3MT in ARPEGE

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What it is “3MT in ARPEGE”

Use ARPEGE physics except moist deep convection almost “as is”:

- Smith condensation and cloudiness;
- Use prognostic cloud water also in radiation;
- Shallow convection – KFB scheme;
- Microphysics – ARPEGE options in APLMPHYS;
- RRTM radiation;
- All set-ups in vertical diffusion, gravity wave drag, soil interaction as in ARPEGE.

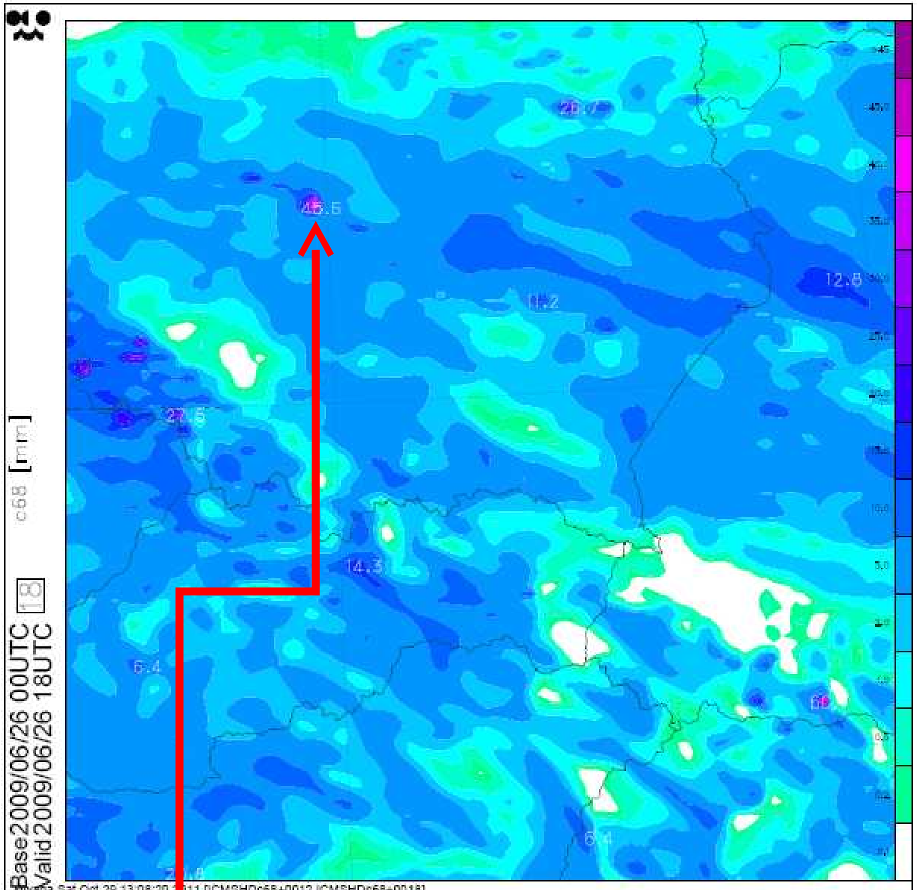
Specific solutions – condensation (1)

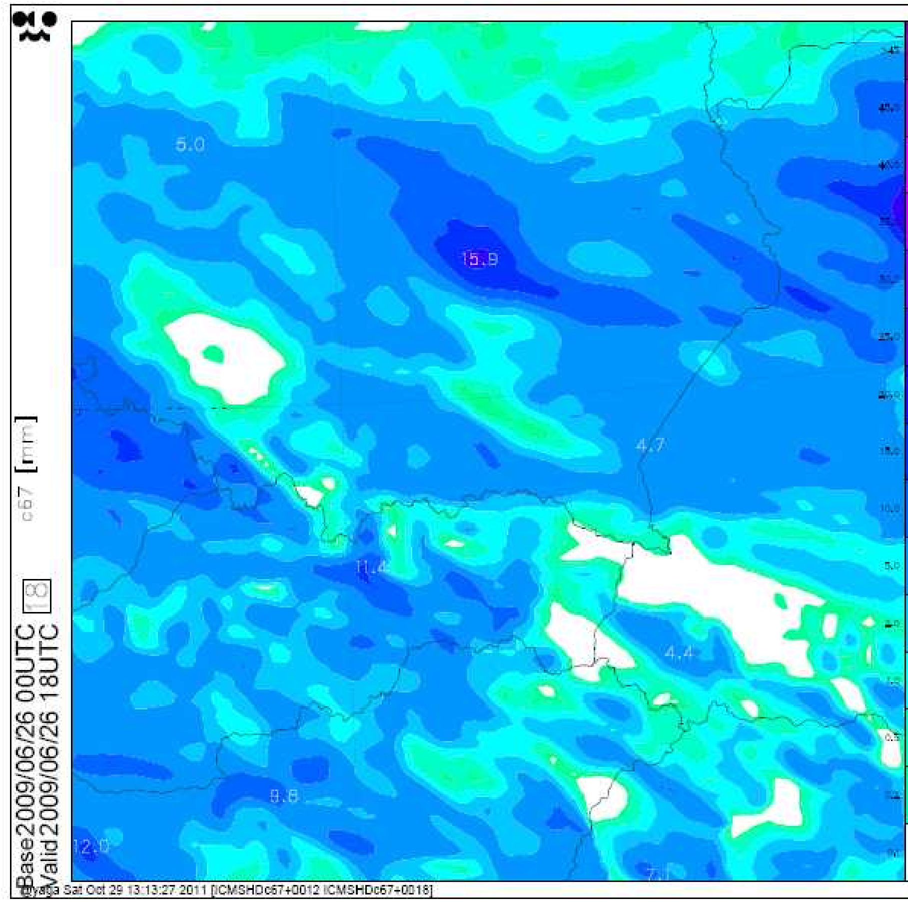
- Smith scheme: algorithm taken "as is" (in the code we also have Luc's version of Smith scheme - LSMGCDEV)
- Problems to be solved:
  - Protection of convective cloudiness against re-evaporation;
  - In some isolated points we got a very intense precipitation.
- Both problems are related to the fact that, contrary to Xu-Randall based scheme, there is no relationship between cloud fraction N and cloud water qc in Smith scheme.

Specific solutions – condensation (2)

- Protection of Ncv (qcv) in case of Smith:
  - Based on proportion of convective cloud (PUNEBH) with respect to total cloudiness; it is quite simple but no better way found for Smith scheme so far (Smith scheme is too basic);
  - such type of solution was present in the approach by Luc; now we applied a slightly smoother function.
- Intense isolated precipitations: 2 corrections (again borrowed from Luc)
  - When condensate, impose some cloudiness;
  - Reduce excessive cloudiness (in proportion of layer thickness).

intensive precipitation spots





Isolated spot of 45mm/6h

Result after applying the two corrections

Specific solutions – cloudiness for radiation

- Prognostic cloud water (and the associated cloud fraction) serves as input to the radiation scheme;
- In case of 3MT: we have at disposal the cloud water of stratiform and moist deep convection;
- In case of 3MT in ARPEGE, cloud water of shallow convection is added;
- Four cloud cover fraction: random overlap hypothesis is used for combining the stratiform, moist deep convection and shallow convection cloudiness values.

Microphysics options

- APLMPHYS is called with ARPEGE choices (local switches in first versions, made global since CY38T1):
  - Lagrangian sedimentation;
  - Fixed fall speed;
- ARPEGE options activated in processes (ACACON, ACCOLL, ACEVMEL);
- As a result, APLMPHYS can fully work in ARPEGE regime except for geometry of cloudiness and seeded mesh fractions (anyhow 3MT-specific).

fine-scale test

9km

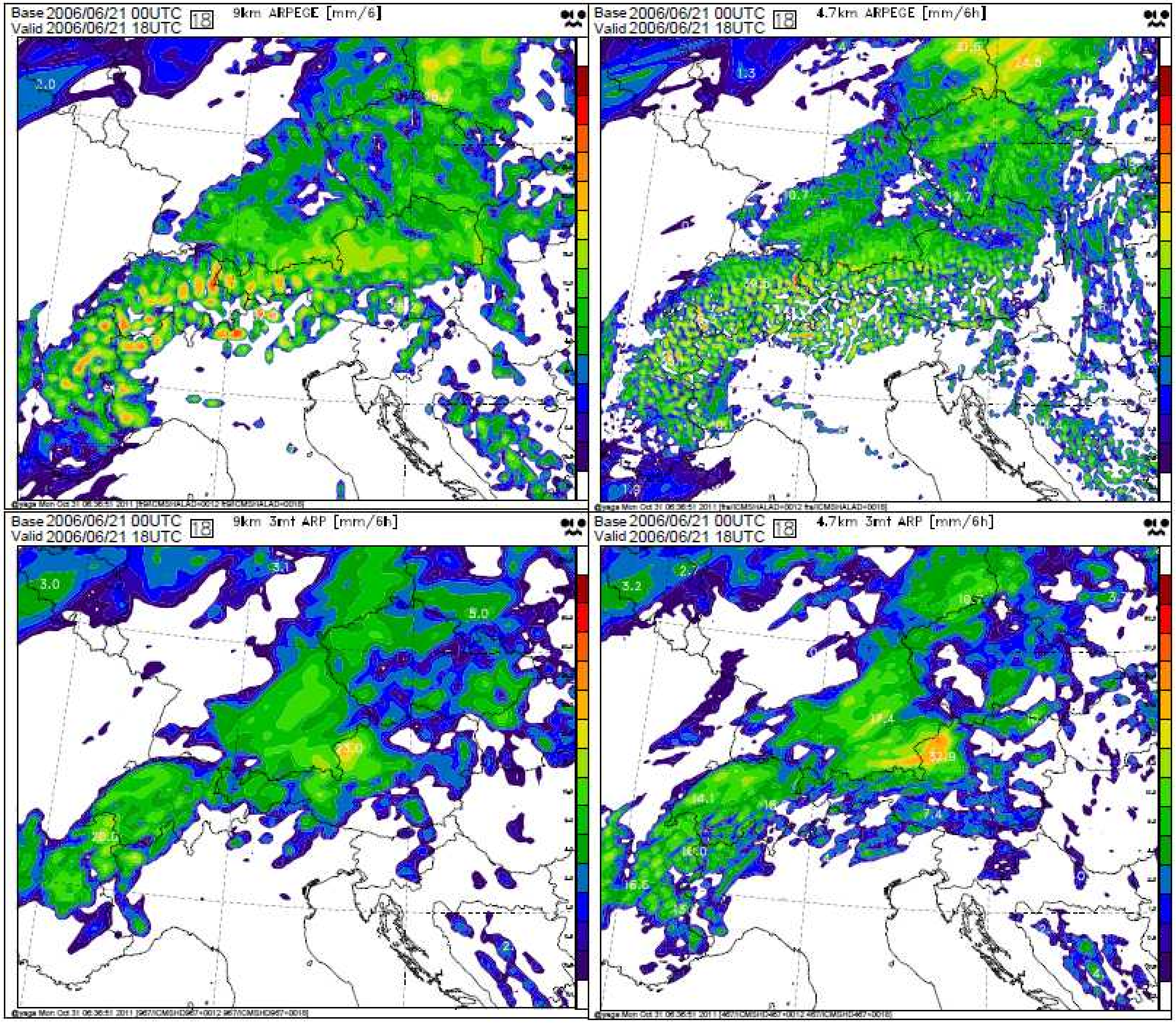
4km

6h precipitation amounts.

3MT shows a reasonable solution at both resolutions.

Old convection shows a very bad pattern, especially at 4km mesh (‘grey-zone syndrome’).

Old CV



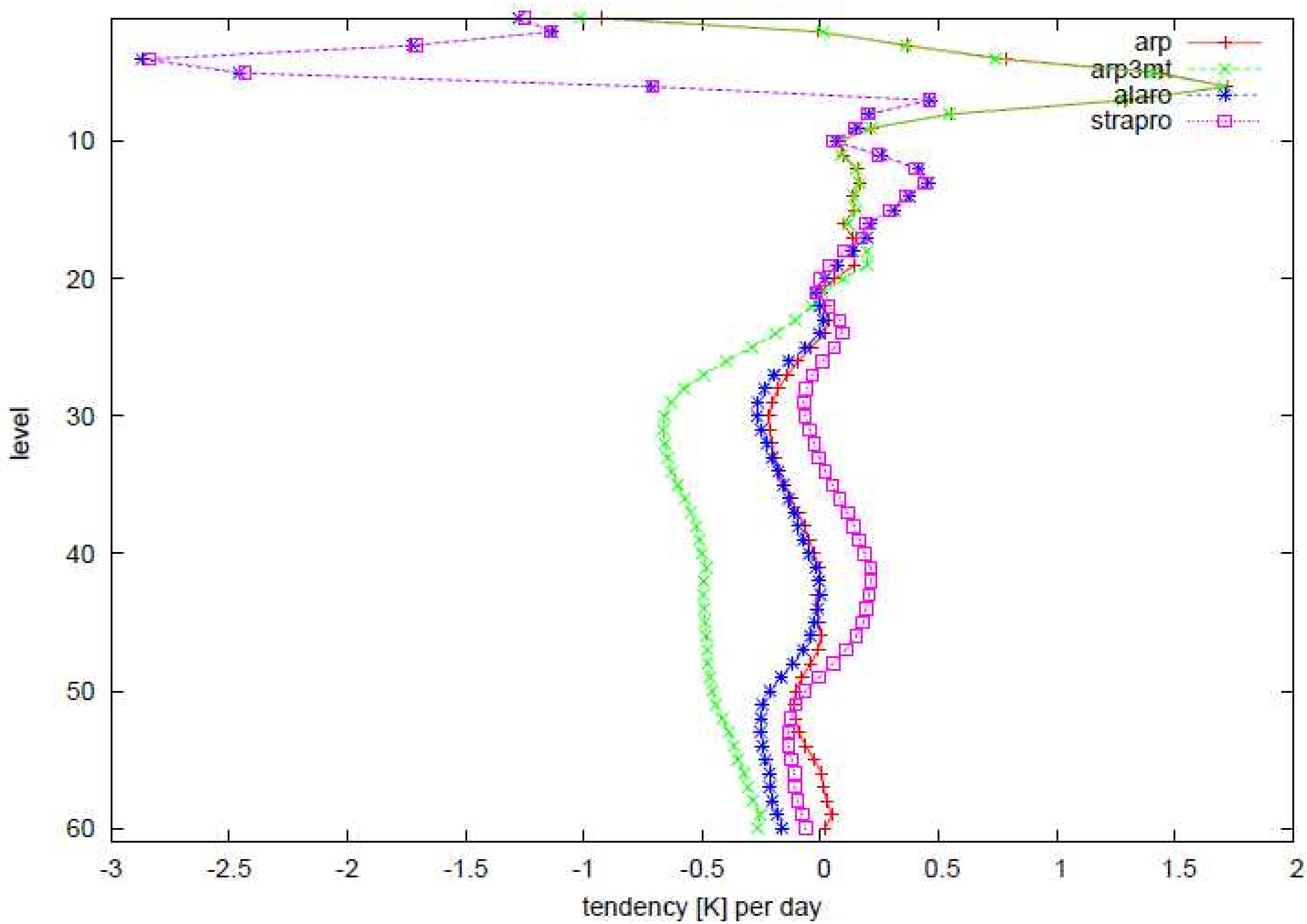
3MT

Test at coarser resolution on the globe

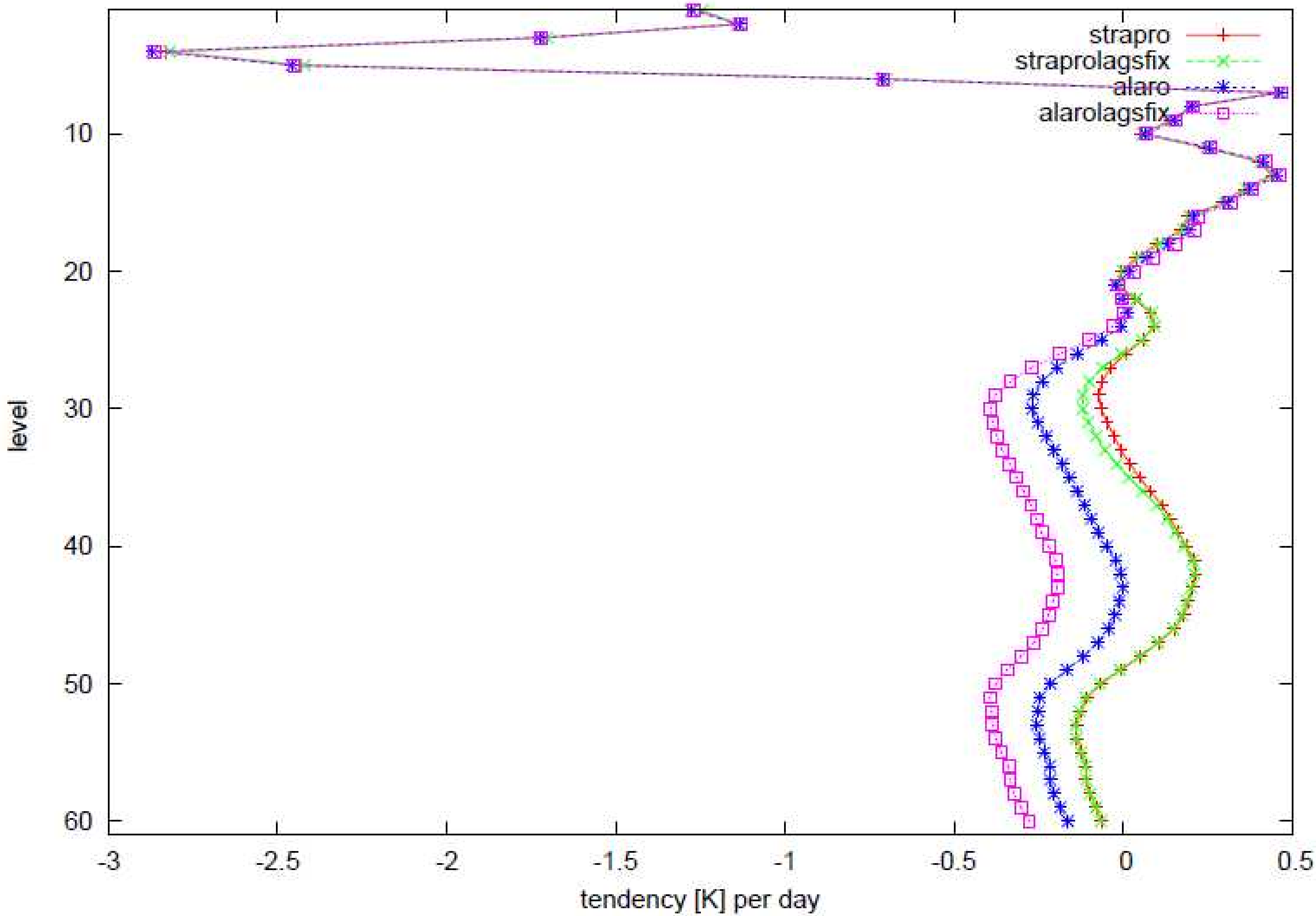
- First test done in cooperation with Francois Bouyssel:
  - Validation of the phasing in CY38T1;
  - Pure Smith scheme is now part of ACNEBCOND, ACCDEV => small code unification;
  - Problems persist at DDH level; new data flow (LFLEXDIA) does not work with OpenMP;
  - Configuration chosen by Francois :

T224 with uniform resolution (90km, no stretching) and 60 levels.

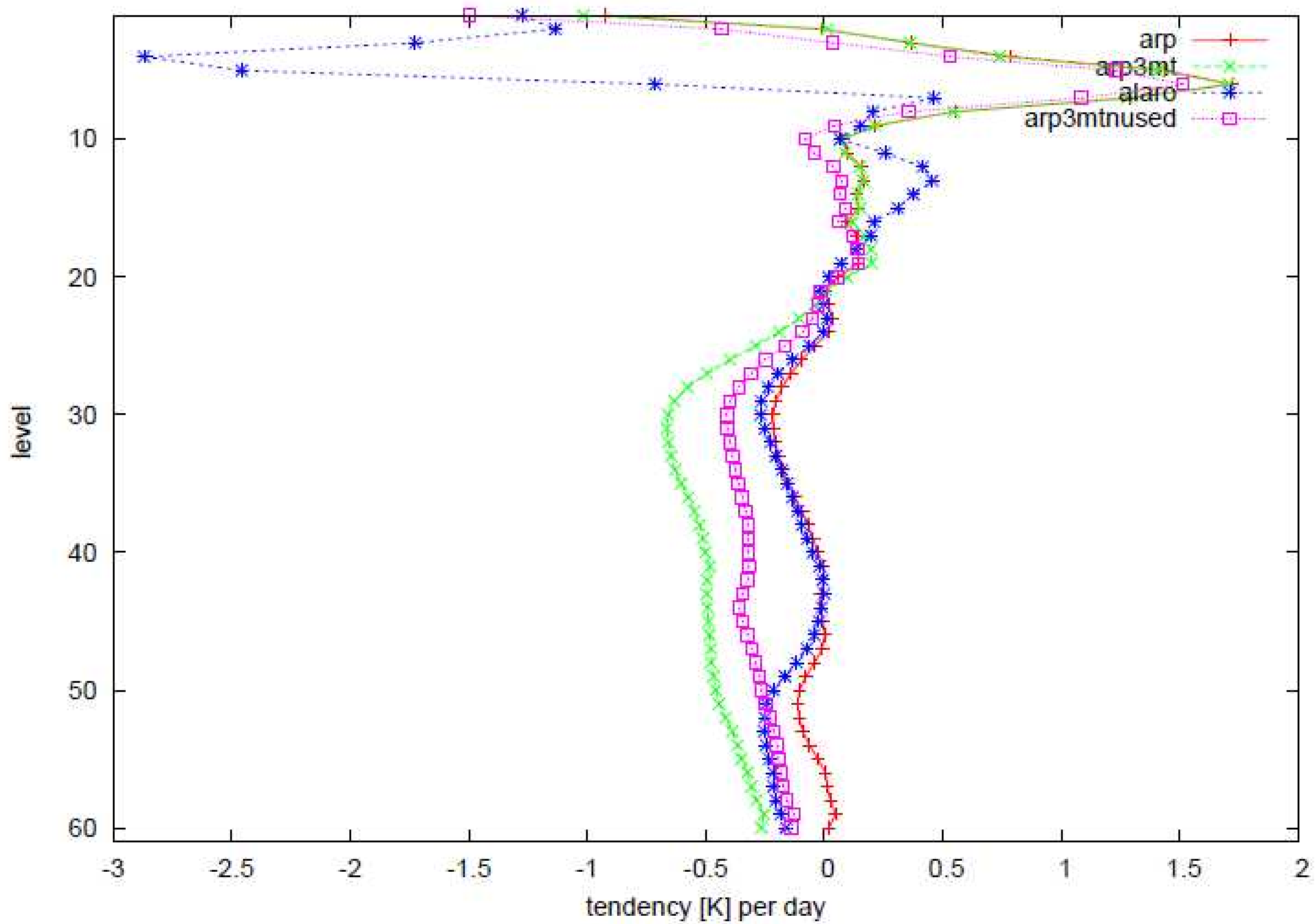
Global tendencies – cooling influence of 3MT; stronger in ARPEGE, but why? ALARO globally OK, by the way!



Global tendencies – influence of sedimentation specifically active in convective clouds (fixed speed irrealistic then)



Global tendencies – influence of sedimentation and GCVNU on 3MT (still something to explain!)



Conclusions

- 3MT in ARPEGE is a very good research tool (at least for ALARO … [*see other related talk*]);
- It is also nice to test the physics on the globe, including tropics;
- We see that 3MT has the tendency to be “colder” than old convection, but in case of 3MT-ARPEGE it is too much – we do not know yet why;
- Sedimentation of precipitation has a very large impact in case of 3MT and tropical convection with prognostic convective water. The ‘dispersive solution’ of ALARO is then clearly more realistic.