CO_2 flux estimation by top-down approach over the Arctic region

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Top-down approaches (or atmospheric inversions) using atmospheric transport models with CO_2 observations are an effective way to estimate carbon fluxes at global and regional scales. We used the CCSR/NIES/FRCGC AGCM-based Chemistry Transport Model (ACTM) for simulations of various greenhouse gases and ozone depleting chemicals. Following validation of ACTM transport at regional and hemispheric scales, we conducted CO_2 flux estimations by using a Bayesian synthesis inversion framework. Monthly CO_2 fluxes were estimated for 84 regions (54 lands + 30 oceans) over the globe during the period of 1990–2011 with observed atmospheric CO_2 concentrations at 74 sites.

As a result of time-dependent inversions, mean total flux (excluding fossil fuel) for the period 1990–2011 is estimated to be –3.33 PgC/yr, where land (incl. biomass burning and land use change) and ocean absorb an average rate of –1.98 and –1.35 PgC/yr, respectively. For 2000's, mean fluxes over Arctic regions were estimated to be –0.22, –0.04, and –0.26 PgC/yr for Arctic total, Arctic land, and Arctic ocean, respectively, and they contributed 9.8%, 2.9%, and 7.4% of global land, global ocean, and global total sinks (Fig. 1). Interannual variations in the estimated fluxes will be also investigated.

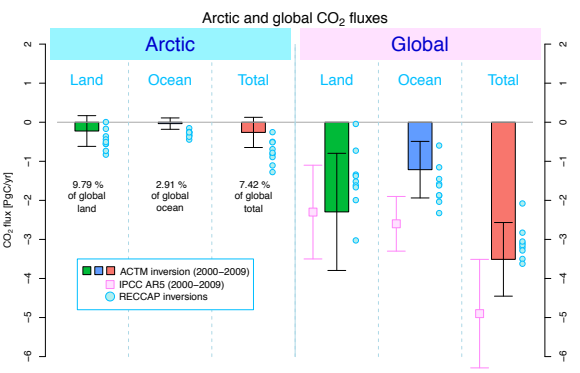

Figure 1: CO_2 fluxes around the Arctic region compared to the global totals estimated by the ACTM inversion.