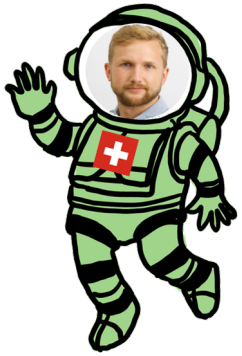
MELiSSA
MICRO-ECOLOGICAL LIFE SUPPORT SYSTEM ALTERNATIVE

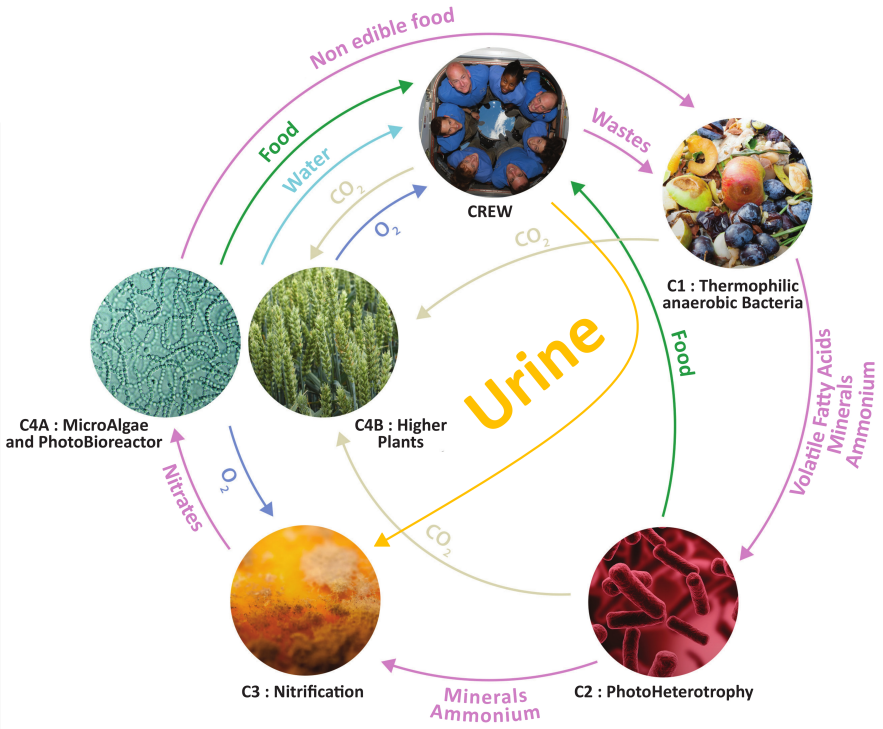
CREATING A CIRCULAR FUTURE

Control of pH and process modelling contribute to stable alkalinity-limited urine nitrification

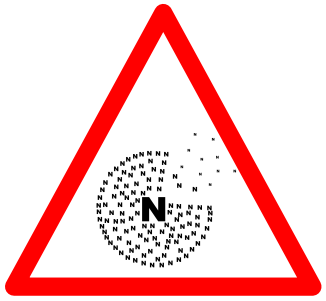
Valentin Faust, Ramon Ganigué, Siegfried E. Vlaeminck, Kai M. Udert

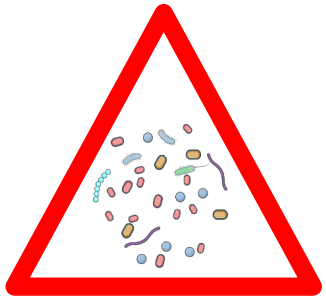


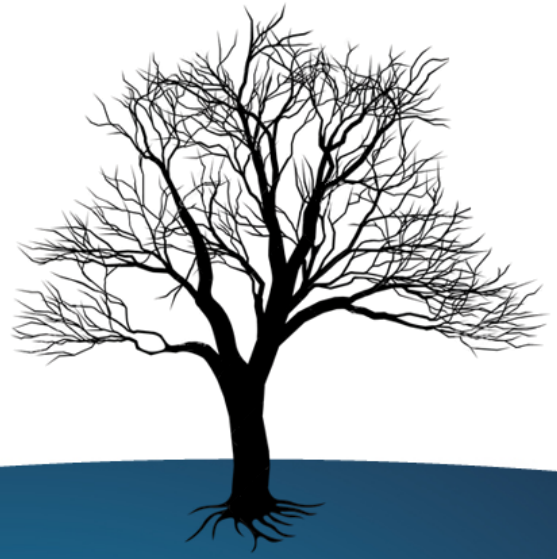
MELiSSA: Urine treatment



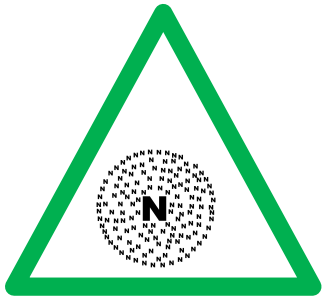
Why urine treatment?

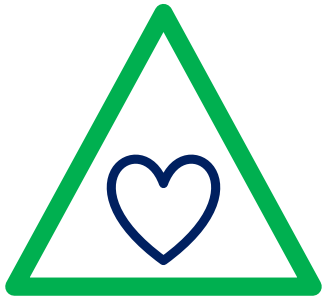






Why urine treatment?





Possible treatment chain

✗ **Heavy metals (not present in urine)**

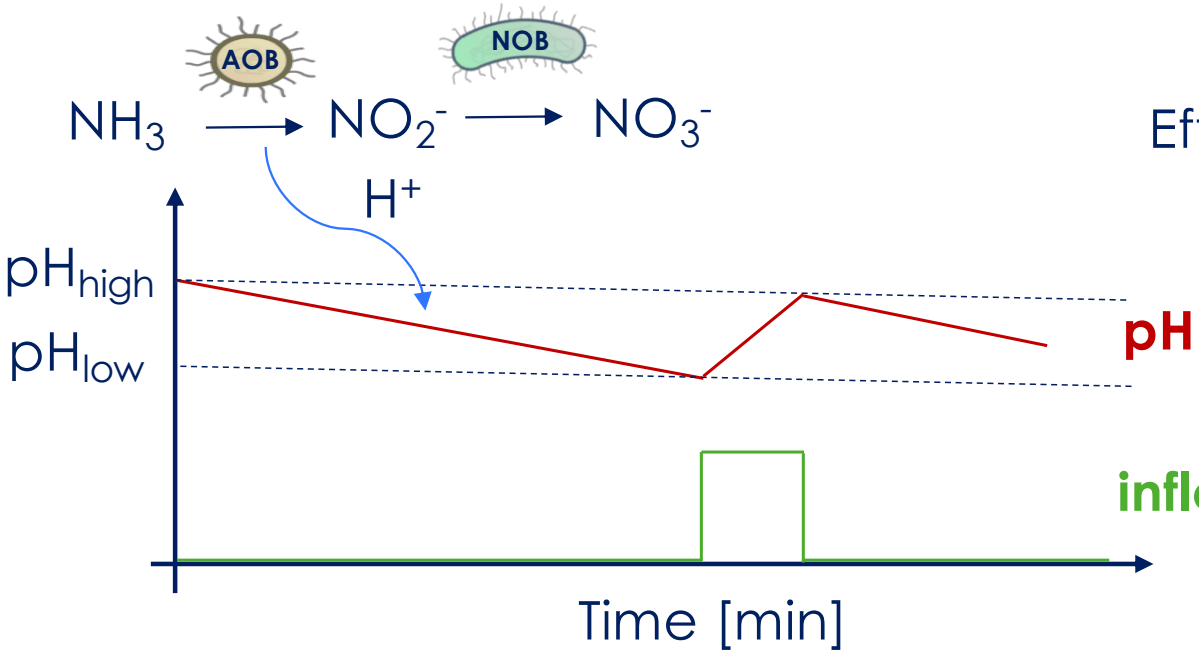
Smell, volatile ammonia ✗

Pharmaceutical residues ✗

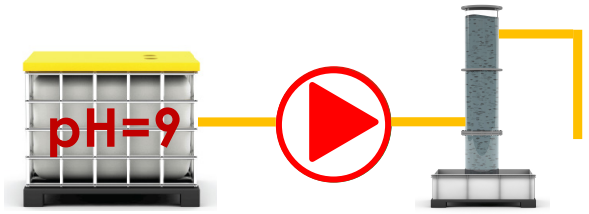
Pathogens ✗

Macro-nutrients (e.g. nitrogen, phosphorus, potassium) and micro-nutrients (e.g. zinc, boron) ✓

Alkalinity-limited urine nitrification



Effluent ≈ 50% NH_4^+,50% NO_3^-



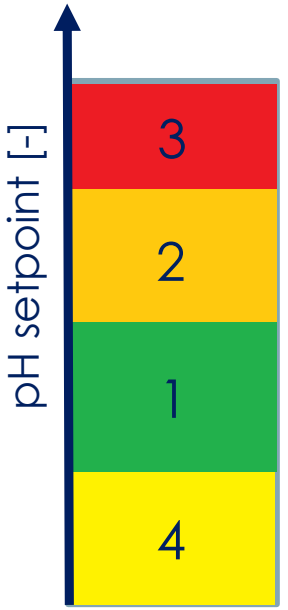
With or without alkalinity addition

Alkalinity-limited nitrification (50% NH_4^+, 50% NO_3^-) Ex. Fumasoli et al. 2016	Full nitrification (100% NO_3^-) Ex. Jolien et al. 2020
⊕ 50% less oxygen ⊕ No base addition ⊕ High TRL (licensed fertilizer) ⊕ High urine treatment rate	⊕ Rather stable process
⊖ **Process stability**	⊖ Oxygen consumption ⊖ Base addition or electrolysis unit
? Ammonium-nitrate fertilizer	? Nitrate fertilizer ? TRL

Process stability

Four different scenarios were observed in the past years:

1. Stable nitrification
2. Nitrite accumulation and nitritation
3. Complete stop of nitrification
4. Growth of acid-tolerant AOB



Hypothese

Goal of this study: Investigate the four different scenarios

1. pH=6 and pH=5.8 will lead to stable nitrification
2. pH=7 will lead to nitrite accumulation and nitritation
3. pH=8.5 will lead to a complete stop of nitrification
4. Inflow stop will lead to the growth of acid-tolerant AOB

Experimental procedure

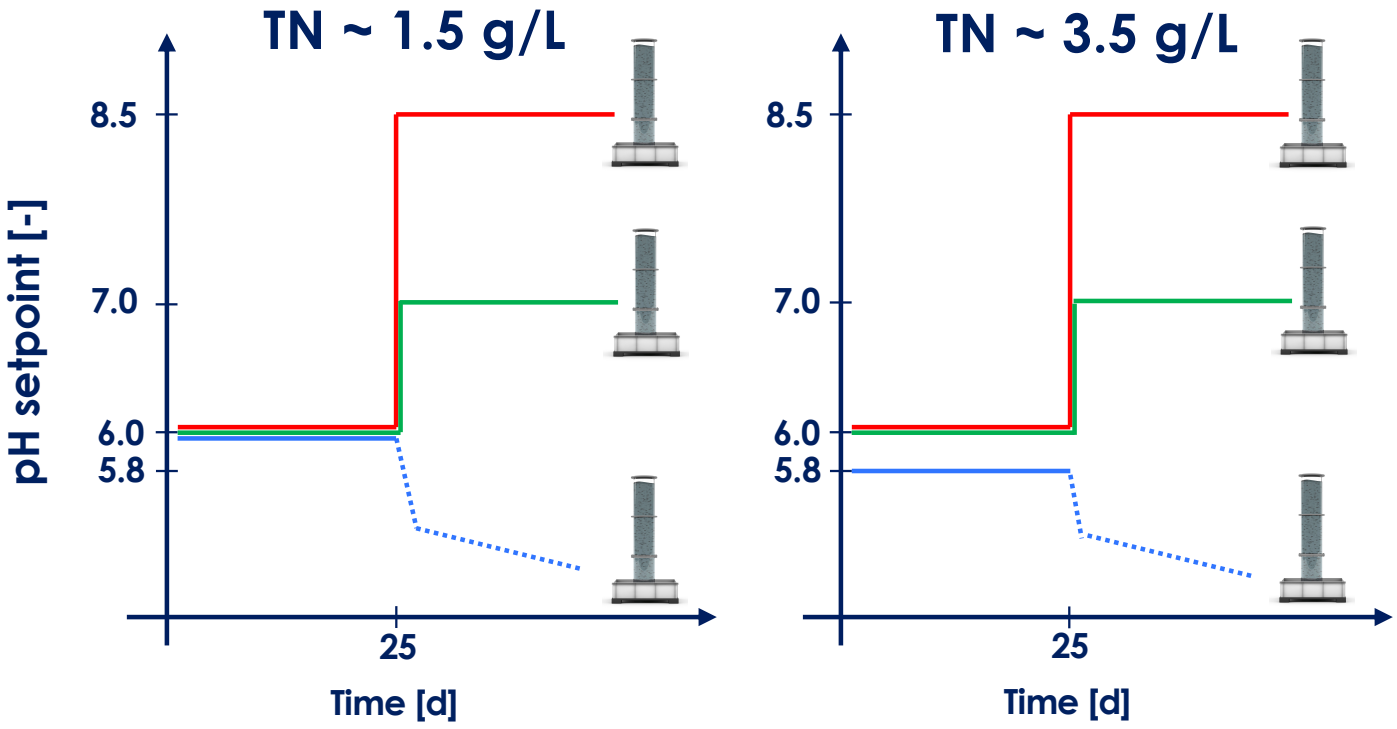
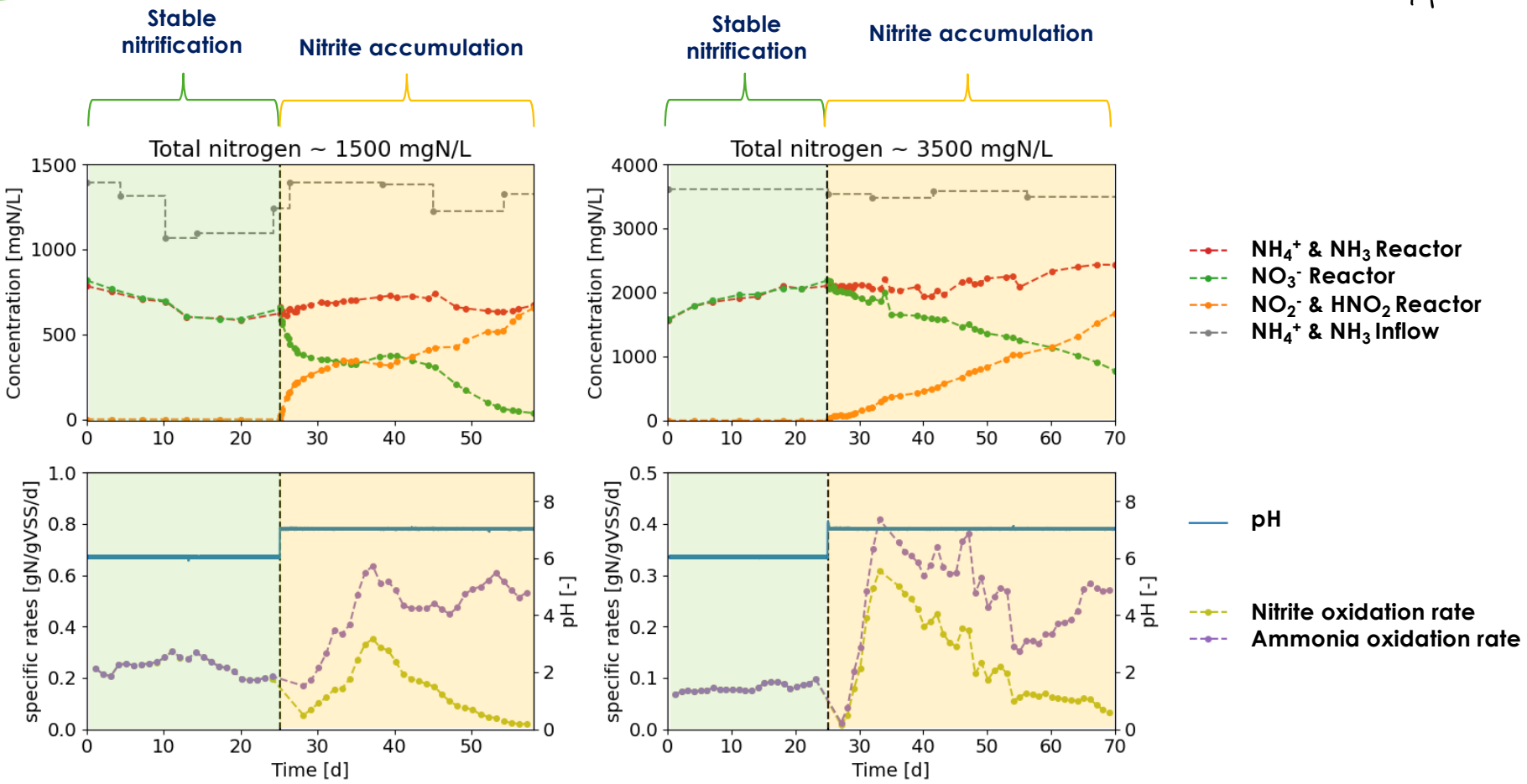
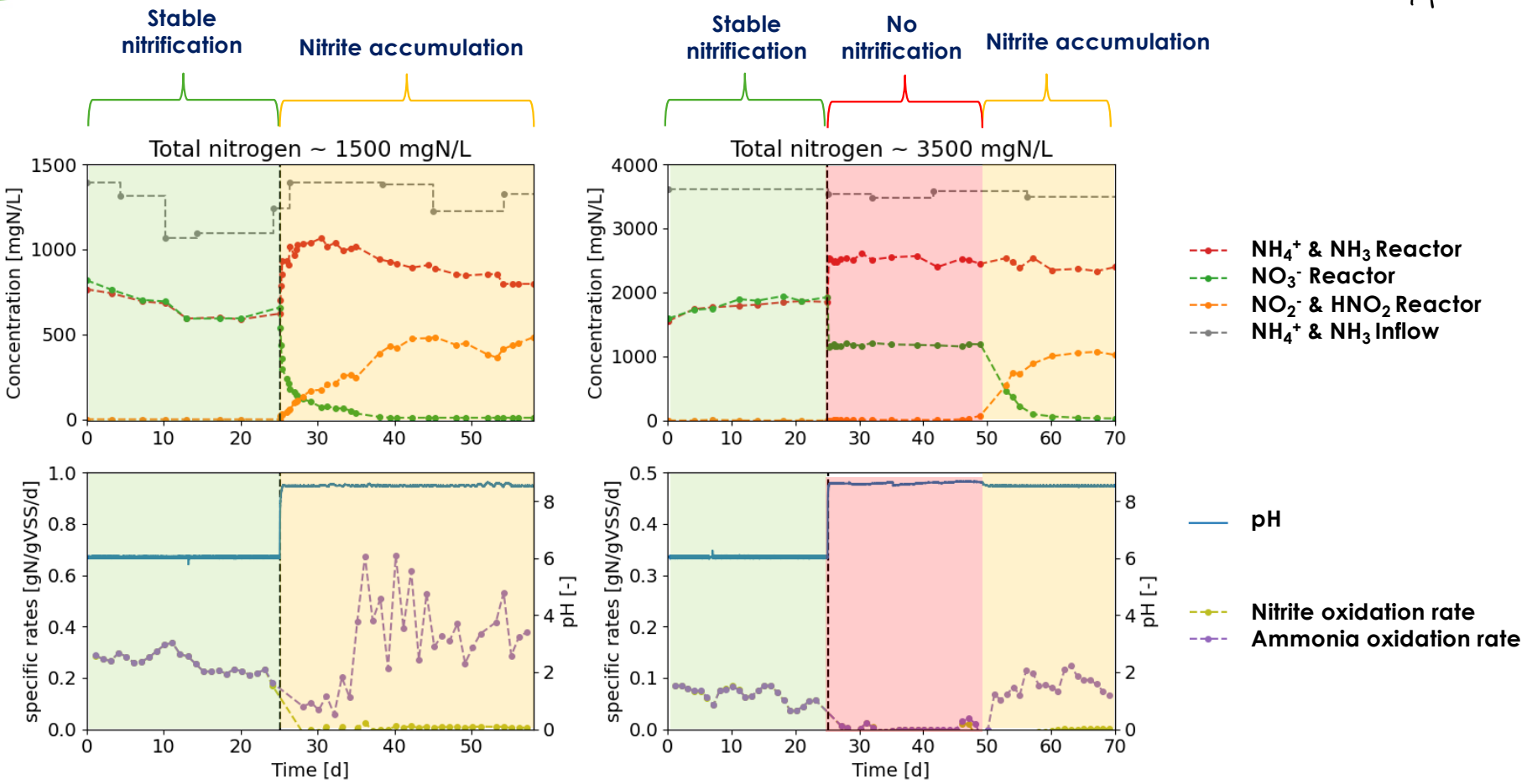


Fig.: 12L reactor

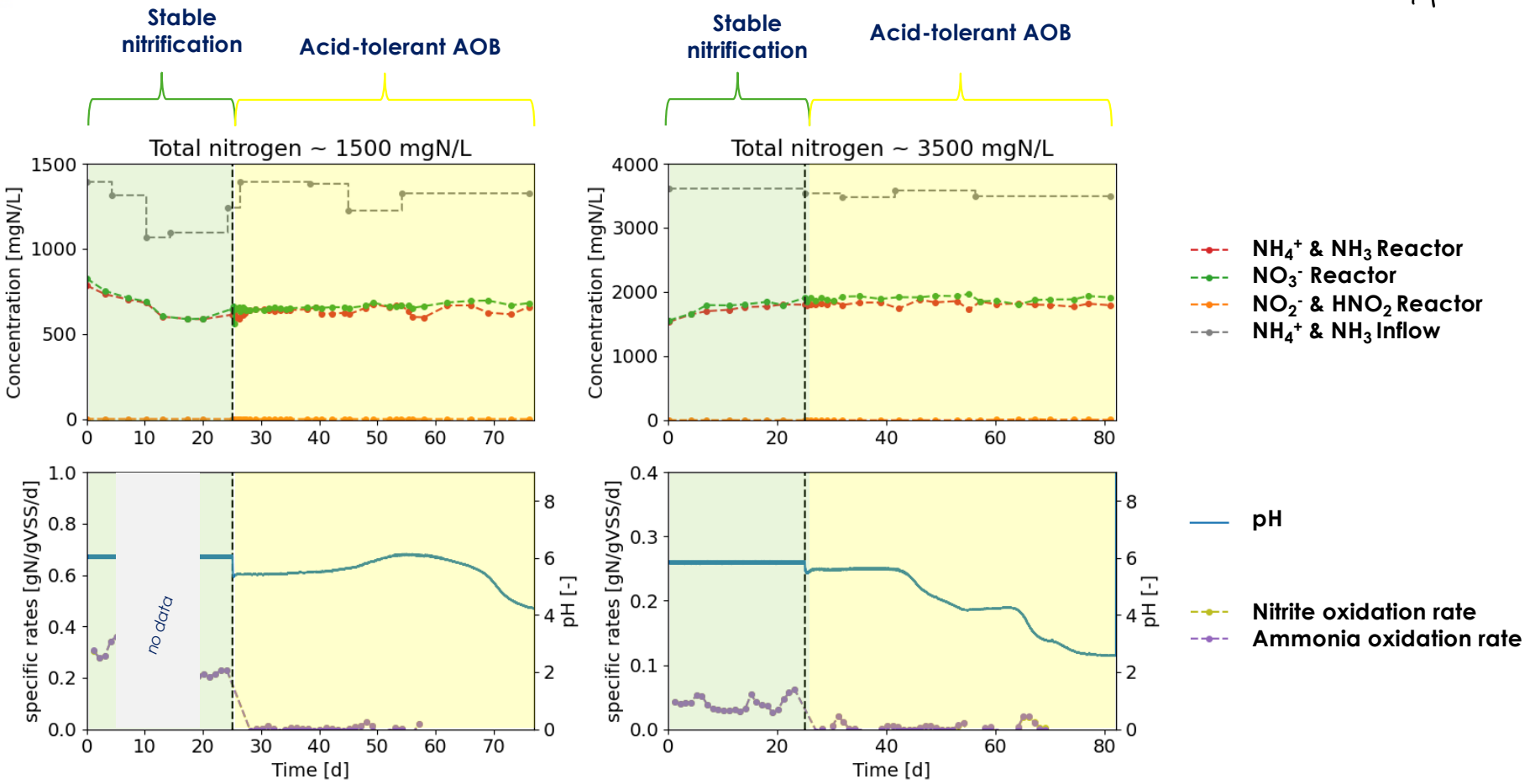
pH=6.0/6.05 and increase to pH=7.0/7.05



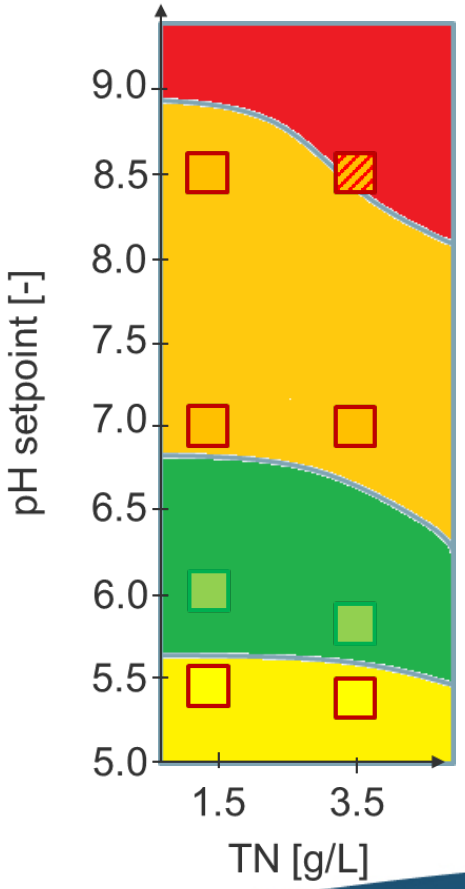
pH=6.0/6.05 and increase to pH=8.50/5.55



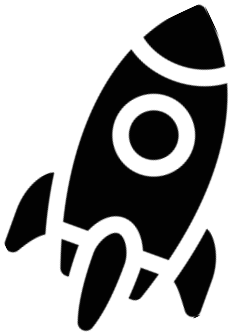
pH=6.0/6.05 resp. pH=5.8/5.85 and stop inflow



Conclusion and outlook



- Complete cessation of nitrification
- Nitrite accumulation/Nitritation
- Stable nitrification
- Growth of acid tolerant AOB



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THANK YOU.

Valentin Faust
Eawag/ETH/UGent
valentin.faust@eawag.ch

www.**melissafoundation**.org

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