Analysis of short-term variations of atmospheric CO_2 and O_2 observed at Ny-Ålesund, Svalbard

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There is a strong negative correlation between the variations of atmospheric oxygen (O_2) and carbon dioxide (CO_2) in the combustion processes of fossil fuels. To represent the quantitative relationship between the O_2 and CO_2 variations, oxidative ratio (OR) is defined as the molar exchange ratio of O_2 and CO_2 ($OR = -\Delta O_2$ [mol]/ΔCO_2 [mol]). The OR value varies depends on the fuel type, such as coal, oil and natural gas (e.g. Keeling et al., 1988). In this study, we estimated the distribution of OR values in Europe by analyzing short-term CO_2 increasing events observed at Ny-Ålesund (78º55'N, 11º56'E), Svalbard.
Correlation analysis of the continuous CO_2, O_2 (Goto et al., 2017) and CO (Myhre et al., 2020) data identified a total of 868 short-term CO_2 increase events which were attributable to fossil fuel combustion between 2012 and 2019. The OR values were calculated for each event and the distribution of OR value of fossil fuel combustion in Europe were also examined using the OR values and footprints calculated by Lagrangian particle diffusion model (FLEXCPP, Zeng, et al., 2013) for each event. The OR values calculated from observations were generally consistent with those estimated from statistical data, but partly lower than those estimated in the previous study (Steinbach et al., 2011).

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