

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

#213 June 26, 2016

Rising Seas and Submerging Shorelines

Daniel Patrick Moynihan, a four-term U.S. Senator, ambassador, and also an academic at one time, once said: “Everyone is entitled to his own opinion, but not his own facts”. Neil deGrasse Tyson expressed a similar thought: “The good thing about science is that it’s true, whether or not you believe in it”.

These two quotes seem particularly relevant in today’s discussion of climate change. Climate change is not a belief; we don’t get to vote on it, although unfortunately it has become very politicized.

One contributor to this problem is that media of all types often have an apparent need to generate controversy rather than report the science. A single climate change denier is often given the same weight or coverage as 100 climate scientists, with the conclusion being that there is still doubt or controversy so let’s not change our habits.

The science debate is over, and has been over for some time, with 97% of climate scientists agreeing that the warming trends of the past century are caused primarily by human activity. There are simply too many people on the planet generating too many greenhouse gases, which are all trapping more heat.

We can’t release four million tons of carbon dioxide every hour into the atmosphere for decades and not expect some response. The signs and impacts are all around us, although there are some, who for a variety of reasons, often economic, are still in denial.

A former student recently summed it up for me in five two-word sentences: It’s real. It’s bad. It’s us. Scientists agree. There’s hope. Although I would add a few words to the last one- there’s hope, if we start acting now.

We live on a big planet, surrounded by a very large atmosphere and a massive ocean, and we’ve been gradually changing the temperature and chemistry of both for well over a century. The records and history of these changes are diverse, widespread and well documented.

One of these changes that is affecting low-relief coastal regions around the world is sea-level rise. As more of the planet's ice melts, sea level continues to rise higher. Contributing to the rise is the warming of the oceans, which increases their volume, also raising sea level.

Some of the more widely publicized impacts of this increasing rise are the gradual inundation of a number of very low-lying atolls in the tropical Pacific and Indian Oceans. These include the islands of Tuvalu, Tokelau, Palau, the Maldives, Kiribati, Micronesia and French Polynesia, home to about 775,000 people. Many of these are living only a few feet above sea level and now looking for new places to live.

The nations bordering the northern Indian Ocean face similar problems. Seventeen million people in Bangladesh live within five feet of sea level. They are not only being driven inland by rising ocean levels, but are also regularly hit by tropical cyclones. In 1991, a cyclone struck the Chittagong district of Bangladesh with a 20-foot storm surge, killing at least 138,000 people. Twenty-one years earlier in 1970, cyclone Bhola killed nearly 500,000 people, all living very close to sea level.

Neighboring Myanmar's Irrawaddy delta is also very low-lying and very densely populated. Cyclone Nargis made a direct hit on the delta in 2008, passing right through the capital Yangon, taking more than 138,000 lives.

Closer to home, the Mississippi delta is exposed to frequent hurricanes. New Orleans actually lies in a bowl, below the level of the river and Lake Pontchartrain. Hurricane Katrina in 2005 claimed 1,245 lives when levees and floodwalls failed and water filled the bowl.

A combination of groundwater pumping and compaction of delta sediments causes the entire Mississippi Delta region to subside. As a result, sea level is rising relative to land in New Orleans about three times faster than the global rate. You can almost stand there and watch sea level rise at over inch every three years. With a continuing rise in sea level, the risks of flooding are only going to increase.

Along the Atlantic seaboard, a combination of slow land subsidence and a rising sea level are now causing tidal flooding in some streets 30 to 40 days a year in a number of cities, including Washington D.C., Annapolis, Wilmington, Cape May, Atlantic City, Sandy Hook, and Charleston. While called nuisance flooding, it's the

very real impact of sea-level rise on shoreline cities that is projected to increase to 100 days a year in most of these places by 2030.