Two Decades of Atmospheric O_2 Measurements and Their Implications

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Time series of atmospheric O_2/N_2 ratio by the Scripps O2 program now span more than two decades. These measurements enable refined estimates to be made of land and ocean carbon sinks and provide benchmark tests for models depicting the response of ocean biogeochemistry to changing climate on a range of time scales, extending from seasonal, El Nino, to multi-decadal. The measurements are also relevant for quantifying the global loss of O_2 from the oceans, or "deoxygenation" and for detecting changes in ocean ventilation and production associated with warming-induced stratification that may influence future deoxygenation.

This presentation will provide highlights of several results of general interest. An updated estimate of the global land and ocean sinks of CO_2 for the decades of the 1990s and 2000s will be provided based on the O_2/N_2 data. The downward trend in O_2/N_2 has accelerated since 1999, potentially signaling an increase in the uptake rate of CO_2 by the oceans. This result will be discussed in the context of studies based on other lines of evidence that suggest, in contrast, that the ocean CO_2 sink is no longer increasing. The long-term average magnitude of the ocean sink will also be compared with studies based on the penetration of Chlorofluorocarbons into the oceans. The seasonal cycles in O_2/N_2 provide a metric of the stability of the functioning of ocean biological systems. Although some small variability in these cycles from year to year is notable, the data show little evidence of long-term trends, suggesting that ocean productivity at middle and high latitudes has not undergone major changes over the past 20 years. Interannual variability in O_2/N_2 of oceanic origin is evident on a range of additional time scales. These data provide potentially powerful constraints on the impact of changing climate or other perturbations on the ocean CO_2 sink.

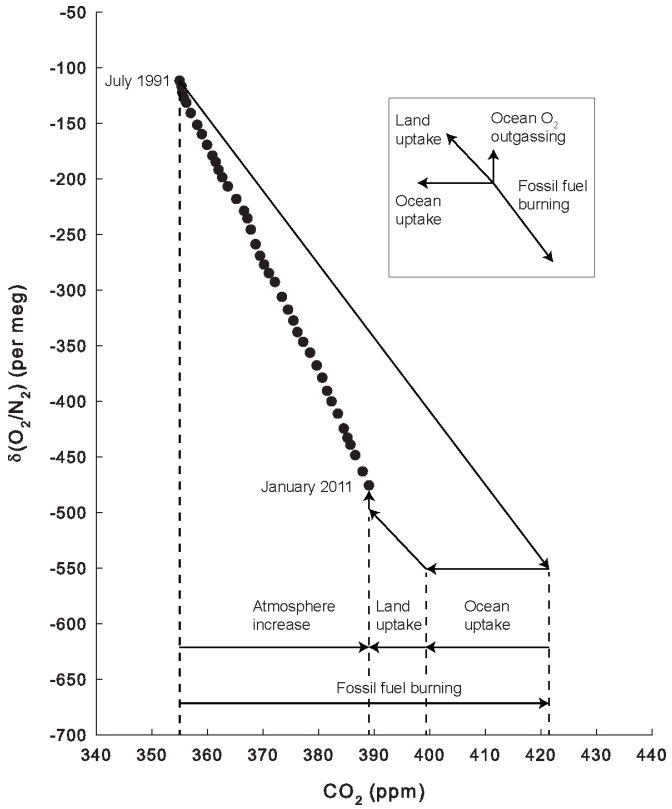

Figure 1. Land and ocean sinks from 1991 to 2011 as derived from trends in O_2/N_2 and CO_2 concentration.