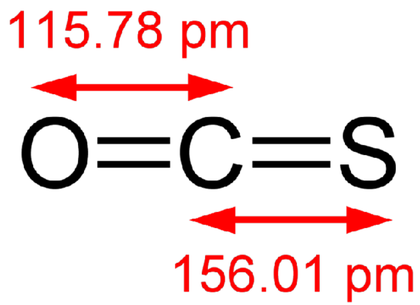
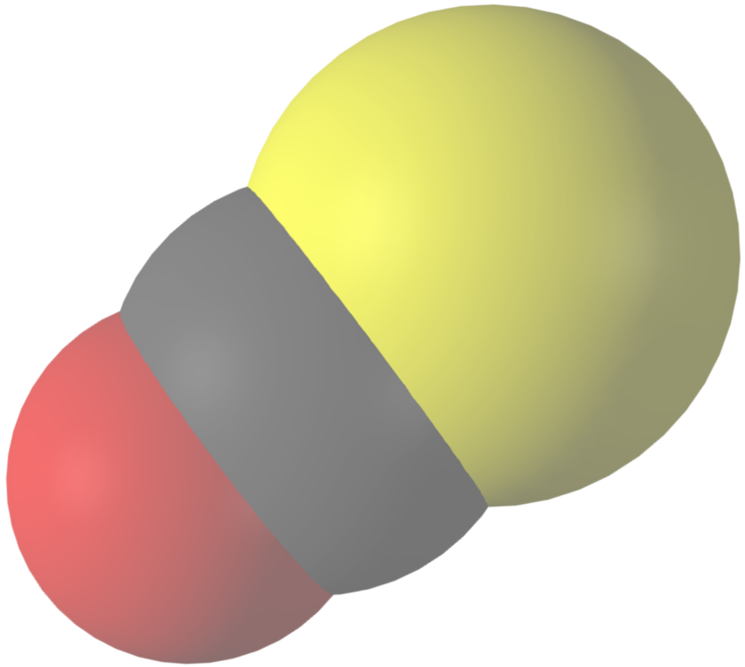


COS-OCS

TM5 in the COS-OCS project

TM meeting, Bremen, Dec 2022

Maarten Krol



European Research Council
Established by the European Commission

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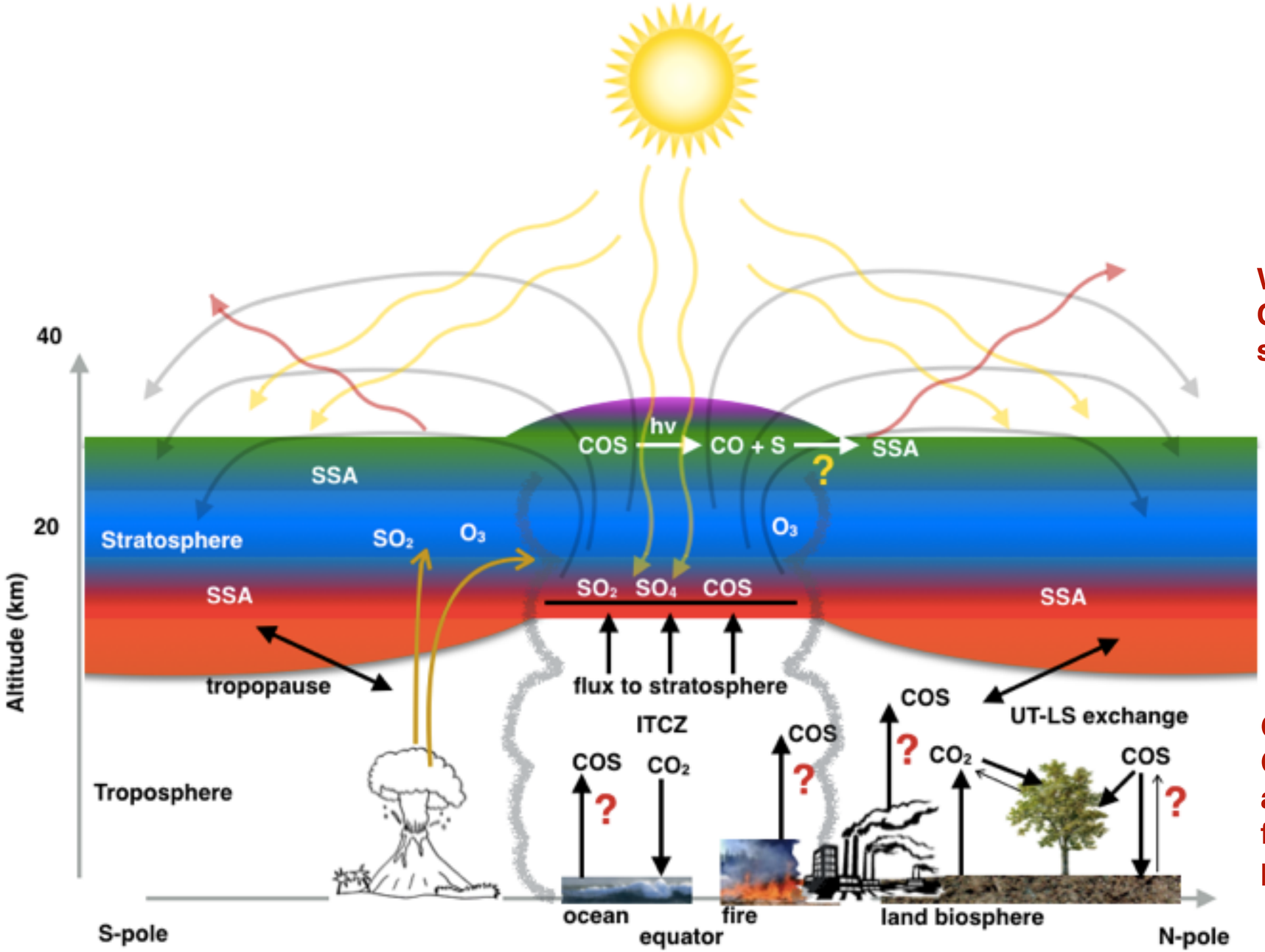

What is the contribution of COS to the stratospheric sulphate aerosol layer?

Can the global budgets of COS and CO_2 be reconciled, and what are the implications for terrestrial gross primary productivity?

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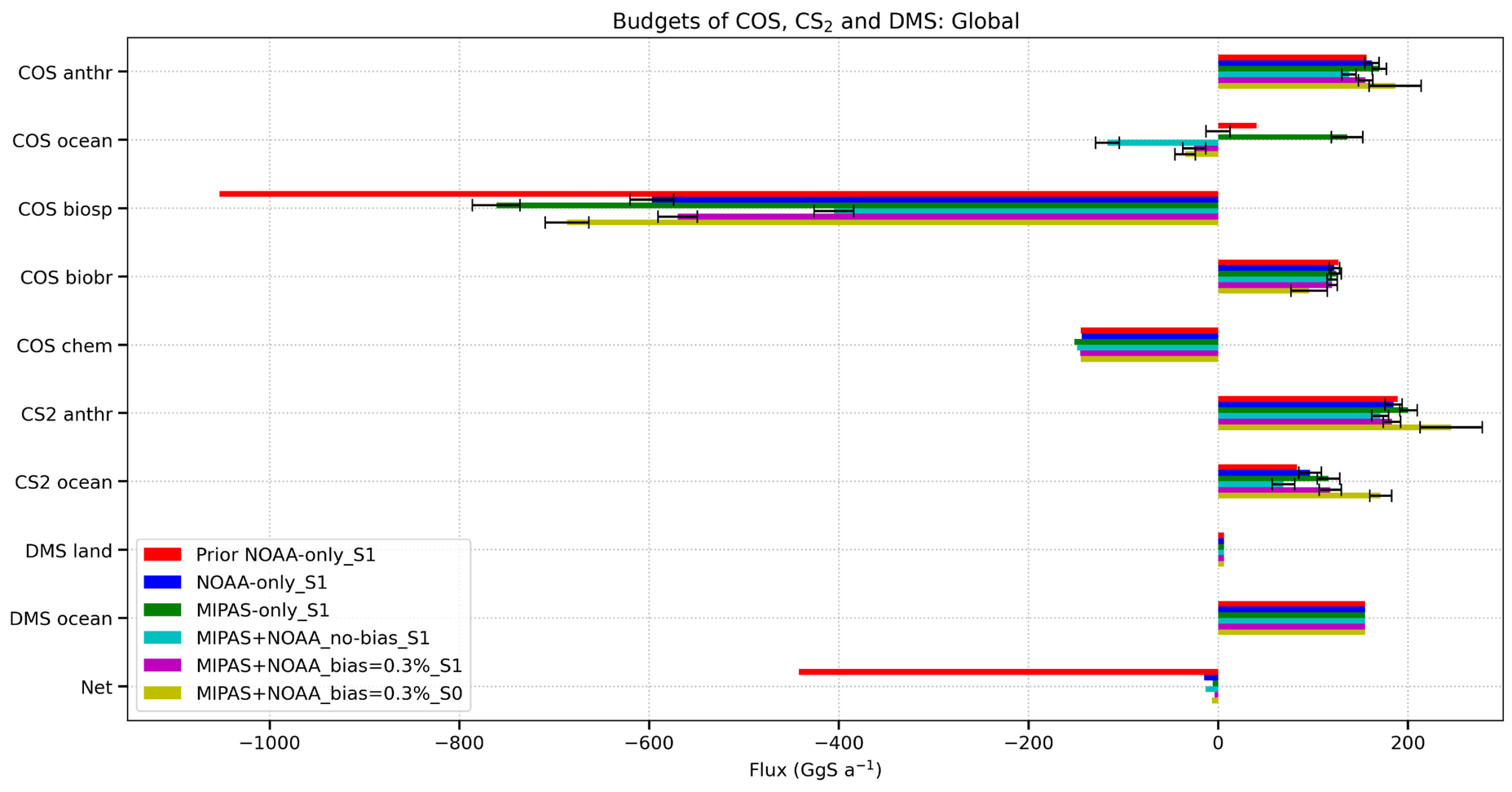
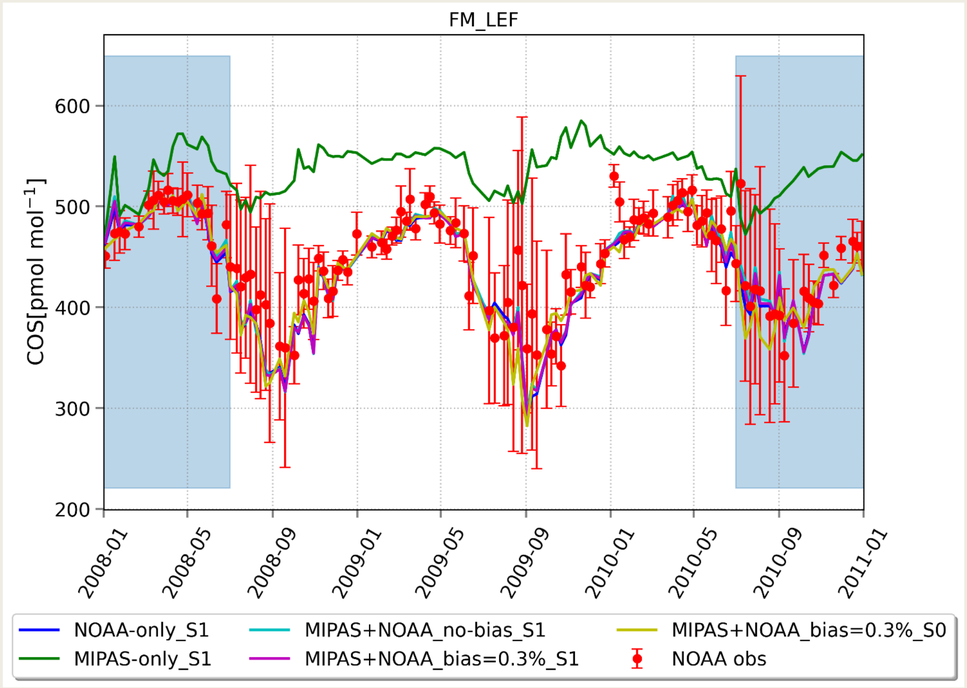
Global budgets with posterior errors

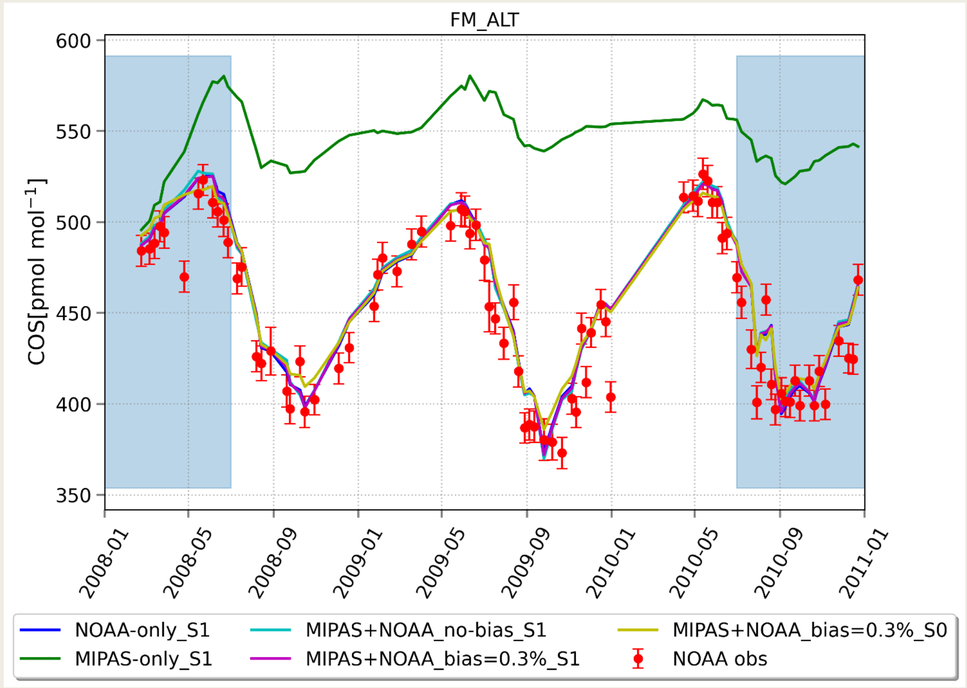


- Global budgets are closed technically in all inversions
- Biosphere flux gets reduced in all inversions

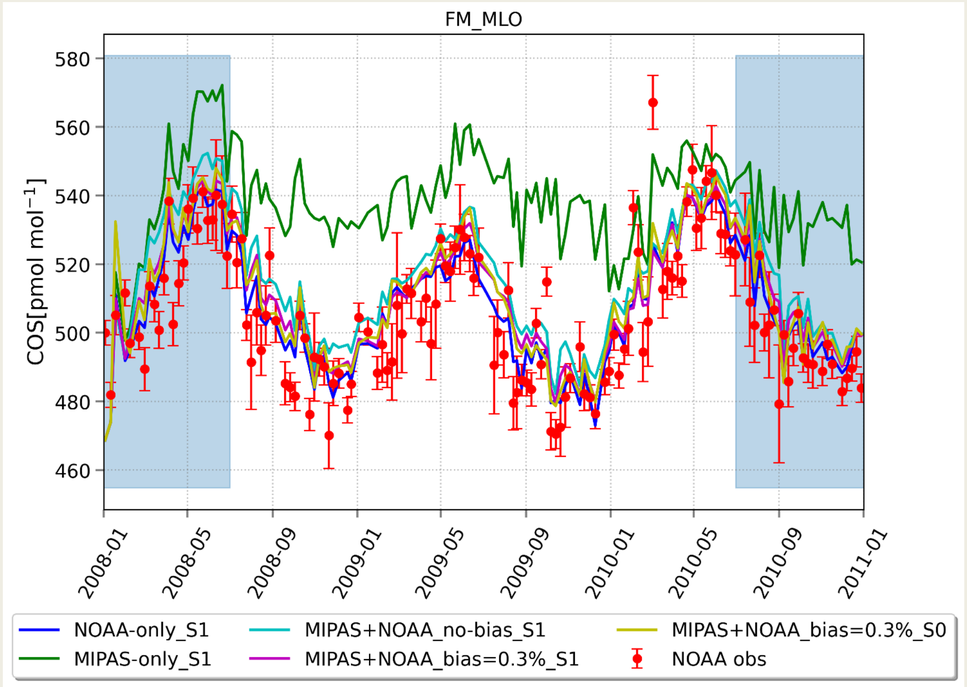
LEF



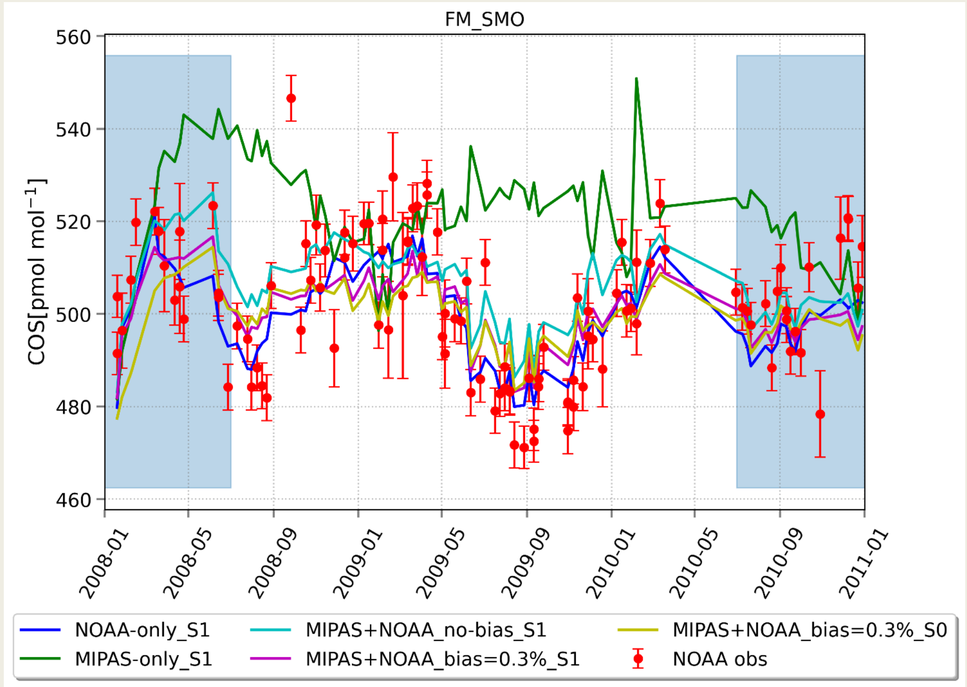
ALT



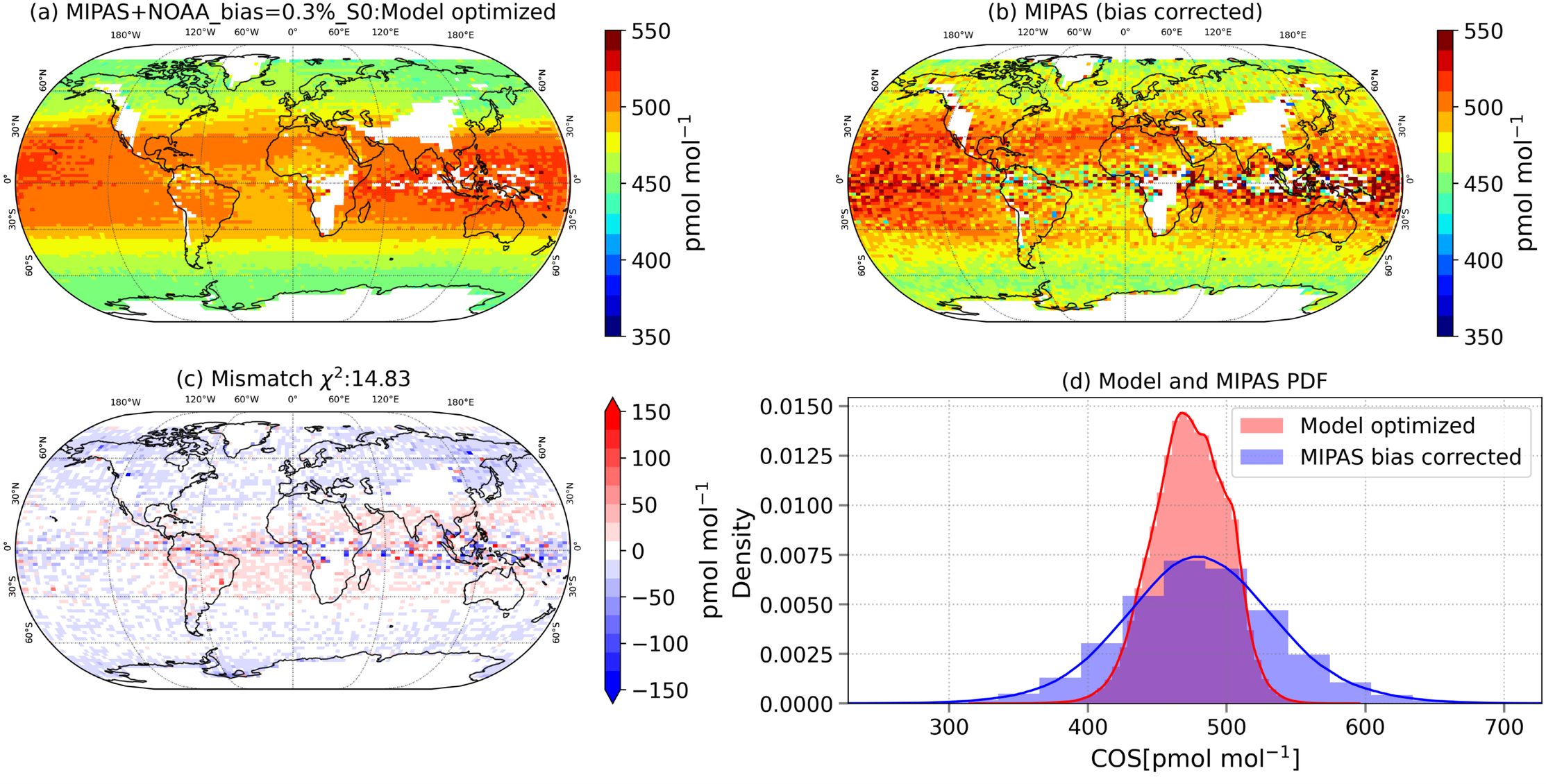
MLO



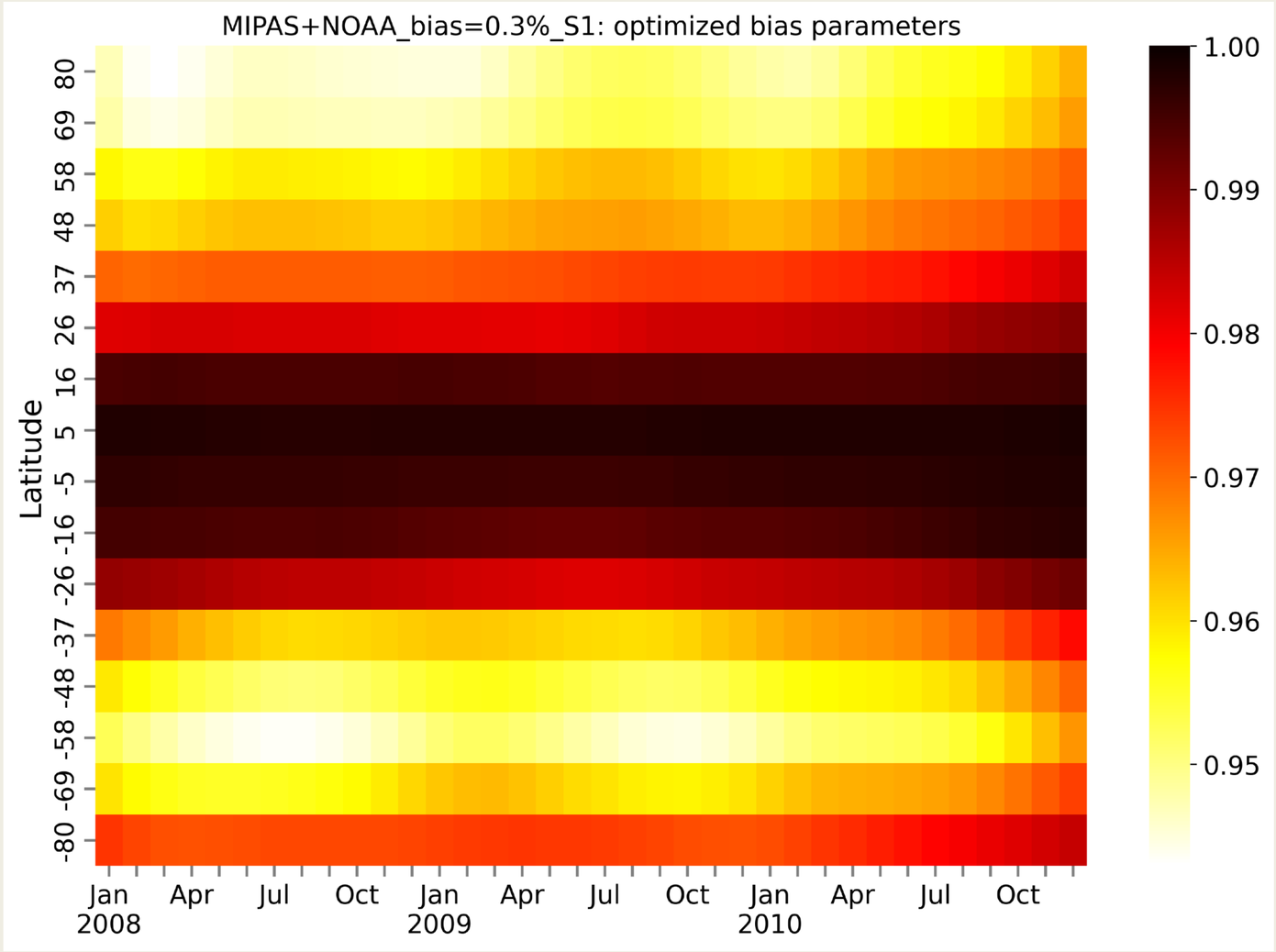
SMO



Model fitting with MIPAS in troposphere: MIPAS+NOAA bias=0.3%



Optimization of bias correction: MIPAS+NOAA bias=0.3%



- It lowers down MIPAS observations in order to fit better, range in 0.94-1.00.
- High latitudes get most adjustment.
- Slight seasonal cycle: maybe indicate potential model error.

Remaining things to do (working on it)

- Coupled CO2-COS inversion
- Isotopes

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Coupling CO2 & COS

- State vector:
  - CO2: GPP & Respiration, Ocean (other fluxes fixed?)
  - COS: Ocean, Biosphere, (other fluxes fixed?)
- Proposed approach:
  - Optimise field A(:,:) = 1.0, and apply this field to GPP and COS-biosphere flux

COS-OCS

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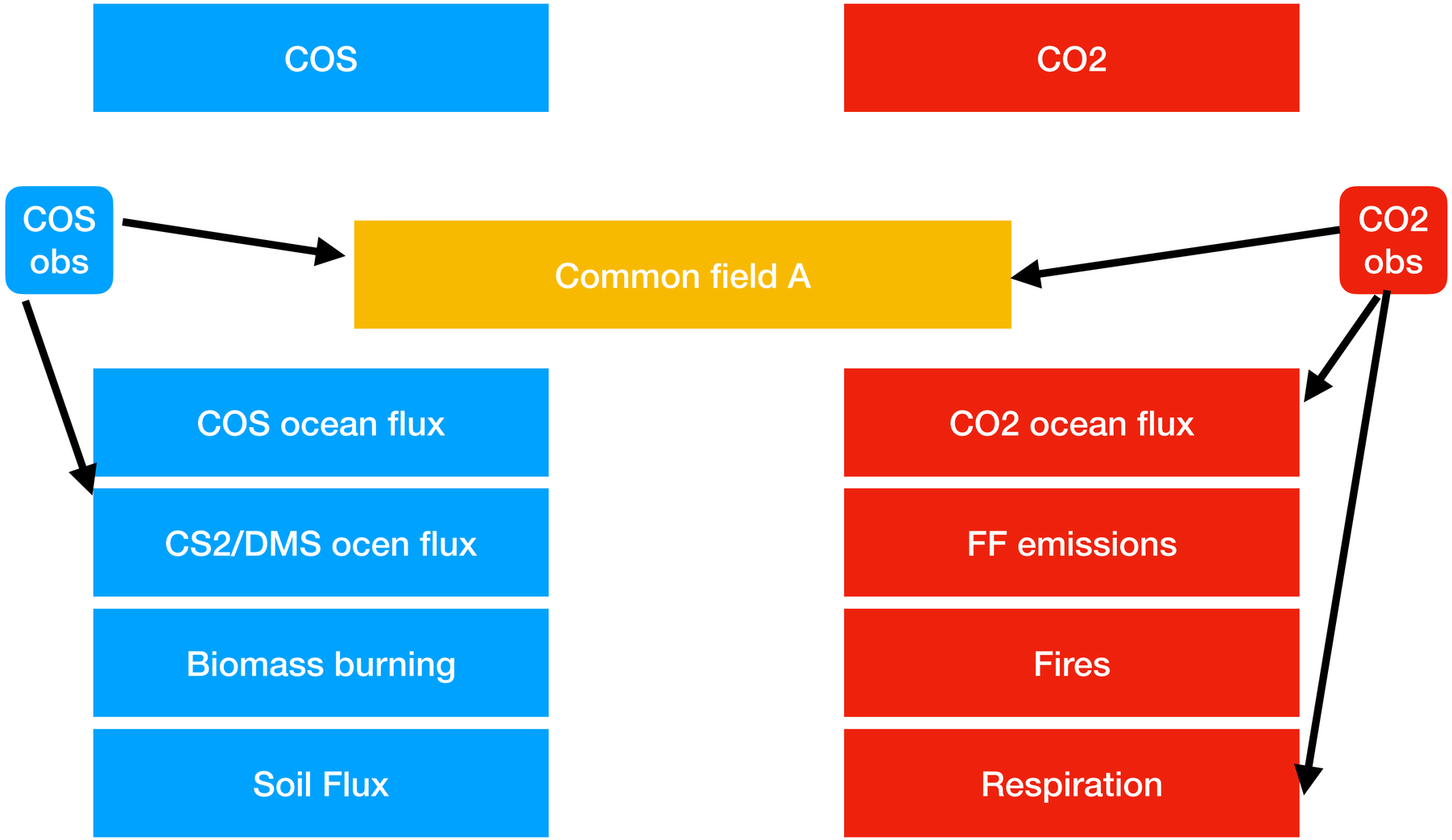

Biosphere = A*(SIB4 COS)

GPP = A*(SIB4 GPP)

Note: In absence of COS, GPP and Respiration adjustments would be identical

COS-OCS

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Isotopes

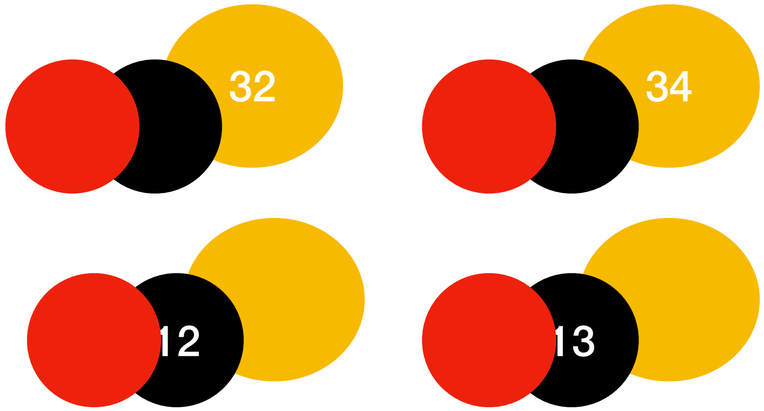
What is known about 34S?

Ocean sources: heavy ~ 15 per mill

Anthropogenic sources: ~ 8 per mill

Biosphere prefers 32S (makes atm heavy)

Chemistry and photolysis: 32S reacts faster



Current steps

- **Implementation in TM5**
- **3x2, 67 vertical layers**
- **Assumptions about emission signatures & fractionation constants**

COS-OCS

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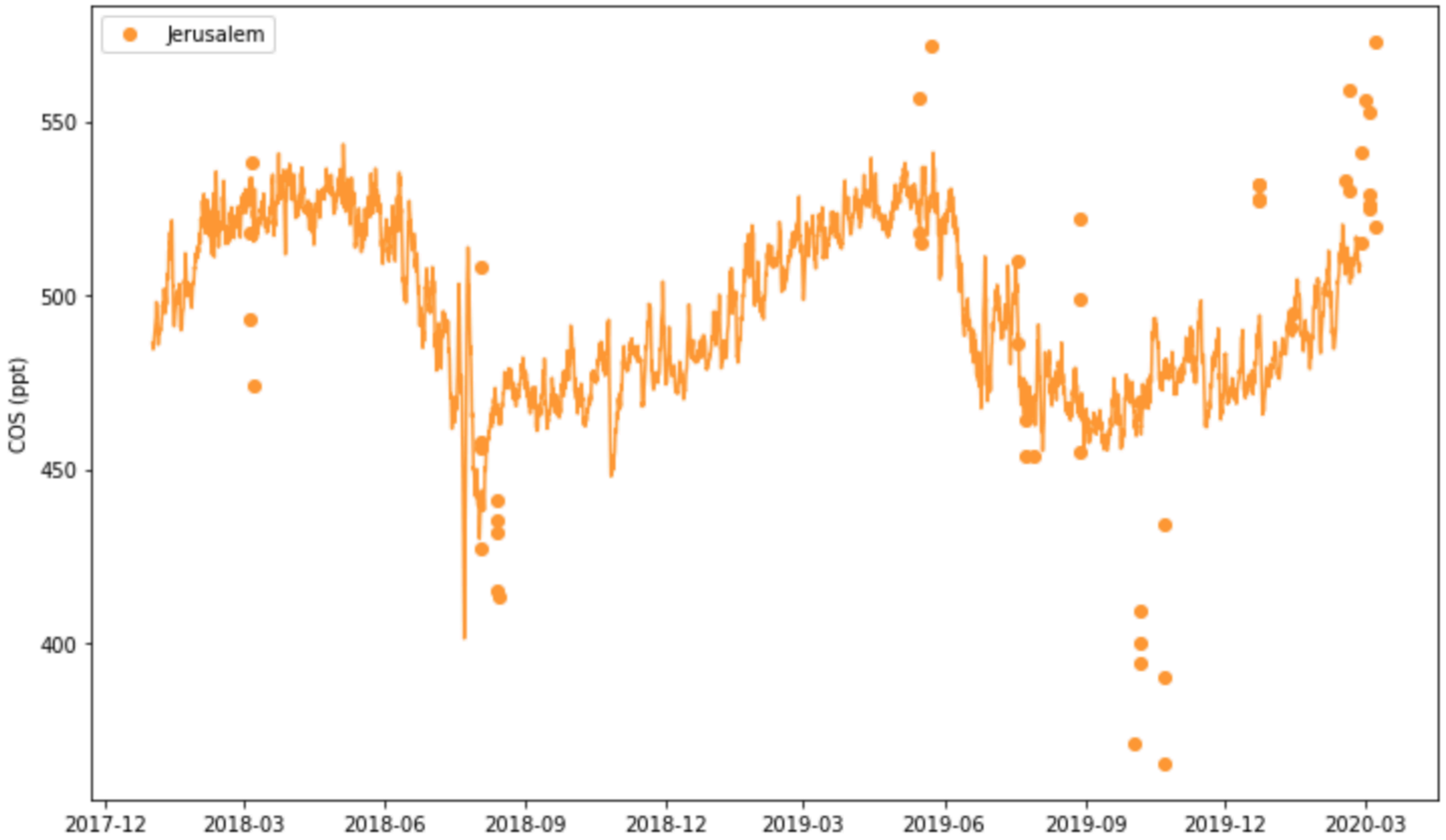
Isotope modelling in TM5

```
chemistry.COS.yield_CS2   : 0.83
chemistry.COS.yield_DMS   : 0.007
chemistry.epsilon_cosoh   : -0.00256
chemistry.epsilon_cosuv   : -0.003
chemistry.epsilon_cs2oh   : 0.0
chemistry.epsilon_dmsoh   : 0.0
emission.cos.epsilon_anthr : 0.0080
emission.cos.epsilon_ocean : 0.0147
emission.cos.epsilon_biobr : 0.0080
emission.cos.epsilon_biosp : -0.0019
```



COS-OCS

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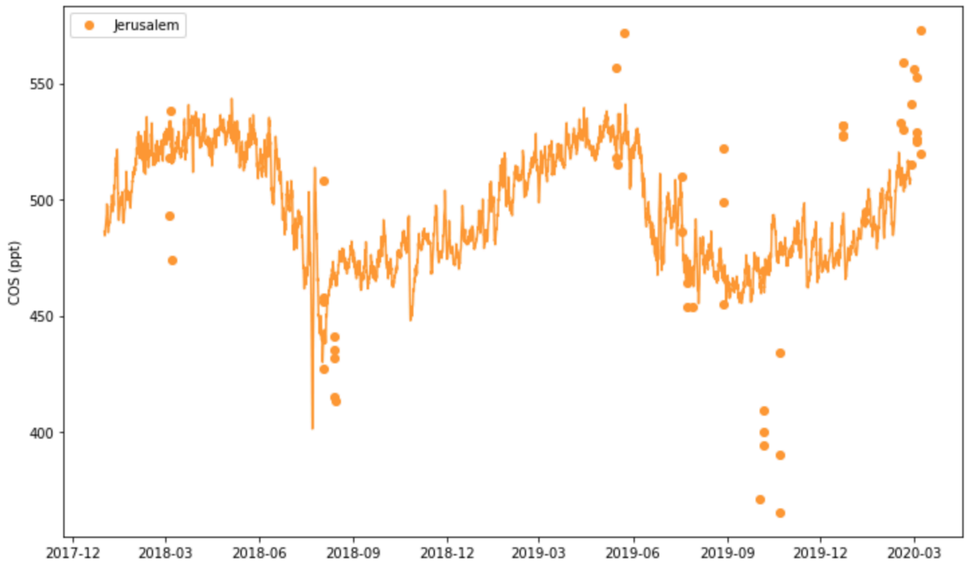
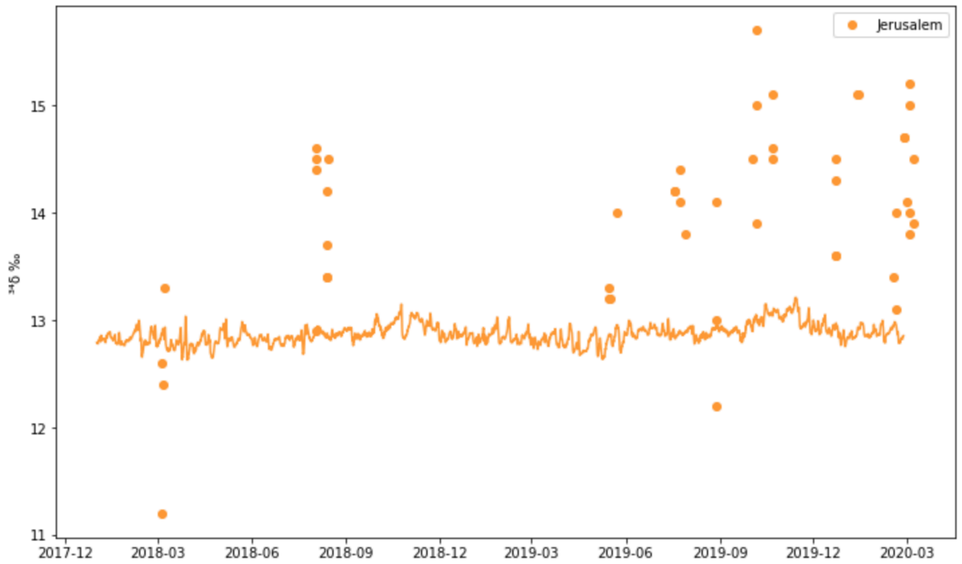
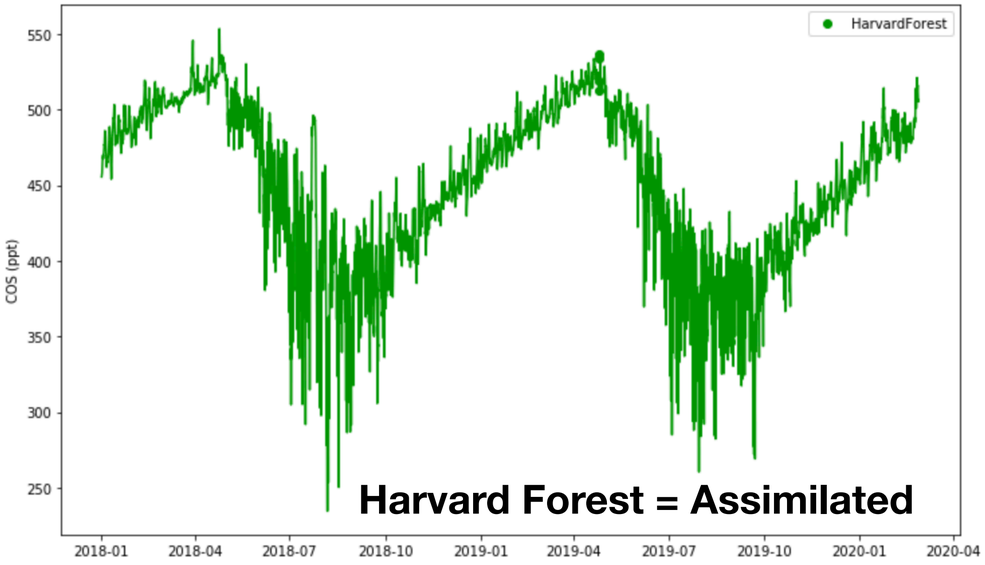
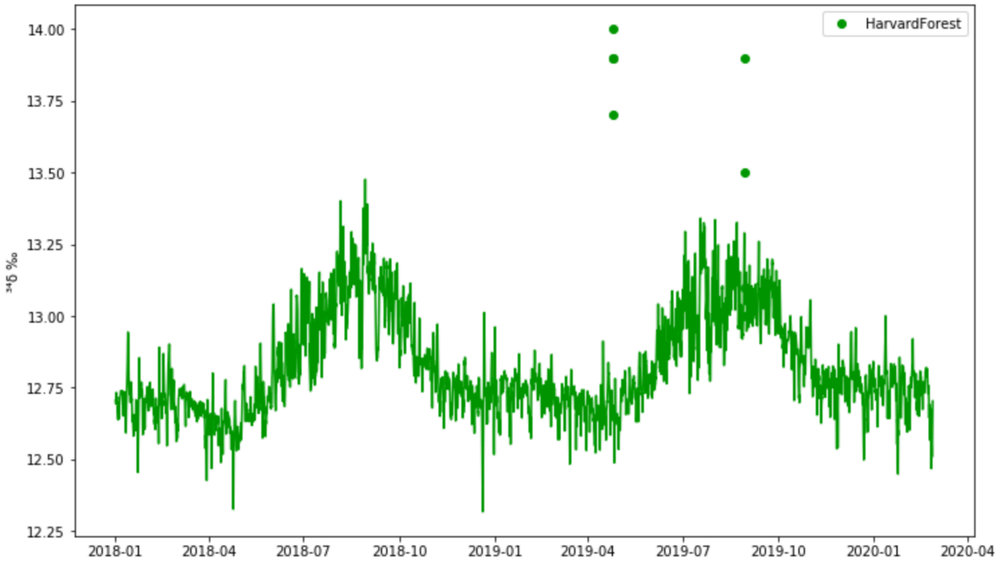
COS-OCS









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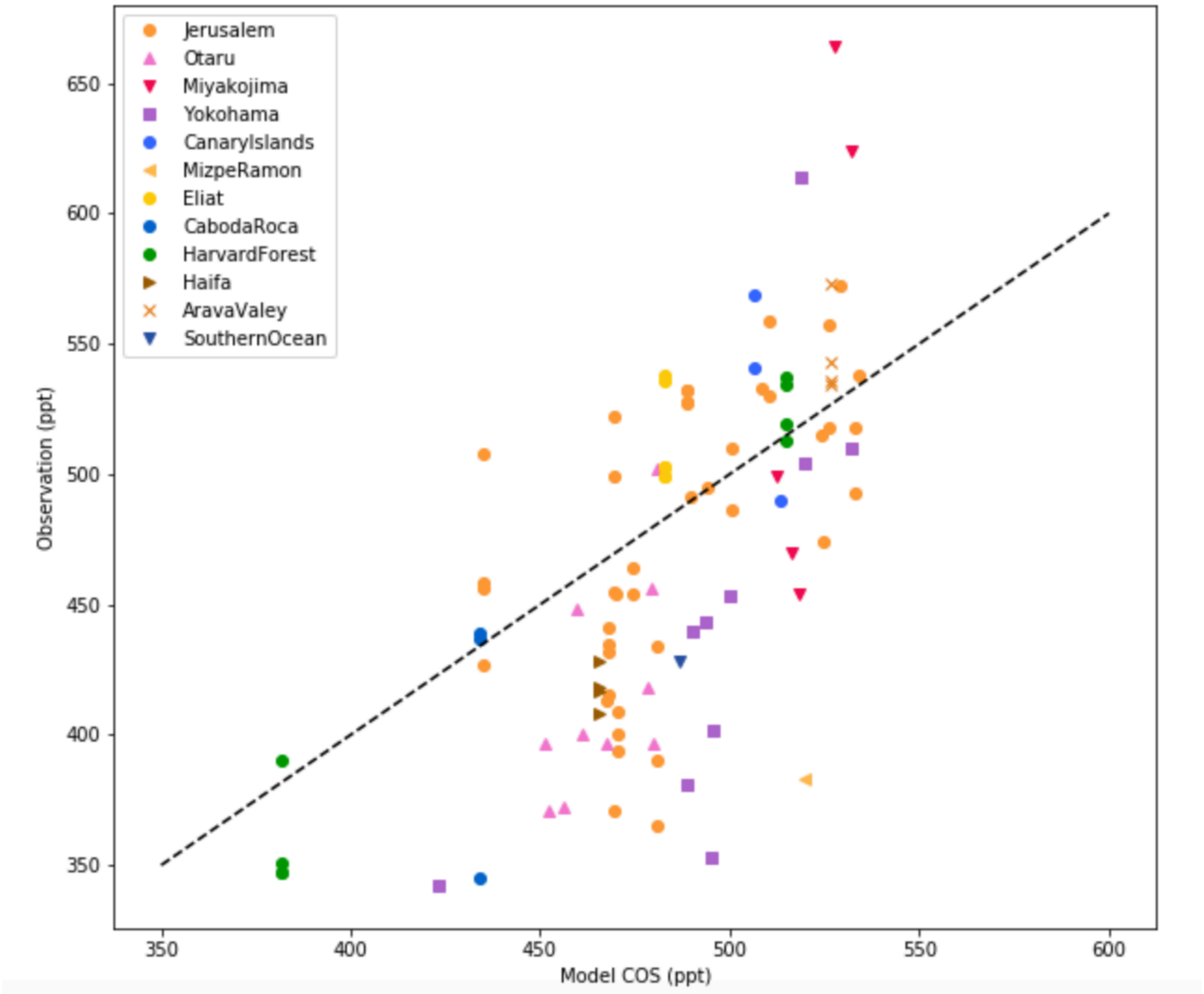
COS-OCS



Where there is some skill in modelling COS mole fractions….

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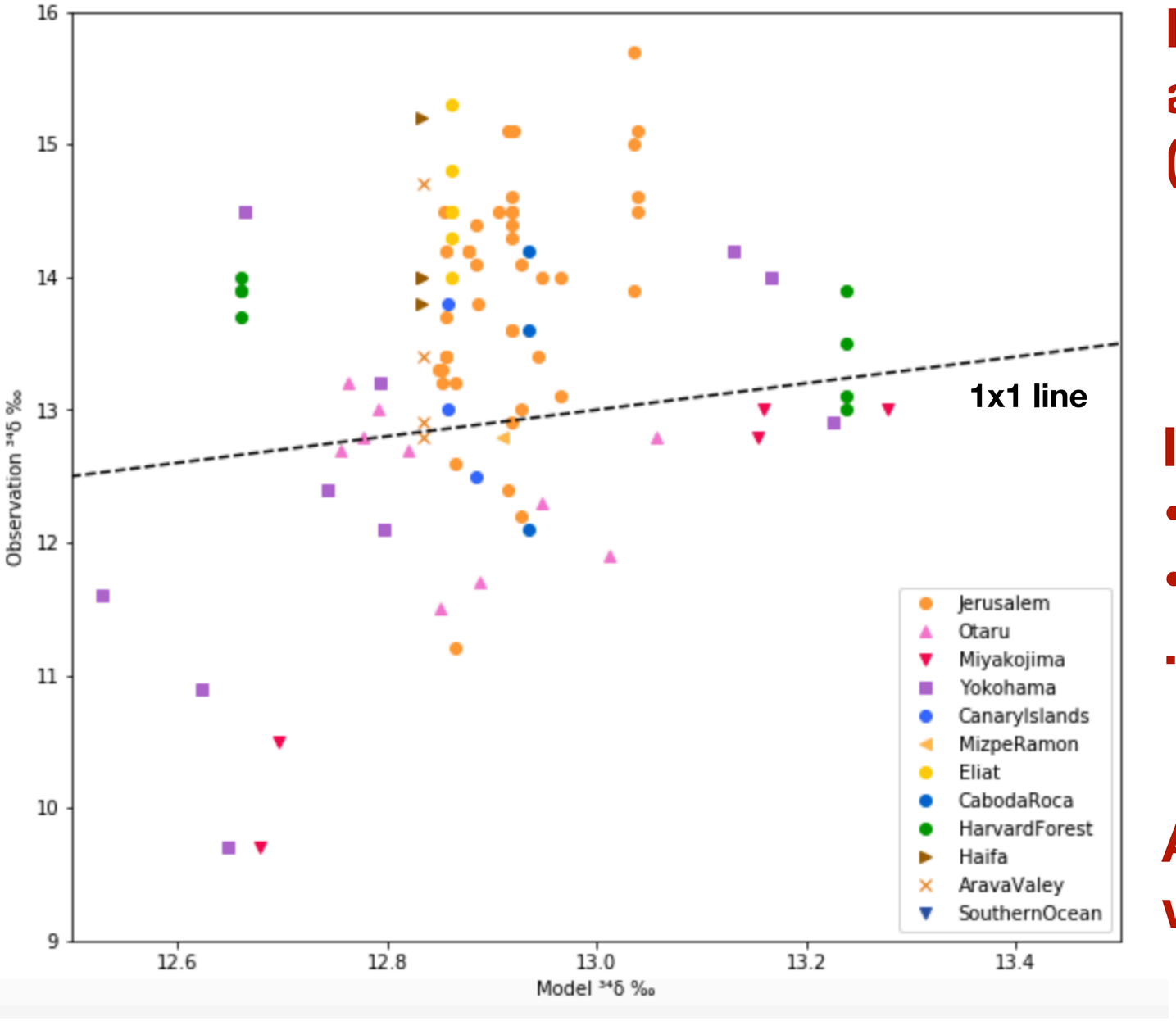
COS-OCS



Isotopic values are all over the place (note the scale)….

Implying variability in:

- **source signatures**
- **fractionation factors**

….

And we have a long way to go

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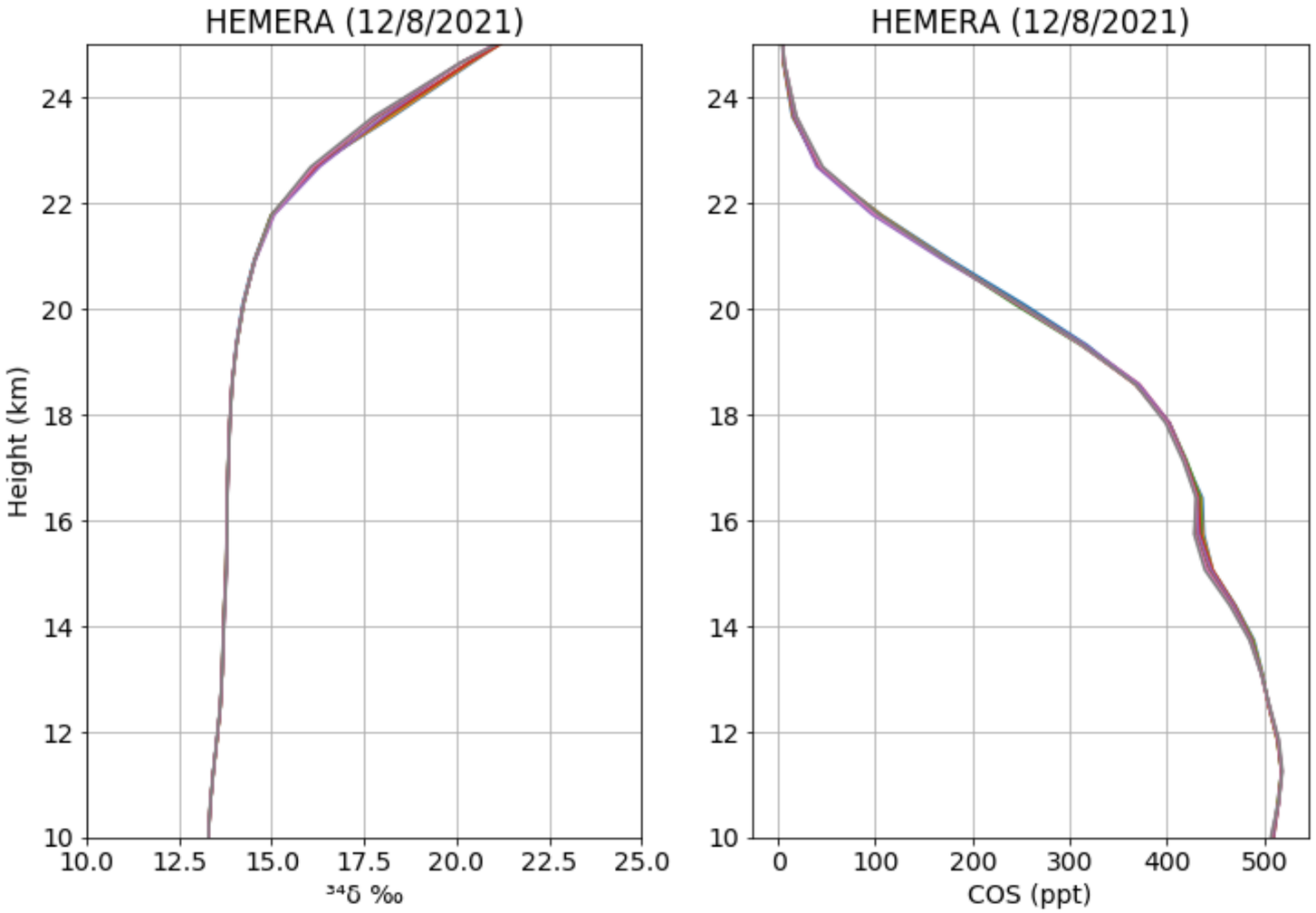
Fresh results for Hemera 2021

lines represent 3-hourly samples on 12/8/2021



COS-OCS

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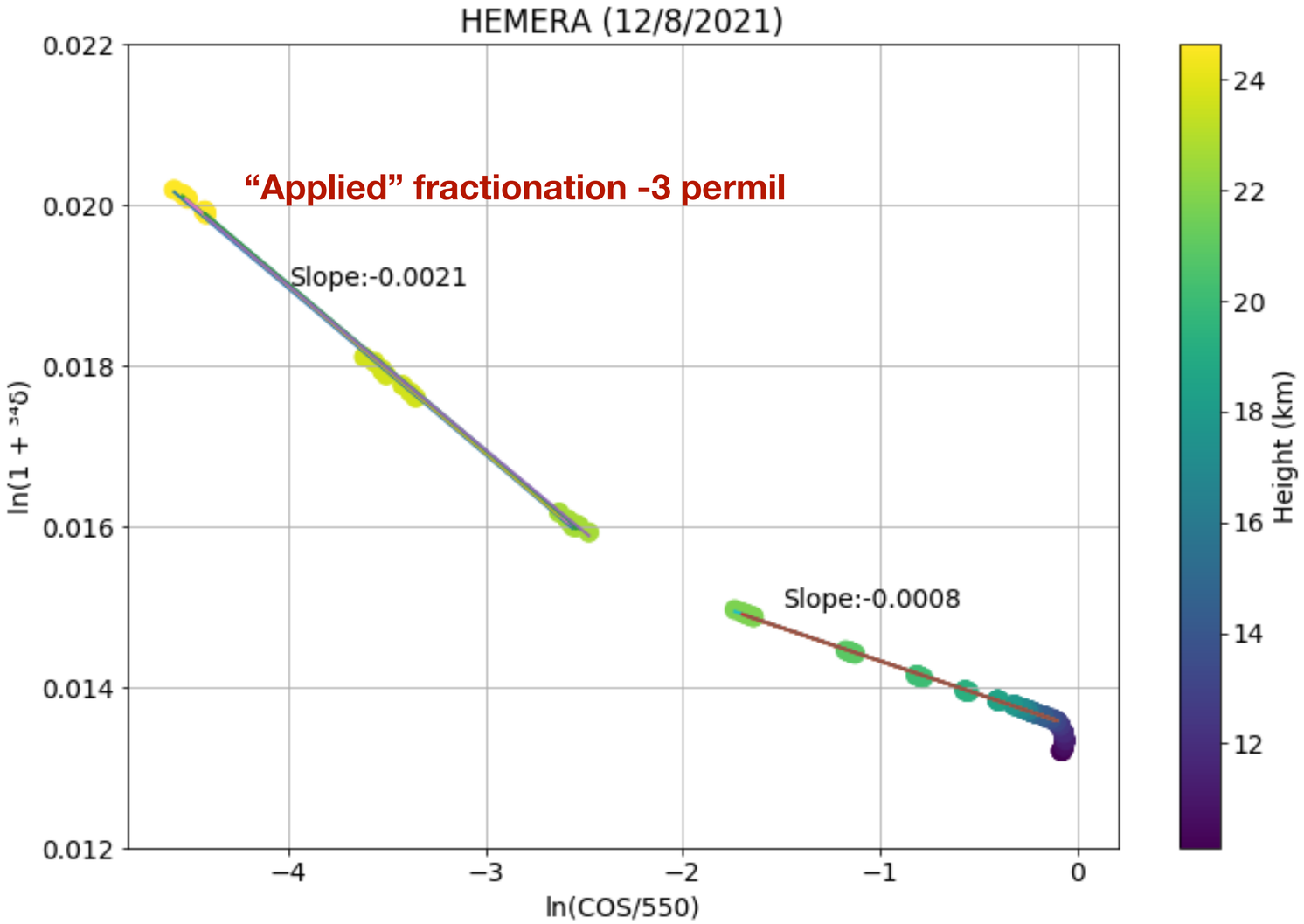
Fresh results for Hemera 2021 (Rayleigh plot)

lines represent 3-hourly samples on 12/8/2021



COS-OCS

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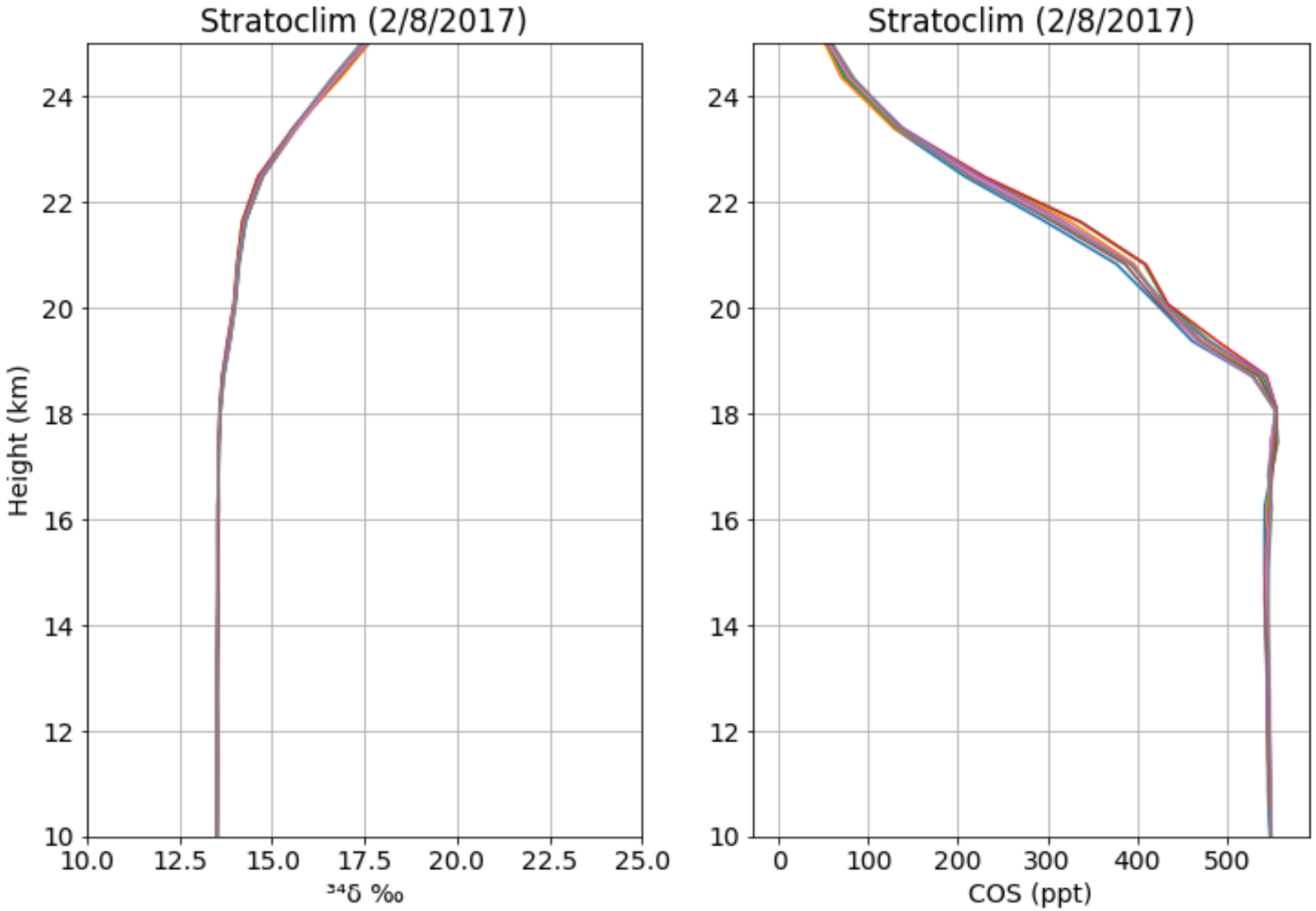
Stratoclim (Indian monsoon)



lines represent 3-hourly samples on 2/8/2017

COS-OCS

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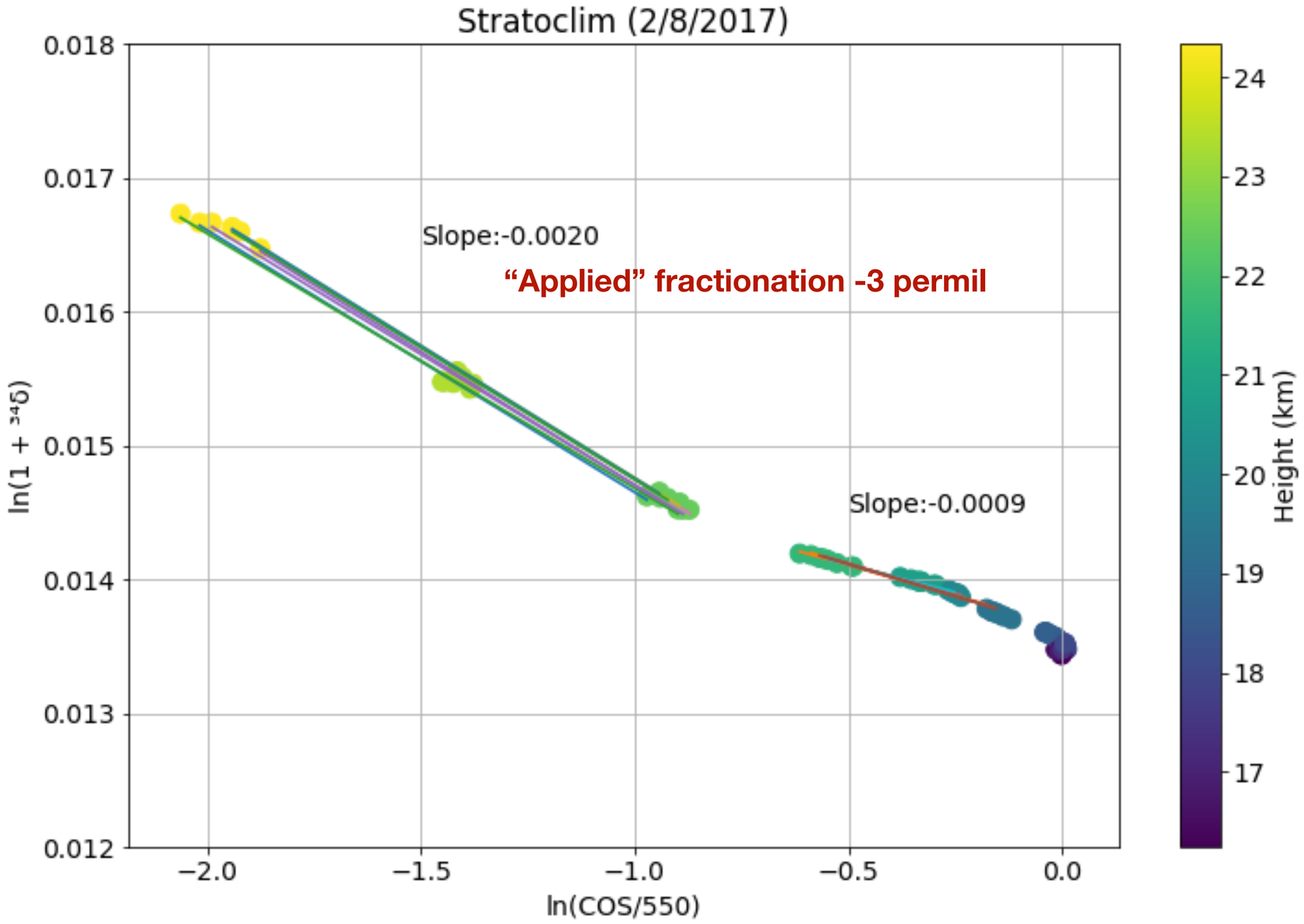
Stratoclim (Rayleigh plot)

lines represent 3-hourly samples on 2/8/2017



COS-OCS

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Conclusions

- TM5 (& 4DVAR) was important for COS-OCS
- New:
  - off-line COS version, including CS2/DMS
  - Coupled COS/CO2 version
  - Isotopes (34S, 13C)
- Jin informed you about the inter comparison project

COS-OCS

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