Nitrous Oxide Fluxes from the Gulf of Mexico “Dead Zone”

Primary Investigator: Craig Stow - NOAA GLERL

Co-Investigators: John Walker - U.S. EPA, Office of Research and Development, National Risk Management Research Laboratory

Overview

Nitrous oxide is a potent greenhouse gas with a global warming potential ~300 times that of carbon dioxide, and is produced as a byproduct of denitrification. Coastal hypoxic areas with low dissolved oxygen levels and high nitrogen inputs have the potential to generate significant amounts of nitrous oxide. However, the nitrous oxide budget of these areas has not been extensively measured and no data are available for the northern Gulf of Mexico. In 2008 we measured nitrous oxide levels in the water column of the “Dead Zone” during the NGOMEX cruise. In 2009 we will analyze these data to provide estimates of nitrous oxide emissions from the Gulf Dead Zone.

Objective

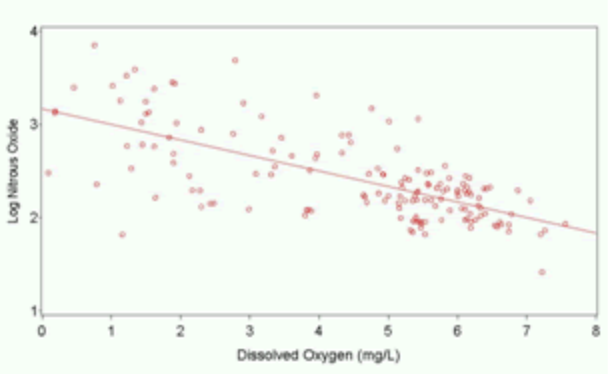
Increase number of regional coastal and marine ecosystems delineated with approved indicators of ecological health and socioeconomic benefits that are monitored and understood.

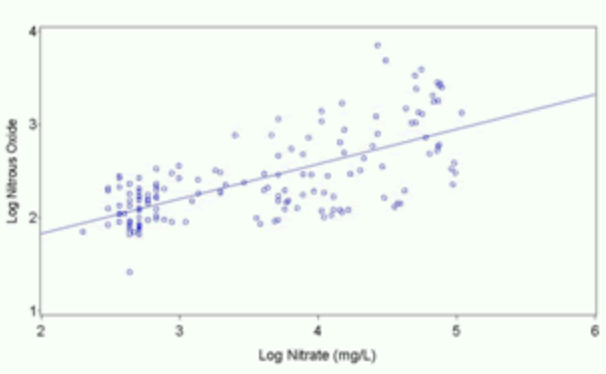
Proposed Work

During 2009 we will focus on data analysis, estimation of emission rates and preparation of two manuscripts. The first manuscript will focus on episodic events, an opportunity provided by the passage of Tropical Storm Edouard during the 2008 cruise, and will be targeted at a high profile journal such as Science. The second manuscript will be a data synthesis and presentation targeted for the Journal of Geophysical Research or a similar outlet.

Scientific Rationale

Nitrous oxide is a potent greenhouse gas with a global warming potential ~300 times that of carbon dioxide, and is produced as a byproduct of denitrification. Coastal hypoxic areas with low dissolved oxygen levels and high nitrogen inputs have the potential to generate significant amounts of nitrous oxide. However, though they may be important sources, the nitrous oxide budget of these areas has not been extensively measured (Bange 2006). During the first leg of the 2008 NGOMEX cruise we were joined by a colleague from the EPA Research Triangle Park lab, who brought sampling equipment and a gas chromatograph on board to measure nitrous oxide in the water column. Additionally, we collected water samples which were returned to the lab for analysis of relevant chemical characteristics. Exploratory data analysis reveals clear relationships between nitrous oxide concentration, dissolved oxygen levels, and nitrate concentrations as shown below:





These data, along with meteorological data collected during the cruise can be used to estimate nitrous oxide emission rates in and around the Gulf hypoxic region and possibly other similar areas. In addition, we were “fortunate” enough to be sampling when Tropical Storm Edouard passed directly over the area, providing before and after data that captures the episodic nitrous oxide release associated with a large storm event (Running 2008).

In 2009 we plan to prepare two manuscripts based on these data – the first estimating the episodic release of nitrous oxide caused by the tropical storm, and the second a broader data synthesis and analysis. Requested funds for this project include travel to North Carolina for a short meeting to work on the manuscripts ($900) and a one-year site license for the SAS statistical software ($100) to load on the laptop.

Governmental/Societal Relevance

Assessing the potential impact of global climate change is an integral part of NOAA’s current activities. Coastal hypoxic regions have the potential to generate significant quantities of nitrous oxide, a potent greenhouse gas. This project will help evaluate the role of coastal hypoxic regions by providing and synthesizing data from one of the worlds largest, most persistent hypoxic zones.

Relevance to Ecosystem Forecasting

Global climate change forecasts require accurate estimates of greenhouse gas emission rates. Currently, there are few measurements available of nitrous oxide emissions form coastal hypoxic areas. The Dead Zone in the Gulf of Mexico is one of the largest, most persistent areas of hypoxia in the world. Emission rate estimates from this region will help fill the current knowledge gap.

References

Bange, H.W. The importance of oceanic nitrous oxide emissions. 2006. *Atmospheric Environment,* 40: 198-199.

Running, S.W. 2008. Ecosystem disturbance, carbon and climate. *Science*, 321: 652-653.