Physics overview

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Contents presentation

- Summary Brac workshop
- Summary Jeju (Korea, WRF) workshop
- Comparison AROME-France & COSMO-DE
- Possible topics for cooperation

Summary Brac

- Held to discuss the way forward with mesoscale physics modelling in ALADIN/HIRLAM
- Laterality
- Stochasticity
- Memory
- (Scalability)

Brac: Laterality

- In AROME/ALARO no 3D effects of turbulence (and other processes)
- May help to dampen the activity of the non-organized air mass convection
- We need 3D turbulence, Piotrowski paper shows that this is delicate issue

Laterality

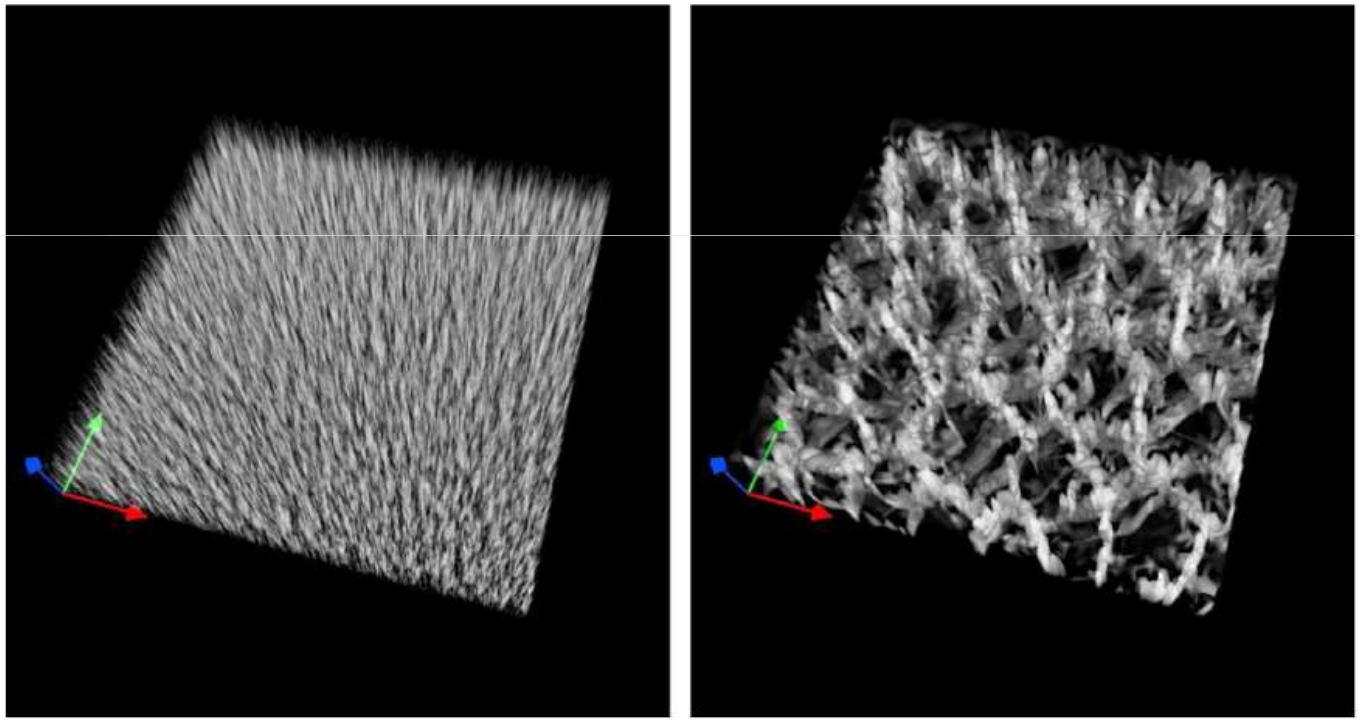

Fig. 2. Structure of thermal convection over heated plane. Vertical velocities after 6 h of simulated time are shown within the PBL depth; bright volumes denote updrafts. The only difference between the two solutions is the value of viscosity in the horizontal.

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Brac: Stochasticity

- Physics routines represent average response, may smooth fields too much
- Reduces the energy in models at smallest scales (together with diffusion)
- Addition of stochastic elements may result in better energy spectra, variance and representation of convection at smallest scales.

Memory

- Convection behaves differently depending on the history
- Initial convection small scale, large impact of environment (entrainment)
- After initial burst organization of updrafts on cold pool edge, larger scales and less impact of entrainment
- Entrainment dependent on convection memory (through cellular automatons)

Summary Jeju Workshop

- Organized by WRF

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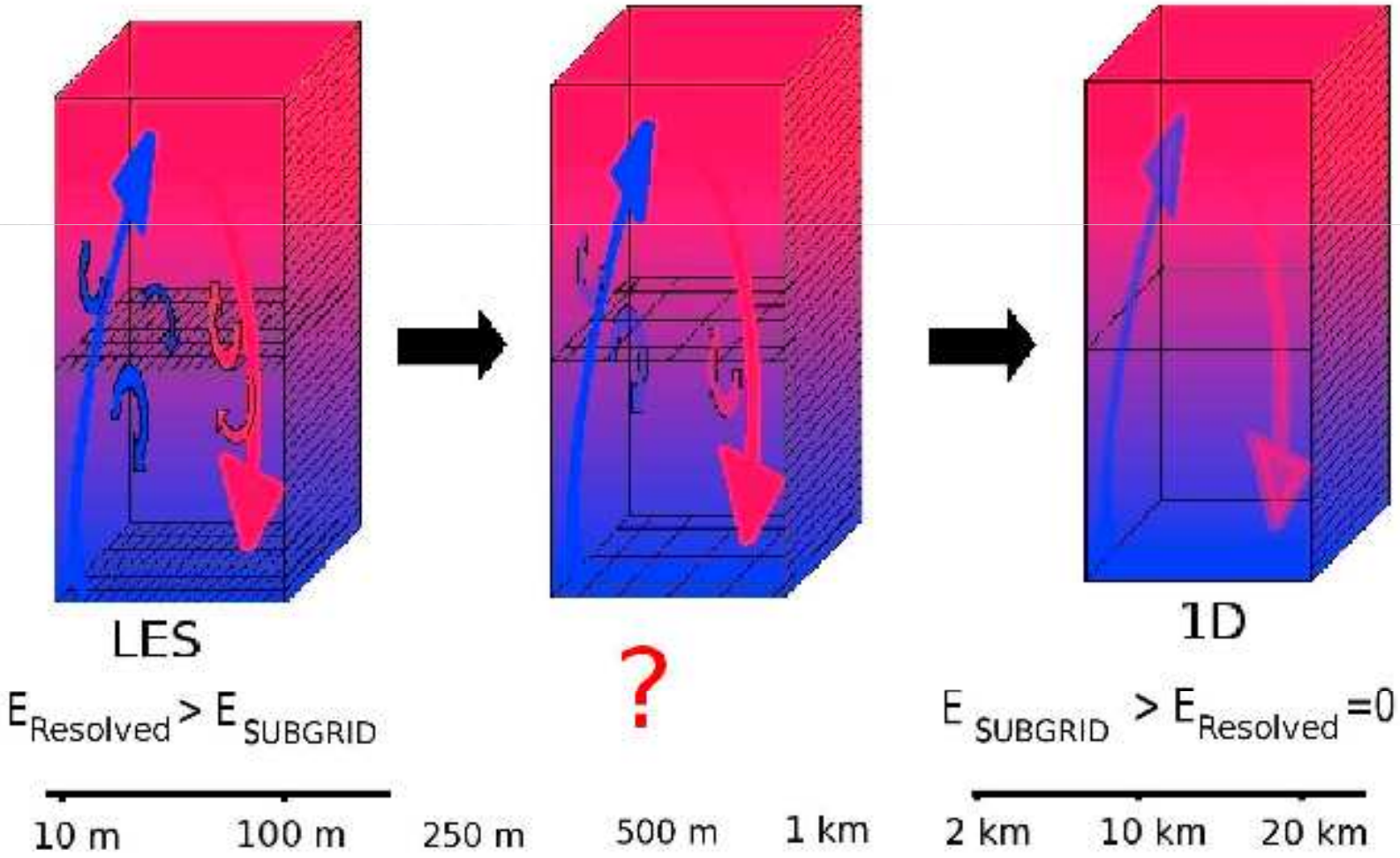
Summary Jeju (S. Niemela)

- Current state High Res NWP, operational 1.5 – 4 km
- Multi scale modelling, super parameterizations, more for GCM's
- Precipitation and chemistry physics: 2 moment schemes. Chemistry modules too expensive for current operational use.
- Turbulence: shallow convection schemes like EDKF, QNSE for stable conditions
- LES: essential tool for developing future PBL schemes at 100-1000 metres resolution -> grey zone for turbulence: talk Rachel Honnert (next slides)

What happens at intermediate scales ?

Use Meso-NH in LES mode to see what happens at NWP-scale



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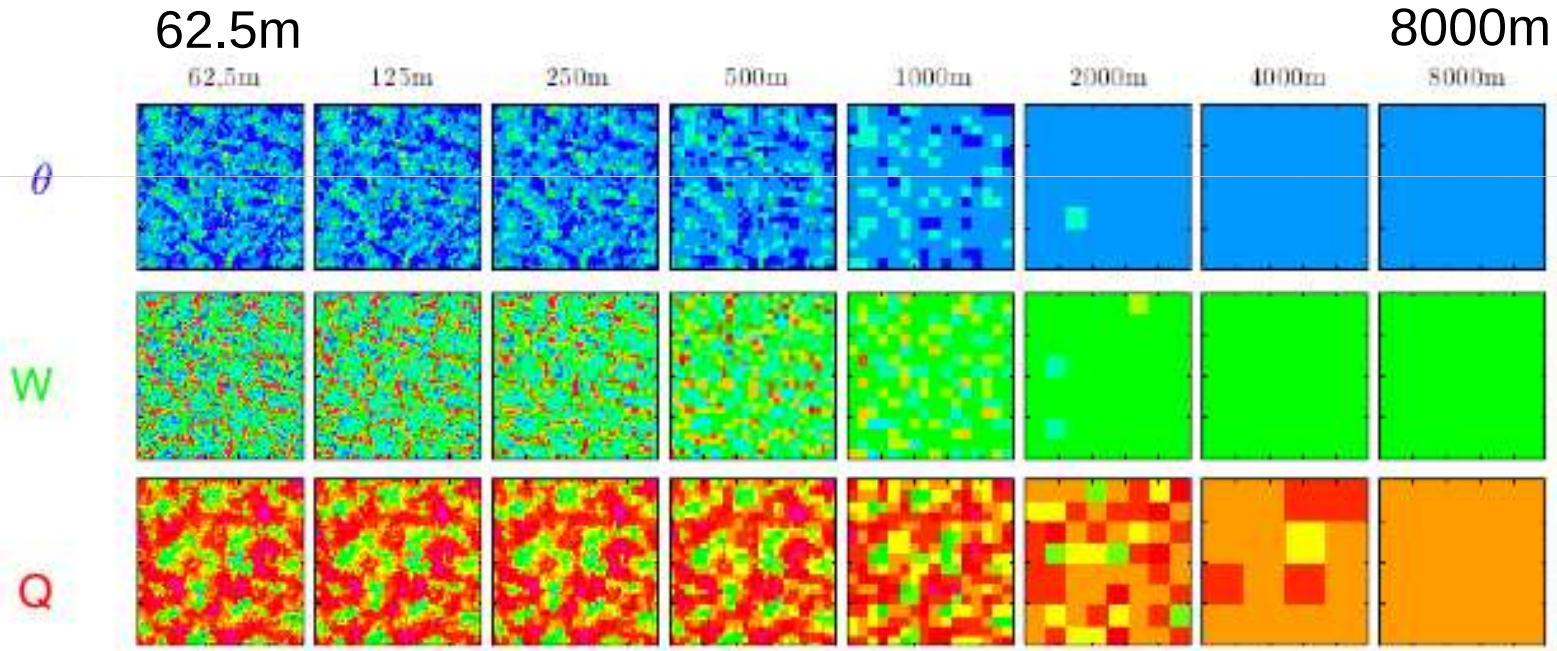
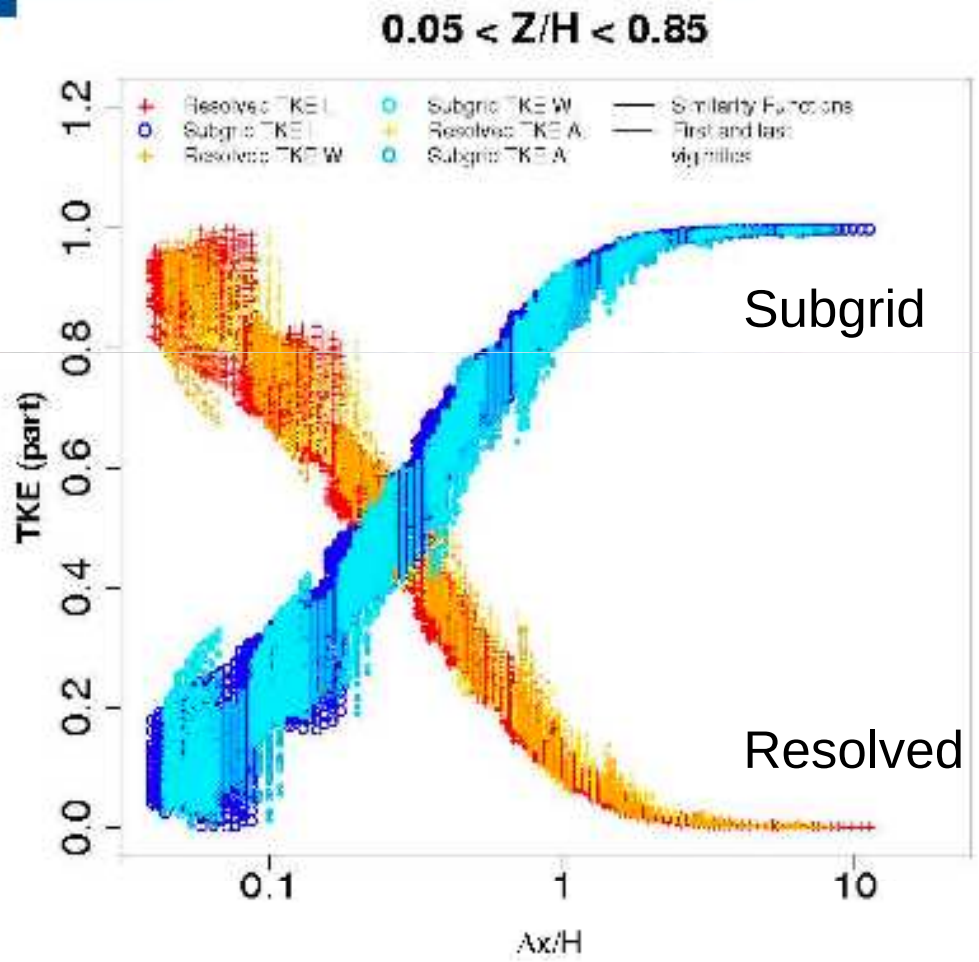
Calculation of the resolved and subgrid TKE

Horizontal cross section in the middle of the boundary layer



Averaging over larger boxes of original 62.5m results in Meso-NH

Partial Similarity functions : TKE in the mixed layer



DX/H

- The data follow the same function.
- For the fine meshes (near the LES), the subgrid part is smaller than the resolved one.
- When the mesh becomes coarser, the subgrid part grows up.
- For coarser meshes, the parameter becomes entirely subgrid as the resolved part is null.

Defaults of the partitions

Simulations without PMMC09

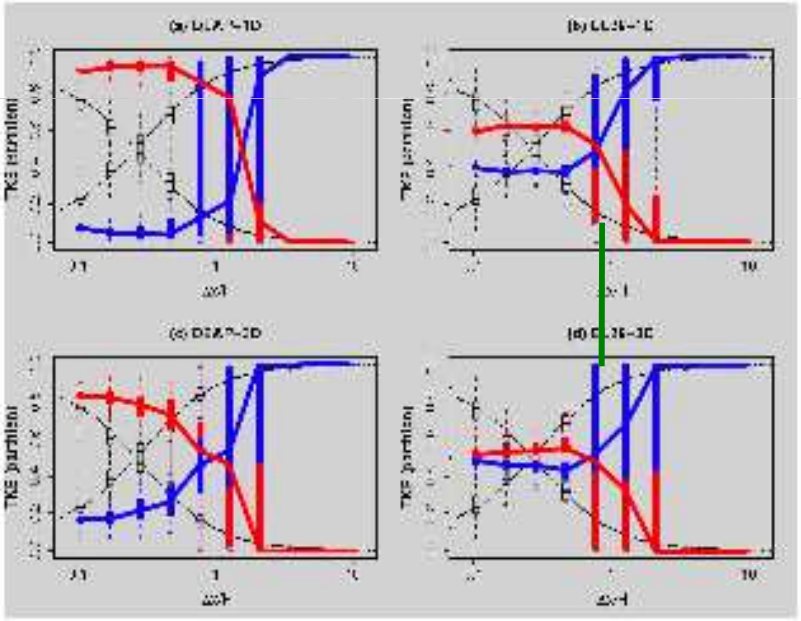
Simulations with PMMC09

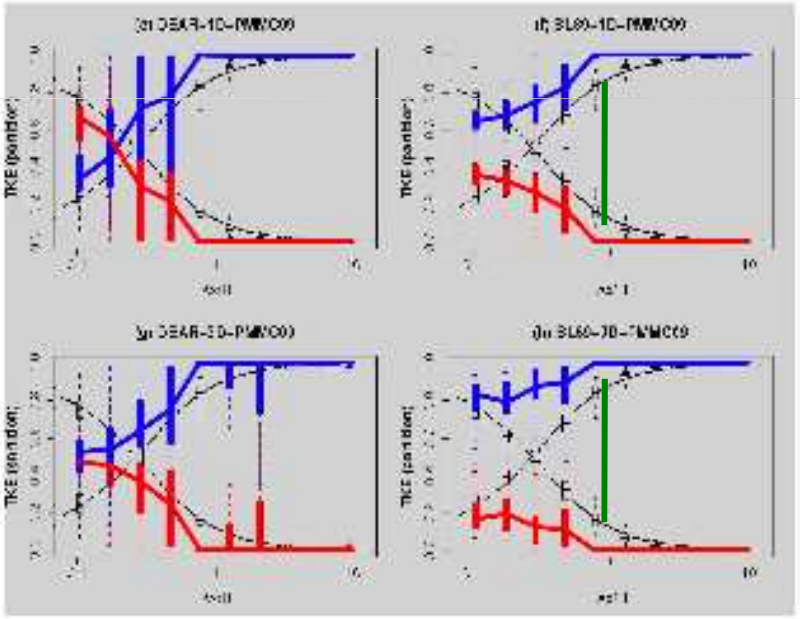
CBR

EDKF

1D

3D





The "Gray-Zone" of turbulence is ill-represented whatever the configuration.

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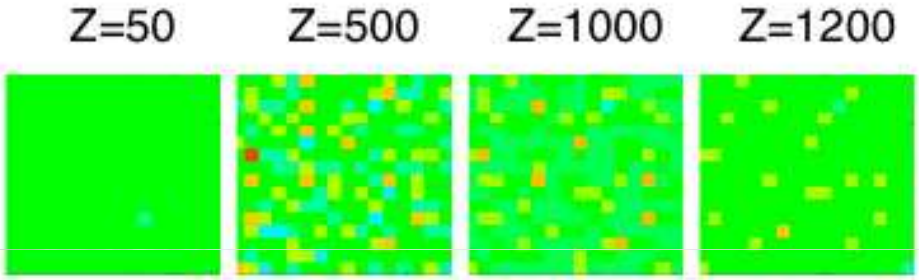
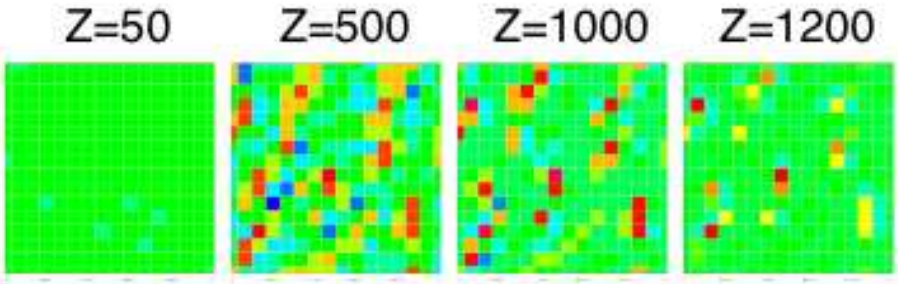
Horizontal cross-sections : IHOP, 1000 m resolution

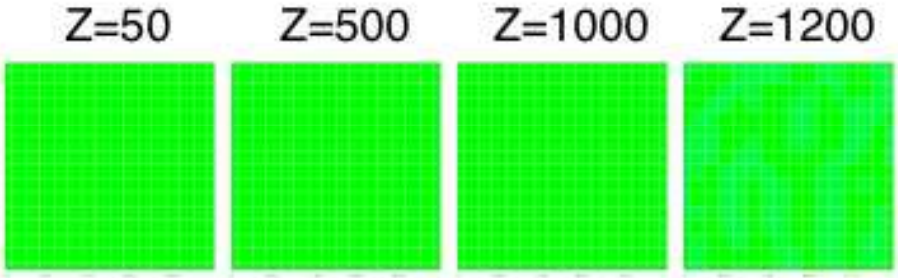
Reference



BL89-1D



BL89-1D-PMMC09



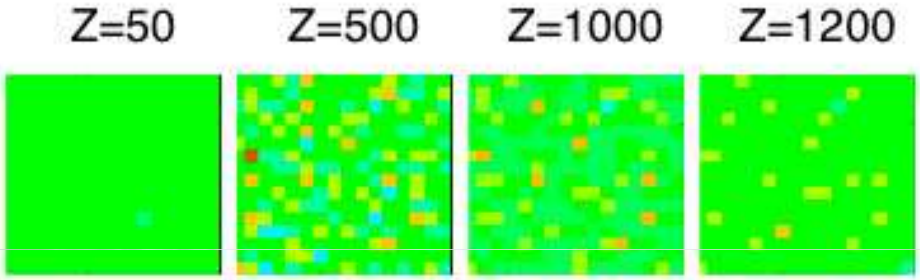
Without the mass-flux scheme

- Resolved movements too important.
- Too large structures.

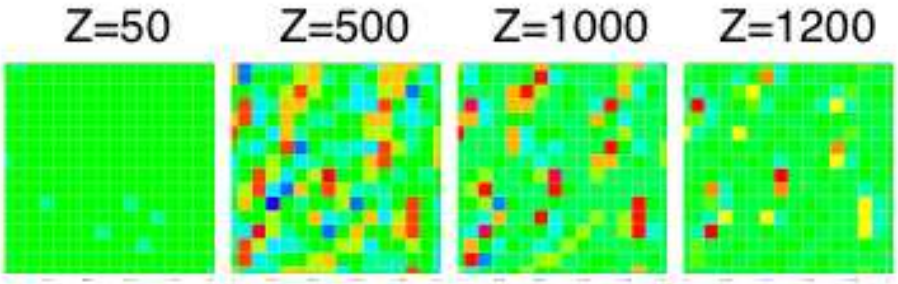
METEO FRANCE
Toujours un temps d'avance

Horizontal cross-sections : IHOP, 1000 m resolution

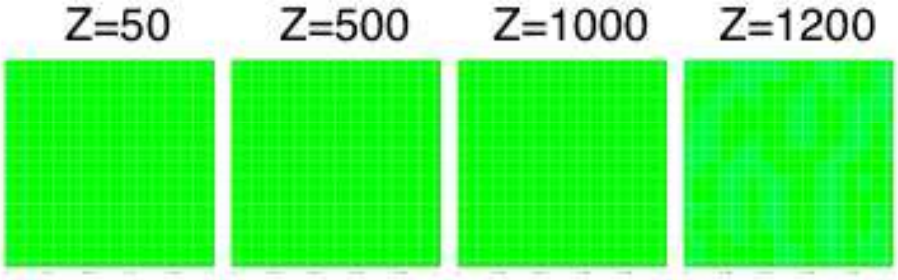
Reference



BL89-1D



BL89-1D-PMMC09



With the mass-flux scheme

- Deficit of variability.

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Toujours un temps d'avance

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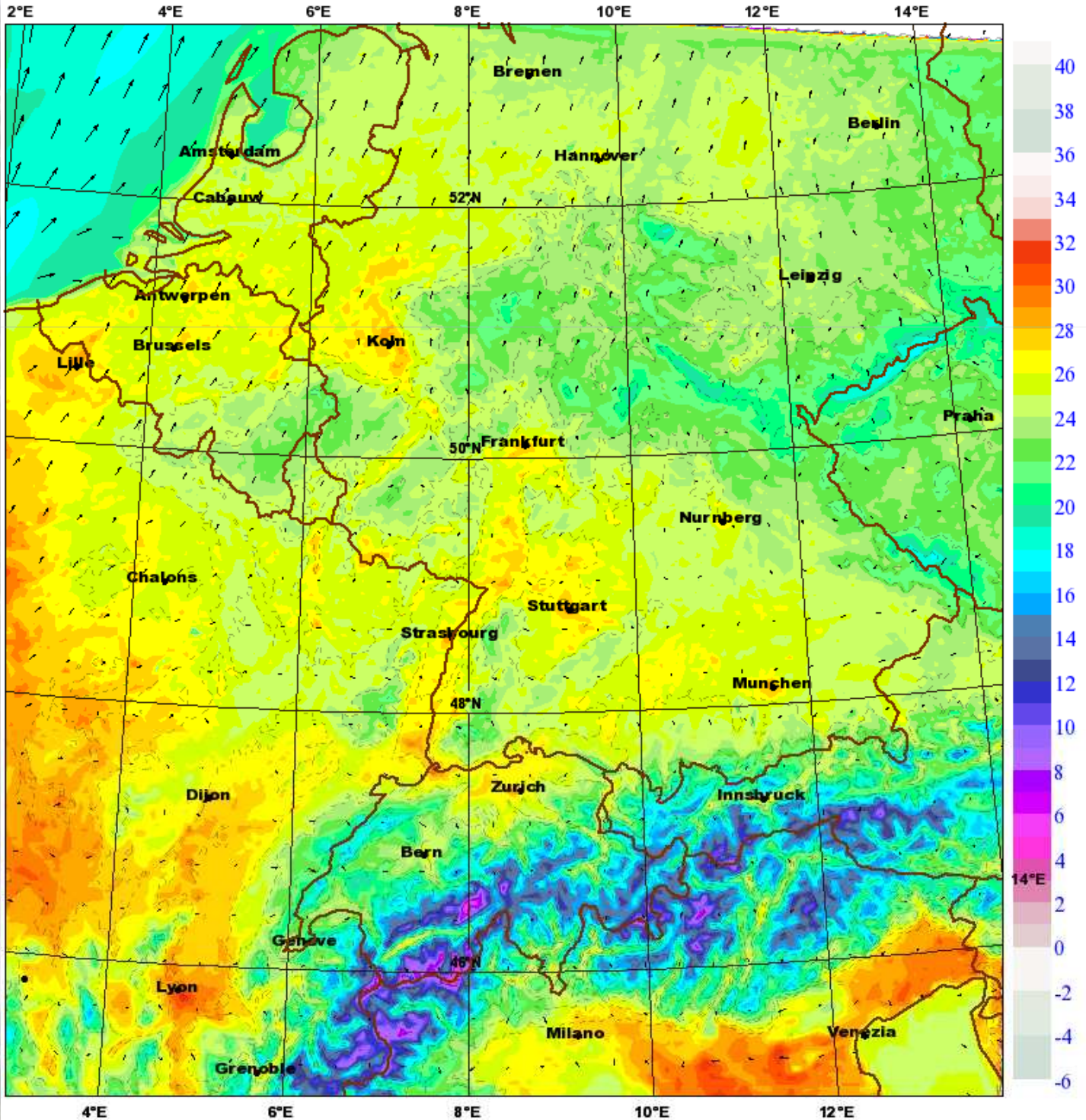
Lessons

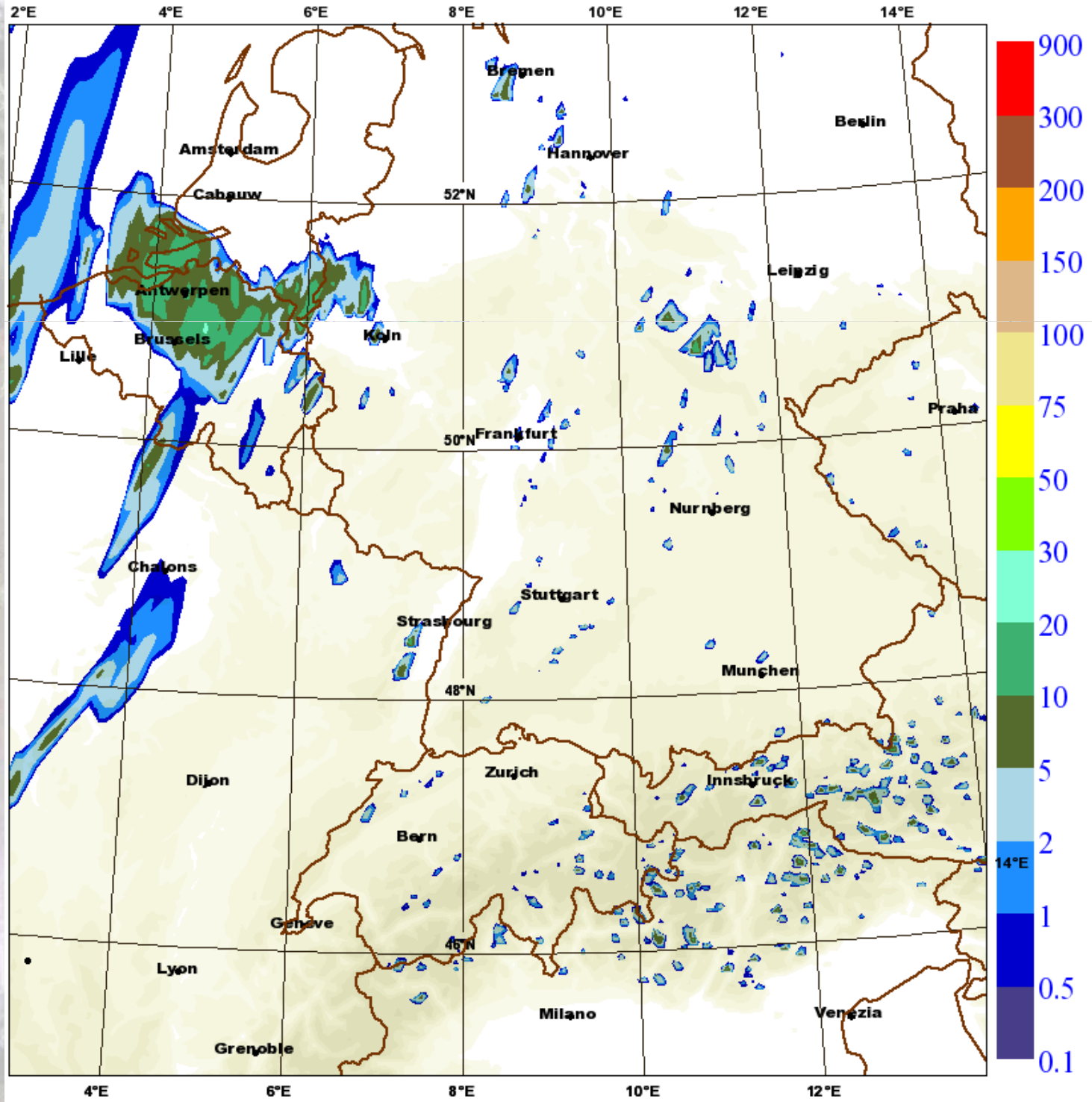
- Simple TKE scheme causes too many resolved eddies in PBL, too many small showers in deep convection situations, too early onset of convection
- Eddy Diffusion Mass Flux scheme not enough resolved eddies, too few small scale showers
- Old AROME versus new AROME

Comparison AROME-COSMO

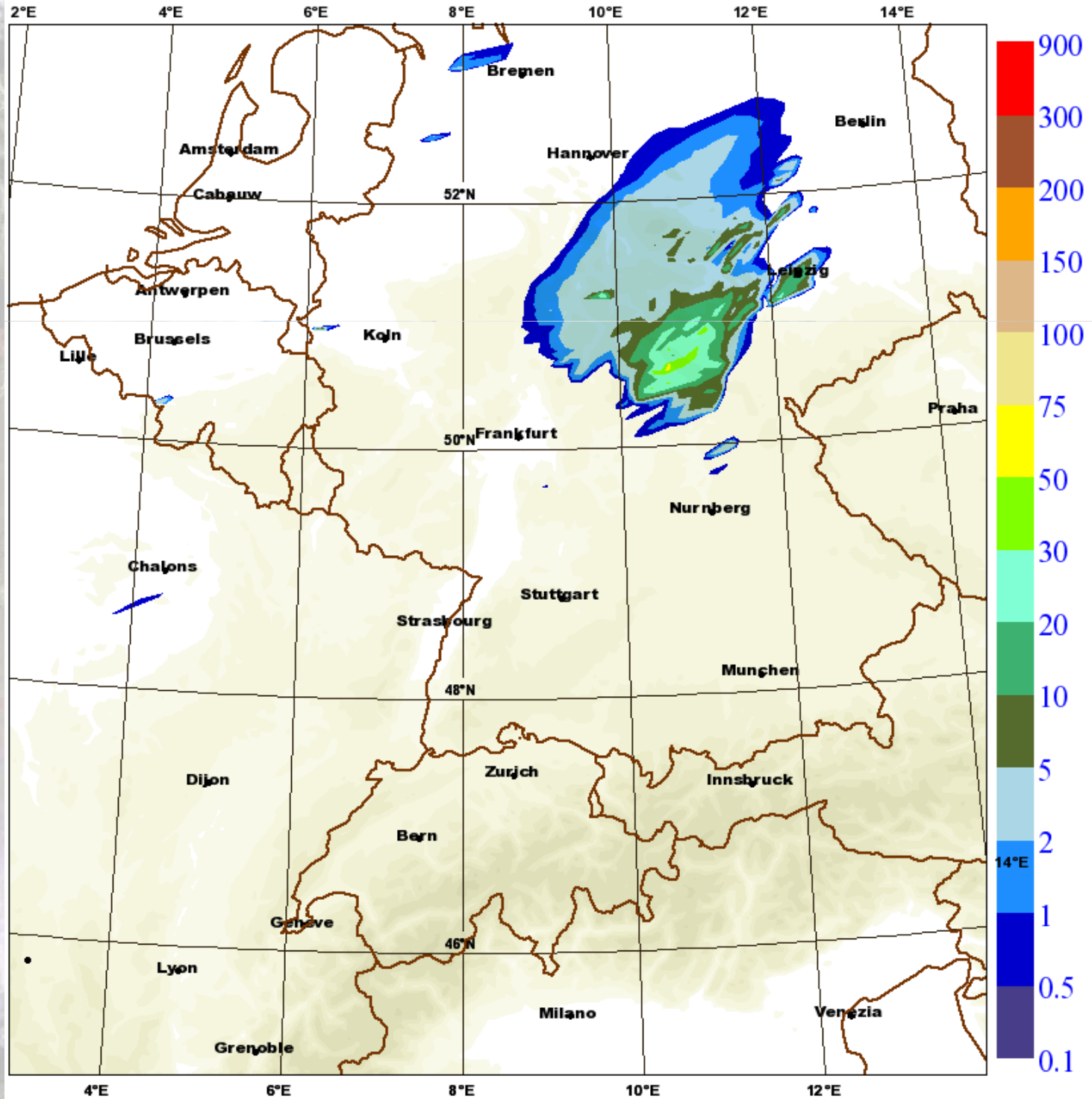
- Comparison page set up after Brac meeting (Francois Bouttier and Axel Seiffert)
- Goal find differences in overlapping area and learn from them
- No beauty contest, careful with effect of boundaries, different initialization etc.
- Many convective situations show significant differences.

dblaro 2010082000+1400 T2m(C) & V10m




cosmo 2010071200+1200 totalrain(mm) over last 1h
2°E
4°E
6°E
8°E
10°E
12°E
14°E
Bremen
Berlin
Amsterdam
Hannover
Cabauw
52°N
Leipzig
Antwerpen
Brussels
Köln
Lille
Praha
50°N
Frankfurt
Nurnberg
Chalons
Stuttgart
Strasbourg
Munchen
48°N
Dijon
Zurich
Innsbruck
Bern
Geneve
46°N
Lyon
Milano
Venezia
Grenoble
4°E
6°E
8°E
10°E
12°E
14°E
900
300
200
150
100
75
50
30
20
10
5
2
1
0.5
0.1

cosmo 2010082200+1800 totalrain(mm) over last 1h



Possible topics for cooperation

- Tried to make an inventory for possible topics of cooperation
- Heterogeneous group probably causes low response
- 2 reactions

Possible topics for cooperation (1)

- Quote Dmitrii Mironov:
- “to exchange our experience, ideas, scepticism, as to e.g.
  - the interaction of SGS cloud schemes with radiation, turbulence, surface flux calculation, and, where appropriate, deep convection schemes;
  - consistency of parameterisation of SGS cloudiness (does the radiation uses the same SGS cloudiness as turbulence, or are there turning devices applied in each scheme for "practical" reasons?); and
  - (not the least) where members of different consortia see major drawbacks and potential for improvements.”

Possible topics for cooperation (2)

- Question from Andy Brown:
- SRNWP convection study?
- Initially proposed Dutch/Swedish study on 30-04-2006
- Too complicated (surface boundary)
- Ideas now:
  - Convection over sea (simple boundary conditions, open cell convection)
  - Strongly forced convection