Nonlinear response of transients to tropical pacific SSTs and their role to seasonal potential predictability

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Workshop on Hierarchical Modeling of Climate

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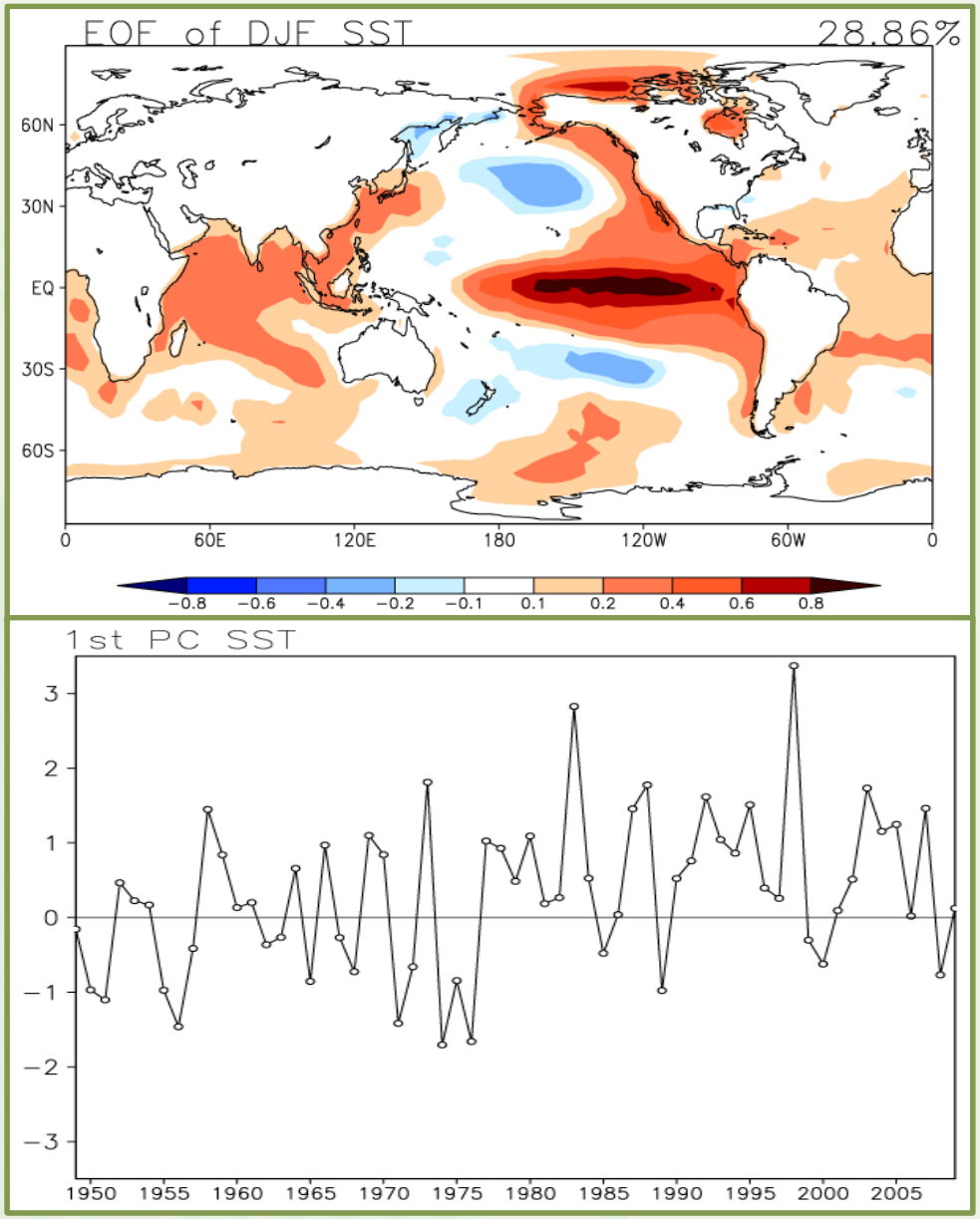
Objective

- Kang et. al. (2010), studied the impact of transients on extra-tropical seasonal-mean predictability.
- The role of tropical pacific SSTs to the transient activity.
- The effect of transient activity to the seasonal potential predictability in extra tropics.
- Intra El-Niño and Intra La-Niña variability, its association to transient activity.

Experimental setup

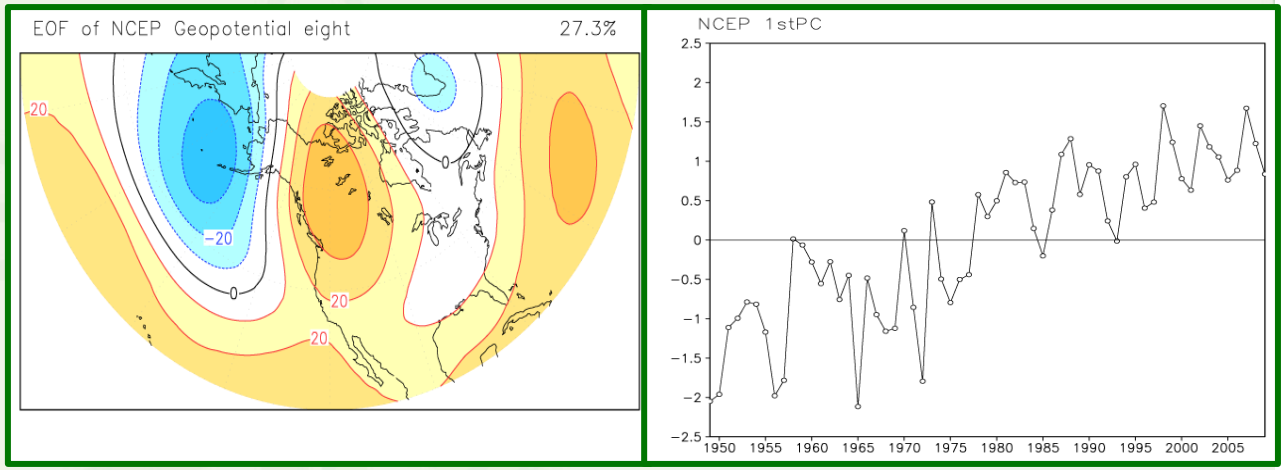
- The ICTP AGCM (SPEEDY) with T30 resolution.
- Model is forced with observed HadISST dataset for the period 1870 -2009.
- Number of Ensemble members are 50.
- NCEP dataset has been used as an observed .
- 2-10 days time filter is applied over $\Phi_{200\ hPa}$ for the high frequency component “transients”.
- Analysis focused over Winter (DJF) season.

- 1st EOF mode of the SSTs for the period 1871-2009
- The increase in the amplitude of the SSTs variability is high in the late 20th Century.

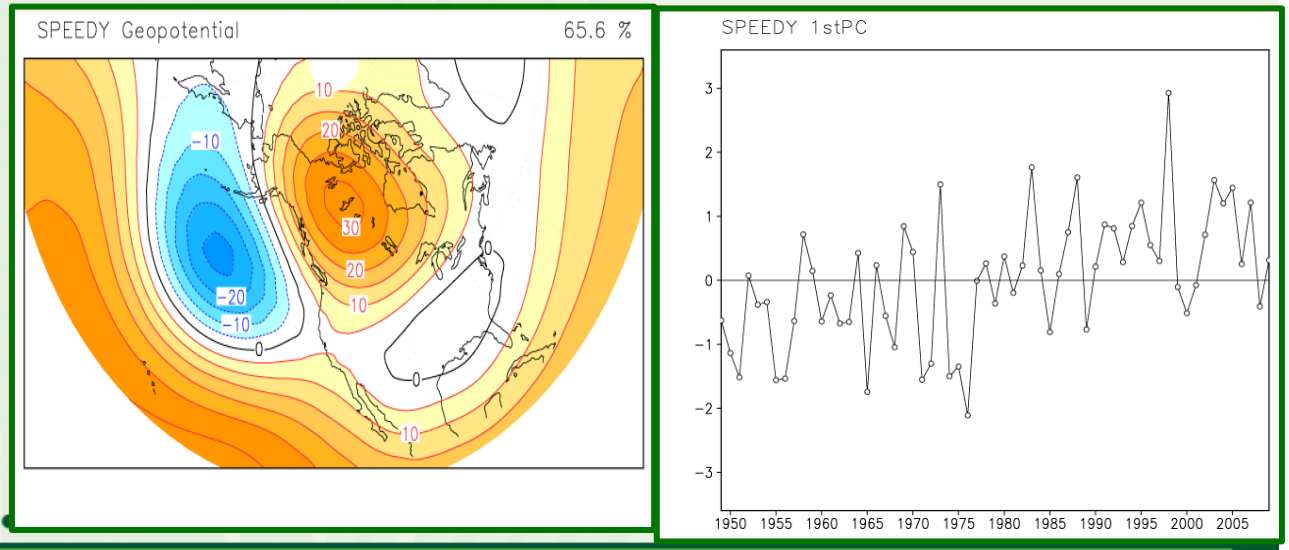


Observed

- There is a trend in the of variability of PNA pattern.



SPEEDY



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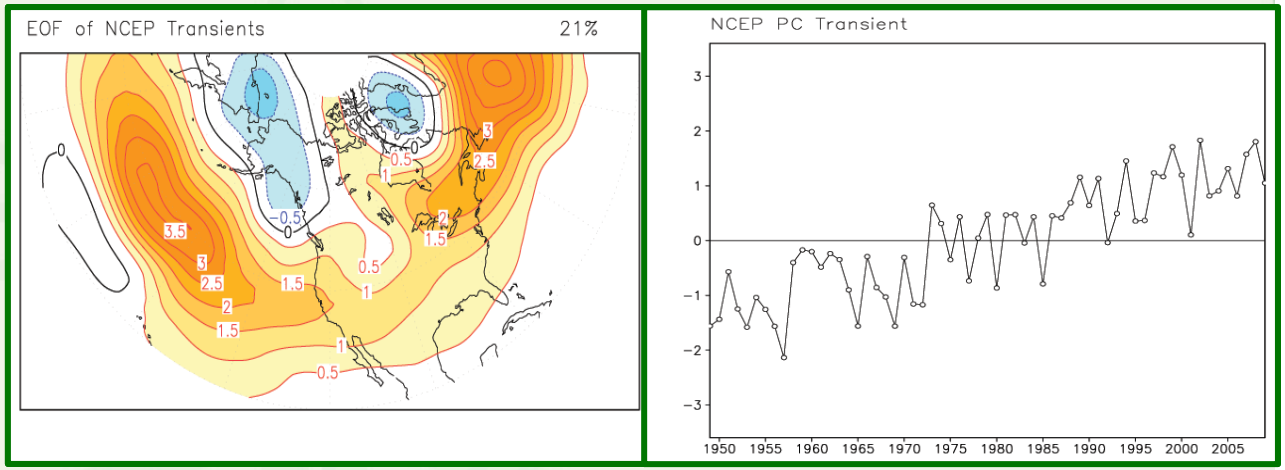
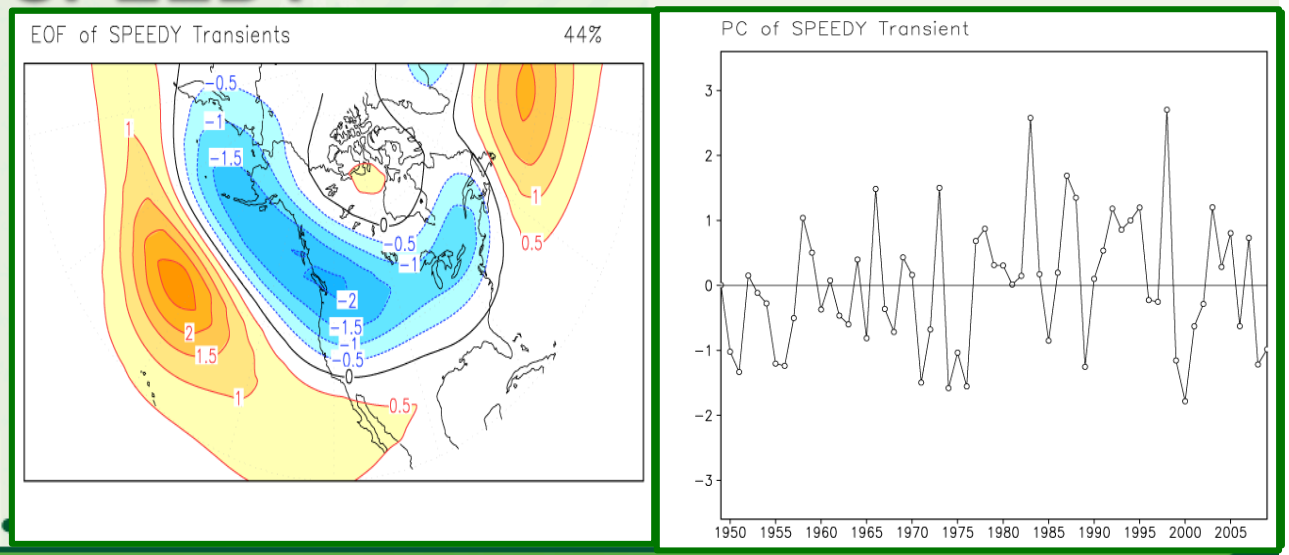


SPEEDY

- In Transient Activity the observed shows the trend, however model shows more of variability



Historical El-Niño and La-Niña events

32 El-Niño events since 1900

21 La –Niña events since 1900

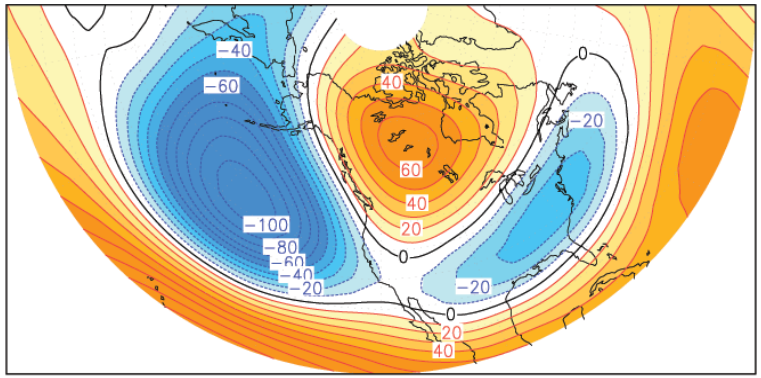
EL- Niño Years	La -niña Years
1901, 1903, 1906, 1912, 1915, 1919, 1924, 1926, 1931, 1933, 1940, 1941, 1942, 1947, 1952, 1954, 1958, 1964, 1966, 1970, 1973, 1977, 1978, 1983, 1987, 1992, 1993, 1995, 1998, 2003, 2005, 2007	1904, 1907, 1909, 1917, 1921, 1925, 1929, 1932, 1939, 1943, 1950, 1955, 1965, 1971, 1974, 1976, 1989, 1996, 1999, 2001, 2008

Source: www.stormfax.com/elnino.htm

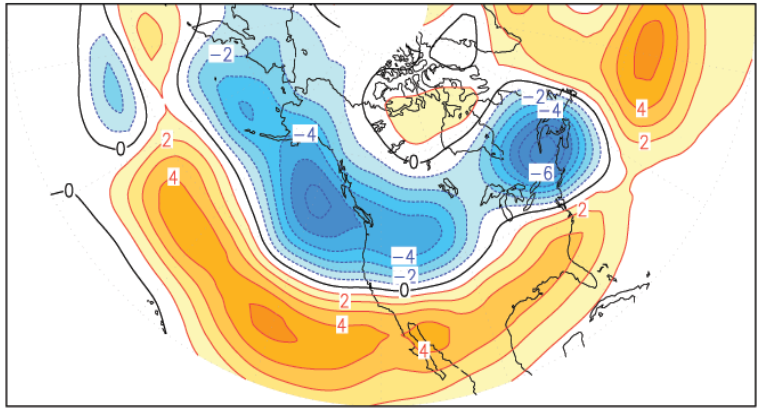
$$ENSOanomalies = \{El - N\tilde{n}o\}_{comp} - \{La - N\tilde{n}a\}_{comp}$$

OBSERVED

NCEP ENSO anamolies

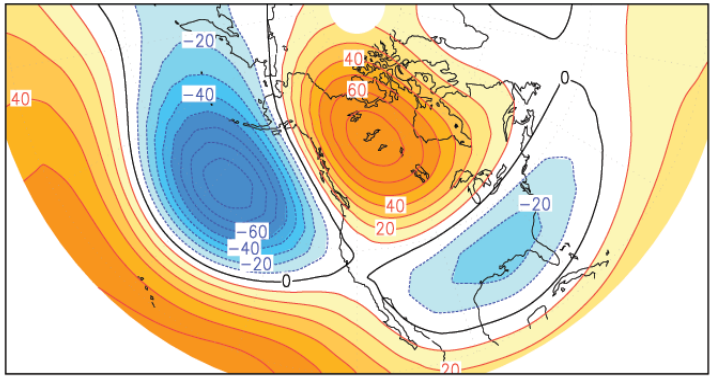


NCEP ENSO Transient anomalies

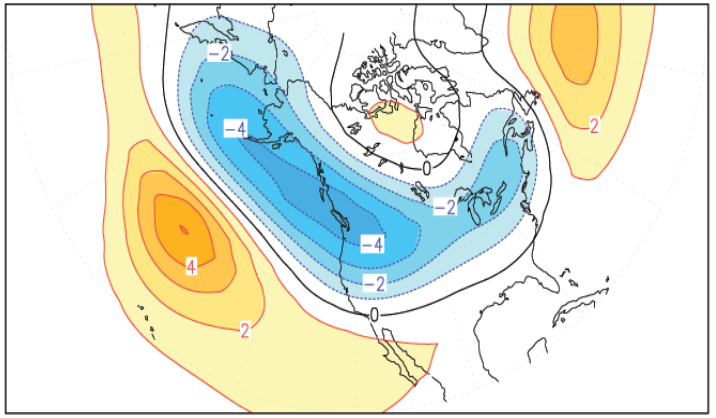


SPEEDY

ENSO Geopotenial height anamolies

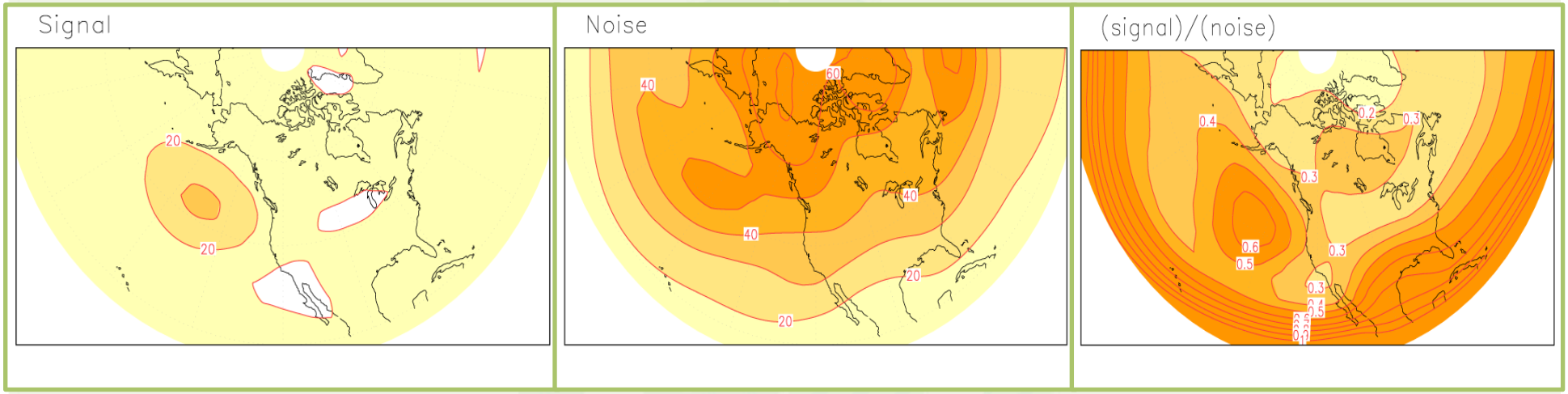


SPEEDY ENSO Transient anomalies



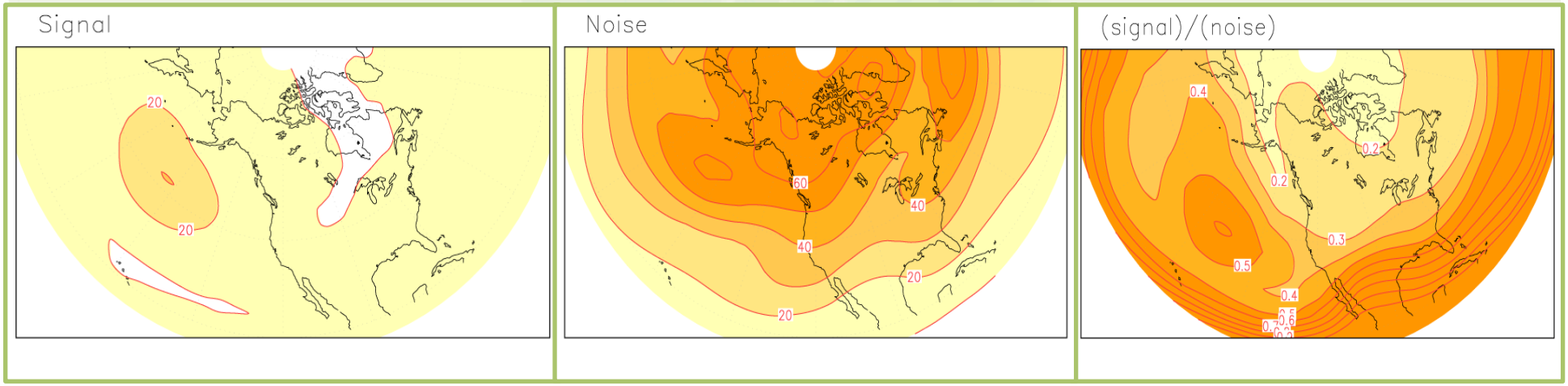
Signal to Noise Φ_{200hPa} (El-niño vs La-niña)

El Niño



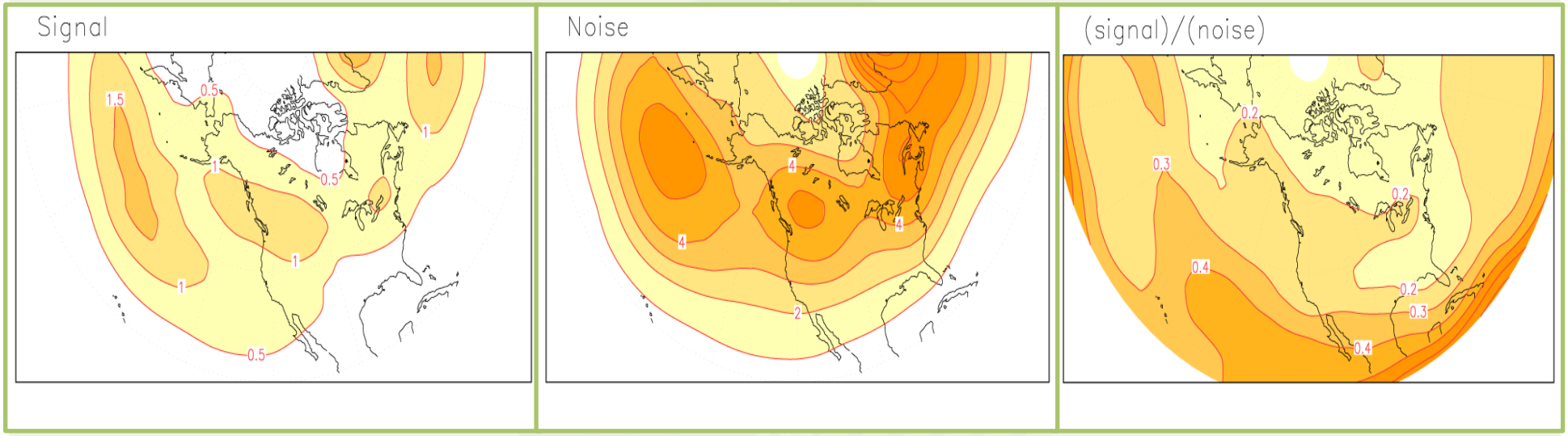
- Signal is the amplitude of the ensemble mean
- Noise is compatively larger in La-niña as compare to El-niño

La Niña



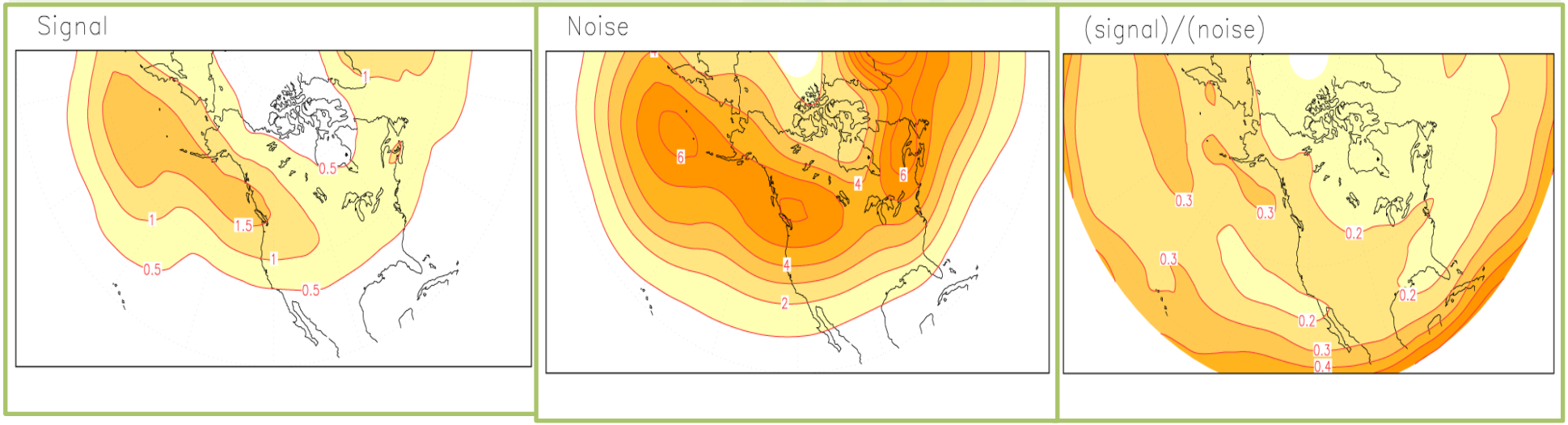
Signal to Noise of Transient Activity (El-niño vs La-niña)

El Niño



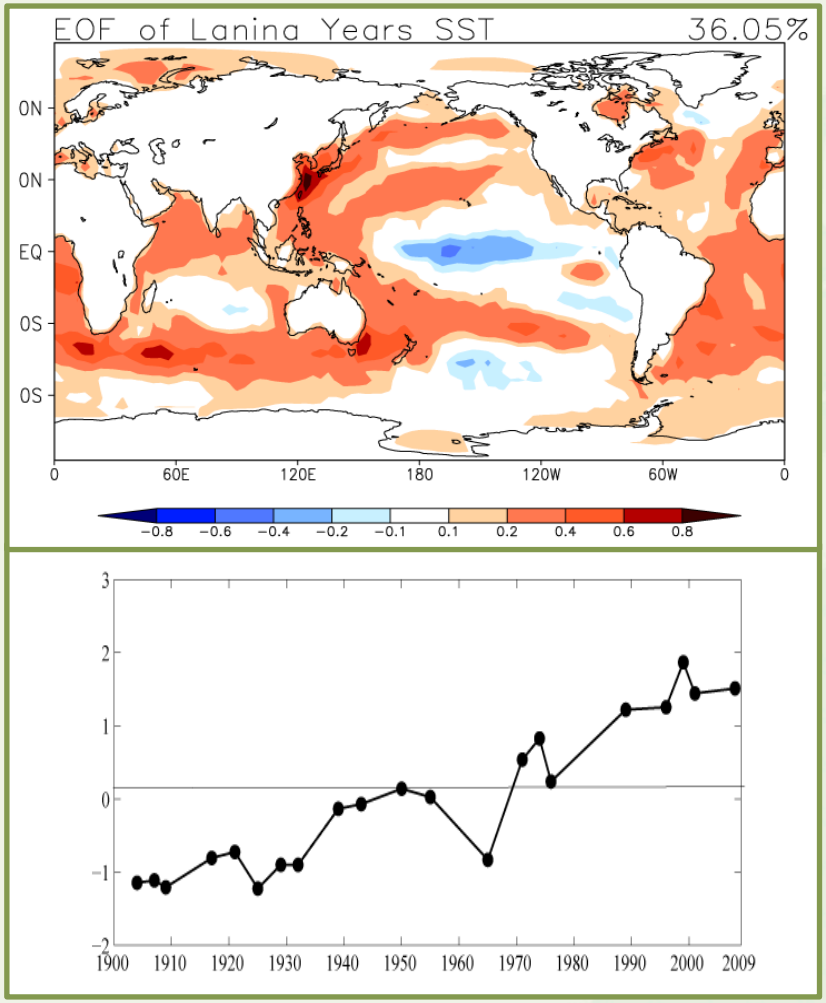
La Niña

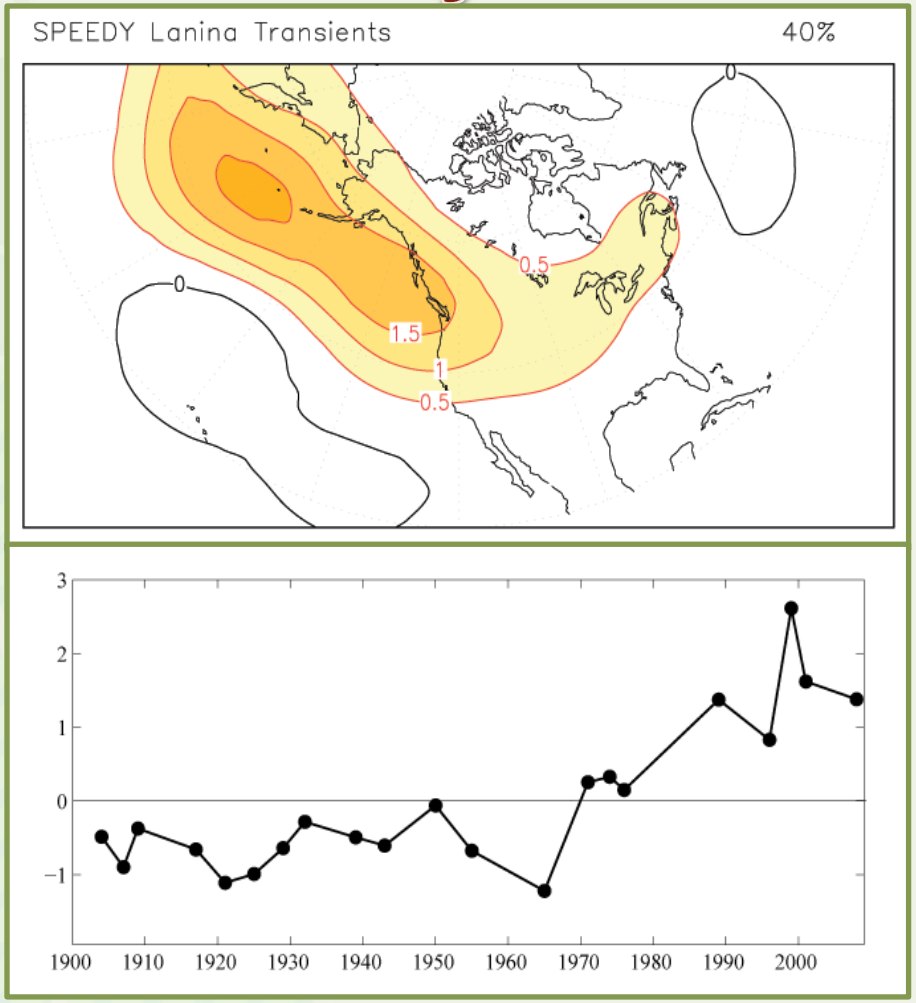
- Transient Activity enhances the noise during the la-niña



Intra El-Niño and La-Niña Variability

Intra-La-Niña variability



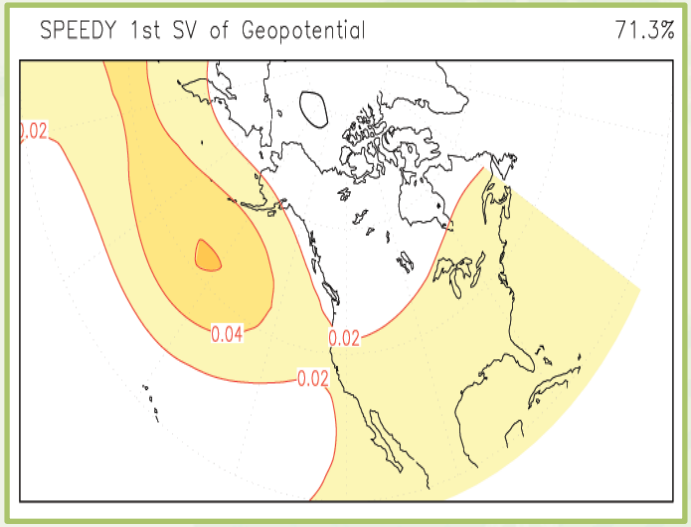


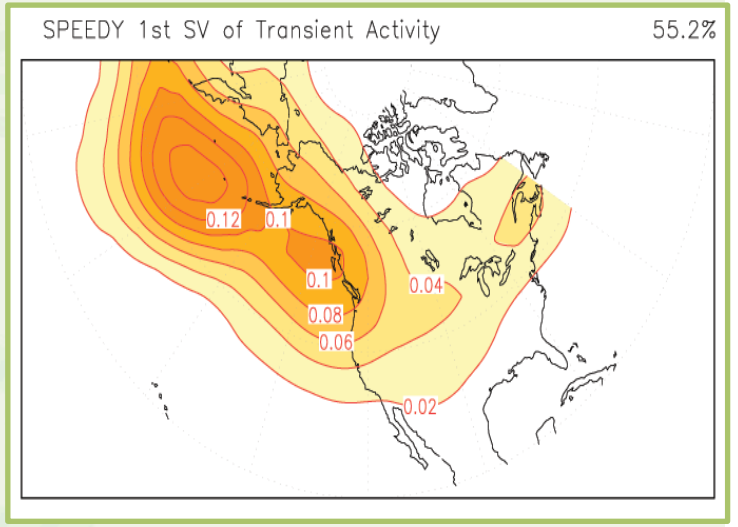
- There is a trend in the La- niña SST

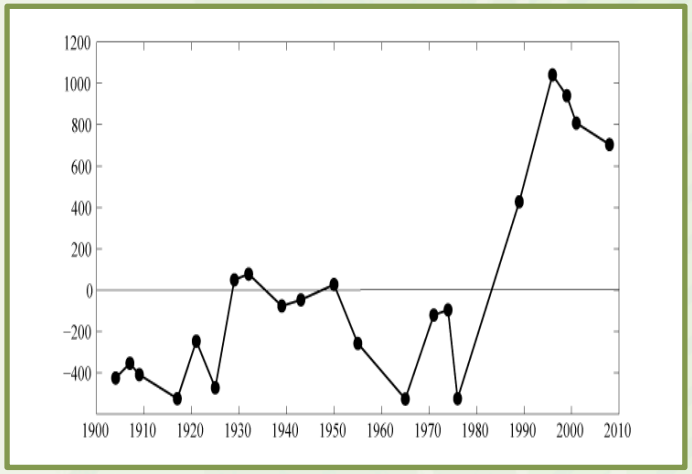
- The 1st EOF of transient activity from the model shows a trend

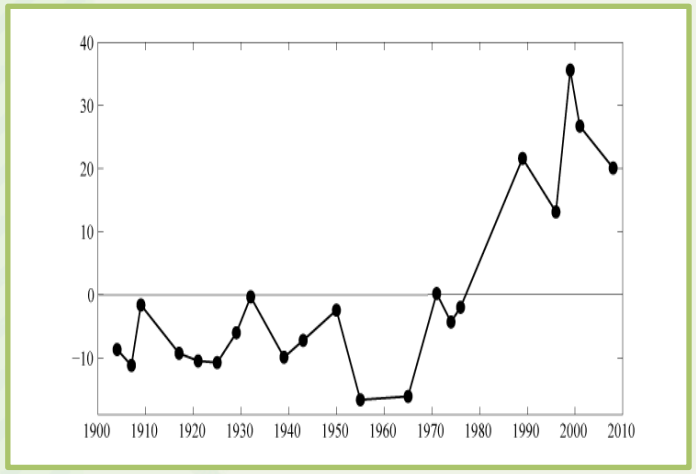
Intra La-niñaTransient Activity relationship with Geopotential height

The Correlation is =0.87

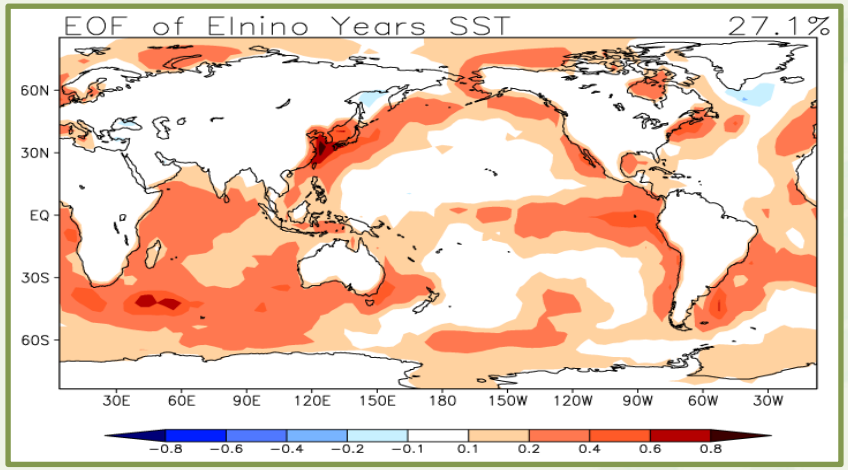


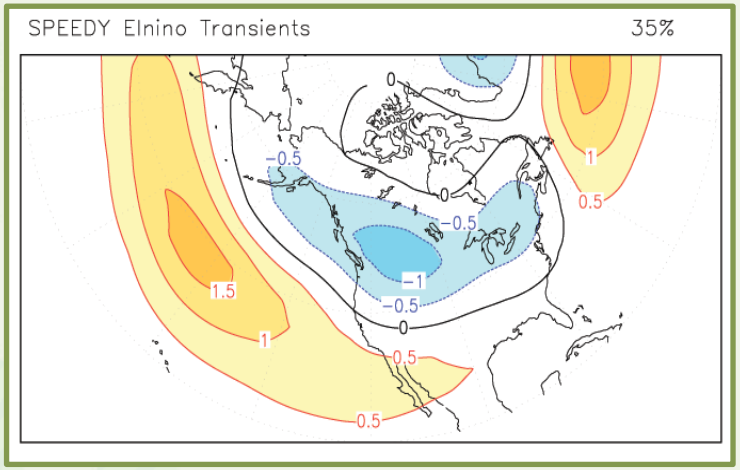


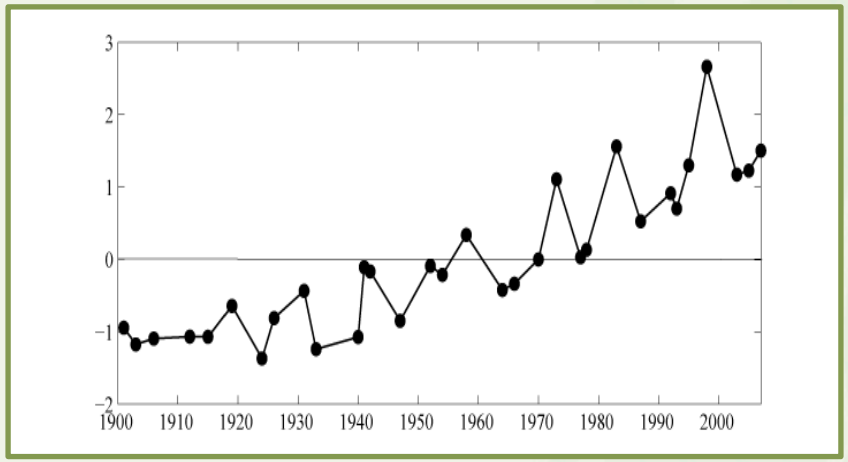


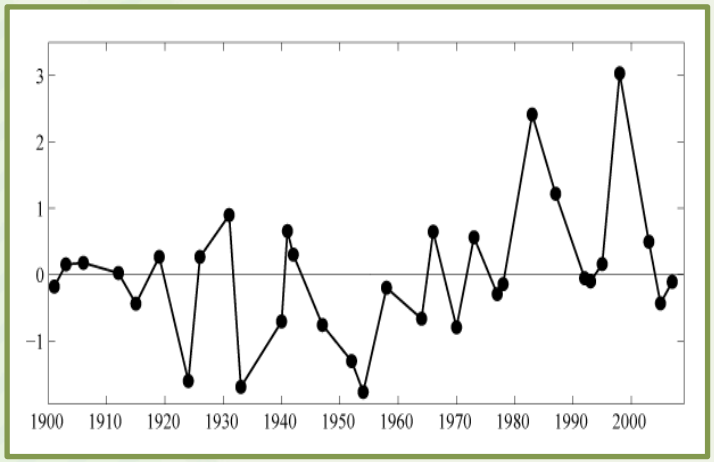


Intra-El-Niño Variability







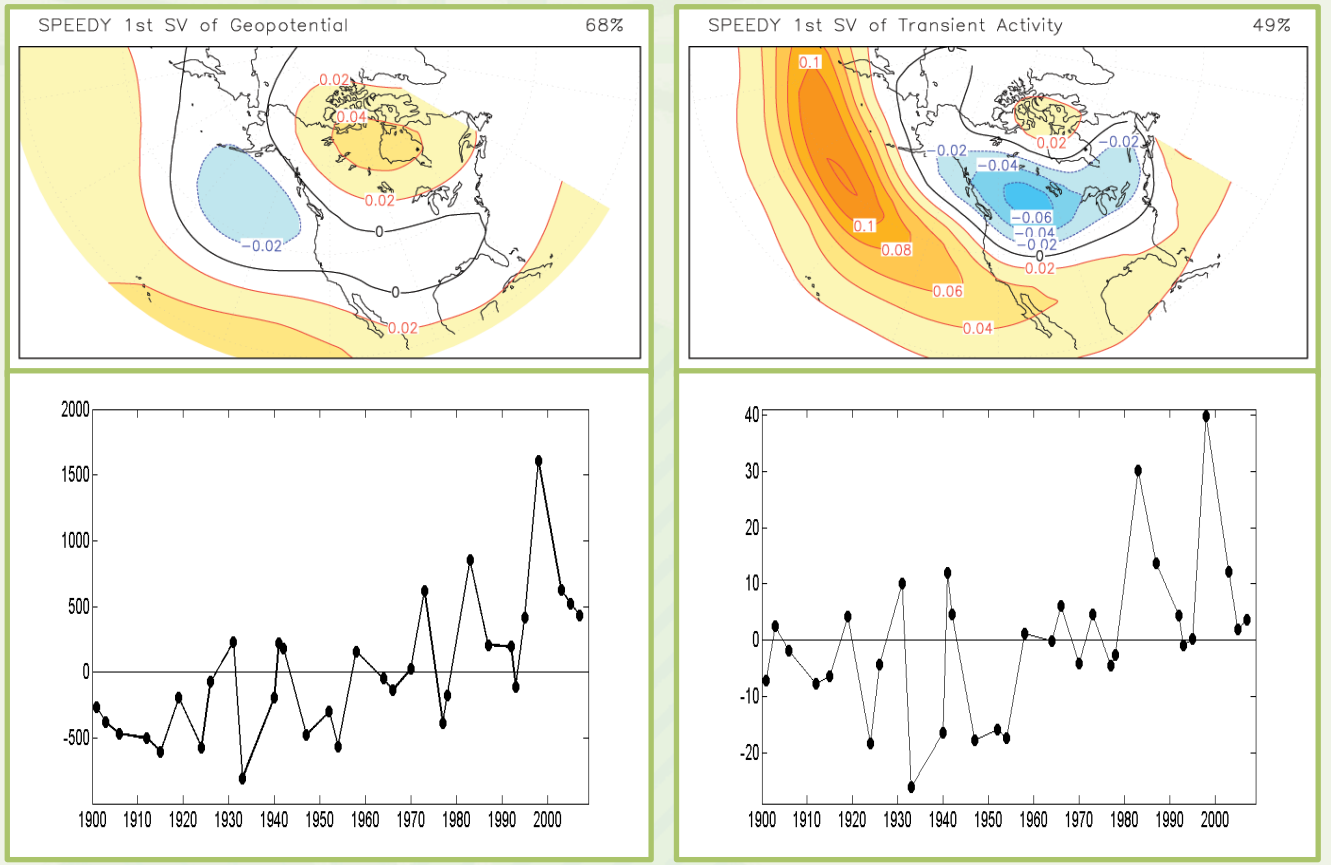


Intra-El-Niño Trasient Activity relationship with Geopotential height

- The correlation between the two pattern is **0.86,**

- The 1st SV mode of Φ_{200hPa} shows the trend

- This shows that Transient Activity and Φ_{200hPa} follows the SST



Conclusion

- Transient activity in the model is more of variability as compared to NCEP, where trend has been observed.
- The noise is large within la-Niña as compared to El-Niño.
- The better representation of transient statistics in the model can improve the seasonal predictability in extra-tropics.
- The model behavior in this case is more linear.

Thanks