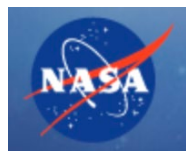


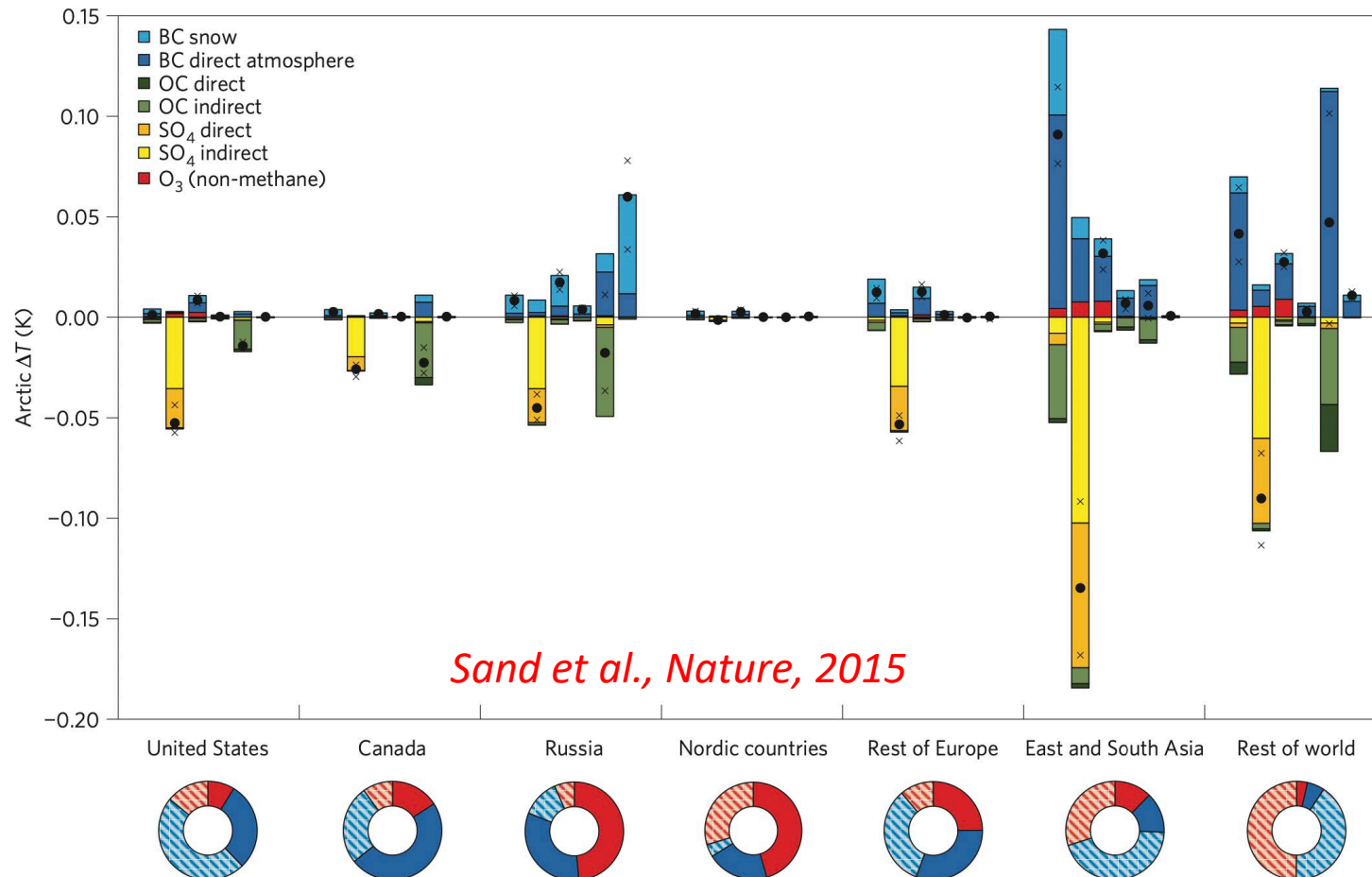
Arctic temperature responses to East Asian anthropogenic organic carbon emissions: impacts of externally vs internally mixed aerosols

Ulas Im, Kostas Tsigaridis, Annika M.L. Ekman, Hans-Christen Hansson



MOTIVATION

- Arctic is warming 2-3 times faster than the global average.
- Largest Arctic warming source is from emissions within the Asian nations (large emissions).



Regional temperature potential (RTP)

✓ Per forcing or per emission perturbation

➤ Shindell and Faluvegi, 2009

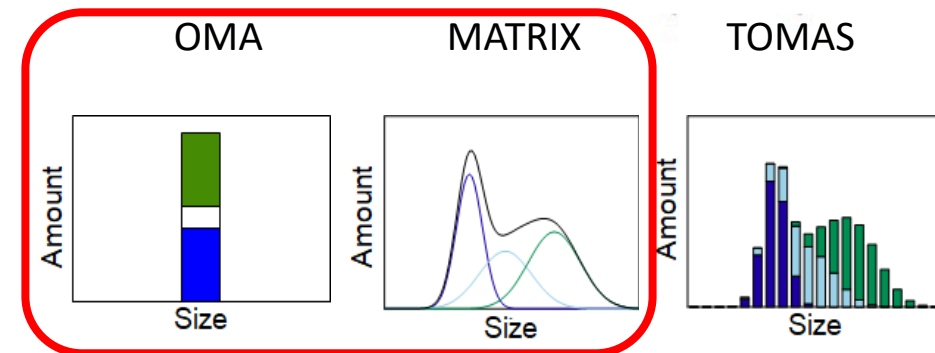
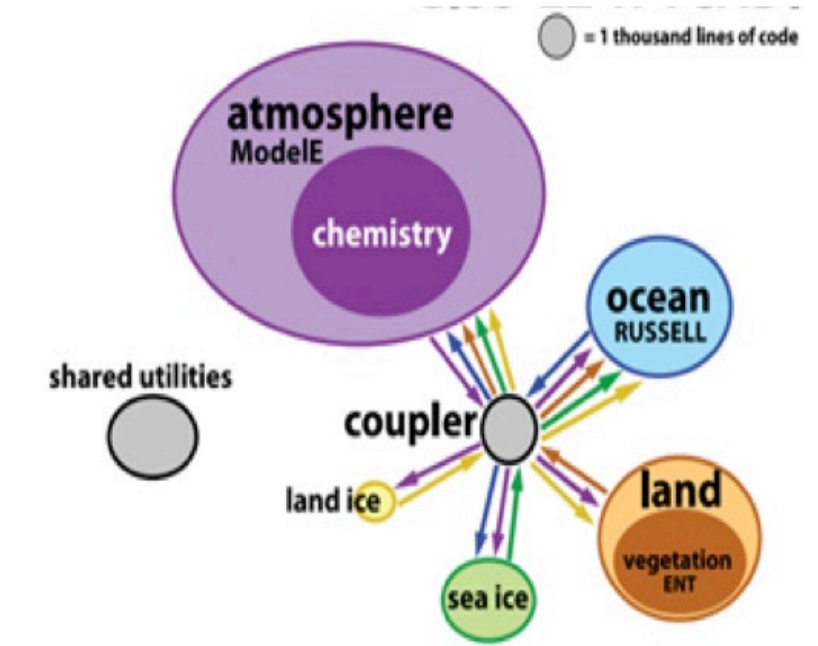
➤ Shindell, 2012

➤ Lewinschal et al., 2019

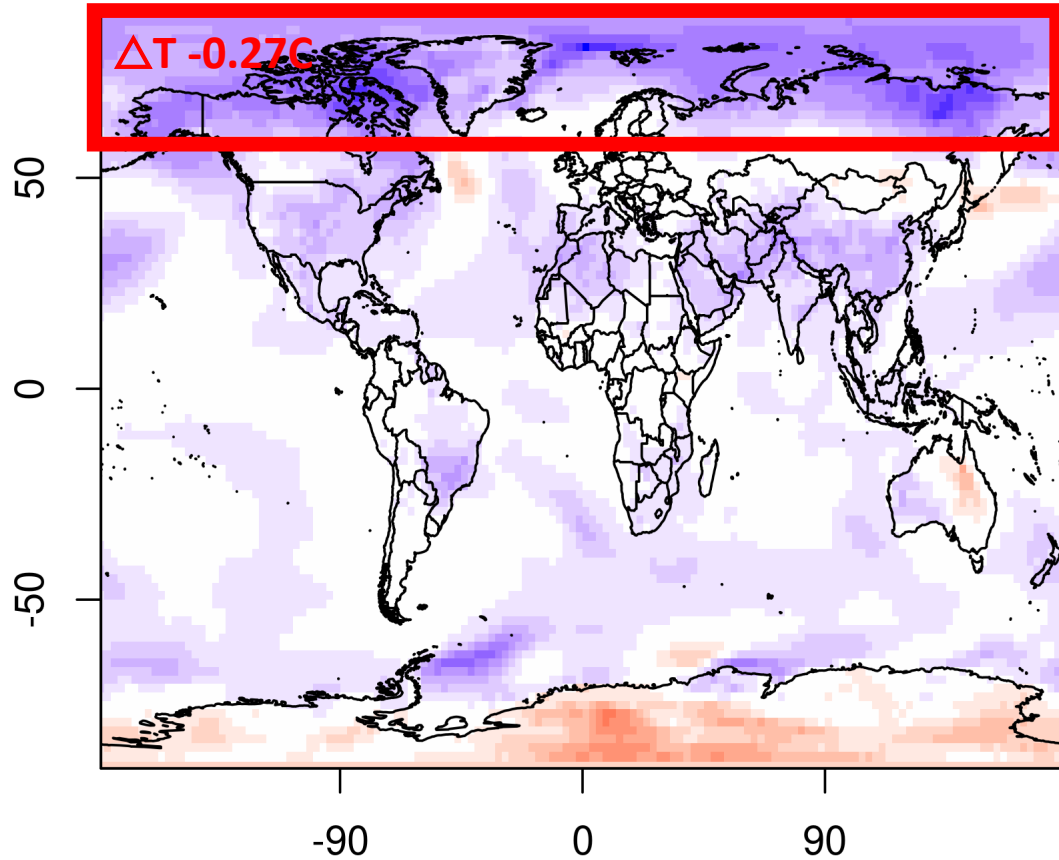
➤ Westervelt et al., 2020

MODEL & SIMULATIONS

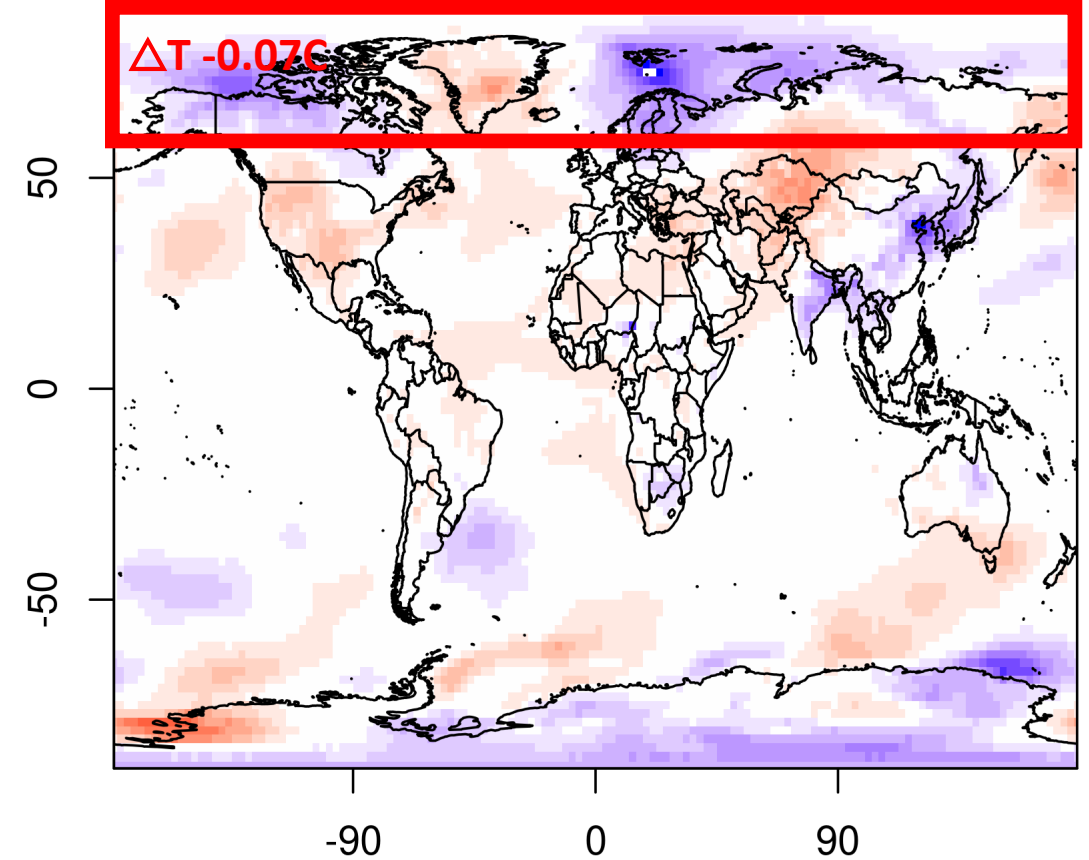
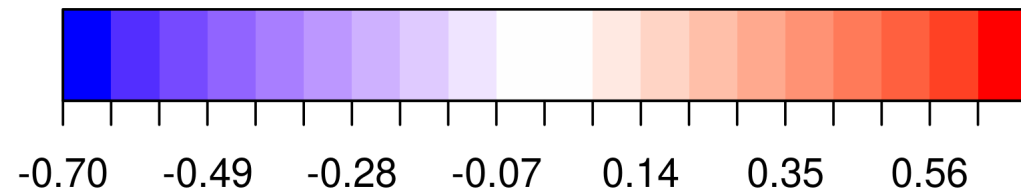
- GISS-E2.1/NorESM
- CMIP6 version (*Kelley et al., 2020*)
- Atmosphere/Land/Ice:
 - $2^\circ \times 2.5^\circ$ spatial resolution, 40 vertical layers
- Ocean (GISS Ocean V1):
 - $1^\circ \times 1.25^\circ$ spatial resolution, 40 vertical layers
- 5 x EAS Land-based OC emissions (Anth+ BB): 48 Tg
- 7 x EUR Land-based OC emissions (Anth+ BB): 14 Tg
- OMA 70 years → External Mixing
- MATRIX 70 years → Mixing state



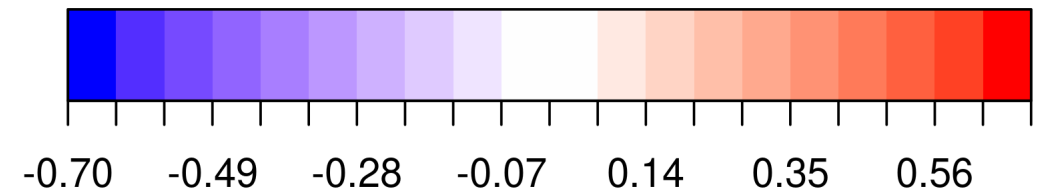
SURFACE TEMPERATURE RESPONSE



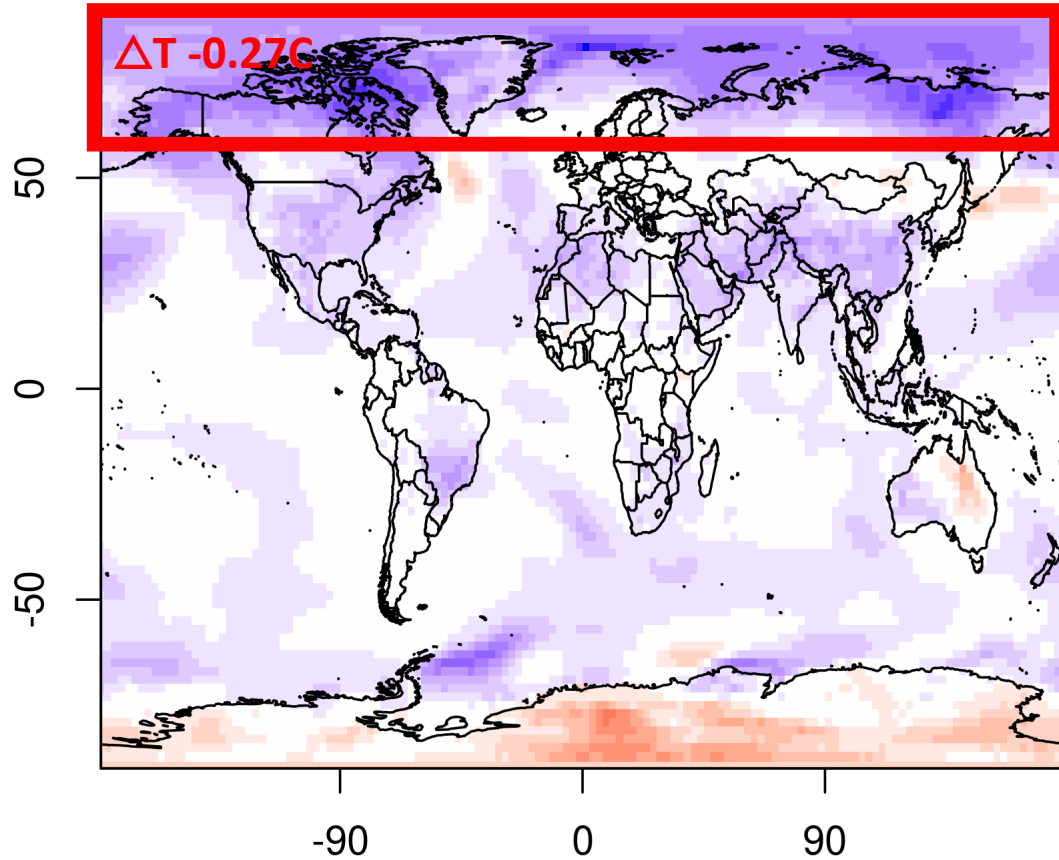
OMA 5xEAS $\Delta T (^{\circ}\text{C})$



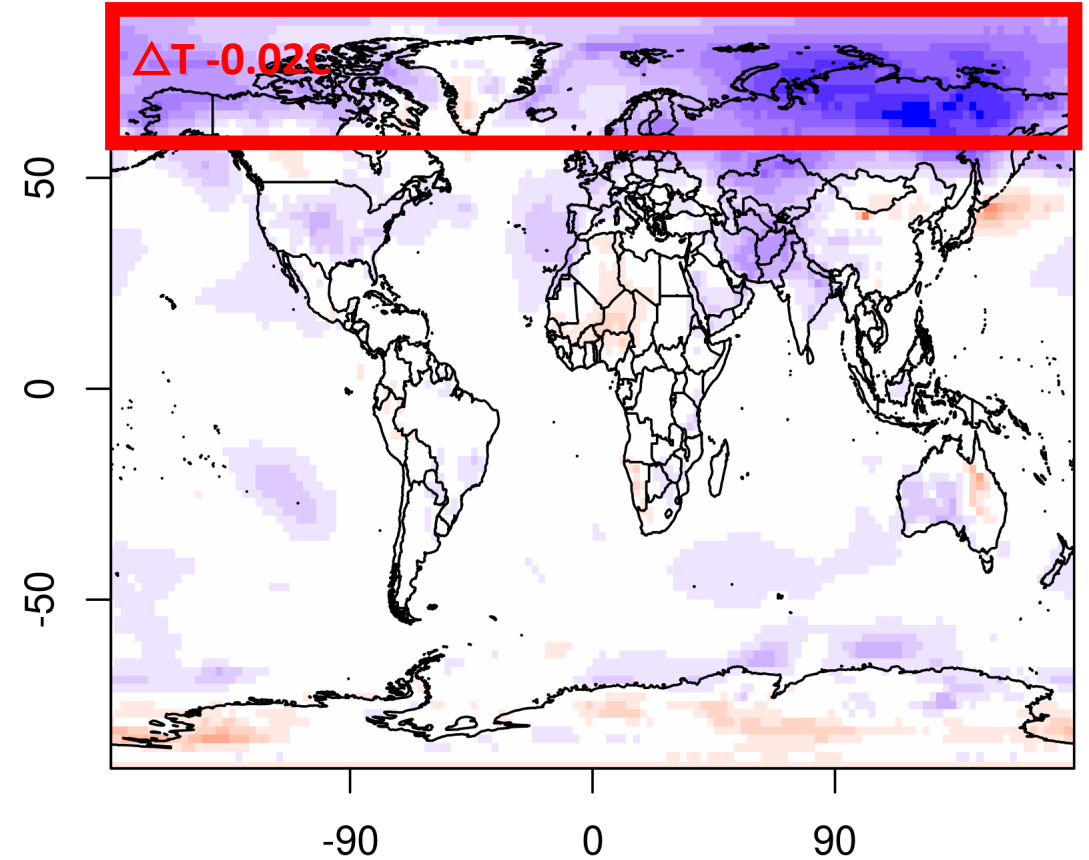
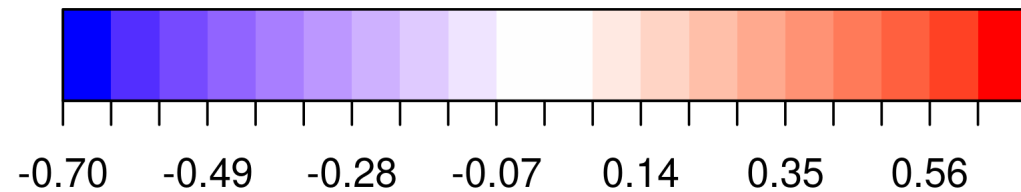
MATRIX 5xEAS $\Delta T (^{\circ}\text{C})$



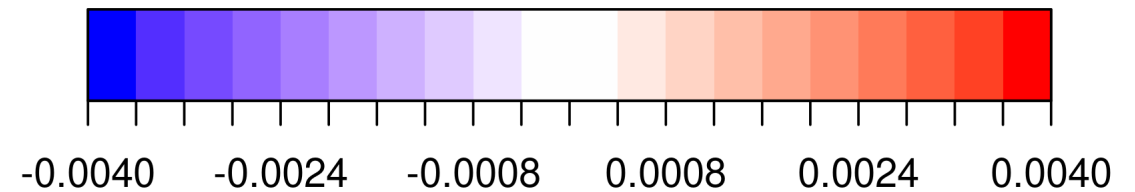
SURFACE TEMPERATURE RESPONSE



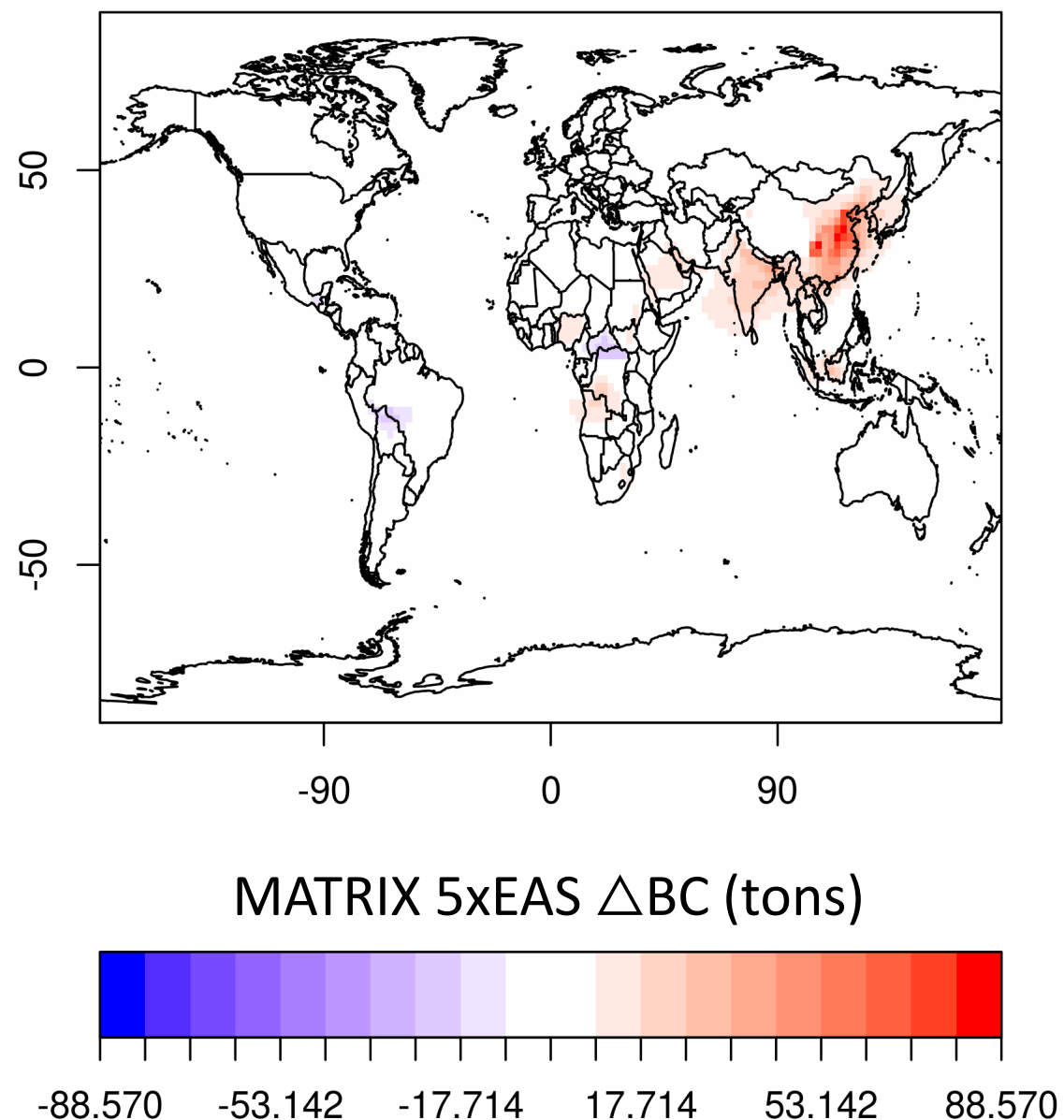
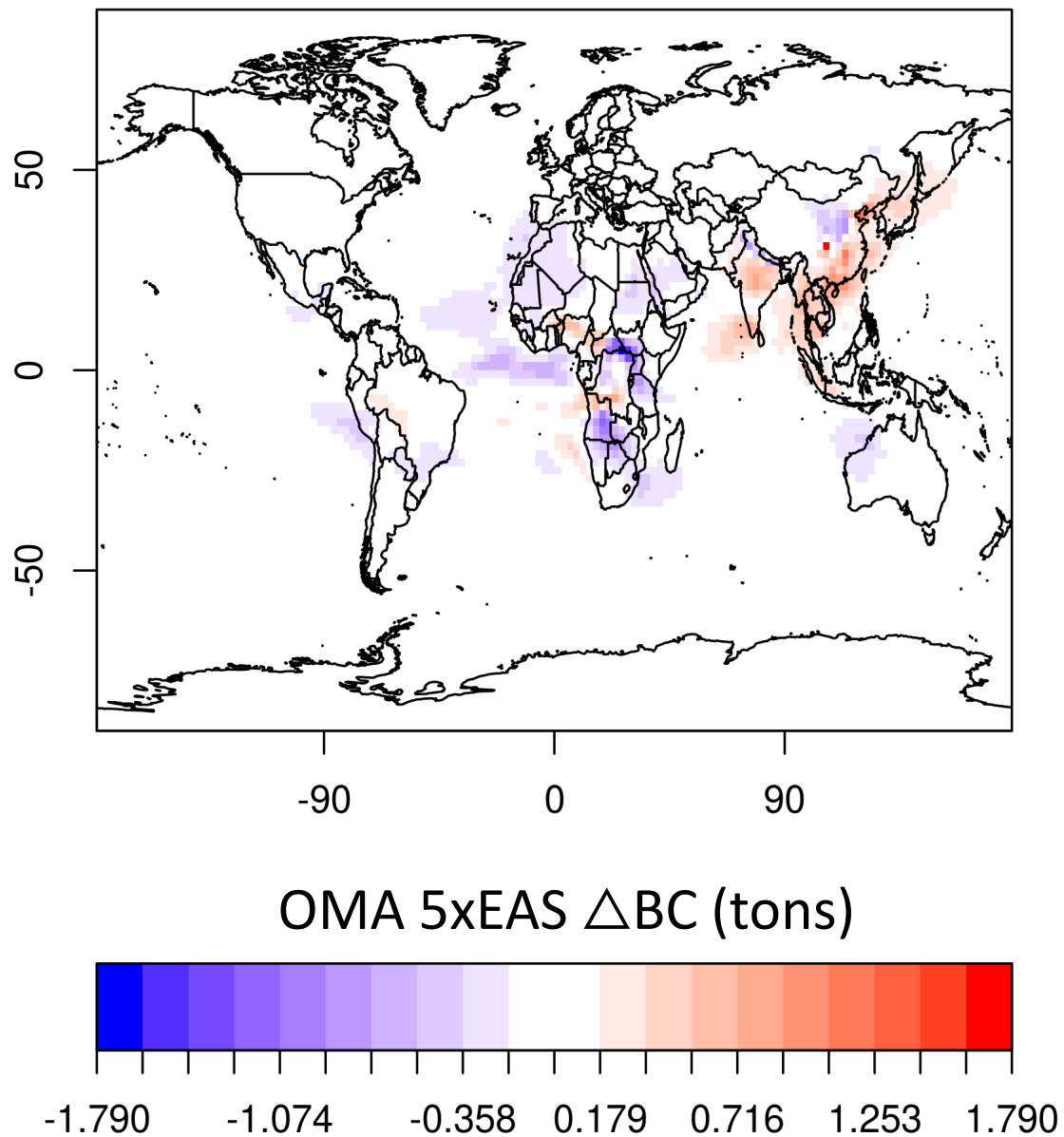
OMA 5xEAS $\Delta T (^{\circ}\text{C})$

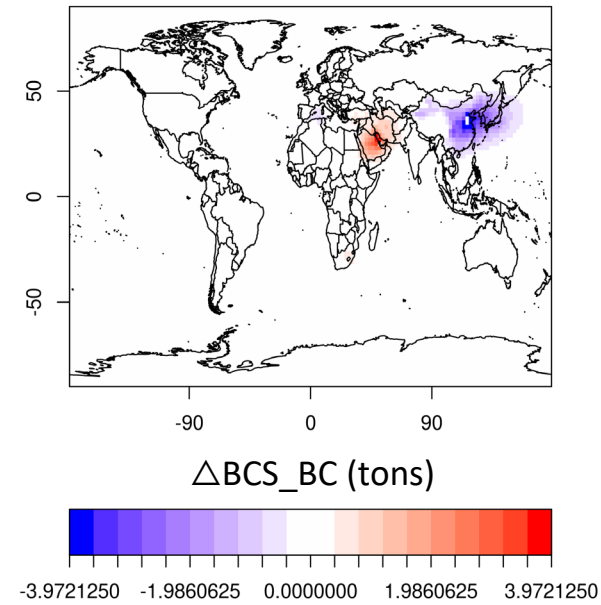
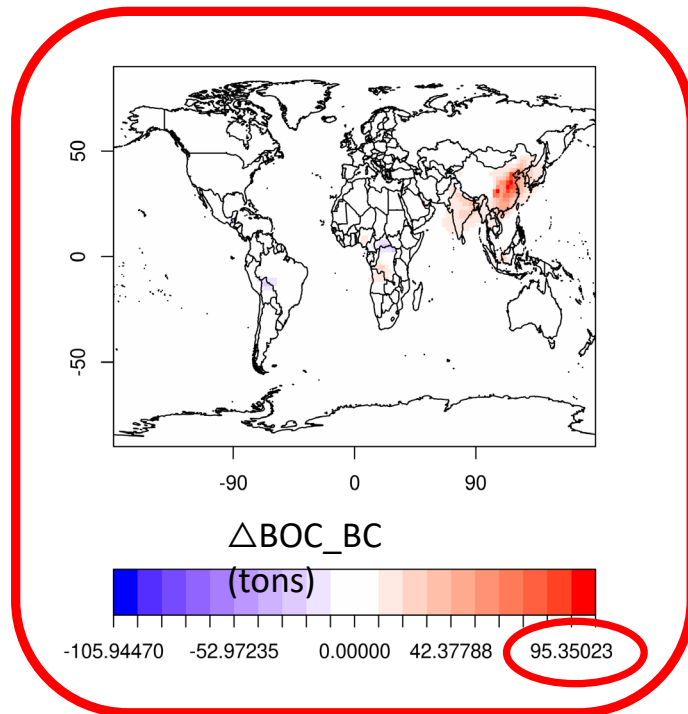
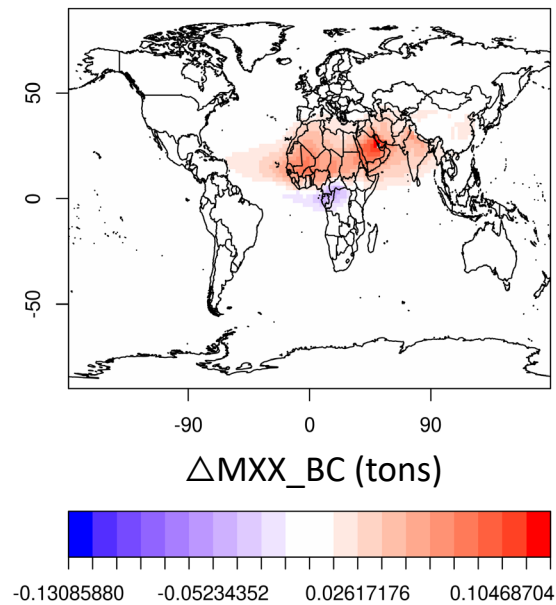
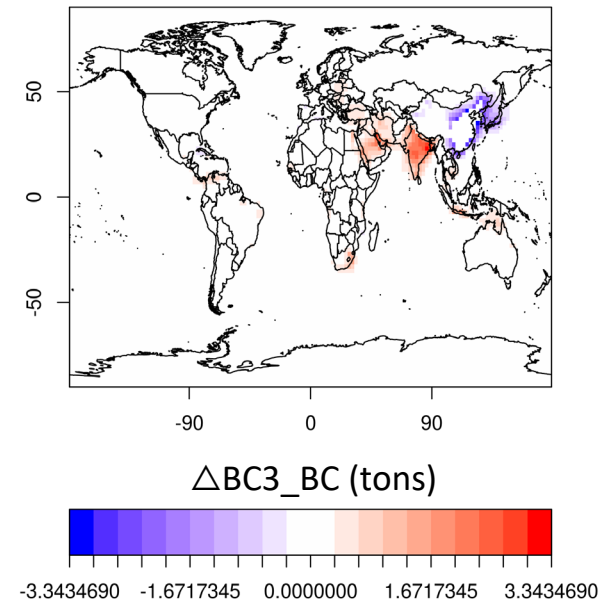
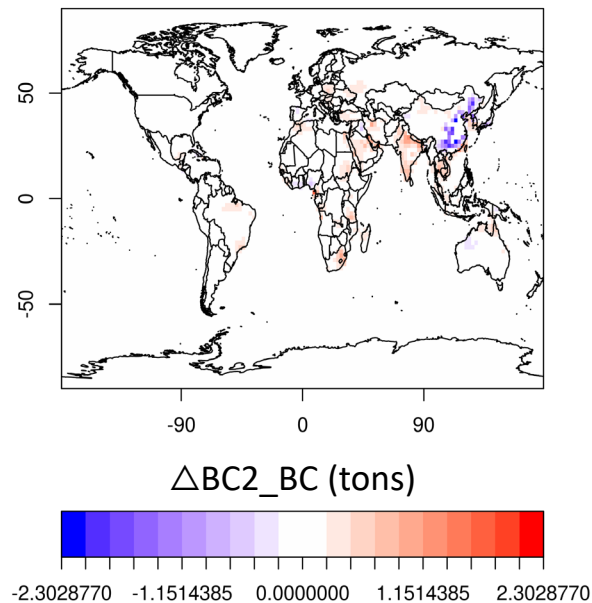
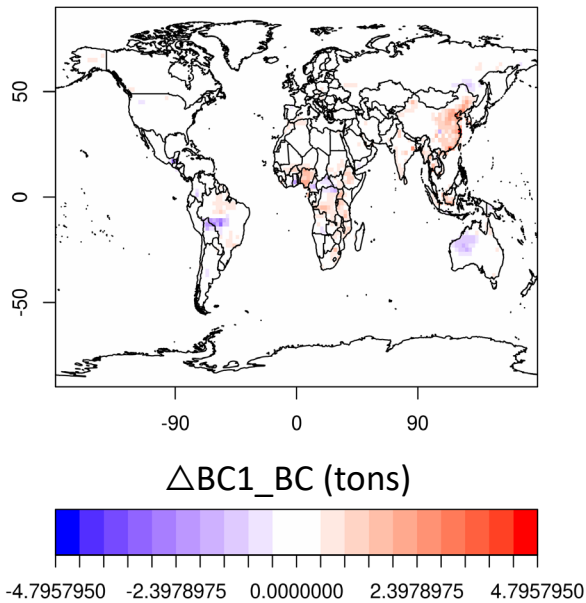


OMA 7xEUR $\Delta T (^{\circ}\text{C})$

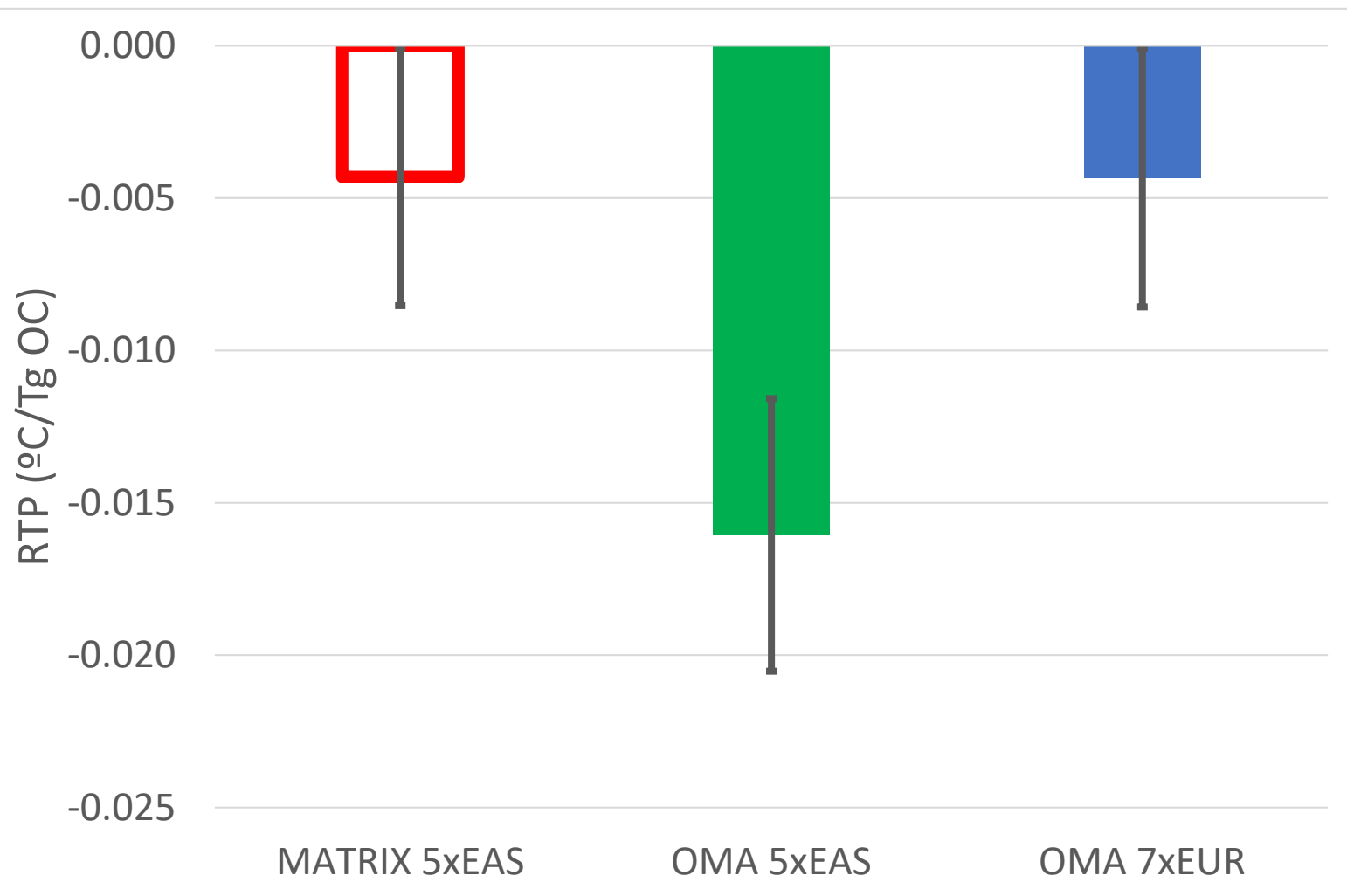


BC BURDEN – 5xEAS OC

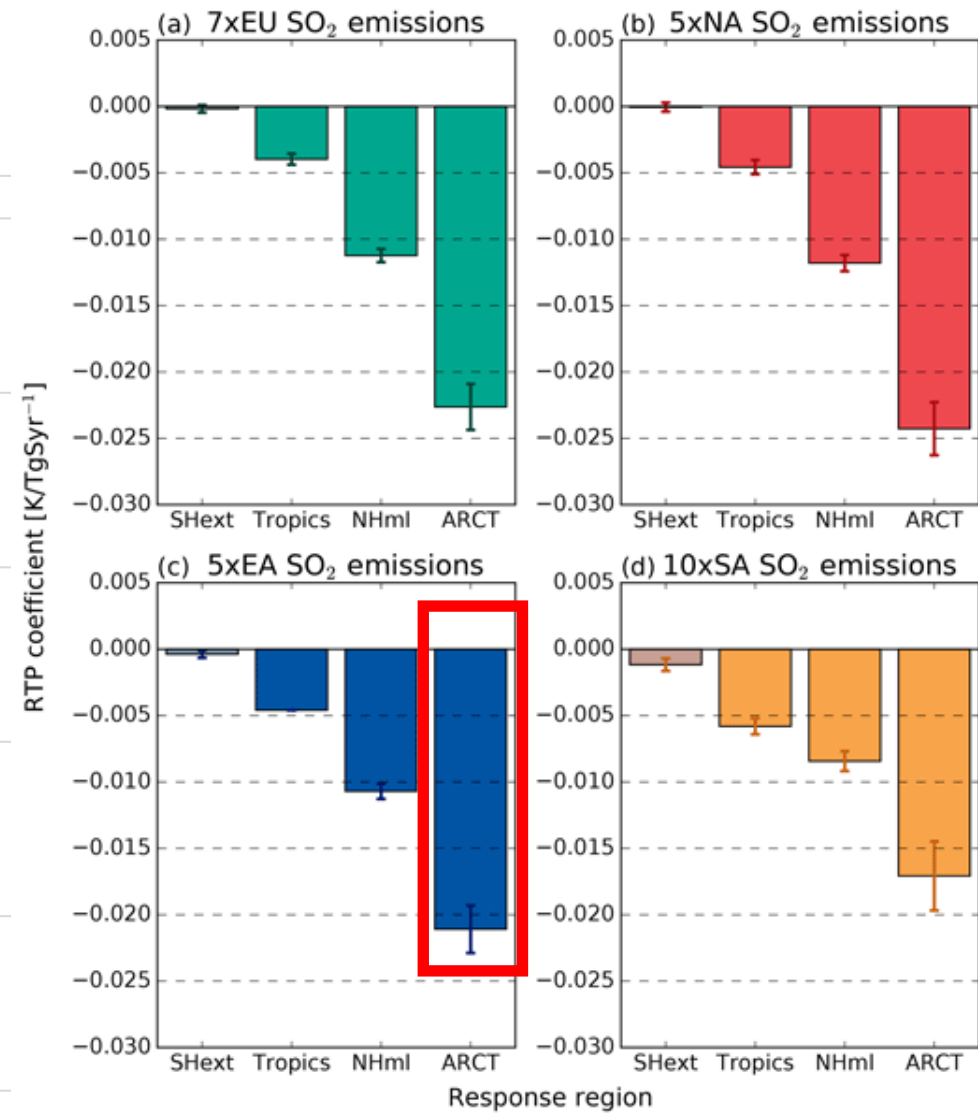
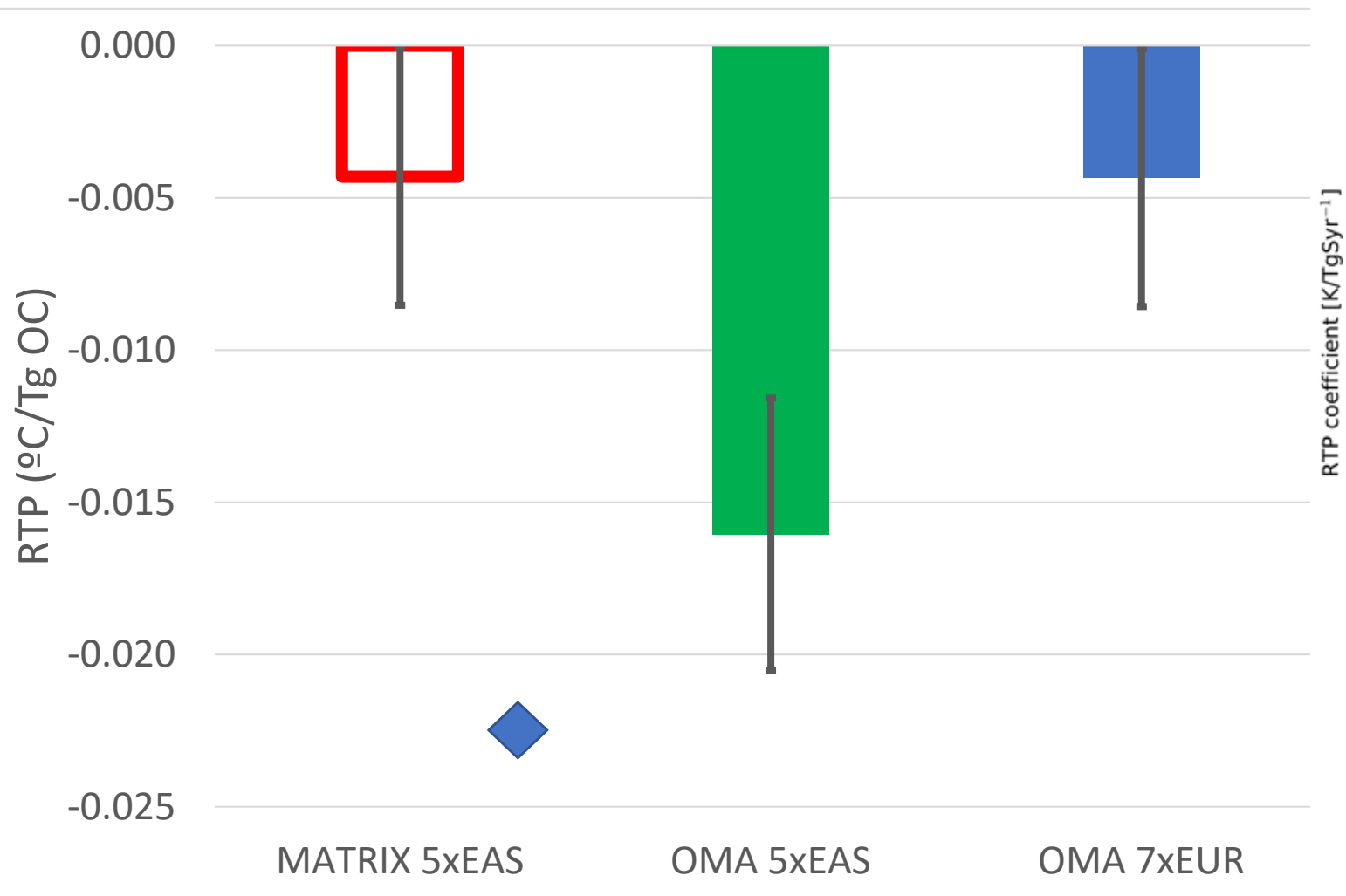




Arctic RTP

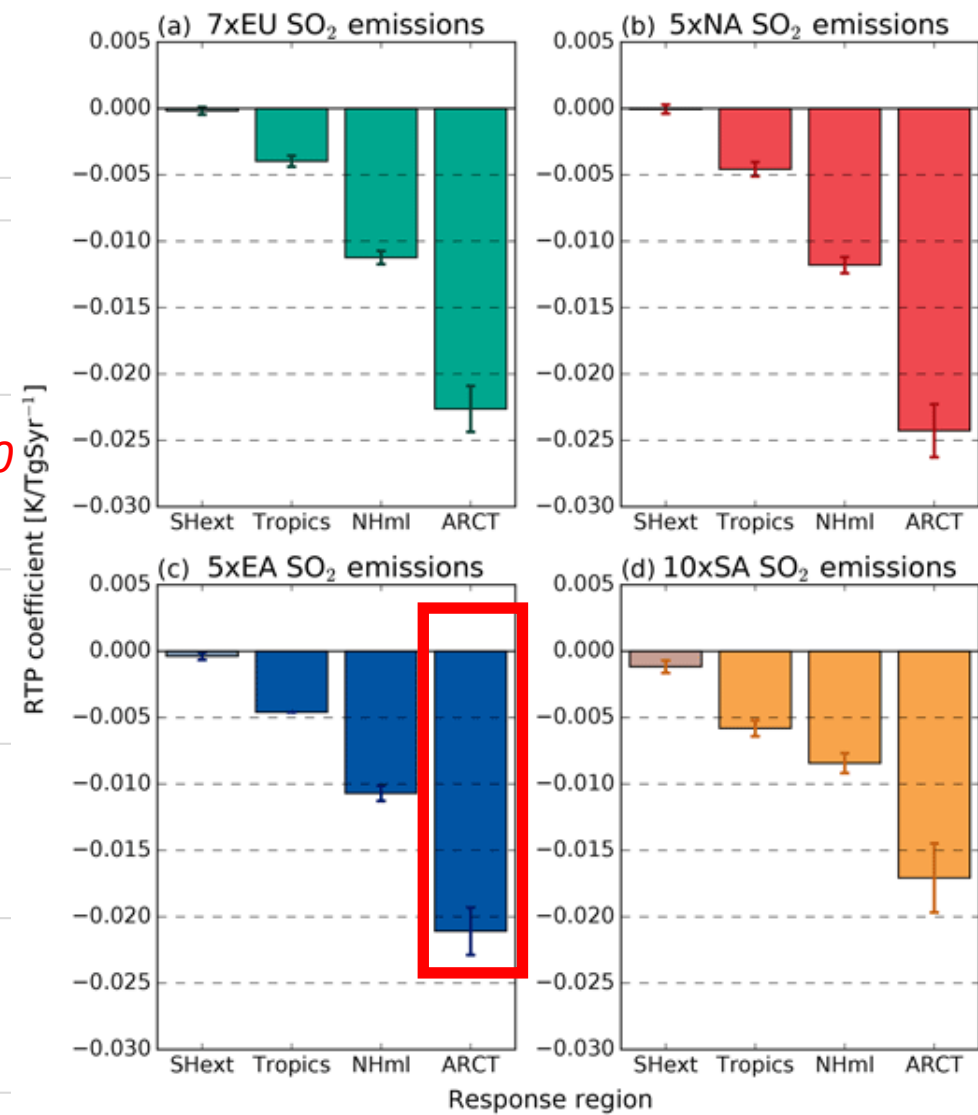
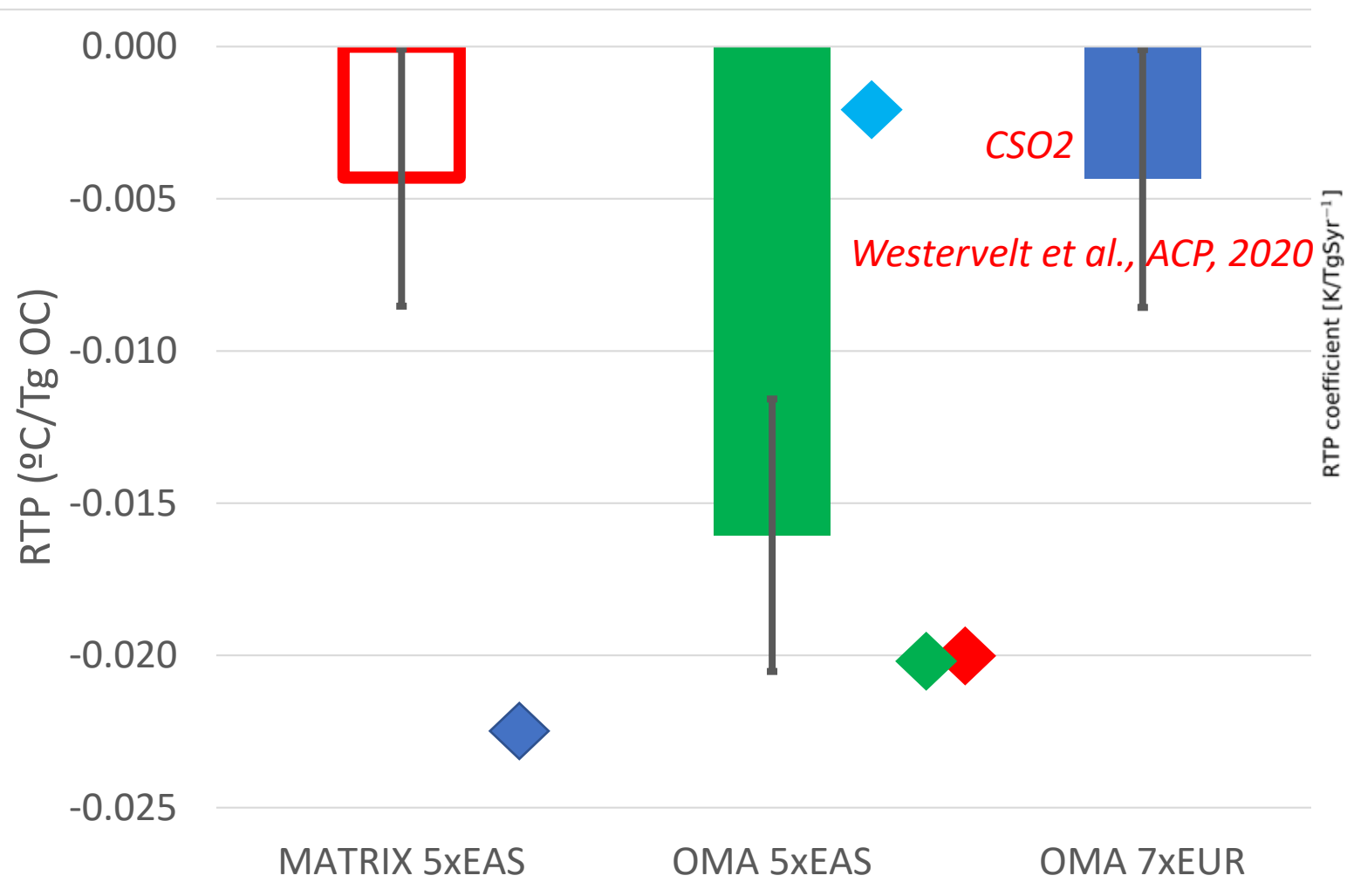


Arctic RTP



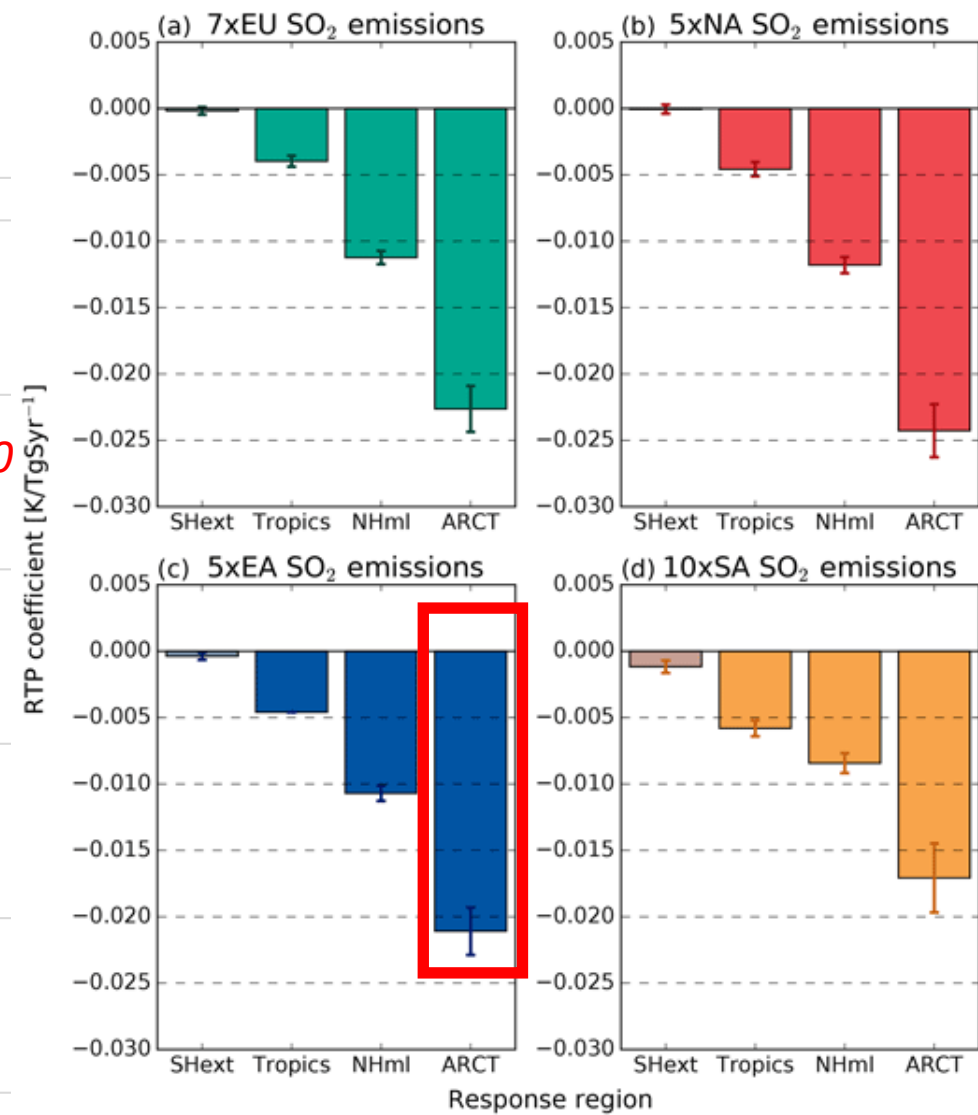
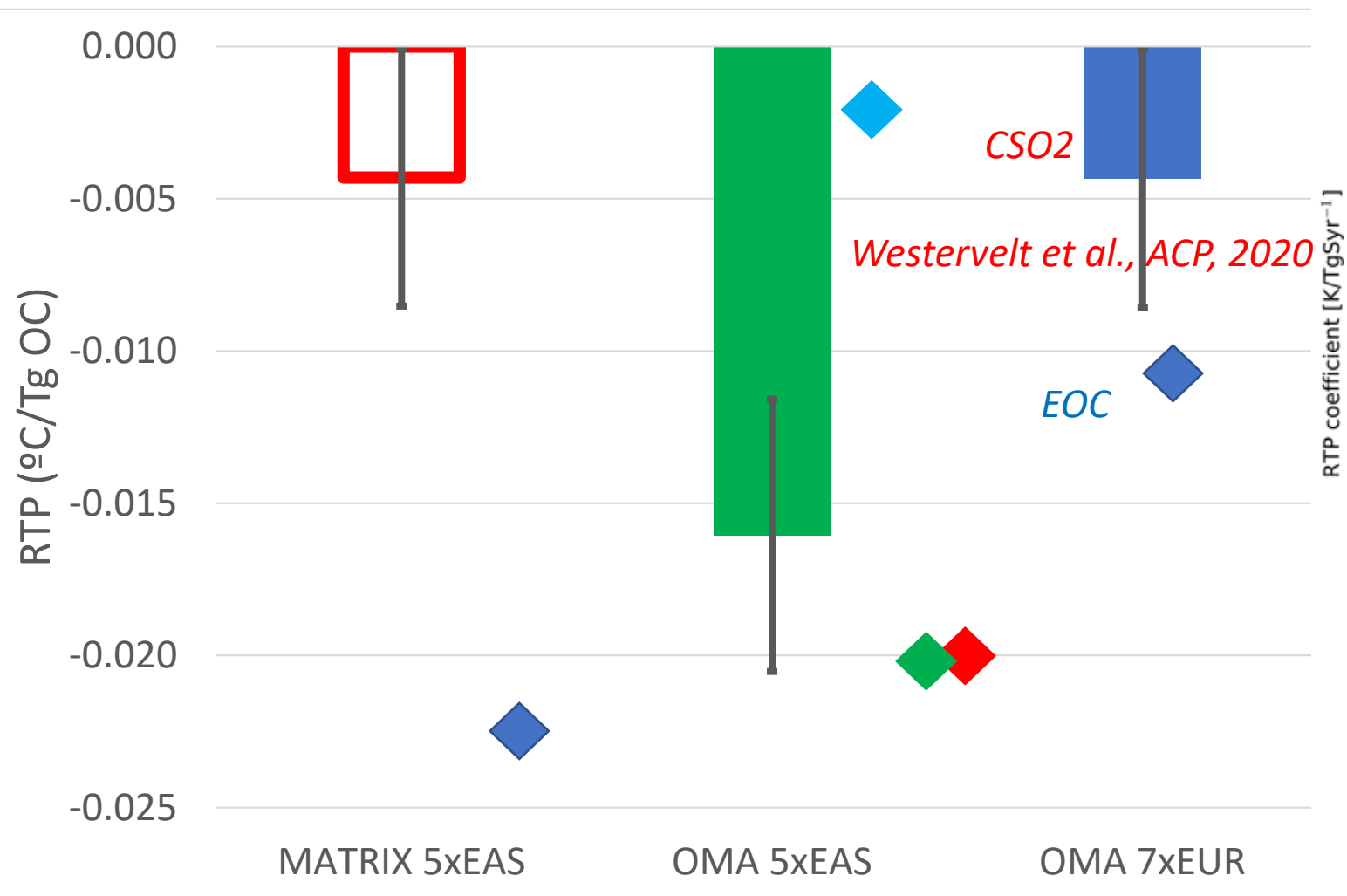
Lewinschal et al., ACP, 2019

Arctic RTP



Lewinschal et al., ACP, 2019

Arctic RTP



Lewinschal et al., ACP, 2019

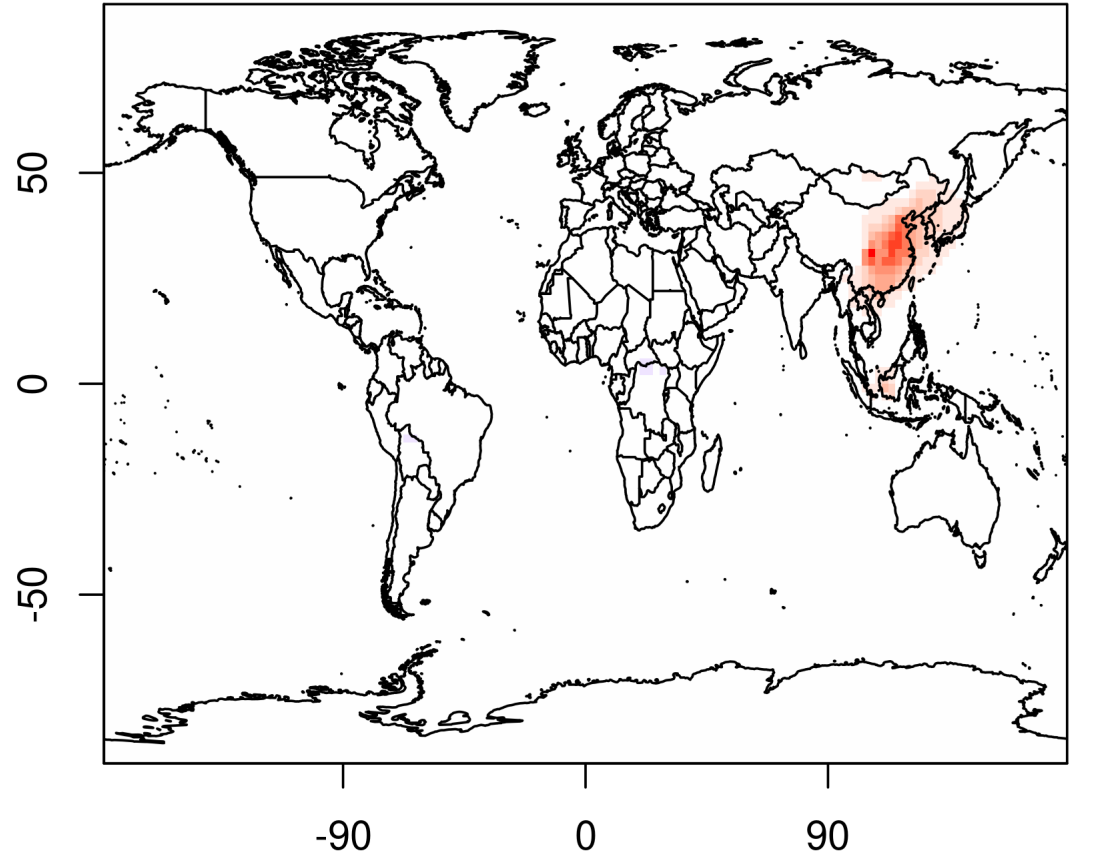
CONCLUSIONS

- Mixing state assumptions can have large impacts on temperature response
- Increased OC emissions lead to increase in coated BC (internal mixing) leading to:
 - A large increase in BC burden
 - Decreased cooling effect
- Asian emissions impact the Arctic surface temperature larger than European emissions
 - Magnitude of emissions (4 times larger OC in EAS)

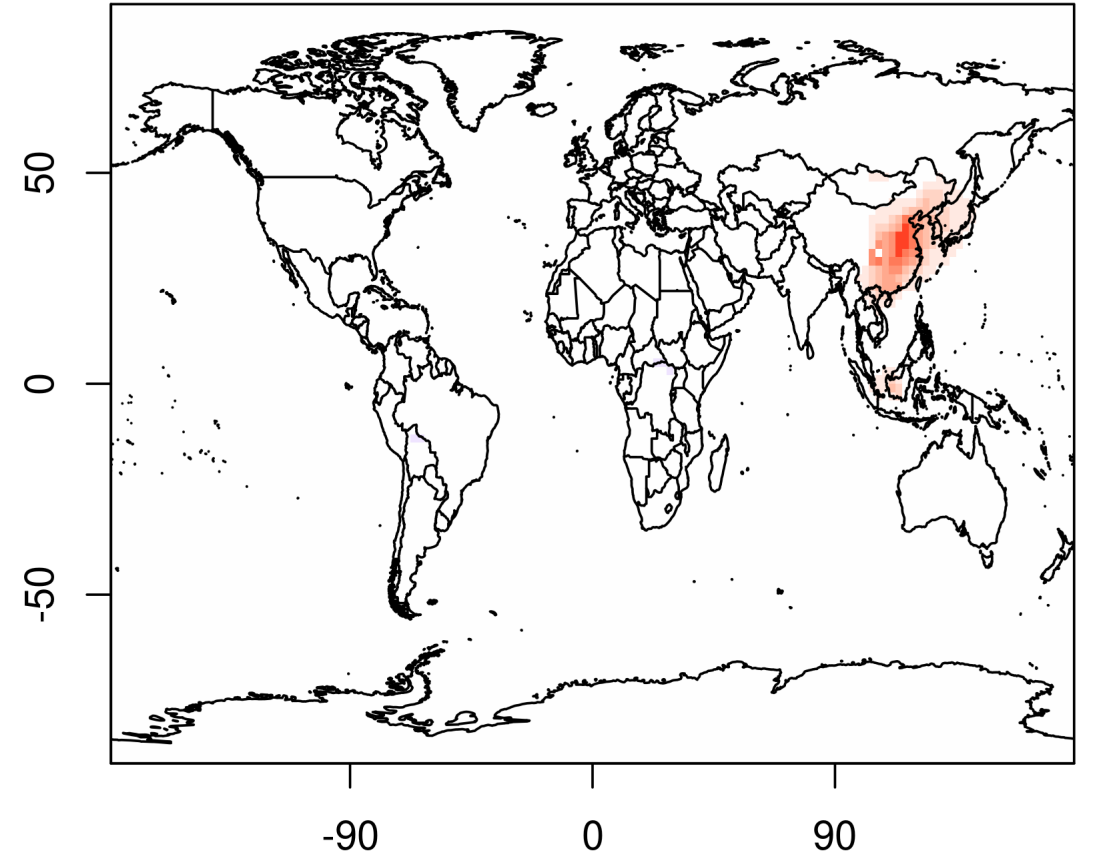
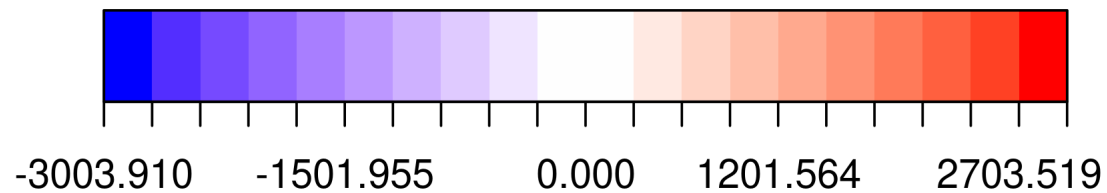
THANK YOU

ulas@envs.au.dk

OC BURDEN – 5xEAS OC



OMA 5xEAS Δ OC (tons)



MATRIX 5xEAS Δ OC (tons)

