

CCSM4-CAM4 (Track 5) Coupled Simulations

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+ many others



Coupled Model Versions

- CCSM3.5 (CCSM3+...)
 - Undilute -> dilute CAPE calculation
 - Convective momentum transport
 - Freeze drying cloud
- CCSM4-CAM3.5.1 (Track I)
 - New surface components (cice, pop2, clm4)
 - ~CAM3.5 atmosphere
- CCSM4-CAM4 (Track 5)
 - New surface components (cice, pop2, clm4)
 - CAM4 atmosphere
 - MG microphysics
 - RRTM radiation
 - Modal aerosol model
 - UW PBL/Sh Convection
 - Macrophysics updates



Coupled Model Simulations

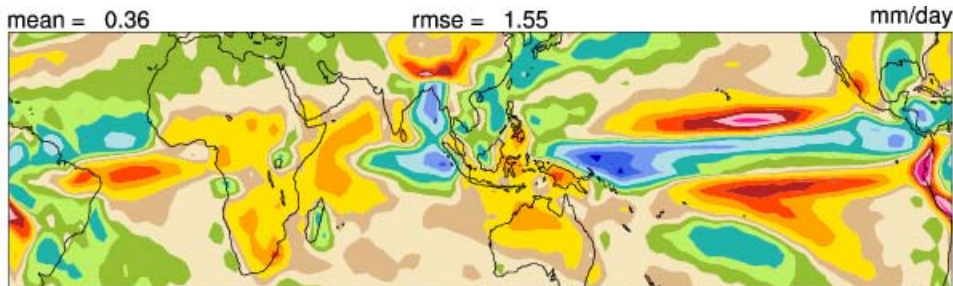
- CCSM3.5
 - 1990 Control simulation (100 years)
- CCSM4-CAM3.5.1 (Track I)
 - 1850 Control simulation (100 years)
 - 2000 Control simulation (100 years)
 - Prescribed aerosol burdens
- CCSM4-CAM4 (Track 5)
 - 1850 Control simulation (100 years)
 - 2000 Control simulation (100 years)
 - Prescribed aerosol emissions



Rainfall

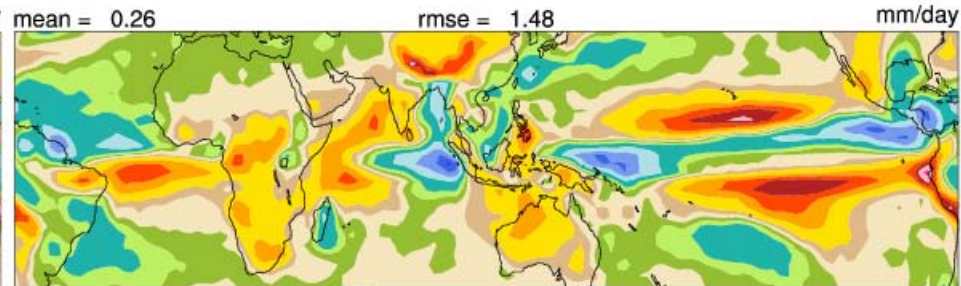
mm/day

CCSM4-CAM4

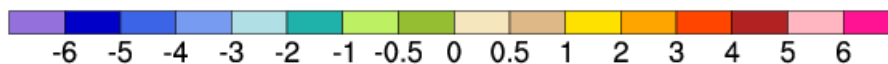


Min = -5.31 Max = 9.26

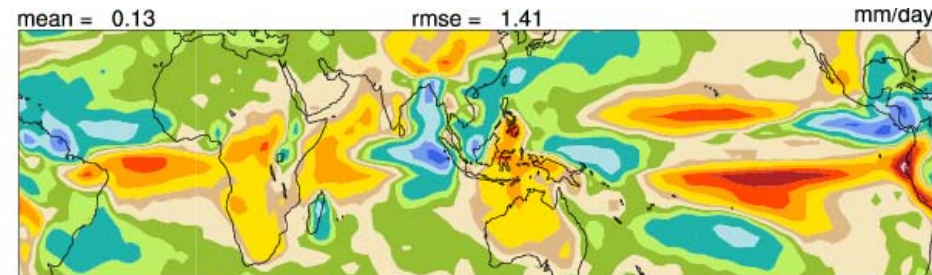
CCSM4-CAM3.5.1



Min = -5.20 Max = 6.42

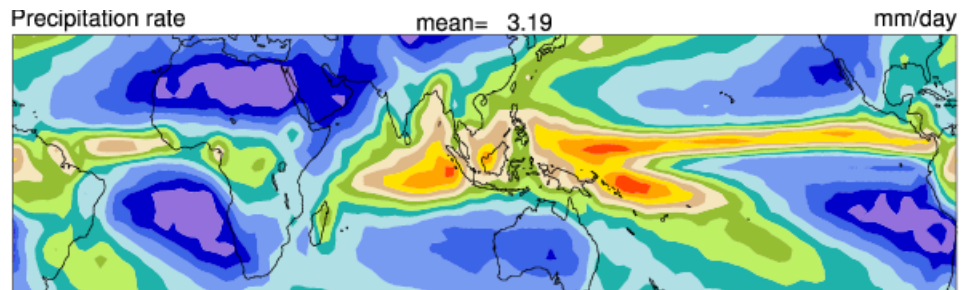


CCSM3.5

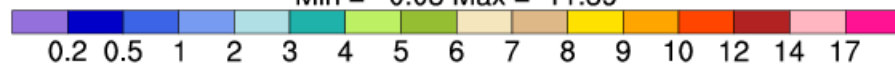


Min = -5.04 Max = 6.93

CMAP (Obs.)



Min = 0.03 Max = 11.39



SST error

CCSM4-CAM4

Bias and RMSE

CCSM4-CAM3.5.1

mean = 0.41

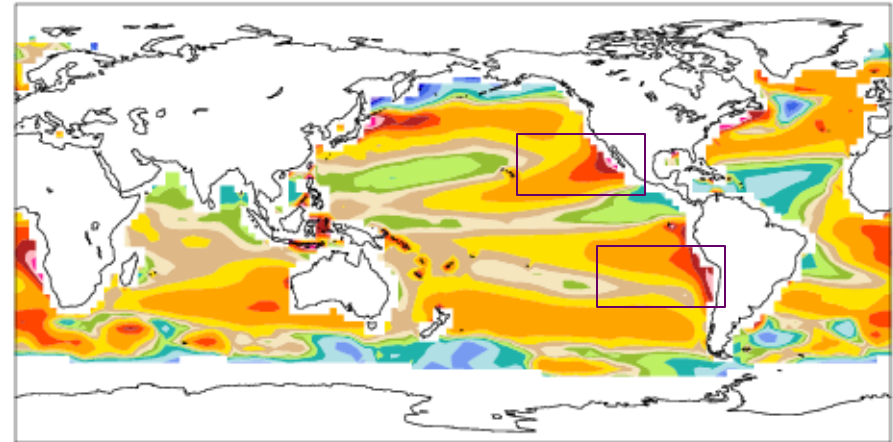
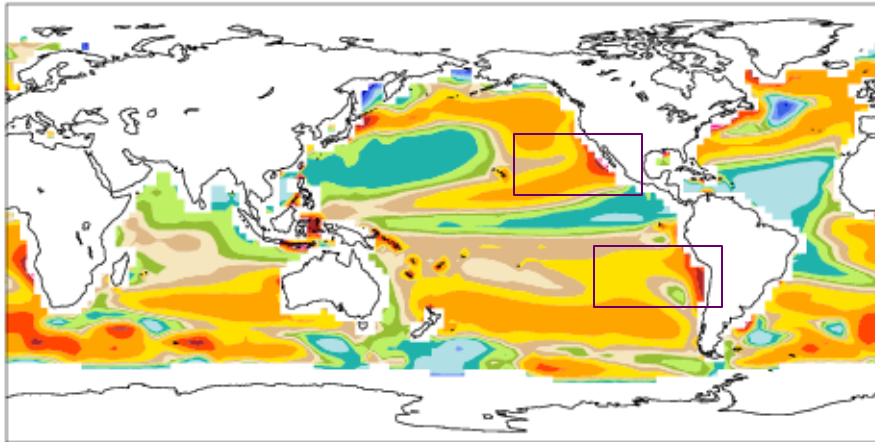
rmse = 1.21

C

mean = 0.63

rmse = 1.40

C

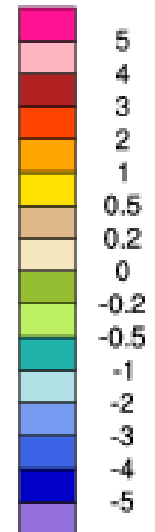
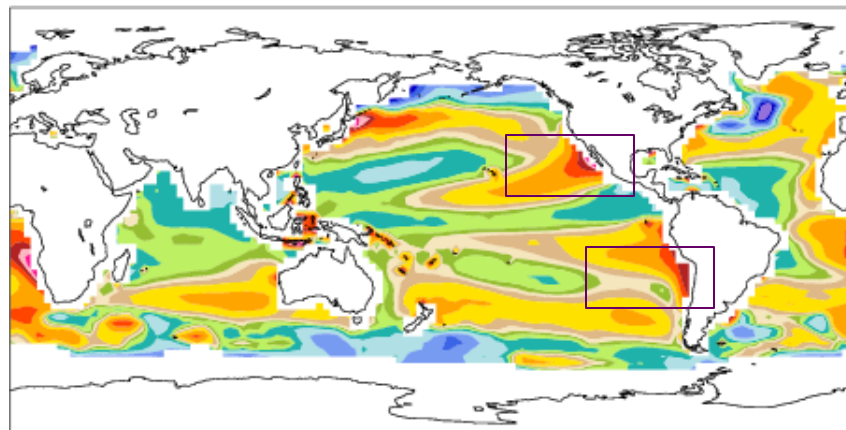


CCSM3.5

mean = 0.13

rmse = 1.23

C



Stratocumulus SW cloud forcing

JJA W/m^2

CCSM4-CAM4



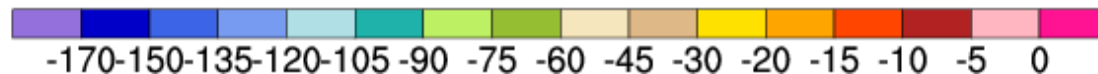
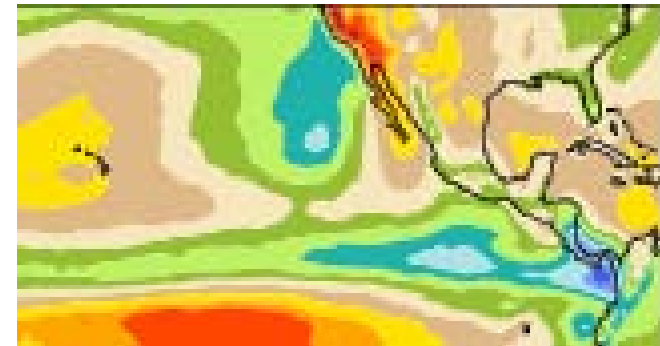
CCSM4-CAM3.5.1



CCSM3.5



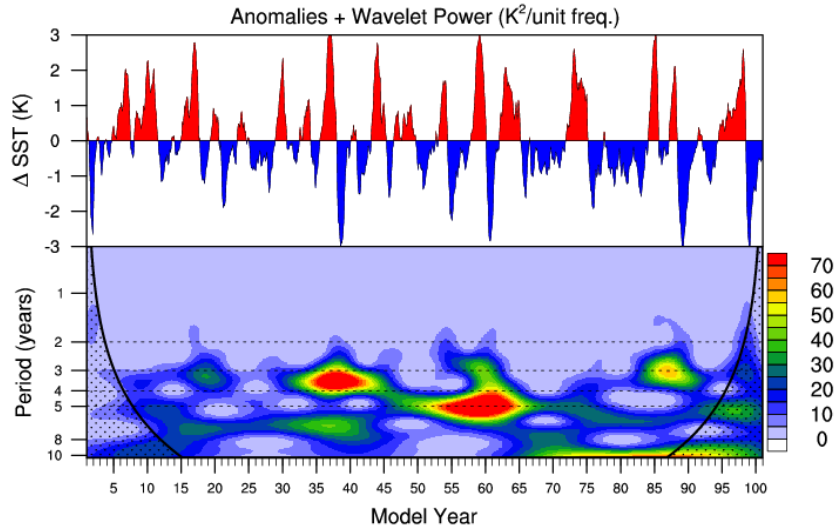
CERES-EBAF (Obs.)



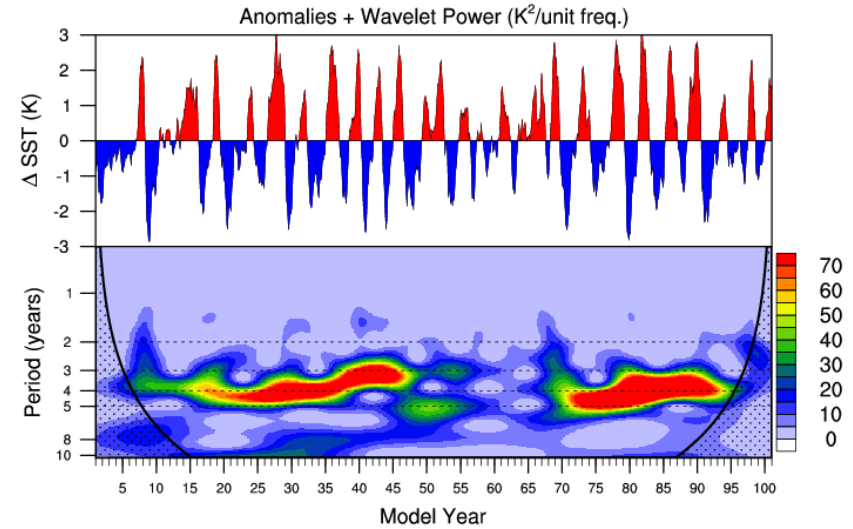
ENSO Variability

nino3.4 SST anomalies

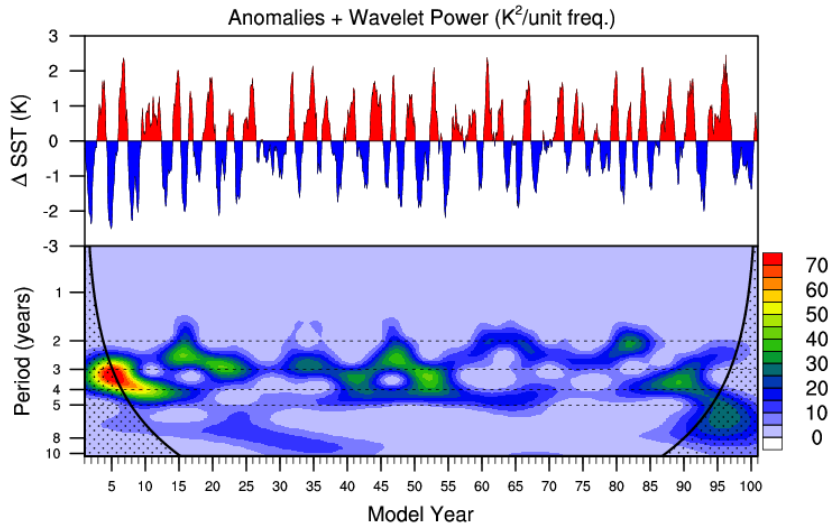
CCSM4-CAM4



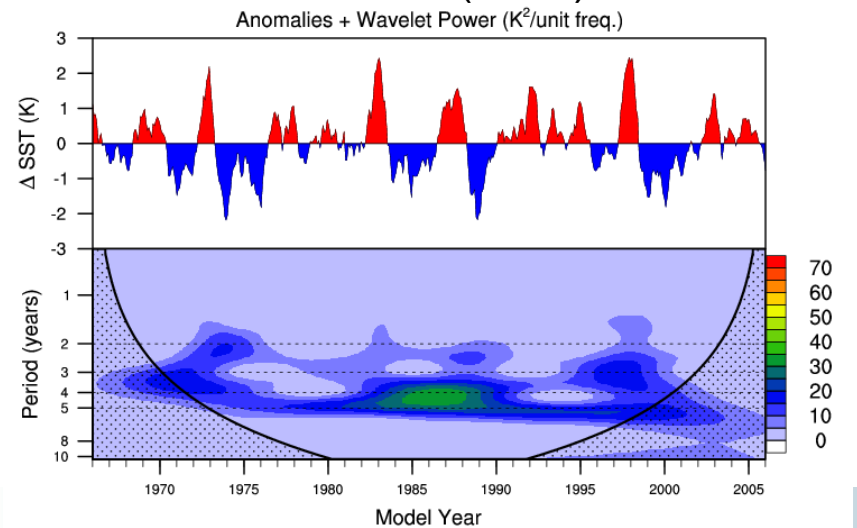
CCSM4-CAM3.5.1



CCSM3.5



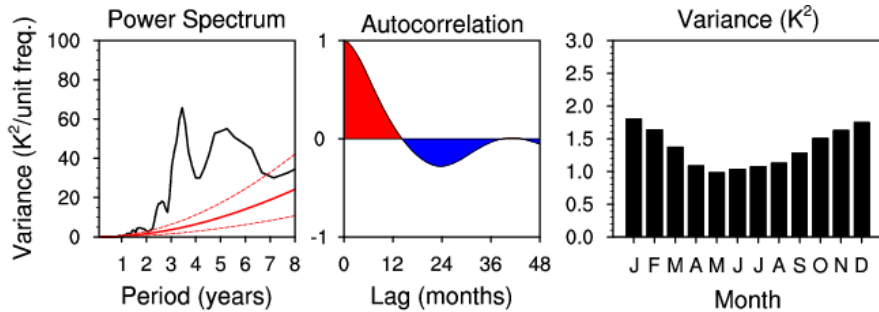
HadISST (Obs.)



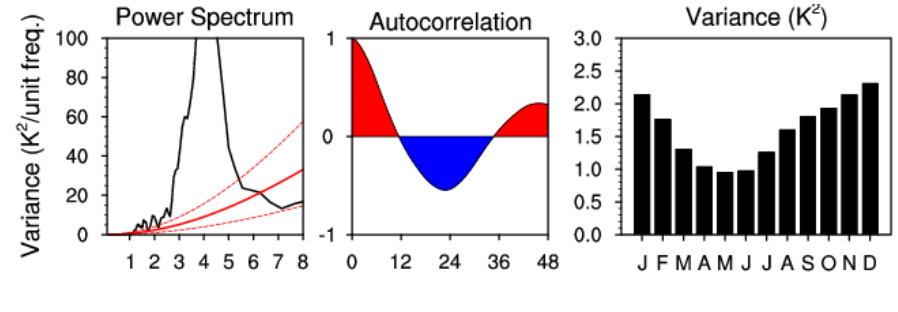
ENSO Period

nino3.4 SST anomalies

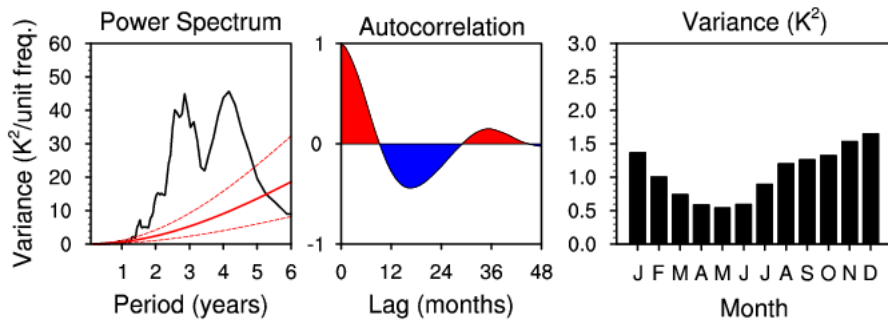
CCSM4-CAM4



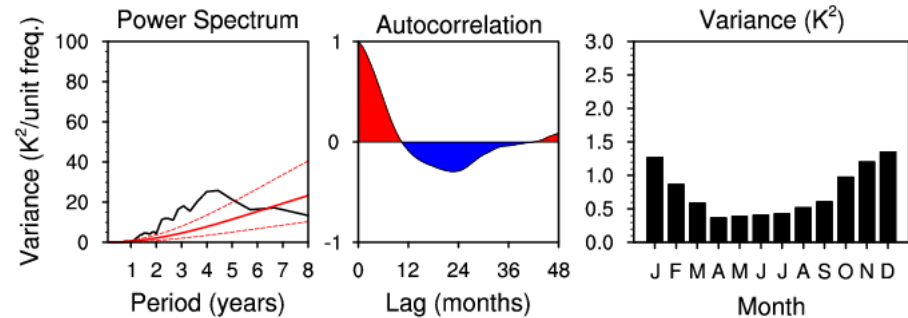
CCSM4-CAM3.5.1



CCSM3.5



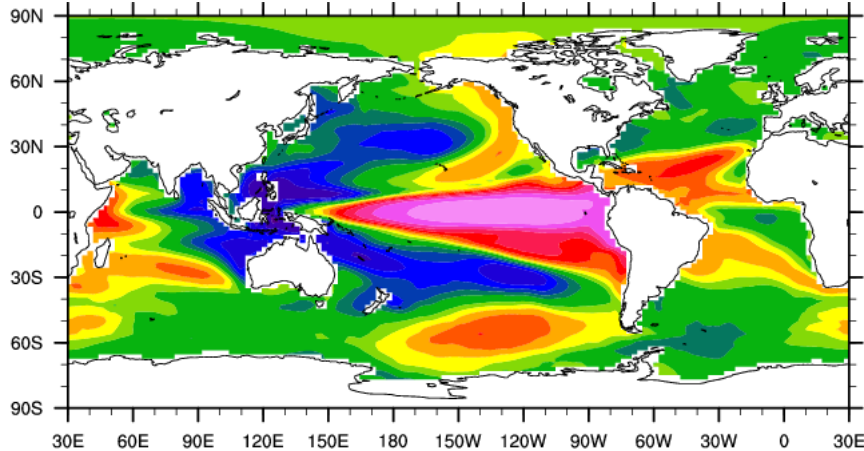
HadISST (Obs.)



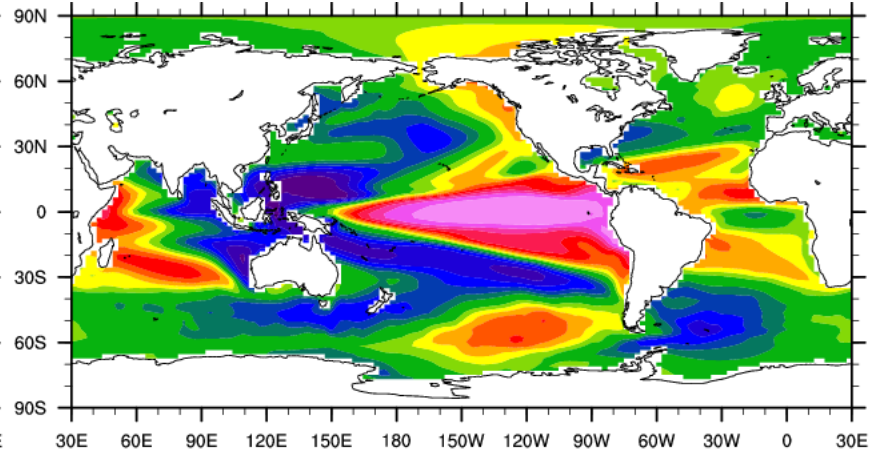
ENSO Teleconnections

lag-0 SSTA correlations

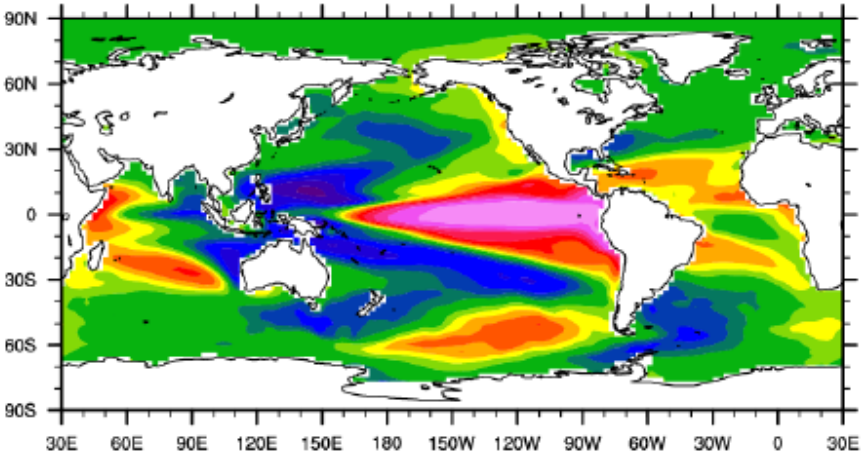
CCSM4-CAM4



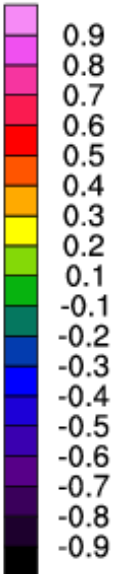
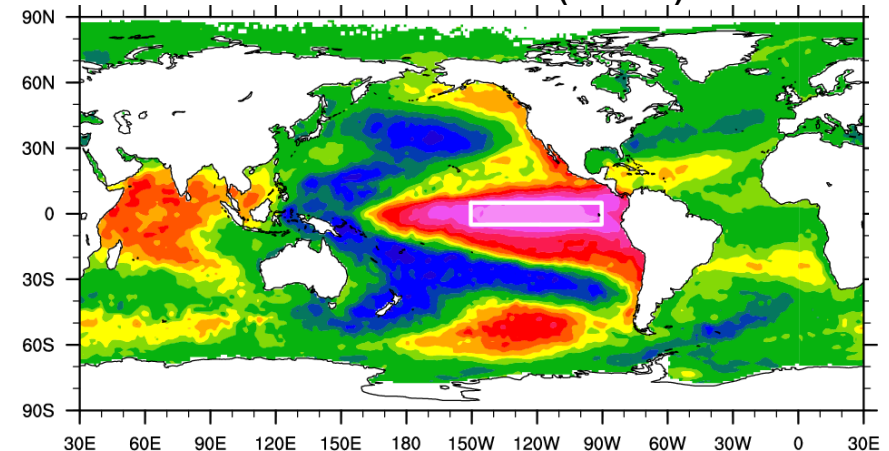
CCSM4-CAM3.5.1



CCSM3.5



HadISST (Obs.)

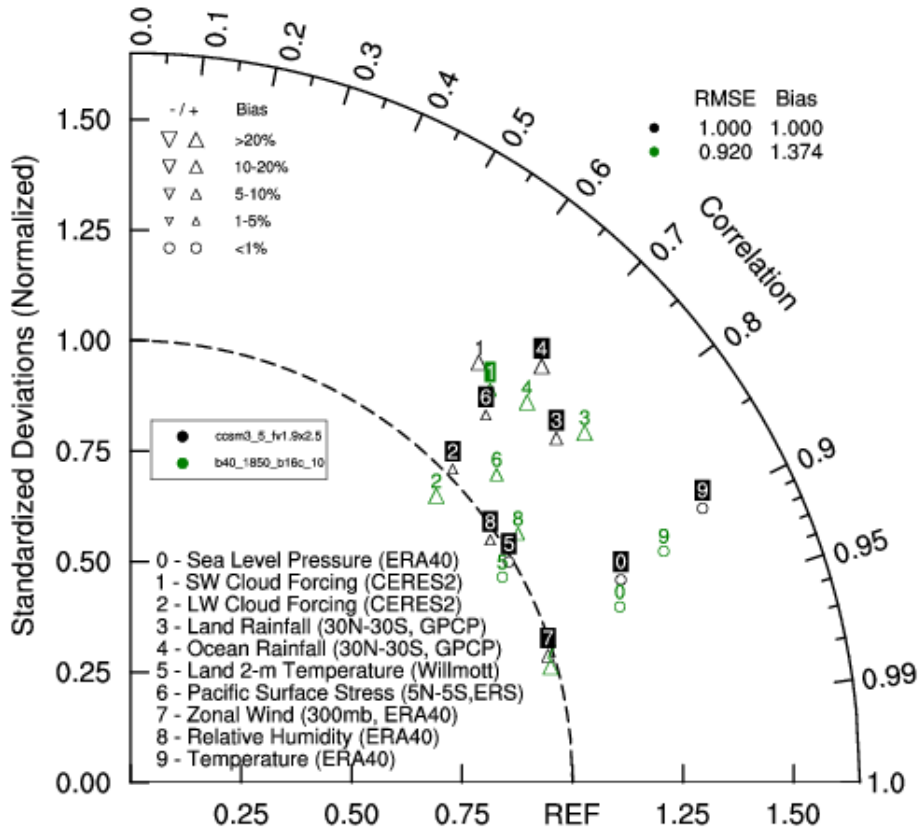


Climate Summary

Taylor Diagram

CCSM4-CAM4

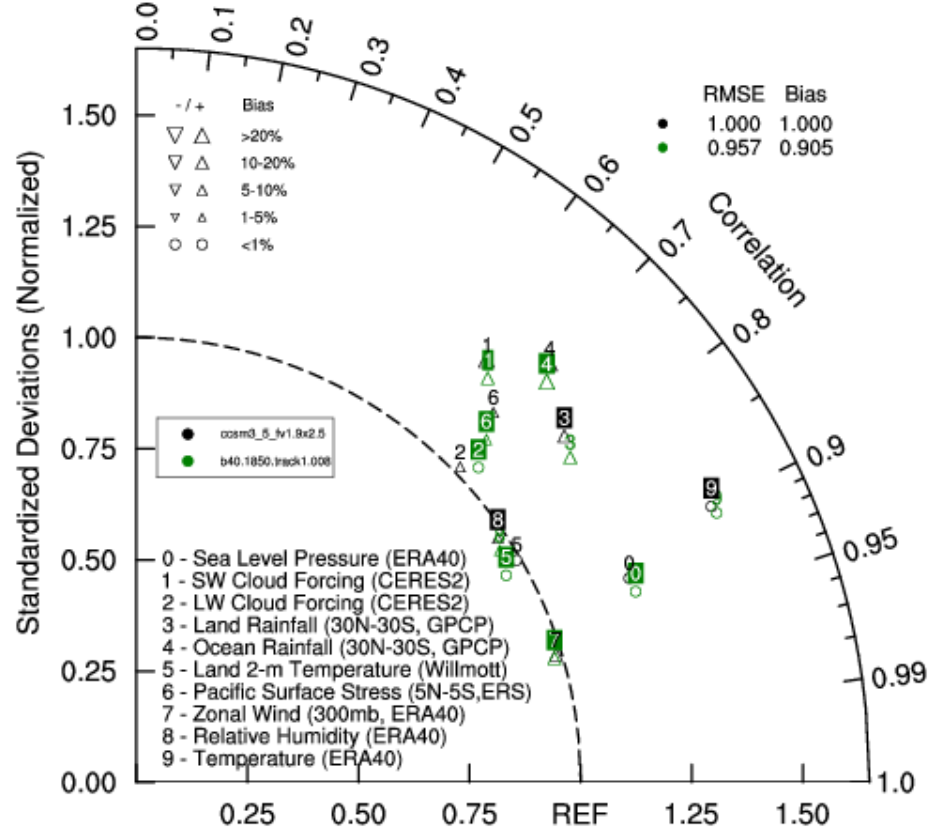
CCSM4-CAM3.5.1



0.920
1.374

RMSE improved
Bias poorer

0.957
0.905



Problems are LW Cloud Forcing, Land Rainfall

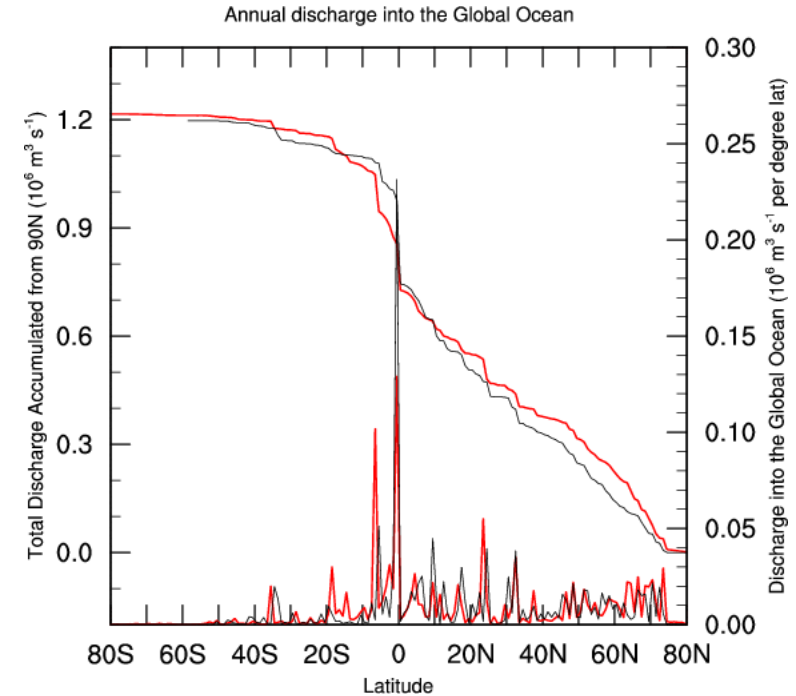
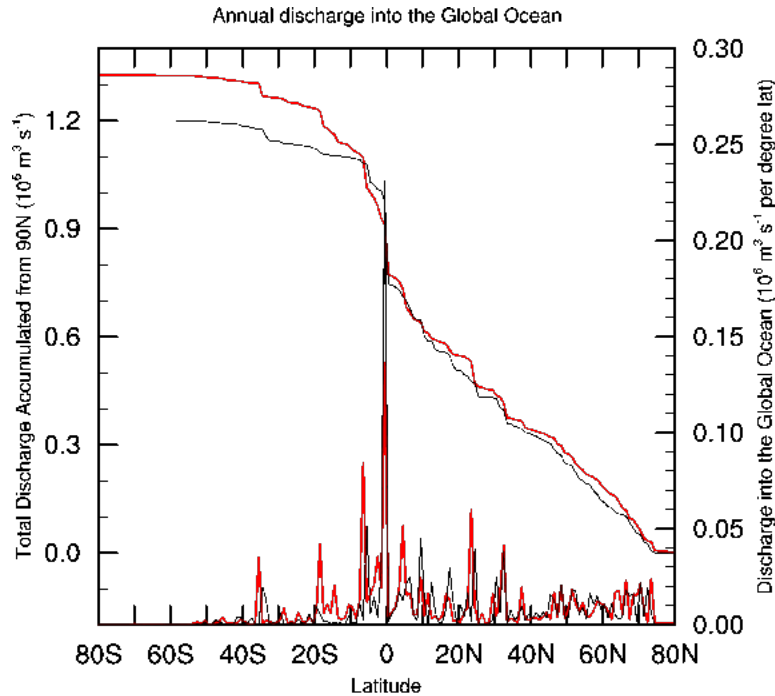


Surface Components

Land (CLM4)

CCSM4-CAM4

CCSM4-CAM3.5.1



Integrated river discharge

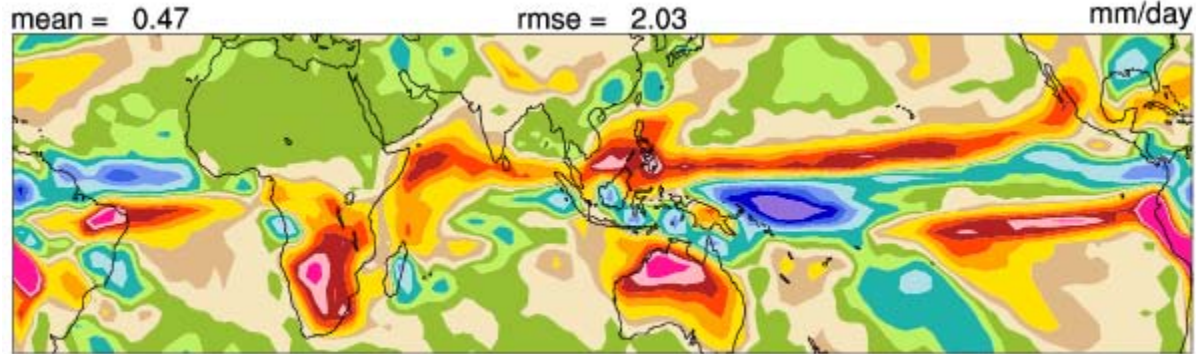
MODEL/OBS



Rainfall Over Land

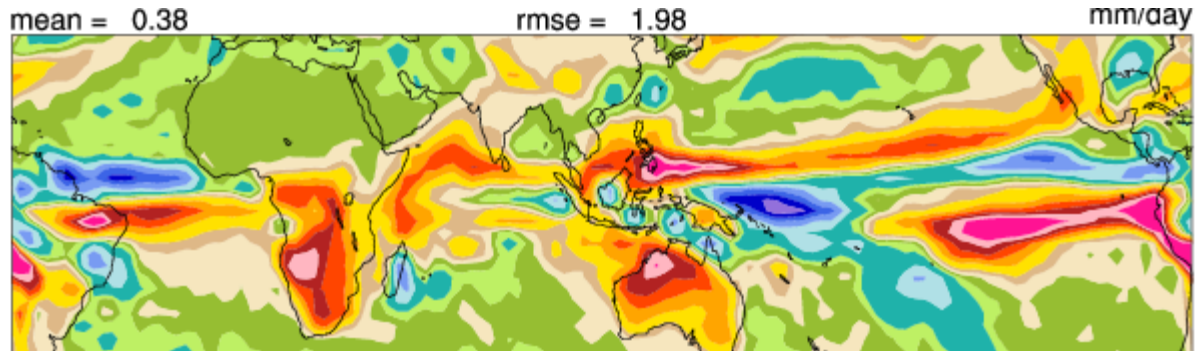
DJF

CCSM4-CAM4

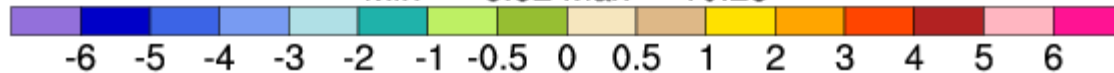


Min = -7.88 Max = 14.14

CCSM4-CAM3.5.1



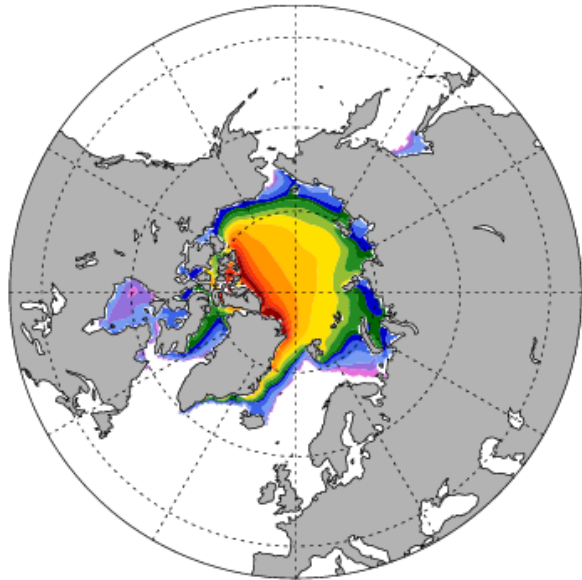
Min = -6.82 Max = 10.25



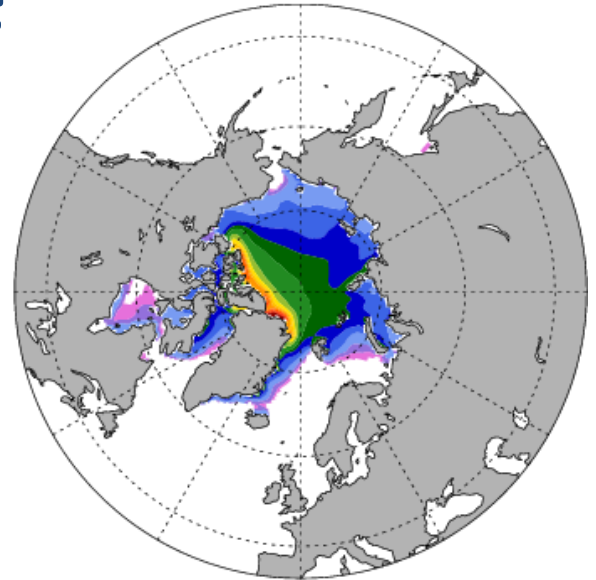
Arctic Sea Ice

JAS thickness

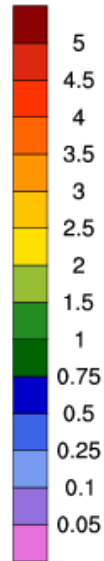
CCSM4-CAM4



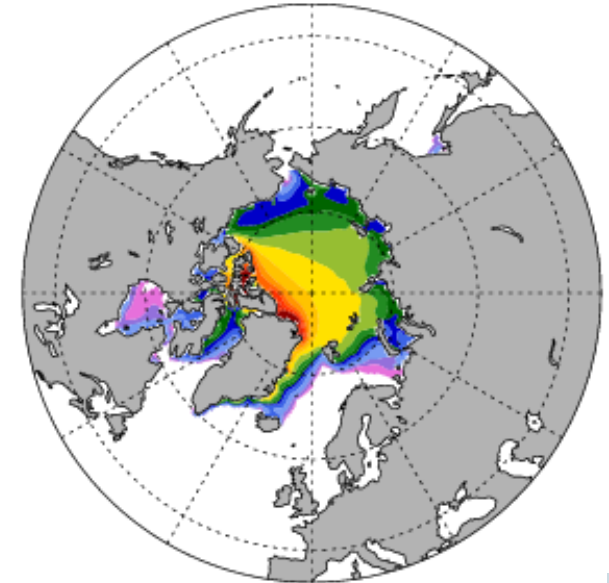
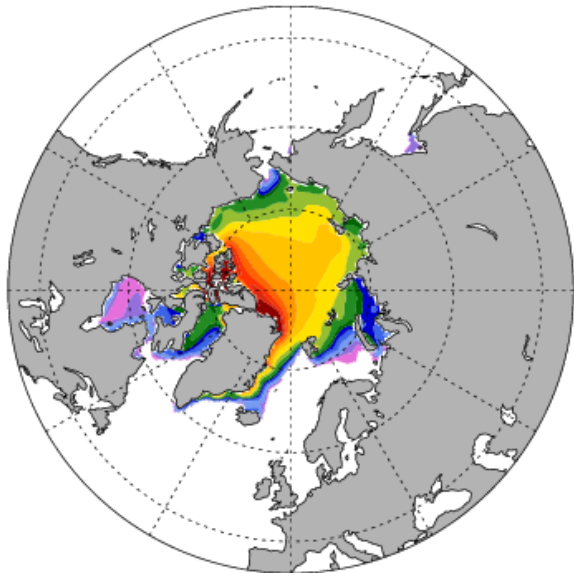
1850



2000

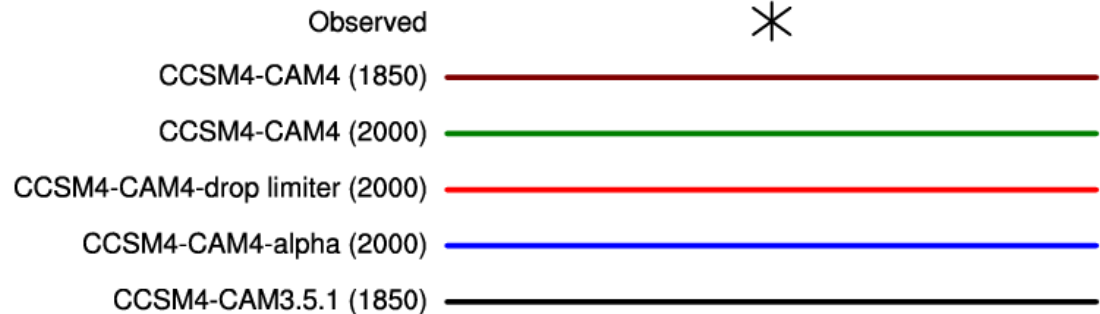
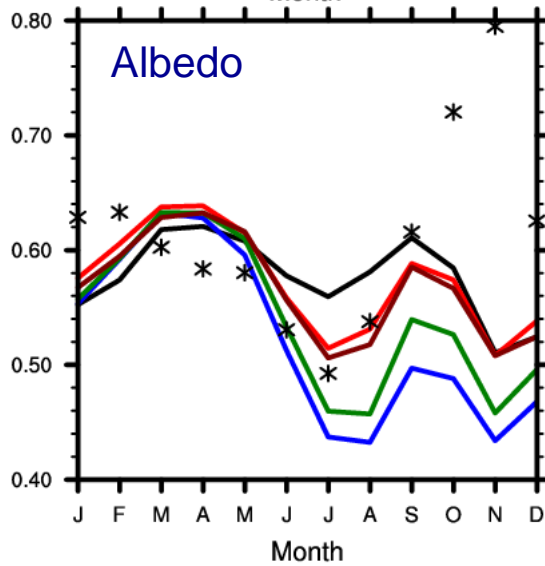
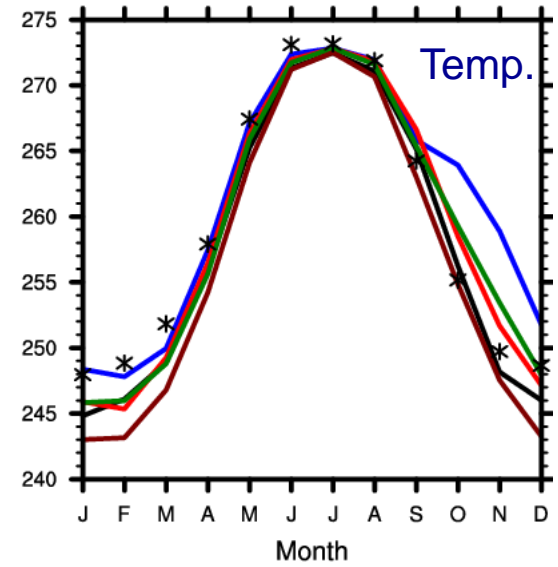
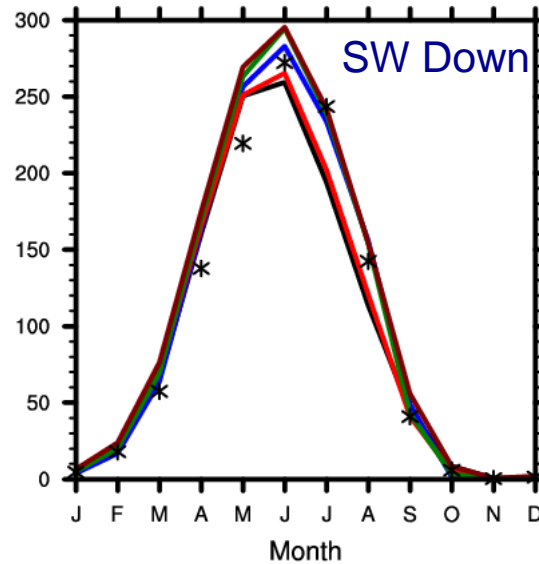
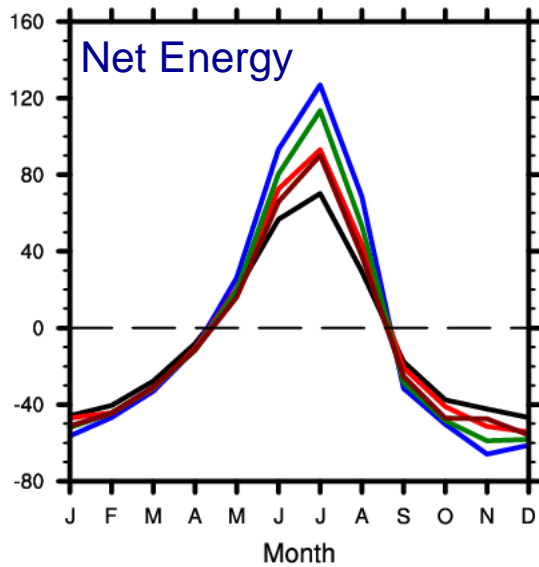


CCSM4-CAM3.5.1



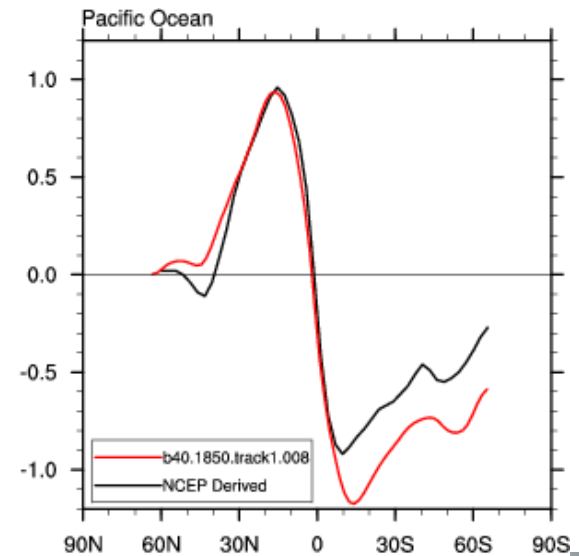
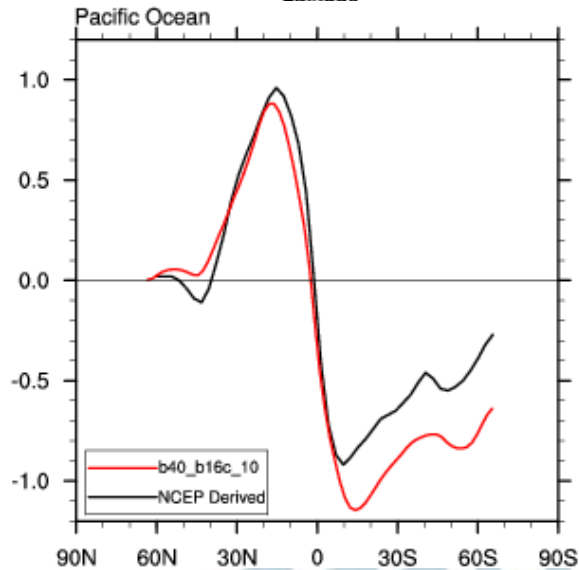
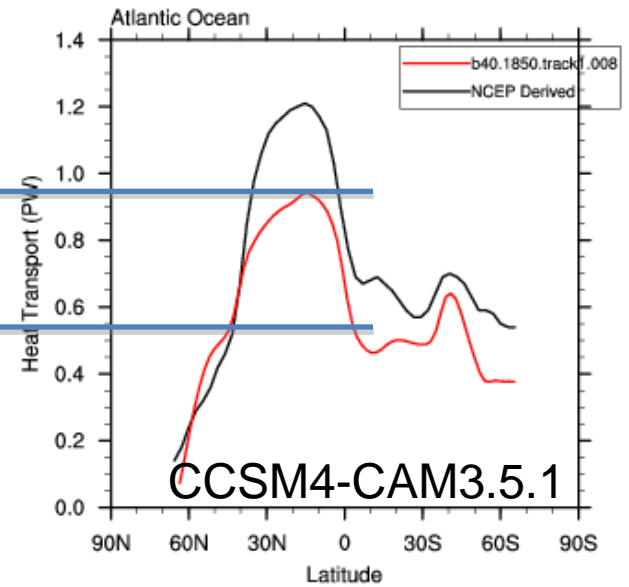
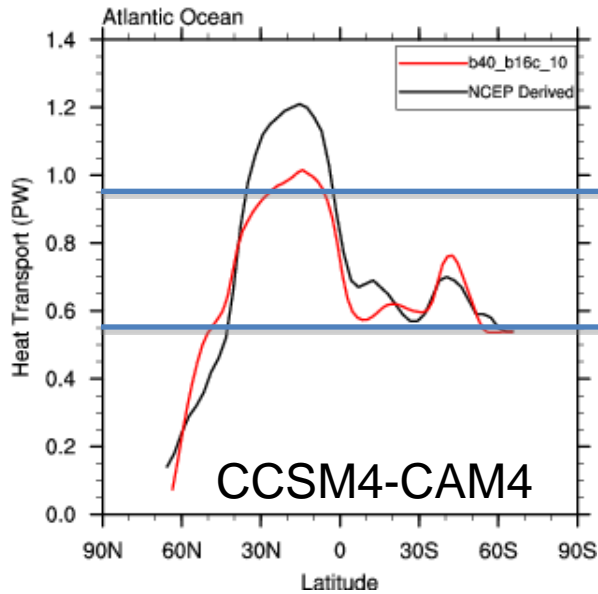
Arctic Surface Forcing

Surface > 50% ice



Ocean Heat Transport

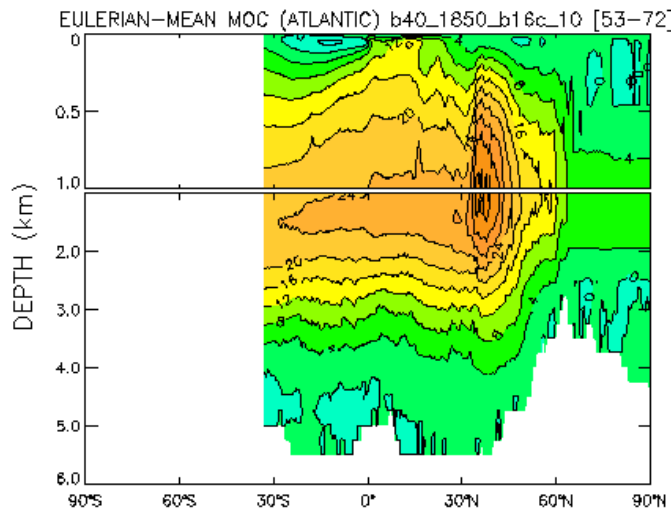
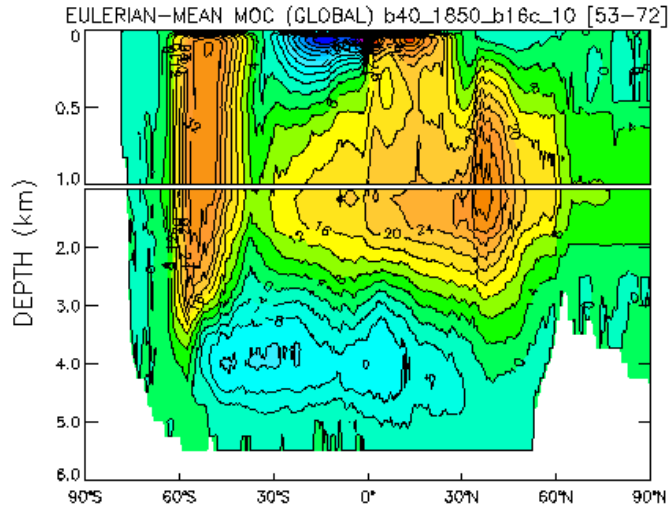
Pacific, Atlantic



Meridional Overturning Circulation

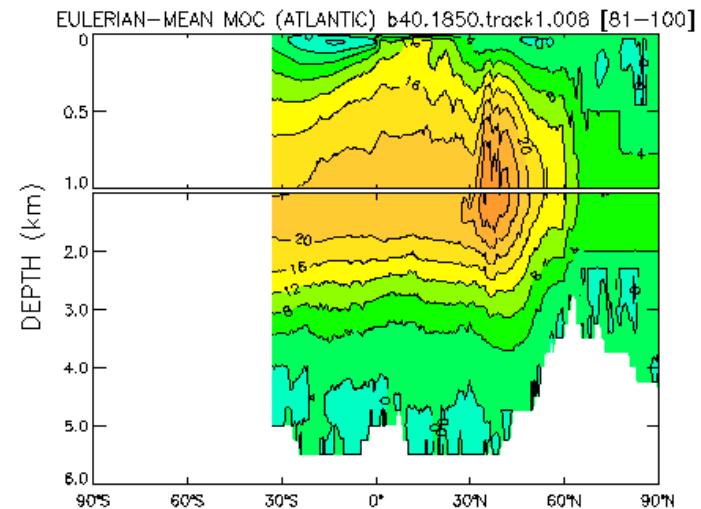
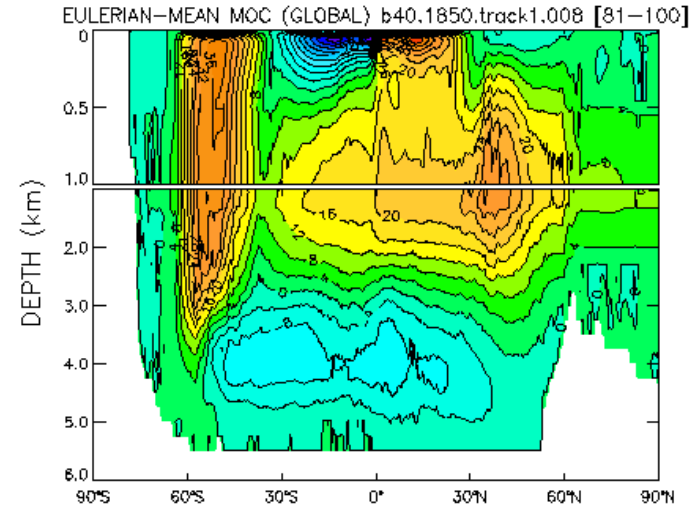
Sv

CCSM4-CAM4



UNITS = Sv

CCSM4-CAM3.5.1

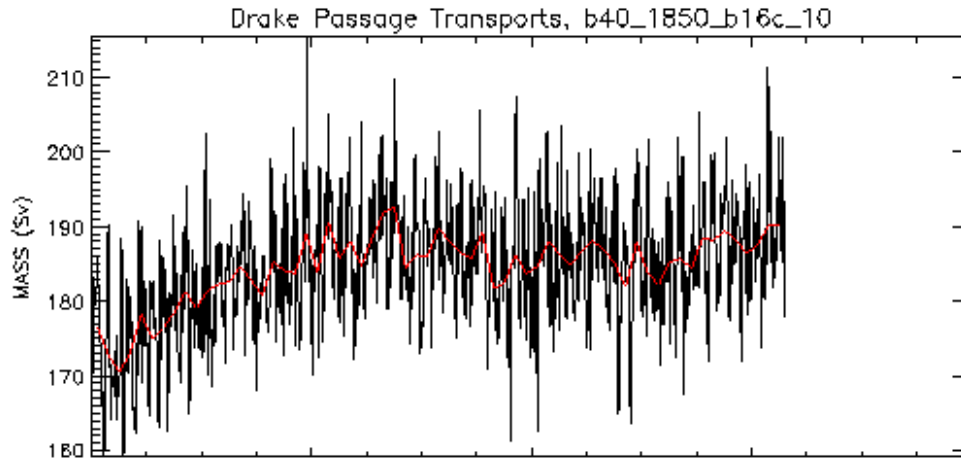


UNITS = Sv



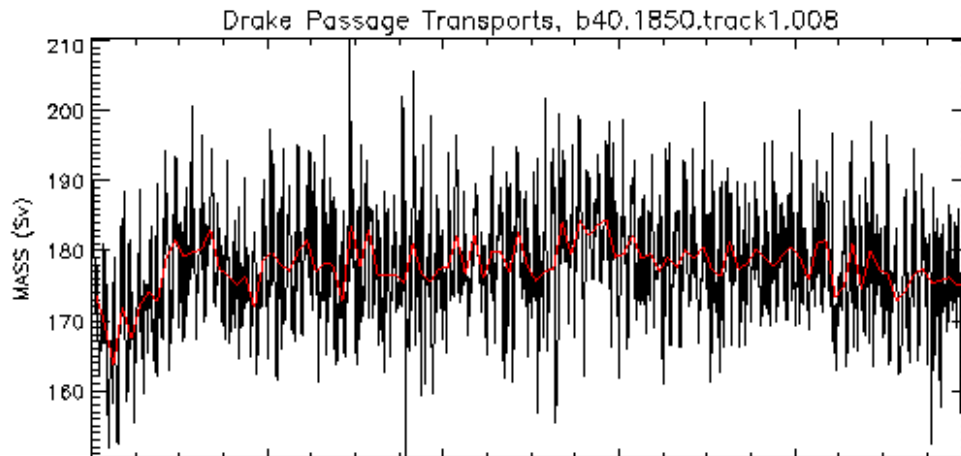
Drake Passage Transport

CCSM4-CAM4



190 Sv

CCSM4-CAM3.5.1



180 Sv



Summary

- CCSM4-CAM4 (Track V)
 - Stable coupled simulation
 - Competitive with CCSM4-CAM3.5.1
 - Improved SST and low cloud response
 - ENSO characteristics maintained
 - Excessive winter sea-ice problem contained
 - Low summer sea-ice problem to be addressed
 - Corrected SW bias, high ocean heat transport
 - Excessive land precipitation impacts SH river runoff
 - Ocean heat transport, MOC, ACC higher
- Climate sensitivity
 - Early indications are good for reproducing the 20thC climate
 - RFP is 0.5-0.7 W for 2000 minus 1850 controls
 - Indirect effect compensated by 'low cloud feedbacks' (SW)

