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CO_2 emissions from wildfires in Siberia: FRP measurement based estimates constrained by satellite and ground based observations of co-emitted species

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Wildfires play an important role in the global carbon balance, being one of the major processes of the carbon cycle and by providing a considerable contribution to the global carbon dioxide emissions. Meanwhile, significant discrepancies (especially on a regional scale) between the available wildfire emission estimates provided by different global and regional emission inventories indicate that the current knowledge of wildfire emissions and related processes is still deficient. Although studies of wildfire emissions of several important species have greatly benefited from the recent advent of satellite measurements of the tropospheric composition, the informativeness of direct satellite measurements of CO_2 in such a context still remains rather limited.

We develop a new approach [1] to estimate CO_2 emissions, which is based on the use of satellite measurements of co-emitted species in combination with chemistry transport model simulations and "bottom-up" emission inventory data. In this study we apply this approach together with the earlier developed method [2] for estimation of wildfire emissions to constrain the parameters of a fire emission model and to estimate emissions of CO_2, CO and aerosol from wildfires in such an important carbon-rich region of the world as Siberia. We employ the MODIS fire radiative power (FRP) measurements to obtain spatial-temporal fields of fire activity and other (IASI CO and MODIS AOD) satellite observations in combination with simulations performed with the CHIMERE chemistry transport model to estimate the FRP to biomass burning rate conversion factors for different vegetative land cover types. The conversion factors (which are believed to be much more uncertain than the available estimates of the emission factors for major species) derived from the CO and AOD measurements are additionally evaluated with independent ground based measurements in Zotino and Tomsk and are combined in the Bayesian way to obtain CO_2 emission estimates indirectly constrained by both the satellite and ground-based measurements. The use of the ground based observations allows us to reduce the impact of possible biases in satellite data and model simulations on our estimates. The obtained estimates of CO_2 and CO emissions for three years (2007, 2008 and 2012), as well as the retrieved conversion factors are compared with corresponding data (when available) of global emission inventories (GFAS and GFED).

References:

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