Convective Season Synoptic Climatology by ENSO Phase in the North Central U.S.

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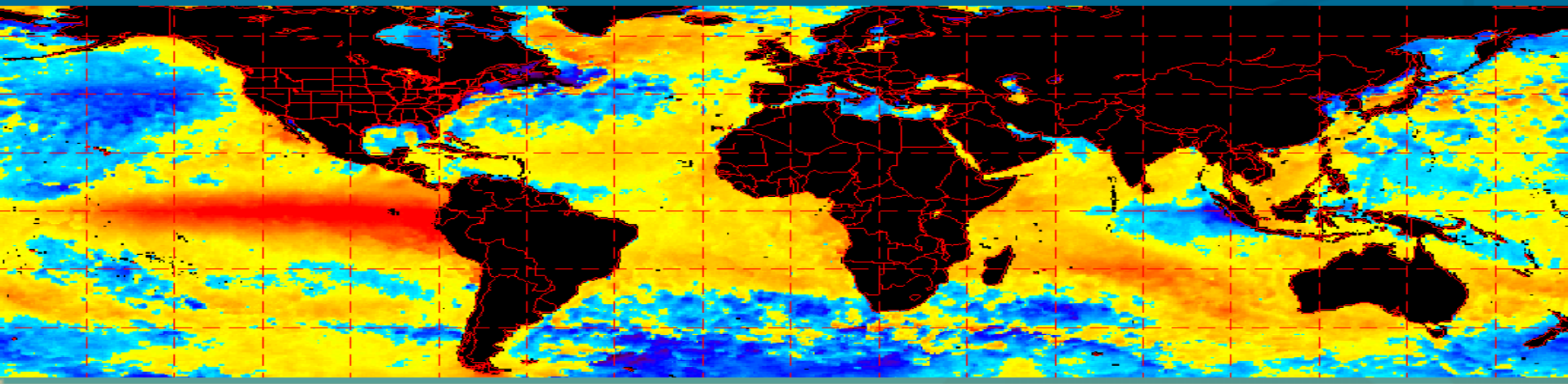
Presentation Outline

- Recap: Impact of ENSO phase on tornado climatology
- Spring 2008 ENSO phase
- Impact of La Niña and El Niño on synoptic patterns

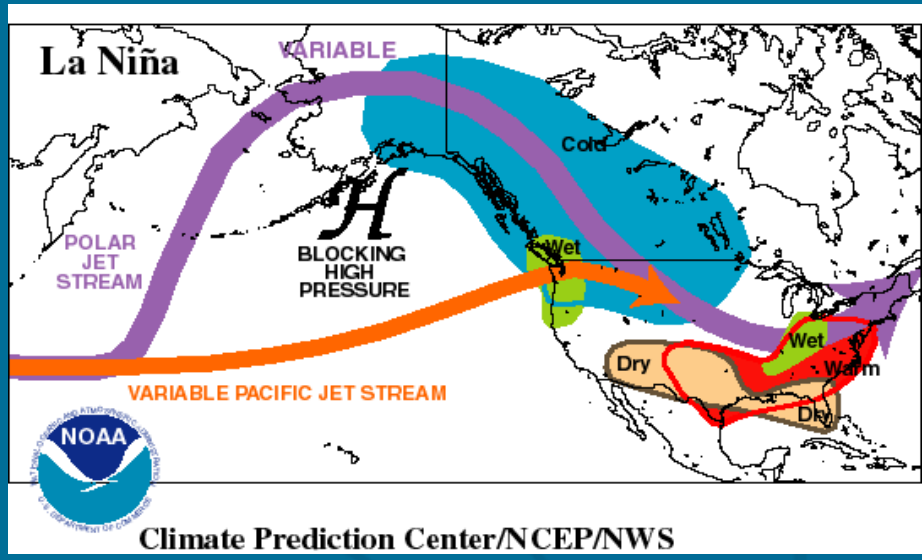


How does ENSO phase impact tornado activity in the Plains?

La Niña: North American Perspective

- Blocking high in the Gulf of Alaska
- Variable jet speed
- Increased storminess in central N. America
- Cold air in AK/Canada spilling into the Plains
- Warm and dry in the Southeastern U.S.
- Wet in the Ohio Valley
- Higher than average Atlantic hurricane activity

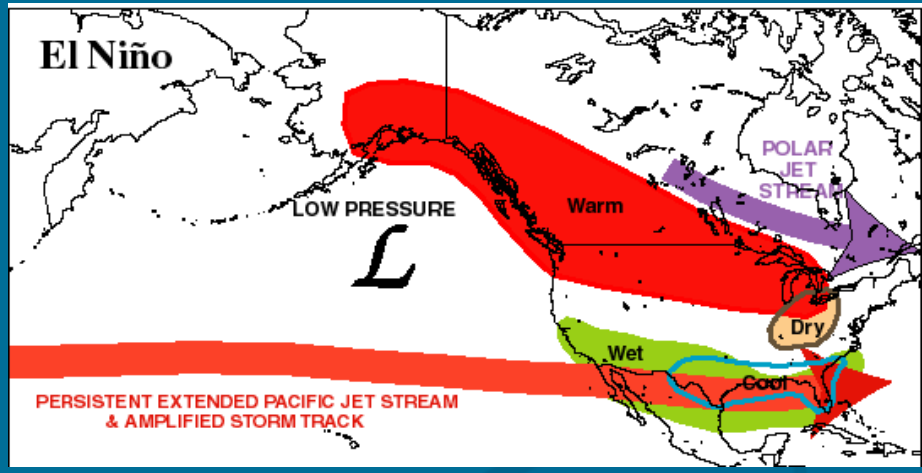
Typical JFM weather patterns and anomalies during a moderate to strong La Niña



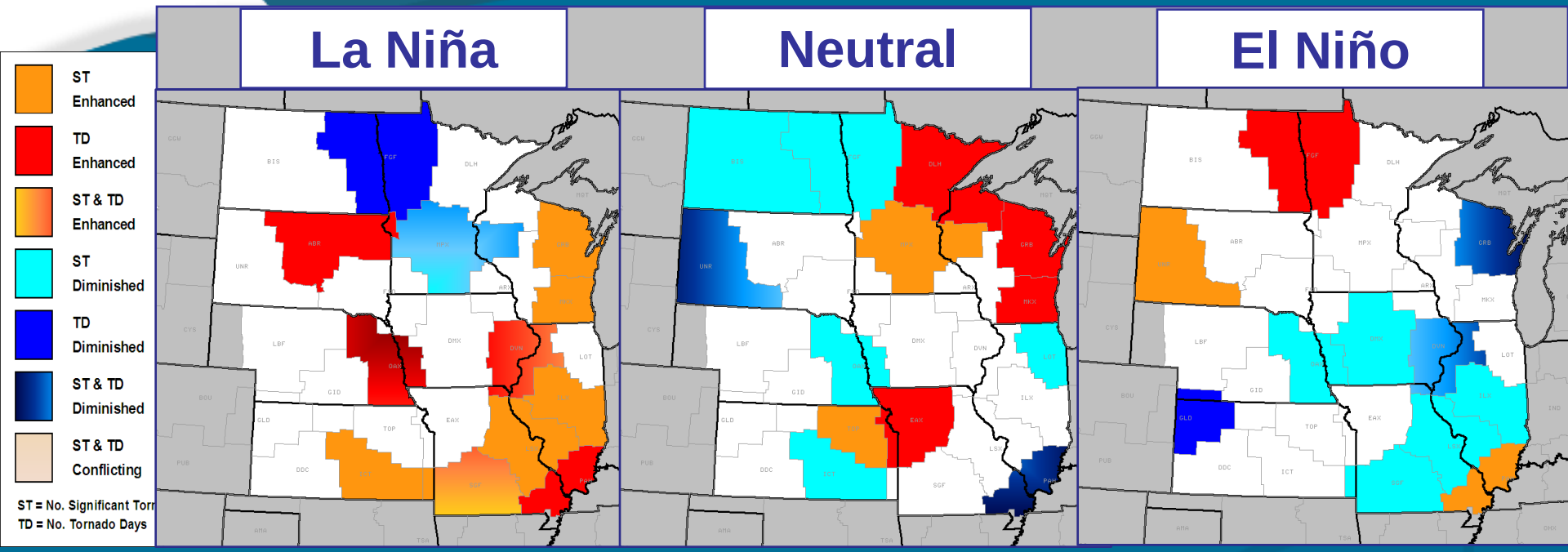
El Niño: North American Perspective

- Anomalous low in the Gulf of Alaska
- Zonal jet stream
- Wet in California
- Cool and wet in the Southeastern U.S.
- Dry in the Ohio Valley
- Lower than average Atlantic hurricane activity

Typical JFM weather patterns and anomalies during a moderate to strong El Niño



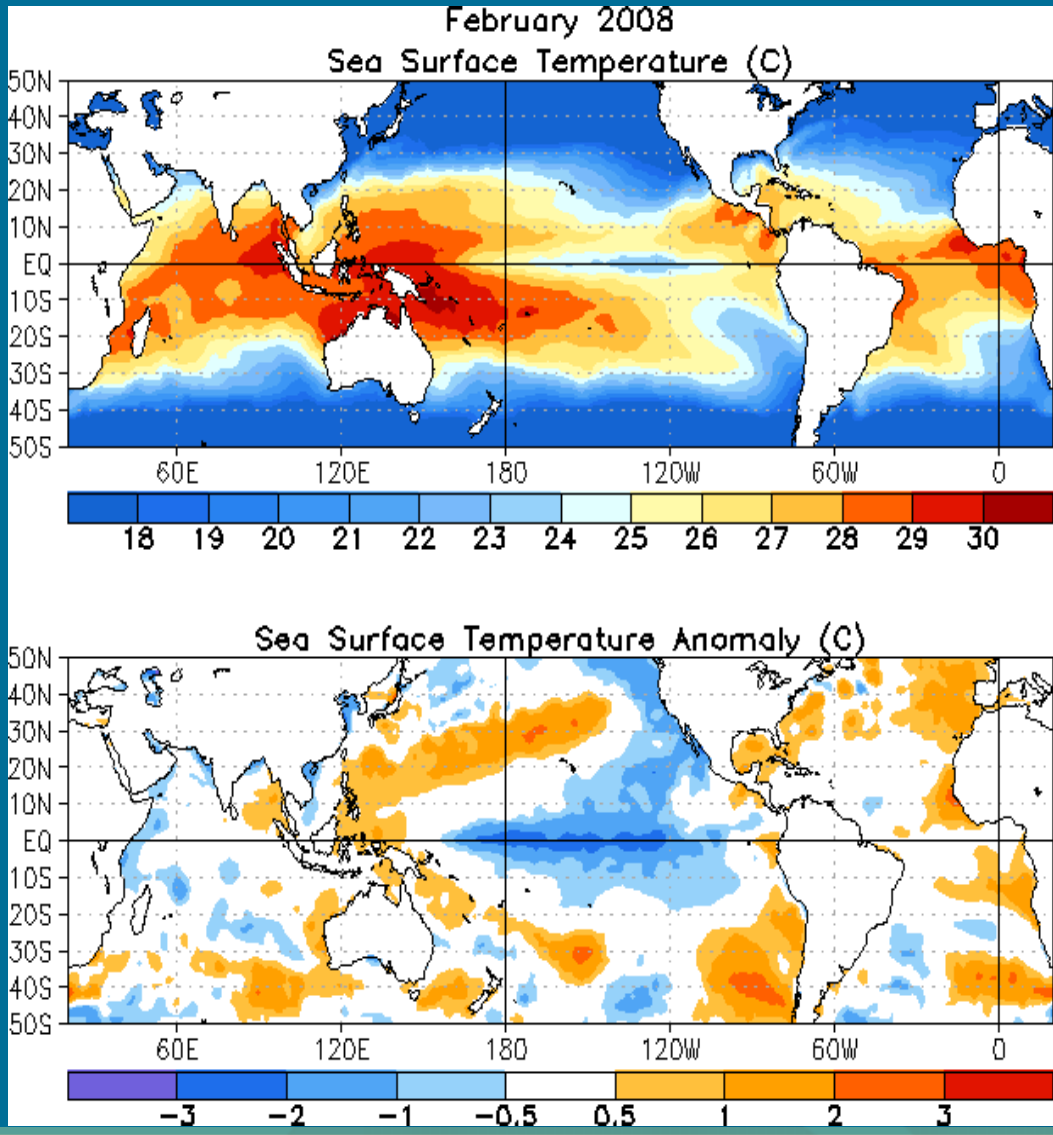
Impact of ENSO on Tornado Activity: Late Spring through Summer



- **ENSO phase during MJJ-SON seasons**
- **Tornado activity during MAMJ:**
  - Number of significant tornadoes
  - Number of tornado days
- **Reference: Mayes et al, 2007**

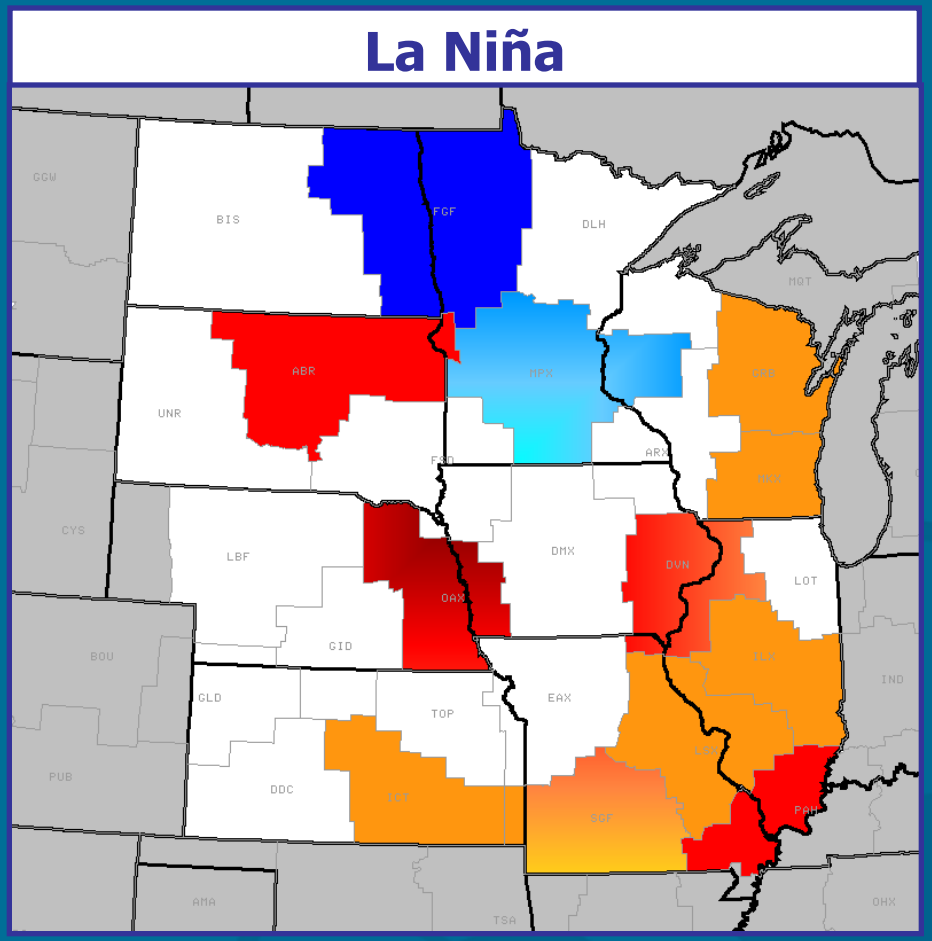
ENSO Phase: Early Spring 2008

- **Moderate to strong La Niña**
  - Duration: JAS 2007 to AMJ 2008
  - Strongest ONI value: -1.5°C in DJF 2007-08
  - Moderate to strong (ONI ≤ -1.0°C) for 6 seasons
- **Weakened during late spring/ early summer 2008**



Spring 2008: La Niña

- **Research suggests a higher than usual chance for:**
  - More tornado days than average range
    - *Average range in OAX CWA: 6-8 days with tornadoes*
    - *So far in 2008: 11 days*
  - More significant (EF2 or greater) tornadoes than average range
    - *Average range in OAX CWA: 2-3 significant tornadoes*
    - *So far in 2008: 4 significant tornadoes*

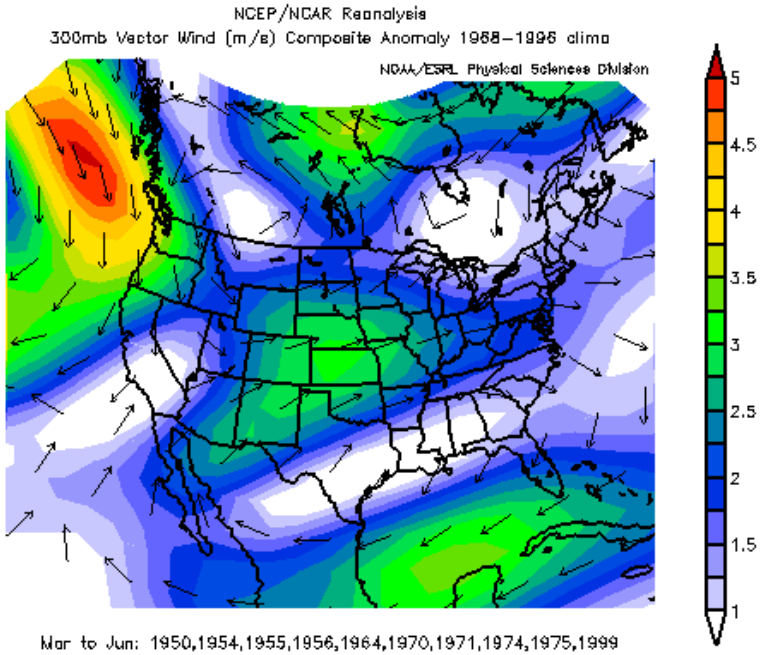


Creating Composites Based on ENSO Phase

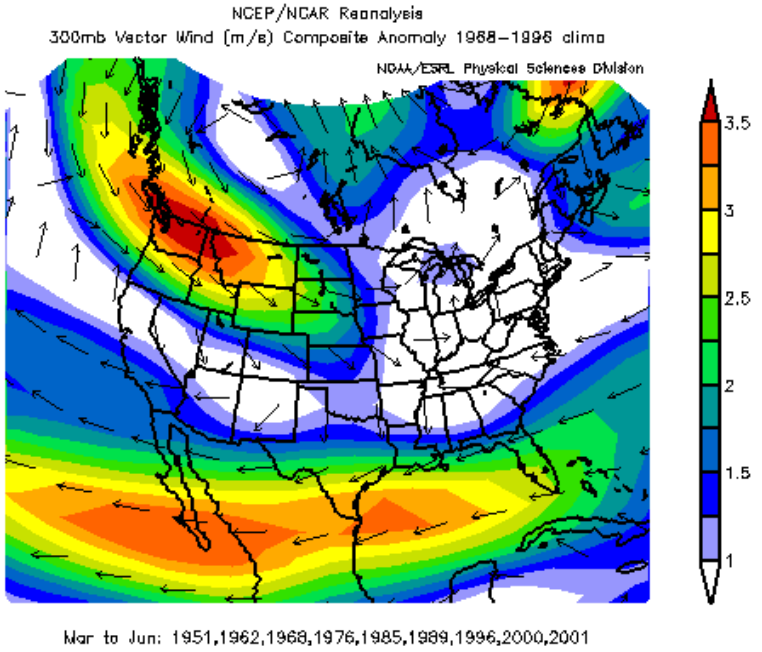
- **Sorted Mar-Apr-May-Jun (MAMJ) for all years 1950-2005 into ENSO phase.**
  - Based on ENSO phase during seasons overlapping MAMJ: JFM, FMA, MAM, AMJ, MJJ, JJA
  - Going into La Niña or El Niño if neutral at beginning of MAMJ and enter into phase during those months
  - Going out of La Niña or El Niño if in the phase at the beginning of MAMJ and neutral by the end of those months.
  - In La Niña or El Niño if in the same phase for all seasons covering MAMJ
  - Not included if transitioned from one phase to the opposite during MAMJ
- **Created composites for each of the 5 phases using NOAA Climate Diagnostics Center (CDC) Monthly/ Seasonal Climate Composites website.**

Results for La Niña: 300 hPa Winds

La Niña: In/Going In

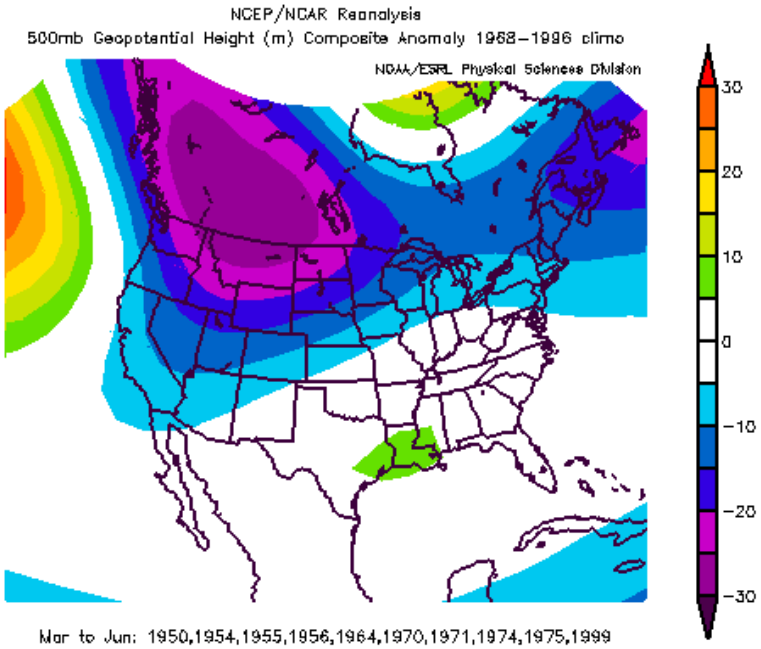


La Niña: Going Out

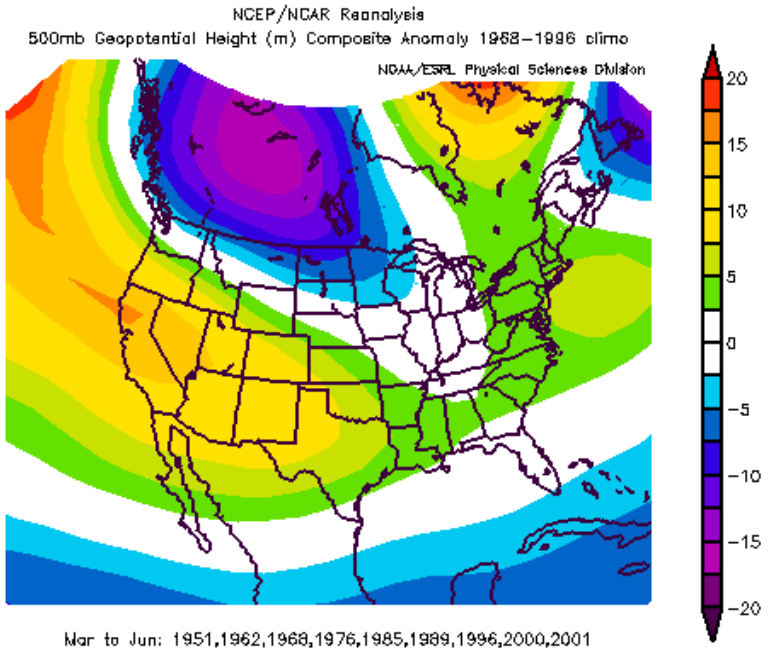


Results for La Niña: 500 hPa Height

La Niña: In/Going In

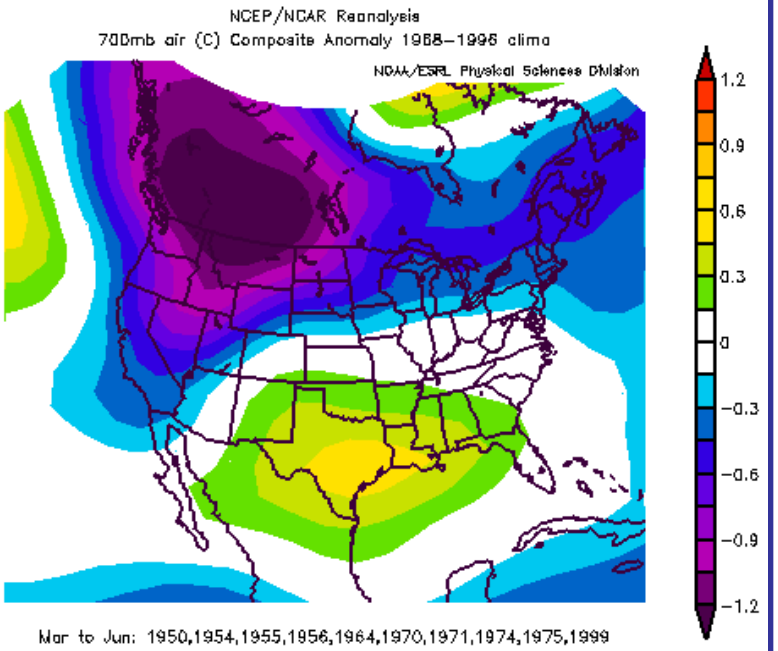


La Niña: Going Out

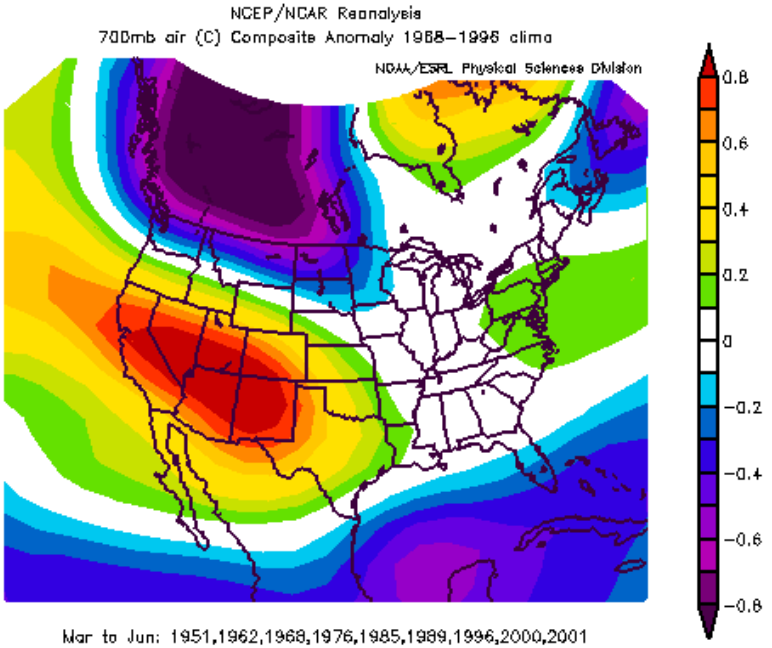


Results for La Niña: 700 hPa Temperature

La Niña: In/Going In

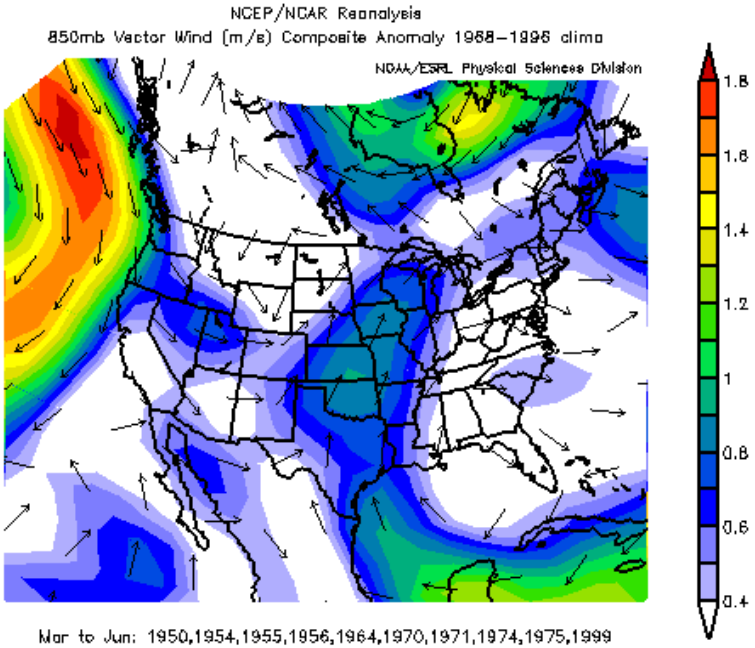


La Niña: Going Out

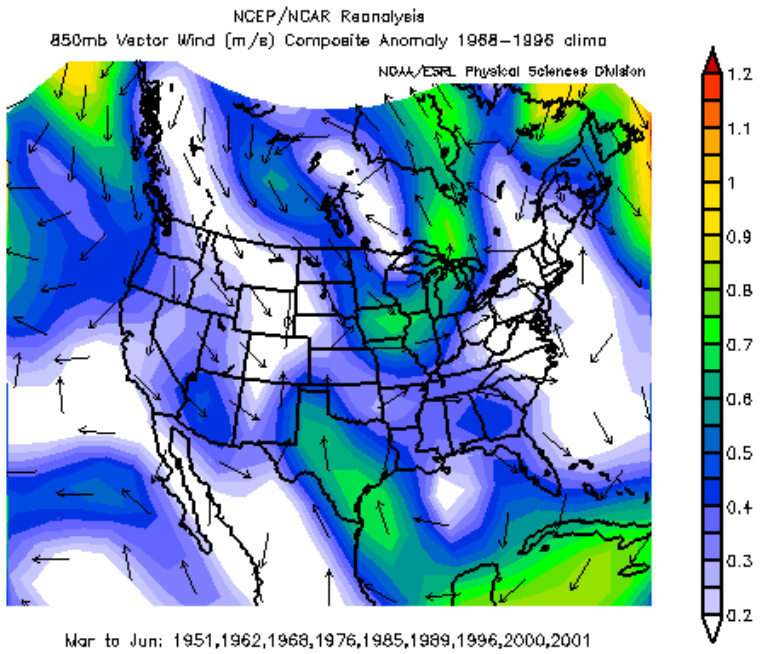


Results for La Niña: 850 hPa Winds

La Niña: In/Going In

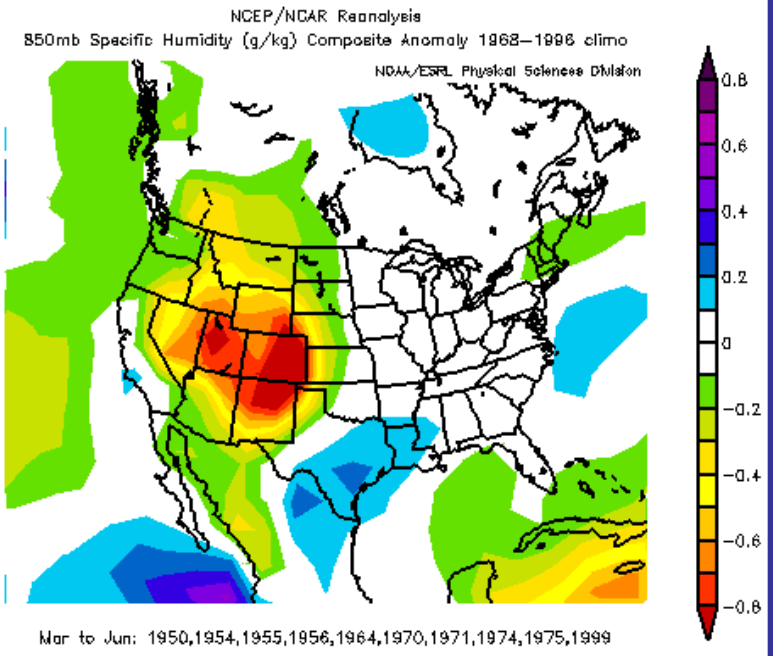


La Niña: Going Out

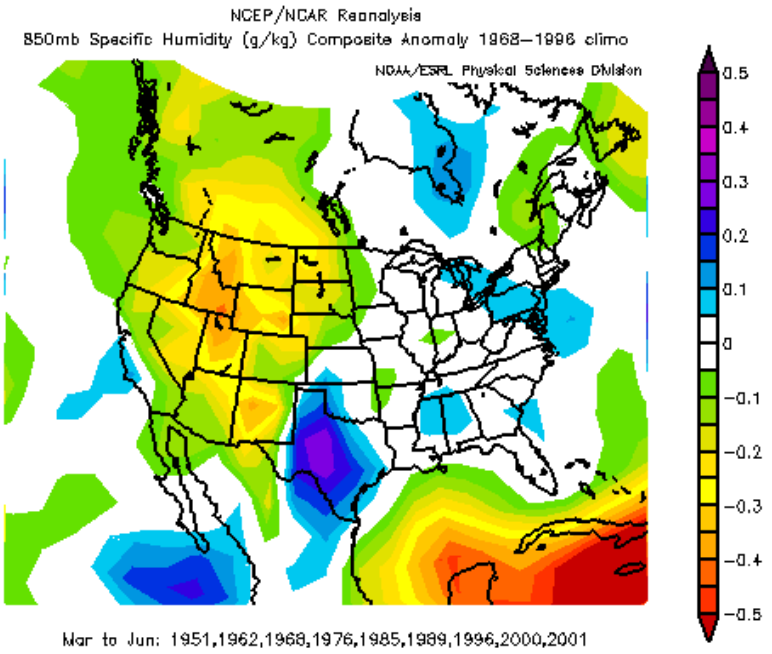


Results for La Niña: 850 hPa Specific Humidity

La Niña: In/Going In

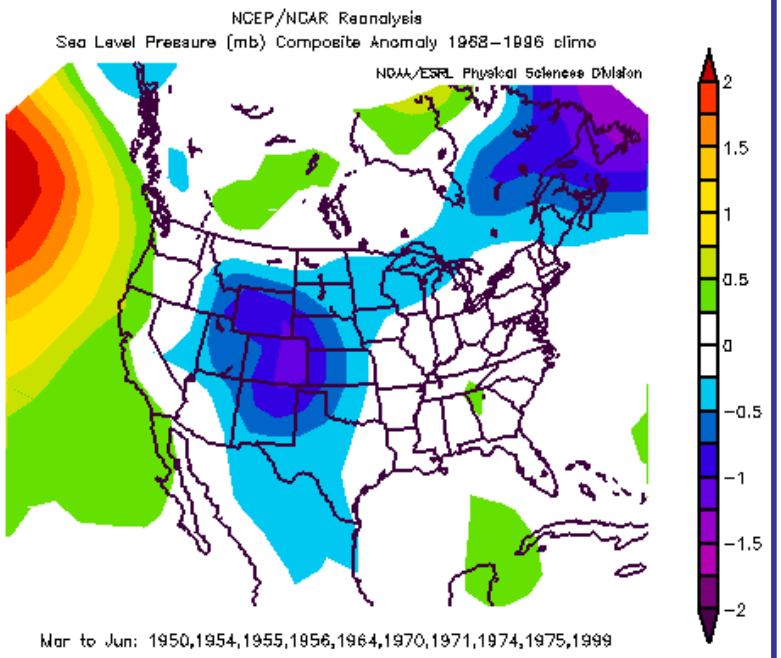


La Niña: Going Out

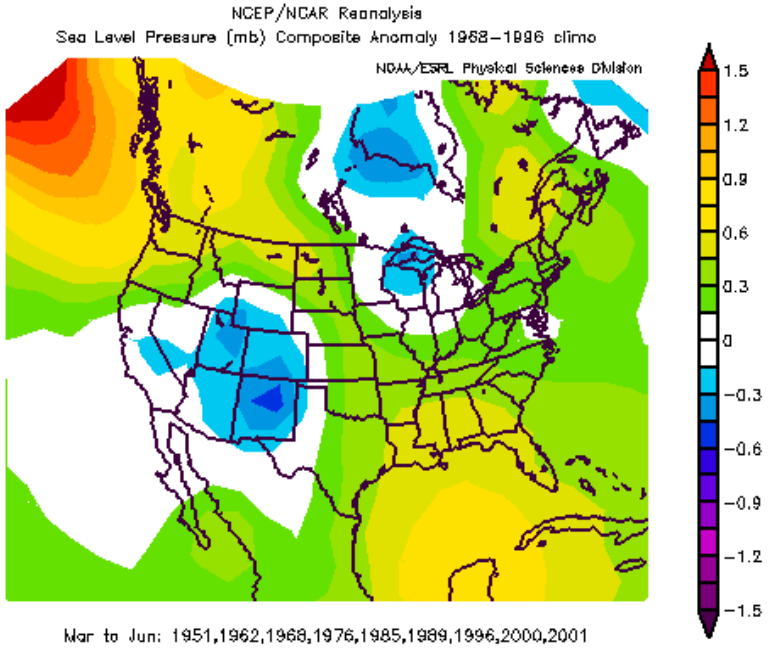


Results for La Niña: Surface Sea Level Pressure

La Niña: In/Going In



La Niña: Going Out

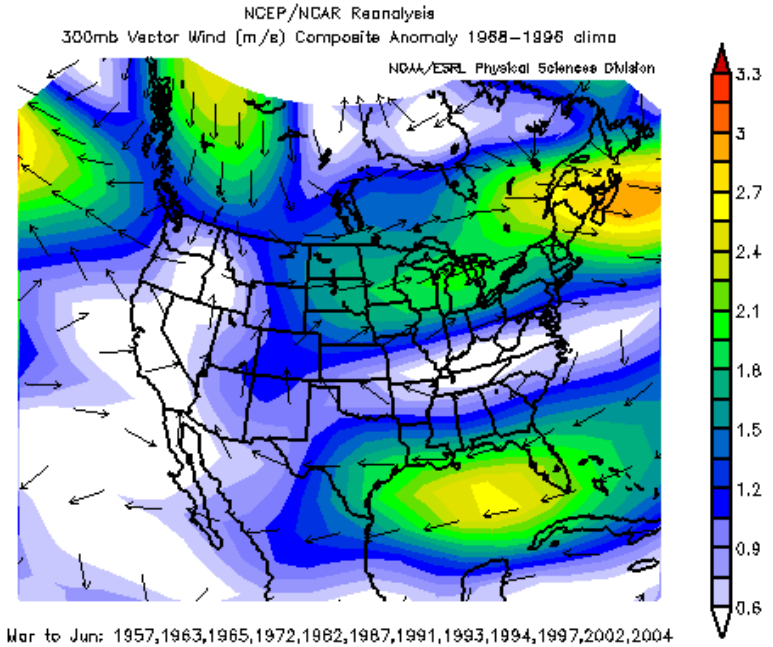


Conclusions for La Niña

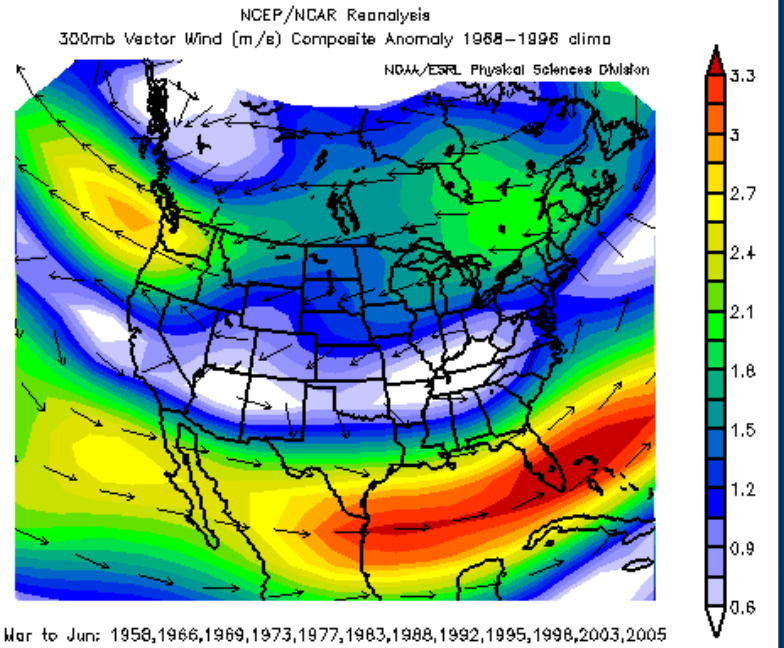
- **Features with La Niña (especially in or going in) would enhance convection across the Plains:**
  - Enhanced upper low in the West
  - Enhanced upper southwesterly flow
  - Enhanced southerly low-level jet
  - Favored dryline location pushing eastward into the Central Plains
  - Enhanced surface trough in lee of Rockies

Results for El Niño: 300 hPa Winds

El Niño: In/Going In

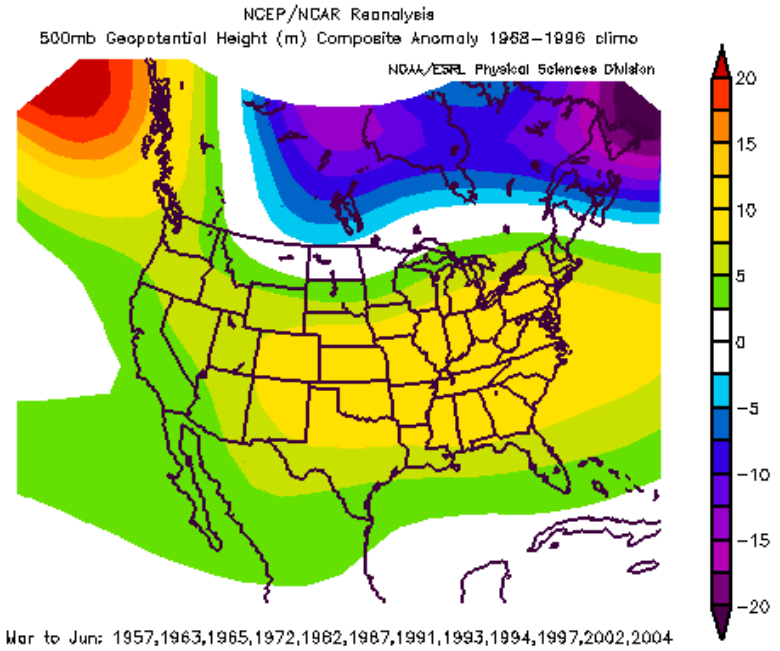


El Niño: Going Out

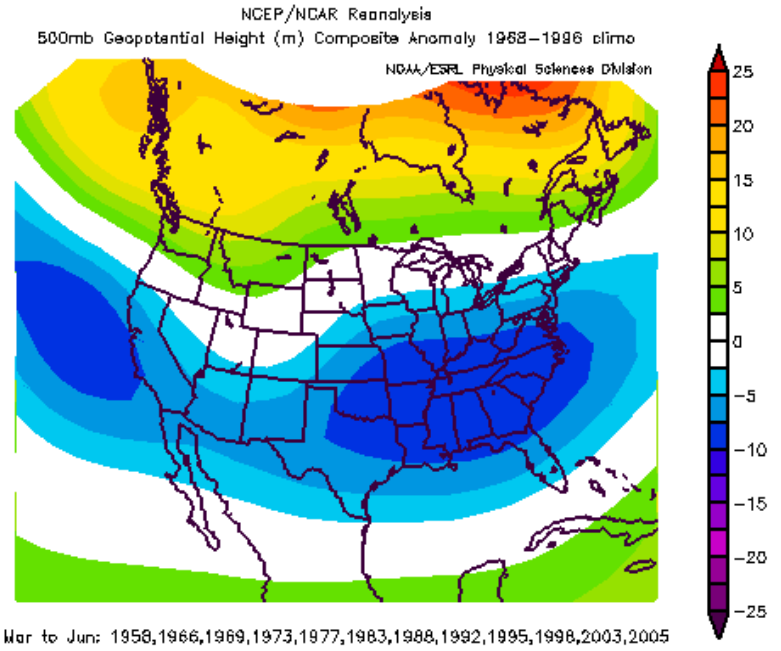


Results for El Niño: 500 hPa Height

El Niño: In/Going In

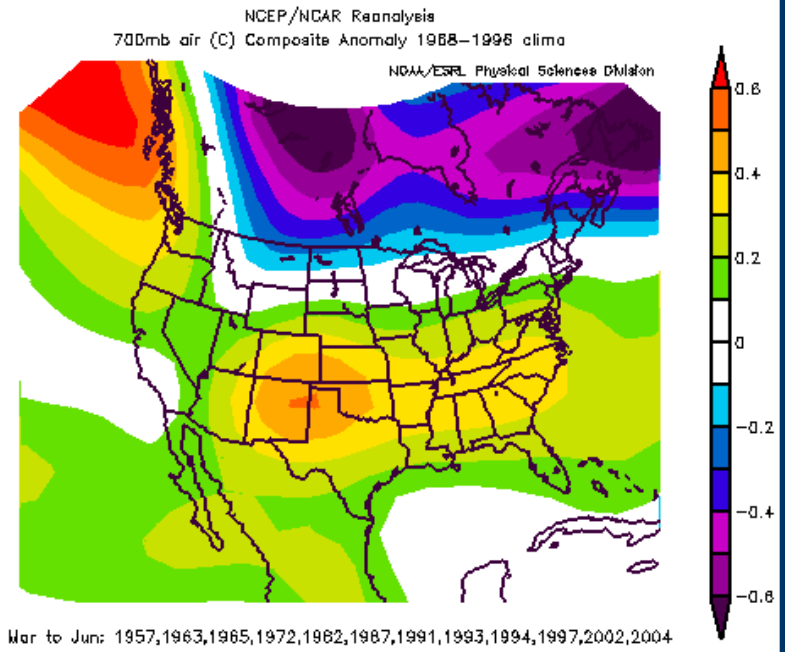


El Niño: Going Out

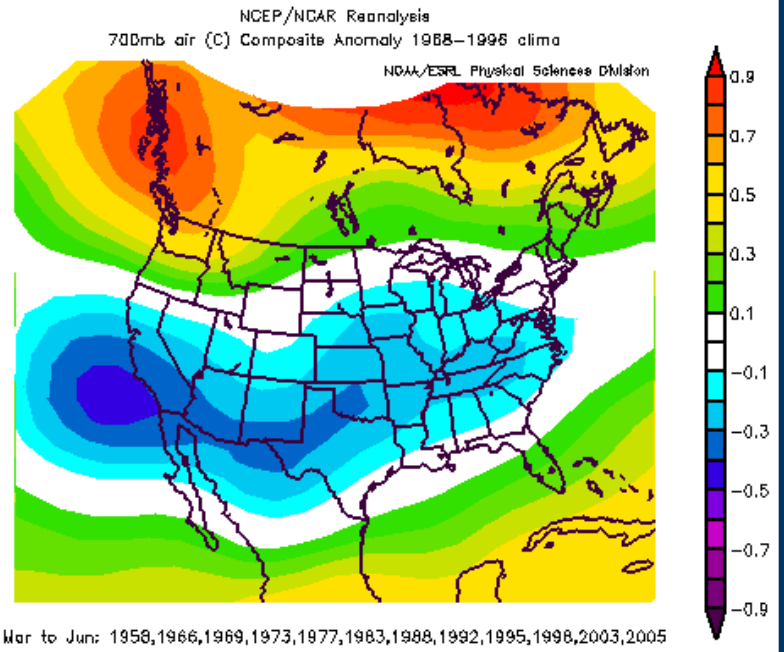


Results for El Niño: 700 hPa Temperature

El Niño: In/Going In

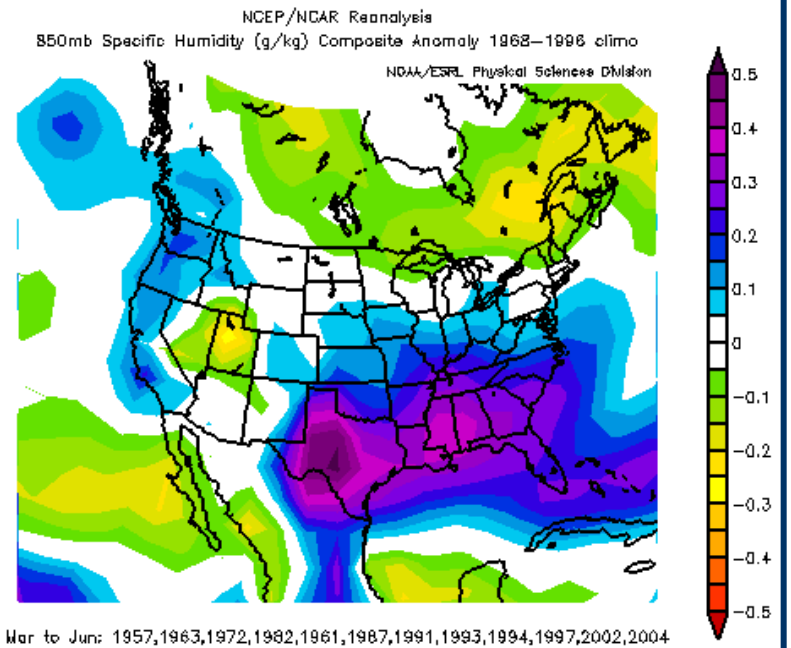


El Niño: Going Out

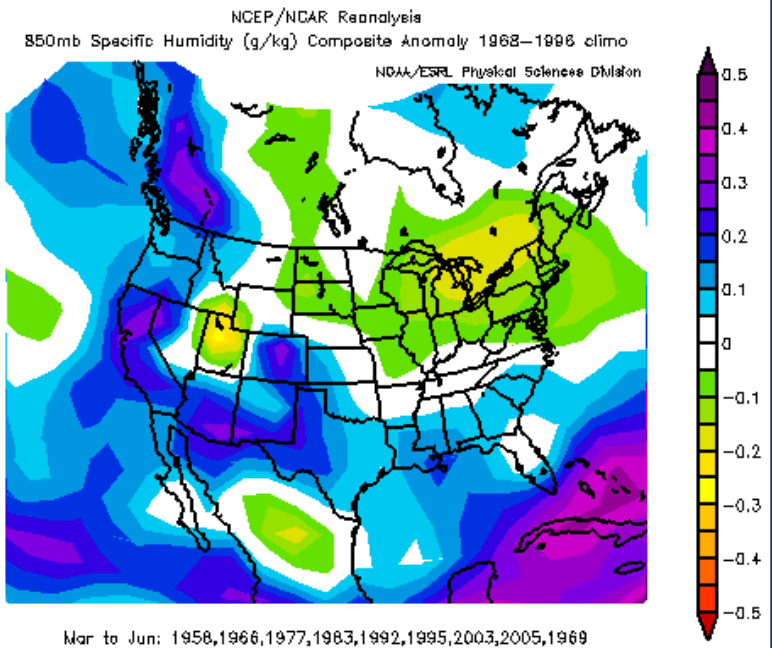


Results for El Niño: 850 hPa Specific Humidity

El Niño: In/Going In

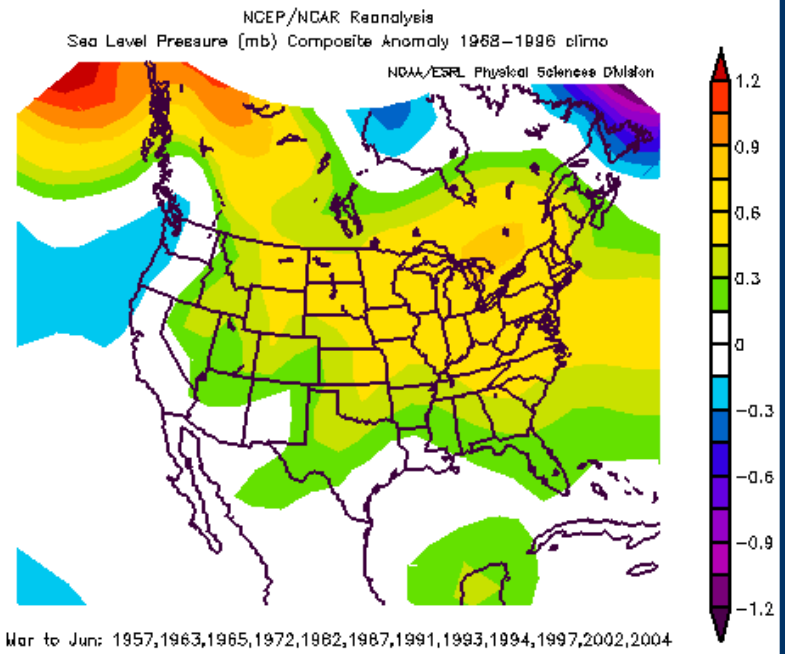


El Niño: Going Out

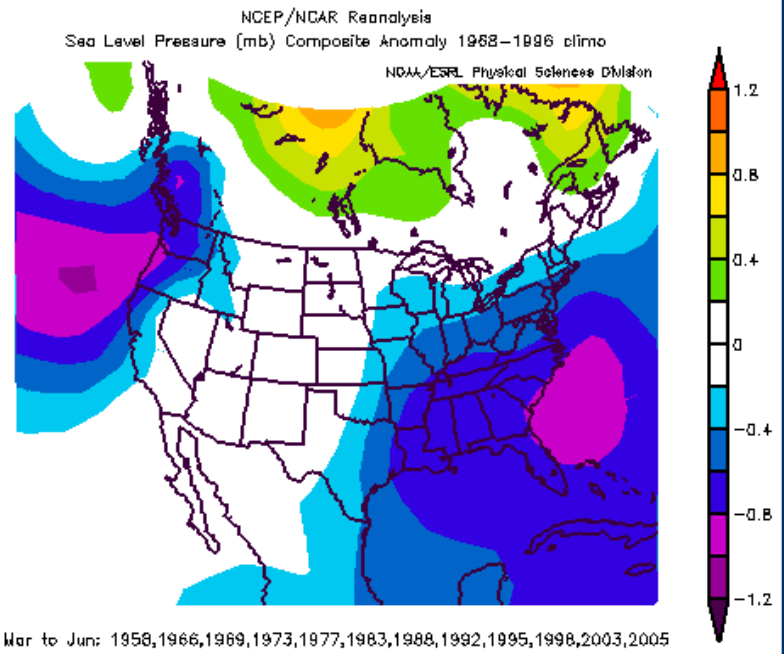


Results for El Niño: Surface Sea Level Pressure

El Niño: In/Going In



El Niño: Going Out



Conclusions for El Niño

- **Features with El Niño (especially coming out) would suppress convection across the Plains:**
  - Upper-level jet suppressed southward, zonal
  - Blocking/ridgy 500mb flow pattern
  - Decreased mid-level baroclinicity
  - Anomalous surface low in the southeast U.S. or anomalous surface high in the central Plains

Future Steps

- **Utilize CDC reanalysis dataset**
  - Investigate convective “ingredients”
    - *Shear (i.e. 0-6km bulk shear)*
    - *Instability (i.e. mid-level lapse rates, lifted index)*
  - Customize composite graphics
  - Create schematic diagrams
- **Publish results**

Thank you!

Questions?

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References

- Mayes, B.E., C. Cogil, G.R. Lussky, J.S. Boyne, and R.S. Ryrholm, 2007: Tornado and severe weather climatology and predictability by ENSO phase in the north central U.S.: A compositing study. Preprints of the 19th Conference on Climate Variability and Change, San Antonio, TX, Amer. Meteor. Soc.
- Training and documentation for compositing: http://www.weather.gov/om/csd/pds/pcu4/web/support/stats.htm
- NOAA Climate Diagnostics Center Monthly/Seasonal Climate Composites: http://www.cdc.noaa.gov/cgi-bin/Composites/printpage.pl

Forecast for ENSO Phase This Fall/Winter

- Large forecast spread averaging around neutral conditions
- NCEP Climate Forecast System (CFS) indicates neutral on average