

stratosphere. But it's not true.

There was also a paper on the ozone hole given at the 1992 meeting in Hawaii, and the researchers showed that the ozone hole in Antarctica developed immediately after the sulfur gases from Pinatubo and from Mt. Hudson in Chile reached the Antarctic stratosphere. . . .

Interview: Hugh W. Ellsaesser

El Niño is really a normal situation

Dr. Ellsaesser, one of the world's most respected atmospheric scientists, retired from the U.S. Air Force after 20 years as an Air Weather Service officer, and from the Lawrence Livermore National Laboratory after 23 years of atmospheric and climate research. He was interviewed by Elijah Boyd of 21st Century Science & Technology.

Q: What is the current situation or the general situation of an El Niño?

Ellsaesser: There are a number of misconceptions about El Niño, even among the scientific community. It is a warming of the eastern Pacific Ocean, and an El Niño is regarded as an abnormal situation; actually, El Niño is a normal situation. It's what happens to the temperature, if you do not have the trade winds causing upwelling. The easterly trade winds cause the surface water to move toward the east, and that brings into play the Coriolis force, which causes them both to move poleward; that causes a sucking up of the cold water from below. That is a normal situation. The El Niño is brought on by a weakening of the trade winds, and we don't know what causes that. It's difficult to model, from that point of view.

But the weakening of the trade winds stops the upwelling of the cold water, and therefore allows the surface water to warm back to its normal temperature. But that normal temperature which occurs during the El Niño, is a degree or two or three warmer than what we see regularly, which we consider to be normal. That causes several things to happen. It causes the main updraft of the convective cells in the Pacific to move from the Indonesia region, out to the Dateline in the mid-Pacific, and it causes the normal subsidence of the western coast of the Americas to cease or to be reversed, so that we start having updrafts on the eastern Pacific, rather than the western Pacific. So, we get rains in Peru which are very un-

usual, and in California, which are relatively unusual, in certain seasons at least.

They tell me that this [El Niño] is expected to be actually warming more rapidly than the record one of 1982, which is the past one I referred to. I have not been watching any current data, so I can only tell you what I read in the papers like the rest of you, on the current situation.

Q: How do you assess what has been going on, especially since most people have the situation backwards?

Ellsaesser: In any model studies, they start the model off with the temperature, the change in the surface temperature of the ocean. In other words, they consider that to be the perturbing force. The actual perturbing force is what precedes it: the weakening of the trade winds. But, a weakening of the trade winds is something which is very difficult to put in a model. . . .

But it is very easy to change the surface temperature of the ocean, so they can make model studies of that. But I've always been concerned about what the model does with that, compared to what the actual atmosphere does, because of the weakened trade winds, which start the whole thing.

Q: What about the recent results of the NASA experiment called SOHO, which sort of radar-mapped the Sun?

Ellsaesser: There might be some similarities in the physics involved, but I'm not familiar enough with what's going on in the Sun to comment, other than that. But, I see no reason to think that the Sun is involved in what's happening here, other than that the normal flux of sunlight is what warms the ocean's surface, back during the El Niño, towards what would be its normal temperature.

If you look at the Climatological Mean Maps, you see this cold water in the eastern Pacific along Peru and along the Equator, but it is cold, because of the upwelling which is occurring. But, the upwelling is occurring because of the easterly trade winds, and when those weaken, then the upwelling stops, and the water warms back up to its normal temperature, as it would if that sunlight were received and not counteracted by the upcoming cold water. In that sense, it's related to the Sun; not to any change in the Sun, but through the normal flux. . . .

If you look at the global maps of sea surface temperatures, you find that in most of the oceans, the isotherms are pretty much east-west—that is, pretty much close to the latitude circles; but there are certain areas in which they are not, and one of them, of course, is the Gulf Stream. It's rather amazing, that in the Gulf Stream they're never displaced more than about five degrees of latitude from a normal position. . . .

But, if you look in the northeastern Atlantic, around the Spitzbergen region, you find that the temperatures there are very much higher than they are anywhere else at those latitudes in the ocean.

In other words, the temperature pattern is very much disturbed from what you would anticipate from the normal solar flux. That accounts for the mild climate of Europe, and the fact that the isotherms between Europe and Asia are almost north-south, rather than east-west, as they are elsewhere.

The other places where you find these non-east-west isotherms are in the southeastern Pacific, where the El Niño occurs; and during the El Niño, we go back toward the normal situation of east-west isotherms, or closer to it. With the El Niño, we have north-south isotherms off the coast of South America, and the coast of California. You can see from looking at it, that something abnormal is going on, and it's due to cold water which is brought on primarily by upwelling, and somewhat from the currents from the polar direction. El Niño is a situation which causes that to relax back to the normal situation, which we would anticipate with the normal solar flux.

The viewpoint you get from most people is to consider the El Niño as abnormal and the other as normal; but it's the other which is abnormal, and the El Niño which is closest to normal.

Interview: James O'Brien

Nothing to do with global warming

Dr. O'Brien is the director of the Center for Ocean-Atmospheric Prediction Studies (COAPS) at Florida State University. He gave this comment to Elijah Boyd of 21st Century Science & Technology.

El Niños have been going on forever. We can trace them in corals back a thousand years, so they have nothing to do with global warming, or anything like that. I just wanted to get that straight, because there was a meeting in the Congress today, some idiots, namely Kevin Trindberg at NCAR [National Center for Atmospheric Research], kept saying that because this is the biggest one, this year, that it's due to global warming. I hate this stuff. . . . There have been bigger ones; it's the second biggest one this century, but we certainly can find bigger ones in the last century.

The mainstream of knowledgeable scientists who understand both the ocean and the atmosphere, would tell you that this is an unstable but self-limiting oscillation between the

atmosphere and the ocean, and depending on if they are more of an oceanographer or more of an atmospheric scientist, they'll tend to give one of the fluids more credit than the other. The equatorial Pacific Ocean has a sloshing mode that's very close to being right around four years, to go between high, and high again.

The meteorologists, who have lots more data, because they have an international data network, continue to search for trigger mechanisms: strange things coming out of the Indian Ocean, air flowing out of the Tibetan plateau, or strange things coming up along the east coast of Australia, and triggering it—and things like this, or Bill Gray's favorite, the Biannual Oscillation.

None of these things ever seem to work out, in a strict observing mode. What seems to happen, sometime between February and June, is that the western Pacific will have anomalous winds from the west. They can show up in more active storms near the Equator; this kicks up Kelvin waves. If the two fluids interact to amplify this, then, you end up with a warm event. These westerly winds are usually not way over at the boundary, so they actually trigger a Rossby wave going the other way, and the round trip. . . . Let me put it this way: The Kelvin waves that come in from the westerly wind burst lower the thermocline in the eastern tropical Pacific, and it destroys the local heat balance and the thing warms up; but, there is a reflected wave off the South American continent which takes about nine months to go back; it then reflects back, and in the reflecting back, it's the opposite sign, it'll tend to shut the event off. That's why it is self-limiting to little more than a year.

The biggest lie about El Niño, is that the warm water in the western Pacific, west of the Dateline, is transported to Galapagos and Peru.

There is some invective which occurs in the mid-ocean, accounting for the warming, in the eastern third of the ocean. It's basically the normal situation; the thermocline is thin, on the order of 50 meters, and the wind is stirring down heat, or, as the oceanographers say, it is bringing up cold water, keeping it relatively cool, and when the Kelvin wave lowers the thermocline, that mechanism is inefficient, and so it warms up. That gives you the start of warm events, but you also have to get the cold events in there. So, it becomes a difficult pattern. There have been theoretical papers, proposing what is called the Delayed Oscillator, which basically invokes that slower-moving westward Rossby waves, occurring around 10 degrees north or south, take a couple of years to get across. It is a believable mechanism, that when you weaken the trade winds, in an anomaly sense, you will get a Rossby wave of the opposite sign, and it takes about two years to get across, and when it gets across, it'll trigger a cold event. So, if the warm events are big enough, we call them El Niño, and if the cold events are big enough, we call them, most of the world calls them, La Niña. I call them El Viejo, the old man. . . .