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Advances and results of two novel sensors for Surveying the Atmospheric Carbon Cycle

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We will present the preliminary results of the CarbonSurvey project (Towards the Next Generation of Sensors for Surveying the Atmospheric Carbon Cycle). As outlined by the European Commission green report in the framework of the Operational Anthropogenic CO2 Emissions Monitoring and Verification Support (MVS) capacity, the existing ground-based networks currently do not meet all the operational requirements for the Copernicus CO2 MVS capacity due to the lack of in situ measurement data from urban areas and other emission hot spots. The main expected contribution of this project is to address this weakness through the development of a new generation of instruments to enable unprecedented CO2 monitoring capabilities, the biggest GHG contributor to human-caused global warming. The necessary scientific and technical contributions required to reach the main goal of the project involve two complementary developments: (i) firstly, a gas analyzer capable of obtaining the vertical profile (with resolution in altitude) of CO2 concentration. The system, which is based on the Laser Heterodyne Radiometry (LHR) technique, will operate from the Earth's surface analyzing the effect in the spectrum of the received sunlight of the atmospheric components to accurately find the distribution of the concentration of CO2 in the atmospheric column. Thus, this instrument will provide a characterization of the CO2 in the atmospheric volume located above the measurement site. Secondly, (ii) the project aims to develop Photacoustic Spectroscopy (PAS) cost-competitive photonic solution for in situ urban GHG measurements. As a main difference with today’s commercially available instrumentation, the system proposed, based on a compact photoacoustic sensing cell, will combine small-size, high sensitivity, and a straightforward field deployment capacity. This directly enables the possibility of providing an accurate, and potentially gap-free, map of the concentration of gases at ground level. These two sets of instruments provide indeed complementary information for a full reconstruction of the map of CO2 around the areas of interest. It is important to remark that both instrument designs will be equipped as well with an important additional feature: the ability to determine the isotopic fingerprint of CO2 in order to discern between natural and anthropogenic CO2 sources, such as fossil fuel combustion or biogenic respiration.

The CarbonSurvey project is funded by the Spanish State Research Agency, it started December 2022 and last until November 2024. We will present the sensors design and the preliminary laboratory results. By the end of the project, we will have both sensor prototypes fully operational

and calibrated at the Izaña Atmospheric center. Moreover, the sensing systems will be specifically designed for a straightforward in situ deployment in different areas of interest, providing full coverage of the most important blind spots existing today. This new generation of sensors could establish the necessary basis to guide decision-making policies in the green transition process ahead.