EGU21-16098
https://doi.org/10.5194/egusphere-egu21-16098
EGU General Assembly 2021

Assessing the effectiveness of an urban CO2 monitoring network through the COVID-19 lockdown natural experiment

Jinghui Lian, Thomas Lauvaux, Hervé Utard, Grégoire Broquet, François-Marie Bréon, Michel Ramonet, Olivier Laurent, Karina Cucchi, and Philippe Ciais
Suez Group, France (jinghui.lian@origins.earth)

Quantitative monitoring of CO2 sources and sinks over cities is needed to support the urban adaptation and mitigation measures, but it is a challenging task. The Paris metropolitan area is a highly built-up and densely populated region in France. The two national COVID-19 forced confinements that are 1) effective on March 17th, with a duration of 55 days until May 11th, 2) effective on October 30th, with a duration of 46 days until December 15th provide an opportunity to assess the behaviour and robustness of the dedicated atmospheric inversion system for estimating the city-scale CO2 emissions.

In this study, the atmospheric Bayesian inversion approach that couples six in-situ continuous CO2 monitoring stations with the WRF-Chem transport model at 1-km horizontal resolutions has been used to quantify the impacts of lockdown on CO_2 emissions for the Paris megacity. The prior emission estimate was from the Origins inventory, a near-real-time dataset of fossil fuel CO2 emissions by sector (transportation, residential, tertiary, industry and sink) at 1km^2 and hourly resolution recently developed by Origins.earth. Estimates of CO2 emissions were retrieved from the inversion by assimilating CO2 concentration gradients between upwind-downwind stations using a refined configuration of the existing Parisian inversion system developed by Bréon et al. (2015) and Staufer et al. (2016). A set of experiments was performed to assess the sensitivity of the posterior CO2 estimates to the changes in different inversion setups, including the selection of observations, prior flux uncertainties and error correlations. We also analyzed the potential contribution of the expanding CO2 monitoring network, in particular the two newly built urban stations in the city center since 2014, to the inverse modeling systems.

The optimized CO2 estimates show decreases of around 42% and 25% in anthropogenic CO2 emissions during the first and second lockdowns respectively when compared with the same period in past two years. Both lockdown emission reduction estimates from the inversion are consistent with recent estimates from activity data (resp. 37% and 19%), suggesting that our near-real time monitoring system is able to detect and quantify short-term variations at the whole-city level.