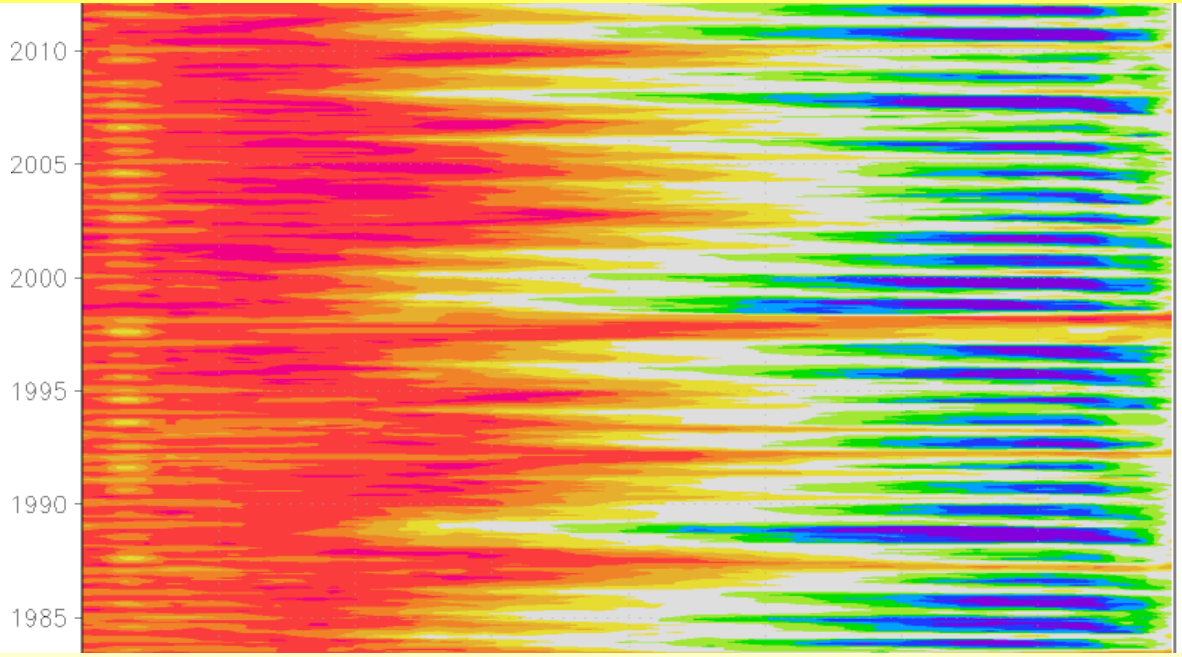
El Nino and La Nina: The Controls on Rainfall and Drought in the Western USA



Bob Endlich
bendlich@msn.com
Cruces Atmospheric Sciences Forum
19 Jun 2021

El Nino and La Nina… OUTLINE

Introduction and Overview of Patterns

Diagnostics: Ocean Temperatures and Global Temperatures

Some Marker El Nino Weather Events

Detailed Diagnostics: Ocean Temperatures.
Global Temperature of the Lower Troposphere.

ENSO Diagrams from Bob Tisdale's book, "*Who turned on the Heat?"*

Sidebars: Sunlight heats seawater
The hottest seawater ever gets
Upwelling of cold water brings the fish

Anomalies Help Understand the Story.

Catastrophe: the Little Ice Age in New Mexico.

El Nino's Big Brother: The Pacific Decadal Oscillation.

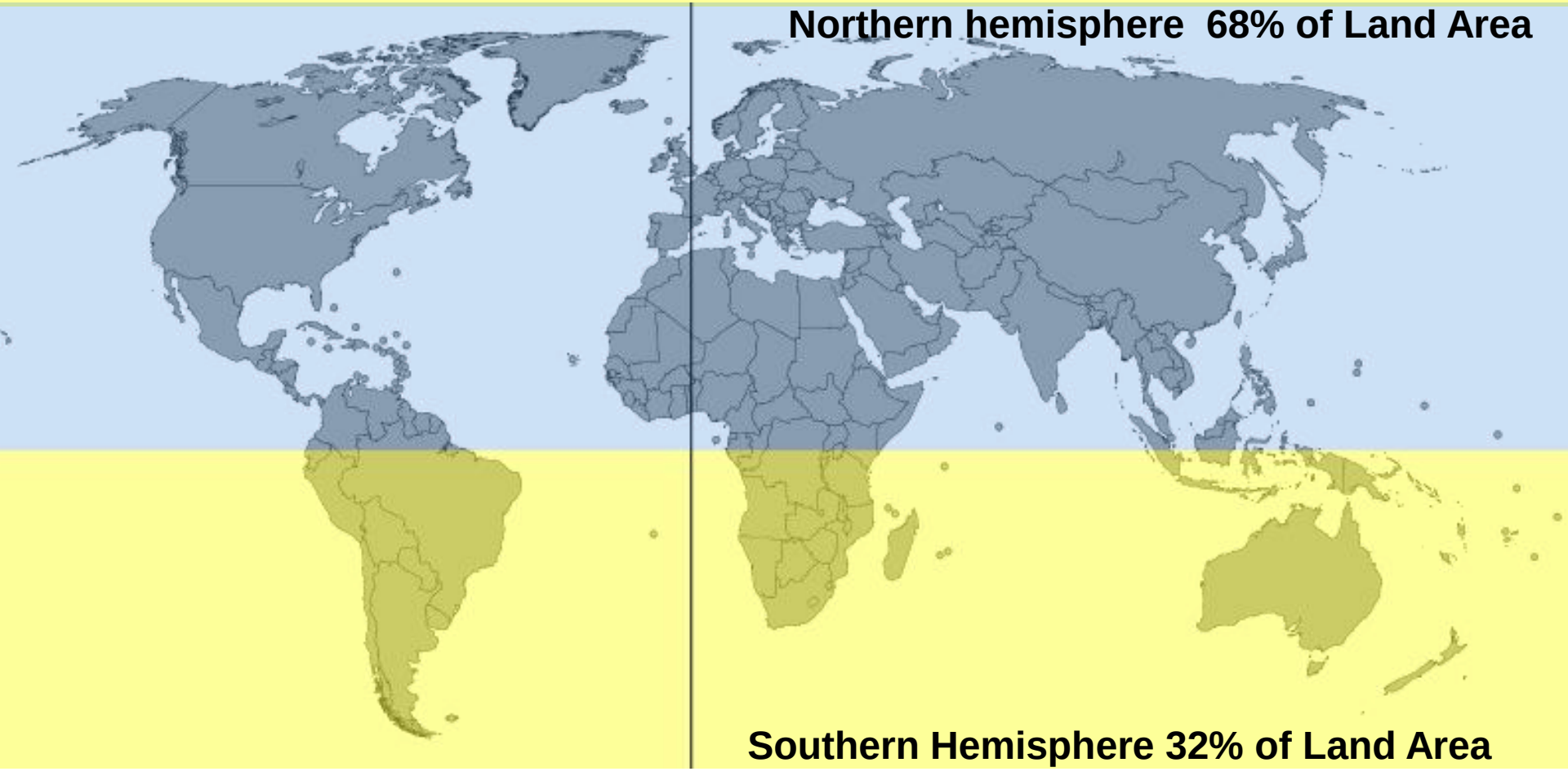
There's no need for False CO2 stories if you understand El Nino.

Introduction. Overview of Patterns.

Origins of the name, *El Niño*

El Niño… originally recognized by fisherman off the west coast of South America as appearance of **unusually warm water in the Pacific Ocean**, ~beginning of the year.

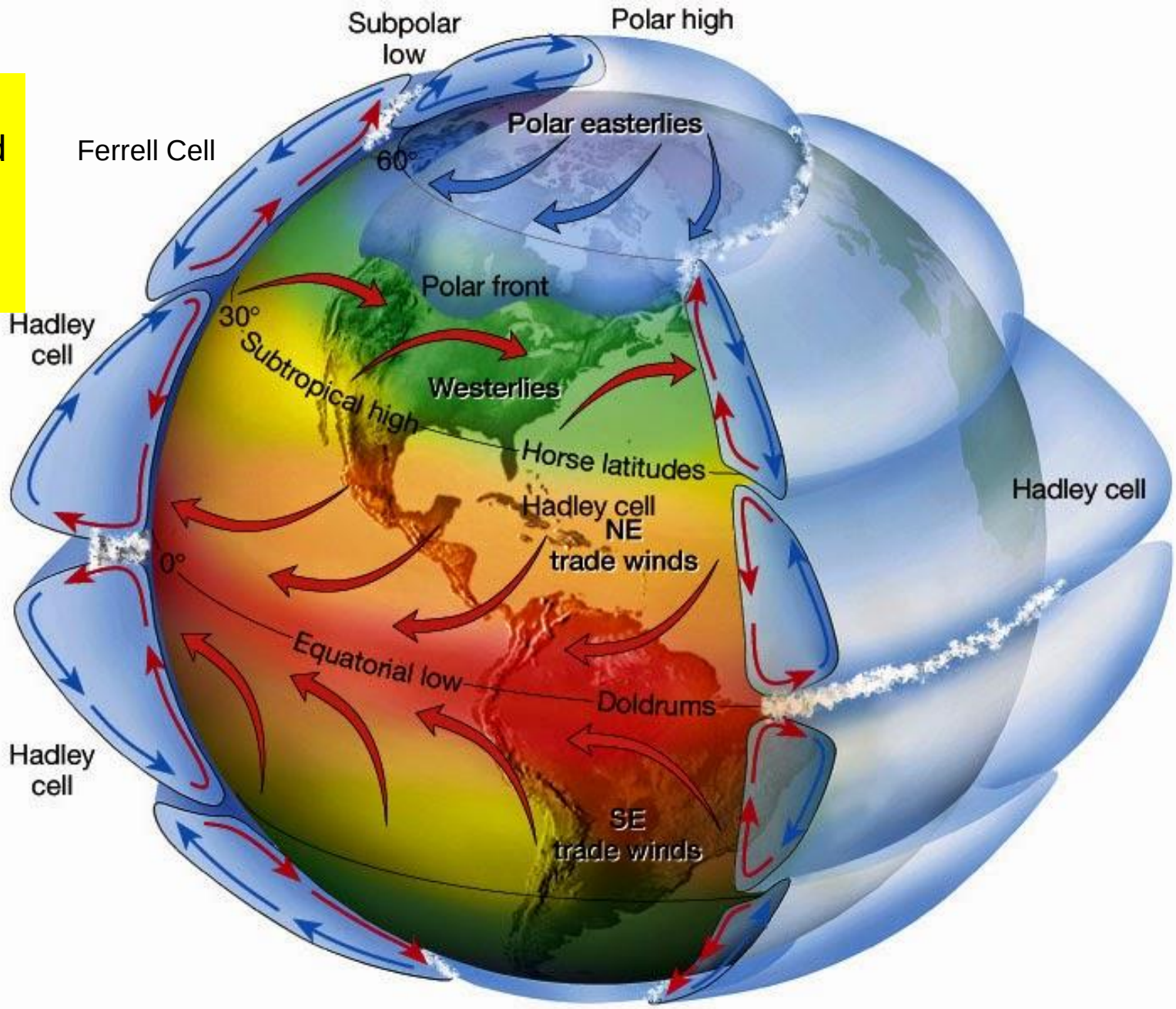
El Niño means *The Little Boy* or *Christ child* in Spanish.
Named for the tendency of the phenomenon to arrive around Christmas… Northern Hemisphere's Winter Solstice



http://1.bp.blogspot.com/tDTpvWrModo/U2XoP6s57XI/AAAAAAAAA7o/r6Ik0N5VHk8/s1600/Hadley+cells+2_ux1_eiu_edu.jpg

Note especially the equatorward areas of both subtropical ridges

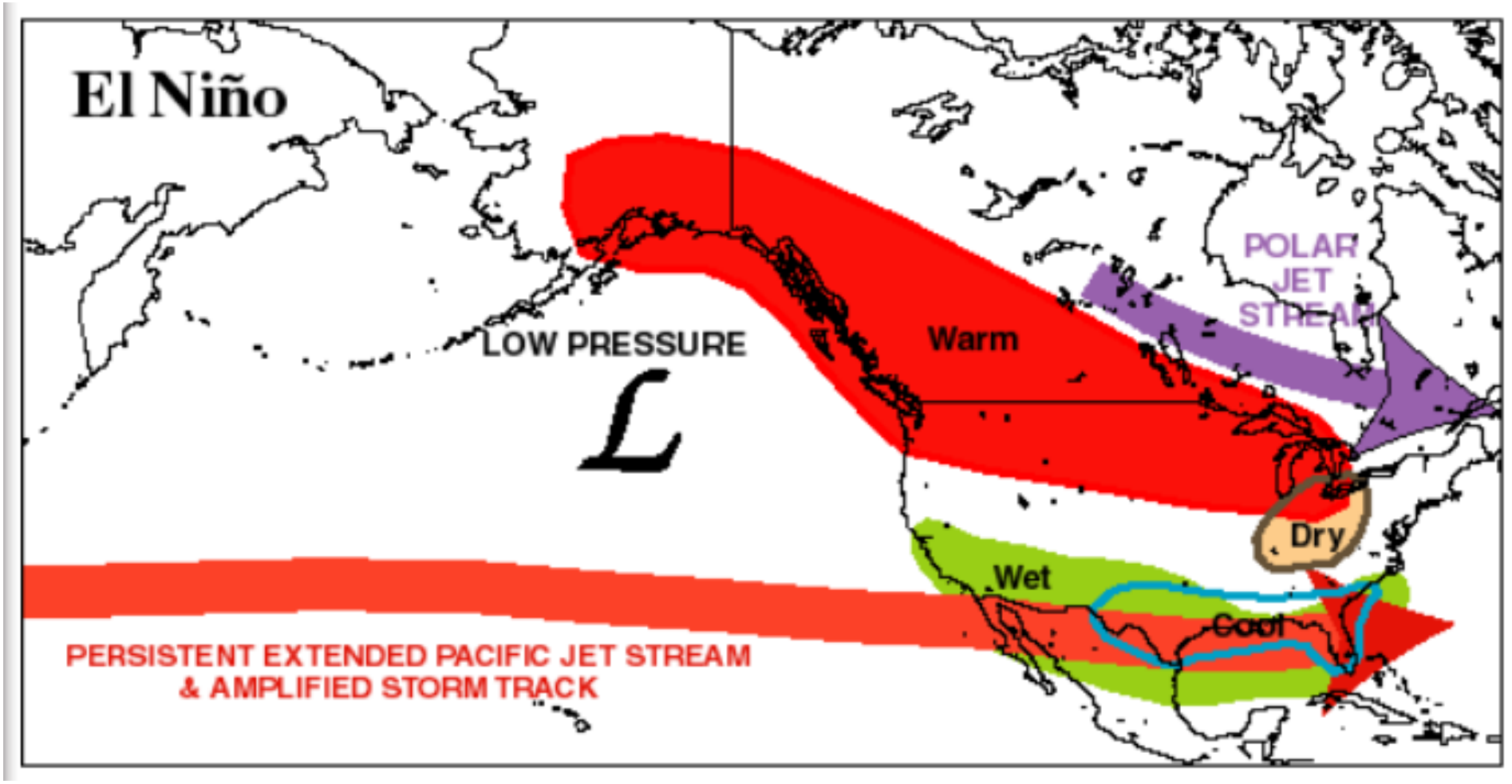
Northeasterly and Southeasterly Trade Winds



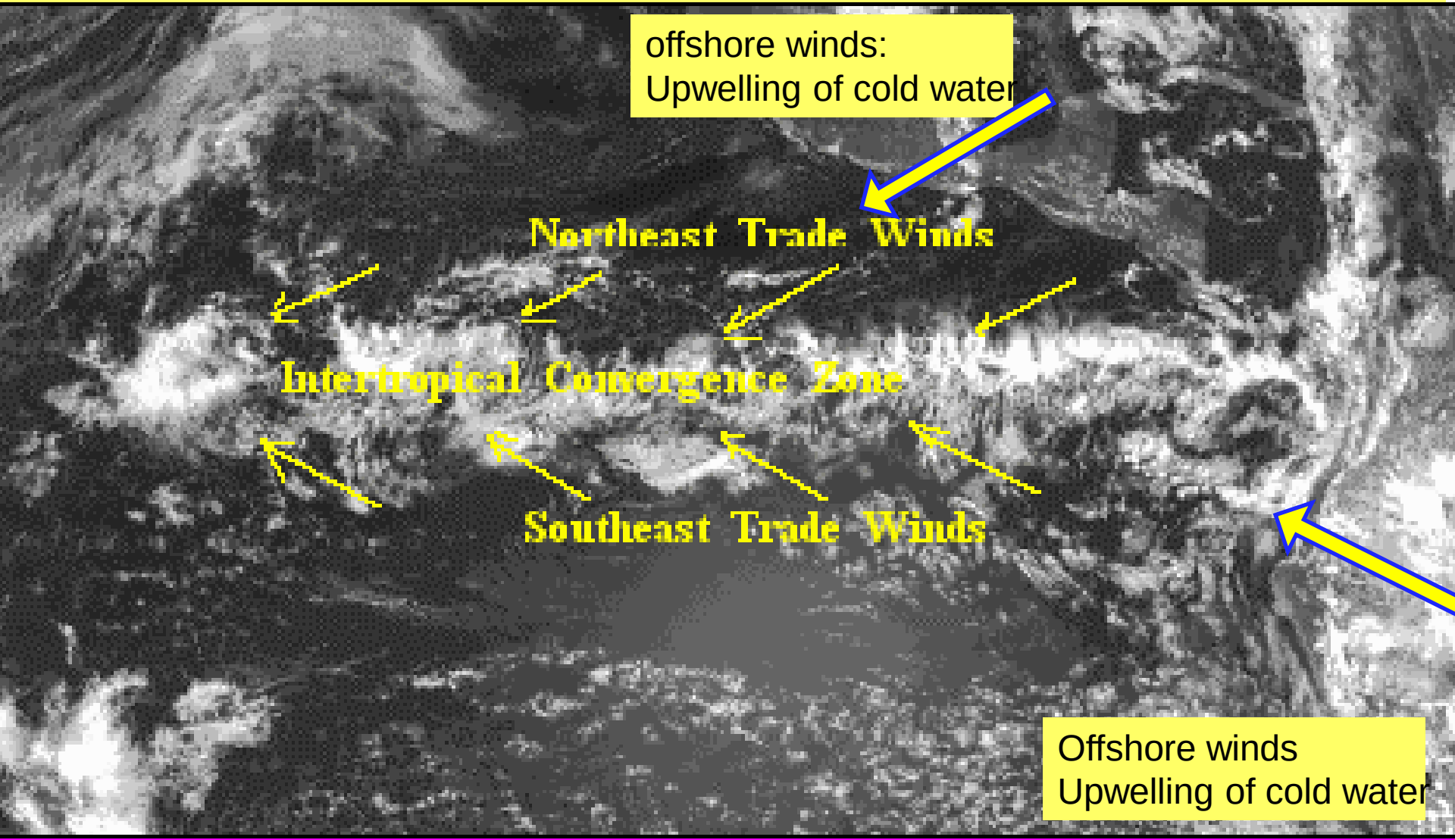
El Nino pattern: wet weather from California to New Mexico to East Coast

Huge Warm Pattern from Gulf of Alaska all the way to Michigan!

http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/ensocycle/nawinter.shtml

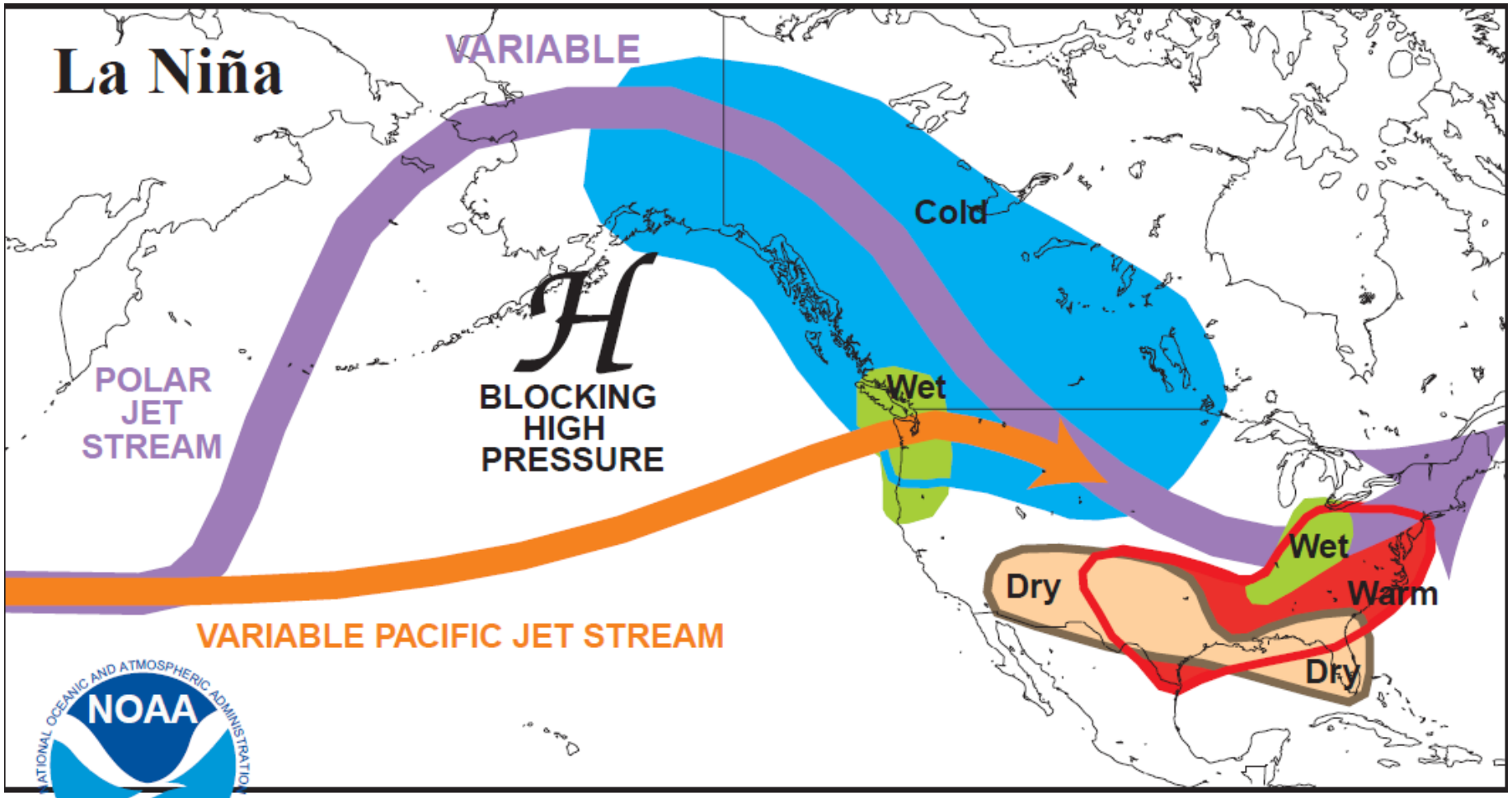


Northeasterly Trade Winds are very prevalent, stronger in La Nina years.
Visitors to Hawaii usually encounter steady winds from the northeast: Trade Winds



But EL NINO is caused by a disruption of this pattern, which allows warm water to flow from Indonesia/Western Pacific across the entire Pacific Ocean.

El Nino's counterpart is La Nina.
http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/ensocycle/nawinter.shtml
La Nina results in dry from ~Arizona to Florida



Climate Prediction Center/NCEP/NWS

Diagnostics:

Ocean Temperatures and
Global Tropospheric Temperatures

These features are diagnostic, not prognostic

Nino 3.4 region: area bounded from 5N to 5S and from 120W to 170W

NOAA NATIONAL CENTERS FOR ENVIRONMENTAL INFORMATION
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

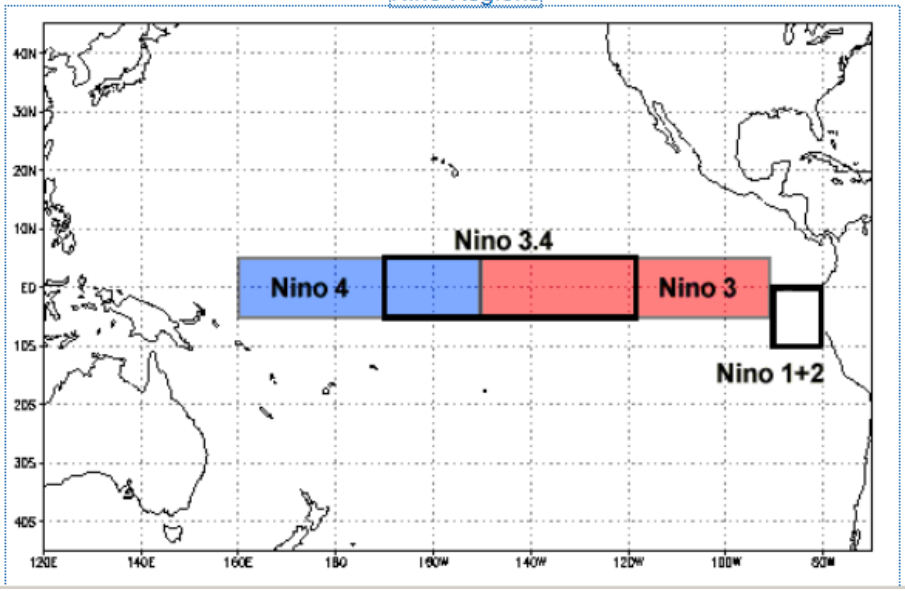
Equatorial Pacific Sea Surface Temperatures

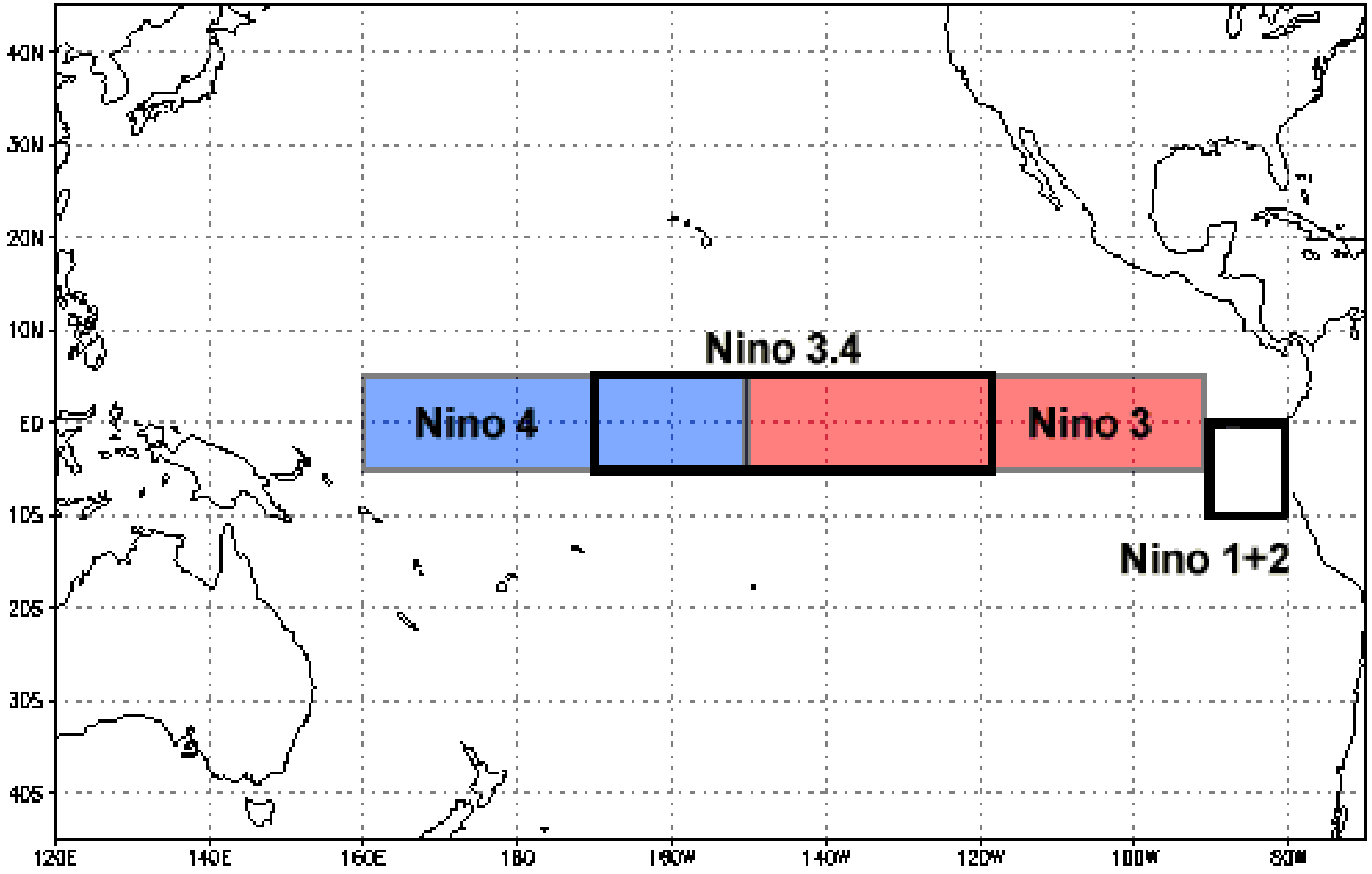
Climate Monitoring
State of the Climate
BAMS State of the Climate
Temp, Precip, and Drought
Climate at a Glance
Extremes
Societal Impacts
Snow and Ice
Teleconnections
GHCN Monthly
Monitoring References

ENSO | Zonal Winds | SSTs | Sea Temps | SST Anomalies | OLR | SOI

El Niño (La Niña) is a phenomenon in the equatorial Pacific Ocean characterized by a five consecutive 3-month running mean of sea surface temperature (SST) anomalies in the Niño 3.4 region that is above (below) the threshold of +0.5°C (-0.5°C). This standard of measure is known as the Oceanic Niño Index (ONI).

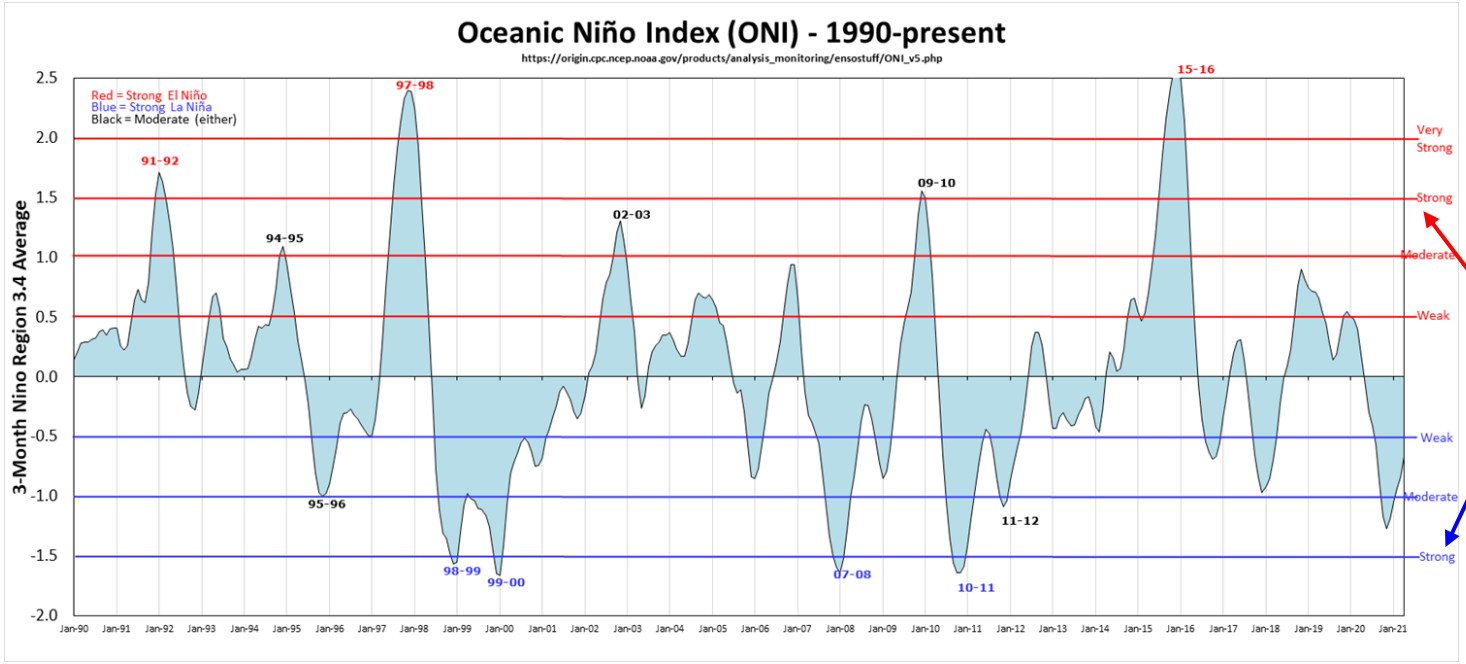
Niño Regions





The **Oceanic Nino Index:** (ONI) is one of the primary **indices** used to monitor **El Nino**-Southern Oscillation (ENSO). The ONI is calculated by **averaging sea surface temperature anomalies** in an area of the east-central equatorial Pacific **Ocean**, which is called the **Nino 3.4 region** (5S to 5N; 170W to 120W).

Ocean Nino Index is the Sea Surface Temperature Anomaly, Nino 3.4 Region



Red = Strong El Niño
Blue = Strong La Niña
Black = Moderate (either)

Jan 1990 Jan 2021

X-Axis, Date since Jan 1990
Y-Axis, Temperature Anomaly in Nino 3.4 Region, 3-month average.

Marker Events:

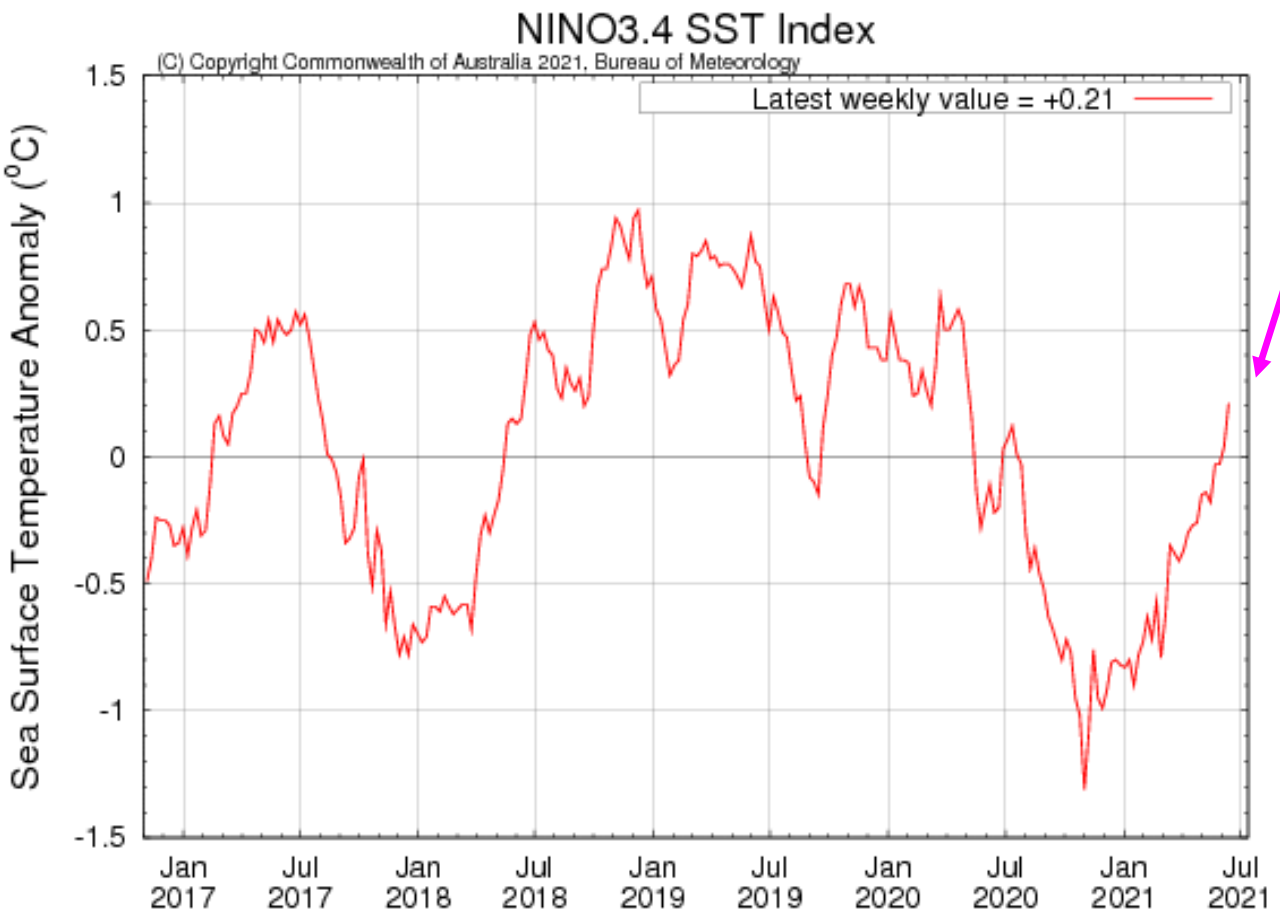
The 1997-98 El Nino. Extensive snowfall with 2 months of snow Organ Mountains.
The 2015-16 El Nino. Heavy rains and snows in South America.
Feb 2017 Oroville Dam, CA, partial failure.

https://wattsupwiththat.com

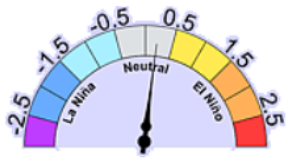
ABOUT CLIMATE FAIL FILES EVERYTHINGCLIMATE REFERENCE PAGES SUBMIT STORY

SEND NEWS TIP

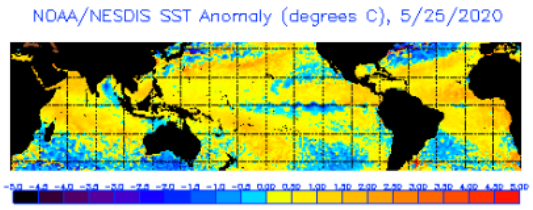
https://i1.wp.com/www.bom.gov.au/climate/enso/monitoring/nino3_4.png



ENSO METER



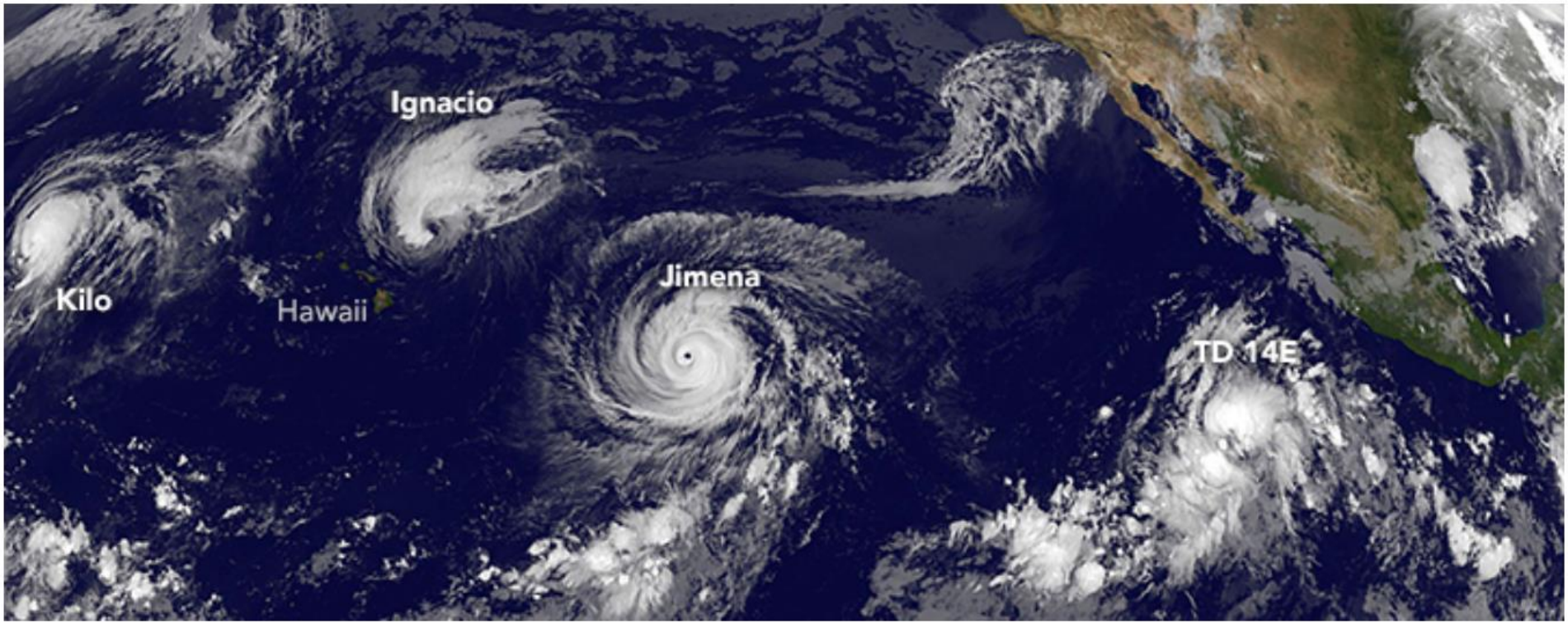
ENSO/SST Page



Australian Bureau of Meteorology uses 1-week average.

More El Nino ‘Marker’ Storms

https://earthobservatory.nasa.gov/features/ElNino



The GOES-West satellite observed four tropical cyclones roiling the Pacific on September 1, 2015, during an El Niño event. (Image courtesy of the NASA/NOAA GOES Project.)

https://www.govtech.com/em/emergency-blogs/disaster-zone/disaster-officials-brace-for-havoc-from-historic-el-nino.html

FILE - In this Jan. 27, 1983, file photo, the landmark Crystal Pier in the San Diego community of Pacific Beach collapses under the force of surging waves during an El Nino storm.
One hundred feet of the 56-year-old structure was lost.

https://www.weareiowa.com/article/news/local/california-home-owners-urged-to-evacuate-as-cliffs-dissapear-into-pacific-ocean

PACIFICA, CA – A cliff-side dwelling may have a great view, but some California residents have been ordered to evacuate for fears their homes could fall into the Pacific Ocean. El Niño-fueled storms have loosened and washed away the ground, leaving the cliffs to crumble.

https://www.usatoday.com/story/weather/2016/01/05/california-drought-el-nino/78304844/

Portions of the 101 freeway flood because of rain Jan. 5, 2016, in Ventura, Calif. *AP*

https://www.cbsnews.com/news/heavy-storms-in-california-signify-return-of-el-nino/

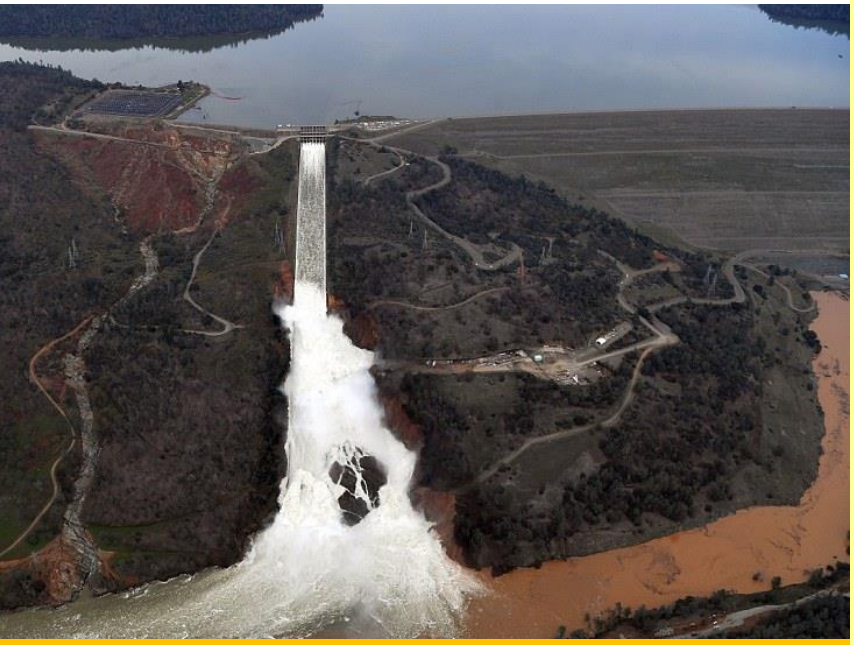
https://abcnews.go.com/US/powerful-western-storms-fueled-el-nino-weather-pattern/story?id=36106177

https://abcnews.go.com/US/powerful-western-storms-fueled-el-nino-weather-pattern/story?id=36106177

Note the bores and hydraulic jump, features of shallow water waves

https://www.latimes.com/local/california/la-me-oroville-floods-norcal-20170216-story.html

It's not just Oroville: Record rain is straining California's whole flood control network



What can be seen is the result of the massive collapse (pictured) when 100,000 cubic feet of water per second was rushing down the spillway

The frantic effort over the last few days to lower water levels at Oroville Dam after the structure's two spillways became damaged is part of a larger drama playing out as California rapidly shifts from extreme drought to intense deluges.

Large swaths of the region are on track to experience their wettest winter on record, with many areas having already surpassed their average precipitation for an entire year.

And all that water is putting new strains on the network of dams, rivers, levees and other waterways that are essential to preventing massive flooding during wet years like this one.

Be prepared: Monster storm could be biggest of season for L.A. area Feb 16, 2017 | 7:45 AM

El Nino in the Southern Hemisphere:

South America

Australia

http://www.bloomberg.com/news/articles/2015-08-12/worst-el-nino-in-30-years-pounds-south-american-economies-polls

El Niño Is Coming Back: Here's What You Need to Know

http://www.bloomberg.com/news/articles/2015-08-12/worst-el-nino-in-30-years-pounds-south-american-economies-polls

The El Nino climatic phenomenon has hit South America's southern cone with a vengeance in the past week, causing flooding and landslides that l damaged crops, cut off roads, disrupted copper mining and might even influence Argentina's presidential elections.

After more than five years of drought caused by La Nina, the switch to El had been forecast for more than a year.

Still, the sudden turnaround has caught people by surprise.

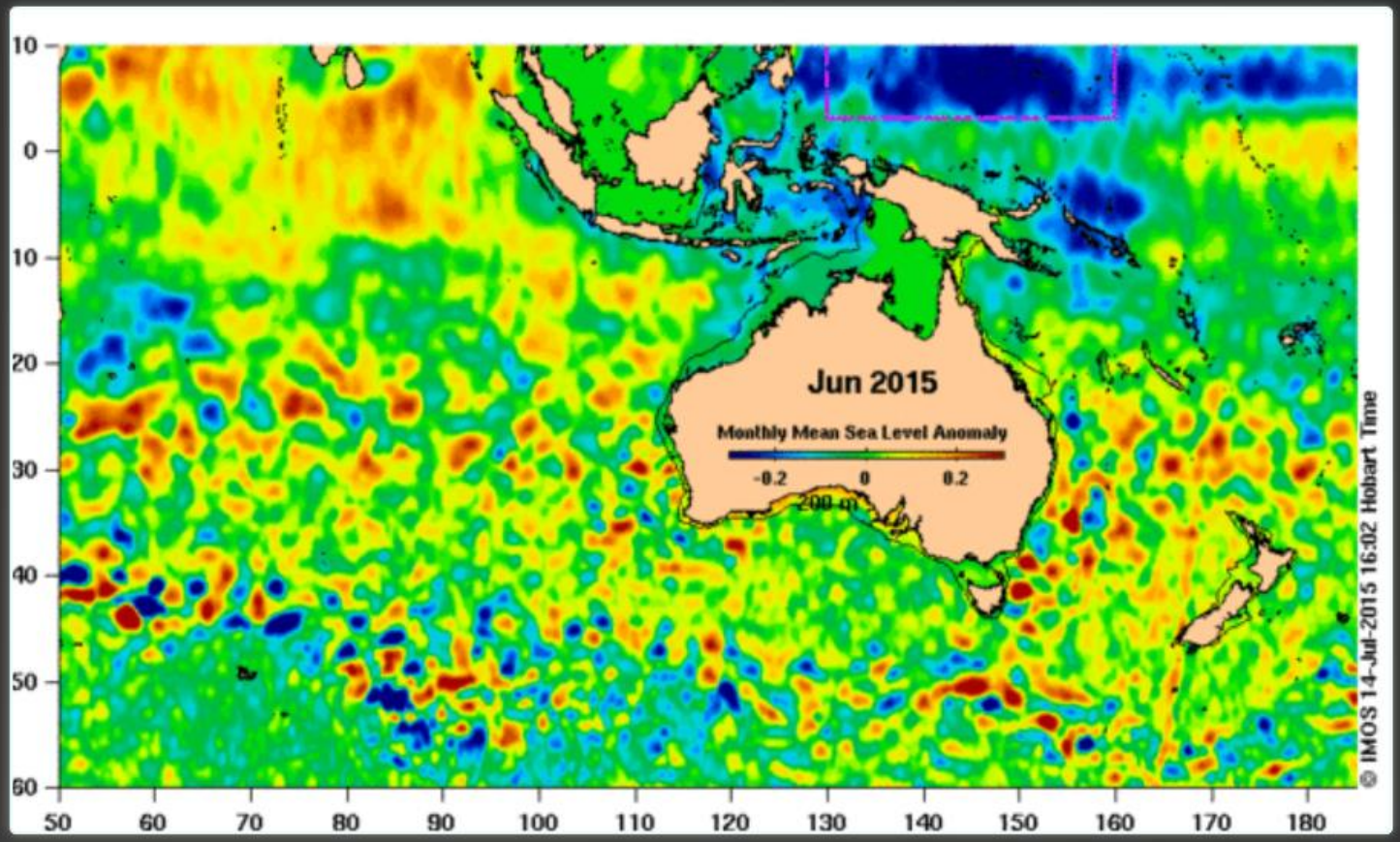
More rains are projected to hit Argentina's agricultural belt in the coming prompting opposition presidential candidate Mauricio Macri to claim the government should be doing more to help.

http://www.bom.gov.au/climate/enso/

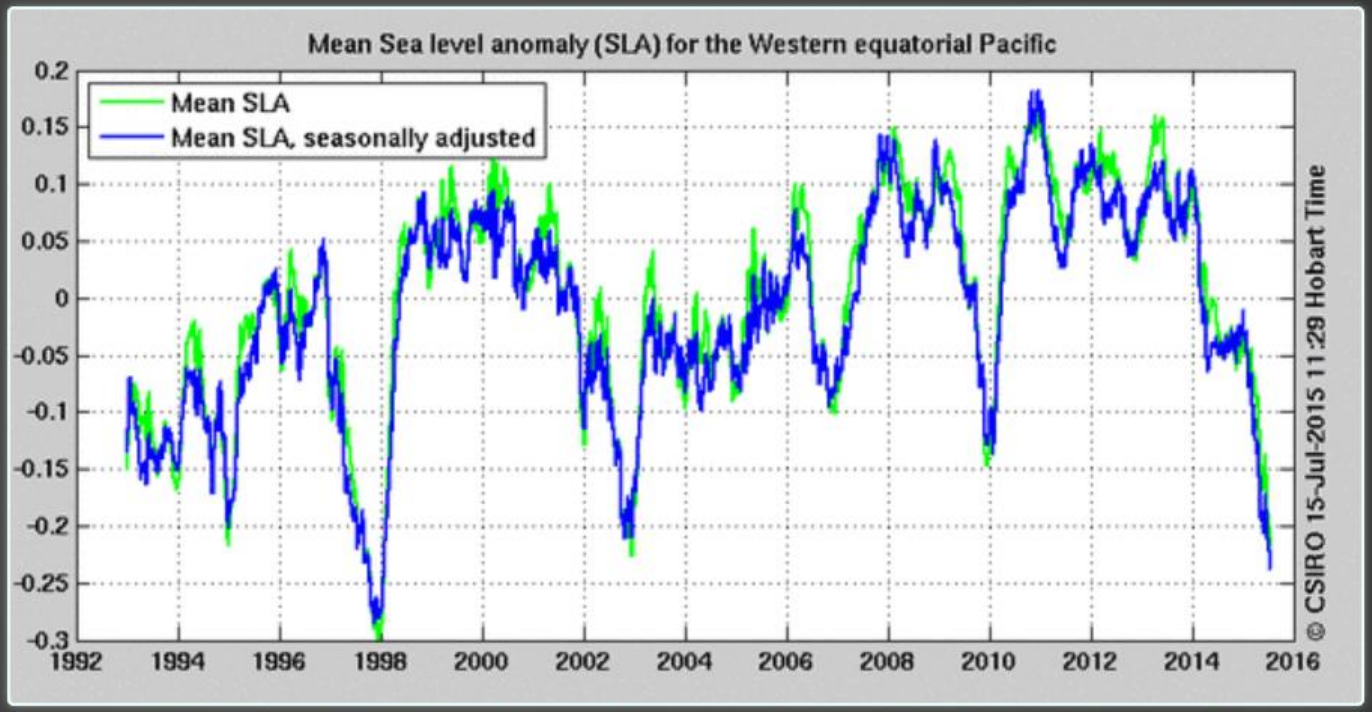
http://www.aviso.altimetry.fr/en/news/idm/2015/jul-2015-el-ninos-return-west-side-story.html

EL NIÑO'S RETURN, WEST SIDE STORY

Image of the Month - July 2015



http://www.aviso.altimetry.fr/en/news/idm/2015/jul-2015-el-ninos-return-west-side-story.html



June monthly Mean Sea Level Anomaly around Australia (top), and the spatial mean SLA of the region (boxed in map) North of New Guinea (bottom) (Credits IMOS/CSIRO)

El *Niño*'s name comes from South America. However, this phenomenon impacts the whole Pacific, the Western part no less than the Eastern, though in opposite ways. While on the Peruvian coasts El *Niño* means heavy rainfalls, higher-than-usual sea levels and temperatures, along the Australian, Papuan and Indonesian coasts it means drought and lower sea levels and temperatures. This being as much a problem as the reverse. In 1997 in particular, a lot of forest fires devastated Indonesia.

Detailed Diagnostics:

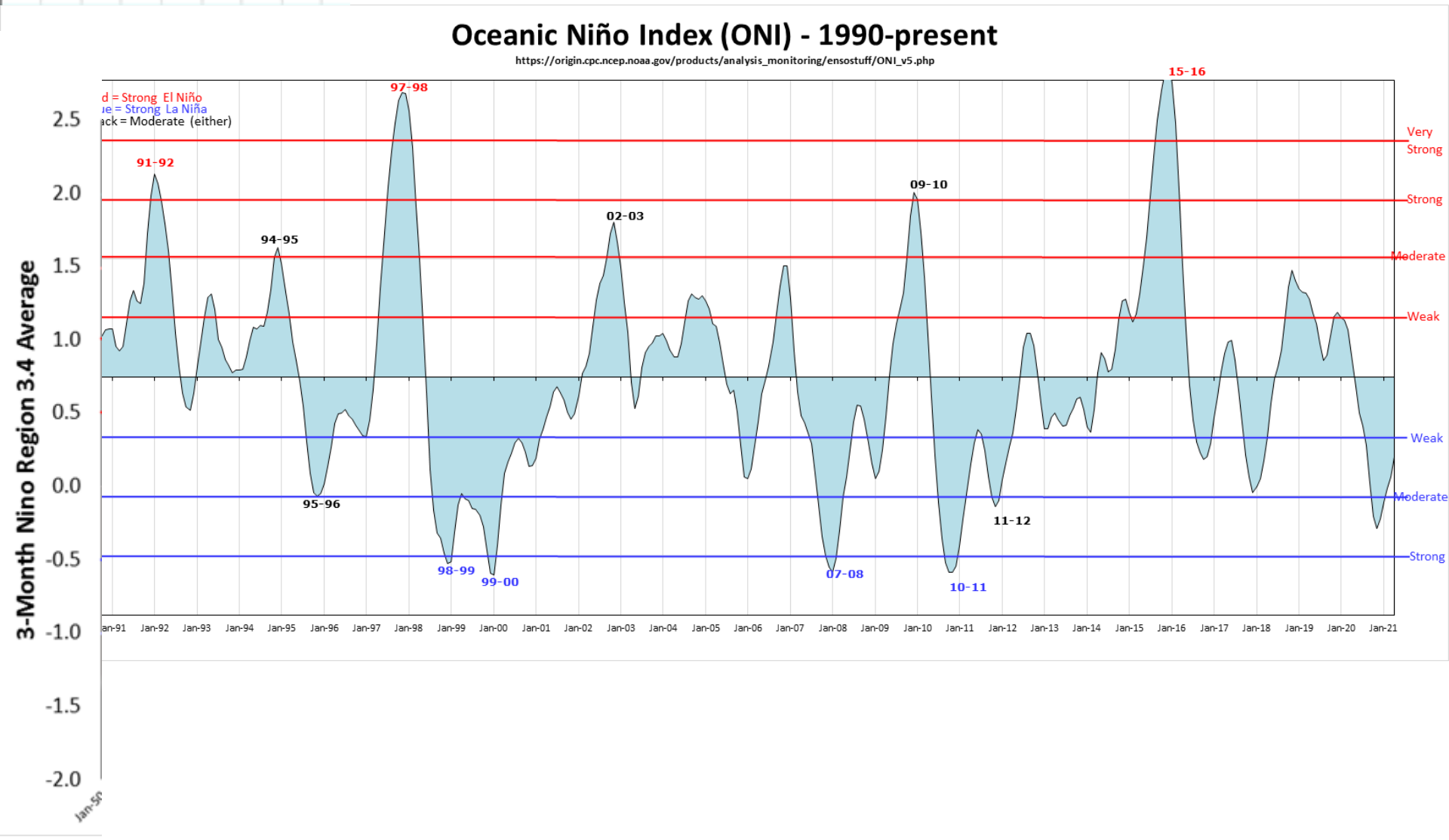
Ocean Temperatures and Global Temperatures

http://ggweather.com/enso/oni.htm

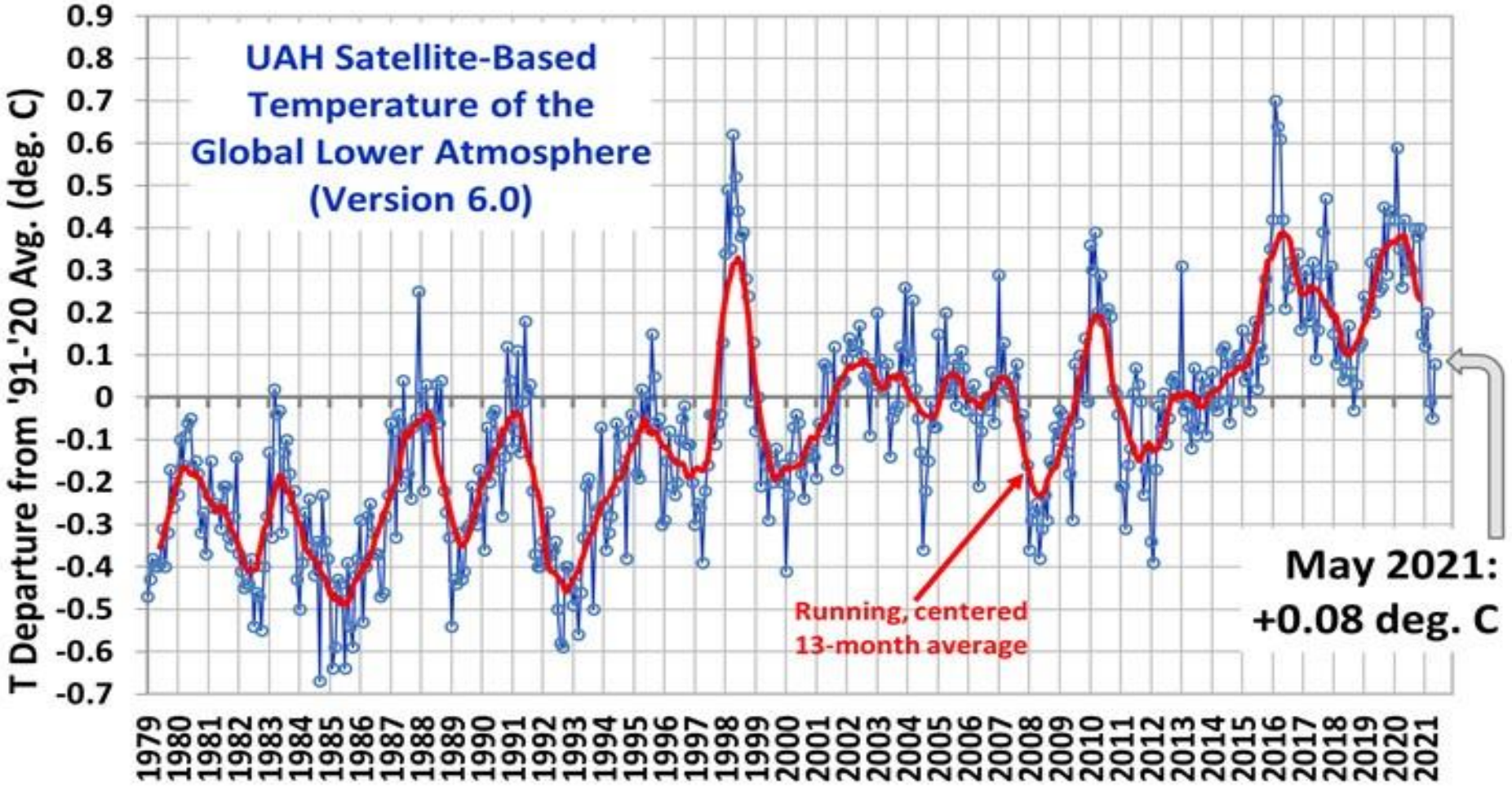
Golden Gate Weather Services, Jan Null; used with permission

Red = Strong El Niño
Blue = Strong La Niña
Black = Moderate (either)

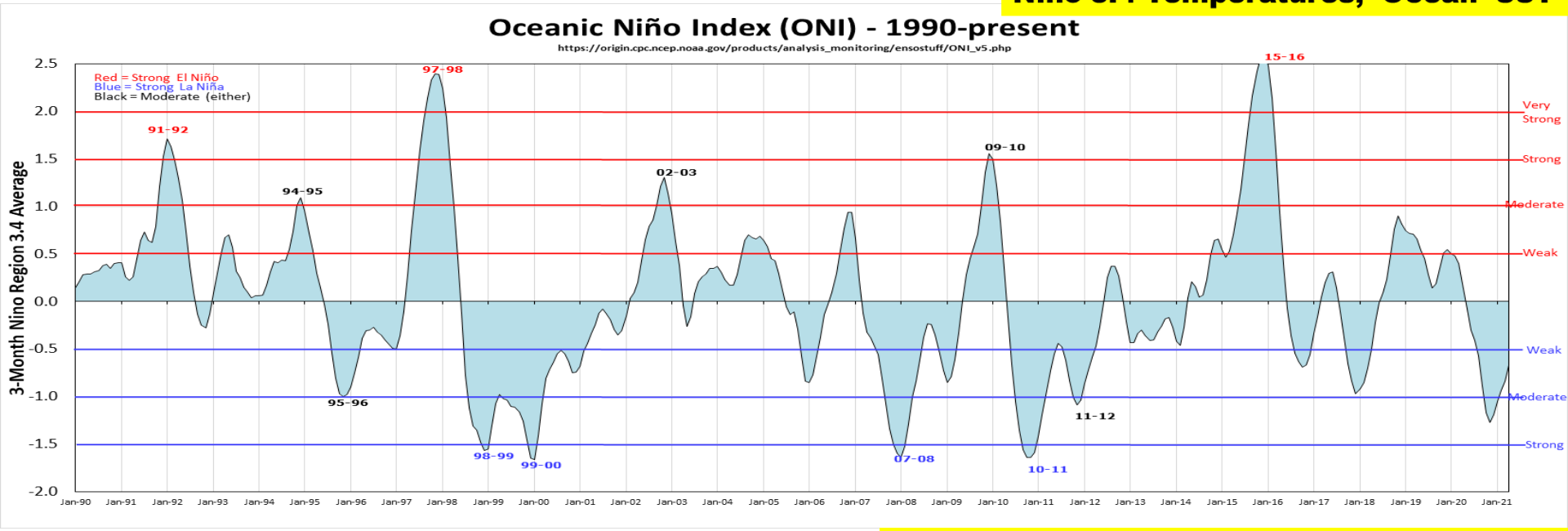
Nino 3.4 *sea surface temperature anomalies*



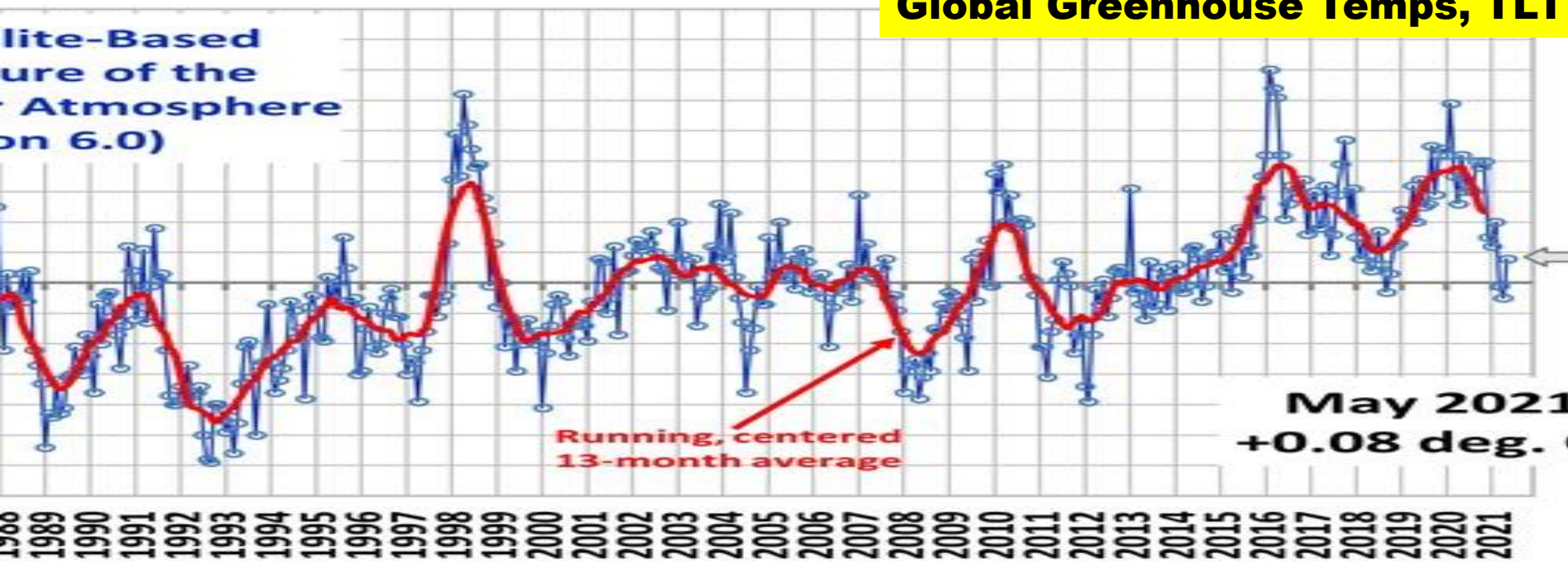
http://www.drroyspencer.com/wp-content/uploads/UAH_LT_1979_thru_May_2021_v6.jpg



Nino 3.4 Temperatures, Ocean SST



Global Greenhouse Temps, TLT

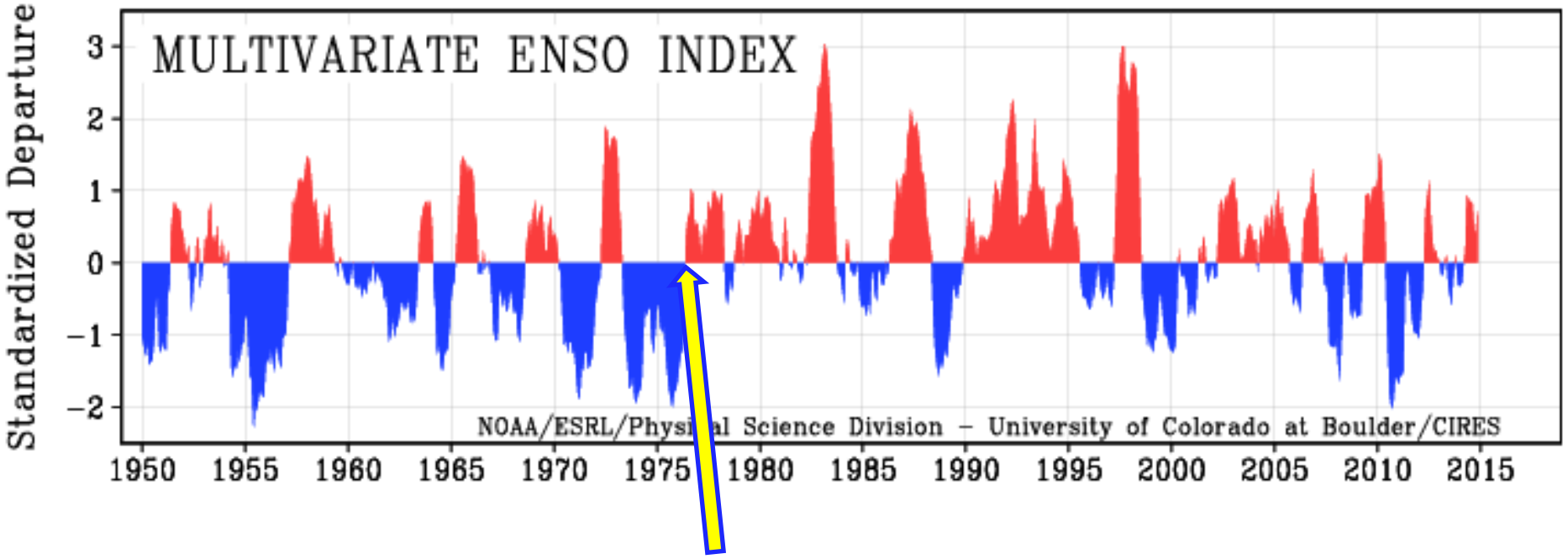


U.S. Department of Commerce | National Oceanic & Atmospheric Administration | NOAA Research

Earth System Research Laboratory

Physical Sciences Division

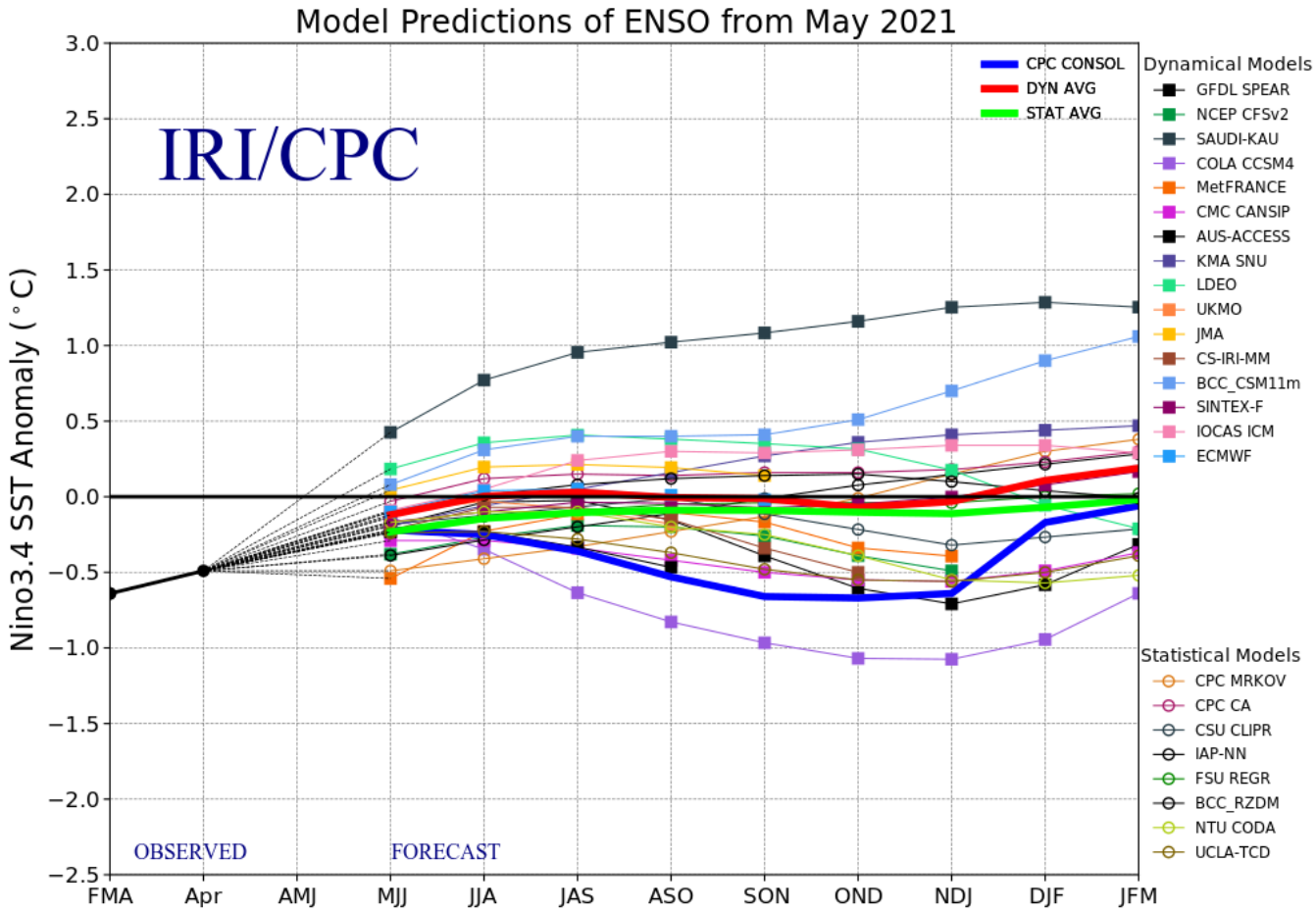
http://www.esrl.noaa.gov/psd/enso/mei/



Notice the Great Climatic Shift of 1976, when the number of El Ninos per decade increased dramatically.

https://iri.columbia.edu/ourexpertise/climate/forecasts/enso/current/

The El Nino Index is diagnostic. Below are current attempts at prognostication.



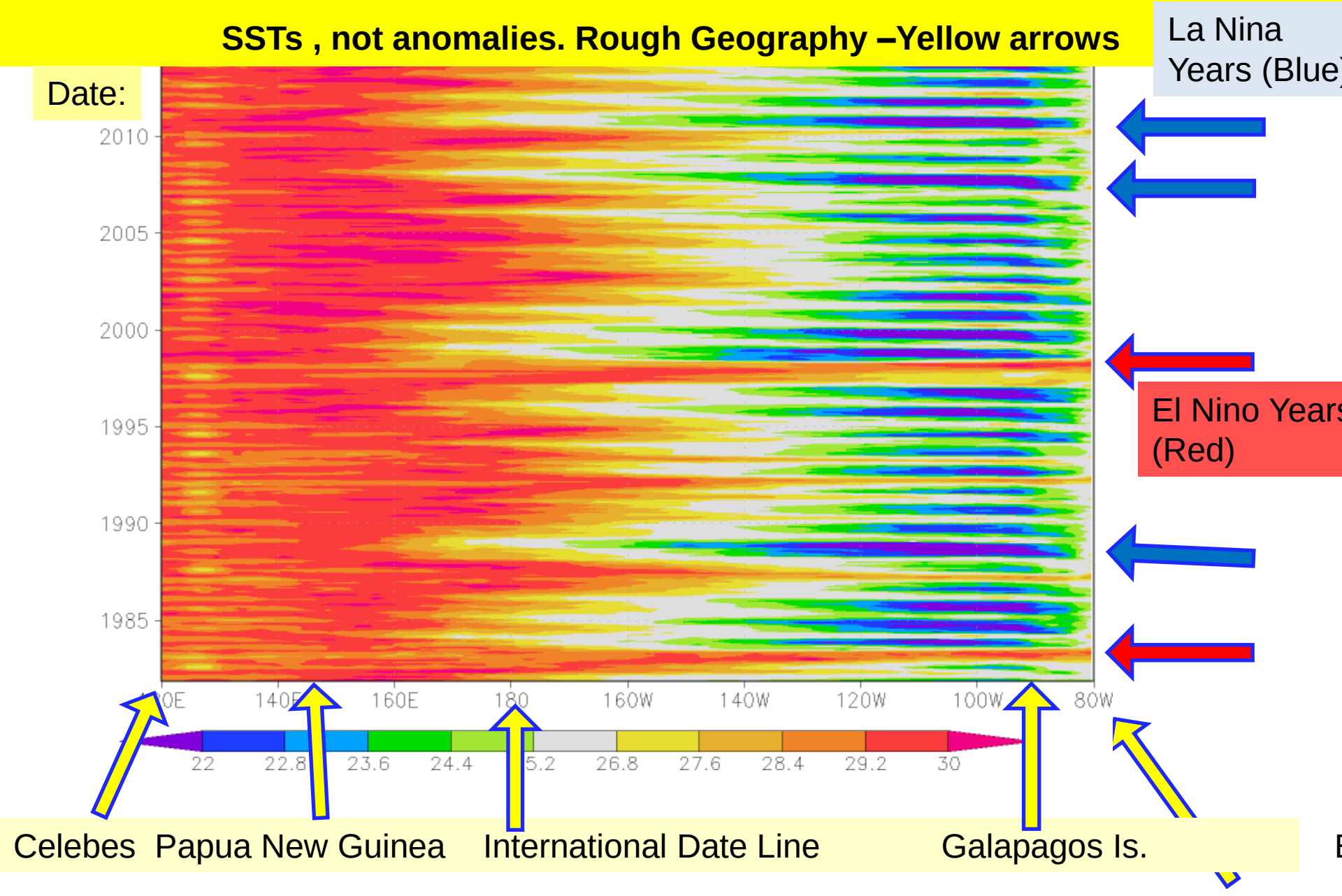
Historically Speaking

El Niño and La Niña events tend to develop during the period Apr-Jun and they

- Tend to reach their maximum strength during October - February
- Typically persist for 9-12 months, though occasionally persisting for up to 2 years
- Typically recur every 2 to 7 years

Bob Tisdale's Hovemuller diagram. Equatorial Sea Surface Temperature (Longitude)

SSTs , not anomalies. Rough Geography –Yellow arrows



El Nino, basics on how

it develops and works…

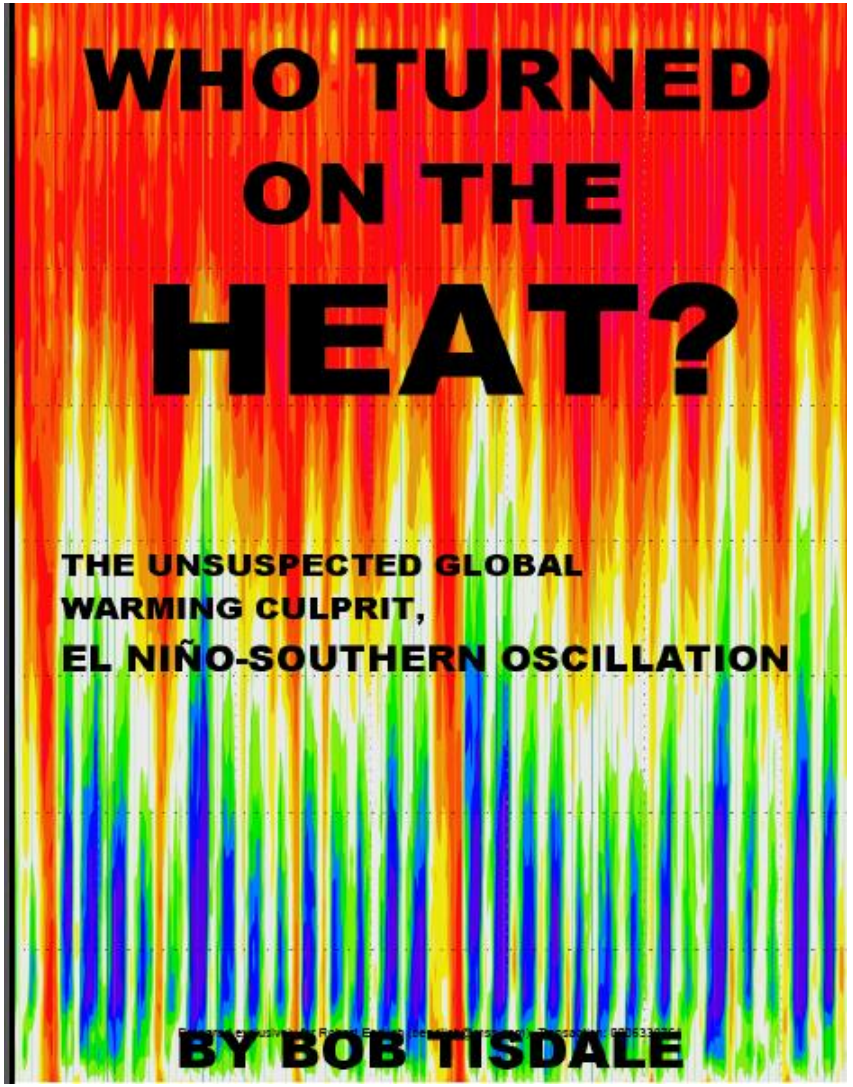
The entire phenomenon is called

ENSO: El Nino-Southern Oscillation

ENSO Diagrams from Bob Tisdale's E-book

A highly-recommended E-book.

This book is the source for the excellent graphics I use later in this section.



1.2 The ENSO Annotated Illustrations

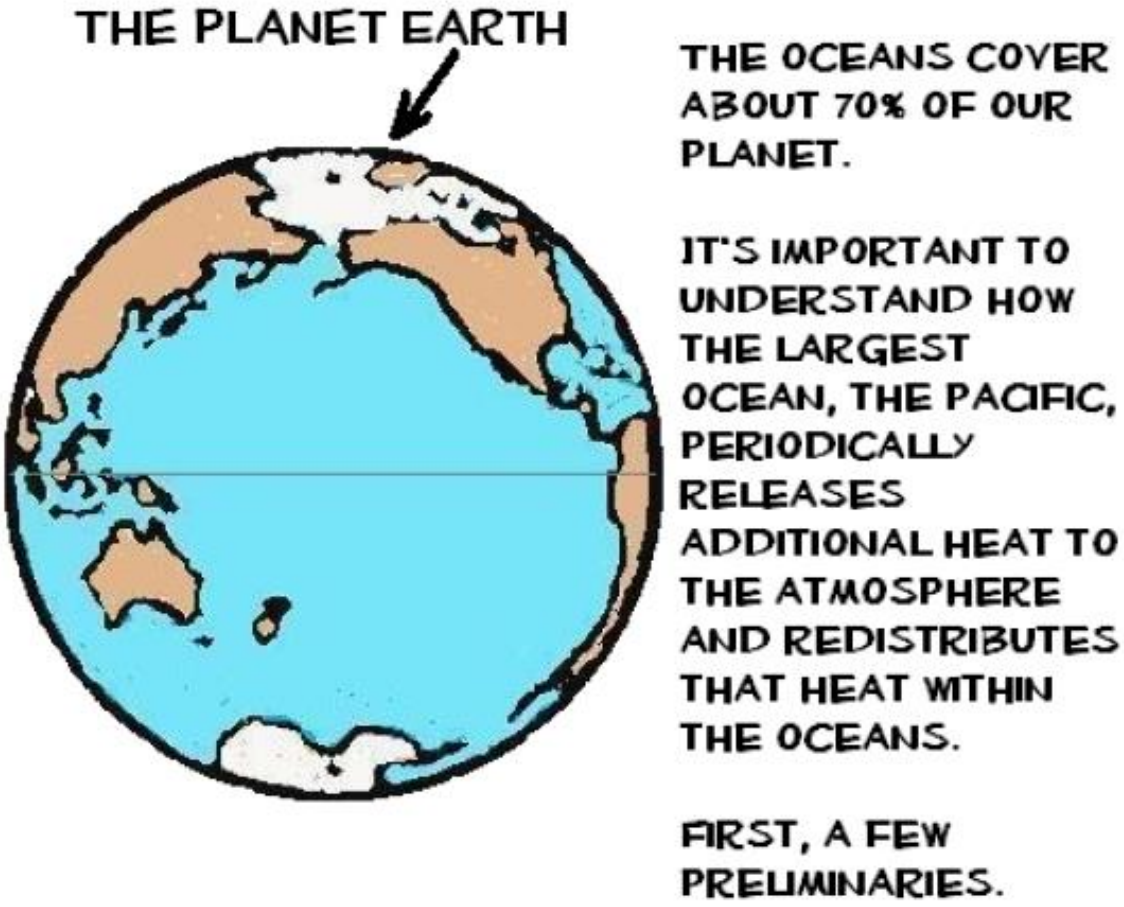
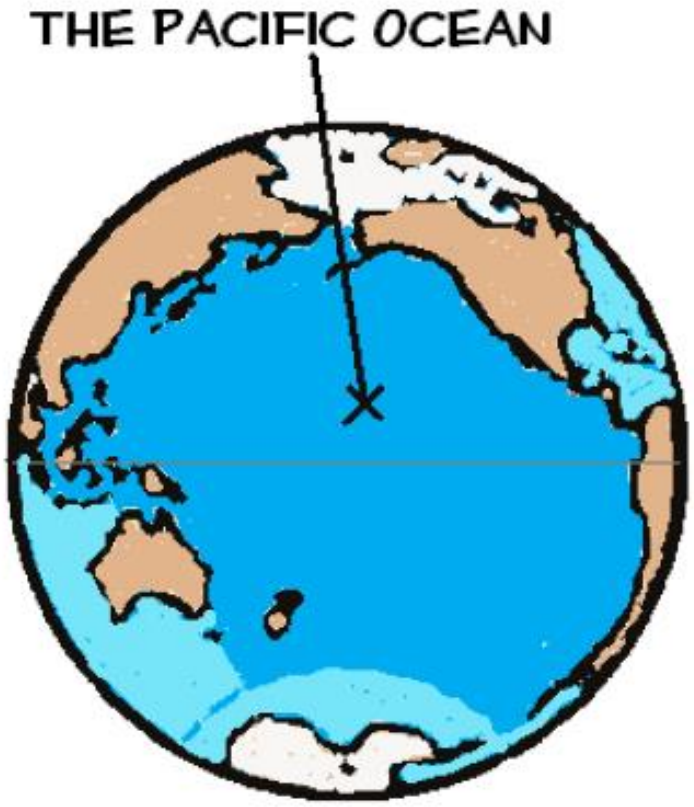


Figure 1-1

HHH



THE PACIFIC OCEAN STRETCHES ALMOST HALFWAY AROUND THE GLOBE AT THE EQUATOR.

IT COVERS THE SURFACE OF THE PLANET FROM ASIA TO NORTH AMERICA AND FROM AUSTRALIA TO SOUTH AMERICA.

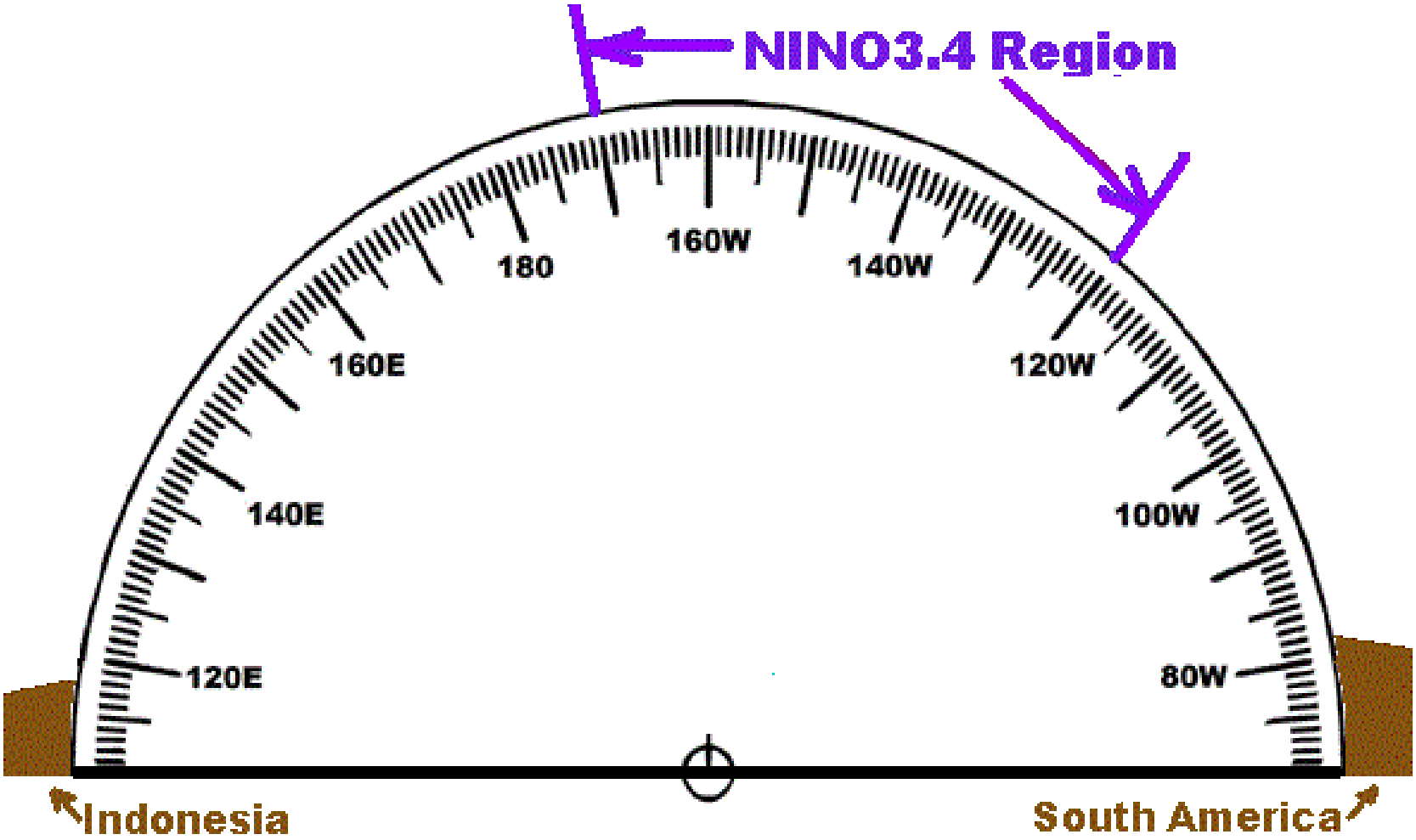
IT REACHES FROM THE BERING STRAIT NEAR THE ARCTIC OCEAN TO THE IMAGINARY BORDER WITH THE SOUTHERN OCEAN THAT SURROUNDS ANTARCTICA.

Figure 1-2 Bob Tisdale

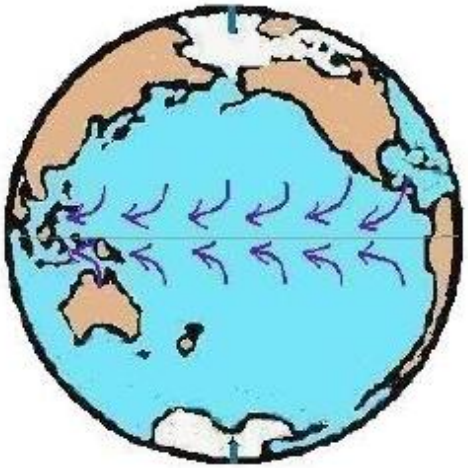
HHH

EQUATORIAL PACIFIC

A Different Perspective of Its Surface



TRADE WINDS

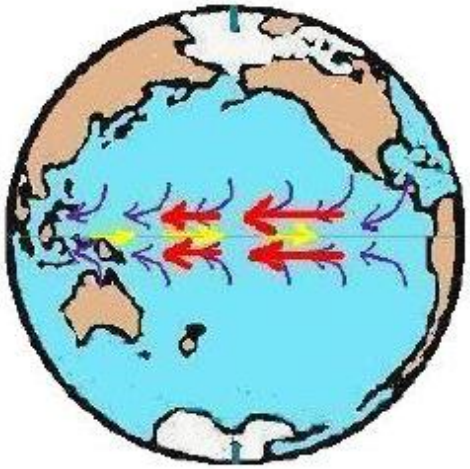


THE TRADE WINDS BLOW ACROSS THE SURFACE OF THE TROPICAL PACIFIC, FROM THE NORTHEAST TO THE SOUTHWEST IN THE NORTHERN HEMISPHERE AND FROM THE SOUTHEAST TO THE NORTHWEST IN THE SOUTHERN HEMISPHERE.

Figure 1.3 Bob Tisdale

HHH

OCEAN CURRENTS



THE OCEAN CURRENTS IN THE TROPICAL PACIFIC ARE DRIVEN BY THE TRADE WINDS.

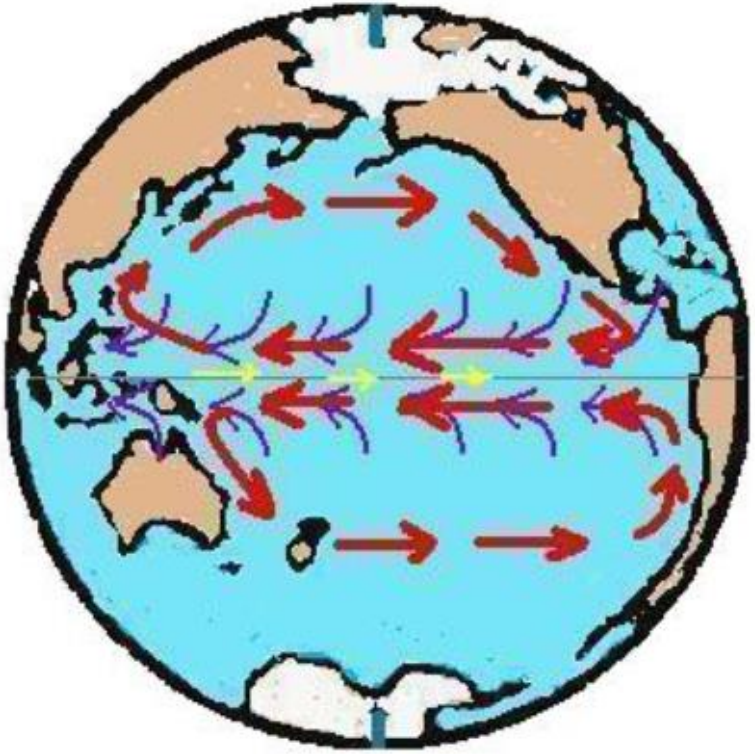
THE CURRENTS NEAR THE EQUATOR ARE CALLED THE NORTH AND SOUTH EQUATORIAL CURRENTS. THEY CARRY WATER FROM EAST TO WEST.

THERE'S ALSO A (NORMALLY) SMALLER CURRENT THAT RUNS BETWEEN THEM CALLED THE EQUATORIAL COUNTER CURRENT.

Figure 1.4 Bob Tisdale

HHH

OCEAN CURRENTS

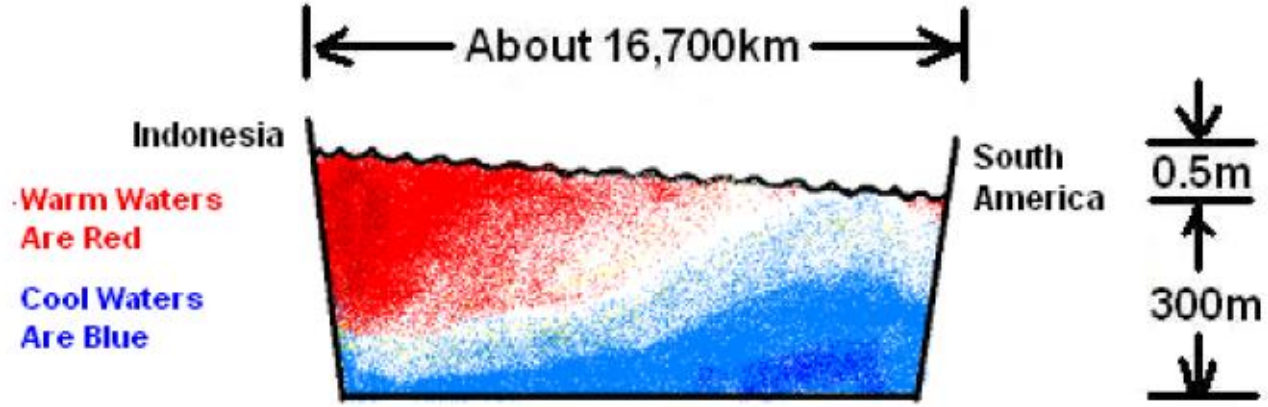


THE TRADE WIND-DRIVEN WATERS COLLIDE WITH LAND SO THEY ARE FORCED TO HEAD TOWARD THE POLES.

THEY THEN CIRCLE AROUND AND FORM WHAT ARE CALLED THE NORTH AND SOUTH PACIFIC GYRES.

Figure 1-5 Bob Tisdale

INTRODUCTION TO THE CROSS SECTION OF THE EQUATORIAL PACIFIC OCEAN USED IN MANY OF THE GRAPHICS THAT FOLLOW



THE DIMENSIONS OF THE CROSS SECTION ARE SKEWED. BUT KNOWING THE SEA LEVEL IS ABOUT 0.5 METERS HIGHER IN THE WEST THAN IN THE EAST UNDER "NORMAL" CONDITIONS IS IMPORTANT.

THE VARIATIONS IN TEMPERATURES BELOW THE SURFACE ARE ALSO IMPORTANT, BUT THEY TAKE PLACE IN THE TOP 300 METERS.

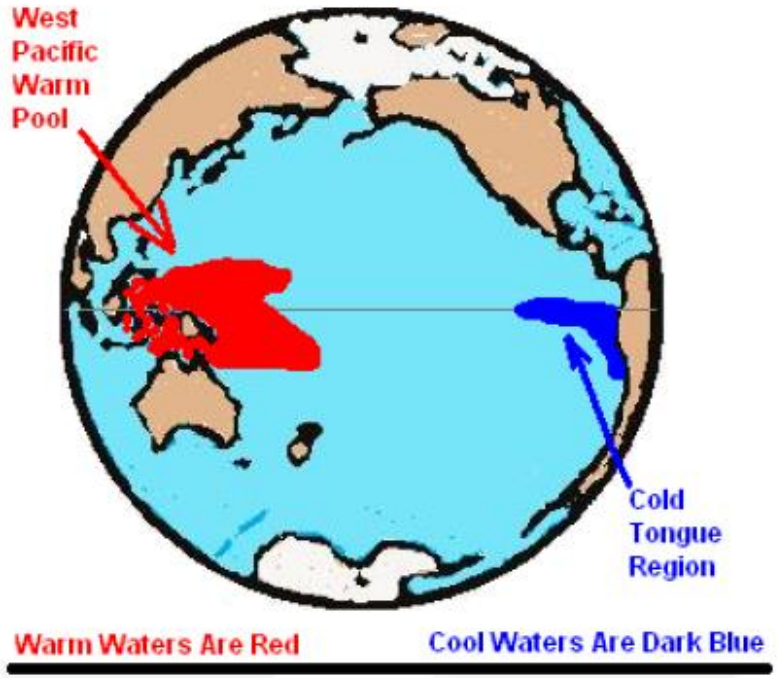
AND THE OVERALL WIDTH OF THE TROPICAL PACIFIC MUST BE KEPT IN MIND.--ALMOST HALFWAY AROUND THE GLOBE.

Figure 1-6

Bob Tisdale

NORMAL OR "ENSO-NEUTRAL" CONDITIONS (A)

(NOT AN EL NIÑO AND NOT A LA NIÑA)



THE TRADE WINDS PUSH THE SUN-WARMED WATER TO THE WEST AND IT ACCUMULATES IN AN AREA CALLED THE WEST PACIFIC WARM POOL, REACHING DEPTHS OF ALMOST 300 METERS.

THE TRADE WINDS ALSO DRAW COOL WATERS FROM BELOW THE SURFACE OF THE EASTERN EQUATORIAL PACIFIC IN A PROCESS KNOWN AS UPWELLING.

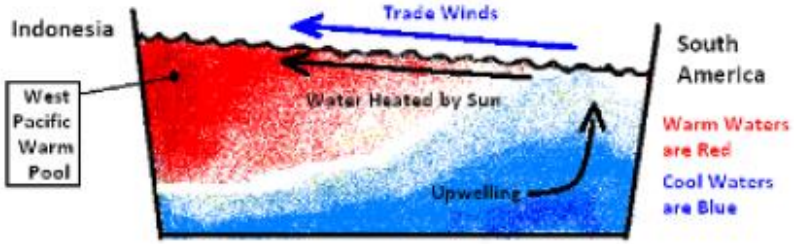


Figure 1-7

Bob Tisdale

SIDEBAR:
Sunlight's absorption in (sea) water for various wave lengths of radiation

Bob Endlich
bendlich@msn.com
15 Jun 2021

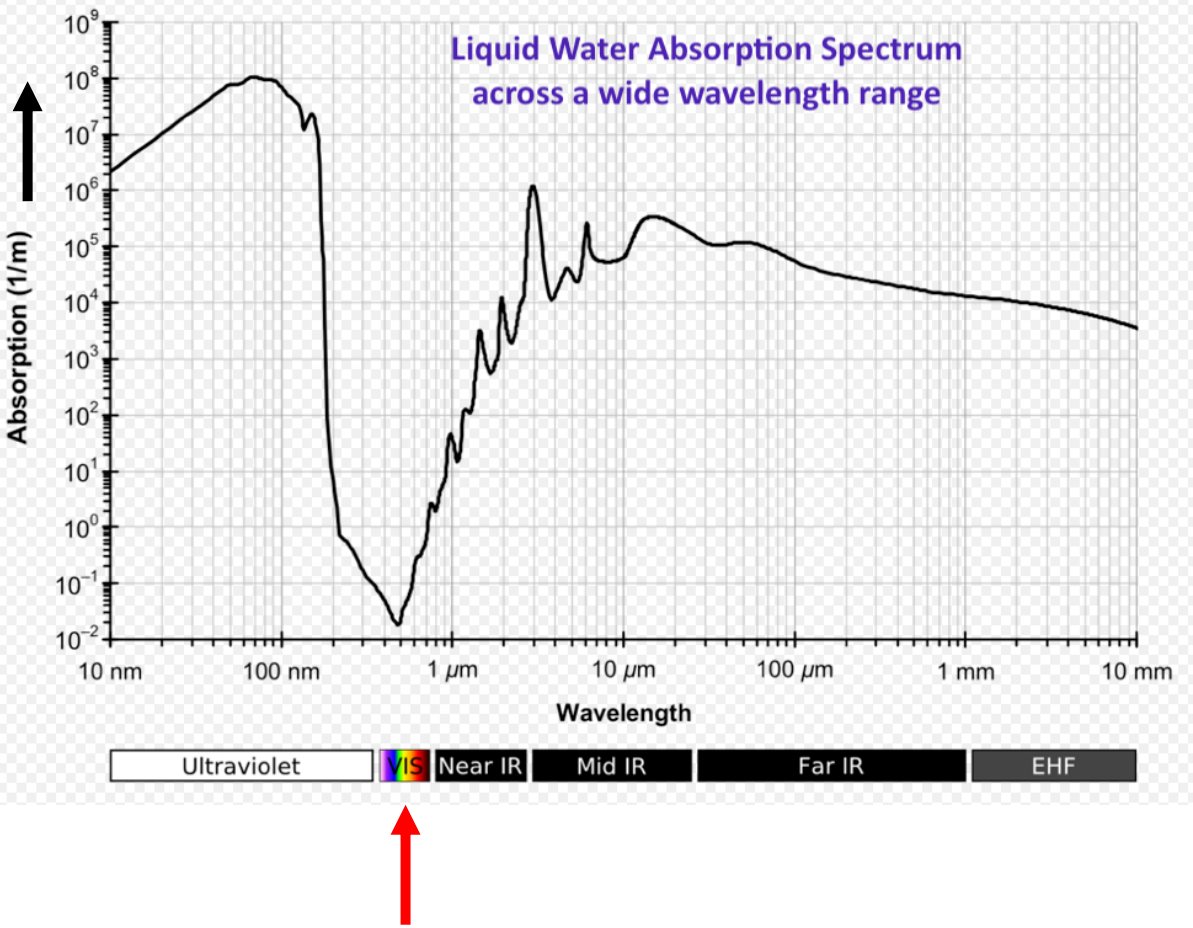
SIDEBAR: Sunlight's absorption in (sea) water for various wavelengths

Explanation: At visible wavelengths, the colored portion of the spectrum, the sun's radiation, penetrates well into the water, because the absorption coefficient is low. Light in the blue-violet portion of the spectrum penetrates easiest and deepest. Yellows and reds are absorbed more; this is responsible for the blue appearance of the water in sunlight.

Back radiation (towards earth) from increased carbon dioxide in the atmosphere, at 10.6 um and ~15 um, does not penetrate ocean, river or lake water to any appreciable depth.

Therefore, increased water temperatures over time are caused by reduced cloudiness, allowing more sunlight to heat the water over time.

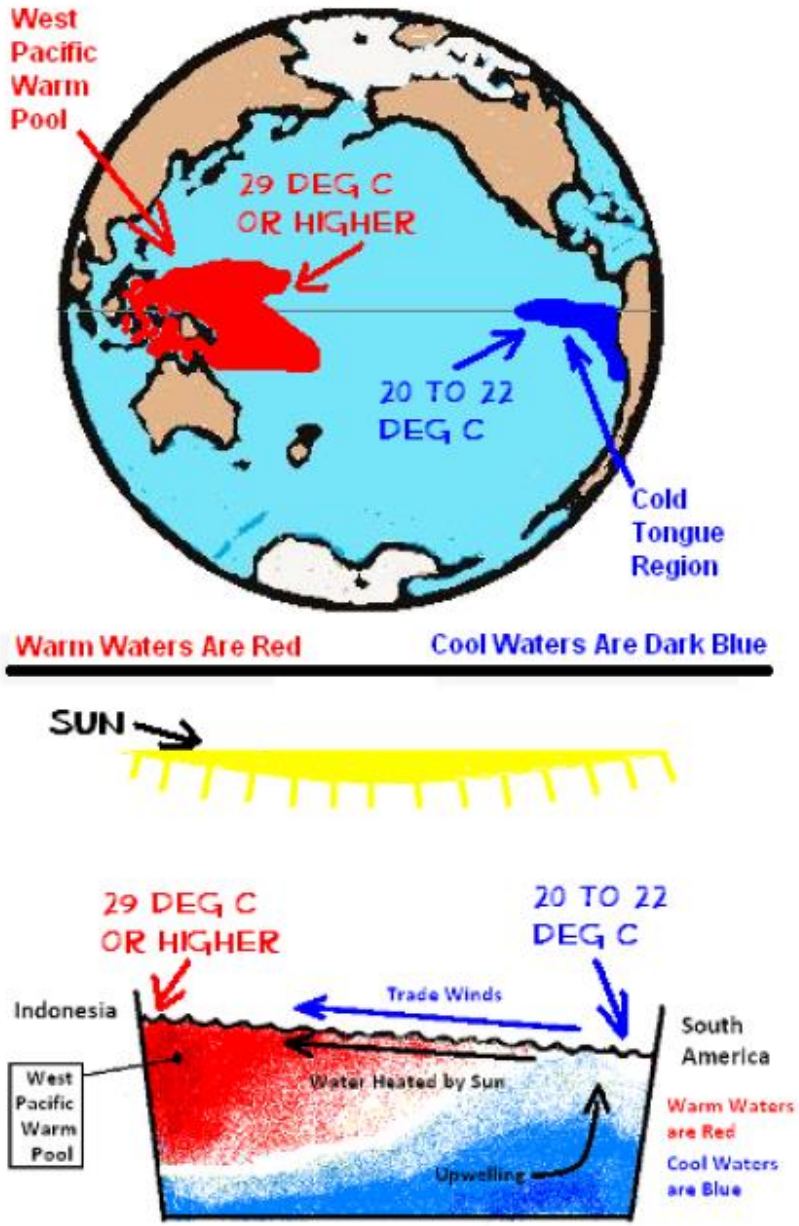
More atmospheric carbon dioxide can not heat river, lake, or ocean waters.



Graphic shows that sunlight heats the water, seawater, as it is transported trans-Pacific by the Trade Winds.

NORMAL OR "ENSO-NEUTRAL" CONDITIONS (B)

(NOT AN EL NIÑO AND NOT A LA NIÑA)



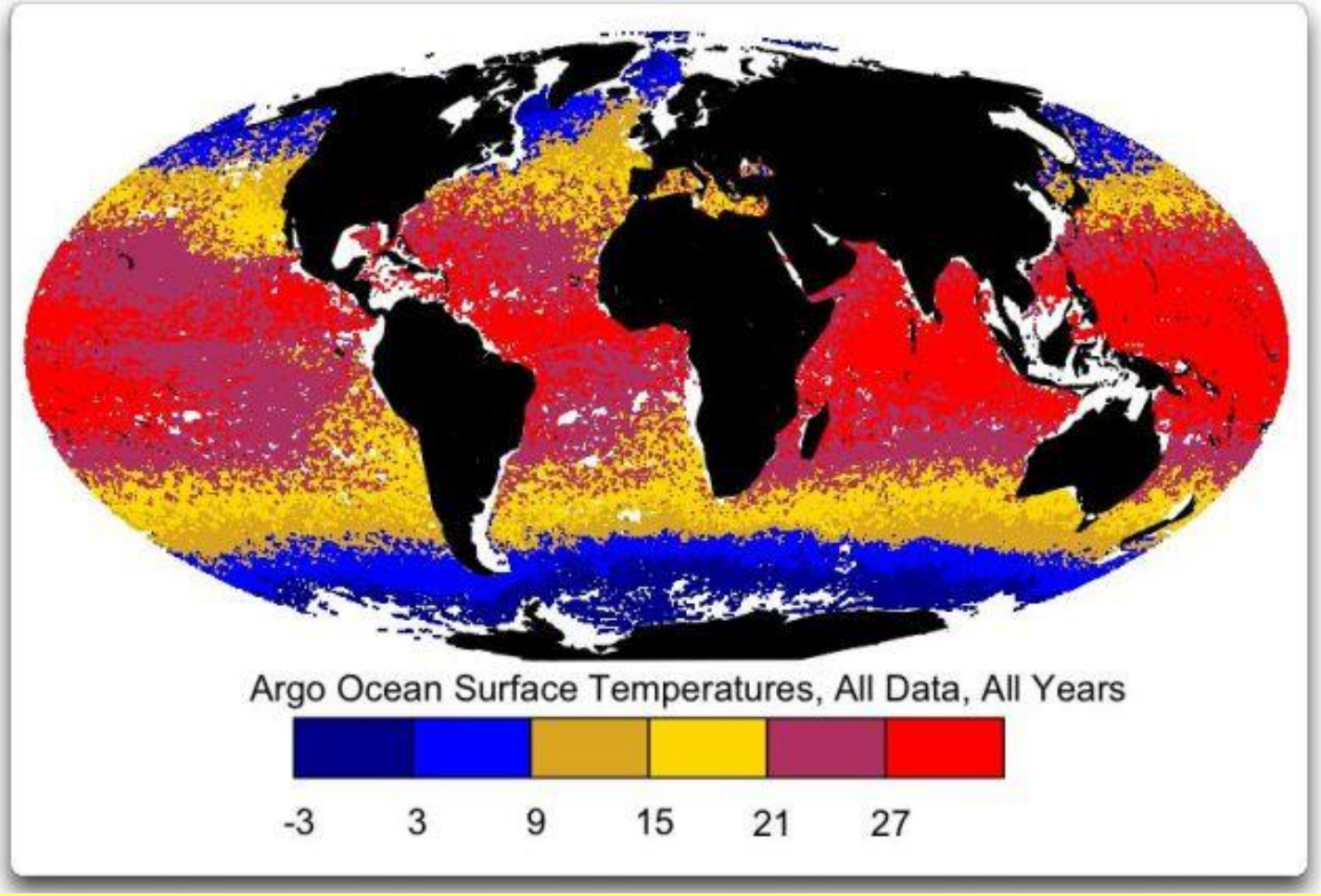
AS A RESULT, THE SEA SURFACE TEMPERATURE IN THE WEST PACIFIC WARM POOL CAN BE 8 TO 10 DEG C WARMER THAN IN THE COLD TONGUE REGION IN THE EAST.

Figure 1-8

Bob Tisdale

SIDEBAR: Maximum Ocean Temperatures are ~29C, from Willis Eschenbach

https://wattsupwiththat.com/2012/02/09/jason-and-the-argo-notes/



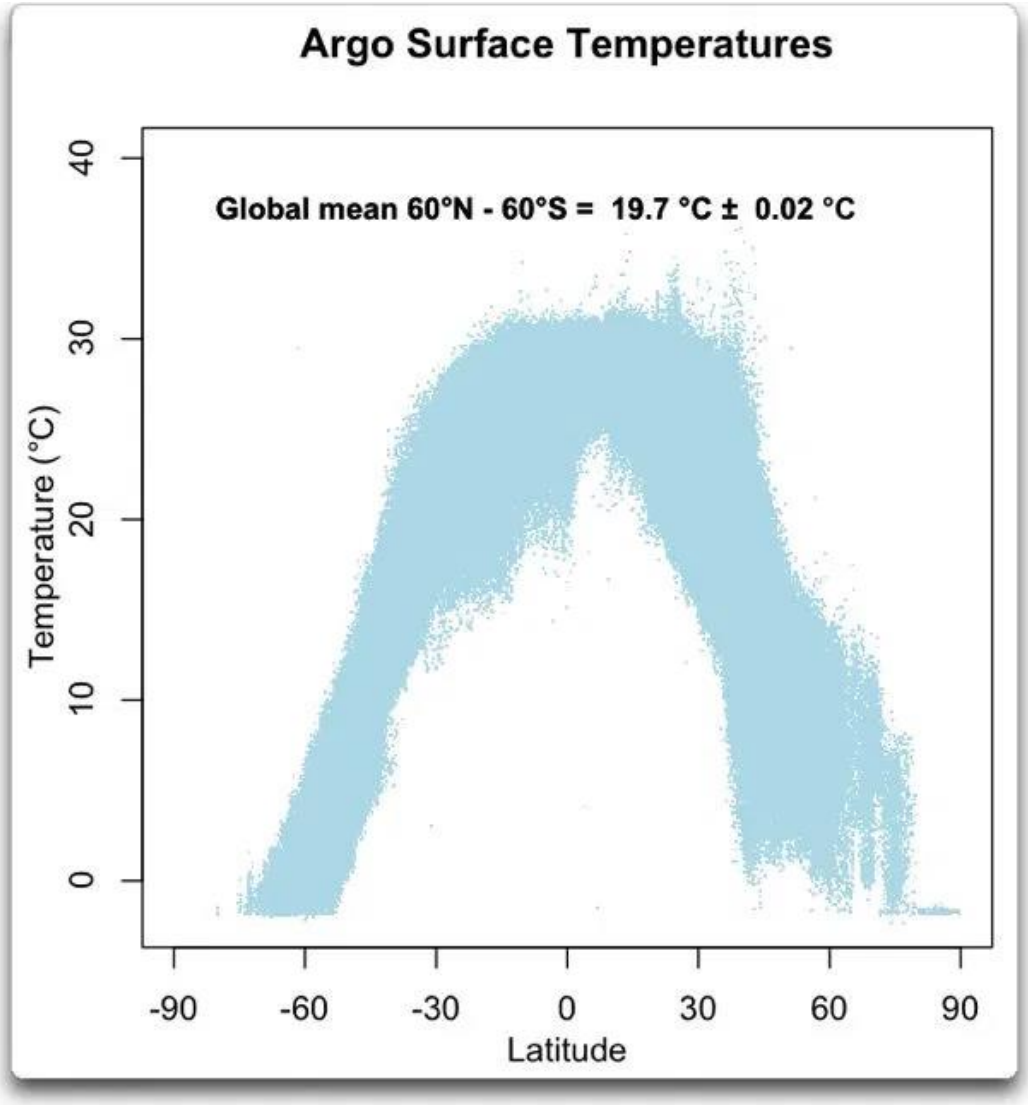
PRECURSOR Figure 1. All Argo ocean surface temperature data. There have been 696,872 Argo measurements to date of the ocean surface temperature.

Precursor:

https://wattsupwiththat.com/2012/02/09/jason-and-the-argo-notes/

Figure 2. All Argo ocean temperatures, sorted by latitude.

Note that there is an obvious upper limit to the ocean temperatures, the “flat-top” on the graph at just above 30°C. No matter how much incoming solar there is, the ocean doesn’t get any warmer than that. This provides a “cap” on how hot the ocean can get. Above that temperature, any extra incoming energy is converted to latent and sensible heat, rather than warming the surface.



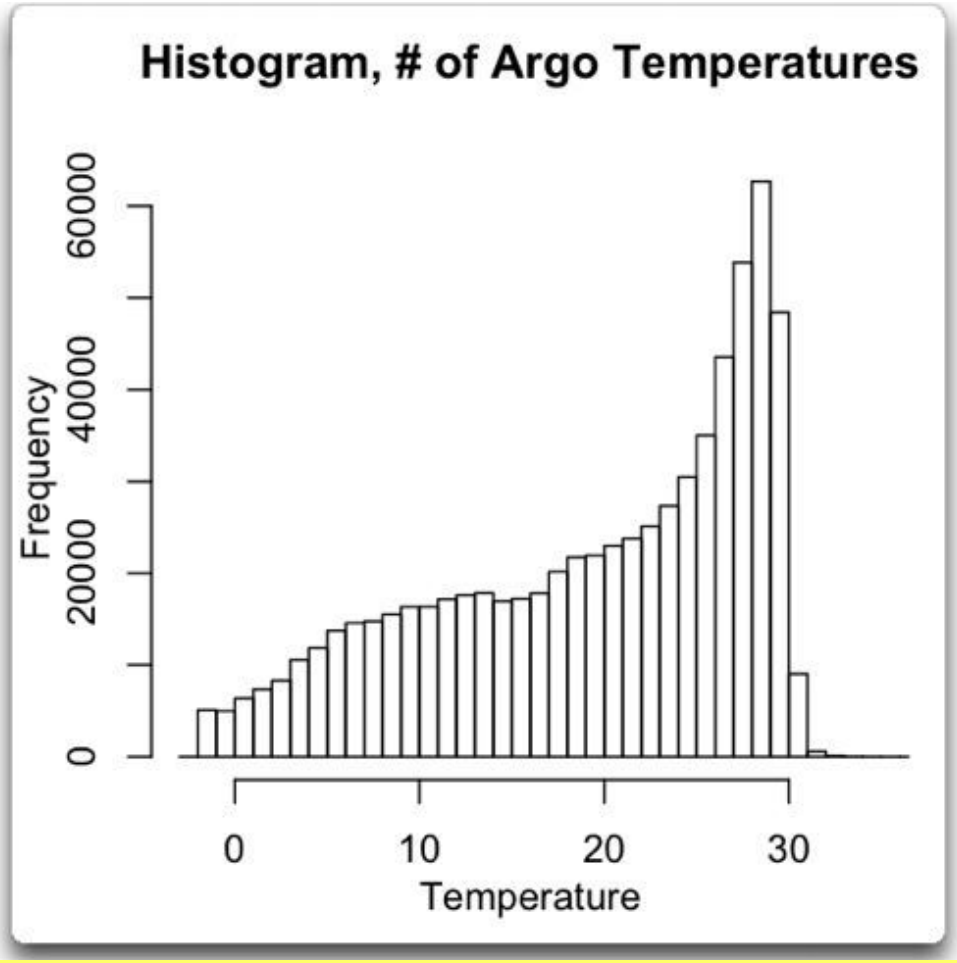
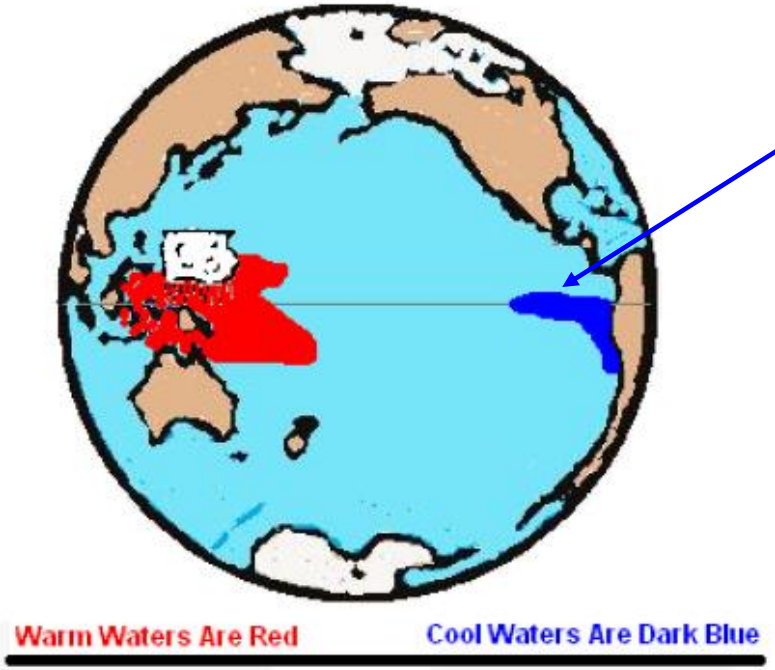
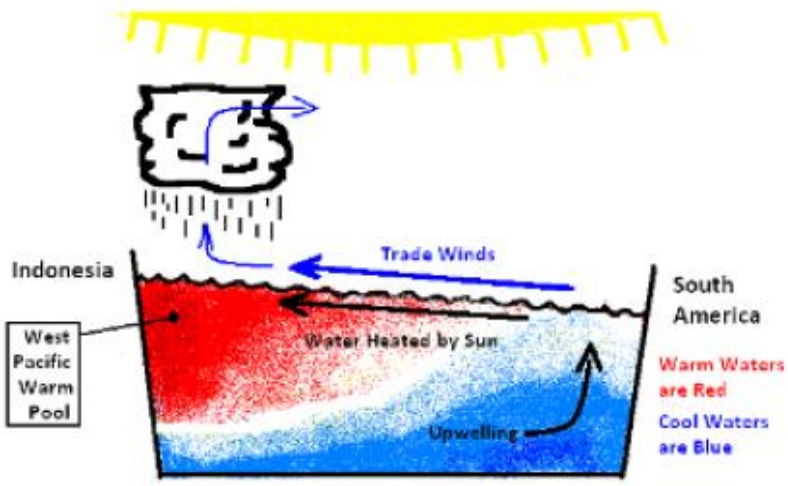


Figure 1. A “histogram” shows how many data points fall in each of the 1°C intervals shown along the bottom axis. The maximum is in the interval 28°-29°C.

NORMAL OR "ENSO-NEUTRAL" CONDITIONS (C)

(NOT AN EL NIÑO AND NOT A LA NIÑA)





Next, Sidebar on Upwelling

THE OCEANS RELEASE HEAT PRIMARILY THROUGH EVAPORATION.

AS THE WARM, MOIST AIR OVER THE PACIFIC WARM POOL RISES, IT COOLS.

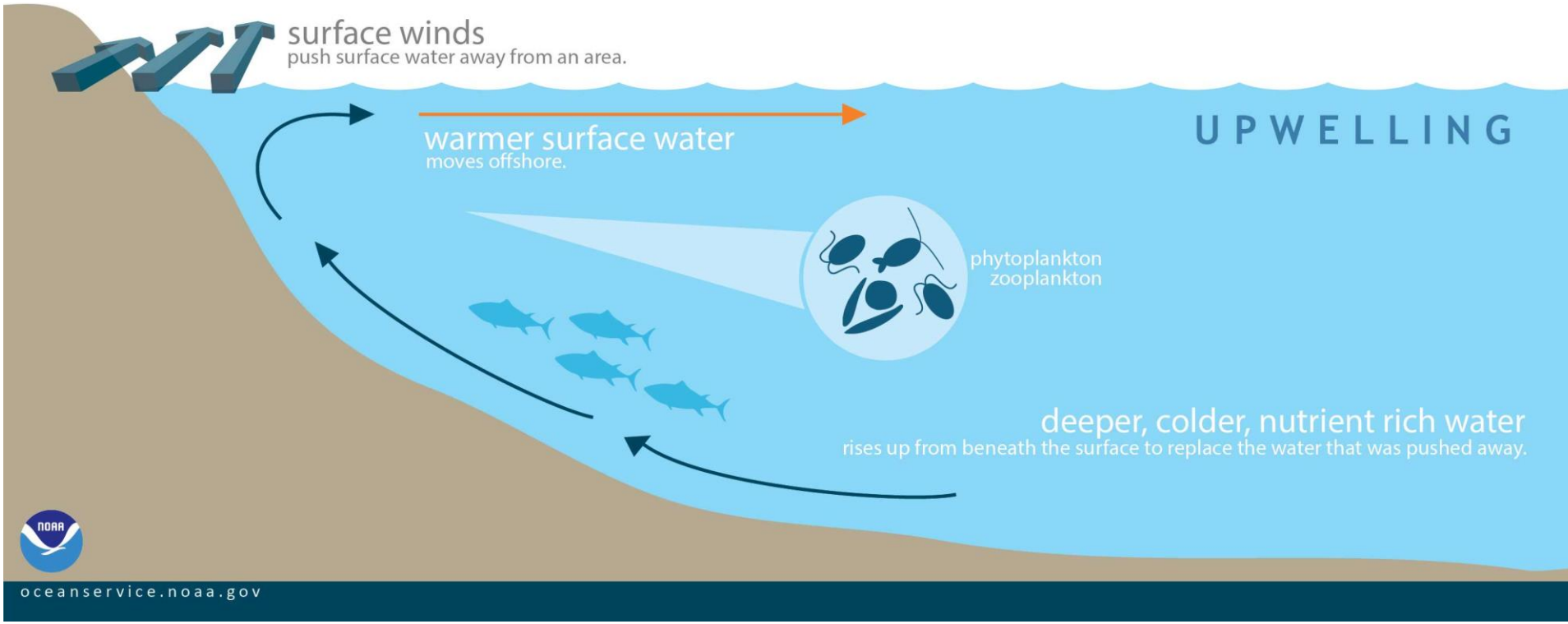
AS IT CONTINUES TO RISE AND COOL, THE AIR CAN HOLD LESS OF THE MOISTURE, AND IT COMES OUT AS RAIN.

IN DOING SO, IT RELEASES THE HEAT FROM THE SUN THAT WAS USED TO EVAPORATE IT.

Figure 1-9

Bob Tisdale

SIDEBAR ON UPWELLING
off West Coasts of North America and South America



Helps answer the question as to why the Pacific Ocean seems so cold; Mark Twain's observation,

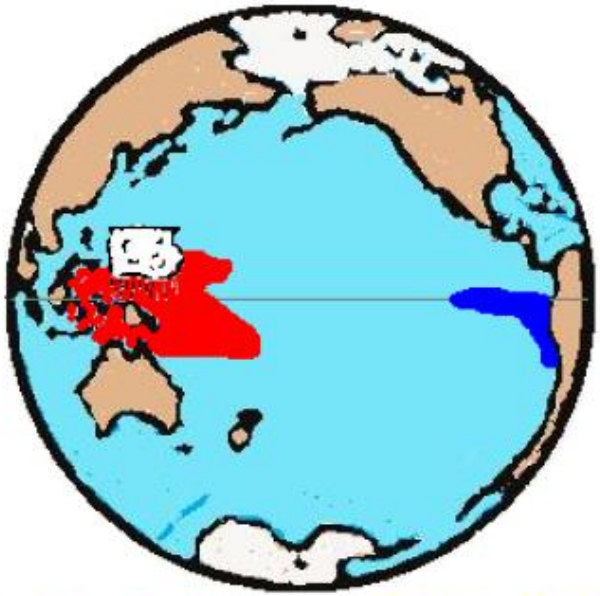
"The coldest winter I ever spent was a summer in San Francisco."

https://www.nationalgeographic.org/encyclopedia/upwelling/

Peruvian Upwelling
Upwelling is the natural process which brings cold, nutrient-rich water to the surface. A huge upwelling regularly occurs off the coast of Peru, which enjoys a large fishing industry as a result.

NORMAL OR "ENSO-NEUTRAL" CONDITIONS (D)

(NOT AN EL NIÑO AND NOT A LA NIÑA)



THE TRADE WINDS REPLACE THE RISING AIR IN THE WEST.

THE AIR SINKS IN THE EAST.

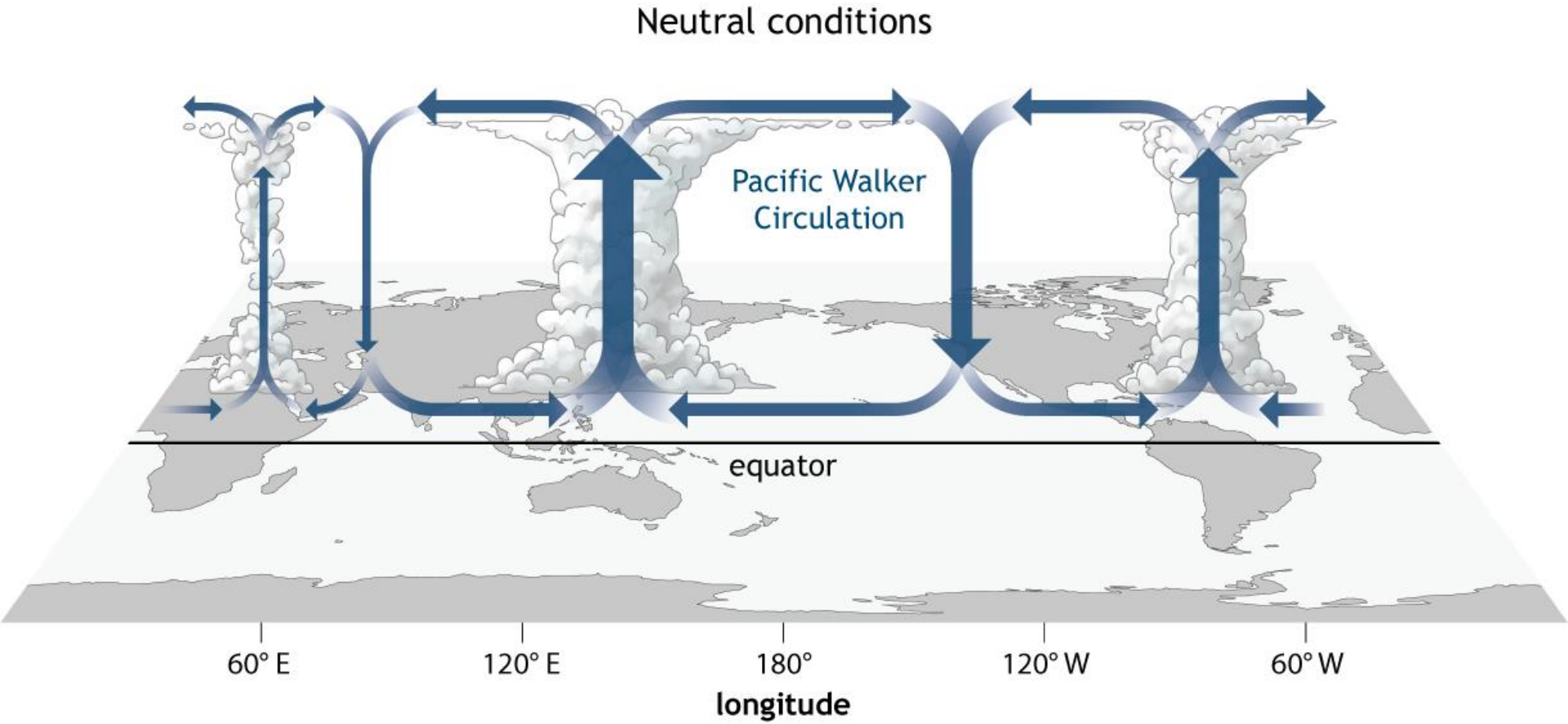
AND THE EASTWARD UPPER WINDS AND WESTWARD TRADE WINDS CONNECT THEM.

THIS IS KNOWN AS WALKER CIRCULATION OR A WALKER CELL, JUST IN CASE YOU WERE WONDERING.

Figure 1-10

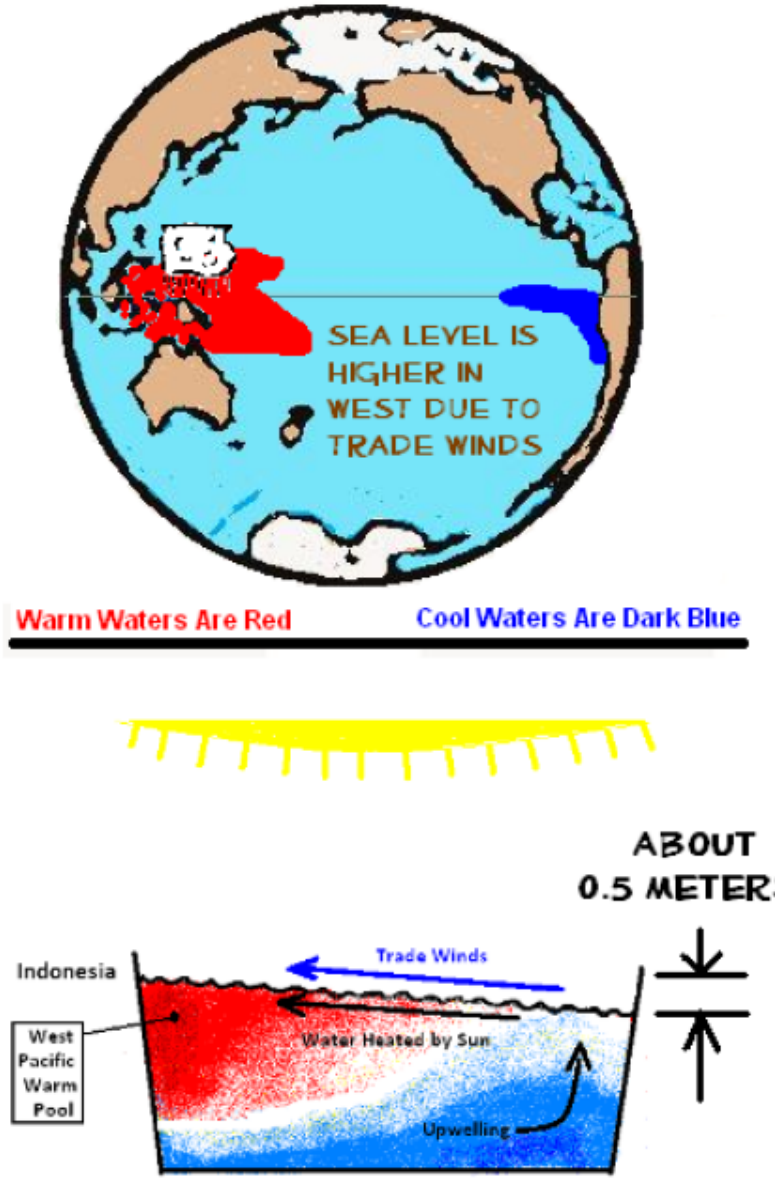
Bob Tisdale

http://www.climate.gov/news-features/blogs/enso/walker-circulation-ensos-atmospheric-buddy



NORMAL OR "ENSO-NEUTRAL" CONDITIONS (E)

(NOT AN EL NIÑO AND NOT A LA NIÑA)



BECAUSE THE TRADE WINDS ARE PUSHING THE WATER TO THE WEST, IT PILES UP THERE.

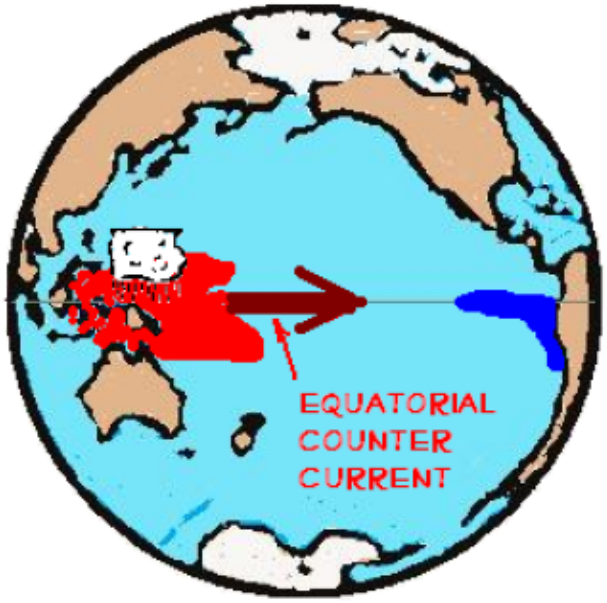
IT IS ABOUT 1/2 METER HIGHER IN THE WEST PACIFIC WARM POOL THAN IT IS IN THE COLD TONGUE REGION IN THE EAST.

GRAVITY WOULD LIKE IT TO BE LEVEL, BUT THE TRADE WINDS ARE HOLDING THE WARM WATER IN PLACE IN THE WEST.

Figure 1-11

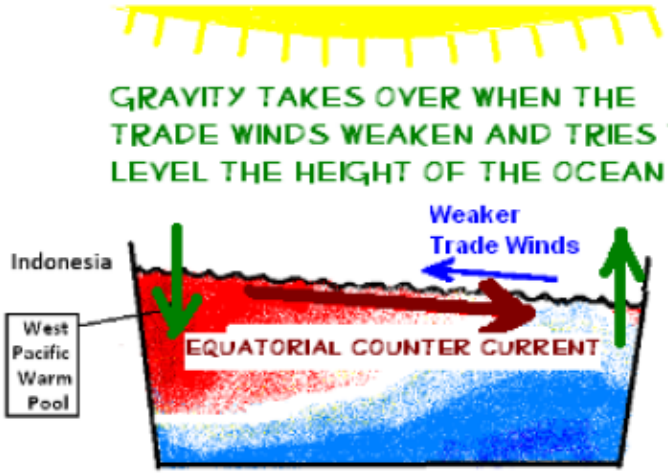
Bob Tisdale

WHAT DO YOU SUPPOSE HAPPENS WHEN THE TRADE WINDS DECIDE TO RELAX?



WHEN THE TRADE WINDS WEAKEN, GRAVITY TAKES OVER AND TRIES TO LEVEL THE SEA SURFACE HEIGHT OF THE EQUATORIAL PACIFIC.

THE EQUATORIAL COUNTER CURRENT GETS MUCH LARGER AND WARM WATER FROM THE PACIFIC WARM POOL SLOSHES TO THE EAST.

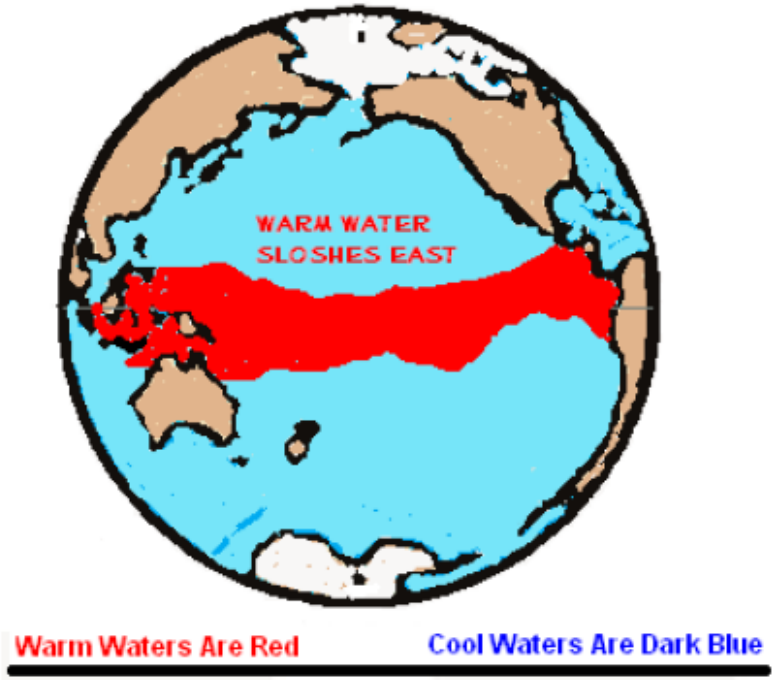


AND THAT'S HOW AN EL NIÑO STARTS!!!!

Figure 1-12

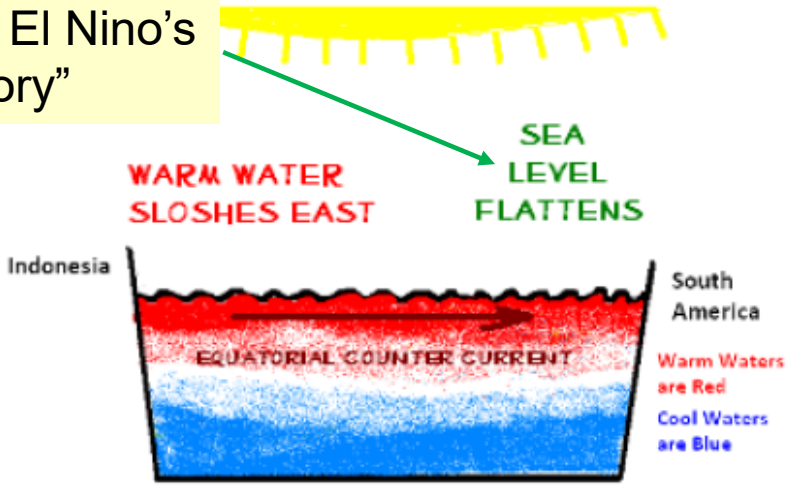
Bob Tisdale

EL NIÑO CONDITIONS (A)



DURING AN EL NIÑO, WARM WATER FROM THE SURFACE AND BELOW THE SURFACE OF THE PACIFIC WARM POOL IS CARRIED EAST AND SPREAD ACROSS THE SURFACE OF THE CENTRAL AND EASTERN TROPICAL PACIFIC, SOMETIMES AS FAR AS THE AMERICAS.

You saw this earlier, El Nino's "West Side Story"

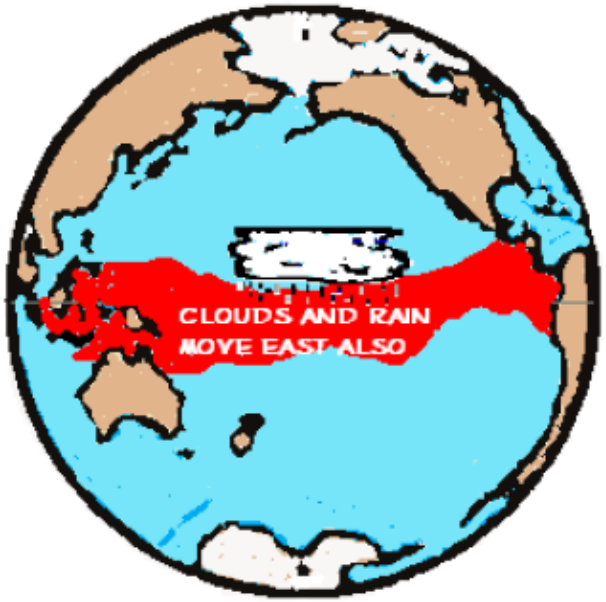


THE WARMER WATER COVERS MORE OF THE SURFACE, AND THAT INCREASES THE SEA SURFACE TEMPERATURE OF THE TROPICAL PACIFIC.

Figure 1-13

Bob Tisdale

EL NIÑO CONDITIONS (B)



THE CLOUDS AND RAIN ACCOMPANY THE WARM WATER TO THE EAST.

BECAUSE THE WARM WATER COVERS A GREATER SURFACE AREA, THERE IS MORE EVAPORATION, MORE CLOUDS AND MORE RAIN.

AS A RESULT, MORE HEAT THAN NORMAL IS DISCHARGED FROM THE TROPICAL PACIFIC OCEAN TO THE ATMOSPHERE.

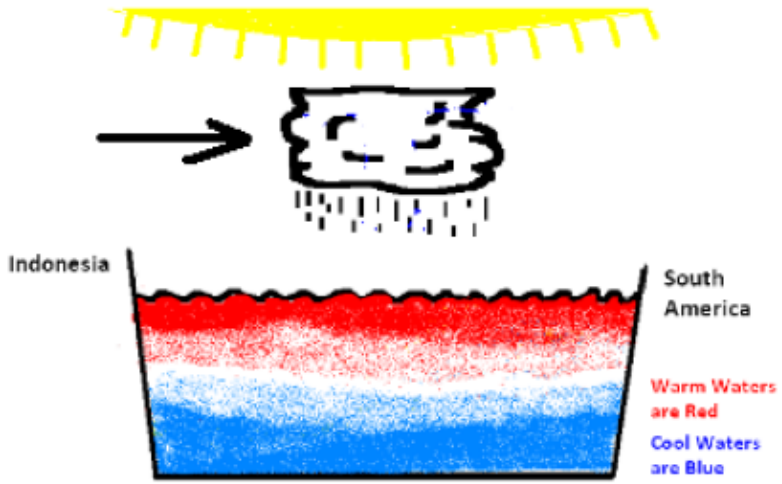
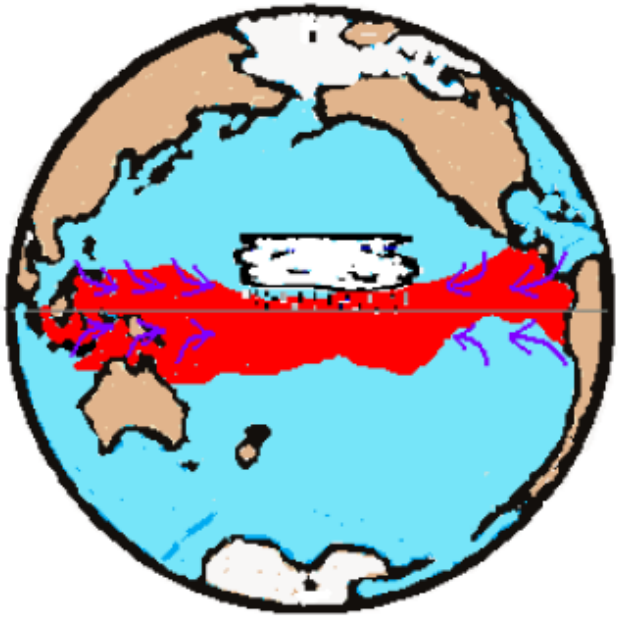


Figure 1-14

Bob Tisdale

EL NIÑO CONDITIONS (c)



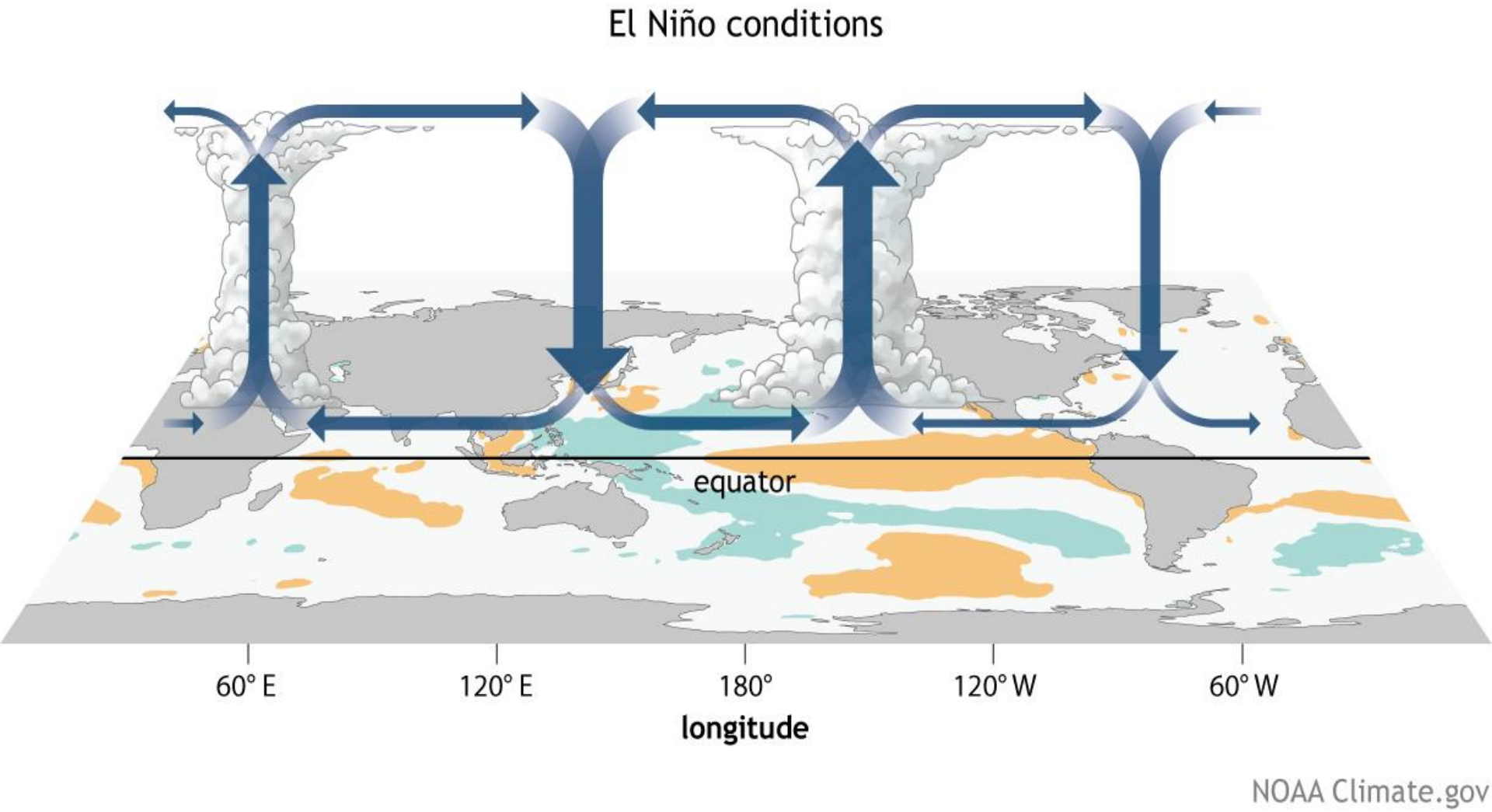
TO FEED THE RISING AIR THAT HAS NOW TRAVELED EAST, THE TRADE WINDS IN THE WESTERN TROPICAL PACIFIC REVERSE DIRECTION AND BECOME WESTERLIES.

THE TRADE WINDS IN THE EASTERN PACIFIC WEAKEN

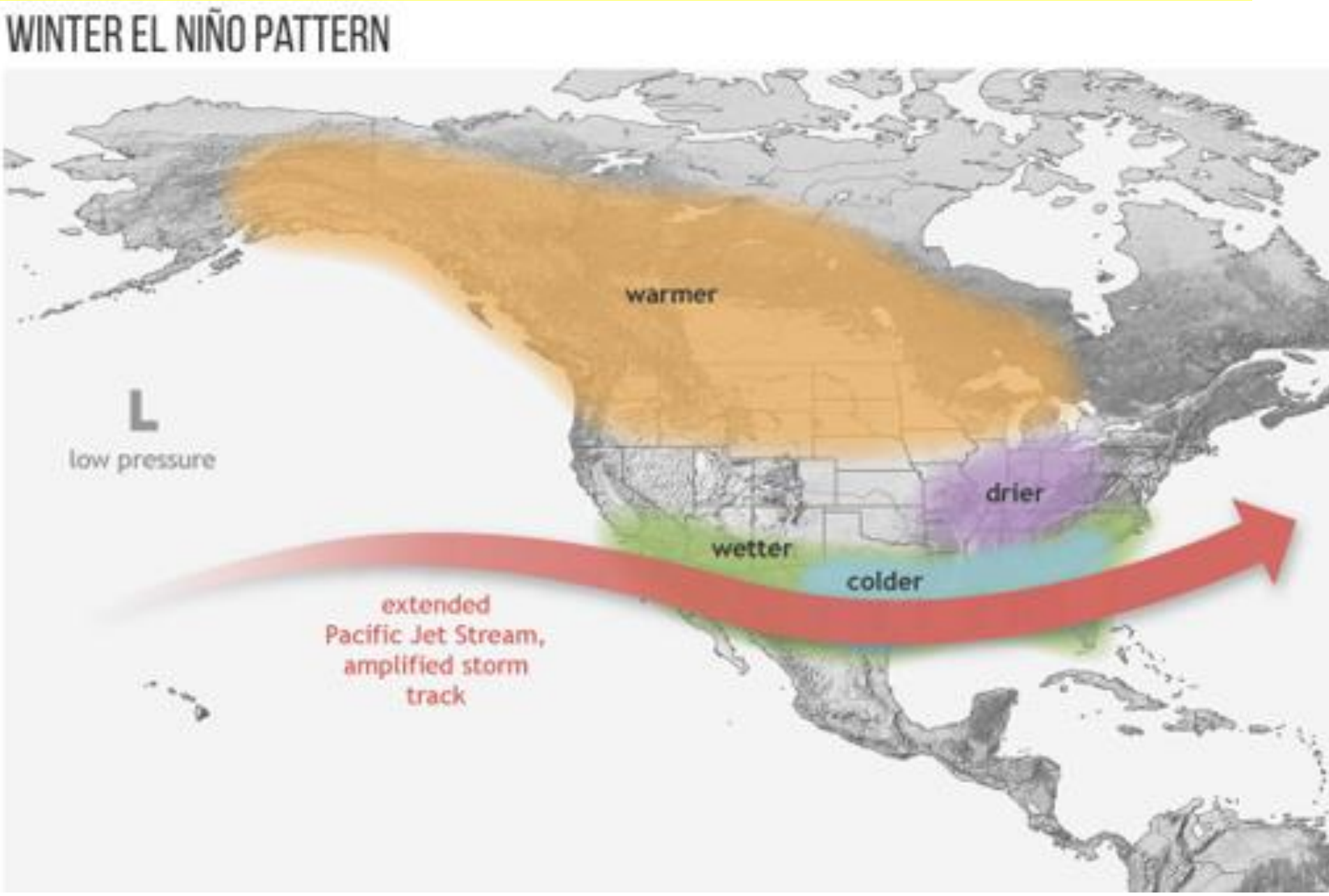
Figure 1.15

Bob Tisdale

http://www.climate.gov/news-features/blogs/enso/walker-circulation-ensos-atmospheric-buddy

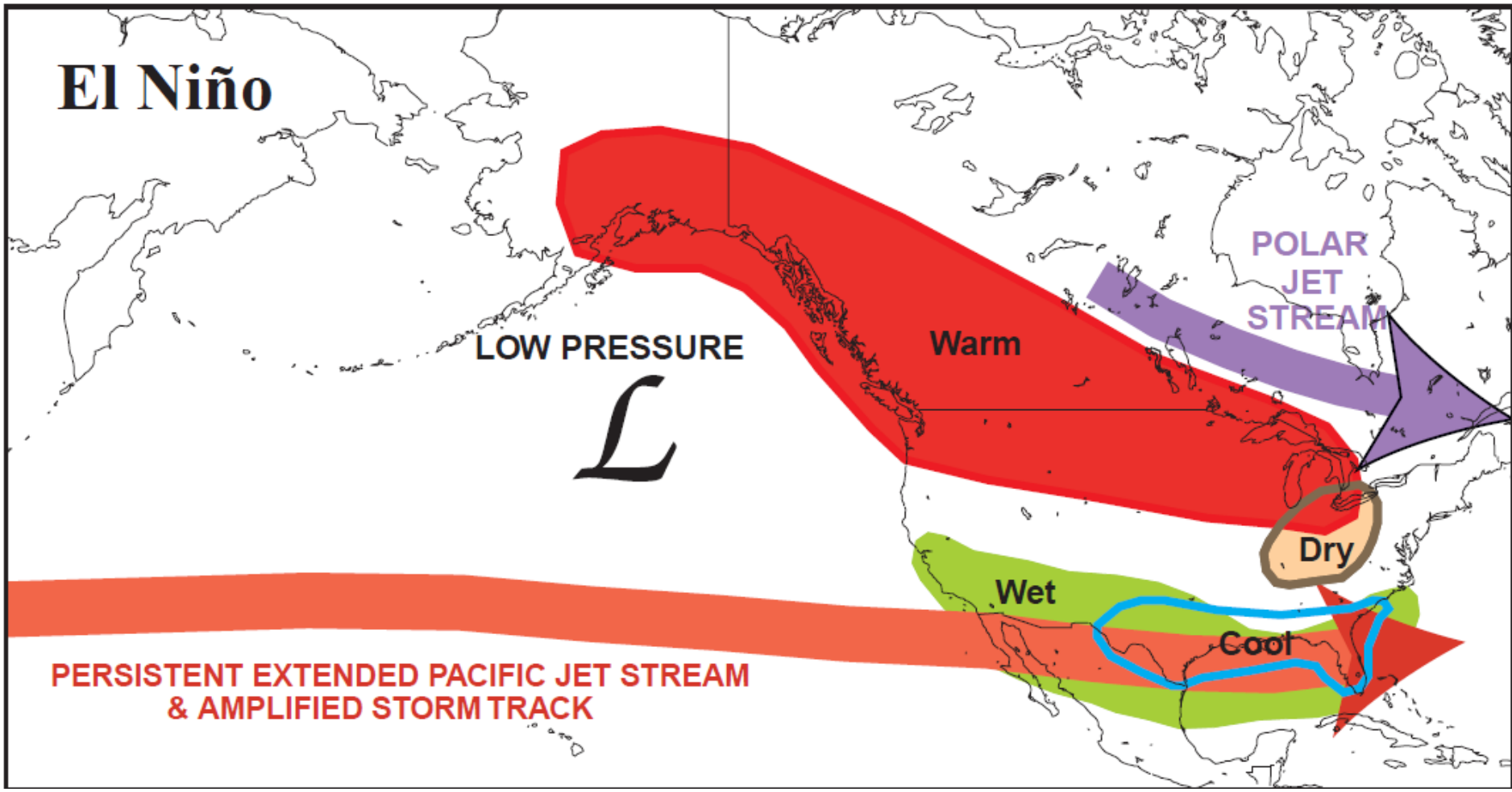


https://www.climate.gov/news-features/featured-images/how-el-ni%C3%B1o-and-la-ni%C3%B1a-affect-winter-jet-stream-and-us-climate

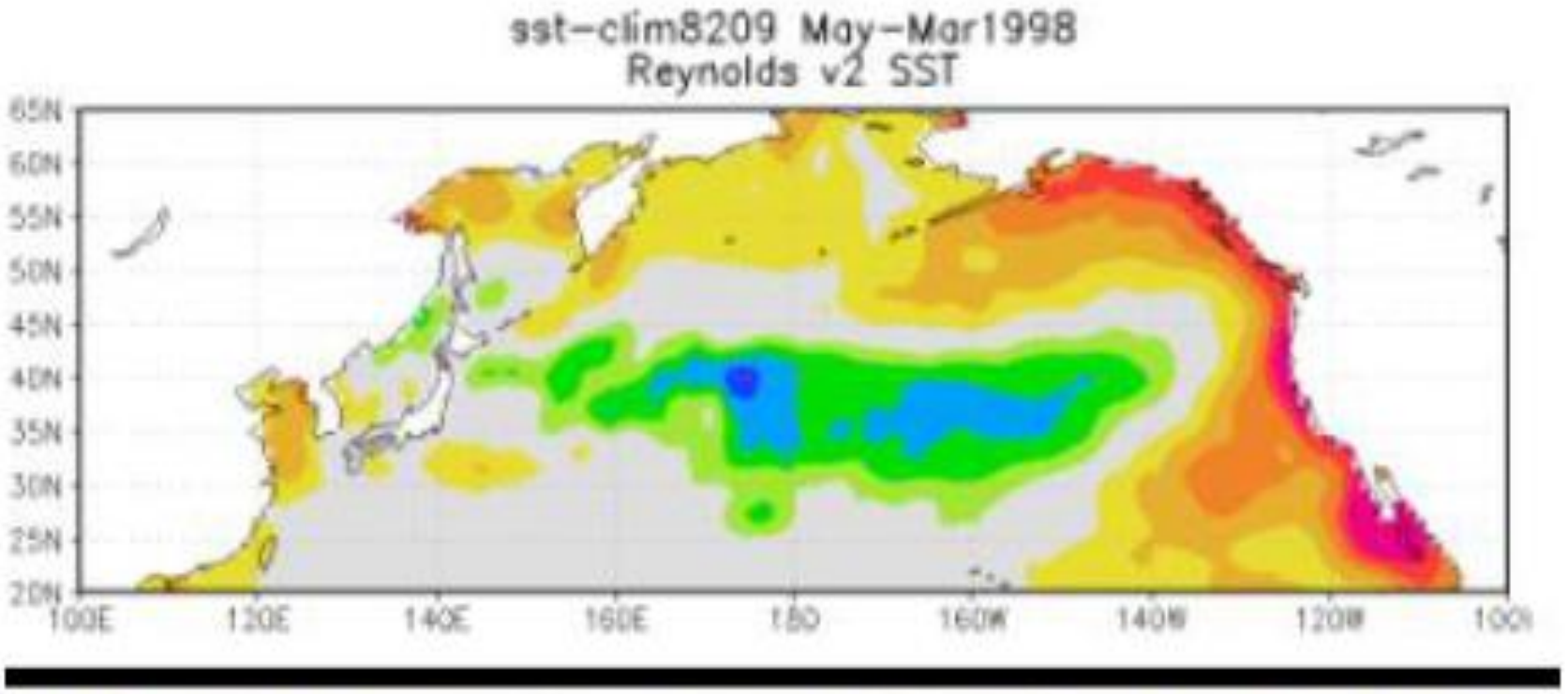


El Nino's effects on Northern Hemisphere Weather Patterns

http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/ensocycle/nawinter.shtml

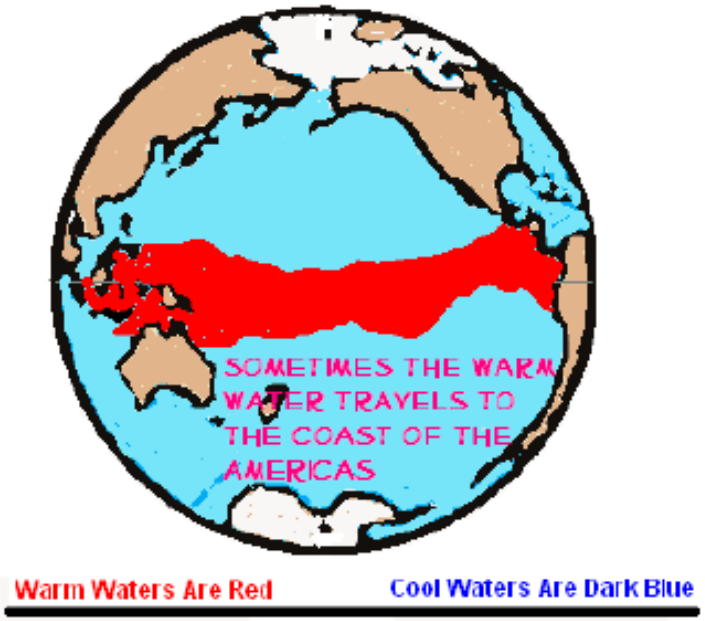


El Niño Sea Surface Temperature Anomaly Pattern In The North Pacific



Shows the warm waters off the Pacific Coasts of Mexico, the USA, Canada, & Alaska.

EAST PACIFIC EL NIÑO EVENTS



DURING EAST PACIFIC EL NIÑO EVENTS, THE WARM WATER REACHES THE COASTS OF THE AMERICAS.

EAST PACIFIC EL NIÑO EVENTS ARE TYPICALLY STRONGER THAN CENTRAL PACIFIC EL NIÑO—SO STRONG, THEY CAN RAISE EASTERN PACIFIC SEA SURFACE TEMPERATURES AS MUCH AS 5 DEG C (9 DEG F) IN SOME PLACES.

DURING A VERY STRONG EL NIÑO, THERE CAN BE MORE WARM WATER BELOW THE SURFACE IN THE EASTERN PACIFIC THAN IN THE WEST.

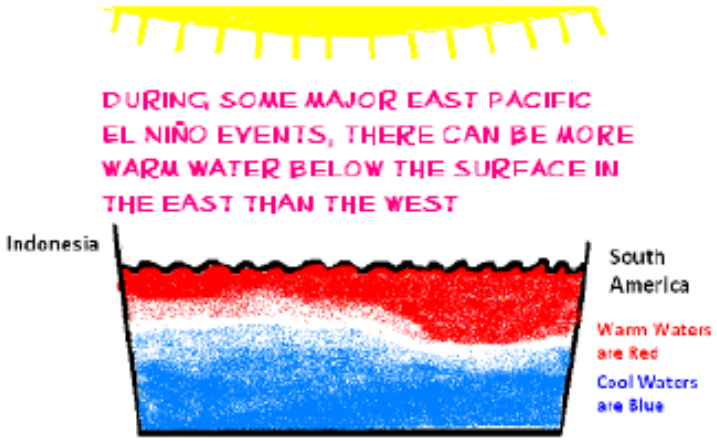
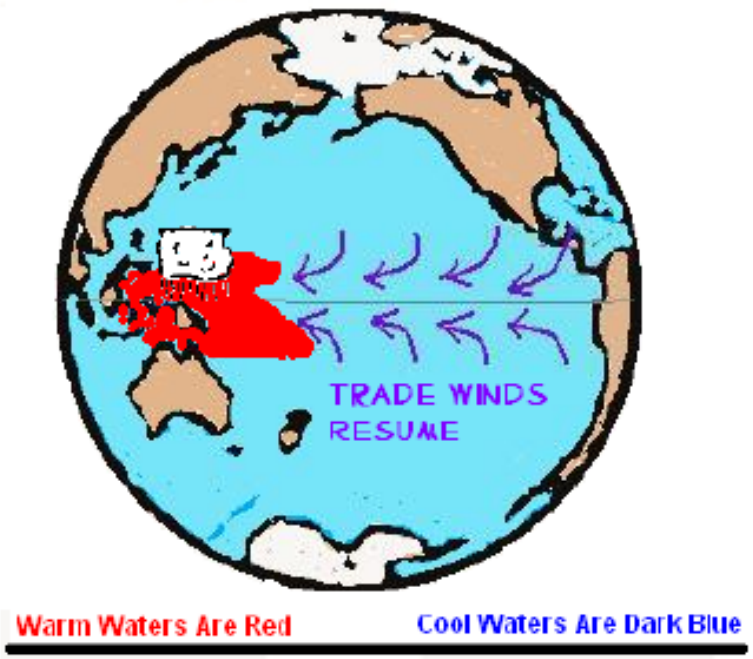


Figure 1-17

Bob Tisdale

HHH

TRANSITION FROM EL NIÑO TO ENSO-NEUTRAL (A)



EL NIÑO EVENTS TYPICALLY PEAK IN DECEMBER AND JANUARY.

AS THE TROPICAL PACIFIC TRANSITIONS FROM EL NIÑO TO ENSO-NEUTRAL STATES, THE TRADE WINDS RESUME THEIR NORMAL EAST TO WEST DIRECTION.

ANY WARM SURFACE WATERS LEFT OVER FROM THE EL NIÑO ARE RETURNED TO THE WESTERN TROPICAL PACIFIC BY THE TRADE WINDS.

Figure 1-18

Bob Tisdale

HHH

TRANSITION FROM EL NIÑO TO ENSO-NEUTRAL (C)

SOME OF THE WARM WATER LEFT OVER FROM THE EL NIÑO HELPS TO RECHARGE THE PACIFIC WARM POOL FOR THE NEXT EL NIÑO.

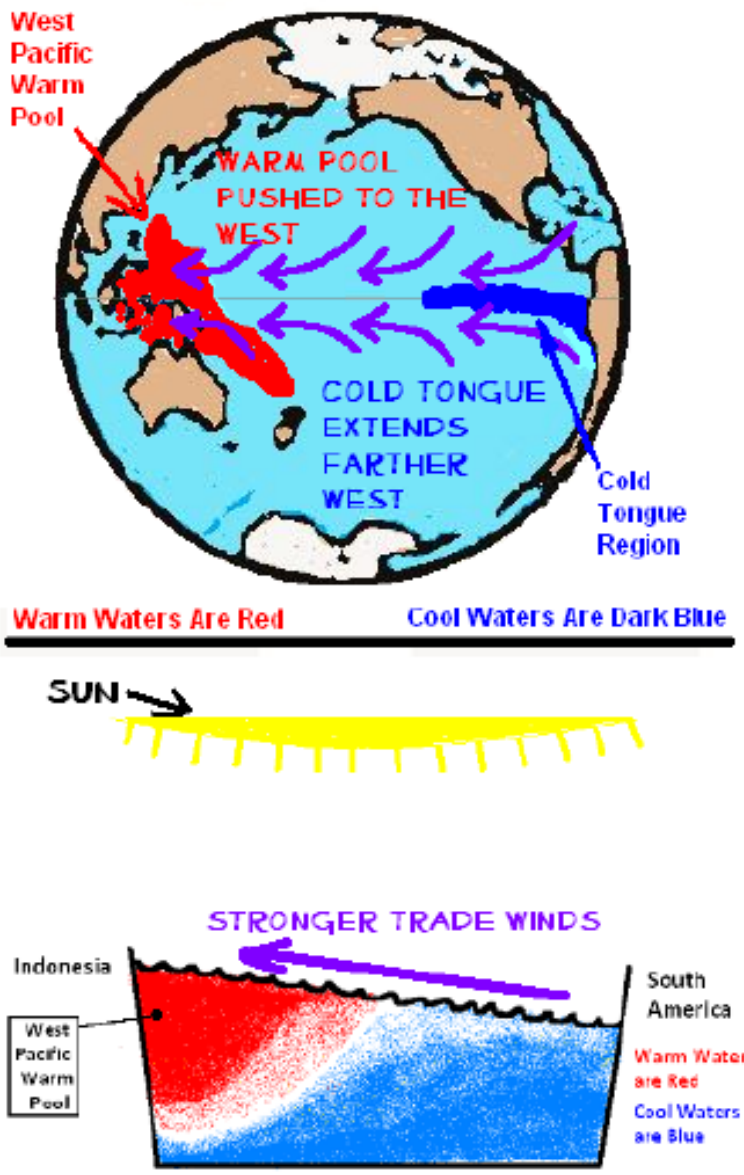
THE REMAINDER IS CARRIED POLEWARD AND INTO THE INDIAN OCEAN.

Figure 1-20

Bob Tisdale

HHH

LA NIÑA CONDITIONS (A)



TRADE WINDS ARE STRONGER THAN NORMAL DURING A LA NIÑA.

THE STRONGER TRADE WINDS PUSH THE WARM WATERS FARTHER TO THE WEST IN THE TROPICAL PACIFIC.

AND THE COLD TONGUE IN THE EAST EXTENDS FARTHER TO THE WEST, TOO.

LA NIÑA EVENTS ARE BASICALLY AN EXAGGERATED ENSO-NEUTRAL STATE.

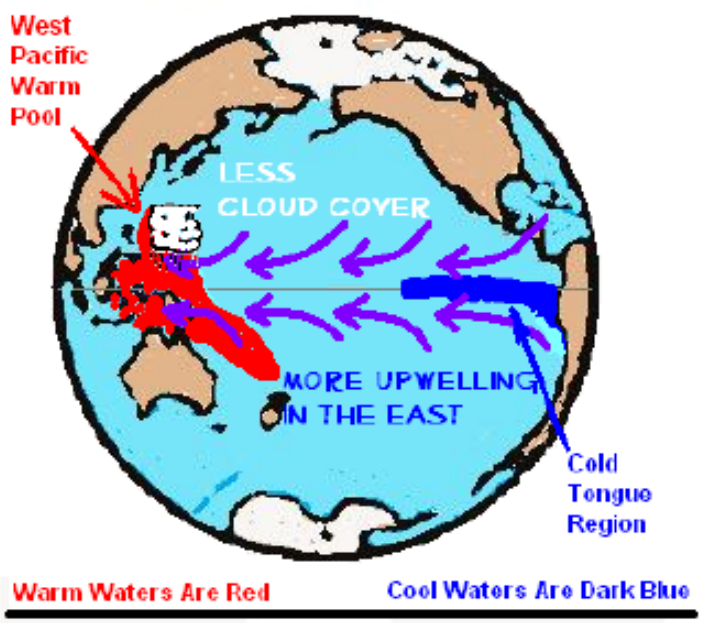
BUT THEY ARE IMPORTANT.

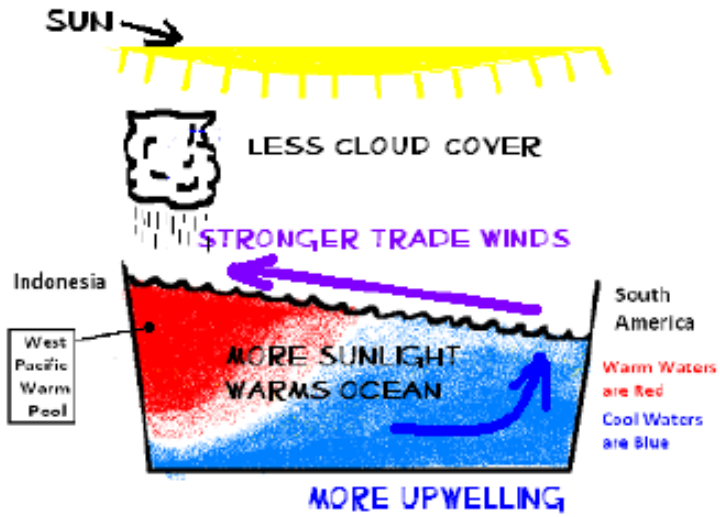
Figure 1-21

Bob Tisdale

HHH

LA NIÑA CONDITIONS (B)





THE STRONGER TRADE WINDS CAUSE MORE COOL SUBSURFACE WATER TO BE DRAWN TO THE SURFACE IN THE EAST (MORE UPWELLING).

AND THE STRONGER TRADE WINDS RESULT IN LESS CLOUD COVER.

WITH LESS CLOUD COVER, MORE VISIBLE SUNLIGHT (DOWNWARD SHORTWAVE RADIATION) REACHES THE SURFACE OF THE TROPICAL PACIFIC. SUNLIGHT PENETRATES AS DEEP AS 100 METERS, DECREASING IN STRENGTH WITH DEPTH.

THE ADDITIONAL SUNLIGHT WARMS THE TROPICAL PACIFIC MORE THAN NORMAL.

Figure 1-22

HHH

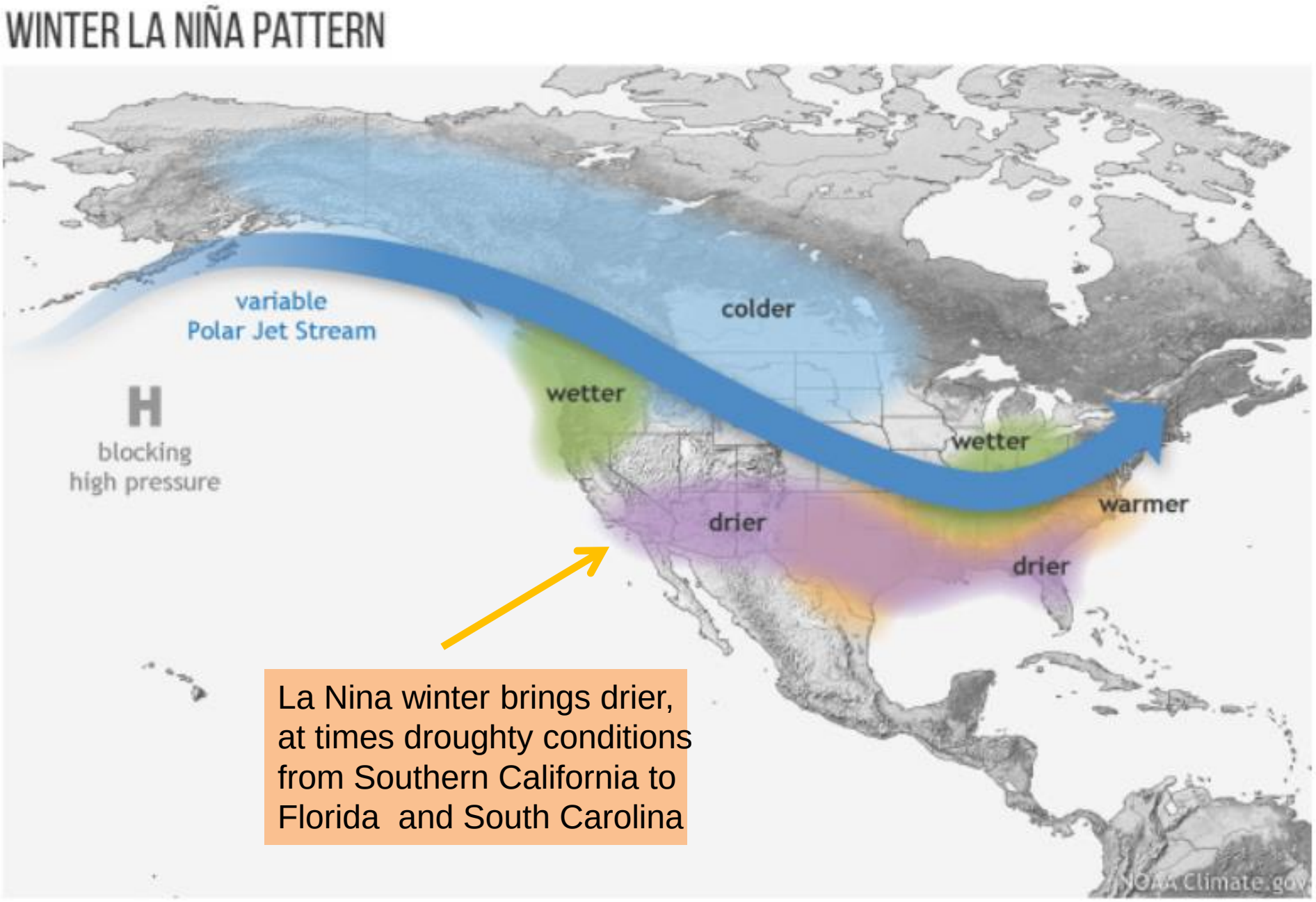
Bob Tisdale

You saw the words,

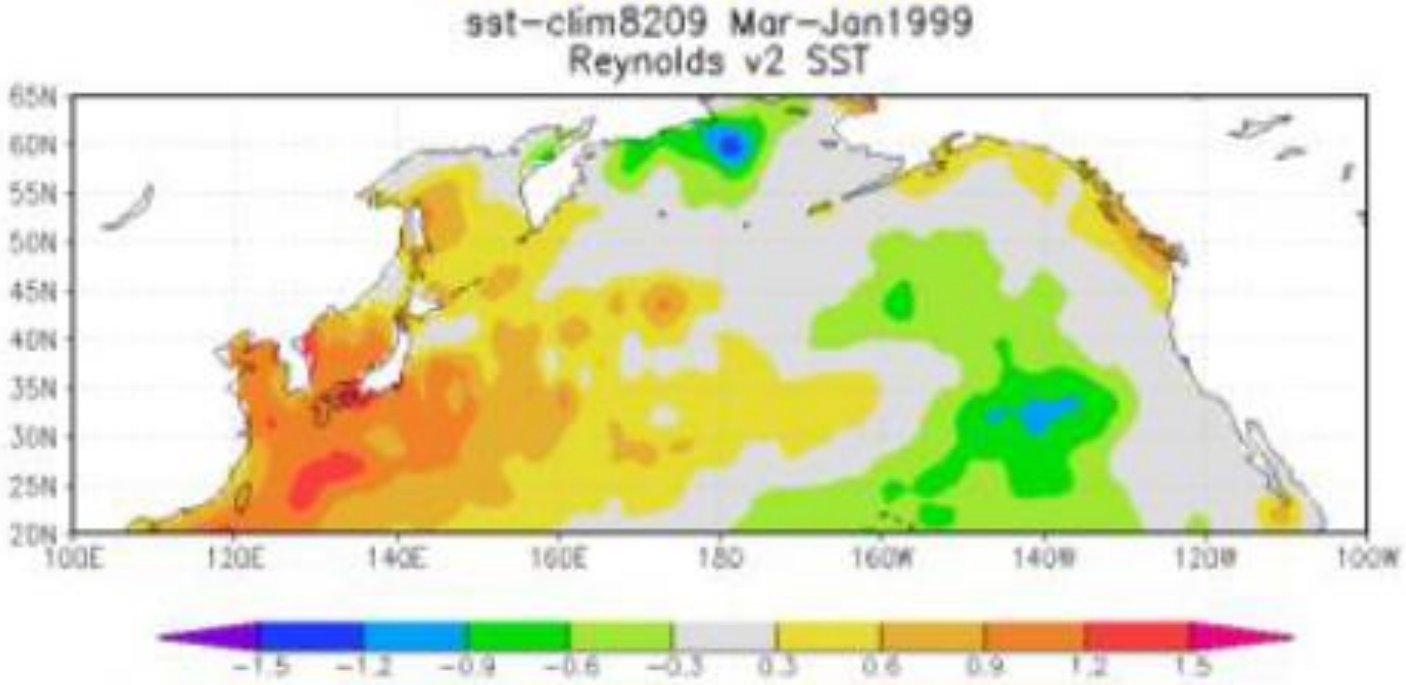
“Sunlight penetrates and heats Pacific Ocean seawater”

In the earlier Sidebar.

https://www.climate.gov/sites/default/files/LaNin%CC%83a_winter_flat_updated_620_0.png



La Niña Sea Surface Temperature Anomaly Pattern In The North Pacific

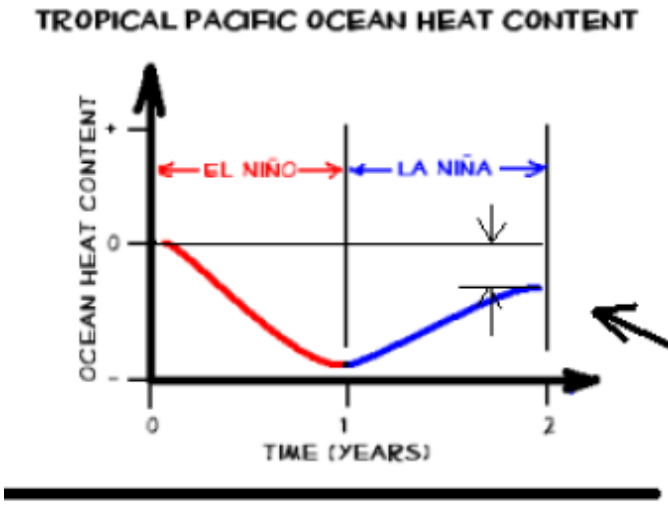


Maps Created at KNMI Climate Explorer

Figure 4-73

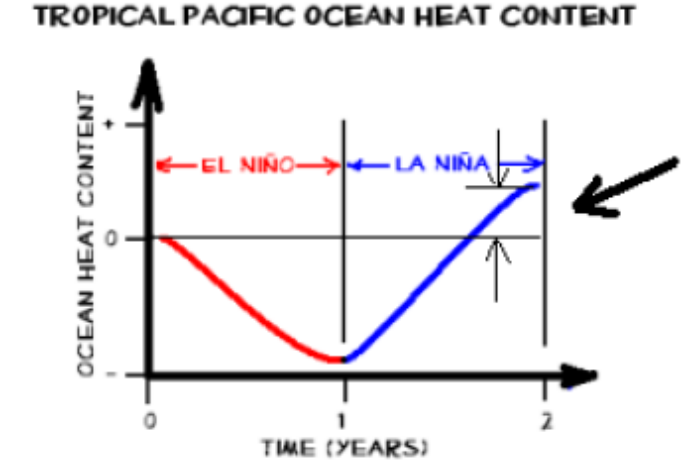
Bob Tisdale

LA NIÑA RECHARGES THE HEAT DISCHARGED BY THE EL NIÑO



BECAUSE MORE SUNLIGHT REACHES AND WARMS THE TROPICAL PACIFIC DURING THE LA NIÑA, OCEAN HEAT CONTENT THERE INCREASES, REPLACING THE HEAT GIVEN OFF DURING THE EL NIÑO.

MOST TIMES, LESS HEAT IS SUPPLIED DURING THE LA NIÑA THAN WAS DISCHARGED DURING THE EL NIÑO.



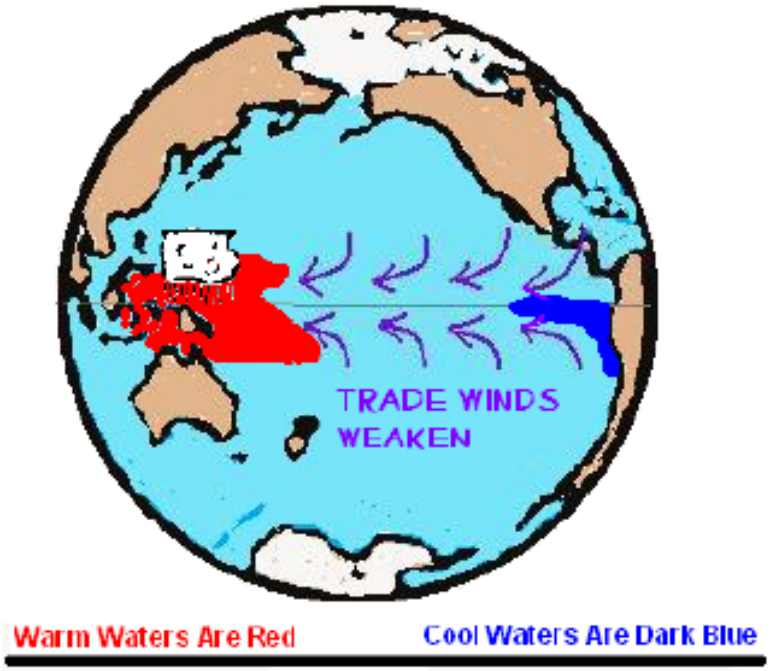
OCCASIONALLY, THE LA NIÑA SUPPLIES MORE HEAT THAN WAS DISCHARGED BY THE EL NIÑO.

THAT "OVERCHARGING" OCCURRED DURING THE 1973/74/75/76 AND 1995/96 LA NIÑA EVENTS!

These data directly contradict Dr Dubois' contention, "*they do not create or store heat.*"

Bob Tisdale

TRANSITION FROM LA NIÑA TO ENSO-NEUTRAL



LA NIÑA EVENTS ALSO TYPICALLY PEAK IN DECEMBER AND JANUARY.

AS THE TROPICAL PACIFIC TRANSITIONS FROM LA NIÑA TO ENSO-NEUTRAL STATES, THE TRADE WINDS WEAKEN TO THEIR NORMAL STRENGTH.

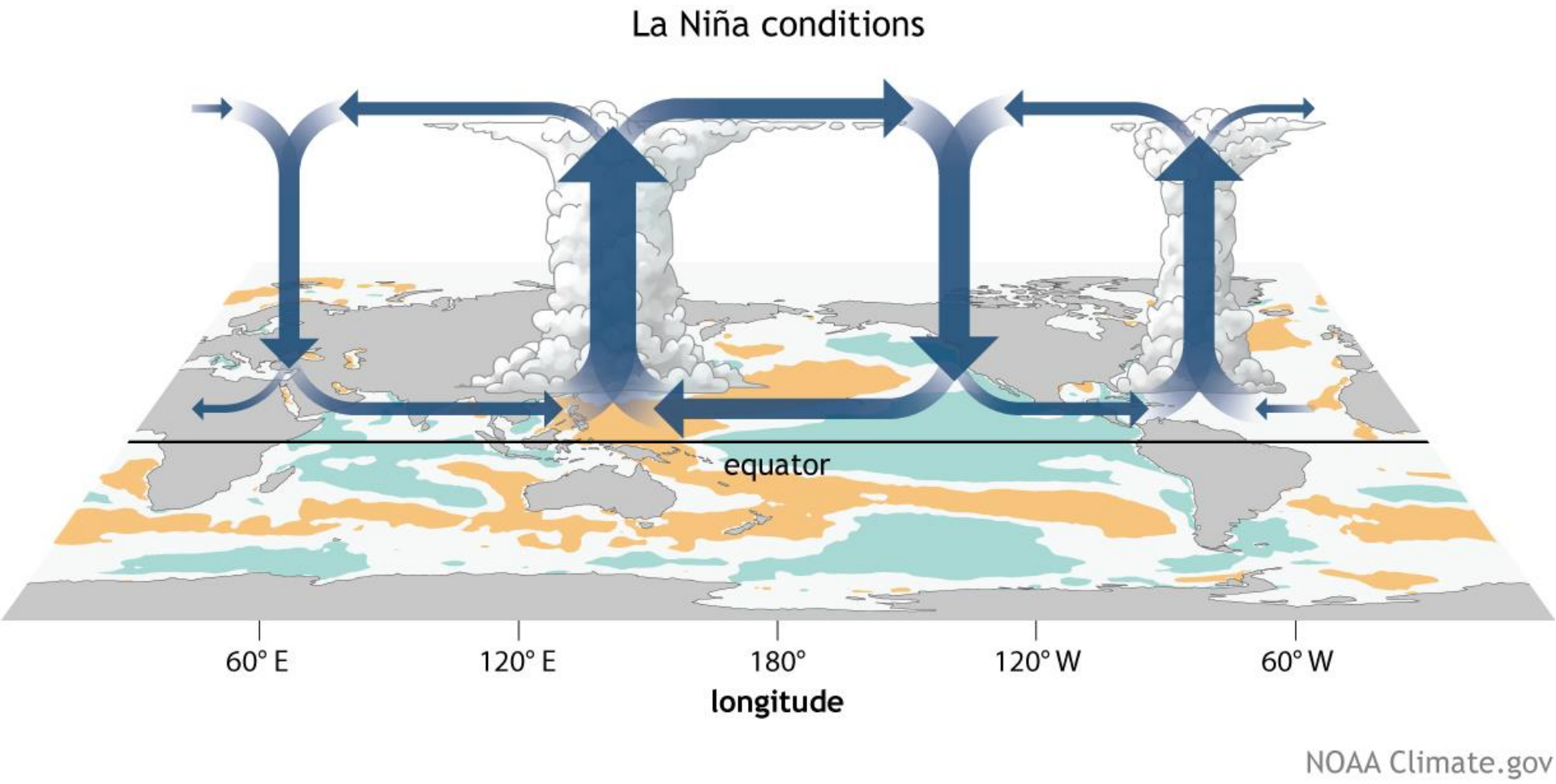
UPWELLING IN THE EAST DECREASES AND THE SEA SURFACE TEMPERATURES WARM IN THE CENTRAL AND EASTERN EQUATORIAL PACIFIC, ALL RETURNING TO NORMAL CONDITIONS.

Figure 1-24

Bob Tisdale

HHH

http://www.climate.gov/news-features/blogs/enso/walker-circulation-ensos-atmospheric-buddy



LA NIÑA IS NOT THE OPPOSITE OF EL NIÑO

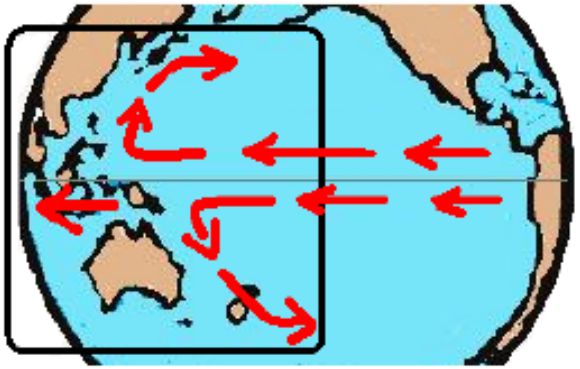
BEFORE EL NIÑO

BEFORE THE EL NIÑO, MOST OF THE WARM WATER THAT WILL BE RELEASED BY THE EL NIÑO IS BELOW THE SURFACE AND EXCLUDED FROM SURFACE TEMPERATURE MEASUREMENTS.

DURING EL NIÑO

DURING THE EL NIÑO, THE WARM WATER FROM BELOW THE SURFACE OF THE PACIFIC WARM POOL THAT HAD BEEN EXCLUDED FROM THE SURFACE TEMPERATURE RECORD IS NOW SPREAD ACROSS THE SURFACE AND INCLUDED IN THE SURFACE TEMPERATURE RECORD.

AFTER EL NIÑO



AFTER THE EL NIÑO, THE WARM WATER IS RETURNED TO THE WEST WHEN FLOW RETURNS TO ITS NORMAL DIRECTION. MUCH OF THE WARM WATER REMAINS ON THE SURFACE AND CONTINUES TO BE INCLUDED IN THE SURFACE TEMPERATURE RECORD.

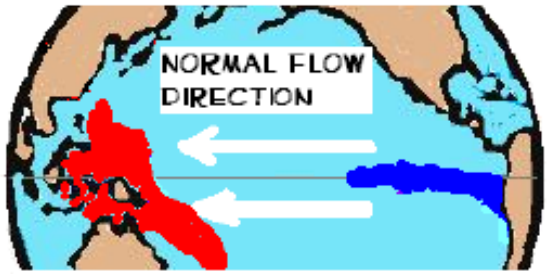
Figure 1-25 Bob Tisdale

LA NIÑA IS NOT THE OPPOSITE OF EL NIÑO

BEFORE LA NIÑA

BEFORE THE LA NIÑA, THE SEA SURFACE TEMPERATURE IN THE EASTERN EQUATORIAL PACIFIC IS DICTATED BY THE TEMPERATURE OF THE UPWELLED WATERS.

DURING LA NIÑA



DURING THE LA NIÑA, STRONGER TRADE WINDS INCREASE THE AMOUNT OF UPWELLING, WHICH EXPANDS THE SURFACE AREA OF COOLER WATERS IN THE EAST. THE WARM POOL IS PUSHED TO THE WEST. THE FLOW IS IN THE NORMAL DIRECTION.

AFTER LA NIÑA

AFTER THE LA NIÑA, THE TRADE WINDS RELAX BACK TO THEIR NORMAL STRENGTH. THE UPWELLING OF COOL WATER SLOWS. THE WARM POOL EXPANDS EAST.

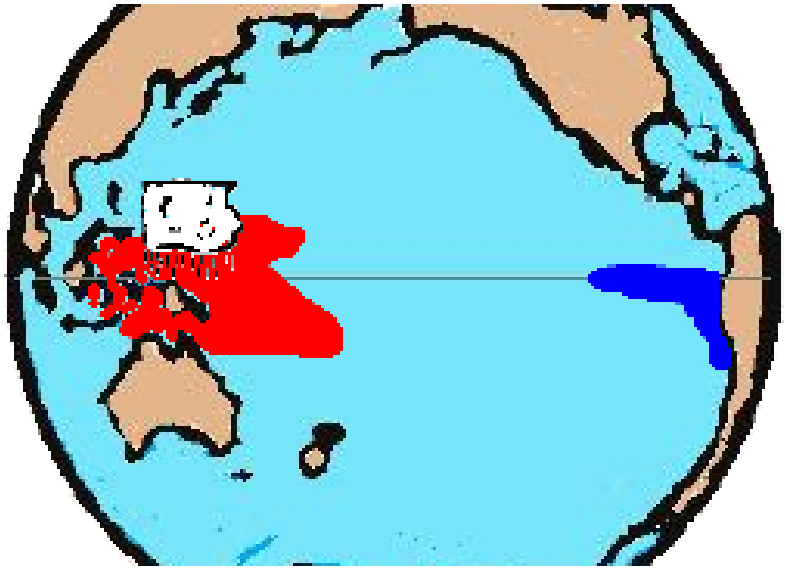
UNLIKE AN EL NIÑO, THERE ARE NO "LEFTOVER" COOL SURFACE WATERS IN THE EASTERN TROPICAL PACIFIC THAT NEED TO BE RETURNED TO THE WEST. THE TRADE WINDS HAVE BEEN PUSHING THE WATER FROM EAST TO WEST ALL ALONG, THROUGH THE ENSO-NEUTRAL AND LA NIÑA PHASES.

Figure 1-26

Bob Tisdale

WHY GLOBAL SURFACE TEMPERATURES WARM DURING AN EL NIÑO (A)

ENSO NEUTRAL



AN EL NIÑO RELEASES HEAT INTO THE ATMOSPHERE. BUT THAT IS NOT WHY GLOBAL SURFACE TEMPERATURES WARM IN RESPONSE TO THE EL NIÑO.

BECAUSE THE PACIFIC WARM POOL IS SO WARM, A LOT OF MOISTURE IS PUMPED INTO THE ATMOSPHERE THERE.

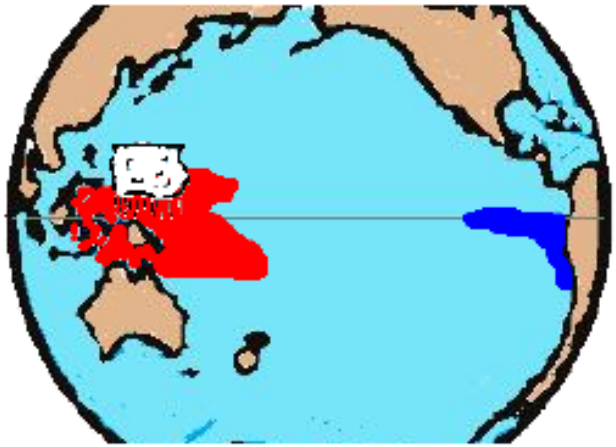
BECAUSE THE PACIFIC WARM POOL IS ALSO SO LARGE, IT IS ONE OF THE DRIVING FORCES OF GLOBAL CLIMATE.

Figure 1-27

Bob Tisdale

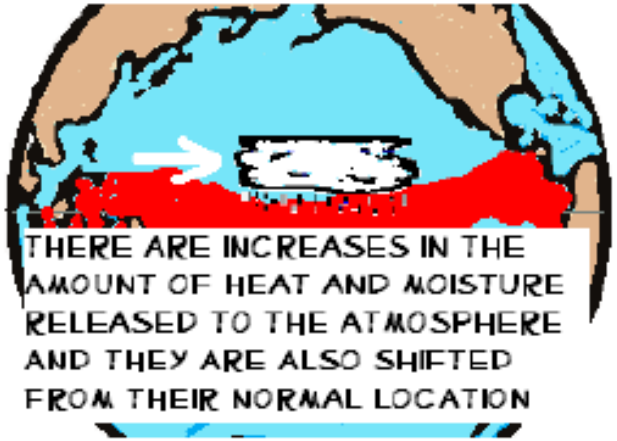
WHY GLOBAL SURFACE TEMPERATURES WARM DURING AN EL NIÑO

ENSO NEUTRAL



THE "NORMAL" STATE OF GLOBAL CLIMATE IS IN PART DEPENDENT ON THE LOCATION OF ALL OF THE MOISTURE AND HEAT BEING RELEASED FROM THE WESTERN TROPICAL PACIFIC.

EL NIÑO



THEN, DURING THE EL NIÑO, NOT ONLY IS MORE HEAT AND MOISTURE BEING RELEASED TO THE ATMOSPHERE, BUT THAT RELEASE OF HEAT AND MOISTURE HAS BEEN SHIFTED ABOUT A QUARTER OF THE WAY (OR MORE) AROUND THE GLOBE .

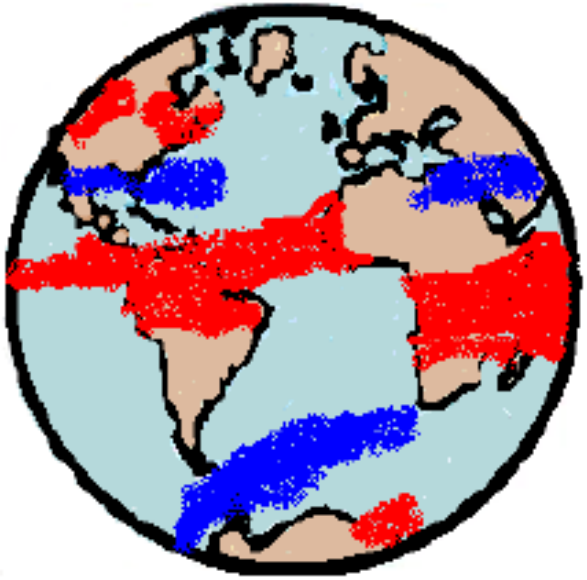
Figure 1-28

Bob Tisdale

HHH

WHY GLOBAL SURFACE TEMPERATURES WARM DURING AN EL NIÑO

CORRELATION OF SURFACE TEMPERATURE WITH ENSO INDEX (3-MONTH LAG)



RESPONSE DURING EL NIÑO

RED --> AREAS THAT WARM

BLUE--> AREAS THAT COOL

THE INCREASED RELEASE OF HEAT AND MOISTURE AND THEIR RELOCATION DURING AN EL NIÑO CAUSE CHANGES IN ATMOSPHERIC CIRCULATION PATTERNS.

IT IS THOSE CHANGES IN ATMOSPHERIC CIRCULATION DURING AN EL NIÑO THAT CAUSE SURFACE TEMPERATURES OUTSIDE OF THE EASTERN TROPICAL PACIFIC TO WARM IN SOME PLACES AND TO COOL IN OTHERS.

SINCE THE AREAS THAT WARM ARE GREATER THAN THOSE THAT COOL, GLOBAL SURFACE TEMPERATURES RISE DURING AN EL NIÑO.

MORE AREAS AROUND THE GLOBE COOL THAN WARM DURING A LA NIÑA SO GLOBAL SURFACE TEMPERATURES COOL.

Figure 1-29

Bob Tisdale

Some Lessons from Bob Tisdale's data set:

ENSO is not a true oscillations.

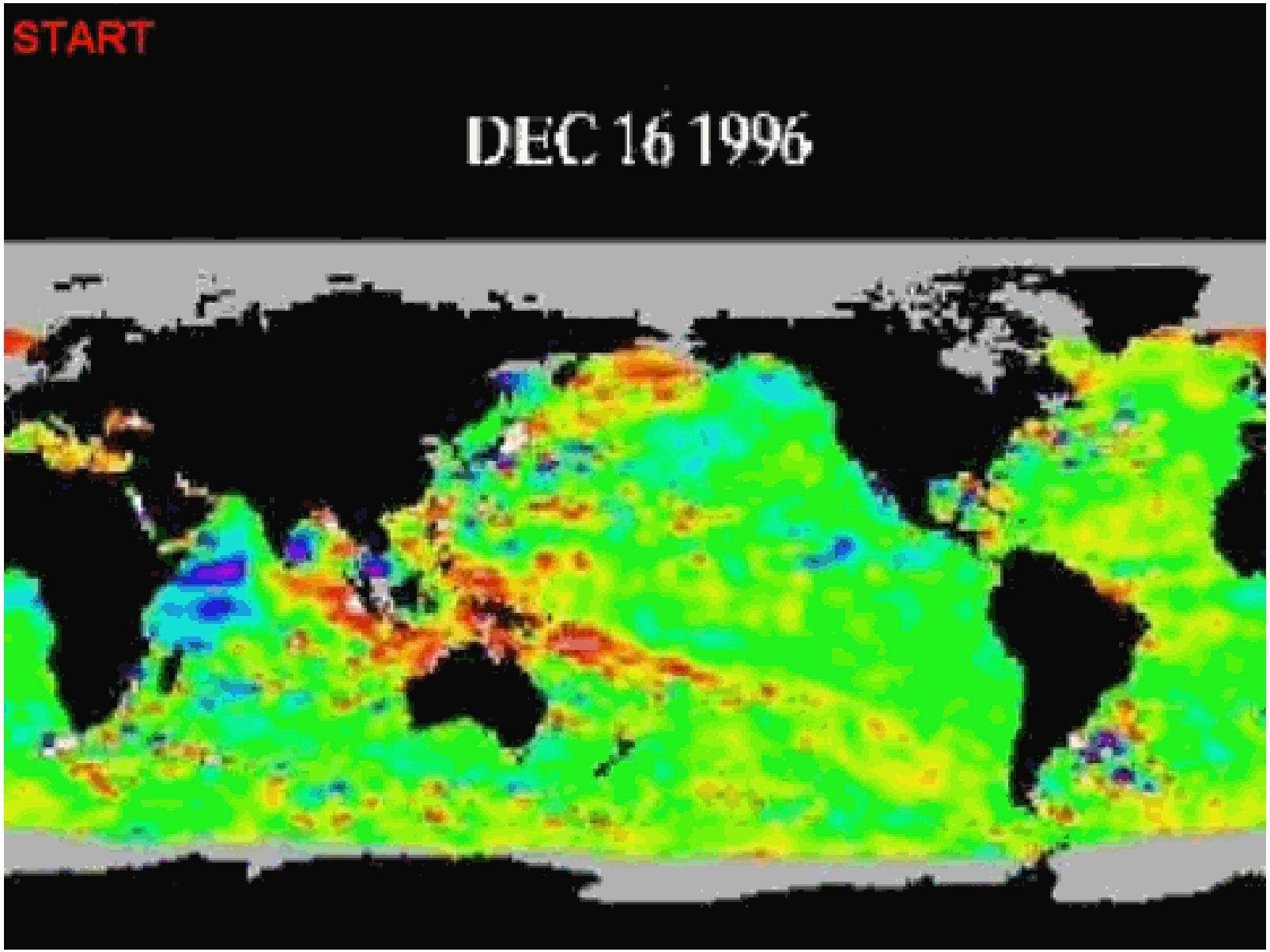
El Ninos are not regular occurrence.

Some El Ninos last a year, some two years, some, almost 3 years long.

La Nina is not the "Opposite" of El Nino

La Ninas are periods when there are strong trade winds and strong upwelling from the Americas' west coasts.

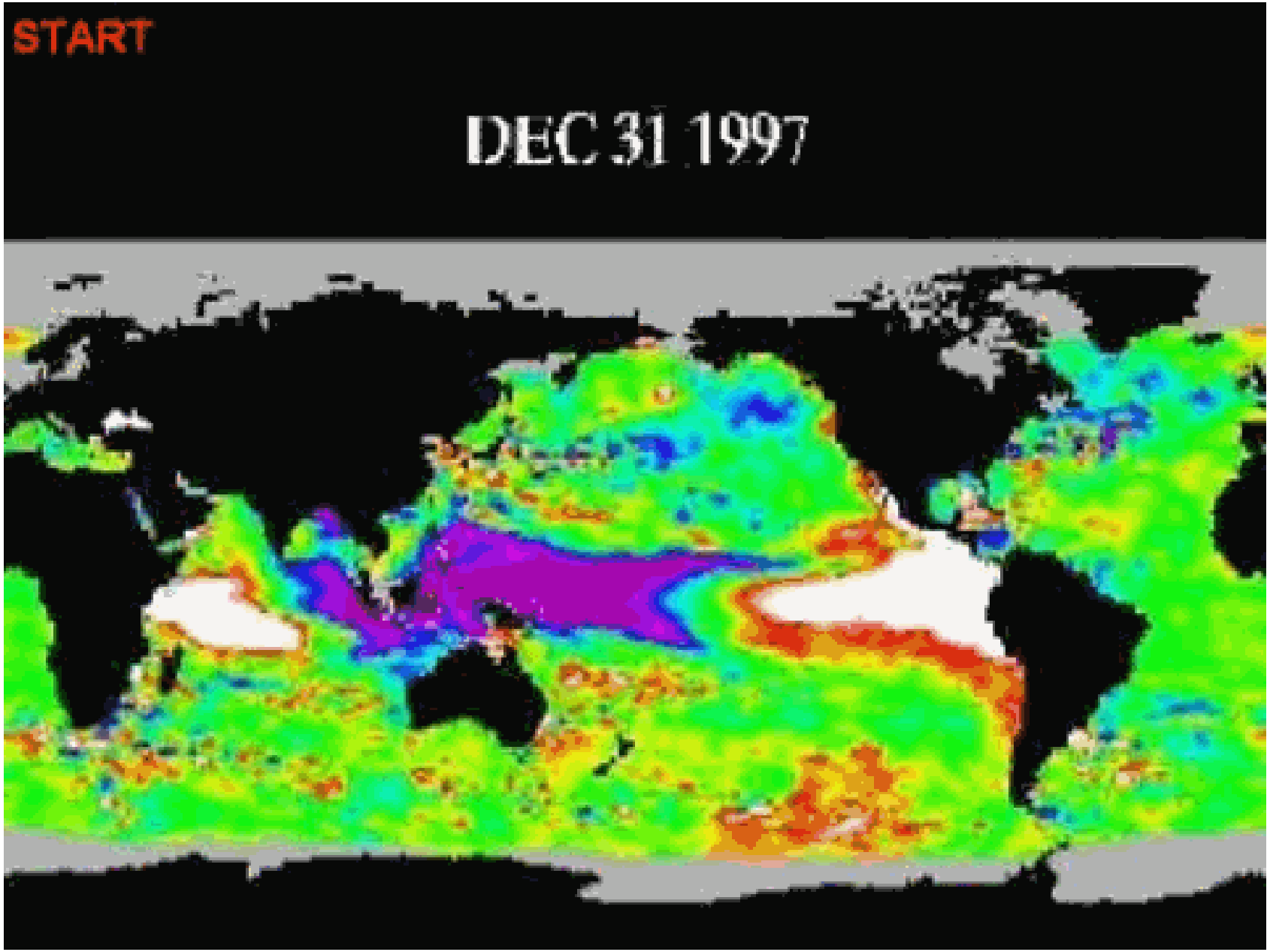
Next graphics show animations of El Nino, and then La Nina



https://casf.me/wp-content/uploads/2020/11/2020-11-30_16-40-04A.mp4

Animation of La Nina beginning on 31 Jan 1998

https://bobtisdale.files.wordpress.com/2012/06/animation-3-1.gif



https://casf.me/wp-content/uploads/2020/11/2020-11-30_16-52-56B.mp4

Why we use anomalies or departures from a mean to help describe weather and climate variations.

This also from Bob Tisdale's book.

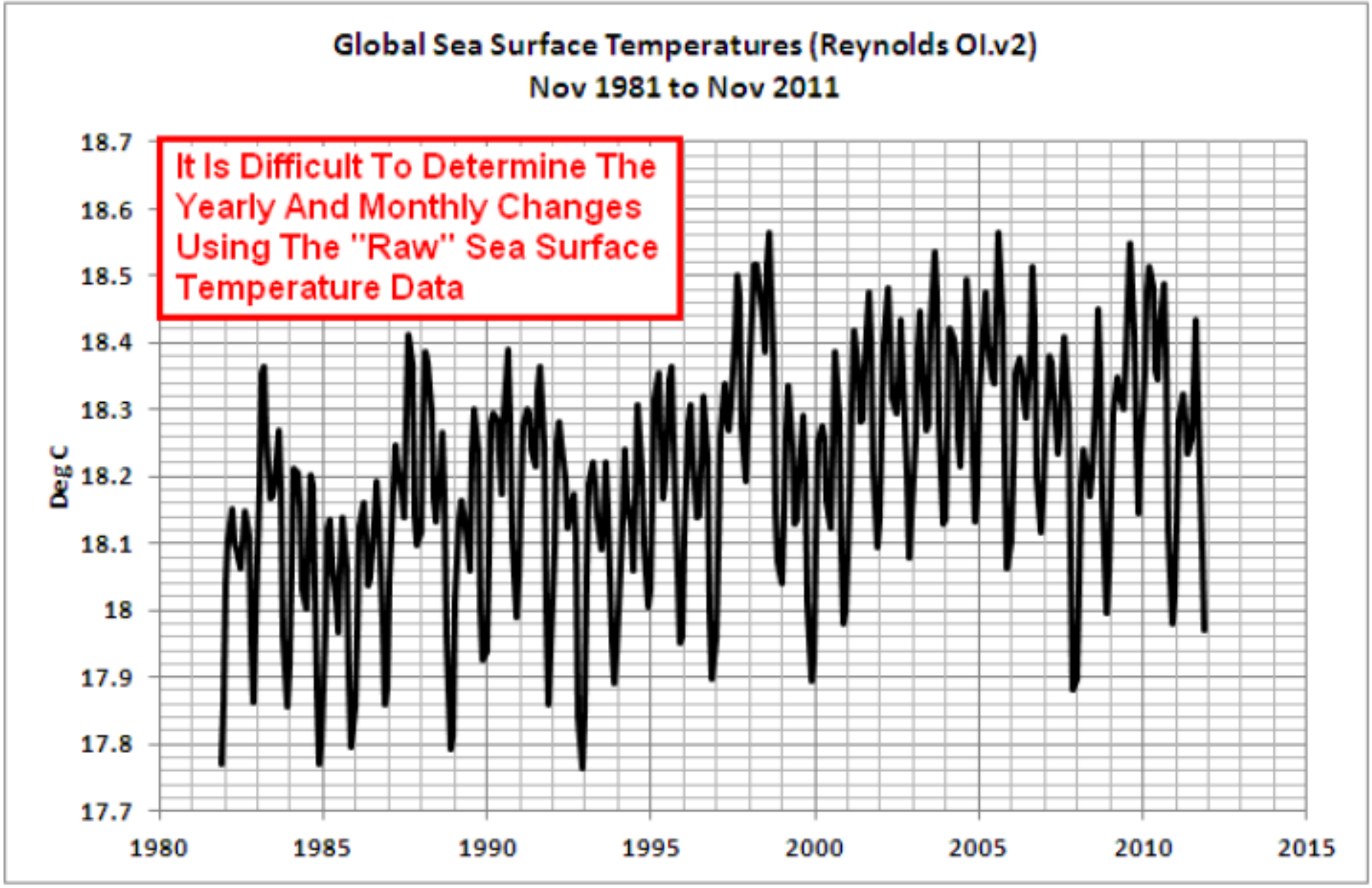


Figure 2-17

Bob Tisdale

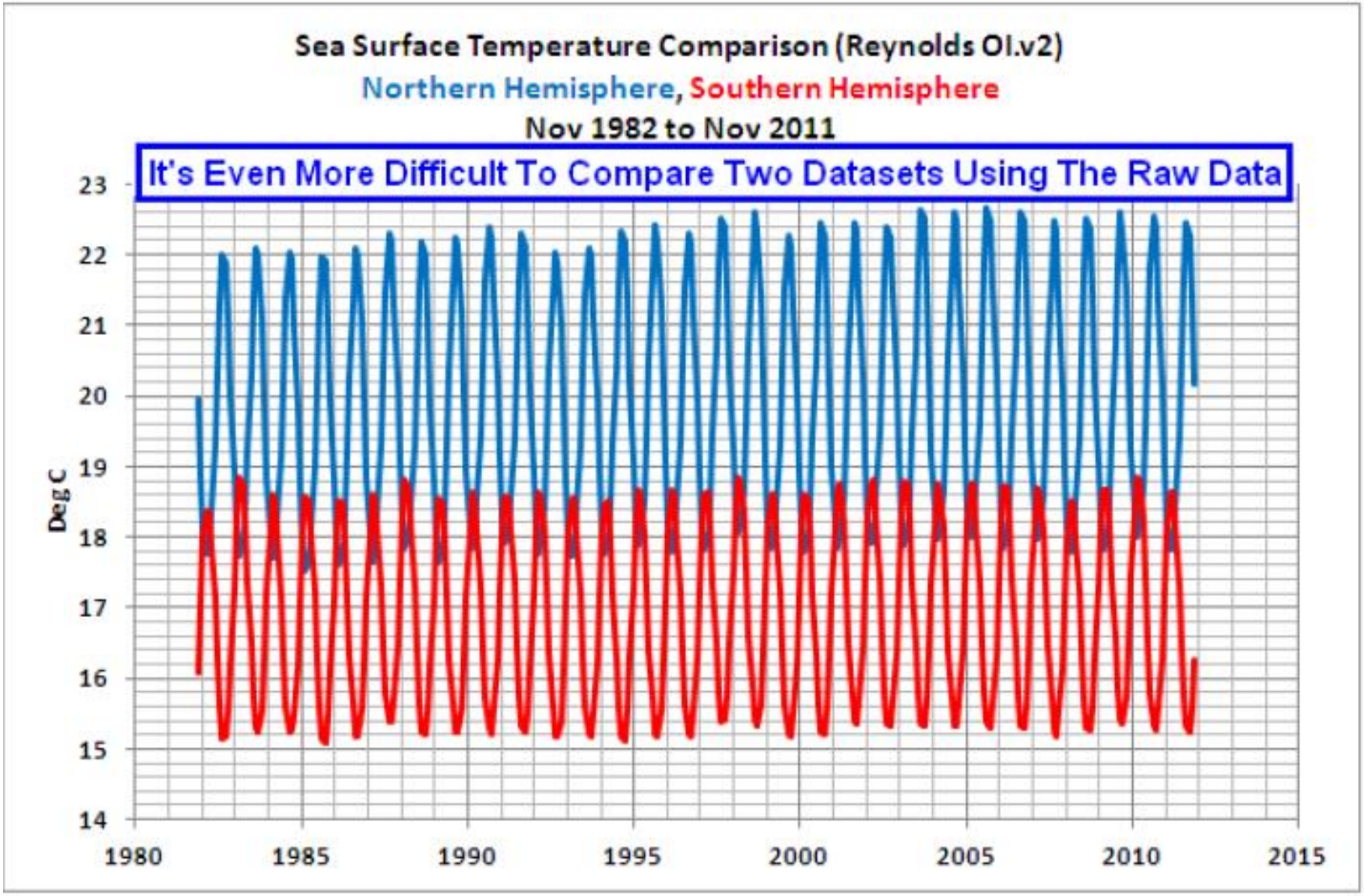


Figure 2-18

Bob Tisdale

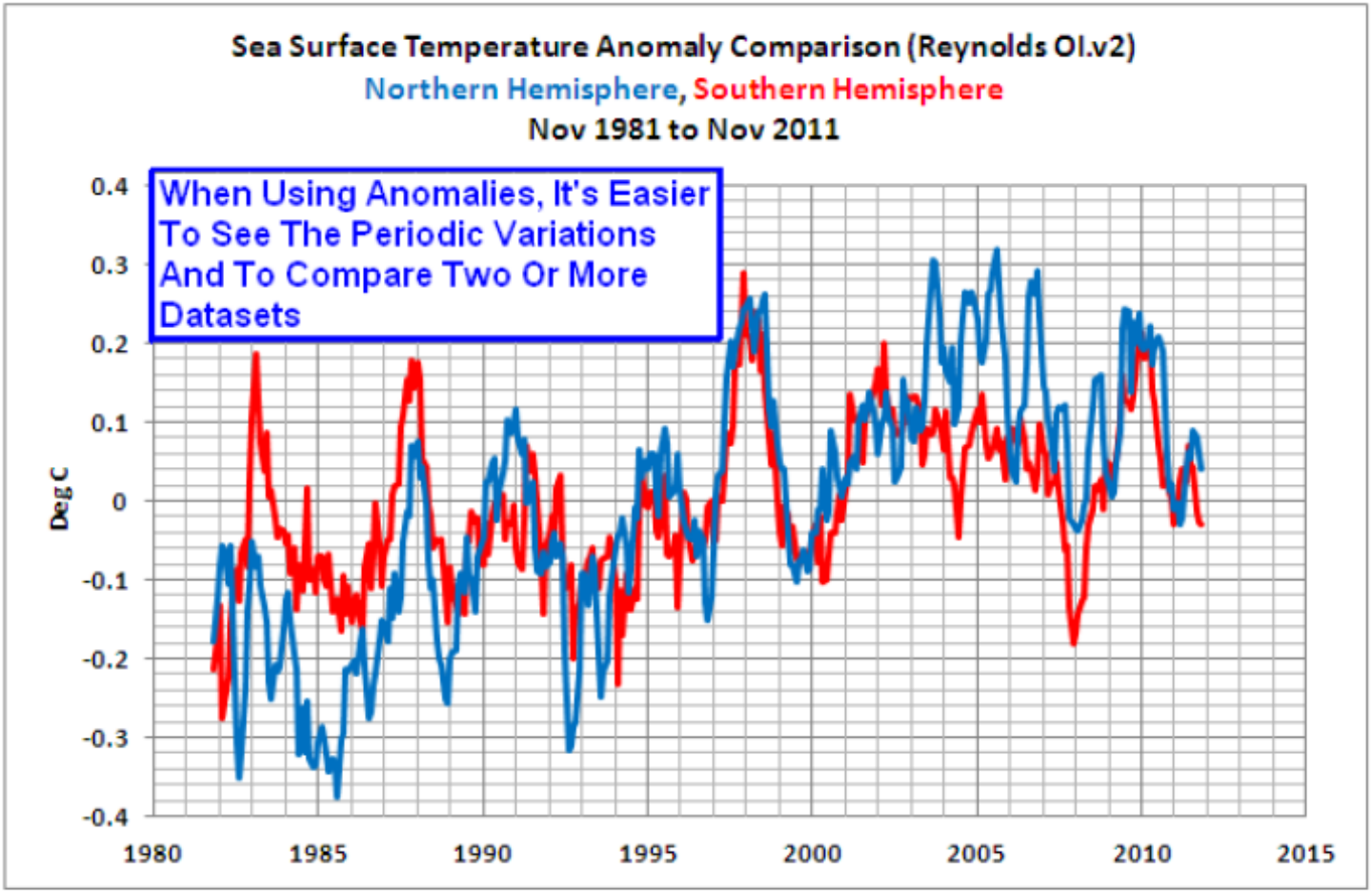


Figure 2-19

Bob Tisdale

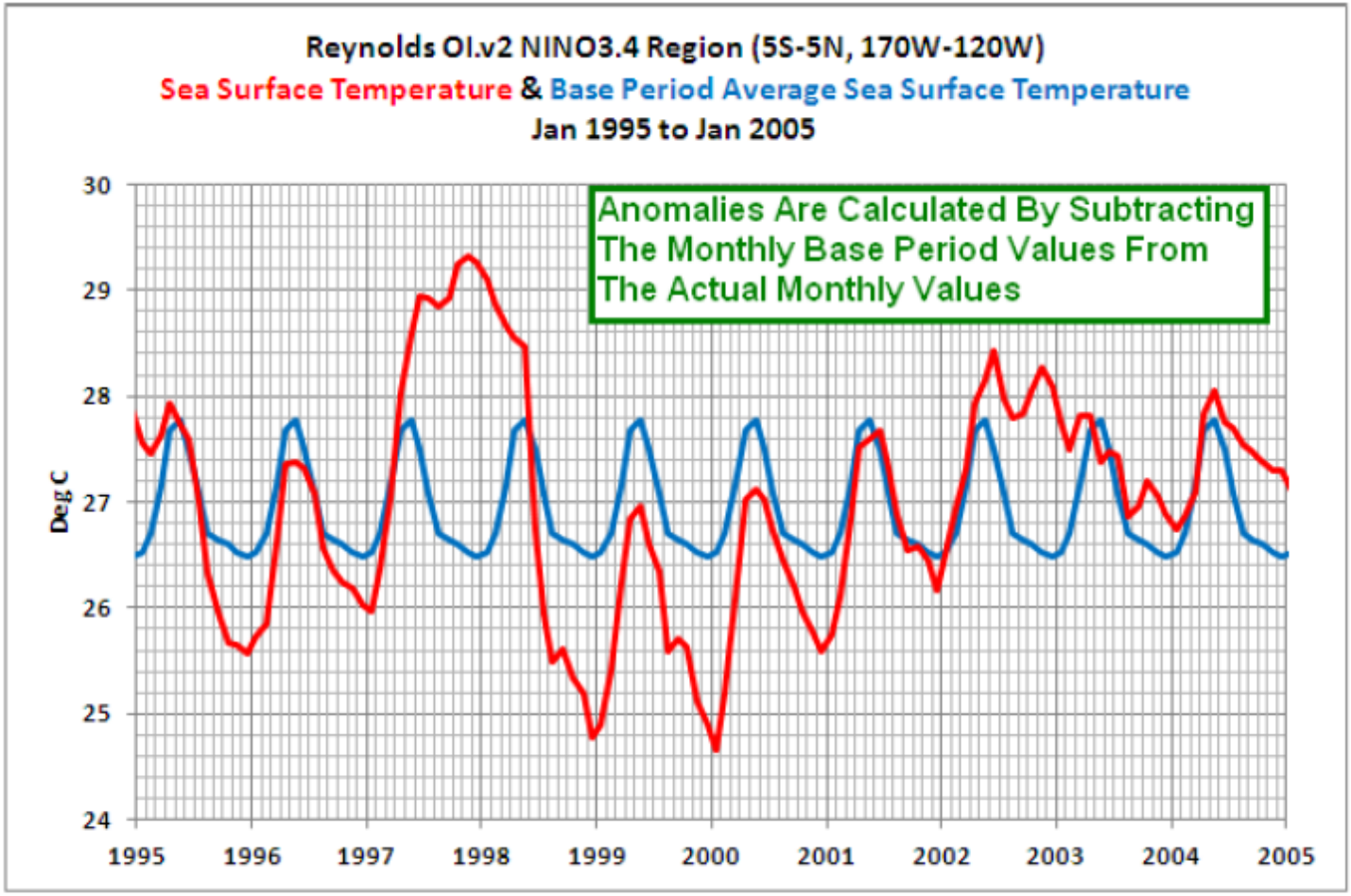


Figure 2-20

Bob Tisdale

1997-98 El Nino that left all that snow in the Organ Mountains.

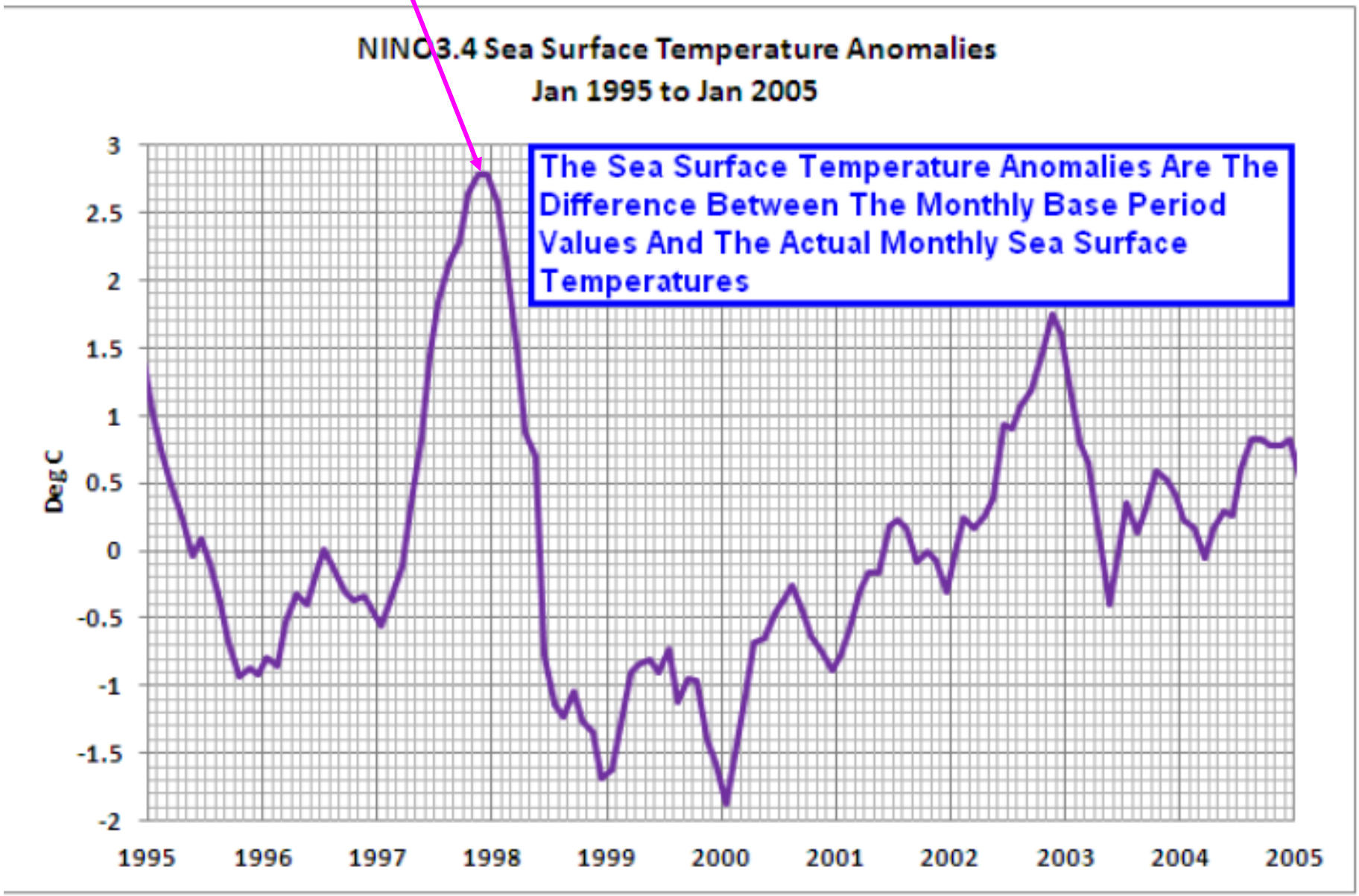


Figure 2-21

Bob Tisdale

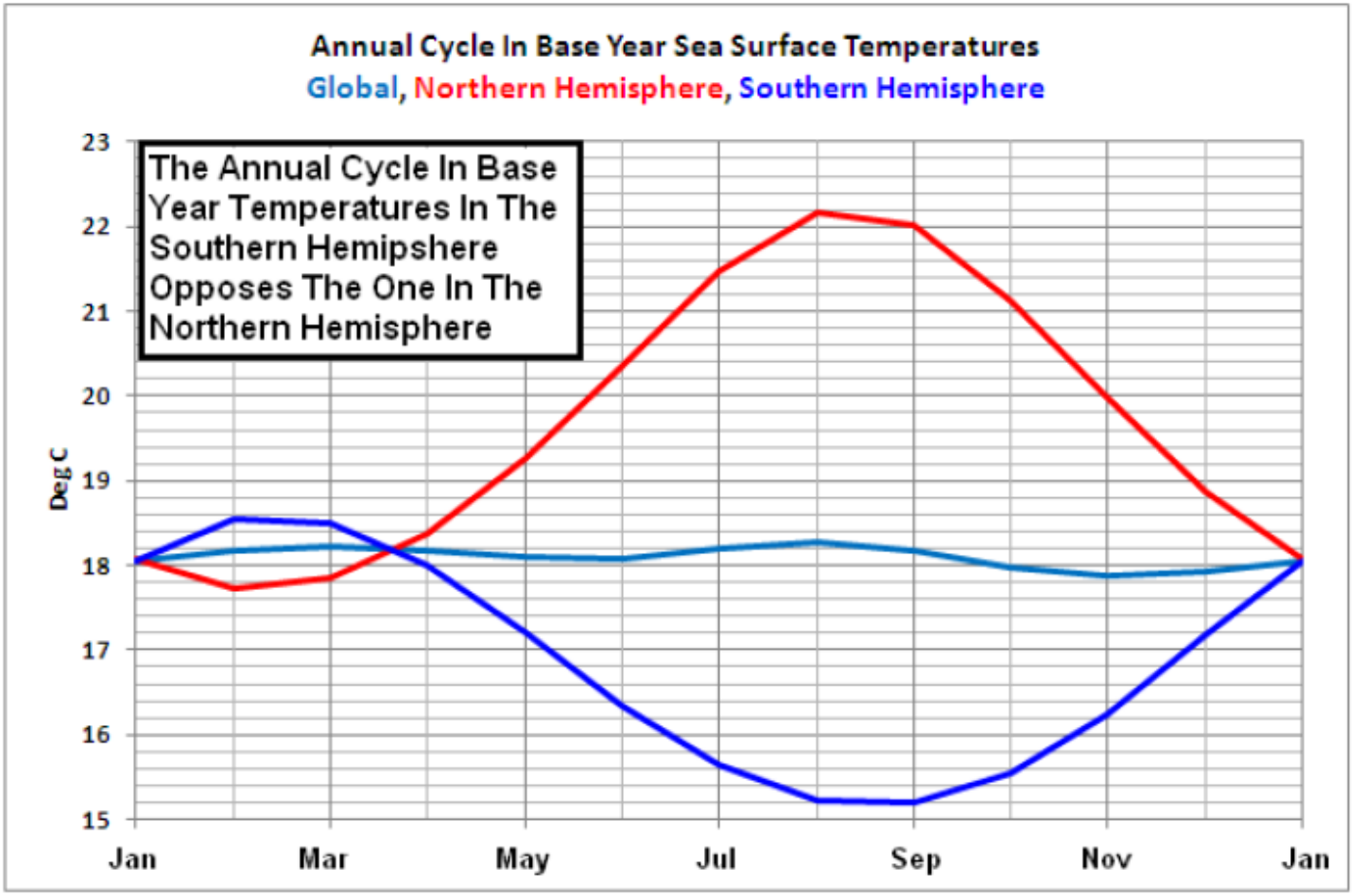


Figure 2-22

Bob Tisdale

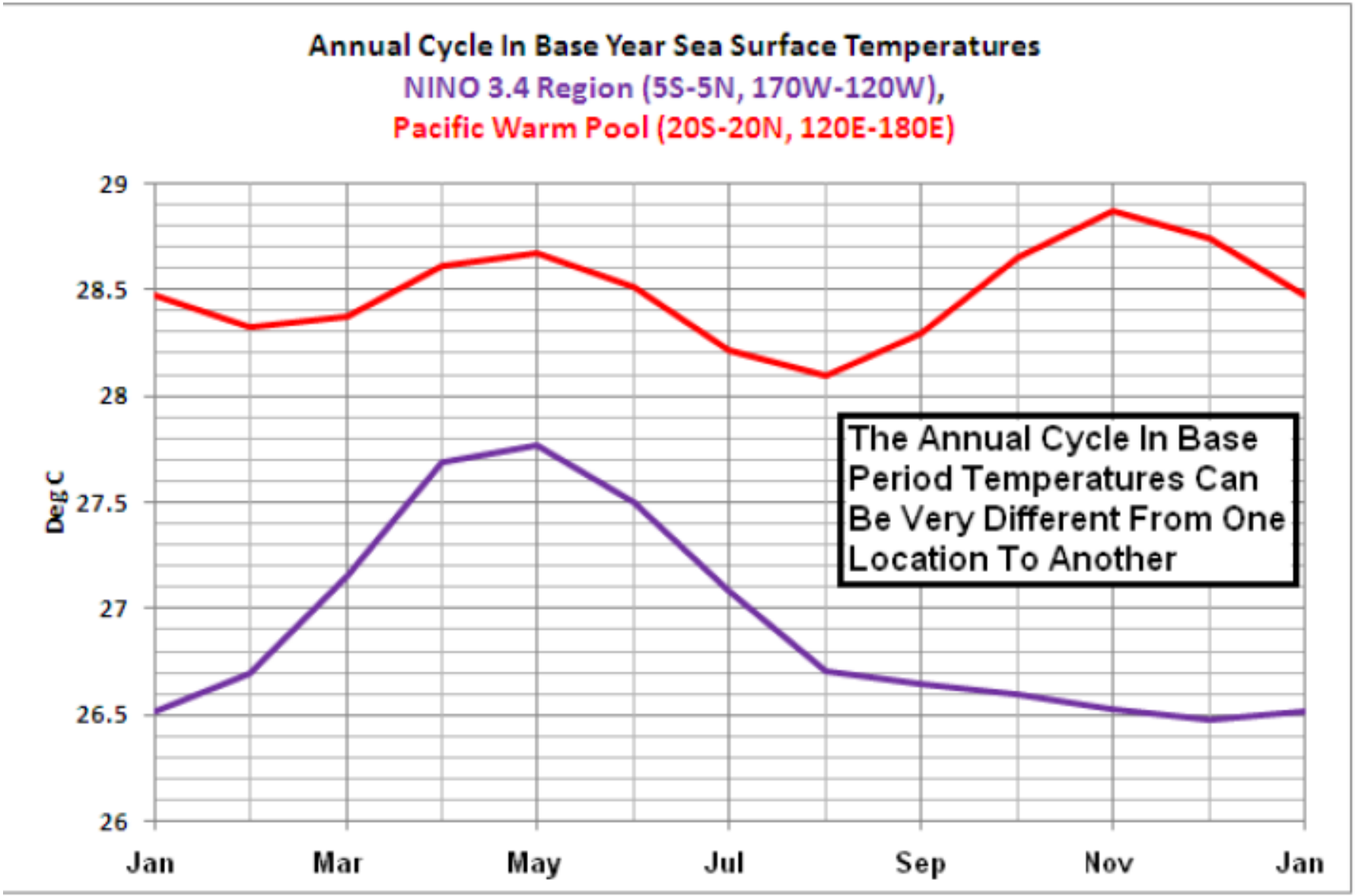
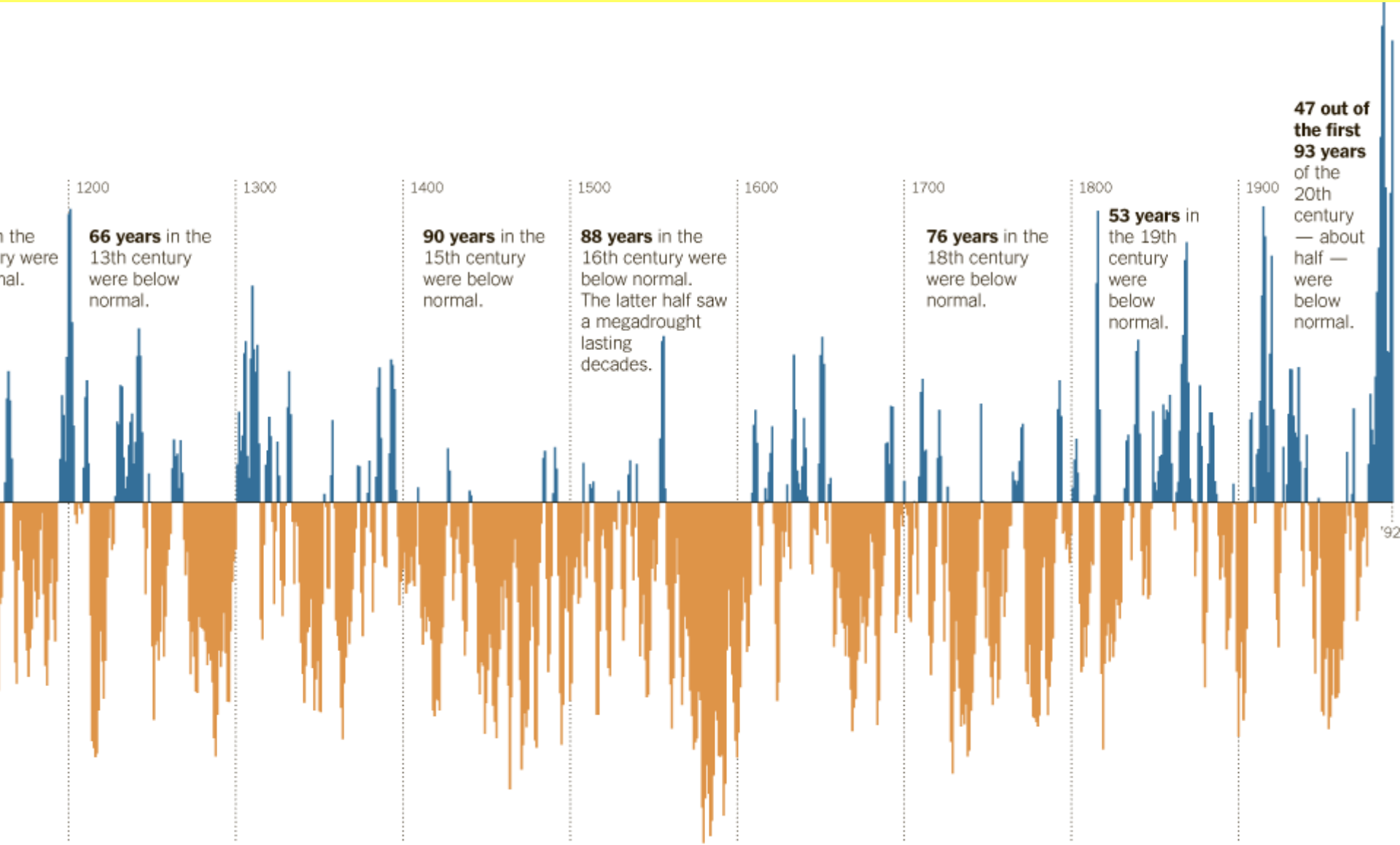


Figure 2-23

Bob Tisdale

Rainfall and Drought Chart: New York Times…U of A Tree Ring Laboratory

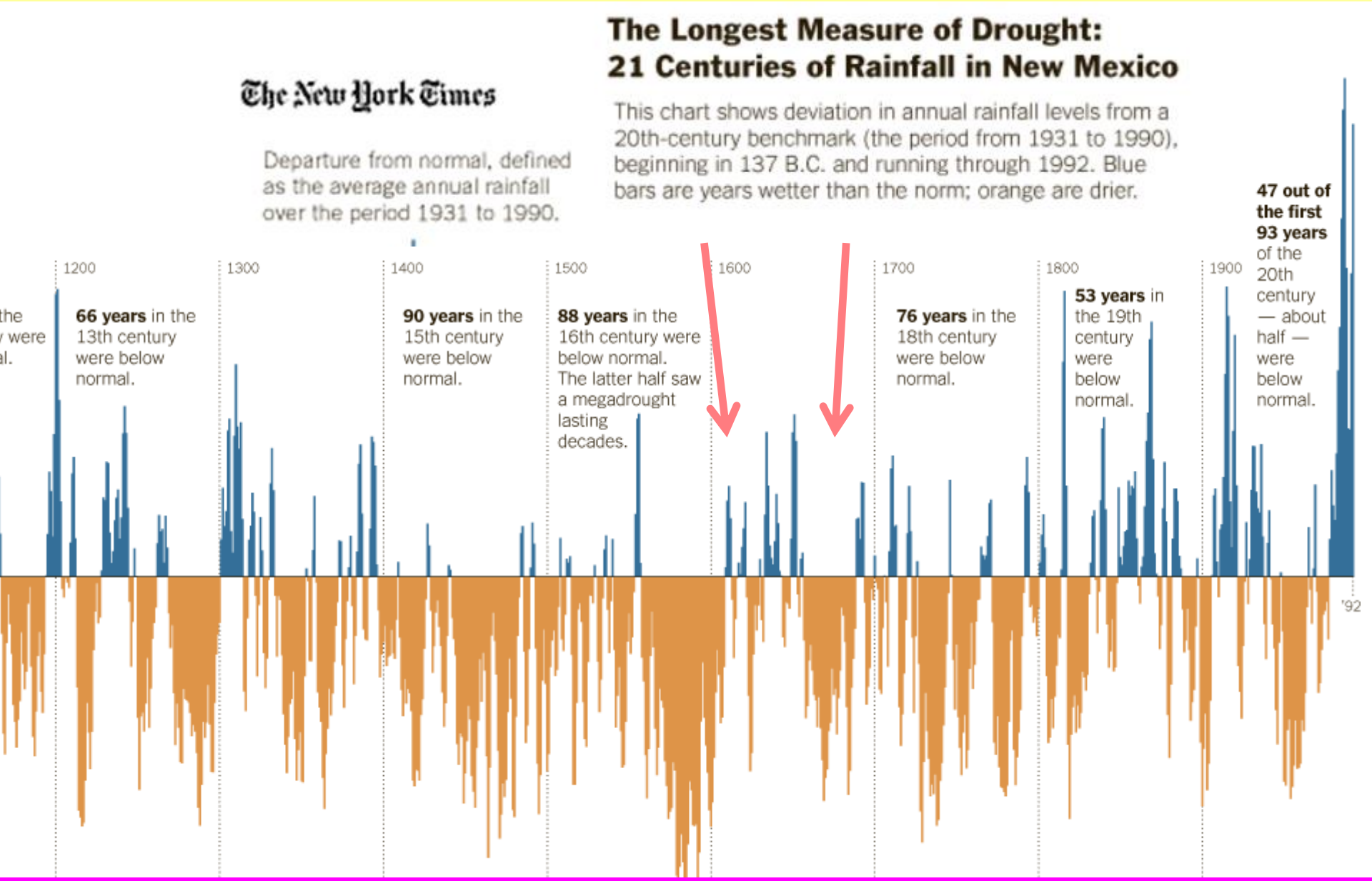


X-Axis Time: 1200s on LEFT -- present on RIGHT

Y-Axis: Rainfall (Blue, above Axis) Drought (Brown, Below Axis)

0 Axis = 20th Century Avg, 1931-1990

http://www.nytimes.com/imagepages/2012/08/12/opinion/sunday/12drought-horizch.html



Late 20th Century wettest in 2000 years. Abo' Mission, Mountainair: founded 1620 re-roofed,1640, abandoned because of drought ~1675.

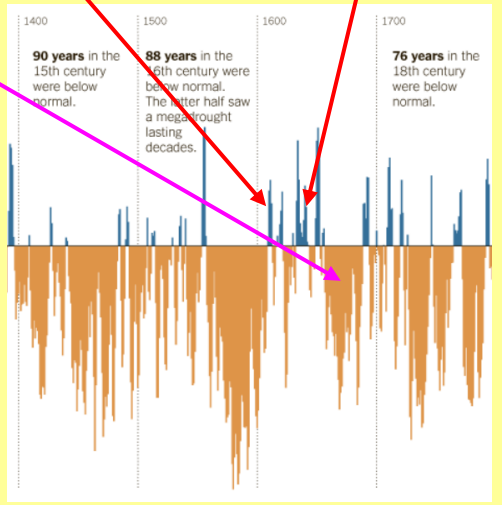
Graphic shows late 20th century was the peak rainfall last 2000 years in New Mexico. National Climate Assessment posits that warmth brings drought and water scarcity, and cool temperatures bring fewer droughts.
2000-year tree ring times series data show the Little Ice Age was very dry here, Spanish mission history of New Mexico's Abo' Mission in Mountainair confirms.

The Little Ice Age was a Catastrophe in New Mexico.

Abo' Mission Church was established in 1620, mission expanded 1640, mission abandoned in late1600s.… **because of the punishing drought**, famine and disease,

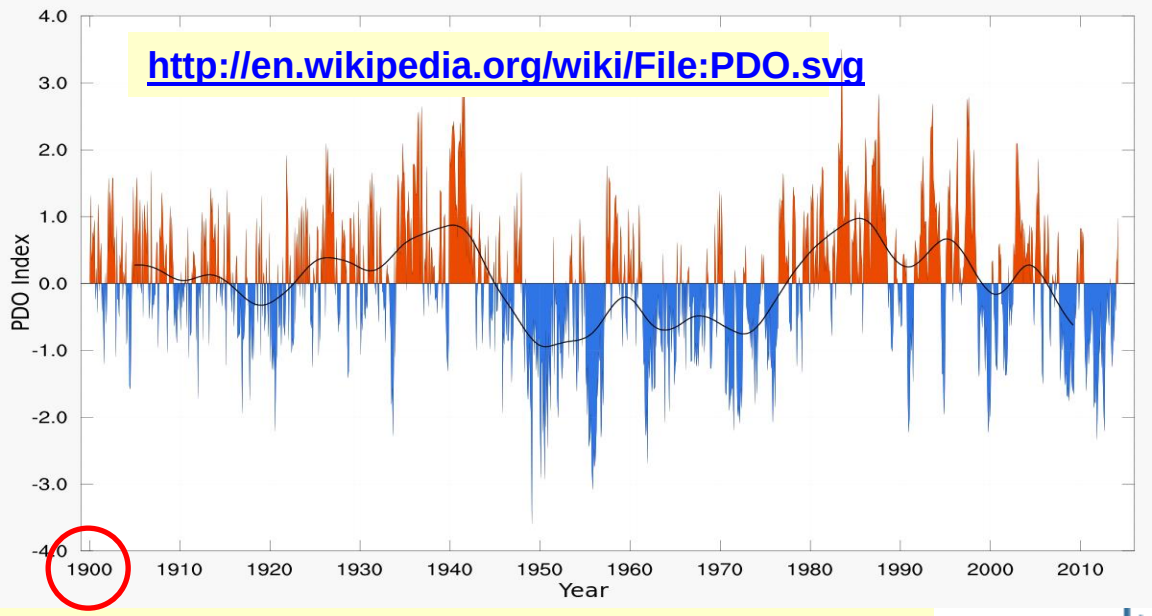
Examining the previous graphic from 1500 to 1700 shows the story:

https://www.nps.gov/sapu/learn/historyculture/abo.htm

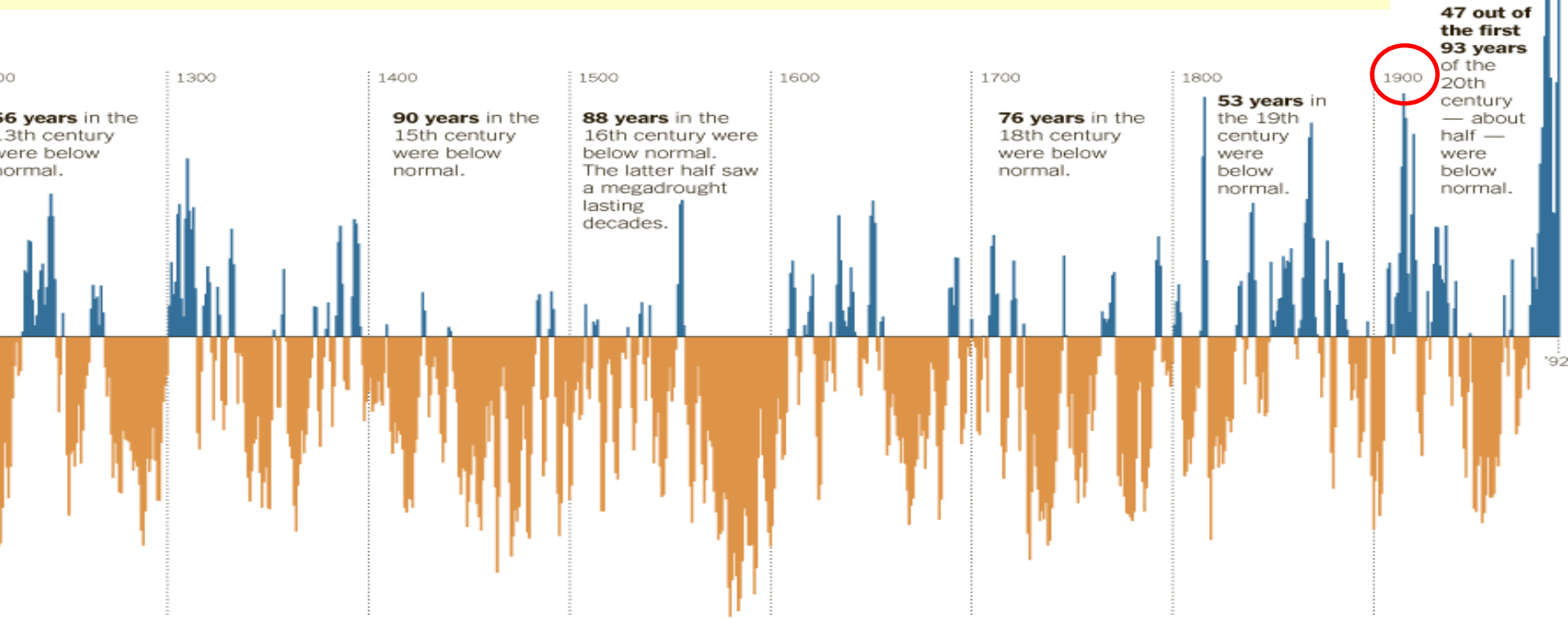


Pacific Decadal Oscillation

Natural change in offshore Water Temperature Pattern Off North America



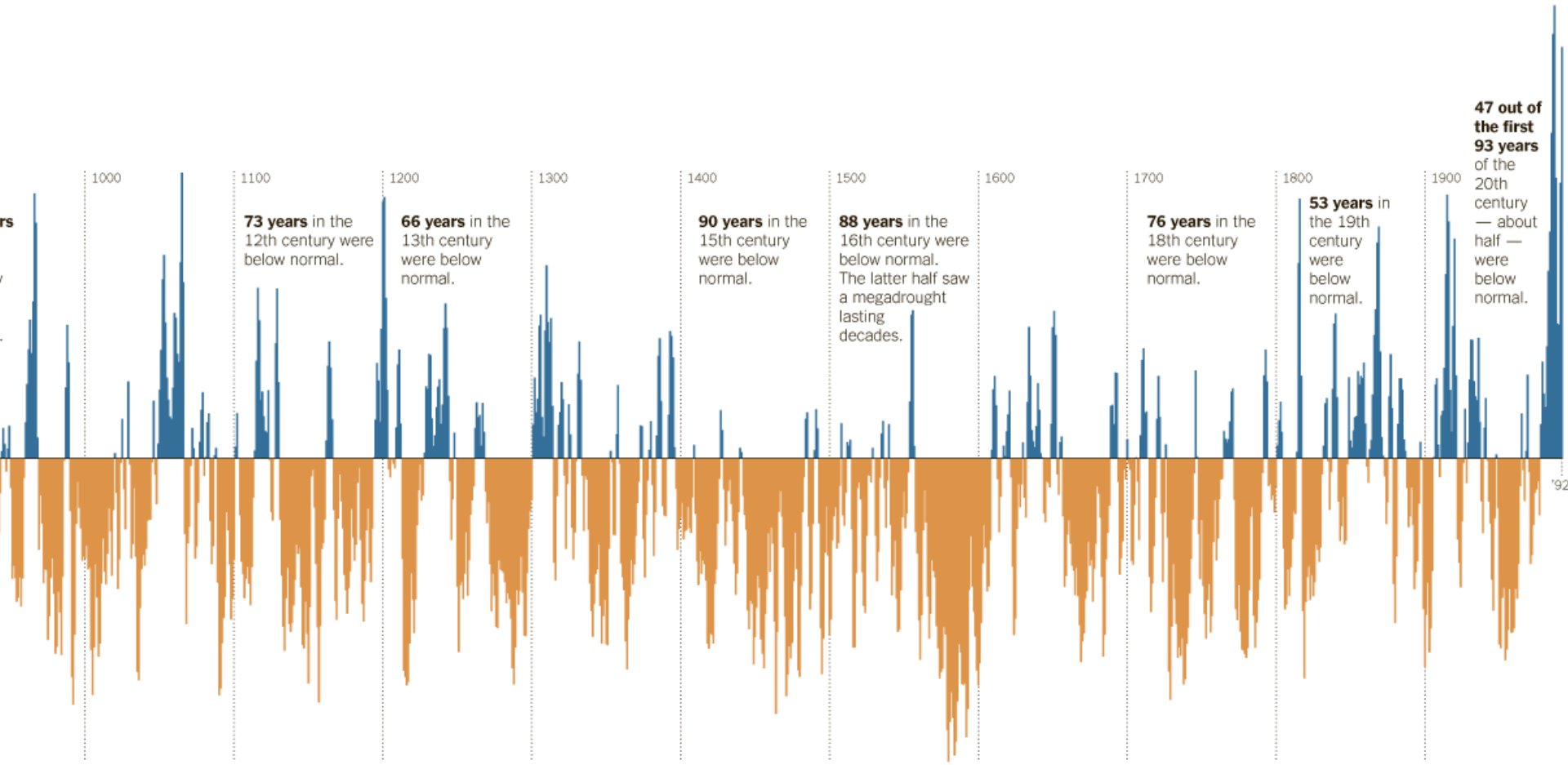
http://www.nytimes.com/imagepages/2012/08/12/opinion/sunday/12drought-horizch.html



http://www.nytimes.com/imagepages/2012/08/12/opinion/sunday/12drought-horizch.html

El Nino/ENSO helps explain dramatic changes from Wet to Dry in New Mexico

60-year Pacific Decadal Oscillation helps explain Rainfall and Drought in NM



IMPORTANT POINT!

WATER TEMPERATURE OF THE OCEAN OFFSHORE NORTH AMERICA DETERMINES RAINFALL/DROUGHT in (especially) Western North America

What determines that water temperature?

The Multi-year weather pattern called EL NINO

Formally, “El Nino Southern Oscillation” “ENSO”

There is also, the 60-year weather pattern
The PACIFIC DECADAL OSCILLATION, the “PDO.”

30 years of MORE El Ninos, and
30 years FEWER El Ninos.

Its not necessary to believe false CO2 stories.

To explain and understand, it's not necessary to resort to human-caused CO2-fueled climate change, as erroneously stated in the Fourth National Climate Assessment, and by others.

It's only necessary to understand the ENSO-influenced climate we have here, naturally.

Next slide, one of those false CO2 stories.

https://www.lcsun-news.com/story/news/2019/09/19/climate-change-means-uncertain-future-new-mexico-chile-farmers/2378419001/

Climate change means uncertain future for New Mexico chile farmers

This year's chile season is in full swing, but it is getting mixed reviews from farmers in southern New Mexico.

Maria Martinez sells her family's produce from Anthony and Brazito on Wednesdays and Saturdays at the Farmers and Crafts Market in Las Cruces. Her booth stands out with red chile ristras strung up around the sides and sacks of chile piled next to them…

She said it's been a struggle this year because of insufficient water.

"It's been kind of hard because they don't give them much water," Martinez said of the local irrigation district.

Climate change is likely to produce more dry years and more unpredictable growing seasons for chile farmers in southern New Mexico, as temperatures increase and the snowpack in northern mountains continues to decline. (Photo: Nathan J Fish/Sun-News)

NCA 4 is wrong!

The Fourth National Climate Assessment is flat wrong concerning southern New Mexico. Below, the NCA4 statement, bordered in Red.

It is wrong, and comes from this source:

https://nca2018.globalchange.gov/ Chapter 5, Water…the first lines of text.

"Rising air and water temperatures and changes in precipitation are intensifying droughts, increasing heavy downpours, reducing snowpack, and causing declines in surface water quality, with varying impacts across regions."

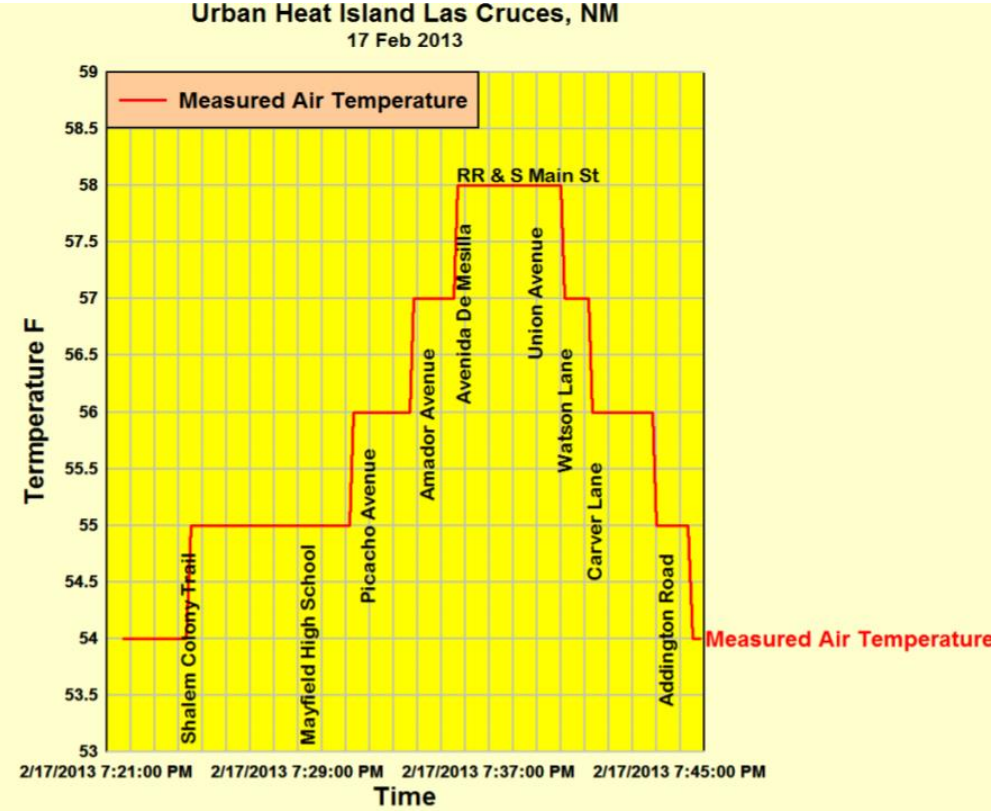
Data showing the Fourth National Climate Assessment's wrongheaded statements comes from the **Western Regional Climate Center** in Reno, Nevada.

We previously included these data in this post, https://casf.me/another-false-climate-alarm/; plotted in following graphics.

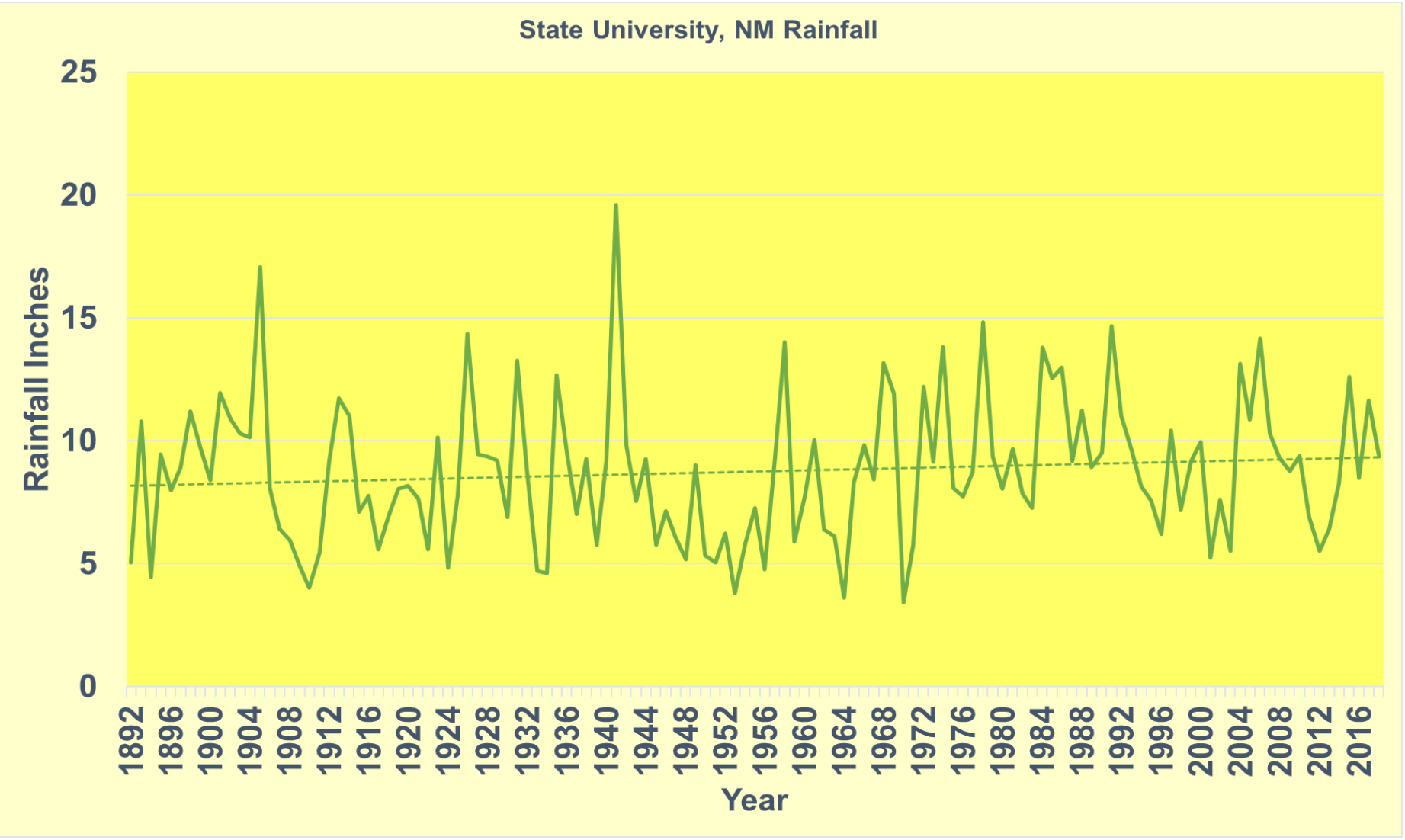
Brief Discussion of the erroneous NCA4 statement

Temperatures at New Mexico State University are hopelessly compromised because the thermometers are located near the center of Las Cruces' Urban Heat Island, and said thermometers are located over bare dirt rather than over low vegetation as specified by NOAA and the World Meteorological Organization.

Max-Min Thermometer System over bare dirt, not low vegetation.



NMSU's rainfall data show rainfall increasing for well over a century, see plot next.



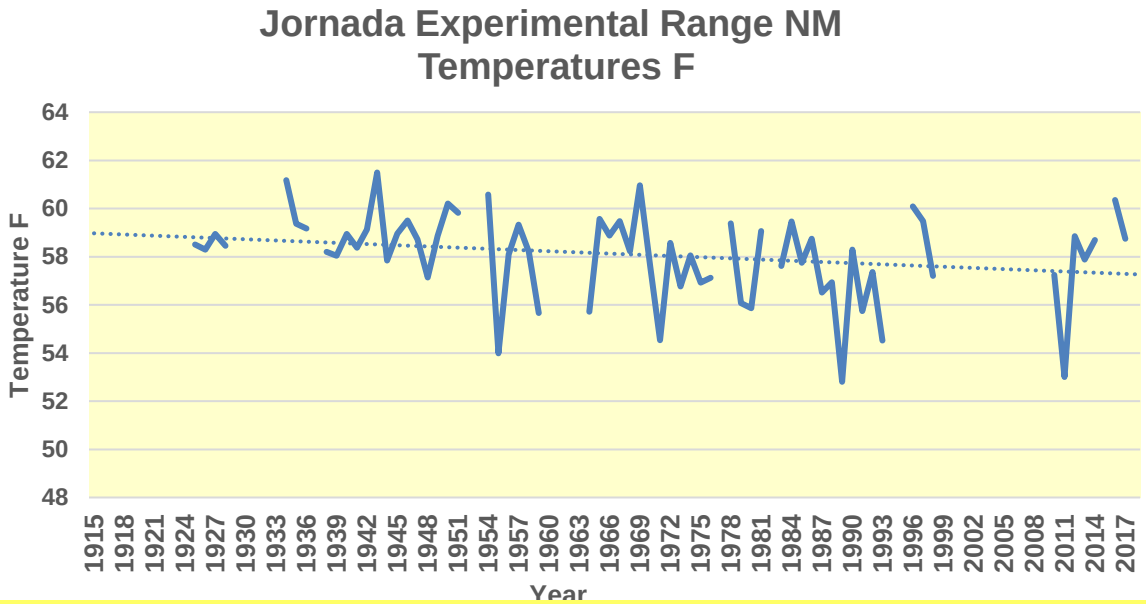
Rainfall at New Mexico State University has been increasing for over 100 years.

Jornada Experimental Range, NM https://wrcc.dri.edu/cgi-bin/cliMAIN.pl?nm4426

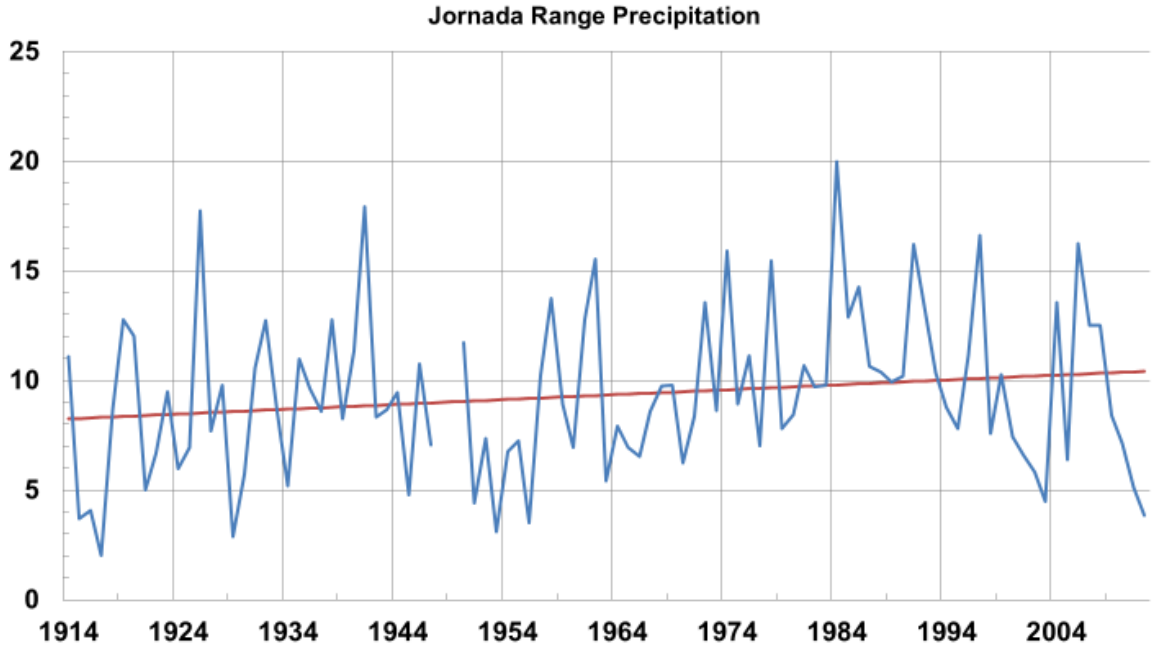
Jornada Experimental Range is located in the Chihuahuan Desert, 20 miles north-northeast of Las Cruces.

Temperatures have been falling for over 100 years.

Rainfall has been increasing for over 100 years.



https://jornada.nmsu.edu/content/usda-noaa-nws-monthly-summary-climatological-data

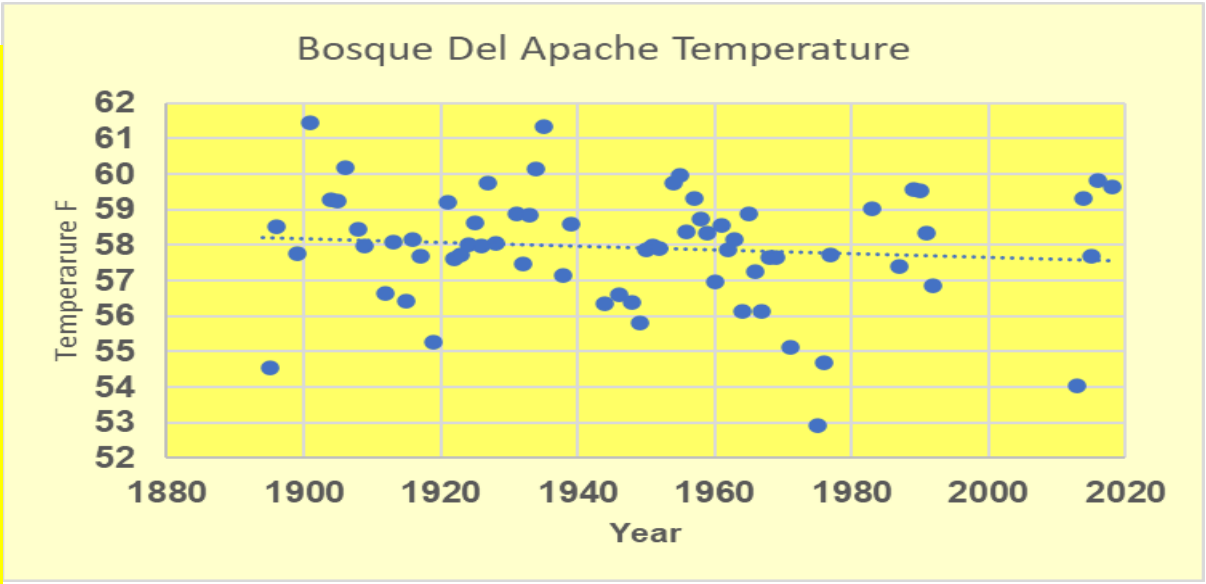


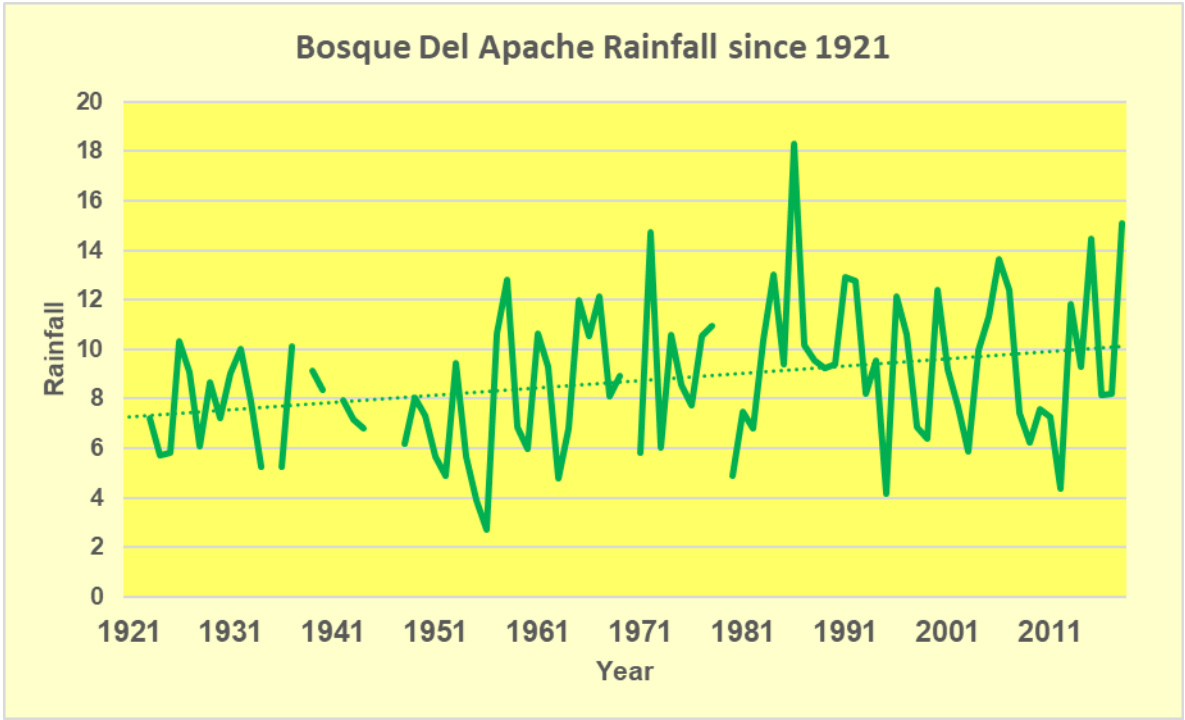
Bosque Del Apache NWR, NM https://wrcc.dri.edu/cgi-bin/cliMAIN.pl?nm1138

Bosque Del Apache National Wildlife Refuge is located on the floodplain of the Rio Grande, about 18 Miles south of Socorro, NM.

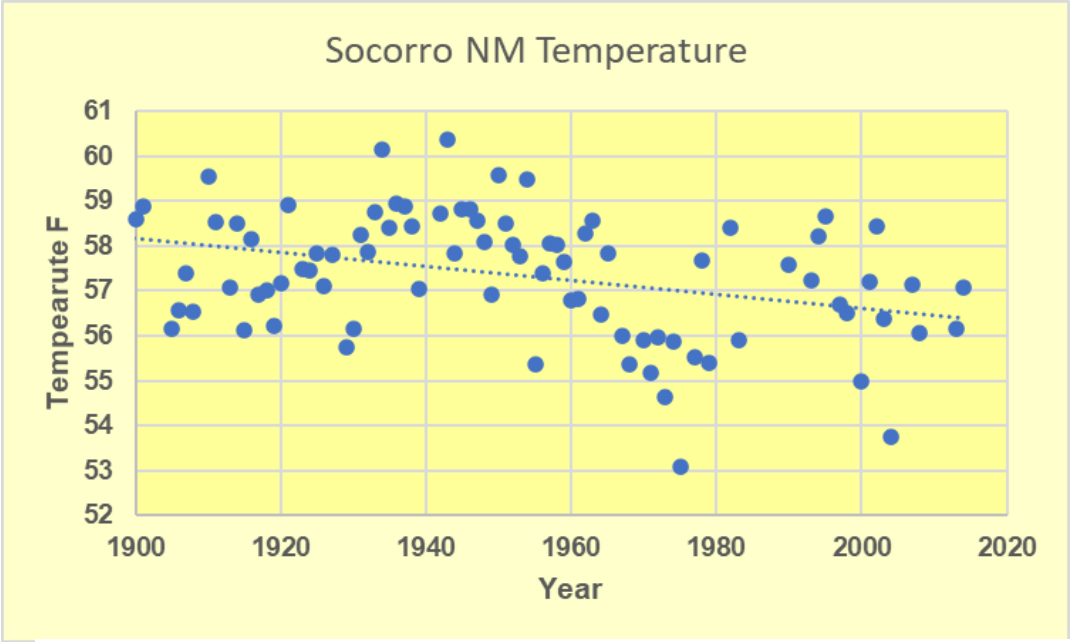
Temperatures have been falling for over 100 years.

Rainfall has been increasing for almost a century.



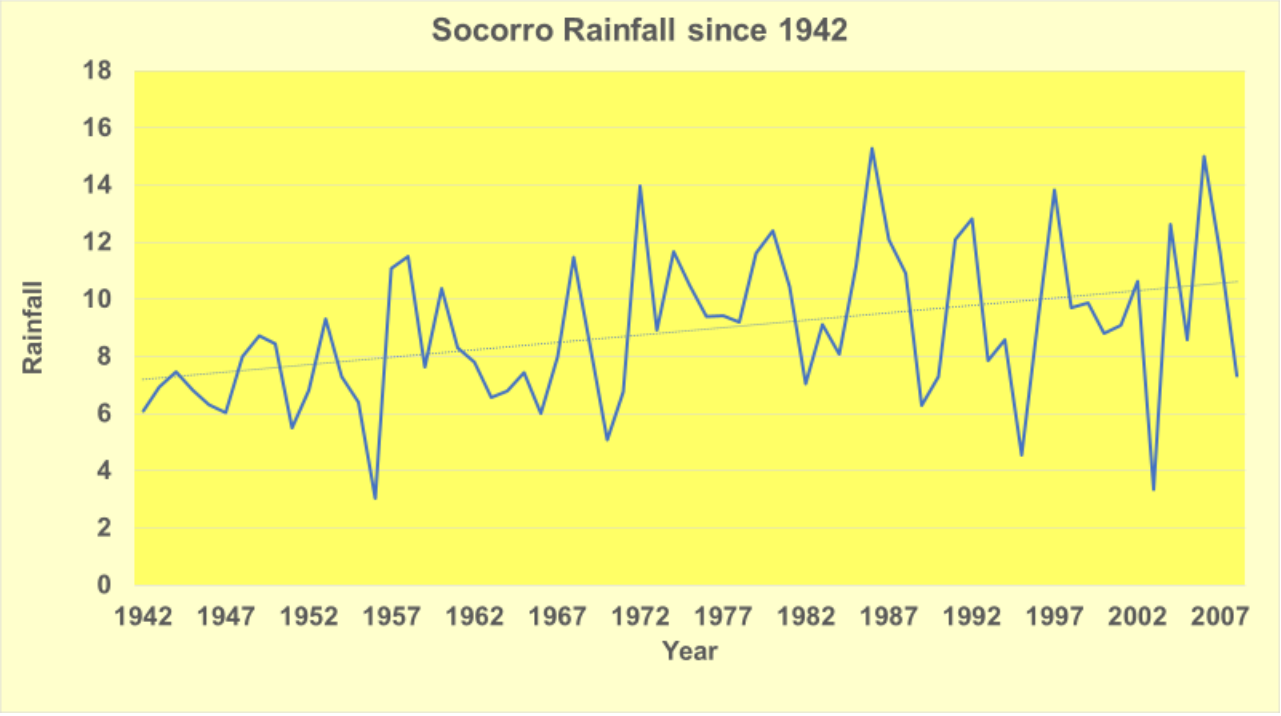


Socorro, New Mexico https://wrcc.dri.edu/cgi-bin/cliMAIN.pl?nm8387



At Socorro, NM, Temperatures have been falling for a century, maybe more.

At Socorro, NM, Rainfall has been increasing for more than half a century.



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Thank you!