ALARO concept

near and longer term development

Main Choices – what are the challenges

The **ALARO concept** was defined back in 2004-2005 to answer challenges linked to the progressively increasing resolution:

- Cost of radiation scheme;
- Complexity of turbulence, still with a need to "parameterize";
- Advances in clouds and precipitation microphysics;
- Keeping complementary parameterization of precipitating convection.

Main Choices – how to tackle the challenges

All valid today

The ALARO development concept :

- Clean governing equations for moist physics (barycentric and conservative system);
- Prognostic schemes; consistency and unification as a goal;
- Keep modular while having consistent interface to the model dynamics;
- Tackle the “grey-zone” or “partly resolved” moist deep convection problem;
- Keep being multi-scale: physics should work correctly also at coarser and higher resolutions, on both sides of the grey-zone scales.

Realizations - highlights

- ALARO-0 baseline
  - Main target: grey zone of moist deep convection;
- ALARO-1 baseline
  - New turbulence and radiation scheme;
  - Coupling of SURFEX with the turbulence scheme;
  - Refinement of the sub-grid-scale moist deep convection scheme;
- ALARO-2 (plan)
  - Enhancements of the microphysics – aerosols, 1and a half (or two) momentum scheme;
  - 3D turbulence

ALARO deployment status

- One of the physical parameterization package inside ALADIN-HIRLAM system

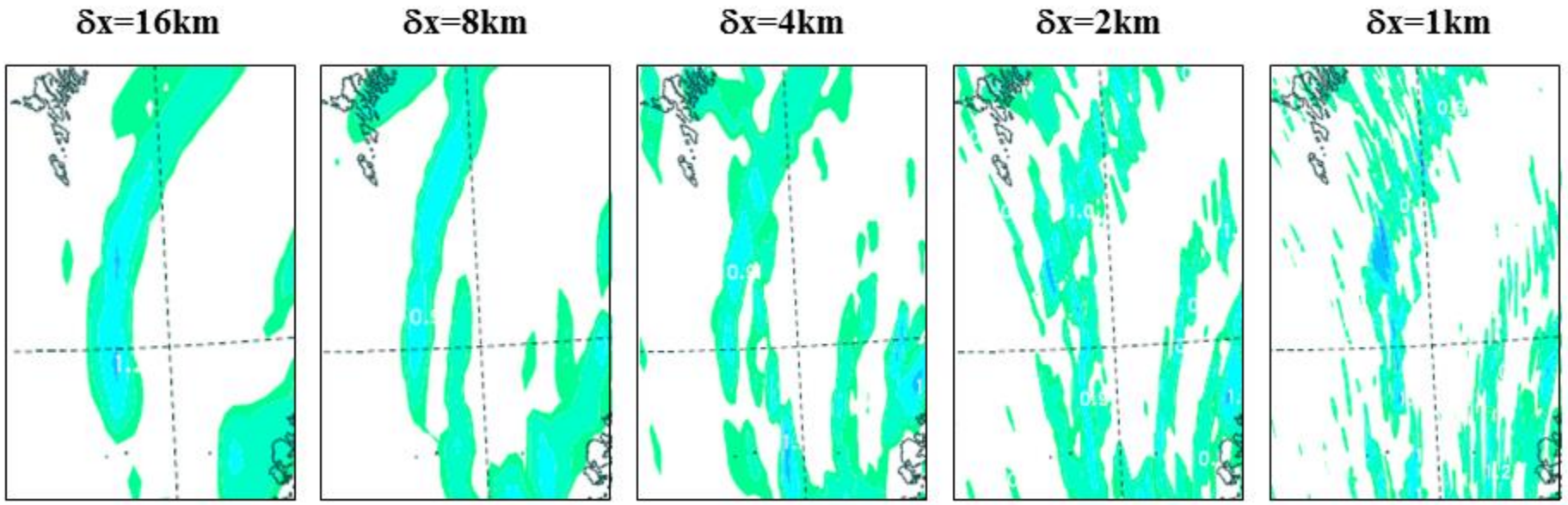
- In the operational use in ALADIN countries
  - ALARO-0: at, be, hr, hu, ro, sk, si, tr
  - ALARO-1vA: cz, po *(e-suite be,tr)*

  model resolution between 8 km – 4 km, 2km

- In EPS systems
  - ALADIN-LAEF, GLAMEPS, EPS at HMS
  - HarmonEPS convection-permitting ensemble system

- In climatological simulations
  - be, cz, se

ALARO “seamless” forecast: precipitation



1h precipitation cumulated from +30h to +31h, forecast base 30 January 2010, 12h UTC, area between Faeroe and Orkney islands.
The general structure of this short time precipitation pattern over a relatively small area is kept, while more detailed solutions continuously appear with finer resolutions of the model.

Development strategy - radiation

- Key advantage of ACRANEB 2 and **the** determining choice
  - **cloud-radiation interaction at every model time-step at affordable cost and balanced precision in contrast to the main stream CKD fully intermittent schemes;**
  - **advantage of scalability (linear cost in number of levels).**
- There is rather a question for AROME:
  - catch up with the IFS radiation (quite some work but the current version is very outdated);
  - try the ACRANEB 2 alternative.

Development strategy - turbulence

- Strong point of TOUCANS (what was the goal)
  - New parameterization is based on the **recent advancements in the theory of turbulence** (such as no Ri values restrictions, Third Order Moments);
  - It takes the advantage from the **recent works on thermodynamics** (P. Marquet) for the formulation of moist turbulence => phase changes and transport of total water;
  - High level of modularity (6 models of turbulence …);
  - There is now a basis on which we can build and improve the scheme step by step, make working the coupling with SURFEX etc.
- challenge: **grey zone of turbulence** and a “soft landing” in the 3D case – the asset of the combination with SLHD and see progress on this topic on the AROME side.

Development strategy - microphysics

- Assets of APLMPHYS:
  - Joint treatment of the resolved and sub-grid-scale condensation input thanks to the **geometry** of clouds and falling precipitation;
  - Algorithm and numerical stability (especially thanks to the statistical sedimentation), allowing for a **long time-steps**.
- Planned developments (similar to the LIMA scheme while keeping the assets):
  - Introduction of aerosols;
  - Enhancement to one and a half momentum scheme (for the liquid phase).

Development strategy – transversal issues

- Consistency of parameterizations (equations, hypothesis, interface, …);
- Unification of parameterizations (schemes share the same information, approaches and level of complexity … prevailing approach in ALARO concept is going prognostic);

Respect of good principles => improvement of model performances