Soil microbial community physiology is altered by snow depth in winter dominated ecosystem in Wyoming

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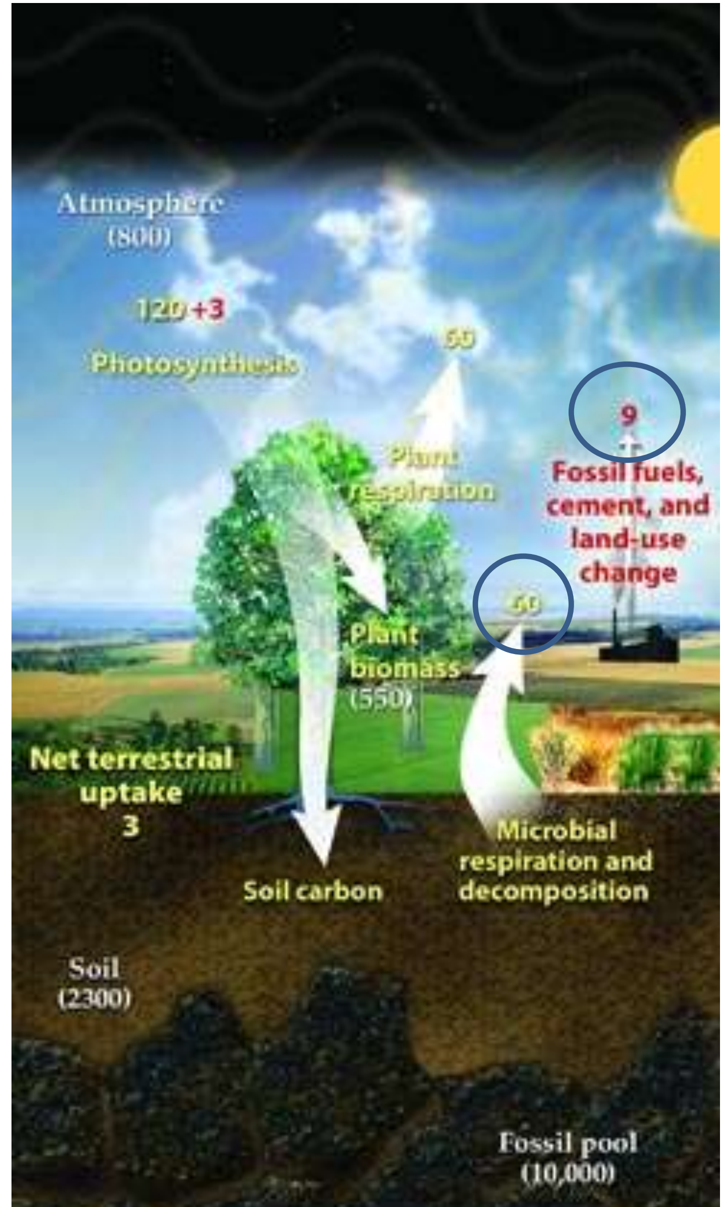
Why is it important to understand soil microbial respiration?

1. Atmospheric CO_2 is an important control on the productivity of plants, as well as the Earth's climate.

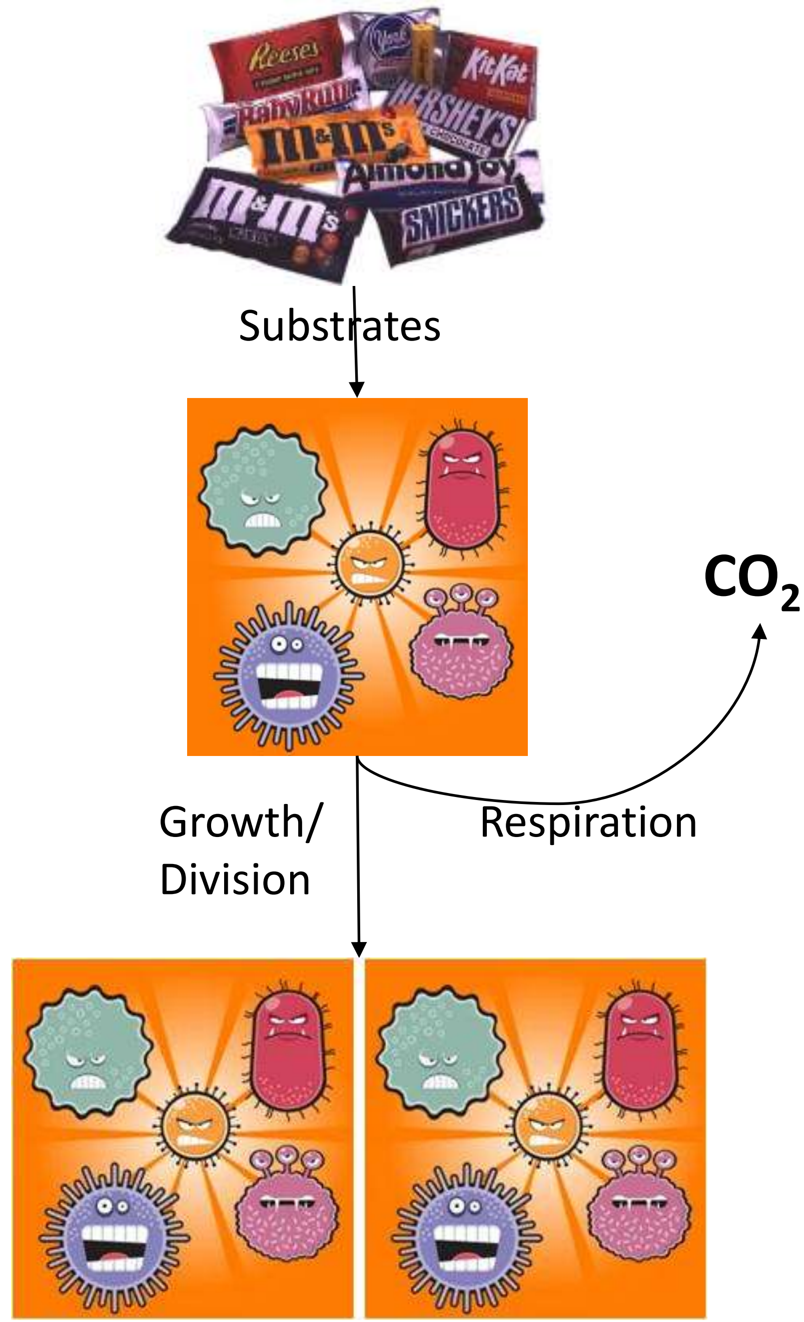
2. CO_2 produced by microbial respiration is nearly 6 times higher than burning fossils fuel.



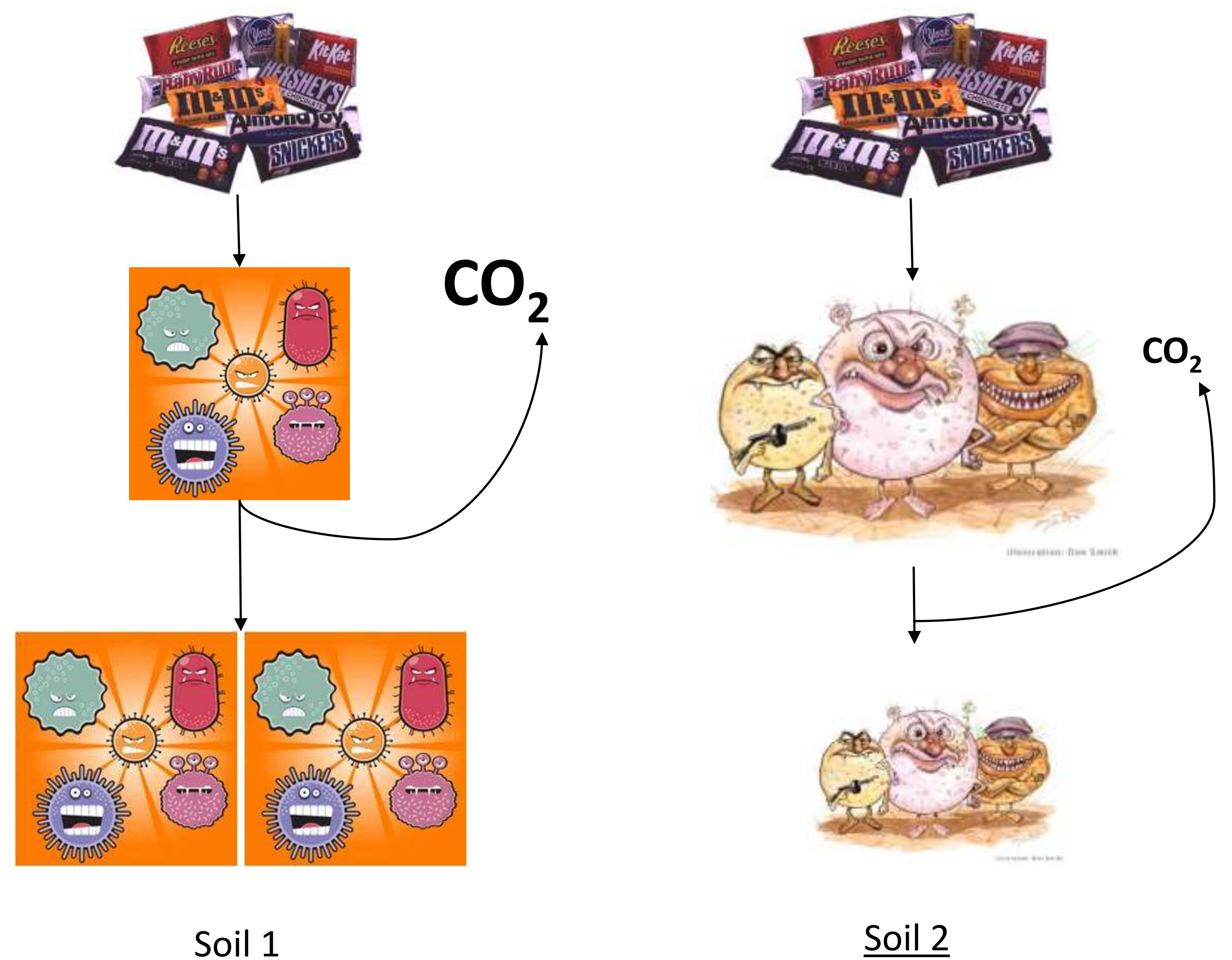
What is soil microbial respiration?

1. Soil microbes convert substrates into CO_2 to provide energy and raw materials for biomass.

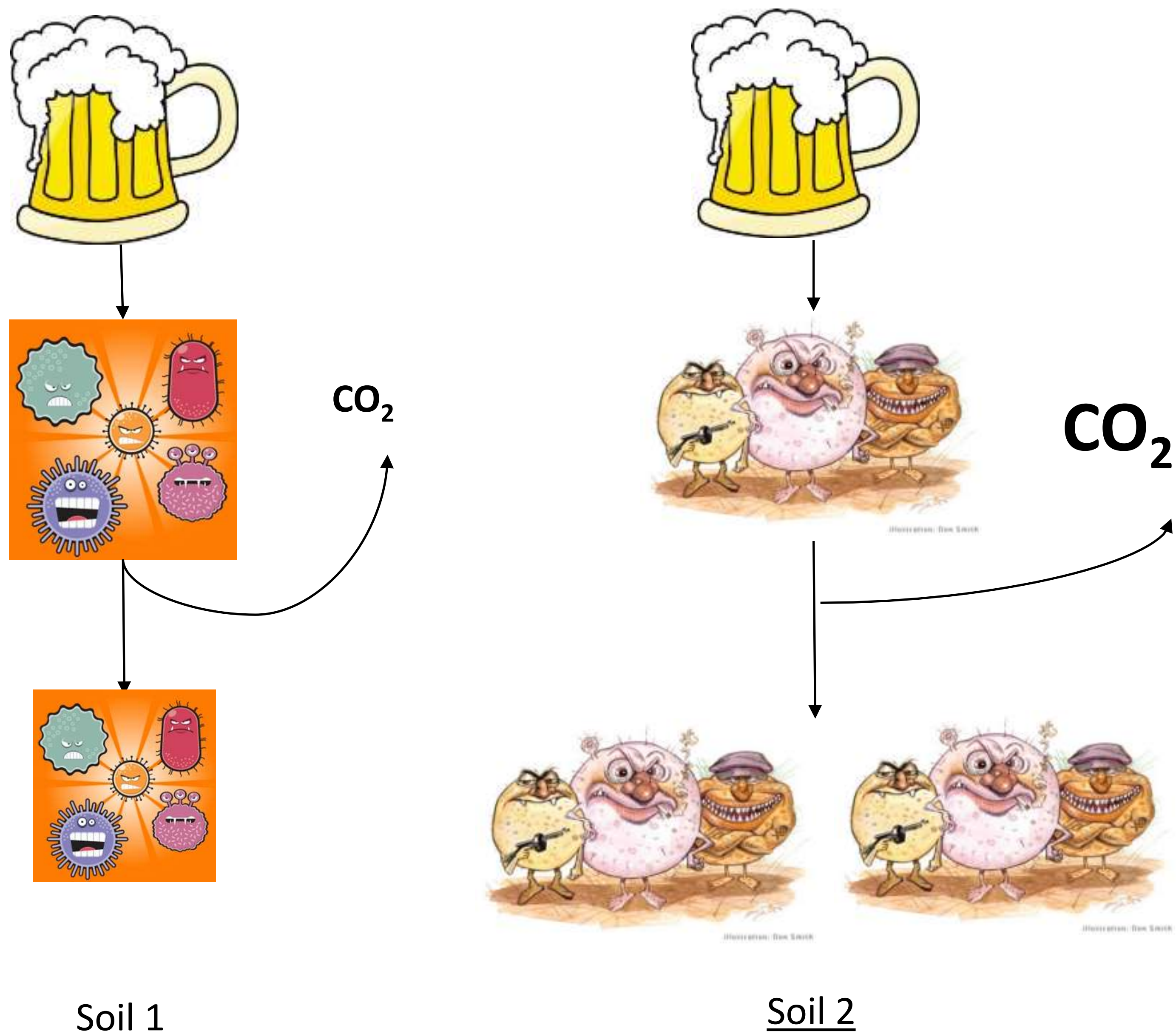
2. Different groups of microbes use different substrates more or less efficiently.



Community level physiological profile.



Community level physiological profile.



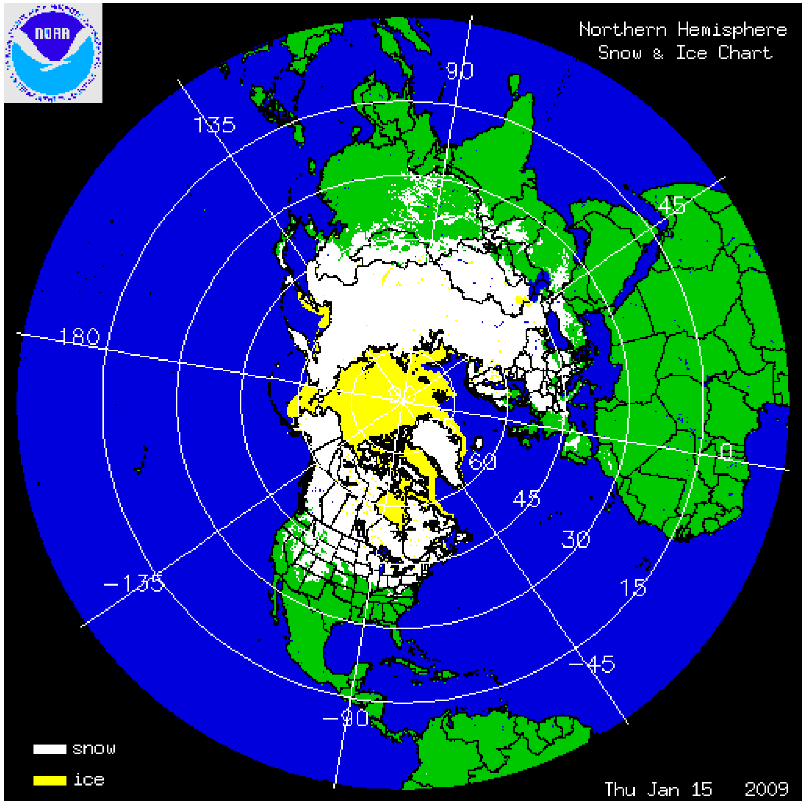
Why do we need to know how snow affects soil respiration?

1. It has been found that 40% of the terrestrial environment is seasonally snow covered.

2. In some winter dominated ecosystems 10 – 50 % of annual soil respiration occurs under the snow.

3. Snow can act as insulator and as well as source of water input to the soil microbial community.

4. Soil microbial processes that lead to emissions of greenhouse gases are dependent on the depth and duration of snow cover.



So we hypothesized :

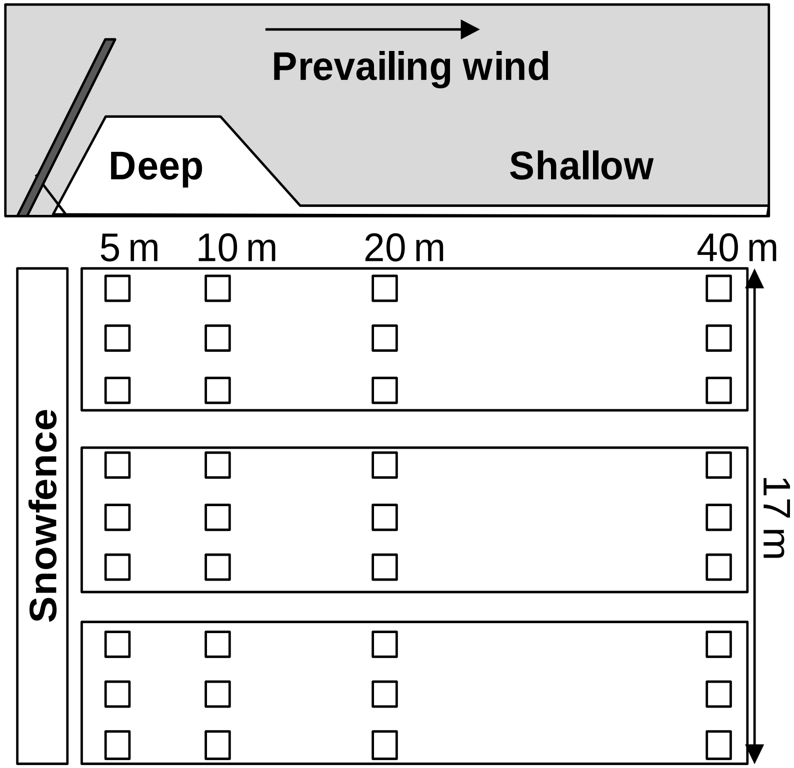
1. Soil microbial CLPP is altered by snow depth.

2. The affect of snow depth on CLPP is different in the winter than the spring and summer.

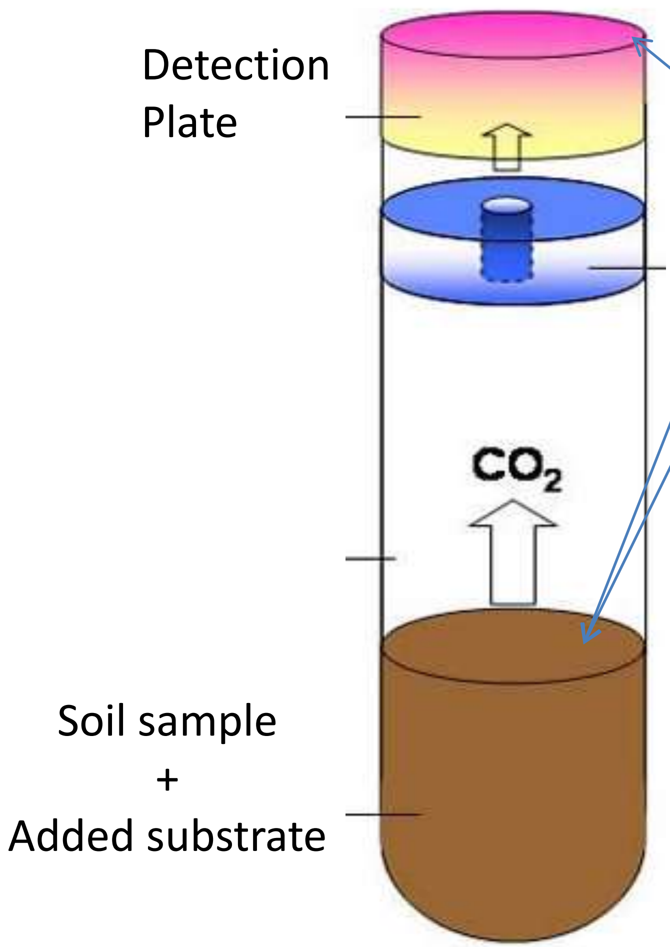
Methods

Snow Fence Project

- Three highway snowfence sites located within 40 miles of Laramie.
- Plots located under ‘deep’ snow and ‘shallow’ snow.
- Soil samples were collected in Feb(Winter), May(Spring), July (Summer) 2012
- Soil samples were sieved in the lab to remove roots and rocks.
- Microresp analysis was conducted to measure CLPP.



How Microresp works:



1. Sieved soil is added to a 96 deep-well plate.
2. 1 of 16 different substrates are added to each well of the deep well plate
3. Detection plate is sealed on top of deep well plate.
4. CO_2 production is measured after 6 hours by reading the color of the detection plate.

Substrate selection

- Sugars

1. Galactose
2. Glucose
3. Fructose
4. Trehalose
5. Arabinose

- Amino acids

1. Glutamic acid
2. Alanine
3. Arginine
4. Glycine
5. Aspartic acid
6. Phenylalanine

- Carboxylic acids

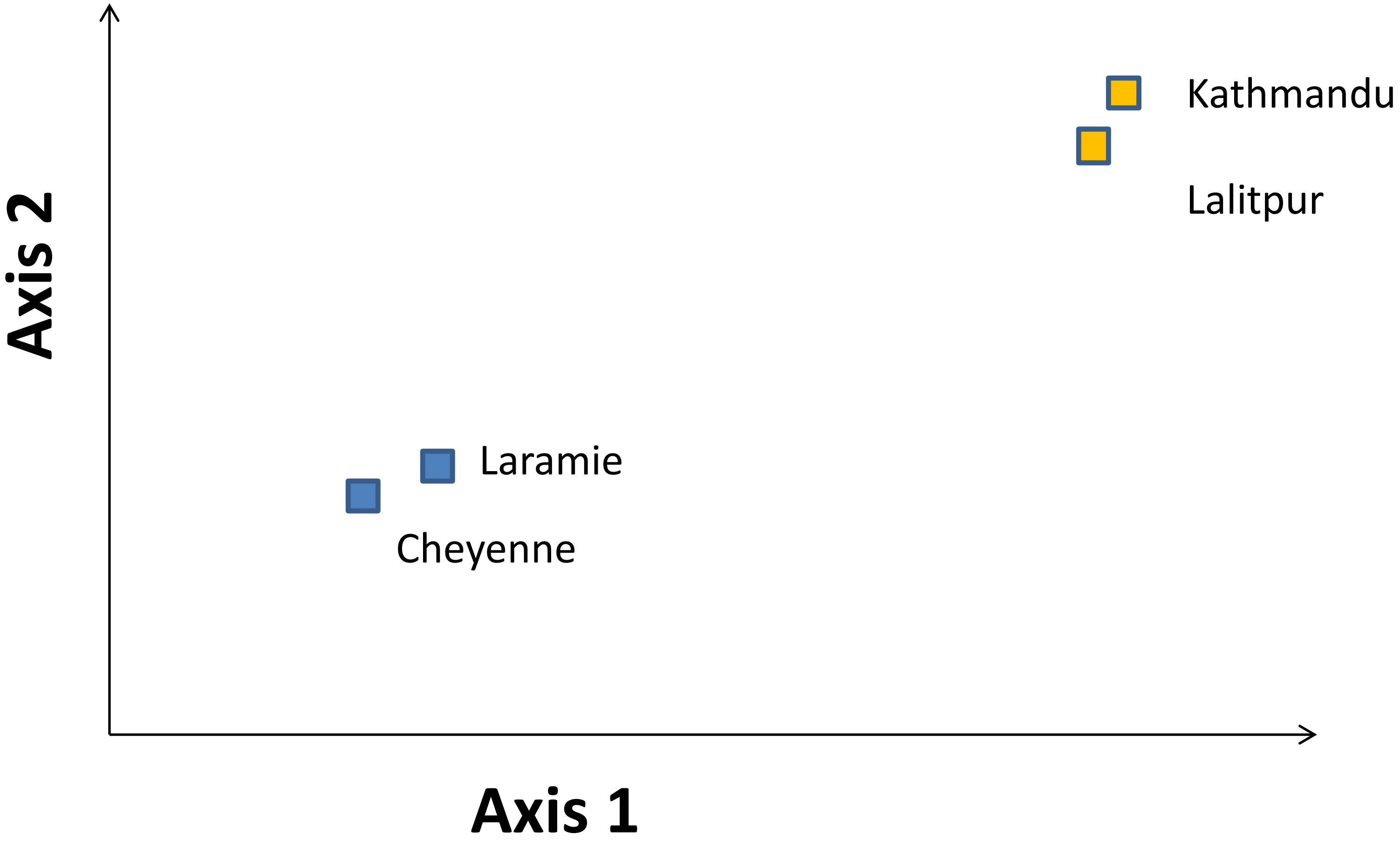
1. Citric acid
2. Malic acid
3. Oxalic acid
4. Succinic acid
5. Di hydroxy benzoic acid

Statistical analysis

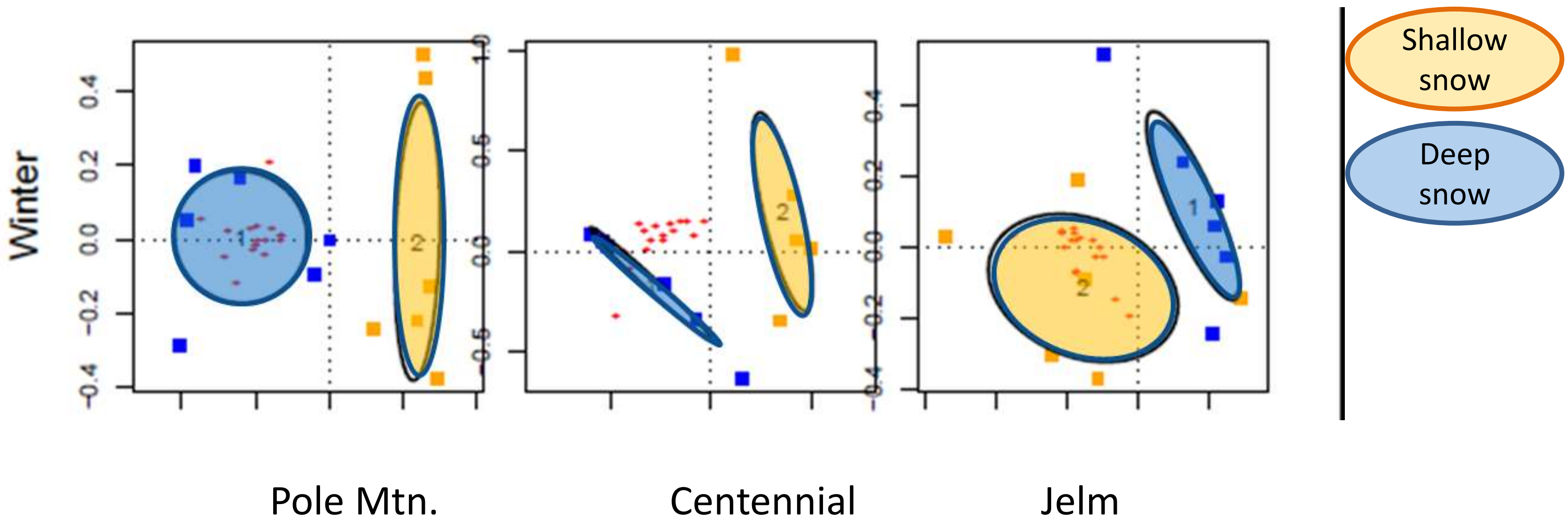
- Data were analyzed using Principle Components Analysis (PCA) ordination

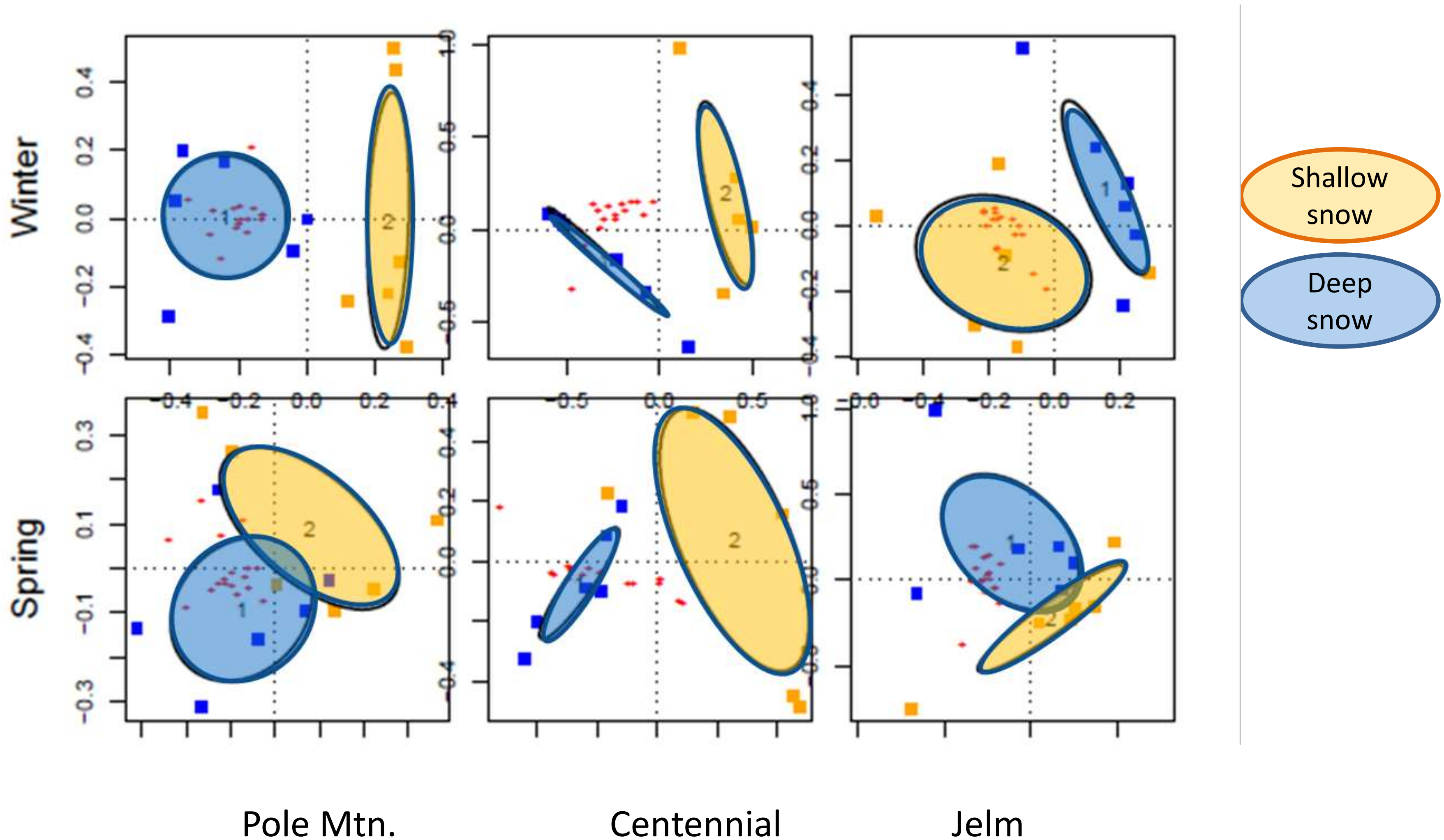
- In PCA, complex data is simplified so that the first axis explains the major driver of the variation and second axis represents the second major driver of the variation and so on.

PCA ordination



Results


Winter
Pole Mtn.
Centennial
Jelm
Shallow snow
Deep snow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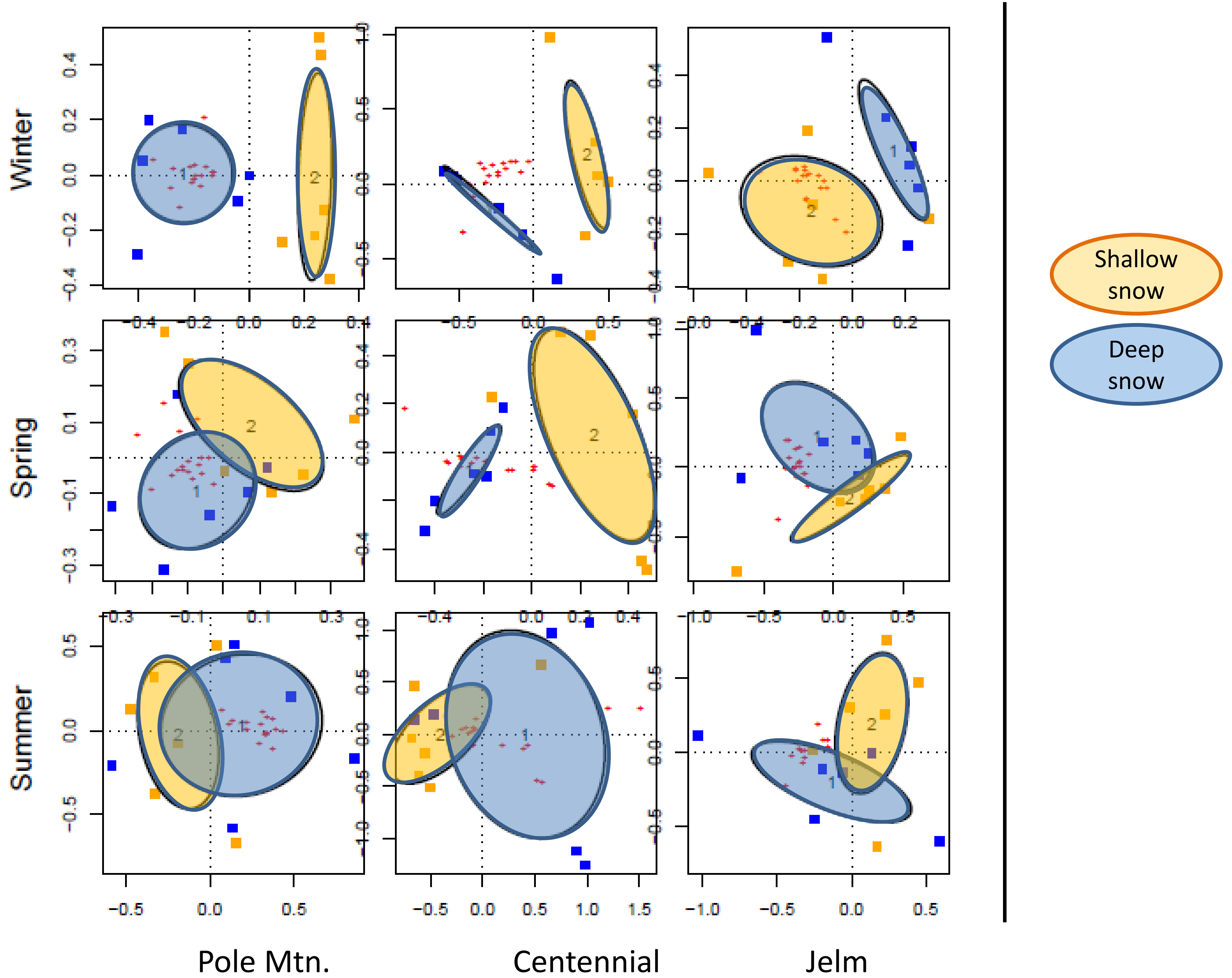

Winter
Spring
Summer
Pole Mtn.
Centennial
Jelm
Shallow snow
Deep snow

Conclusion

- Snow depth can alter the CLPP of a soil:
  - The microbial community level physiological profile is most different between deep and shallow snow areas in the winter, less different in spring, but not at all different in the summer.
- In nature, soil microbial respiration is likely to be sensitive to altered snow depth in winter and spring, but not summer.

Thanks

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- Prof. Elise Pendall
- Pendall Lab Group