TM5 in GEMS / MACC:

Inline chemistry in IFS

Vincent Huijnen

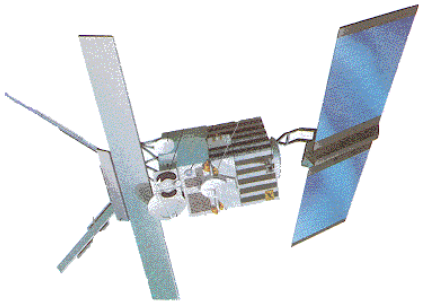
TM5 meeting December 2009

1. Forecast experiments of the 2008 ozone hole

Monitoring atmospheric composition & climate

2. Implementation of TM5 chemistry modules in IFS

Koninklijk Nederlands Meteorologisch Instituut



The GEMS-system

OMI / SBUV / SCIA / MLS

assimilation

Meteo, assimilated O_3, CO, …

IFS (Meteorology, transport)

OASIS-4 coupling

Gobal CTM's (Chemistry)

MOZART

TM5

MOCAGE

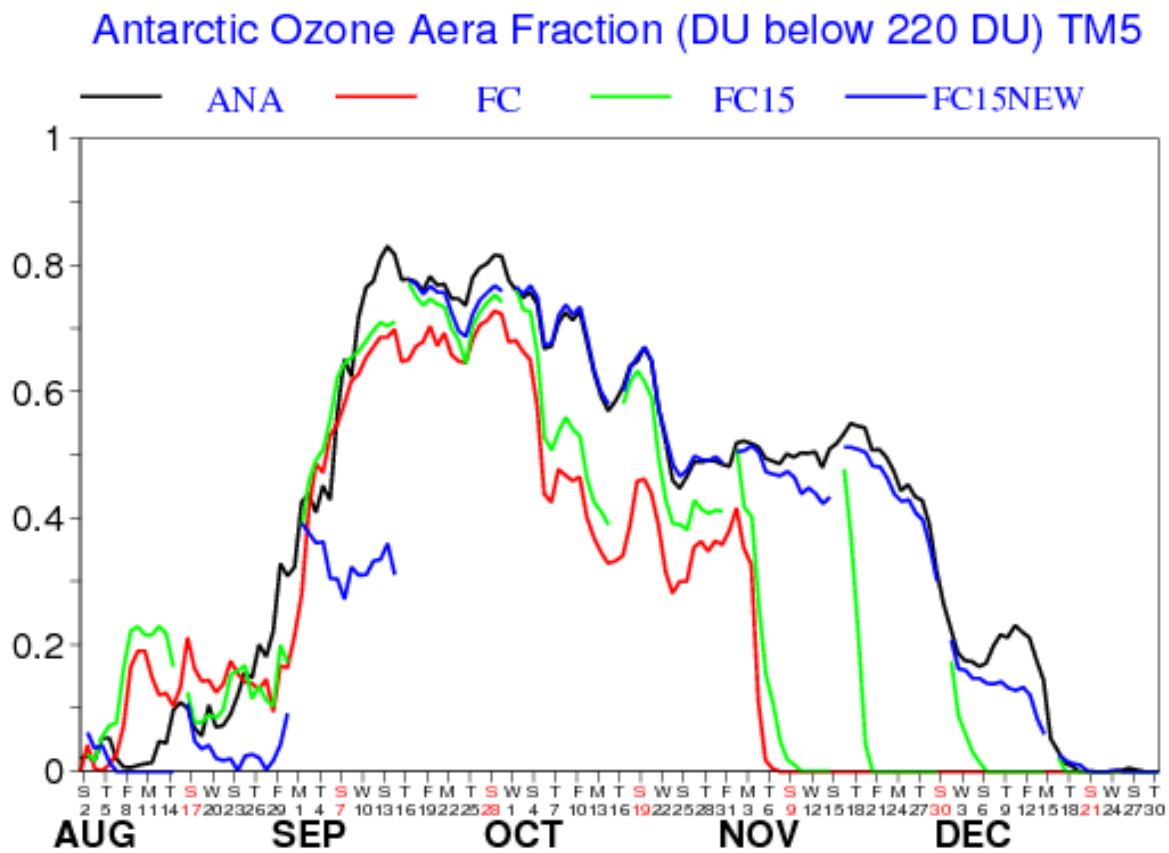
Chemical sources/sinks

Daily global forecasts, Long-term reanalyses

Boundary conditions

RAQ

The 2008 ozone hole



Flemming et al., 2009

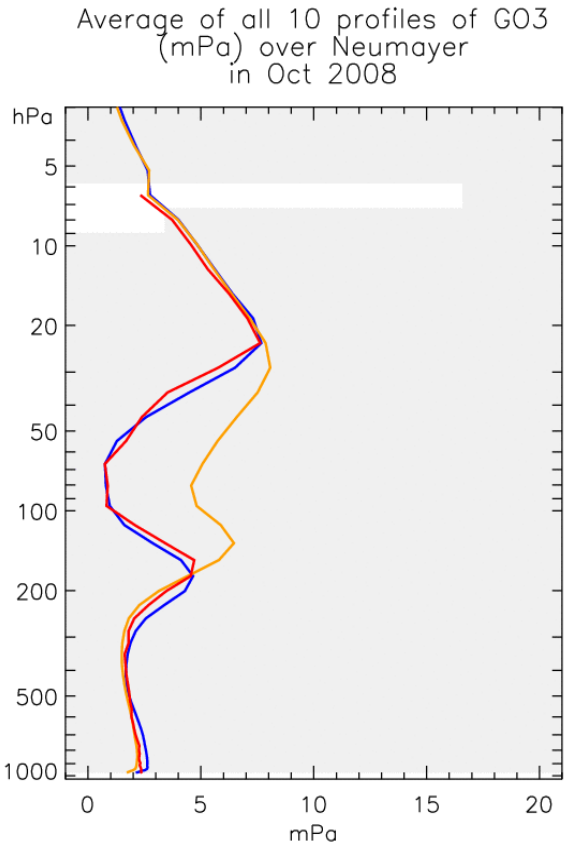
1-day forecast with assimilation

free forecast Constrained by F.-K. climatology

15-day forecast; TM5 ozone nudging to F.-K. climatology

15-day forecast; No constrain

Ozone profile

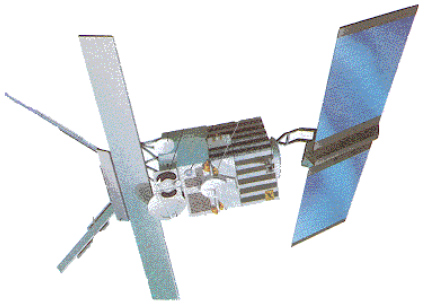


Ozone sonde at Neumayer

free forecast Constrained by F.-K. climatology

1-day forecast from reanalysis

Flemming et al., 2009



The C-IFS-system

OMI / SBUV / SCIA / MLS / …

assimilation

IFS

(Meteorology, transport)

Chemistry modules

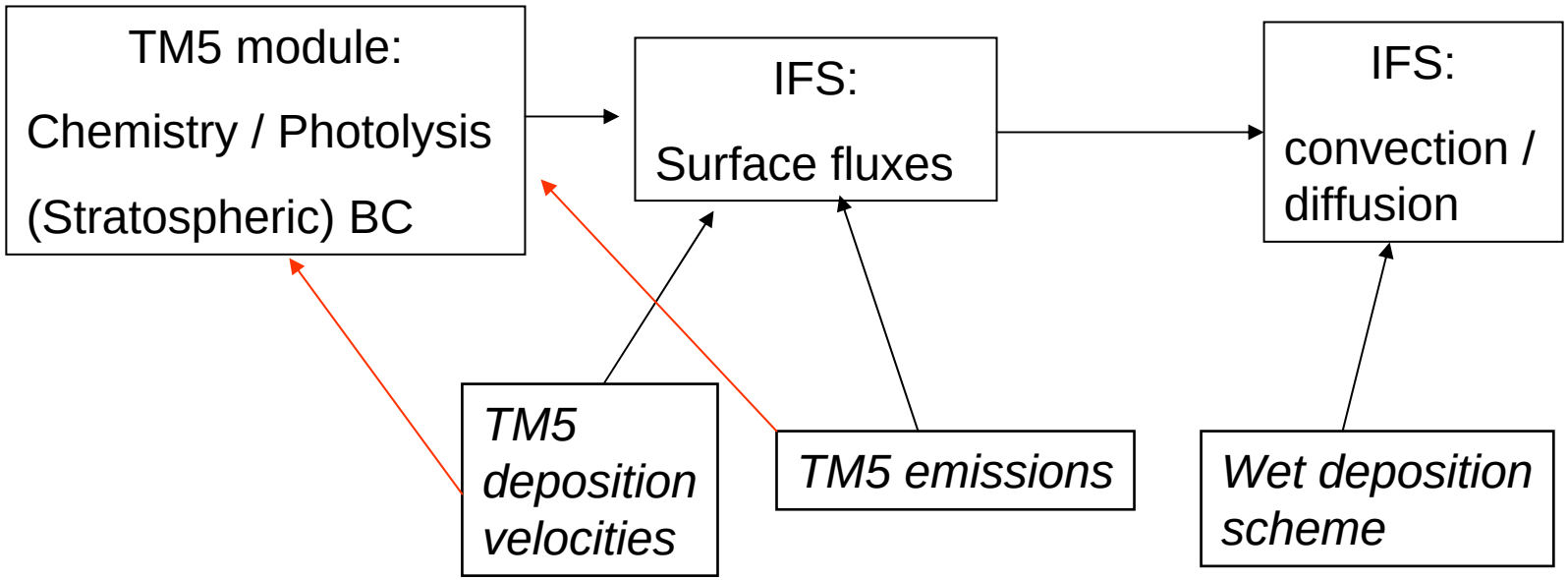
MOZART

TM5

MOCAGE

Koninklijk Nederlands Meteorologisch Instituut

Chemistry-related modules in IFS



Trace gases from TM5-gas phase

- modified CBM4:

  O3, NOx, HNO3, PAN, CO, CH4, CH2O, H2O2, CH3O2H, PAR, ETH, OLE, ALD2, MGLY, ROOH, ORGNTR, ISOP, OH, HO2, CH3O2, NO, NO2, NO3, HNO4, N2O5, C2O3, ROR, RXPAR, XO2, XO2N

- aerosols / precursors:

  NH2, NH3, NH4, SO2, SO4, DMS, MSA, (H2OPART)

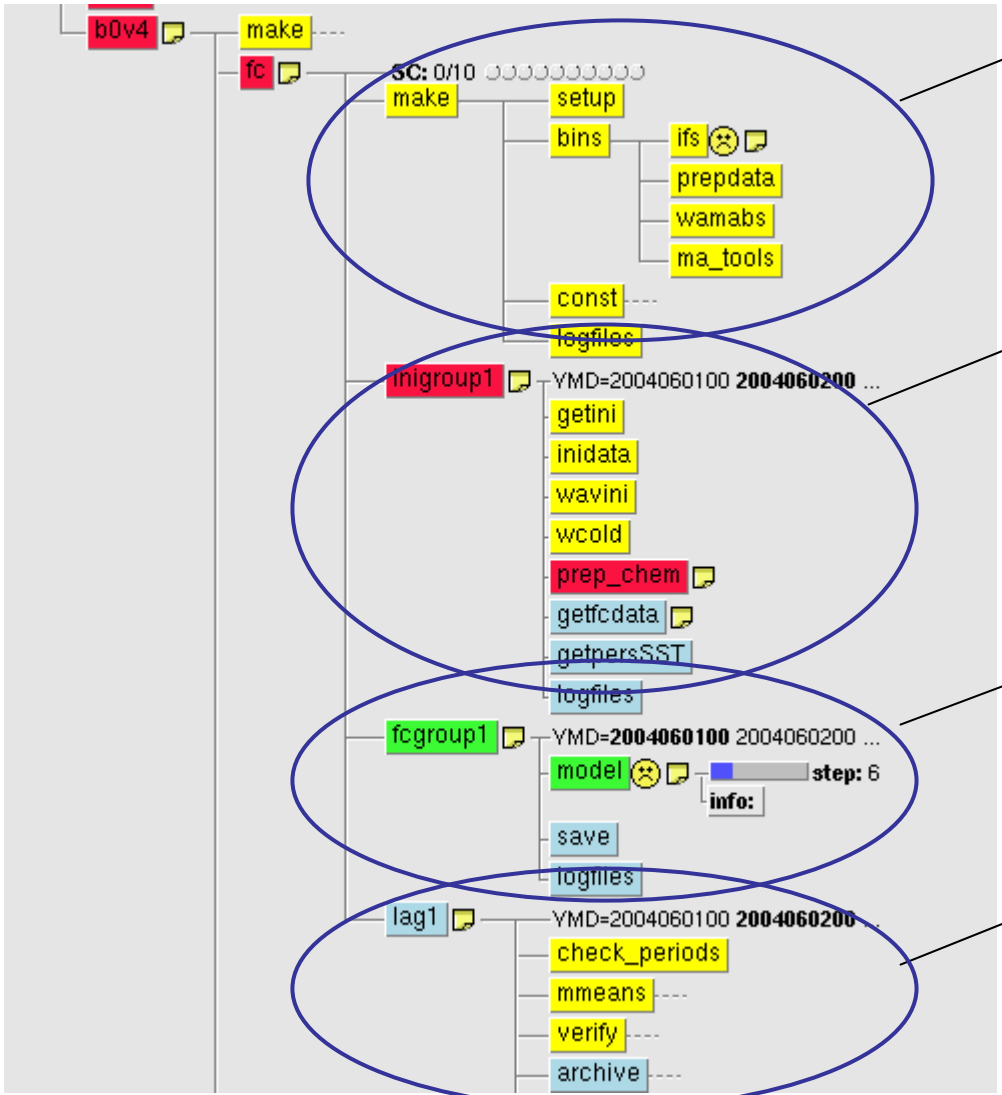
- 2 radioactive tracers:

  Rn222, Pb210

Current status:

- TM5 photolysis/chemistry implemented
- Cariolle implemented based on IFS scheme
- Emissions / TM5 dry deposition fields provided and implemented
- Wet deposition implemented based on IFS routine for aerosol scavenging
- First output generated and verified

C - IFS experiments



Compile & link

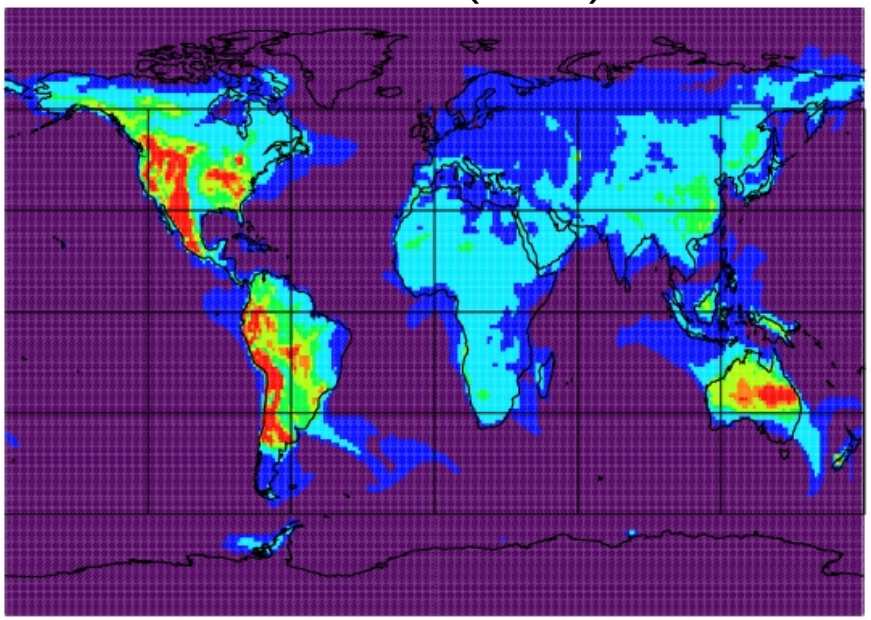
Prepare initial fields, emissions, deposition

Perform forecast run

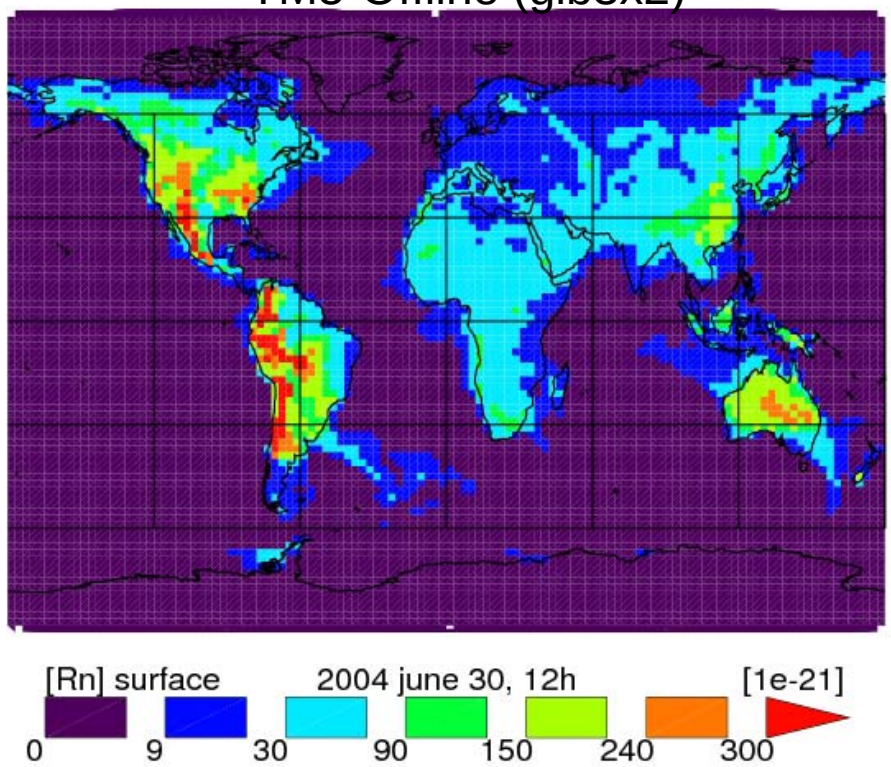
Store output

First results: Rn222 @ surface

C-IFS (T159)

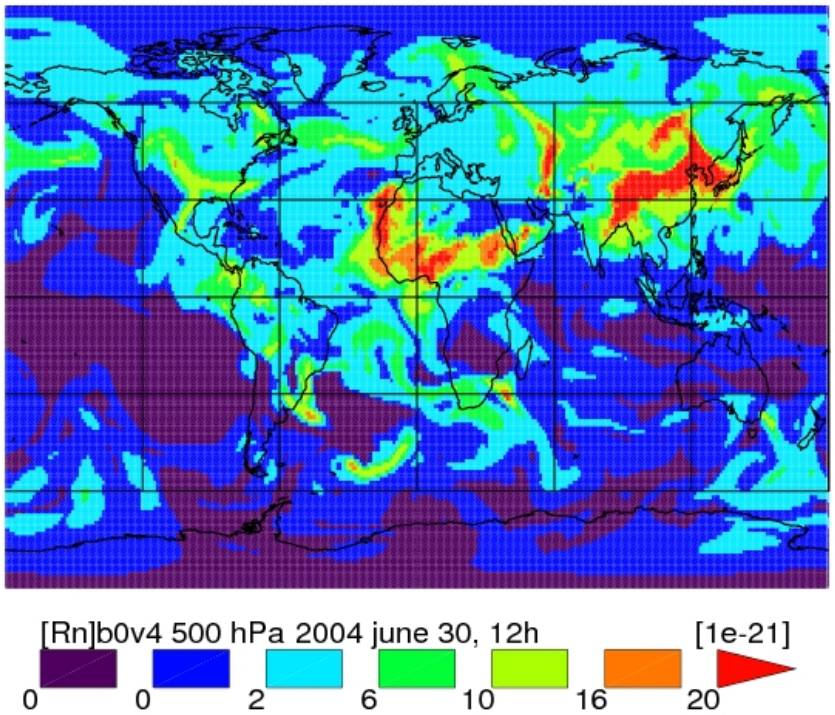


TM5-Offline (glb3x2)

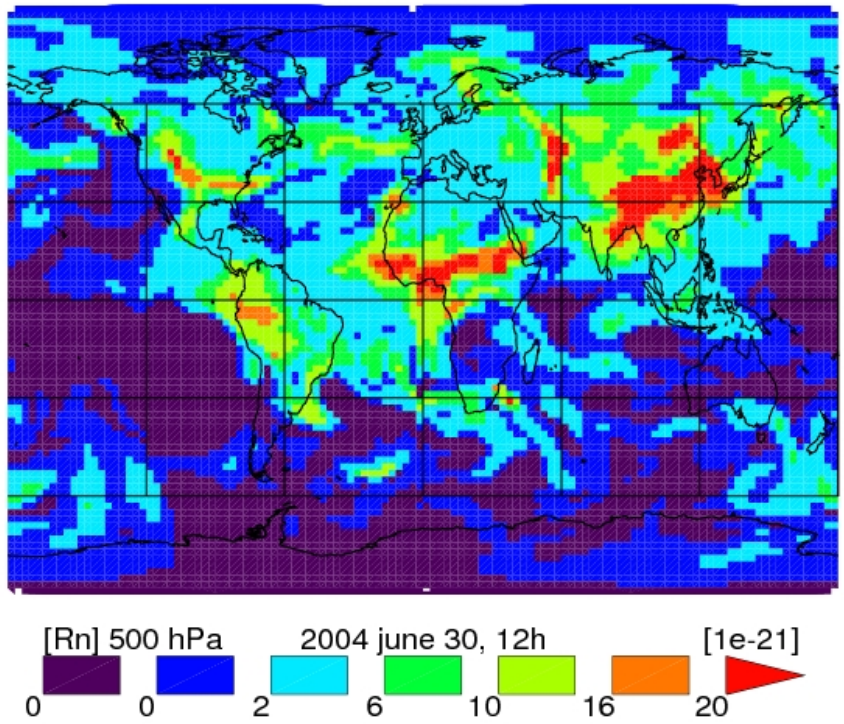


Rn222 @ 500 hPa

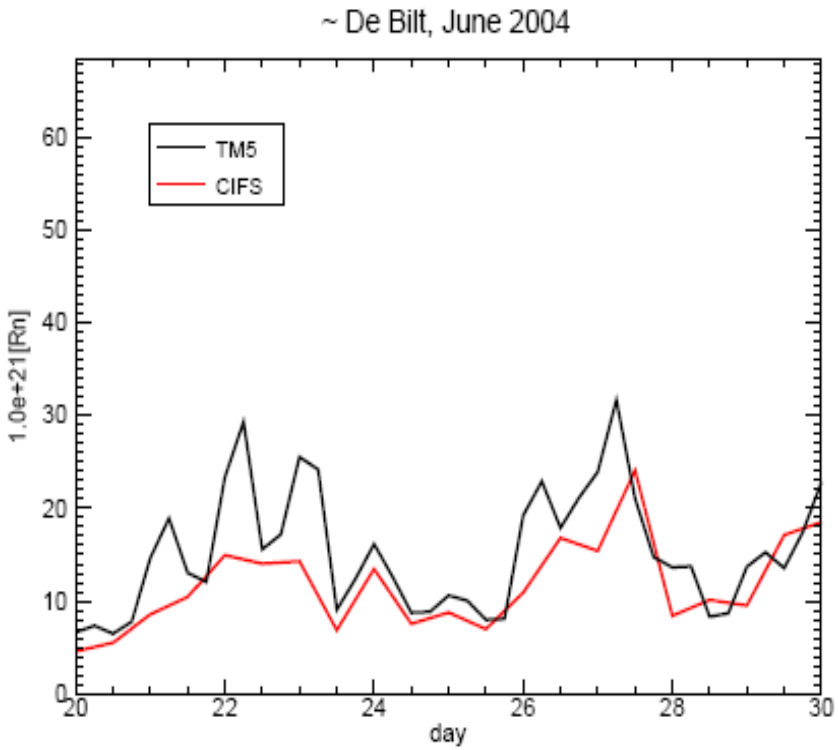
C-IFS (T159)

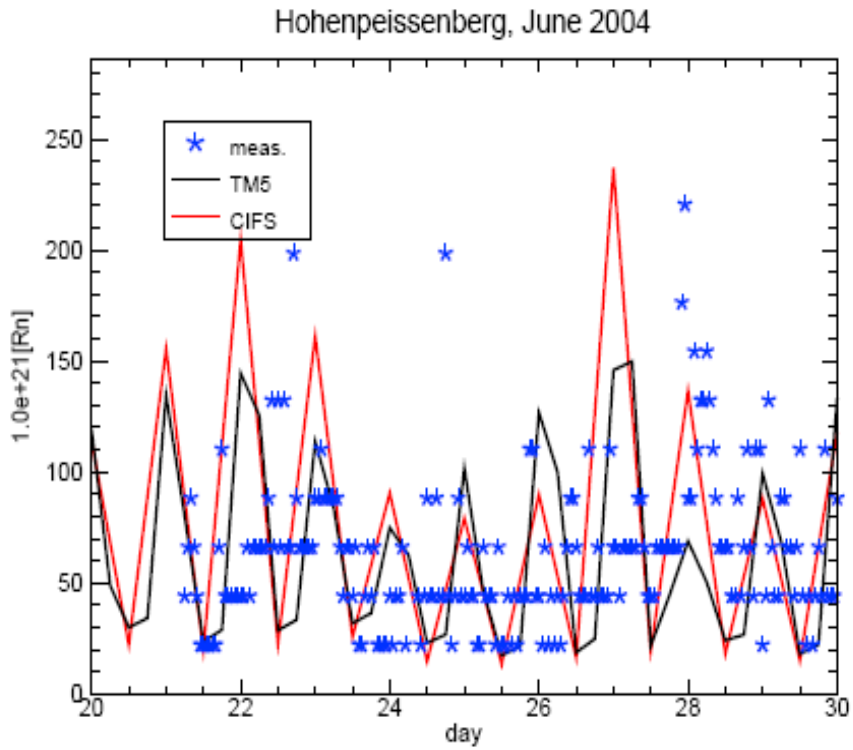


TM5-Offline (glb3x2)



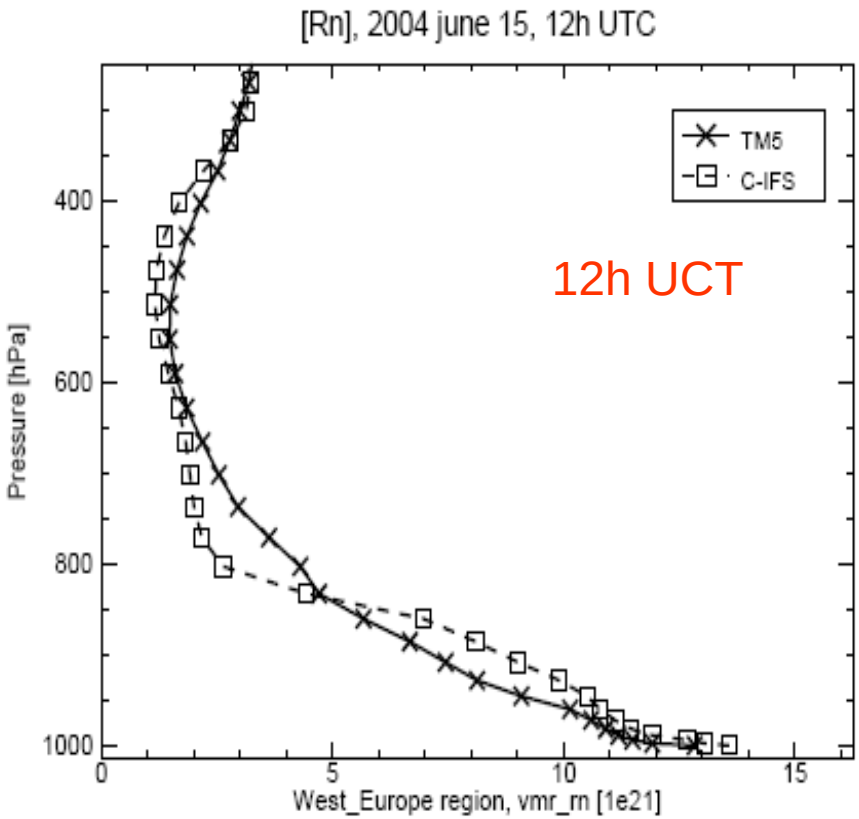
Rn222 time series

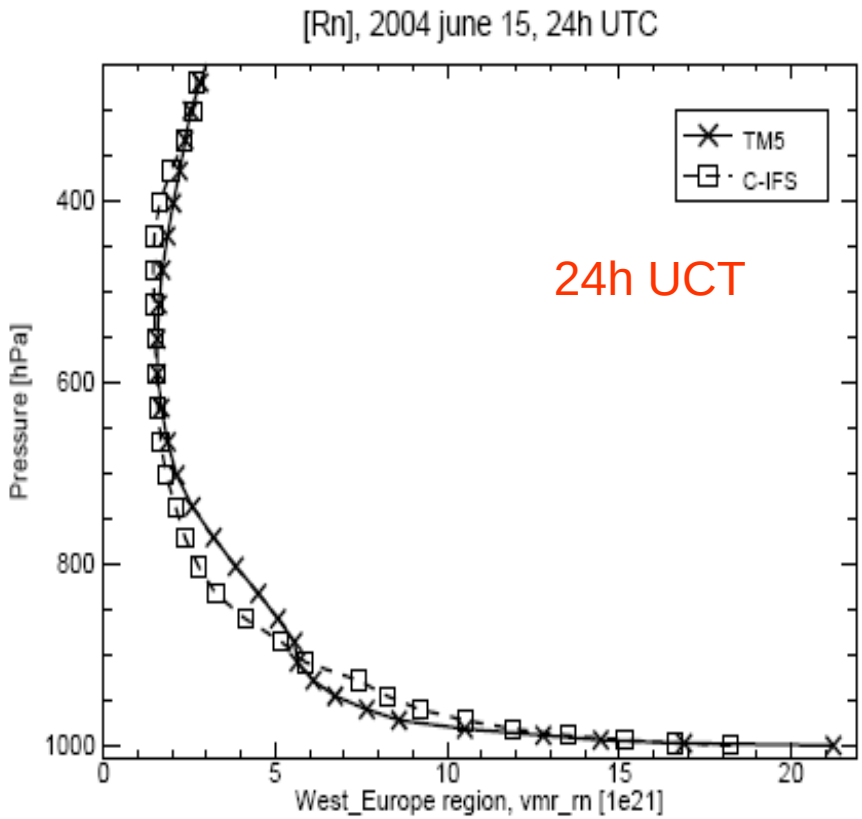




Area-averaged profiles

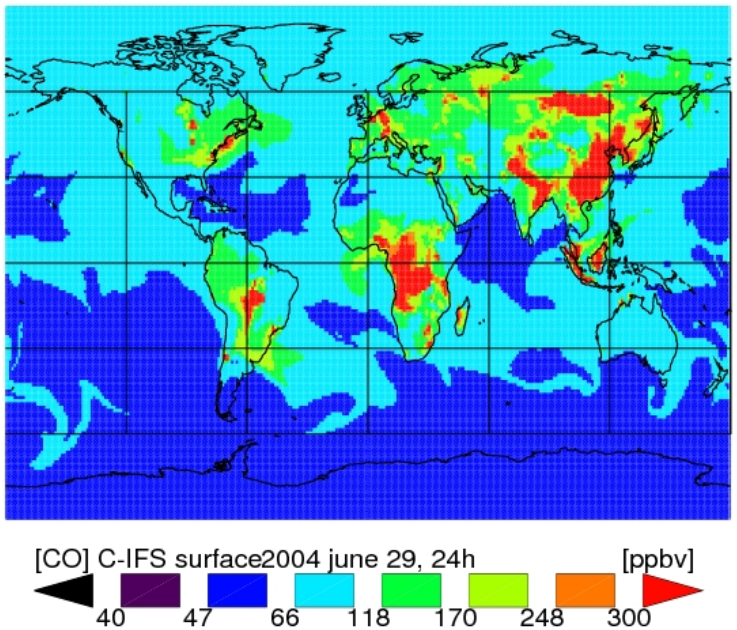
15 June 2004



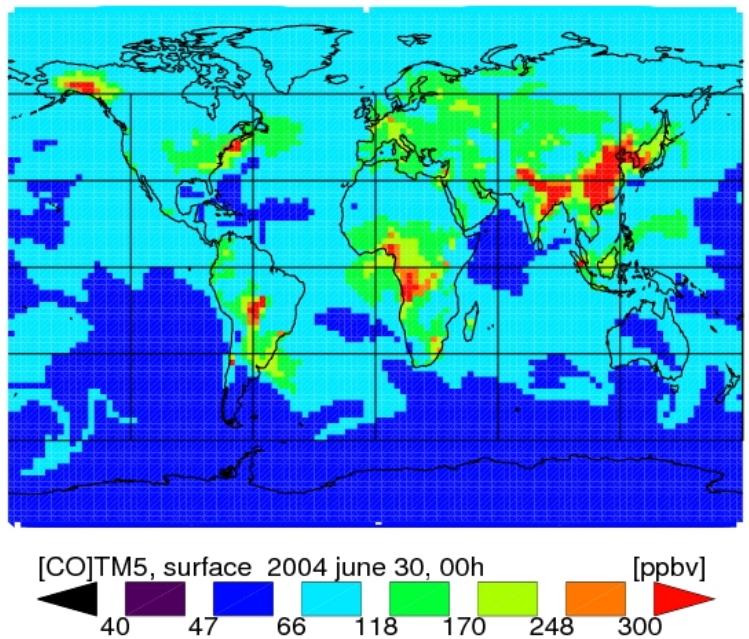


First results: CO after 30 days run

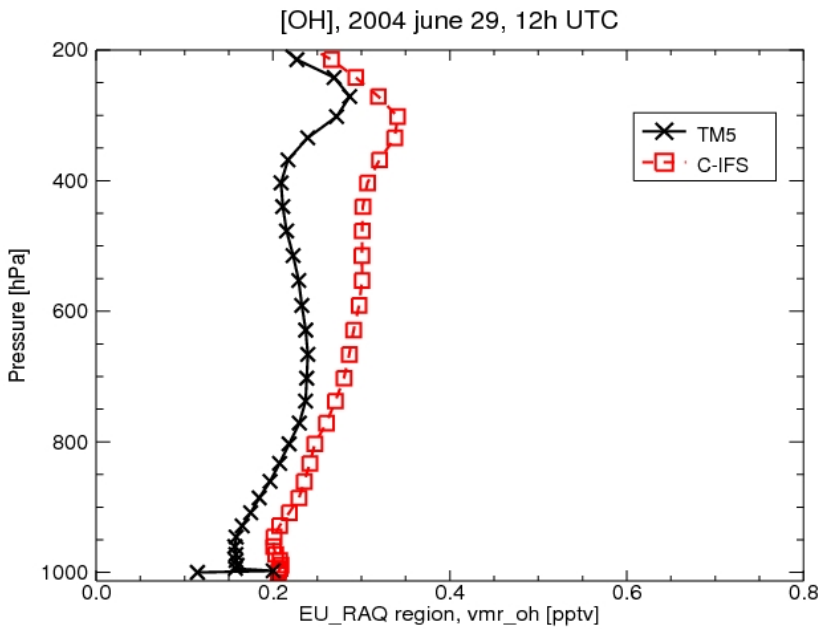
C-IFS (T159)



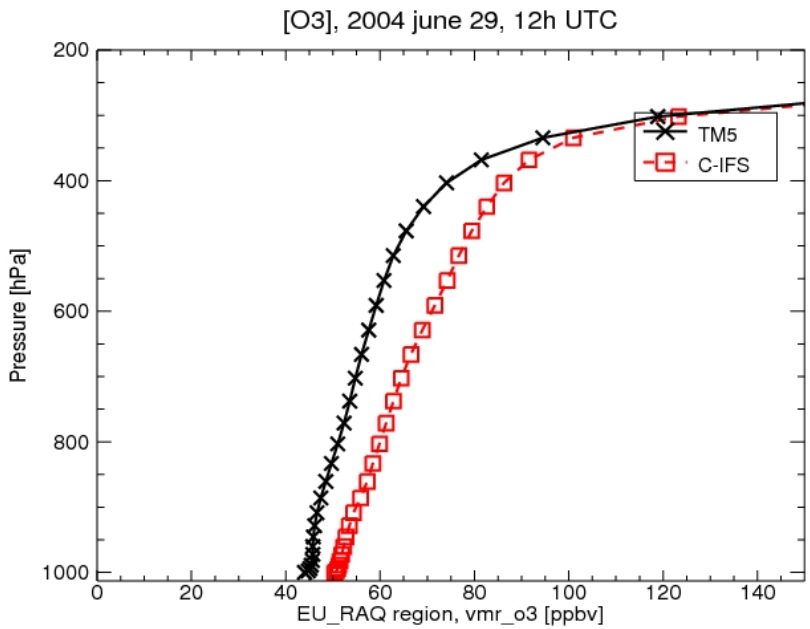
TM5-Offline (glb3x2)



Profiles after 29 days

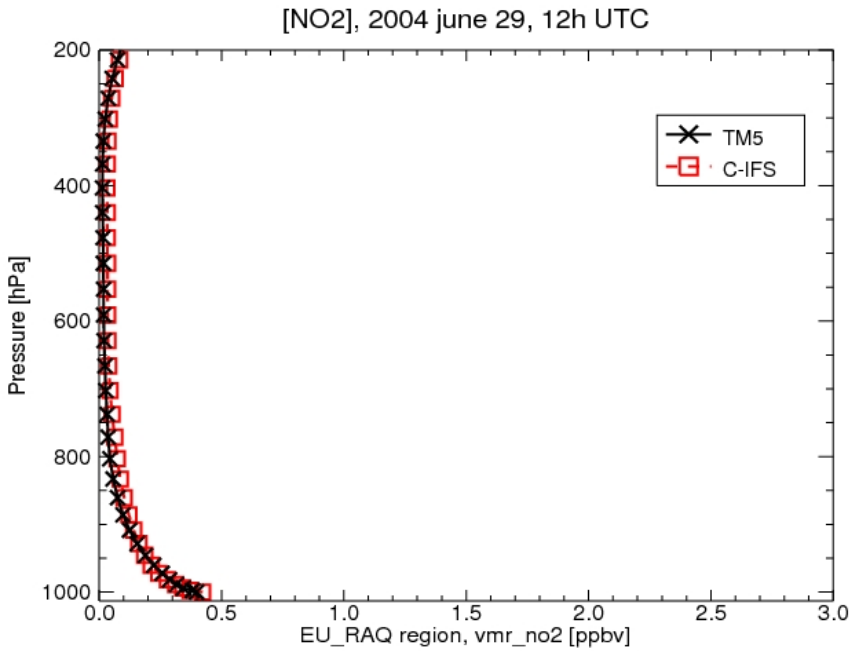


OH

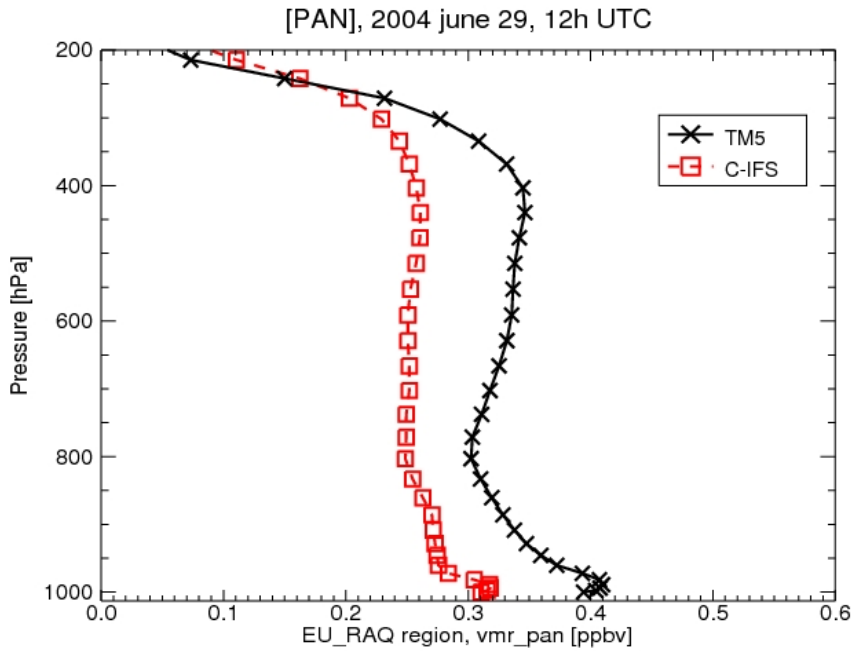


O3

Profiles after 29 days



NO2



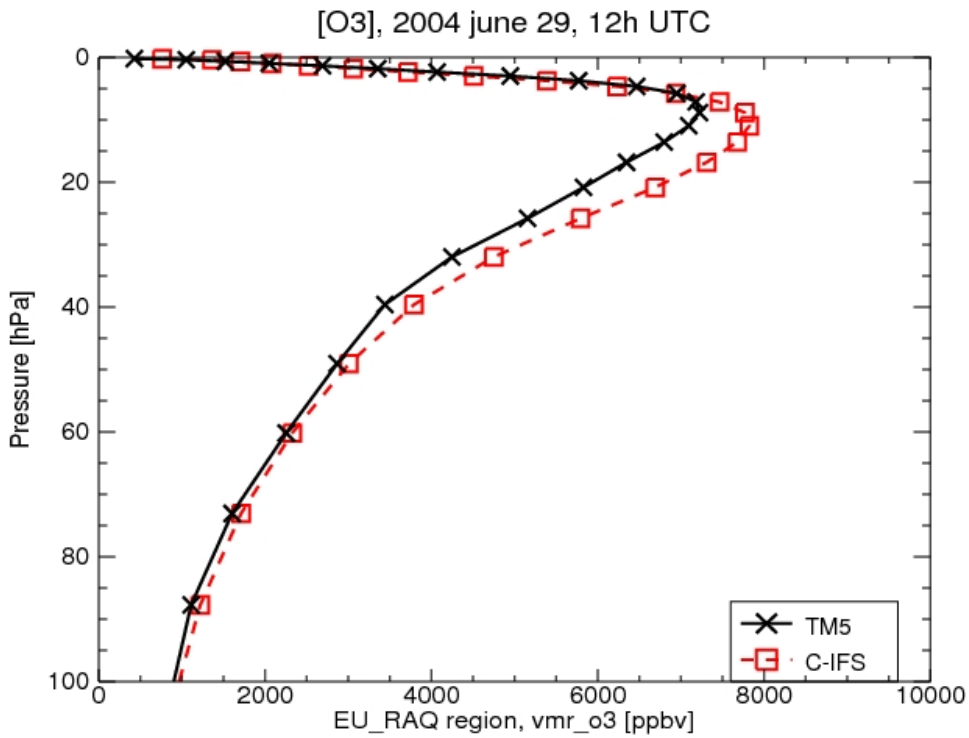
PAN

To be done:

- Test version with transported NOx
- Implement NOx from lightning
- Verify wet deposition scheme
- Update emissions and deposition velocities
- Validate system

Stratospheric ozone

- TM5: Fortuin & Kelder
- C-IFS: Cariolle & Teysedre



Wet deposition

- C-IFS: Simple scheme using available rain water for uptake