



# Exercises using SPEEDY model

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**Advanced School on Tropical-Extratropical Interactions  
on Intra-Seasonal Time Scales**

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# Group photo



# Outline

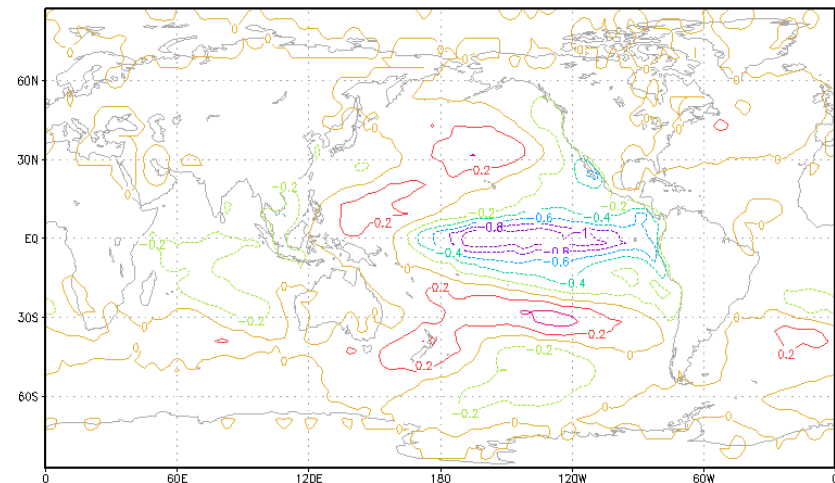
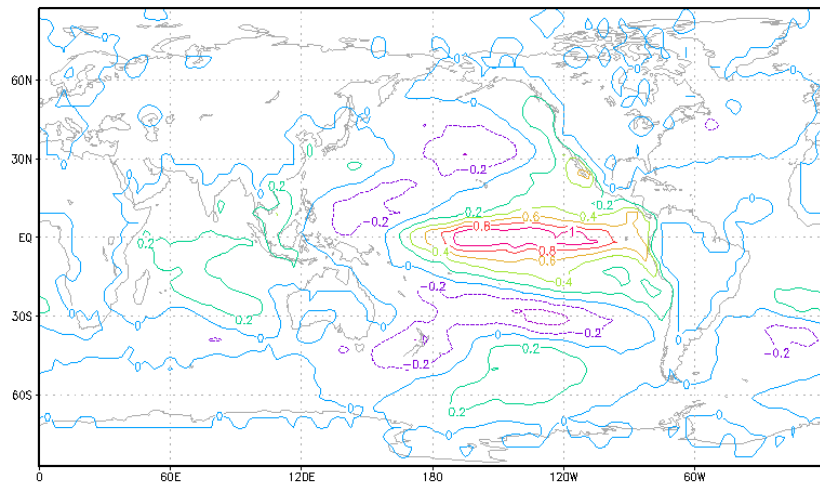
- Speedy Model Performance: - Run with prescribed SSTAs: -
  - El Nino & La Nina type.
  - TP, Atlantic, & Combined (TP + Atlantic).



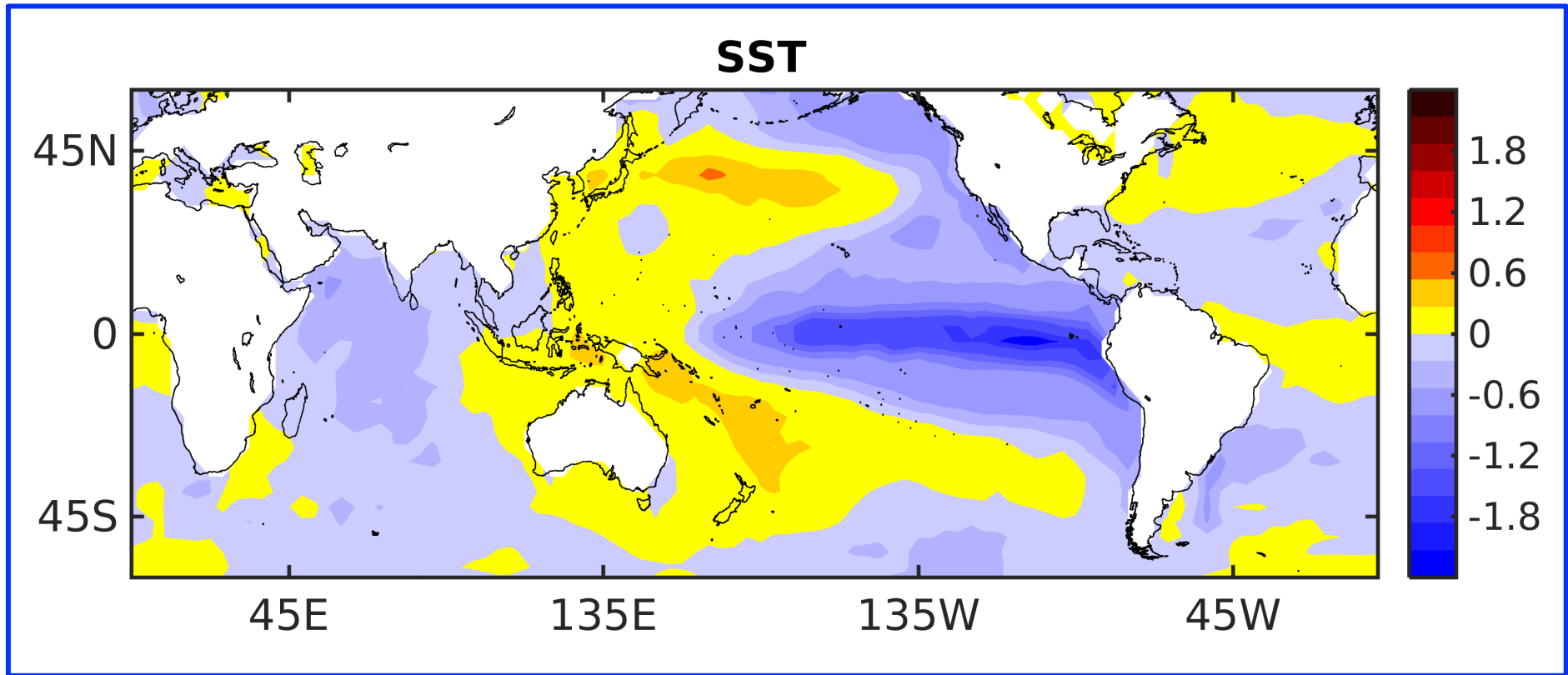
# A. ENSO teleconnection in SPEEDY model

	SST forcing
NINO	Permanent El Nino
NINA	Permanent La Nina

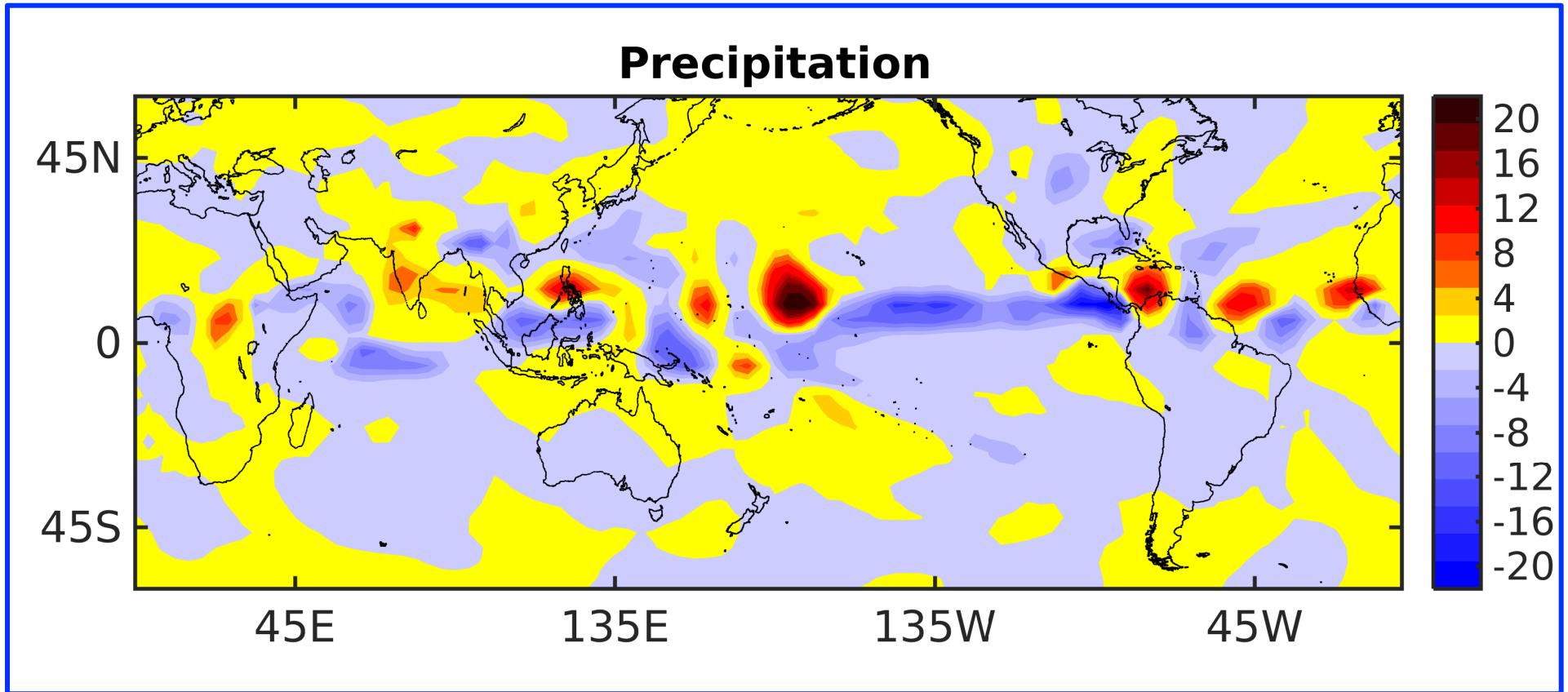
Simulating period:  
1979-2015



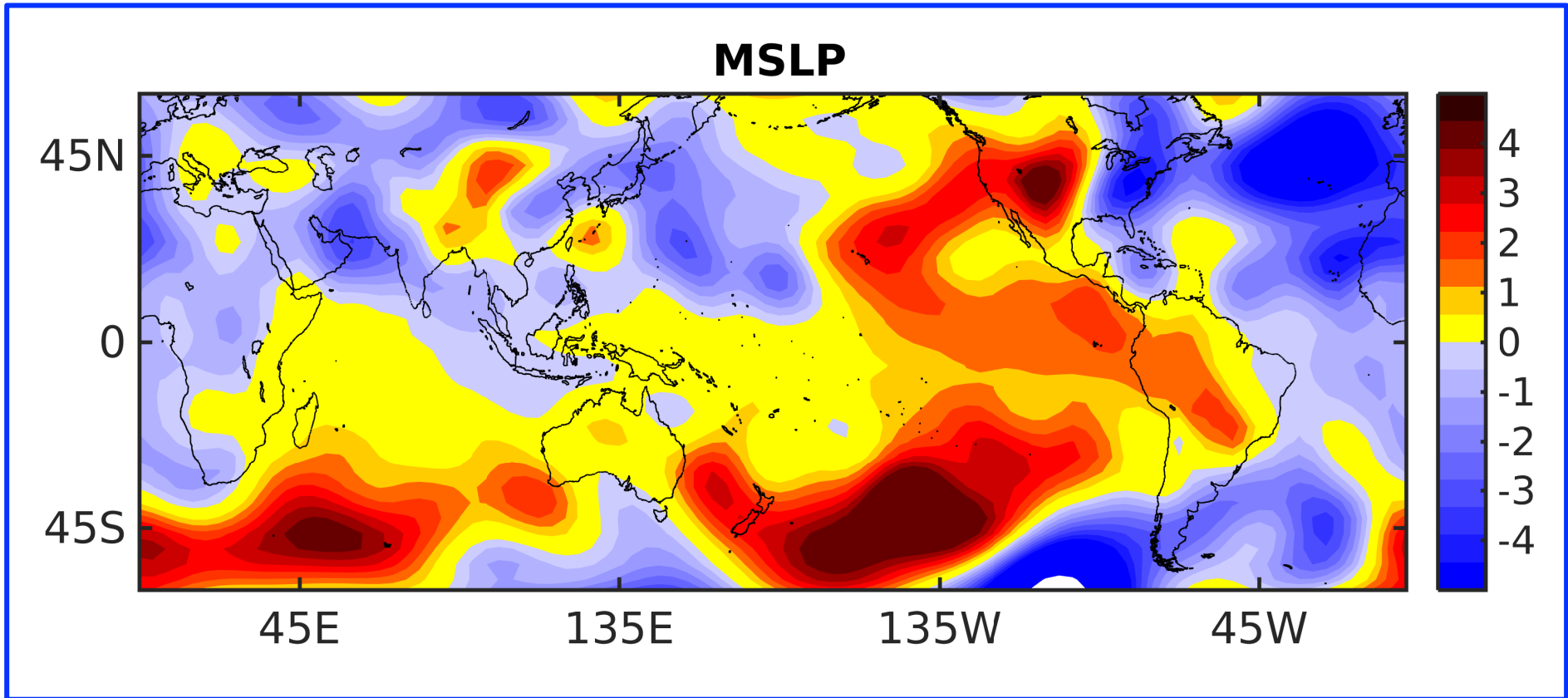




**Fig.** Climatological Seasonal Mean difference of SST between La Nina and El Nino experiments

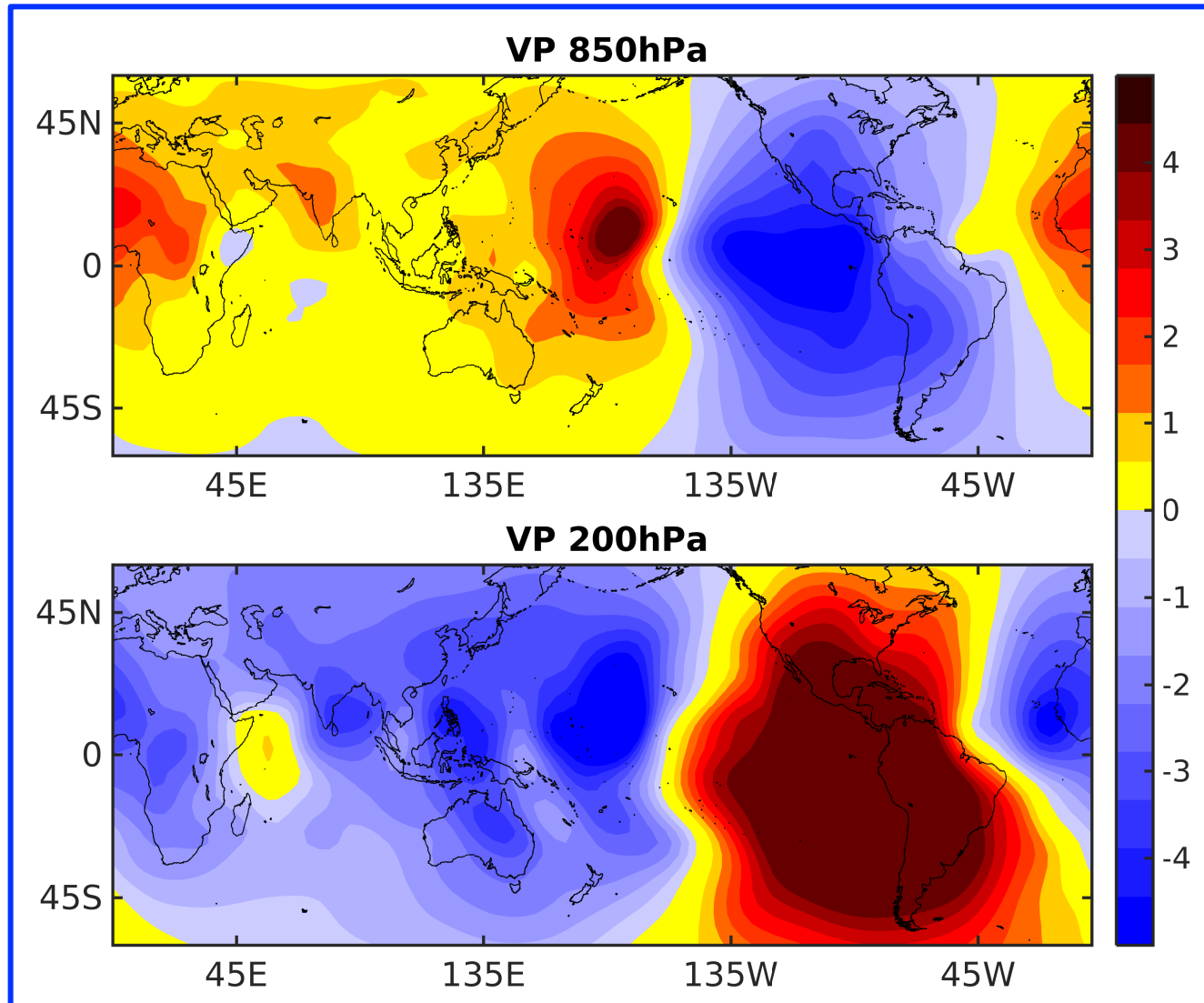


**Fig.** Climatological Seasonal Mean difference of Precipitation between La Nina and El Nino experiments



**Fig.** Climatological Seasonal Mean difference of MSLP between La Nina and El Nino Experiments at lower and upper levels

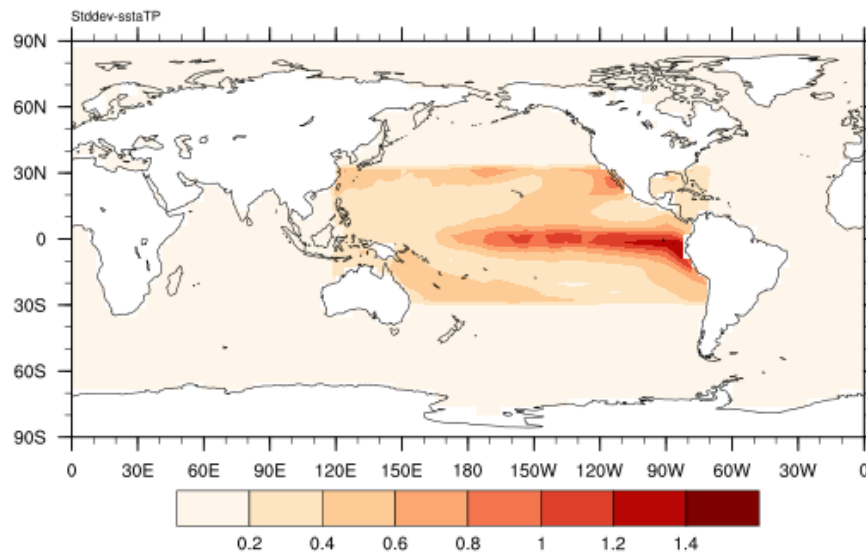




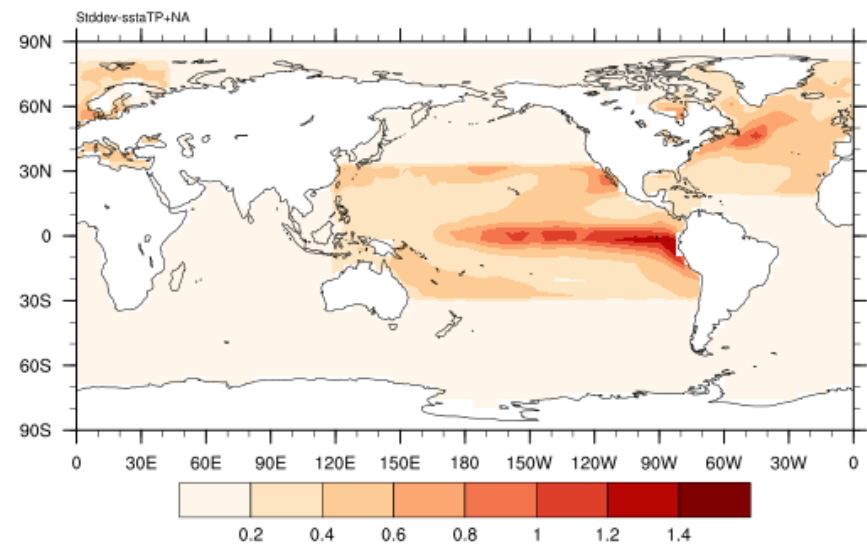
**Fig.** Climatological Seasonal Mean difference of Velocity Potential between La Nina and El Nino experiments at lower and upper levels

Two types of experiments  
Each one has 3 ensemble members  
1990-2000

**TP**  
[Tropical Pacific]



**TPNA**  
[Tropical Pacific + North Atlantic]

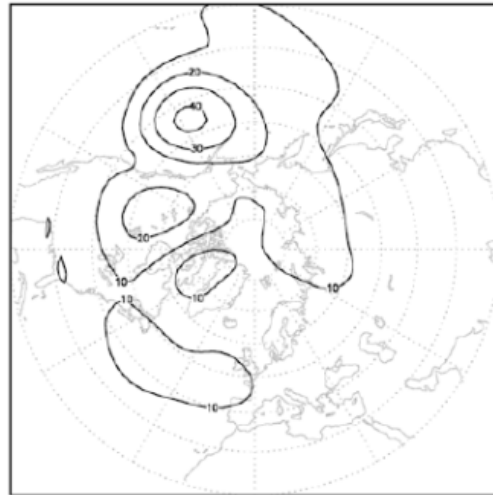


**Standard deviation of SST forcing**

The variability in SPEEDY  
AGCM runs can be separated  
into

**A contribution due to the  
variability of SST forcing**

b) Ensemble mean STDEV SPEEDY DJF



**An internal part, due to the  
intrinsic variability**

c) Internal STDEV SPEEDY DJF



Bracco et al, 2004, Clim. Dyn.

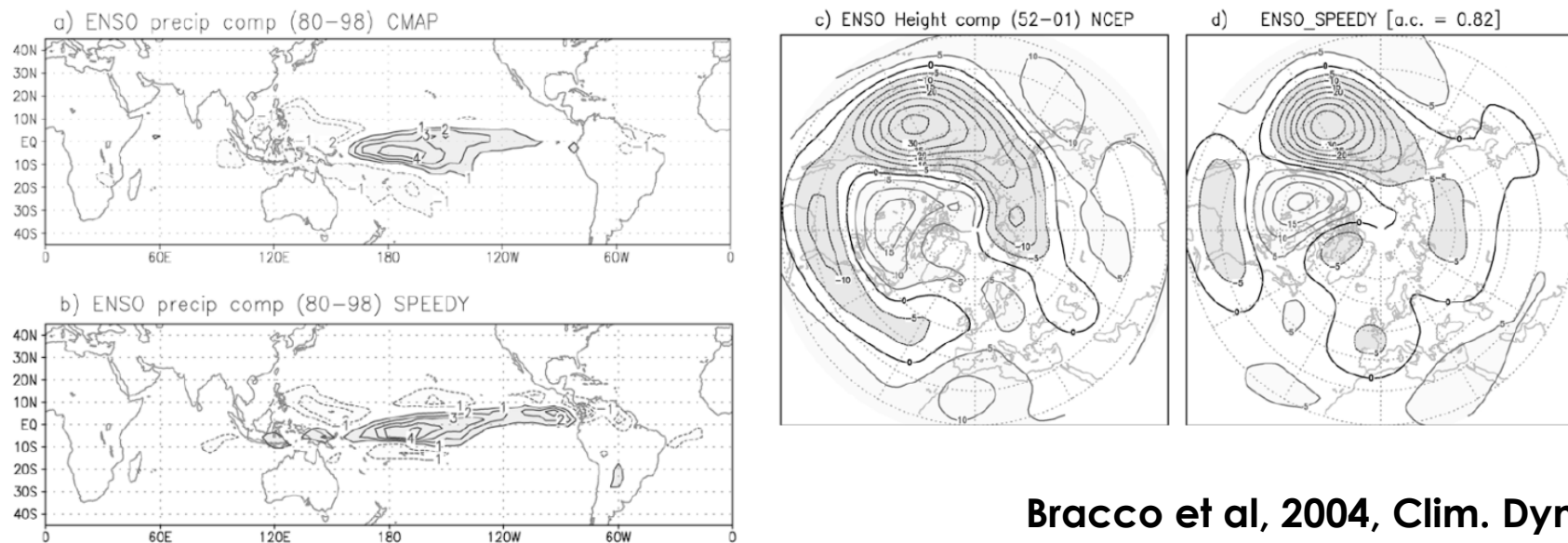
**Ensemble mean** is used to  
quantify the response to SST  
forcing

**Internal variability** is one source of  
uncertainty in future climate  
change (e.g., Hawkins and Sutton  
2009; Tebaldi and Knutti 2007;  
Deser et al. 2012).



## B. Role of internal variability in responses of atmospheric circulation to ENSO

**The SPEEDY model reproduces well the structure and amplitude of the circulation variability induced by ENSO.**

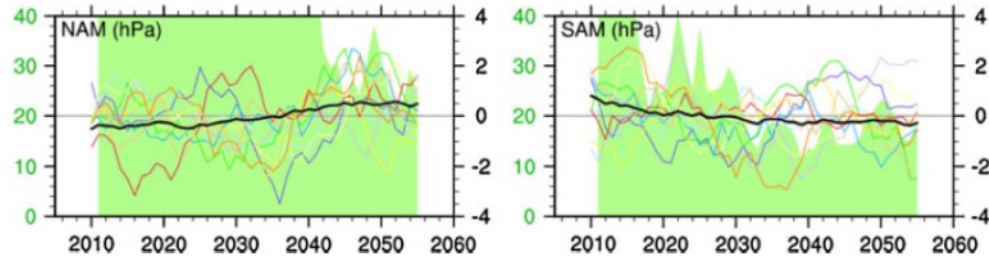


**Bracco et al, 2004, Clim. Dyn.**

**Fig. 2a-d** Regression of precipitation and 500 hPa geopotential height onto the NINO3.4 index: a) precipitation from CMAP data (period 1988-1998), b) precipitation from the SPEEDY ensemble mean (period 1980-1998), c) 500 hPa height from NCEP re-analysis data (period 1952-2001), d) 500 hPa height from the SPEEDY

ensemble mean (period 1952-2001). In the caption of d) the anomaly correlation coefficient of the modelled ENSO composite with c) is given in brackets. CI: 1 mm/day for (a) and (b), 5 m for (c) and (d). *Solid lines* (light shading) indicate positive values, negative values are *dotted* (dark shading)

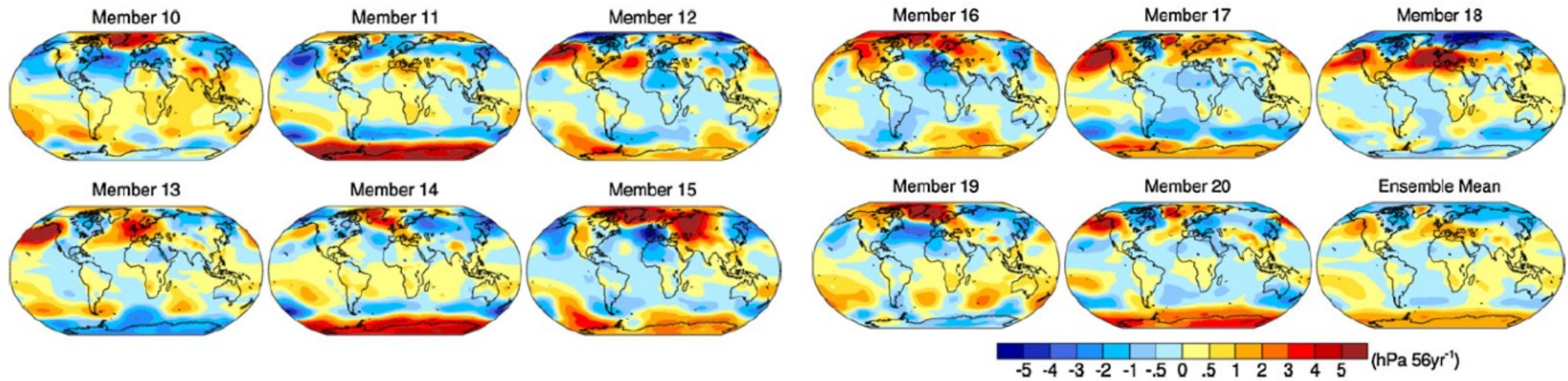
# An example of uncertainty in climate projection caused by internal variability



**Fig. 5** Ten-year running mean DJF time series of the NAM (*left*) and SAM (*right*), defined as the zonally-averaged SLP anomaly difference between high (55°–90°) and middle latitudes (30°–55°) of the northern and southern hemisphere, respectively. The *thick black*

*curve* denotes the 40-member ensemble mean, and the *thin colored curves* denote the first 10 ensemble members. The *green shaded curve* shows the minimum number of ensemble members needed to detect a 95% significant change relative to the decade centered on 2010

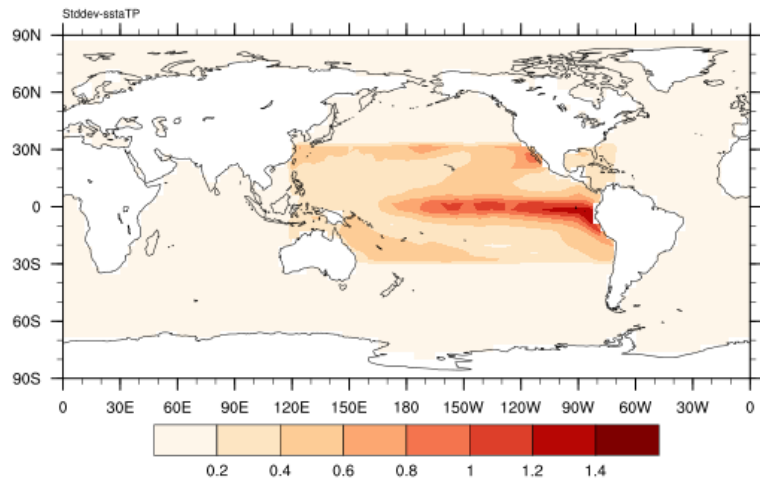
Deser et al. 2012



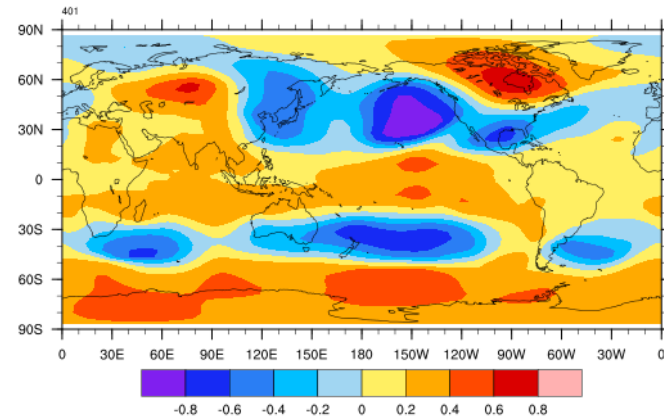
DJF SLP linear trends for individual ensemble members computed over the period 2005-2060

# Role of internal variability in the responses of atmospheric circulation to ENSO

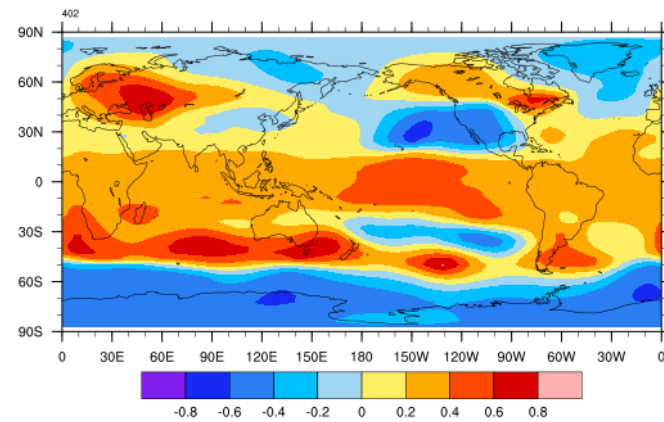
[Only using 3 ensemble members in the TP experiment]



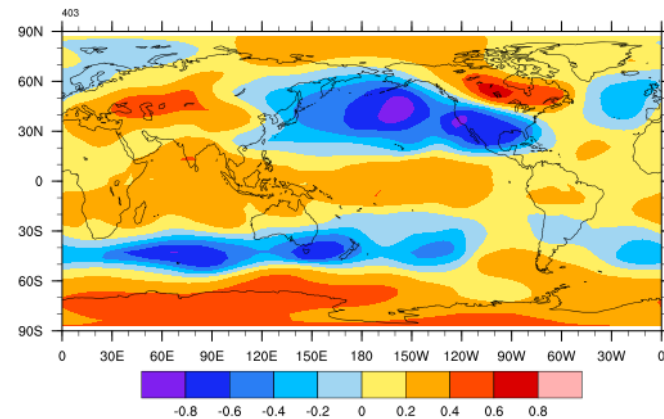
Correlation between the Nino 3.4 index and Z500 in each ensemble member



TP#1



TP#2

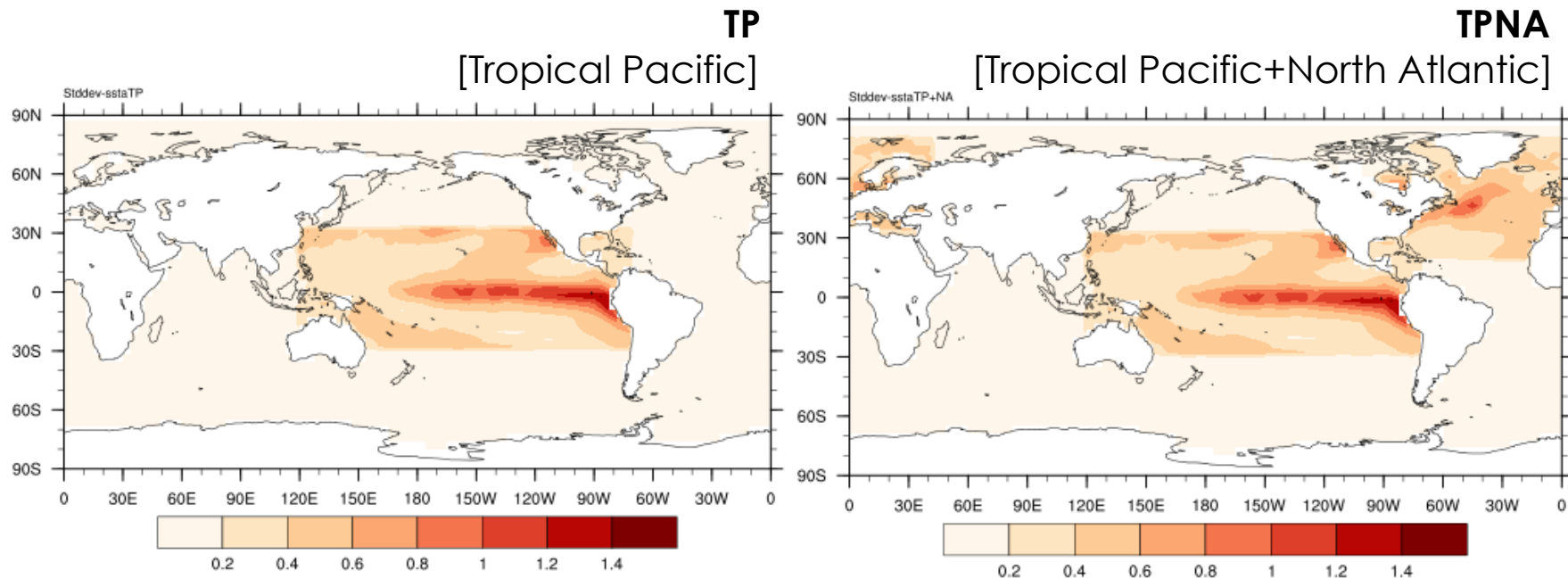


TP#3

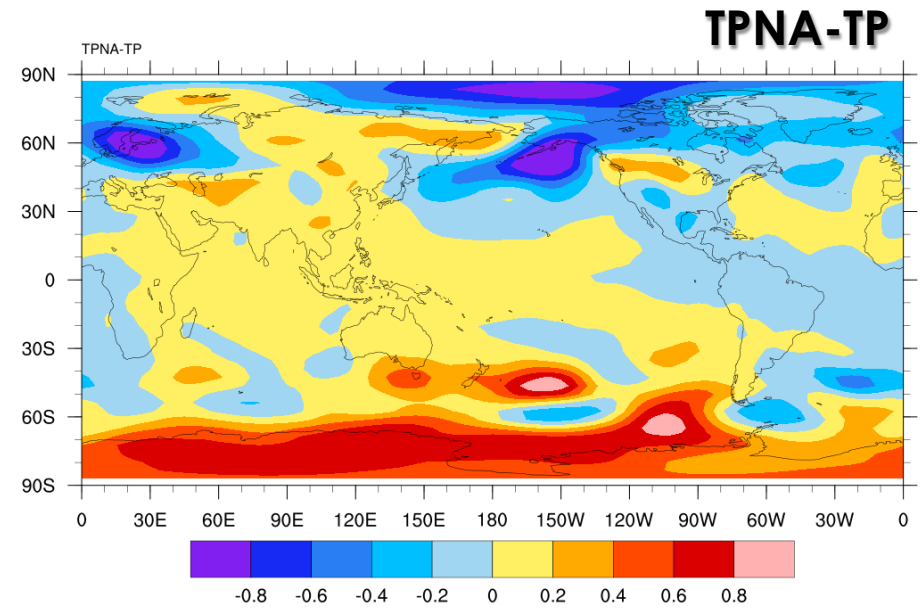
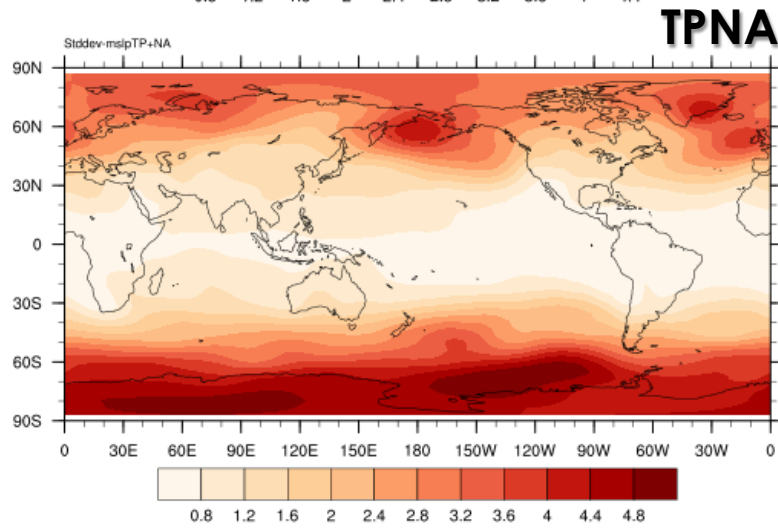
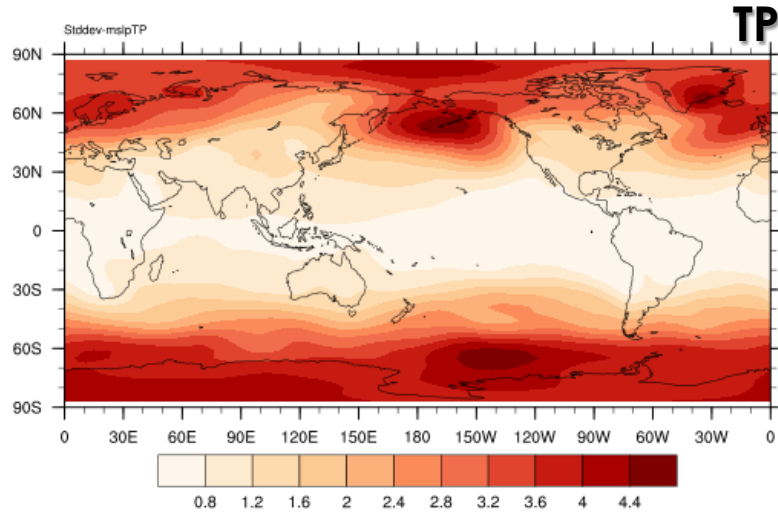


## C. Perturbation role of North Atlantic

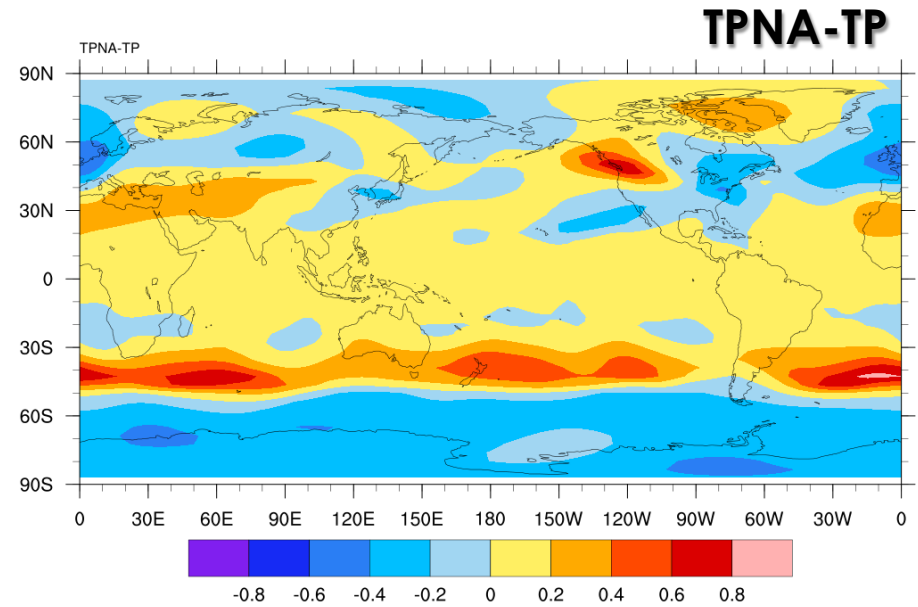
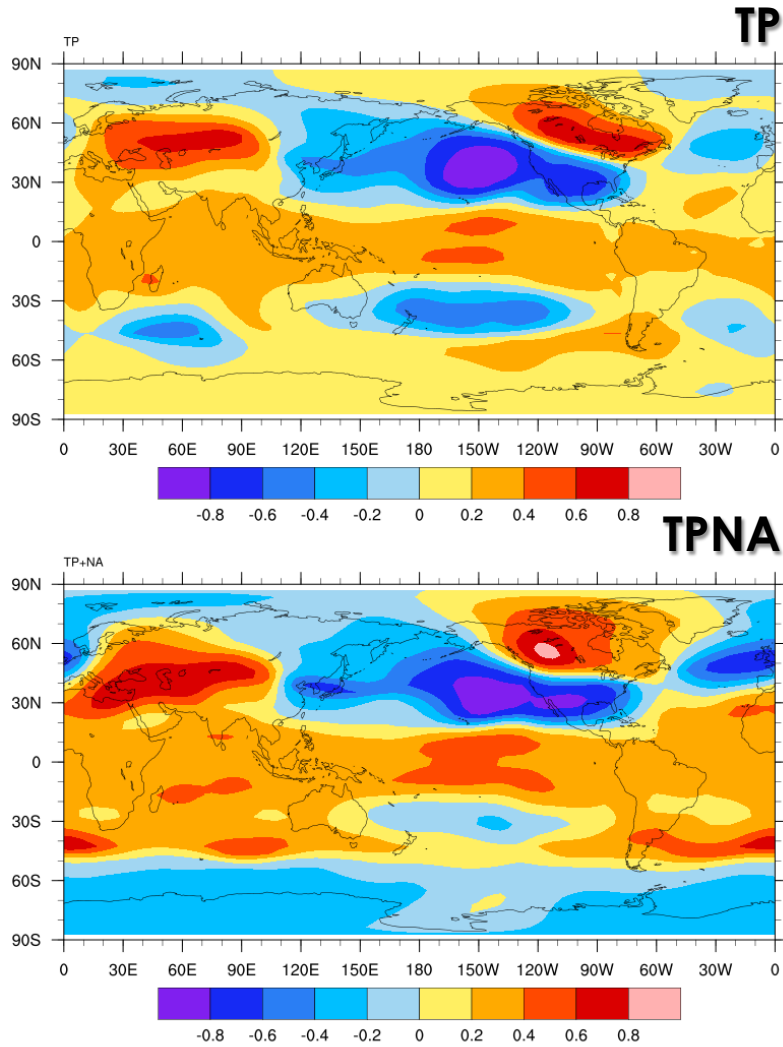
Compare the ENSO teleconnection in the TP and TPNA experiments



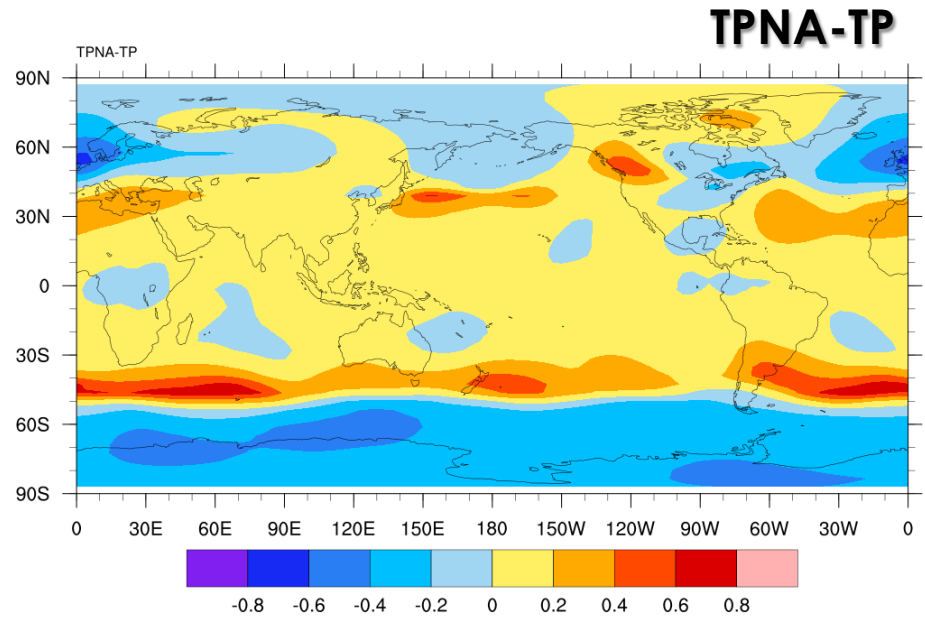
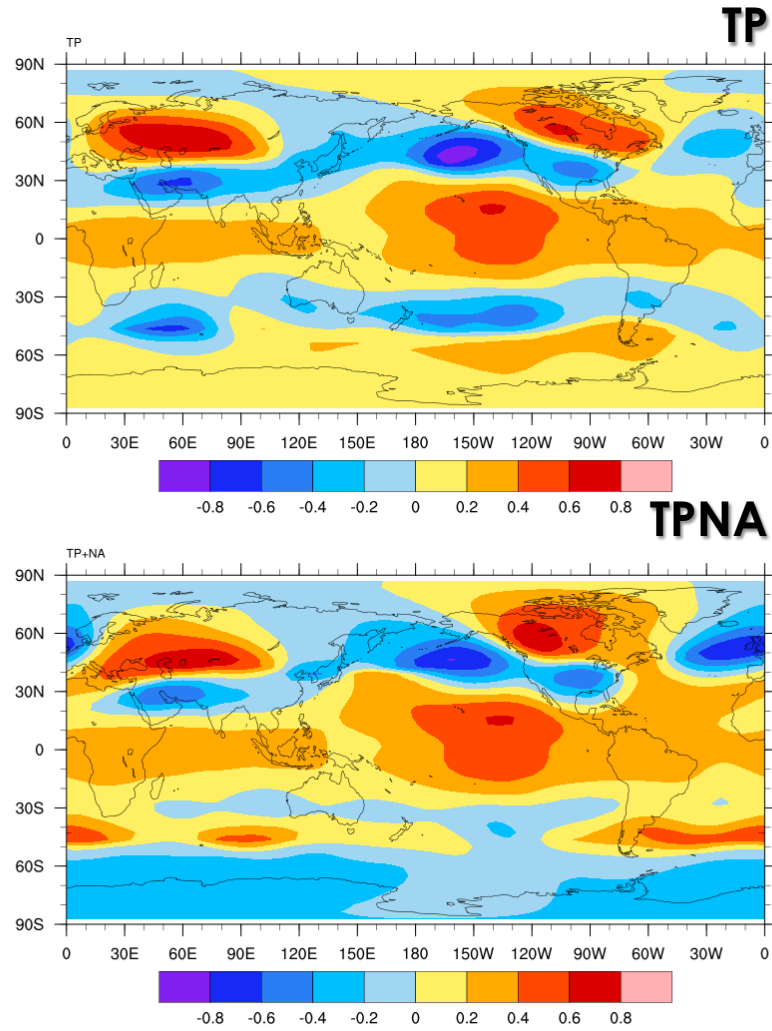
# Standard deviation of surface air temperature anomalies [Ensemble mean]



# Correlation between the DJF ENSO and DJF Z500 [Ensemble mean]



# Correlation between the DJF ENSO and DJF Z200 [Ensemble mean]





# Acknowledgements

We'd like to thank all the researchers who help us learn how to use IRI data library and SPEEDY model, and thanks for help us analyze the results.

**Thank you!**



# Correlation between the DJF ENSO and DJF Z850

