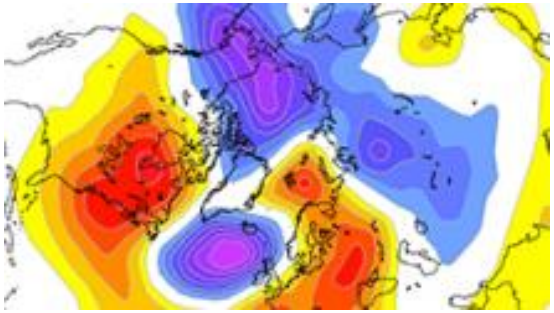




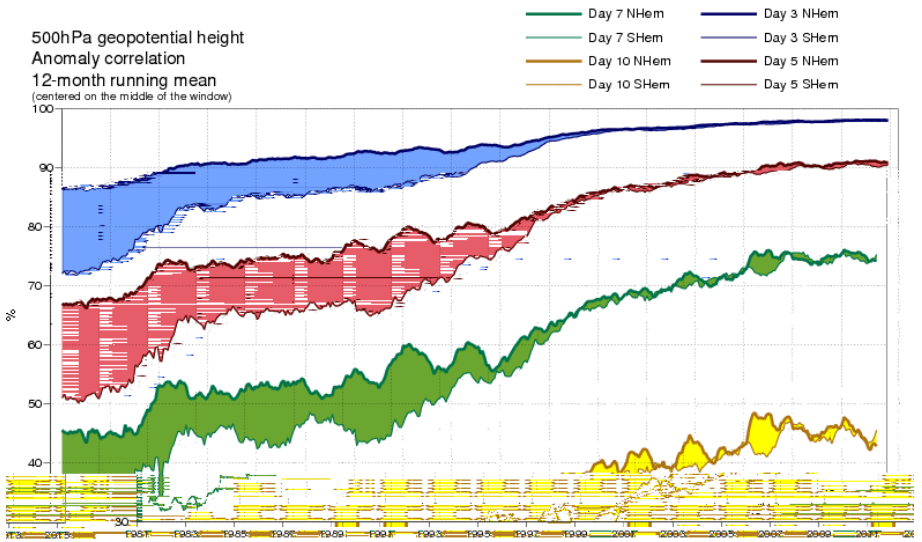
ECMWF Research: a member state perspective

Sarah Jones, DWD

with contributions from all around Germany

40 years of ECMWF

… of ECMWF leading medium-range weather forecasting

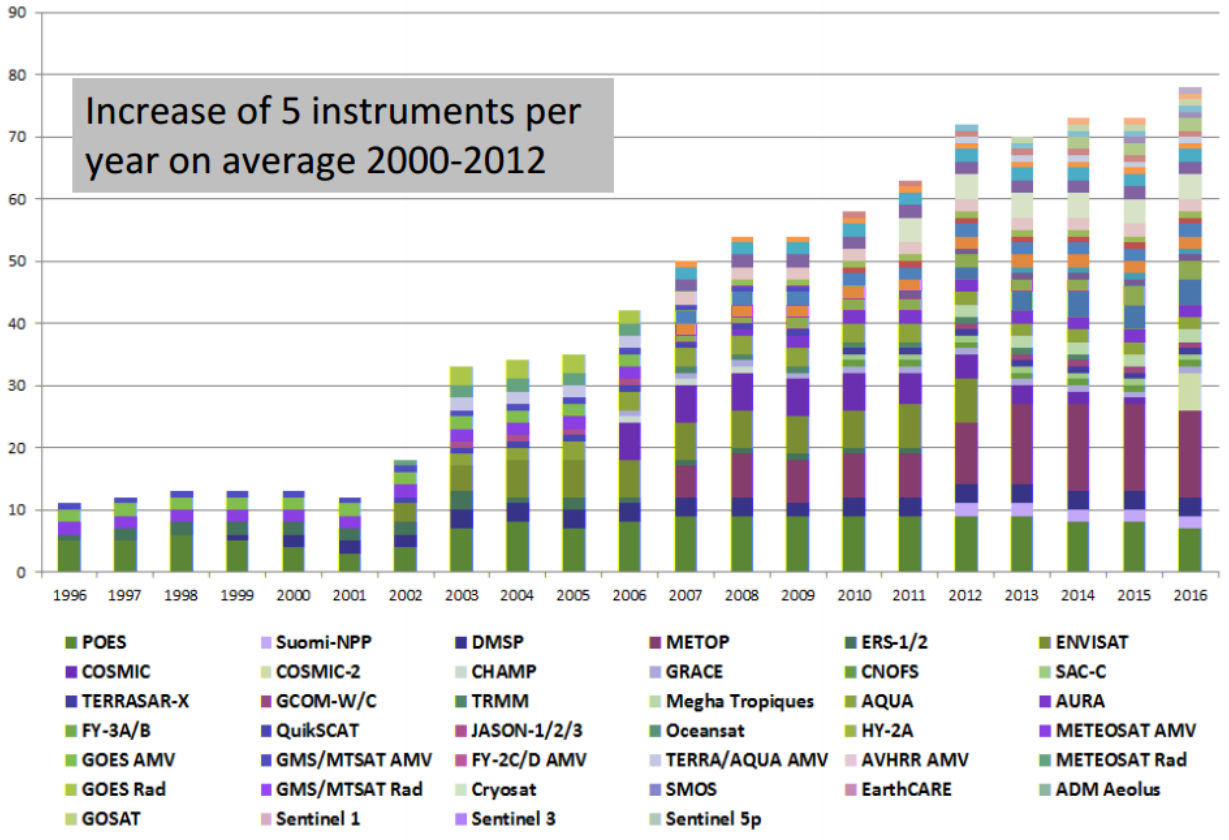


Atmospheric physics
Ocean reanalysis
Assimilation Methods
Atmospheric dynamics
Atmospheric composition
Data Assimilation
ERA 20C Forecast evaluation
Land ERA Interim
Coupled Earth system reanalysis
Modelling and Prediction Marine
Climate Reanalysis
Observations
Quantifying forecast uncertainty

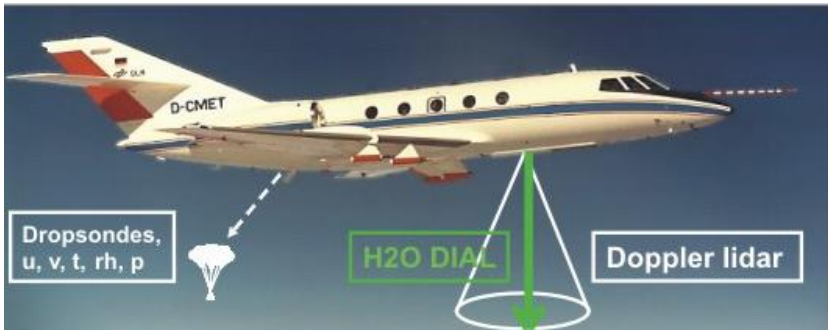
….and ECMWF atmospheric research at the cutting edge

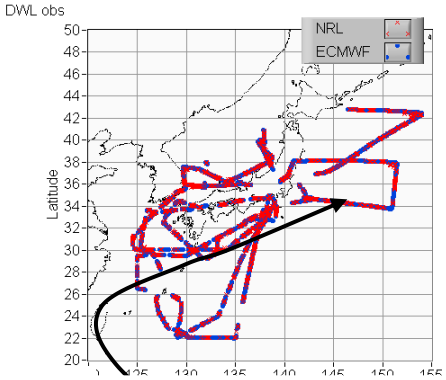
Data Assimilation

- ECMWF leading the use of satellite data for NWP
- .and pioneering soil moisture assimilation
- Exchange and collaboration crucial for German Universities and DWD



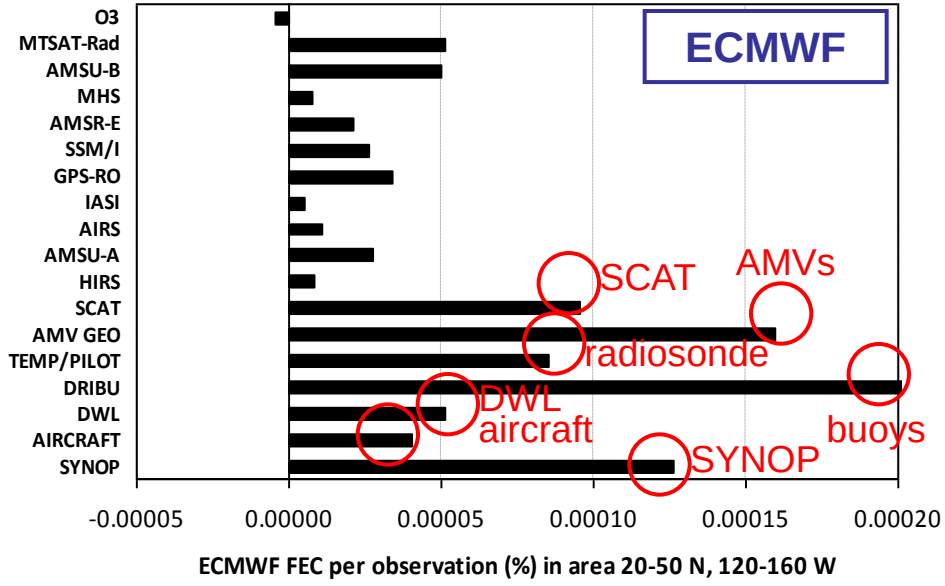
Doppler wind lidar (DWL) assimilation in ECMWF & NOGAPS

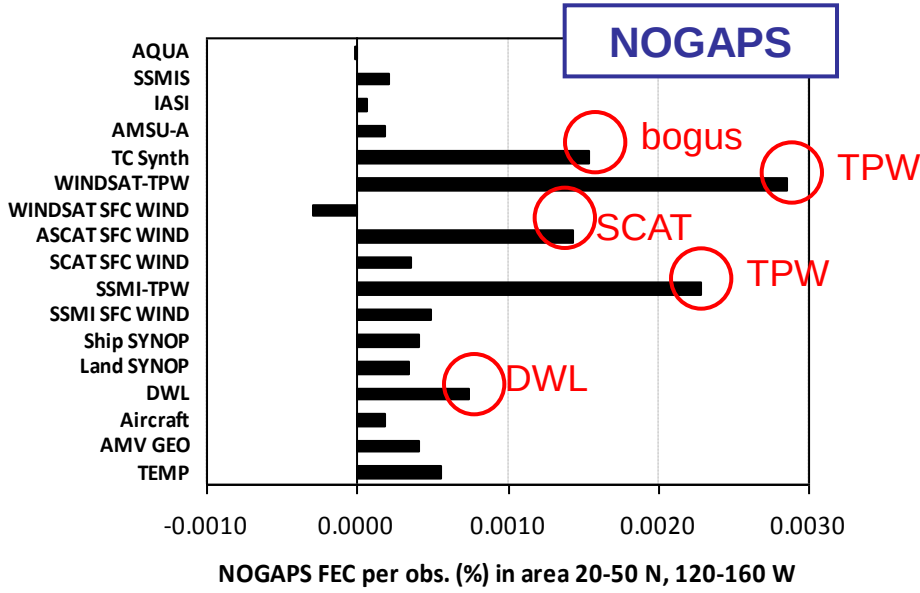




- DWL observations showed significant impact in two modelling systems
- Representative observations

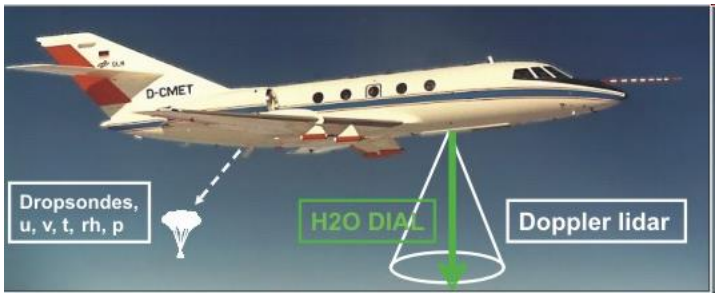
→comparably high impact

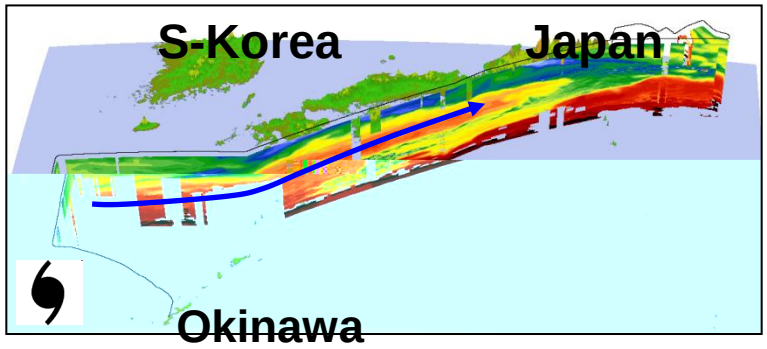


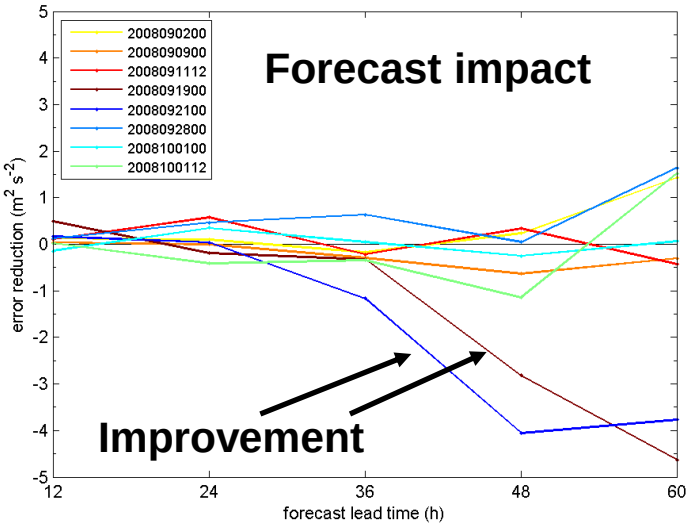


(Weissmann, Langland, Pauley, Rahm and Cardinali, 2012, QJRMS)

Water vapour lidar (DIAL) assimilation at ECMWF







- Observations from 8 flights assimilated in ECMWF system
- Verification with independent dropsondes shows analysis improvement
- Weak forecast impact in most cases, but improvement in two events with modified downstream development

(Harnisch, Weissmann, Cardinali and Wirth, 2011, QJRMS)

Data Assimilation

Forecast sensitivity to observations developed at ECMWF (Cardinali 2009) inspired research in Hans Ertel Centre using ensembles to evaluate sensitivity

QUARTERLY JOURNAL OF THE ROYAL METEOROLOGICAL SOCIETY

RMetS Royal Meteorological Society

Research Article

Monitoring the observation impact on the short-range forecast

FREE

Carla Cardinali*

Article first published online: 21 JAN 2009

DOI: 10.1002/qj.366

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Issue

Quarterly Journal of the Royal Meteorological Society

Volume 135, Issue 638, pages 239–250, January 2009 Part A

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QUARTERLY JOURNAL OF THE ROYAL METEOROLOGICAL SOCIETY

RMetS Royal Meteorological Society

Research Article

Observation impact in a convective-scale localized ensemble transform Kalman filter

Matthias Sommer* and Martin Weissmann

Article first published online: 27 MAR 2014

DOI: 10.1002/qj.2343

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Issue

Quarterly Journal of the Royal Meteorological Society

Volume 140, Issue 685, pages 2672–2679, October 2014 Part B

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Abstract | References | Cited By

Keywords:
observations impact; adjoint system;

Abstract

This paper describes the use of foreca
forecast range. In particular, the forec
observing system experiments perfor
observation data impact obtained with
and similarities are highlighted. Globa
detected that are related either to the
situation can affect the measurements

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Am score

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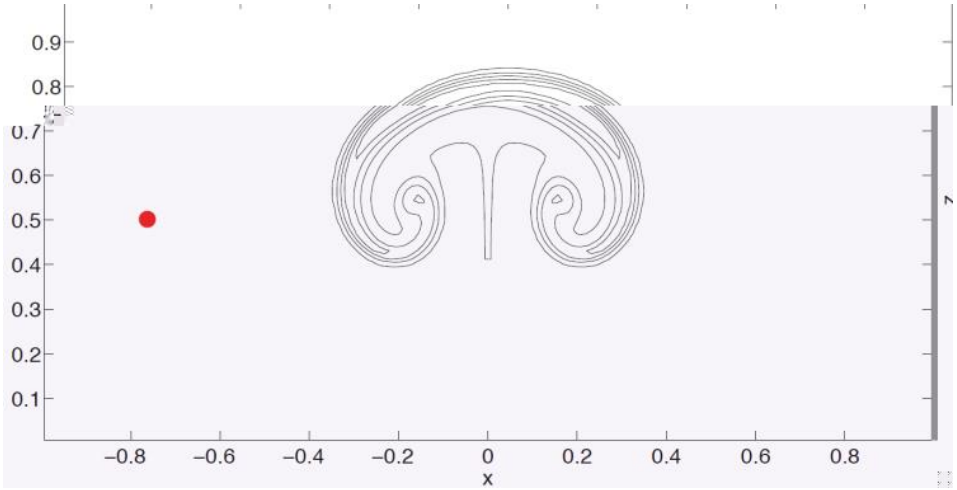
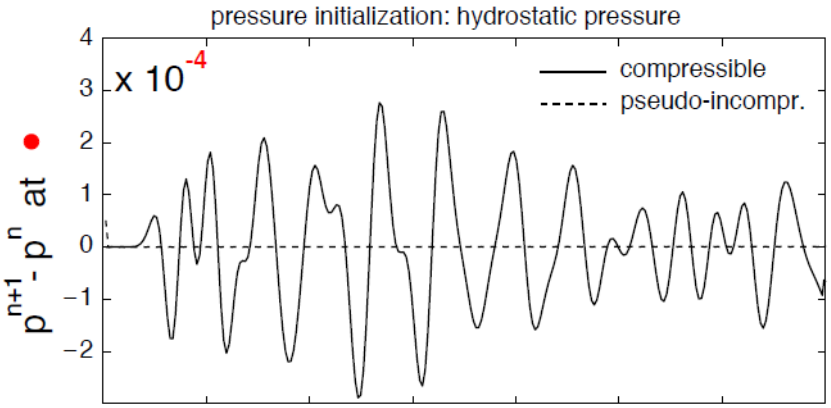
Keywords:
data assimilation; forecast sensitivity to observations; FSO

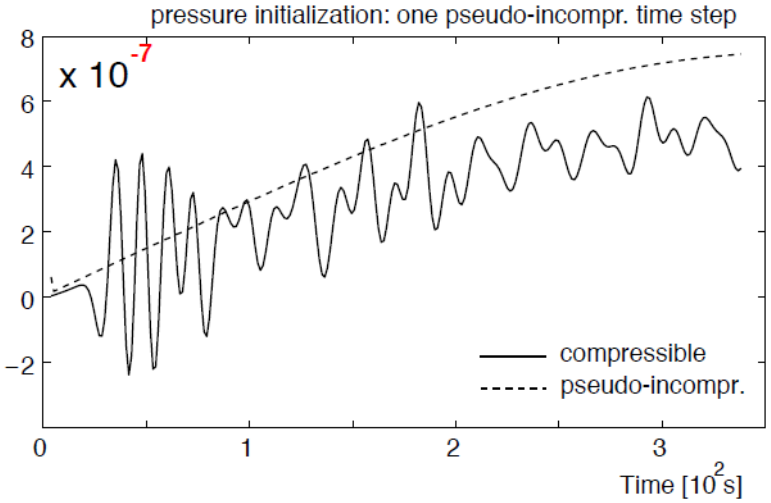
The aim of the present study is the accuracy and sensitivity assessment of a recently developed approximation method for observation impact, i.e. the contribution of observations to forecast-error reduction. The considered method uses an analysis and forecast ensemble for the approximation and does not require the adjoint model. The method is implemented for the first time in a convective-scale limited-area modelling system and its accuracy is assessed through comparison with results from a number of data denial experiments. It has been found that the difference from data denial is not significant and it is possible to assess the impact of subgroups of observations and detect disadvantageous or improperly used observations.

Theory and Numerical Methods



Rupert Klein, Freie Universität Berlin, ECMWF Fellow

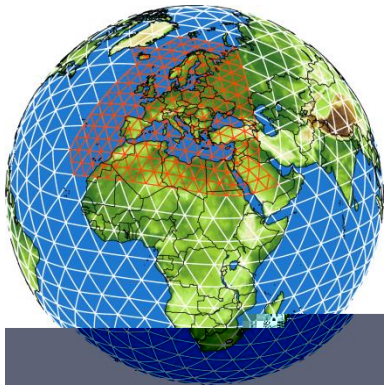




- Investigate variants of reduced dynamical models for atmospheric motions, such as fully compressible, anelastic and their mathematical properties
- test novel numerical integrators that properly incorporate the limiting behaviors reflected in these reduced equations

Physical Processes

ICON



Process	Authors	Scheme	Origin
Radiation	Mlawer et al. (1997) Barker et al. (2002)	RRTM (later with McICA McSI)	ECHAM6/IFS
	Ritter and Geleyn (1992)	δ two-stream	GME/COSMO
Non-orographic gravity wave drag	Scinocca (2003) Orr, Bechtold et al. (2010)	wave dissipation at critical level	IFS
Sub-grid scale orographic drag	Lott and Miller (1997)	blocking, GWD	IFS
Cloud cover	Doms and Schättler (2004)	sub-grid diagnostic	GME/COSMO
	Köhler et al. (new development)	diagnostic (later prognostic) PDF	ICON
Microphysics	Doms and Schättler (2004) Seifert (2010)	prognostic: water vapor, cloud water,cloud ice, rain and snow	GME/COSMO
Convection	Tiedtke (1989) Bechthold et al. (2008)	mass-flux shallow and deep	IFS
Turbulent transfer	Raschendorfer (2001)	prognostic TKE	COSMO
	Louis (1979)	1st order closure	GME
	Neggers, Köhler, Beljaars (2010)	EDMF-DUALM	IFS
Land	Heise and Schrodin (2002), Machulskaya, Helmert, Mironov (2008, lake)	tiled TERRA + FLAKE + multi-layer snow	GME/COSMO

Physical Parametrisations for ICON / COSMO

Physical Processes

ICON surface winds too strong over ocean

Introduced new Charnock coefficient using empirical formula to imitate wave model WAM in IFS

(Jean Bidlot and Peter Janssen, ECMWF)

Improvements in:

- ocean winds,
- Z, RH and T in atmosphere,
- wave height in off-line wave modell.

$$C_H \quad 0.0059 \quad 0.00054\, u_{10m} \quad 0.000041\, u_{10m}^2$$

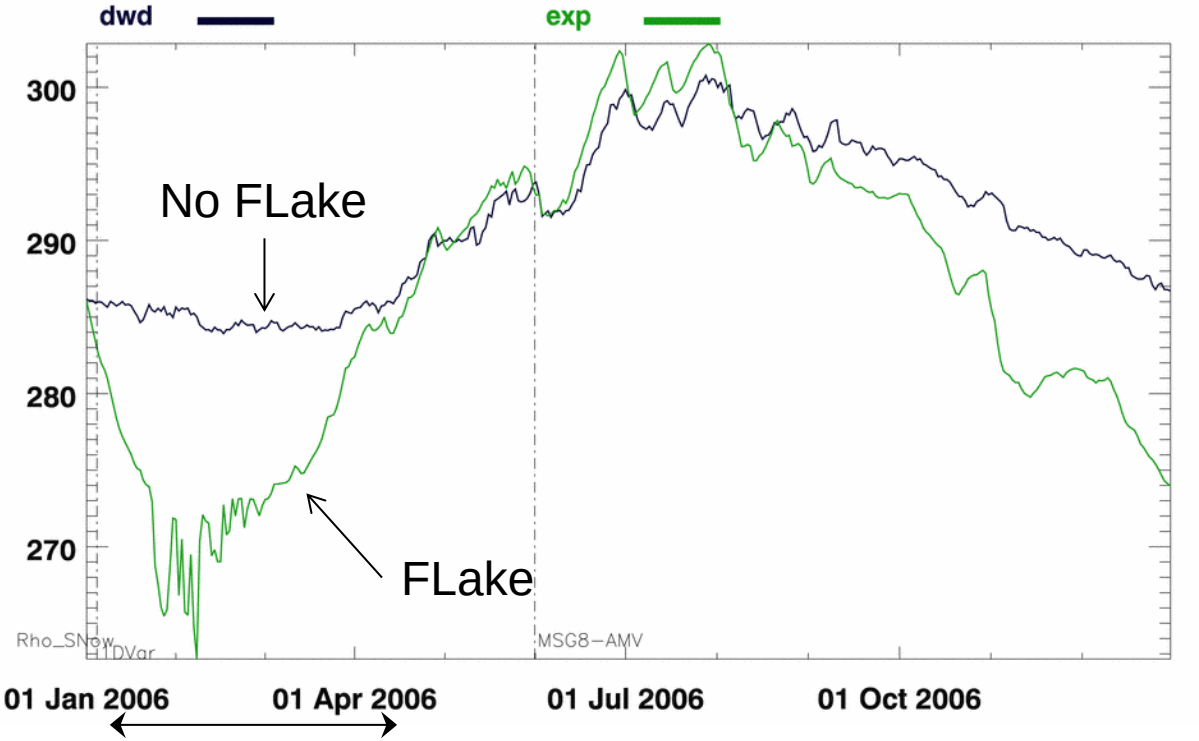
Physical processes

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

Lake Model FLake (Mironov 2008 ; Mironov et al. 2010) improves 2m T in regions with many lakes

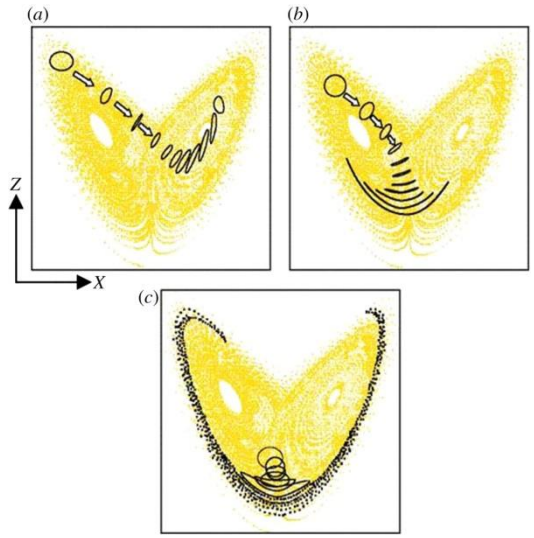
Collaboration DWD – ECMWF

Operational DWD since 2010, 2012, 2015; now operational in IFS



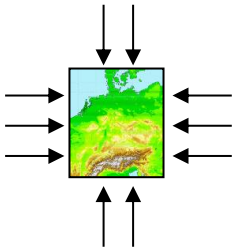
Lake Balaton frozen

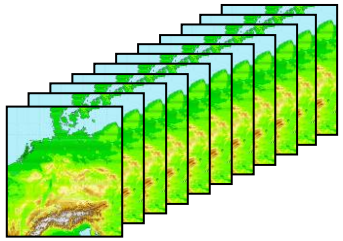
Ensemble Forecasting



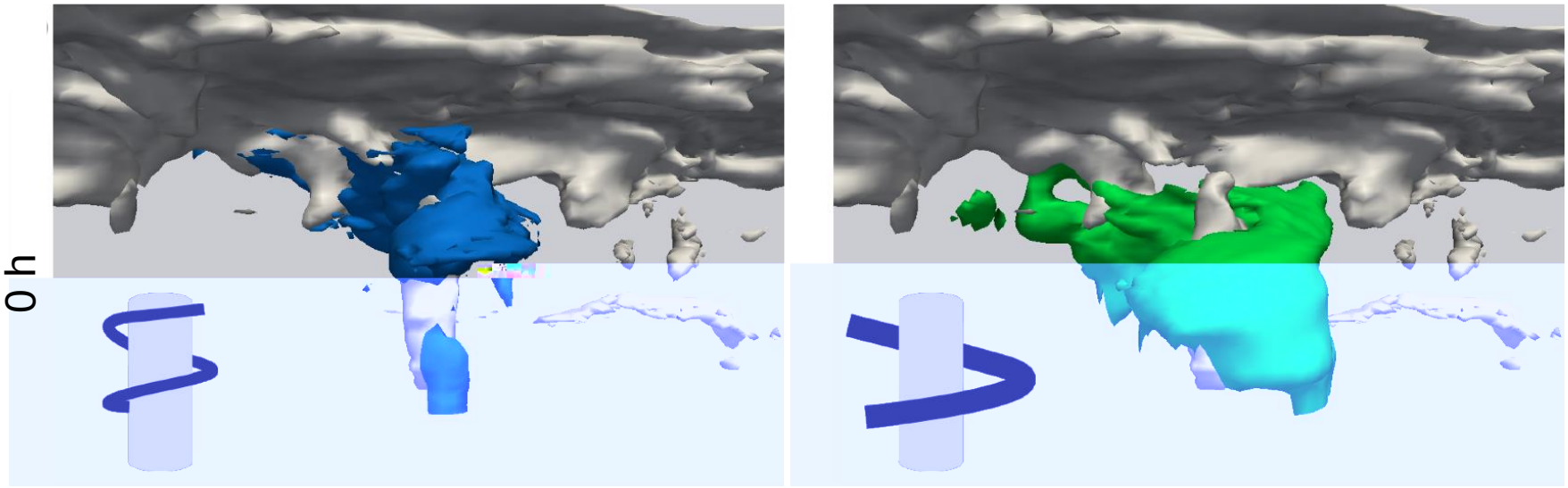
Palmer (2006)

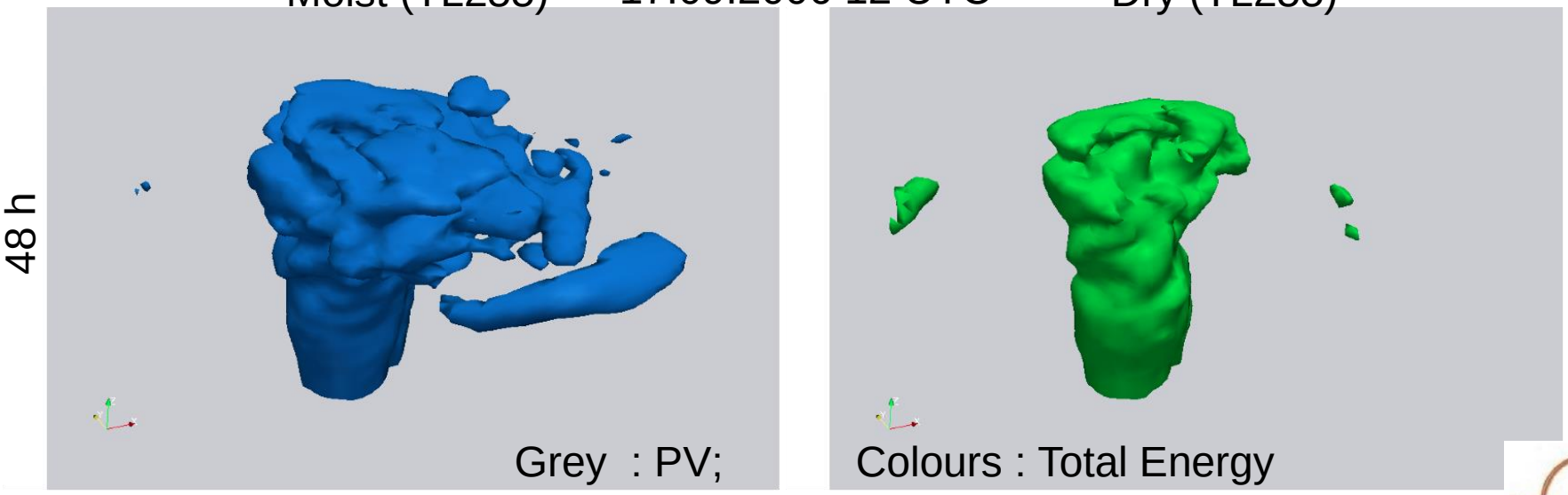
e.g. Palmer *et al.* (1993), Molteni *et al.*(1996), Vitart (2004), Buizza et al. (2007), Leutbecher and Palmer (2008), Vitart *et al.* (2008), …….





Singular Vectors for Extratropical Transition

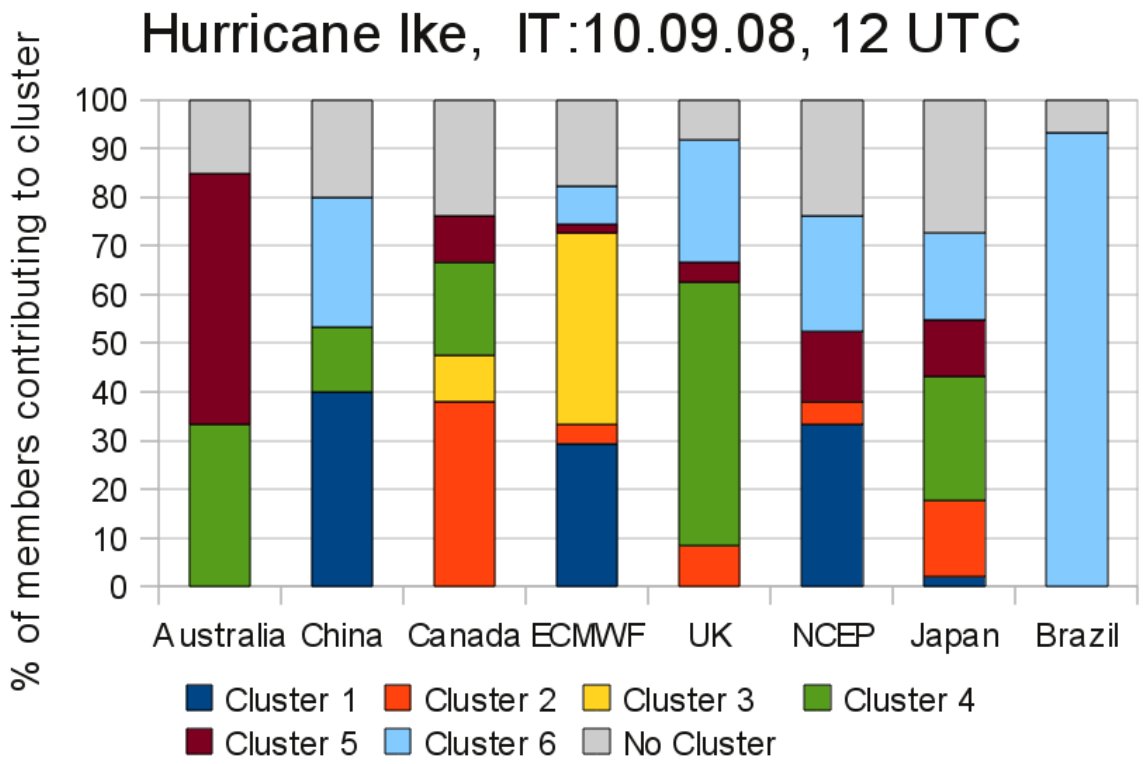




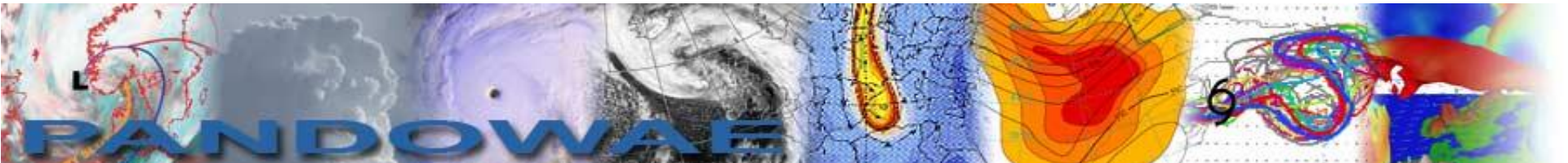
(Lang, Jones, Leutbecher, Peng, Reynolds, 2011; Lang, Leutbecher, Jones, 2012)

TIGGE: a dedicated research dataset

Properties of TIGGE Multimodel EPS during extratropical transition (ET)



Keller et al. (2011)

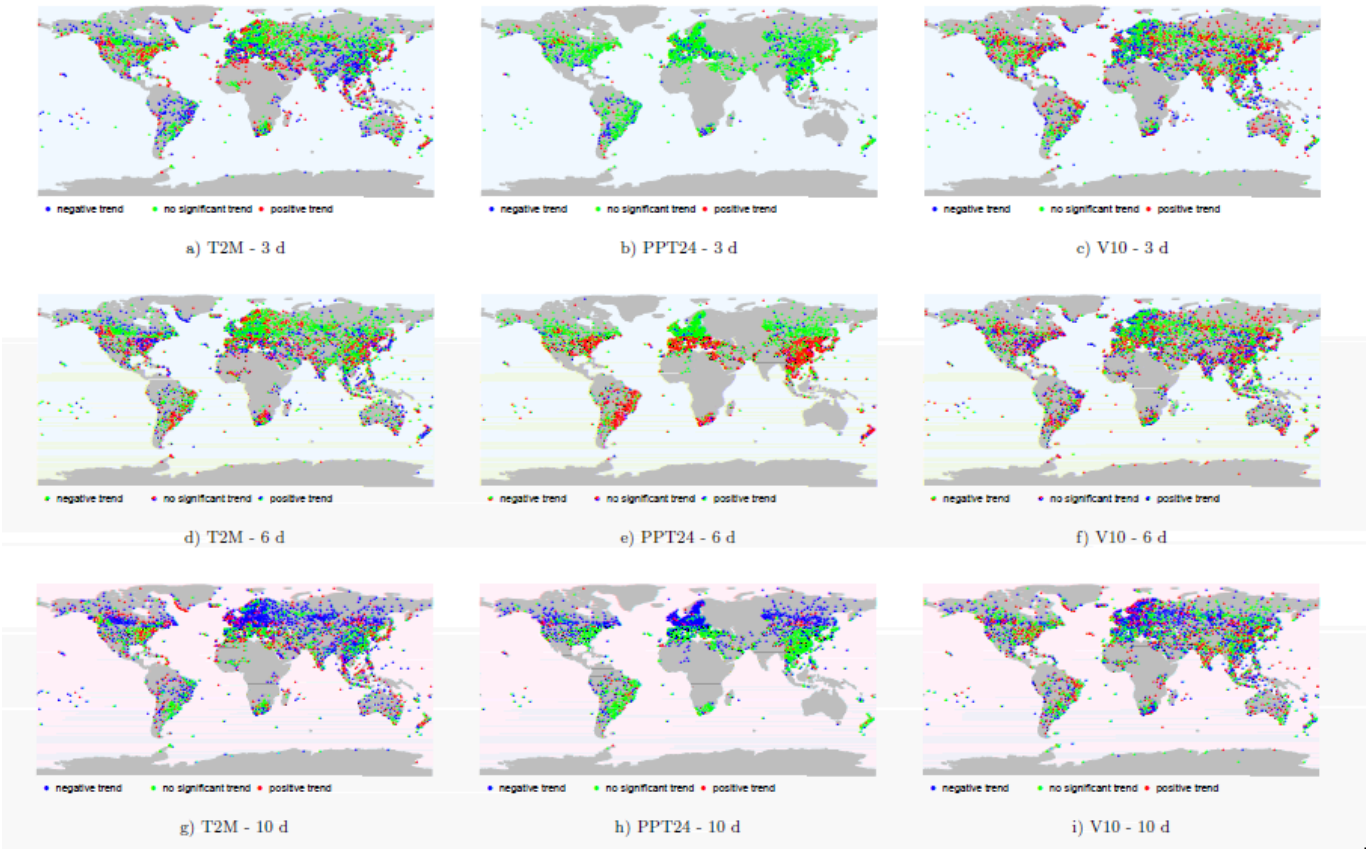


Statistical Postprocessing

Tilman Gneiting, Uni Heidelberg, ECMWF Fellow

„the development of the ECMWF ensemble system has motivated and shaped much of my group's research on statistical post-processing “

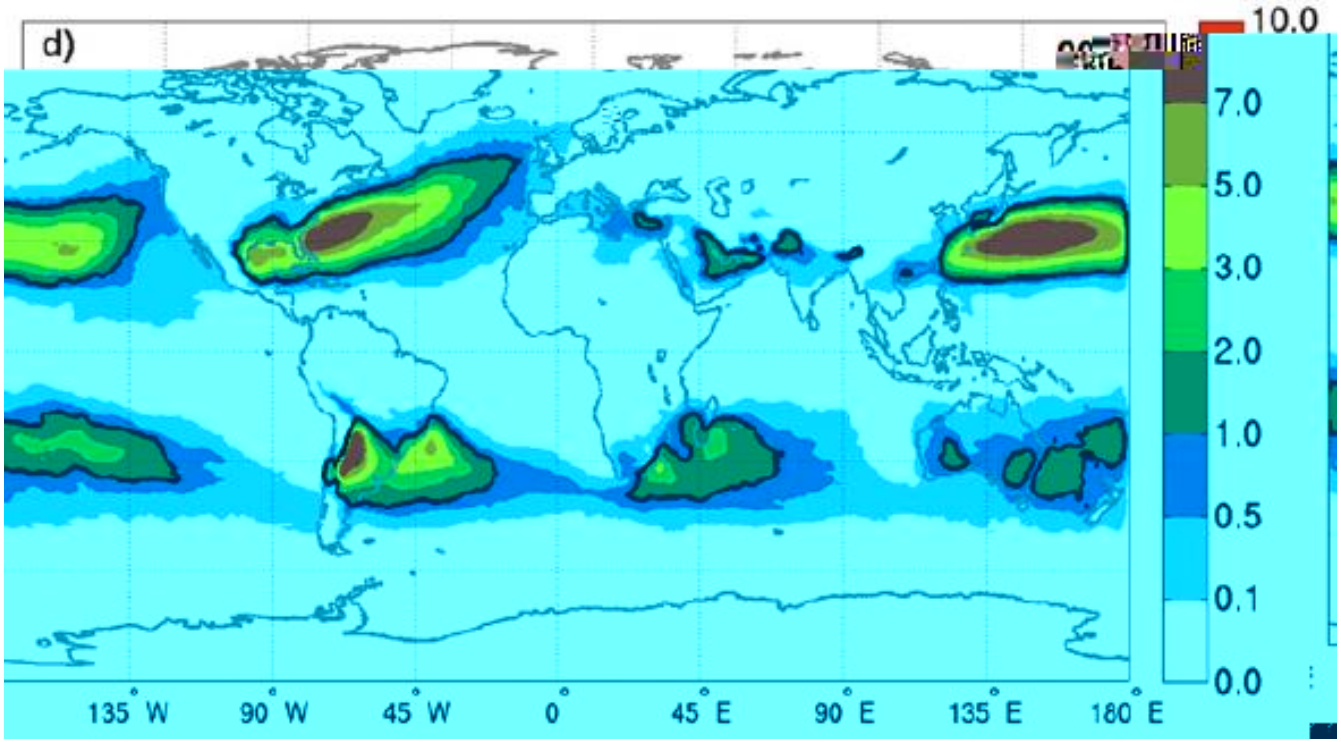
e.g. Hemri, Scheuerer, Pappenberger, Bogner, and Haiden (2014)



Green dots: difference in skill between the raw ensemble and the postprocessed forecasts has remained about the same since 2002

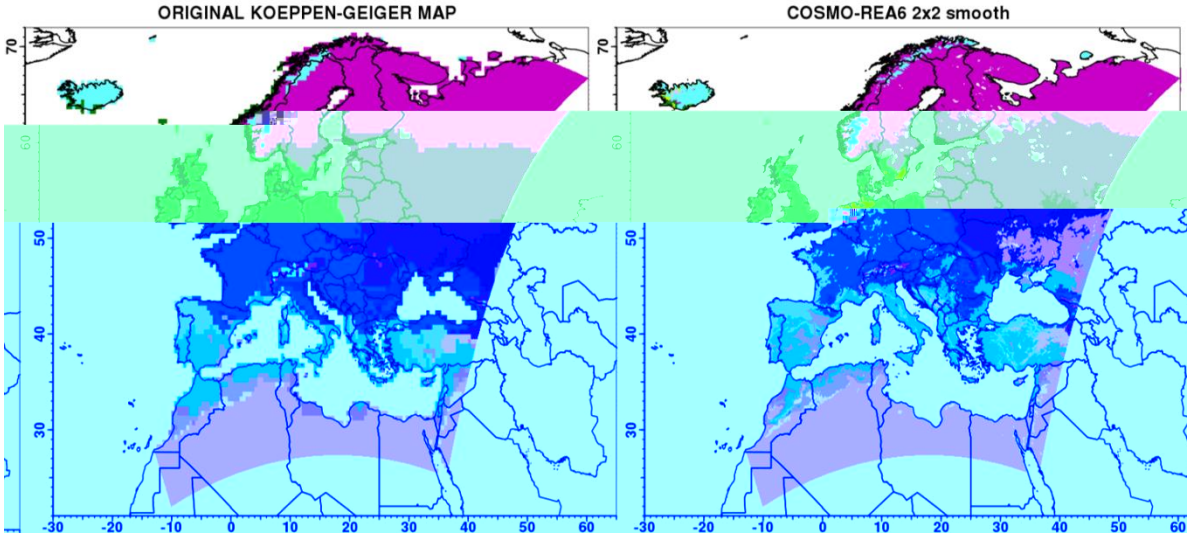
Reanalysis

→



Regional Reanalysis

Hans Ertel Centre Climate Monitoring Branch: Uni Bonn, Uni Cologne, DWD



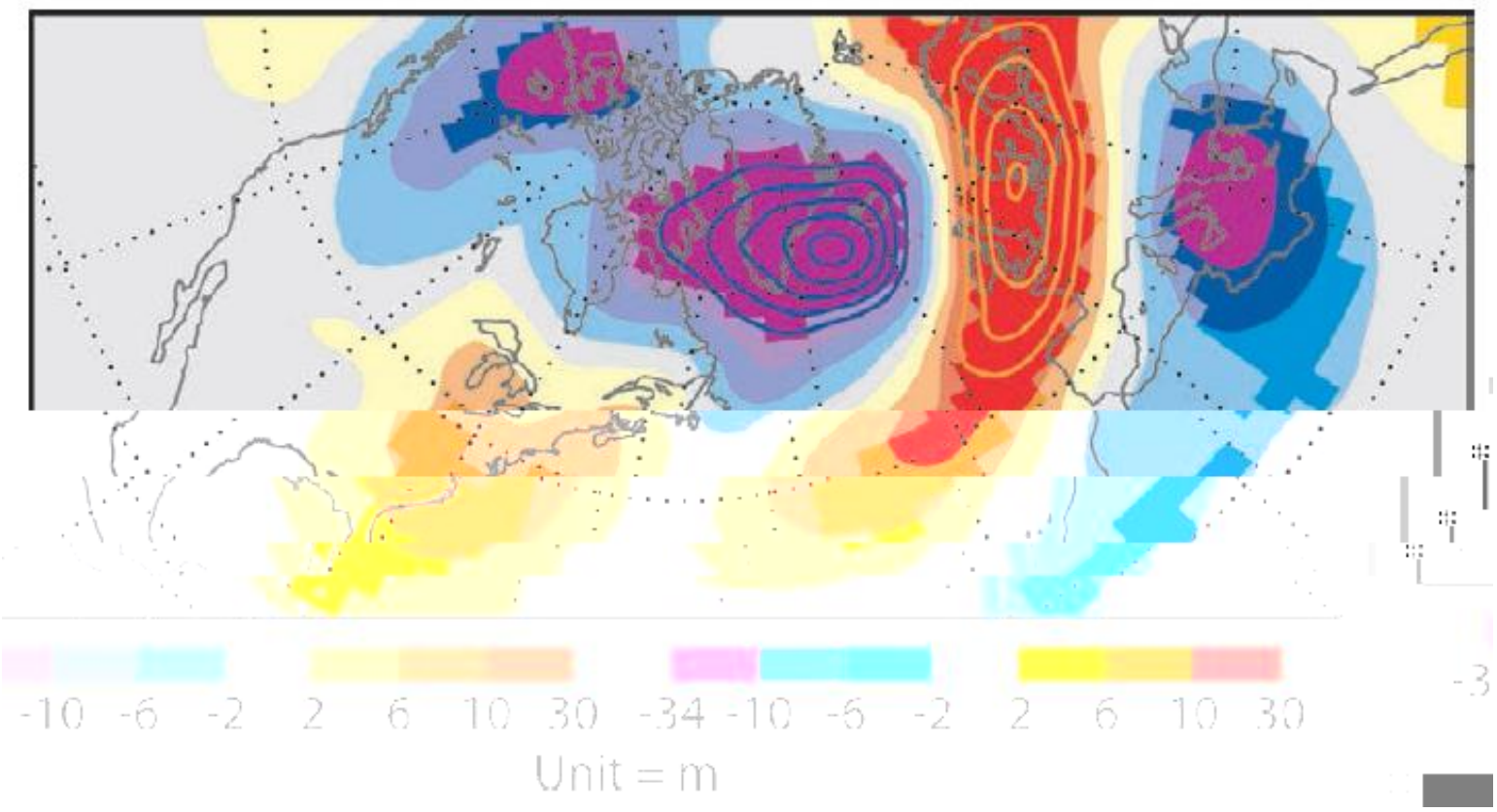
Standard Köppen-Geiger map of Europe after Kottek et al. (2006) (left) and as obtained from the European reanalysis COSMO-REA6 for the period 2007–2012, indicating a finer and slightly different distribution of the standard climate zones based on the regional reanalysis.

Lateral boundaries for COSMO-REA6 fro ERA Interim

Learning from Forecast Evaluation

Rodwell et al. (2013): The mean Z500 verifying analysis anomaly averaged over 584 European bust events

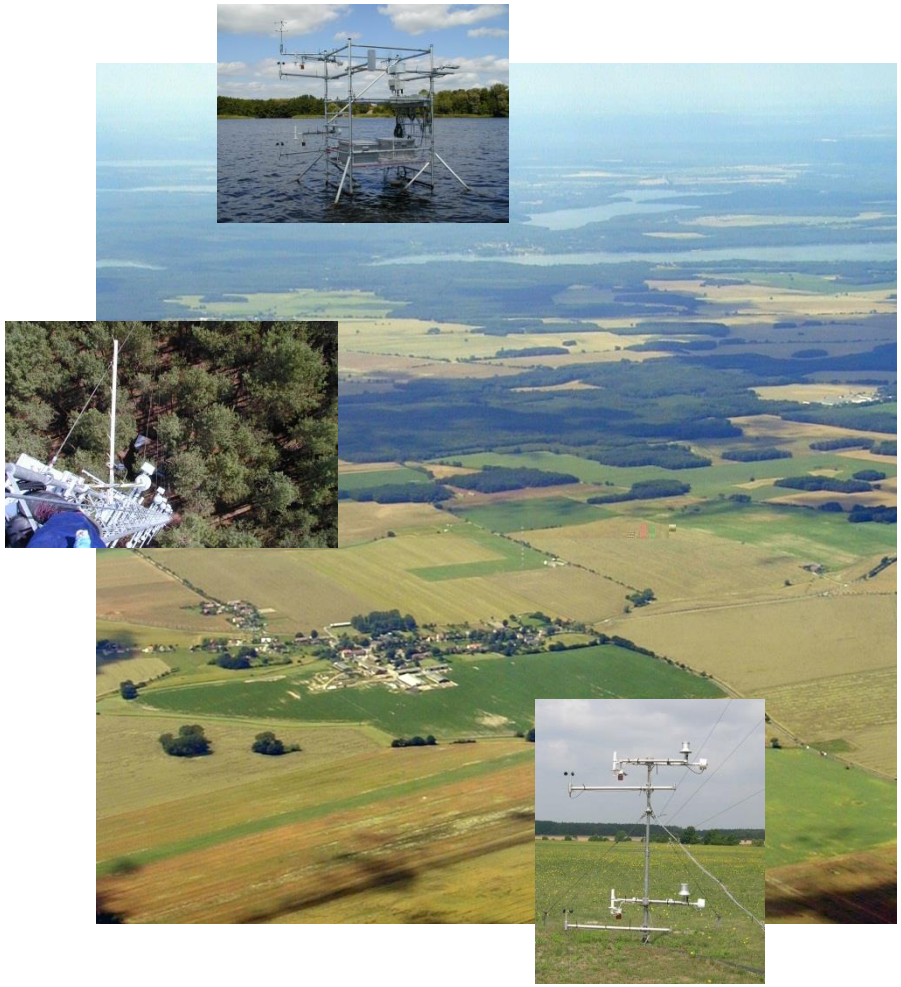
→ Motivates process-based studies on flow situations leading to large forecast errors



Model validation

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

Met. Obs. Lindenberg: Energy Fluxes Over Different Surfaces

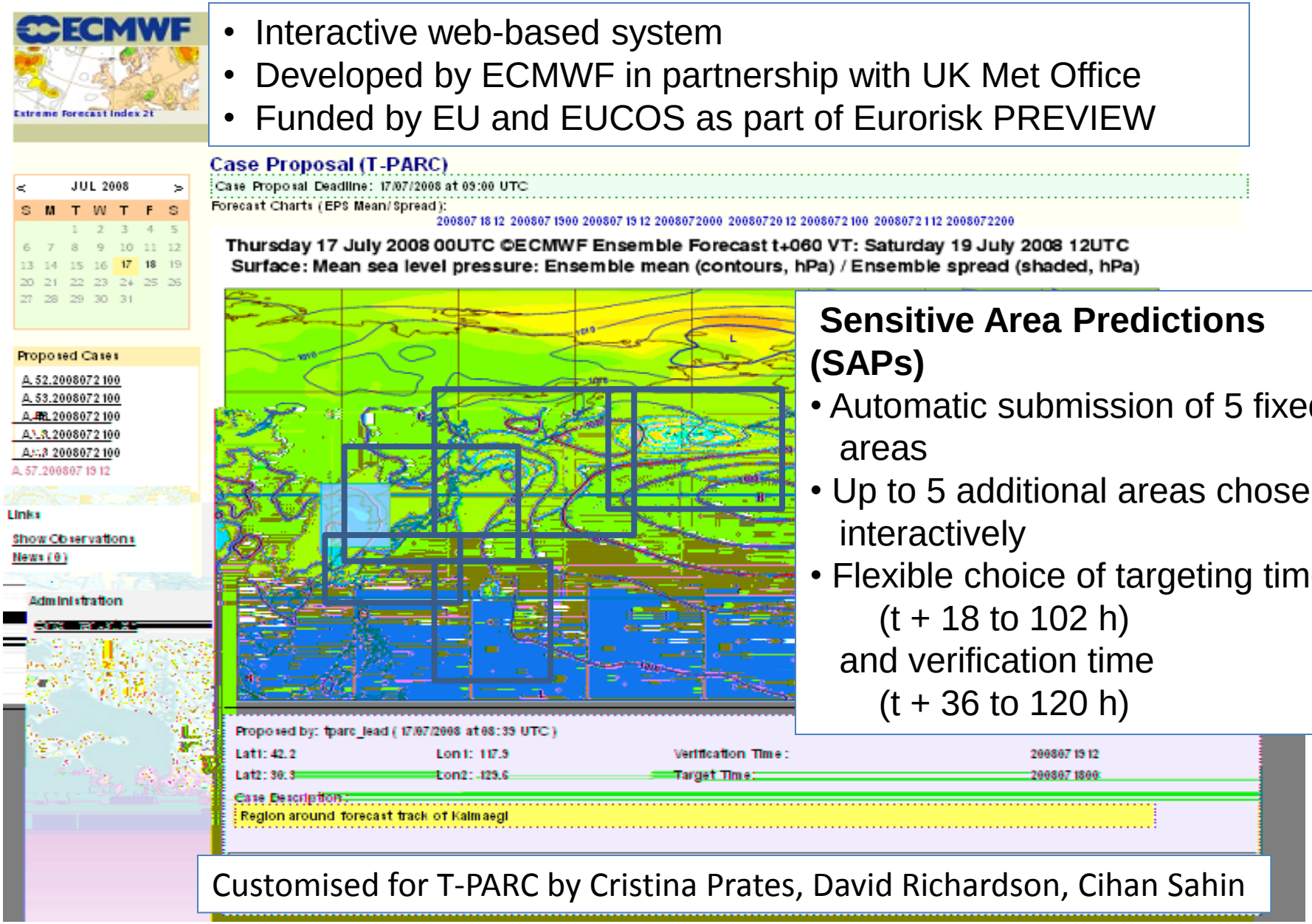


Met. Obs. Hohenpeißenberg: Atmospheric Composition (GAW)

Data Targeting System

THORPEX
A World Weather Research Programme

- Interactive web-based system
- Developed by ECMWF in partnership with UK Met Office
- Funded by EU and EUCOS as part of Eurorisk PREVIEW



Sensitive Area Predictions (SAPs)

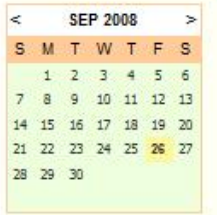
- Automatic submission of 5 fixed areas
- Up to 5 additional areas chosen interactively
- Flexible choice of targeting time
  (t + 18 to 102 h)
  and verification time
  (t + 36 to 120 h)

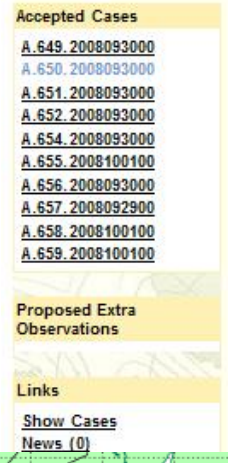
Customised for T-PARC by Cristina Prates, David Richardson, Cihan Sahin

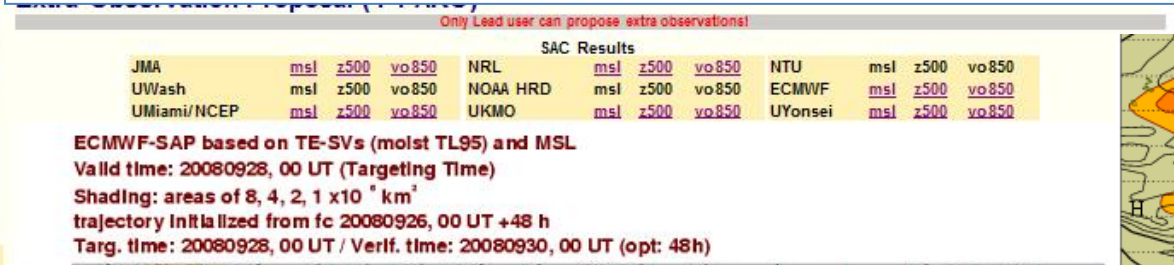
Data Targeting System

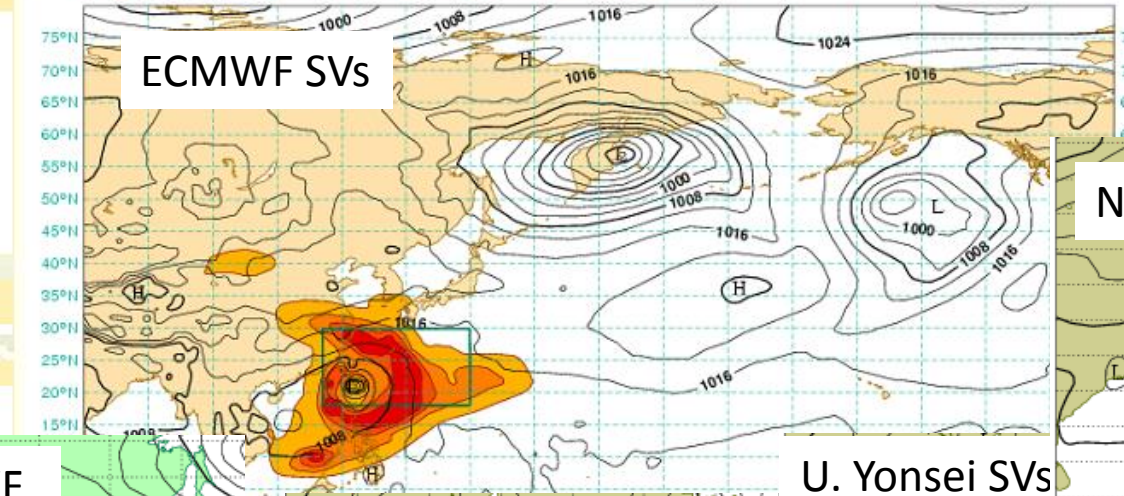
THORPEX
A World Weather Research Programme

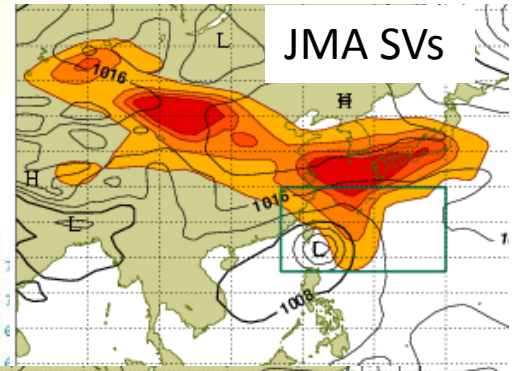
- SAPs from up to 6 different centres displayed in common format
- Icons toggle between calculations from different centres and overlays
- > 500 individual cases during Aug.- Sept. 2008

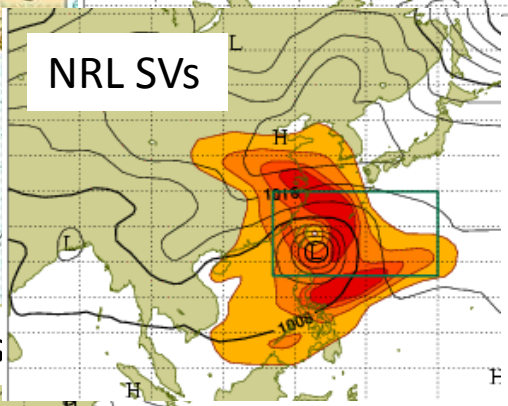


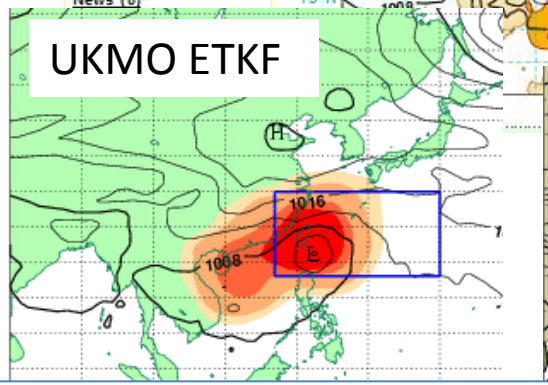


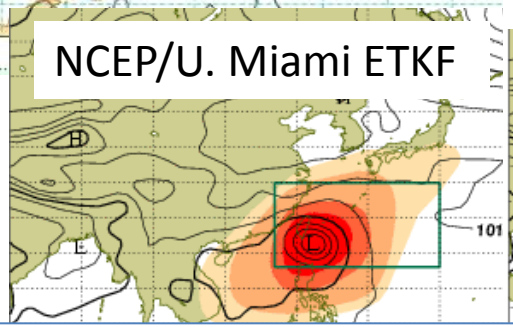


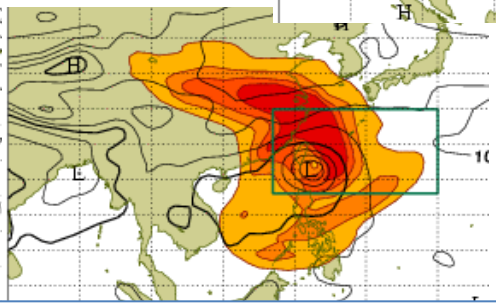








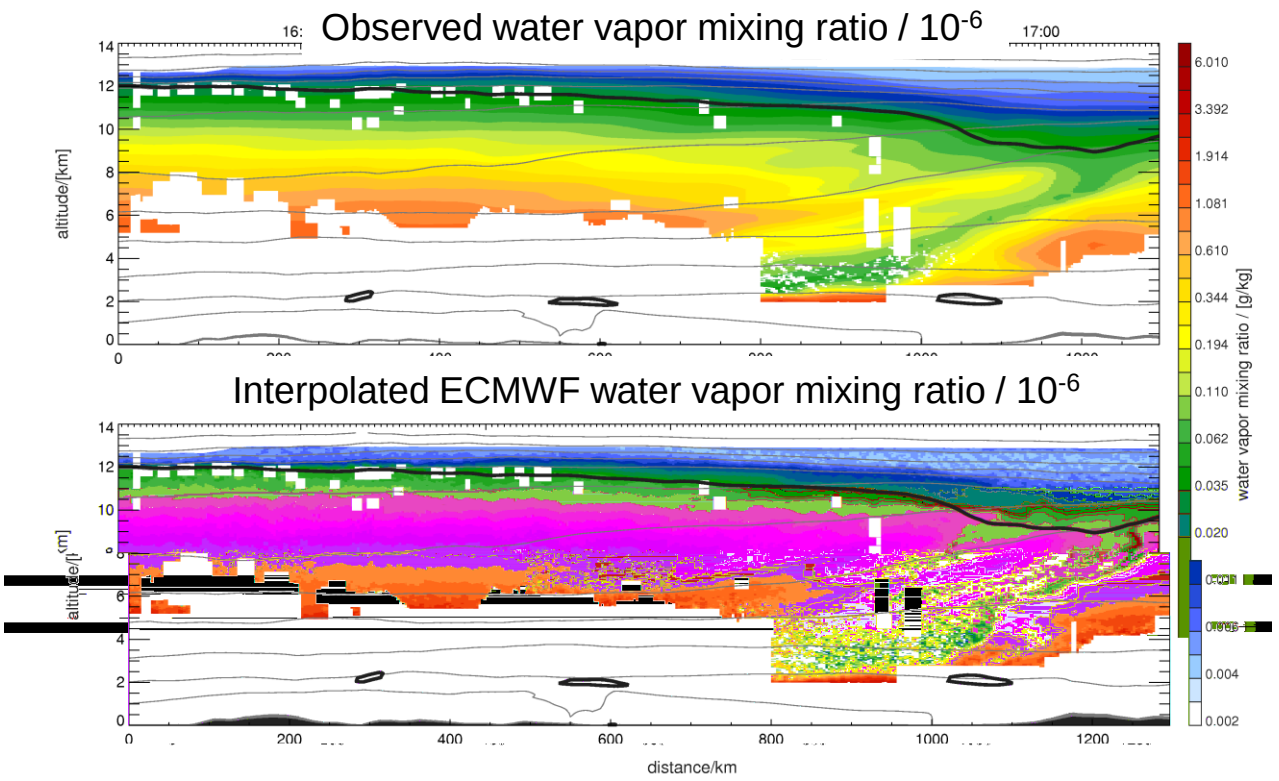


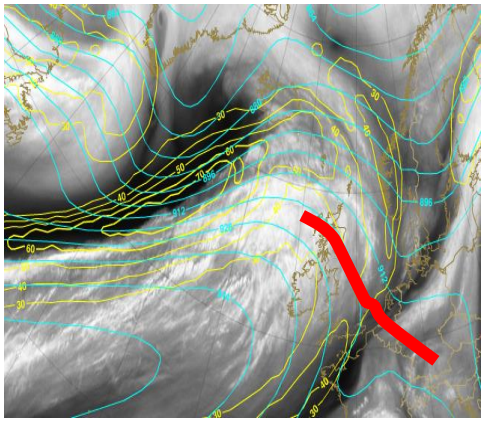


Super Typhoon Jangmi: Targeting Time 28 Sept. 2008 00 UTC, Verification time 30 Sept. 00 UTC

ECMWF Forecasts and Analyses in Field Campaigns

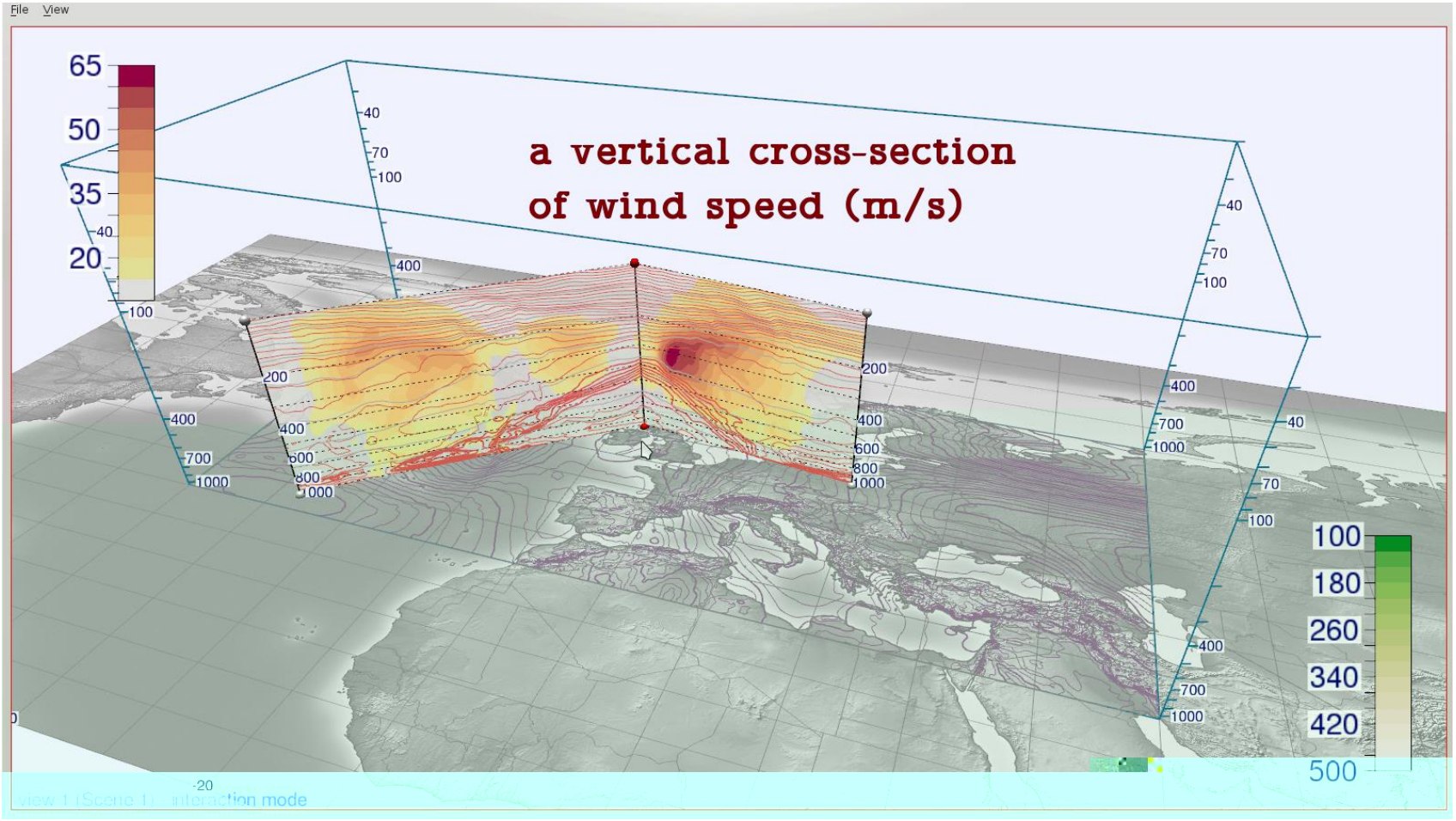
Comparison of observed and forecast water vapor observed over the UK using Differential Absorption Lidar WALES auf HALO **during the ML-CIRRUS campaign in 2014.**





- good representation of oberved water vapor structures
- Structures differ near the tropopause

Met3D – visualisation for flight planning



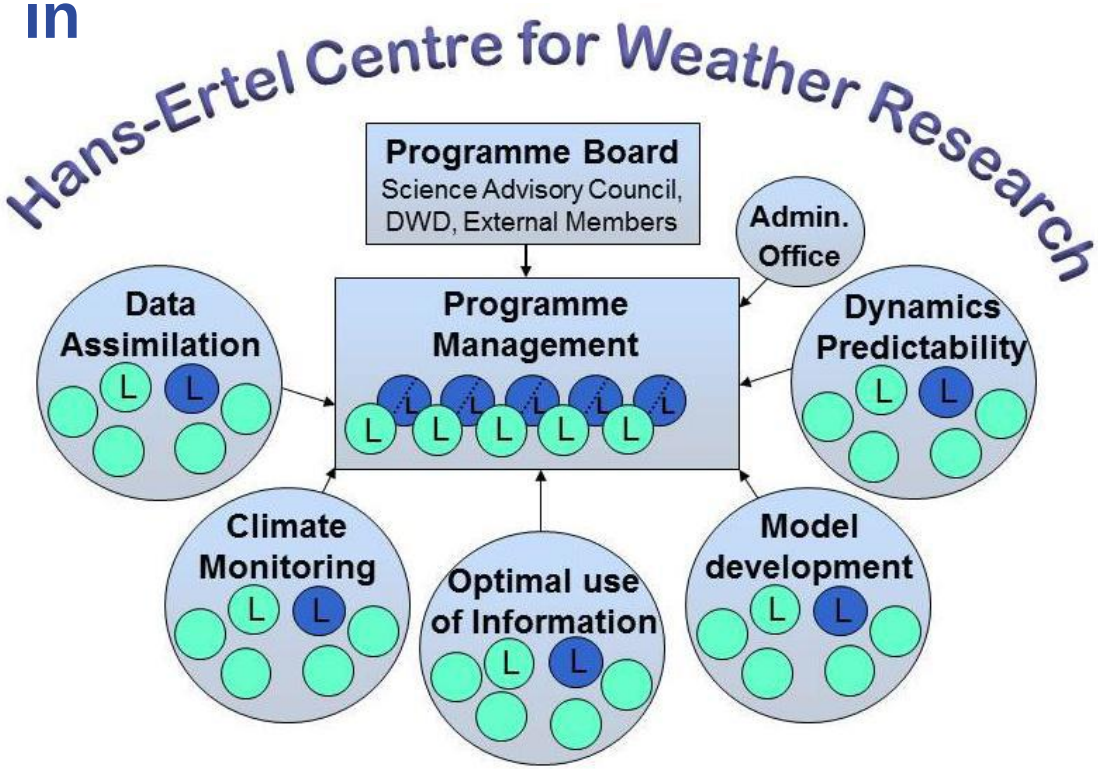
Courtesy of Marc Rautenhaus, TU Munich;
Collaboration with DLR, ETH Zürich, ECMWF

Service to the community

ECMWF Scientific Expertise

Hans Ertel (1904 - 1971)

in



… and other advisory boards & review panels

ECMWF Training courses

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

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Training

Training

- Training course: Numerical Weather Prediction 2015
- Training course: Use and Interpretation of ECMWF products 2015
- Training course: Use of Computing Facilities 2015

Workshops and seminars

Education material

ECMWF has an extensive education and training programme to assist Member States and Co-operating States in the training of scientists in numerical weather forecasting, and in making use of the ECMWF forecast products and computer facilities.

ECMWF training courses are freely available to Member and Co-operating States.

The numerical weather prediction training courses are open to everyone, participants from international organisations and non-member states are required to pay a course fee and priority is given to member and co-operating state applications.

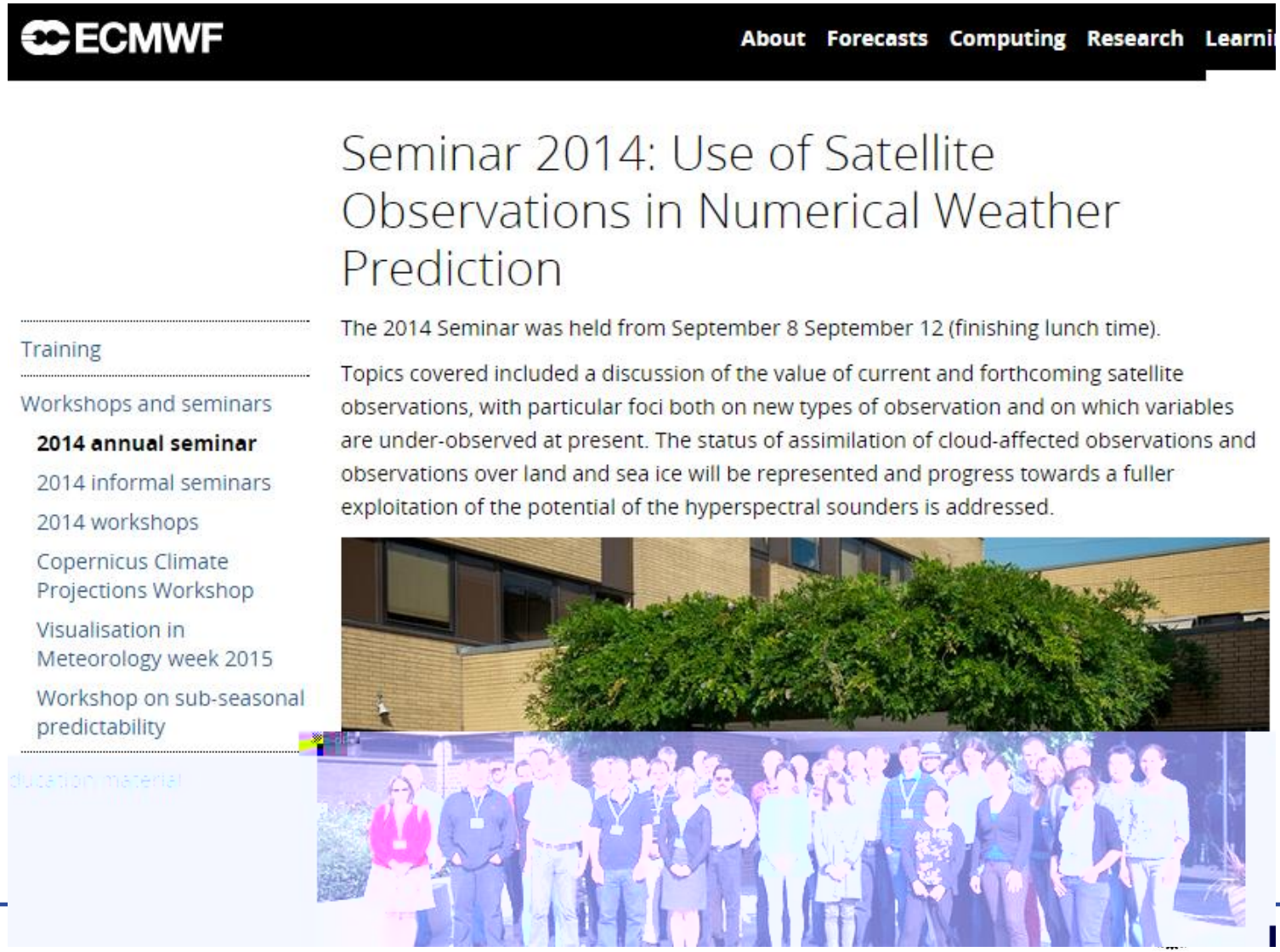
The ECMWF/EUMETSAT NWP-SAF Satellite data assimilation is open to all and has no course fee.

The courses are typically several days in length, though delegates can choose to study the various modules over several years.

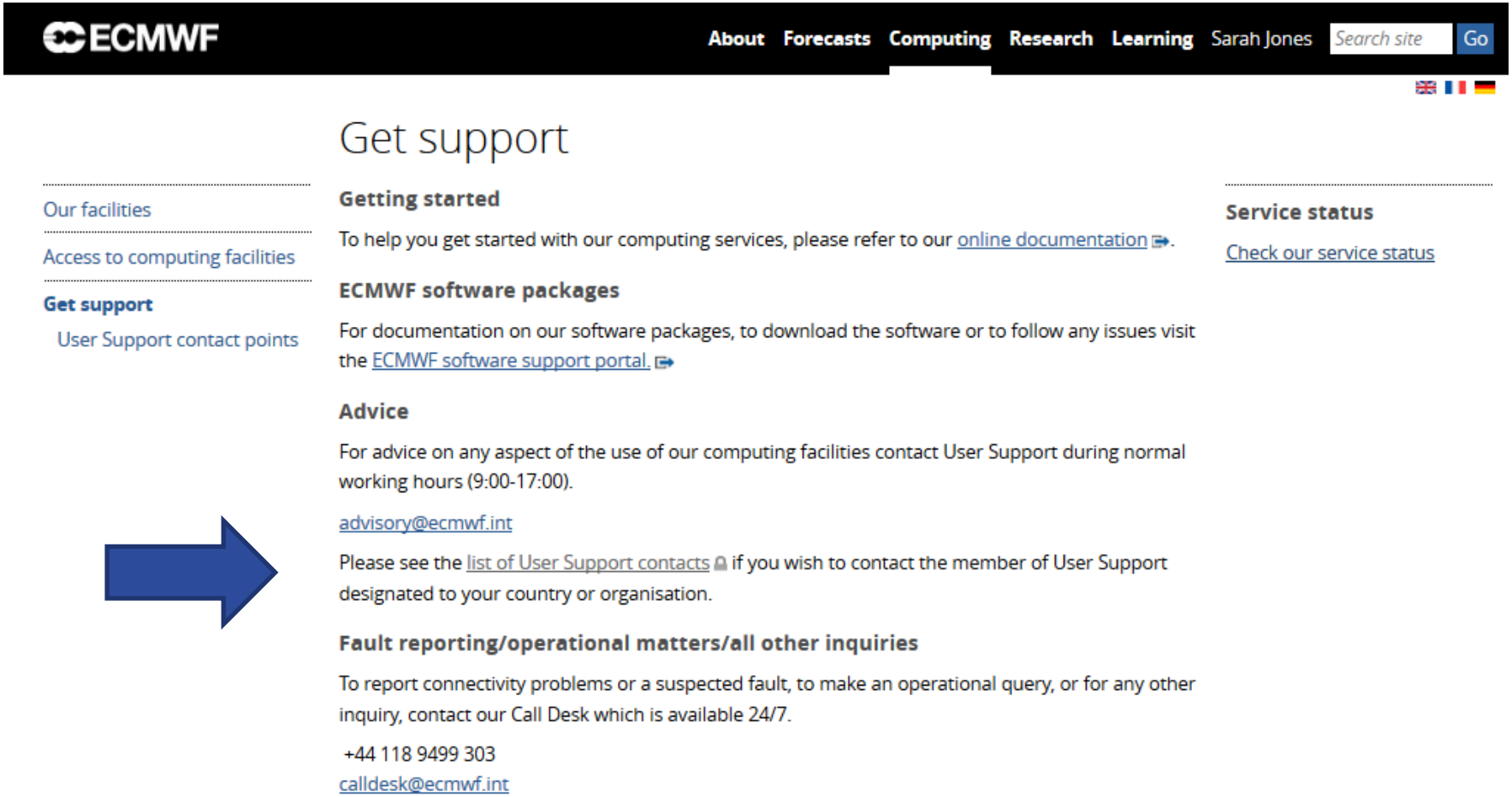
2015	
January 26-30	Training Course: Use and interpretation of ECMWF Products
February 2-6	Training Course: Use and interpretation of ECMWF Products
February 11-13	Computer User Training Course: Introduction to ecFlow
February 24-27	Computer User Training Course: GRIB API: Library and tools
March 2-6	Computer User Training Course: Introduction for new users/MARS

ECMWF Annual Seminar

- Important Training for new staff of operational centers and Universities
- DWD regularly sends staff there
- Good opportunity for exchange and networking



User Support is excellent



ECMWF

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Get support

Our facilities

Access to computing facilities

Get support

User Support contact points

Getting started

To help you get started with our computing services, please refer to our online documentation.

ECMWF software packages

For documentation on our software packages, to download the software or to follow any issues visit the ECMWF software support portal.

Advice

For advice on any aspect of the use of our computing facilities contact User Support during normal working hours (9:00-17:00).

advisory@ecmwf.int

Please see the list of User Support contacts if you wish to contact the member of User Support designated to your country or organisation.

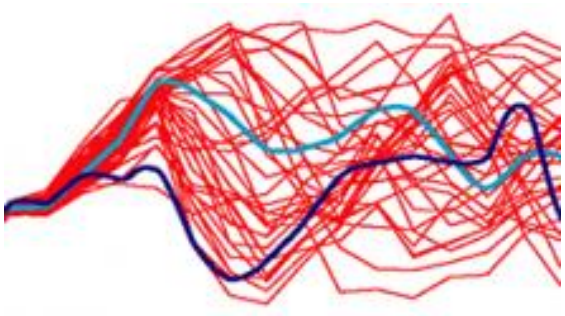
Fault reporting/operational matters/all other inquiries

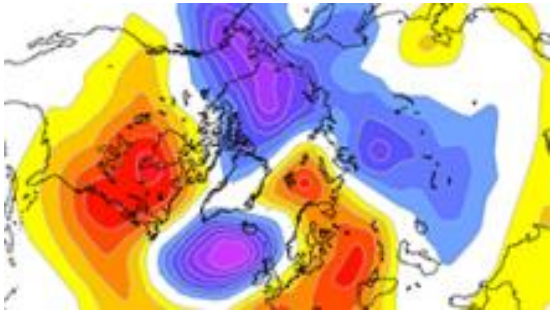
To report connectivity problems or a suspected fault, to make an operational query, or for any other inquiry, contact our Call Desk which is available 24/7.

+44 118 9499 303
calldesk@ecmwf.int

Service status

Check our service status





ECMWF Research:

Here‘s to another 40 years!!!!!!!!!