Guidelines of COSMO WG4 for Interpretation and Applications

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In Appendix 1 of the COSMO Science Plan for 2015-2020 plan related to the tasks of WG4 it is stated that

“The goals of developing post-processing at the consortium level are:

1) to help understanding the characteristics of model output and provide methods to analyse (space, time, parameter, ensemble member) combinations of the output fields; this process should be supported by corresponding verification methods.

2) to provide the users of models (including meteorological forecasters) with recommendations of use of model output; this goal only can be reached by exploiting the conclusions drawn in point 1).”

These goals are still valid, and the work to achieve them will be continued in the next 5 years at least.

The following priority projects have been carried out within the framework of WG4.

- INTERP: study of the scale dependency of the forecasts and searching the optimal scale.
- CORSO: COSMO services for the SOCHI2014 Olympic Games.

The ongoing projects are

- AWARE: verification and post-processing for high impact weather events (joint with WG5 and partly with WG7).
- MILEPOST: exploring the Machine Learning post-processing.

Other WG4 activities have been directed to

- summarizing post-processing methods used by different centres/groups and attempting to exchange them;
- formulating guidelines for forecasters and gathering forecasters’ feedback;
- studying specific post-processing methods, including CAT, icing, energy, and thunderstorm indices.

The above list of the WG4 tasks makes it clear that the WG4 activities are closely related to the activities of WG5 and WG7, and, more generally, to the activities of all other working groups.

WG4 works in close collaboration with the forecasters, and several members of the present WG4 are operational forecasters and experts in verification. This partially helps to overcome the well-known problem that modellers, post-processing developers, and verification experts belong to different departments and their communication is not sufficiently intensive (they participating in different COSMO meetings, etc.).

Continuous actions

1) Work on the guidelines for forecasters.

This action is initiated within the framework of Task 4 of the AWARE priority project. It is planned to continue this task as new, higher-resolution model versions, and in particular ICON-LAM, become operational and new post-processing products become available.

2) Evaluation of the products and feedback from forecasters.

At present, this activity is carried out within the framework of PP C2I task 6 which tries to identify the ICON-LAM added value as compared to COSMO, including the overall model performance and the forecast quality in different weather situations, particularly in cases of severe weather.

3) Collecting and analysing specific cases of model success/failure.

At present, the work is ongoing to establish a unified COSMO system for the analysis of such cases (stratified by the event type) on the COSMO web-site. This system uses the experience of MeteoSwiss in gathering the forecasters' feedback for particular events in the online mode.

4) Consolidation and fostering cooperation with the other COSMO and ICON Groups, and with the other NWP Consortia.

5) Endeavour to share national application developments.

The previous experience shows that, although the WG4 participants are willing to share their national application packages (on MOS, ML post-processing, renewable energy, and so on), it is not easy because of the specificity of local data, needs, and interfaces. Nevertheless, the WG4 is trying to identify possible common needs and applications that can be exchanged. This is in harmony with the global trend at unification, e.g., standardization of verification practices in the world (2020 International Verification Methods Workshop).

Future actions

In short- to mid-term perspective (1-3 years)

1) Consolidation of results obtained within

PP AWARE (development of the best post-processing algorithms for High Impact Weather events, comparison with DMO where possible and relevant verification approaches, both standard and spatial ones, as well as methods developed for rare events, presentation of warnings about HIW to specific users and general public)

and within MILEPOST PP (MachIne LEarning-based POST-processing).

2) Transition to ICON.

This requires new training datasets. As stated in the PP MILEPOST plan, the previous work suggests that the best direction of research will be to focus on the artificial neural networks (ANN). However, other methods [e.g., Recursive Least Squares (RLS) and Multi-Linear Regression (MLR)] should not be neglected and should be developed and tested along with ANNs . Since RLS and MLR require shorter data set for learning (especially with small forgetting factor of RLS), these methods might be beneficial, most notably during the COSMO-to-ICON transition period.

3) A possible PP or PT for understanding the cases of model success and especially model failure (item 3 in "Continuous actions" above).

This would require that some cases from the WG4 collection are re-run by different services (it is important to look if different model versions give consistent results in

particular cases of failure or success). Results from those runs should then be thoroughly analysed in order to understand why the NWP model fails/succeeds in the situation in question. Sensitivity tests should be performed (but physical ideas and "working hypotheses" should be formulated first). Such a PP/PT would require close collaboration of WG4 with the physics and verification people.

In the mid- to long-term perspective (2-5 years)

The activities of the WG4 will be determined by

1) Further increase of model resolution.

At present, models with 2 and 1 km horizontal mesh size are already operational. Higher-resolution model versions are being implemented (e.g., 100 m mesh size is used for urban areas). The use of high-resolution models will require updating statistical post-processing methods (new training datasets, finding other optimal predictors, etc.).

2) Improved model physics and other aspects of the model development.

Actions are the same as above.

3) Advent of novel observational data. Development and evaluation of the best post-processing methods, including non-standard variables, is impossible without using novel types of observations (e.g., remote sensing, citizen observations, and social media).

4) Wider use of ensemble products.

5) Integrating the post-processing into the warning information value chain.

In longer-term perspective (beyond 5 years)

The role of statistical post-processing to correct systematic model errors may decrease due to the improvements of the NWP models.

Some meteorological parameters, like visibility/fog, pollutants, and turbulence, may become part of direct model output so that these parameters will no longer require post-processing. On the other hand, some other non-standard user-specific variables can be included into the post-processing.