

# ACCORD Roadmap regarding Physics interoperability

## Background

The enhancement of interoperability across the Physics of the three ACCORD-based CSC configurations (AROME, HARMONIE-AROME and ALARO) was formulated as one strategic goal in 2020. This goal was repeated within the formulation of the ToR for the Physics Area Leader position opened at the very beginning of ACCORD (at the same time as the other AL positions), however with no candidate. As a response to the lack of candidates for the position, and with the intention not to let this question of enhanced interoperability totally unaddressed from the start of ACCORD, the PM proposed the Assembly in March 2021 to form a dedicated WG. The ToR of the WG was to propose a roadmap for interoperability by the end of 2022. The position of the Physics AL was left closed for 2021-2022 (its possible reopening for the period 2023-2025 is not being addressed in this paper).

## WG-Interop activity

The WG was composed of the PM, Claude Fischer, the two AL for SPTR (Piet Termonia and Daan Degrauwe), the three CSC Leaders (Eric Bazile, Jeanette Onvlee, Martina Tudor) and an additional expert (Sylvie Malardel). In the course of its work, the WG invited two other experts to join (Emily Gleeson, Bogdan Bochenek).

The WG mostly was active during its dedicated meetings, about four per year, and benefited from the involvement of some of its members in other specific areas of strategic interest (like the code adaptation area, aka SPTR). Another strong point for the WG was its overall good representation across the three CSCs, as was the fact that all members of the WG also are leads or co-leads of work packages within the RWP.

The WG arranged a few specific meetings, fairly mixed with the SPTR efforts, in order to communicate with the CSC teams on the ideas and early proposals. Communication across the teams was found necessary, in order to explain the benefits the WG expects by some of its proposals in the field of code design.

## Proposal for increasing interoperability across the physics in ACCORD

The proposal is in the form of a general roadmap, where the several items are listed with broad timing indications only. The WG believes that a very precise, calendar-wise roadmap, for instance in the form of a GANTT chart, would not be suitable. A broad roadmap provides flexibility for taking into account the external constraints (like code adaptation for HPC), the complex nature of the scientific discussions (where the devil lies in details that can not be anticipated at present) and the need to keep a suitable level of communication across the teams. The definition of “physics interoperability” encompasses the implementation of components of parameterizations consistent with the general equations and the scientific assumptions within the ACCORD codes, including the links with the physics-dynamics and physics-surface

interfaces, a close coordination with the code adaptation efforts for new HPC architectures and the intention to progressively move to a transversal organization of the work (across families, across CSCs).

At the level of scientific management, the aim by this roadmap is to encourage and facilitate research and implementation of new scientific ideas in the Physics Area (including novel options in the current parameterization schemes), facilitate the maintenance of the ACCORD codes at the level of parameterizations and at the level of their interfaces with the rest of the code infrastructure, albeit without jeopardizing the scientific collaboration across the whole range of teams in ACCORD. Instead, the implementation of the proposals below is expected to strengthen scientific and technical collaboration within ACCORD as well as with other research communities with whom the codes are shared (ECMWF, the Meso-NH community, the SURFEX community).

The roadmap layed out in terms of a broad timeline then reads:

- short term (2022-2023):
  - code refactoring and cleaning: reorganize and clean the physics codes, address the design of dataflow, of the interface of the physics codes with the rest of the model, of the interfaces within the physics codes. This action is expected to be a coordinated effort between SPTR (code adaptation) and the Physics teams.
- mid-term (2023 and beyond):
  - organize the physics activity along groups of parametrizations (these groups already are reflected in the RWP2023),
  - trigger (encourage) scientific exchange among these groups, in the form of common WW organized by topics (not by CSCs), across-family working days, or a few across-CSC scientific visits (when relevant),
  - organize the work on stochastic aspects in physics in close coordination with EPS and other Areas (DA, surface etc.)
  - use the thematic groups for discussing code design,
  - further enhance the interoperability and the scientific functions of common tools like the single-column model (MUSC) or the diagnostic tools (DDH),
  - as a specific item, assess the relevance of external (code) drivers for evaluating physics components and organize activity for implementing them.
- mid-to long-term (2023-2025 and even beyond):
  - draft a work plan for the development of physics for very high resolution (hectometric-scale) models, using currently available proposals from within ACCORD and possible novel ideas currently outside the scope of ACCORD plans,
  - reassess code design aspects, with the support of programming experts, such as the use of smart data structures and object-oriented programming for the interfacing of the physics parameterizations. Ensure that a regular dialogue between SPTR (the code adaptation Area) and the Physics teams is in place, since the SPTR Area is likely to remain a major driver on programming choices.