

Aquatic 'dead zones' contributing to climate change

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The increased frequency and intensity of oxygen-deprived "dead zones" along the world's coasts can negatively impact environmental conditions in far more than just local waters. In the March 12 edition of the journal *Science*, University of Maryland Center for Environmental Science oceanographer Dr. Lou Codispoti explains that the increased amount of nitrous oxide (N₂O) produced in low-oxygen (hypoxic) waters can elevate concentrations in the atmosphere, further exacerbating the impacts of global warming and contributing to ozone "holes" that cause an increase in our exposure to harmful UV radiation.

"As the volume of hypoxic waters move towards the sea surface and expands along our coasts, their ability to produce the [greenhouse gas](#) nitrous oxide increases," explains Dr. Codispoti of the UMCES Horn Point Laboratory. "With low-oxygen waters currently producing about half of the ocean's net nitrous oxide, we could see an additional significant atmospheric increase if these 'dead zones' continue to expand."

Although present in minute concentrations in Earth's atmosphere, nitrous oxide is a highly [potent greenhouse gas](#) and is becoming a key factor in stratospheric [ozone destruction](#). For the past 400,000 years, changes in atmospheric N₂O appear to have roughly paralleled changes in carbon dioxide CO₂ and have had modest impacts on climate, but this may change. Just as human activities may be causing an unprecedented rise in the terrestrial N₂O sources, marine N₂O production may also rise substantially as a result of [nutrient pollution](#), warming waters and [ocean](#)

[acidification](#). Because the marine environment is a net producer of N₂O, much of this production will be lost to the atmosphere, thus further intensifying its climatic impact.

Increased N₂O production occurs as dissolved oxygen levels decline. Under well-oxygenated conditions, microbes produce N₂O at low rates. But as oxygen concentrations decrease to hypoxic levels, these waters can increase their production of N₂O.

N₂O production rates are particularly high in shallow suboxic and hypoxic waters because respiration and biological turnover rates are higher near the sunlit waters where phytoplankton produce the fuel for respiration.

When suboxic waters (oxygen essentially absent) occur at depths of less than 300 feet, the combination of high respiration rates, and the peculiarities of a process called denitrification can cause N₂O production rates to be 10,000 times higher than the average for the open ocean. The future of marine N₂O production depends critically on what will happen to the roughly ten percent of the ocean volume that is hypoxic and suboxic.

"Nitrous oxide data from many coastal zones that contain low oxygen waters are sparse, including Chesapeake Bay," said Dr. Codispoti. "We should intensify our observations of the relationship between low oxygen concentrations and nitrous oxide in coastal waters."

More information: The article "Interesting Times for Nitrous Oxide" appears in the March 12, 2010 edition of the journal *Science*.

Provided by University of Maryland

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