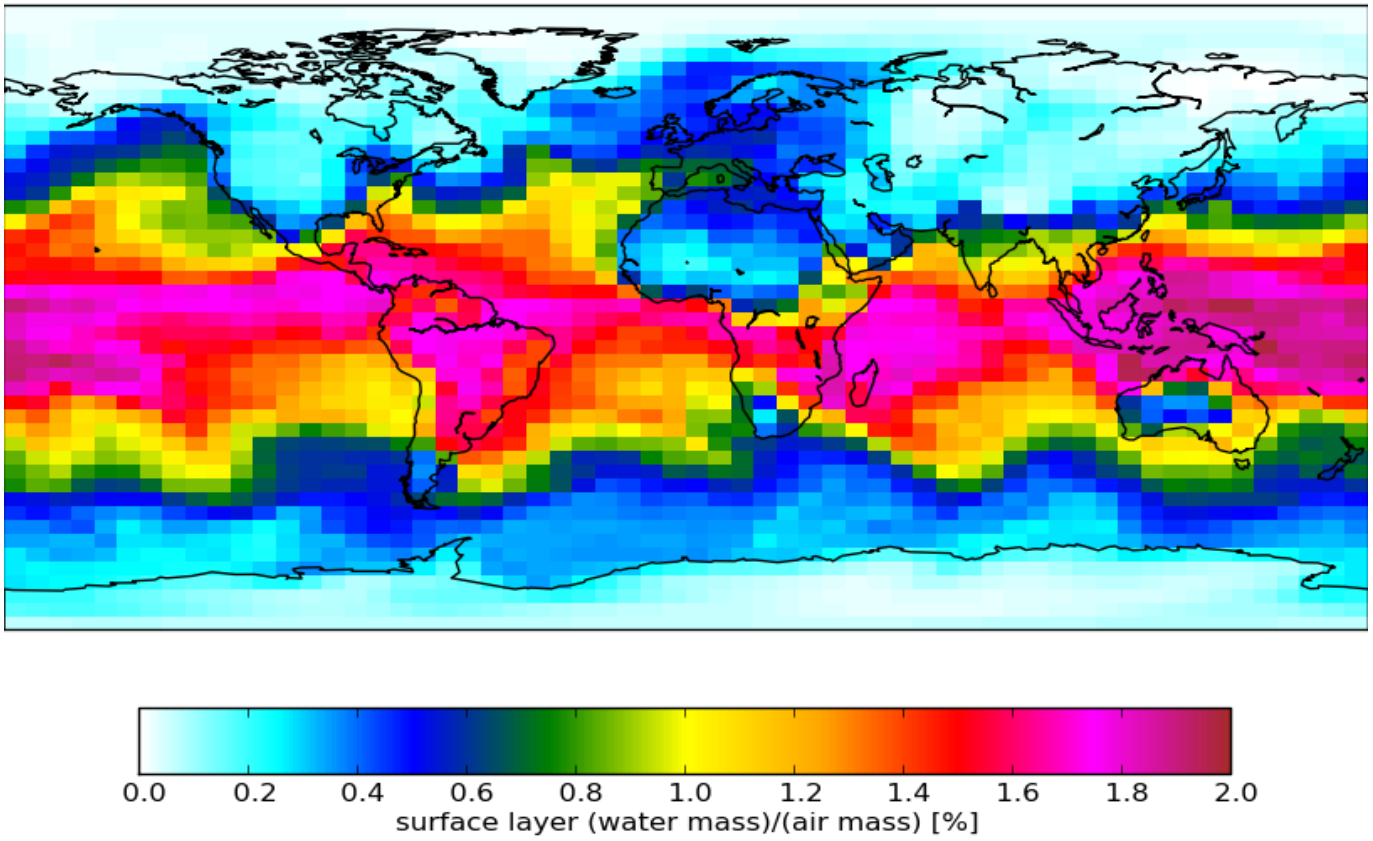
TM5 dry-air version



TNO innovation for life

What was the problem ?

- Email discussion last year on comparison with observations
  (Andy, Wouter, Sander, Sourish, Maarten, David, Tomohiro, John, Arjo, ...)
- Questions raised:
  - **“Is humidity included in the air mass ?”**

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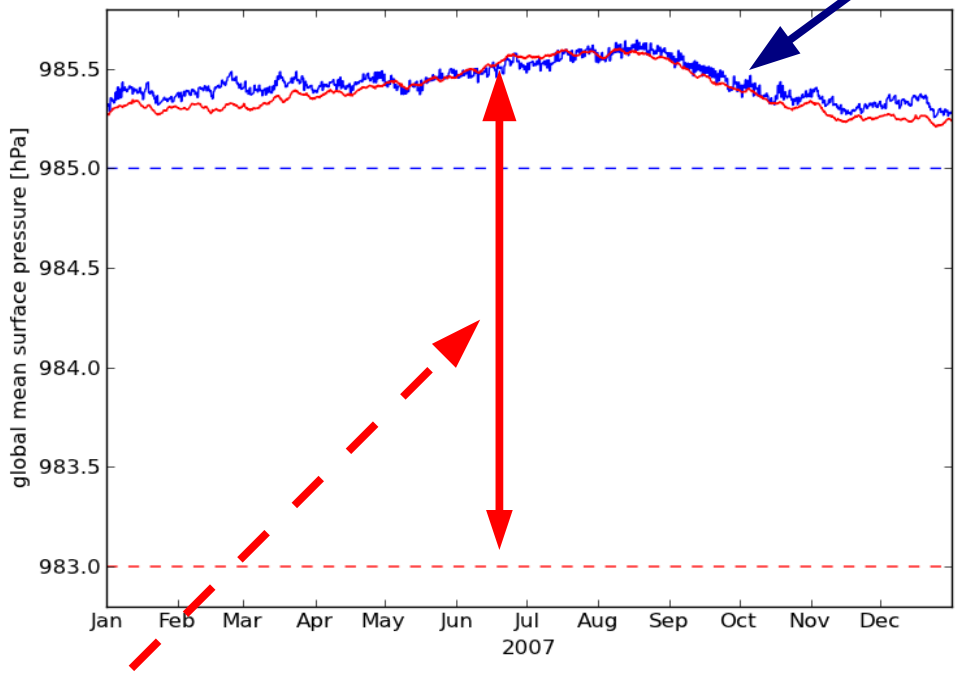
Now in the model:

surface pressures from ECMWF
(total air pressure, including humidity)



Scaled to preserve a global mean of **985 hPa** ...

Problems:
- humid air mass is not conservative
- 985 hPa is not an accurate estimate of average

From analysis of 1 year of ecmwf data:

- dry air mass seems conservative on **983 hPa** global average
- remaining air mass of about **2.5 hPa** is explained by humidity

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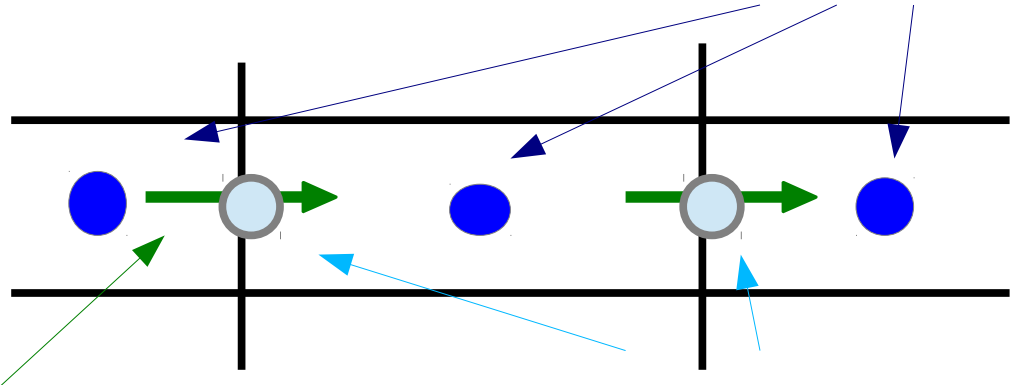
What was the problem ?

- email discussion last year
  (Andy, Wouter, Sander, Sourish, Maarten, David, Tomohiro, John, Arjo, ...)
- Questions raised:
  - **“Is humidity included in the air mass ?”**

    yes and no
  - **“Does this lead to a bias in mixing ratio’s ?”**

Dry air mass

(dry air mass) = (humid air mass) x (1 - **spec.humid.**)
[kg dry air] [kg humid air] [(kg dry air)/(kg hmd.air)]

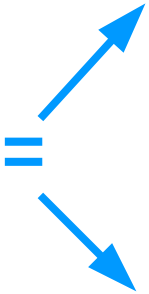


spec. humid. interpolated to cell edges

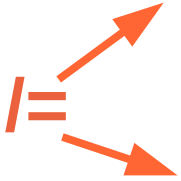
(dry air flux) = (humid air flux) x (1 - **spec.humid.**)
[(kg dry air)/s] [(kg humid air)/s] [(kg dry air)/(kg hmd.air)]

Dry air mass flux

How implemented ?



- **“base”** model
  - latest trunk
  - uses 2D surface pressure and hybride coefficients
  - surface pressures scaled to 985 hPa global average



- **“'humid air”** model
  - no hybride coefficients anymore, use 3D pressure arrays
- **“dry air”** model
  - removed humidity parts from air-mass(fluxes)
  - pressures scaled to 983 hPa global average surface pressure

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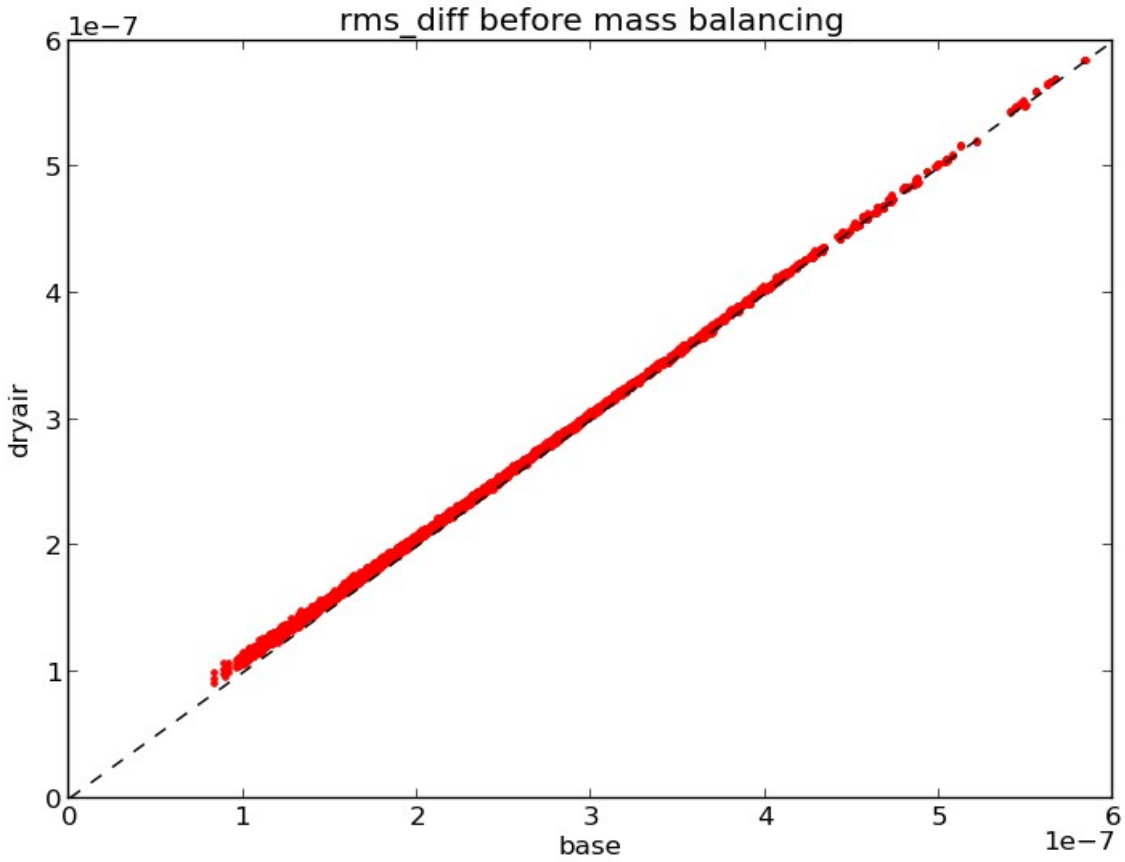
Mass balance check

- rms diff. between estimated and actual surface pressure change



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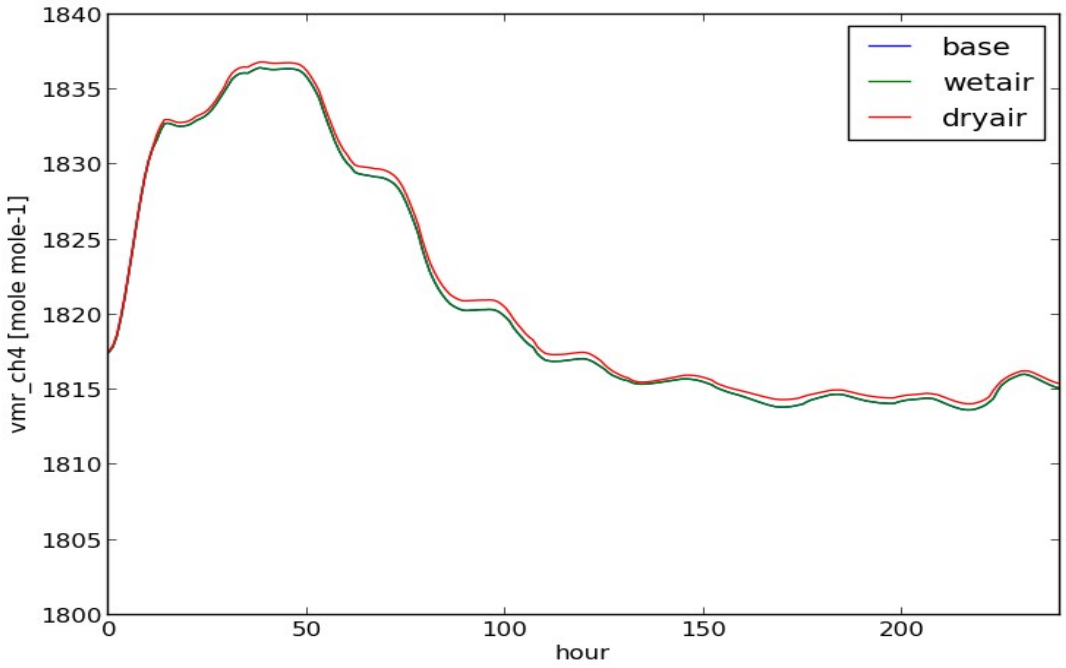
Test run with methane tracer

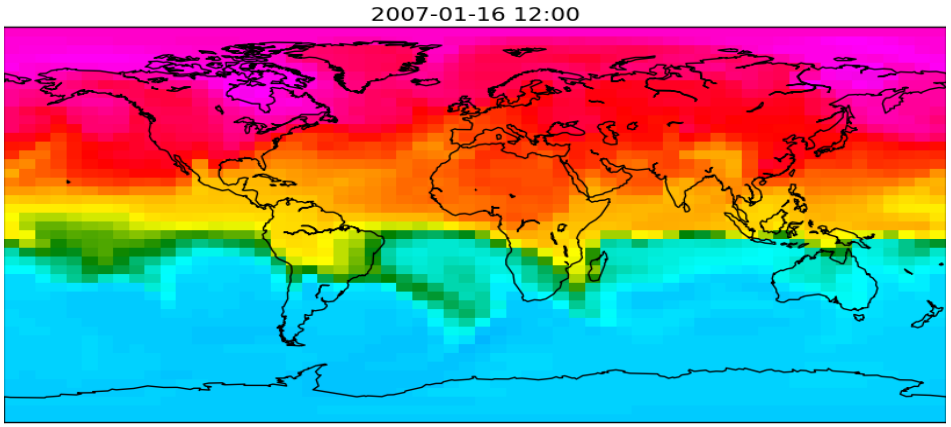
- no emisisons, no sinks, initial field from 4d-var
- example: time series at single surface cell

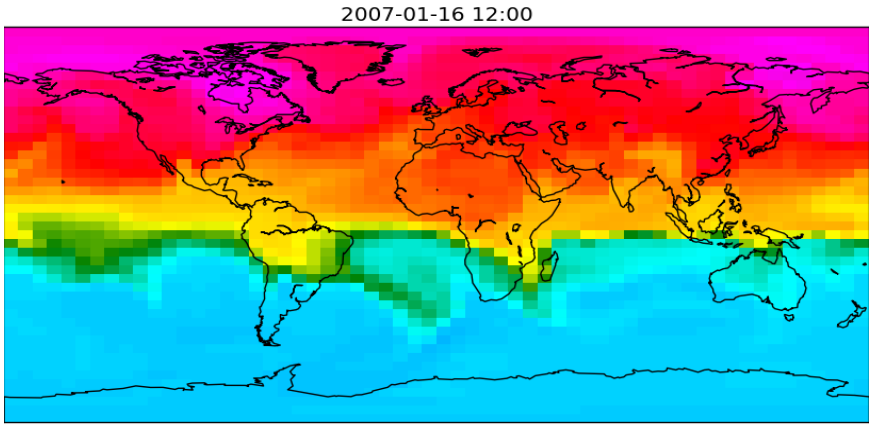


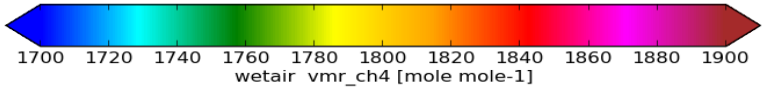
wetair == base

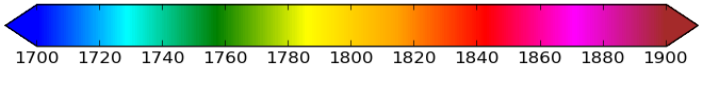
dryair /= wetair

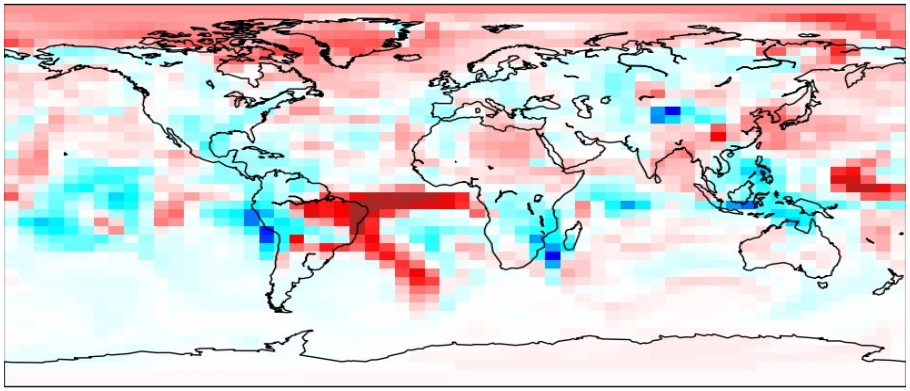
example: maps with surface concentrations

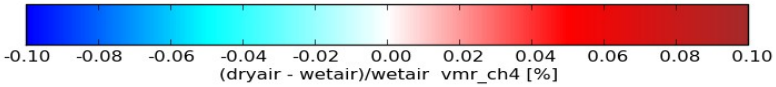


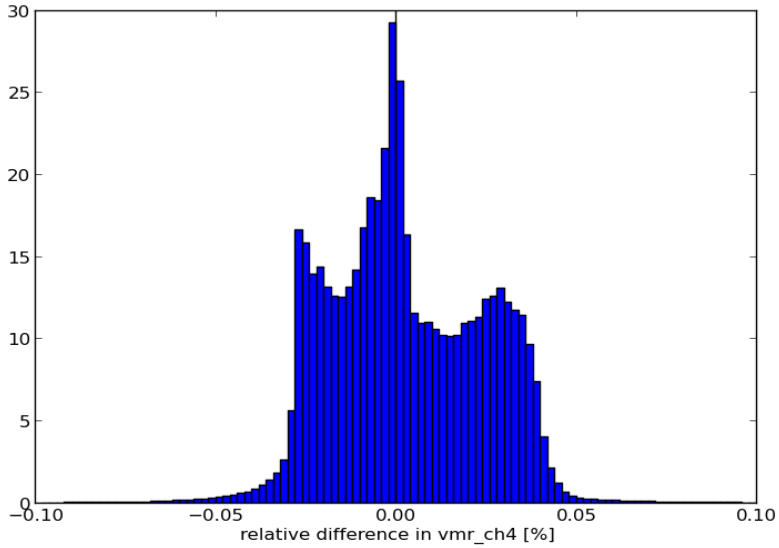












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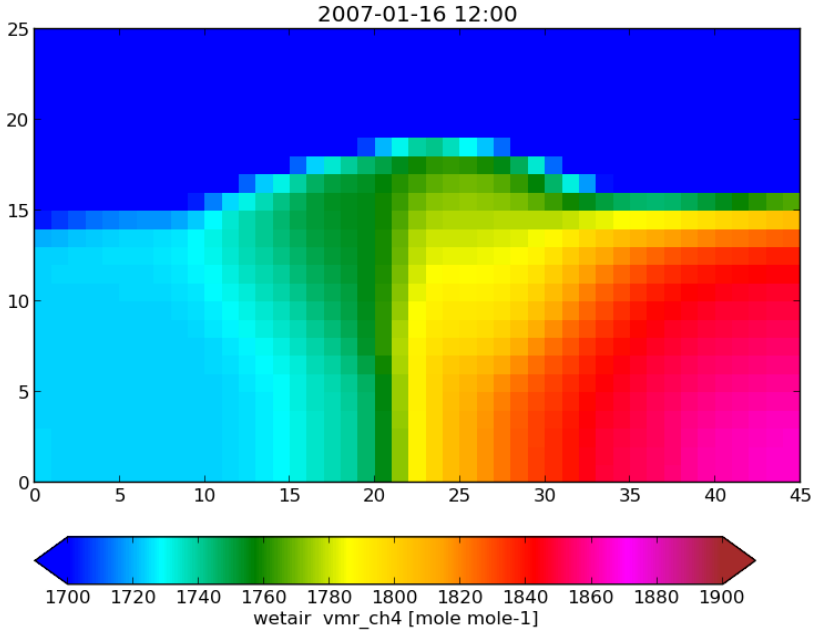
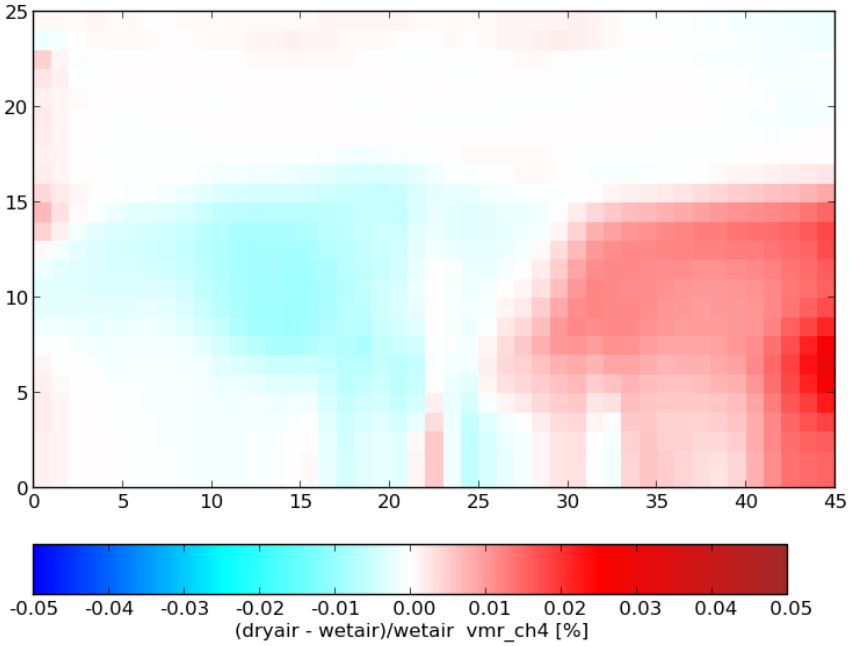
- example: zonal averages over first month





lower in Tropics/SH higher in NH

Conclusions

- Possible to transform TM into a “dry-air” model.
- In first tests:
  - max.difference in surface pressure about 0.05%
  - hemisperic gradient visible
- Full test needed, e.g. methane tracer incl. emissions ?
  - global dry air mass (based on 983 hPa aver)
    is 0.2% less than global humid air mass (based on 985 hPa);
    should lead to 0.2% higher concentrations ?

*Guess: this will not solve *all* your biases ...*