Aerosols at the Poles

An AeroCom Phase II multi-model evaluation

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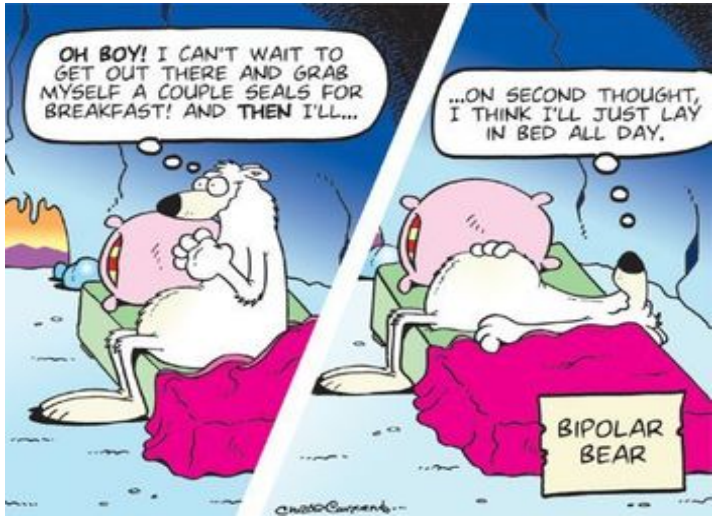
2nd draft to be circulated shortly after this meeting, aiming for ACP

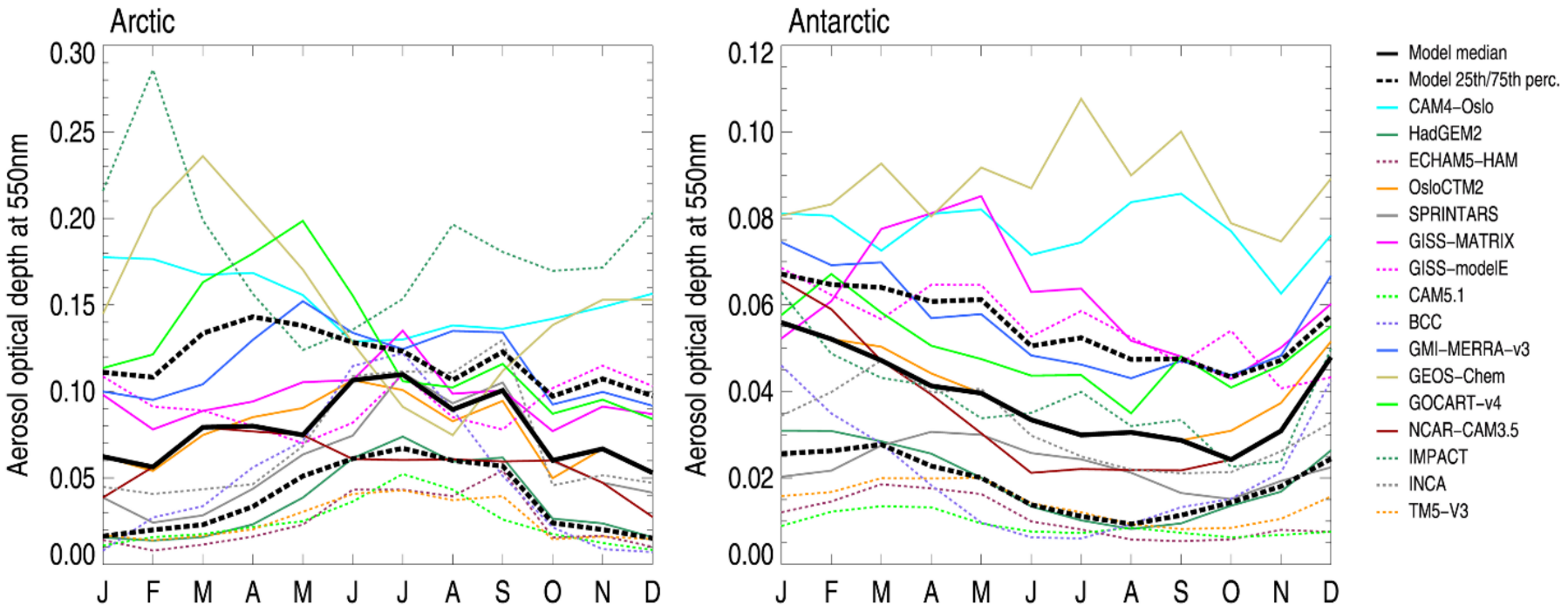
«I hate aerosols. They're coarse and irritating, and they get everywhere»

Anakin Skywalker

- Overview study of AeroCom Phase II model performance at both poles
- 16 models (though not all have reported all species)
- BC, SO4, BB, POM, SOA, NO3, SS, Dust
- Results on:
  - Total AOD from models vs observations
  - Individual species AOD and RF, annual and seasonal
  - Regional forcing efficiency
  - Arctic BC sensitivity study with GISS-modelE on e-folding time and regional emissions

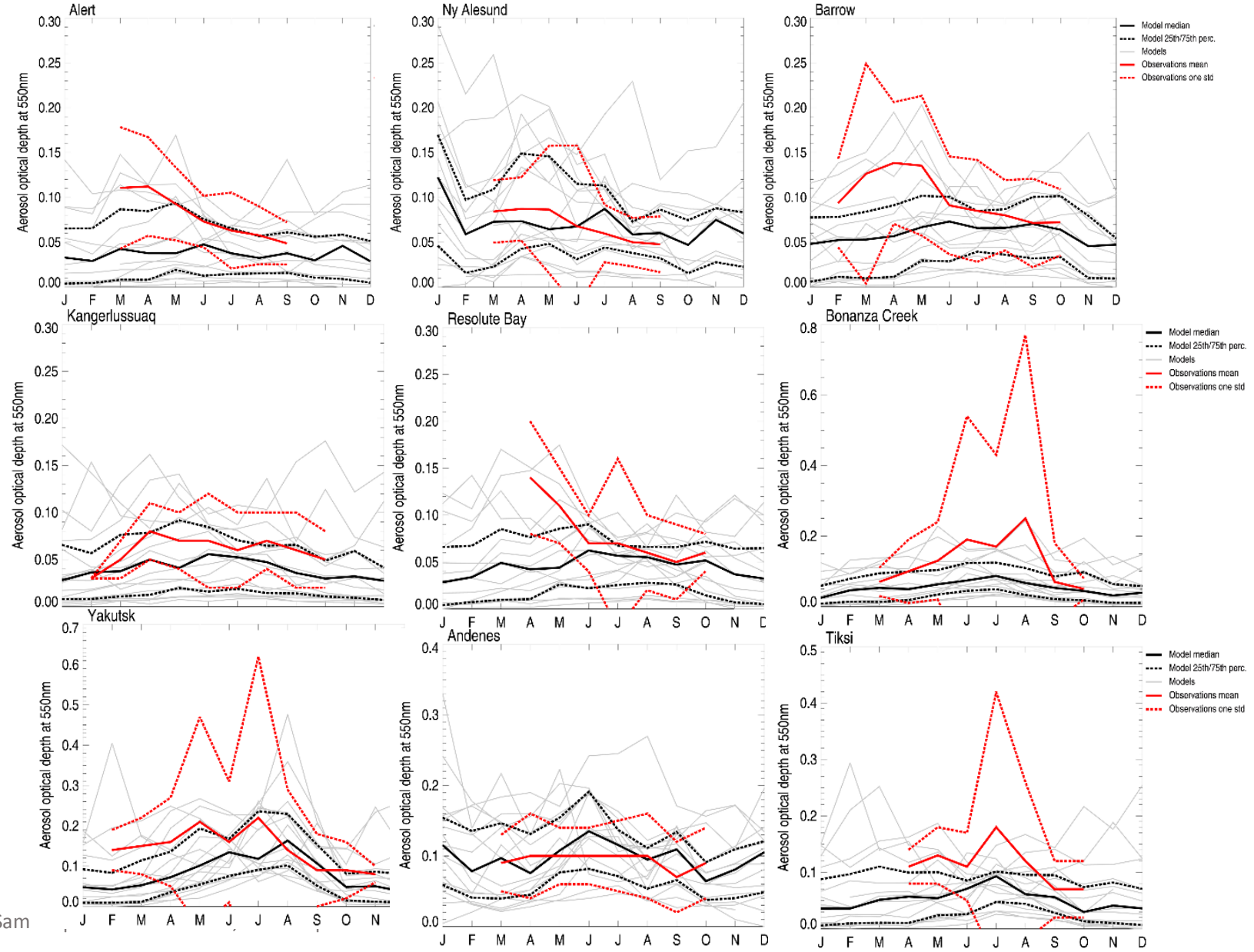


Total aerosol AOD, seasonal

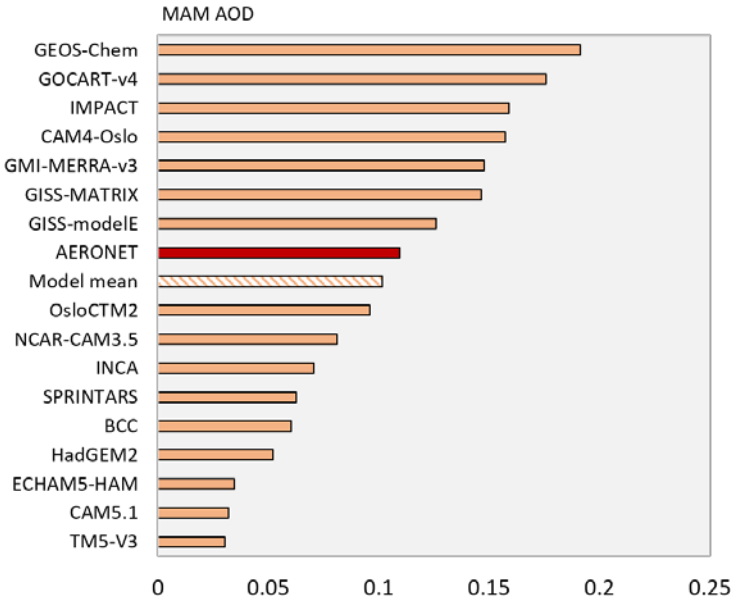


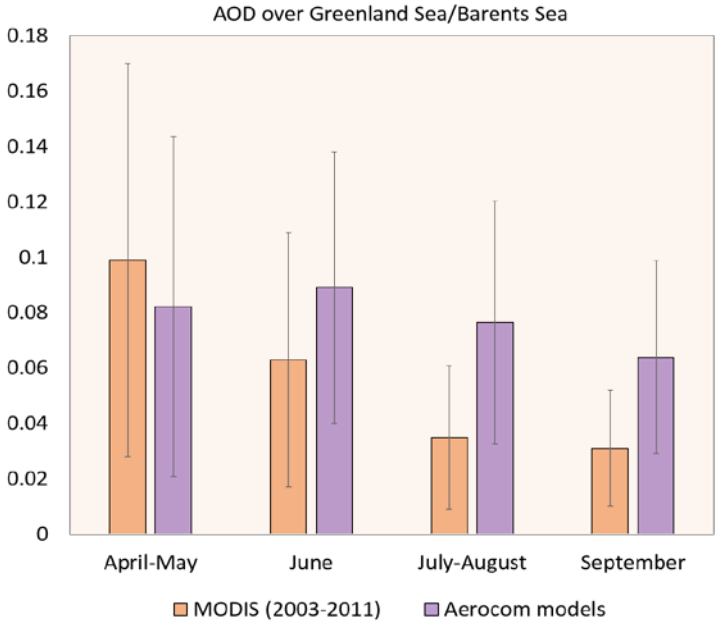
Total aerosol AOD, seasonal, vs Arctic AERONET sites

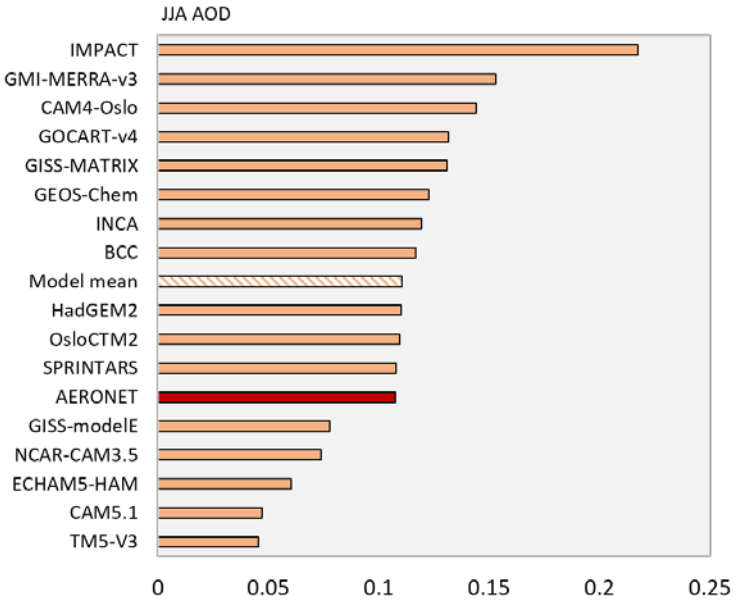
(Closest grid box, modeled 2006 vs obs climatology)



Seasonal multi-model averages vs. observations

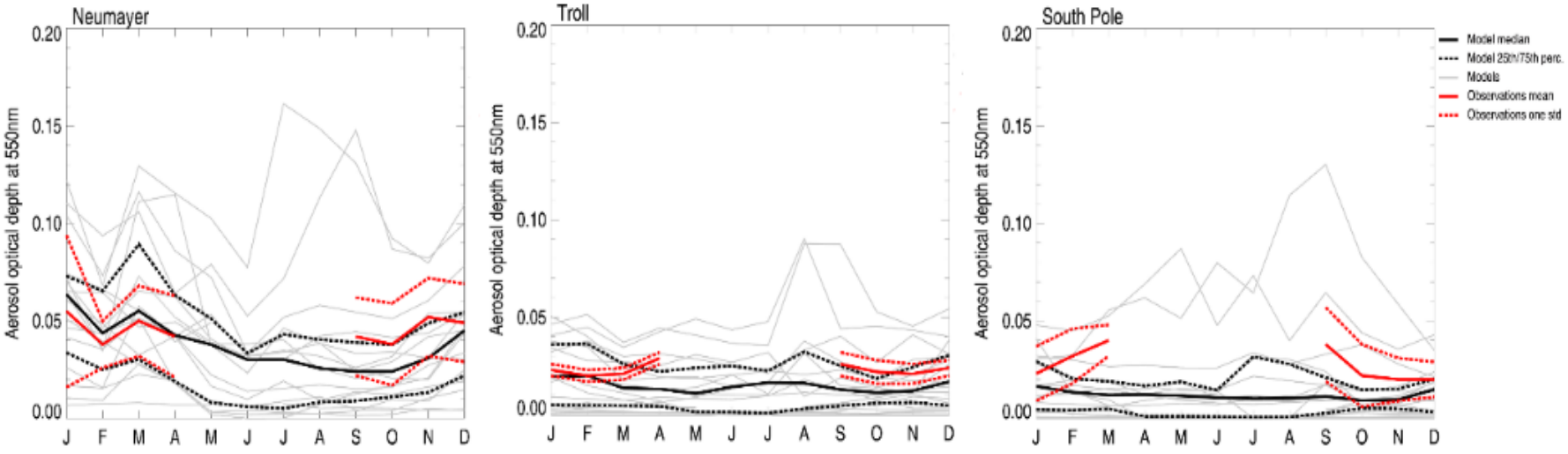






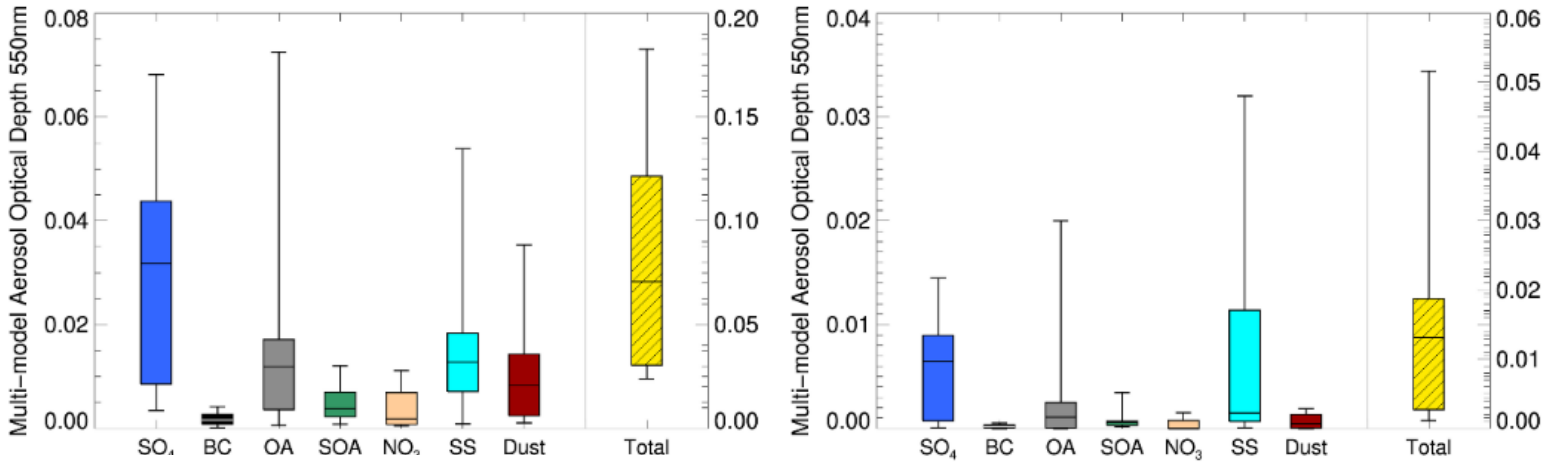
Total aerosol AOD, seasonal, vs Abtarctic AERONET sites

(Closest grid box, modeled 2006 vs obs climatology)

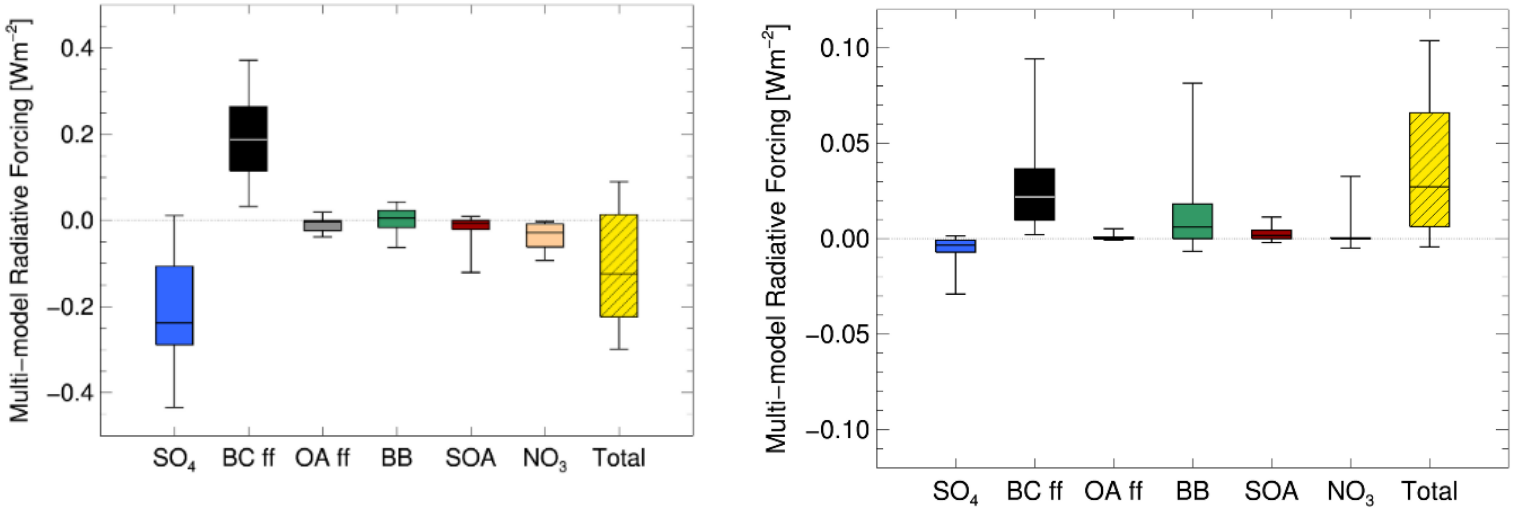


Multi-model AOD and IRF (direct)

AOD



RF



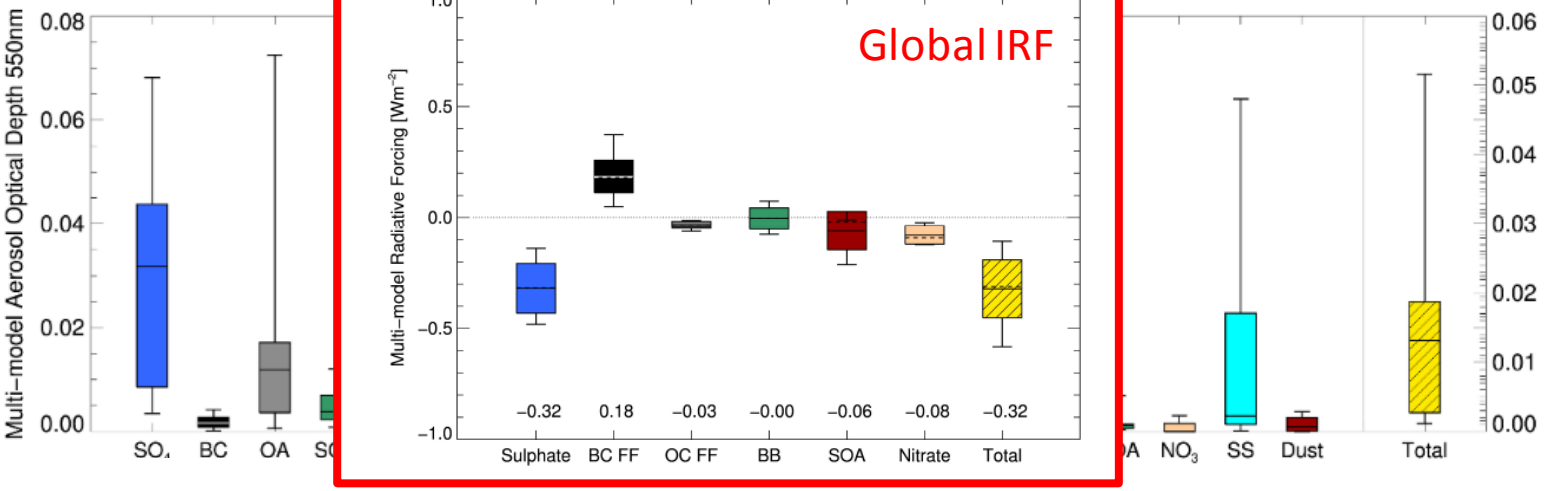
Arctic (60N-90N)

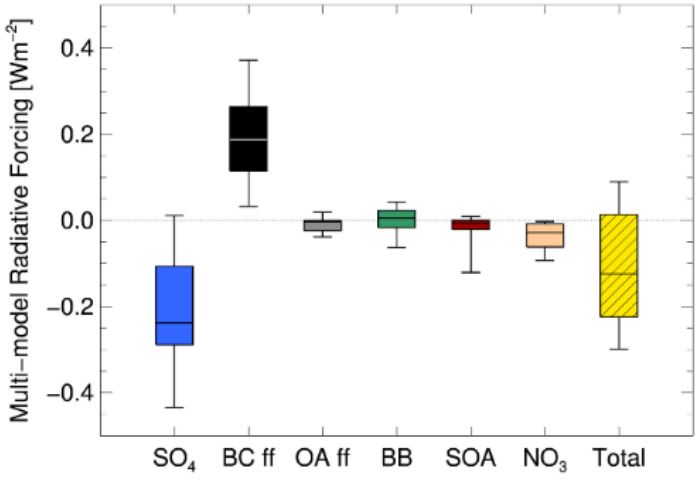
Antarctic (70S-90S)

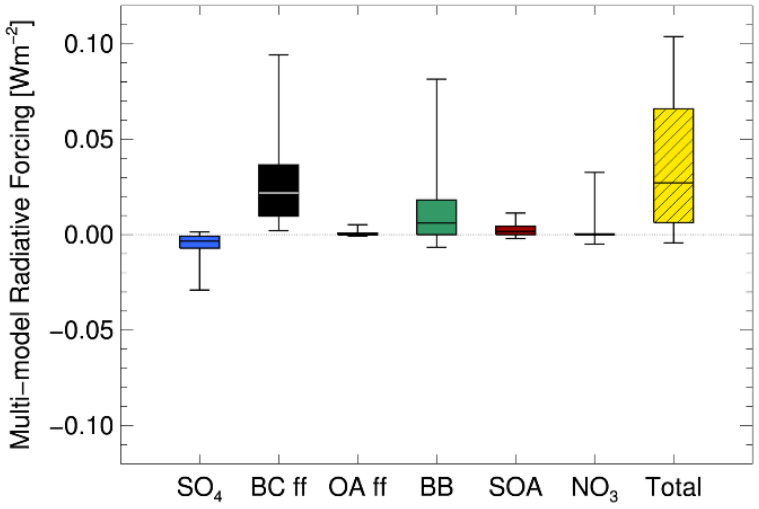
Multi-model AOD and IRF (direct)

AOD

RF

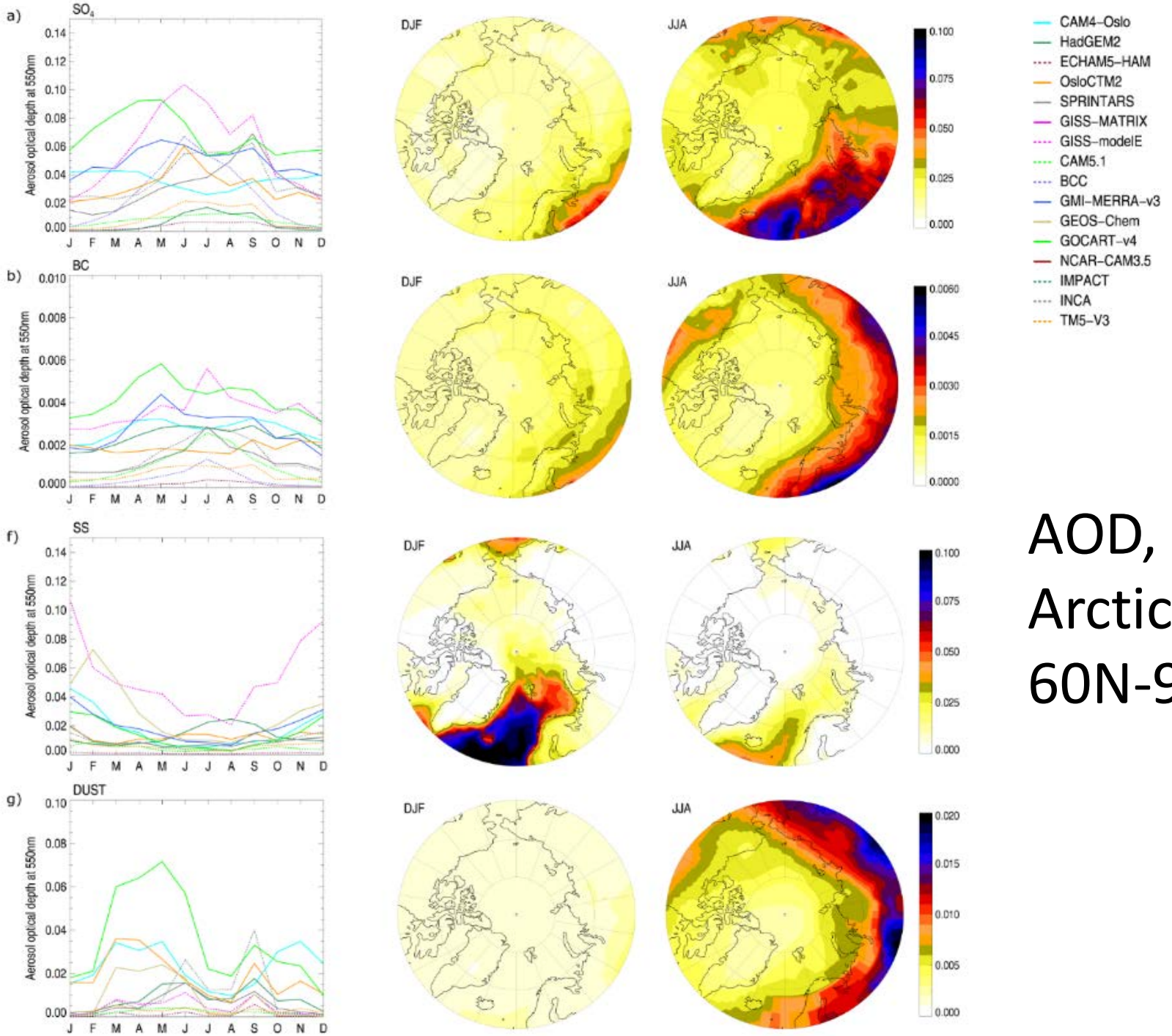




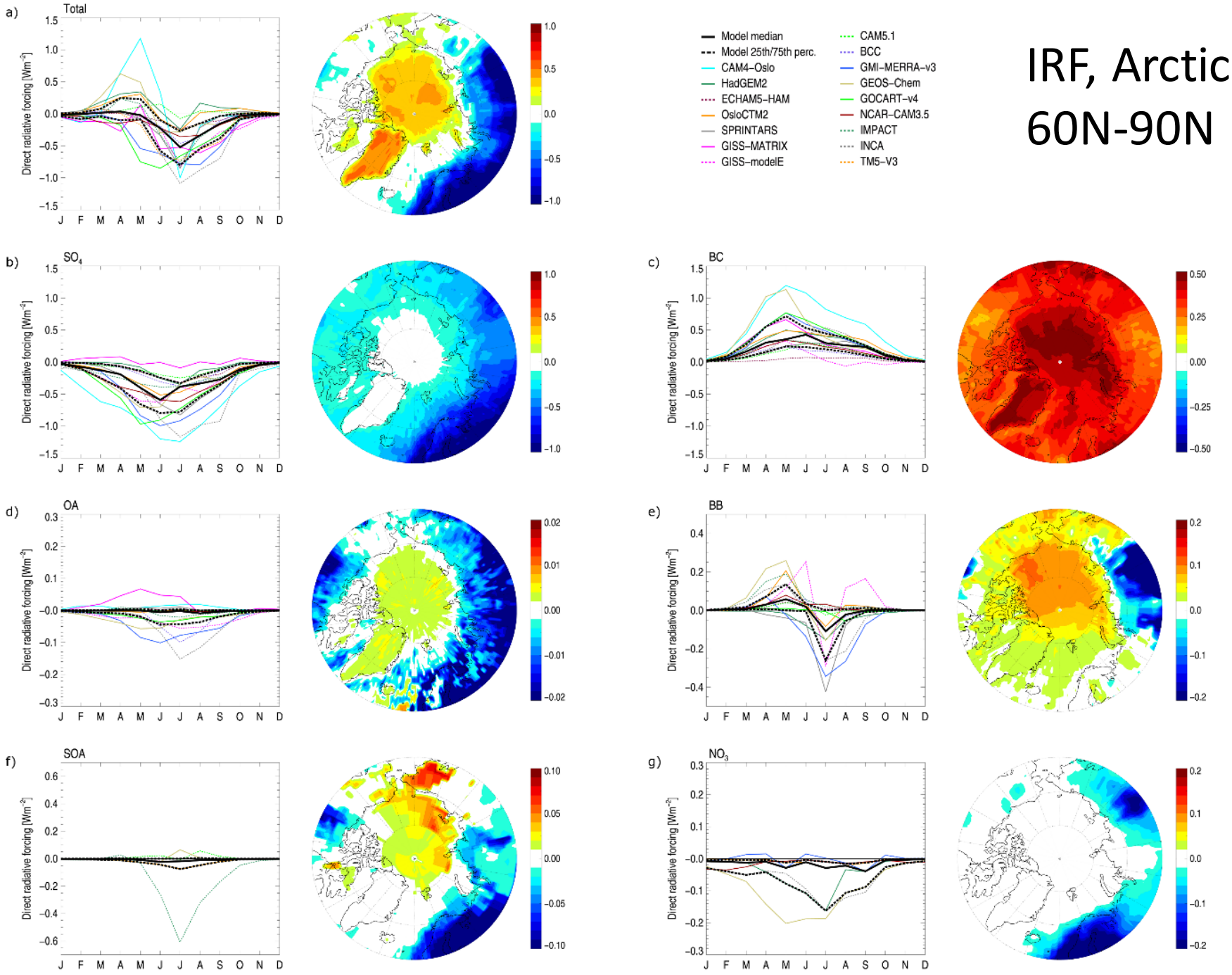


Arctic (60N-90N)

Antarctic (70S-90S)

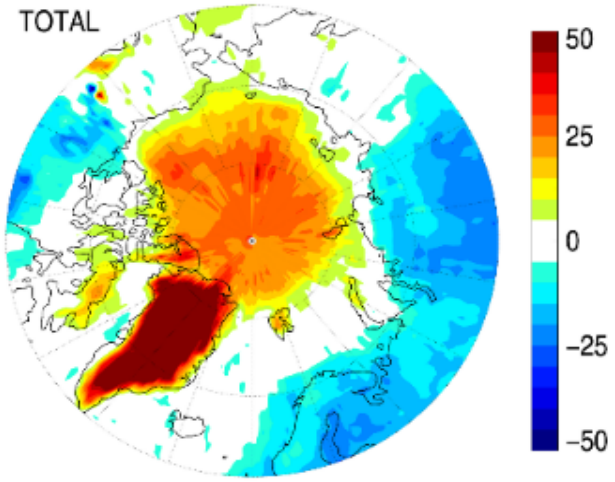


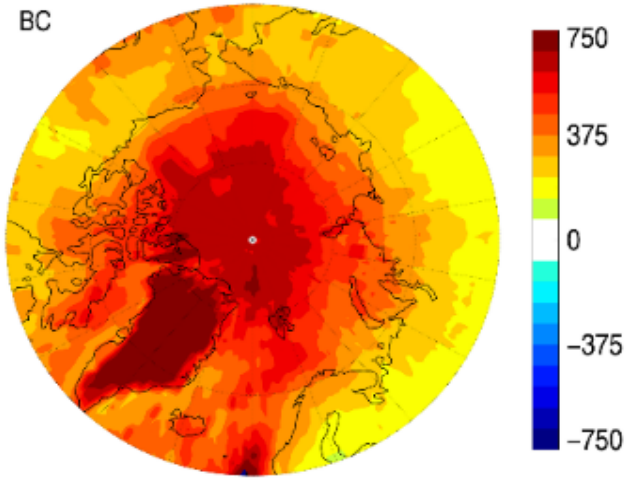
AOD, Arctic, 60N-90N

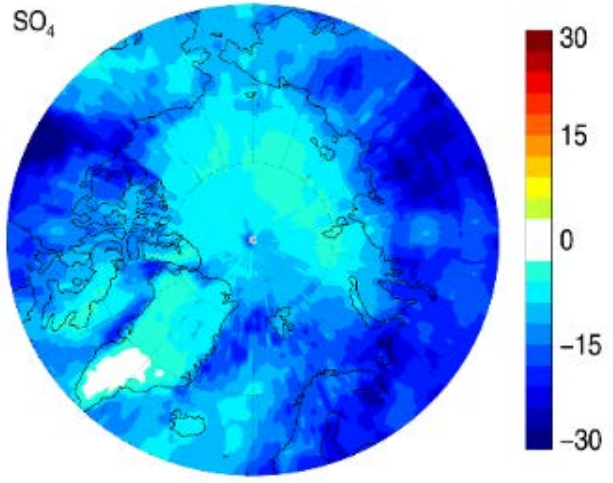


IRF, Arctic 60N-90N

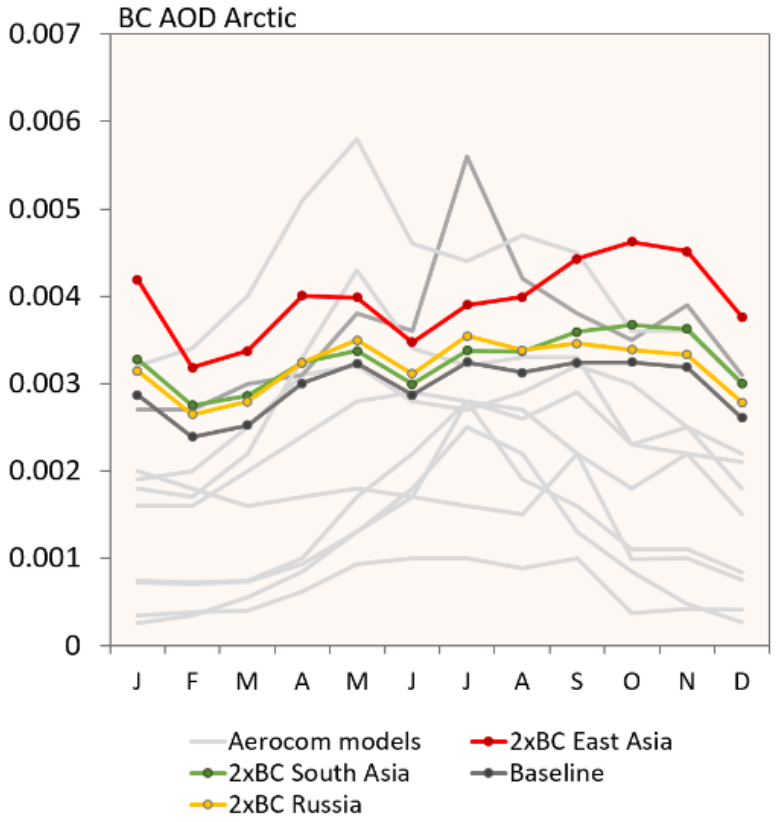
IRF per AOD
Arctic
60N-90N

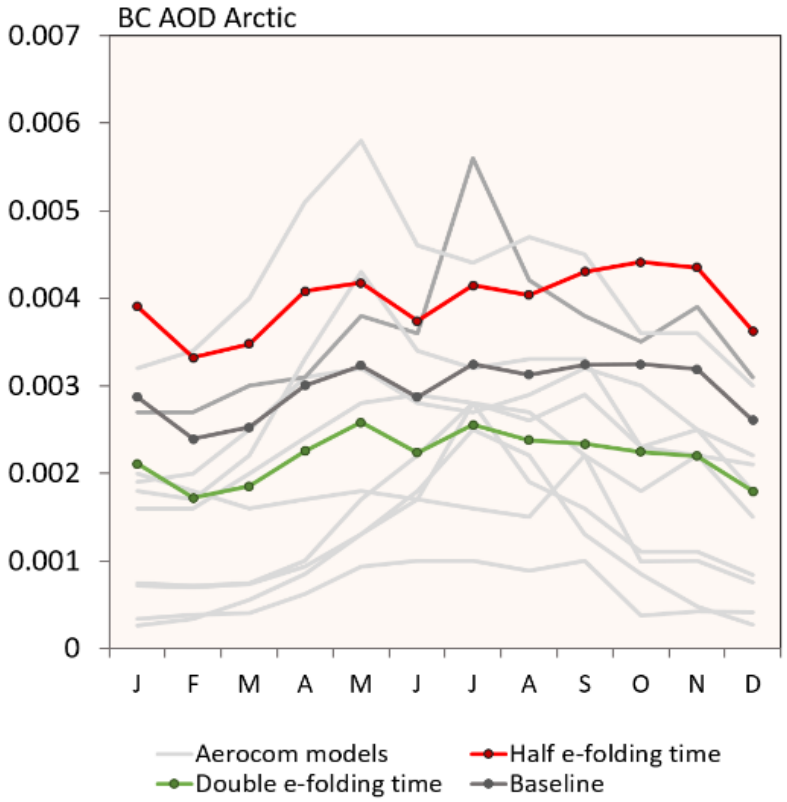


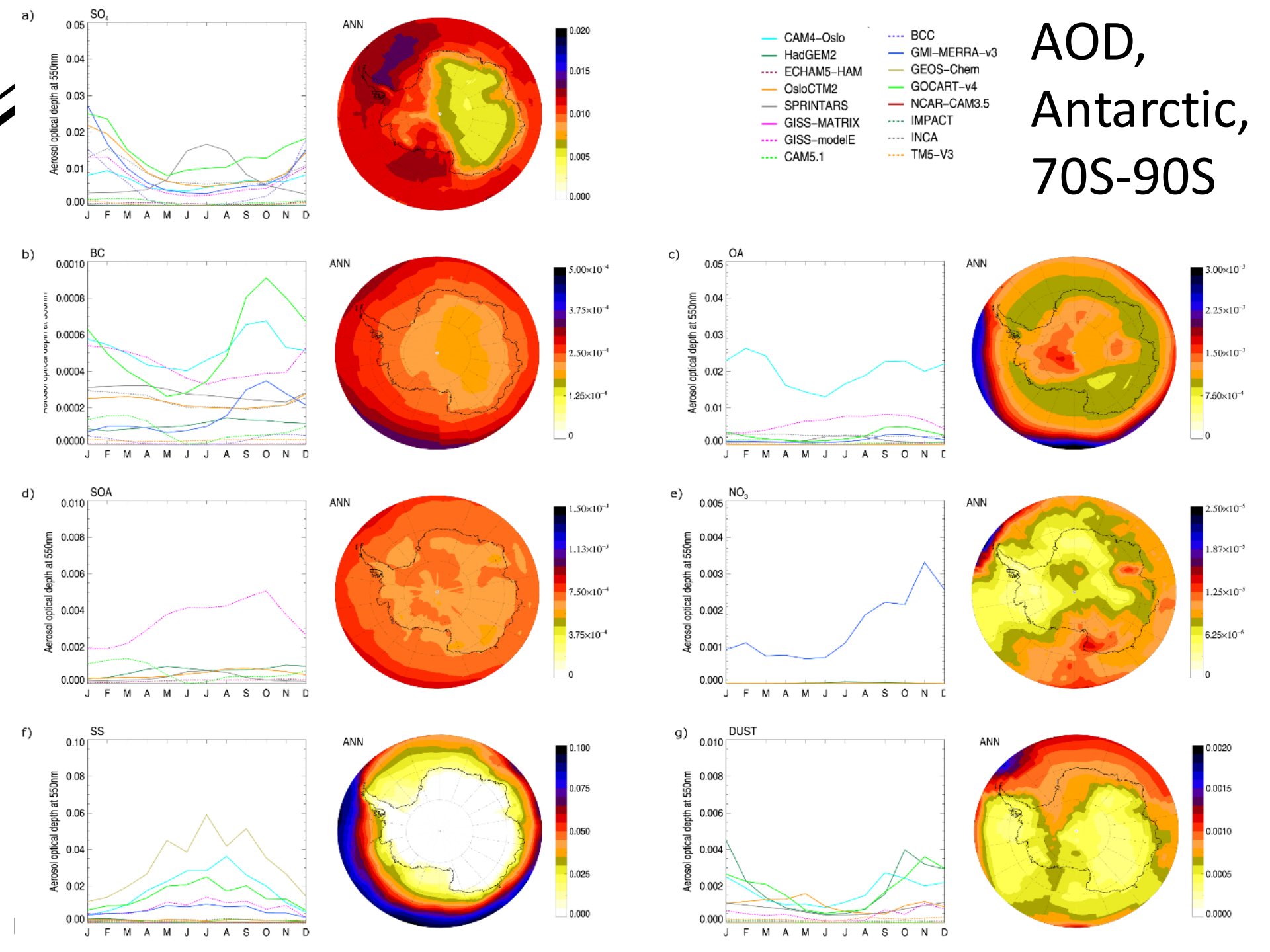




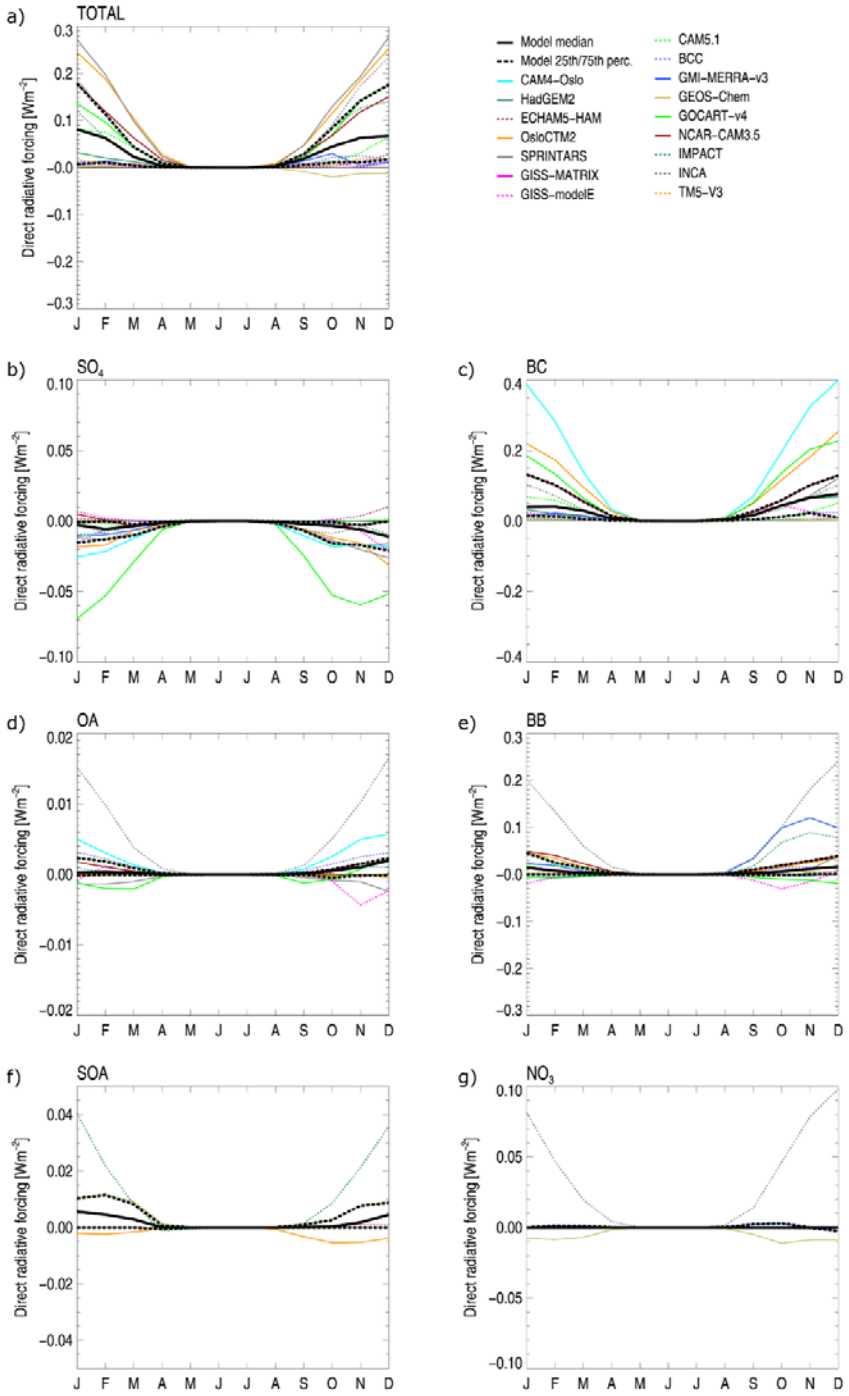
Arctic BC AOD: Sensitivity studies with GISS

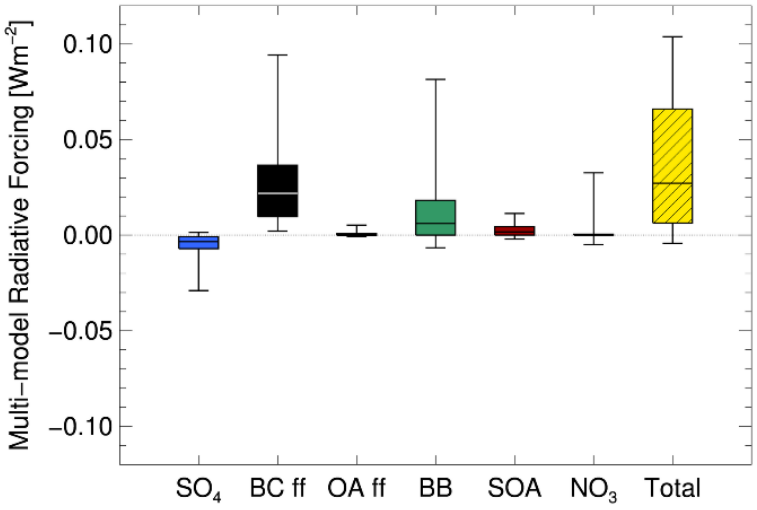





a)
SO4
Aerosol optical depth at 550nm
J F M A M J J A S O N D
ANN
0.020
0.015
0.010
0.005
0.000
CAM4-Oslo
HadGEM2
ECHAM5-HAM
OsloCTM2
SPRINTARS
GISS-MATRIX
GISS-modelE
CAM5.1
BCC
GMI-MERRA-v3
GEOS-Chem
GOCART-v4
NCAR-CAM3.5
IMPACT
INCA
TM5-V3
AOD, Antarctic, 70S-90S
b)
BC
c)
OA
d)
SOA
e)
NO3
f)
SS
g)
DUST

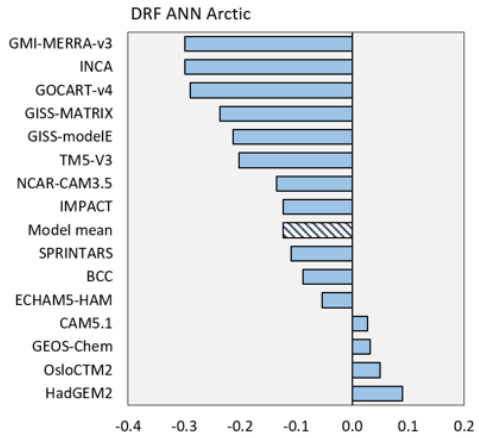
IRF, Antrctic 70S-90S Seasonal

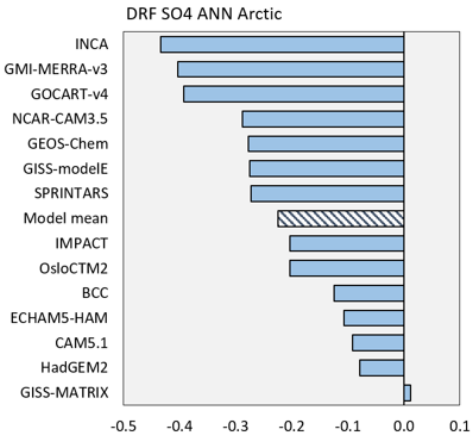


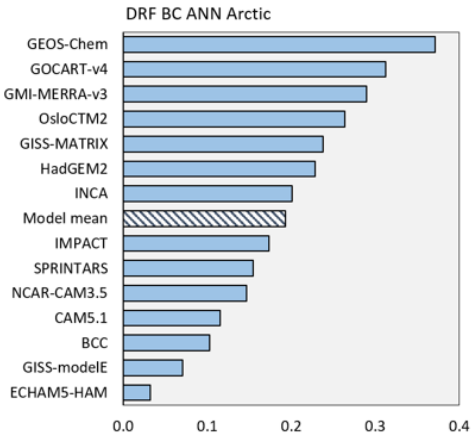


Conclusions

- Aerosols do get everywhere… (According to AeroCom Phase II at least)
- Multi-model mean AOD is close to Arctic/Antarctic observations, but intermodel spread is large
- Multi-model total direct aerosol RF is negative in the Arctic, driven by sulphate, positive in the Antarctic, driven by BC from fossil fuel sources
- Sensitivity experiments on BC regional emissons and lifetime can't fully explain the Arctic muli-model diversity


DRF ANN Arctic
GMI-MERRA-v3
INCA
GOCART-v4
GISS-MATRIX
GISS-modelE
TM5-V3
NCAR-CAM3.5
IMPACT
Model mean
SPRINTARS
BCC
ECHAM5-HAM
CAM5.1
GEOS-Chem
OsloCTM2
HadGEM2
-0.4 -0.3 -0.2 -0.1 0.0 0.1 0.2


DRF SO4 ANN Arctic
INCA
GMI-MERRA-v3
GOCART-v4
NCAR-CAM3.5
GEOS-Chem
GISS-modelE
SPRINTARS
Model mean
IMPACT
OsloCTM2
BCC
ECHAM5-HAM
CAM5.1
HadGEM2
GISS-MATRIX
-0.5 -0.4 -0.3 -0.2 -0.1 0.0 0.1


DRF BC ANN Arctic
GEOS-Chem
GOCART-v4
GMI-MERRA-v3
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Model mean
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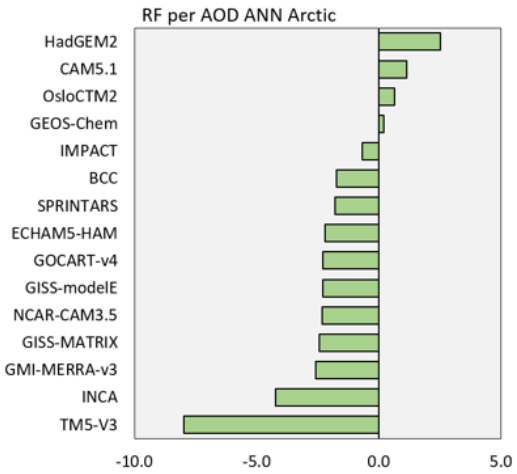
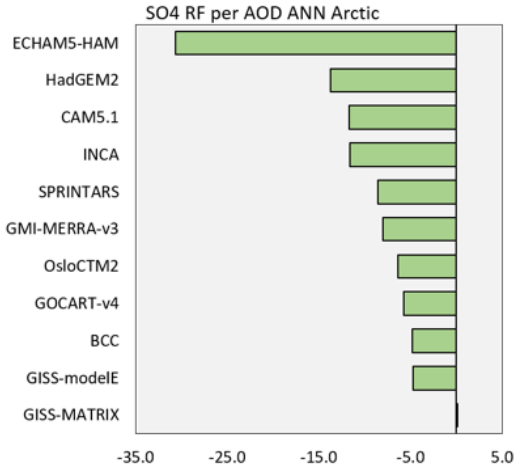
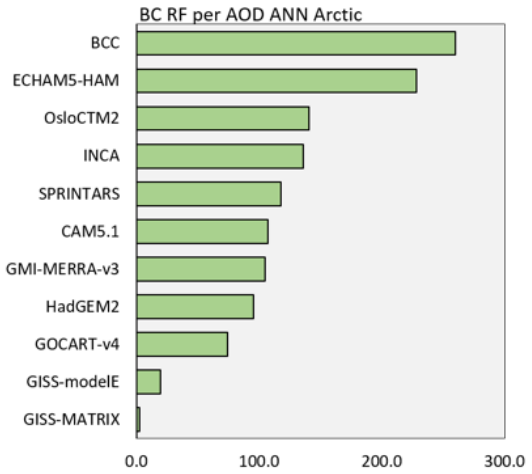
ECHAM5-HAM
0.0 0.1 0.2 0.3 0.4


RF per AOD ANN Arctic
HadGEM2
CAM5.1
OsloCTM2
GEOS-Chem
IMPACT
BCC
SPRINTARS
ECHAM5-HAM
GOCART-v4
GISS-modelE
NCAR-CAM3.5
GISS-MATRIX
GMI-MERRA-v3
INCA
TM5-V3
-10.0 -5.0 0.0 5.0


SO4 RF per AOD ANN Arctic
ECHAM5-HAM
HadGEM2
CAM5.1
INCA
SPRINTARS
GMI-MERRA-v3
OsloCTM2
GOCART-v4
BCC
GISS-modelE
GISS-MATRIX
-35.0 -25.0 -15.0 -5.0 5.0


BC RF per AOD ANN Arctic
BCC
ECHAM5-HAM
OsloCTM2
INCA
SPRINTARS
CAM5.1
GMI-MERRA-v3
HadGEM2
GOCART-v4
GISS-modelE
GISS-MATRIX
0.0 100.0 200.0 300.0