What are the factors influencing the mitigation of pesticides in constructed wetlands ?

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Introduction

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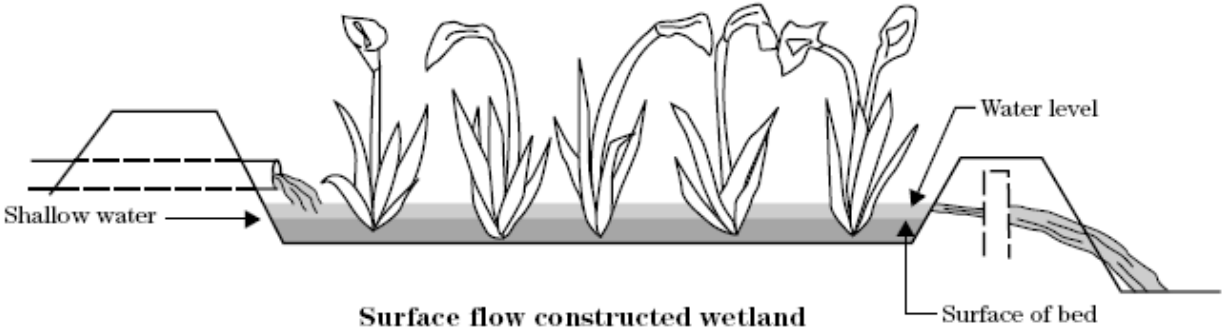
- 'Free Water Surface Constructed Wetland (FWS CW)': mitigation of pesticides concentration transferred into the river *Schultz et al. (1995), Tournebize et al. (2012)*



Surface flow constructed wetland
(From National Engineering HandBook, 2002)

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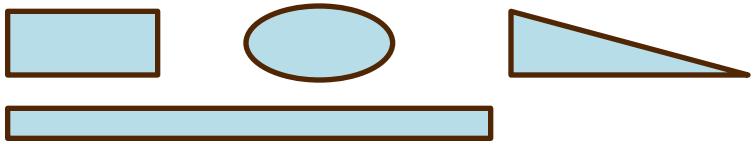

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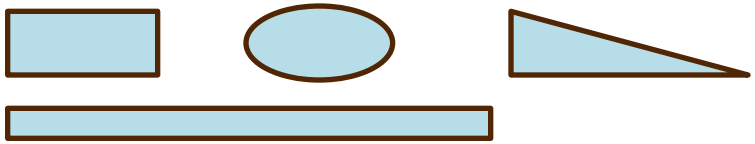

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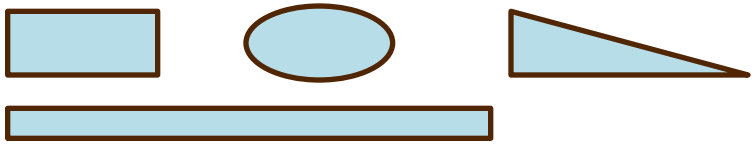

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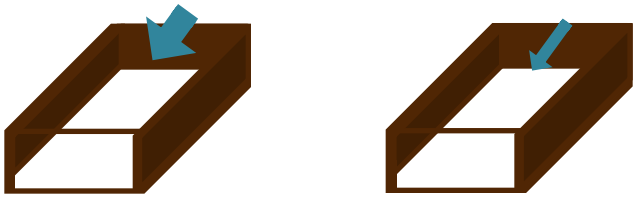

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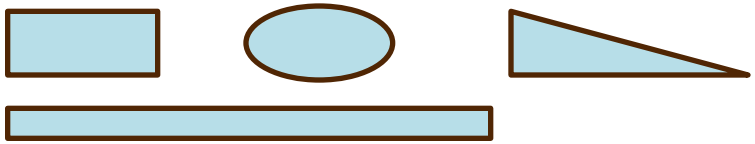

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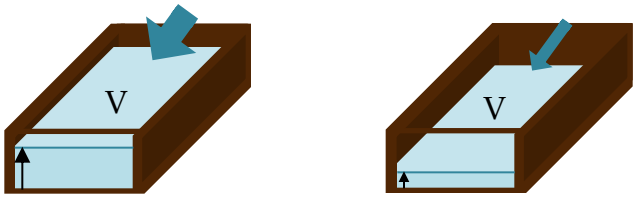

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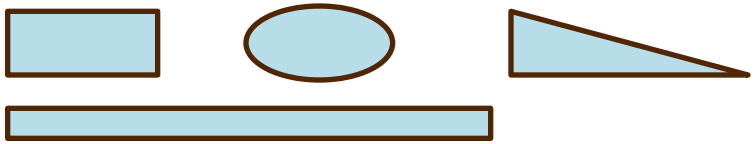

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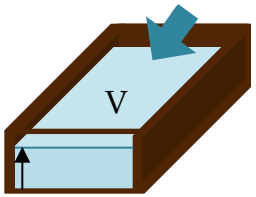

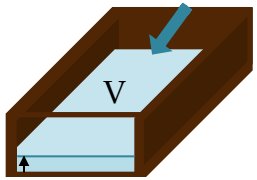

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$$HRT = \frac{V}{Q}$$

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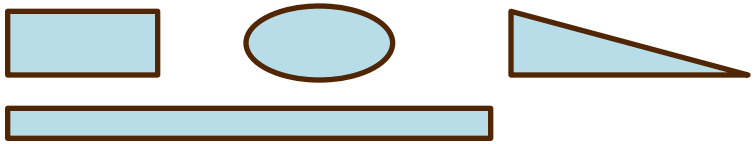

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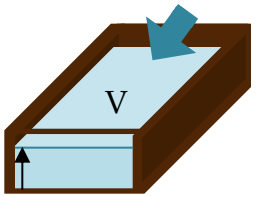

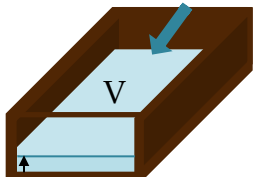

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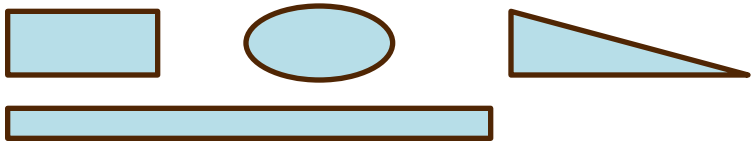

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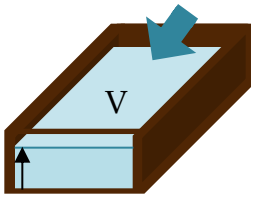

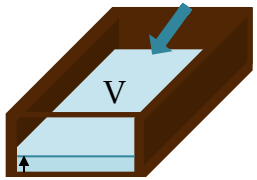

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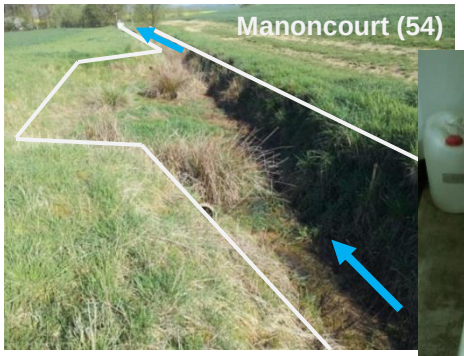
WHAT are the FACTORS influencing the mitigation of pesticides in CW and BY WHICH WAY?

Methodology – Pilot-scale wetland

Pilot = under **controlled conditions** (flow rate, water level, volume)
Phytotronic room (20 ± 2°C, day/night ratio of 14/10 h, hygrometry of 70%, brightness of between 3100 and 3800 lx)



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75 m length – 1 m width
125 m²

Pilot 1:40°
225 cm length
2.5 cm width
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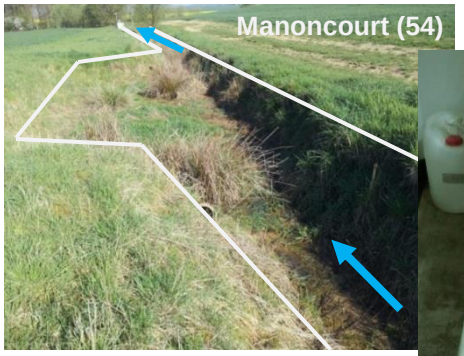

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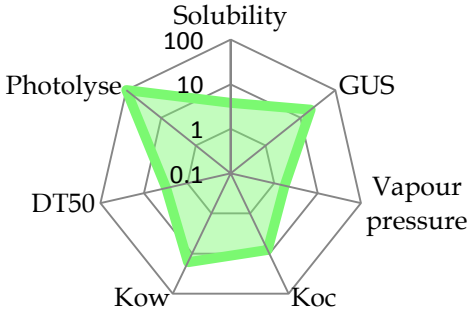
Do morphology of CW influence their effectiveness?

Methodology – Studied molecules

2 herbicides

Isoproturon (IPU)



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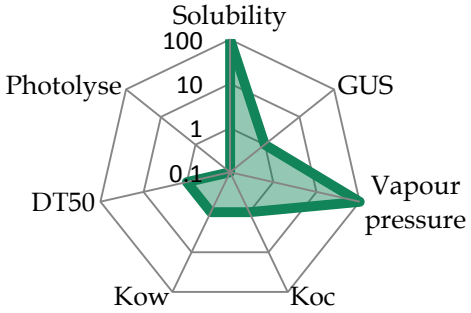
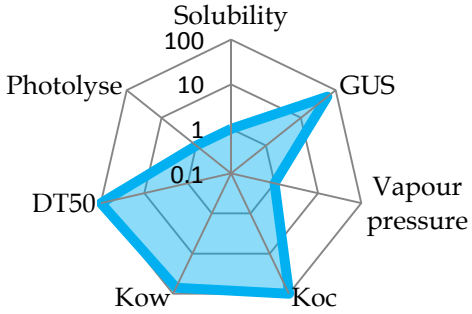
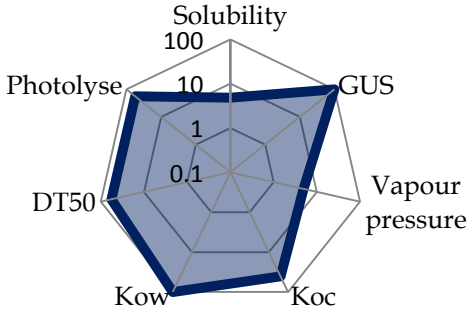


2 fungicides

Boscalid (BSC)



Cyproconazole (CYP)



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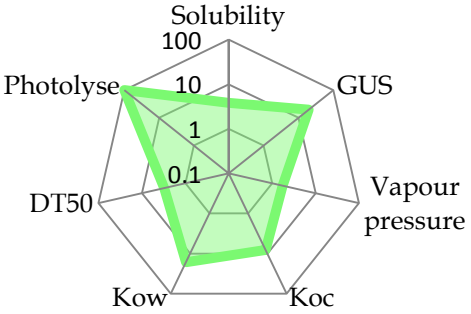

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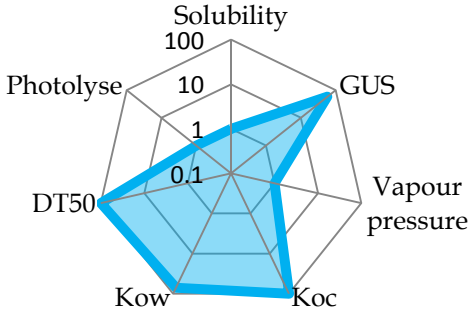

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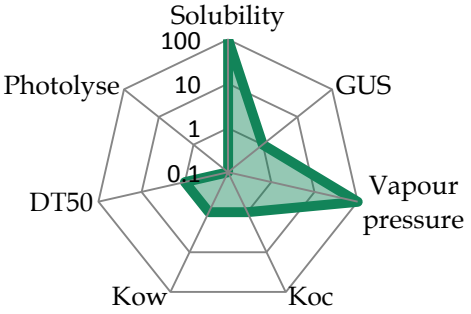

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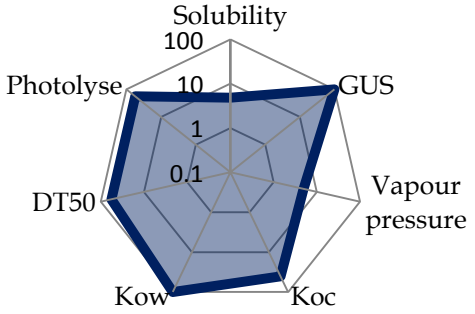
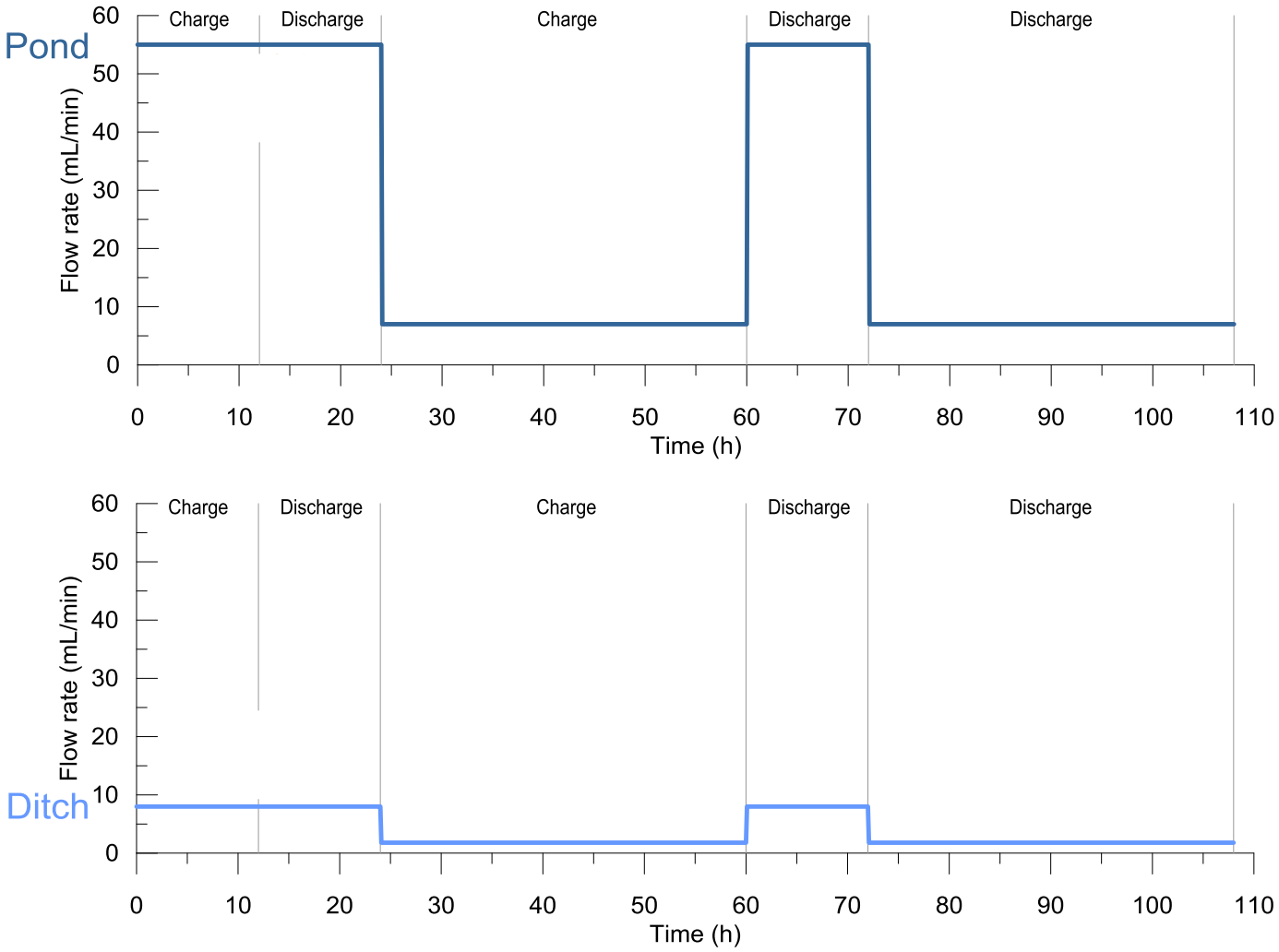


Do pesticides properties influence their mitigation?

Methodology – Experimental protocol



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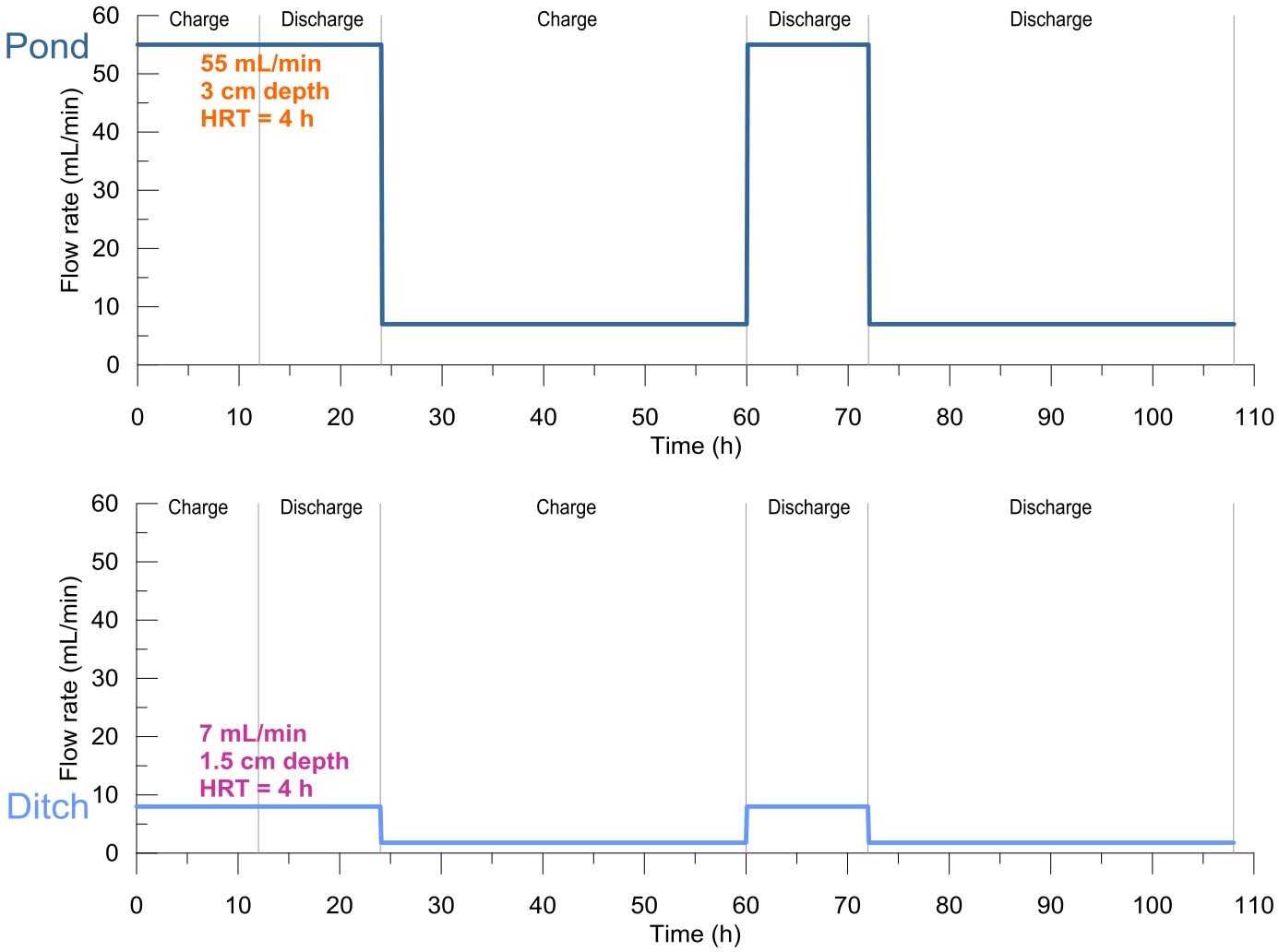

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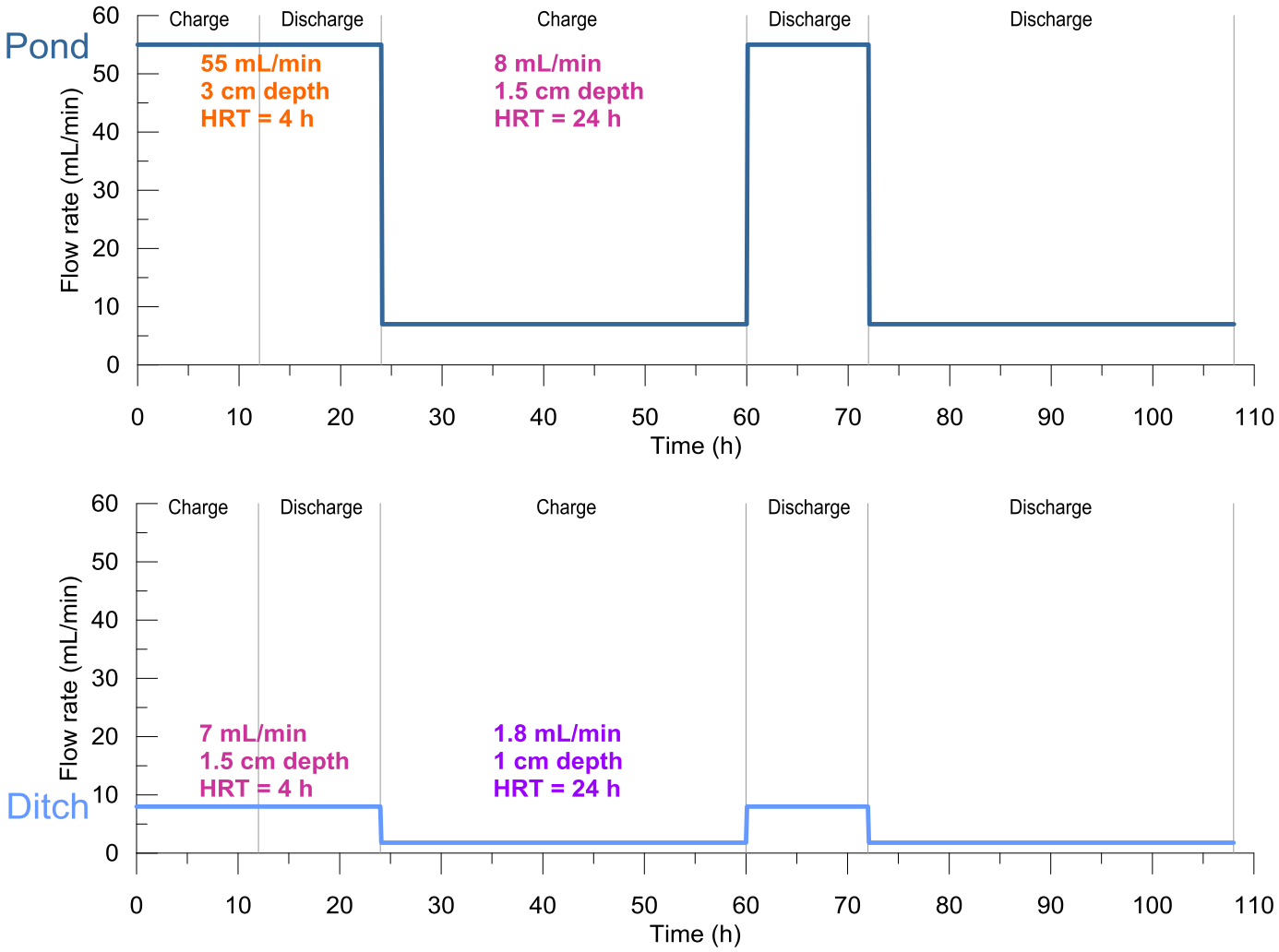

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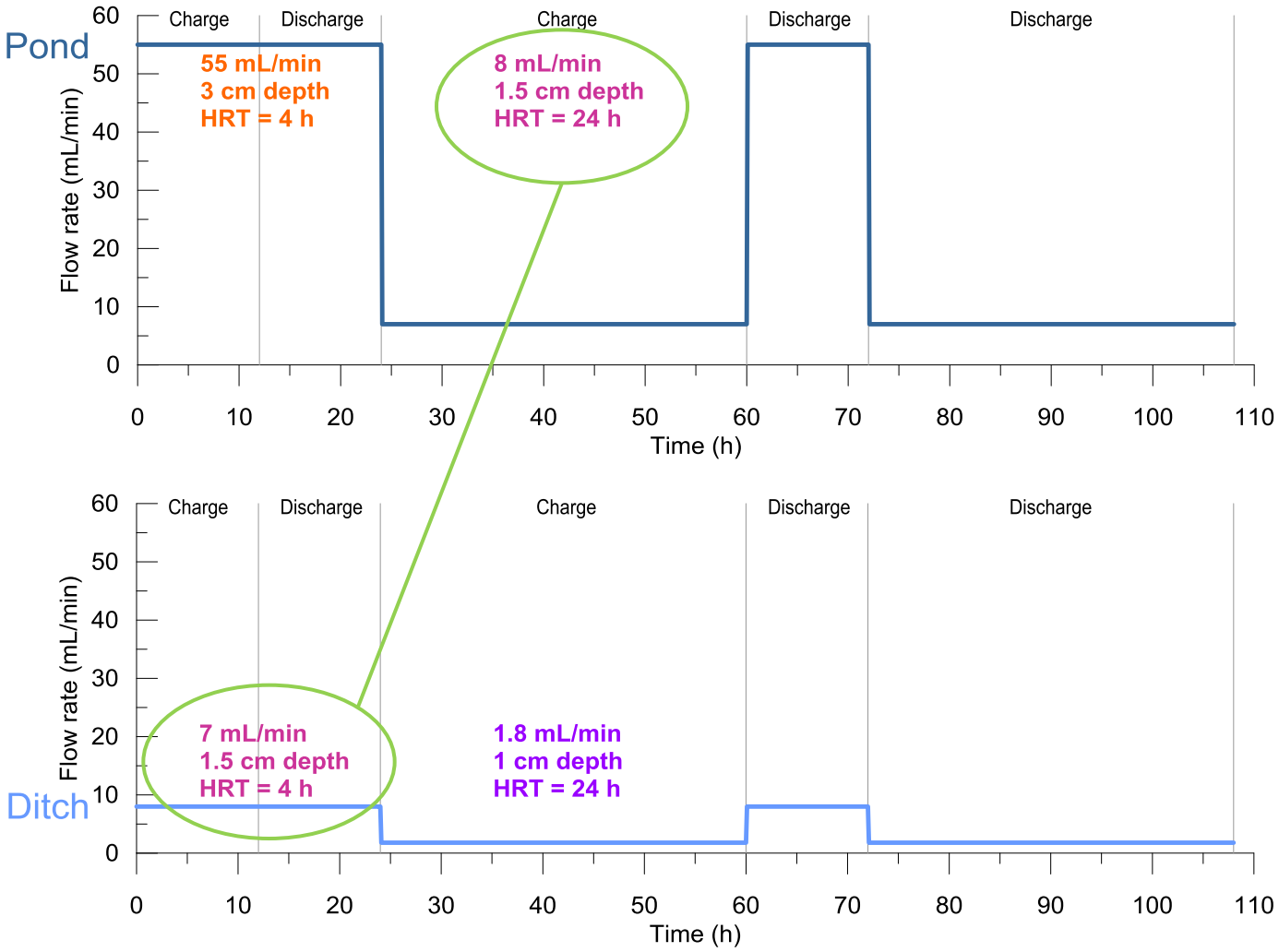

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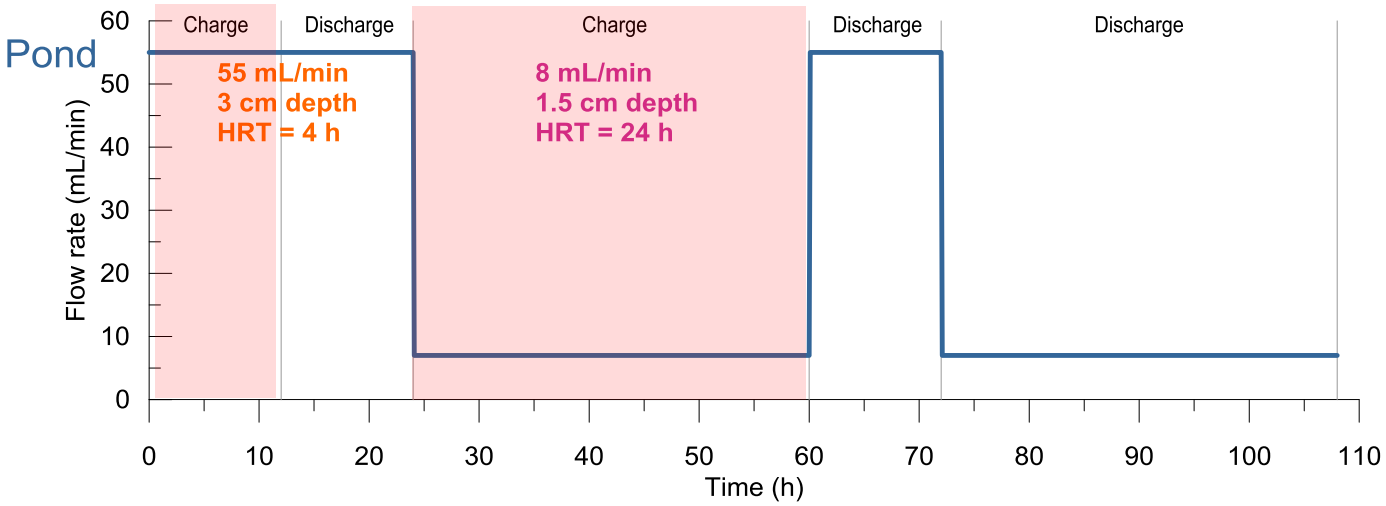

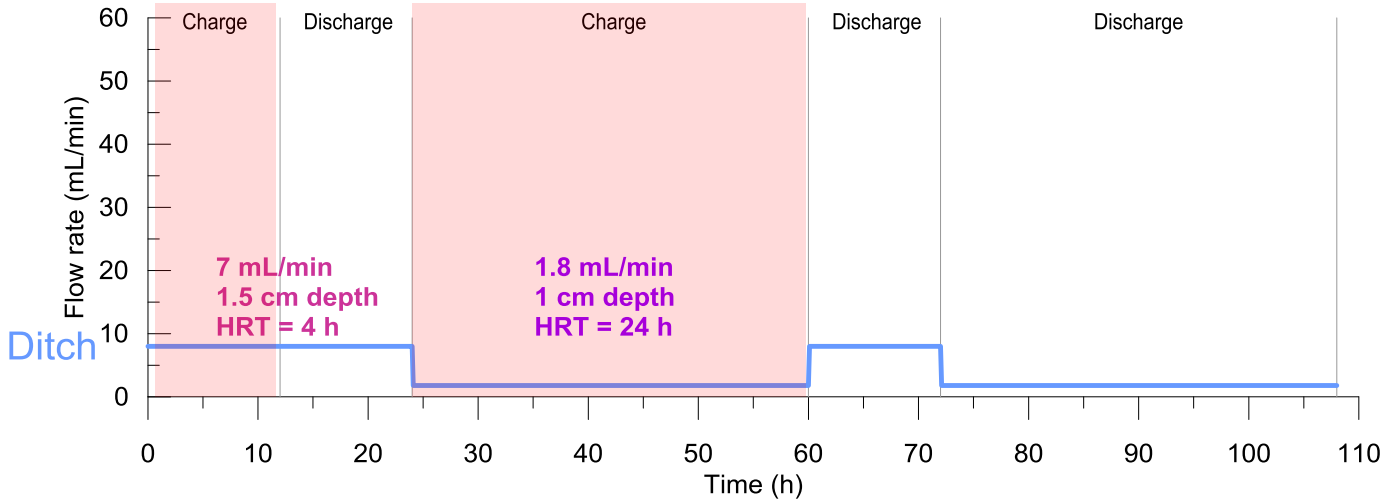

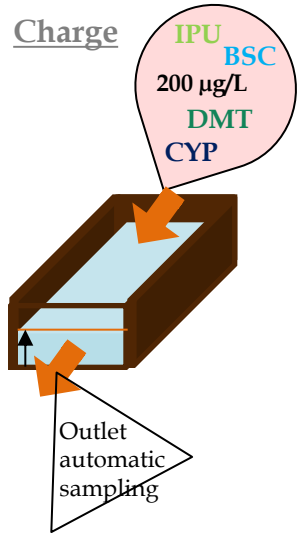

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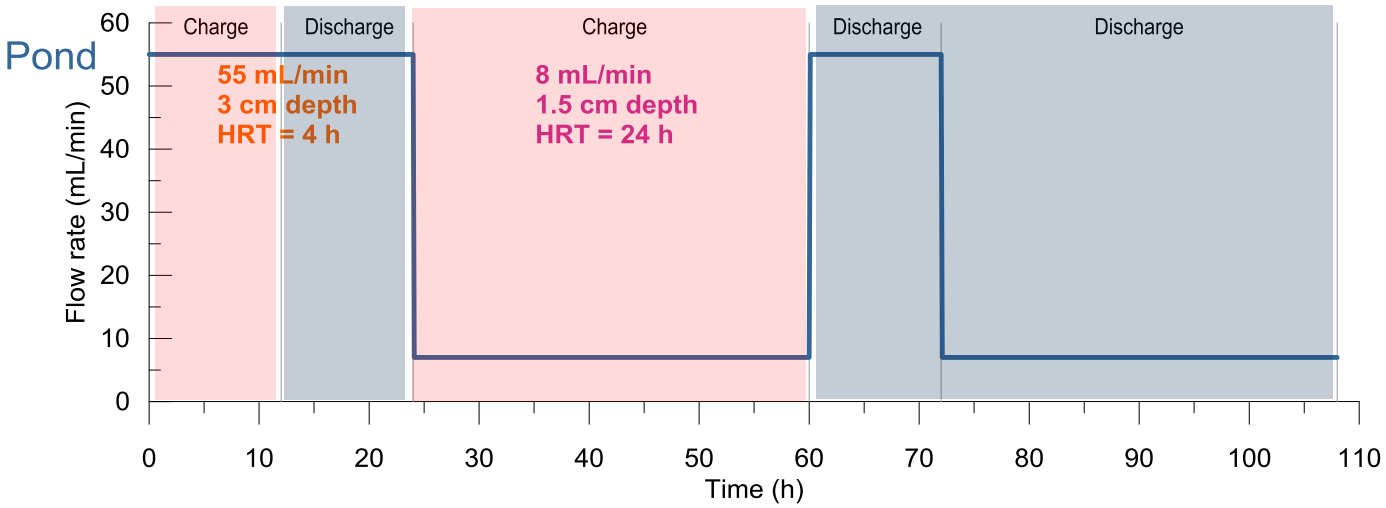

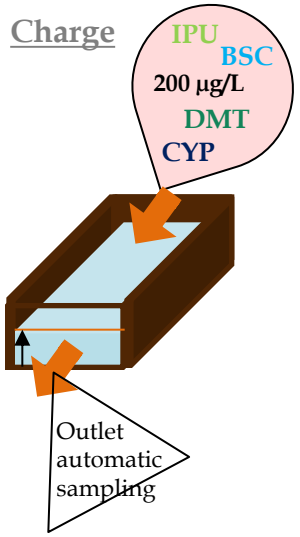

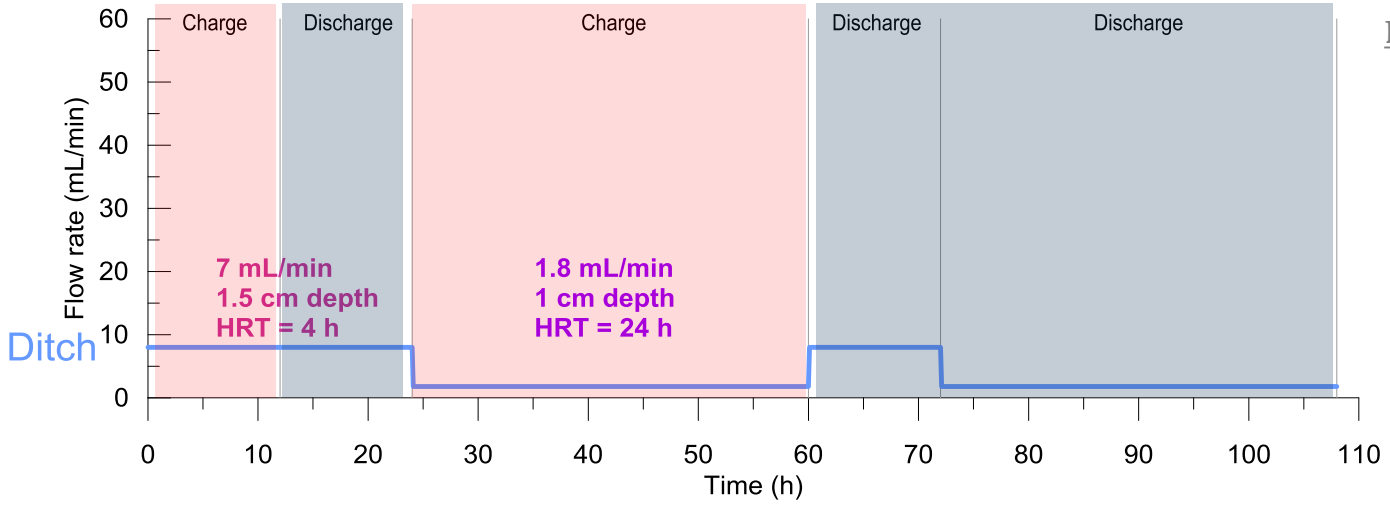

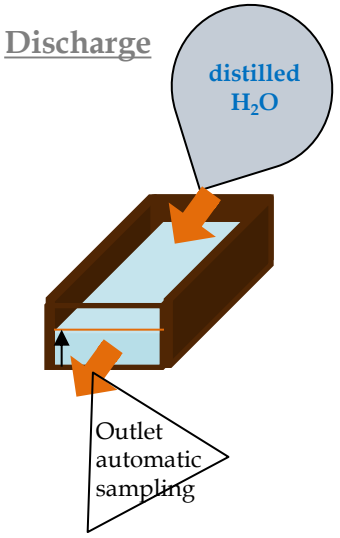

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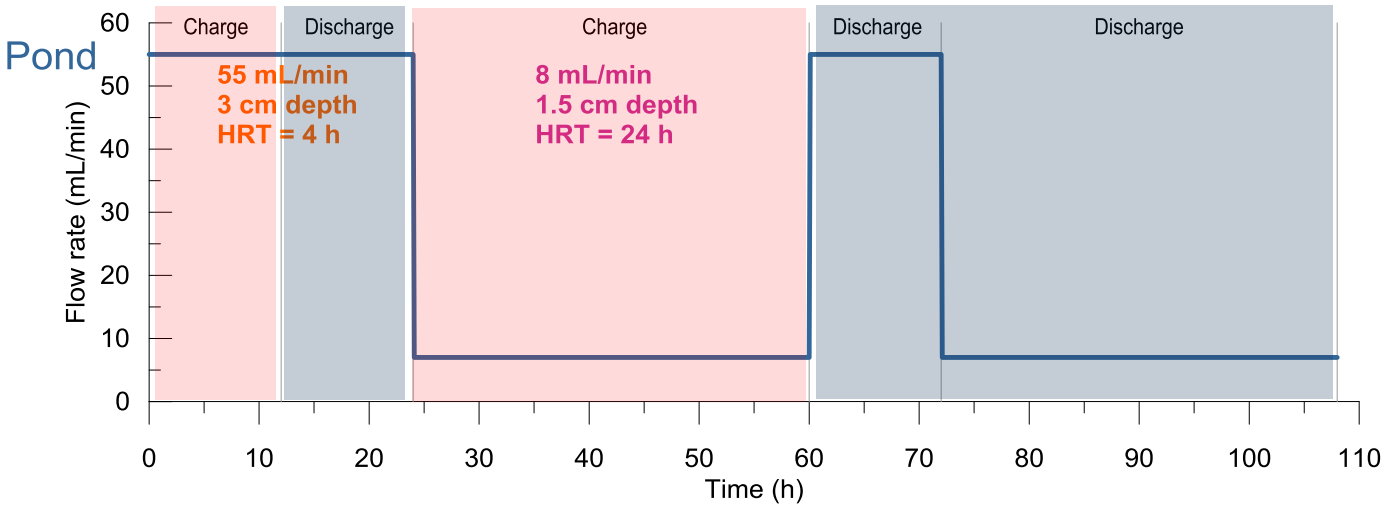
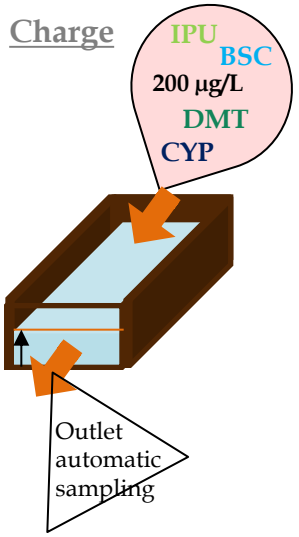
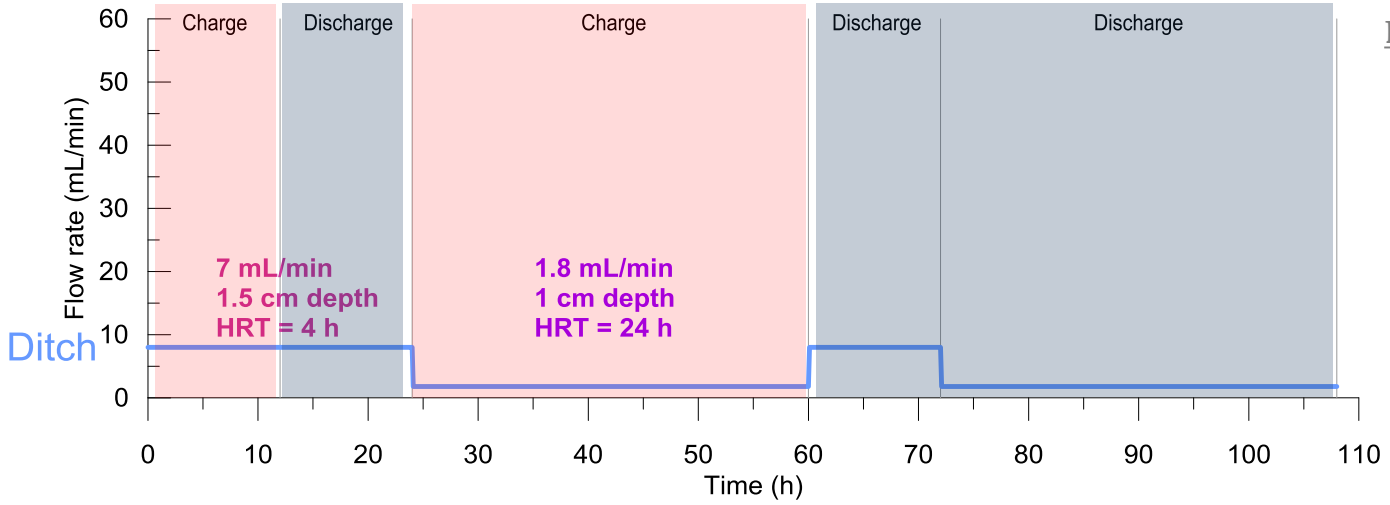
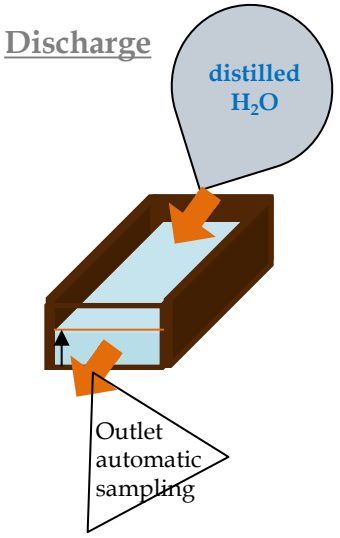


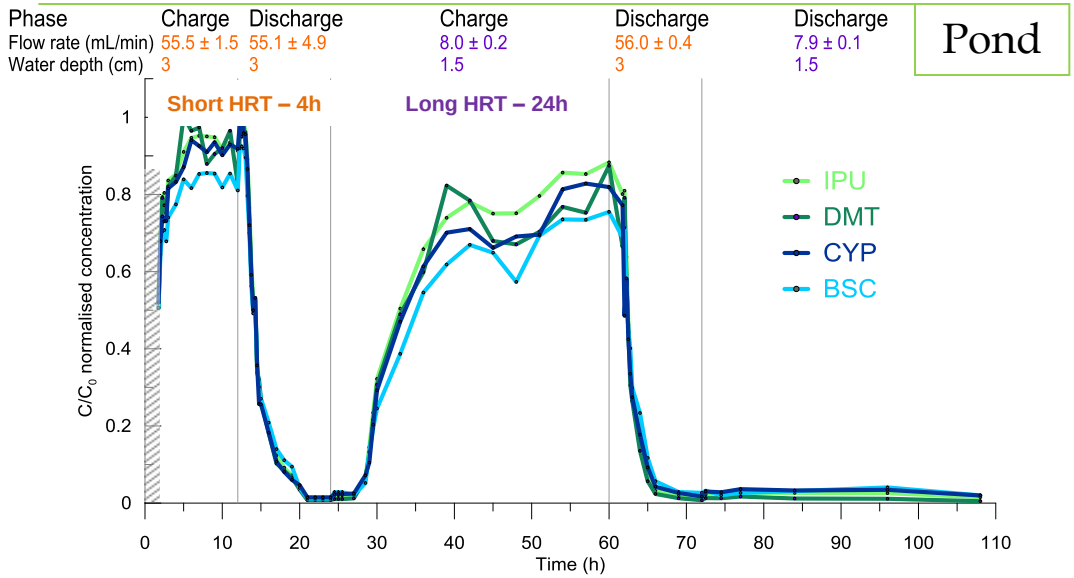


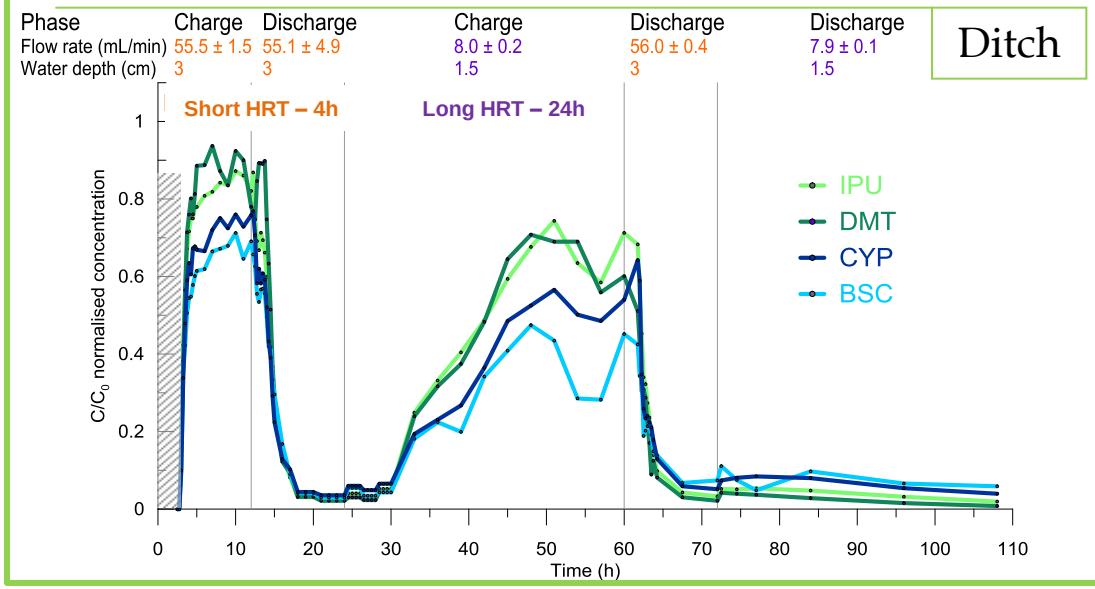




Do hydraulic parameters influence CW's effectiveness?

Results – Pesticides concentrations at the outlet





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→ Higher pesticides removal for longer HRT

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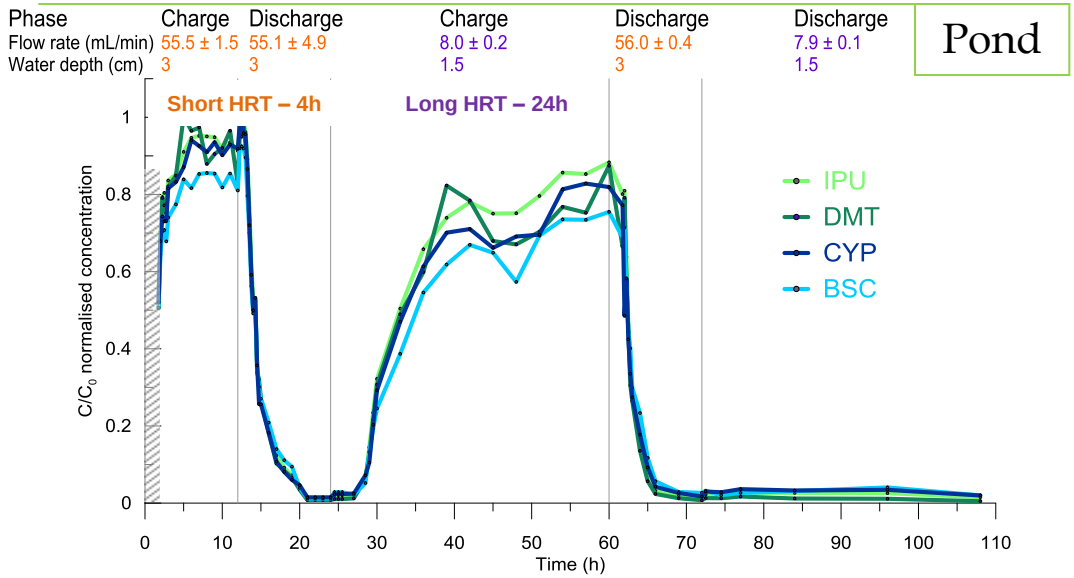

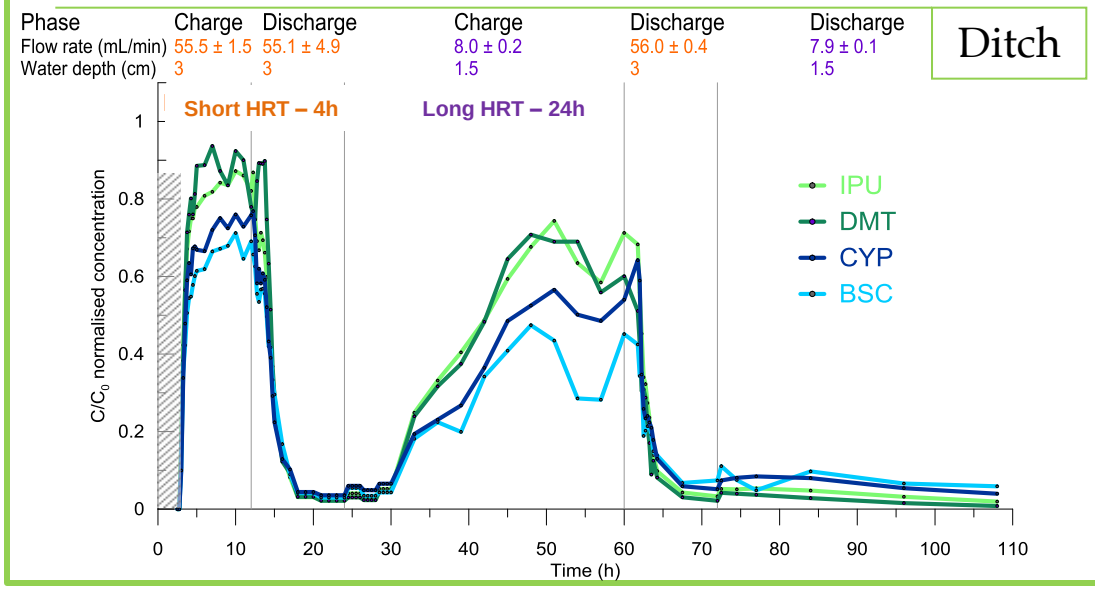

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[IPU] ≥ [DMT] ≥ [CYP] > [BSC]

→ In agreement with their K_d

$1.8 \leq 1.9 < 4.4 < 6.5$

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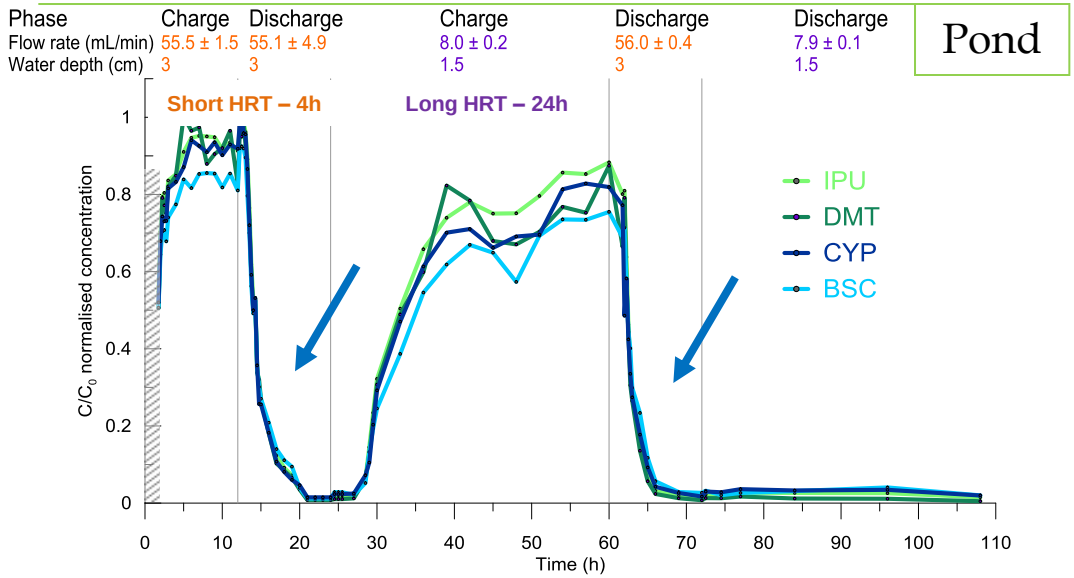

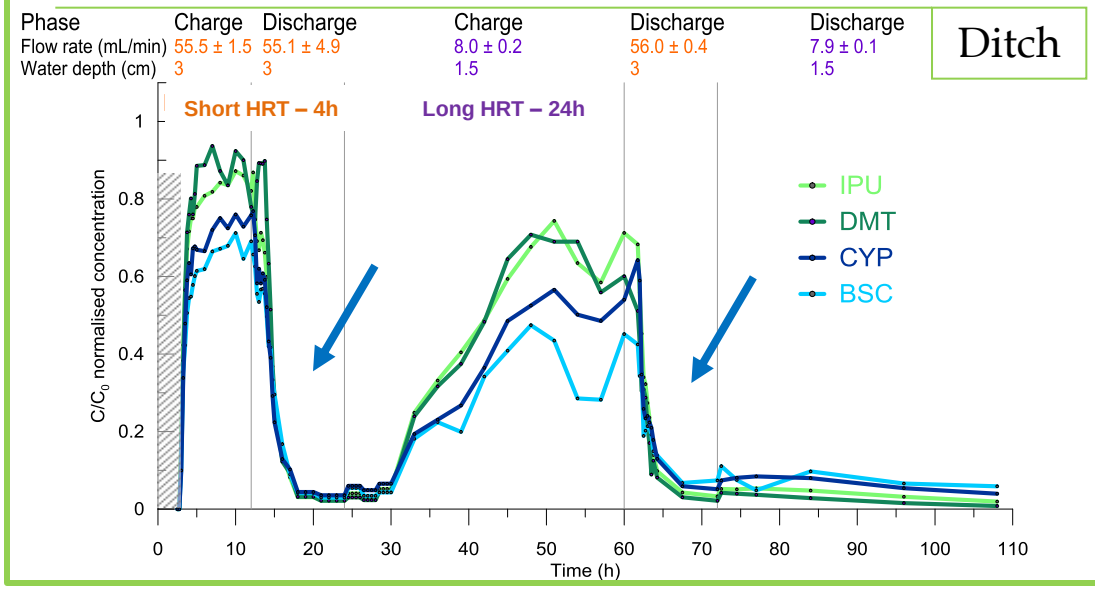

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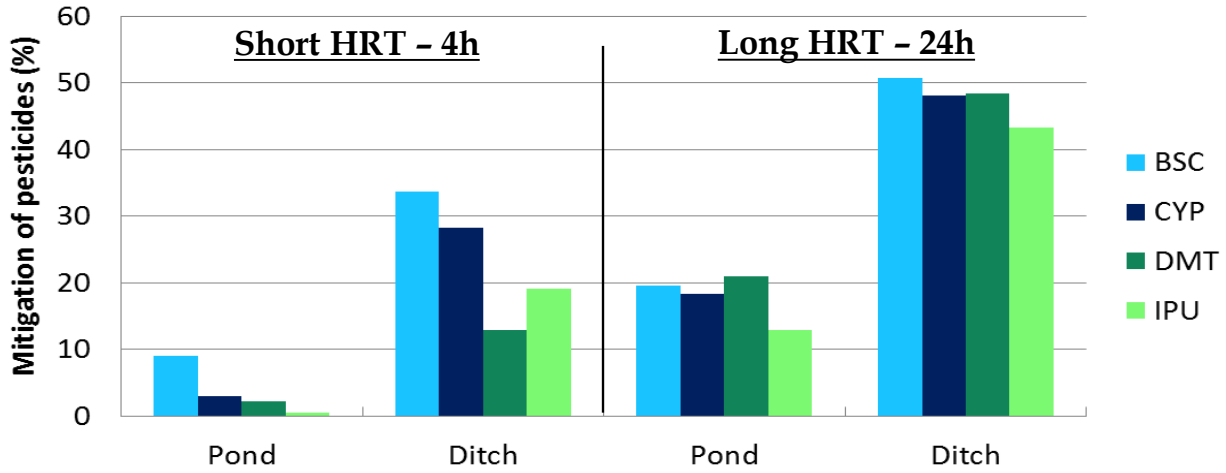
What's the effectiveness?

Results – Effectiveness of the pilot

→ Mitigation calculated for one step of charge and discharge (for short HRT and long HRT)



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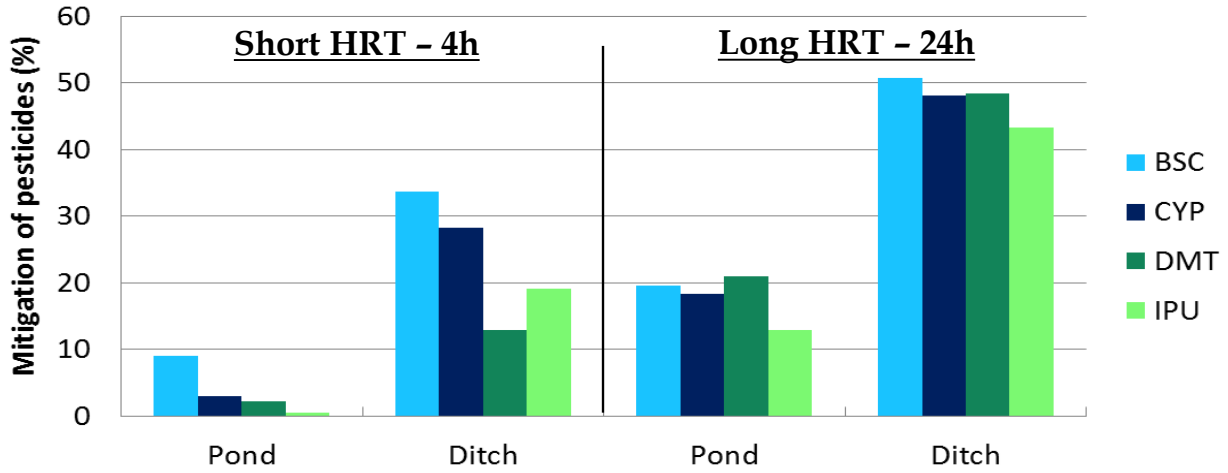

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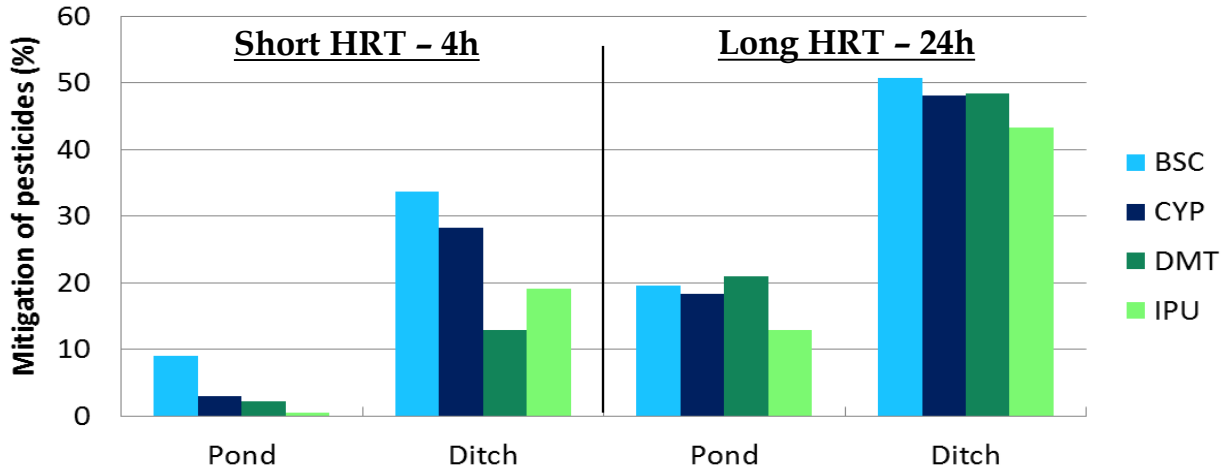

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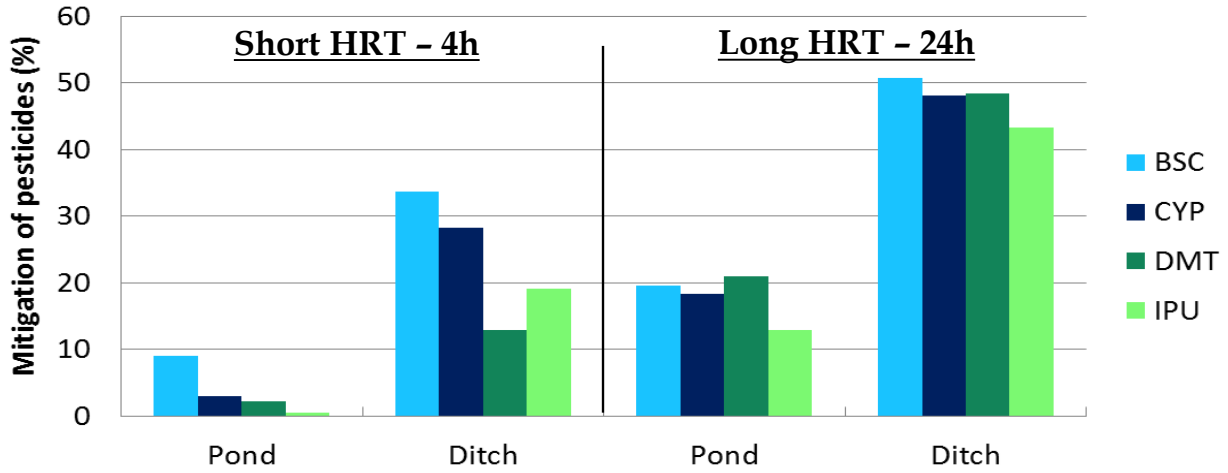

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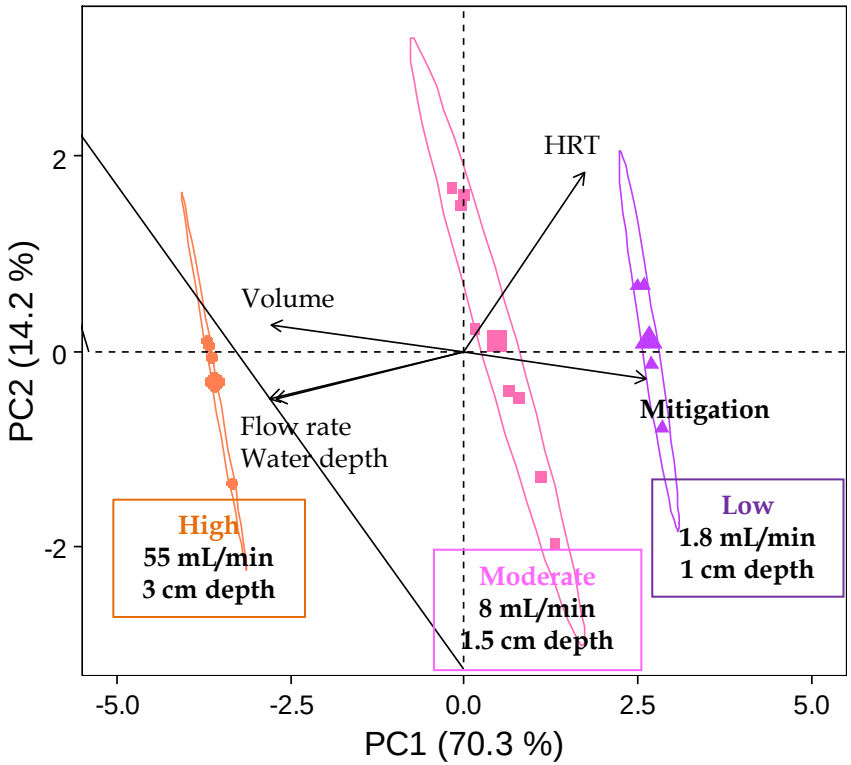
→ Different processes will influenced molecules according to their properties and are improved by a long HRT

Results – Influence of hydraulic on effectiveness



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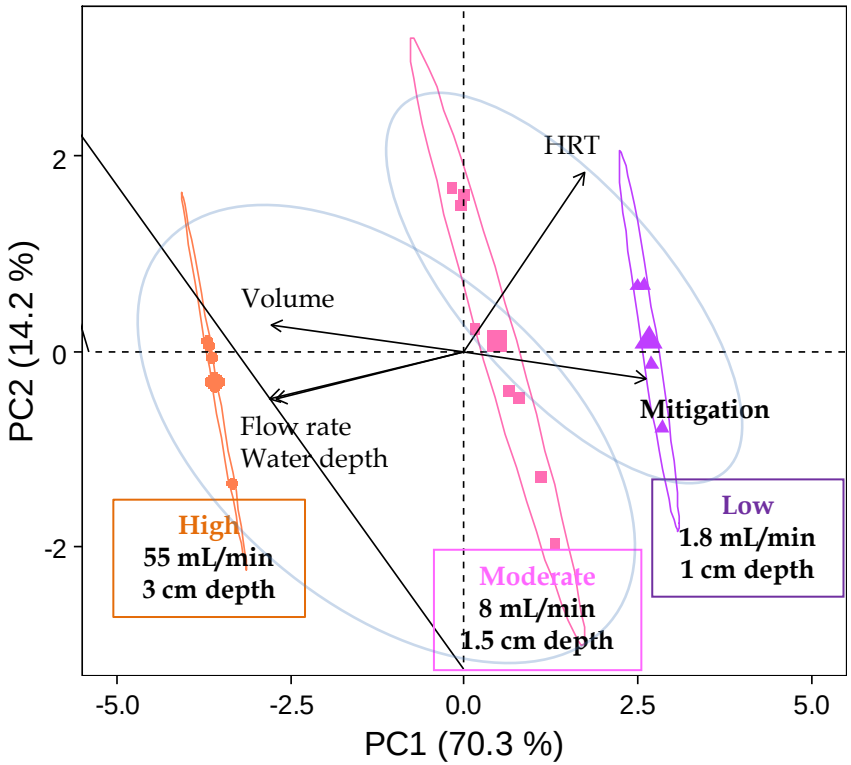

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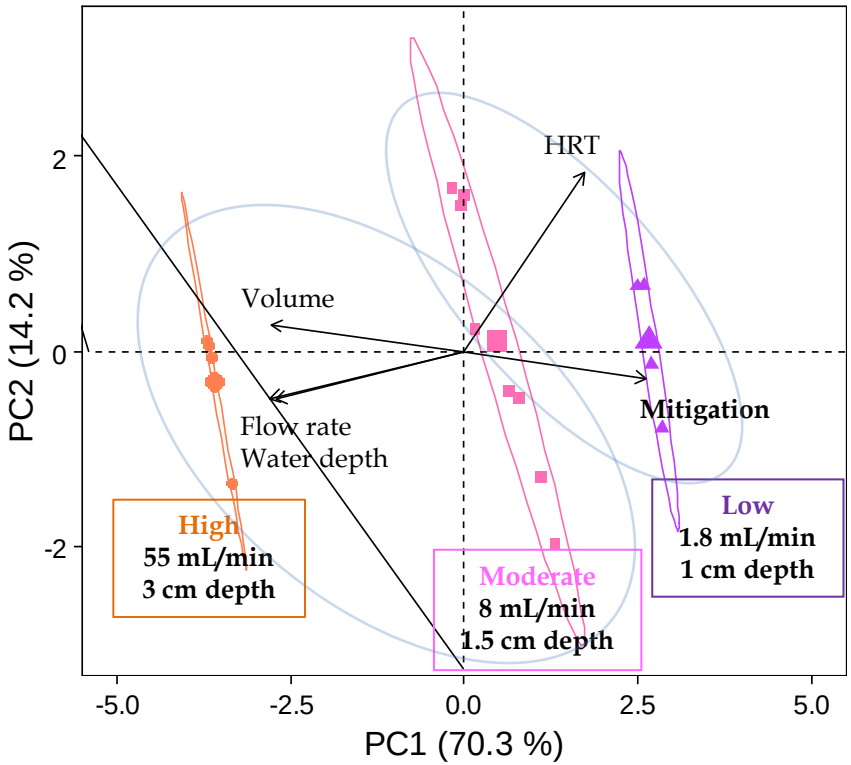

- Lower flow rate (water depth) = higher mitigation (whatever the HRT)
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→ Flow rate more influence the mitigation than HRT ?

Take home message

1. Do morphology of CW influence their effectiveness ?

Efficiency ditch > pond

→ but geometry or volume (and so hydraulic parameters ≠) → need more investigations

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2. Do pesticides properties influence their retention ?

→ Depend of the HRT

Short HRT: higher pesticides removal for higher hydrophobic

Long HRT: different processes occurred according to properties and could favored desorption

3. Do hydraulic parameters influence CW effectiveness ?

Higher effectiveness for lower flow rate and water depth (whatever HRT)

Higher effectiveness for higher HRT

Perspectives

In the field : one drainage period = draining period followed by stagnant period

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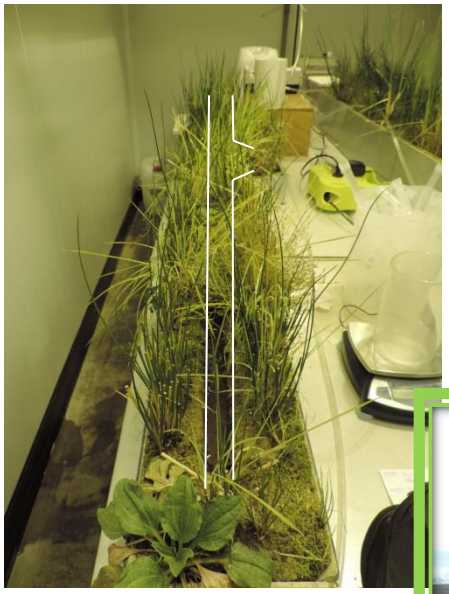
What is the effectiveness and repartition of pesticides for one complete drainage period ?

→ analysis in progress



Thank you for your attention

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