

# Ocean Albedo

The effect of increased sea water albedo is examined.

Ocean albedo is changed from 0.07 to 0.2

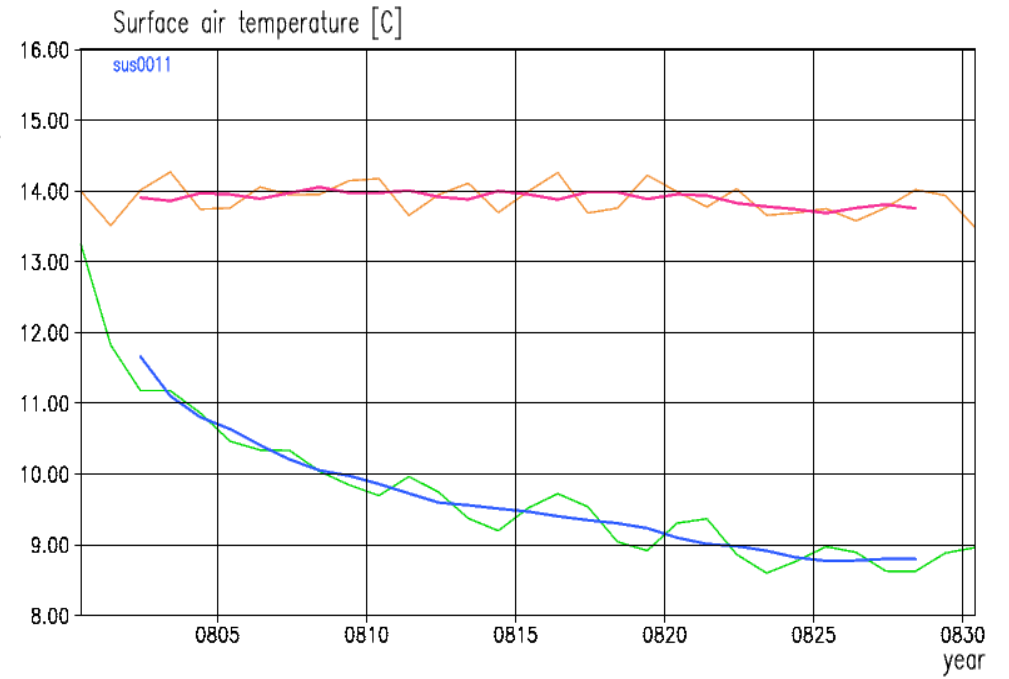
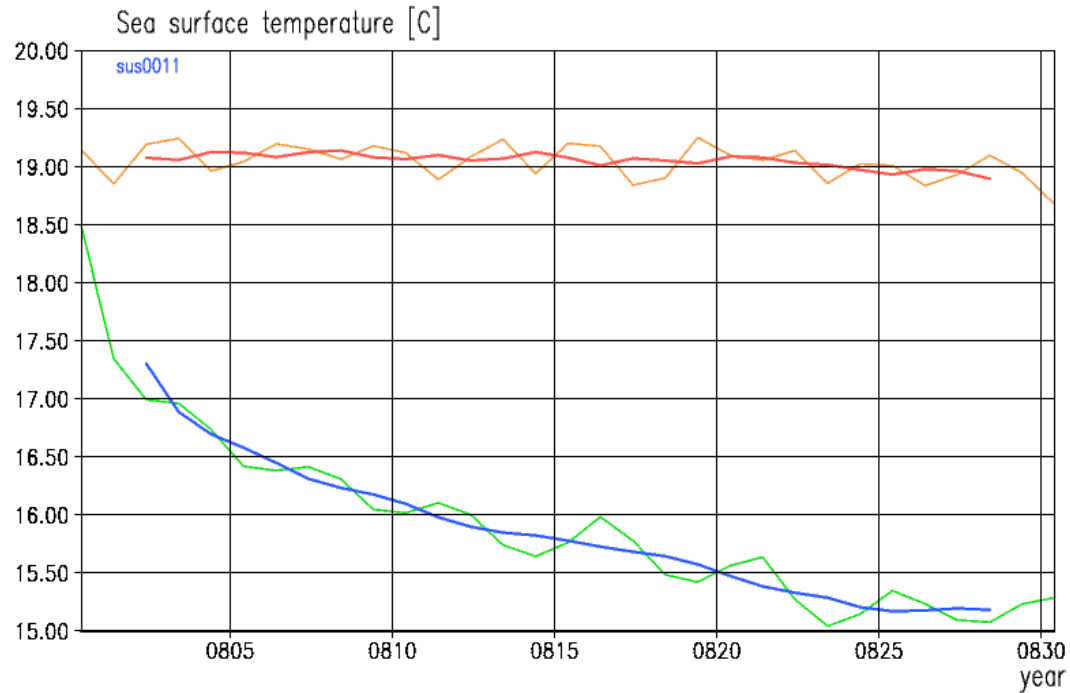
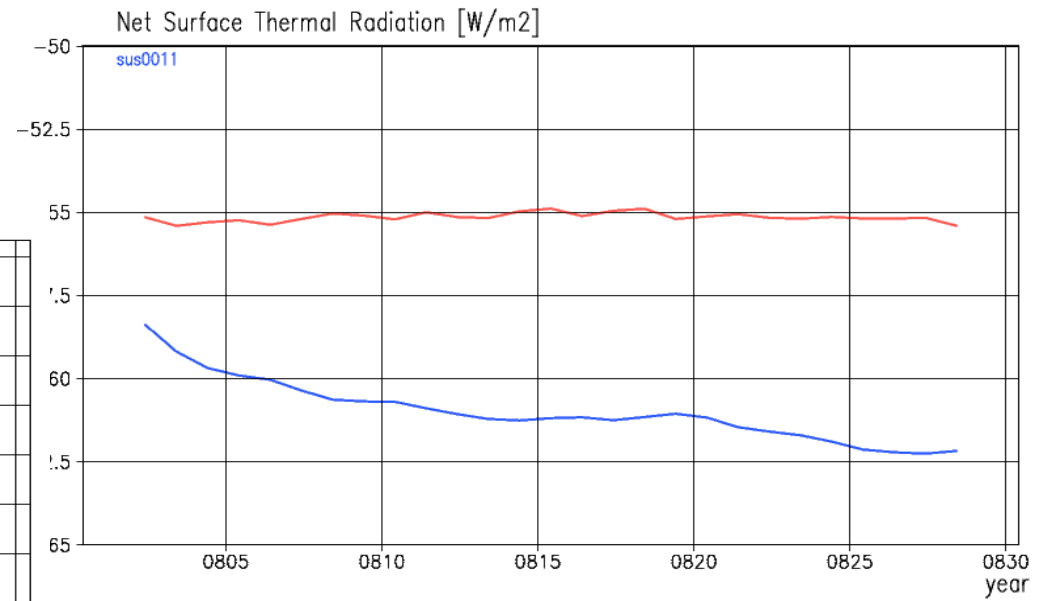
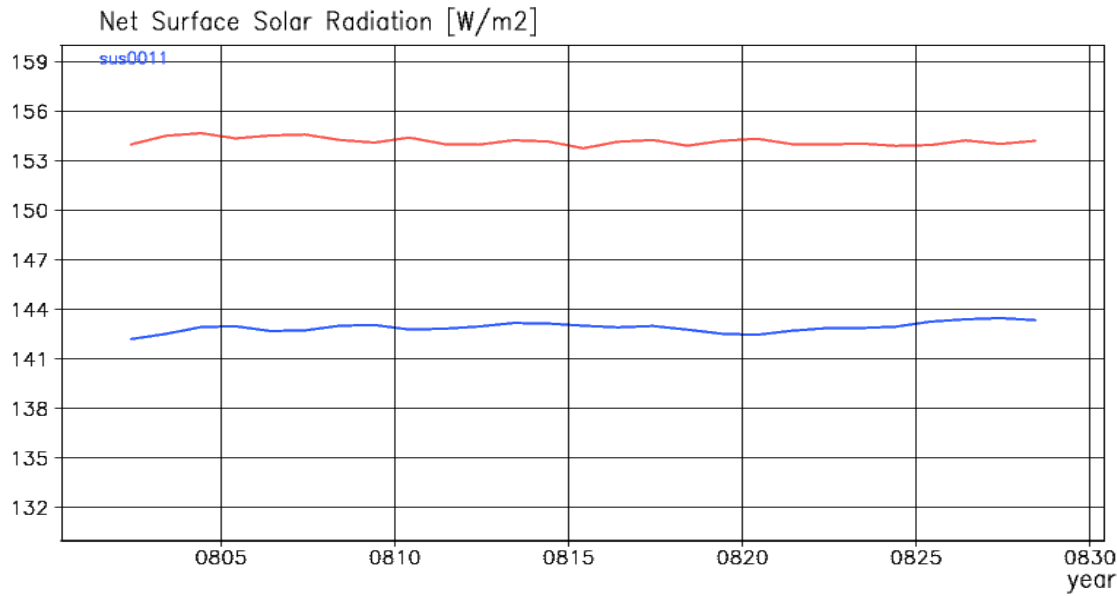
## Hypotheses: (what we expected in the beginning)

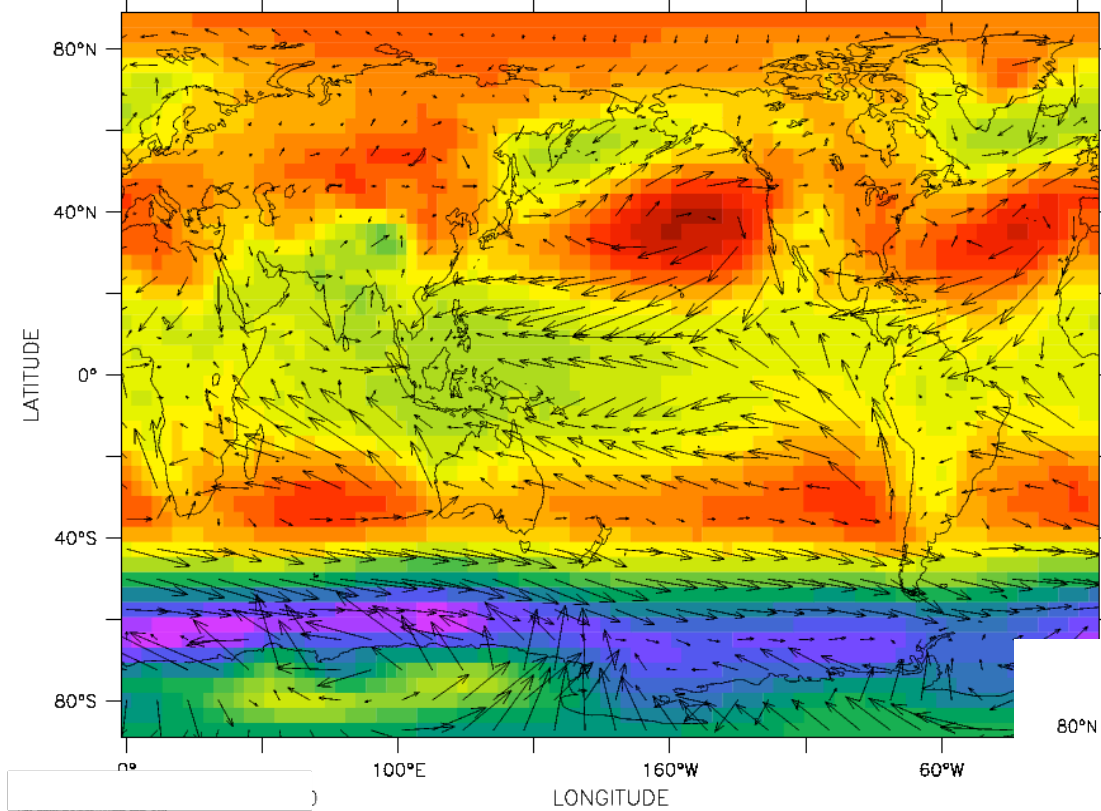
- Temperature change in SST and air temperature
- Change in humidity

and energy fluxes between the atmosphere and the ocean

- Change in the atmospheric and oceanic circulation patterns
- Change in the precipitation fields
- Change in the carbon cycle
- Change in sea ice extension
- Change in the vegetation

# First obvious changes





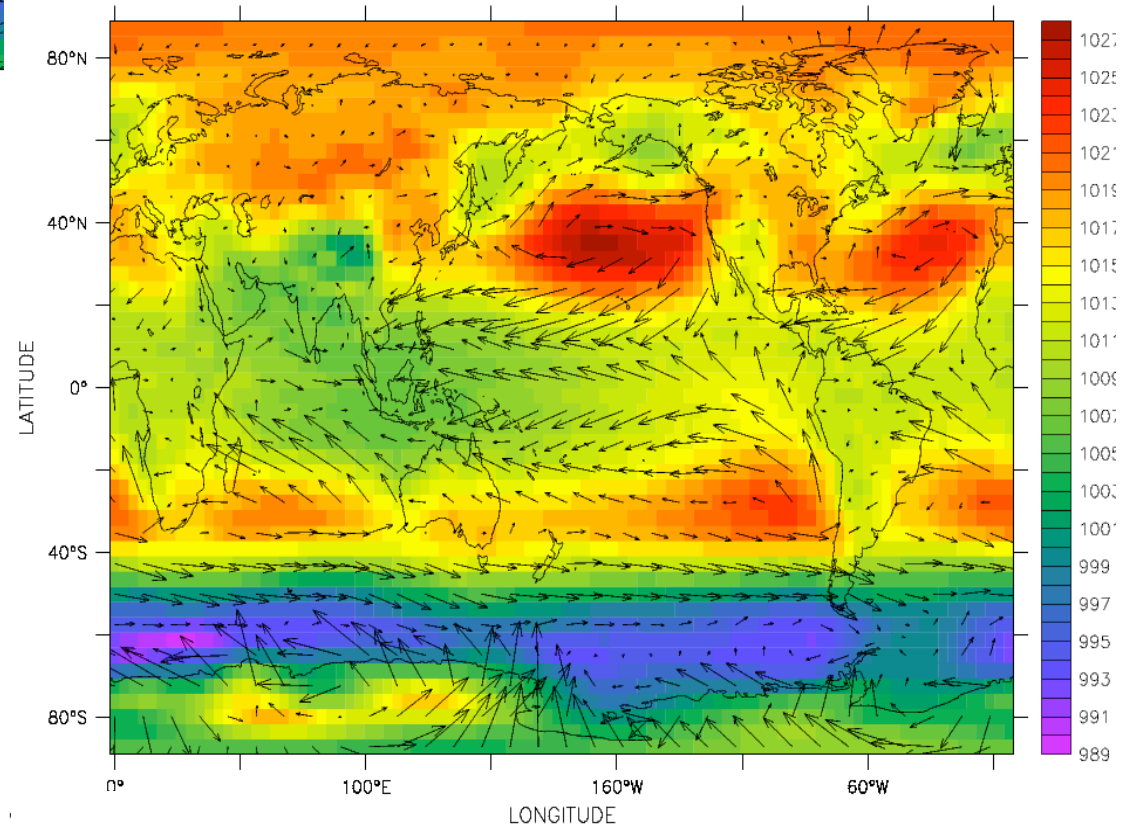
Wind & Surface Pressure (Control)

Control

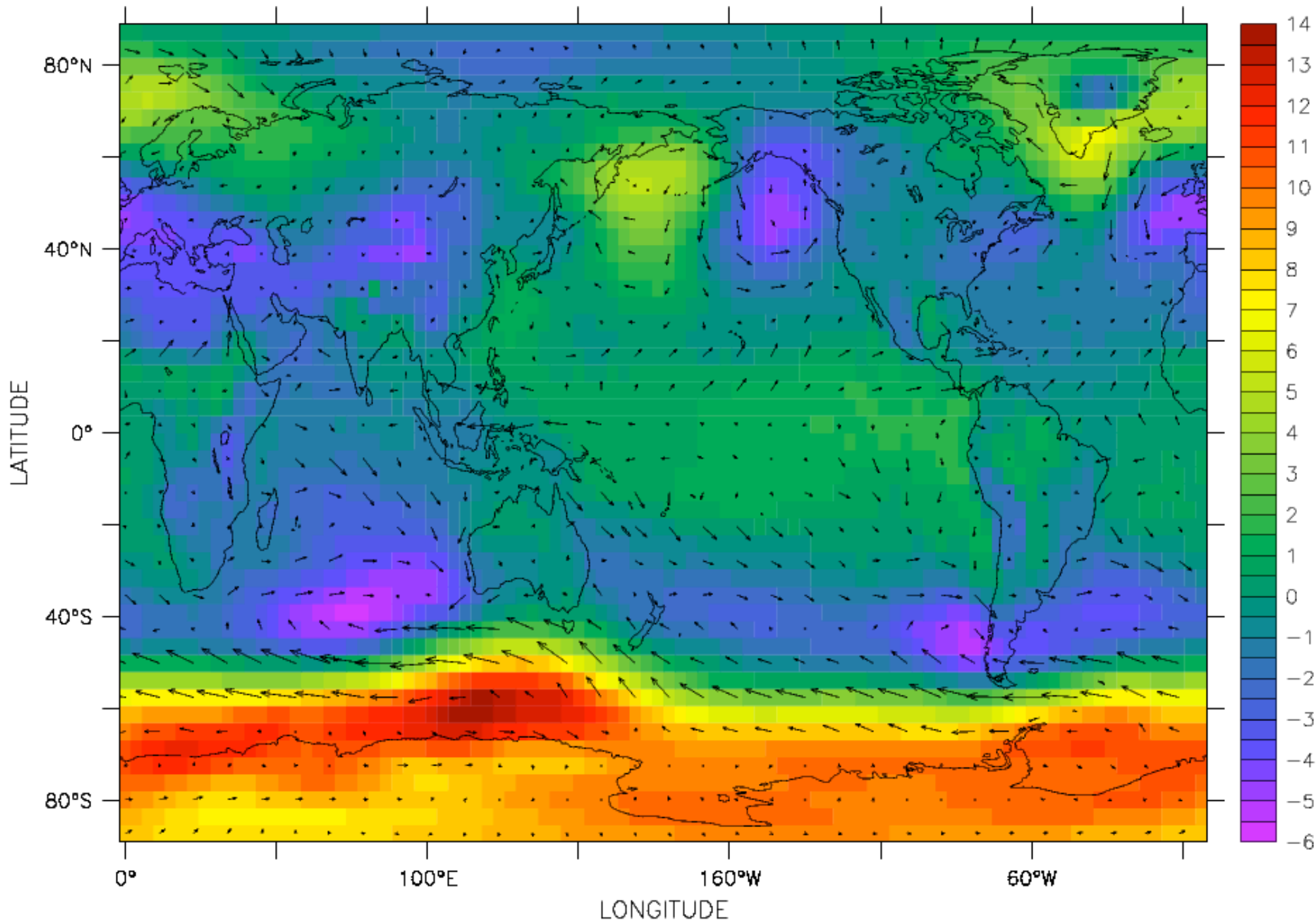
Perturbed

# Effects on atmospheric circulation

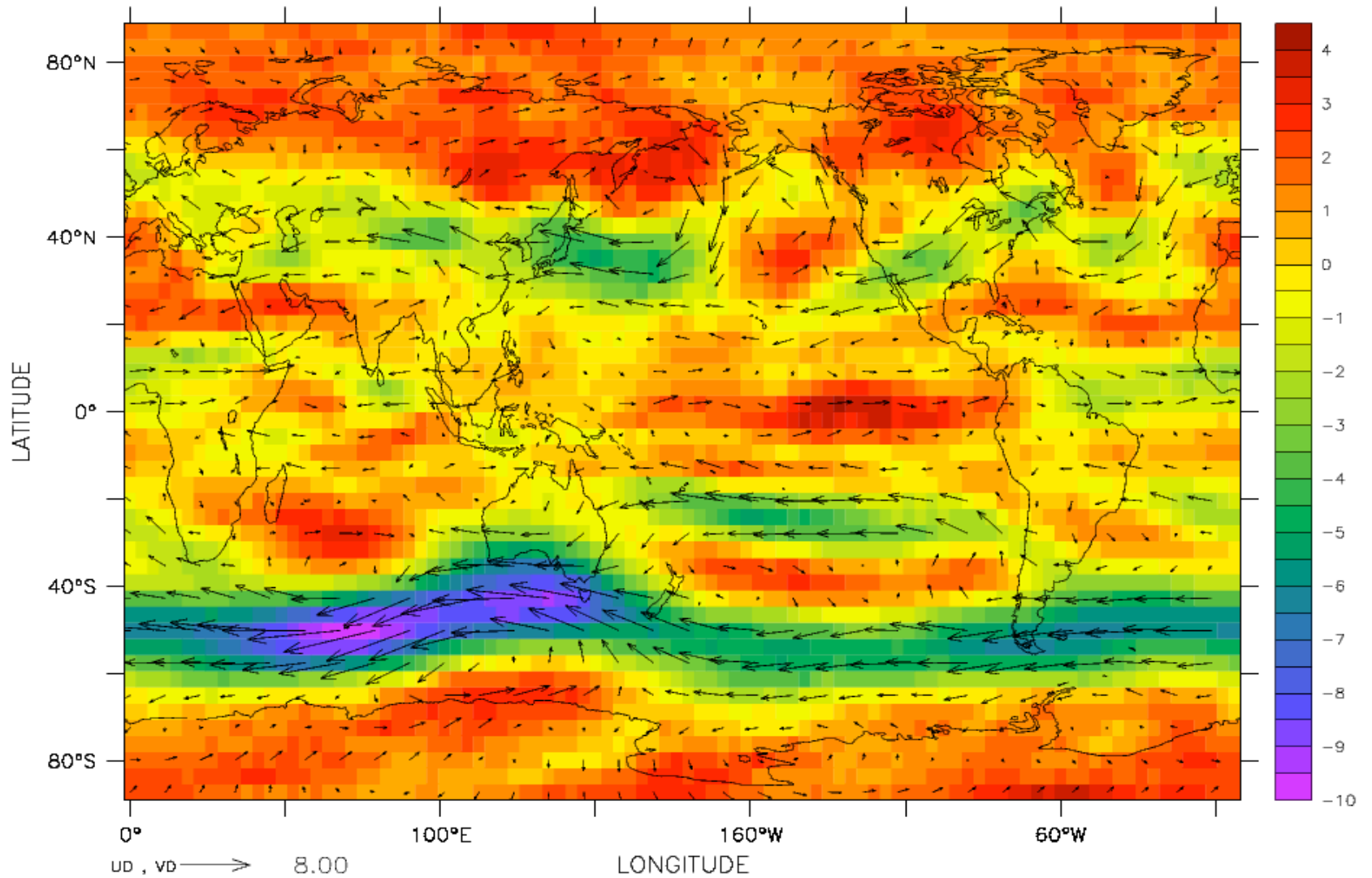
## Surface Wind & Pressure



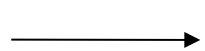
Wind & Surface Pressure (perturbed)



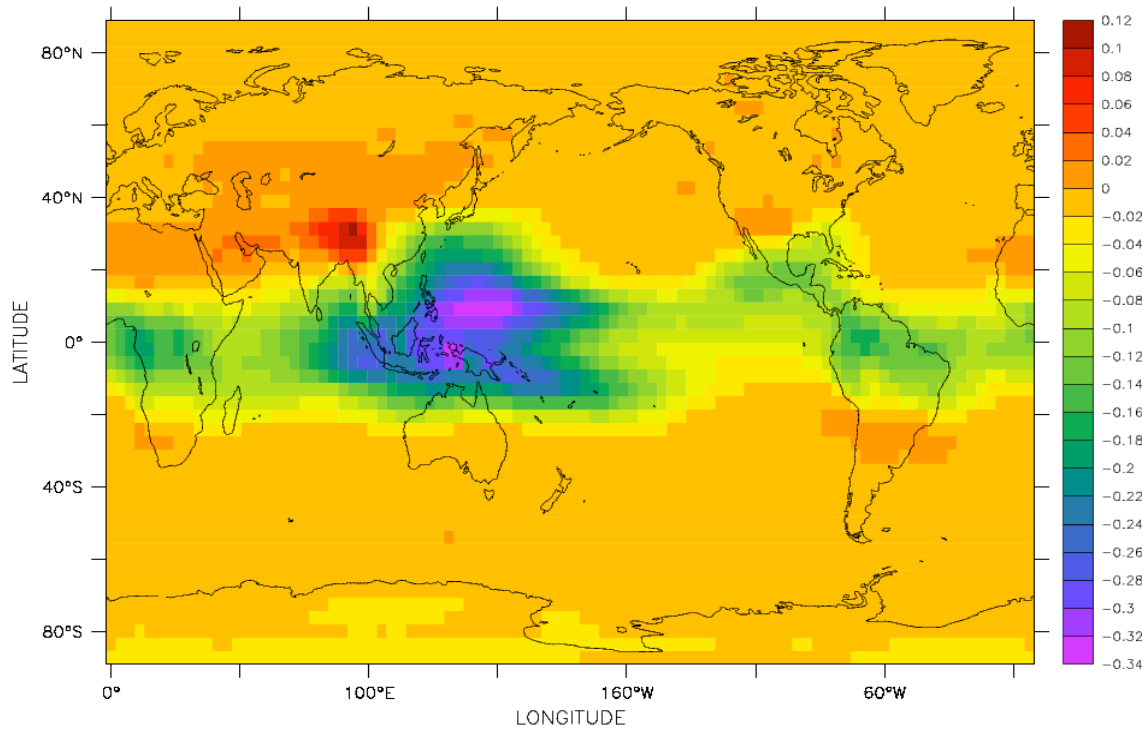
Wind & Surface Pressure (diff)



Wind speed difference and Wind field

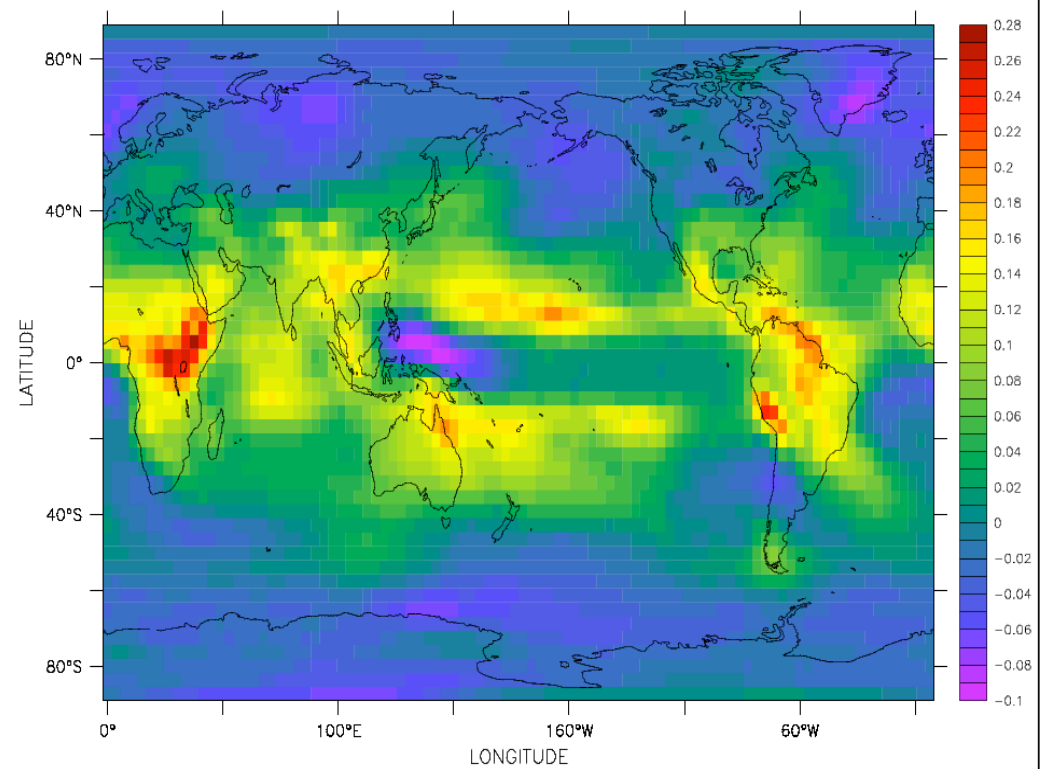


- Less meridional heat transfer of the atmosphere
- Decreased meridional temperature difference leads to lower wind speeds in the „storm track regions“



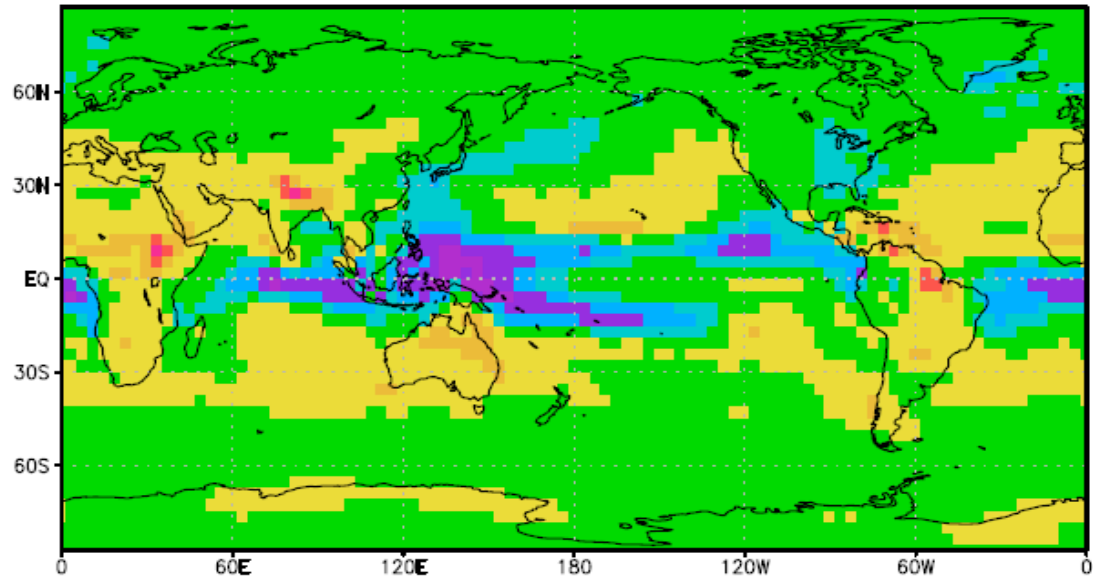
Cloud Cover ( $p = 100$  hPa)

# Cloud cover changes in the tropics



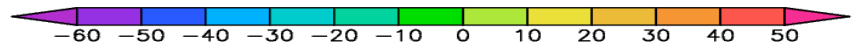
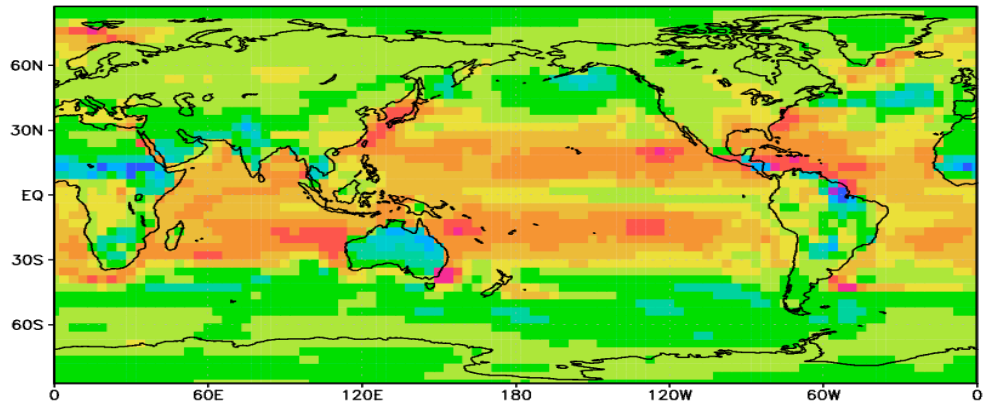
Cloud Cover ( $p=300$  hPa)

P (exp-ctr) - 30 years mean [mm/day]



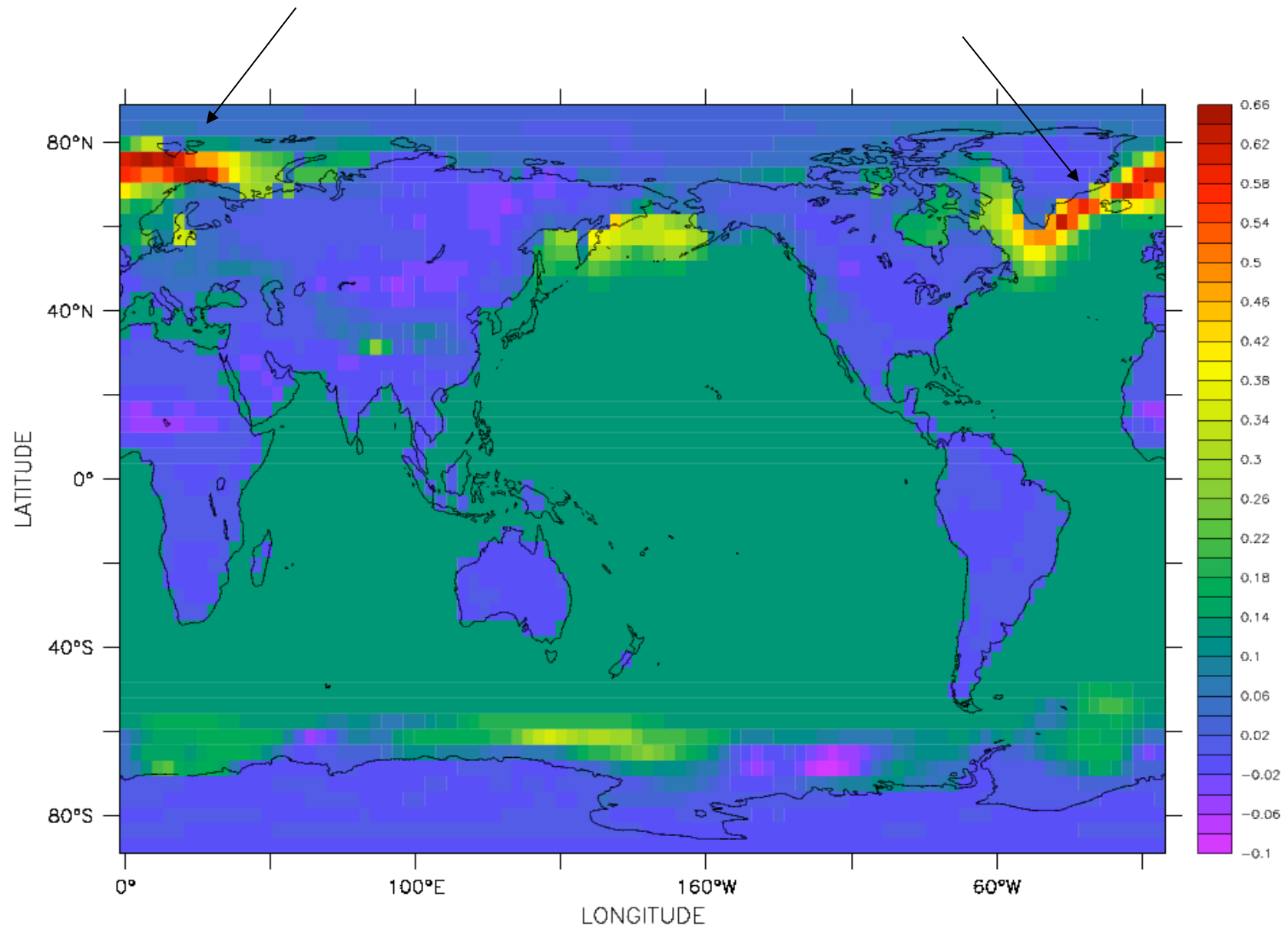
Precip [mm/day]

Latent Heat Flux (exp-ctr) - 30 years mean



Ahfl [W/m\*\*2]

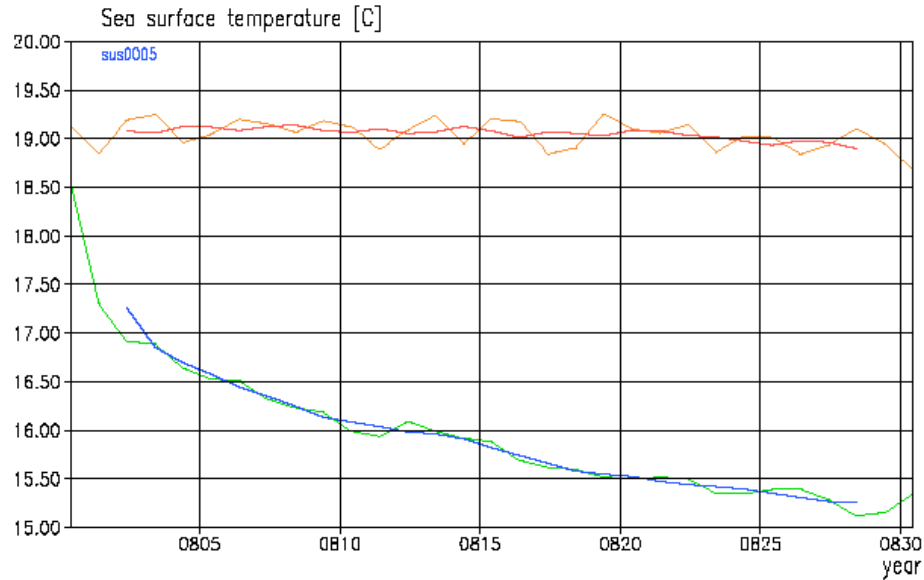
More ice leads to feedback in the albedo



Albedo (diff)

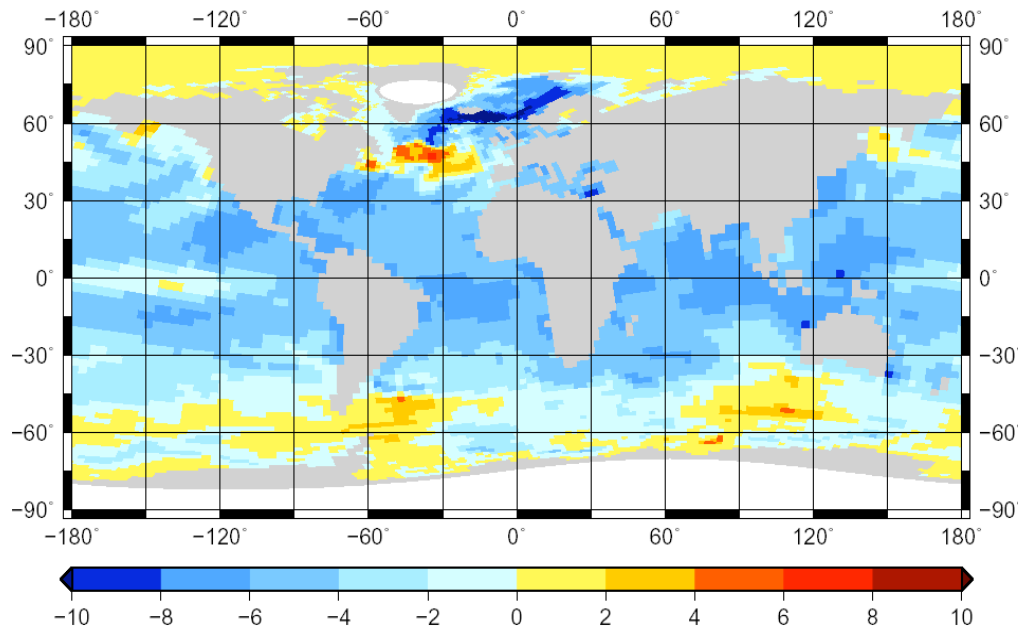
# SST changes

## Global SST change

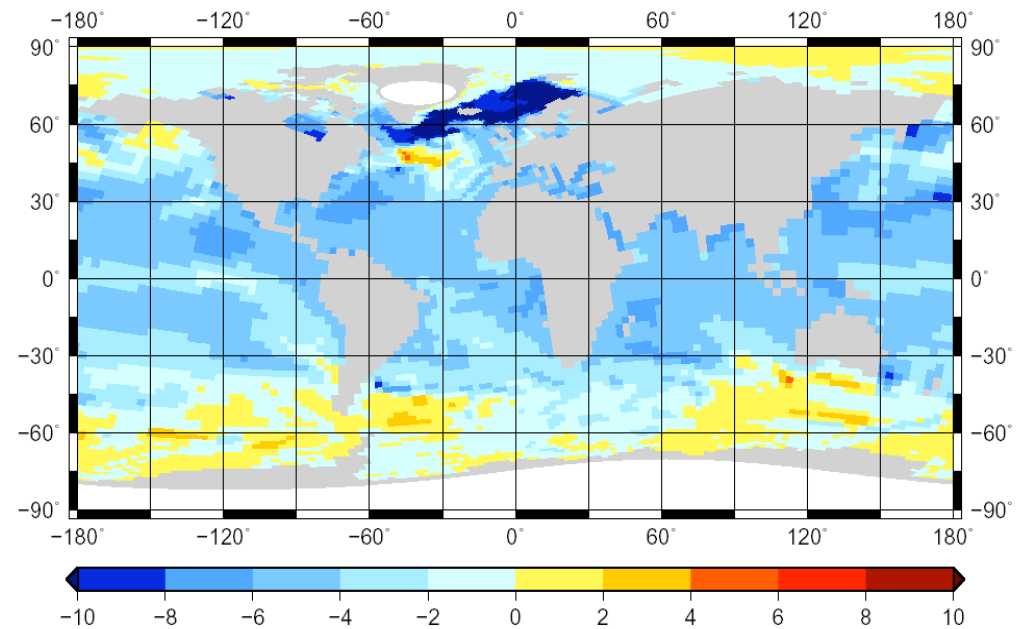


- Consistent decrease in tropics/sub-tropics.
- Western Pacific warm pool is less prominent.
- Warmer region in N. Atlantic, particularly during Boreal winter.

## SST diff\_exp-ctrl (January)

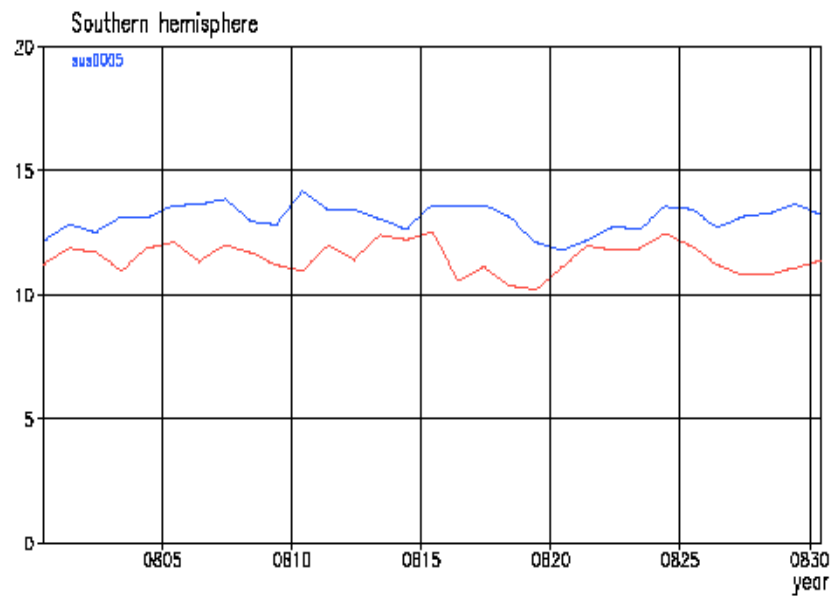
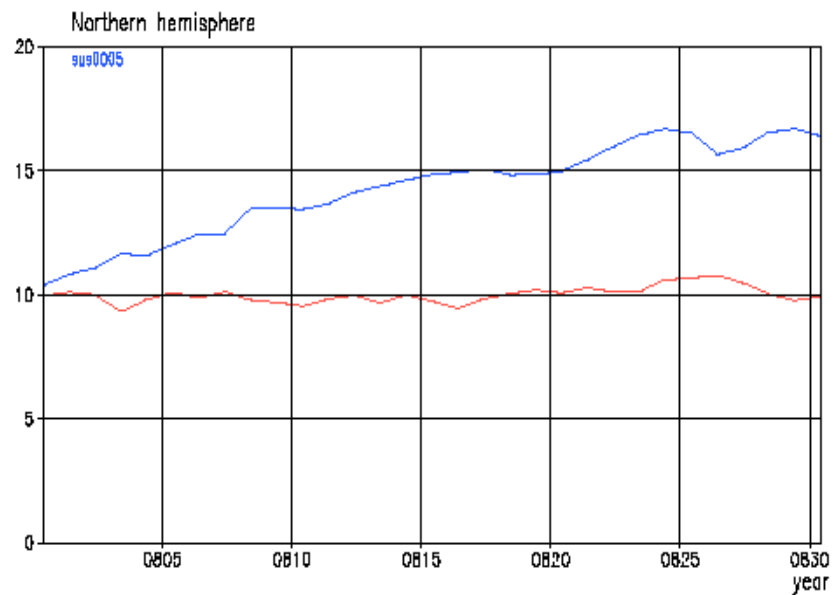


## SST diff\_exp-ctrl (July)



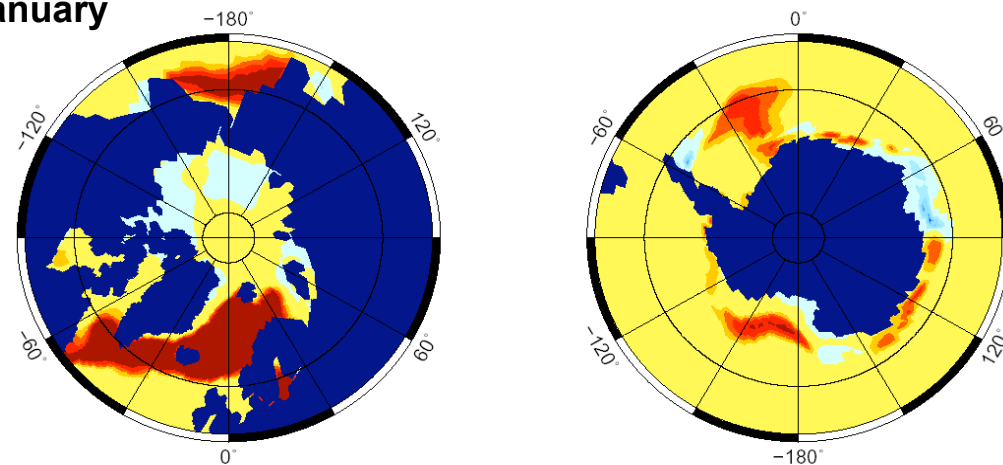
# Sea ice area

Sea Ice Area [ $10^{12}$  m<sup>2</sup>]

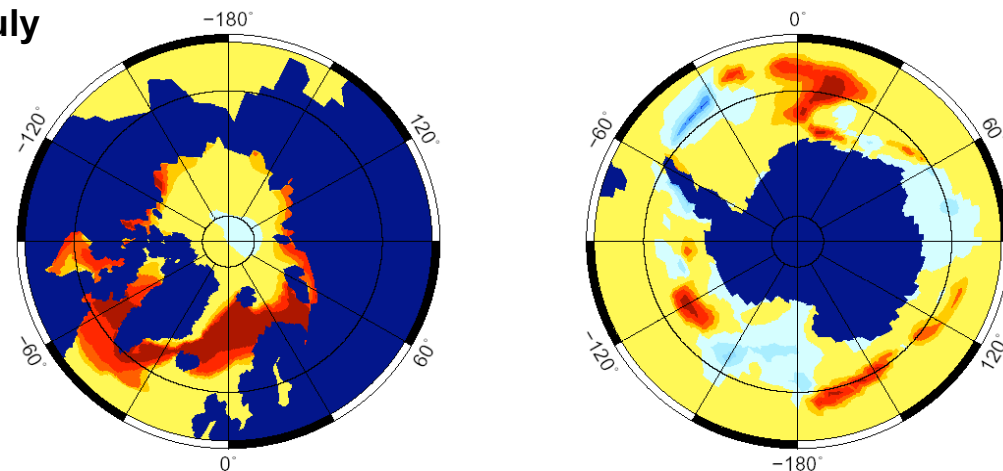


Sea ice area exp-ctrl

January



July



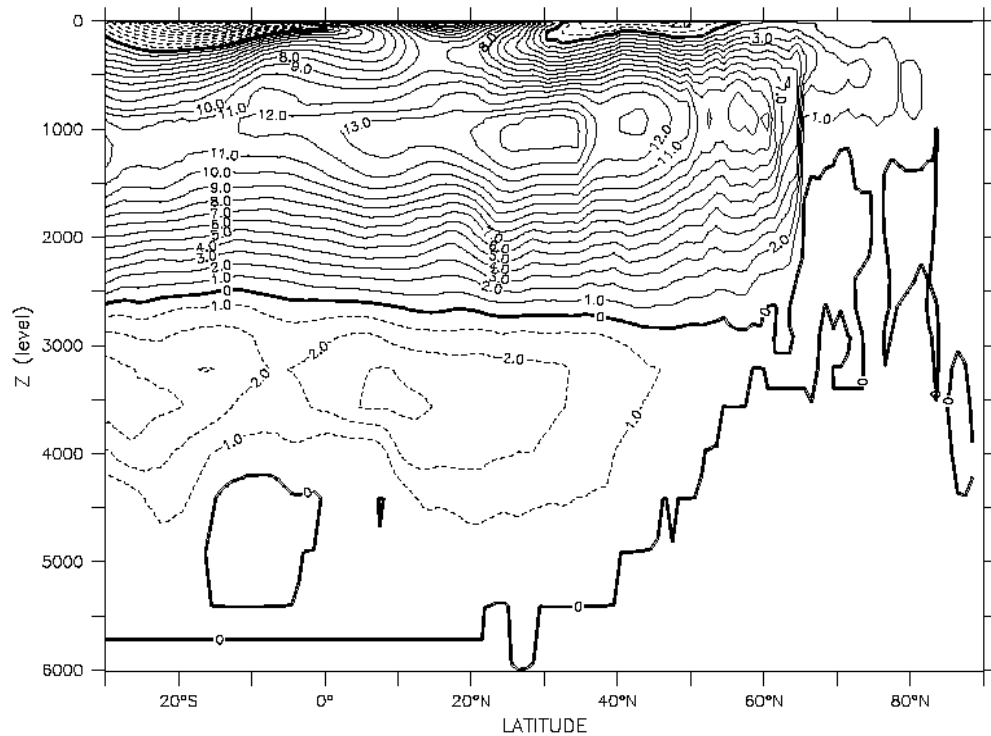
# Atlantic Ocean Transport

## Ocean barotropic streamfunction

### Control

LONGITUDE : OE  
T (day as %Y%m%d.%f) : 8301231

FERRET Ver. 6.2  
NOAA/PUEL TRAP  
Aug 6 2009 16:56

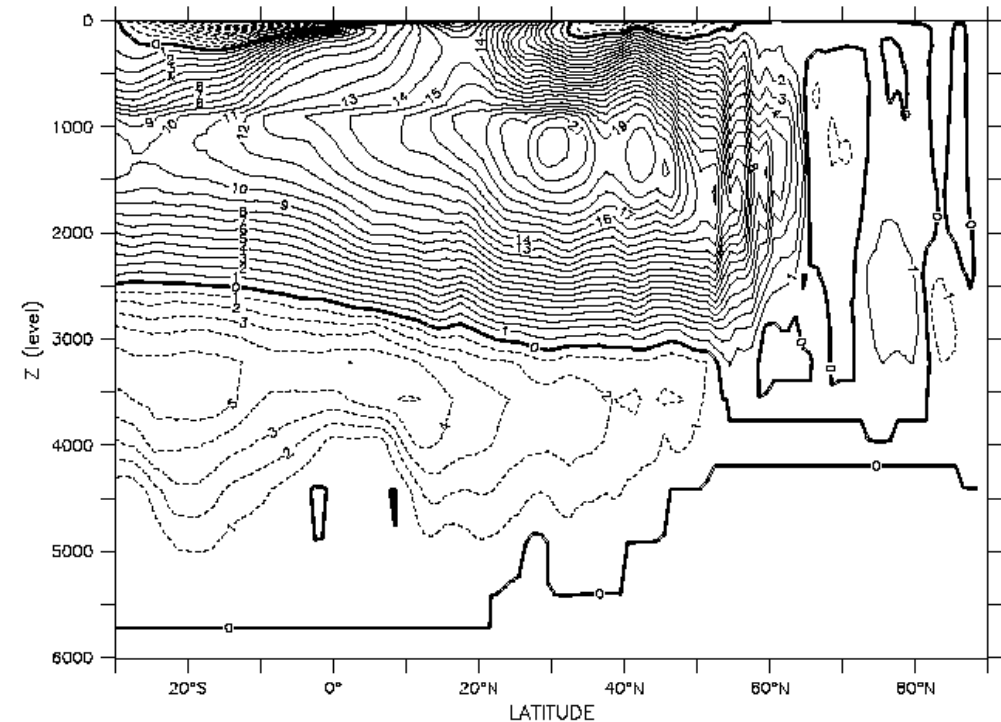


### Experiment

LONGITUDE : DE  
T (day as %Y%m%d.%f) : 8301231

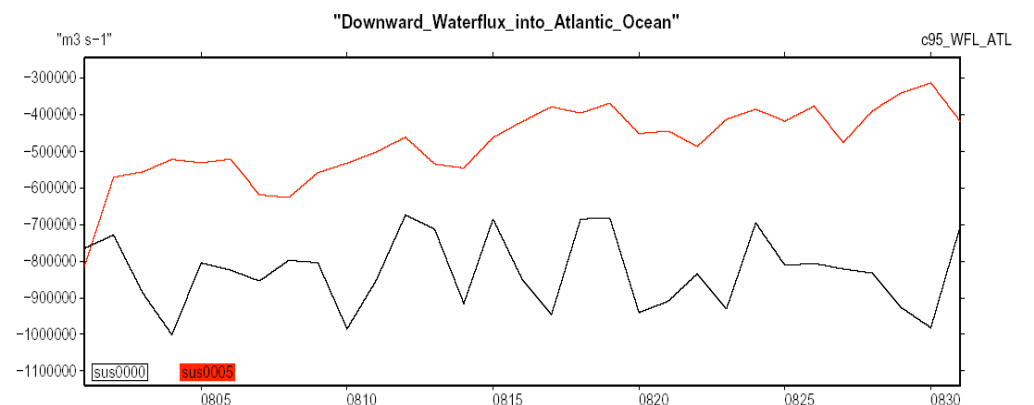
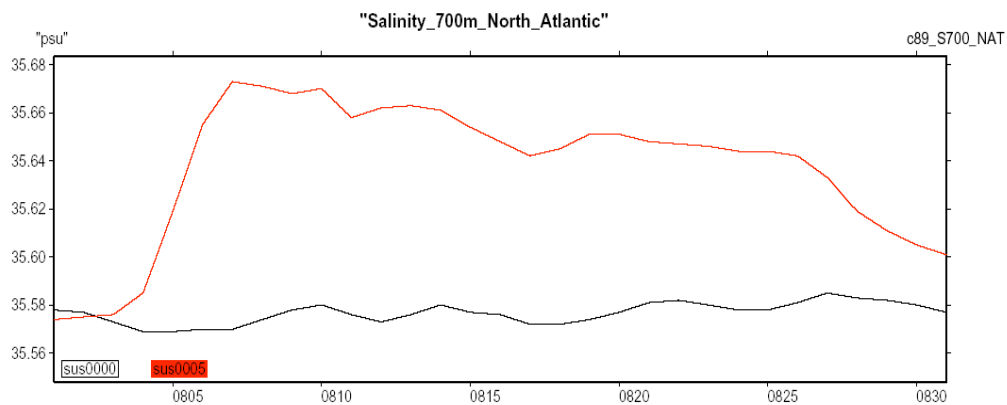
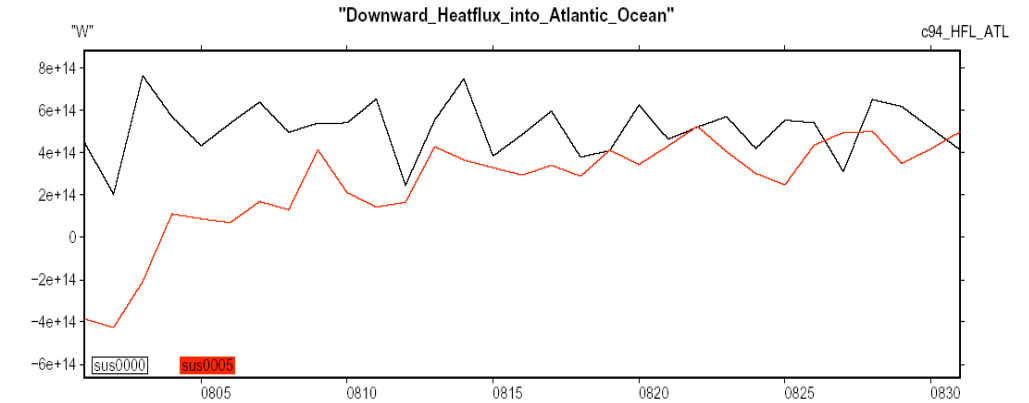
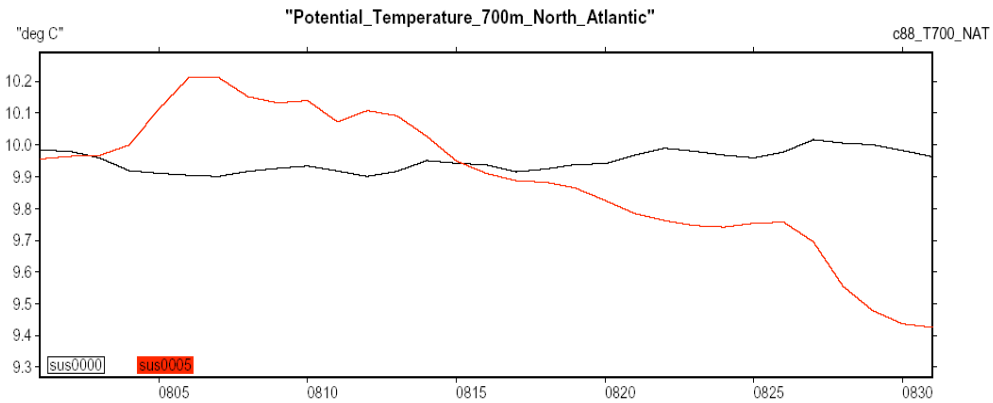
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NOAA/PUEL TRAP  
Aug 8 2009 18:55:52

DATA SET: fort.75.sus0005



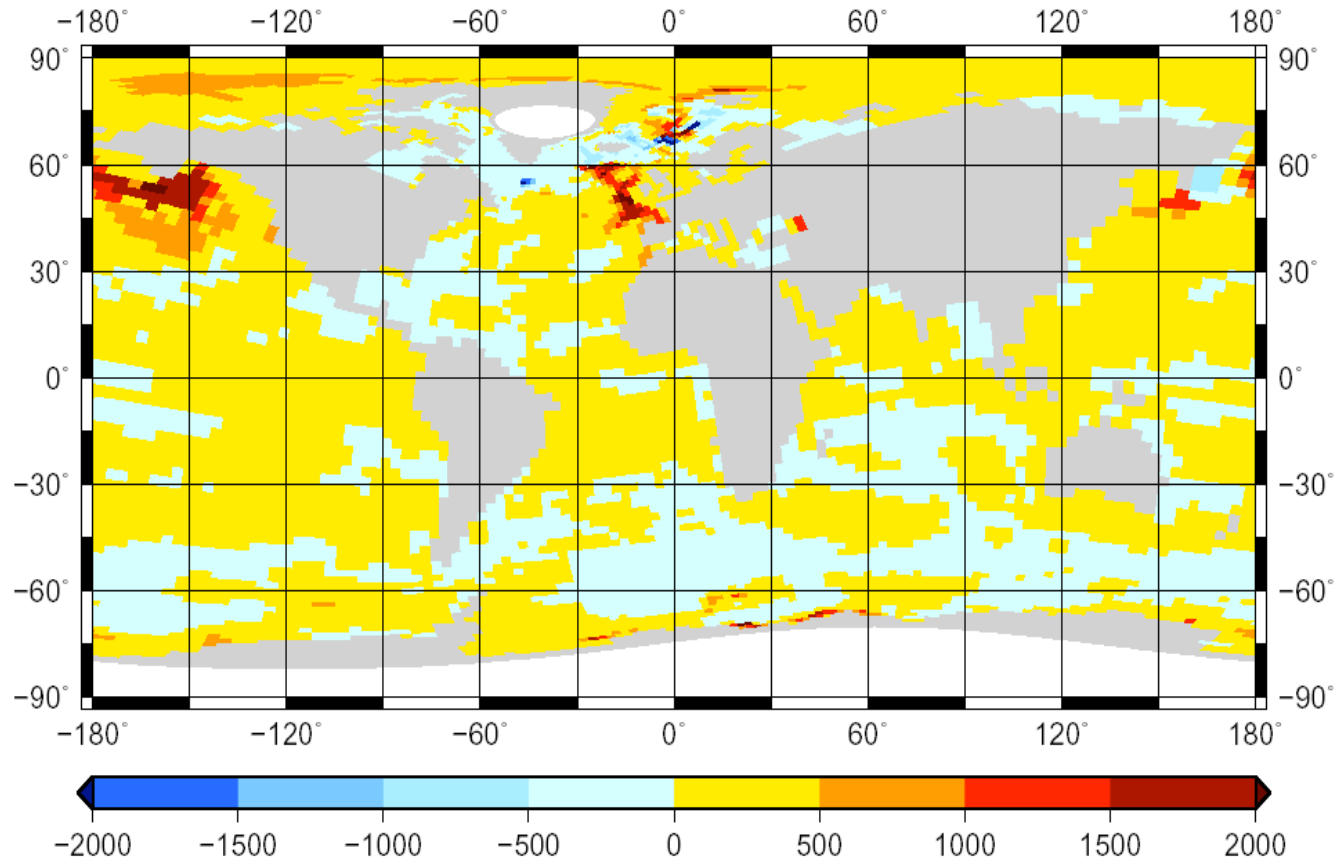
- In the control simulation, northward surface flow extends as far as 80 N.
- Greater sea ice extent in the experiment limits surface transport to 60-65 N.
- Zone of deep water formation exhibits a southerly migration.

# North Atlantic changes

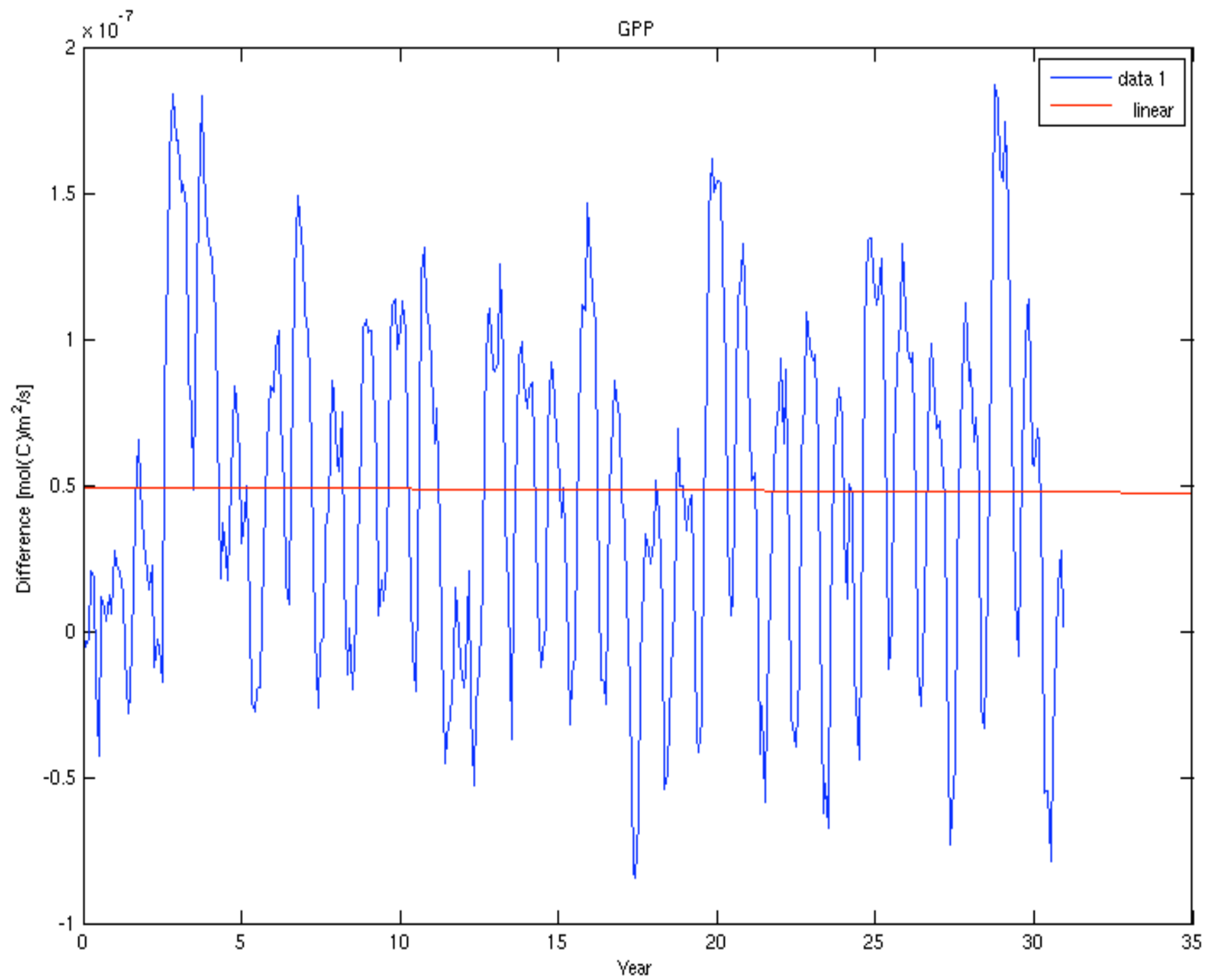


- Greater sea ice extent in the experiment reduces the influx of Arctic freshwater.
- An increase in salinity may explain the increase in downward water flux.

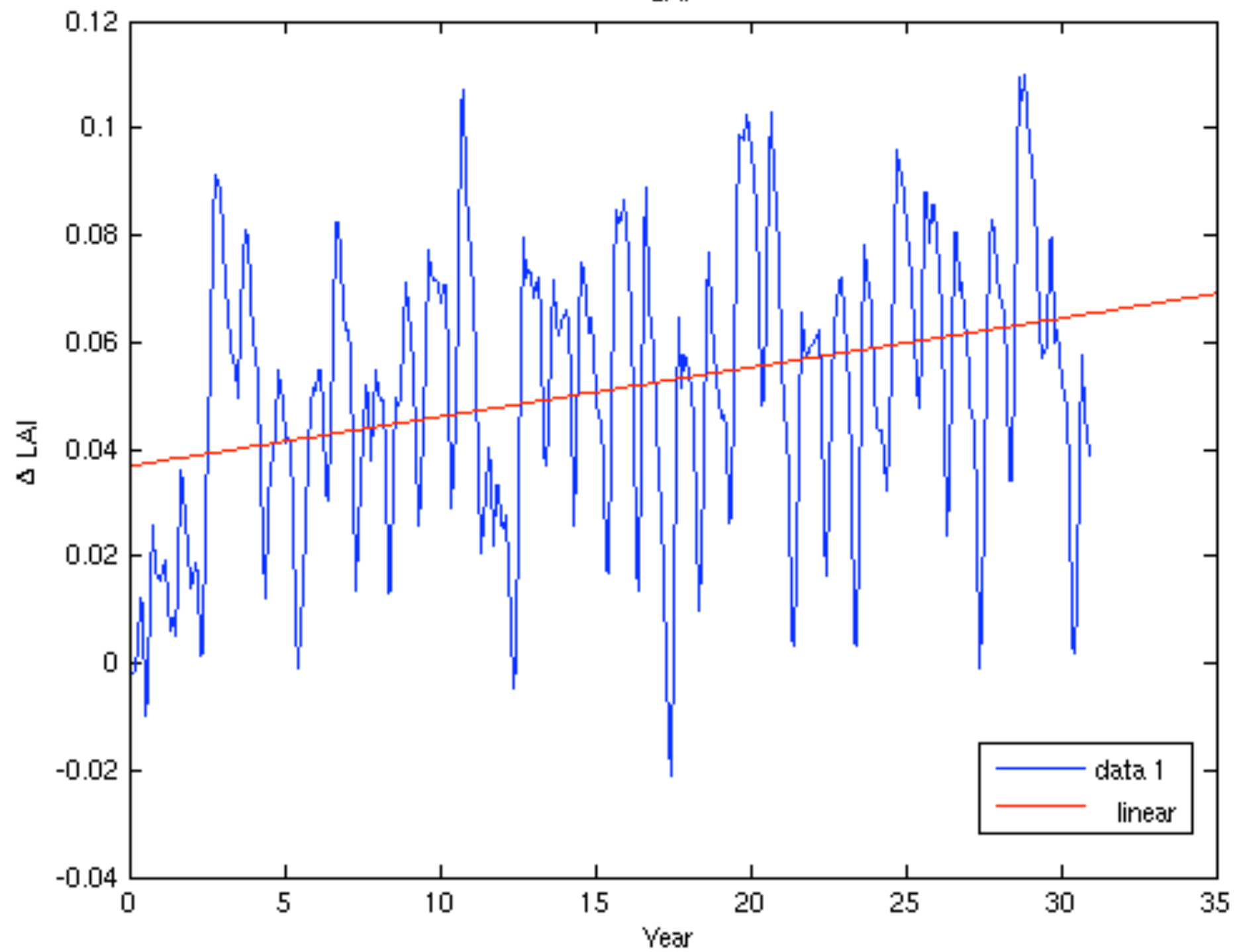
# Ocean mixed layer thickness (January)



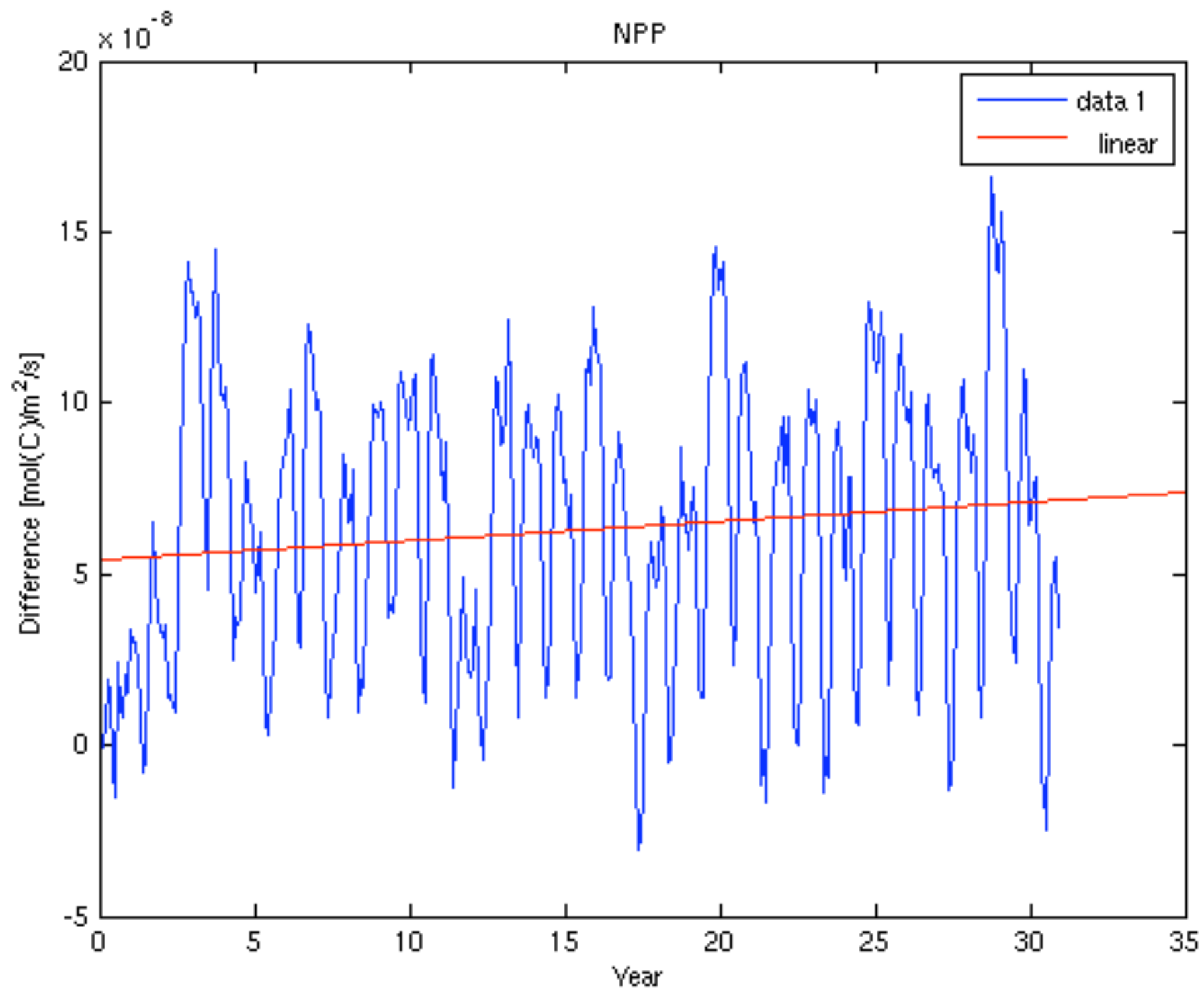
- Change in sea ice extent accounts for the change in thickness of mixing layer in the N. Atlantic.
- Significant increase in mixing layer thickness also noted in N. Pacific; again possibly attributed to sea ice increase.

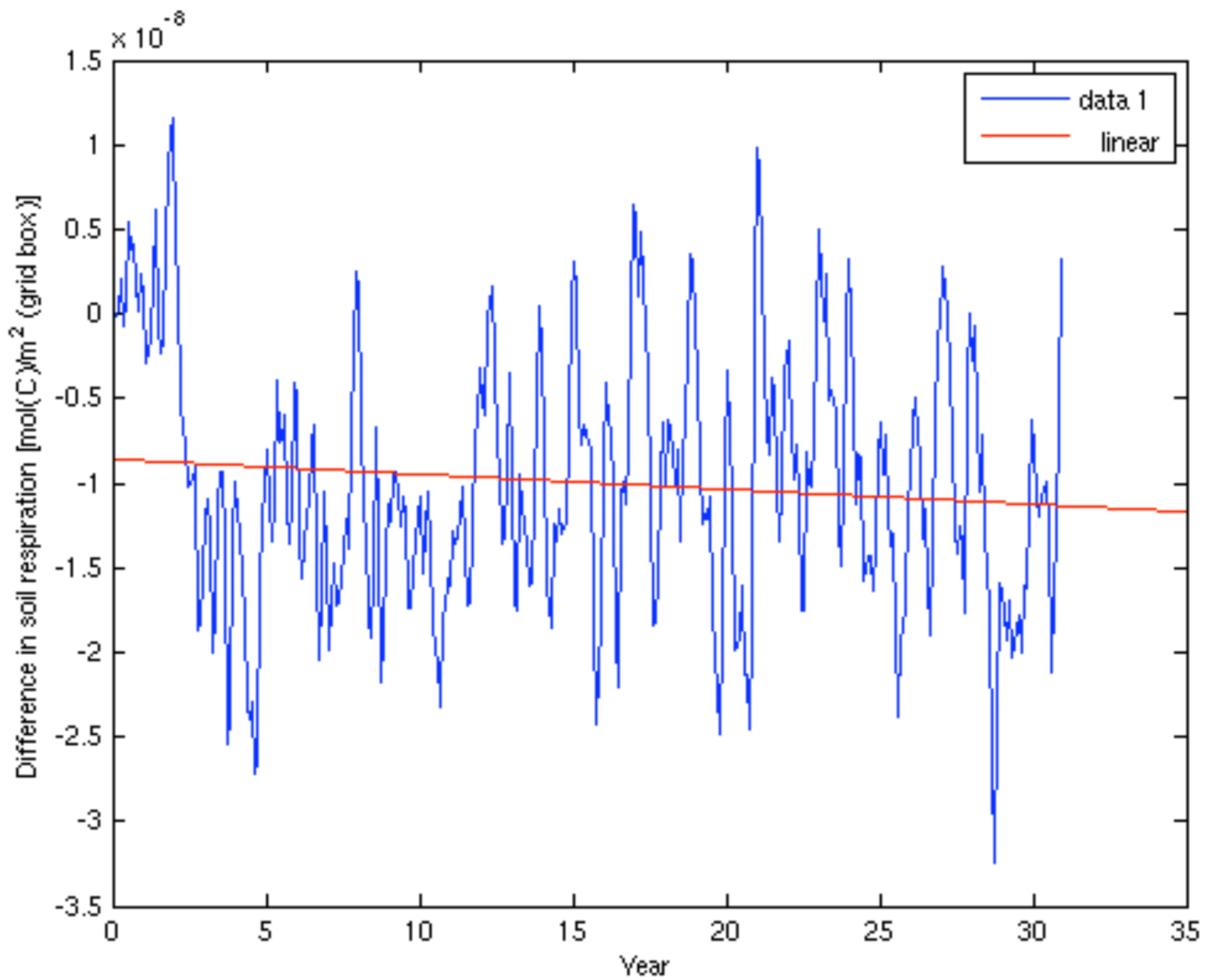


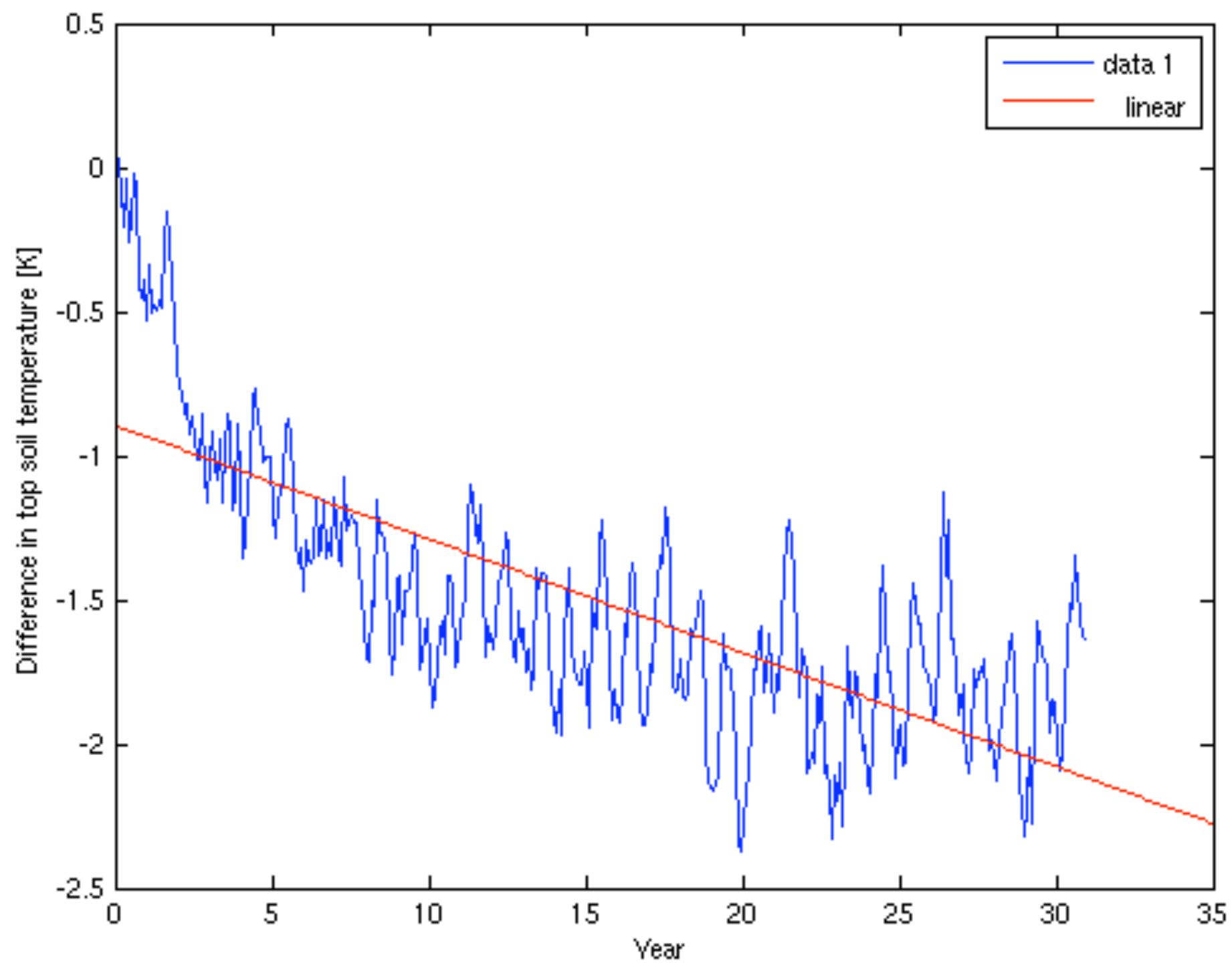
LAI



NPP







# Conclusions

- Less net solar, less net thermal radiation
- Temperature drop
- Less heat transport in the atmosphere
- Less ocean evaporation and tropical precipitation
- Substantial increase in Arctic sea ice
- Important changes in ocean transport in North Atlantic
- Plants grow more but breathe less