Analysis on dry and non-dry conditions in the U.S. Southern Great Plains during La Niña years

Bing Pu, Rong Fu, and Nelun Fernando
Department of Geological Sciences
the University of Texas at Austin

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1.Introduction

- Drought is one of the costliest of natural disasters in the United States (Seager and Hoerling, 2014)
- Severe drought reshape local agriculture, economy, and society (Worster 1979)
- The 2011 Texas drought also caused about 12 billion damage (Seager et al. 2014)
- The hydrological and climatically influences of severe droughts may take years for local environmental system to fully recover

- Recent study suggested that while atmospheric internal variability could trigger and intensify the drought, in some areas such as the southern Great Plains and Gulf States, oceanic influence on annual precipitation may be up to 40% (Seager and Hoerling, 2014).

- **What leads to different SGP rainfall responses in La Nina years?**
- **Is it related to the magnitude of La Nina itself or other factors?**

2. Datasets

- NCEP/NCAR reanalysis: 2.5 by2.5 degree, 1948-2013,
- CRU precipitation: 0.5 by 0.5 degree,1901-2012
- HadISST: 1 by 1degree, 1870-2013
- CPC climate indices: Nino3.4, AMO, PDO, NAO, 1948/1950-present day

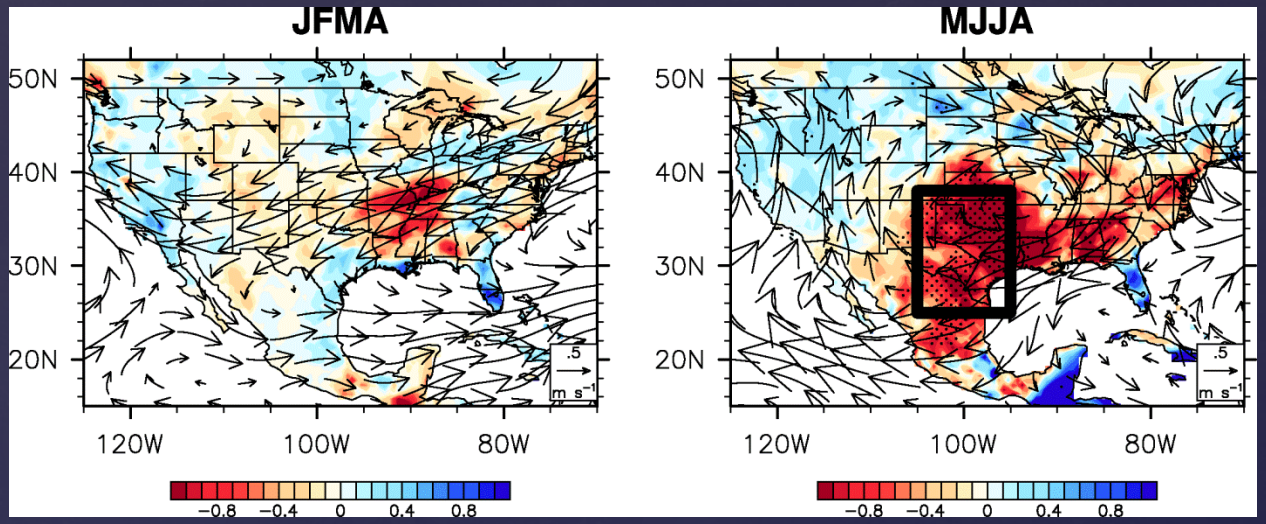
Criteria to pick-up La Niña years:
During DJF-FMA at least 3 consecutive 3-month SSTA greater than -0.5 degree C or 2 during AMJ-JAS

	Years (25)
La Niña during 1950-2013	1950, 1954, 1955, 1956, 1964, 1970, 1971, 1973, 1974,1975, 1976, 1985, 1988, 1989,1996, 1998, 1999, 2000, 2001, 2006, 2008, 2009, 2010, 2011, 2012

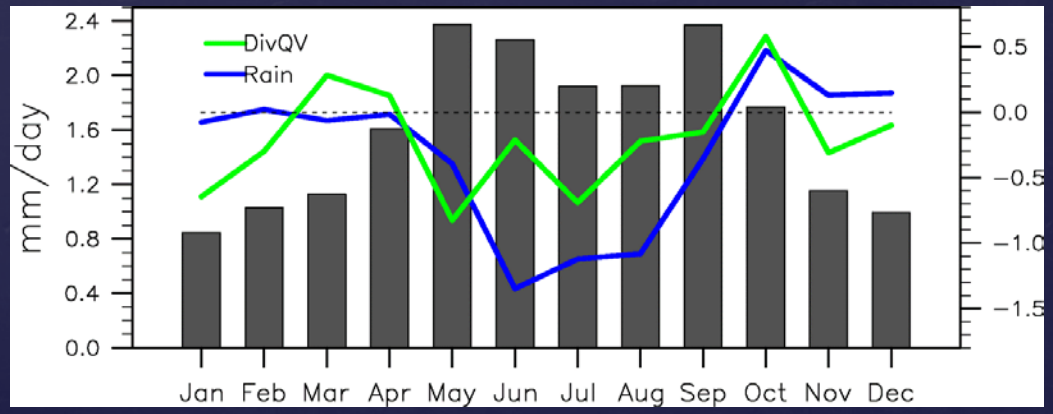
"Dry" and "Wet" years are defined as the 8 driest and wettest years from the total 25 La Nina years

3. Analysis

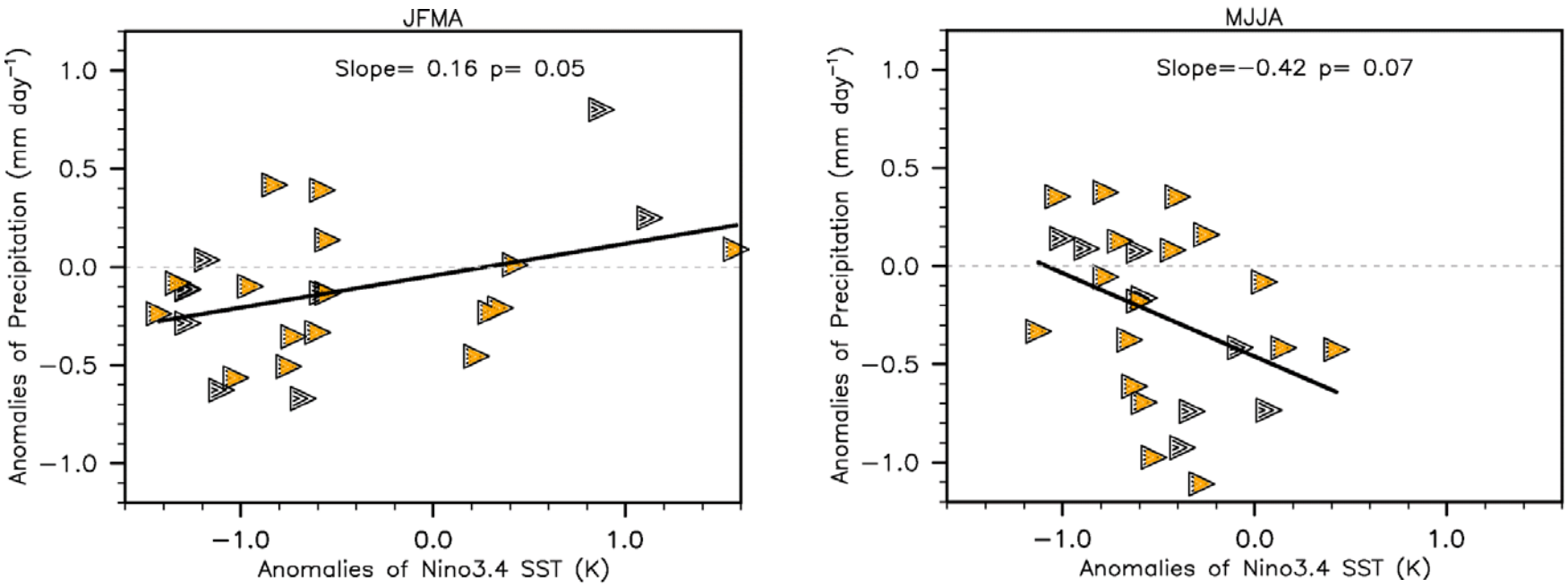
- Rainfall (mm day^{-1}; shading) and 700 hPa wind anomalies (LaDry- LaNondry)



- Seasonal cycle of Southern Great Plains (SGP) precipitation (bar) and differences of rainfall (blue) and moisture convergence (green; right y-axis) between La Nina Dry and non-dry years



- Scatter plot of Nino 3.4 SSTA (K; from CPC) and precipitation anomalies (mm day^{-1}) for 25 La Niña years



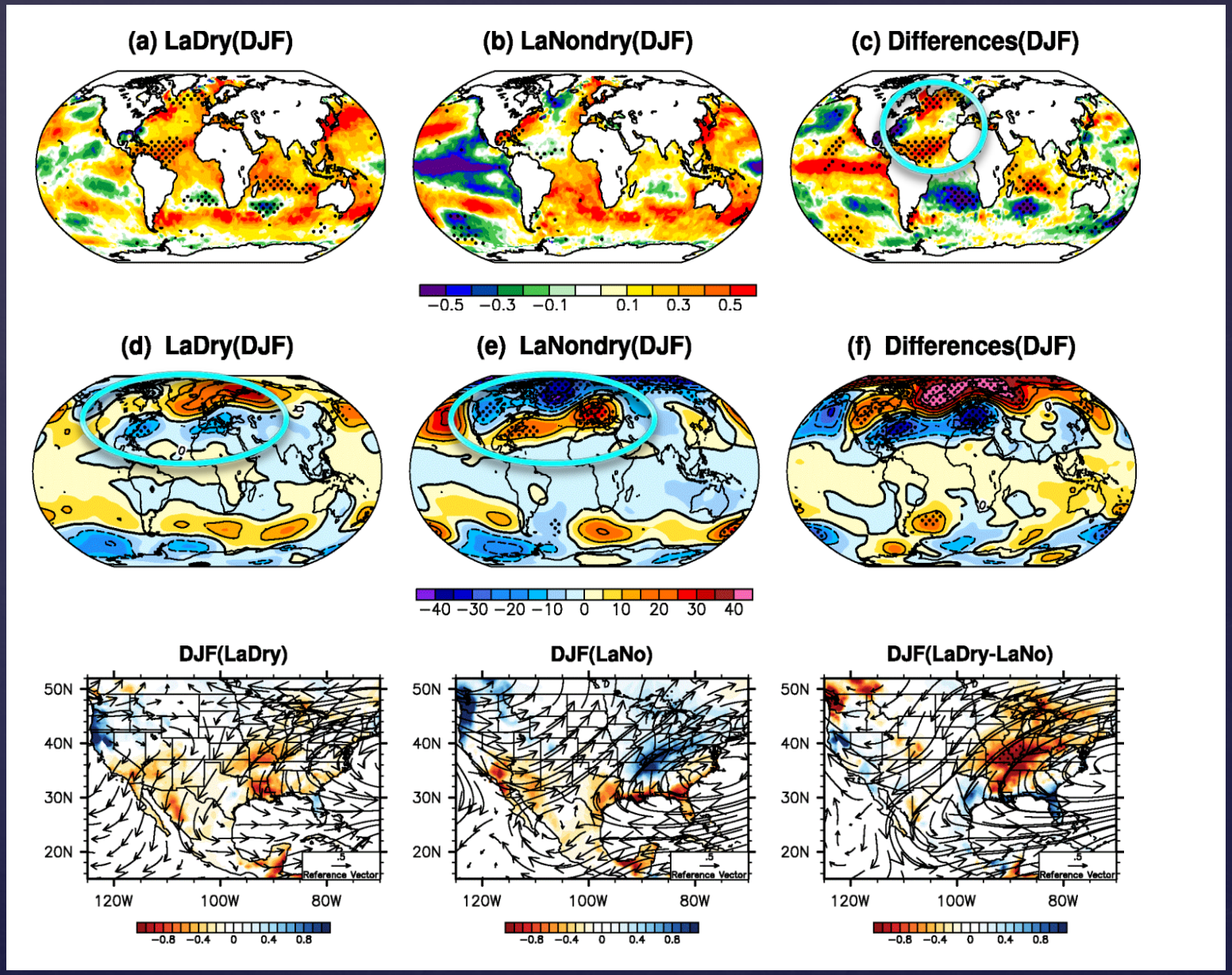
- Rainfall anomalies are positively related to Nino3.4 SST in JFMA but negatively related to rainfall in MJJA
- In total 25 La Niña years, 65% (11/17) of summer dry anomaly is preceded by a negative Nino3.4 SSTA in JFMA, and 75% with negative Nino3.4 SSTA in concurrent summer

- SST, 700 hPa geopotentail height, and rainfall and 700 hPa wind anomalies during LaDry and LaNodry composite in **DJF**

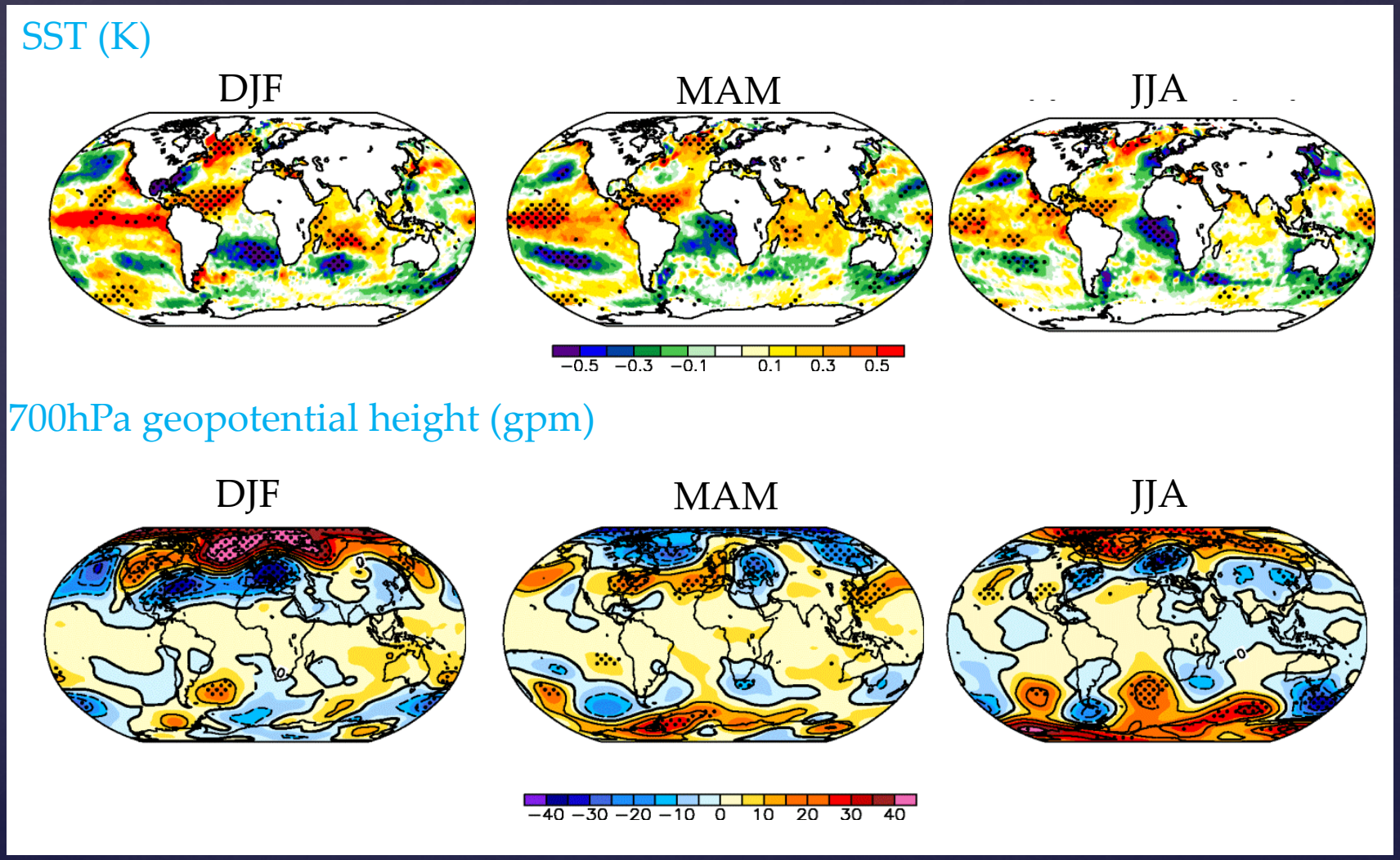
SST (K)

700hPa GPH (gpm)

Rainfall (mm/day) and 700hPa Winds (m/s)

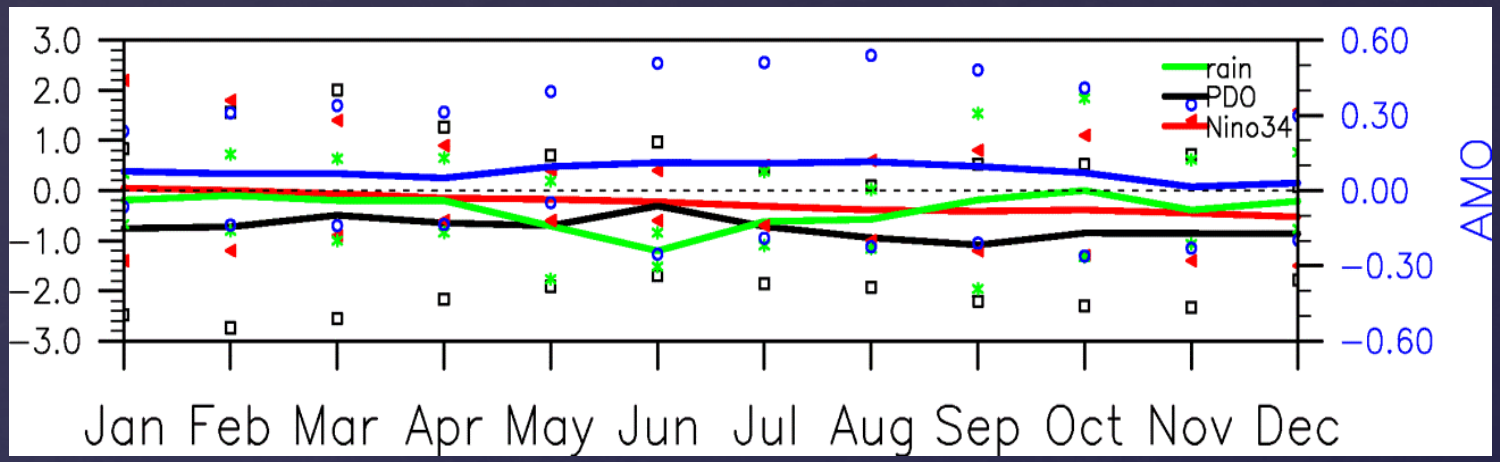


- Differences of SSTA and 700 hPa geopotential heigh between LaDry and LaNonDry

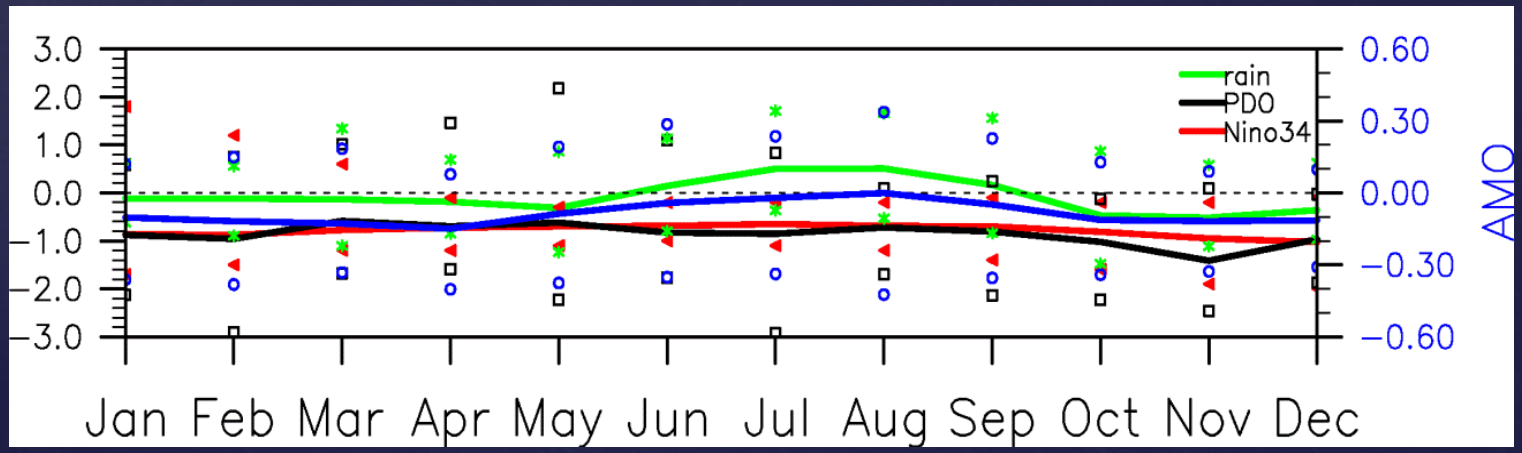


- Seasonal cycle of rainfall (green), Nino3.4 SSTA (red), PDO (black), AMO (blue)

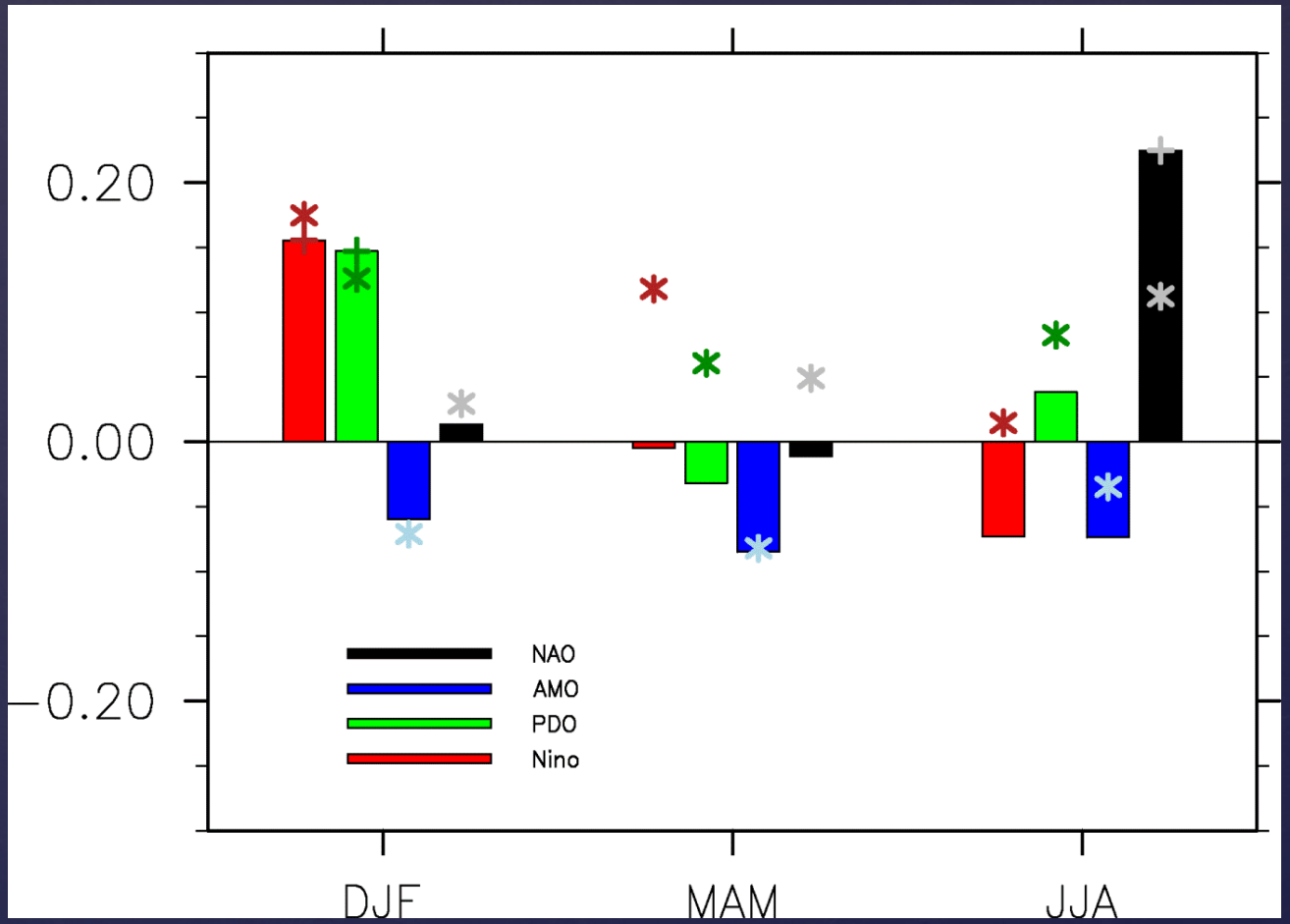
La Nina Dry years



La Nina non-Dry years



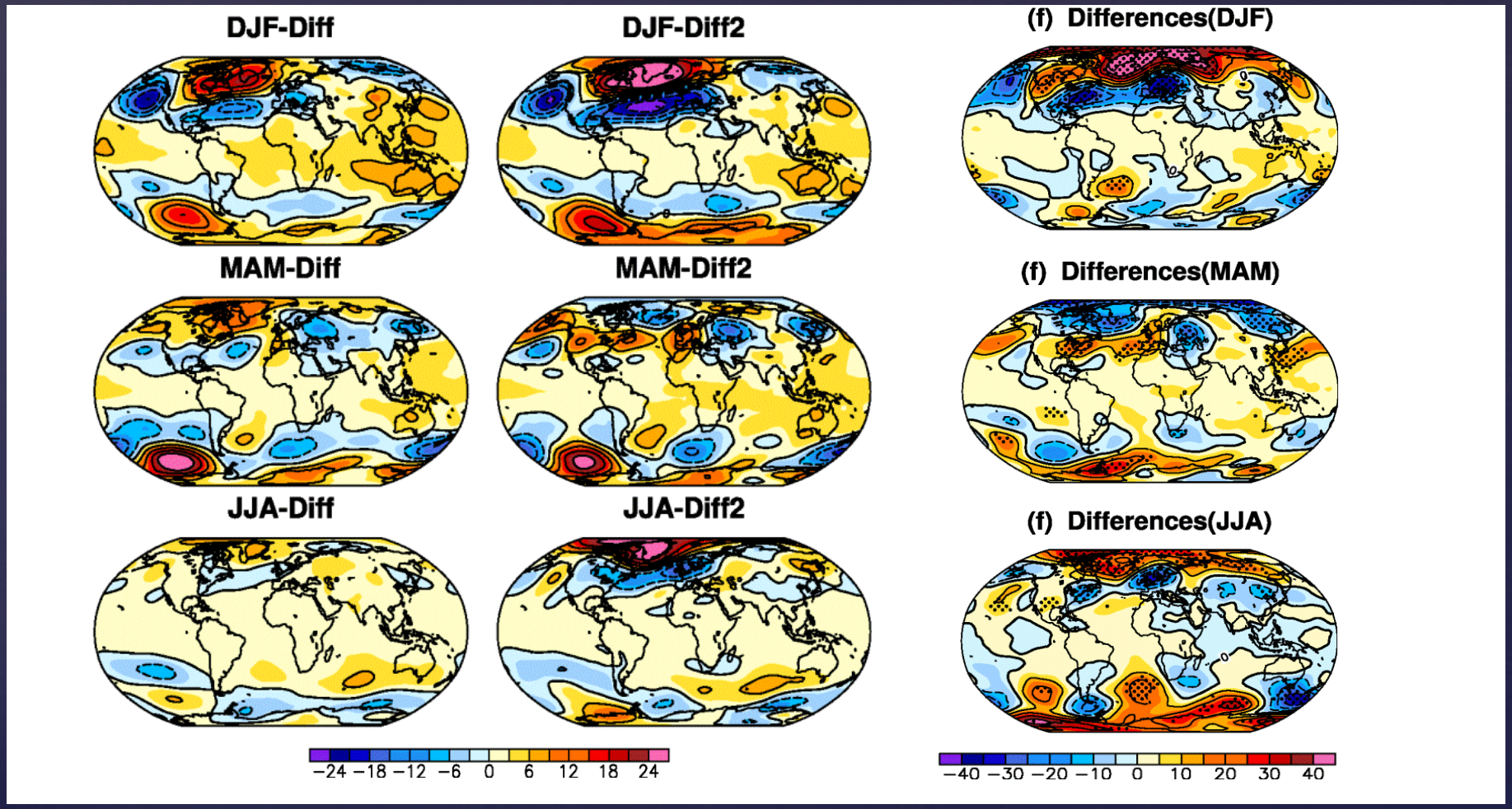
- Regression coefficients for standardized Nino3.4 (red), PDO (green), AMO (blue), and NAO indices onto SGP rainfall during 1950-2013 (stars) and for 25 La Nina years (bars)



- Nino dominates in winter, weaker in MAM, changes sign in JJA
- AMO dominates in MAM, and NAO dominates in JJA

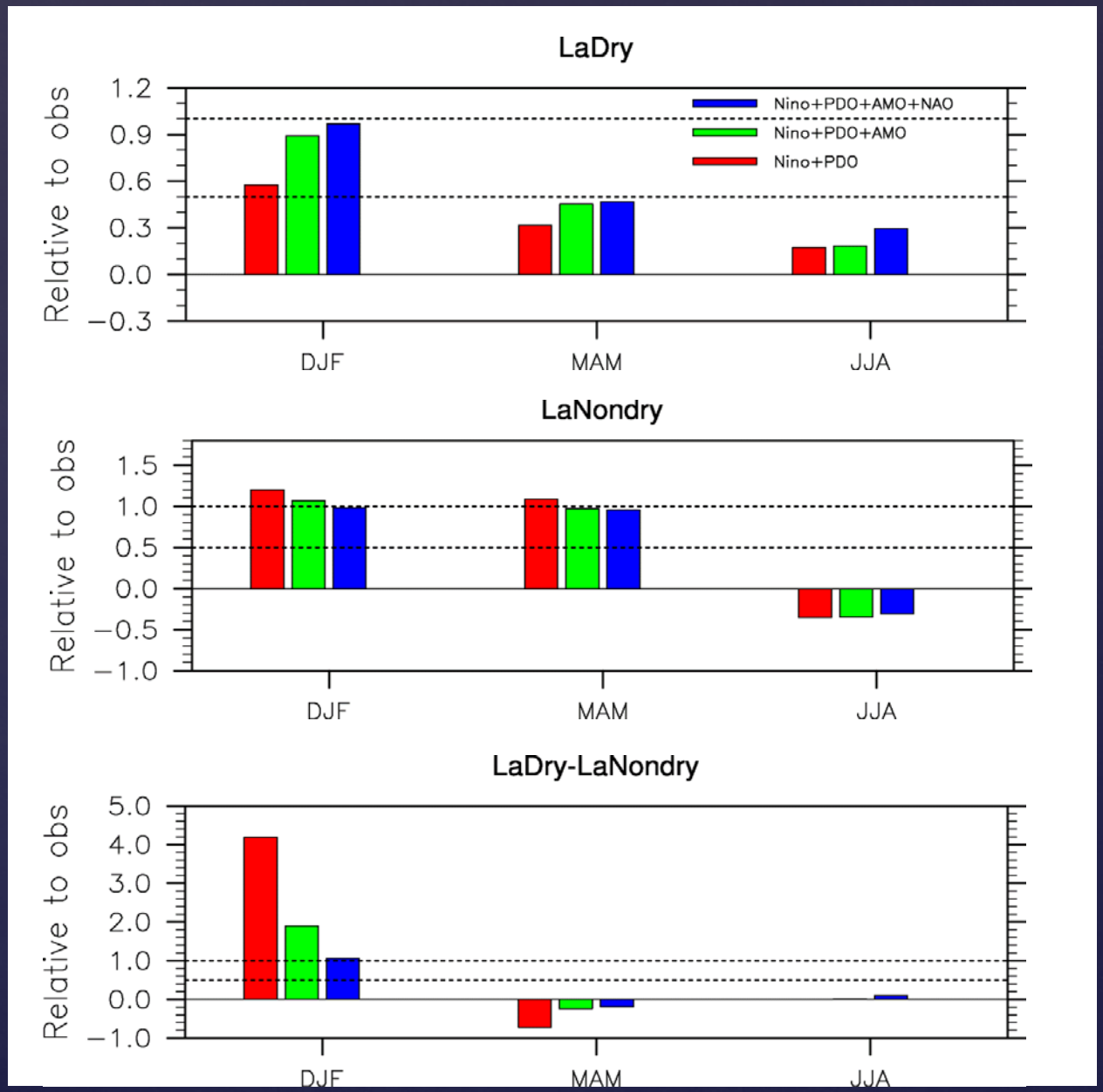
- Regressed 700 hPa geopotential height for the differences between LaDry and LaNondry

3 oceanic indices | 3 oceanic indices+NAO | NCEP



Correlations	DJF	MAM	JJA
A1 –NH	0.81 (0.87)	-0.60 (0.59)	0.63 (0.85)
A2 –US	0.60 (0.73)	-0.05 (0.32)	0.62 (0.49)
A1*A2	0.48 (0.63)	0.03 (0.19)	0.39 (0.42)

- Regressed SGP precipitation (relative to observed rainfall) using three SST indices and NAO index



4. Major conclusions

- There are distinct circulation patterns along with rainfall anomalies in SGP between these La Niña dry and non-dry years
- Nino 3.4 SSTA is positively related to SGP precipitation in JFMA and negatively related to precipitation during MJJA
- Differences of circulation between La Niña dry and non-dry years can be partially explained by SSTA in Nino3.4 area, AMO and PDO pattern in winter, and weakly in summer
- During La Nina dry years, more than 50% of rainfall anomalies in January-March can be explained by the influences of 3 oceanic indices and NAO, but less than 30% during summer , with weakest influences in July

Thank you all!