ICCARUS 2018 - The ICON/COSMO/CLM/ART User Seminar

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1 Overview

The ICON/COSMO/CLM/ART User Seminar (ICCARUS) brings together developers and users of the COSMO-model and the ICON model from different meteorological services, universities and research institutions. With about 200 participants from 17 countries, ICCARUS is the hub for the scientific exchange between these different users and developers. Figure 1 shows a group picture of this years' participants.

Figure 1: Group picture of the ICCARUS 2018 participants.

In this year, the seminar was held for the first time under its new name ICCARUS. The new name became necessary, as users and developers of ICON joined the seminar in the year 2017. This led to the long and unhandy name ICON/COSMO/CLM/ART User Seminar. For this reason, an ideas competition was arranged where ICCARUS was suggested by eight submissions. The search for a new logo was also successful which can be seen in Figure 2.

The program contained 112 contributions in total. 44 of these were presented as oral speeches and 68 in form of a poster. The contributions were organized within 10 different sessions. The sessions are 'Data Assimilation', 'Model Input Data', 'Dynamics and Numeric', 'Clouds, Chemistry, Aerosol and Radiation', 'Planetary Boundary Layer', 'Soil, Vegetation, and Ocean', 'Verification (NWP) and Evaluation (RCM)', 'Predictability and Ensemble Systems', 'NWP Model Applications and Case Studies' and 'RCM Model Applications'. Figure 3 shows a picture of the opening of the seminar held by the president of DWD, Prof. Gerhard Adrian (Figure 3). Then, Prof. Sarah Jones, the head of the DWD Business Area Research and Development, welcomed the participants of the seminar and summarized recent achievements and advances at DWD.

2 Scientific Highlights

Certainly, the invited talks supported by COSMO turned out to be two of the highlights of ICCARUS 2018. Prof. Robin Hogan from ECMWF (European Centre for Medium-Range Weather Forecasts, Reading) provided an overview on radiation in NWP. He focussed on recent advances and the five 'grand challenges'

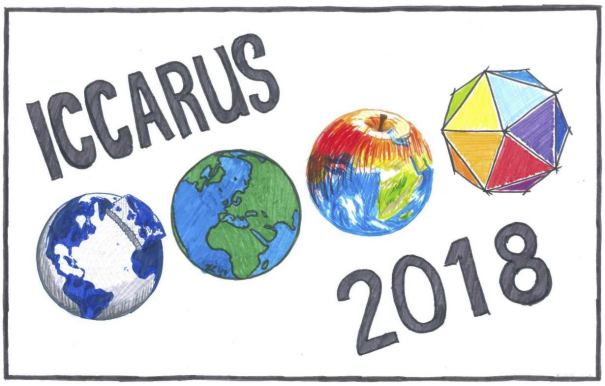

Figure 2: The new logo for ICCARUS designed by Nora Leps (Goethe-Universität Frankfurt, Deutscher Wetterdienst).

Figure 3: The president of Deutscher Wetterdienst, Prof. Gerhard Adrian, opens the ICCARUS 2018.

in the future. These are the surface, clouds, clear-sky absorption, the middle atmosphere and efficiency. The SPARTACUS (Speedy Algorithm for Radiative Transfer through Cloud Sides, [1]) solver to account for complex 3-D surfaces was introduced and the benefits were shown in applications to forests and urban areas. The same solver was also used to account for 3-D effects of clouds leading to, for example, improved solar power forecasts. For clear-sky cases, the improvements in forecasting Indian monsoon rainfall by using recent aerosol estimates were pointed out. A large stratospheric temperature bias during the polar winter has been persistent in the IFS model for at least 25 years. Removing this temperature bias in an experiment with an artificial reduction of water vapor significantly increased the overall forecast quality. In terms of computational efficiency, radiation in global models is typically used at a decreased spatial, temporal or spectral resolution or a combination of these. An assessment of the current state in the IFS model showed that the balance should be shifted towards an increased temporal resolution.

The second invited talk was held by Dr. Martin Losch from AWI (Alfred Wegener Institute, Bremerhaven). The presentation stressed the importance of high resolution in sea ice modelling. After introducing the concept of viscous-plastic sea ice models, impressive visualizations of high-resolution horizontal sea-ice distributions were shown. From comparisons with satellite measurements, it was clearly visible that the spatial scaling properties are reproduced well. However, the number of deformation events is too low in models. To stress the importance of accurate sea ice modelling, Dr. Losch focussed on land fast ice in the second half of his talk. This is the term for ice that is fastened to the shore lines and is not moving. The border of land fast ice plays a significant role as polynyas can develop there. These polynyas are important for energy transfer,

the mixing of water layers and salinity. Although the solutions do not converge, the results of high-resolution models are more realistic. Thus, this further highlights the importance of high resolution sea ice modelling especially for coupled models.

Besides the invited talks, there are traditionally overview talks concerning each of the different models and communities involved in ICCARUS. Dr. Ulrich Schättler from DWD could present the long awaited version 5.05 of the COSMO-model. Starting with a retrospective summary, he explained the reasons for the late delivery of the COSMO-model version 5.05. After the introduction of the common COSMO-ICON physics package, the different tests showed heterogeneous results. While hindcasts showed benefits, the full data assimilation experiements performed worse with one problem being the drying out of soil. Even some crashes of ensemble members happened. This led to the decision to introduce DWDs' new setup COSMO-D2 with the old physics settings. Dr. Schättler also stressed the point, that, anyways, due to significant differences in the preprocessing of external data not all ICON physics developments could be used in COSMO. The real unification of the physics used in global and regional NWP will come along with ICON-LAM (ICON in limited-area mode).

Dr. Günther Zängl from DWD presented the plans for a transition from the COSMO-model to ICON-LAM. The basic motiviation is to establish one unified modelling system covering all the operational applications at DWD. This results in a reduction of the workload for implementing and testing model improvements. These plans include a coupling of KENDA and ICON-LAM with a first version being ready in the summer 2018. A consolidated version can be expected at the end of 2018. This marks one of the crucial steps for the operationalization of ICON-LAM, which is planned for summer 2019 in the parallel routine and finally becoming operational in the second half of 2020. As this is a sort of pioneering work with ICON-LAM, the transition plan for the other COSMO members is temporally shifted. To prepare and organize this process, Dr. Daniel Rieger from DWD initiated the COSMO priority project C2I (Transition of COSMO to ICON) that accompanies the intended joint transition of the COSMO members to ICON-LAM. Dr. Zängl then showed the results of first ICON-LAM tests in a configuration that matches closely the COSMO-D2 setup. These hindcast experiments driven by data from ICON-EU assimilation cycle cover seven different months spread over all seasons. The results were also compared to two months of COSMO-D2 reference experiments. The outcome is that ICON-D2 shows significantly better scores than COSMO-D2, in particular for variables for which the COSMO model has known weaknesses. This provides a good starting point for upcoming experiments with data assimilation cycling.

ICON is being developed in a strong collaboration between DWD and Max-Planck-Institute for Meteorology in Hamburg. For the first time, this was also reflected in the presentations at ICCARUS. Dr. Marco Giorgetta, the head of development of the atmospheric component of the ICON climate mode, presented an overview of the climate physics package and recent evaluation experiments. The most important requirements for these developments are a closed water cycle, a realistic energy budget and acceptable biases. It should also be flexible enough to cover a wide range of resolutions. The primary goals of the tuning efforts were a near-zero energy balance at the top of the model atmosphere and small errors in ocean surface stress. In summary, the tuning efforts were successful for a certain resolution providing a good representation of the mean climate and its variability. The improvements due to the tuning efforts were larger than changes that can be achieved by simply increasing the resolution without re-tuning. Circulation patterns in the middle atmosphere and the vertical distribution of clouds are challenges to be addressed in the future.

The Aerosols and Reactive Trace gases (ART) extension has a long history together with COSMO in academic as well as in operational applications. In this year, the presentation of Dr. Heike Vogel from KIT (Karlsruhe Institute of Technology) focussed on the development of ICON-ART. A large part of the parameterizations that are needed for aerosol and chemistry simulations are already implemented and successfully tested in ICON-ART. The remaining parameterizations have reached a state where first tests are being conducted. ICON-ART is already used for quasi-operational mineral dust forecasts in the framework of the PerduS project. The modelling system is also ready to be used in case of accidental releases of pollutants as well as volcanic eruptions. A particular focus was laid on the flexibility of the ICON-ART system. The complexity of the aerosol dynamics as well as of the chemical mechanism can be chosen freely. This allows for a wide range of applications with ICON-ART. This ranges, e.g., from stratospheric chemistry on climate time scales down to studies dealing with the impact of aerosol particles on radiation and clouds on weather time scales.

3 Outlook

It can be seen from the highlights of the invited and solicited talks that ICON has arrived at ICCARUS with a growing number of contributions. This of particular importance for the upcoming COSMO priority project C2I. As the next few COSMO years will be concerned with this transition to ICON used in limited area mode, ICCARUS offers a platform to bring the different communities involved in COSMO and ICON further together.

We want to thank all participants of ICCARUS 2018 for their contributions to the success of this informative and inspiring seminar. Special thanks go to the members of the organizational committee: Anja Thomas, Daniel Egerer and Bernd Kress. We also want to thank the helpers at the seminar, Heidelore Turau and Alexander Schreiner, and to Bernd Frey who is responsible for the registration website. Last but not least, we want to thank Dr. Barbara Früh and Dr. Ulrich Blahak for sharing their experience in organizing this seminar whenever needed.

With the international popularity of the COSMO- and ICON-model, ICCARUS 2018 offered a program with many outstandig scientific contributions. The diverse scope of topics ranging all the way from LES simulations to climate projections shows that the communities and models connected to ICCARUS already cover what is summarized by the term 'seamless prediction'.

References

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