Spatial and temporal pCO₂ and O₂ variability during the North Atlantic Deep Ocean Gas Exchange Experiment (DOGEE)

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Introduction
The earth’s carbon cycle has been dramatically altered by contemporary civilization. The movement of carbon from ancient fossil deposits to the atmosphere and into marine and terrestrial biomes has many consequences, few of which we currently fully understand or are able to predict. Much of the needed understanding of the carbon cycle may come from better observational methods that can characterize large spans of time or space. One group of observational methods, autonomous sensors, can provide high temporal resolution data within air, earth or water systems. Here we present results from in situ biogeochemical measurements performed during the UK SOLAS Deep Ocean Gas Exchange Experiment (DOGEE). Sensors for the partial pressure of CO₂ (pCO₂) (Figures 1 and 2), dissolved O₂ (DO), light intensity (PAR), and chl-a fluorescence were mounted on two Air Sea Interaction Spar (ASIS) buoys at 1 m and 5 m depths (Figure 3). These data are used to elucidate the processes that control the air-sea CO₂ flux. We also examine if the pCO₂–DO combination can be used to estimate gas transfer rates using an in-situ “dual-tracer” methodology.

Field program
The ASIS buoys were deployed on 22 June 2007 in two tracer-spiked water masses located at ~44°N, 16°W and remained in the water until 11 July 2007. One of the tracer patches contained an artificial surfactant. The buoys did not successfully follow the patches but traced a parallel trajectory ~30 km apart (Figure 5).

In situ sensors
Figure 7: The 1 m ASIS1 sea surface pH record with the increase due to thermal heating (Figure 6) removed.

In situ biogeochemical data

Deployment platform

Future work
Further analysis and modeling will elucidate the processes that controlled CO₂ and O₂ variability during the DOGEE field program. A model that includes coupled 1-D physics and CO₂ biogeochemistry will be used (DeGrandpre et al. Martz et al. 2008). The model simulations described above suggest that k can be estimated with <10% error when under O₂ saturation is significant (>10%). In the very near future, we will test these ideas using the DOGEE data set.

References

Acknowledgements: We thank Mike Rebozo, Joe Gabriele and the captain and crew of the RSS Discovery for technical support. We also thank Nick Hardman-Mountford and Craig McNeil for providing underway pCO₂ and O₂ data, respectively. The U.S. National Science Foundation funded this work (grant OCE-0223584).