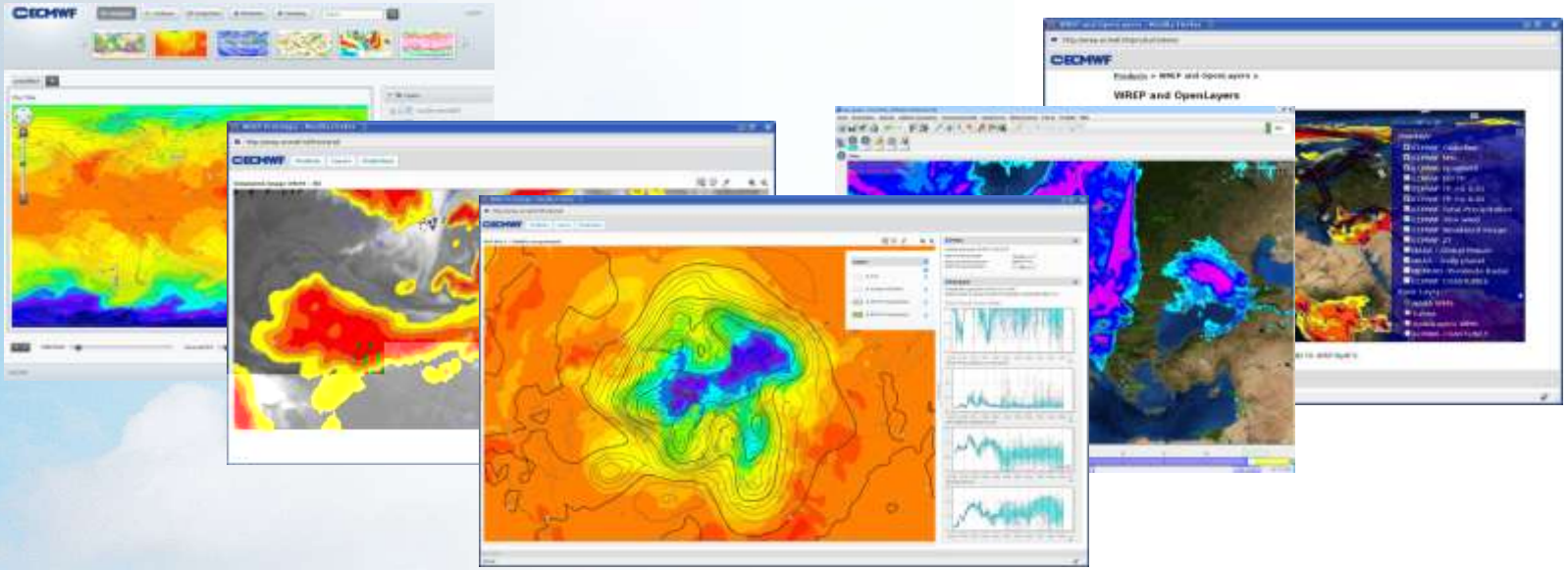
ECMWF Web re-engineering project

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



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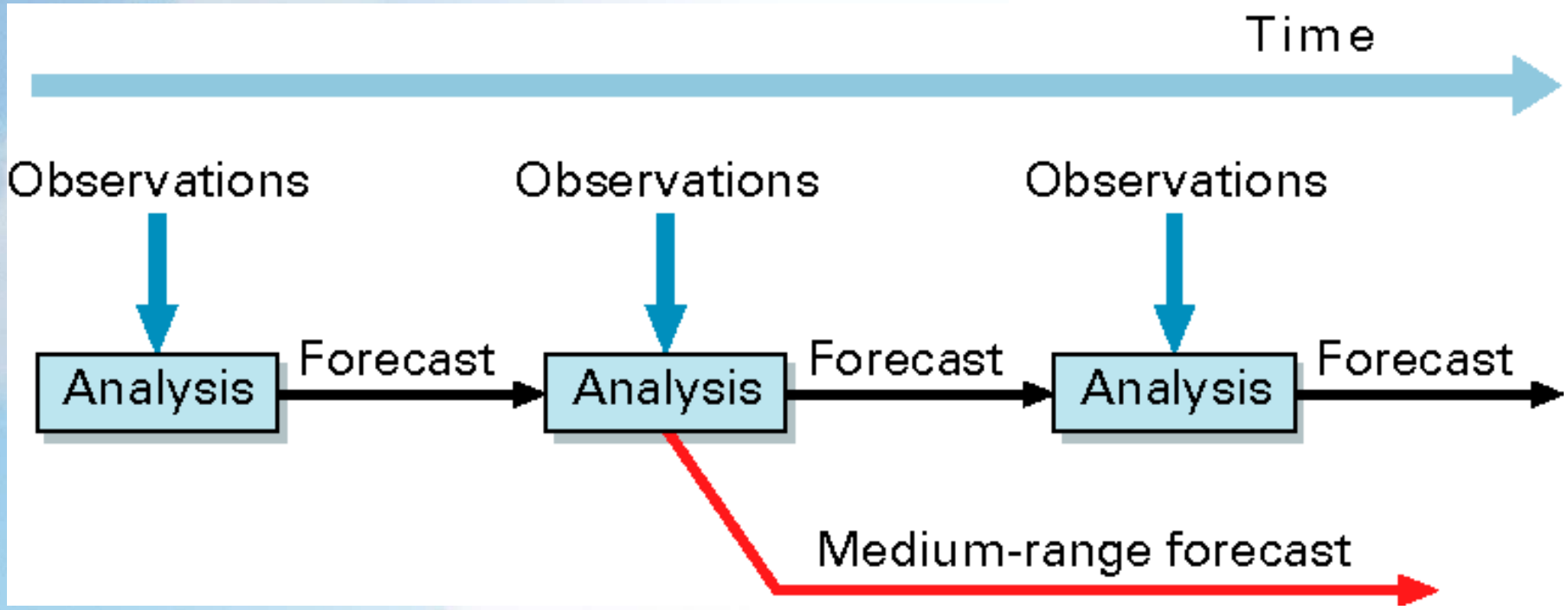
Dealing with large amount of multi-dimensional data

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



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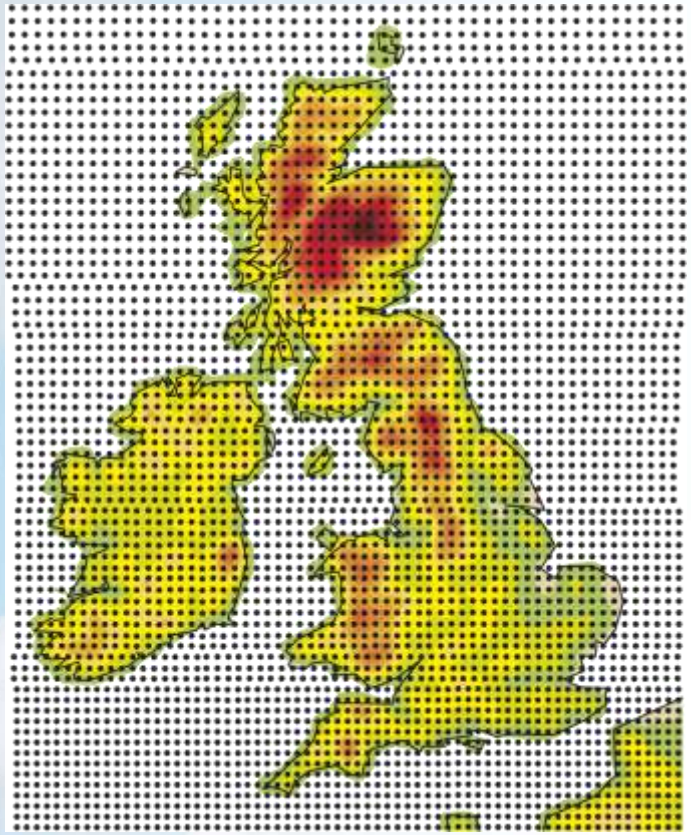
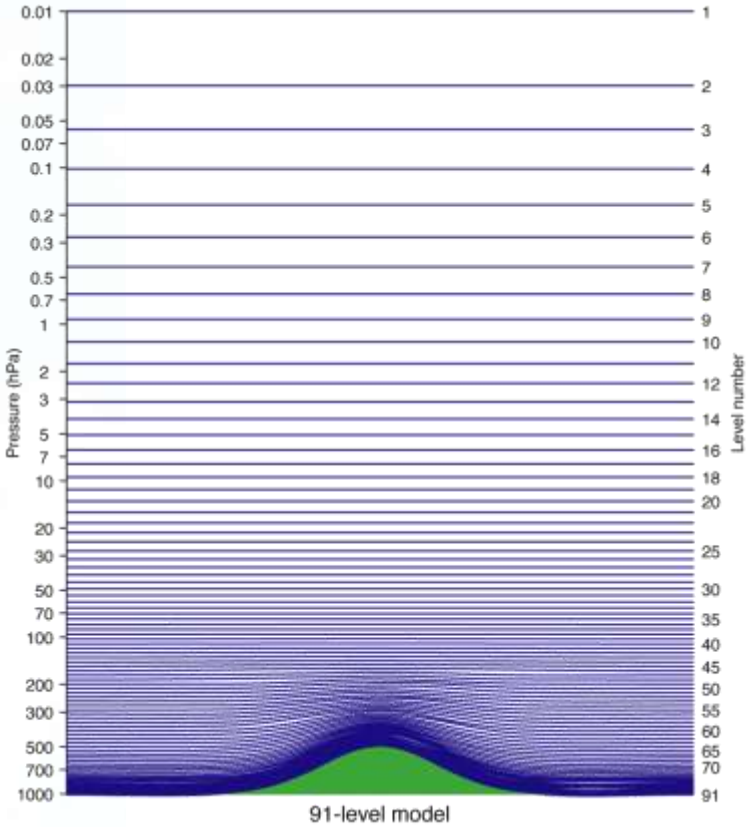
Dealing with large amount of multi-dimensional data (cont.)

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





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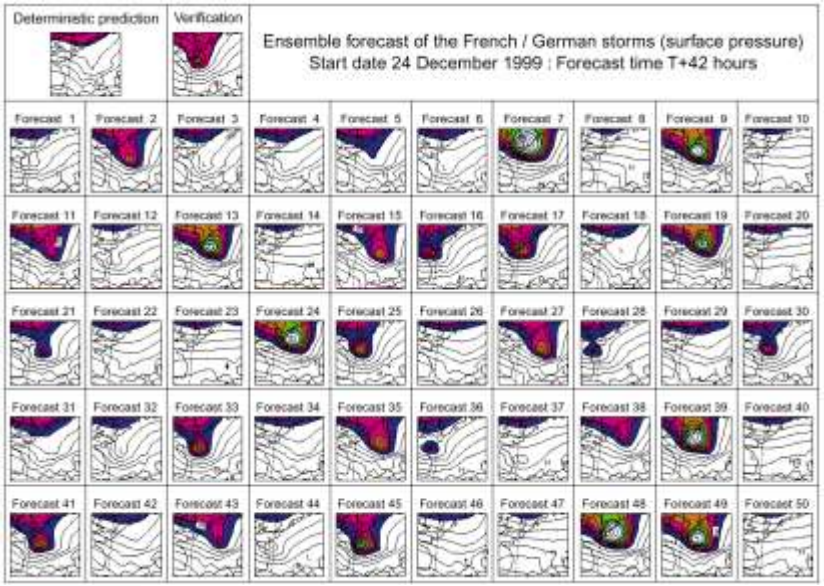
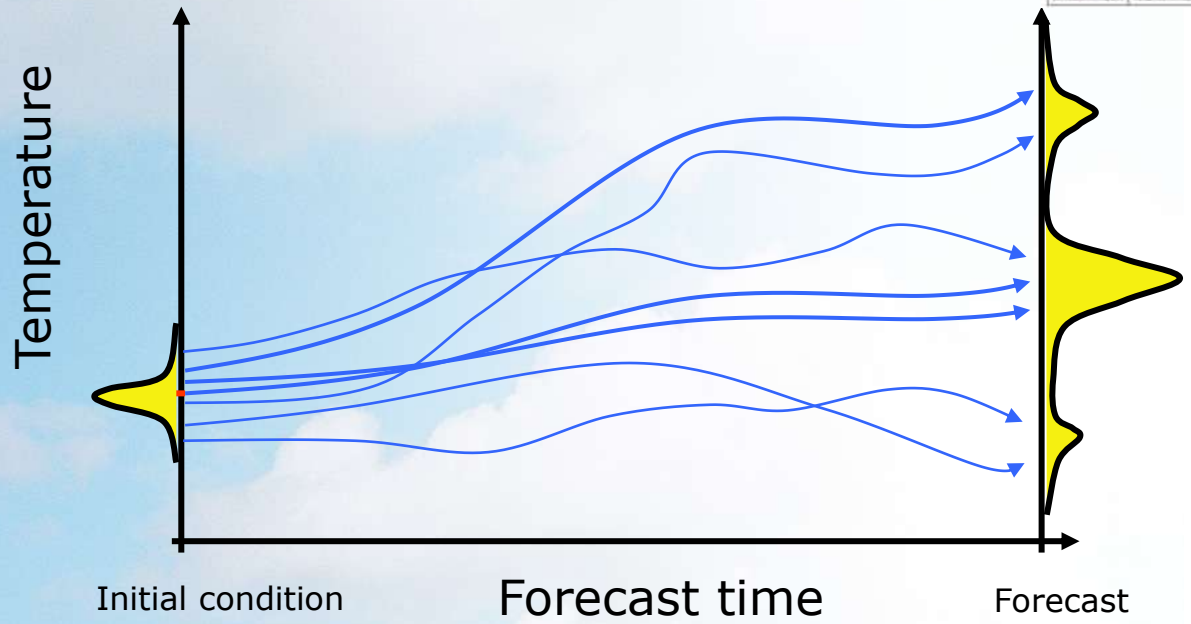
Dealing with large amount of multi-dimensional data (cont.)

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





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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)

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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)

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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

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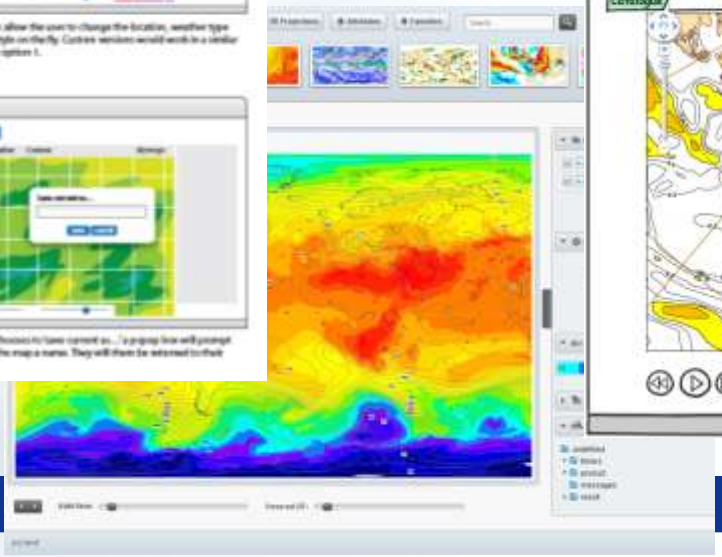
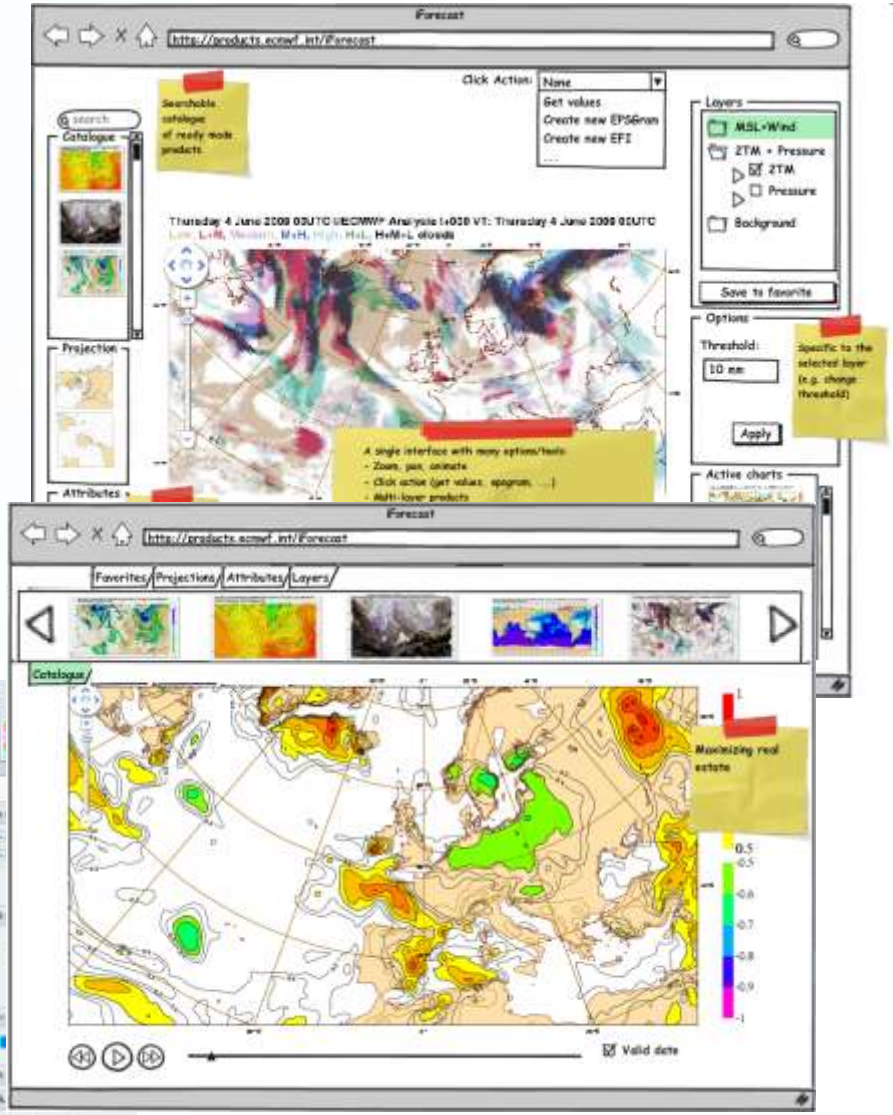
Gathering of user requirements

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





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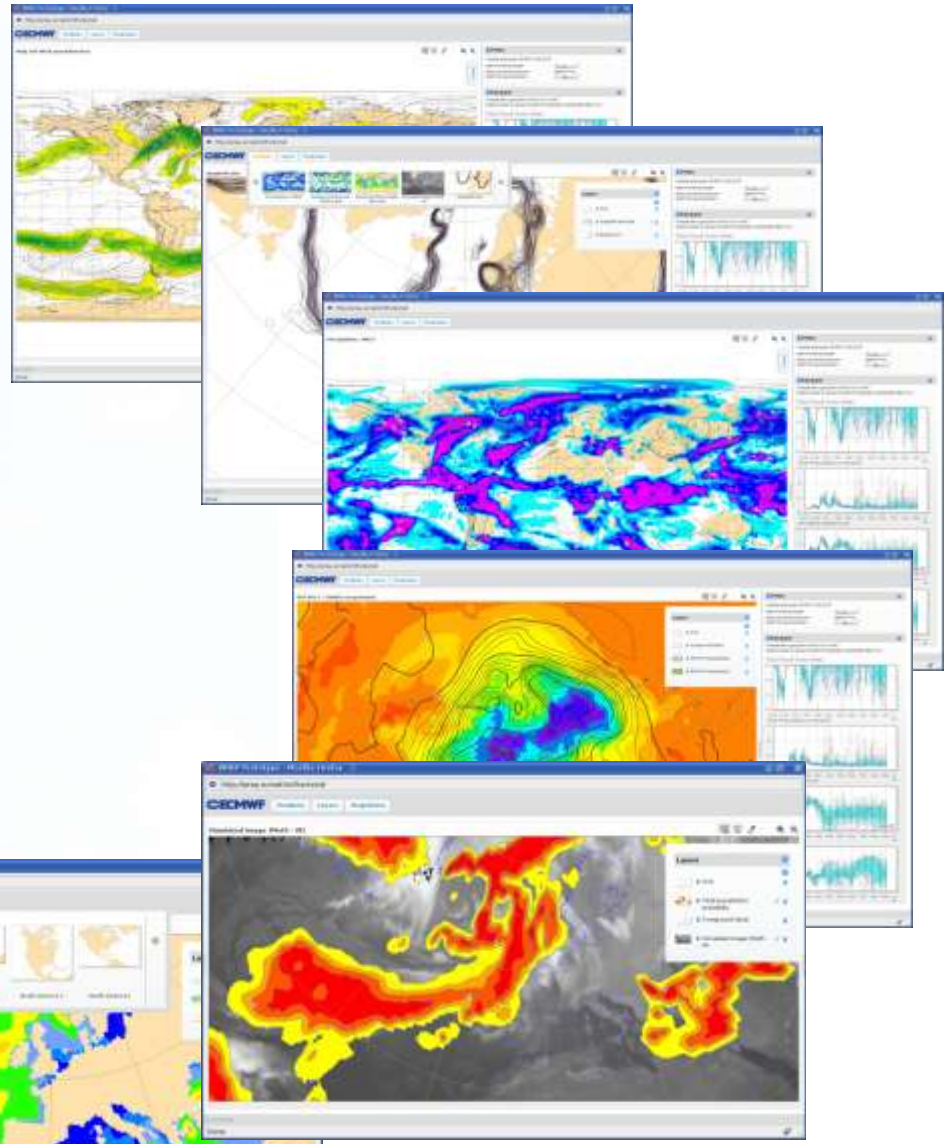
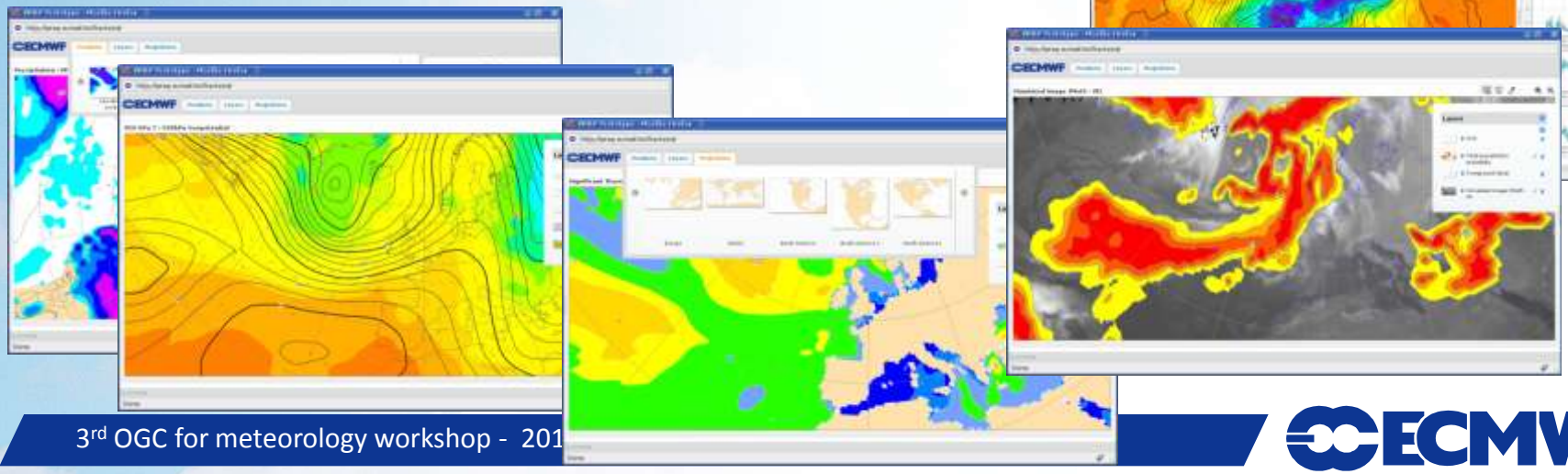
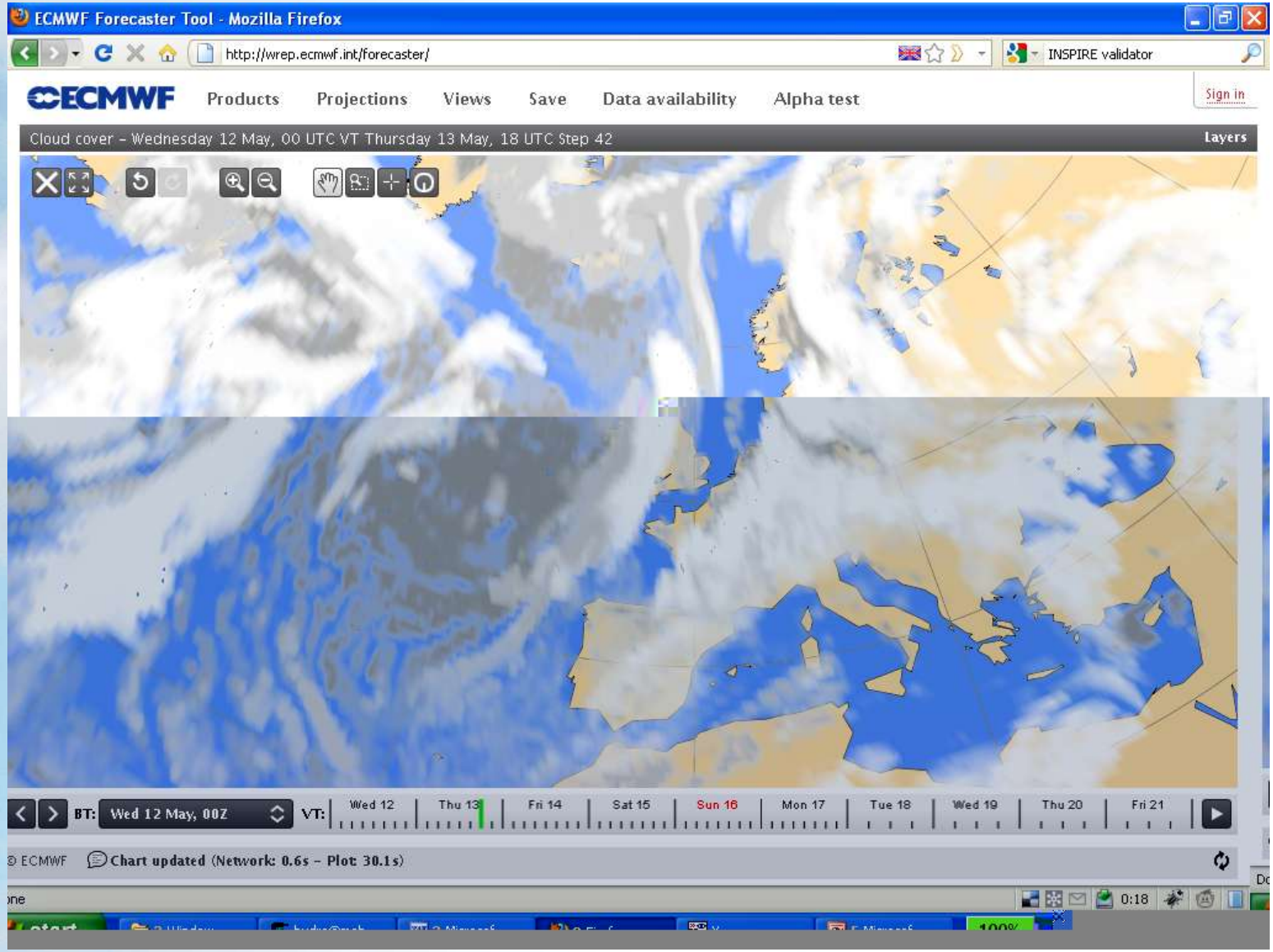
Application 1: Web based forecasting tool

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





Forecasting tool main user interface



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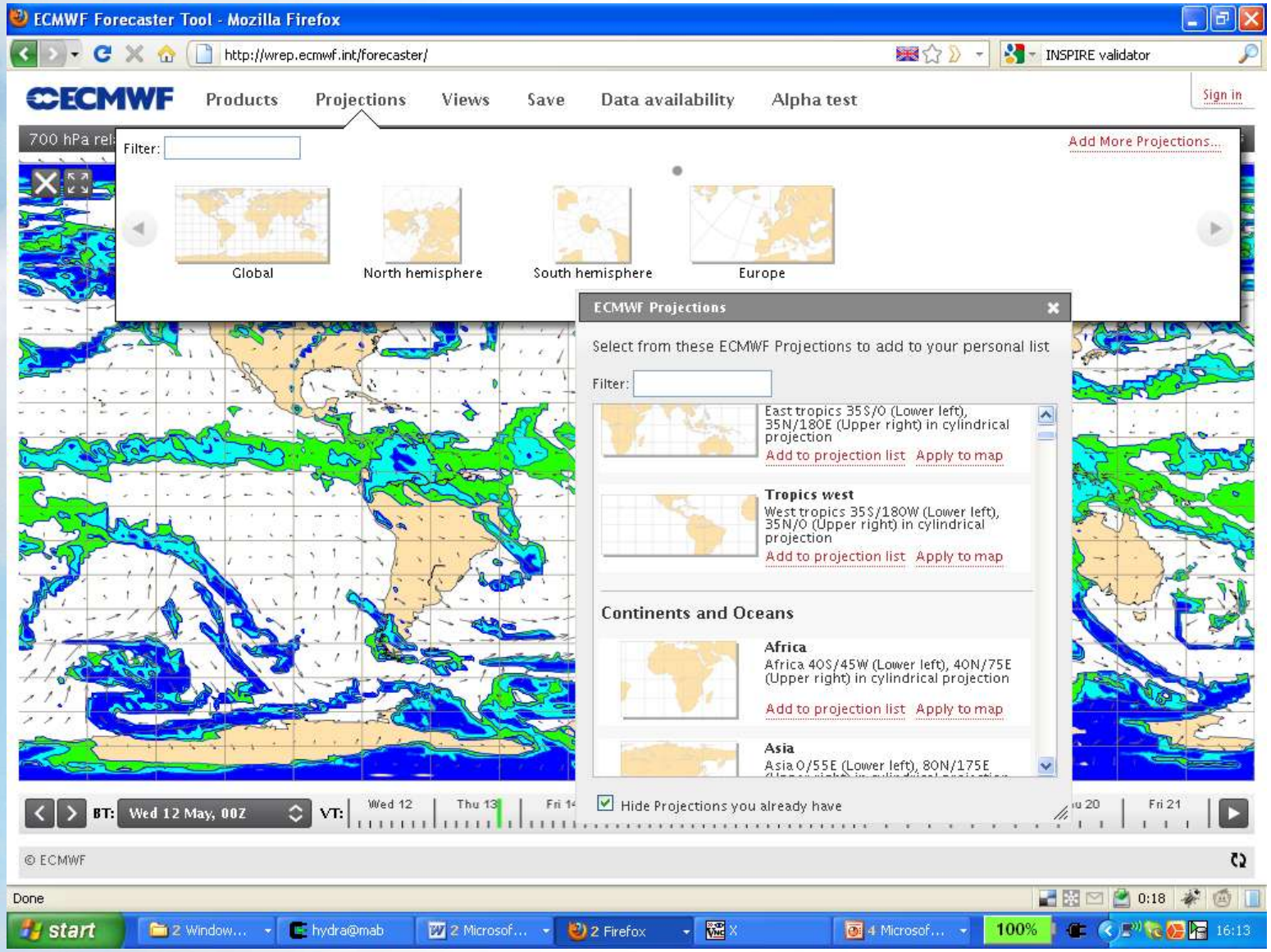
Predefined projections



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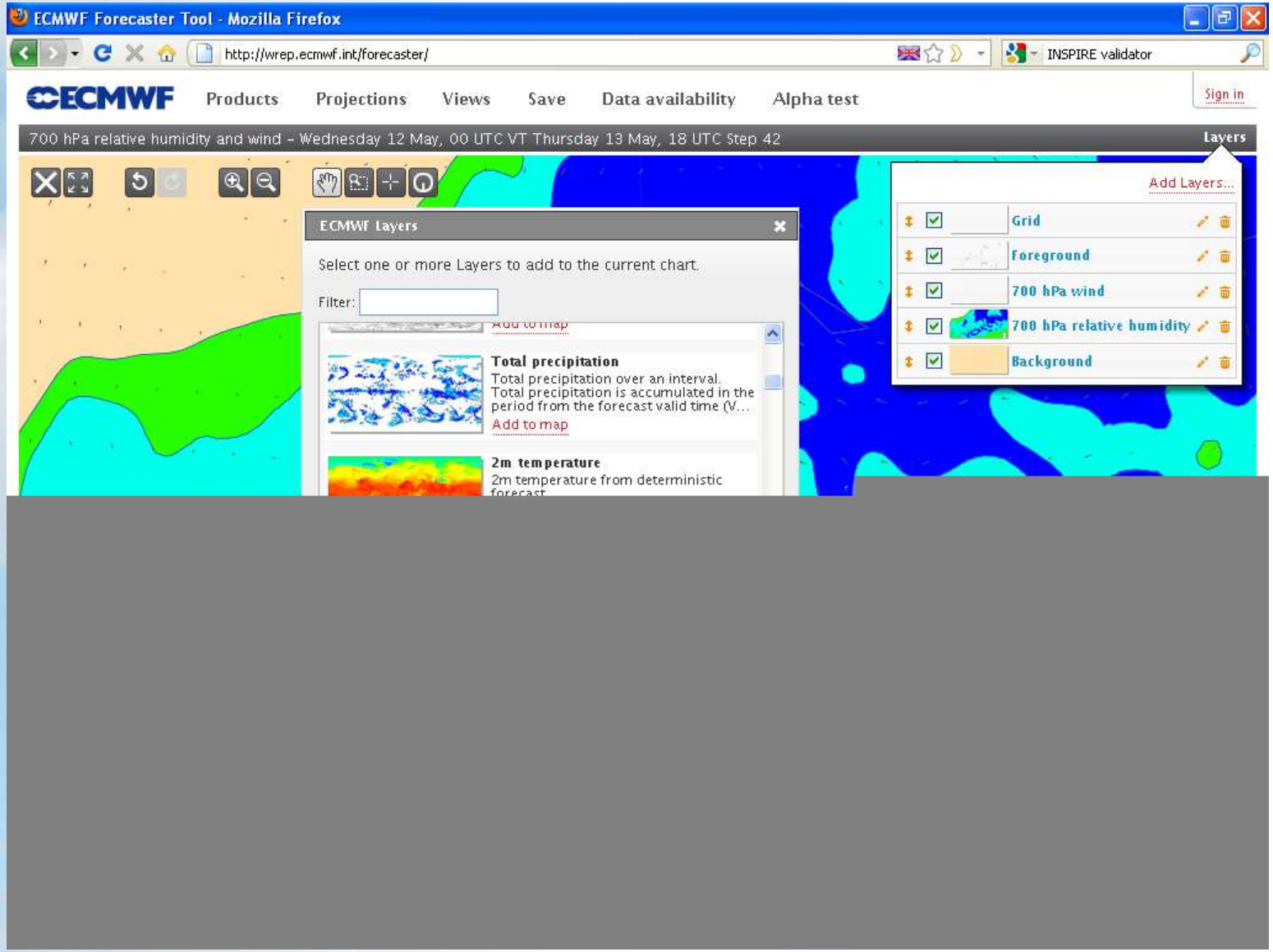
Multi-layer maps



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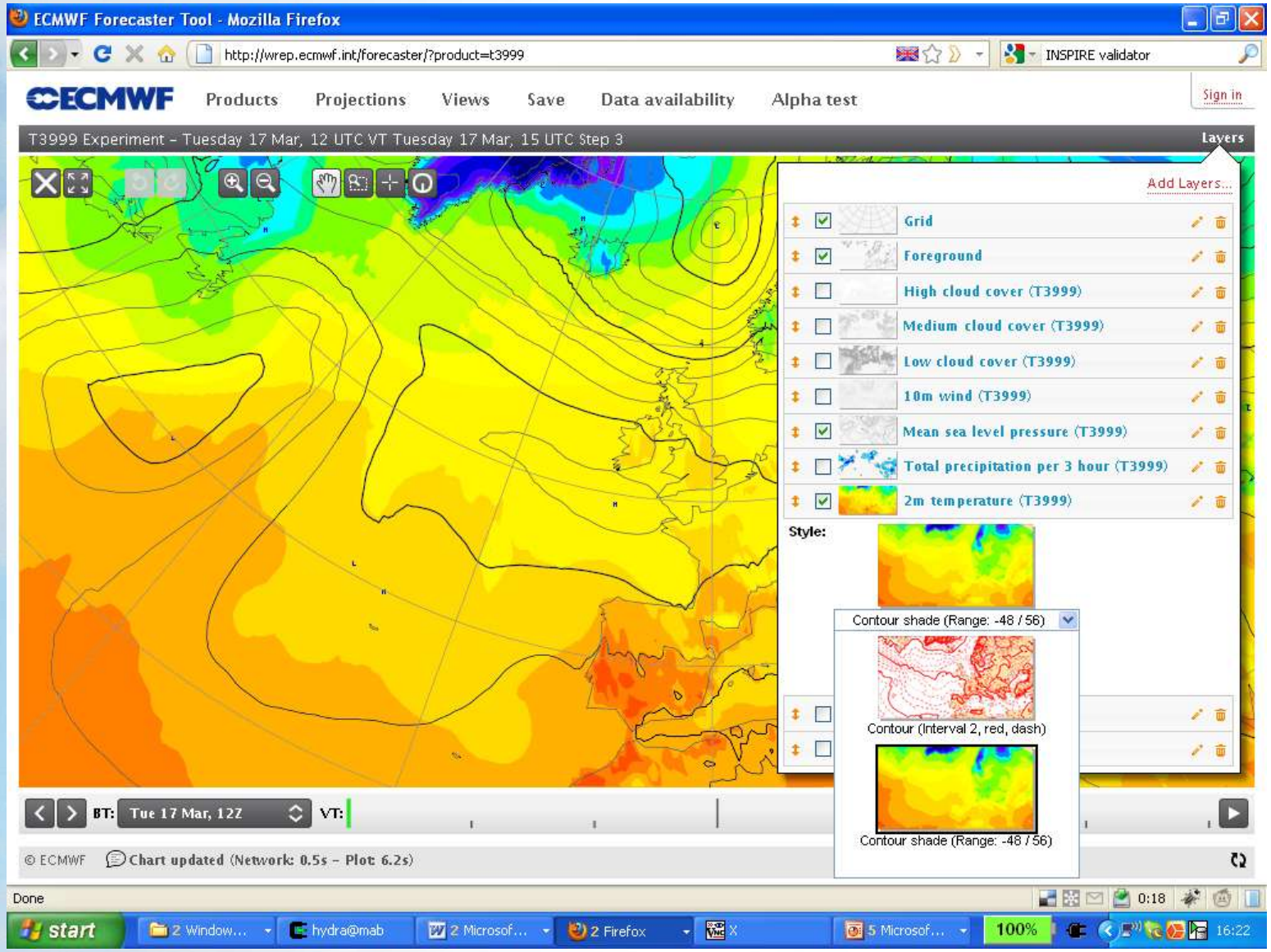
Controlling style



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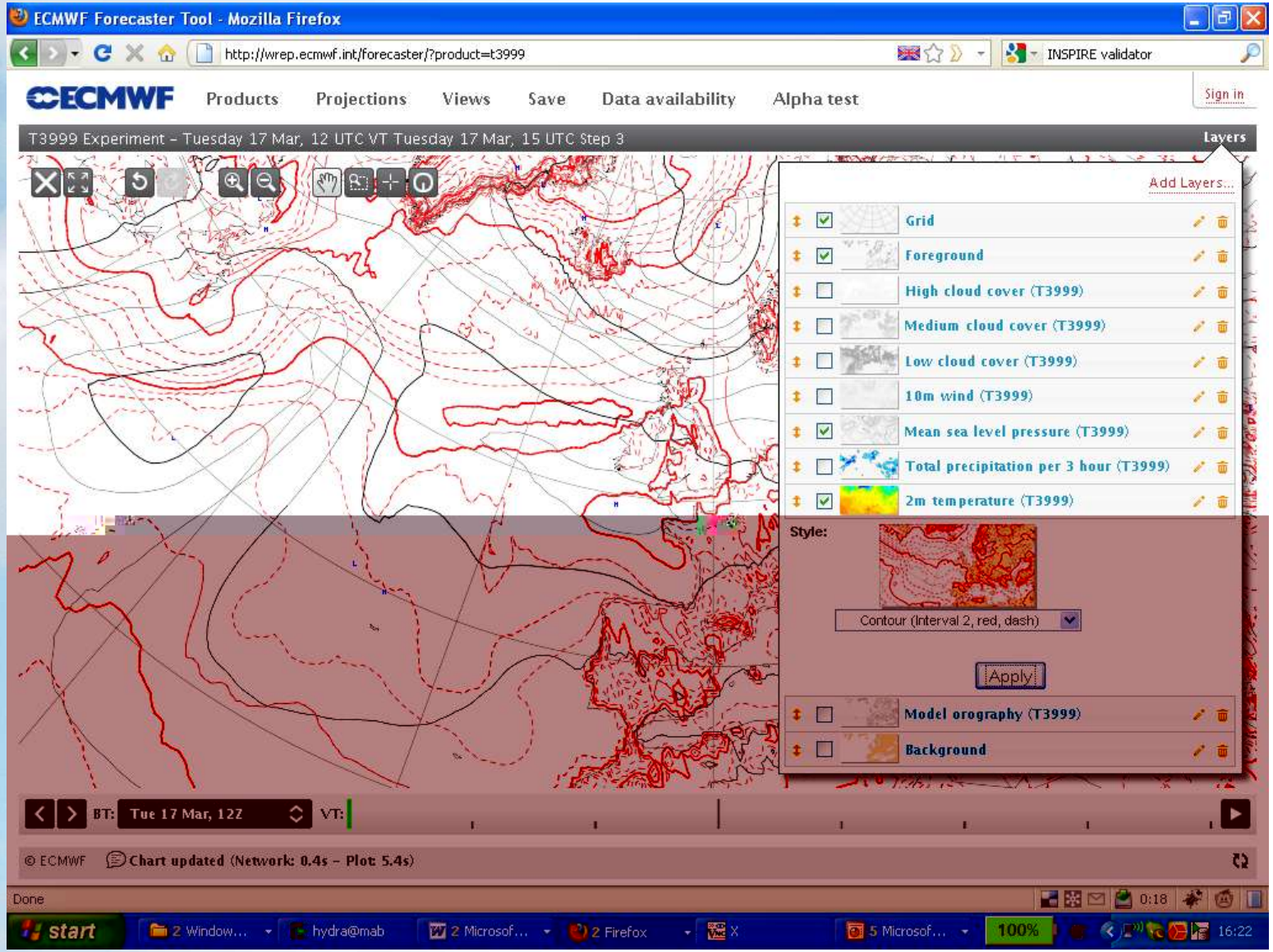
Controlling style (cont.)



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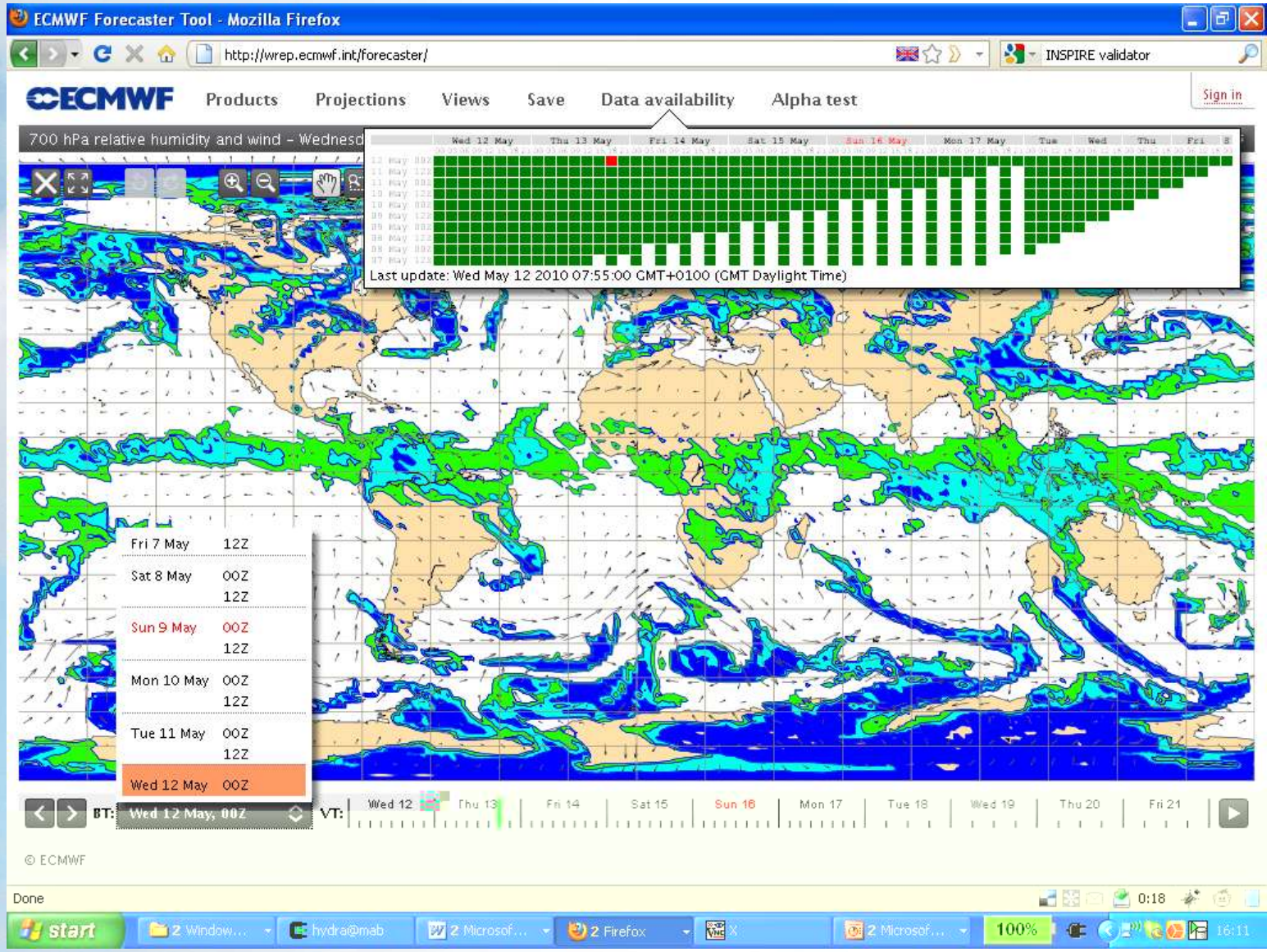
Handling time dimensions



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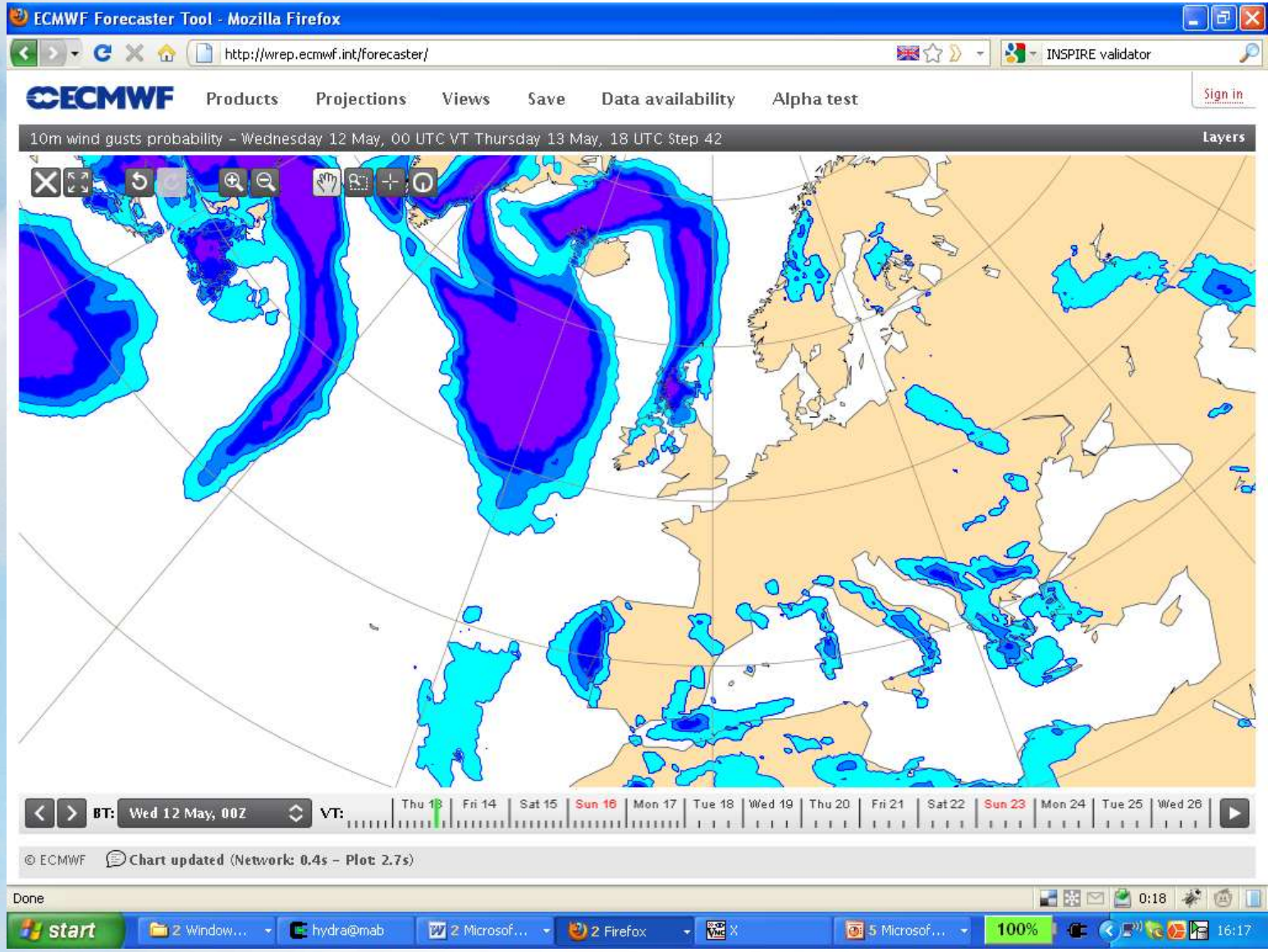
EPS data: probability maps



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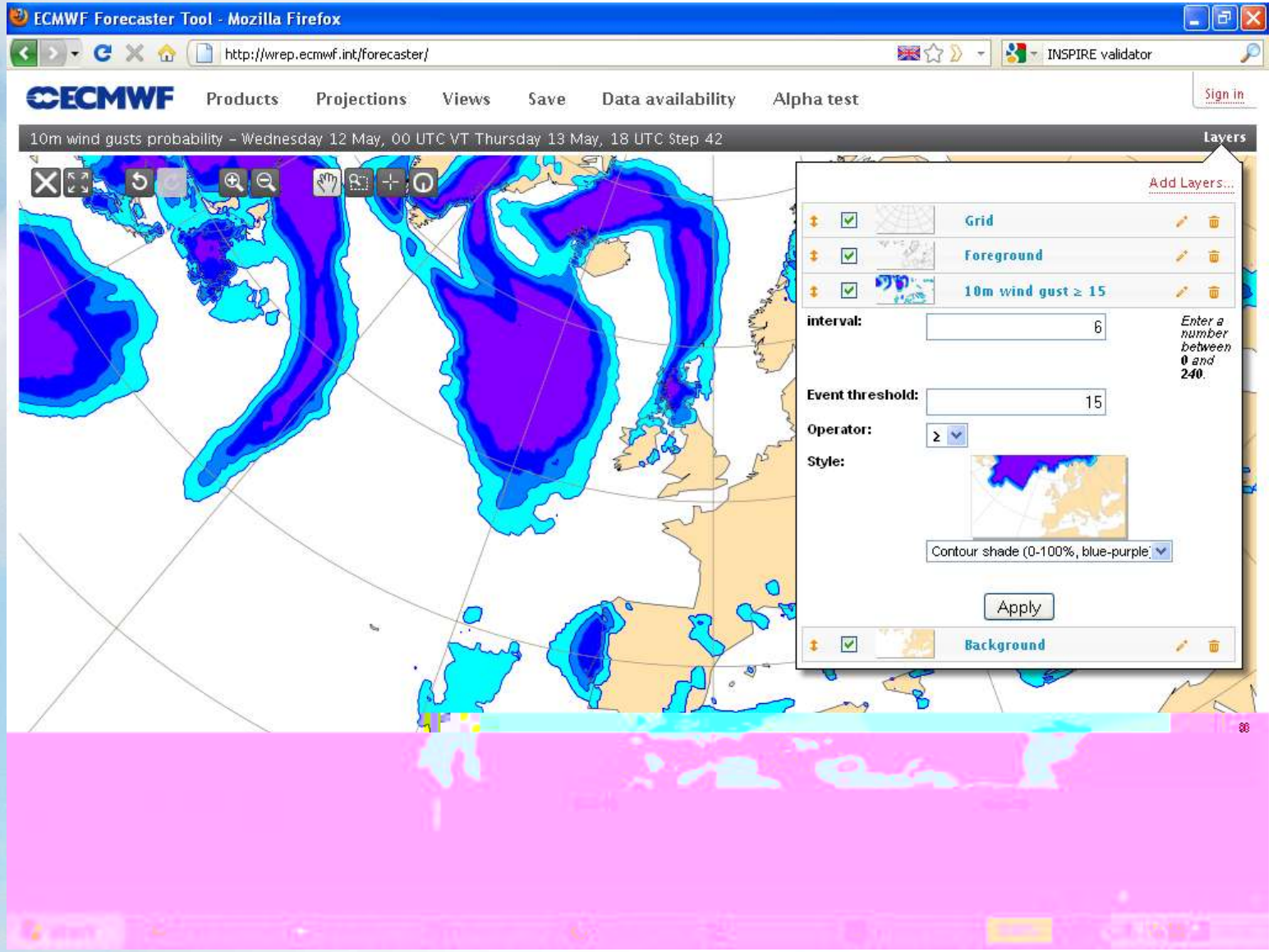
EPS data: probability maps (cont.)



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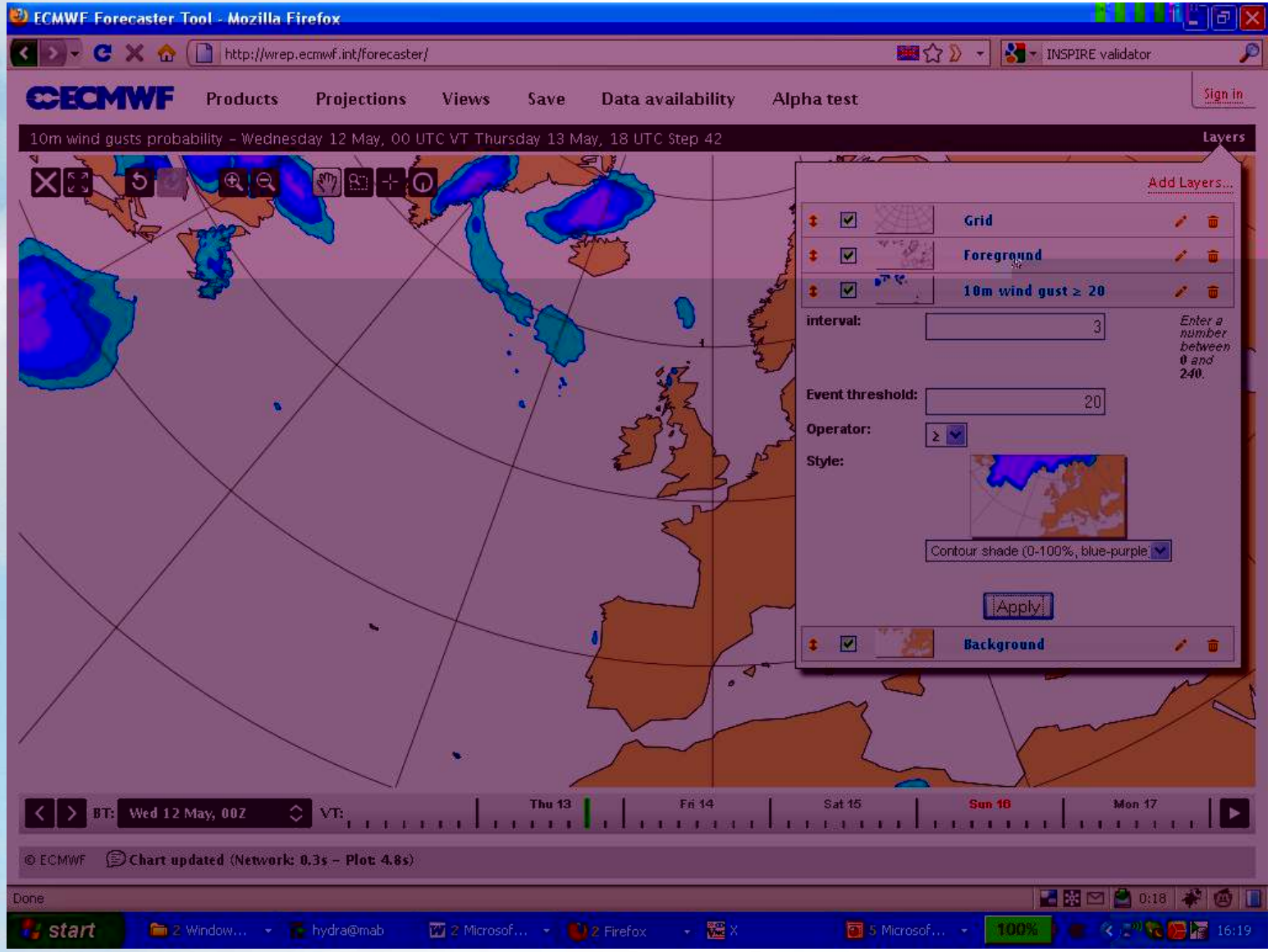
EPS data: probability maps (cont.)



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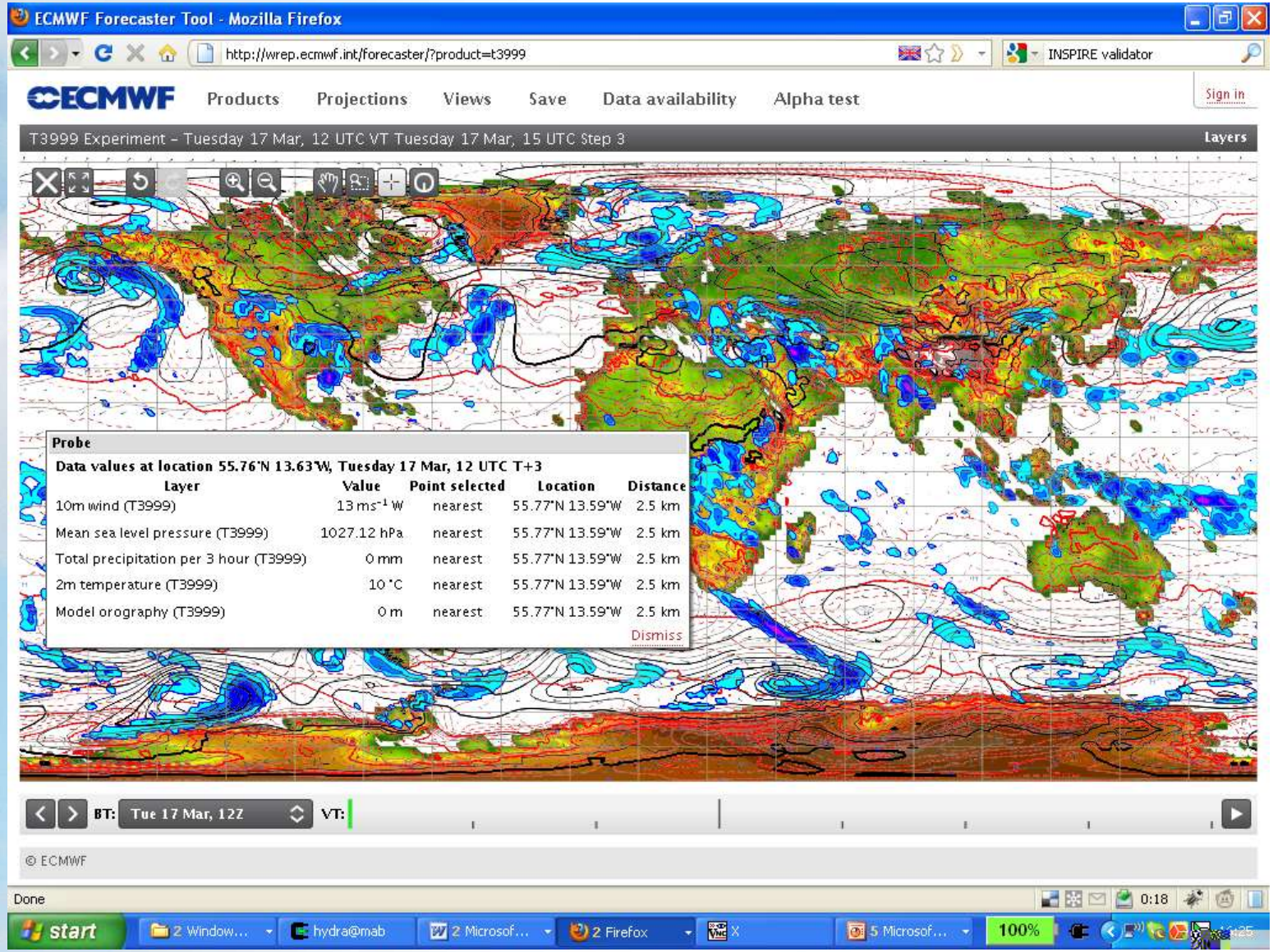
Data exploring tools



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Data exploring tools (cont.)

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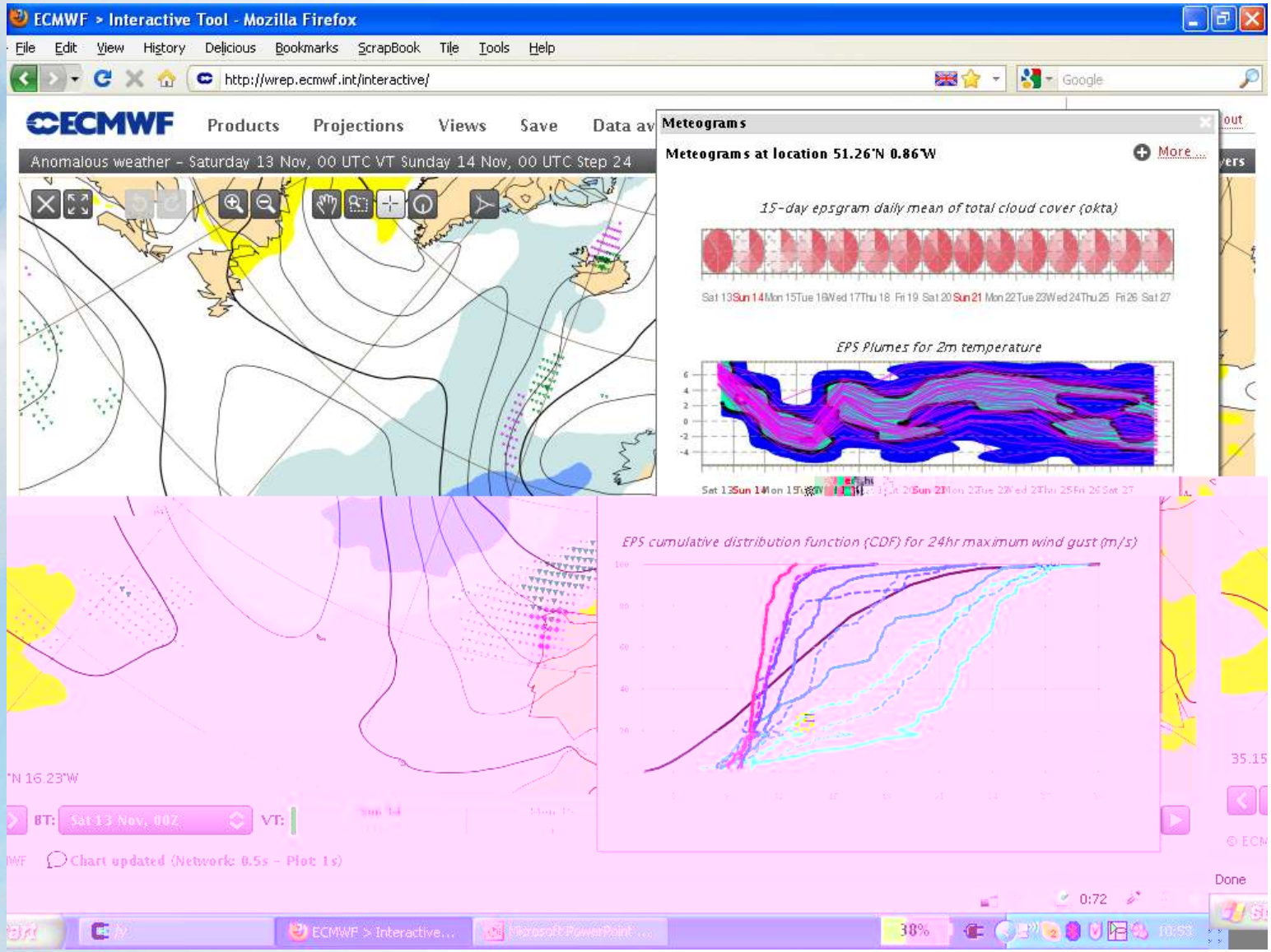
Data exploring tools (cont.)



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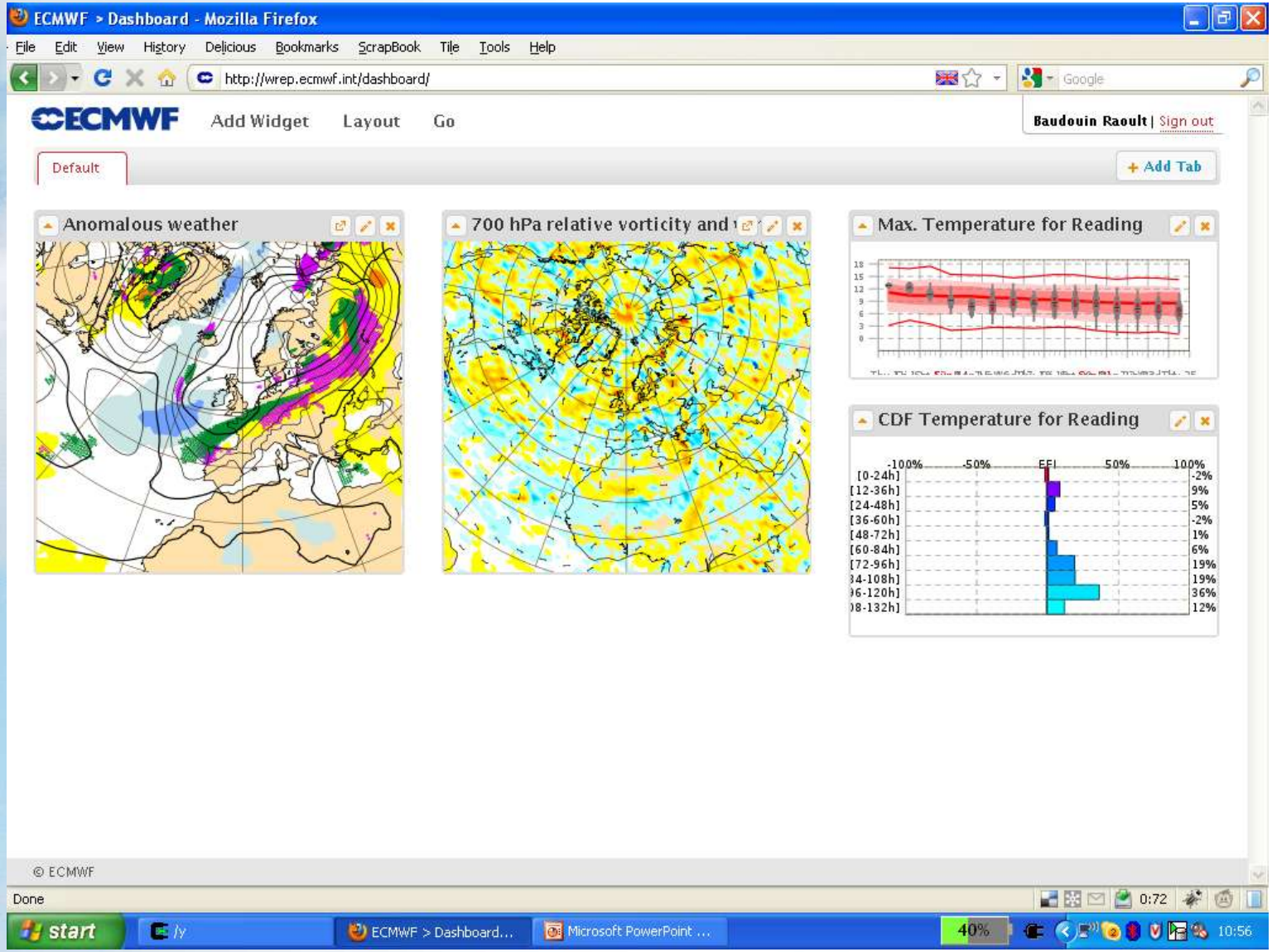
Application 2: Dashboard



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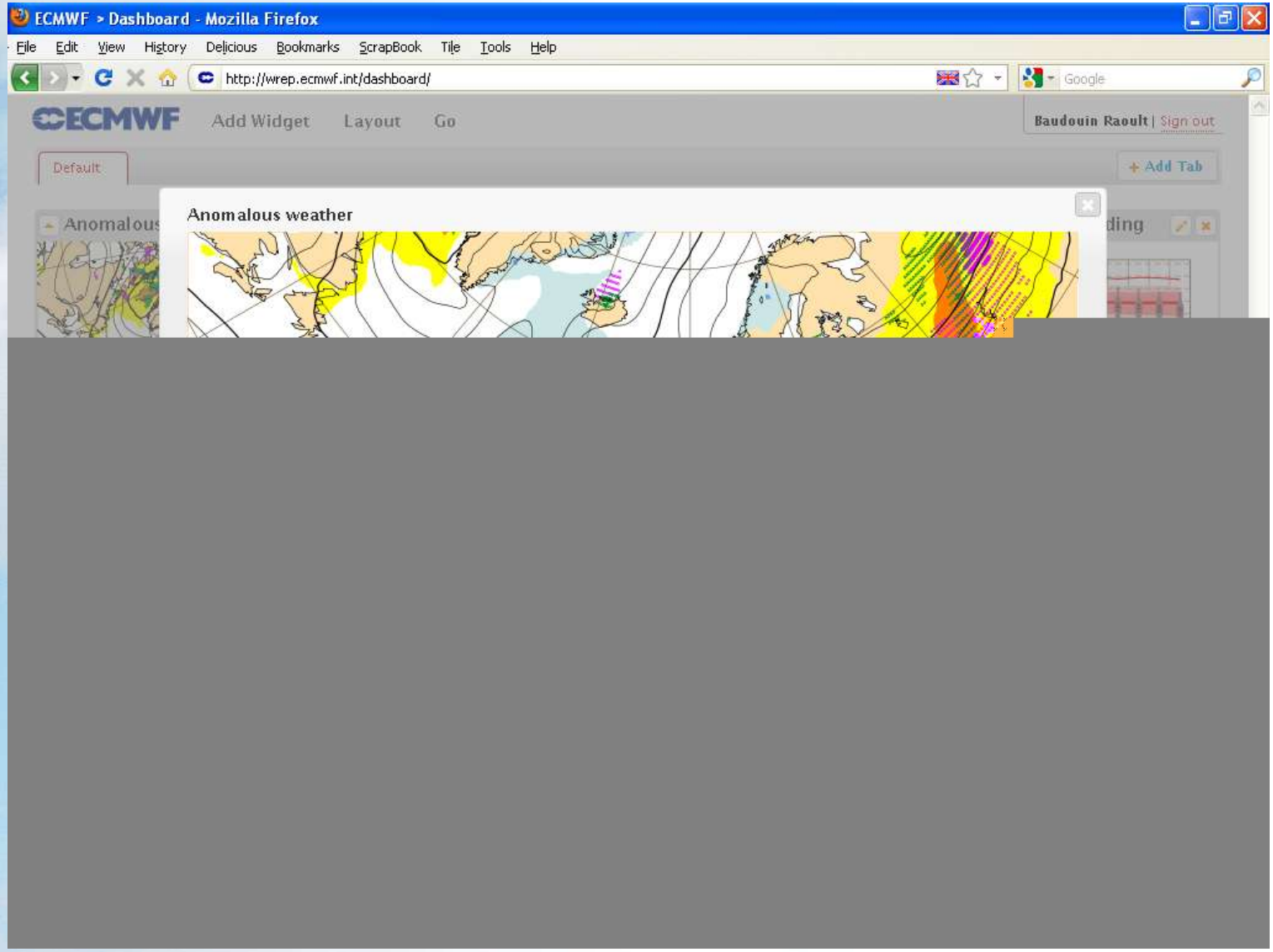
Application 2: Dashboard



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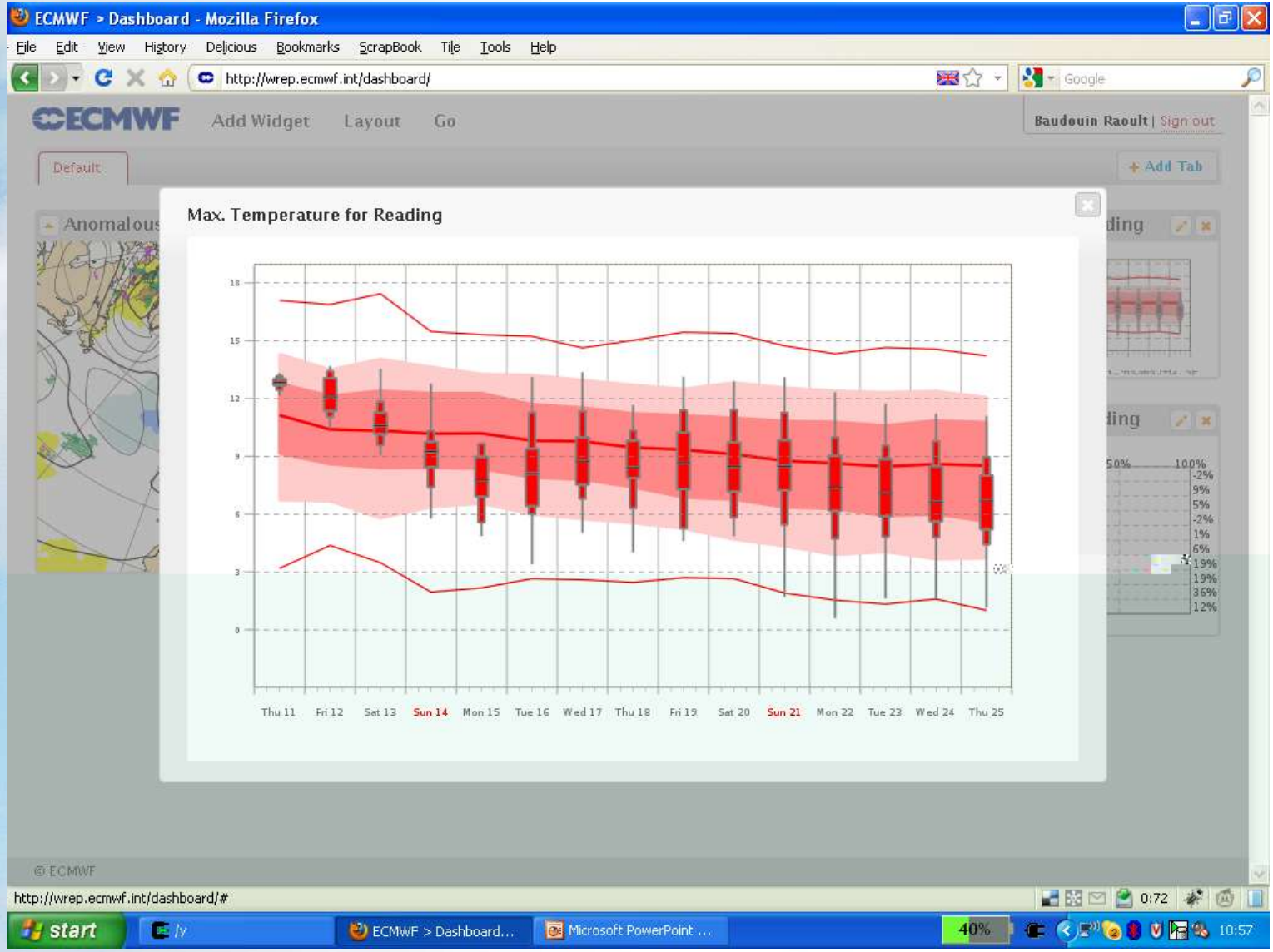
Application 2: Dashboard



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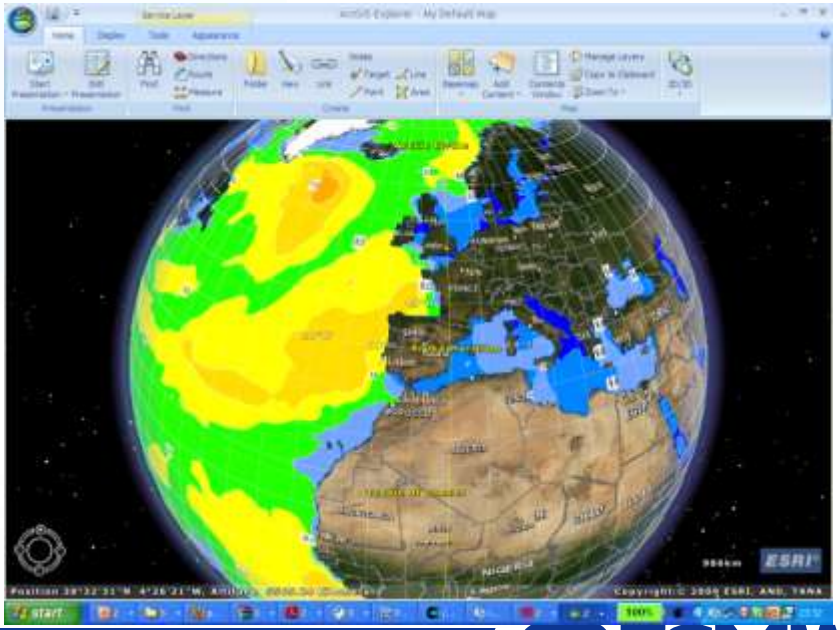
Application 3: OGC Web Map Services

- 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



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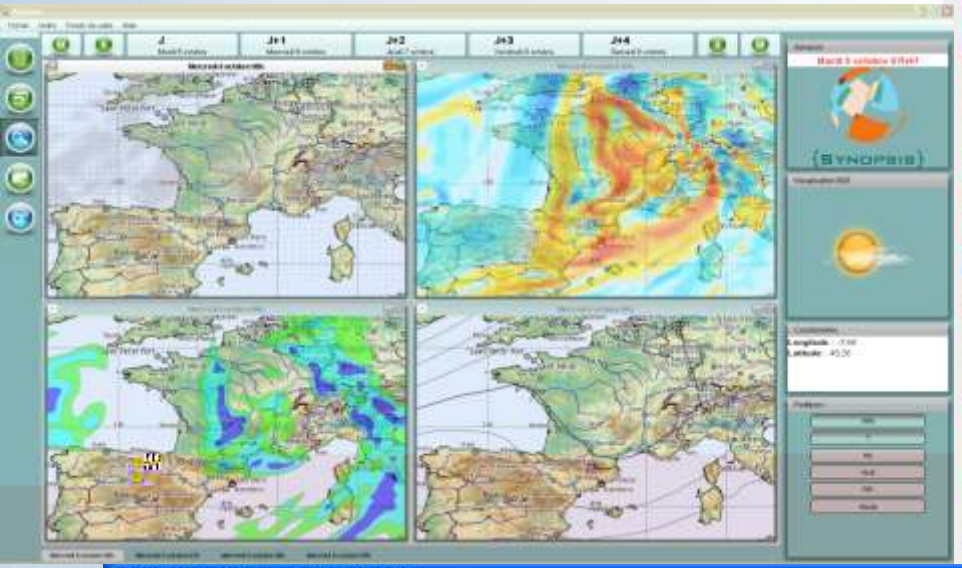
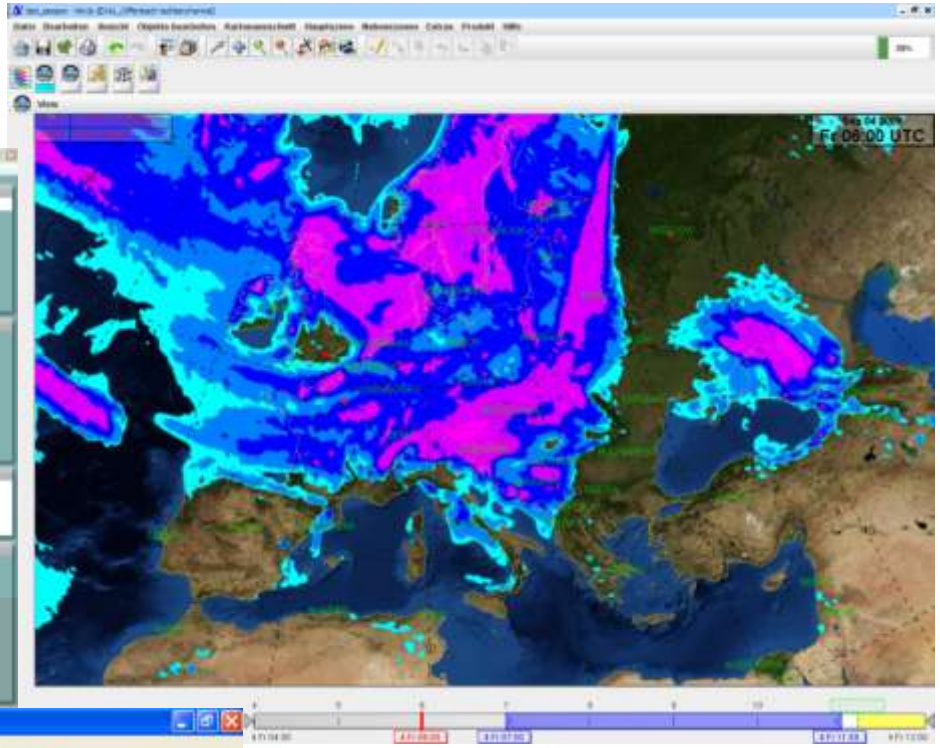
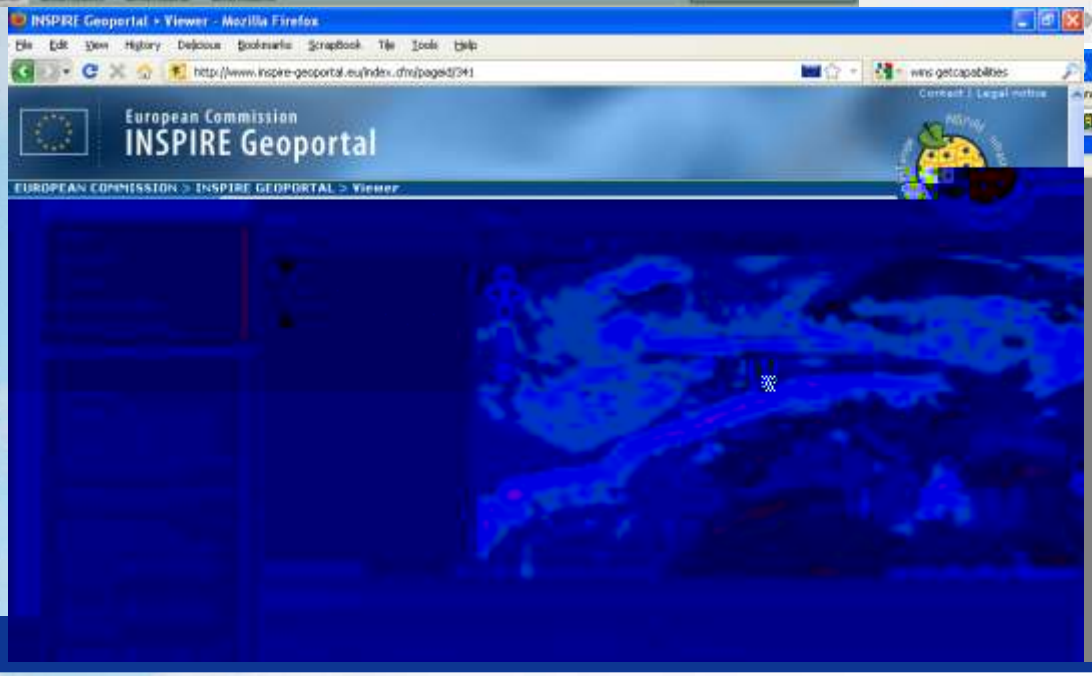
OGC WMS - examples







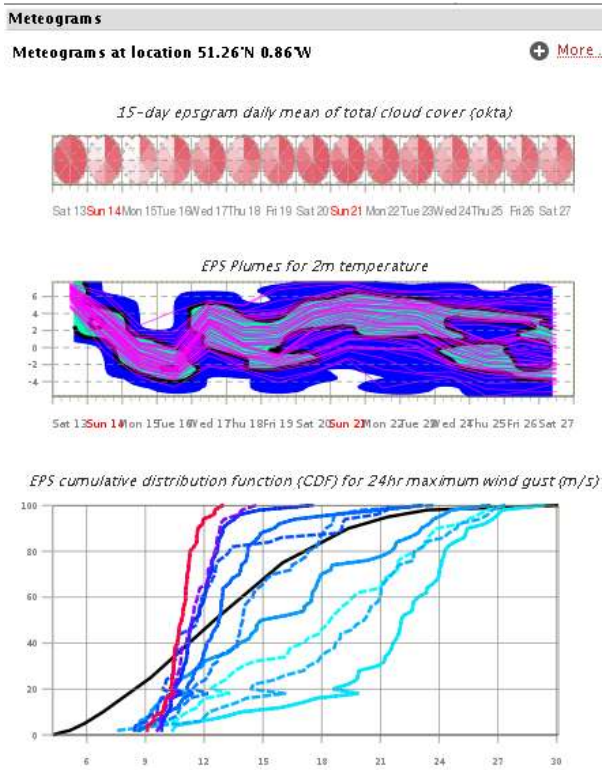
Parameterisation using DIM_ensions

- Example below:
  - Map of the probability that precipitation accumulated over a 12 hour interval and greater than 10 mm
  - TIME=2010-11-13T06:00:00Z, DIM_INTERVAL=12, DIM_THRESHOLD=0.01, DIM_OPERATOR=>
- Best practices? Names? Units?


```
– <Layer queryable="1">
    <Name>tp_proba_interval</Name>
    <Title>Total precipitation probability </Title>
  – <Abstract>
      Total precipitation probability over an interval. Total precipitation probability is accumulated in the period from the forecast valid time (VT) to (VT -
      selected interval).
    </Abstract>
    <SRS>EPSG:4326</SRS>
    <LatLonBoundingBox minx="-180" miny="-90" maxx="180" maxy="90"/>
    <Dimension name="time" units="ISO8601"/>
    <Dimension name="interval" units="hour"/>
    <Dimension name="threshold" units="tp_m"/>
    <Dimension name="operator" units="unknown"/>
  – <Extent name="time" default="2010-11-13T06:00:00Z" multipleValues="0" nearestValue="0">
      2010-11-08T18:00:00Z,2010-11-08T21:00:00Z/2010-11-19T00:00:00Z/PT3H,2010-11-19T06:00:00Z/2010-11-28T00:00:00Z/PT6H
    </Extent>
    <Extent name="interval" default="6" multipleValues="0" nearestValue="0">6,12,24,48</Extent>
    <Extent name="threshold" default="" multipleValues="0" nearestValue="0"/>
    <Extent name="operator" default="<=" multipleValues="0" nearestValue="0">&lt;=,&gt;=,&lt;,&gt;,=,&lt;&gt;</Extent>
```

GetFeatureInfo

- Given a latitude-longitude, many possible “info” can be returned :
  - Value of grid point, vertical profile, tephigram, timeseries…
- How can we tell the user (in the GetCapabilities document), that the server can provide many different pieces of information?
- How can the user request a specific piece of information (e.g. a vertical provide), in the GetFeatureInfo request?



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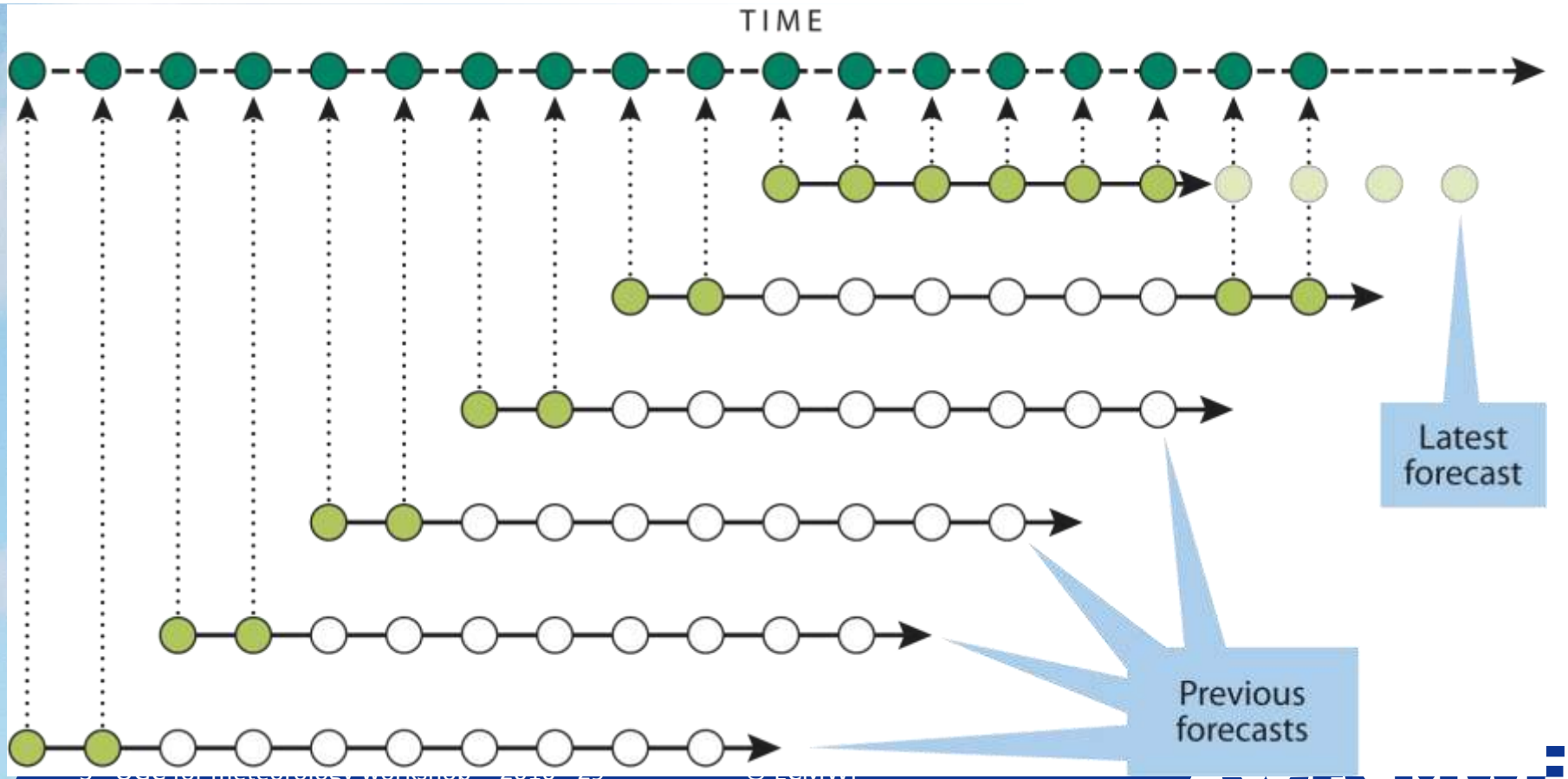
Availability of new data (e.g. the time extent as changed)

- How to notify the client of changes in the GetCapabilities document

```
<Dimension name="operator" units="unknown"/>
– <Extent name="time" default="2010-11-13T06:00:00Z" multipleValues="0" nearestValue="0">
    2010-11-08T18:00:00Z,2010-11-08T21:00:00Z/2010-11-19T00:00:00Z/PT3H,2010-11-19T06:00:00Z/2010-11-28T00:00:00Z/PT6H
  </Extent>
```



Project Status

- 75% into the project
  - Alpha test with forecasters from our Member States done
  - Beta test to start soon
- Infrastructure work
  - Security and access control
  - Monitoring, alerts and service statistics
  - Management tools
  - Performance tuning
- Product development
  - Clustering
  - Tropical cyclone tracks
  - Monthly and seasonal products
  - …
  - Quality and performance scores

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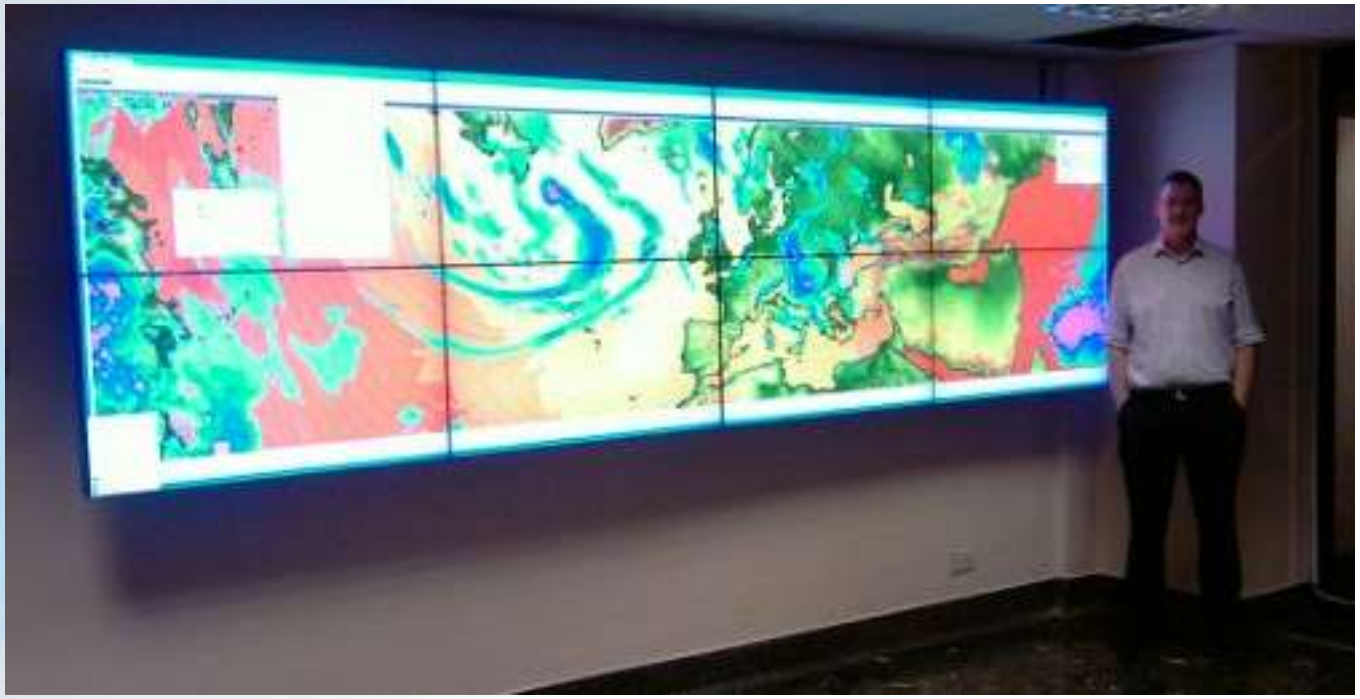
Thank you



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