Evaluating the ability of the pre-launch TanSat-2 satellite to quantify urban CO_2 emissions

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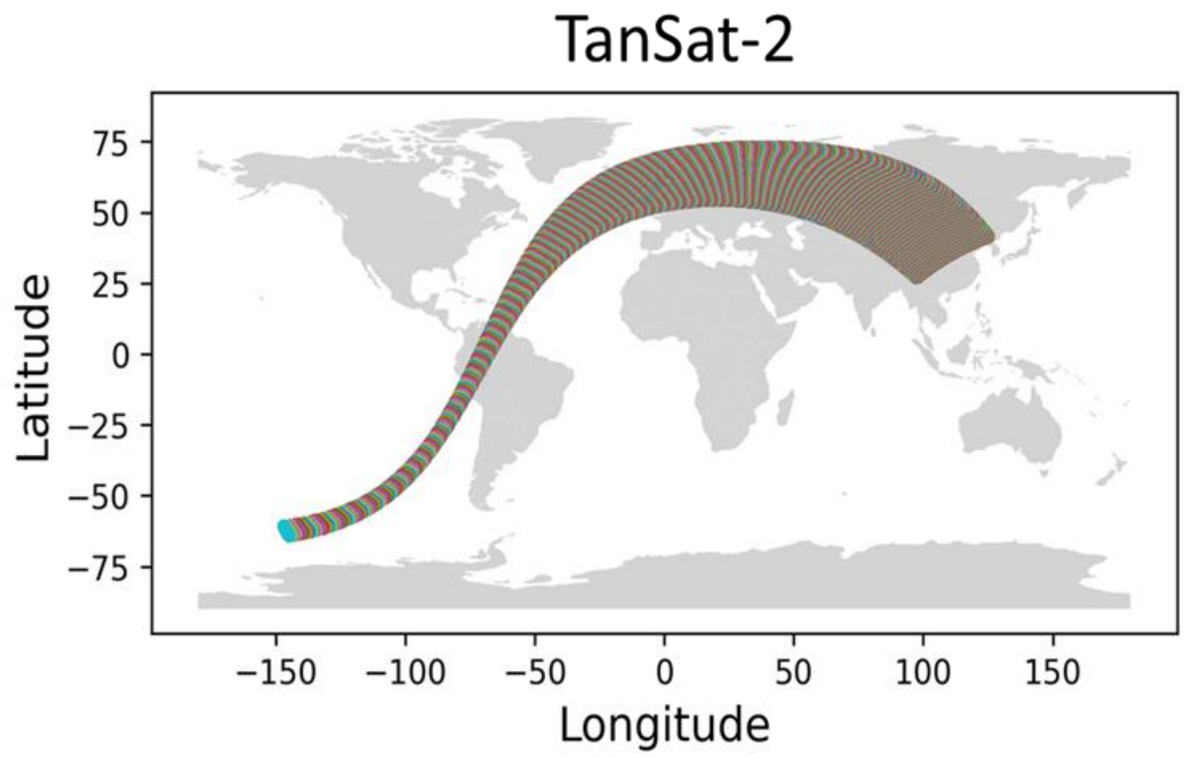
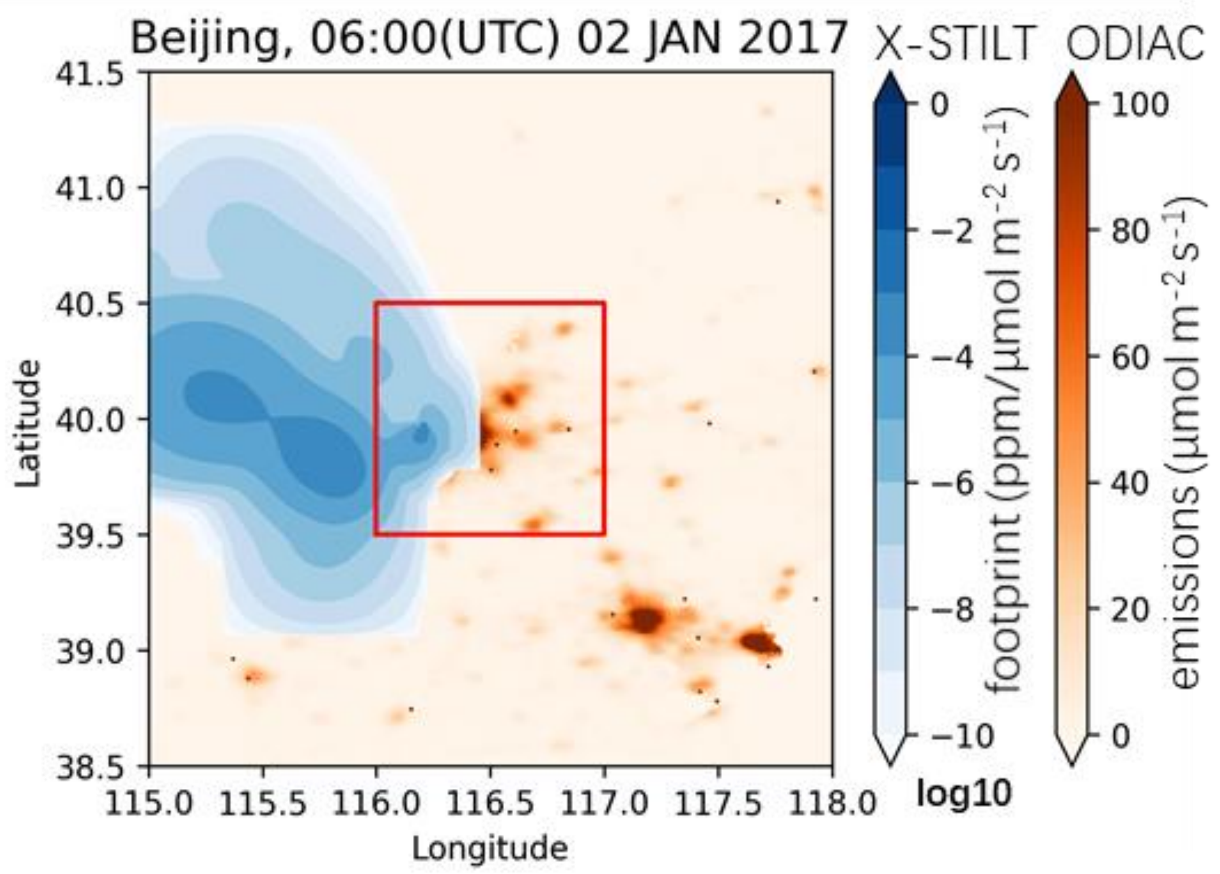
TanSat-2 is planned to launch in 2025 as a satellite cluster with 2 or 3 satellites measuring column averaged CO_2 (XCO_2) at 3000 km wide across-track swaths, with a pixel size of 2 km × 2 km. The precision of data is designed to be less than 1 ppm. It will fly in a medium Earth orbit (MEO) with an apogee of 7840 km and a perigee of 522 km.





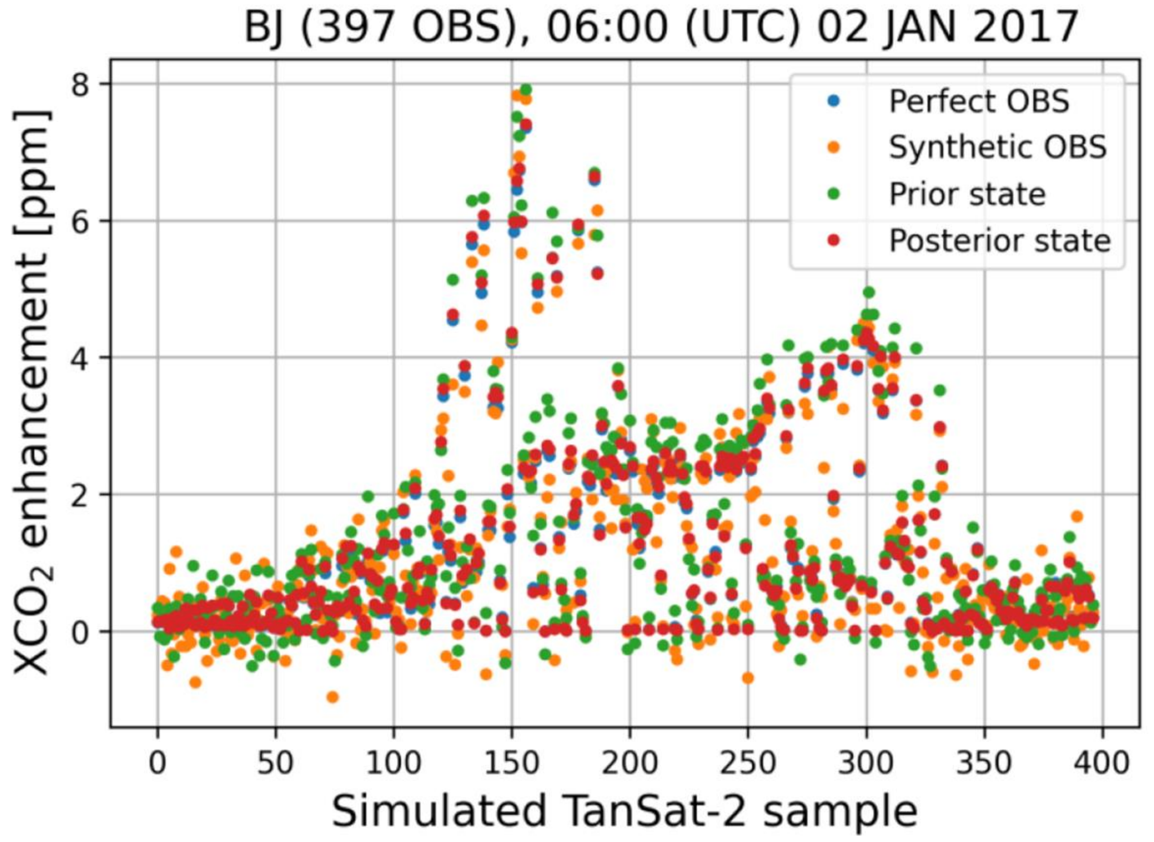
We investigate the theoretical potential of using TanSat-2 data to infer urban CO_2 emissions.

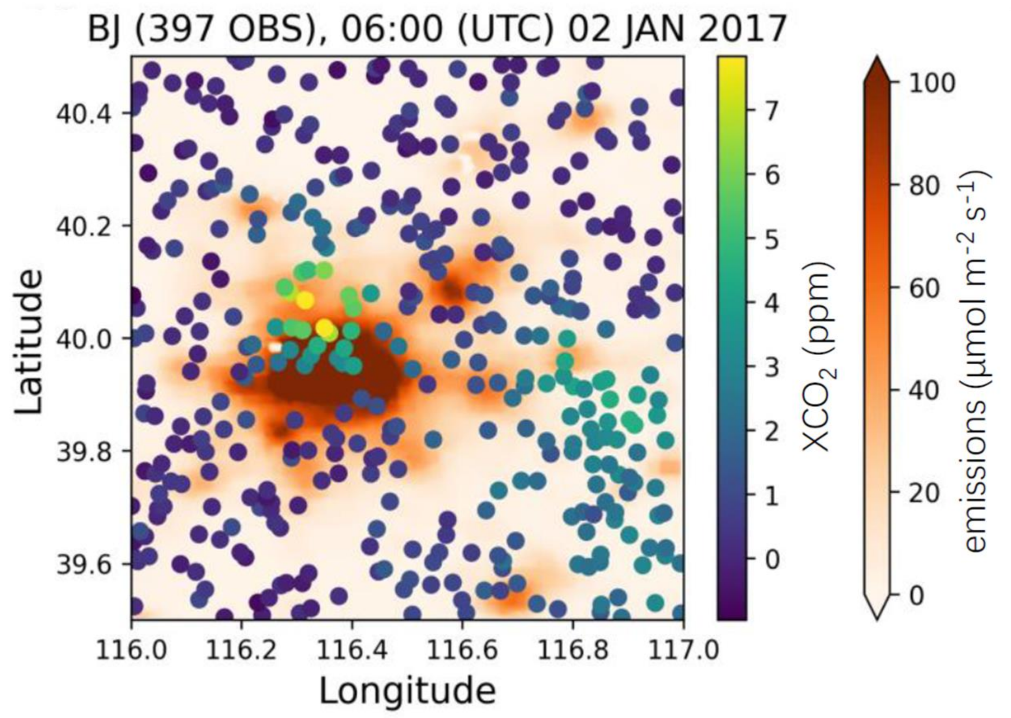
We test the impacts of sampling patterns and XCO_2 retrieval errors on reducing flux errors.

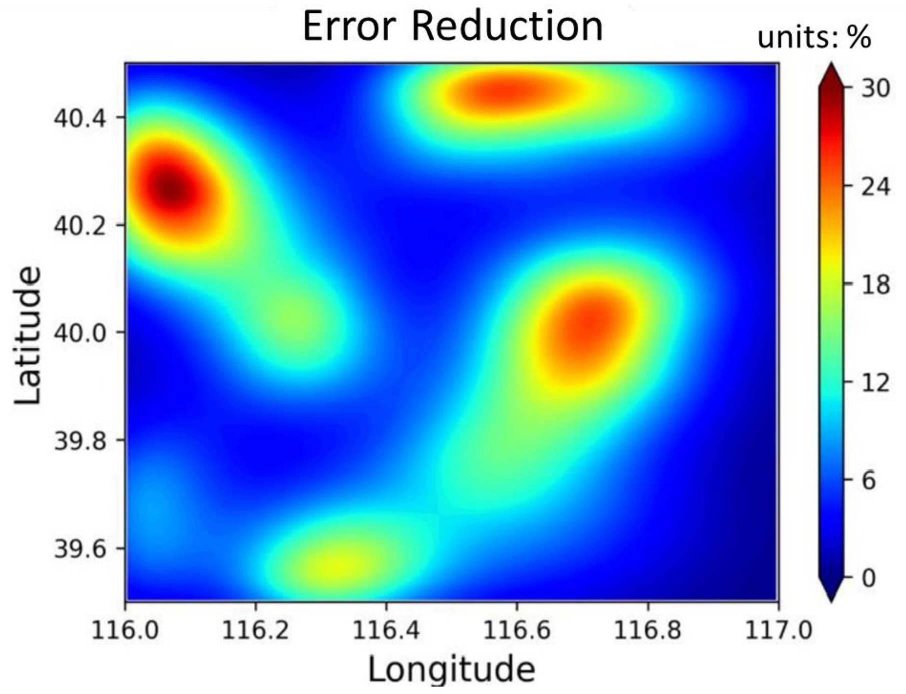
X-STILT and ODIAC are used to simulate synthetic data and build an urban CO_2 inversion system.

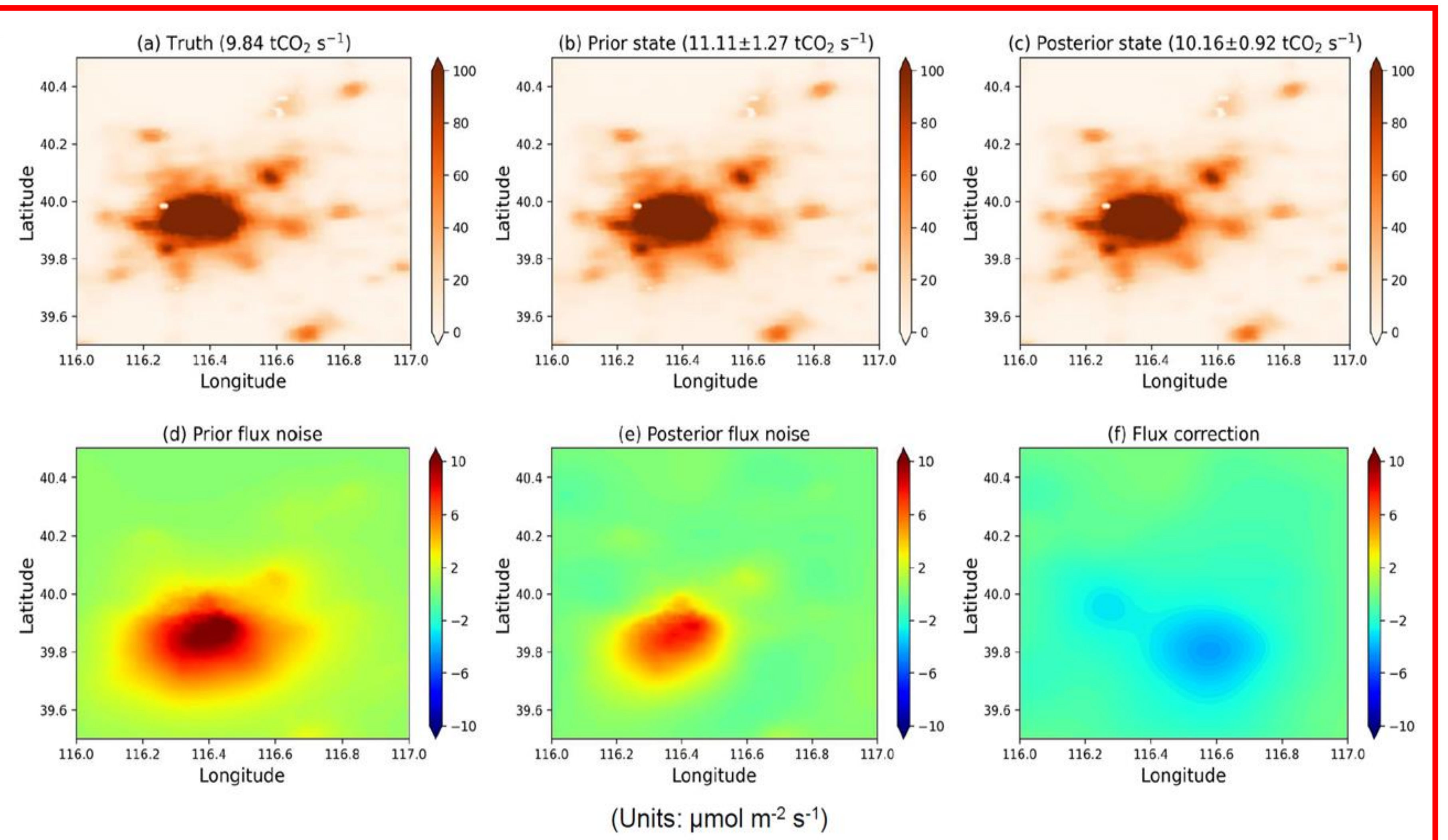
We simulate XCO_2 enhancements in Beijing (BJ) and assess the ability of using these data to optimize urban flux estimates.

ERA5 total cloud cover are used to identify cloud-free samples of the TanSat-2 satellite.









Results: Outside the growing season, assimilating cloud-free TanSat-2 data can correct prior flux noise with a 10-30% reduction in flux error as a function of measurement error and wind field.

Reduction in systematic and random flux errors is correlated with the signal-to-noise ratio of TanSat-2 satellite measurements.

Correction in systematic flux error is sizable assuming unbiased satellite samples.

Although satellite data can reduce flux errors for cities with high CO_2 emissions, there are many limitations and uncertainties in this issue.