

# CAMS comparison of IFS and TM5 simulated CH<sub>4</sub>

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# Background

- TM5-4DVAR delivers CH<sub>4</sub> fluxes within Copernicus Atmospheric Monitoring Service (CAMS)
- Fluxes are used in IFS for a CH<sub>4</sub> reanalysis and forecast
- Performance of IFS CH<sub>4</sub> relies on the consistency between the transport modelled in TM5 and IFS.
- Good opportunity to test this, with support of ECMWF.

# Relevance for the TM5 community

- Discussion about the use of IFS archived convective mass fluxes.
- Improved performance N-S exchange but deteriorated over continents.
- Is 'convec' really better than 'sub'?
- Here: Which one comes closest to IFS.

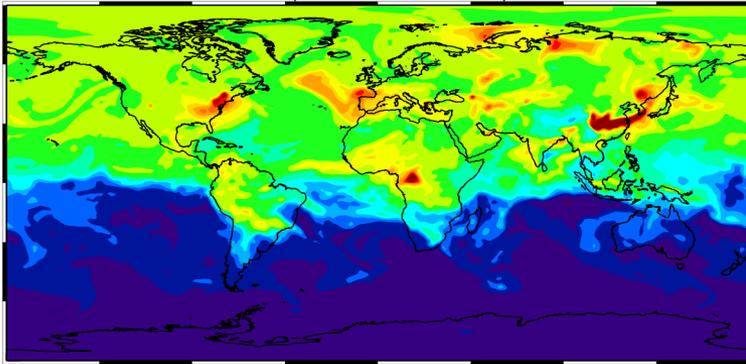
# Setup

- Gridded emissions provided by ECMWF (March 2013 – April 2014)
- Chemical turnover provided by ECMWF (life time in each grid box – i.e. no test of T differences, etc.)
- Concentration fields provided (new version with mass fixer Agusti-Panareda et al (2017))

# Sanity check: Initial conditions

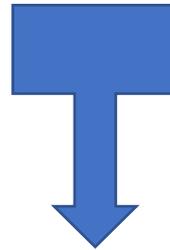
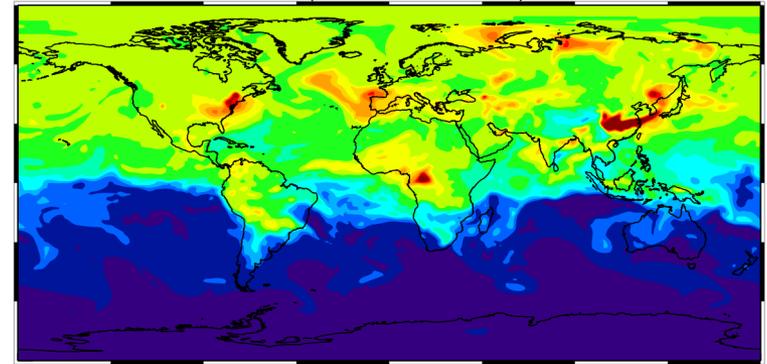
IFS (850 hPa)

IFS (20130301 850 hPa)



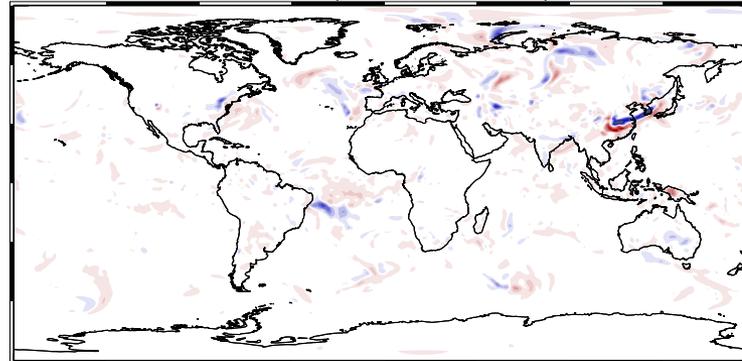
TM5 (850 hPa)

TM5 (20130301 850 hPa)



TM5 - IFS

TM5 - IFS (20130301 850 hPa)



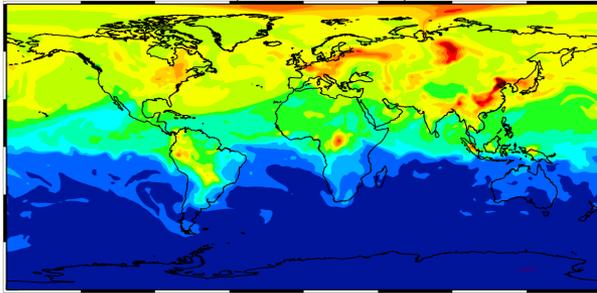
-43.3 -36.7 -30.0 -23.3 -16.7 -10.0 -3.3 3.3 10.0 16.7 23.3 30.0 36.7 43.3 50.0 ppb

# Same differences progressing in time

After t=1 month

IFS

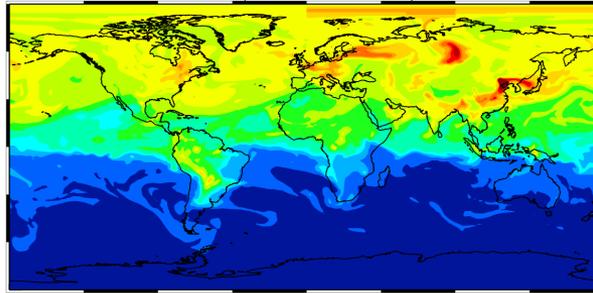
IFS (20130401 850 hPa)



1.72 1.74 1.76 1.78 1.80 1.82 1.84 1.86 1.88 1.90 1.92 1.94 1.96 1.98 2.00 ppm

TM5

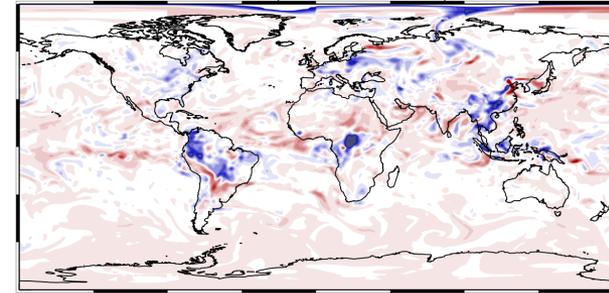
TM5 (20130401 850 hPa)



1.72 1.74 1.76 1.78 1.80 1.82 1.84 1.86 1.88 1.90 1.92 1.94 1.96 1.98 2.00 ppm

TM5 - IFS

TM5 - IFS (20130401 850 hPa)

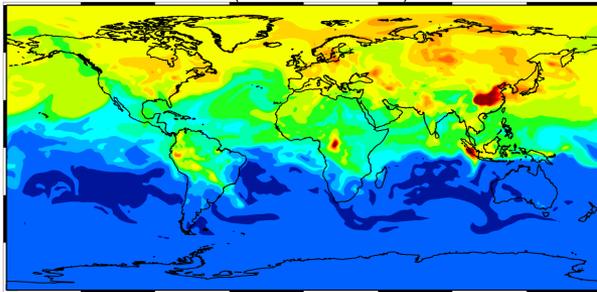


-43.3 -36.7 -30.0 -23.3 -16.7 -10.0 -3.3 3.3 10.0 16.7 23.3 30.0 36.7 43.3 50.0 ppb

After t=1 year

IFS

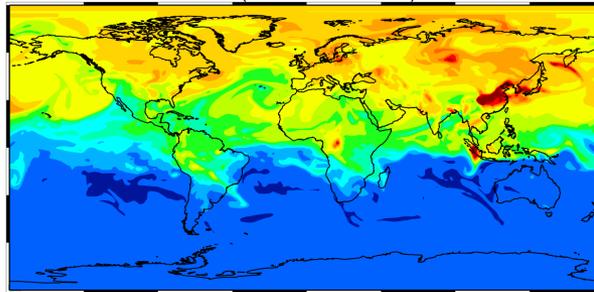
IFS (20140301 850 hPa)



1.72 1.74 1.76 1.78 1.80 1.82 1.84 1.86 1.88 1.90 1.92 1.94 1.96 1.98 2.00 ppm

TM5

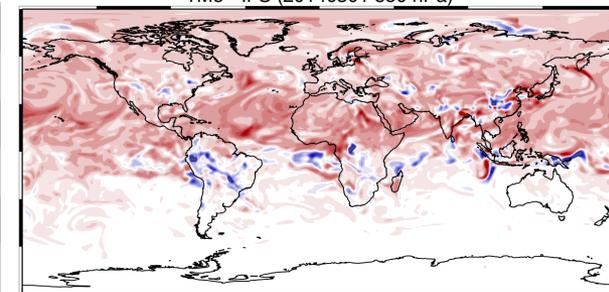
TM5 (20140301 850 hPa)



1.72 1.74 1.76 1.78 1.80 1.82 1.84 1.86 1.88 1.90 1.92 1.94 1.96 1.98 2.00 ppm

TM5 - IFS

TM5 - IFS (20140301 850 hPa)



-43.3 -36.7 -30.0 -23.3 -16.7 -10.0 -3.3 3.3 10.0 16.7 23.3 30.0 36.7 43.3 50.0 ppb

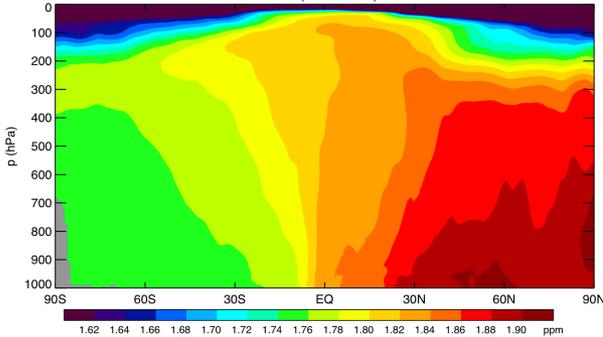
# Differences in the vertical direction

- Zonal averages

After t=1 month

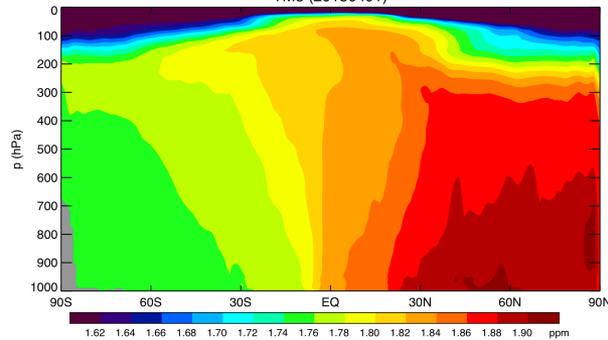
IFS

IFS (20130401)



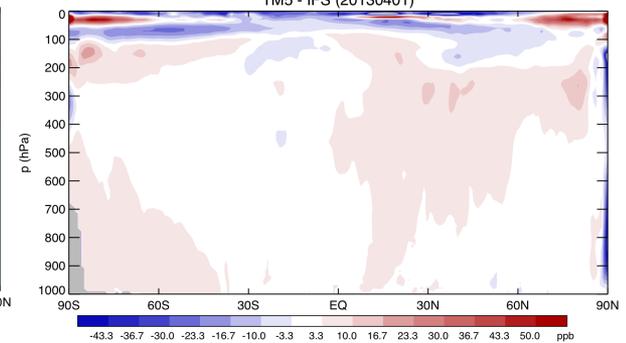
TM5

TM5 (20130401)



TM5 - IFS

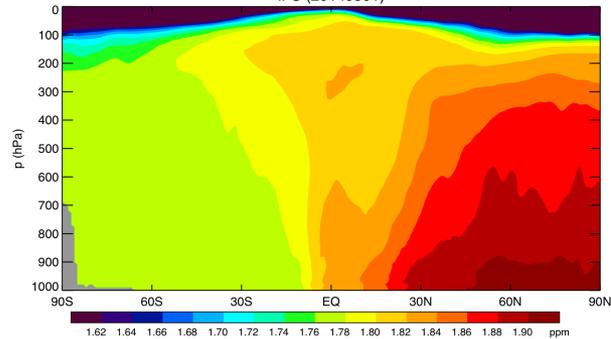
TM5 - IFS (20130401)



After t=1 year

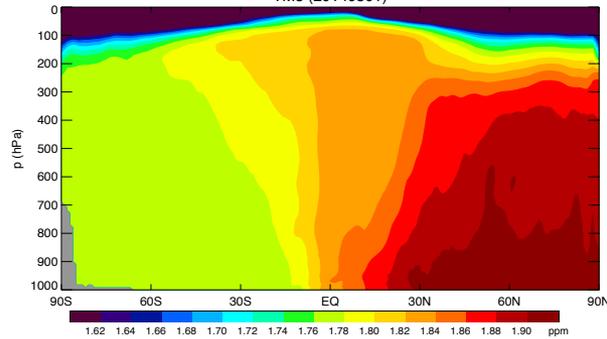
IFS

IFS (20140301)



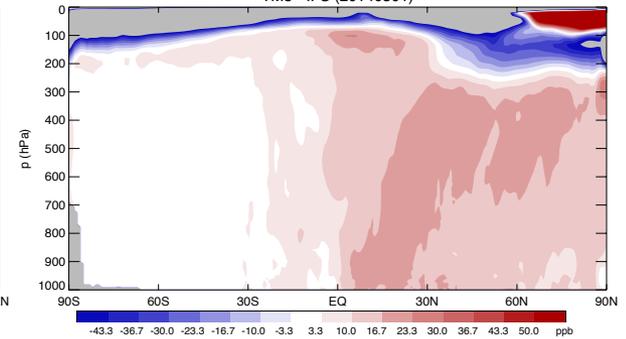
TM5

TM5 (20140301)



TM5 - IFS

TM5 - IFS (20140301)

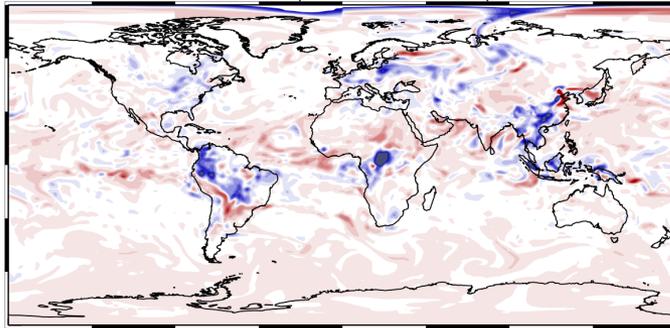


# TM5 'convec' vs TM5 'sub'

TM5 **convec** – IFS

t=1 month

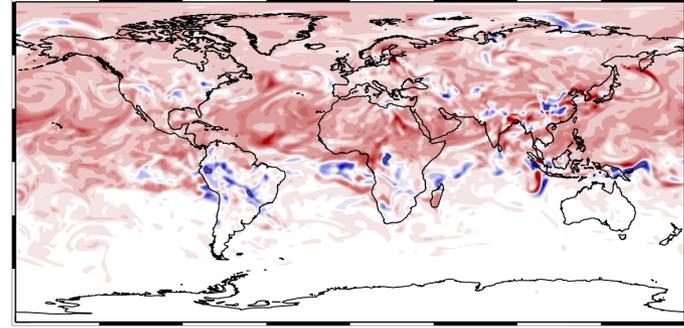
TM5 - IFS (20130401 850 hPa)



-43.3 -36.7 -30.0 -23.3 -16.7 -10.0 -3.3 3.3 10.0 16.7 23.3 30.0 36.7 43.3 50.0 ppb

t=1 year

TM5 - IFS (20140301 850 hPa)

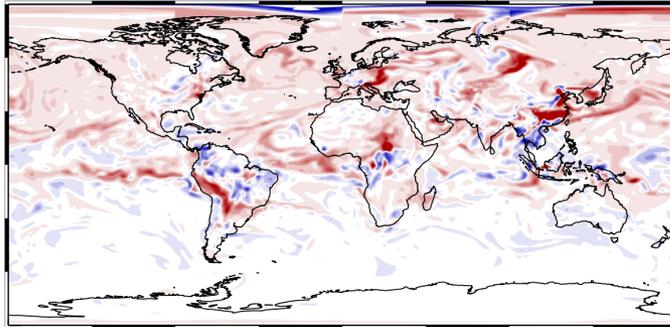


-43.3 -36.7 -30.0 -23.3 -16.7 -10.0 -3.3 3.3 10.0 16.7 23.3 30.0 36.7 43.3 50.0 ppb

TM5 **sub** – IFS

t=1 month

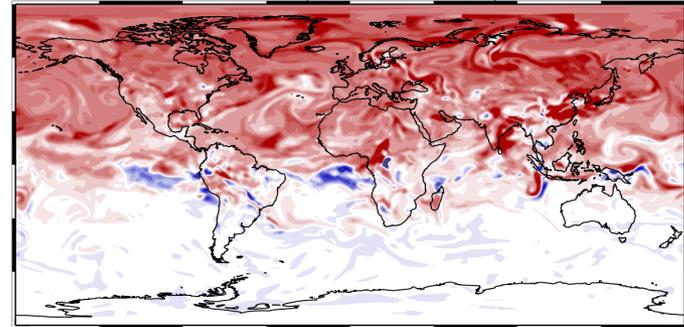
TM5 - IFS (20130401 850 hPa)



-43.3 -36.7 -30.0 -23.3 -16.7 -10.0 -3.3 3.3 10.0 16.7 23.3 30.0 36.7 43.3 50.0 ppb

t=1 year

TM5 - IFS (20140301 850 hPa)

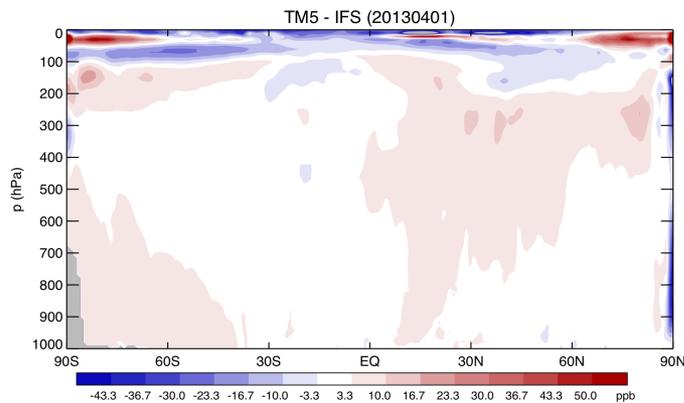


-43.3 -36.7 -30.0 -23.3 -16.7 -10.0 -3.3 3.3 10.0 16.7 23.3 30.0 36.7 43.3 50.0 ppb

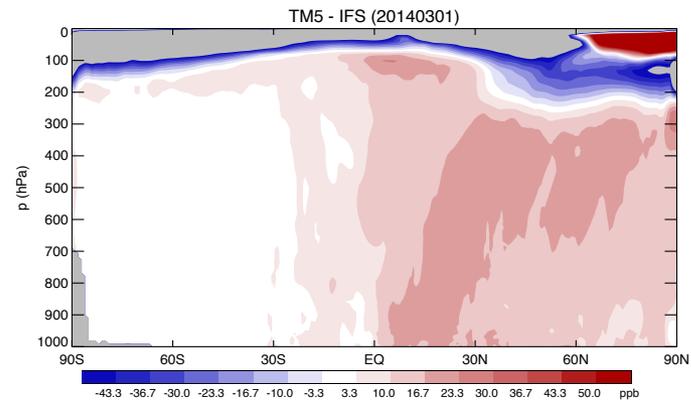
# TM5 'convec' vs TM5 'sub'

TM5 **convec** – IFS

t=1 month

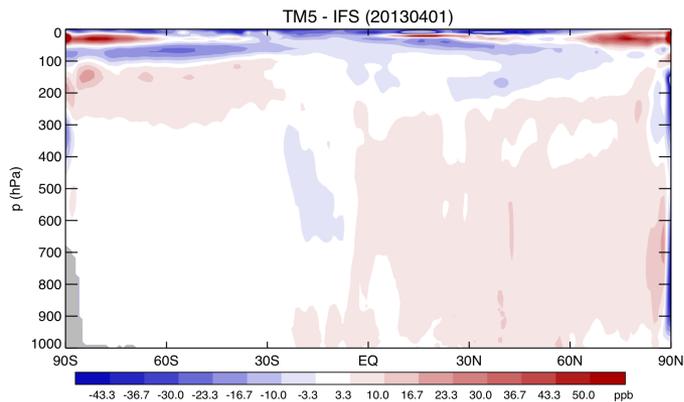


t=1 year

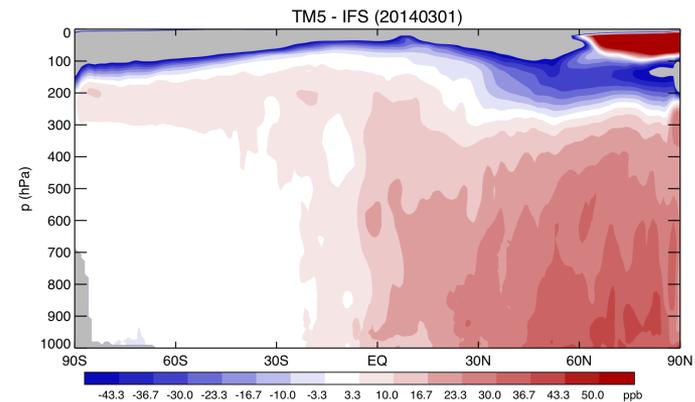


TM5 **sub** – IFS

t=1 month



t=1 year

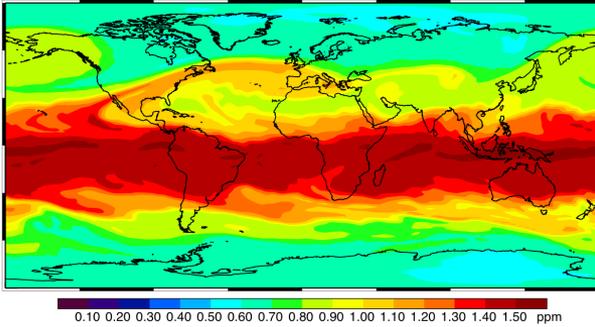


# convec – sub in the stratosphere

TM5 **convec** (10 hPa, t=1 month)

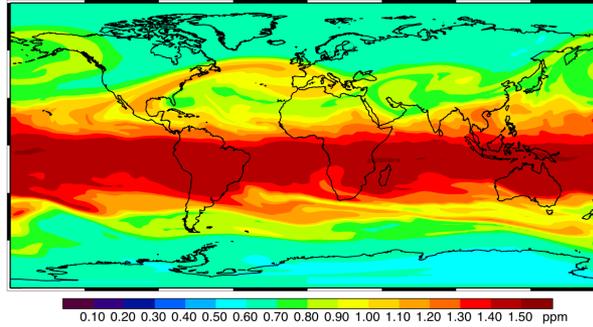
IFS

IFS (20130401 10 hPa)



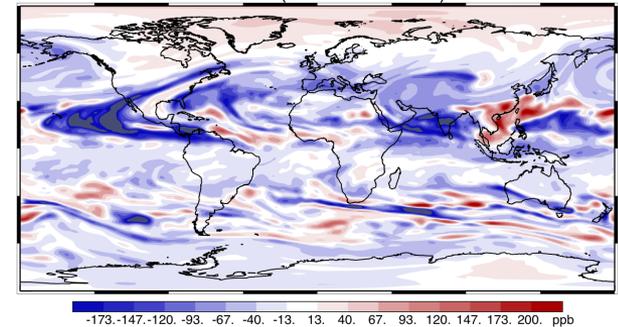
TM5

TM5 (20130401 10 hPa)



TM5 - IFS

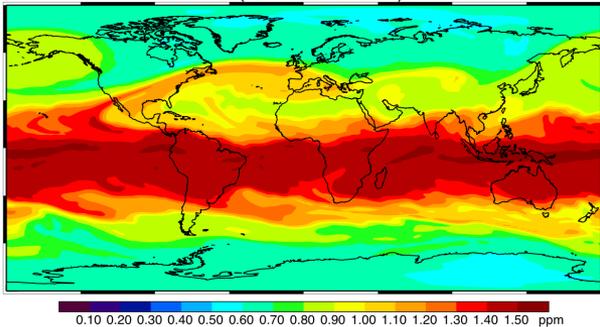
TM5 - IFS (20130401 10 hPa)



TM5 **sub** (10 hPa, t=1 year)

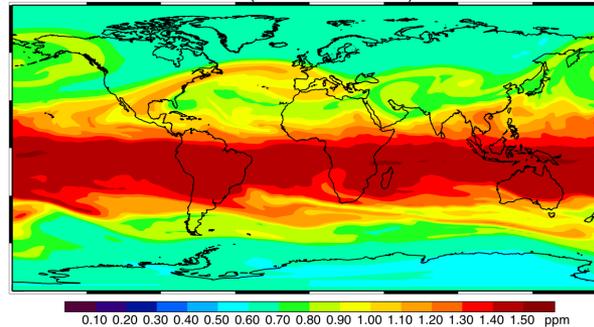
IFS

IFS (20130401 10 hPa)



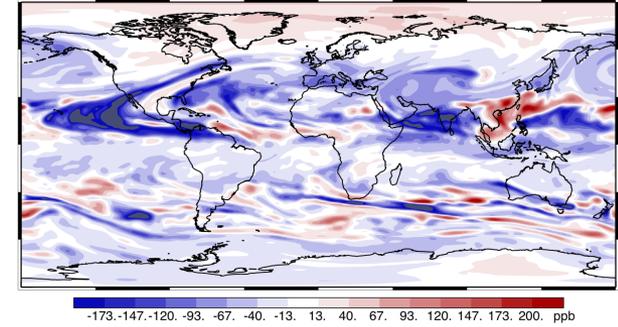
TM5

TM5 (20130401 10 hPa)

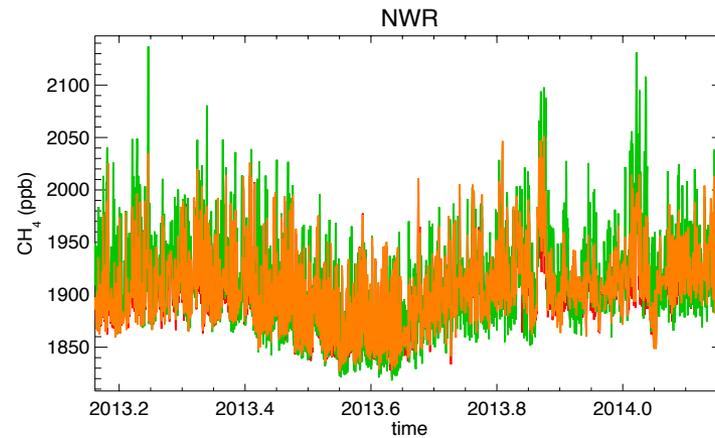
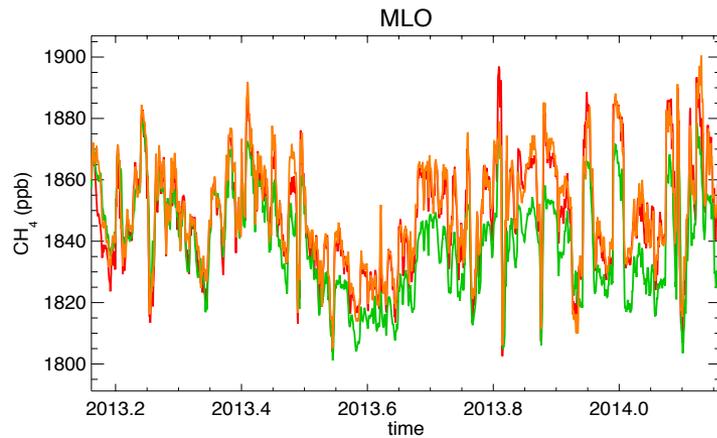
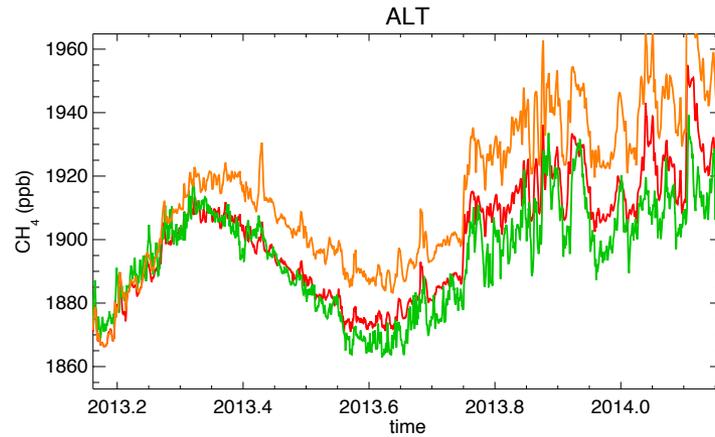
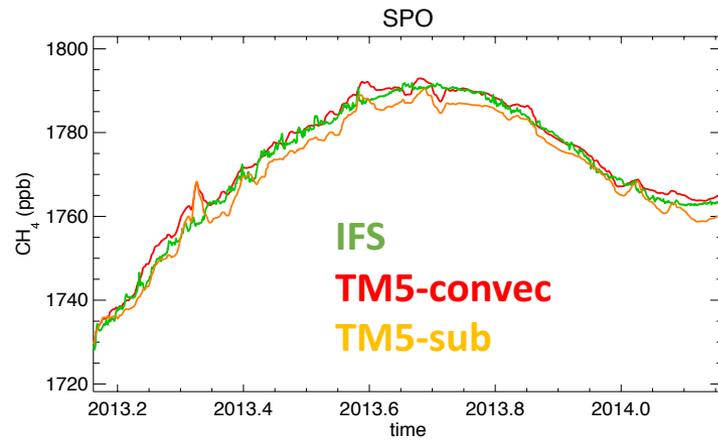


TM5 - IFS

TM5 - IFS (20130401 10 hPa)



# Time series at surface sites

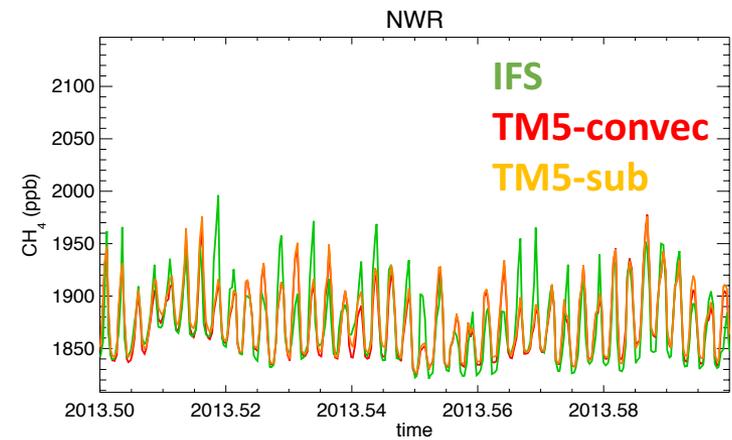
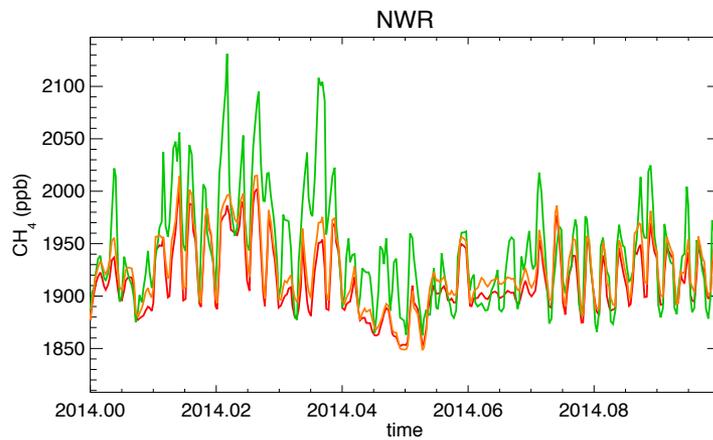


# Zoom in on continental time series

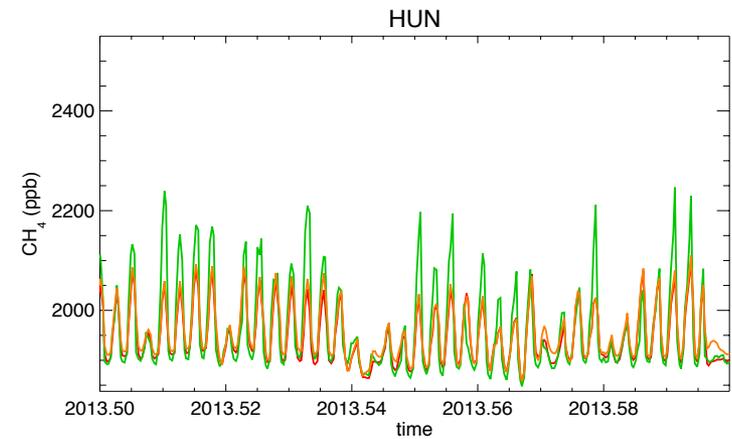
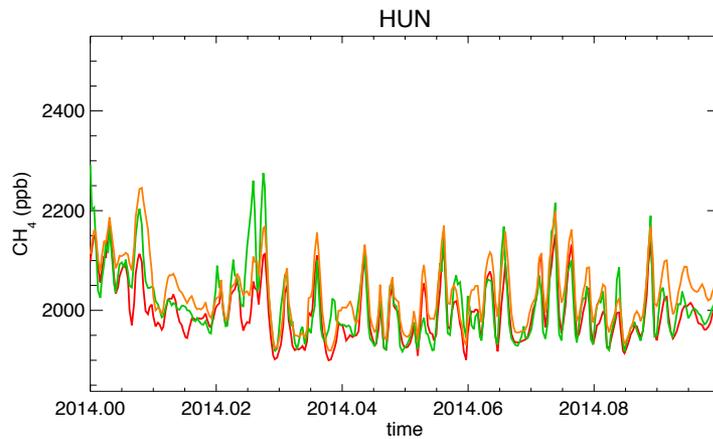
January

July

NWR

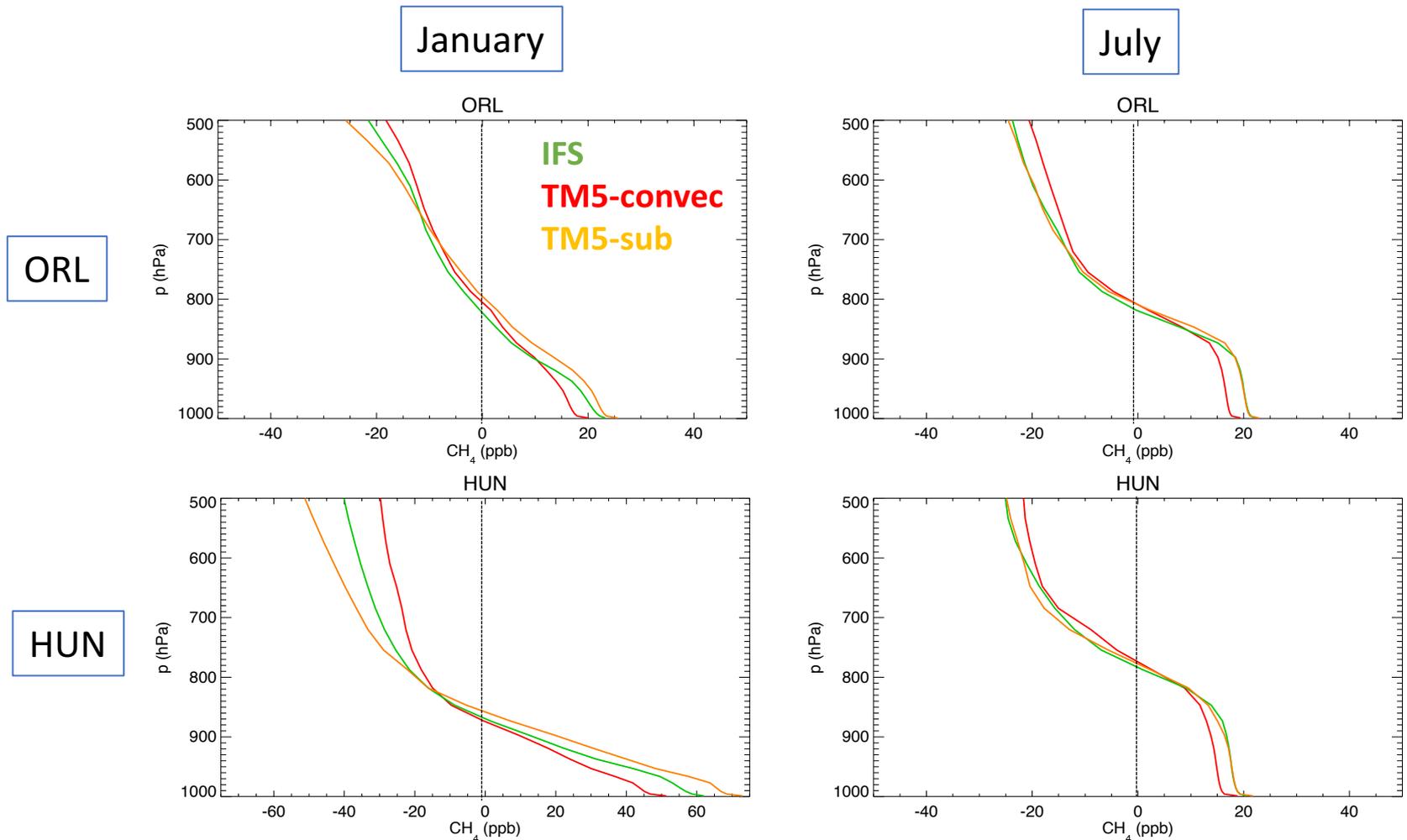


HUN



# Vertical profiles over Europe

- Mid afternoon averages



# Next steps

- Try diffusive mass fluxes in TM5
- Adjust convection & diffusion cut-off in the stratosphere
- Compare with measurements (although a bit tricky in this setup ...)

# Summary

- Comparisons confirm that the use of 'convec' in TM5 fixed differences in north-south exchange.
- Gradient differences not so visible at lower latitudes (?)
- Diurnal amplitude larger in IFS.
- Difference in strat-trop exchange that are insensitive to convec vs sub.
- Vertical profile differences over continents as found before: IFS is closer to TM5 sub in summer (but not in winter)