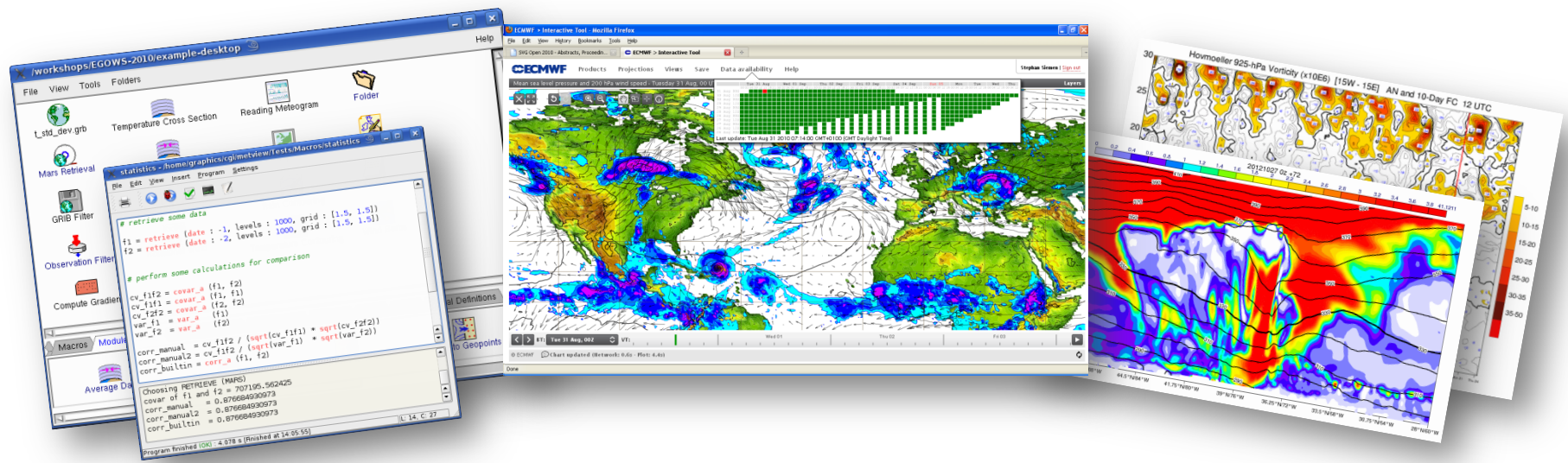


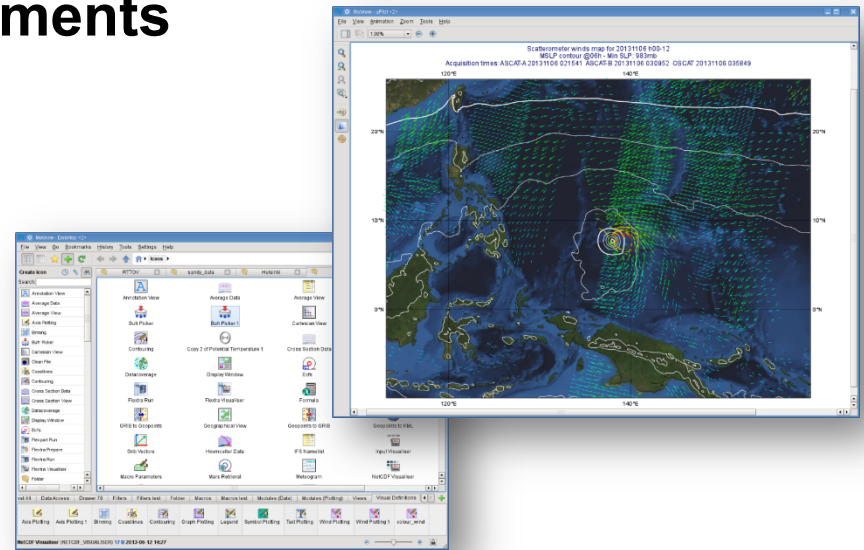
Update on software and service developments at ECMWF



Stephan Siemen
*Head of Development Section
Forecast Department*

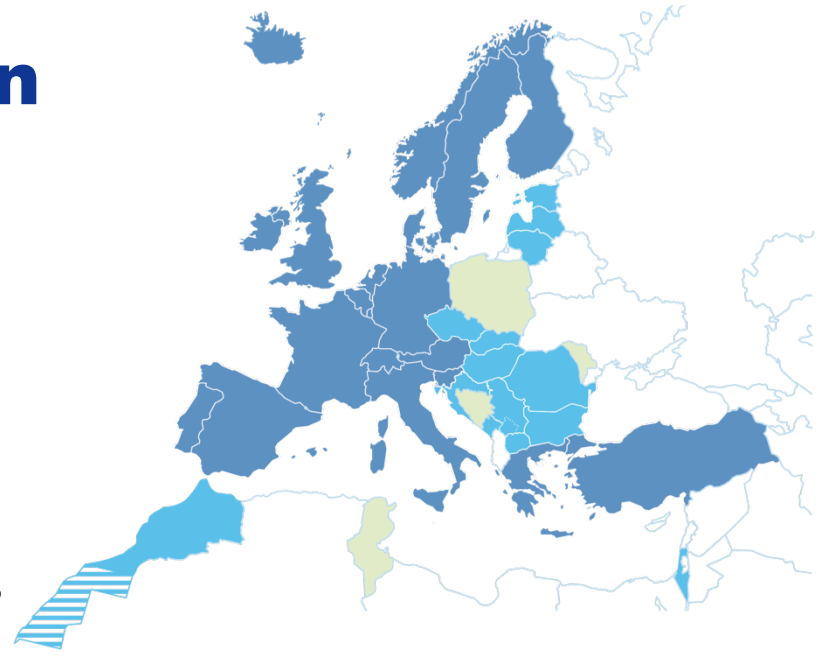
Agenda

- ECMWF reorganisation
- Changes to our software development environment
- Update on software developments
- Projects
 - Product Delivery
 - Scalability
 - Web2013
- ECMWF's new web charts
- ecCharts
- Changes to our forecast system



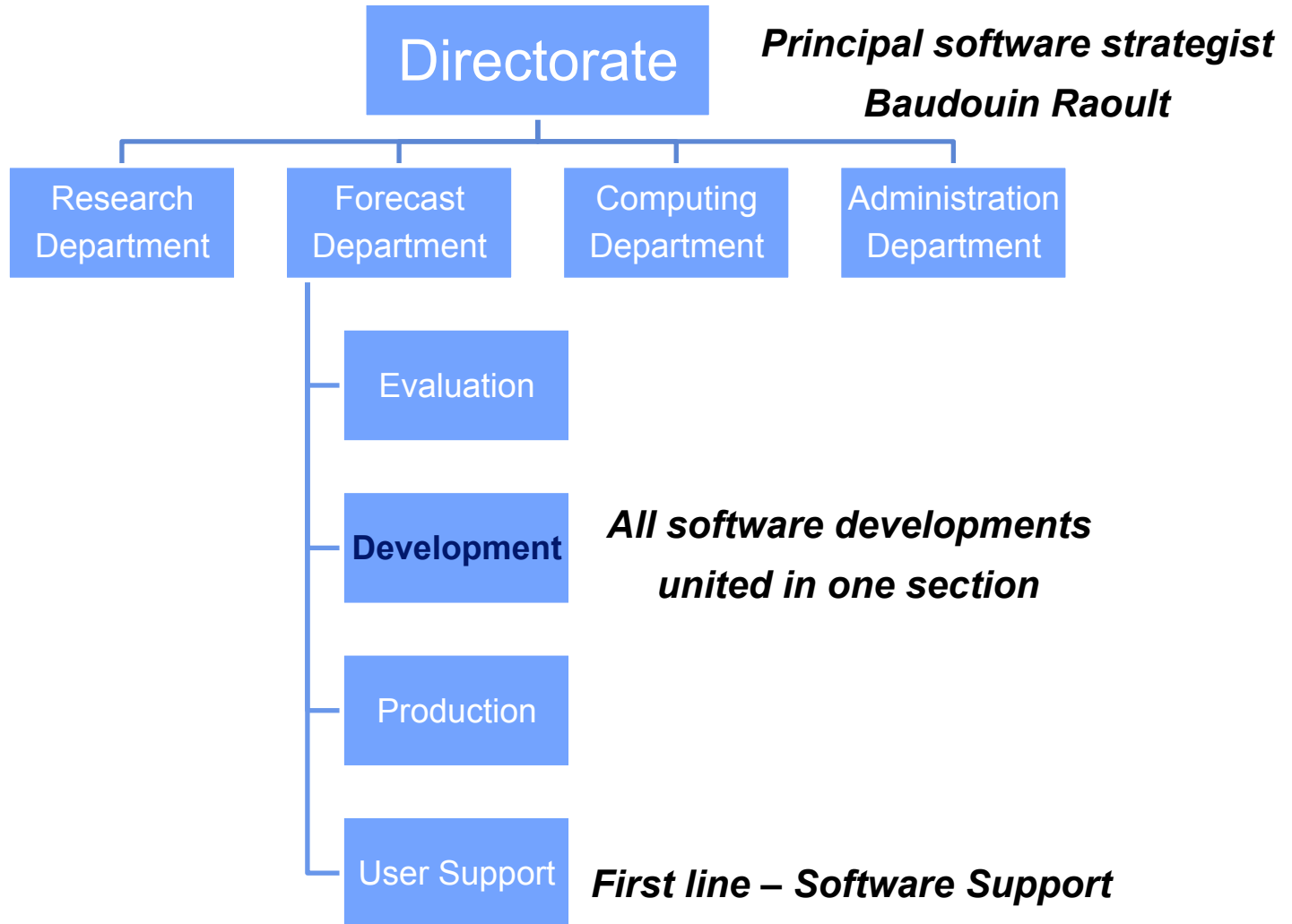
ECMWF reorganisation

ECMWF reorganisation

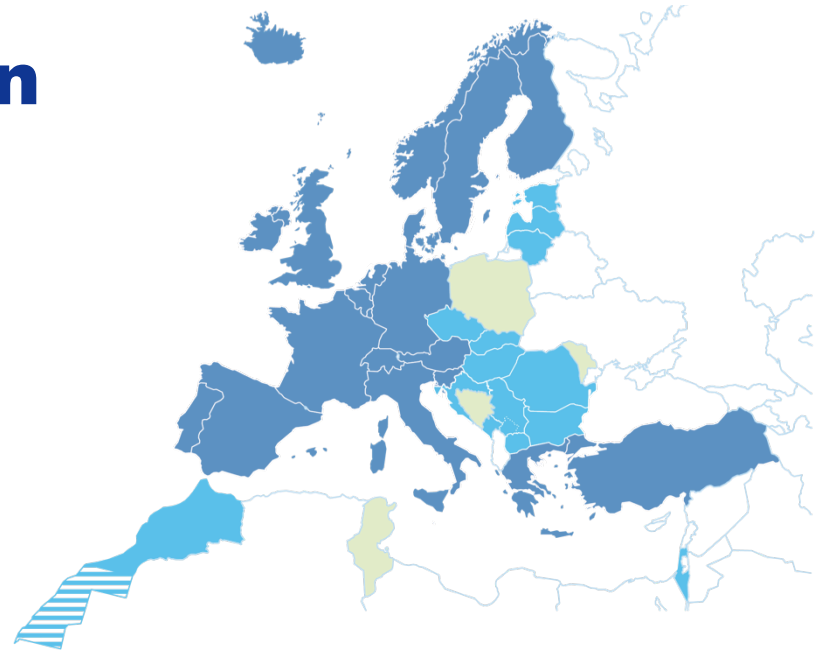


- Took effect on 1st July 2013
- Move from 3 to 4 departments
 - *Operations Department* gone
 - New: *Forecast and Computing Department*
- Reorganisation became “real” with office move in November 2013

New structure



ECMWF reorganisation



● What does it mean for software development?

- Clear separation between operational support and development
- More harmonised approach between packages
- Better communication and training between developers
- More efficient coding
 - Code sharing
 - Follow common conventions

Software strategy and roadmap

- **We develop a software strategy**
 - Set out the aim of ECMWF's software development
 - Clarifies roles after reorganisation
 - Avoid duplications of efforts
 - Establishes a board to advise on development priorities
 - Establishment of a public software roadmap
- **We will welcome external code contributions**
 - Software solution is *git* hosted through Atlassian *Stash*
 - We work to simplify the contribution agreements
 - Establish framework to test for regressions through contributions

Changes to our software development environment

Changes to our development environment

● Migration to Git

- Most packages have been now migrated
- User interface through *Atlassian Stash*

● Unifying our development environment

- Documentation all on Confluence
- All installations use CMake/ecBuild
- Aim to introduce standard workflow for branching and versioning
- Working towards unified testing framework

● Encourage code reuse

- Traditionally all our packages use similar code blocks
 - Date/Time, threading, I/O, fields ...
- Code will be consolidated into a new library *ecKit*

What does CMake mean for users

- **Benefits to move to CMake**

- Unified setup between packages (“ecbuild”)
- More modern interface – easier to read
- Could natively support builds on Mac OS X and Windows

- **Differences to *autotools***

- The ‘cmake’ tool needs to be installed
- *-DENABLE_<feature>* instead of *-enable-<feature>*
- Out-of-source builds
 - Use different location for build than where source code is
 - One source can be used to build various configurations
- Each package provides a config file for CMake to detect

Update on software developments

GRIB API

- **There have been 3 releases in the last 12 months:**
 - **1.11.0 (Aug 2013)**
 - **Alternative CMake installation**
 - **GRIB-API addition of WMO GRIB Edition2 Version 11**
 - **Update the local concepts for DWD (edzw)**
 - **1.12.0 (05 March 2014)**
 - **Improved grib_to_netcdf**
 - **1.12.1 (07 May 2014) - Bug fix release**
- **There has been much collaborative work (e.g. with DWD, FMI and MPI) to accept contributions**
- **Also GRIB API has been ported to Microsoft Windows to aid more widespread adoption.**
 - **This is not yet released but pre-release beta versions have been sent to interested parties**
 - **Needs much more testing (Not a platform we use at ECMWF)**

Emoslib

- Documentation is now on Confluence

<http://software.ecmwf.int/emoslib>

- 000393 – change of default installation paths (internal)
- 000394 – changes for Cray compiler (internal)
- 000395 – changes for reduced Gaussian grids

Next external release!

- 000399 – first installation using Cmake
(clean-up on platforms)

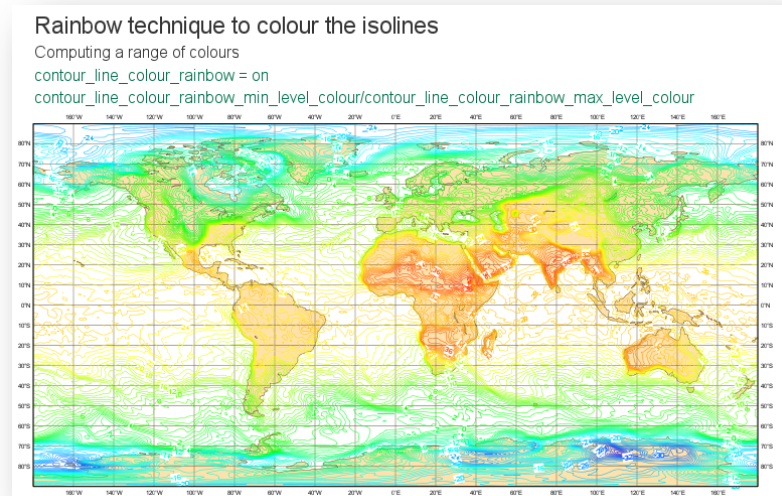
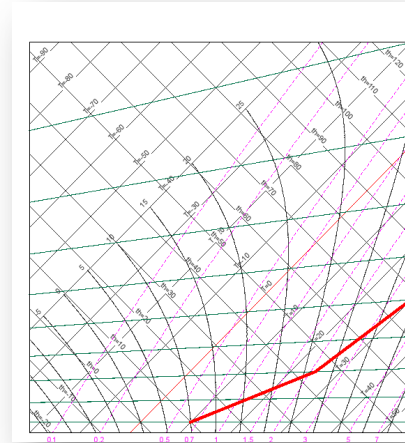
- No changes to GRIBEX
- Separate BUFRDC release of 000401

New interpolation library - MIR

- **We have the strong need to replace Emoslib interpolation routines**
 - Hard to maintain, old design does not scale on new architectures
 - In Product Generation, MARS, Metview, Magics++
- **We have a prototype (although not ready for distribution)**
 - Share experiences and code with research
 - Interfaces through command line tool and C++ API (future also Python)
 - Results are encouraging in both quality and efficiency
- **MIR is part of the Scalability Programme (HERMES)**
 - We are investigating existing solutions (ESMF, fimex, ...)
 - Explore alternative computing backend's for “many-core” architectures

Magics++

- Last release 2.22 used Cmake
 - We received good feedback
- Allows the easy use of ecCharts styles
 - Names of styles can be used to set them
- More options to colour isolines



- BTW: Last machine running MAGICS 6 has retired in 2013!

Misc

- **SMS to ecFlow migration takes pace**
- **Development of Qt based ecFlowview 2.0**
- **ODB_API wiki & documentation should go online soon**
- **ecCodes is getting tested for BUFR decoding**
 - **Extension to GRIB_API**

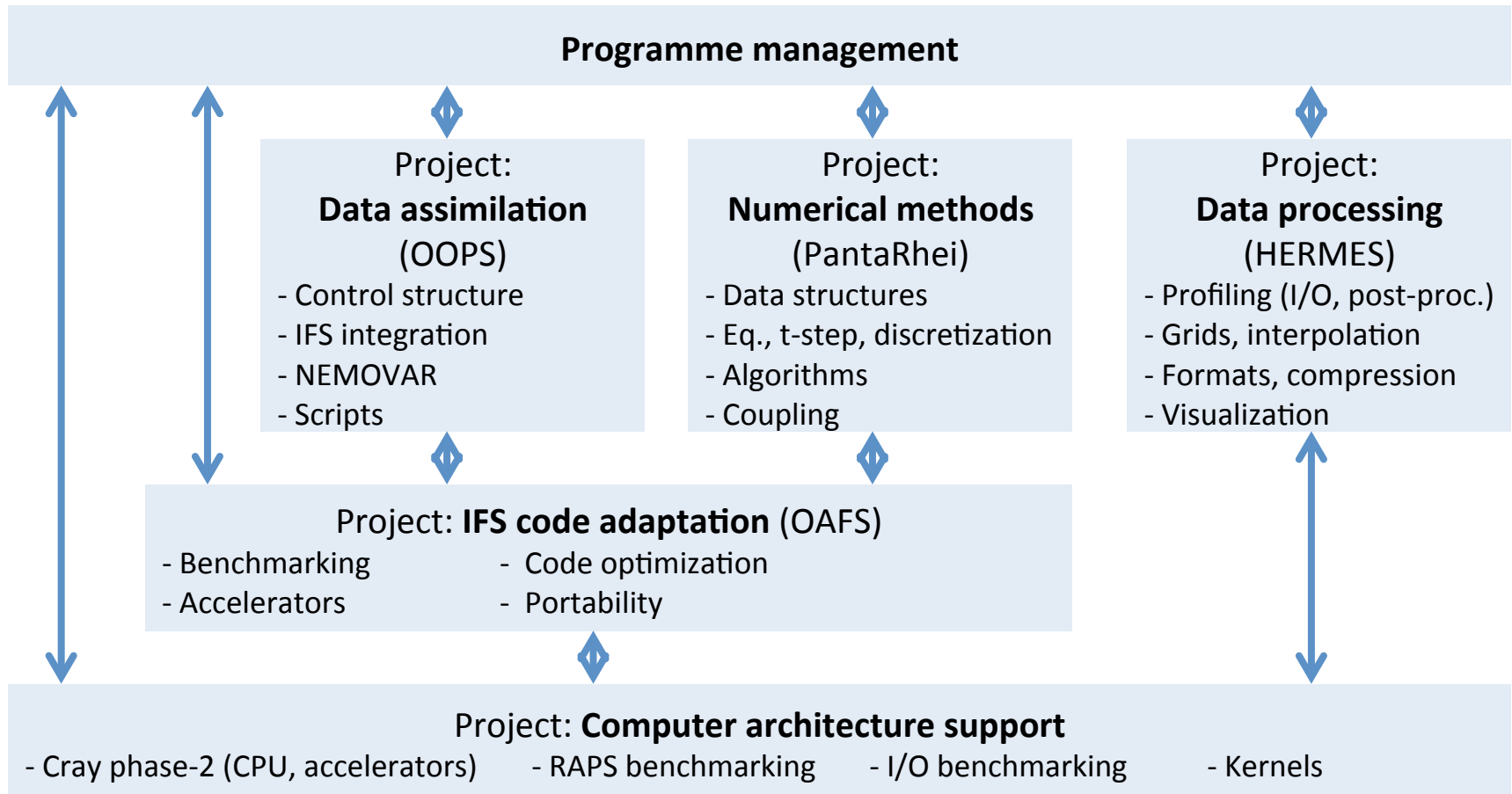
Programmes and Projects

Product Delivery project

- **As presented last year, we plan major developments & changes to our product delivery system to make it fit for the challenges of the next decade**
- **The project already achieved much**
 - Survey (presented last year)
 - Decision on using OpenWIS & web_api
 - Started the development of new web interface for Product Delivery system
 - Study on cloud services
- **Since the start of the project the environment around it changed**
 - Reorganisation → developments focused in new Development Section
 - Start of Scalability Programme → new focus on scalability of our systems
- **Therefore it was decided to continue the work either as**
 - software development projects in the Development Section or
 - within the Scalability Programme

Scalability Programme

- Implement a formal structure at ECMWF to coordinate science & software activities across departments for efficient exa-scale computing/archiving
- Coordinate activities with Member States, European HPC facilities, research centres, academia, vendors & international NWP centres



Experiments with IFS: Evolution

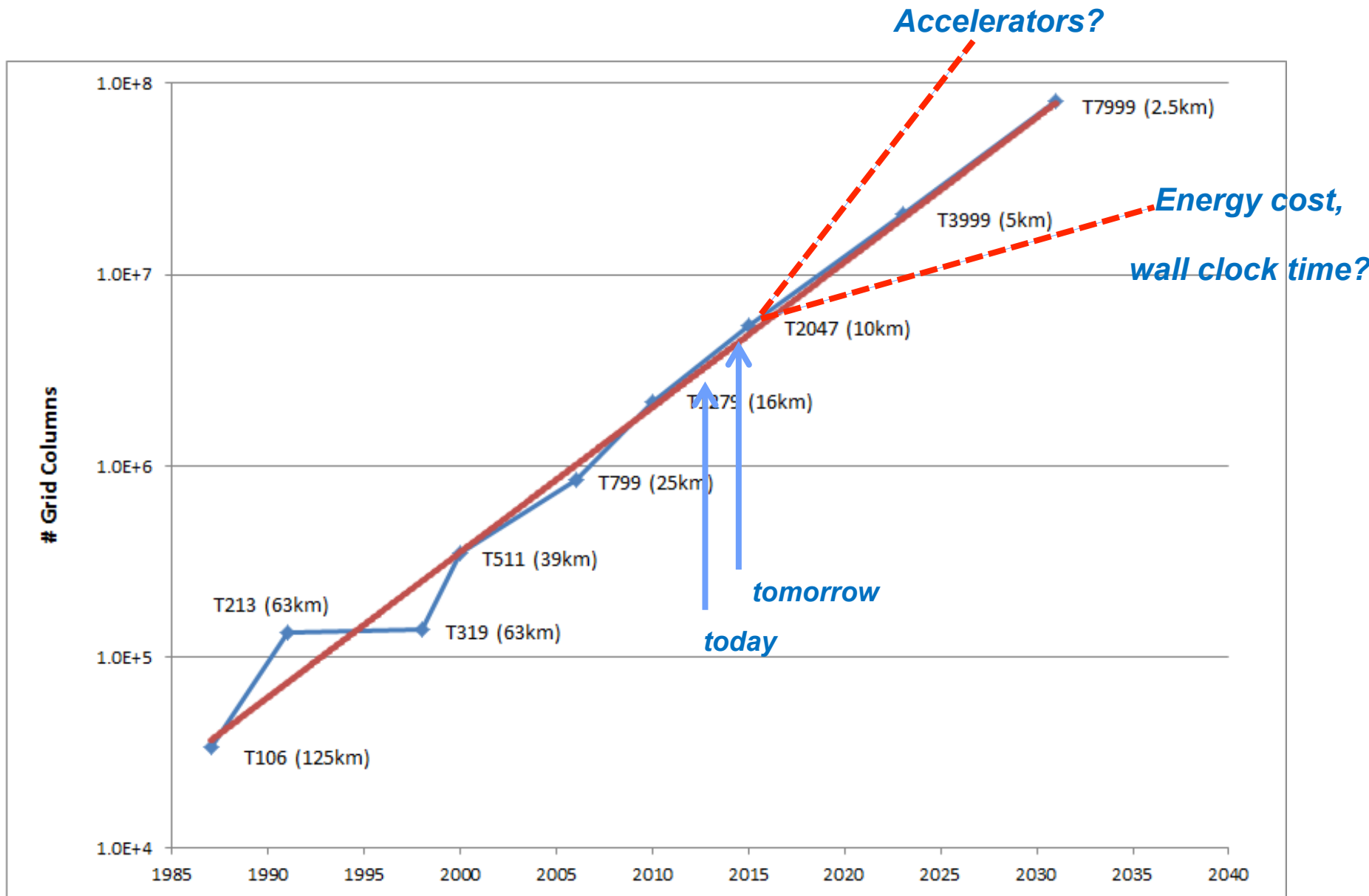
IFS model resolution	Envisaged Operational Implementation	Grid point spacing (km)	Time-step (seconds)	Estimated number of cores*
T1279 H	2010 (L91) 2012 (L137)	16	600	1100 1600
T2047 H	2014-2015	10	450	6K
T3999 NH	2020-2021	5	240	80K
T7999 NH	2025-2026	2.5	30-120	1-4M

*Rough estimate for the number of 'Power7' equivalent cores needed to achieve a 10 day model forecast in under 1 hour (~240 FD/D), system size would normally be 10 times this number.

H = Hydrostatic Dynamics

NH = Non-Hydrostatic Dynamics

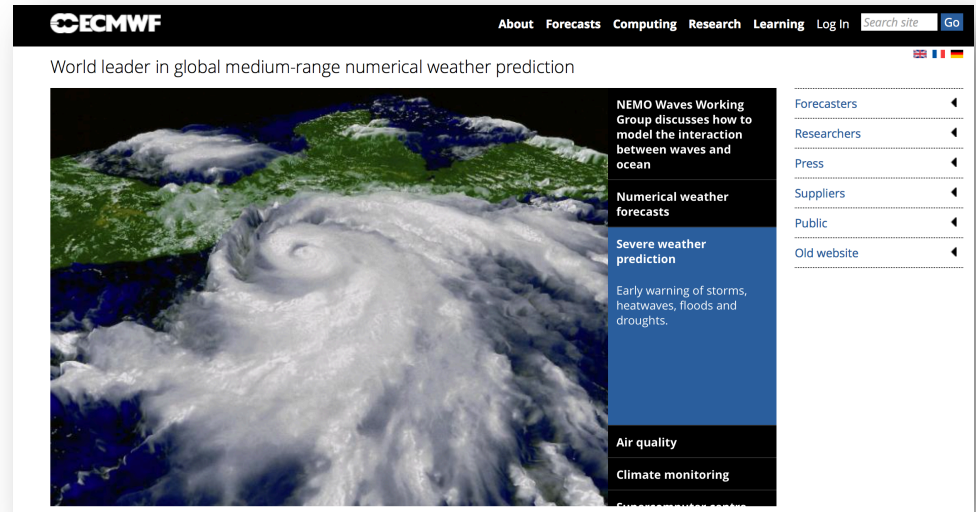
Model resolution



Web2013

- **Big project to update the corporate web page**

- Inspired by work on ecCharts
- Released in April:
<http://www.ecmwf.int>



- **Technical (software) documentation moves to separate Wiki**

- Based on confluence
<http://software.ecmwf.int>
- With exception of BUFREX & MARS which still need to move
- Please use new pages! (Old ones are not updated anymore!)

ECMWF's new web charts

Web - Charts

- Modernize the look in the context of Web2013 project.
- **Modernize software infrastructure to migrate existing products and to offer new products.**
- Search based navigation and discovery.
- **Building fundamentals to extend current charts by adding interactive tools such as zoom, pan and click.**

Charts

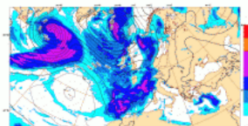
Select and view our charts - forecasts and associated verification

Our Integrated Forecasting System (IFS) provides forecasts for multiple time ranges.

We provide a range of forecast products to address different user requirements. These present key aspects of the forecast evolution and the associated uncertainty. Specific products designed to highlight potential severe weather events include the Extreme Forecast Index and tropical cyclone activity.

Click on the category title or the associated thumbnail below to access *all* charts for that category.

Medium range

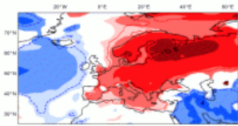


Up to 15 days ahead.

[Overview \(text\)](#)

[ENS meteograms](#)

Extended range

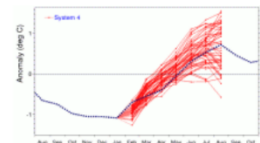


Up to 30 days ahead.

[Overview \(text\)](#)

[Plumes](#)

Long range



Up to 13 months ahead.

[Overview \(text\)](#)

[Nino plumes](#)

Web - Navigation and discovery

- Hierarchical navigation replaced with faceted navigation based on search facility.
- Faceted navigation can list all products based on pre-defined facets (ie: Display all tropical cyclone products, display all temperature products ...)
- An improved search facility

Charts catalogue
Showing 1-10 of 10 results for **Tropical cyclones** ×.

Tropical cyclone activity (including genesis)

ecCharts service

Extended range tropical storm activity

Long range tropical storms

Filter charts
Filter charts

- ▼ **Range**
 - Medium (15 days) (3)
 - Extended (30 days) (2)
 - Long (Months) (5)
 - Analysis (1)
- ▼ **Type**
 - Forecasts (10)
- ▼ **Component**
 - Atmosphere (10)
 - Surface (3)
 - Geography (1)
- ▼ **Product type**
 - ENS (10)
 - Combined (1)
 - Extreme forecast index (1)
 - HRES (1)
 - Meteograms (1)
- ▼ **Parameters**
 - Tropical cyclones
 - Temperature (40)
 - Wind (39)
 - Precipitation (32)
 - Ocean waves (28)
 - Geopotential height (20)

Search results
Site: [Charts](#) [Datasets](#) [FAQs](#)

Showing 1-10 of 54 results for **"temperature"** ×.

Search charts

► Sort by

▼ **Range**

- Medium (15 days) (36)
- Extended (30 days) (7)
- Long (Months) (12)
- Analysis (11)

▼ **Type**

- Forecasts (47)
- Verification (7)

▼ **Component**

- Atmosphere (33)
- Surface (24)
- Geography (4)

▼ **Product type**

- ENS (39)
- HRES (15)
- Extreme forecast index (14)
- Combined (7)
- Meteograms (4)

► Parameters

2m temperature
Two meter temperature probabilities ...

2m temperature
2m temperature probabilities The plot shows probability information derived from the ensemble ... (ENS), specifically; Probability of 2 metre temperature being below 0C at the validity time (colour ... member is assigned an equal probability of 1/50). The 2m temperature is a post-processed product, derived ...

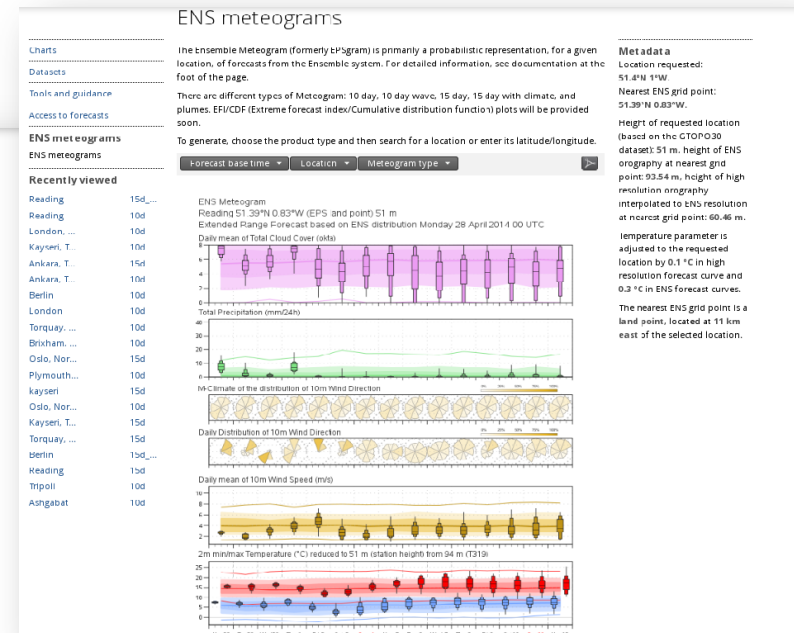
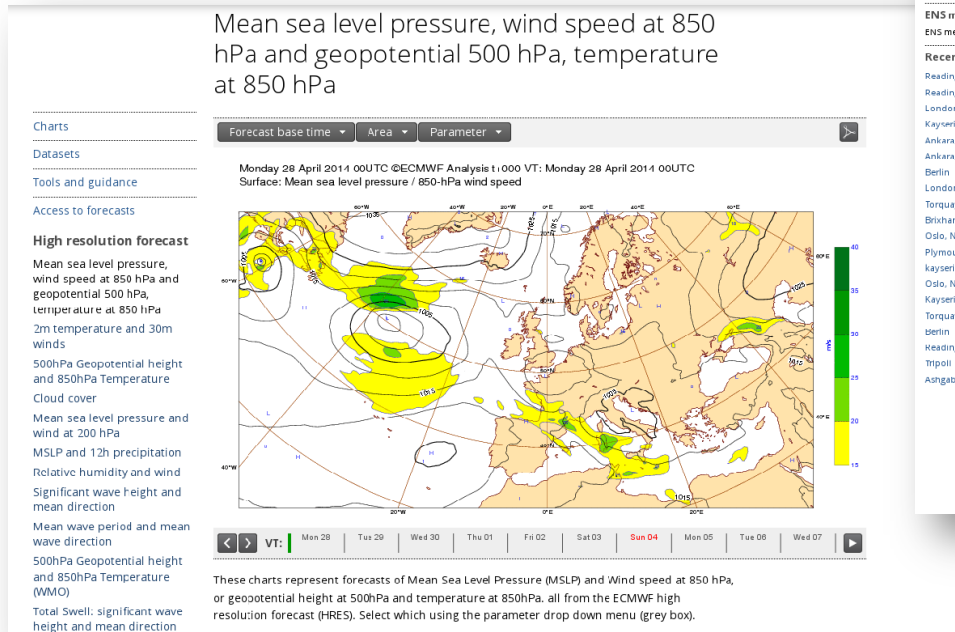
2m temperature and 30m winds
2m temperature and 30m winds On this page you can visualise the high-resolution forecasts (HRES) ... Arrow length is proportional to wind speed. Two metre temperature (colour shading, 4C intervals). The 2m ... temperature is a post-processed product, derived by non-linear interpolation between temperatures ...

2m temperature and 30m winds
Two metre temperature and 30m winds over Africa ...

500hPa Geopotential height and 850hPa Temperature
These charts show 500 hPa geopotential height (contours) and temperature at 850 hPa (shading) from ... troposphere whilst high heights indicate ridges and anticyclones. 850 hPa Temperature Colour shading indicates ... temperature at the 850 hPa level in degrees Celsius (°C) in 1.0 C colour ...

Web - Chart products

- Migration of essential products (~140) is completed.
- New user interfaces for chart display and Meteogram display are completed.

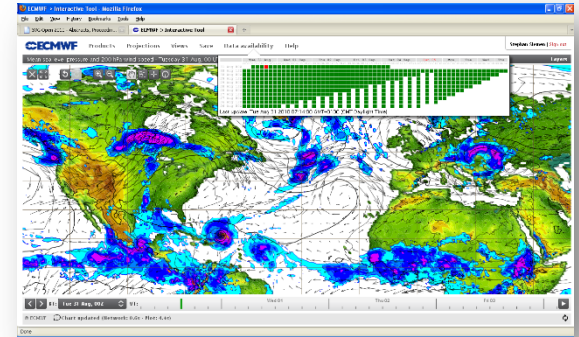


ecCharts

ecCharts - new products

- New EFI parameters
- Extension of EFI to 7 days (from 5)
- 250 hPa parameters
- Relative humidity
- K-index

→ Available now!



Changes to our forecast system

Time line of changes

- **Nov 2013 Cycle 40R1**
 - The vertical resolution and the vertical extent used for the medium-range and monthly ensemble forecasts has changed: the number of levels of the ENS has increased from 62 to 91 with the model top raised from 5 hPa to 0.01 hPa. The pressure levels remain unchanged.
- **June 14 – update on ecCharts**
- **September 2014 – Retirement of IBM HPCF**
- **Autumn 2014 – Cycle 40R2 – scientific changes**
- **Spring 2015 – 41r1 Horizontal resolution upgrade**
 - Horizontal resolution increases to 10Km (T2047)
- **Sep/Oct 2015 - MOS workshop & EGOWS**

Pages about ECMWF model changes

- “Old” page will disappear in the next 12 months

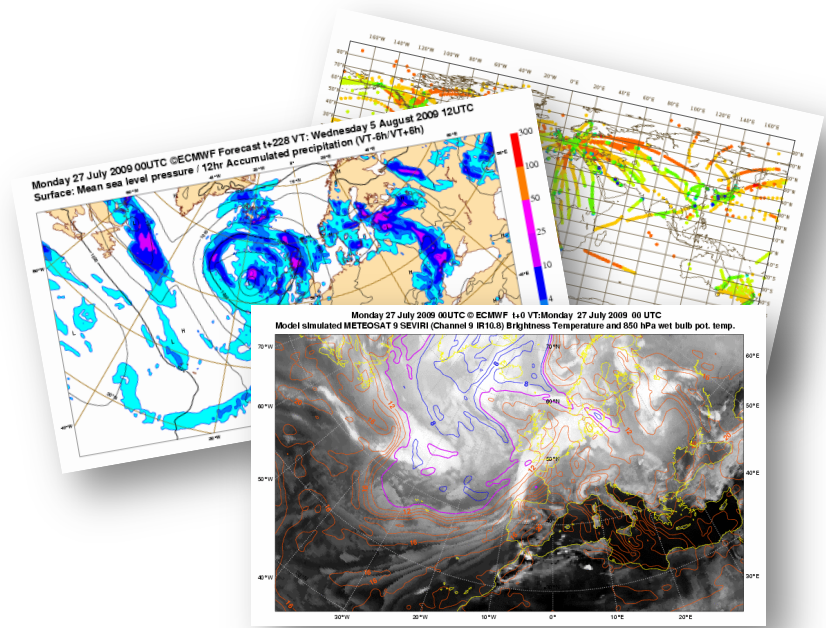
<http://old.ecmwf.int/products/changes/>

- New page for model changes under

<http://www.ecmwf.int/en/forecasts/tools-and-guidance/documentation-and-support/changes-ecmwf-model>

New ECMWF information pages for forecast users

- New web-based facility as part of a strategy to enhance our engagement with users
- Initially this contains two components:
 1. An area where forecasts of (recent) severe weather events are illustrated and discussed, which you can contribute to.
 2. A list of known 'issues' with ECMWF model output that forecasters should be aware of.
- These spaces are accessible via <https://software.ecmwf.int/wiki/display/FCST/Forecast+User+Home>



Questions?

EGOWS 2015

26th EGOWS 2015

- ECMWF is happy to host the event
- Proposal
 - Co-host with MOS workshop
 - Share demonstration and presentations
 - Technical presentations at EGOWS
 - More general ones at MOS
 - Reduce EGOWS to 1 ½ days?
 - Before or after MOS?
 - September/October?
 - Royal Meteorological Society offers to hold event on Visualisation on one of the afternoons



EGOWS 2010 at ECMWF

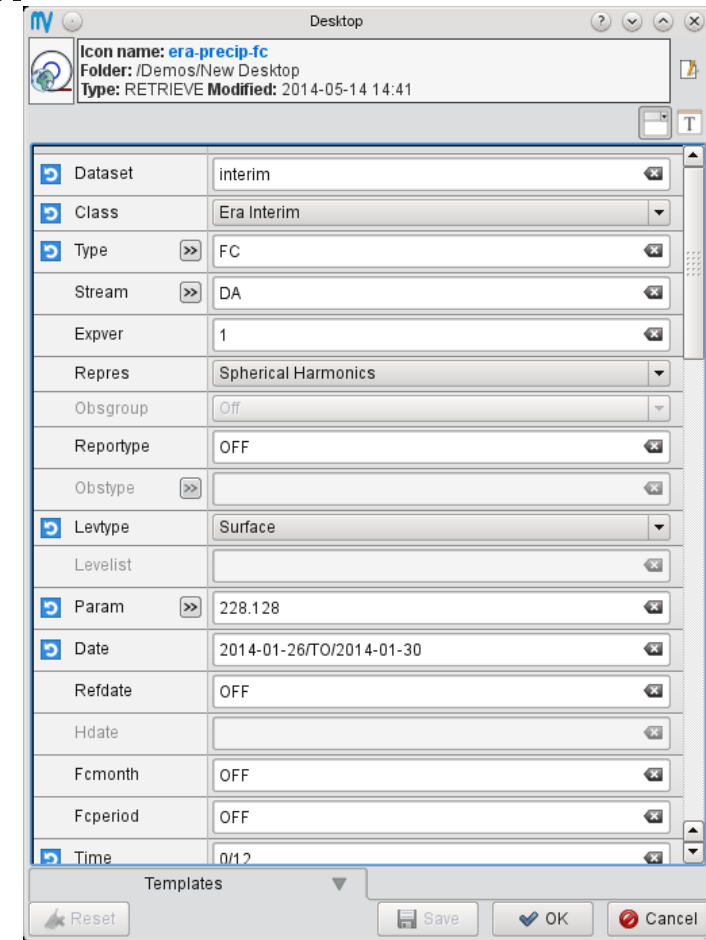
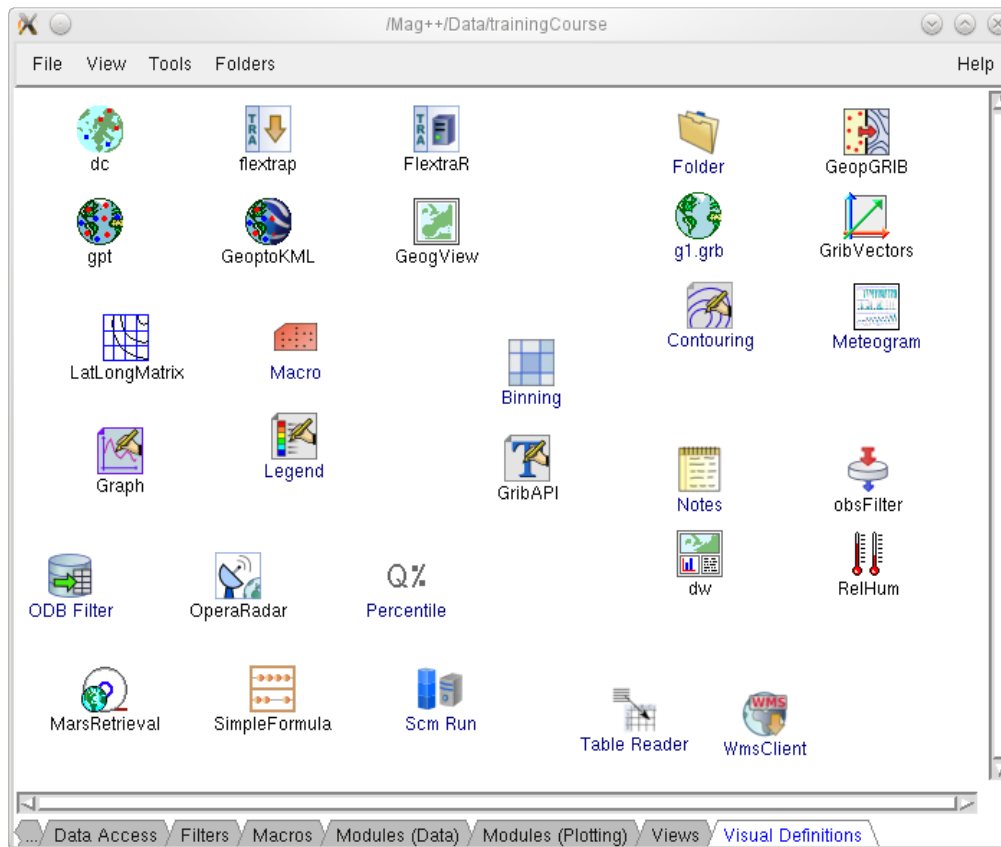
→ You might have to give more than one talk ;-)

Working Group User interface design

Icon-based interface (Metview)

- Everything is represented by an icon

- Data, settings and processes



Visualisation

GRIB file



wgust.grib

execute

visualise

examine

save

analyse

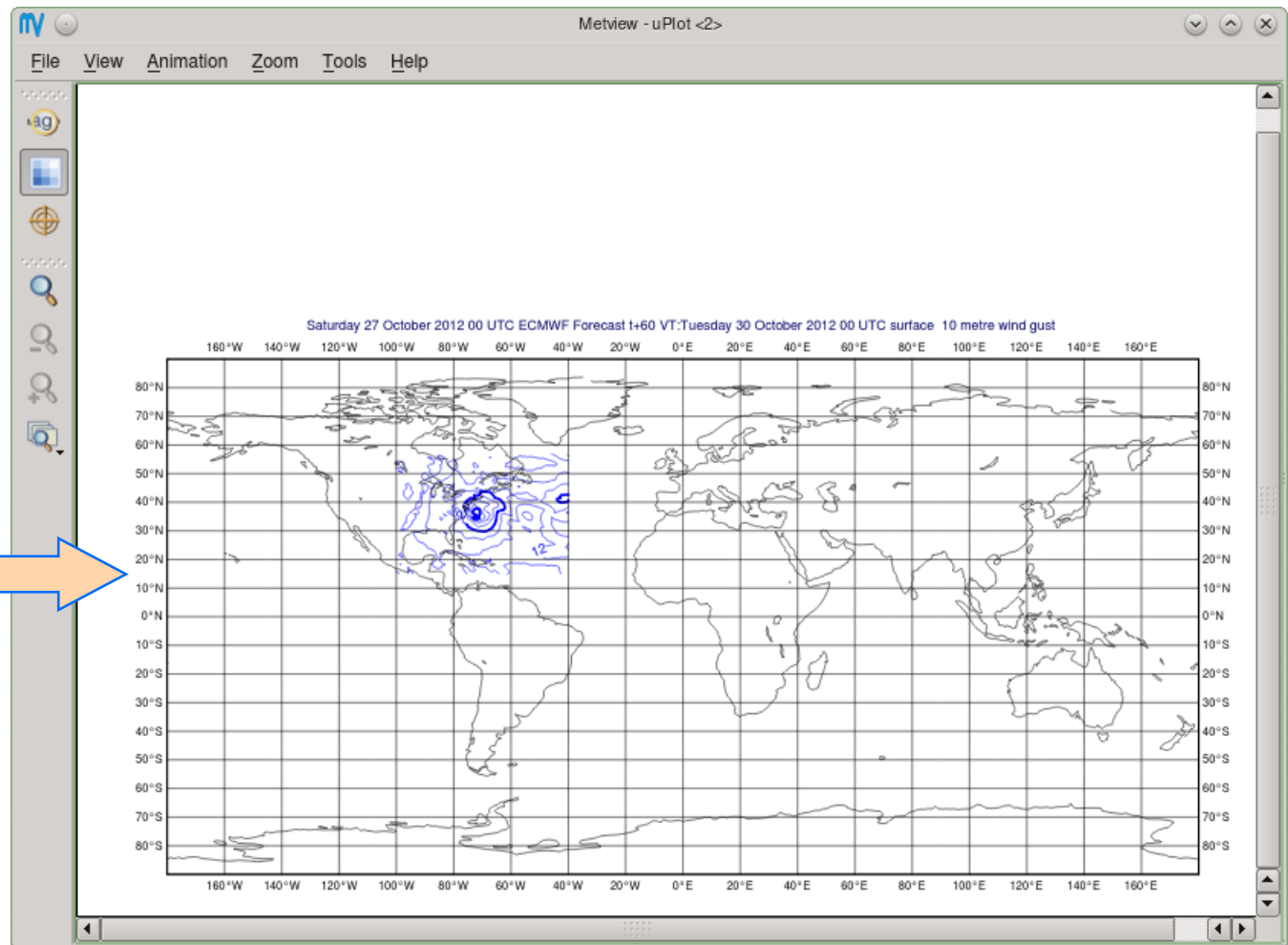
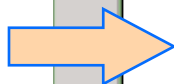
edit

duplicate

delete

empty

output

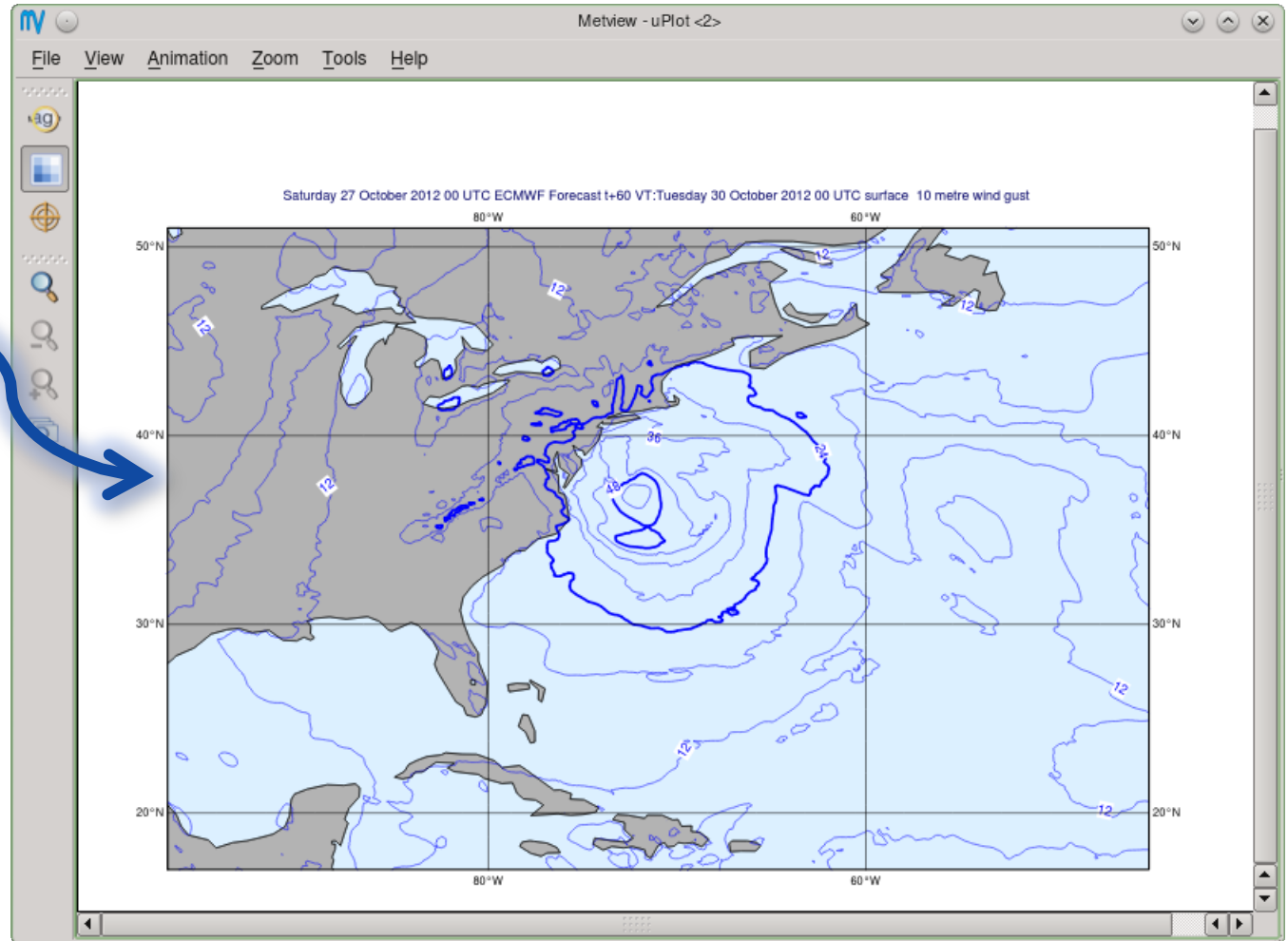


Drag and Drop

Map view



map_sandy

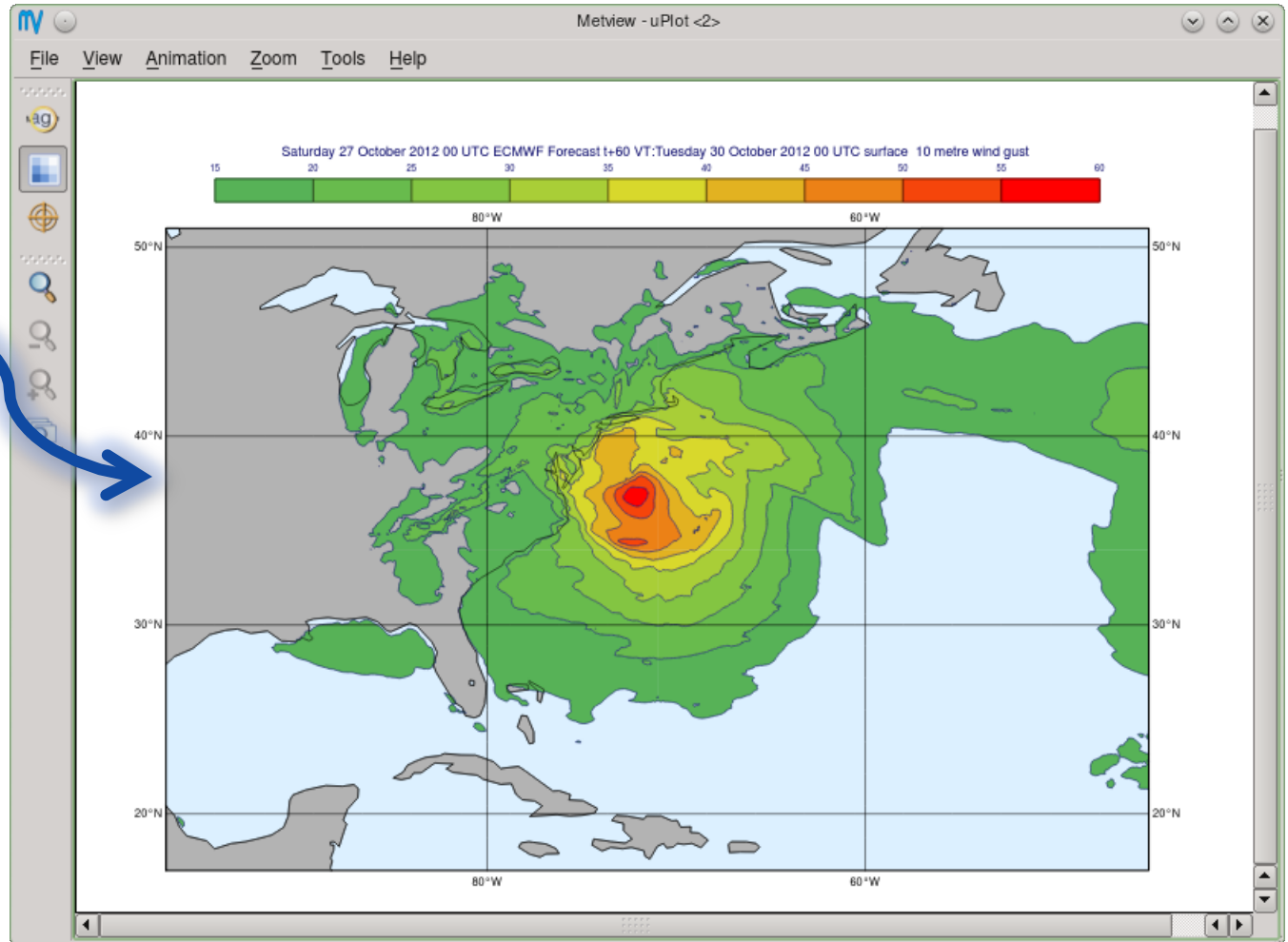


Drag and Drop

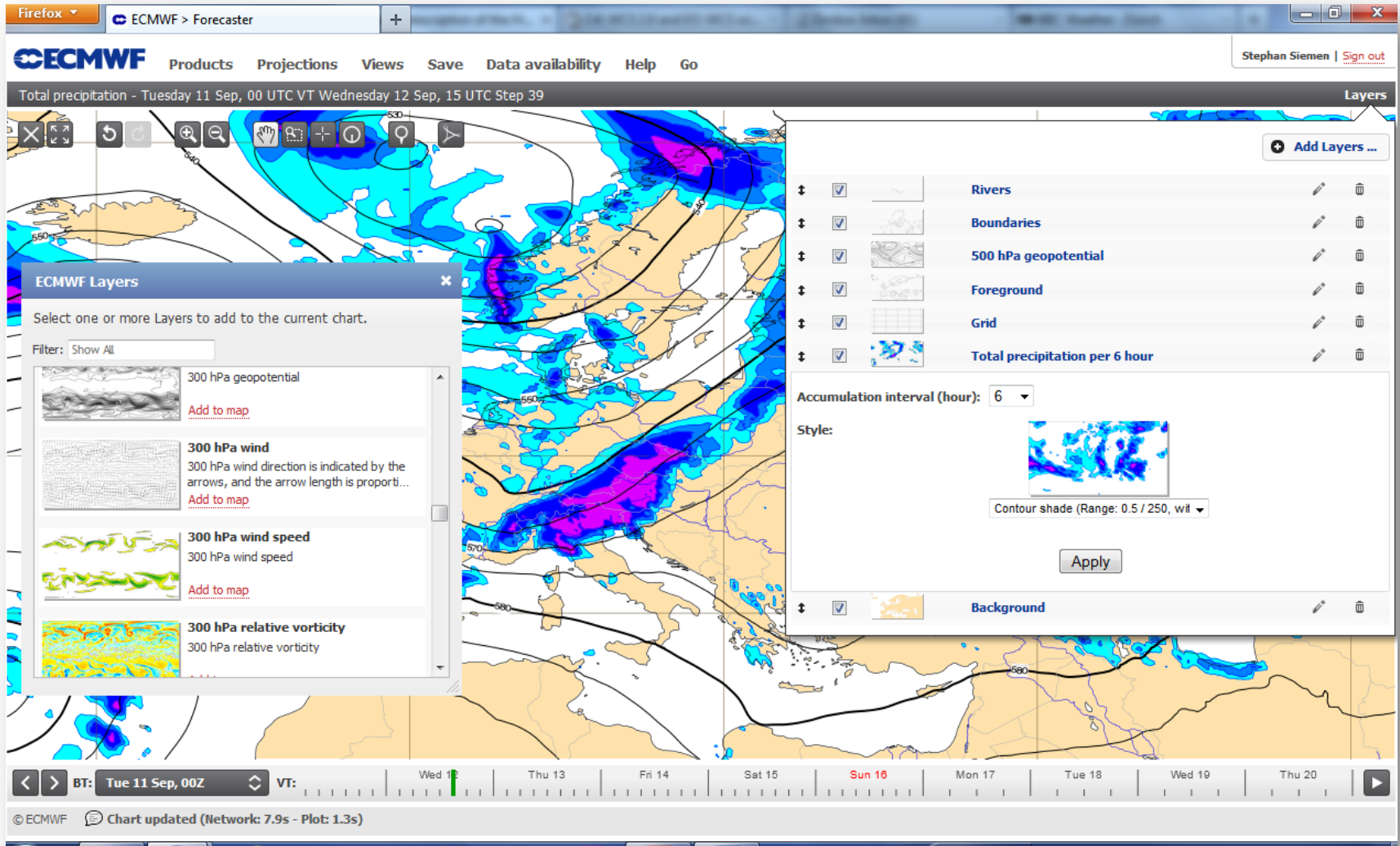
Contour shading



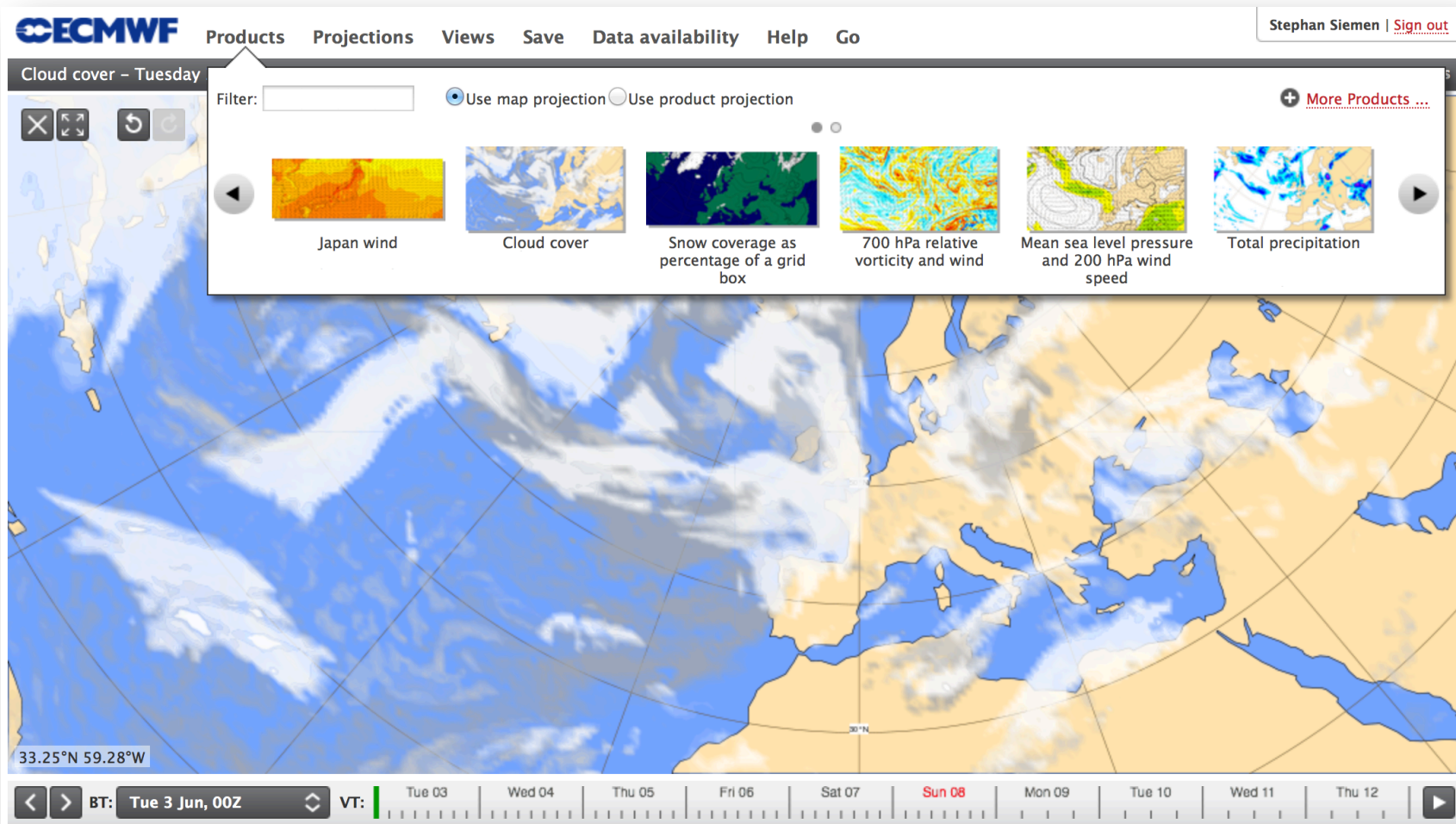
wgust_shade



Web interface - ecCharts 2



Web interface – ecCharts 3



Challenges

- **Powerful versus clean simple design**
- **Web versus traditional desktops**
 - Legends on full screen displays
 - Without clutter the display with windows
- **Responsive design**
 - Tablets versus 4K screens
- **Touch displays**
 - Has anyone experiences yet?
 - Which role will they play for forecasters/ decision makers?