

Visualisation Week

Welcome



Use of visualisation at ECMWF

Stephan Siemen

Development Section, ECMWF

Thanks to Jens Daabeck, Glenn Carver, Sylvie Lamy-Thepaut,
Iain Russell, Fernando li, Sandor Kertesz

Examples shown in this presentations are the work of scientist and analysts at ECMWF



Many events in one week ...

- Workshop of Meteorological Operational Systems (MOS)
 - Review of current state and discuss future trends
 - Present technical developments from ECMWF
- European working Group on Operational meteorological WorkStations (EGOWS)
 - Share experiences and discuss new standards
- Royal Meteorological Society Seminar on Visualisation in Meteorology
 - Here we are ;-)
- OGC MetOcean Plugfest
 - Exploring the interoperability between OGC services and clients

| Visualisation in Meteorology Week 28 September – 2 October 2015 | | | | |
|---|---|--|---|---|
| Monday | Tuesday | Wednesday | Thursday | Friday |
| | 09:30 MOS Sessions Big data & Scalability | 09:30 MOS & EGOWS Visualisation for forecasters & public on the web/desktop | 9:30 EGOWS Technical challenges in developing forecaster tools | 09:30 OGC plugfest Demonstration session |
| 11:00 MOS Opening Keynotes | | 12:30 MOS Closure | | 12:00 Conclusion & Recommendations |
| Lunch break (13:00 – 14:00) | | | | |
| 14:00 MOS Session Cloud services & Visualisation | 14:00 MOS & EGOWS Visualisation in operational meteorology | 14:00 RMetSec <i>The visualisation of meteorological data</i> | 14:00 EGOWS Working groups <i>Challenges we face in developing forecaster systems</i> | |
| 17:30 End of day | 16:00 MOS & EGOWS Exhibition of Visualisation systems | | 16:00 EGOWS closure | |

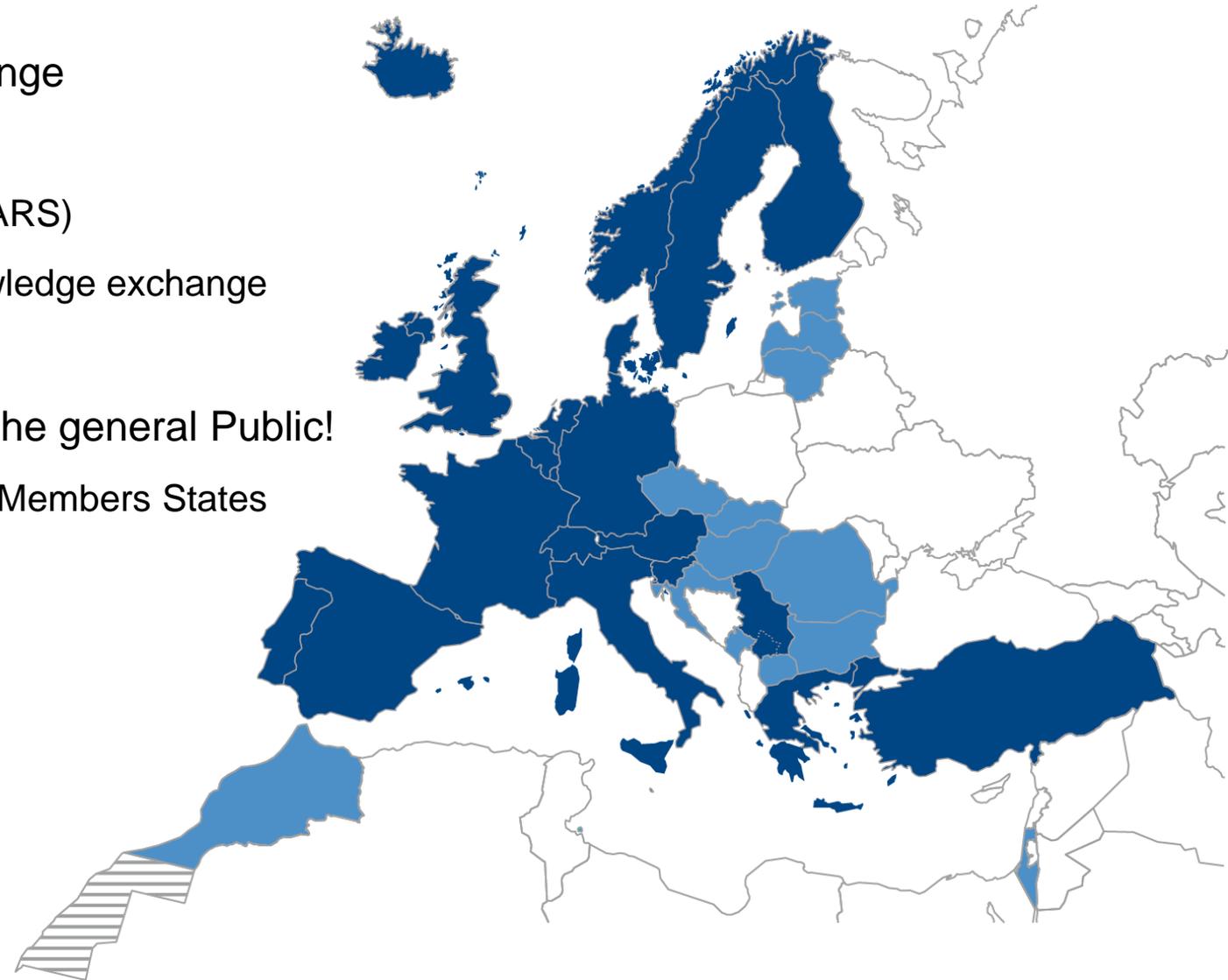


What is ECMWF?

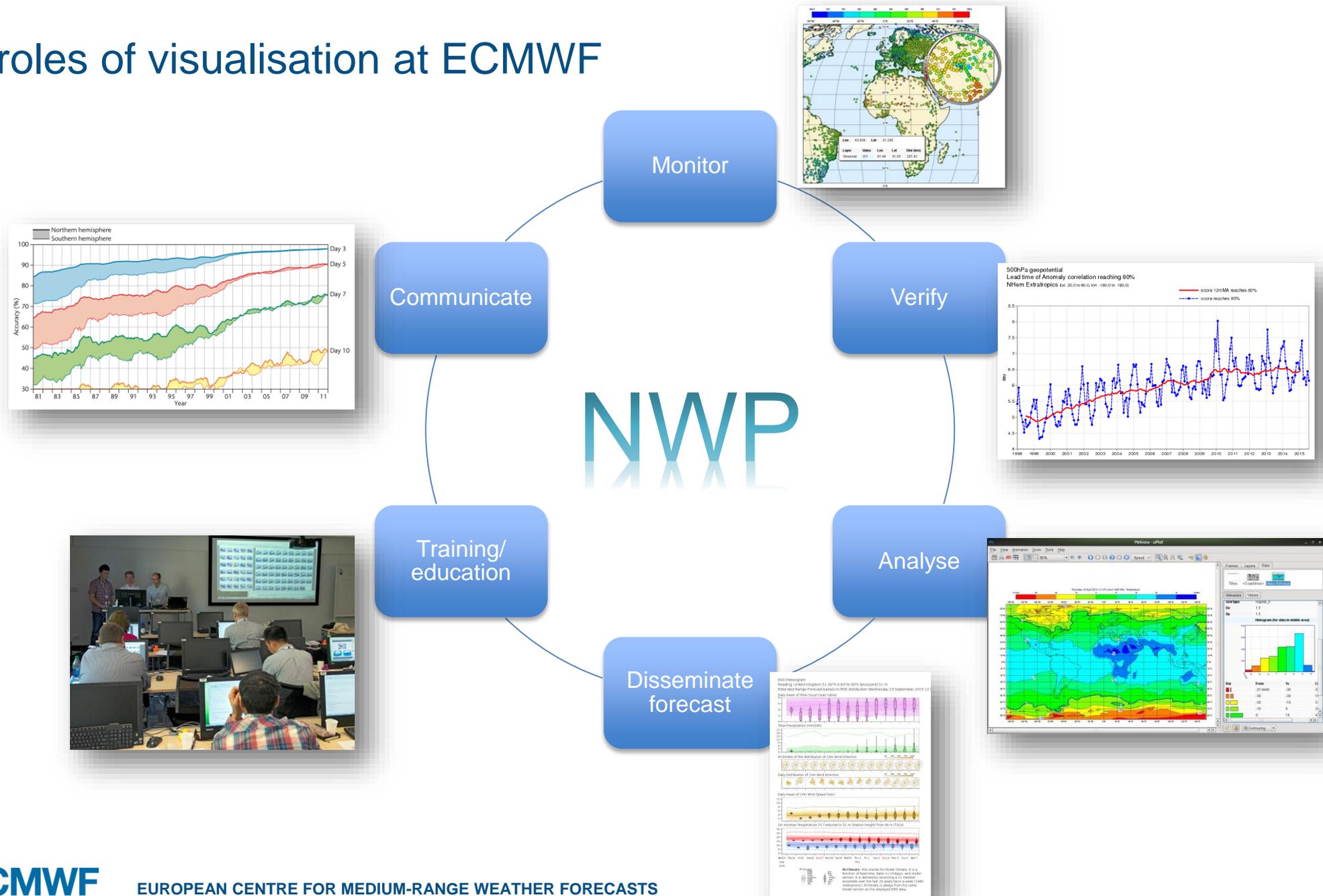


of advancing global NWP through co-operation

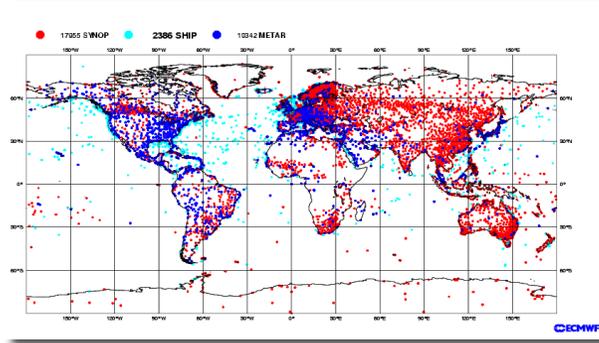
- ECMWF is an NWP centre for the medium-range
 - Running operational forecasts
 - Develop & operate meteorological archive (MARS)
 - Meeting place for technical and scientific knowledge exchange
- ECMWF products and services do not serve the general Public!
 - National Weather Services (NWS), especially Members States
 - Commercial customers
 - The users are experts in their field
 - But not always meteorologist!



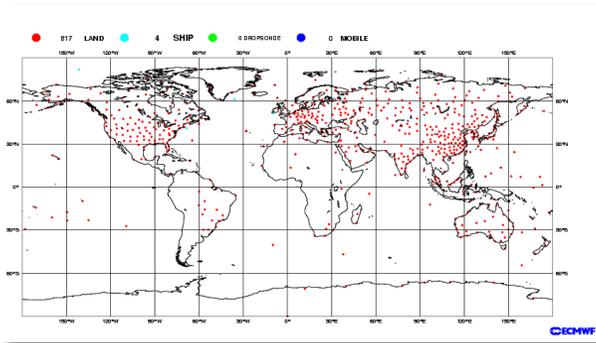
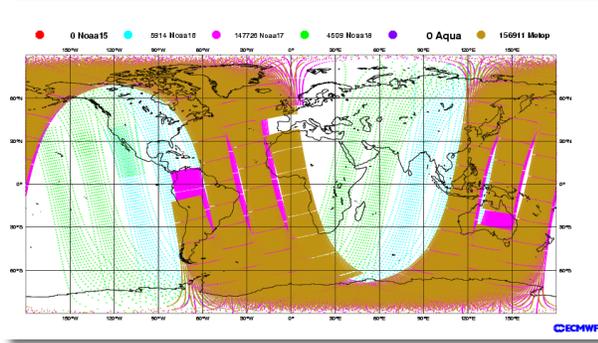
The roles of visualisation at ECMWF



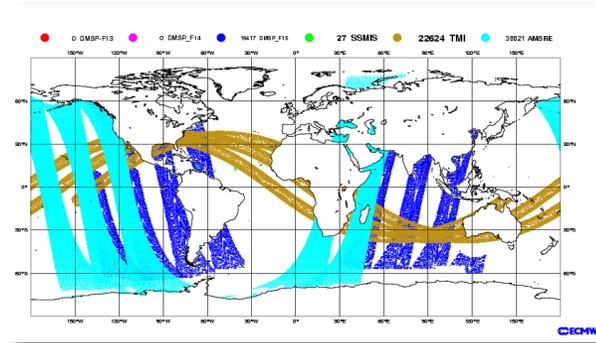
Visualisation for observation monitoring ...



Polar,
infrared

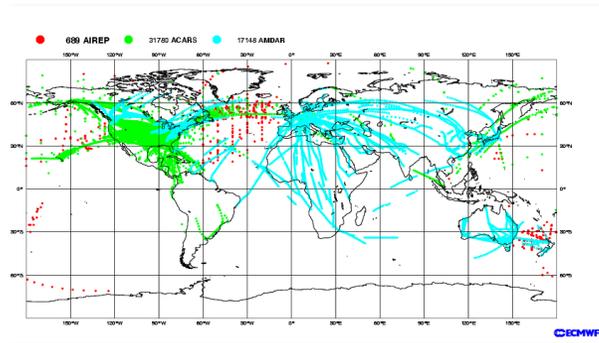


Radiosonde
balloons

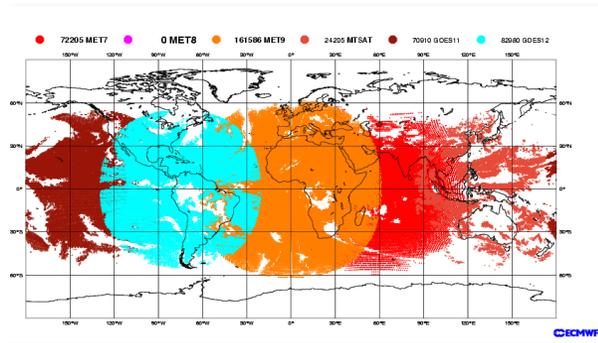


Polar,
microwave

Aircraft



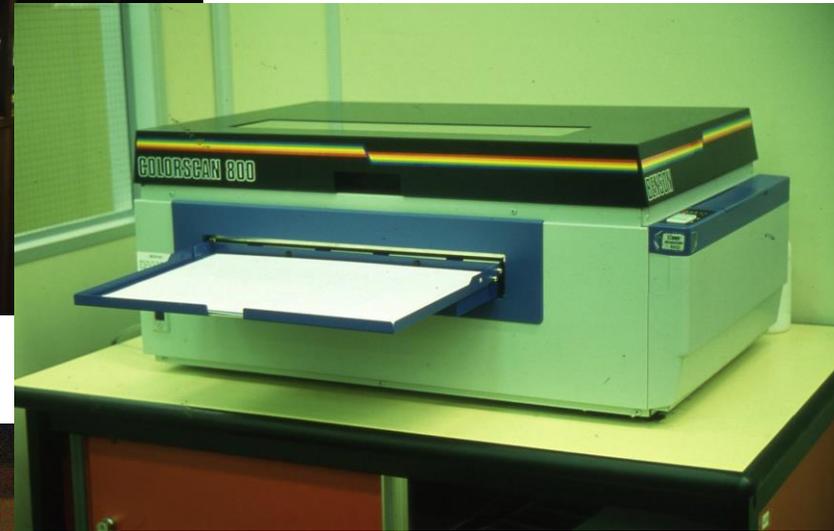
Geostationary, IR



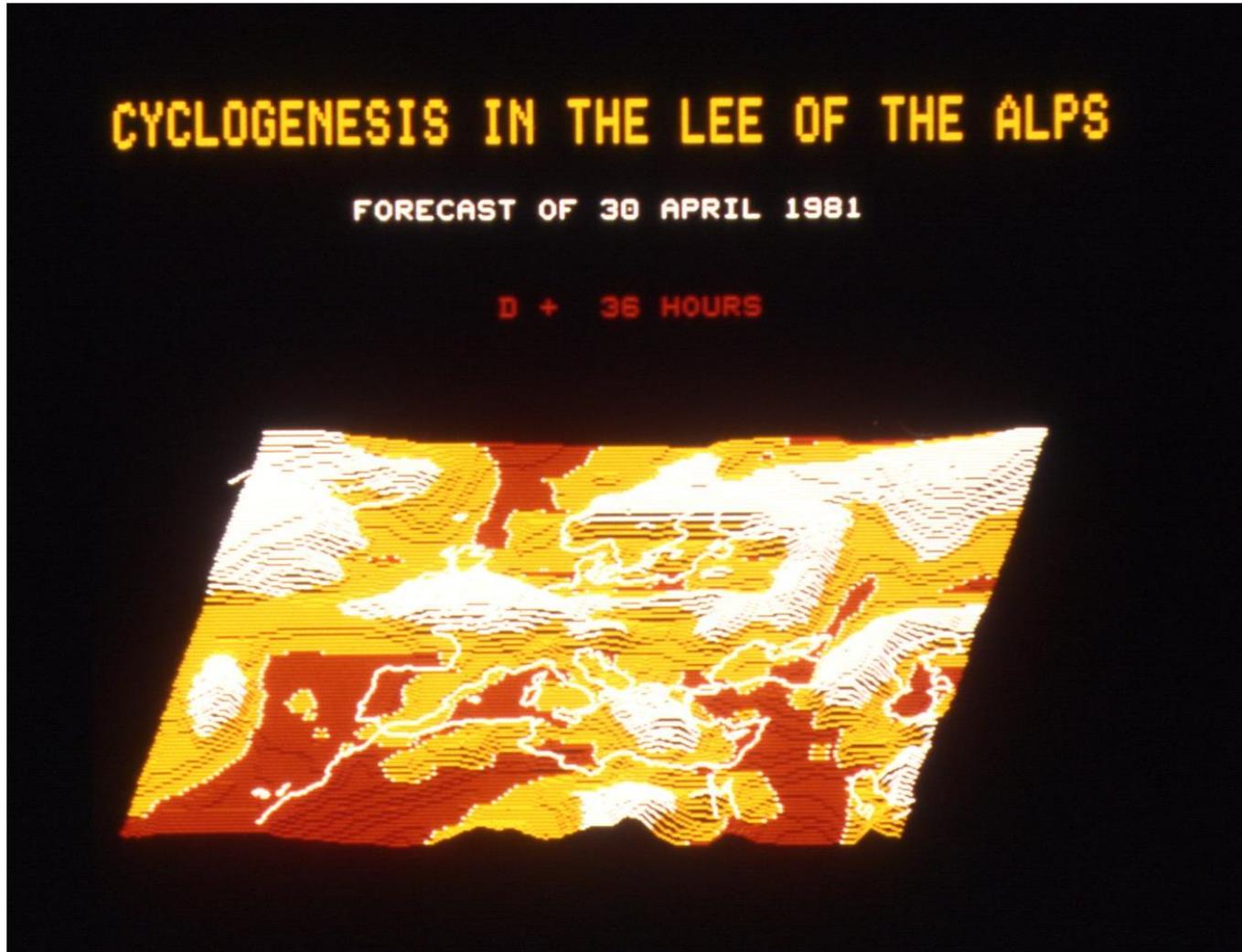
A bit of history ...



Early days at ECMWF ...



On screen graphics ...



For long time paper was the main medium ...

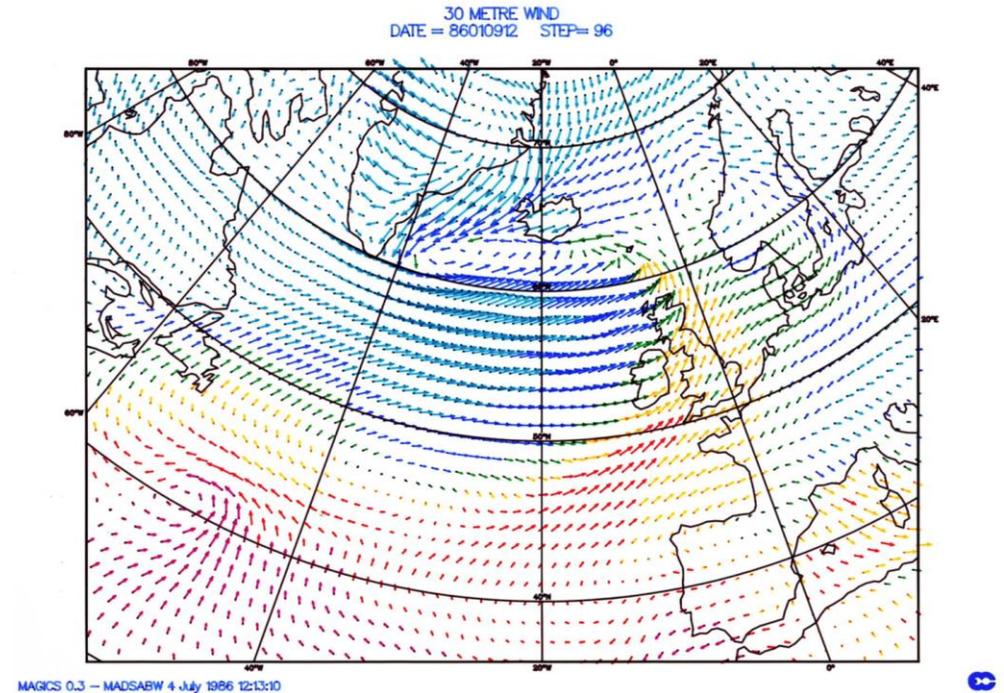


Meteorological Operations "MetOps" Room
1999 - 2014



History of graphics/visualisation at ECMWF

- 1983 Start developments on **M**eteorological **A**pplication **G**raphics **I**ntegrated **C**olour **S**ystem
 - Library with extensible API running on HPC
- 1985 MAGICS 0.3 plotting coloured wind arrows
- 1987 MAGICS 1.0
 - Many contributions from external users
- 1988 MicroMagics (on DOS by INPE)
- 1990 Start development of Metview
- 2003 Start work on Magics++
 - Increasing call for on on-demand web plots
- 2012 Release of Metview as Open Source
- 2013 Dedicated graphics/visualisation team is merged with other development teams



→ Challenges move from hardware (networks, printers) to software and styling

Metview's desktop & Batch system

Allows fast prototyping and conversion to Macro for batch processing

The screenshot displays the Metview desktop environment with several windows open:

- Metview - Desktop <2>**: A file manager window showing a directory structure with icons for various tools like Annotation View, Average Data, Average View, Axis Plotting, Bufr Picker, Cartesian View, Clean File, Contouring, Datacoverage, Flextra Run, GRIB to Geopoints, Grib Vectors, and Macro Parameters.
- Metview - uPlot**: A main visualization window showing a global map of temperature data for Thursday 24 April 2014 at 12 UTC. The map uses a color scale from blue (cold) to red (hot). A histogram for the visible area is shown, with a bar chart and a legend. The legend indicates temperature ranges: -37.9446 to -30, -30 to -20, -20 to -10, -10 to 0, and 0 to 10.
- Properties Panel**: A panel on the right side of the uPlot window showing various map settings such as Map Coastline, Map Coastline Colour, Map Coastline Style, Map Coastline Thickness, Map Coastline Resolution, Map Coastline Land Shade, Map Coastline Land Shade Colour, Map Coastline Sea Shade, and Map Coastline Sea Shade Colour. It also includes a color wheel and a 'Select colour' button.
- Table**: A table at the bottom right of the uPlot window showing data for 9 messages. The table has columns for Index, Name, Date, Time, Step, Level, and LevType.

| Index | Name | Date | Time | Step | Level | LevType |
|-------|------|----------|------|------|-------|---------|
| 01 | t | 20150206 | 1200 | 0 | 1000 | pl |
| 02 | t | 20150206 | 1200 | 6 | 1000 | pl |
| 03 | t | 20150206 | 1200 | 12 | 1000 | pl |
| 04 | t | 20150206 | 1200 | 18 | 1000 | pl |
| 05 | t | 20150206 | 1200 | 24 | 1000 | pl |
| 06 | t | 20150206 | 1200 | 30 | 1000 | pl |
| 07 | t | 20150206 | 1200 | 36 | 1000 | pl |
| 08 | t | 20150206 | 1200 | 42 | 1000 | pl |
| 09 | t | 20150206 | 1200 | 48 | 1000 | pl |

Presenting our forecast in graphical form ...

Web is the medium

ECMWF About Forecasts Computing Research Learning Stephan Siemen Search site Go

Charts catalogue

Showing 1-59 results for **Medium (15 days)** **Forecasts**

High resolution forecast

Filter charts

Filter charts Go

Range

- Medium (15 days) (59)
- Extended (30 days) (16)
- Long (Months) (23)
- Analysis (32)

Type

- Forecasts (59)
- Verification (27)

Component

- Atmosphere (38)
- Surface (34)
- Geography (4)

Product type

- ENS (34)

Surface parameters

ECMWF Products Projections Views Save Data availability Help Go

700 hPa relative vorticity and wind - Thursday 21 May 2015, 00 UTC VT Thursday 21 May 2015, 00 UTC Step 0

Layers

- Grid
- Foreground
- 700 hPa wind
- 50 % percentile for 2m temperature
- Background

Probe

Data values near location 51.54°N 0.33°W, Thursday 21 May, 00 UTC T+0

| Layer | Value | Point selected | Location | Distance |
|------------------------------------|------------------------|----------------|----------------|----------|
| 700 hPa wind | 7 ms ⁻¹ N-W | nearest | 51.52°N 0.22°W | 7.81 km |
| 50 % percentile for 2m temperature | 8.1 °C | nearest | 51.57°N 0.42°W | 6.86 km |

BT: Thu 21 May, 00Z VT: Thu 21, Fri 22, Sat 23, Sun 24, Mon 25, Tue 26, Wed 27, Thu 28, Fri 29, Sat 30

© ECMWF Chart updated (Network: 7.2s - Plot: 0.6s)

Tropical storm frequency - Long range forecast

Forecast base time

ECMWF Seasonal Forecast
Tropical Storm Frequency
Forecast start reference is 01/09/2015
Ensemble size = 51, climate size = 300

System 4
ONDJFM 2015/16
Climate (initial dates) = 1990-2009

Forecast mean Standard deviation Climate mean

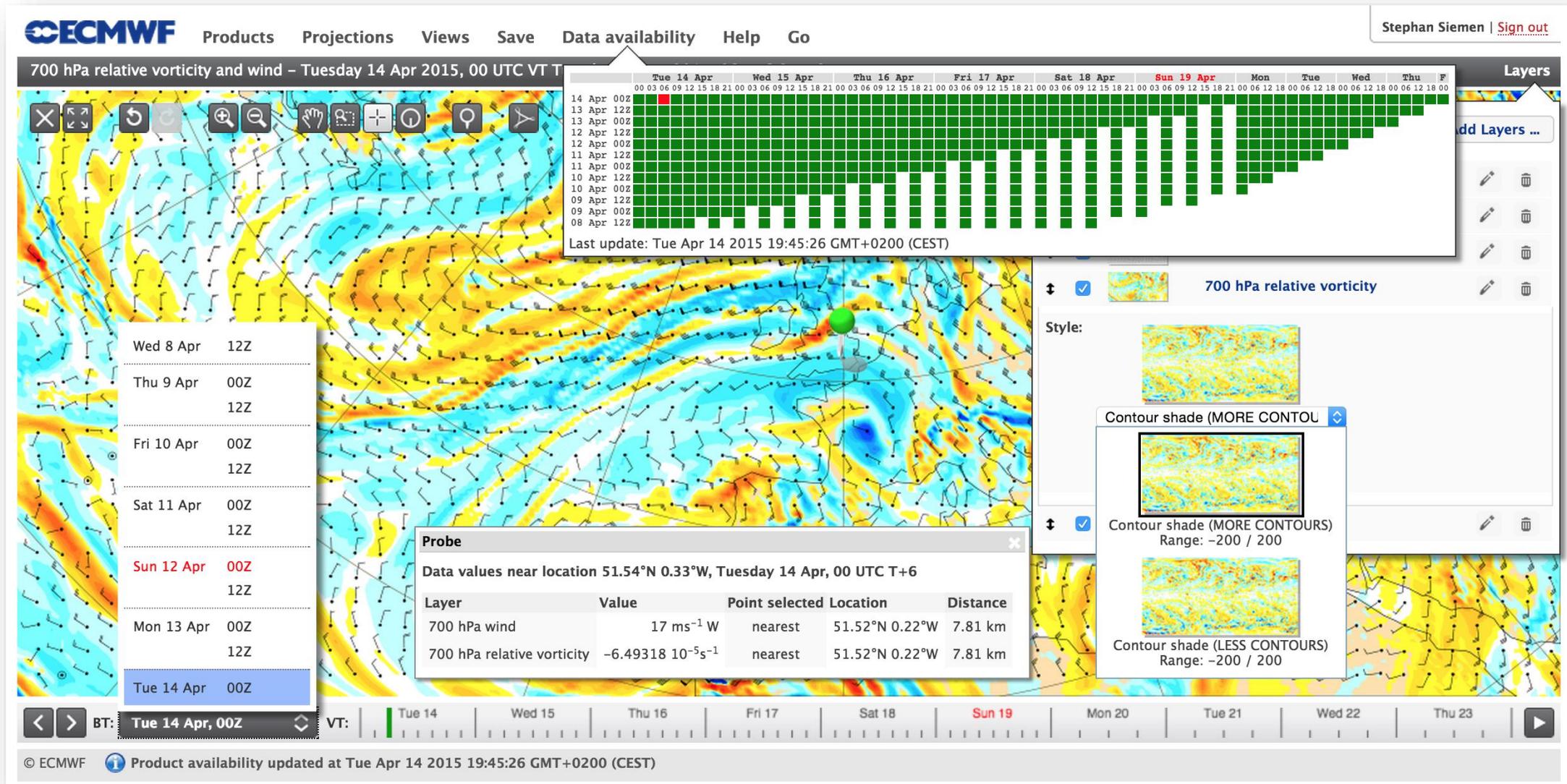
Back to charts

Related charts

- Accumulated Cyclone Energy - Long range forecast
- Hurricanes Typhoon frequency - Long range forecast
- Tropical storm standardized density - Long range forecast
- Tropical storm density

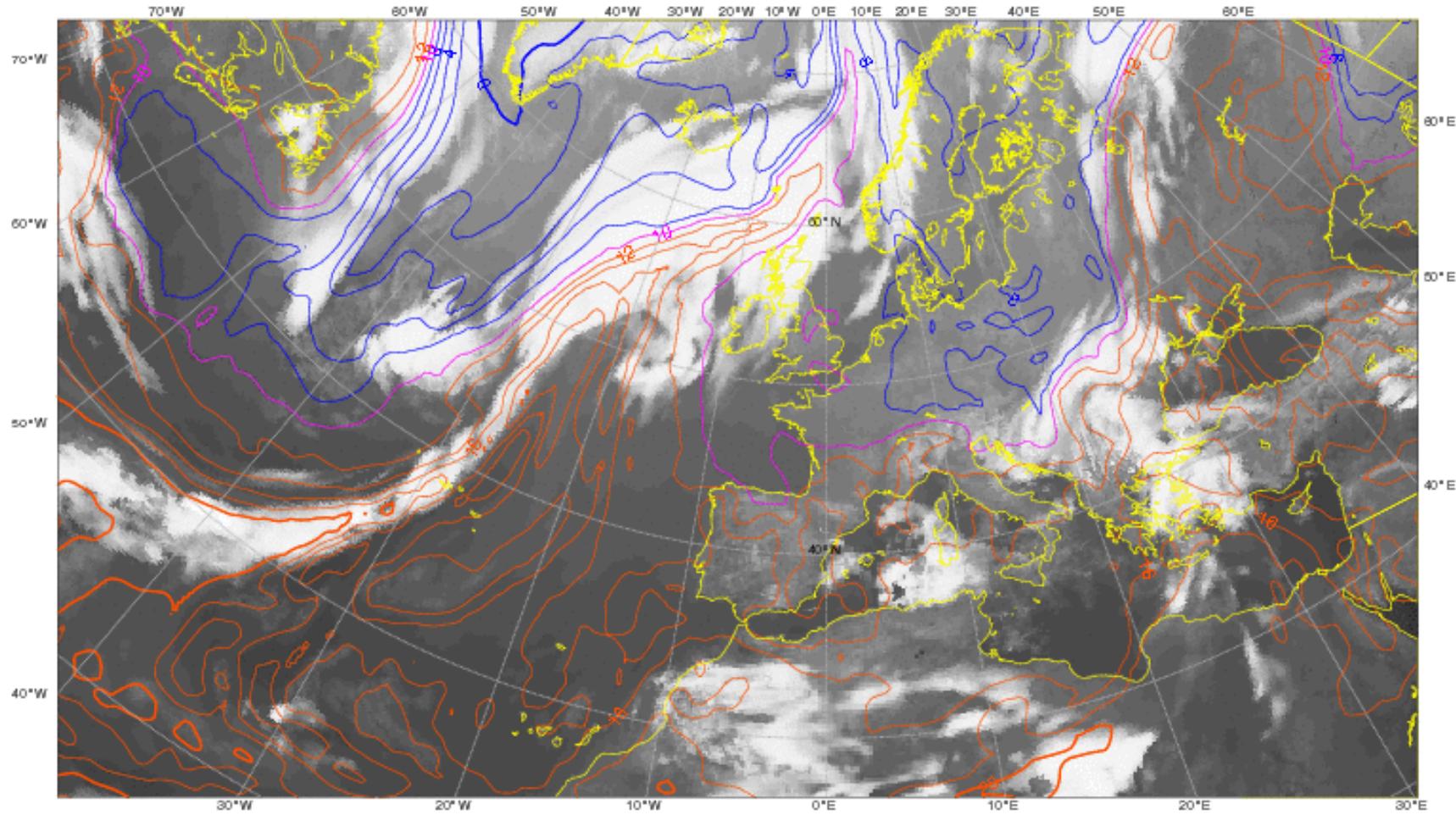
Stephan Siemen | Sign out

What is the best user interface?



Overlay is essentials

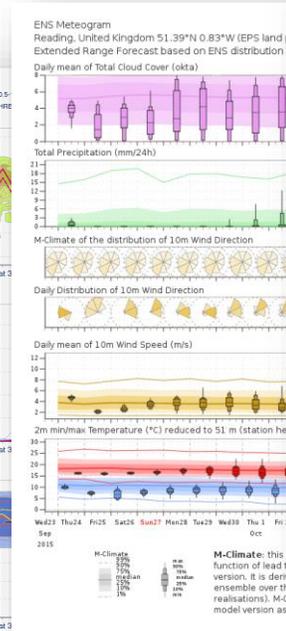
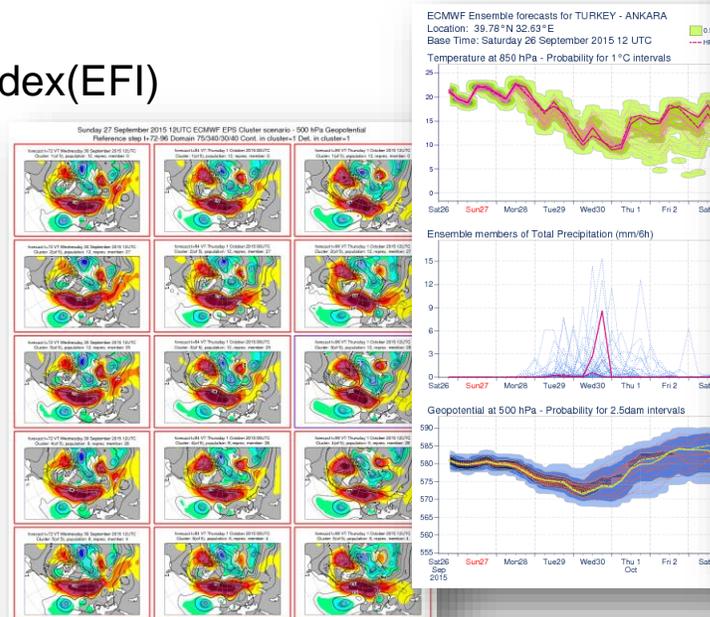
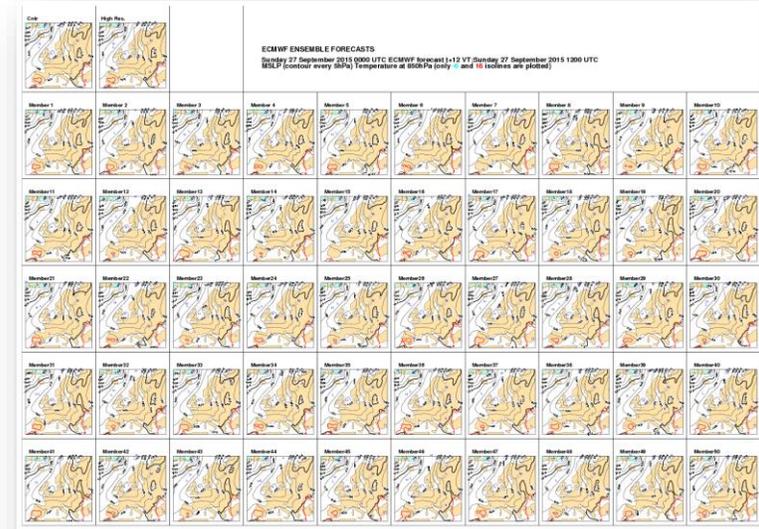
Monday 28 September 2015 0000 UTC + 3 VT: Monday 28 September 2015 0300 UTC
Model simulated METEOSAT 10 SEVIRI (Channel 9 IR10.8) Brightness Temperature and 850 hPa wet bulb pot. temp.



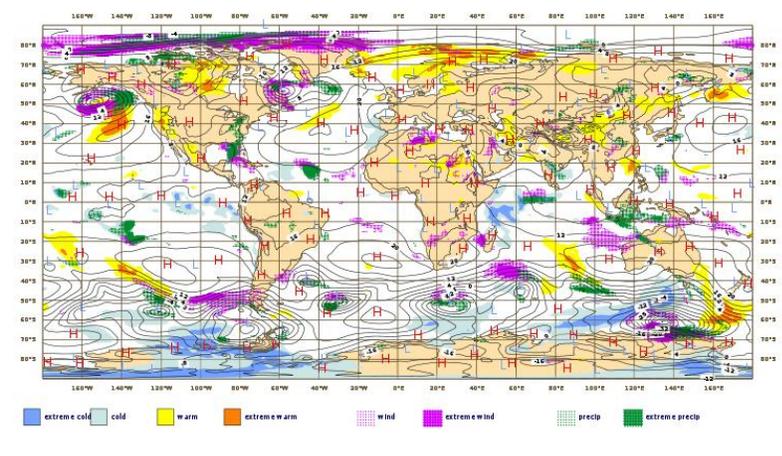
The challenge of Ensemble forecast (ENS) products

- Operating ensemble of forecasts brings its own challenges
 - Ensembles should be seen only in their context, not on their own
 - The 51 forecasts are too much for most users to process
- Users can make use of statistical products
 - Mean, Standard-deviation, ...
- ECMWF can offer graphical products

- ENS Metgrams & Extreme Forecast Index(EFI) are successful examples of this

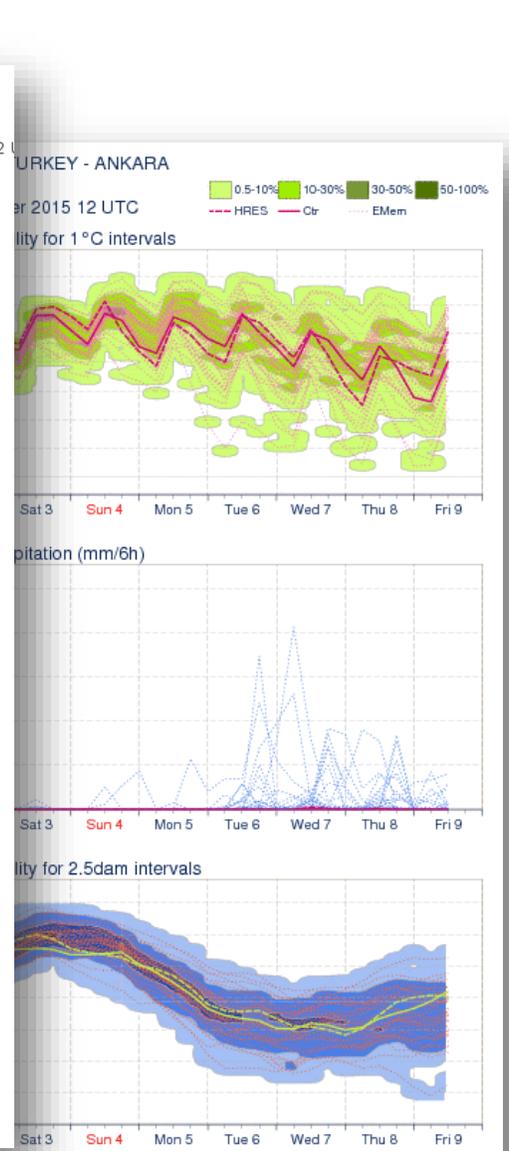
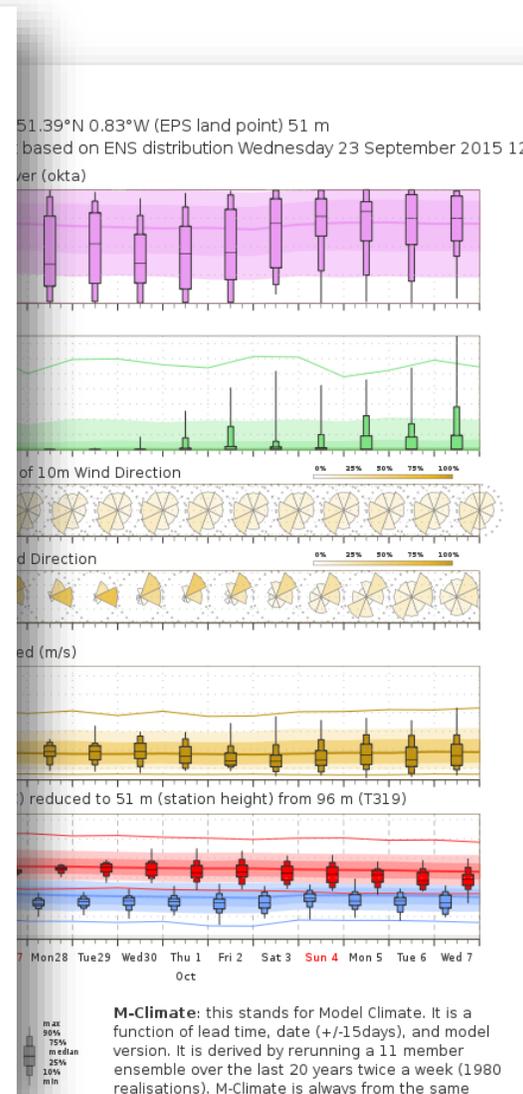
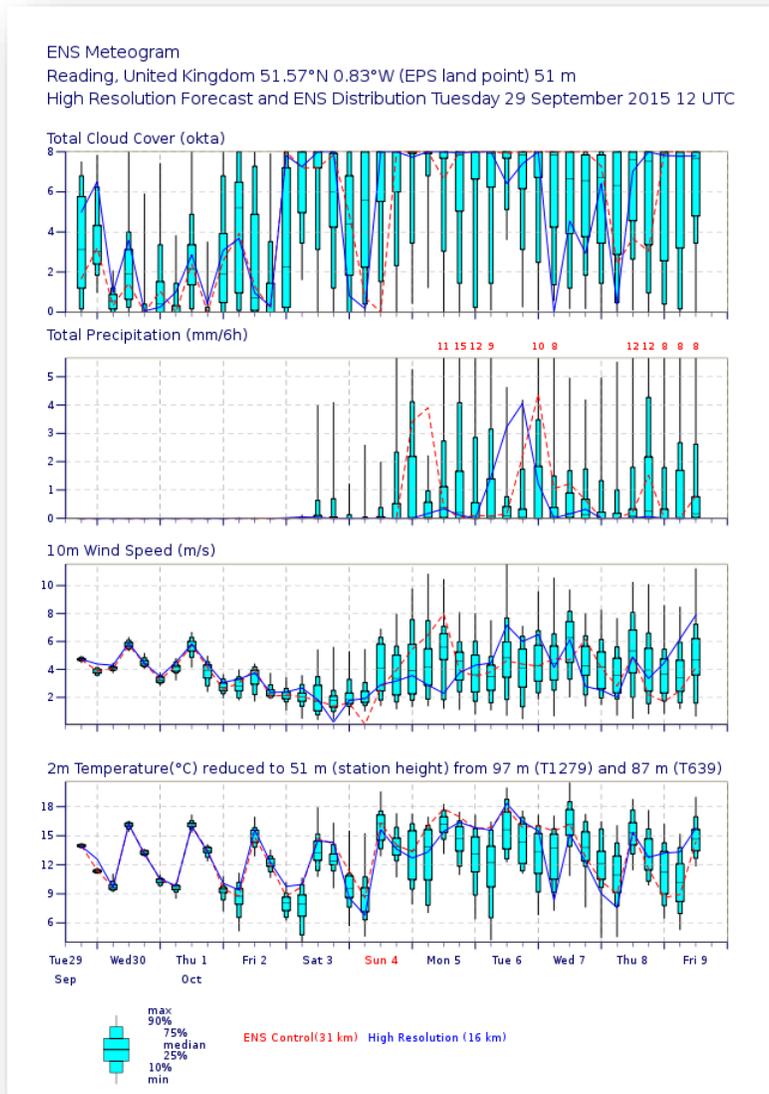


Anomalous weather predicted by EPS: Wednesday 05 June 2013 at 12 UTC
 1000 hPa Z ensemble mean (Thursday 06 June 2013 at 12 UTC)
 and EFI values for Total precipitation, maximum 10m wind gust and mean 2m temperature (all 24h)
 valid for 24hours from Thursday 06 June 2013 at 00 UTC to Friday 07 June 2013 at 00 UTC



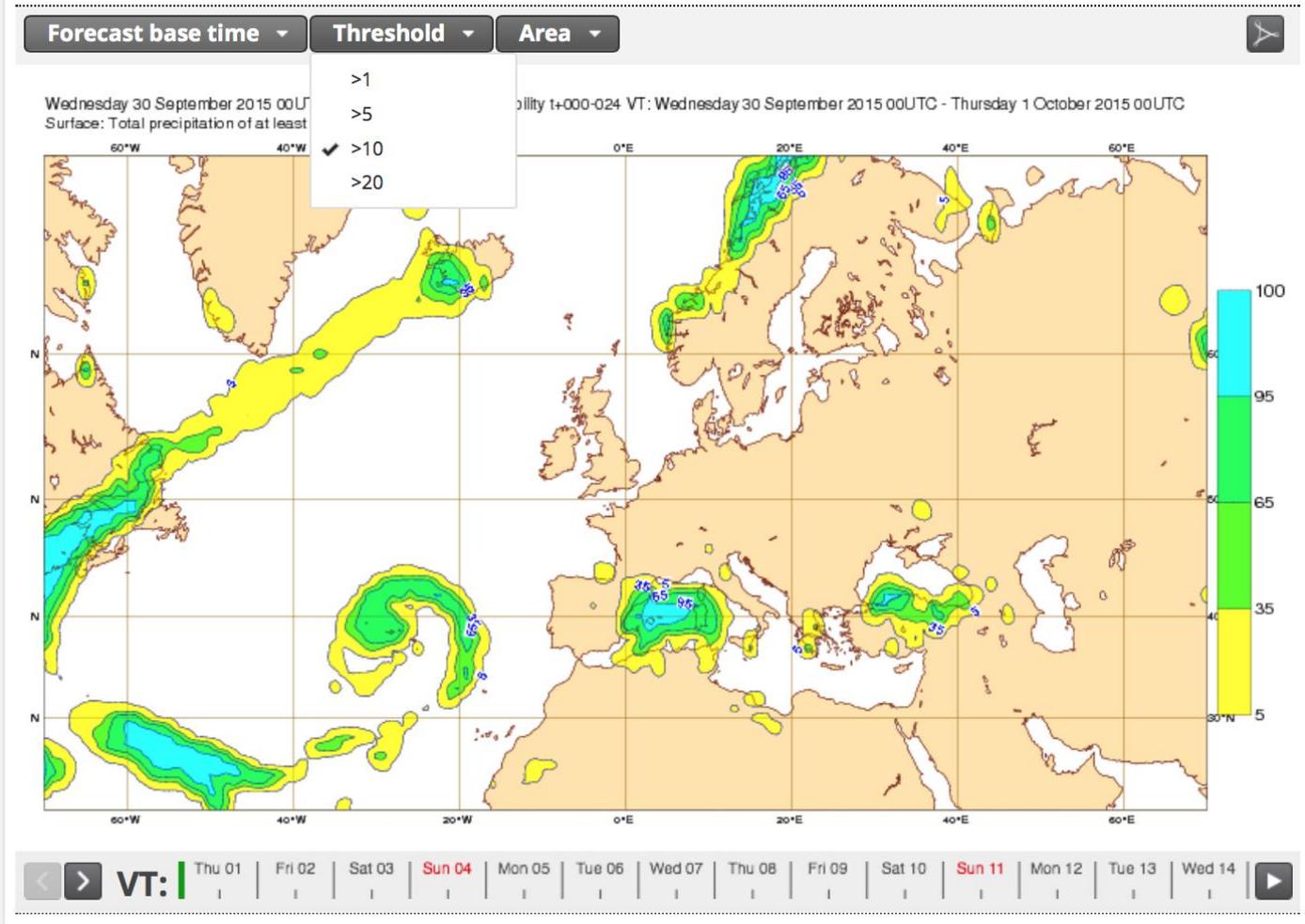
Extreme Forecast Index (EFI)

If there is the one graphics ...



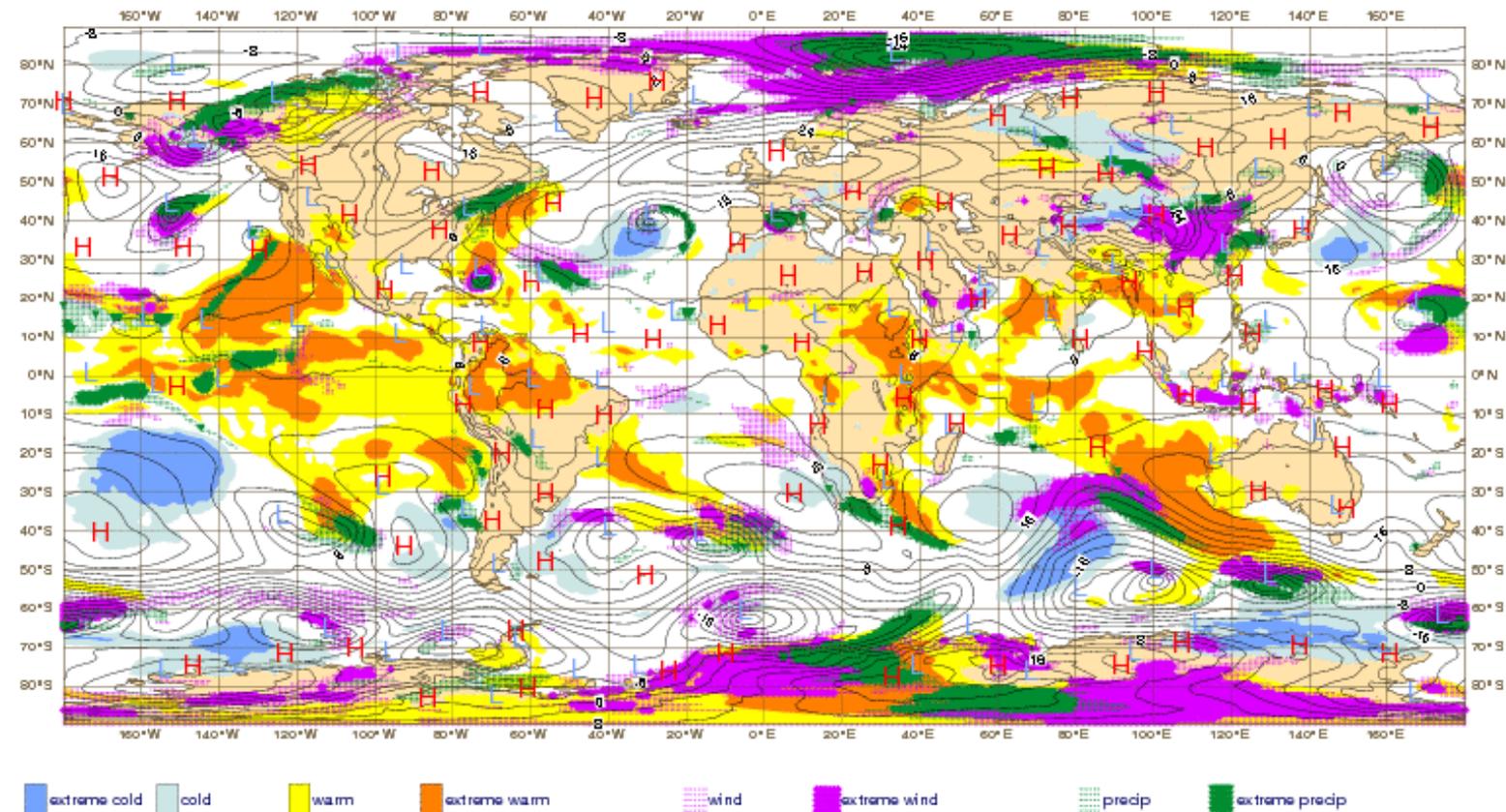
Probabilities

Probabilities: 24h precipitation

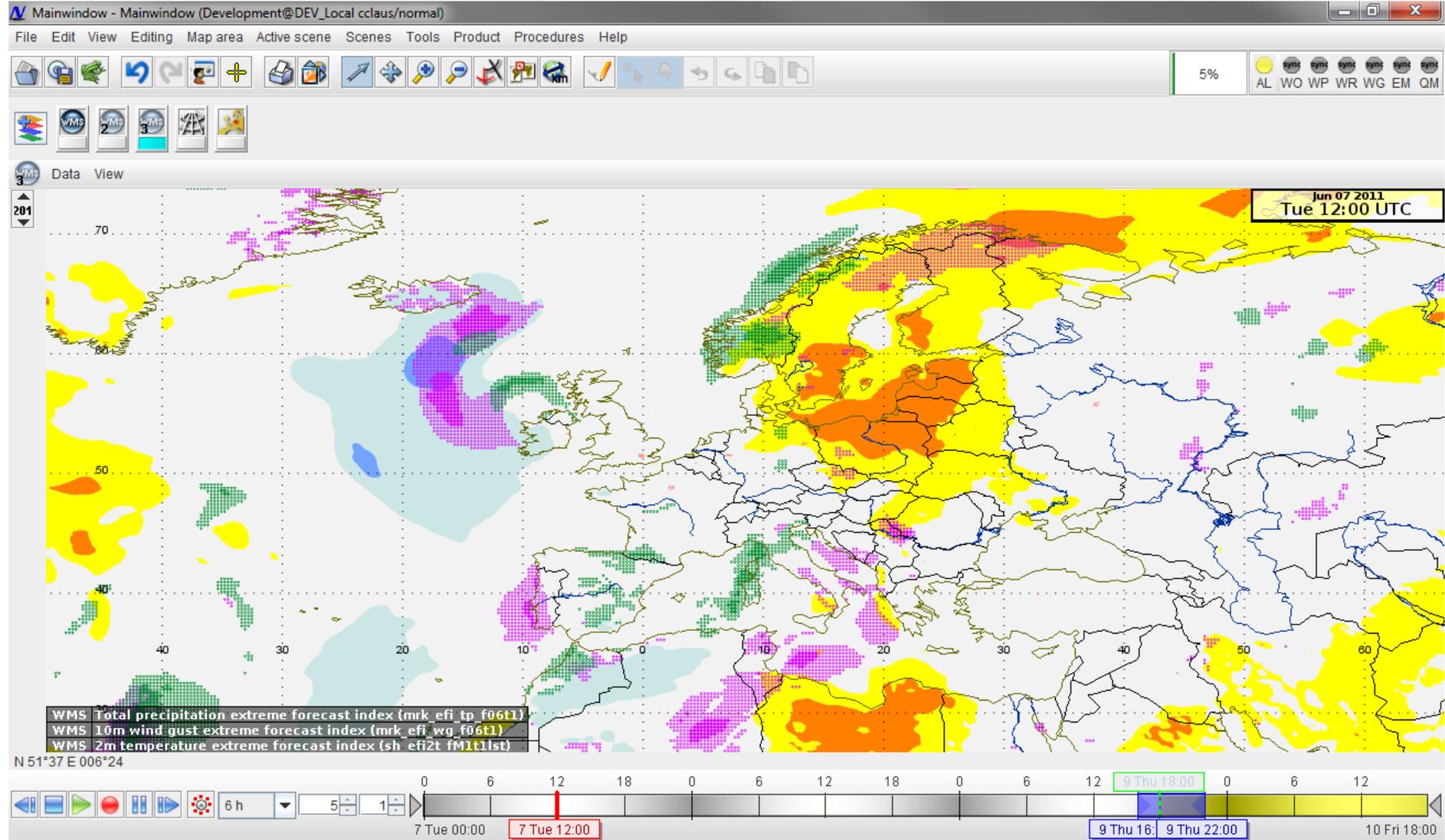


Another success – the Extreme Forecast Index (EFI)

Anomalous weather predicted by EPS: Tuesday 29 September 2015 1200 UTC
1000 hPa Z ensemble mean (Wednesday 30 September 2015 1200 UTC)
and EFI values for Total precipitation, maximum 10m wind gust and mean 2m temperature (all 24h)
valid for 24 hours from Wednesday 30 September 2015 0000 UTC to Thursday 01 October 2015 0000 UTC

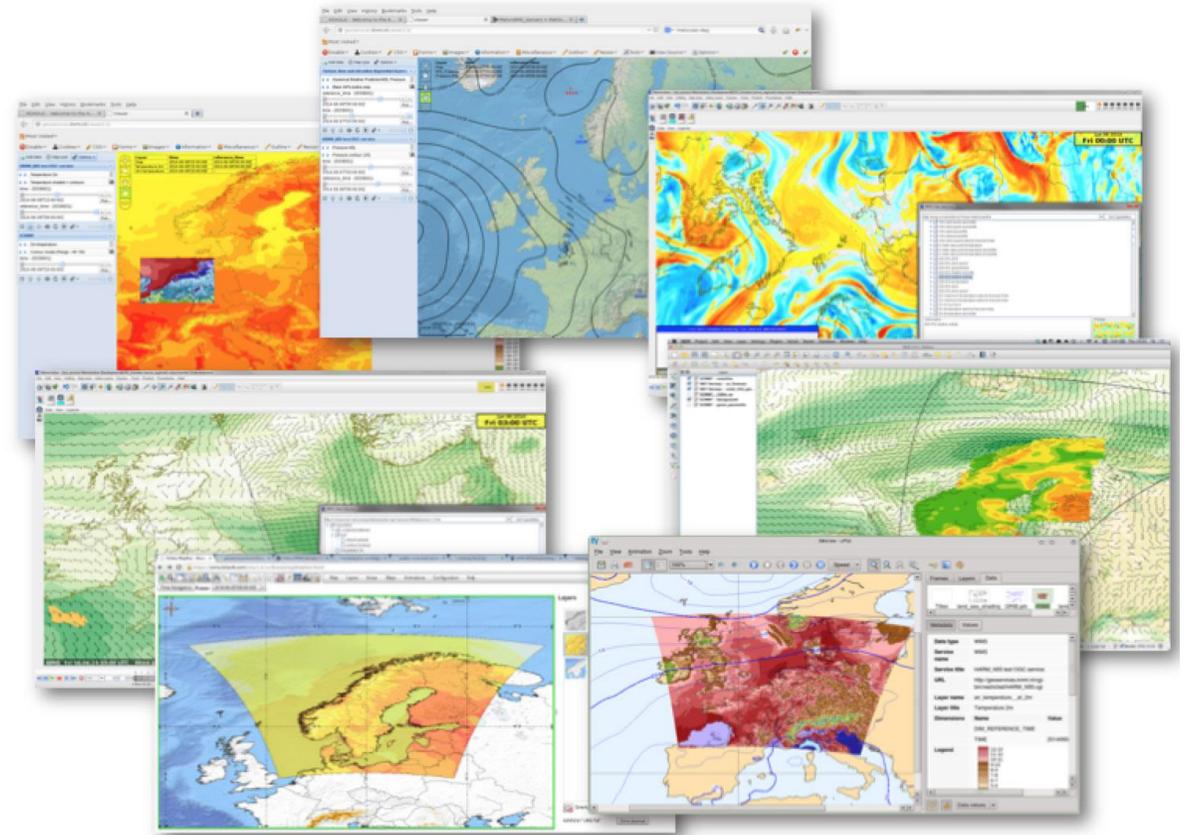


ECMWF map overlaid in NinJo



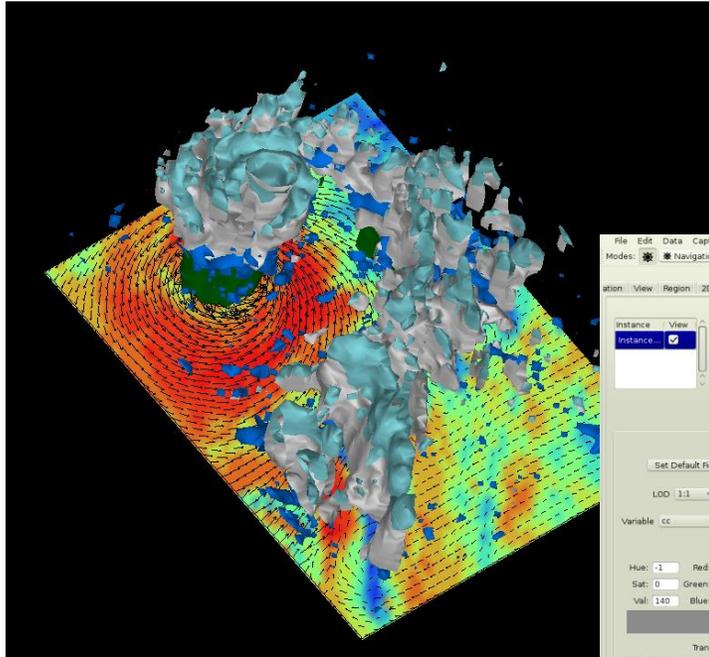
New ways of exchanging maps and data

- The last decade saw the need to develop machine-to-machines web services
- This was raised and discussed at the MOS workshop in 2007 here at ECMWF
 - Engage with the well established GIS community and explore their existing services for delivering maps and data
 - Open Geospatial Consortium (OGC)
 - Establishment MetOcean Domain Working Group

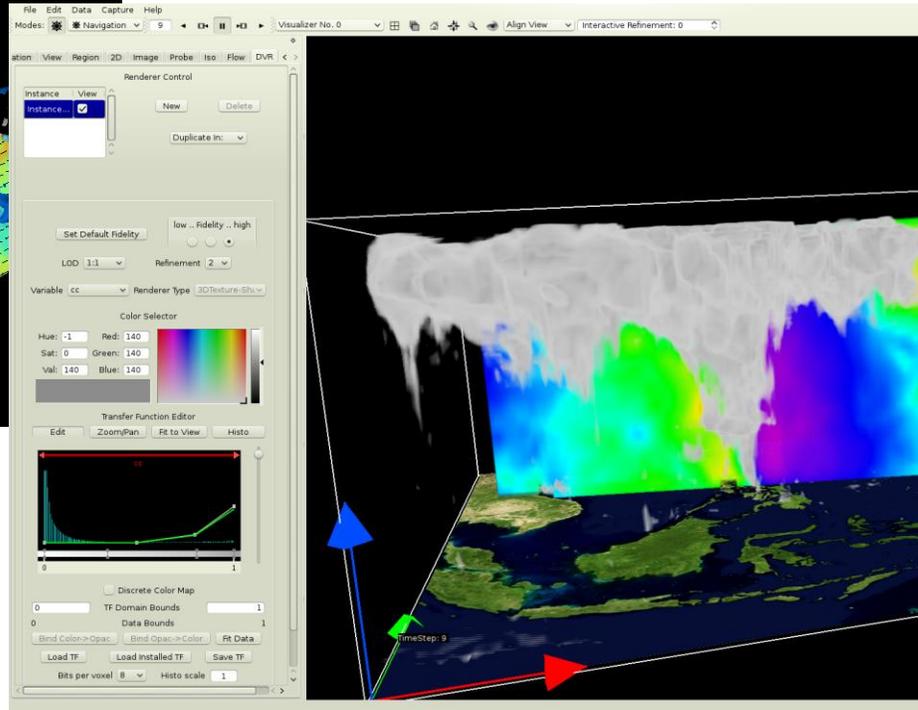


What about 3D/4D at ECMWF?

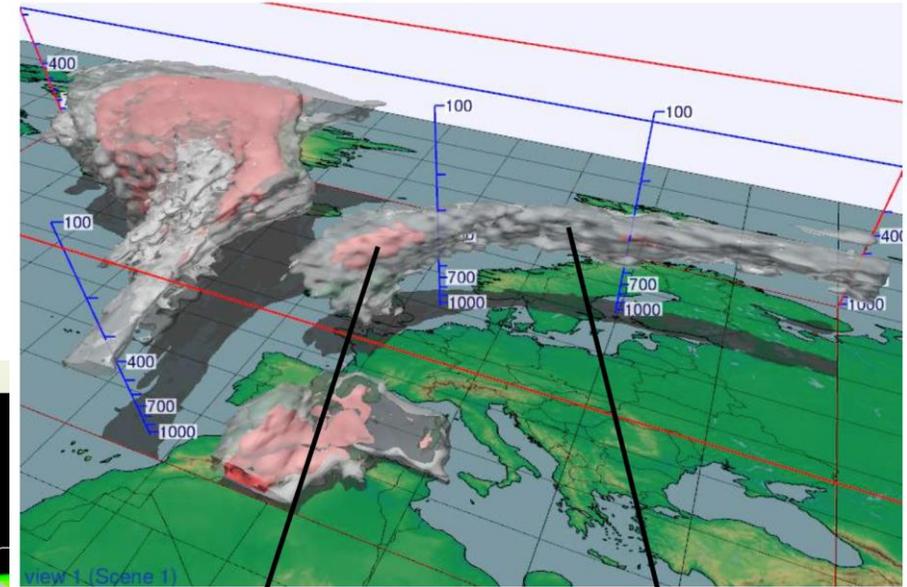
What about 3D/4D at ECMWF?



Vis5D



Vapor



30% probability

10% probability

Met3D

The comeback of 3D/4D?

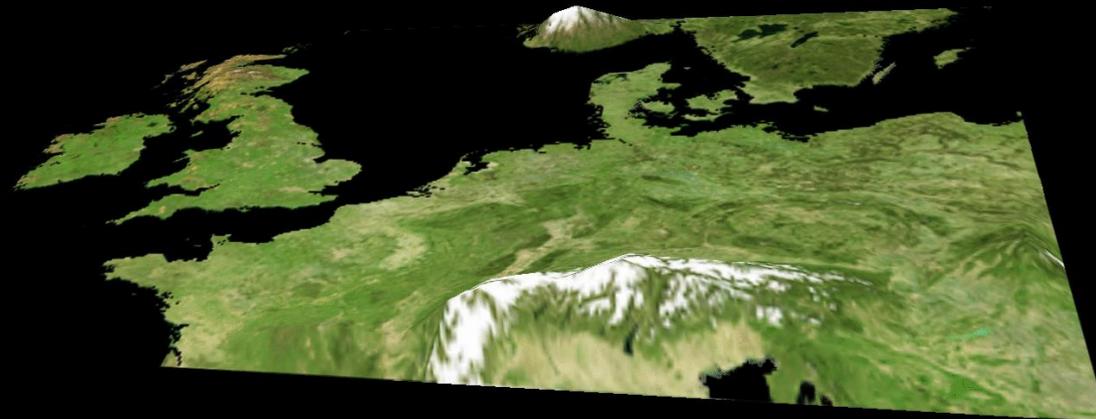
St Judes storm visualisation

12Z 27th October 2013: 48 hr forecast

IFS T1279. Hourly frames.

Glenn Carver, Sandor Kertesz : ECMWF

Produced with VAPOR (CISL, NCAR)



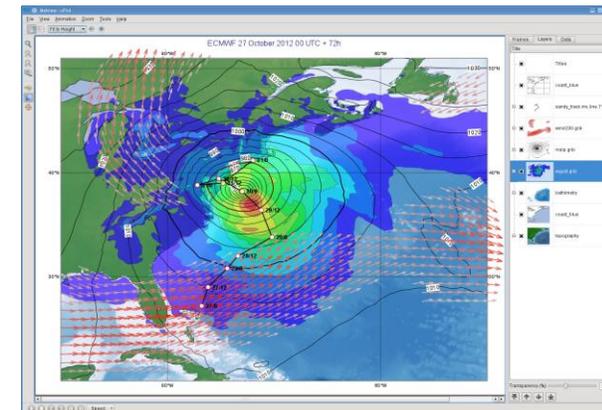
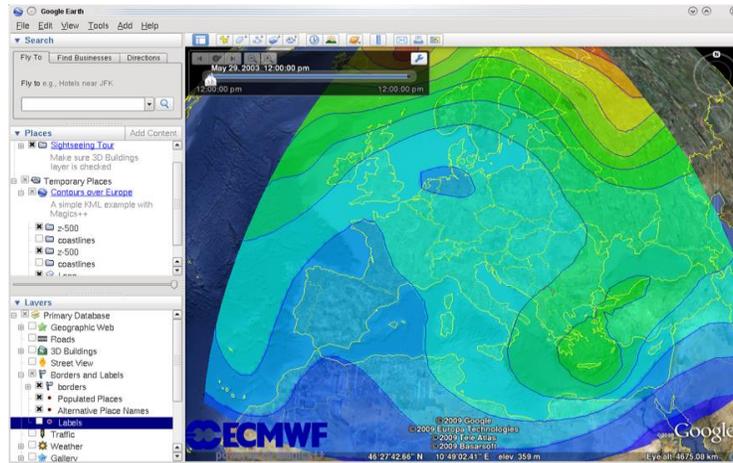
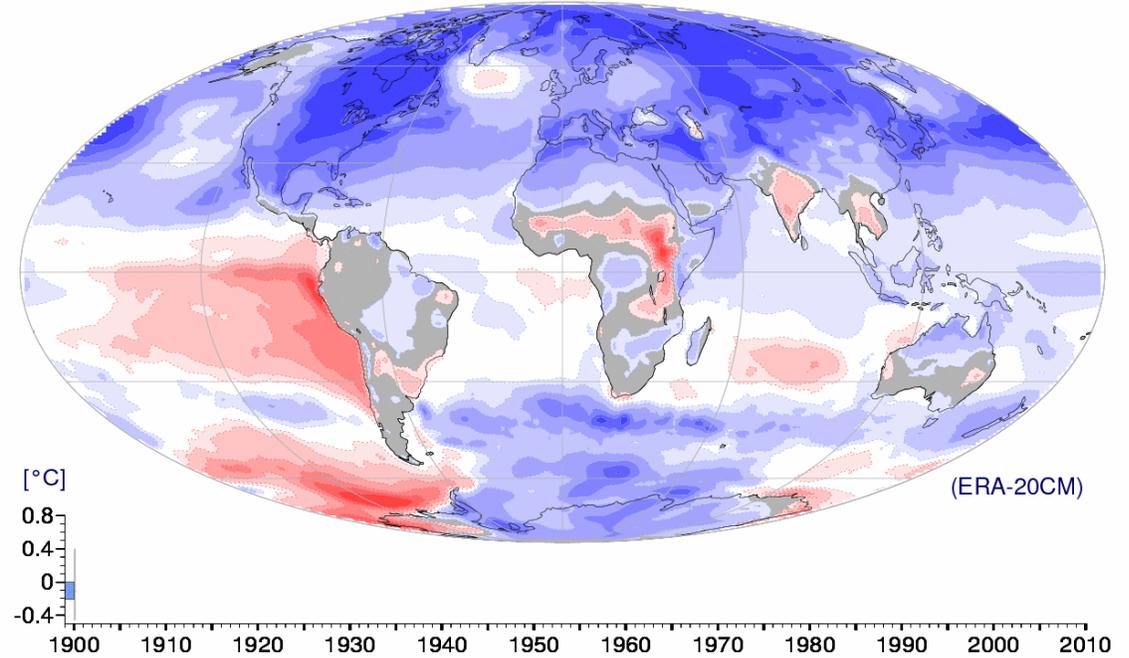
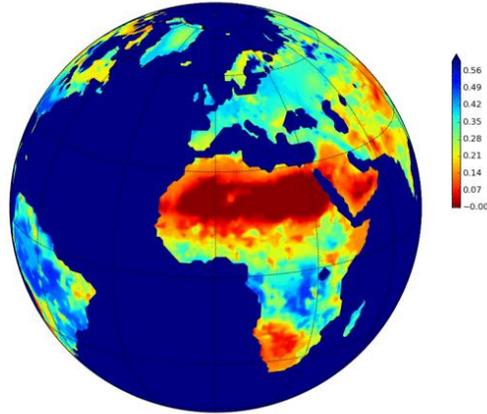
St Judes storm, 27th October 2013
Thanks to Glenn Carver from the OpenIFS project
(Using Metview and Vapor)

Get the message?

Supporting communication and outreach

Global warming relative to 20th-century average

Root-Zone Soil moisture (0-100cm)
January 1993



Any questions?

