These solar astronomical cycles are what determine the Earth's climate, not any man-made emissions, and it is on the basis of these cycles that we can definitely say there is no global warming. Until the early 1970s, climate scientists thought in terms of 100,000-year, or at least 10,000-year cycles, which corresponded to the advancing glaciation of an Ice Age and the warmer, interglacial periods, respectively. Climate scientists also were talking about *global cooling,* because the evidence indicated that the Earth was coming out of a 10,000-year interglacial period and on the way to a new Ice Age. Although Malthusian ideology intervened to shift the climate funding and research to "global warming," because it was more scary,[5] the fact remains that we are in an interglacial period that has already lasted beyond the 10,000-year average.

A study of El Niño, its causes and effects, presents scientists—and the public—with a chance to understand the real and complex forces that shape the Earth's climate. *EIR* intends to continue this series in order to help that process of understanding.

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[5] See the statement of Dame Margaret Mead, who convened a meeting of scientists on "The Atmosphere: Endangered or Endangering," in November 1975, in Rogelio A. Maduro, "Orbital Cycles, not CO_2, Determine Earth's Climate," *EIR,* May 16, 1997, p. 10.

Interview: Robert E. Stevenson

The ocean is full of nonlinear structures

Oceanographer Robert Stevenson is a consultant based in Del Mar, California, who trains NASA astronauts in oceanography and marine meteorology. He was secretary general of the International Association for the Physical Science of the Oceans from 1987-95, and worked as an oceanographer for the U.S. Office of Naval Research for 20 years. He was interviewed by Marjorie Mazel Hecht.

EIR: You have described large structures in the oceans, and in the atmosphere, that cannot be modelled on a computer. So what are the climate modellers doing with the oceans?

Stevenson: They have bypassed going out into the world to learn what the world is about, because they can now do computer models, which are no good anyway, because everything you are trying to model in nature is nonlinear. You can't model nonlinearities. Everything we do, everything that exists on Earth and in life, is nonlinear.

EIR: You have a wonderful collection of photographs of the oceans taken from the Space Shuttle. What are some of the discoveries you made from looking at these photos in the early Shuttle days?

Stevenson: I think that the discoveries that are clearly significant, to oceanography and to what we understand about the ocean, were those of the spiral eddies, number one, because they represent scales of motion, scales of turbulence in the ocean, that are smaller than the 150 km diameter eddies that people had known about before (like the Gulf Stream rings), and they are larger than ocean waves and very tiny turbulence.

The eddy scale is 15 to 30 km in diameter, which we now call a sub-mesoscale—a scale that nobody knew about before. We learned that these eddies represent motion down to depths of as great as 300 meters, but mostly down to about 150 meters; that they are ubiquitous, everywhere in the ocean, except near the Equator, because near the Equator, the effect of the rotation of the Earth's Coriolis disappears, but then comes in again on the other side, but going the other way. You're not going to have rotational forms right over the Equator. We haven't been able to find any of these within 7 degrees of either side of the Equator, although the astronauts have looked very hard.

Number 2 was the discovery of solitons, that is, solitary groups of waves that have lengths of about 10 km and heights—in the ocean, not on top of the ocean—of from 300 to 500 meters. On the surface they just make a little ruffle, so that's how we can see them in the Sun's reflection pattern. These solitons—which are different from solitons in physics and solar physics—travel as a group at speeds up to 10 knots (about 14 miles per hour) forward through the ocean. As a consequence, anything that gets in their way—they're big waves—gets wiped out.

For example, Exxon had floating oil-drilling platforms in the Andaman Sea, which is on the eastern side of the Bay of Bengal. These huge platforms were torn loose from their moorings and carried several tens of miles through the sea, before the waves went past them and they were left floating 50 miles from where they started.

We know that solitons exist primarily in enclosed bodies of water, like the Mediterranean Sea, the Andaman Sea, where the enclosure is islands, and in the seas in Southeast Asia and around Indonesia and the Philippines, and places like that, where you have openings between the islands, and you get a big pulse—or it may be a storm, or just the tides—giving a push to the water between islands, and this will start these things going.

Then, finally, there are things that the Russians call *suloys*. These are boundaries of pieces of water that are moving in the ocean. They are either rotating, like boundaries of a large eddy, or they are boundaries of water which are moving through the ocean. For example, the peak wave of a soliton would be called a *suloy* on the surface by the Russians.

All three of these things represent that sub-mesoscale of motion, so they introduced into oceanography an energy field which no one had recognized before. This has been the biggest change in oceanography in the last 50 years, the fact that the kinetic energy in the ocean is primarily within these meso and sub-mesoscale features. Up into the 1970s, everybody thought that all the kinetic energy was bound up in ocean currents. So this was a dramatic change.

EIR: What does the existence of these structures imply for climate models that involve the oceans?

Stevenson: What these features imply in climate models is that because they are turbulent, they are therefore not only involved in kinetic energy, but they are also carrying thermal energy, both up and down. The eddies are carrying thermal energy from below, upward. They are cold down at the bottom, and warm at the top, and so it represents a very distinct patchiness that occurs at the surface of the sea. And if you don't know this patchiness, there is no way you can ever really calculate the amount of thermal energy that is being exchanged between the ocean and the atmosphere.

EIR: Can you model patchiness at all?

Stevenson: You can't even come close to that.

EIR: Briefly, what is the relationship between the oceans, the weather, and climate?

Stevenson: There isn't any question that the very primary climatic features respond to the ocean and not to the land. This is why you get warm climates some places and cold climates in others. When you come to the oceans and weather, that's a totally different question.

When you talk about climatic changes, you are talking about nonlinear things, natural nonlinear activity. And you can't predict nonlinearity, you can't calculate it. The same is true with weather, and the same is true with the ocean and the atmosphere.

Let me point out one thing, when you're talking about El Niño in reference to the weather. And this El Niño that everyone is talking about is really an El Niño event. It's warming in the Pacific, but no other ocean. When we go back in the history, back to when we have reasonably good data on the great, huge, El Niño events, the largest one in the nineteenth century, the largest sequence of events was 1884 through 1891. This was a very large El Niño event. The next largest one was 1982 to 1983.

And what happened just before those El Niños? A huge series of volcanic eruptions. And it's very, very clear.

It does make a great deal of difference as to what is ejected from the volcano. If it's a sulfur-rich volcano, that distinctly results in a warming of the ocean in the tropics, and a cooling, of course, of other parts of the atmosphere. When Krakatoa went off in 1883—which is the biggest eruption that anyone ever talks about—the amount of sulfur ejected into the atmosphere was about 55 megatons—*but,* it did not go into the stratosphere.

Whereas the eruption of El Chicon, in 1982, put up 20 megatons of sulfur and injected it into the stratosphere. That's the difference. The same thing happened in 1912, with Katmai, one of a whole series of volcanoes in the Aleutian Islands. It put up 30 megatons of sulfur, all the sulfur acids and all the sulfur cations came from these volcanoes. But, if it's not a sulfur-rich volcano, then it does not influence the climate, and the atmosphere, and the weather systems.

For example, in very detailed ocean cores, you can't see the eruption of Krakatoa, but you can very easily see the eruption of Katmai, and of Agung in the Indonesia area, because they very clearly were sulfur-rich eruptions.

EIR: Why is that?

Stevenson: Because the sulfur aerosols get into the stratosphere, and they form a layer. They fall very, very slowly. They are not chemically reactive with anything in the stratosphere at 26 km, and so they stay there. In fact right now, there is a strong layer of aerosols between 12 and 26 km, and this clearly came from the eruptions of the Kamchatka volcanos in 1994 and the volcanoes that have erupted and are continuing to erupt in Papua New Guinea in the past two and a half years.

So, El Niños can't be predicted, and they very clearly are a reaction to volcano activity.

EIR: That's not mentioned in the current El Niño stories. . . .

Stevenson: That I understand, because the meteorologists and the climatologists absolutely do not want anybody to understand that, because of course they can't model it. There was a meeting in 1992 in Hilo, Hawaii, on the effects of volcanic activity on the environment and the atmosphere, and so on. Nearly 40% of the papers were on the influence of volcanic eruptions on weather systems, on the ocean, changes in ocean temperature, and on medium-term influence on climate. Those papers were never published, and the final report that was put out by American Geophysical Meeting—it was their meeting, a Chapman Physical Conference, which they run—never mentioned any of those papers, or any one of the scientists who gave those papers.

The climatologists don't like this.

EIR: What about the interaction with the atmosphere? The global warming and ozone-hole proponents are adamant in saying that the chlorine and other gases from the oceans don't reach the stratosphere, or are not important. What's the real picture?

Stevenson: Chlorine and everything else from the ocean gets into the stratosphere in great volumes every day from these towering cumulus, which are like chimneys, that punch right through the tropopause into the stratosphere. There are about 10,000 of these structures going on all the time. There have even been reports from people who send up these balloons with devices that try to screen particles out of the atmosphere, that they have even found portions of microorganisms from the ocean up in the stratosphere. So, don't tell me that chlorine doesn't get up there.

EIR: But the ozone hoaxsters say that natural chlorine doesn't get up there.

Stevenson: They say that the chlorine is hydroscopic, that it hooks up with the water, and rains out before it gets to the

The ocean seen from space

Scientists are using a number of satellites to look at the Pacific Ocean, to examine El Niño.

The latest addition is the SeaStar spacecraft, launched in August by the Orbital Sciences Corp. Onboard SeaStar is the Sea-viewing Wide Field-of-View Sensor developed by NASA. By observing the changes in color in the Pacific Ocean, SeaWiFS will be able to measure the amount of phytoplankton and dissolved organic matter and suspended sediments. Scientists plan to use the data to assess the global impact of El Niño on marine ecosystems, including the coastal waters of the Pacific Ocean.

An older member of the fleet is the Topex/Poseidon satellite, launched in 1992. It is collecting data on ocean topography, including the features of ocean circulation that produce hills and valleys in the sea surface. Topex/Poseidon's radar altimeter studies ocean currents and sea level, and is able to map global sea circulation with an accuracy of 1.8 inches. Every ten days, scientists are able to produce a complete map of global ocean topography, and calculate the speed and direction of worldwide ocean currents.—*Marsha Freeman*

Artist's rendering of TOPEX/Poseidon satellite.

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 unusual, 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.