Meeting the challenges of the next generation of user interfaces

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Overview

- Metview
  - a meteorological workstation

- The next generation of user interfaces
  - challenges and solutions

- Magics++
  - a meteorological graphics plotting library
Metview

- Working environment for Operational and Research Meteorologists

- Co-operative project:
  - ECMWF
  - INPE/CPTEC (Brazil)
  - Meteo-France
Metview - Design

- Open and portable design

Modules, e.g. MARS, Vis5D, Hovmöller
- straightforward to add more

Standard software libraries, e.g. OpenGL, Motif, PNG

Platforms:
Linux, IBM, SGI, HP, SUN
**Metview - Interactive**

- Icon-based interface (drag and drop)

- Icons represent everything in Metview

- Data, visual definitions, macros
Metview – Macro Language

- **Macro language**
- powerful meteorologically oriented language

- Simple, modern script language
- Extensive list of operators/functions
- Macro programs: interactive or batch mode
- Automatically convert icons to equivalent macro code
- Macro editor – built-in or selected by user
- NEdit: enhanced Macro editor
Metview - Data Processing

- Meteorological Data Access and Processing Package
- GRIB, BUFR, MARS, ODB, geopoints, ...

```
v = retrieve(
    date  : -1,
    param : "v",
    level : 700,
    area  : area_xx,
    grid  : [1.5,1.5]
)

# Compute the gradient of Q
q = gradient(v)

# Extract the area we are calculating on
q = read ( area : area_xx, data : q)

# Compute the advection of Q
a = q[1]*u + q[2]*v
a = -a * (1.0 ^ 8) # units will be 10^-8 (kg/kg)/sec
```
Metview - Plotting

- Meteorological Desktop Plotting Package
- Uses MAGICS 6 as its plotting engine
- Will soon use Magics++
Metview – Display Window

- Interactive display window
- Zoom, scroll through fields, animate, print, generate macros
- Some interactive editing possible
Metview - New Features

- New Percentile application
- New Macro language capabilities
  - in-memory creation and manipulation of geopoints
    - bypasses need for temporary geopoints file
  - stopwatch() macro functions for performance tuning
- Lots more new functions and improvements
- Quick Installation Guide
Metview - Availability

- Available as source code for build/install on own system
- Export version 3.10 available soon from Software Services: http://www.ecmwf.int/products/data/software/
- Installed in more than 50 organisations around the world

Annual training course at ECMWF (Feb / March)

```
% cd metview
% ./mvbuild
```
Metview - Current Developments

- More automated installation
  - using the ‘configure’ tool, learning from experience with Magics++

- GRIB 2 support
  - replacement of GRIBEX with GRIB API library for decoding/encoding GRIB data

- Macro Library / Examples
Use Magics++ in the new plotting module

- convert Metview icon definitions to Magics++ objects
- plot using the new Magics++ OpenGL driver
- user can select and modify some elements of the plot; modifications are sent back to Magics++
- experimental – need to create a new Display Window to take full advantage of new features
Full integration with Magics++
- new Display Window module
- all the advantages of Magics++
- 64-bit Metview possible
New user interface?

- time to replace Motif?
  - e.g. GTK, Qt
- developments in Magics++ are putting more interactivity into outputs themselves (SVG, PNG + JavaScript)
- what about web applications?
  - Adobe AIR, Mozilla PRISM, Microsoft Silverlight take web applications to the desktop
Metview - Future Focus

- A web interface for Metview?
  - Run on a local web server
  - Calculations performed using local resources
    - still important in meteorology
    - but remote calculations also possible
  - User interface
    - JavaScript, widgets libraries
      - e.g. jQuery, YUI
  - Debugging tools
  - Maintainability
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  - a meteorological graphics plotting library
Interactive Magics++

The new design of Magics++ will allow it to be used in the new generation of meteorological workstations: Desktop or Web-oriented!

- What is the role Magics++ as a graphical package in a meteorological application?
- The Magics++ interactive functionalities.
- Magics++ latest news.
Interactive Magics++

- Magics++ is meteorologically oriented, but it is not a standalone application...
- Magics++ is the visualisation component of a more complex framework.
- Magics++ offers a set of interactive functions: The client application will be designed on top of it to offer a powerful tool tailored to the need of its users:
  - Researchers
  - Forecasters
  - Web users
Interactive Magics++

- Designed in parallel in 2 interactive environments
  - An OpenGL driver for the desktop applications
    - Motif Widget
  - A JavaScript module for web applications
    - JavaScript-on-demand
    - jQuery
- Offers a toolkit which can be used consistently in both environments.
- Tested in the new Metview Visualisation module and in the service-on-demand web project.
Interactive Magics++

- Navigation of the maps
  - Implementation of a tooltip facility
- Selection Modes
  - Area
  - Line
  - Polyline
- Layers
  - Defined by the client application
  - Visible or not
Interactive Magics++

- Change of layout or graphical properties
  - Resizable plots.
  - Resizable texts.
  - Positioning of the legend or text box.
  - Change of graphical properties (ex: lines attributes)

Can these changes be saved?
  if yes, the Magics graphical tree can be saved at any time and the application informed of the changes!
Magics++ as presented last workshop

Programming interfaces

Fortran  C++  MagML

Data-Input

GRIB 1 & 2  BUFR  NetCDF  ODB  Matrices

Features new in Magics++

Output

PostScript & EPS  PDF  PNG & GIF  SVG  OpenGL → Metview
Magics++ latest News – Version 2.3

Programming Interfaces

Data-Input

- GRIB 1 & 2
- BUFR
- NetCDF
- ODB
- Matrices
- MapGen
- Geopoints

Fortran → C → C++ → MagML

Output

- PostScript & EPS
- PDF
- PNG & GIF (animation + meta info)
- SVG
- KML
- OpenGL → Metview

Features new in Magics++

New contouring
Decoding of Grib data is done using *Grib API*.

Use of *Grib API* keys to customise the automatic title.
Magics++ - Netcdf plotting

Regular Y Axis

Logarithmic Y Axis
Magics++ - Odb Access

Using the in-house ODB server.

```
Odb:odb://banquo/var/tmp/cgr/odb/ECMA.conv/ECMA
    select lat, lon, codetype from hdr where obstype=1
```

![World map showing data points and markers for different types of observations.](image)
Magics++: Box plots and wind roses
Magics++ - Simple polyline shading

Sea Surface temperature valid on 1992-02-16 at 12:00:00
Magics++ : KML output
Magics++ : SVG output
Magics++ - MagML 3.0

- XML based format to describe Magics++ plots.
- A MagML template is interpreted to produce an output.
- Description close to Metview’s icon convention.
- Interpreter can be easily called in user code.
- Can be integrated into more complex XML request descriptions.

Œ Ideal as backend for web interfaces with static layout and visual properties but changing data.
MagML – code example

```xml
<magics version='3.0'>
  <drivers>
    <ps name='${name=myname}'>
  </drivers>
  <definition>
    <contour id='tempe' .../>
  </definition>
  <page>
    <nopageid/>
    <map>
      <cylindrical upper_right_longitude='60' upper_right_latitude='60'
                    lower_left_longitude='20' lower_left_latitude='20'/>
      <plot>
        <grib input_file_name='${grib=t850.grb}'>
        <contour use_id='tempe'/>
        </plot>
        <coastlines/>
      </map>
    </page>
  </magics>
```

To interpret this template:
```
magmlx  template.magml  -grib=today_t850.grib  -name=today
```
General benefits of Magics++

- Fortran interface was cleaned-up and made more consistent (driver calls, default values)
- Support user’s interactions
- Magics++ produces better publication-quality plots by supporting PNG, EPS and by optimising PostScript output
- Supports 64 bit memory addressing
- The *Apache license* makes Magics++ available freely for everyone
The Last Slide

- Contact details:
  - Metview: metview@ecmwf.int
  - Magics++: magicsplus@ecmwf.int

- See us at the exhibition
  - Thursday, 5:30pm
  - Meeting room 1 near the atrium in the new building