Interactive 3D visualization of ECMWF ensemble weather forecasts

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3D ensemble visualization for forecasting

Met.3D – improve forecasting for flight planning by use of ensemble uncertainty information and combined 2D/3D exploration techniques.
Met.3D – an interactive 3D forecasting tool

User interface elements required for forecast exploration.

time & ensemble navigation

multiple views with 2D & 3D visualization
Met.3D – an interactive 3D forecasting tool

- multiple views with 2D & 3D visualization
- time & ensemble navigation

User interface elements required for forecast exploration.

GPU based.
Outline

(1) A „bridge“ from 2D to 3D,

(2) support for (ECMWF) ensemble forecasts,

(3) interactive ensemble forecast products,

(4) future work in „Waves to weather“ – feature based ensemble visualization.

Technical specs:

- desktop application (C++/OpenGL/Linux);
- support for ECMWF ENS NetCDF/Grib;
- support for hybrid sigma-pressure levels.
Do not replace proven 2D techniques but put them into a 3D context and use 3D elements to add value.
Bridge from 2D to 3D – horizontal sections

Geopotential Height (m) and Horizontal Wind (m/s) at 250 hPa
Valid: Fri 2012-10-19 18:00 UTC (step 66 hrs from Wed 2012-10-17 00:00 UTC)

Interactively move section: fast means to explore vertical structure.

Do not replace proven 2D techniques but put them into a 3D context and use 3D elements to add value.
Bridge from 2D to 3D – vertical sections

Shadows and vertical axes for spatial perception.
Bridge from 2D to 3D – Skew-T-diagrams

Spaghetti plots for temperature and dew point
Support for ensemble forecasts

jetstream – 3D isosurfaces 50 m/s and 30 m/s

- single member
- animation over ensemble members
- ensemble statistics (e.g. probabilities)
- mean and standard deviation

\[ p( v > 50 \text{ m/s} ) \]
– video –
select trajectories according to ascent:

e.g. **500 hPa in 48 hours**
(interactively in Met.3D)

(Wernli and Davis, 1997)
Probability of WCB occurrence
video
Current work: Spaghetti plots and clustering

Interactive clustering of an ensemble of streamlines/trajectories

Future work: feature based ensemble visualization in „Waves to weather“ (2015-19)

[PhD position available!]
Summary

Met.3D

Bridge from 2D to 3D

Ensemble support

Ongoing research in visualization techniques
Summary

Publication: Rautenhaus et al. (2015a,b) Geosci. Model Dev. (8)

Met.3D open-source repository: https://bitbucket.org/wxmetvis/met.3d

Users wanted!
Contact me at marc.rautenhaus@tum.de
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See Met.3D live at the exhibition!

Thank you!