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# Carbon Tracker Switzerland: A high resolution data assimilation system for biospheric $CO_2$ fluxes

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Continued anthropogenic emissions of $CO_2$ and other greenhouse gases (GHG) are expected to impact the future climate. In the Paris Agreement, adopted in December 2015, nearly all countries worldwide agreed to reduce their emissions to keep the global surface temperature rise below 2ºC above pre-industrial levels. To select the best strategies for the reduction of GHG emissions it is crucial to understand and quantify their atmospheric sources and sinks. This is especially relevant for $CO_2$, because of its high concentrations and long lifetime. The largest uncertainties are related to the exchange between $CO_2$ and the terrestrial biosphere, particularly at the regional scale. In order to estimate the biospheric sources and sinks of $CO_2$, we have developed a data assimilation system composed of the mesoscale numerical weather prediction model COSMO, adapted for GHG (COSMO-GHG), and the Carbon Tracker Data Assimilation Shell (CTDAS). CTDAS is based on an ensemble Kalman smoother that was originally developed at NOAA for global-scale applications. We have coupled CTDAS with high-resolution ($\sim$2 km $\times$ 2 km) COSMO-GHG simulations in order to resolve the complex topography and landscape of Switzerland, and for optimizing the strength of $CO_2$ sources and sinks of 10 different plant functional types at weekly time resolution. Observations from up to five high-precision laser spectrometers (CRDS, Picarro Inc.) and 20 low-cost sensors (NDIR, Sensair HPP) are assimilated by the system, providing strong constraints on regional biospheric fluxes and anthropogenic emissions in Switzerland. Here we present the overall setup of COSMO-GHG-CTDAS including the preparation of the high-resolution input data of anthropogenic emissions and a priori biospheric fluxes, and provide a first assessment of the performance for selected time periods in 2018 and 2019.