TM5-IFS assimilation and forecast experiments: the Russian forest fires and other applications.

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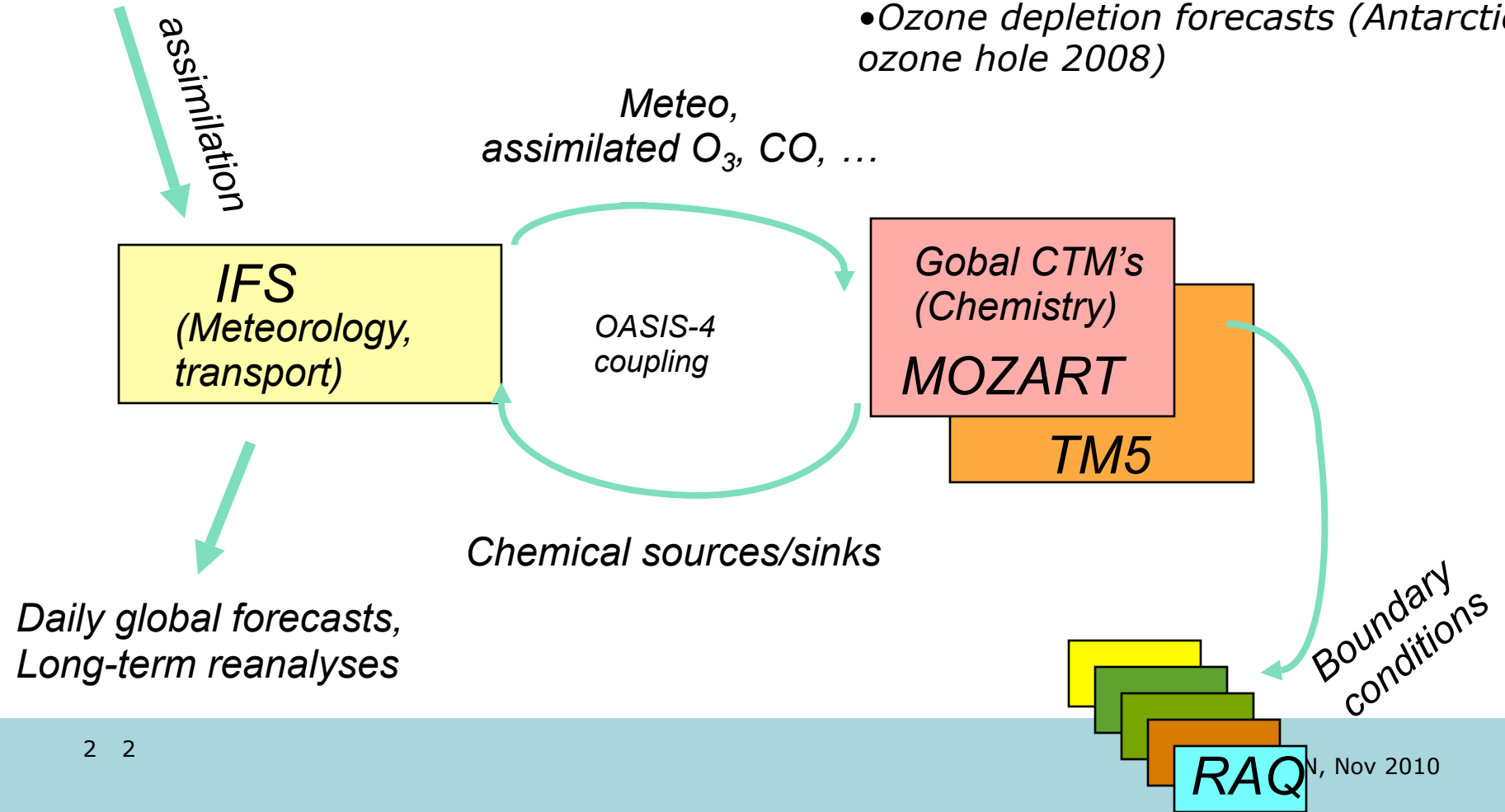
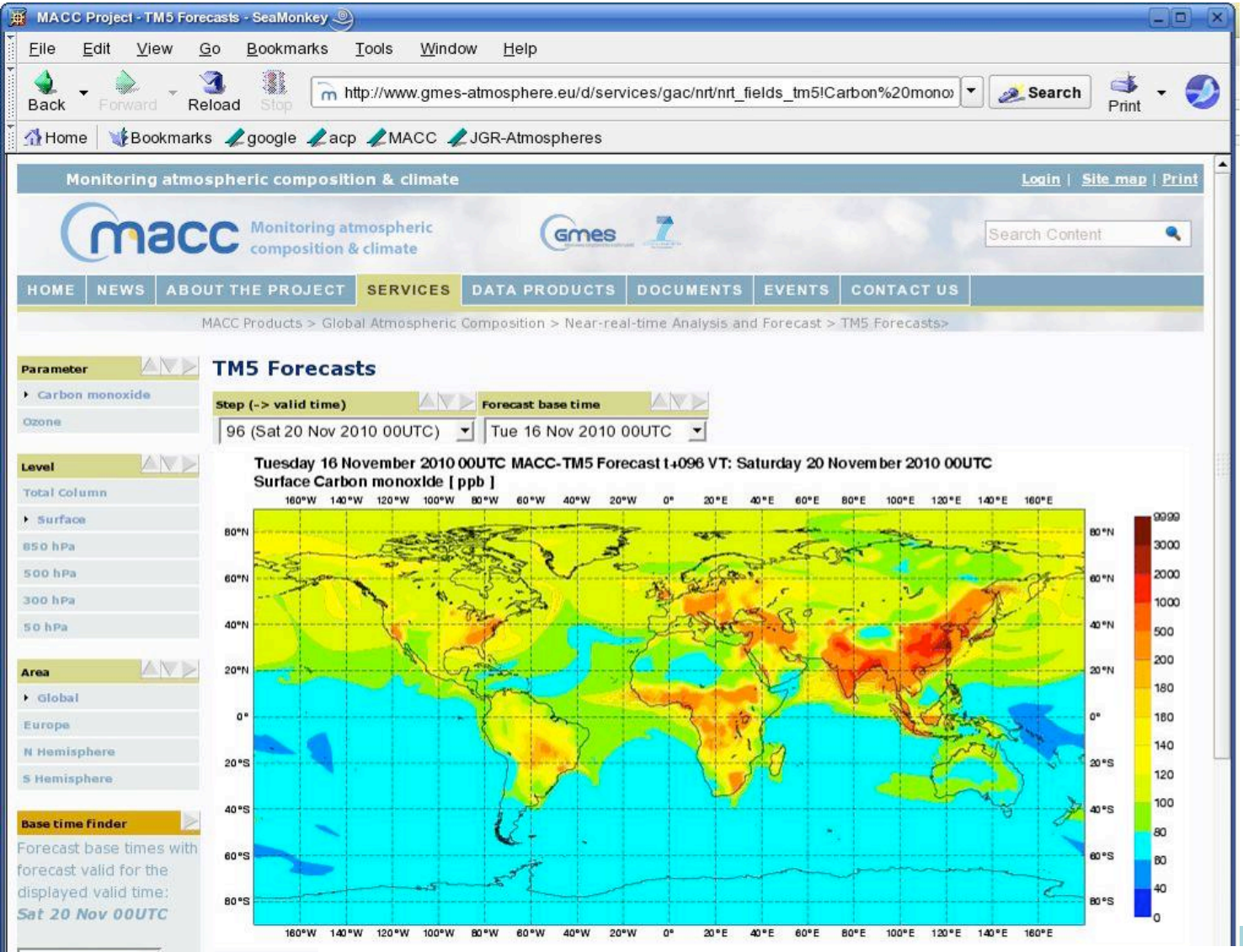
The GEMS/MACC Coupled system

Experiments aim at improving forecast skills for general as well as specific conditions, e.g.:
- *Fire episodes (Russian fires 2010)*
- *Ozone depletion forecasts (Antarctic ozone hole 2008)*

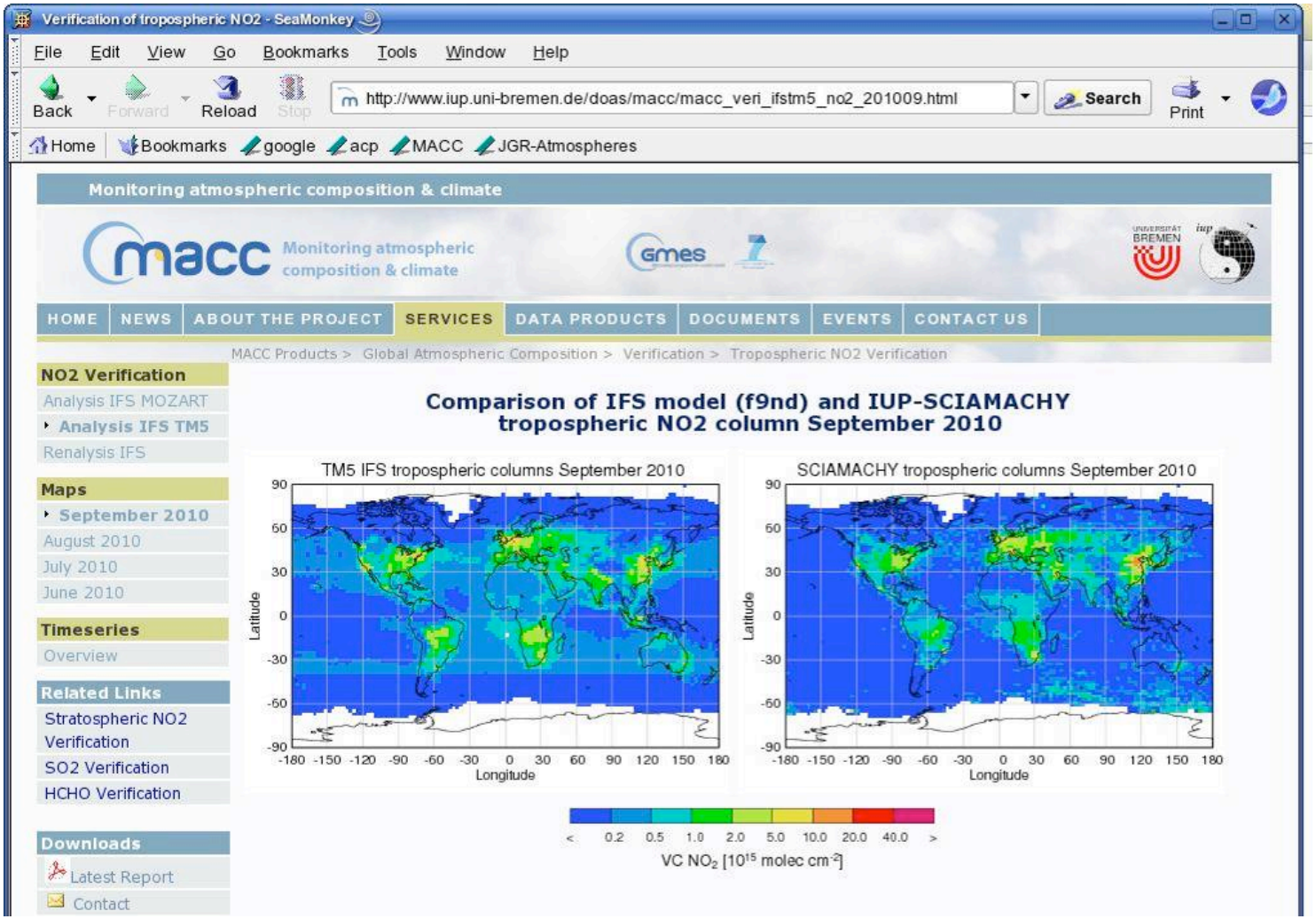


TM5-IFS forecasts availabe on MACC website…

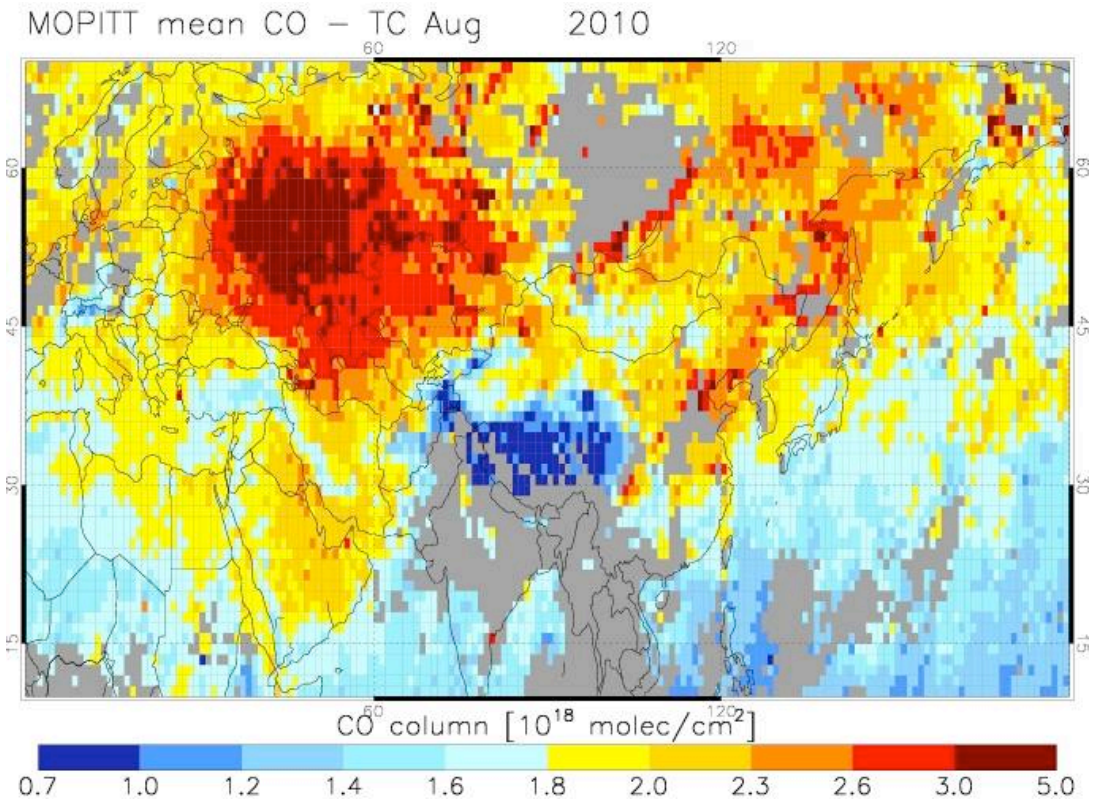


http://www.gmes-atmosphere.eu/d/services/gac

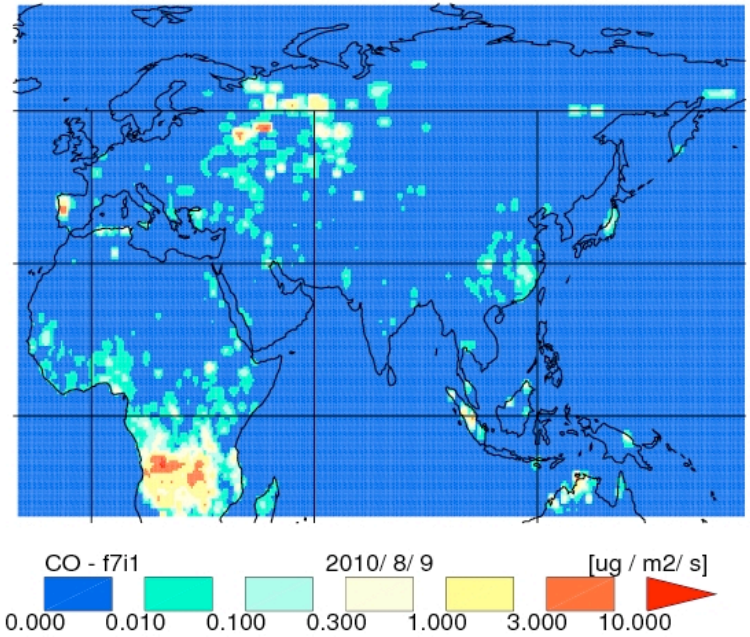
…as well as some validation…



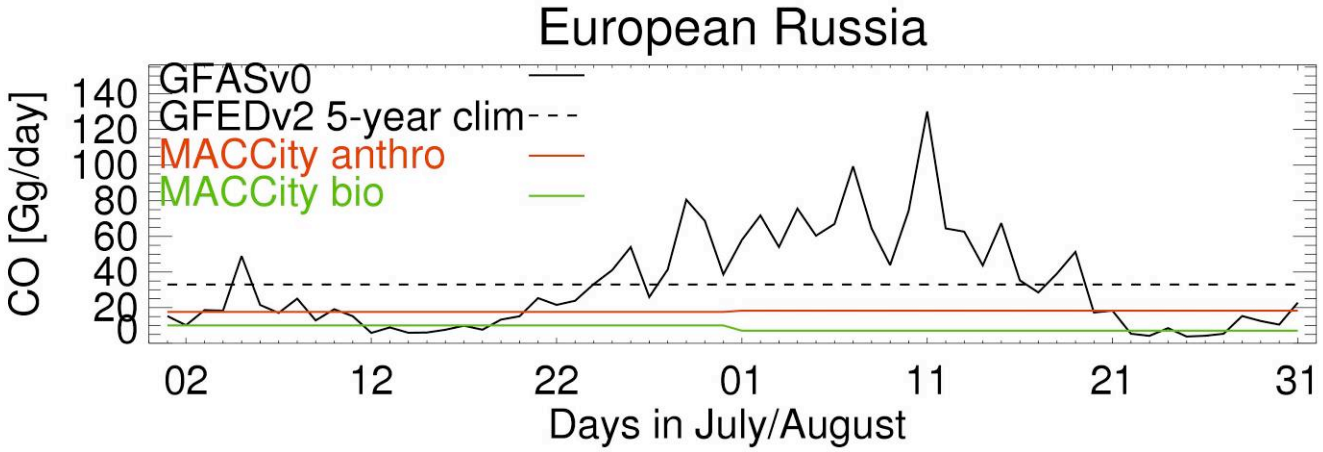
Case study 1: Forecast experiments during Russian fire episode (August 2010)



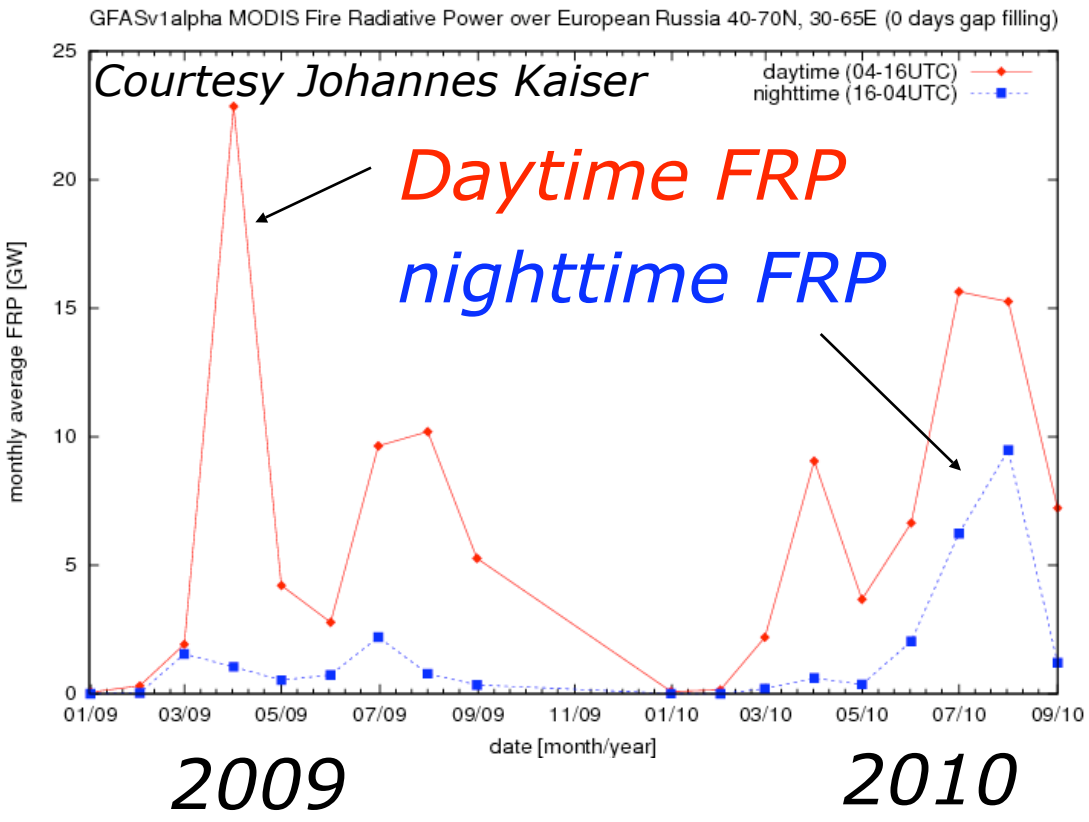
CO emissions from GFASv0 product (Kaiser et al.)



- Timeseries show that fires start around end of July, lasting up to half August.
- Total fire emissions only slightly larger than climatology



Problems in GFASv0:



Classification of emission type was wrong: attribution to 'boreal fires' whereas in reality this was peat fires: Continued burning in the night!

->Different emission factors for 'peat' compared to 'boreal forest':

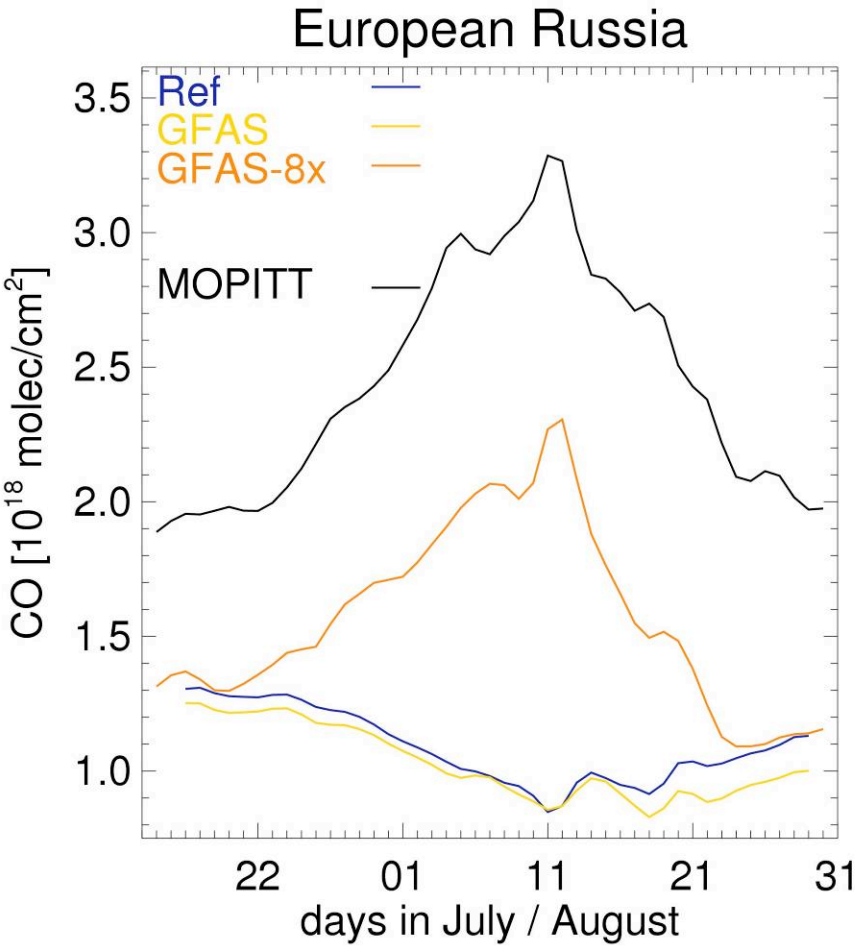
CO: 13 x higher

NOx: 5 x higher

CH4: 29 x higher

NMVC: 8 x higher

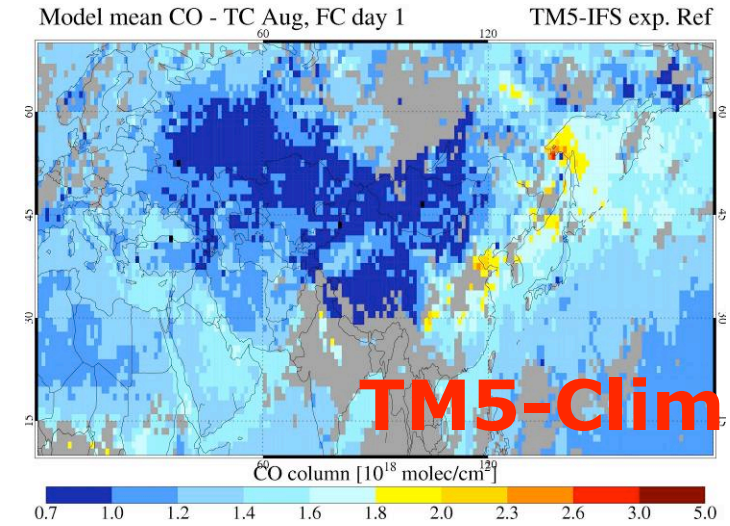
Evaluation of total CO columns – Free runs

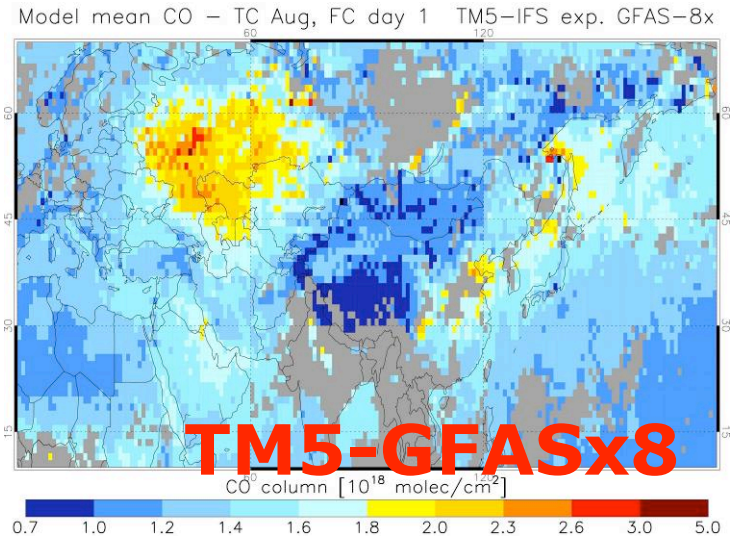


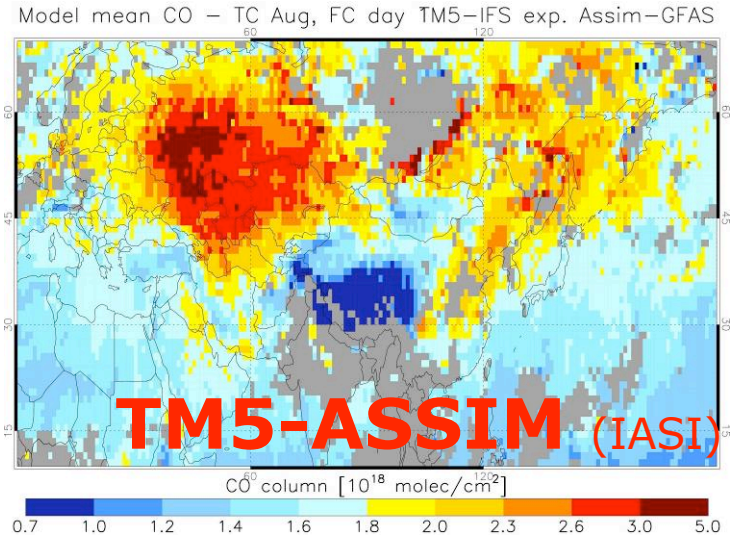
- TM5 forecast runs with varying BMB-emissions:
  - REF: GFEDv2-climatology
  - GFAS: GFAS emissions
  - GFASx8: locally 8x enhanced GFAS

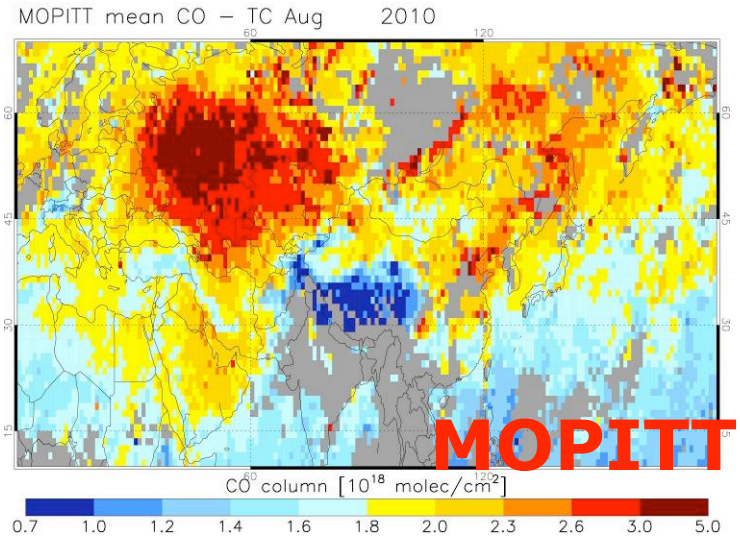
- Other emissions are from AR5-RCP 8.5 (i.e. rather low?):
  - Global ant. CO: 584 Tg/yr
  - Global bio. CO: 96 Tg/yr

CO total columns from varying systems

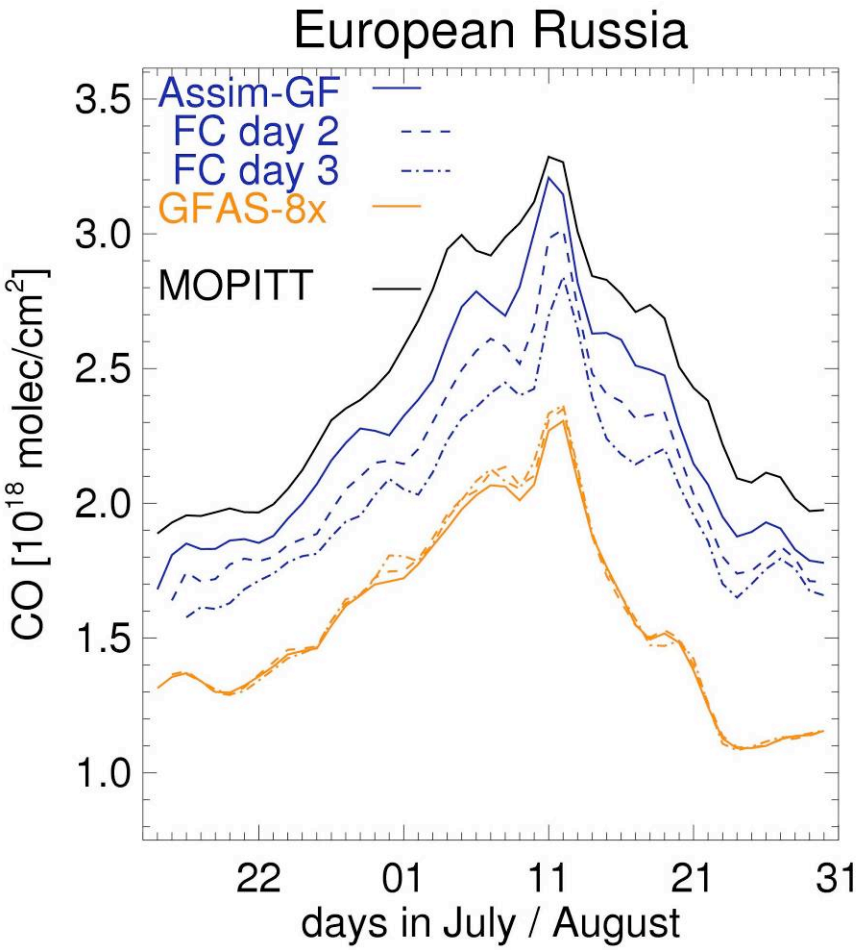








Evaluation of total CO columns – effect of assim.

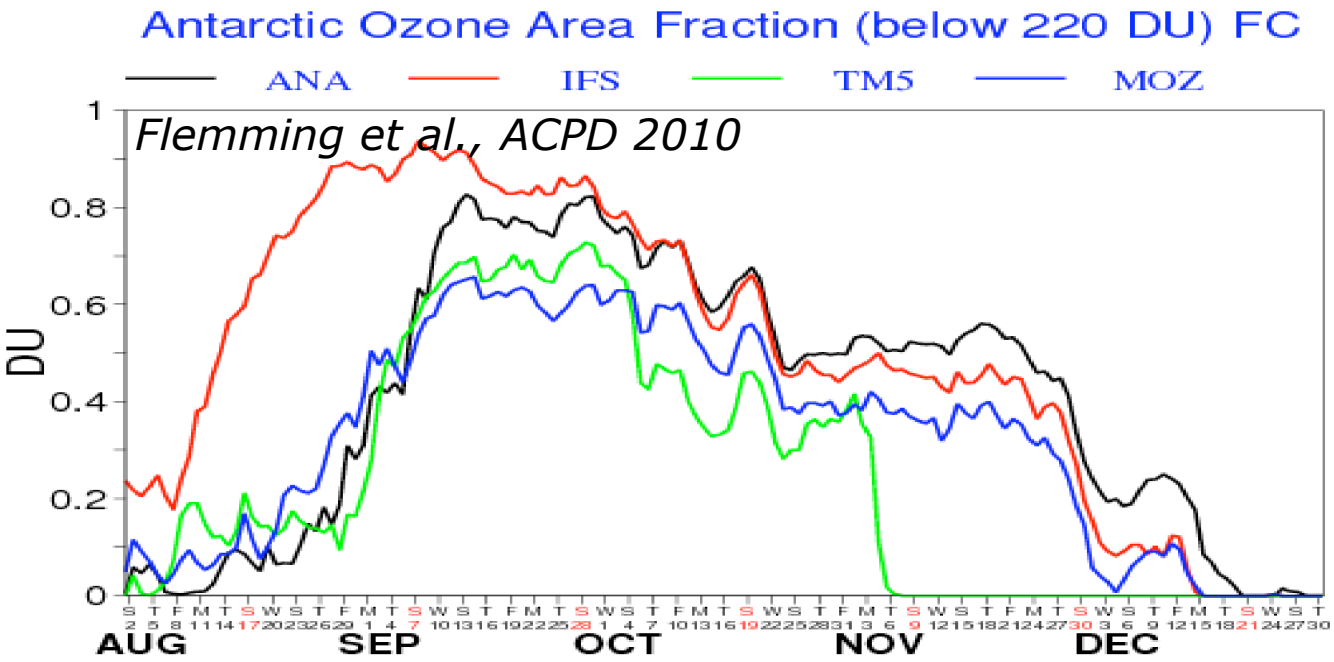


- Including CO assimilation (IASI) combined with original GFAS emissions: small bias wrt MOPITT…
- But 2nd and 3rd day forecasts started from analysis show clear degradation: Need for better emission estimates!
- 2nd and 3rd day forecasts from run '8x GFAS' are in line with 1st day forecasts of 8x GFAS: system is in equilibrium

Future work:

- Additional forecast experiments when update of GFAS-product becomes available; focus on:
  - Evaluate effect of assimilation & emission products,
  - Evaluate forecast skill for different systems / settings
  - Evaluate forecasts of surface O3/CO concentrations (when available?!)

2008 ozone hole experiments: Free running forecasts



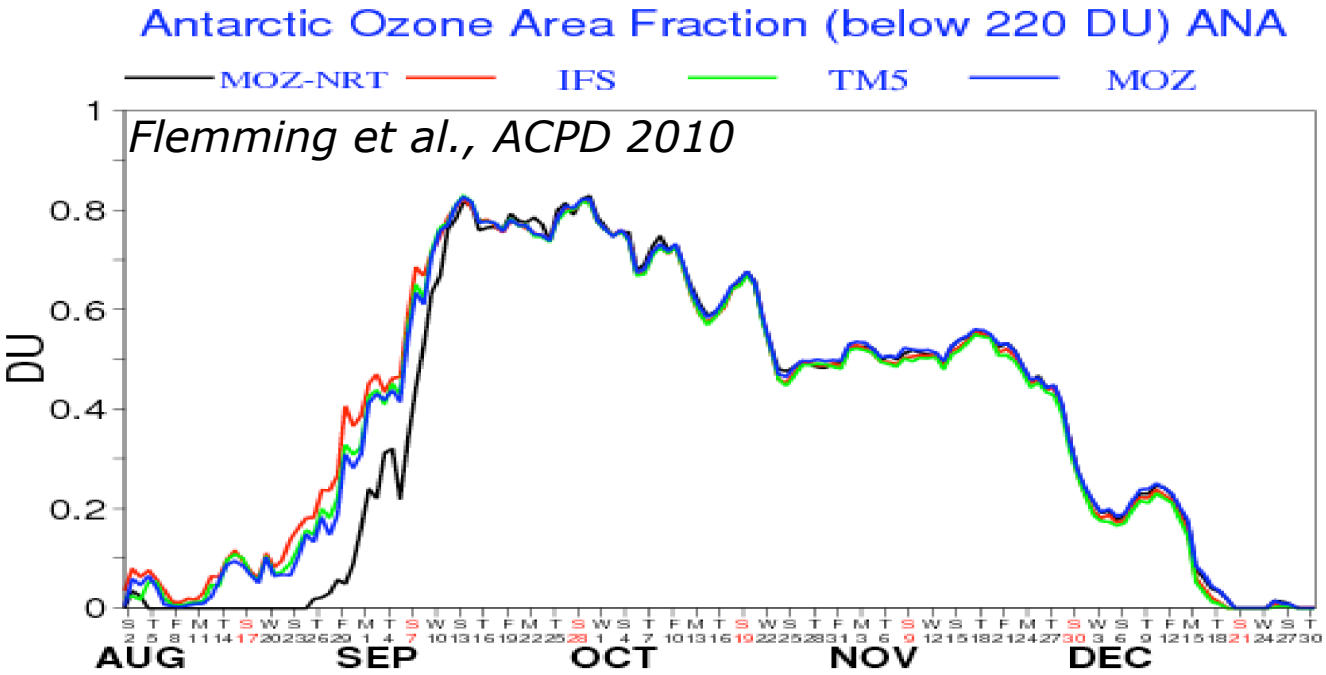
Analysis: 'reality'

TM5 here uses Fortuin-Kelder climatology

MOZART-3: stratospheric chemistry

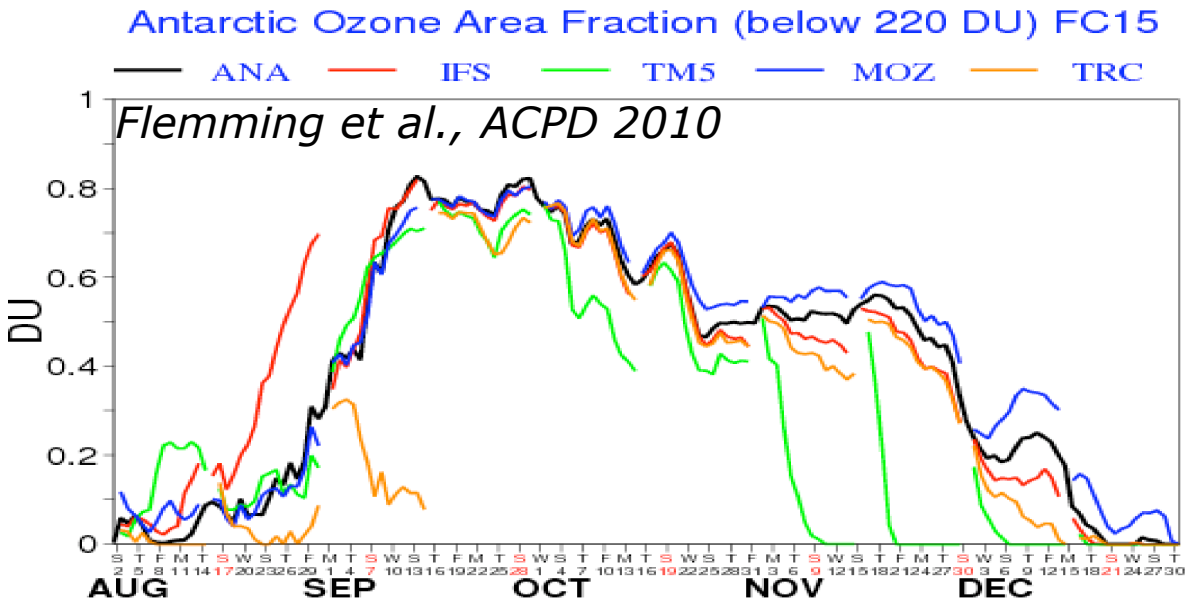
IFS: Cariolle scheme

2008 ozone hole Analyses



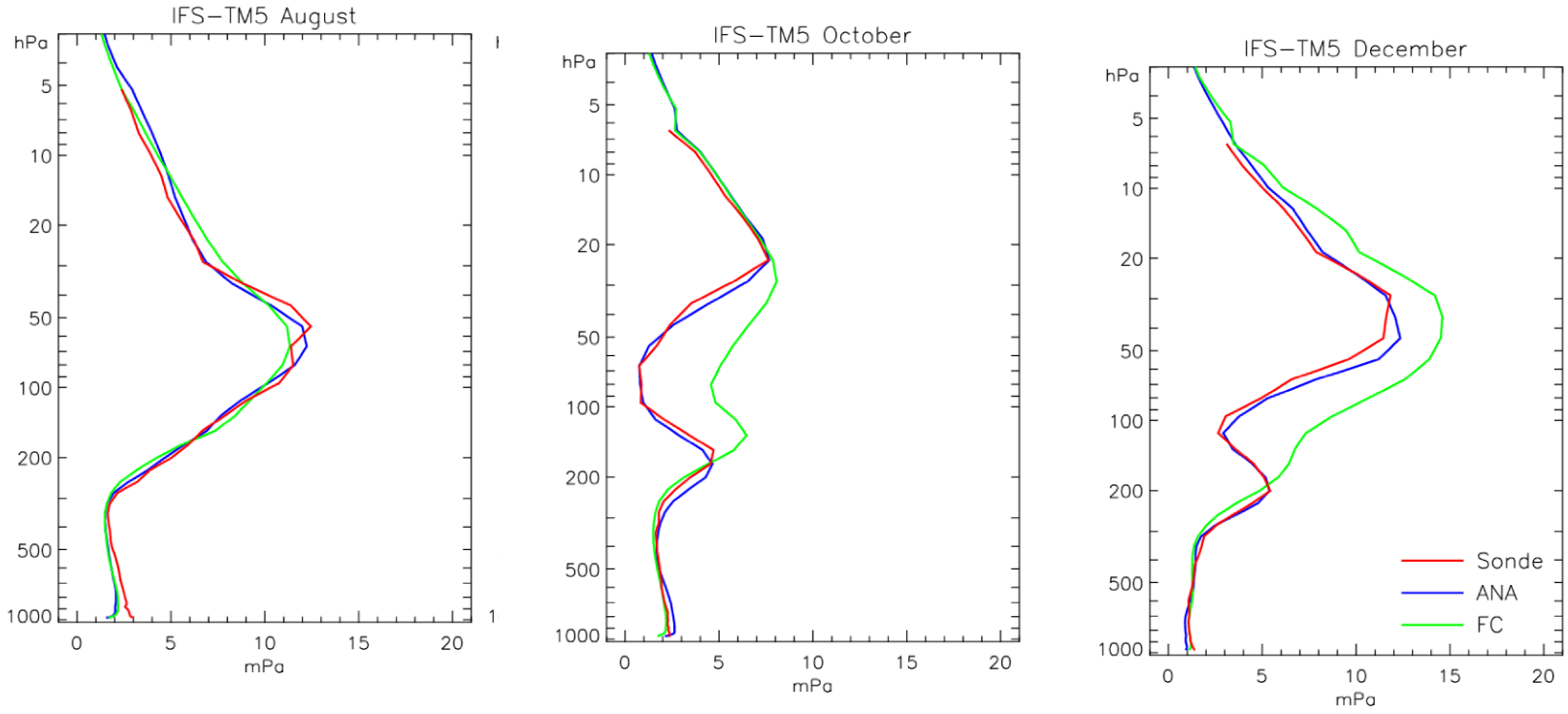
Multi-sensor O_3 assimilation system (SCIA, OMI, MLS, SBUV) pulls all analyses on top of each other

2008 ozone hole: 15 day forecasts



TM5 climatological approach obviously fails

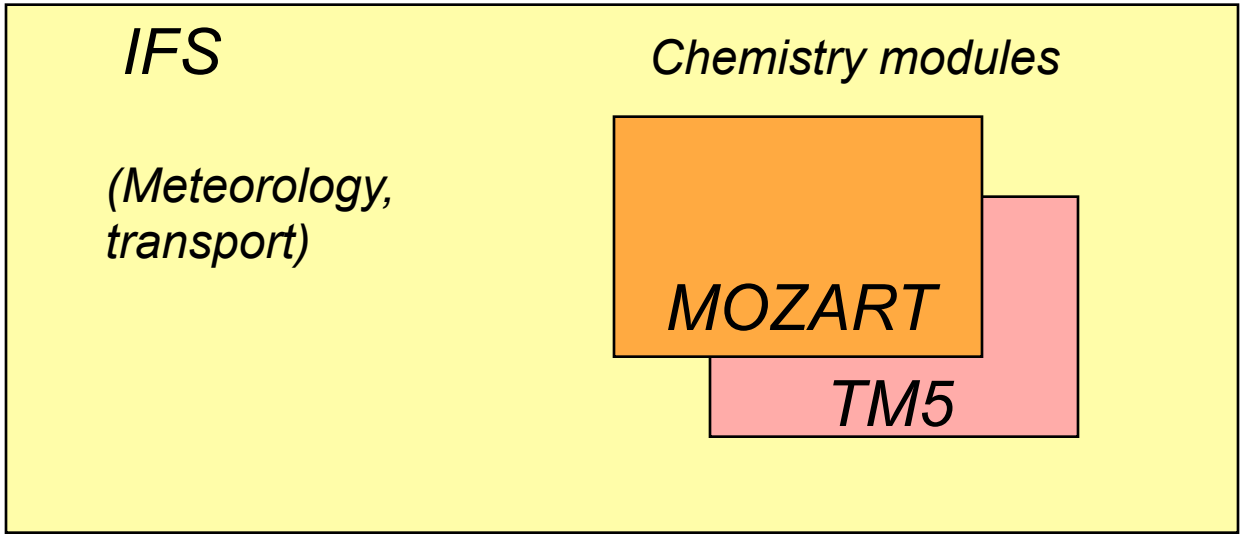
Comparison to Neumayer sonde obs.



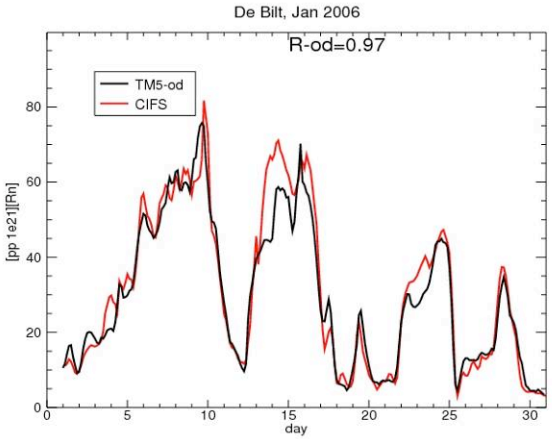
15 *Flemming et al., ACPD 2010*

Latest developments of the C-IFS-system

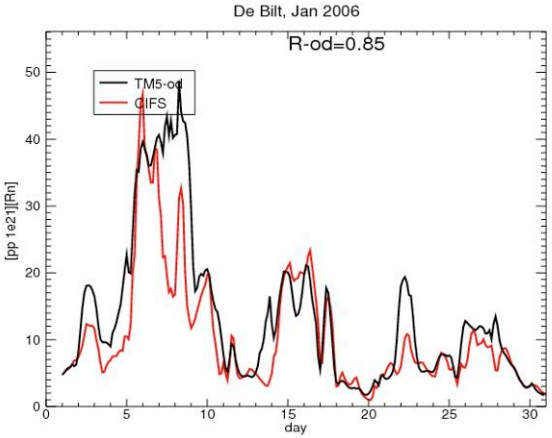
assimilation



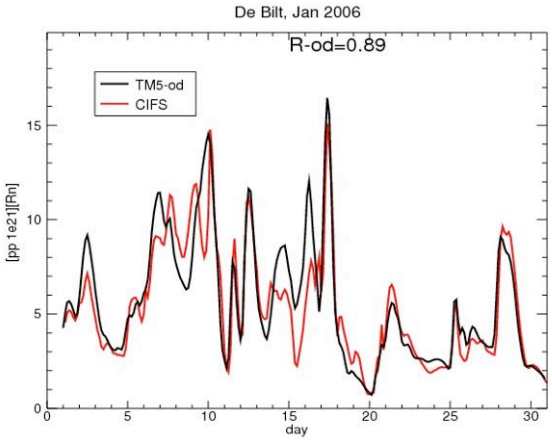
Time series of ^{222}Rn at De Bilt, C-IFS versus TM5



980hPa



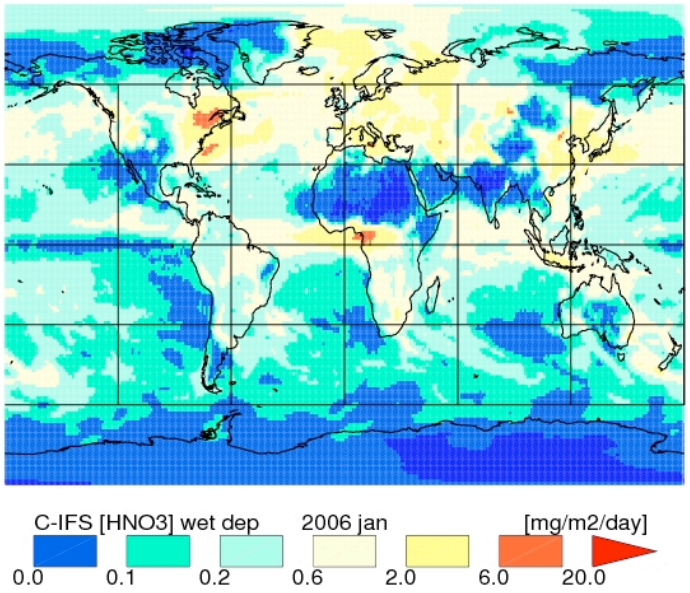
900hPa



800hPa

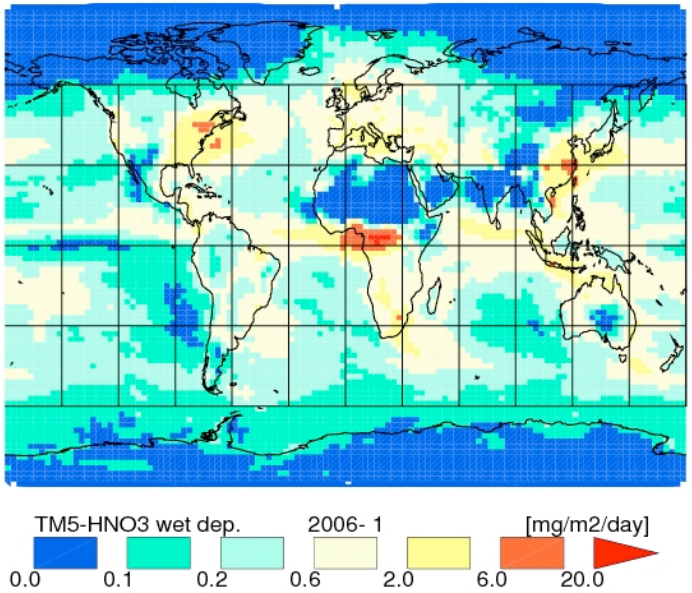
System checks: e.g. HNO_3 wet deposition

C-IFS



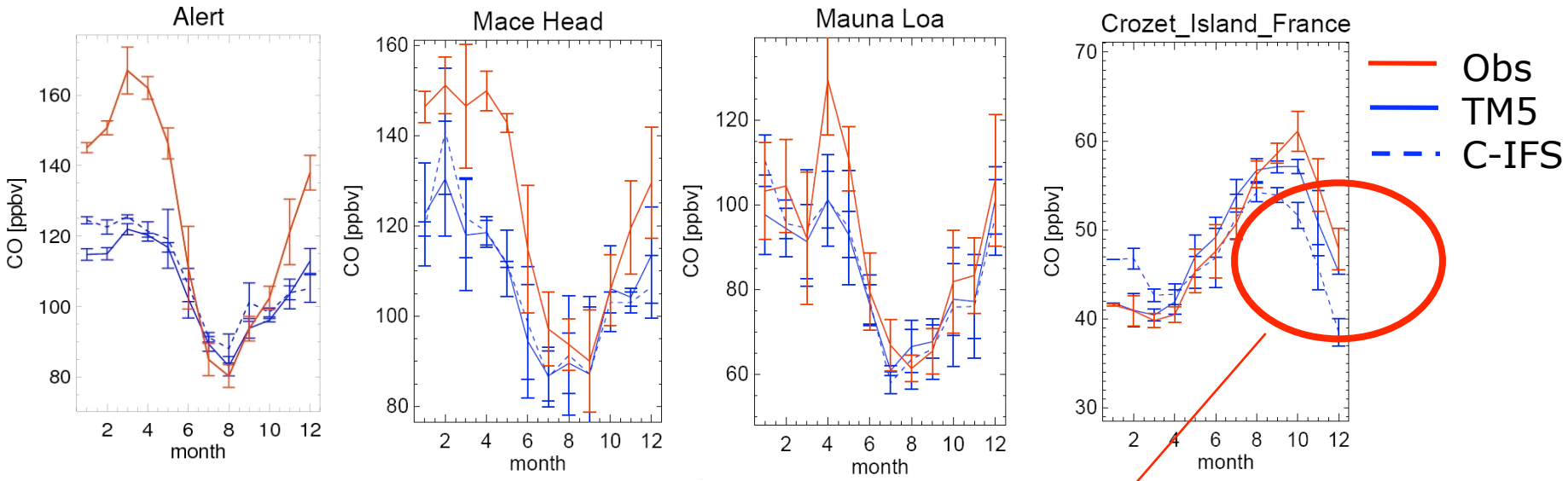
C-IFS: 123 Tg/year

TM5



TM5: 98 Tg/year

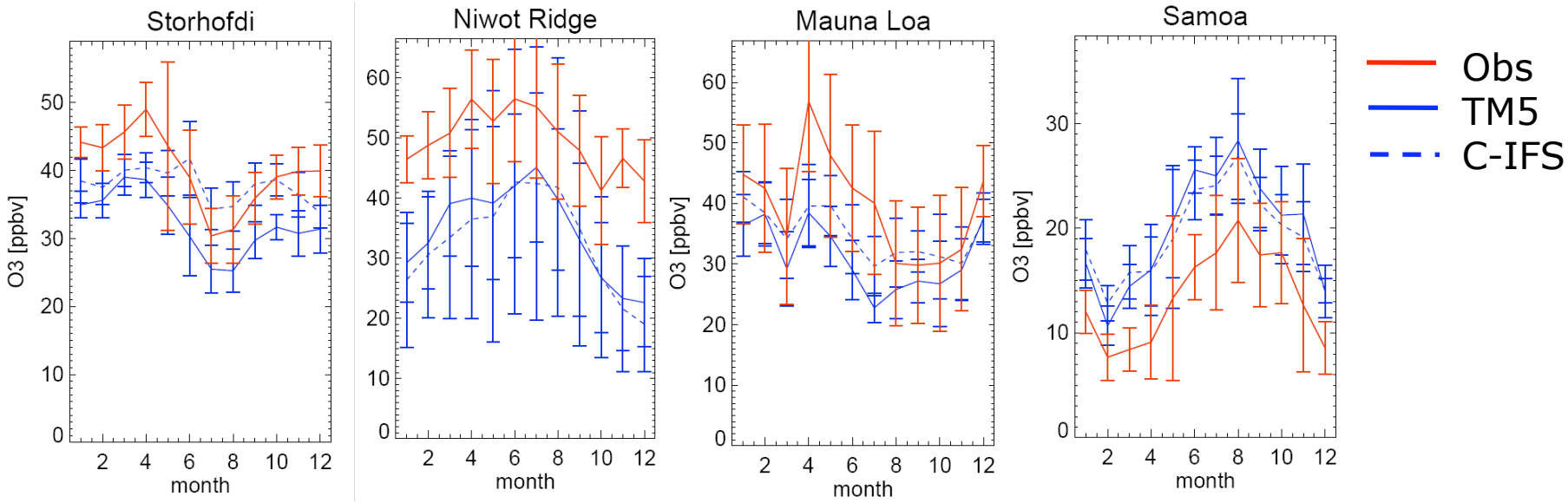
CO comparison to GMD stations (2006)



Reasonable agreement but…

Currently facing problems with too high OH…

O_3 comparison to GMD stations (2006)



C-IFS: Conclusions / future work

• C-IFS: an efficient system of inline chemistry in IFS; mass loss issues 'seem' not to cause serious problems.

• Budgets for dry, wet deposition & chemistry generally within 10-20% to TM5, but more detailed checks need to be done.

• Tropospheric CO and O_3 show encouraging agreement to observations (& to TM5), but longer runs show degradation: too short methane lifetime.

Thanks!

TM5-IFS sensitivity experiments for Russian fires

Model version	Fire emissions	Assimilation
Ref (ffjs)	GFEDv2-clim	No
GFAS (ffjw)	GFASv0 (CO, NOx, SO2 and NMVC)	No
GFASx8 (ffqv)	8xGFASv0 (CO, NOx, SO2 and NMVC)	No
Assim (ffjr)	GFEDv2-clim	CO ***(IASI)***,O3,NO2
Assim-GFAS (fezf)	GFASv0 (CO, NOx, SO2 and NMVC)	CO ***(IASI)***,O3,NO2

- Assimilation runs started on 15-July 2010
- Runs w/o assim started on 1 July 2010