El Niño and La Niña impacts on American seasonal weather anomalies: the OLR perspective

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Outline

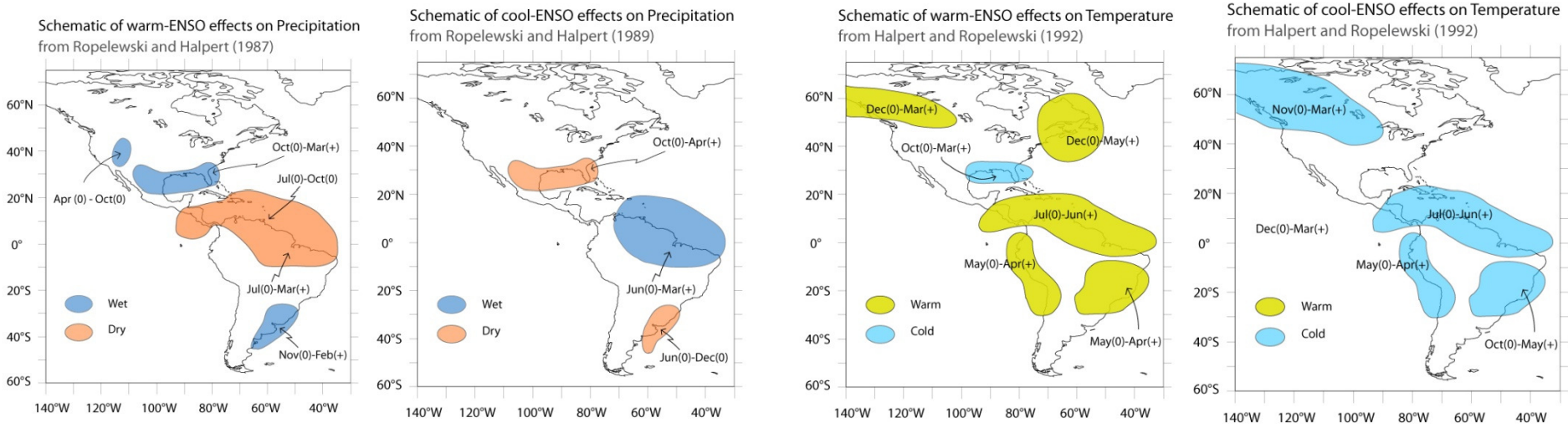
- Background
- Characterizing warm-ENSO (El Niño) w/ OLR
- OLR El Niño seasonal weather impacts
- Characterizing cool-ENSO (La Niña) w/ OLR
- OLR La Niña seasonal weather impacts
- Conclusions/Future work

Background

- The El Nino-Southern Oscillation (ENSO) involves major disruption of oceanic and atmospheric circulation in the tropical Pacific – but also elsewhere
- Substantial seasonal weather anomalies in affected regions around the globe have been associated with ENSO events
- Where the linkages are statistically strong enough, they form the basis for seasonal weather prediction

Background

- Composites of seasonal temp. and precip. have been used to identify the associations between seasonal weather anomalies and ENSO

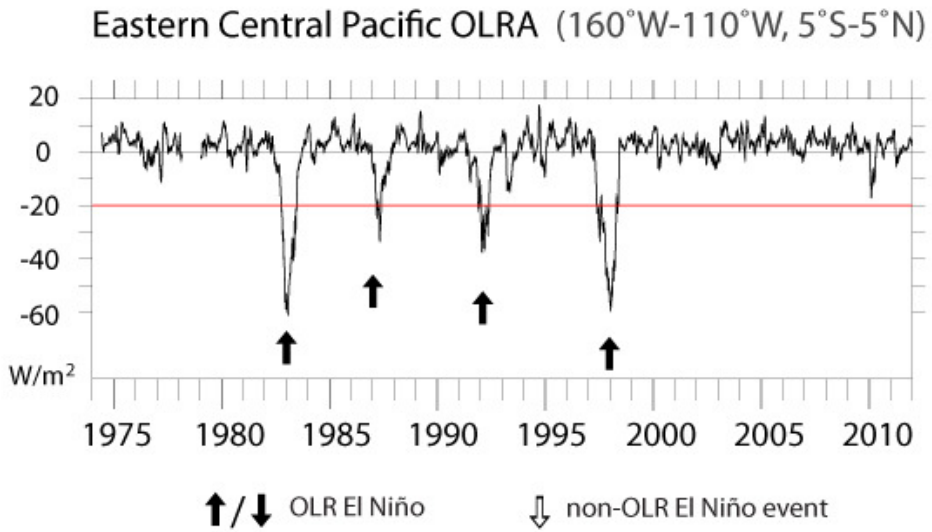


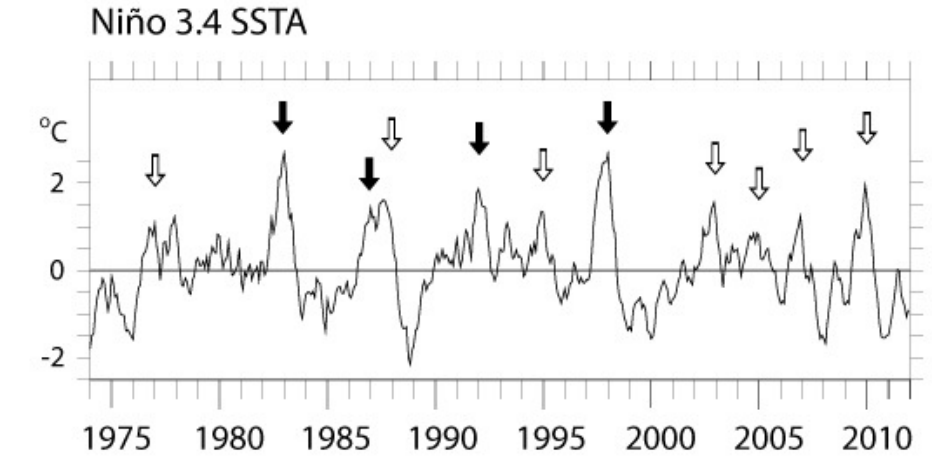
- But considerable differences in strength and pattern exist between the seasonal weather anomalies seen in the commonly identified ENSO years (e.g. Harrison and Larkin 1998)

Background

- Recently there has been discussion about whether the commonly used ENSO definitions can be improved for the purposes of regional seasonal forecasting (Larkin and Harrison 2005, Weng et al. 2009).
- This work indicates that it can, and considering outgoing longwave radiation (OLR) behavior is key.

Characterizing warm-ENSO with OLR

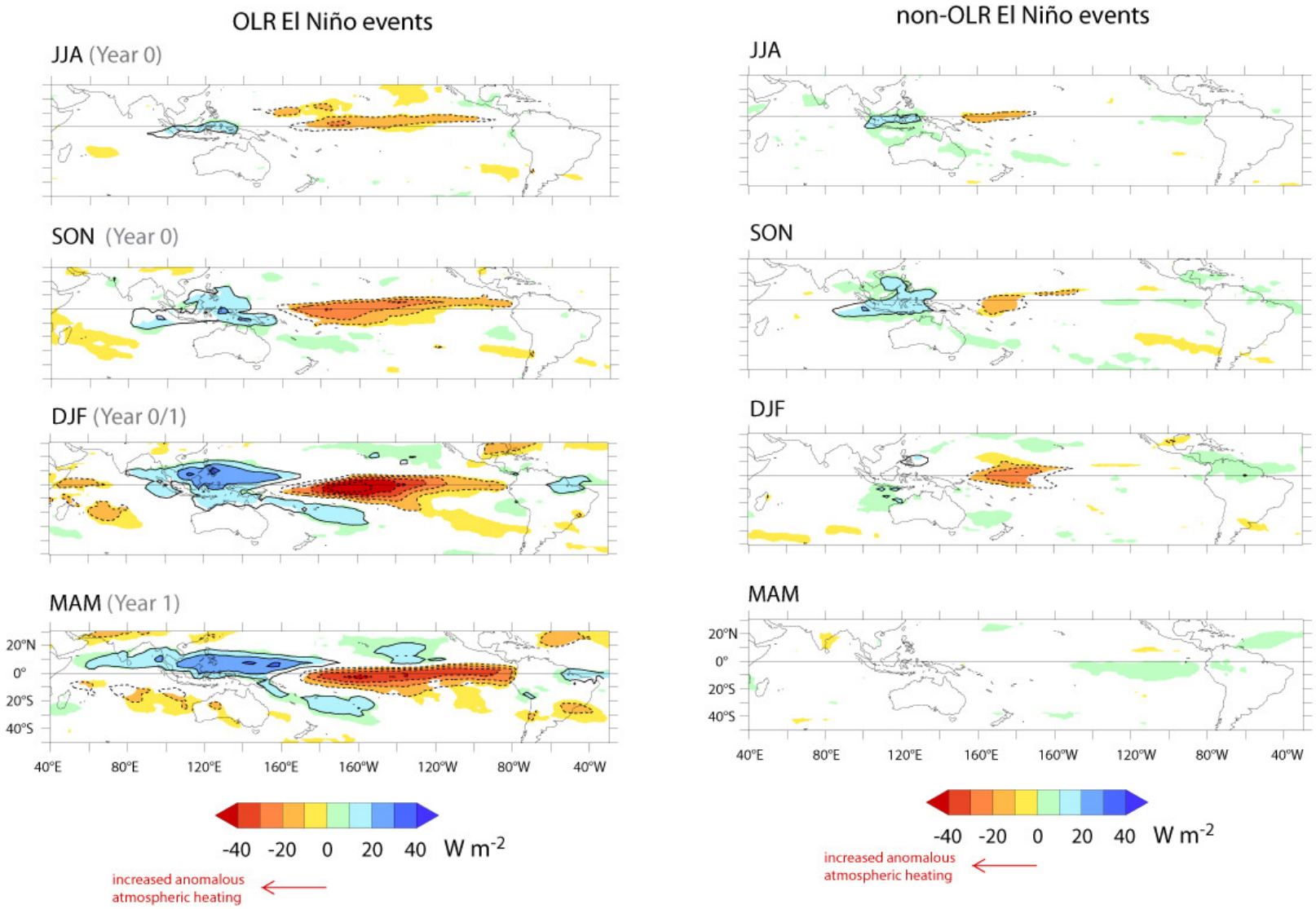




El Niño year	**1982-83**	**1991-92**	**1986-87**	**1997-98**
Date	October 1982	Nov 1991	March 1987	May 1997

From Chiodi and Harrison (2012, in revision at J. Climate).

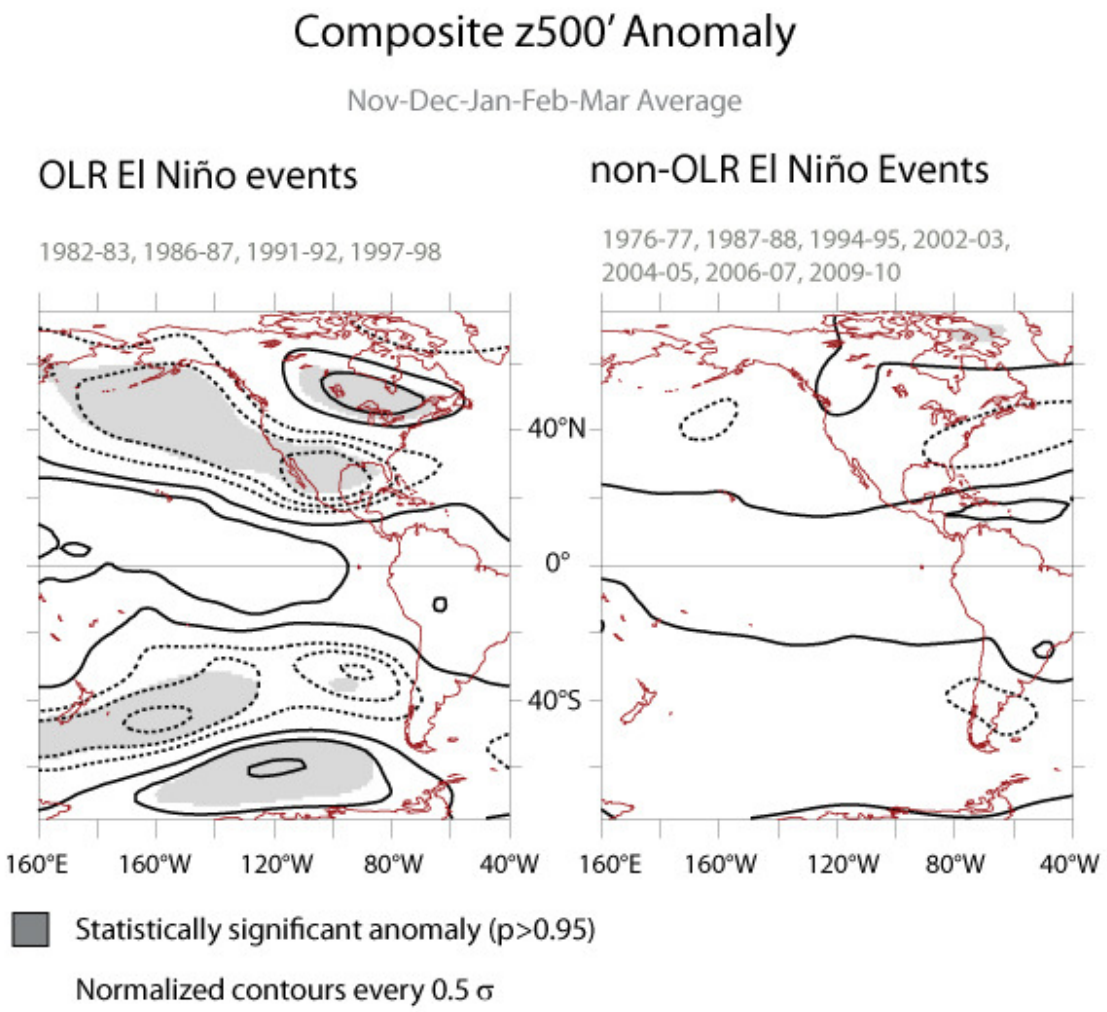
Characterizing warm-ENSO with OLR: OLR composites



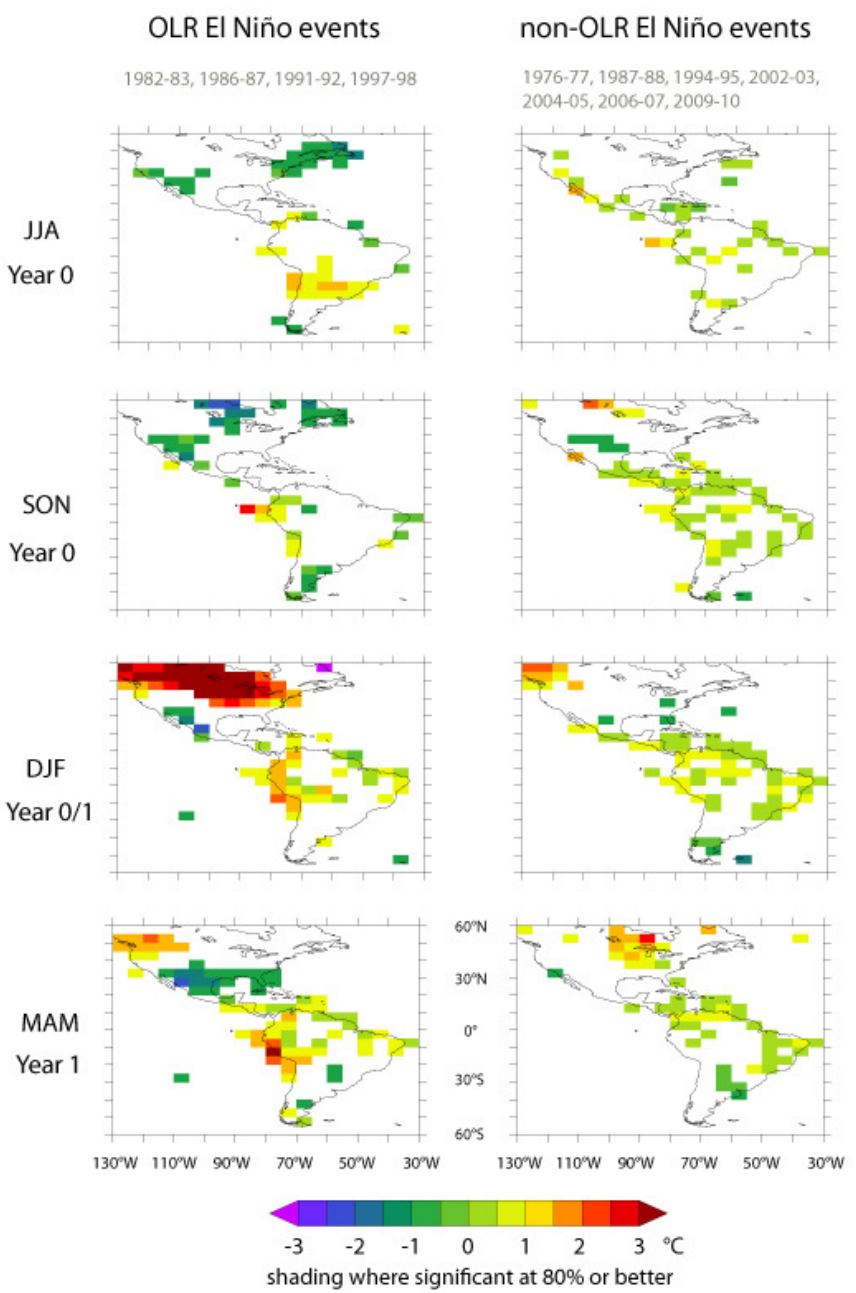
Shading where significant at 95% or better. Data from NOAA interpolated OLR data set

Characterizing warm-ENSO with OLR

Significant atmospheric circulation anomalies are seen mainly in the OLR event composite – the composite effect of the non-OLR events is small.



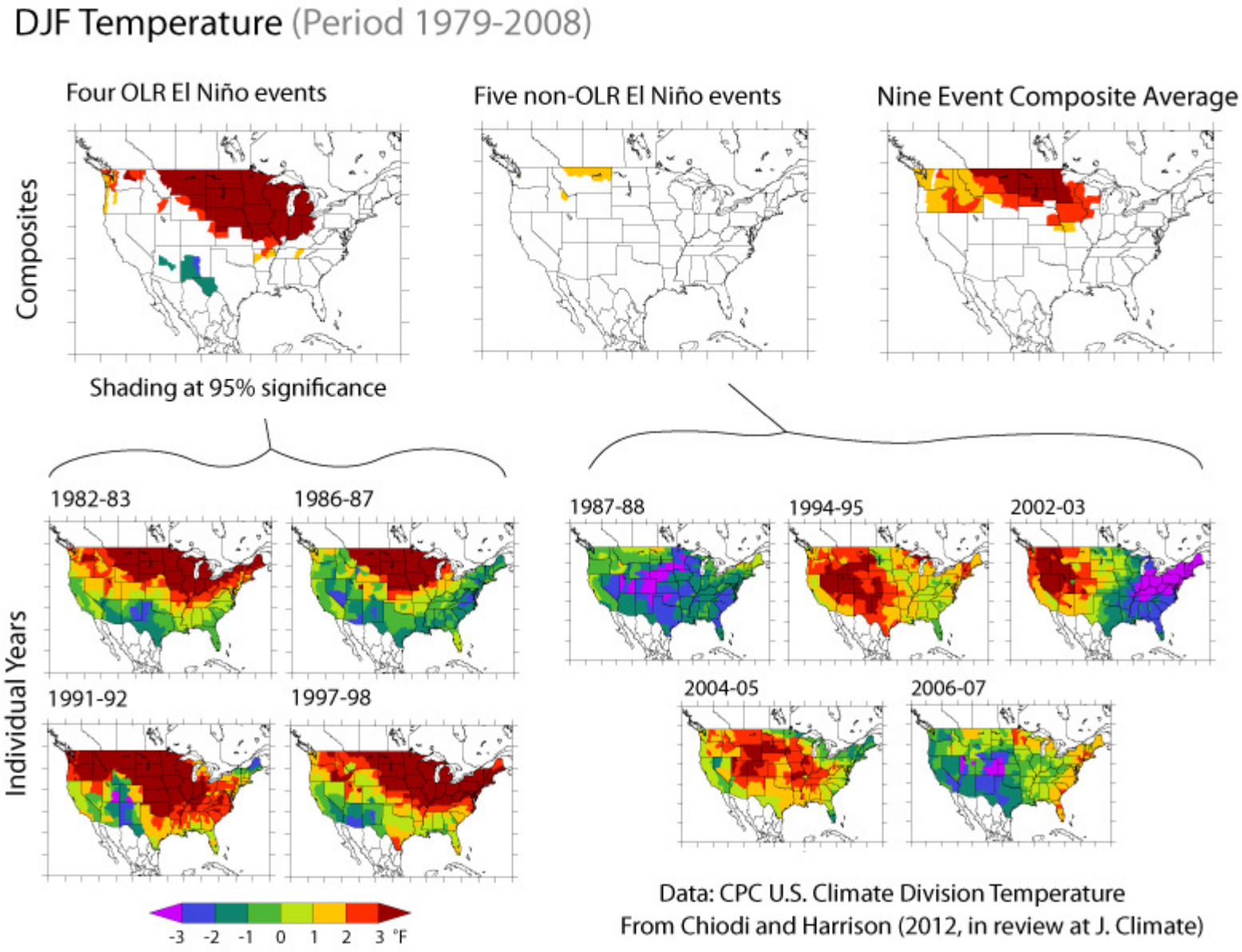
OLR El Niño impacts: Temperature



Temperature anomalies are strongest in the OLR events, around and after the end of the calendar year, especially in N. America in DJF

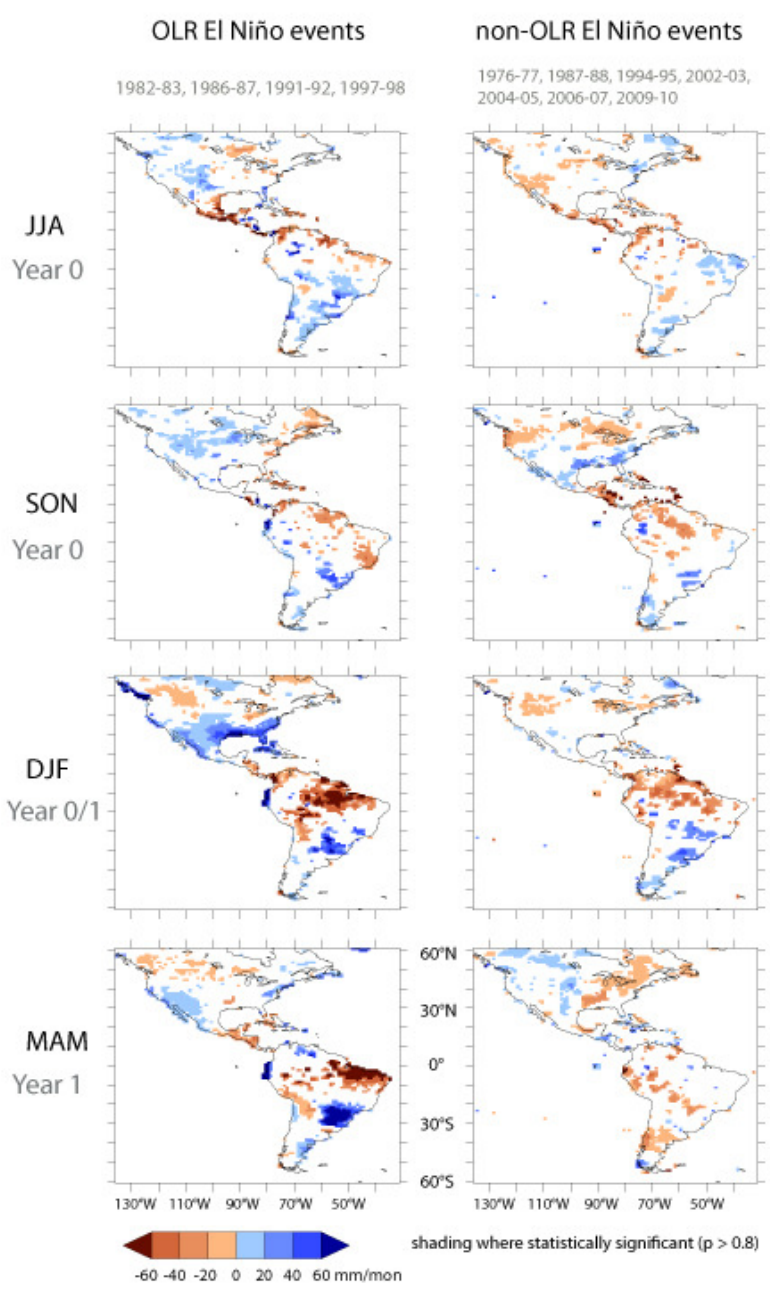
Data from Hadley Centre CRUTEM3 data set

OLR El Niño impacts



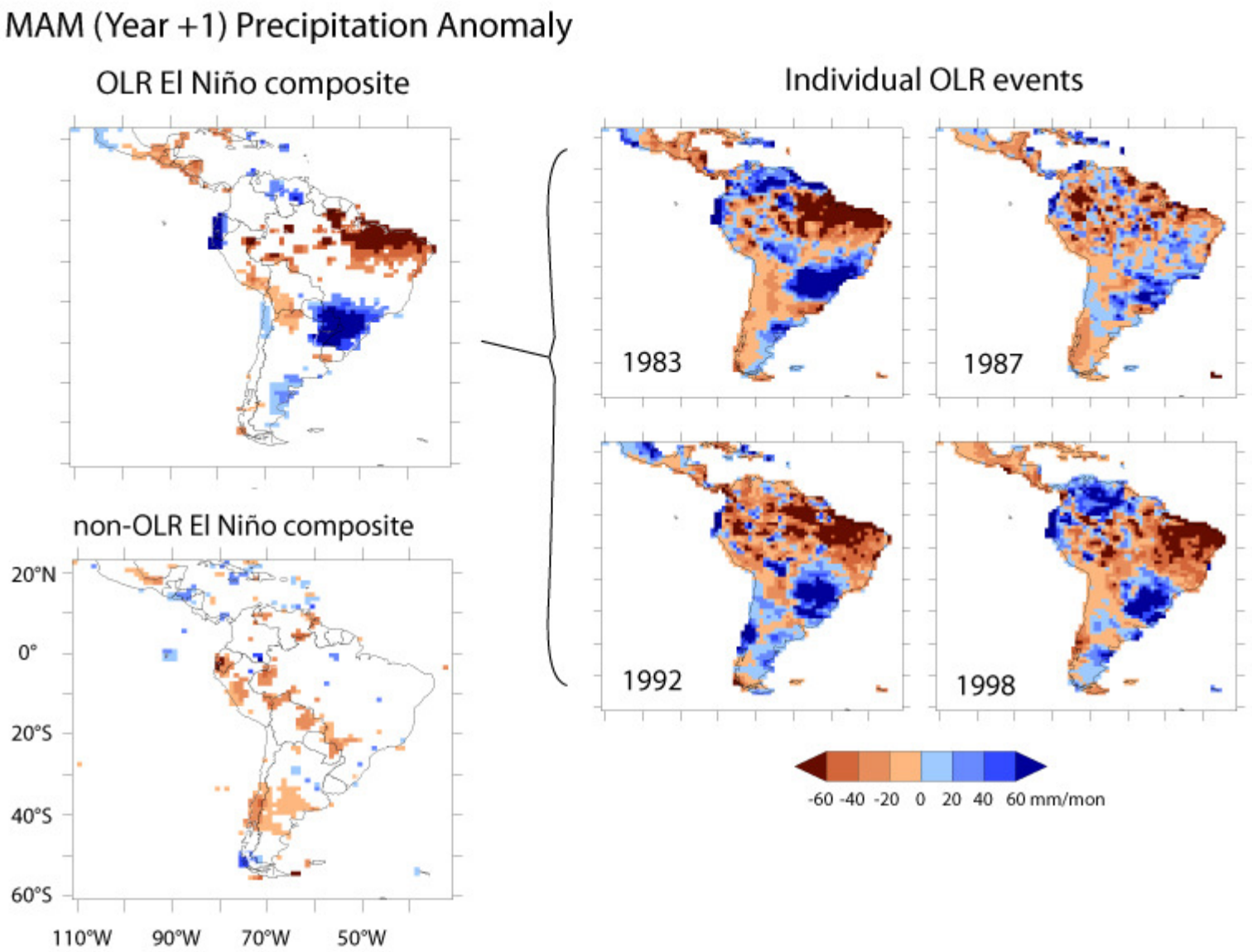
OLR El Niño impacts: Precipitation

South American composite precipitation anomalies are strongest in the OLR events, around and after the end of the calendar year



Based on Global Precipitation Climatology Centre (GPCC) Data

OLR El Niño impacts: Precipitation

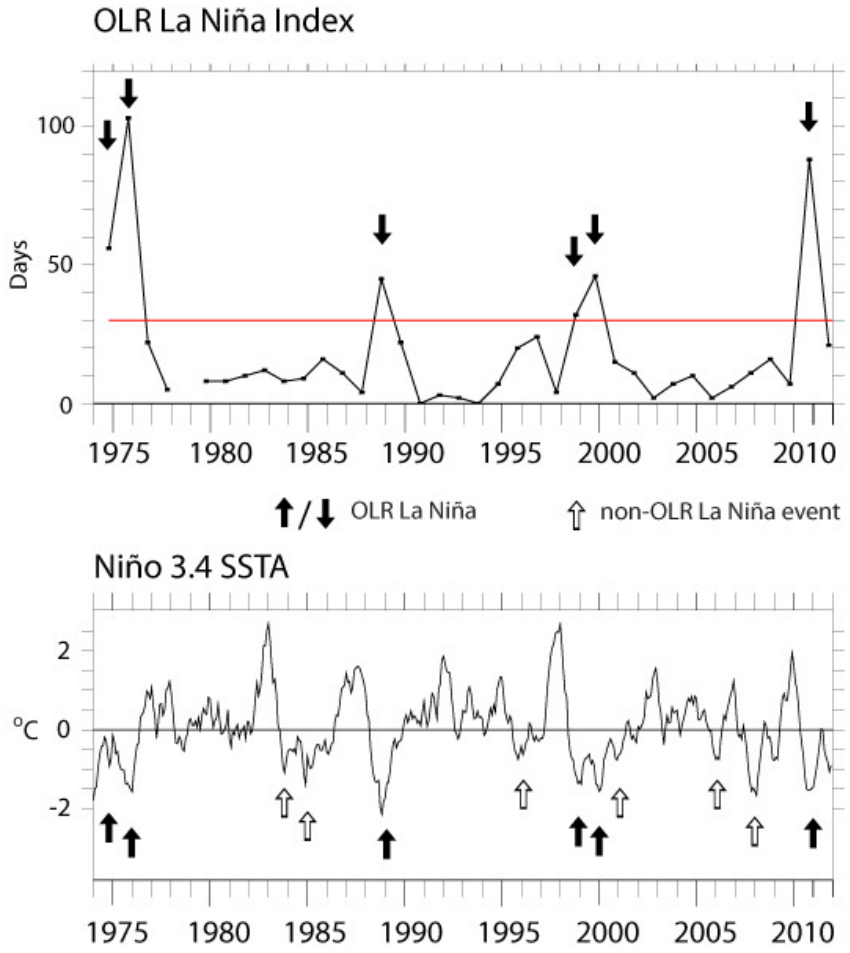


OLR El Niño Summary

- Monthly average OLR behavior in the eastern central tropical Pacific distinguishes some El Nino years from others
- Most of the useful American seasonal weather impacts are from the OLR El Nino events
- Distinguishing OLR from non-OLR events will be useful to statistical forecasting

In the most affected regions forecasts based on previous statistical linkages that include both OLR and non-OLR events will be dominated by the OLR events and not representative of the others

Characterizing cool-ENSO with OLR



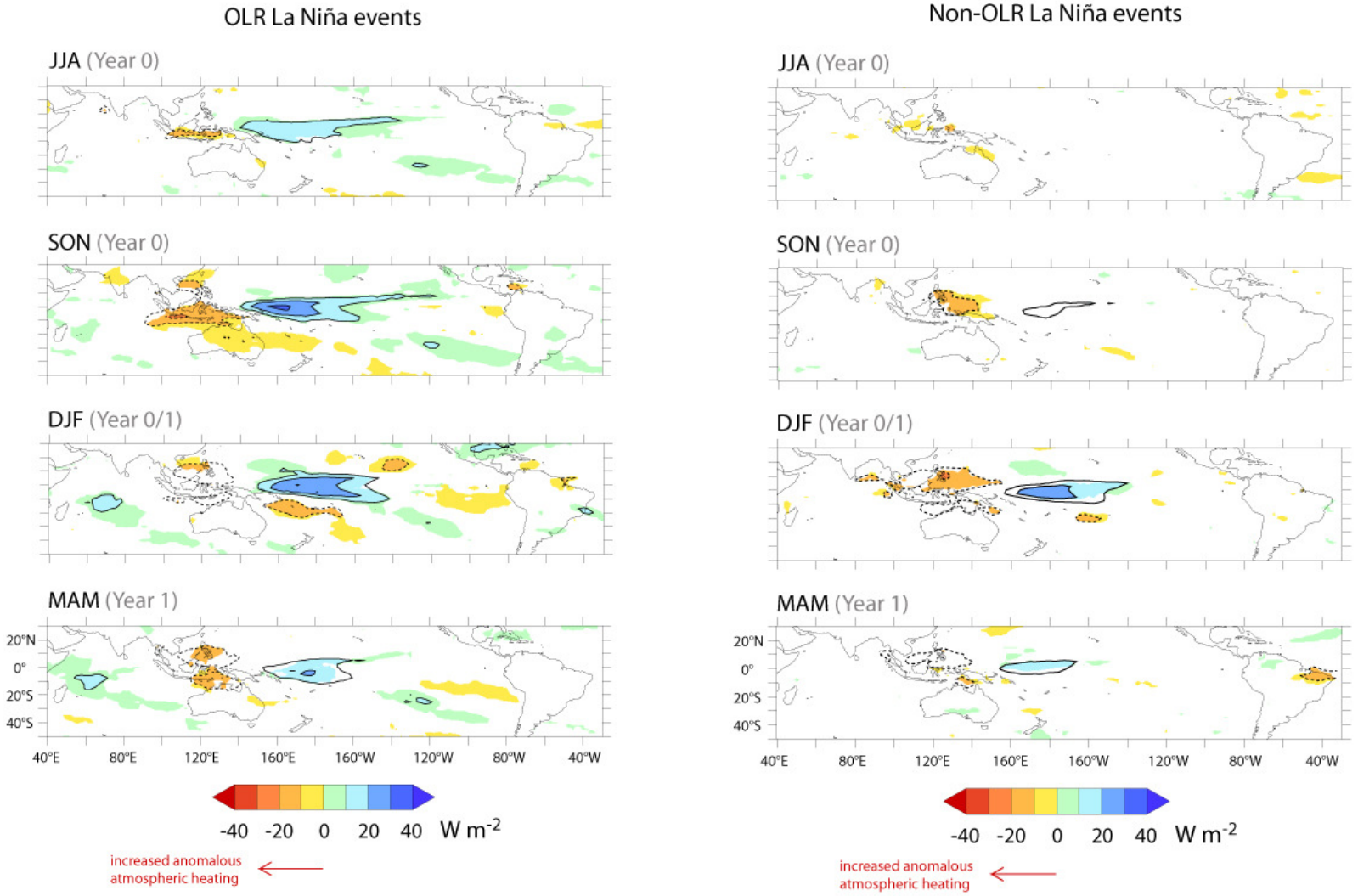
Cool-ENSO OLR Index: Number of days since April with "cloud free" conditions (area average OLR > 265W/m^2), 5S-5N, 150E-180

•The six OLR La Nina events are distinguished from others by the end of November

1974-75	1975-76	1988-89	1998-99	1999-00	2010-11
Sep 1974	July 1975	Sep 1988	Nov 1998	Oct 1999	Sep 2010

Dates when OLR-Index crossed 30 day-level

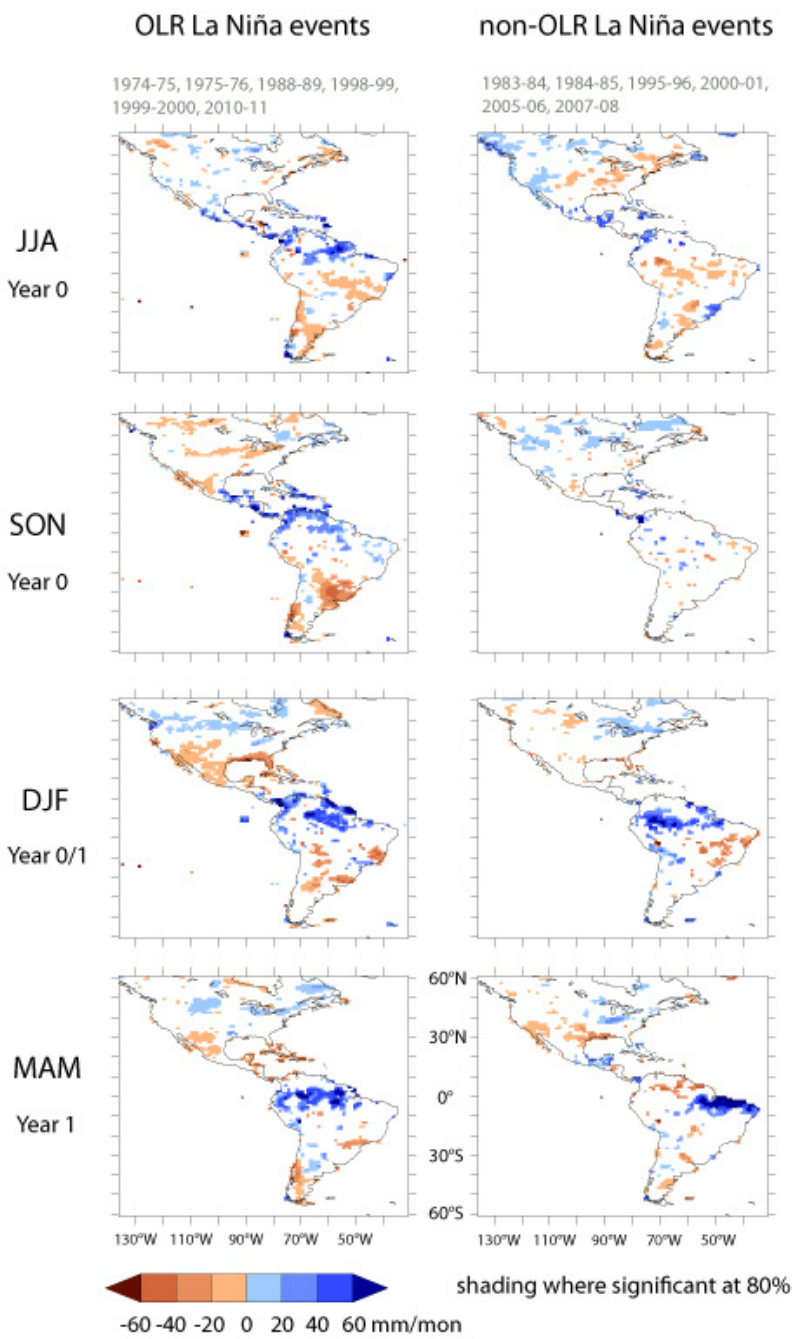
Characterizing cool-ENSO with OLR: OLR composites



Shading where significant at 95%

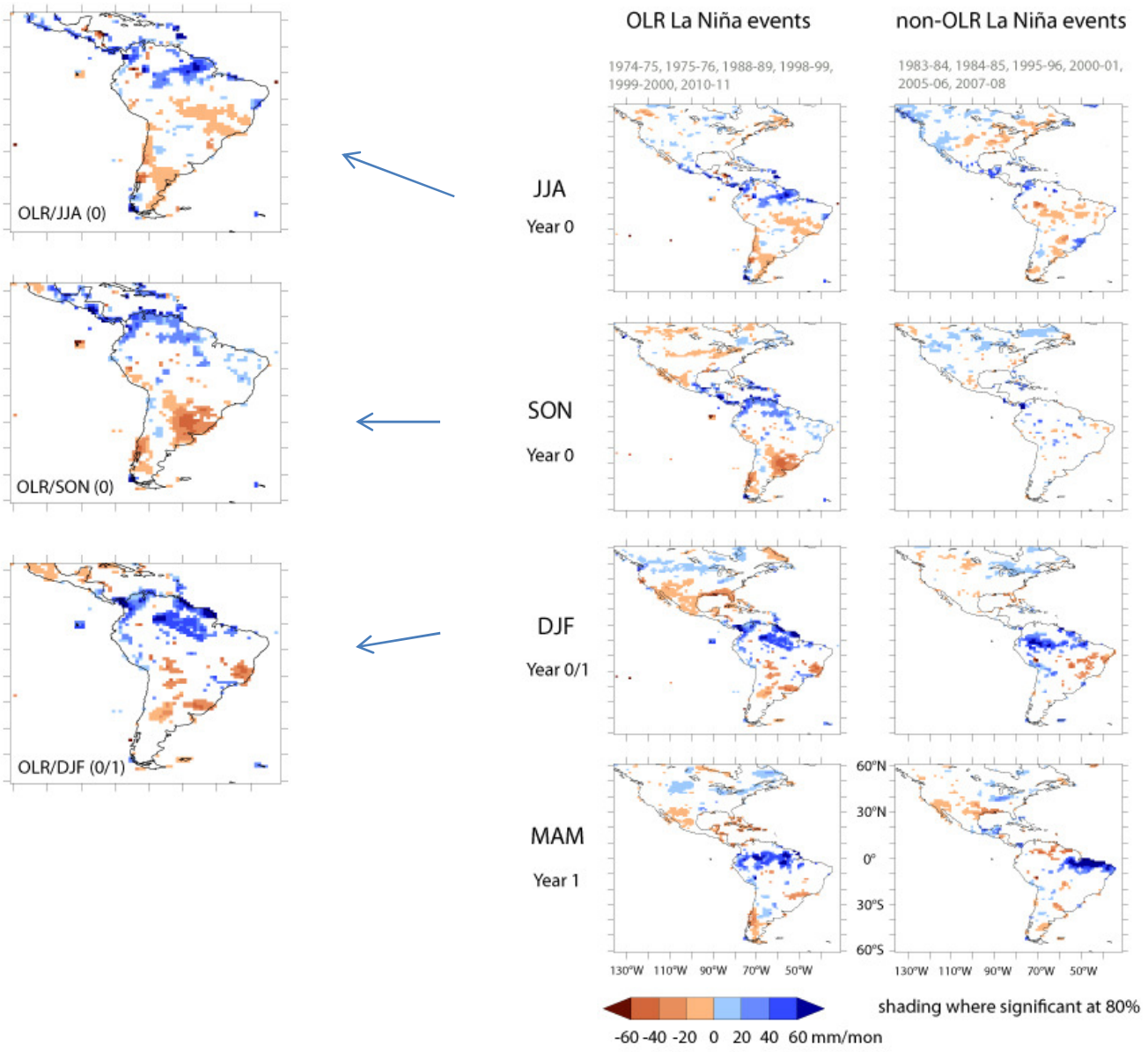
OLR La Niña impacts: Precipitation

The characteristic wet-tropical to dry-subtropical S. American precipitation anomaly pattern is seen before December in the OLR event years, but not the other years



OLR La Niña impacts: Precipitation

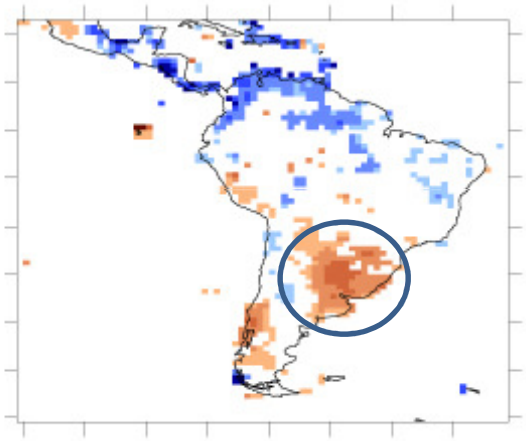
Only the OLR-event composites reach "field significance" ($p > 0.9$). SON is the most significant.

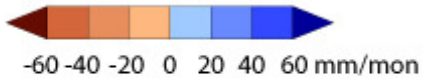


OLR La Niña impacts: Precipitation

SON (Year 0)

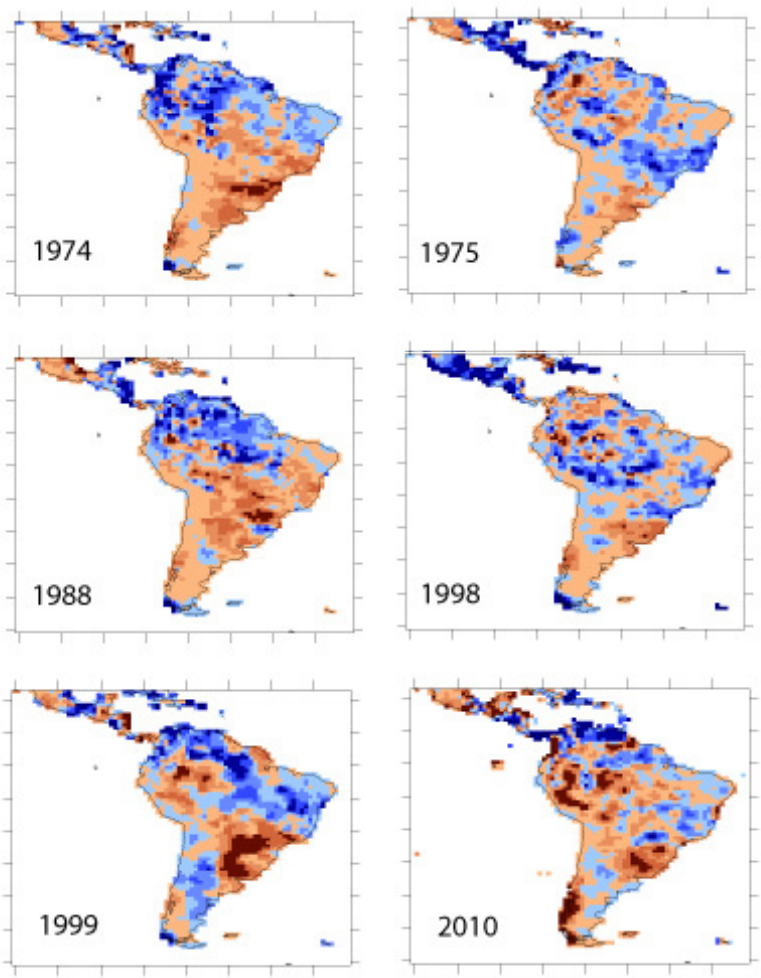
OLR event composite





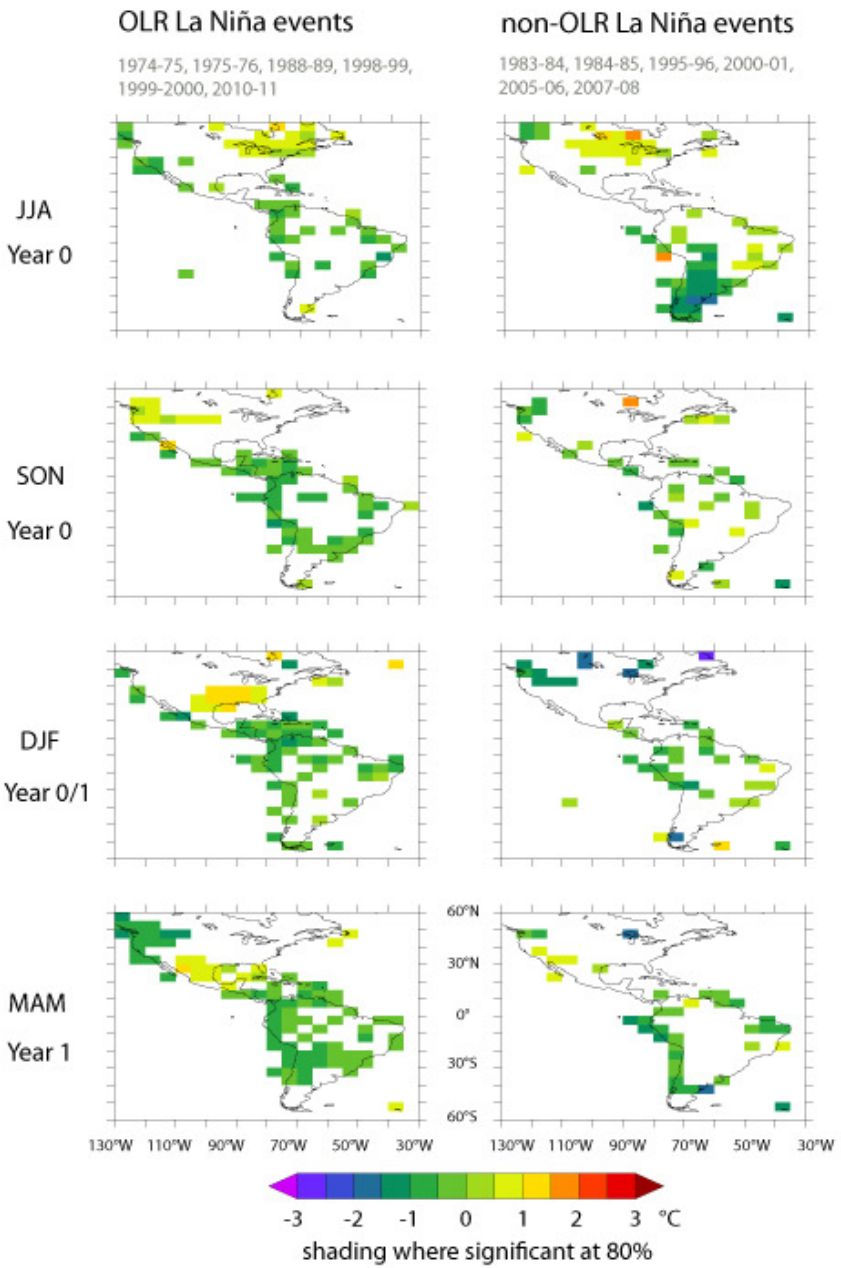
shading where significant at 80%

Individual years

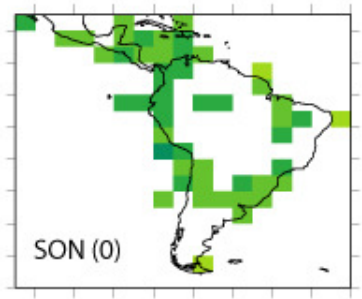


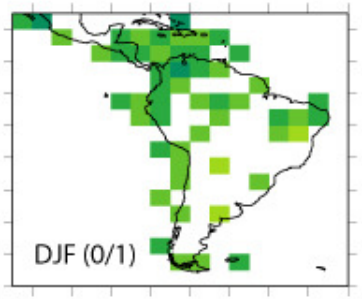
OLR La Niña impacts: Temperature

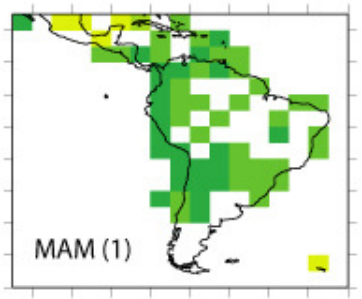
Significantly more cooling is seen in the tropics and along the western coastline of S. America in the OLR events than non-OLR events.

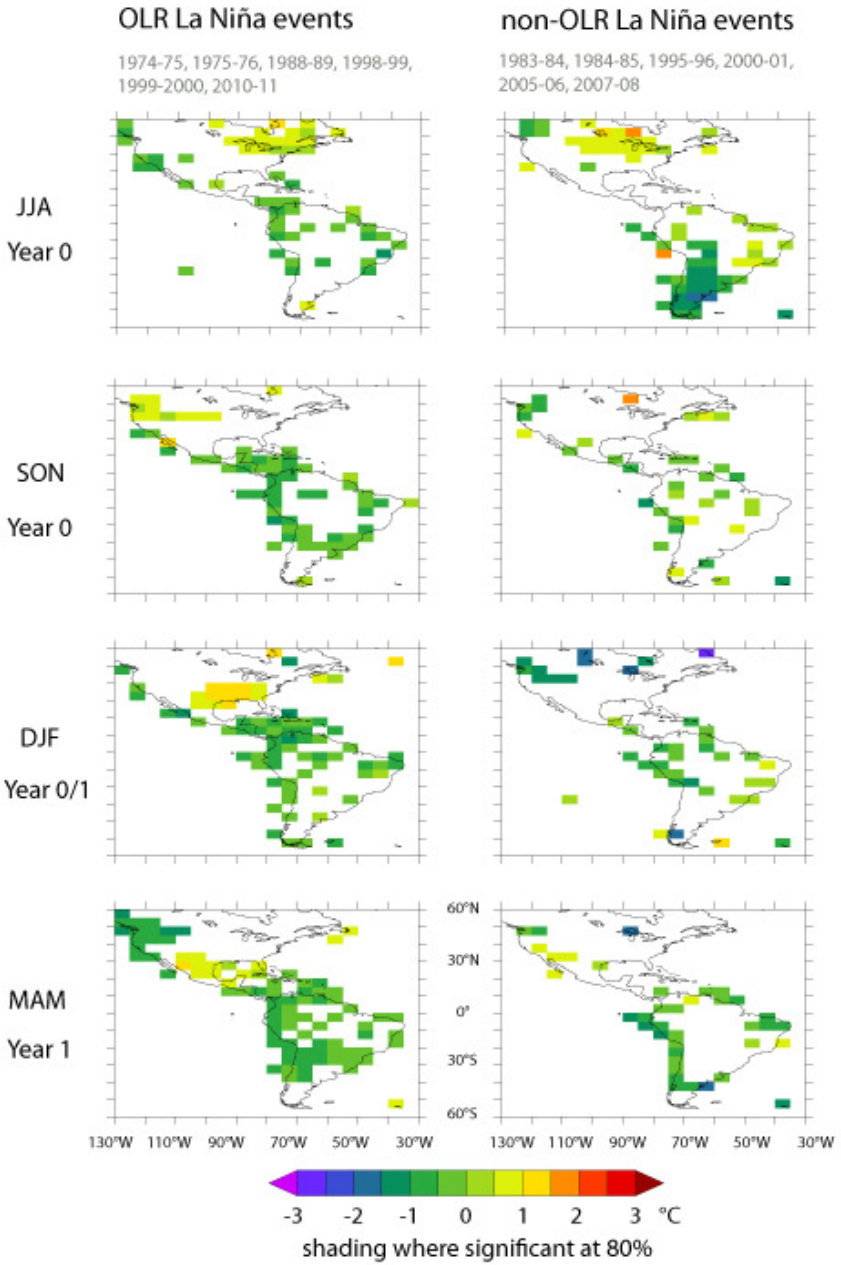


OLR La Niña impacts: Temperature









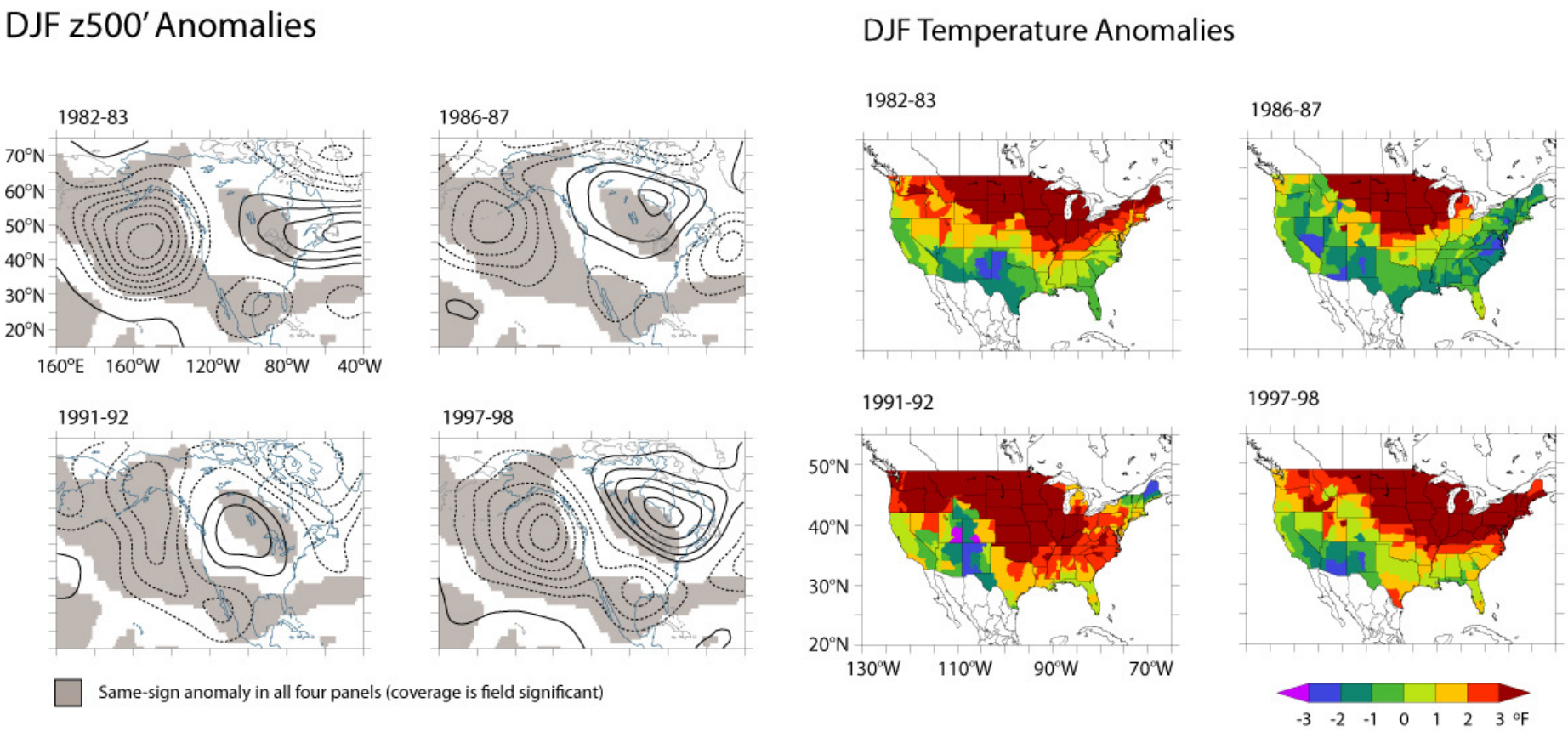
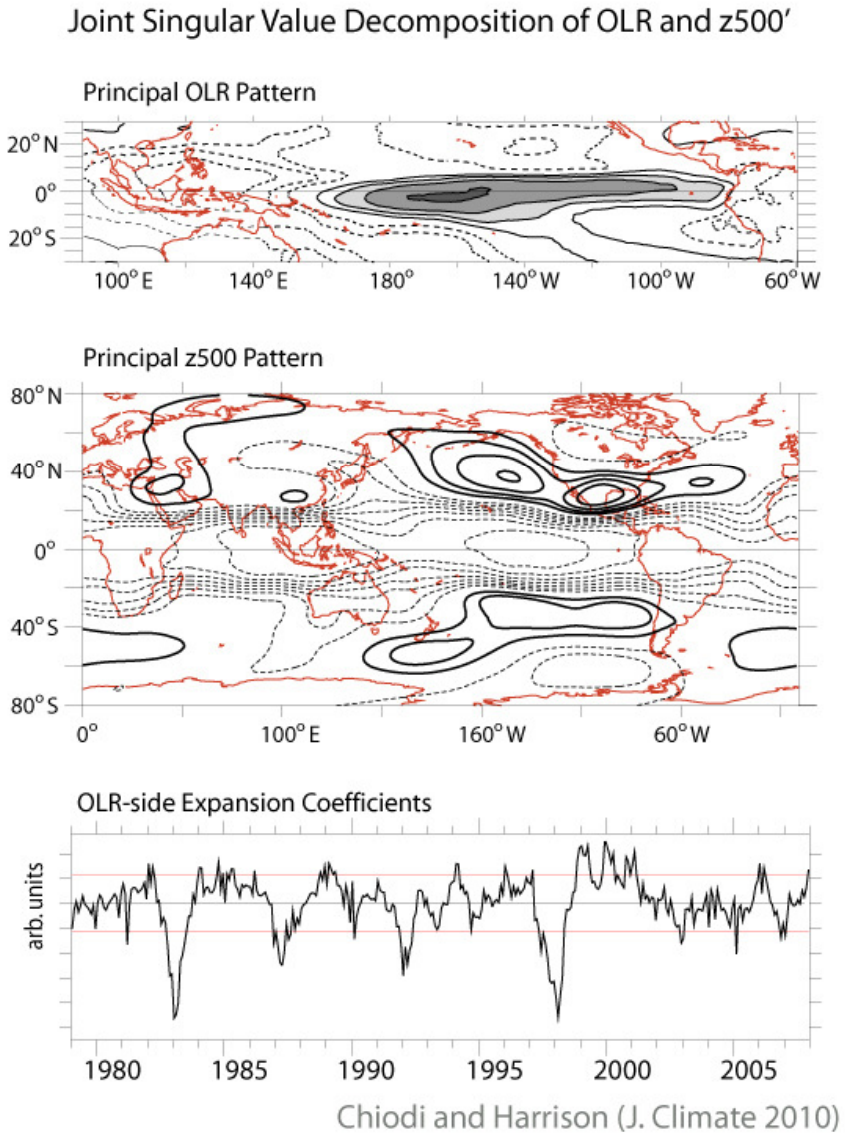
OLR La Niña summary

- Our OLR La Nina index distinguishes some events from others by the end of austral spring
- Composite OLR anomalies are strong in the austral spring in the OLR event case, but not in the non-OLR events.
- Robust S. American precip. anomalies are seen in the OLR event composites at this time – but not non-OLR event composites
- Forecasting will be needed to operationally identify OLR La Nina events prior to SON.

Conclusions/Future Work

- The OLR-event seasonal weather anomalies are similar to those seen in previous ENSO composites
- What is new here, is that most of the useful ENSO impacts on seasonal weather are found just in the OLR events. It is difficult to find much statistically significant anomaly in the non-OLR composites.
- Distinguishing OLR from non-OLR El Nino and La Nina events will help seasonal forecasting in the affected regions
- Our operational indices tend to do this by December
- We suggest more attention be paid to predicting tropical Pacific OLR behavior

OLR El Niño impacts



Characterizing warm-ENSO with OLR