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LIMITS ESTIMATING METHANE EMISSIONS FROM AN UNCOVERED PIG SLURRY LAGOON

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THE PROJECT

- The present study has been carried out within the project **LIFE CLINMED-FARM** (LIFE20 CCM/ES/001751 - www.lifeclinmed.eu)
- The project aims to develop **resource-efficient and sustainable slurry management** at farm-scale for approaching **climate-neutral models** in Mediterranean area farms.
- The project **design** is the case-control approach **in the 3 three main stages of the manure management chain** (production, storage, and fertilisation).
  - **Control**: **traditional agricultural practices**.
  - **Case**: **simple but innovative techniques** in line with BATs.

INTRODUCTION AND OBJECTIVE

Around **40% of the anthropogenic methane** (CH_4) **emissions come from agriculture**, the sector with the largest contribution to these emissions (IEA, 2023). It is mostly produced in the **digestion of livestock ruminant animals** and in the **storage facilities for manure**.

The study **aims** to **estimate CH_4 fluxes emitted from the uncovered pig slurry lagoon** (control scenario) and learn about the used methodology, determining its weaknesses for improvement in the subsequent measurements.

MATERIALS AND METHODS

- CH_4 emissions were **estimated** based on:
  - **Air CH_4 concentration** over the lagoon. It was measured every second by a gas analyser based on open-path tunable diode laser absorption spectroscopy in summer and autumn 2023 for three four-day periods.
    - The analyser was placed **downwind in the lagoon surroundings** with the laser path **perpendicular to the wind** direction.
    - Average **background** air CH_4 concentration measured in the days before each campaign **in the farm surroundings** far away from any CH_4 sources.
  - **Backward Lagrangian stochastic inverse dispersion model** (WindTrax software).
  - **Meteorological data** (recorded by a ClimaVUE™50 weather sensor).
- **Laser data were filtered** to discard poor and non-reliable measurements; that is, removing and interpolating these values.

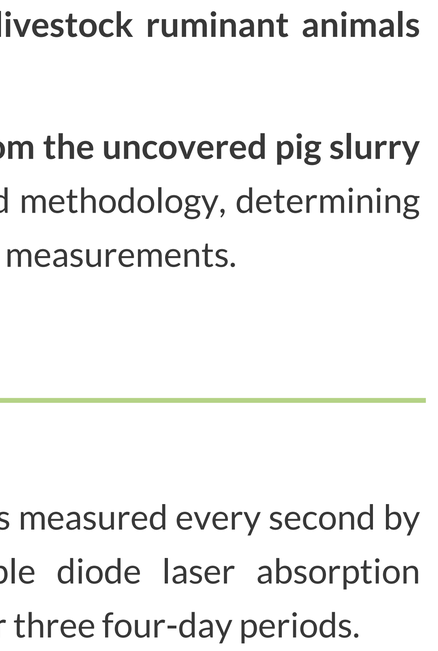

Fig.1. Gas analyser measuring air CH_4 concentration over the lagoon.

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RESULTS AND DISCUSSION

Farm-lagoon layout (Fig. 2) hindered CH_4 emissions quantification at low wind speed conditions (<2 m s^{-1}), frequently detected at night due to strong atmospheric stability; thus, these data were filtered. Cross-contamination episodes were observed in these conditions probably driven by the close animals' buildings in the surrounding farm area.

Fig.2. Farm-lagoon layout and analyser position depending on the wind direction.

In the bibliography, low touchdown values are considered not credible (Ro *et al.,* 2013). **Touchdowns <22%** were detected at dawn, presumably because the **first light of day** triggered changes in wind movement under the study conditions. This moment **coincided with pig slurry removal activities from the lagoon** for agricultural fertilisation when a stirrer was used and huge amounts of CH_4 were released into the atmosphere. **If the filtering criterion is applied** (exclusion and interpolation), **this CH_4 emissions peak is overlooked**; however, its contribution to total emissions is notable (Fig. 2).

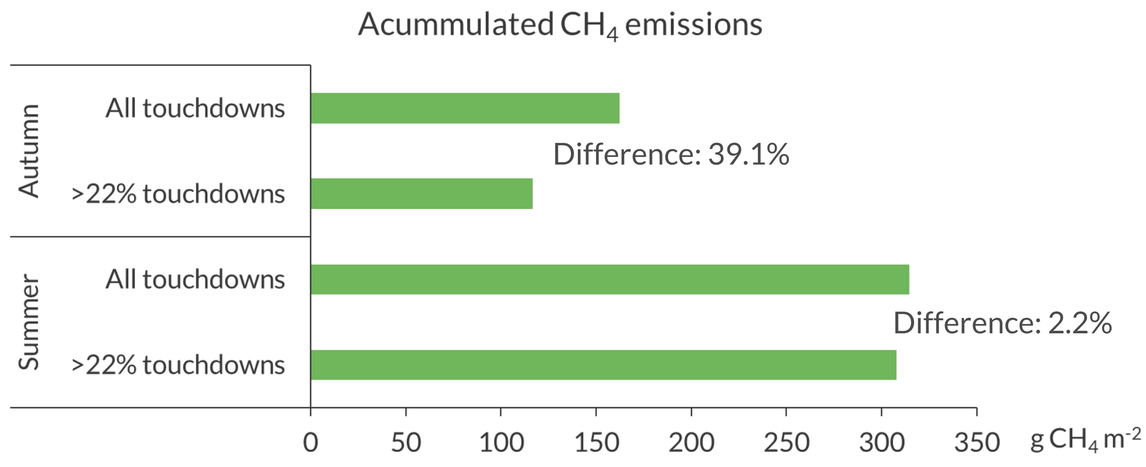

Fig. 2. Cumulative CH_4 emissions during the studied period and for the different filtering criteria.

In **summer**, the contribution of CH_4 **flux peaks** derived from slurry stirring **was probably concealed because of the greater average fluxes** associated with higher temperatures throughout that campaign in comparison to autumn.

CONCLUSION

LIFE CLINMED-FARM provides information for a **better understanding** of CH_4 emissions from uncovered lagoons and the **evidence of limiting factors for obtaining reliable estimations in field measurements at farm-scale**.

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IEA (2023). Global Methane Tracker 2023, International Energy Agency (December 13, 2023).

Ro K.S., Stone K.C., Johnson M.H., Hunt P.G., Flesch T.K., Todd R.W. (2014). Optimal sensor locations for the Backward Lagrangian stochastic technique in measuring lagoon gas emission. J. Environ. Qual., 43, 1111-1118.