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Study the influence of environmental drivers on N₂O emissions under semi-controlled conditions using a rainfall simulator

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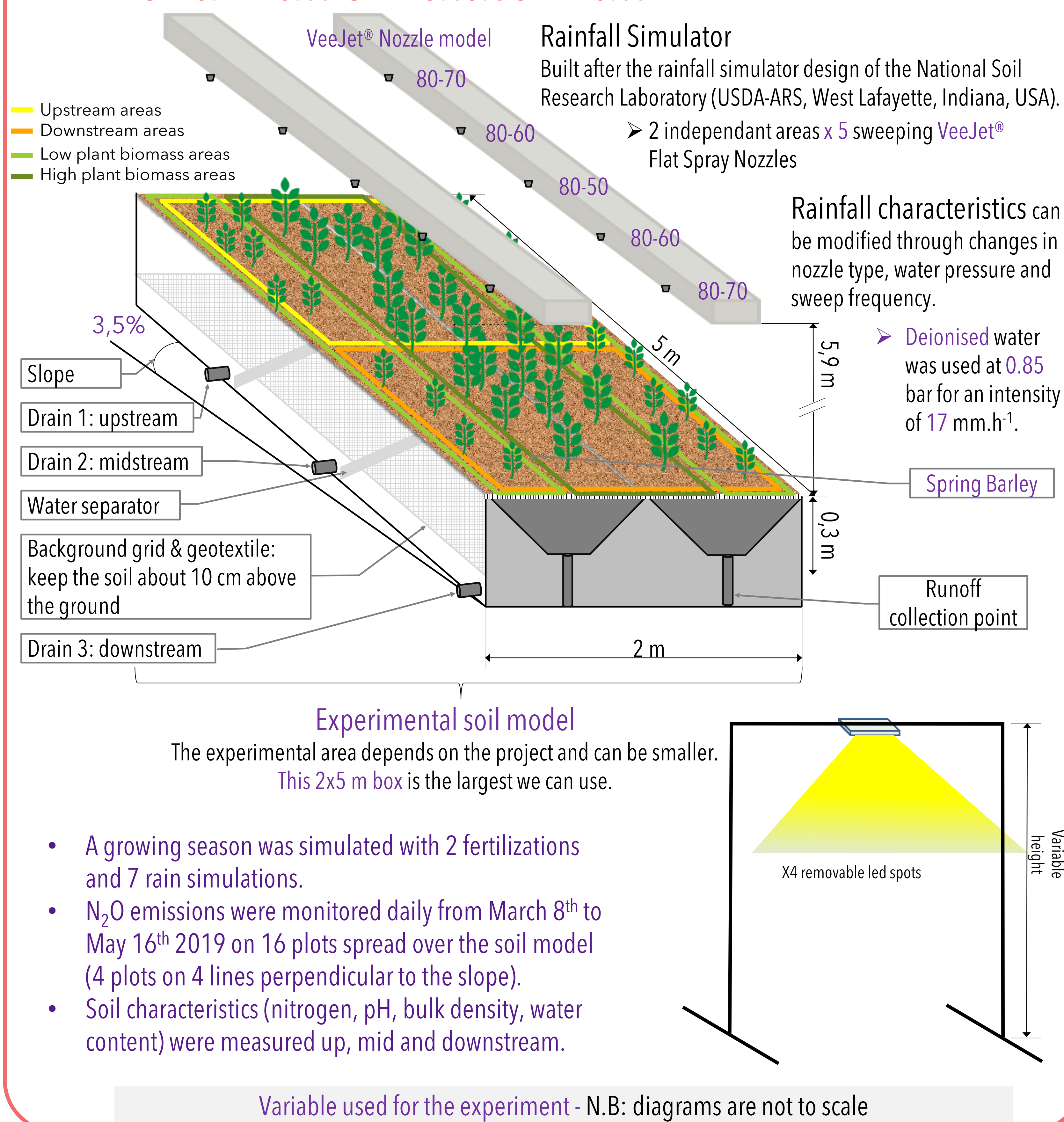
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1. Context

- N₂O emissions, the third anthropogenic greenhouse gas, is a major environmental issue.
- Objectives:
 - In semi-controlled conditions, reproduce the behaviour of a drained agricultural field, with soil N₂O emissions similar to field observations.
 - Analyse the relationships between the dynamics of N₂O emissions and water functioning of a cultivated fertilized soil.
 - Better understand N₂O production hotspots and hot moments to help reducing uncertainty in N₂O emissions estimation.

2. The rainfall simulator hall



3. Results

- The simulated rainfalls had a Christiansen coefficient > 90 %.

N ₂ O fluxes (gN ₂ O.ha ⁻¹ .d ⁻¹)	Min	Mean	Max
Before 2 nd fertilization	0	12	43
After 2 nd fertilization	0.4	33	177

- First N₂O peak observed after the 26 mm rainfall on all experimental plots.
- Second but lower N₂O peak observed after a 8.5 mm rainfall only for plots with higher plant biomass production.

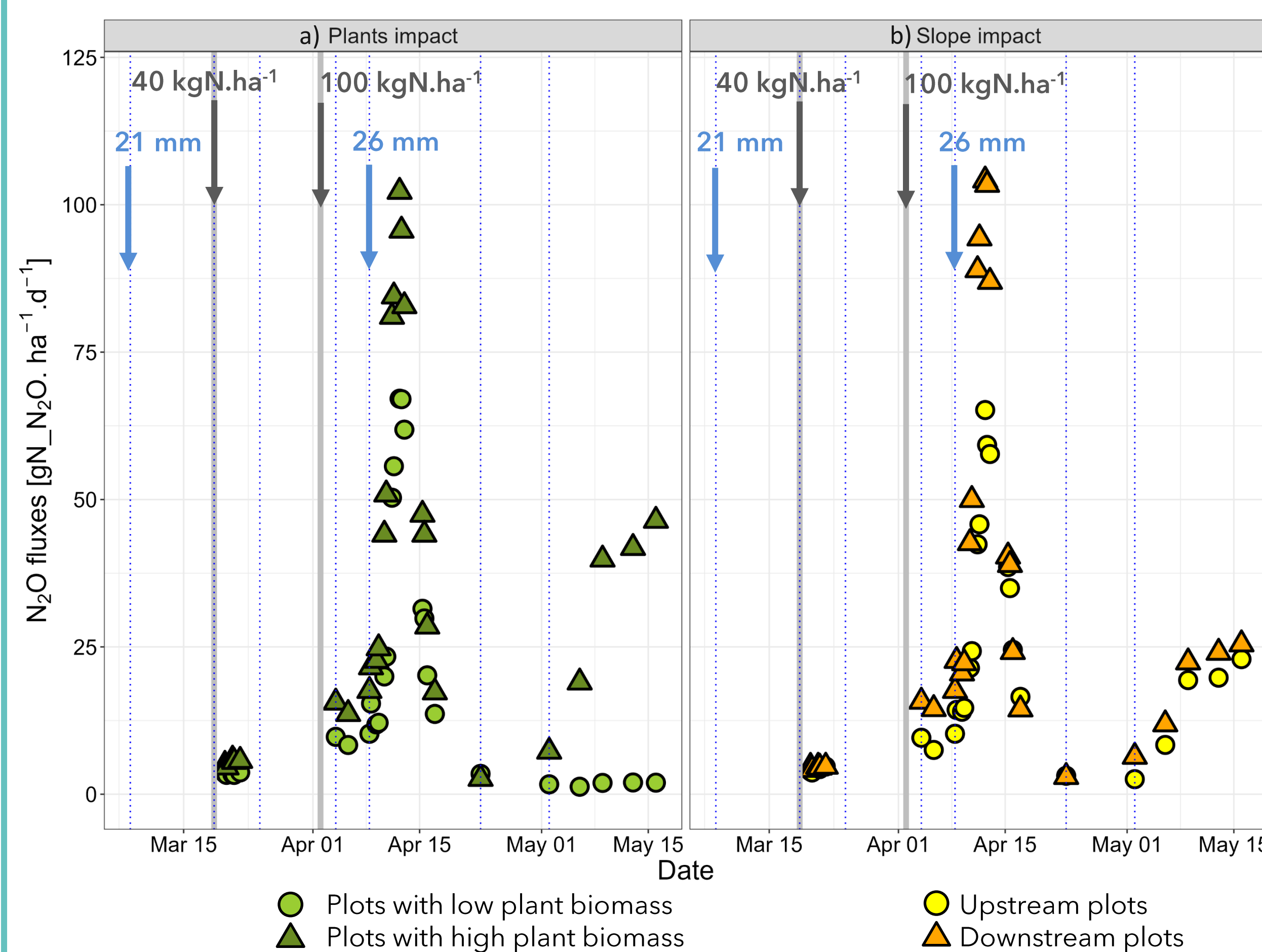


Fig. N₂O fluxes calculated from concentrations measured on the 16 experimental plots. Mean fluxes a) on plots with low or high plant biomass and b) on plots upstream and downstream of the device. Blue dotted lines = rains (2 major rains indicated by blue arrows, others were of 8.5 mm) and the grey dotted lines = the two fertilizations (grey arrows = N inputs).

4. Conclusions

The use of the rainfall simulator hall (rainfall simulator + soil model) allowed to correctly reproduce the behaviour of a drained agricultural field, regarding N₂O emissions:

- The N₂O emissions were in accordance with field measurements on drained agricultural fields (Grossel et al., 2016, Gu et al., 2011).
- Slope affects water processes dynamics (lateral flows, accumulation of water at the bottom of the slope), inducing stronger emissions at the downstream positions.
- Higher N₂O emissions were observed for plots with higher plant production. It may be linked to i) limitation of soil compaction caused by rainfalls, which increased soil porosity and gas diffusion at the soil surface, and ii) higher organic matter inputs.

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2nd Rainfall Simulator Workshop

"Towards harmonisation in the use of rainfall simulators"

22-24 May 2023, Coimbra, Portugal