INSIGHTS ON UAV-BASED METHODS FOR DUST AND GAS EMISSIONS MEASUREMENT: SENSING TECHNOLOGIES AND PROTOCOLS IN THE PERSPECTIVE OF RAPID ON-FARM ASSESSMENTS

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Abstract:

UAV-based techniques for atmospheric chemical sensing have been increasingly investigated as an alternative to traditional methods for emission determination, as evidenced by the exponential growth of applied research in recent years [1]. The need for rapid detection and quantification of gaseous losses has prompted research mainly in the oil and gas industry sector, to help applying targeted mitigation strategies. A similar concept could be transposed to livestock farming, where the rapid identification of critical emitting processes and their quantification is crucial to adopt precision mitigation practices and to assess farm-based environmental performances. In this context, we investigated and tested approaches based on unmanned aerial vehicle sensing for the assessment of dust and gaseous emissions at the farm level. The aim of this contribution, thus, is to provide a comprehensive view on the perspective of their applications in the livestock sector. First, for sensing technologies to use on-board UAVs, a trade-off between their sensitivity and accuracy and the need comply with the drone's payload capacity is required. Among the commercially available technologies, electrochemical and non-dispersive infrared sensors were largely employed on UAVs for their low cost and weight [2], although they may not always represent an adequate solution for on-farm surveys in terms of accuracy of measurements and sensitivity of the sensor. Optical analysers offer better perspectives of application due to the quality of measurements, although their cost and size are possible points of weakness. The second key aspect influencing the effectiveness of the surveys and the reliability of the results involves the sampling protocol, with special attention to the identification of the optimal flight pattern designs. Finally, the choice of the modelling approaches for the quantification of emissions, which must consider their specific assumptions, encompasses several categories of models. In literature, optimization based models and mass-balance based models were adopted to estimate gaseous emission using UAVs as sensing platforms. Besides the evidences of the literature review, the outcomes of an experimental application of a prototype multi-sensor system for in-flight and ground based dust and gas measurements in dairy farms is presented and discussed.

References:

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