ALADIN : Starting a new networking

Group Report 2003-2004

http://www.cnrm.meteo.fr/aladin/

MAIN EVENTS

A long list ...

last ALATNET seminar

Kiralyret (Hu), 15-17 October 2003
presentations by the Young Researchers
debriefing
discussions about future RTN with SRNWP partners

mini workshop on data assimilation

Budapest (Hu), 20-22 October 2003

8th Assembly of partners

Cracow, 31 Octobre 2003

13th ALADIN workshop

Prague (Cz), 24-28 November 2003
ALADIN applications in very high resolution

A & AAA meetings

Prague (Cz), 12-13 February 2003
trying to clarify the bases of the ALADIN-2 project

closure of the ALATNET project

29 February 2004 for actions, *30 April 2004* for reports
a successful research training network supported by U.E. (5th FP)

training course on ALADIN and NH dynamics

Toulouse (Fr), 15-19 March 2004
ALADIN and HIRLAM "students"

14th ALADIN workshop

Innsbrück (Au), 1-4 June 2004
Which physics for which scales

MAIN EVENTS

A few conclusions

A difficult year indeed !

But an effective launching of a new, more decentralized ALADIN cooperation

Moving towards an enhanced cooperation with the HIRLAM group

Changes in operations

Many ...

Let 's look at national posters !

MAIN RESEARCH ACTIONS IN DYNAMICS

First real case experiments with NH dynamics

→ *Yann' s talk*

Further work on Iterated Centred Implicit (or Predictor/Corrector) schemes

→ *Dijana' s talk*

Chimney problems in NH dynamics

semi-Lagrangian or diffusive ones

inconsistency between Lower Boundary and Semi-Implicit formulations

→ *Dijana' s talk*

Further studies on SLHD

→ *Dijana' s talk*

Exact introduction of diabatic forcing in NH dynamics

relaxing the projection of diabatism on hydrostatic modes

i.e. using : $\frac{dp}{dt} = -\frac{c_p p}{c_v} D_3 + \frac{\boldsymbol{Q\ p}}{\boldsymbol{c_v T}}$; $\frac{dT}{dt} = -\frac{RT}{c_v} D_3 + \frac{Q}{\boldsymbol{c_v}}$ (1),

exact,
simpler,
consistent the definition of NH variables and the continuity equation

instead of : $\frac{dp}{dt} = -\frac{c_p p}{c_v} D_3$; $\frac{dT}{dt} = -\frac{RT}{c_v} D_3 + \frac{Q}{\boldsymbol{c_p}}$ (2).

designed to limit the generation of acoustic waves

Tests on academic and real cases :

➔ both solutions converge very quickly

➔ initial differences are small, but fields look more sensible with (1)

Impact of the mapping factor on the stability of SI schemes

hardly any in hydrostatic dynamics (orographic instability slightly enhanced)

real stability problems in NH dynamics

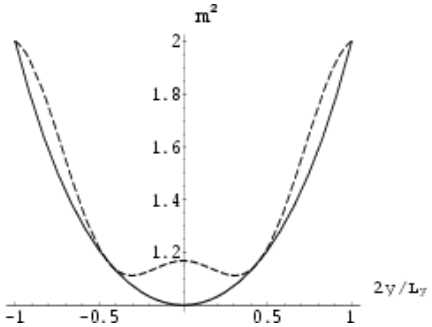
even without orographic forcing
m is described by a constant (maximum) in the SI model
important for large domains

a temporary solution ?

new variable for divergence : $\boldsymbol{d' = d / m^2}$
allows $\boldsymbol{m} < 1.2$ in an academic framework

another solution :

rotated Mercator geometry
use of a 2nd degree approximation and a pentadiagonal matrix in SI



SOME PROGRESS ON COUPLING PROBLEMS

To avoid missing rapidly moving systems

Further successful tests of spectral coupling

details in the Romanian poster

Introduction of a warning index in the coupling model

based on a high-pass recursive filtering of *ln(Ps*)

new fields available in coupling files

already coded, experimentation soon

details in the Belgian poster

Piet Termonia, MWR, 132

Resuming work on transparent boundary conditions in a spectral model

PhD thesis just starting

WHICH PHYSICS FOR WHICH SCALES ?

1. Framework

The main topic of the 14th ALADIN workshop (Innsbrück, 1-4 June 2004)

A crucial question of the ALADIN-2 project,

since trying to develop quasi-simultaneously "new", improved, physics

for LAM NWP applications for scales in the range :

2 - 3 km

4 - 7 km

≥ 8 km

while converging with that of climate applications in the global coupling model (ARPEGE) !

WHICH PHYSICS FOR WHICH SCALES ?

2. Strategies

Available ingredients :

1 . operational set of parameterizations
*(validated in NWP mode at the present scales : ≥ **8 km**)*

2 . on-going developments in NWP framework
*(evaluated in NWP mode at the present scales and below : ≥ **4 km**)*

3 . physics developed for very high resolution in research models
*(Meso-NH here, validated in research mode for fine scales : **2-3 km**)*

4 . new, external, ideas
from anywhere !

5 . test-beds to investigate the impact of increasing resolution on the behaviour of each parameterization
e.g. ALPIA

Methods :initial choices

2 - 3 km : the "AROME" prototype
jump directly to **3** (concepts and code)
*successful according to the first tests, ... **(Yann's talk)***

4 - 7 km : the "ALARO-5" guidelines
start from **1** and **2**
add concepts from **3** and **4**
use whenever possible **5**
*cf developments in orographic forcing, radiation, ... **(Neva's talk)***

≥ 8 km : the "ALARO-10" prototype
jump directly to **3** (concepts and code)
and just add a convection scheme *(KFB)*

WHICH PHYSICS FOR WHICH SCALES ?

3. First results with the ALARO-10 strategy

after ~3 person×year of work on prototypes

4 situations carefully examined up to now

cost increase between ALADIN and the ALARO-10 prototype : ×2.8

4. A new strategy for scales around 10 km

Similar strategy as for the so-called "grey zone"

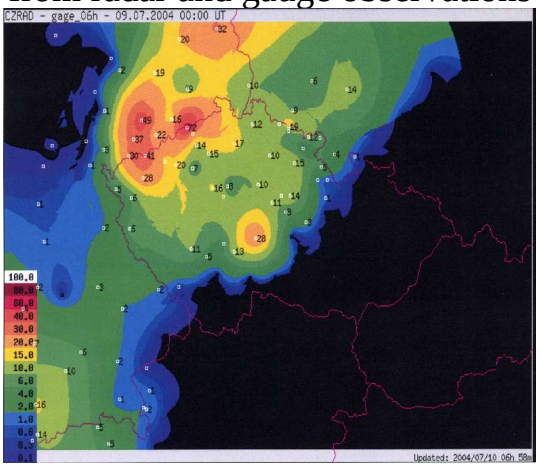
Progressive improvements of the present parameterizations, with the introduction of innovative concepts (from Meso-NH and elsewhere)

Divergence with large-scale physics (global model)

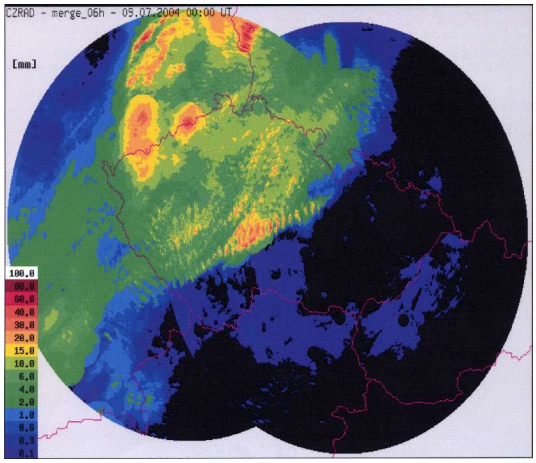
Situation : 09 July 2004 00 UTC
an intense cold front with severe precipitations in Central Europe

observed cumulated rainfall 08/07/04 18 UTC – 09/07/04 00 UTC

from radar and gauge observations

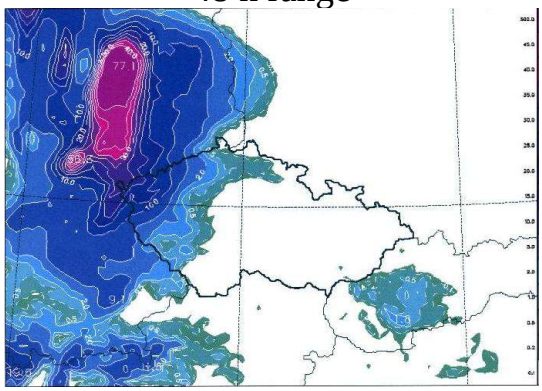


from radar observations

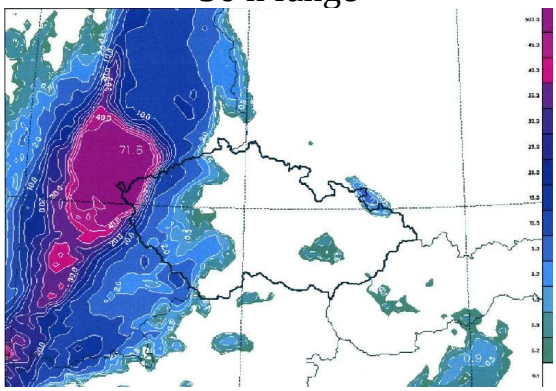


corresponding operational ALADIN-CE forecasts

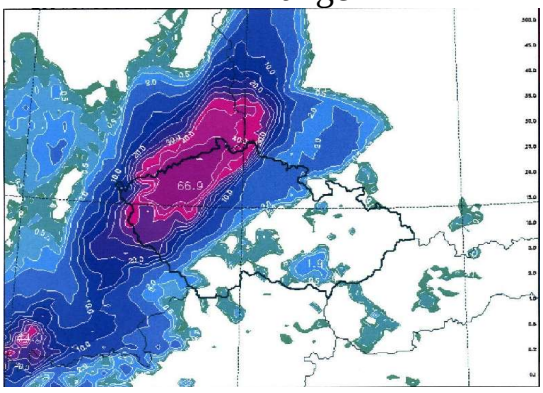
48 h range



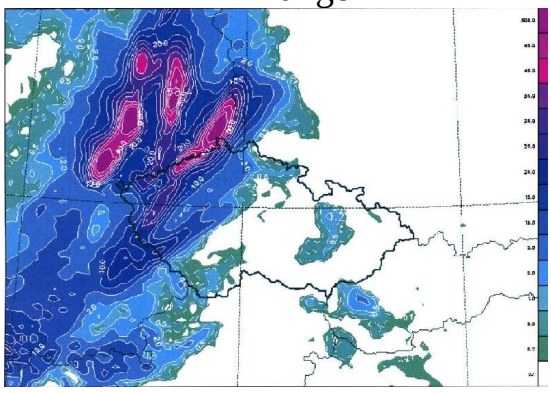
36 h range



24 h range



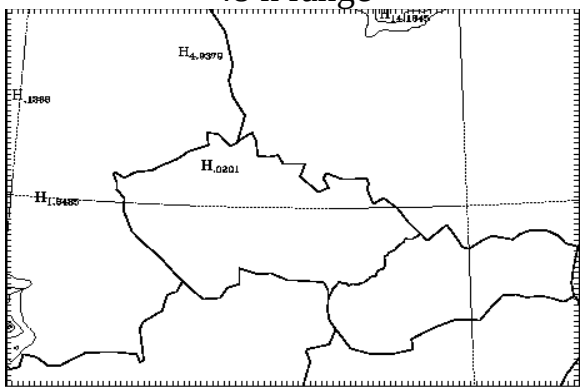
12h range



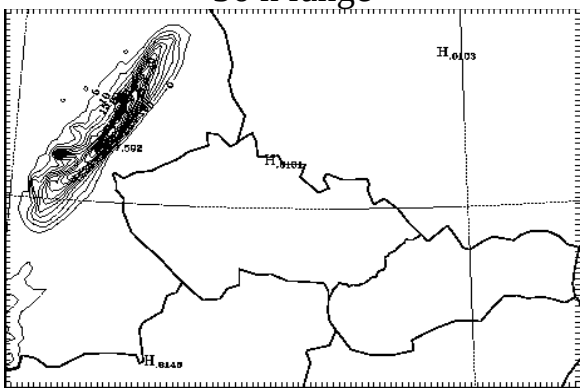
Δx = 9 km with a linear spectral truncation, 43 levels in the vertical, ***Δt = 360 s***

corresponding ALARO-10 ...

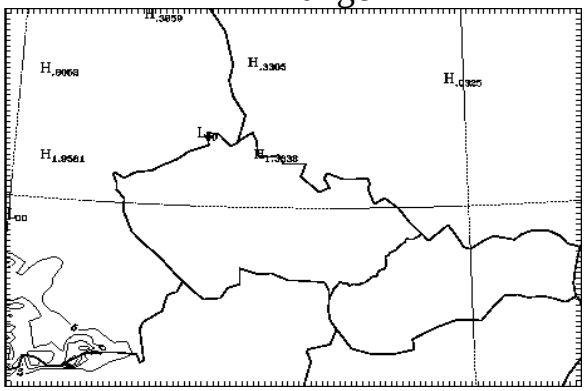
48 h range



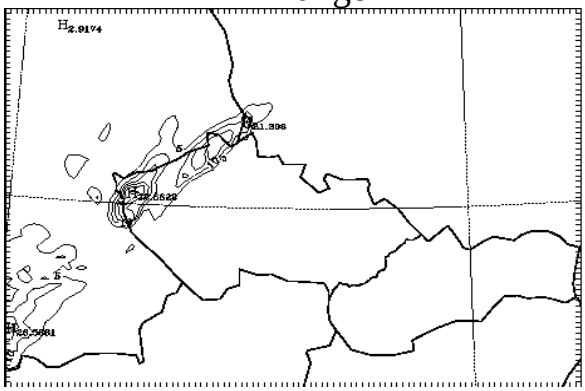
36 h range



24 h range

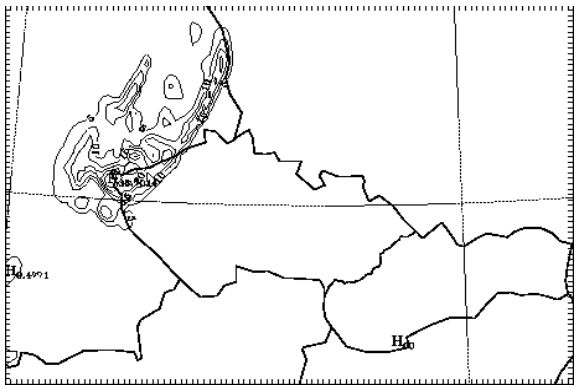


12h range



... and Meso-NH simulations

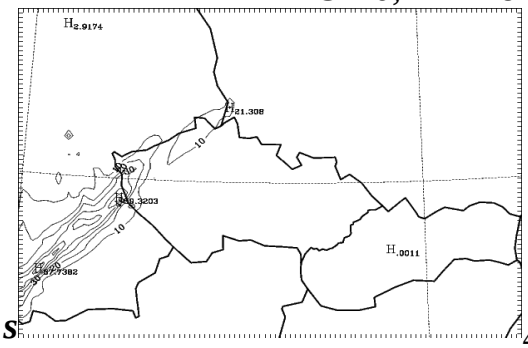
12h range



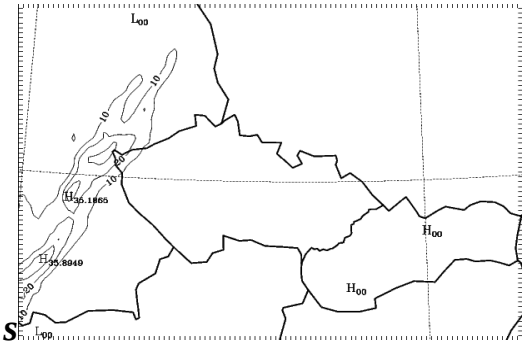
Δx = 9 km with a linear spectral truncation, 41 levels in the vertical, ***<u>Δt = 60 s</u>***

ALARO-10, 12 h forecast, cumul over 12 h

Δt =60 s



Δt =300 s



WHICH PHYSICS FOR WHICH SCALES ?

5. Key of success : a flexible physics-dynamics interface

Equations :

the most general ones !

"for a complex micro-physics with prognostic equations for falling condensates"

use of a barycentric system for the whole mass of a given layer

→ all sub-grid scale fluxes as treated as diffusive ones

ok at least for ARPEGE/ALADIN and Meso-NH physics ☺

Transparent to :

semi-Lagrangian options (*position in space of the forcing "along the trajectory"*)

time-stepping (*position in time inside the time-step, "before or after dynamics"*)

sequential or parallel call to individual parameterizations

"δm option" (*total mass conservation or modification by surface evap. - precip.*)

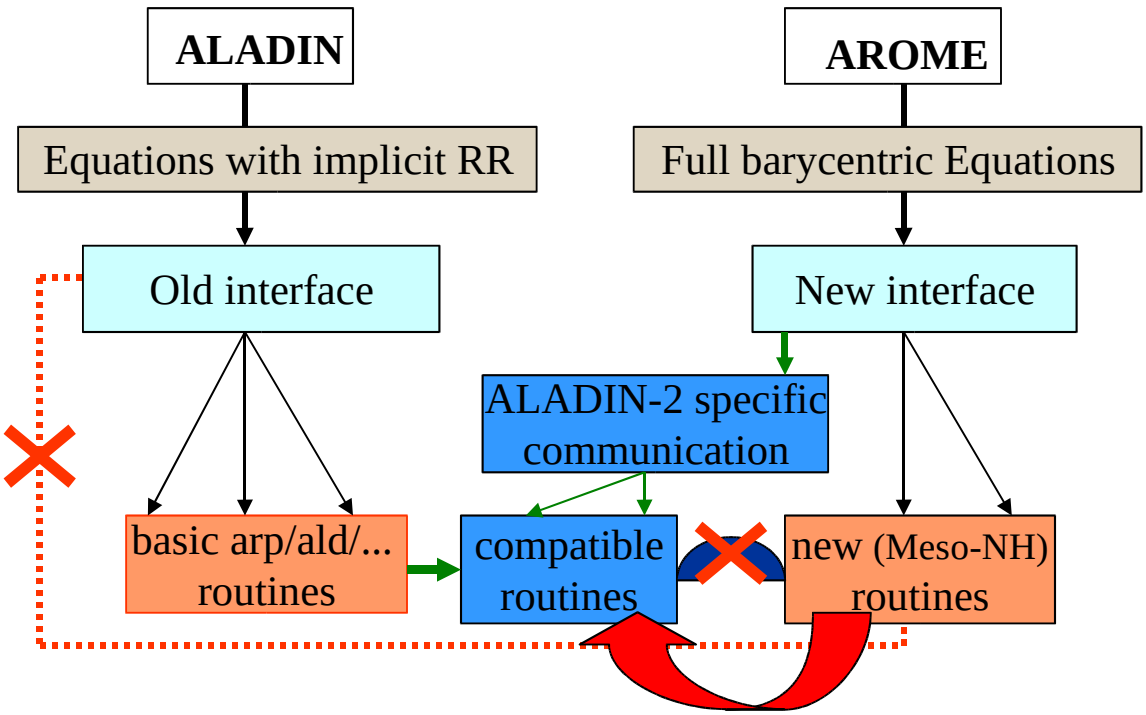
"exact" versus "classical quasi-hydrostatic" **projection of diabatic forcing** in NH

...

When ?

Dedicated workshop in Prague, 22-26 November 2004 !

A practical proposal for ALADIN-2



3D-VAR

1. Cycling

Still evaluating various choices :

standard coupling (to analyses)

explicit or dfi blending → *blendvar* and *varblend*

→ *Dijana' s talk*

in combination with various Jb formulations

A new proposal : the Jk cost function

a new formulation of the error vector,

considering the projection of the large-scale analysis onto a subspace

$$\begin{pmatrix} x^b - x^t \\ y - H(x^t) \\ H_1(x^{AA}) - H_2(x^t) \end{pmatrix}$$

a generalized covariance matrix

$$W = \begin{pmatrix} B & E(\varepsilon^b \varepsilon^{o\mathrm{T}}) & E(\varepsilon^b \varepsilon^{k\mathrm{T}}) \\ E(\varepsilon^o \varepsilon^{b\mathrm{T}}) & R & E(\varepsilon^o \varepsilon^{k\mathrm{T}}) \\ E(\varepsilon^k \varepsilon^{b\mathrm{T}}) & E(\varepsilon^k \varepsilon^{o\mathrm{T}}) & V \end{pmatrix} \approx \begin{pmatrix} B & 0 & E(\varepsilon^b \varepsilon^{k\mathrm{T}}) \\ 0 & R & 0 \\ E(\varepsilon^k \varepsilon^{b\mathrm{T}}) & 0 & V \end{pmatrix}$$

$$J(x) = J_b(x) + J_o(x) + J_k(x)\,,$$

$$J_k(x) = (H_1(x^{AA}) - H_2(x))^T\, V^{-1}\, (H_1(x^{AA}) - H_2(x))\,,$$

neglecting non-diagonal terms

evaluation using ensemble statistics in ALADIN-France :

→ **the first experiments are promising**

3D-VAR

2. Jb

Many aspects addressed :

β-plane formulation

further evaluation of ensemble statistics and comparison to NMC ones

details in the French poster

new wavelet formulation

details in the Belgian poster

...

3. Jo

Refinements in the use of "classical" observations in LAMs :

new bias computation for ATOVS, sensitivity experiments in Hungary

details in the Hungarian poster

Use of MSG-SEVIRI data

high resolution information on temperature and humidity

positive impact in 3D-Var assimilation

details in the French poster

Work on radar reflectivities started

3D-VAR

4. Var-Pack

Use of 3D-Var and surface observation for diagnostic analyses

To replace Diag-Pack, based on O.I.

Some changes required for 3D-Var :

retuning of background error statistics
(increase of standard deviations in the lowest levels)

modification of surface temperature (gridpoint, not directly handled)
(shift of the vertical profile between surface and the last level)

Promising evaluations

details in the Bulgarian poster

5. Pre-operational tests

In Hungary, France, Morocco ...

Individual choices, described in posters

OTHER IMPORTANT ISSUES

Predictability studies

→ *Andras' talk*

MAP downscaling

→ *Yong's and Stjep's talks*

Common verification project

Started !

Slovenian team as project leader

→ *Dijana' s talk*

Code optimization and portability