Who Turned on the Heat?

The Unsuspected Global Warming Culprit -- El Niño-Southern Oscillation

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The cover art was created at the KNMI Climate Explorer. It is a Hovmöller diagram of the sea surface temperatures for the equatorial Pacific (120E-80W) from November 1981 to June 2012. Refer to **ABOUT THE COVER** for more information. The illustration looks awfully warm, because it includes the longitudes of the Pacific Warm Pool. Sea surface temperature anomalies for the equatorial Pacific (5S-5N, 120E-80W) have cooled at a rate of -0.047 Deg C per decade for the period of November 1981 to June 2012, which is the time span of that satellite-based dataset.

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INTRODUCTION

The title asks the question, *Who Turned on the Heat?* It is asked in disbelief, with the emphasis on "Who". The subtitle, *The Unsuspected Global Warming Culprit, El Niño-Southern Oscillation,* identifies the real perpetrator, which is not the one being marketed by the Intergovernmental Panel on Climate Change. There's no evidence in the sea surface temperature records that increased carbon dioxide emissions are responsible for the warming over the past three decades. This will become crystal clear as you read this book.

Speaking of disbelief: You're probably saying to yourself, *Oh great, another theory about global warming*. You may also be wondering how a weather phenomenon that includes oscillation in its name could cause global warming. If you're really being critical, you're likely thinking (incorrectly) *El Niño and La Niña events are opposites—they oppose and cancel each other.*

Wonder and be critical no longer. Everything presented in this book is supported by data. The sea surface temperature records, if you're not aware, contradict the hypothesis of anthropogenic global warming as presented by climate models. If the data does not agree with the hypothesis, the hypothesis is flawed.

Also, the use of the word "oscillation" in "El Niño-Southern Oscillation" is a matter of convenience—nothing more. The Southern Oscillation was discovered decades before it was found to be related to El Niño and La Niña events, which are not repetitive in time, so they are not parts of a true oscillation. While there are portions of El Niño and La Niña processes that behave as cycles, those cycles break down, and an El Niño or a La Niña can evolve as an independent event. Further, El Niño and La Niña are not opposites. That's also very obvious in the sea surface temperature records. La Niña is an exaggeration of the normal state of the tropical Pacific, while an El Niño is the anomalous phase. That's why many researchers believe there are only two states of the tropical Pacific: El Niño and "other". Also, over the last 30 years it's rare when a La Niña has been as strong as the El Niño that preceded it. How then could a La Niña counteract an El Niño? Of course, the temperature records also show a multidecadal period when La Niña were as strong as El Niño, and it's no coincidence that global surface temperature did not warm during it.

El Niño events cause catastrophic events around the globe. At the bottom of page 5 of the World Meteorological Organization (WMO) document **The 1997/98 El Niño Event in Brief** is a small table, replicated below. They're grim statistics about the 1997/98 El Niño, citing the U.S. NOAA Office of Global Programs:

"The Global Assessment"

Direct loss	US$34 billion
Mortality	24 thousand
Morbidity	533 thousand
Displaced persons	6 million
Affected persons	111 million
Land affected	56 million acres

Curiously, two terms are absent from that 1999 WMO document: "global warming" and "climate change". However, they do include a subheading on page 2 that reads "A recurring pattern of climate extremes", which is an excellent representation of the global weather responses to El Niño and La Niña.

Further, a very strong El Niño like the one in 1997/98 is capable of temporarily raising global surface temperatures more than 0.4 deg C (about 0.7 deg F) over a 12-month period, and for some reason, many climate scientists claim such an event has no long-term aftereffects. This means those scientists have failed to account for the warm water that is redistributed after a strong El Niño and for the effects those leftover warm waters have on global climate. Those aftereffects are blatantly obvious once you know they exist.

An El Niño and his sibling La Niña can cause flooding in some parts of the world, droughts in others—blizzards in some areas, record low snowfalls elsewhere. The strong storms they produce erode coastlines. They can suppress the development of tropical cyclones (hurricanes) in some parts of the globe and enhance the conditions for their development in others. It should go without saying that they cause heat waves and cold spells depending on the season and location. These causes and effects have been known for decades. Recently, however, a few headline-seizing climate scientists, with the help of mainstream media and blogs, have now redirected the blame for those weather events to carbon dioxide and other greenhouse gases.

Specialized weather models, those used to predict whether the next event will be an El Niño or a La Niña, still can't forecast the upcoming phase more than a few months in advance, yet they've been trying for decades. By the time the models get the phase right, precursors of the El Niño or La Niña have happened and the event is underway. The lack of a reasonable prediction time is really not the forecasters' fault. Mother Nature has created a "springtime prediction barrier", which limits the forecasting range of the models used to predict El Niño and La Niña events.

At the other end of the spectrum, there are the climate models used by the Intergovernmental Panel on Climate Change (IPCC). Those models are not able

to simulate the coupled ocean-atmosphere processes associated with El Niño and La Niña events. Needless to say, if El Niño and La Niña events had long-term effects on global surface temperatures, those impacts would not be simulated by the IPCC's climate models. As this book will plainly show, El Niño and La Niña events, when they're large enough, can and do have long-lasting effects on global surface temperatures.

Uh-oh. I've mentioned a political entity twice. Now some people will think this book was motivated by politics. They're wrong. Only political people believe the global warming debate is centered on partisan politics. They understand what drives them and think others are focused the same way. Me? I am not a political person, far from it. My motives are simple. They are to educate readers about the processes driving El Niño and La Niña events, to present the plainly evident long-term reverberations of those events, and to correct the misunderstandings about the processes that cause those long-lasting effects—misunderstandings manufactured and sustained by those who misrepresent the causes of global warming.

Also, I'm simply using IPCC to represent the group of activist climate scientists who have been very successful at convincing a very gullible public that anthropogenic greenhouse gases, primarily carbon dioxide, are the primary cause of global warming, when they clearly are not. IPCC is much easier to write.

The IPCC uses climate model simulations of global surface temperatures with and without radiative forcings from manmade greenhouse gases to show that the warming of global surface temperatures for the past three decades could only be simulated by the models that included anthropogenic greenhouse gases. For the IPCC, this provided irrefutable proof that greenhouse gases were responsible for the warming. To the general public, however, it suggested another possibility. If climate models without radiative forcings from greenhouse gas couldn't simulate the warming, then those assumption-based climate models might be seriously flawed. This book, using the outputs of the climate models used by the IPCC, confirms that they are in fact flawed. Climate models show no skill whatsoever at being able to simulate the ocean processes that produced the warming of global sea surface temperatures for the past 3 decades.

Maybe the IPCC should examine the sea surface temperature records for the past 30 years. Why? They do not agree with the IPCC's conclusions. Satellite-based sea surface temperature records show El Niño and La Niña are responsible for most of the warming of global sea surface temperatures over the past 3 decades. That fact shows up plain as day in sea surface temperature records. It's tough to miss. It really is. Maybe the IPCC has overlooked it intentionally.

Who Turned on the Heat? includes detailed introductions to El Niño and La Niña and how those phases interact with temperatures globally and regionally. Therefore, even if the processes of El Niño and La Niña are new to you, the background information allows you to confirm what's described and illustrated by the data herein.

Who Turned on the Heat? uses observations-based data, not climate models, to illustrate where and how ENSO is capable of raising global sea surface temperatures over periods of 10, 20, 30 years and more. Because land surface air temperatures are basically along for the ride, mimicking the variations in sea surface temperatures, ENSO can be said to be responsible for most of the warming of global land plus sea surface temperatures for the past three decades as well.

El Niño and La Niña events are often described as the "unusual" warming (El Niño) and cooling (La Niña) of the surface of the eastern tropical Pacific Ocean. They happen every couple of years, so there's really nothing unusual about them. In fact, based on the NOAA's **Oceanic NINO Index (ONI)**, official El Niño and La Niña months occurred about 55% of the time since 1950. Also, scientists who study historical changes in climate (paleoclimatologists) have presented evidence that El Niño and La Niña events were occurring 3 to 5 million years ago. See **Watanabe et al (2011)**. In other words, not only do El Niño and La Niña events occur often, they've been around a long, long time.

El Niño and La Niña are siblings, Mother Natures' mischievous but mighty children. Contrary to popular beliefs, they do not counteract one another. This is also plainly evident in sea surface temperature data. Further, El Niño is usually more powerful than his sister. On the other hand, La Niña can endure for as long as three years, while the stronger El Niño normally lasts for less than one year. Look out, though, when they both decide to test themselves as strong events in sequence, wrestling with global surface temperatures as a tag team. Together they can cause global surface temperatures to shift upwards for a decade, until they act together again as a team and cause another persistent change in surface temperatures around the globe. This happens because of some not-so-subtle differences between La Niña and El Niño phases, a fact that is very apparent once you understand those phases.

To simplify the discussion, *Who Turned on the Heat?* uses the standard acronym ENSO when talking about the process as a whole. ENSO stands for El Niño-Southern Oscillation: El Niño representing the ocean portion of the coupled ocean-atmosphere process, and Southern Oscillation representing the atmospheric side. When discussing the warming events, we'll use El Niño and, likewise, we'll use La Niña when discussing what are often described as the cooling events. However, La Niña is much more than a cooling event as you shall discover. Other than ENSO, very few acronyms are used in the text to make it easy to read and understand.

ENSO is misunderstood, modeled poorly, and misrepresented. Some climate scientists and statisticians present ENSO in ways that mislead those who study global climate change—and mislead those who make policy decisions based on those scientific studies. Example: those scientists and statisticians would like you to believe an ENSO index represents the process of ENSO and all of its aftereffects. The reality: Using an ENSO index in that way is like trying to do a play-by-play analysis of a soccer game from the overhead view of one goal. Those climate scientists and statisticians, claiming that ENSO only creates noise in the global temperature record, use that ENSO index in their simplistic attempts to remove the effects of so-called ENSO noise from the global surface temperature data. They then proclaim the remaining global warming is caused by anthropogenic greenhouse gases. Their misguided efforts are, to put it in simple words, nonsense.

Climate models used by the Intergovernmental Panel on Climate Change (IPCC) cannot match the sea surface temperature records that show how often and how strongly ENSO events have occurred since 1900. Climate models can't even simulate the ENSO events since the start of the recent warming period in the mid-1970s. However, the models need to be able to mimic the historical instrument-based ENSO records. In fact it's critical that they do, and it's easy to understand why. The strength of ENSO phases, along with how often they happen and how long they persist, determine how much heat is released by the tropical Pacific into the atmosphere and how much warm water is transported by ocean currents from the tropics toward the poles. During a multidecadal period when El Niño events dominate (a period when El Niño events are stronger, when they occur more often and when they last longer than La Niña events), more heat than normal is released from the tropical Pacific and more warm water than normal is transported by ocean currents toward the poles—with that warm water releasing heat to the atmosphere along the way. As a result, global sea surface and land surface temperatures warm during multidecadal periods when El Niño events dominate. They have to. There's no way they cannot warm. Conversely, global temperatures cool during multidecadal periods when La Niña events are stronger, last longer and occur more often than El Niño events. That makes sense too because the tropical Pacific is releasing less heat and redistributing less warm water than normal then.

The IPCC's climate models are allegedly used to determine the causes of the past warming and cooling of global surface temperatures, and they are employed to project global surface temperatures into the future based on a number of assumptions. Here's a simple but realistic way to look at the climate models: Climate models show how surface temperatures would warm IF they were warmed by manmade greenhouse gases. The truth is, the Earth's oceans do not respond to manmade greenhouse gases as the modelers have assumed. The sea surface temperature records show the global oceans couldn't care less

about a little back radiation from anthropogenic greenhouse gases. While global sea surface temperatures have definitely warmed over the past 3 decades, there is no indication that additional infrared radiation from increased concentrations of carbon dioxide caused the warming.

For example: the climate models simulate all ocean basins warming at basically the same rate. To contradict that, the sea surface temperature data shows:

1. 33% of the surface area of the global oceans, an area that occupies more than half of the largest ocean basin, hasn't warmed in 30 years. Naturally created warm waters from below the surface of the western tropical Pacific slosh into this area during an El Niño, and they slosh back out when it's over. On the other hand,
2. 53% of the surface area of the global oceans warms only during major El Niño events and does not cool proportionately during the La Niña events that follow them. The lack of cooling during the La Niña is attributable to the warm waters left over from the major El Niño. When the warm water sloshes back out of the ocean basin (1.) above, it has to go somewhere, and it winds up in this large part of the global oceans. And,
3. An ocean basin that represents about 14% of the surface area of the global oceans has an additional mode of natural variability that has caused it to warm significantly more than the other ocean basins over the past 30 years, but it's "cycle" is close to reaching its peak, if it hasn't already attained that peak, and it will soon begin to warm less than the other ocean basins, if not cool. Paleoclimatological data shows this basin has warmed and cooled in this fashion for thousands of years.

Climate modelers missed (or purposely suppressed in the models) a very basic reality. ENSO is a variable source of naturally created and released thermal energy, and because their climate models can't simulate it, the scientists who rely on those models cannot determine if past long-term warming and cooling of global surface temperatures are actually the results of manmade greenhouse gases. That fact will become very obvious to you while reading this book.

Examples of climate model problems: Most of the climate models used by the IPCC in their 2007 4th Assessment Report (AR4), in addition to the failings already discussed, have multiple flaws with how they simulate the natural processes taking place in the tropical Pacific. They have difficulties simulating precipitation, cloud cover, downward shortwave radiation, trade wind speeds and location, etc., which are all interrelated and associated with El Niño-Southern Oscillation. Climate models tend to make La Niña events as strong as El Niño events, while in the real world, starting in the late 1970s, El Niño events have tended to be stronger than La Niña events. Recently, though, they've been working their way back to a regime when El Niño and La Niña are more equally weighted. It is well known that El Niño and La Niña events are tied to the seasonal cycle with both phases peaking around December, but this

is not the case in all climate models. These problems and others are discussed and documented in numerous scientific studies, and those problems are presented within these pages. Hopefully, if I've done my job, by the time you reach that chapter, you will have a sufficient background in El Niño-Southern Oscillation to understand why those are major problems in climate models.

Who Turned on the Heat? relies on observational data (satellite-based sea surface temperature records primarily) for the discussions of El Niño and La Niña events and for the presentations of their long-term impacts on global surface temperatures. More to the point, this book presents data in very simple and logical ways that allow the data to show you how and why it has warmed. This cannot be done by looking at data on a global basis. It has to be broken down into logical subsets. I've limited that breakdown to four regions.

The data is presented in graphs. Many people have little need to study graphs as part of their daily routine, so they may have a little difficulty interpreting them. For those readers, I've included easy-to-read, entry-level discussions about the types of graphs presented in this book, how linear trend lines are calculated and why they're important.

Very basic, non-technical terms are used in *Who Turned on the Heat?* to introduce and explain the coupled ocean-atmosphere processes that are part of ENSO events. Don't let the phrase "coupled ocean-atmosphere processes" scare you. Those events may appear complex at first due to the number of variables and due to the interactions between those variables, but in reality the processes that drive El Niño and La Niña events are relatively easy to understand. You may need to study the discussions in Sections 1 and 3 a couple of times, that's to be expected, but eventually it will all fall into place. That little light above your head will click on, you'll snap your fingers and say, *Now I get it*! Of course, I'm available to answer questions at my blog **Climate Observations** if something just won't click.

Some of you have searched through the hundreds of web pages that describe ENSO and you're still having trouble understanding it. There's nothing unusual about that. The descriptions at some websites are vague and under illustrated; at others, the descriptions are overly complex and under illustrated. This book details the processes of ENSO with fundamental descriptions and illustrations, taking the key features of many presentations around the web and merging them. One thing for certain about this book: it is well illustrated.

The biggest problem with most descriptions of ENSO is their use of the word opposite when discussing El Niño and La Niña. They are not opposites. They may have opposing effects on weather in certain parts of the globe, but in others their effects are cumulative. *Who Turned on the Heat?* presents the multiyear aftereffects of specific ENSO events that are clearly visible in the instrument-based records.

Who Turned on the Heat? presents data to confirm that El Niño and La Niña events are natural processes, that they are phenomena Mother Nature has devised to vary the rate at which naturally stored thermal energy (in the form of warm water) is released by, and renewed in, the tropical Pacific Ocean. Very simply, after reading this book, you'll understand why global surface temperatures warm during multidecadal periods when El Niño events are stronger, last longer, and occur more often than La Niña events and why the opposite occurs when La Niña events dominate.

We'll compare satellite-based sea surface temperature data for the past 30 years to the outputs of the climate models used by the IPCC for their 4th Assessment Report. You'll quickly understand that climate models have no skill at being able to simulate the observed warming of sea surface temperatures. No skill at all.

Why is that important?

1. Surface temperatures are the metric most often used to describe global warming (that makes sense because we live on the surface),
2. Sea surface temperatures are the metric used for the surface temperatures of the global oceans,
3. The oceans cover about 70% of the surface of our planet Earth,
4. Land surface air temperatures (representing the other 30%) mimic and exaggerate the changes in sea surface temperature, so,
5. If the climate models show no skill at being able to reproduce the sea surface temperature records of the past 30 years, both globally and on an ocean-basin basis, there is no reason to believe the models have any use as a tool to project future climate globally or regionally. No reason whatsoever to believe them.

Proponents of anthropogenic global warming, after reading one of my blog posts that discuss and illustrate the long-term effects of ENSO, often try to redirect the discussion to a dataset called ocean heat content, claiming that Mother Nature can't explain the warming of the global oceans below the surface layers. They're wrong, of course. The warming of the global oceans can be explained by natural variables. One simply has to divide the global oceans into logical subsets in order to show it. This and other failed arguments by proponents of manmade global warming are presented in *Who Turned on the Heat?*

There have always been problems with the hypothesis of anthropogenic global warming and there still are. A big problem with it: how can downward longwave radiation (infrared radiation associated with greenhouse gases) have any impact on the surface and subsurface temperatures of the global oceans when infrared radiation can only penetrate the top few millimeters of ocean surface? For those readers not familiar with metric measurements, 2

millimeters is less than 3/16 inch. This book shows that greenhouse gases do not have a measureable impact the surface and subsurface temperatures of the oceans. This implies that the infrared radiation from manmade greenhouse gases only adds to the evaporation at the ocean surface, as many oceanographers and physicists have stated all along. Manmade greenhouse gases may impact land surface temperatures, but they should now appear far down on the list of contributors to the warming there.

A few of the chapters from my first book have been rewritten and expanded in the Preliminary Discussions (Section 2) of this book. However, the vast majority of the discussions in this book are new. I've provided more detail on the transitions between ENSO-neutral, El Niño, and La Niña phases. I've presented why and where global sea surface temperatures should decline during a multidecadal period when La Niña dominates the ENSO record, something we haven't seen during the satellite era. Many of the topics covered in these pages have never been discussed in my blog posts.

I've added notes to most illustrations to highlight what's important, with hope of reducing the amount of time you, the reader, need to study them. Some of you will likely skim through the illustrations the first time through, just to get a feel for the subject matter. Hopefully, you'll then go back and read the rest of the book.

This book relies on data from satellites that measure sea level, precipitation, cloud cover, sea surface temperature, temperatures of the atmosphere at a given altitude, etc. We use the 1997/98 El Niño and the three-year La Niña event that followed it for many of the discussions. That El Niño was the strongest event the 20th Century, strong enough to overcome the normal weather noise that hinders the study of lesser events. In this book, I've also illustrated and discussed how minor El Niño events are not the same as the major events.

Who Turned on the Heat? as mentioned above, is well illustrated. In includes more than 380 graphs, color-coded maps, and annotated illustrations (cartoon-like depictions) of the process of ENSO. If you're wondering why the pdf edition of this e-book is about 22MB, it's all of those color illustrations. They are intended to help readers understand how ENSO functions and how it is responsible for the warming of global sea surface temperatures over the satellite era—the last 30 years. There are more than 300 hyperlinks to scientific papers; meteorological-, oceanographic- and climate science-related websites; blog posts; animations; etc., to support and further document ENSO.

One last group of notes: I only present quick looks at the history of ENSO research in this book. There are no equations provided in it. There are no pictures of **Gilbert Walker** or **Jacob Bjerknes** who, among others, helped form our current understanding of ENSO. If you're looking for equations and a

detailed history of ENSO research, this is not the book for you. This is basically a show-and-tell book that describes and illustrates the many facets and aftereffects of the ENSO process using publicly available data. I've attempted to make this as easy to understand as possible, but it is a somewhat complex subject. For those looking for more in-depth discussions, I have also covered a multitude of ENSO details—beyond the basics. Please read the table of contents.

If you're a graduate student or a research scientist looking for an e-book that includes detailed theoretical discussions of the physics of ENSO processes with equations, you'll want to look elsewhere. On the other hand, if you're interested in a detailed, easy-to-read and well-illustrated overview of ENSO, then *Who Turned on the Heat?* should satisfy your needs. *Who Turned on the Heat?* should help you understand the natural processes that can and do explain the vast majority of the warming of global sea surface temperatures over the past 3 decades.

Let's jump right into it with a description of the ENSO process with annotated (cartoon-like) illustrations.

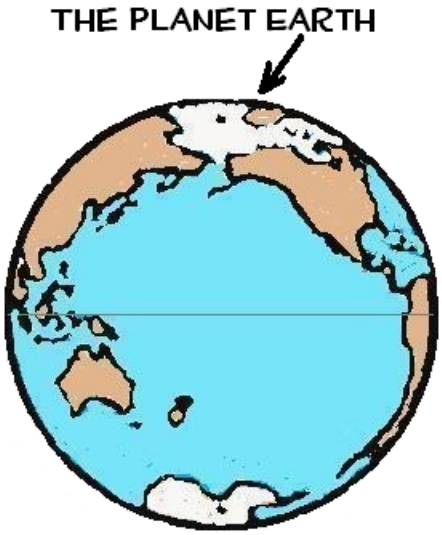
Section 1 - A Description of El Niño and La Niña Events Using Annotated Illustrations

1.1 Preliminary Discussion of the ENSO Annotated Illustrations

Most introductions to the El Niño-Southern Oscillation (ENSO) on the web include boiler-plate descriptions and three illustrations: one each for El Niño, La Niña and ENSO-neutral phases. The reader has to jockey back and forth, scrolling up and down, to read the text and compare it to the illustrations. Unfortunately, much of what's discussed in the text of those ENSO introductions isn't shown in the graphics. To overcome that, I've prepared a 29-cell series of annotated (cartoon-like) illustrations that first introduce readers to background information about the Pacific Ocean. There are also introductions to trade winds and ocean currents, both of which have important roles in ENSO. With multiple cartoon-like illustrations for each phase and the transitions between them, the reader is taken through a complete cycle of ENSO phases: ENSO neutral to El Niño, back to ENSO neutral, on to La Niña, and then back to ENSO neutral. At each phase, the interaction between sea surface temperatures across the tropical Pacific, trade winds, sea surface height, precipitation and subsurface ocean temperatures are illustrated and discussed. Also presented are the differences between El Niño and La Niña events and the reasons why global surface temperatures vary in response to ENSO events.

To reinforce and confirm what's presented in this section, Section 3 includes more-detailed, data-reinforced descriptions and illustrations.

1.2 The ENSO Annotated Illustrations



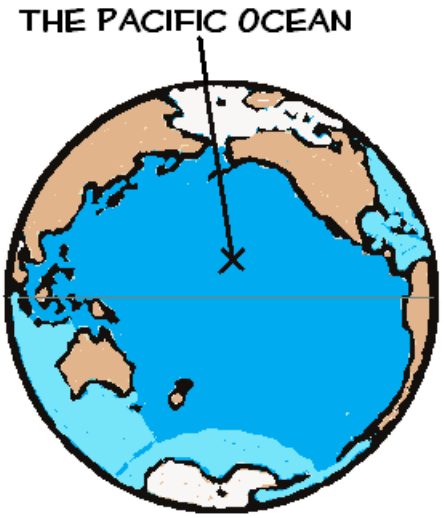
THE OCEANS COVER ABOUT 70% OF OUR PLANET.

IT'S IMPORTANT TO UNDERSTAND HOW THE LARGEST OCEAN, THE PACIFIC, PERIODICALLY RELEASES ADDITIONAL HEAT TO THE ATMOSPHERE AND REDISTRIBUTES THAT HEAT WITHIN THE OCEANS.

FIRST, A FEW PRELIMINARIES.

Figure 1-1 Bob Tisdale

HHH



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

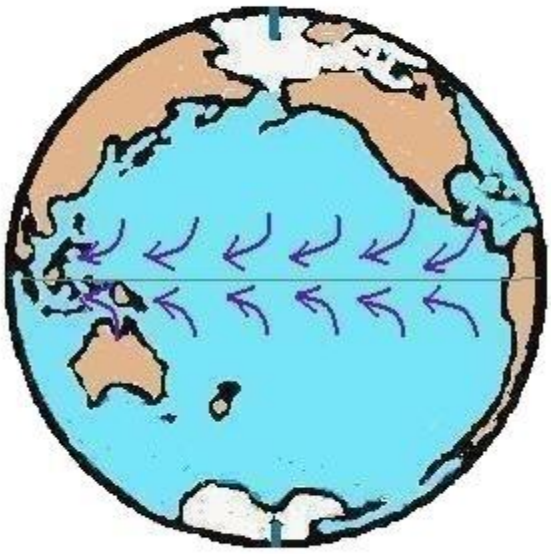
IT COVERS THE SURFACE OF THE PLANET FROM ASIA TO NORTH AMERICA AND FROM AUSTRALIA TO SOUTH AMERICA.

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

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

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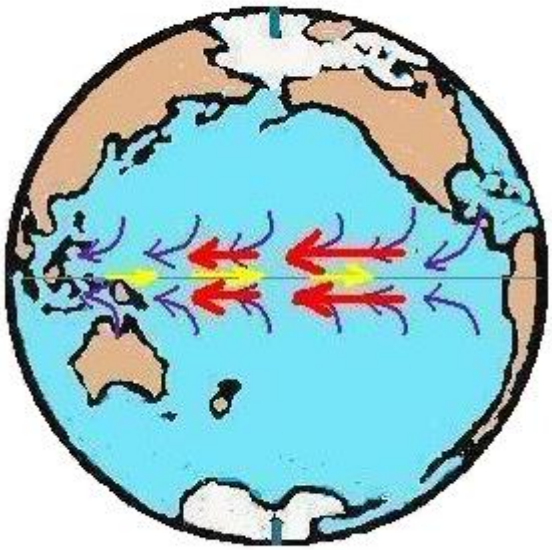
OCEAN CURRENTS



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

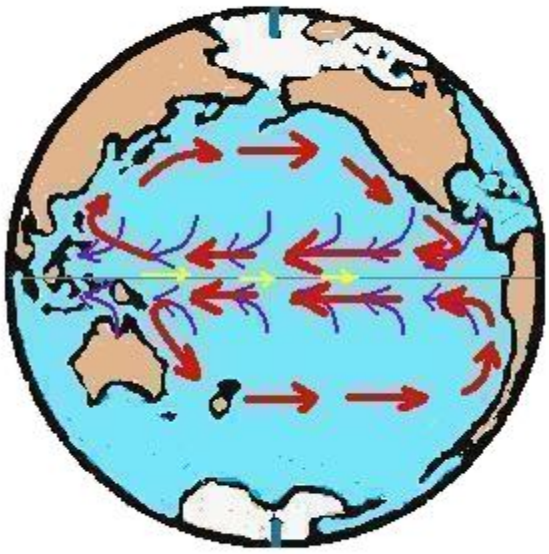
THE CURRENTS NEAR THE EQUATOR ARE CALLED THE NORTH AND SOUTH EQUATORIAL CURRENTS. THEY CARRY WATER FROM EAST TO WEST.

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

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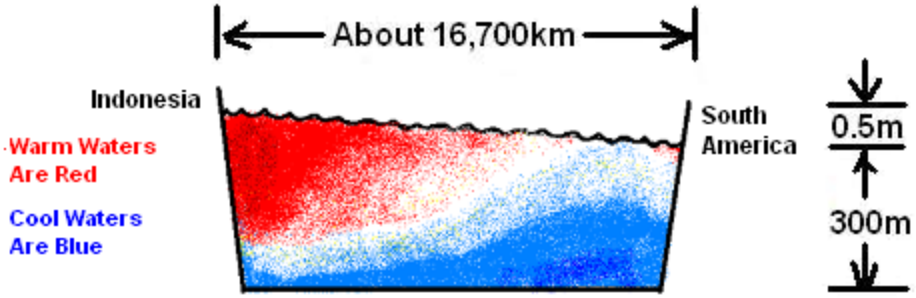
INTRODUCTION TO THE CROSS SECTION OF THE EQUATORIAL PACIFIC OCEAN USED IN MANY OF THE GRAPHICS THAT FOLLOW



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

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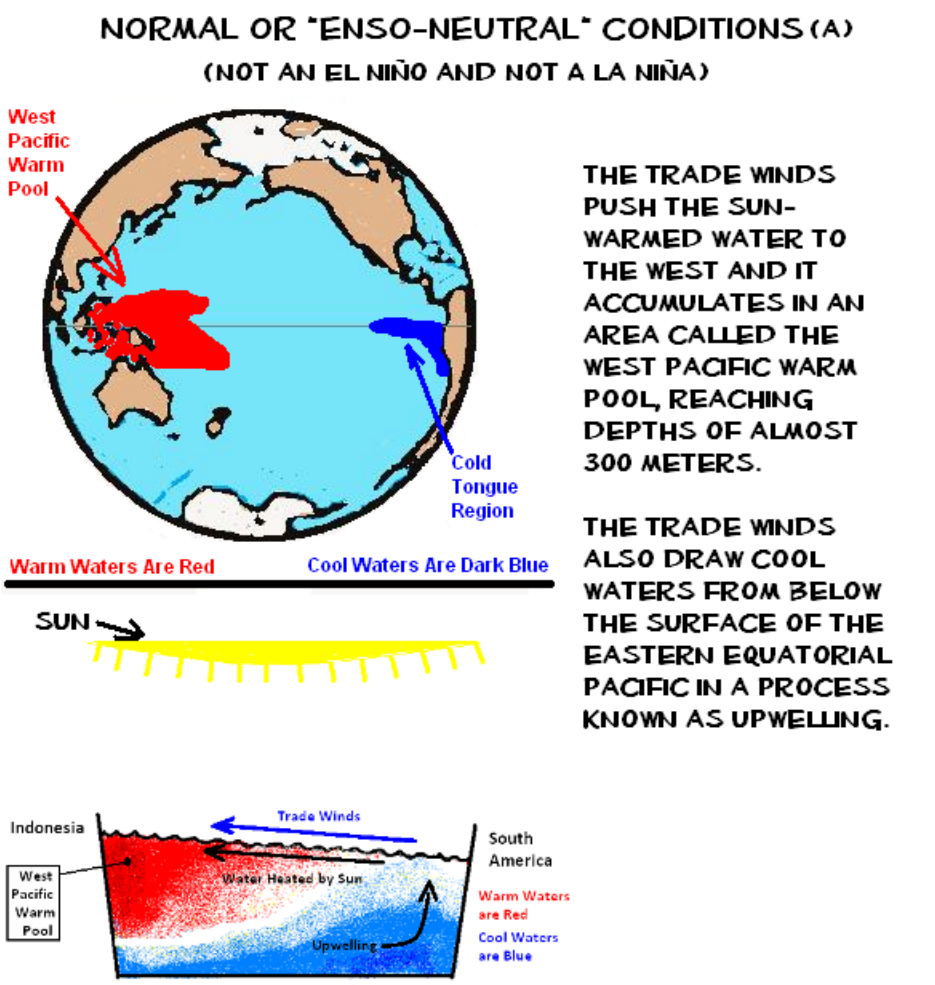

Figure 1-7 Bob Tisdale

HHH

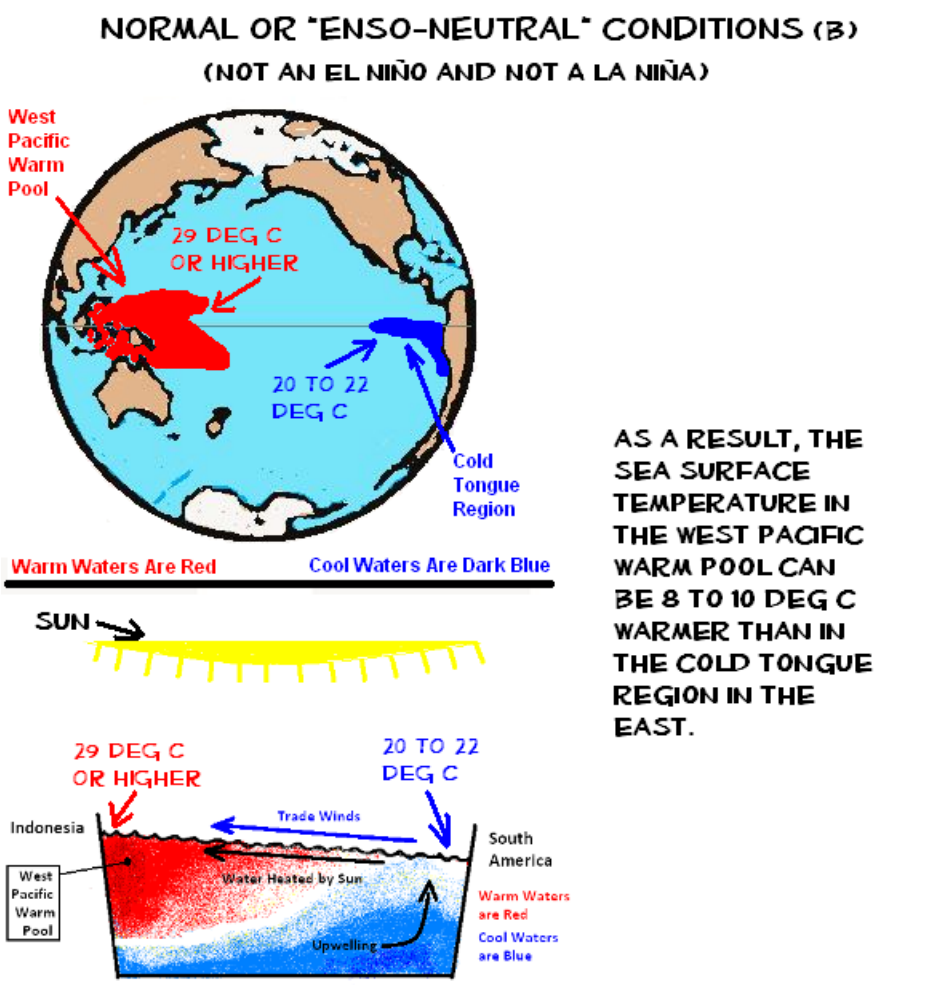

Figure 1-8

Bob Tisdale

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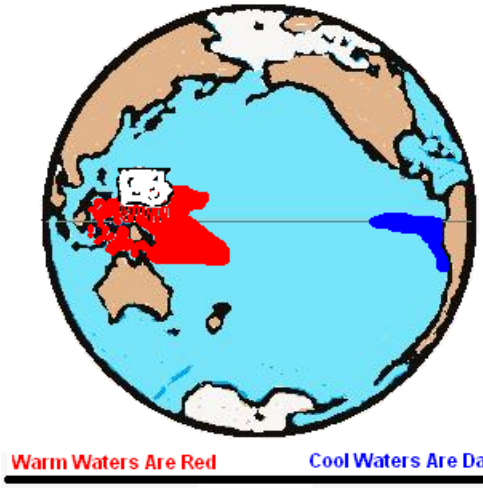
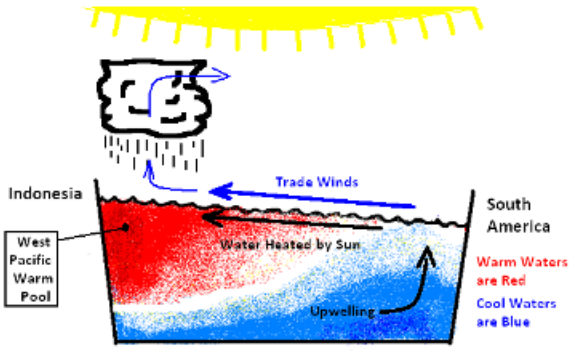
NORMAL OR "ENSO-NEUTRAL" CONDITIONS (C)

(NOT AN EL NIÑO AND NOT A LA NIÑA)





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.

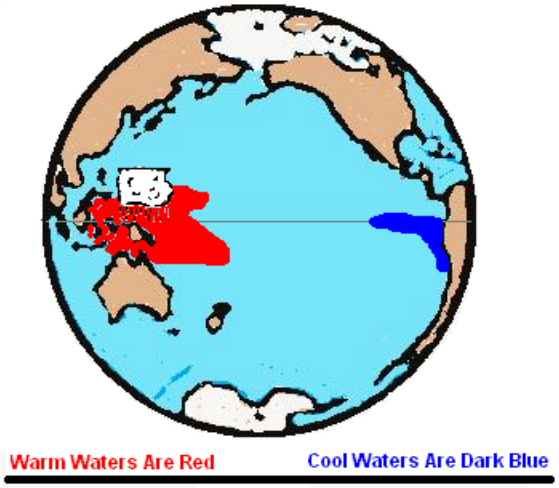
Figure 1-9

Bob Tisdale

HHH

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.

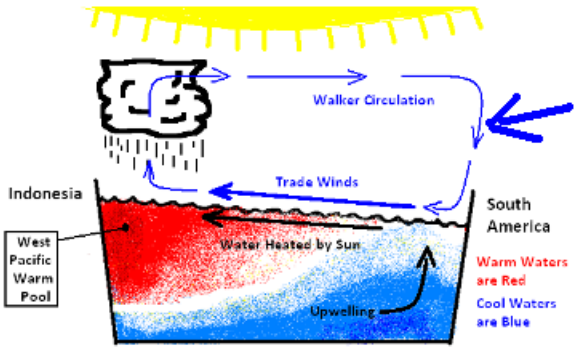


Figure 1-10 Bob Tisdale

HHH

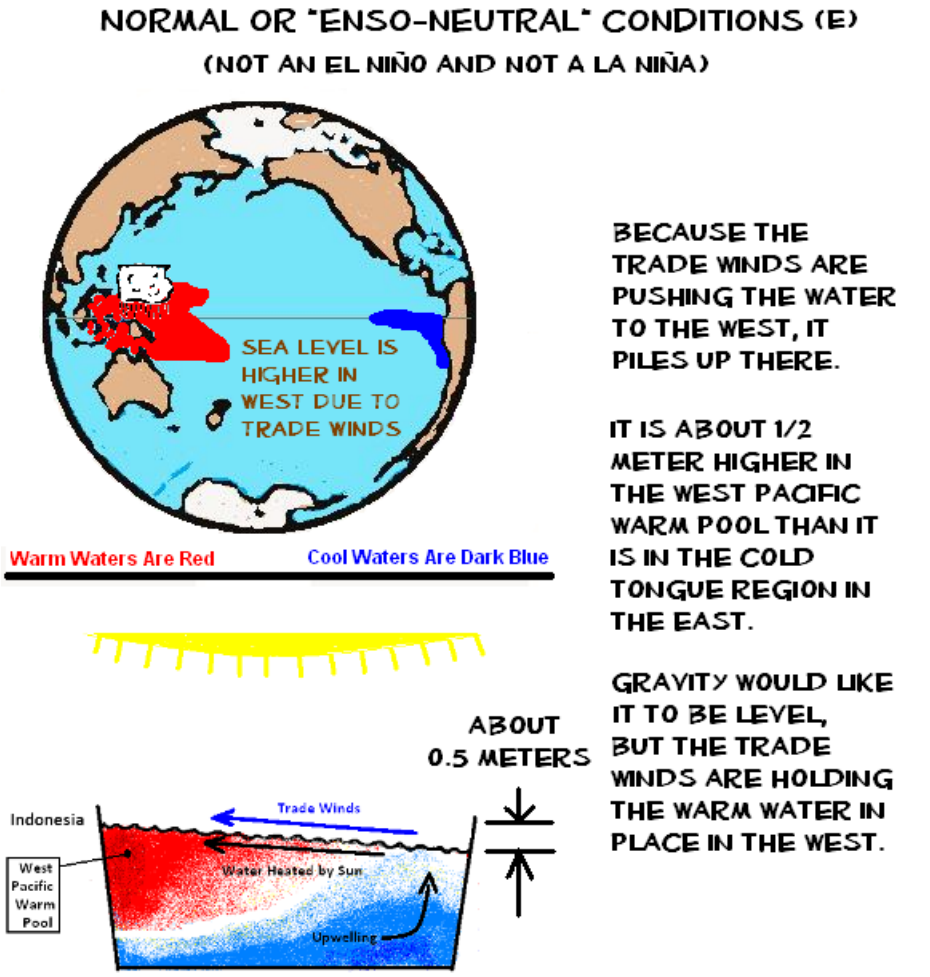


Figure 1-11

HHH

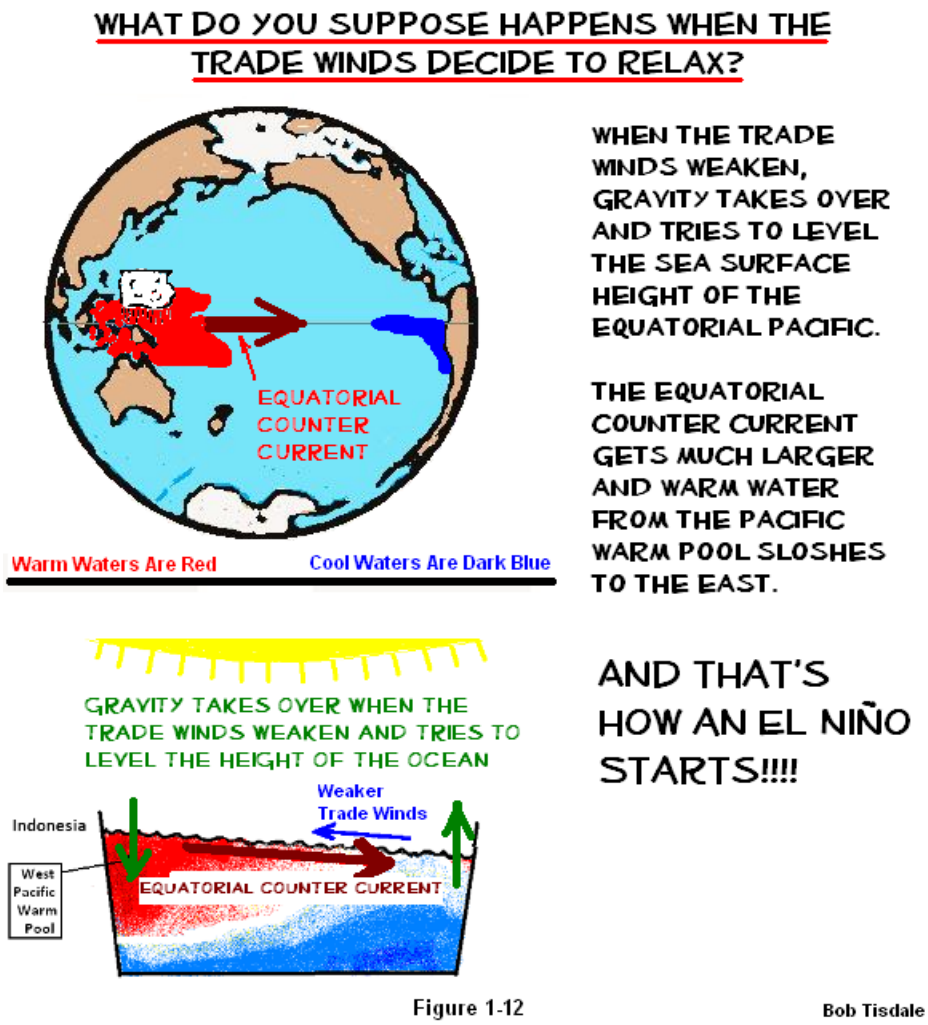


Figure 1-12

Now's a good time to take a quick break from the cartoon-like illustrations. We'll go into more detail in Section 3 about the interrelated processes taking place before an El Niño, but it's important now to reinforce what's been discussed so far. I'll reword the presentation a little with hope that it will help make things click for you.

The trade winds are an important part of our discussion of ENSO-neutral, or "normal", conditions in the tropical Pacific. They blow from east to west across the surface and cause the surface waters to also travel from east to west. That makes sense. If you blow on a liquid long and hard enough, the surface of the liquid will move it the direction you're blowing.

The trade winds also blow clouds toward the west. That's not hard to imagine, either. This allows that wonderfully strong tropical sun to beat down on the surface of the tropical Pacific and to reach into the subsurface waters to depths of 100 meters. Though most of that sunlight is absorbed nearer the surface, in

the top 10 meters (roughly 33 feet) or so, it does reach farther. All of Mother Nature's glorious sunlight warms the tropical Pacific waters as they travel west.

The trade winds push the waters up against the land masses of Indonesia and Australia. This causes the warm water to, in effect, pile up in the western tropical Pacific, in an area called the west Pacific Warm Pool. The trade winds driving the westward movement of surface waters also draw cool waters from below the surface of the eastern equatorial Pacific, in a process called upwelling. That upwelled water provides a continuous source of cool water at a relatively constant temperature that's then warmed by the sun as it travels west. The water is, therefore, cooler in the eastern equatorial Pacific, in an area called the Cold Tongue Region, than it is in the west Pacific Warm Pool. Remember, the tropical Pacific stretches almost halfway around the globe, so that nice cool supply of water in the east travels a long way under the tropical sun before it reaches the warm pool in the west.

The trade winds cause the temperature difference between the east and west portions of the tropical Pacific. Now, here's the interesting part. The temperature difference between the eastern and western tropical Pacific causes the trade winds to blow. That's right. The temperature gradient of the tropical Pacific sea surface temperatures and the trade winds interact with one another in a positive feedback loop called Bjerknes feedback.

Why does that happen?

There nothing mysterious going on. The warmest water is in the western tropical Pacific. We've discussed that, and we'll confirm it in Section 3. The warm water there heats the air above it, and that relatively hot air rises. All of that rising hot air has to be replaced by other air, and it's the trade winds out of the east that supply the necessary make-up air. Because the tropical Pacific is cooler in the east, the air sinks there, and eastward-blowing upper winds complete the circuit. Overall, the warm air rises in the west; it cools as it's carried east by the upper winds; then it sinks in the eastern tropical Pacific, where it heads back to the west as the trade winds. That circuit is called a Walker cell. The trade winds continuously push cool water from the east to the west, sunlight warms the water as it travels west, and when that warm water reaches the west Pacific Warm Pool, it supplies the heat necessary to maintain the updraft, which, in turn, causes to trade winds to blow. The briefest way to explain it: the trade winds and the sea surface temperatures are coupled, meaning they interact with one another.

With all of that warm water being piled up in the western tropical Pacific, and with all of the cool water being drawn from the eastern equatorial Pacific, the surface of the water—the sea level—in the west Pacific Warm Pool is about 0.5 meters (approximately 1.5 feet) higher in elevation than it is in Cold Tongue Region in the east.

Everything's in tune, running in its normal state. The temperature difference between the east and west keeps the trade winds blowing—and—the trade winds maintain the temperature difference between east and west—and—the trade winds keep the warm water in the west Pacific Warm Pool at a higher elevation than it is in the eastern equatorial Pacific.

We can't forget about gravity. It's always there, our constant companion. Gravity would like the sea surface height in the west to equal the height in the east. It likes level playing fields. It's working against the trade winds, and the trade winds are piling up the warm water against gravity. Still, everything is in relatively constant state of balance, with little gives and takes here and there.

Then some weather event—and that's precisely what it is, a weather event or group of weather events—causes the trade winds to relax. That means the coupled ocean-atmosphere processes taking place in the tropical Pacific are no longer in balance. Sometimes, the weakened trade winds aren't strong enough to hold the warm water in place in the west Pacific Warm Pool against gravity, so gravity takes over and all of that lovely warm water that was piled in the west Pacific Warm Pool suddenly sloshes to the east. That's how an El Niño starts.

I'm now going discuss parts of the process that haven't been shown in the illustrations yet.

The Pacific Ocean is awfully wide at the equator, so it takes a while, about 2 months, for the warm water to slosh to the east as far as the coast of South America.

Let's put things into perspective. The west Pacific Warm Pool holds a massive amount of warm water. It varies in size. When it's large, the west Pacific Warm Pool can cover a surface area of about 19 million square kilometers (7.3 million square miles) but it averages about 12 million square kilometers (4.6 million square miles). Numbers that large are hard to embrace, so, when the west Pacific Warm Pool is larger than normal, think of an area the size of Russia or a little less than twice the size of the United States. Refer to the Mehta and Mehta (2004) presentation **Natural decadal-multidecadal variability of the Indo-Pacific Warm Pool and its impacts on global climate**. Also imagine the warm water reaches depths of 300 meters (about 1000 feet). Sometimes, during a very strong El Niño, most of that water from the west Pacific Warm Pool will be transported east and much of it will spread across the surface of the central and eastern tropical Pacific. Now remember that the Pacific stretches almost halfway around the globe at the equator. An El Niño dwarfs all other weather-related events. How big are they? Sometimes it takes a pair of tropical cyclones just to trigger an El Niño. Yes, tropical cyclones as in hurricanes.

Let's return to the ENSO-neutral phase for a second. A weather event—for example, a couple of tropical cyclones or a pair of them that straddle the equator—a weather event that's teeny by comparison, has caused the Pacific trade winds to relax, which in turn has unleashed a monstrously large phenomenon that is capable of raising global temperatures 0.4 degrees C in less than a year. In turn, there are heat waves and cold spells. Floods will strike some parts of the globe. Drought conditions form in others. Snowfall will pile to record heights in some areas, and in others it will decrease. These effects were studied and documented decades ago, and they're still being studied, for example, to account for differences between Central Pacific and the more powerful East Pacific El Niño events.

ABOUT THE COVER

The cover art is a Hovmöller diagram of the sea surface temperatures (not anomalies) for the Equatorial Pacific (120E-80W) from November 1981 to June 2012. It was created at the KNMI Climate Explorer. The x-axis is longitude. The west Pacific Warm Pool is to the left. The Cold Tongue Region is to the right. The y-axis is time in months from November 1981 (bottom) to June 2012 (top). The contour levels of the temperature scale range from 27 to 30 deg C. See illustration below. For the cover, I rotated it 90 degrees clockwise, then tweaked the colors a little, before adding the title, subtitle and name.

The Cover Artwork Is A Hovmöller Diagram Of The Sea Surface Temperatures Of The Equatorial Pacific From Nov 1981 to Jun 2012

It Was Rotated 90 Deg Clockwise And Cropped To Isolate The Diagram

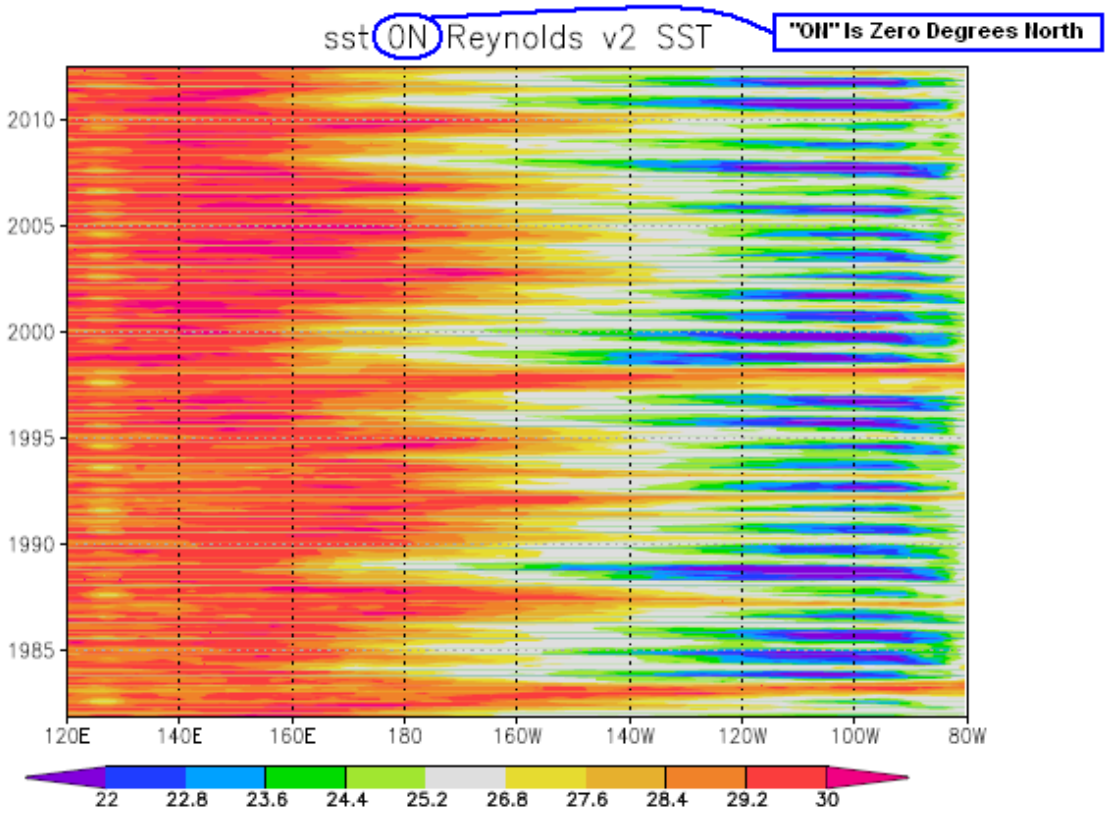


Image Created At The KNMI Climate Explorer
http://climexp.knmi.nl/selectfield_obs.cgi?someone@somewhere

Figure ATC-1 **Bob Tisdale**

As shown below, sea surface temperature anomalies for the equatorial Pacific (5S-5N, 120E-80W) have cooled at a rate of -0.047

Deg C per decade for the period of November 1981 to June 2012, which is the time span of that satellite-based dataset.

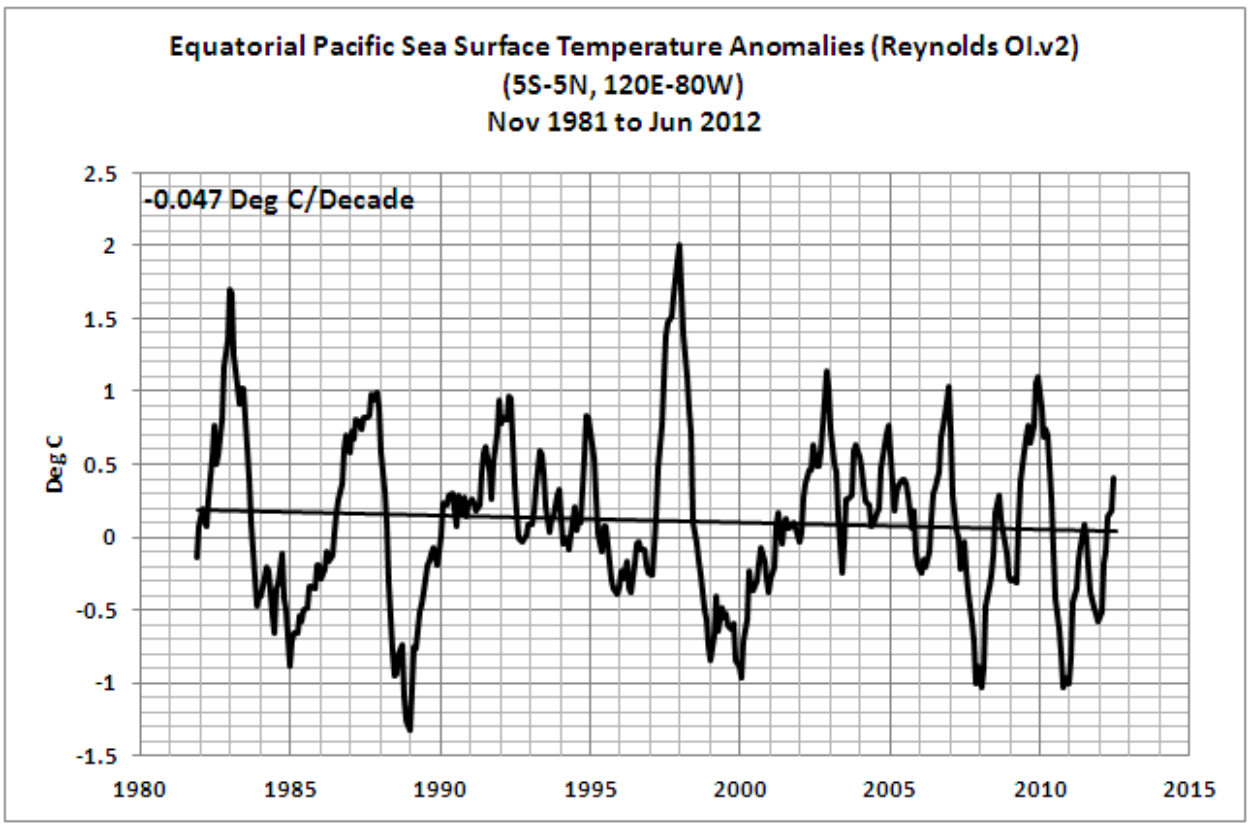


Figure ATC-2 Bob Tisdale

CLOSING

Thanks for buying *Who Turned on the Heat? - The Unsuspected Global Warming Culprit, El Niño-Southern Oscillation*—a book about the phenomenon called the El Niño-Southern Oscillation. *Who Turned on the Heat?* also detailed the contributions of the El Niño-Southern Oscillation to the global warming of the past 30 years, the satellite era of sea surface temperature data. I find the mechanism Mother Nature created to vary the rate at which heat is distributed from the tropics to the poles extremely interesting, and I hope this book ignited your interest as well.

Proponents of anthropogenic global warming, after reading the book from cover to cover, might conclude that I did not disprove the hypothesis of manmade carbon dioxide-driven global warming, and they're correct. I even admitted that within these pages. It's likely anthropogenic greenhouse gases have had an impact on the additional warming of land surface air temperatures that's above and beyond the warming attributable to the natural warming of the global oceans. That additional land surface air temperature warming, however, has also been caused by land-use change, the urban heat island effect, poor surface station siting, overly aggressive corrections to the land surface temperature records, black carbon, aerosols, etc.

However, this book clearly illustrated and described the following:

1. The sea surface temperature and ocean heat content data for the past 30 years show the global oceans have warmed. There is no evidence, however, that the warming was caused by anthropogenic greenhouse gases in part or in whole; that is, the warming can be explained by natural ocean-atmosphere processes, primarily ENSO;

2. The global oceans have not warmed as hindcast and projected by the climate models stored in the CMIP3 and CMIP5 archives, which were used, and are being used, by the IPCC for their 4th and upcoming 5th Assessment Reports; in other words, the models cannot simulate the warming rates or spatial patterns of the warming of the global oceans; and,

3. Based on the preceding two points, the climate models in the CMIP3 and CMIP5 archives, which are used by the IPCC, show no skill; that is, the climate models provide little to no value as tools for projecting future climate change on global and regional levels.

Many thanks to Roger Knights, for his guidance on the title of this book.

Last, thank you again, reader, for your interest in *Who Turned on the Heat? - The Unsuspected Global Warming Culprit, El Niño-Southern Oscillation.* If you

have any questions, please ask them on any thread at my blog **Climate Observations**

Sincerely,

Bob Tisdale