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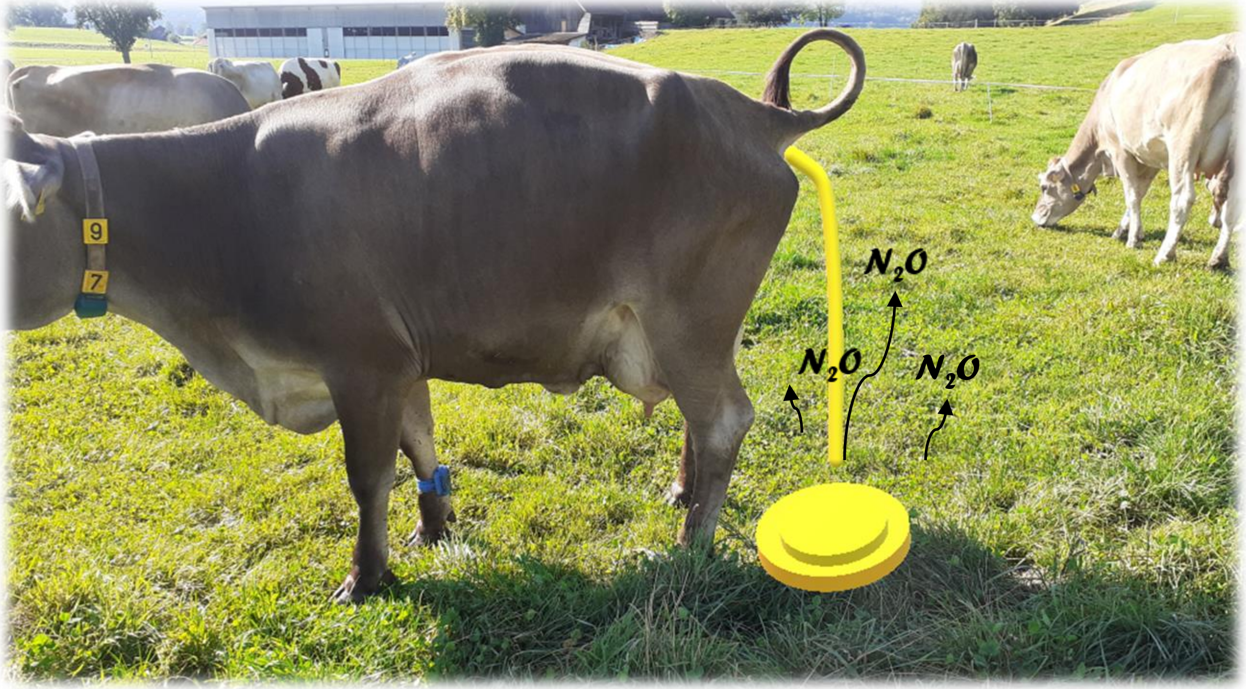

N_2O emissions from a grazed pasture – Effects of urine patch characteristics and environmental drivers

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Lena Barczyk, K. Kuntu-Blankson, P. Calanca, J. Six, C. Ammann
e-mail: lena.barczyk@agroscope.admin.ch

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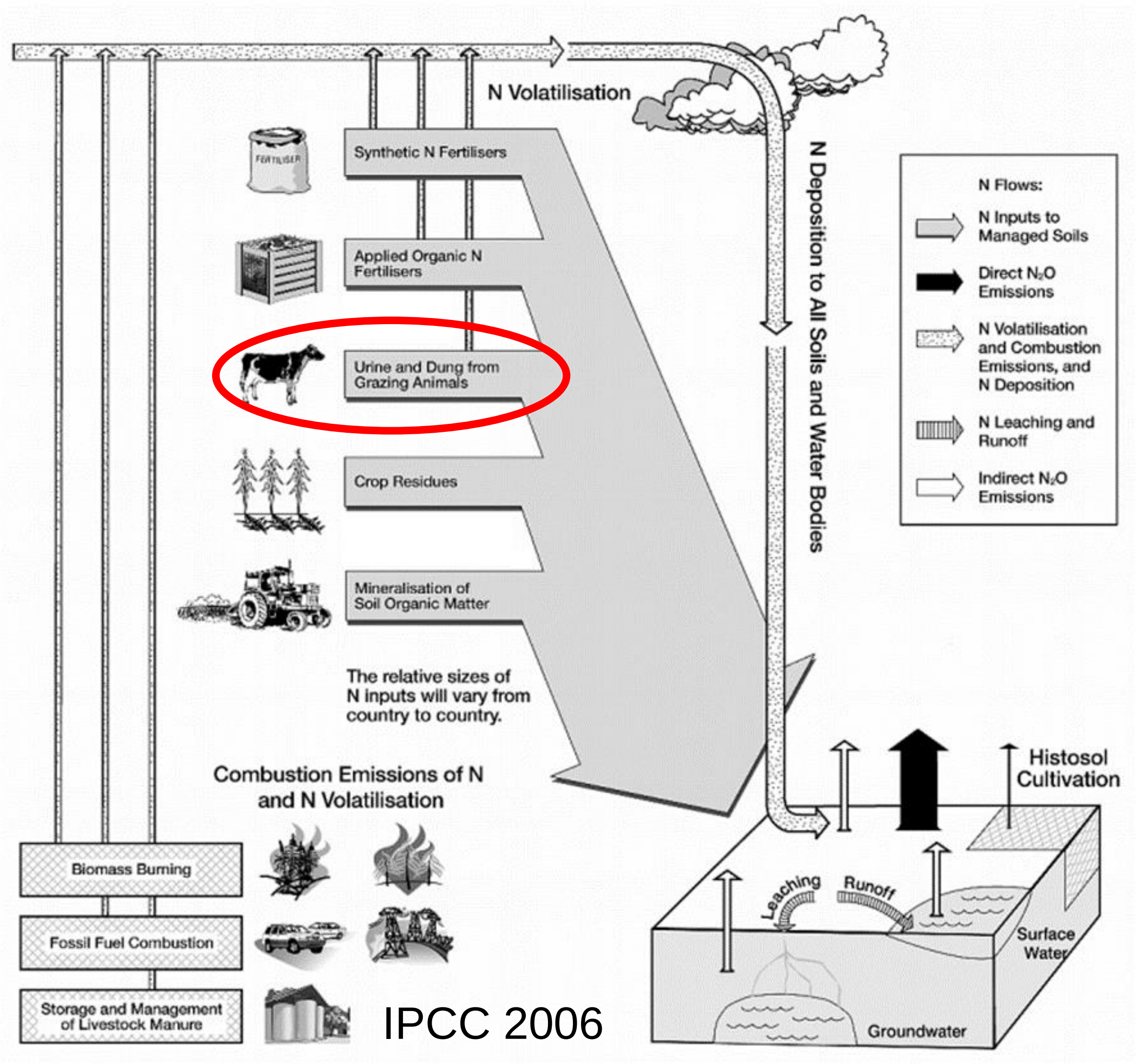
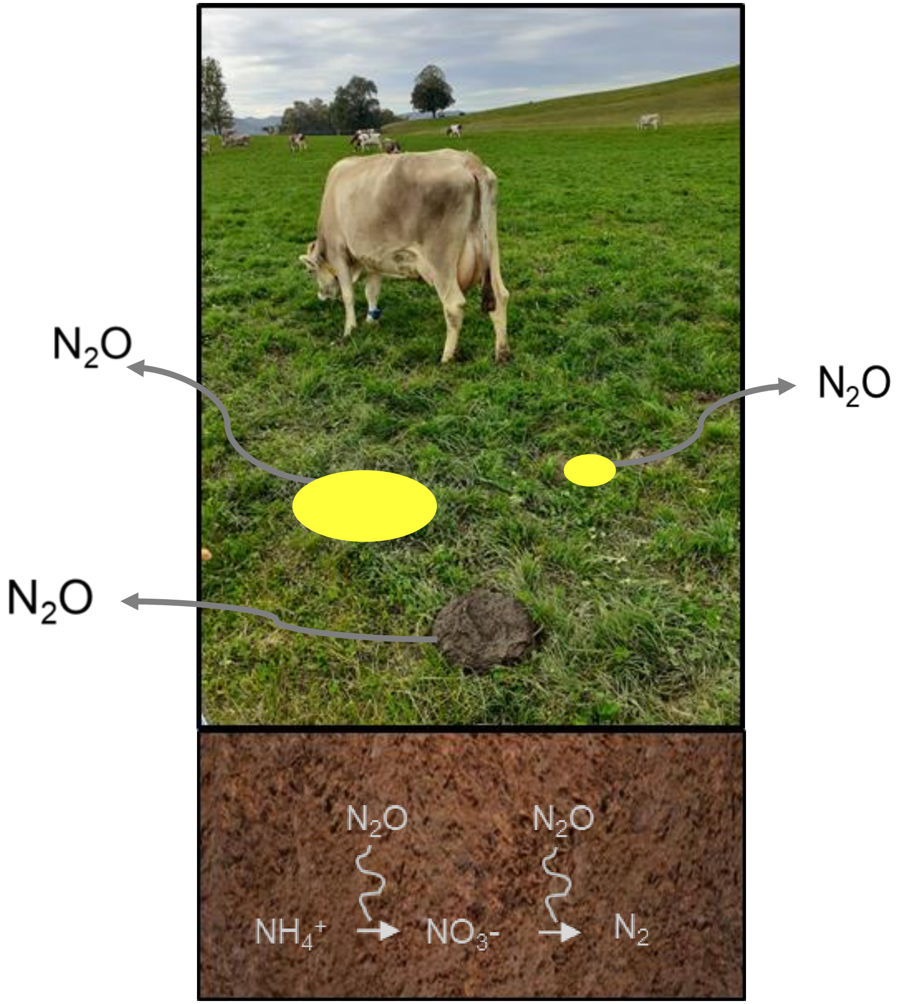
Motivation: N_2O

- GHG ~300 CO_2-eq. & stratospheric ozone depletion
- Important source is agriculture



IPCC 2006



Motivation: Quantification of N_2O emissions from grazing

- Most countries use IPCC Tier1 default EF → N_2O quantified as a fraction of N input

EF_3 old	EF_3 new (aggregated)	EF_3 new (disaggregated)
2.0 %	0.4 %	wet climates: 0.6 % dry climates: 0.2 %

Emission = EF x N_{Input}

5-20 g N patch^{-1}
=
500-2000 kg N ha^{-1}

Use of default EF involves uncertainties

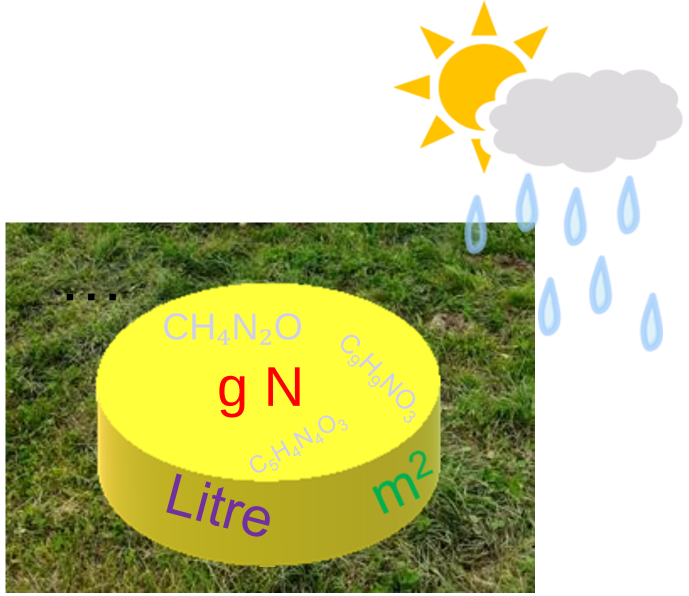
- EF based on limited studies (NZ, UK, BR)
  Considerable range reported
- Contradictory results in influence of urine patch characteristics (total N, urine volume)
- Inconsistent seasonal pattern found in temperate climates

→ Usage of higher Tiers (country-specific data needed)

→ Further disaggregation recommended

Aims of study

1. Investigate the effect of urine patch characteristics on EF value
2. Determine EFs over the whole grazing season & identification of drivers



Realization

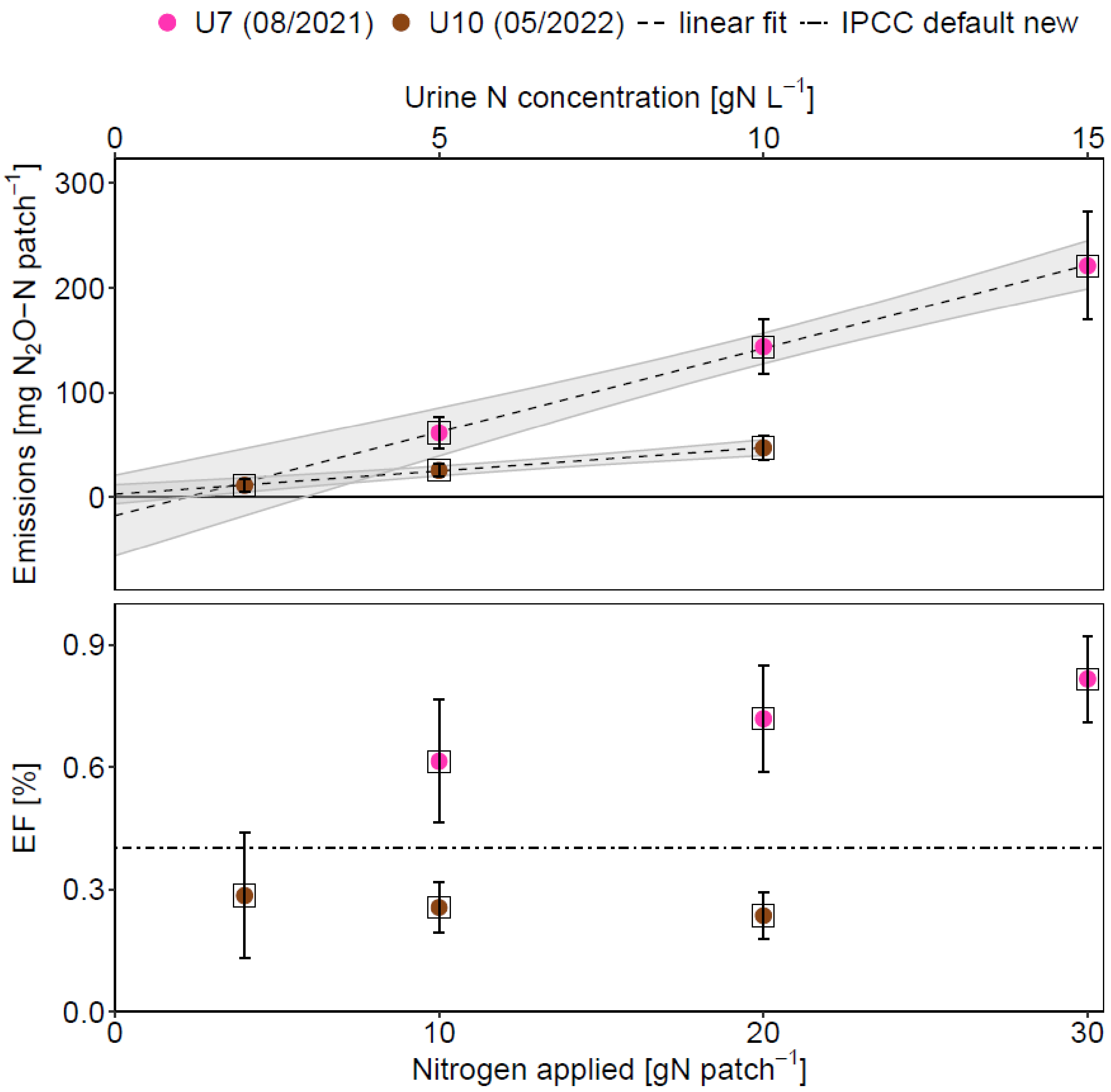
- Manual chamber N_2O measurements in a fenced-out subarea of pasture
- Controlled application of real & synthetic cattle urine in 10 experiments (U1-U10)
  - Standard urine patch applied in every experiment: (2 L, 20g N total, 0.12 m^2, 91% of N urea & 9 % hippuric acid)
  - Varying urine N concentrations (same volume) → U7, U10
  - Varying patch size → U8
  - Varying urine volume → U2, U3, U5
  - Varying urine water volume (same total N) → U10

Urine N concentration

<u>Hypothesis:</u> N_2O emissions increase rather exponentially than linearly by increasing the N input.

→ Linear increase F_{N2O} by N input

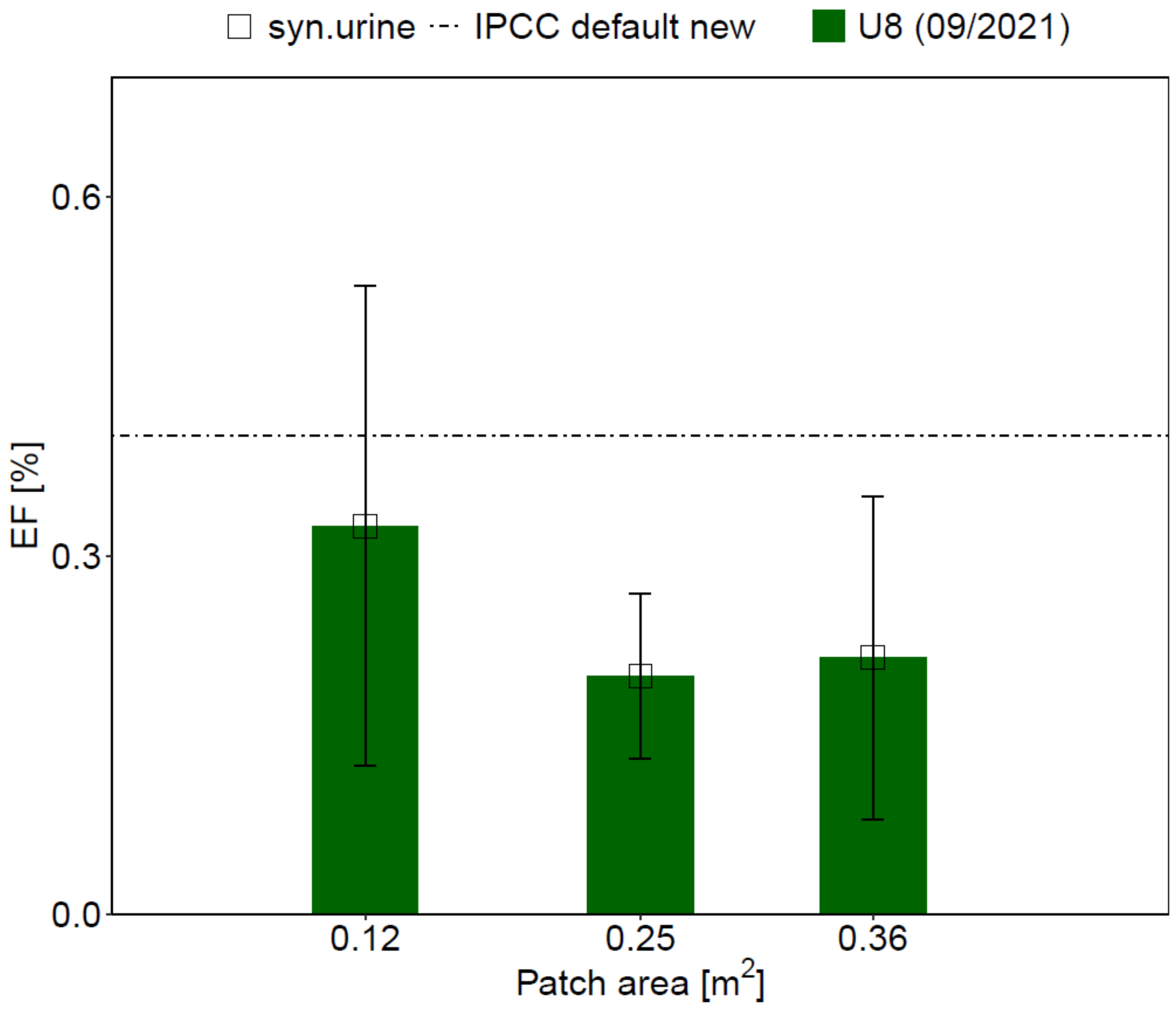
→ EF stayed constant



Patch area

<u>Hypothesis:</u> Higher emissions from a smaller patch area (N input can exceed plant assimilation more easily)

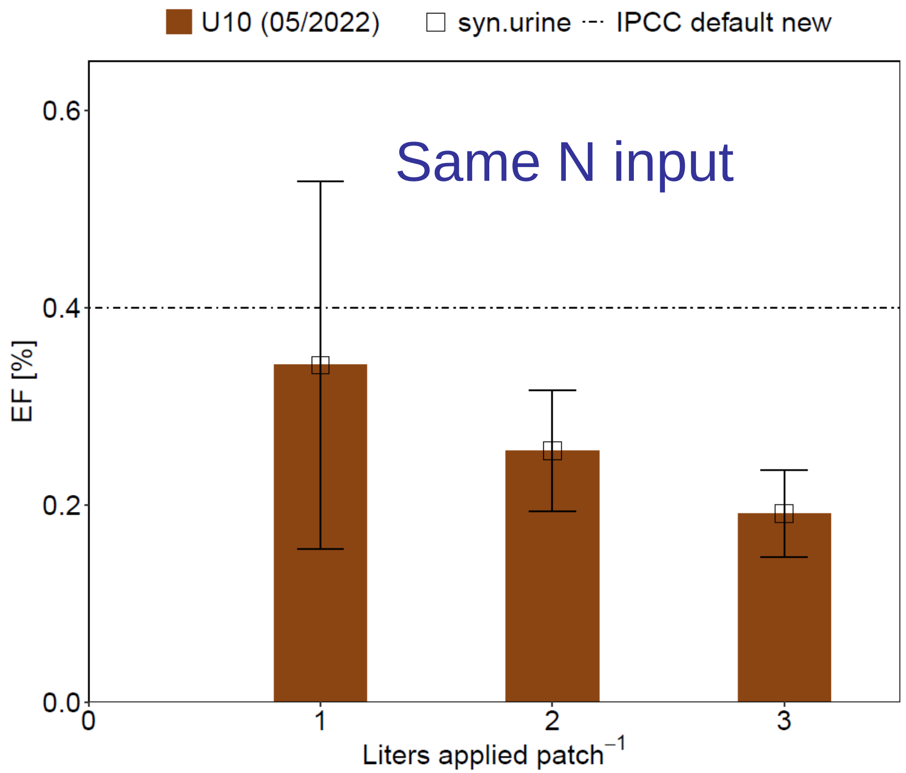
→ No significant differences between treatment levels

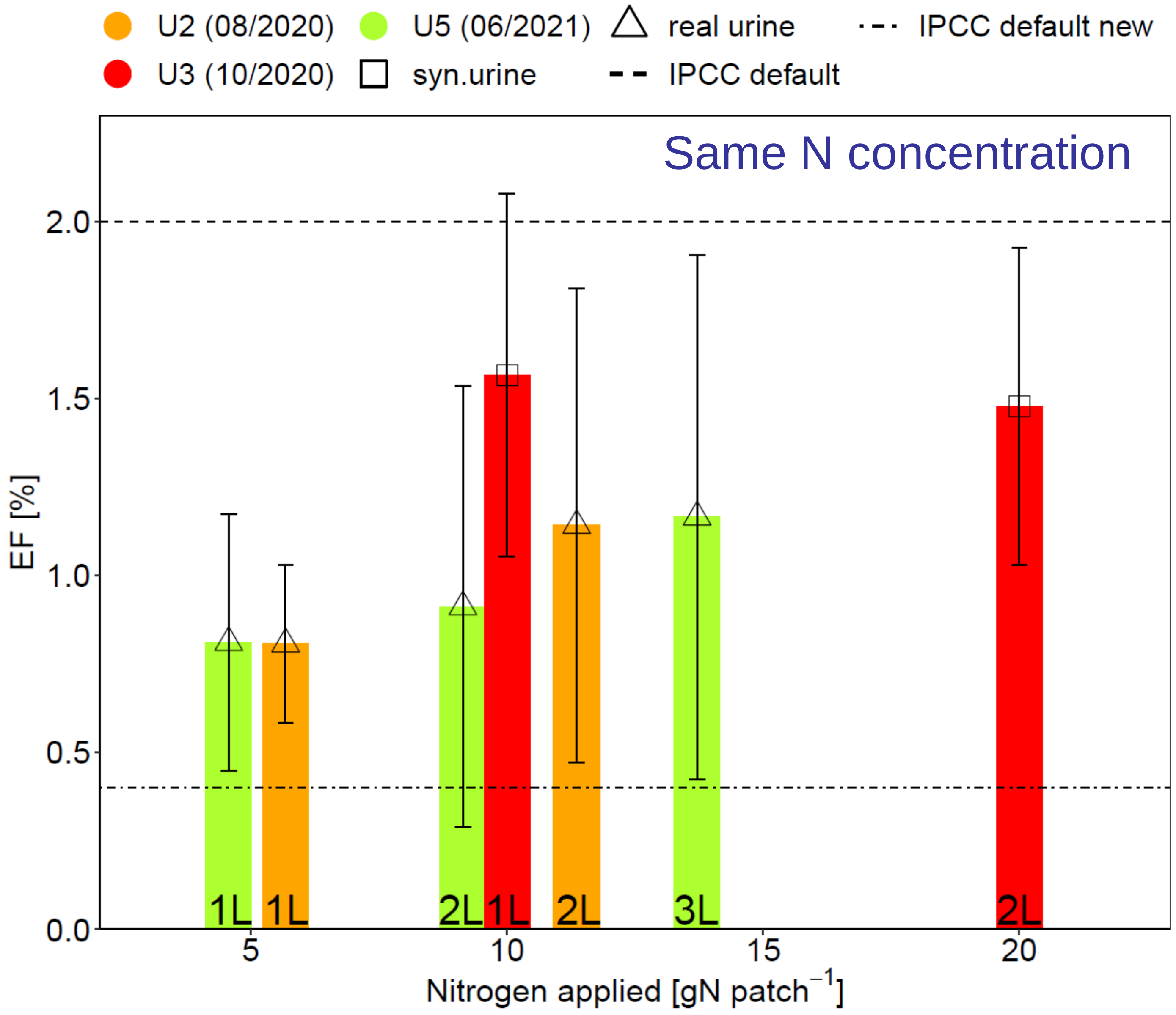


Urine volume

<u>Hypothesis:</u> EF decreases with increasing urine volume due to a deeper infiltration.

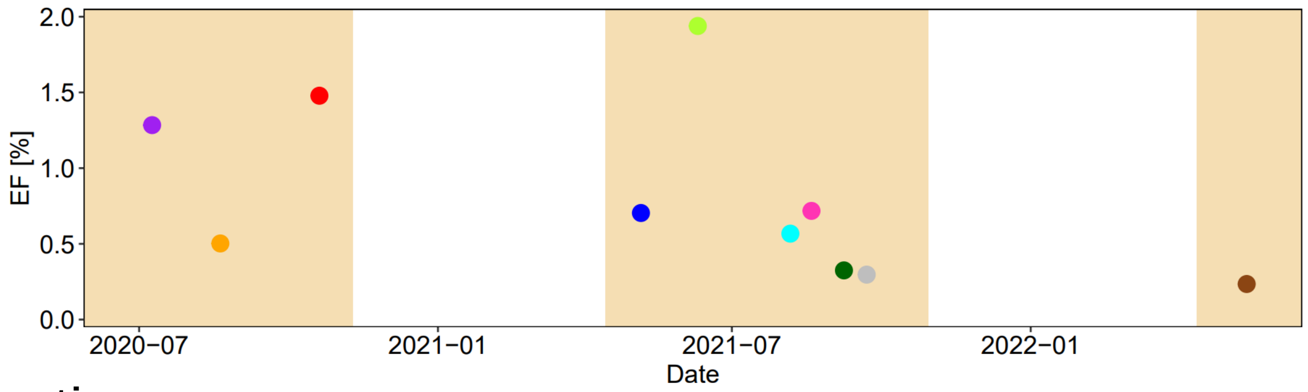
→ EF stayed constant



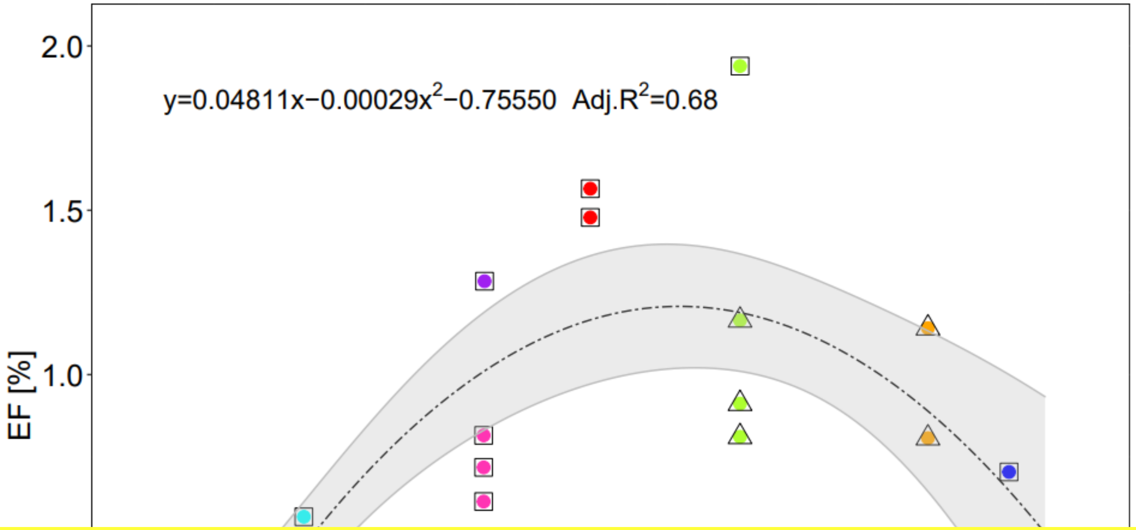


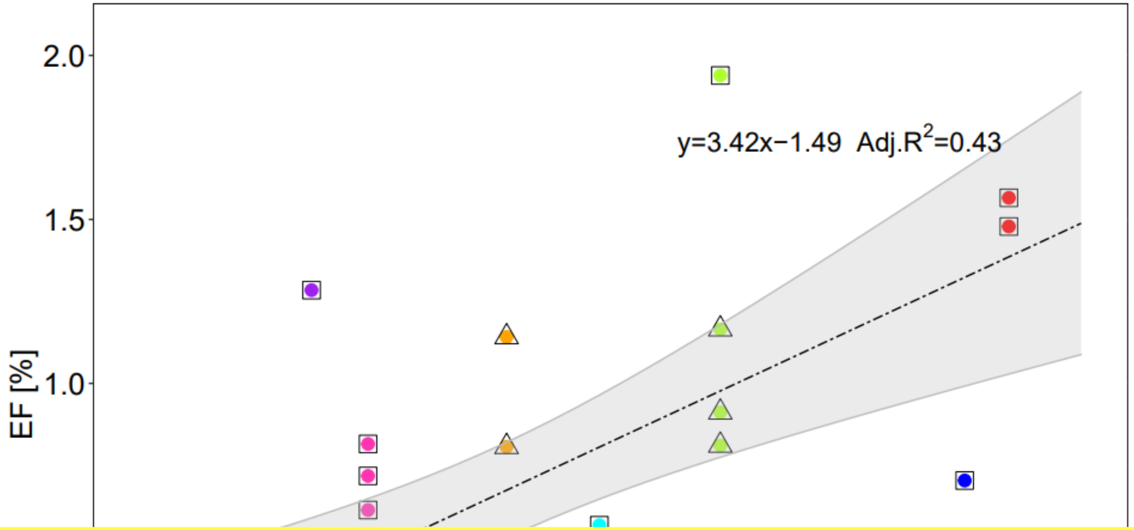
Environmental drivers

- EF varied strongly (0.2-1.9%)



- Two main drivers were identified:
  → Cumulated precipitation 20 days past urination
  → Averaged WFPS 30 days past urination



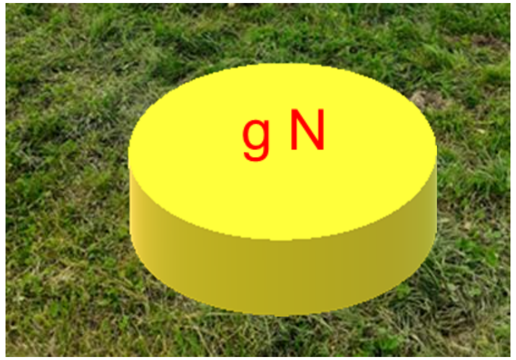


$$\text{Eff } N_2O\text{-}N = N_{input} \cdot (0.04811P - 0.00029P^2 - 0.75550)/100 \quad (R^2=0.74,\ p<0.0001)$$

$$\text{Eff } N_2O\text{-}N = N_{input} \cdot (3.41WFPS - 1.49)/100 \quad (R^2=0.42,\ p<0.001)$$

Summary & Conclusion

- EF stayed constant for varying urine N inputs
  → confirms assumptions of constant EF
  → contradictory findings in literature may be linked to site specific conditions controlling pasture N uptake & microbial activity

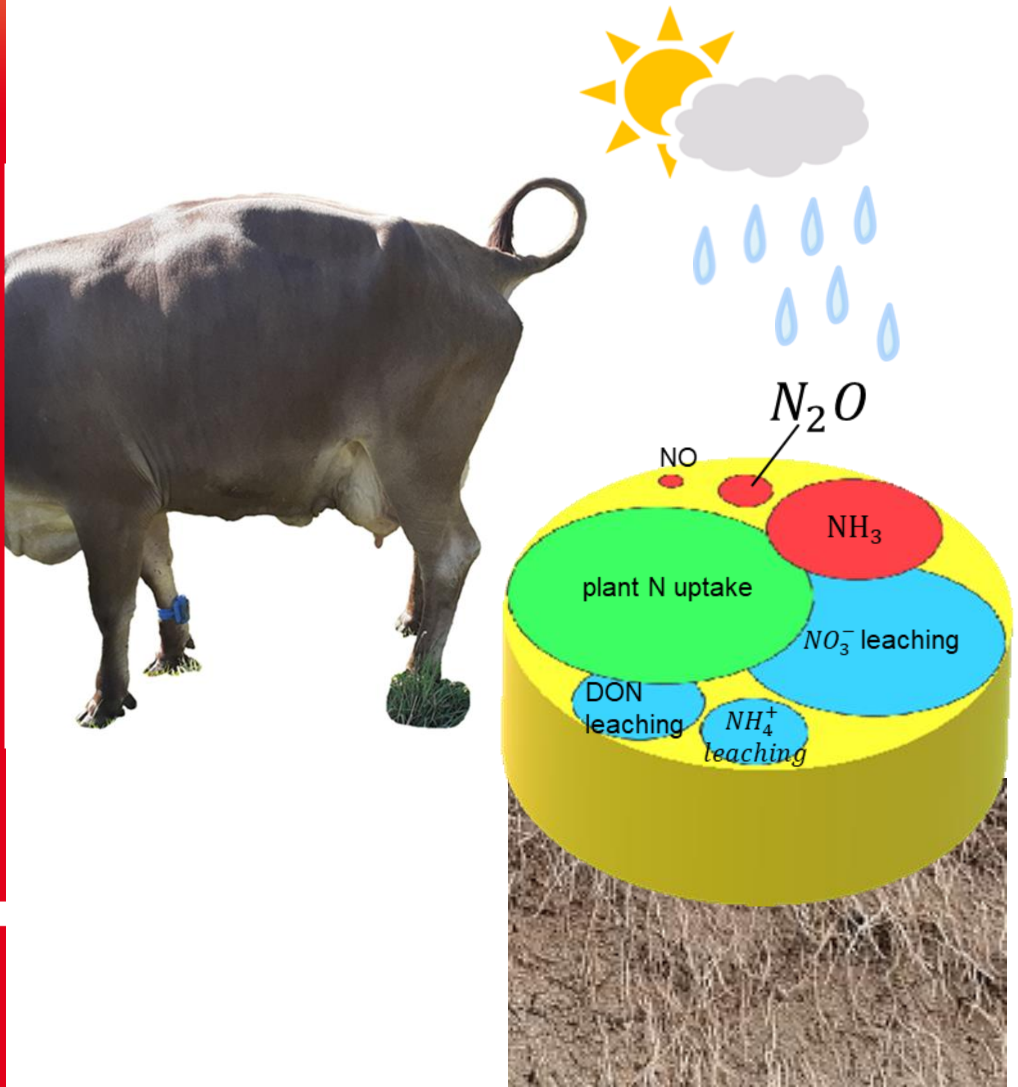


- No effect of (wetted) patch area on EF
  → effective patch area not known

- No effect of urine volume/urine liquid on EF
  → for site-specific soil texture
  → but potentially strong variation of soil infiltration capacity during the season

- EF varied strongly over the seasons linked to cumulated precipitation & mean WFPS
  → Microbial activity known to increase with WFPS
  → N leaching after excessive rainfall (decreasing EF at high rainfall values)

Outlook



- Implementation of higher Tiers (country-specific) for more accurate quantification of N_2O emissions → more data needed
- Effects of soil & climate zone have not been addressed here and might involve different results
- Fate of N in urine patches: quantitative analysis needed

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Thanks for listening !

Lena Barczyk, lena.barczyk@agroscope.admin.ch

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