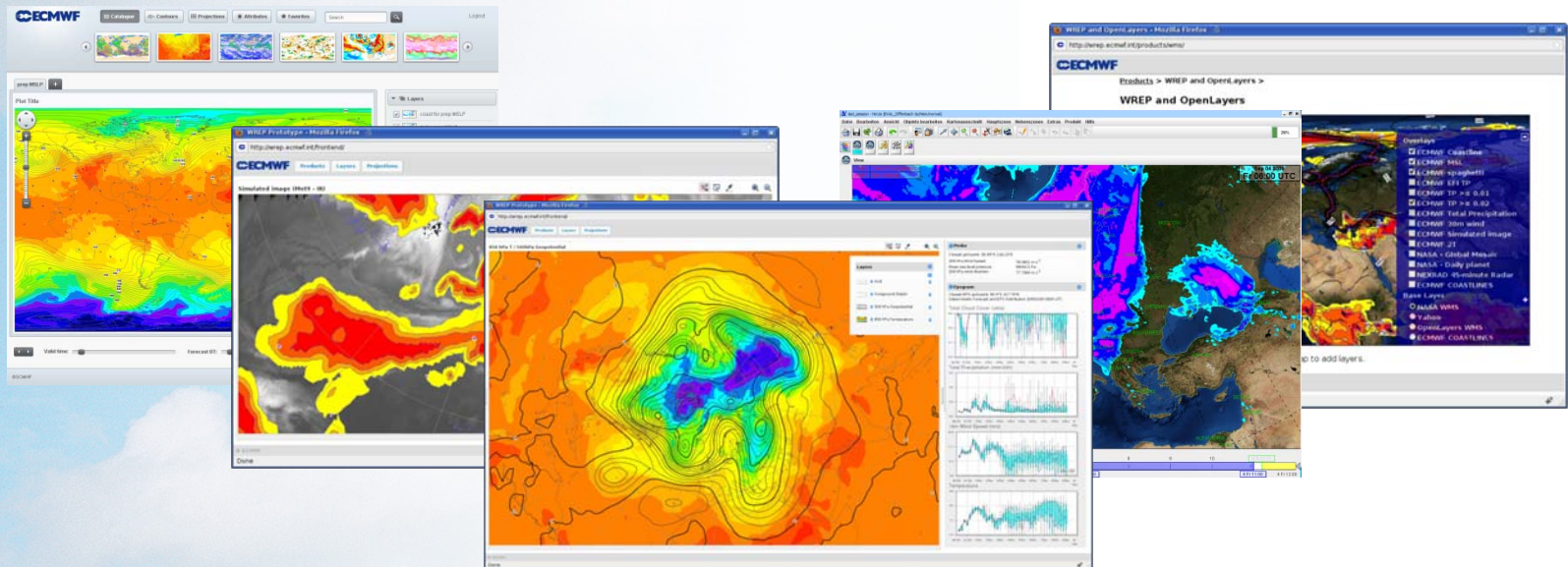


ECMWF Web re-engineering project

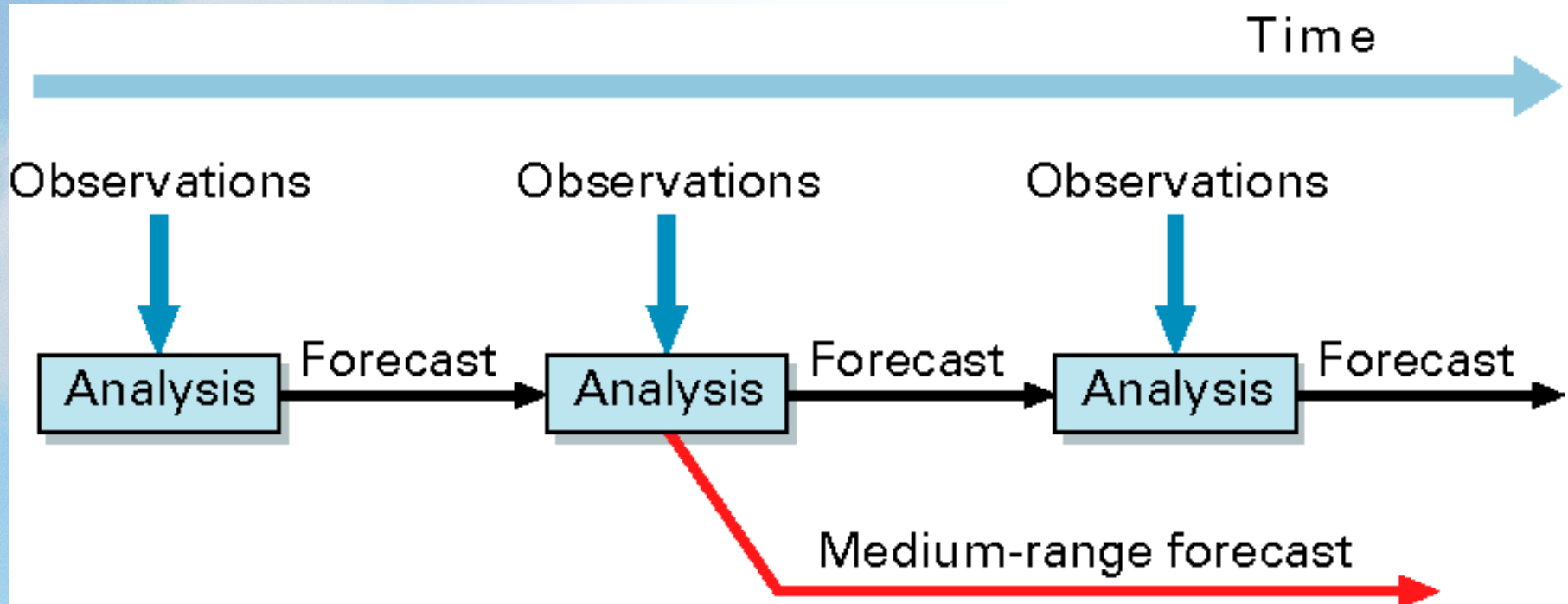
Baudouin Raoult

Peter Bispham, Andy Brady, Jose Louis Casado, Ricardo Correa, Sylvie Lamy-Thepaut, Tim Orford, David Richardson, Cihan Sahin, Stephan Siemen, Carlos Valiente, Daniel Varela



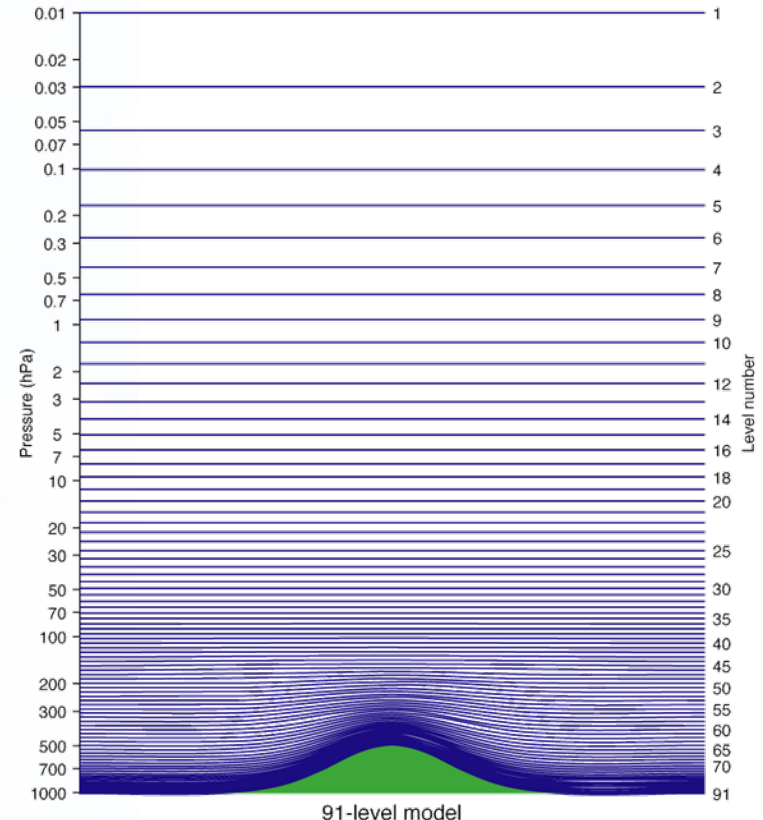
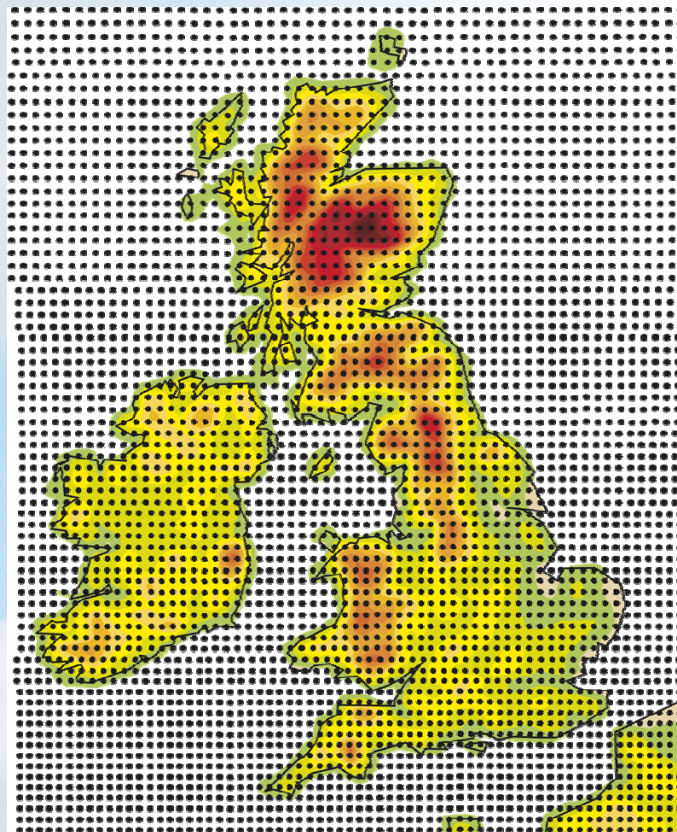
Dealing with large amount of multi-dimensional data

- Forecasts run several times a day, providing regular update of the possible future



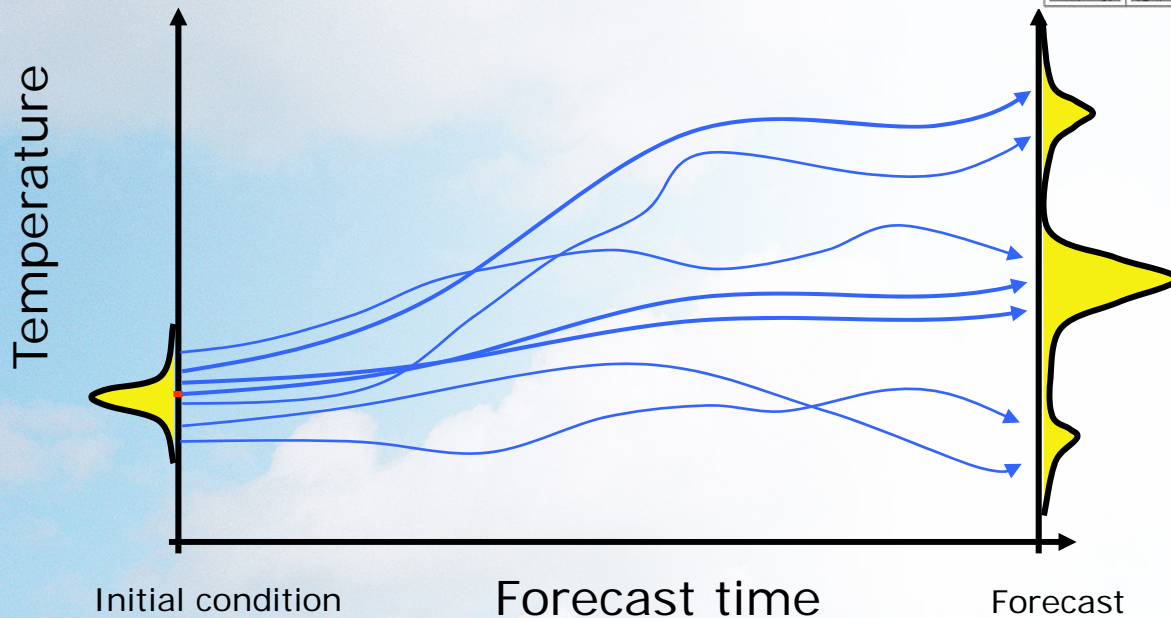
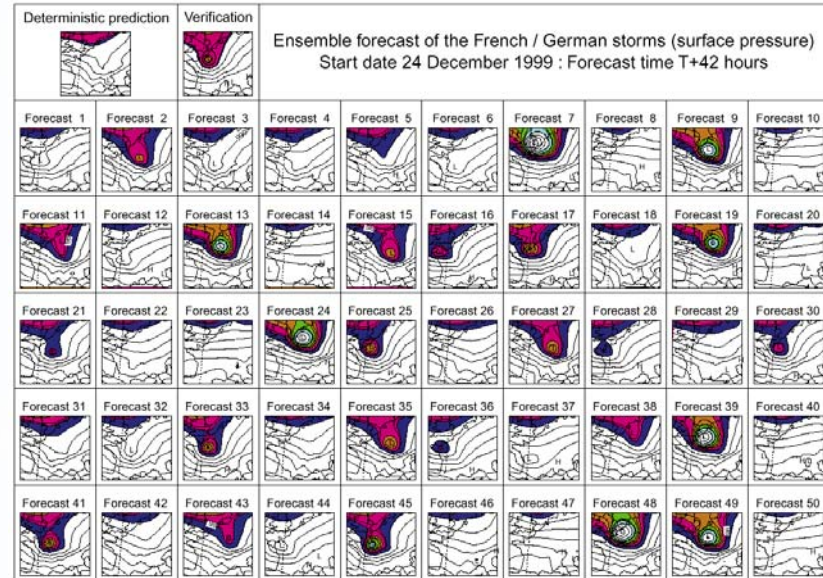
Dealing with large amount of multi-dimensional data (cont.)

- Each model grid point represent hundreds of meteorological variables: temperature, pressure, precipitations, ...
- The atmosphere is split vertically into many levels



Dealing with large amount of multi-dimensional data (cont.)

- Ensemble Forecasts: capturing the chaotic nature of the atmosphere
- Forecast many equally possible futures



Dealing with large amount of multi-dimensional data (cont.)

- Meteorological data is multi-dimensional
 - 3 dimensions of space
 - 2 dimensions of time (analysis time, forecast time)
 - ... and many more for ensemble prediction systems (many possible futures)
 - 100s of variables (Temperature, Wind, Clouds, Humidity,...)
 - many different models
 - Short range, Medium range, Monthly, Seasonal, ...
 - Global, Limited area
 - From several NWP centres around the world
- Current web interfaces are limited to:
 - 2 space dimensions (screen)
 - 1 time dimension (animation)
 - 4 colour dimensions (red, green, blue and transparency)

Dealing with large amount of multi-dimensional data (cont.)

- Make full use of available graphical tools
 - Layering
 - Colour, transparency, symbols
 - Animations
 - Re-projections
- Provide statistical analysis tools
 - Means, probabilities, clustering, ...
 - Time series, cross-sections, ...
- Give the user full control over these tools
 - ... so they can choose what suit their current workflow
 - Requires the ability to run these tools “on-demand”, based on user input, in a reasonable time (e.g. <10s)

ECMWF Web re-engineering project:

- Motivations

- Increasing use by our supporting states and many commercial customers of our web products
 - Demand for a high availability service
- Users request more tailored products
 - Requires on-demand plot production

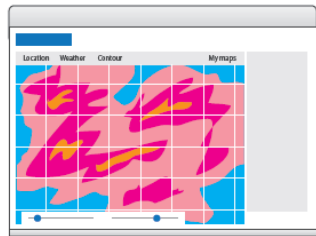
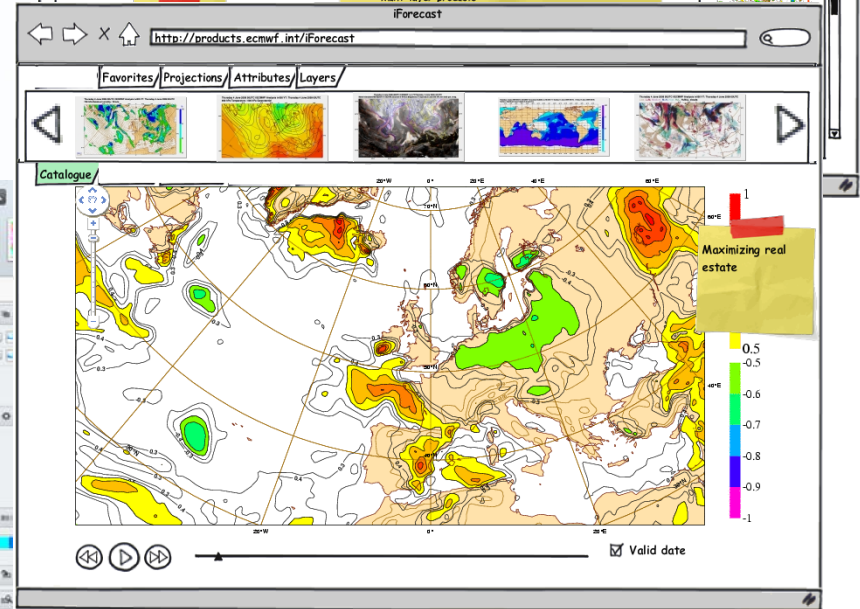
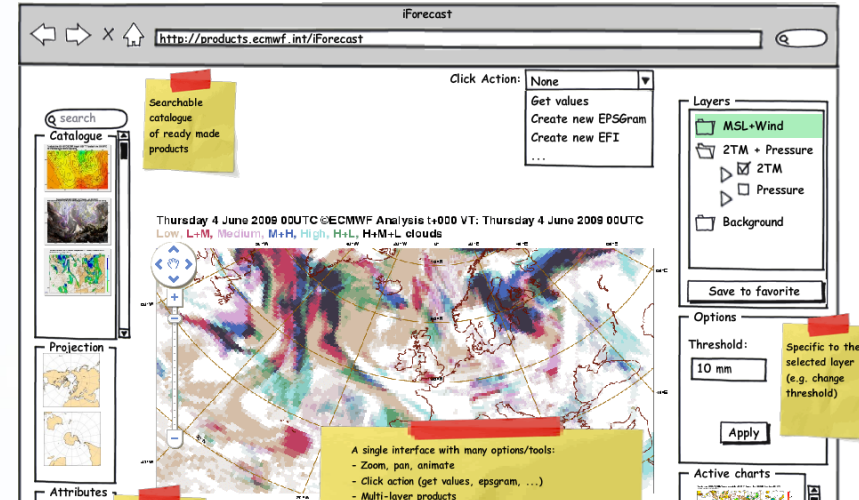
- Goals

- Redesign the web infrastructure so that the web service is highly available
- Provide more interactivity (e.g. zoom, pan, overlay parameters)
- Allow product customisation (e.g. control the event threshold on probability maps)
- Use open (OGC) standards so that ECMWF products can be embedded in users' own software

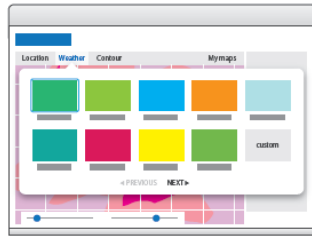
- Aimed directly at our Member States forecasters and commercial customers

Gathering of user requirements

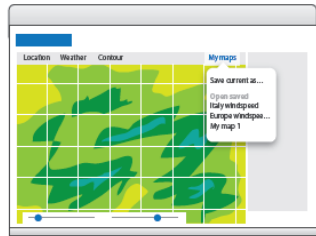
- The project has been presented on several occasions
- Consultation process will continue throughout the project
- Focus on usability



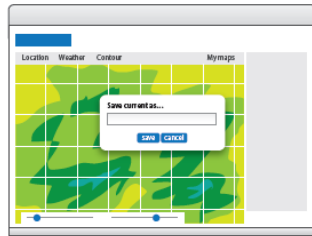
1. The user would arrive and be greeted by a default map. Along the top are the main selectors, along the right is the legend and the time controls are along the bottom.



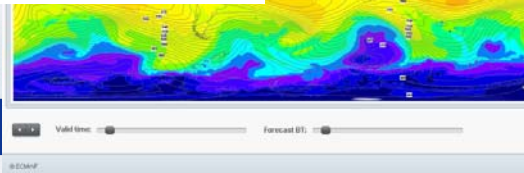
2. The selectors allow the user to change the location, weather type and contour style on the fly. Custom versions would work in a similar way to no6 in option 1.



4. Users can save their settings using the 'my map' menu. Users can also use this screen to access previously saved maps.

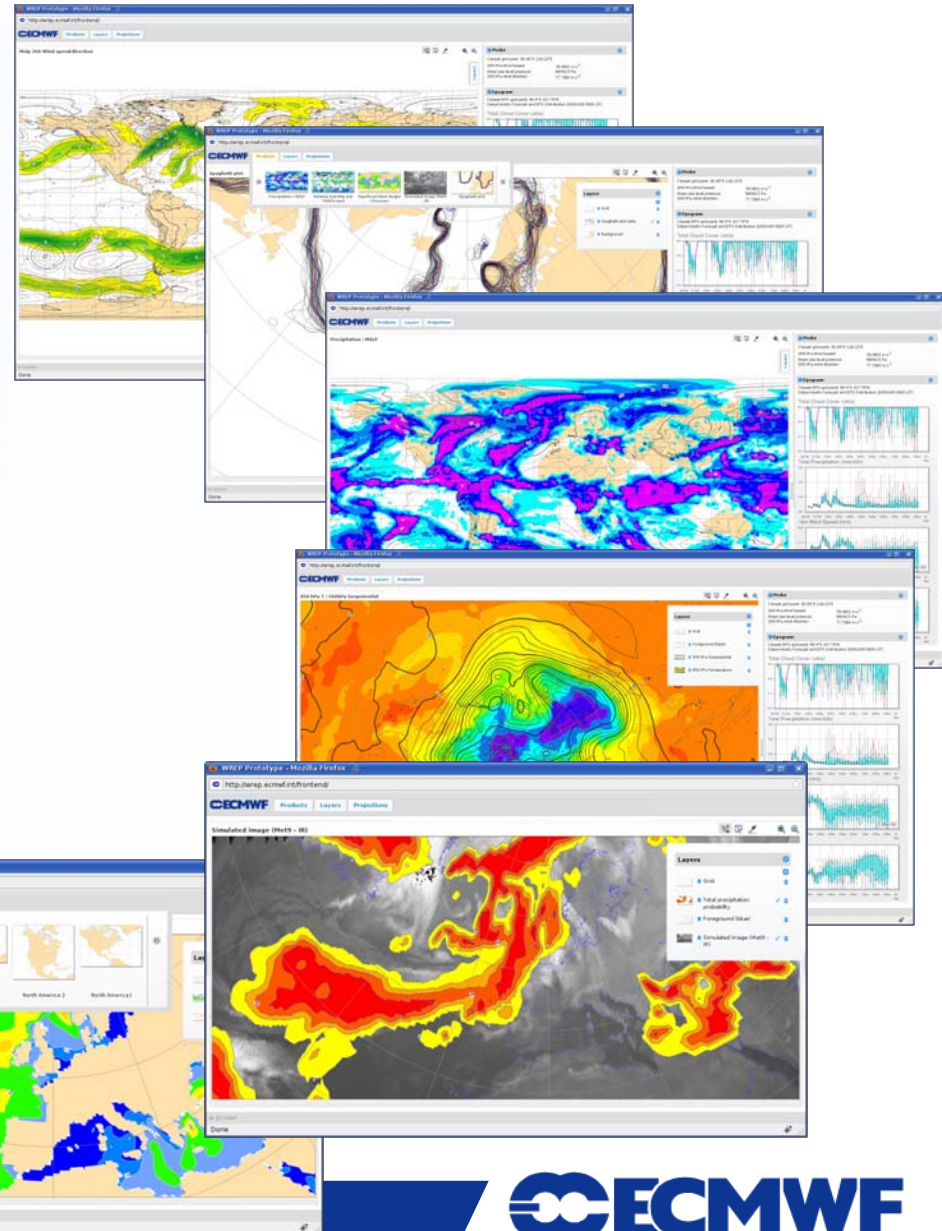


5. If the user chooses to 'save current as...' a popup box will prompt them to give the map a name. They will then be returned to their map.



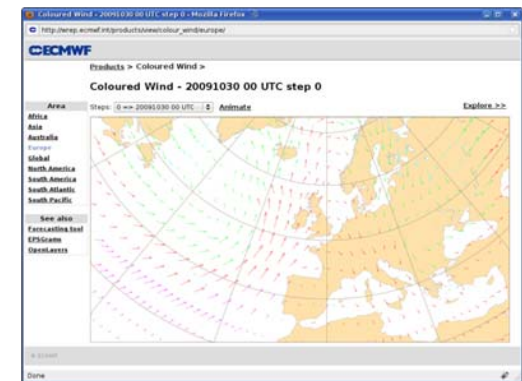
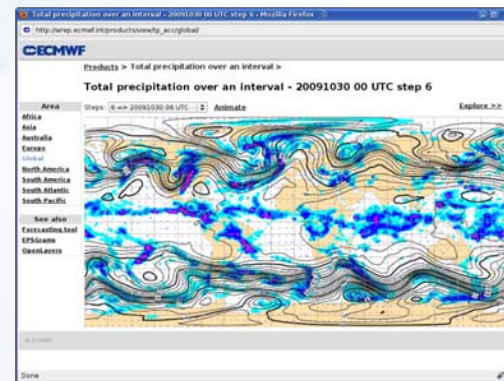
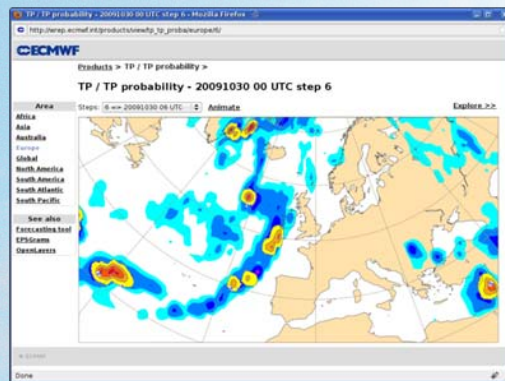
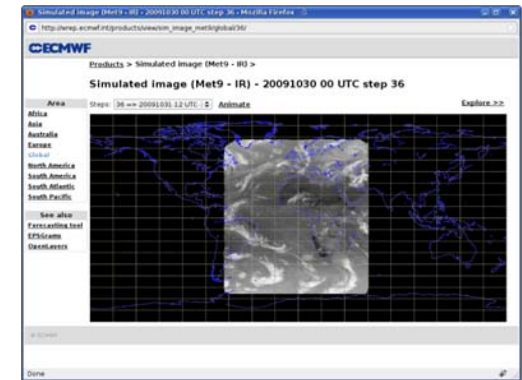
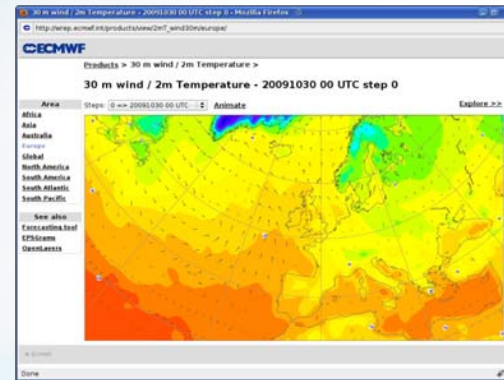
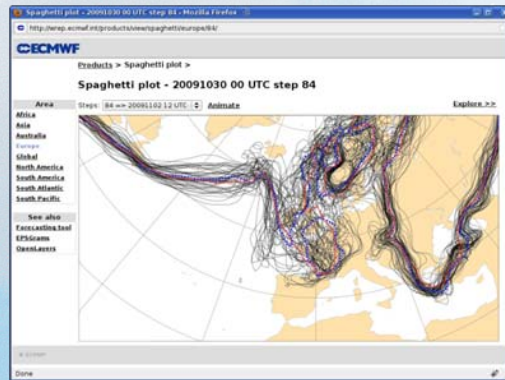
Application 1: Web based forecasting tool

- Fully Interactive:
 - zooming, panning, ...
 - animations
- Customisation:
 - Probabilities threshold, ...
 - Show/hide, add/remove layers
- Associated tools: e.g. meteograms
- For expert users (forecasters)



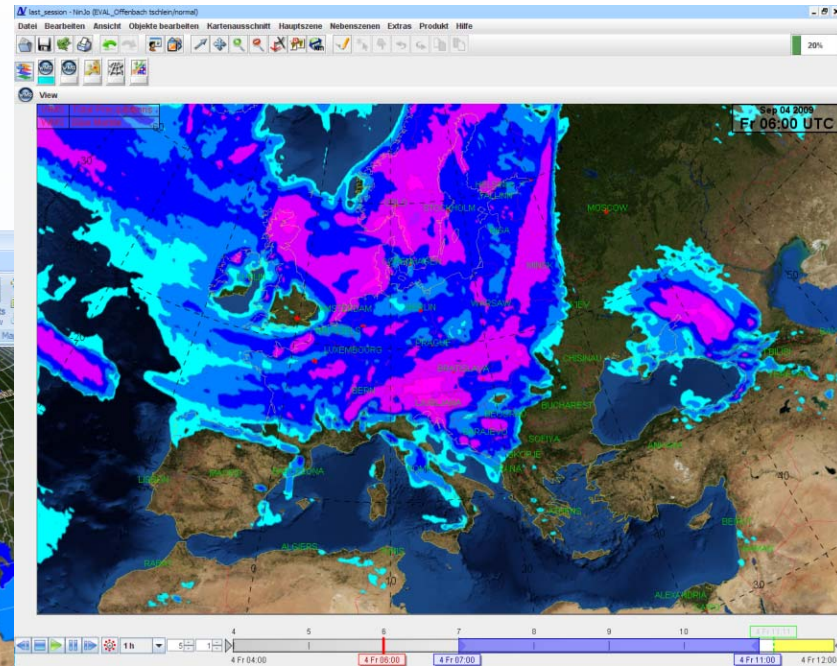
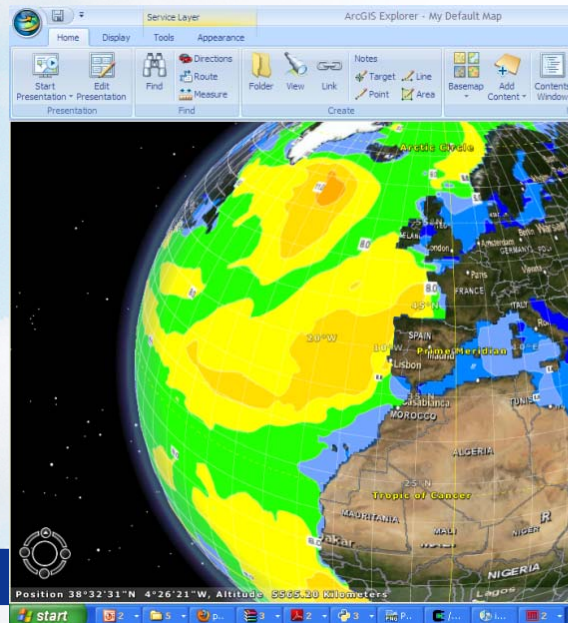
Application 2: Product catalogue

- Browsable and searchable graphical product catalogue
- Limited interactivity – Preset number of projections, animation
- Intended to be used by a wider audience

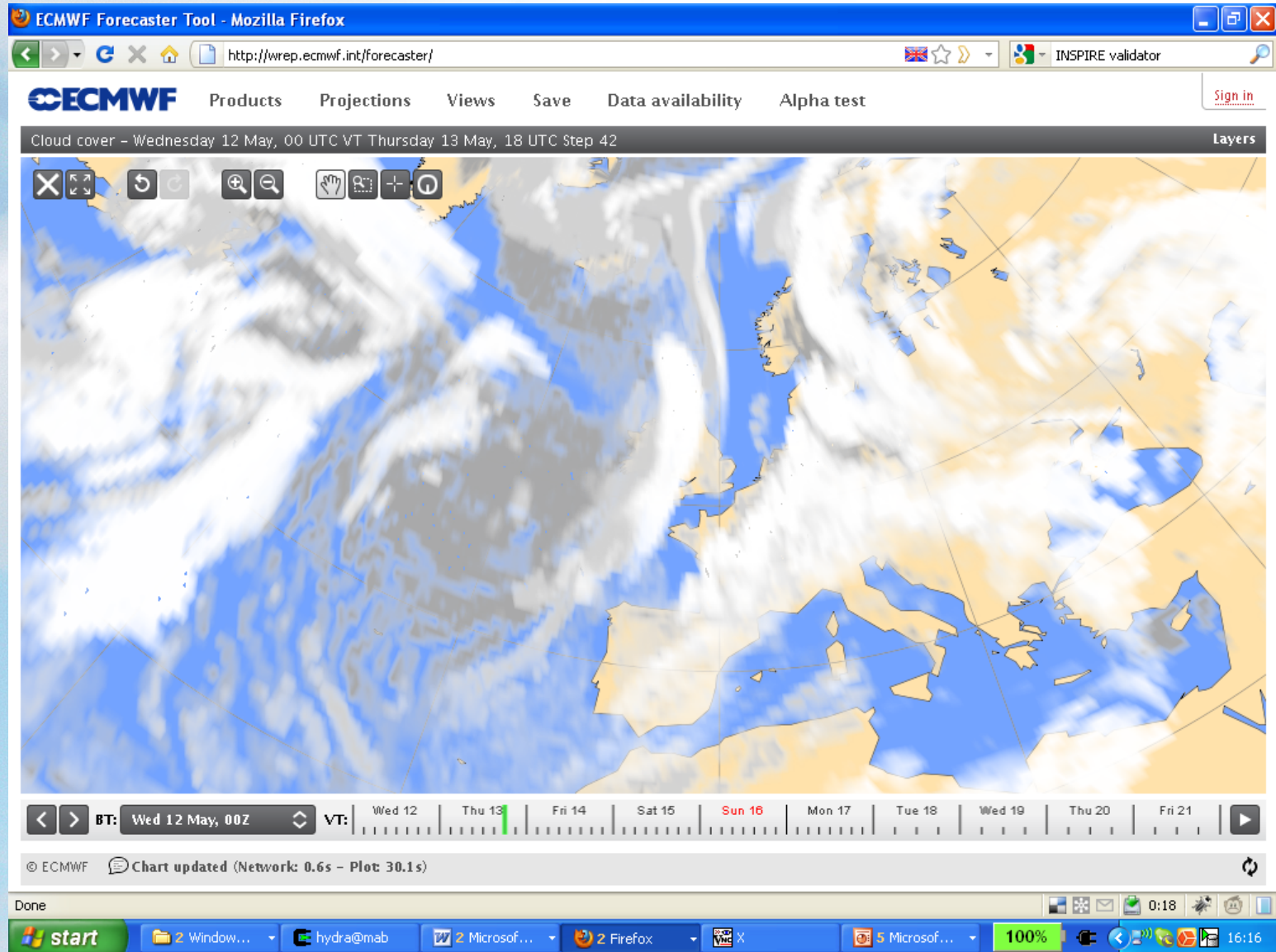


Application 3: OGC Web Map Services

- So that ECMWF products can be directly embedded in the forecasters' workstations application
- All products accessible via WMS protocol:
 - “GetCapabilities” document build dynamically from product catalogue content
 - Layers are created on-demand
- Challenges:
 - access control
 - time dimension
 - customisation



Forecasting tool main user interface



Predefined projections

The screenshot displays the ECMWF Forecaster Tool interface in Mozilla Firefox. The browser address bar shows <http://wrep.ecmwf.int/forecaster/>. The main navigation menu includes **Products**, **Projections**, **Views**, **Save**, **Data availability**, and **Alpha test**. A **Sign in** link is located in the top right corner.

The interface features a main map area showing a 700 hPa relative humidity field over a grid. A **Filter:** input field is positioned above the map. A **Projections** panel is open, displaying four projection thumbnails: **Global**, **North hemisphere**, **South hemisphere**, and **Europe**. An **ECMWF Projections** dialog box is overlaid on the map, containing a **Filter:** field and a list of predefined projections:

- East tropics 35S/0 (Lower left), 35N/180E (Upper right) in cylindrical projection**
[Add to projection list](#) [Apply to map](#)
- Tropics west**
West tropics 35S/180W (Lower left), 35N/0 (Upper right) in cylindrical projection
[Add to projection list](#) [Apply to map](#)
- Continents and Oceans**
 - Africa**
Africa 40S/45W (Lower left), 40N/75E (Upper right) in cylindrical projection
[Add to projection list](#) [Apply to map](#)
 - Asia**
Asia 0/55E (Lower left), 80N/175E...
[Add to projection list](#) [Apply to map](#)

The bottom of the interface includes a time control bar with **BT:** Wed 12 May, 00Z and **VT:** Wed 12, Thu 13, Fri 14. A **Hide Projections you already have** checkbox is checked. The footer shows the ECMWF logo and copyright information.

Multi-layer maps

The screenshot displays the ECMWF Forecaster Tool interface in Mozilla Firefox. The browser address bar shows the URL <http://wrep.ecmwf.int/forecaster/>. The page title is "ECMWF Forecaster Tool - Mozilla Firefox". The main content area shows a weather map titled "700 hPa relative humidity and wind - Wednesday 12 May, 00 UTC VT Thursday 13 May, 18 UTC Step 42". The map displays a color-coded background representing relative humidity and overlaid wind vectors. A "Layers" panel on the right lists the active layers: Grid, Foreground, 700 hPa wind, 700 hPa relative humidity, and Background. A dialog box titled "ECMWF Layers" is open, allowing the user to select additional layers to add to the chart. The dialog includes a filter input field and a list of available layers with their descriptions and "Add to map" buttons.

ECMWF Forecaster Tool - Mozilla Firefox

http://wrep.ecmwf.int/forecaster/

INSPIRE validator

ECMWF Products Projections Views Save Data availability Alpha test Sign in

700 hPa relative humidity and wind - Wednesday 12 May, 00 UTC VT Thursday 13 May, 18 UTC Step 42 Layers

ECMWF Layers

Select one or more Layers to add to the current chart.

Filter:

Total precipitation
Total precipitation over an interval. Total precipitation is accumulated in the period from the forecast valid time (V...
[Add to map](#)

2m temperature
2m temperature from deterministic forecast
[Add to map](#)

10m wind
10m wind direction as indicated by the arrows. The arrow length is proportional to the wind speed as well
[Add to map](#)

10m wind speed
10m wind speed from deterministic forecast
[Add to map](#)

Layers

[Add Layers...](#)

Grid

Foreground

700 hPa wind

700 hPa relative humidity

Background

BT: Wed 12 May, 00Z VT: Wed 12 Thu 13 Fri 14 Sat 15 Sun 16 Mon 17 Tue 18 Wed 19 Thu 20 Fri 21

© ECMWF

Done

start 2 Window... hydra@mab 2 Microsof... 2 Firefox X 5 Microsof... 100% 0:18 16:15

Controlling style

The screenshot displays the ECMWF Forecaster Tool interface in a Mozilla Firefox browser window. The browser address bar shows the URL `http://wrep.ecmwf.int/forecaster/?product=t3999`. The page header includes the ECMWF logo and navigation links: Products, Projections, Views, Save, Data availability, and Alpha test. A 'Sign in' link is located in the top right corner.

The main content area shows a weather map titled 'T3999 Experiment - Tuesday 17 Mar, 12 UTC VT Tuesday 17 Mar, 15 UTC Step 3'. The map displays a color-coded temperature field over Europe and the Mediterranean, with contour lines overlaid. A toolbar with navigation and zoom controls is positioned above the map.

On the right side, a 'Layers' panel is open, listing various data layers with checkboxes and icons for visibility and deletion:

- Grid
- Foreground
- High cloud cover (T3999)
- Medium cloud cover (T3999)
- Low cloud cover (T3999)
- 10m wind (T3999)
- Mean sea level pressure (T3999)
- Total precipitation per 3 hour (T3999)
- 2m temperature (T3999)

Below the layers list, a 'Style' section is visible, showing a preview of the 2m temperature layer. A dropdown menu is open, showing two options for contour shading:

- Contour shade (Range: -48 / 56) - Selected
- Contour (Interval 2, red, dash)

The selected option shows a preview of the temperature field with red contour lines. The 'Contour (Interval 2, red, dash)' option shows a preview of the contour lines without shading.

At the bottom of the browser window, the Windows taskbar is visible, showing the start button, open windows for 'Window...', 'hydra@mab', '2 Microsof...', '2 Firefox', and '5 Microsof...'. The system tray shows the time as 16:22 and the battery level at 100%.

Controlling style (cont.)

The screenshot displays the ECMWF Forecaster Tool interface within a Mozilla Firefox browser window. The browser's address bar shows the URL <http://wrep.ecmwf.int/forecaster/?product=t3999>. The page header includes the ECMWF logo and navigation links: Products, Projections, Views, Save, Data availability, and Alpha test. A 'Sign in' link is located in the top right corner.

The main content area features a weather map titled 'T3999 Experiment - Tuesday 17 Mar, 12 UTC VT Tuesday 17 Mar, 15 UTC Step 3'. The map shows a geographical region with various weather data overlays, including red dashed contour lines and a color-coded temperature field. A toolbar with navigation icons (back, forward, home, search, zoom, pan, etc.) is positioned above the map.

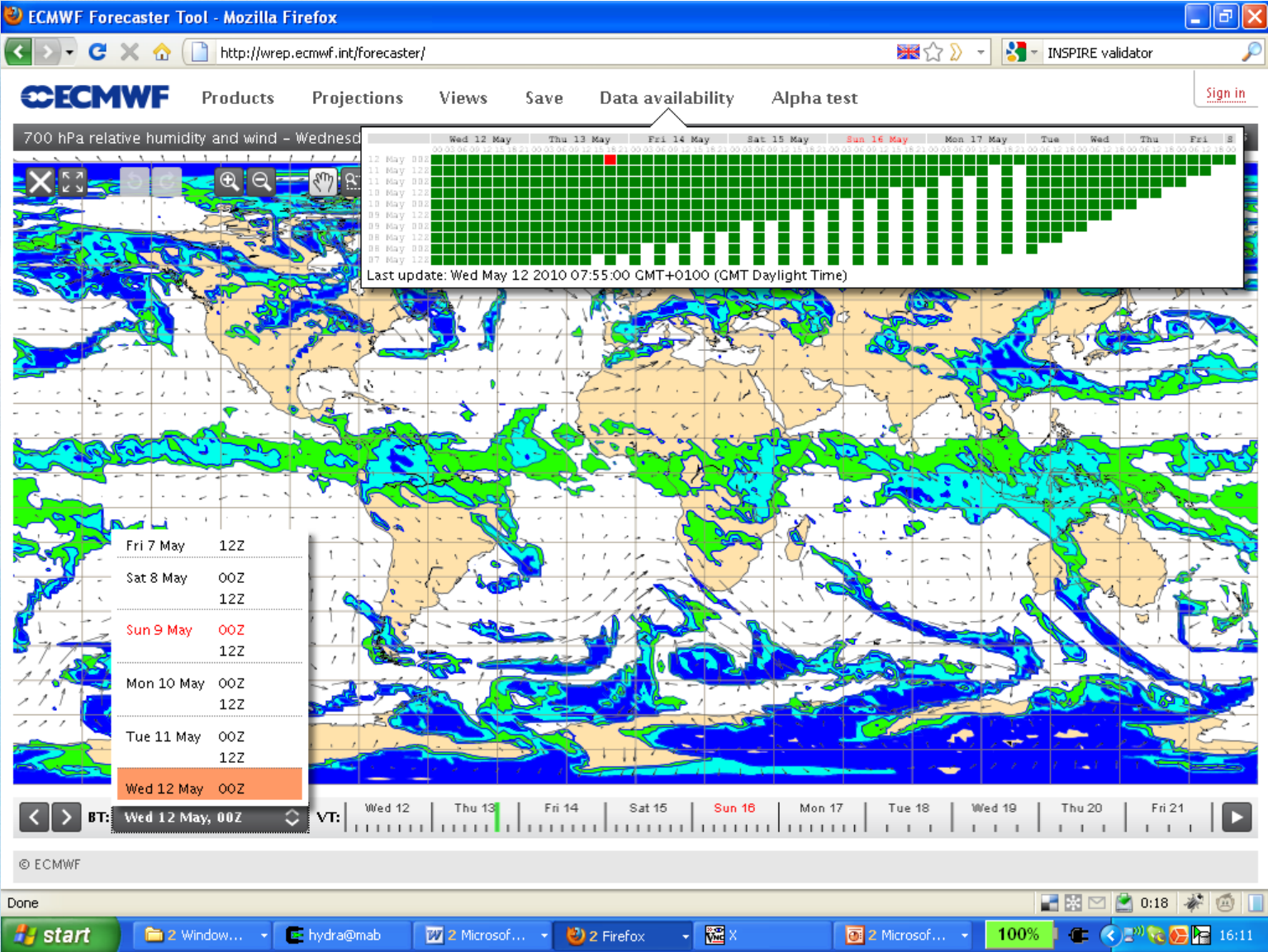
On the right side, a 'Layers' panel is open, listing several data layers with checkboxes and icons for visibility and deletion:

- Grid
- Foreground
- High cloud cover (T3999)
- Medium cloud cover (T3999)
- Low cloud cover (T3999)
- 10m wind (T3999)
- Mean sea level pressure (T3999)
- Total precipitation per 3 hour (T3999)
- 2m temperature (T3999)

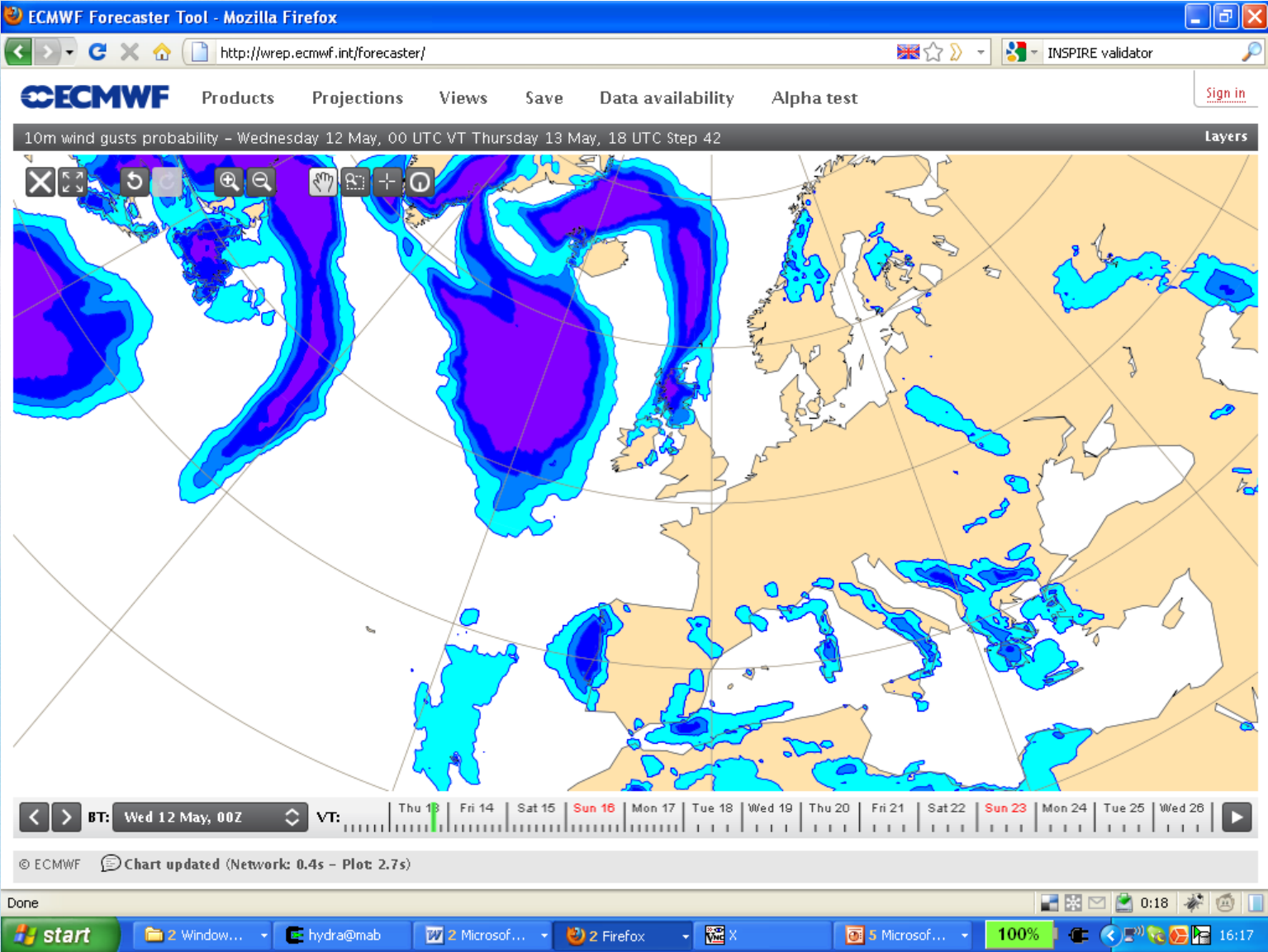
Below the layers list, a 'Style' section is visible, showing a preview of the selected layer (2m temperature) and a dropdown menu set to 'Contour (Interval 2, red, dash)'. An 'Apply' button is located below the dropdown.

At the bottom of the interface, there is a time control bar with 'BT: Tue 17 Mar, 12Z' and 'VT:'. Below this, a status bar indicates '© ECMWF Chart updated (Network: 0.4s - Plot: 5.4s)'. The Windows taskbar at the very bottom shows the system tray with the time '16:22' and various background applications.

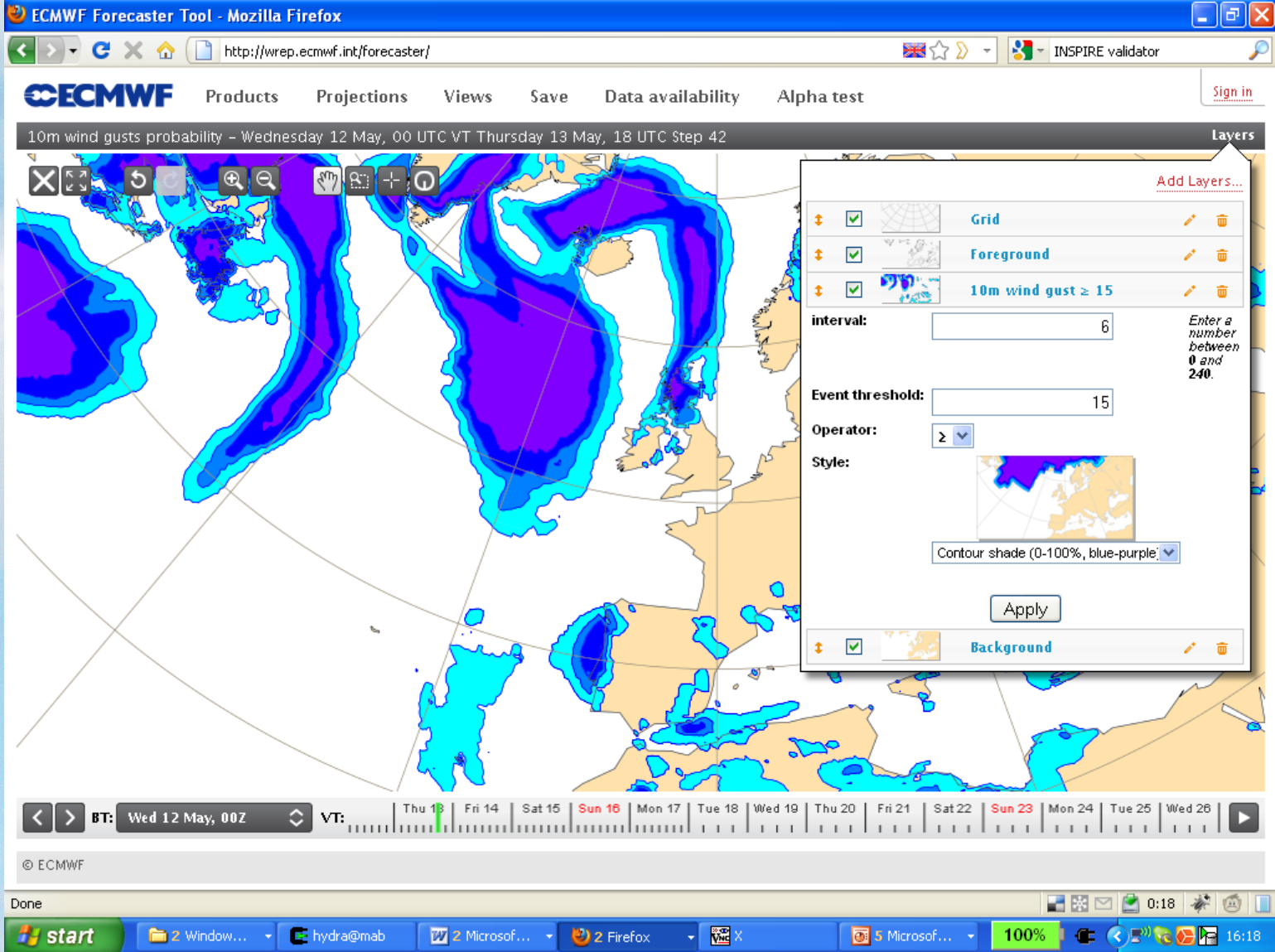
Handling time dimensions



EPS data: probability maps



EPS data: probability maps (cont.)



EPS data: probability maps (cont.)

ECMWF Forecaster Tool - Mozilla Firefox

http://wrep.ecmwf.int/forecaster/

INSPIRE validator

ECMWF Products Projections Views Save Data availability Alpha test Sign in

10m wind gusts probability - Wednesday 12 May, 00 UTC VT Thursday 13 May, 18 UTC Step 42

Layers

- Grid
- Foreground
- 10m wind gust \geq 20
 - interval: 3
 - Event threshold: 20
 - Operator: \geq
 - Style: Contour shade (0-100%, blue-purple)
- Background

BT: Wed 12 May, 00Z VT: Thu 13 Fri 14 Sat 15 Sun 16 Mon 17

© ECMWF Chart updated (Network: 0.3s - Plot: 4.8s)

Windows taskbar: start, Window..., hydra@mab, 2 Microsof..., 2 Firefox, 5 Microsof..., 100%, 0:18, 16:19

Data exploring tools

ECMWF Forecaster Tool - Mozilla Firefox

http://wrep.ecmwf.int/forecaster/?product=t3999

INSPIRE validator

ECMWF Products Projections Views Save Data availability Alpha test Sign in

T3999 Experiment - Tuesday 17 Mar, 12 UTC VT Tuesday 17 Mar, 15 UTC Step 3 Layers

Probe

Data values at location 55.76°N 13.63°W, Tuesday 17 Mar, 12 UTC T+3

Layer	Value	Point selected	Location	Distance
10m wind (T3999)	13 ms ⁻¹ W	nearest	55.77°N 13.59°W	2.5 km
Mean sea level pressure (T3999)	1027.12 hPa	nearest	55.77°N 13.59°W	2.5 km
Total precipitation per 3 hour (T3999)	0 mm	nearest	55.77°N 13.59°W	2.5 km
2m temperature (T3999)	10 °C	nearest	55.77°N 13.59°W	2.5 km
Model orography (T3999)	0 m	nearest	55.77°N 13.59°W	2.5 km

Dismiss

BT: Tue 17 Mar, 12Z VT:

© ECMWF

Done

start 2 Window... hydra@mab 2 Microsof... 2 Firefox X 5 Microsof... 100% 0:18 16:25

Data exploring tools (cont.)

ECMWF Forecaster Tool - Mozilla Firefox

http://wrep.ecmwf.int/forecaster/?product=t3999

INSPIRE validator

ECMWF Products Projections Views Save Data availability Alpha test Sign in

850 hPa relative humidity and wind - Friday 7 May, 12 UTC VT Friday 7 May, 18 UTC Step 6 Layers

Time Series (Experimental)
Data values at location 46.2°N 6.15°E, Genève, Switzerland
 Mean sea level pressure (hPa)

1019.9
1001.7

7 May 8 May 9 May 10 May 11 May 12 May 13 May 14 May 15 May 16 May 17 May 18 May

850 hPa wind

Total precipitation per 6 hour (mm)

7.7
0.0

7 May 8 May 9 May 10 May 11 May 12 May 13 May 14 May 15 May 16 May 17 May 18 May

2m temperature (°C)

20.4
4.0

7 May 8 May 9 May 10 May 11 May 12 May 13 May 14 May 15 May 16 May 17 May 18 May

This functionality is experimental, and may be very slow to load. Dismiss

City Finder
 Enter a city name: geneva 126 matches [hide](#)

Matches may be very close to each other and show as one point on the map. Dismiss

Probe
Data values at location 46.2°N 6.15°E, Friday 7 May, 12 UTC T+6, Genève, Switzerland

Layer	Value	Point selected	Location	Distance
Mean sea level pressure	1006.01 hPa	nearest	46.18°N 6.2°E	5.01 km
850 hPa wind	5 ms ⁻¹ E-N-E	nearest	46.32°N 0.82°E	409.41 km
Total precipitation per 6 hour	0 mm	nearest	46.18°N 6.2°E	5.01 km
2m temperature	11.4 °C	nearest	46.18°N 6.2°E	5.01 km

Dismiss

Mon 10 Tue 11 Wed 12 Thu 13 Fri 14 Sat 15 Sun 16

© ECMWF

Done

start Window... hydra@mab 2 Microsof... 2 Firefox X 5 Microsof... 100% 0:18 16:37

Project Status

- Half way into the project
 - Alpha test with forecasters from our Member States will start soon
- Infrastructure work
 - Security and access control
 - Monitoring, alerts and service statistics
 - Management tools
 - Performance tuning
- Product development
 - Clustering
 - Tropical cyclone tracks
 - Extreme forecast indices
 - Monthly and seasonal products
 - Quality and performance scores
 - ...

Thank you

