

Observations at the COP-21 UN Summit on Climate

Global Climate Change and its Impacts upon the Oceans

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by
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The following notes were taken on December 3rd in Paris at an international panel of scientists and representatives from UNESCO, the United Nations Environmental Programme (UNEP) and the French CNRS (National Center for Science Research).

Why are the Oceans forgotten in the discussions about climate change? Oceans cover roughly 71% of the world's surface. They play a major role in shaping the planet's weather patterns and climate. The rise of atmospheric CO₂ is impacting the world's oceans as severely as its climate. The causes are similar to climate change, but there are many distinctively different consequences.

Dr. Jane Lubchenco, former director of the (US) National Oceanic and Atmospheric Administration (NOAA), has characterized ocean acidification as the "evil twin" of global climate change. The impacts on the oceans are both urgent and destructive.

To understand the cause, some history is helpful. Before large scale industrialization, the concentration of carbon dioxide in the atmosphere was roughly 275 parts per million (ppm). As fossil fuel use increased, that number has risen to now over 400 ppm and this level is continuing to rise up into higher concentrations at a rate of about 2 to 3 ppm per year.

Ocean scientists calculate that the ocean is absorbing one quarter to one third of the increasing levels of CO₂. When CO₂ desolves into ocean water, it forms carbonic acid. As a result ocean waters are becoming more acidic. By measurement, ocean water is now about 30% more acidic than prior to industrialization. About half of the anthropogenic (human caused) CO₂ in the ocean is found in the upper 400 meters (1,200 feet) of the ocean water column, while the other half has penetrated into the lower thermocline and deep ocean. Density- and wind-driven circulation help mix the surface and deep waters in some high latitude and coastal regions, but in most of the open ocean, deep pH changes are expected to lag surface pH changes by a few centuries.

Rising acidification is important because it affects marine organisms, especially those that build shells and skeletons from calcium carbonate. Thus corals, oysters, clams, mussels, snails, phytoplankton and zooplankton (the tiny creatures at the base of the marine food chain), crabs and lobsters are affected. So are the fish, birds and mammals higher on the food chain that rely on these creatures for food. Already plankton levels in parts of the Pacific are at greatly reduced levels. Thus starving seal and sea lions are coming ashore frail and skinny as food sources are sharply down. Higher acidity levels are causing algae blooms in some areas. This is responsible for toxic conditions arising in crabs and some shellfish. Sea mammals are becoming sick and in some cases dying.

These effects and many others are being observed in many marine creatures around the world. This is especially true in tropical and deep-sea corals. They are showing reduced ability to calcify coral under increasingly acidic conditions. The impact on corals is of concern because they produce reefs that provide habitat for important fish and shellfish species.

Coral reefs are vital as sources of food and medicine, as protection from storms, and as the basis for eco-tourism. In addition to corals, acidification impairs the ability of plankton - at the base of the food chain - to build and maintain shells. Marine biologists already observe increased larval mortality in key fish and shellfish species.

Ocean acidification is now occurring 30 to 100 times faster than at any time in the past several million years – because of the corresponding rapid rise of atmospheric CO₂. This is unprecedented in geological history. According to the Intergovernmental Panel on Climate Change (IPCC), economic and population

scenarios predict that atmospheric CO₂ levels could reach 500 ppm by 2050 and perhaps higher by the end of the century – IF nations and people fail to restrain the use of fossil fuels. This will lead to higher temperatures in the atmosphere and ocean, but it will also further acidify ocean water. If we do not reduce CO₂ emissions, this will push ocean pH to an estimated 150 percent increase in acidity over preindustrial levels. At that level, many oceans species will no longer be able to survive. This shows how climate change becomes an important moral and ethical issue as the survival of many species is at stake.

If society continues in a “business-as-usual” scenario, IPCC models of ocean biogeochemistry scientists project that surface waters will become highly corrosive to the shells and skeletons of marine calcifiers like planktonic marine snails known as pteropods.

Warmer ocean waters will cause storms to become stronger and winds more intense. Storm surges from tropical storms will become larger and this will inundate many coastal areas previously above the water line. Wind patterns will shift and agriculture may be adversely affected in some areas. New patterns of rainfall will emerge – in some cases more intense, and in others bringing less rain and even drought. These changes are already emerging.

Although ocean acidification has only recently emerged as a scientific issue, it has quickly raised serious concerns about its many impacts on marine organisms and the long-term health of the ocean.

Many other ocean issues exist:

Overfishing is reducing the quantities of ocean fish while ocean acidification is reducing the bottom of the food chain. Some methods of fishing such as industrial scale trawlers which drag huge nets along the sea bottom are destroying deep corals and ruining spawning grounds while depleting forage fish. Without top predators and with a declining bottom of the food chain, some scientists claim the oceans could fill with unpalatable jellyfish.

Massive fields of plastic waste and trash are emerging in a dozen gyres across the world's oceans, mostly at the centers of the ocean's slow swirling currents.

The laws of the sea are poorly defined and even more poorly adjudicated. This remains an essential area for further definition. This is a field out on the frontier of international law.

Ocean mining of minerals from gold to manganese to rare earth minerals is growing and causing new types of underwater pollution. For the future health of the oceans these minerals must be left on the seabed. Thousands of oil wells already exist and tap fossil fuels below the sea floor. These wells often leak oil, sometimes in large quantities as has happened in the North Sea and the Gulf of Mexico.

The rise of ocean sea level will become a major issue. Bangladesh is already in serious danger. With over a hundred million citizens living close to sea level, plans are being frustrated for places to relocate. India is building barriers to hold off a suspected flood of refugees. The Canary Islands with 8 million residents and often 12 million tourists in summer is another low-lying location in jeopardy. Residents of numerous low lying Pacific Islands already foresee the need to flee as they are experiencing more violent storms and increasing periods of coastal flooding. Their hope is to be able to migrate from their ancestral islands with dignity. In an already crowded world, this is not always easy.

Because nations can expect several feet of ocean rise by 2050 cities in France and Italy will see flooding along coastal areas. In the U.S., over 400 coastal towns and cities can expect flooding. These include major Eastern and Southern cities such as Miami, New Orleans, Galveston in the southeast, and on the Atlantic coast Camden, Newark, New York City, and Boston. On the West Coast San Diego, San Pedro, Santa Monica, Oakland, San Francisco, Seattle and others are projected to experience sea rise. This will displace tens of thousands of people who live near the water. Where will these domestic refugees go?

In France regulations far-sightedly already prohibit new coastal development within four kilometers of the ocean.

Questions

A discussion arose about how to end subsidies for fossil fuel corporations since we now understand how harmful carbon dioxide is for the world. Discussion examined how this problem might be moderated if governments could eliminate subsidies for fossil fuel development. In France companies such as Total, Eni, BP and others, as a legacy of the past, still receive government assistance. (In the U.S., oil and gas development subsidies amount to about \$37 billion annually - over \$10 per citizen.) A removal of government subsidies would raise the price of fossil fuels and make clean alternative energies more competitive. (What came into focus is the irony of how some U.S. legislators will propose free market solutions but who will readily dispense with their principles to provide lucrative government welfare for already wealthy oil and coal corporations.)

Despite all of these issues, the COP21 climate negotiations are not yet developed enough to include these ocean issues. They will surely become a larger topic of discussion in the near future.

