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Remote sensing of trace gases as link between small and large scale pollution sources in the Ruisdael Observatory

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Greenhouse gases like CO₂ and CH₄ play an important role in the earth's energy budget. Both local sources and long range transport can influence their concentration in the atmosphere. Within the Ruisdael project, which aims to map and understand the atmosphere over the Netherlands in a changing climate, a trailer was fitted with a range of instruments for flexible operations within the Ruisdael Observatory measurement network, among them an EM27/SUN, on which we will focus here. This instrument is a portable Fourier transformation infrared spectrometer to measure the columnar abundance of the trace gases CO₂, CH₄ and CO from the spectral absorption of direct sun light. The additional CO measurements can provide valuable information for attributing CO₂ and CH₄ enhancements to either biological processes or fuel burning. The instrument was equipped with a custom build rain cover that is fixed to the moving sun tracker and set up for remote operation, which greatly increased data coverage. It was then installed on the roof of the Ruisdael trailer, along with several in situ instruments inside.

The EM27 was deployed in the Ruisdael trailer at the Cabauw tall tower site from May till September 2021. The RITA (Ruisdael Land-Atmosphere Interactions Intensive Trace-gas and Aerosol measurement campaign) campaign took place in and around the Cabauw tower in September 2021. During this time, additional measurements in the boundary layer by a mobile truck and an aircraft give the possibility of separating local and regional influences on the columnar trace gas abundance. Here, we present the results from the columnar trace gas measurements in the context of the large scale circulation and the in-situ measurements at the tower, with the mobile truck, and by aircraft. While the in situ measurements capture local pollution very well, only the larger pollution plumes are distinguishable in the EM27 data. The CO₂ columnar abundance is mostly influenced by the large scale circulation. In the columnar abundance of CH₄ and CO, larger pollution plumes are distinguishable as increases of up to several ppb. The presented measurements demonstrate how the EM27 can help to distinguish influences of local emissions and large scale transport in an urban monitoring network.