Oceanic carbon uptake in the simulation with the IAP RAS global climate model.

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The climate model of intermediate complexity developed at the A.M. Obukhov Institute of Atmospheric Physics RAS (IAP RAS CM) [1] is extended by the state-of-the-art oceanic carbon cycle module [2]. The IAP RAS CM's carbon cycle is closed by respective terrestrial module and the atmospheric CO_2 compartment in a well-mixed approximation [3, 4]. A simulation with the IAP RAS CM is performed which is forced by fossil fuel+industrial CO_2 emissions, by atmospheric concentrations of CH_4, N_2O, tropospheric and stratospheric sulphates, by changes in extent of crops and pastures and by variations in total solar irradiance. These agents were prescribed according to protocol "Historical simulation" for 1765-2005 and according to scenario RCP 2.6 in 2006-2100 (for more details, see http://cmip-pcmdi.llnl.gov/cmip5/forcing.html).

In these simulations, the IAP RAS CM realistically reproduces basic characteristics of the global carbon cycle. In particular, the 20th century deviations of the simulated carbon dioxide content from the observed one are not larger than 7 ppmv. Global oceanic carbon uptake $F_{CO2,o}$ in 1980s (1990s) in the model is 1.5 PgC/yr (1.9 PgC/yr) which is within the respective uncertainty range 1.8±0.8 PgC/yr (2.2±0.4 PgC/yr) [5], see Fig. 1. Its spatial distribution is in reasonable agreement with the empirical data [6] (Fig. 2, top panel). Under the RCP 2.6 scenario, $F_{CO2,o}$ continues to increase till the middle of the 21st century reaching 4.1 PgC/yr and decreases thereafter amounting 3.3 PgC/yr in year 2100. Most marked changes are predicted in high latitudes due to receding sea ice which exposes more open ocean water to atmosphere (Fig. 2, bottom panel).

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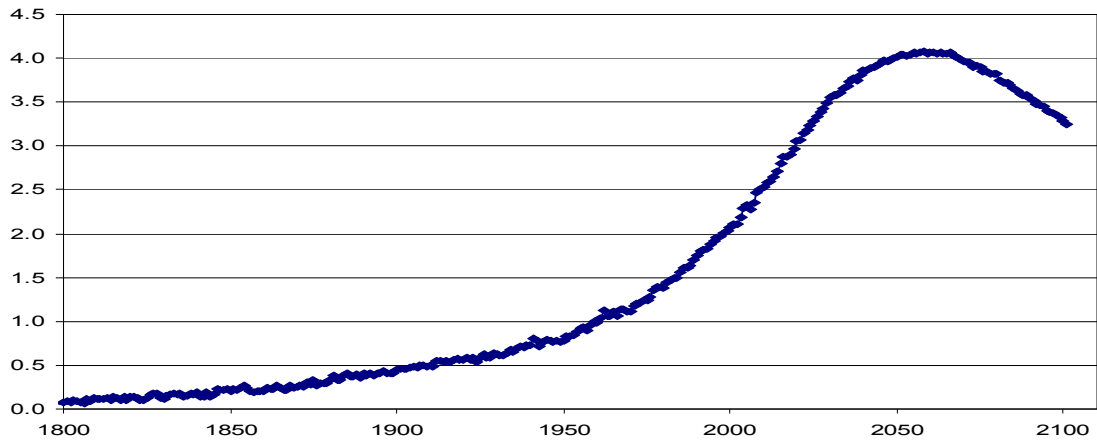
Fig. 1. Global oceanic CO_2 uptake [PgC/yr] vs. time.
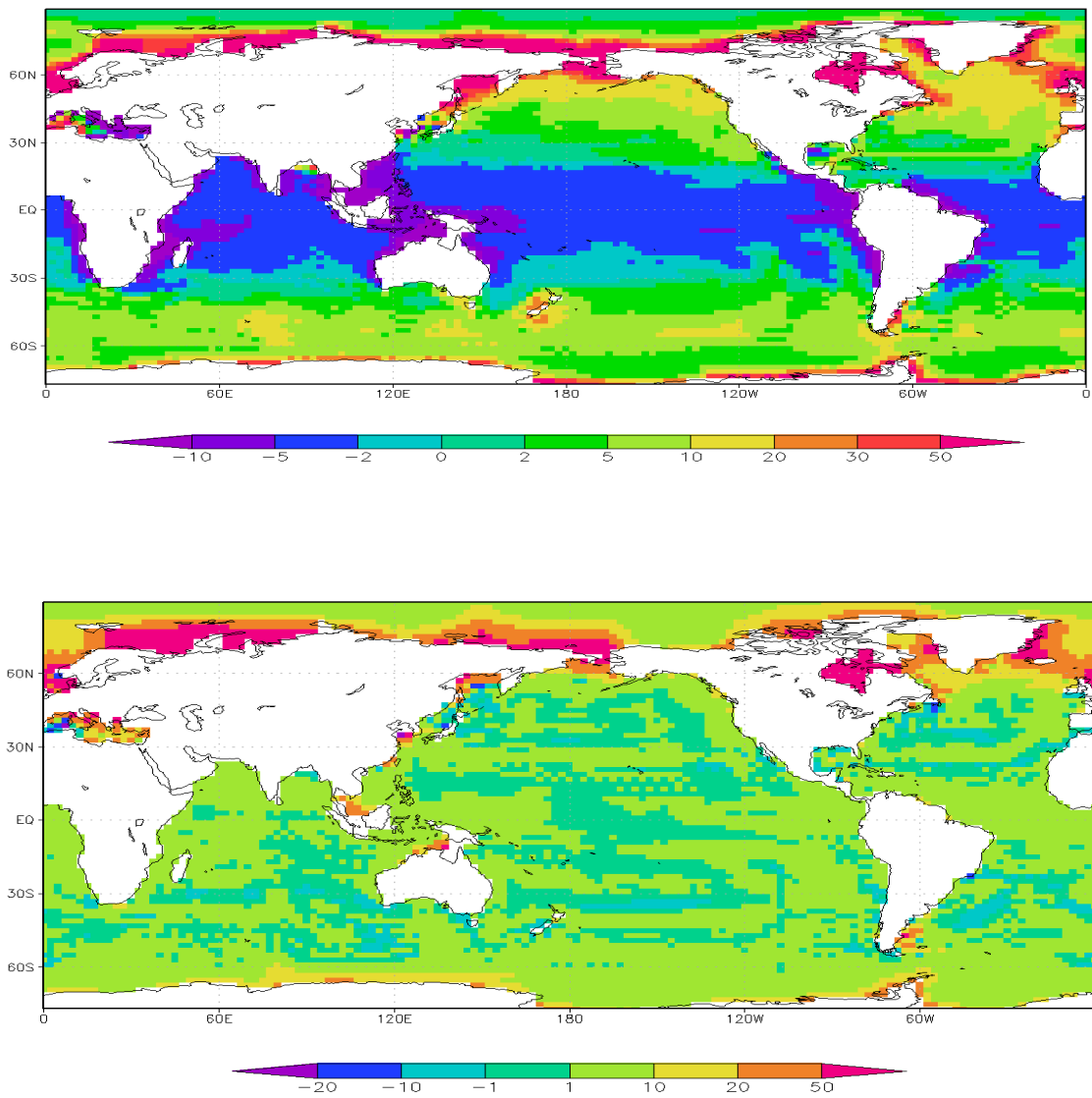
Fig. 2. Oceanic carbon uptake per unit area [grams C m^{-2} yr^{-1}] averaged for 1991-2000 (top) and change of this uptake from 1991-2000 to 2091-2100 (bottom).