AROME-ALADIN special workshop

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4 - Convergence between the Aladin and Arome projects: opportunity and challenges

Météo-France needs to develop a high-resolution, non-hydrostatic forecast model and data assimilation system in order to meet its commitments for regional operational forecasting from 2008 onwards. This project, called Arome (Application of Research to Operations at MesoscalE), will be built upon the existing Aladin software architecture, plus new state-of-the-art components imported from the Méso-NH mesoscale research community model: convection-resolving physics with prognostic turbulence and microphysics, detailed land surface external module, variational assimilation of high-resolution data from radar reflectivities, geostationary products and mesoscale observing networks. The model will be non-hydrostatic with an horizontal resolution of at least 3km. Compared to the current operational Aladin, this new model will consume of the order of 50 times more CPU per forecast hour on an equivalent domain, and use significantly more memory.

This project is possible thanks to the valuable contributions from many Aladin scientists, some of them world-class, notably on non-hydrostatic dynamics and 3D-Var analysis. The next step is to turn this work into a competitive NWP system at the convection-resolving scales that are necessary to properly resolve mesoscale weather events such as intense precipitation, thunderstorms and squalls, along with the improvement of low-level actual weather forecasting with the representation of fog and fine-scale orography.

The Arome project requires some thought from our Aladin partners. The first reason is scientific: there are indications throughout the international NWP community that only little benefit can be obtained by modest model horizontal resolution increases between 3 and 10km. Although some improved dry adaptation to orography can be expected, important precipitation and convection events in this resolution range are ill-posed at these resolutions and very difficult to model in an efficient way. The view taken by Arome (as in other large NWP centres) is that the best long-term benefits will be obtained by investing now in models of at least 3-km resolution: then, deep convection is explicitly resolved, and radar and satellite imagery data are correctly used together with regional observing stations. In summary, a resolution jump is needed.

The second reason for thinking is more political. The Aladin collaboration is productive because all partners are working on the same model. If some partners prefer staying with Aladin instead of moving to Arome (e.g. if they believe Arome is going to be too expensive), software maintenance will be problematic because Aladin will not be as well phased as it is now. And of course, scientific and technical development will be slower because less people will be working on Aladin than now. It would be a sad situation since Aladin partners are already part of Arome in the fields of model dynamics and data assimilation: the problem lies only in the physics/dynamics interface part of the model. Finally, it would be an awkward collaboration if France were investing into one model (Arome) and all Aladin partners were investing into another one (Aladin).

For the above reasons we believe that a smooth evolution of the Aladin collaboration towards Arome is in the interest of our Aladin partners and we invite them to take part in it now. The plan is to continue the shared maintenance of the follow-on of the current Aladin system until 2008. The new Arome system will be developed in research mode until 2008. At this point, Météo-France will implement Arome operationally and stop maintaining Aladin as such. Aladin partners will have free access to the Arome software and can decide, either to switch to the full-fledged Arome at 3-km resolution, or to switch to a lower-resolution version of Arome, or to keep maintaining the legacy Aladin software themselves. Eventually, as computers improve, all Aladin partners will be able to run

the complete Arome system at convection-resolving resolutions, and get full return on their investment on Arome.

In order to encourage an early switch from Aladin to Arome, Météo-France will develop and maintain an 'extended version' of the Arome model, that can be run at resolutions coarser than 3km (in fact at about 10 km) and with cheaper physics. The recommended physical package will include prognostic microphysics, 1-D turbulence and parameterisation of subgrid-scale convection (whereas the full-fledged Arome physics will use 3-D turbulence and will not require subgrid-scale convection). This model will be more expensive to run than Aladin at the same resolution (by a CPU factor of about two), but it is expected to deliver interesting meteorological improvements in return. On the other hand it does not address either the specific problems of the 10 to 3km scales as they are mentioned above. Météo-France may actually use it for some special applications. A first prototype of the Arome model software will be made available to the Aladin partners during 2005, including both options.

The Arome developments on dynamics and data assimilation will be fully compatible with the current Aladin activities and plans, so that the impact of Arome will be more staff and new topics in these fields. In that sense, the Aladin/Arome scientific cooperation has already started.

Scientist specifically interested in working on the new Arome models (3-km model and lower resolution version) will be welcome when the prototype software is phased into the main Aladin branch, early in 2005. After the phasing, the main impact on Aladin scientists will be new algorithmic constraints on the physics/dynamics coupling interface with the new physics, while still allowing to run the ARPEGE-type physics and its possible evolutions towards something more specific to the 3-7 km mesh-size range, for interested ALADIN Partners. Such extensions should however be developed and maintained by the same teams that will value their specific cost-benefit ratio with respect to the solution, chosen by Météo-France for its own needs, of a coupling jump over those “difficult” scales. Whatever operational choice they favour, the expertise from our partners will be much appreciated in order to help us in the phasing exercise, so that the conversion of Aladin into the Arome model goes as smoothly as possible for everyone.