

Status, plans & interactions of AROME

- Objectives and constraints
- Status
- Latest plans
- Méso-NH and HIRLAM aspects
- The ALADIN/AROME transition problem: a small institute's point of view ?

Why AROME ?

- ALADIN is a useful model but not evolving quickly enough to meet user needs at kilometric scales and short ranges.
- Research CRMs demonstrate large improvements to cloud/precip forecasting – at a price: $dx < 3\text{km}$, NH and explicit microphysics.
- Growing competition from MM5, WRF, UM, LM, ECMWF – including data assimilation : a threat to the **survival of national NWP**. Customers do not care about models, only products.
- Untapped potential from mesoscale obs: sounders, radars, surface networks, etc.
- CPU is getting cheaper: we must use it.
- Separating NWP work from research institutes is wasting manpower and expertise: it's **bad for everyone**

Arome deliverables

- Provide substantial **added value** over global models for short-range forecasts of **precipitation, actual weather, extreme weather**
- Justify funding of high-resolution regional observations
- Analyses & forecasts for **hydrology, air quality, nowcasting**
- **Optimal interaction with scientific community** on NWP modelling and research data assimilation tools

Arome constraints in Météo-France

- Start operational production with $dx < 3\text{km}$ over mainland France (range 36h, assimilation of hourly data) in 2008
- Hence, preoperational tests must start in 2006, first experiments need to run in 2004: **very tight schedule !**
- Choice: use as much as possible of Aladin software, except physics from Méso-NH (no competing package available in Aladin)
- Arome model will be 30-100 times more expensive than Aladin, but much cheaper than Méso-NH or MM5
- Most of the **physics development to be done using Méso-NH expertise in the short term**
- All other developments to **have maximum Aladin compatibility and expertise: assimilation, dynamics, predictability, coupling, maintenance**
- Arome experimentation & validation **work shared between NWP and scientific teams**

Arome ingredients

- See many papers in Newsletter, ECMWF/Hirlam seminar, etc.
- **Data assimilation is 99% pure Aladin**, only at higher resolution (+ cloud initialization issue)
- **Model is 90% pure Aladin**: Aladin-NH dynamics, 80 Méso-NH-specific physics routines, external surface code
- Important parametrisations: prognostic microphysics (5 species), prognostic TKE turbulence, new radiation, new surface (+ future schemes)
- Resolution: $dx=2.5\text{km}$, L80, rectangular linear truncation, $dt=1\text{mn}$
- Assimilation requires **FGAT**, high resolution Jb and emphasis on **MSG**, **radar & low-level data**.
- A new computer will be needed in Météo-France
- Research assimilation using 3DVar/Méso-NH hybrid tool
- **Validation facilities** are still insufficient (clouds, precip, weather)
- Strong demand for a **portable system** and **Nowcasting** products

Arome people

- New permanent staff allocated by Météo-France on top of Arpège and Aladin staff i.e. **no slowing down of Aladin-1 work**
- **Sylvie Malardel:** physics (Mésos-NH side)
- **Yann Seity:** model (Aladin side) and phasing
- **Frédéric Duret:** experimentation tools and support for research users
- **Eric Wattrelot:** radar data assimilation
- **Ludovic Auger:** high-resolution analysis and observations (50% on nowcasting applications)
- [**François Bouttier:** interim project manager]
- [**Gwenaëlle Hello/Jean-François Geleyn:** Aladin/Arome transition international issues]
- [a dozen of students and part-time helpers mainly in GMAP and GMME (mesoscale research group)]

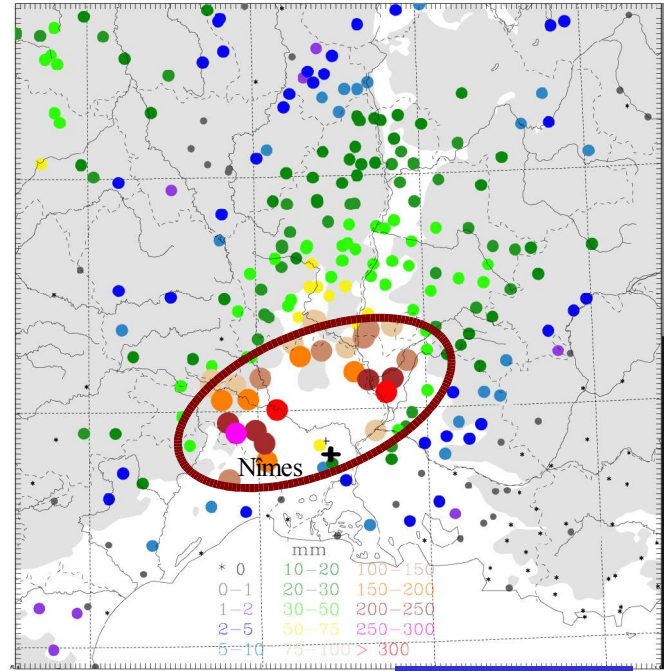
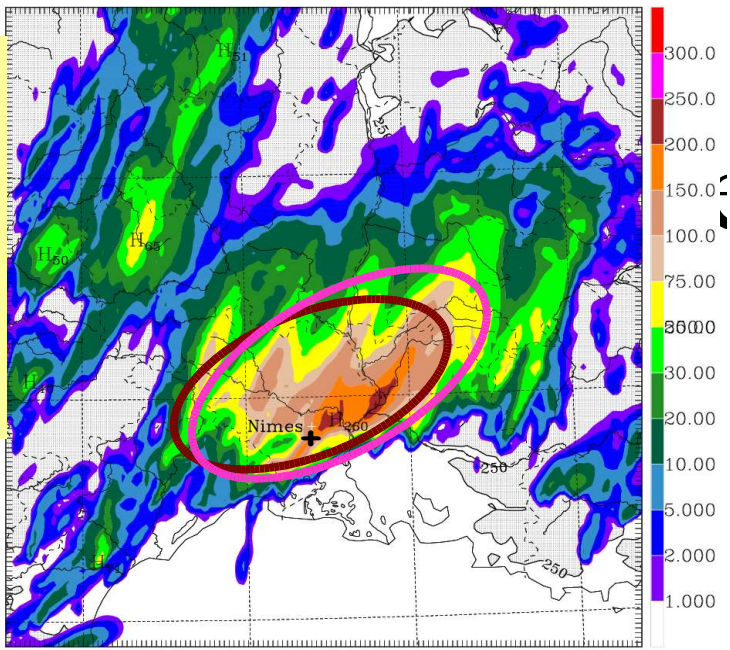
Arome status on 10 Feb 2004

- Arome model prototype **completely validated in 1D** column mode
- **Full 3D code runs** with microphysics and 1D turbulence (squall line case), compares well with Méso-NH
- Externalised ISBA **surface will be finalised in April**
- Hybrid **research assimilation** is being done on Mediterranean flood cases and African JET experiment in GMME (ongoing Jb improvements)
- **MSG radiances** are going preoperational in Aladin 3DVar in April
- **Real radar development** is starting in March
- Aladin 3DVar is integrated inside the OLIVE tool

TESTING OF MESOSCALE ANALYSIS IMPACT (V. DUCROCQ, DEC 2004)

(Min: 0.000E+00, Max: 0.260E+03)

Initial conditions : mesoscale analysis (surface obs, radar, satellite) for 12UTC, 8th Sept. 2002

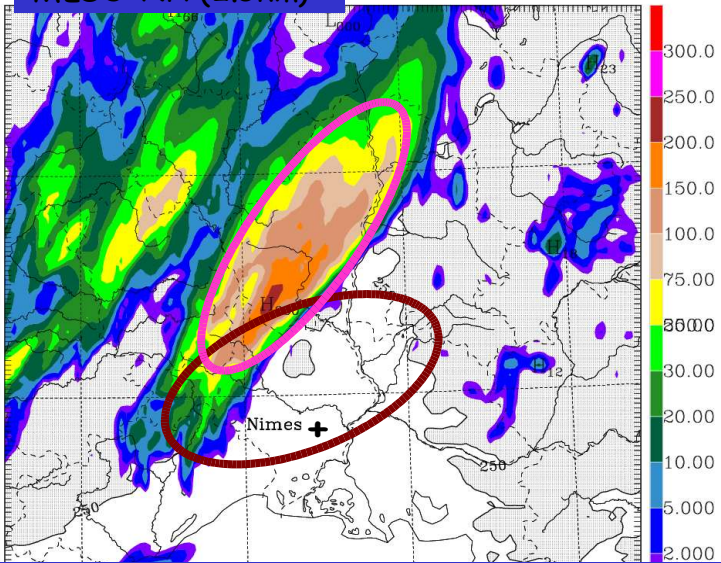


Raingauges

MESO-NH (2.5km)

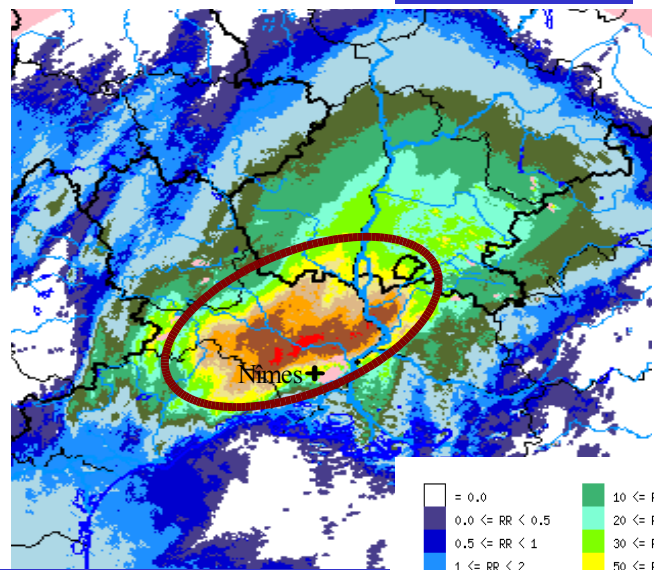
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Initial conditions : large scale ARPEGE analysis for 12UTC, 8th Sept. 2002



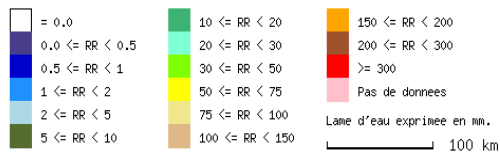
Observations

Ducrocq et al, 2003

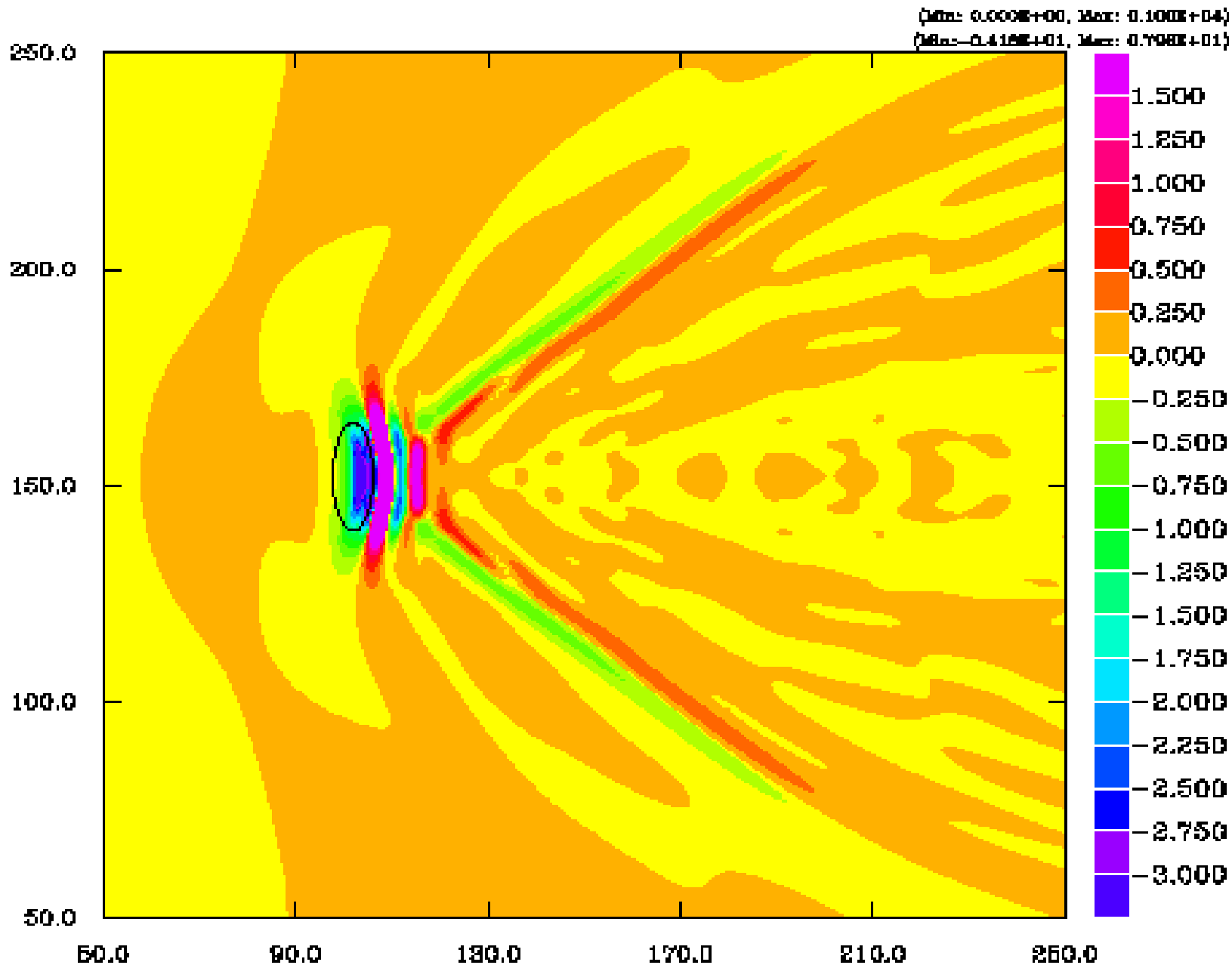


Nîmes radar

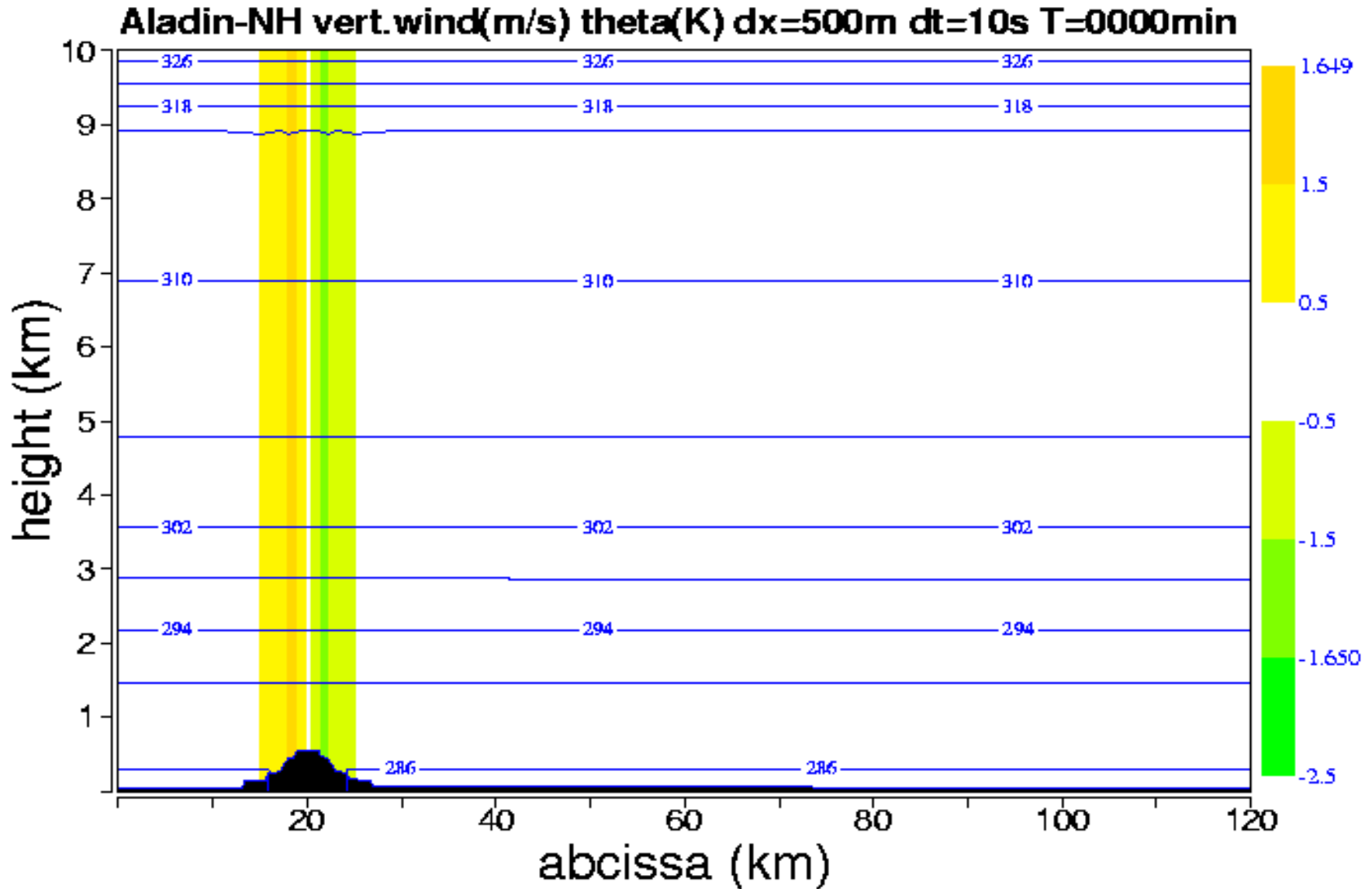
12-h accumulated rainfall from 12 UTC, 8 Sept to 0 UTC, 9 Sept 2002



Academic 3D lee wave test (Aladin-NH W field)



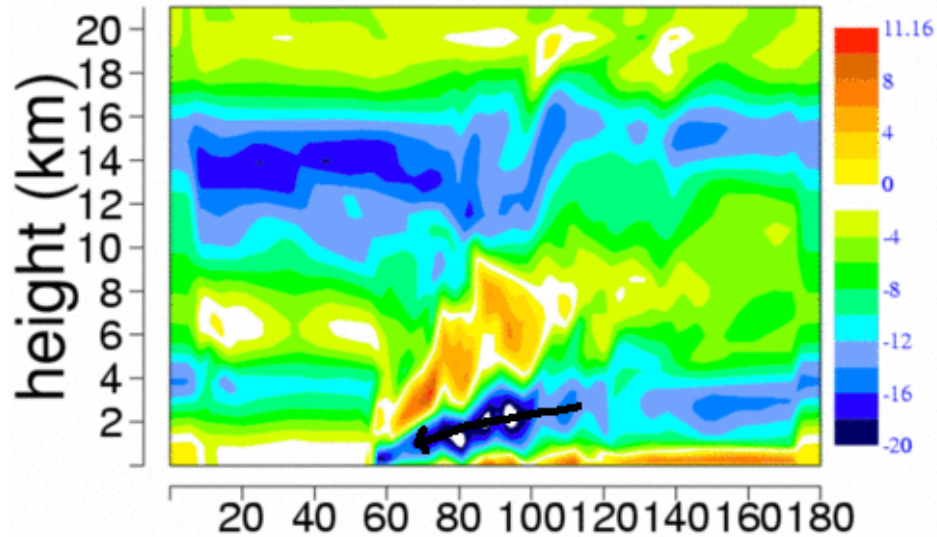
Academic 2-D lee waves test (Aladin-NH W and theta)



Test-run of Arome: academic squall line (Y.Seity, Feb 2004)

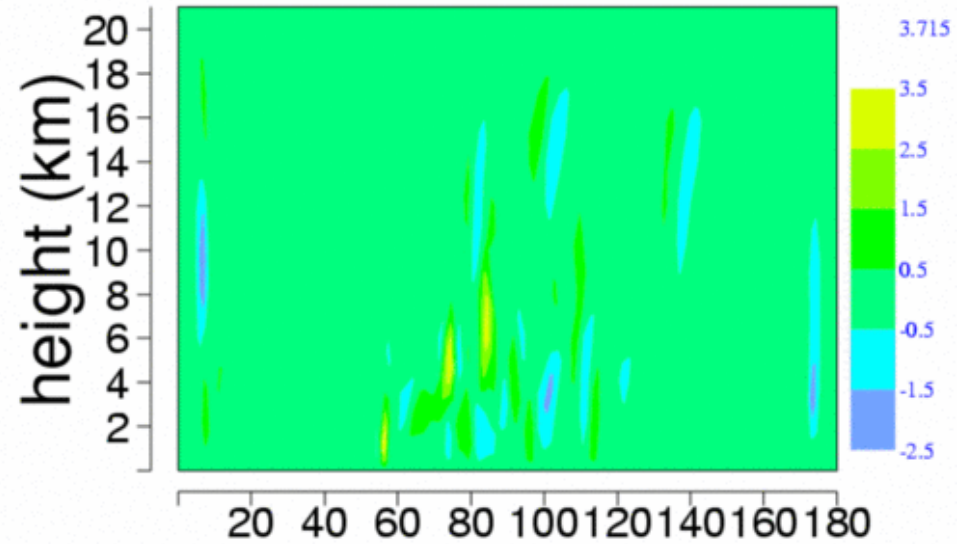
horizontal wind

VArôme Micro+turb 7.5s F_1_d4 +8h max: 10.7732391357 min: -21.7251014709



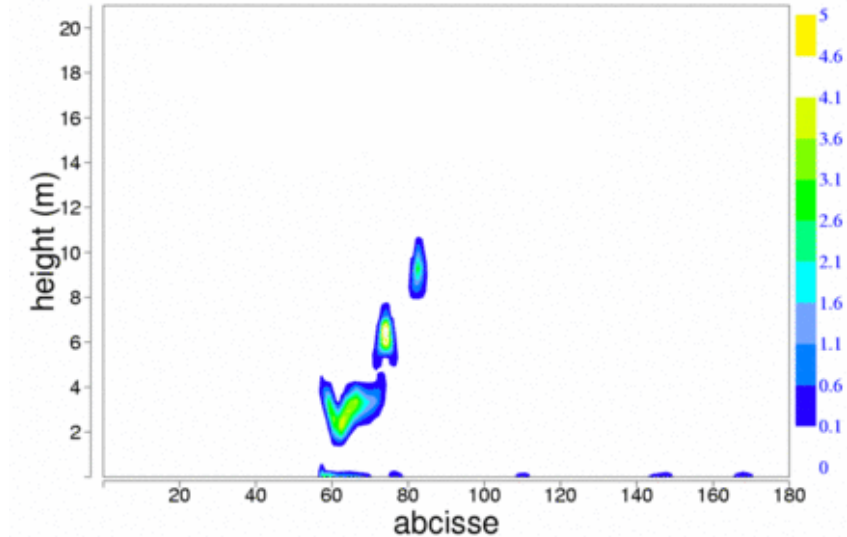
vertical wind

wNHArome Micro+turb 7.5s F_1_d4 +8h max: 3.68327999115 min: -2.32777023315



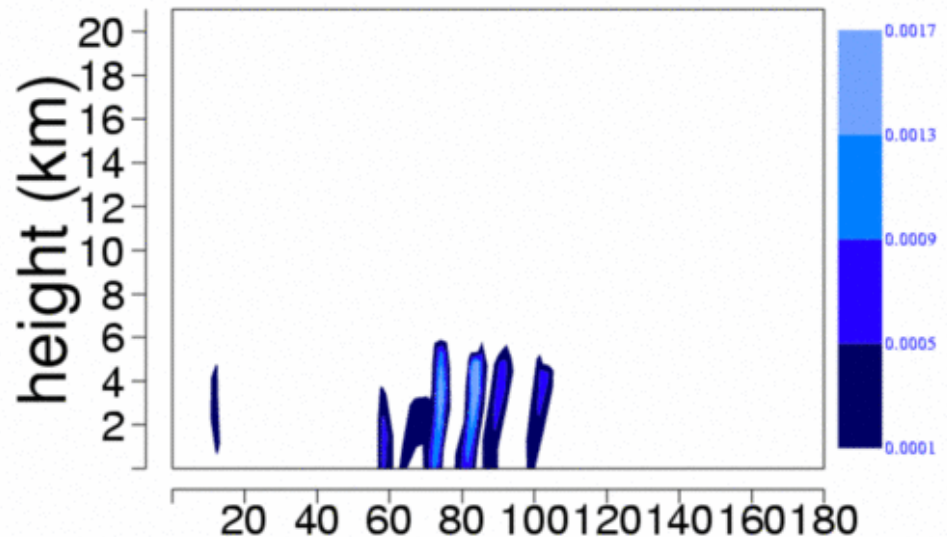
turbulent kinetic energy

TKE Arome_7.5s F_1_d4+8 max: 5.9314799772 min: 9.99999429041e-07

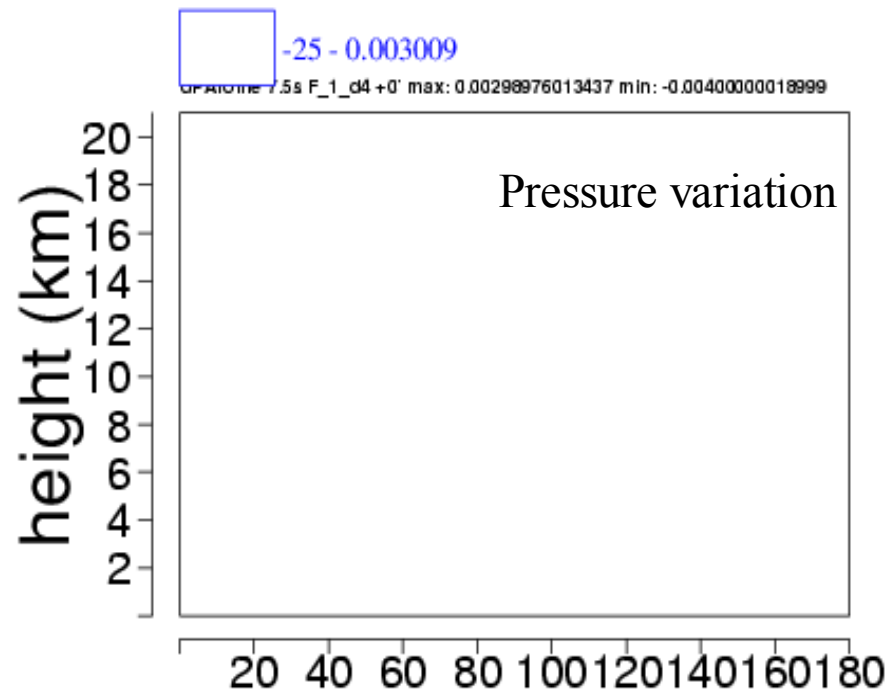
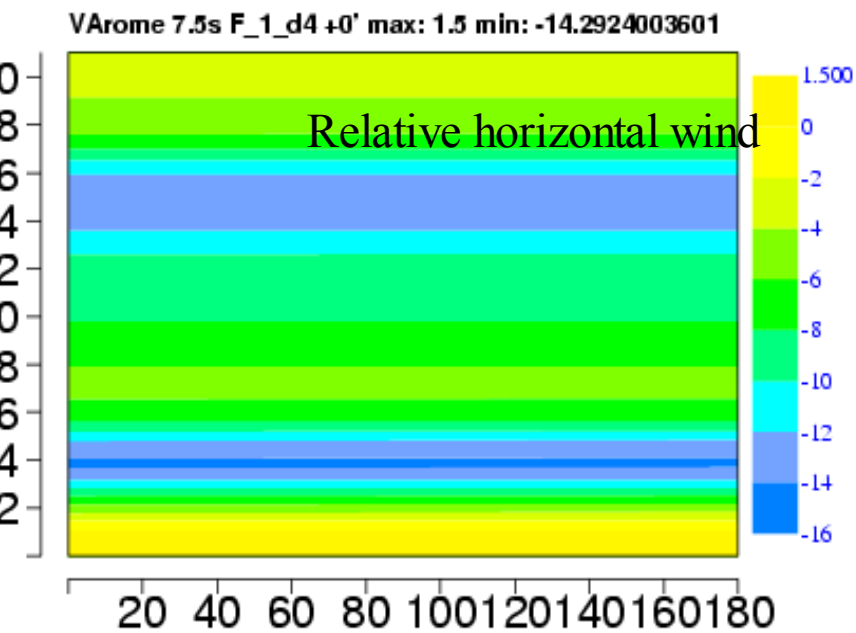
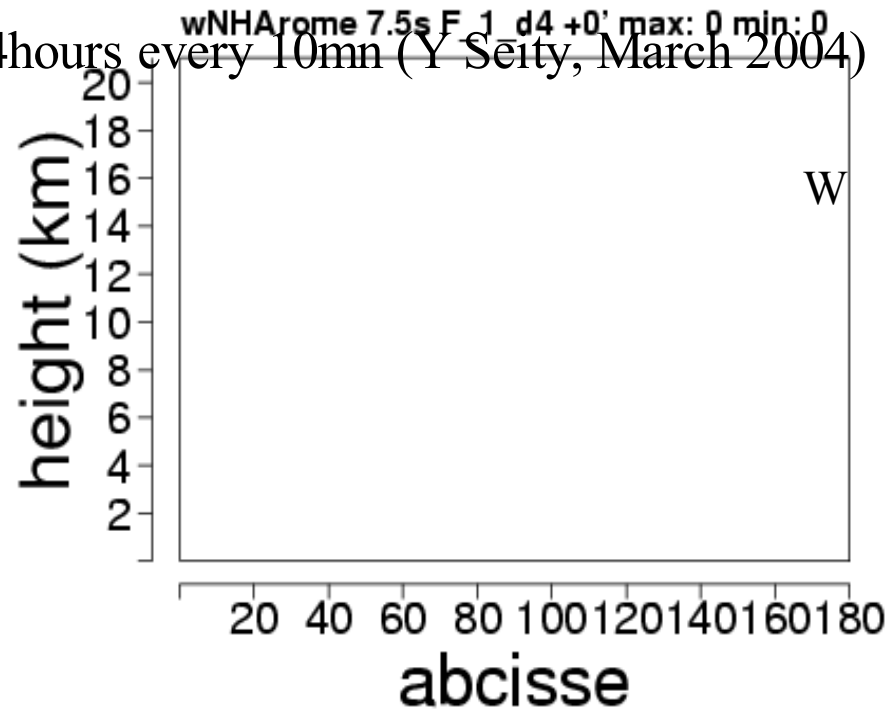
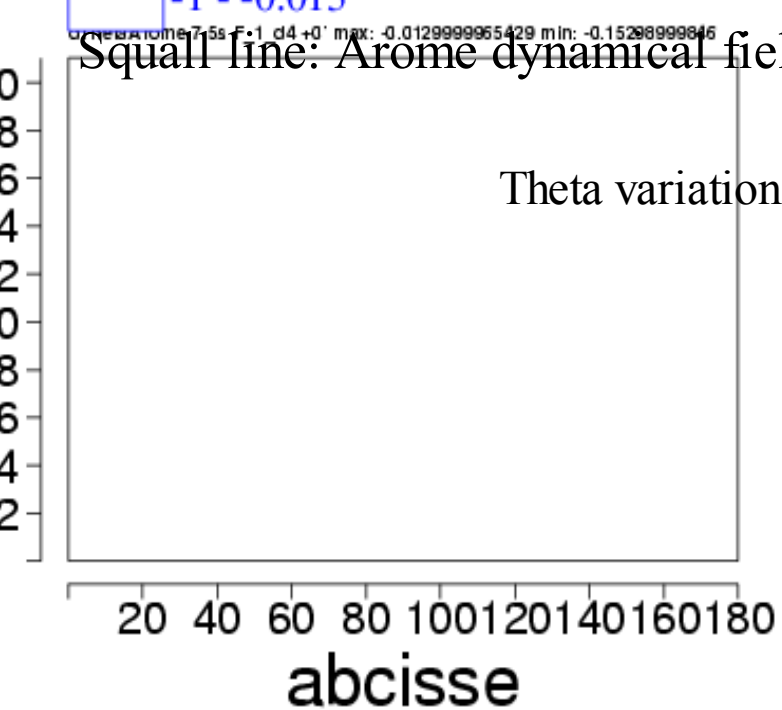


rainwater

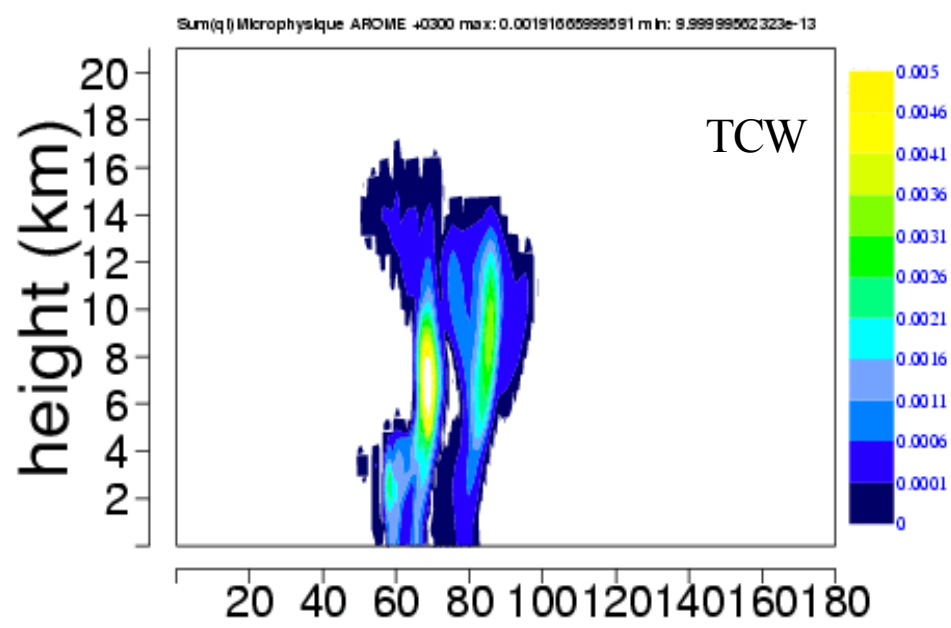
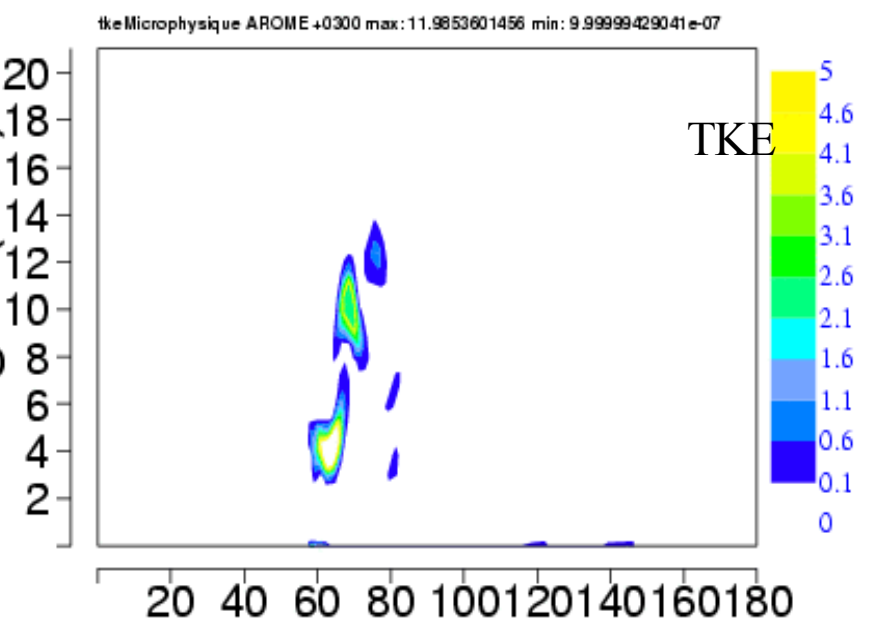
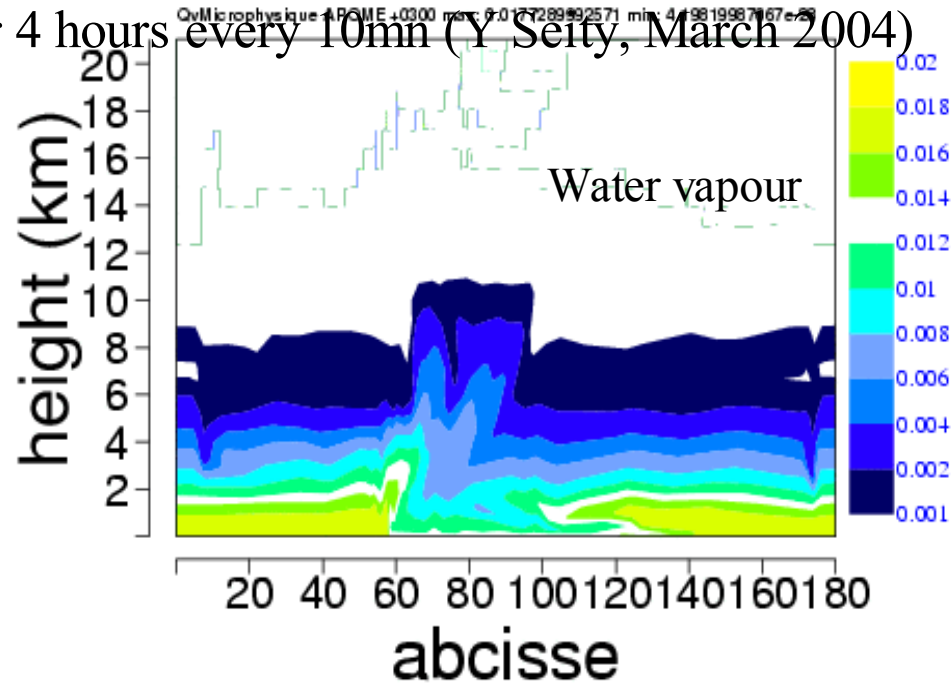
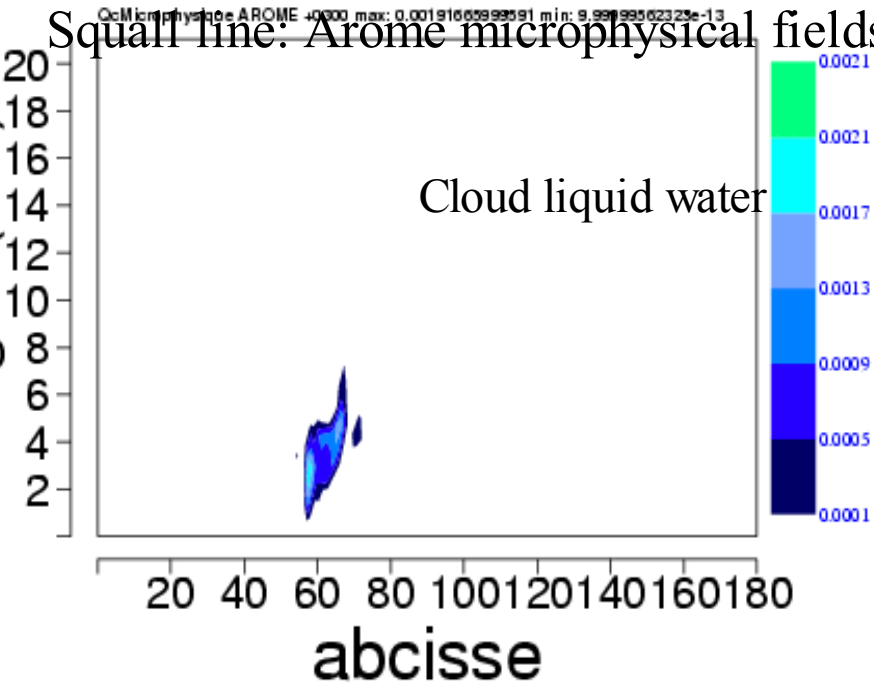
qrMicrophysique Arome_7.5s F_1_d4+8 max: 0.00161776004925 min: 9.99999562323e-13



Squall line: Arome dynamical fields for 4hours every 10mn (Y Seity, March 2004)



Squall line: Arome microphysical fields for 4 hours every 10mn (Y Seity, March 2004)



Arome current plans

- First model prototype runs this winter, benchmarked & improved before **research release** end 2004
- First version of radar assimilation and cloud analysis, autumn 2004
- Intercomparisons with UM and WRF, early 2005
- **First Aladin backphasing**, early 2005
- Physics added/tuned in 2005/2006: 3D turbulence, shallow clouds, coupling with chemistry and 3D coastal ocean model, cleaning of physics interface
- Official **research release in 2006** (AMMA, MAP FDP, scientific cooperations)
- NWP-oriented validation and optimization in 2006/2007
- **Operational-grade version not ready until mid-2007**

The Méso-NH aspects

- Arome will heavily rely on Méso-NH activities on physics & assimilation **until it is a mature model with its own experts**
- **Expertise & manpower** on most Arome physics is so far available only in Méso-NH community: **GMME, Laboratoire d'Aérodynamique**. But they are **open to scientific cooperation with Aladin partners**. It would be beneficial to the future Arome NWP quality.
- Méso-NH is used in small labs, even on Linux PCs
- Méso-NH has **experimentation tools** that are missing in Aladin: **gridnesting, turbulence** diagnostics, **LES simulation** mode, research-oriented **graphics**.
- In-depth studies of **case studies, field experiments, instrumented sites**, that NWP teams can't do.
- In touch with a **wide scientific & NWP community** outside Aladin
- Examples : cloud **turbulence**, orographic **convection**, ice **microphysics**, **chemistry & aerosols**, **ocean fluxes**, **radar physics**

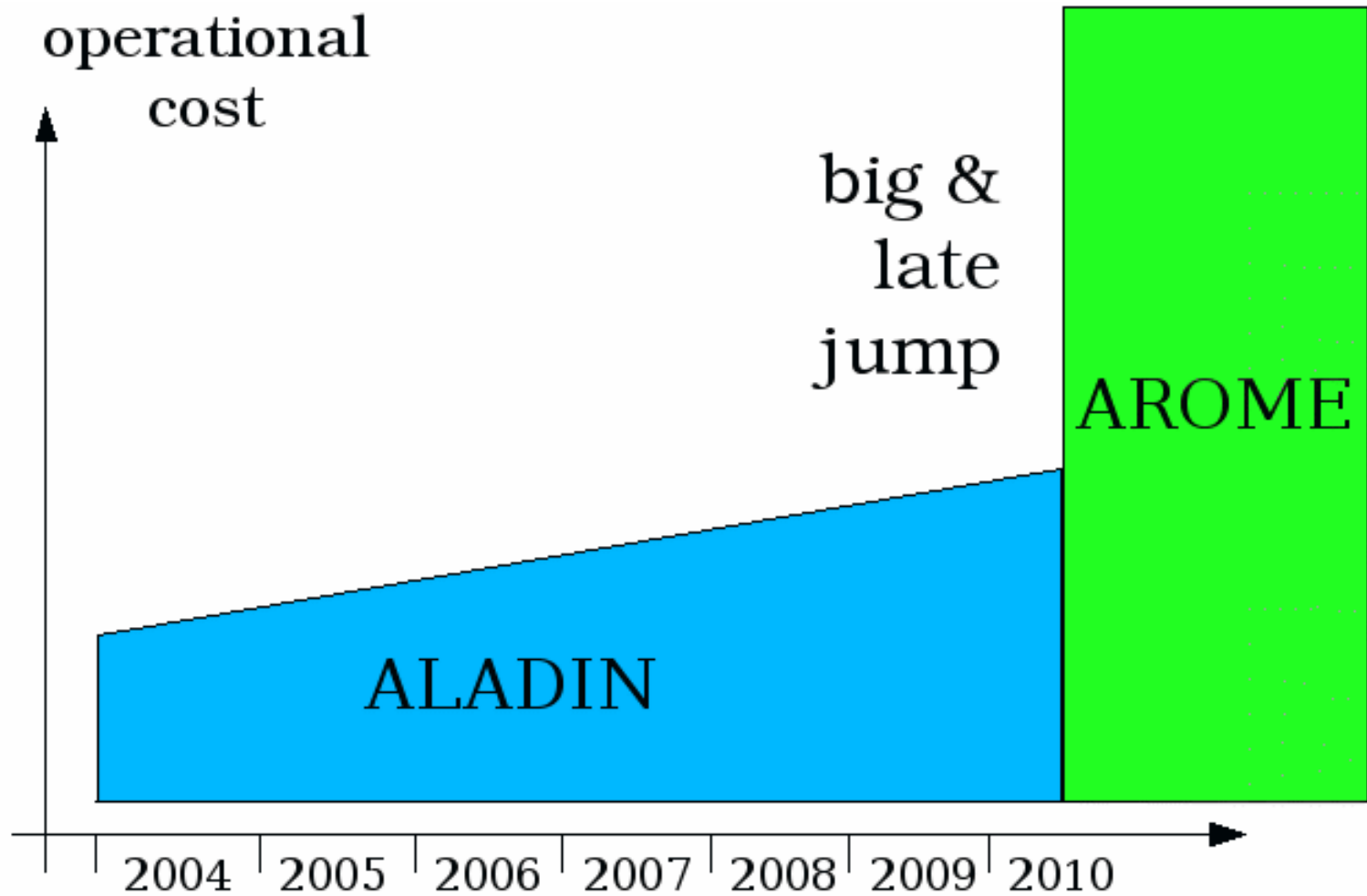
The HIRLAM variable

- The Hirlam group is really interested in Aladin-NH dynamics and Arome collaboration
- But they have not yet decided on a real software cooperation
- They are sure they want to keep the HIRLAM name
- Their motivation: compatibility with ECMWF software, especially in assimilation
- Our interest: more manpower on physics, Doppler radar, mesoscale satellite data
- **Problem:** (even !) more time spent on work coordination, phasing, political arguments, overheads
- Has potential to produce **the world's best mesoscale NWP** system if it works – with a job for all of us

The Aladin/Arome transition

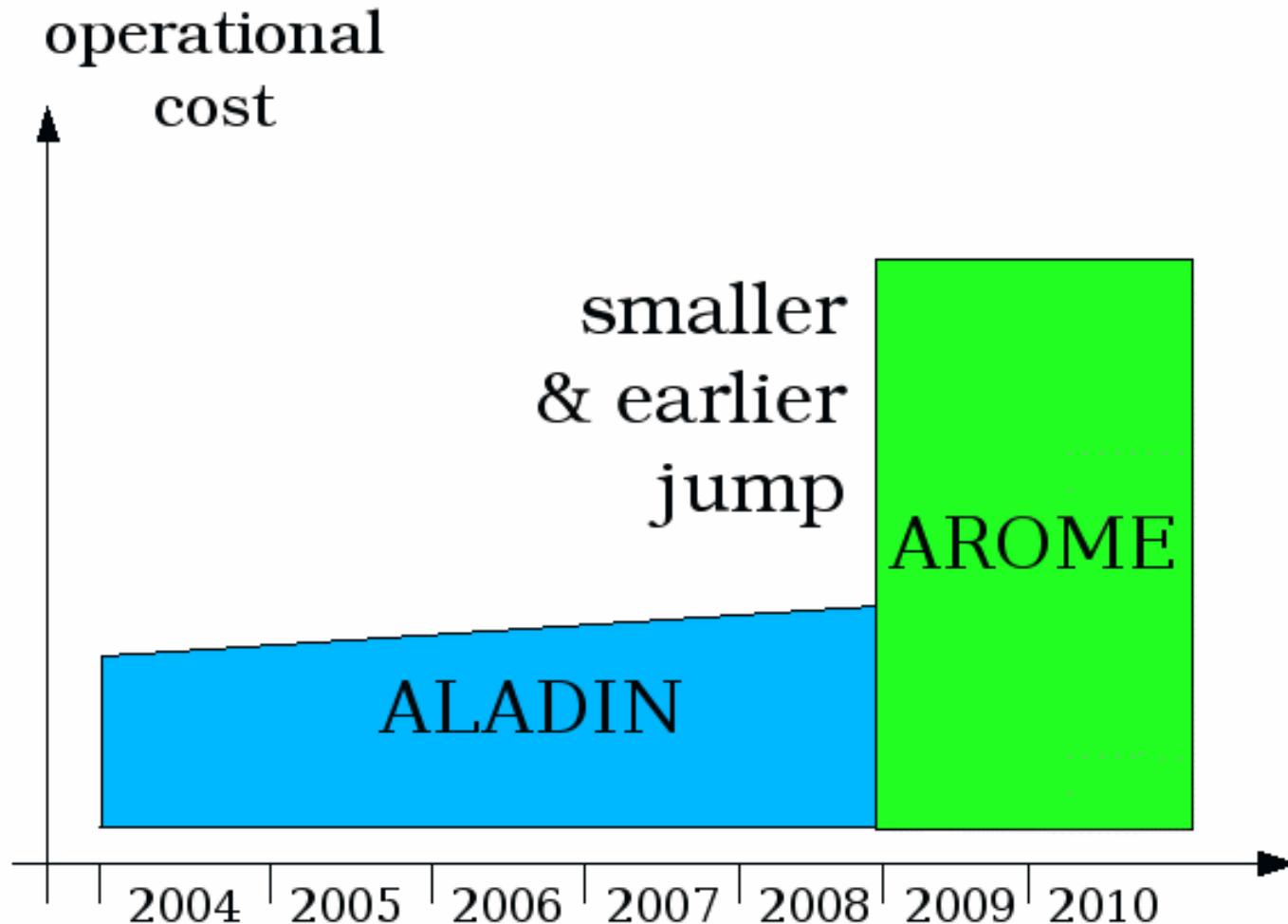
- Given my computer upgrade schedule, how to run the best national NWP model every year ?
- Météo-France has the same problem and a long-term approach has been preferred
- **3 different paths to choose from:** put the effort on Aladin, on Arome, or Alaro
- **Alaro still lacks a critical mass of manpower (3 to 5 people) to exist**

With max effort on Aladin:
business-as-usual, **best for short term**, others
will prepare Arome for you

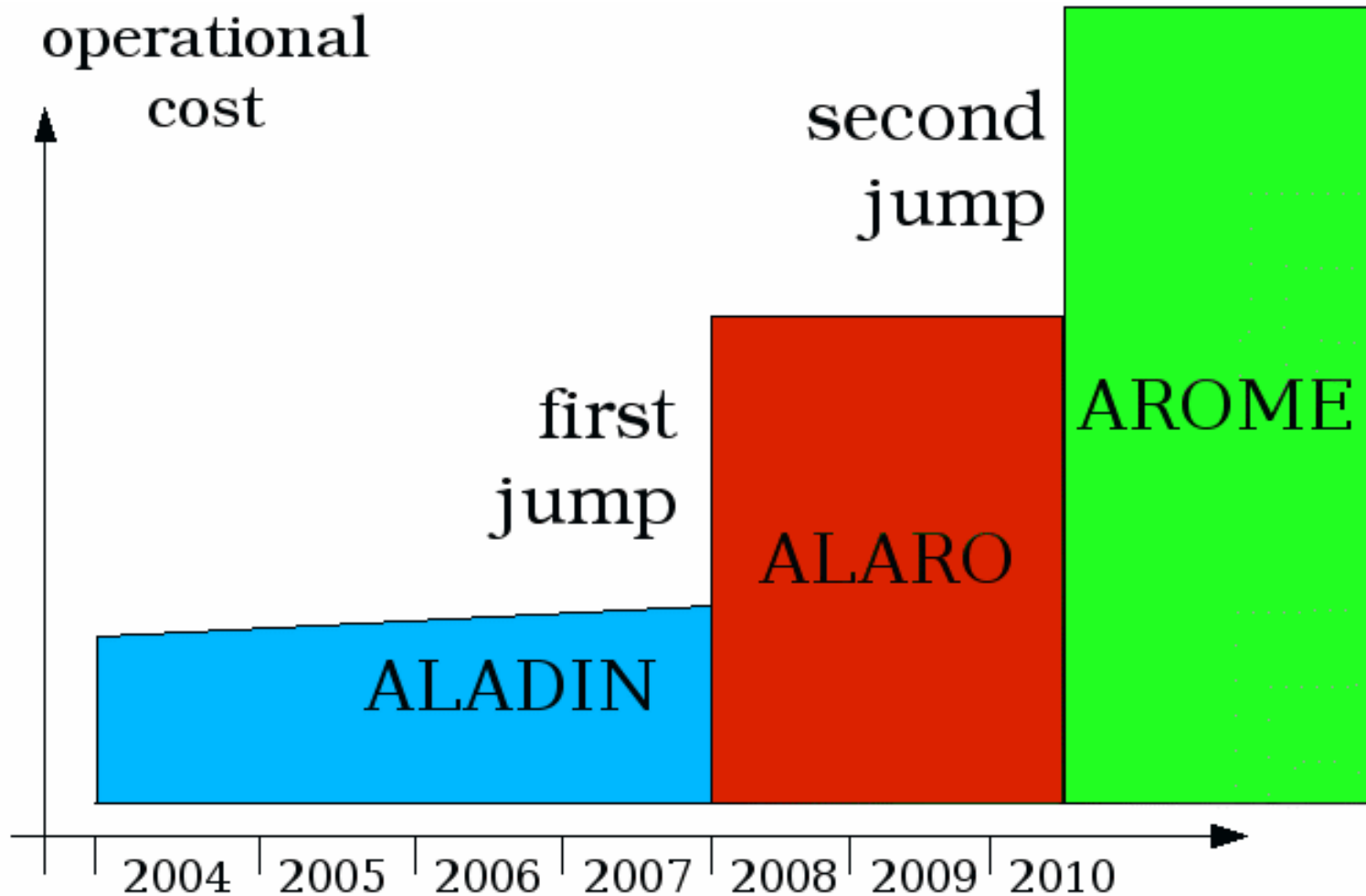


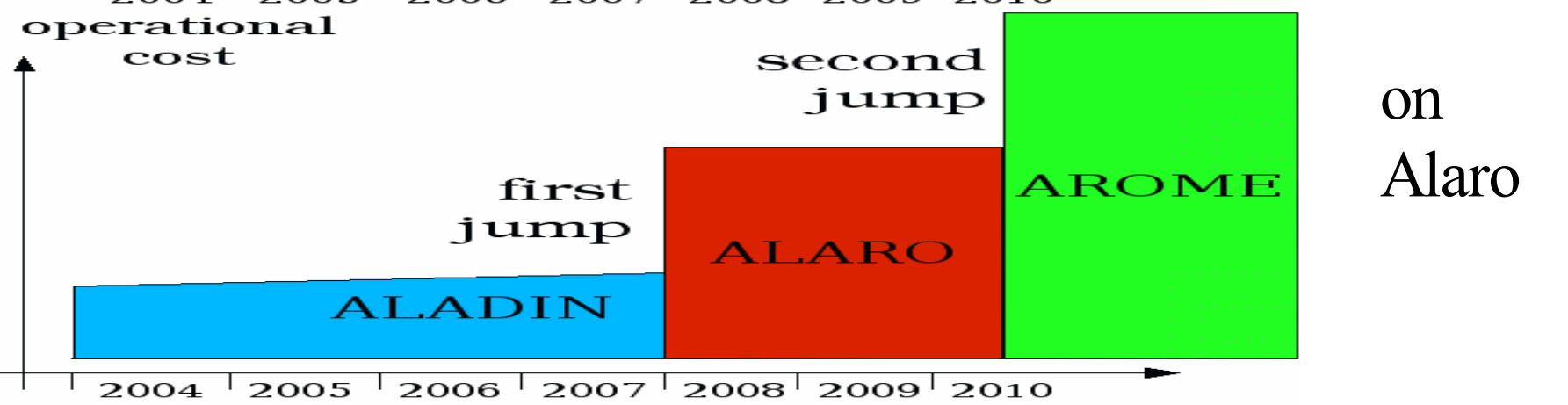
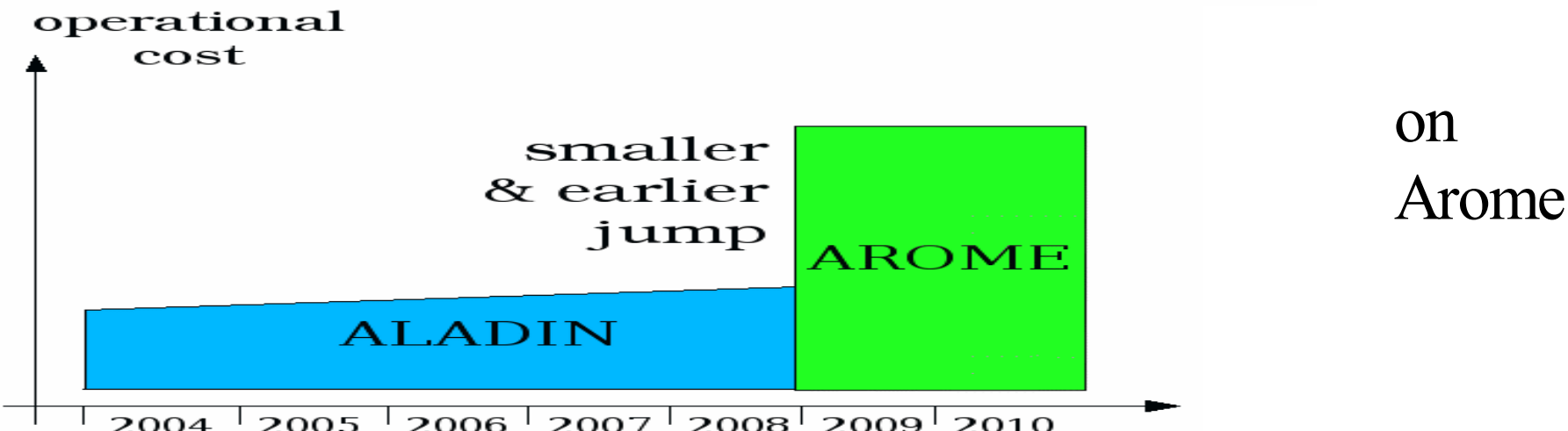
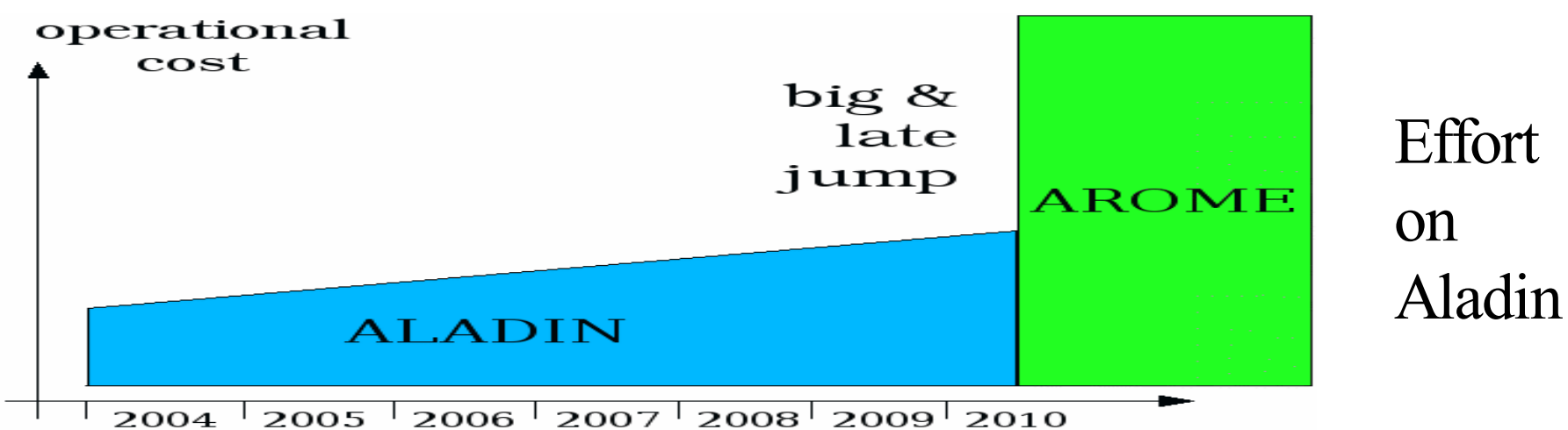
With max effort on Arome:

radically new tool, **best for long term**, Aladin will improve through Arpege/Arome work



With max effort on Alaro:
create a 3rd model to reduce the
'jumps', **best for medium-term.**





The obvious (?) reality

If you invest more into one project, it will become shorter, scientifically better and computationally more efficient.

Manpower is limited: we have to save on some projects to make others work better.