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CO₂ spatial distribution over Mexican urban centers from satellite observations

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The Mexico City Metropolitan Area (MCMA), located in proximity to an active volcano, is the largest urban center in North America and there is great interest to better characterize carbon emissions of this and other major urban centers in the country. NASA's Orbiting Carbon Observatory (OCO-3) was installed in the International Space (ISS) in 2019. The inclusion of a Pointing Mirror Assembly (PMA) in this third iteration allows for a new mode of data collection that samples an area of ~80 x 80 km in approximately 2 minutes. This mode is used to collect map-like data, called Snapshot Area Maps (SAMs), over areas of interest (e.g. volcanos or urban areas). The OCO-3 module has collected SAMs over the MCMA (and the Popocatépetl volcano) throughout 2020, and also of the metropolitan areas of Guadalajara and Monterrey throughout the second half of 2020.

Using data from the public release of OCO-3 Level 2 (L2) "Lite EarlyR" product, available at the Goddard Earth Sciences Data and Information Services Center (GES DISC), we have built maps of the spatial distribution of xCO₂ for these regions. Data is filtered according to the reported quality flag in the data product, compared with ground-based FTIR measurements of column xCO₂ over the MCMA region and averaged with an oversampling method. Surface pressure data with the averaged xCO₂ is used to calculate the concentrations within the mixed layer (xCO₂^{ML}) in order to compensate for the effects of the complex terrain. This product is also used for comparison with CO spatial distributions obtained from TROPOMI data products and a simple xCO^{ML}/xCO₂^{ML} ratio is obtained and mapped for the three urban centers. This work showcases the utility of SAMs in cooperation with ground-based measurements to produce detailed descriptions of the spatial distribution of CO₂ for a wide variety of applications, as well as the importance of frequent soundings over important emission sources around the world.