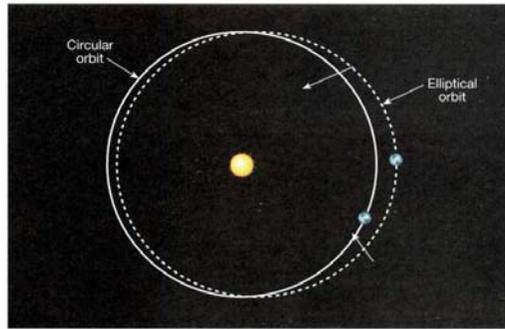


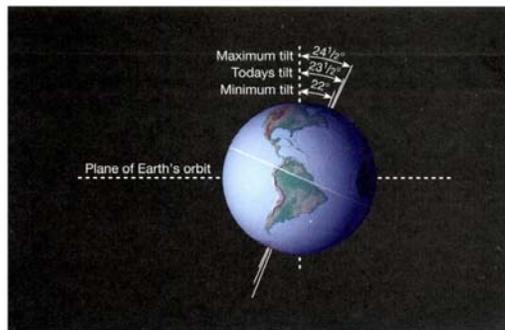
Our Ocean Backyard — *Santa Cruz Sentinel* columns by Gary Griggs, Director, Institute of Marine Sciences, UC Santa Cruz.

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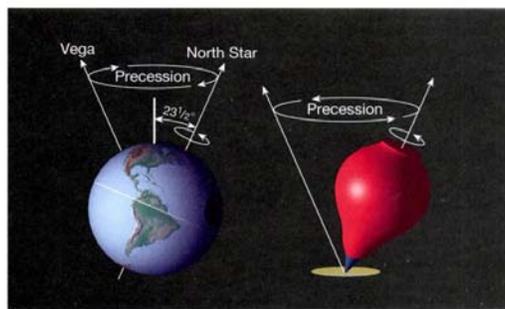
Sunlight and sea level—what’s the connection?



(a)



(b)



(c)

The Milankovitch cycles, which describe the variations in the Earth's orbit around the sun, are the major reasons behind the Ice Ages and climate change of the past several million years.

I feel compelled to first answer the question I ended my last column with because several of you have asked- “*was it ice*”? Is that your final answer? It was ice. The 10,000,000 cubic miles of sea water that were removed from the oceans 20,000 years ago, that lowered sea level 400 feet to expose the offshore continental shelf,

ended up as ice caps and glaciers that covered large parts of North America and northern Europe. Glaciers scoured Yosemite Valley. Seattle was buried under hundreds of feet of ice. Cape Cod consists of all the sand and gravel left behind as the glaciers covering New England melted and retreated, and vast glaciers scoured out the Great Lakes and extended from the North Pole to Kansas.

We have had many periods of glaciation throughout the Earth's history with the last interval beginning about 3 million years ago. Glacial periods have alternated with warmer intervals over time periods of about 20,000 to 40,000 years. During each of the glacial periods the water that formed all that ice came out of the oceans. So sea level has risen and fallen hundreds of feet repeatedly in concert with these periods of glaciation.

The next question is why? Why Ice Ages? Why periods of major climate change, global warming and cooling, way before we had cars and freeway and power plants to produce greenhouse gases? Stay with me here. There are several different factors that together affect whether or not we have an Ice Age and how severe it is. The most fundamental of these, the pace maker so to speak, is the delivery of heat from the sun. And it's not constant, but varies over some well-understood cycles that determine how far the Earth is away from the sun, and therefore how much heat we get.

The Earth's orbit around the sun isn't circular but is an ellipse, so over a period of about 100,000 years we move a little closer to the sun and then get a little farther away, which makes things here a bit warmer or colder. The Earth also tilts slightly on its axis, which produces the seasons. But over a period of about 40,000 years this tilt changes by a few degrees, which also affects the amount of sunlight reaching different parts of the Earth. The third piece of the puzzle is a wobble in the Earth's rotation, which changes over a cycle of about 21,000 years.

These three irregularities in the Earth's orbit have been taking place throughout the 4.6 billion year history of the Earth, and in combination, determine how much heat we receive from that burning mass 93 million miles away. When combined with a few other global changes, like how the continents and oceans are distributed around the planet, the Earth's overall temperature can change by as much as 6 degrees C. This is enough to bring on or end an Ice Age, change sea level by hundreds of feet, and make the difference between walking or sailing to the Farallons.