Top-down estimation of terrestrial CO_2 flux in Northern Eurasia

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We present a multi-year trend of terrestrial CO_2 flux from northern Eurasia, estimated by atmospheric inversion using a coupled model GELCA (Global Eulerian-Lagrangian Coupled Atmospheric model). Global monthly CO_2 flux distributions were estimated for the period 2002-2015 for 42 land and 22 ocean regions using the Observation Package data products (ObsPack GLOBALVIEWplus) which includes data from various types of atmospheric CO_2 direct measurements provided by large numbers of laboratories in the world. In this study, we added 9 tower observations from JR-STATION (Japan-Russia Siberian Tall Tower Inland Observation Network) to better constrain the area of interest.

In order to examine the impact of additional observational constraints in Siberia, we compared the inversion results with and without JR-STATION data. For the entire period, estimated global land fluxes agreed well with each other regardless of JR-STATION data. At regional scales, estimated fluxes showed significant difference mostly in Siberia and northeastern Europe. When focusing on the mean seasonal variations, summer uptake increased in western Siberia and northeastern Europe whereas it decreased in northeastern Siberia by adding JR-STATION data.

In terms of the long-term trend, the terrestrial sink was increasing both in Siberia and in Europe. Terrestrial CO_2 fluxes estimated for Siberia using JR-STATION data is -0.88 ±0.55 $GtCyr^{-1}$ and -1.36 ±0.42 $GtCyr^{-1}$ over the period 2002-2009 and 2010-2015, respectively. Those for Europe is -0.19 ±0.43 $GtCyr^{-1}$ and -0.42 ±0.30 $GtCyr^{-1}$, respectively. The increasing trend of the carbon sink in northern boreal areas can be explained by the combination of warming climate and the fertilization effect . Time series of these fluxes also reflect the effect of ENSO and extreme weather conditions. The interpretation of the multi-year variation of estimated fluxes in northern Eurasia will be presented.

Keywords: CO2, carbon flux, inverse modeling, greenhouse gas, Siberia, climate change

