AR5: main findings & knowledge gaps on Short-Lived Climate Forcers and their Radiative Forcing

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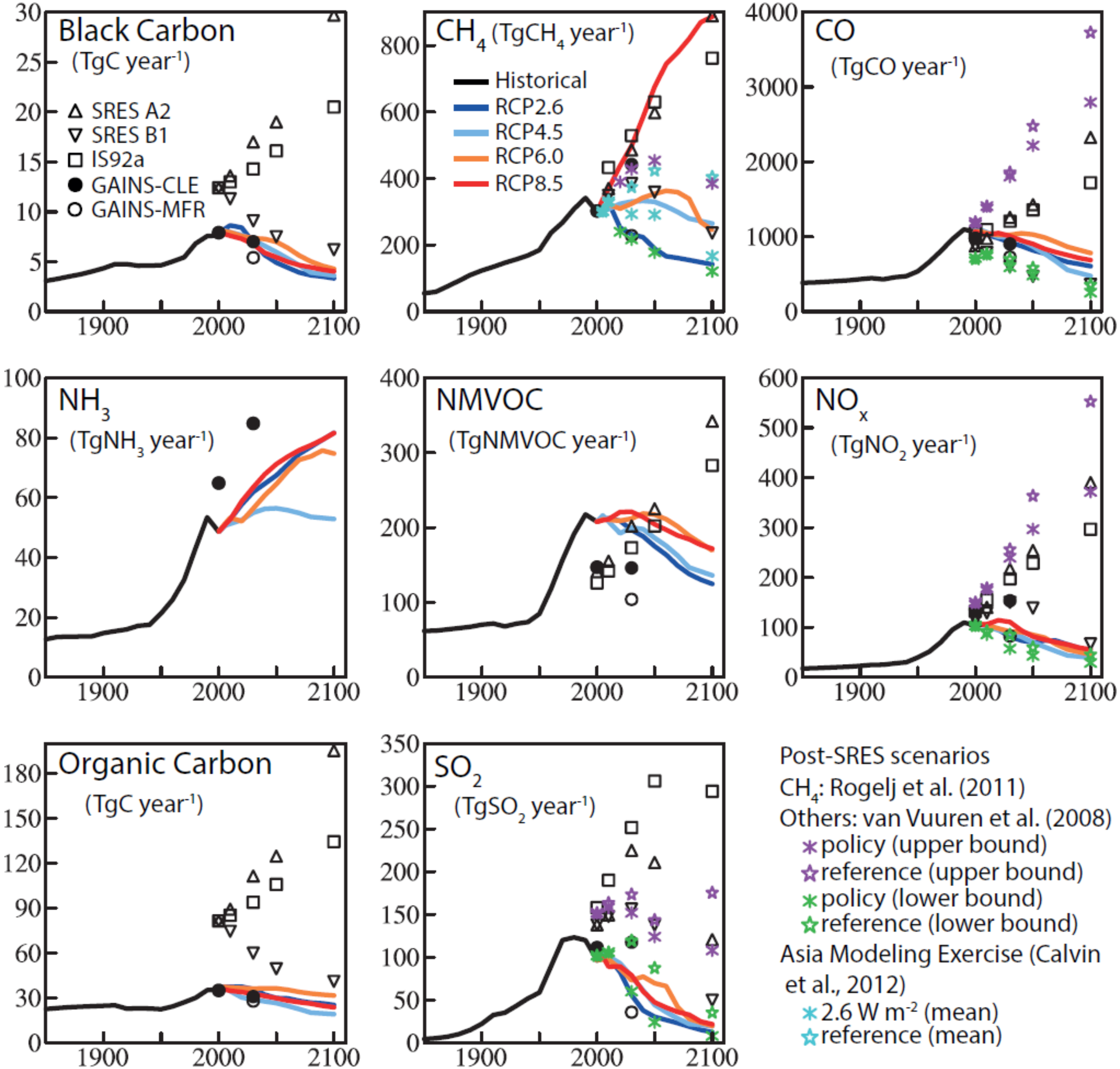


SLCF

Some gas
Some particulate

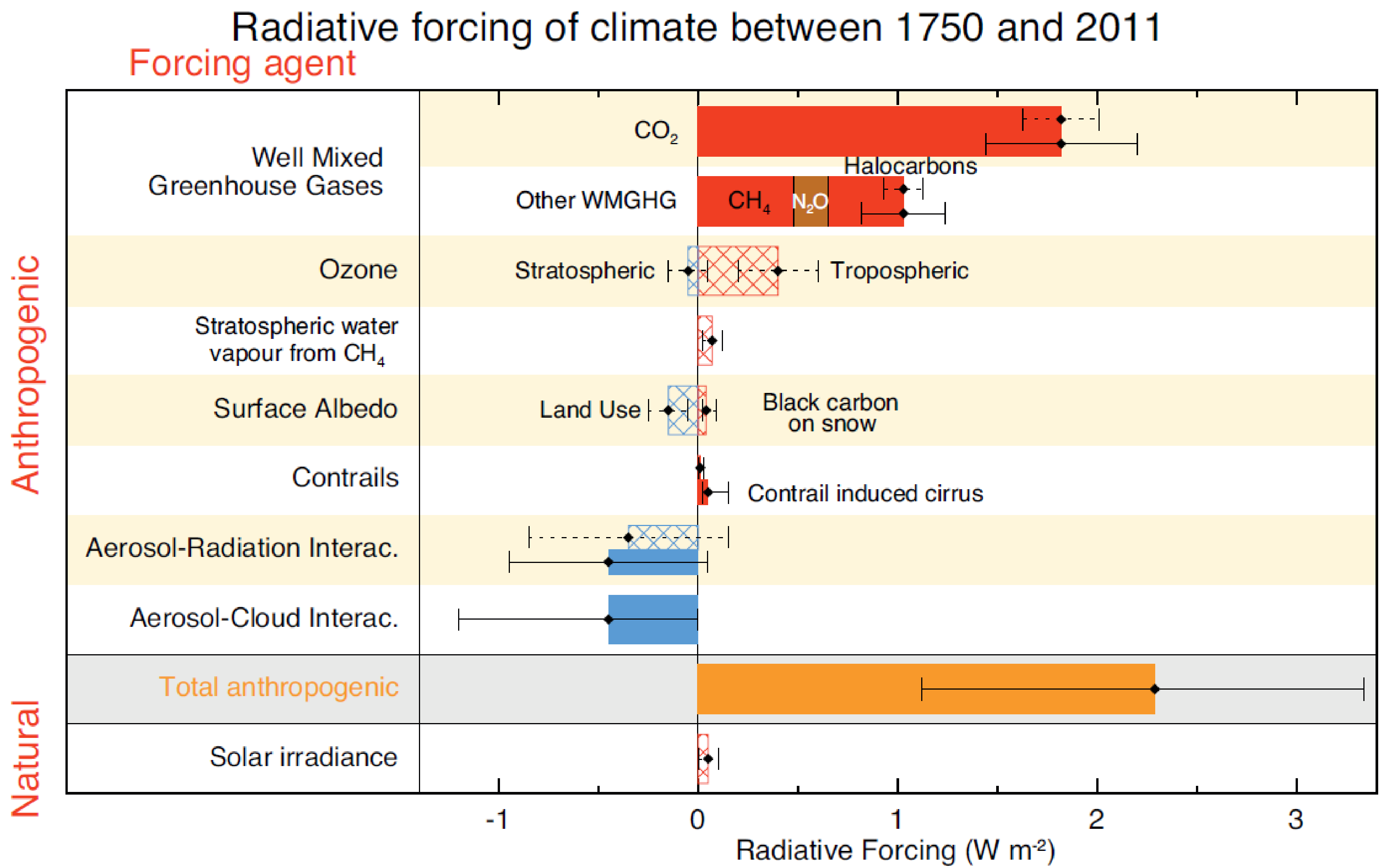
Short-lived (<>CH_4)

Often co-emitted

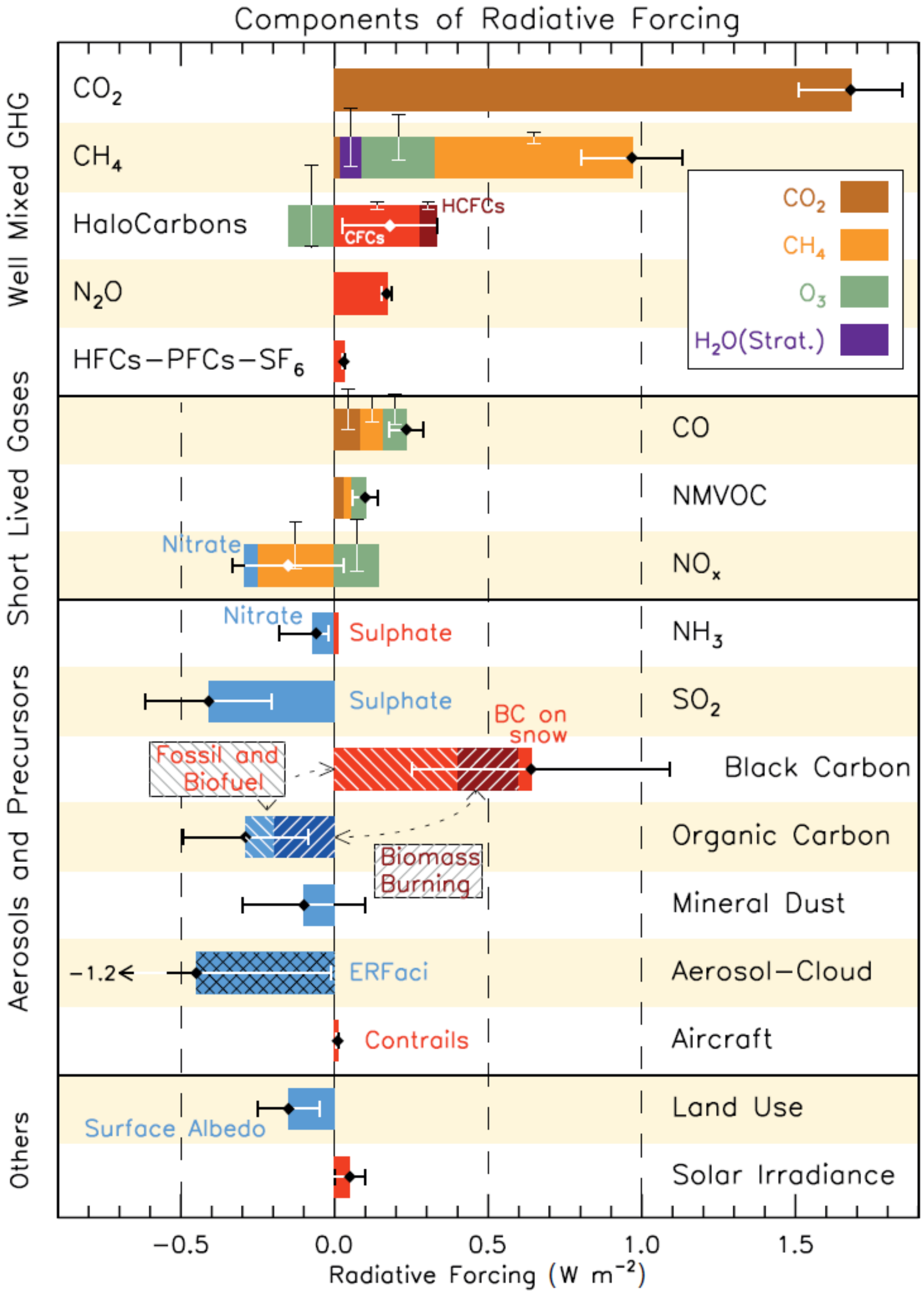
Emissions could decrease in the future

In part driven by air quality measures or as a by-product of GHG mitigation

Myhre et al., Chapter 8, AR5, 2013



Myhre et al., Chapter 8, AR5, 2013



Radiative forcing of climate change by emitted species

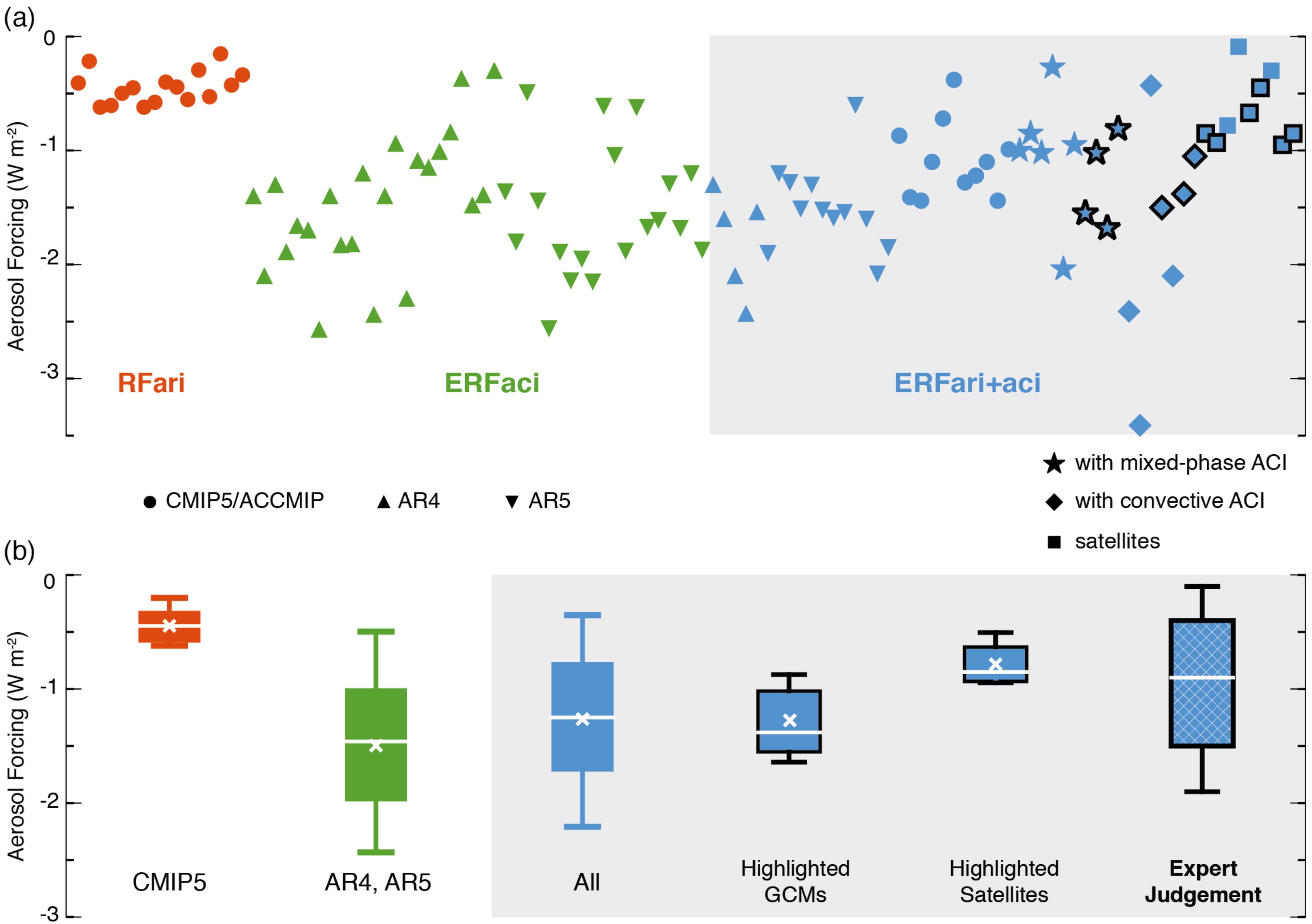
=> Some cool

=> Some warm

=> Large uncertainties

Myhre et al., Chapter 8, AR5, 2013

=> uncertainties are large, here for ERFaci…



Boucher et al., Chapter 7, AR5, 2013

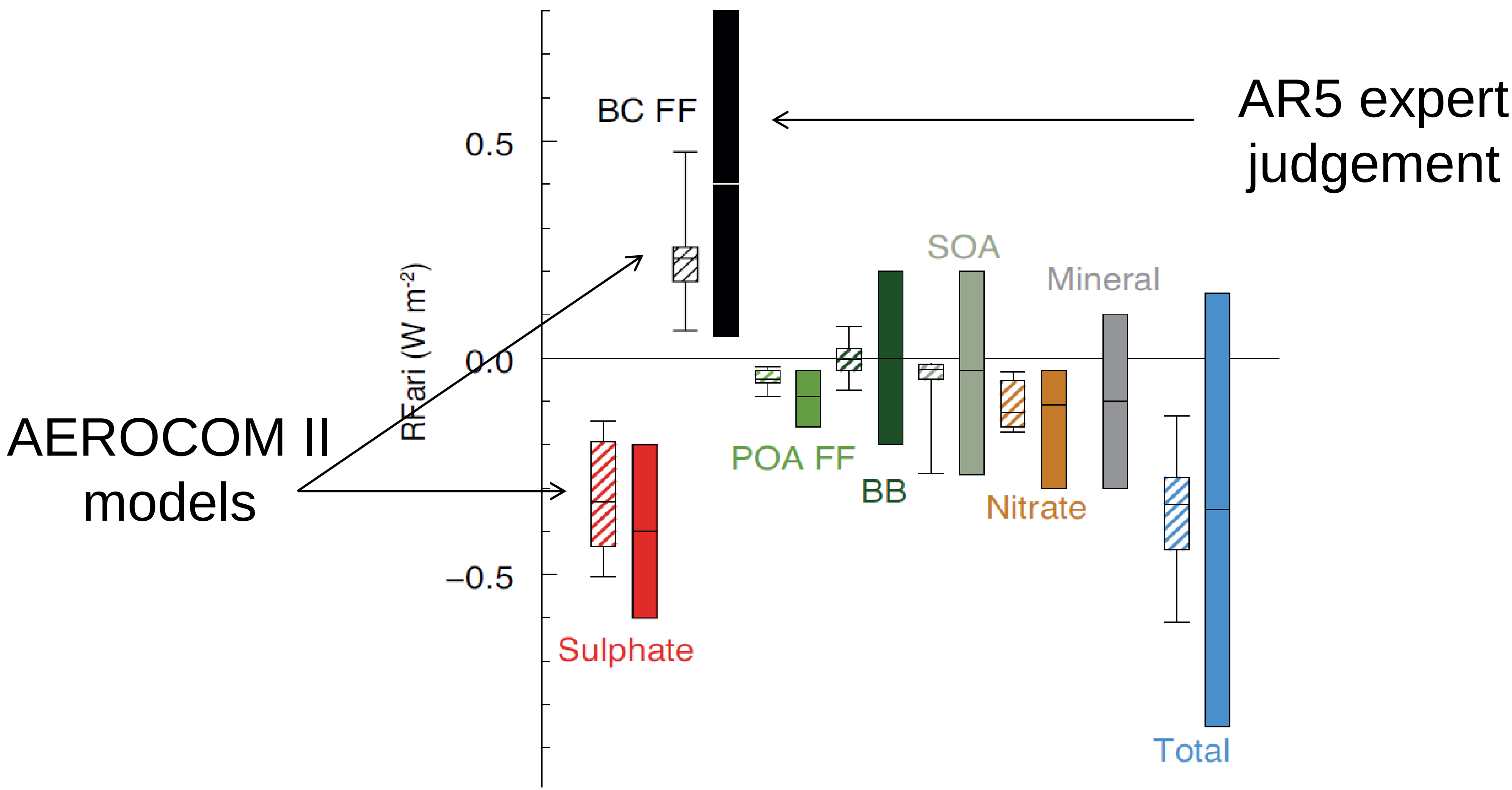
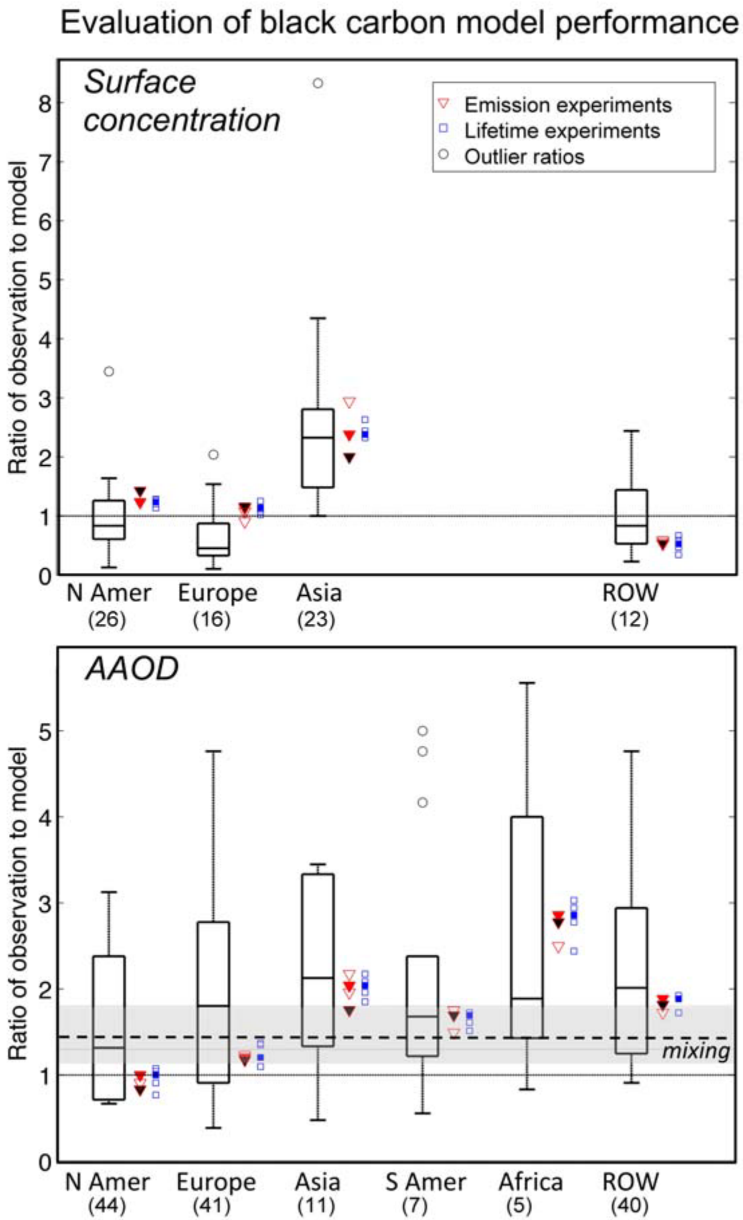
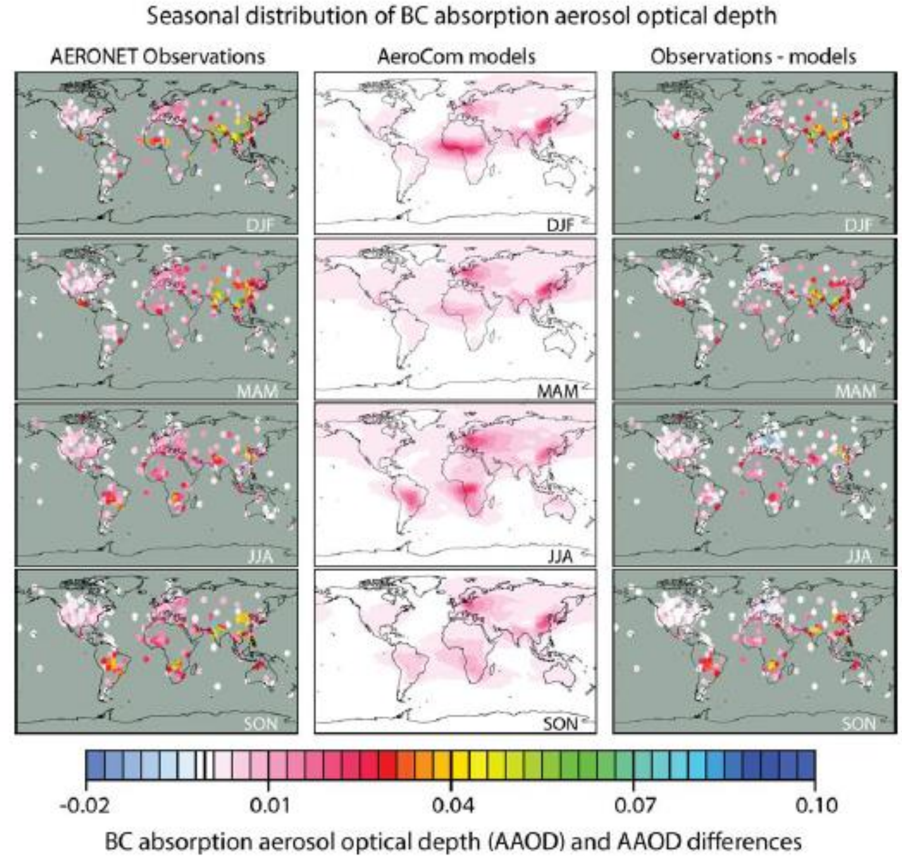


Figure 7.18 | Annual mean top of the atmosphere radiative forcing due to aerosol–radiation interactions (RFari, in W m^{-2}) due to different anthropogenic aerosol types, for the 1750–2010 period. Hatched whisker boxes show median (line), 5th to 95th percentile ranges (box) and min/max values (whiskers) from AeroCom II models (Myhre et al., 2013) corrected for the 1750–2010 period. Solid coloured boxes show the AR5 best estimates and 90% uncertainty ranges. BC FF is for black carbon from fossil fuel and biofuel, POA FF is for primary organic aerosol from fossil fuel and biofuel, BB is for biomass burning aerosols and SOA is for secondary organic aerosols.

Boucher et al., Chapter 7, AR5, 2013



Bond et al., JGR, 2013



AAOD from AERONET

- in principle valid for AOD>0.4
- but used for all AOD values

Yet roughly 15% of AOD is more than 0.4 which corresponds to <10% of BC rad. effects

- What should be the role of SLCF in mitigating climate change?
- Is it possible and desirable to decrease emissions of warming species while keeping emissions of cooling species the same?
- What are the co-benefits of decreasing emissions of SLCF?
- How well do we know emissions, concentrations and radiative forcings of SLCF?

Black Carbon

Coverage	Nation -wide
Scope	• Carbon Dioxide (CO_2) • Methane (CH_4) • Nitrous Oxide (N_2O) • Hydrofluorocarbons (HFCs) • Perfluorocarbons (PFCs) • Sulphur hexafluoride (SF_6) • Black Carbon

MÉXICO

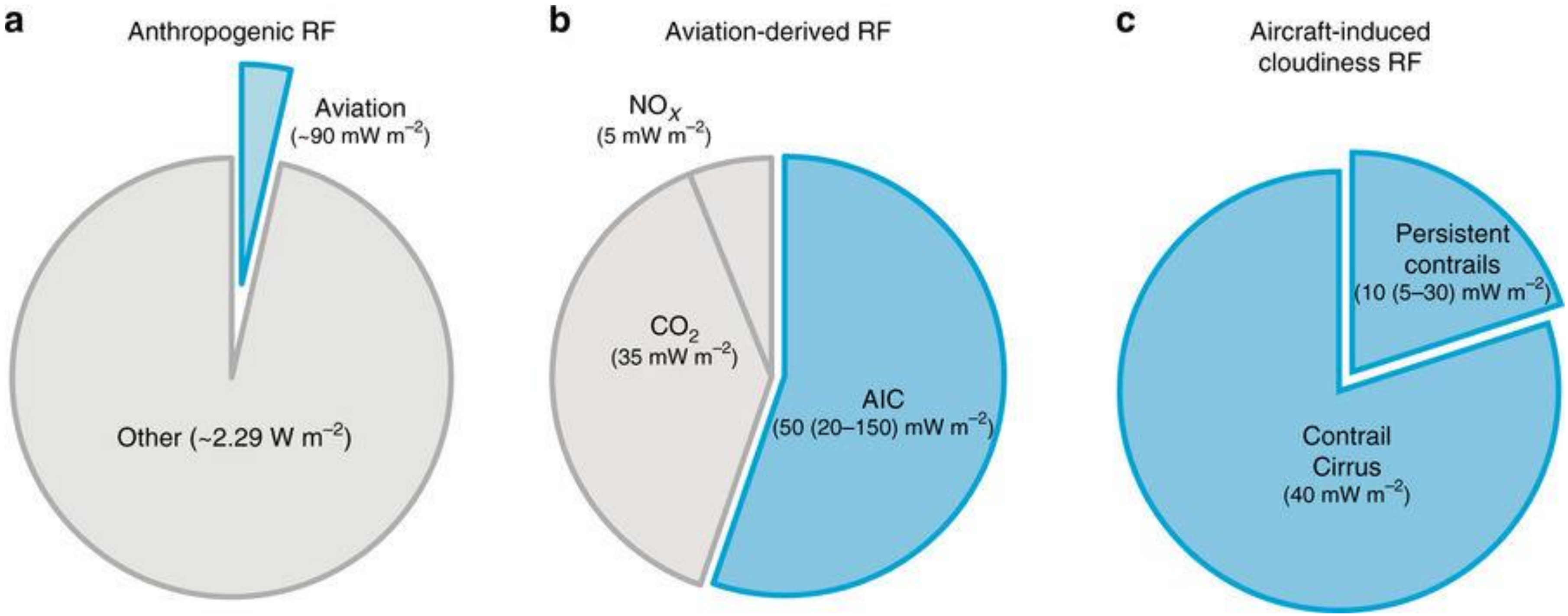
GOBIERNO DE LA REPÚBLICA

INTENDED NATIONALLY DETERMINED CONTRIBUTION

Unconditional Reduction	Mexico is committed to reduce unconditionally 25% of its Greenhouse Gases and Short Lived Climate Pollutants emissions (below BAU) for the year 2030. This commitment implies a reduction of 22% of GHG and a reduction of 51% of Black Carbon[1].

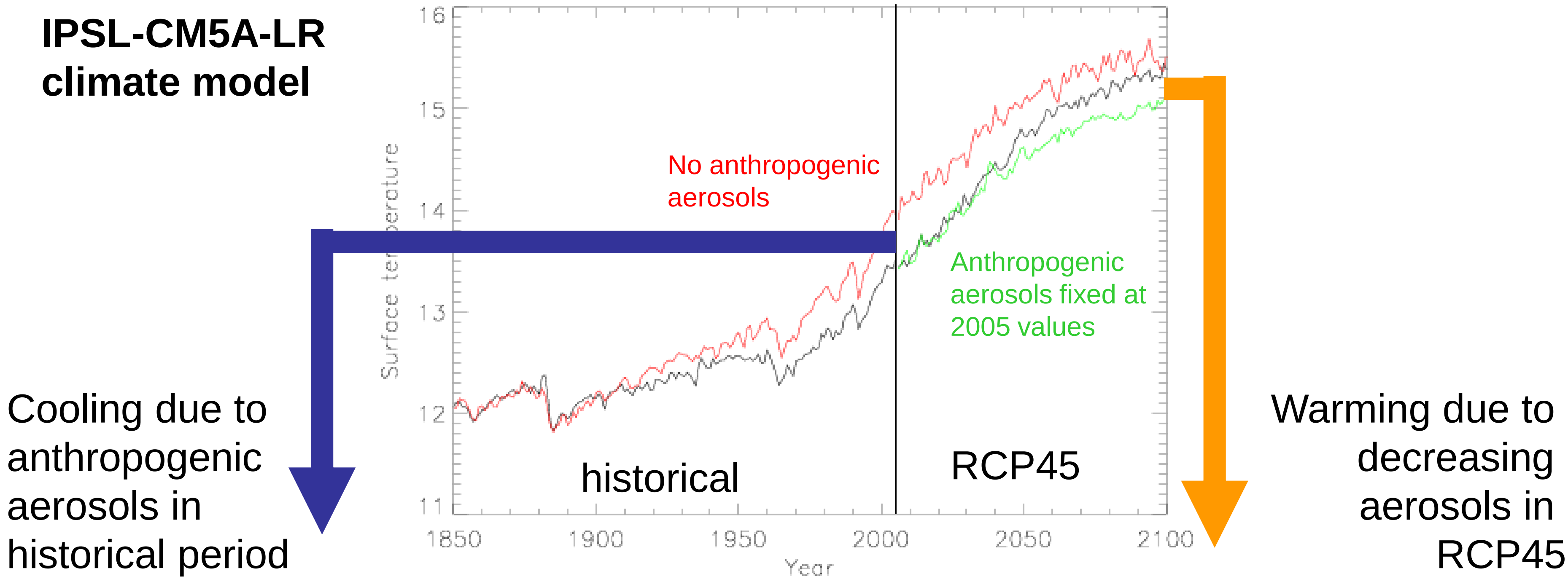
[1] This commitment is coherent to the mandate established in Mexico´s Climate Change Law to prioritize cost-effective mitigation actions with social benefits such as the improvement of public health.

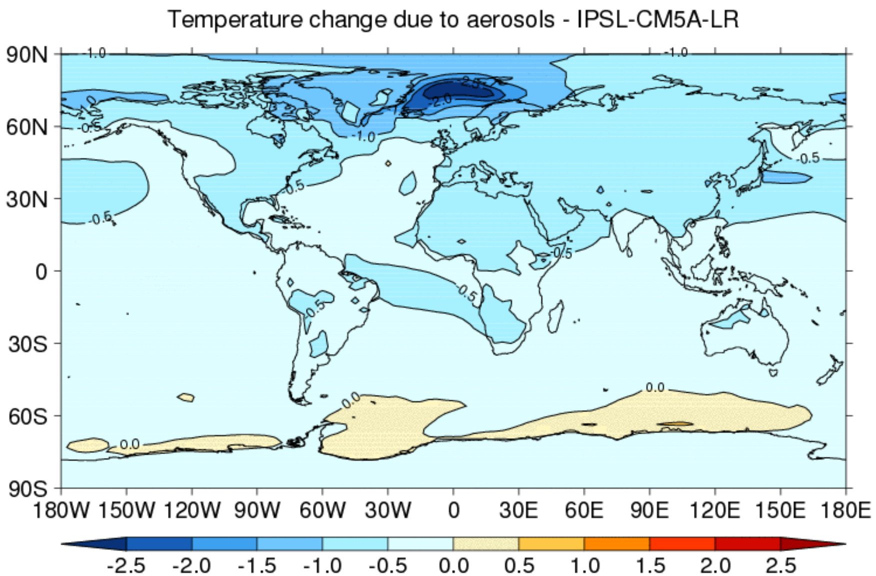
Aviation-induced cloudiness

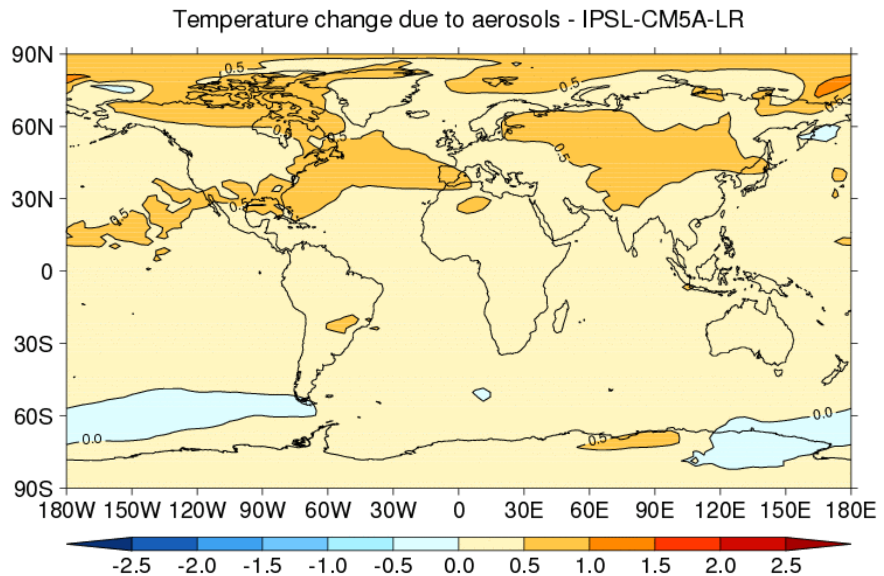


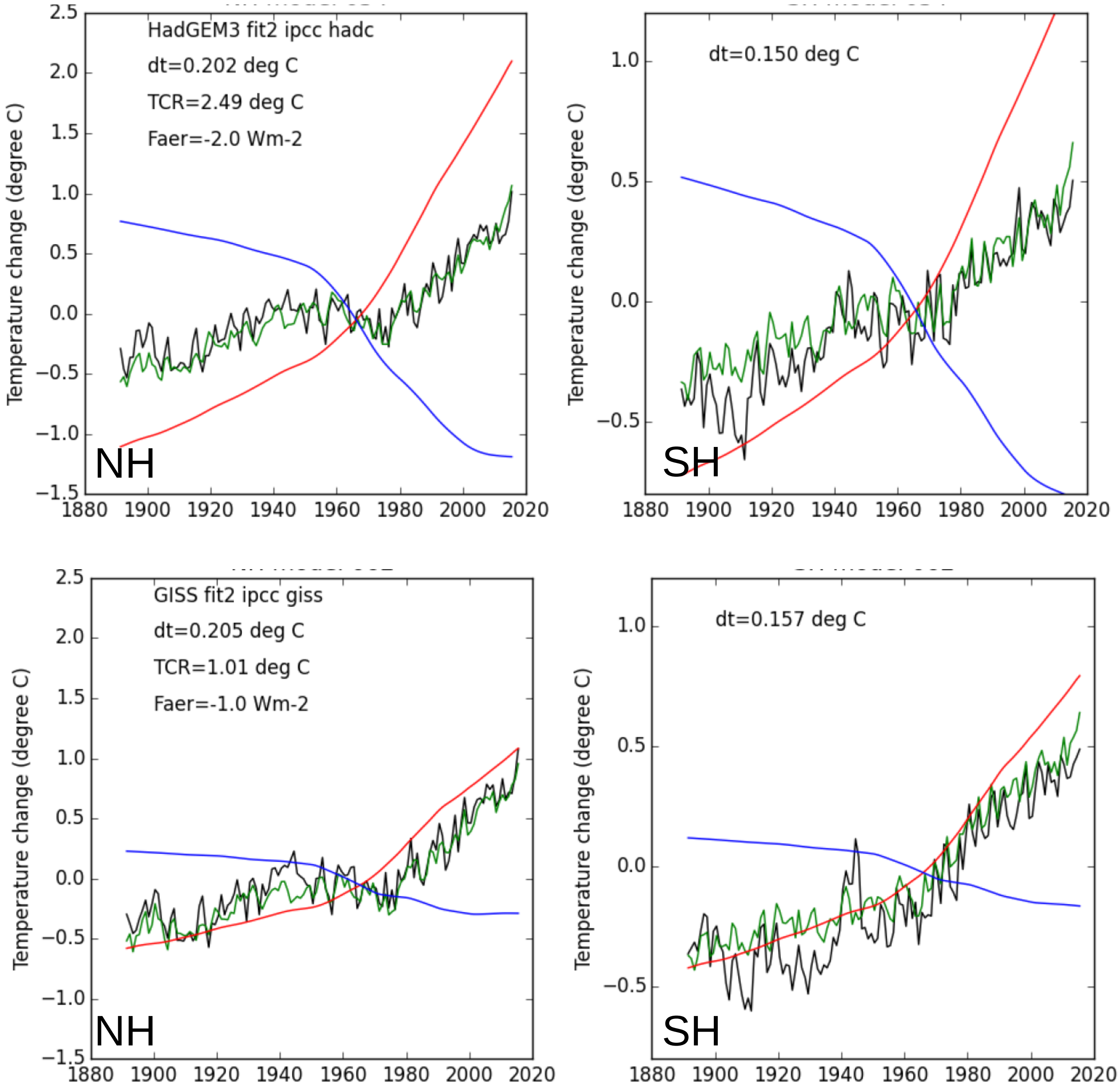
Kärcher, *Nature Comms,* 2018

IPSL-CM5A-LR climate model









Reconstruction of NH and SH T change

with a large TCR of 2.5 K and a large (negative) aerosol ERF of -2 Wm^{-2}

with a small TCR of 1 K and small (negative) aerosol ERF of -1 Wm^{-2}

IMO

Frequently Asked Questions

The 2020 global sulphur limit

IMO has set a global limit for sulphur in fuel oil used on board ships of 0.50% m/m (mass by mass) from 1 January 2020. This will significantly reduce the amount of sulphur oxide emanating from ships and should have major health and environmental benefits for the world, particularly for populations living close to ports and coasts.

- **What are the limits on sulphur in the regulations?**

The current global limit for sulphur content of ships' fuel oil is 3.50% m/m (mass by mass).

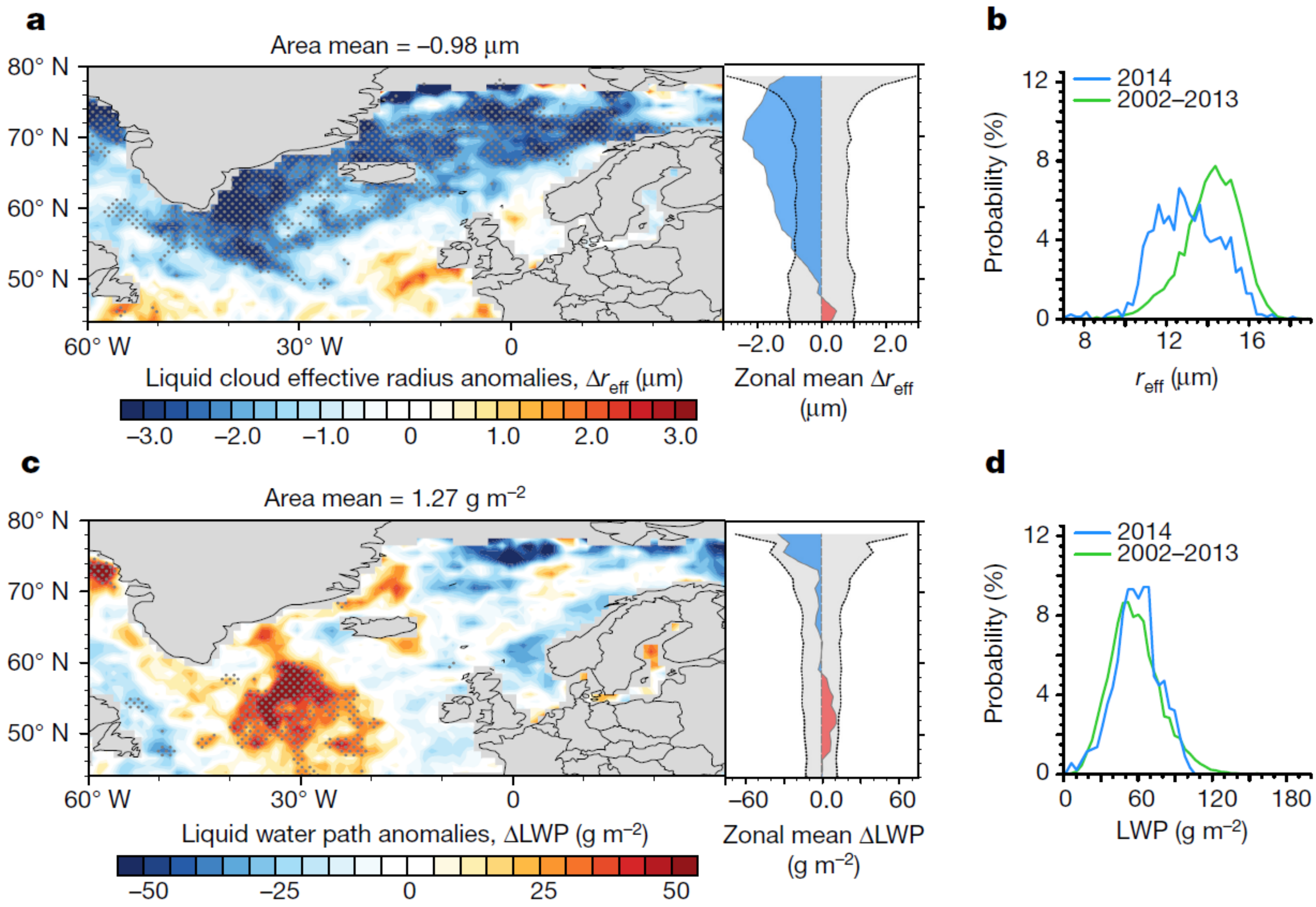
⇒ A factor of 7 reduction

The new global limit will be 0.50% m/m will apply on and after 1 January 2020.

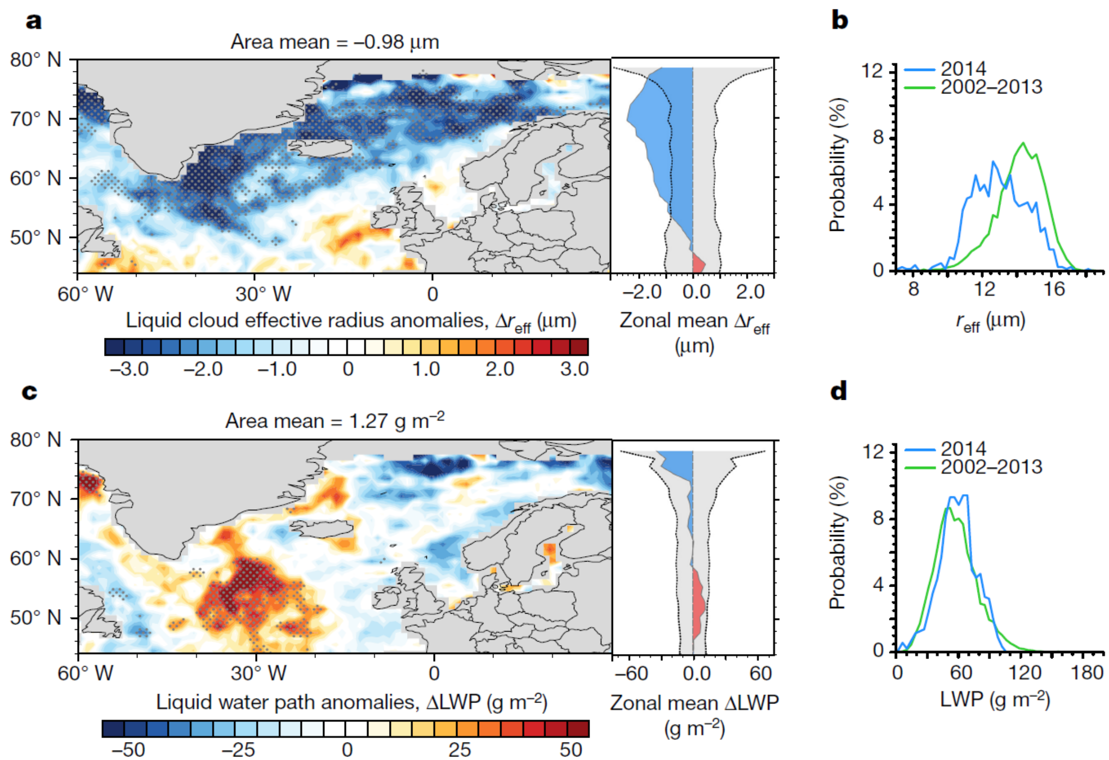
- **When was the date of 1 January 2020 decided?**

The date of 1 January 2020 was set in the regulations adopted in 2008. However, a provision was adopted, requiring IMO to review the availability of low sulphur fuel oil for use by ships, to help Member States determine whether the new lower global cap on sulphur emissions from international shipping shall come into effect on 1 January 2020 or be deferred until 1 January 2025.

⇒ Clear environmental and health benefits (eg, Sofiev et al, *Nature Comms*, 2017) but what climate effects?



Malavelle et al., *Nature*, 2017



Scaling the Malavelle et al. results to shipping emissions…

2 Tg SO_2 mth^{-1} emissions from Holuhraun => - 0.21 Wm^{-2} RF in Sept-Oct 2014

100 Tg SO_2 yr^{-1} global emissions => - 0.9 Wm^{-2} RF from sulphate ACI

Reducing shipping emissions of 10 Tg SO2 yr^{-1} by a factor 7 =>

- 0.15 Wm^{-2} => 0.15 K cooling within 10 years

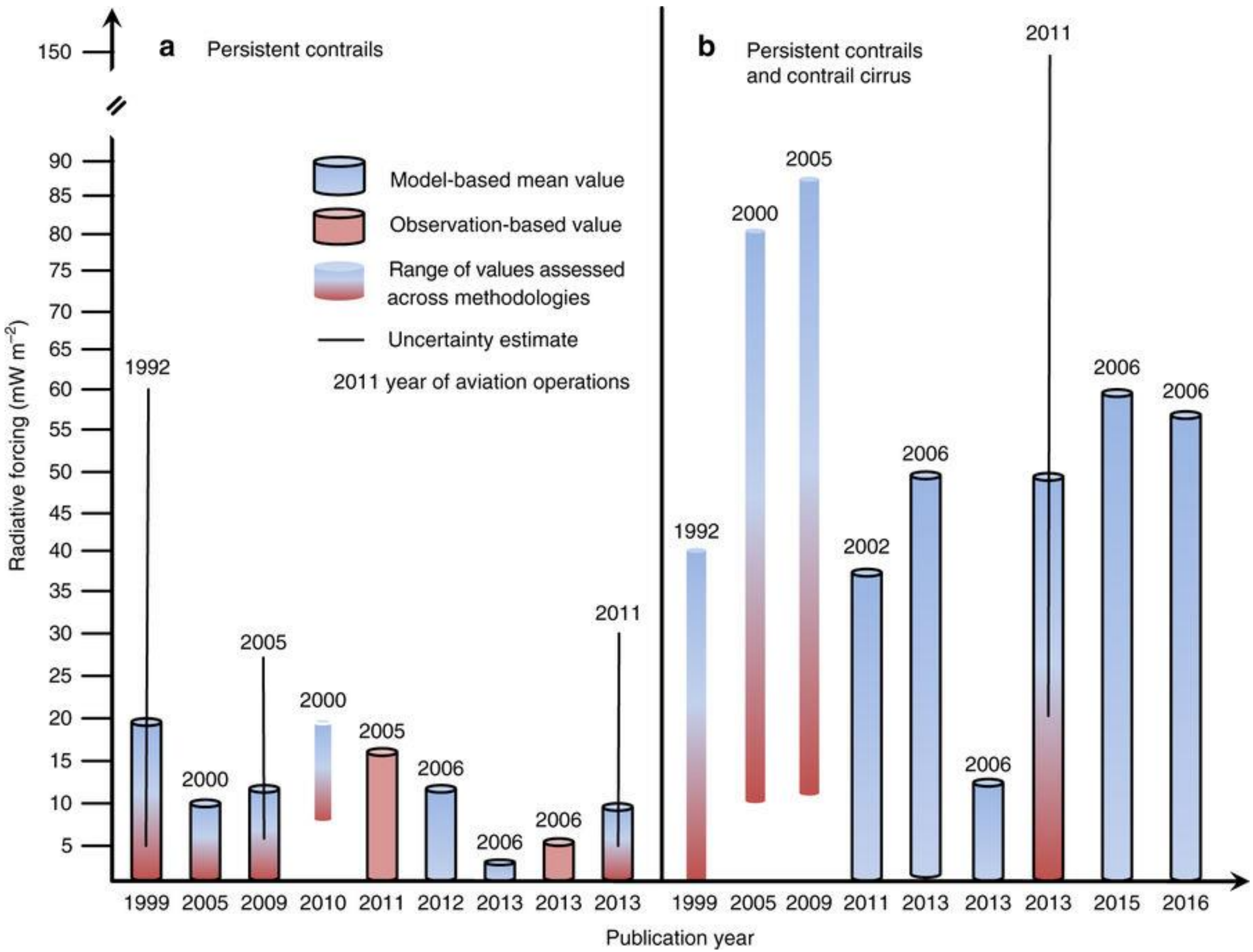
(with a factor of 2 enhancement because of the spatio-temporal distribution)

Conclusions

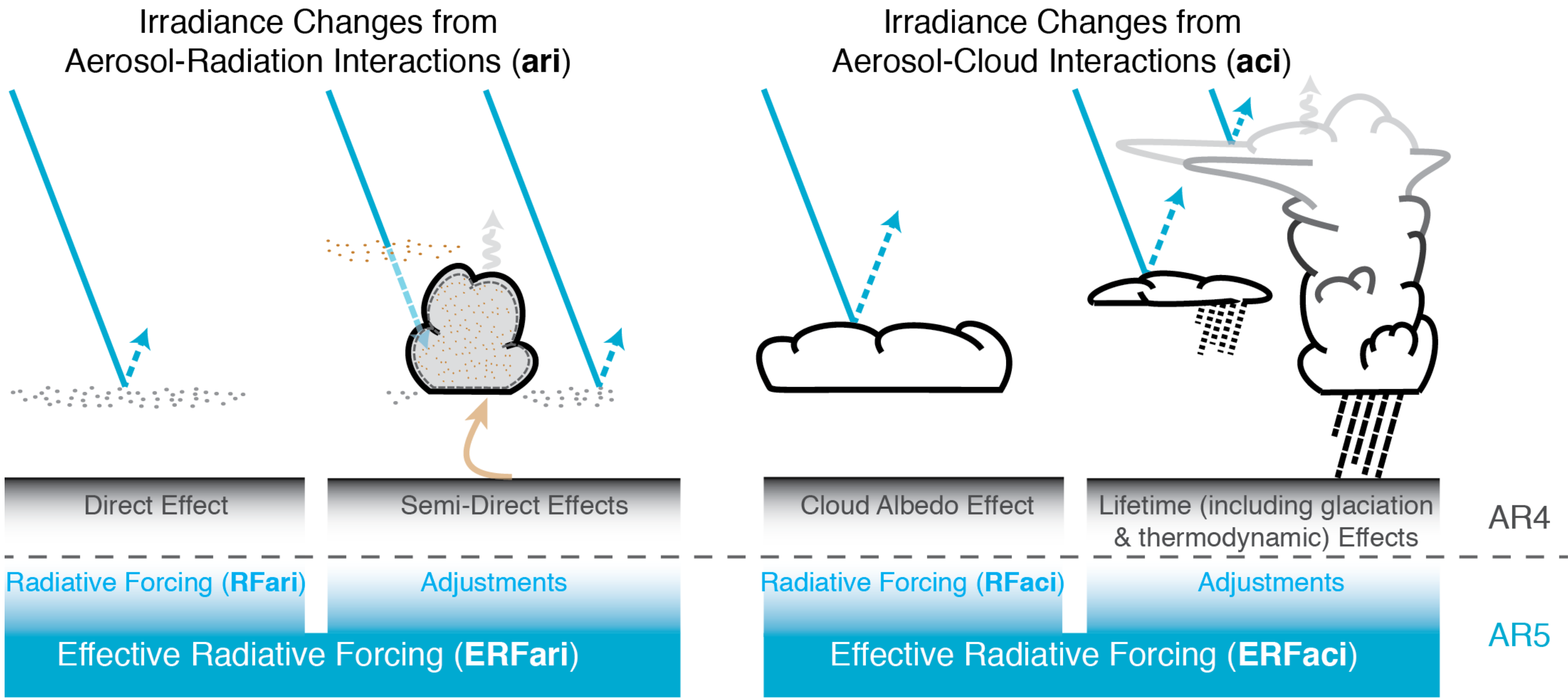
- SLCF offer in principle some climate mitigation opportunities but …
  - only few SLCFs have warming effects and may not be so easy to mitigate
  - other species are often co-emitted
  - there are trade-offs involving climate warming
  - uncertainties are large
- In any case monitoring of SLCFs is needed hence knowing emissions and their evolution is paramount

END

https://atmosphere.copernicus.eu/services/climate-forcing



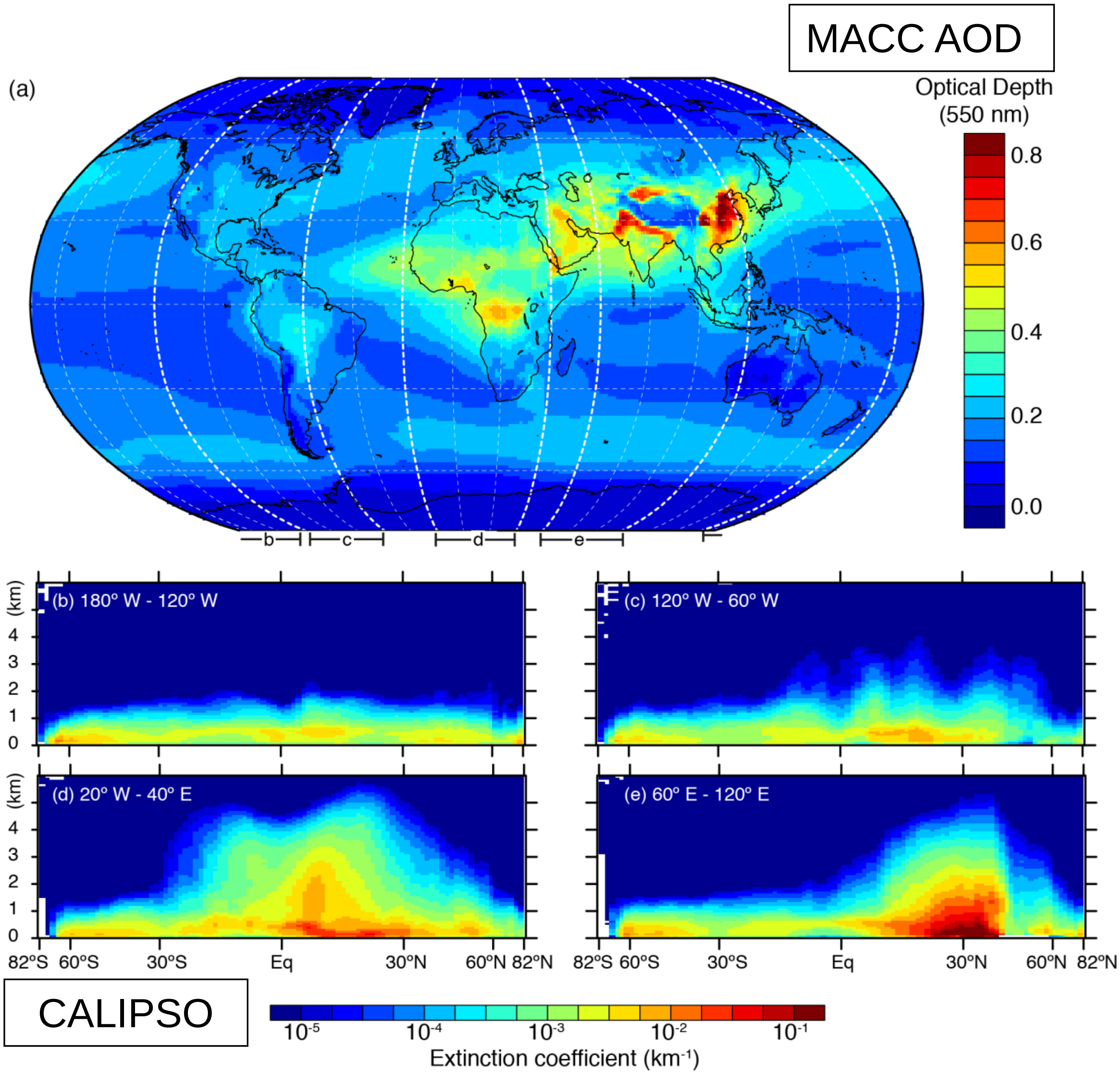
Kärcher, *Nature Comms,* 2018



Boucher et al., Chapter 7, AR5, 2013

Executive Summary – Clouds and Aerosols

- **Climate-relevant aerosol processes are better understood, and climate-relevant aerosol properties better observed, than at the time of AR4.**



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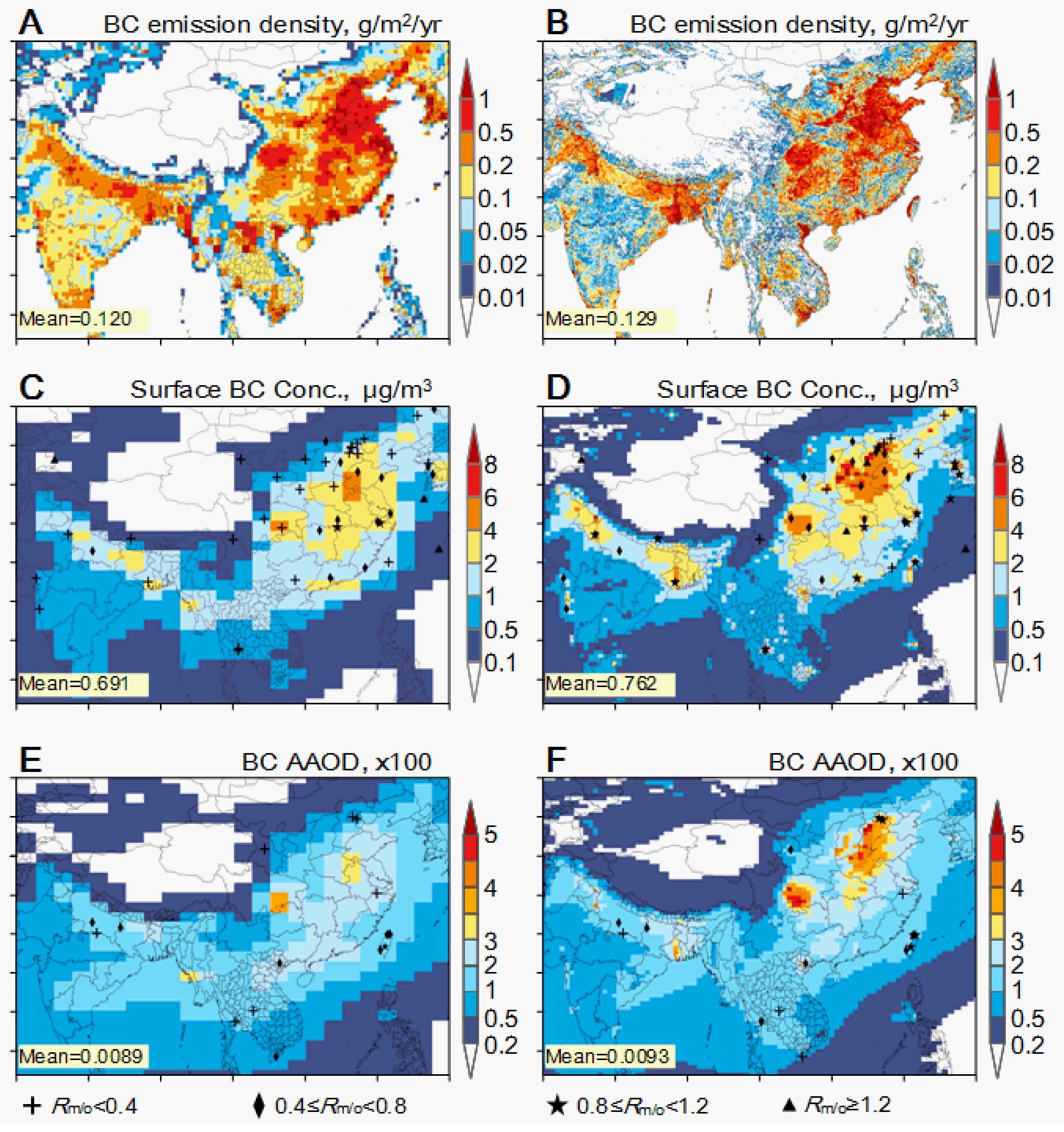
➔ No statement on the anthropogenic fraction of AAOD

➔ No statement on the anthropogenic fraction of ice nuclei

Need for higher resolution



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