What is ALARO ?

Let us first see what ALARO is not

It is not a model (it has neither an independent library, nor an individual view of data assimilation and its modelling part **first aims at respecting the well proven IFMG rules**).

It is neither a miraculous solution for any forecasting problem, nor a rush in the unknown, nor something disconnected from basic research (*).

(*) Richard Fournier (LE, UPS, Toulouse), Jean-Luc Redelsperger (GAME/GMME), Jean-Marcel Piriou (GAME/GMME, 2003-2005), Luc Gerard (IRM, Brussels), François Lott (IPSL, Paris), …

ALARO

A safeguard concept a s well as a bridging & training opportunity !!

Radmila Brozkova (in the name of many others)

16th ALADIN-Workshop, 16/5/2006, Sofia, Bulgaria

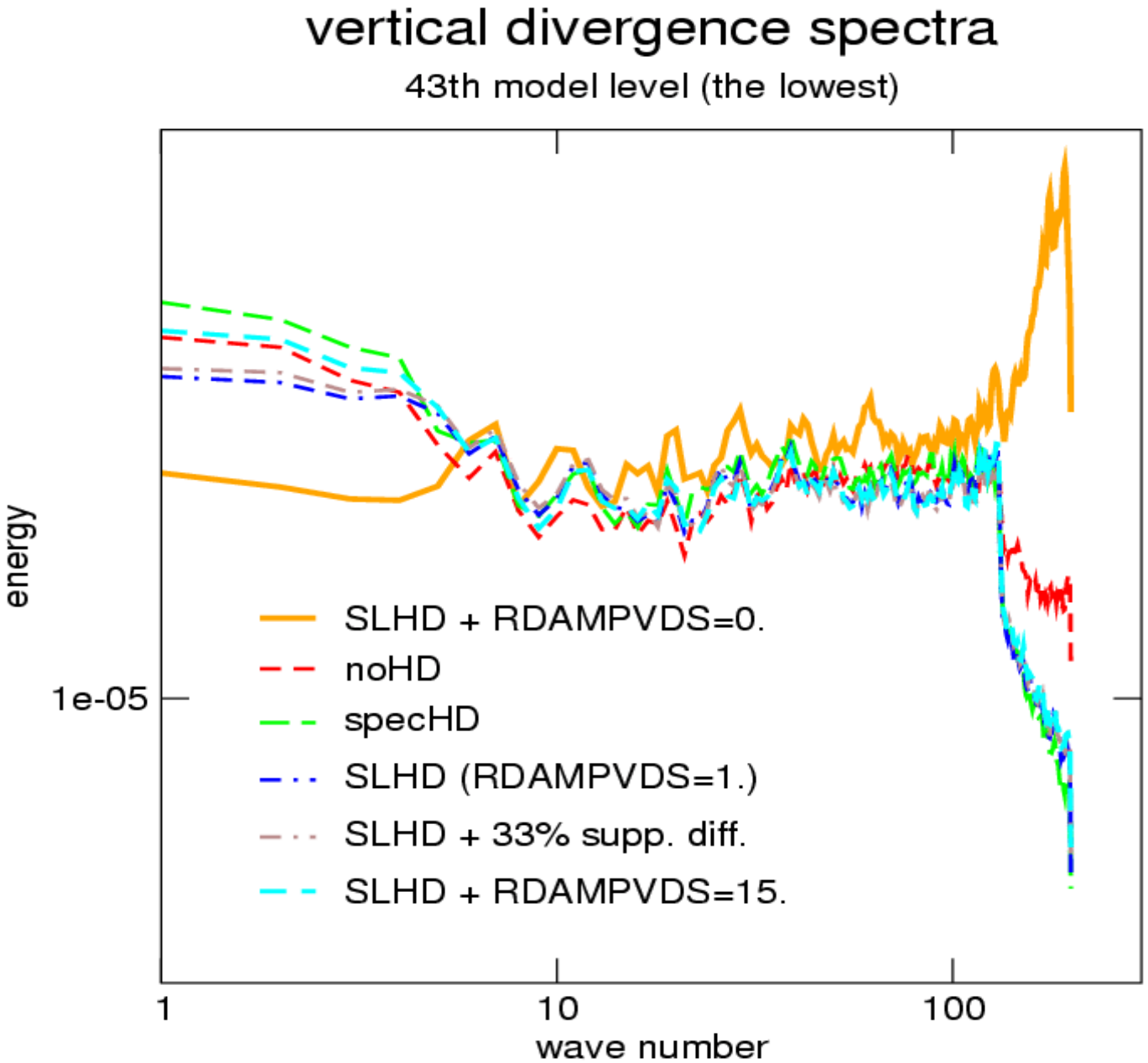
Scope of the presentation

- Dynamics
- Physics
  - Principles of the design
  - Radiation
  - The water cycle (in a broad sense)
    - Microphysics
    - Turbulence (p-TKE)
    - Convection
    - Cloudiness
- Conclusions

Dynamics

- One single item: SLHD ('**S**emi-**L**agrangian **H**orizontal **D**iffusion').
- Characteristics:
  - Designed (already a long time ago) to offer an economic and more precise alternative to spectral linear diffusion at high horizontal resolutions;
  - First developed (and tuned) for HPE;
  - Made 'NH⇔HPE transparent' in the past months;
  - Improvement of the latter step thanks to a 'surprise' in AROME tests (cf. Jozef Vivoda's talk).
- Perspectives:
  - 3D- and mountain-flow-compatible full version;
  - Possible prototype for the 3D turbulence complex technical problem in IFS-type codes?

The 'surprise' (F. Vana & J. Seity)



Principles of the 'physical' design of ALARO-0

- Economy, whenever easily achievable;
- Modularity/Flexibility, as the main motto;
- Security (reuse what is working well in ALADIN implementations);
- Transversal compatibility (among schemes, plus between their ensemble and the so-called 'AROME equations');
- Decoupling: between 'general' algorithmic choices and 'locally' produced code of a given physical problem;
- Prognostic character favoured in all aspects;
- Selective short-term ambitions (in 3MT).

The starting point: pre-ALARO-0

- Main original items:
  - Radiation scheme based on the **N**et **E**xchange **R**ate formulation of Green (1967), recently revisited and modernised by a team of Université Paul Sabatier (but from the other side of “Canal du Midi”);
  - Completely revised version of the mountain drag scheme with a first operational use of F. Lott’s ‘lift-force’ idea;
  - A revised version of the diagnostic cloudiness scheme which combines ARPEGE Xu-Randall’s approach, ZAMG’s proposals and a fully interactive method for inversion clouds (Brozkova et al., 2006);
  - Several MFSTEP-driven improvements of the surface-fluxes exchange formulae over sea [moist gustiness, $z_{0m} \neq z_{0h}$, … (same reference)].

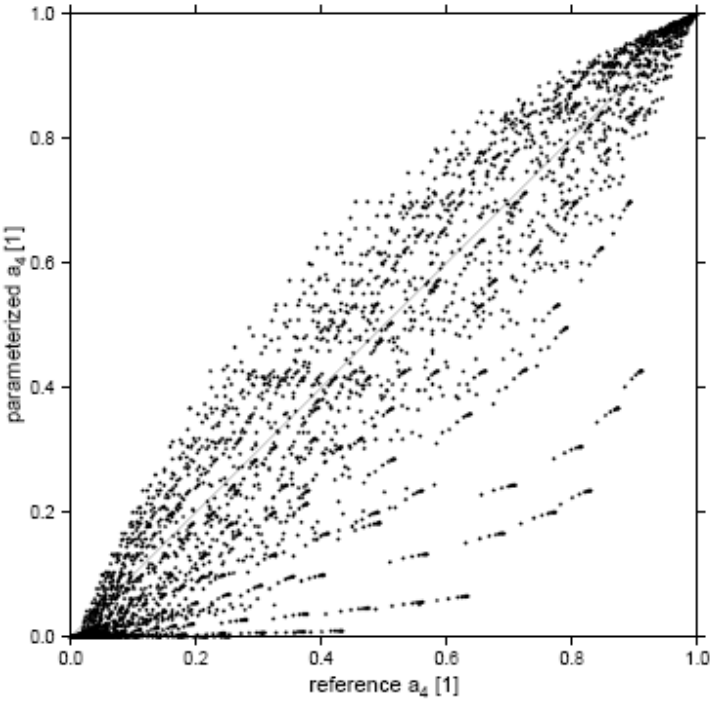
Radiation

- General ideas:
  - Have a code as good as RRTM for a cheaper price if called at the same frequency and an affordable price if called at all time steps (cloud-radiation interaction);
  - Have a simplified version but also cloud-interactive (for intermittent use);
  - Have a ‘statistical version’ for current use (safety net).
- Several on-going (or alas delayed) studies:
  - Extending the scope of the ‘statistical model’;
  - Aerosol model compatible with ARPEGE’s one;
  - Upper levels’ Doppler line-broadening;
  - Better compatibility with the RRTM gaseous effects.
- A promising study on broad-band cloud optical properties (see Jan Masek’s talk on Thursday).

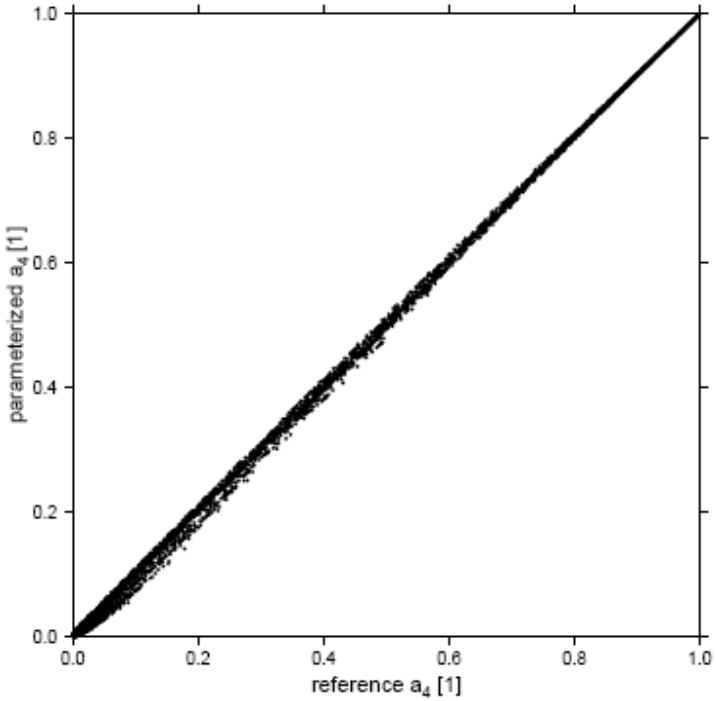
From a well-tuned to a more physical model of cloud impact (appetiser on JM's talk)

Parameterized versus reference total transmittance T,
sample of homogeneous clouds
(solar band, $\mu_0 = 0.1, 0.3, 0.5, 0.7, 0.9$)

current scheme



new scheme



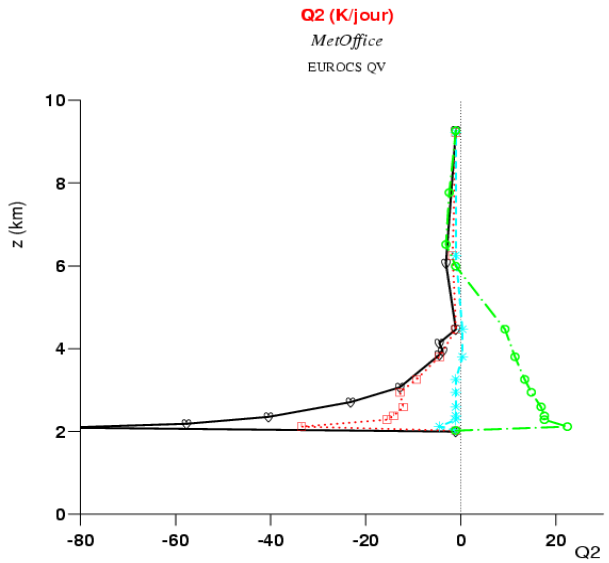
The water cycle (3MT & p-TKE & …) (1/2)

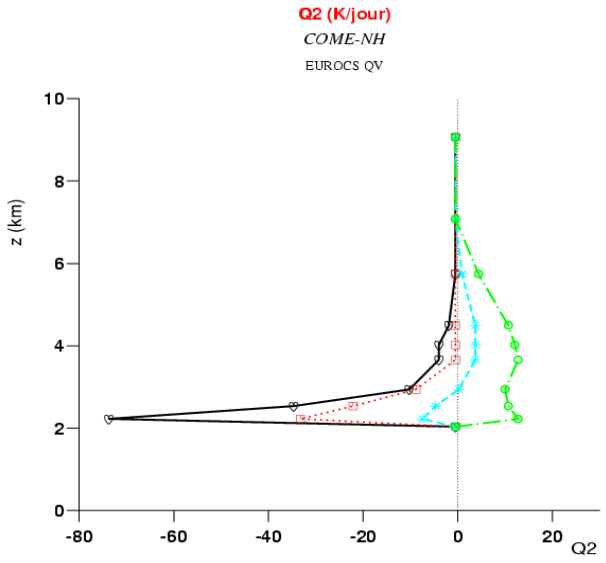
- General ideas:
  - Rely on three rather new concepts and on some natural synergies between them (see Luc Gerard's talk on Thursday):
    - The **M**icrophysics vs. **T**ransport split of convective computations proposed by J.-M. Piriou;
    - A (grey-zone targeted) treatment of the **M**ulti-scale cloud/precipitation problem through a unified (LS + CV) input to microphysical computations;
    - A **M**odular approach to solve the dilemma between parallel and sequential physics (also see Martina Tudor's talk on Thursday).
  - Go as much as possible prognostic while choosing algorithms which stationary solution gives close results to that of the pre-ALARO-0 physics. See for instance the talk on **p-TKE** on Thursday by Jure Cedilnik and myself. Also prognostic convective mass-fluxes in 3MT.

The water cycle (3MT & p-TKE & …) (2/2)

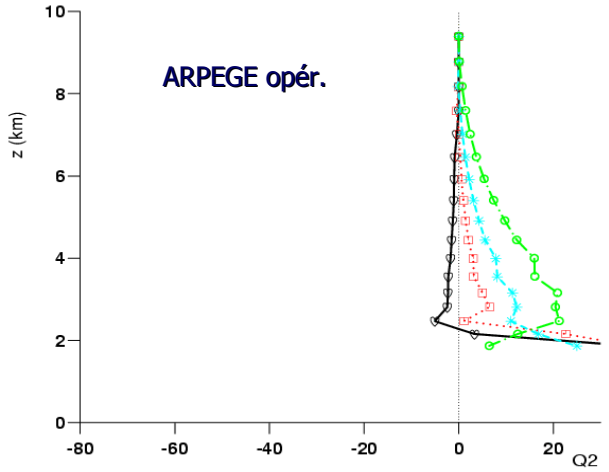
- Some solid individual bricks:
  - M-T as validated in the PhD work of JMP;
  - A convection-oriented prototype version of 3MT tested by LG for the grey-zone problem;
  - Promising first results of the p-TKE => one may avoid the dilemma between the ‘M-T’ & ‘moist turbulence’ incompatibility on the one hand and a need to attack the shallow convection problem ‘from scratch’ on the other hand.
- A rather complex assembling problem, especially since one wants to prepare for a full use of the ‘AROME equations’ (Catry & Geleyn + Malardel & Bénard) => **some delays …**

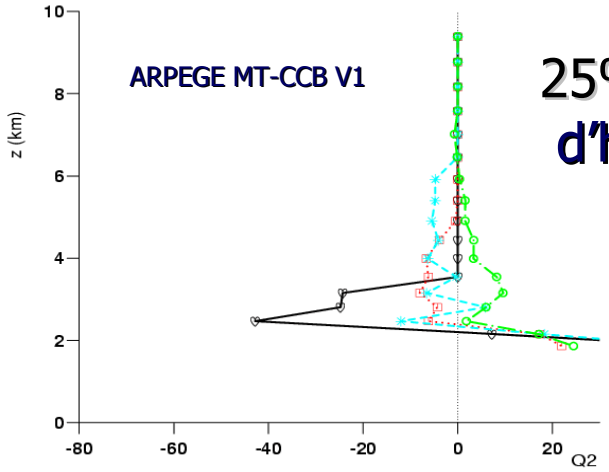
Eurocs test of the simulated Q2 sensitivity of deep convection to the ambient humidity. The upper panels are LES references. Accvimp (bottom-left) shows sensitivity but with too much a drying behaviour, M-T does far better





Q2 (K/jour): opposé de la tendance de vapeur d'eau due à la convection, fois L/cp.

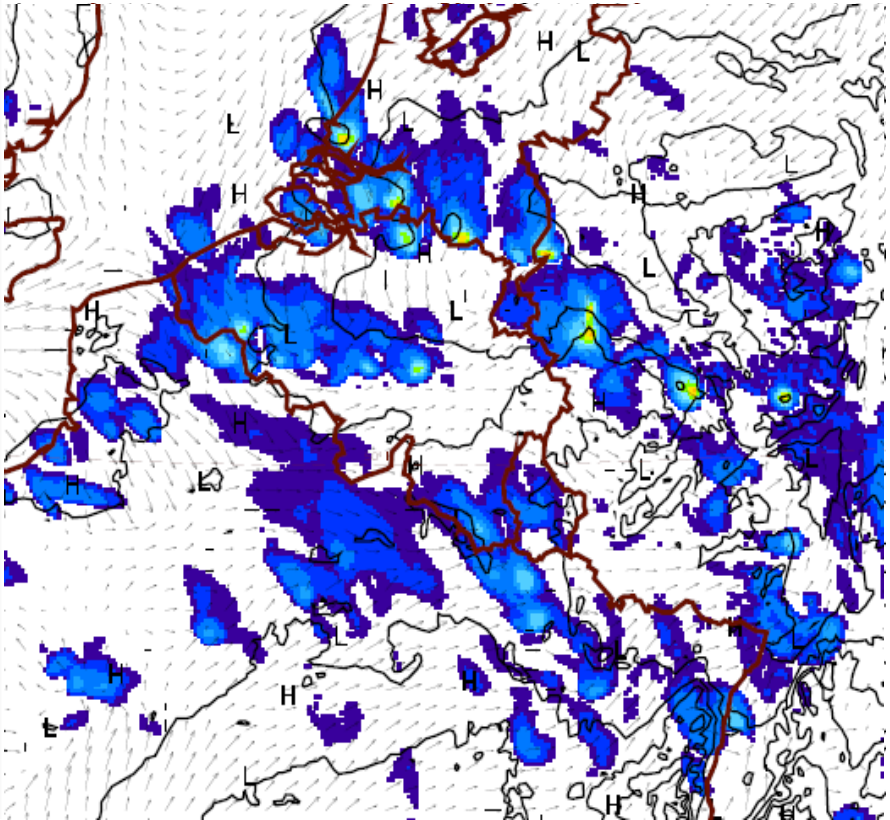


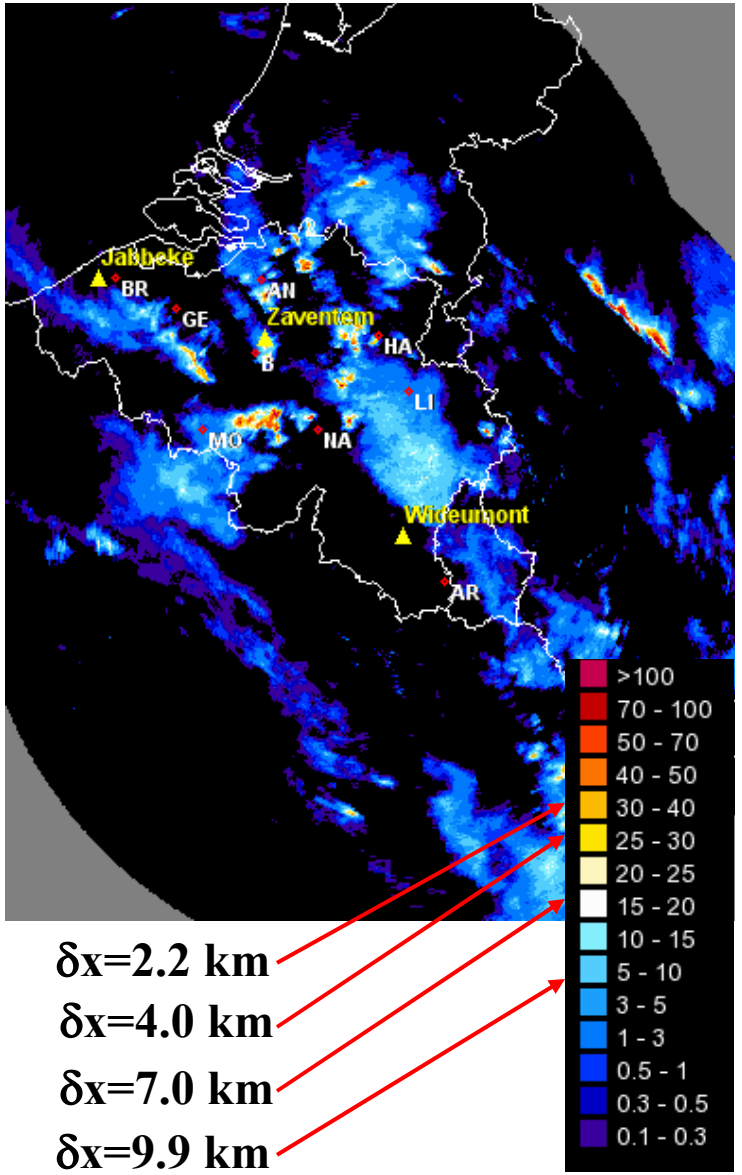


25%, 50%, 70% ou 90% d'humidité relative

The first 3MT convective prototype test are encouraging

The simulation converges realistically when resolution increases. There is hardly any sign of a ‘grey zone’ syndrome.





δx=2.2 km

δx=4.0 km

δx=7.0 km

δx=9.9 km

Conclusions

- ALARO is at the same time:
  - A concept, with trust in algorithmics put first among other design rules;
  - A hope for less yes/no choices in operational matters;
  - A way to ‘think NWP’ before jumping to conclusions, for its design and build-up phases;
  - A forthcoming nitty-gritty challenge for its validation and tuning phases;
  - A proposal for mutualised, well-controlled and scientifically-open future developments.