Seminar on Physics and Chemistry of the Atmosphere
February 19, WiSe 2020/2021, IUP Bremen

How to use existing satellite data to obtain information on localized CO_2 emission sources

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Carbon dioxide (CO_2) is the most important anthropogenic greenhouse gas and the main driver of global warming. Its atmospheric concentrations have risen more than 40% since pre-industrial times. Almost 90% of these emissions are the result of fossil fuel combustion, to a large extent emitted from localized sources. In order to control CO_2 emissions it is necessary to accurately monitor them. Under the Paris Agreement, progress of emission reduction efforts is tracked on the basis of regular updates to national Greenhouse Gas (GHG) inventories, referred to as bottom-up estimates. Emission estimates can also be obtained top-down using atmospheric observations for verification and to obtain additional information. In this context, especially satellite observations are important as they can provide relevant information globally.

Due to CO_2's long lifetime and large fluxes of natural origin, the column-average concentrations resulting from anthropogenic emissions from individual source points are usually small compared to the background concentration, and these enhancements are often barely larger than the satellite's instrument noise. This makes the detection of CO_2 emission plumes and the quantification of anthropogenic fluxes challenging.

NO_2 is co-emitted with CO_2 in the combustion of fossil fuels. It has a much shorter lifetime, and as a result, its vertical column densities can exceed background values and sensor noise by orders of magnitude in emission plumes. This makes it a suitable tracer for recently emitted CO_2.

Here, we focus on the quantification of CO_2 emissions from localized sources such as power plants using XCO_2 (the column-averaged dry air mole fraction of CO_2) retrievals from the Orbiting Carbon Observatory 3 (OCO-3). We present some relevant previous research on the topic, a plume detection method using NO_2 as a tracer and an inversion technique to quantify CO_2 emissions from detected CO_2 plumes.