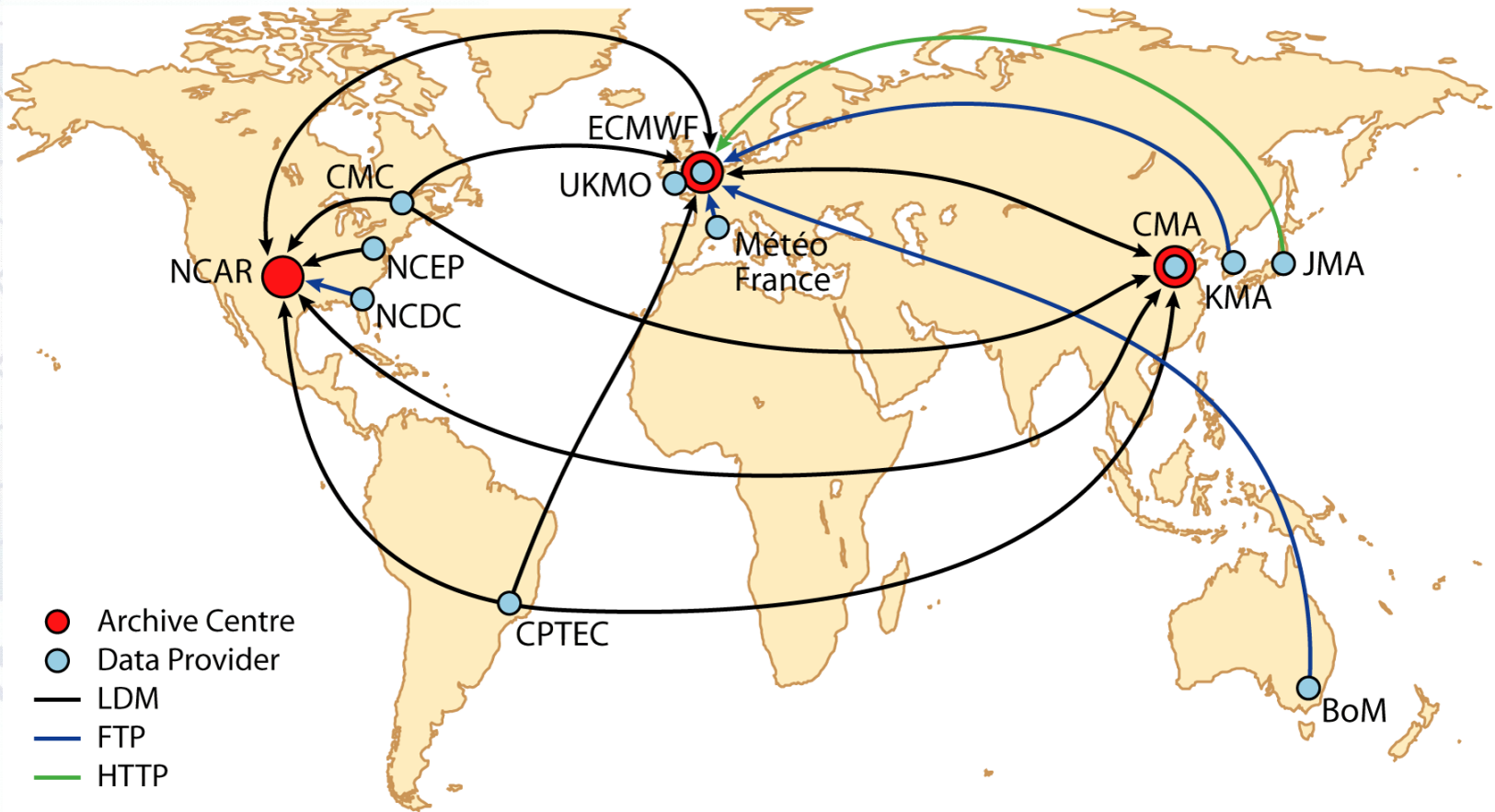
A key component of THORPEX: The TIGGE project has developed databases (at ECMWF, NCAR and CMA) of global ensemble forecasts collected in near real-time.

## **Objectives:**

- Enhance collaboration on ensemble prediction, both internationally and between operational centres & universities.
- Facilitate research on ensemble prediction methods, especially methods to combine ensembles and to correct systematic errors
- Enable evolution towards a prototype operational system, the “Global Interactive Forecast System”

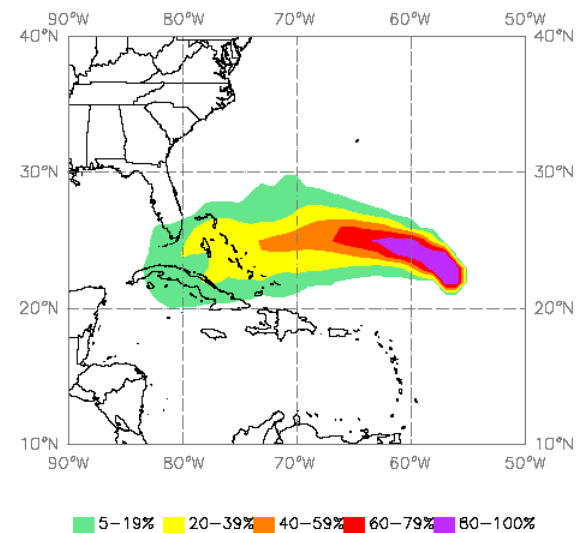
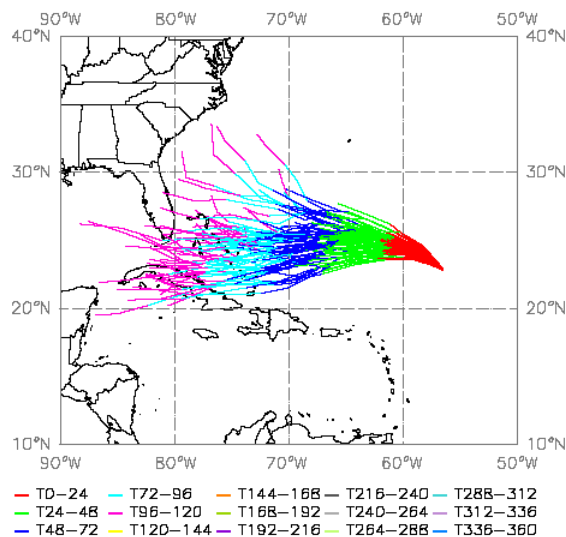
# TIGGE data flows (6 to 30h after real time)

300 GB per day



# Towards the Global Interactive Forecast System (GIFS)

- The objective of the GIFS is to realise the benefits of THORPEX research by improving the delivery of improved forecasts of high-impact weather.
- As a first step, the GIFS-TIGGE working group set up a pilot project for the exchange of real-time tropical cyclone predictions using “Cyclone XML” format.
- Forecast and research demonstration projects are being developed by the GIFS-TIGGE WG and regional centres to predict tropical cyclone tracks and heavy rainfall



# DAOS WG - Data Targeting

- Value of extra-tropical targeted data has been found to be positive, but small, on average
- Observations taken in sensitive areas have more value than observations deployed randomly
- There are limitations due to the current assimilation methodologies (not yet fully flow-dependent)
- Sensitive area characterization does not appear to be the first order problem
- Additional observations for tropical cyclones have proven to be useful (further T-PARC analysis important)

## Global Prediction

High-resolution operational  
deterministic-model data sets

## Integrated Observations

Satellite, field-campaign, *in-situ*  
data sets

Organized Tropical Convection



Year of Tropical  
Convection

Global Interaction

## Research

Attribution studies of global data sets; parameterized,  
superparameterized, and explicit convection in  
regional-to-global models; theoretical studies



# Year of Tropical Convection (YOTC)

## Tropical Convection – Global Interaction

### \*\*\*\*\* Organized Precipitation Systems \*\*

Mitch Moncrieff, NCAR

&

Duane Waliser, JPL/CalTech

Co-Chairs, YOTC Science Planning Group



*Seamless Prediction*

\*\*\*\*\* Time-scales up to Seasonal \*\*\*\*\*

# International Polar Year



2007 - 2008

## The IPY-THORPEX CLUSTER OBJECTIVES (WMO Bulletin, Oct. 2007)

- Assess and seek to improve the quality of operational analyses and research reanalysis products in the Polar Regions
- Address improving data assimilation techniques for Polar Regions
- Assess the skill in the prediction of polar to global high impact weather events for different observing strategies in higher latitudes
- Demonstrate the utility of improved utilization of ensemble weather forecast products for high impact weather events and for IPY operations, when applicable
- Develop recommendations for the design of the Global Observing System in polar regions for weather prediction
- Conduct field campaigns during the IPY intensive observing period to assist achievement of the goals
- Address two-way interactions between polar and sub-polar weather regimes

January 2009

# IPY Cluster

- **The Greenland flow Distortion Experiment** – the focus is upon Greenland tip jets, air-sea interactions, barrier winds and mesoscale cyclones – the field campaign took place in February 2007 ( Ian Renfrew, University of East Anglia)
- **Storm Studies of the Arctic** – includes enhanced observations in the eastern Canadian Arctic, gap flow, air-sea interactions, orographic precipitation, interaction of cyclones with topography etc., (John Hanesiak, University of Manitoba)
- **Concordiasi** - IASI assimilation in Antarctica, polar processes, the circumpolar vortex, using IASI data for climate monitoring, stable boundary layers, polar clouds, etc (Florence Rabier, Meteo- France)
- **Norwegian IPY-THORPEX** - here the focus is on the optimisation of new satellite data, improved modelling of the latent heat cycle, extreme weather, improved operational NWP ensembles. (Jon Egill Kristjansson, University of Oslo)
- **TAWEPI** - the primary objective is to develop a regional polar NWP system at 10-15 km resolution over the Arctic including data assimilation aspects, it will also involve field campaigns and process studies, the development of new physics, sea –ice and land surface packages etc.,(Gilbert Brunet, Canada)
- **Greenland Jets** - will consider mesoscale flows, including orographic disturbances, mesocyclones and surface fluxes. (Andreas Dornbrack, DLR, Germany)

(Exeter, January 2008)

# IPY Projects

- **GREENEX** - considers forecasting of small-scale weather phenomena including extremes. Meso- and fine –scale flows in the vicinity of orography and sea ice and downstream weather development as well as scale –interactions.(Haraldur Olafsson, Iceland in cooperation with DLR)
- **Arctic Regional Climate Model Intercomparison Project** - targeted observations on the North Pole station over the Arctic Ocean, feedbacks between the planetary boundary layer and meso-cyclones. Climate processes and feedbacks within the coupled Arctic climate system. (Klaus Dethloff, Alfred-Wegener Institute, Germany)
- **Impacts of surface fluxes on severe Arctic storms, Climate Change and Arctic coastal orographic processes** - includes studies of storm activity in the western Arctic in the context of surface fluxes from changing ice, ocean and land surface conditions. Studies of coastal ocean processes and assessment of severe weather and climate factors that can impact human communities.(Will Perrie, Bedford Institute of Oceanography, Canada)
- **T-PARC/Winter T-PARC** ( the THORPEX Pacific Asian Regional Campaign) - includes studies of ET (Extra-Tropical transition ) and links between tropical/mid-latitude and polar weather. (David Parsons, NCAR, USA)
- **High Resolution Data Assimilation** - will include modelling and re-analysis for the Arctic. (Peter Kallberg, SMHI, Sweden)



# THE GREENLAND FLOW DISTORTION EXPERIMENT

BY I. A. RENFREW, G. W. K. MOORE, J. E. KRISTJÁNSSON, H. ÓLAFSSON, S. L. GRAY, G. N. PETERSEN, K. BOVIS, P. R. A. BROWN, I. FØRE, T. HAINE, C. HAY, E. A. IRVINE, A. LAWRENCE, T. OHGASHI, S. OULTEN, R. S. PICKART, M. SHAPIRO, D. SPROSON, R. SWINBANK, A. WOOLLEY, AND S. ZHANG

We present an overview of an aircraft-based field campaign focusing on the dynamics and air–sea interaction associated with tip jets, barrier winds, and mesoscale cyclones, as well as a targeted observation program.

- GFDex overview edition of Bull. Amer. Met. Soc

- Quarterly Journal of the RMetS

A millennium ago pioneering Icelanders and Norwegians were exploring and settling the southern coastline of Greenland when, almost accidentally, they stumbled across North America. Their exploits are recorded in the *Icelandic Sagas*,<sup>1</sup> some of the oldest writing in the western world, including the *Vinland Sagas*, which contain two largely consistent accounts of these events. In both of these narratives, stormy weather plays a pivotal role. In *Eirik the Red's Saga* Eirik's son, Leif Eiriksson, departs for Greenland, whereupon

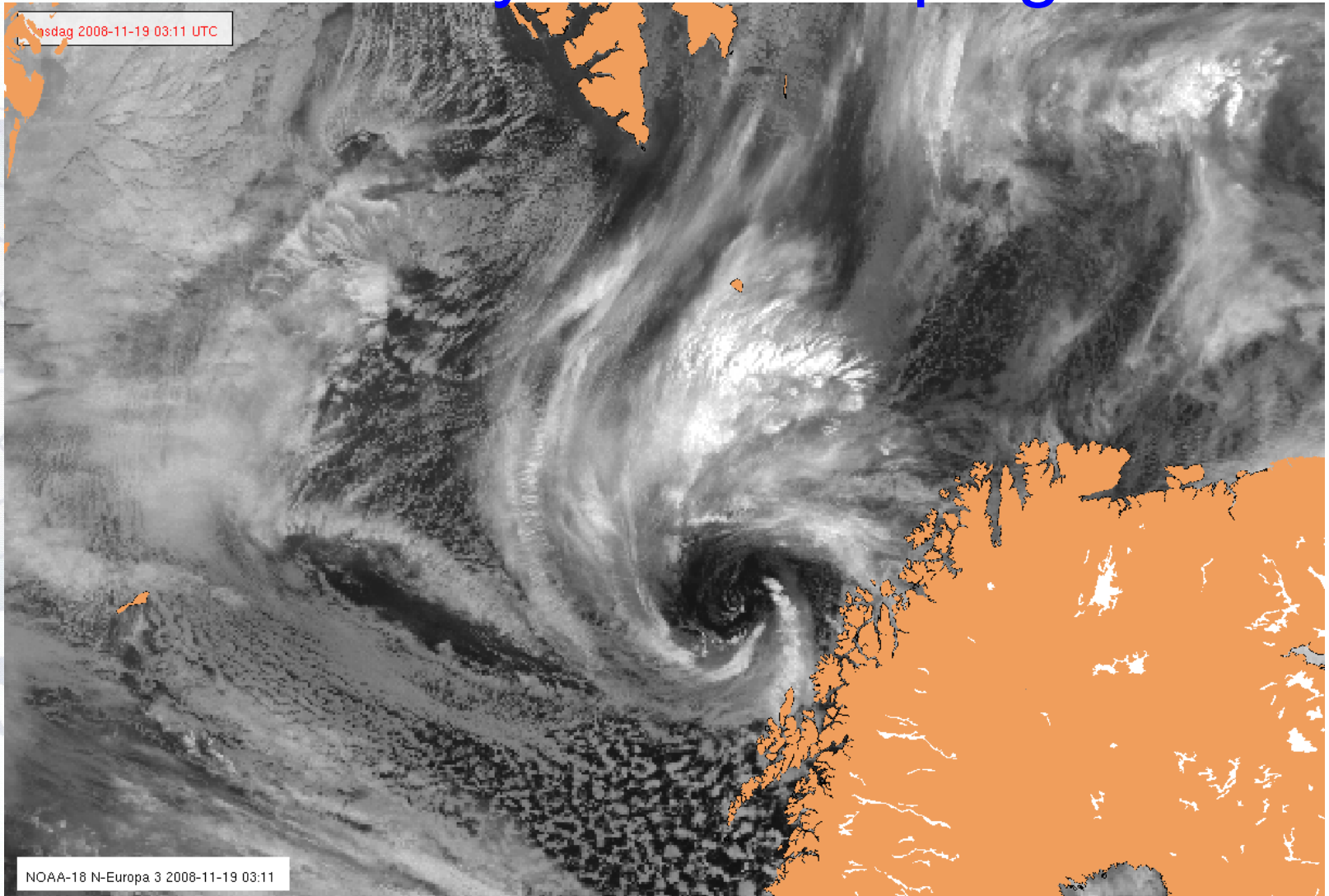
After being tossed about at sea for a long time he chanced upon land where he had not expected any to be found. Fields of self-sown wheat and vines were growing there; also, there were trees known as maple.

In *The Sagas of the Greenlanders*, Bjarni Herjólfsson is blown off course, ►

<sup>1</sup> The *Icelandic Sagas* are derived from the oral tradition of recounting historical events and so tend to have been written down (often anonymously) many years after the events they describe. The translations quoted here are from the compendium *The Sagas of the Icelanders: A Selection*, Preface—J. Smiley, Introduction—R. Kellogg, published by Penguin Books, 2000; with these translations first published in *The Complete Sagas of Icelanders*, Volumes I-V, Leifur Eiriksson Publishing Ltd, Iceland, 1997. A recent review of environmental understanding amongst the early Norse cultures can be found in the article by Haine (2008).

Coastal mountains of southeast Greenland, at about 66°N, 35°W, on 5 March 2007. (Photo: G.W.K. Moore)

# IPY-THORPEX-Norway: The 2008 Andøya field campaign

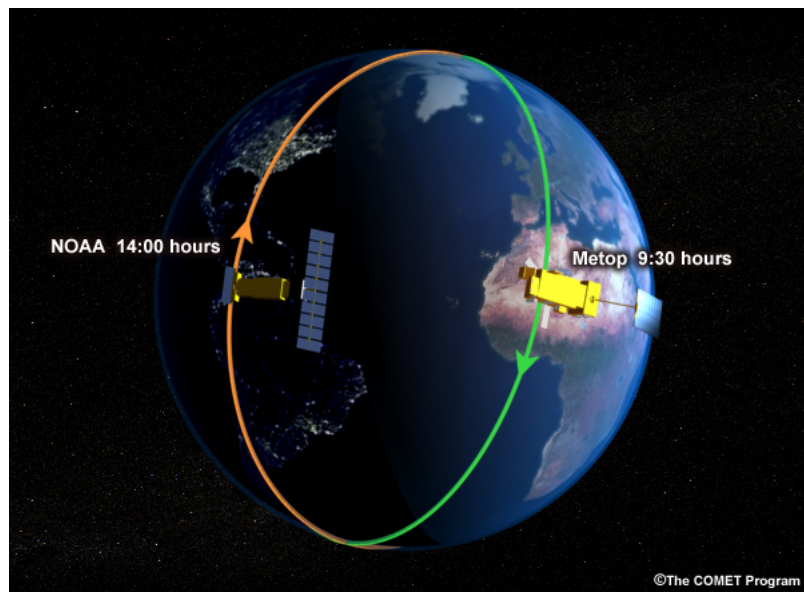


# IPY - Preliminary summary on the predictability of Polar Lows

- Arctic mesoscale weather events are a major forecasting challenge
  - 3-4 March Polar Low was quite well predicted by the operational models – Why? Well-defined low-level baroclinicity?
  - 16-17 March Polar Low was extremely poorly predicted – Why? More convective?
- Information from ensemble simulations important
- Information from extra observations important
- Data for understanding dynamical systems of the Arctic
- Data for improving physical parameterization of clouds, - liquid water vs ice in Arctic clouds

# The International Project Concordiasi

THORPEX



WWRP/JSC 3

WWRP

WMO  
OMM



# IPY Legacy

- Additional data for improving physical parameterization in NWP models, -clouds, microphysics, surf fluxes
- Improved assimilation techniques for high latitudes with emphasis on satellite data
- Increased understanding on the effect of the use of ensemble simulations for high latitudes
- Increased understanding on the effect of targeting in high latitudes
- Increased understanding of dynamics of high latitude, high impact weather phenomena
- Demonstration of the effect of new instruments
- Demonstration of the effect of increased Arctic and Antarctic observations for local and extra-tropical NWP forecasting

# Longer range research outlook

- Basic issues of predictability and key dynamical processes
- The required initial conditions and implied observational coverage
- Strategies for observations targeting in critical situations
- Tackling the problem issues in data assimilation especially at high resolution
- Handling of the tropics particularly organised convection, tropical cyclones and extra-tropical transition and interactions
- **Polar weather – IPY Legacy Project**
- Seamless prediction of weather and climate from days to weeks and seasons

# Proposed IPY Legacy Project

- **CAS XV : ADVANCING WEATHER, ICE AND ENVIRONMENTAL PREDICTIONS IN THE POLAR REGIONS: AN IPY LEGACY** (*agenda item 8.4*)

- **The Commission noted:**

- (i) the success of the THORPEX IPY cluster including a high-resolution sea-ice modelling system in Canada;
- (ii) the success of the JCOMM IPY Ice Logistics Portal;
- (iii) the European GMES Marine Core service and its polar prediction and sea ice information provision services; and
- (iv) the scientific and operational advances in satellite data assimilation.

# IPY Legacy Project

**First step is to convene:**

- **A WWRP, THORPEX, WCRP, GAW Workshop - main goals**
- **Early October 2010 in Norway**

# IPY Legacy Project

- Main goal of the Workshop is the establishment of an IPY Legacy Project that would provide a valuable framework to foster co-operative international research and development efforts to improve weather and environmental prediction capabilities for the Polar Regions.
- The workshop is likely to review a fairly wide range of science issues in polar regions (probably more focus later):

# IPY Legacy Project

## ➤ *Weather to seasonal forecasts*

*Data assimilation, physical processes, regional NWP systems, snow processes etc.,*

## ➤ *Coupled NWP/EP*

*The linkage between land, ocean, sea-ice, hydrology and the atmosphere, water cycle and surface processes, biogeochemistry and the ecosystem*

## ➤ *Verification*

*Review and explore the potential for verification and assessment activities in polar regions inc. Verification of sea ice and coastal forecasts.*

# IPY Legacy Project

➤ **Joint Chairs:**

**Thor Erik Nordeng** (Met No., THORPEX IPY Project Cluster leader)

**Gilbert Brunet** (EC, WWRP/JSC Chair)

➤ **Committee** in the process of being formed.