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Multi-Angle Polarimeter observations supporting the Copernicus Anthropogenic CO_2 Monitoring (CO2M) Mission

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As part of the Copernicus Programme, the European Commission and the European Space Agency (ESA), are expanding the Copernicus Space Component to include measurements for anthropogenic CO_2 emission monitoring. The greatest contribution to the increase in atmospheric CO_2 comes from emissions from the combustion of fossil fuels and cement production. In support of well-informed policy decisions and for assessing the effectiveness of strategies for CO_2 emission reduction, uncertainties associated with current anthropogenic emission estimates at national and regional scales need to be improved. Satellite measurements of atmospheric CO_2, complemented by in-situ measurements and bottom-up inventories, will enable, by using advanced (inverse) modelling capabilities, the transparent and consistent quantitative assessment of CO_2 emissions and their trends at the scale of megacities, countries, and at global scale.

This presentation will provide an overview of the Copernicus CO_2 Monitoring (CO2M) mission and the role of aerosol. Operational monitoring of anthropogenic emissions requires high precision CO_2 observations (0.7 ppm) with, on average, weekly effective coverage at mid-latitudes. While the main measurements will be made by observing spectra in the NIR and SWIR for retrieving CO_2, the measurements will be complemented by (1) aerosol observations with a multi-angle polarimeter (MAP), to minimise biases due to incorrect light path corrections, and (2) NO_2 observations as tracer for high temperature combustion. Retrieval of CO_2 is further facilitated by a cloud imager, to identify measurements contaminated by low clouds and high-altitude cirrus. The presentation will first focus on the role of MAP for improving CO_2, which was supported by a study of Rusli et al [1] and provide the outcomes from a recent science study that confirms these earlier results and show that observations significantly improve by adding MAP observations in the retrieval of CO_2 lowering its bias and enhancing the data yield. Then an overview of the MAP instrument architecture will outline the way the generated observations are used in the product generation. Finally, the presentation is an opportunity to give the implementation status of the Copernicus CO2M space segment, as keystone of the future global CO_2 stocktake.

References

[1] Rusli, S. P., Hasekamp, O., aan de Brugh, J., Fu, G., Meijer, Y., and Landgraf, J.: Anthropogenic CO2 monitoring satellite mission: the need for multi-angle polarimetric observations, *Atmos. Meas. Tech.*, 14, 1167–1190, https://doi.org/10.5194/amt-14-1167-2021, 2021.