all experiments by Klaus Stephan

Starting point:

convection-permitting COSMO version as operational in summer 2007 strongly underestimates diurnal cycle of precipitation

in convective conditions

test period : 31 May – 13 June 2007: weak anticyclonic, warm and rather humid, rather frequent and strong air-mass convection



# **Model changes**

- 'old PBL': COSMO V4\_0, 'original' model version (operational in summer 2007)
- 'old PBL / SL': COSMO V4\_8, with Semi-Lagrange instead of Bott advection for humidity, hydrometeors, turbulent kinetic energy (opr. during winter 08/09)
- 'new PBL': COSMO V4\_8, with Bott advection and reduced turbulent mixing (opr. summer 09):
  - reduced max. turbulent length scale (Blackadar length : 200 m  $\rightarrow$  60 m )

- reduced subgrid cloud fraction in moist turbulence





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# 'new PBL' : improves diurnal cycle of precip, except for first 12 hrs of 12-UTC runs





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'new PBL' : improves scores mainly at night (both 0- and 12- UTC runs) (spatial location also in the evening)



'new PBL' greatly improves diurnal cycle of precip, 42-hour forecasts: except for first 12 hours (incl. peak in afternoon) of 12-UTC runs 0.2 OBS radar obs 6643 0.18 0.18 7024 old PBL new PBL 0.16 0.16 0.14 0.14 0.12 0.12 0.1 0.1 0.08 0.08 0.06 0.06 0.04 0.04 0.02 0.02 0-UTC runs, up to + 42 h 12-UTC runs, up to + 42 h 0 20 25 30 15 25 30 35 40 20 35 5 10 4 10 15 40 45 50 5 0

Possible reasons for problems with 12-UTC runs:

- Latent Heat Nudging ?
- radiosonde humidity (daytime RS92 dry bias) ?
- radiosonde / aircraft temperature ?
- other ?









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**old** PBL / SL : no radiosonde humidity: afternoon much better, too much at night no upper-air temperature: afternoon even slightly better, worse scores









# Summary

- obs biases Vaisala RS92 : dry bias at daytime
  - aircraft : warm bias (mainly ascents, dep. on aircraft type)
- model biases:
  - old PBL: diurnal cycle of precip far too weak, dep. on initial time of forecast
    - much too humid above PBL , little T-bias
  - new PBL: much better diurnal cycle of precip (still too weak), except first 12 h of 12-UTC runs
    - still too humid above PBL
    - too warm and unstable in low troposphere at daytime
- sensitivity tests done:
  - little impact of LHN on biases
  - no RS humidity: improves precip of 12-UTC run only with old PBL, hardly with new PBL
  - no temperature (only old PBL): slight further improvement





- further tests: no T (+ ps) obs with new PBL
  - bias correct Vaisala RS92 obs: total error, or only radiation error  $\rightarrow$  not likely to cure problem
- what to do with T-obs? correct obs bias : aircraft-T ( $\rightarrow$  worse?)
  - adjust T-obs to model T-bias ? ( $\rightarrow$  hides model problems)
  - omit daytime T-obs at low troposphere (up to which height ?)
    (→ loss of info)
- model biases: make the job for data assimilation very hard, will not get better with advanced DA methods that make stronger use of the NWP model (LETKF)
  - $\rightarrow$  (should we investigate) reason for these model biases ?
    - insufficient resolution (to resolve convection) ?
      - $\rightarrow$  look at runs with resolution  $\leq$  1 km ? (and vertical resolution ?)
    - parameterisations not fully adequate ?
      could they still be improved at current resolution ?
      (also have biases in PBL in absence of convection (small dep. on resolution)
  - $\rightarrow$  or should we adjust DA (correct obs to model bias (T, q), omit obs)?
  - $\rightarrow$  or should we live with the problem ? (do other COSMO members have it too ?)



