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Cities with their large, dense populations are concentrated sources of CO2 emissions to the atmosphere. Although more than 60% of global fossil fuel CO2 emissions are from cities, yet we lack high-quality city-level emissions inventories and/or independent verification datasets across the majority of global cities. Several cities have also adopted ambitious goals of reaching net-zero emissions by 2030 or 2050. In fact, most recently at COP28, several cities, including those in non-Annex I countries, signed up to be part of the Coalition for High Ambition Multilevel Partnerships for Climate Action (CHAMP ; UNFCCC COP28), thereby obligating themselves to report emissions on a timely basis. So, how can we assist city-scale and local policy and decision-making entities to utilize information from space-based observations to monitor and track GHG emissions? In this presentation, I will show the application of OCO-2 and OCO-3 data across a suite of global cities worldwide. I will show that well-defined and robust mathematical frameworks can exploit the information content in dense, fine-scale, space-based CO2 data to deliver not only whole-city or total emission estimates but also attribute them to individual sectors, such as large point sources, on-road emissions, etc. I will also show examples from recent studies that illustrate the value of exploiting information from co-located emissions of other species to obtain insights into sectoral emission characteristics. Examples from OCO-3, TROPOMI and EMIT data will be shown to demonstrate the value of assimilating information from disparate tracers for reliable source attributions. Even though there are methodological challenges in setting up a multi-species framework, the problem is not insurmountable. Development and refinement of such multi-species frameworks need to start now in order to unlock the true potential of space-based datasets. This is also crucial to optimally utilizing the information from future space-based CO2 emission monitoring sensors, such as Carbon Mapper, ESA’s CO2M, JAXA’s GOSAT-GW and other planned missions. The presentation will conclude with a discussion of implications of space-based datasets for tracking city- and country-level progress towards meeting proposed CO2 emission reduction goals and its value and benefit for advancing bottom-up emission inventories.
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