A New Model for Synthesis

The Soil Warming Experiment to Depth Data Integration Effort (SWEDDIE)

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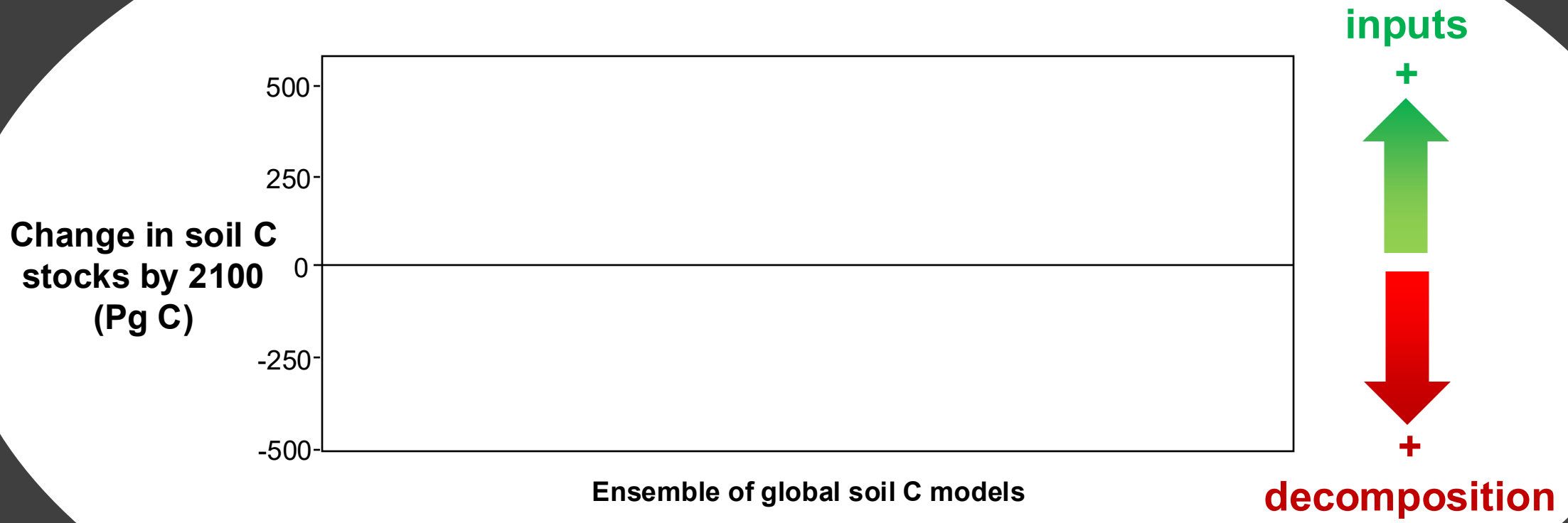
When soils warm…

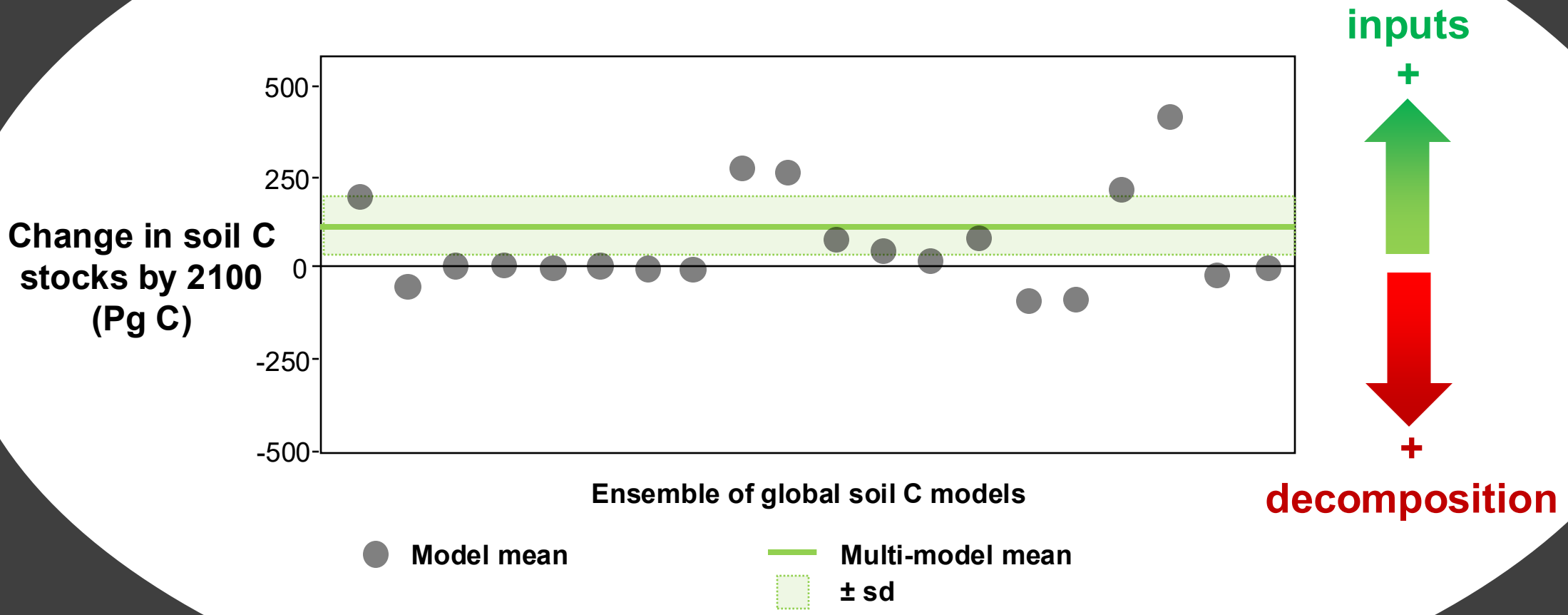
Predicted ΔSOC



(figure adapted from Todd-Brown et al., 2018)

When soils warm…

Predicted ΔSOC



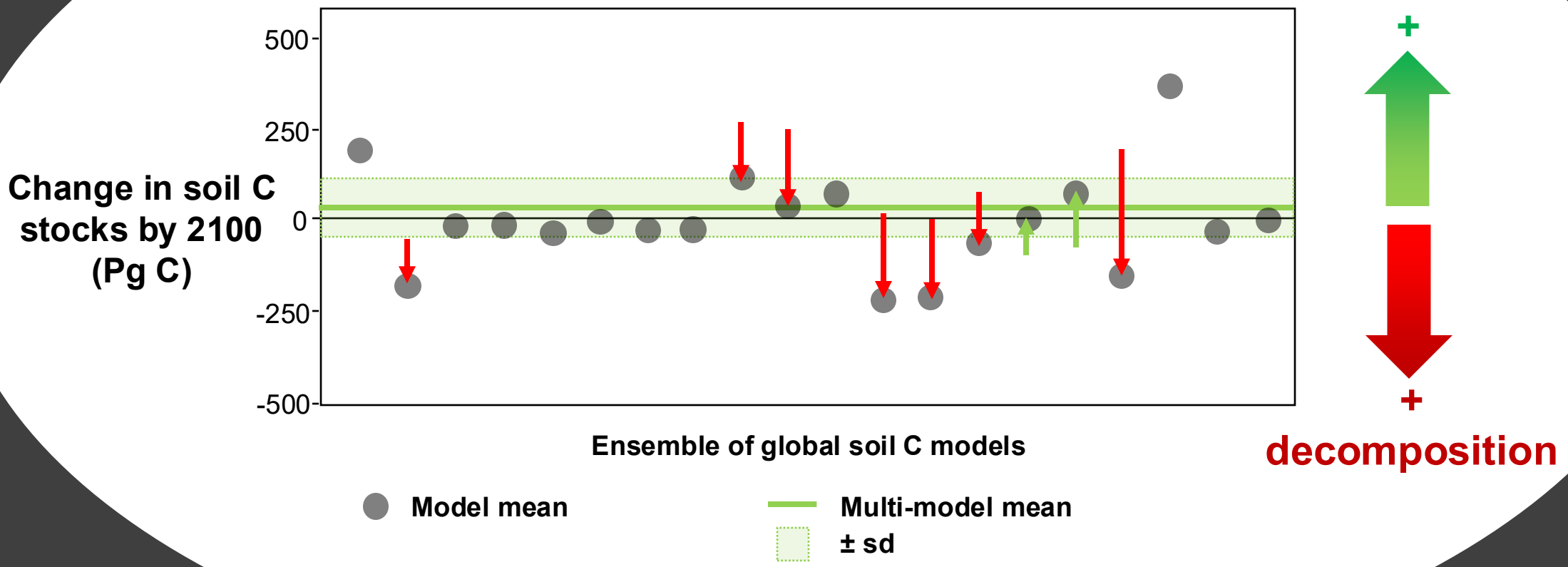
(figure adapted from Todd-Brown et al., 2018)

…C is gained?

When soils warm…

Predicted ΔSOC

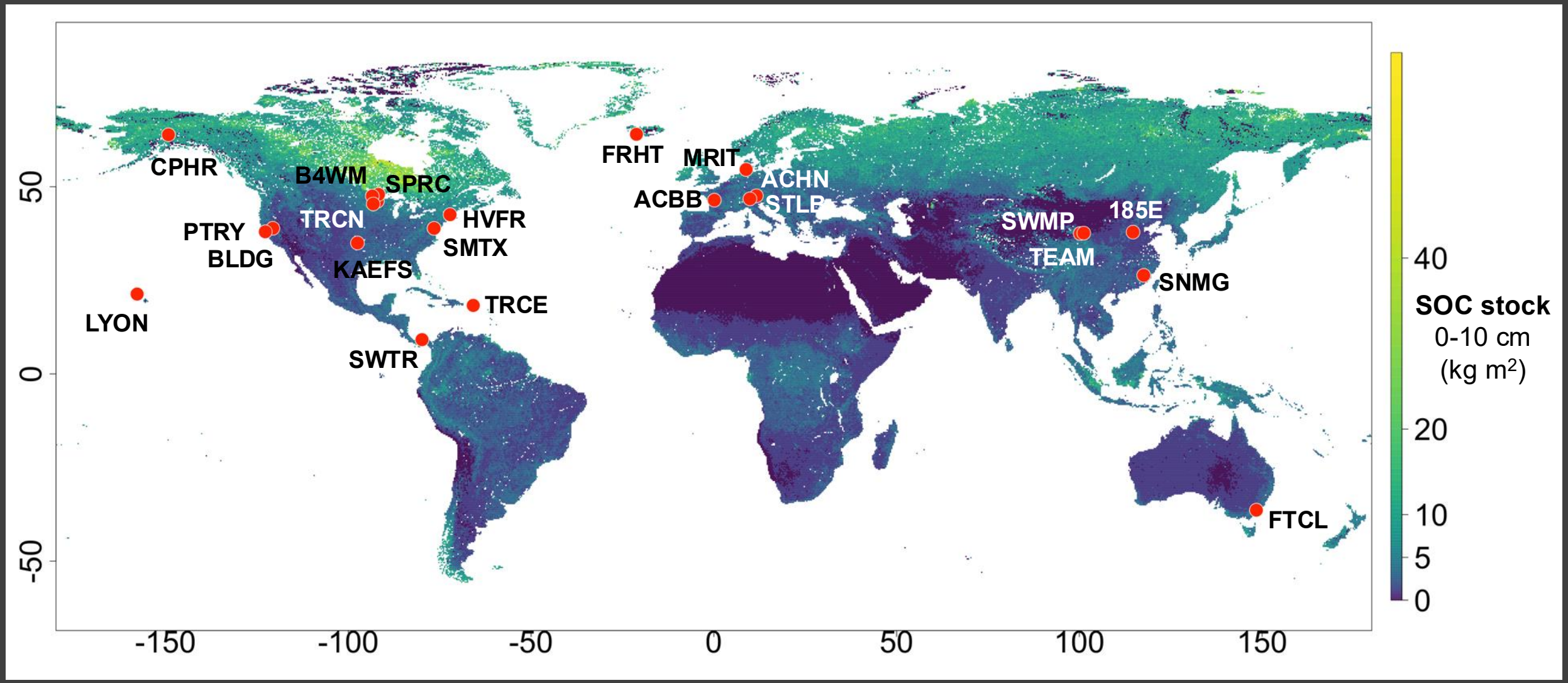
informed by warming experiments

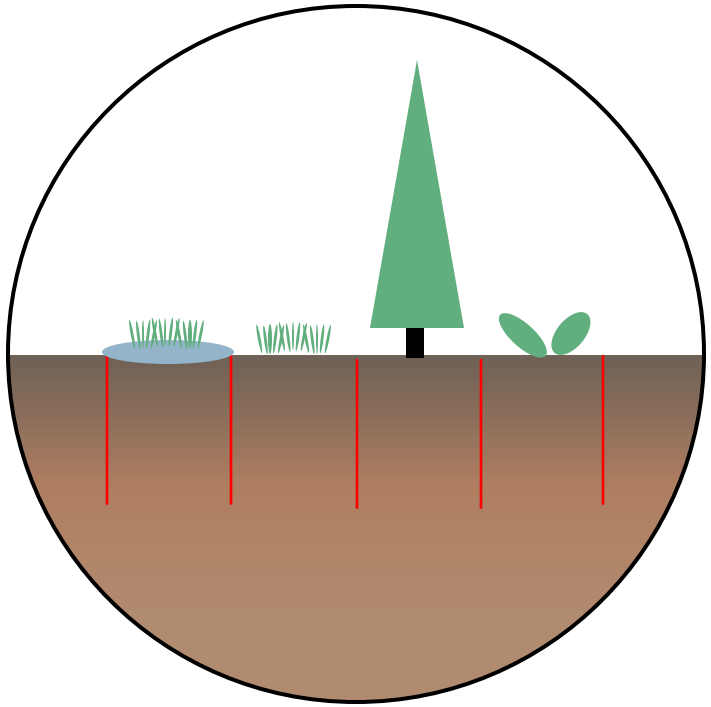


(figure adapted from Todd-Brown et al., 2018)

…or is C lost?

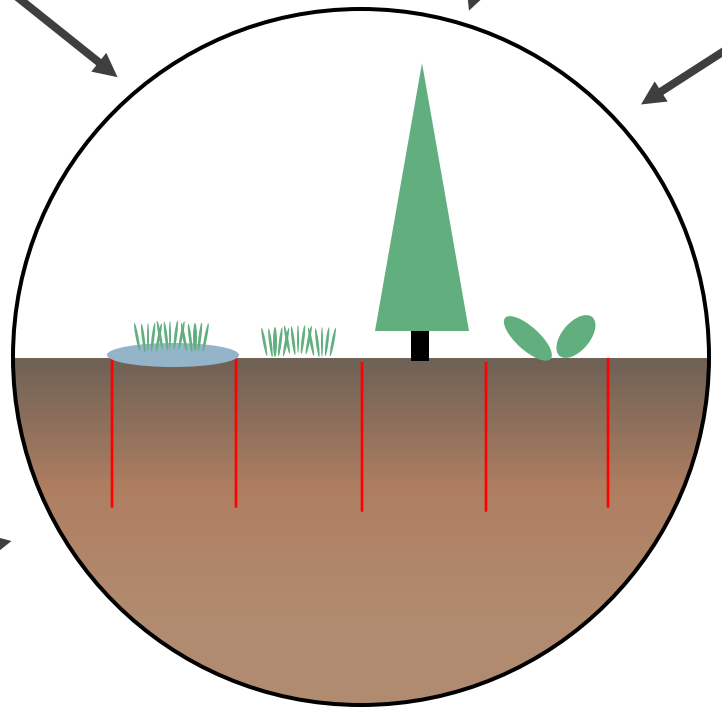
DeepSoil 2100 Warming Experiments





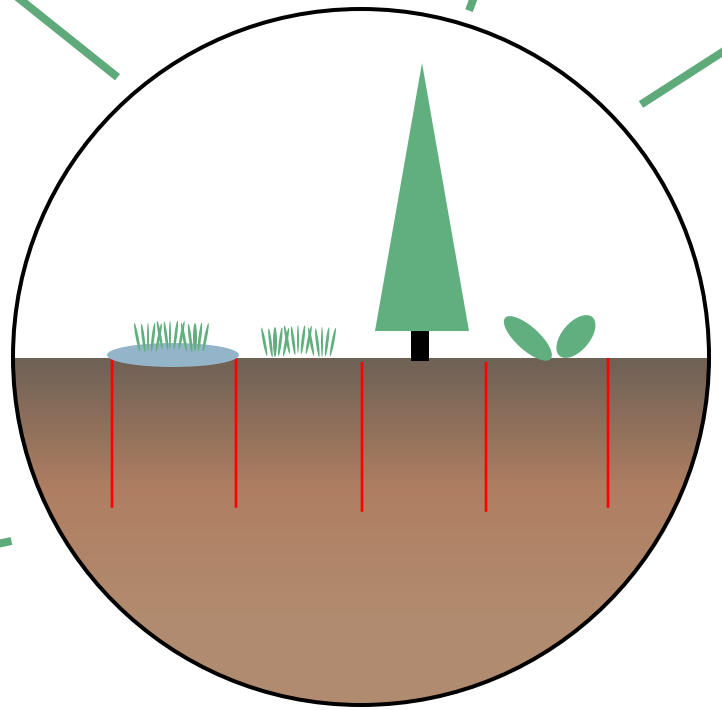
Soil
Warming
Experiment
to **D**epth
Data
Integration
Effort

Raw data harmonized in database…



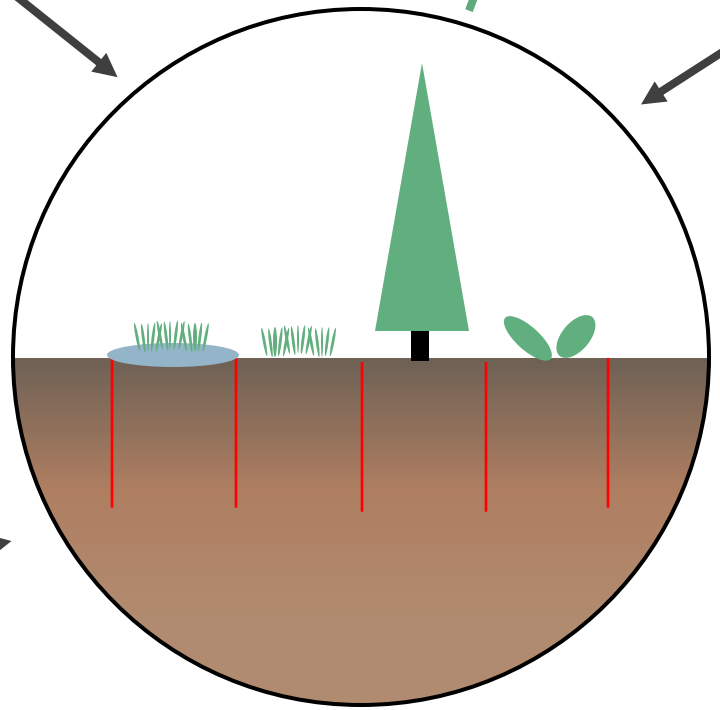
Soil
Warming
Experiment
to **D**epth
Data
Integration
Effort

…creating positive feedback—methods & knowledge sharing, coordinated sampling…



Soil
Warming
Experiment
to **D**epth
Data
Integration
Effort

…yielding publications throughout the cycle



DATA PIPELINE

raw data

Photo credit: C. Hicks Pries
'output' fig. from Hicks Pries et al. 2017

ESS-DIVE
Deep Insight for Earth Science Data

data

.csv

dictionary

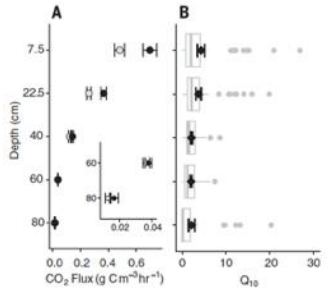
.csv

harmonization

database

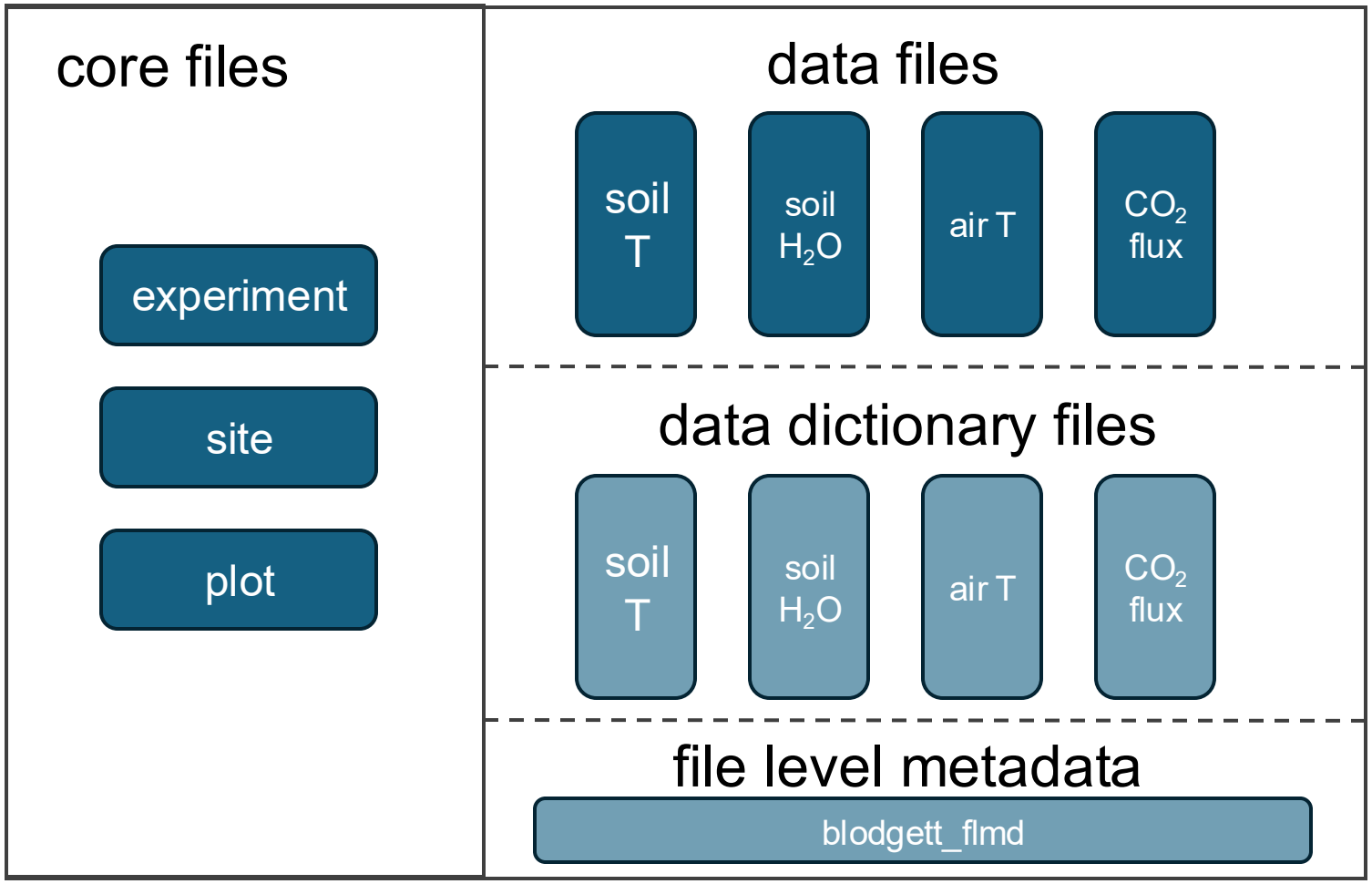
analysis

output

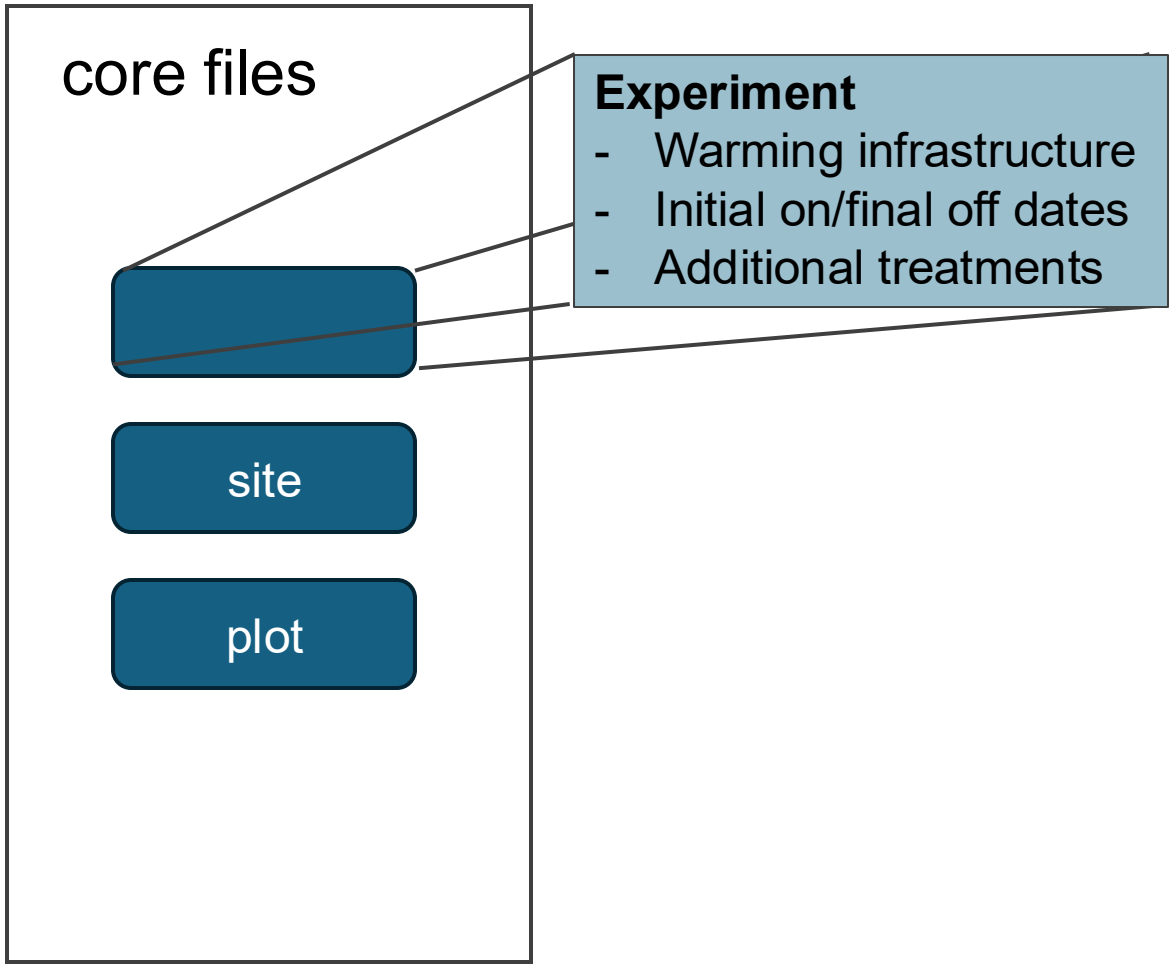


DATA MODEL

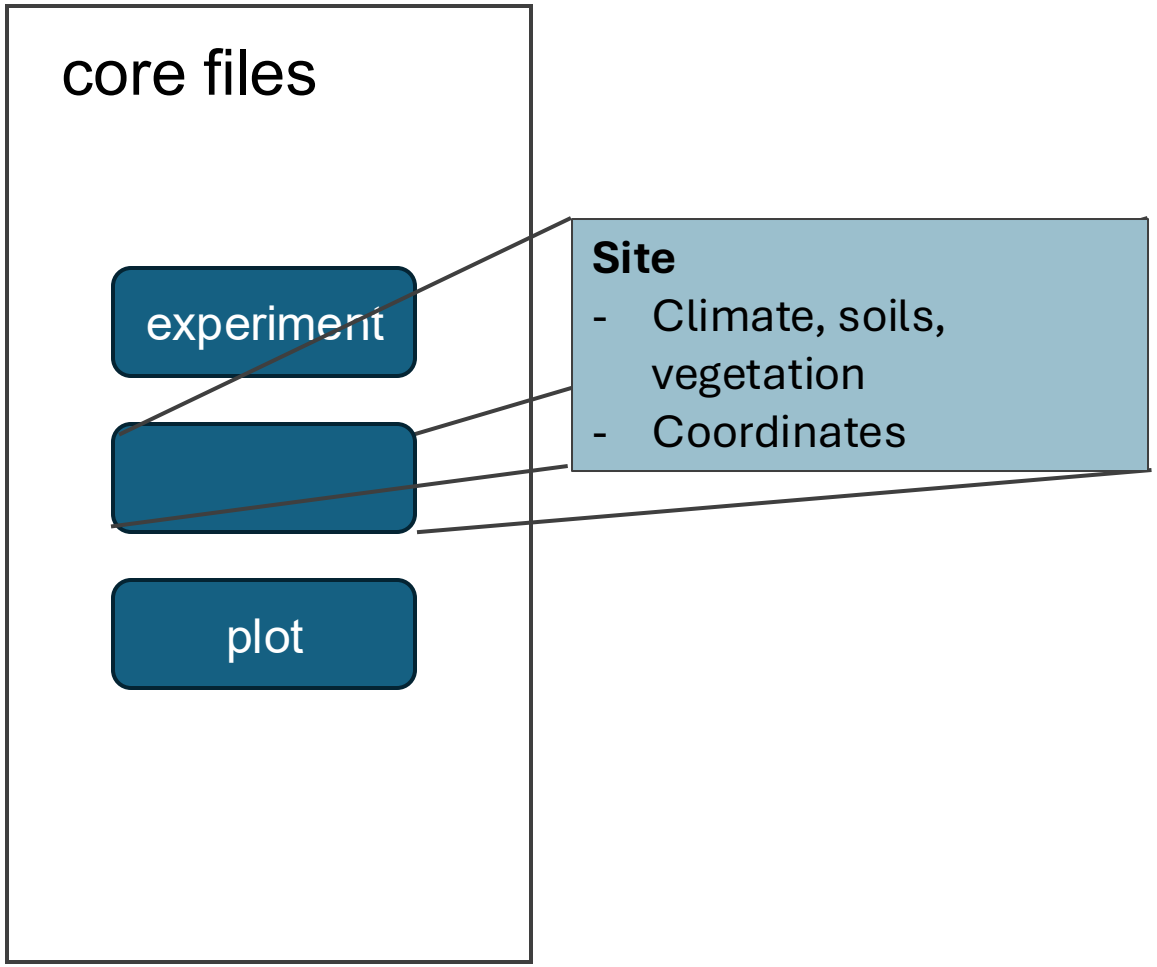
Blodgett Forest



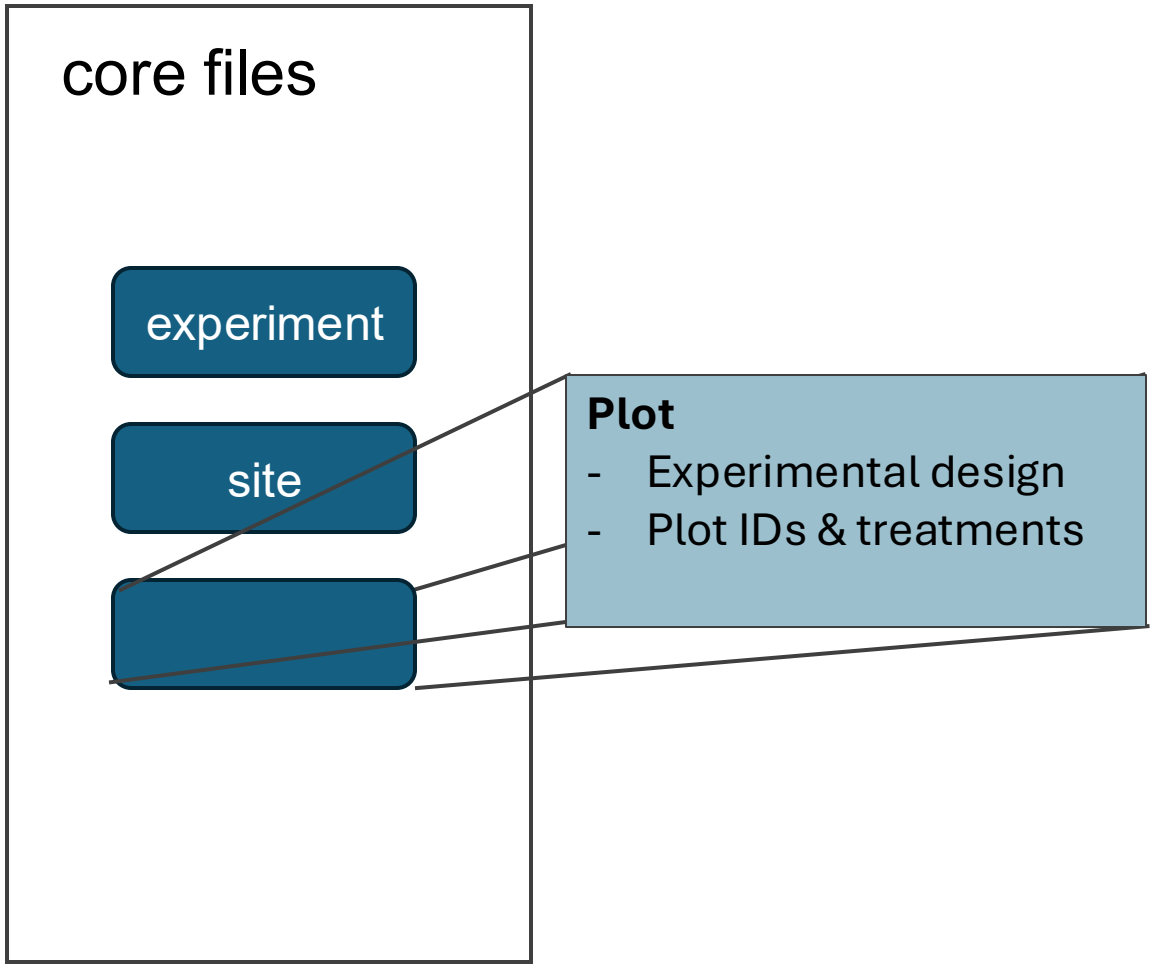
DATA MODEL


core files
Experiment
- Warming infrastructure
- Initial on/final off dates
- Additional treatments
site
plot

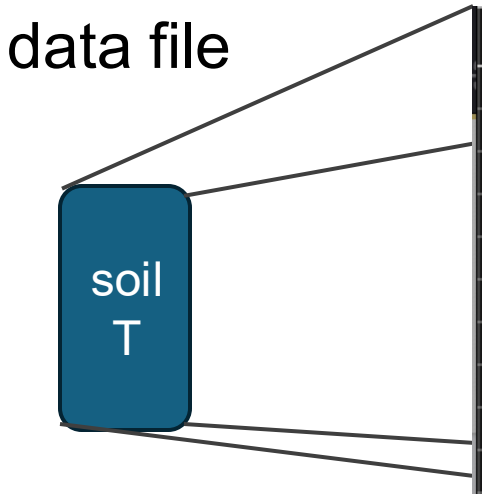
DATA MODEL


core files
experiment
plot
Site
- Climate, soils, vegetation
- Coordinates

DATA MODEL


core files
experiment
site
Plot
- Experimental design
- Plot IDs & treatments

DATA MODEL



	A	B	C	D
1	depth	time	plot	temp
2	5	2018-06-17	1	12.1575938
3	5	2018-06-17	2	15.1479688
4	5	2018-06-17	3	12.6165625
5	5	2018-06-17	4	15.04
6	5	2018-06-17	5	13.37
7	5	2018-06-17	6	15.6615625
8	5	2018-06-17	7	14.5314063
9	5	2018-06-17	8	15.4478125
10	5	2018-06-18	1	9.67252778

DATA MODEL

data file

soil T

	A	B	C	D
1	depth	time	plot	temp
2	5	2018-06-17	1	12.1575938
3	5	2018-06-17	2	15.1479688
4	5	2018-06-17	3	12.6165625
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9	5	2018-06-17	8	15.4478125
10	5	2018-06-18	1	9.67252778

soil T

data dictionary file

	A	B	C	D	E	F	G
1	colName	description	unit	dataType	varName	sensorMakeModel	methodName
2	depth	depth of measurement	cm	numeric	depth		
3	time	date of measurement	yyyy-mm-dd	date	timestamp		
4	plot	plot ID		string	plot		
5	temp	soil temperature	deg C	numeric	soil temperature	Campbell Scientific T type thermocouples	

DATA MODEL

plot file

links treatments & data

	A	B	C	H	I
1	exp_name	sit_name	plt_name	plt_treat_heat	plt_heat_level
2	Blodgett	Blodgett	control_1	control	0
3	Blodgett	Blodgett	control_2	control	0
4	Blodgett	Blodgett	control_3	control	0
5	Blodgett	Blodgett	treatment_1	treatment	4
6	Blodgett	Blodgett	treatment_2	treatment	4
7	Blodgett	Blodgett	treatment_3	treatment	4

plot

data file

soil T

	A	B	C	D
1	depth	time	plot	temp
2	5	2018-06-17	1	12.1575938
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soil T

data dictionary file

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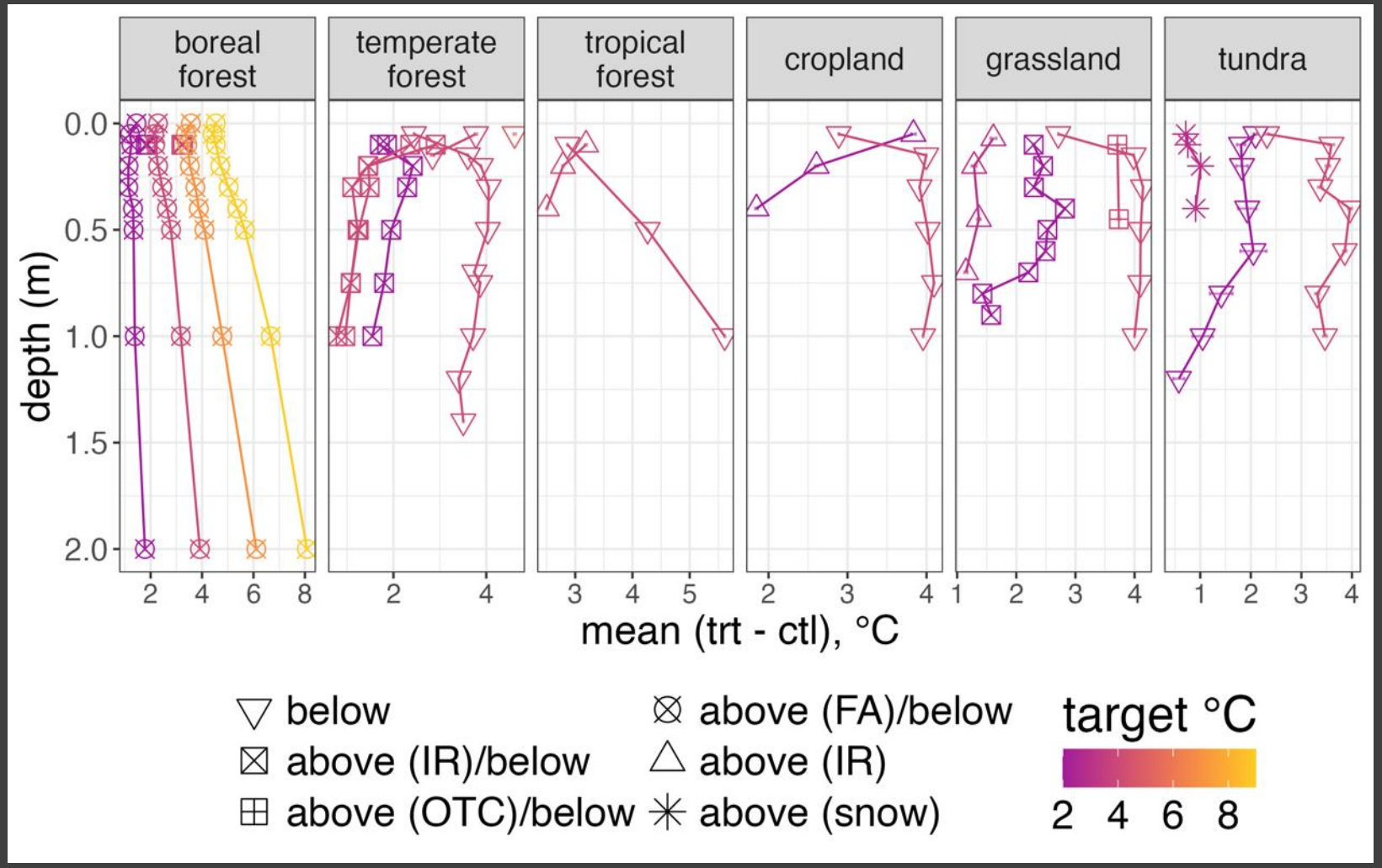
5	temp	soil temperature	deg C	numeric	soil temperature	Campbell Scientific T type thermocouples	

First Synthesis Results!

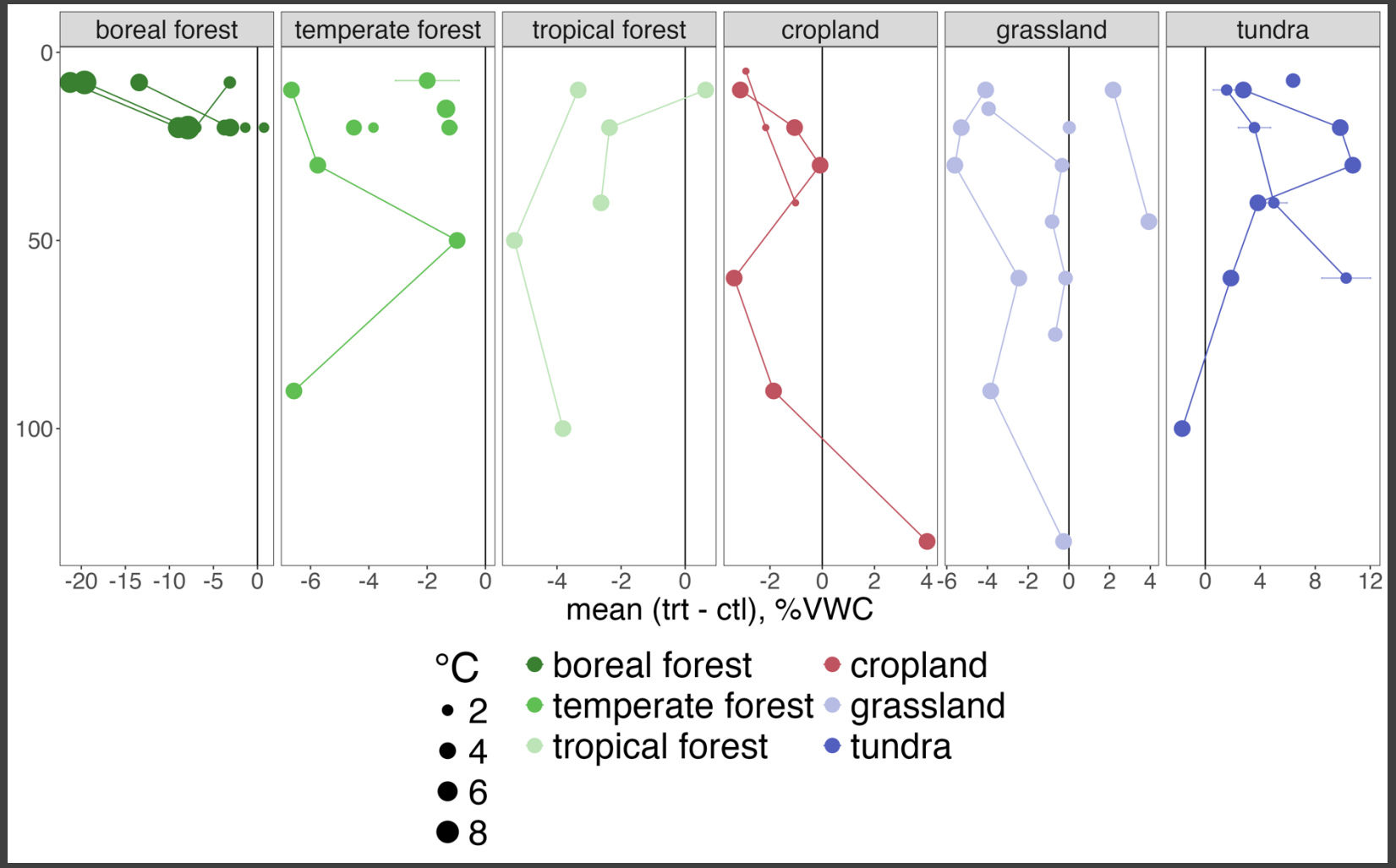
How does warming change…

…soil T with depth?



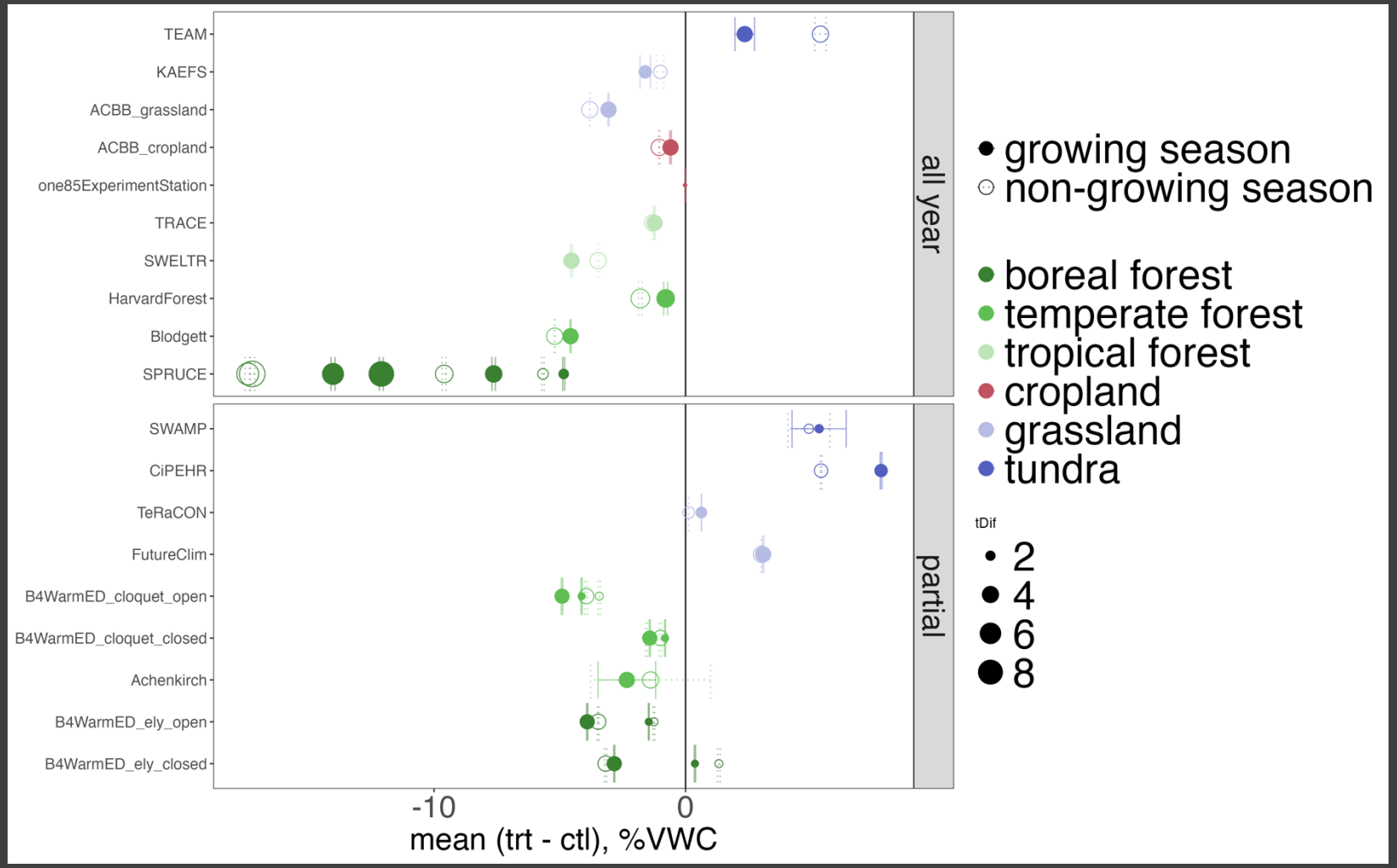
How does warming change...

...soil moisture with depth?

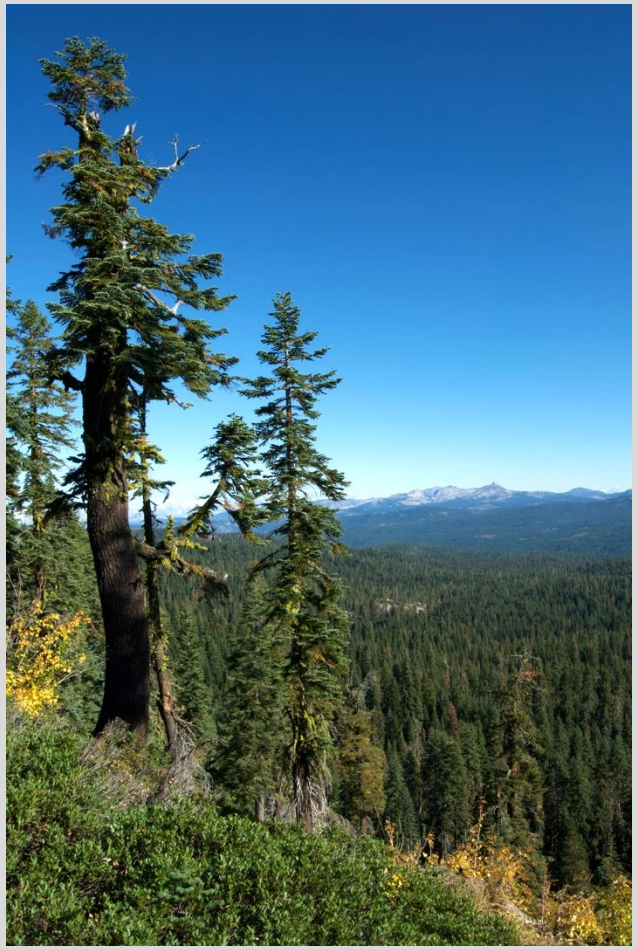


How does warming change...

...soil moisture overall?



Sneak peak at next steps...

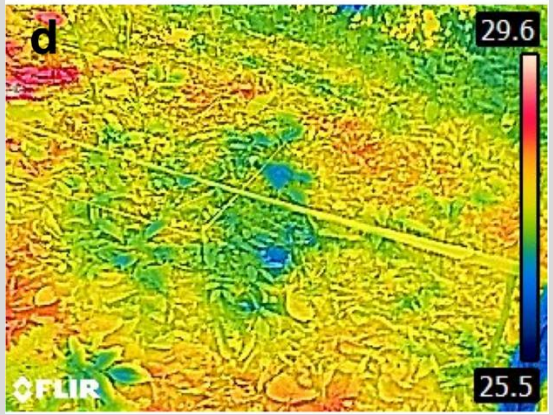


Blodgett
temperate forest

TEAM
alpine grassland

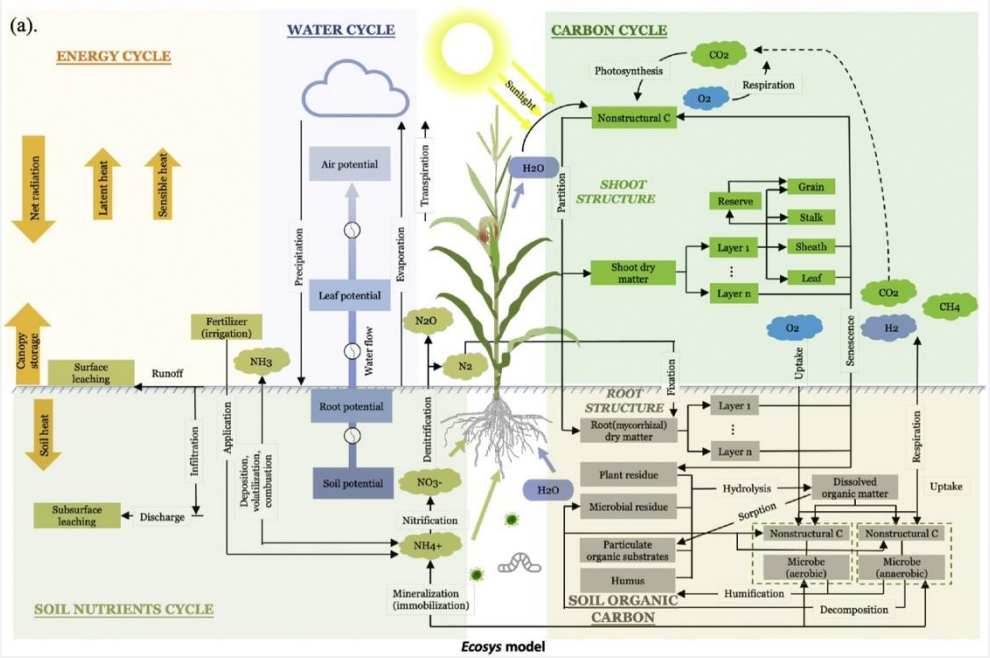
Is excess CO_2 from newly fixed or formerly stable SOC?

SWELTR
tropical forest



ACBB
temperate grassland/ cropland

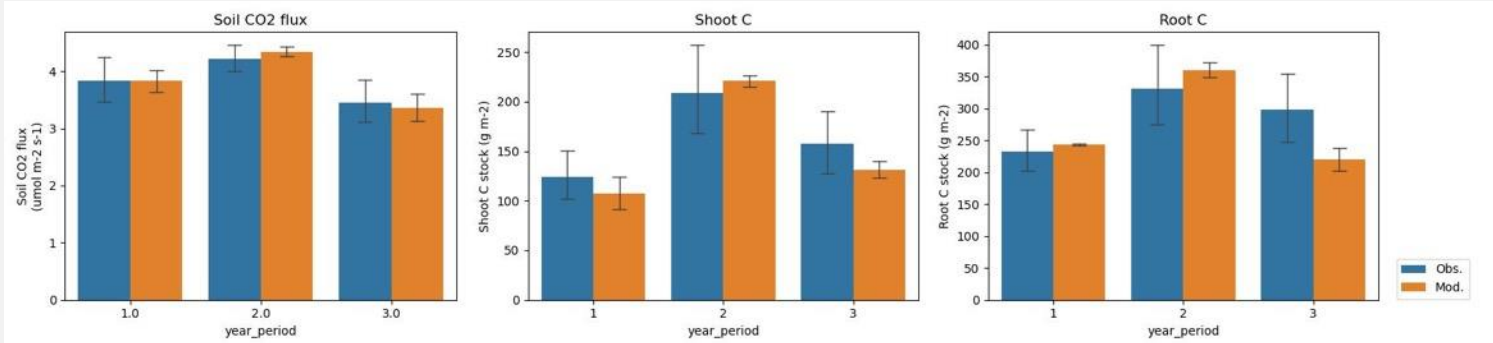
Using a process-rich model (*ecosys*) at TeRaCON

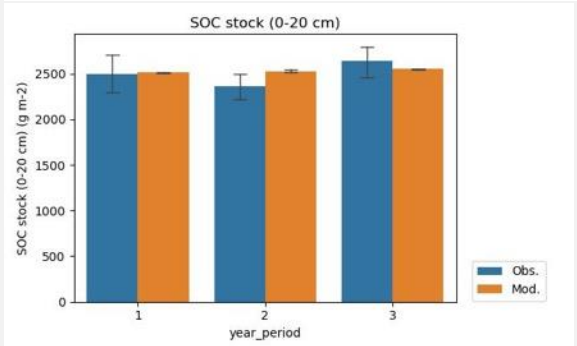


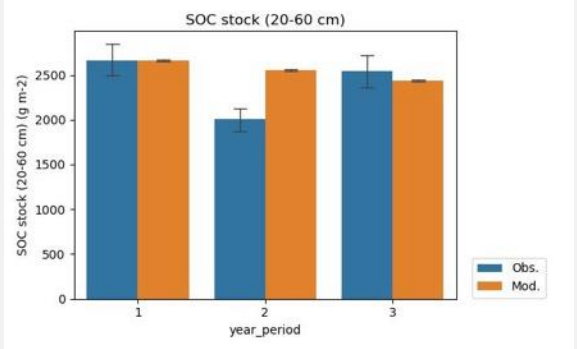
A sub-hourly time-step mechanistic model fully coupled plant-microbe-soil carbon and nutrient cycling

Lei Zhang, William Riley, Peter Reich, Jinyun Tang, Margaret Torn, et al. (In prep).

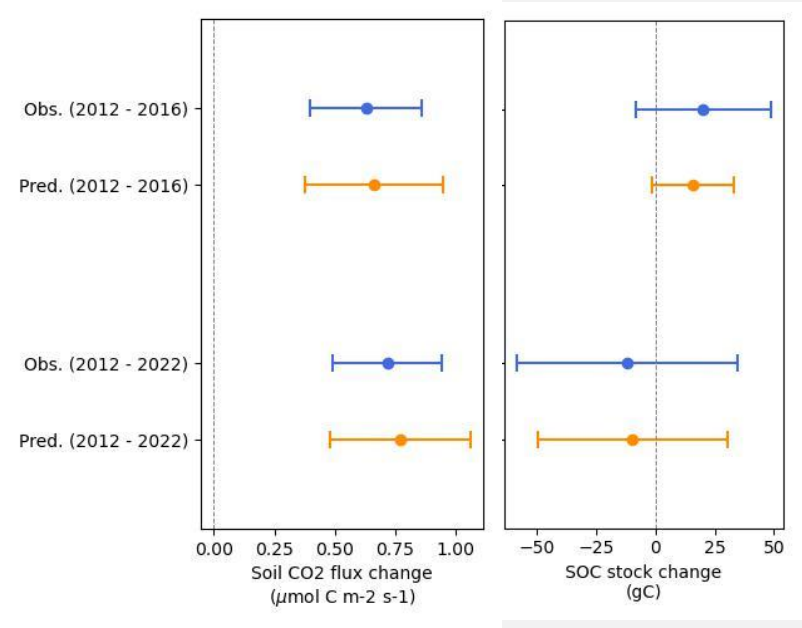
Capture the yearly changes







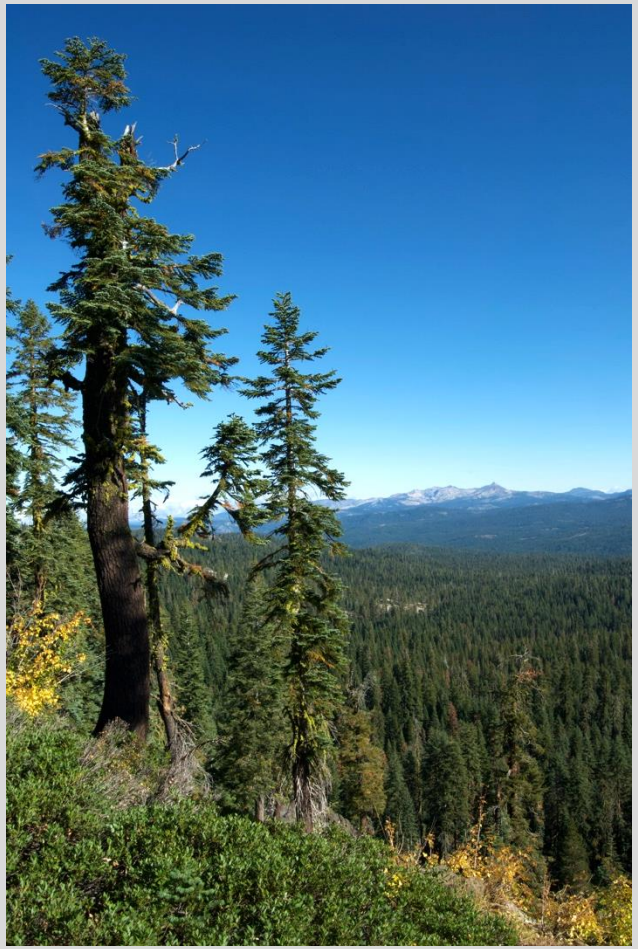
Capture the differences between ambient and warming plots



Thanks!

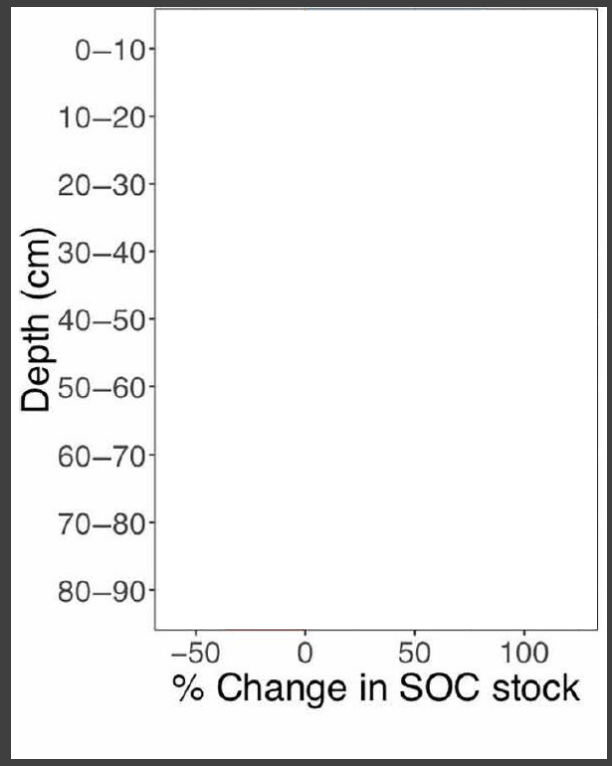
https://iscn.fluxdata.org/network/partner-networks/deepsoil2100/

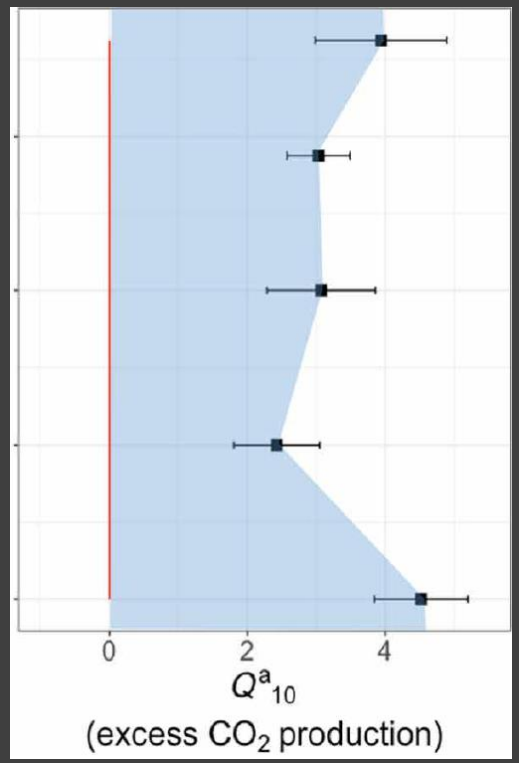
Grassland Warming Experiment Site
Point Reyes, USA



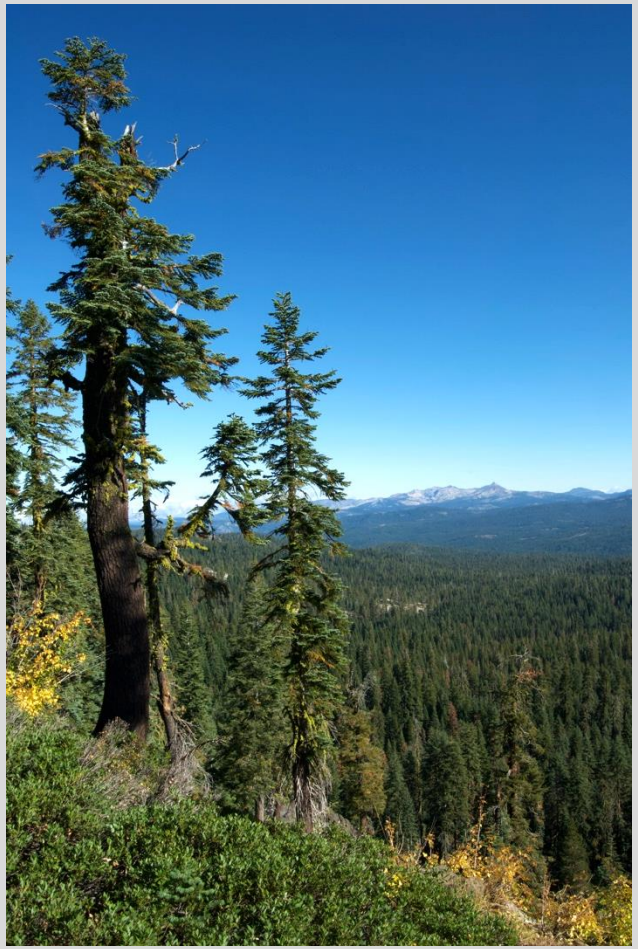
Warming increases ecosystem respiration…

Blodgett Forest
+ 4 °C



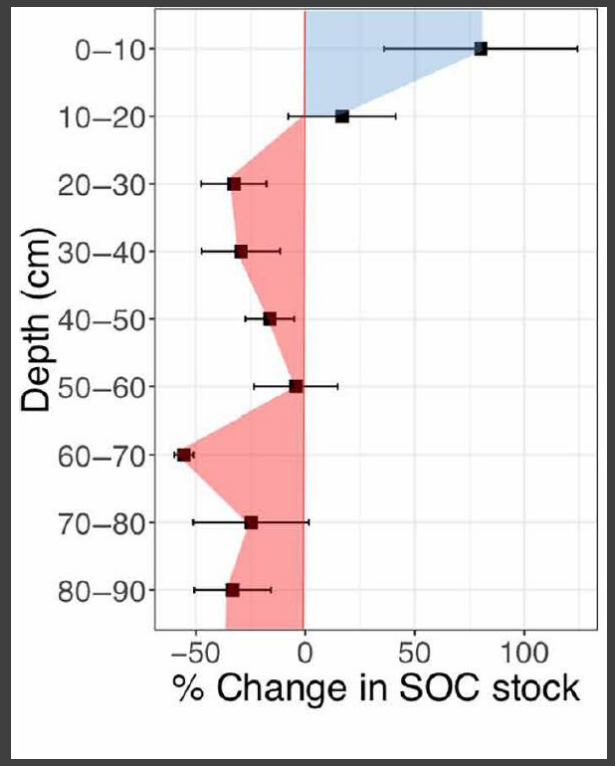


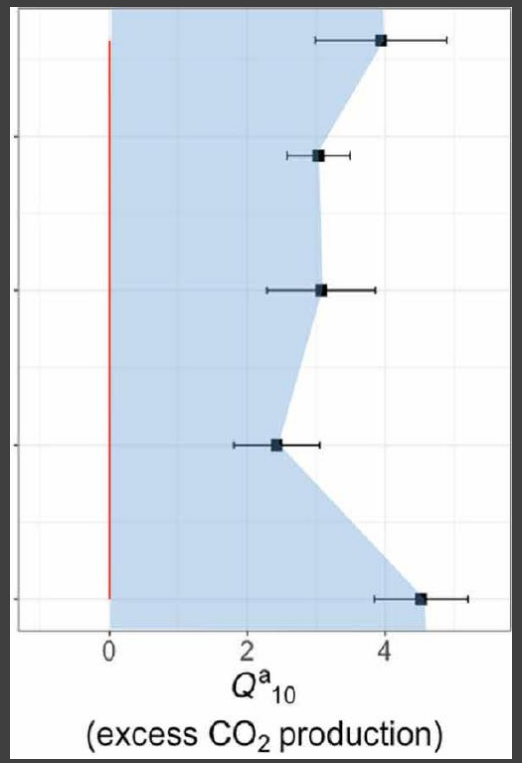
Soong et al., 2021. Five years of whole-soil warming led to loss of subsoil carbon stocks and increased CO2 efflux. Saci. Adv.



Warming increases ecosystem respiration… …and decreases SOC stocks

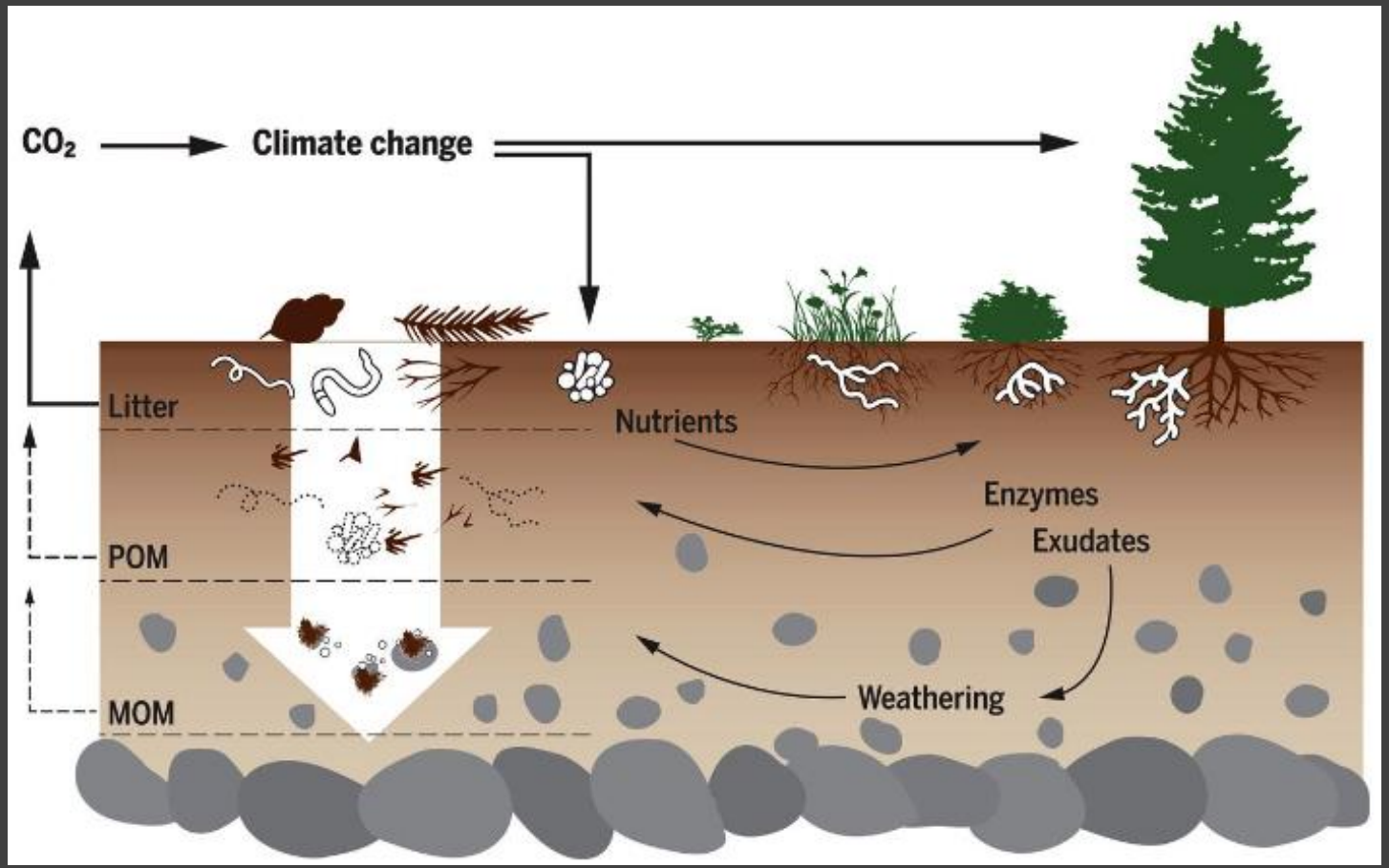
Blodgett Forest
+ 4 °C





Soong et al., 2021. Five years of whole-soil warming led to loss of subsoil carbon stocks and increased CO2 efflux. Saci. Adv.

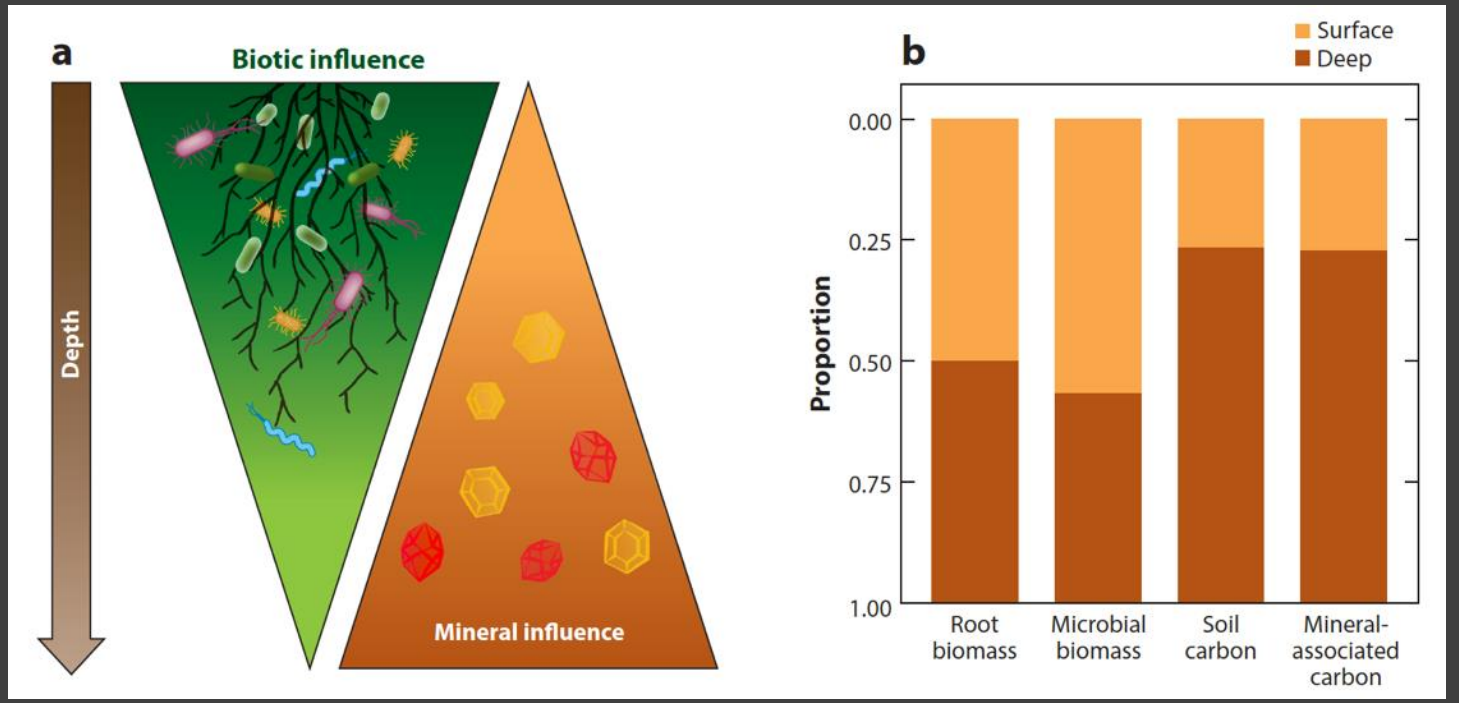
How does warming affect ecosystem C cycling?



(Fig. from Hagedorn et al., 2019, DOI:10.1126/science.aax4737)

How does warming affect ecosystem C cycling?

...with depth?



(figure from Hicks Pries et al., 2023)

Hicks Pries et al., 2023. The Deep Soil Organic Carbon Response to Global Change. Annu. Rev. Ecol. Evol. Syst. 2023. 54:375–401