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Carbon Cycle Processes Study over East Asia with Carbon Tracker in KMA

S.-B. Park, K.-H. Seol, K.-O. Boo, J. Lee, CH Cho, and Y.-H. Byun

National Institute of Meteorological Research/Korea Meteorological Administration, Seoul, Korea
(sungbin.beaniya@gmail.com)

East Asian region has heterogeneous ecosystem and is known to contribute to the global carbon budget considerably (Piao et al., 2009). Although there is a great uncertainty in carbon budget, there are a number of studies pointing out that the East Asia would be great potential sink in the budget. Thus, more efforts would be needed to clarify the carbon-climate feedback in the East Asian region.
Here we provide the evaluation results for carbon exchange by terrestrial and marine ecosystems using the Hadley Centre Global Environmental Model version 2 (HadGEM2-AO). The model used in this study includes TRIFFID and diat-HadOCC as ecosystem components to simulate the carbon cycle and its interactions with climate (Collins et al., 2011). The simulation has been performed for 31-year from December 1979, with CMIP5 forcings for GHGs and aerosols. Our analysis mainly focuses on; (1) the evaluation of the global carbon cycle using available observation/analysis datasets including results from Carbon Tracker, and (2) the effect of increasing atmospheric CO_2 on land and ocean ecosystems over East Asia.
Over land, both HadGEM2-AO and CT show reasonable features for land carbon fluxes during 2001 and 2009. They have strong carbon sinks (source) in summer (winter) from mid- to high-latitudes in the northern hemisphere. The horizontal and zonal distributions of vegetation productivity and terrestrial carbon storage such as NPP, GPP, and total soil carbon (SC) show similar patterns like in the previous studies. Simulated present day (1980∼2010) productivities and carbon stores are comparable for the distribution of annual mean states in previous studies. The mean annual global NEE, NPP, GPP, and SC are 1.4±1.7, 83±3, 162±2.6, and 1270±1.7 PgC/yr, respectively, and the values are within the ranges from the previous studies. The terrestrial biosphere was neutral to net carbon exchange during 1980s, but has changed to sinks for both 1990s and 2000s.
Over ocean, the model reproduces well the global distributions of surface pH and air-sea CO_2 fluxes. Maximum (minimum) outgassing (surface pH) appears in the equatorial Pacific due to intense upwelling. Strong CO_2 sink zones in 20°-50° in both hemispheres and a sink in the North Atlantic north of 50°N due to strong phytoplankton blooms in spring and strong cooling in winter are also well represented. But the magnitudes of outgassing and sink are slightly less than those of observations. The global ocean CO_2 sink of 1.34 PgC/yr is well within the observed ranges compared to 1.61±1.18 from CT. With increasing atmospheric CO_2 concentration, the model produces an increase in ocean surface pH of -0.0017 yr-1, which is close to the observed trend (-0.00015 and -0.0024 yr-1) (González-Dávila et al. 2010, Olafsson et al. 2009). Because of low resolution of CT near the East Asian ocean, the HadGEM2 results will be used to understand the ocean carbon cycle and its changes especially over the region. More detailed results from evaluations and processes for carbon cycle processes in Asian regions will be discussed in the presentation.

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