METHANE FLUX MEASUREMENTS ON MULTIPLE SCALES IN AN AGRICULTURAL LANDSCAPE: LINKING TALL TOWER FLUX MEASUREMENTS WITH SHORT EDDY COVARIANCE TOWERS

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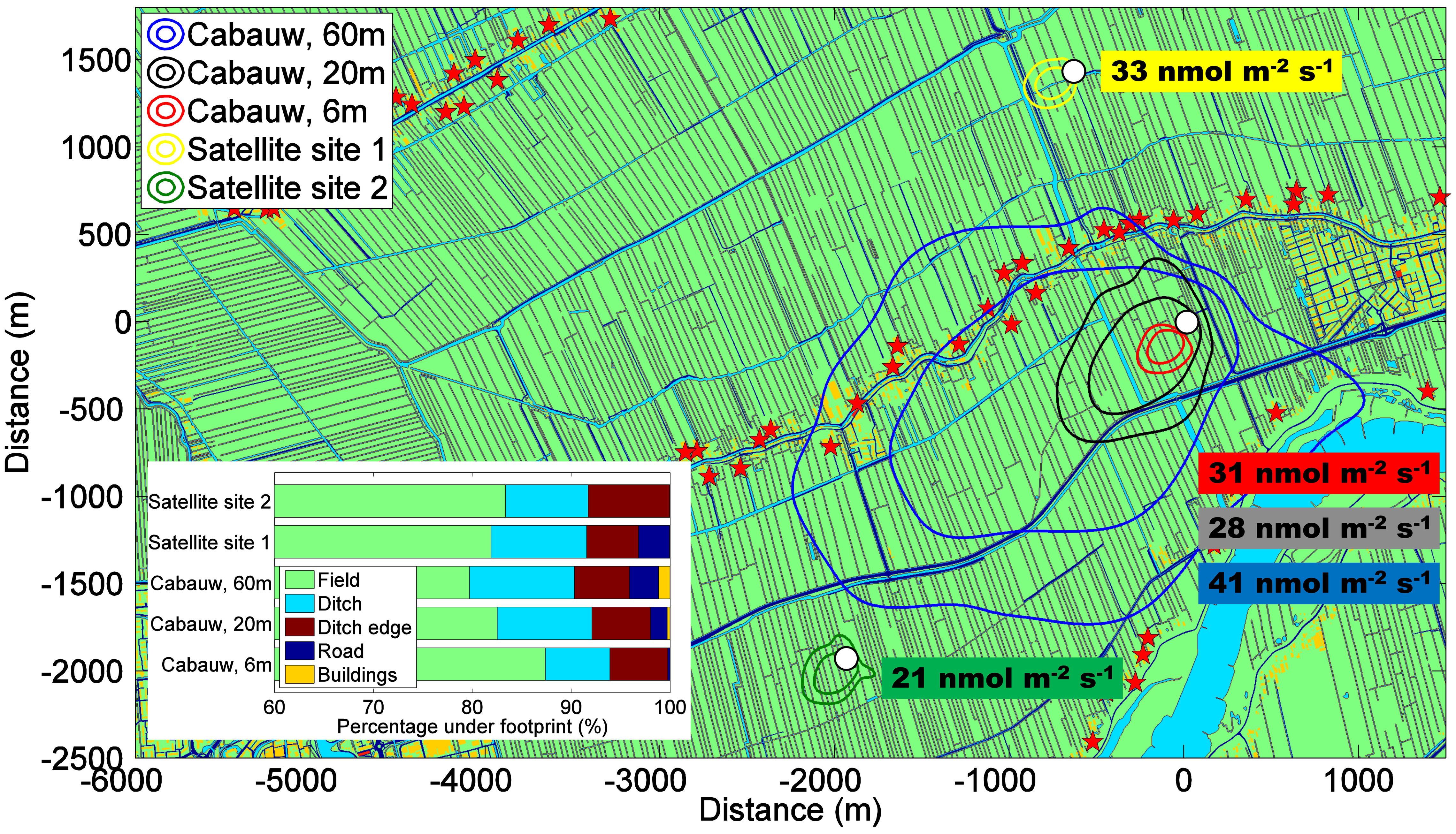


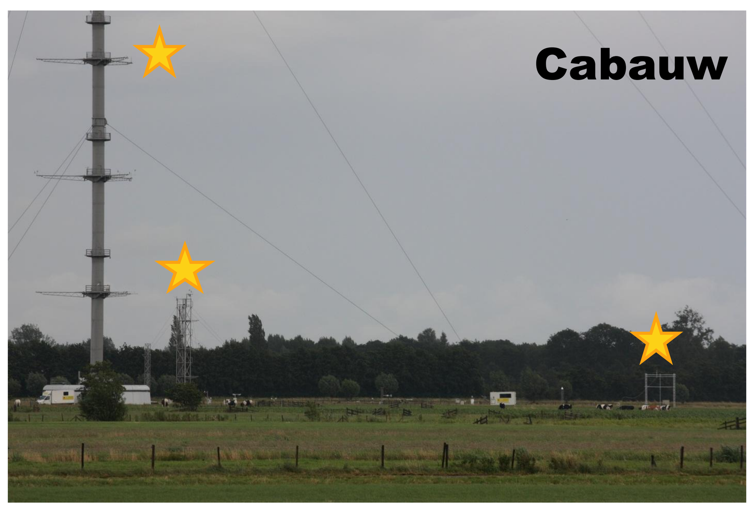
Figure 1: Cumulative footprints, i.e. source areas, for different flux measurement locations. Footprints were calculated based on Kljun et al. (2004). 80th and 60th percentile curves are shown, meaning that 80 % (60 %) of the measured signal originated from within the shown area. Land cover map was created using TOP10 vector product [5]. White dots show the tower and red stars show the farm locations. Average flux levels are also shown in the plot. Inset: percentage of different land use elements within the footprints on average.

INTRODUCTION

Eddy covariance (EC) method is nowadays widely used to study surface-atmosphere exchange in various ecosystems and conditions [1]. The method integrates surface fluxes over certain source area, called footprint, which is usually few hectares. The measured fluxes are often upscaled to represent the fluxes at the surrounding landscape. In this study it is tested whether this upscaling procedure is valid for methane in an intensively managed agricultural landscape (07/2012 in Cabauw, the Netherlands). Peaty soils in the landscape constitute a major CH_4 source with hotspot emissions originating from drainage ditches and ditch edges between the fields [3, 4]. Furthermore, strong CH_4 emissions from the farms complicate the overall emission patterns in this landscape.

CH_4 FLUXES AT THREE HEIGHTS

- CH_4 EC fluxes were measured at three levels (6m, 20m & 60m) at the Cabauw site
- Flux source areas increased significantly with increasing measurement height (Figure 1).
- 60 m level fluxes are strongly affected by farm emissions (Figure 2).
- CH_4 emissions from each farm were estimated based on information obtained about the farms [6], in addition to ruminant CH_4 emission factors. Using footprint modelling, effect of these emissions to 60 m level flux measurements were approximated (Figure 2 & 3)



Cabauw site
60 m height: Gill R3 + FGGA gas analyser (Los Gatos Research)
20 m height: Gill Windmaster Pro + G1301-f gas analyser (Picarro Inc)+ FMA gas analyser (Los Gatos Research)
6 m height: METEK USA-1+ G2311-f gas analyser (Picarro Inc.)

Satellite site 1
6 m height: METEK USA-1 + FMA gas analyser (Los Gatos Research)

Satellite site 2
6 m height: Gill Windmaster Pro + DLT-100 gas analyser (Los Gatos Research)

ACKNOWLEDGEMENTS

The research leading to these results has received funding from the European Community's Seventh Framework Programme (FP7/2007-2013) in the InGOS project under grant agreement n 284274. Also support from Magnus Ehrnrooth Foundation, by the Academy of Finland Center of Excellence program (project no 272041) and the Nordic Center of Excellence DEFROST are greatly acknowledged.

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[5] https://www.pdok.nl/
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Integrated non-CO2 Greenhouse gas Observing System

CH_4 FLUX VARIABILITY BETWEEN SITES

- On average 30% lower CH_4 fluxes were observed at the Satellite site 2 than at the two other sites (Figure 1 & 3)
- The difference between sites cannot be explained by different land use within the source areas (inset in Figure 1).
- Effect of environmental variables (WTD, soil T) needs to be studied

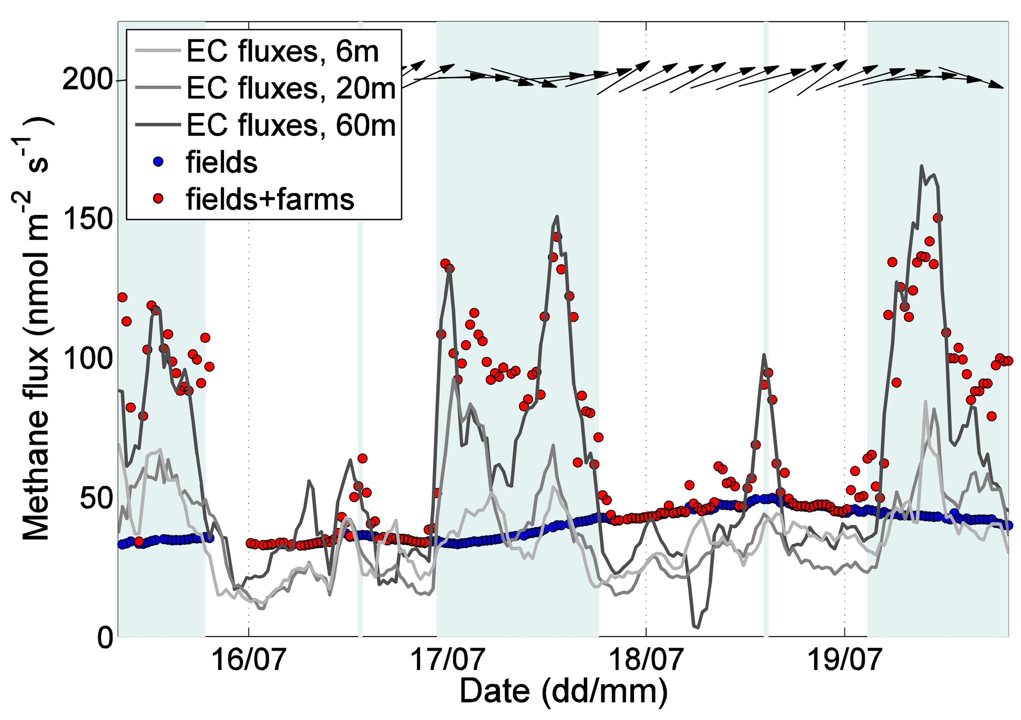

Figure 2: Time series of CH_4 EC fluxes measured at the Cabauw station (lines) and modelled CH_4 fluxes within 60 m level footprint (dots). Arrows at the top of the figure show wind direction and light blue areas highlight periods with farm emissions.

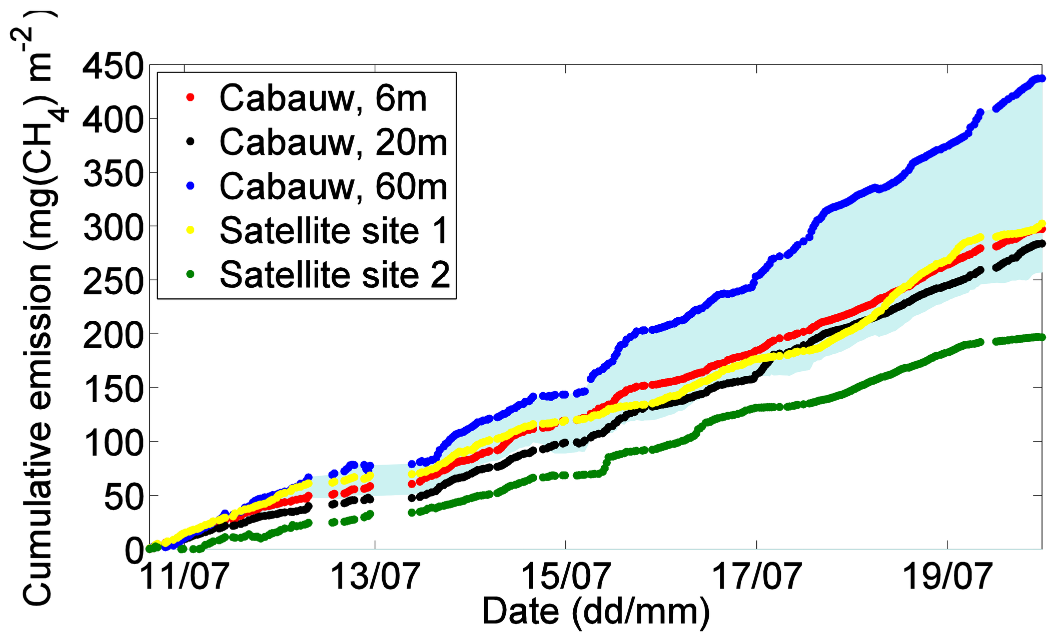

Figure 3: Cumulative CH_4 emissions during a part of the campaign (from 11th to 20th of July). Light blue area shows the effect of farm emissions to 60 m level fluxes.

SUMMARY

- CH_4 fluxes were measured at three different locations and at three heights at one location during July 2012 in Cabauw, the Netherlands
- Effect of farm emissions were successfully estimated with footprint modelling => This result highlights the importance of proper footprint analysis when measuring fluxes at a landscape with complex emission patterns
- After removing the farm effect, **tall tower fluxes agree with short tower fluxes**

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