ALARO Physics developments

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LACE Working group for physics

ALARO-0 concept

- **continuous transition from ARPEGE/ALADIN to AROME (continuity + improvements)**
- **to treat 'grey-zone' 3-7 km mesh size**
- **economical computation, numerical efficiency**
- **algorithmic flexibility → good basis for further developments**

Content

- **Dynamic**
  - **SHLD, NH**
- **Physics**
  - **New interface (governing equations)**
  - **Radiation: NER scheme, cloud optical properties**
  - **Turbulence: pseudo-prognostic TKE**
  - **Mountains: new GWD and lift scheme**
  - **Moist processes:**
    - **Full prognostic microphysics**
    - **3MT cascade,**
    - **Prognostic convection,**
    - **historic entrainment**
  - **SURFEX**

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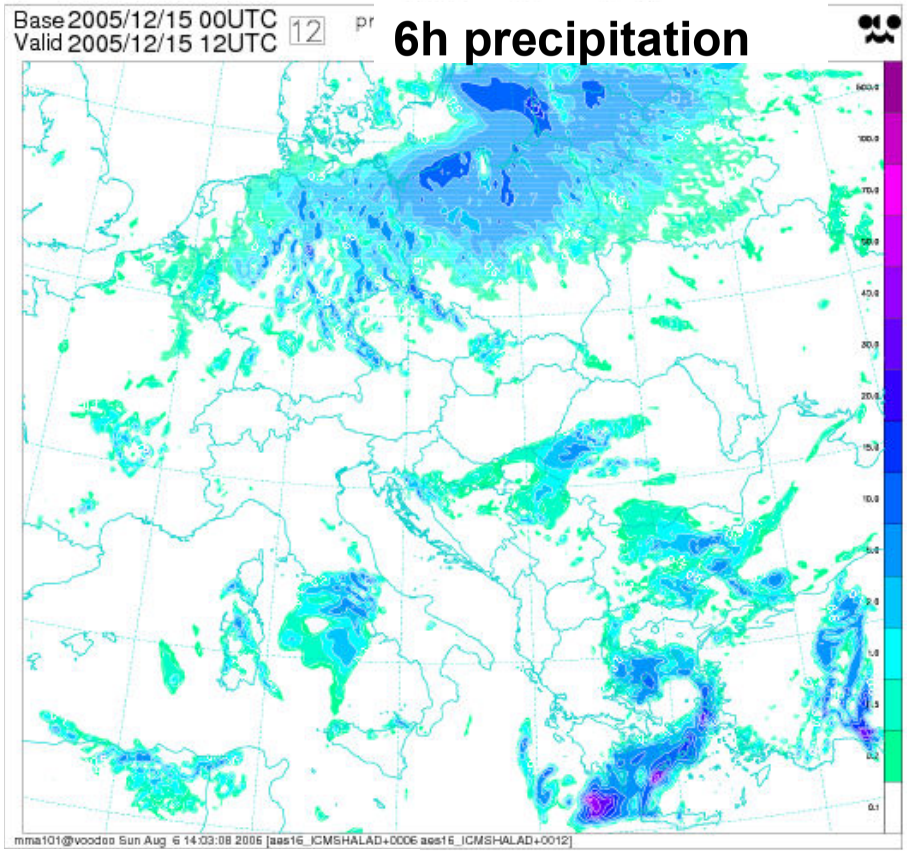
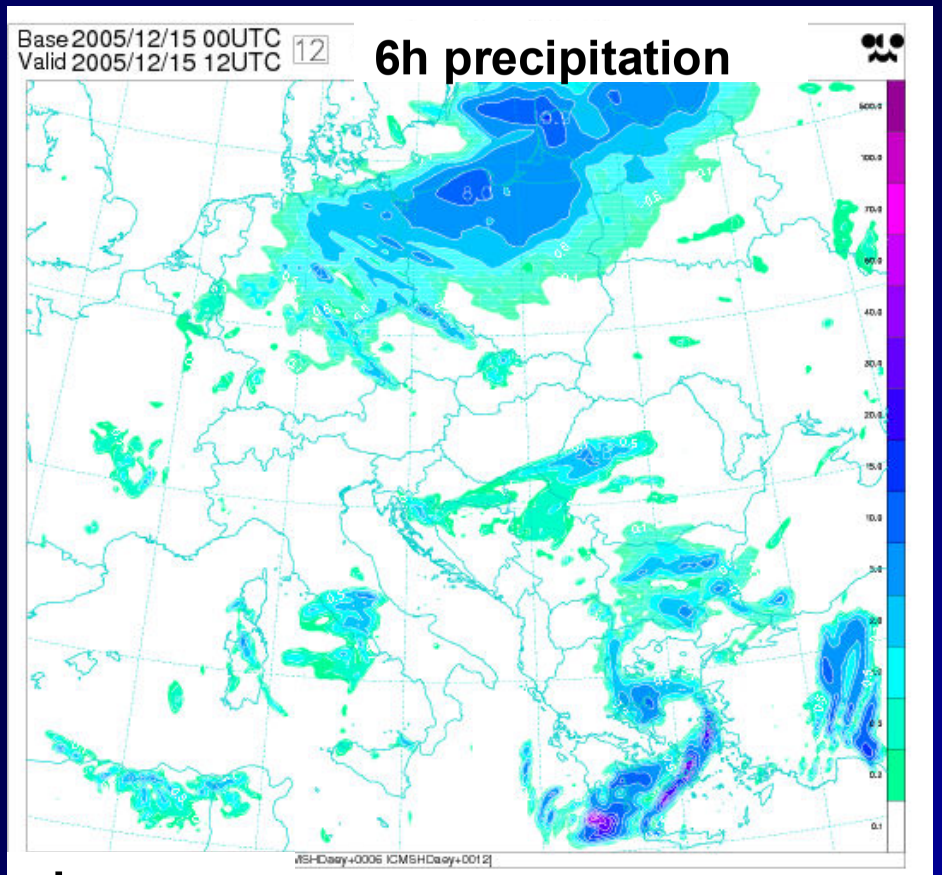
ALARO-0 without 3MT (LSTRAPRO)

- **Prognostic microphysics**
  - **cloud water, cloud ice, rain, snow - prognostic variables**
  - **statistical approach for sedimentation of rain and snow**
- **Old diagnostic deep convection scheme**

ALARO-0 without 3MT



oper pre-alaro



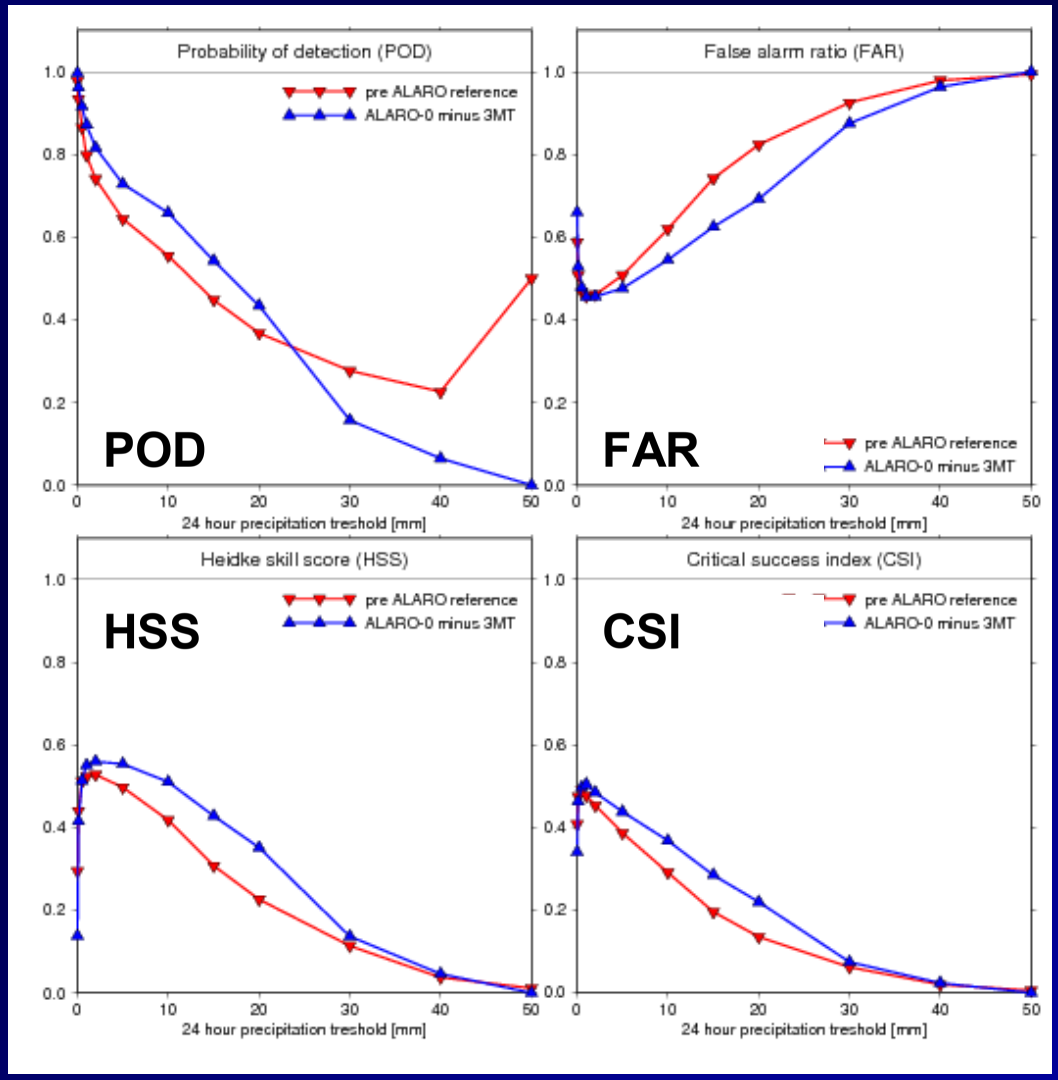
alaro

better spatial distribution of precipitation

ALARO-0 without 3MT

- 24 hour cumulated precipitation
- Mar-Apr-May 2007
- 600 stations over Slovakia

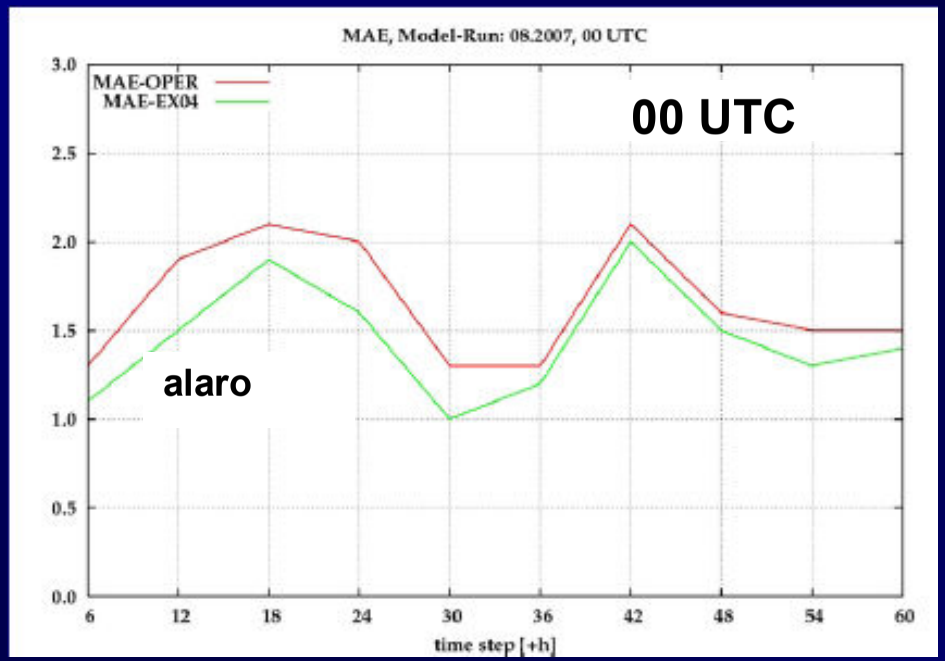
- positive signal

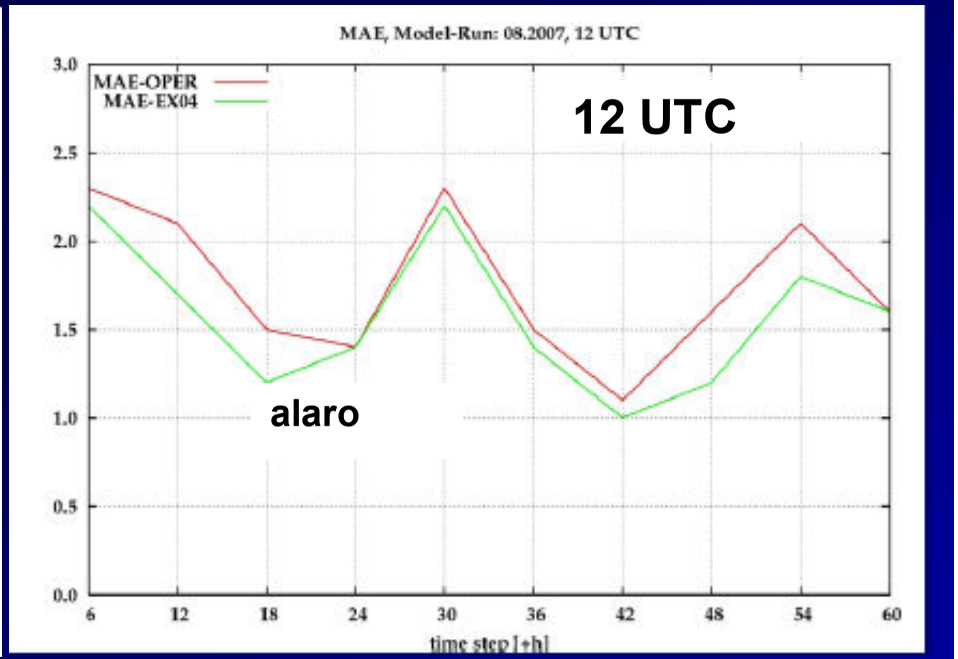


ALARO-0 without 3MT

MAE in precipitation forecast against INCA analysis

August 2007 Austria





3MT

- **Modular**
- **Multiscale**
- **Microphysics and Transport**

- J.-M. Piriou et al.: An approach for convective parameterization with memory, in separating microphysics and transport in grid-scale equations, J.Atmos. Sci. 2007
- L. Gerard and J.-F. Geleyn, Evolution of a subgrid deep convection parameterization in a limited area model with increasing resolution,QJRMS 2005
- L. Gerard, An integrated package for subgrid convection, clouds and precipitation compatible with the meso-gamma scales, QJRMS 2007

3MT - goals

- **Simulations of water cycles with results as independent as possible from grid mesh size**
- **Introduction of 'memory' for the convective activity**
- **Prognostic microphysics for the treatment of convective condensation**

3MT means

- **Cascade approach with one unique (total) source of condensation for microphysics**
- **Prognostic equations for mass-flux, condensates and precipitating species**
- **Taking into account cloud & precipitation geometry in microphysical computations**

Catalyser: M-T approach for convective equations => entrainment (diagnostic now, prognostic later) at the heart.

Microphysics and Transport

A new equation frame for convective parameterization

- **Clean separation between microphysics and transport. The parameterization exercise is partly moved from detrainment to microphysics.**
- **Allow to relax the cloud stationary assumption.**
- **Buoyant condensation at the heart of the parameterization system.**
- **Ideally can deal with dry, non-precipitating convection and precipitating convection.**

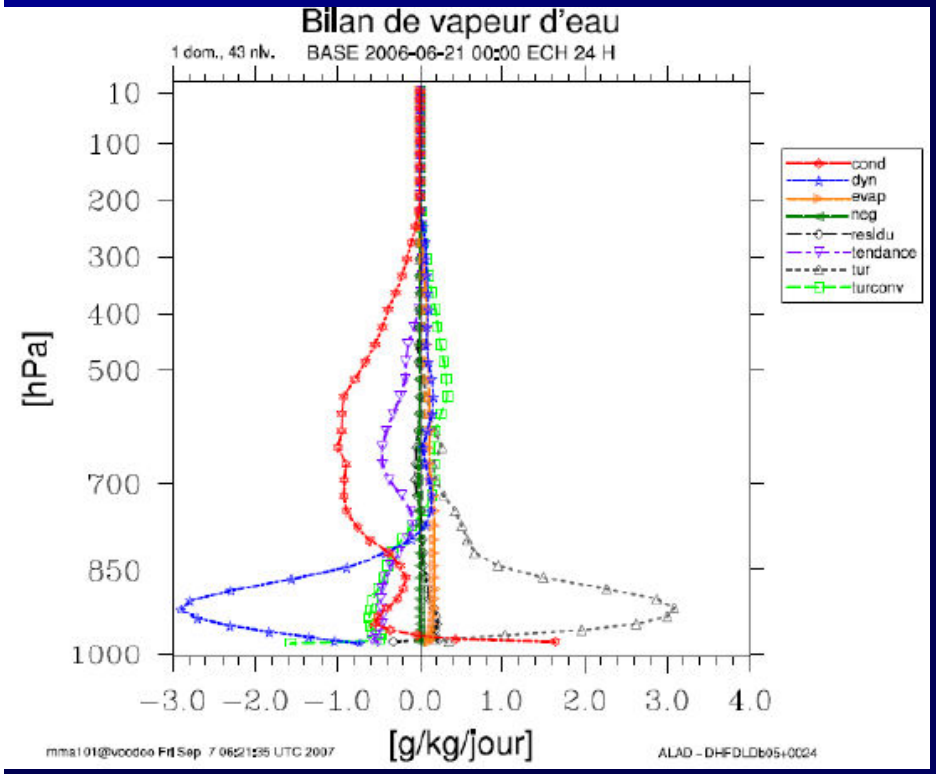
Modular

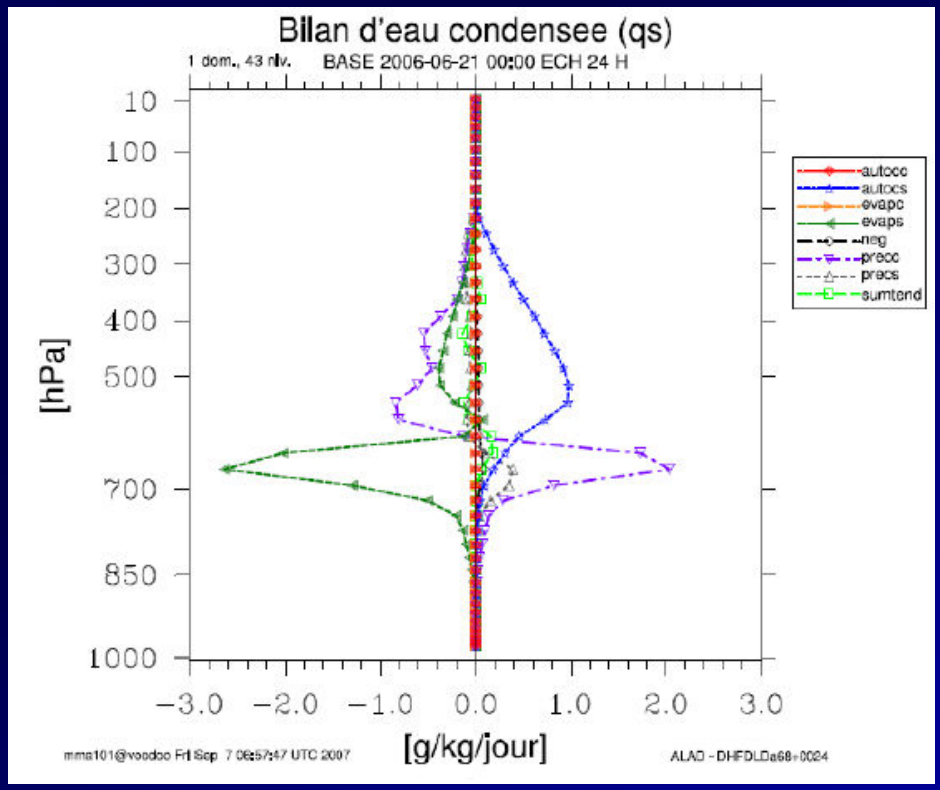
- **Modularization of the algorithms**
- **Many options in microphysics**
  - **PDF-based sedimentation functions;**
    - **Statistical**
    - **Step function one (mimics Lagrangian)**
  - **Fixed or precipitation rate dependent fall-speeds;**
  - **A pseudo-graupel effect is included or not;**
  - **Random-maximum or random overlap of clouds and precipitation areas;**
  - **ALARO-0 or ARPEGE solutions for: auto-conversion, collection, evaporation...**

3MT

- **Valitation and tuning**
  - **1D tests, 3D tests**
  - **Use of DDH tool**
    - **Vertical profile of average budgets over a selected horizontal area**
    - **Components of physical tendency**
    - **Budgets for new prognostic variables**
    - **New contributions to budgets**

DDH product

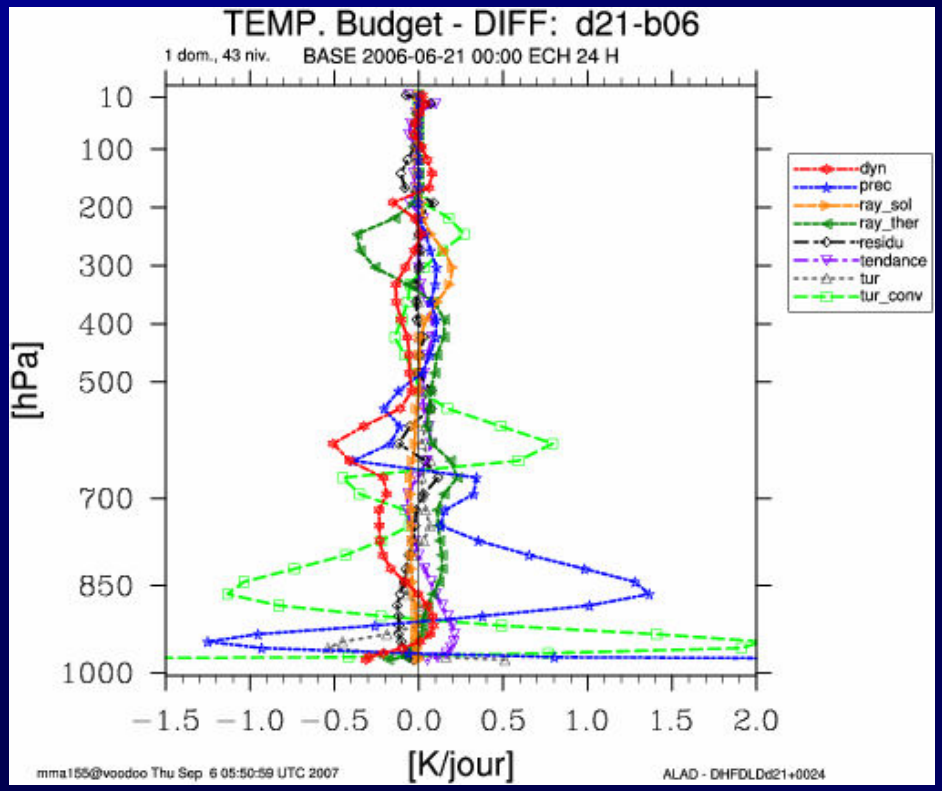


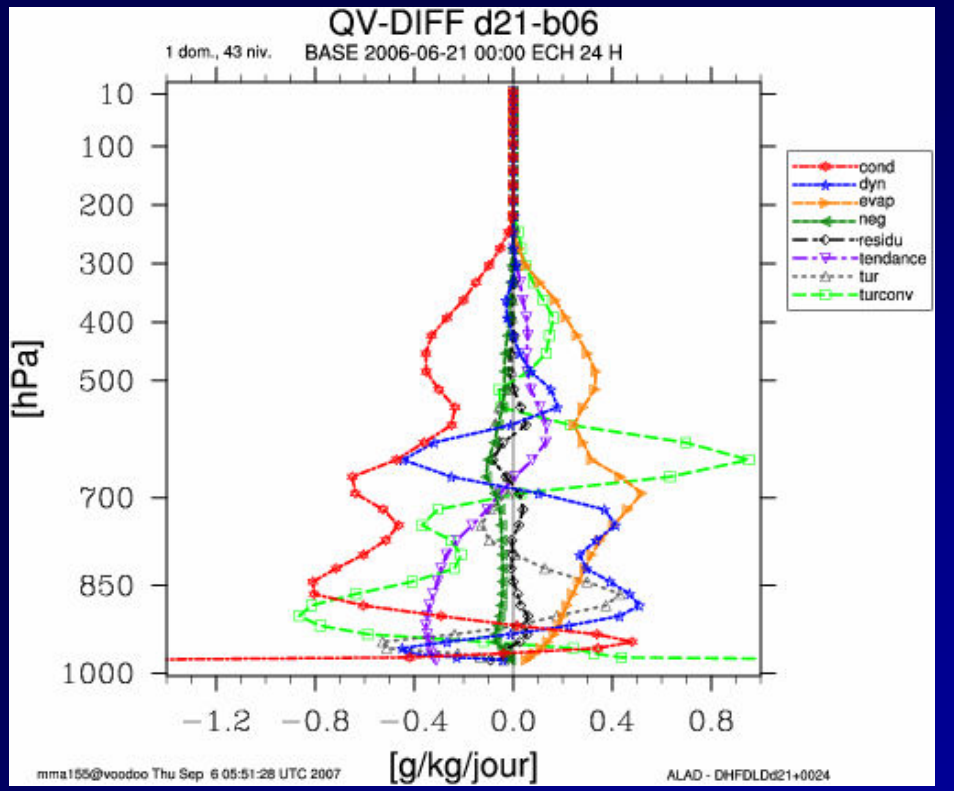


Vertical profile of budgets

DDH product

Detection of problems

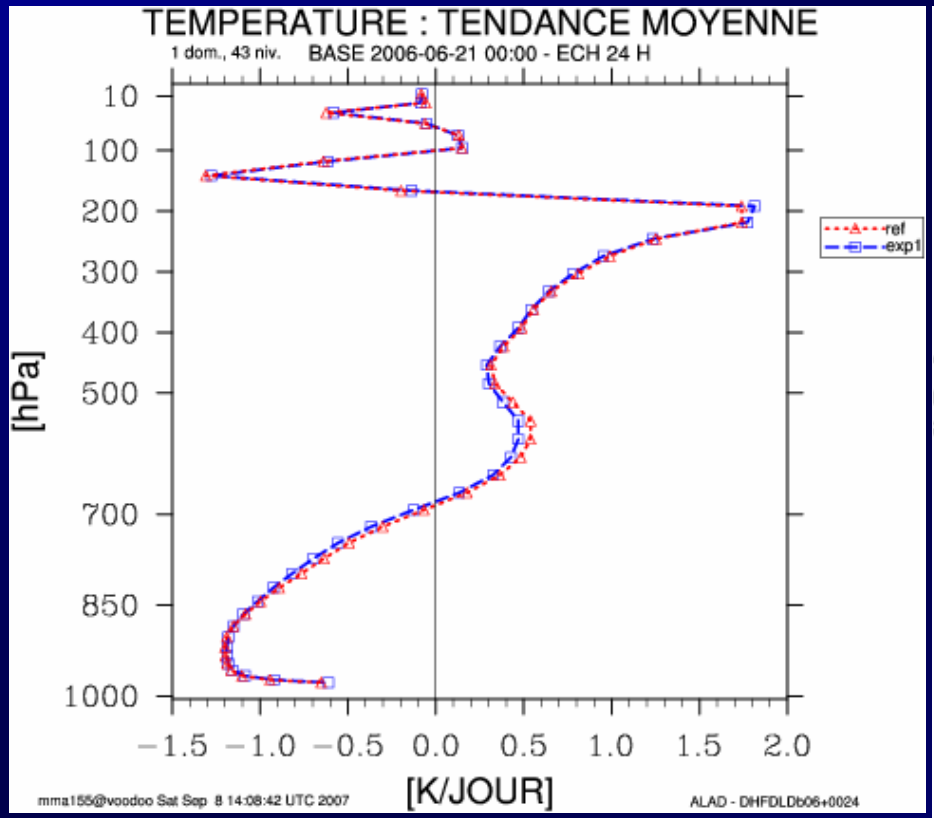


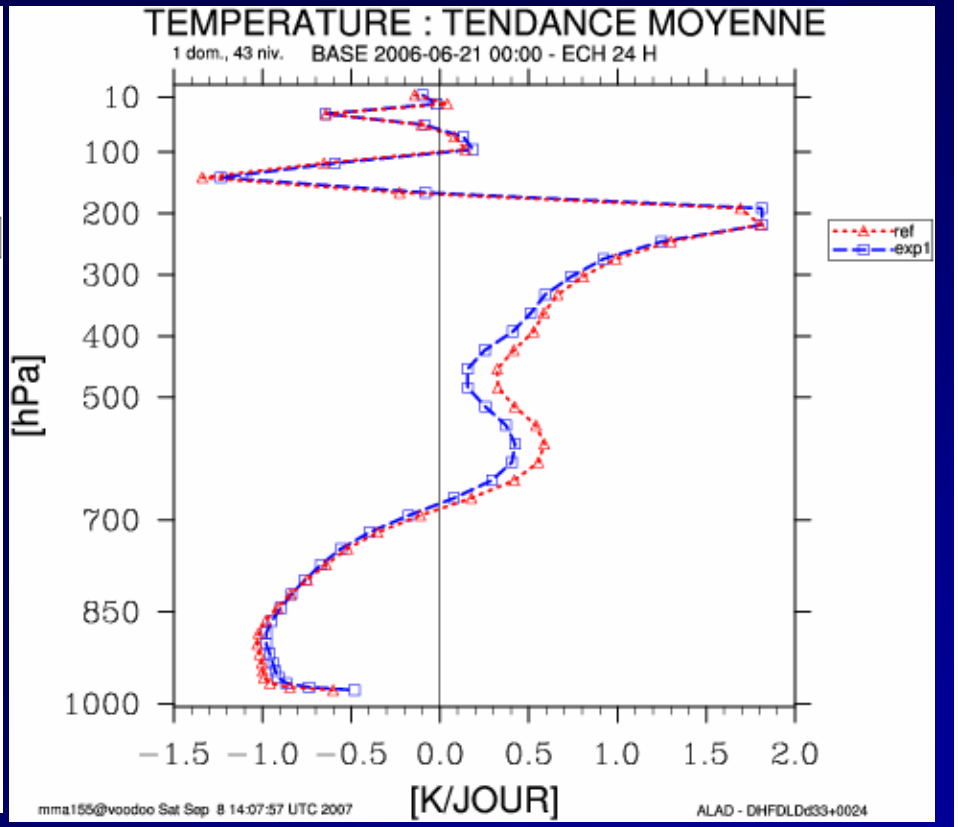


Difference of budgets between two experiments

DDH product

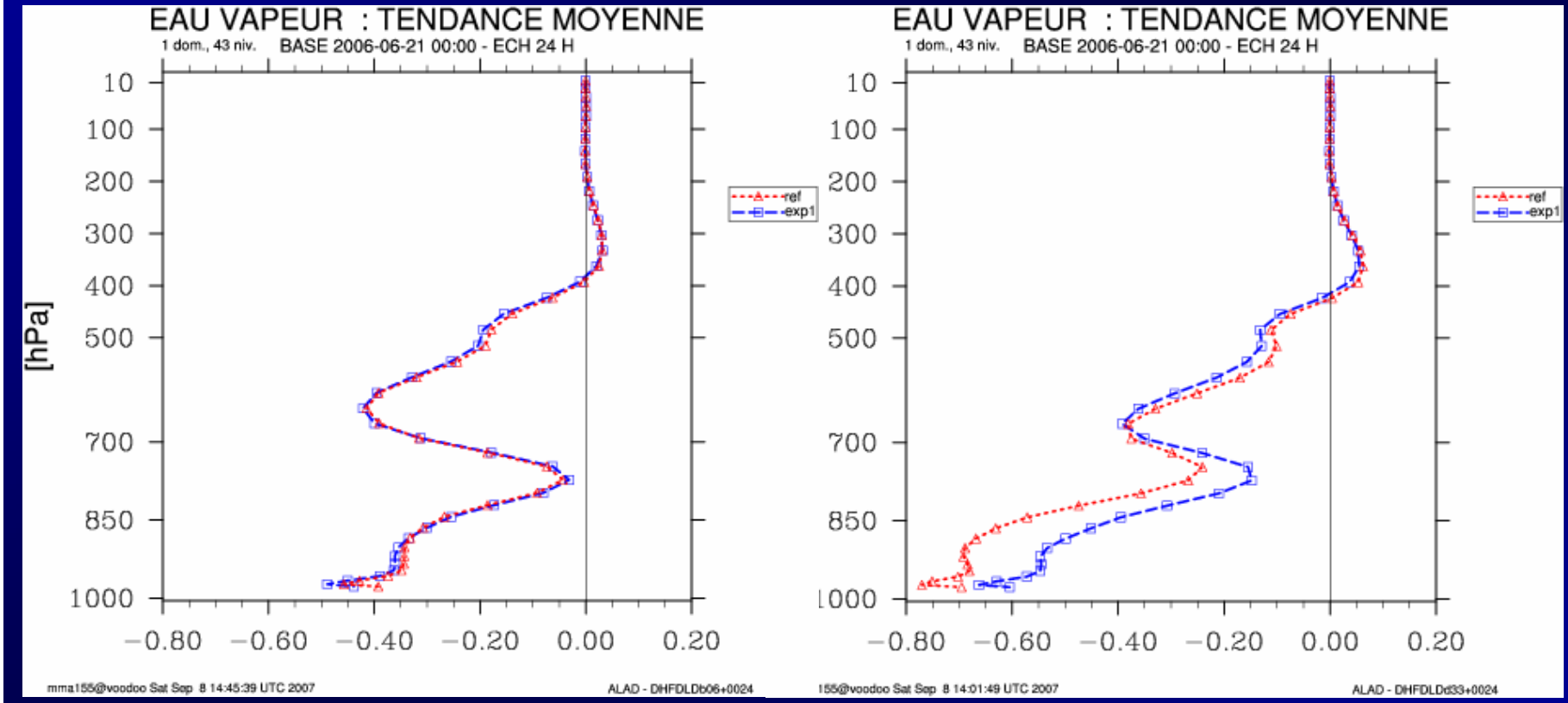
Influence of tuning



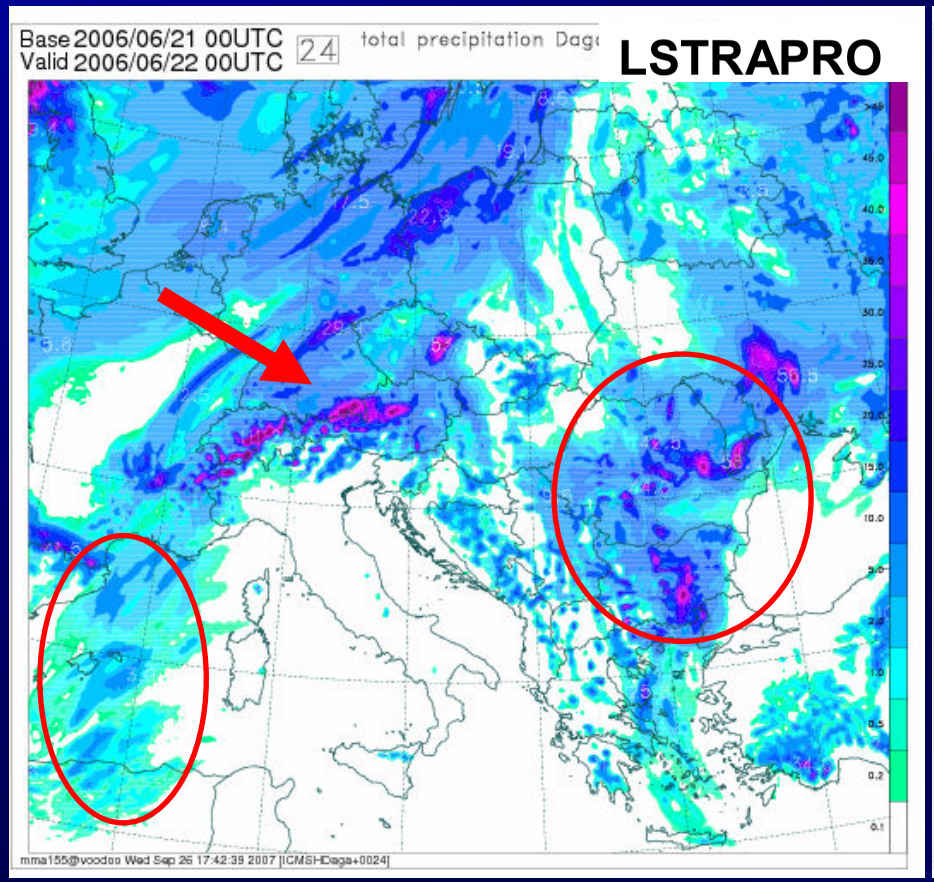


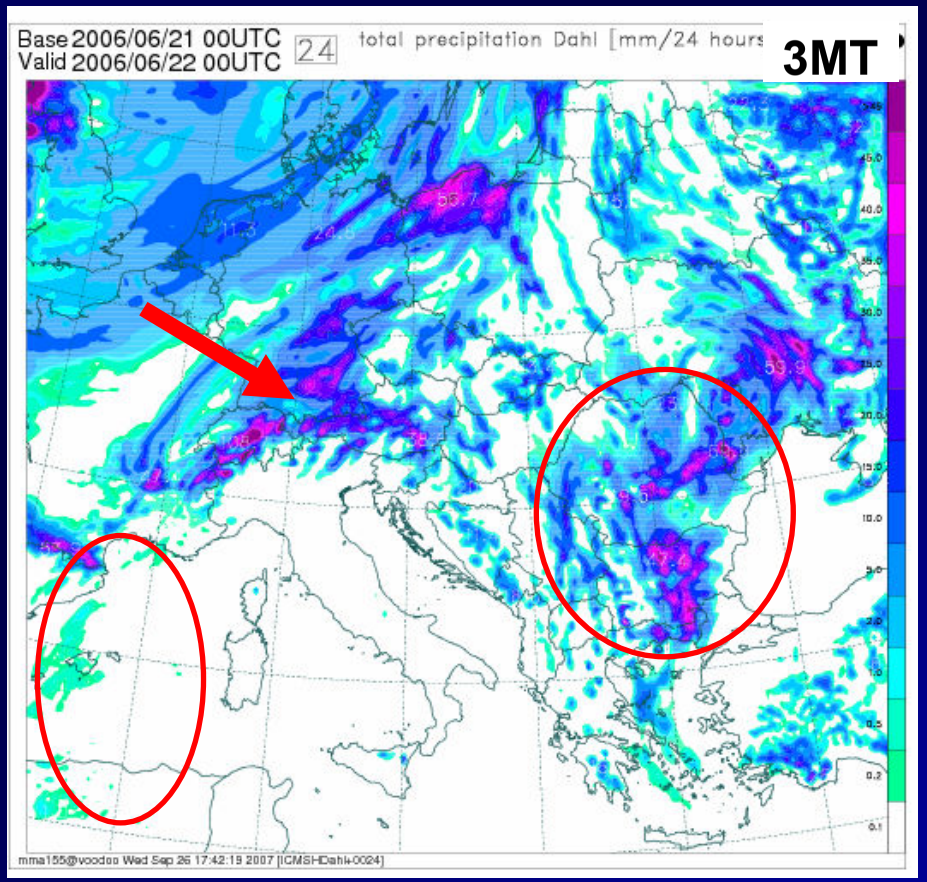
DDH product

Influence of tuning



3MT results

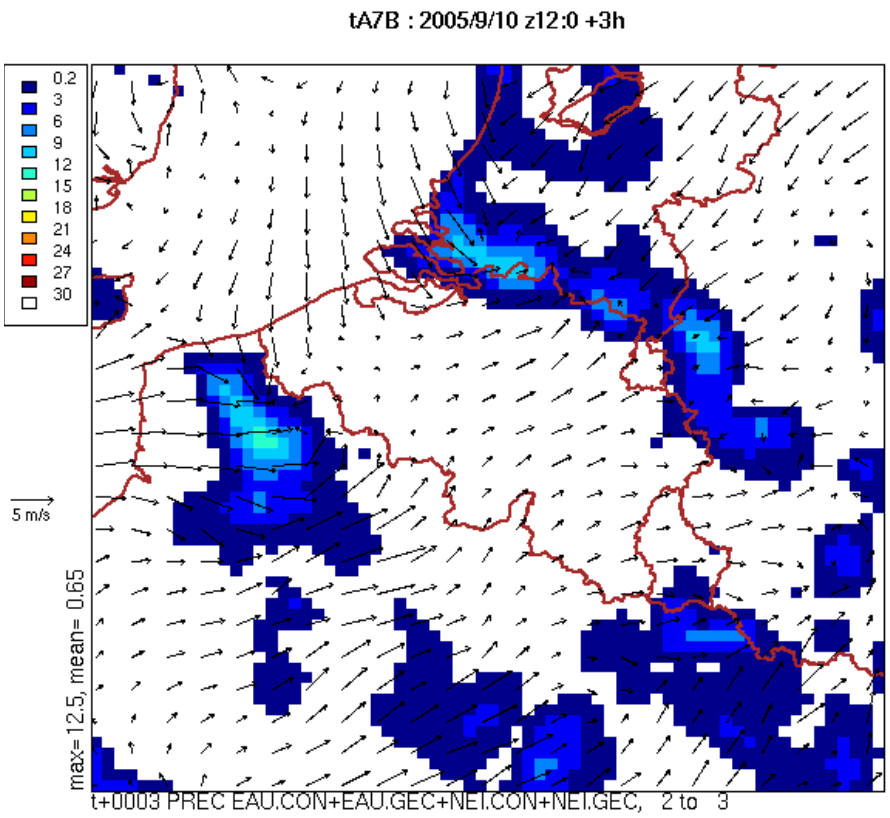




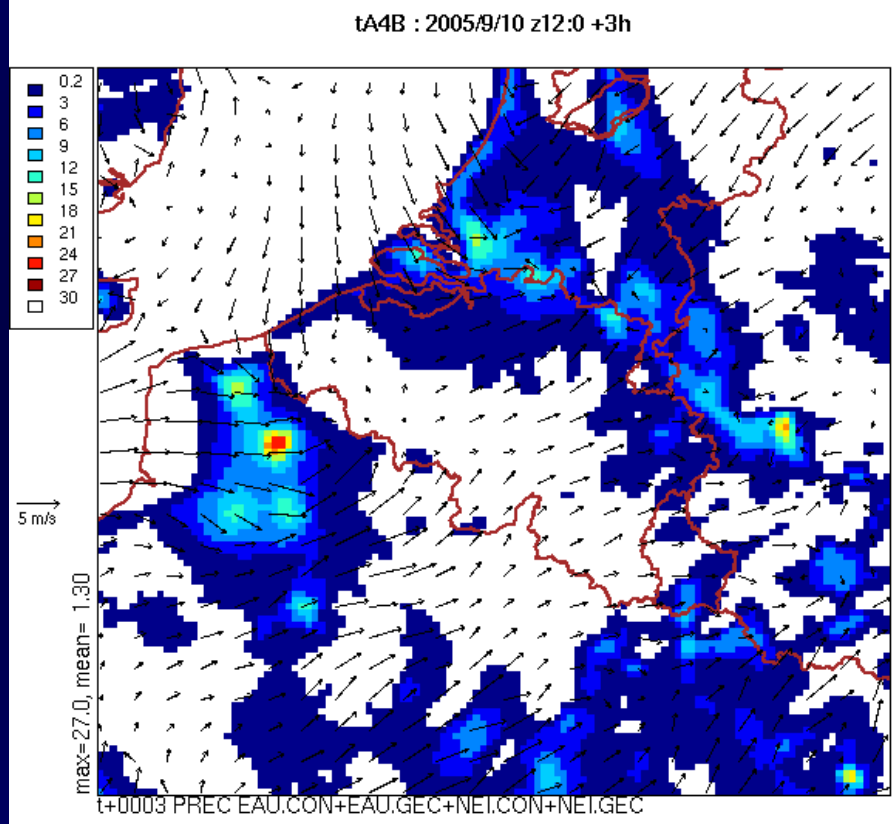
More realistic structure

3MT results

3MT 7km



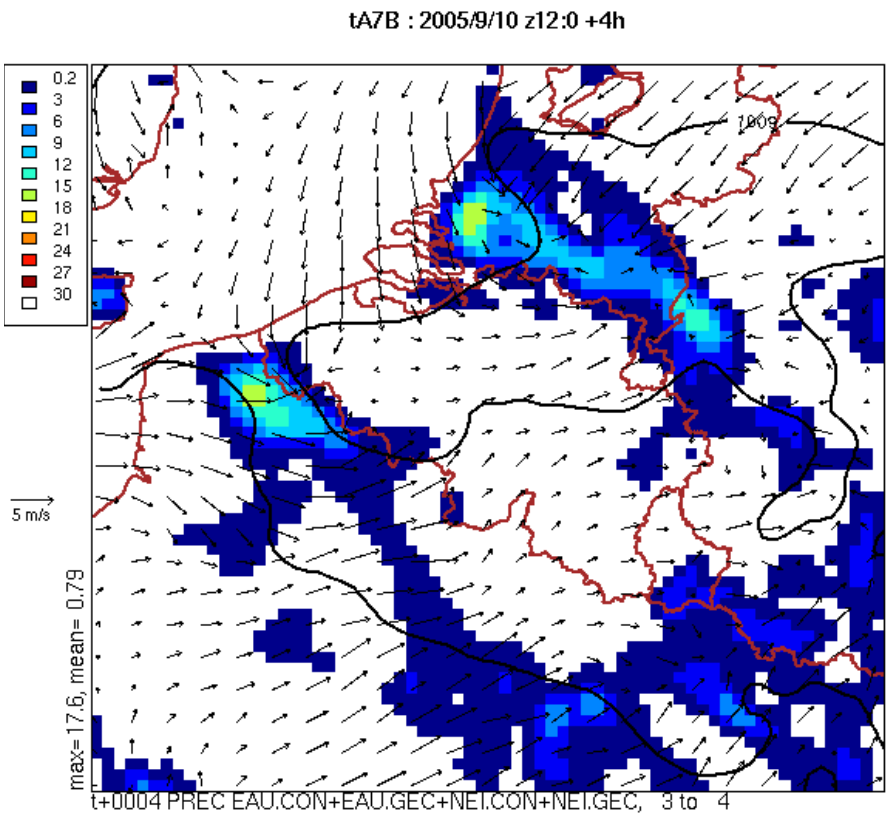
3MT 4km



10.9.2005 +03

3MT results

3MT 7km



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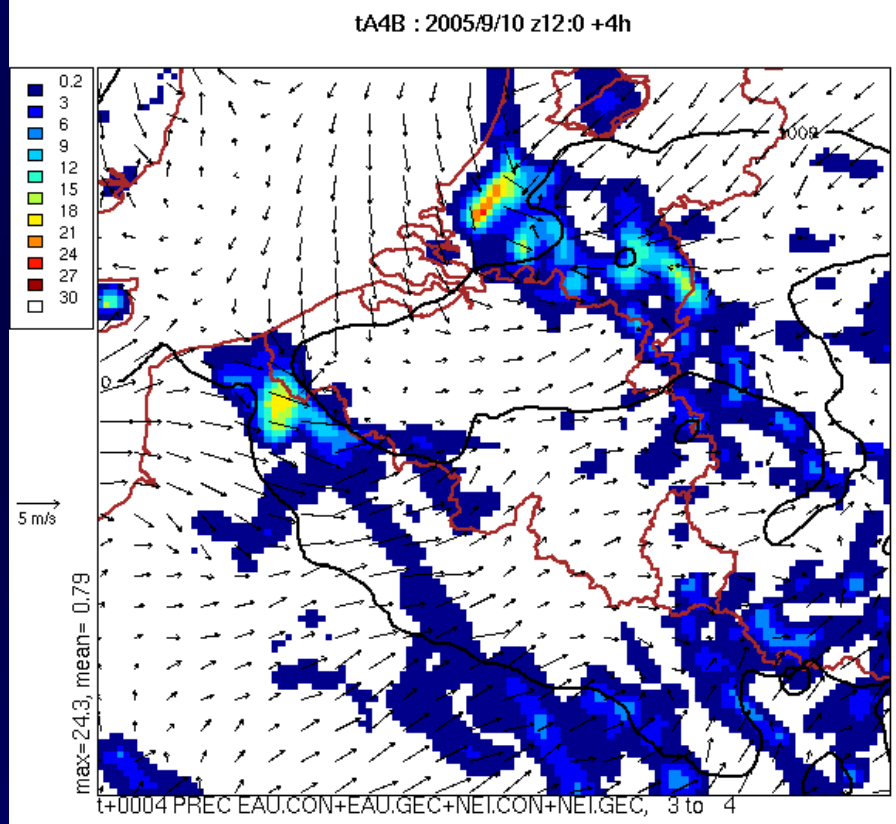

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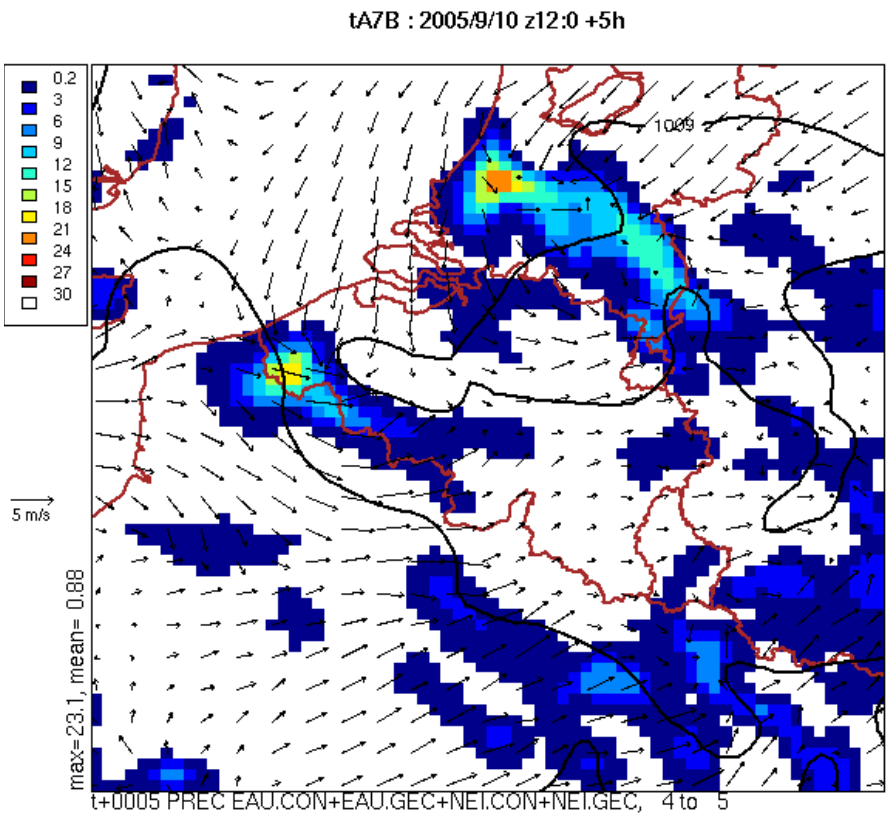
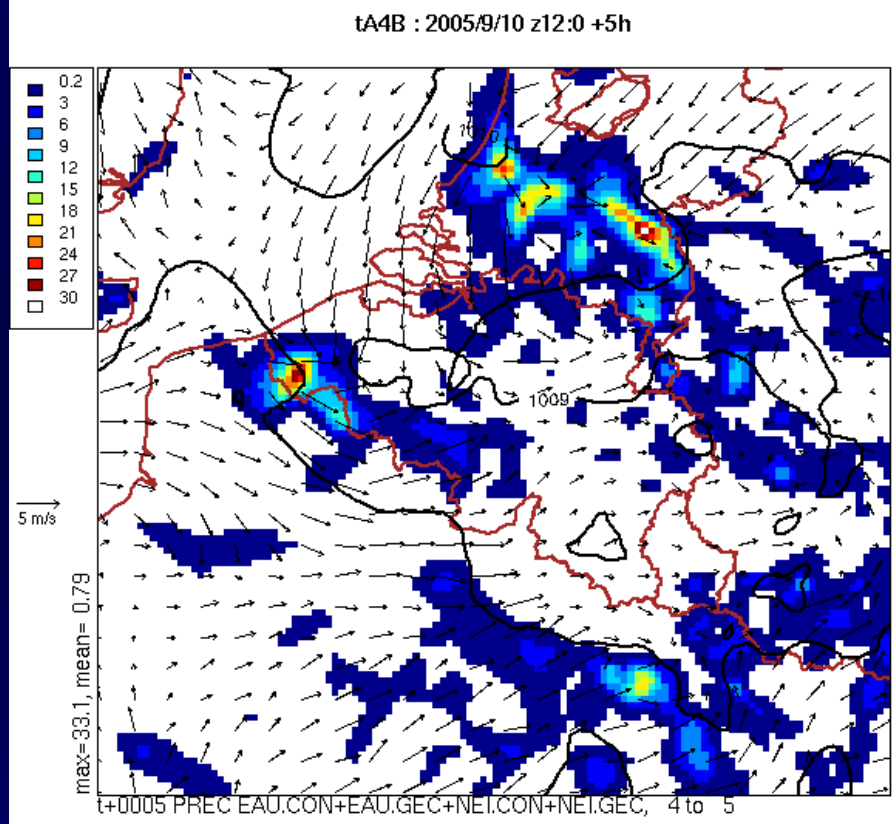
3MT results

3MT 7km



3MT 4km



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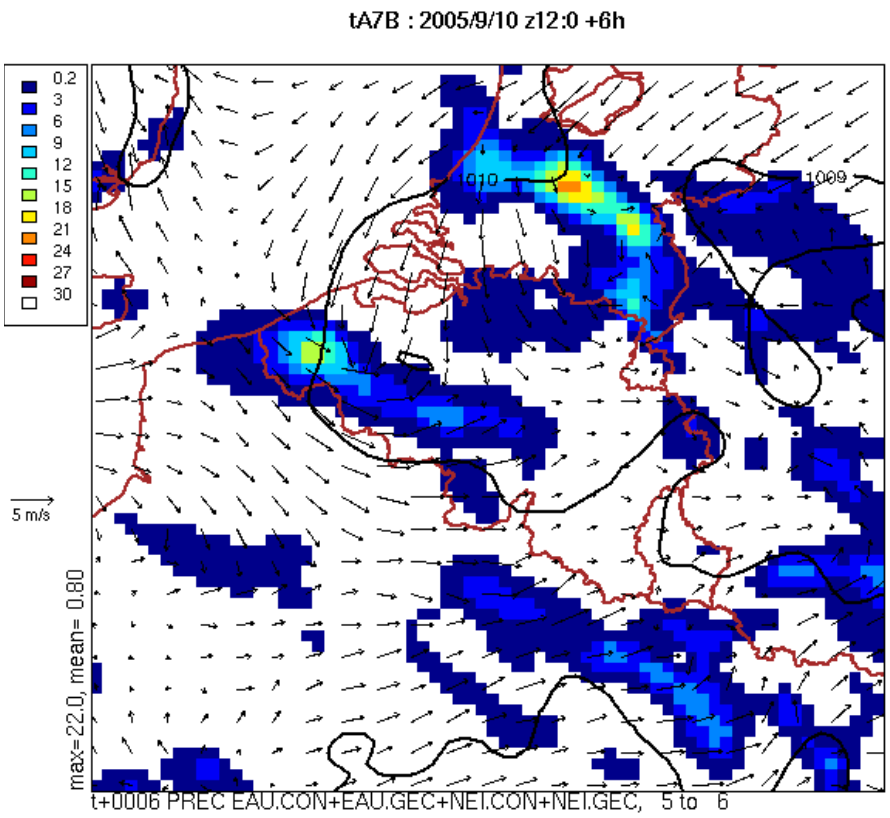
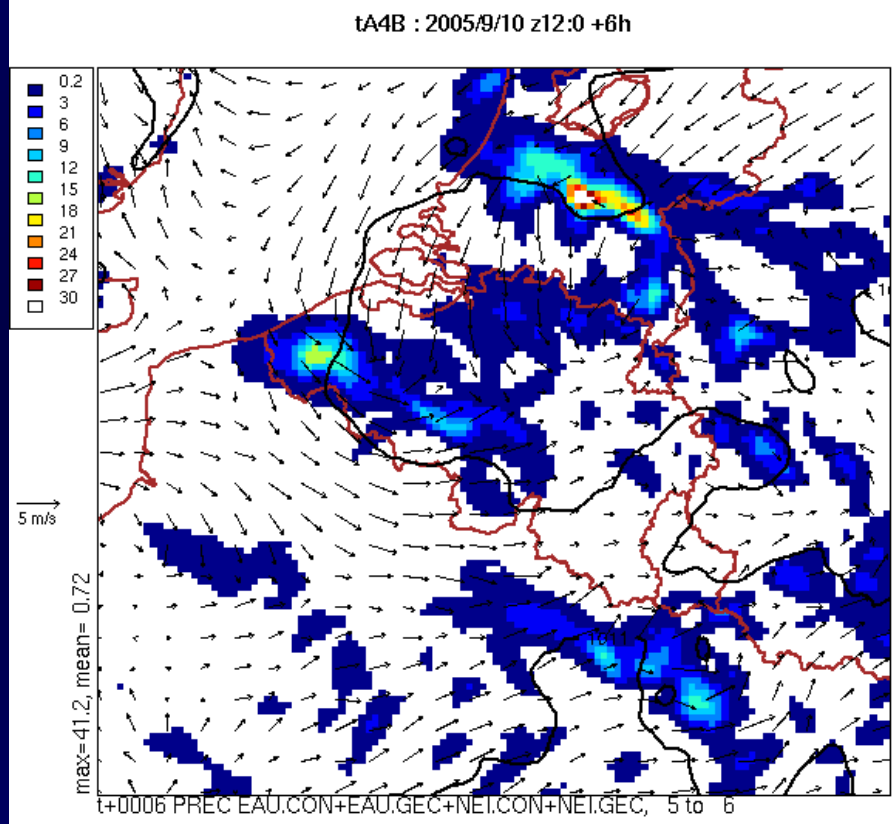
3MT results

3MT 7km



3MT 4km



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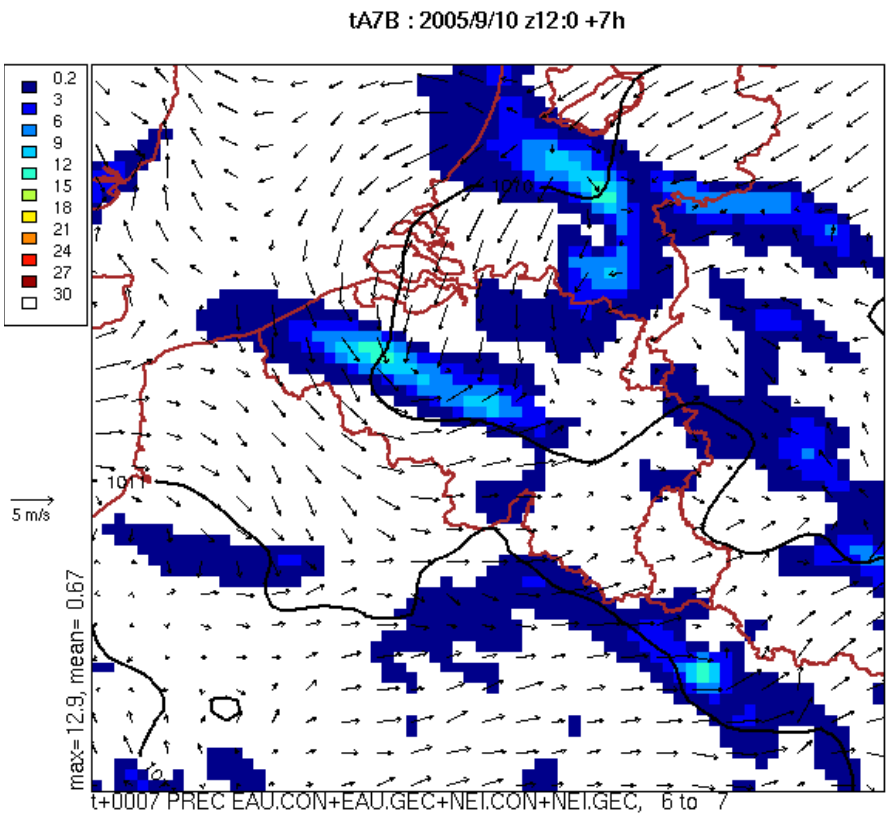
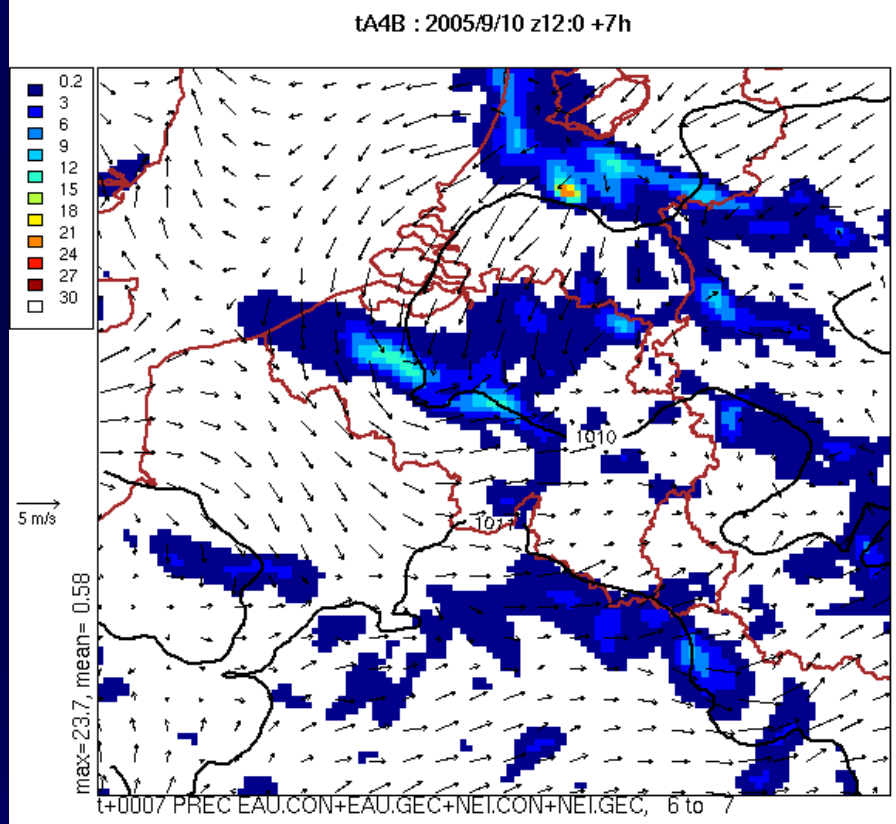
3MT results

3MT 7km



3MT 4km



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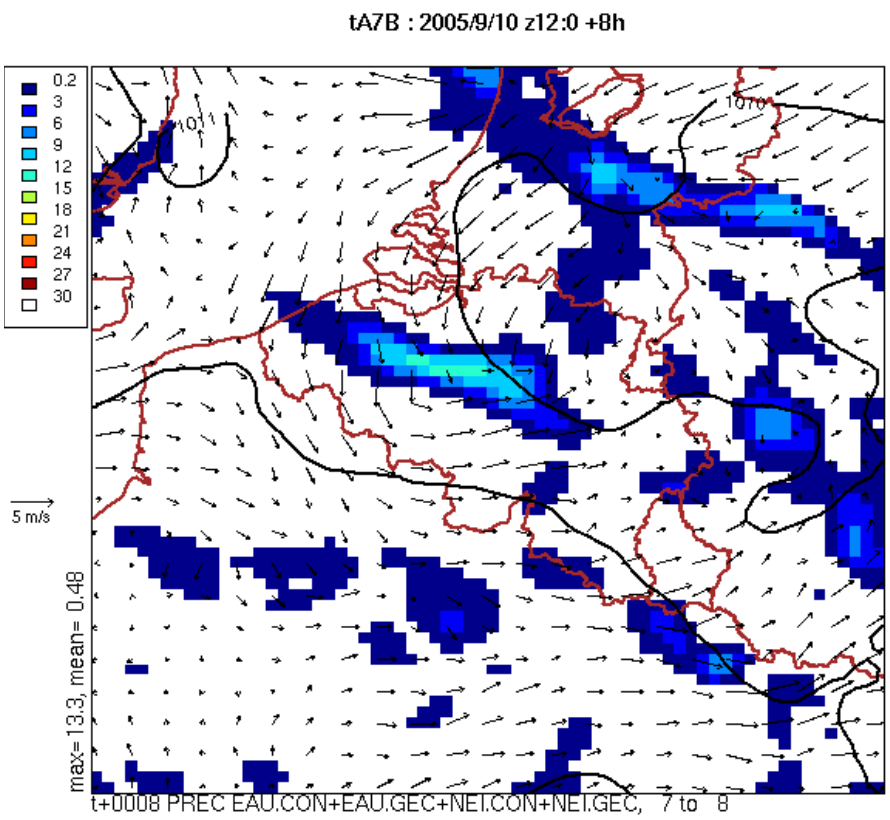
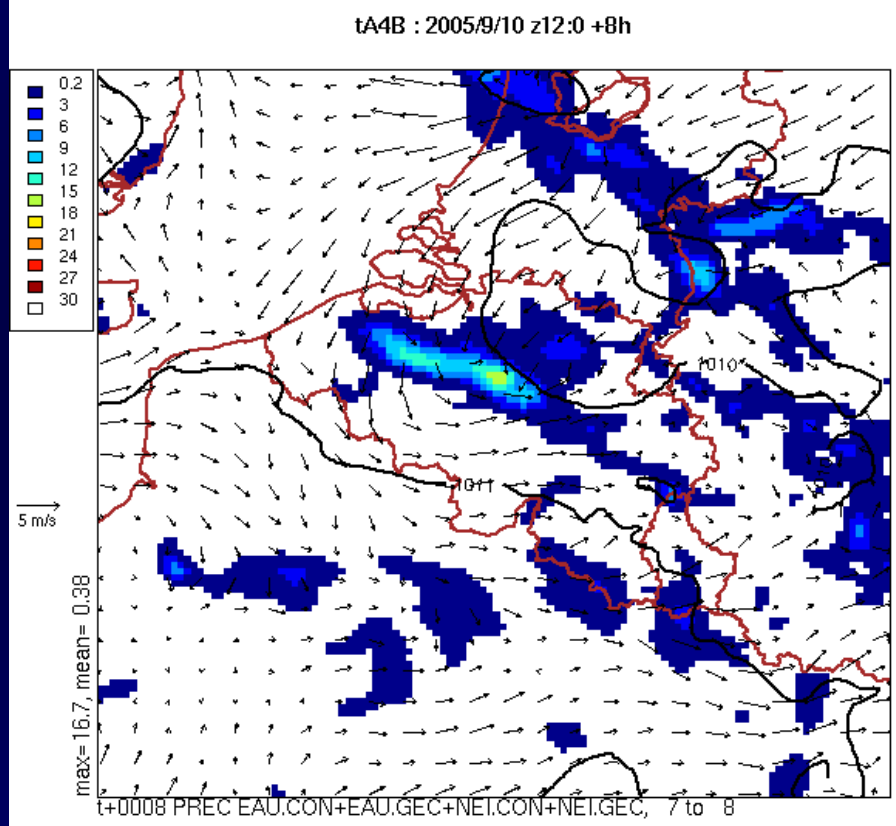
3MT results

3MT 7km



3MT 4km



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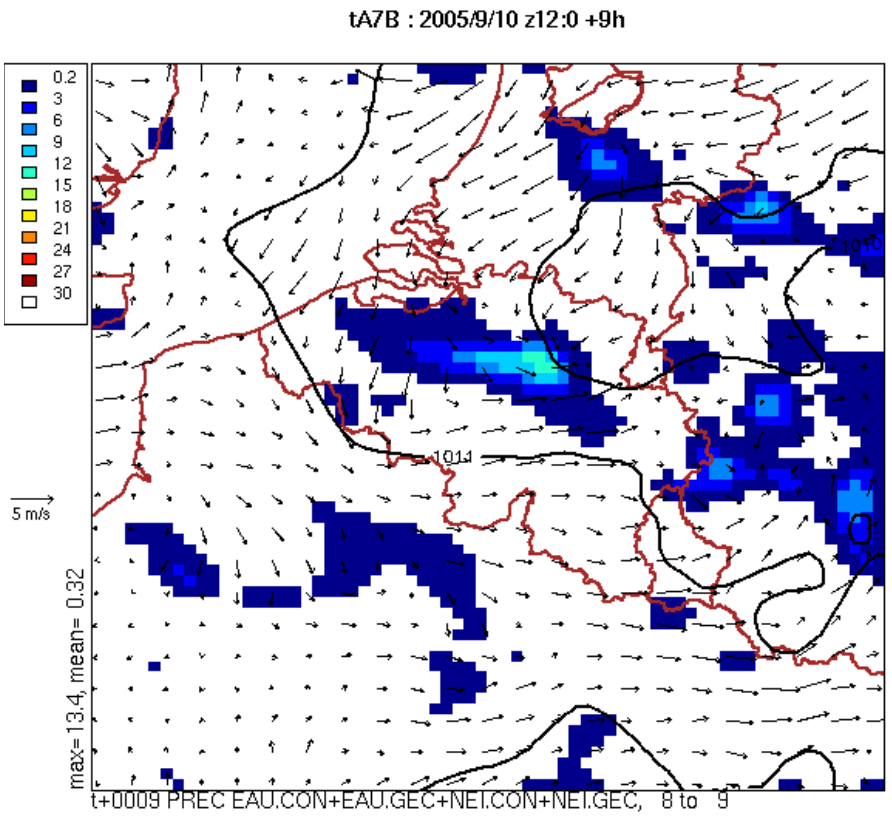
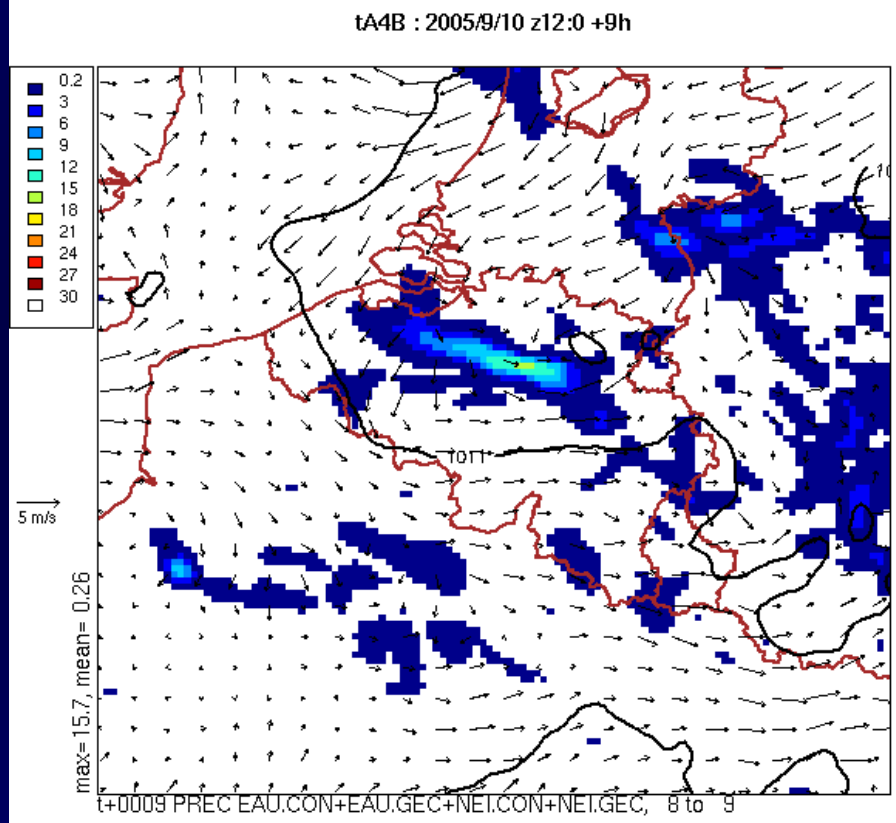
3MT results

3MT 7km



3MT 4km



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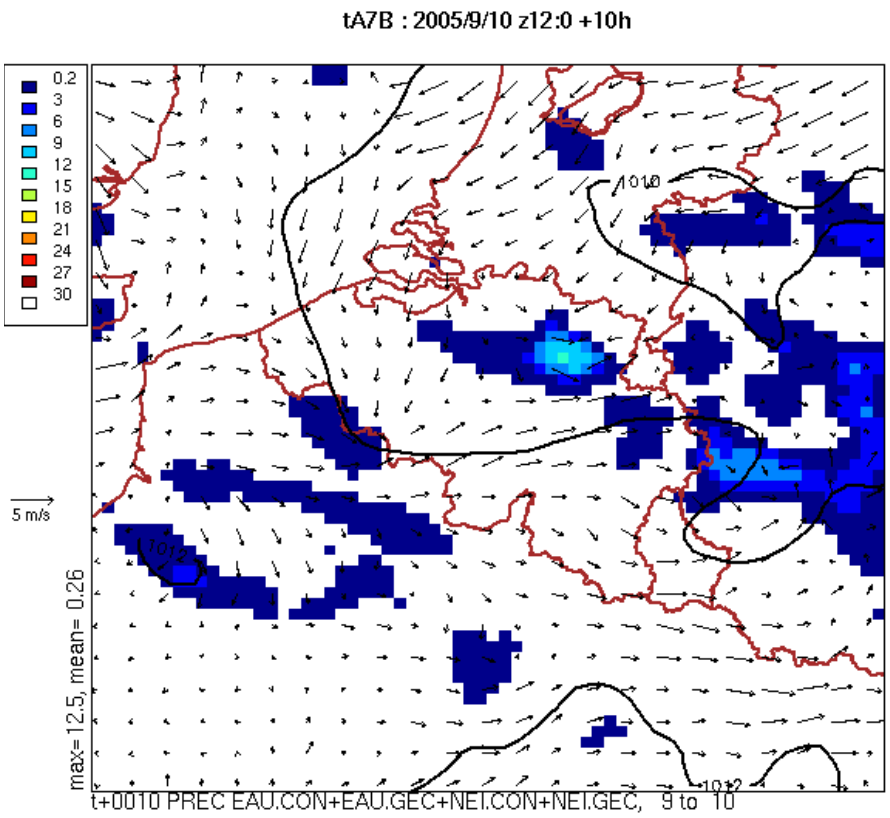
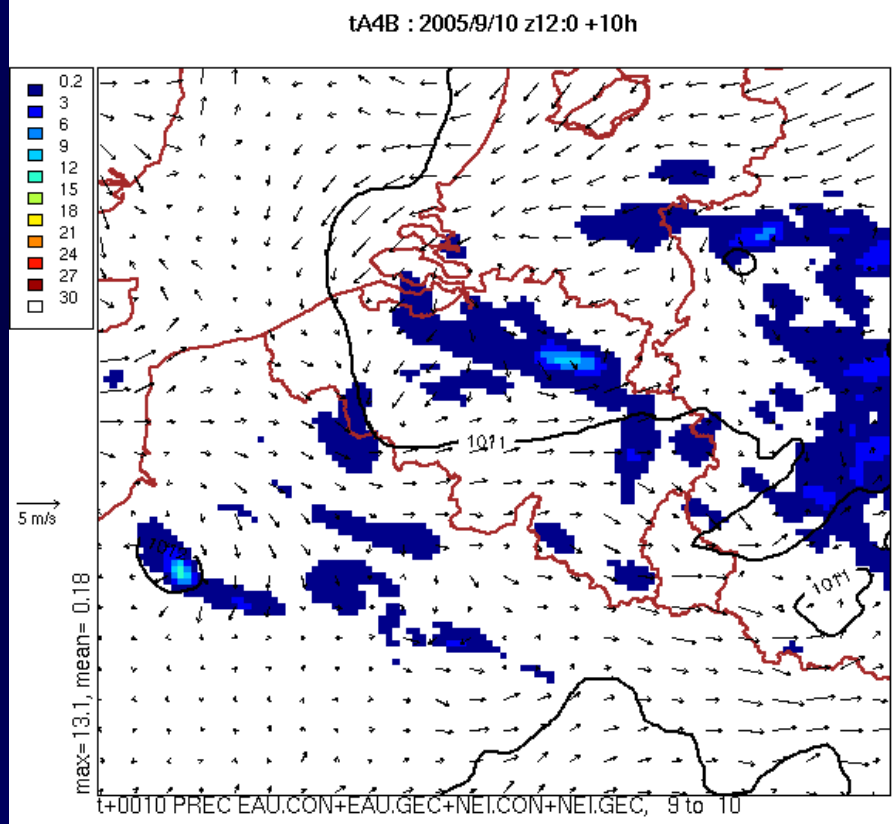
3MT results

3MT 7km



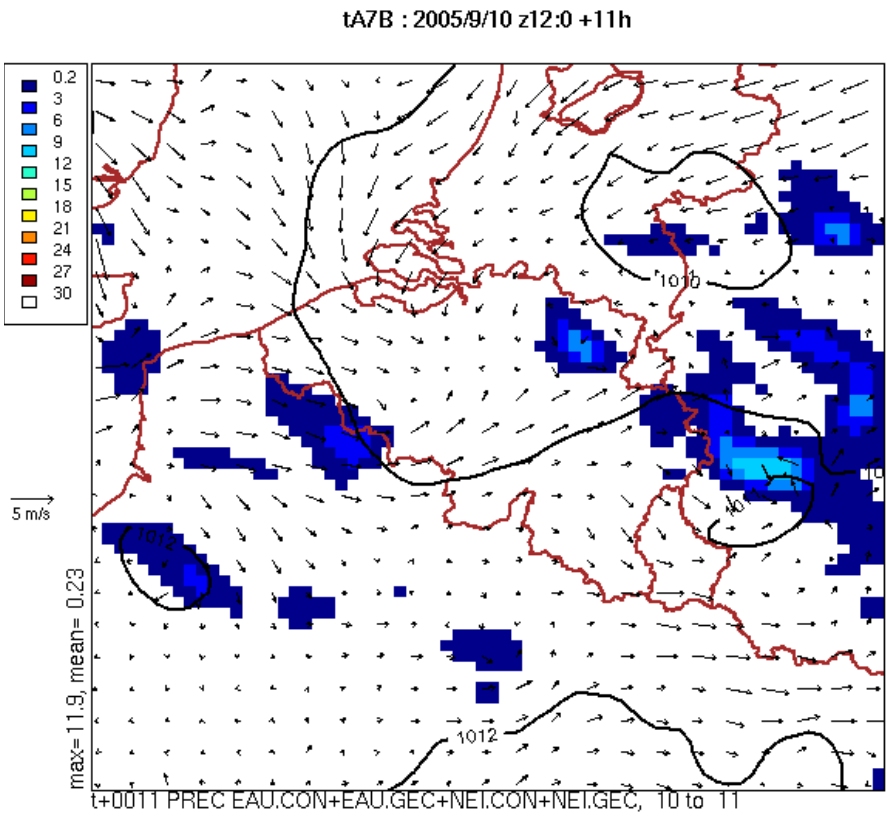
3MT 4km



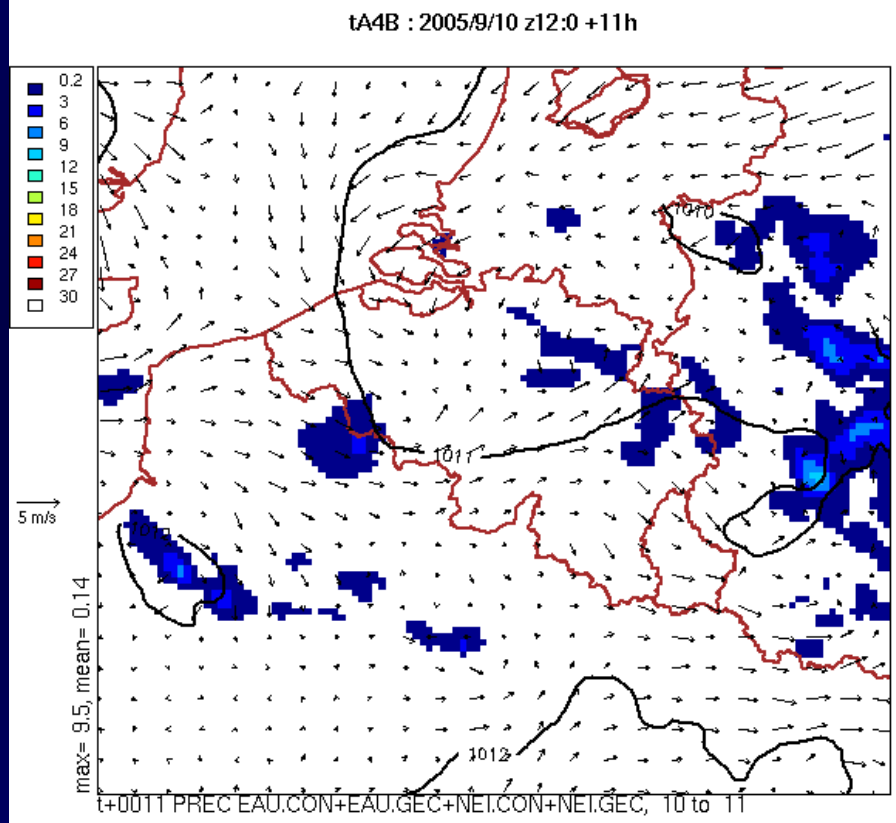
10.9.2005 +10

3MT results

3MT 7km



3MT 4km



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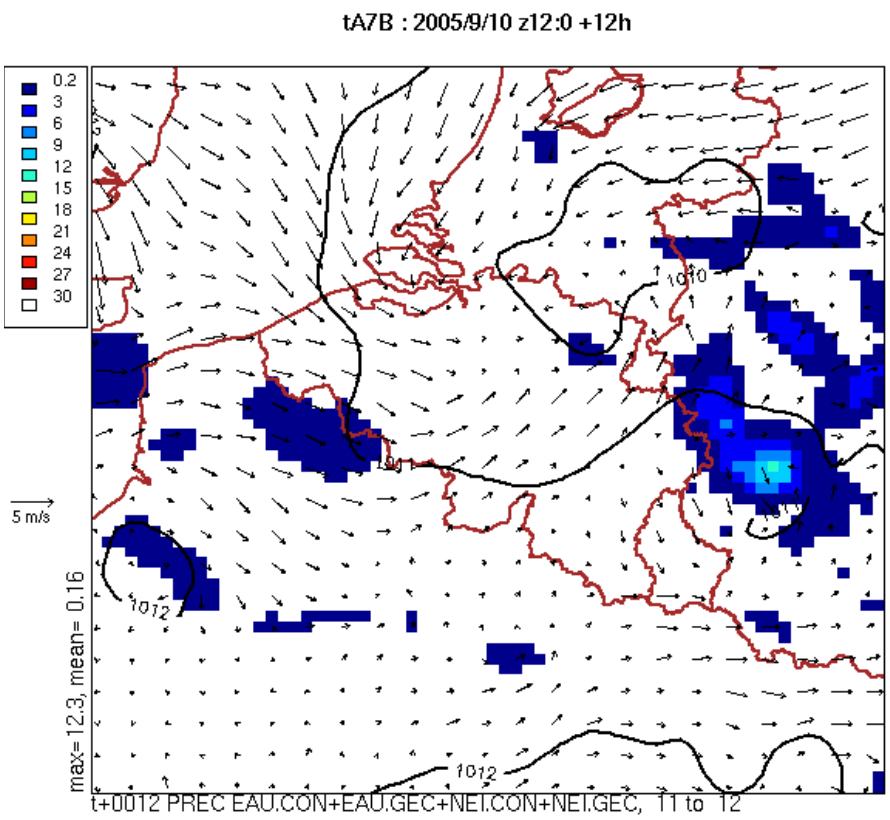
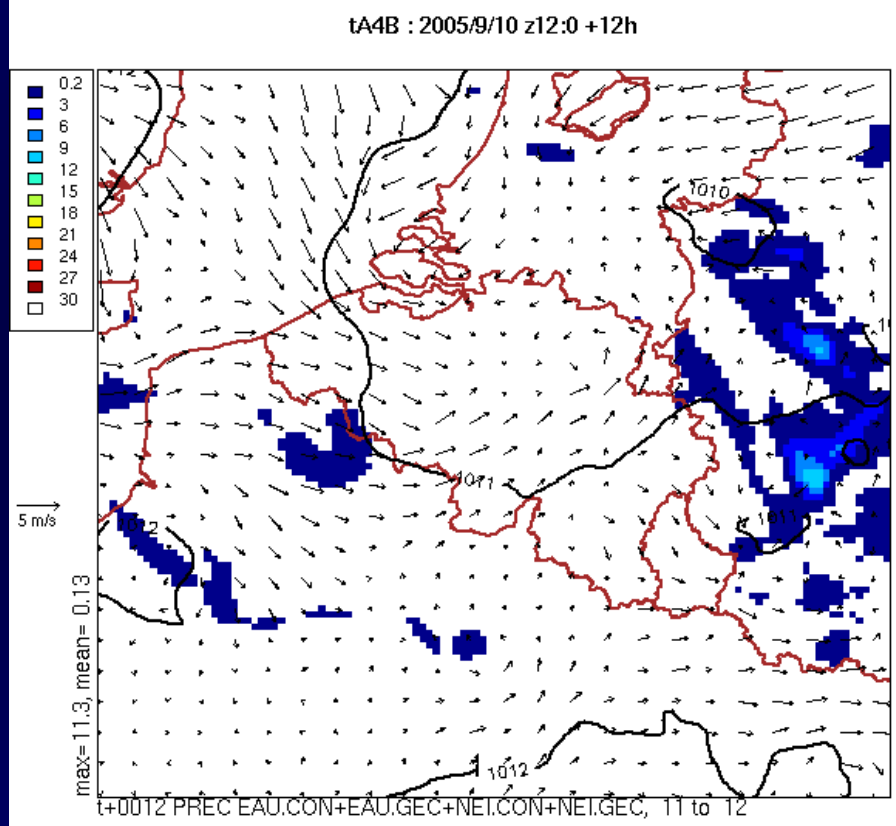
3MT results

3MT 7km



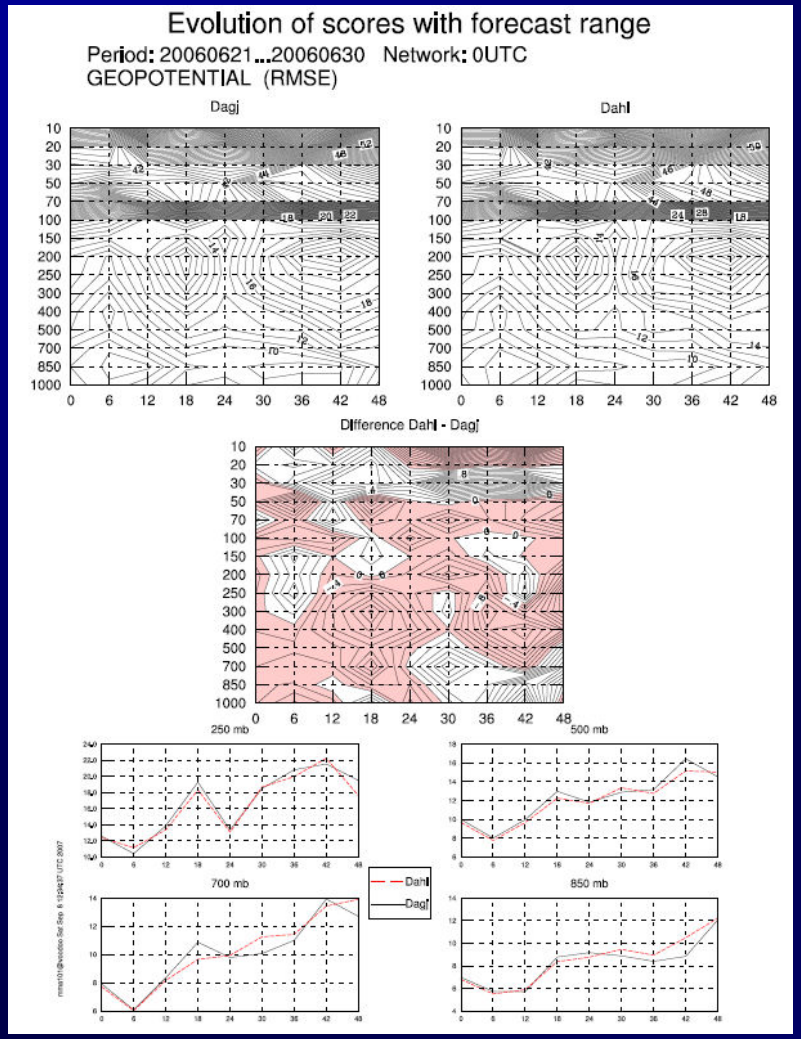
3MT 4km

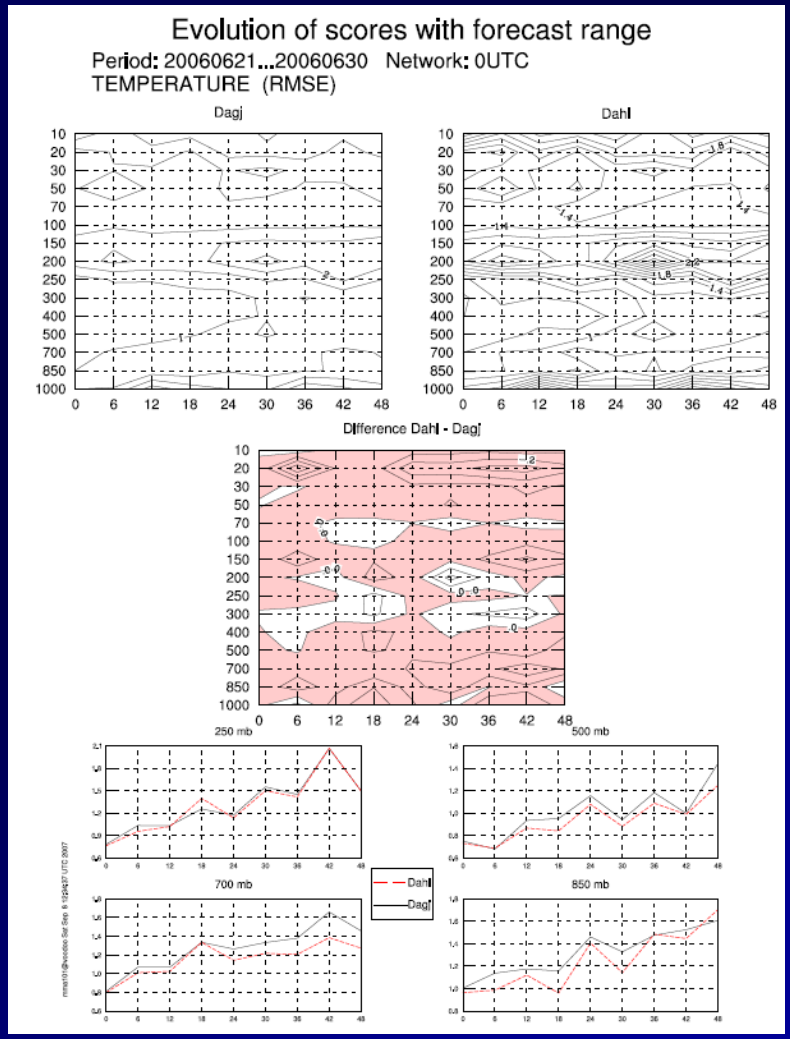


10.9.2005 +12

consistant

3MT results


Evolution of scores with forecast range
Period: 20060621...20060630 Network: 0UTC
GEOPOTENTIAL (RMSE)
Dagj
Dahl
Difference Dahl - Dagj
250 mb
500 mb
700 mb
850 mb
Dahl
Dagj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Difference Dahl - Dagj
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Dahl
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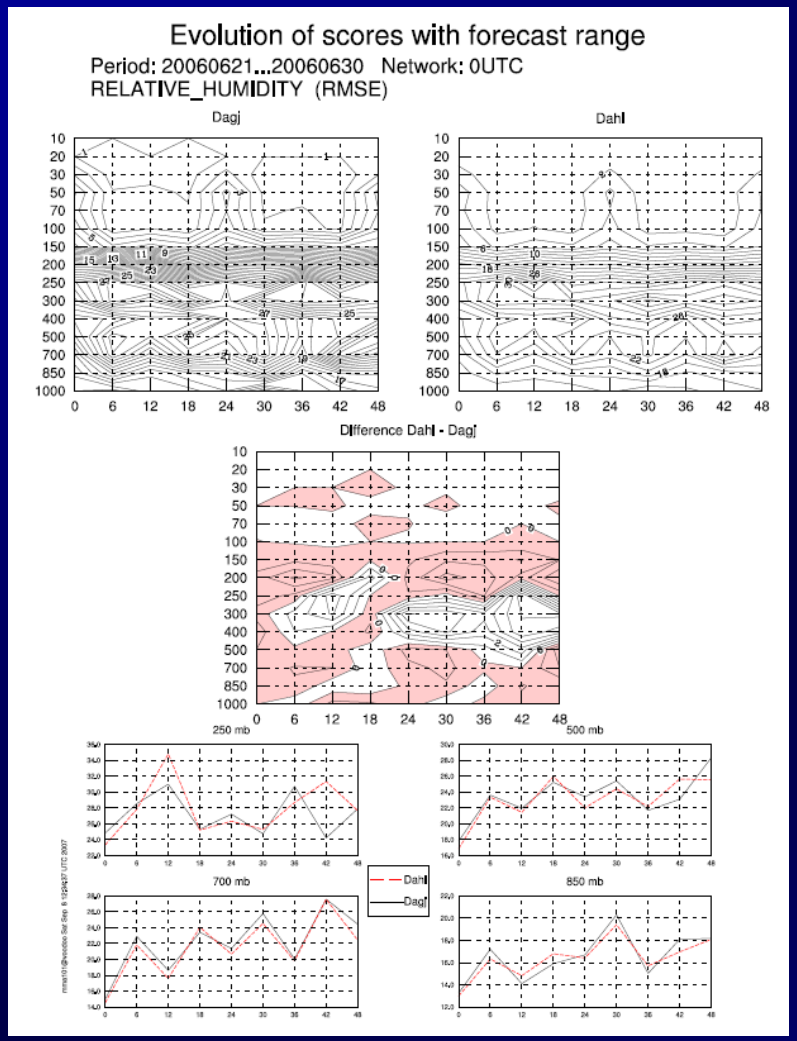
3MT results


Evolution of scores with forecast range
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RELATIVE_HUMIDITY (RMSE)
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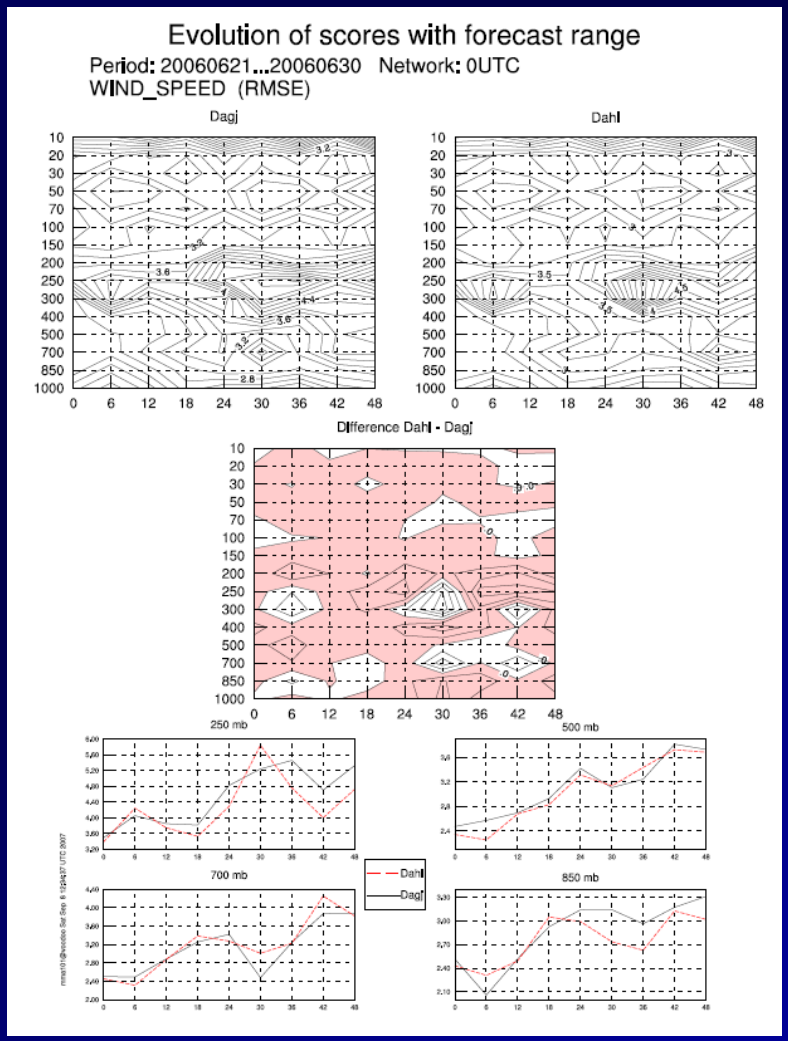
Dahl
Difference Dahl - Dagj
250 mb
500 mb
700 mb
850 mb
Dahl
Dagj


Evolution of scores with forecast range
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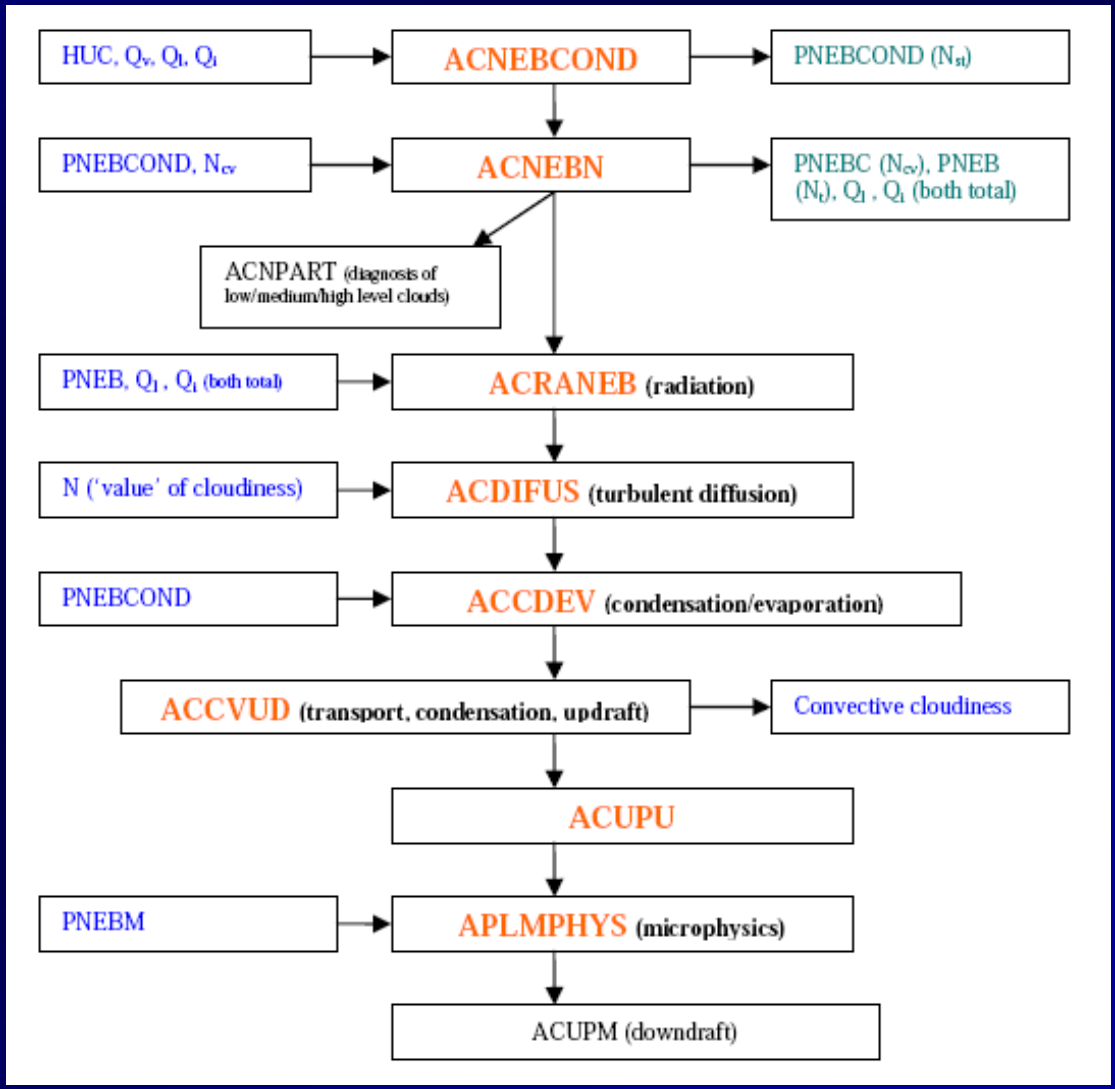
WIND_SPEED (RMSE)
Dagj
Dahl
Difference Dahl - Dagj
250 mb
500 mb
700 mb
850 mb
Dahl
Dagj

Cloudiness

- **Work has started**
- **Analysis from scratch of the problem**
- **Aim: modularity and generality**



Plans

- To solve already diagnosed problems in 3MT
- Evaluation of parameterization developments
  - Technical and scientific validation
  - Case studies, verification
- 3MT in operations in 2008

- Turbulence, radiation, cloudiness (modular approach also)

ALARO-0 training

- **26-30 March, Radostovice**
- **27 participants from 12 countries**
- **Lectures, exercises, working groups**

- **http://www.rclace.eu/?page=99**