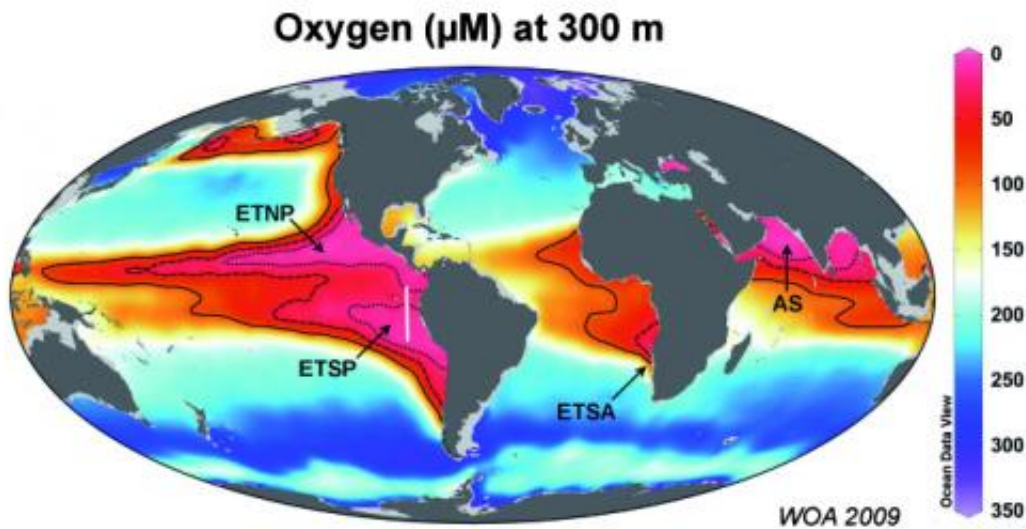


# Scientists identify key factor that controls ocean nitrogen availability

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Oceanic oxygen minimum zones. Depicted is the oxygen concentration at 300 meter water depth. Around 30- 50% of global marine N-loss takes place in these areas, which represent only ca. 0.1% of the ocean's volume. Credit: Image is modified after World Ocean Atlas 2009 [nodc.noaa.gov](http://nodc.noaa.gov)

(Phys.org)—During an expedition to the South Pacific Ocean, scientists from the Max Planck Institute for Marine Microbiology in Bremen, along with their colleagues from the GEOMAR and Christian-Albrechts University in Kiel, discovered that organic matter derived from decaying algae regulates nitrogen loss from the Ocean's oxygen minimum zones. They published their discovery in the renowned scientific journal *Nature Geoscience*.

One of the central aims of today's marine research is to better predict the response of our Ocean to global warming and human activity in general. Understanding of the oceanic [nitrogen cycle](#) is of key importance in this effort as nitrogen is the limiting nutrient for life in the Ocean. Its bio-available form (so-called fixed nitrogen, such as ammonium) is produced biologically from nitrogen gas by bacteria or is transported to the ocean as dust or river run-off. However, due to the activity of marine microorganisms growing in virtually oxygen free conditions, this fixed nitrogen is rapidly converted back to [nitrogen gas](#), which escapes from the Ocean to the atmosphere. There are two processes, which are mainly responsible for this nitrogen loss: denitrification and anammox ([anaerobic oxidation](#) of ammonium with nitrite), both performed by [anaerobic bacteria](#).

Up to 40% of global oceanic nitrogen loss occurs in so-called oxygen minimum zones (OMZ), which are areas with low to non-measurable oxygen concentrations. "The eastern tropical [South Pacific](#) OMZ is one of the largest OMZs in the world," explains Tim Kalvelage from the Max Planck Institute for [Marine Microbiology](#), the first author of this study. "We assumed that if we could identify and constrain the parameters that regulate N loss from this OMZ, we could better predict the N loss from all OMZs, and possibly from the Ocean, as well." Professor Andreas Oschlies of GEOMAR Kiel and speaker of the Collaborative Research Centre SFB 754 adds: "This research is fundamental for improving our current biogeochemical models that, so far, cannot reliably reproduce the patterns of N loss that we measure."

As a part of the German National Research Foundation (DFG) funded SFB 754 a series of expeditions onboard of the research ship Meteor in 2008/2009 were specifically dedicated to collect samples from the South Pacific OMZ. Further analyses and measurements followed in the laboratories of the Max Planck Institute for Marine Microbiology in Bremen, GEOMAR Helmholtz Centre for Ocean Research and Institute

for General Microbiology in Kiel. The results provide a detailed overview of nutrient distributions, rates of N loss processes and abundances and identity of bacteria in the South Pacific OMZ. Furthermore, models were employed to calculate the amount of algal biomass that is exported from the surface to the deeper OMZ waters. This large-scale study resulted in the so far most comprehensive nitrogen budget for an oceanic OMZ. The results were surprising: "We saw that the rates of nitrogen loss, mainly due to anammox, strongly correlated with the export of organic matter," explains Tim Kalvelage. "This was unexpected because anammox bacteria do not grow on organic matter but use ammonium and CO<sub>2</sub>." The scientists found out that the N-rich [organic matter](#) most likely serves as a key source of [ammonium](#) for the anammox reaction.

Professor Marcel Kuypers concludes: "Our results will help to more realistically estimate the short- and long-term impacts of human-induced ocean de-oxygenation and changing productivity on [nitrogen](#) cycling in the OMZs, as well as the rest of the Ocean. This is critical to estimate how much CO<sub>2</sub> can be taken up by the Ocean in the future."

**More information:** Nitrogen cycling driven by organic matter export in the South Pacific oxygen minimum zone, Tim Kalvelage, Gaute Lavik, Phyllis Lam, Sergio Contreras, Lionel Arteaga, Carolin R. Löscher, Andreas Oschlies, Aurélien Paulmier, Lothar Stramma and Marcel M. M. Kuypers, *Nature Geoscience* (2013)  
[doi:10.1038/NNGEO1739](https://doi.org/10.1038/NNGEO1739)

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