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Towards improving current estimates of CO2 emissions and sinks in the Aix-Marseille metropolis area, France, and developing virtuous CO2 mitigation scenarios in link with local stakeholders and socio-economic actors.

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Most of the world population leaves in urbanized areas, and this is expected to expand rapidly in the next decades. Cities and their industrial facilities are estimated to emit more than 70% of fossil fuel CO_2. Still, these estimates, mostly based on bottom-up emission inventories, need to be verified at the city scale. Atmospheric top-down approaches are a tool of choice in this sense. They rely mostly on continuous atmospheric CO_2 measurements inside and outside of the studied urbanized area to catch the urban plume and its variability (either from in-situ, remote sensing or airborne instrumentation), on the use of emission tracers such as carbon monoxide and black carbon for combustion processes, of volatile organic compounds and of carbon isotopes to distangle the contribution of natural, modern and fossil fluxes, on mass balance approaches which needs measurements of the atmospheric boundary layer height, and on direct and inverse modeling frameworks. Furthermore, as they represent the main anthropogenic CO_2 emission sector, cities and industrial facilities are strategic places where actions on mitigating CO_2 emissions should be undertaken in priority.

The Aix-Marseille metropolis (AMm), located in the south-east of France, is the second most populated area of France (1.8 M inhabitants). It is also much industrialized, and is located in the SUD-PACA region, which is strongly exposed to the risks of Climate Change. Since 2017, two top-down research projects have been funded by the LABEX OT-MED (AMC project, 2016-2019) and by the French National Research Agency ANR (COoL-AMmetropolis project, 2020-2024) to fullfill the following objectives : 1/ assessing the spatio-temporal variability of atmospheric CO_2 in the AMm area ; 2/ characterizing the different sources and sinks that control CO_2 through the use of tracers and carbon isotopes ; 3/ verifying independently the high-resolved CO_2 emission inventory delivered by the regional air quality agency ATMOSUD ; 4/ developing a direct modeling framework, facing challenges such as the complex AMm topography, coastal boundary layer dynamics, and some specific meteorological features that are mistral and land/sea breezes ; and 5/ developing scenarios to the horizon 2035 for mitigating AMm CO_2 emissions and find the most effective way to integrate vertuous scenarios, defined in interaction with stakeholders, into legal and urban planning schemes, tools, charters or practices. A synthesis of the results obtained until now from these two projects will be presented.