FUTURE LEVELS OF AEROSOLS & RADIATIVE FORCING OVER THE ARCTIC

U. IM[1,2*], K. TSIGARIDIS[3,4], C.H. WHALEY[5], G.S. FALUVEGI[3,4], Z. KLIMONT[6], K. VON SALZEN[5]

*Aarhus University, Department of Environmental Science, Denmark

*Interdisciplinary Centre for Climate Change (iClimate), Department of Environmental Science, Denmark

AARHUS UNIVERSITY

IM, ULAS, PHD
SENIOR SCIENTIST

EGU2020
4-8/04/2020

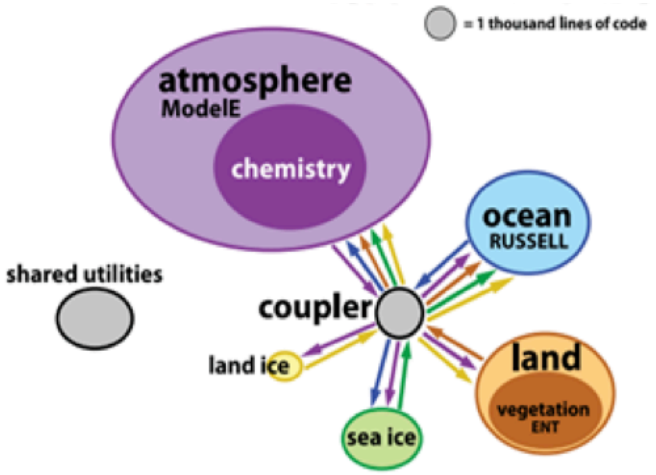
ARCTIC MONITORING & ASSESSMENT PROGRAMME (AMAP)

- AMAP is currently assessing the impacts of Short-Lived Climate Forcers (SLCF) on Arctic climate and air quality for the upcoming assessment report.
- provide projections of future air quality and climate over the Arctic using fully-coupled Earth System Models (ESM).
- In support of this task, we use five fully-coupled ESMs to simulate SLCF concentrations and their radiative forcing globally and impacts on climate change between 2015 and 2050.

Model	Horizontal Resolution	Levels	No. of Ens.
CESM2	1.9 x2.5	70	4
GISS ModelE2	2.0 x2.5	40	3
MRI-ESM2	1.125 x1.125	80	5
NorESM-HAPPI	0.9 x1.25	26	3
UKESM	1.875x1.25	85	3

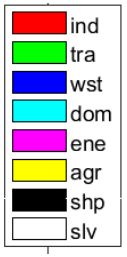
EARTH SYSTEM MODEL

- NASA GISS modelE2.1.1 (CMIP6 version: *Kelly et al., 2020*)
- Fully-coupled ESM
- Atmosphere/Land/Ice:
  - 2°×2.5° spatial resolution, 40 vertical layers
- Ocean (GISS Ocean V1):
  - 1°×1.25° spatial resolution, 40 vertical layers
- One Moment Aerosol (OMA: *Bauer & Tsigaridis, 2020)*
- Direct & First indirect effect (droplet concentration caused by increases in CCN)

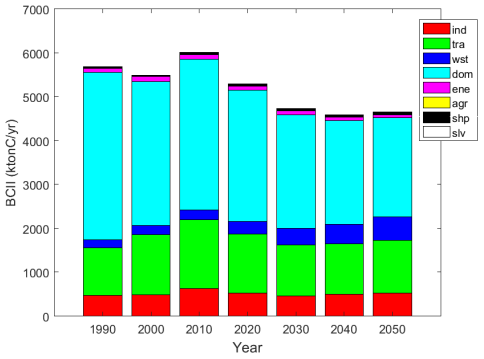


EMISSIONS

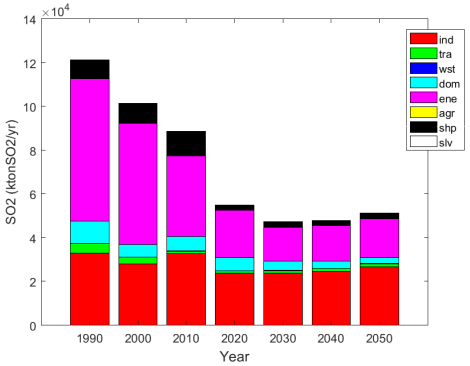
- ECLIPSE v6b, 0.5°× 0.5°, monthly
- Baseline emissions: 1990-2014
- Current Legislation (CLE): 2015-2050
- Maximum Feasible Reduction (MFR): 2020-2050



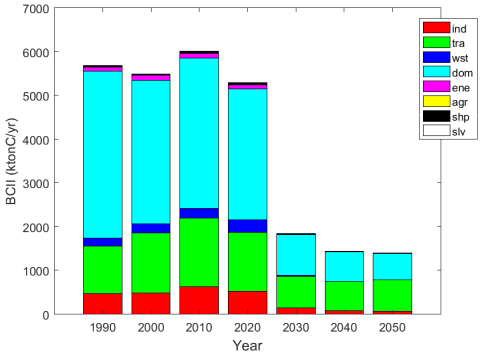
BC - CLE



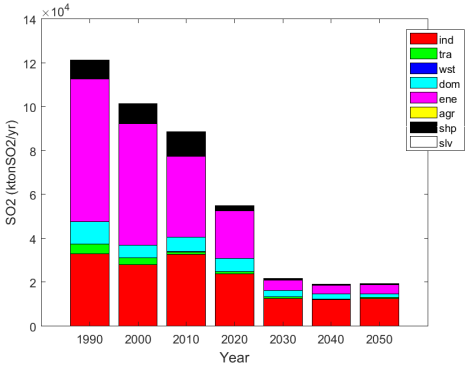
SO_2 - CLE

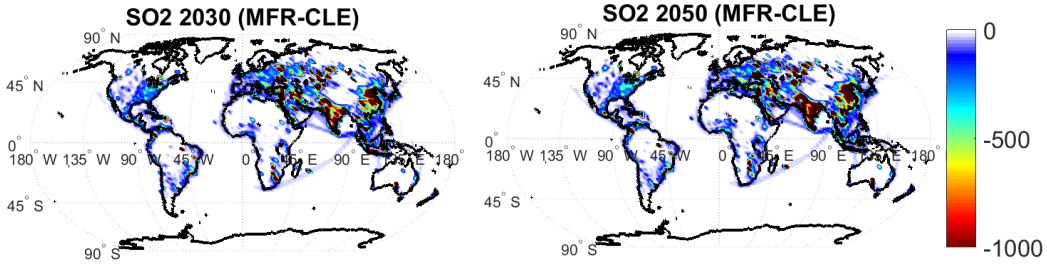


BC - MFR



SO_2 - MFR

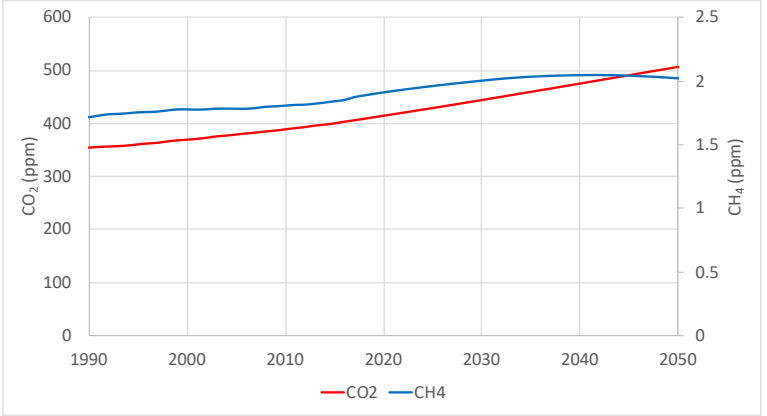


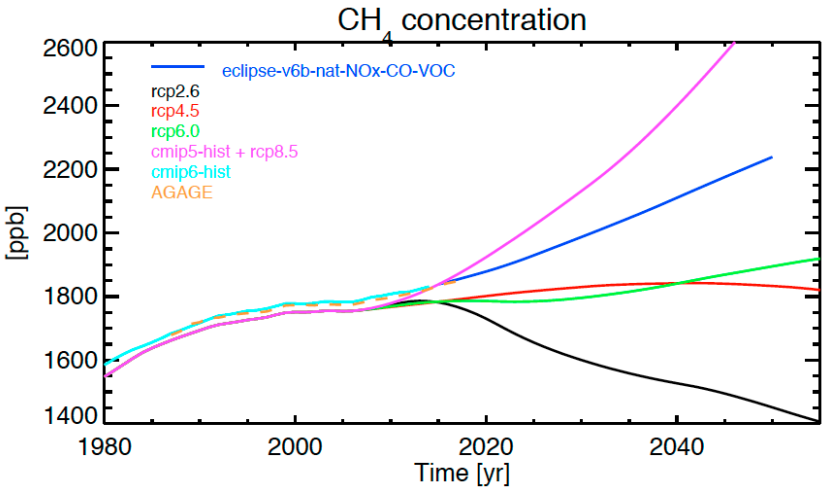


SIMULATIONS

- 3 simulations, each with 3 ensemble members:
  - Historical: 1990-2014
  - CLE: 2015-2050
  - MFR: 2020-2050

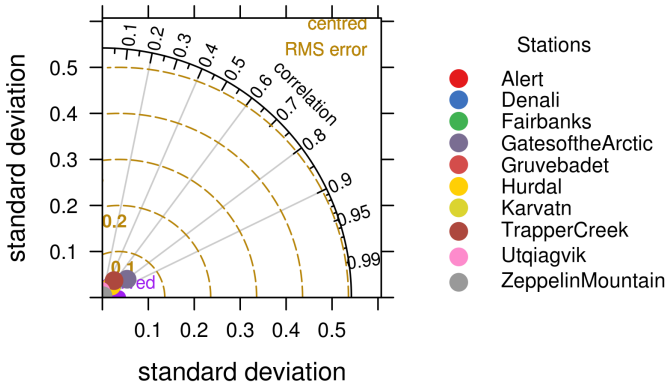
- Prescribed CH_4 (ECLIPSE-v6b-nat: *Olive, 2019*)



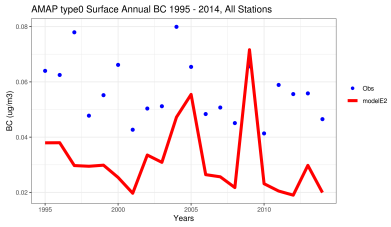


EVALUATION

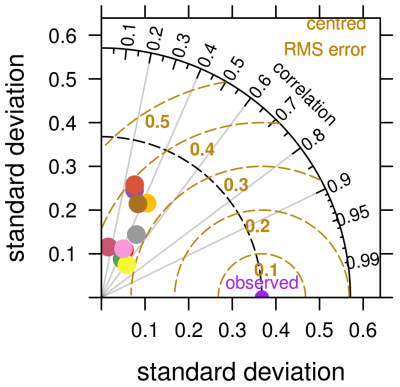
BC: NMB=-60% [-95%, +4%]



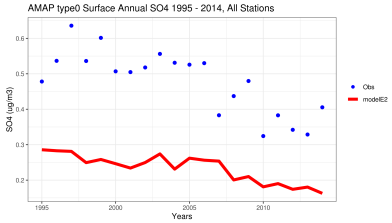
BC All Stations Mean



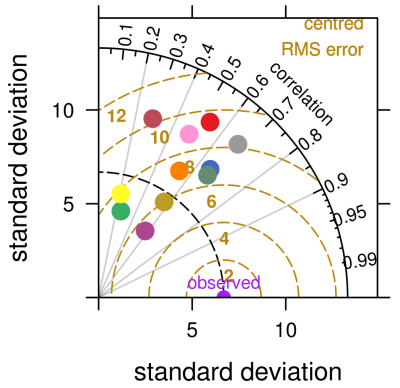
SO_4: NMB=-42% [-72%, +39%]

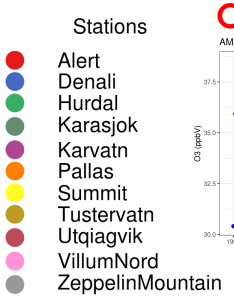


SO_4 All Stations Mean

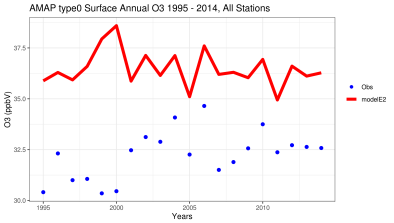


O_3 : NMB=14% [-1%, +39%]

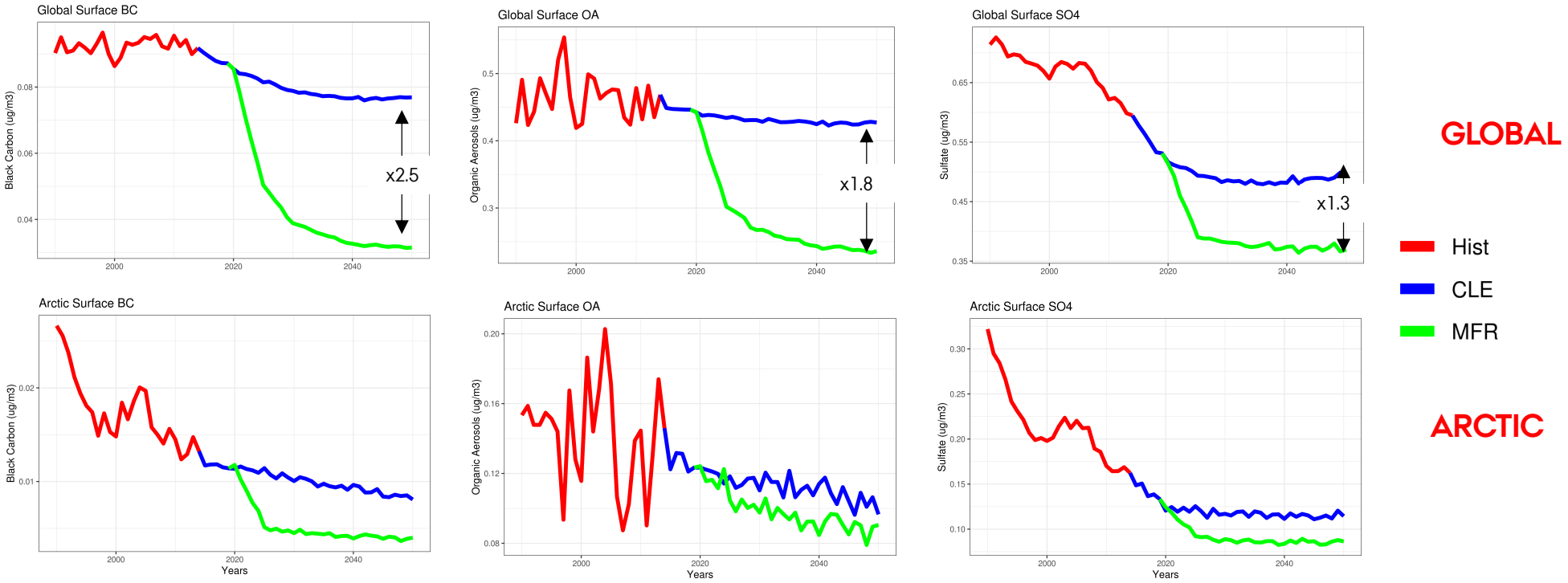




O_3 All Stations Mean

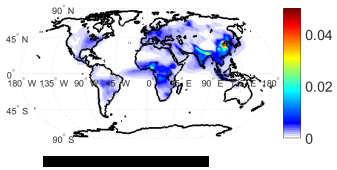


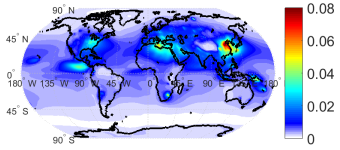
GLOBAL & ARCTIC AEROSOL LEVELS



FUTURE AEROSOL RESPONSE

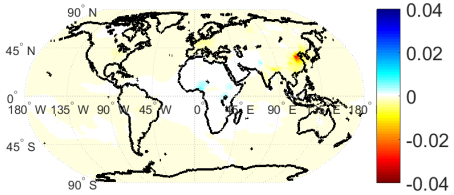
HIST: 2000-2010
NEAR: 2020-2030
MID: 2040-2050



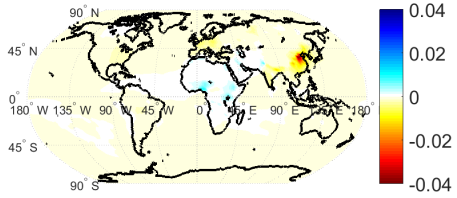


CLE

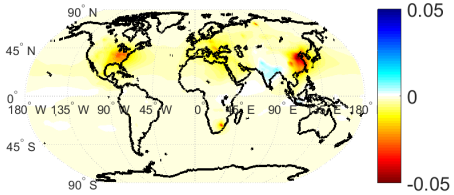
BC NEAR-HIST (-11/-34%)



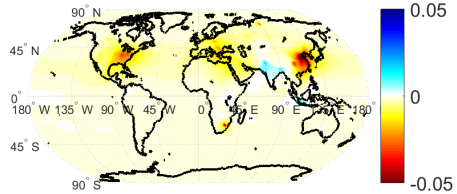
BC MID-HIST (-17/-48%)



SO_4 NEAR-HIST (-25/-41%)

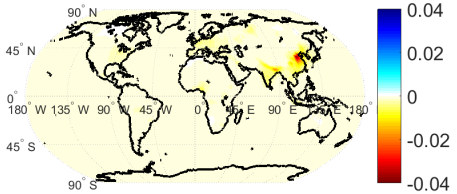


SO_4 MID-HIST (-26/-44%)

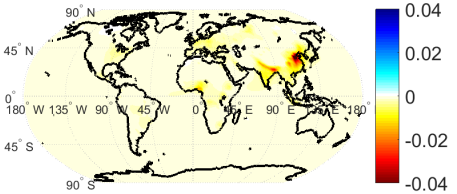


MFR

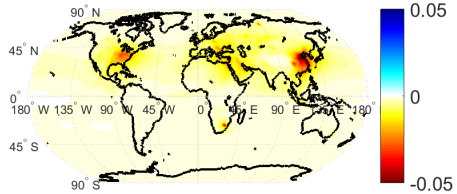
BC NEAR-HIST (-37/-58%)



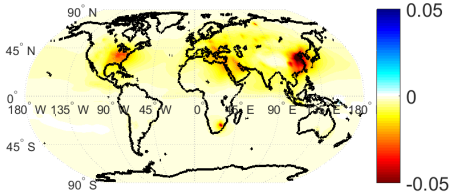
BC MID-HIST (-66/-76%)



SO_4 NEAR-HIST (-36/-50%)



SO_4 MID-HIST (-44/-58%)



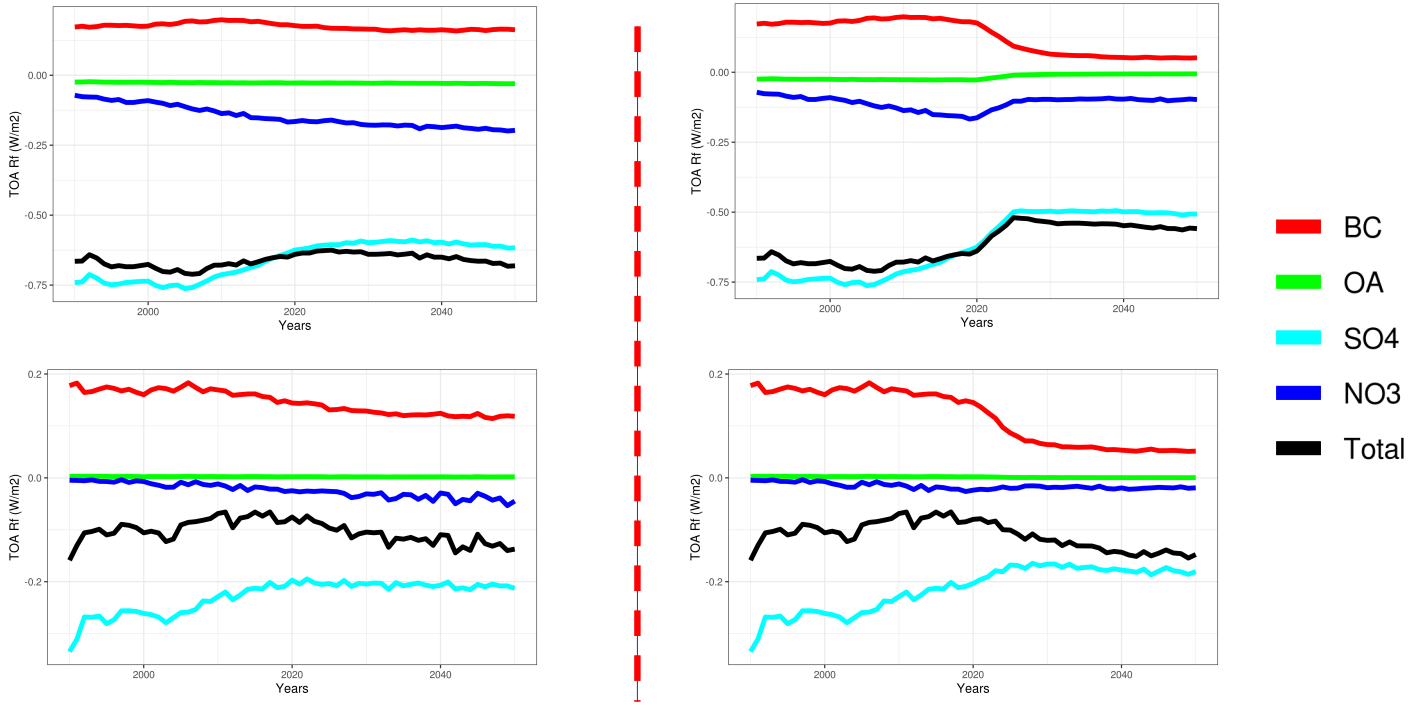
TOA ANTHROPOGENIC AEROSOL RADIATIVE FORCING

HIST+CLE

HIST+MFR

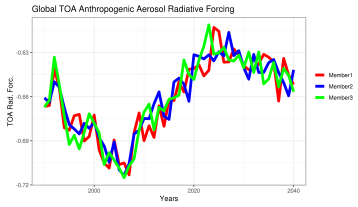
GLOBAL

ARCTIC

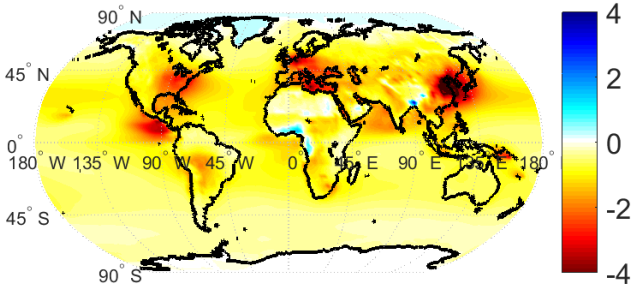


TOA AEROSOL RADIATIVE FORCING

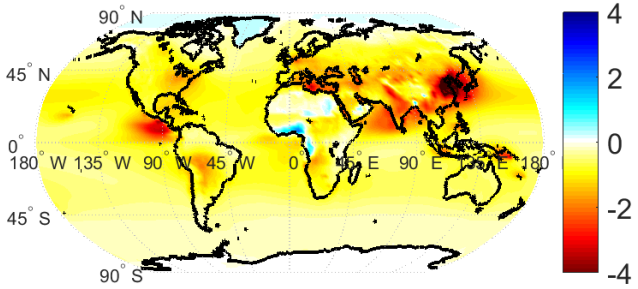
HIST: 2000-2010
NEAR: 2020-2030
MID: 2040-2050



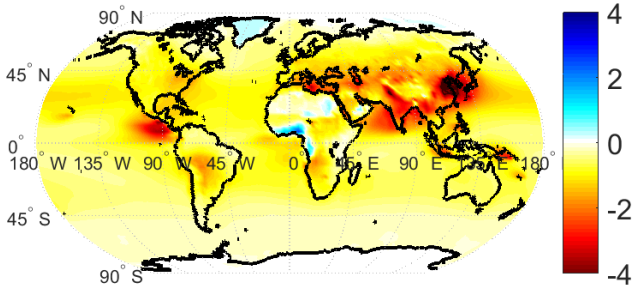
HIST (-0.70/-0.1 Wm^{-2})



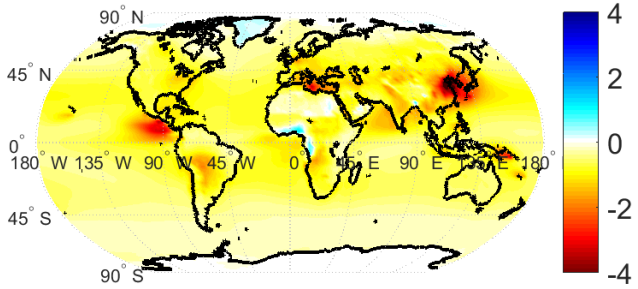
CLE NEAR (-0.63/-0.09 Wm^{-2})



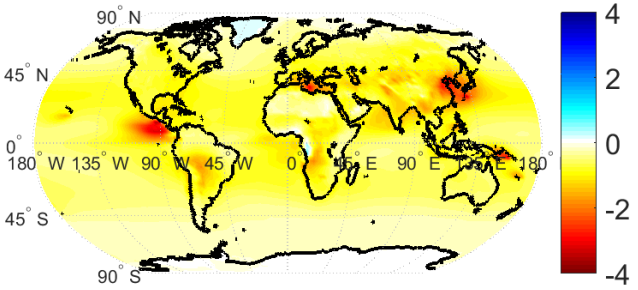
CLE MID (-0.67/-0.13 Wm^{-2})



MFR NEAR (-0.56/-0.1 Wm^{-2})



MFR MID (-0.56/-0.15 Wm^{-2})



ACKNOWLEDGEMENTS

Ministry of Environment and Food of Denmark
Environmental Protection Agency

Danish Energy Agency

Nordic Co-operation

Working Group of the Arctic Council

AMAP / ARCTIC MONITORING & ASSESSMENT PROGRAMME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