Simulation of CO_2 and CH_4 in Siberia using coupled Eulerian-Lagrangian model

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Siberia is an extensive geographical region with large amounts of plant biomass and soil organic carbon, so this region has a substantial sources and sinks of CO_2 and CH_4. The magnitude and distribution of CO_2 and CH_4 fluxes are still uncertain, so accurate estimation of carbon fluxes and study of CO_2 and CH_4 seasonal cycles in the subarctic regions are essential.
In this work, we use forward simulation employing the Global Eulerian–Lagrangian Coupled Atmospheric (GELCA) model in order to estimate CO_2 and CH_4 seasonal cycles in the subarctic. GELCA consists of an Eulerian National Institute for Environmental Studies global Transport Model (NIES-TM) and a Lagrangian particle dispersion model (FLEXPART). This approach utilizes the accurate transport of the Lagrangian model to calculate the signal near to the receptors, and efficient calculation of background concentrations using the Eulerian global transport model.
We setup a long simulation period to obtain a better understanding of the role of emissions (using a set of CO_2 and CH_4 emissions scenarios), and transport model characteristics, such as the stratosphere/troposphere exchange and tracers concentration variations in the troposphere. We also analyzed modeled and observed long and short-term trend, seasonal cycle of CO_2 and CH_4.
Model results were compared with observations from the World Data Centre for Greenhouse Gases (WDCGG 2015) and the Siberian observations obtained by the Center for Global Environmental Research (CGER) of the National Institute for Environmental Studies (NIES) and the Russian Academy of Science (RAS), from six tower sites (JR-STATION).
The analyses have shown that CELGA is effective in capturing the seasonal variability of atmospheric tracer at observation sites strongly influenced by local emissions and global transport at the same time.

Keywords: atmospheric transport model, carbon cycle, carbon dioxide, methane

