Aladin-Hirlam strategy meeting

TT for quality assurance

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WHY verify?

… we want to give the best possible tools to our operational meteorologist, customers

… we need to justify the use of ressources to the management

… to define deficiencies and the fields of model development

…

WHY verify?

- Continuous monitoring of the quality of operational forecasting systems:
  - Limited when using standard verification methods and data from surface observation networks (double-penalty effect, missing of high impact weather in standard observation, …)
  - fair comparison between forecasting systems of different resolution is not possible using standard verification methods and observations.
- Verification tools to support model development:
  - A wide range of parameters are modelled explicitly (clouds, precipitation types, fluxes, lightning, etc.).
  - Tools to deal with this wide range of parameters (feature tracking, observational data originating from remote sensing)
- Operations – to – research feedback:
  - Inclusion of daily experience of operational meteorologists
  - Judging the quality of a model on a daily basis
    - to stimulate model development
    - increase acceptance and acknowledgement of the benefits of high-resolution models

WHAT we need?

Common verification tools

- Harp is developed as a number of R-packages using existing verification methods,
- flexible for the implementation of newly developed methods.
- Open to the development of new methods,
- capability to deal with the wide range of different input data.
- Goal is to provide harp either as an implementation in the post-processing of the forecasting system, or as a standalone tool, including formal tests and full documentation of the harp system.
- Currently, however, the way verification and QA is technically implemented is differing inside the Consortium.

WHAT we need?

Development of verification methodologies / metrics

- Neighborhood methods seem to provide more information on skillful scales of very high-resolution forecasts. Development of methods will be directed towards spatial-temporal methods for eps forecasts, including the use of the more parameters (e.g. cloud, lightning, etc.).
- High-impact weather and it’s verification is hard to capture with standard observational networks. Crowd-sourced very high resolution data and the development of methods for extreme can bridge the gap in observation density.
- Machine learning (ML) and the use of artificial intelligence is currently limited in the field of verification. ML-methods could contribute in the context of automated pattern detection (e.g. clustering algorithms, pattern of rainfall-objects, pattern-shifts by model upgrade).

WHAT we need?

Verification of 3- and 4-D processes

- Cloud-, precipitation- and radiation-processes and their interactions are more and more explicitly modelled.
- Conventional observation of this type of parameters are rare and usually not even available in observational networks,
- Remote-sensing observations provide information about these parameters in 3(4) dimensions.
  - Physical properties of satellite channels by radiative transfer modelling
  - Use of SAF products.
  - Lightning data as indicator of high-impact weather.

WHAT we need?

Enhanced user - developer interaction

- Operational meteorologists play an important role in the evaluation of model updates / new operational models as key users.
- Establish a feedback culture:
  - Operational meteorologist meetings,
  - Preparation of scorecards dedicated to the user needs
  - Regular information about verification status at a homepage(s).
  - A team of people involved in operational verification and monitoring of the operational systems.

HOW?

Co-operation with other fields of model development:

- Data assimilation: High potential of a common use of data sources and quality-control-methods (availability, pre-processing, radiative transfer modelling, …)
- Physics and Surface: it will be important to understand the modelled processes / parameters and their exact physical meaning.
- EPS: A strong connection in methods of post-processing, calibration, storage and machine learning is seen here.
- System: Implementation of verification-toolbox in the CSC's

HOW?

Development of common tools and methods:

- Implementation of new spatial/temporal verification methods
- Work out how harp can be implemented in the common code / as a post-processing tool and as a stand-alone-tool.
- Testing, documentation and training for the users (webinars, tutorials, trainings)

HOW?

Verification methods

- Involves mainly spatial/temporal verification and the use of high resolution verification data from analysis systems, remote sensing (radar, satellite and lightning detection) for operational verification including inventory, radiative transfer modelling, ...
- Development of tools for extreme / high-impact weather and methods for conditional verification.
- In connection to this issues an assessment of potential benefit of machine-learning techniques.

HOW?

Enhance user-developer feedback

- Intuitive presentation of the model / verification of the model.
- Scorecards targeted to the user needs. It will be important to show to each of the users, what he/she needs to see (operational meteorologist, scientist, management).
- Organization of training and provide tools to guide users to use ensembles optimally.
- Regular feedback sessions to discuss quality of operational models and benefits / shortcomings of planned new model cycles.

Opportunities

- Currently different verification tools are already established and used in national institutes (harp, monitor, MF-specific, local python/fortran/C++ tools).
- Work towards an integrated toolbox inside the system would increase comparability of verification and reduce efforts on development of local systems.
- “harp” - for example - has been developed with the objective to serve as a future common system for verification in the LAM community.
- Comparability and integration of new methods / metrics makes them available for all
- Inline/offline versions of toolboxes are available to all partners.