Imprint of Urban CO_2 Emissions Detected by OCO-2 Observations of Total Column CO_2

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Independent verification of carbon dioxide (CO_2) emissions over urban area is a critical need for implementing effective mitigation strategies of CO_2 emissions from fossil-fuel energy consumption. With global coverage, space-based observations of total column averaged CO_2 concentration (XCO_2) are expected to have an important role in constraining the surface CO_2 fluxes using atmospheric inversion methods. Although the potential of satellite XCO_2 retrievals for global or regional scale flux inversions has been examined based on assimilation of realistic observations as well as observation system simulating experiments, only few studies demonstrated their potential applicability at urban scale. In this study, we investigate the potential of XCO_2 measurements retrieved from the NASA Orbiting Carbon Observatory-2 (OCO-2) in the context of multi-city inversions of CO_2 emissions for Riyadh, Cairo, and Los Angles. Enhancements in XCO_2 induced by urban fossil-fuel CO_2 emissions and atmospheric transport are examined through OCO-2 retrievals and compared to that from forward transport model simulations using the Weather Research and Forecasting model with chemistry (WRF-Chem) and the Open-source Data Inventory for Anthropogenic CO_2 (ODIAC). By simulating urban CO_2 plumes for different meteorological conditions, we evaluate the availability of OCO-2 retrievals for detecting urban emission signals. Taking transport model error and boundary inflow into consideration, we discuss the implications of the detected signals on constraining urban fossil-fuel CO_2 emissions and its potential for trend detection at the city scale.

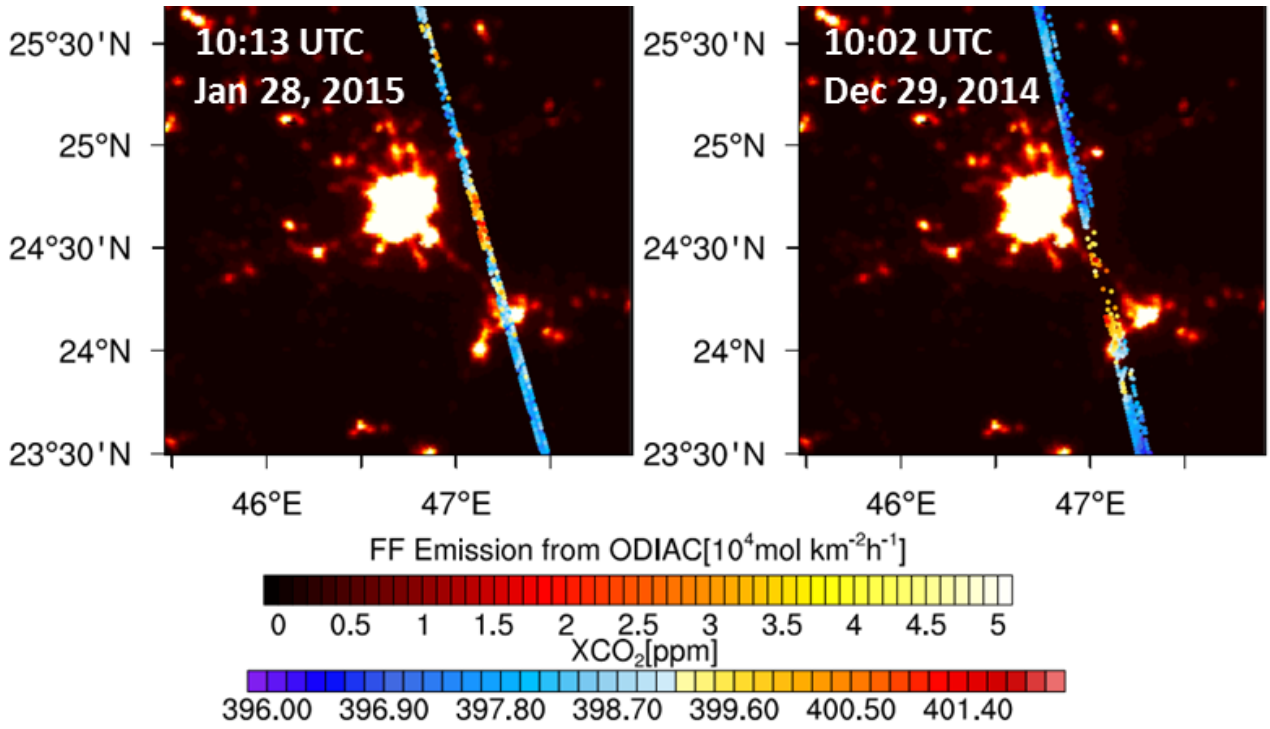

Figure 1. OCO-2 XCO_2 observations overpassing Riyadh, Saudi Arabia at about 10:13 UTC January 28, 2015 and 10:02 UTC December 29, 2014 and maps of urban CO_2 emissions for corresponding months derived from the Open-source Data Inventory for Anthropogenic CO_2 (ODIAC).