Going from ALARO-0 to ALARO-1

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ALARO-0 marked an internationally recognized breakthrough in the direction of some reasonable forecasting capacity at the scales of the so-called grey-zone [7 to 3km mesh sizes], although it was previously considered as inaccessible, except for wind and pressure fields.
This success has been achieved thanks to three ingredients:

- the 3MT core element to treat moist physics;
- some progress on all other aspects of the physics in a fully 3MT-compatible way;
- the use of SLHD diffusion for lateral mixing.

In view of the acquired experience in running ALARO-0 with and without 3MT at various resolutions (results coming from HIRLAM as much as from ALADIN), we now have a pretty good idea of the four main weaknesses of ALARO-0:

- compensating errors between radiative forcing and moist physics;
- a too simplistic and heuristic formulation of the boundary layer representation;
- deficiencies in 3MT's behaviour when used at the 'finer 'border' of the grey-zone;
- the absence of a unifying concept for the cloud representation.

Within the RC-LACE project for physics and at IRM Brussels, individual steps have long been undertaken to cure these deficiencies. Last June it appeared that progress was sufficient to warrant the definition of a 'federating hat' named ALARO-1.

The first sketch of ALARO-1 was mainly aiming at:

- allowing to push the 3MT concept until the kilometric scales: it is now more and more recognised by the European NWP teams that, unlike previously assessed, precipitating convection cannot be resolved with 2km to 3km mesh-sizes;
- solving the most urgent moist boundary layer parameterisation problems, while staying at the complexity level of a single additional prognostic variable, i.e. the Turbulent Kinetic Energy (TKE);
- suppressing most of the compensating errors, through the acceptance of additional feed-back mechanisms.

Recent further study additionally showed that (with small but key variations with respect to the original design) one could also address the issue of consistency within the whole physics time-step. This should pave the way to an even more modular and flexible use of the options currently implemented or under development. This should also allow having a better reactivity to HIRLAM's diagnostic of yet undetected problems.

The outcome of all this could indeed help tackling problems which other frameworks for high resolution forecasting might find too challenging:

- sorting out cases where deep convection still needs to be parameterised at the kilometric scale from those where resolved clouds suffice;
- obtaining a consistent picture between radiative, turbulent and microphysical forcings for clouds at the top of the PBL, without relying on arte-facts like 'top cloud entrainment';
- avoiding the disappearance of turbulent friction at very high stability, a feature of old prognostic TKE schemes now contradicted by a wealth of measurements and theoretical arguments;
- solving the problem of numerical compatibility between parameterising moist turbulence and accounting for the non flux-gradient part of vertical diffusive transport.