Status of AROME
news since Bratislava '05

based on contributions from CNRM GMAP & GMME teams,Lab. Aérologie, aladinists

1. System & workforce
2. Model & software
3. Assimilation
4. The Future

METEO FRANCE

1. Multiscale NWP in 2007/2008

AROME on small domains
resolution 2.5km
forecast ranges 1-24h + nowcasting

coupling

ALADIN/ALARO on big domains
resolution close to 10km
forecast ranges 6-48h + ensembles

coupling

ARPEGE global
resolution 15km (T539)
ranges up to 3 days +
ensembles

ECMWF's IFS
resolution 25km,
up to 7 days + ensembles

2
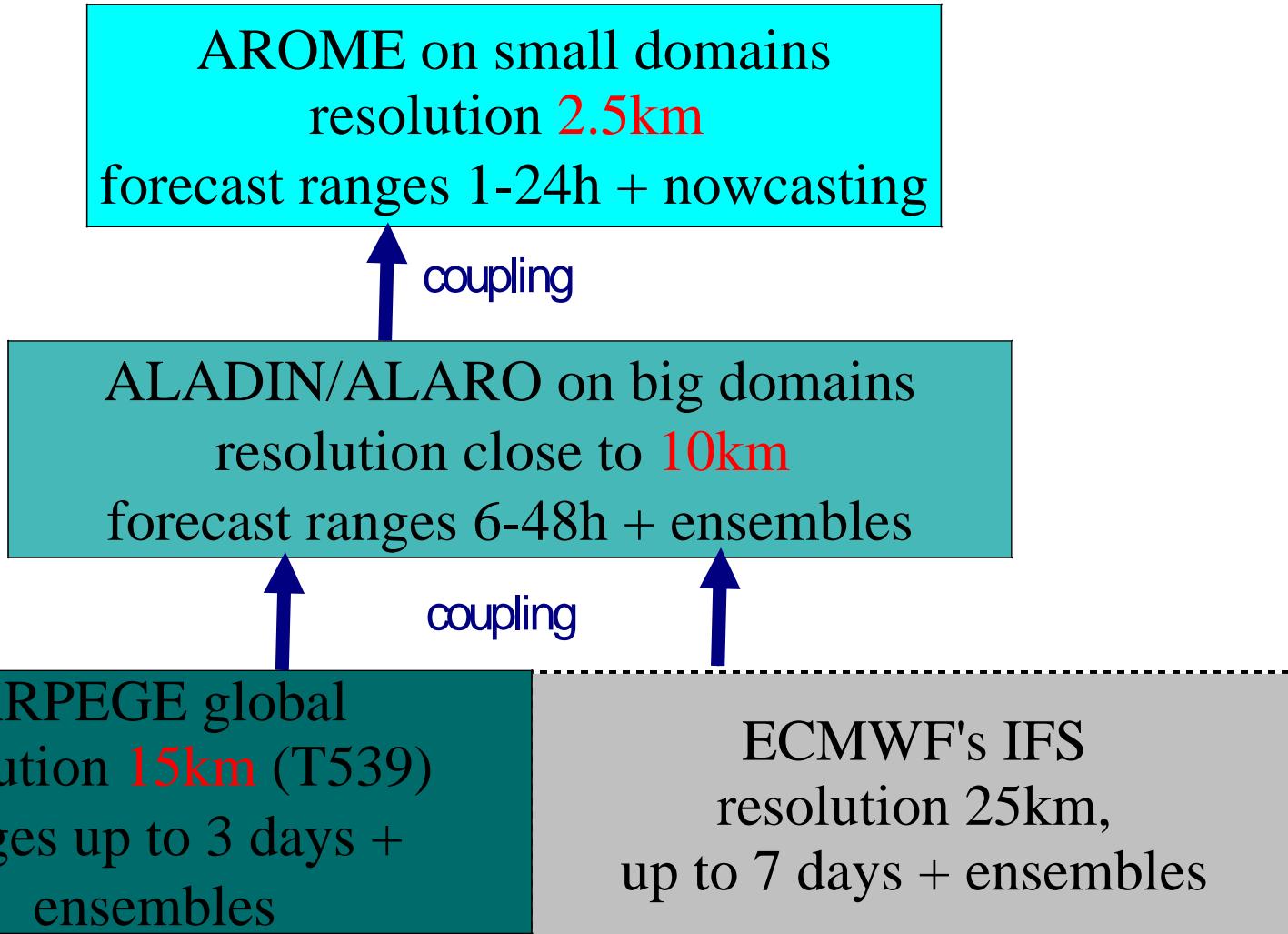
ARPEGE forecast quality, lately
in 2006: L46, much improved radiation & clouds
### *(see Y. Bouteloup's talk)*

erreurs

Erreur Quadratique Moyenne de prévision à 72 heures
par rapport aux radiosondages
GEOPOTENTIEL à 500 hPa - Domaine EUROPE
Moyenne glissante sur un an (M-5 à M+6)

Pays

- FRANCE
- UKMO
- CMC
- DWD
- ECMWF
- NCEP
- JMA
- TROPIQUES

France

temps

En Mètres

2002   2003   2004   2005   2006
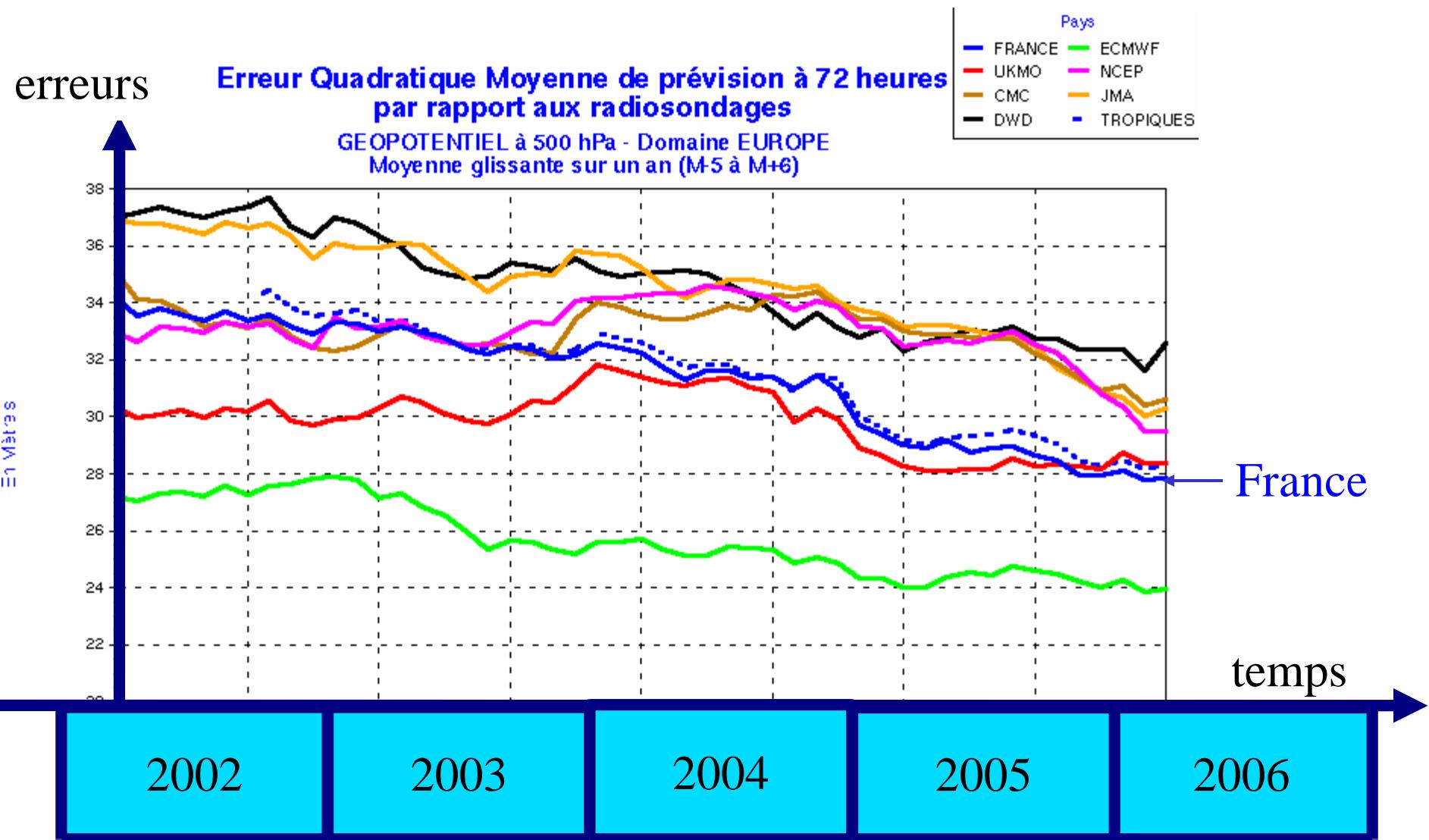
No global model is always the best

erreurs

Erreur Quadratique Moyenne de prévision à 72 heures par rapport aux RADIOSONDAGES
Géopotentiel à 500 hPa - Domaine EUROPE

Pays
- FRANCE
- UKMO
- PTRO
- ECMWF
- DWD

best: France

best: ECMWF

best: France

temps

mars 2006

avril 2006
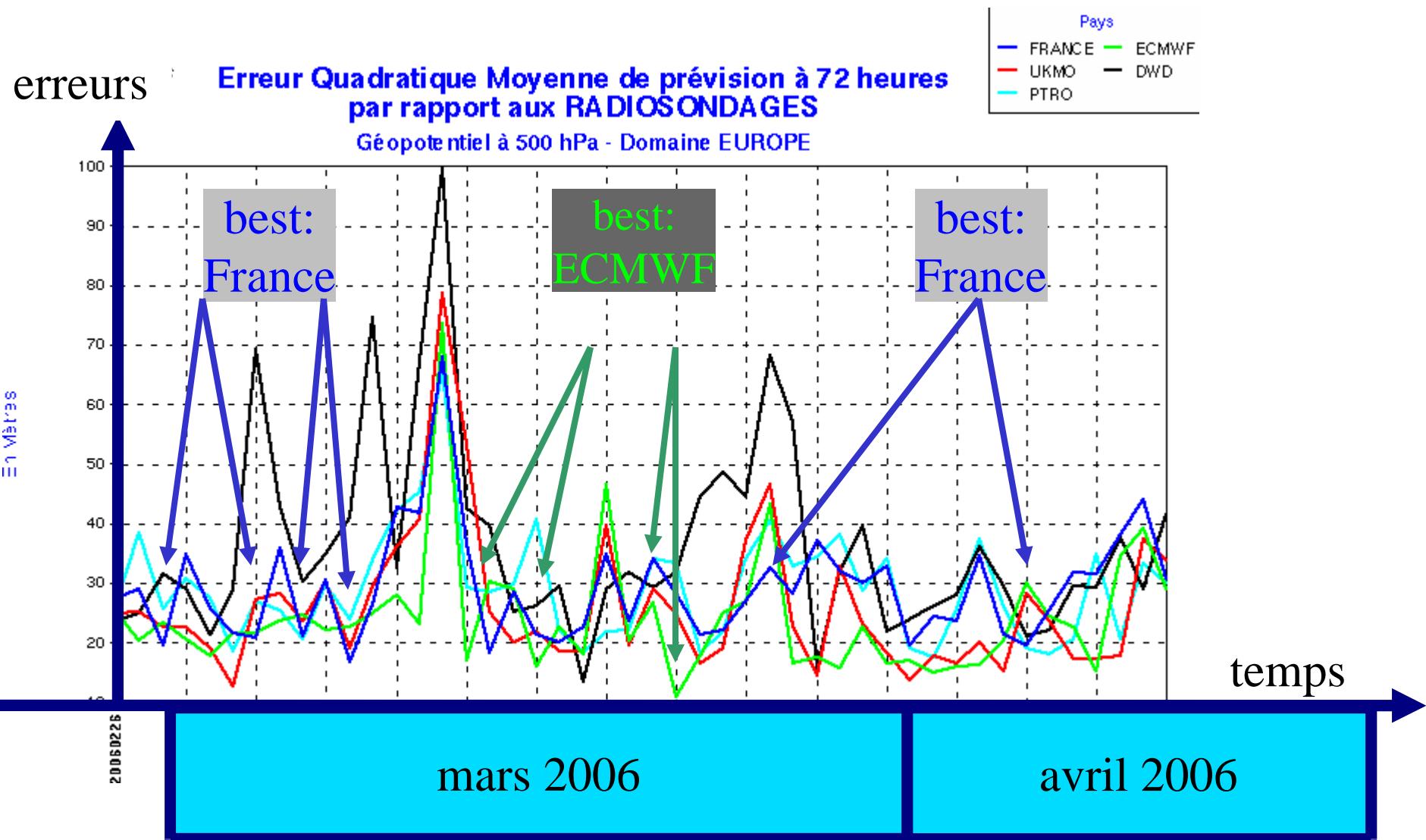
System & workforce

- Arome NWP-oriented modelling: mostly in **GMAP** team: embedding (clim files, 927, postprocessing, DDH diags, Surfex interfacing, APLXXX interface), case studies with forecasters. *see talk by G. Hello & JD. Gril, T. Kovacic*

- Arome **assimilation**: common with ALADIN 3DVar, plus radar work.

- Arome **upstream R&D**: mostly in GMME. Current priority on improving clouds (shallow convection, 3MT, fog) and SURFEX. *see talks by S. Malardel, E. Martin, L. Kraljevic*

- **the rest of NWP in Toulouse**: roughly 10% on ARPEGE/ALADIN, 10% on AROME/MésoNH, 80% on transversal activities (software, assimilation, Aladin support) - *see P. Pottier's statistics and Aladin web site*

- **Aladin partners**' contribution: NH cleaning, code phasing, phys/dyn interfacing. Most Aladin work is good for Arome. *e.g. see talk by J. Vivoda*

- Increasing **deported testing** of Arome in several Aladin & Hirlam centres (Denmark, Sweden, Finland, Norway, Hungary, Austria, Czech Rep...) *see talk by L. Kullmann*

METEO FRANCE
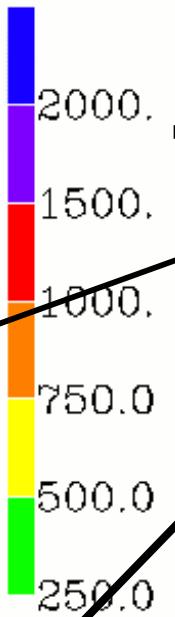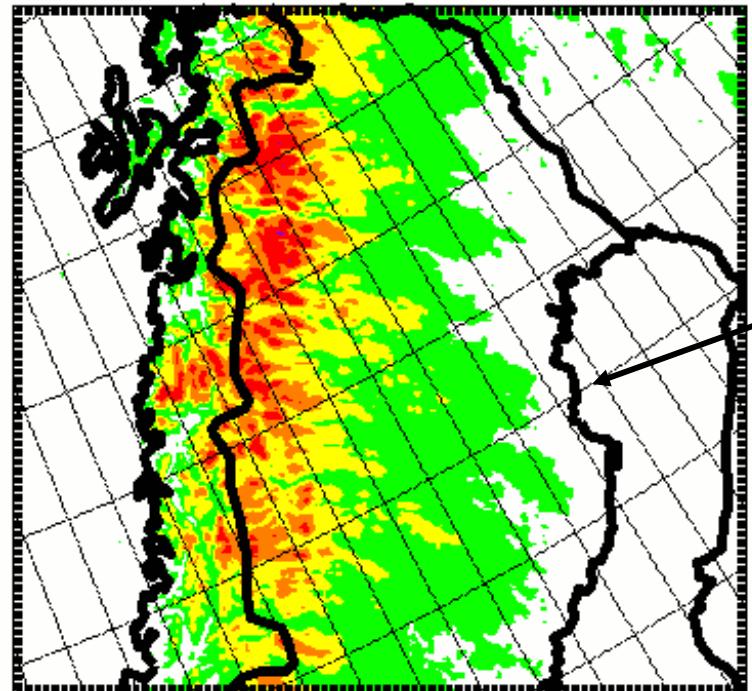
Sweden : 270x288, 2.5km, ?L
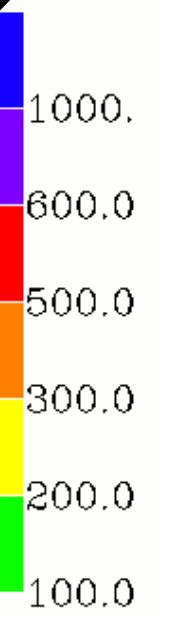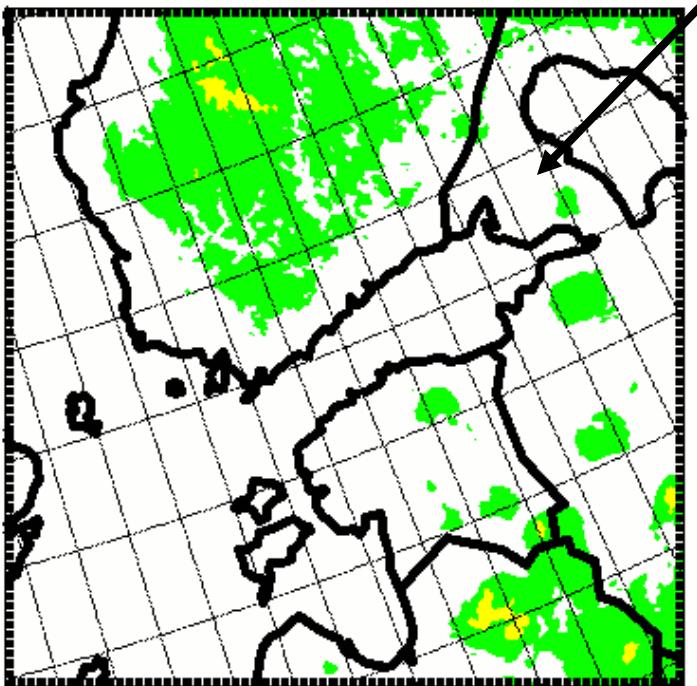
Finlande : 384x324, 2.5km, ?L
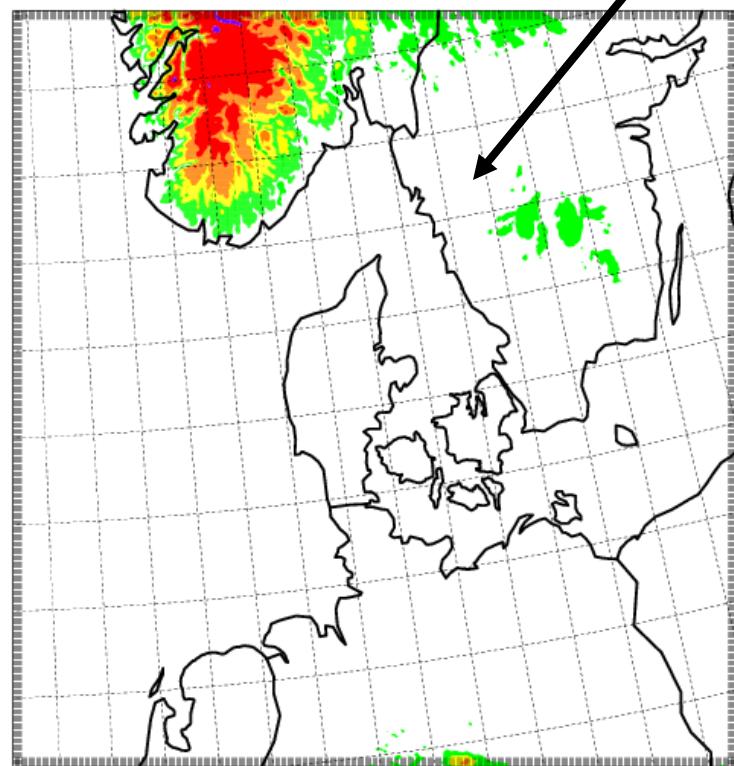
Danemark : 400x384, 2.5km, ?L
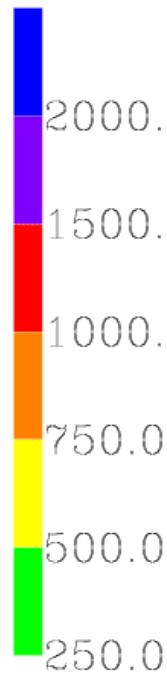
*Hungary (Laszlo Kullmann)*:

on IBM regatta at Budapest.
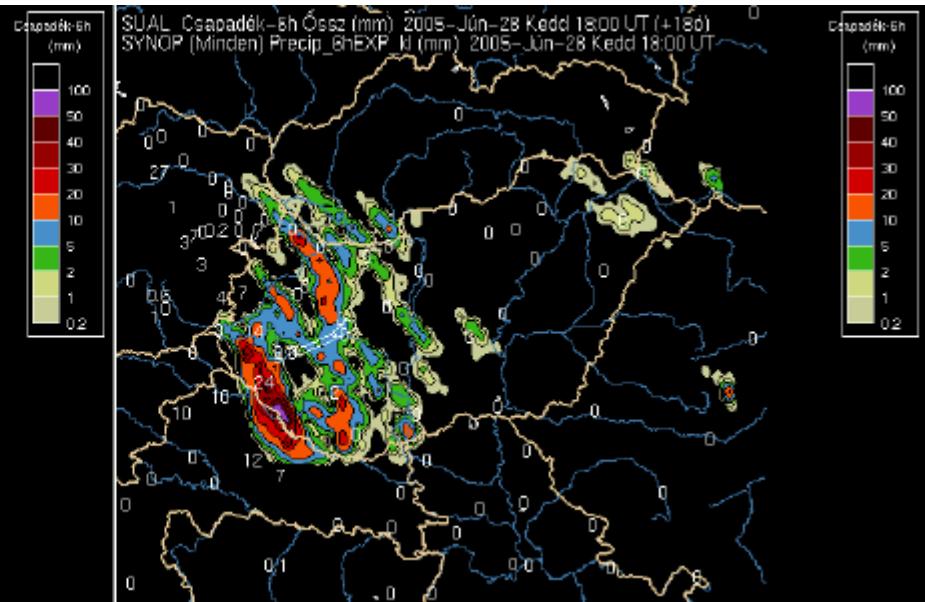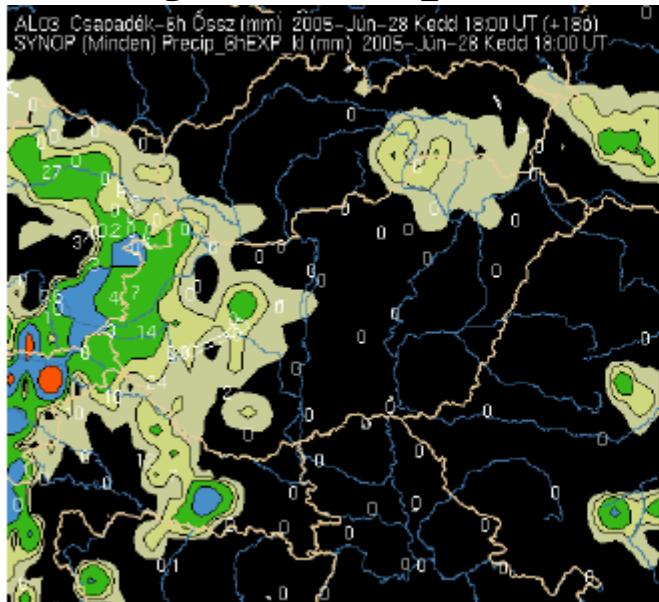
2. Model work

- **Prototype** is fully included in the joint cycles (with MésoNH & SURFEX bits) and available at ECMWF (gmkpack) *see talk by Ryad El Khatib*

- **One year of successful daily runs** over various weather types, tests on ocean, T1 storm, snowstorms, AMMA, precipitation studies...

- **Thematic studies** on fog, ocean fluxes, wind power, shallow clouds, snowfalls, mountain weather

- activated use of **SLHD** (still tricky dyn in deep valleys)

- activated **subgrid cloudiness**

- activated **KFB shallow convection** (still needs improvement)

- developed **flux budget diagnostics, Arome FullPOS**,

- developed **full interactive chemistry, dust & aerosols** option

- **bugfixes** on soil initialization, physiographies, NH cleaning

METEO FRANCE

# Resolved convection in Arome (04-08-94, 15 à 18h UTC)
couleurs: glace, eau nuageuse, pluie
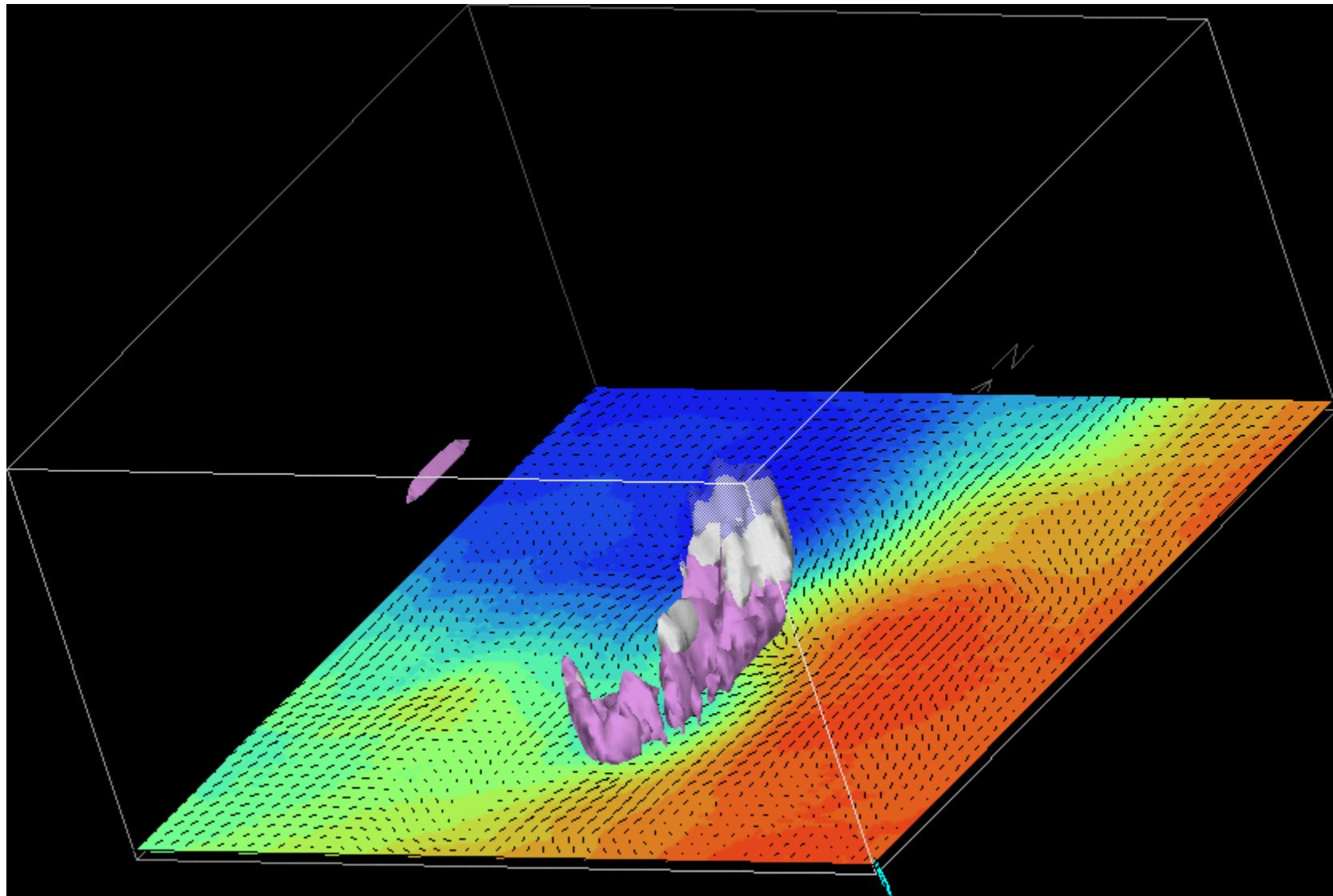
# Winter synoptic weather: ALADIN (top) vs AROME (bottom)

radar

mm/h
20.00
10.00
6.300
4.000
2.500
1.600
1.000
0.500
0.100

METEO FRANCE
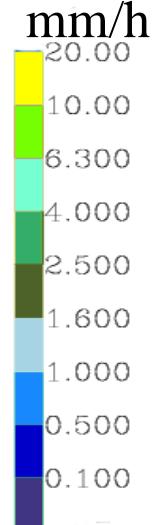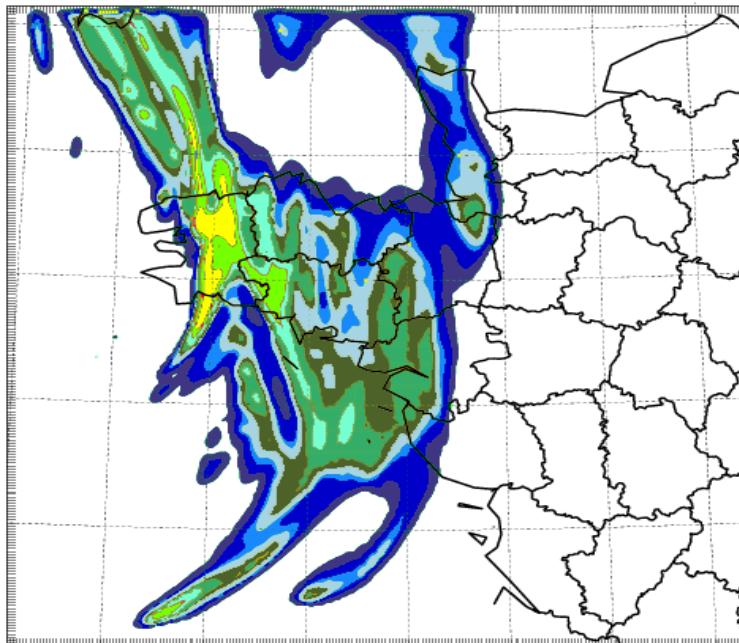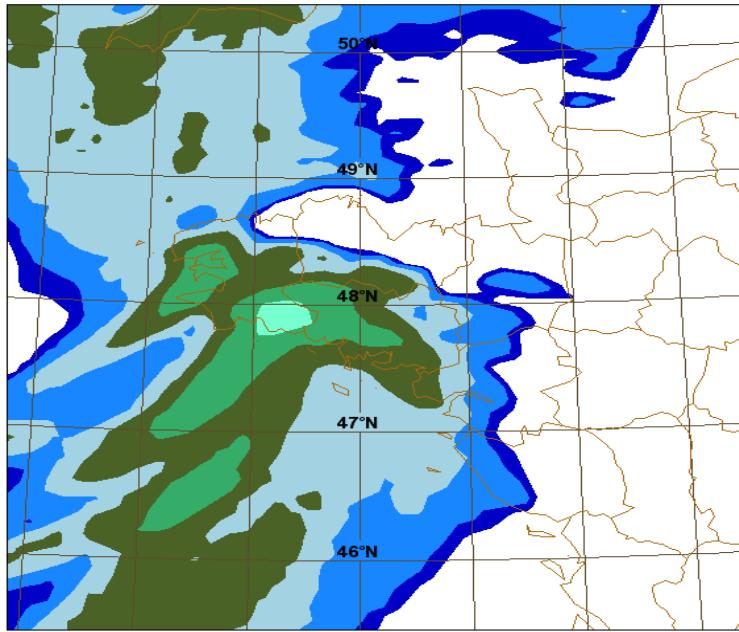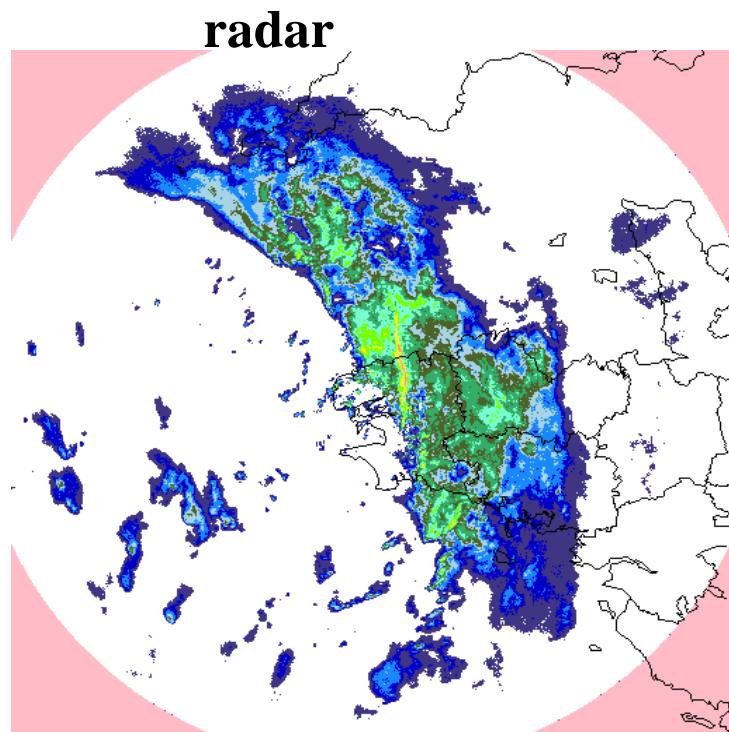
Real-time AROME forecast of isolated thunderstorm (27/6/2005)

Pluies vues par les radars
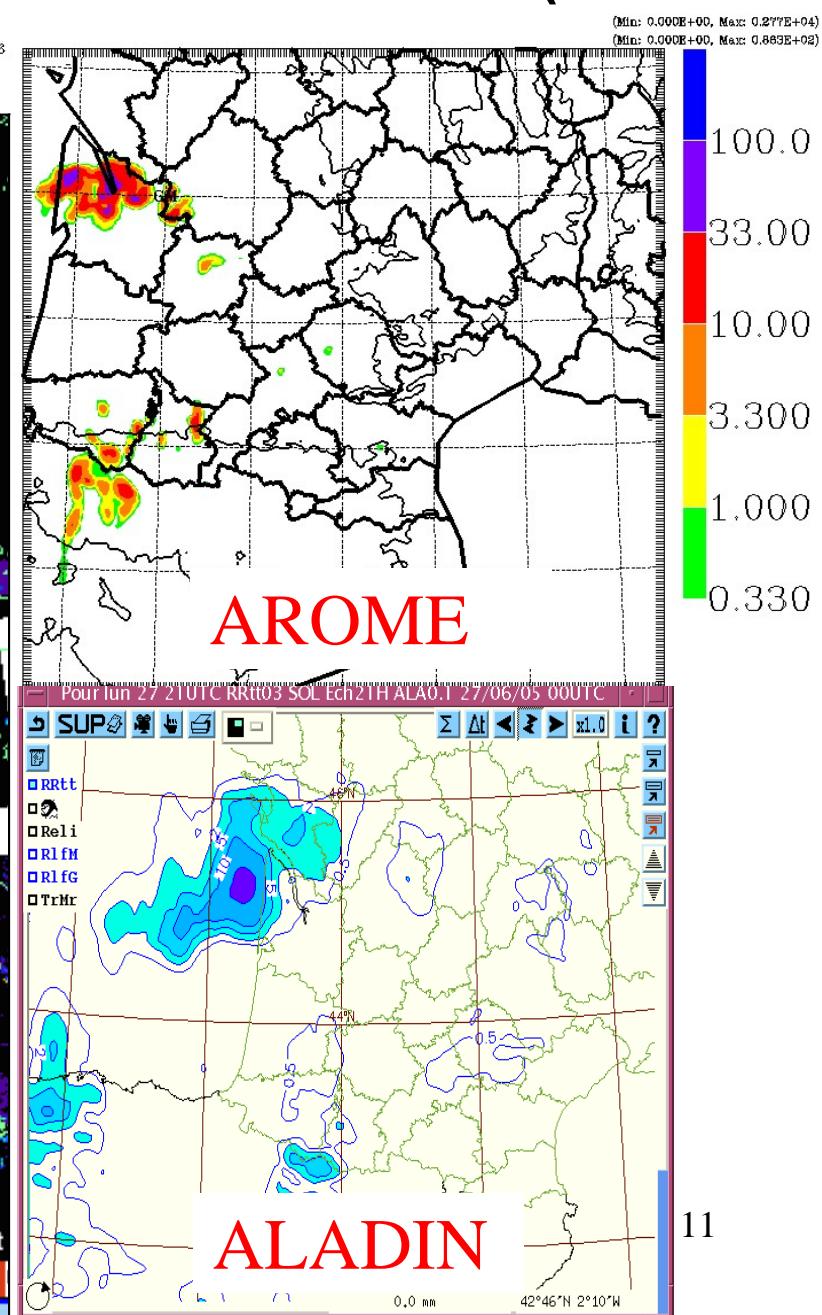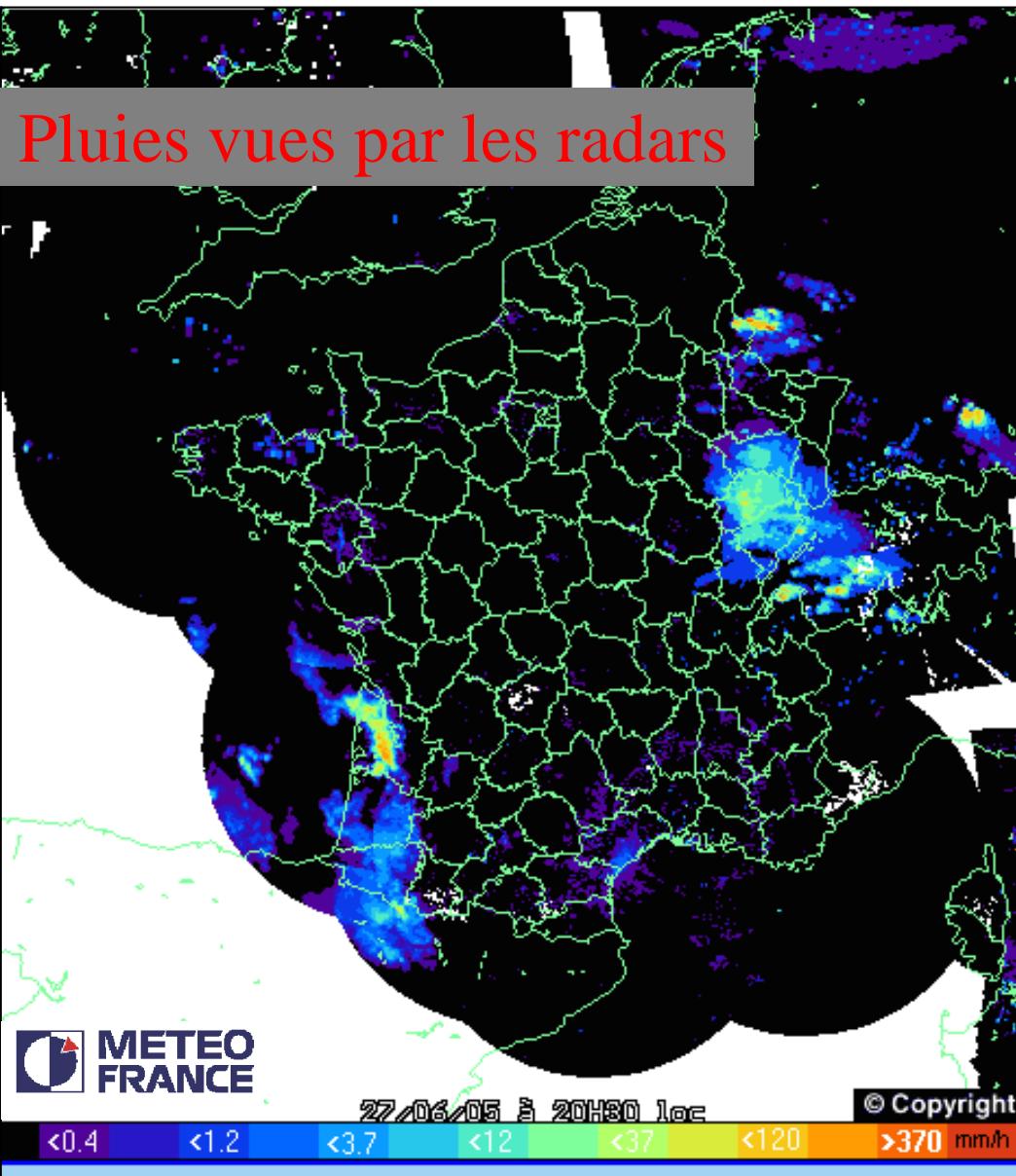
AROME

ALADIN

Mediterranean flash flood event on 6/9/2005

prévision ALADIN

prévision AROME

observations raingauges

observations radar

METEO FRANCE
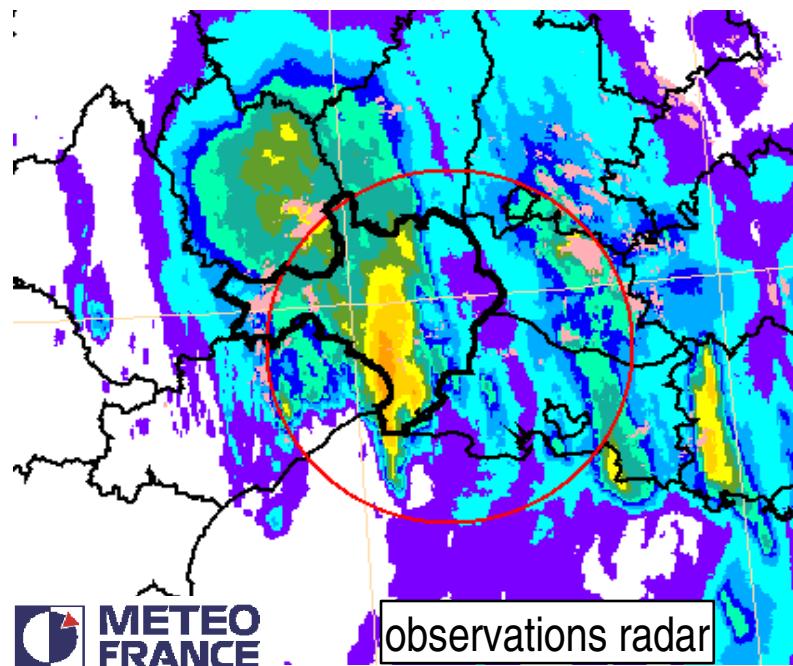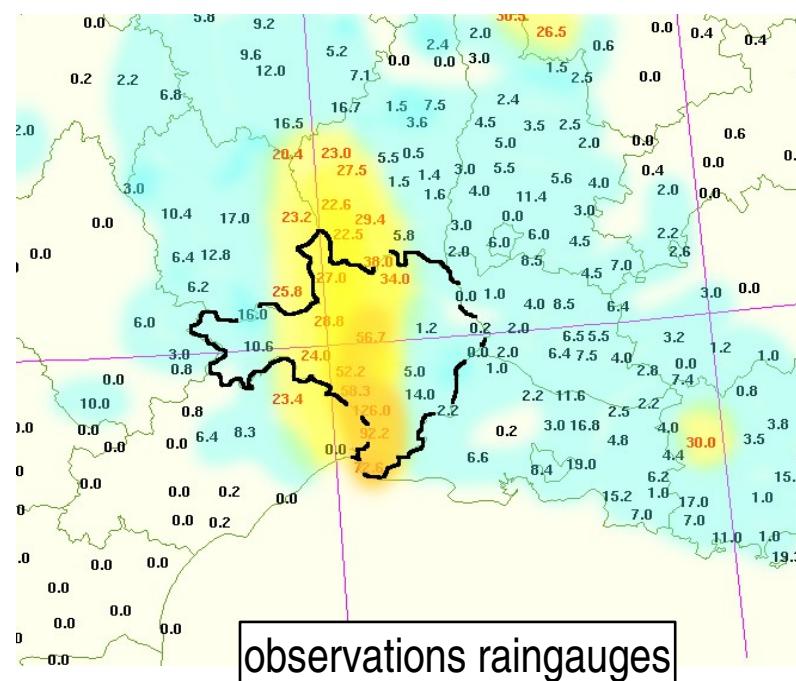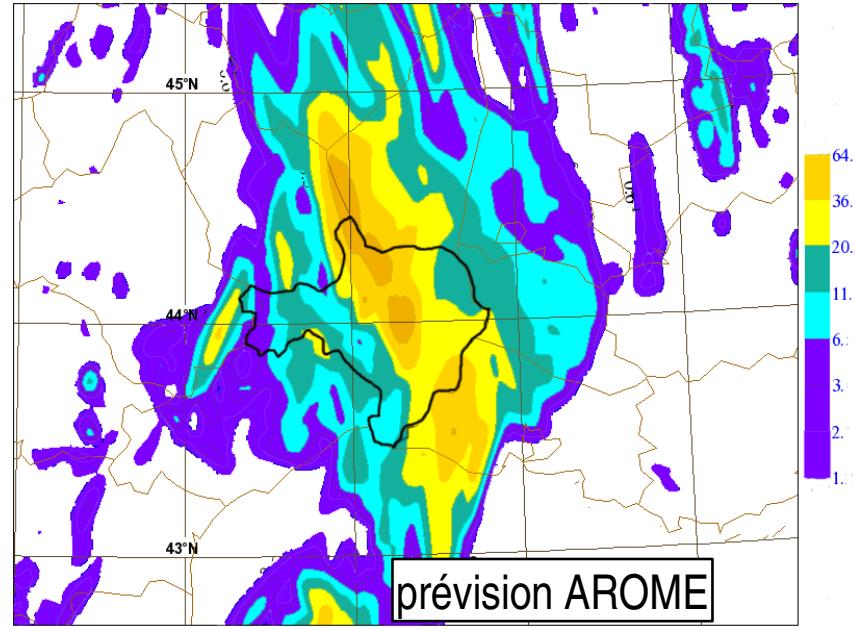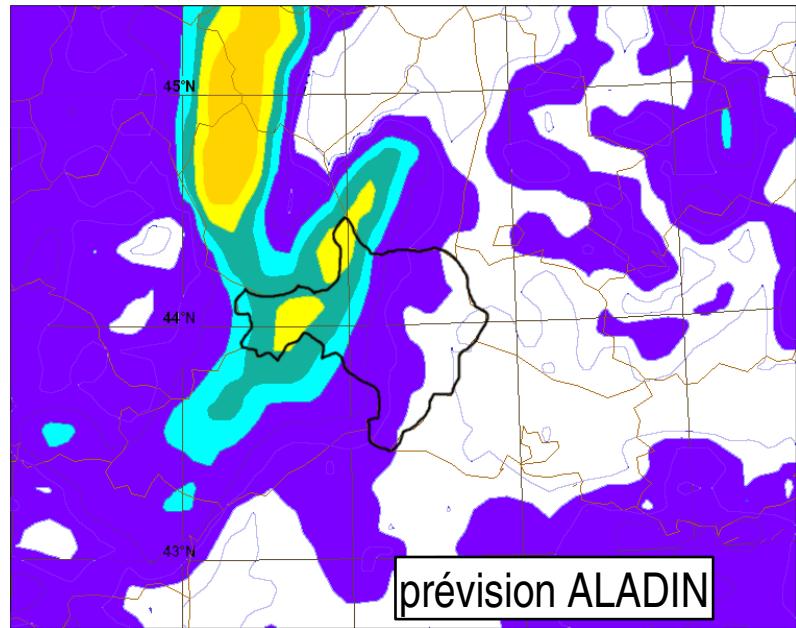
Verification:
Hydrological
validation

1-month
precip over
Austria
(work done
with ZAMG)

Observations

Prévisions
ALADIN

CENSORED !

see talks by
E. Bazile & T. Haiden

Prévisions
AROME
(prototype)

METEO
FRANCE
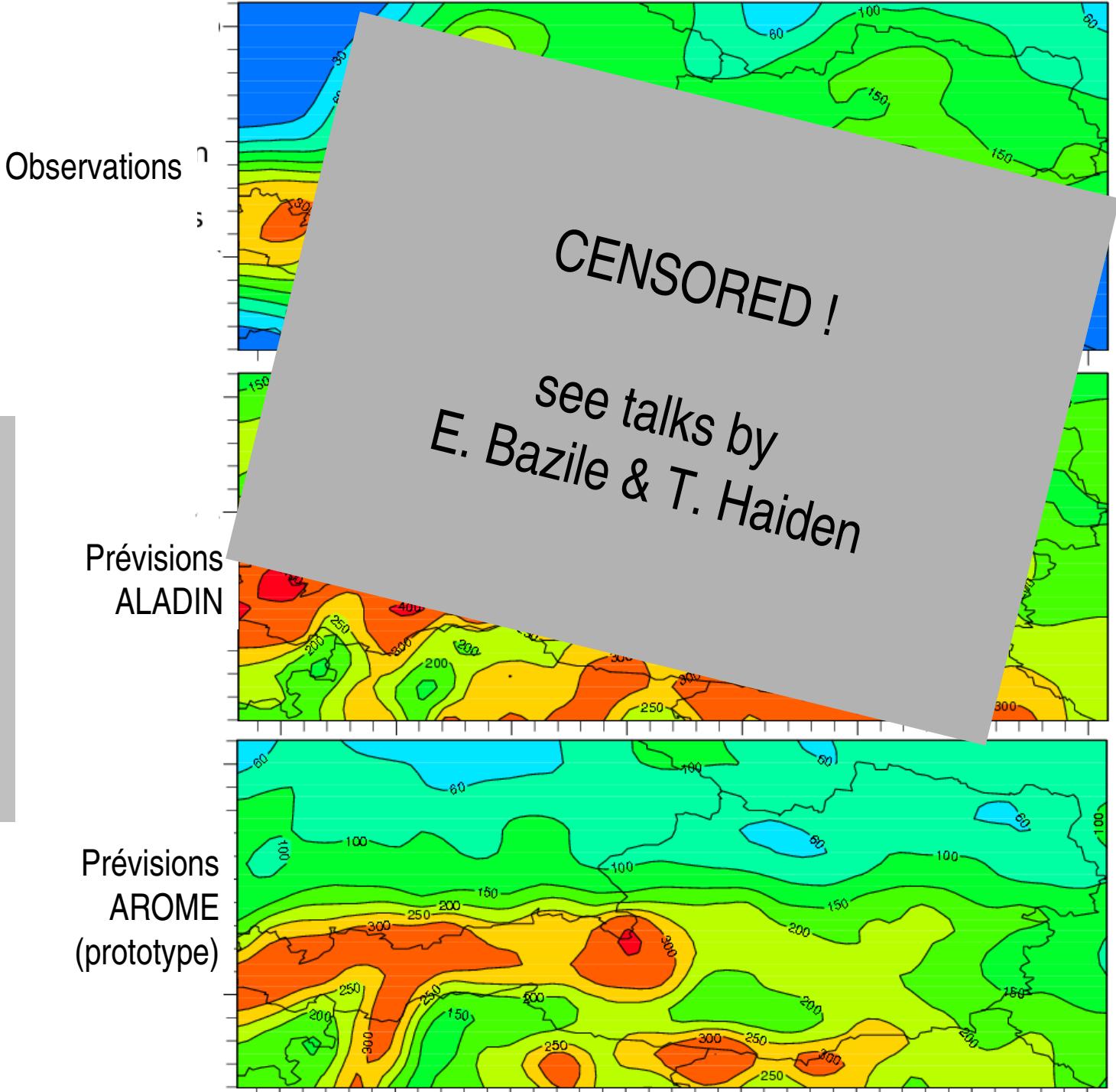
T2m validation on ALADIN (left) and AROME (right)

Aladin 2006041300+1200 T2m (C) & V10m

Aro 2006041300+1200 T2m (C) & V10m

Obs 2006041300+1200 Obs T2m (C)

Montpellier

vérité terrain
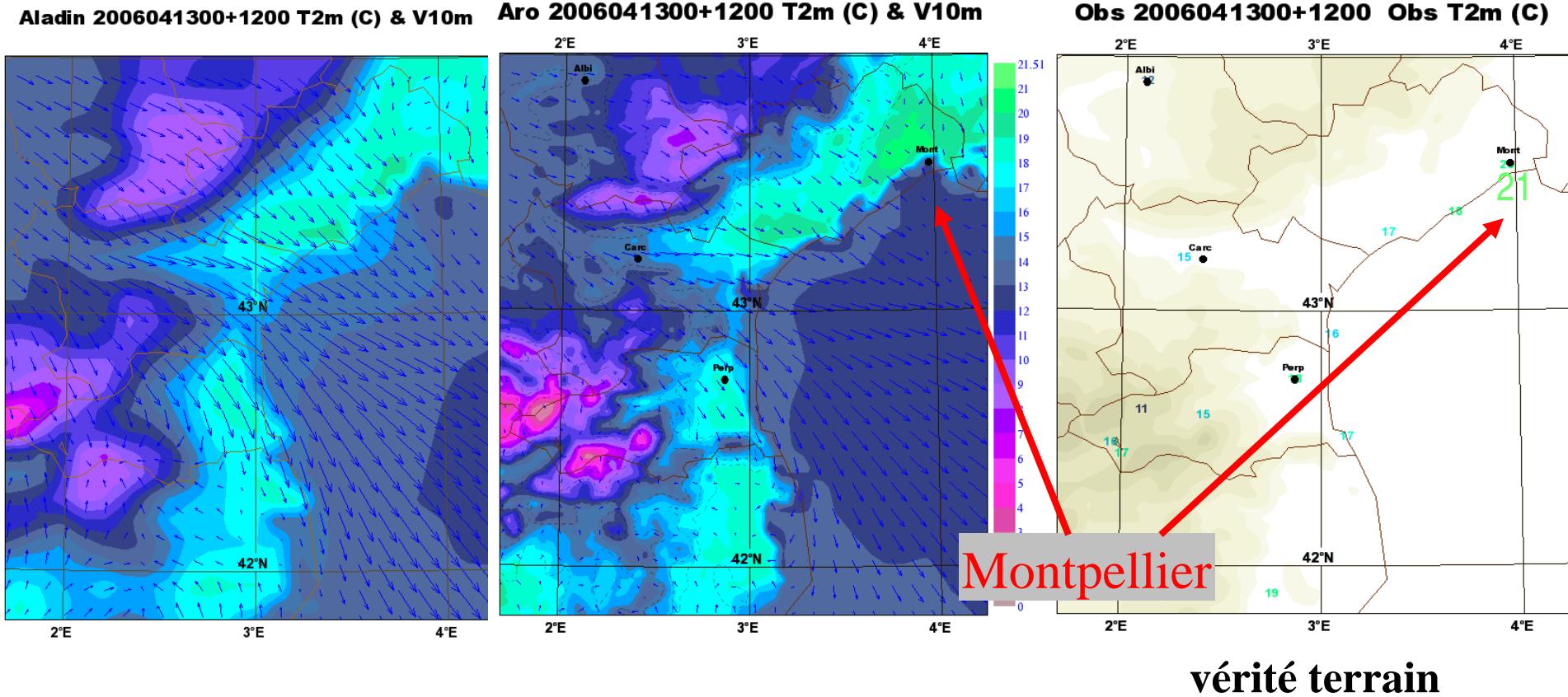
Better in valleys, on mountains, in big cities

T/wind in mountain regions (Alps)


Températures d'Aladin
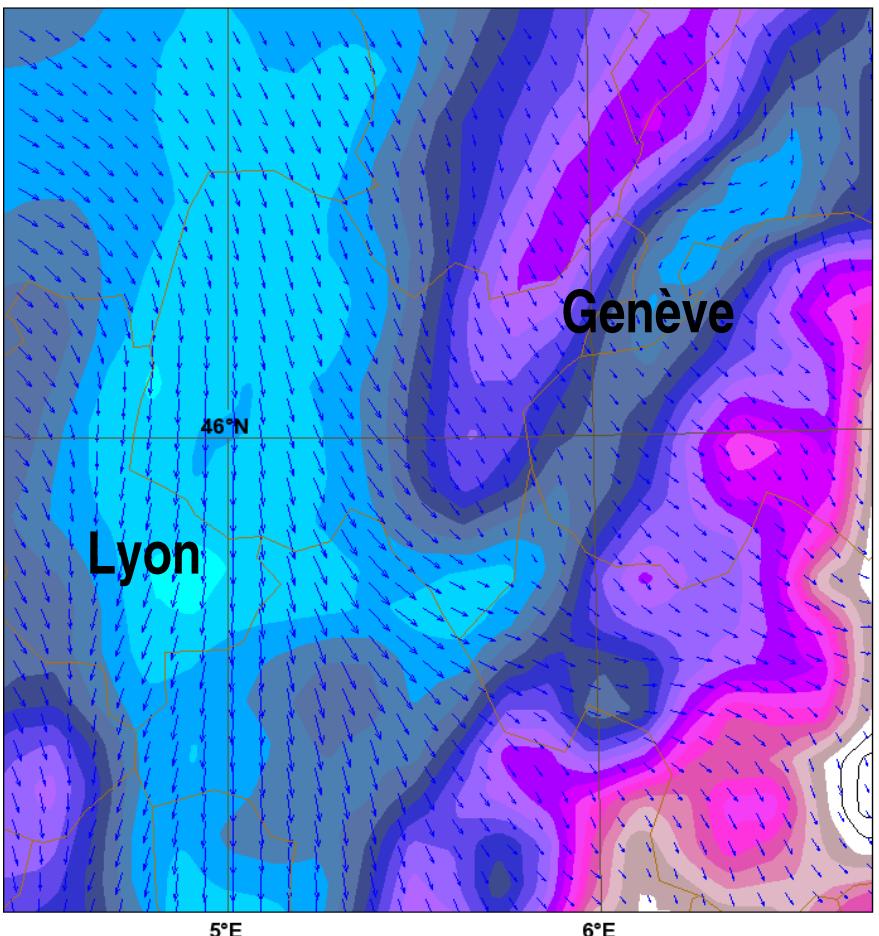
Températures d'Arome
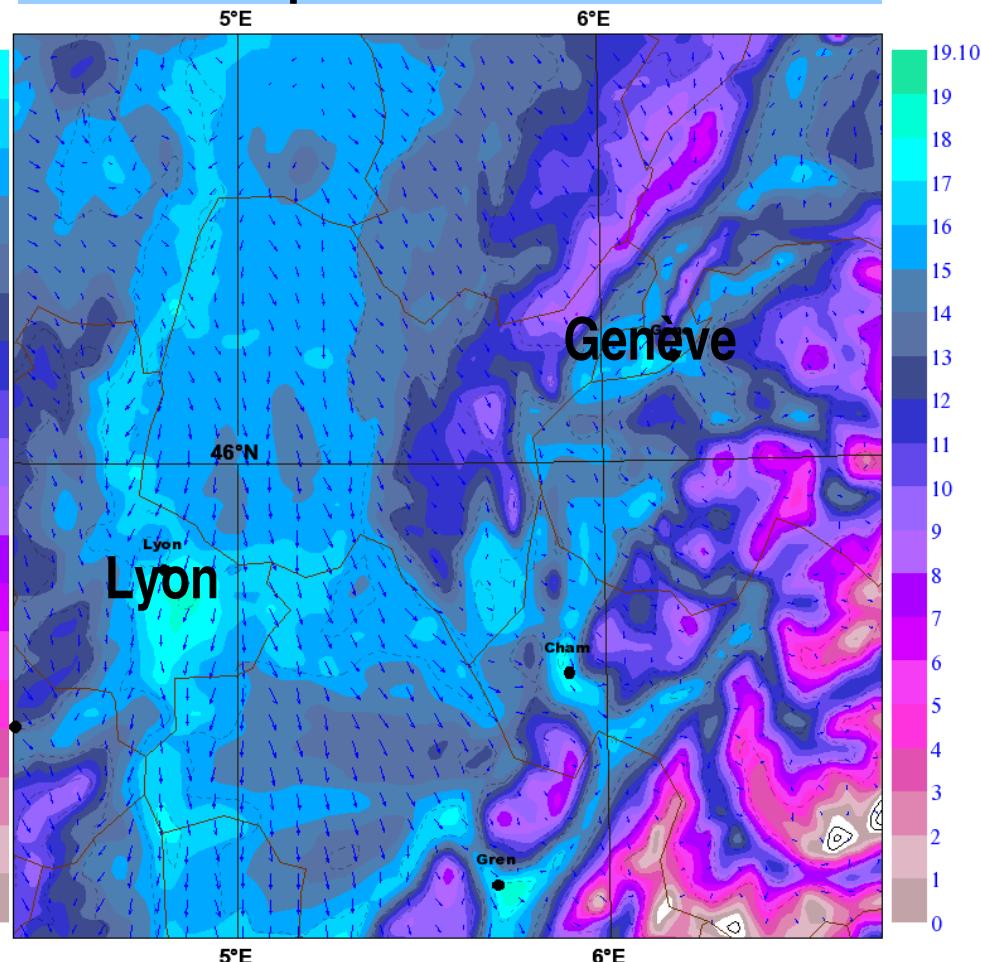
Better wind modelling:

## application on forest fires, pollution events, air quality, coastal ocean modelling, air traffic safety


Aladin
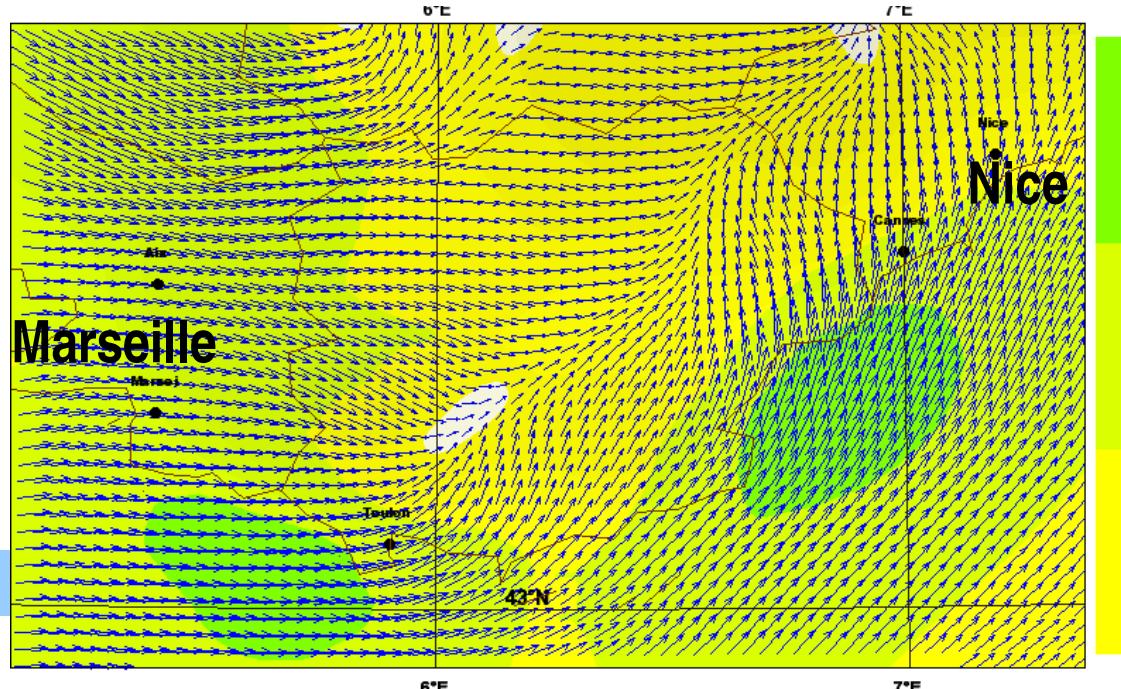
Arome

METEO FRANCE
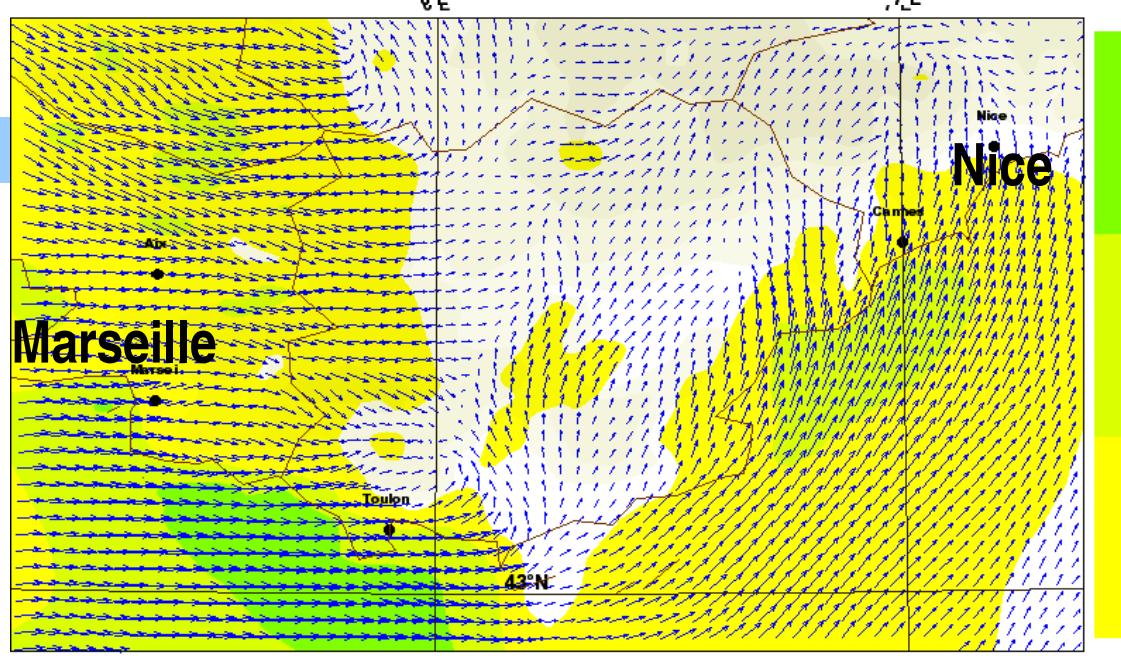
# New AROME product:
3D TKE
with NH effects

Turbulence at 140m above ground

Nice

Marseille
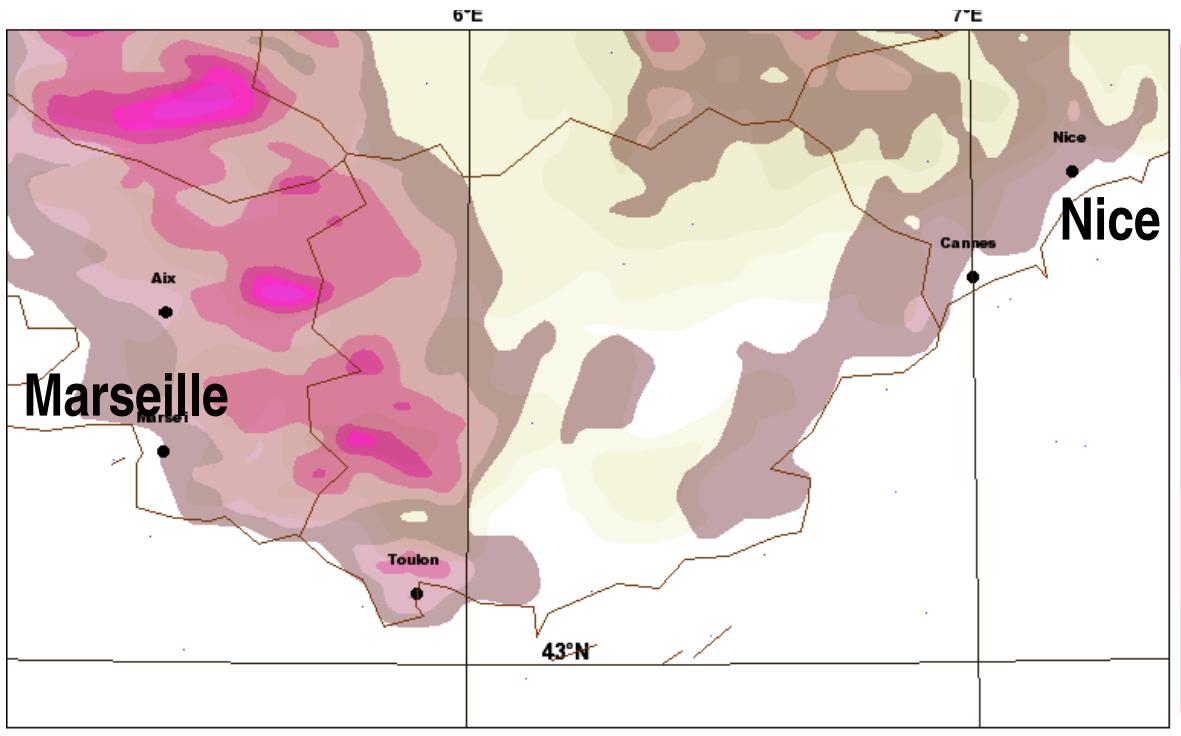
**vertical cross-section**

Nord

Sud

METEO FRANCE
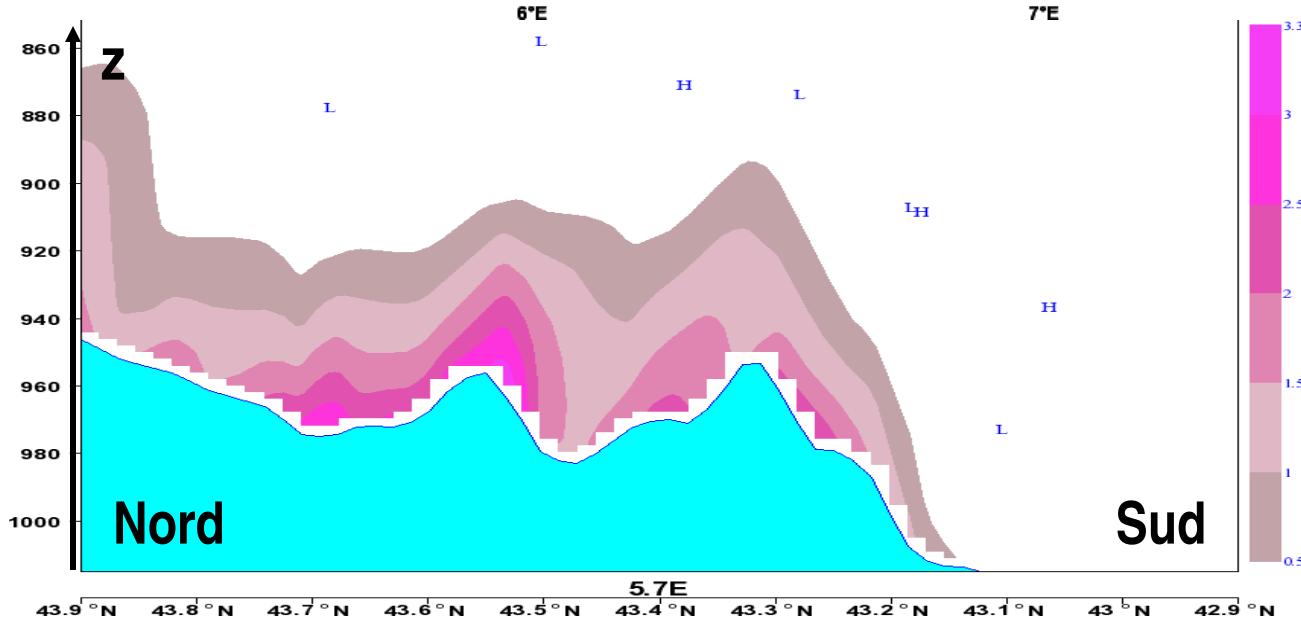
Validation of fog forecast by AROME

Arome low cloud cover
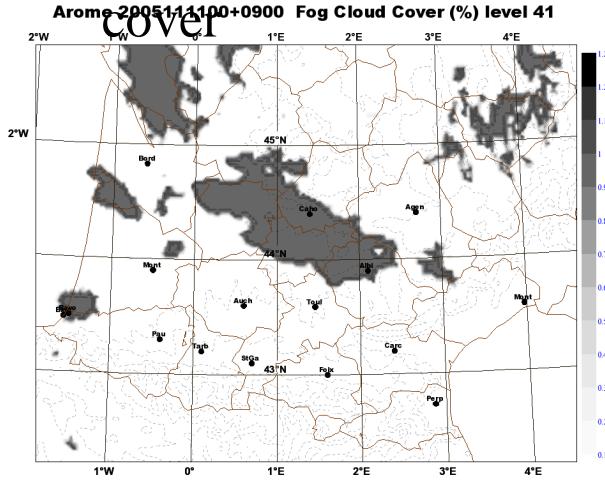
11 nov. 2005
Humidity Arome

MSG satellite

Arome 2005111100+0900 Fog Cloud Cover (%) level 41
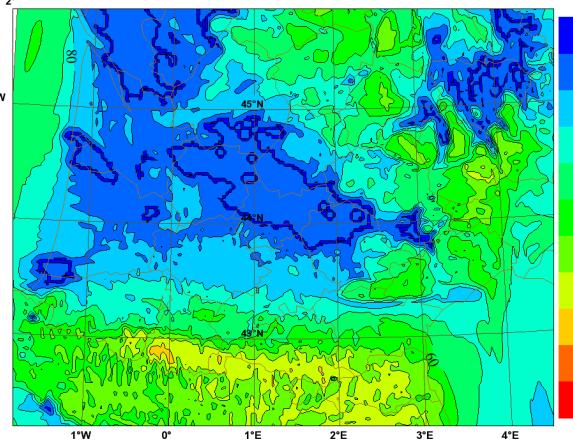
Arome 2005111100+0900 17m RH (%)
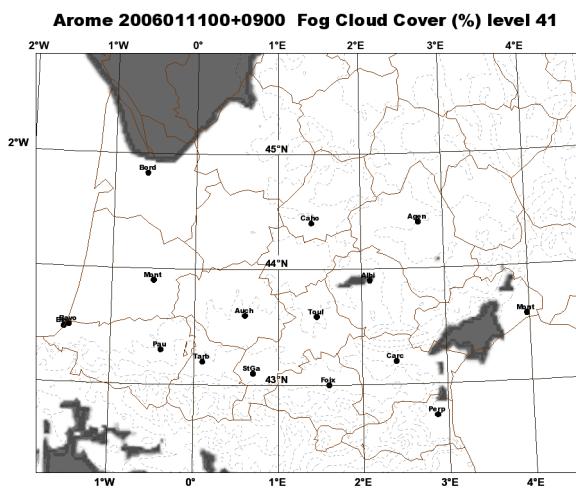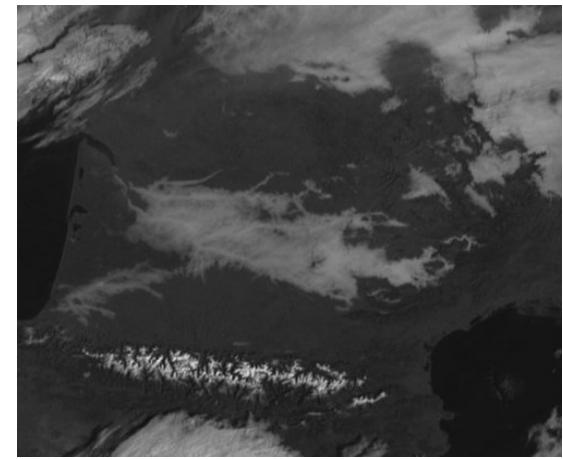
11 janv. 2006

Arome 2006011100+0900 Fog Cloud Cover (%) level 41

Arome 2006011100+0900 17m RH (%)

18

(communication Y. Seity et G. Hello,)
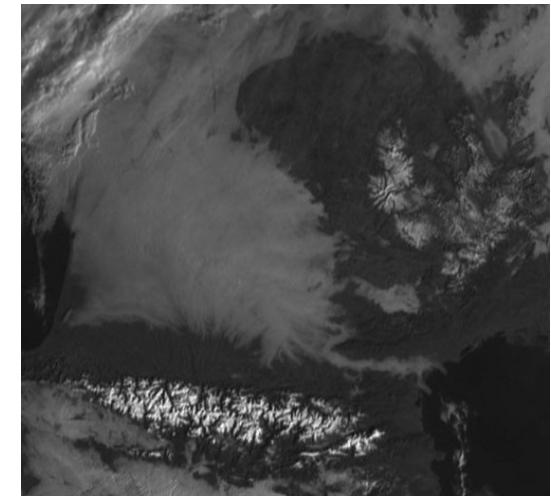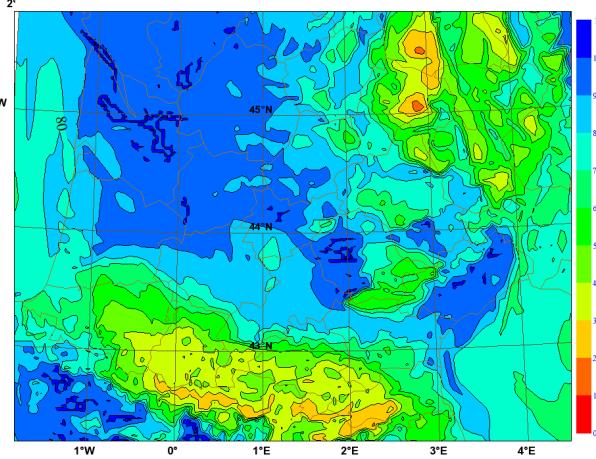
Fog sensitivity to the aerosol specification

(research tests with Méso-NH & ORILAM physics)

countryside aerosols

urban aerosols

Cloud liq water

stratus

fog

Cloud liq water

(communication P. Tulet)
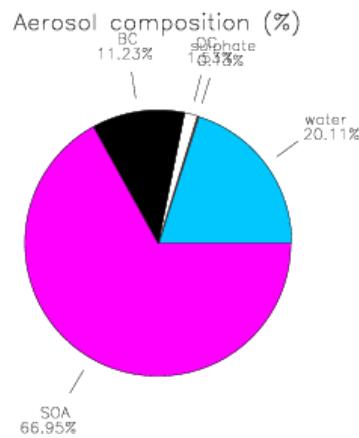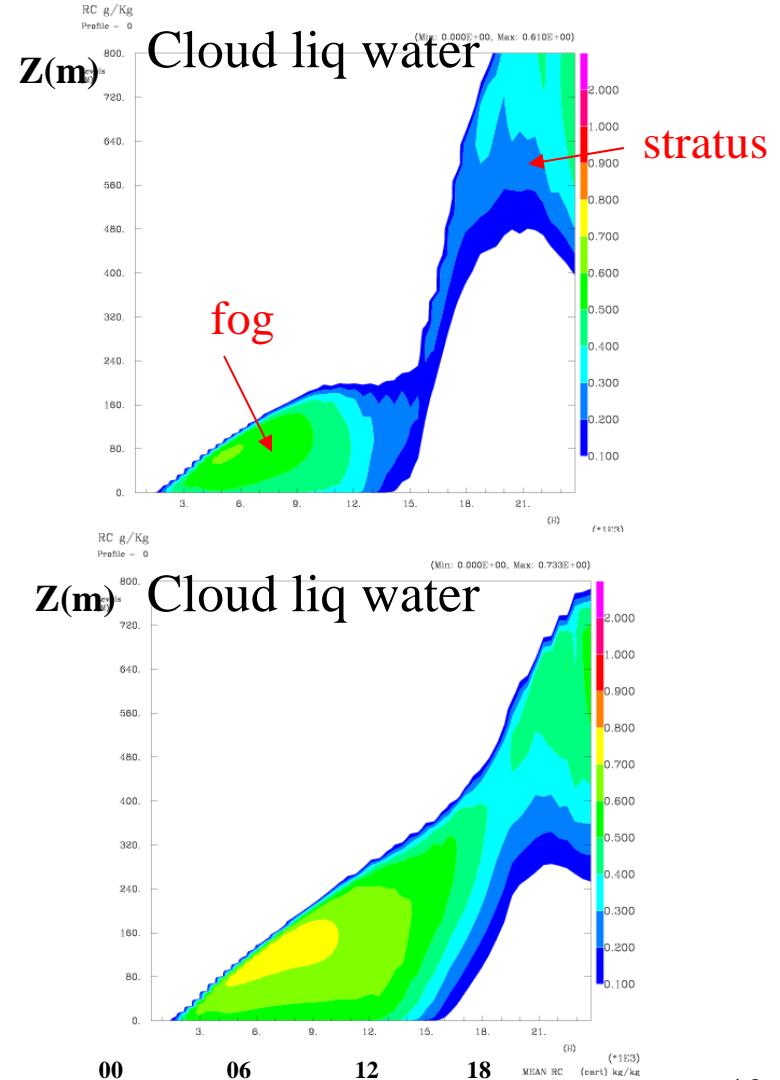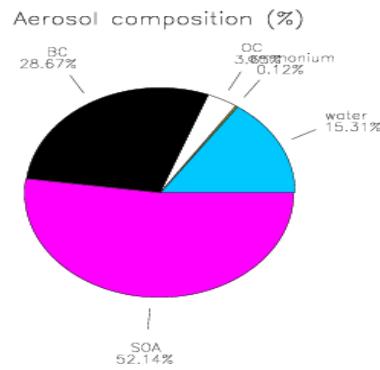
Air pollution : ESCOMPTE field exp.
(AROME / CHEMISTRY)

NOx
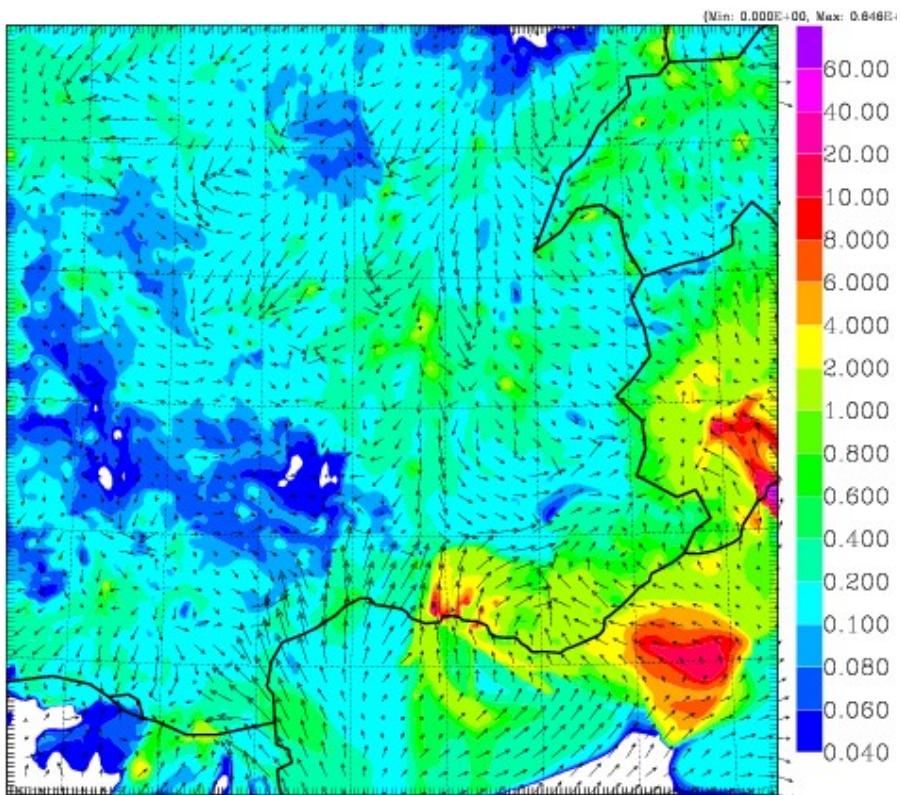
O3
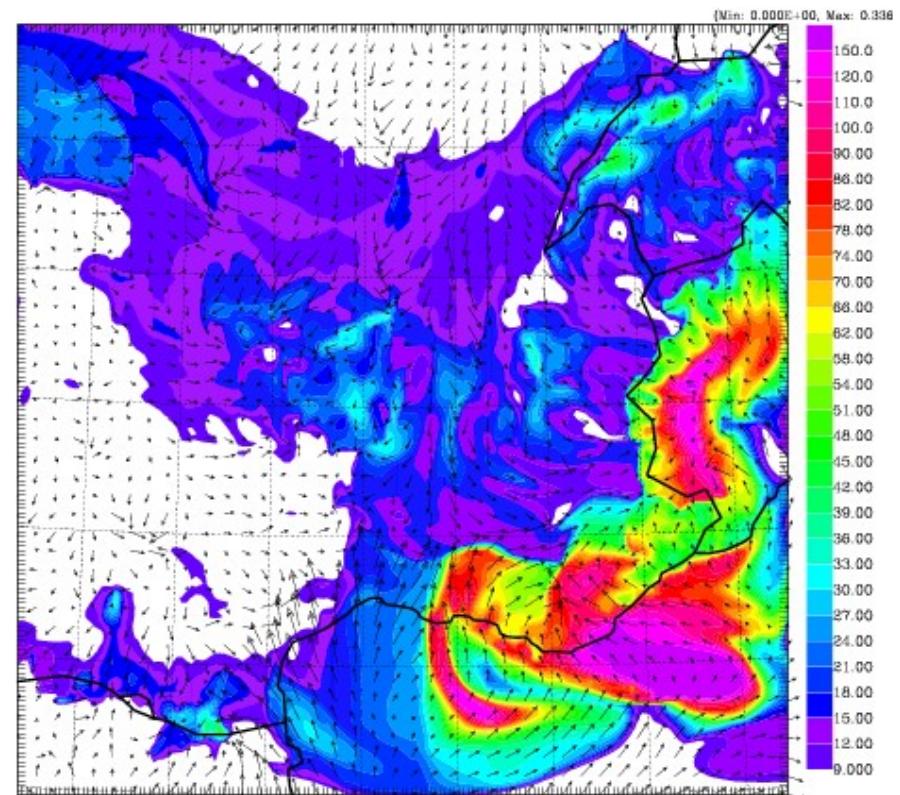
Low-level fields : 24 June 2001 at 14 UTC

(38 hours of simulation)

Tulet et Seity, 2006

3. Assimilation work

- **ALADIN 3DVar** now operational in France, Hungary, Africa, proven beneficial impact *see C. Fischer*

- **hybrid Méso-NH**/3DVar assimilation tests on Mediterranean convection showed good behaviour but need to improve Jb

- successful **Arome 3DVar 2.5km hourly assimilation** tests show very good impact, even with fixed obs network

- **3DVar diagnostic analysis**, hi-res in PBL. Supersedes CANARI

- need to calibrate 2.5km native Jb using ensemble of Arome runs

- **radar reflectivity** work is proceeding: Bayesian inversion technique, work on data management

- growing **Doppler radar** team in Toulouse. Screening works.

- ground zenithal **GPS** assimilation works.

- more work planned on **scripts** (OLIVE interface), high-resolution use of radiances, bogus cloud data. *(P. Brousseau, E. Sevault)*

METEO FRANCE

Conceptual model of data assimilation for convective scales

Radiances IR

Hydrométéors

Radiances μW

Radiances IR

Radiances μW & Scat
Sea surface wind

Synops

PBL

Radar
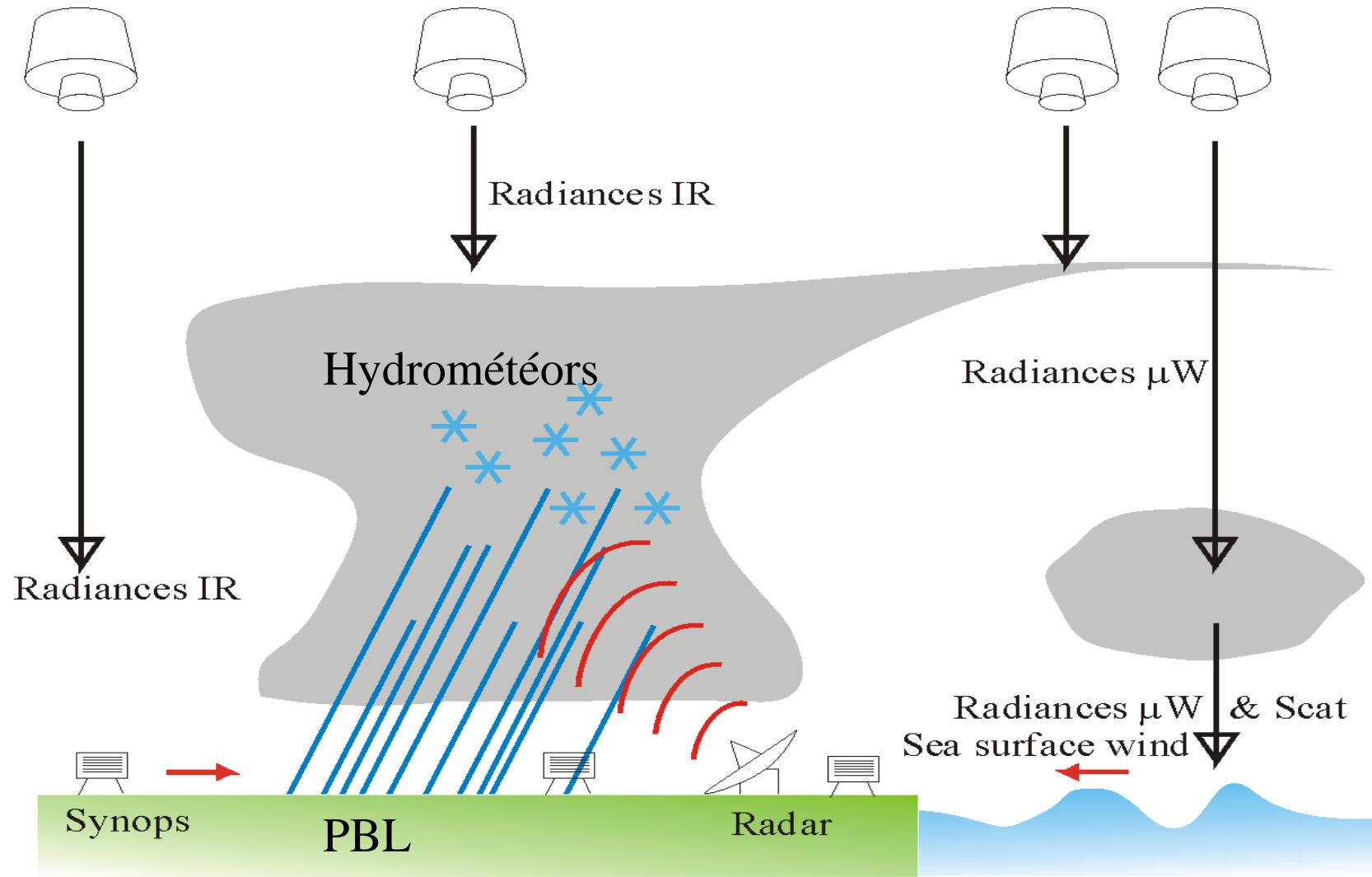
Impact of 3DVar assimilation on ALADIN forecasts: frontal convection

only works if enough hi-res obs e.g. radiances

see talk by C.Fischer etc.

2004/07/18 12UTC
RR P12 – P6


no assimilation
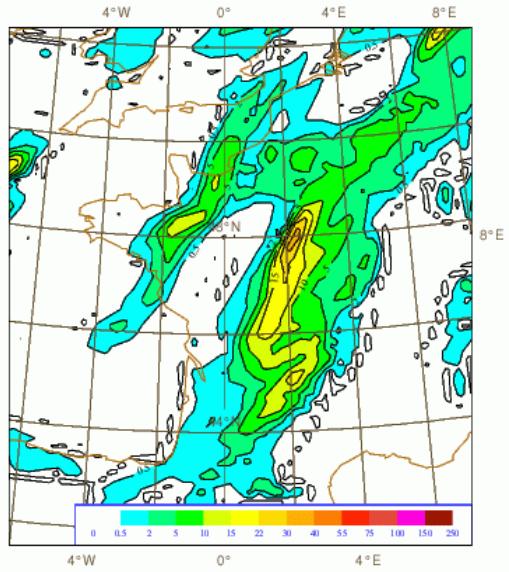
observations
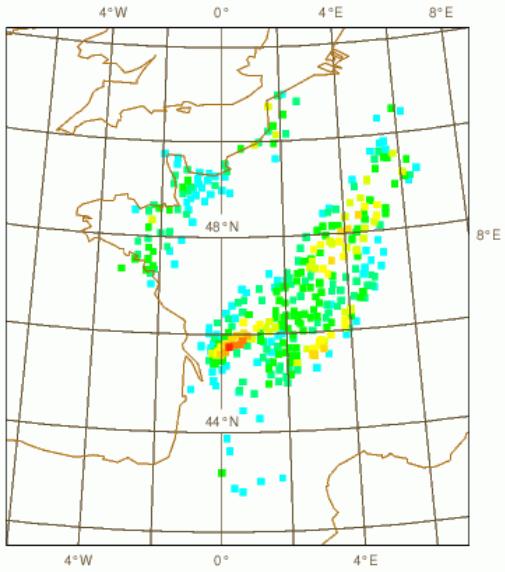
with assimilation
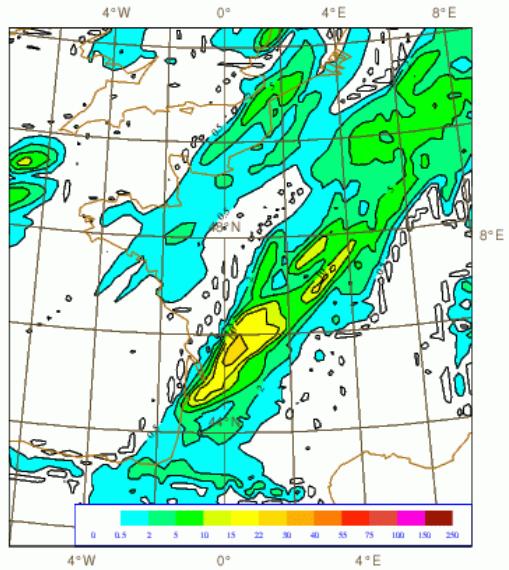
assim with Météosat radiances

METEO FRANCE
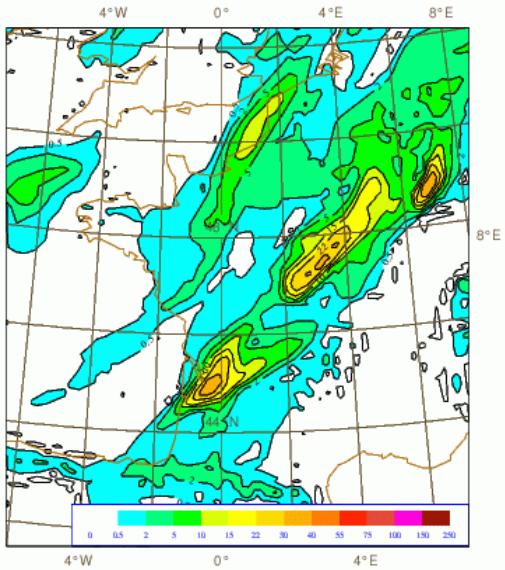
4-h extreme precip forecasts: impact of assimilation

pluies du modèle Arome no assimilation

vérité radar
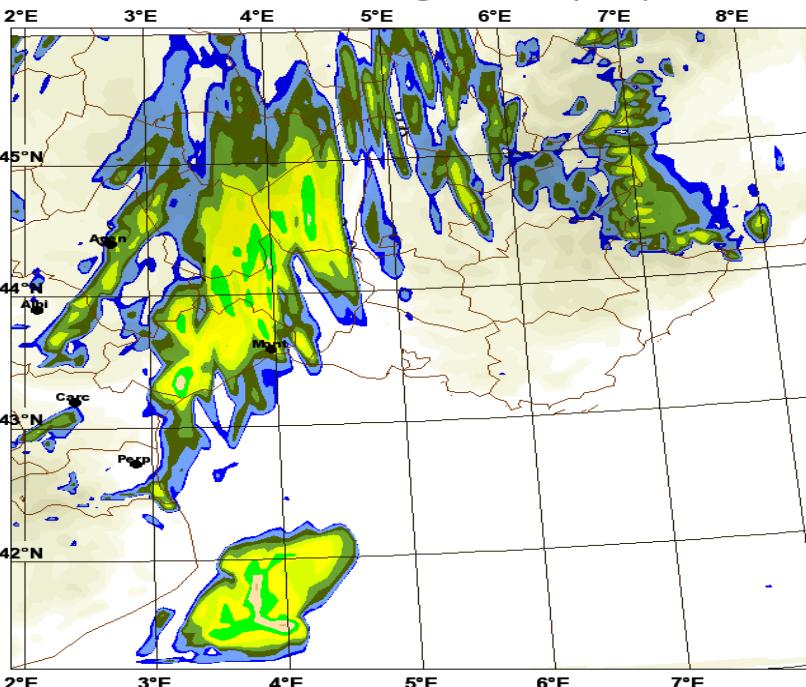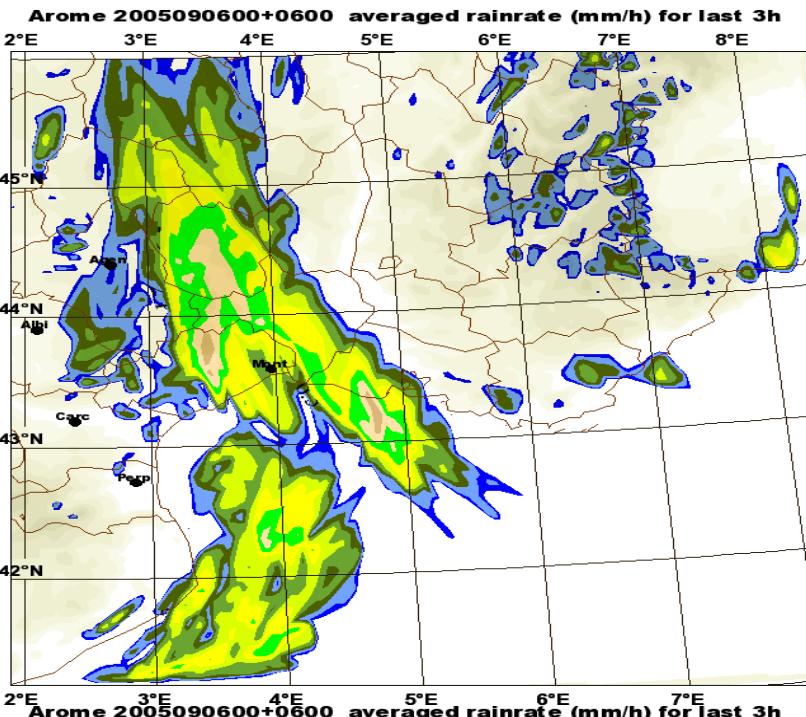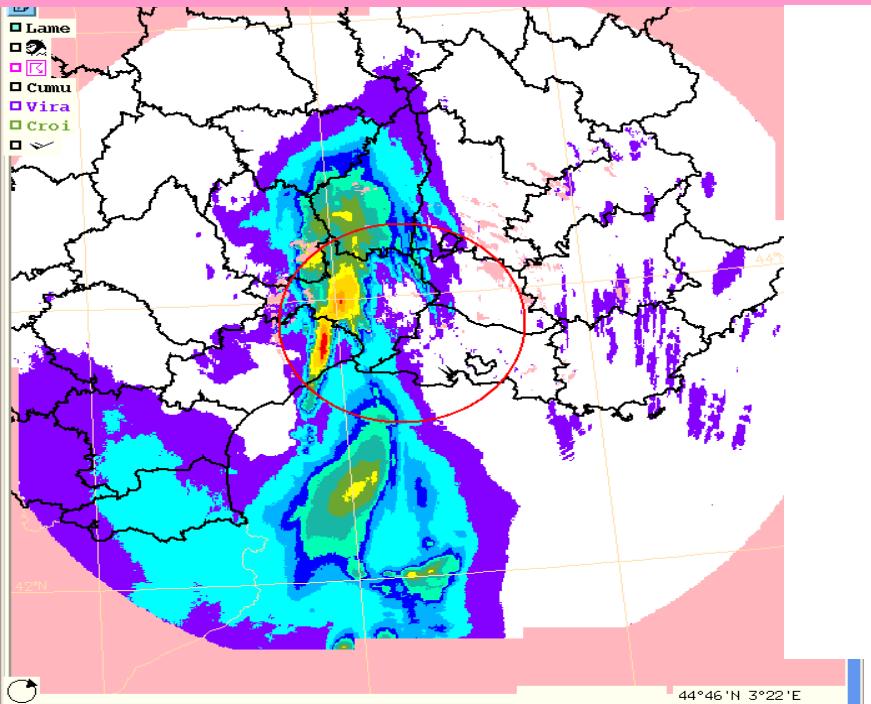
forecast with assimilation

Quikscat wind assimilation

e **pink: observations, received** ₑₛ

e **black: observations, active**

blue: guess
red: analysis
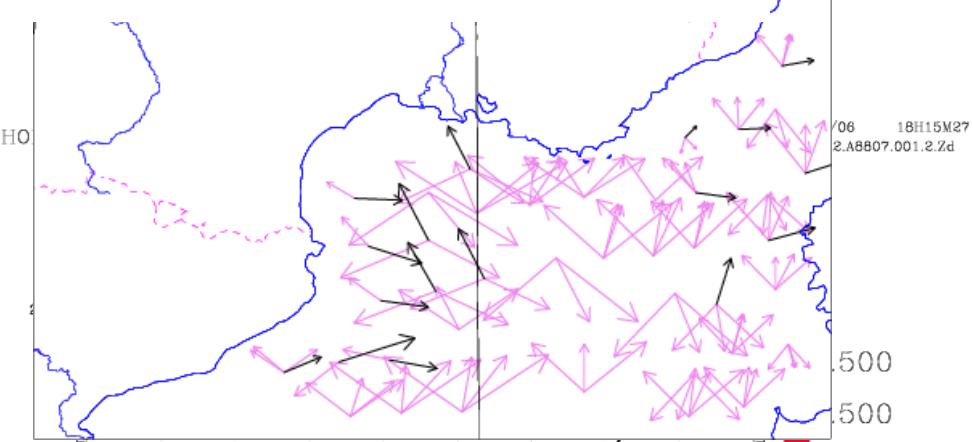
horizontal increment of wind speed
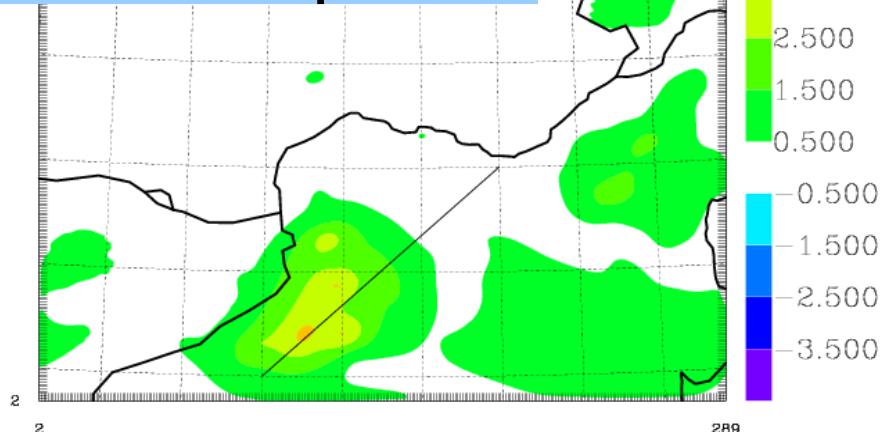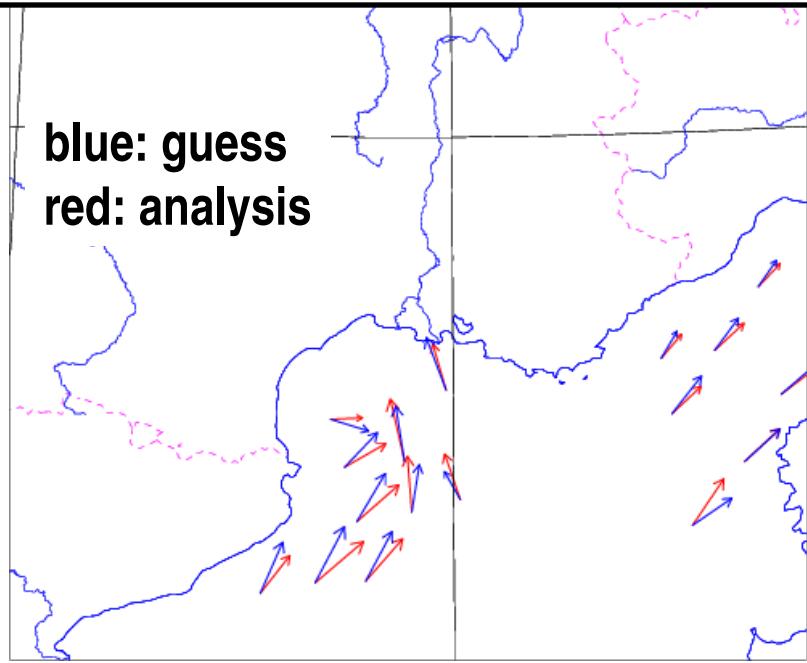
vertical increment xsect
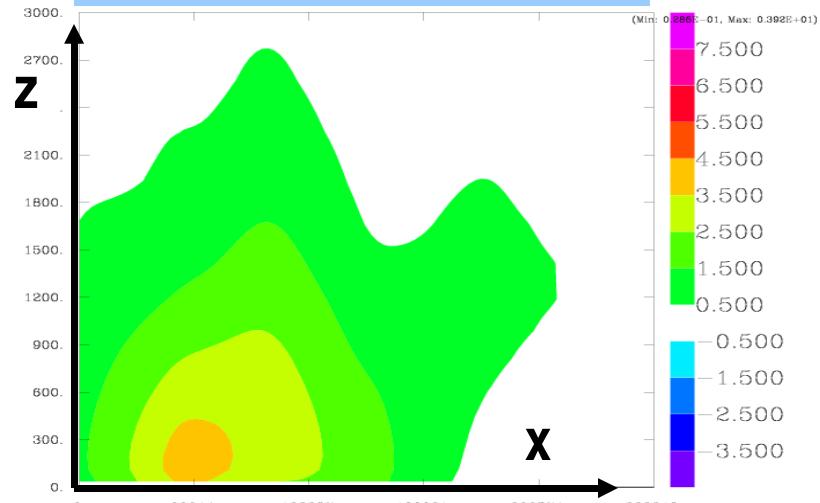
Doppler radar observation operator:
radial wind component in the PBL

observed
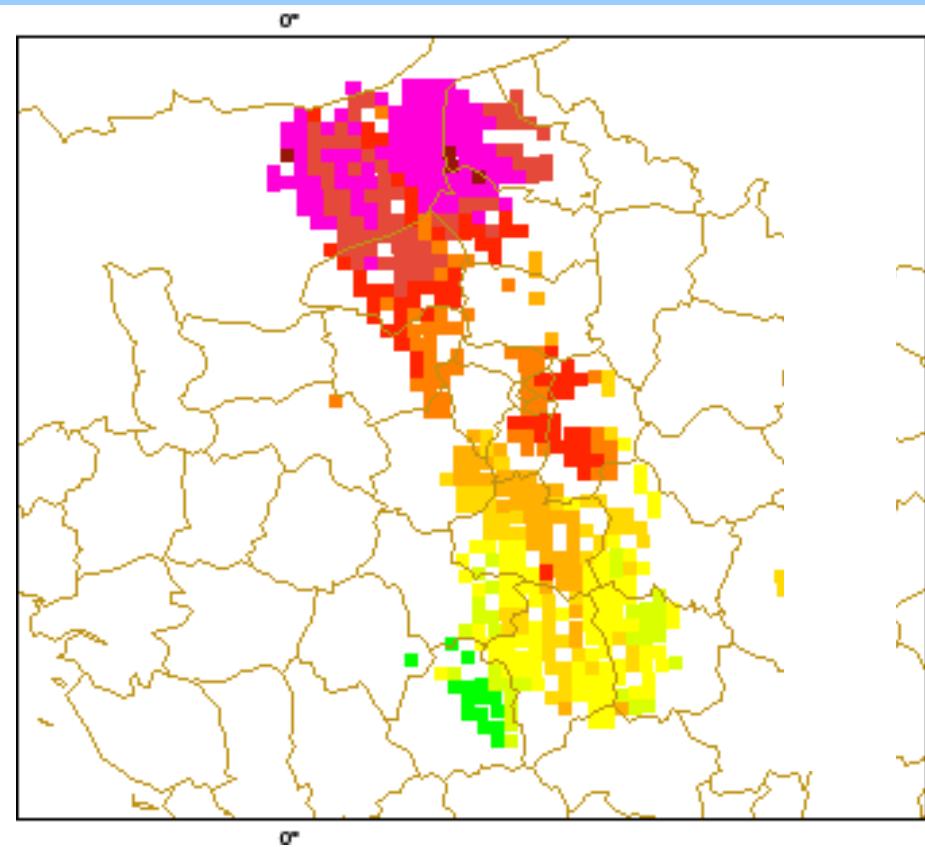
ALADIN guess
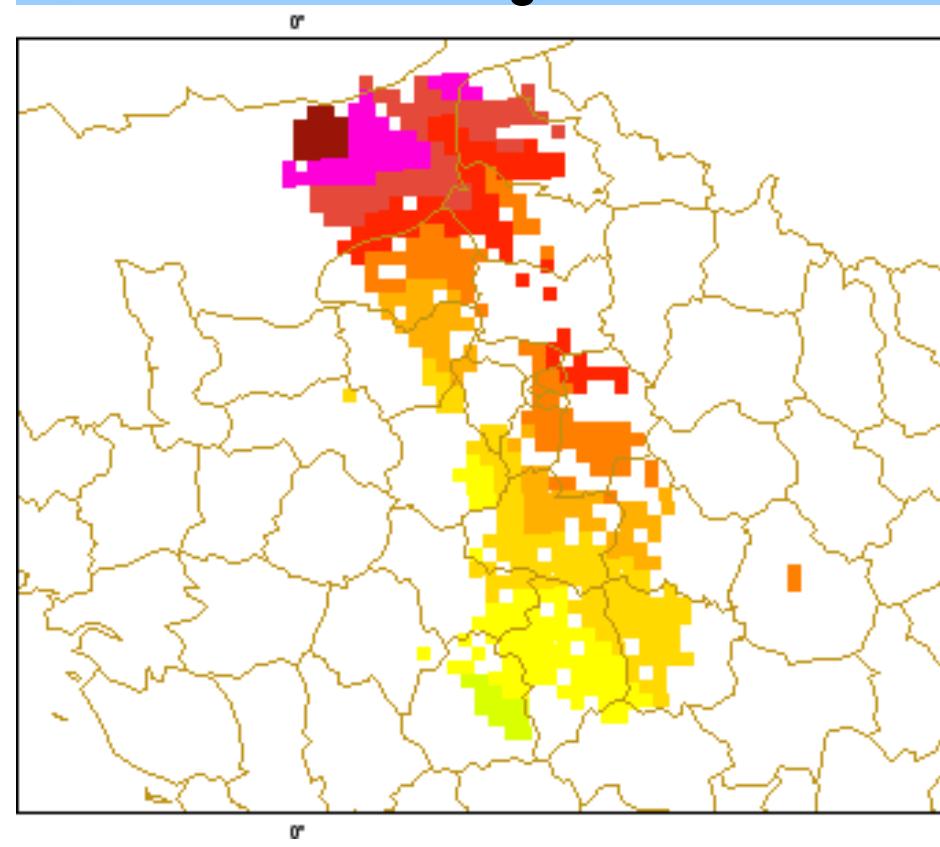
4. The future (i.e. 2006/2007)

- **computer optimization** (NEC, IBM, Linux)
- **data assimilation:** used for all daily runs, compute improved Jb
- short-range hourly forecasts for nowcasting
- test of Saharian dust modelling & SURFEX advanced features
- increase vertical resolution for fog & low clouds
- even more coupling file compression
- even more work on radar & satellite cloud data
- continuing **phys/dyn interface cleaning (for all new devs.)**
- development of **3MT deep convection** with ALARO *(see L Gérard)*
- improvement of Soares EDMF new **shallow convection**
- **critical review of all physics schemes & more verification**
- *preparing the post-AROME work: adaptive discretization, vertical slopes, 3D turbulence, interactive gridnesting, better large-scale coupling, mesoscale predictability, 4DVar/KF, toolbox of physics, merge with ALARO & HARMONIE ?*