



Climate, Weather And Landscapes in the Years Ahead

DR BOB RANDALL •

Weather, Climate, and Landscaping in the Years Ahead

- *Our long drought compared*
- Normal Climate & its causes
- “Normal” weather and why it changes year to year?
- Is our climate getting dryer?
- Weather & climate data: what is it and where is it?

Houston Arboretum September 2011





Lake Conroe —The City of Houston's Backup Water Supply August 2011



Droughts Require Landscapers and Home Owners to Plan & Plant for Fire Prevention



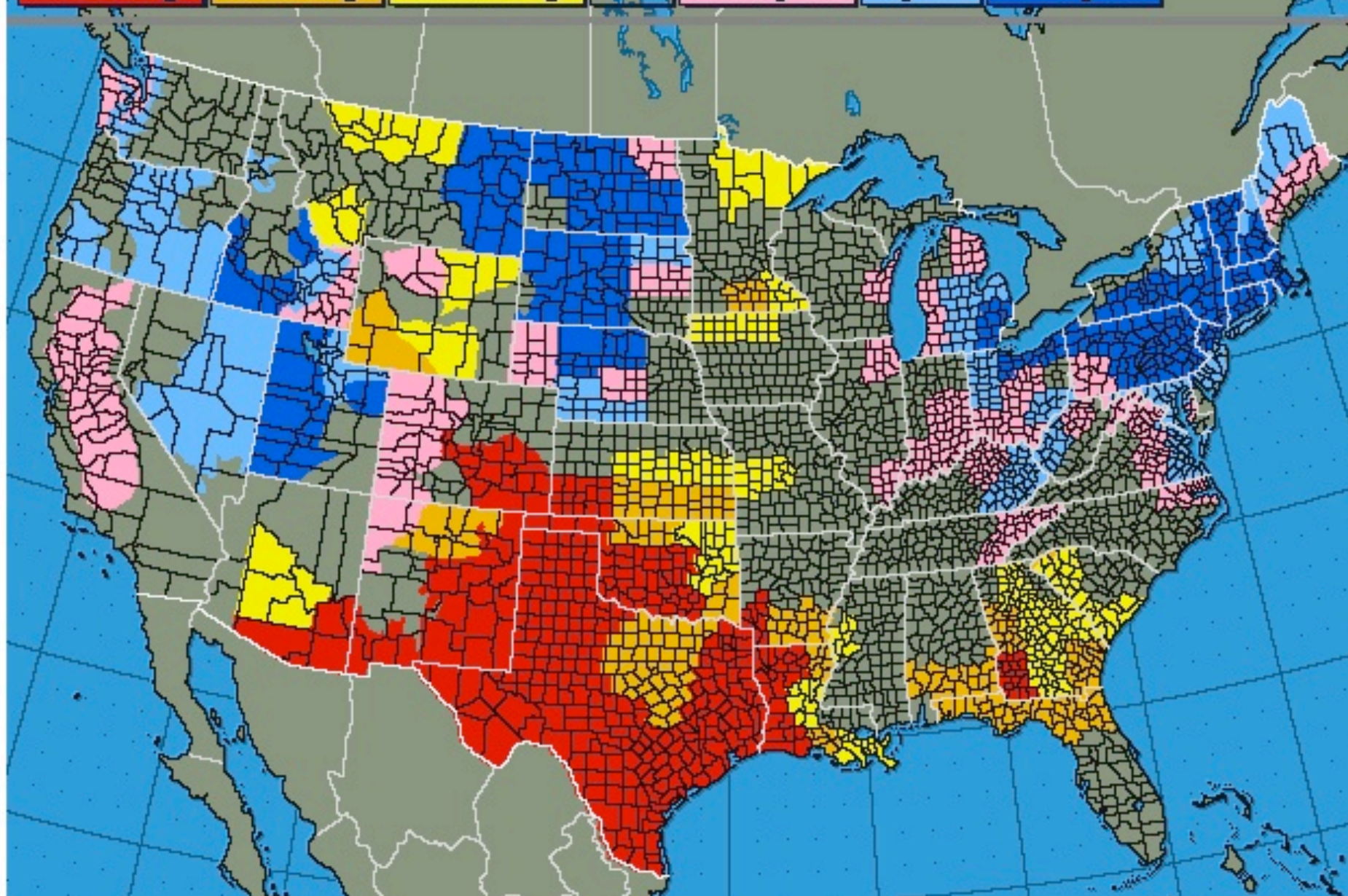
2011 Bastrop Wildfire

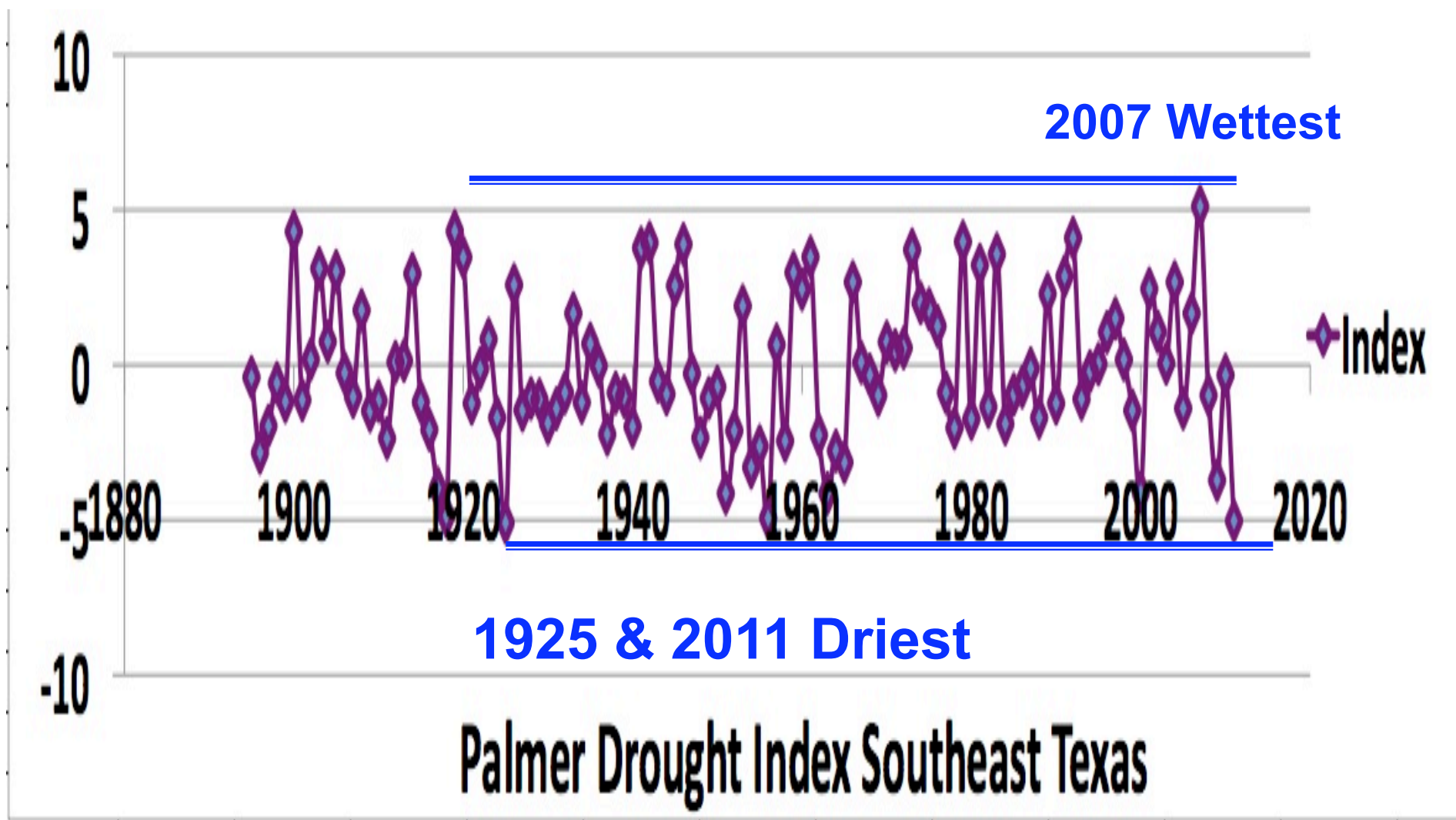
Palmer Drought Index

Ending Saturday, Nov 05, 2011

TELVENT

Extreme Drought Severe Drought Moderate Drought Normal Unusually Moist Very Moist Extremely Moist



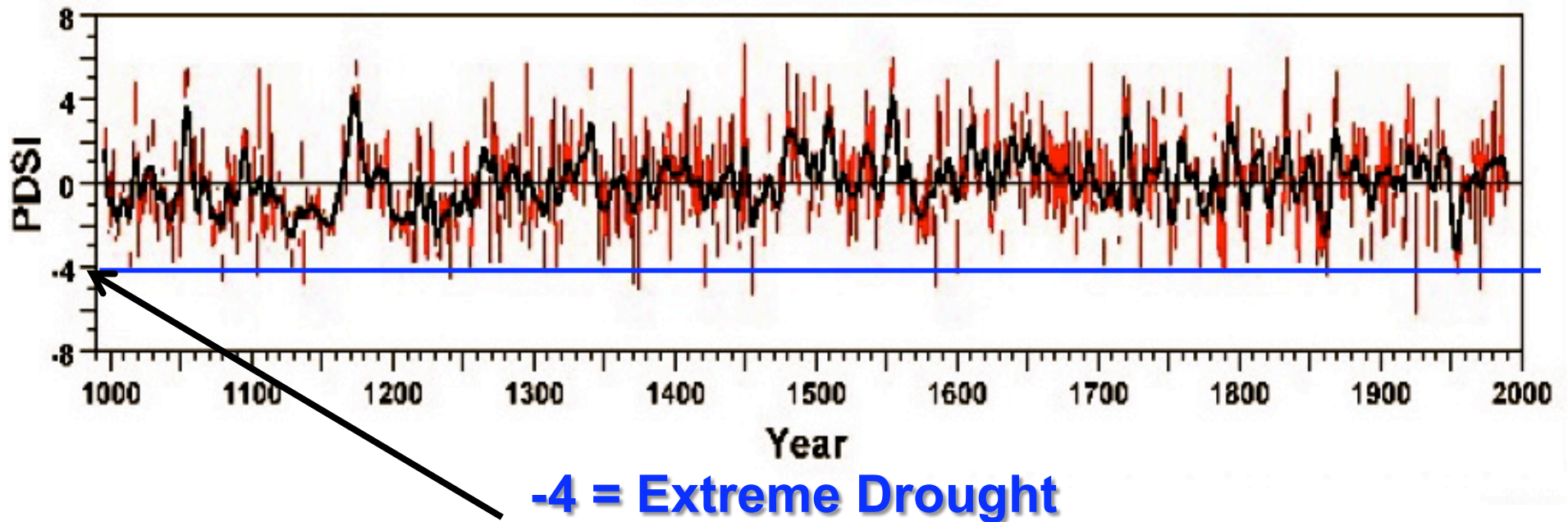


There is Much that is Known About Weather History from Tree Rings and Pollen Studies

**Palmer Drought Severity for
June, July, August**

**West of
San
Antonio**

**Reconstructed Summer PDSI (JJA)
Cook Gridpoint 166**



1000 AD

1500 AD

2000 AD

Edwards Plateau Feb to May Rain Over 436 Years

2.89 2011



Worst

4.88
in
1748

Case	1 Yr	2 yr	3 yr	4yr	5yr	10 yr.
1 (Worst)	1748/ 4.88	1818-1819/ 5.93	1818-1820/ 6.56	1817-1820/ 7.26	1818-1822/ 7.24	1571-1580/ 7.84
2	1847/ 5.39	1950-1951/ 6.38	1817-1819/ 7.08	1899-1902/ 7.39	1950-1954/ 7.57	1950-1959/ 7.84
3	1904/ 5.45	1684-1685/ 6.38	1583-1585/ 7.18	1950-1953/ 7.45	1666-1670/ 7.60	1576-1585/ 7.84
4	1818/ 5.75	1899-1900/ 6.46	1878-1880/ 7.28	1818-1821/ 7.48	1664-1668/ 7.71	1573-1582/ 7.91
5	1685/ 5.83	1728-1729/ 6.66	1666-1668/ 7.31	1666-1669/ 7.51	1819-1823/ 7.74	1572-1581/ 7.94
6	1899/ 5.85	1805-1806/ 6.73	1728-1730/ 7.33	1953-1956/ 7.52	1951-1955/ 7.76	1773-1782/ 7.99
7	1861/ 5.90	1879-1880/ 6.87	1879-1881/ 7.39	1573-1576/ 7.54	1622-1626/ 7.76	1575-1584/ 8.00
8	1925/ 5.90	1573-1574/ 6.94	1578-1580/ 7.40	1582-1585/ 7.56	1576-1580/ 7.79	1574-1583/ 8.05
9	1773/ 6.04	1819-1820/ 6.96	1573-1575/ 7.41	1878-1881/ 7.57	1573-1577/ 7.79	1949-1958/ 8.07
10	1971/ 6.08	1584-1585/ 7.02	1727-1729/ 7.42	1667-1670/ 7.58	1953-1957/ 7.81	1570-1579/ 8.08
11	1573/ 6.09	1579-1580/ 7.06	1667-1669/ 7.46	1819-1822/ 7.62	1572-1576/ 7.82	1577-1586/ 8.11
12	1819/ 6.12	1667-1668/ 7.14	1859-1861/ 7.47	1623-1626/ 7.64	1900-1904/ 7.85	1948-1957/ 8.12
13	1806/ 6.25	1592-1593/ 7.19	1623-1625/ 7.48	1777-1780/ 7.65	1817-1821/ 7.86	1871-1880/ 8.13
14	1950/ 6.27	1773-1774/ 7.24	1899-1901/ 7.49	1622-1625/ 7.67	1898-1902/ 7.86	1817-1826/ 8.14
15	1822/ 6.30	1559-1560/ 7.27	1953-1955/ 7.49	1559-1562/ 7.71	1558-1562/ 7.87	1946-1955/ 8.16
16	1729/ 6.33	1822-1823/ 7.27	1949-1952/ 7.50	1727-1730/ 7.73	1773-1777/ 7.88	1818-1827/ 8.16
17	1951/ 6.49	1870-1871/ 7.32	1950-1952/ 7.52	1870-1873/ 7.74	1571-1575/ 7.89	1775-1781/ 8.16
18	1880/ 6.59	1623-1624/ 7.34	1902-1904/ 7.54	1577-1580/ 7.75	1776-1780/ 7.89	1663-1672/ 8.18
19	1851/ 6.68	1846-1847/ 7.37	1683-1685/ 7.55	1571-1574/ 7.78	1581-1585/ 7.90	1664-1673/ 8.19
20	1542/ 6.68	1583-1584/ 7.38	1898-1900/ 7.55	1572-1575/ 8.78	1949-1953/ 7.90	1947-1956/ 8.19

All Blue Spots Since 1960 All Red Spots in 1948-1960

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Main Causes of Weather

- **The main differences in weather year-to-year result from contrasts in temperatures between the poles and the equator.**
- **Hot air rises more than does cold air.**
- **So parts of the planet with warm air tend to have lower air pressure than do cooler areas.**
- **These cooler areas have relatively higher pressure.**

Wind & Rain

- **Generally, high pressure moves to lower pressure.**
- **So you get wind!**
- **And when warm air masses and cooler ones collide, you get condensation, rain, storms.**

Some Causes of Climate

- **The interaction between warm tropical air and cold arctic air**
- **Plus the earth's spin**
- **Creates regular wind patterns.**
- **Also, cold water sinks and warm water rushes in to take its place.**
- **So you get regular ocean currents and these affect climate near coasts.**

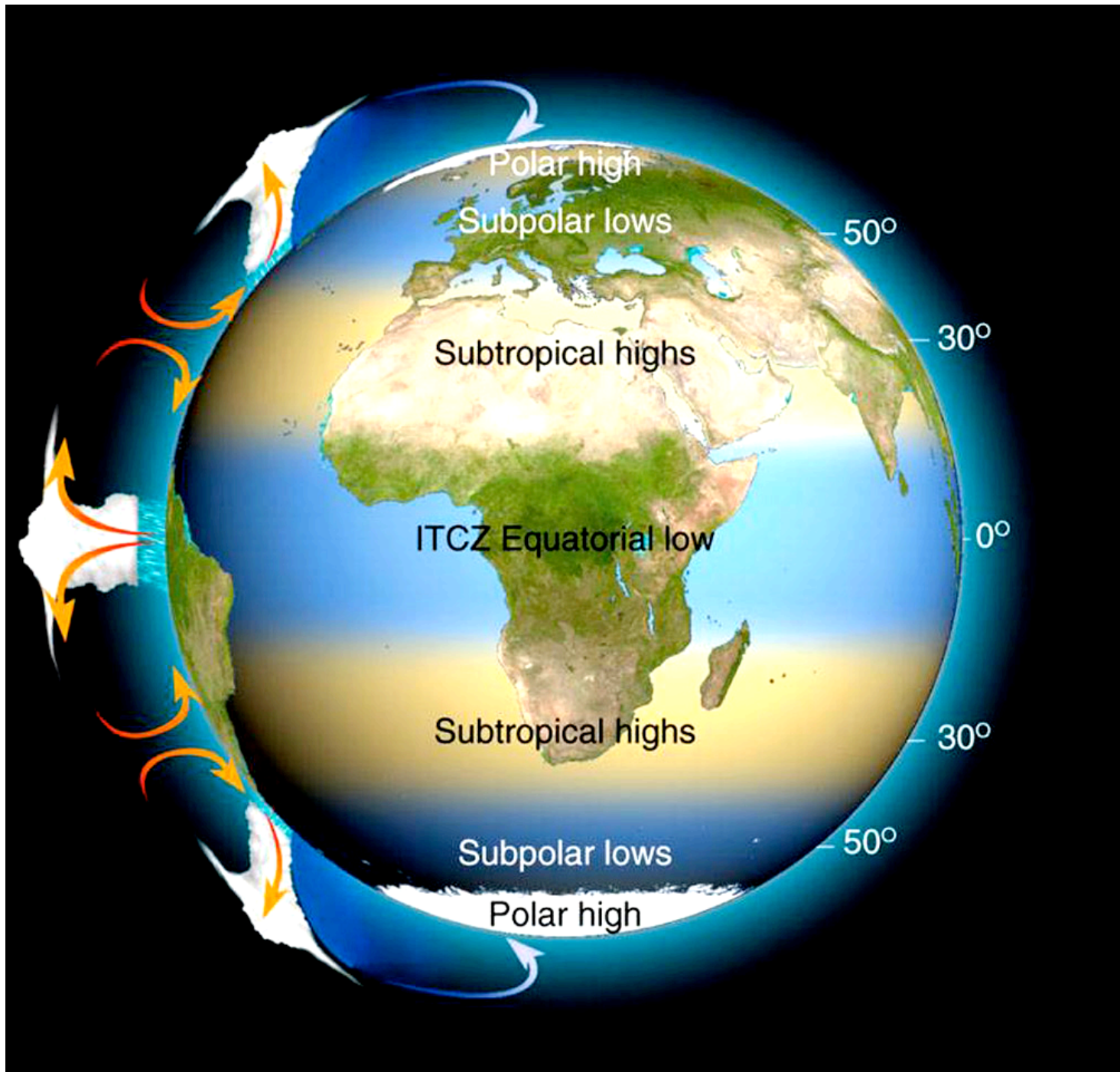
Warm Rising Air from a Temperate or Tropical Region

Cold Polar Air
= Higher Pressure

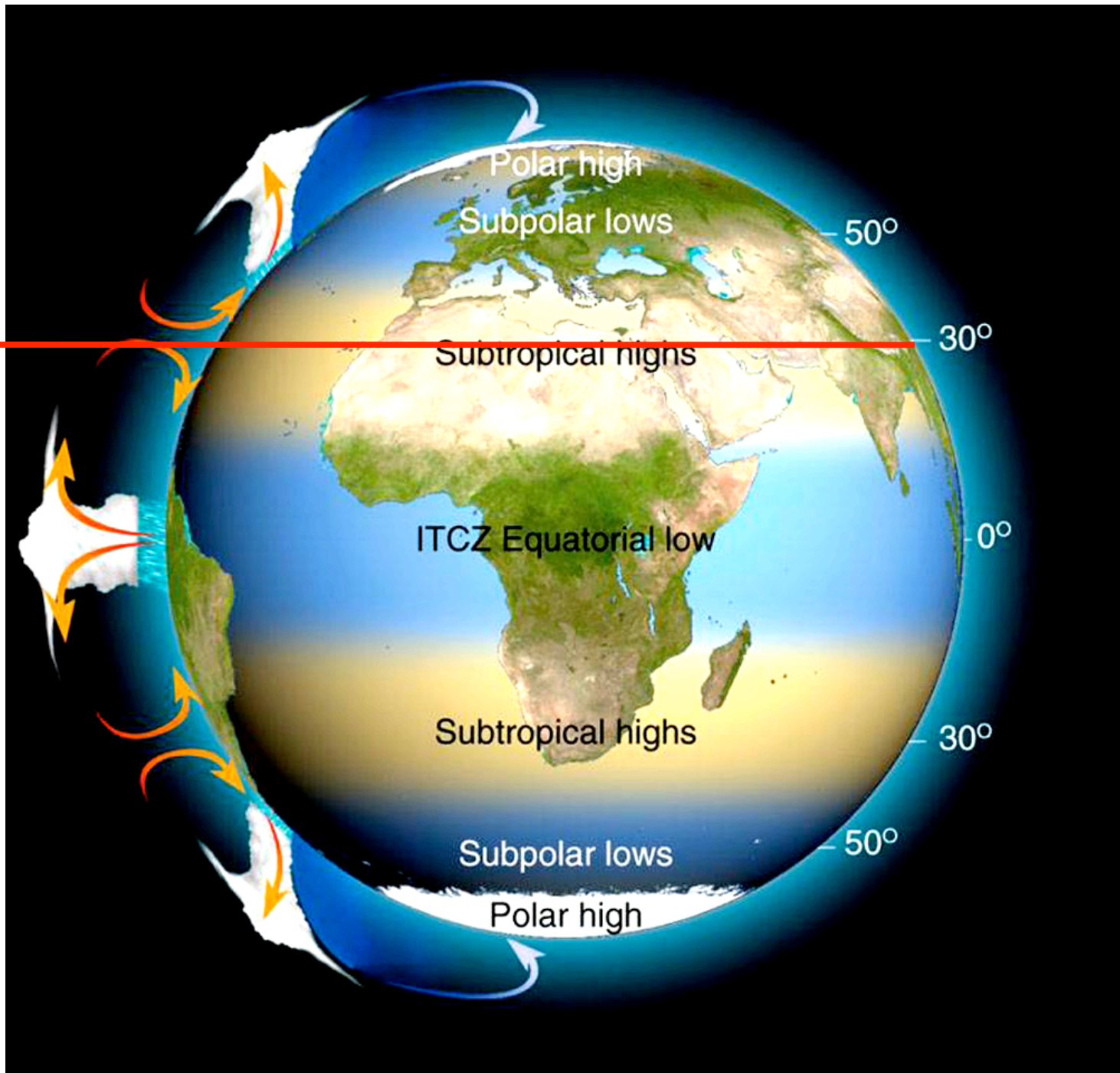


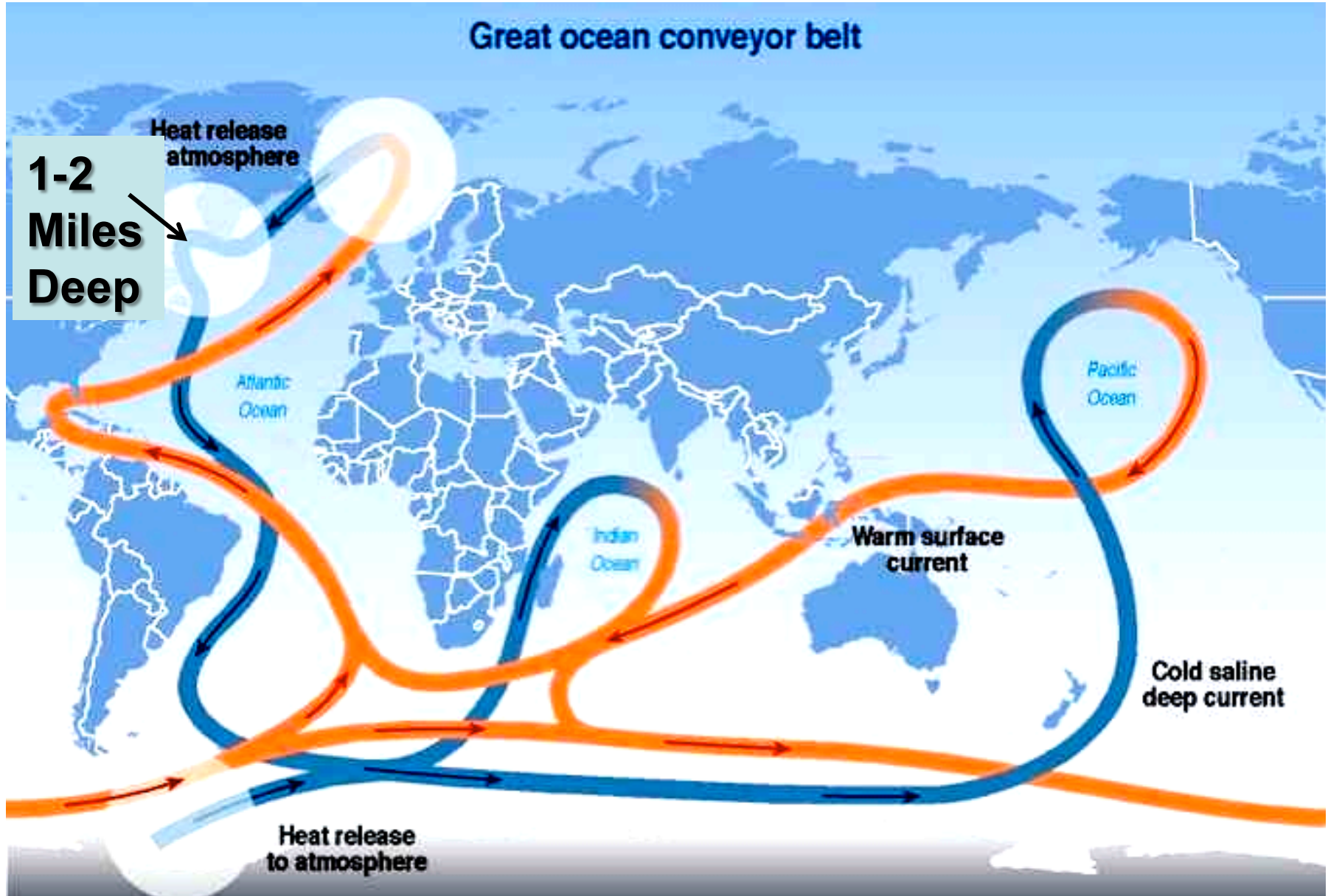
= Low Pressure





Houston





The Ocean Conveyor


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Pressure Oscillations

- There are pairs of places on the planet whose air pressures predictably **see-saw or oscillate** every few years between relatively high and relatively low.
- Over time, oscillations go from above average ratios (more pressure) to neutral to below average ratios (less pressure).
- These cause predictable weather differences from year to year.
- By combining observations from several different oscillations, fairly accurate predictions for the coming year can be made.

Some Important Oscillations:

- **North Atlantic Oscillation (NAO) is part of the Arctic Oscillation (AO)**
- **Southern Oscillation (ENSO)**  **El Niño!!**
- **The Pacific Decadal Oscillation (PDO)**

The Arctic & North Atlantic Oscillations

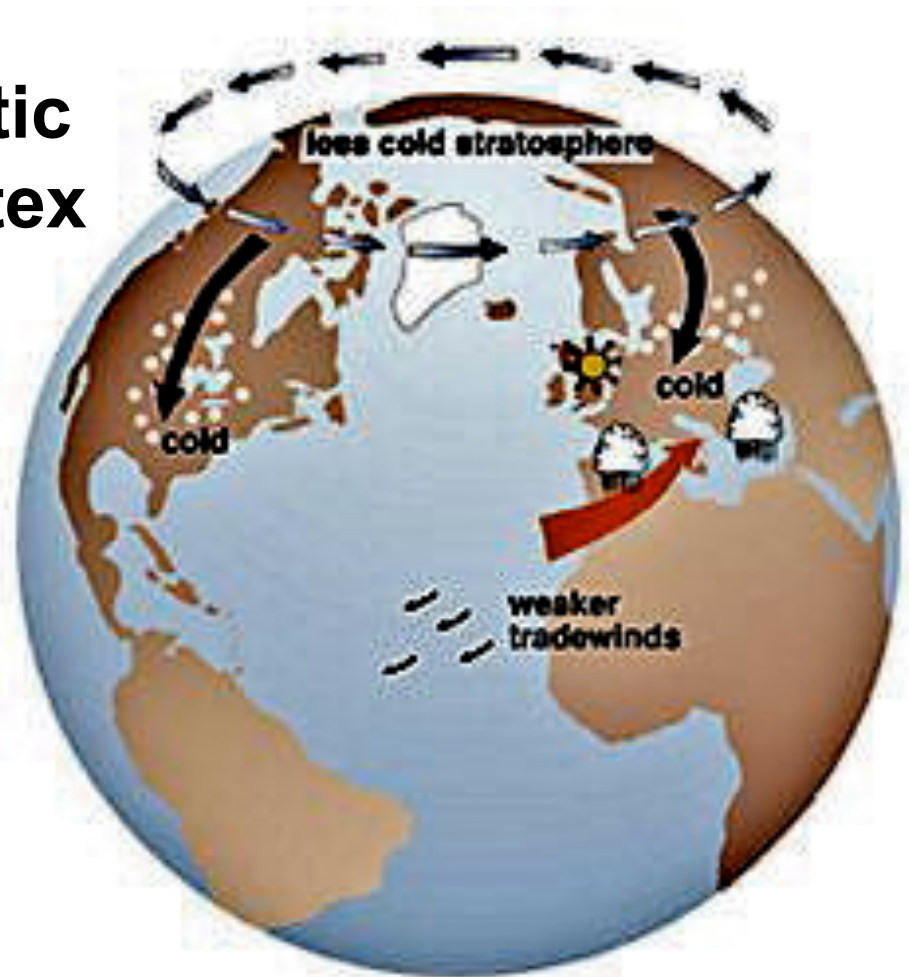
- **If the North Atlantic Oscillation is positive *in winter*, the northeastern US is hotter and drier;**
- **And the central US is wetter and colder.**
- **When the NAO is negative, the tropical Atlantic and Gulf Coast have stronger hurricanes; the northeastern US is colder.**



Arctic Vortex

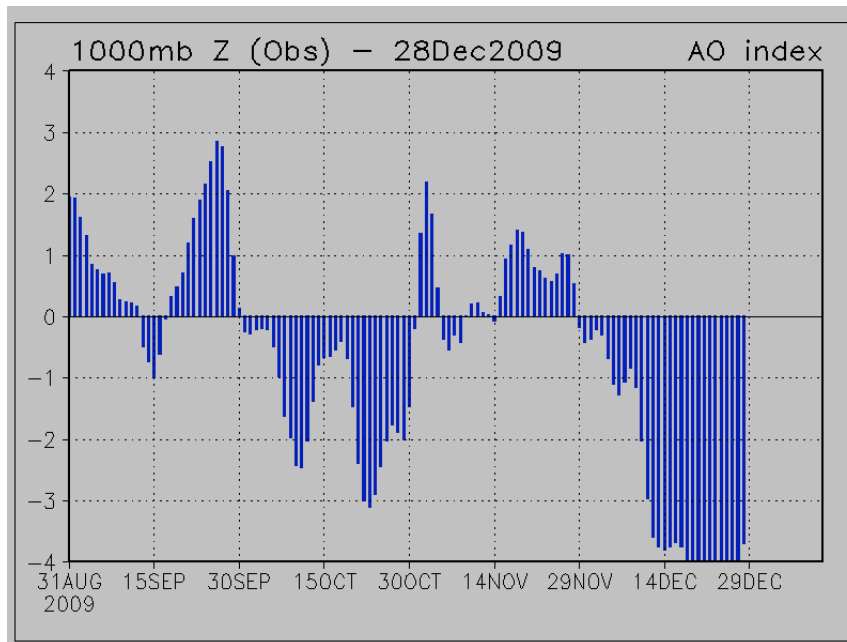
Effects of the Positive Phase
of the Arctic Oscillation

Positive Phase AO

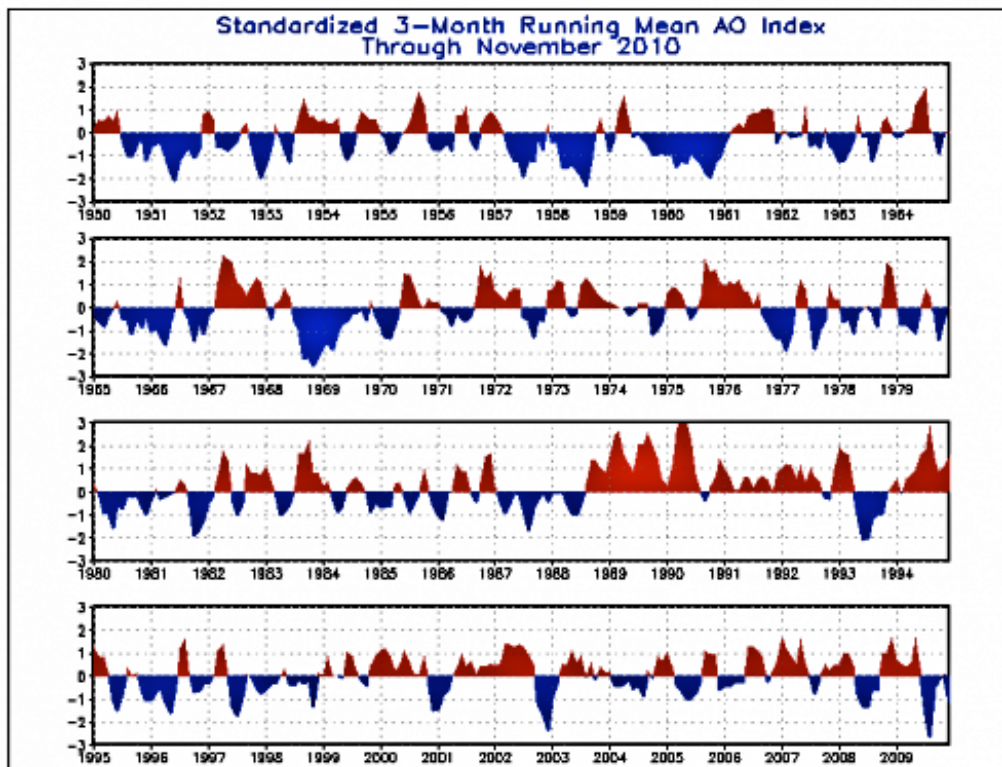


Effects of the Negative Phase
of the Arctic Oscillation

Negative Phase AO



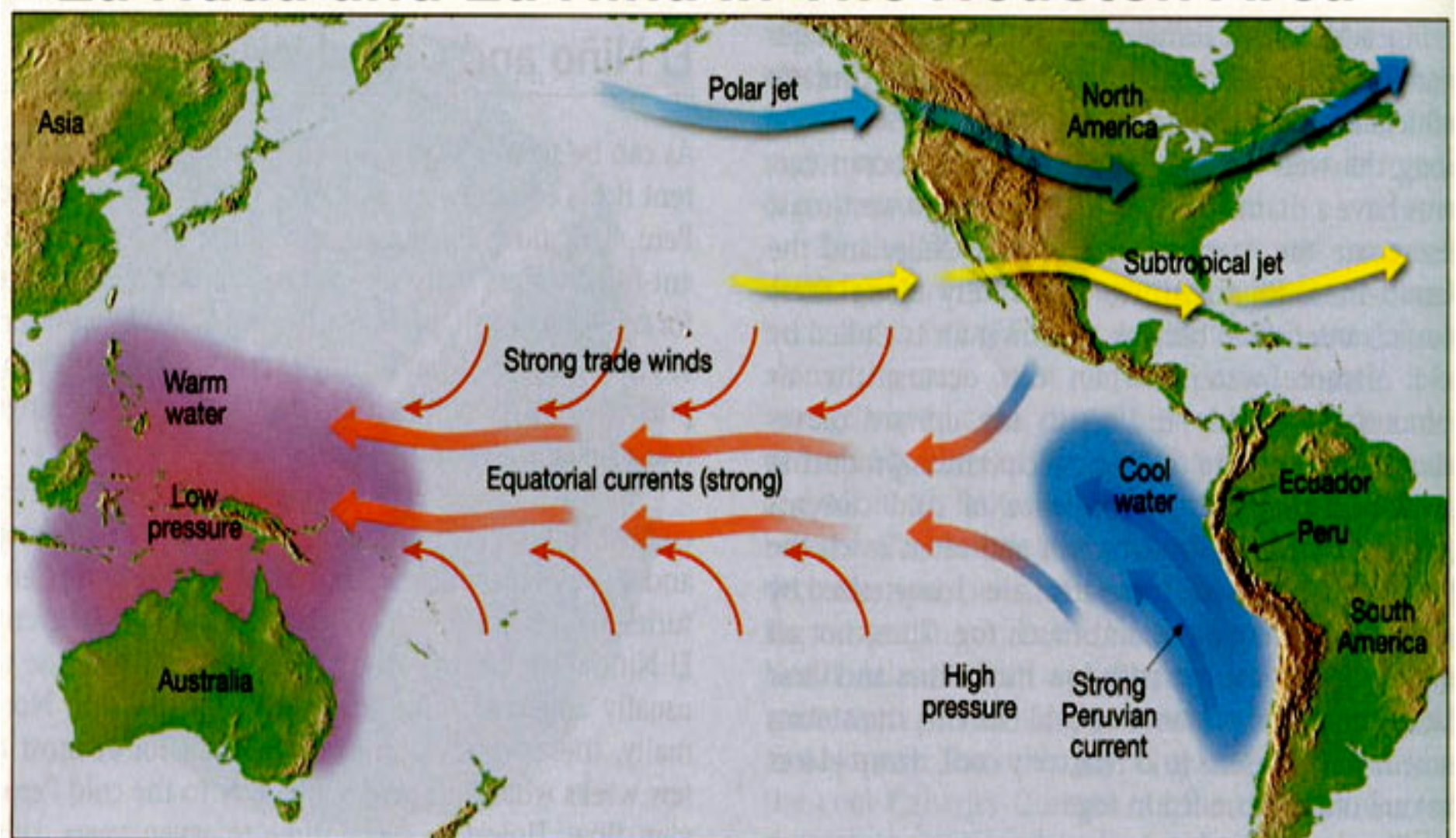
Winter 2009-10 had the most negative Arctic index since records began in 1951 (-3.41 in Dec) and the third coldest Houston temperature average ever for a winter.



The Southern Oscillation/ El Niño

- **There is a "see-saw" movement of air back-and-forth every year or two in the tropics and subtropics between Darwin in Australia and Tahiti.**
- **When “normal” conditions exist (*La Nada* or a stronger type called *La Niña*), trade winds blow westward across the tropical Pacific, piling up warm surface water in Indonesia.**
- **To replace the water that went west, cool sea water rises from the depths off the South American coast and this affects air pressure, evaporation, and rainfall.**

Warmer & Drier During La Nada and La Niña In The Houston Area

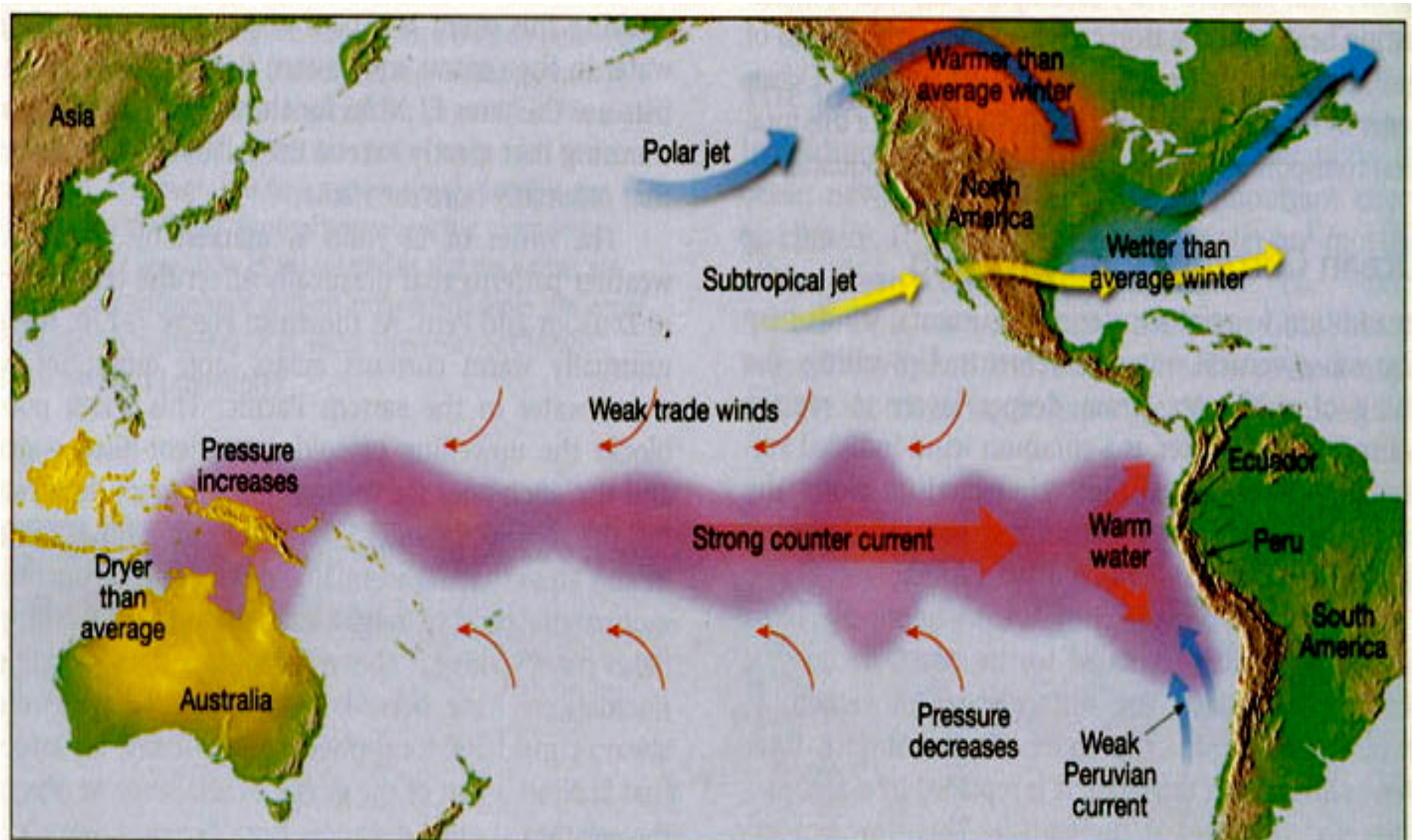


La Nada And A Stronger Version La Niña

El Niño

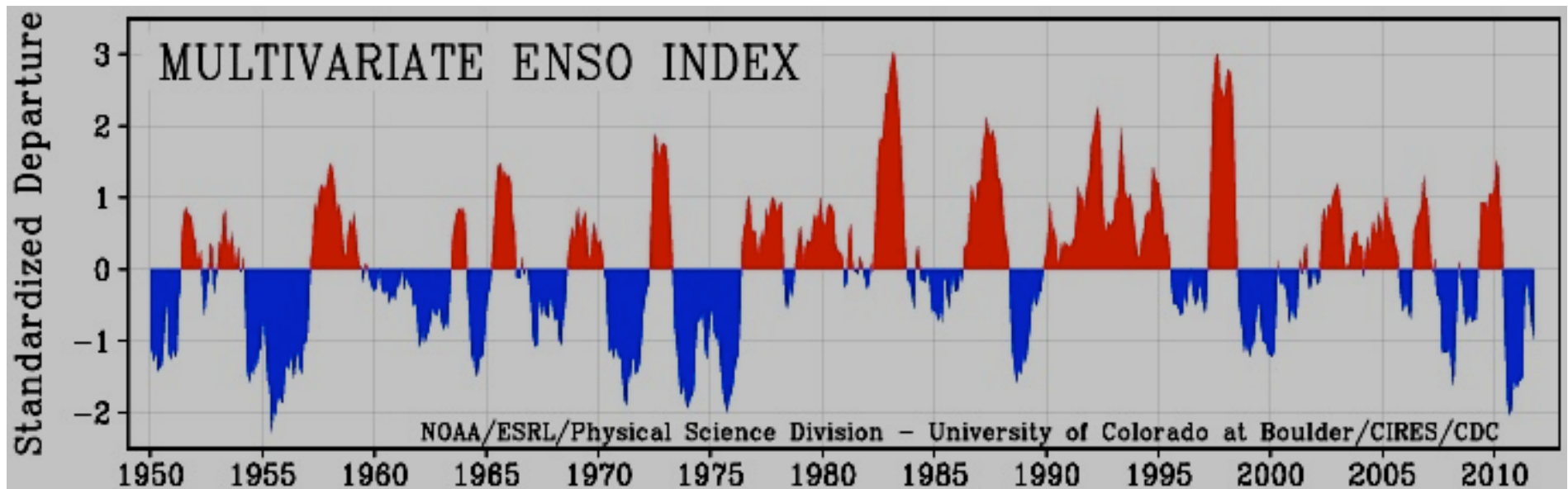
- **When this process reverses, there is an El Niño.**
- *In the Houston area in winter, it is wetter, less sunny, and a little colder.*

Wetter and because of clouds somewhat cooler in Houston

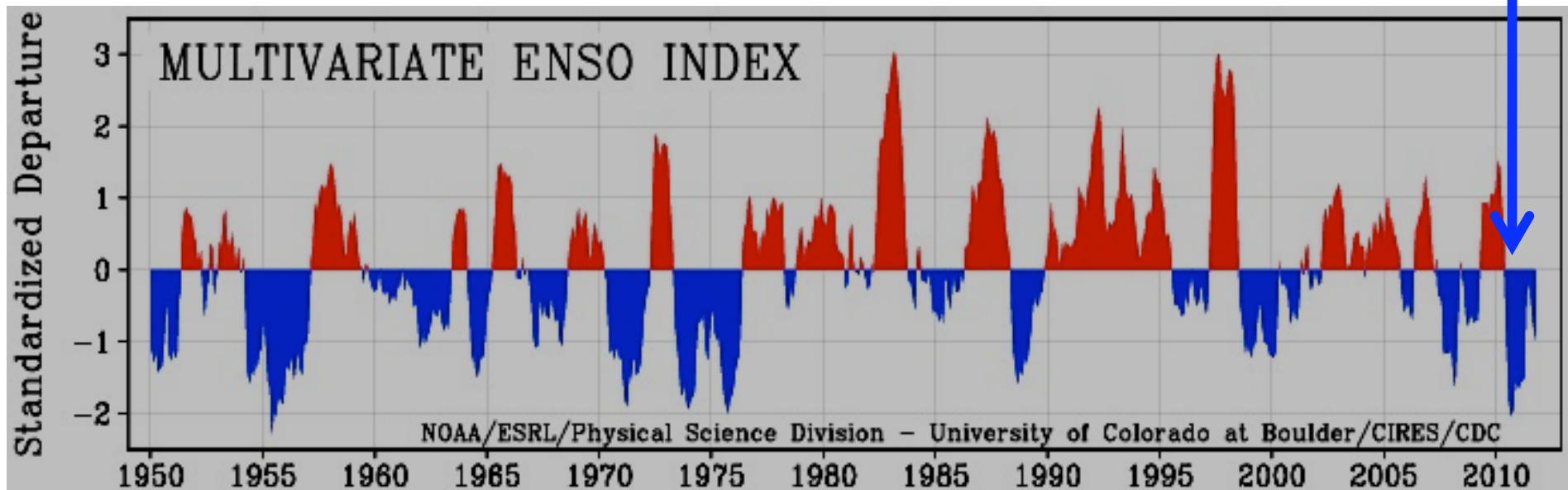


An El Niño Event

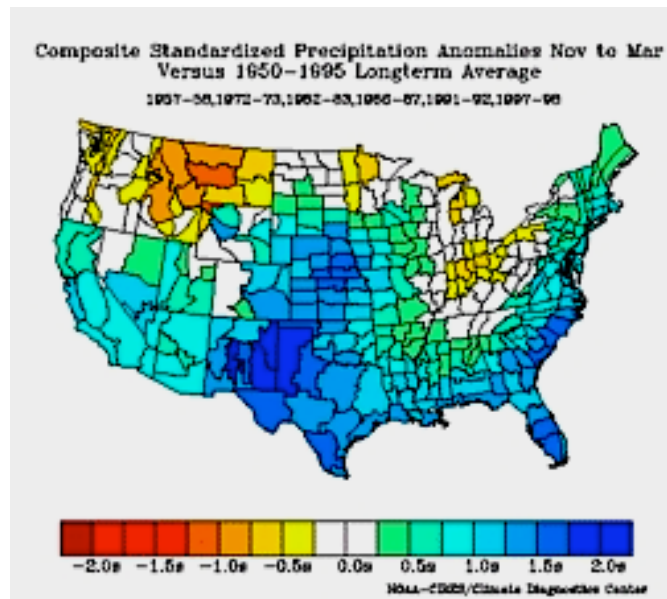
- **We last had El Niño effects in our area during the wet, cold Jan.-Mar. 2010.**
- **Winter 2010-11 was the strongest La Niña since the record drought years of the 1970's and 1950's.**



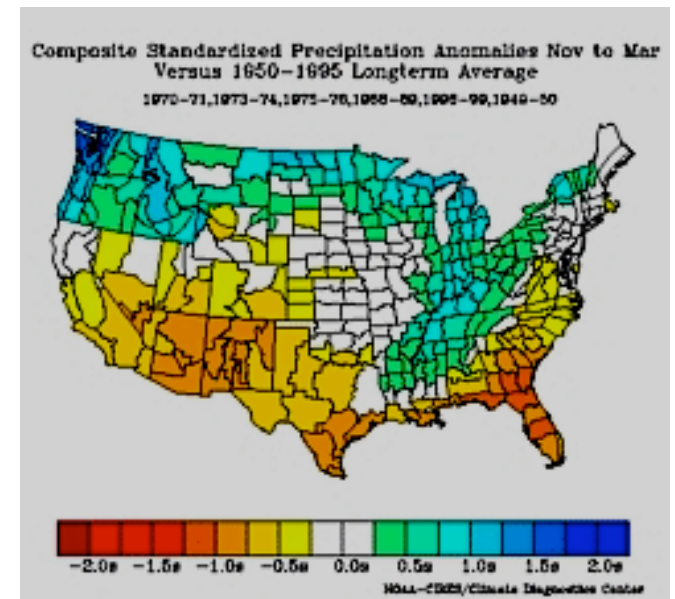
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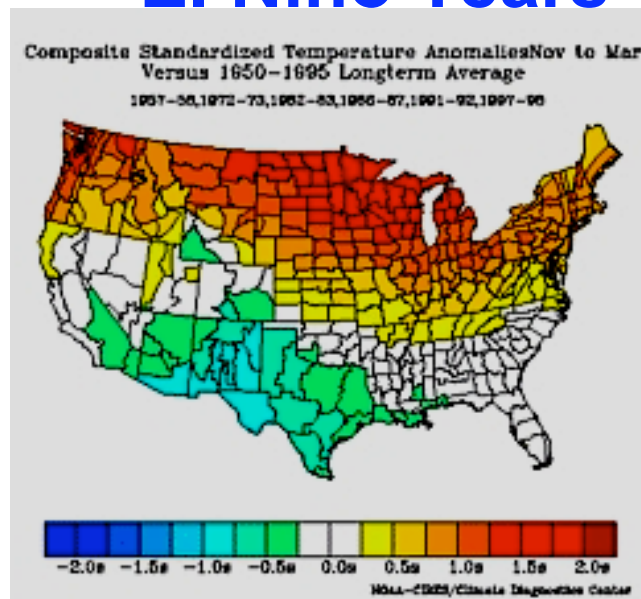
“Normal” US Winter Weather



↔
**RAIN &
SNOW**

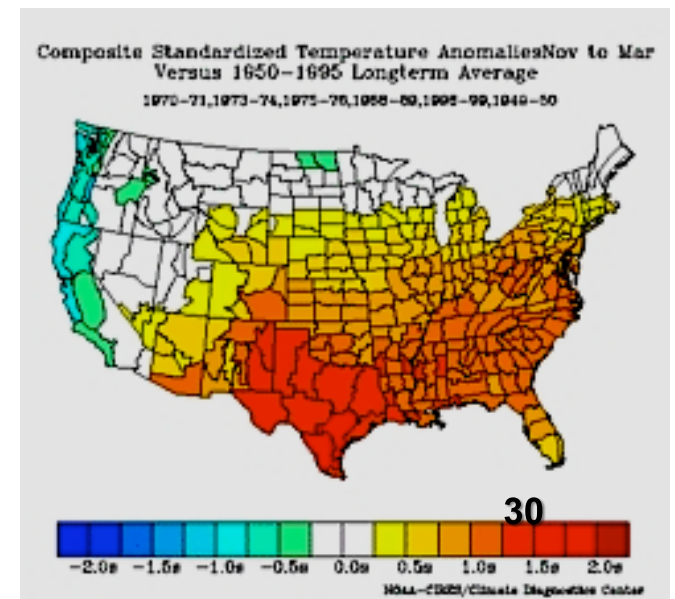


El Nino Years



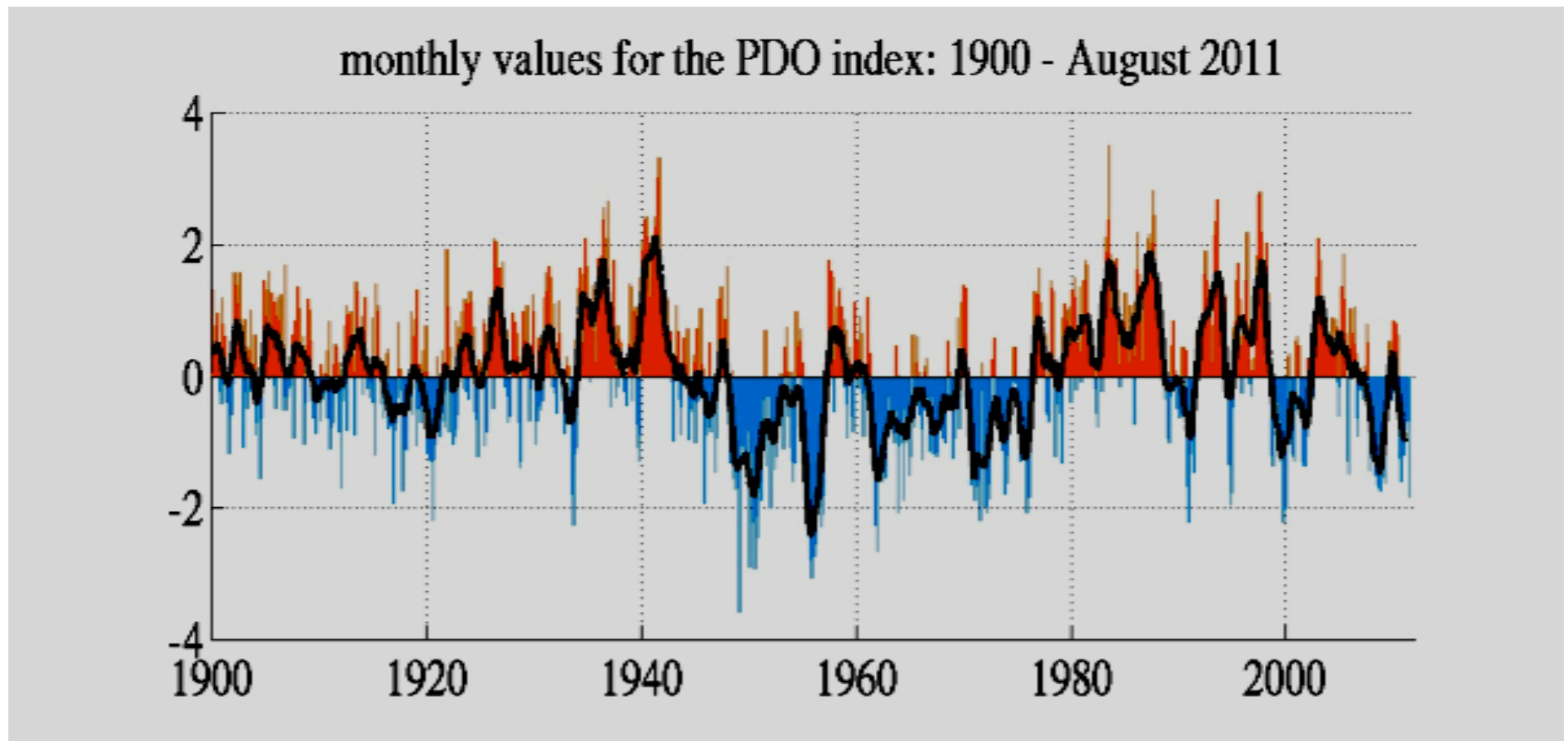
↔
Temperature

La Nina Years



Pacific Decadal Oscillation

- This Oscillation is a **20-30 year** El Niño-like pattern of northern Pacific climate oscillation.



Our Area

- When the index is negative, our October to March *temperatures are higher than average and our rainfall is below average.*
- When the index is positive, our October to March *temperatures are below average and rainfall is above average.*
- Some meteorologists think we have been in a multi-decade dry phase since 1997.

Houston Area Summary

	PDO	ENSO Winter	NAO/ AO	
Usual, Westward, Warm or Positive Phase	Cooler, Wetter (1975- 1995)	Drier, warmer-- La Niña (2011)	Wetter & Warmer central US Fewer arctic fronts	
Less Common, Eastward, Cool or Negative Phase	Warmer Drier (1997- 2011)	Wetter, colder --El Niño (2010)	More Hurricanes Colder fronts (2010, 2011)	33

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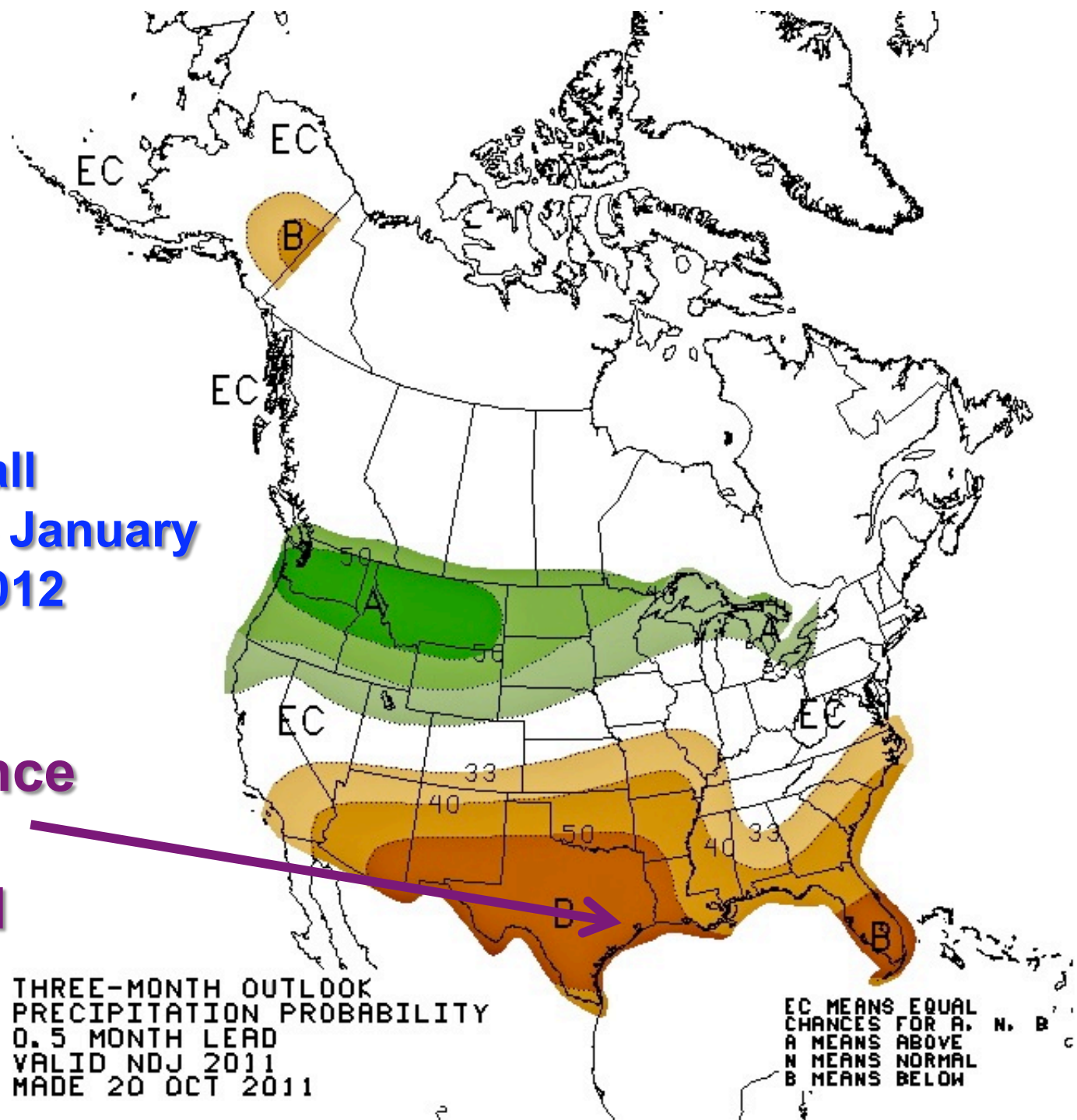
Monitoring Weather Predictions

- I have put web sites useful for monitoring daily weather (even in your neighborhood), as well as predictions of what the winter and summer will bring at my blog:
- <https://yearroundgardening.wordpress.com/category/weather-climate/>
- These websites represent what I think are the most informed opinions on these subjects.

Predictions for 2012-2013

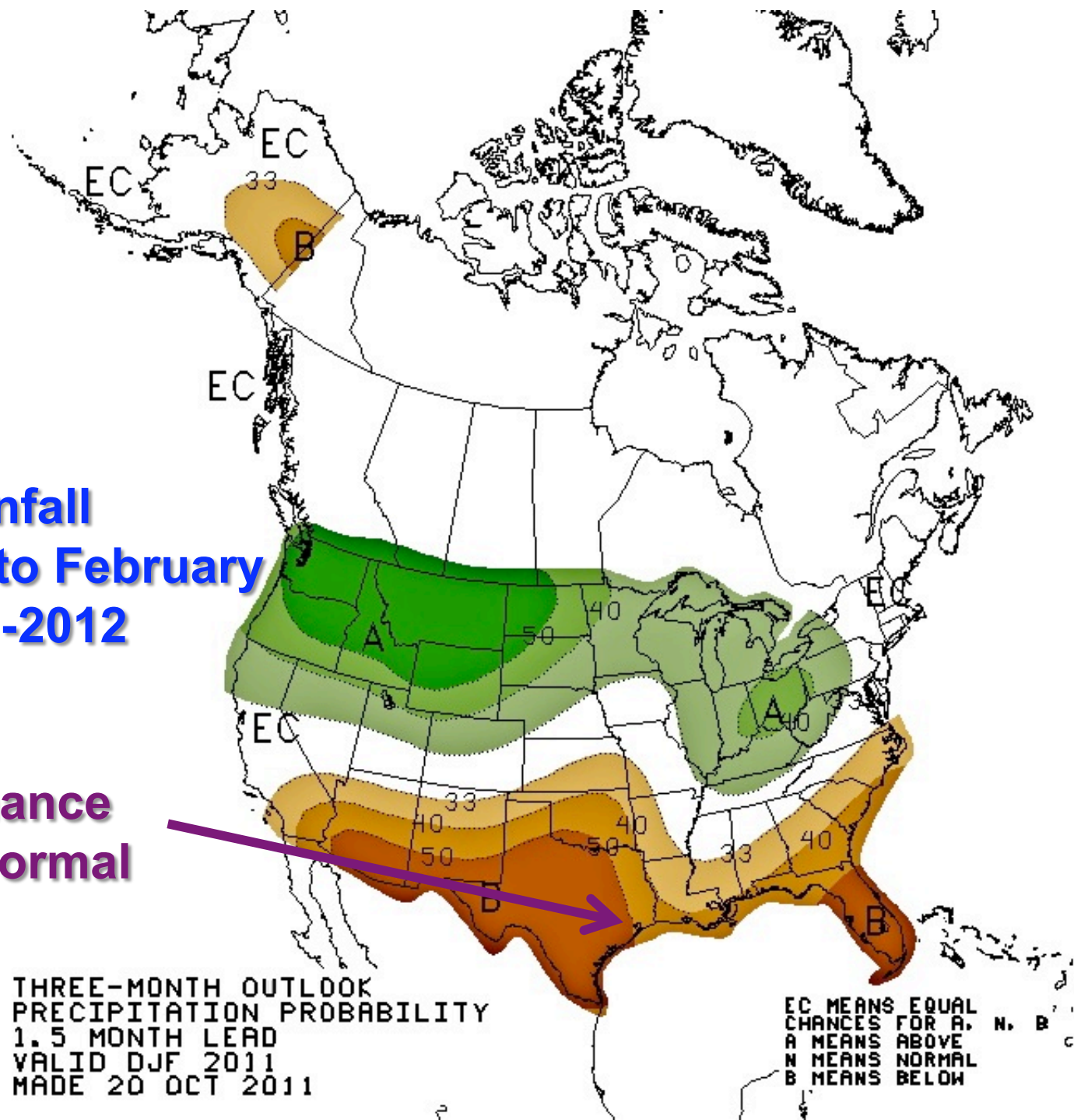
**Rainfall
November to January
2011-2012**

**60% Chance
Below
Normal**



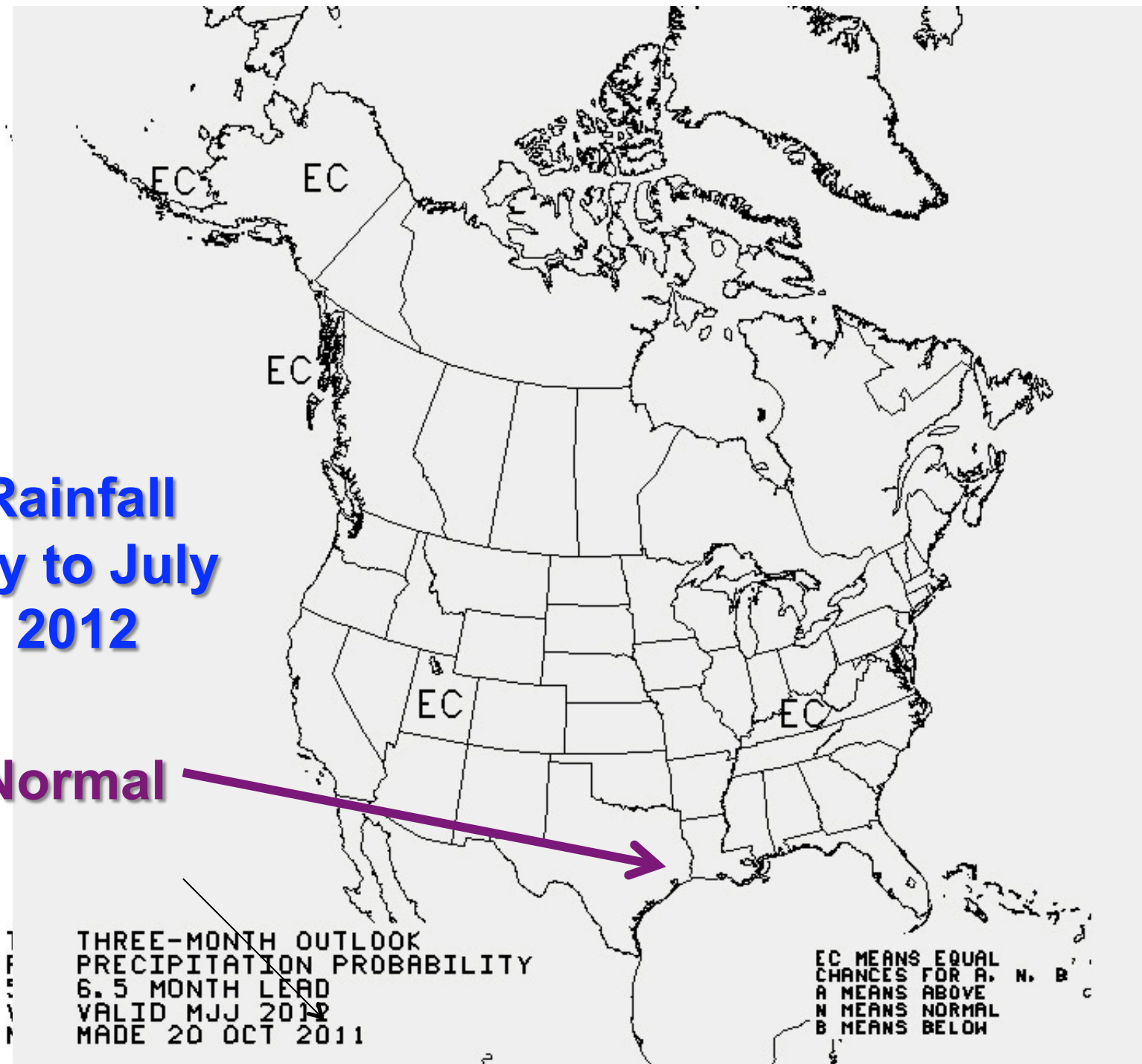
**Rainfall
December to February
2011-2012**

**45% Chance
Below Normal**



Rainfall May to July 2012

Normal



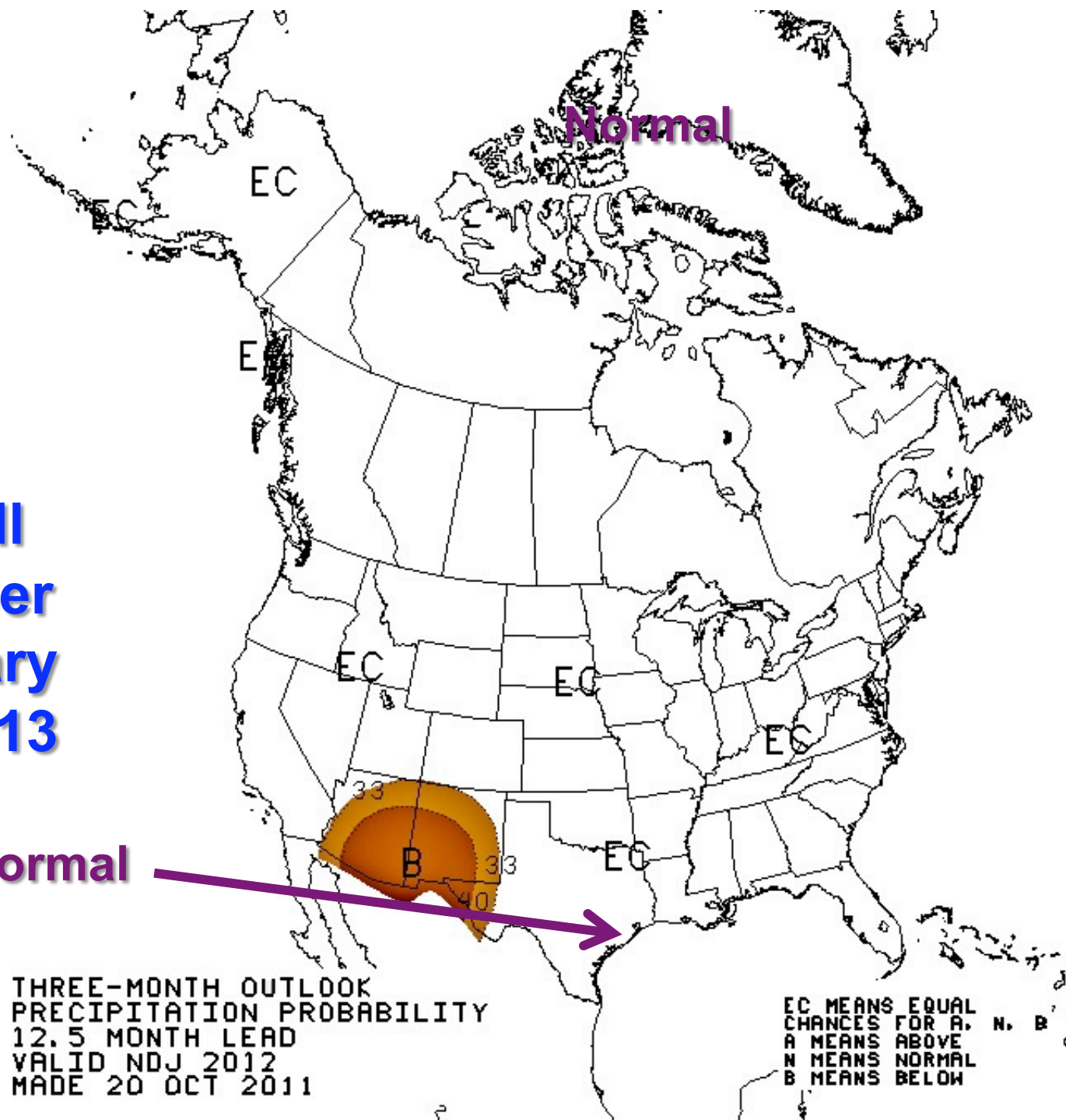
Rainfall November to January 2012-2013

Normal

Normal

THREE-MONTH OUTLOOK
PRECIPITATION PROBABILITY
12.5 MONTH LEAD
VALID NDJ 2012
MADE 20 OCT 2011

EC MEANS EQUAL
CHANCES FOR A, N, B
A MEANS ABOVE
N MEANS NORMAL
B MEANS BELOW



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We Have Had a Lot of Rain Not So Long Ago

Tropical Storm Allison 2001



Tropical Storm Allison 2001



The following is a list of Houston's Top 10 wettest, driest, warmest, and coolest years (see note below table).

16.83 2011 to Nov 10 ←

Houston's Annual Lists (1889-2010)

Top 10 Wettest	
72.86	1900
72.38	1919
71.18	2001
70.16	1973
68.97	1946
65.51	2007
64.96	2004
64.22	1949
63.85	1959
62.84	1923

Top 10 Driest	
17.66	1917
22.93	1988
27.09	1901
27.23	1951
28.08	1999
29.03	1893
29.46	1948
30.43	1967
30.59	1910
31.56	1956

Rainfall in Inches



Getting Much Hotter But Not Drier

- **Worldwide both oceans and land areas are warming. This is especially true at the poles, and that is making weather more extreme.**
- **The Houston weather station has been operating for 122 years, so there are all sorts of records about rain and heat, drought and cold.**

Getting Much Hotter But Not Drier

- Over the last 20 years, both summer and winter months have been **much, much warmer** than expected.
- There have been **both record wet periods and record dry periods**
- But there have been almost no cold extremes.
- See your booklet for a summary.

This Year Will Break Heat Records

HOTTEST TEMPS FROM JANUARY 1 THROUGH NOVEMBER 10

CITY OF HOUSTON	HOUSTON HOBBY	COLLEGE STATION	CITY OF GALVESTON
74.2 1962	★ 74.6 2011	★ 74.2 2011	★ 74.7 2006
★ 74.2 2011	★ 74.2 2000	73.7 1911	★ 74.3 2011
73.7 1911	★ 73.7 2009	★ 73.0 2009	74.1 1927
73.6 1963	★ 73.6 1999	★ 72.8 2000	74.0 1882
★ 73.2 2009	★ 73.5 2006	72.8 1927	★ 73.8 1995

Global Warming:

“Climate is an angry beast we are poking at with sticks”

-- W. Broecker



Something Needs to Be Fixed!



The Take Home Lesson

- **So, even when good rain returns, hotter temperatures will mean more evaporation, less water on the average than there use to be, and more plant stress.**
- **So efforts to reduce evaporation through shade, improved soil water retention, and more efficient roots, are the way to design landscapes in the years ahead.**