

Visual Weather web services

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Outline

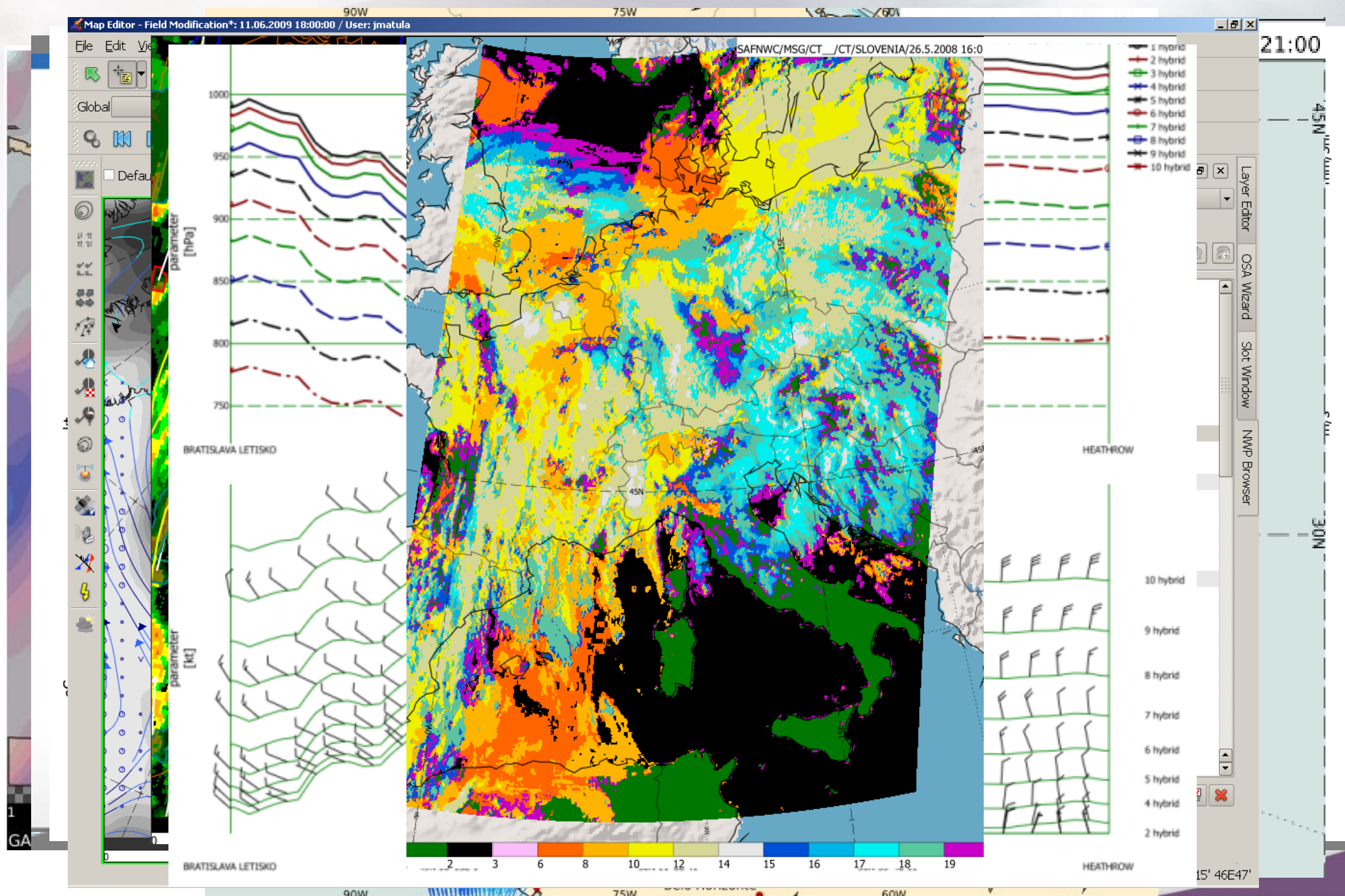
- Visual Weather in a nutshell.
- Path from Visual Weather (as meteorological workstation) to Web Server (server providing web services).
- What is Flexi Weather and Online Weather.
- There is always something what can be optimised.



Visual Weather in a nutshell

- Visual Weather is a meteorological workstation SW:
 - Met data processing and visualisation (observations, NWP, remote sensing, other GISs)
 - Interactive forecasting tools
 - Forecast production and workflow management
 - Batch production
 - Extensible with Python API
 - Web services (WMS, WCS, WFS, JMBL, bespoke in Python)
- From all-in-one laptop to enterprise client-server
- Highly configurable and integration-capable.

Various VW screenshots & products



Quick audience survey

- Who worked/works on development of a visualisation workstation?
- Who knows what is OGC?
- Who knows what is a Web Service?



FROM WORKSTATION TO PROVIDING WEB SERVICES

What a web services is

- Wikipedia: *A **Web service** is a method of communication between two electronic devices over a network.*

[very precise explanation of imprecise thing]

- **Why are people building applications using them?**
 1. For fun (experimenting what is possible).
 2. Because it is a fashion.
 3. There is a desire for web applications with no installation and maintenance costs.
 4. To decouple the presentation vs. data/business logic tiers and allow “remote use”.
 5. Customers want it.

What we have done

- Our 1st OGC Web Map Service server 6 years ago
 - Heavily using WMS dimensions
 - Custom extensions on the edge of standard
- OGC Web Coverage Service to access NWP data with NetCDF, GeoTIFF and GRIB outputs.
- OGC Web Feature Service:
 - For weather conceptual feature models (fronts, clouds, H/L, storm areas...)
 - For all kinds of in situ-data (observations, lightning, station locations...)
- Various bespoke Web Service (Python API, JSON)



Need for a client

- At certain stage we realised that for building and testing our web service capabilities we need:
 - Experimental application which understands all our protocols and can utilise them:

Online Weather

- Design & code patterns allowing mocking-up testing applets easily:

Flexi Weather

- We chose the Adobe Flex Web 2.0 technology (uses Action Script language) as our client platform because of good browser-market share and comprehensive graphics support.

Online Weather

- Set of web applications which mimic their “elder & richer brother” applications in *Visual Weather*:
 - **Browsing Weather** - data visualisation and layering, animation, chart editing.
 - **Weather Monitor** - monitoring of observed properties reaching warning/critical thresholds.
 - **Message Editor** - forecast form entry production application with NWP/obs. first-guess support.
 - **Task Manager** - task and workflow management tool (a kind of forecaster’s ToDo list)
 - **Product Delivery Monitor** - application to track delivery of products (e-mails, faxes).

Browsing Weather - Satellite & Lightning

The screenshot displays a weather visualization application. At the top, a menu bar includes 'Map', 'Layers', 'Areas', 'Maps', 'Configuration', and 'Help'. The main map area shows a satellite view of Europe with green and yellow outlines. A 'Loaded layers' panel on the right lists: 'Static/Overlays/Border lines', 'Lightning Tue Nov 1 04:00:00 2011 UTC', 'MSG/MSG Infrared Tue Nov 1 04:00:00 2011 UTC' (highlighted), and 'Static/Google Maps'. A 'Time axis' at the bottom shows a timeline from 5Z to 23Z with 'Lightning' and 'MSG/MSG' layers. A 'Mouse over readout' tooltip shows: 'MSG/MSG Infrared', '-57 C (IR spectra)', '[Satellite]', and 'Lightning'. The bottom right shows 'Orientation: Bottom, Right - Left' and 'mouse position: 01:34 01.11.2011'. An 'Animation Settings' button is at the bottom center.

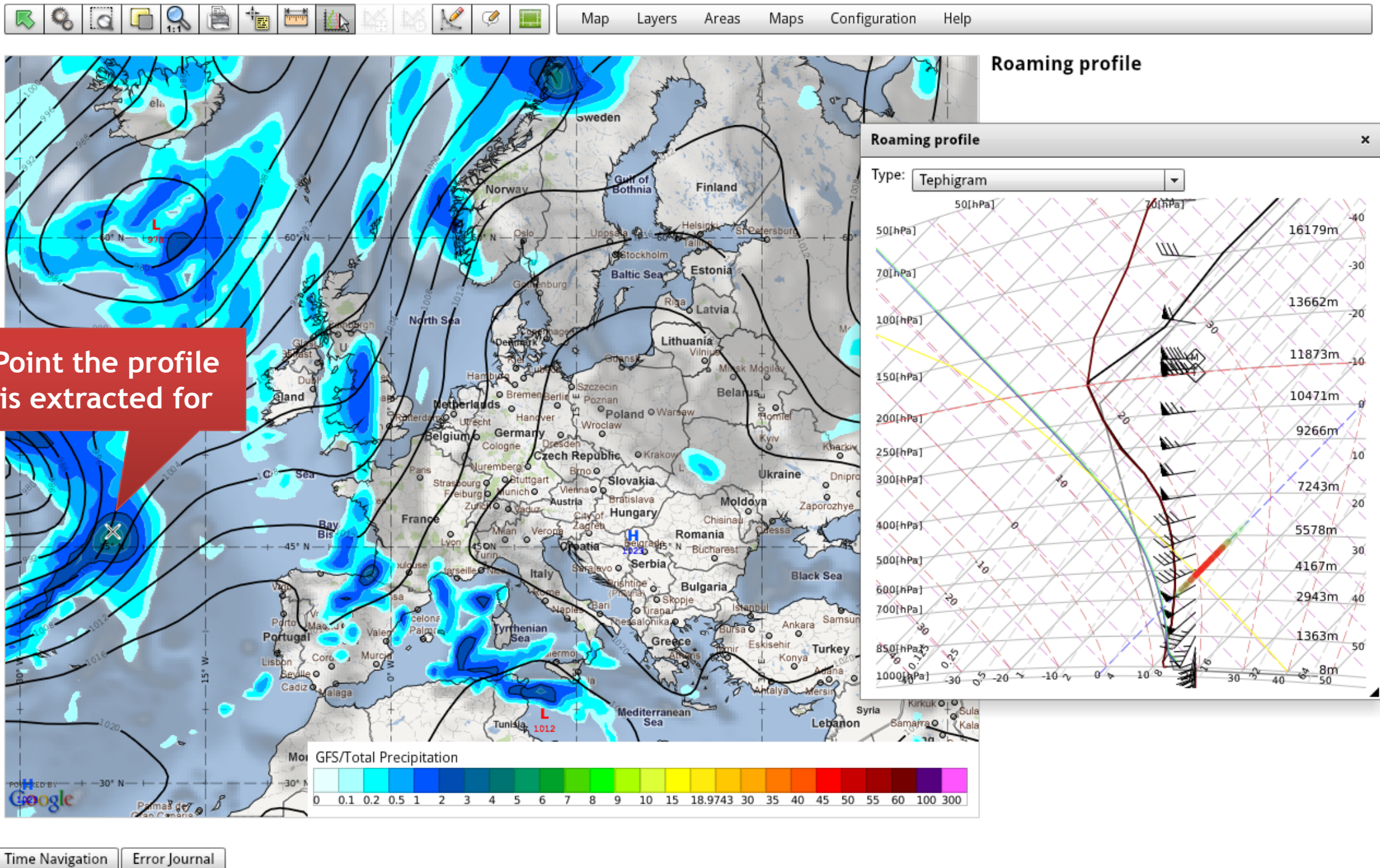
Loaded layers

Mouse over readout

Time axis

MSG/MSG Infrared
-57 C (IR spectra)
[Satellite]
Lightning

Browsing Weather -NWP vertical profiler



Browsing Weather (NWP Verification)

The screenshot displays the Visual Weather software interface. At the top, there is a toolbar with various icons for navigation and editing, and a menu bar with options: Map, Layers, Areas, Maps, Configuration, and Help. The main window shows a weather map of Europe and the Mediterranean region. The map includes contour lines, pressure systems (labeled 'L' and 'H'), and numerous data points. A red callout box with a white border points to a specific area on the map, containing the text: "Areas where model MSLP differs from observations".

Layers

- Static/Overlays/Border lines
- MSL Pressure from observations
Tue Nov 1 00:00:00 2011 UTC
- Observations/Surface observations
yes
yes
yes
no
- Static/Backgrounds/DEM

Orientation: Bottom, Right - Left

54N58'44" 35E45'50"

Time Navigation | Error Journal

Browsing Weather - ECMWF web service

The screenshot displays the Visual Weather web interface. At the top, there is a navigation bar with icons for home, search, and other functions, and a menu with 'Map', 'Layers', 'Areas', 'Maps', 'Configuration', and 'Help'. A status bar on the right indicates '0/1 jobs done'. The main area shows a map of Europe with a precipitation overlay. A 'Layer Options' dialog is open, showing configuration for the 'ECMWF Total Precipitation' layer. The dialog includes a 'Dimension time' dropdown with values from 'Thu Jun 9 06:00:00 2011 UTC' to 'Thu Jun 9 21:00:00 2011 UTC'. The 'Dimension interval' is set to 6 hours. The 'Dimension threshold' is 0.002, and the 'Dimension operator' is set to \geq . The 'Styles' dropdown is set to '(default)'. Buttons for 'Delete Layer' and 'Zoom to layer extent' are visible. A red callout box points to the map area, and another red callout box points to the 'Layer Options' dialog. At the bottom, there are 'Time Navigation' and 'Error Journal' buttons, and a coordinate display '49N37'15" 27E49'20"'. The bottom right corner features the website 'www.iblsoft.com'.

0/1 jobs done

Static/Overlays/Border lines

ECMWF Total Precipitation
Tue Jun 14 06:00:00 2011 UTC
6
0.002
 \geq

Layer Options

Transparency

Dimension time
(default: 2011-06-14T06:00:00Z)
Thu Jun 9 06:00:00 2011 UTC
Thu Jun 9 09:00:00 2011 UTC
Thu Jun 9 12:00:00 2011 UTC
Thu Jun 9 15:00:00 2011 UTC
Thu Jun 9 18:00:00 2011 UTC
Thu Jun 9 21:00:00 2011 UTC

[ISO8601]
Styles: (default)

Delete Layer Zoom to layer extent

Dimension interval (default: 6)
6
12
24
48
72
[hour]

Dimension threshold 0.002
Set
[tp_m]

Dimension operator (default: \leq)
 \geq
 $<$
 $>$
 $=$
 $<>$
[unknown]

Orientation Bottom, Right - Left

49N37'15" 27E49'20"

Time Navigation Error Journal

www.iblsoft.com



ECMWF probability of Tot. precipitation ≥ 20 cm

Configuration of ECMWF WREP precipitation WMS Layer

Online Weather - Task Manager

Working shift time range

Choose roles From: 20:00 To: 08:00 Brief mode Show UTC time Refresh

2011-10-31 21:00:00LT	Check data reception In the Operator Console look on all SADIS channels and verify that some data is being received recently.	Reopen ✓
2011-10-31 21:00:00LT	 Create Low Level SIGWX chart Inspect the actual WAFC SIGWX forecasts and latest model data. In Feature Editor create the LAF product.	Edit ⚙
2011-10-31 21:30:00LT	Call Fire Police Call Fire Police +00123456911 and brief them about daily forecast and fire hazards.	Reopen ✓
2011-10-31 23:00:00LT	Check data reception In the Operator Console look on all SADIS channels and verify that some data is being received recently.	Reopen ✓
2011-11-01 01:00:00LT	 Create High Level SIGWX chart In Feature Editor insert the latest WAFC forecast and adjust according to local need.	Edit ⚙
2011-11-01 01:00:00LT	Check data reception In the Operator Console look on all SADIS channels and verify that some data is being received recently.	Reopen ✓
2011-11-01 01:00:00LT	Shift rotation and briefing from previous shift	Reopen ✓
Date: 2011-11-01 01:37:40LT		
2011-11-01 03:00:00LT	Check data reception In the Operator Console look on all SADIS channels and verify that some data is being received recently.	Acknowledge 📄
2011-11-01 05:00:00LT	Check data reception In the Operator Console look on all SADIS channels and verify that some data is being received recently.	Acknowledge 📄

Daily tasks, red line marks the current time

Available actions for each task

Online Weather - Forecast Entry

* test TAF

TAF LZIB

COR AMD CNL

TAF body

Station: LZIB

Validity: 0818/0918 Wind: 30525KT Visibility: 4000 Weather: +RA FZFG Clouds: FEW030CB TX: TN:

+ BECMG - Validity: 0820/0821 30010KT 3000 Weather: FZFG Clouds:

Guidance

Latest METAR:

METAR LZIB 081630Z 05005KT 5000 BR OVC004 06/05 Q1003

NWP model: Model run: 2010-12-08 06:00

Time	18:00	21:00	00:00	03:00	06:00	09:00	12:00	15:00	18:00	21:00
Wind	210 / 01	210 / 02	280 / 05	340 / 04	310 / 15	320 / 20	310 / 14	300 / 11	280 / 10	290 / 13
Temp/RH	4 / 99	3 / 99	4 / 98	3 / 98	2 / 98	-1 / 93	0 / 93	0 / 93	-1 / 94	-2 / 93
Clouds (L/M/H)	N/A / N/A / N/A	N/A / N/A / N/A	N/A / N/A / N/A	N/A / N/A / N/A	N/A / N/A / N/A	N/A / N/A / N/A	N/A / N/A / N/A	N/A / N/A / N/A	N/A / N/A / N/A	N/A / N/A / N/A
Precipitation (C)	N/A / N/A / N/A	N/A / N/A / N/A	N/A / N/A / N/A	N/A / N/A / N/A	N/A / N/A / N/A	N/A / N/A / N/A	N/A / N/A / N/A	N/A / N/A / N/A	N/A / N/A / N/A	N/A / N/A / N/A

Input form with gross error check and semantic verification

```

Preview
FTSQ31 LZIB 081700
TAF LZIB 081700Z 0818/0918 30525KT 4000 +RA FZFG FEW030CB BECMG
0820/0821 30010KT 3000 FZFG=
    
```

Final text message

Flexi Weather

- *Geospatial mapping and data visualisation library for Adobe Flex with strong focus on the presentation of meteorological data.*
- Open Source available at:
<http://code.google.com/p/flexiweather>
- Fixes problems of “Solid Earth GIS” libraries
- Supports WMS and tiling, layer superimposition, WFS, conceptual weather symbol rendering, ...
- Supports portable devices (touch gestures)

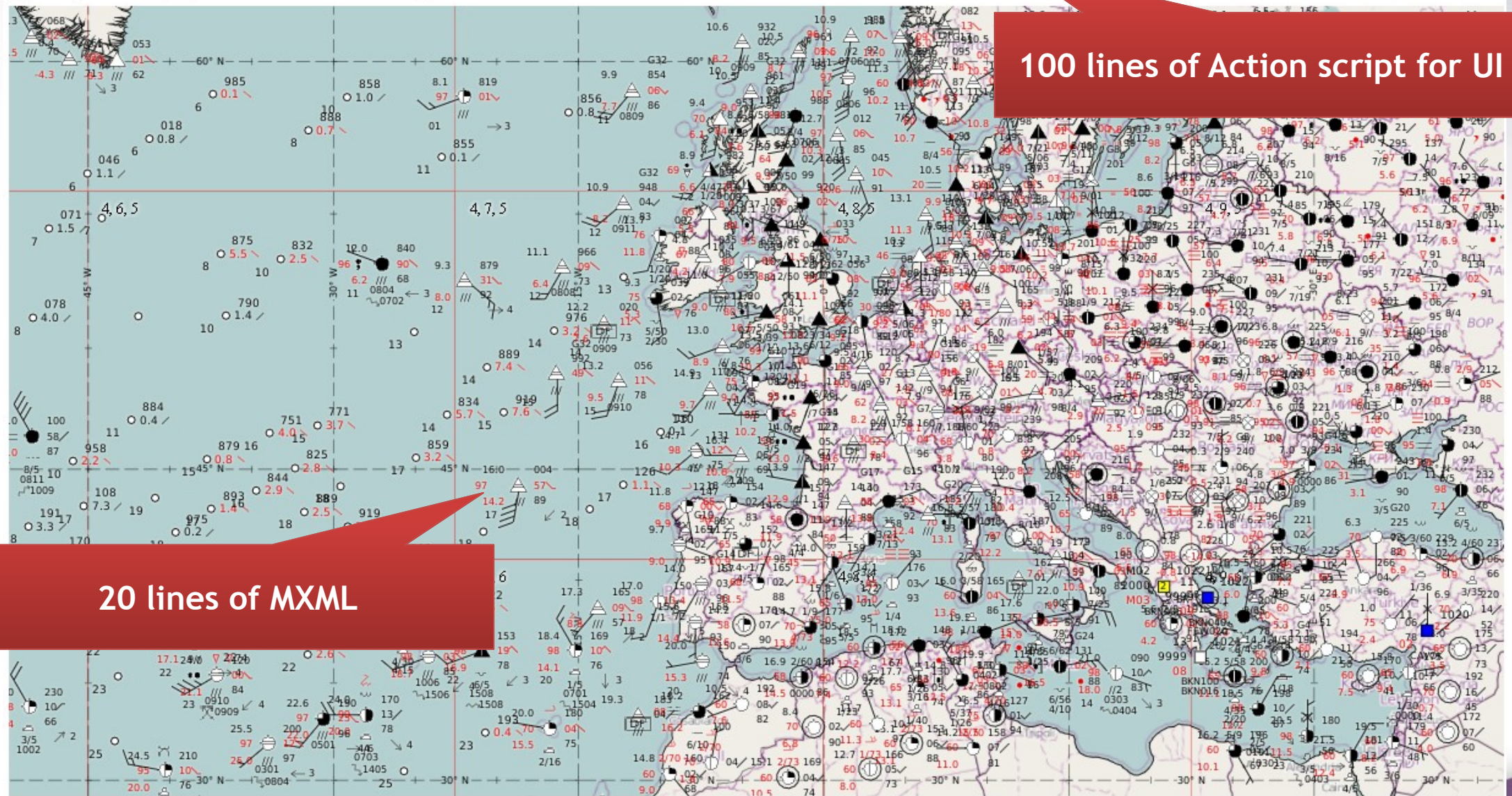
Flexi Weather - Simple example

This example demonstrates basic OpenGIS WMS functionality including tiling with custom WMS dimensions support, zooming, panning, change of projection reference system and data layer autorefresh.

Tools: Projections:

Displayed surface observations: SYNops METARs BUOYs Plot distance: [%] [754, 248] = 51N29'22" 8E36'32"

Use Open Street Map if possible Alpha:



100 lines of Action script for UI

20 lines of MXML

Flexi Weather & Online Weather on a tablet



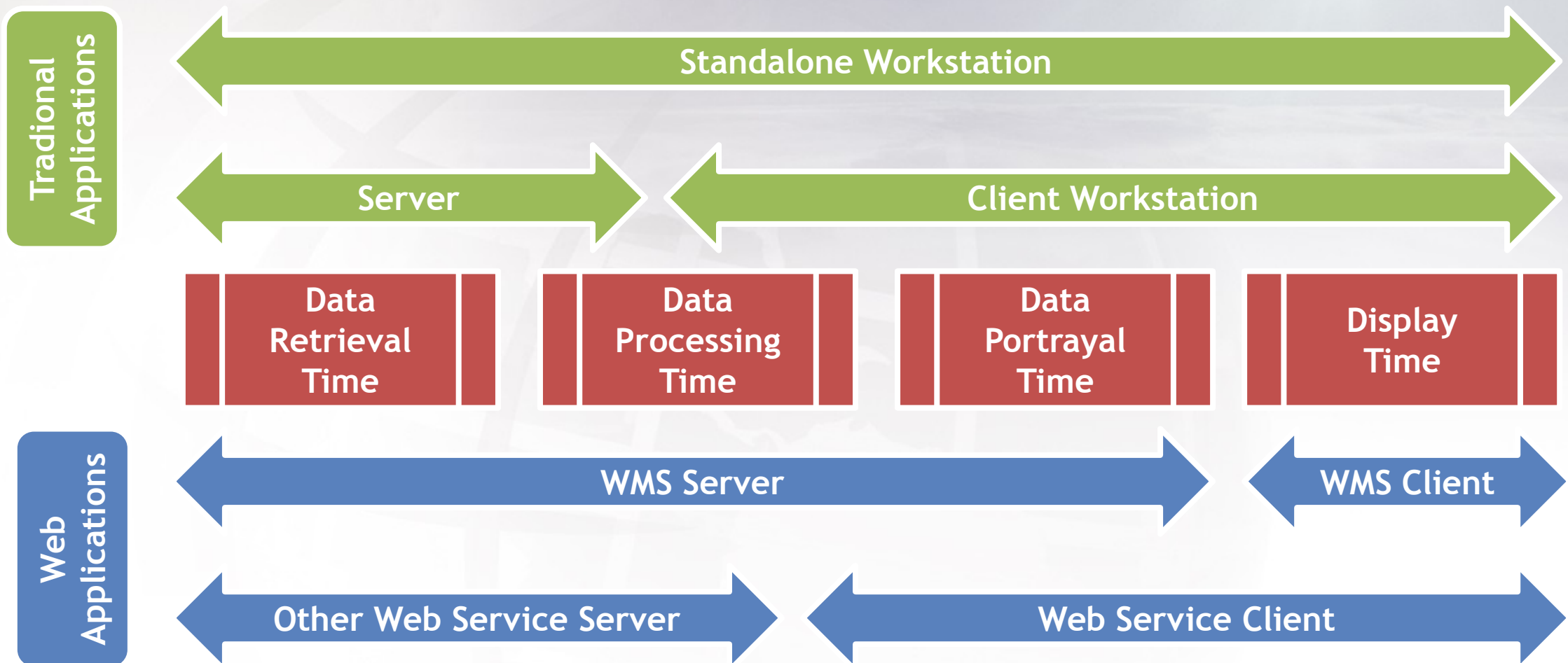


**THERE IS ALWAYS SOMETHING WHAT
CAN BE OPTIMISED**



Performance, performance, performance...

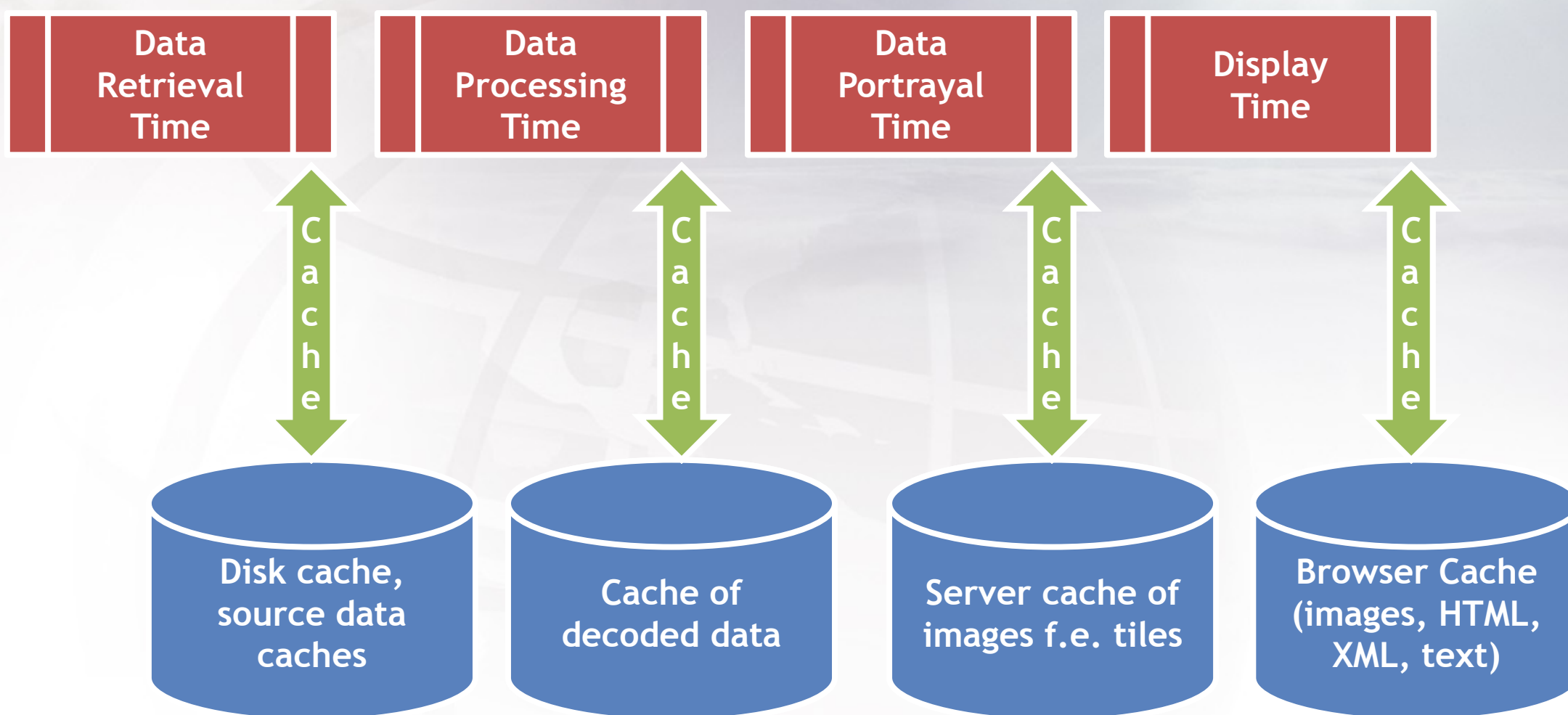
- Data access time is composed of:



- “Page loading...” effect - it takes even 4-5 seconds, but it makes you feel better, because you see the progress.



Traditional improvement by caching



- Not everything can be cached
- Visual Weather has a memory cache of decoded data and rendered tiles.

Possibilities for improvement

Data
Retrieval
Time

- Disk caches/SSD disks/fast network are the key places for improvements
Data structure improvement, if possible

Data
Processing
Time

- We utilise multi CPU core parallelisation and High Performance clustering (with facading load balancer)

Data
Portrayal
Time

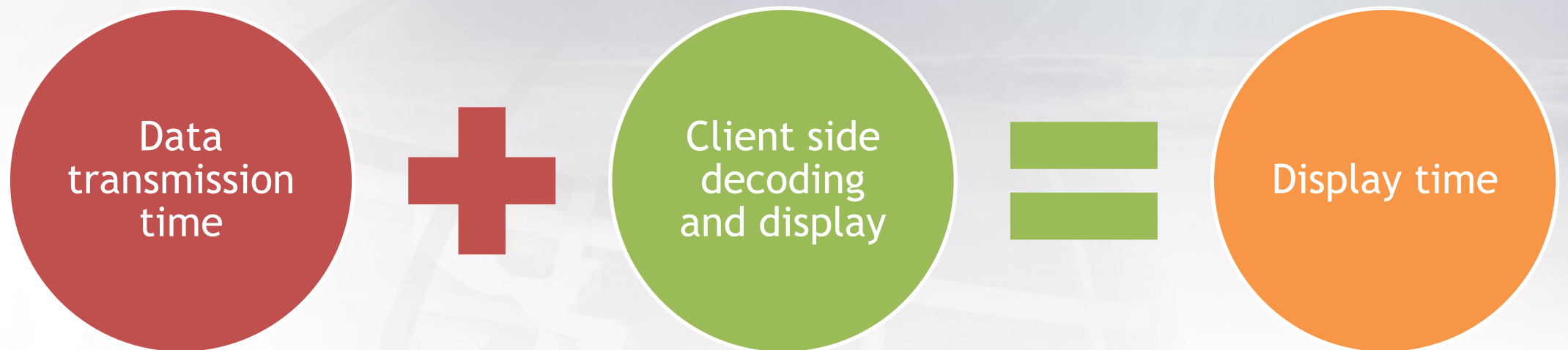
- Same as above
- Converting layer portrayal to tiles effectively and caching them.

Display
Time

- Out of our control, but...
...we had one use case which lead to surprising result...

Problems with low bandwidth users

- Low bandwidth usually implies high network latency



- Client side handling is insignificant
- Logically if data is smaller => will download faster => overall “feeling” would improve.
- Run-around time of multiple (for example 30 tiles) requests can be significant.
- **Images and XML - how can these be smaller?**

Compression of XML catalogs (Capabilities)

- Capabilities document of OGC are big XML files, very verbose having often ~several MB
- Luckily they can be well compressed with conventional algorithm ratios around 5:1.
- Compression could be explicit, but HTTP protocol allows transparent compression - quite rarely used feature, despite good support in browsers.

```
HTTP/1.1 200 OK  
Content-Encoding: gzip  
Content-Type: text/xml
```

How to make images smaller?

- When it comes to topic of which image formats browsers understand - one has only few real options - JPEG, GIF, PNG, BMP (SVG, JPEG2000 and others are purely supported).
- When dealing with transparency only PNG and GIF remain, while GIF is limited to simple 1-bit masking in comparison with PNG with real alpha channel.
- Surprise! There exists 8-bit PNG with alpha channel.

8-bit PNG, isn't it medieval technology?

- Again surprisingly it works in most of the browsers (where true color PNG works)
- Almost nobody can produce it 😊
- We tried and find out:
 - Pure compression time of 8-bit PNG is approximately only $\frac{1}{4}$ of the True Color ARGB PNG image.
 - Image size is typically 30-50% less than ARGB PNG.
 - Because Visual Weather rendering is True Color with anti-aliasing, most significant time of this is conversion to 8-bit paletted image.
 - Smaller = you can cache more.

Summary

- We have built and will continue building web services and web applications in parallel to traditional visualisation workstation - both OGC and bespoke - as needed.
- Optimising and scaling (caching, tiling) for (rendering) speed is only one side of the coin - reducing size of data being transmitted improves the response time particularly over WAN/low-bandwidth connections:
 - XML can be well compressed on HTTP level
 - 8-bit PNG is typically smaller than true color.

Thank you for attention!

Questions?