In June 2009 first list of topics for ALARO-1 developments was done. Recent studies additionally showed that the consistency within the whole physics time-step has to be addressed. Jean-Francois Geleyn wote in October more detailed list of actions, which can be seen as a complementry to the first one.

ALARO-1 actions (ongoing and planned)

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In the following sections we shall try and present an itemisation of both the ongoing or additionally planned actions and of the (now sometimes more ambitious) motivations behind them.

The foreseen steps

A) Separating nearly completely the physics time step (still in cascading mode) in 3 parts:
   (i) Radiative cloud properties and radiative fluxes' computation
   (ii) (Moist) turbulence and diffusive transport
   (iii) Condensation/evaporation associated processes (including deep convection)

B) In (i), three actions:

- new radiative transmission functions for the thermal spectrum and use of ARPEGE-type aerosols' optical properties;
- early computation of a shallow convective cloud-cover;
- 'radiative' cloudiness and cloud water content computed from an initial call of the adjustment process, with protection against re-evaporation in both deep and shallow convective cloud-covered parts.

C) In (ii), six actions:

- keeping from p-TKE the solver and the sequence of updates, but going otherwise for a full TKE scheme; the 'moist' aspect will entirely be related to a change of the Richardson number consistent with the value of the shallow convection cloud-cover;
- introduction of a parameterisation of Third Order Moments (TOMs) effects (sometimes abusively called 'counter-gradient fluxes'); the discretisation shall resemble the one of a mass-flux approach, alike in EDMF-type schemes;
- a posteriori correction of the final value for the prognostic TKE in order to take into account TOMs effects and the implicit character of the diffusive fluxes' solver;
- jump from stability functions from the Louis-type to a simplified Reynolds Stress Modelling (RSM) framework or (more likely) to a QNSE declination in this simplified-RSM 'model';
- introduction of a panoply of flow-dependent mixing-length formulations;
- re-introduction of the diffusive transport of cloud liquid and ice water, but on the basis of the shallow convective formulation and not anymore on that of the adjustment process.

D) In (iii), three actions:

- redoing the adjustment computations (in the same conditions as at the beginning) but with an input modified by the (moist) turbulent diffusion (also incorporating TOMs' effects);
- modifiying the deep convective computation in order that the solutions with and without its activation converge at very high resolution;
- making this modification such that, at the 'end of the grey zone' (dx~1.5 km), the scheme acts selectively, in order to treat only non-resolved convective motions.

E) Making the recent incorporation of the Rash-Kristjansson condensation scheme of HIRLAM in 3MT compatible with the steps 'B', 'C' and 'D' above.

F) Not forgetting to include a '3D minus 1D' turbulent part, by extension and diversification of the existing SLHD functionalities.

Motivations

The aim of ‘A’ is obvious. After the preparatory step of ALARO-0, concentrated on the best possible introduction of the 3MT concept (targeted at grey-zone scales), one wishes to rationalise the physics time-step organisation.

The first bullet of ‘B’ corresponds to a long indentified and rational need. But the realisation was blocked by the existence of compensating errors between the present radiation computations and other parts of the physics. Hence the ‘improvement’ of the radiative code should happen together with other important changes.

The second and third bullets of ‘B’ are related to the codification of a paradigm already ‘announced’ by 3MT: in the case of convective clouds one puts cloudiness where the condensation mechanism has been detected, while in the case of stratiform clouds one computes condensation where clouds are diagnosed.

The first, fourth and fifth bullets of ‘C’ show the concretisation of a long-term (first of academic-type and progressively application-oriented) investment in the understanding of (moist) turbulent processes. This investment was done in parallel to the heuristic step that p-TKE represented within ALARO-0. The result should reflect a very modern view of prognostic turbulence in dry as well as cloudy environments.

The second and third bullets of ‘C’ correspond to an additional parameterisation step aimed at suppressing the main weaknesses detected in our present parameterisation of boundary layer fluxes, i.e. the lack of heat and moisture vertical convergence below inversions, especially cloud-related ones.

The sixth bullet of ‘C’ and the first bullet of ‘D’ are meant to consistently ‘close the loop’ between the three parts of the physics time step. The numerical robustness of this step may have to be improved after experimentation, despite the care now taken to have the best possible data flow between the said three parts.

The second and third bullets of ‘D’ are supposed to cure problems detected when using 3MT at the ‘high resolution border’ of the so-called ‘grey-zone’, i.e. mesh sizes of 2km to 3 km.

‘Since the Rash-Kristjansson condensation scheme adds new possibilities and sophisticat ion, it should become available also in the reorganised code. This raises new problems that cannot be solved by simple means. 'E' can then be seen as an effort made in cons equence of a deliberate policy to favour modularity and flexibility and to share this aim with interested partners.

‘F’ corresponds to an old dream that did not yet materialise for lack of an application field. Now (according to most specialists) time seems to be ripe for such a concrete realisation. The tuning aspects might however be quite hard to master and the whole step towards a harmonious behaviour of ‘vertical-type’ turbulence and SLHD-type smoothing will surely take time.