# Soil aging mechanisms, relation with climate proof design, sea or river conditions

Sep 14, 2023, Martine van der Ploeg

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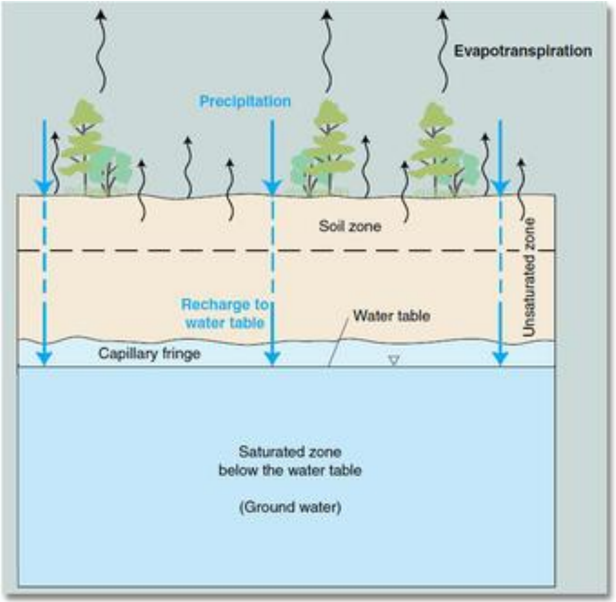
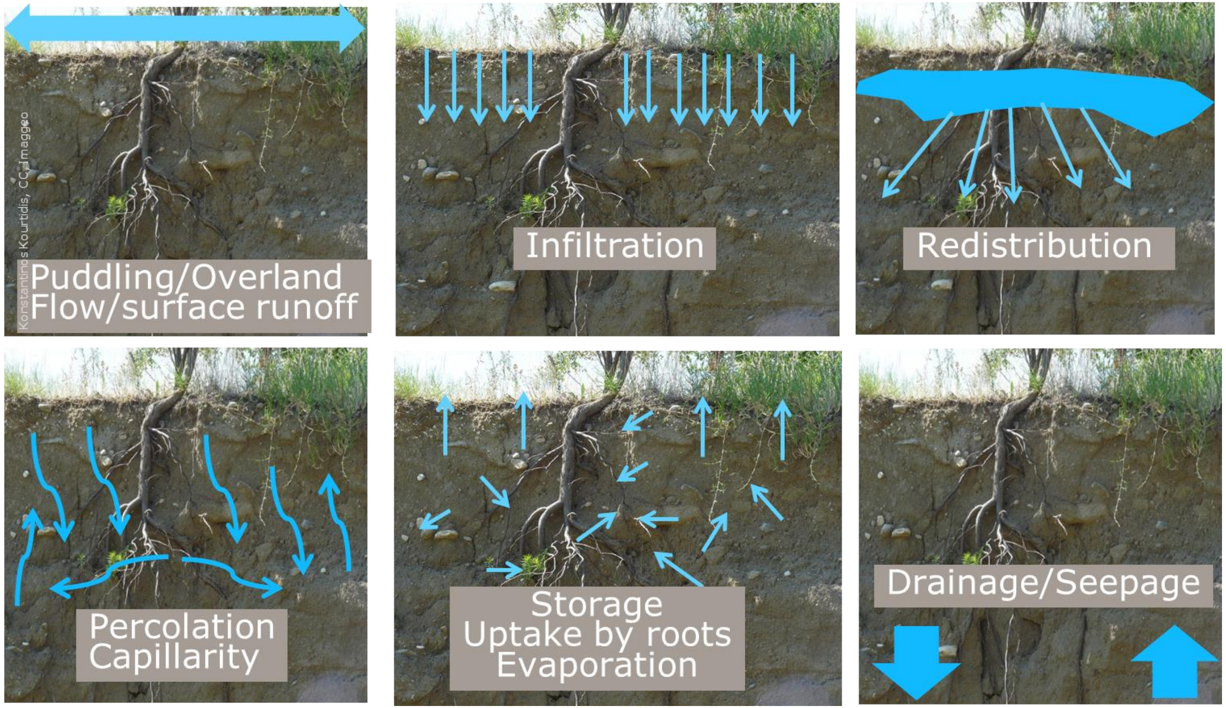
# Soil aging by biophysical interactions

- Driven by water



# Soil aging by biophysical interactions

i. Organic matter inputs changing bulk density, porosity and/or pore size distribution (Franzluebbers, 2002; Jarvis et al., 2017; Rawls, Nemes, & Pachepsky, 2004; Yang et al., 2014)

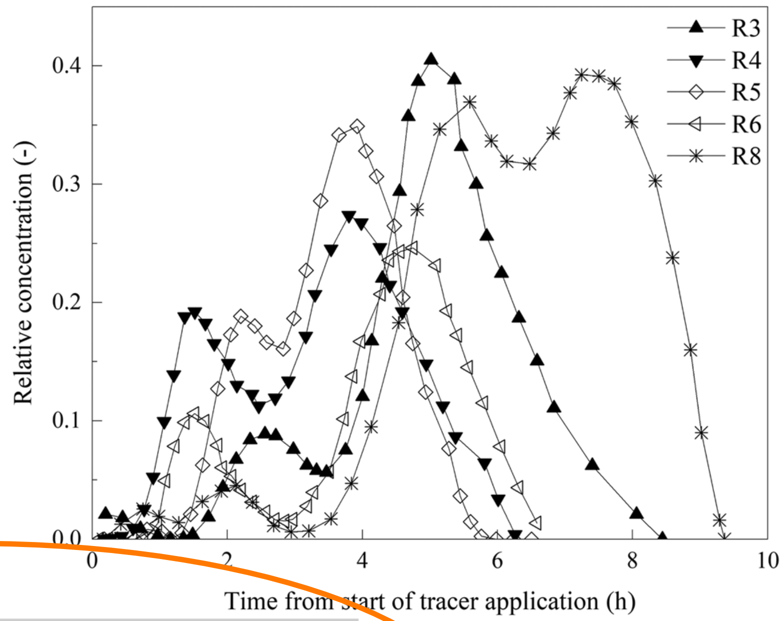
ii. Rooting structure and decreases in porosity through compression induced by new root growth, or macropore generation when roots decay (Bodner, Leitner, & Kaul, 2014; Fischer et al., 2015; Koestel & Schlüter, 2019)

iii. Biopore characteristics and abundance resulting from the activity of macrofauna, the "ecosystem engineers" (Berry, 2018; Smettem, 1992)

iv. Microbial activity, especially in the rhizosphere, which impacts hydrophobicity (Hallett, 2008).

# Soil aging by biophysical interactions

- Driven by soil biology, for example earth worms

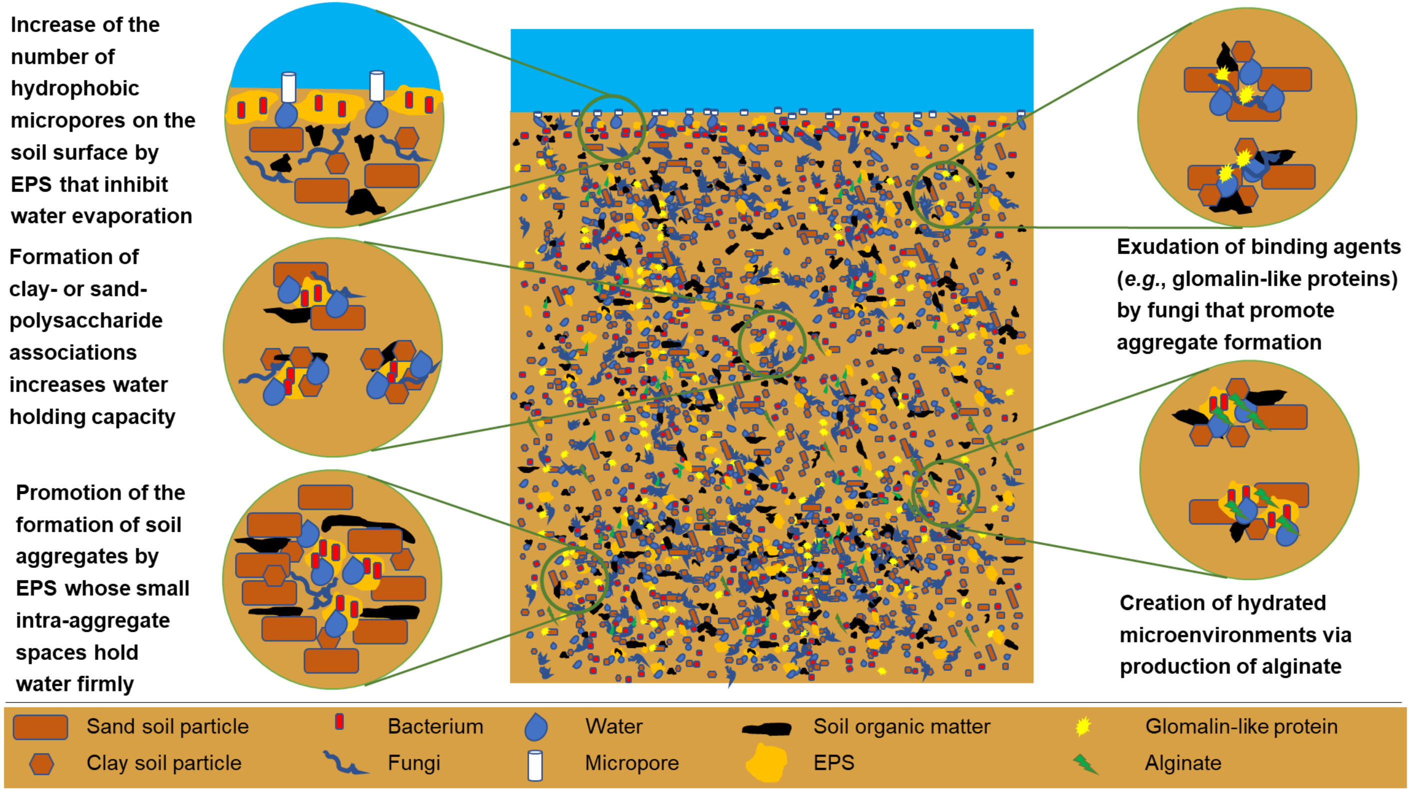



Yu et al. 2019, DOI: 10.1002/vzj2.20059

| Treatment | Drainage flux | T5% | T25% | T50% | Total time |
| --- | --- | --- | --- | --- | --- |
| | ml min$^{-1}$ | h | | | |
| MP | 13.01 ± 2.62a | 1.59 ± 0.38b | 2.07 ± 0.37b | 2.38 ± 0.41b | 3.67 ± 0.61b |
| EW-L | 8.87 ± 2.60b | 2.25 ± 0.99a | 3.62 ± 1.16a | 4.52 ± 1.21a | 7.19 ± 0.92a |
| MP-EW-L | 7.86 ± 1.46b | 2.05 ± 0.77a | 3.12 ± 1.23a | 3.88 ± 1.48a | 7.04 ± 0.67a |

*Note*. T5%, T25%, and T50% are the relative arrival times of 5, 25, and 50% tracer mass. The values are mean ± SD; the letters "a" and "b" indicate significance test of mean differences among three groups of soil columns. a > b (one-way ANOVA, $p < .05$)

# Aggregate formation by microbes

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Coban et al., DOI: 10.1126/science.abe0725

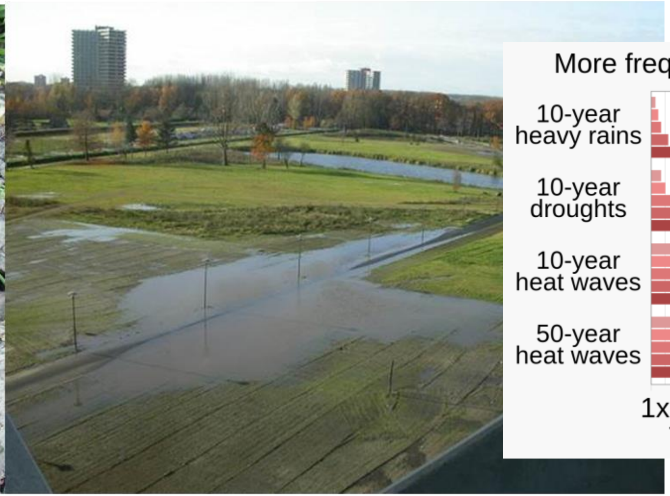
# Changes in the water cycle related to climate change

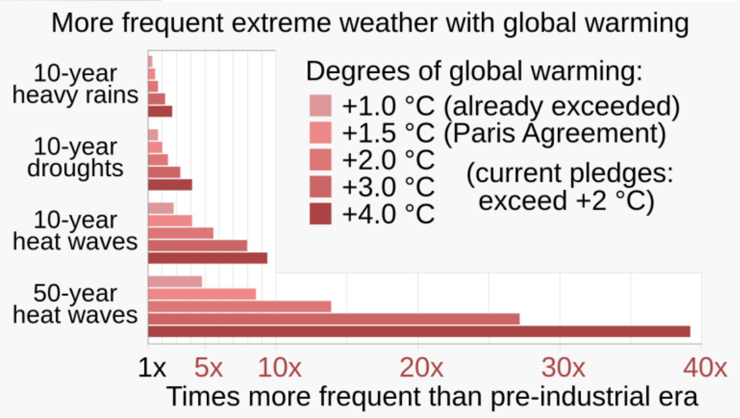
Droughts

Drier

Floods

Wetter






Te Brake 2011

IPCC 2021, doi:10.1017/9781009157896.001

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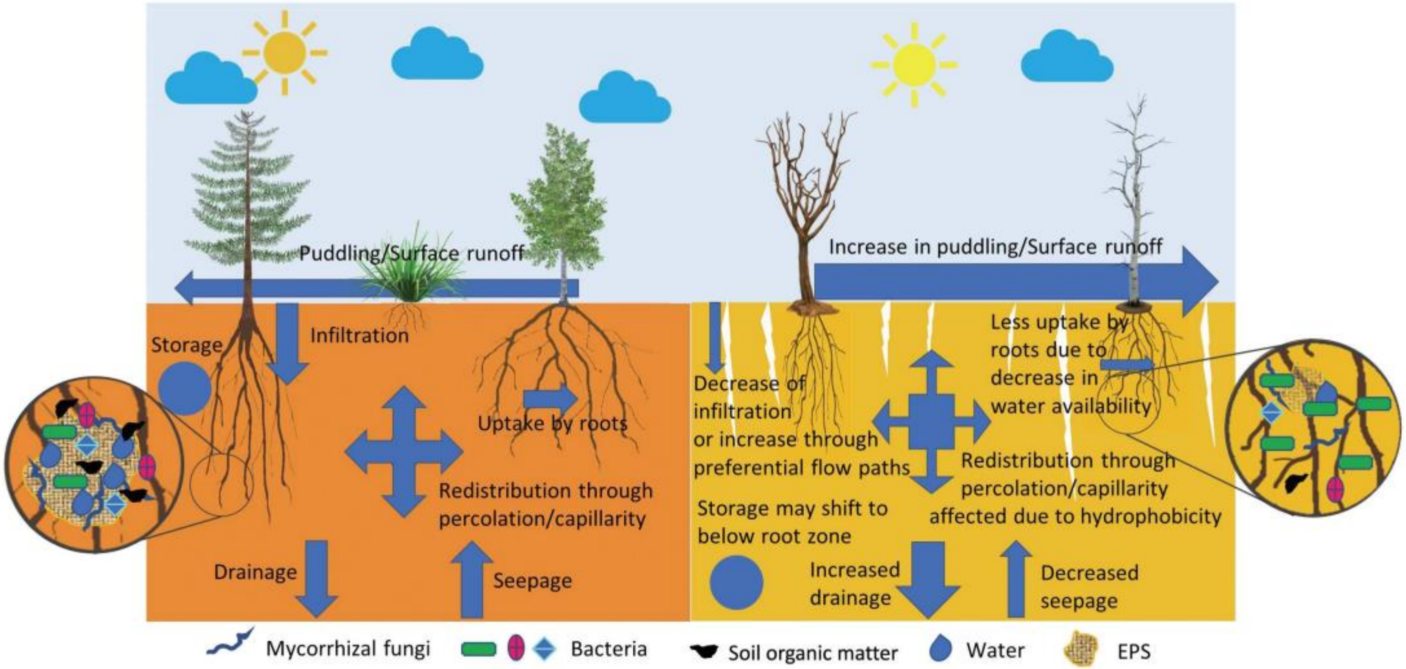
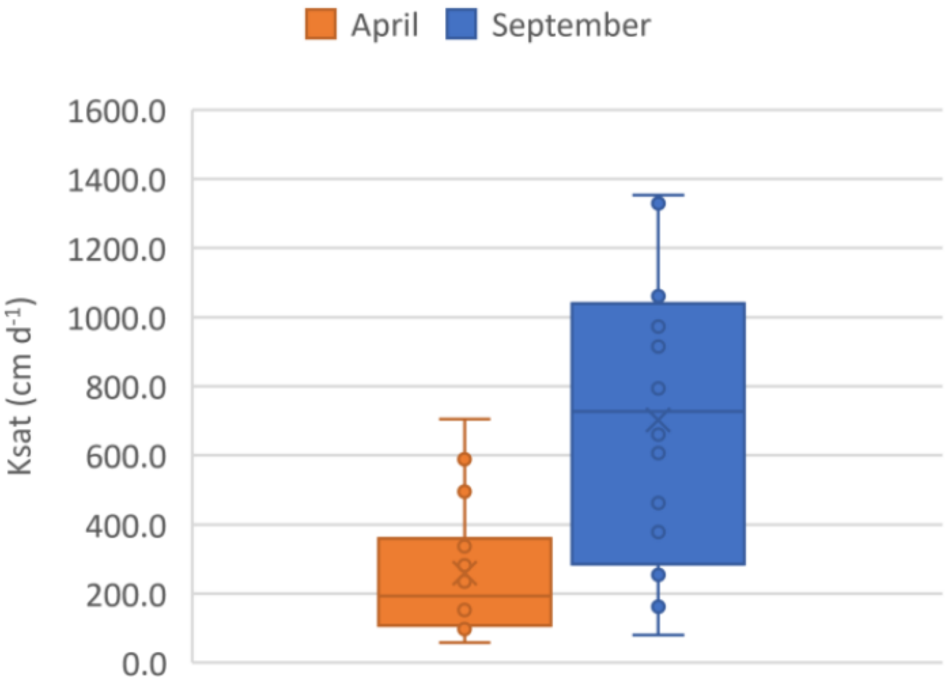
# Impacts on soil structure




Coban et al., DOI: 10.1126/science.abe0725

# Effect drought summer 2022 on soil structure

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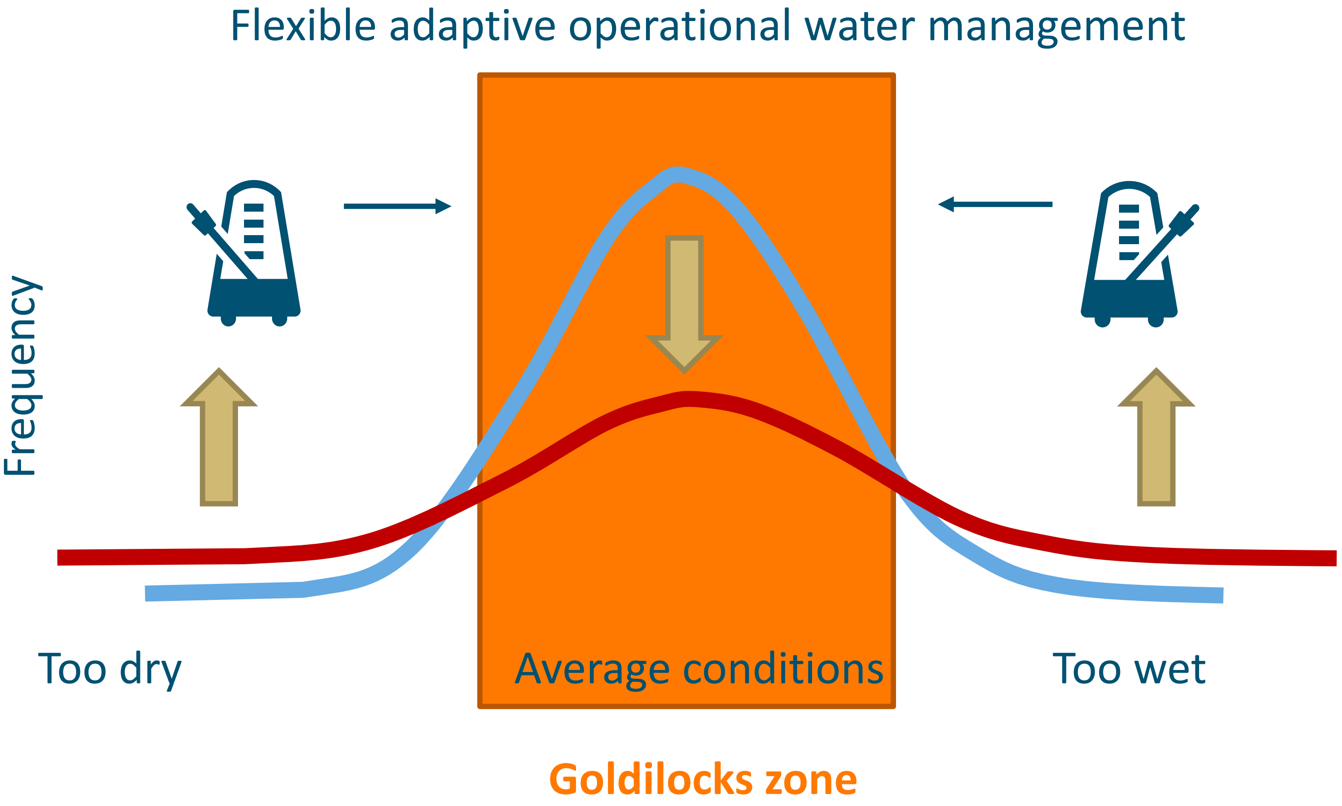
# Main issues/ambitions/recommendations

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# Questions

i. How do changing alterations of dry-wet conditions (impacting biophysical processes) under climate change impact structure?

ii. How does soil aging change as a result of biophysical processes in more biodiverse dikes?

iii. How do biodiverse dikes with possible shrinking/swelling clay properties impact safety criteria?

# Shared slide

- Short-term: add extra monitoring options to current projects to follow structure developments, either in situ, proximal, remote. If possible investigate differences between large cracks/eroded areas and surrounding material.
- Long-term:  Living-lab setting: a stakeholder-focussed, iterative, open innovation environment operating in a defined context, to integrate concurrent research and innovation processes within a public-private-people partnership.
- Ambition: formulate research project to tackle questions together as an expert group