Urban Greenhouse Gas Emission Monitoring in Seoul and Tokyo

Poster attendance:
July 12, 15 - 16 JST
July 13, 10 - 11 JST

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Background

In order to achieve carbon neutrality and counter the impacts of climate change, greenhouse gas (GHG) emissions must be reduced.

Urban and industrial areas contain various emission sources that contribute to the dispersion of GHGs. Seoul and Tokyo are two megacities with large GHG emissions and play an important role in mitigating climate change.

Objective

Diagnose the current conditions of GHG emissions in the urban atmosphere of Seoul and Tokyo. Set a starting point for continuous observations and verification of climate mitigation efforts in the Seoul and Tokyo megacities.

Campaign design

From February 14 to February 25, 2022, we deployed five EM27/SUN FTIR spectrometers from the COCCON network to observe CO_2, CO, and CH_4 concentrations simultaneously in Seoul and Tokyo. In Tokyo, the instruments were placed appr. 50 km apart to observe gradients on a regional scale. For Seoul, the distance between the spectrometers was 10 km to observe gradients on a smaller scale. Additional instrumentation include in-situ measurements, NO_2 column observations, mobile in-situ measurements in downtown Seoul and aircraft overflights in Seoul within the planetary boundary layer.

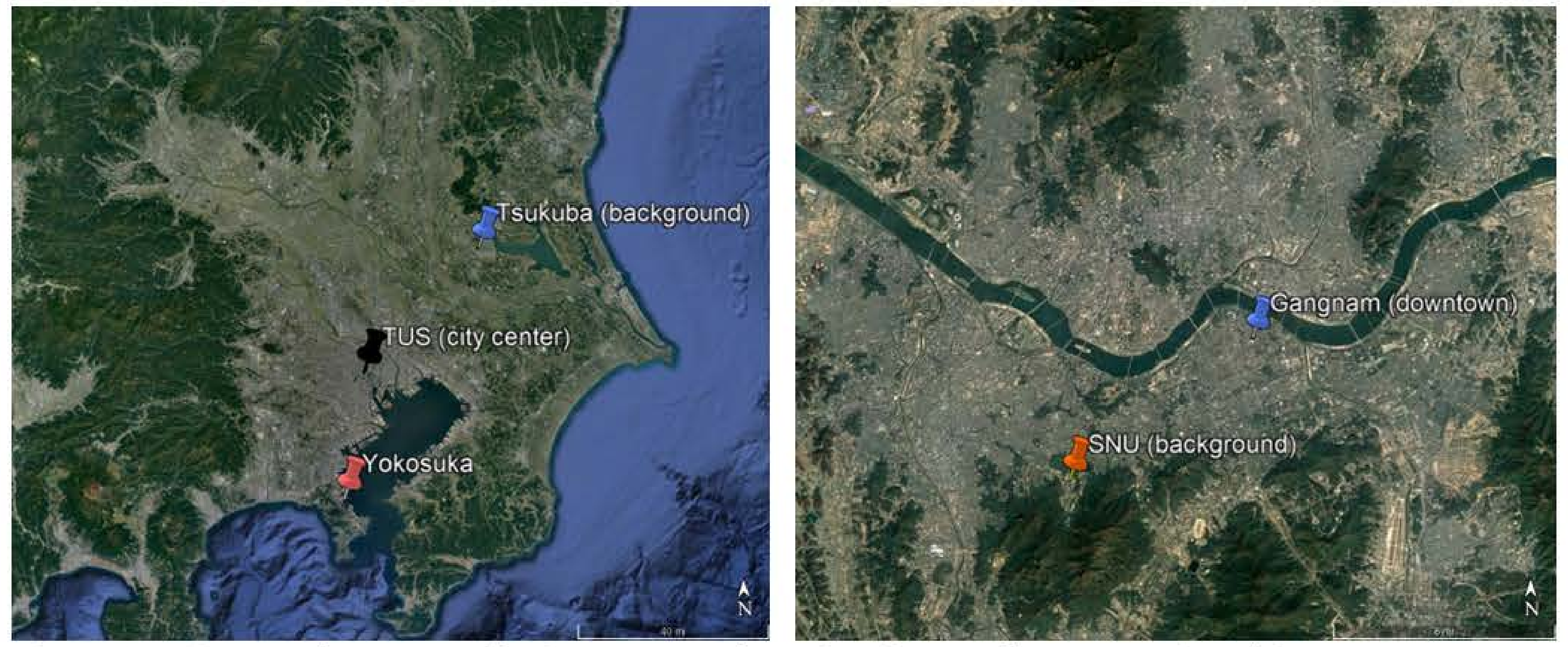

Fig. 1: Google earth image depicting the EM27/SUN measurement stations. Left side Tokyo, right side Seoul.

First results: Tokyo

Fig. 2 shows the XCO_2, XCO, and XCH_4 timeseries of the EM27/SUN observations. For most days, clear gradients for all gases are seen between the background site (blue dots) and the other two sites. The diurnal variability between the gases differs.

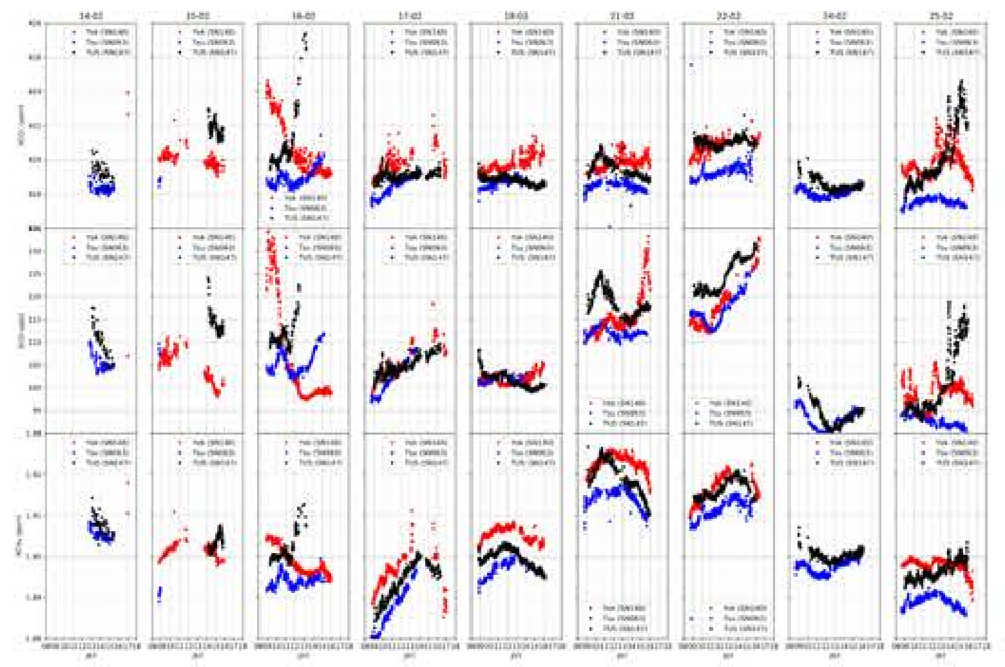

Fig. 2: Tokyo EM27/SUN X_{gas} timeseries.

For February 16, the day with the strongest diurnal X_{gas} variability, we compare the XCO_2 observations with a STILT simulation utilizing the ODIAC 2020 emission inventory (Fig. 3, Fig. 4). The model can adequately reproduce the observations.

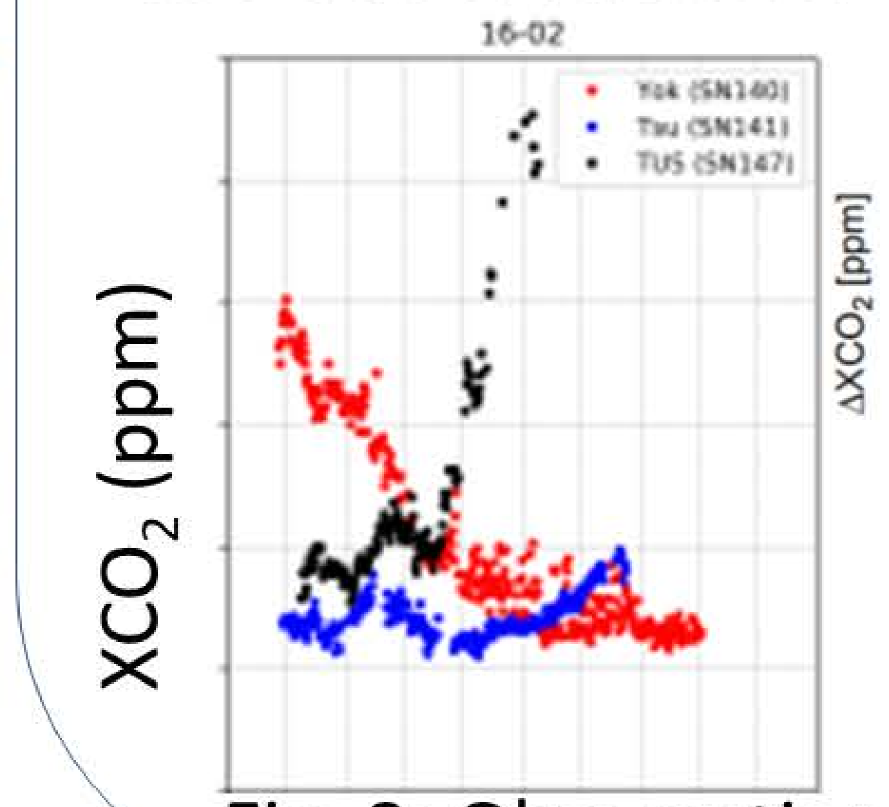

Fig. 3: Observations.

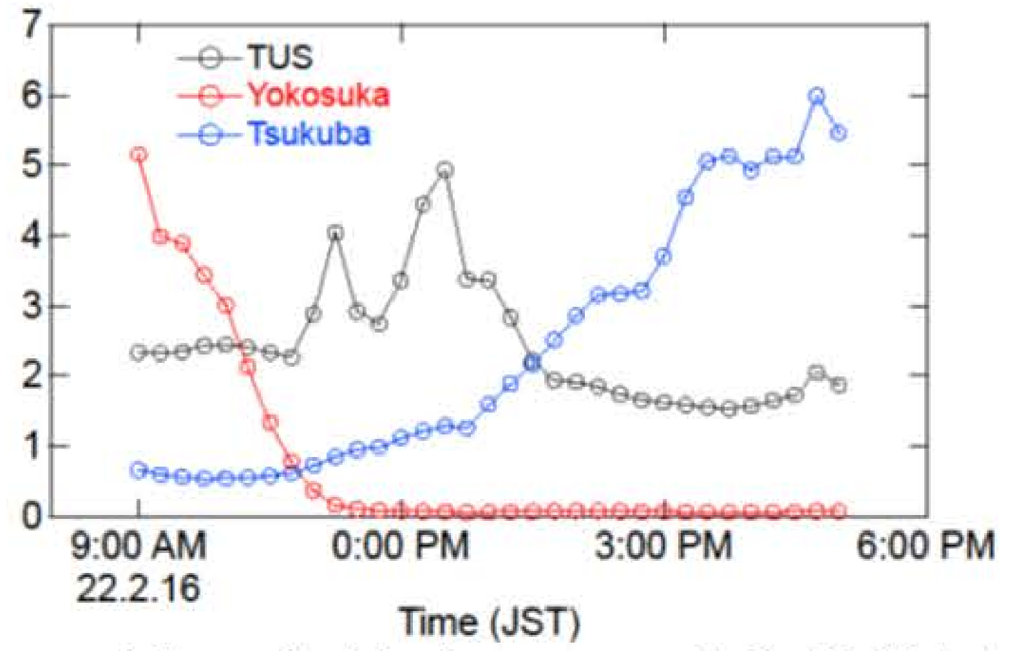

Fig. 4: February 16 STILT simulation.

First results: Seoul

Fig. 5 Shows the daily X_{gas} results.

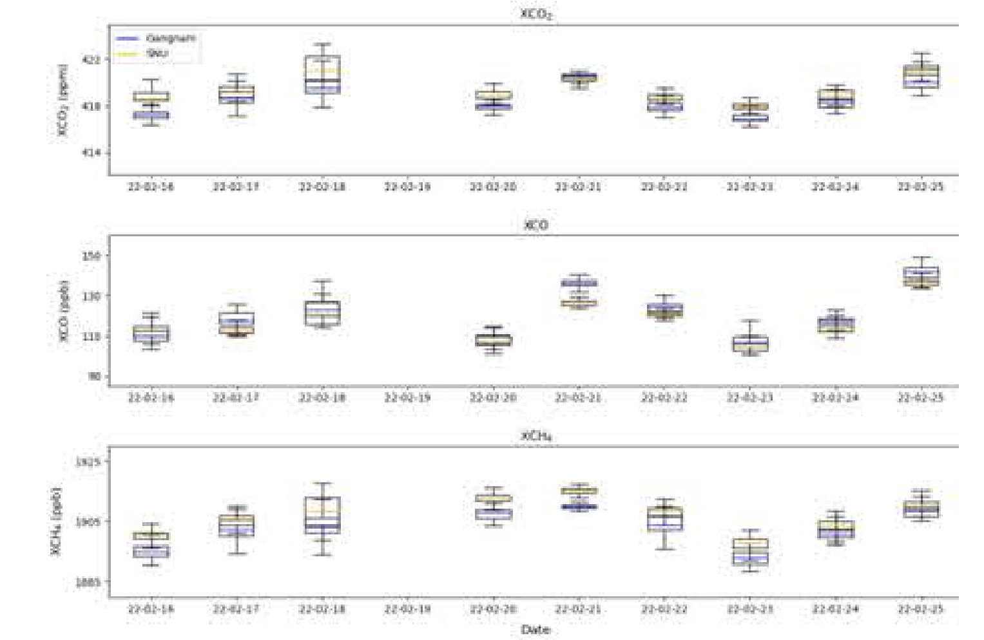

Fig. 5: Boxplots of the Seoul observations.

Additionally, in Fig. 6 we depict the averaged mobile in-situ CO_2 and Ch_4 measurements. CO_2 enhancements are defined using background observations from a tall tower.

Fig. 6: Mobile in-situ measurements.

Summary

We show observations from Seoul and Tokyo ranging from micro- to regional scale. First results indicate good agreement between Tokyo measurements and STILT model runs. Further analysis in progress…