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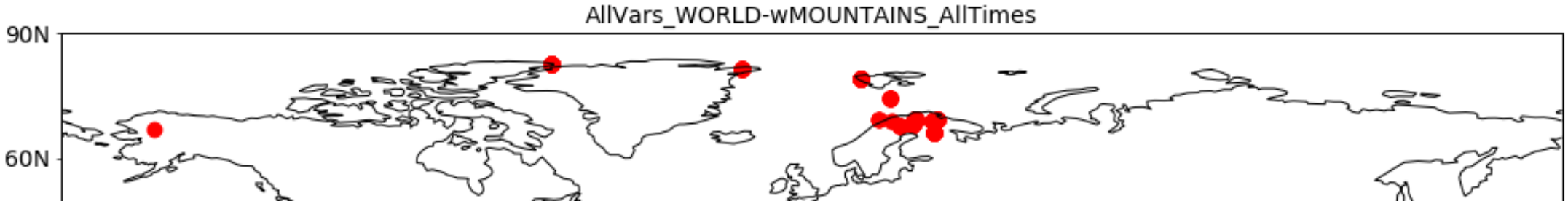
AOD biases in climate models

- Group 2
- Assistant (and my saviour): Jonas Gliß
- Work connected to Ingeborg R. Julsrud

UiO : Universitetet i Oslo

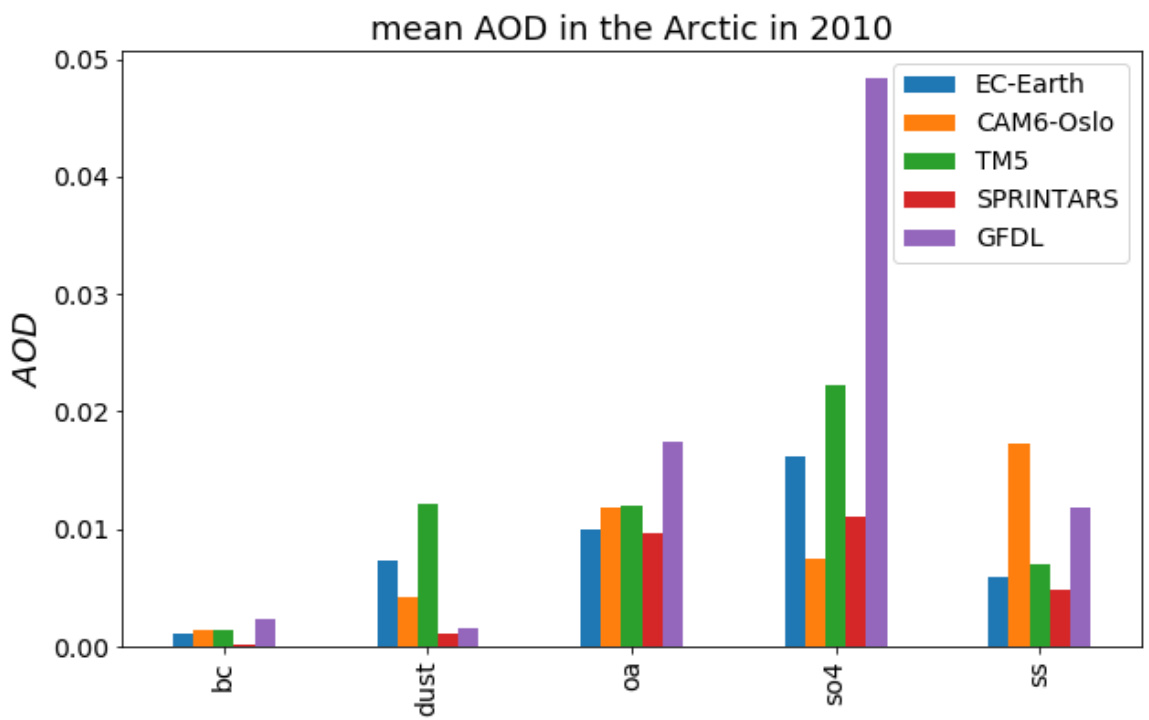
Methods

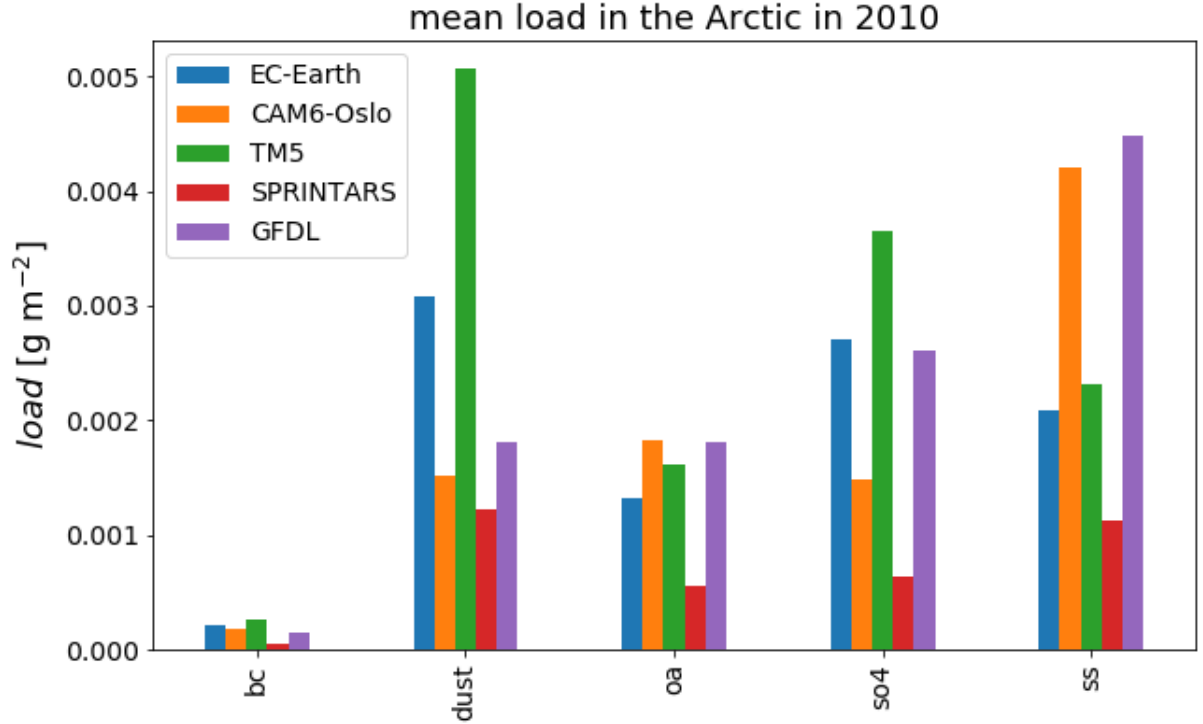
- Model data from AeroCom CTRL 2019: GFDL, NorESM (CAM6-Oslo), EC-Earth, SPRINTARS, TM5
- Observation data from EBAS (surf. Conc. SO4, SS)
- Aerosol species: sea salt (ss), sulfate (SO_4), black carbon (bc), organic aerosols (oa), dust
- Variables: optical depth at 550 nm (od550), mass load in a column, mass mixing ratio (mmr), surface concentrations

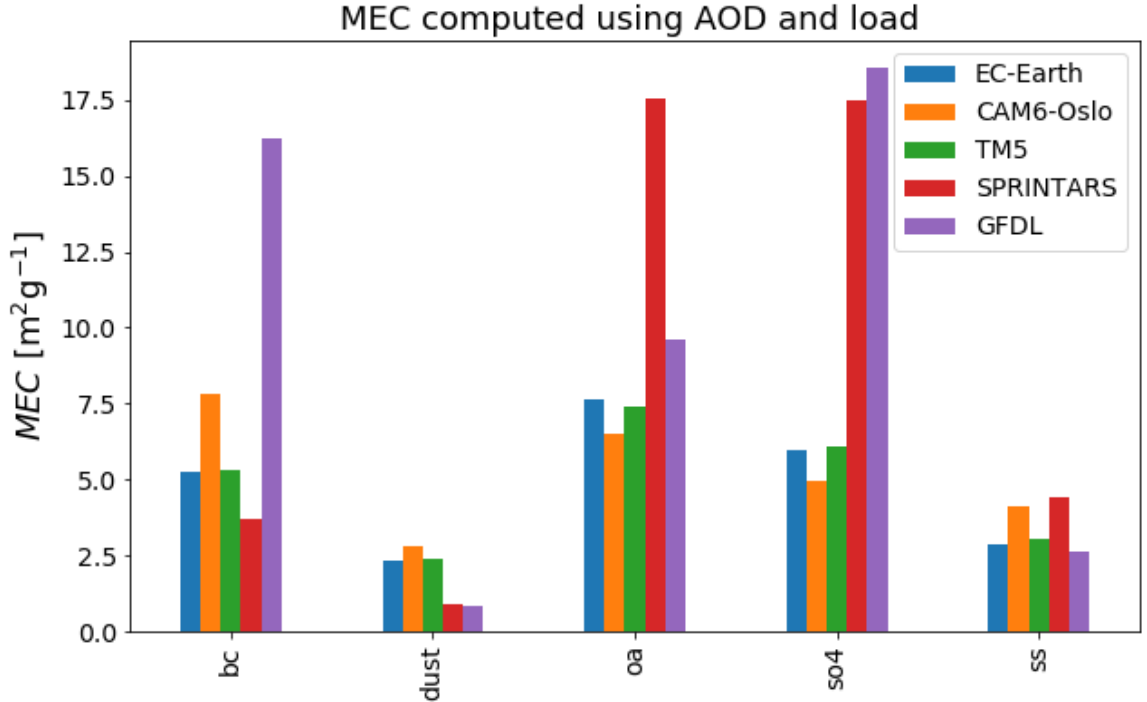


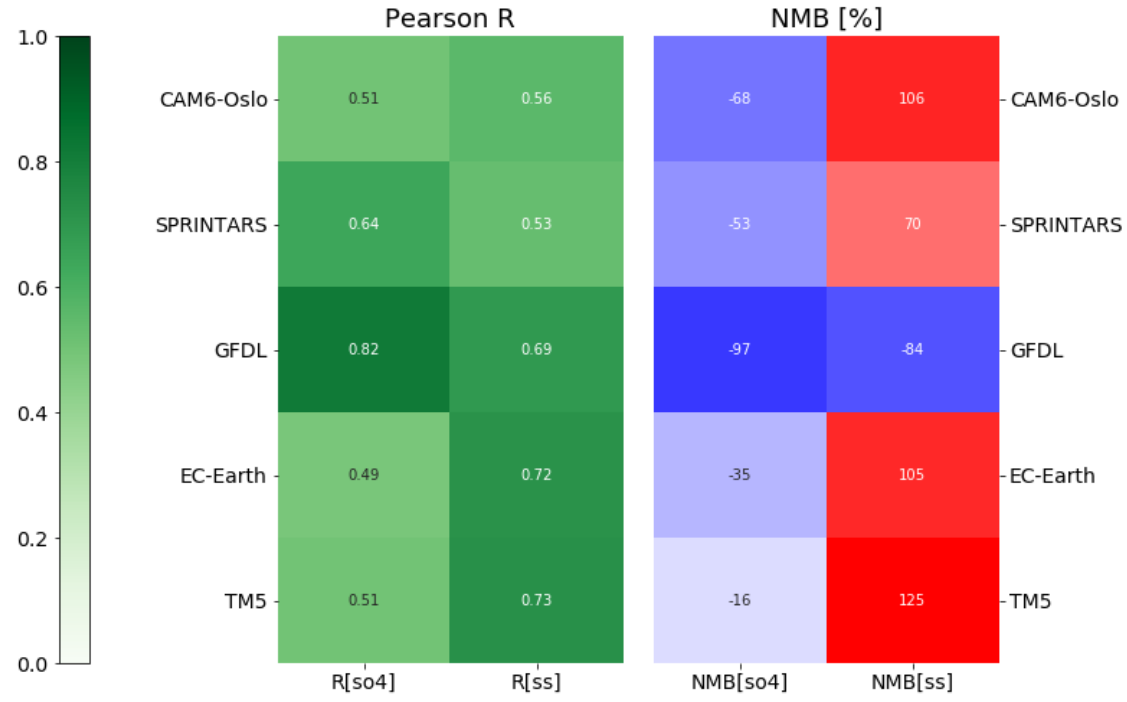
Methods

- Mass extinction coefficient: $\mathrm{MEC_i} = \frac{\mathrm{AOD_i}}{\mathrm{load_i}}$
- Modelled mass mixing ratio to surface concentration: $\mathrm{c_i} = \mathrm{MMR_i} \times \rho_{air}$
- Density of air: `geonum.atmosphere.density` using station altitude and T=273 K
- Arctic > 66°N


mean AOD in the Arctic in 2010
AOD
0.05
0.04
0.03
0.02
0.01
0.00
EC-Earth
CAM6-Oslo
TM5
SPRINTARS
GFDL
bc
dust
oa
so4
ss


mean load in the Arctic in 2010
load [g m^{-2}]
0.005
0.004
0.003
0.002
0.001
0.000
EC-Earth
CAM6-Oslo
TM5
SPRINTARS
GFDL
bc
dust
oa
so4
ss


MEC computed using AOD and load
MEC [m^{2}g^{-1}]
17.5
15.0
12.5
10.0
7.5
5.0
2.5
0.0
EC-Earth
CAM6-Oslo
TM5
SPRINTARS
GFDL
bc
dust
oa
so4
ss


Pearson R
NMB [%]
CAM6-Oslo
SPRINTARS
GFDL
EC-Earth
TM5
0.51
0.56
0.64
0.53
0.82
0.69
0.49
0.72
0.51
0.73
-68
106
-53
70
-97
-84
-35
105
-16
125
R[so4]
R[ss]
NMB[so4]
NMB[ss]
1.0
0.8
0.6
0.4
0.2
0.0
100
75
50
25
0
−25
−50
−75

Summary & Conclusions

- CAM6-Oslo: 100% positive bias in SS conc.
  - Known problem: model was tuned such that it has more seasalt
- Sprintars: lowest load in all variables but high MEC OA, SO4 and SS
  - Still, lowest AODs (-> cf. Ingeborg)
  - BUT: SPRINTARS surface SS concentrations overestimated (+70% bias)
- GFDL:
  - Underestimates SS and SO4 conc. against EBAS (~ -90%) but high correlation
- EC-Earth & TM5 higher correlation in SS than SO4

What have I learned

- Working with climate models
- Many methods for getting and visualizing data in Python

Further research needed…

- Stations representative for the Arctic?
- Is modelled AOD better in some weather conditions?
  - Modelled relative humidity vs. observed?
  - Modelled Hygroscopic growth? -> enhances the light scattering!
- Height distribution of modelled mass / light extinction (-> Goutan)