Improving CO_2 Air-sea Fluxes by Combining O_2 and CO_2 Data

L. Resplandy[1], R. Keeling[1], A. Jacobson[2] and C. Roedenbeck[3]

[1]Scripps Institution of Oceanography, La Jolla, CA; 858-534-9944, E-mail: lresplandy@ucsd.edu
[2]Cooperative Institute for Research in Environmental Sciences (CIRES), University of Colorado, Boulder, CO 80309
[3]Max Planck Institute (MPI) for Biogeochemistry, Jena 07701, Germany

The evolution of CO_2 and O_2 in the atmosphere is strongly coupled by the processes controlling their exchange with the land and the ocean. Combining O_2 and CO_2 data thus provide additional constraints on CO_2 fluxes and key insights into the processes at play. In particular, estimates of CO_2 fluxes based on atmospheric data assimilation such as Carbon Tracker are heavily tied to the ocean "prior" they use (i.e. the first guess of air-sea CO_2 fluxes obtained independently from atmospheric CO_2 data).

In this study, we exploit the strong link between O_2 and CO_2 data in the ocean and the atmosphere to constrain the estimate of air-sea CO_2 fluxes. This also provides insight into the process controlling the strong variability of oceanic origin that depends on the rate of ocean uptake of CO_2, ocean production/respiration, warming/cooling and mixing, all processes which impact both air-sea CO_2 and O_2 fluxes. Ultimately, this estimate will improve our estimate of ocean "priors".

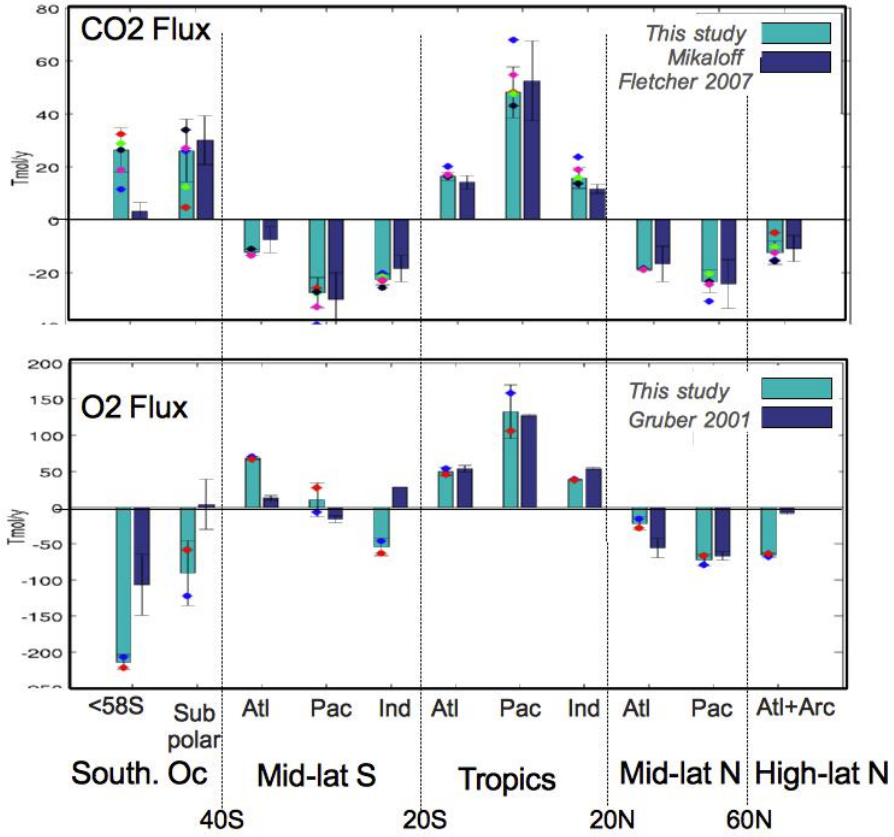

Figure 1. Estimates of regional CO_2 and O_2 fluxes obtained by an oceanic inversion in this study and in previous estimates. This illustrates the links between CO_2 and O_2. For example, in the Southern Ocean, deep convection brings carbon-rich/oxygen-poor waters to the surface, leading to strongly coupled CO_2 out-gas and O_2 in-gas. *Positive fluxes towards the atmosphere and symbols indicate estimates based on different ocean model parametrization.*