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IDENTIFYING AND QUANTIFYING POINT SOURCE GREENHOUSE GAS EMISSIONS: A REVIEW OF TRADITIONAL AND MACHINE LEARNING METHODS

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As part of the Paris Agreement, the European Union pledged to become the first climate-neutral society by 2050. The Corporate Sustainability Reporting Directive (CSRD) and European Sustainability Reporting Standards (ESRS) were introduced to support this goal. These regulations are driven by the steady rise in atmospheric greenhouse gases (GHG), with carbon dioxide increasing by more than 2 ppm annually over the past 12 years.

This review aims to analyze methods for identifying and quantifying GHG emissions using hyperspectral data. The research methodology involved systematic review, combining traditional approaches and AI-based tools like LitMap and advanced large language models to streamline the analysis. Altogether, 235 publications were selected and 53 analysed.

A review of the literature indicates that the most widely used methods for GHG determination include the matched filter (MF) and the iterative maximum a posteriori method based on differential optical absorption spectroscopy (IMAP DOAS). Both have been widely used for more than a decade, however, as the analysed studies indicate, determining the extent of the GHG cloud using these techniques faces difficulties, especially in morphologically diverse areas.

Recently, interest in machine learning methods, particularly deep learning techniques, has increased. Whereas, few scientific papers have addressed the effectiveness of GHG determination using traditional methods (like MF) versus machine learning methods. The results of existing studies suggest that deep learning techniques are capable of significantly improving the accuracy of identification of GHG emissions.

The literature review underscores the need for further research on applying machine learning methods in GHG emissions monitoring.