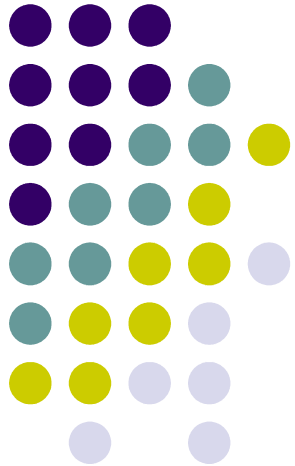
ALADIN DYNAMICS



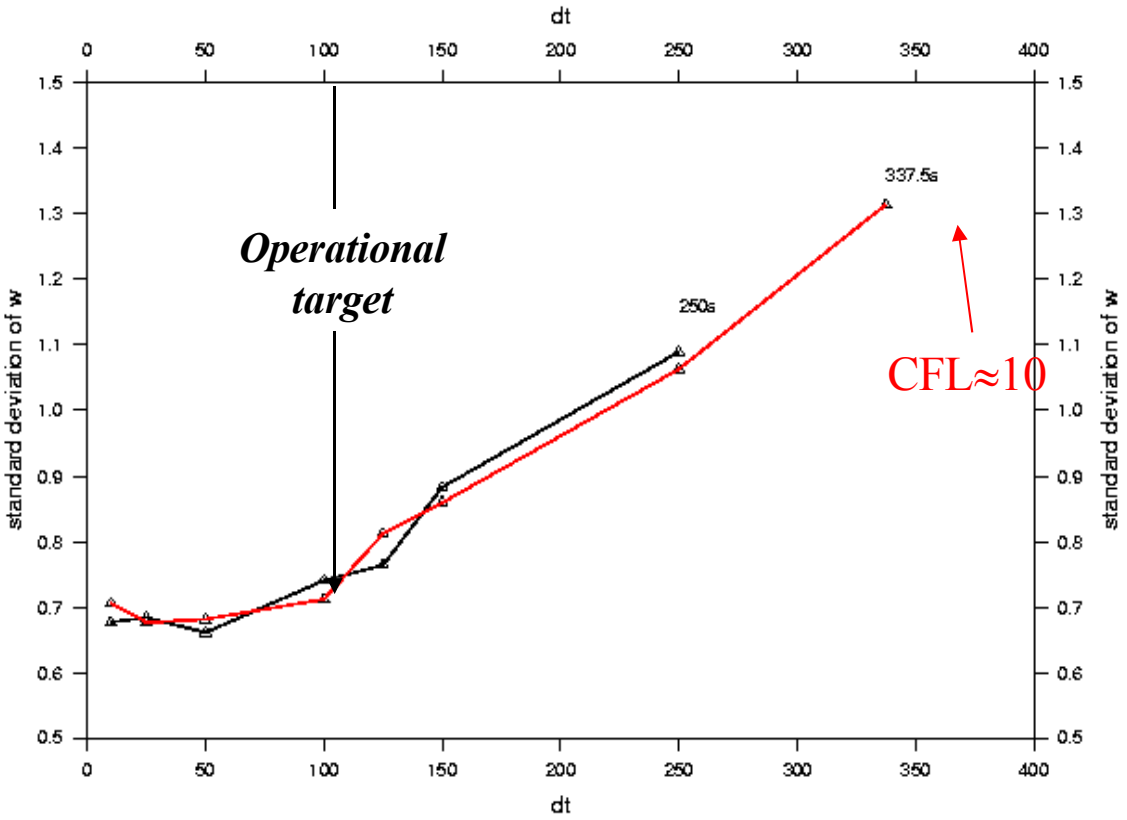
Non-hydrostatic core

- Basis: choice of the vertical coordinate known as ‘mass coordinate’.
- This choice was strategically crucial:
  - Building on the robust NWP methods: semi-implicit, semi-Lagrangian and spectral;
  - Clean switch between the hydrostatic primitive equations (HPE) and Euler equations (fully compressible NH).
- Result: a world record in the efficiency while keeping a good precision of the scheme

The ‘world record’!

ICI scheme robustness - ALPIA 3D idealized case

Stdev of w comparing to REF Eulerian experiment with $\Delta t = 10s$.

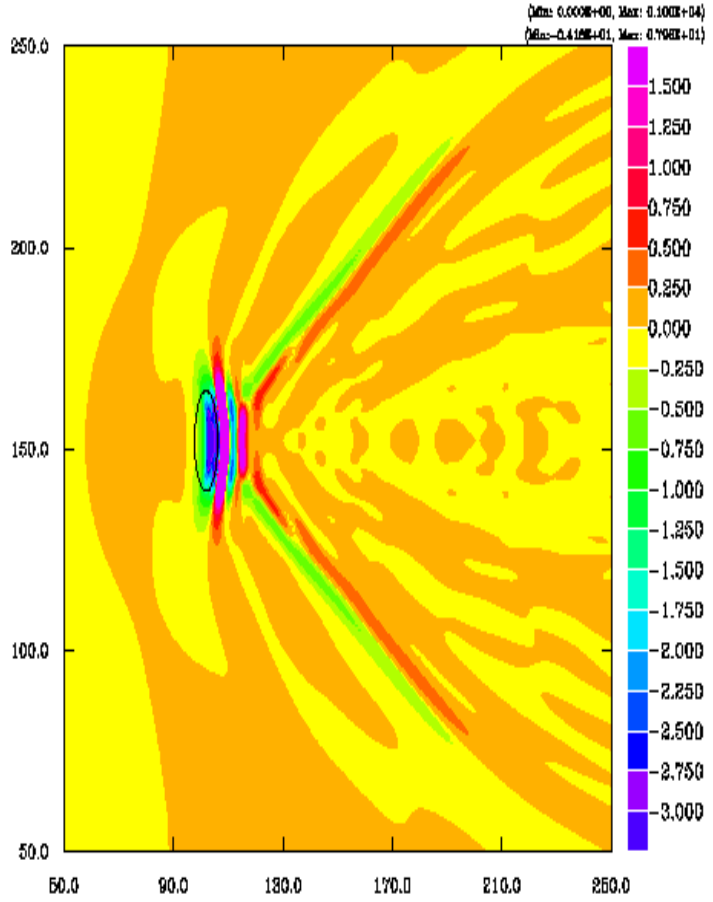


2TL ICI(1)	2TL ICI(0) second order extrapolation

dx=2.5km

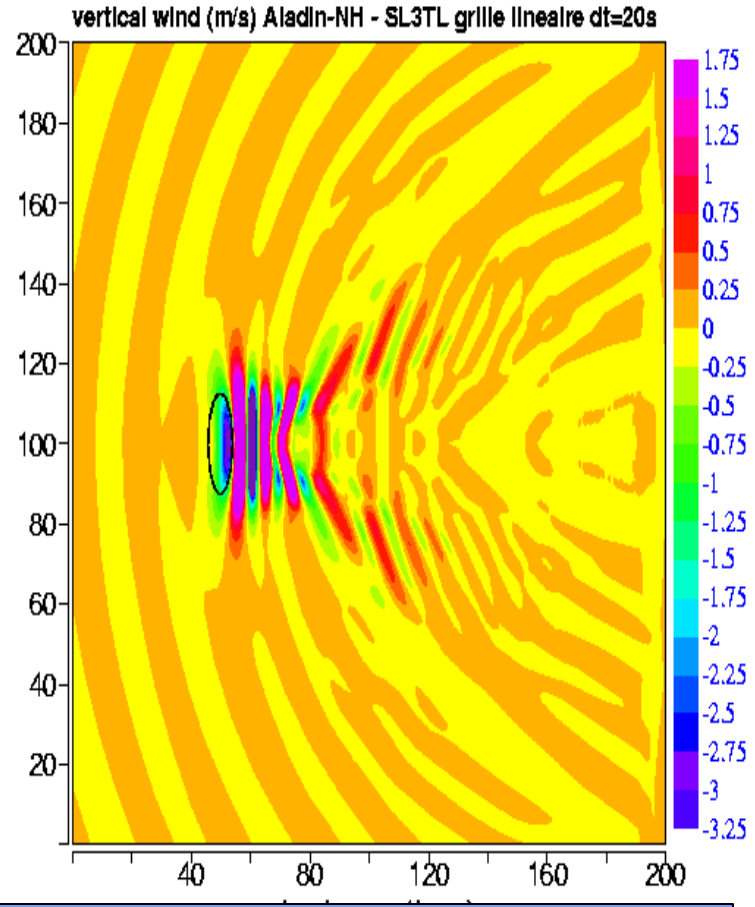
And about the precision …

3D trapped oscillating lee waves problem
Vertical wind at 2000 m; dx=2km; dt=5s vs. 20s



Efficiency ≈ 1 / 10

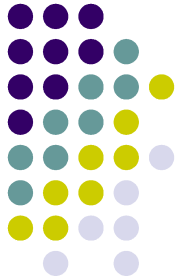
Quality = ➔



Exp. => Eul. => fin. diff. => z-coordinate => anelastic

SI => SL => spec. lin. grid => p-coordinate => elastic

ALADIN Non-hydrostatic core: a success story ….



Good news:

- ALADIN NH is ready for operational-like tests (from the release CY30T1);
- It was chosen for AROME dynamical core;
- It was one of the strong motivations of HIRLAM colleagues to join us;
- It was successfully extended to ARPEGE global model;
- Last summer it was run for the first time also in the IFS model of ECMWF;
- The efficiency ratio when compared to the Eulerian schemes grows geometrically with the number of advected variables (hydrometeors, chemical species, …).

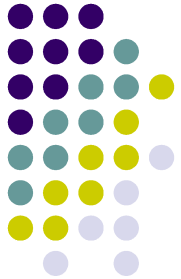
… or Pyrrhic victory?

ALADIN NH used to be like a champion suspected by the *Comité International pour la Prévention du Numérique* to use heavy doping

Indeed otherwise it would not have been possible to declare ALADIN NH winner of a race suddenly having no looser!

Furthermore, the type of decision process used today in the ALADIN Programme would most likely lead not to start the R&D work on a compressible version of ALADIN.

When to switch LNHDYN=.TRUE. in ALADIN?

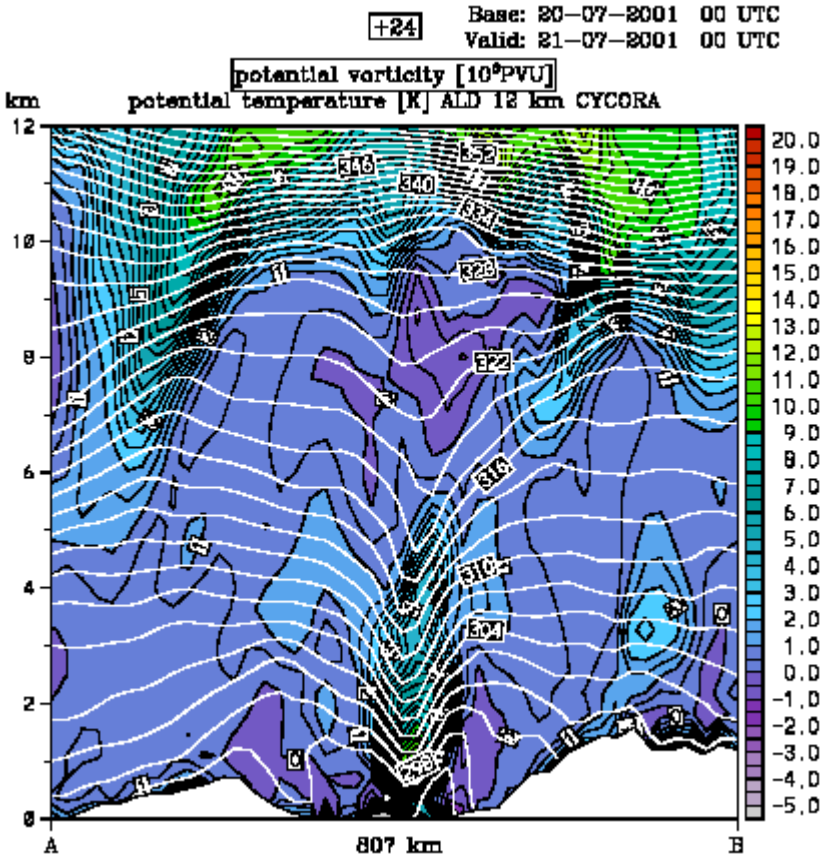


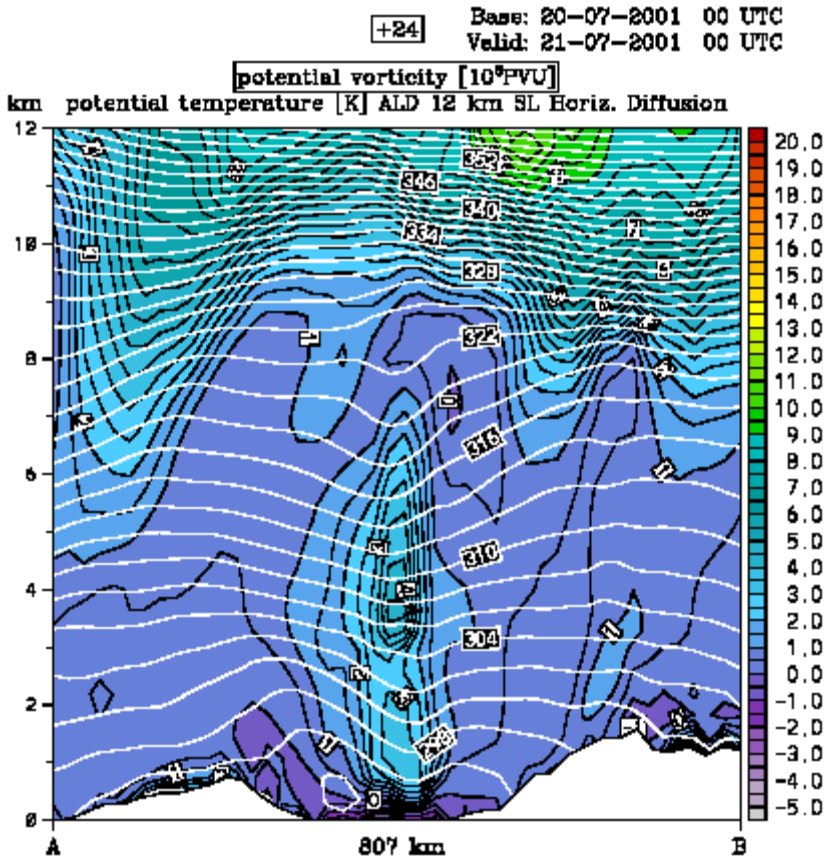
- Various tests show that around ***dx***=10km the differences between H and NH simulations are marginal.
- Economy reasons then tell you to use the so-called "HPE booster" of your fully compressible ALADIN model when you use a ***dx*** still close to 10km.
- ALPIA tests at 5km show that the NH dynamics should be used (e. g. because of mountain forced flow), even if many times the differences in weather forecast will still remain small.

Semi-Lagrangian based Horizontal Diffusion scheme (SLHD)

- The Idea: use diffusive properties of the semi-Lagrangian interpolators.
- Hence one obtains a method able to solve other important issue: to get at no-cost a 3D non-linear, local and scale selective diffusion operator.
- The SLHD scheme is now tuned for any choice of model domain and of resolution and is operational in several ALADIN applications.

SLHD result example





Without

With

Outlook

- It is time to go for NH pre-operational tests while there is not really a worry to still use HPE ‘booster’ at ***dx*** ~ 10km. This flexibility is an advantage and not a weakness, we should use it without any complex!
- In the current research plan there are other important topics, such as the vertical finite element discretisation scheme of the NH equations, lateral coupling, and so on.
- Let’s be proud of the ALADIN dynamics and let’s hope that the numerical and algorithmic implementation of new scientific ideas will be apprised. Why indeed should it either be over-looked or considered as a sort of purely esthetic trade (our ‘doping’ case)?