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Portable Automated Enclosure for a Spectrometer Measuring Greenhouse Gases

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The column concentrations of greenhouse gases can be measured by ground-based spectrometers using the sun as light source. For that purpose the compact solar-tracking FTIR spectrometer EM27/SUN from Bruker has been utilized. Operating just one of those devices is already labour-intensive, as an operator has to be on site during the measurement time.

In order to determine the emissions in a certain area, the differential column measurement method can be used [1]. It requires several spectrometers leading to significant increase of the personnel costs. Therefore, for realizing a long-term monitoring sensor network consisting EM27/SUN, it is essential to have automated protection enclosures, which can undertake the tasks of the operators. This includes protecting the spectrometers against harmful weather conditions and maximizing the amount of measurement data. It is realized by opening the enclosure and starting the measurements automatically when it is sunny. The enclosure will close and measurements will stop when bad weather occurs or there is not enough sunlight.

We have developed two generations of automated protection enclosures. The first enclosure has been deployed in central Munich for greenhouse gas monitoring for 1.5 year as a stationary measurement site and withstood all critical weather conditions [2]. Special features in the second generation are portability, increased safety and reliability, and cost reduction. Furthermore, it should be a preparation for small-scale production to also allow other institutes to use such an automated GHG measurement station. To that end, industrial components are used.

The functionality of the portable enclosure has been verified during a six week Munich measurement campaign in September and October 2017. It can be carried up easily to the measurement locations on rooftops as it is lightweight (about 30 kg) and simple to transport. In comparison to the first generation 60 % of weight have been saved. Furthermore, the enclosure is completely waterproof. During the period of over one month with diverse harsh weather conditions no water could be detected inside. Additionally, the used components have worked without any malfunction during the campaign period. Thanks to the automated protection enclosures, multiple stations were operated at the same time by a single remote operator while the daily setup and dismantling efforts were reduced to zero.

To conclude, a reliable enclosure has been developed which can serve for a stationary as well as for a mobile GHG measurement station. It provides a foundation for a fully automated GHG observing system.

[1] J. Chen, C. Viatte, J. K. Hedelius, T. Jones, J. E. Franklin, H. Parker, E. W. Gottlieb, P. O. Wennberg, M. K. Dubey, and S. C. Wofsy. Differential column measurements using compact solar-tracking spectrometers. Atmospheric Chemistry and Physics, 16(13): 8479–8498, 2016.

[2] L. Heinle and J. Chen. Automated enclosure and protection system for compact solar-tracking spectrometers. Atmospheric Measurement Techniques Discussions, https://doi.org/10.5194/amt-2017-292