Real-time Measurements of Gaseous and Particulate Emissions from Livestock Buildings and Manure Stores with Novel UAV-based System

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**Abstract.** In the framework of the European environmental policies towards a green transition, the adoption of strategies improving the sustainability of the agricultural system is a key element. When planning actions requiring efforts and investment for the farm enterprise, ensuring the efficacy of these measures becomes crucial. In a perspective of adaptive management where a continuous monitoring process is implemented to meet the goal of environmental and economic sustainability of food productions, new tools need to be developed to provide cost-effective and real time measurements. In this context, a novel system based on Unmanned Aerial Vehicles (UAVs) and on prototypical ground stations equipped with low-cost sensors was designed and developed. The system is based on a flexible architecture which can be adapted to a variety of operational fields and is organized in four levels: 1) sensors; 2) data transmission; 3) data collection, storage and analysis; 4) data presentation. A portable measurement unit was developed to be employed both at ground and as payload on a quadcopter drone. The unit is provided with a sensor board to monitor environmental conditions, gaseous pollutants and particulate matter. The whole system is designed to measure gaseous and particulate concentrations both at specific sites inside or around housing facilities and near known emission sources as manure or feed storage buildings, with the aim to detect emission hotspots and to provide real-time graphic alerts by means of a web-app once preset concentration threshold are exceeded. A prototype version of the system was tested in a commercial dairy farm to assess the feasibility of the project. The results obtained during the field tests confirmed that the designed system can be implemented at farm level, given that further research is required to validate field measurements with reference instruments and techniques.