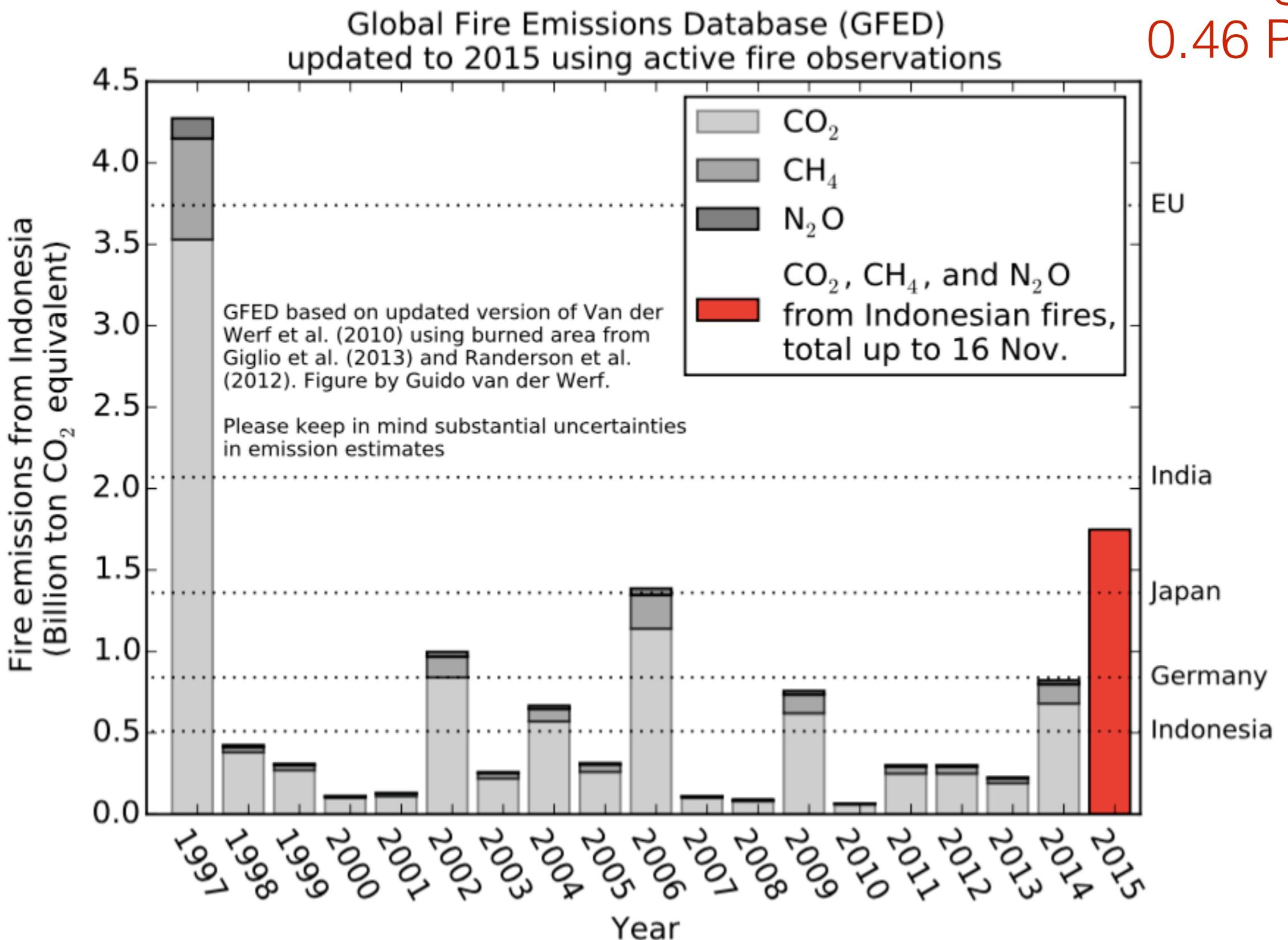


Carbon Emissions from the 2015 Indonesian fires

Maarten Krol; Narcisa Nechita; Thijs van Leeuwen; Sourish Basu; Pierre Coheur; Cathy Clerbaux

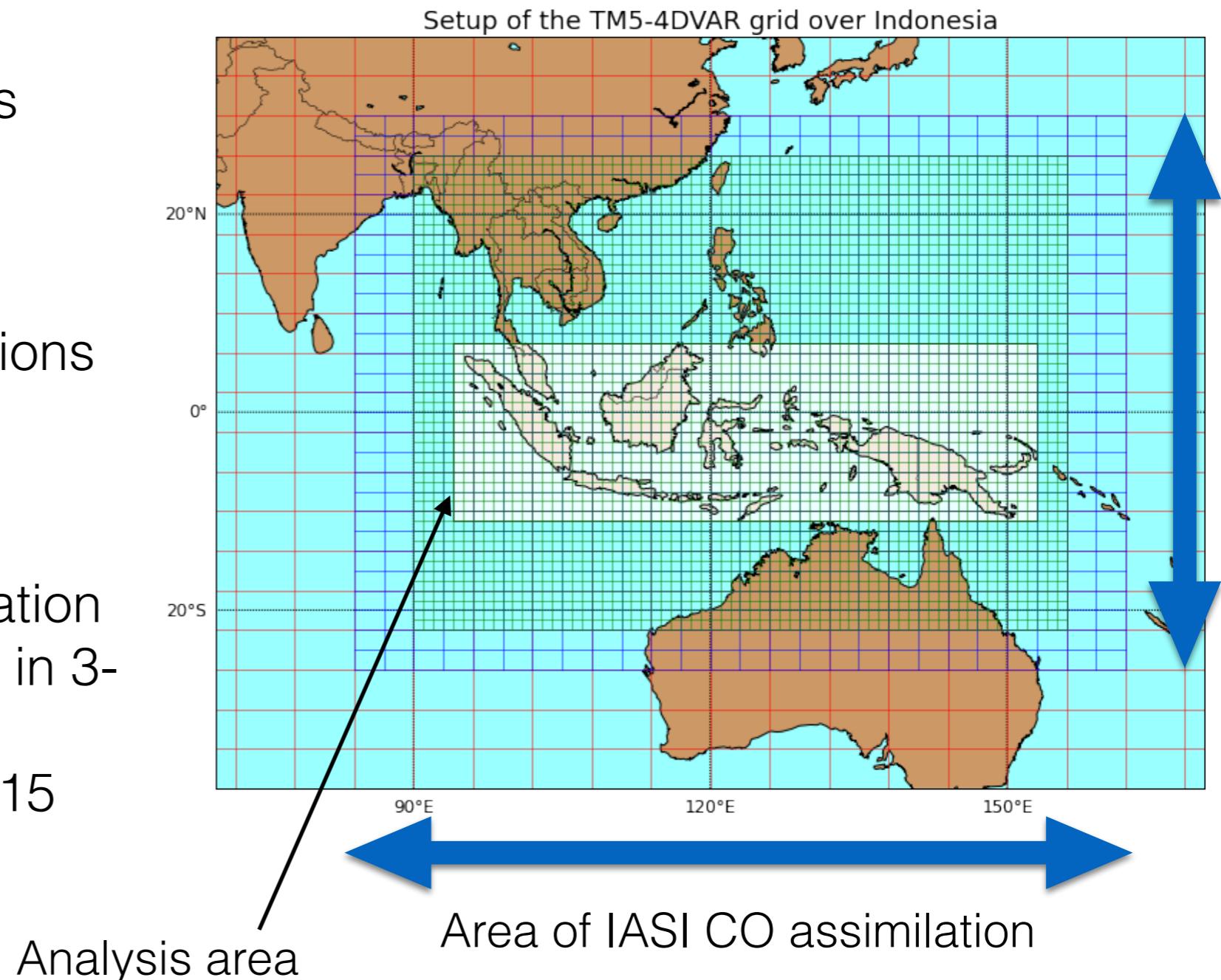
Thanks to Vincent Huijen, Johannes Kaiser and
Guido van der Werf

1.7 Pg CO₂ =
0.46 Pg C

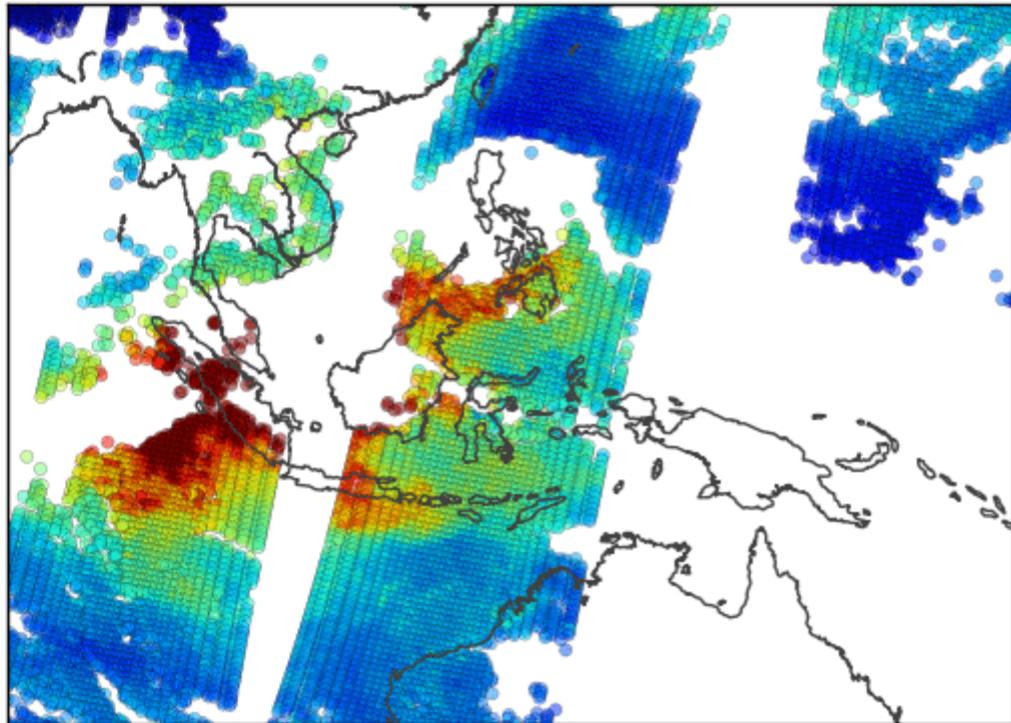


Setup TM5-4DVAR CO emission optimisation

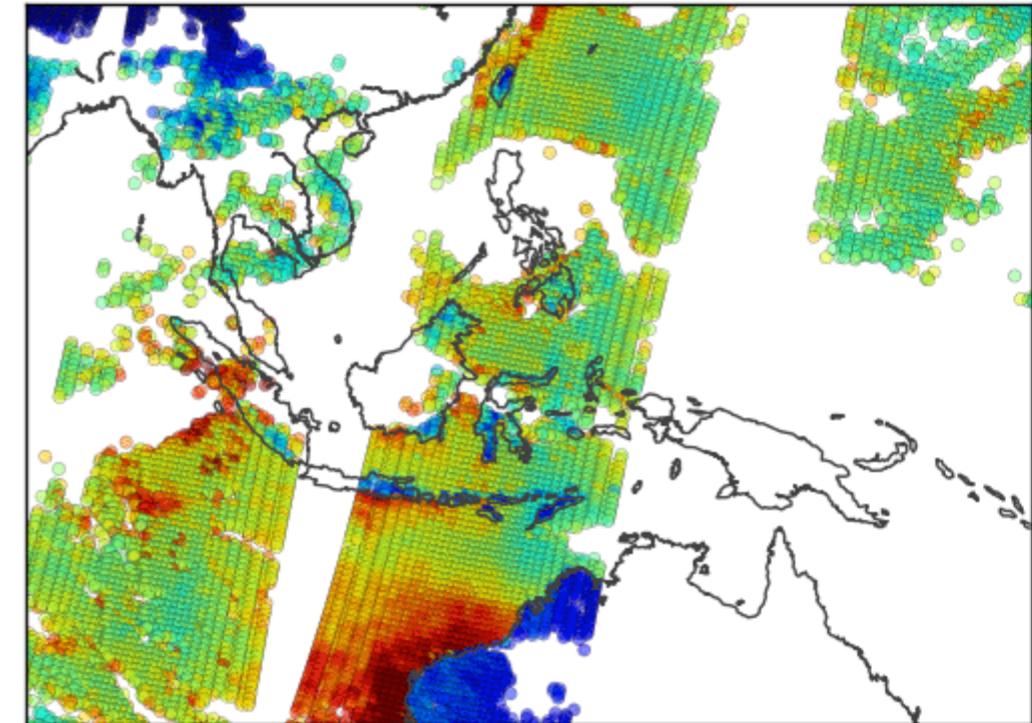
- GFAS CO-BB emissions
- Prescribed source VOCs
- sink OH prescribed
- NOAA-surface observations
- IASI CO satellite data
(applying AK)
- Iterative 4DVAR optimisation
- BB emissions optimised in 3-daily periods
- 1 Aug 2015 - 15 Dec 2015



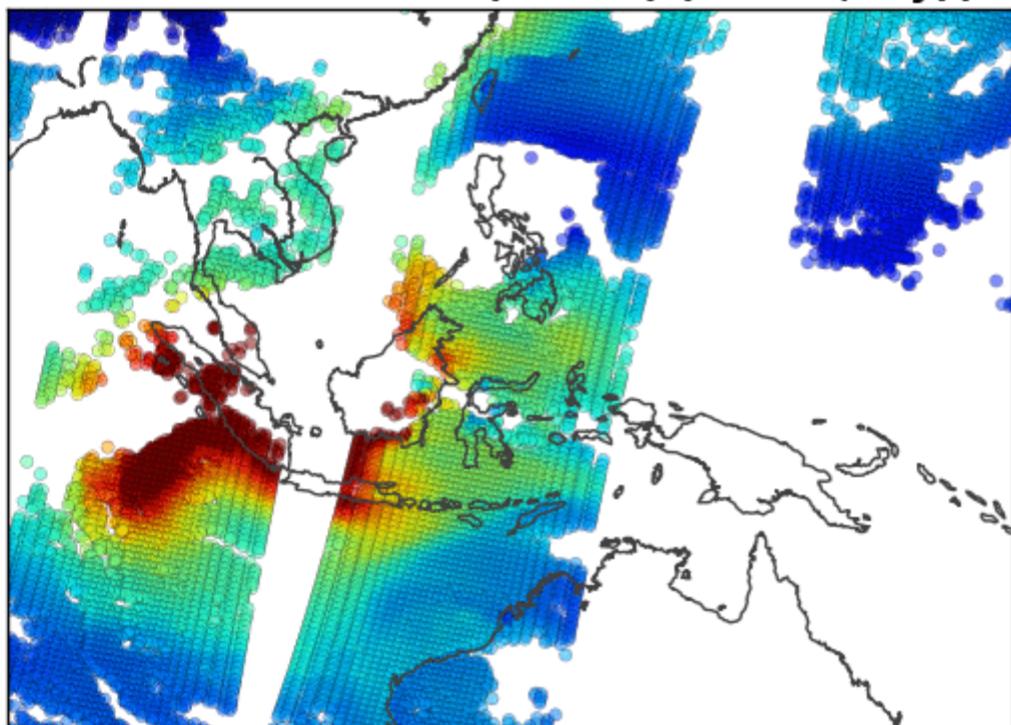
IASI columns (#/cm²) (month,day)(10,1)



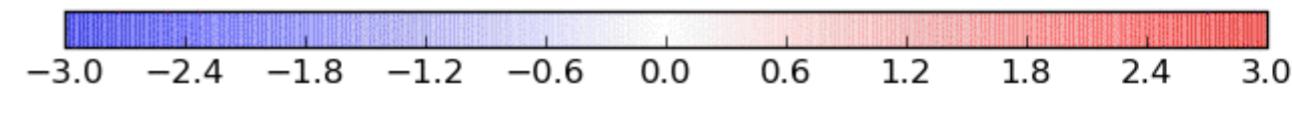
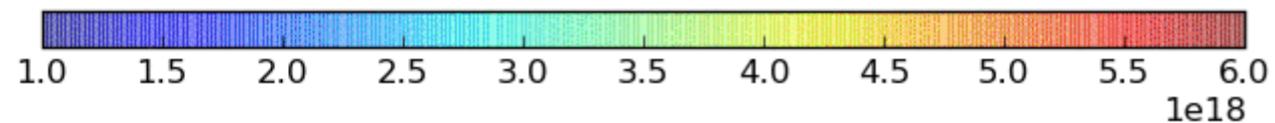
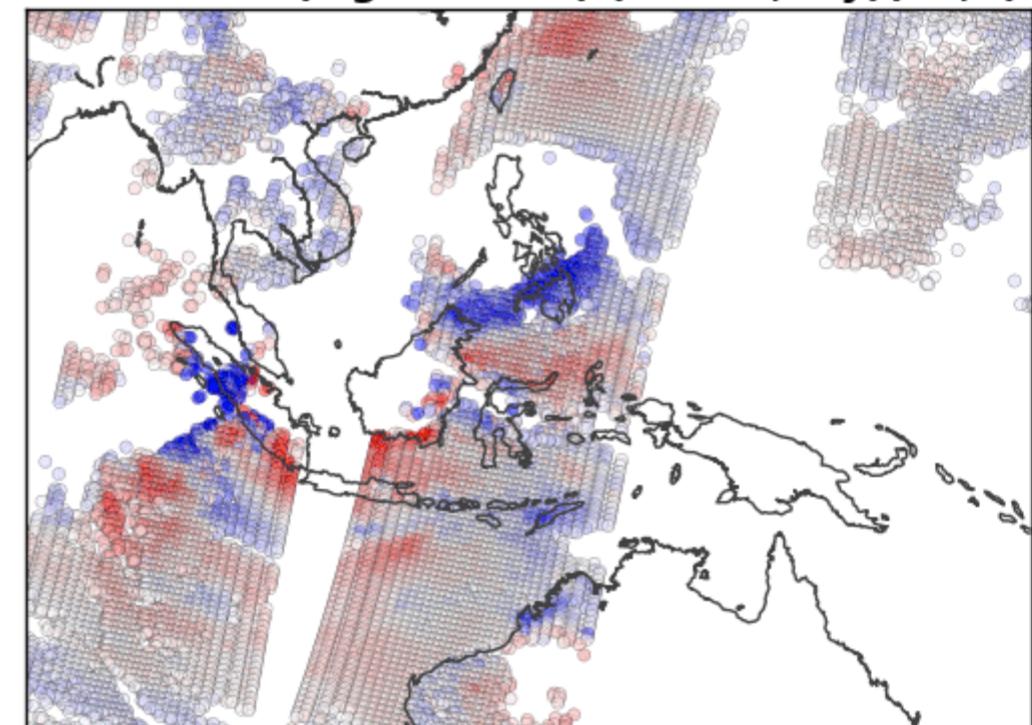
Error*5 (#/cm²) (month,day)(10,1)



poste Modeled columns (#/cm²) (month,day)(10,1)



Model-Obs (sigma units) (month,day)(10,1)

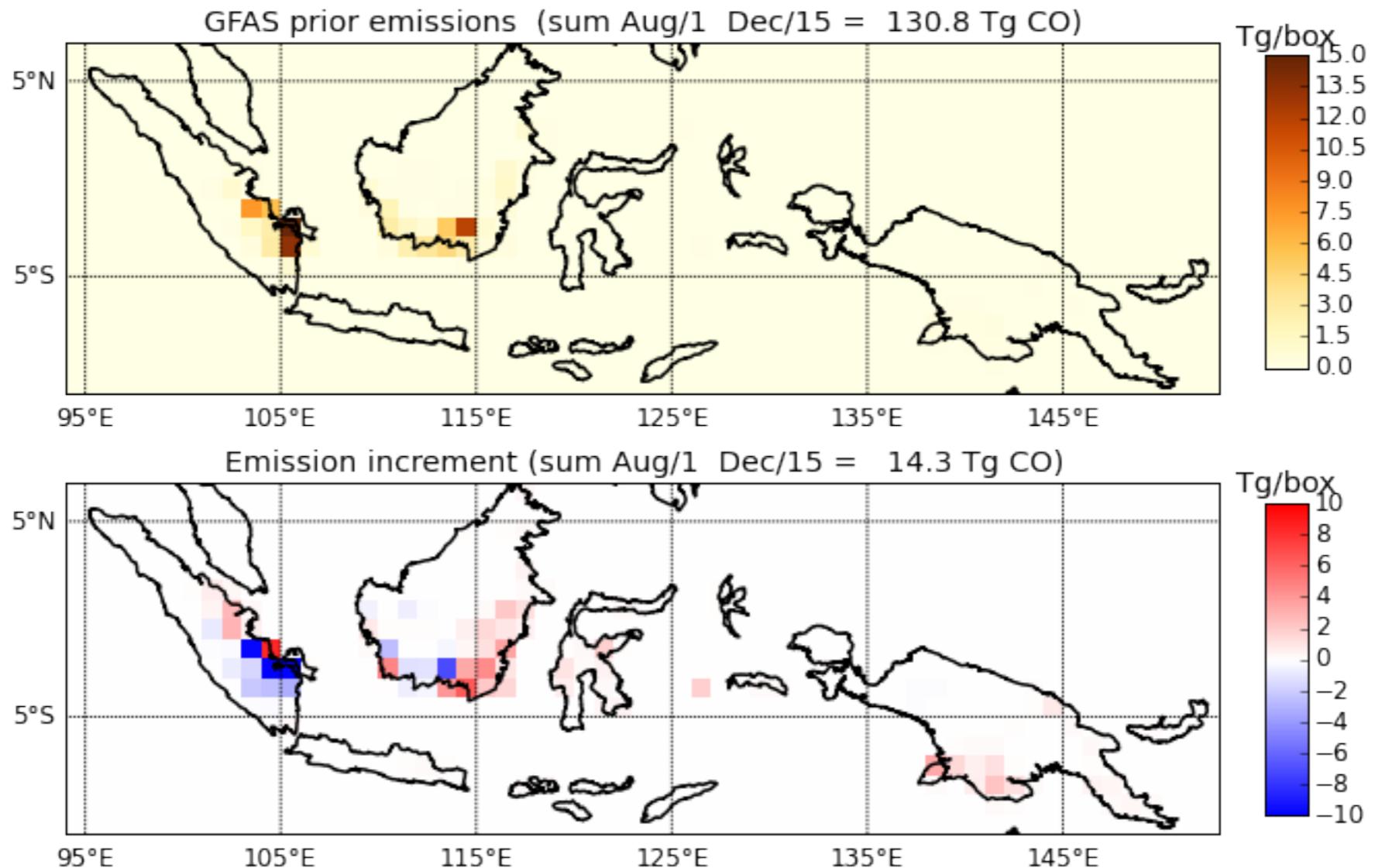


$6 \times 10^{18} \text{ molecules CO cm}^{-2} = 280 \text{ ppb}$

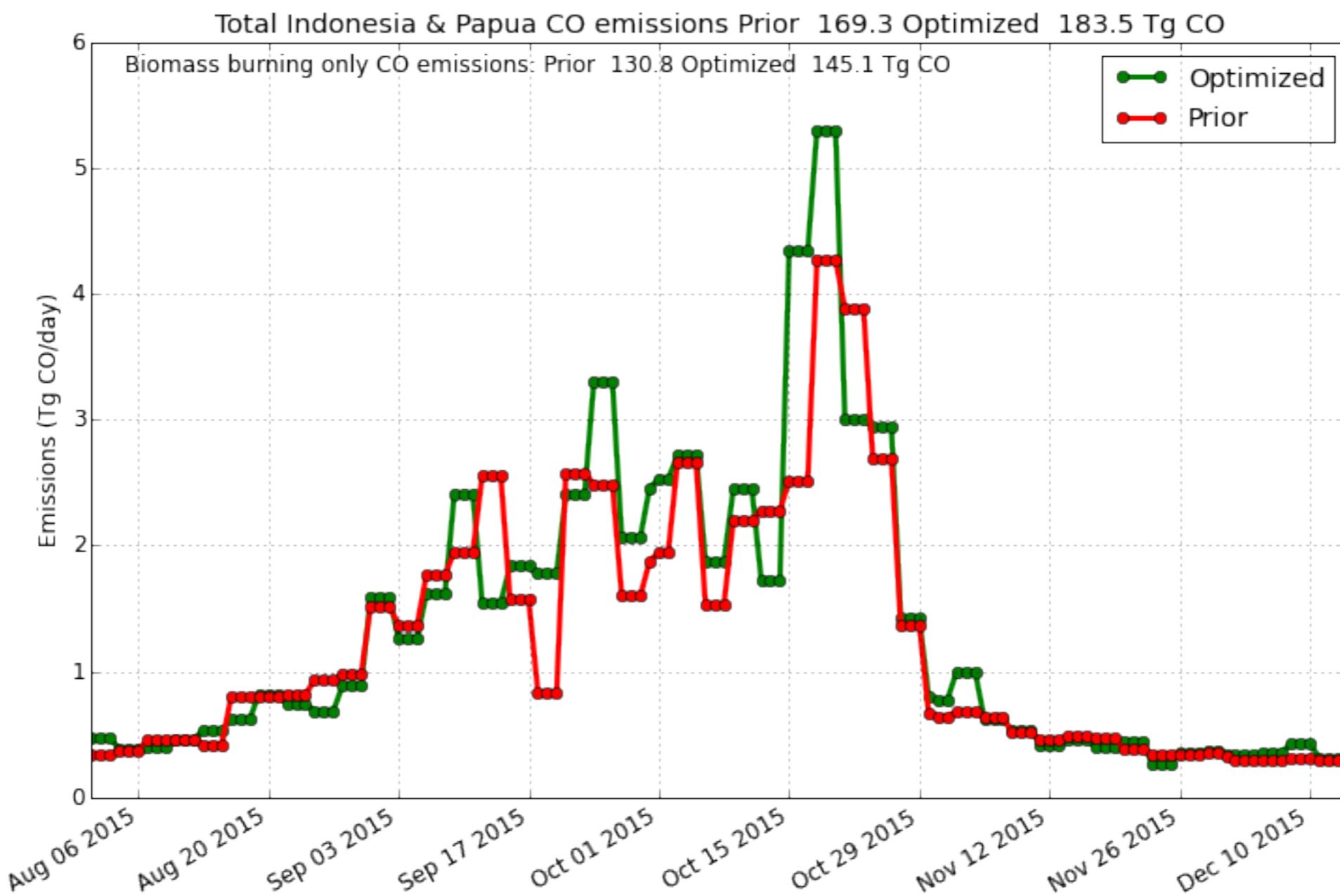


Institute for Marine and
Atmospheric research Utrecht

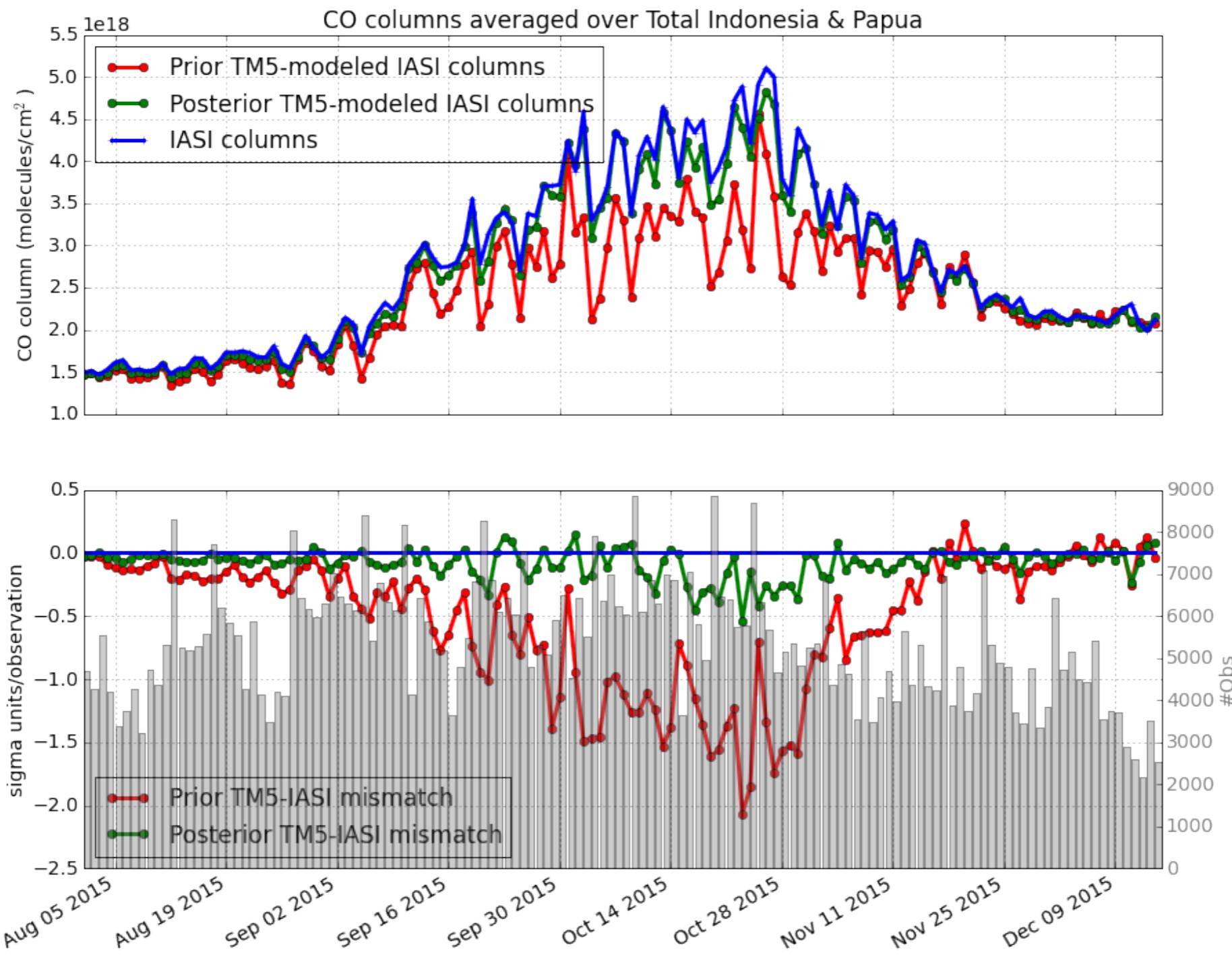
Total Indonesia & Papua (Aug-Dec 15)



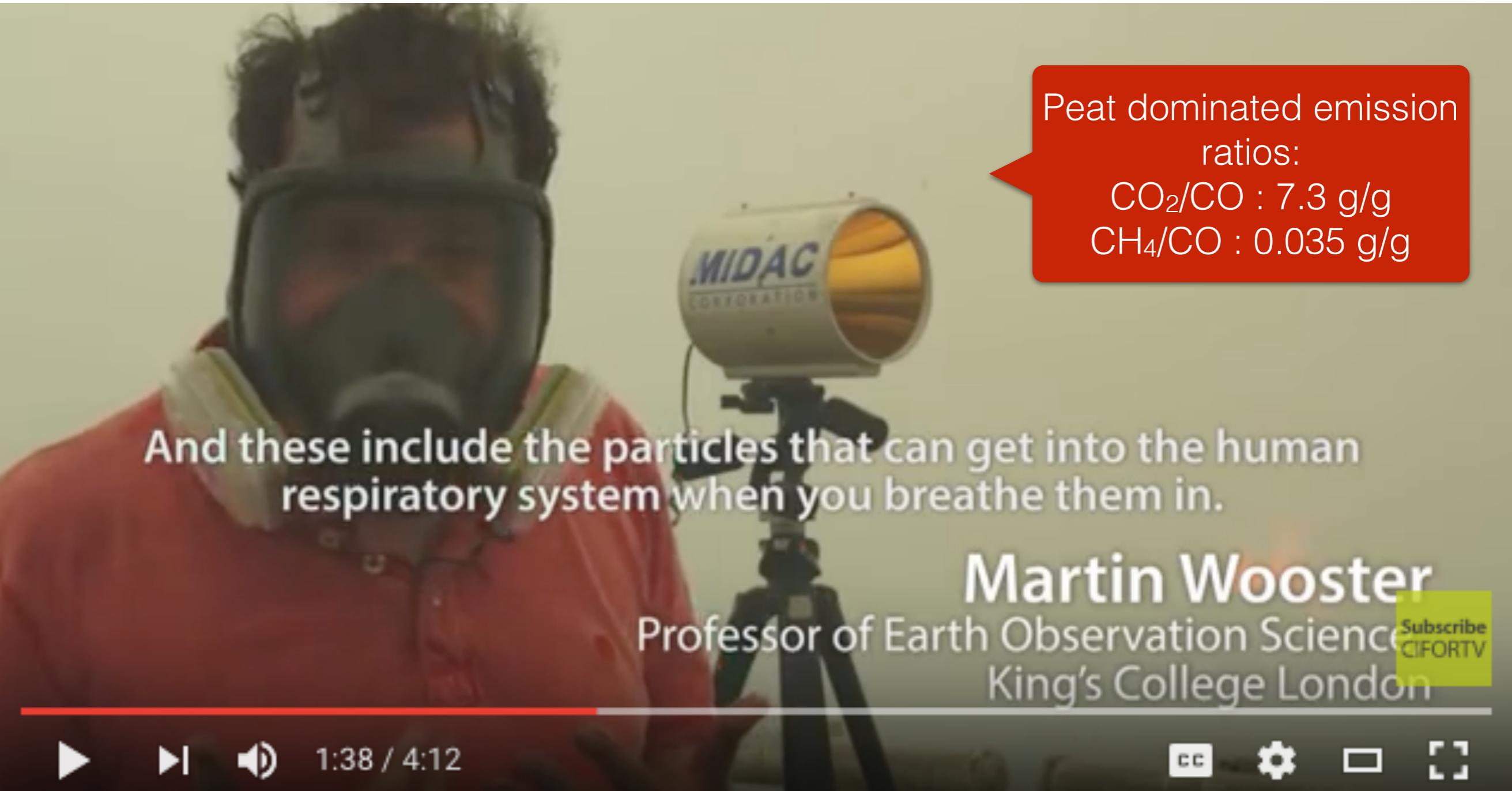
Total Indonesia & Papua



Total Indonesia & Papua



Peat dominated emission ratios:
 CO_2/CO : 7.3 g/g
 CH_4/CO : 0.035 g/g



And these include the particles that can get into the human respiratory system when you breathe them in.

Martin Wooster
Professor of Earth Observation Science
King's College London

Subscribe
CIFORTV

▶ ▶! 🔊 1:38 / 4:12

CC ⚙ □ ▣

<https://www.youtube.com/watch?v=2e5flg8QJxs>

in TgCO sept+oct	W-Sumatra	Kalimantan	E-Indonesia & Papua	Total
GFAS1.2	72	37	3	112
TM5 optimised	34	67	21	126 *
Huijnen et al. (2016)	30	50	4	84

*Total area is larger than three regions; applies to sept-oct 2015

Fire Emissions	CO (Tg)	CO ₂ (Tg)	CH ₄ (Tg)	Total C (PgC)
TM5 optimised	126	1038 *	4.8 *	0.34 0.39 ***
Huijnen et al. (2016)	84	692 *	3.2 *	0.23
GFED				0.47 **

*Using effective ERs

** Jun-Nov16

*** Aug-Dec15

Age of Air model inter-comparison

Maarten Krol, Marco de Bruine, Huug Ouwersloot, and
others

Goals AoA experiment

- Quantify transport timescales
 - Vertical mixing
 - Inter hemispheric Transport
 - Stratosphere-Troposphere exchange
- Link model characteristics to physical processes
 - Advection/Convection/Resolution

Approach

- prescribe linearly growing boundary condition in time
 - $BC = a \cdot t$ (a in $[1/s]$)
- simulate mixing ratios “mr”
- Calculate age-of-air as:
 - $AoA = (t - "mr")/a$ ($AoA [s]$ collapse to 0 at BC)

Tracer	Boundary Condition	Atmospheric Lifetime	Sensitivity
^{222}Rn	Land emission	5.5 days (e-folding)	Vertical mixing
^{222}RnE	Land emission (EU spec)	5.5 days (e-folding)	Vertical mixing
e90	surface emissions	90 days	strat-trop exchange
SF_6	surface emissions	3200 year	inter-hemispheric transport
surface	Earth surface	(age of air tracer)	vertical mixing, strat-trop
stratosphere	Stratosphere	(age of air tracer)	strat-trop exchange
troposphere	Troposphere	(age of air tracer)	stratospheric age of air
NH surface	NH surface	(age of air tracer)	inter-hemispheric transport
SH surface	SH surface	(age of air tracer)	Inter-hemispheric transport
land	All land masses	(age of air tracer)	Lifetime over oceans
ocean	All water bodies	(age of air tracer)	Lifetime over land

LMDZ5a

TM5 3x2

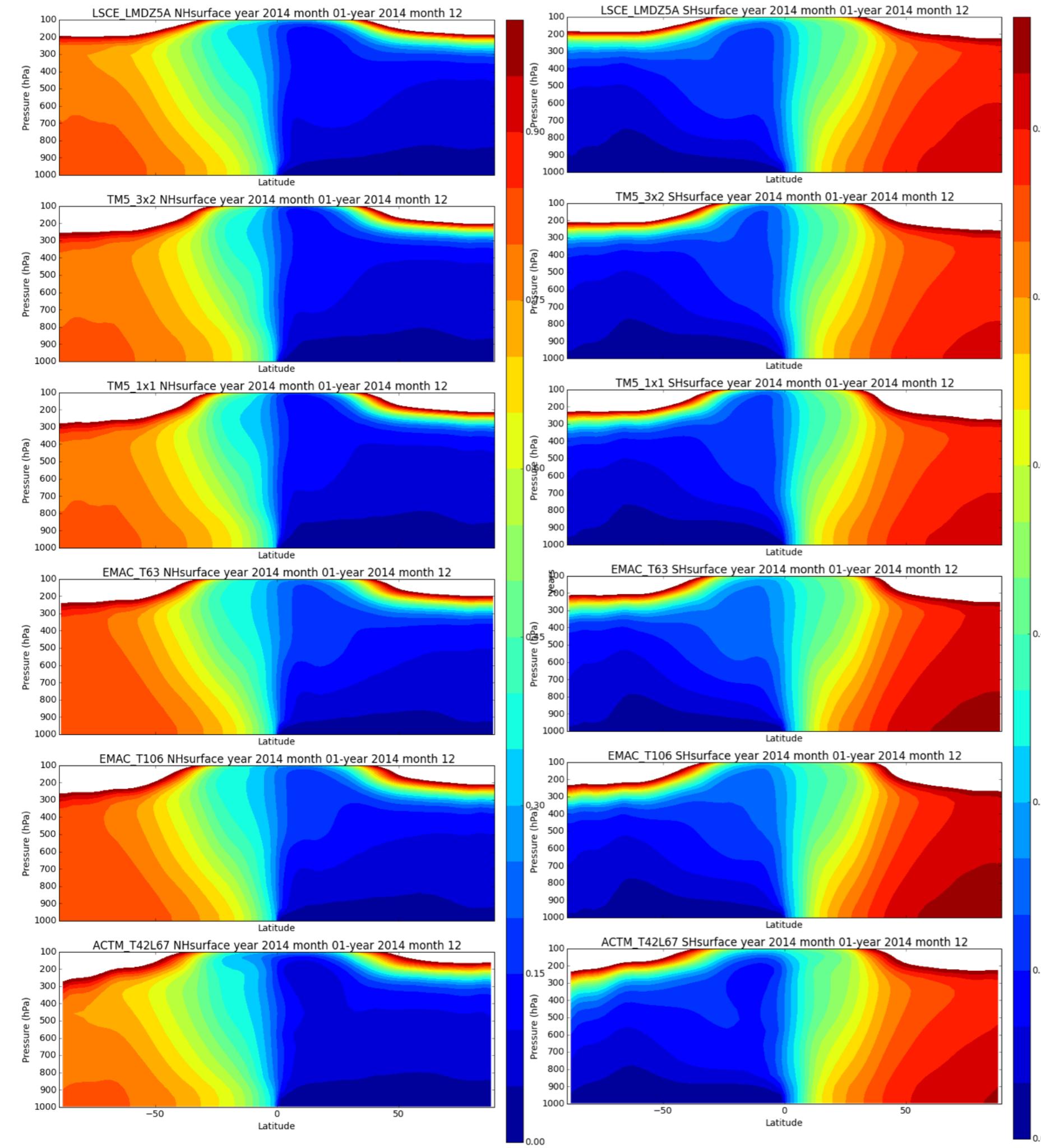
TM5 1x1

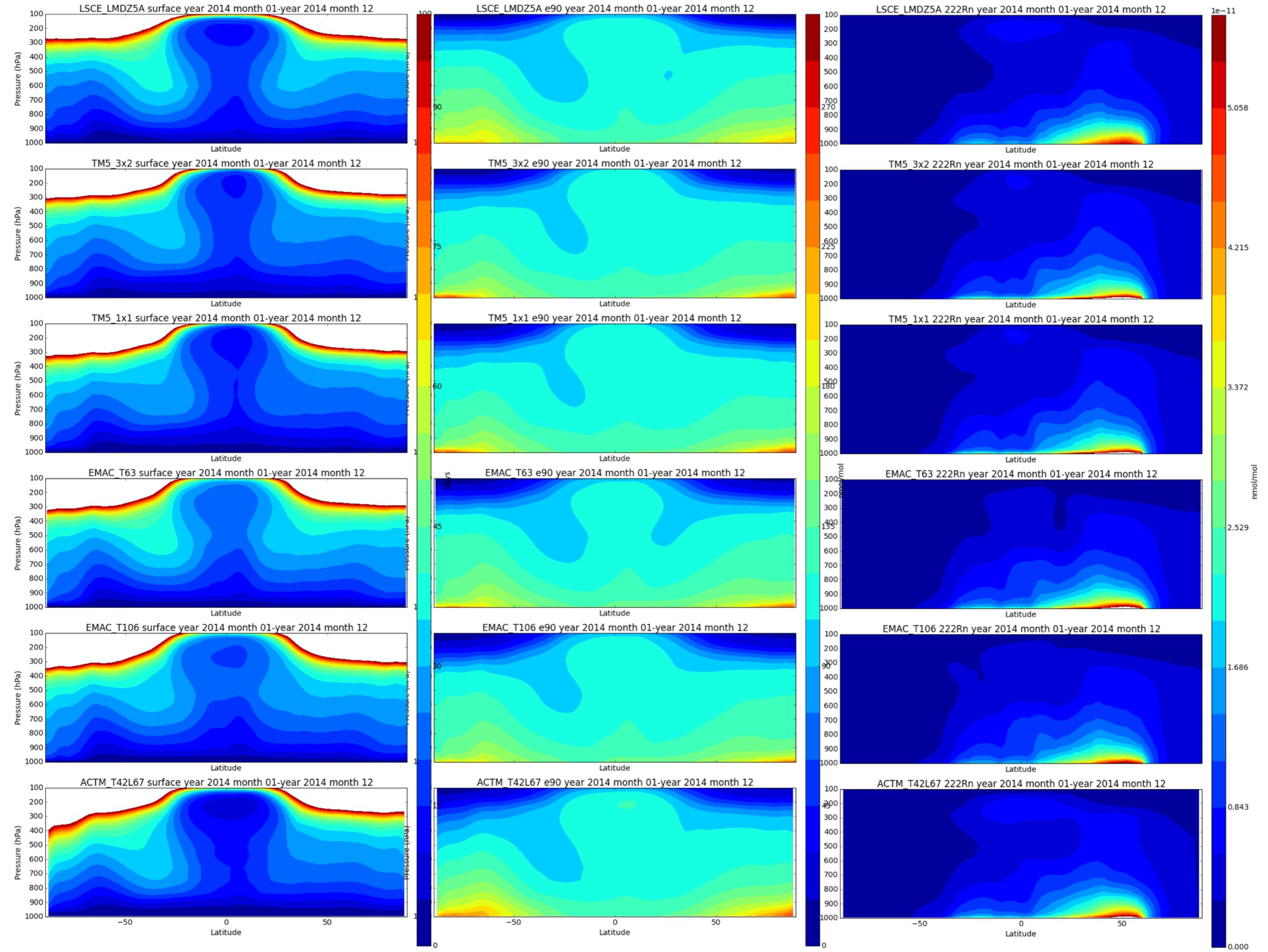
EMAC T63

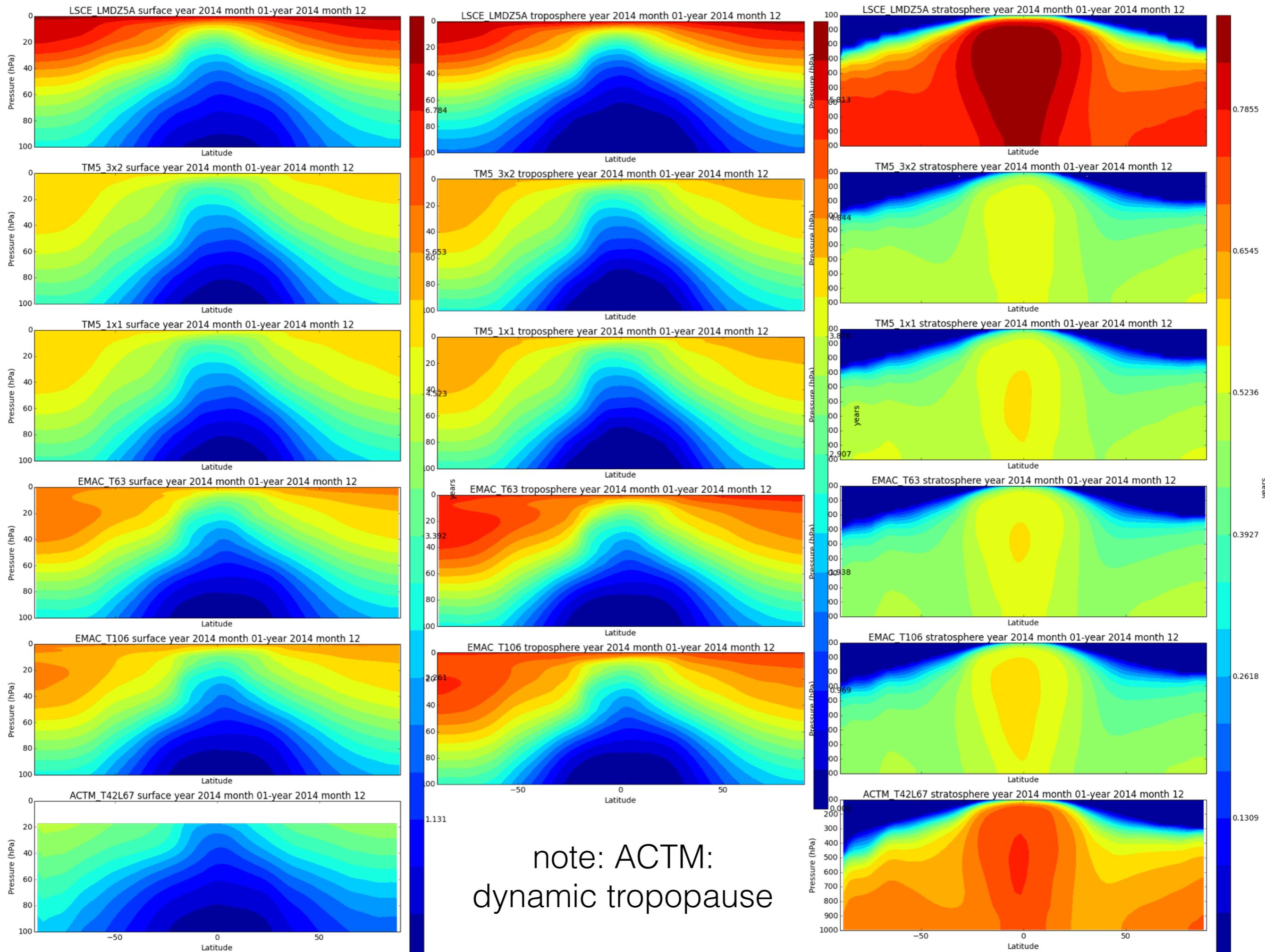
EMAC T106

ACTM

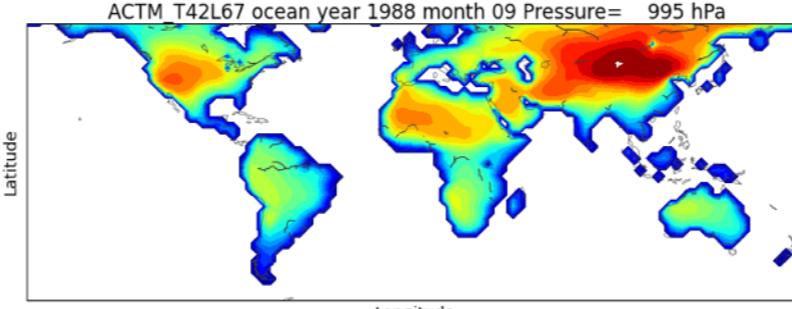
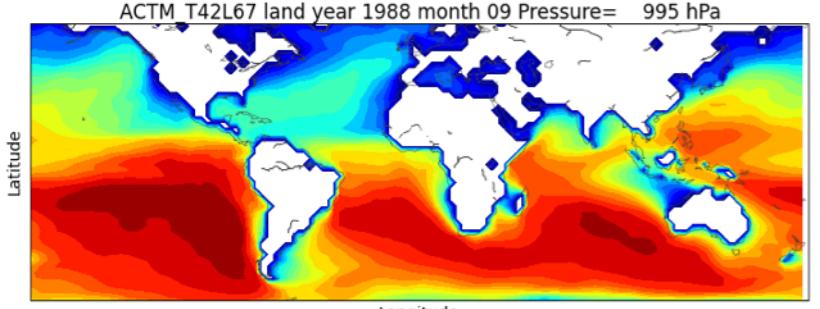
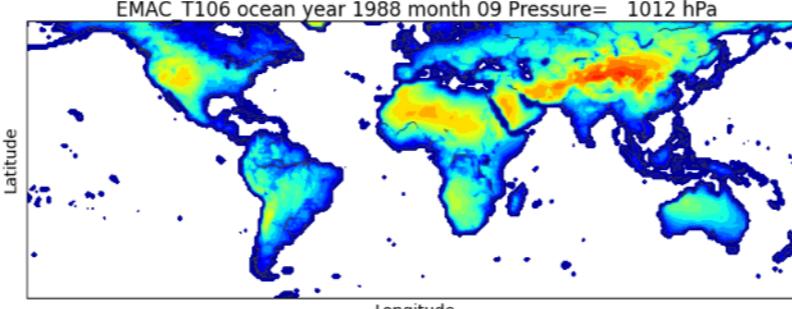
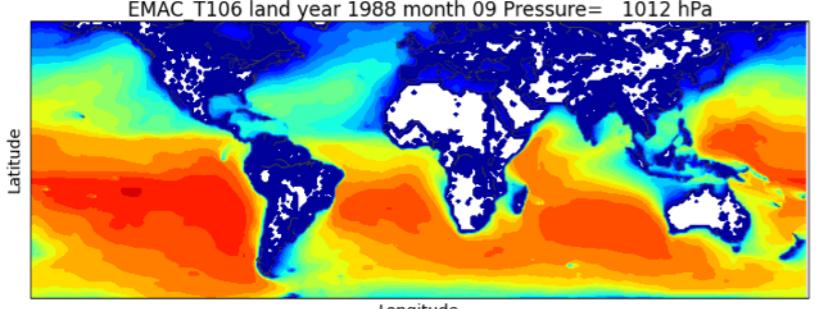
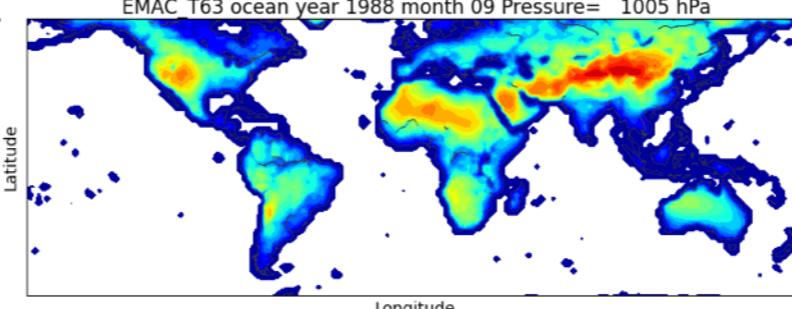
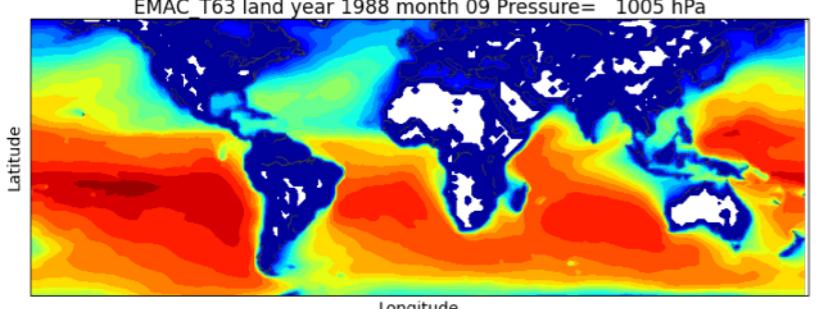
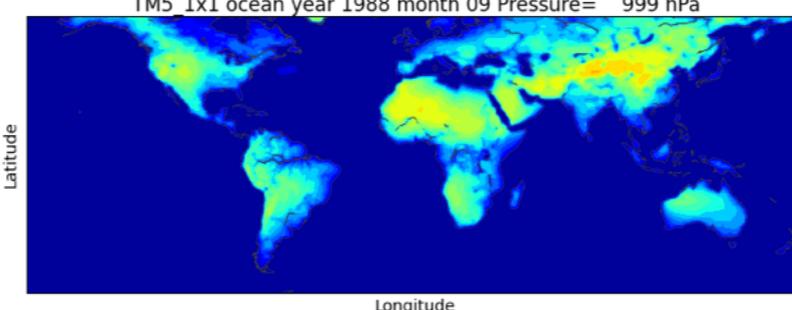
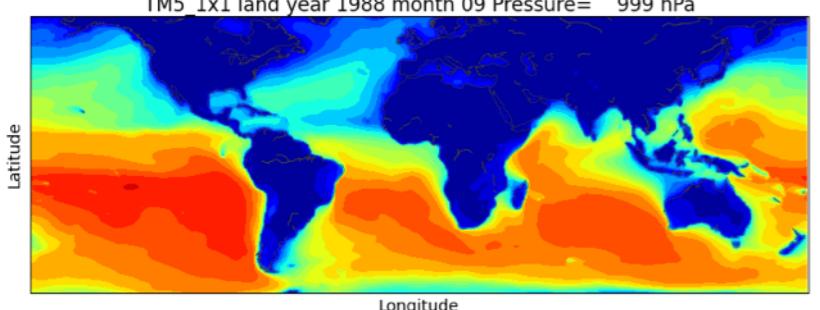
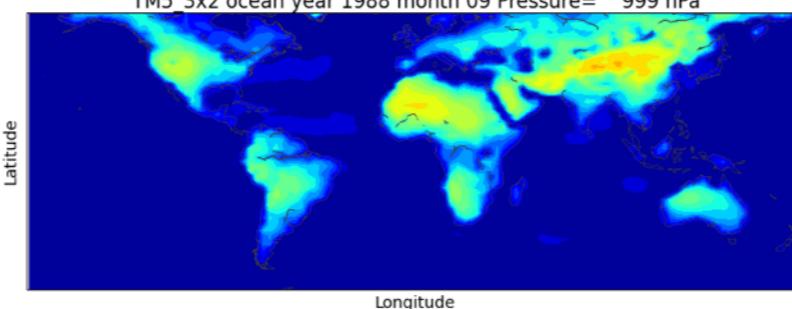
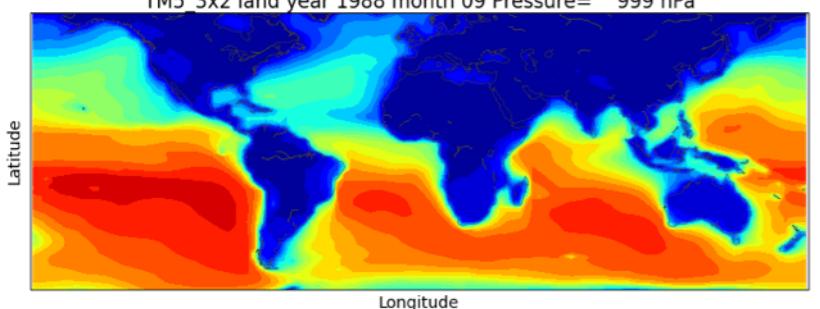
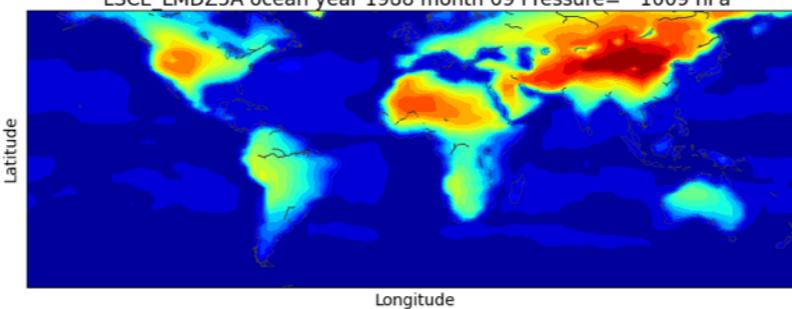
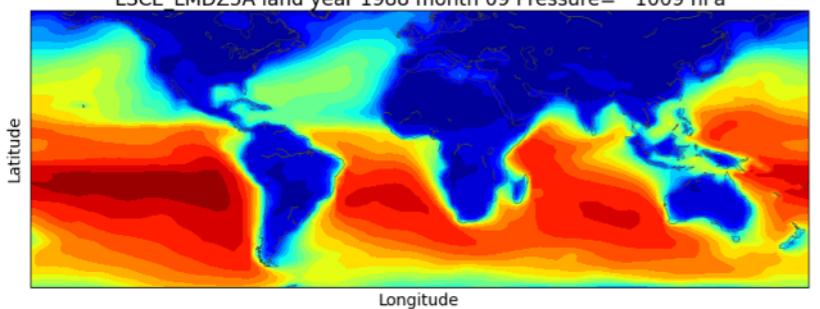
TOMCAT and GEOS-Chem pending







LMDZ5a



TM5 3x2

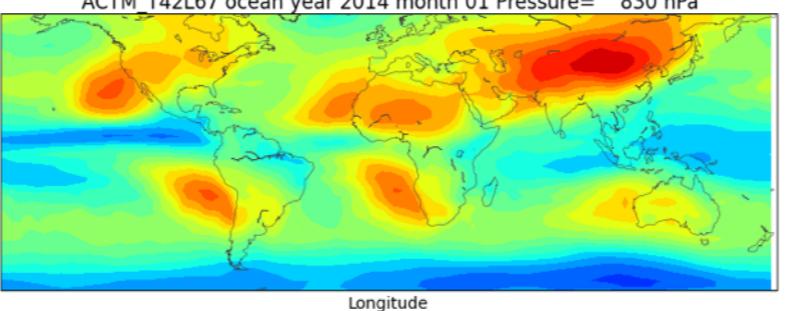
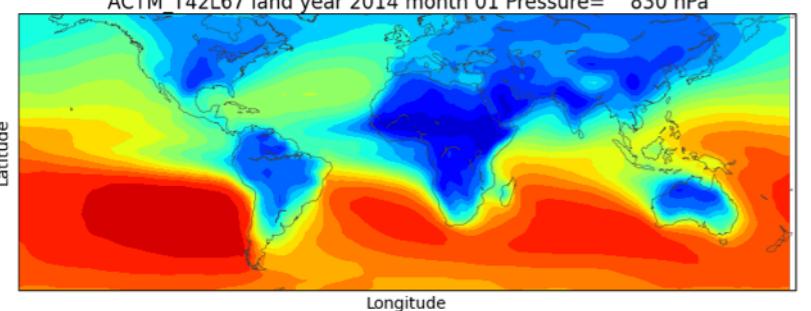
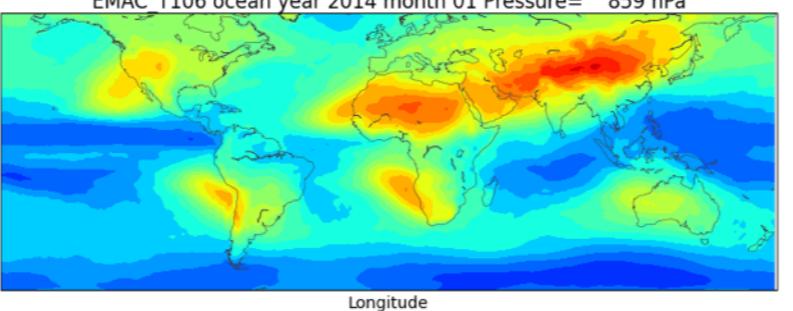
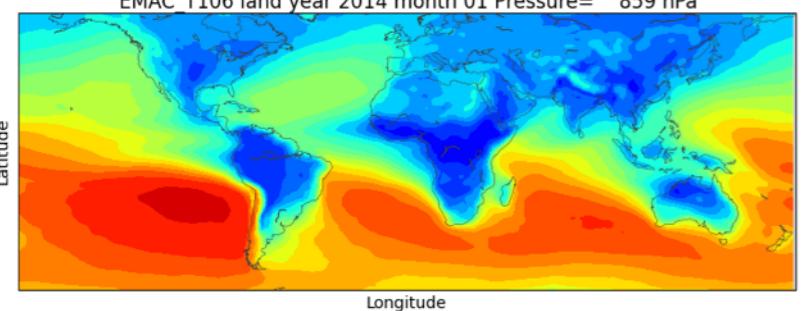
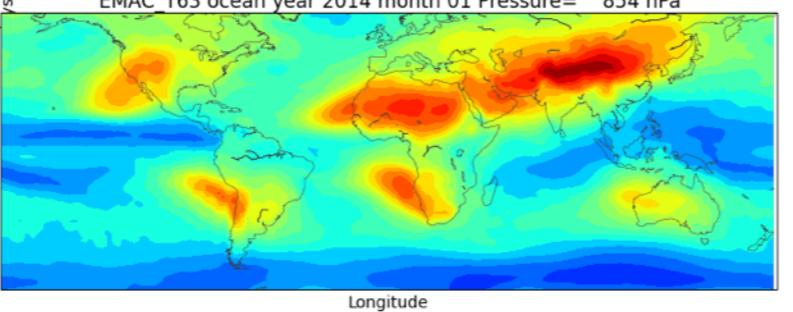
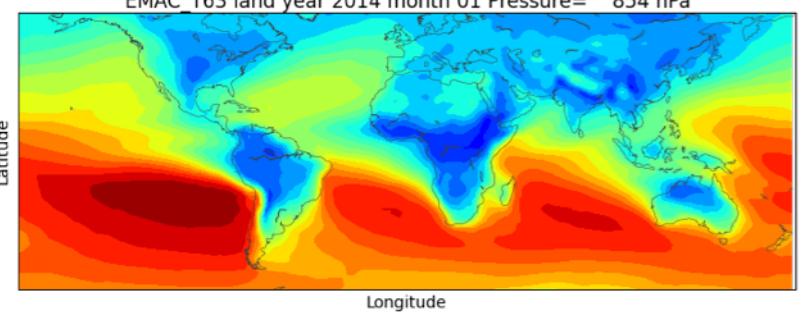
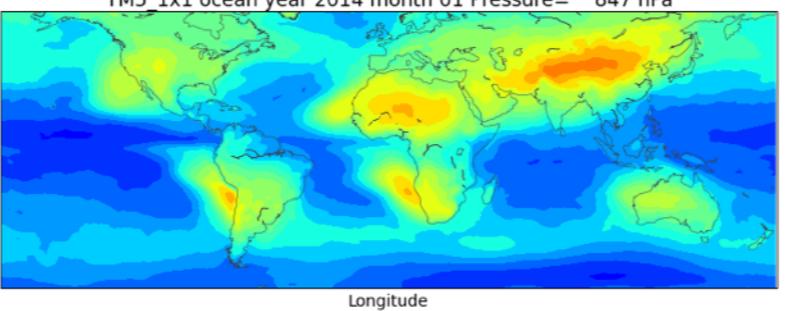
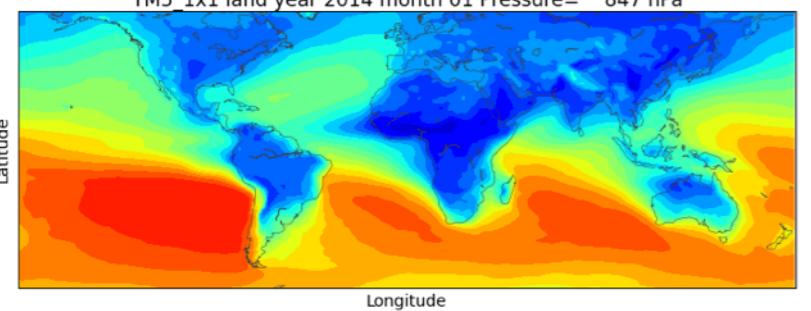
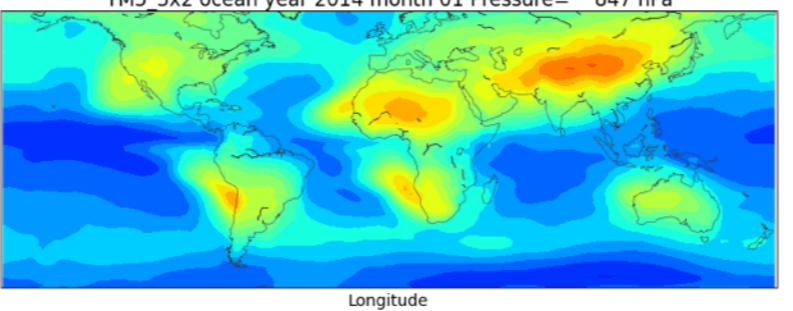
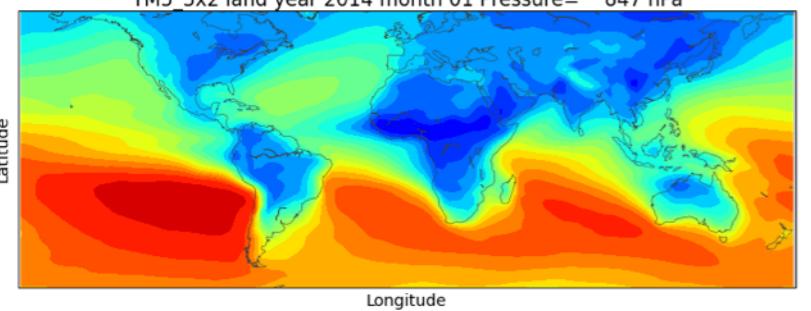
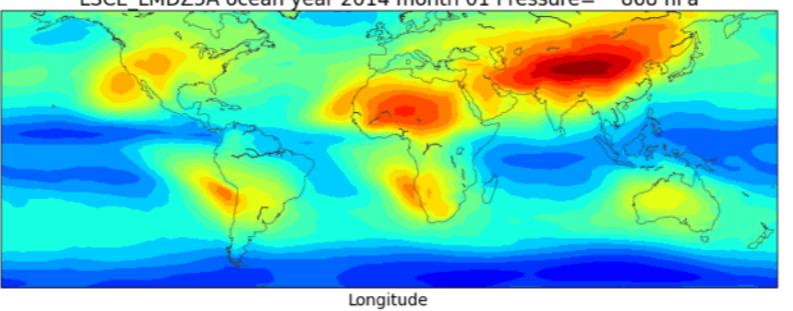
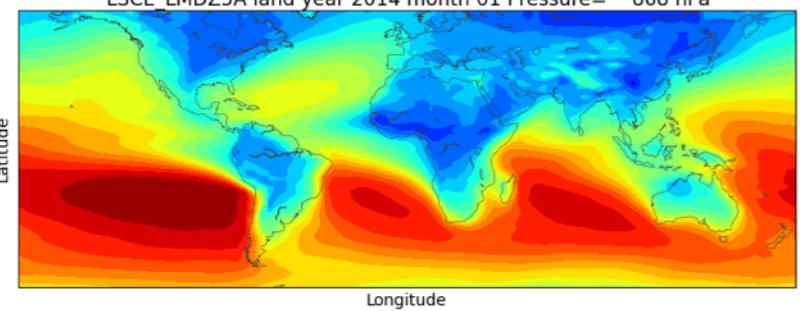
TM5 1x1

EMAC T63

EMAC T106

ACTM

LMDZ5a



TM5 3x2

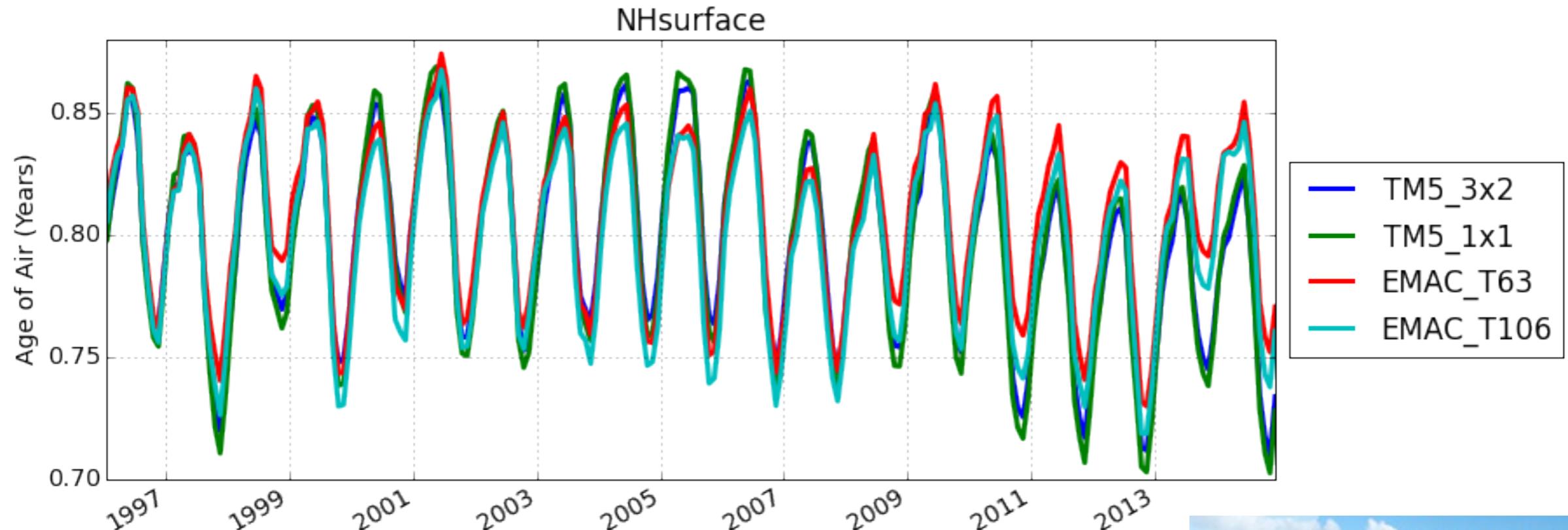
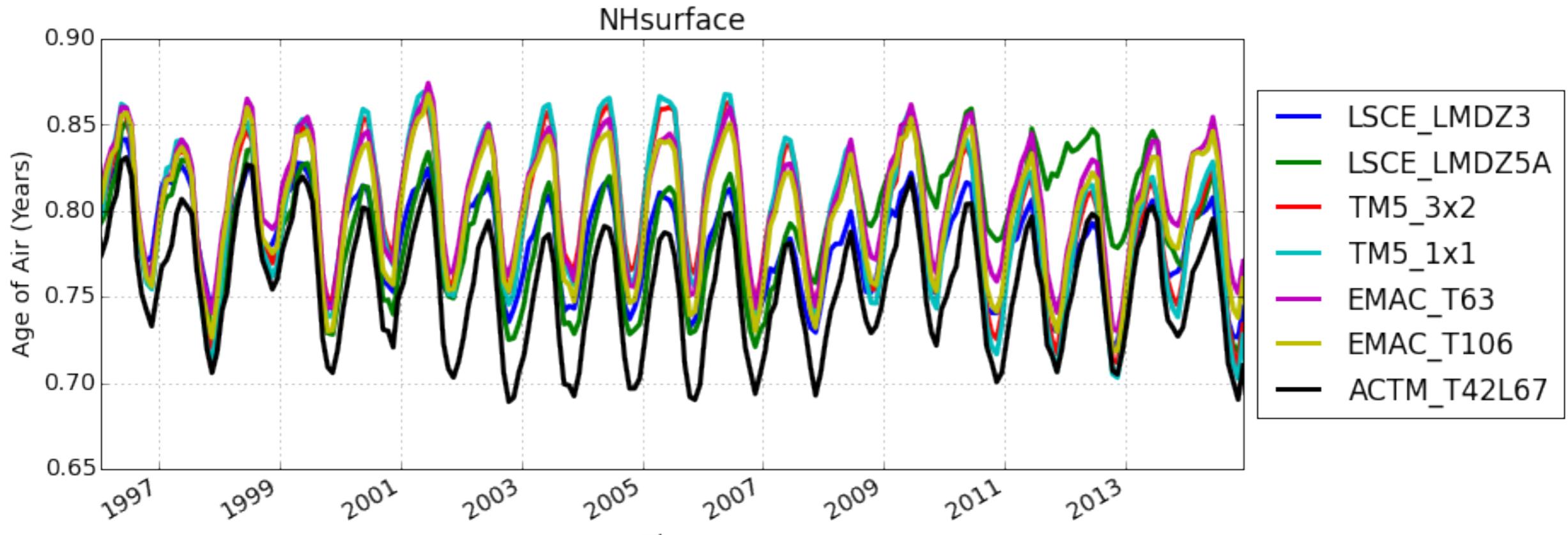
TM5 1x1

EMAC T63

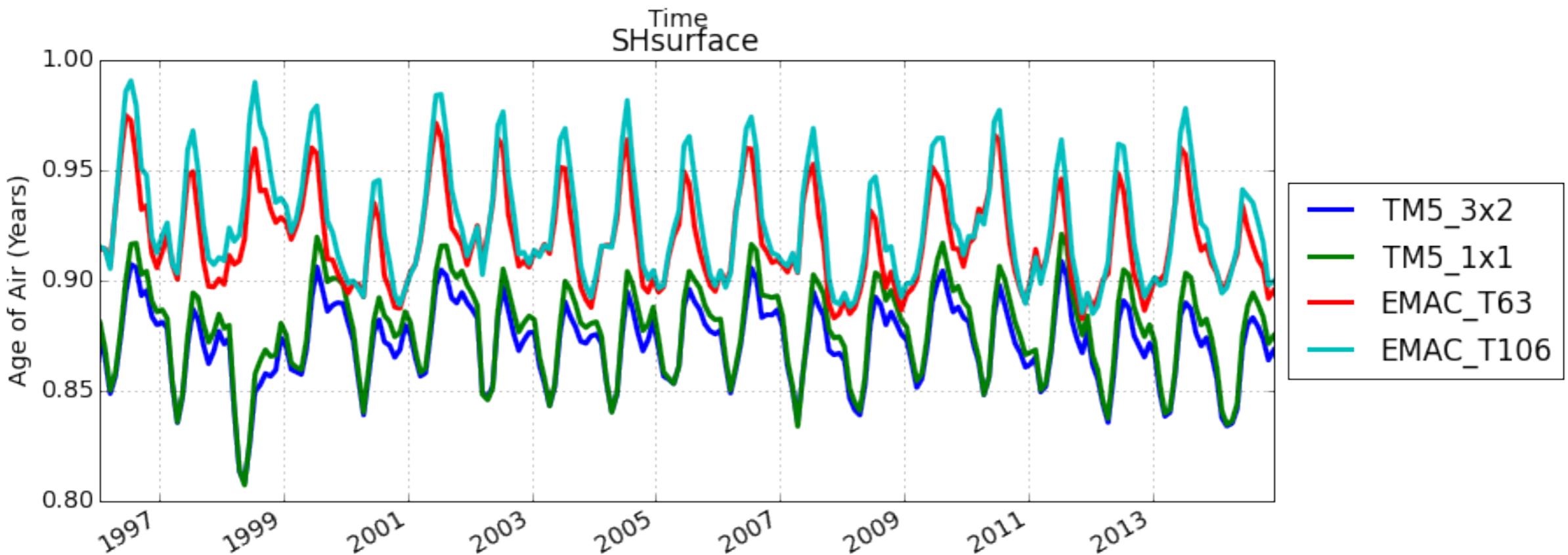
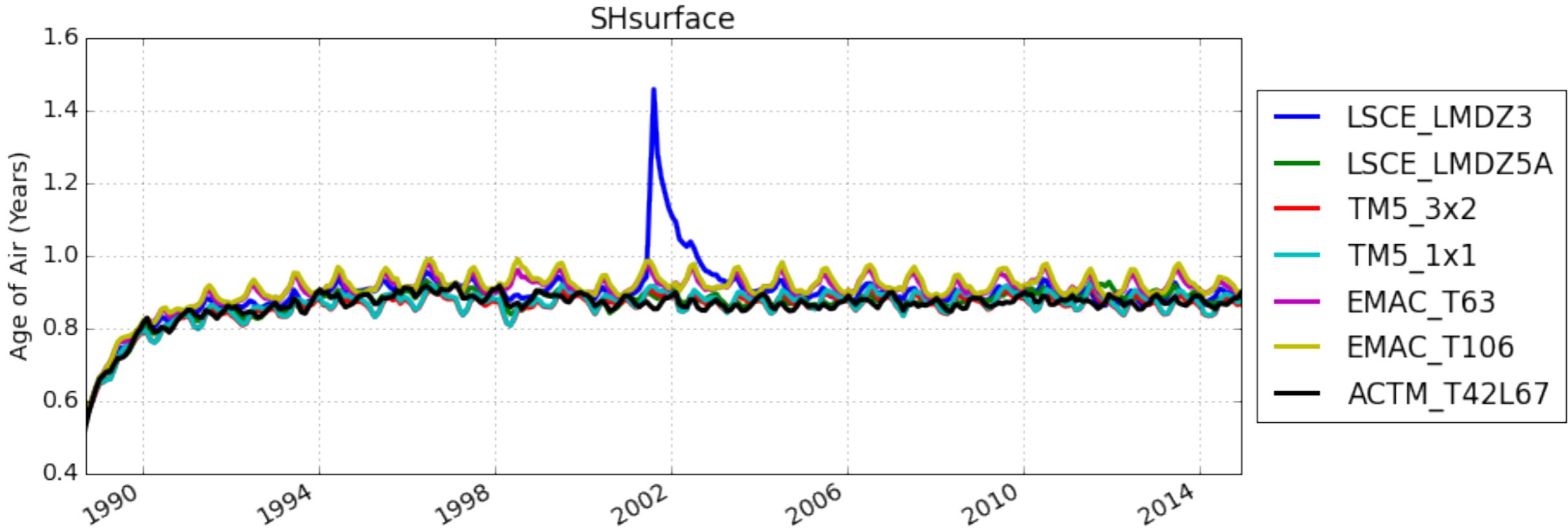
EMAC T106

ACTM

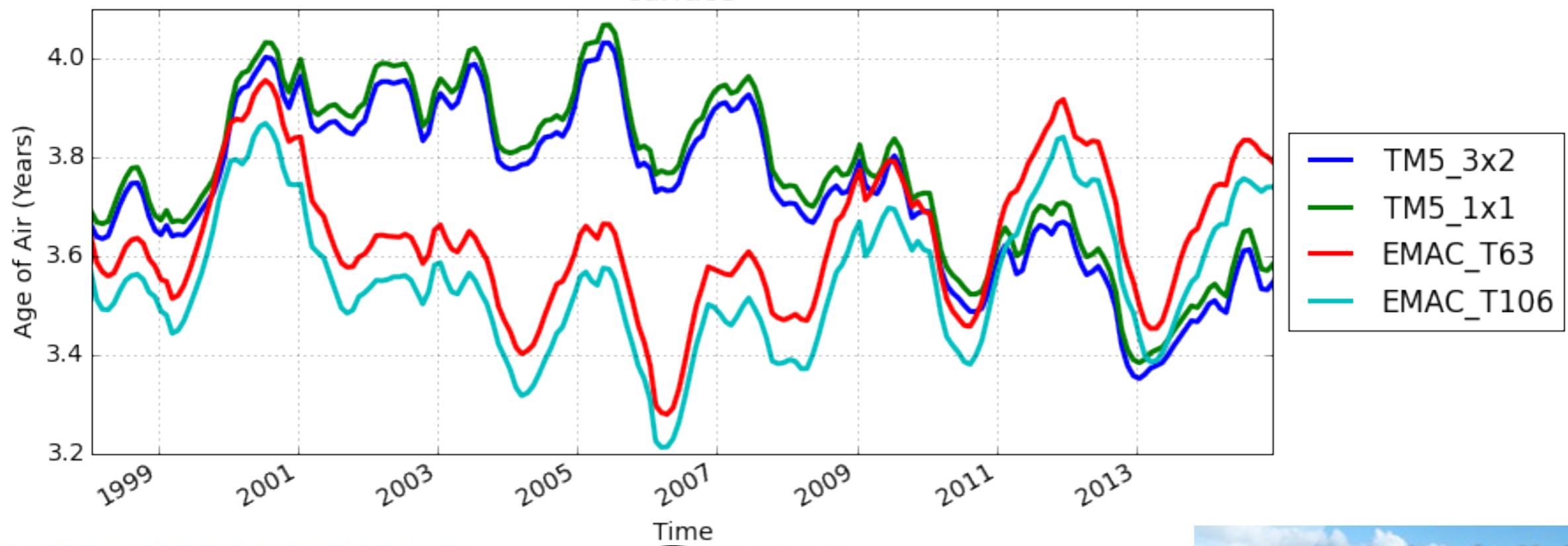
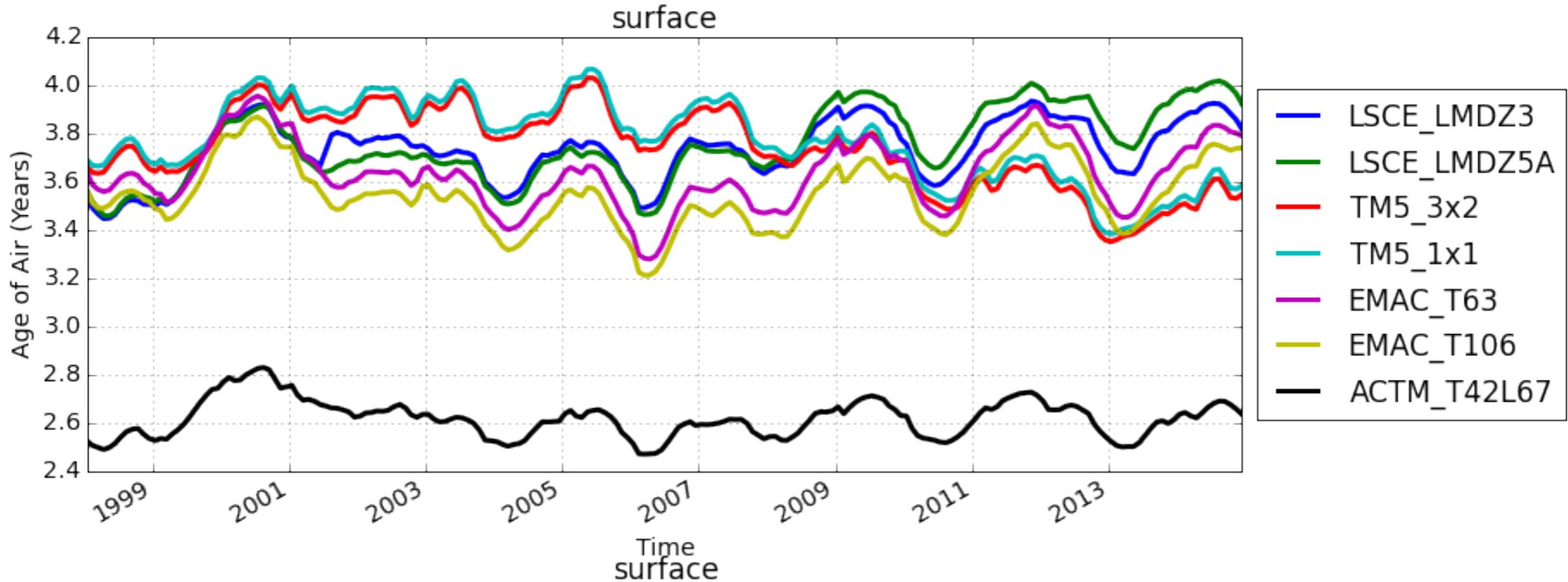
Tracer NH-surface: Sampled 60S-90S, 400-700 hPa



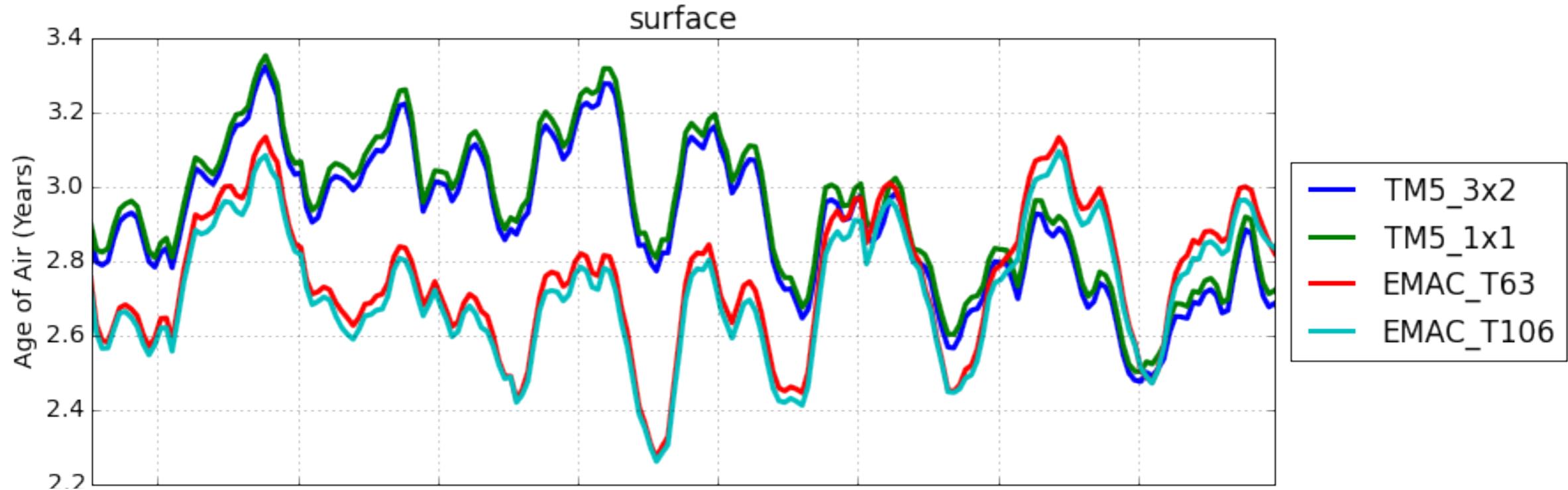
Tracer SH-surface: Sampled 60N-90N, 400-700 hPa



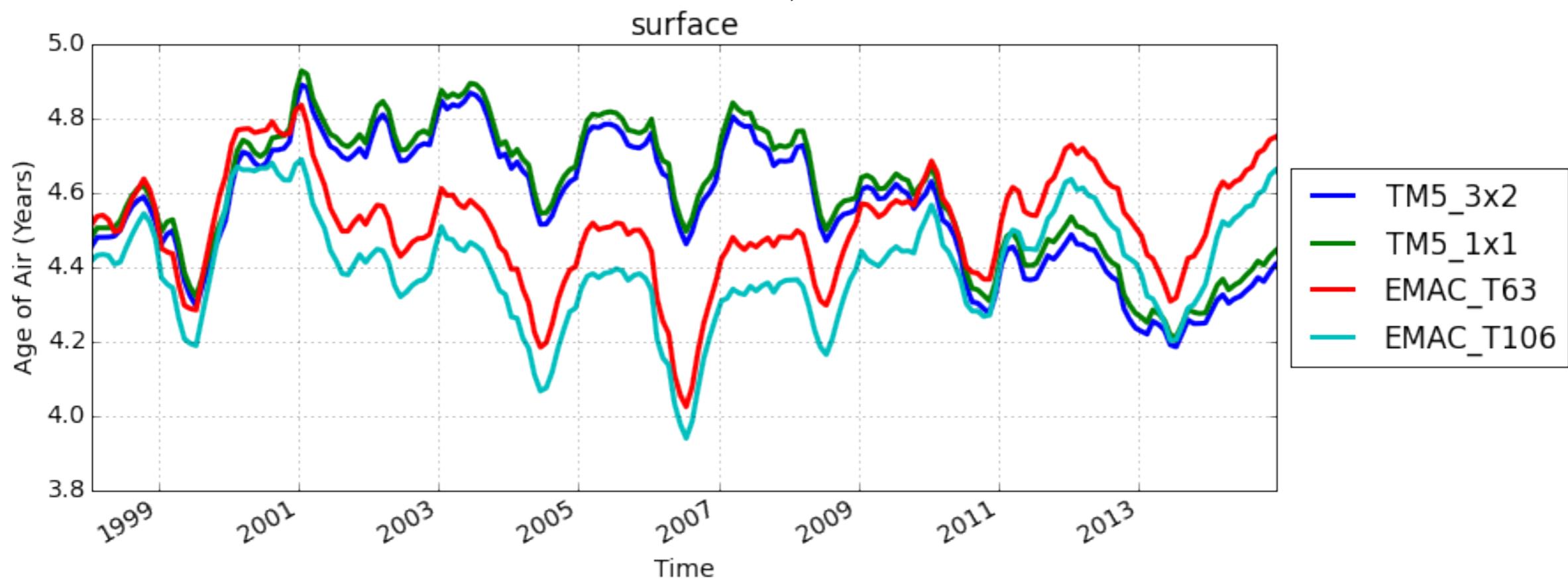
Tracer surface: 50-20 hPa

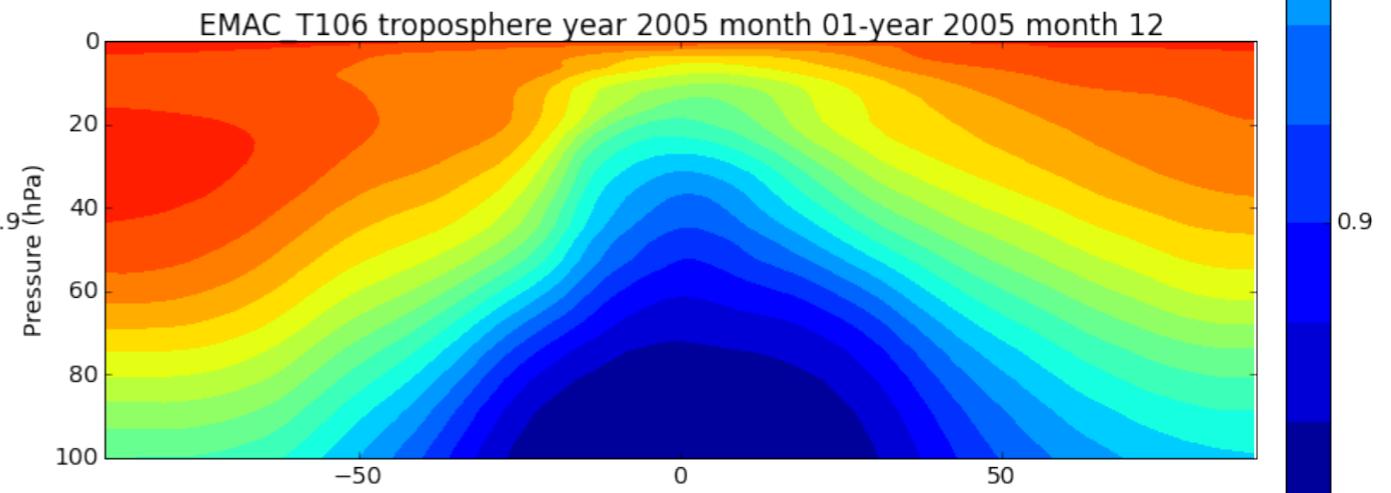
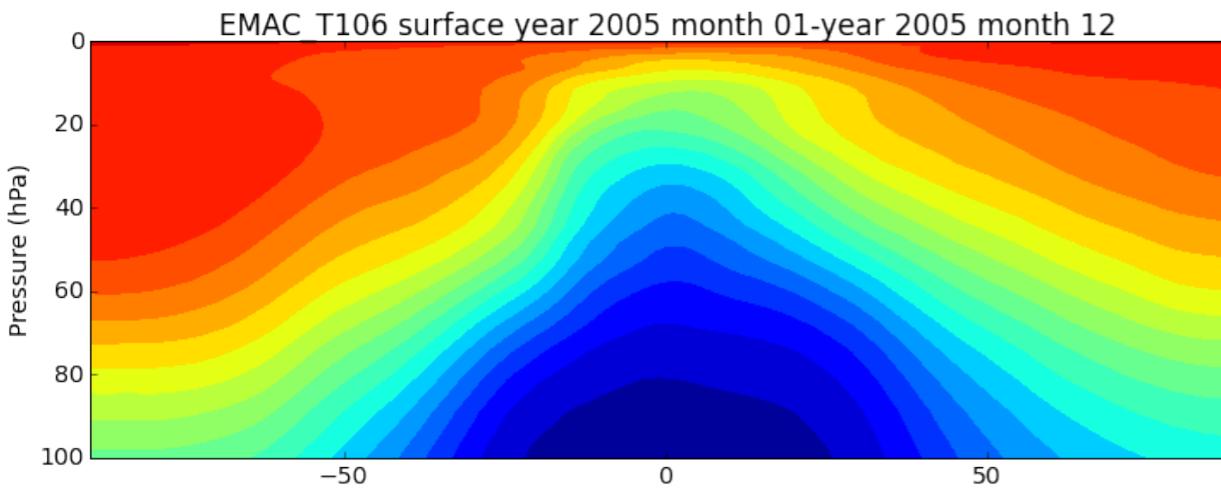
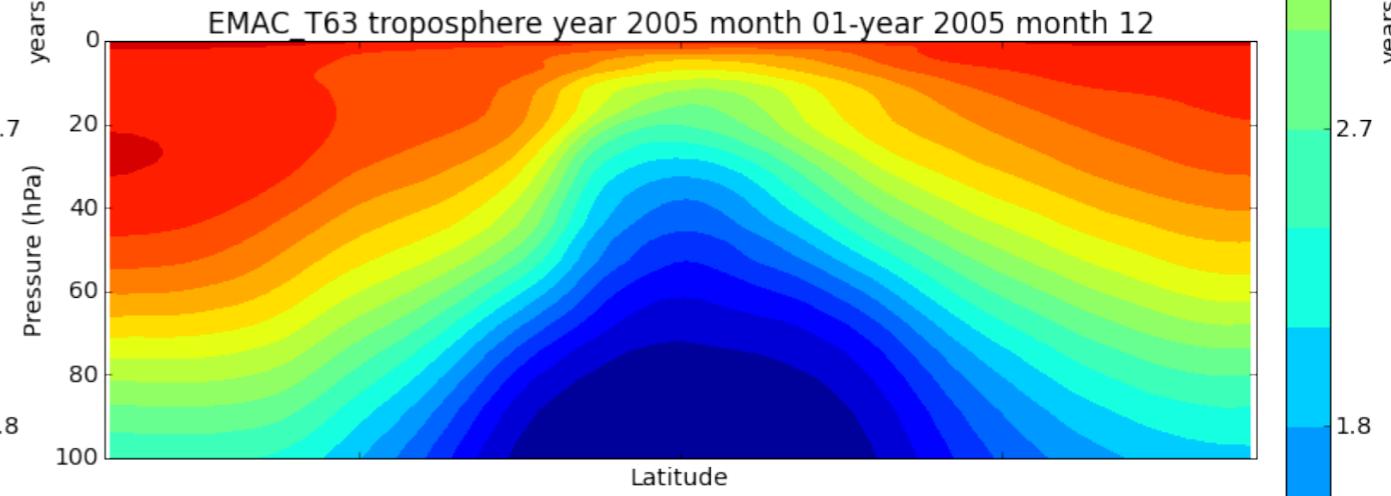
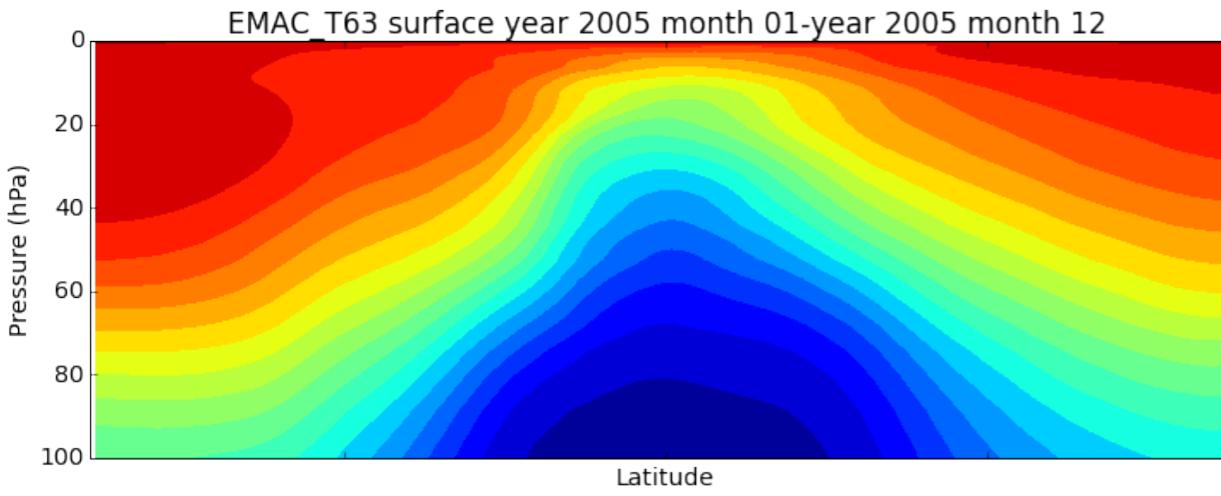
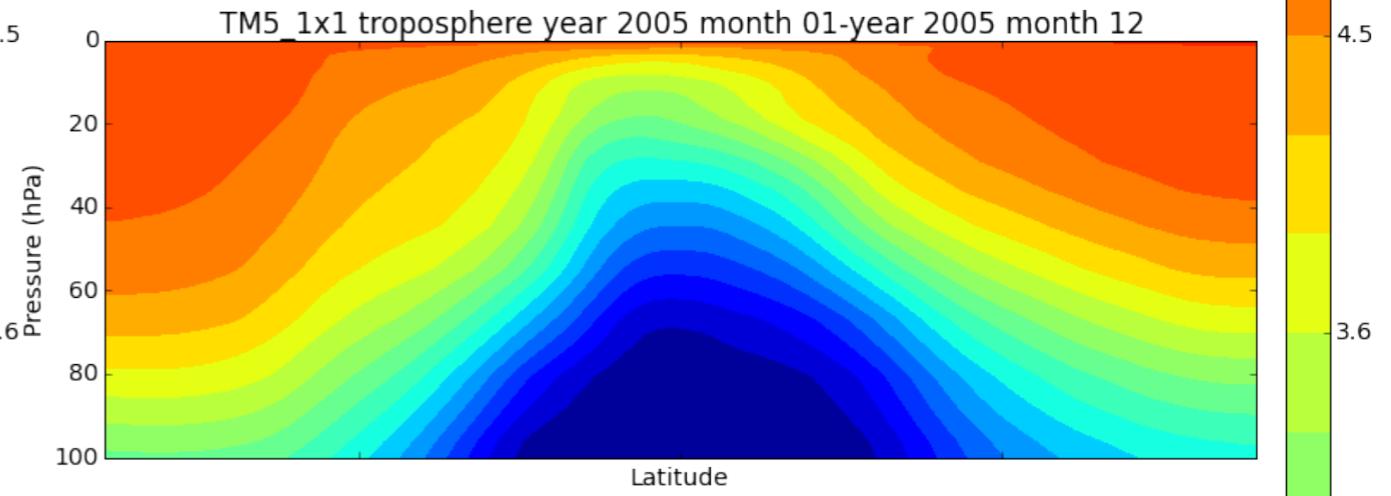
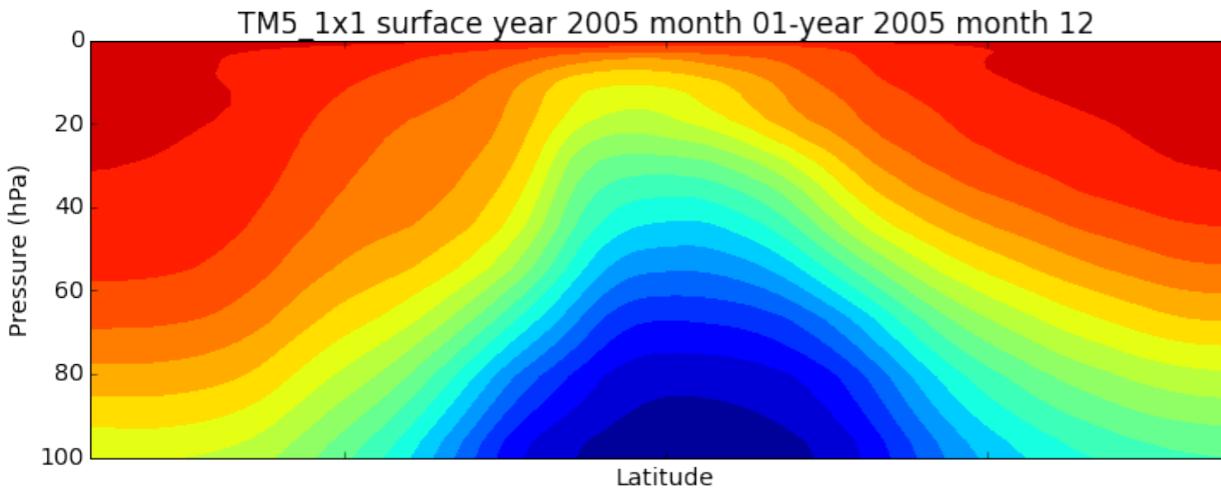
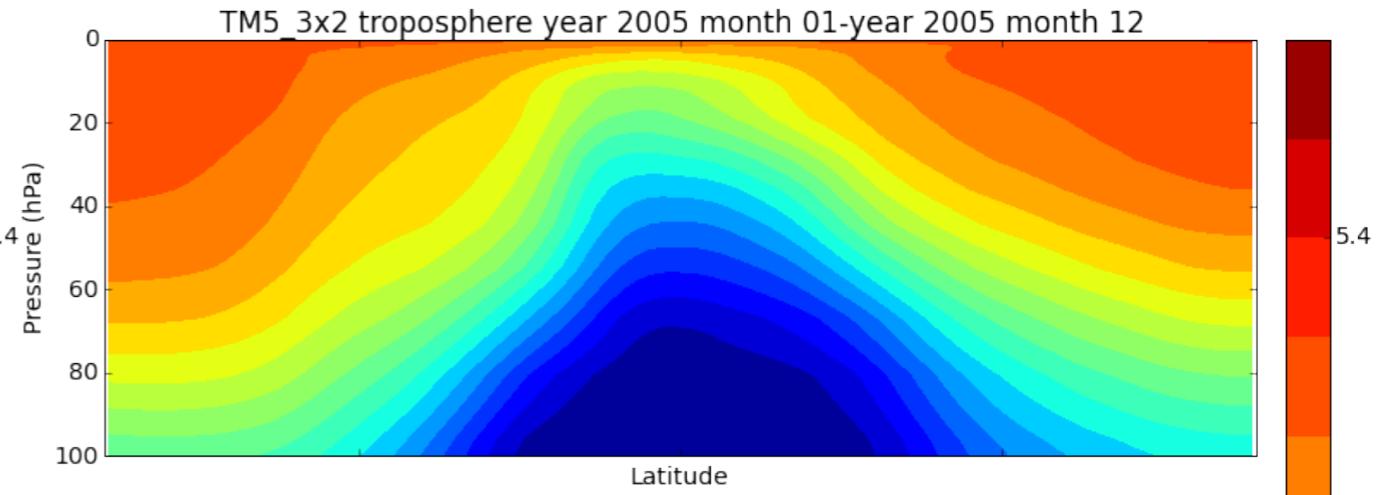
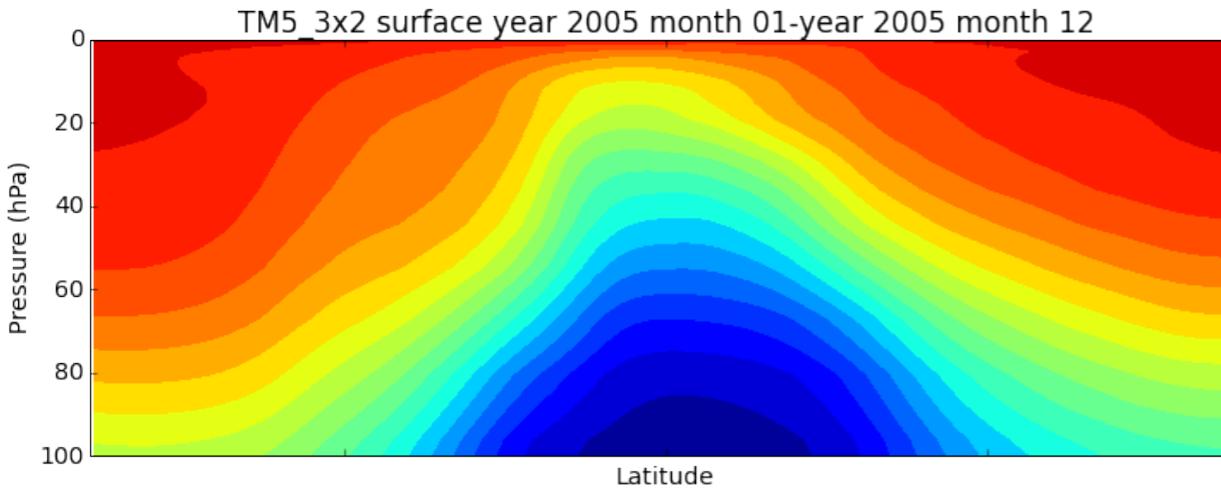


Tracer surface: 50-20 hPa, 30S-30N

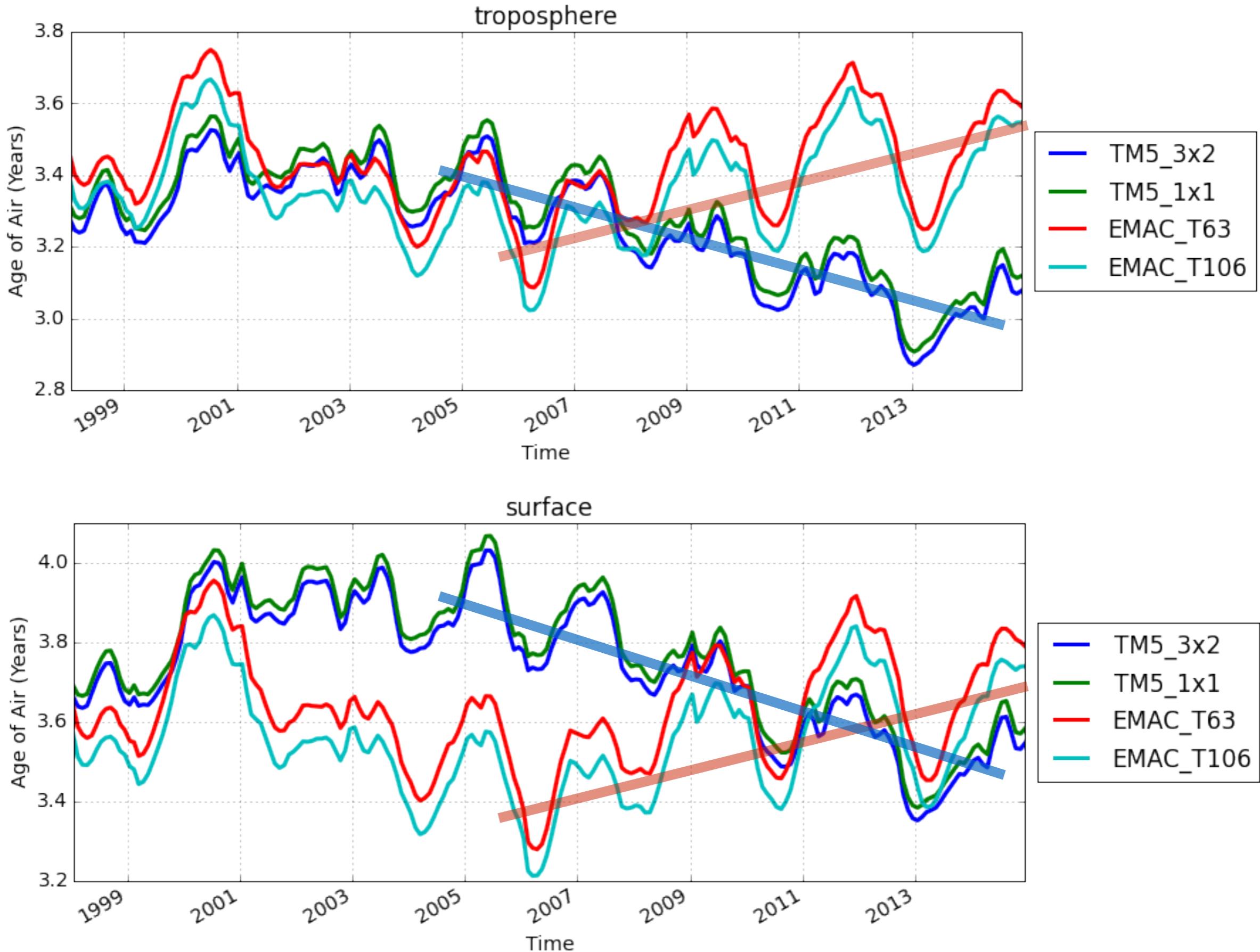


Tracer surface: 50-20 hPa, 90S-30S 30N-90N





Troposphere & Surface tracer: sampled 20-50 hPa



Conclusions

- Relatively consistent results
- Three themes for 1st paper:
 - N <→ S, Strat <→ Trop, Land <→ Ocean
- Details EMAC-TM5 not consistent