



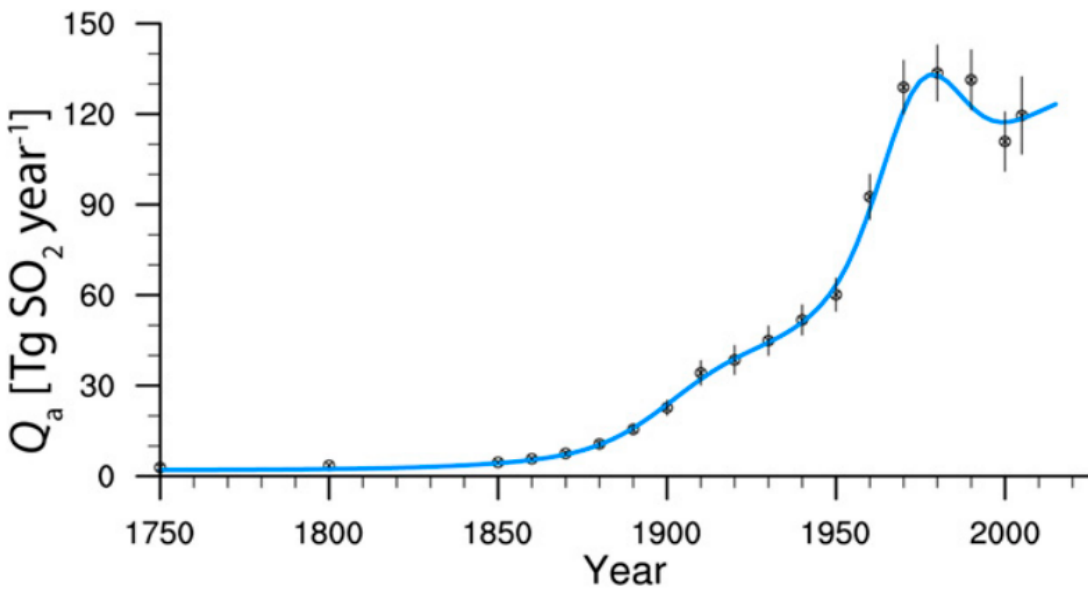
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Constraints on aerosol forcing from the 20th century?

AEROCOM meeting Helsinki

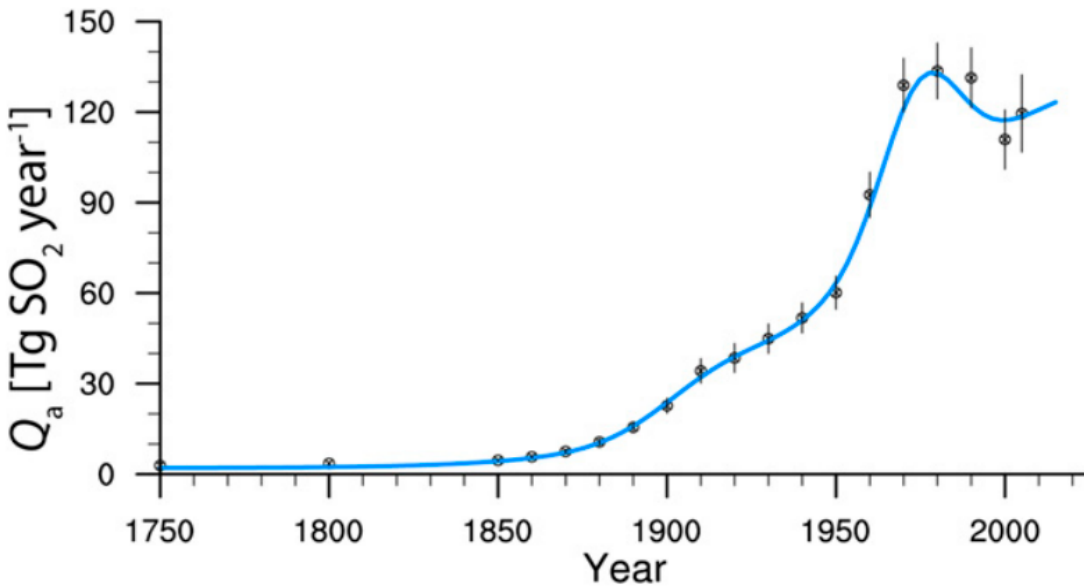
Johannes Quaas | <http://research.uni-leipzig.de/climate>





Global-mean anthropogenic SO₂ emissions

Smith et al. Atmos. Chem. Phys. 2011



Global-mean anthropogenic SO₂ emissions

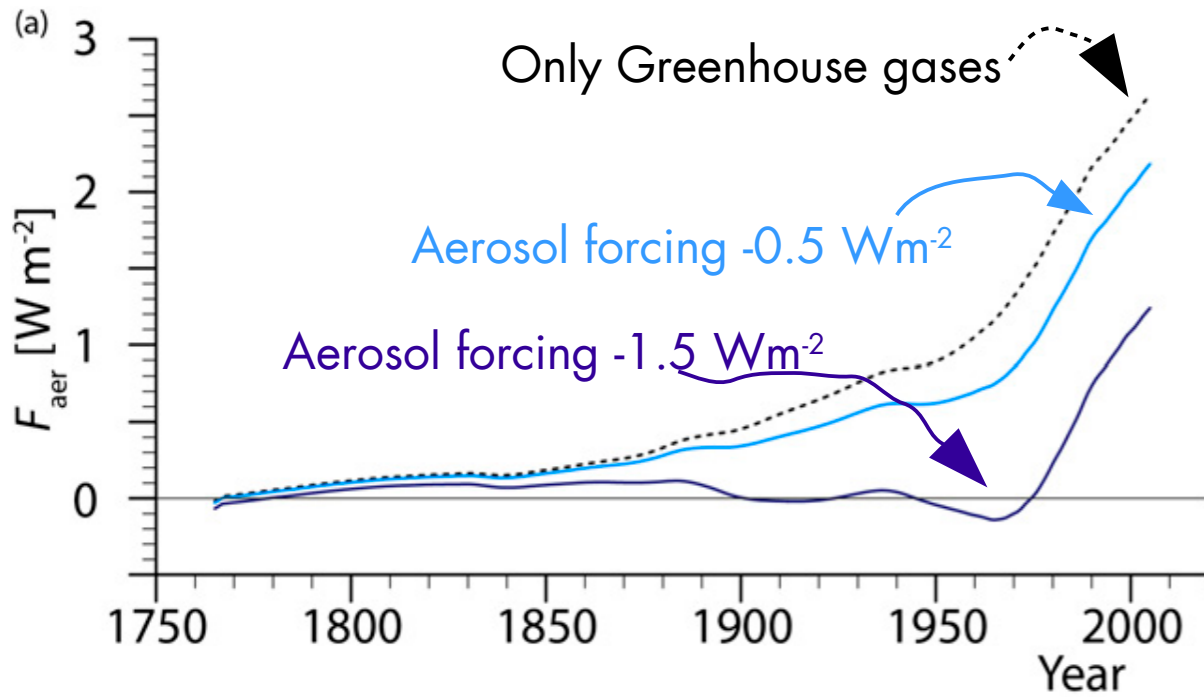
Smith et al. Atmos. Chem. Phys. 2011

$$\bar{F}_{\text{aer}} = -\alpha \bar{Q}_a - \beta \ln \left(\frac{\bar{Q}_a}{\bar{Q}_n} + 1 \right)$$

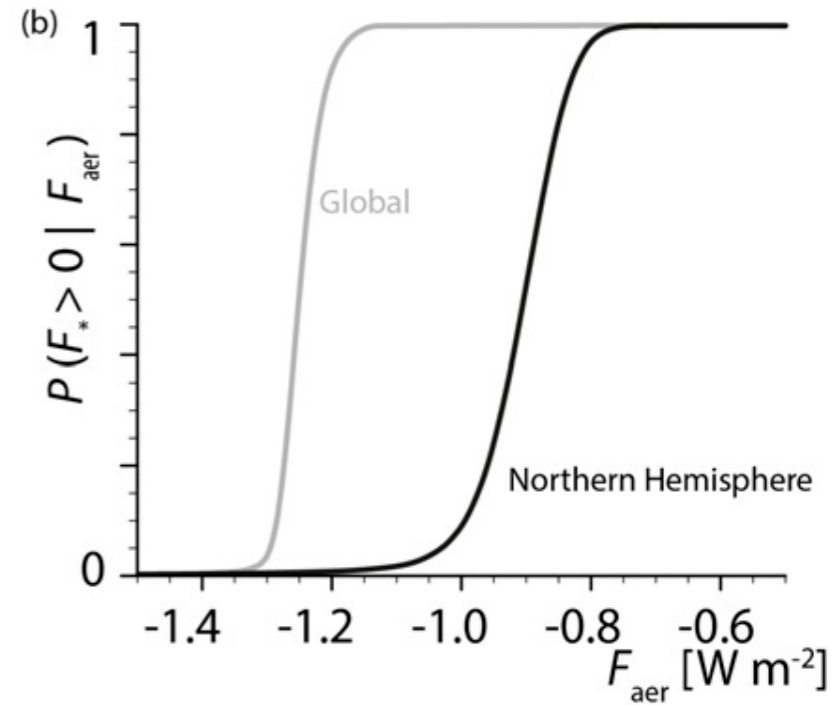
Stevens' model for aerosol ERF:

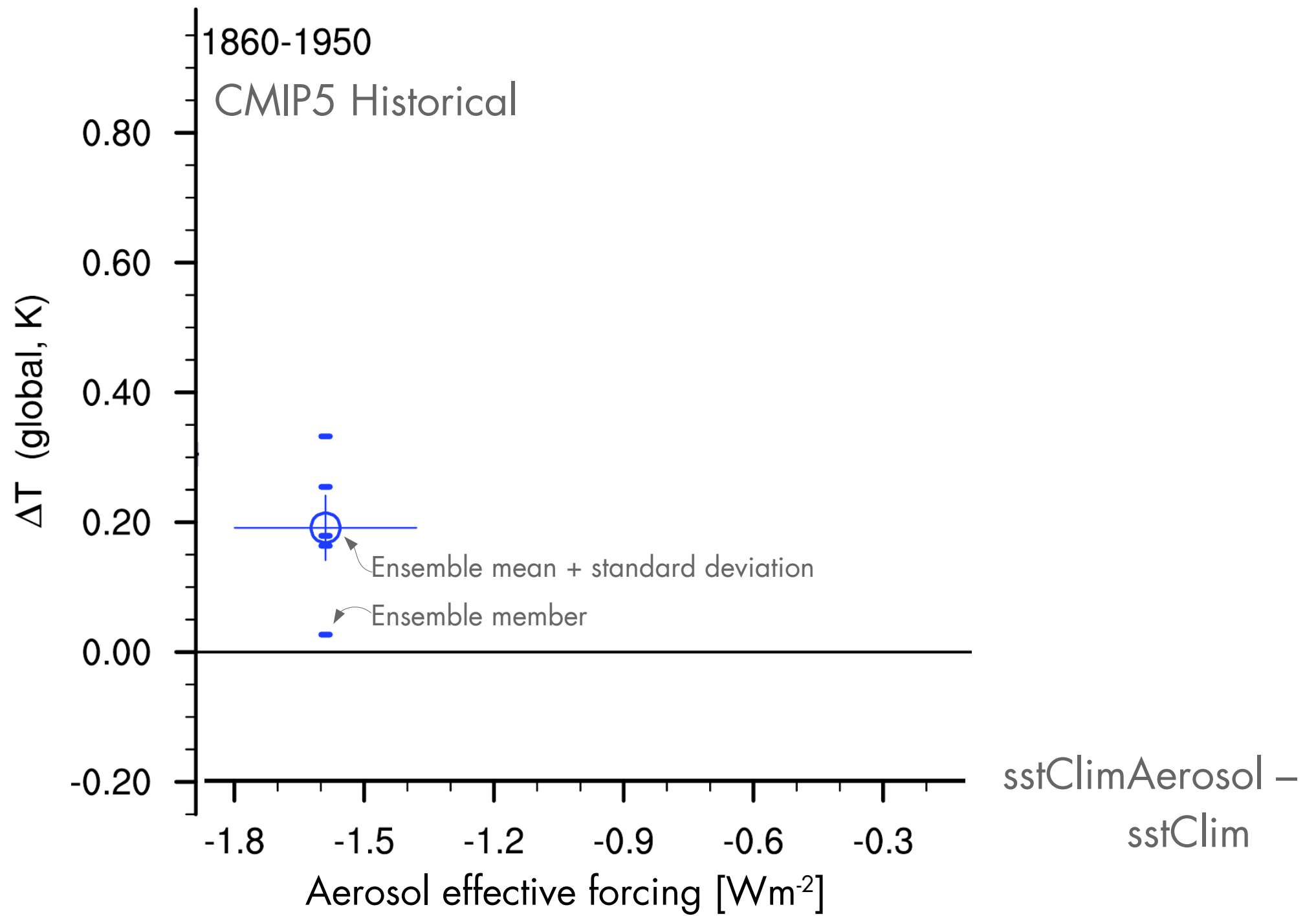
- linear in Q_a for aerosol-radiation interactions
- logarithmic in Q_a for aerosol-cloud interactions

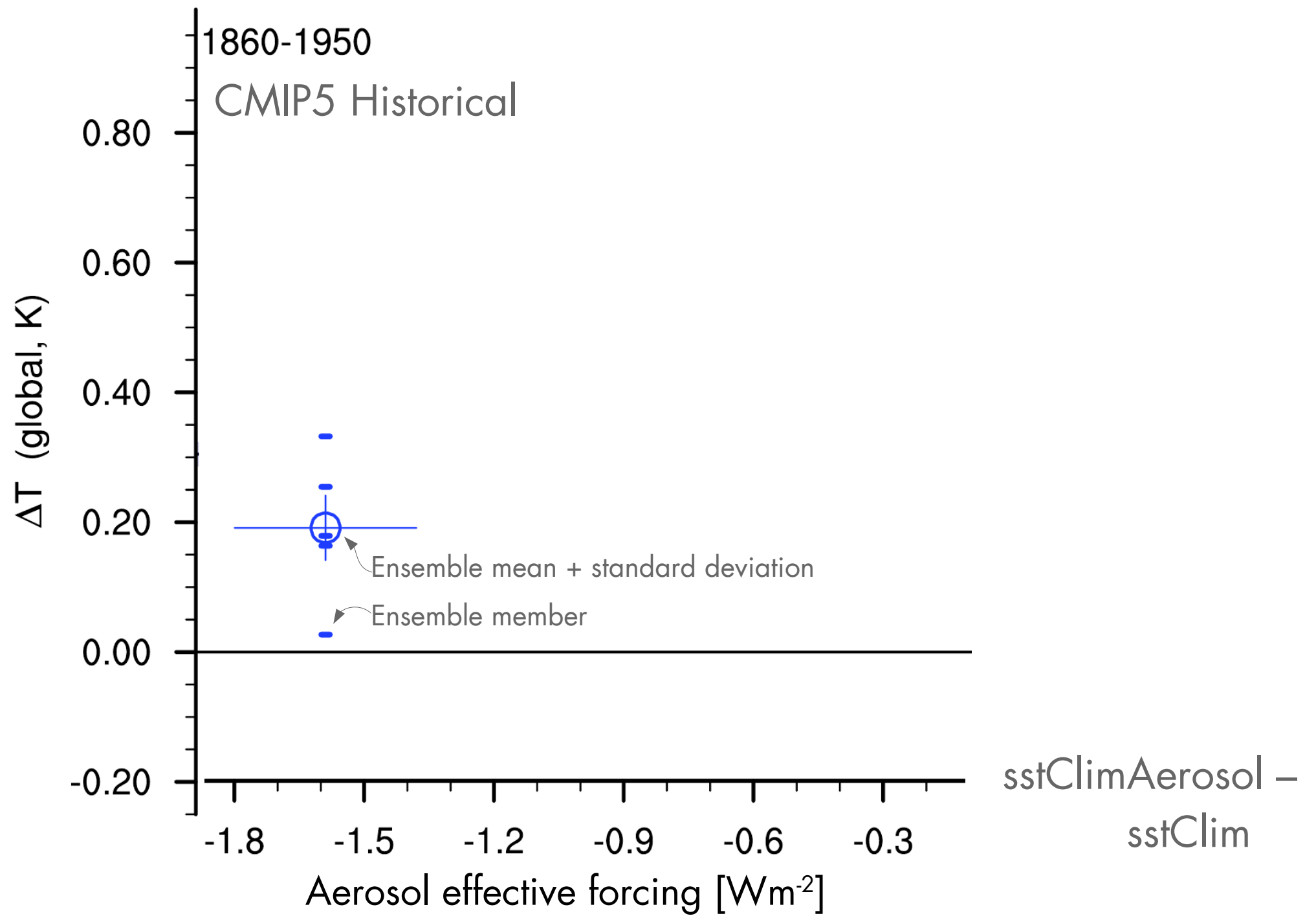
Total anthropogenic effective radiative forcing
(Stevens model for aerosol ERF)

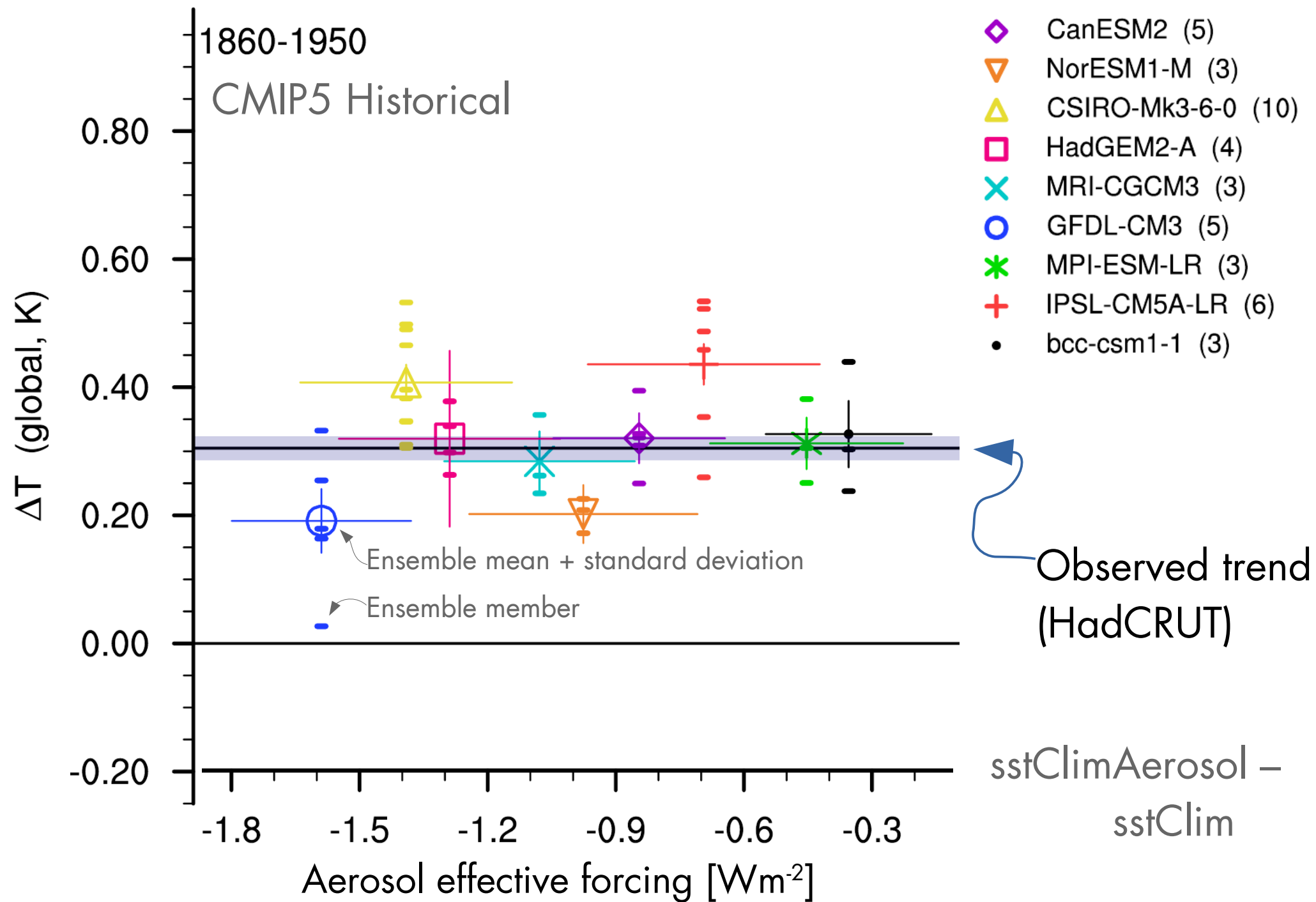


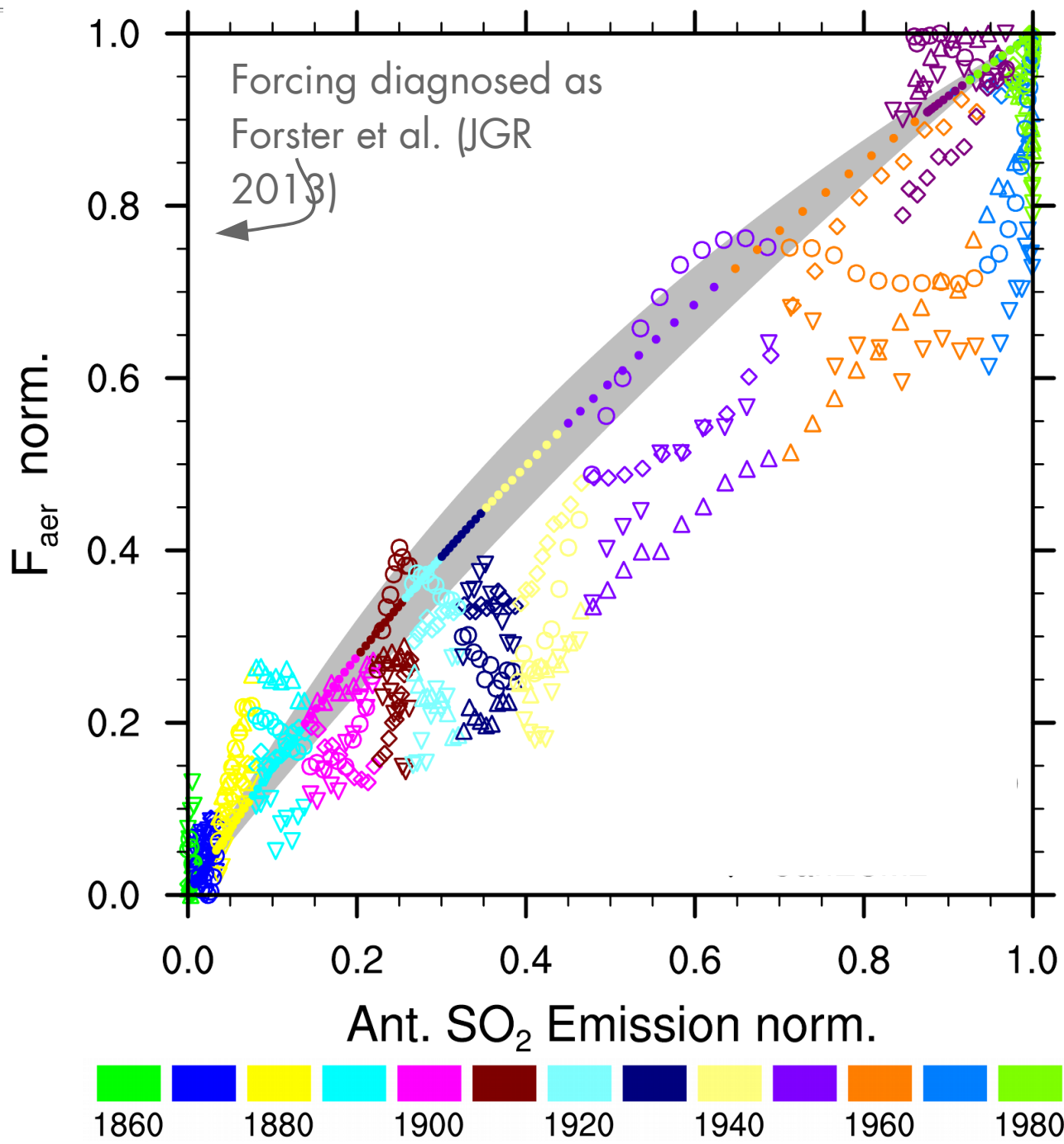
Constraint on lower bound ERF_{aer} :
total forcing > 0



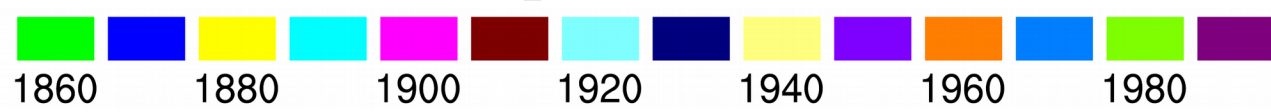








- Stevens
- GFDL-CM3
- △ CSIRO-Mk3
- ▽ NorESM1-M
- ◇ CanESM2



1950

2000

ERF (historicalAA) 1900-1950

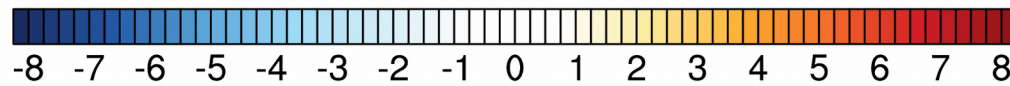
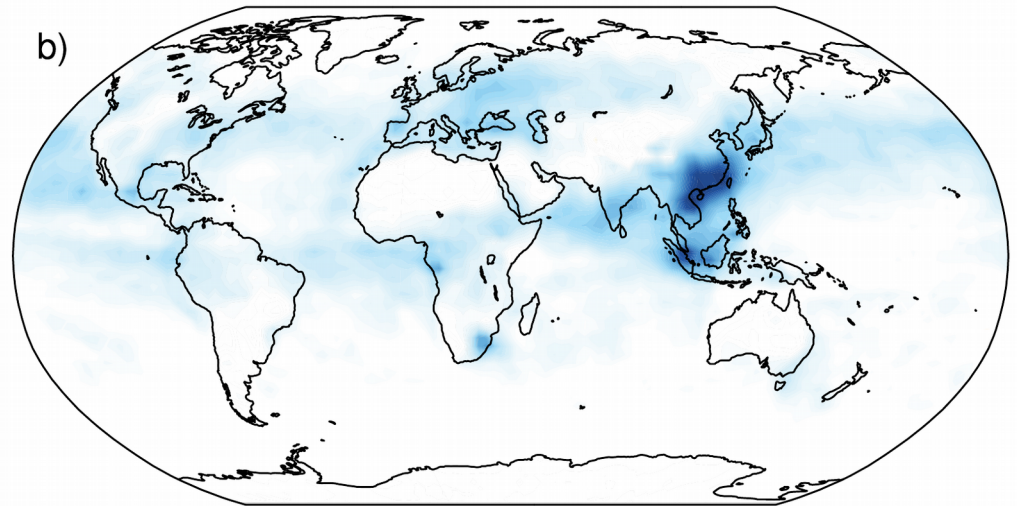
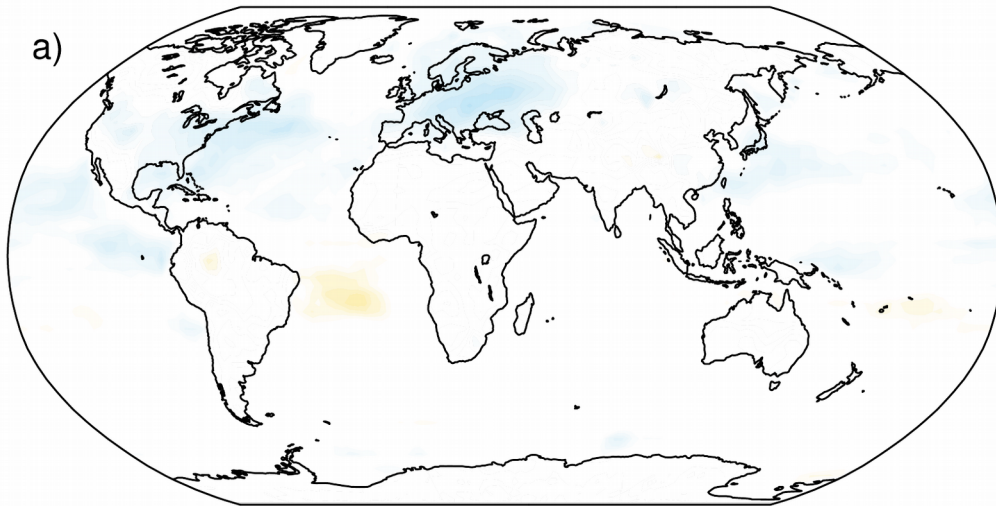
$W m^{-2}$

ERF (sstClimAerosol-sstClim)

$W m^{-2}$

a)

b)



See also Rotstayn, Collier, Shindell, Boucher, *J. Climate* 2015

Constraint on ERFaer from CMIP6?

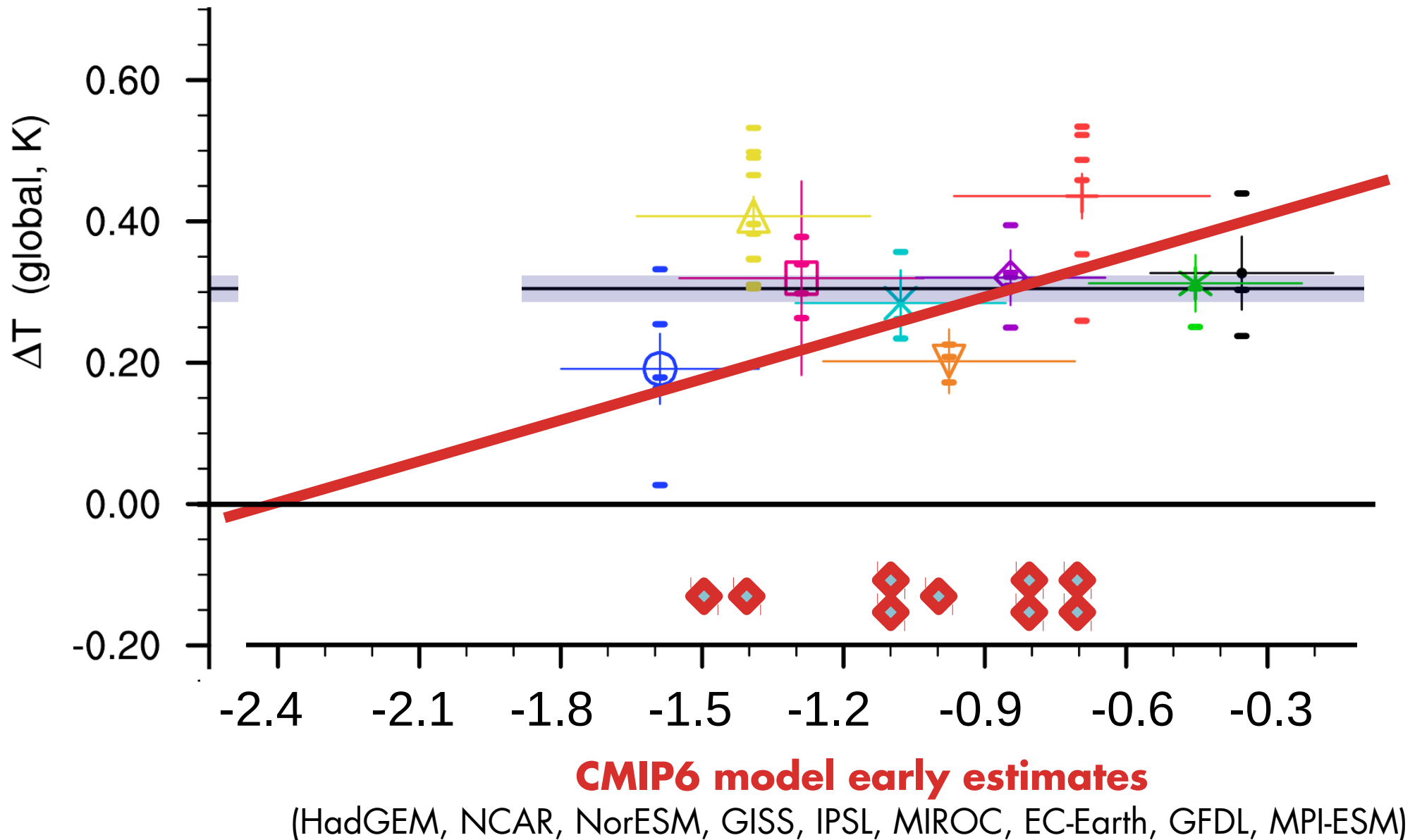


Table 5. RFMIP simulations with specified anthropogenic aerosols (SpAer). All simulations are all based on the MACv2-SP prescription of anthropogenic aerosol optical and cloud active properties. They are only to be performed to replicate other simulations in the DECK, within the ERF component of RFMIP, or within the Detection and Attribution Model Intercomparison Project (DAMIP) in the case when MACv2-SP is not used as the default aerosol climatology in the parent simulation.

Experiment Title	Experiment_id	Tier	Period (or years)	Members	Parallel Experiment_id
RFMIP-SpAerO3-all	hist-spAerO3-all	1	1850–2014	1 (4)	CMIP6 historical
RFMIP-SpAerO3-aer	hist-spAerO3-aer	2	1850–2014	4	Historical-Aer (DAMIP)
RFMIP-SpAerO3-ERF-anthro	piClim-spAerO3-anthro	2	30	1 (4)	piClim-anthro (RFMIP-ERF)
RFMIP-SpAerO3-ERF-aer	piClim-spAerO3-aerO3	2	30	1 (4)	piClim-aerO3 (RFMIP-ERF)
RFMIP-SpAerO3-ERF-histall	piClim-spAerO3-histall	2	1850–2014	1 (4)	piClim-histall (RFMIP-ERF)
RFMIP-SpAerO3-ERF-histaer	piClim-spAerO3-histaer	2	1850–2014	1 (4)	piClim-histaer (RFMIP-ERF)

IDEAS

It didn't happen that models accidentally simulated a cooling

- (according to poll this spring)

Conduct extra experiments with tuned-up aerosol forcing?

- EasyAerosol?
- Interactive-aerosol?
- My guess: with $ERF_{\text{aer, (2011 vs. 1850)}} < -1.6 \text{ Wm}^{-2}$ the 1950s cool



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THANK YOU

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FARBWERTE

Folgende Farben werden verwendet:

- Rot: 176 / 47 / 44



Zusätzlich für Diagramme und Tabellen:

- Hellrot: 214 / 66 / 66
- Hellblau: 138 / 194 / 209
- Hellgrau: 201 / 201 / 201
- Dunkelgrau: 38 / 42 / 49



Die angegebenen Werte gelten für den Farbraum RGB.

Untertitel – Arial Regular

ZWISCHENFOLIE OHNE BILD IN ARIAL BOLD

FORMATIERUNGSANMERKUNG

Zwischenüberschriften bzw. Überschriften und Fließtext werden beim Eintippen der ersten Textzeile automatisch formatiert.

- Aufzählungen können über die Schaltfläche „Aufzählungszeichen“ eingestellt werden.
- Nach einem Umbruch (Enter) erscheint ein weiteres Aufzählungszeichen.
 - Durch Drücken der Tabulatortaste wird der Text im Format der nächsten Gliederungsebene dargestellt.