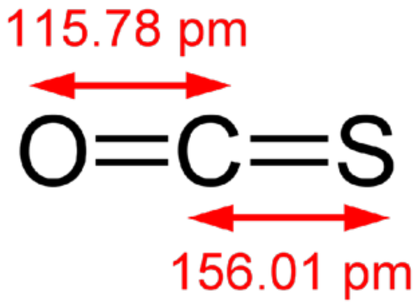


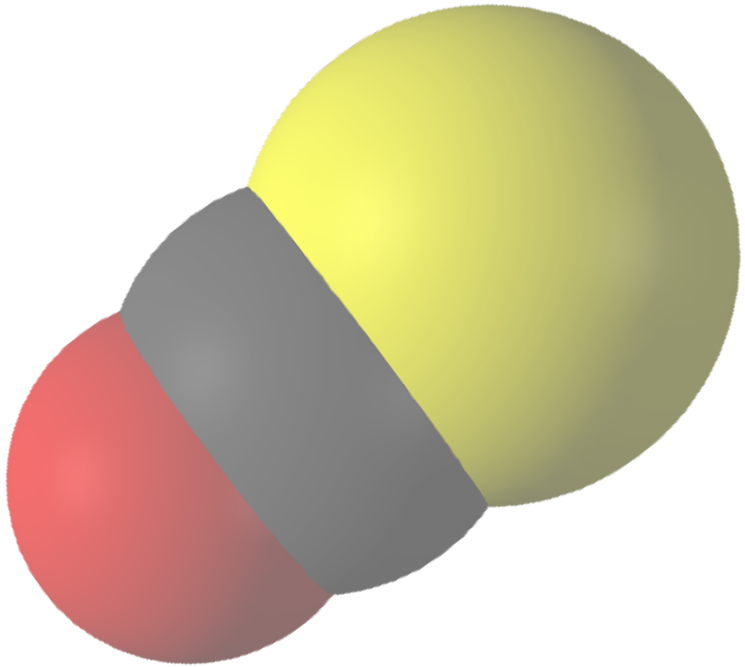
COS-OCS

Modelling $CO^{34}S$: the effect of vertical resolution on transport to the stratosphere

TM meeting, October 2023, Crete

Maarten Krol & Jin Ma & Sophie Baartman

Utrecht University & Wageningen University



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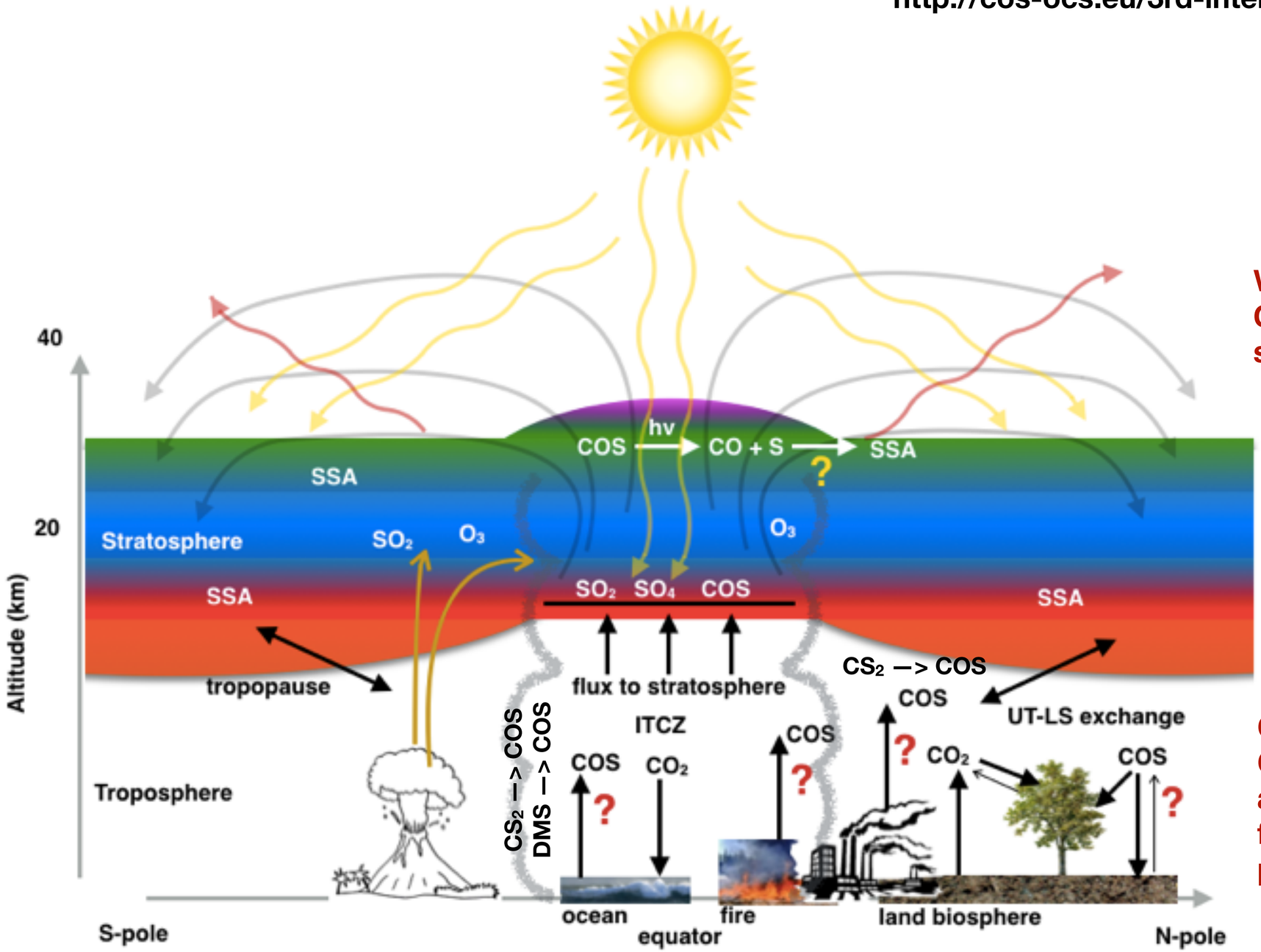
COS-OCS

http://cos-ocs.eu/3rd-international-cos-works.html



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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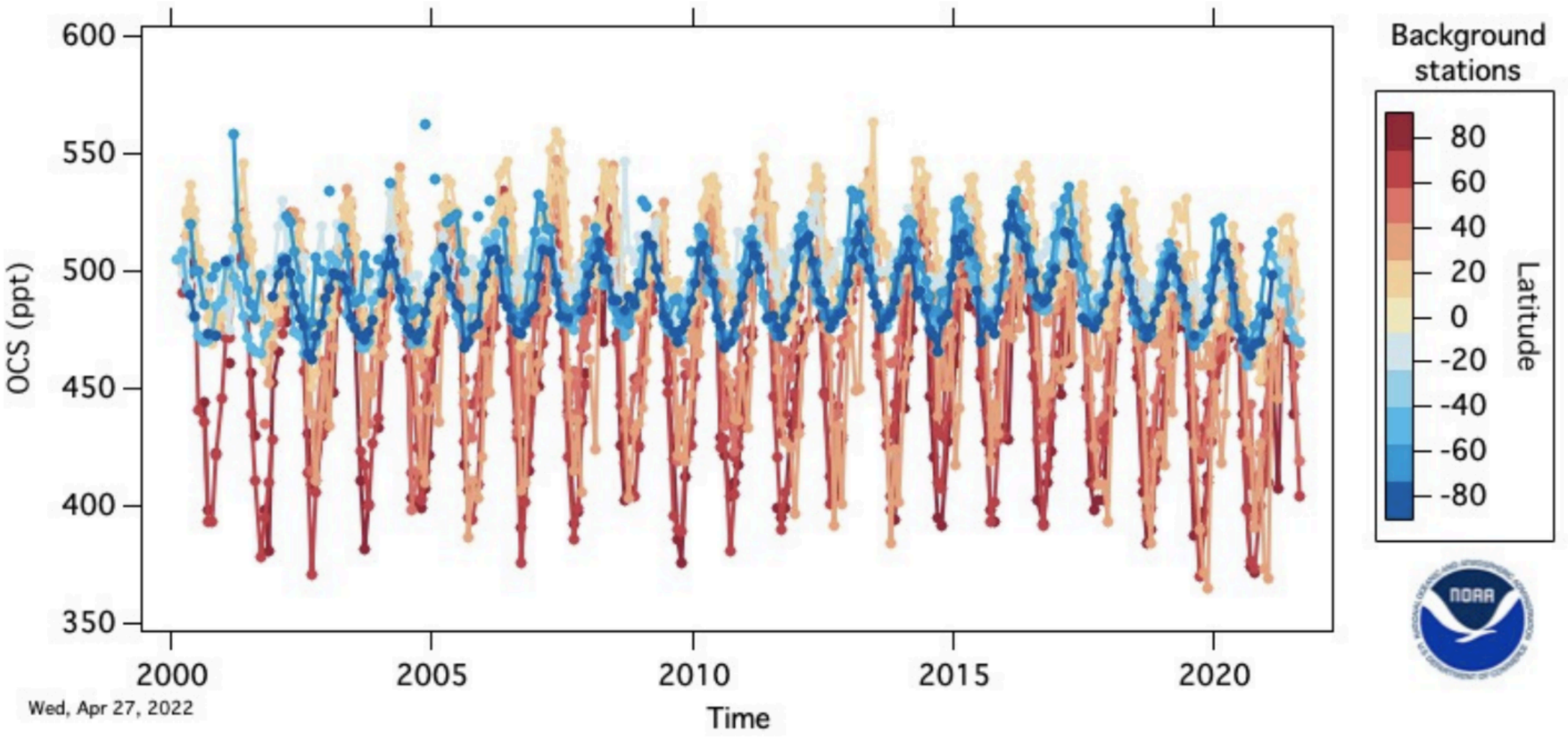
COS-OCS



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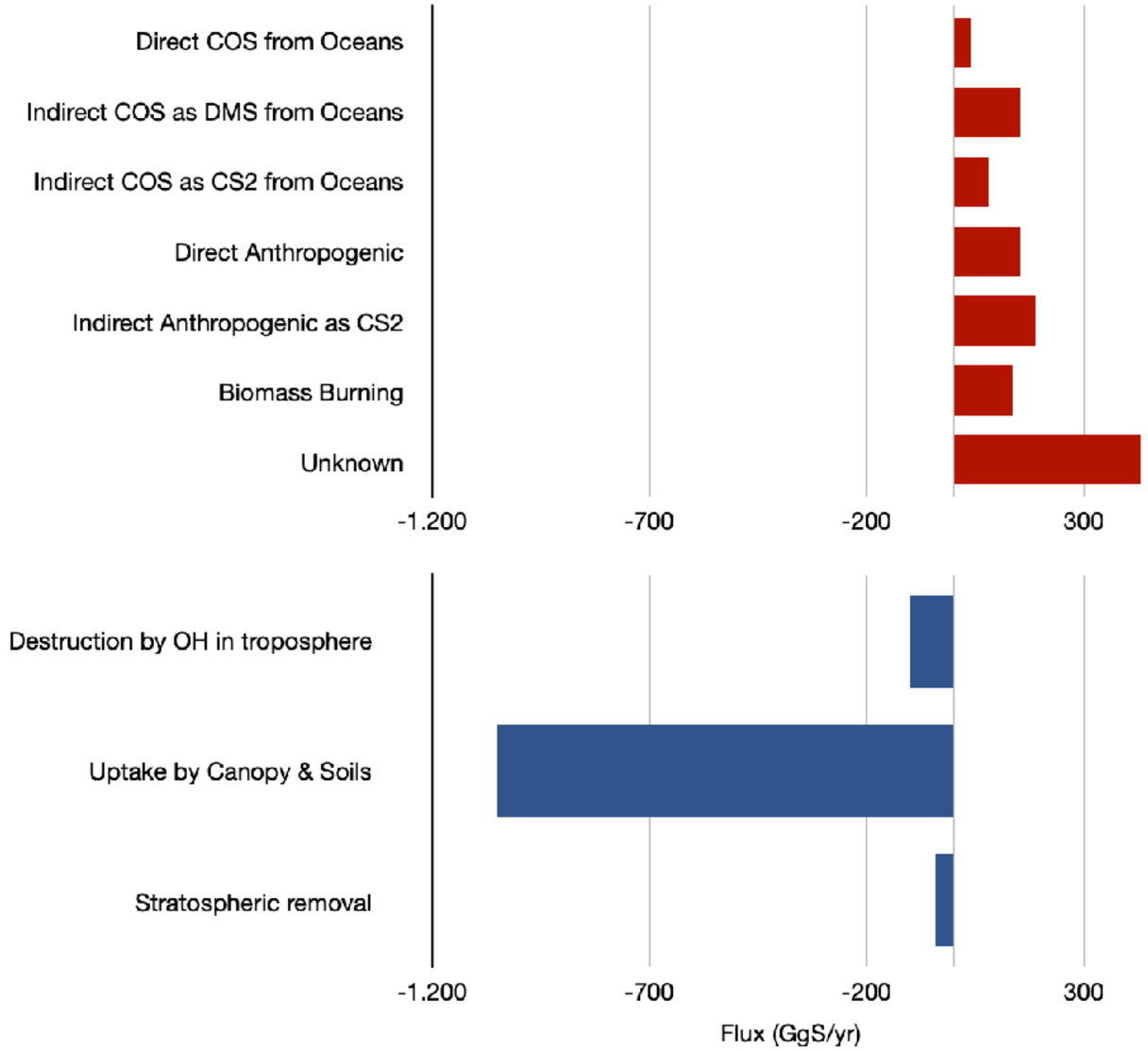
COS Budget Prior

Sources		
Direct COS from Oceans	40	GgS/yr
Indirect COS as DMS from Oceans	156	GgS/yr
Indirect COS as CS2 from Oceans	81	GgS/yr
Direct Anthropogenic	155	GgS/yr
Indirect Anthropogenic as CS2	188	GgS/yr
Biomass Burning	136	GgS/yr
Unknown	432	GgS/yr
Total sources	**1.188**	**GgS/yr**

Sinks		
Destruction by OH in troposphere	-101	GgS/yr
Uptake by Canopy & Soils	-1.053	GgS/yr
Stratospheric removal	-40	GgS/yr
Total sources	**-1.194**	**GgS/yr**



COS-OCS

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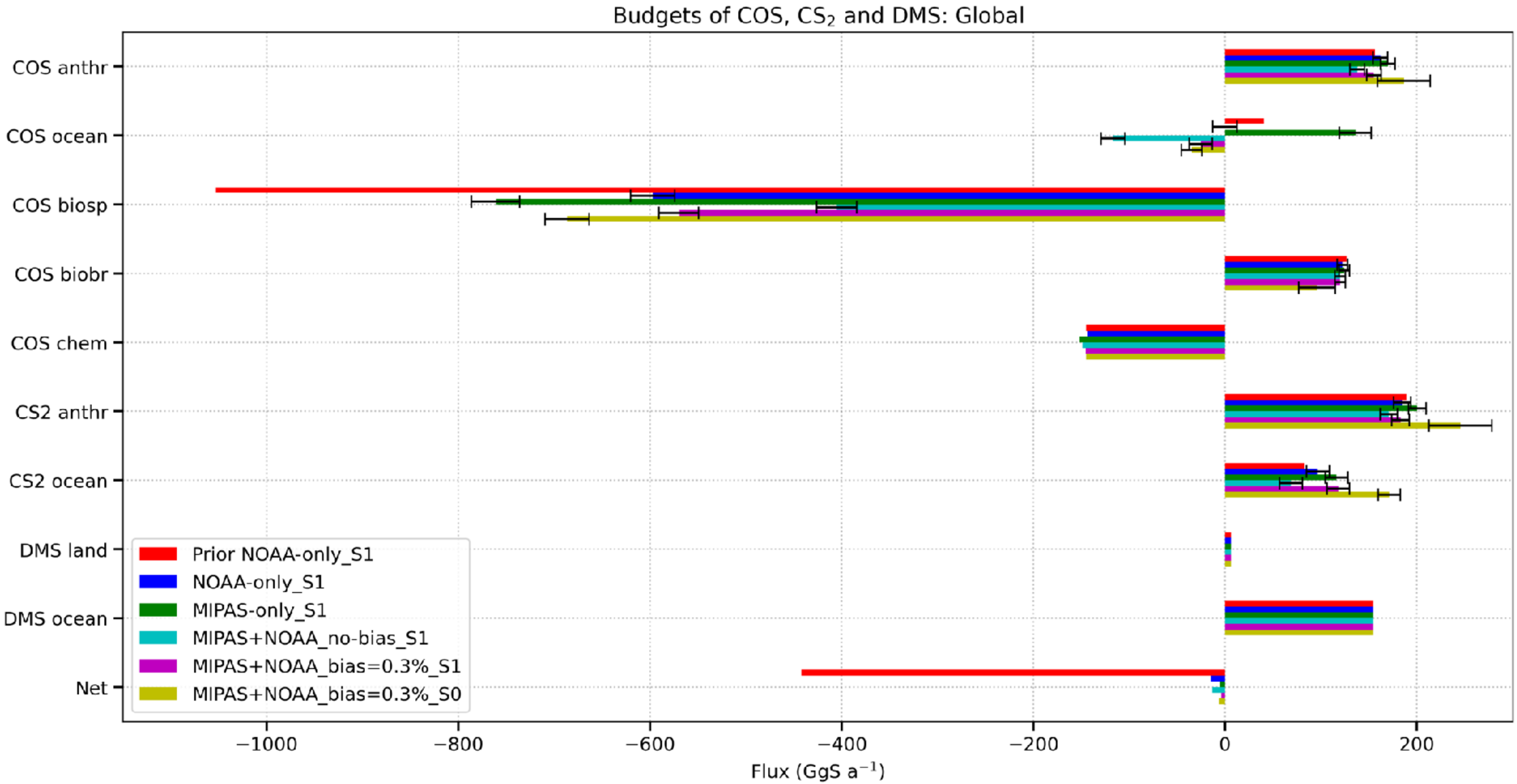
Optimised COS budget



COS-OCS

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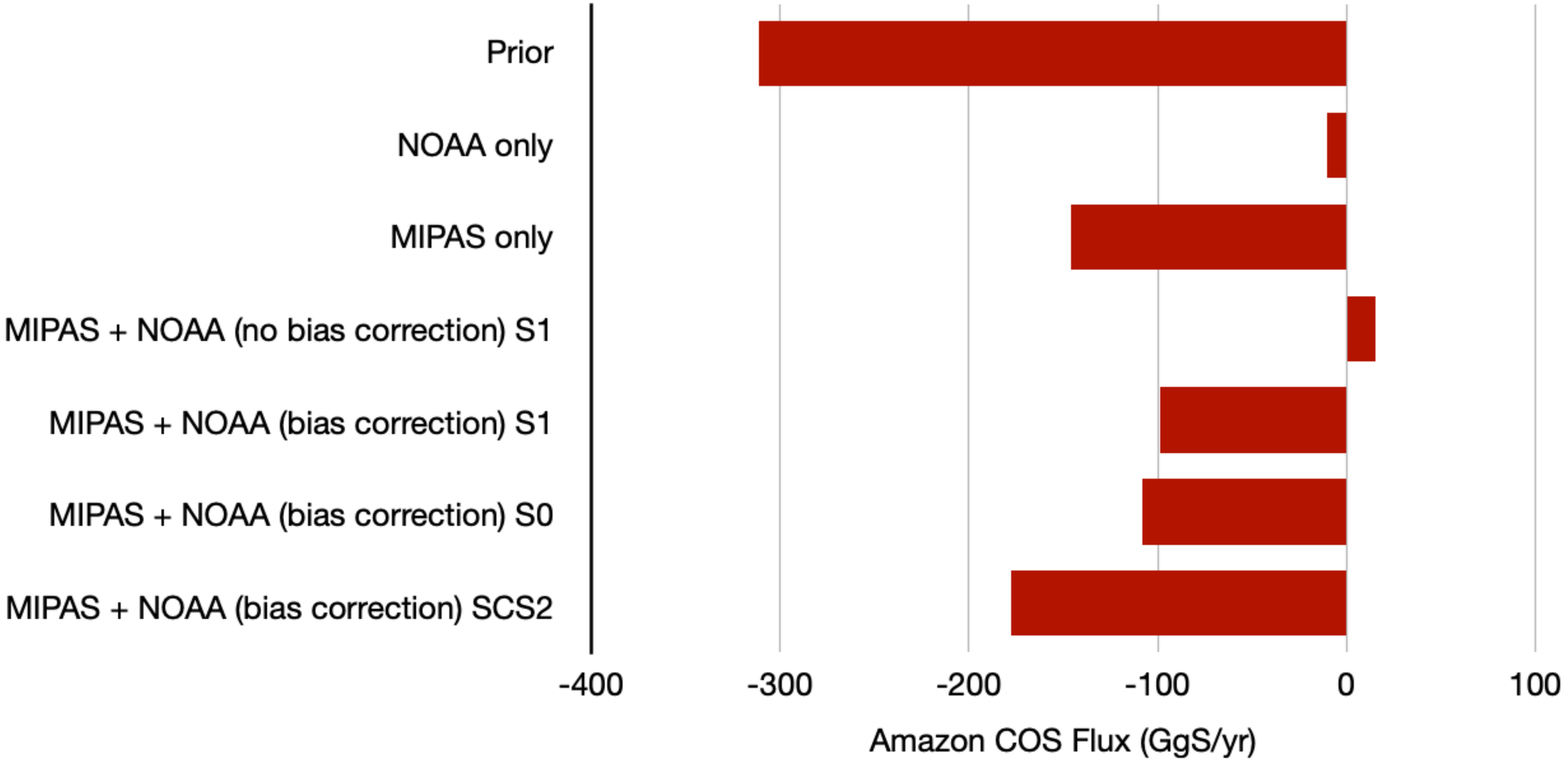
Posterior Fluxes over the Amazon



S1 = 50% error on biosphere

S0 = 10% error on biosphere

SCS2 = 10% error on COS biosphere, 150% error on CS_2 emissions

COS-OCS

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This presentation

- Implemented $CO^{32}S$ & $CO^{34}S$
- Scattered information available
- HEMERA flight (KLIMAT2021) sampled stratosphere, but samples were bad
- StratoClim2017 (Indian Monsoon) samples were OK
- Modelling ^{34}S of COS (3 x 2 degree)
- Used this project to investigate different vertical resolutions

COS-OCS

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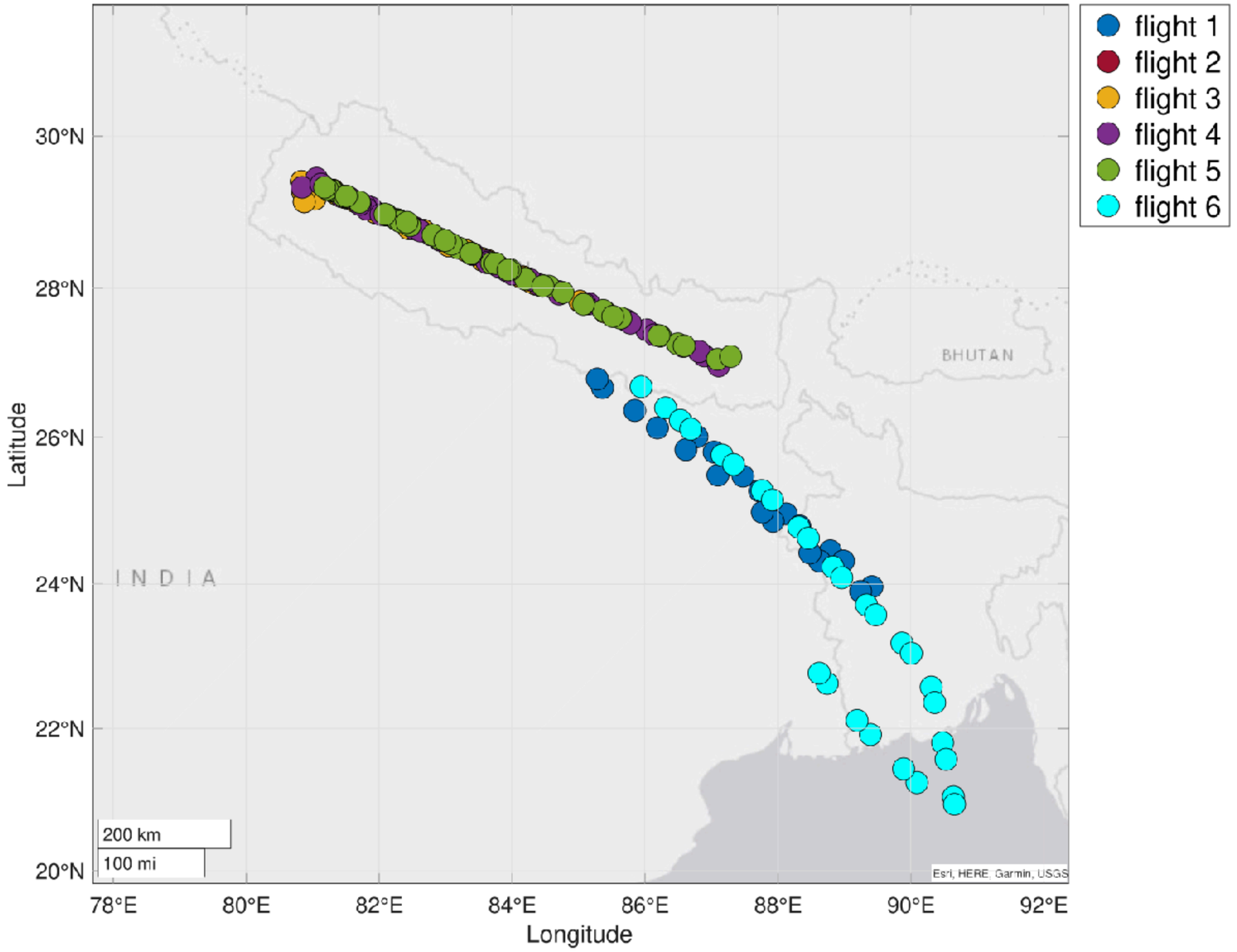

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COS-OCS

Category	Flux	δ^{34}S (‰)	ϵ^{34} (‰)
COS unknown	426.7	14.7	-
COS biomass	142.2	8.0	-
COS anthropogenic	161.3	8.0	-
COS ocean	40.7	14.7	-
CS_2 anthropogenic	236.4	8.0	-
CS_2 ocean	83.2	14.7	-
DMS land	6.1	-	-
DMS ocean	154.9	14.7	-
COS biosphere	–1066.4	-	–1.9
OH-oxidation	-	-	–2.56
Photolysis	-	-	–3

S	%
32	95.02
33	0.75
34	4.21
36	0.02

$$^{33,34}R = \frac{^{33,34}S}{^{32}S}$$

$$^{33,34}\epsilon = \frac{^{33,34}k}{^{32}k} - 1$$

$$\delta^{33,34}S = \frac{R^{33,34}_{sample}}{R^{33,34}_{standard}} - 1$$

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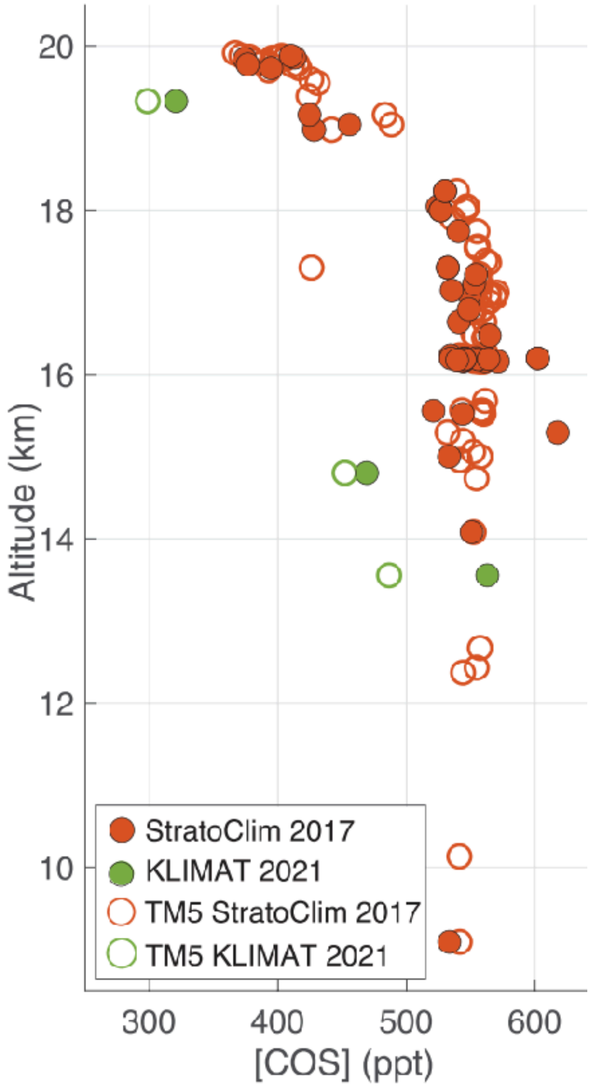

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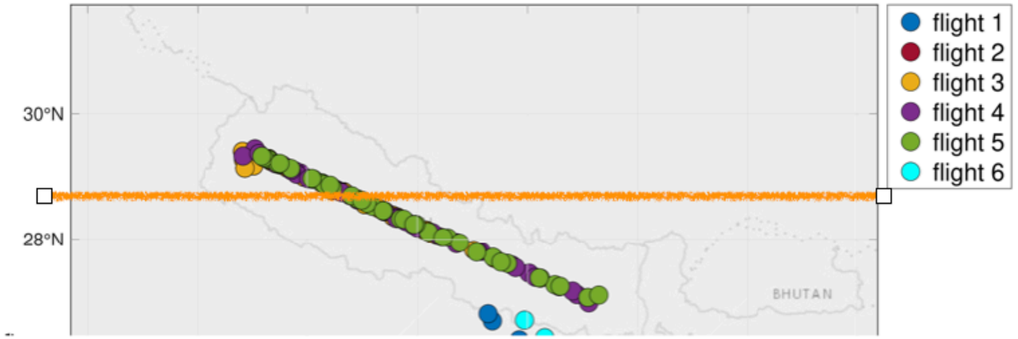

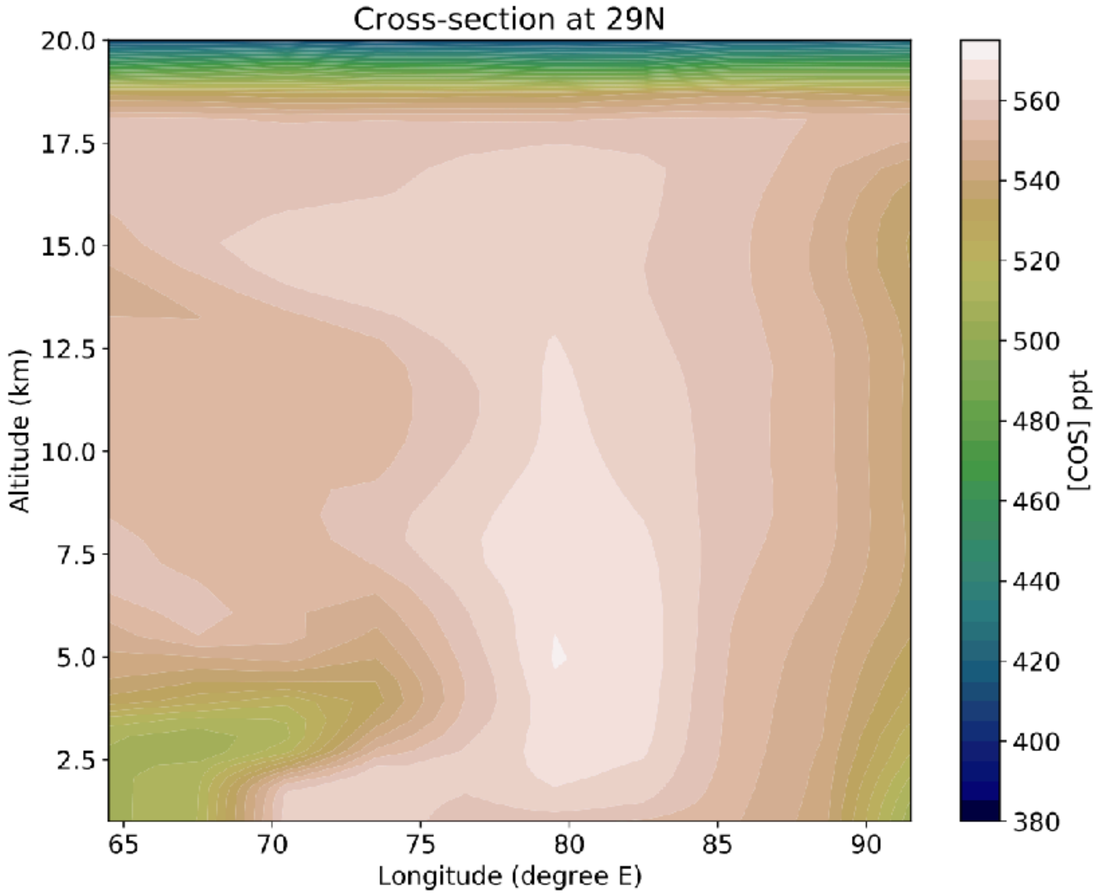

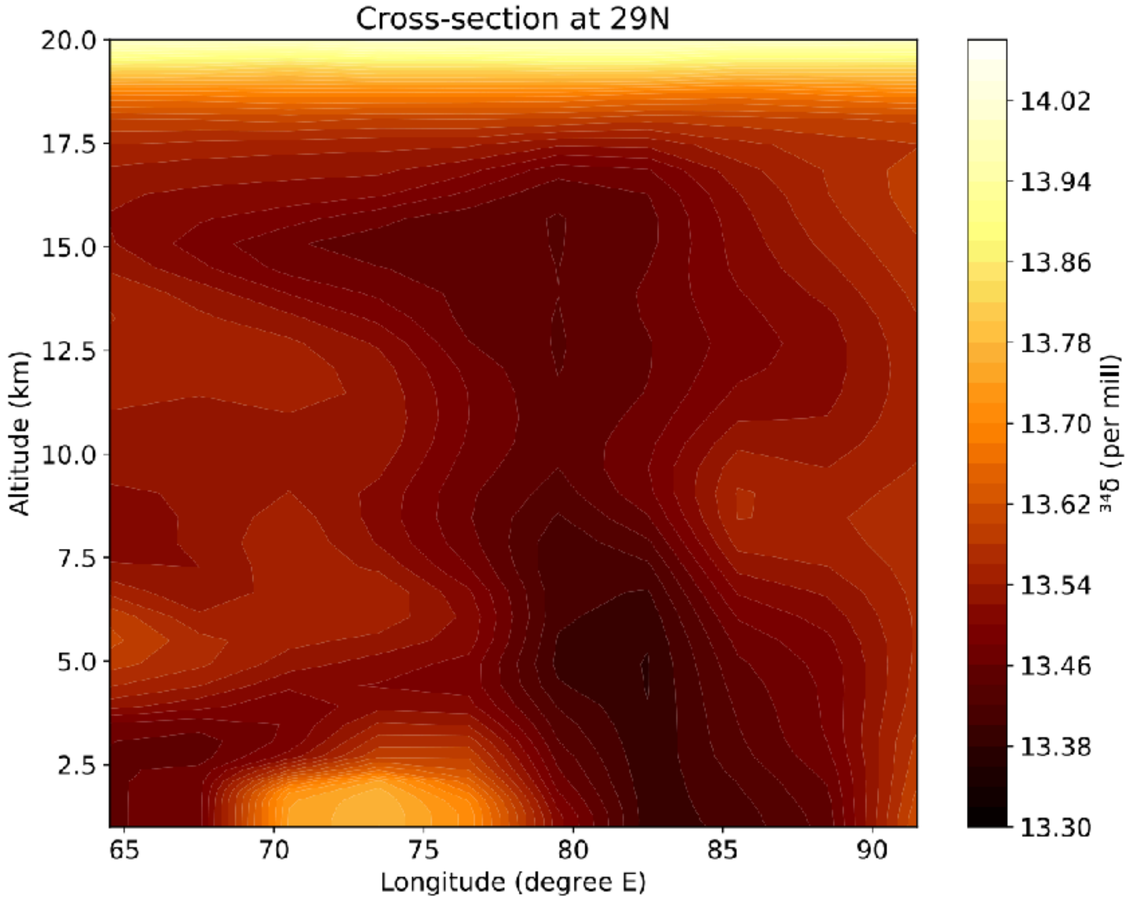

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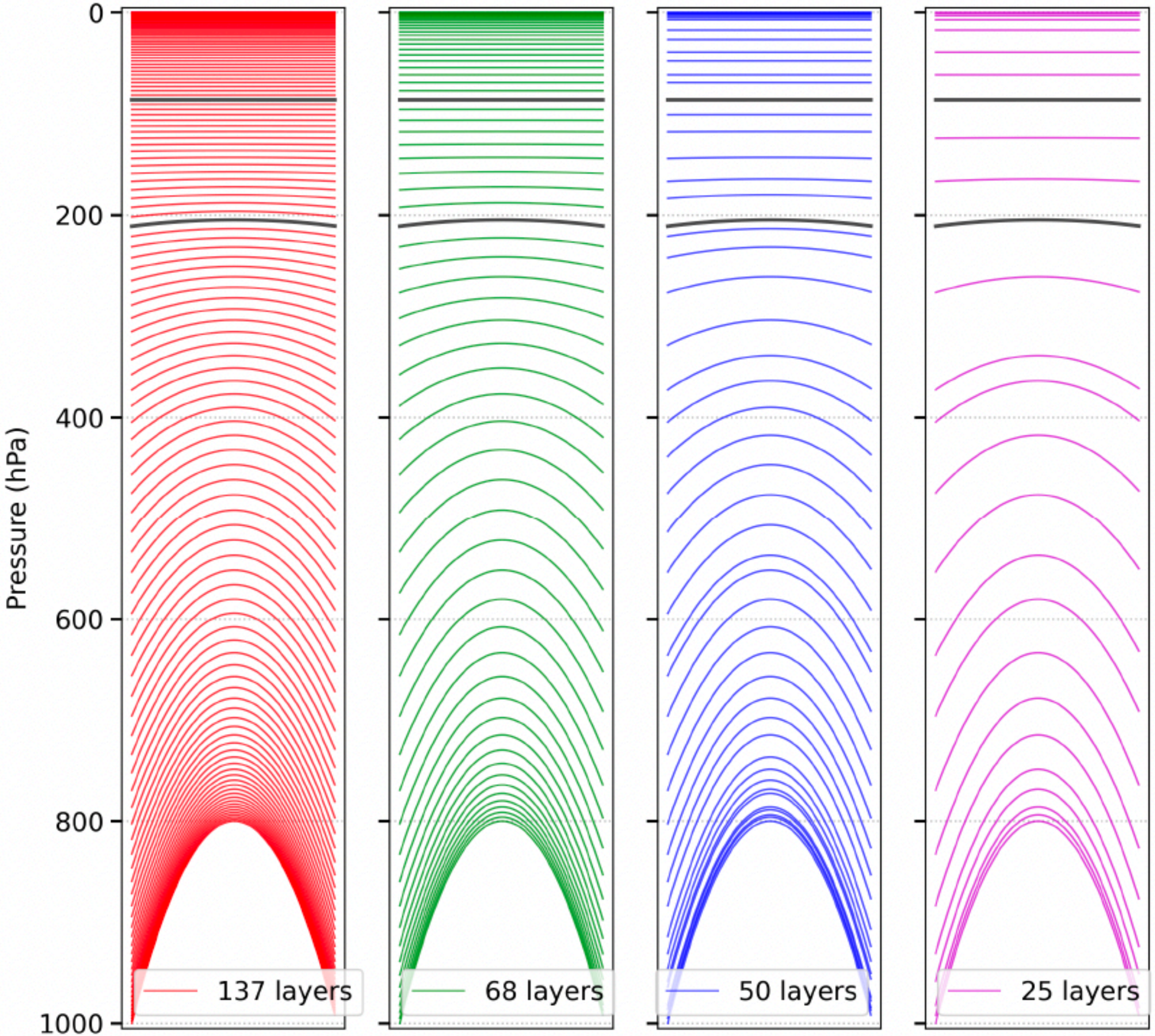
COS-OCS



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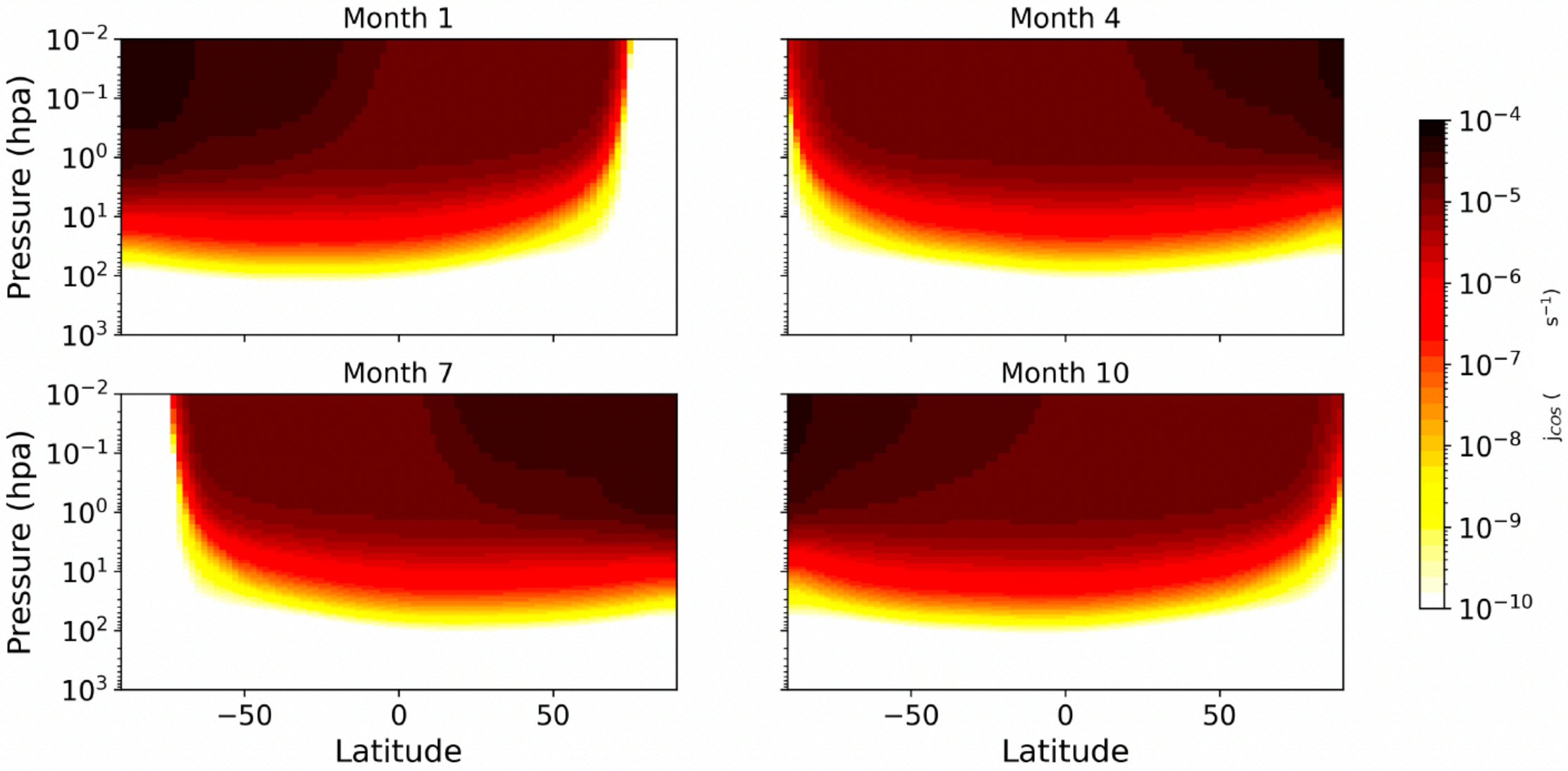

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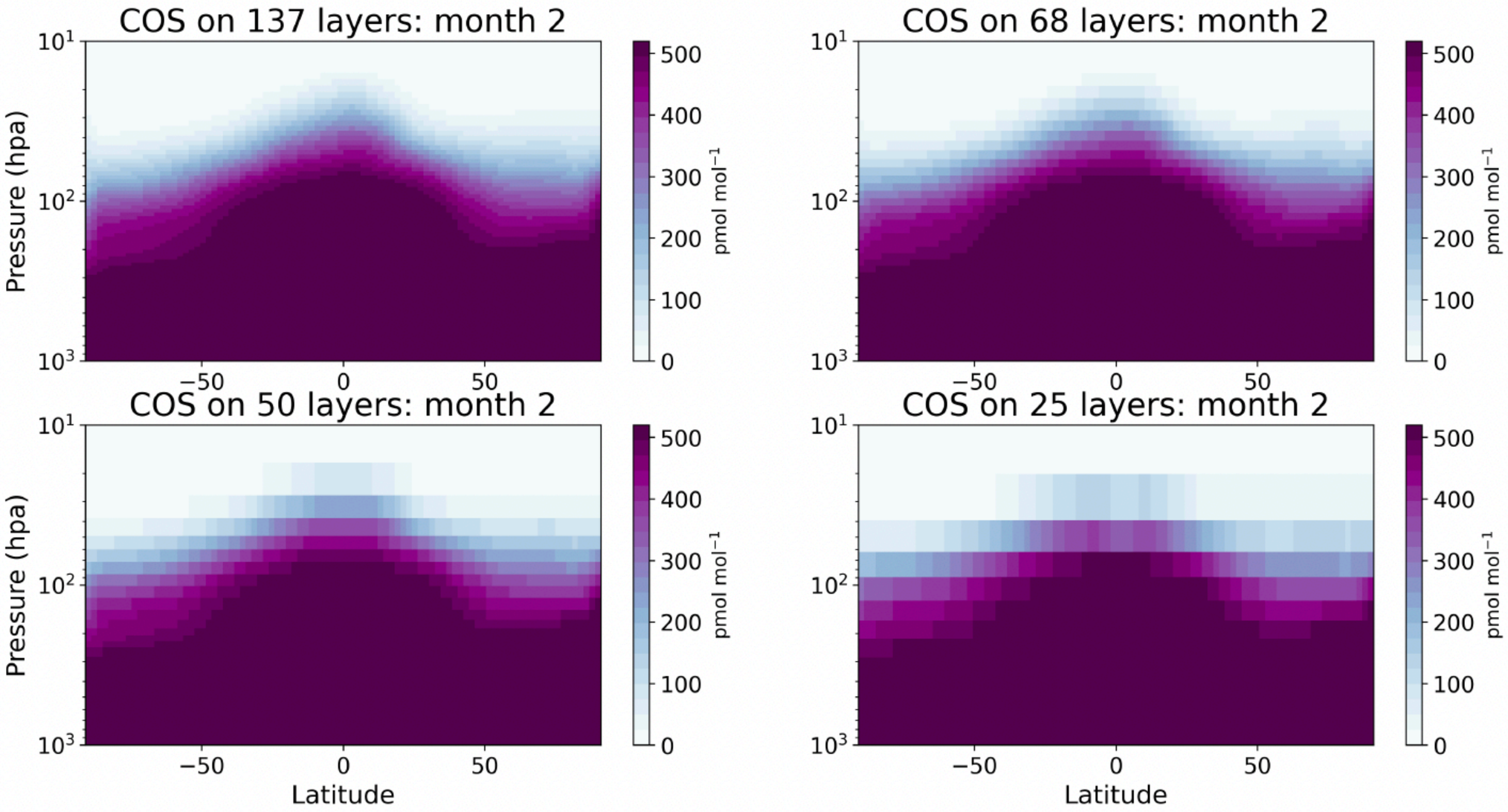

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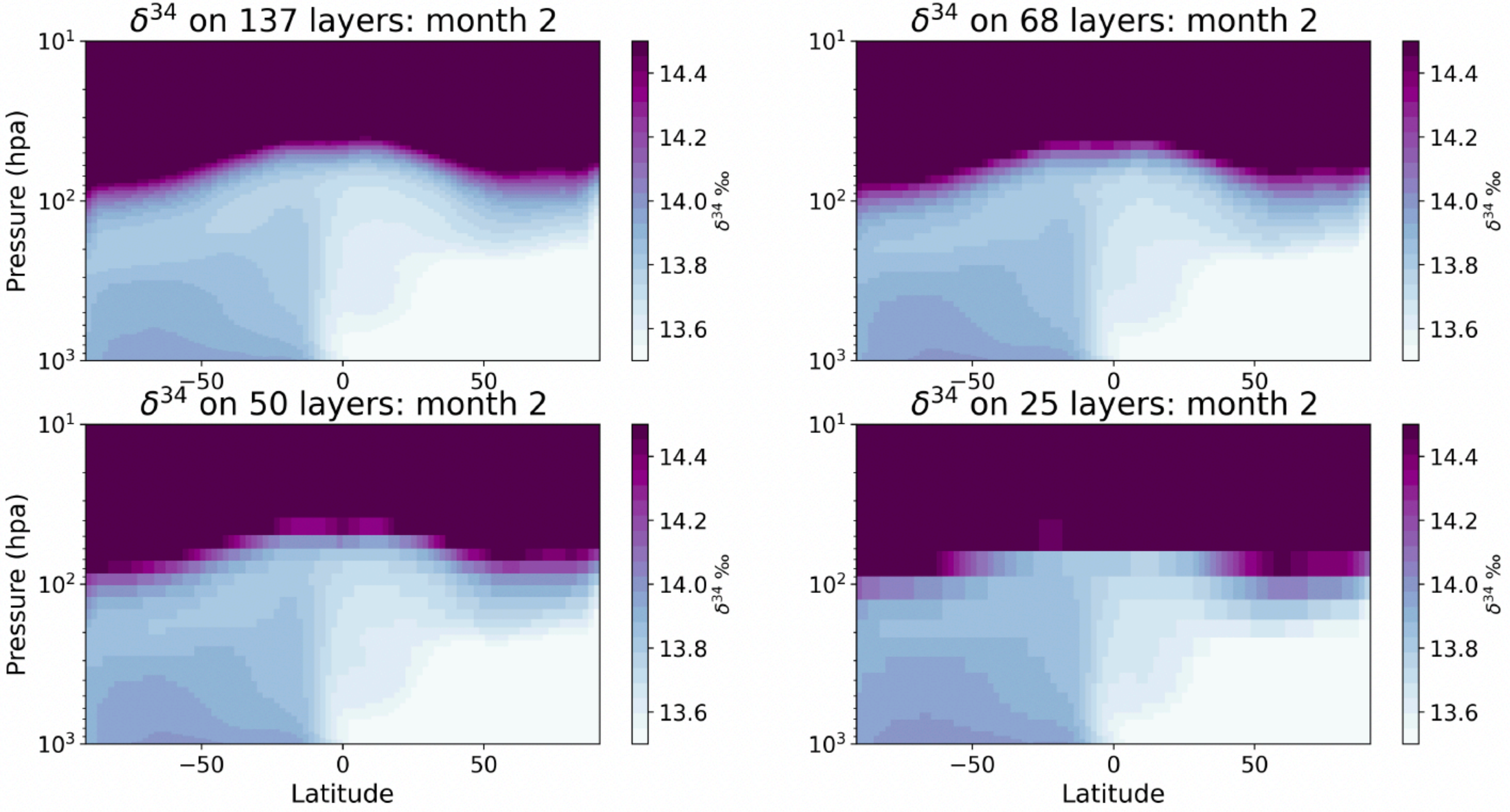

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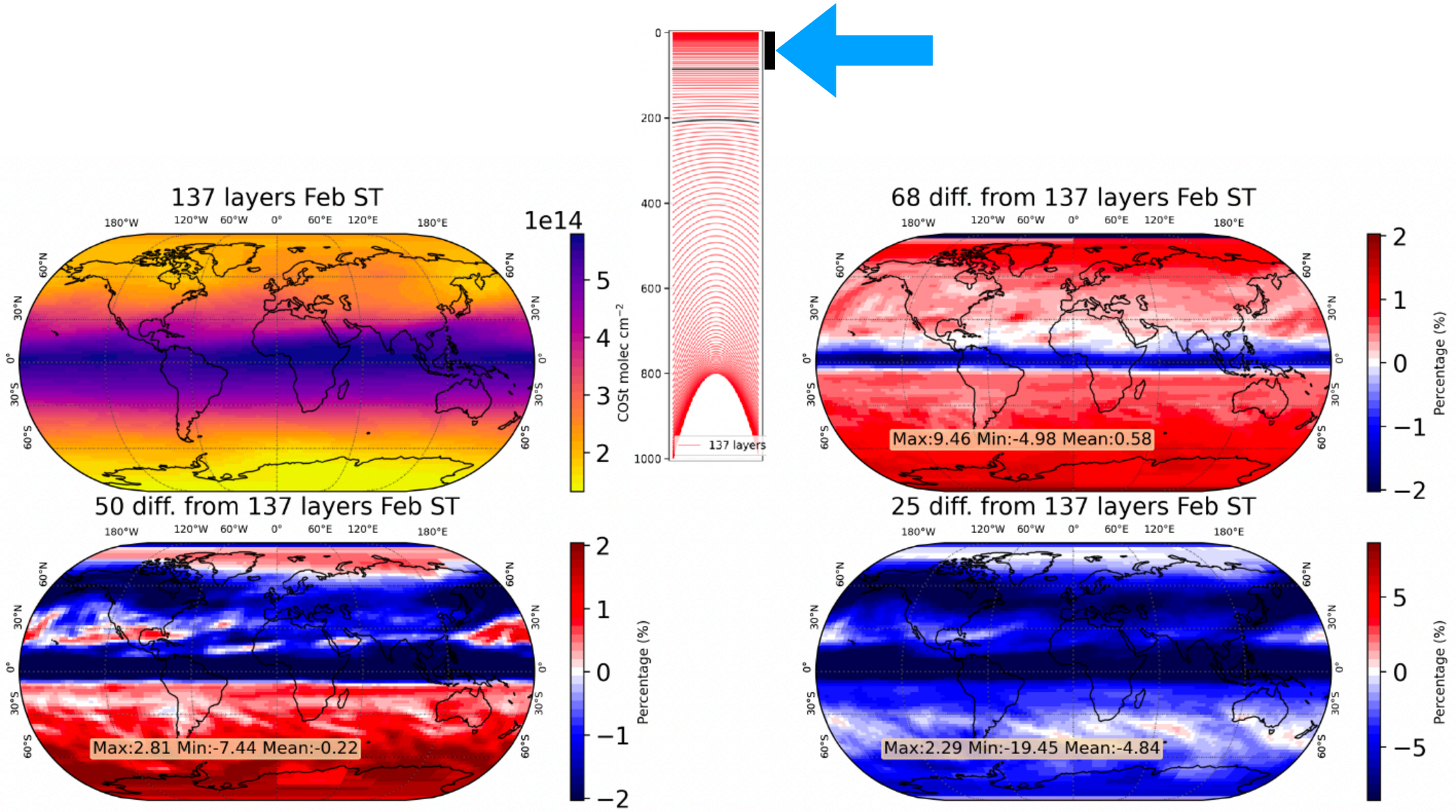

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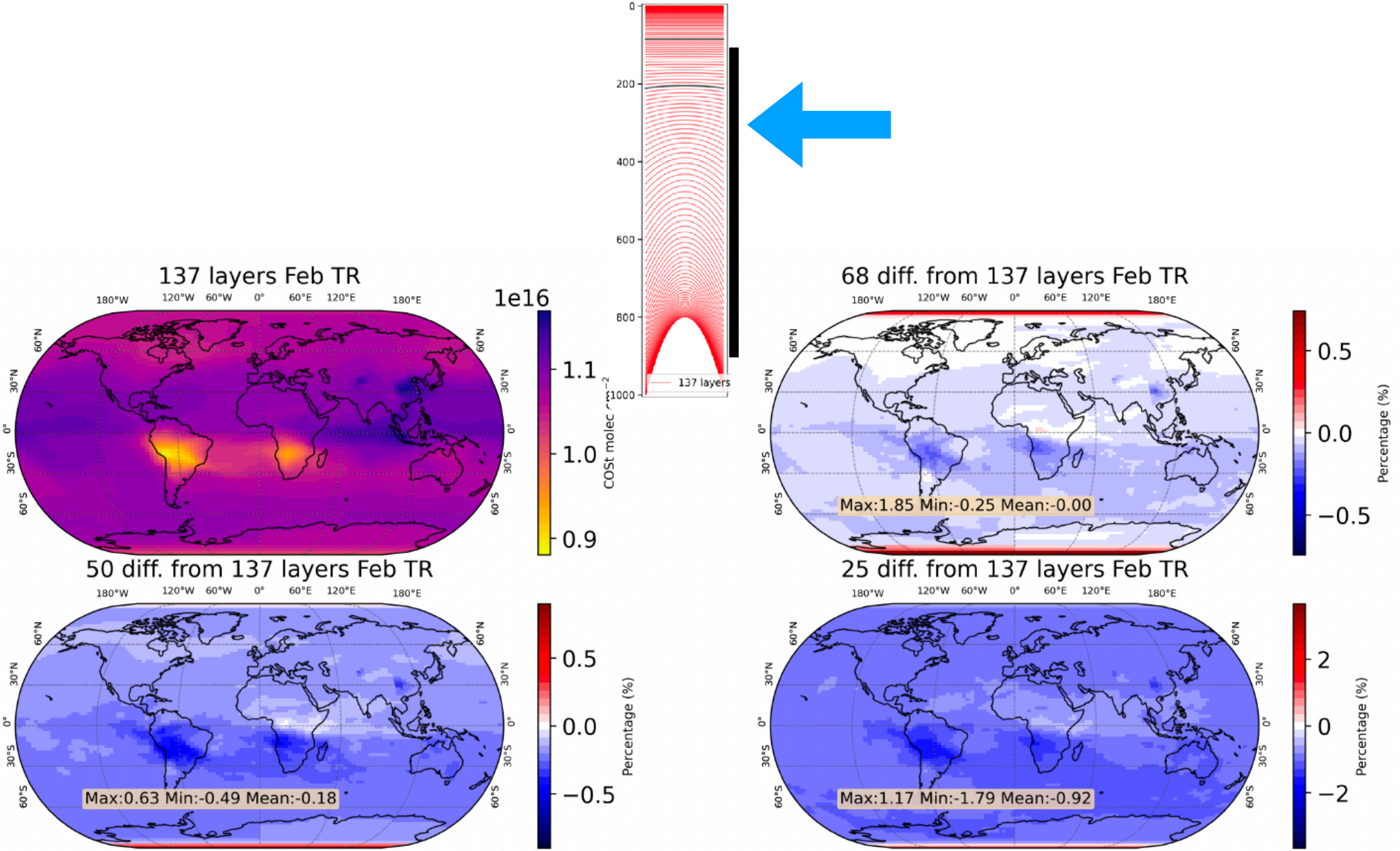

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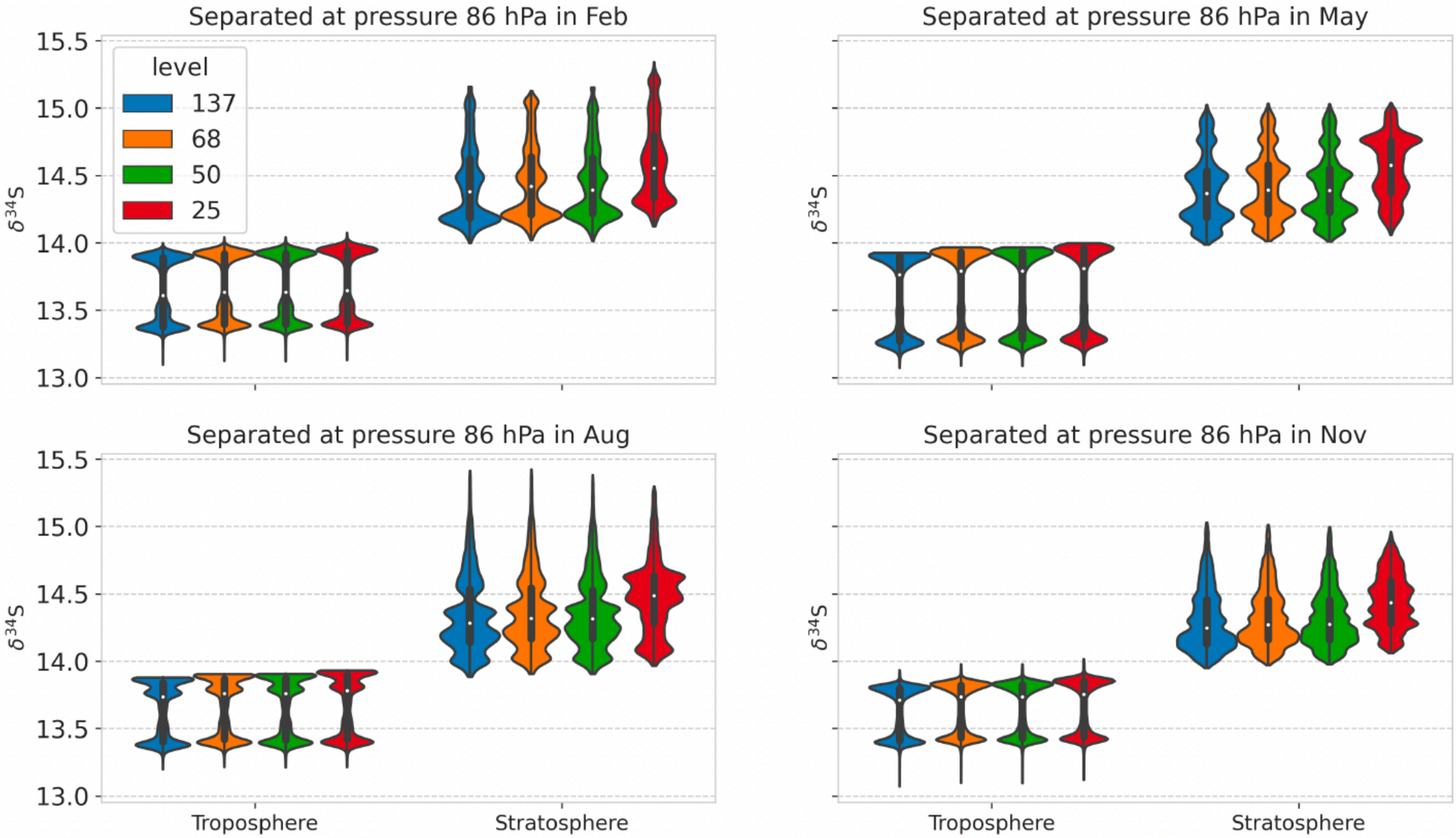

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Table 5.3: COS global chemical removal terms for four vertical resolutions, with unit in GgS a^{-1}. The differences are calculated relative to the 137 layer model in percentage. Note that the prior surface fluxes of emissions and uptake are also provided in Table 5.2 and the Net budget adds all sources and sinks from Table 5.2 and this table.

Category	137 layers	68 layers	50 layers	25 layers	68 layers div (%)	50 layers div (%)	25 layers div (%)
OH Loss	-108.9	-108.9	-108.7	-107.7	-0.1	-0.2	-1.1
Photolysis	-37.5	-37.3	-37.8	-42.0	-0.4	0.9	12.0
Chemical Loss	-146.4	-146.2	-146.5	-149.7	-0.2	0.1	2.2
Net	38.8	39.0	38.7	35.5	0.6	-0.2	-8.4

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Conclusions

- COS simulations with isotopes
- Stratospheric removal: currently too little fractionation
- Resolution effects: 25 layers too diffusive, 50 or 68 layers OK (w.r.t. 137)