# Evaluation of Ocean Model Performance for

## NUIST-CSM-2.0.1

# historical Experiment

June 23, 2018

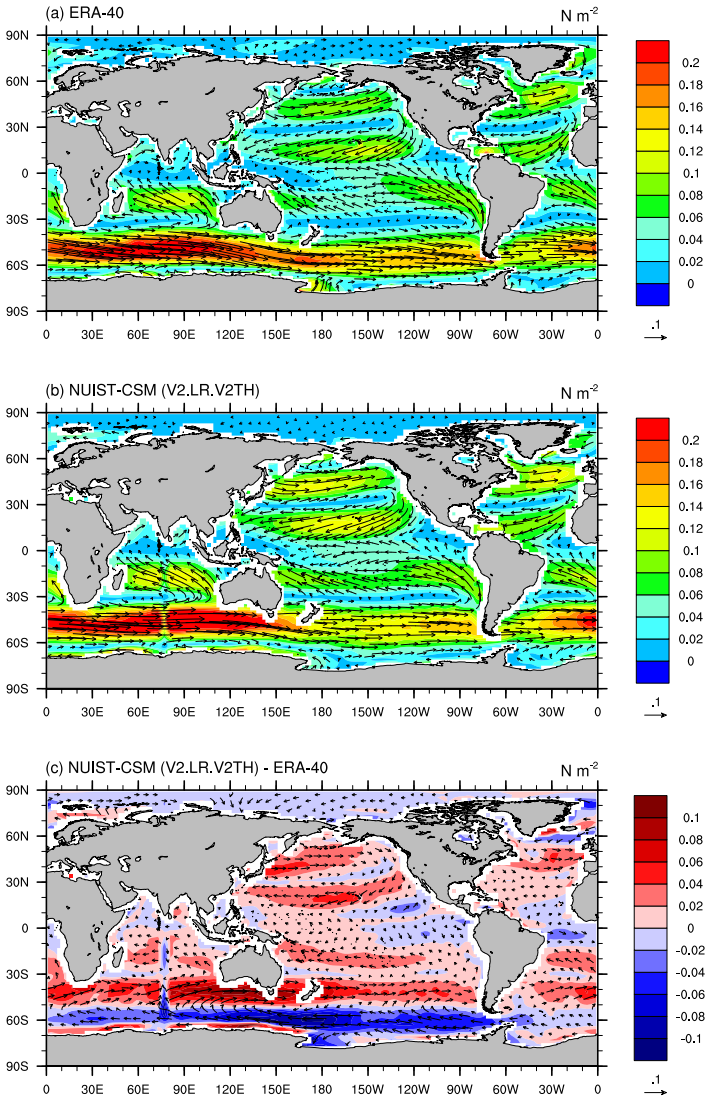
# Summary Table

## Summary of model performance by PCC, NRMSE

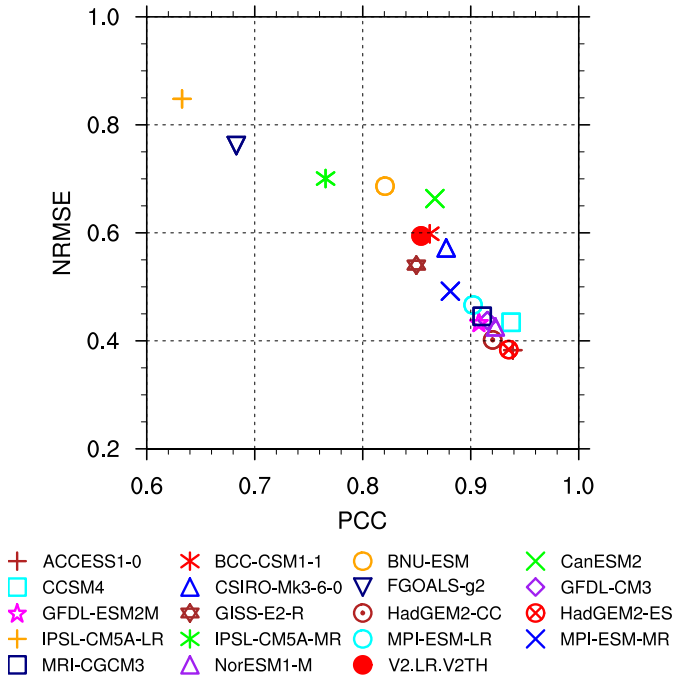
| ID | Metrics | Top 30% | | Top 50% | | V2.LR.V2TH | |
|---|---|---|---|---|---|---|---|
| | | PCC | NRMSE | PCC | NRMSE | PCC | NRMSE |
| 01.03 | Wind Stress Mag | 0.92 | 0.43 | 0.90 | 0.47 | 0.85 | 0.59 |
| 01.04 | Wind Stress Curl | 0.81 | 0.61 | 0.79 | 0.66 | 0.85 | 0.56 |
| 02.01 | Down Net Heat Flux | 0.81 | 0.95 | 0.78 | 0.97 | - | - |
| 03.01 | Down Fresh Water Flux | 0.67 | 0.88 | 0.63 | 0.94 | - | - |
| 11.01 | Sea Surf Temp | 0.99 | 0.12 | 0.99 | 0.13 | 0.99 | 0.15 |
| 11.01.01 | Sea Surf Temp DJF | 0.99 | 0.14 | 0.99 | 0.15 | 0.99 | 0.16 |
| 11.01.03 | Sea Surf Temp JJA | 0.99 | 0.13 | 0.99 | 0.15 | 0.99 | 0.18 |
| 11.01.11 | Sea Surf Temp JJAS-DJFM | 0.96 | 0.31 | 0.95 | 0.33 | 0.94 | 0.38 |
| 11.01.12 | Sea Surf Temp AM-ON | 0.94 | 0.35 | 0.94 | 0.38 | 0.94 | 0.38 |
| 11.11 | Sea Water Temp - EQ | 0.98 | 0.23 | 0.98 | 0.26 | 0.97 | 0.24 |
| 11.16 | Sea Water Temp - GLB Zonal Avg | 0.99 | 0.16 | 0.99 | 0.25 | 1.00 | 0.17 |
| 11.21 | Sea Surf Temp Seas Cyc | 0.91 | 0.56 | 0.90 | 0.66 | 0.90 | 0.51 |
| 12.01 | Sea Surf Salin | 0.92 | 0.51 | 0.90 | 0.57 | 0.65 | 0.95 |
| 12.16 | Sea Water Salin - GLB Zonal Avg | 0.92 | 0.68 | 0.90 | 0.74 | 0.52 | 2.06 |
| 14.01 | Therm Depth - 20 degC | 0.85 | 0.59 | 0.81 | 0.63 | 0.83 | 0.62 |
| 15.01 | Mixed Layer Depth - -0.5 degC | 0.82 | 0.80 | 0.77 | 0.88 | 0.58 | 1.00 |
| 15.01.08 | Max Mixed Layer Depth - -0.5 degC | 0.52 | 1.03 | 0.50 | 1.10 | 0.55 | 0.83 |
| 21.01 | Sea Surf Height | 0.99 | 0.28 | 0.98 | 0.57 | - | - |
| 22.04 | Sea Surf Curr Mag | 0.82 | 0.64 | 0.78 | 0.67 | 0.84 | 0.55 |
| 22.11 | Upper Lev Zonal Curr - EQ Pacif | 0.94 | 0.36 | 0.93 | 0.44 | 0.94 | 0.35 |
| 22.16 | Upper Lev Zonal Curr - Pacif | 0.89 | 0.43 | 0.87 | 0.54 | 0.86 | 0.48 |
| 23.16 | Merid Overt Streamf - GLB | 0.86 | 0.69 | 0.82 | 0.73 | 0.88 | 0.56 |
| 23.17 | Merid Overt Streamf - Atlan | 0.68 | 0.90 | 0.62 | 1.03 | 0.78 | 0.69 |

Red: reach the top 30%; Green: reach the top 50%; Blue: not reach the top 50%.

# 01.03 Wind Stress and Its Magnitude

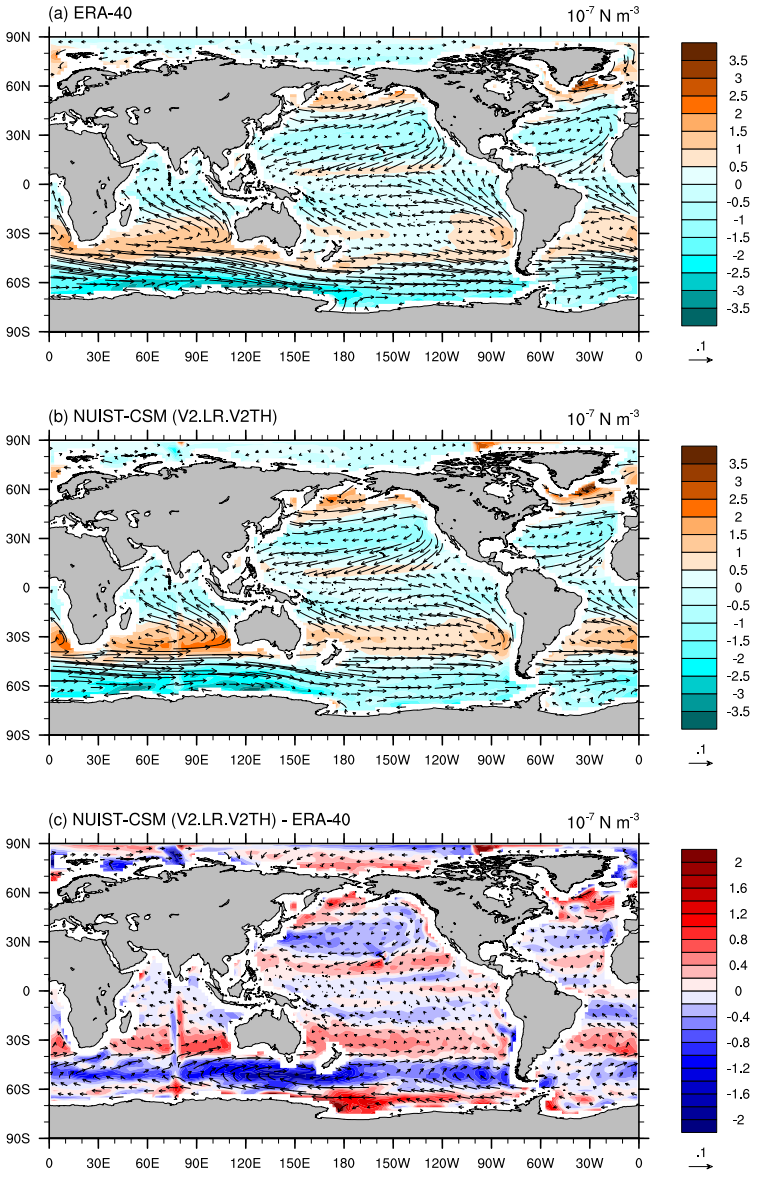



## Comparison with CMIP5 models by PCC and NRMSE

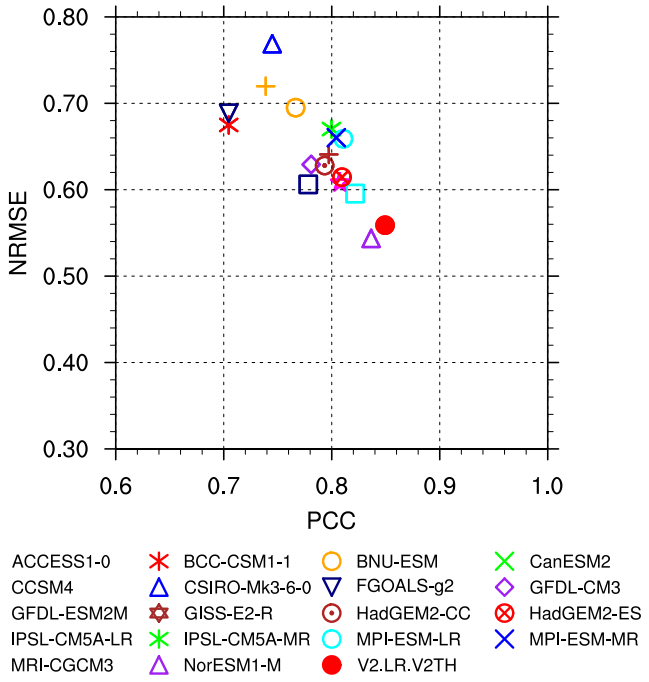



Back to introduction | Back to summary table

# 01.04 Wind Stress and Its Curl

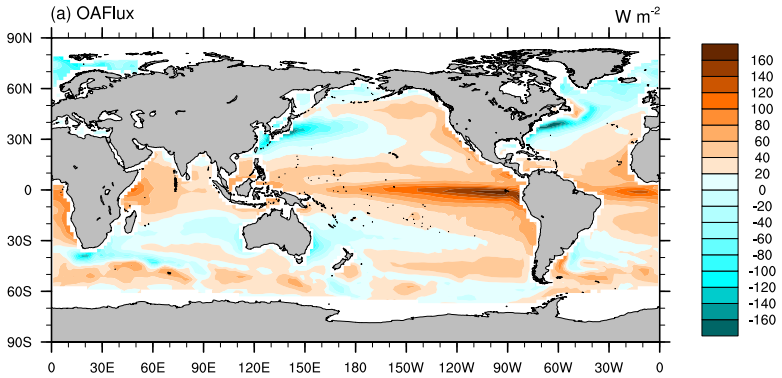



## Comparison with CMIP5 models by PCC and NRMSE

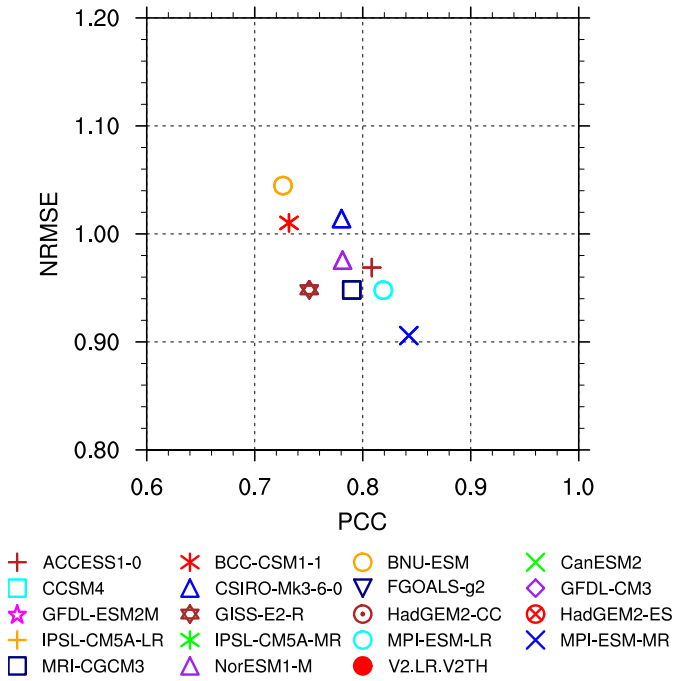



Back to introduction | Back to summary table

# 02.01 Sea Surface Downward Net Heat Flux

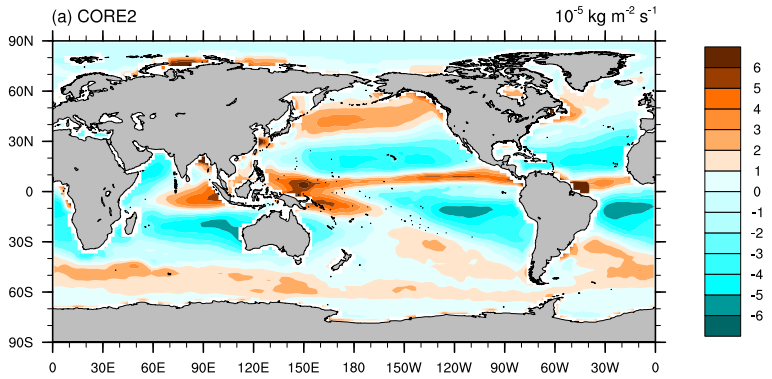



## Comparison with CMIP5 models by PCC and NRMSE

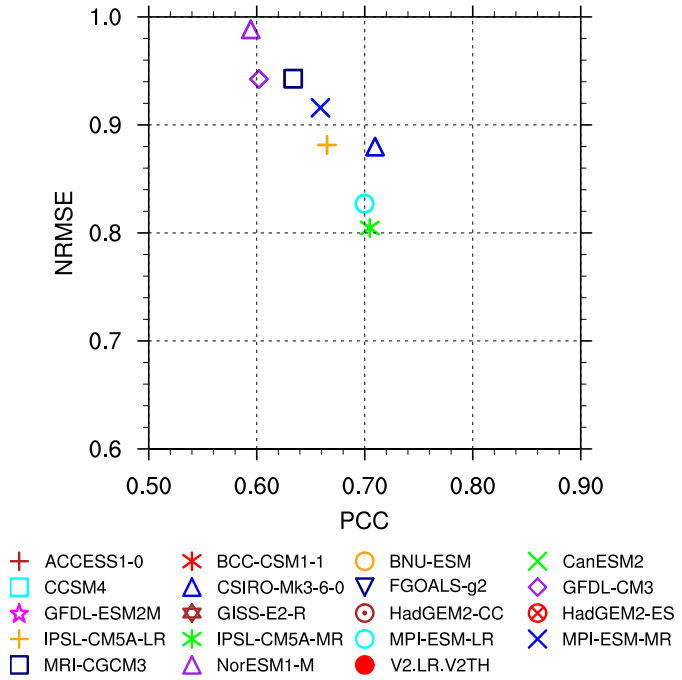



Back to introduction | Back to summary table

# 03.01 Sea Surface Downward Fresh Water Flux

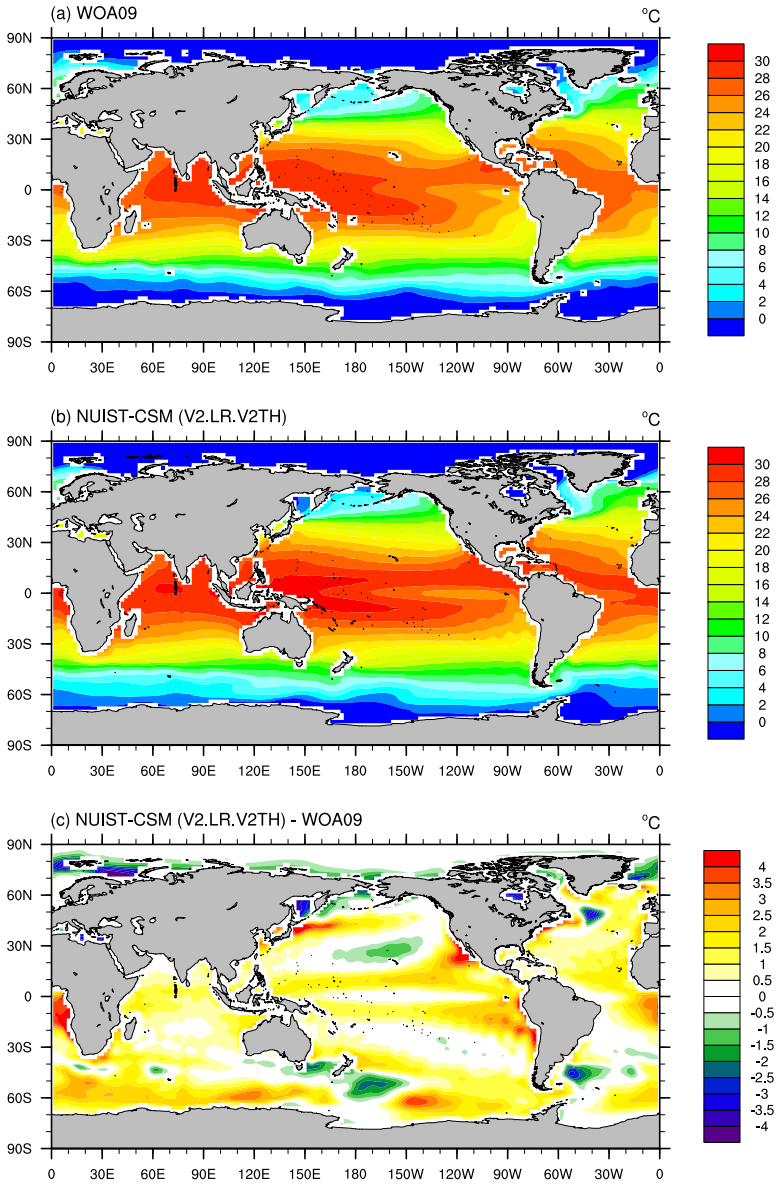



## Comparison with CMIP5 models by PCC and NRMSE

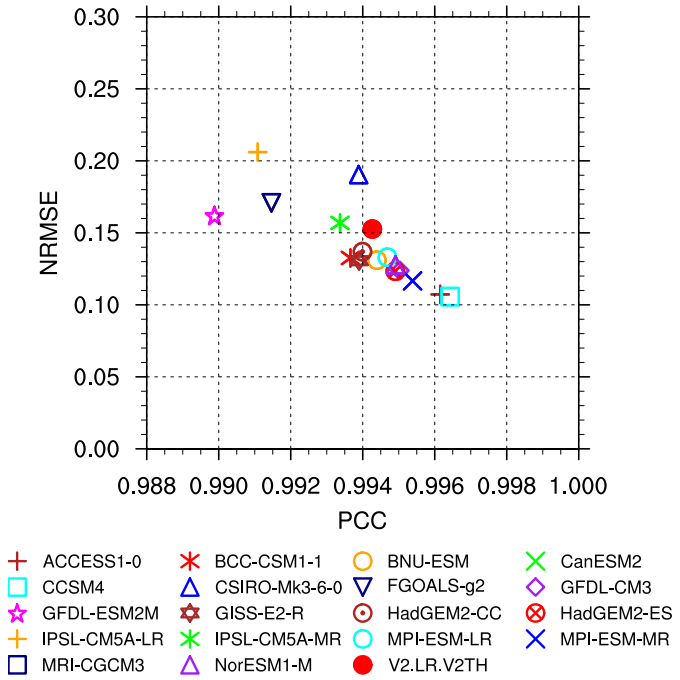



Back to introduction | Back to summary table

# 11.01 Sea Surface Temperature

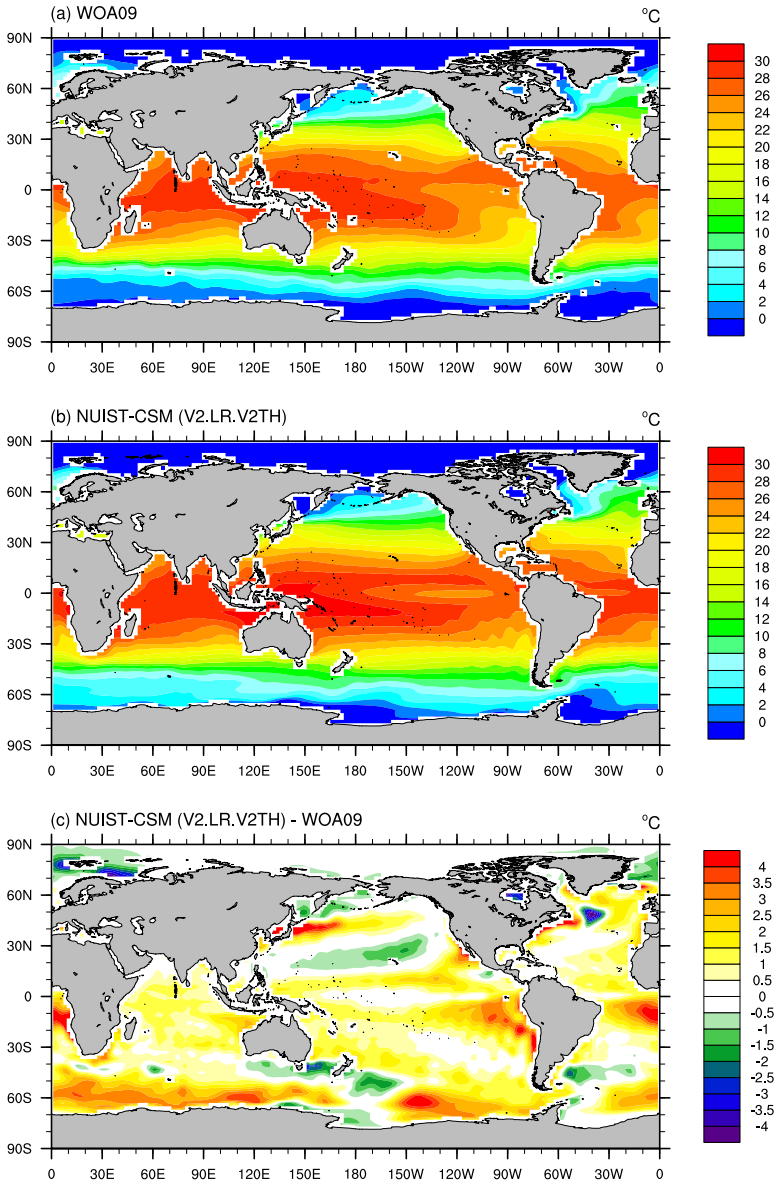



## Comparison with CMIP5 models by PCC and NRMSE

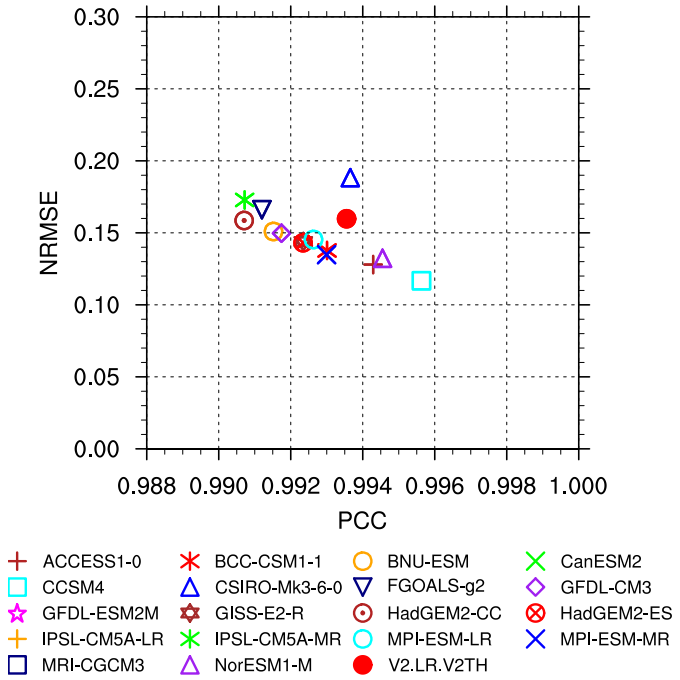



Back to introduction | Back to summary table

# 11.01.01 Sea Surface Temperature DJF Mean

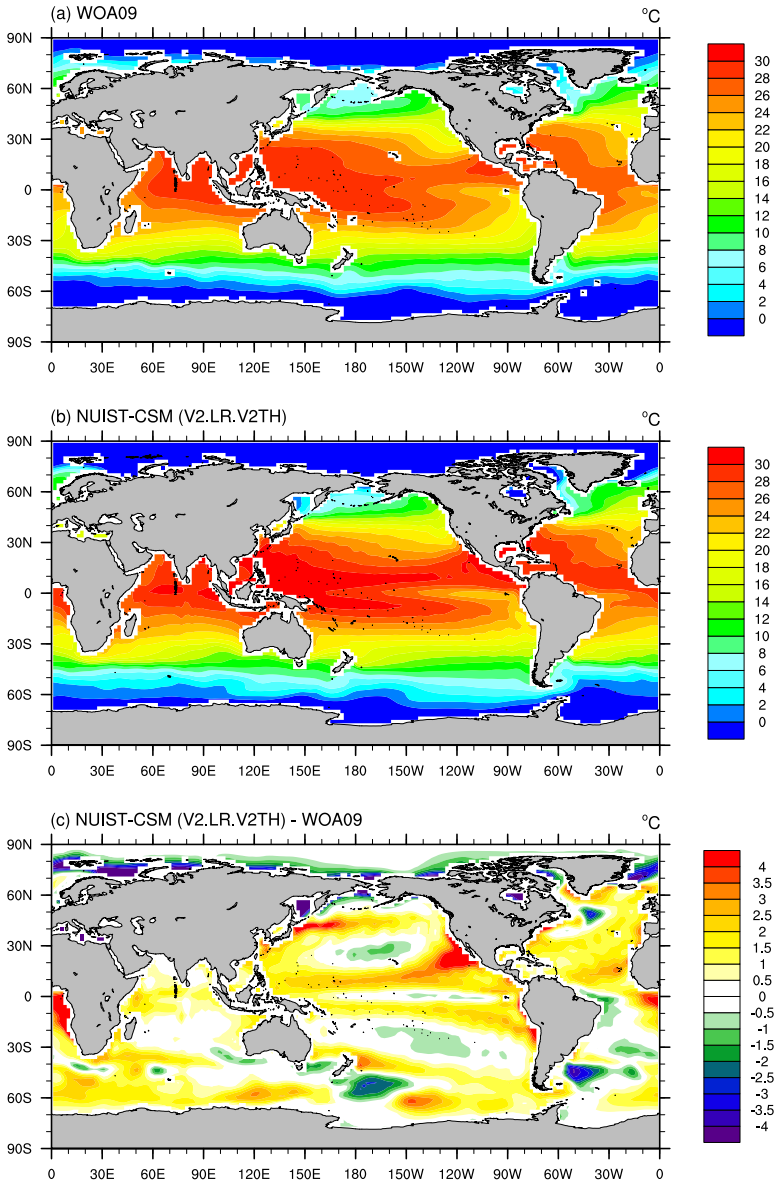



## Comparison with CMIP5 models by PCC and NRMSE

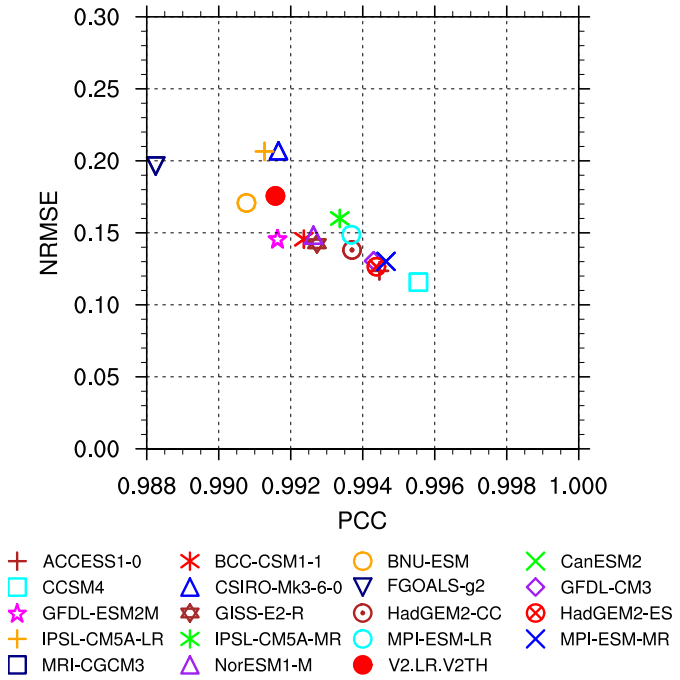



Back to introduction | Back to summary table

# 11.01.03 Sea Surface Temperature JJA Mean

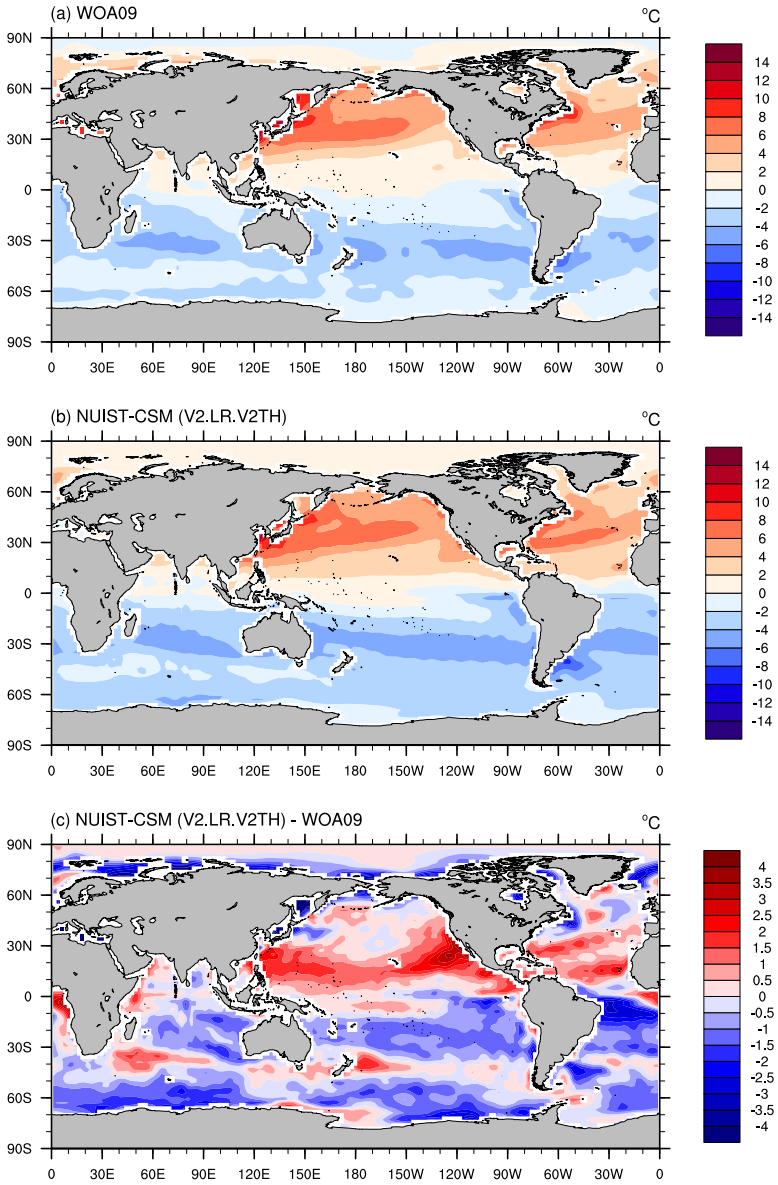



## Comparison with CMIP5 models by PCC and NRMSE

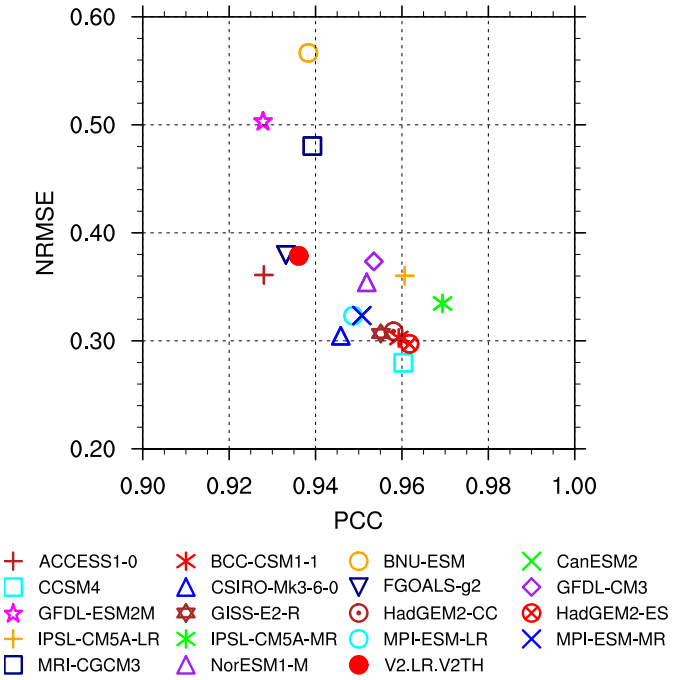



Back to introduction | Back to summary table

# 11.01.11 Sea Surface Temperature Seasonality JJAS-DJFM

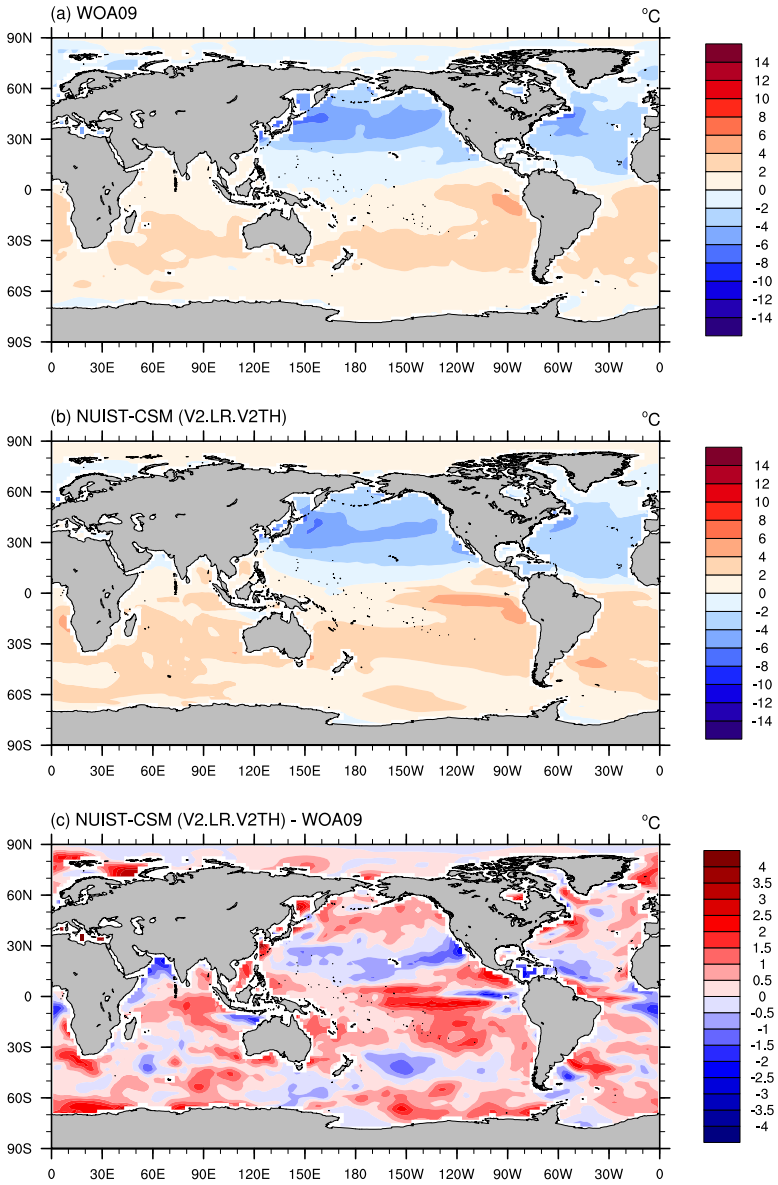



## Comparison with CMIP5 models by PCC and NRMSE

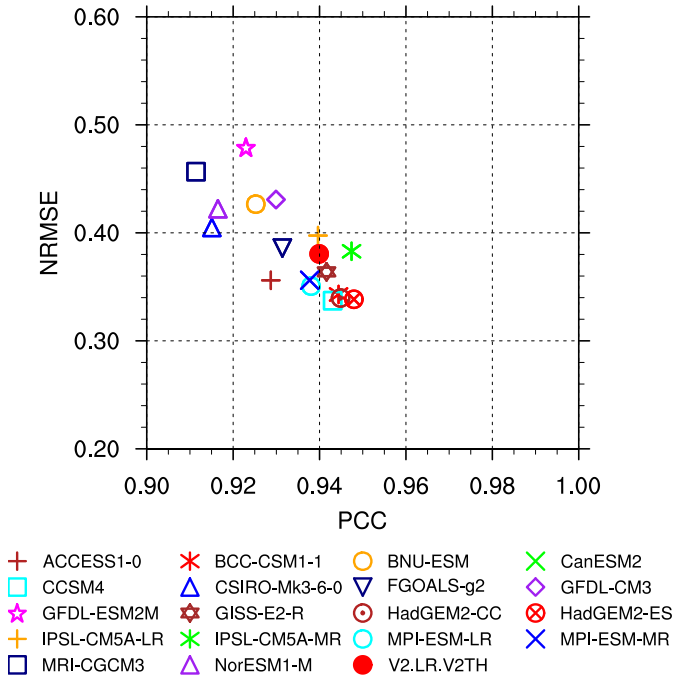



Back to introduction | Back to summary table

# 11.01.12 Sea Surface Temperature Seasonality AM-ON

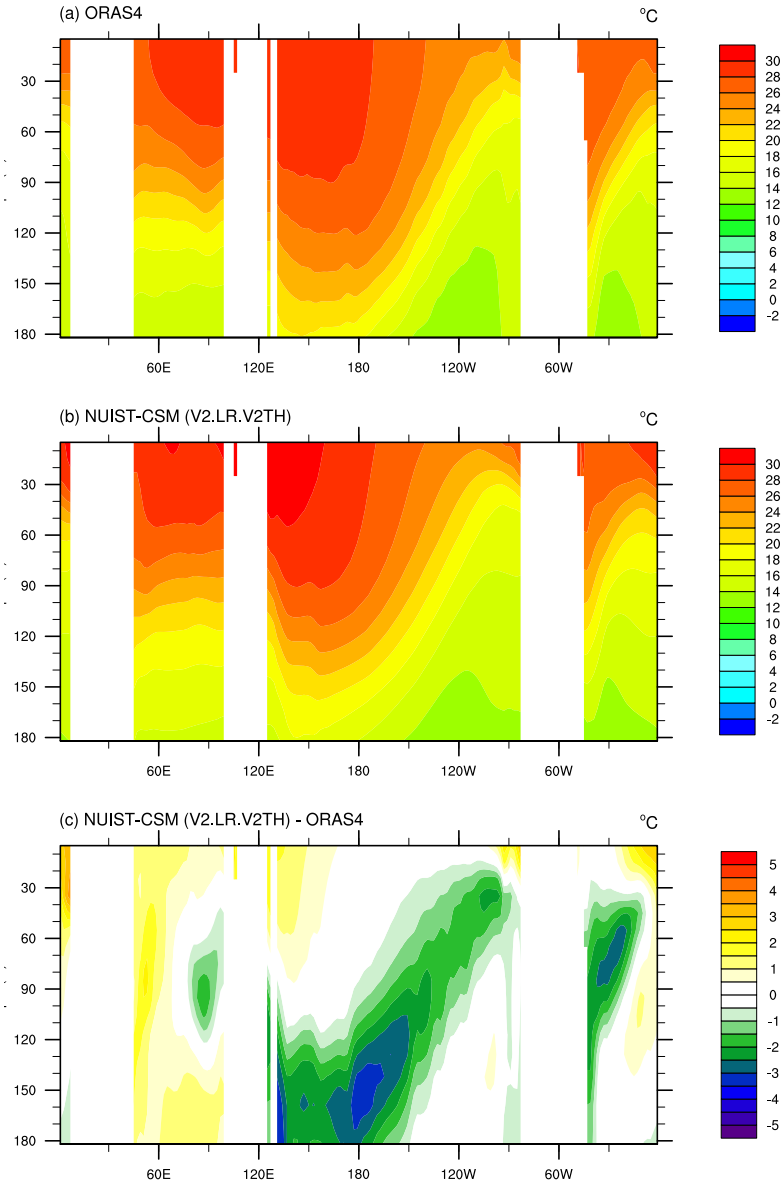



## Comparison with CMIP5 models by PCC and NRMSE

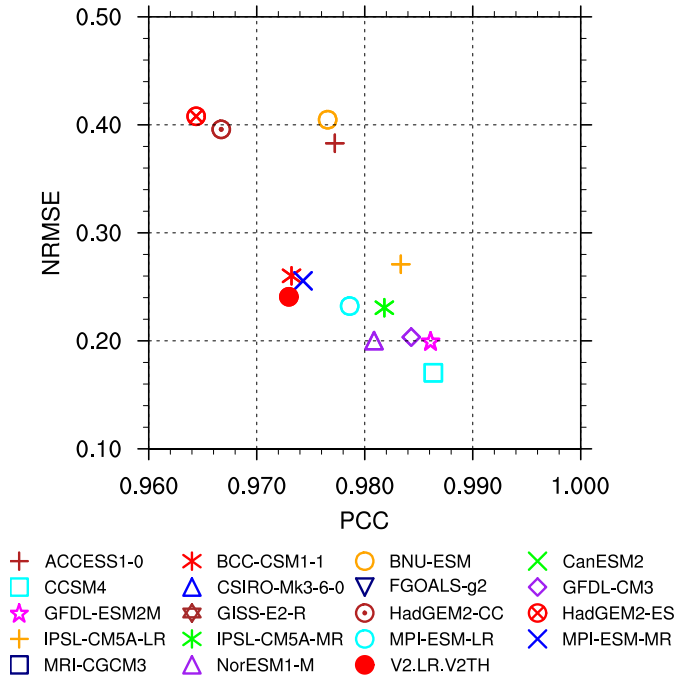



Back to introduction | Back to summary table

# 11.11 Sea Water Temperature Longitude-Depth Section

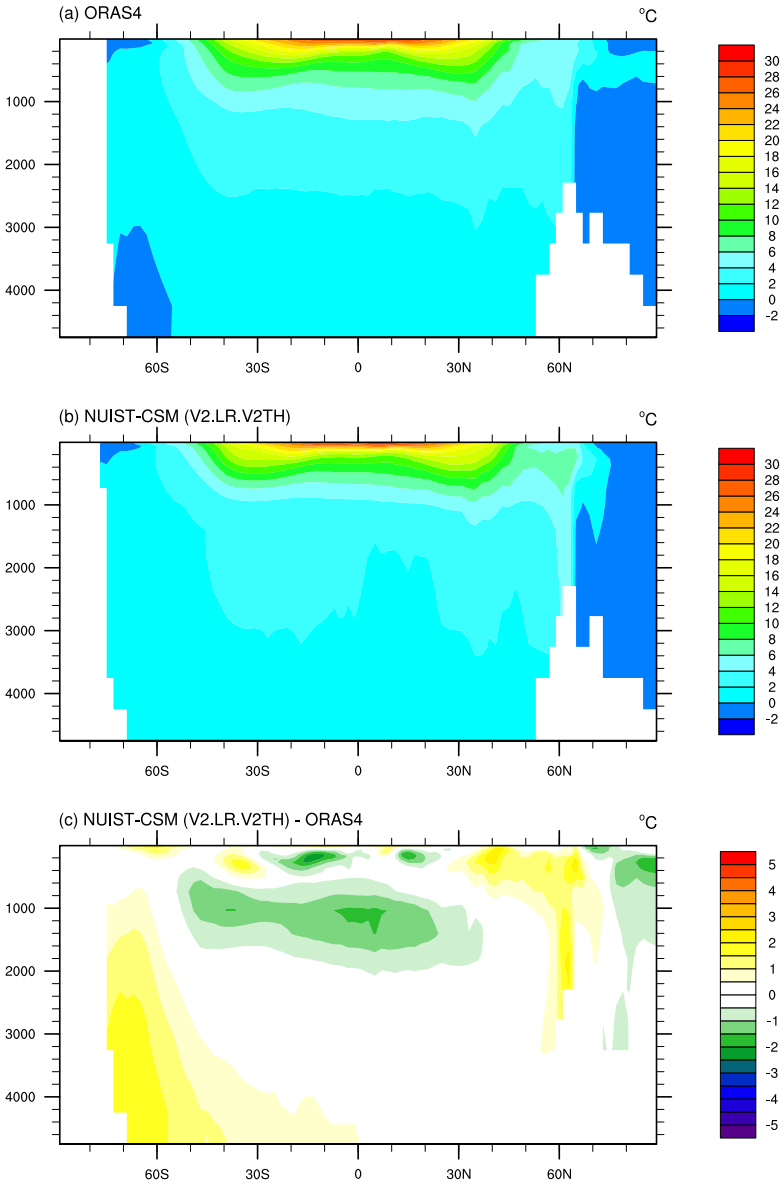



## Comparison with CMIP5 models by PCC and NRMSE

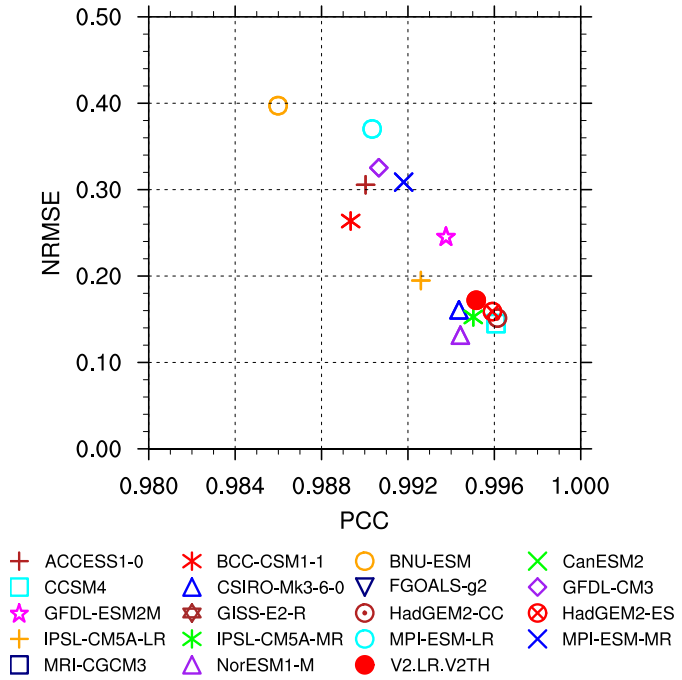



Back to introduction | Back to summary table

# 11.16 Sea Water Temperature Latitude-Depth Section

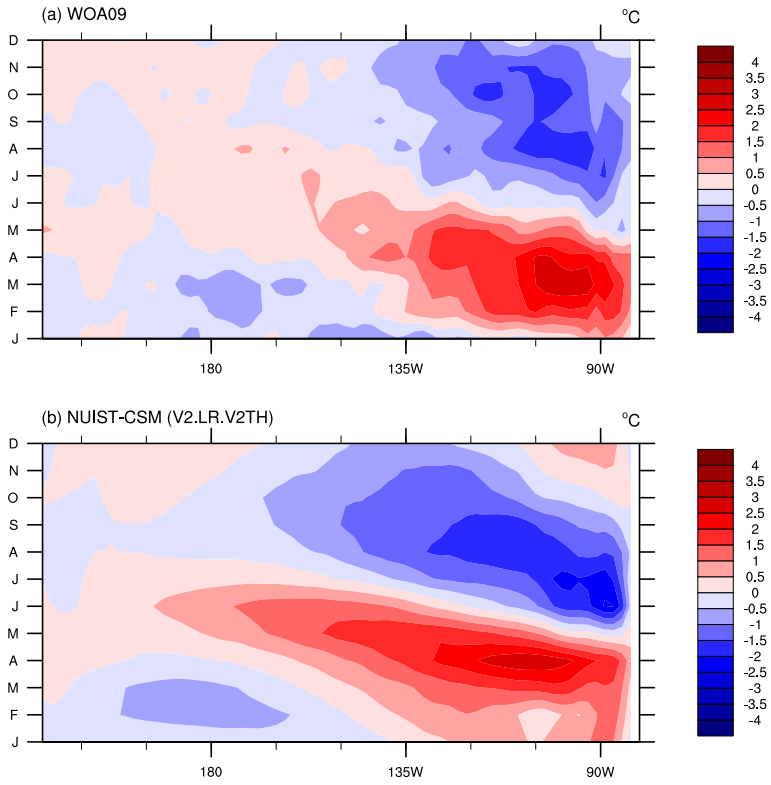



## Comparison with CMIP5 models by PCC and NRMSE

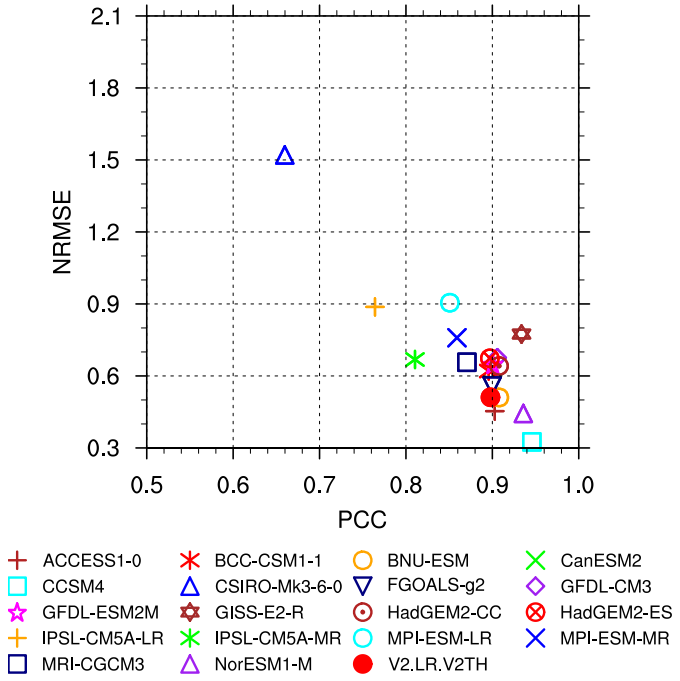



Back to introduction | Back to summary table

# 11.21 Sea Surface Temperature Seasonal Cycle (EQ Pacific)

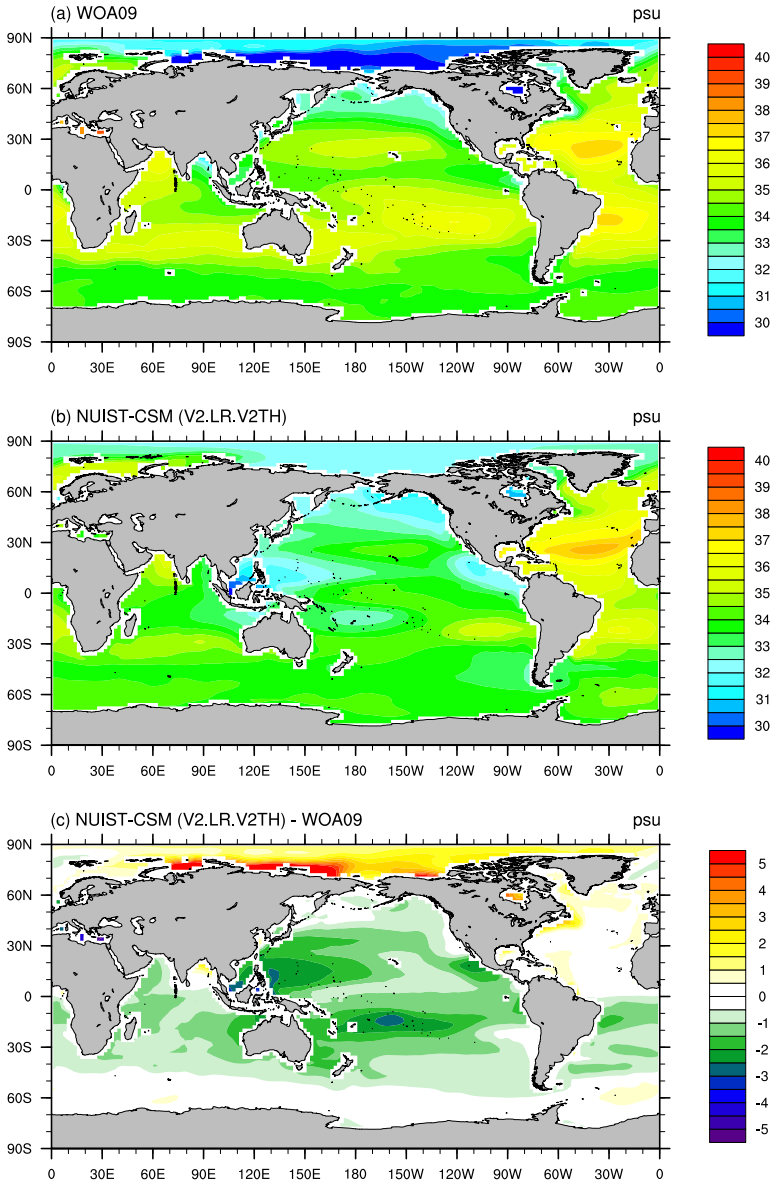



## Comparison with CMIP5 models by PCC and NRMSE

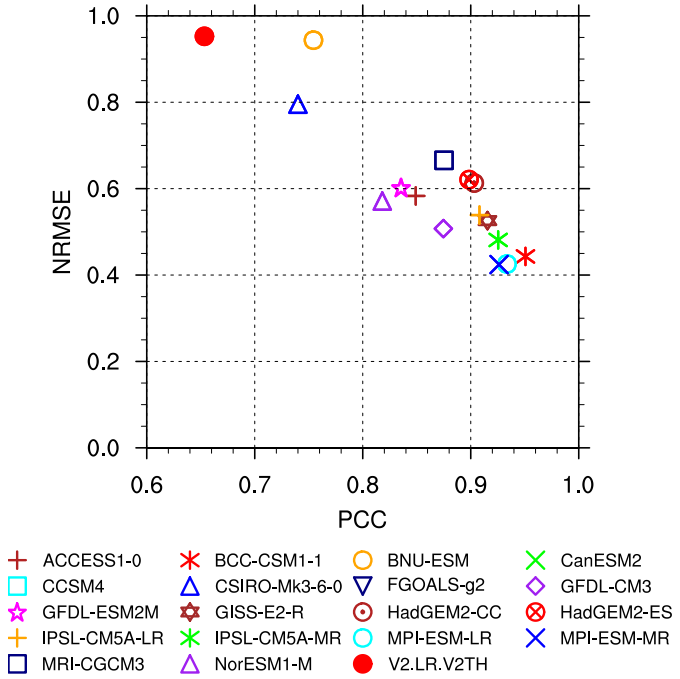



Back to introduction | Back to summary table

# 12.01 Sea Surface Salinity

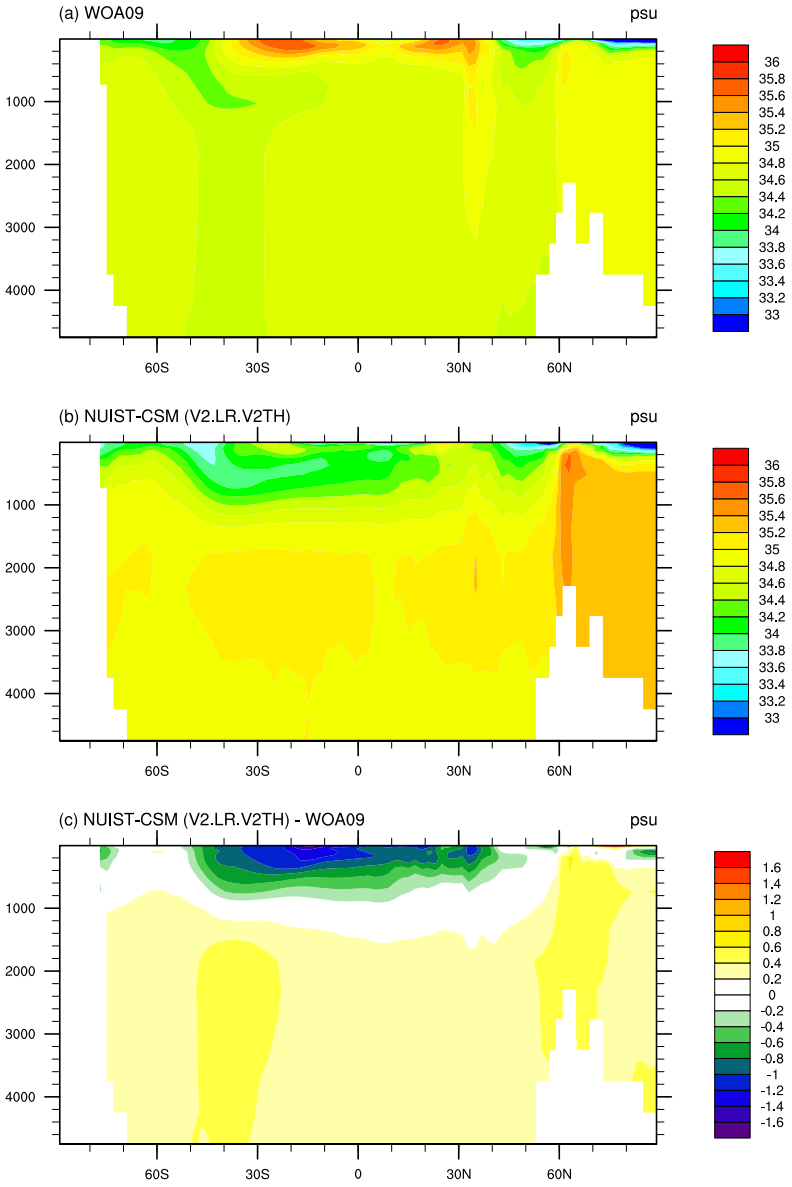



## Comparison with CMIP5 models by PCC and NRMSE

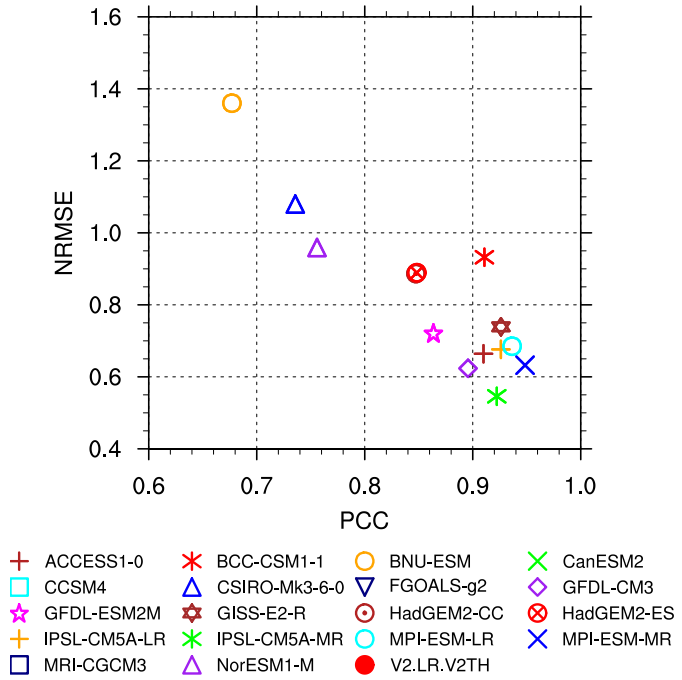



Back to introduction | Back to summary table

# 12.16 Sea Water Salinity Longitude-Depth Section

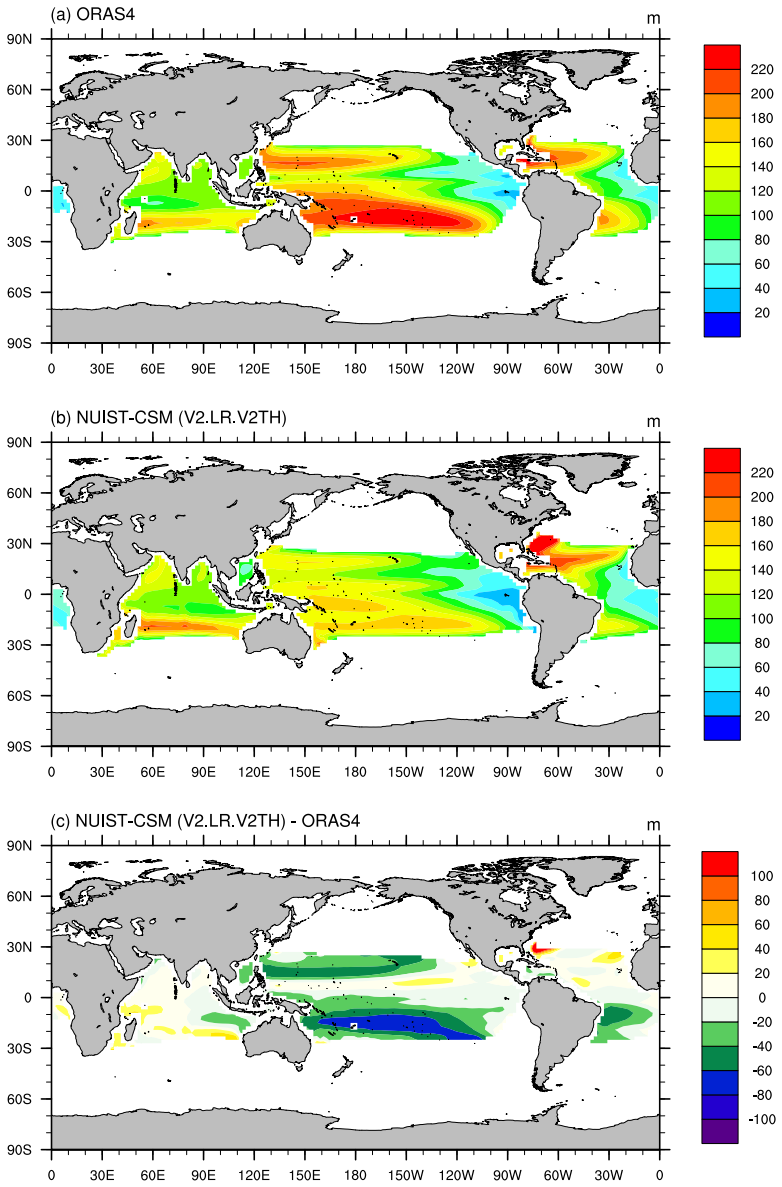



## Comparison with CMIP5 models by PCC and NRMSE

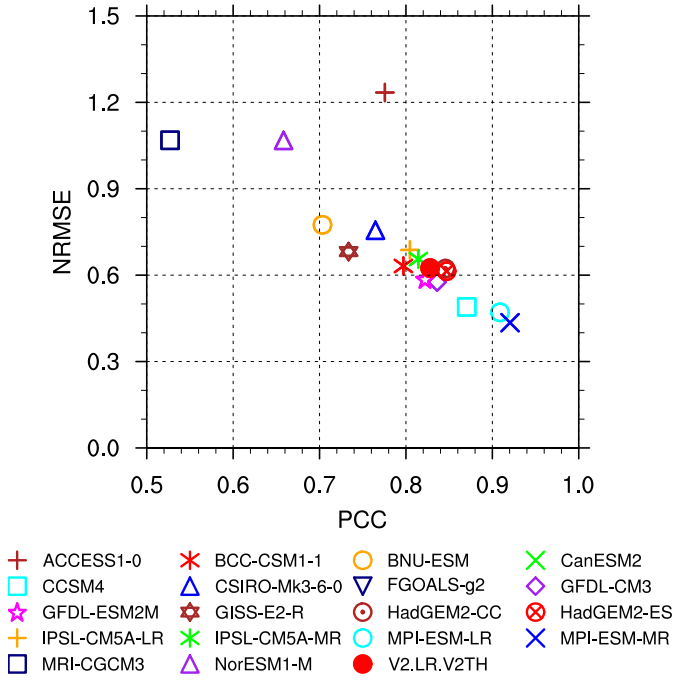



Back to introduction | Back to summary table

# 14.01 Thermocline Depth (20 degC Isotherm Depth)

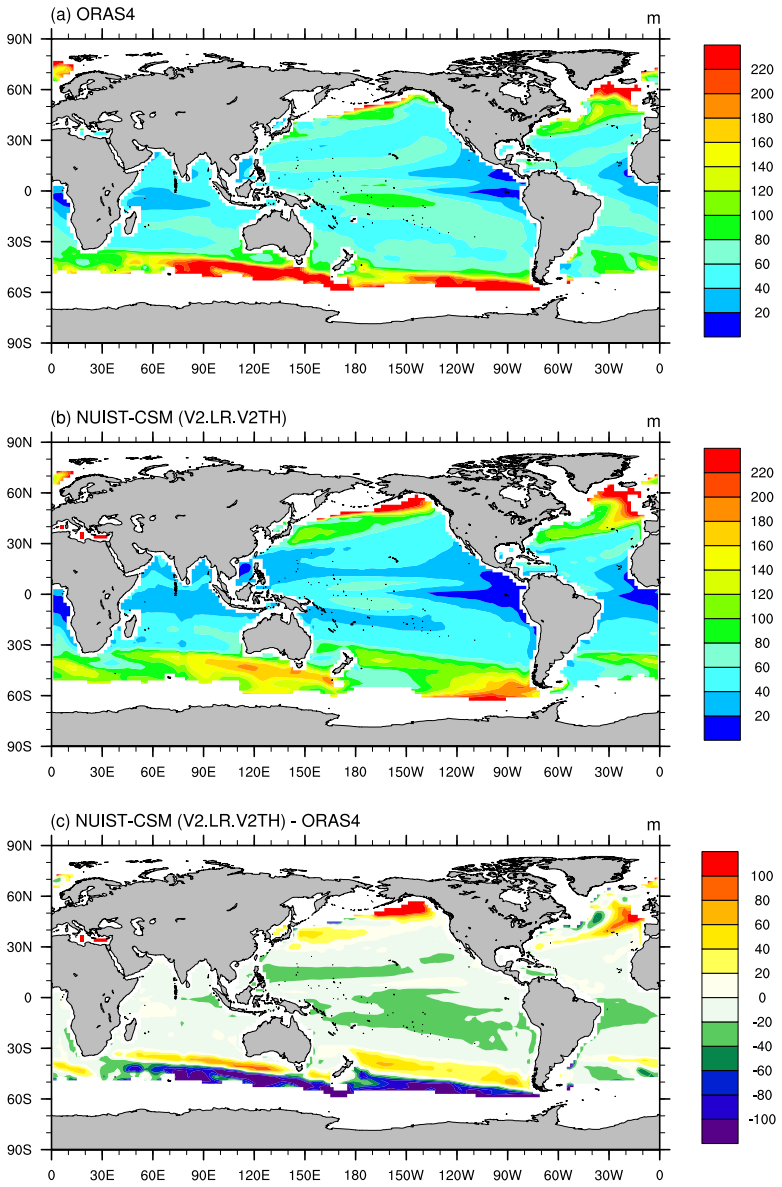



## Comparison with CMIP5 models by PCC and NRMSE

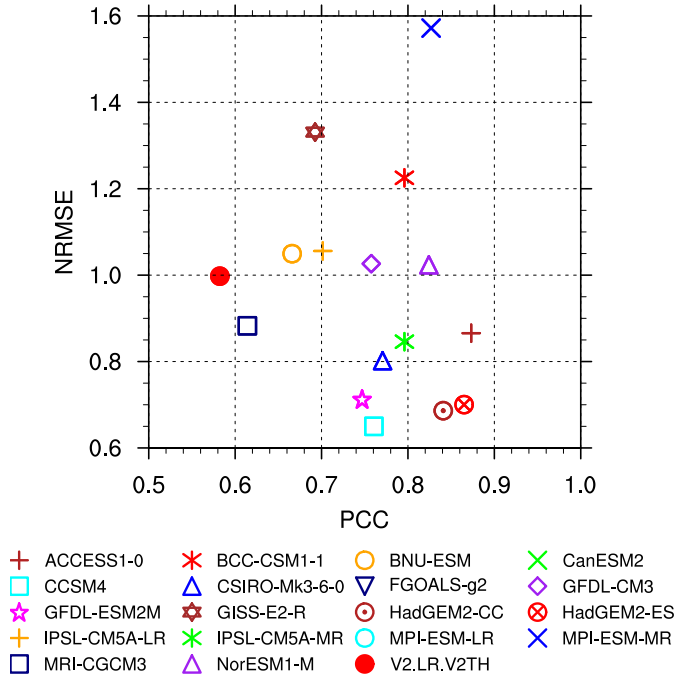



Back to introduction | Back to summary table

# 15.01 Mixed Layer Depth (T - Tsurf = -0.5 degC)

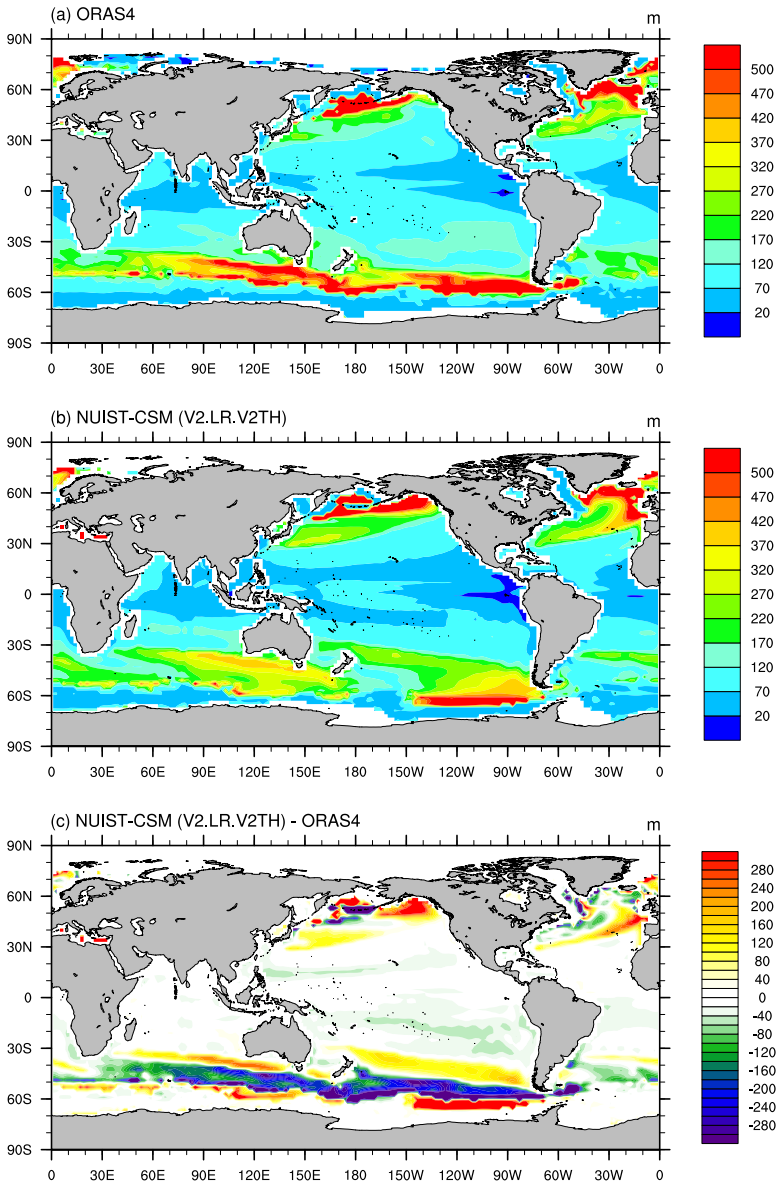



## Comparison with CMIP5 models by PCC and NRMSE

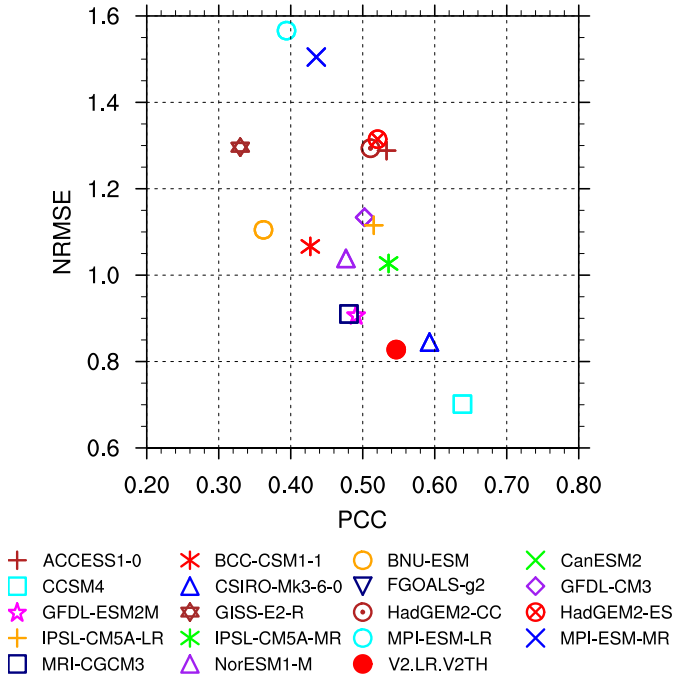



Back to introduction | Back to summary table

# 15.01.08 Mixed Layer Depth (T - Tsurf = -0.5 degC) Maximum

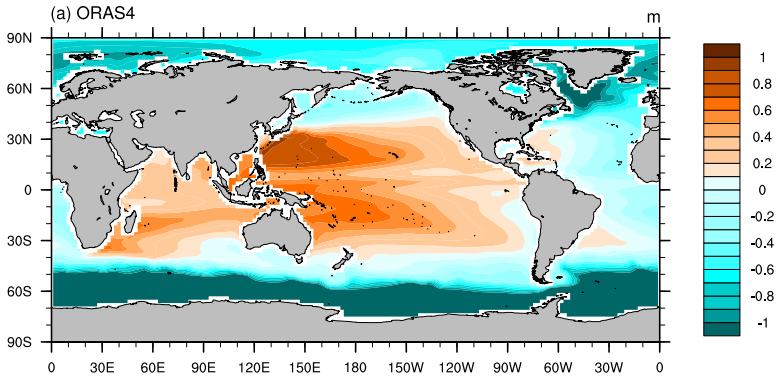



## Comparison with CMIP5 models by PCC and NRMSE

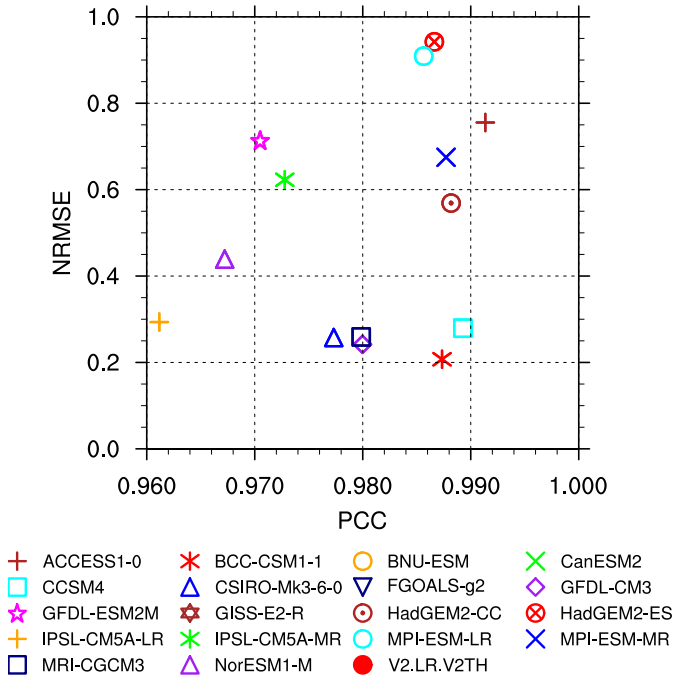



Back to introduction | Back to summary table

# 21.01 Sea Surface Height

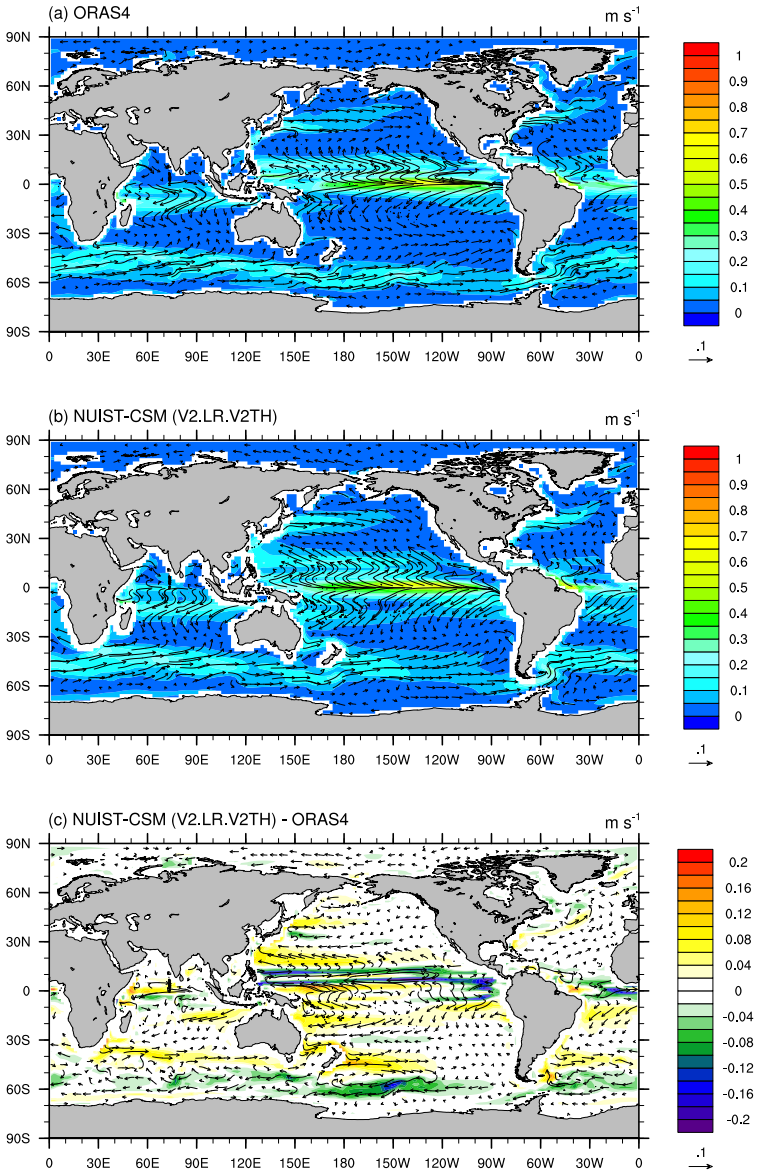



## Comparison with CMIP5 models by PCC and NRMSE

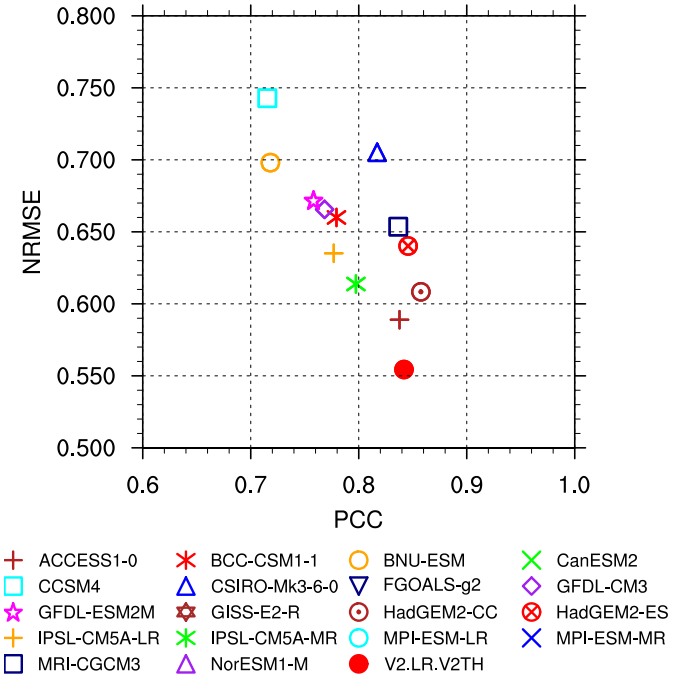



Back to introduction | Back to summary table

# 22.04 Sea Surface Velocity and Its Magnitude

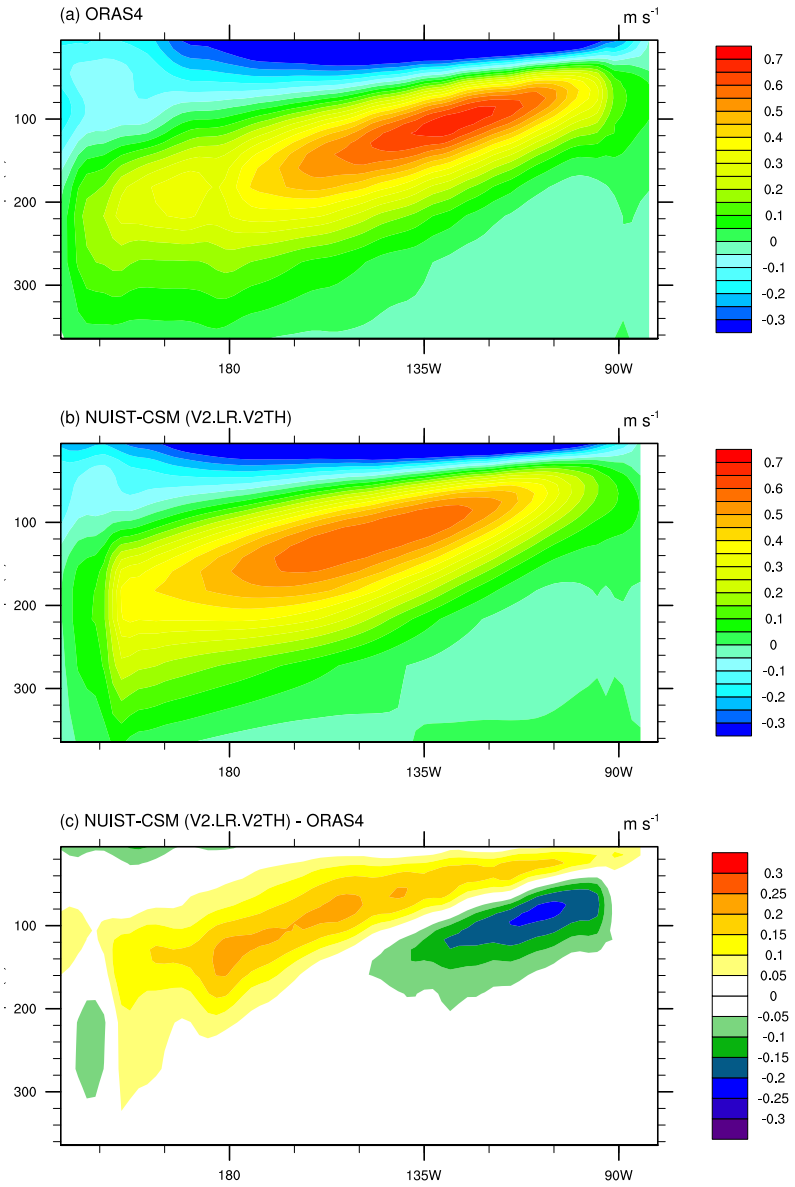



## Comparison with CMIP5 models by PCC and NRMSE

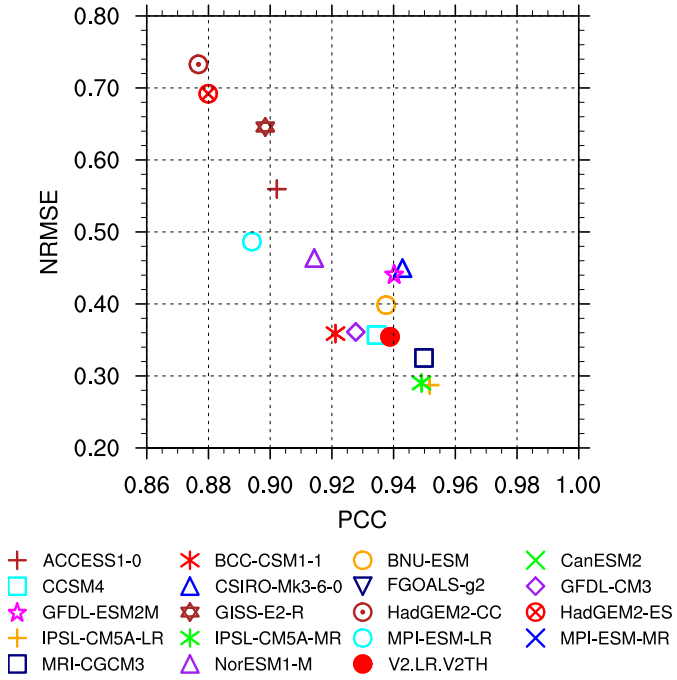



Back to introduction | Back to summary table

# 22.11 Ocean Zonal Velocity Longitude-Depth Section (EQ Pacific)

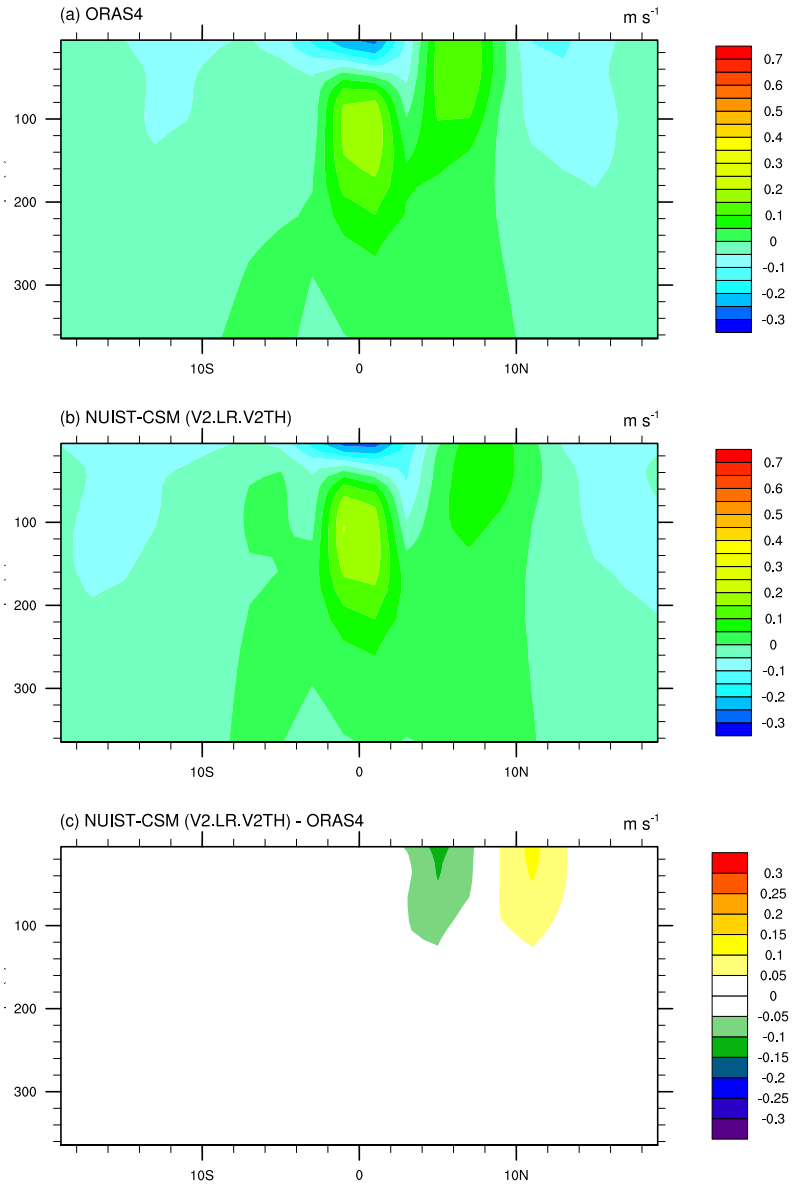



## Comparison with CMIP5 models by PCC and NRMSE

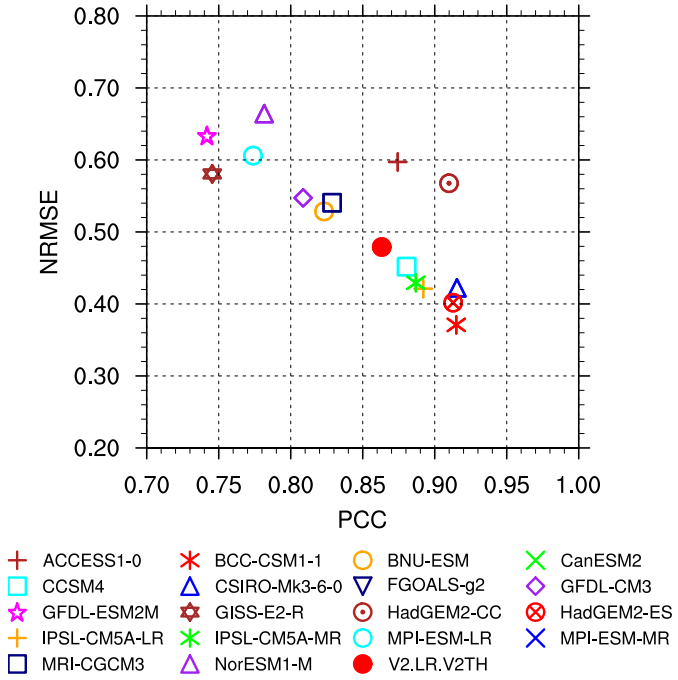



Back to introduction | Back to summary table

# 22.16 Ocean Zonal Velocity Latitude-Depth Section (Pacific)

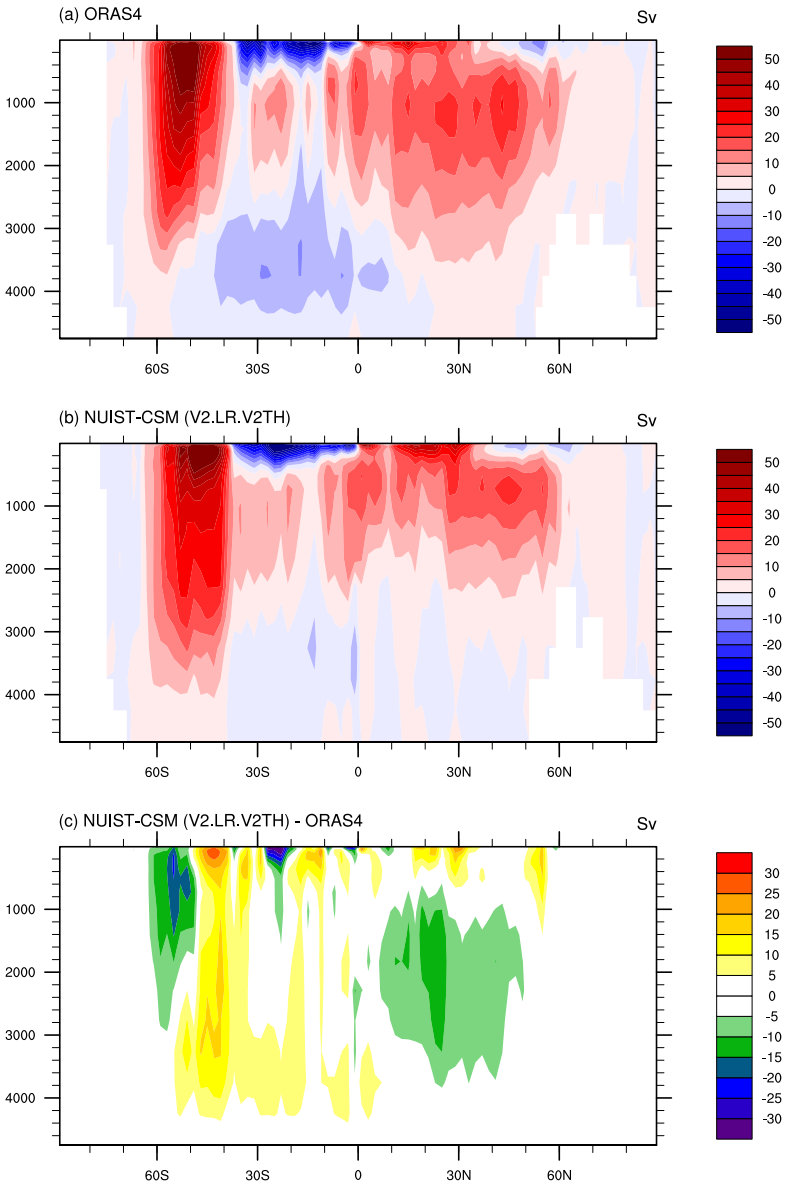



## Comparison with CMIP5 models by PCC and NRMSE

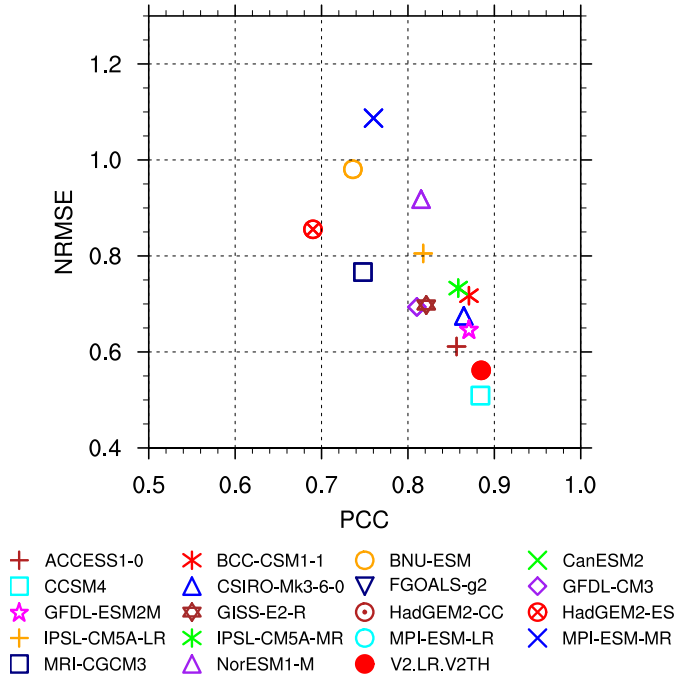



Back to introduction | Back to summary table

# 23.16 Meridional Overturning Streamfunction (Global)

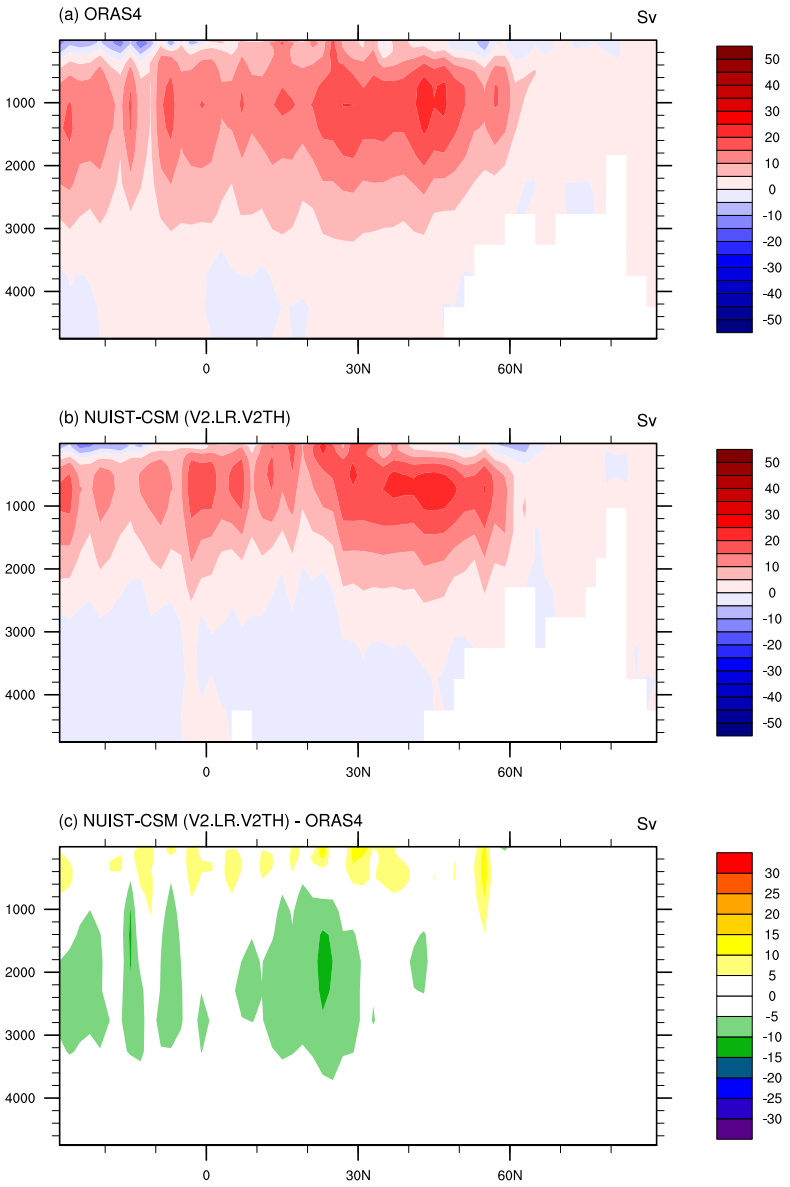



## Comparison with CMIP5 models by PCC and NRMSE

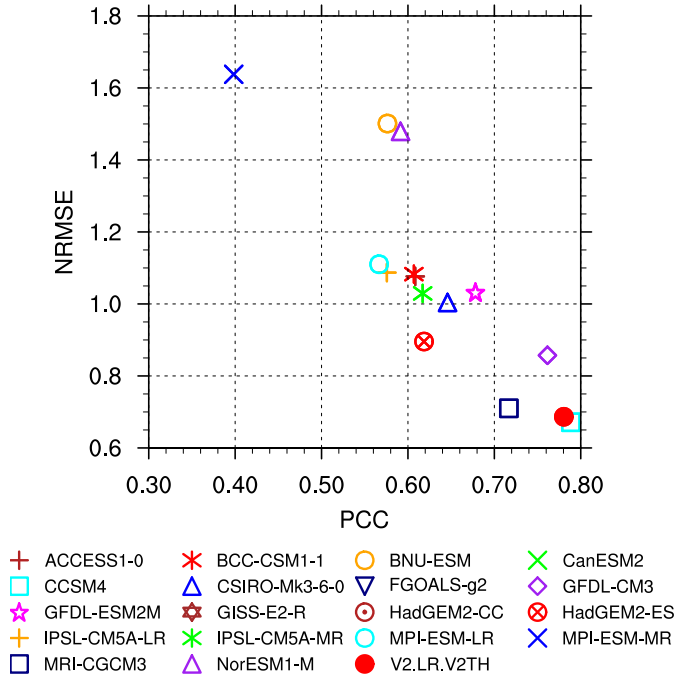



Back to introduction | Back to summary table

# 23.17 Meridional Overturning Streamfunction (Atlantic)




## Comparison with CMIP5 models by PCC and NRMSE




Back to introduction | Back to summary table

# The End

# Evaluation of Ocean Model Performance for

## NUIST-CSM-2.0.1

## piControl Experiment

June 23, 2018

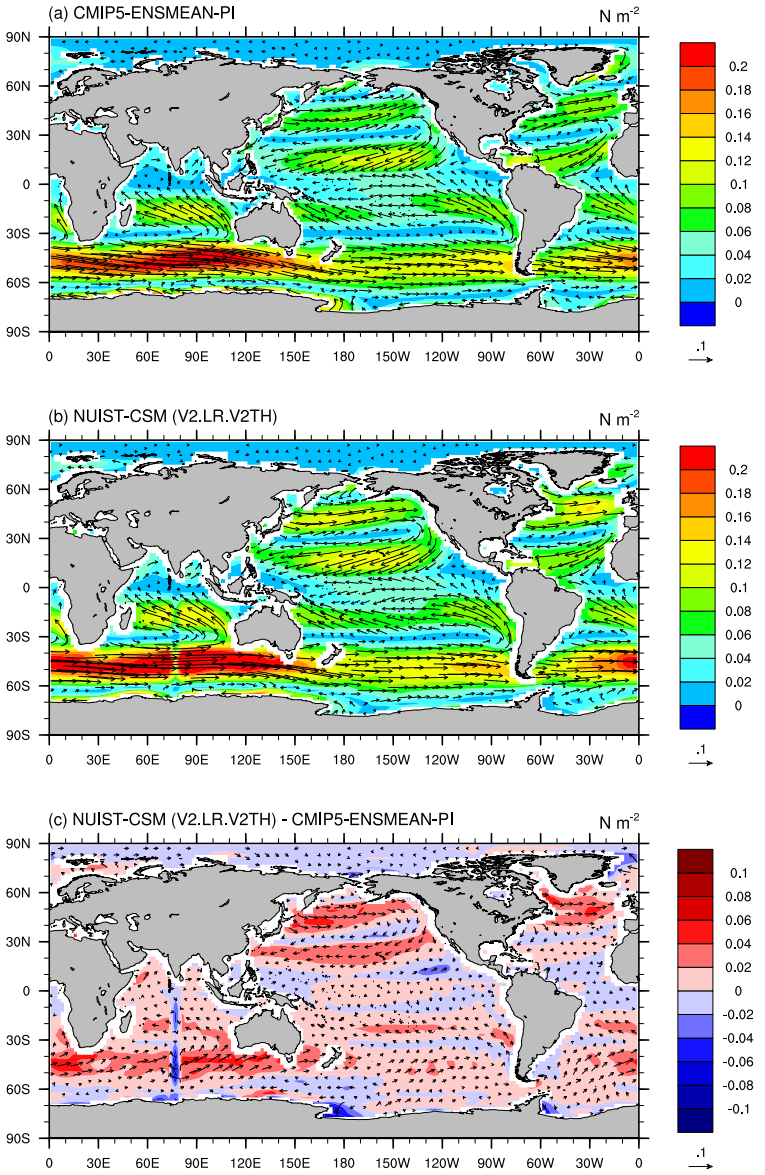
# Summary Table

## Summary of model performance by PCC, NRMSE

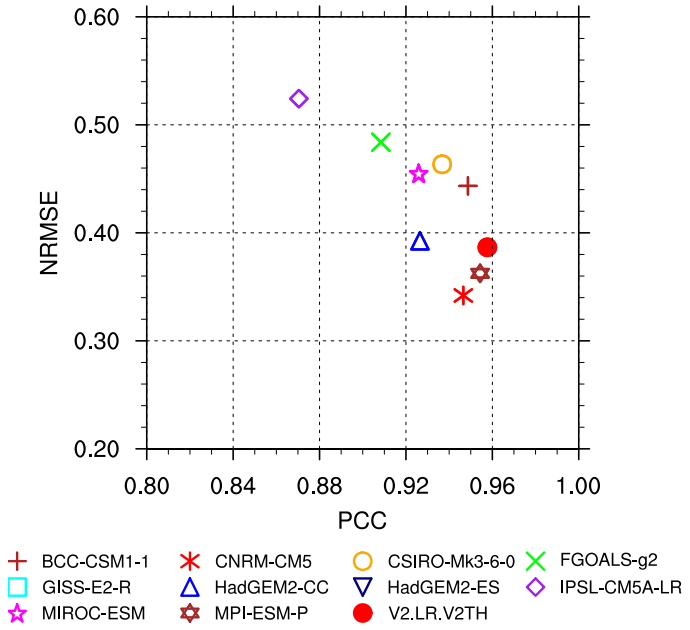
| ID | Metrics | Top 30% | | Top 50% | | V2.LR.V2TH | |
|---|---|---|---|---|---|---|---|
| | | PCC | NRMSE | PCC | NRMSE | PCC | NRMSE |
| 01.03 | Wind Stress Mag | 0.95 | 0.36 | 0.94 | 0.44 | 0.96 | 0.39 |
| 01.04 | Wind Stress Curl | 0.89 | 0.43 | 0.87 | 0.51 | 0.93 | 0.38 |
| 02.01 | Down Net Heat Flux | 0.89 | 0.60 | 0.87 | 0.63 | 0.86 | 0.67 |
| 03.01 | Down Fresh Water Flux | 0.86 | 0.64 | 0.82 | 0.68 | 0.72 | 0.70 |
| 11.01 | Sea Surf Temp | 0.99 | 0.14 | 0.99 | 0.15 | 0.99 | 0.14 |
| 11.01.01 | Sea Surf Temp DJF | 0.99 | 0.15 | 0.99 | 0.16 | 0.99 | 0.15 |
| 11.01.03 | Sea Surf Temp JJA | 0.99 | 0.14 | 0.99 | 0.16 | 0.99 | 0.17 |
| 11.01.11 | Sea Surf Temp JJAS-DJFM | 0.96 | 0.30 | 0.96 | 0.31 | 0.93 | 0.38 |
| 11.01.12 | Sea Surf Temp AM-ON | 0.95 | 0.37 | 0.94 | 0.40 | 0.95 | 0.40 |
| 11.11 | Sea Water Temp - EQ | 0.99 | 0.22 | 0.99 | 0.24 | 0.99 | 0.23 |
| 11.16 | Sea Water Temp - GLB Zonal Avg | 1.00 | 0.14 | 1.00 | 0.15 | 0.99 | 0.27 |
| 11.21 | Sea Surf Temp Seas Cyc | 0.90 | 0.69 | 0.87 | 0.74 | 0.91 | 0.46 |
| 12.01 | Sea Surf Salin | 0.96 | 0.39 | 0.94 | 0.44 | 0.74 | 0.75 |
| 12.16 | Sea Water Salin - GLB Zonal Avg | 0.96 | 0.70 | 0.93 | 0.92 | 0.69 | 1.80 |
| 14.01 | Therm Depth - 20 degC | 0.92 | 0.46 | 0.90 | 0.54 | 0.90 | 0.46 |
| 15.01 | Mixed Layer Depth - -0.5 degC | 0.92 | 0.40 | 0.91 | 0.49 | 0.70 | 0.76 |
| 15.01.08 | Max Mixed Layer Depth - -0.5 degC | 0.69 | 0.64 | 0.64 | 0.71 | 0.52 | 0.85 |
| 21.01 | Sea Surf Height | | | | | | |
| 22.04 | Sea Surf Curr Mag | 0.91 | 0.52 | 0.90 | 0.59 | 0.89 | 0.50 |
| 22.11 | Upper Lev Zonal Curr - EQ Pacif | 0.97 | 0.29 | 0.96 | 0.36 | 0.98 | 0.32 |
| 22.16 | Upper Lev Zonal Curr - Pacif | 0.95 | 0.30 | 0.95 | 0.46 | 0.91 | 0.41 |
| 23.16 | Merid Overt Streamf - GLB | 0.77 | 0.73 | 0.73 | 1.07 | 0.91 | 0.84 |
| 23.17 | Merid Overt Streamf - Atlan | 0.72 | 0.69 | 0.70 | 0.94 | 0.81 | 0.76 |

Red: reach the top 30%; Green: reach the top 50%; Blue: not reach the top 50%.

# 01.03 Wind Stress and Its Magnitude

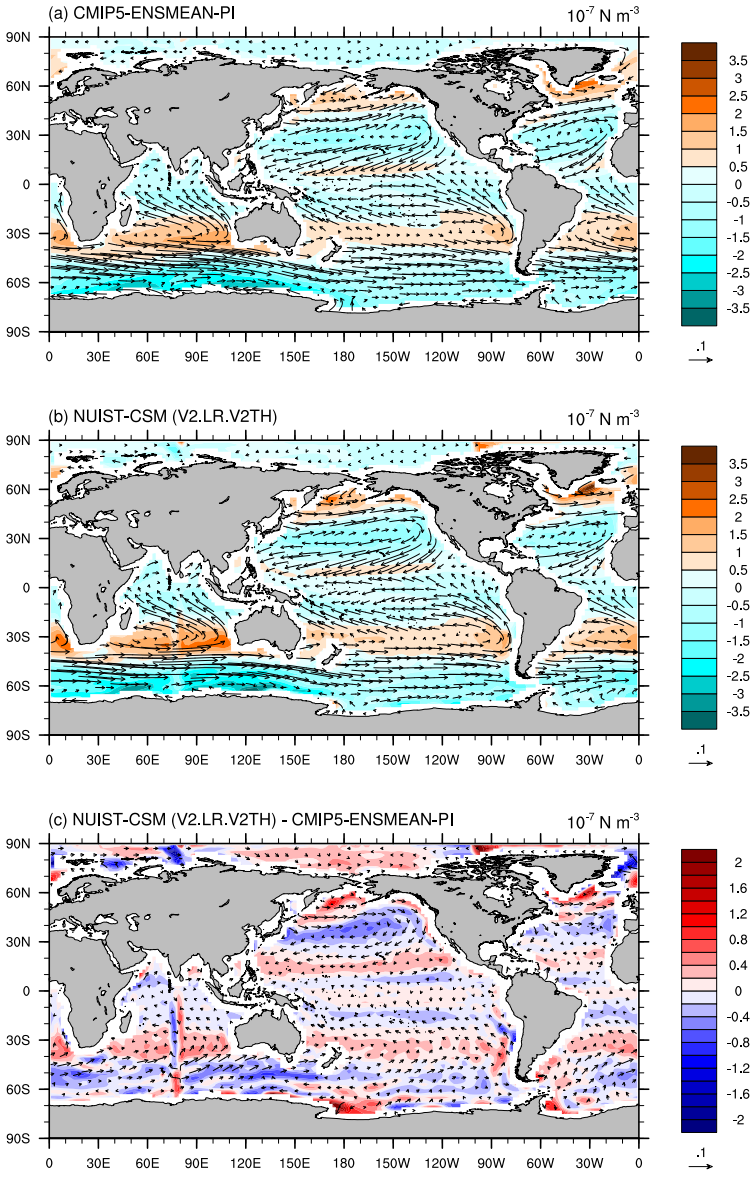



## Comparison with CMIP5 models by PCC and NRMSE

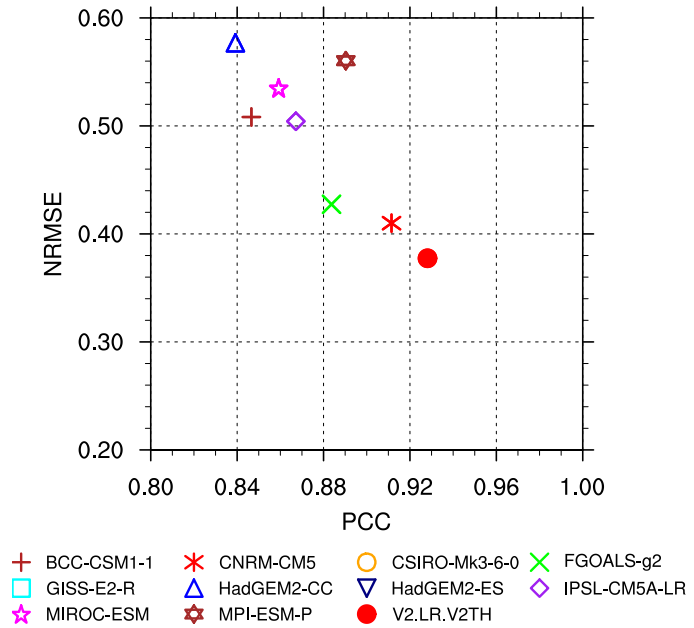



Back to introduction | Back to summary table

# 01.04 Wind Stress and Its Curl

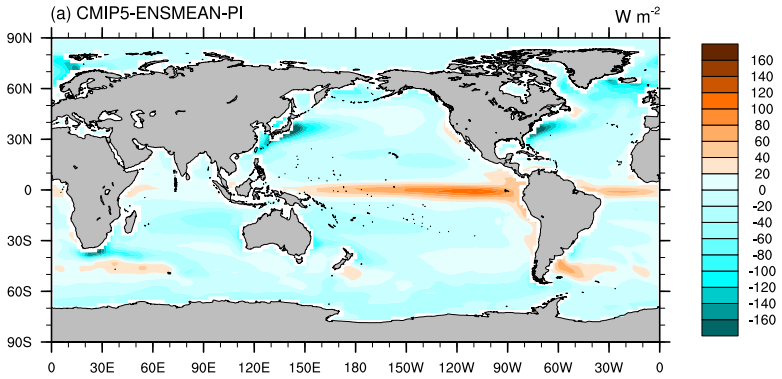


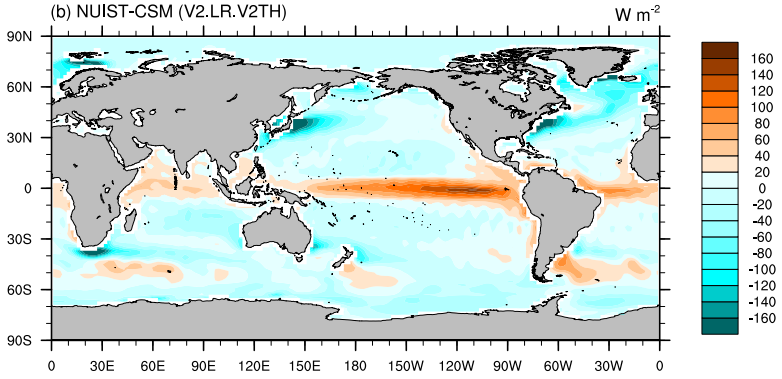

## Comparison with CMIP5 models by PCC and NRMSE

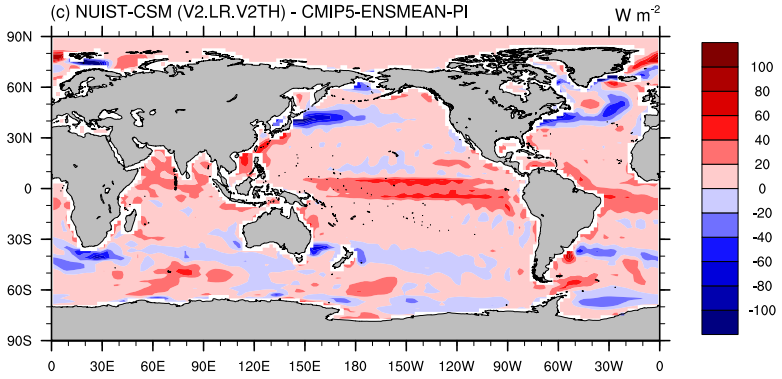



Back to introduction | Back to summary table

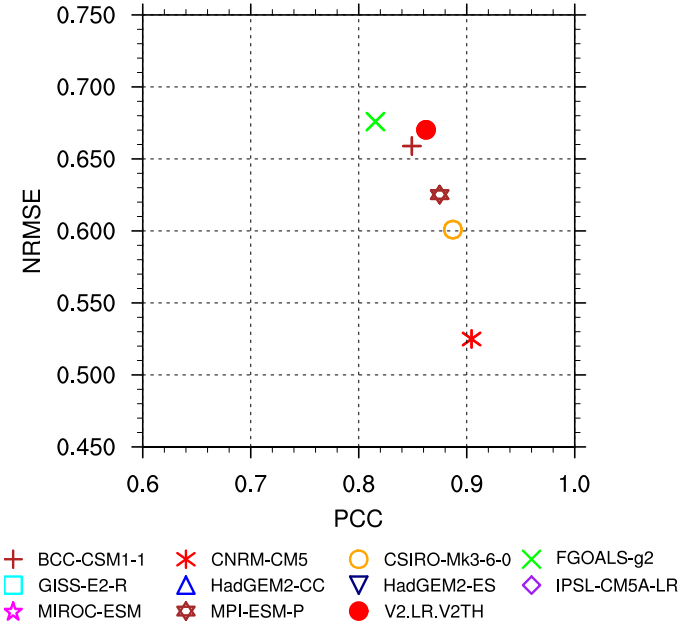
# 02.01 Sea Surface Downward Net Heat Flux



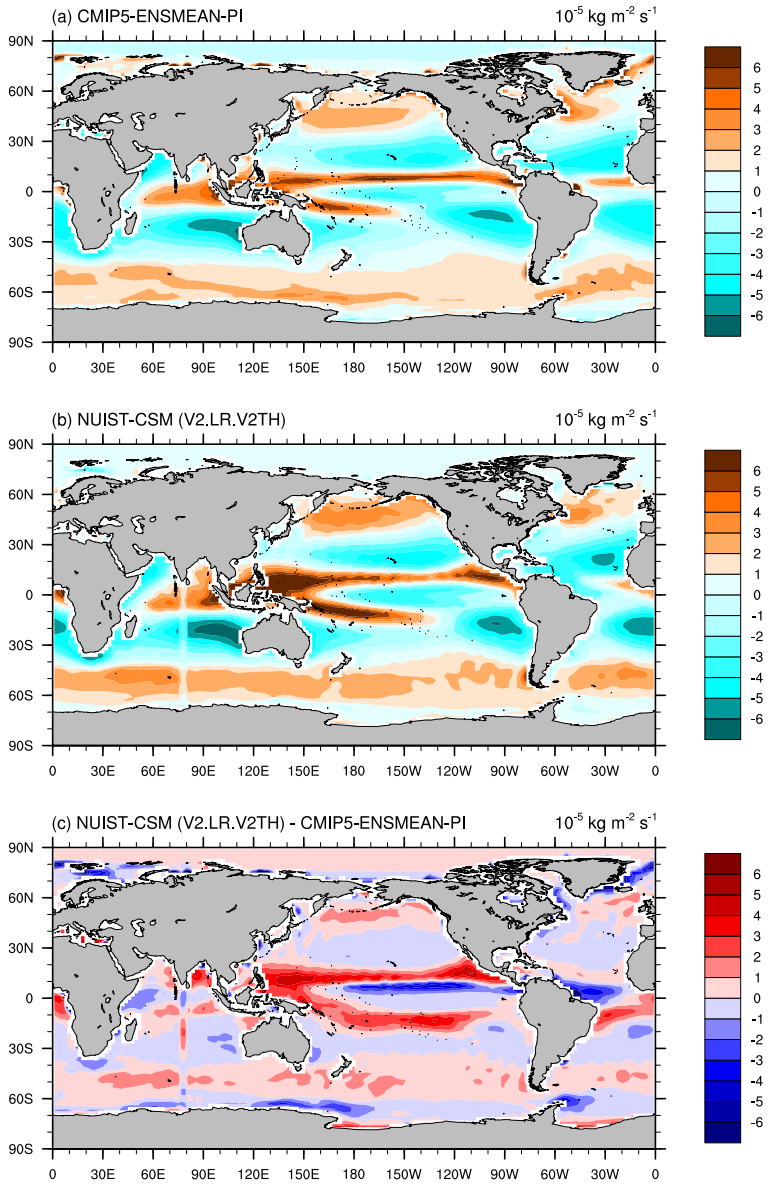




## Comparison with CMIP5 models by PCC and NRMSE

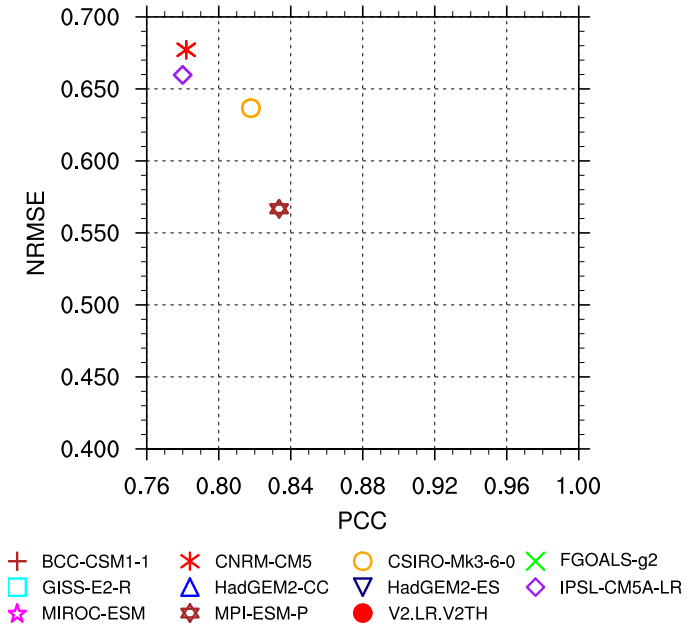



Back to introduction | Back to summary table

# 03.01 Sea Surface Downward Fresh Water Flux

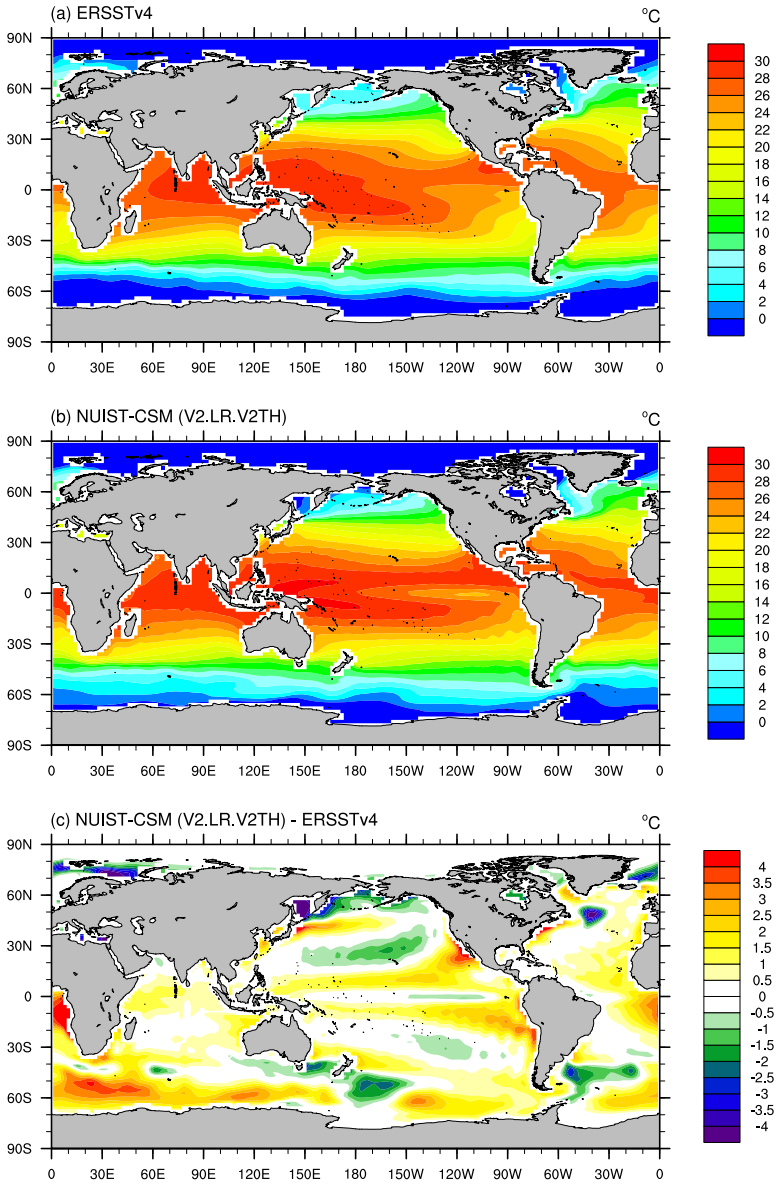



## Comparison with CMIP5 models by PCC and NRMSE

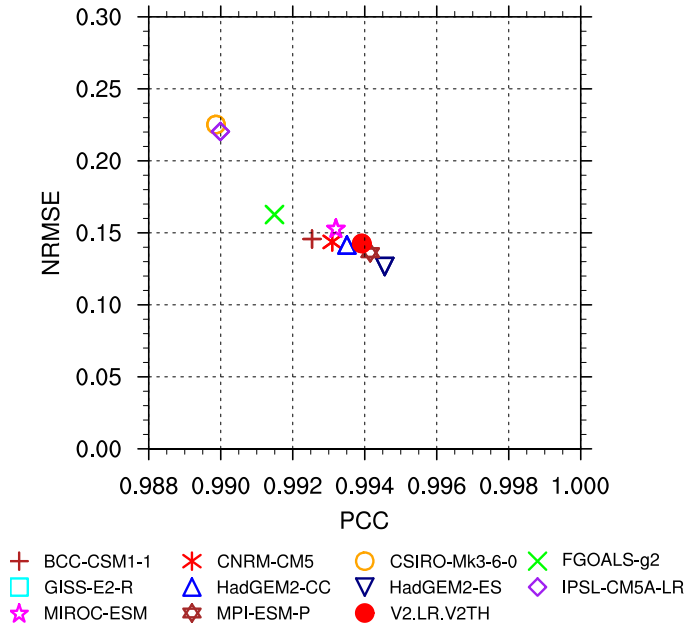



Back to introduction | Back to summary table

# 11.01 Sea Surface Temperature

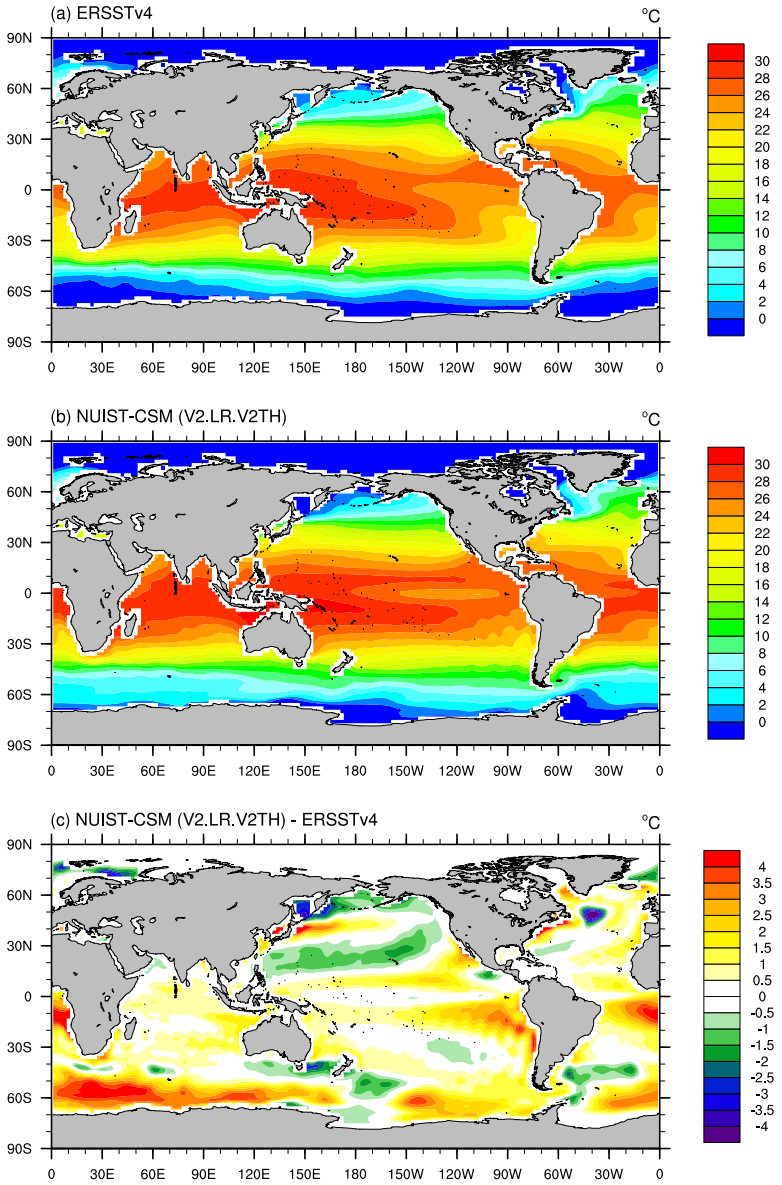



## Comparison with CMIP5 models by PCC and NRMSE

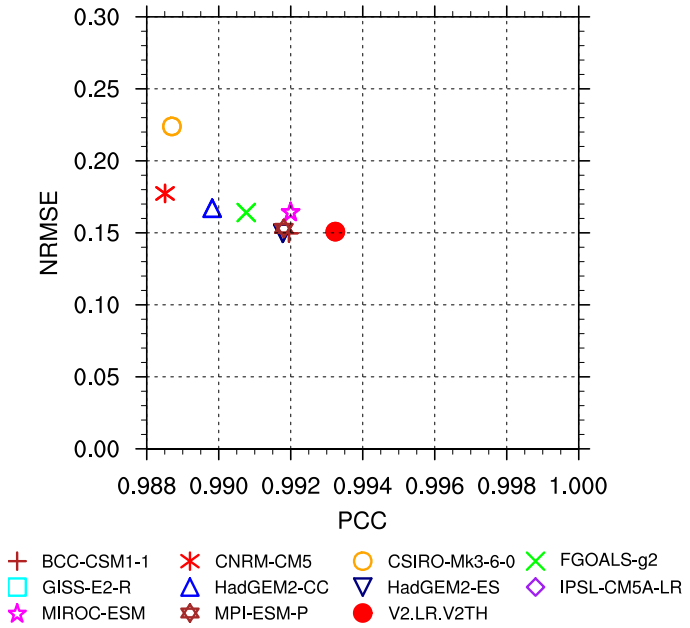



Back to introduction | Back to summary table

# 11.01.01 Sea Surface Temperature DJF Mean

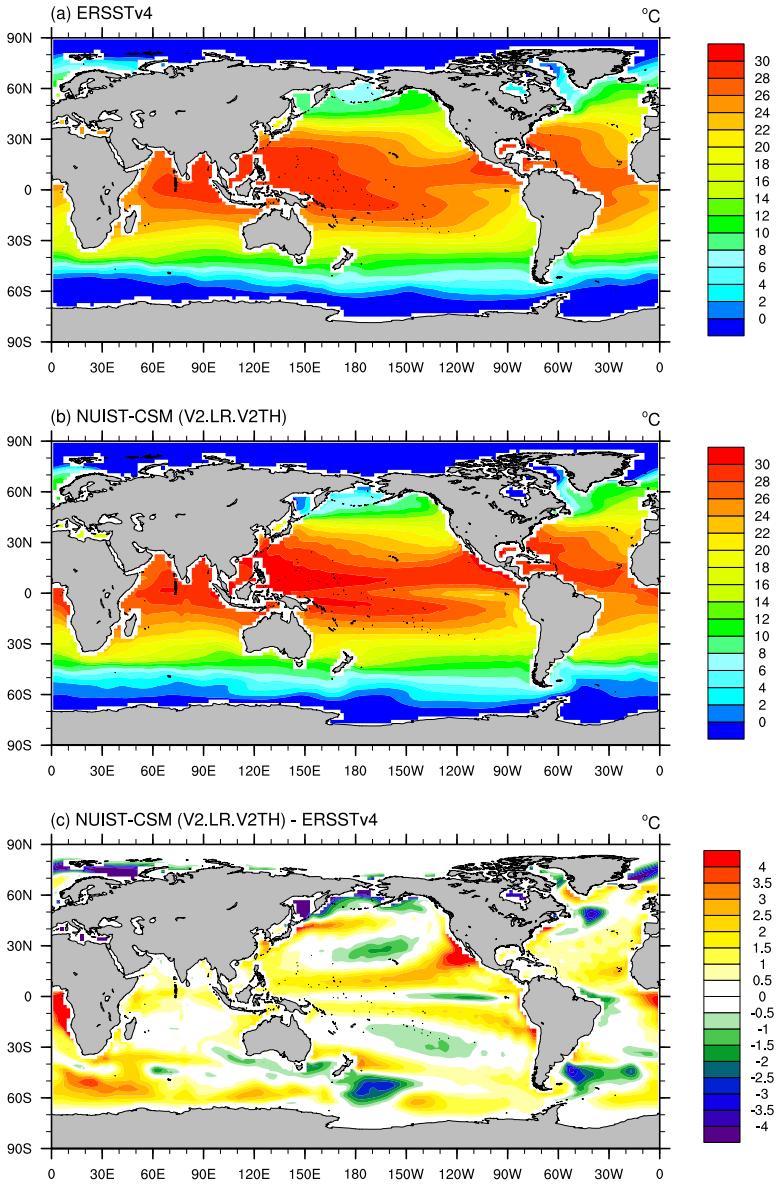



## Comparison with CMIP5 models by PCC and NRMSE

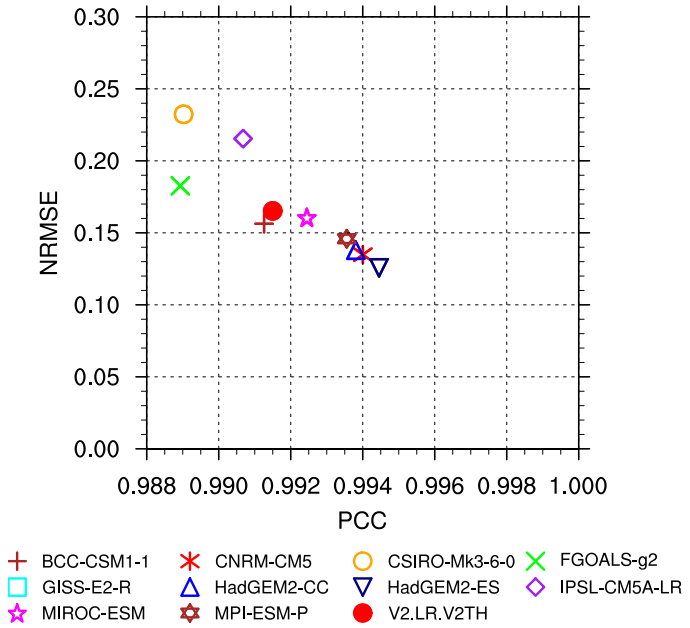



Back to introduction | Back to summary table

# 11.01.03 Sea Surface Temperature JJA Mean

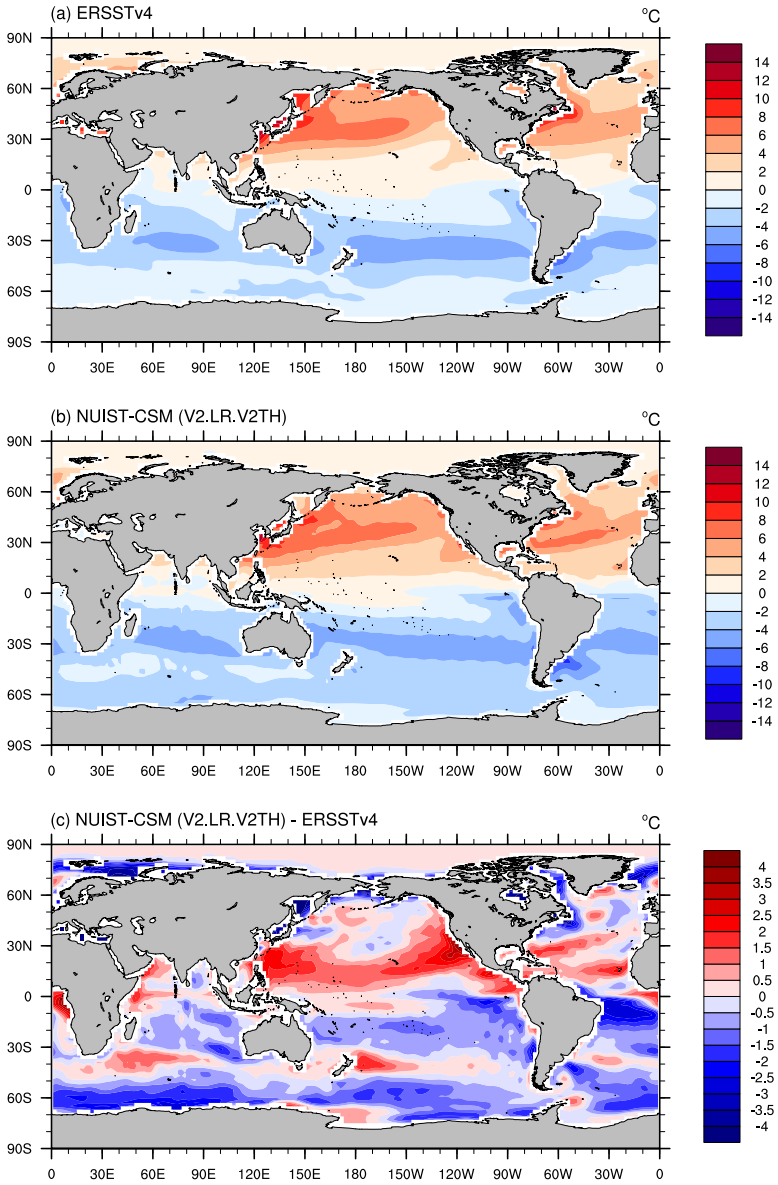



## Comparison with CMIP5 models by PCC and NRMSE

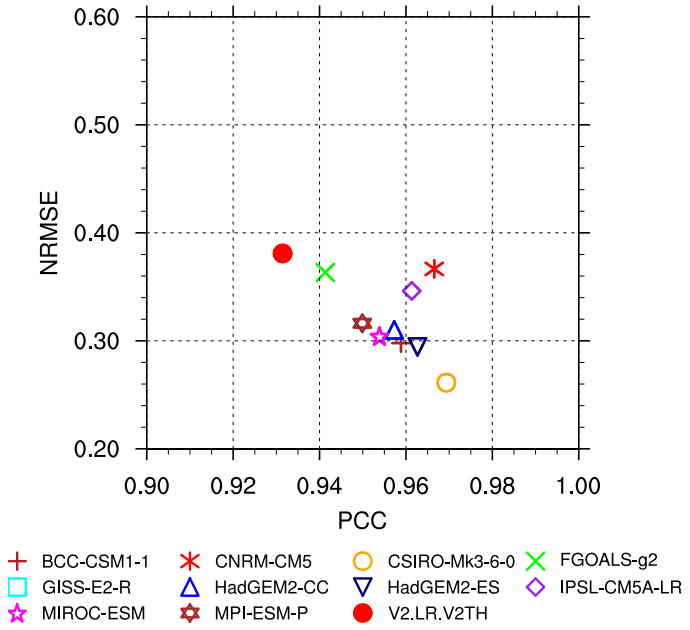



Back to introduction | Back to summary table

# 11.01.11 Sea Surface Temperature Seasonality JJAS-DJFM

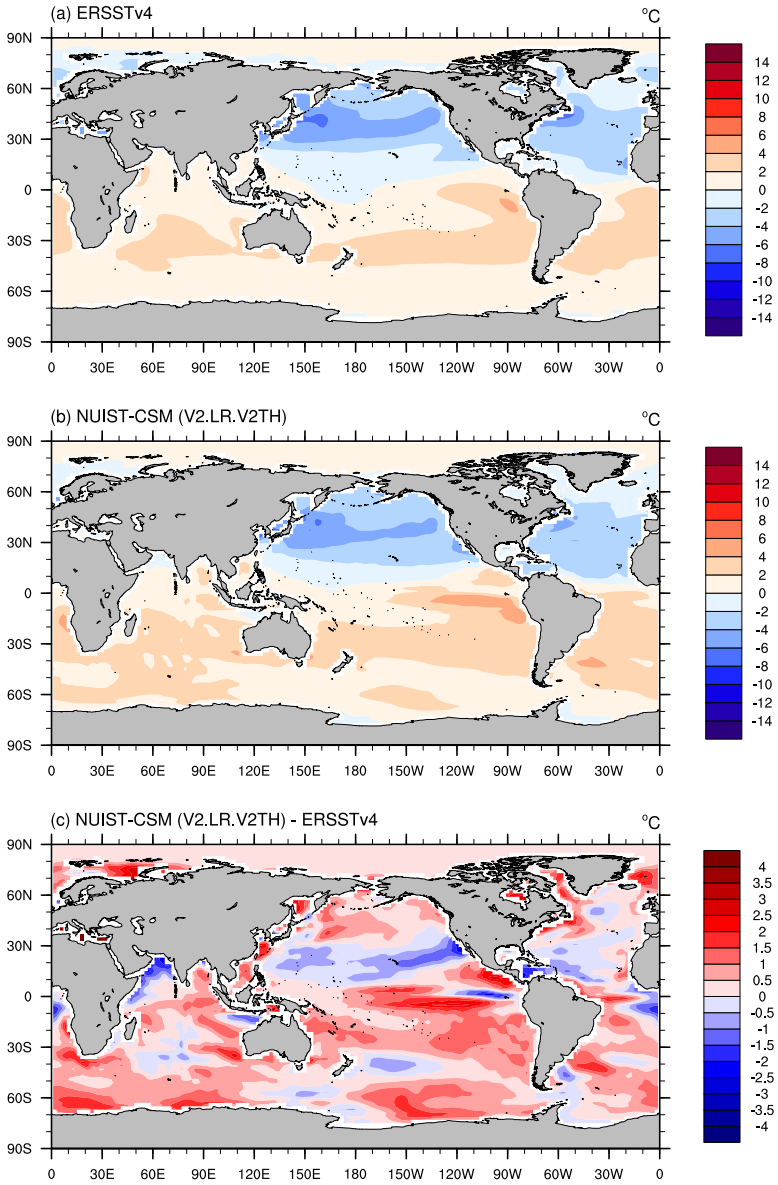



## Comparison with CMIP5 models by PCC and NRMSE

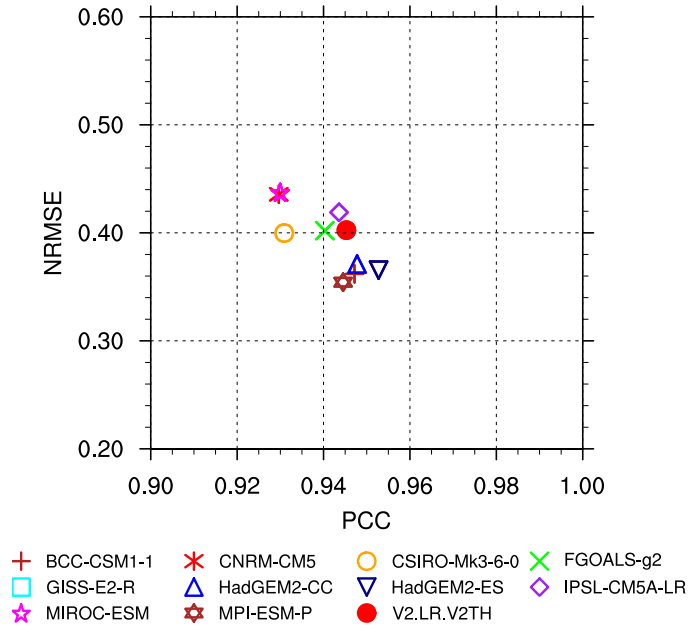



Back to introduction | Back to summary table

# 11.01.12 Sea Surface Temperature Seasonality AM-ON

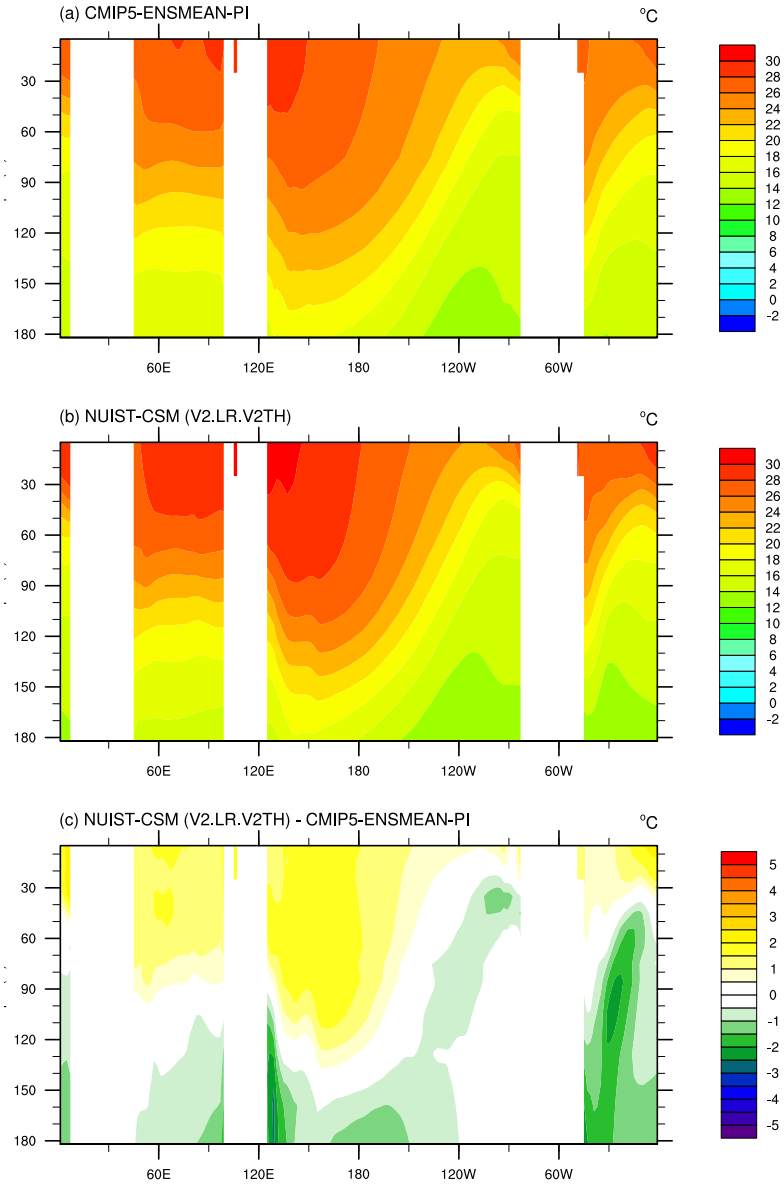



## Comparison with CMIP5 models by PCC and NRMSE

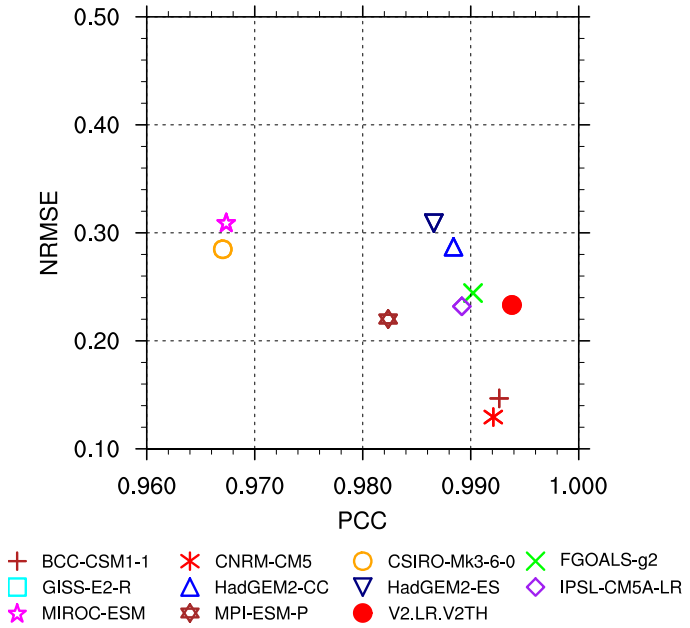



Back to introduction | Back to summary table

# 11.11 Sea Water Temperature Longitude-Depth Section

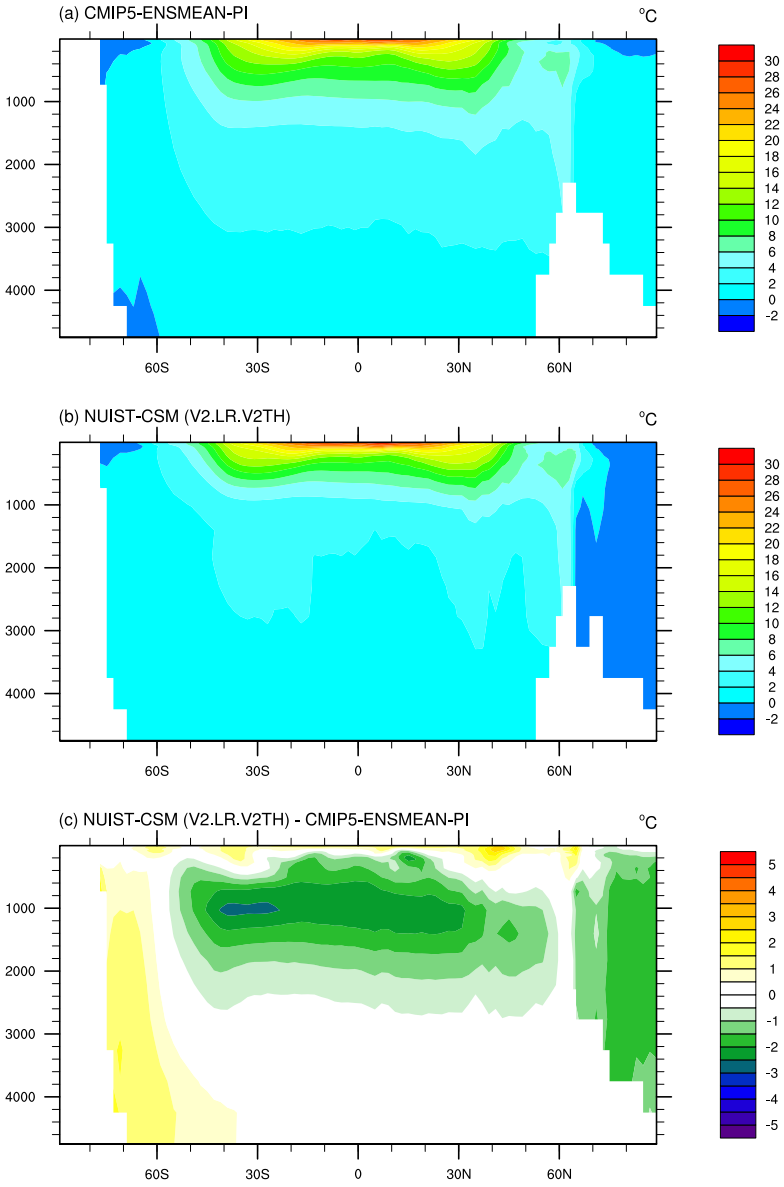



## Comparison with CMIP5 models by PCC and NRMSE

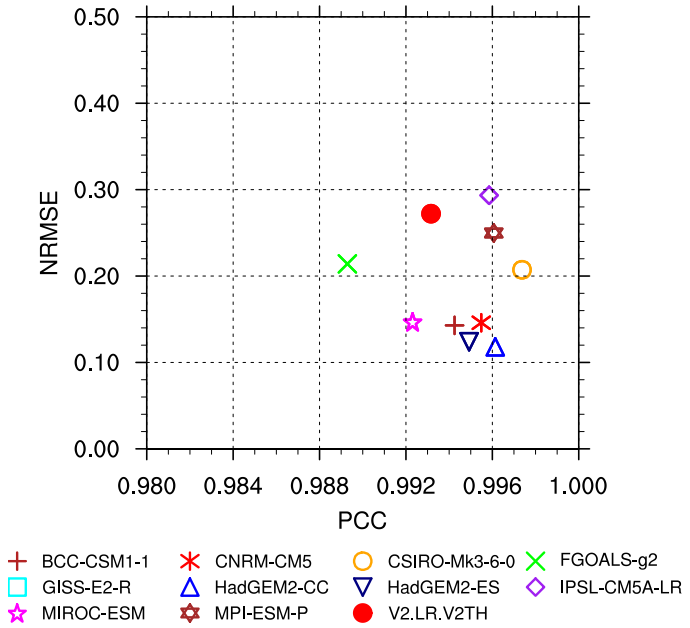



Back to introduction | Back to summary table

# 11.16 Sea Water Temperature Latitude-Depth Section

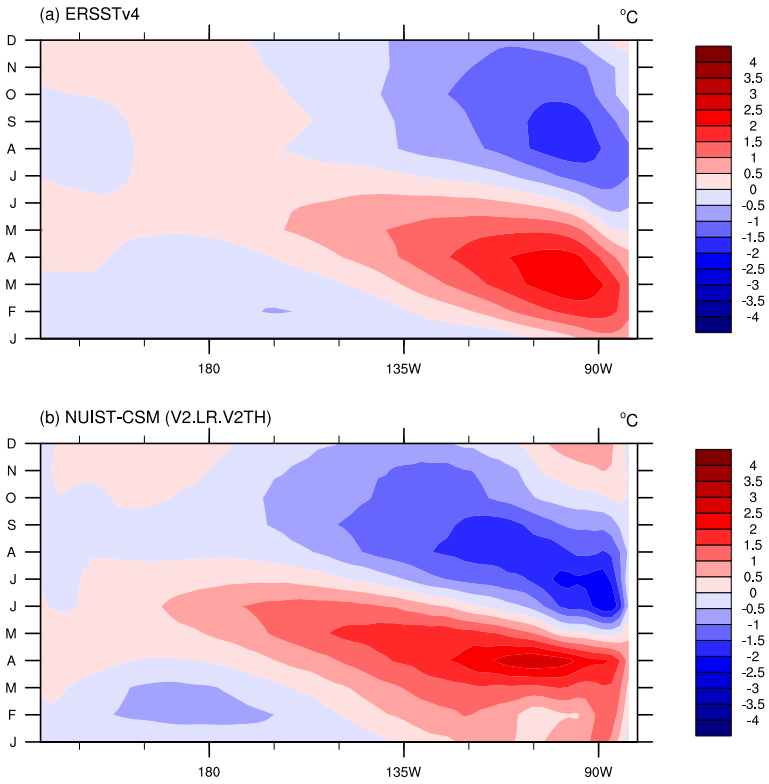



## Comparison with CMIP5 models by PCC and NRMSE

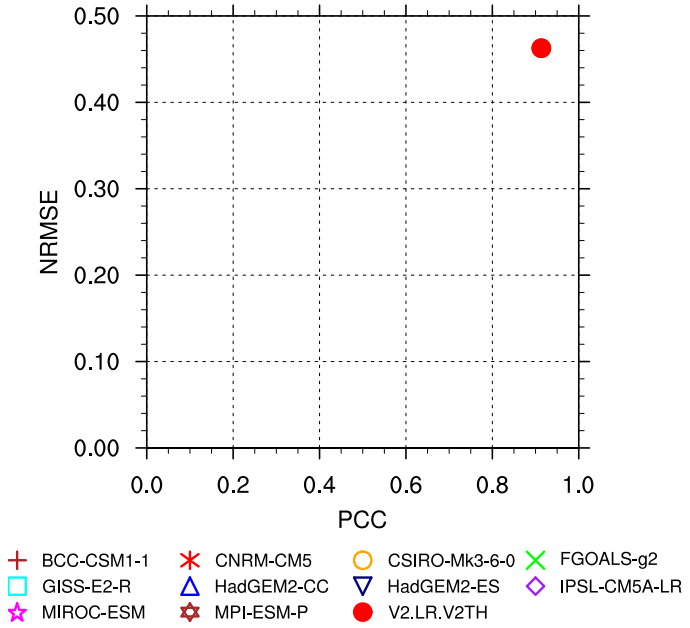



Back to introduction | Back to summary table

# 11.21 Sea Surface Temperature Seasonal Cycle (EQ Pacific)

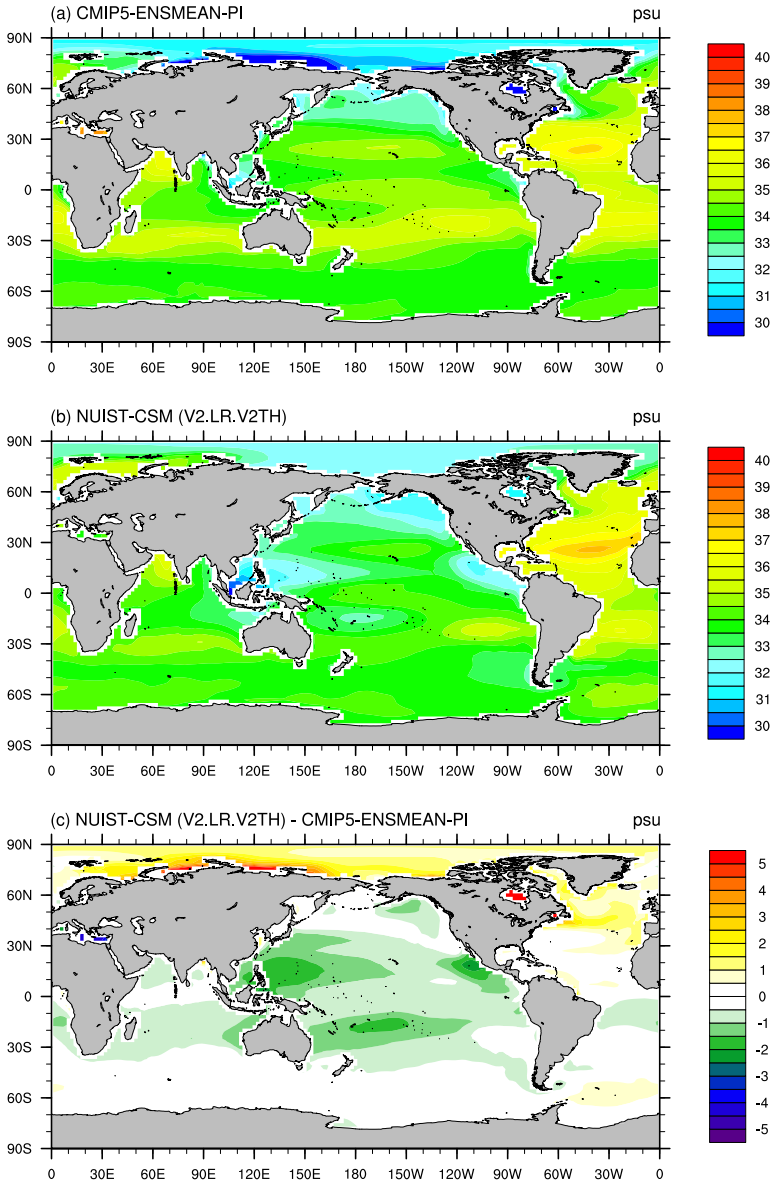



## Comparison with CMIP5 models by PCC and NRMSE

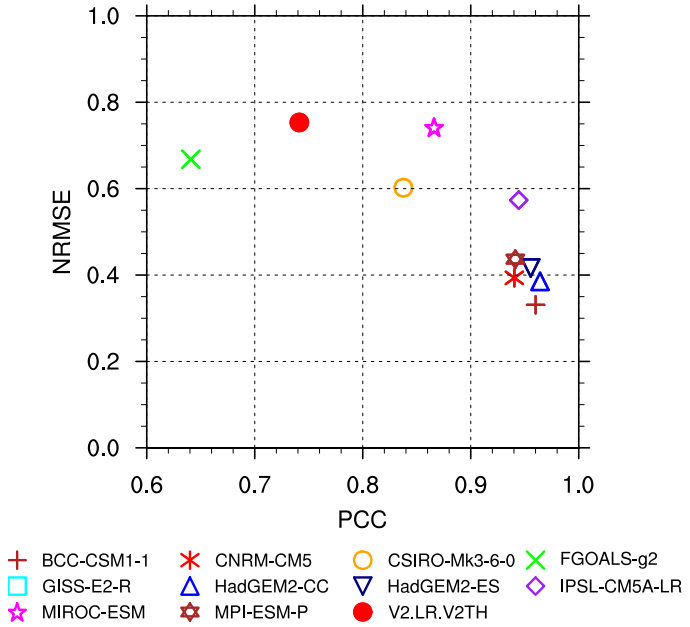



Back to introduction | Back to summary table

# 12.01 Sea Surface Salinity

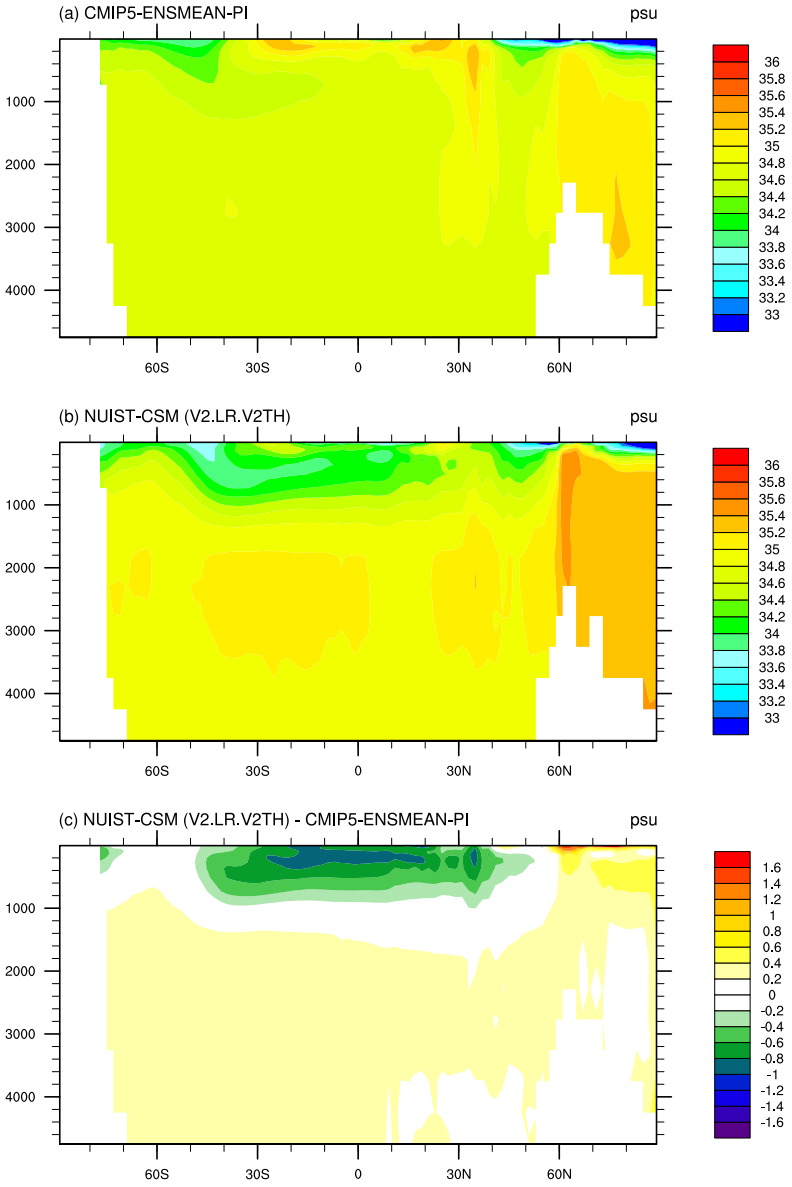



## Comparison with CMIP5 models by PCC and NRMSE

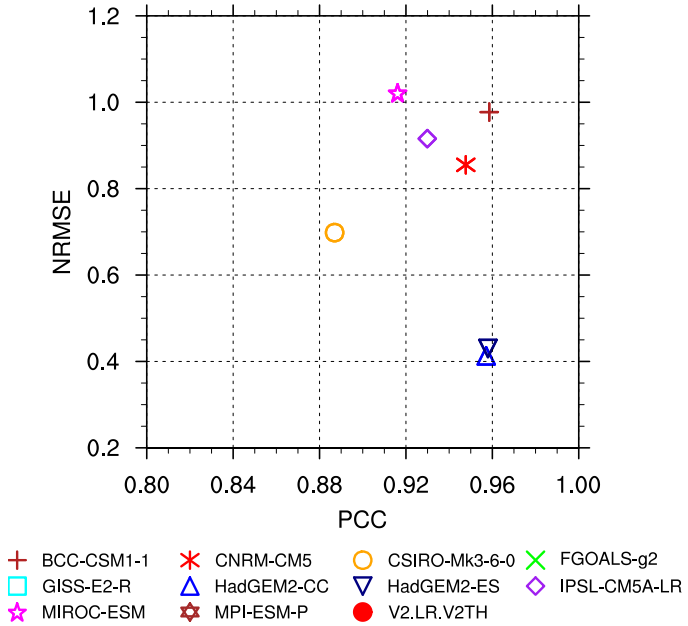



Back to introduction | Back to summary table

# 12.16 Sea Water Salinity Longitude-Depth Section

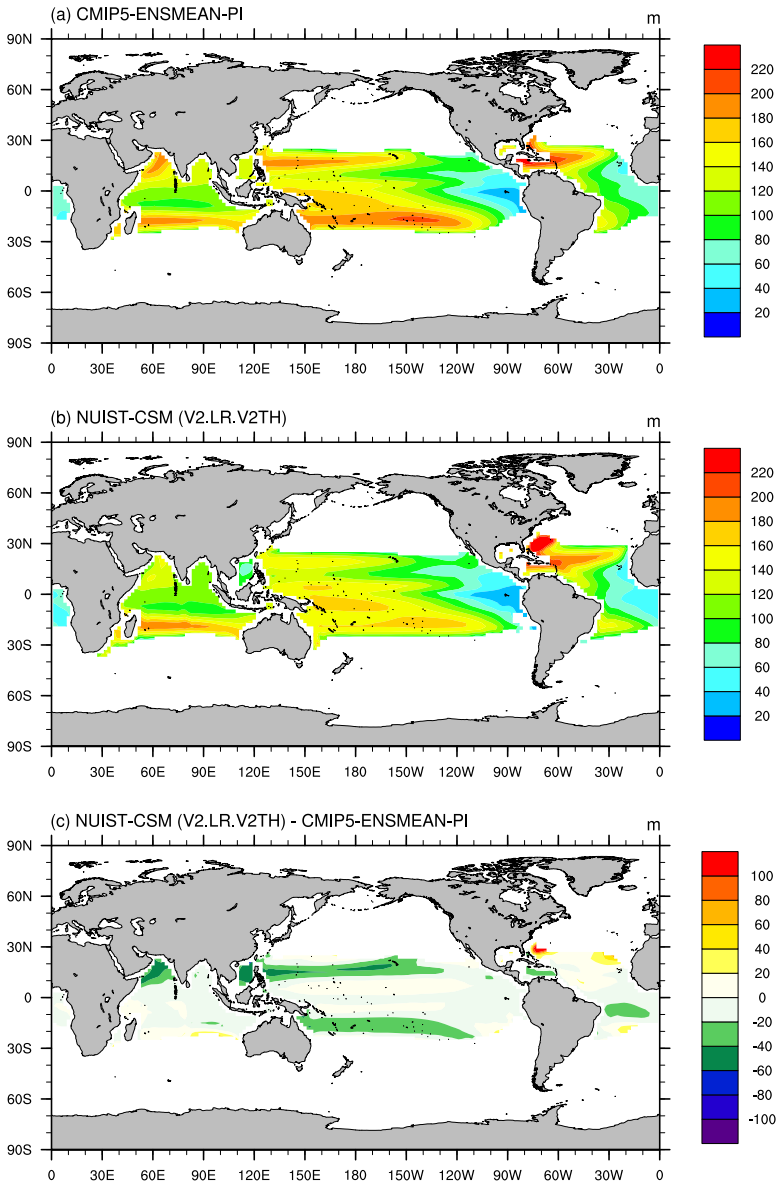



## Comparison with CMIP5 models by PCC and NRMSE

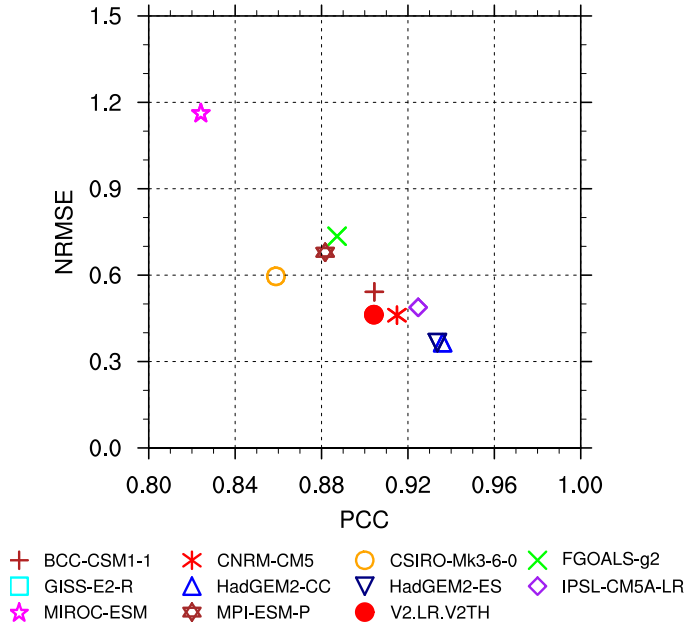



Back to introduction | Back to summary table

# 14.01 Thermocline Depth (20 degC Isotherm Depth)

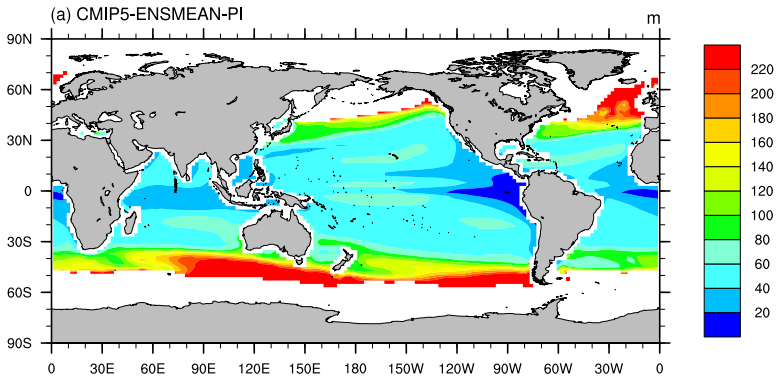


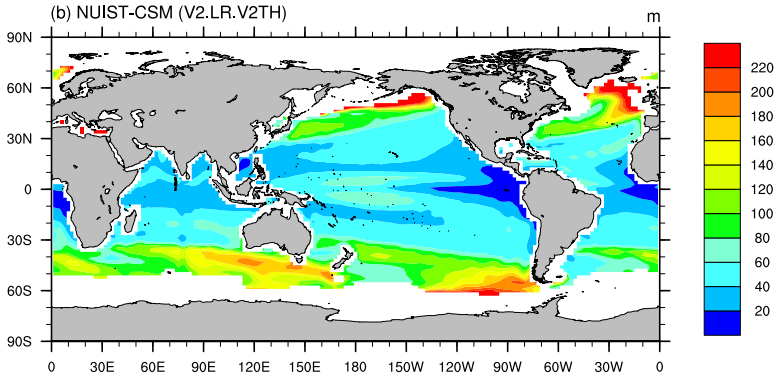

## Comparison with CMIP5 models by PCC and NRMSE

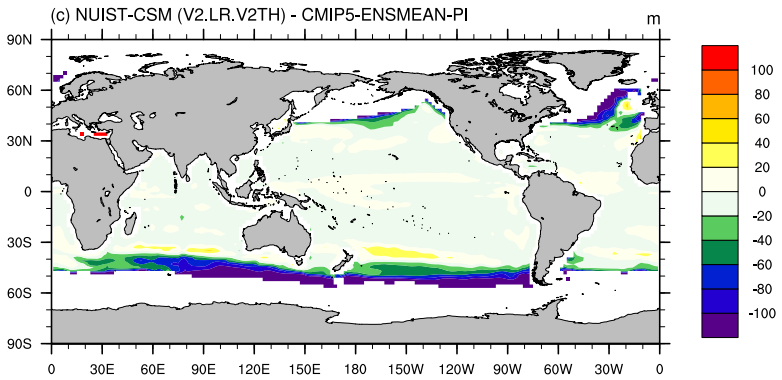



Back to introduction | Back to summary table

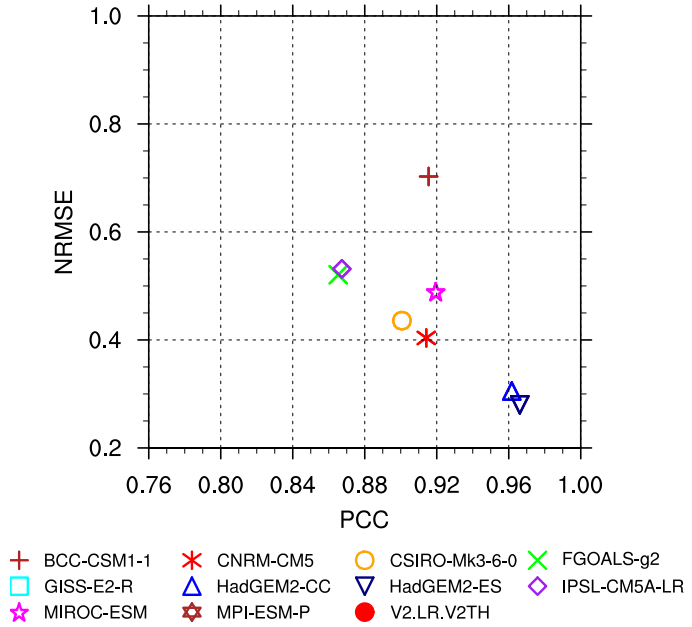
# 15.01 Mixed Layer Depth (T - Tsurf = -0.5 degC)



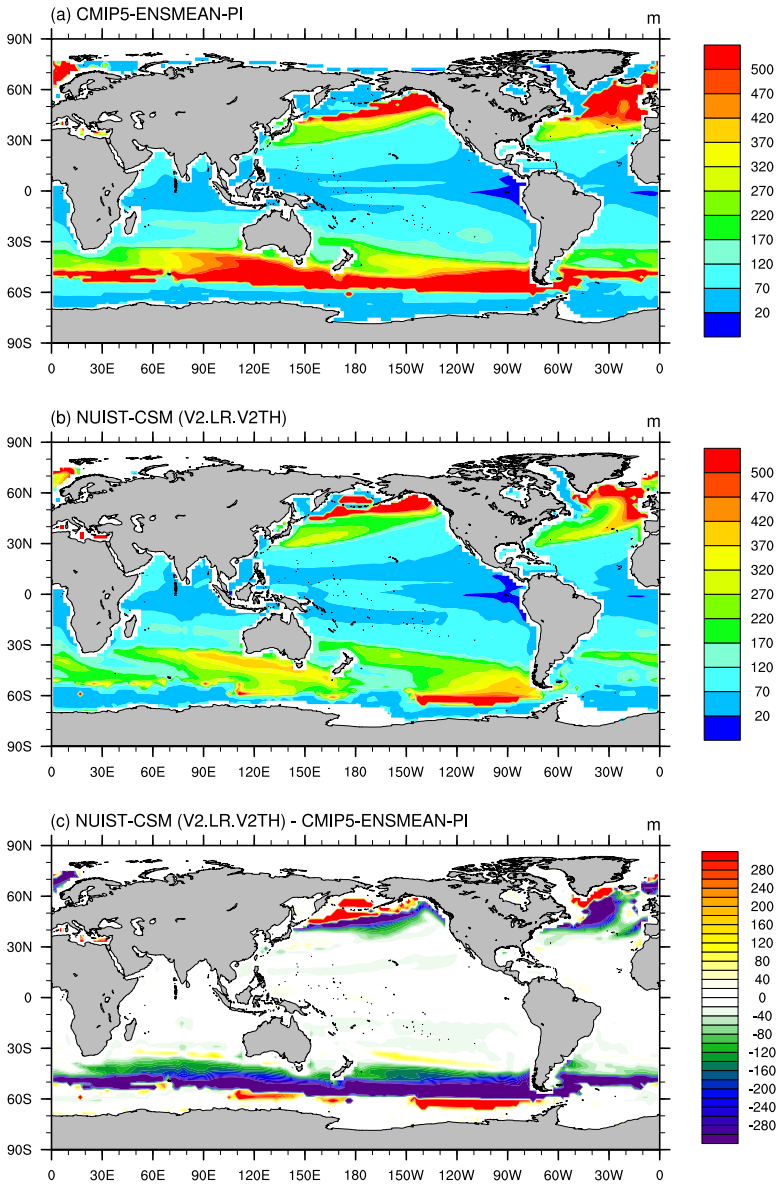




## Comparison with CMIP5 models by PCC and NRMSE

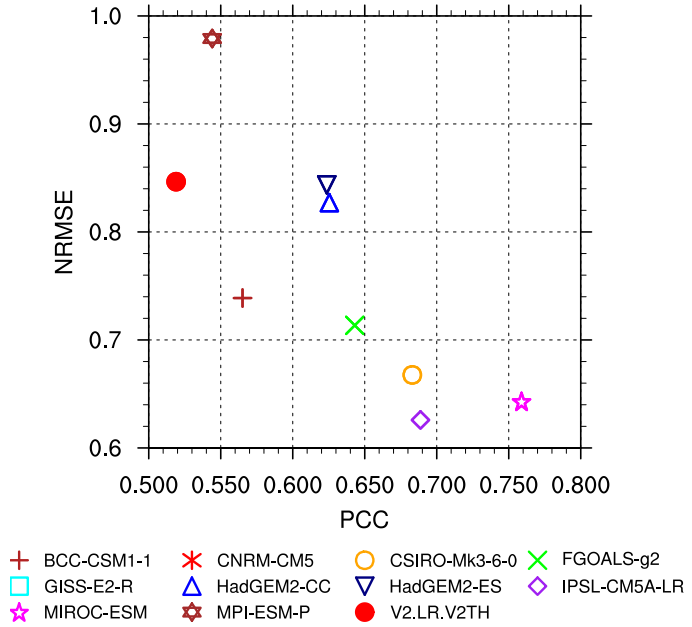



Back to introduction | Back to summary table

# 15.01.08 Mixed Layer Depth (T - Tsurf = -0.5 degC) Maximum

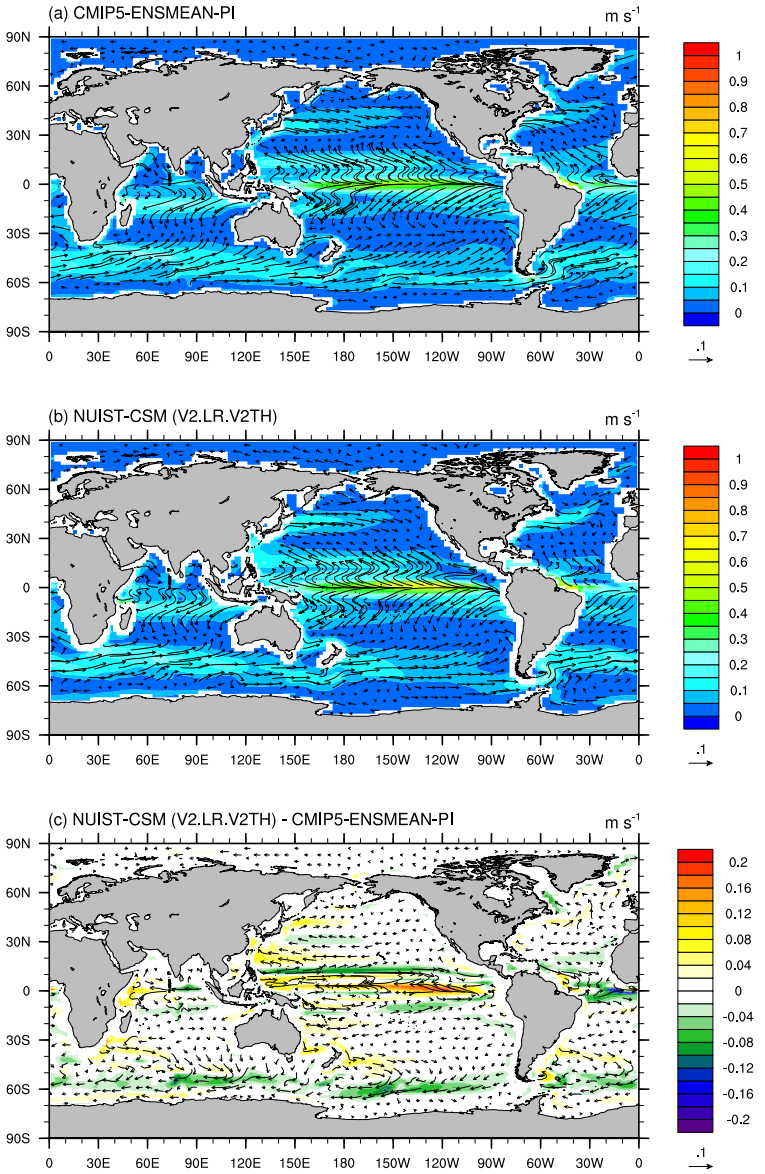



## Comparison with CMIP5 models by PCC and NRMSE

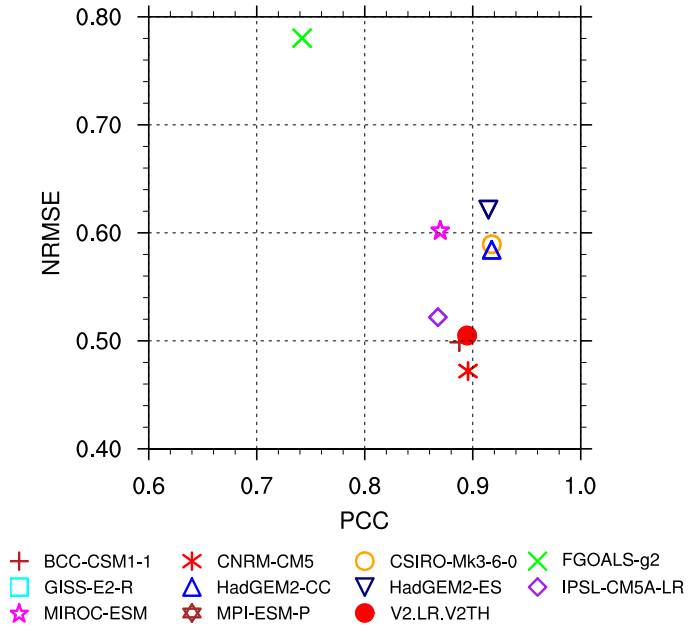



Back to introduction | Back to summary table

# 22.04 Sea Surface Velocity and Its Magnitude

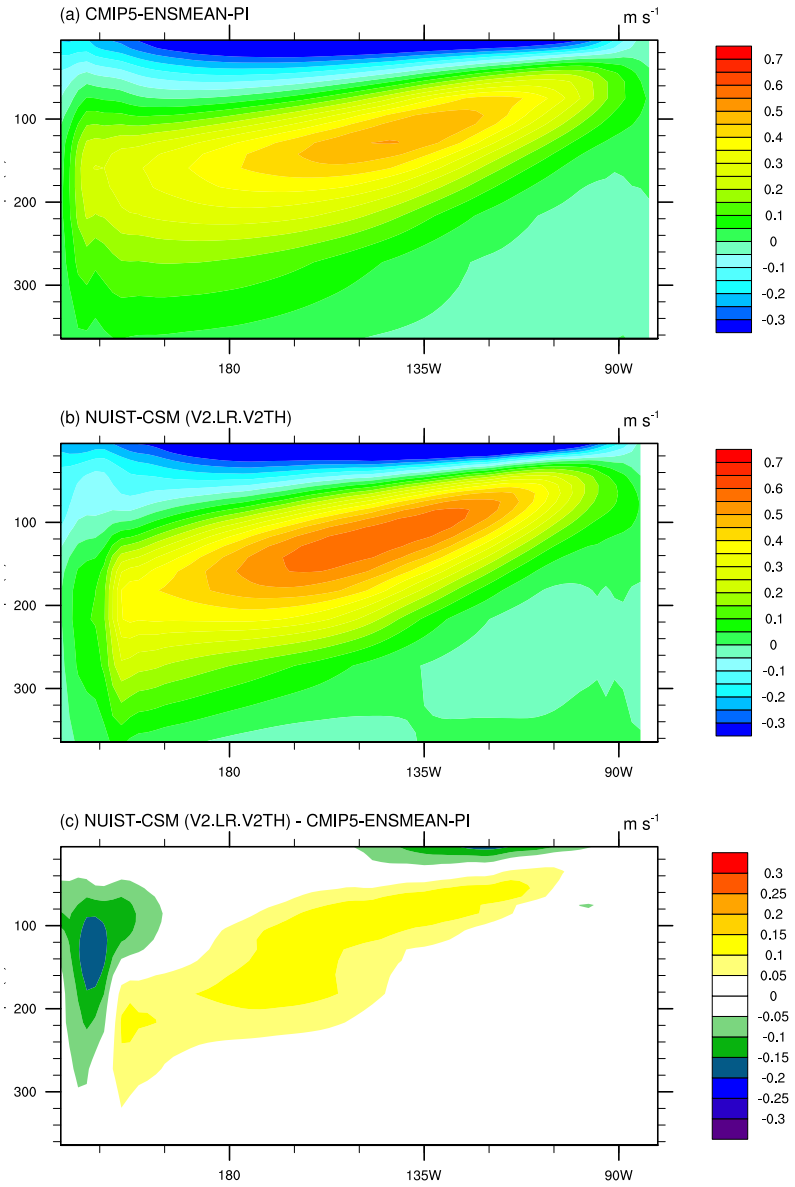



## Comparison with CMIP5 models by PCC and NRMSE

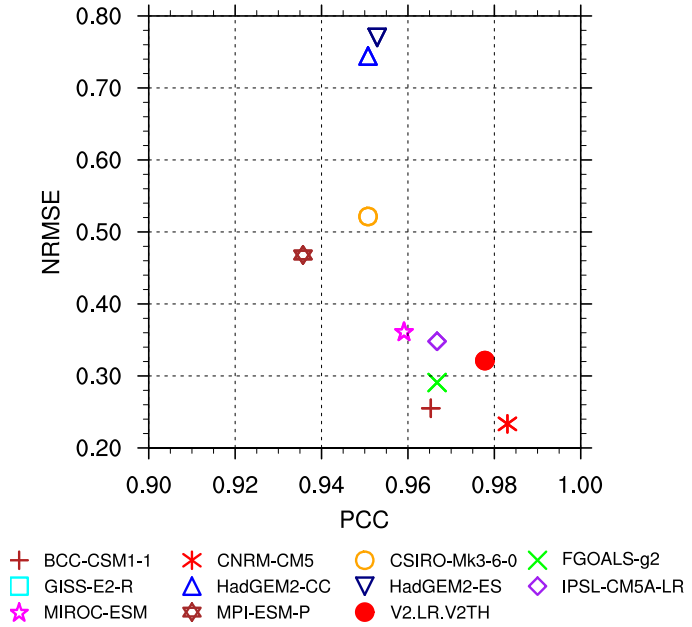



Back to introduction | Back to summary table

# 22.11 Ocean Zonal Velocity Longitude-Depth Section (EQ Pacific)

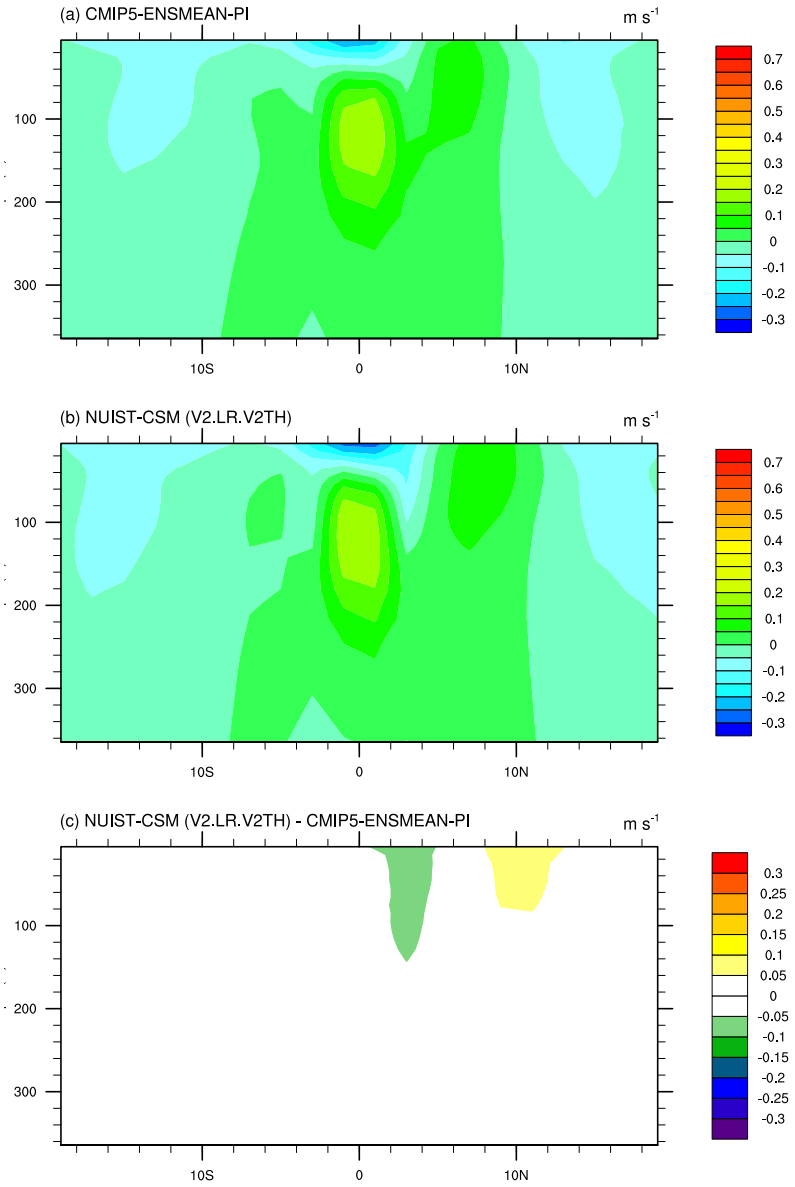



## Comparison with CMIP5 models by PCC and NRMSE

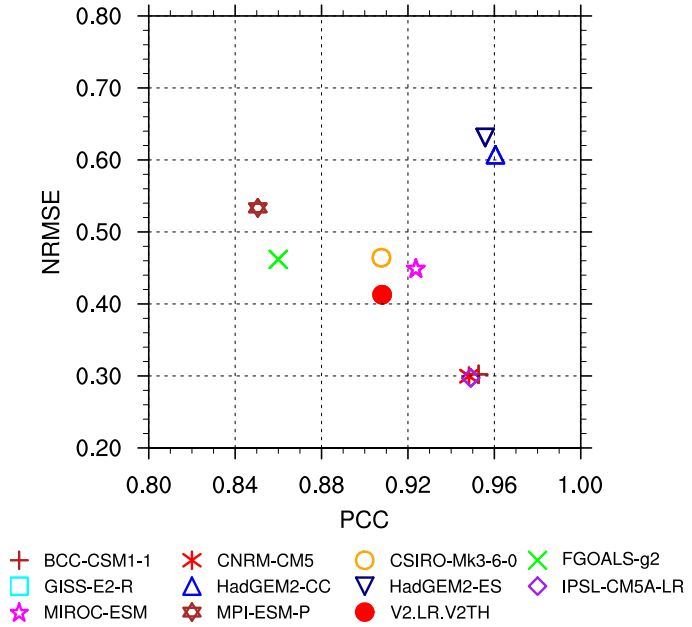



Back to introduction | Back to summary table

# 22.16 Ocean Zonal Velocity Latitude-Depth Section (Pacific)

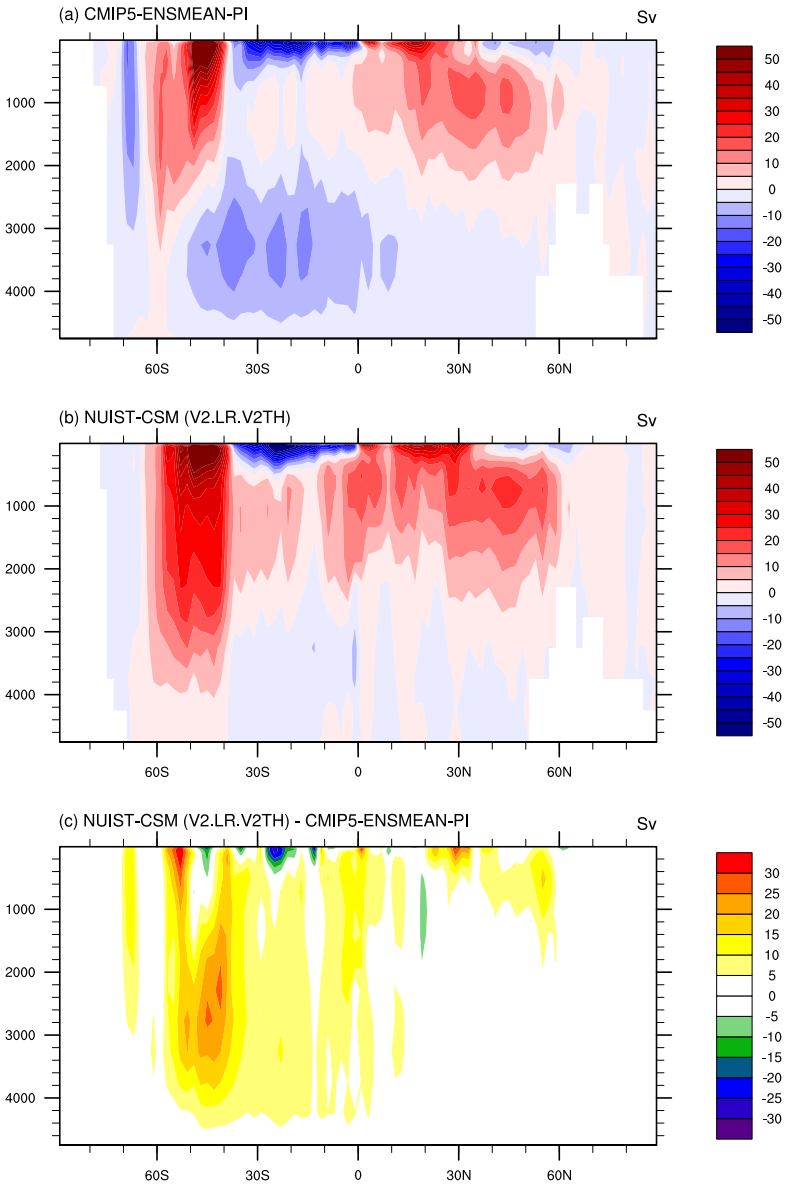



## Comparison with CMIP5 models by PCC and NRMSE

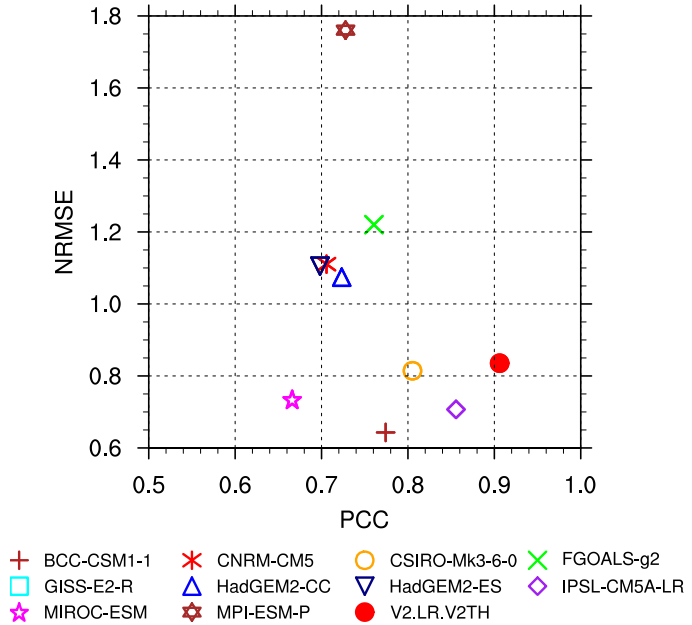



Back to introduction | Back to summary table

# 23.16 Meridional Overturning Streamfunction (Global)

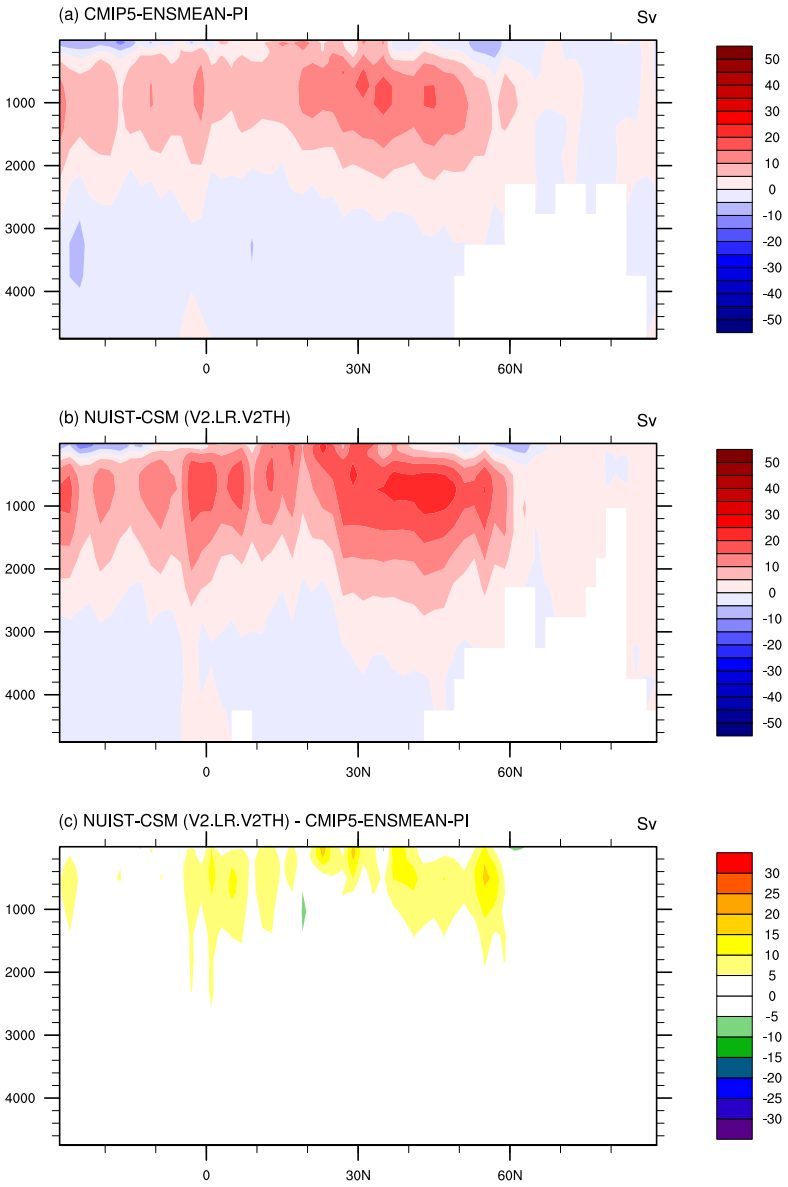



## Comparison with CMIP5 models by PCC and NRMSE

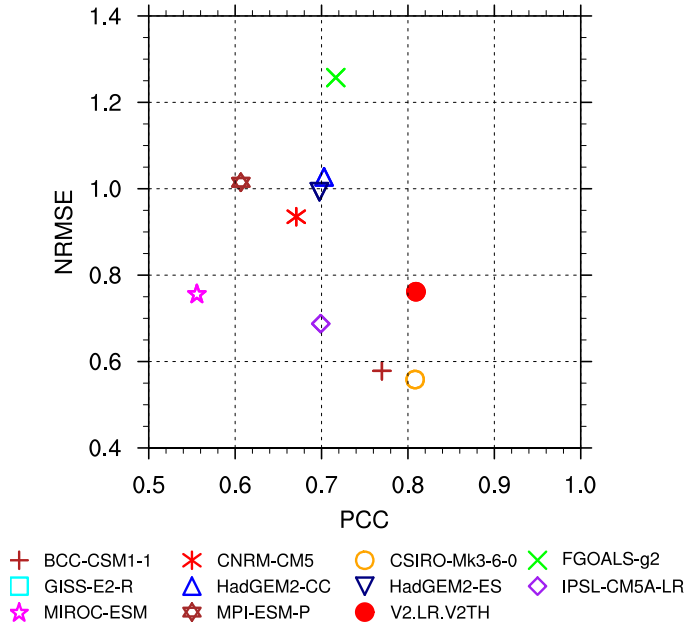



Back to introduction | Back to summary table

# 23.17 Meridional Overturning Streamfunction (Atlantic)




## Comparison with CMIP5 models by PCC and NRMSE



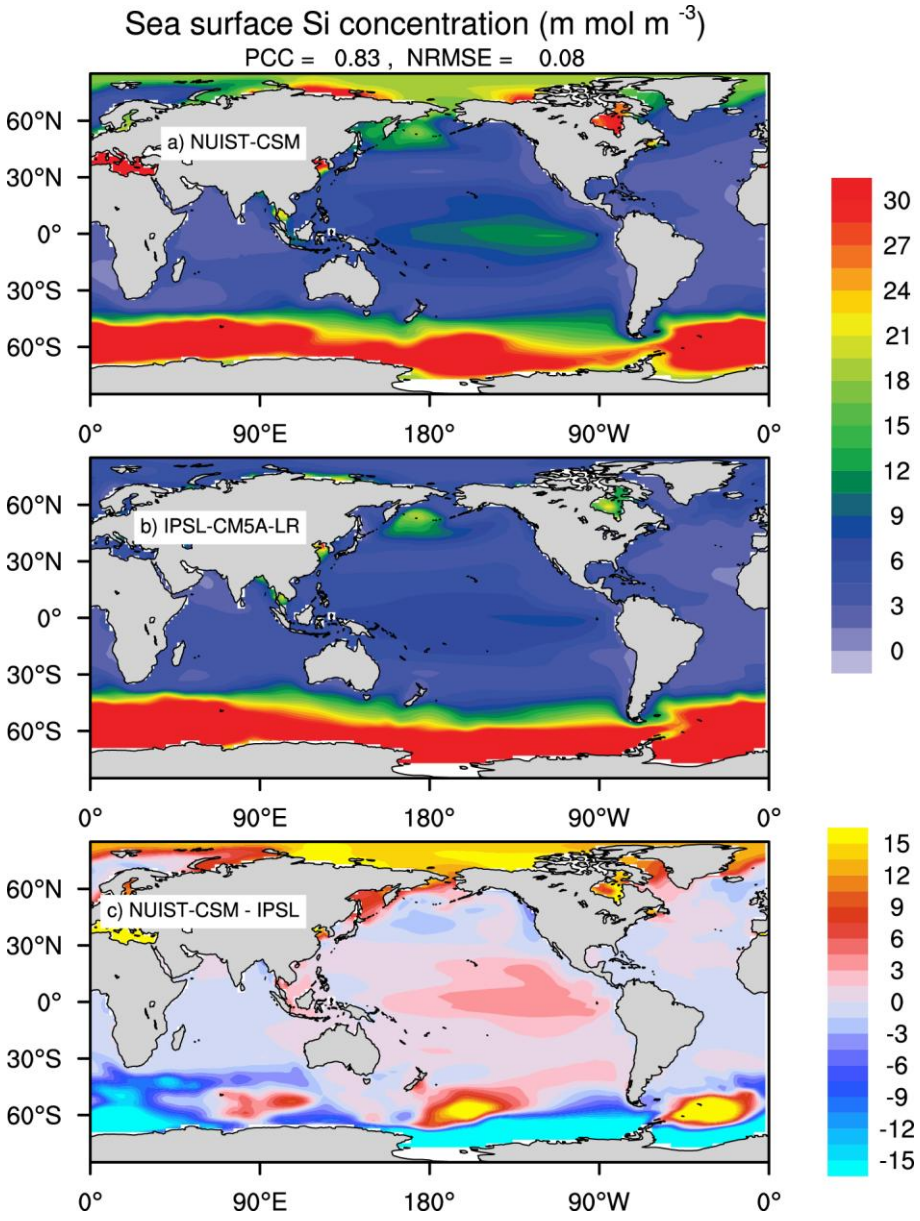

Back to introduction | Back to summary table

# The End

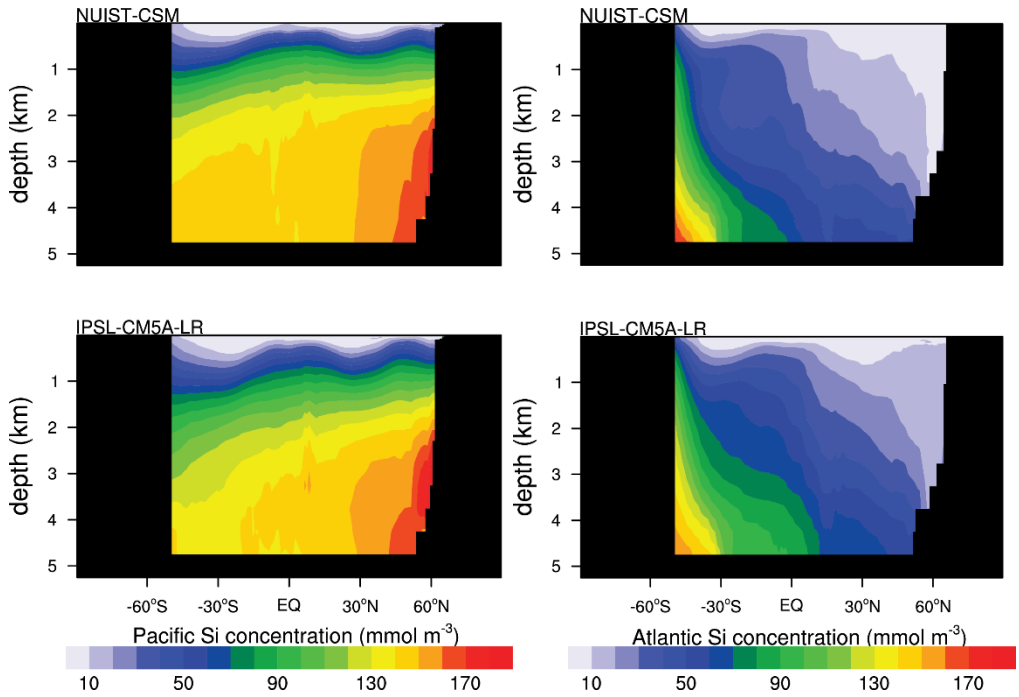
# Evaluation of Ocean Model Performance

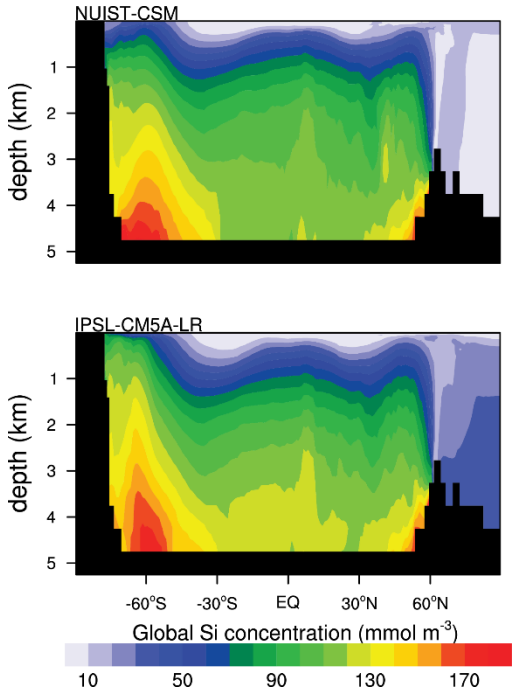
for NUIST-CSM-2.0.1

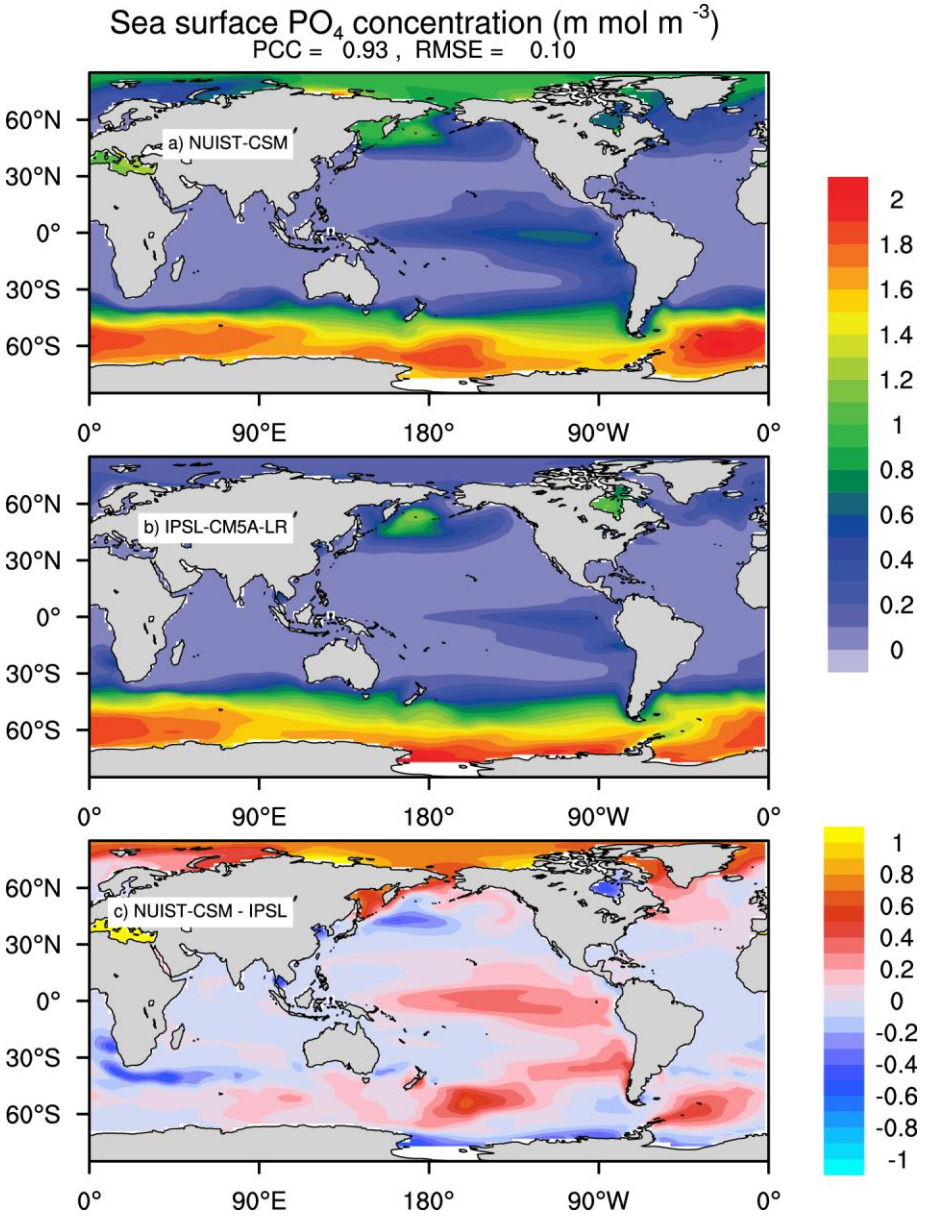
Compared with IPSL-CM5A-LR


Sea surface Si concentration (m mol m -3)
PCC = 0.83 , NRMSE = 0.08
a) NUIST-CSM
b) IPSL-CM5A-LR
c) NUIST-CSM - IPSL
60°N
30°N
0°
30°S
60°S
0°
90°E
180°
90°W
0°
30
27
24
21
18
15
12
9
6
3
0
15
12
9
6
3
0
-3
-6
-9
-12
-15

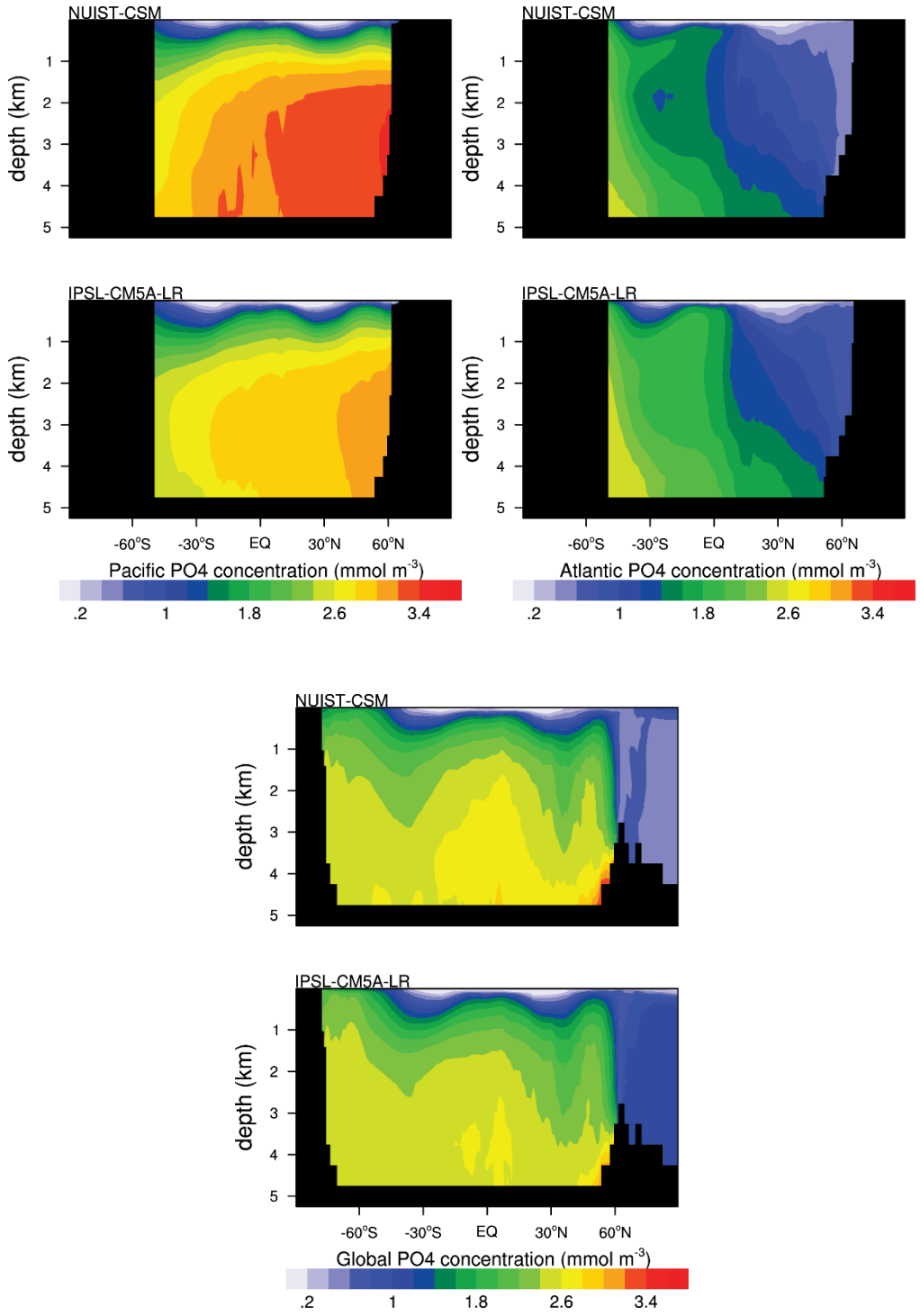
Latitude-depth distribution of Si in different oceans

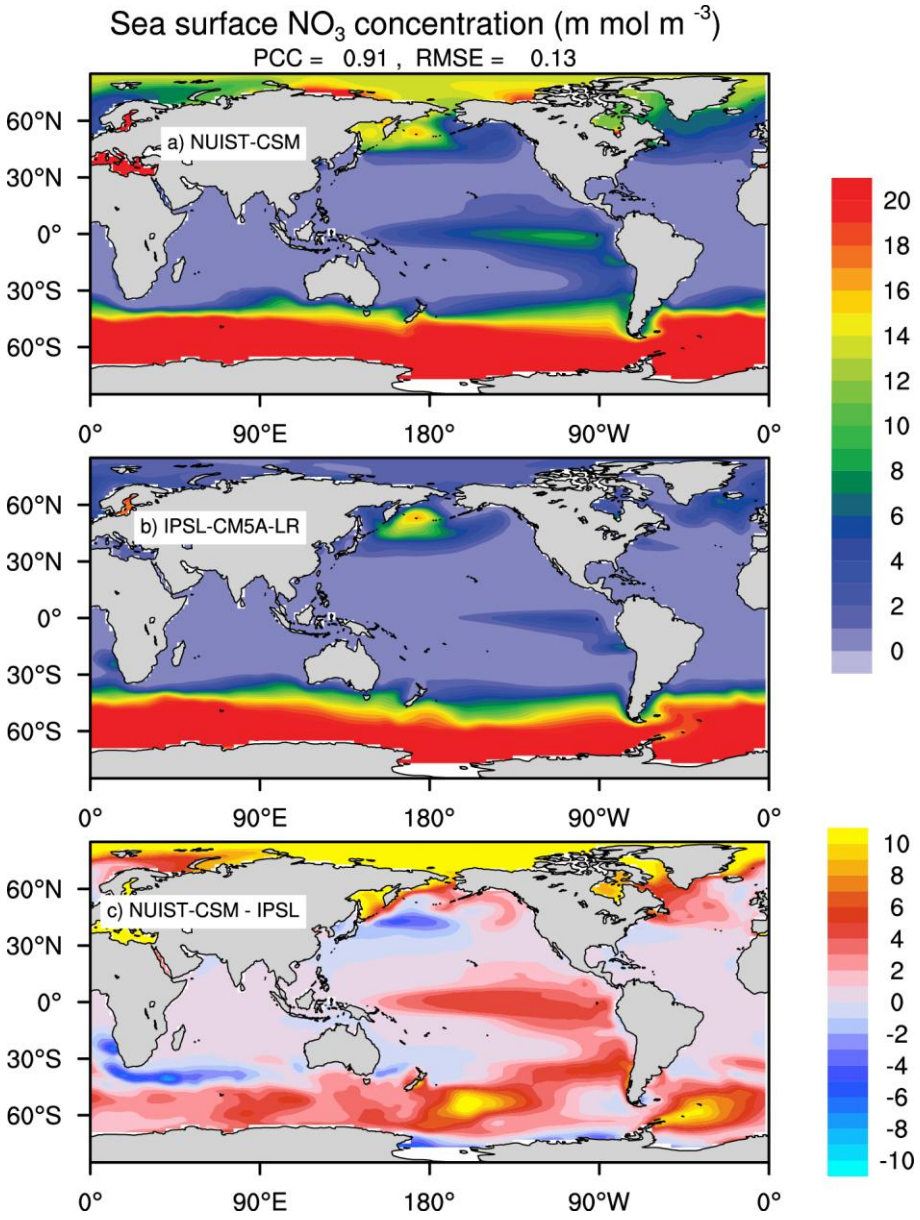


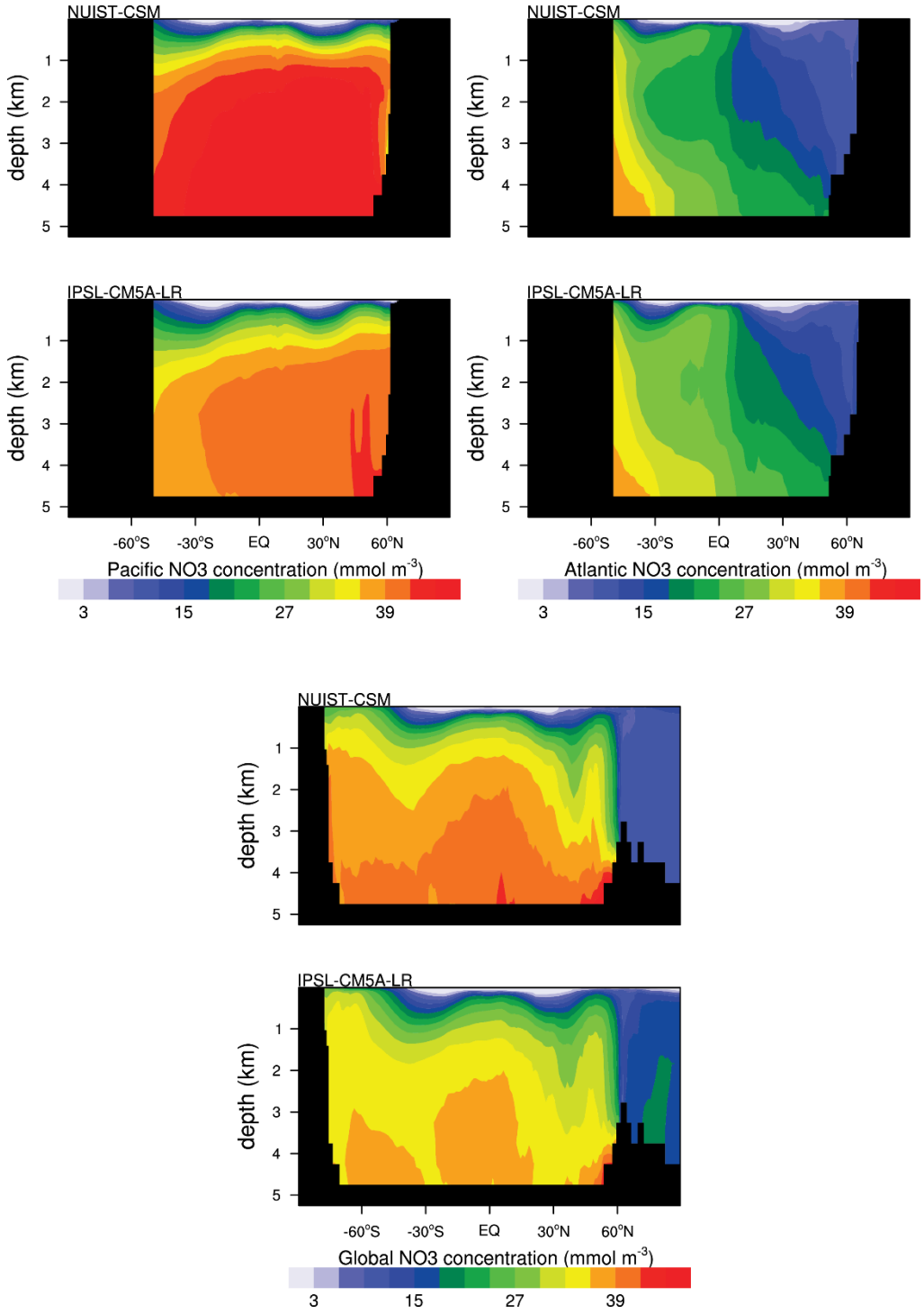

Sea surface PO4 concentration (m mol m -3)
PCC = 0.93 , RMSE = 0.10
a) NUIST-CSM
b) IPSL-CM5A-LR
c) NUIST-CSM - IPSL
60°N
30°N
0°
30°S
60°S
0°
90°E
180°
90°W
0°
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1

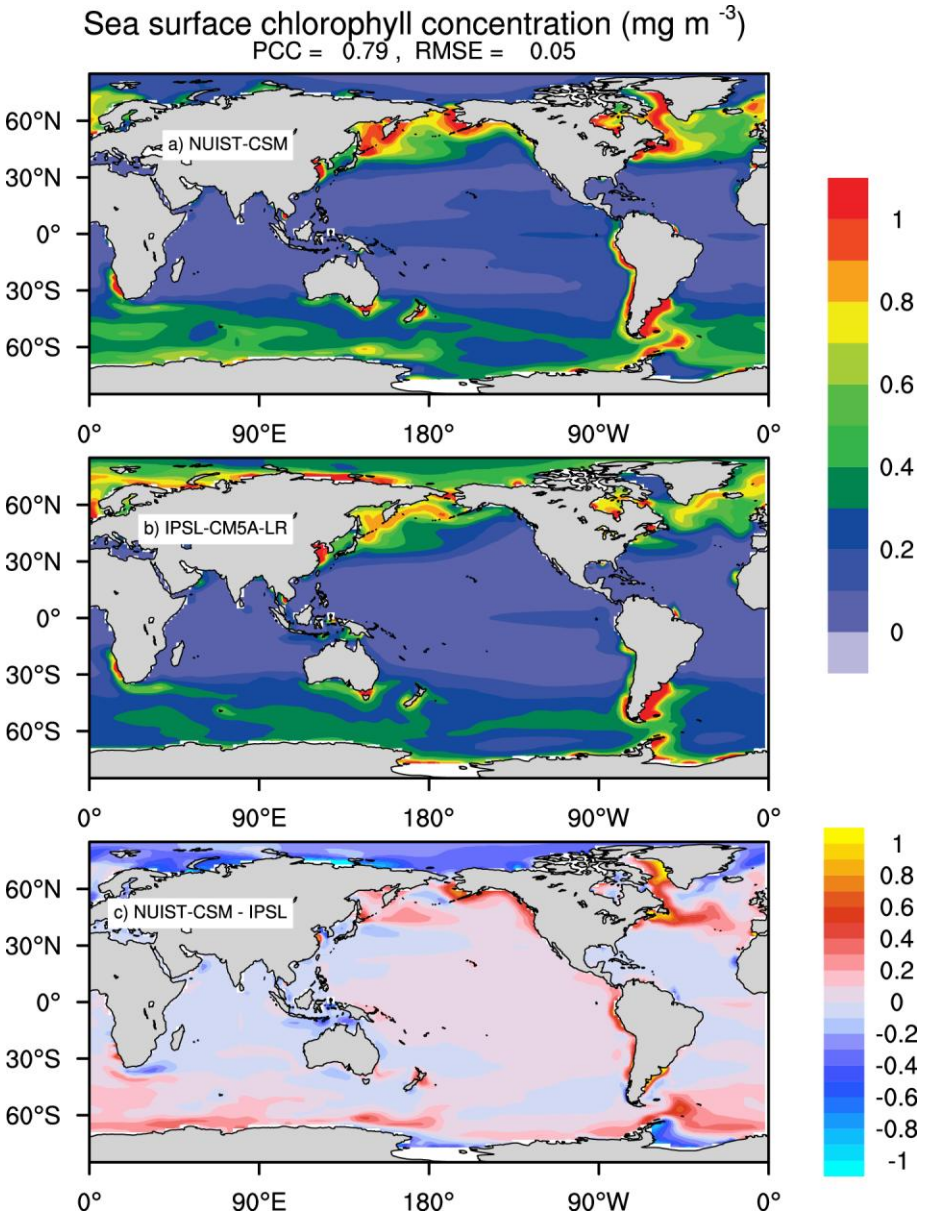
Latitude-depth distribution of PO4 in different oceans

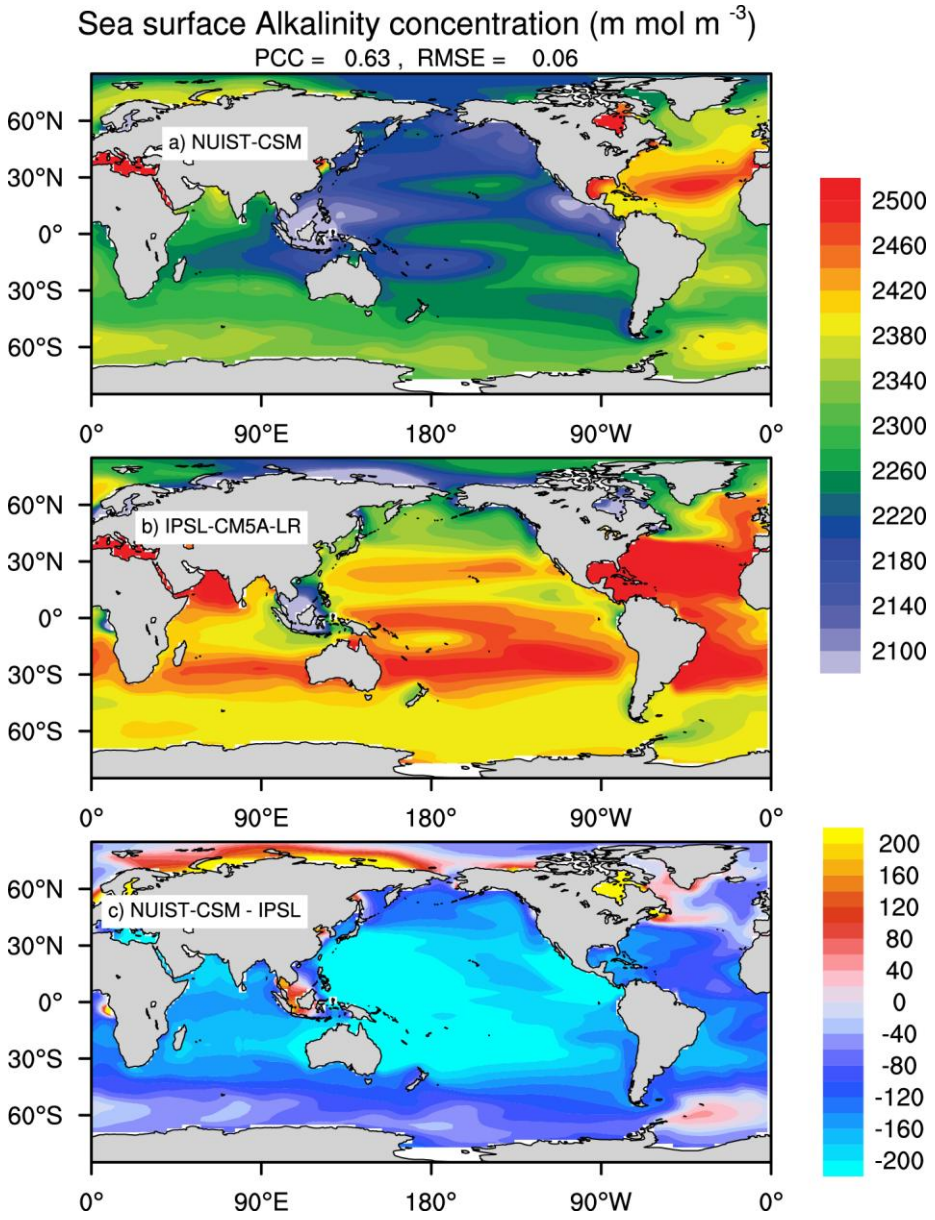



Sea surface NO3 concentration (m mol m -3)
PCC = 0.91 , RMSE = 0.13
a) NUIST-CSM
b) IPSL-CM5A-LR
c) NUIST-CSM - IPSL
60°N
30°N
0°
30°S
60°S
0°
90°E
180°
90°W
0°
20
18
16
14
12
10
8
6
4
2
0
10
8
6
4
2
0
-2
-4
-6
-8
-10

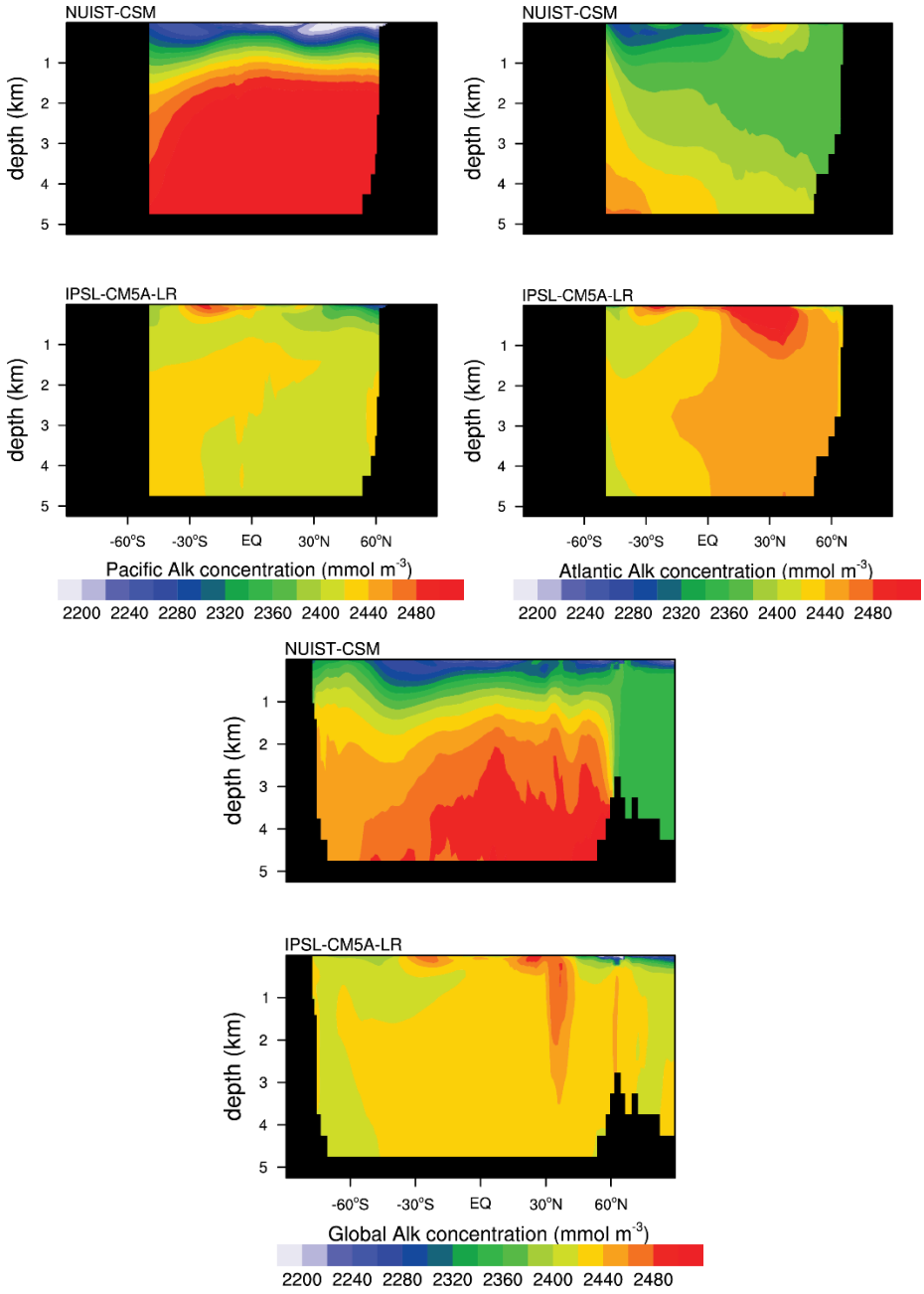
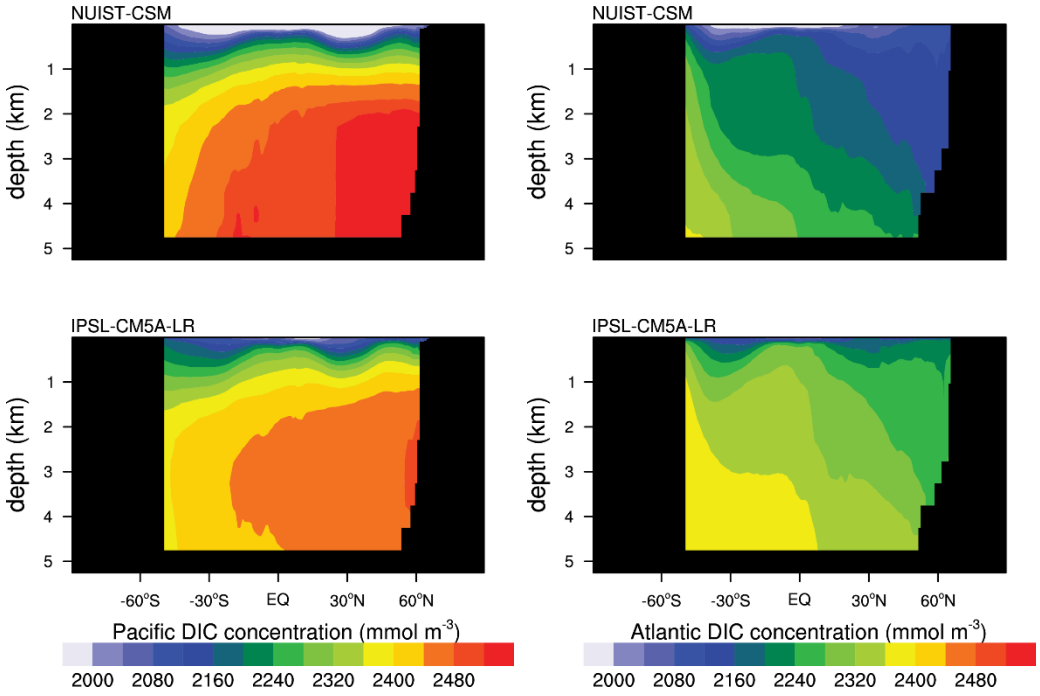
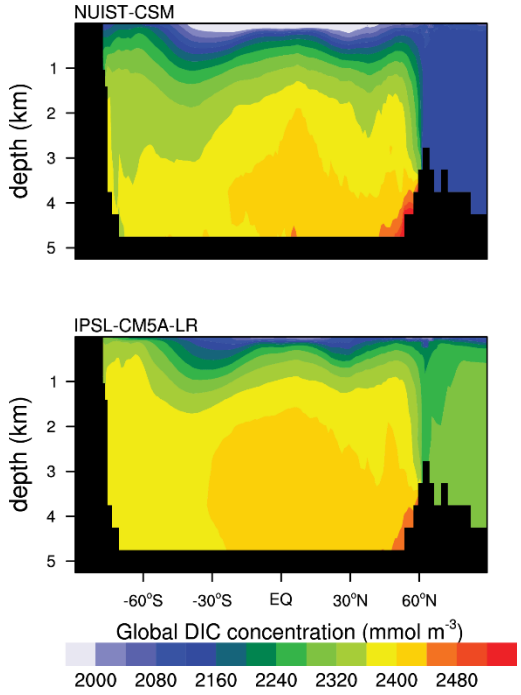
Latitude-depth distribution of NO3 in different oceans




Sea surface chlorophyll concentration (mg m -3)
PCC = 0.79 , RMSE = 0.05
a) NUIST-CSM
b) IPSL-CM5A-LR
c) NUIST-CSM - IPSL
60°N
30°N
0°
30°S
60°S
0°
90°E
180°
90°W
0°
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1


Sea surface Alkalinity concentration (m mol m -3)
PCC = 0.63 , RMSE = 0.06
a) NUIST-CSM
b) IPSL-CM5A-LR
c) NUIST-CSM - IPSL
60°N
30°N
0°
30°S
60°S
0°
90°E
180°
90°W
0°
2500
2460
2420
2380
2340
2300
2260
2220
2180
2140
2100
200
160
120
80
40
0
-40
-80
-120
-160
-200

Latitude-depth distribution of Alkalinity in different oceans



Latitude-depth distribution of DIC in different oceans