# Modelling respiration pulses at rewetting as a stochastic process

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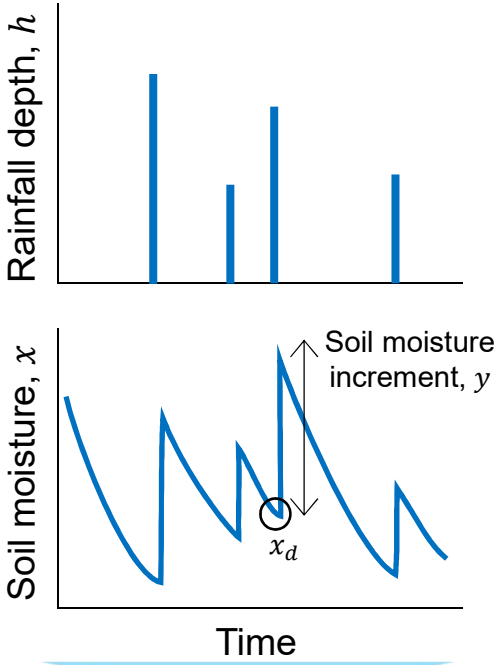
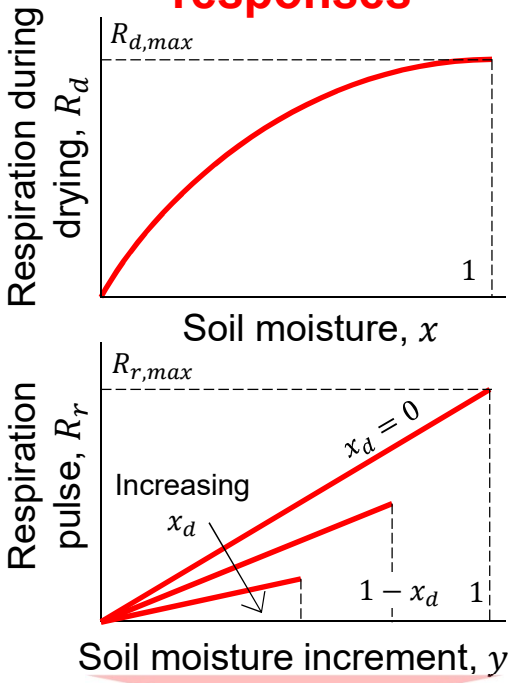
Rainfall intensification increases the contribution of rewetting pulses to soil respiration

# Materials

## 1) Stochastic precipitation and soil moisture



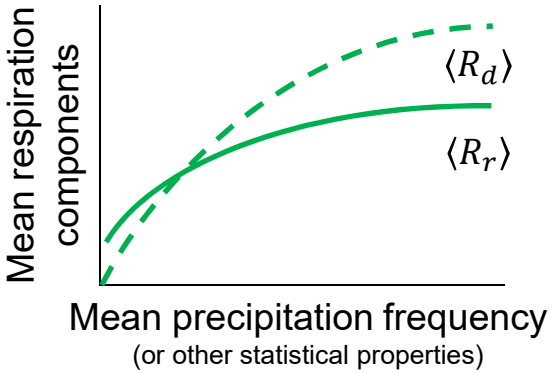

## 2) Heterotrophic respiration responses

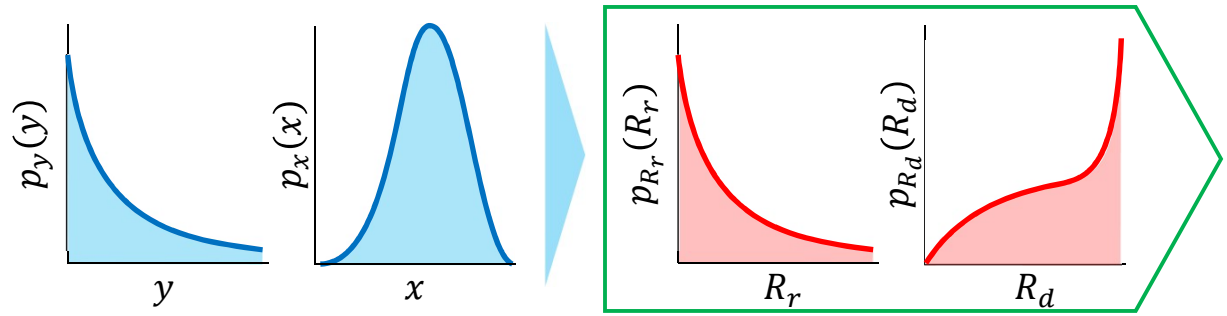



Soil heterotrophic respiration = respiration under steady soil moisture ($R_d$) + respiration pulse at rewetting ($R_r$)

Empirical relations between respiration and soil moisture based on measurements from incubation studies

## 3) Long-term mean respiration components



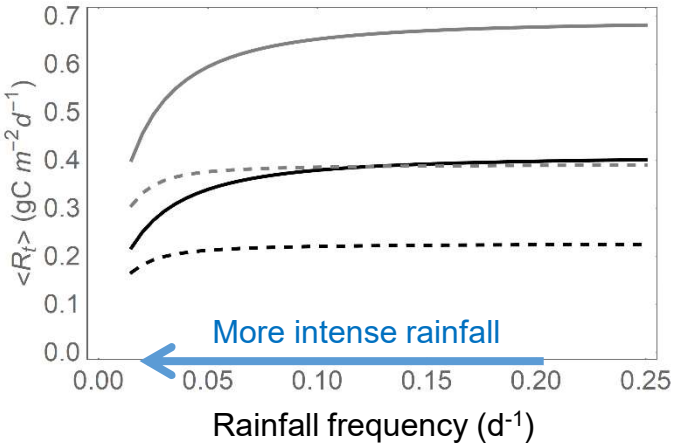

Analytical framework based on stochastic processes theory

# Results

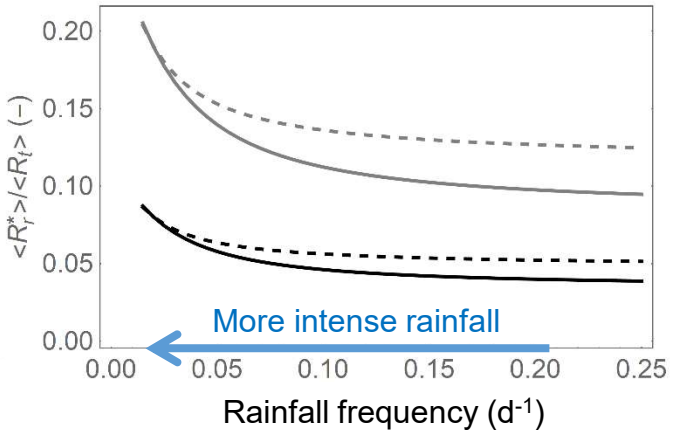
Rainfall intensification described by varying both rainfall frequency and rain event depth for fixed total rainfall <P>

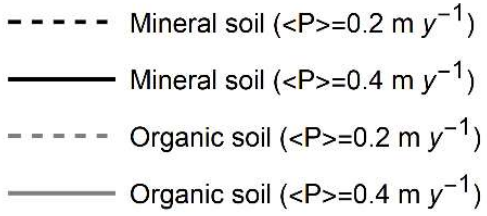
1) Total heterotrophic respiration decreases with more intense rainfall (due to higher runoff, lower mean soil moisture)
2) Respiration pulses contribute more with more intense rainfall
3) Higher total rainfall increases total heterotrophic respiration (solid vs. dashed lines), but decreases the contribution of respiration pulses
4) Soils with more organic carbon have higher total respiration and higher contribution of respiration pulses (grey vs. black lines)

**Soil heterotrophic respiration**




**Fraction of heterotrophic respiration due to pulses at rewetting**



# Discussion

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1. Approach: novel perspective on heterotrophic respiration based on the theory of stochastic processes
2. Advantage: analytical relations between statistical properties of respiration and statistical properties of rainfall → suitable approach for climate change scenarios
3. Prediction: respiration pulses contribute more to total heterotrophic respiration under more intermittent rainfall
4. Consequences: processes associated with pulses will gain importance under climate change—e.g., nutrient mineralization can become de-coupled from plant uptake