

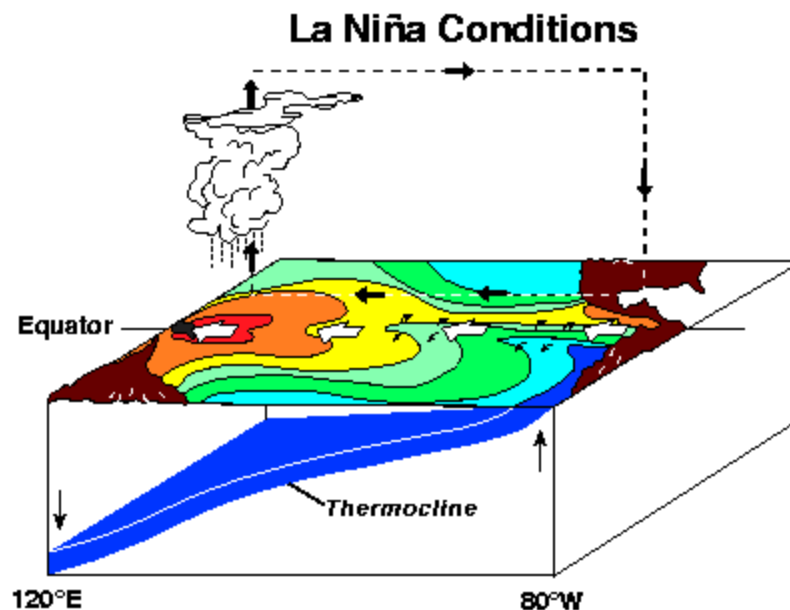
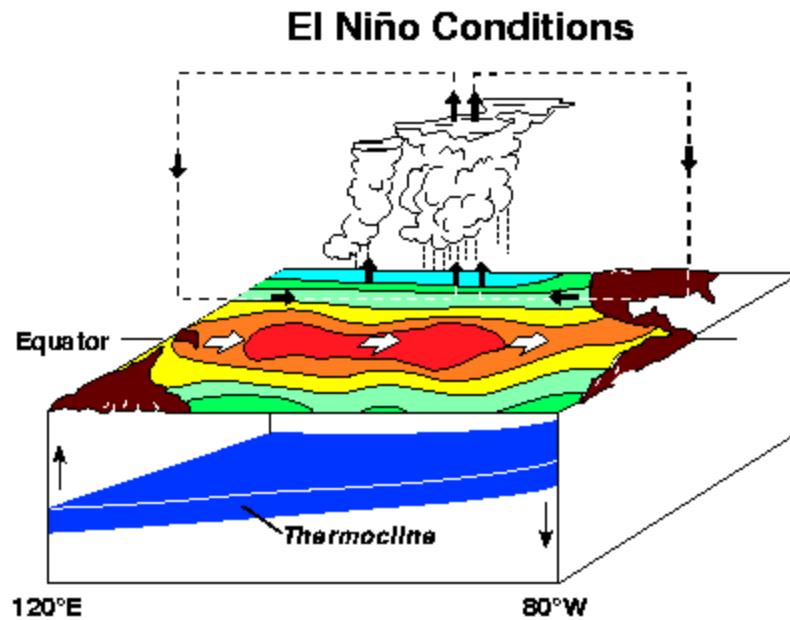
OLR Indices for ENSO Impacts on Seasonal Weather Anomalies

Andy Chiodi & Ed Harrison

Univ of WA (JISAO) and NOAA/PMEL
ENSO Diversity Wkshp
Boulder, Feb 2013

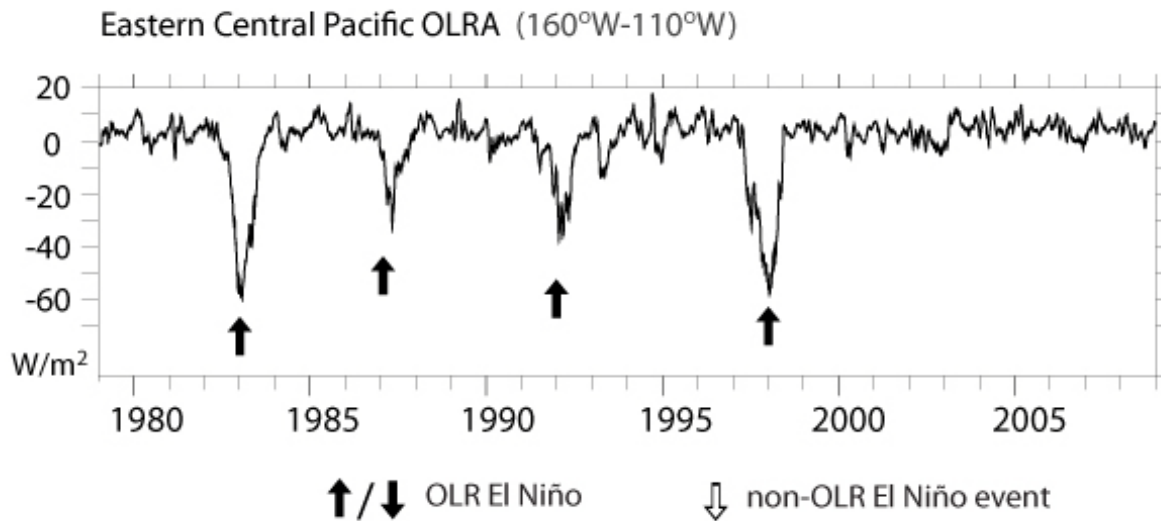
An OLR Perspective on ENSO seasonal weather associations

- SLP, SST and OLR all provide measures of coupled-system anomalies during ENSO, but OLR provides best look at atmospheric heating anomalies which drive temp. and precip. anomalies elsewhere
- *Most of the statistically significant seasonal weather anomalies around the globe result from a handful of events which can be identified by their OLR features*
- *Chiodi and Harrison (2013a), in this month's J. Climate and Chiodi and Harrison 2013b (in revision)*

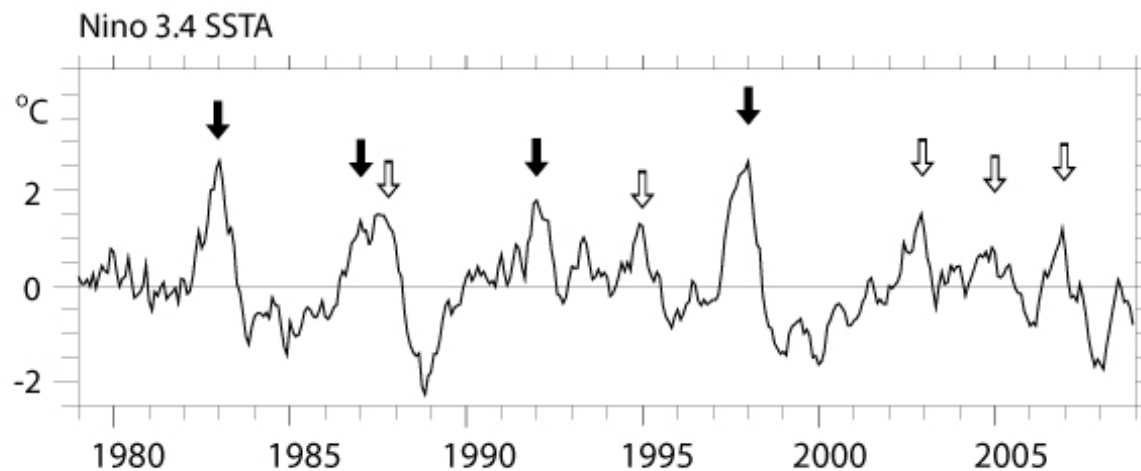


*OLR approach
motivated
initially by our
familiar ENSO
Cartoons*

Eastern Central Pac. OLR and El Niño



Monthly OLR Anom.
160°W:110°W and
5°S-5°N

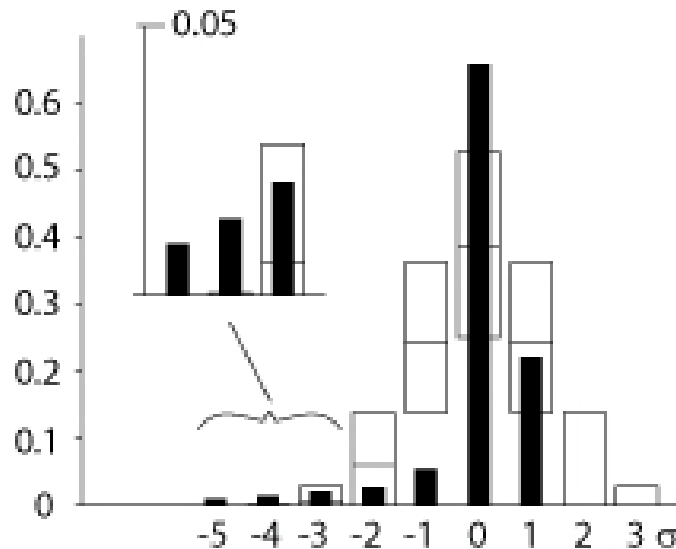


NINO3.4 SSTA

OLR from NOAA Interpolated (Liebmann and Smith, 1996)

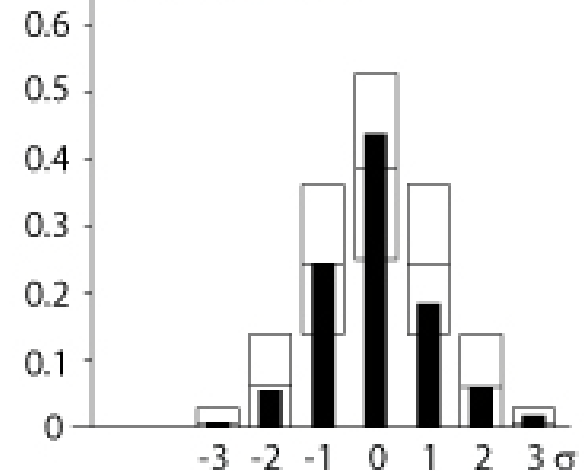
OLR behavior is more event-like than SSTA, SLP

OLR El Niño Index



Only in the 4 large events does the index cross the -1.5σ boundary, and it does so before winter in 3 of 4 cases.

Niño 3.4



<table border="1"><tr><td>p=0.95</td></tr><tr><td>expected</td></tr><tr><td>p=0.05</td></tr></table>	p=0.95	expected	p=0.05	}	based on commensurate Gaussian distribution
p=0.95					
expected					
p=0.05					

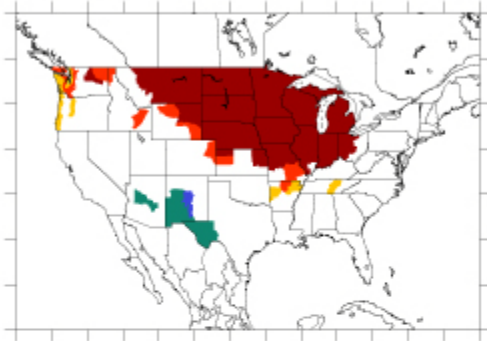
Seasonal Weather Associations

- It is easier to examine seasonal weather anomalies in one region first.
- The U.S. is one strongly affected region, but similar results are obtained elsewhere.

USA Winter Surface Temp Anomaly for different subsets of El Nino events.

DJF Temperature

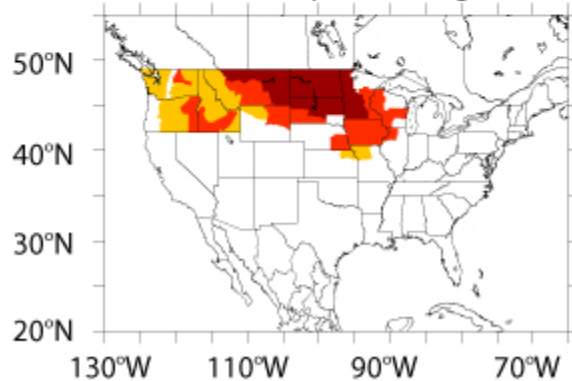
a) Four OLR Events



b) Five non-OLR Events



c) Nine Event Composite Average



Shading at 95% significance

OLR-El Nino
Event
Composite

Non-OLR El
Nino Event
Composite

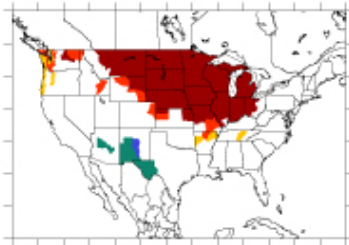
All-Event
Composite

Temp patterns are consistent among the OLR-EN years; different patterns seen in other years

DJF Temperature Anomalies

Composites

OLR El Niño



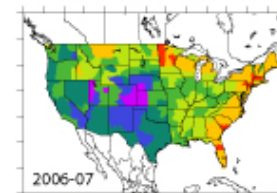
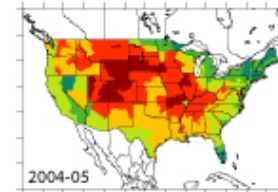
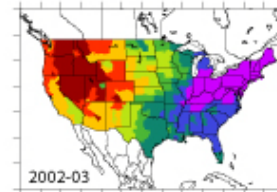
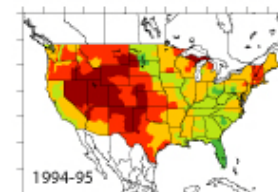
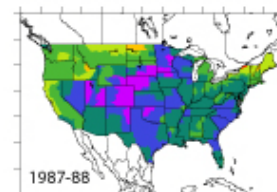
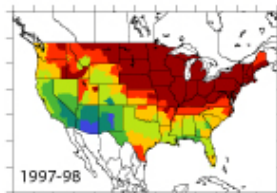
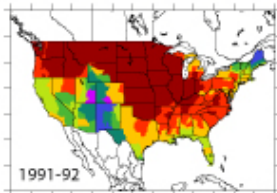
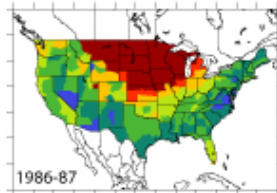
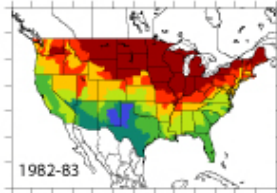
shading where significant ($p > 0.95$)

non-OLR El Niño



shading where significant ($p > 0.95$)

Individual years

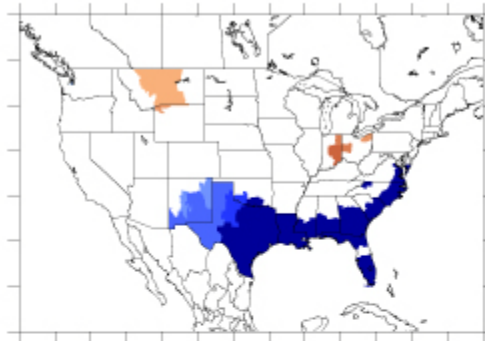


As before, only for seasonal surface precipitation anomaly

DJF Precipitation

For OLR-El
Nino Events

a) Four OLR Events



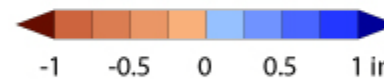
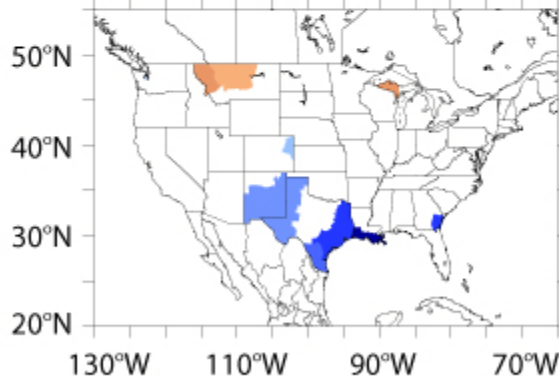
For Non-OLR
El Niño
Events

b) Five Dateline Events



Including all
El Niño
Events

c) Nine Event Composite Average



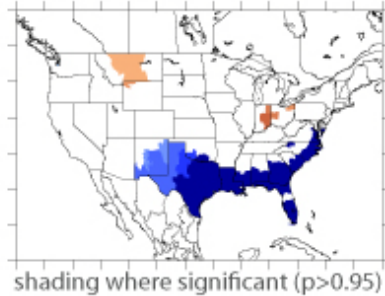
Shading at 95% significance

Again, as before, only for seasonal surface precipitation anomaly

DJF Precipitation Anomalies

Composites

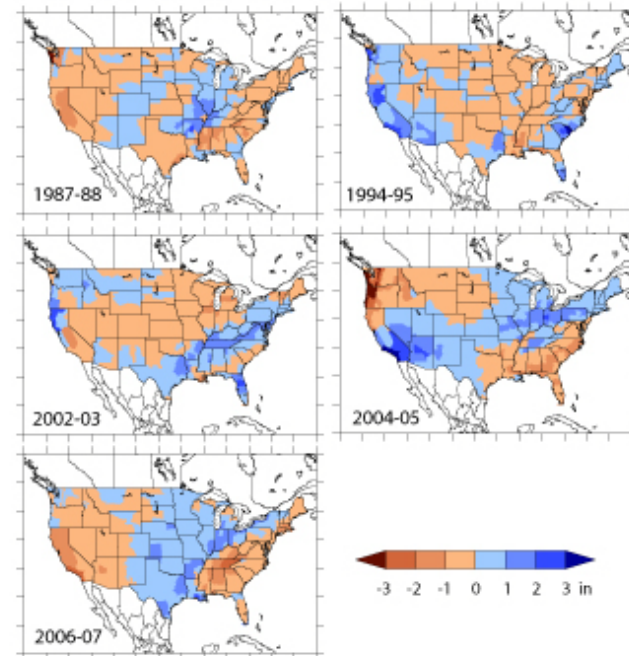
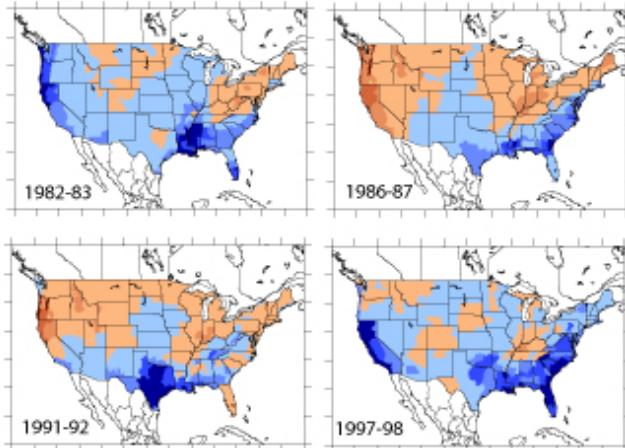
OLR El Niño



non-OLR El Niño



Individual years

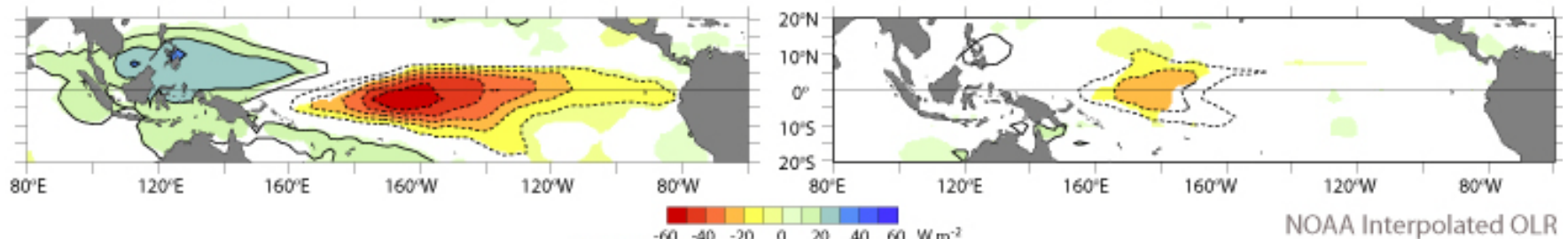


Seasonal Tropical Anomaly Conditions

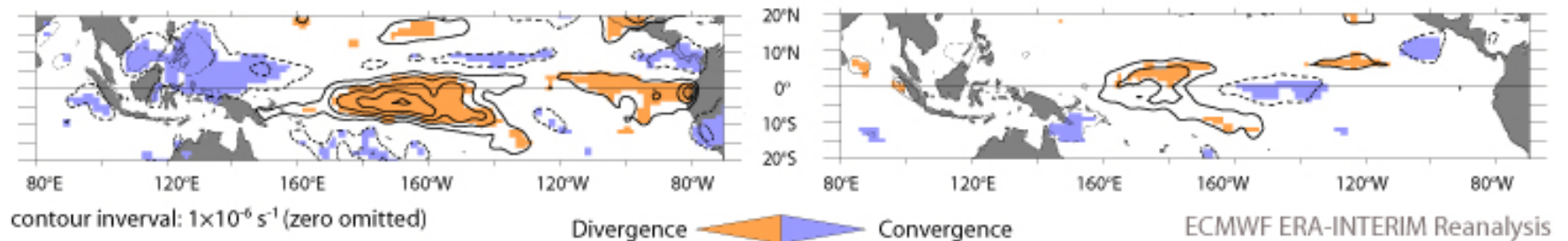
OLR-El Niño events

non-OLR events

DJF OLR Anomaly



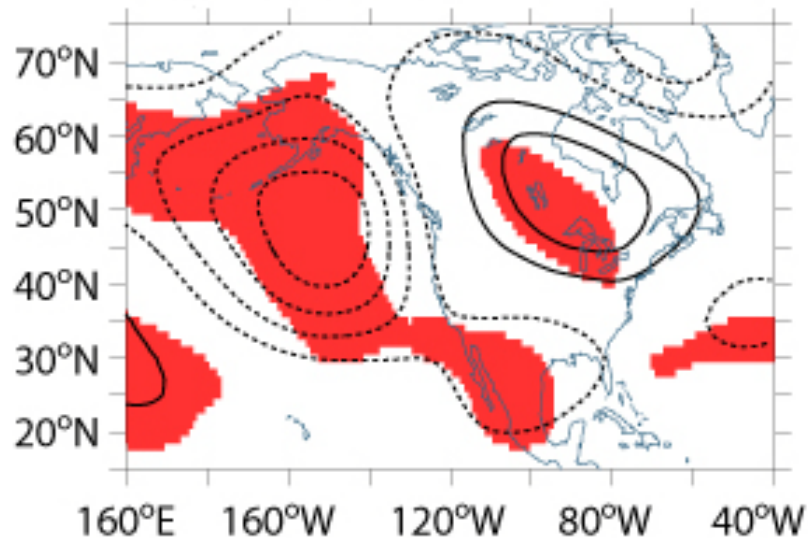
DJF 200 hPa Divergence



Seasonal Atmospheric Circulation Anomaly

OLR El Nino Events

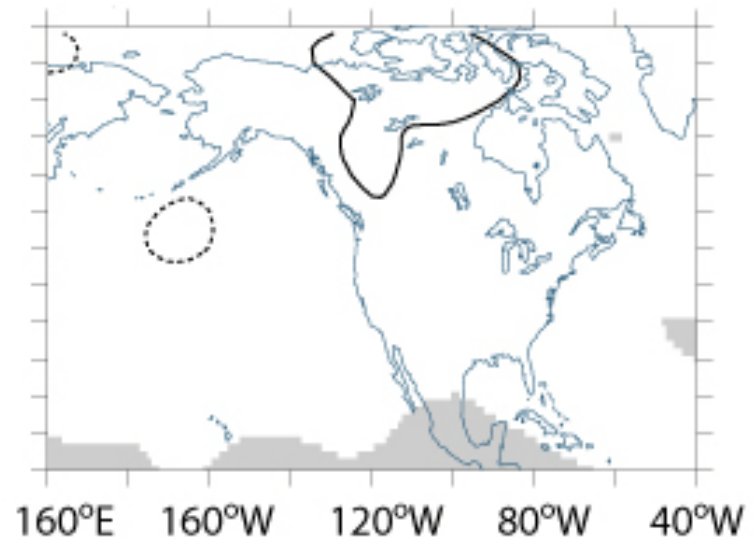
DJF z500'



Contours every 20m

Shading at 95% local significance:

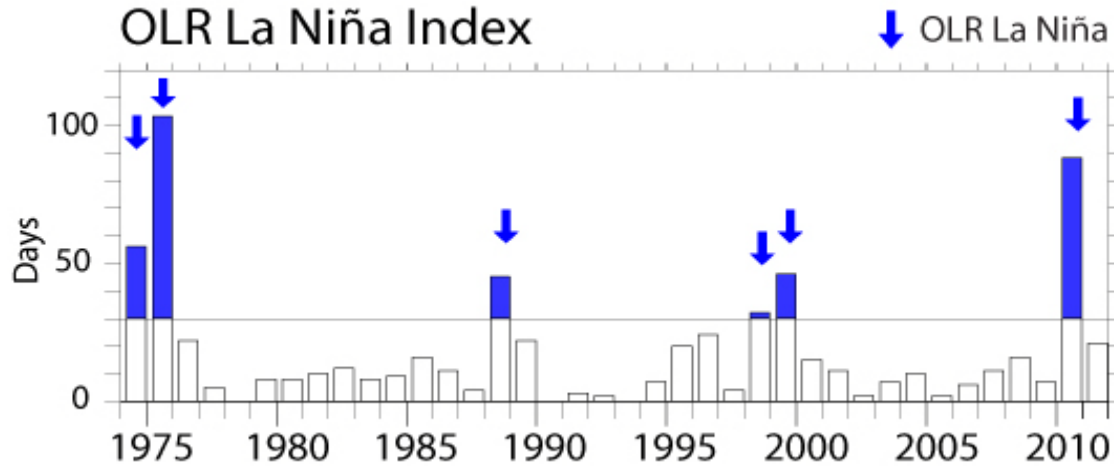
non-OLR Events



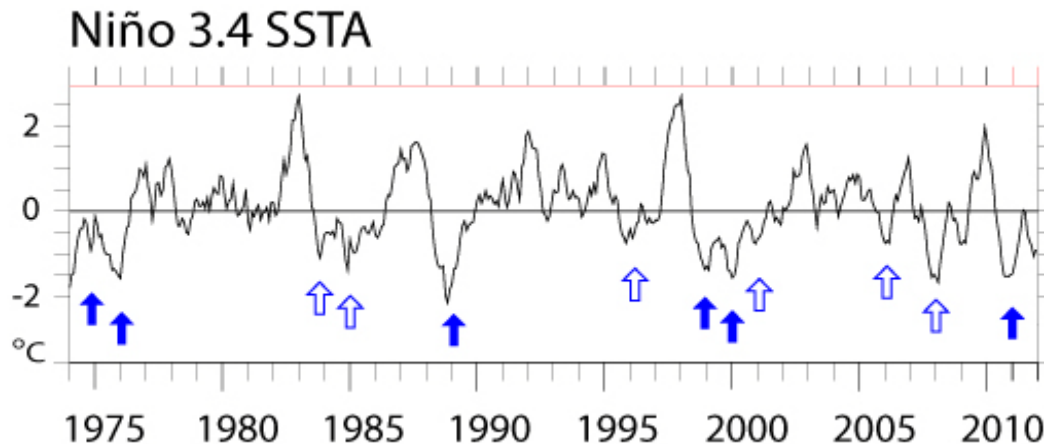
■ not field significant

■ 95% field significance

An OLR index for La Nina

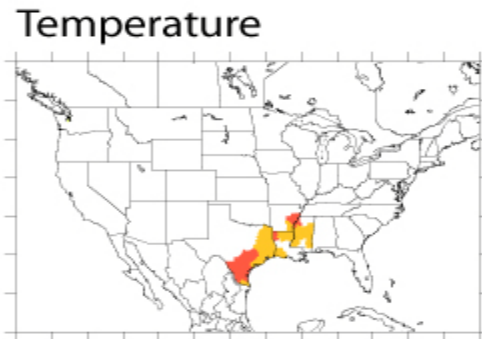


***OLR-La Nina
Index counts
days of clear sky
from 1 April to
31 Dec over
150E:180x5S:5N***

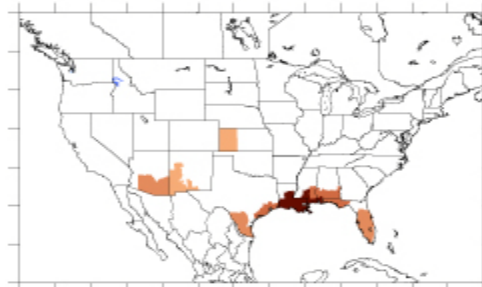


DJF Composite Anomalies

OLR La Niña
(6)



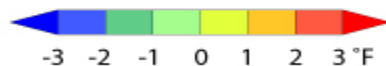
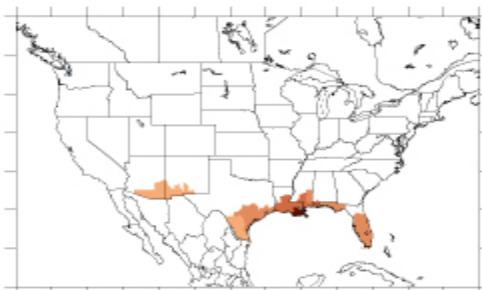
Precipitation



non-OLR
(6)



Combined
(12)

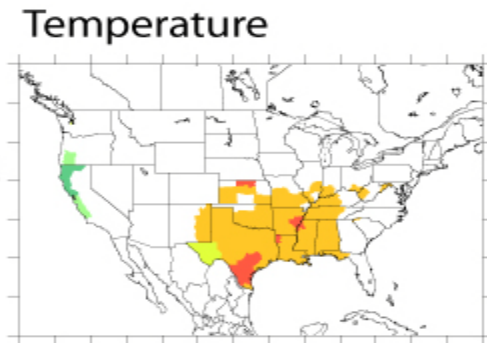


shading where significant ($p > 0.95$)

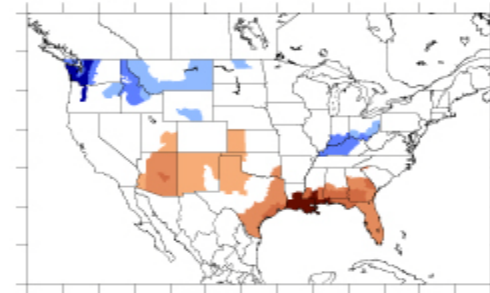
95% stat
sig

DJF Composite Anomalies

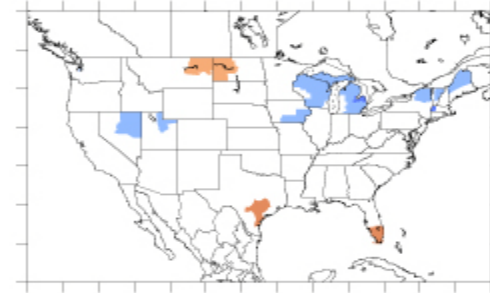
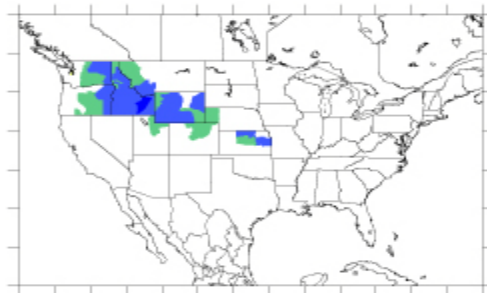
OLR La Niña
(6)



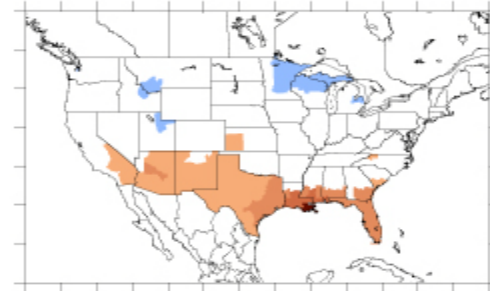
Precipitation



non-OLR
(6)



Combined
(12)



shading where significant ($p > 0.8$)

80% stat
sig

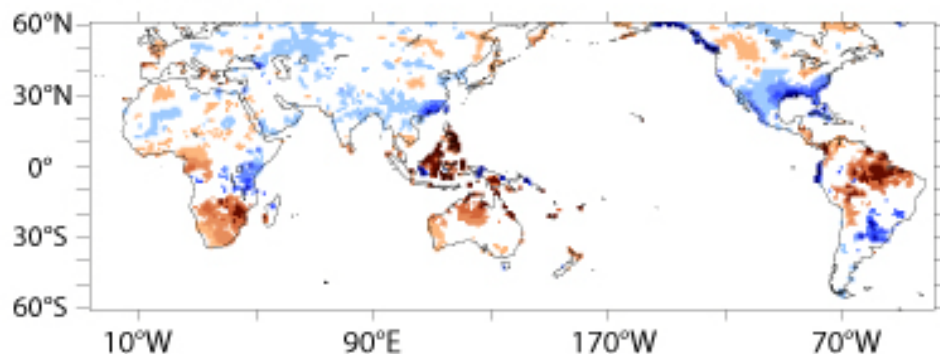
Global Seasonal Weather Associations

- We have performed global, or “field significance” tests on precip. and found that only **OLR EN (DJF)** and **OLR LN (SON)** years pass at $p=0.95$
- Other seasons reach $p=0.9$ in the OLR-case (**EN: SON, MAM, LN: DJF**)
- All non-OLR cases considered are ***not*** field significant ($p < 0.66$), except EN-SON ($p=0.84$, Australia?)

El Nino Seasonal Precipitation Anom.

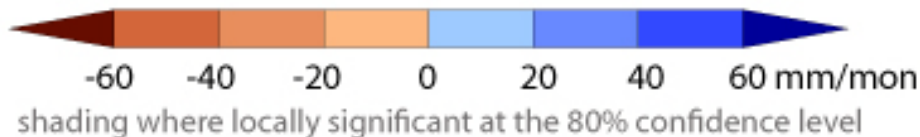
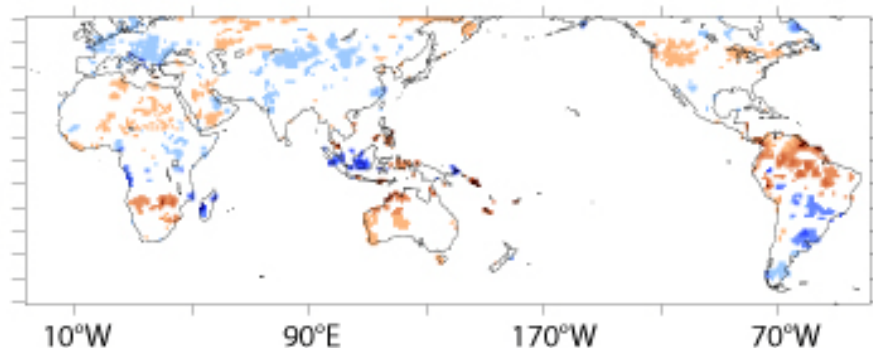
OLR El Niño events

DJF Year 0/1



non-OLR El Niño events

DJF Year 0/1

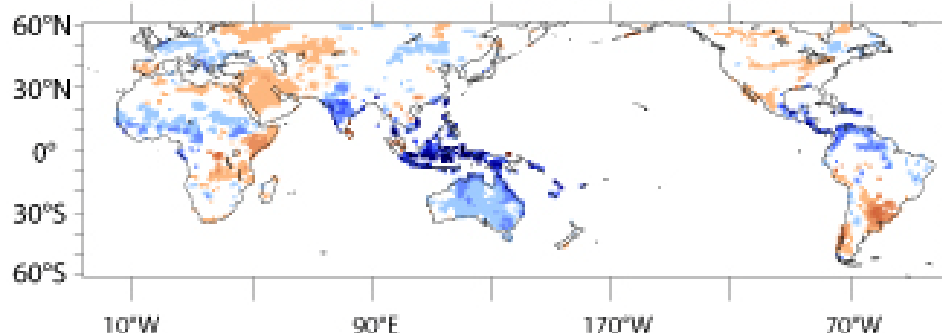


La Nina Seasonal Precipitation Anom.

OLR La Niña events

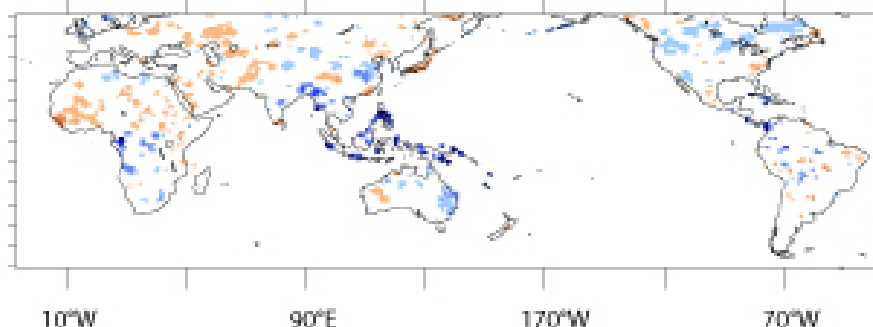
SON Year 0

1974-75, 1975-76, 1988-89, 1998-99, 1999-2000, 2010-11



non-OLR La Niña events

1983-84, 1984-85, 1995-96, 2000-01, 2005-06, 2007-08



shading where locally significant at 80%

We find that using OLR indices for El Nino and La Nina identifies the subset of commonly considered events that most strongly account for the familiar winter seasonal temp and precip anomalies over the US.

There is little high statistical significance weather anomalies associated with the non-OLR events.

There is no simple mapping from Nino3.4 SSTA to the list of OLR events.

This suggests that paying more attention to the OLR behavior of the tropical Pacific may result in higher-confidence seasonal weather predictions.

Agenda Questions:

2. How well do climate models reproduce the “observed” characteristics of ENSO diversity?

We suggest it may be useful to look at how well the observed OLR behavior is reproduced in these models

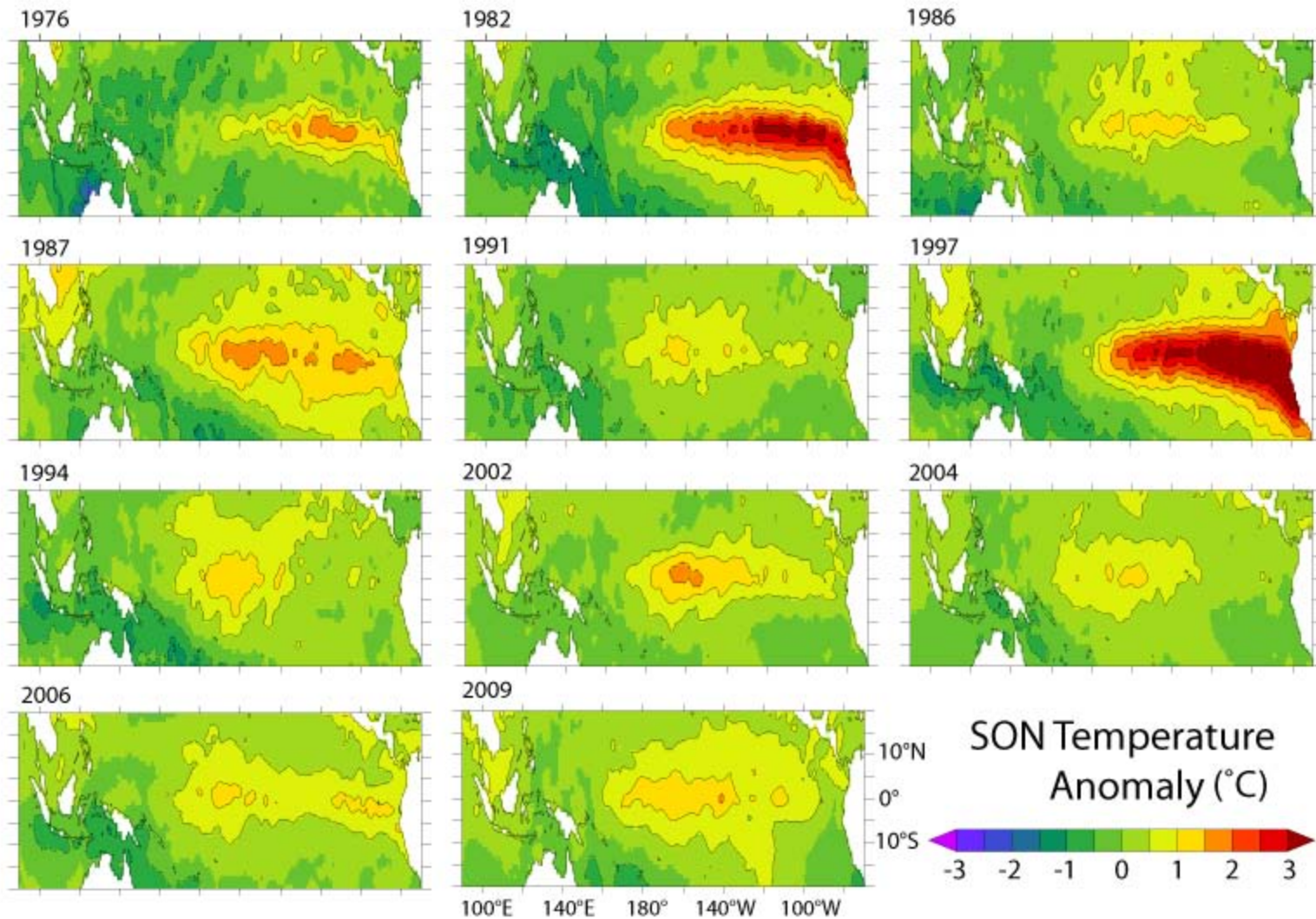
3. Do discrete classes of ENSO events emerge from observations and models, or is ENSO diversity better described as a continuum with some interesting extremes?

OLR features suggest an event-like nature that may help identify the events most likely to influence seasonal weather conditions in the U.S. and other affected regions.

4. Are oceanic indices sufficient to characterize ENSO diversity, or indices/metrics accounting for the atmospheric state are necessary?

We think that keeping track of the tropical Pacific deep convection conditions is key.

El Nino Seasonal SSTA patterns



El Nino Seasonal SSTA patterns

