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Greenhouse gas column observations from a portable spectrometer in Uganda

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The natural ecosystems of tropical Africa represent a significant store of carbon, and play an important but uncertain role in the atmospheric budgets of carbon dioxide and methane. Recent studies using satellite data have concluded that methane emissions from this geographical region have increased since 2010 as a result of increased wetland extent, accounting for a third of global methane growth (Lunt et al 2019), and that the tropical Africa region dominates net carbon emission across the tropics (Palmer et al 2019). The conclusions of such studies are based on the accuracy of various satellite datasets and atmospheric transport models, over a geographical region where there are few independent observations available to check the robustness and validity of these datasets.

Here we present the first ground-based observations of greenhouse gas (GHG) column concentrations over tropical East Africa, obtained using the University of Leicester EM27/SUN spectrometer during its deployment at the National Fisheries Resources Research Institute (NaFIRRI) in Jinja, Uganda. During the deployment we were able to operate the instrument remotely, using an automated weatherproof enclosure designed by the Technical University of Munich (Heinle and Chen 2018, Dietrich et al 2020). The instrument ran near-continuously for a three month period in early 2020, observing total atmospheric column concentrations of carbon dioxide and methane, along with other gases of interest including water vapour and carbon monoxide. We describe the data obtained during this period, processed using tools developed under the COCCON project (COllaborative Carbon Column Observing Network, Frey et al 2019), and demonstrate the value of performing GHG column measurements over tropical East Africa. We then evaluate the performance of CO_2 observations from OCO-2 and CH_4 from Sentinel 5P TROPOMI - datasets previously used in the studies of Palmer et al 2019 and Lunt et al 2019 respectively - and interpret the comparison with the ground-based observations in the light of

data from the GEOS-Chem atmospheric chemistry transport model and the CAMS (Copernicus Atmospheric Monitoring Service) reanalyses.

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