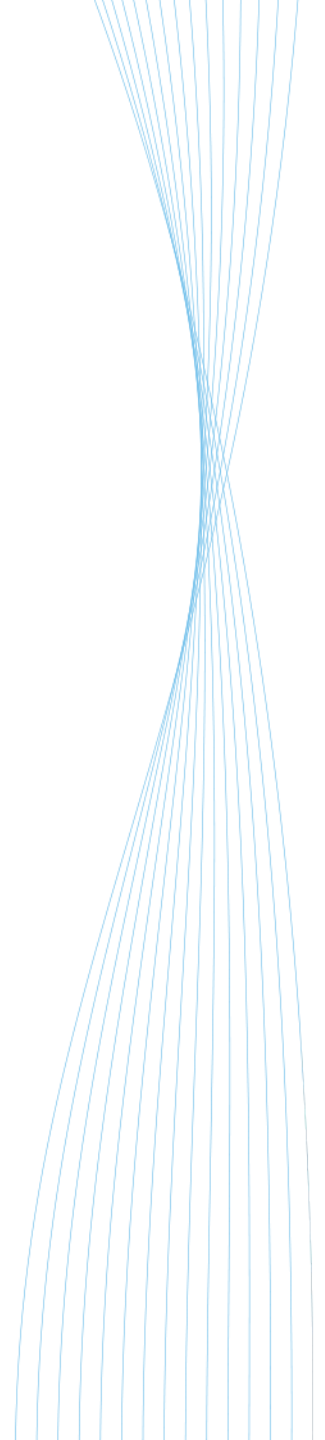
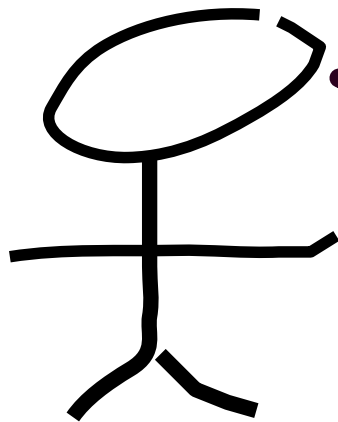
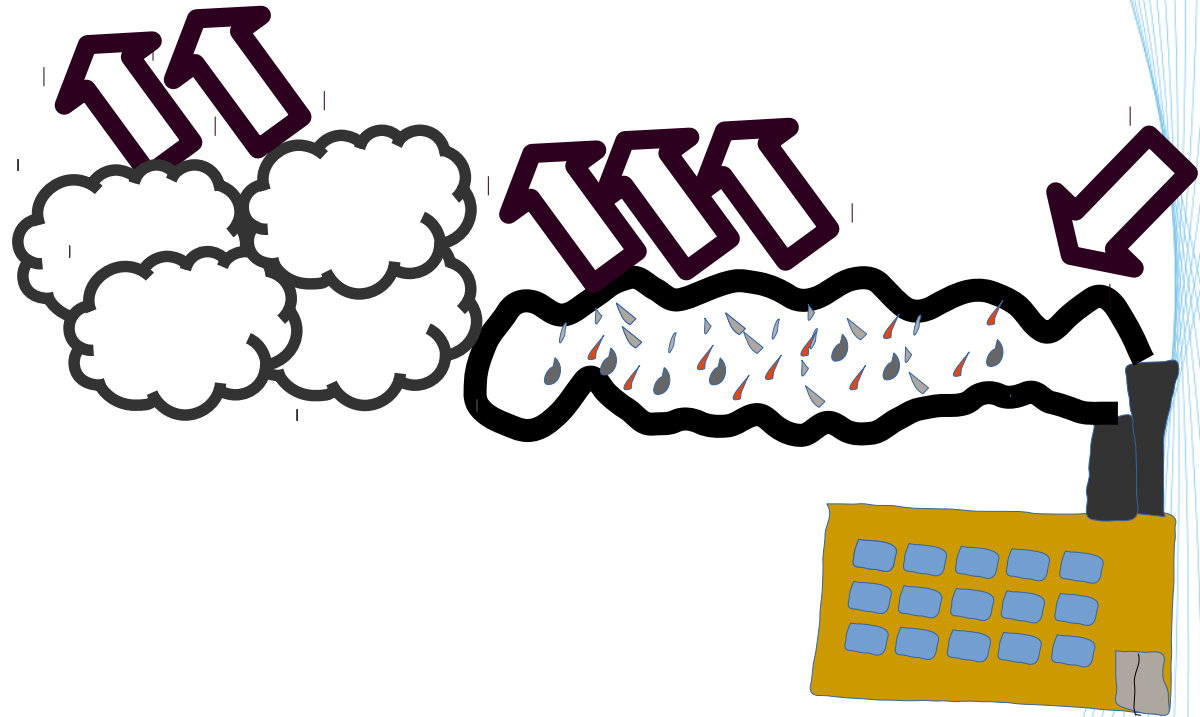




Climate effect from anthropogenic aerosol emissions on Arctic region

Kalle Nordling (kalle.nordling@fmi.fi), Joonas Merikanto, Petri Räisänen,
Petteri Uotila, Declan O'Donnell, Hannele Korhonen



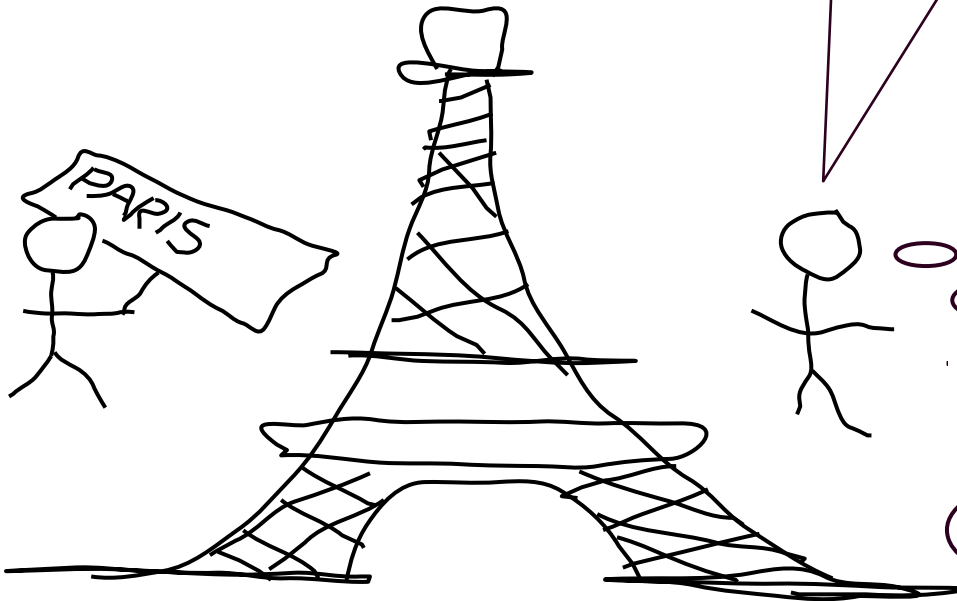


- ✓ Aerosols and greenhouse gases have a common source.
- ✓ Aerosols reflect sunlight (direct effect)
- ✓ Aerosols brighter clouds which reflect more sunlight
- ✓ This leads to aerosols **cooling effect**

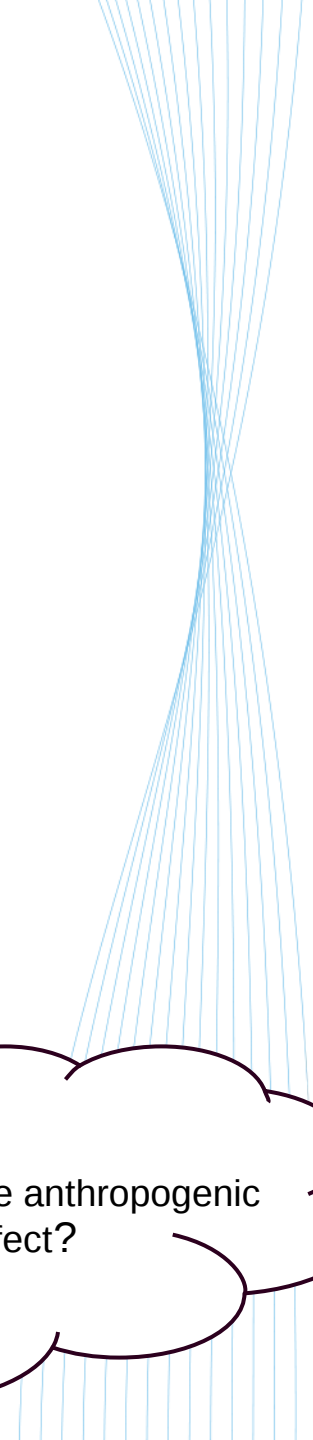


Motivation

Governments have committed to limit the global mean temperature rise to 1.5-2 degree.
This requires reduction of GHG emissions
This also reduce anthropogenic aerosol emissions

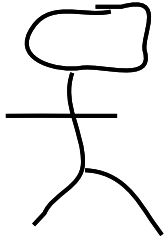


What happens when we remove anthropogenic aerosols' cooling effect?

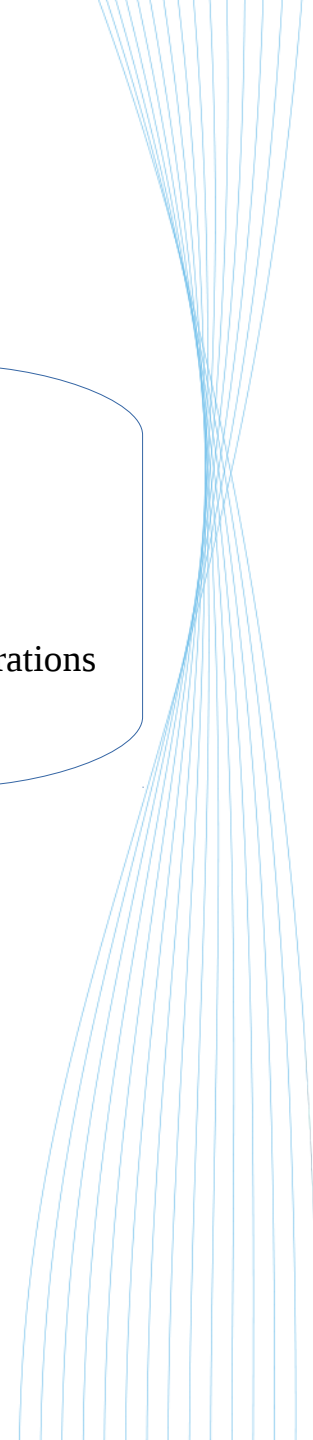
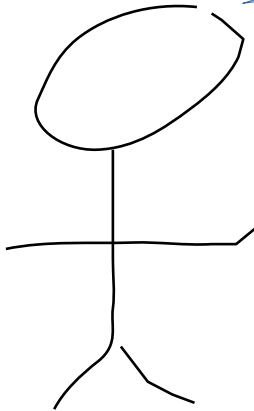




How do you study that when climate models have a different response to removing aerosols?

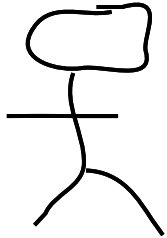


- We have two independent models
Echam6.1 and NorESM
- Standardized anthropogenic aerosol representation
MACv2-SP
- Provides a simple representation of the changes
in aerosol optical properties and cloud droplet number concentrations
due to anthropogenic aerosols.

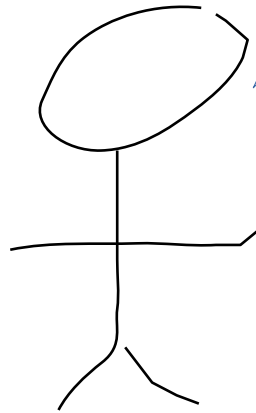




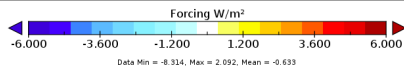
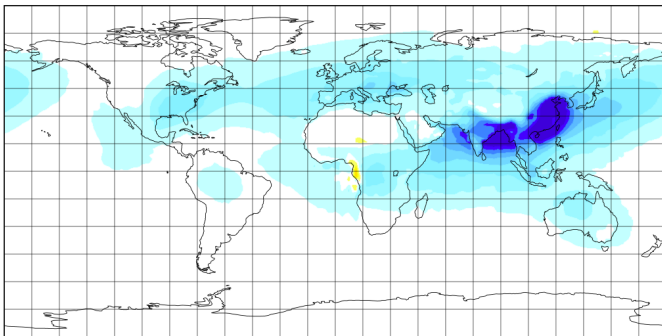
MACv2-SP?



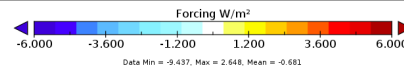
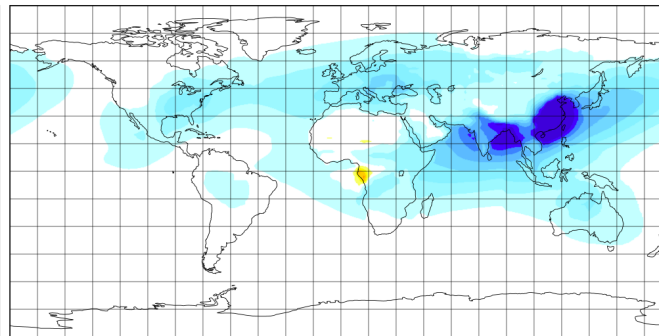
- 9 different plumes
- 4 biomass dominated
- 5 industrial emissions
- Mean instantaneous radiative forcing -0.6 W/m^2



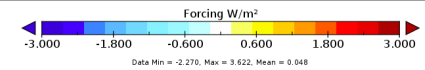
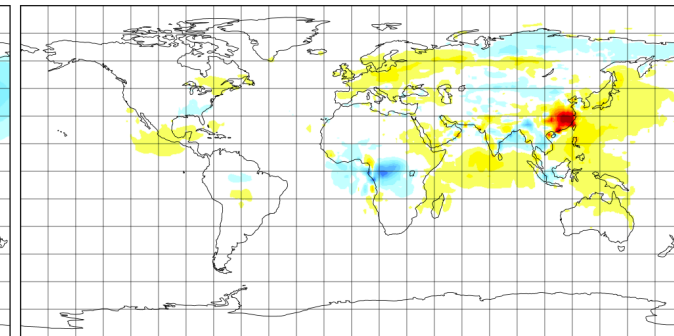
Echam sw forcing all sky top of the atmosphere



NorESM sw forcing all sky top of the atmosphere

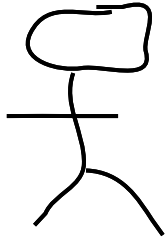


Echam - NorESM sw forcing difference all sky top of the atmosphere

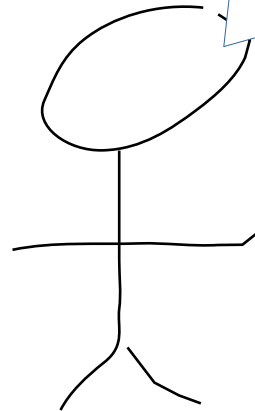




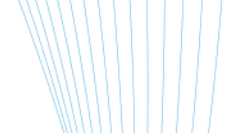
What kind of experiments you had?



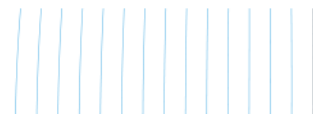
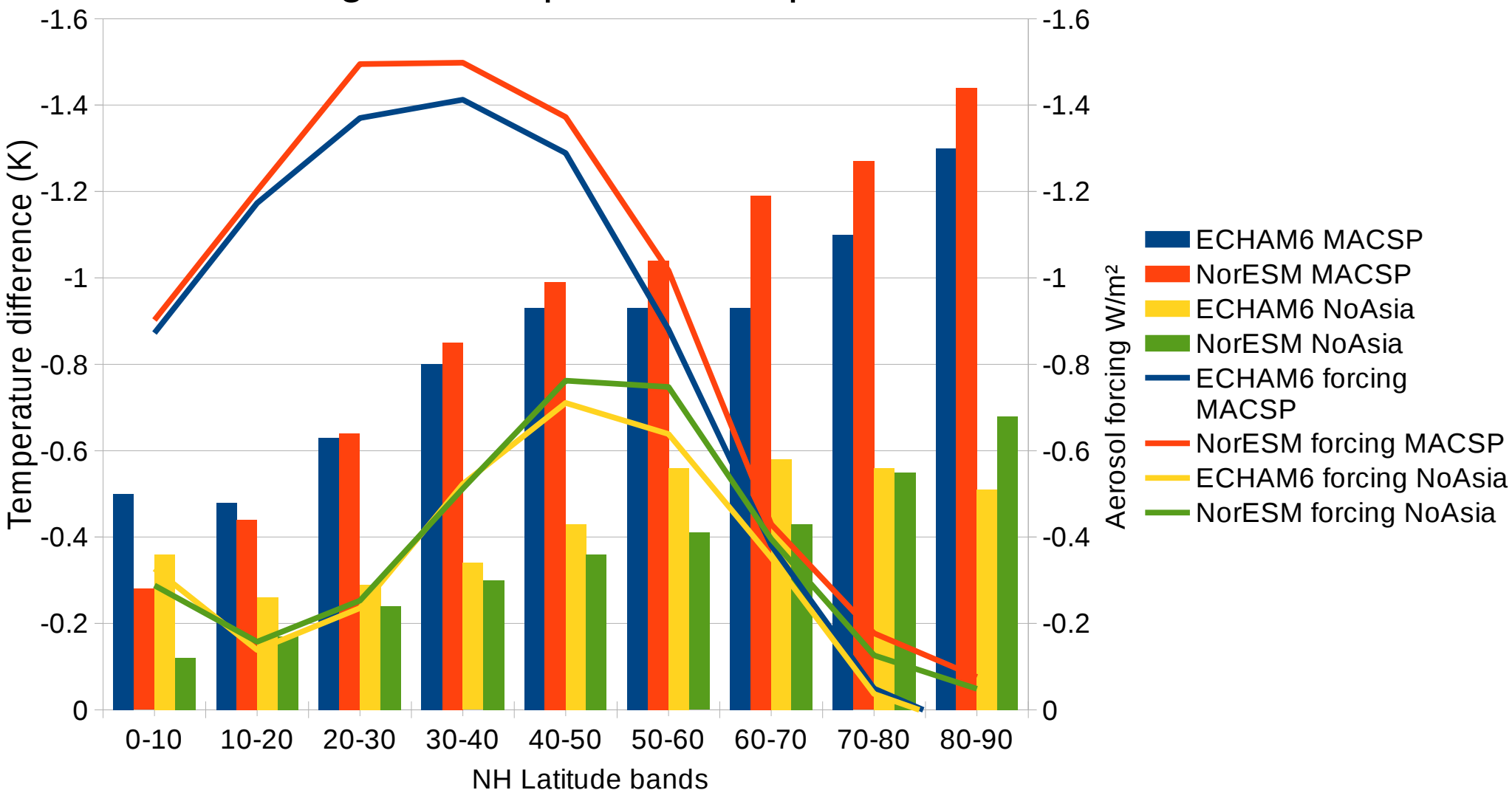
Three different experiment setups
(see table below)



Name	Lenght	Aerosols
Control	2*100 y, 60 y for analysis	No MACSP
MACSP	100 y, 60y for analysis	All MACSP + background
No-Asia	100 y, 60y for analytsis	MACSP-without two asian plumes

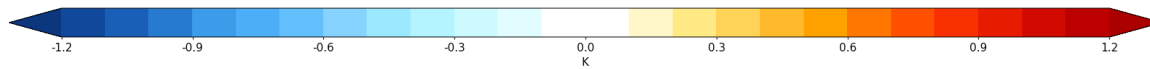
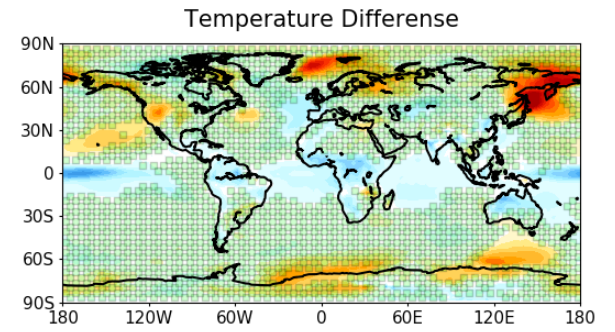
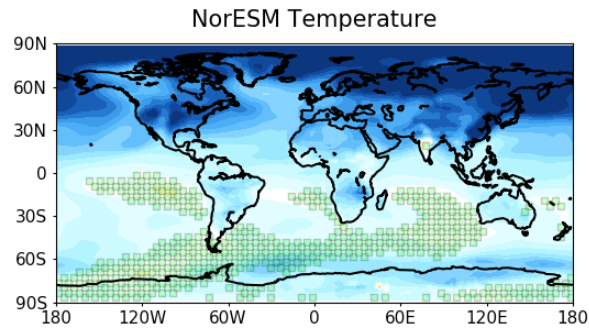
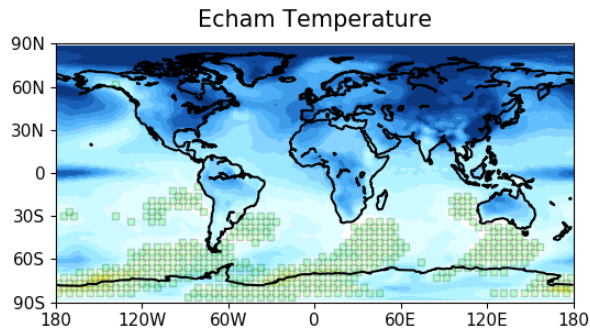


Aerosol forcing and temperature response over NH latitude bands





Temperature response MACSP - CTRL

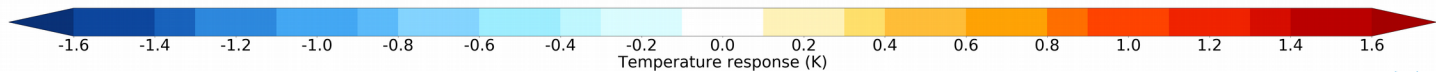
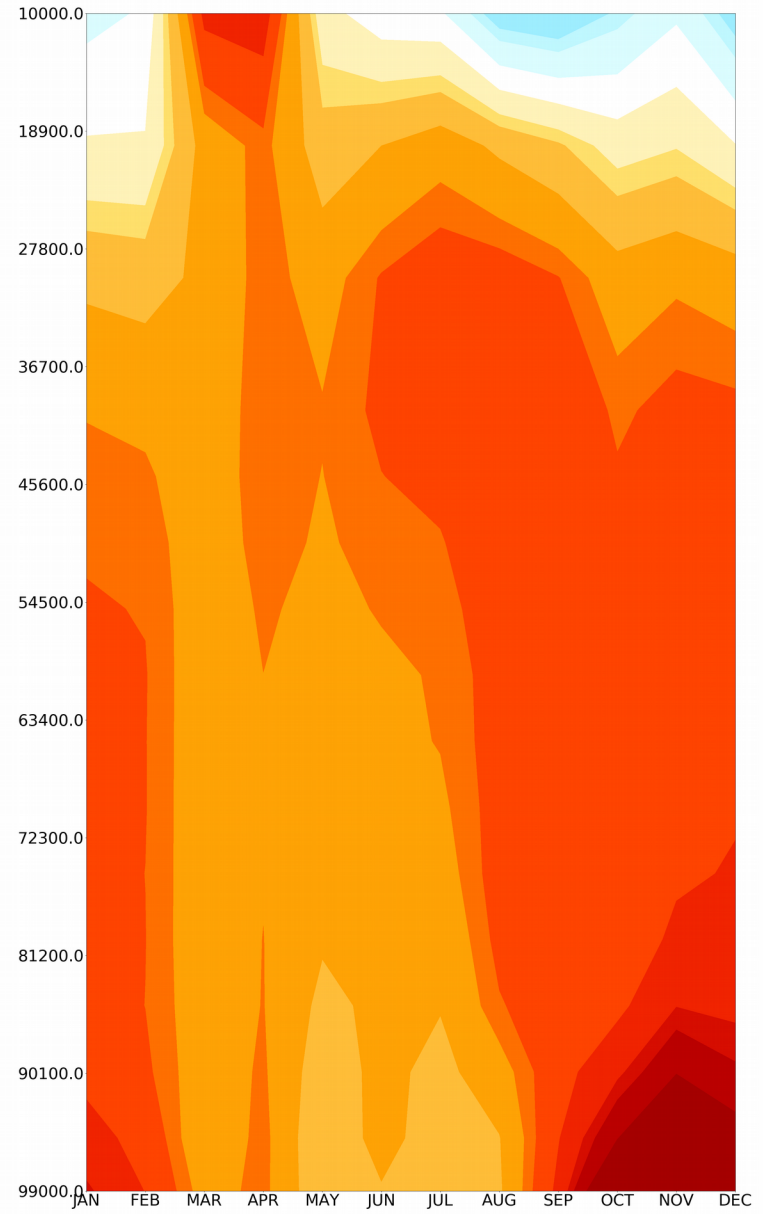
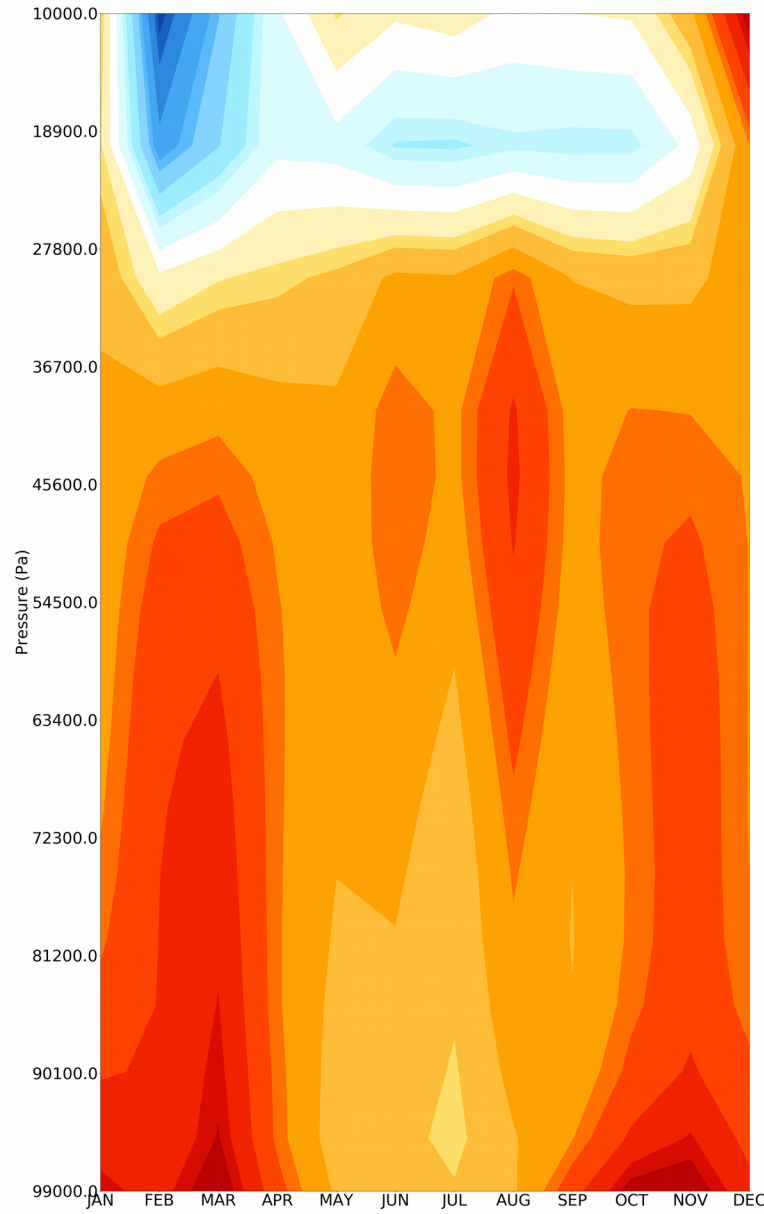


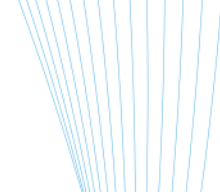


Seasonal response in Echem and NorESM models (70N-90N)

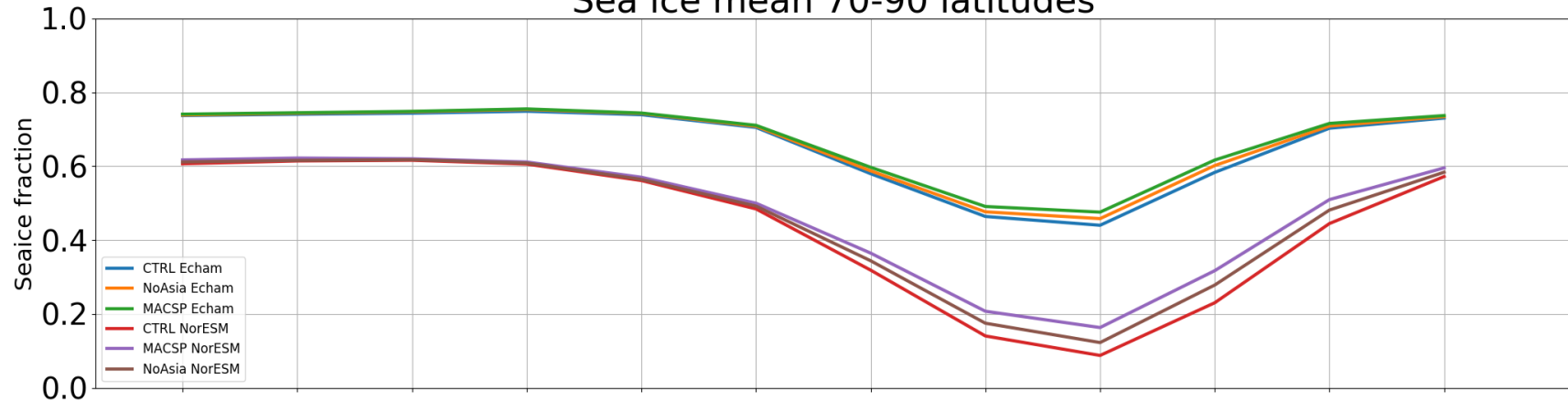
Echam Temperature

NorESM Temperature

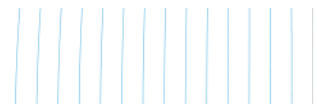
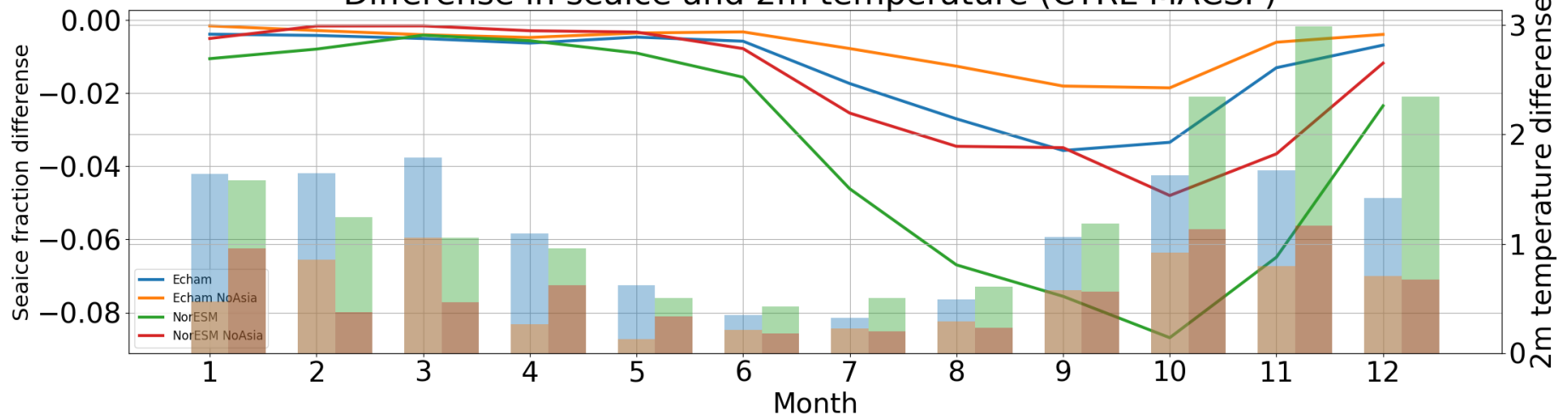




Sea ice mean 70-90 latitudes



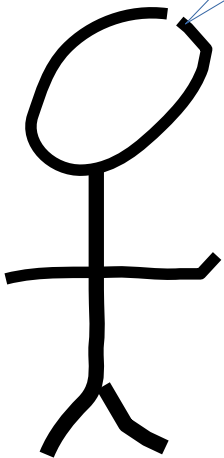
Difference in seaice and 2m temperature (CTRL-MACSP)





Conclusion

1. Anthropogenic aerosol forcing is mainly in the mid-latitude region. Still, the largest temperature impact is seen in the Arctic.
 - Anthropogenic aerosols affects meridional heat transport
2. Strongest warming in the Arctic surface starts from the September. This effect wintertime sea ice forming
Leading to larger temperature change in the Arctic





Thank you!
Questions?

