Session: C9 Poster: M107B

The ECCO Consortium: Estimates of air-sea carbon exchange between turbulent ocean and atmosphere during 2009-2010

Holger Brix[†]; Dimitris Menemenlis; Chris Hill; Stephanie Dutkiewicz; Mick Follows; Daiwei Wang; Oliver Jahn; Hong Zhang; Kevin Bowman
[†] UCLA, USA
Leading author: hbrix@ucla.edu

The exchange of carbon dioxide between the atmosphere and other reservoirs on Earth due to natural variability and anthropogenic influences is of highest societal and political interest. To gain deeper understanding of these processes and to monitor carbon fluxes NASA has started a "Carbon Monitoring System" pilot project that incorporates satellite and in situ measurements, improved numerical models, and inverse techniques. For the oceans the air-sea carbon flux maps produced by Takahashi and collaborators are the "gold standard" when it comes to applying boundary conditions for stand-alone atmospheric or oceanic numerical circulation models with carbon cycles. Due to the sparsity of CO2 measurements in space and time, however, the variability of these maps is limited and may result in the misleading perception that the physical ocean uptake of carbon is a slow and steady process. Here we explore the variability of air-sea gas exchange using a full-depth, global-ocean configuration of the Massachusetts Insitute of Technology general circulation model (MITgcm), eddying estimates of ocean circulation from the Estimating the Circulation and Climate of the Ocean, Phase II (ECCO2) project, the MIT ecosystem model (Darwin), and a marine carbon chemistry model. The ECCO2/Darwin air-sea carbon flux estimates display high-frequency and high wavenumber variability with standard deviation of 1.83 molC/m2/yr (up to 54.5 molC/m2/yr locally) , which can be compared to the 0.30 molC/m2/yr global mean uptake and 0.56 molC/m2/yr (5.3 molC/m2/yr local maximum) standard deviation of the Takahashi climatology. The simulated ECCO2/Darwin variability includes signatures of both atmospheric boundary conditions and of oceanic circulation, indicating that the first step of ocean uptake is highly variable, that it depends on interplay between winds, ocean mixed layer preconditioning, and biological uptake. We find that the air-sea carbon flux is considerably variable and using monthly mean values as boundary conditions for atmospheric models may be misleading.