Using Models to Improve our Ability to Monitor Ocean Uptake of Anthropogenic Carbon

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1. PROJECT SUMMARY

How is the ocean carbon cycle responding to human activity? Recently a number of studies have argued that the rate of carbon uptake by the ocean has been slowing over the last decade. This could occur if climate-induced changes in the ocean/atmosphere system are leading to changes in the exchange of carbon between the atmospheric and oceanic reservoirs. However, the detection of changes in carbon uptake by the ocean are complicated by the fact that the ocean exhibits variability in its circulation on nearly all time scales over which we measure. Or this reason the detection of the rate of carbon uptake becomes a signal-to-noise problem.

The main goal of this project is to use models and remotely sensed altimetry data to reduce uncertainty in estimate the rate of uptake of anthropogenic carbon by the ocean from Repeat Hydrography measurements. Models and satellite data will be important to developing our mechanistic understanding of the natural background variability of carbon, and for developing better methods to separate the natural carbon signal from the anthropogenic signal.

Over the last four months, we have completed (and submitted; Rodgers et al., 2008) a research project focused on a model/data synthesis of carbon variability in the ocean. In the study, we used observations and ocean models to identify mechanisms driving large seasonal to interannual variations in dissolved inorganic carbon (DIC) and dissolved oxygen (O_2) in the upper ocean. We began with observations linking variations in upper ocean DIC and O_2 inventories with changes in the physical state of the ocean. Models were subsequently used to address the extent to which the relationships from short-timescale (6 months to 2 years) repeat measurements are representative of variations over larger spatial and temporal scales.

The main new result of the study was that convergence and divergence (column stretching) attributed to baroclinic Rossby waves can make a first-order contribution to DIC and O_2 variability in the upper ocean. This results in a close correspondence between natural variations in DIC and O_2 column inventory variations and sea surface height (SSH) variations over much of the ocean. Oceanic Rossby wave activity is an intrinsic part of the natural variability of the climate system and is elevated even in the absence of significant interannual variability in climate mode indices.

2. PUBLICATIONS/PRESENTATIONS

Rodgers, K.B., R.M. Key, A. Gnanadesikan, J.L. Sarmiento, O. Aumont, L. Bopp, S.C. Doney, J.P. Dunne, D.M. Glover, A. Ishida, M. Ishii, A. Jacobson, C. Lo Monaco, E. Maier-Reimer, N. Metzl, F.F. Pérez, A. Rios, R. Wanninkhof, P. Wetzel, C.D. Winn, and Y. Yamanaka, 2008:

Altimetry helps to explain patchy changes in hydrographic carbon measurements. *J. Geophys. Res.*, submitted.