Shrinking snowpacks and microbial phenology: Exposing knowledge gaps under the snow

Will Wieder

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This material is based upon work supported by the National Center for Atmospheric Research, which is a major facility sponsor ed by the National Science Foundation under Cooperative Agreement No. 1852977.

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Images from chronolog



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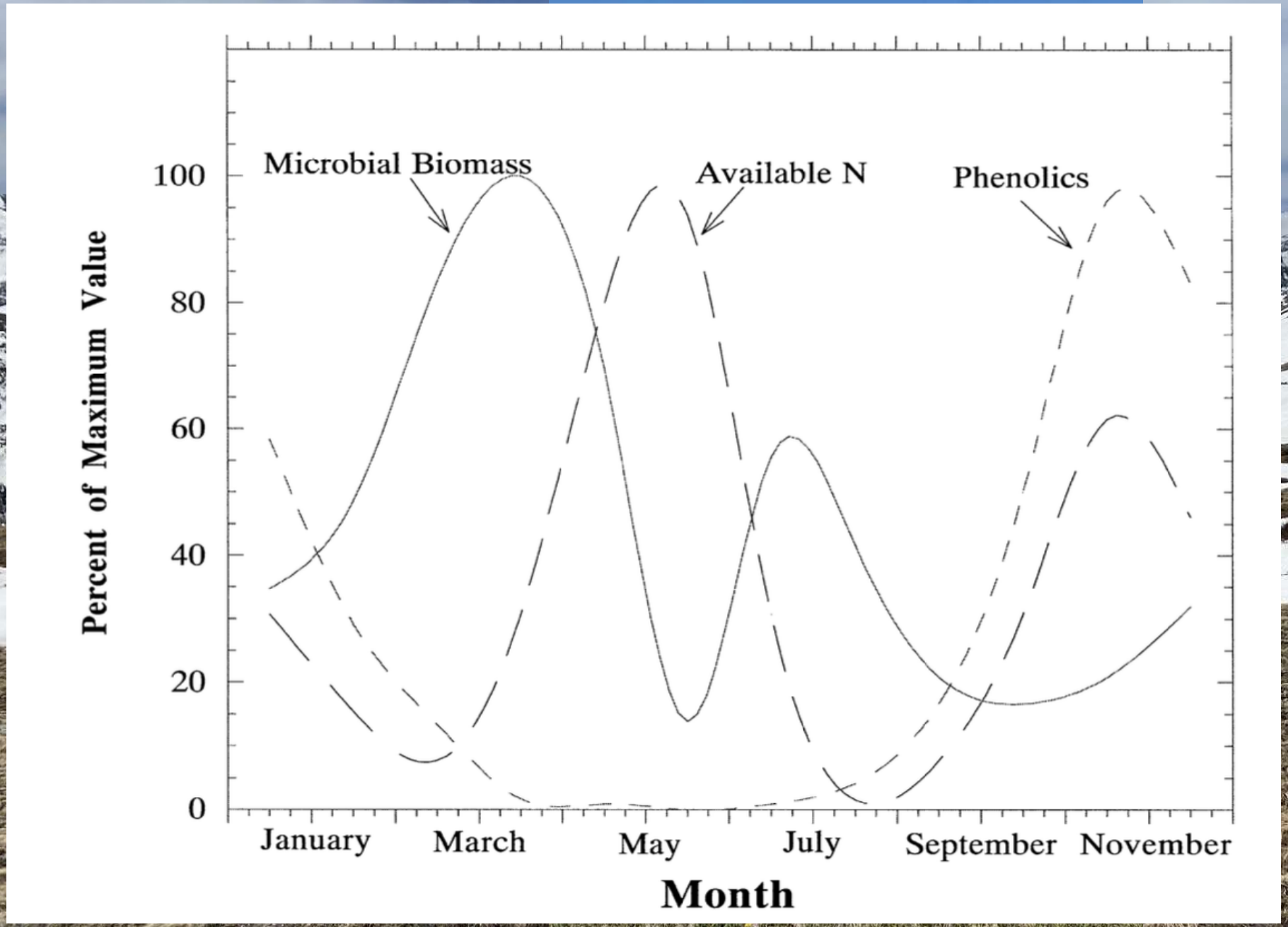

Schmidt & Lipson 2004

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East River Valley & Gothic Mountain
Rocky Mountain Biological Lab, CO

Mariah Carbone

Austin Simonpietri

Genevieve Blumencwejg

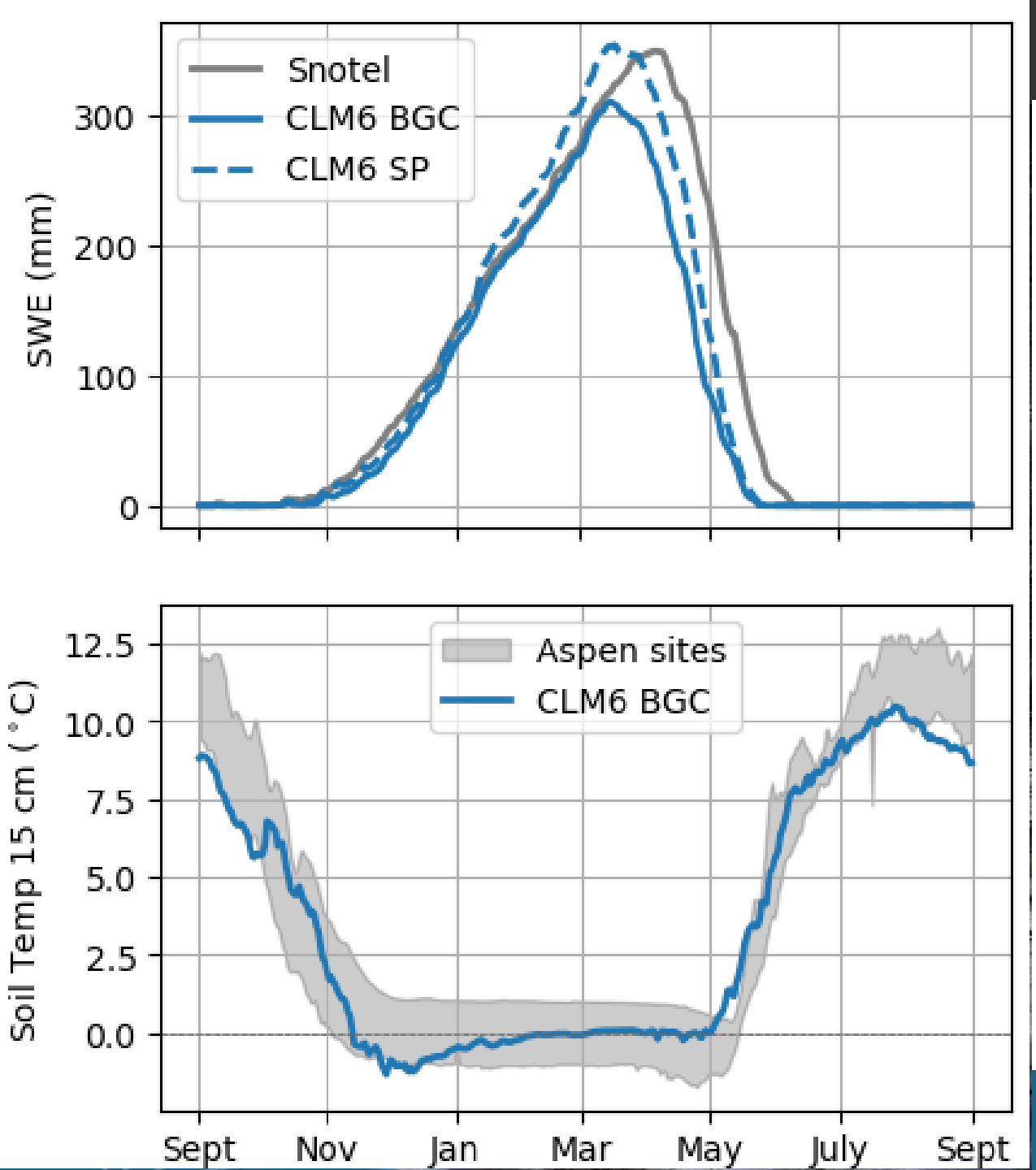
Phenocam Images: Snodgrass Mt (Rocky Mountain Biological Lab, Gothic CO)

May 6

June 15

Nov 1

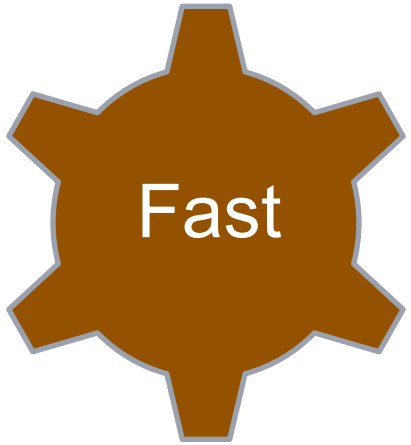
Biophysical model adequacy? 👍

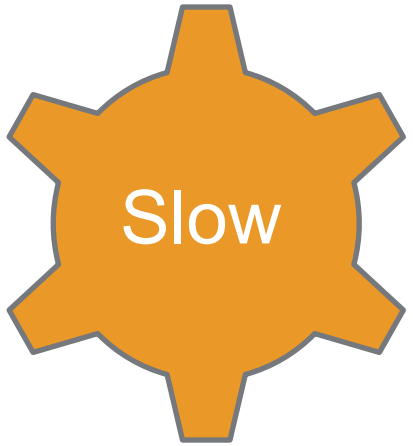


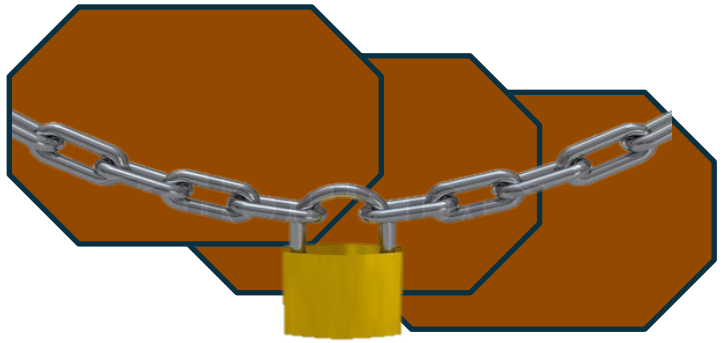
MIMICS

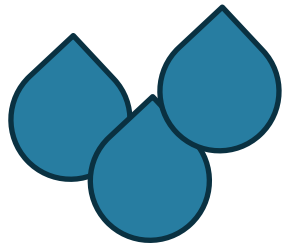
Substrate Quality + Microbial Explicit + Mineral protection → Globally

CLM

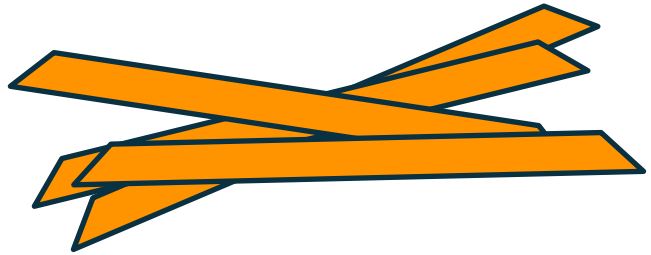








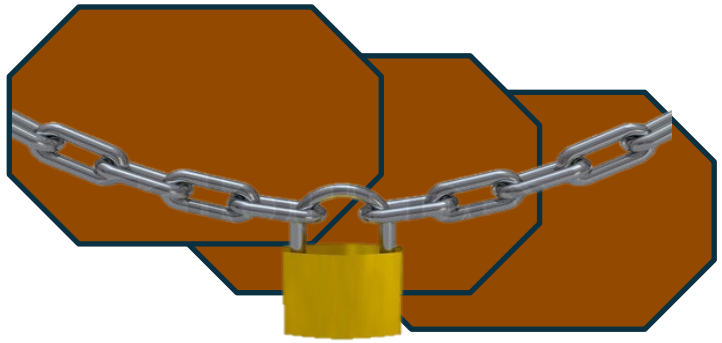
Wieder et al. 2014,
Wieder et al. 2015
Kyker-Snowman 2020
Wieder et al. 2024



MIMICS

CLM

Substrate Quality + Microbial Explicit + Mineral protection



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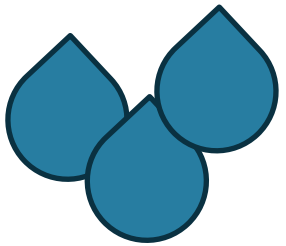

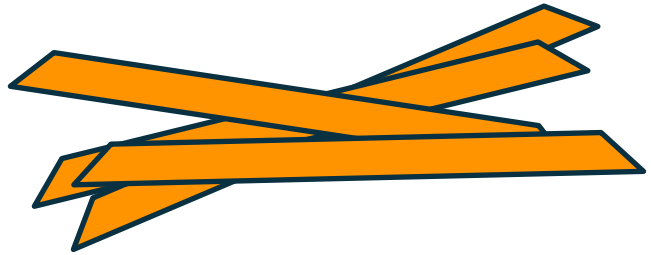

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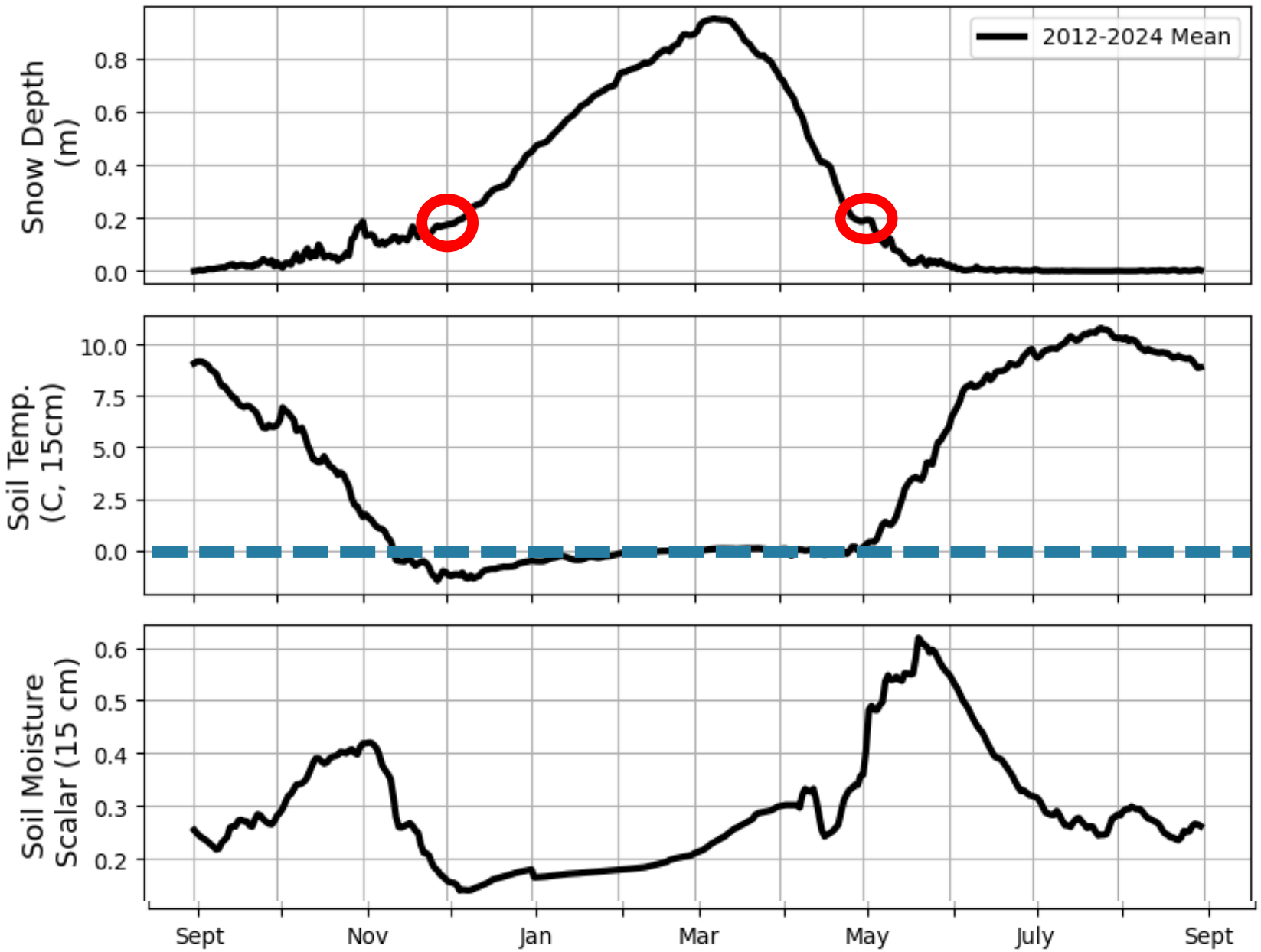
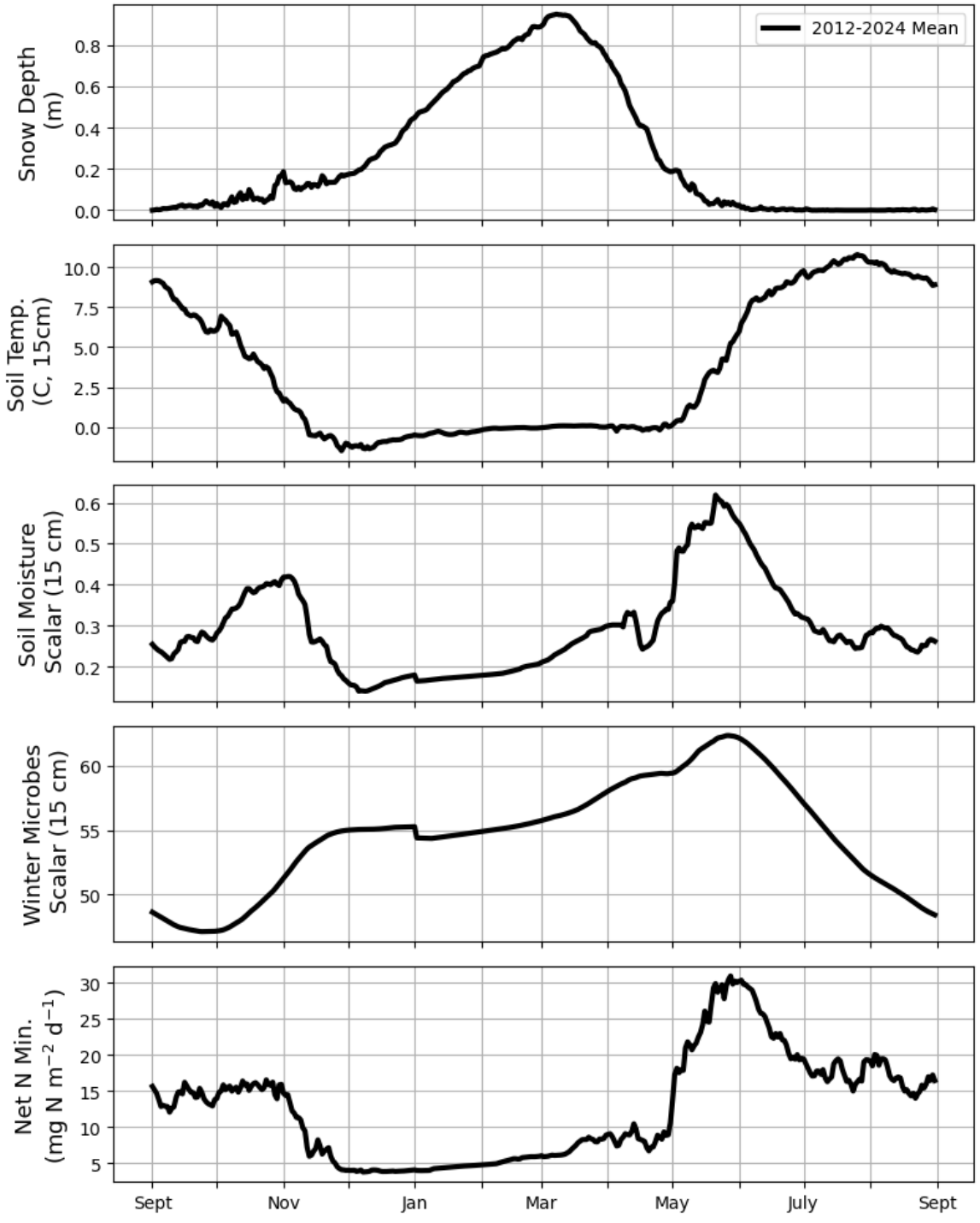


Mean Water years 2012-2024

- Snow covered ~ Dec-May

- Soils can freeze in Dec,
- Not frozen much of winter

- *Liquid* water availability controls microbial activity



Mean 2012-2024

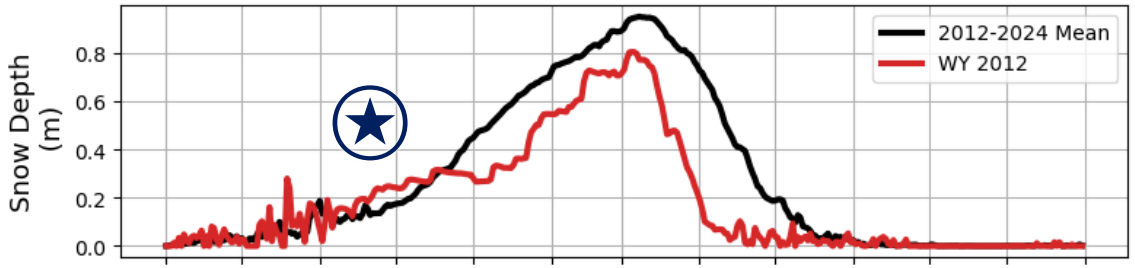
- Snow covered ~ Dec-May

- Soils can freeze in Dec,
- Not frozen much of winter

- Liquid water availability controls microbial activity

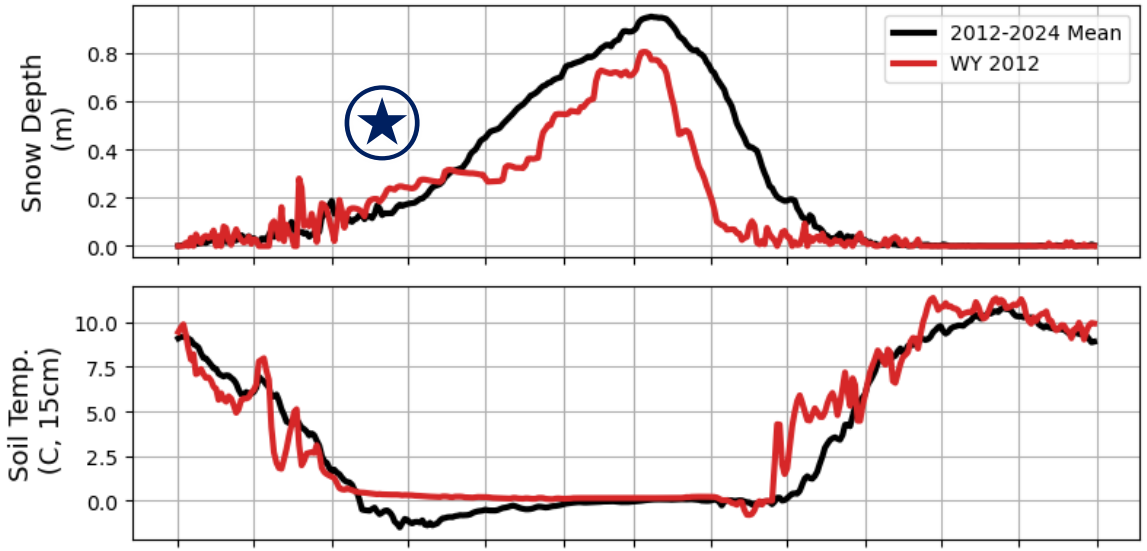
- "Winter" microbes behave poorly

- Low winter N min, but not zero



Water Year 2012

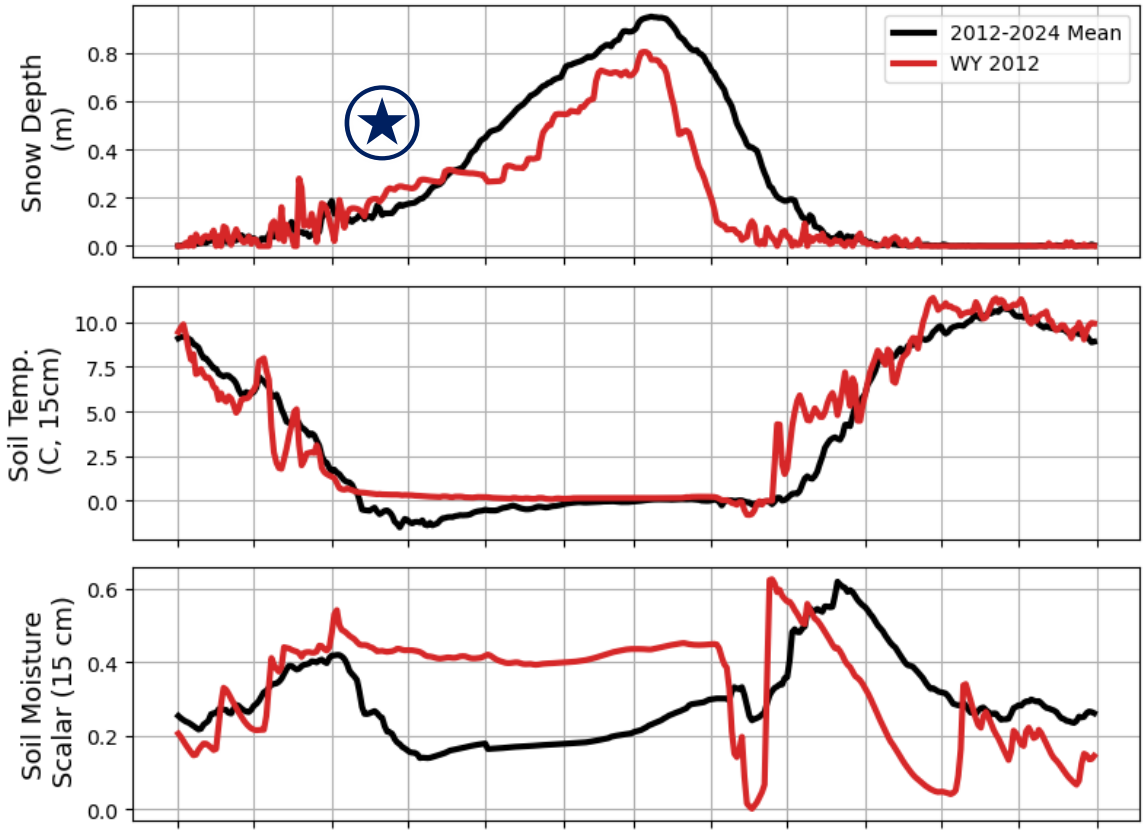
- Above average Dec snow & Early melt



Water Year 2012

- Above average Dec snow & Early melt

- Soils [never] freeze

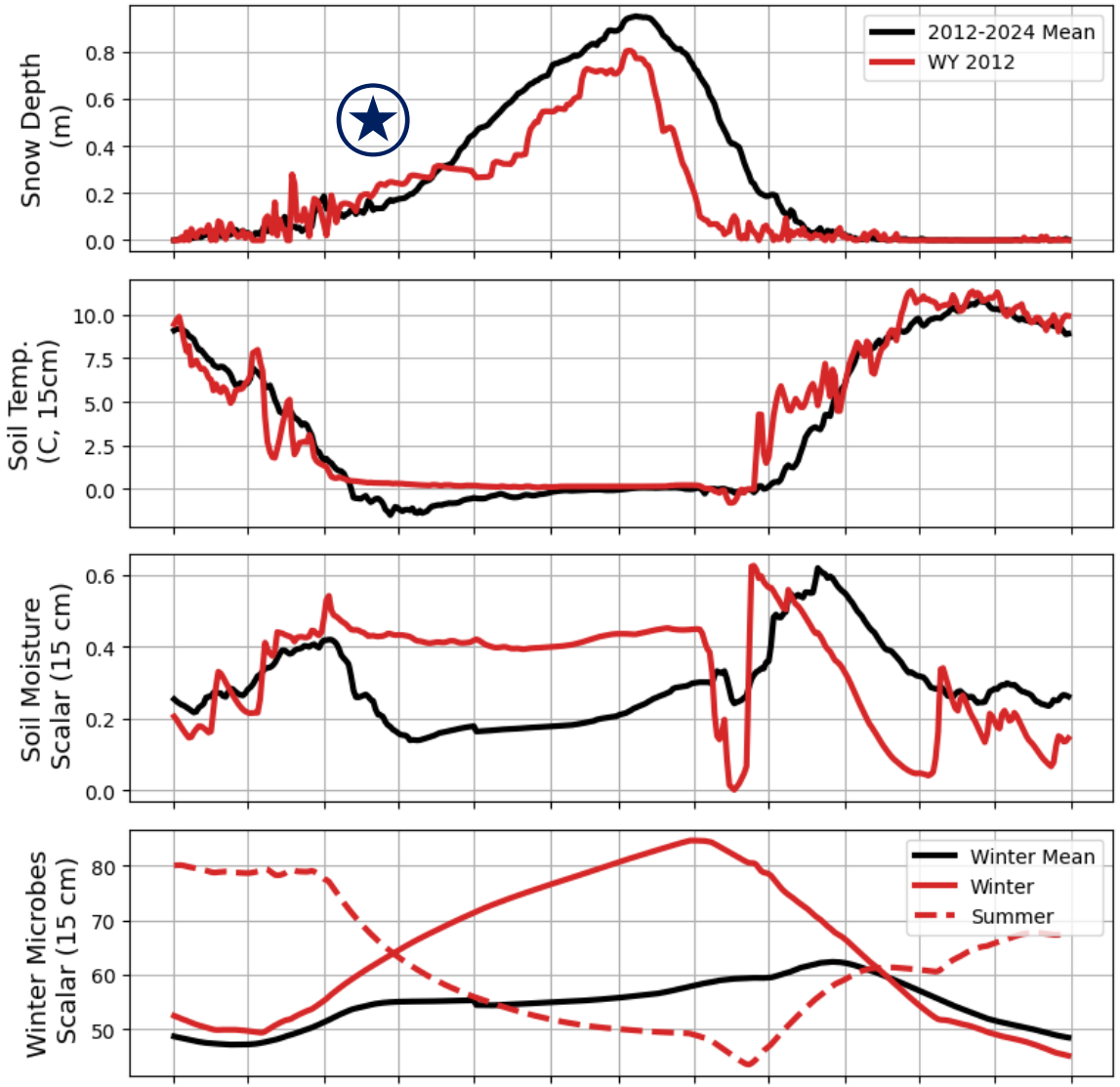


Water Year 2012

- Above average Dec snow & Early melt

- Soils [never] freeze

- High winter liquid water
- Good summer monsoon



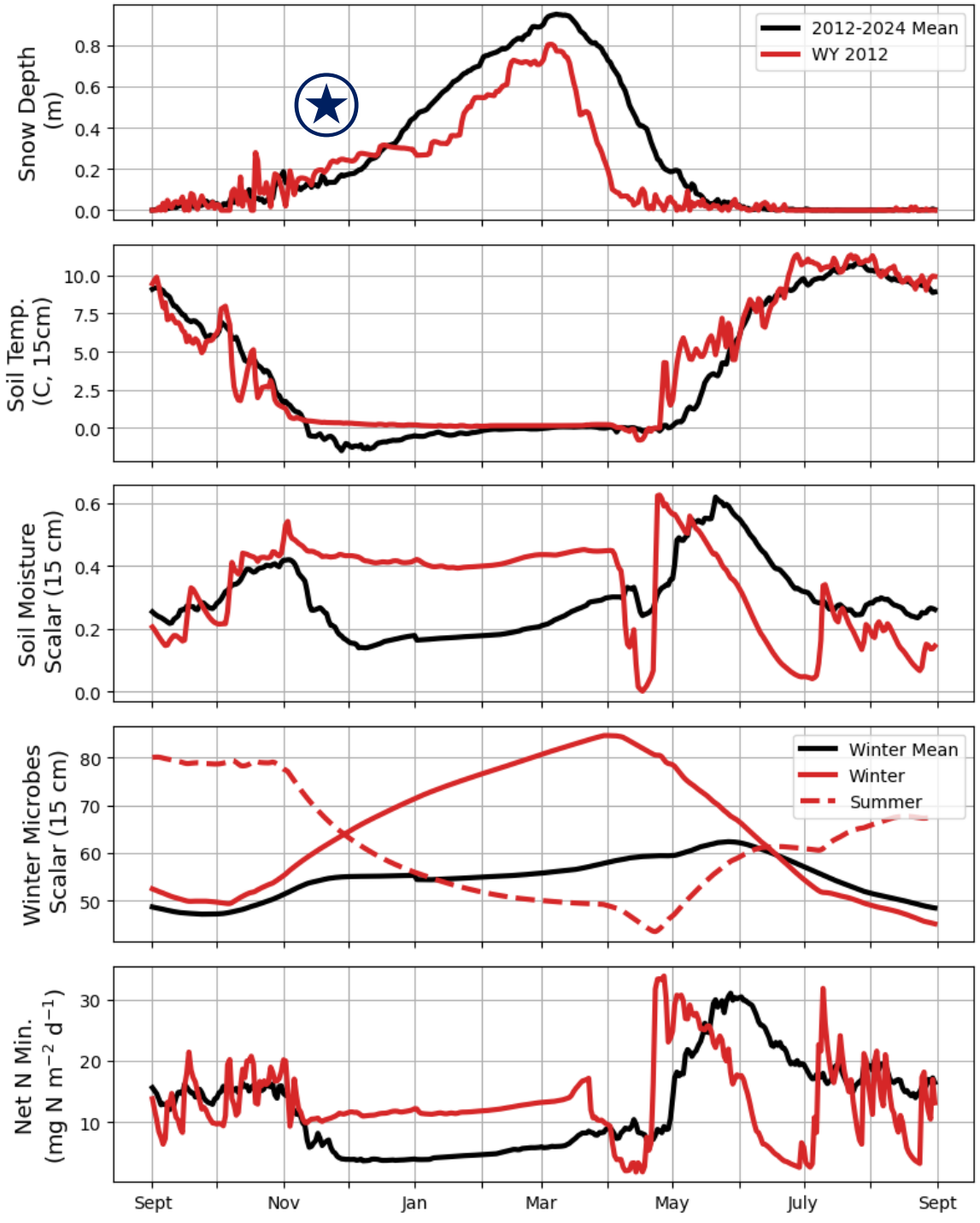
Water Year 2012

- Above average Dec snow & Early melt

- Soils [never] freeze

- High winter liquid water
- Good summer monsoon

- "Winter" microbes behave



Water Year 2012

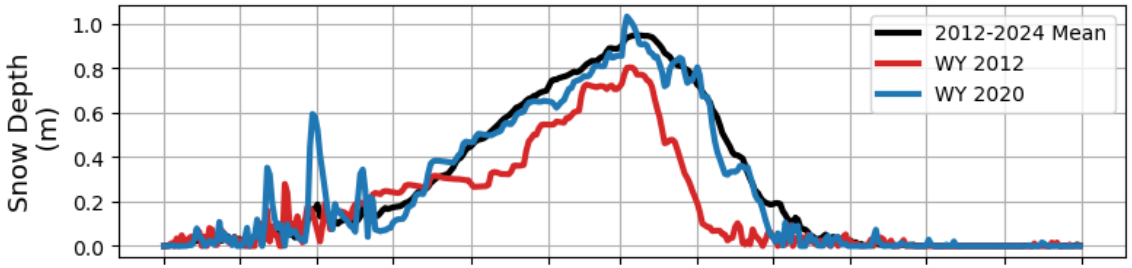
- Above average Dec snow & Early melt

- Soils [never] freeze

- High winter liquid water
- Good summer monsoon

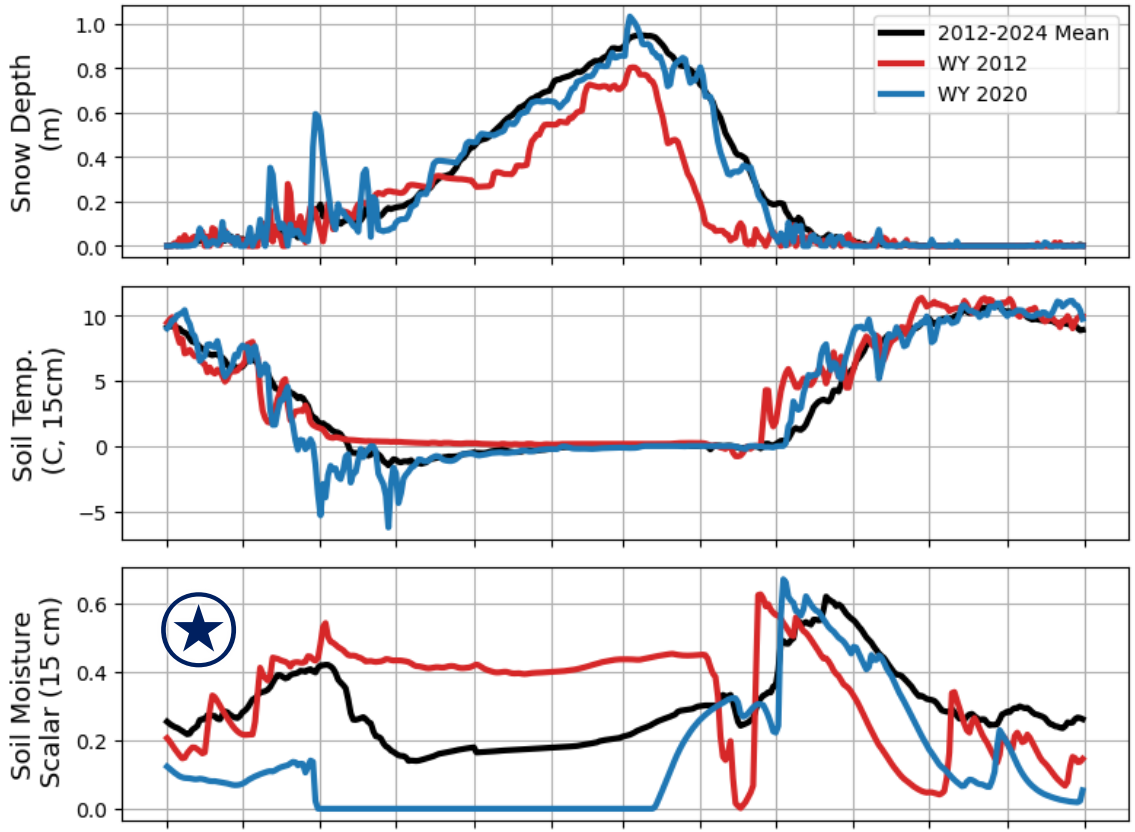
- "Winter" microbes behave

- Higher N-min through winter



Water Year 2020

- Below average Dec & Average snow year

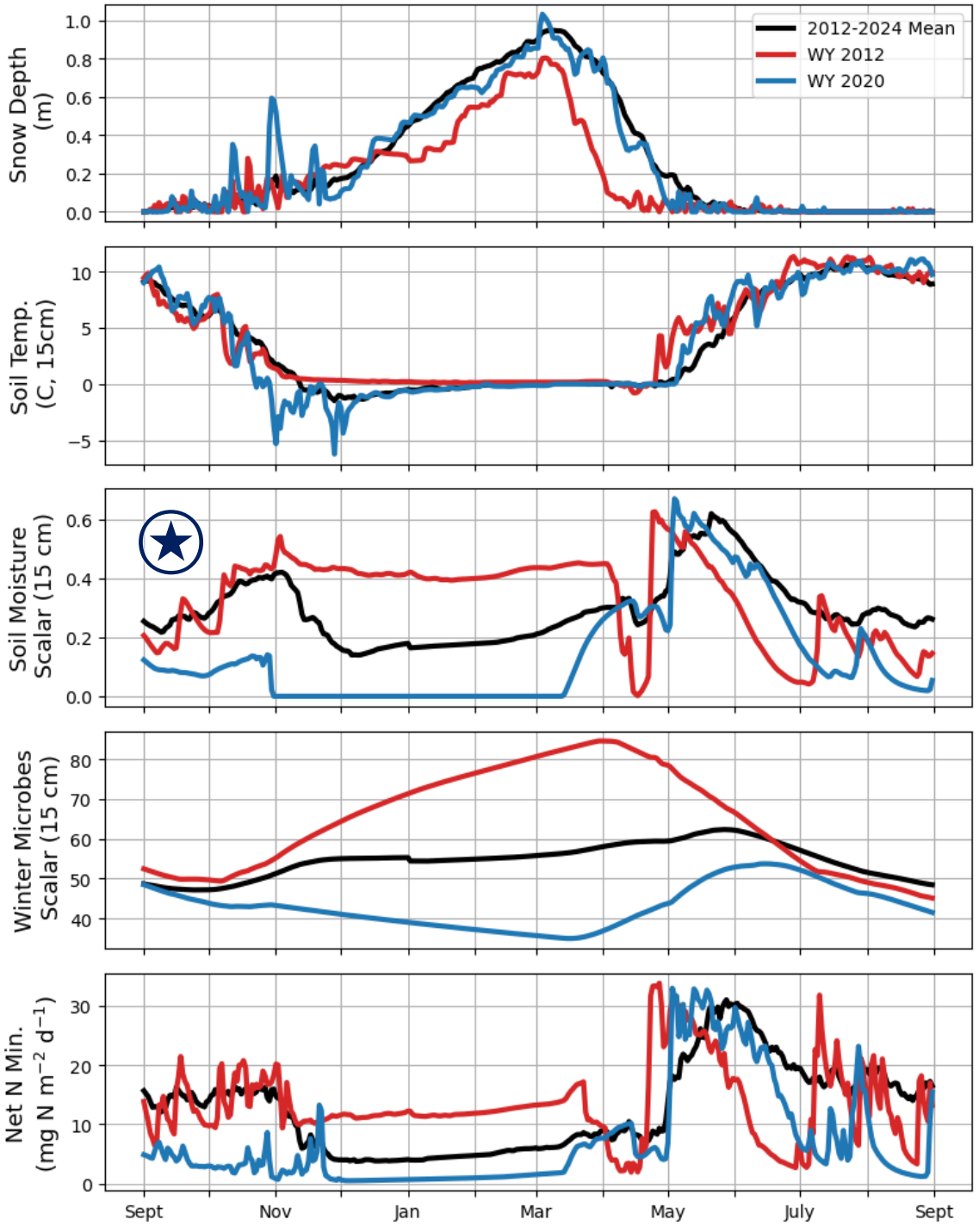


Water Year 2020

- Below average Dec & Average snow year

- Soils freeze early

- Dry fall, soil water freezes & remains ice



Water Year 2020

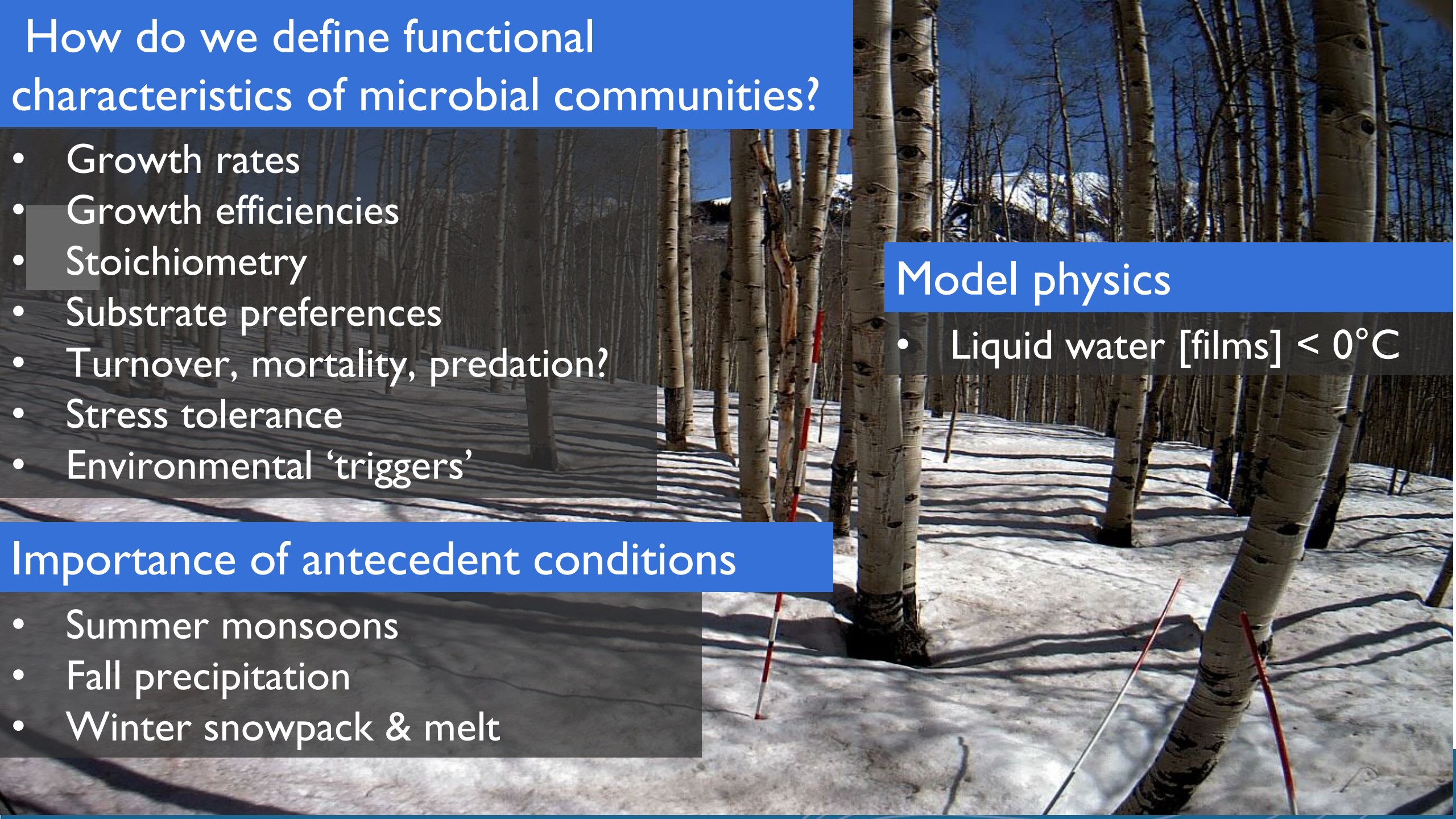
- Below average Dec & Average snow year

- Soils freeze early

- Dry fall, soil water freezes & remains ice

- "Winter" microbes collapse

- Zero winter N-min



How do we define functional characteristics of microbial communities?

- Growth rates
- Growth efficiencies
- Stoichiometry
- Substrate preferences
- Turnover, mortality, predation?
- Stress tolerance
- Environmental ‘triggers’

Model physics

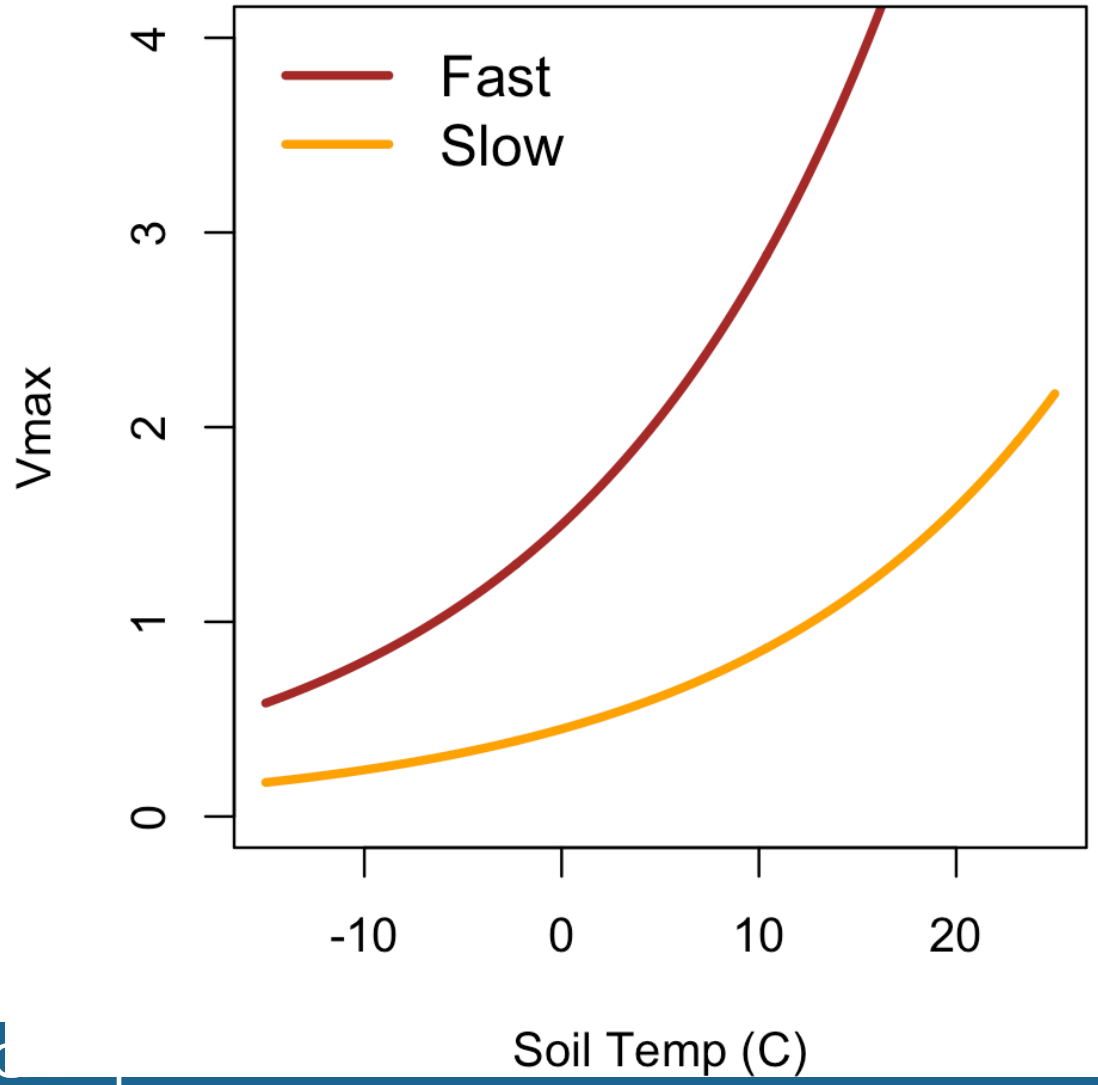
- Liquid water [films] < 0°C

Importance of antecedent conditions

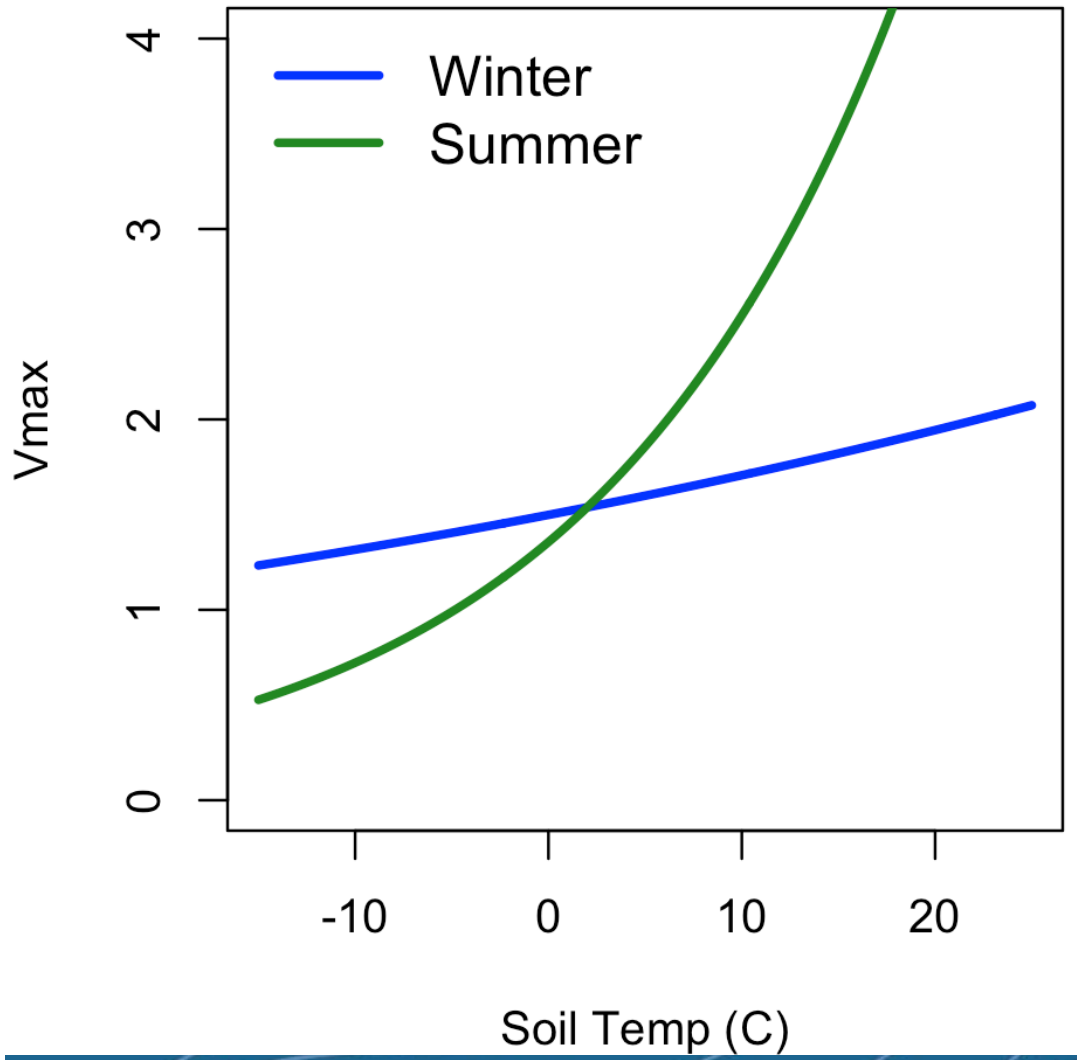
- Summer monsoons
- Fall precipitation
- Winter snowpack & melt

MIMICS

Default



Seasonal



MIMICS

	Default	Seasonal
Kinetics	Community x Substrate	Substrate & Community
CUE	Community x Substrate	Substrate
Turnover	Community	Temperature x Community
Stoichiometry	Community	Community

MIMICS

Default

Seasonal