Response of Tropical Precipitation to El Niño SST Anomalies in different Oceans

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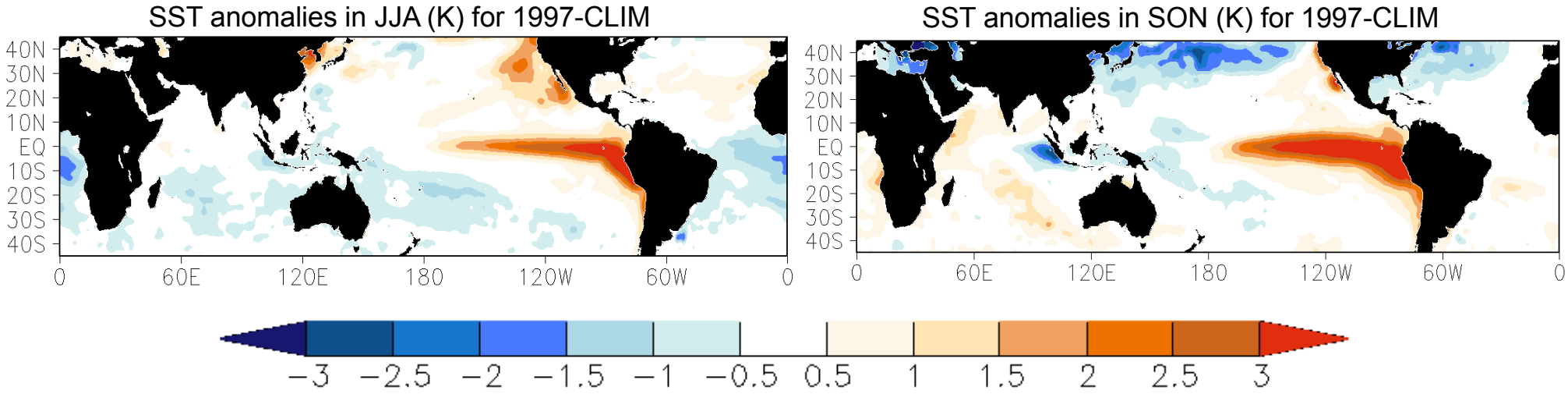
Outline

- El Niño SST anomalies
- Objectives
- The Tropical Band configuration of RegCM4.3
- Experimental design and basin SST anomalies
- Results – impact of El Niño SSTs
- Conclusions and further work

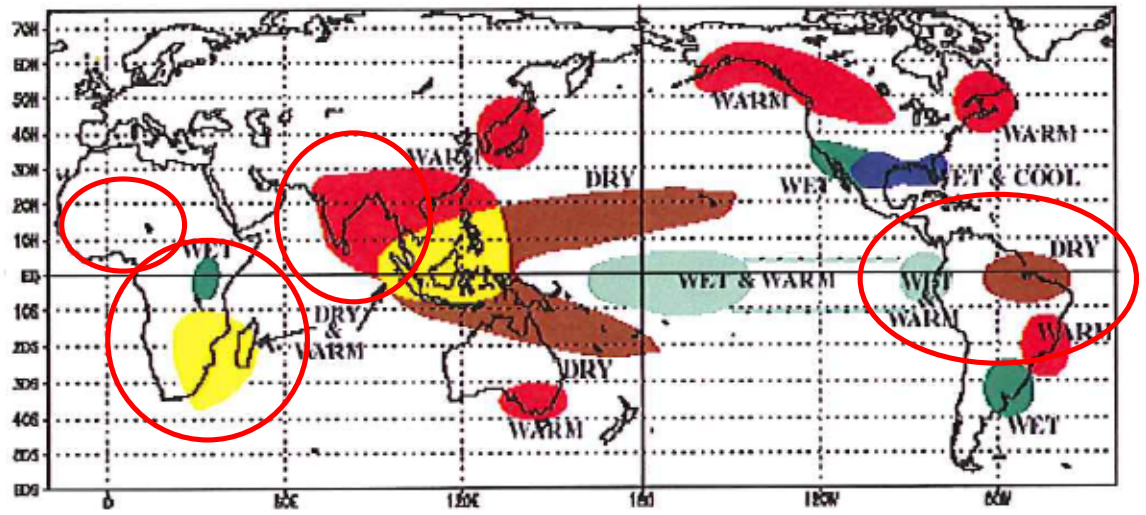
El Niño SST anomalies



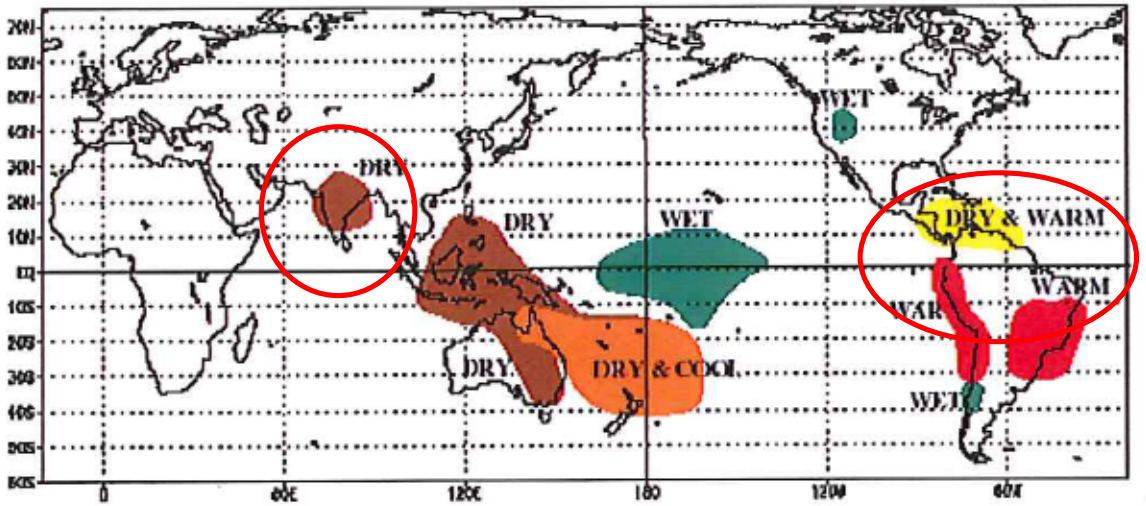
Warm anomaly in eastern Pacific.
Cold anomaly in western Pacific.

El Niño impacts

WARM EPISODE RELATIONSHIPS DECEMBER - FEBRUARY



WARM EPISODE RELATIONSHIPS JUNE - AUGUST



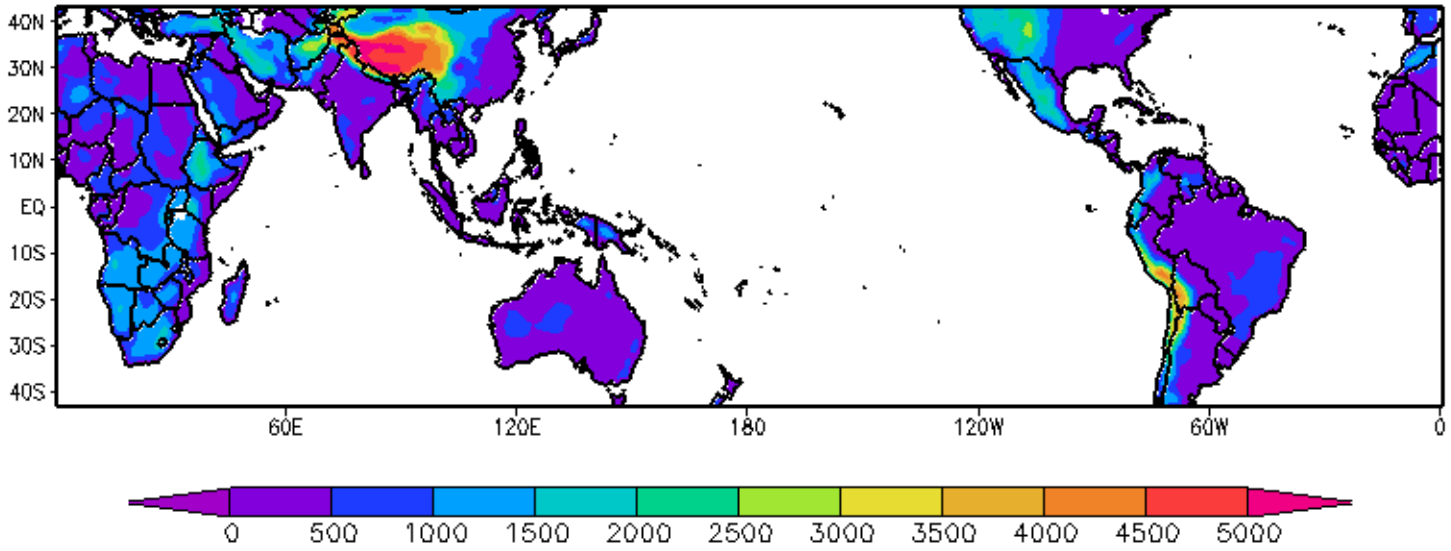
Objectives

- Use of the tropical-band configuration of the RegCM4 to study the sensitivity of tropical precipitation to SST anomalies

- To study the impact of El Niño SST anomalies in specific ocean basins on tropical precipitation simulation

Tropical Band Configuration

Elevation (m)



Resolution: jx = 512, iy = 139 (dx ~ 80 km) Reanalysis: ERA-Interim1.5

- Cumulus convection scheme: Grell scheme
- Convective closure assumption: Fritsch & Chappell (1980)
- Boundary layer scheme: Holtslag PBL (Holtslag, 1990)
- Large scale precipitation scheme: Explicit moisture (SUBEX; Pal et al 2000)
- Ocean flux scheme: Zeng et al (1998)
- Land-surface scheme: BATS

Experiment Design

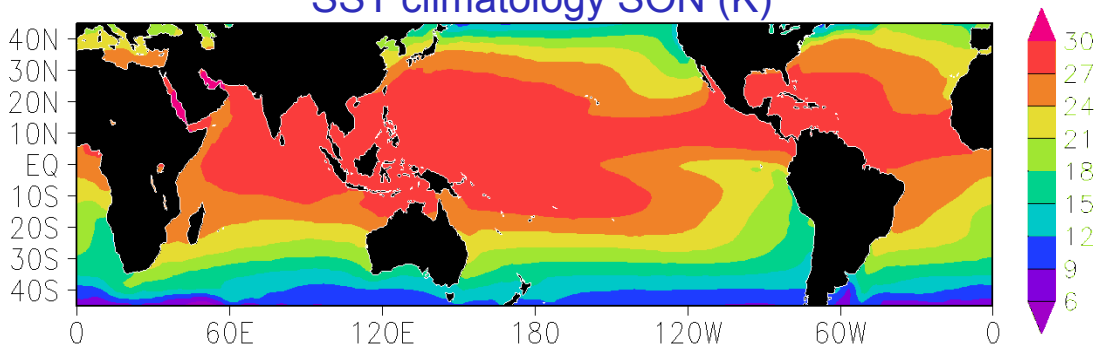
Experiment set – Impact of SSTs

	Pacific Ocean	Atlantic Ocean	Indian Ocean	Atmosphere
3yr_Pac	1997-1999	climatology	climatology	1997-1999
3yr_Atl	climatology	1997-1999	climatology	1997-1999
3yr_Ind	climatology	climatology	1997-1999	1997-1999
3yr_Control	1997-1999	1997-1999	1997-1999	1997-1999

SST Climatology taken from 1990-2010

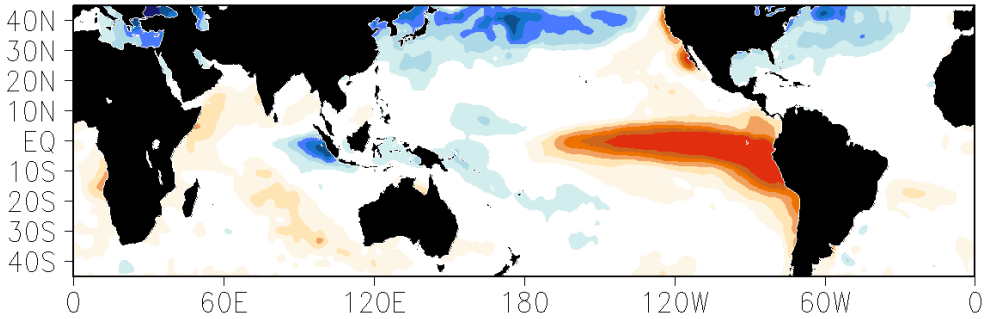
Experiment Design

SST climatology SON (K)

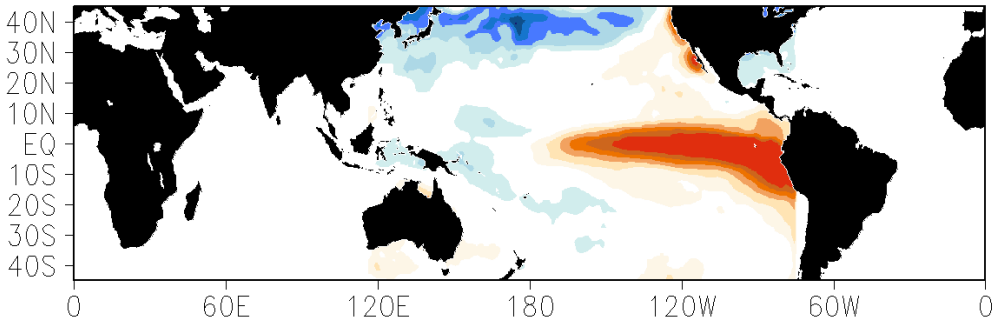


SST anomalies for 1997-CLIM, SON

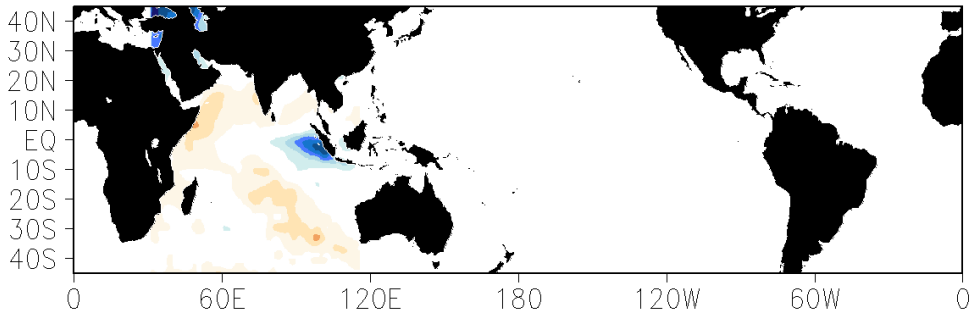
Global SST anomalies (K)



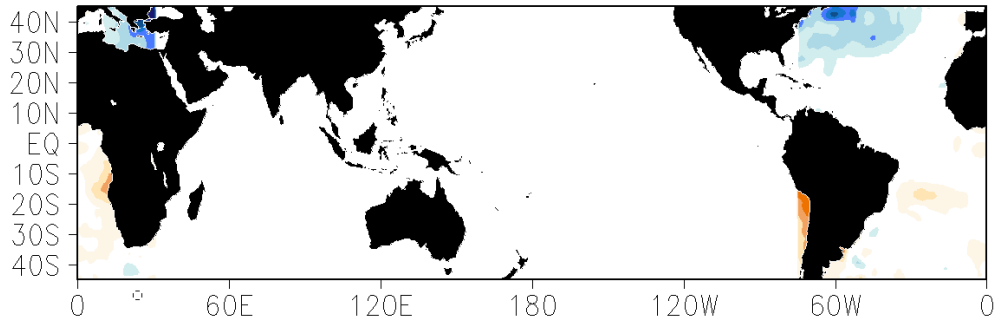
Pacific Ocean Only SST anomalies (K)

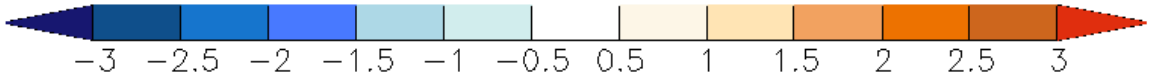


Indian Ocean Only SST anomalies (K)



Atlantic Ocean Only SST anomalies (K)

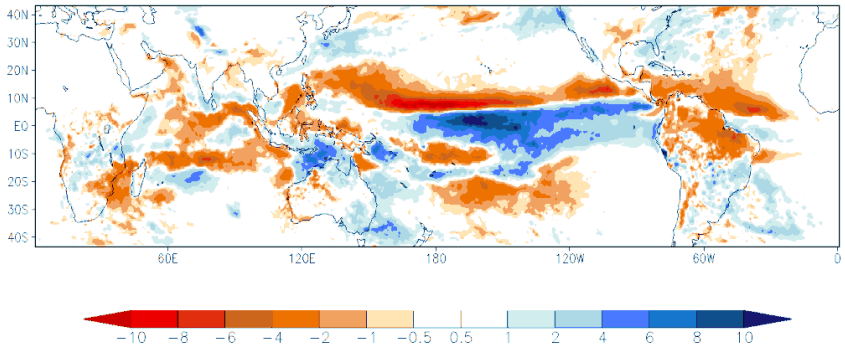




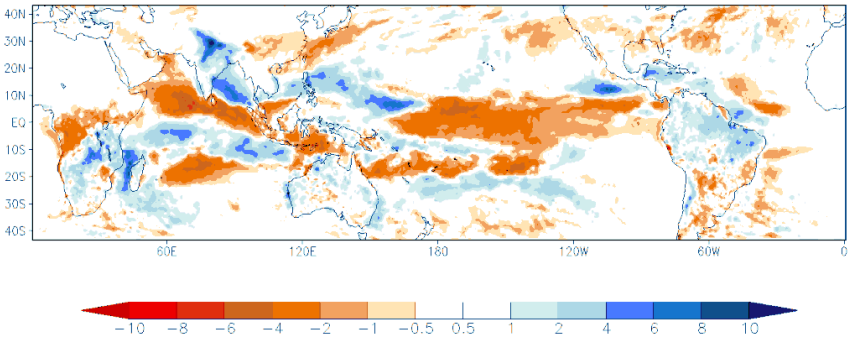
Results
Validation

RegCM4.3

Model precipitation anomalies DJF97-98

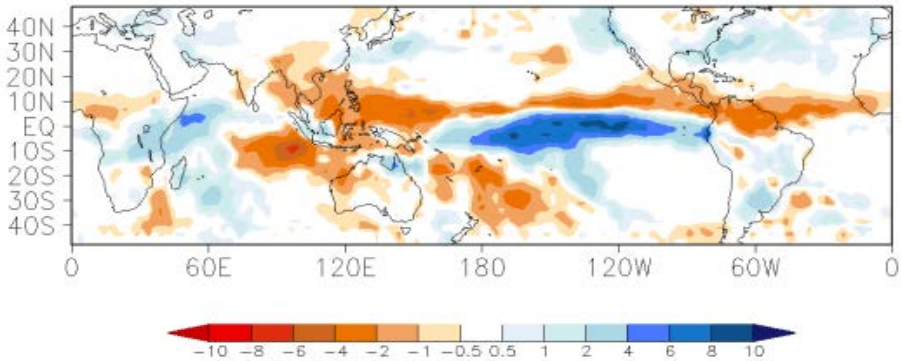


Model precipitation anomalies DJF98-99

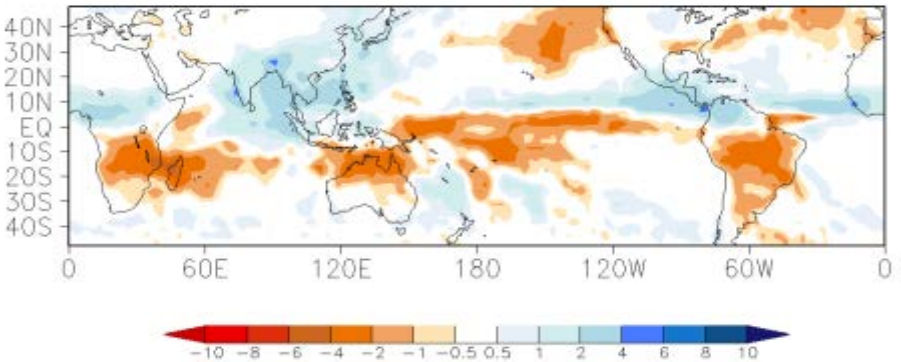


Observations (GPCP)

GPCP precipitation anomalies DJF97-98

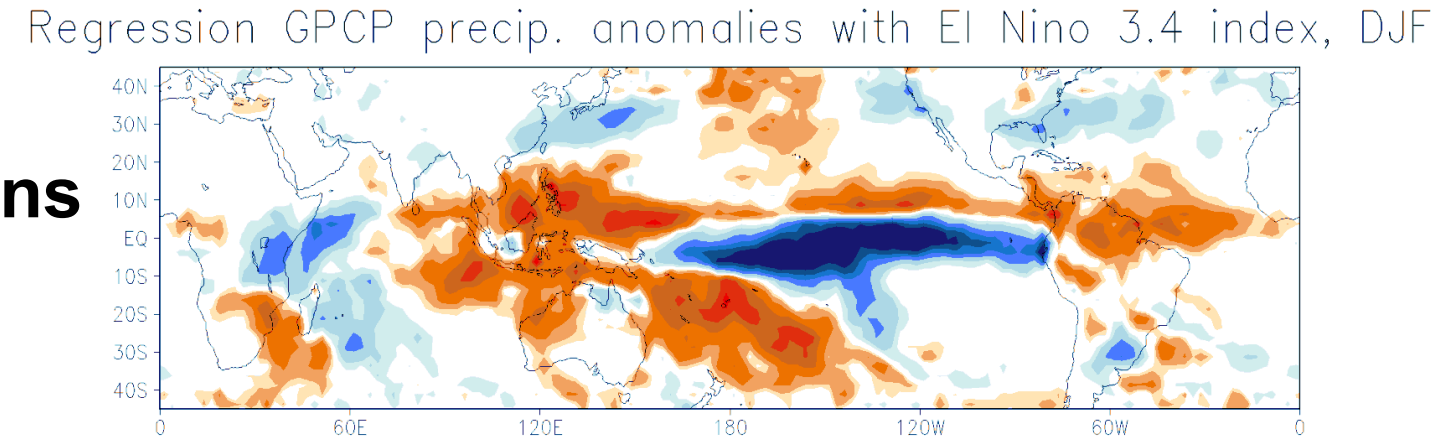


GPCP precipitation anomalies DJF98-99

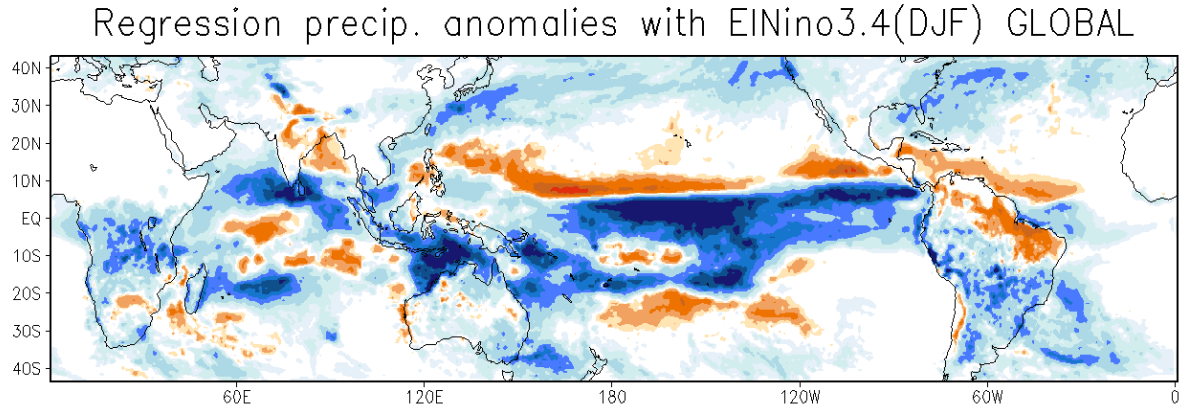


Results
Regression analysis, DJF

Observations (GPCP)

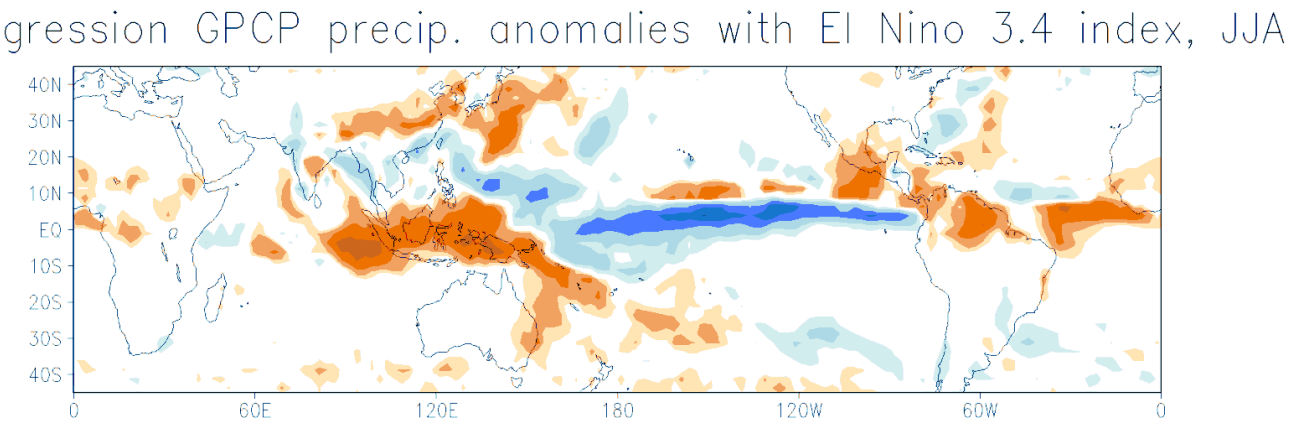


RegCM4.3

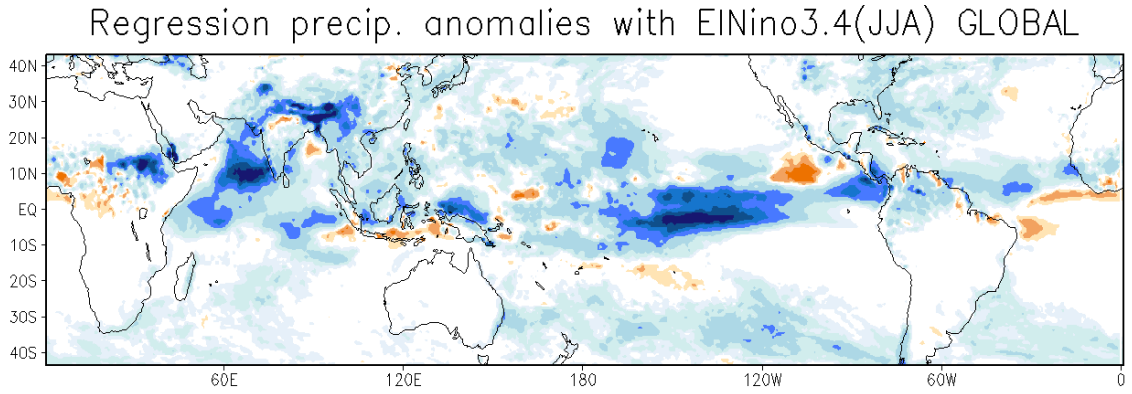


Results
Regression analysis, JJA

Observations (GPCP)

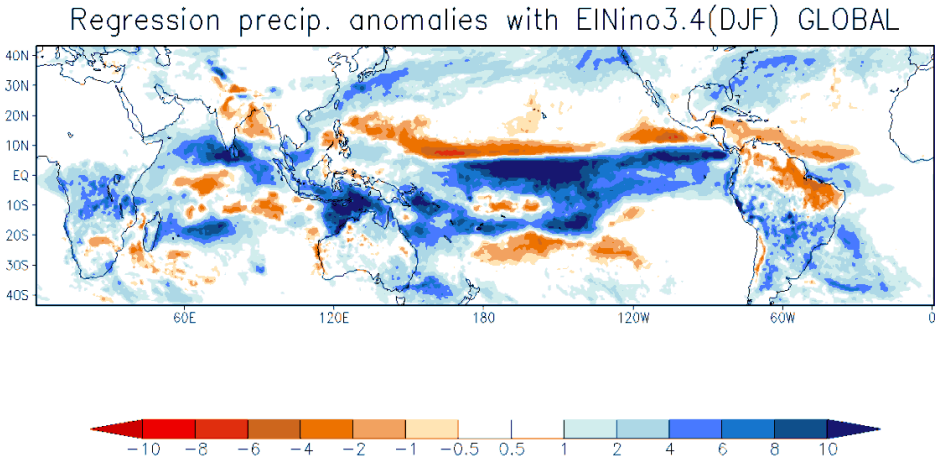


RegCM4.3



Results
Regression analysis, DJF

GLOBAL



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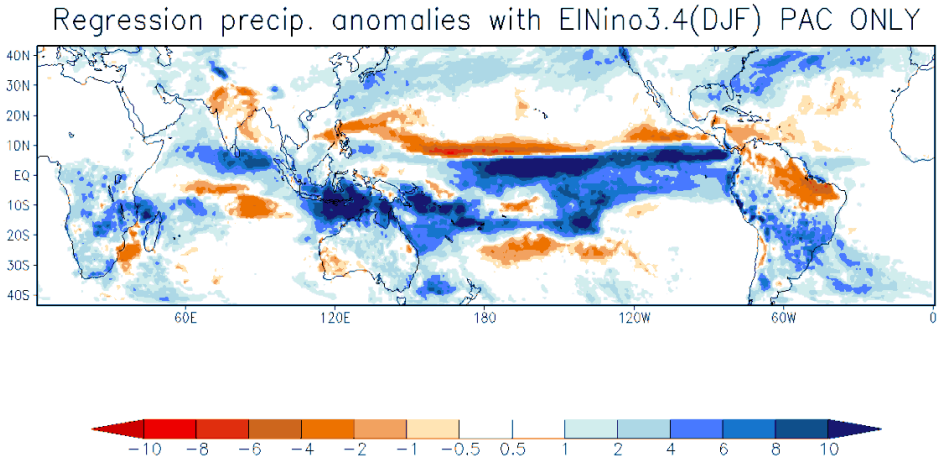

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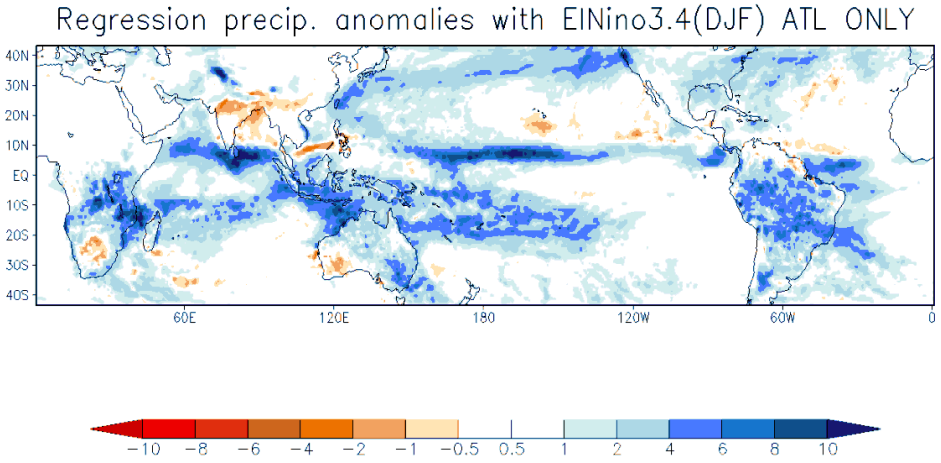

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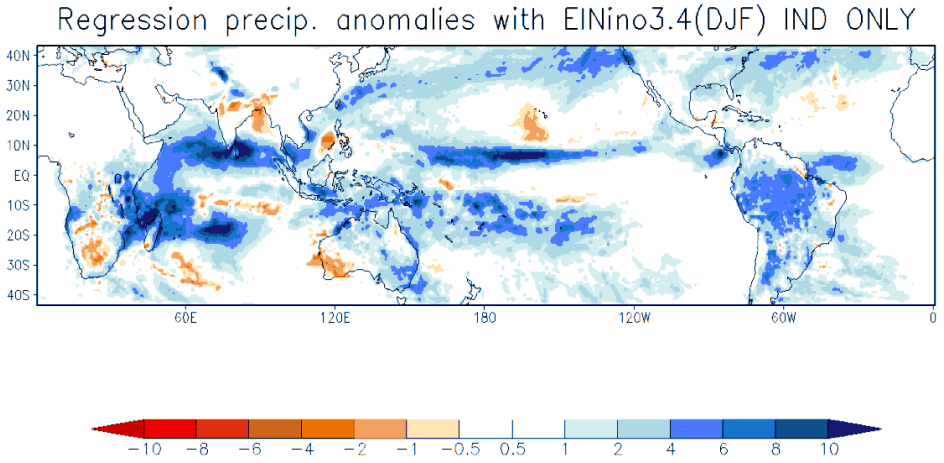
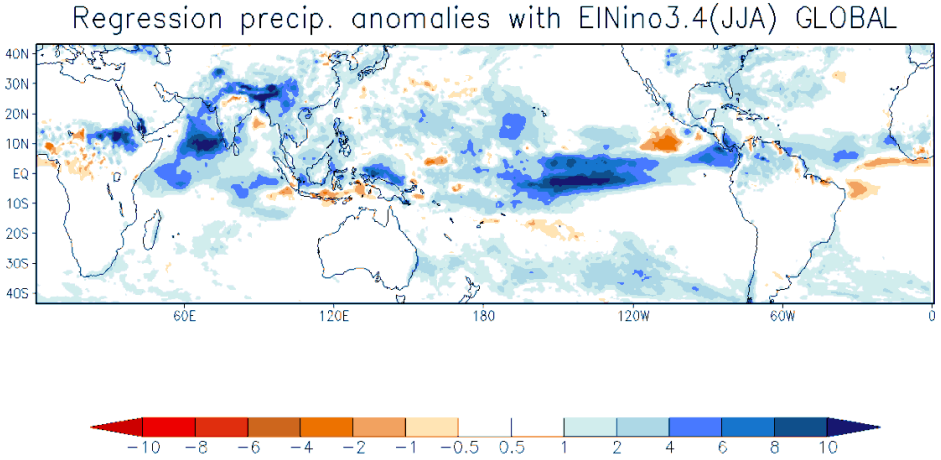


Results
Regression analysis, JJA

GLOBAL



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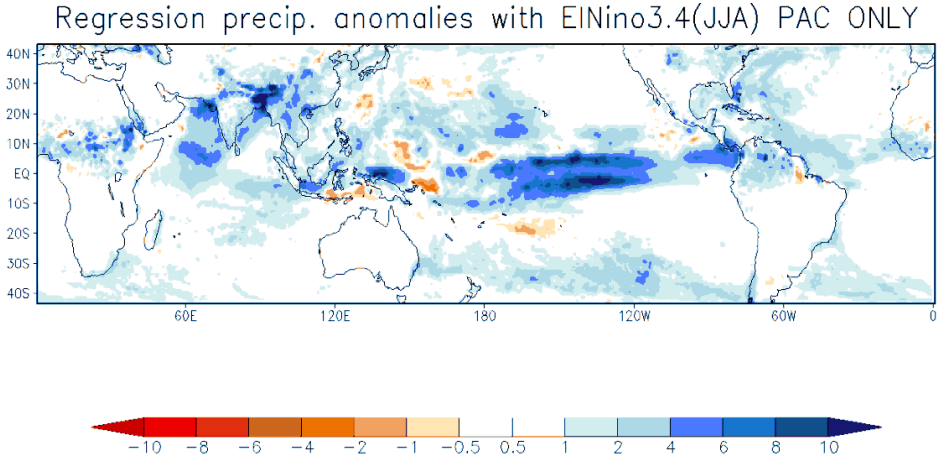

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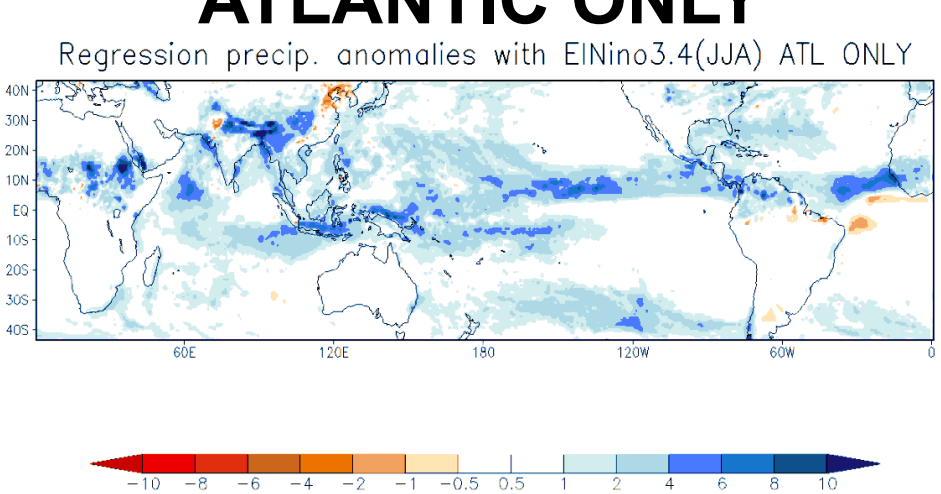

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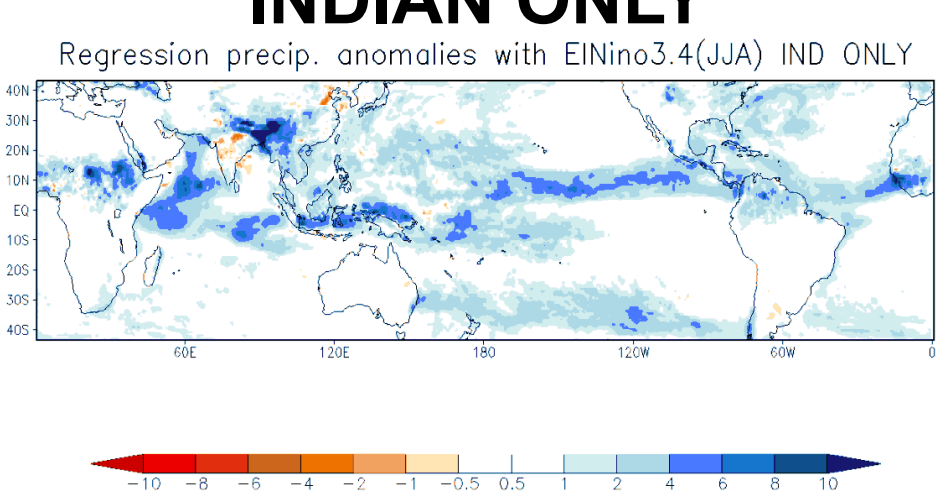


Conclusions

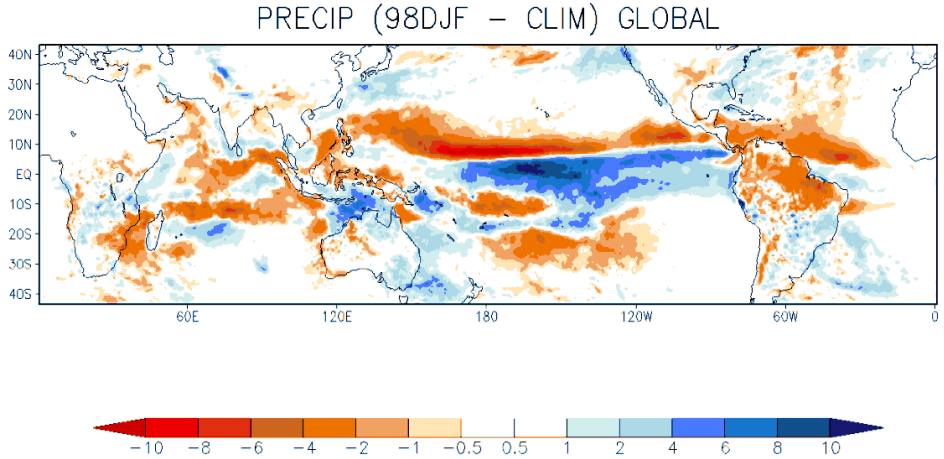
• Regression analysis of observed precipitation and El Niño Index 3.4 for three years reproduces the main features of a longer term analysis.
• The RegCM4.3 is unable to do this for this short period.

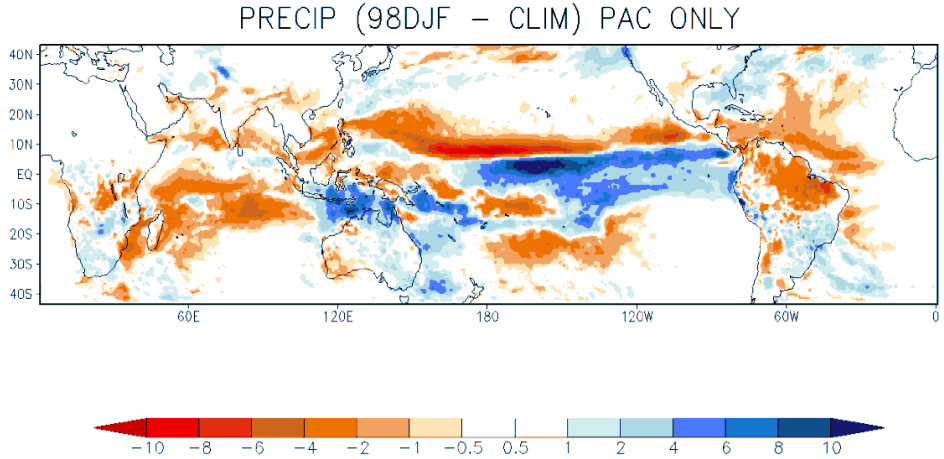
• Regression analysis for individual basins show the global El Niño precipitation response is dominated by the Pacific Ocean Sea Surface anomalies.
• Both the Indian and the Atlantic Oceans do play a role in the precipitation response.
• All the individual oceans produce a similar pattern of rainfall response: this could be an artifact of the small number of years or an interesting mechanism related to ENSO.

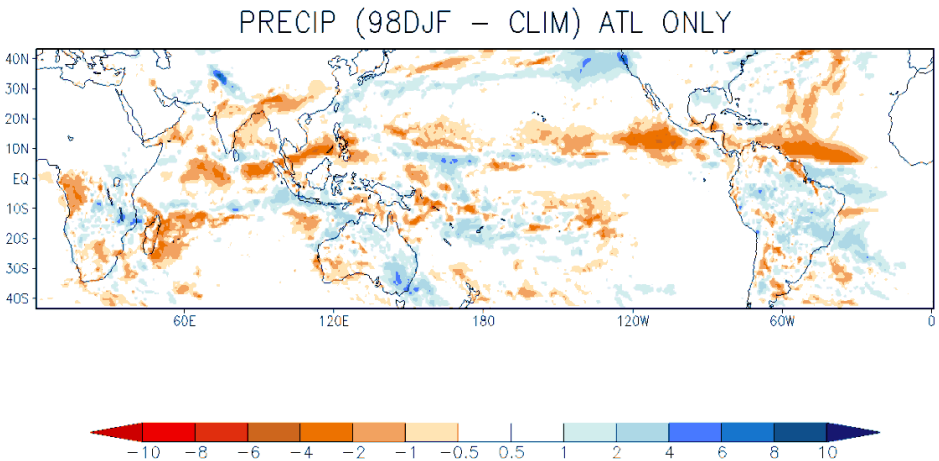
Future work

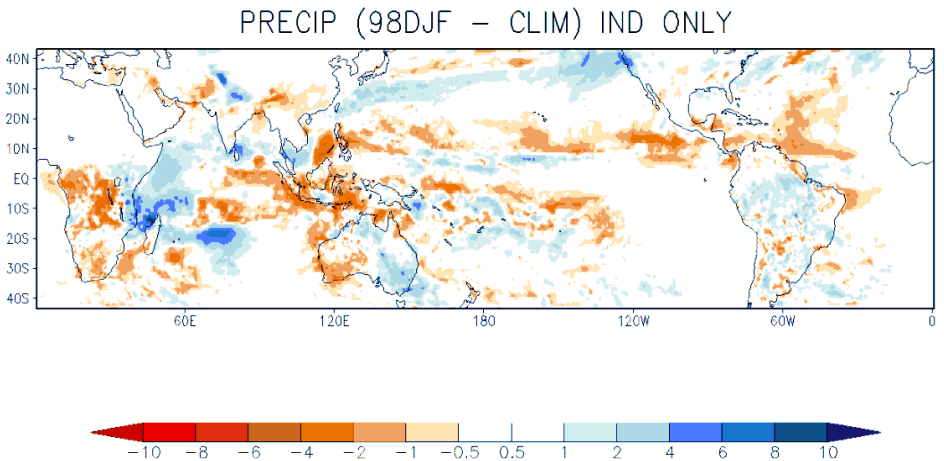
• To simulate more years for a better regression analysis.
• To study the response of a climatological atmosphere to ENSO SST.

Results
DJF 1998:El Niño



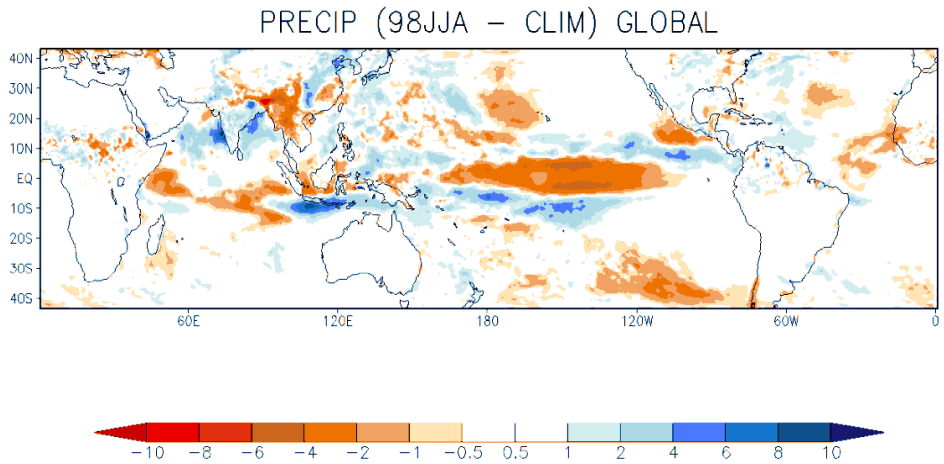


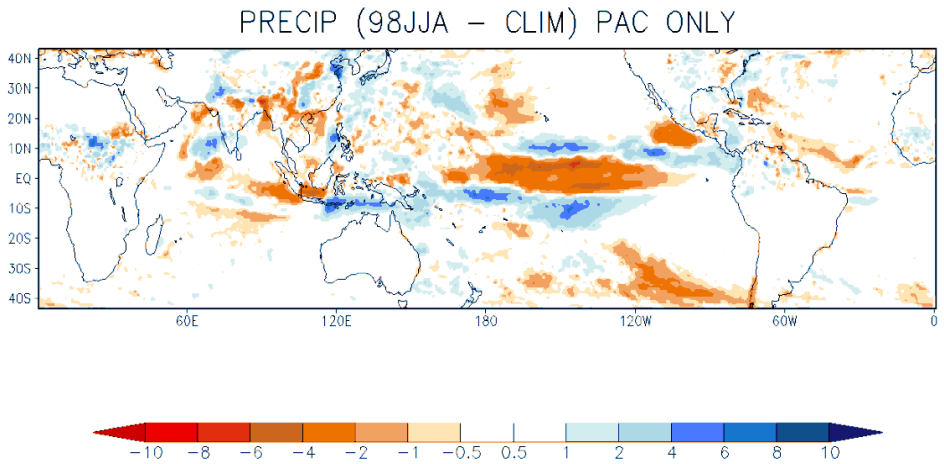


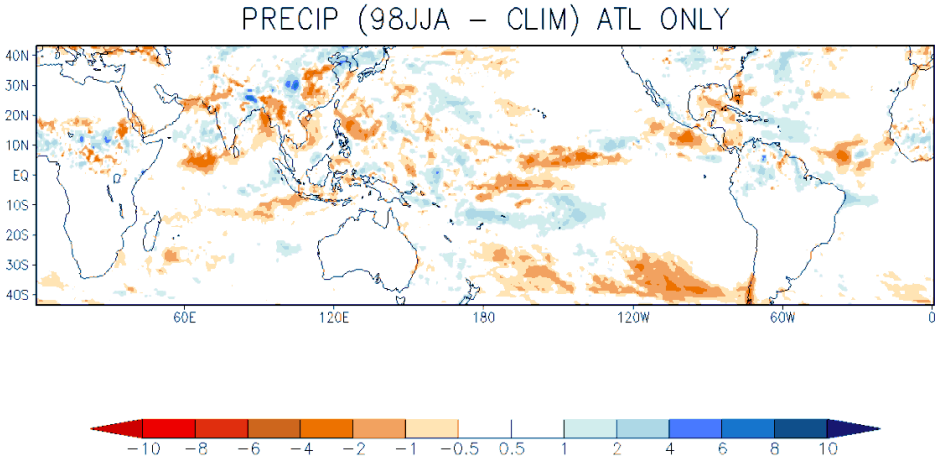


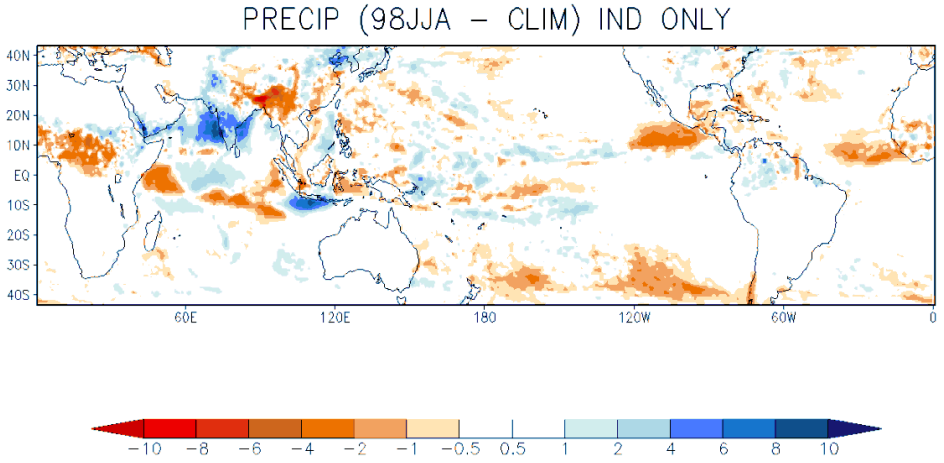
Results

JJA 1998: El Niño → La Niña



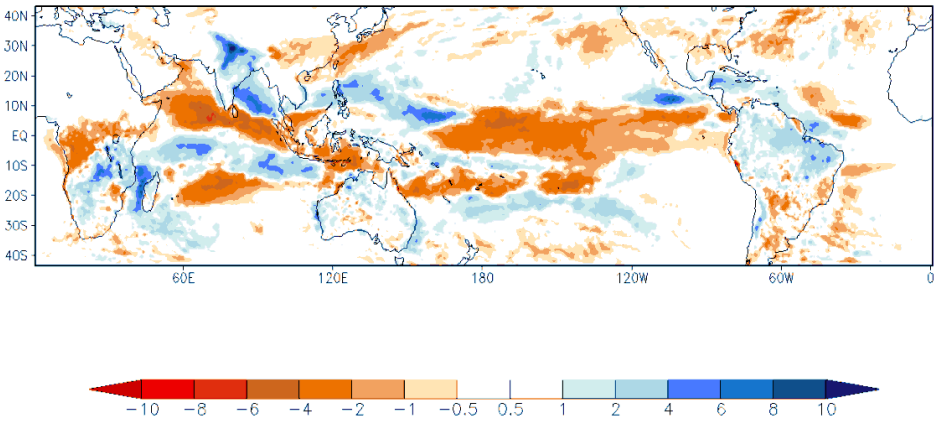






Results
DJF 1999:La Niña

PRECIP (99DJF – CLIM) GLOBAL



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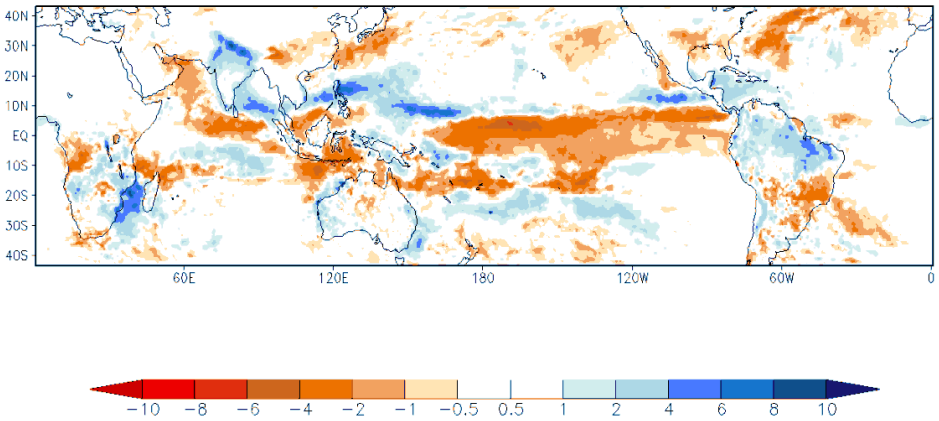

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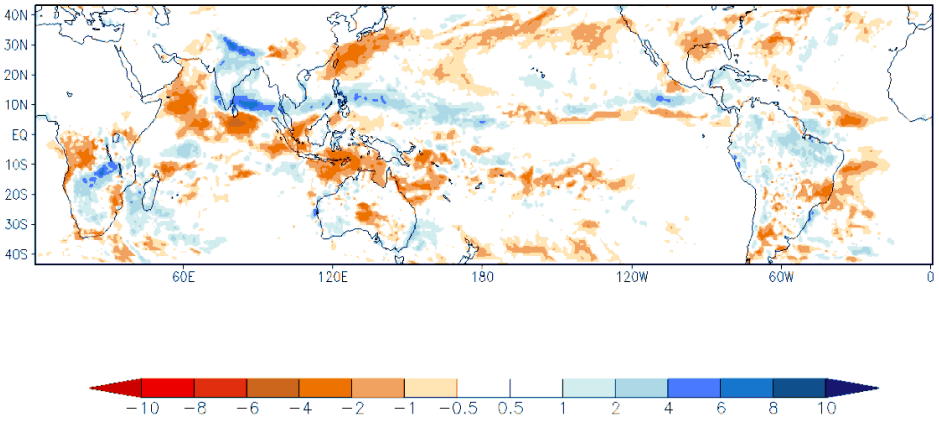

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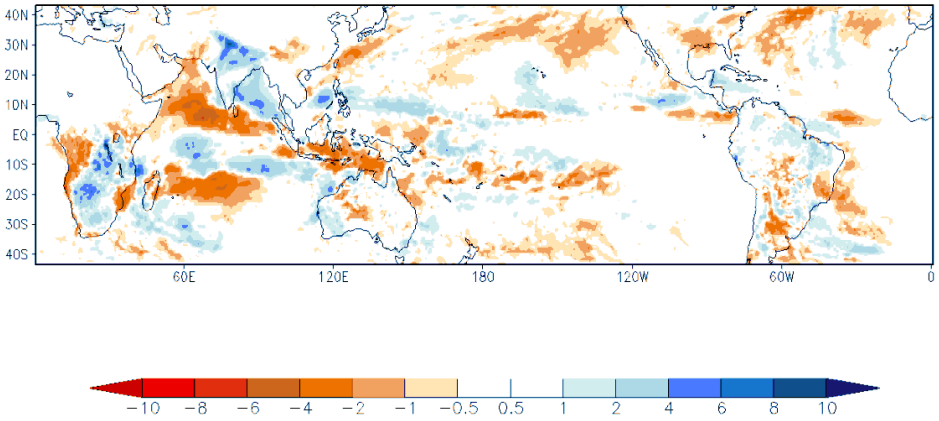
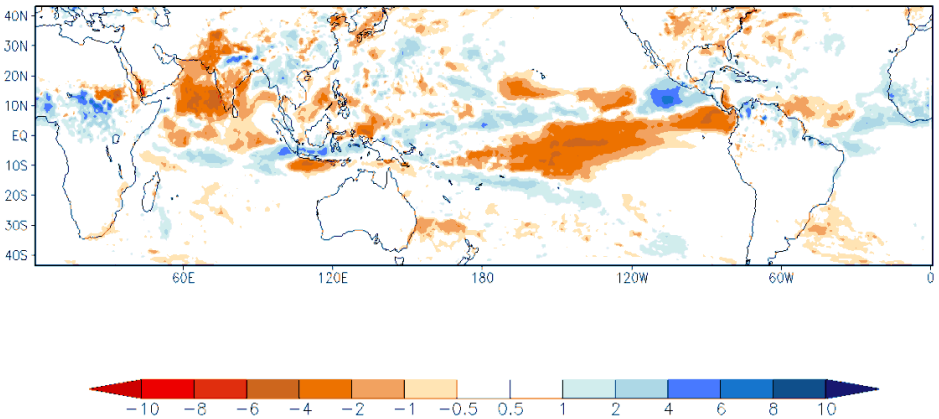


Results
JJA 1999:La Niña

PRECIP (99JJA – CLIM) GLOBAL



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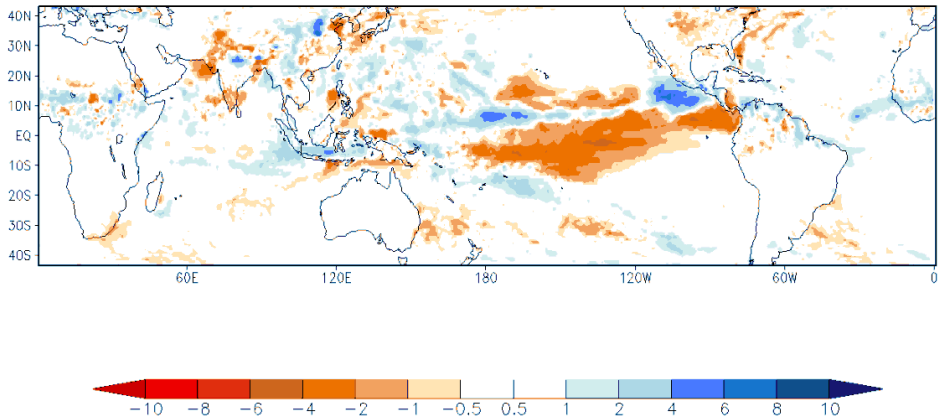

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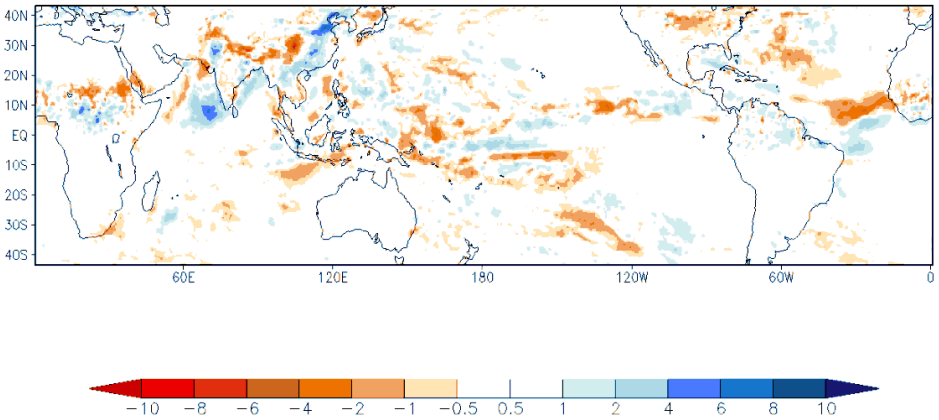

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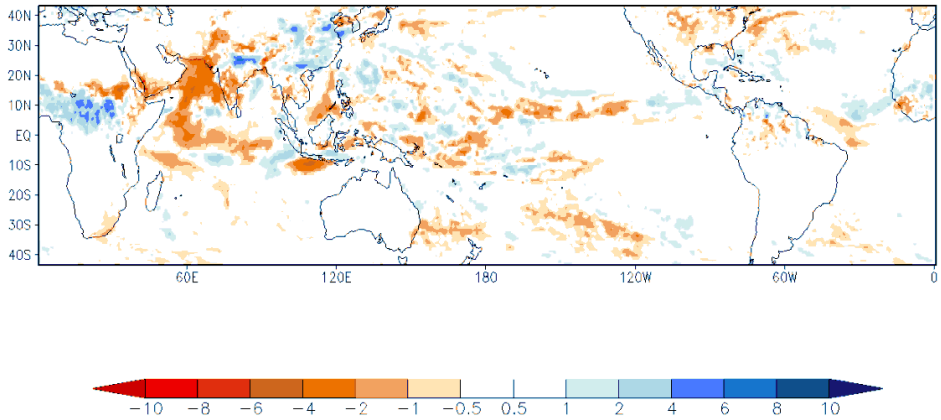

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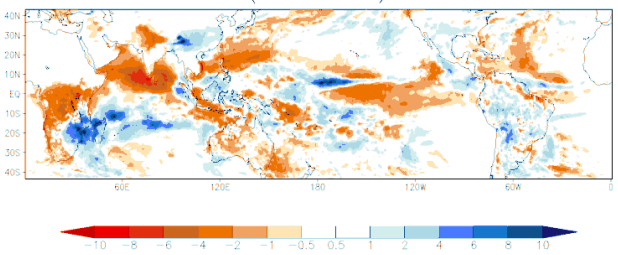

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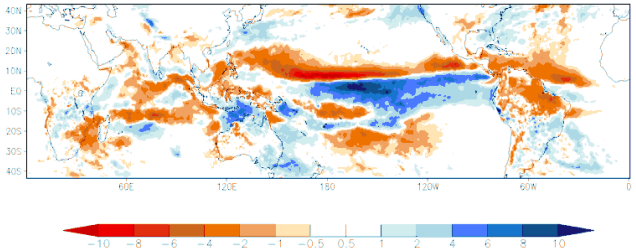

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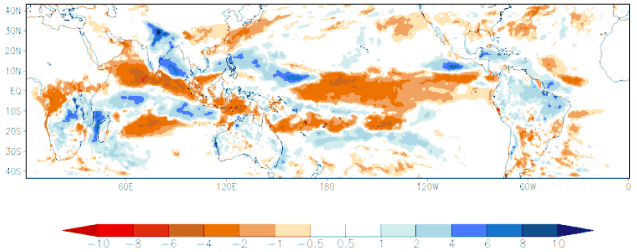

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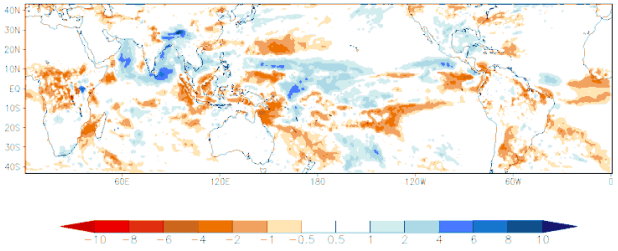

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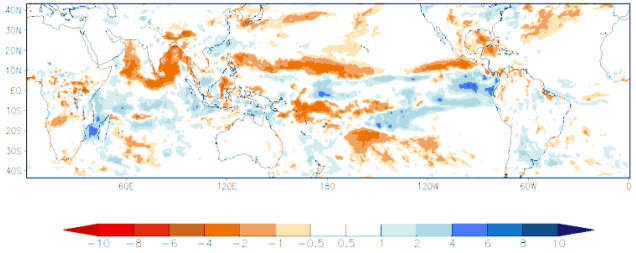

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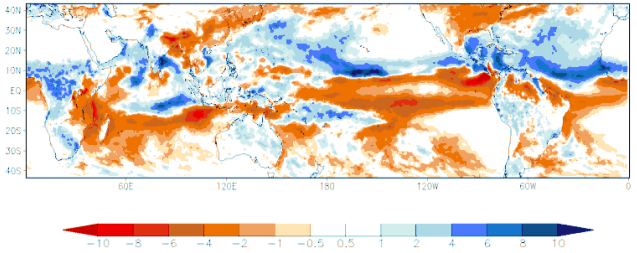

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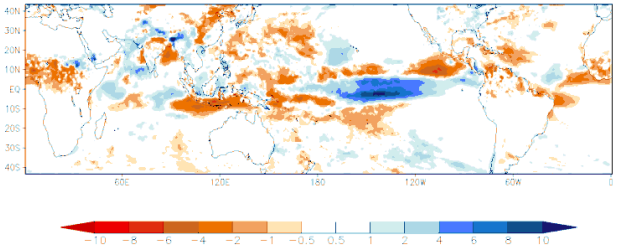

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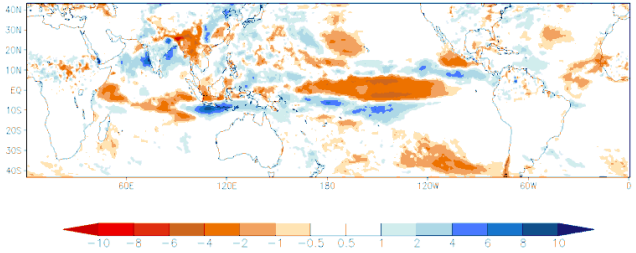

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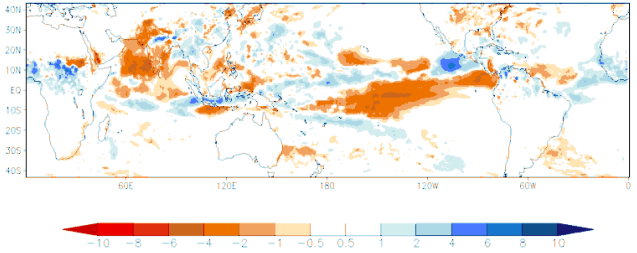

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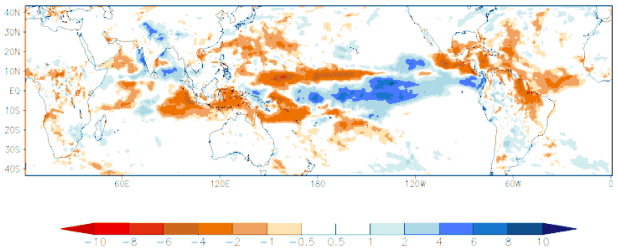

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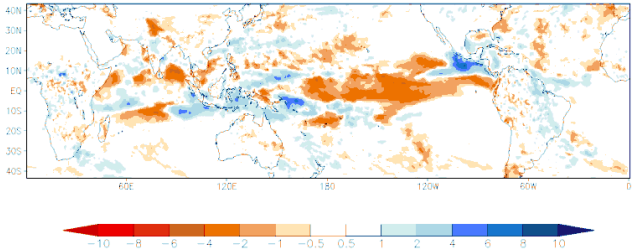

PRECIP (99SON – CLIM) GLOBAL