Towards collaborative developments applied to meteorology

WWOSC 2014
Montreal, Québec

Sandrine Edouard, D. Figueras Nieto, F. Fortin, M. Klasa, M. Beauchemin, L. Pelletier, G. Hardy, S. Fortier, N. Taylor, G. Croteau, J. St.-Cyr, P. Mann

Service Météorologique du Canada/ Meteorological Service of Canada

July, 17th 2014
A wide range of data formats and projections

• Data formats
  ➢ NetCDF (Network Common Data Format)
  ➢ GRIB (GRIdded Binary)
  ➢ CSV (Comma-separated values)
  ➢ BUFR (Binary Universal Form for the Representation of meteorological data)
  ➢ Etc…

• Projections
  ➢ Polar stereographic
  ➢ Universal transverse Mercator
  ➢ Lambert conformal conic
  ➢ Etc…
A wide range of software and community models

• Libraries and software
  ➢ R statistical computing and graphics software
  ➢ Python meteorological libraries
  ➢ Octave, high-level computing software
  ➢ Etc…

• Community models
  ➢ Weather Research and Forecasting model (WRF)
  ➢ NCAR Community Atmosphere Model (CAM)
  ➢ Nucleus for European Modelling of the Ocean (NEMO)
  ➢ Etc…

• What about Post-processing ?
  ➢ Ex: NCEP Unified Post Processor
Canadian Meteorological Center’s post-processing system

SPOOKI

Système de Production Orienté-Objet contenant une Kyrielle d’Informations /
Object-oriented production system containing a myriad of information

• Modular plug and play approach
• Plugin: robust, reusable, specialized and autonomous
• Well-documented system (en/fr)
• Minimum system requirements:
  ➢ Linux32/64 bits
  ➢ BOOST and Sqlite libraries
The development cycle of a SPOOKI plugin

• Analysis
  ➢ The science

• Plugin request
  ➢ What the computer scientist needs to know and what we want to tell the users

• Coding
  ➢ The collaboration between the coding experts and the weather experts
  ➢ Standardized and automatically-generated documentation

• Validation
  ➢ Unit and integration testing
  ➢ Let’s make sure it works well and under different configurations (different grids, resolution, etc...)
Some SPOOKI plugins currently available – Stable version

Robust version that has been validated in an extensive way
45 available plugins

• Toolbox plugins :
  – Horizontal and vertical interpolations
  – Vector direction and modulus
  – Etc...

• Meteorological plugins :
  – Thermodynamics variables (ex: vapour pressure, water vapour mixing ratio)
  – Stability indices (ex: George K, SWEAT)
  – Wind chill
  – Etc…
Some SPOOKI plugins currently available – Beta version

Experimental version - 70 available plugins

• **Toolbox plugins** :
  - Digital filter
  - Arithmetic calculations (ex: mean, square root, absolute value)
  - Etc…

• **Meteorological plugins** :
  - Humidity variables (ex: specific and relative humidity, dew point depression)
  - Stability indices (ex: CAPE, lifted index, LCL)
  - Wind vertical shear
  - Etc…
Some SPOOKI plugins usage examples

• TemperatureWetBulb
  ➢ Convective indices
  ➢ Snow line

• EnergyMeanIsothermMethod
  ➢ Instantaneous precipitation type
  ➢ CAPE

• VerticalScan
  ➢ Freezing levels
  ➢ Convective indices
  ➢ Instantaneous precipitation type
Collaborative developments

Hydrometeorology and Arctic Laboratory (Edmonton)

Summer Convection products

CMC post processor SPOOKI

Aviation Research Group (Toronto)

High Impact Weather Laboratory (Montreal)

Summer severe weather indices
Icing (aviation)

Wind gust (AutoTAF)

Snow line forecasts

Coastal and Mountain Meteorology Laboratory (Vancouver)

Current work

Future work

Experimental mode
Challenges and opportunities encountered

- **Revision of the science**
  - Faster elimination of obsolete code/algorithm

- **Expansion to different models**
  - Adds robustness and flexibility to the code

- **Generalising**
  - Increases adaptability
  - Having a long-term vision

- **Modularisation**
  - Avoids redundancy
  - Reduce maintenance
Current and future work

• Complete the technology transfer of the Hydrometeorology and Arctic Laboratory summer convection products to the CMC operational post-processing suite

• Collaborate with the Montreal High Impact Weather Laboratory to implement new summer and winter severe weather algorithms to the future 2.5km high resolution system over Canada

• Develop plugins to support GRIB2, XML, BUFR data formats
Conclusion

Develop collaboratively and you will spend more time doing SCIENCE…
Thank you
/
Merci

Questions?