Metview 4: Providing enhanced interaction with meteorological models

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What is Metview?

- Working environment for operational and research meteorologists
- Retrieve/manipulate/visualise meteorological data
- Allows analysts and researchers to easily build products interactively and run them in batch mode

Built on core ECMWF technologies:

MARS, GRIB_API, Magics, ODB, Emoslib

- Since August 2012 Open Source under Apache Licence 2.0
  - Increased interest from research community
- Metview is a co-operation project with INPE (Brazil)
What is Metview?

● **Service Oriented Architecture**

● **Data:**
  - Access
  - Examine
  - Manipulate
  - Plot
  - Overlay

  ![Image](image.png)

  - GRIB
  - BUFR
  - NetCDF
  - ODB
  - Geopoints
  - ASCII

● Can be run interactively or in batch

● Can be easily installed and runs self-contained standalone
  - From laptops to supercomputers
  - No special data servers required
Metview’s main features
Icon-based interface

- 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
Drag and Drop

Coastlines

cost_grey_light
Drag and Drop

Contour shading

wgust_shade
Drag and Drop - Overlay

Overlay works for all the data types!

MSLP (GRIB)

Contouring

MOS 2013 - Metview
Display Window - Magnifier
Display Window - Cursor Data
Display Window - Layer Metadata

Sidebar with various tabs

Histogram (for data in visible area)

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Macro language

- Powerful high-level meteorologically oriented script language
- All Metview tasks can be written or saved as macros, and run in batch or interactive modes
- Interfaces with Fortran/C/C++ code
- Outputs:
  - derived data
  - interactive plotting window
  - graphics formats (e.g. PS, PNG, SVG, KML, PDF)

# Read a grib file
temp = read ( "/home/graphics/temp.grb" )

# Re-scaling field
if threshold > 0 then
  temp = temp – 100
  a = integrate ( temp )
end if

# Compute the gradient
q = gradientb ( temp )

# Save field
write ( "/home/graphics/gradient.grb" , q )

# Plot field
plot ( [ps,svg], q )
Metview Macro drag and drop

Strong synergy between Icons & Macros

- Every icon can be translated into a Macro command

```plaintext
#Metview Macro

mslp_grib=read("mslp.grib")

mslp_black = mcont(
  contour_line_thickness : 2,
  contour_line_colour : "black",
  contour_highlight : "off",
  contour_level_selection_type : "interval",
  contour_interval : 5,
  contour_label_height : 0.2,
  grib_scaling_ofDerived_fields : "on"
)

plot(mslp_grib,mslp_black)
```
Large variety of meteorological charts

- Tephigram
- Hovmöller
- WMS with Satellite and radar by NOAA nowCOAST
- Strike Probability Map
- Clusters
- Scatter plots
- Interface with FLEXTRA
- Coloured Wind

MOS 2013 - Metview

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Metview’s interface with meteorological models
OpenIFS with Metview

- Portable, easy-to-use version of the ECMWF IFS model
  - Reduced version of IFS
  - Based on previous operational model
  - Started Dec 2011
  - In development phase

- For training and academic research

→ Metview: ideal application for analysing and displaying OpenIFS output GRIB files

- Metview was used in OpenIFS training course in Helsinki (June 2013)
OpenIFS support in Metview

- All the Metview functionality works with the OpenIFS output
- Examples icons are available from:

https://software.ecmwf.int/wiki/display/OIFS/Using+MetView+with+OpenIFS
Interfacing external models

- Researchers use various smaller, more specific models for their research

- These models are seen by Metview as a ‘black box’
  - Metview prepares the input
  - Metview runs (external) model executable
  - Metview handles (visualises) the output

- This concept works easily with Metview’s service-oriented architecture (SOA)
Metview - Trajectories

- Metview has been interfaced with FLEXTRA via modules which:
  - prepare the data, run the calculation by FLEXTRA and display the results

- Detailed description can be found in Newsletter article and tutorial on the web

- We are currently integrating the dispersion model FLEXPART in similar fashion
IFS Single Column Model (SCM)

- Simplistic approach: simulate IFS for a single grid point
- Useful tool to study the physics in more detail
- Allows to study subset of processes or single process only
- Very useful for comparing different models or different versions of the same model
- Computationally cheap

→ Ideal for interactive research work with Metview

- Metview was used in the “Parameterisation of diabatic and subgrid processes” training course at ECMWF (April 2013)
SCM-Metview: Modifying an input data file

- Custom editor for SCM input netCDF files
SCM-Metview: Running the model

- SCM Run icon:
  - allows users to specify how to configure and run the model
  - runs the model and caches the result
SCM-Metview: Visualising the result

- Time-value curve
- Time-sliced profiles
- Time-height matrix
RTTOV Introduction

- A fast radiative transfer model
- Models infra-red and microwave satellite radiometers

Inputs:
- Atmospheric profile of temperature and gas concentrations
- Surface / cloud / satellite properties

Outputs:
- Top of atmosphere radiances / brightness temperatures for each simulated sensor channel
- Jacobian matrix – shows which atmospheric layers are most sensitive to changes in the input profile for each channel

Metview was used in “ECMWF/EUMETSAT NWP-SAF Satellite data assimilation” training course at ECMWF (July 2013)
RTTOV-Metview: Input Data Generation

- Retrieve data from MARS and extract profiles (using existing modules)
RTTOV-Metview: Input Data Inspection

- The SCM editor can also be used for RTTOV data
RTTOV-Metview: Running the Model

- RTTOV Run icon:
  - allows users to specify how to configure and run the model
  - runs the model and caches the result
RTTOV-Metview: Visualising the result

Rtov Visualiser

Output of RTTOV calculations: calculated Jacobians for AMSUA

Jacobian as matrix

Tb per channel

Jacobian as curves
Future developments (1)

- New Qt based desktop (alpha version stage)
Future developments (2)

- **Short term**
  - Thermodynamic diagrams
  - More clients for OGC web services formats (SOS, WaterML)
  - Integrate ECMWF’s new interpolation package
  - Exploring interfaces to 3D packages (e.g. Vapor)
  - New MARS client access through MARS web-api
    - External users can directly access ECMWF’s MARS

- **Long term**
  - Python based Macro Language
  - Combine experience of WREP (ecCharts) with long-term experience of Metview to produce a common architecture
For more information ...

email us:

❖ Metview:  metview@ecmwf.int

visit our web pages:

❖ http://software.ecmwf.int/metview
❖ Download
    ❖ source tarball or virtual machine
❖ Documentation and tutorials available
❖ Metview articles in ECMWF newsletters