WG4 Potential new PPs/PTs

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COSMO GM 2021

PP or PT for visibility/fog forecast improvement

- Motivation: High demand from forecasters (PP C2I survey) and, in particular, at the airports
- Available experience: AWARE task 4.1:

  Overview of Postprocessing Model Data for Fog Forecast (Ju. Khlestova et al. talk on 13 Sept AWARE session)
- Could be joint between WG3a and WG4 (as this task relates to microphysics and postprocessing)

Postprocessing model data for fog forecast

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23[th] COSMO General Meeting
13/09/2021

WG4

Directions of fog forecast development

a) Empirical ratios

$$\beta = f(k_1, k_2, k_3 \ldots)$$

k_i – meteorological parameters (air temperature, dew point temperature, wind speed, relative humidity).

(Zverev A.S., 1977)

Base: measurements

b) Machine learning methods

$$\beta = f(k_1, k_2, k_3 \ldots)$$

k_i – meteorological parameters (air temperature, dew point temperature, wind speed, air pressure, relative humidity).

(Abdulkareem et al., 2019; Zhu et al., 2017; Oguz and Pekin, 2019)

Base: measurements or NWP results

c) NWP forecast (or postprocessing)

$$\beta_\lambda = \int_0^\infty Q_{ext,\lambda} n(r) r^2 dr$$

or need the parametrization of β

(Kunkel B.A., 1984; Wilkinson et al., 2013; Creighton et al., 2014)

Base: NWP results

WG4

Ju. Khlestova et al. talk on 13 Sept AWARE session

Visibility forecast based on ICON/COSMO results

- **Liquid water content (QC)**

Which one is more appropriate for fog forecast?

need the analysis and comparisons

QC in microphysics scheme

QC in turbulence scheme

QC in radiation scheme

- **Number concentration of cloud droplets (N_c)**

only for two-moment microphysics

WG4

Ju. Khlestova et al. talk on 13 Sept AWARE session

PP for understanding the cases of model success and especially model failure

- **From WG4 Guidelines (http://www.cosmo-model.org/content/consortium/reports/WG4_Guidelines_2021.pdf):**
- **“This would require that some cases from the WG4 collection are rerun 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”**

Past PP QPF led by M.Arpagaus, finished in 2007

- **Priority Project "QPF"**
  Tackle deficiencies in quantitative precipitation forecasts
- http://www.cosmo-model.org/content/tasks/pastProjects/qpf/default.htm
- QPF final report
  http://www.cosmo-model.org/content/tasks/pastProjects/qpf/qpf_finalReport.pdf

Past QPF PP led by M.Arpagaus, finished in 2007

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Не защищено | cosmo-model.org/content/tasks/pastProjects/qpf/default.htm

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Priority Project "QPF"
Tackle deficiencies in quantitative precipitation forecasts

Last updated: 2008
See also: final report | workshops

Project leader: Marco Arpagaus (MCH), with support from Silke Dierer (MCH)

Description

Quantitative precipitation forecasting (QPF) is one of the most important reasons to utilize and pay for a numerical weather prediction model, both for forecasters and customers. Unfortunately, it is also among the most difficult parameters to quantitatively forecast for an NWP model, and the COSMO is not doing a particularly good job at it (other models may not be much better, though).

This project aims at looking into the COSMO deficiencies concerning QPF by running sensitivity experiments on a series of well chosen cases which have verified very poorly. If successful, the outcome of these sensitivity experiments will be a more effective set of COSMO namelist or model parameters for QPF, or a clear idea of what parts of the model need to be reformulated and improved most urgently to obtain better quantitative precipitation forecasts.

There are various indications, both from verification (WG5) and from forecasters in various COSMO countries, that the COSMO has serious deficiencies in forecasting precipitation. Some of these problems are longstanding (and not necessarily unique to the COSMO), some others seem fairly recent. This project aims at collecting, consolidating, and highlighting these deficiencies in order to then investigate, understand, and possibly improve some of them (for more details on the individual tasks, see the respective section below).

Project subtasks

Task 1: Consolidate forecast failure reports and verification findings
This task is focused on getting a better and quantitative idea of the COSMO problems related to precipitation. This will include a consolidation of the available problem reports from all the COSMO member states and all the 7 COSMO implementations (i.e., LM-DWD/LME, aLMo, LAMI, EuroLM, LM-HNMS, LM-IMGW, LM-NMA) , as well as a thorough assessment of the existing verification results from all the partners.

This will result in a first list of test cases. To ensure that the observed COSMO problems are not due to an old version of the model (or a very specific COSMO implementation), the test cases will then be run with a LM reference version, and the test cases, for which the COSMO reference version reproduces the QPF deficiencies, will constitute a final list of test cases recommended for sensitivity studies.

Task 2: Provide standardized set of model changes to be used for sensitivity studies
The second task will be to establish a standardized set of model changes for sensitivity studies, starting from the suggestions of the experts from working groups 1 to 3 (i.e., data assimilation, dynamics and numerics, physics).

Task 3: Run the sensitivity experiments and draw conclusions concerning possible improvements of the LM QPF performance
This task is to investigate the sensitivity of the COSMO for the weather situations and test cases identified as error prone by the verification efforts (task 1) with respect to the standardized set of model changes (task 2).

Task 4: Make idealized runs for moist benchmark cases
This fourth task is to run idealized moist benchmark cases for the same set of standardized model changes. Additionally, the benchmark cases can also be used to determine the most sensitive parameters of the model to define the set of standardized model changes in the first place.

Task 5: Publish results of the project in a peer-reviewed journal
Finally the results of the project will be published in a peer-reviewed journal.

Conclusions

The project was completed in 2007 and only reporting and publication (task 5) were left for 2008. The Final Report was prepared in March 2008. It is available as a pdf file (download (6.2Mb))

WG4

Final report of the COSMO priority project „Tackle deficiencies in quantitative precipitation forecasts"

S. Dierer[1], M. Arpagaus[1], U. Damrath[2], A. Seifert[2], E. Avgoustoglou[7], T. Andreadis[7], M. Baldauf[2], R. Dumitrache[9], V. Fragkouli[7], F. Grazzini[3], W.Interewicz[8], P. Louka[7], P. Mercogliano[6], P. Mezzasalma[3], M. Milelli[4], D. Mironov[2], A. Morgillo[3], E. Oberto[4], A. Parodi[5], I. V. Pescaru[9], U. Pflüger[2], F. Schubiger[1], K. Starosta[8], M. S. Tesini[3]

[1]MeteoSwiss (CH), [2]DWD (D), [3]ARPA Emilia Romagna (IT), [4]ARPA Piedmont (IT), [5]Uni Genova (IT), [6]CIRA-CMCC (IT), [7]HNMS (GR), [8]IMGW (PO), [9]NMA (RO)

Workshops and meetings

1) LM User Seminar, Langen, Germany, 8 March 2006
2) COSMO General Meeting, Bucharest, Romania, 18 September 2006
3) LM User Seminar, Langen, Germany, 8 March 2007
4) Visit of Axel Seifert at MeteoSwiss, 24-25 April 2007
5) COSMO General Meeting, Athens, Greece, 21 September 2007

Presentation of QPF results

1) Silke Dierer et al.: LM User Seminar, Langen, Germany, 6-8 March 2007
2) Federico Grazzini et al.: National Meeting of Geophysics, Ischia, Italy, 11-15 June 2007
3) Massimo Milelli et al.: EMS, San Lorenzo de El Escorial, Spain, 1-5 October 2007
4) Silke Dierer et al.: COSMO General Meeting, Athens, Greece, 19 September 2007
5) Silke Dierer et al.: SRNWP Workshop, Bad Orb, Germany, 5-7 November 2007
6) Antonella Morgillo et al.: SRNWP Workshop, Bad Orb, Germany, 5-7 November 2007

Main conclusions from QPF

- The focus of the project was on numerical methods and physical parameterizations, while the effects of inaccurate initial and boundary data were largely neglected.

- The selected test cases thereby fall into two prominent groups of forecast errors: 9 test cases with stratiform overestimation, mainly in Germany, Switzerland, and Poland, and 7 test cases of convective underestimation, mainly in Italy and Greece.

- As a second step, a set of sensitivity studies concerning initial conditions, numerics, and model physics has been prepared (about 700 experiments)

- The evaluation of the sensitivity experiments is based on the 24h area averaged precipitation for selected evaluation regions with a minimum size of 100km times 100km. Hence, the focus is on large scale over- or underestimation of QPF. Problems of wrong small-scale localization or wrong temporal simulation are not looked at.

Main conclusions from QPF

- The sensitivity experiments show that the strongest influence on QPF is caused by changes of the initial humidity and by using the Kain-Fritsch/Bechtold convection schemes. Both sensitivity experiments result in average relative differences of the area averaged precipitation values in the range of 30-40%.

- Using the Runge-Kutta time integration scheme instead of the Leapfrog scheme, applying a modified warm rain and snow physics scheme or a modified Tiedtke convection scheme all change the area averaged precipitation by roughly 10%.

- Finally, but only for the Roman and Greek test cases, which all have a strong influence from the sea, the heat and moisture exchange between surface and atmosphere is of great importance and can cause changes in the range of up to 25%.

WG4

Such a PP on the new stage?

- Mainly for ICON-LAM?
- High-resolution model versions -> errors in localization and timing
- Such a PP/PT would require close collaboration of WG4 with the physics and verification people
- Participants?

PP C2I follow-on PT

- Forecasters’ feedbacks as more members begin operational providing with ICON-LAM
- Updated forecaster feedback
- Verification?
- Comparisons of objective verification and forecasters’ subjective evaluation

We will discuss this potential PT tomorrow at WG5 around 11:15 AM