

Modelisation and simulation
centres:
the example of the European
Centre for Medium-range
Weather forecasts (ECMWF)

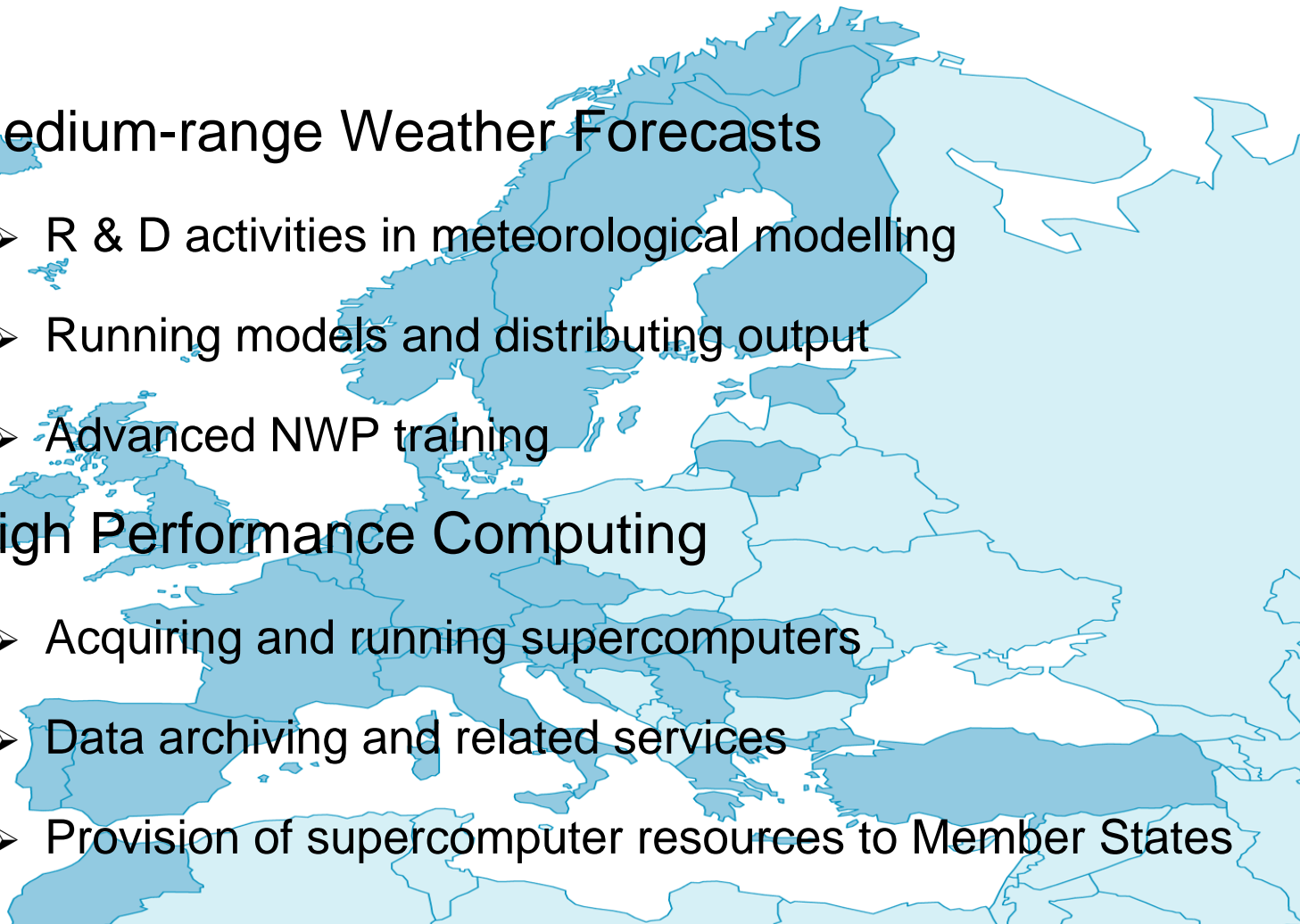
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www.ecmwf.int

Headers of the presentation

- **ECMWF: a research infrastructure in NWP**
- **About Numerical Weather Prediction (NWP)**
- **The European Meteorological Infrastructure (EMI)**
- **Trends and evolution**

ECMWF's primary objectives

- 
- **Medium-range Weather Forecasts**
 - R & D activities in meteorological modelling
 - Running models and distributing output
 - Advanced NWP training
 - **High Performance Computing**
 - Acquiring and running supercomputers
 - Data archiving and related services
 - Provision of supercomputer resources to Member States

The European Centre for Medium-range weather forecasts

Belgium

Denmark

Germany

Spain

France

Greece

Ireland

Italy

Luxembourg

The Netherlands

Norway

Austria

Portugal

Switzerland

Finland

Sweden

Turkey

United Kingdom

Co-operation agreements or working arrangements with:

Czech Republic

Croatia

Estonia

Hungary

Iceland

Lithuania

Morocco

Romania

Serbia

Slovenia

(Latvia)

(Slovakia)

(Israel)

(Montenegro)

ACMAD

ESA

EUMETSAT

WMO

JRC

CTBTO

CLRTAP

Specificities of modelisation in meteorology

➤ **Duality research – operations:**

- **Daily verification of the forecasts**
- **Comparison between global centres**

➤ **Data assimilation**

- **Determination of the initial value**

➤ **Multi-component system**

- **From atmospheric model to earth system: waves, ocean, land ...**

➤ **Ensemble forecasting**

- **Providing probabilistic forecasts**

Permanent verifications of the forecasts

ECMWF FORECAST VERIFICATION 12UTC

500hPa GEOPOTENTIAL

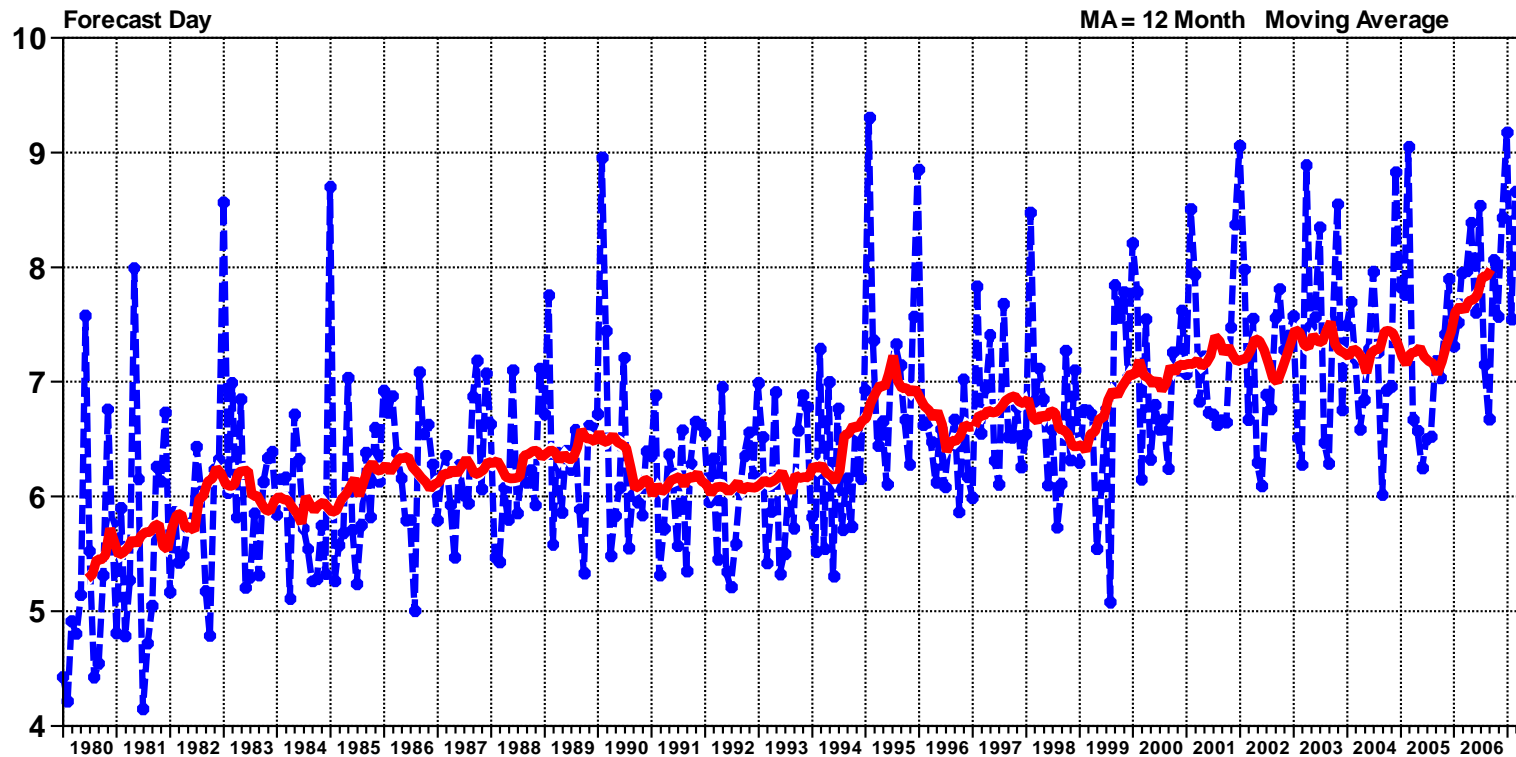
ANOMALY CORRELATION

FORECAST

EUROPE LAT 35.000 TO 75.000 LON -12.500 TO 42.500

—●— SCORE REACHES 60.00

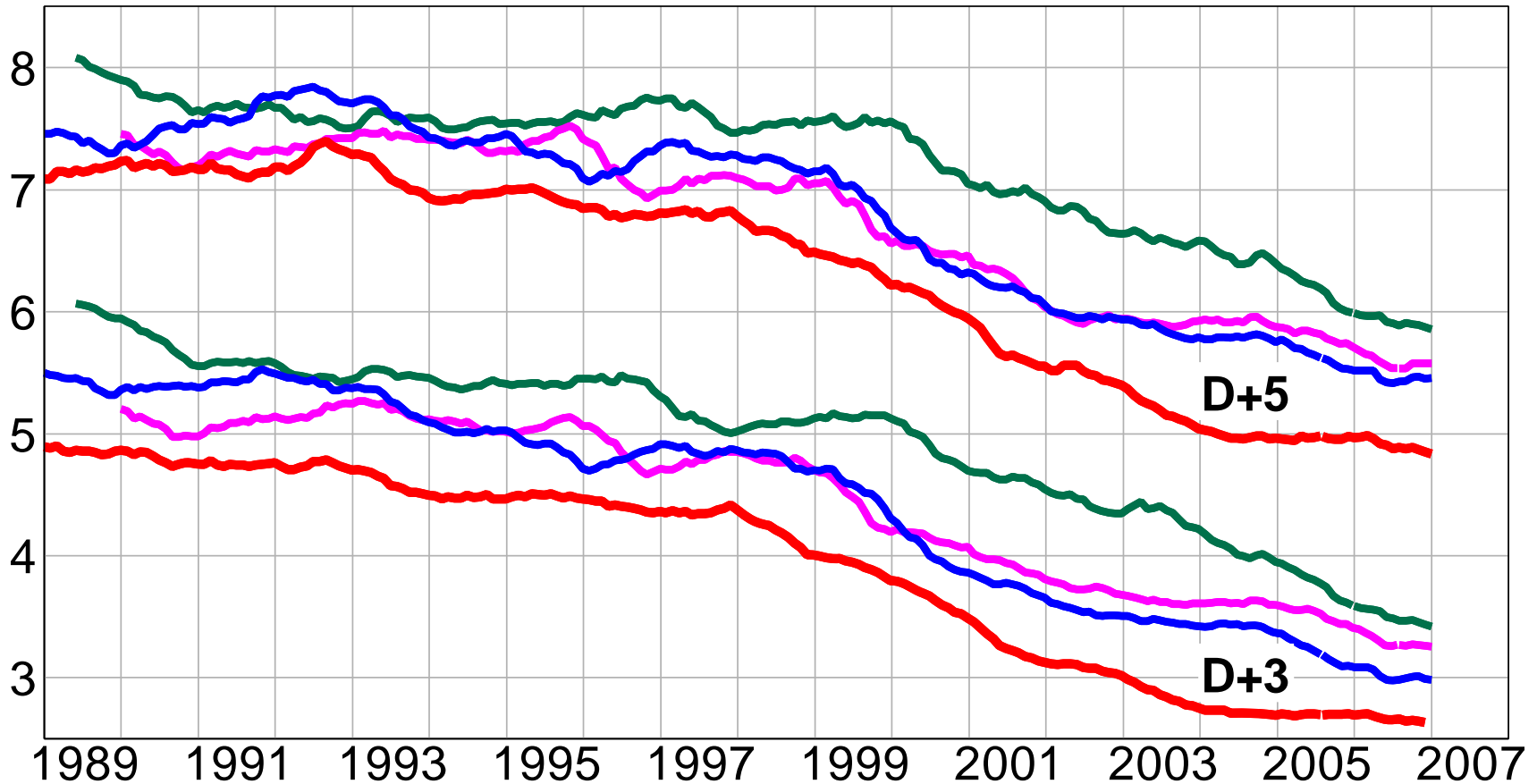
— SCORE REACHES 60.00 MA



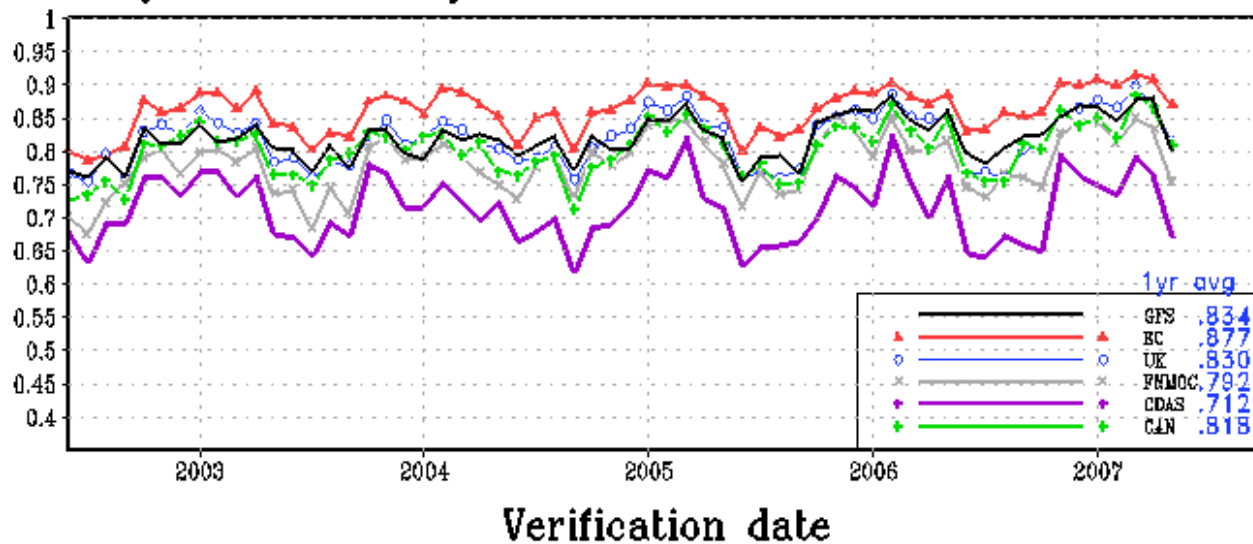
ECMWF scores compared to other major global centres

R.m.s. error (hPa) of surface-pressure forecasts for three and five days ahead

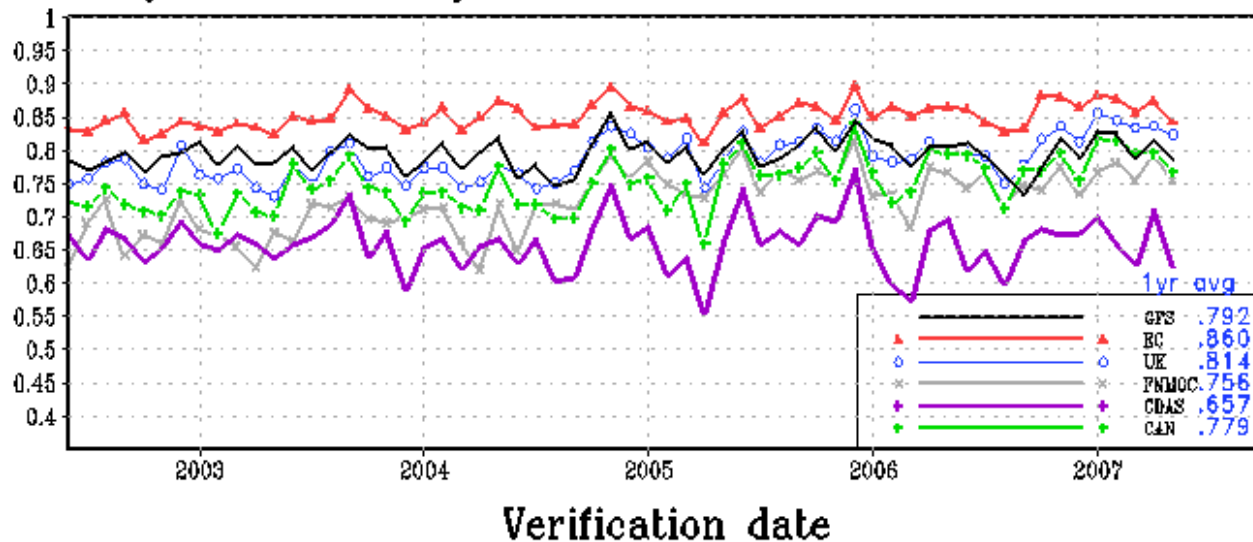
— ECMWF — UK — USA — JAPAN



Anomaly Correl day 5 Z 500mb n hem lat 20-80



Anomaly Correl day 5 Z 500mb s hem lat 20-80

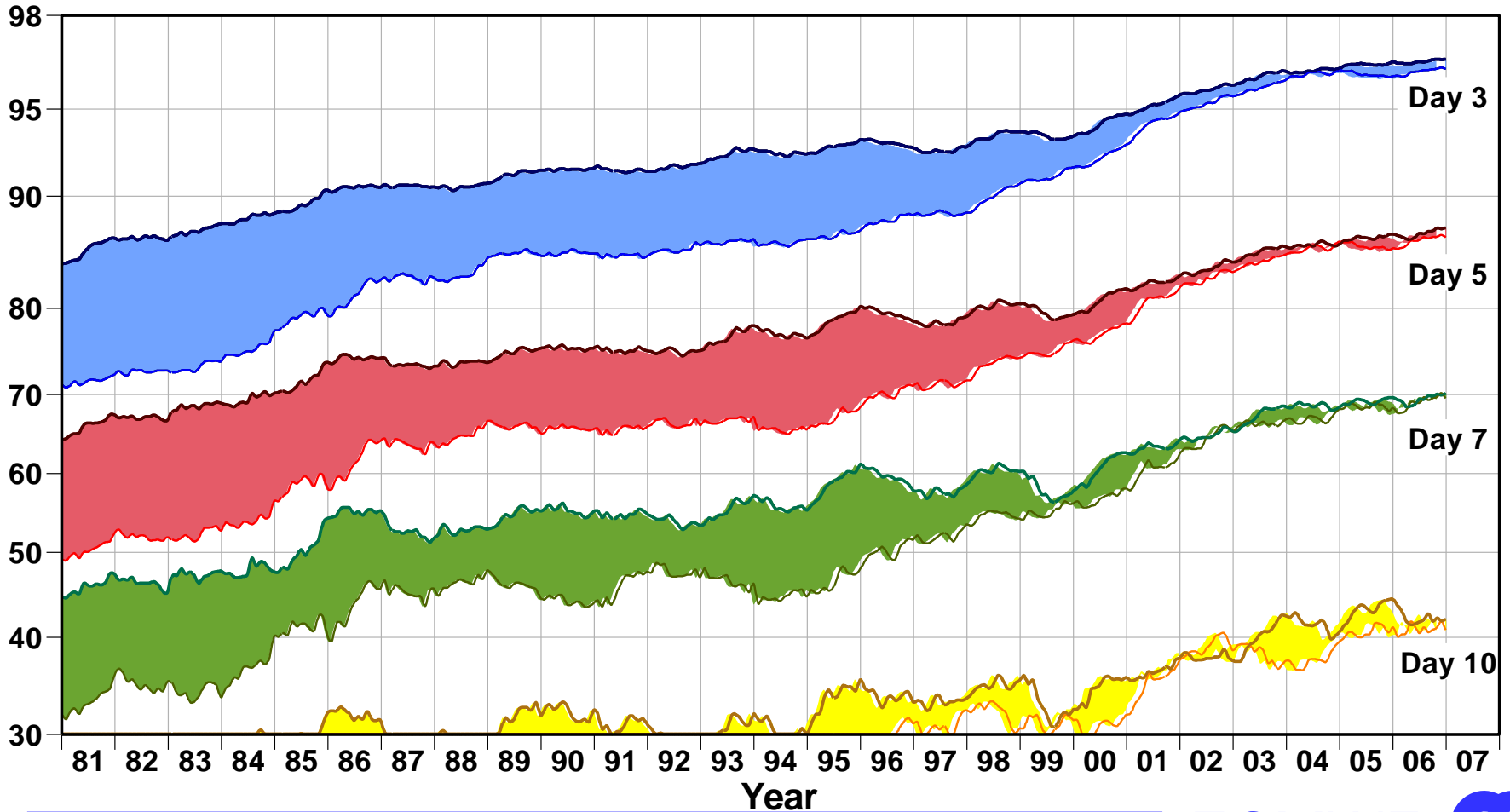


Score comparison from the US national weather service website

Determination of the initial value: comparison northern and southern hemispheres

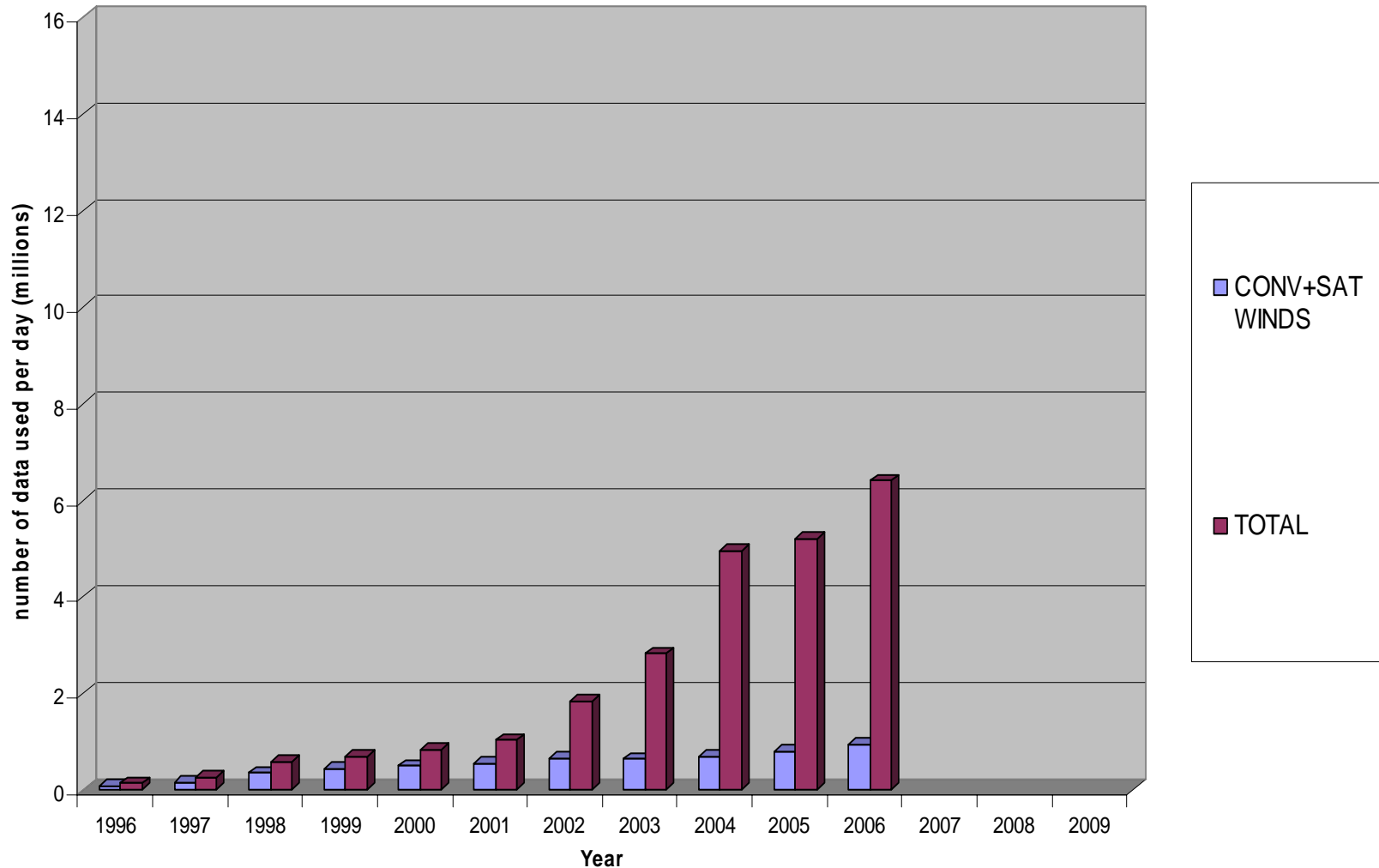
Anomaly correlation (%) of 500hPa height forecasts

— Northern hemisphere — Southern hemisphere



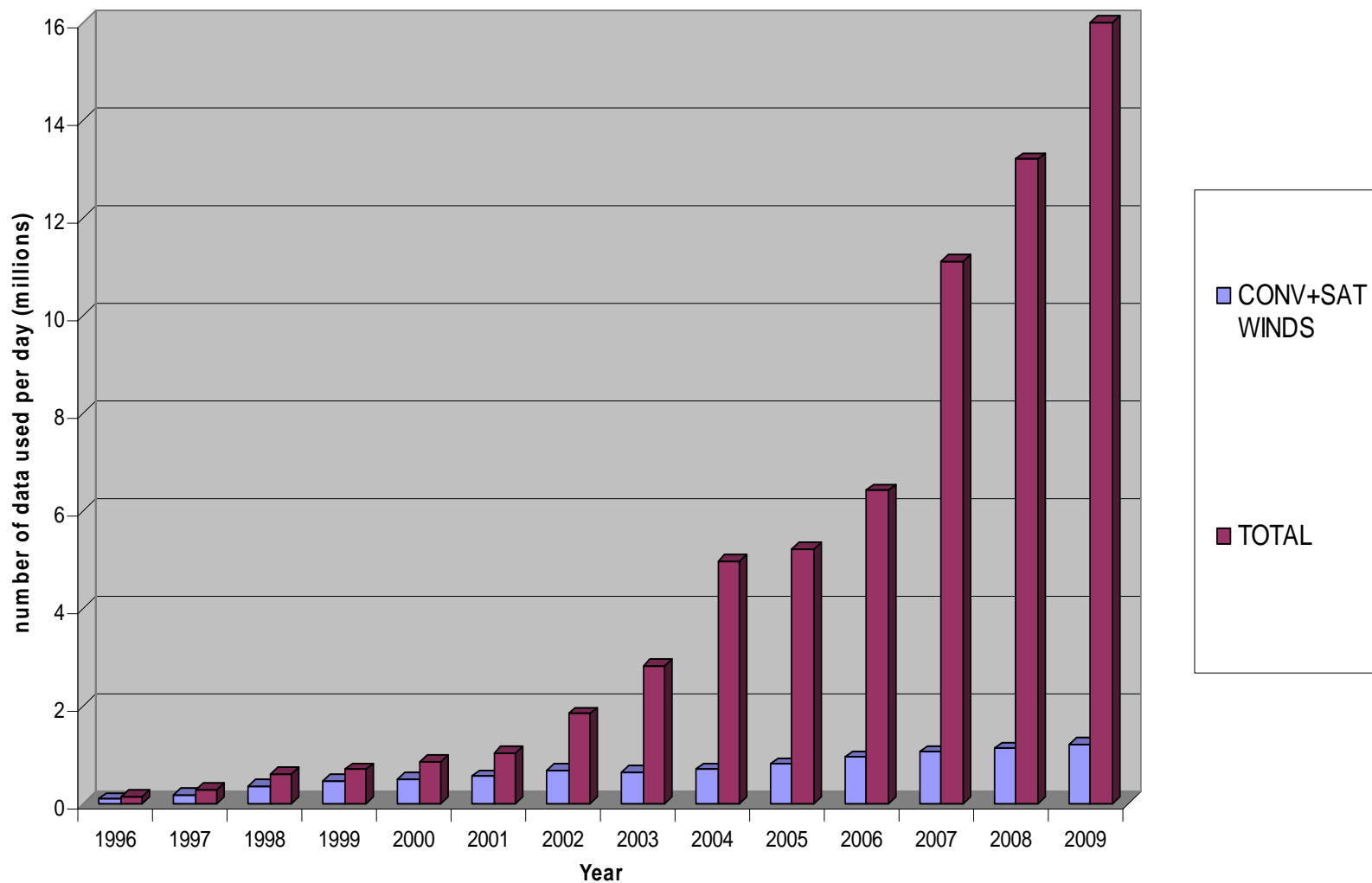
Today 6 millions data used per day (out of 160 millions data screened – only 4%)

quantity of satellite data used per day at ECMWF

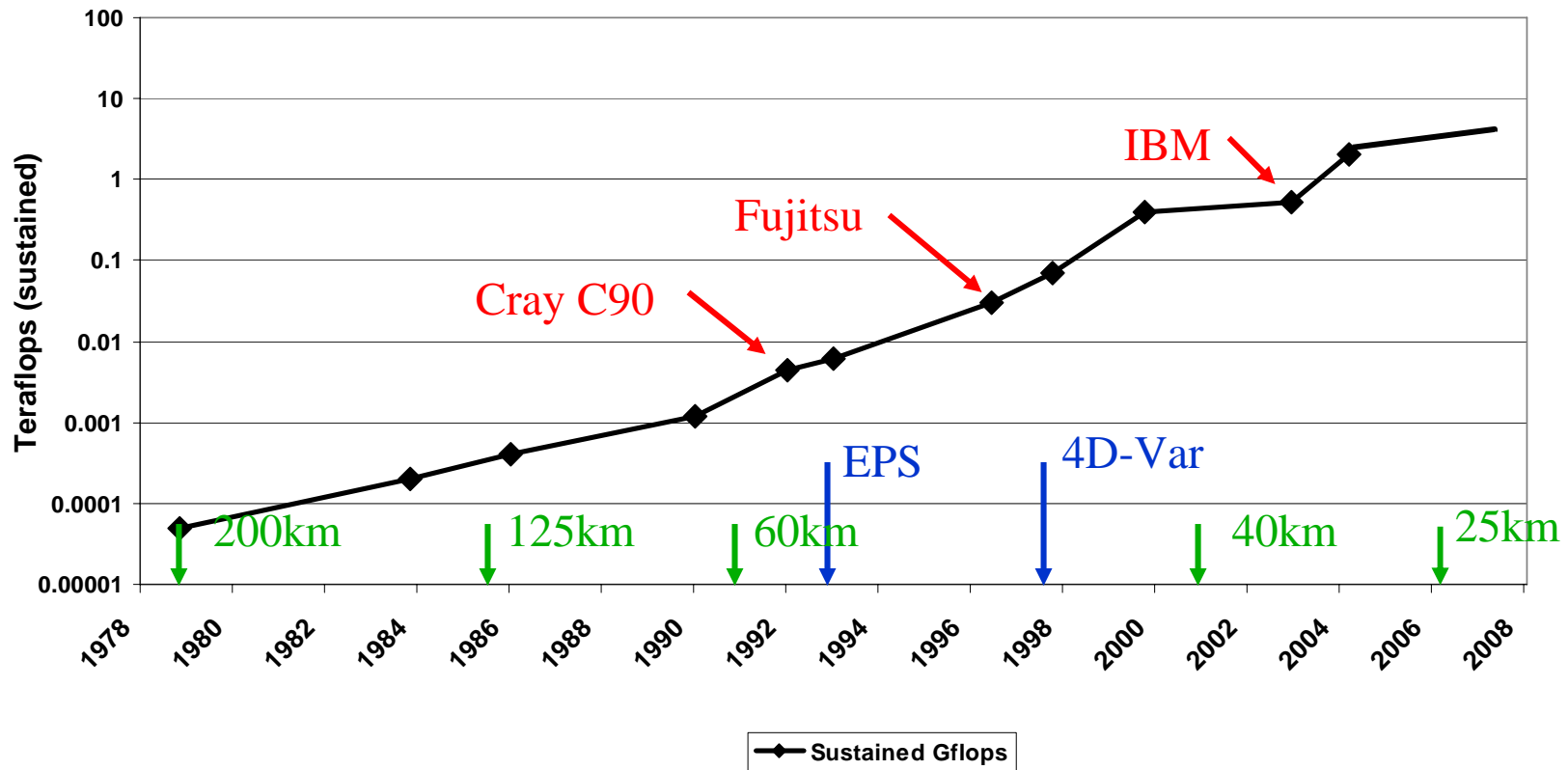


Tomorrow

quantity of satellite data used per day at ECMWF



The evolution of ECMWF computing power (sustained performance)

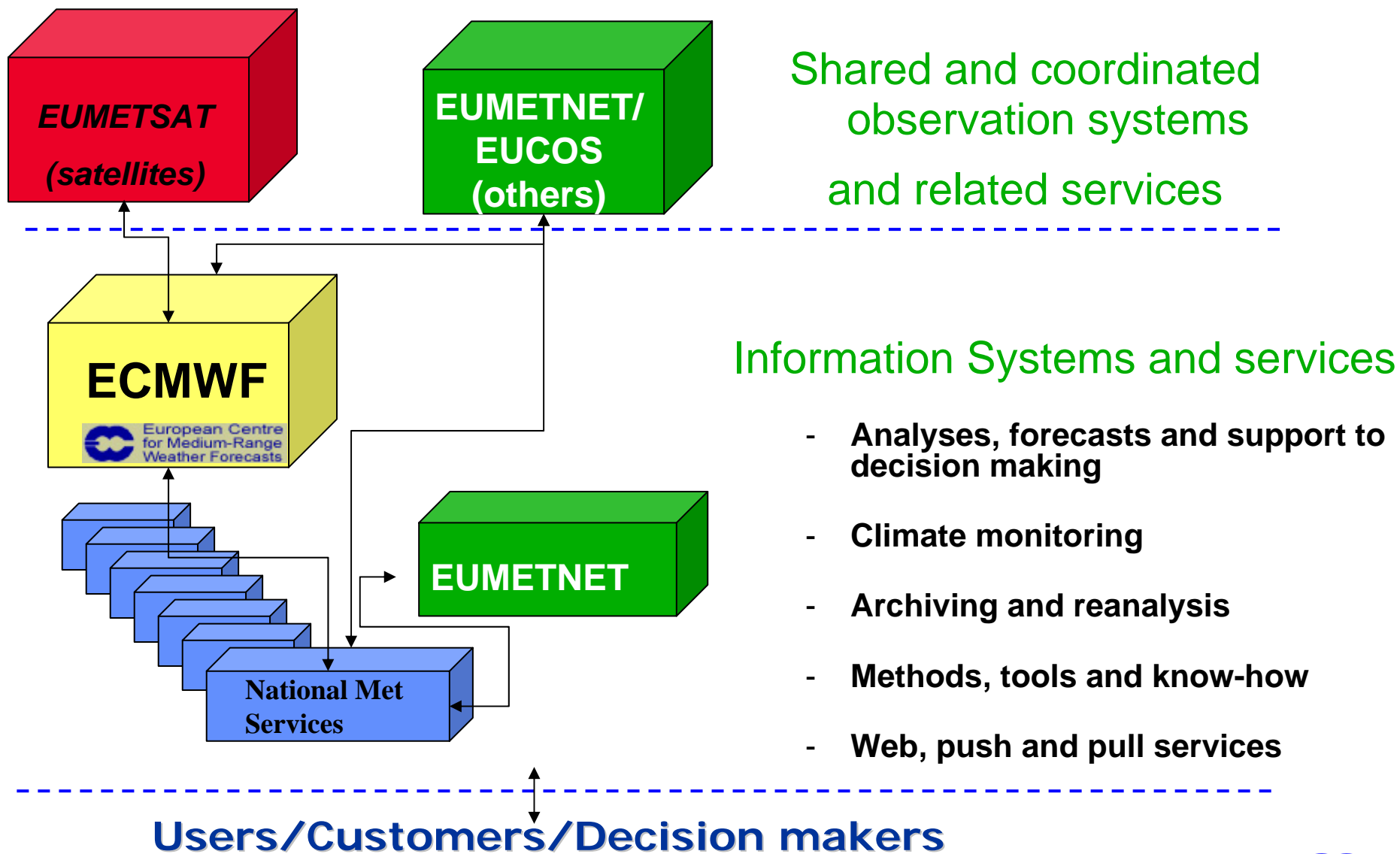


The European Meteorological Infrastructure (EMI)

- **EUMETSAT: A space agency for operational meteorological satellites (also environment, climate)**
- **ECMWF: a global modelisation centre**
- **National Meteorological Services (NMS): in-situ observations, short-range high-resolution limited-area modelling, services**
- **Regrouped in EUMETNET**

WMO

The European Meteorological Infrastructure (EMI)



The requirements for further developing meteorological modelisation

- **Coping with increased volume and complexity of satellite data**
- **Developing an early warning system for severe weather**
- **Preparing for climate change**
 - Increased frequency
 - Increased danger (e.g. storm surge)
- **Increased societal sensitivity**



Trends in meteorological modelisation

➤ **Earth system modelling:**

- **Sea-ice, vegetation, hydrology, aerosols**
- **Air quality**

➤ **Increasing resolution**

➤ **Increasing ranges**

➤ **Multi-model**

➤ **Convergence between weather and climate models**

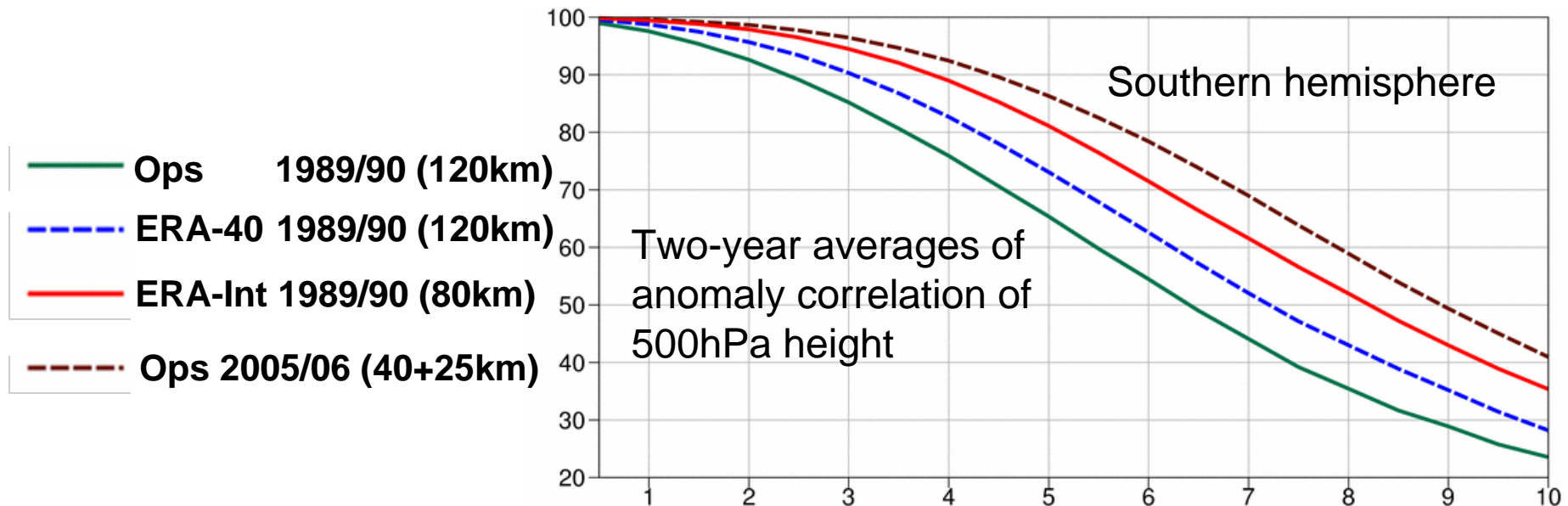
- **Initial value vs boundary condition problems**
- **Beneficial both ways**

The ECMWF archive

- **The largest NWP archive worldwide**
- **Built since ECMWF operations started in 1979**
- **Holds more than 5 petabytes today**
- **6 terabytes added daily**
- **Contains:**
 - **All data used**
 - **All analyses**
 - **All forecasts**
 - **Reanalyses**
- **Fully accessible on-line to Member States users**

A by-product: reanalysis

- Rerun the latest assimilation system, over a long period of time
- Provides an improved and consistent description of the atmosphere
- Improvement measured from impact on re-forecasts
- Use for observing system studies, climate studies



Summary: ECMWF

- **A European intergovernmental organisation**
- **Small**
- **Focused**
- **Strongly connected to Member States users**

Thank you

www.ecmwf.int

