

Influence of constructed wetlands on global warming



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1. Introduction

- 2.3 billion people does not have access to sanitation. In developing countries sanitation coverage is below 50% in many countries in Southern Asia and Sub-Saharan Africa;
- Such countries require simple and low-cost solutions for wastewater treatment to support effective sanitation;
- In this scenario, constructed wetlands are considered an economical and efficient option for wastewater treatment systems, since a great range of effluents can be used in this system, as well as different kind of vegetation to achieve satisfactory results.
- Woody species: good adaptation to wetlands, high organic matter removal, high nutrient accumulation and can work as a sink for CO₂.

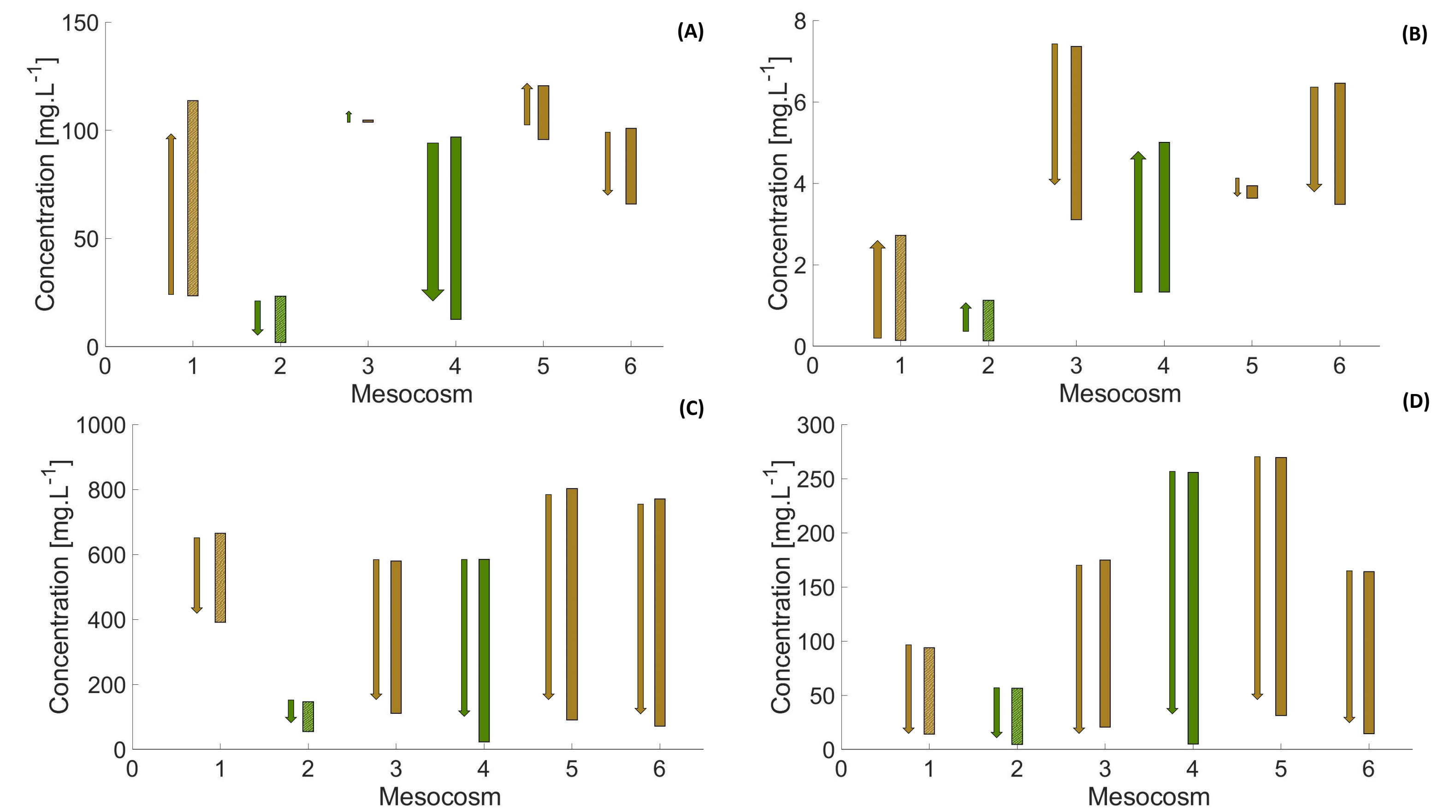
2. Objectives

- Quantify removal of common pollutants such as Ammonia, Orthophosphate, COD and TOC. from a synthetic secondary wastewater;
- Measure methane emission by the different parts of the mesocosm: trees and soil.

Table 1. Flume Map

Mesocosm	Flood Regime	Flood:Dry (Days)	Planted/Control
1	Intermittent	2:1	Control
2	Steady	-	Control
3	Intermittent	2:1	Planted
4	Steady	-	Planted
5	Intermittent	1:2	Planted
6	Intermittent	2:2	Planted

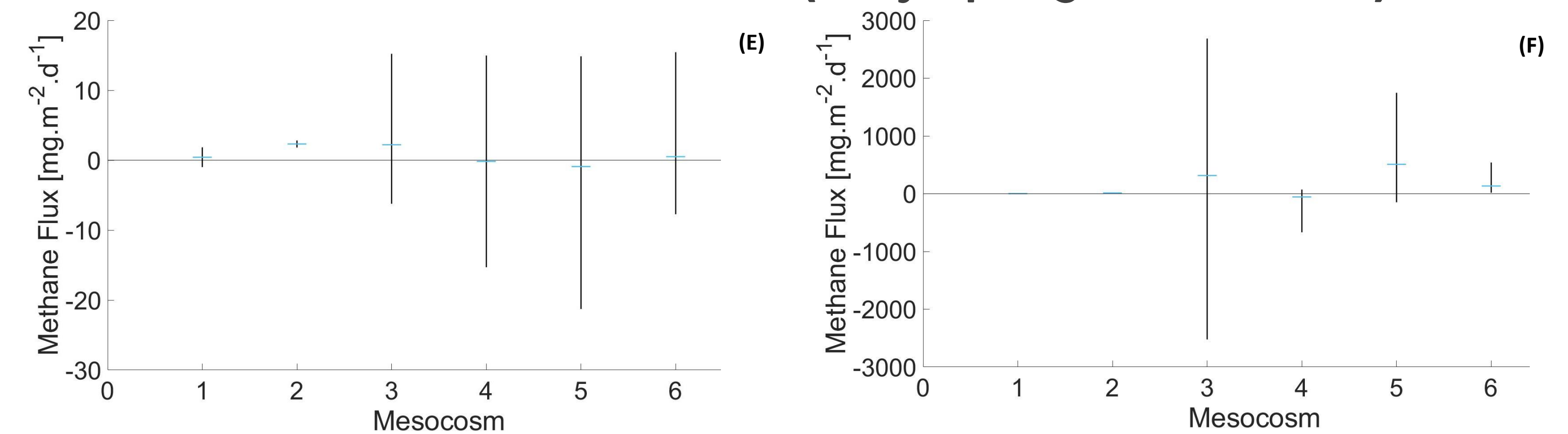
3. Wastewater Treatment Results



4. Discussion – Wastewater treatment

Ammonia removal (Figure A) in steady flow mesocosms showed a superior removal rate of up to 92%. These mesocosms also have high levels of dissolved oxygen (up to 67%), aiding in ammonia oxidation. Orthophosphate removal (Figure B) was better in the planted mesocosms. Steady flows had the highest removal rate at 74%, followed by intermittent flows at 58%, 46%, and 8% in mesocosms 3, 6, and 5, respectively. COD removal (Figure C) was also better in the steady flow planted mesocosms (96%), followed by intermittent mesocosm 6 at 91%, mesocosm 5 at 89%, and mesocosm 3 at 81%. Similar trends were observed for TOC (Figure D), with steady flow reaching up to 98% removal and intermittent flow achieving 91% removal.

5. Methane Emission Results (Early Spring and Summer)

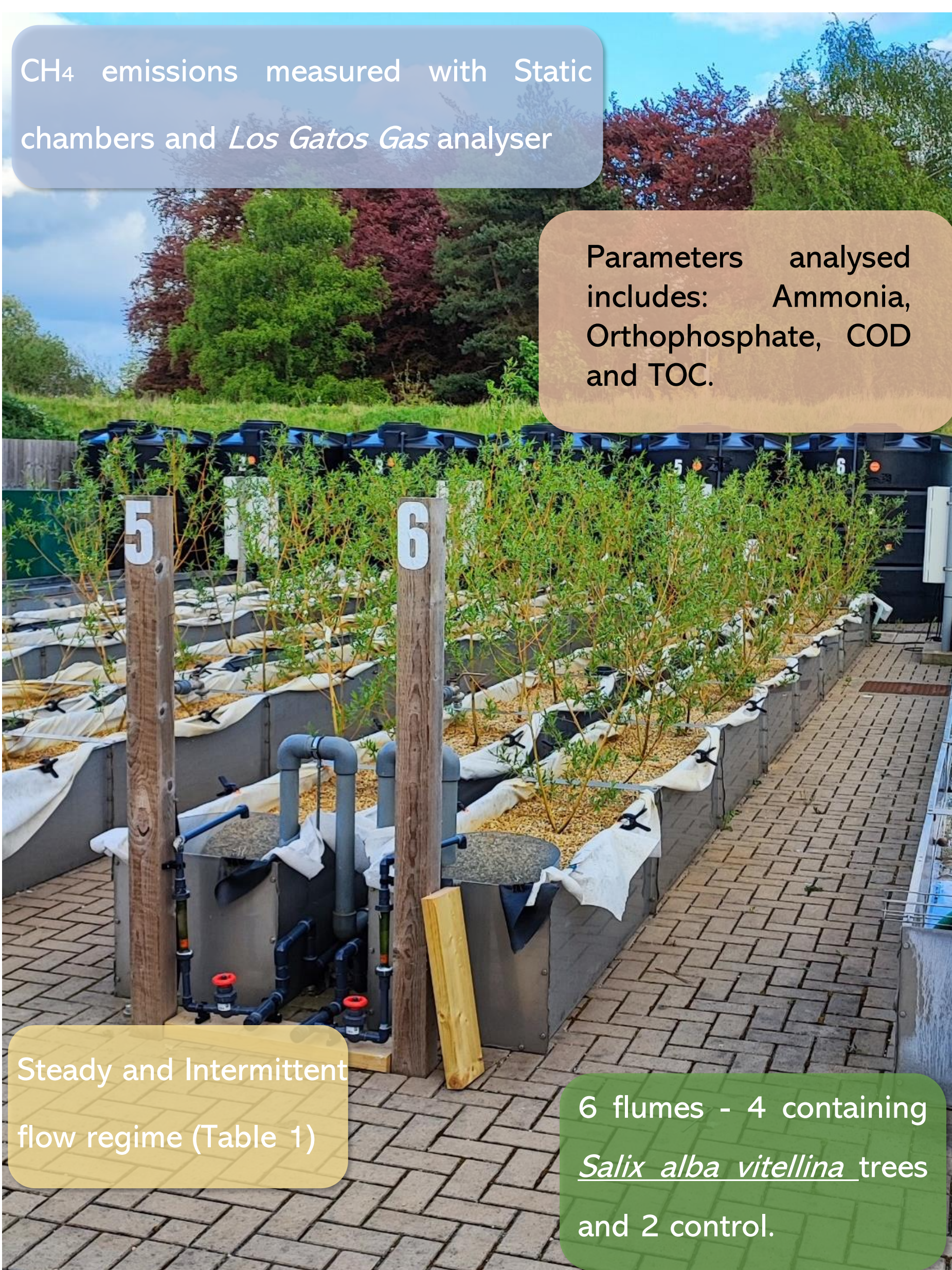


5. Discussion – Methane Emissions

Fluxes were lower in April 2022 (Figure E), where the mesocosms emitted a similar maximum monthly average of 15.44 mg/m².d. In July (Figure F), however, the emissions increased, in some cases more than 1000 times for most of the intermittent flumes. The maximum emissions for the steady flow mesocosms, on average, was lower (71 mg/m².d), while the intermittent ones emitted 540 to 2686 mg/m².d. The higher temperatures in July accelerated microbial activity and methanogenesis.

6. Conclusion and future work

- The planted steady-flow Mesocosm 4 was the most efficient in nutrient removal;
- Methane emissions were lower in spring and higher in summer;
- Planted steady-flow mesocosm 4 showed lower maximum monthly average emissions on summer;
- In general, steady-flow planted mesocosms showed best wastewater treatment and lower emissions when compared to the other mesocosms, followed by intermittent planted mesocosm 6 (2:2 flood:dry).



CH₄ emissions measured with Static chambers and Los Gatos Gas analyser

Parameters analysed includes: Ammonia, Orthophosphate, COD and TOC.

Steady and Intermittent flow regime (Table 1)

6 flumes - 4 containing *Salix alba vitellina* trees and 2 control.