# Interpreting the algorithmic of parameterisation via ‘dynamics’ and ‘observed physics’

## The ALARO-0 and 3MT examples

*The ALADIN Programme Manager, Toulouse, 24-25/9/08*

# What is so special about ALARO-0? (1/3)

- There is the M-T solution (Piriou et al., 2007). Yes, but it is just LIKE rewriting the advective terms from Eulerian to semi-Lagrangian. The 'eliminated' part is the direct effect of detrainment, but for a regular behaviour both solutions are fully equivalent.
- There is the prognostic handling of convection. But Chen and Bougeault (1990) and Gerard and Geleyn (2005) have shown that the stationary solution of the prognostic system is the one of Bougeault (1985) and the code faithfully reflects this. It is just LIKE going from quasi-geostrophic to HPE equations or from the latter to Laprise (1992) ones. One introduces a useful 'memory' of indirectly important terms with oscillations around the same slow-manifold.

# What is so special about ALARO-0? (2/3)

- There is the joint input of 'resolved' plus 'convective' condensation sources to microphysics. If one considers the microphysics as the 'Helmholtz solver' of moist physics (an idea more and more popular in GCSS) it is LIKE using Michel Rochas' idea to combine the advective and Coriolis terms on the 'right hand side'. In case one of type of motions is dominating nothing changes, when both count ('grey-zone') the solution is smoother. A hidden fact is that the 'solver' must take sub-grid effects into account.
- There is the independent closure for donwdrafts. This is the logical positive consequence of the three above bullets, LIKE being able to go to the 'deep atmosphere equations' once the system is very close to the Euler equations with the 'thin atmosphere'. The bonus is the sedimentation impact of the downwards convective advection (albeit computed with an approximation).

# What is so special about ALARO-0? (3/3)

- There is the p-TKE prognostic handling of the deviations of the turbulent state around a stationary solution using the tool proposed by Redelsperger et al., 2001. One must understand that the stationary solution might not be a diagnostic one but an implicit prognostic one, e.g. from CBR. It is LIKE changing to a more universal solver able to treat various presentations (filtered or unfiltered) of the right hand side (cf. d, d3, d4 in Bénard et al.).

- ***Summing up, what is sometimes considered as the 'shaking certainties' side of ALARO-0 (and especially of 3MT) is hardly revolutionary for the underlying science. And it employs the same algorithmic line of thoughts that have been at the basis of progress in dynamics in recent decades.***

# Speaking a bit about ‘flexibility’ (1/2)

- Recently the pre-operational version of AROME encountered ‘teething problems’ and found the solution to them in the pre-existing panoply of ‘options’ in the ALADIN-NH dynamical core:
  - ‘Fire works’ => a flexible and transparent solution for the set-up of ‘horizontal diffusion’;
  - Length of the time step => going from the ‘predictor-corrector’ solution to the ‘extrapolating 2TL’ one;
  - Control of the tail of the spectrum for ‘grid-point’ hydrometeors => SLHD as flexible alternative to linear spectral horizontal diffusion;
  - Risk of runaway precipitation feed-back => luckily the ‘LSPRT’ option was available from scratch to avoid an unsuspected (also for those who developed the ‘switch’!) problem.

# Speaking a bit about ‘flexibility’ (2/2)

- It is a strong credo of the ALARO-0 team to push for a development strategy in parameterisations that:
  - Does not immediately deem ‘redundant’ previous options that showed their strength in many years of use; even favours ‘ascending compatibility’ when possible;
  - Allows several solutions of ‘apparently’ equivalent scope whenever feasible;
  - Tries to make the forth and back switching between the latter solutions as transparent as possible to other decisions;
  - Separate as cleanly as possible what are the decisions about science and those about algorithmic.
- ***Hopefully the benefits will be as ‘telling’ as those born out of the same ideas for dynamics and recalled in the previous viewgraph!***

# The key issue is about ‘modularity’

- In fact there are several ways of considering modularity:
  - For its own sake. This is useful for maintenance and readibility and seems to have no direct impact. But think how a “level by level” modularisation of physical computations would ease the issue of vertical numbering of levels between Meso-NH and IAAAA!
  - Algorithmic modularity. This is a factor of efficiency and true flexibility. But it bears the disadvantage that it is very difficult to escape particularism (the reproach made to ALARO-0).
  - Scientific modularity. This used to be the norm. But the frontiers between processes that can be clearly separated are getting much and much solution-dependent (see later) and hence there is no true interoperability associated (the reproach made to ARPEGE-AROME).
- We ought to work together to get over such discrepancies, but it is difficult to do it when starting from an already itemised landscape.

# Some ‘propaganda’ about 3MT

- Sur le plan scientifique l’approche 3MT se présente à ce jour comme une fusion du travail "MT" de la thèse (Piriou, 2005) avec les idées de Gerard et Geleyn en matière de gestion multi-échelles. Les deux points sont synergiques.
- Comme expliqué plus haut les auteurs actuels de 3MT pensent que cette approche sera à même de favoriser le développement des physiques convectives paramétrées, pour les GCM, LAM et CSRM.
- 3MT se présente comme un cadre pour exprimer les processus physiques, synergique avec les modèles à plus haute résolution.
- De même qu’un langage 3MT combine des règles strictes **(celle de la partition RMT)** avec des stratégies souples, de sorte qu’il pourra importer et bénéficier d’une grande diversité de vues sur la physique de la convection.

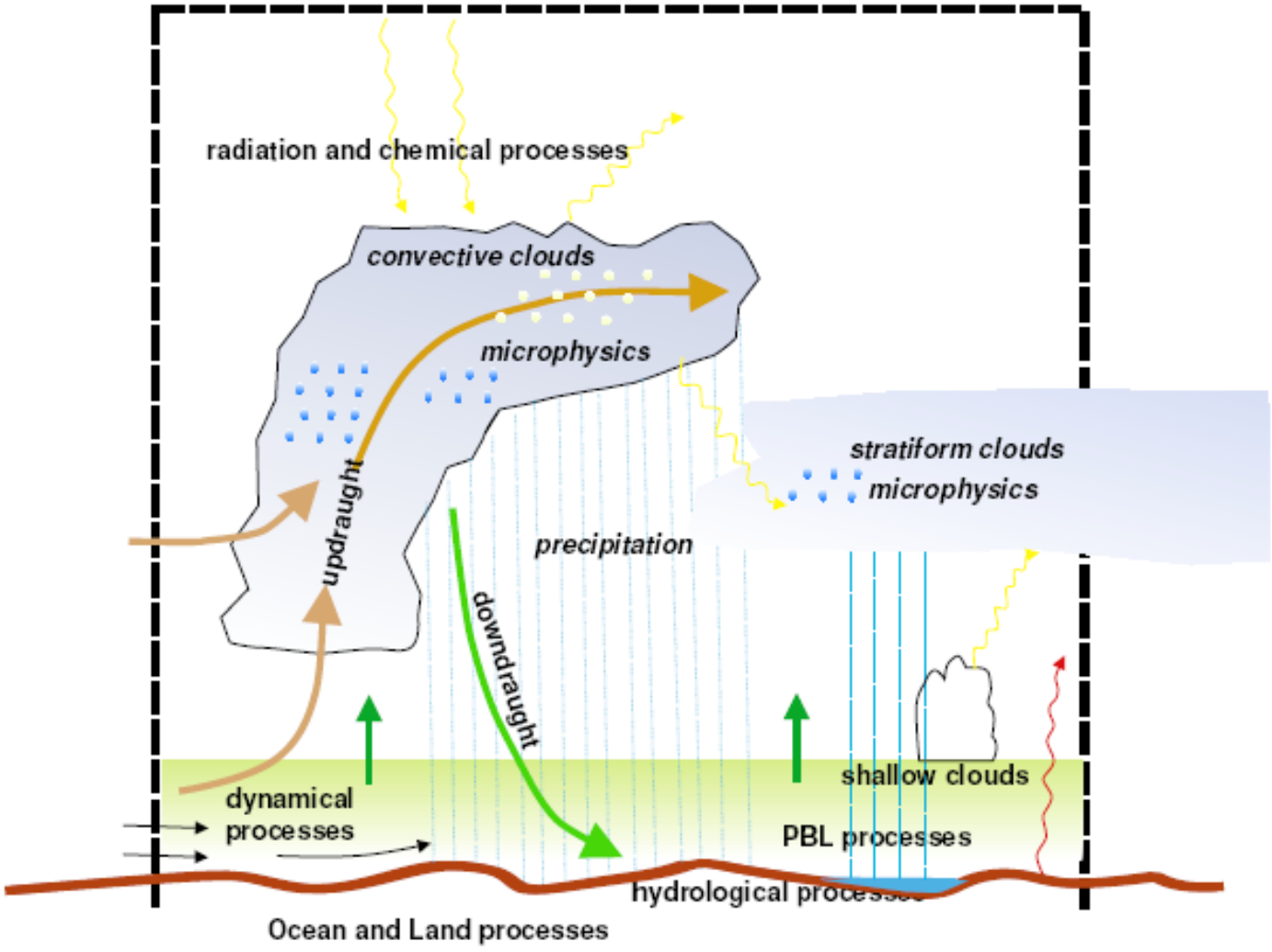
# Explanation about the previous viewgraph

- This was extracted from a text by Jean-Marcel Piriou, on 6/12/05 (… as time goes by …). Title:

  **"Unification of the parameterisation exercise for ascending and descending sub-grid parts, cloudy and cloud-free"**

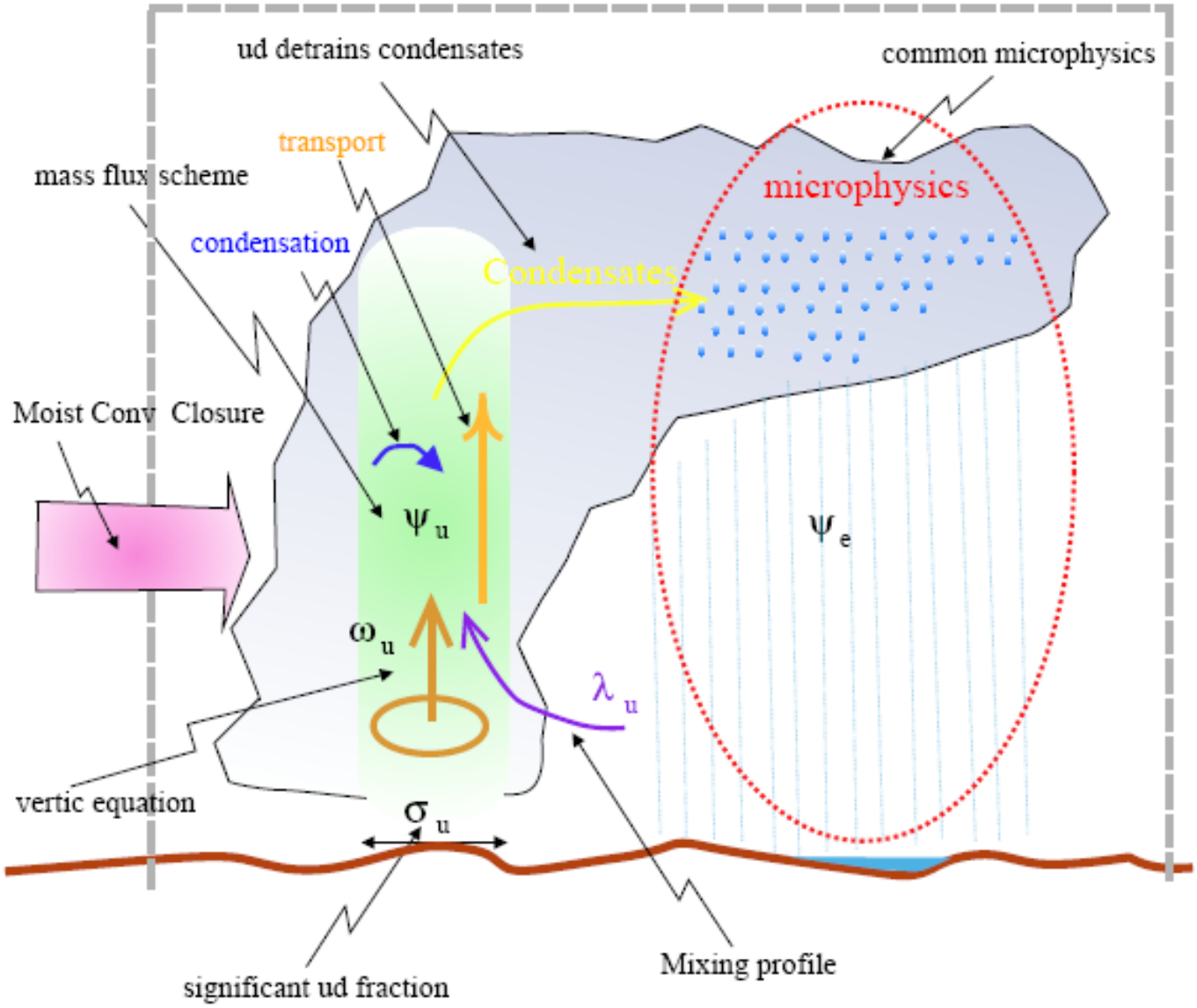
- The Radiation-Microphysics-Transport (RMT) approach (a slang for the underlying idea) consists in extending the M-T idea to the ab-initio partition of the CONTINUOUS spectrum of turbulent and convective processes observed in the atmosphere:
  - Rather than distinguishing turbulence from convection, cloudy- from clear-sky parts, precipitating from non-precipitating phenomena,
  - one considers the basic diabatic processes (radiation + phase changes) each in a unified way => the remaining challenge is to find a correct multi-scale parameterisation for the various shapes of 'transport'; 3MT is only a first step in this way of attacking the parameterisation exercise from a new angle (continuity).

# Physical context : towards unified physics



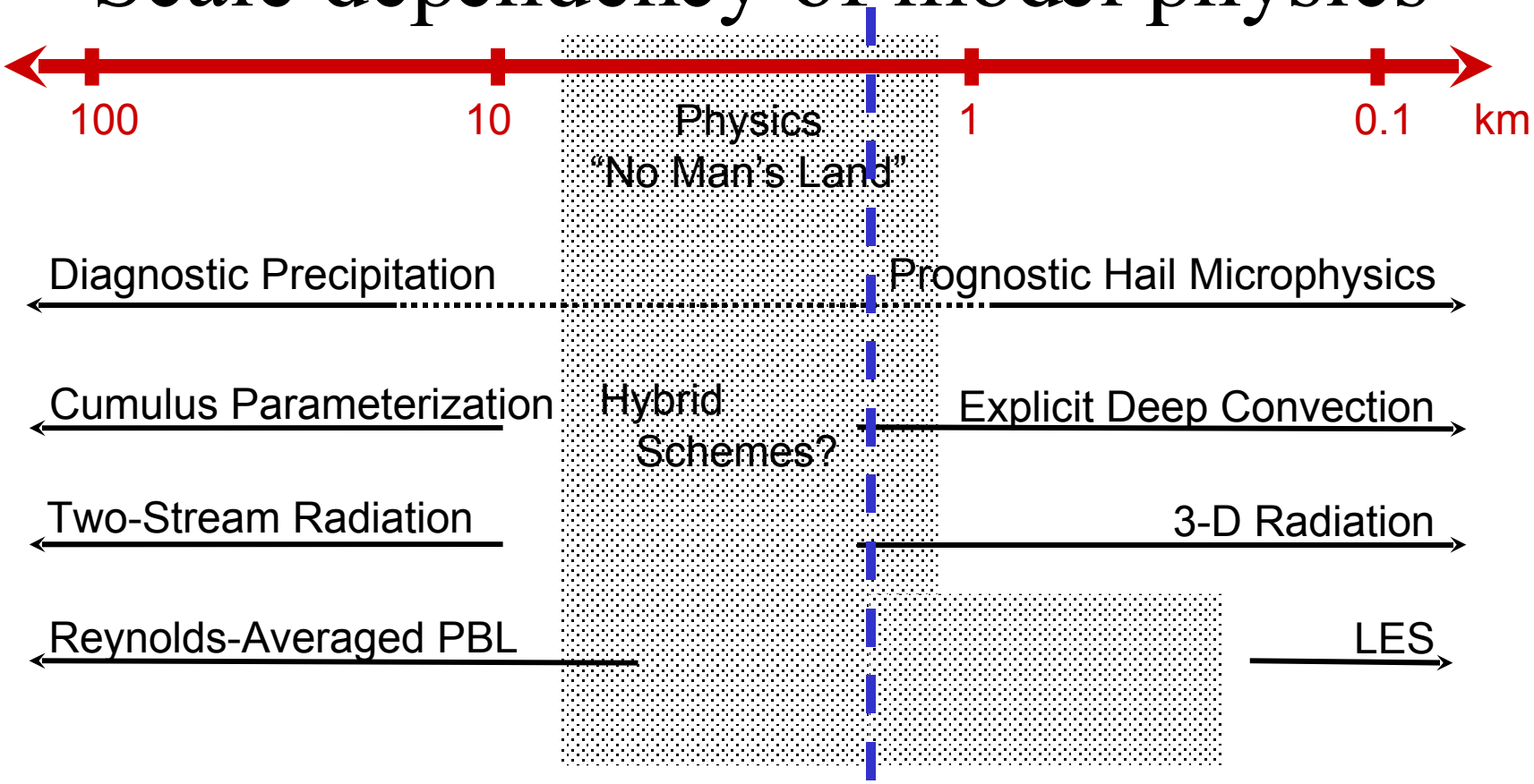

L. Gerard, 29 March 2007

# Main Choices



- People involved in ALARO-0 are not the only ones to think in such a direction:
  - See conclusions of the NETFAM Workshop in Tartu (January 2005);
  - Similar ideas can be found in a recent ‘review paper’ by Mironov;
  - And more generally, at DWD, they care about the issue =>

# Scale dependency of model physics




(adapted from Klemp 2007, by Seifert [GCSS, Toulouse, June 2008])

# The core issue

- Are we going to risk missing an opportunity of innovation, just because we are unable to treat problems which essentially boil down to the absence of a consensual view on ‘modularity’?
- The ‘Convergence days’ may help answering (in any direction) this question mark.