ECMWF Annual seminar 2015: Physical processes in present and future large-scale models

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This year ECMWF annual seminar, which took place in Reading, UK, was focused on the physical processes represented in large-scale models.
To keep models as physical as possible, these processes are described by physical parameterizations (physics package), which have become a crucial ingredient for forecasts and their applications in the last years. Including parameterizations of physical processes can improve model forecast, e.g. the representation of precipitation got better after incorporating microphysics. In the past, random errors in model results sometimes turned out to be systematic (missing physical processes or wrong description of processes), which shows the importance of physical parameterizations.

Since numerical weather prediction (NWP) brings a lot of atmospheric processes together, there are a wide range of physical processes/aspects that have to be parameterized for a successful forecast. Because of that, the talks of this year's seminar spanned over a comprehensive range of topics and were very diverse. The main atmospheric processes and their parameterizations that were examined during the seminar were radiation, convection, cloud, gravity wave, boundary layer and land surface processes. In addition, insight was given into the physics of data assimilation and the verification and uncertainty of models.

The seminar addressed common problems in the development and verification of physical parameterizations and gave a broad overview of the research status and future outlook. An aspect related to that is how parameterizations depend on large-scale variables, e.g. T, RH, stability. The correct dependence of physical sub-grid processes on large-scale variations is crucial and has to be tested extensively during the development, e.g. in a single column setup. In the future, parameterization developments will be done with reference to observations on a process-level or through data assimilation. Another important aspect for parameterization developments is the consideration of interactions between different processes.

The seminar showed how connected different processes are and how they interact with each others on different levels, e.g. the boundary layer height is

important for tracers and can thus influence the distribution of aerosol particles, which has an impact on air pollution modeling or on cloud microphysics in models with an interactive aerosol microphysics scheme. Improving a single parameterization scheme can lead to a wrong behavior of the model if the new parameterization scheme does not fit in well with the other parameterization schemes. The interactions and feedbacks are thus crucial for predictability but also need careful evaluation. In the future it could become more and more important to work with parameterization suites (meaning a combined package of parameterization schemes) instead of single developed parameterizations that consider the interactions and feedbacks only indirectly.

Another topic was concerning movement across different scales- from large eddy simulations (LES) to earth system models (ESM). The NWP environment is highly suitable for parameterization development, because the weather system are quite well-constrained on this scale. The developed parameterization schemes can very often also be used in climate models. On the other hand there are cases where ESM help to improve NWP parameterization development because parameterization schemes can be tested in different perspectives. With increasing computer power, the benefit of high resolution simulations increases as well. High resolution simulations will not only change the role of parameterization schemes but can also serve as a data source for the further development of parameterizations. It is important that parameterization schemes account for different scales.

I would like to thank the European Meteorological Society for supporting me with the "Young Scientist Travel Award" to attend the seminar. It gave me the possibility to broaden my knowledge about physical parameterizations, especially also across different scales. Additionally, it gave me the opportunity to discuss the topic and my related research with other scientists during the seminar and establish future collaborations. I also would like to thank everyone who contributed to this seminar.