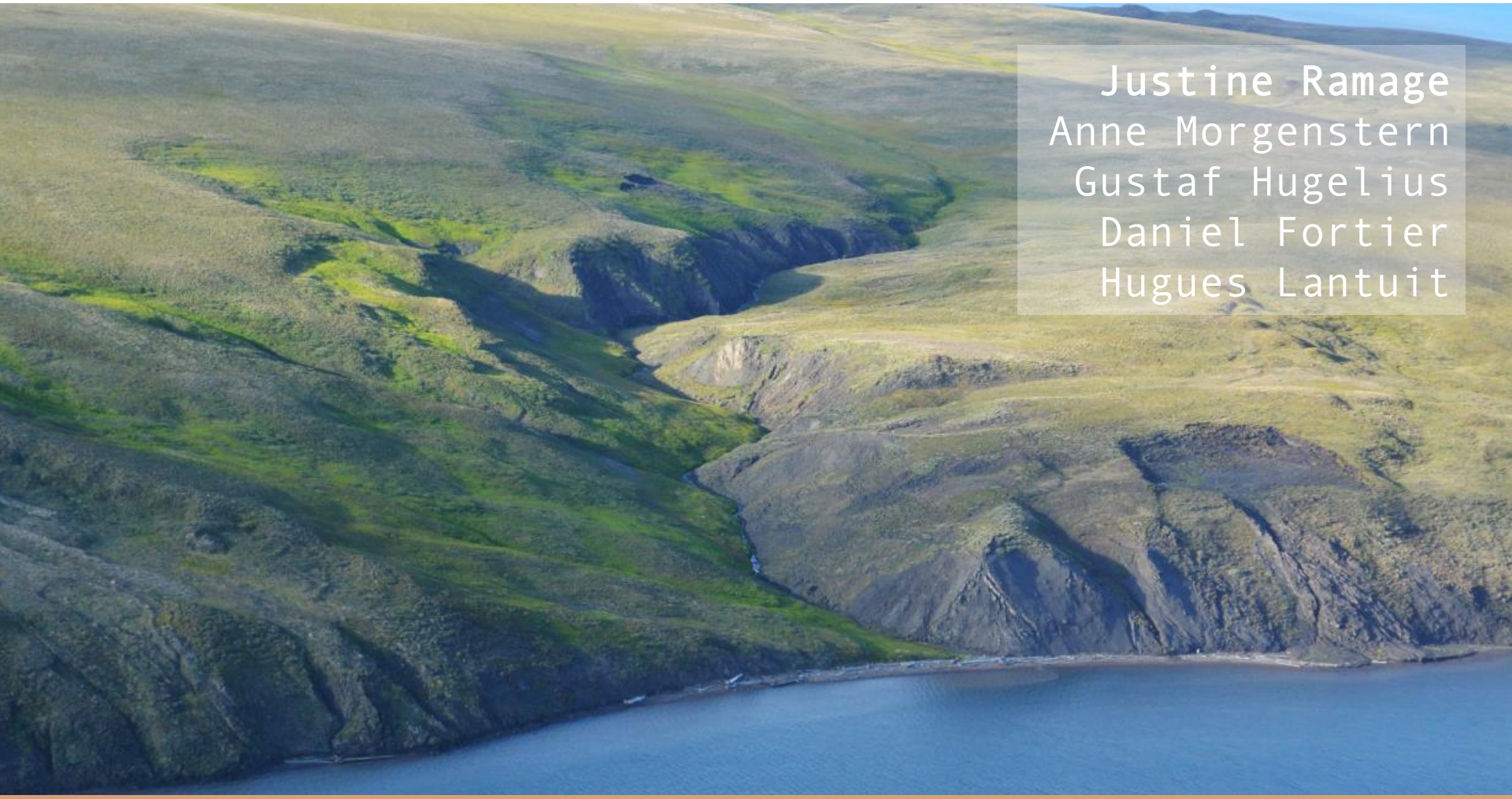
Snapshot of Carbon Distribution and Degradation in Arctic Valleys



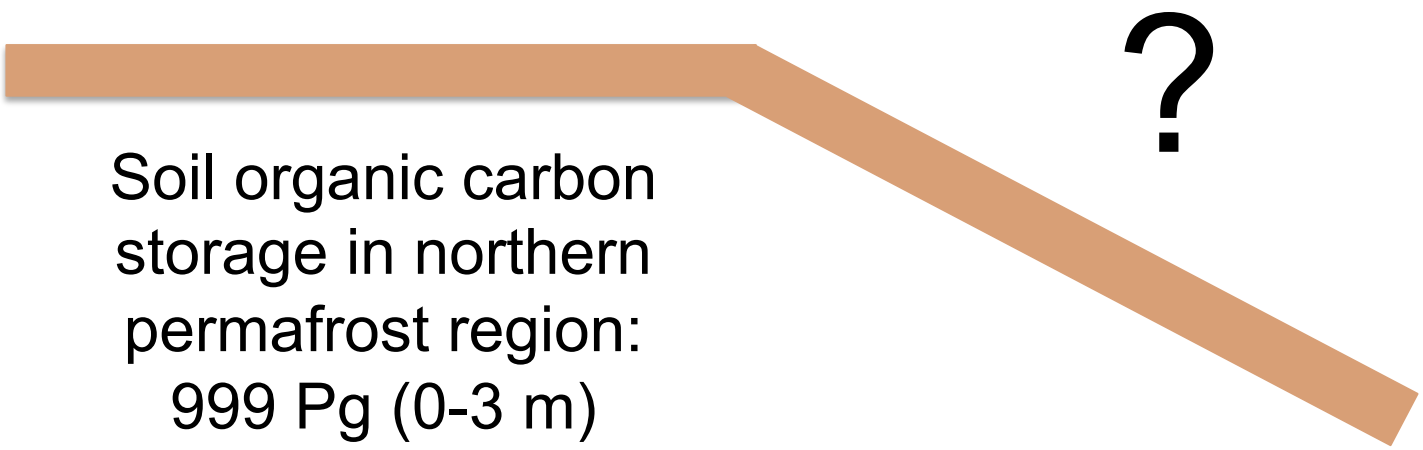
Justine Ramage
Anne Morgenstern
Gustaf Hugelius
Daniel Fortier
Hugues Lantuit

Carbon stocks in the Arctic

Soil organic carbon storage in northern permafrost region: 999 Pg (0-3 m)

Hugelius, G., Strauss, J., Zubrzycki, S., Harden, J. W., Schuur, E., Ping, C. L., ... & O'Donnell, J. A. (2014). Estimated stocks of circumpolar permafrost carbon with quantified uncertainty ranges and identified data gaps. *Biogeosciences*, *11*(23), 6573-6593.

Carbon stocks in the Arctic



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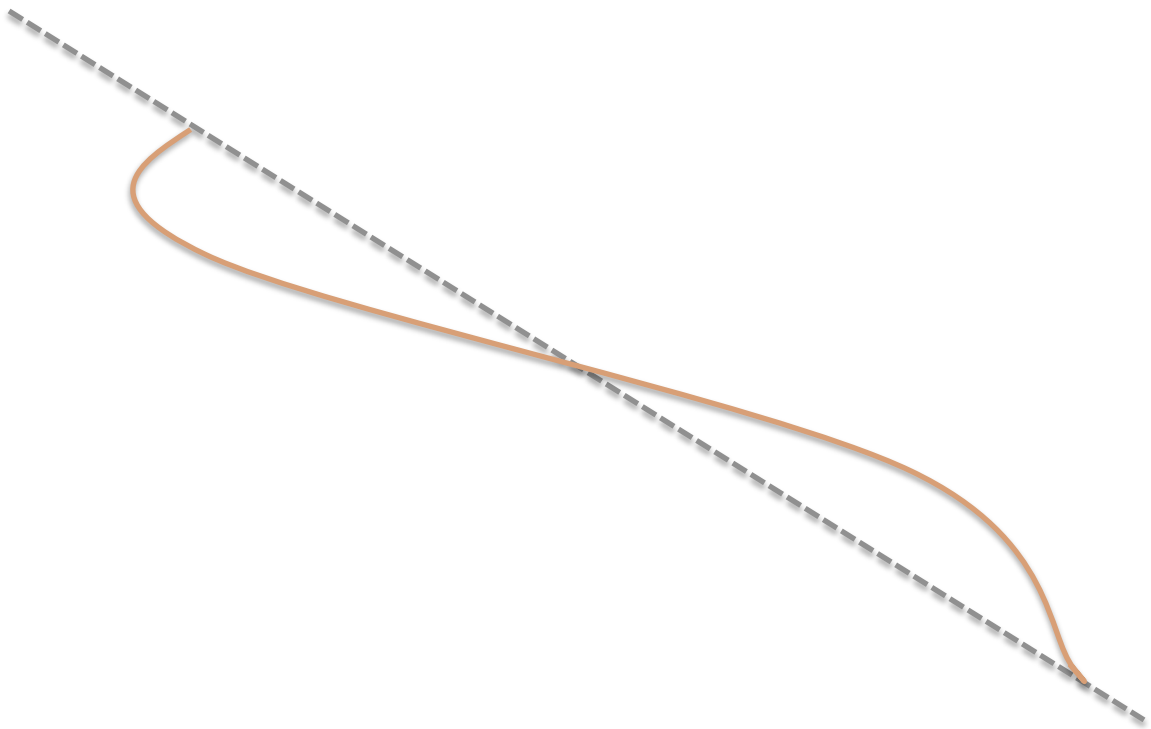
Hillslope processes



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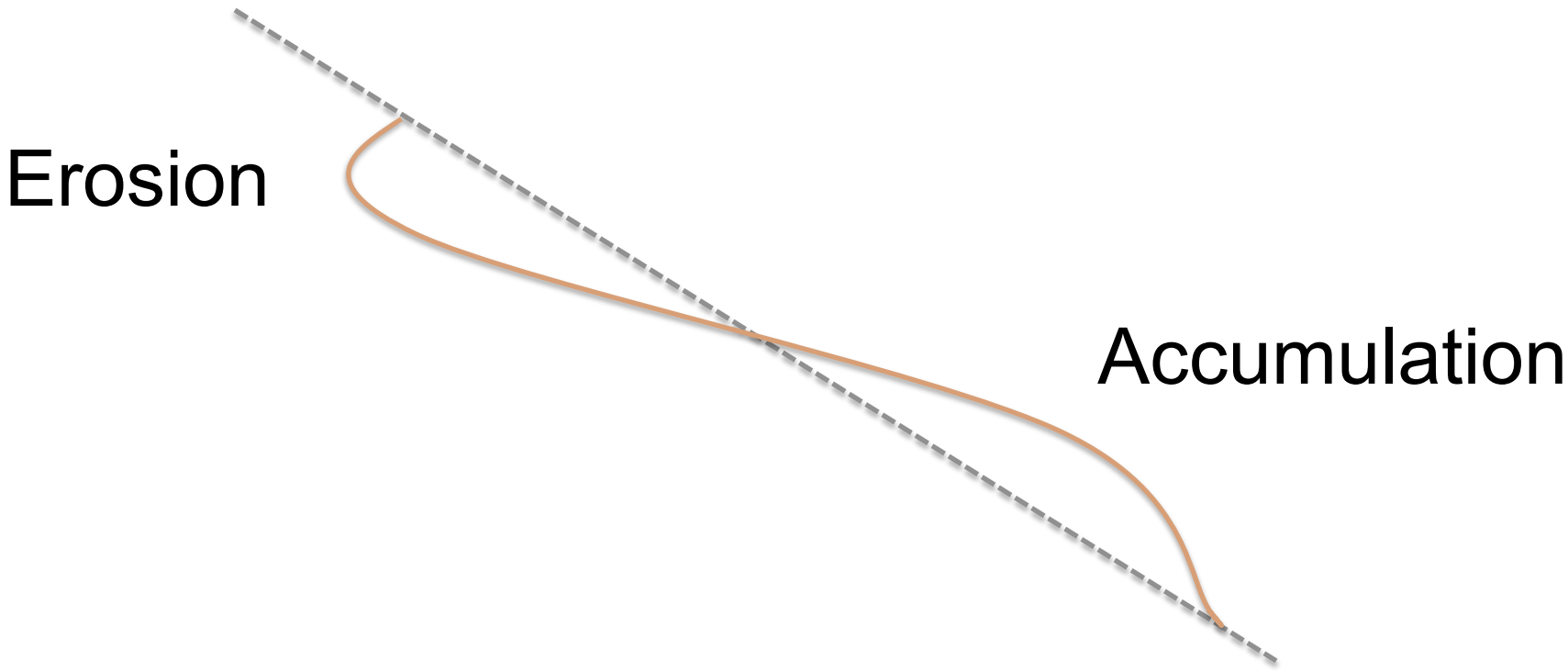

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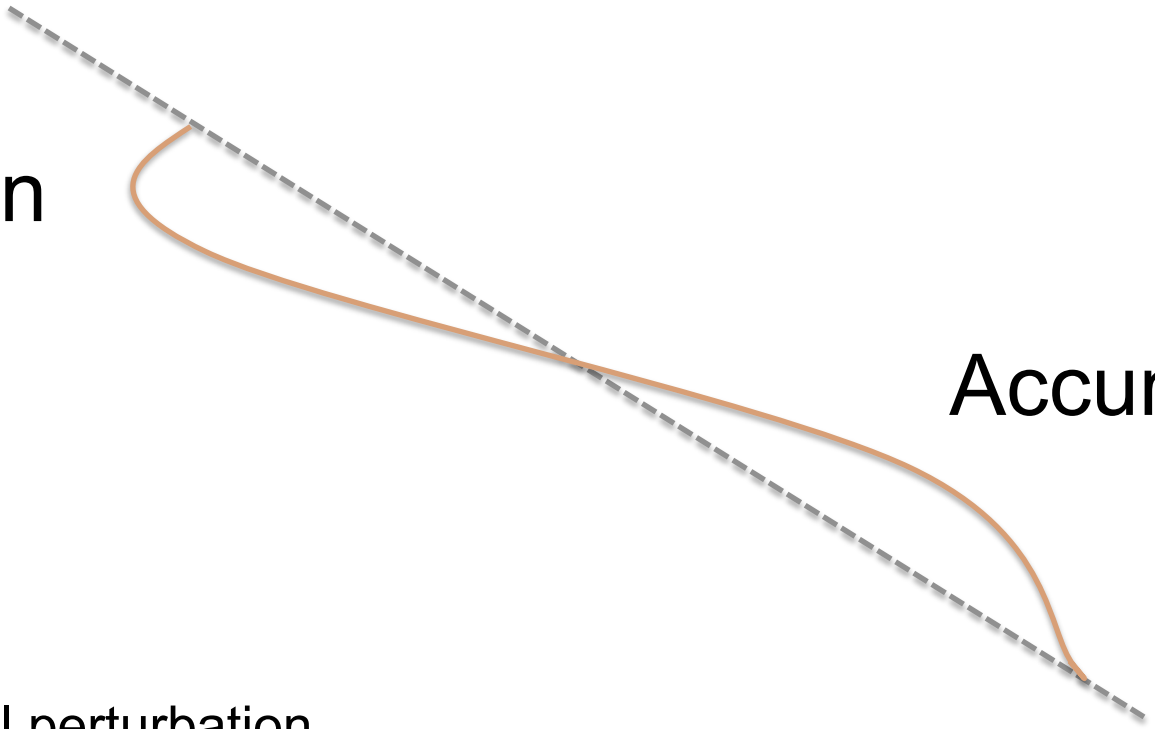
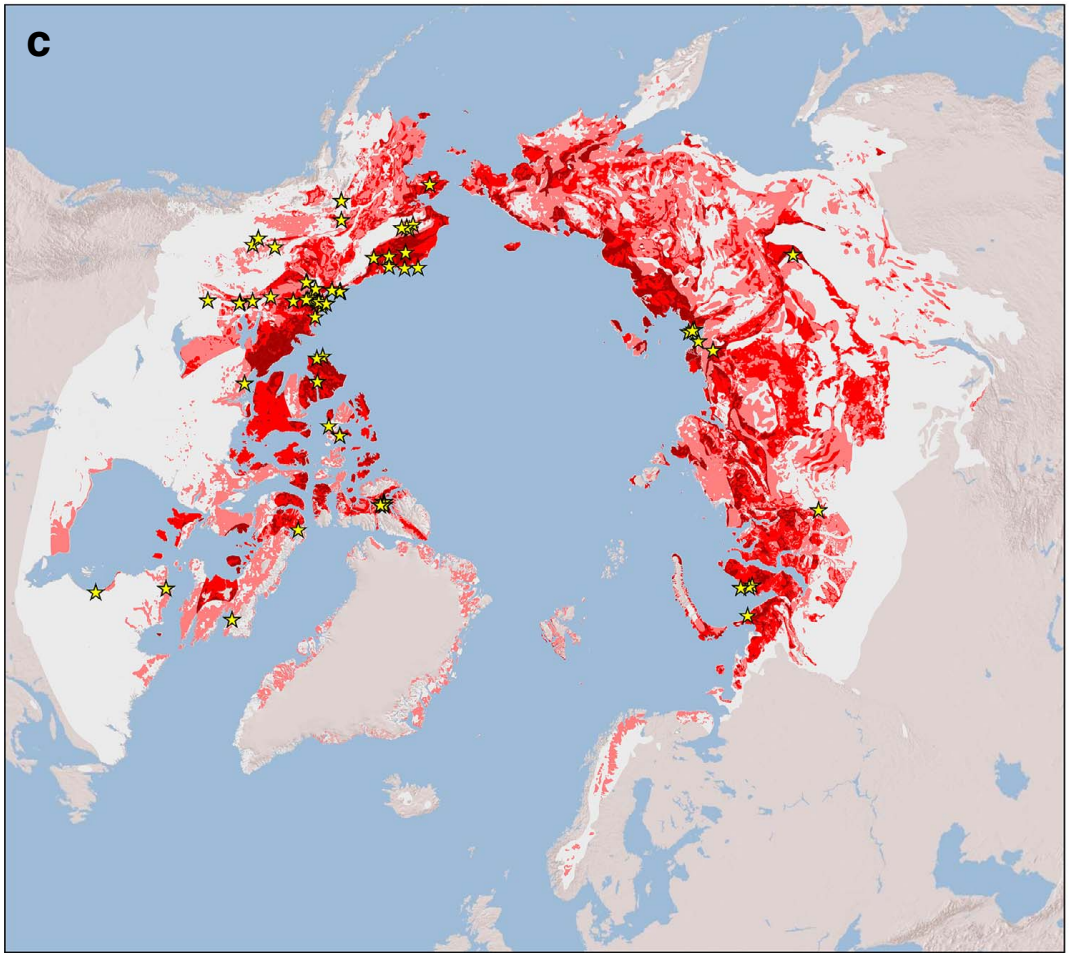


- Thermal perturbation
- Localized disturbances: solifluction, active layer detachments, thaw slumps

Hillslope thermokarst terrains



4.9%
of the northern circumpolar permafrost region

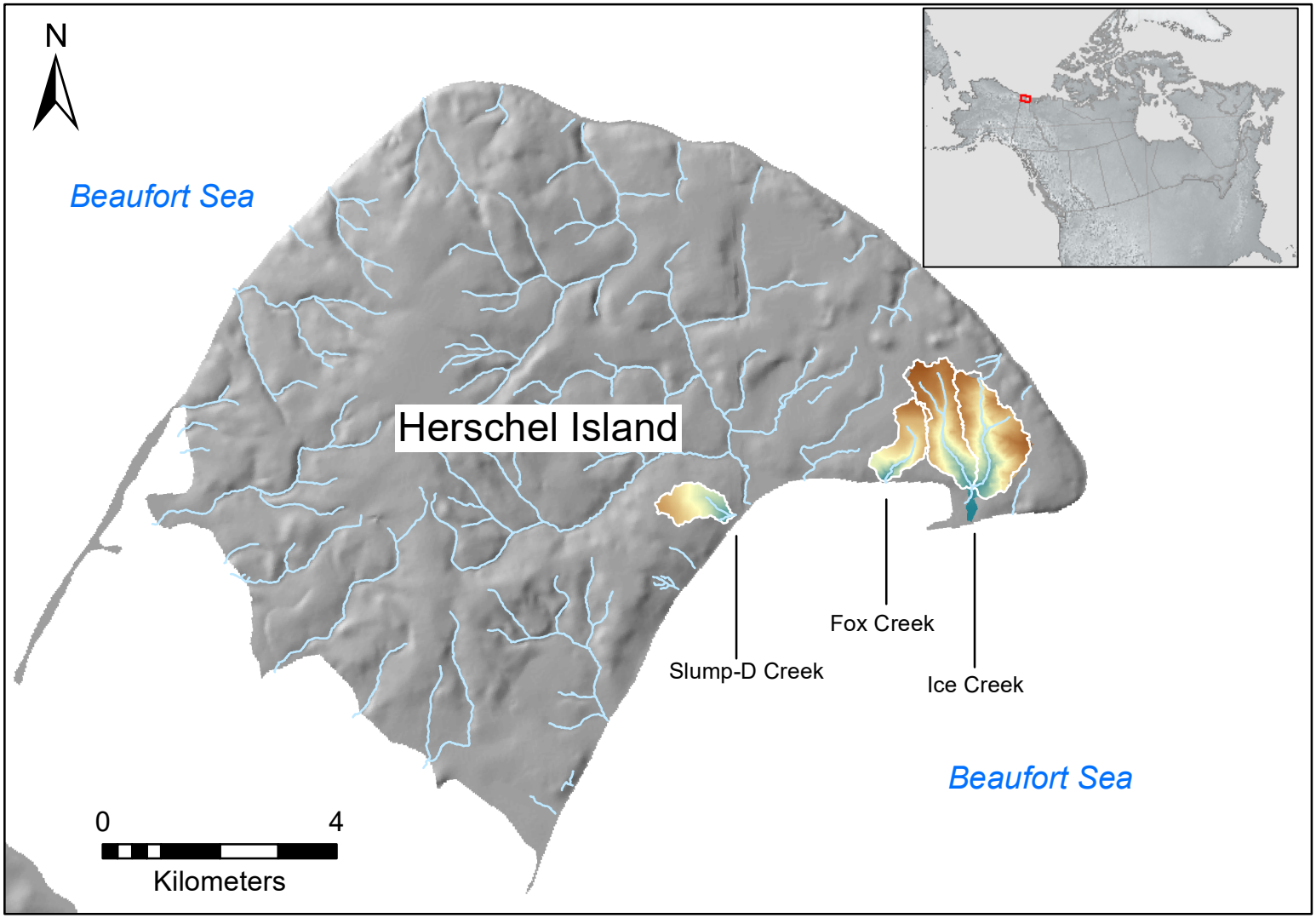
6.2%
of SOC storage

Olefeldt, D., Goswami, S., Grosse, G., Hayes, D., Hugelius, G., Kuhry, P., ... & Turetsky, M. R. (2016). Circumpolar distribution and carbon storage of thermokarst landscapes. *Nature communications*, *7*.

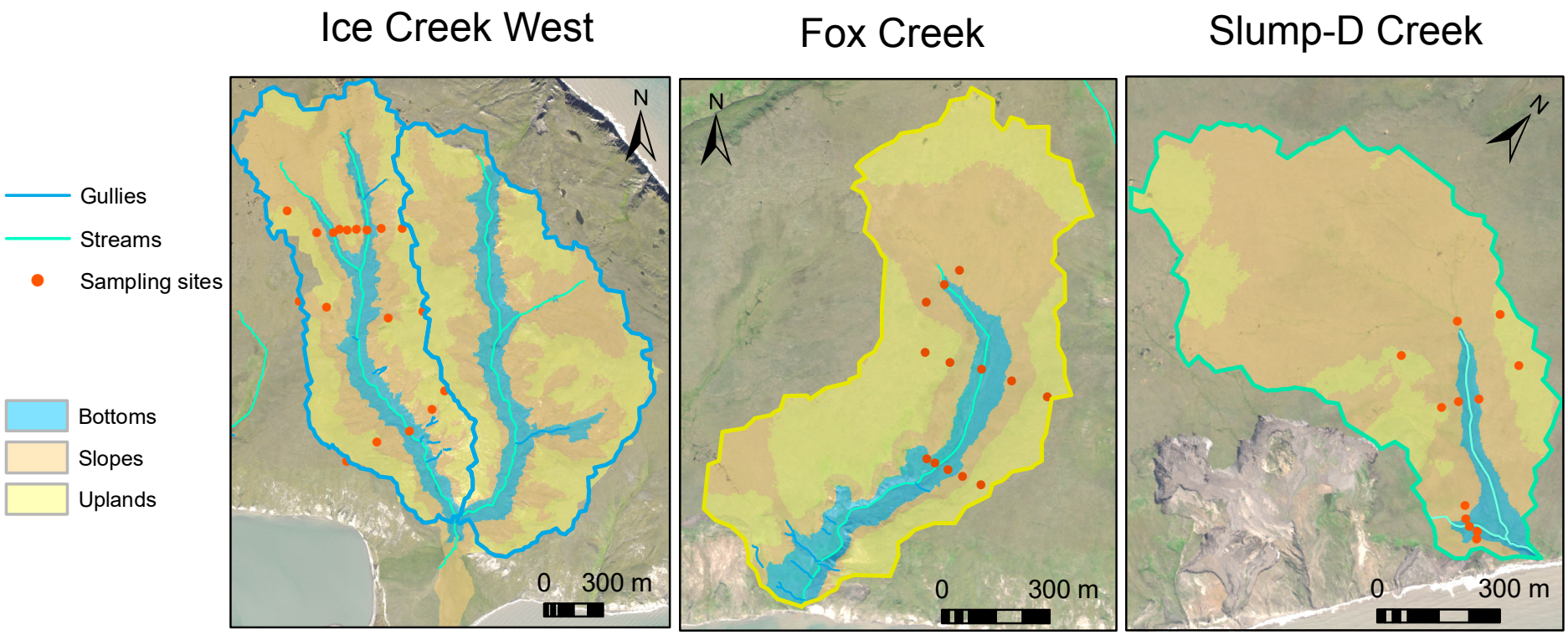
Research Question

WHAT IS THE IMPACT OF HILLSLOPE PROCESSES ON CARBON STORAGE IN VALLEYS?

Study Area


N
Beaufort Sea
Herschel Island
Slump-D Creek
Fox Creek
Ice Creek
Beaufort Sea
0
4
Kilometers

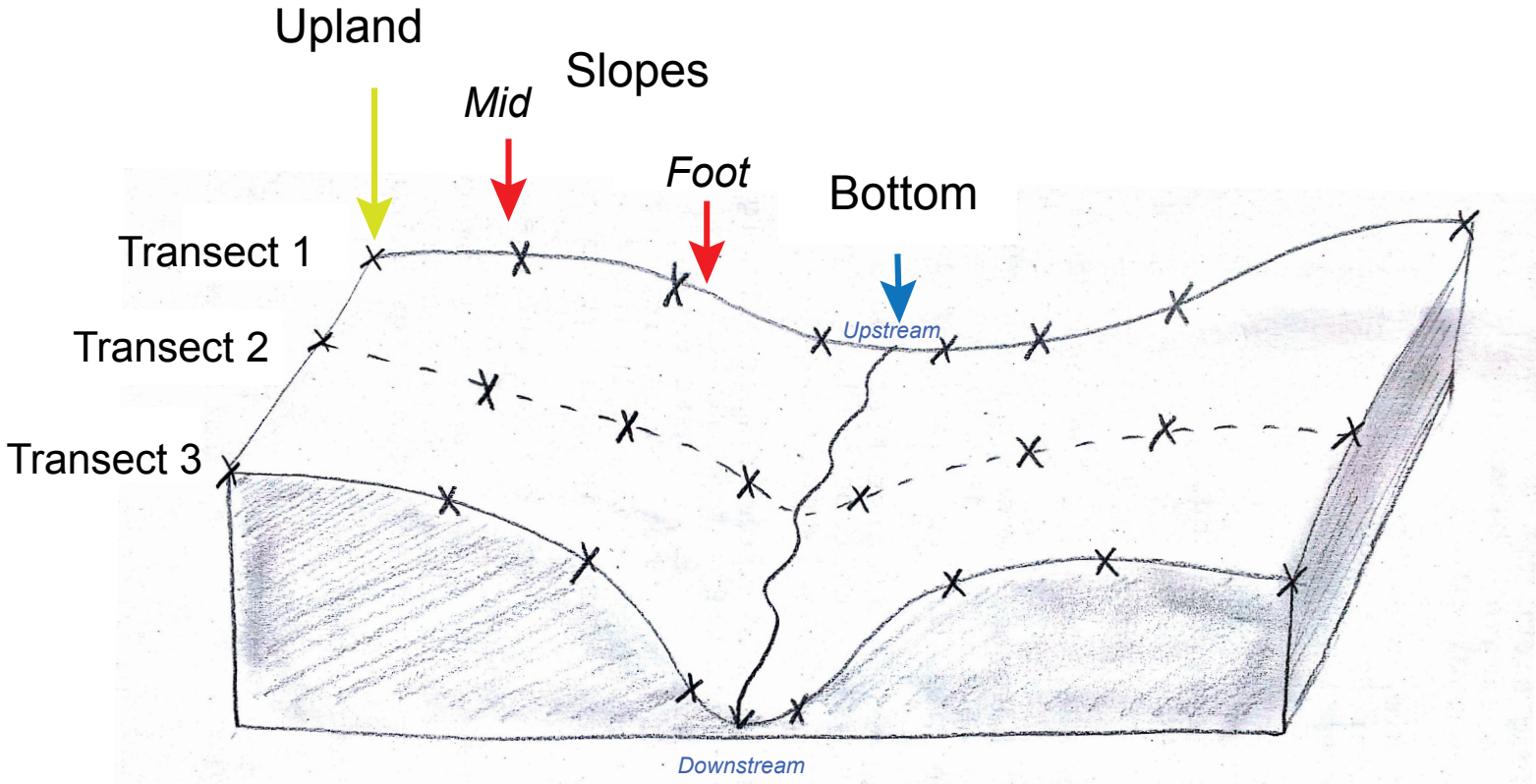
Origin and Geomorphology



	Ice Creek West	Fox Creek	Slump-D Creek
Watershed:	140 ha	77.5 ha	61.8 ha
Stream length:	2.5 km	1.4 km	0.9 km
Elevation:	81 to 5 m	68 to 4 m	55 to 5 m

Sampling Scheme

Soil pits: active layer & permafrost



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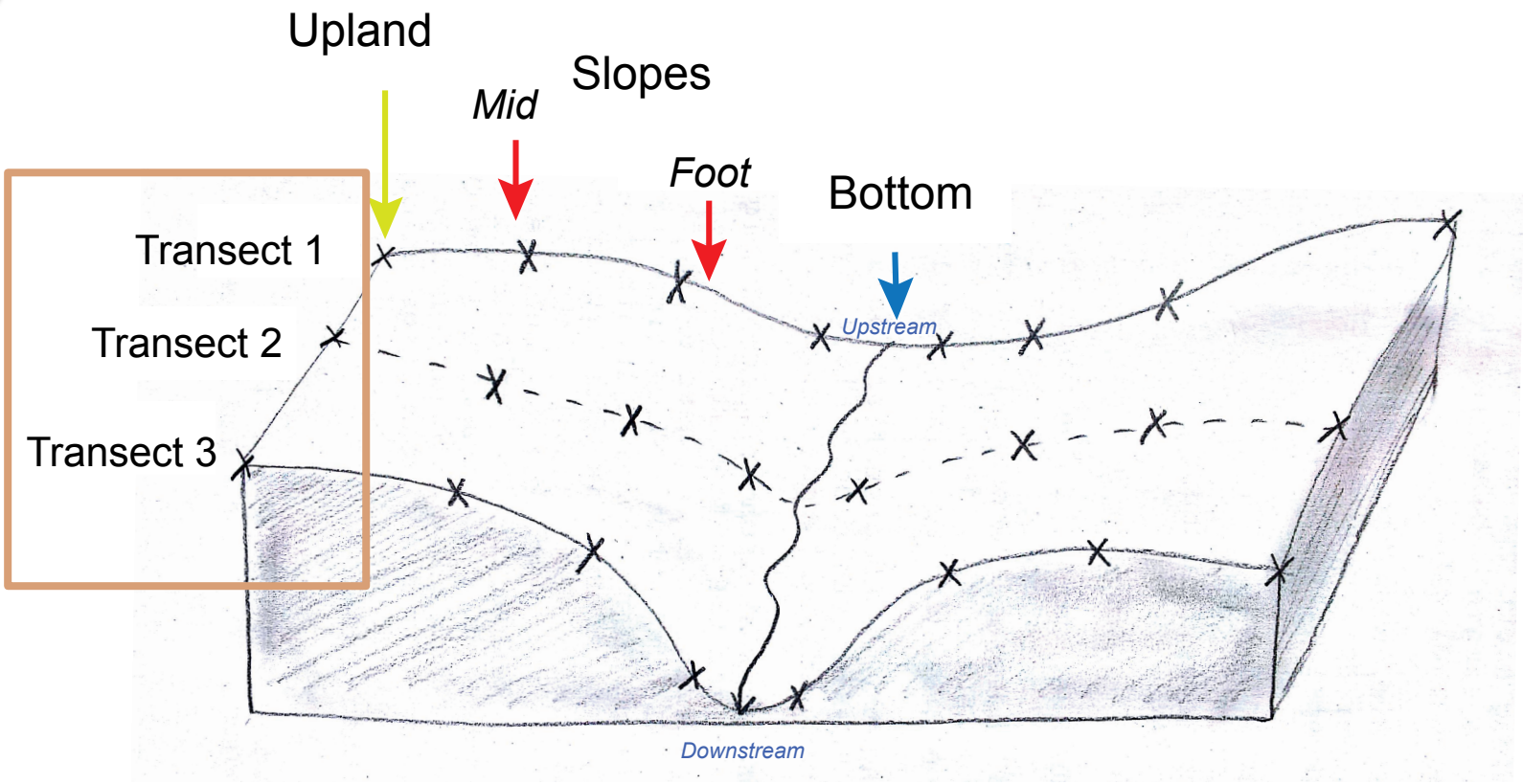


Sampling Scheme

Transects

Transect 1: Upper valley

Sampling Scheme

Transects

Transect 2: Middle valley

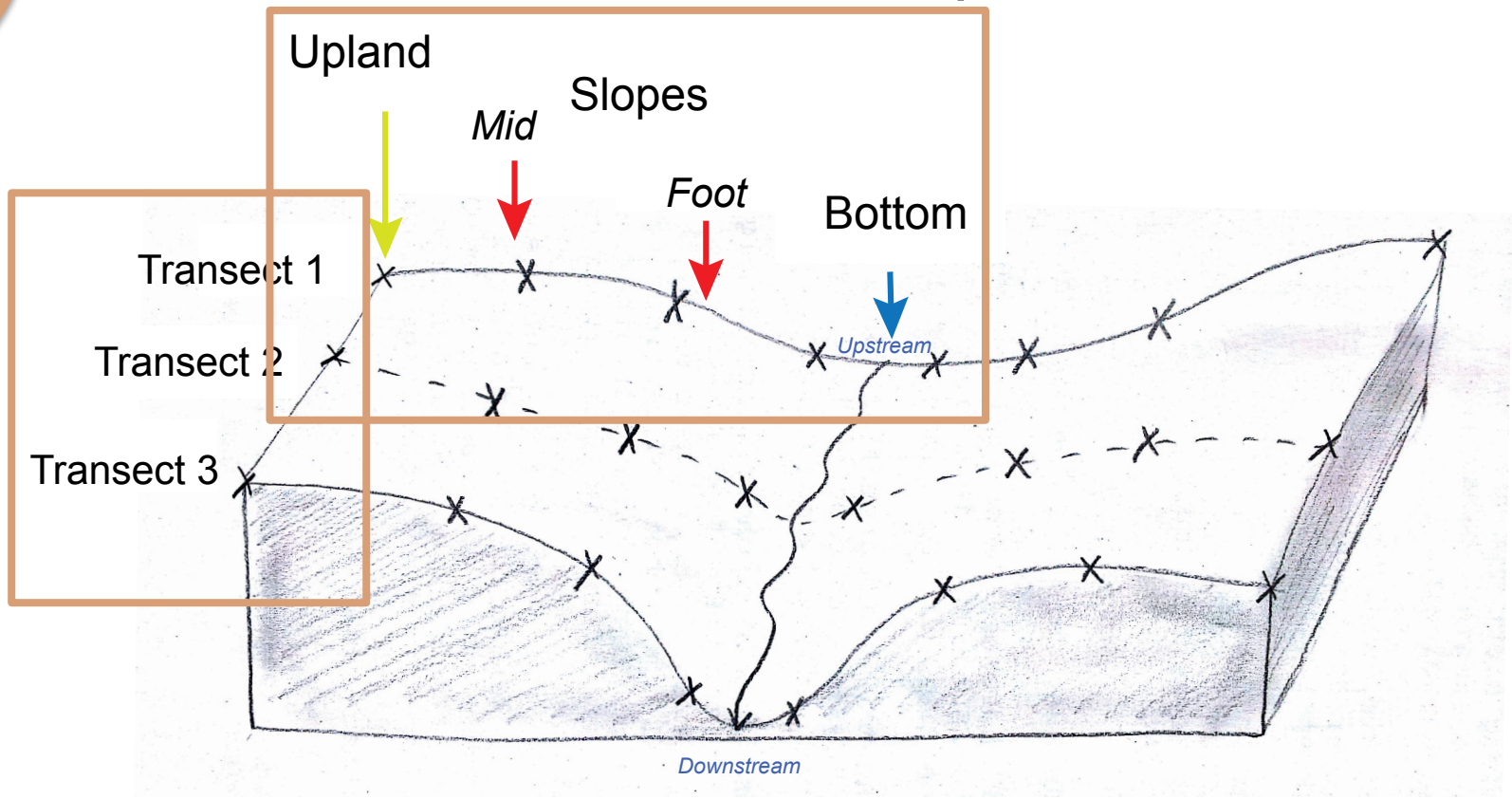
Sampling Scheme

Transects

Transect 3: Lower valley

Sampling Scheme

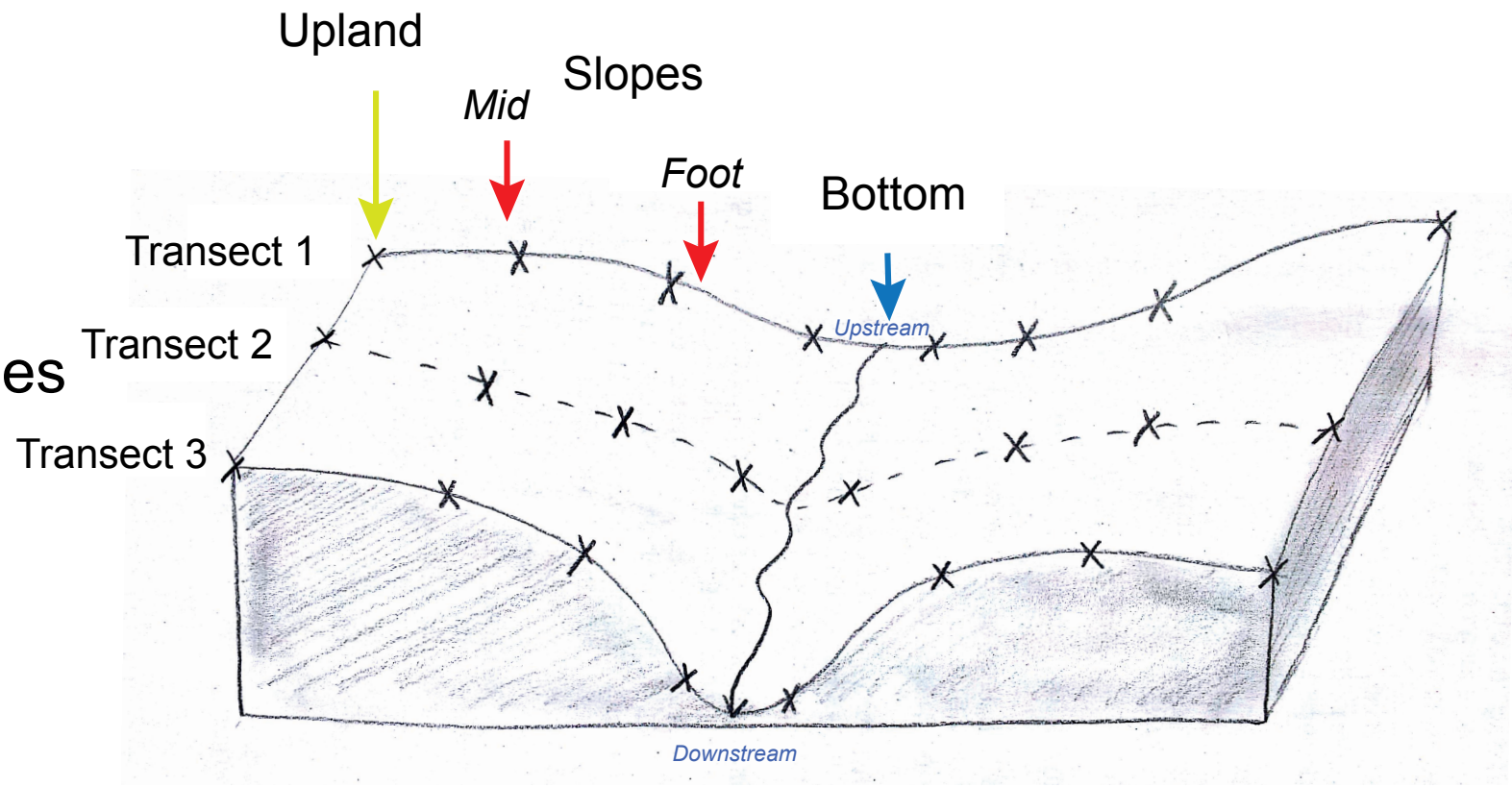
Soil pits: active layer & permafrost



Sampling Scheme

Soil pits: active layer & permafrost

3 valleys
45 sites
316 samples



Sampling Scheme

Soil pits: active layer & permafrost

3 valleys
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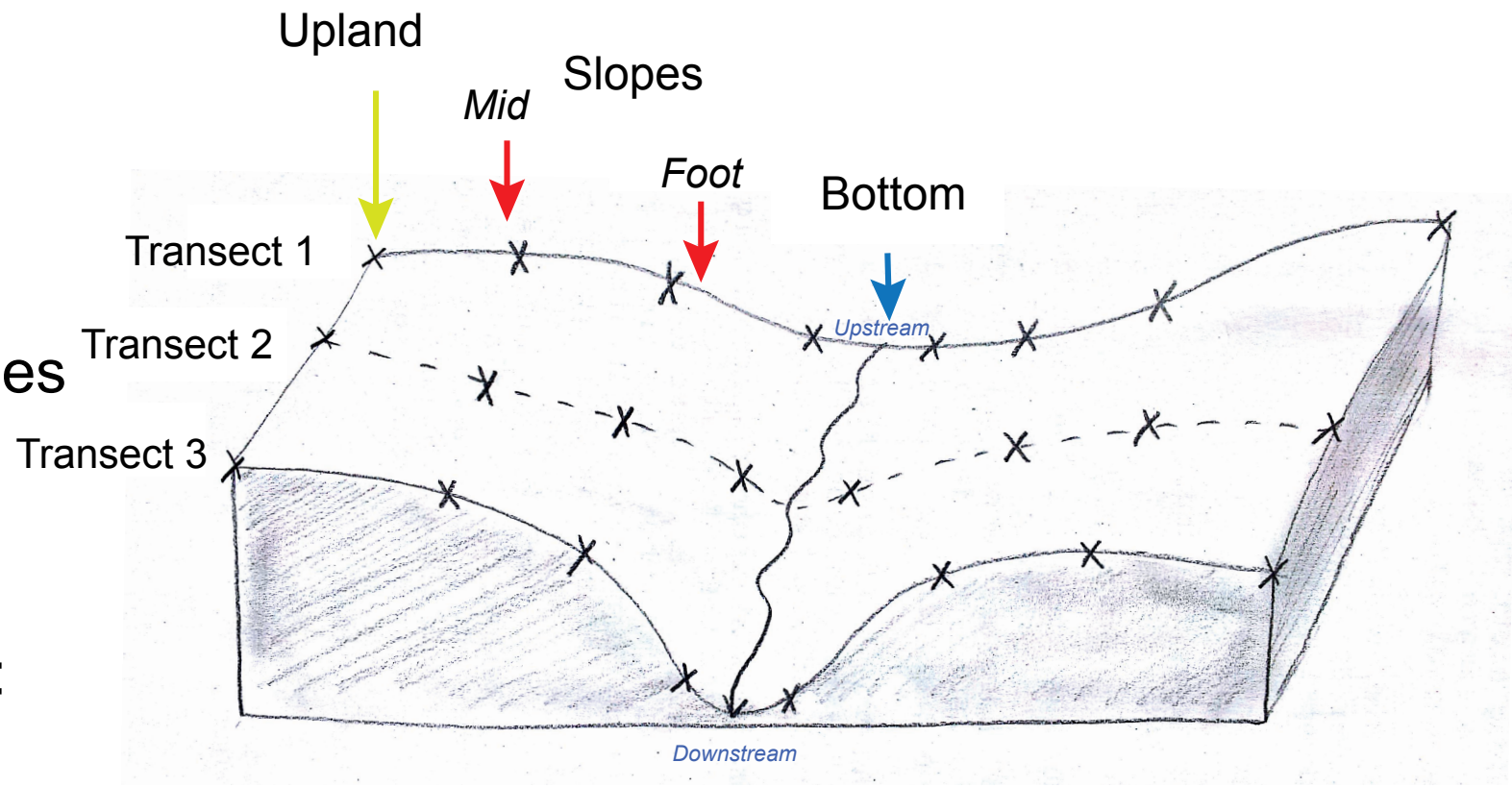
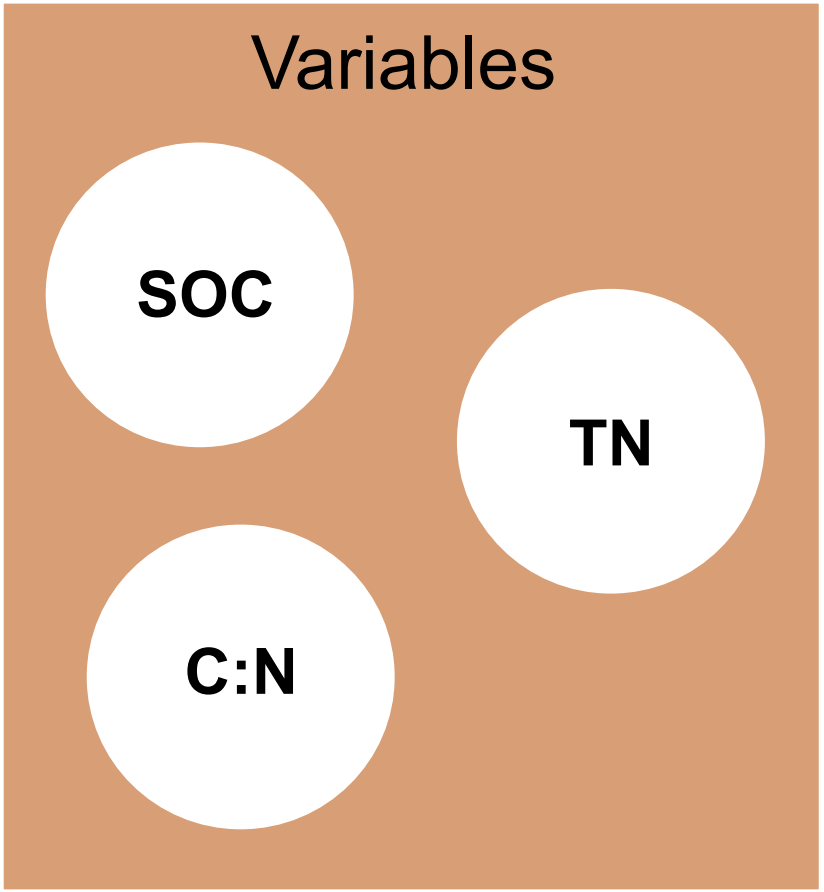


Analyses:
%C
%N
%TOC

Results

Carbon distribution and degradation



Results

Carbon distribution and degradation

Spatial parameters

- Valley position
- Hillslope position
- Slope orientation

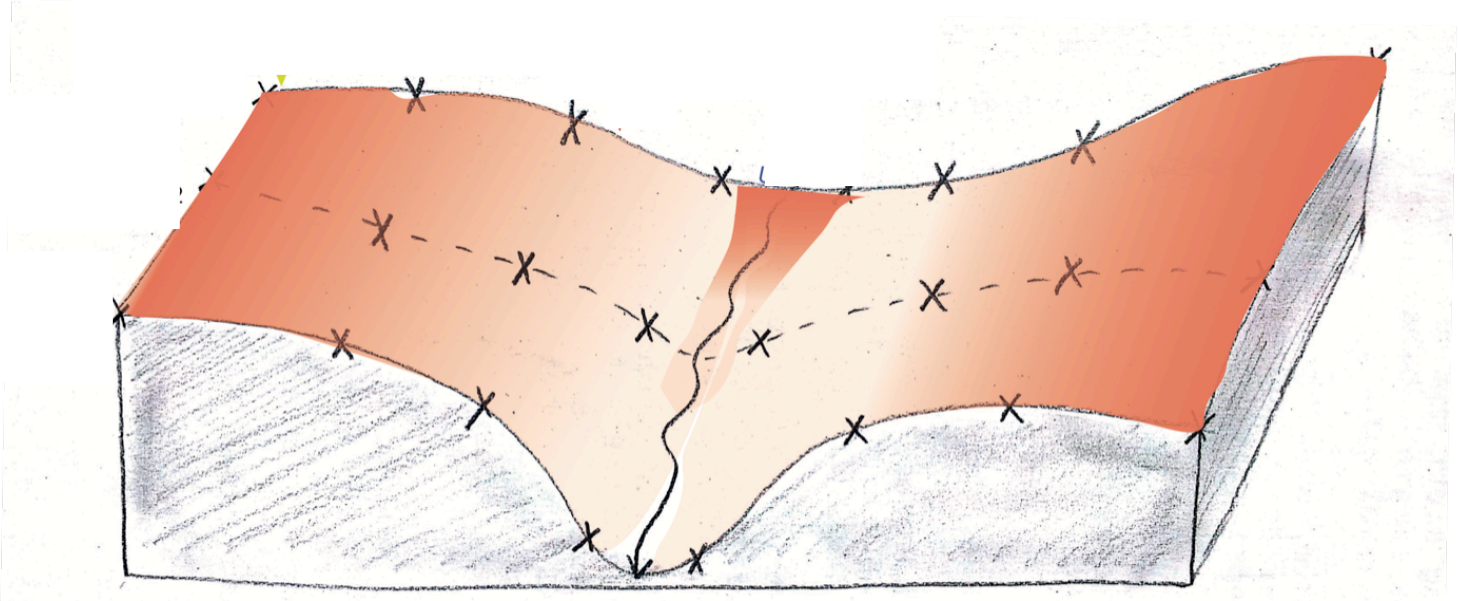
Variables

- SOC
- TN
- C:N

Results

Carbon distribution and degradation

Hillslope position



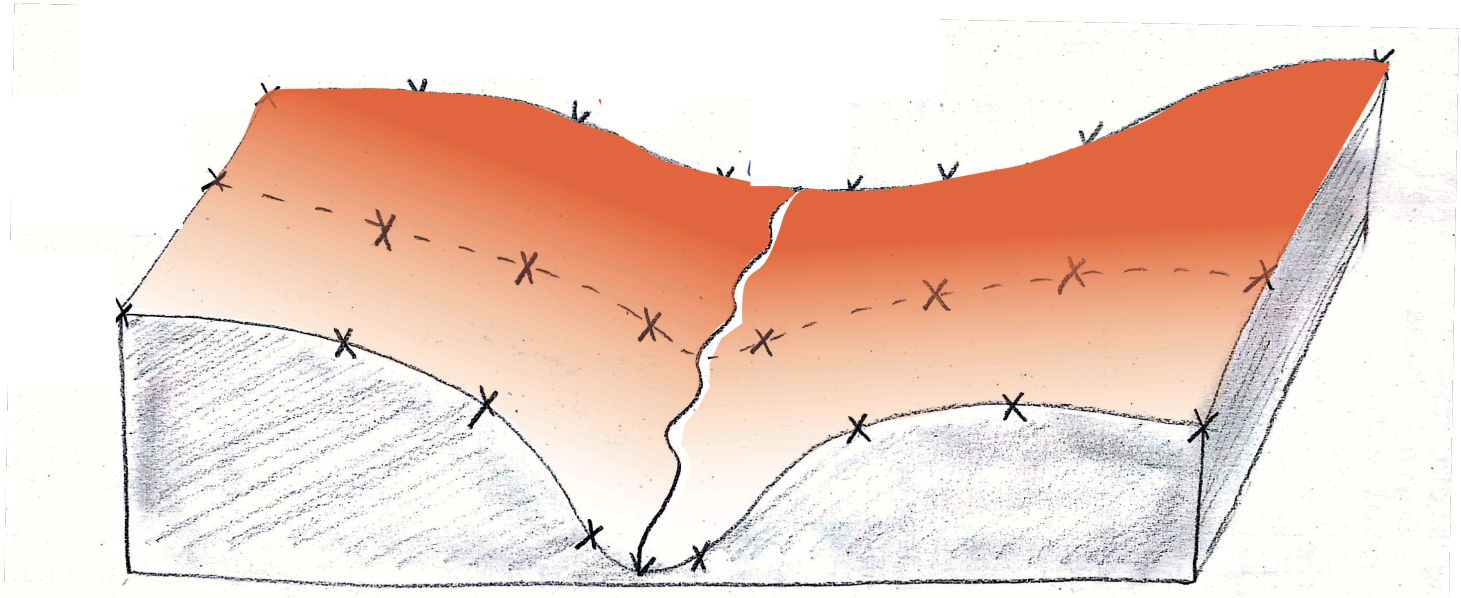
	ALD mean (cm)	SOC mean (kg C m^2)	TN mean (kg N m^2)	C:N mean
Bottom	41.2 ± 9.3	33.8 ± 9.1	2.5 ± 0.8	14.1 ± 2.1
Footslope	94.5 ± 11.0	18.5 ± 6.3	1.9 ± 0.7	11.0 ± 1.5
Midslope	57.6 ± 17.7	25.3 ± 10.4	2.2 ± 0.6	11.8 ± 1.5
Upland	41.1 ± 8.8	27.1 ± 6.3	2.1 ± 0.4	13.9 ± 2.2

** $p < 0.05$

Results

Carbon distribution and degradation

Valley position

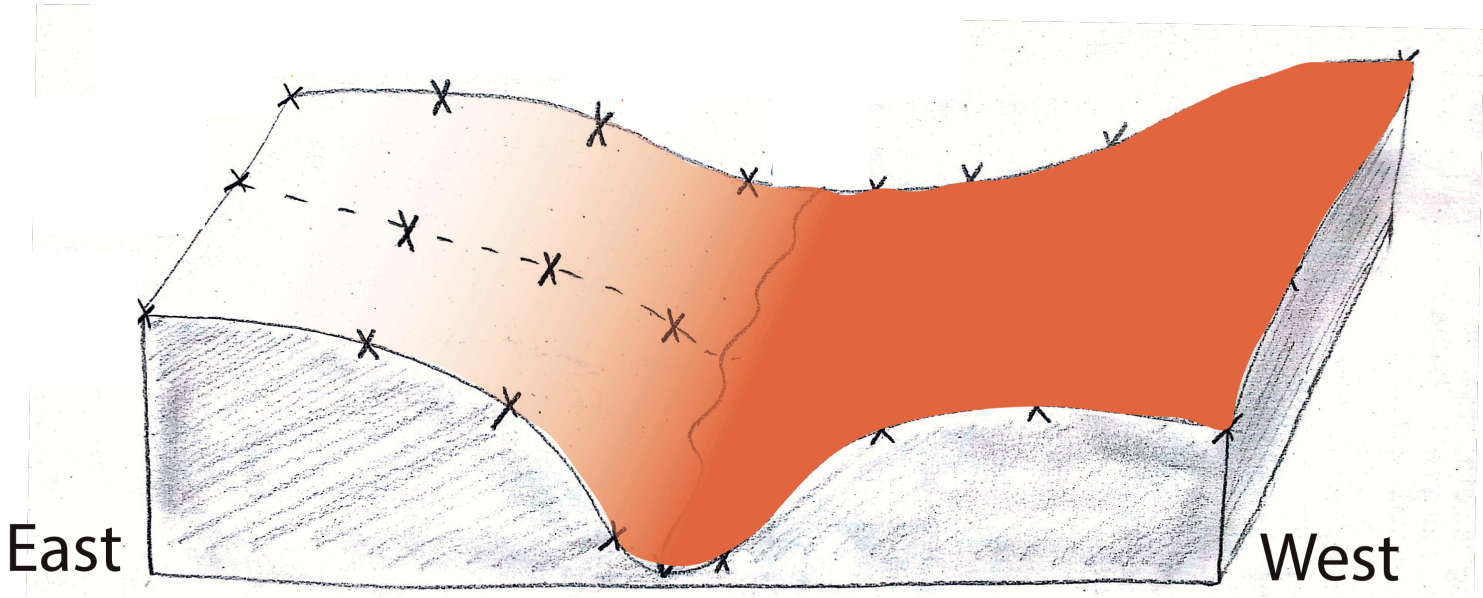


	ALD mean (cm)	TOC mean (kg C m^2)	TN mean (kg N m^2)	C:N mean
Downstream	58.5±22.6	25.1±10.3	2.1±0.7	12.5±2.5
Mid-stream	51.6±19.7	26.3±8.8	2.2±0.5	12.6±1.9
Upstream	38.7±6.0	30.2±4.0	2.2±0.3	14.9±1.6

** $p < 0.05$

Results

Carbon distribution and degradation

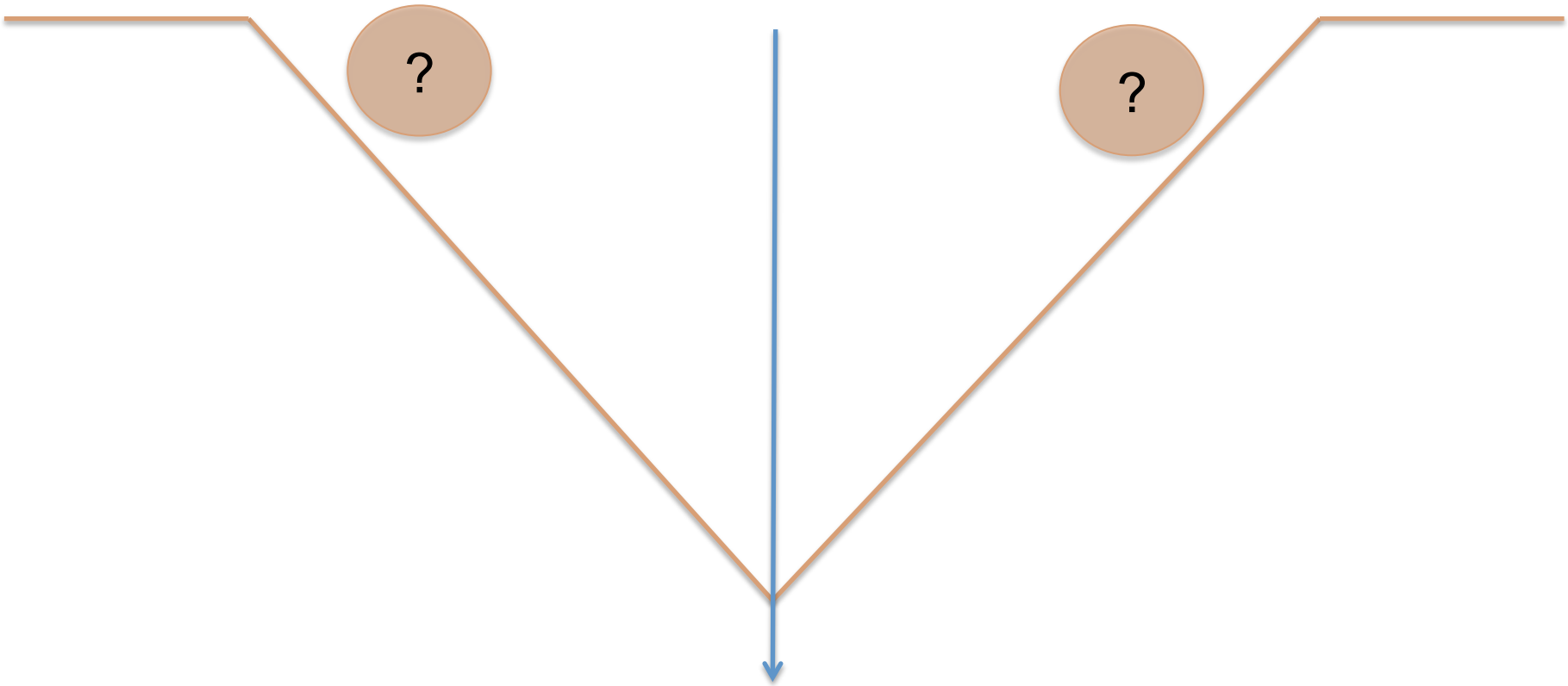


Slope orientation

	SOC mean kg m^2	TN mean kg m^2	C:N mean
East	30.6 ± 6.7	2.3 ± 0.6	14.3 ± 0.7
West	26.7 ± 3.3	2.1 ± 0.2	13.5 ± 0.2

** $p < 0.05$

Summary



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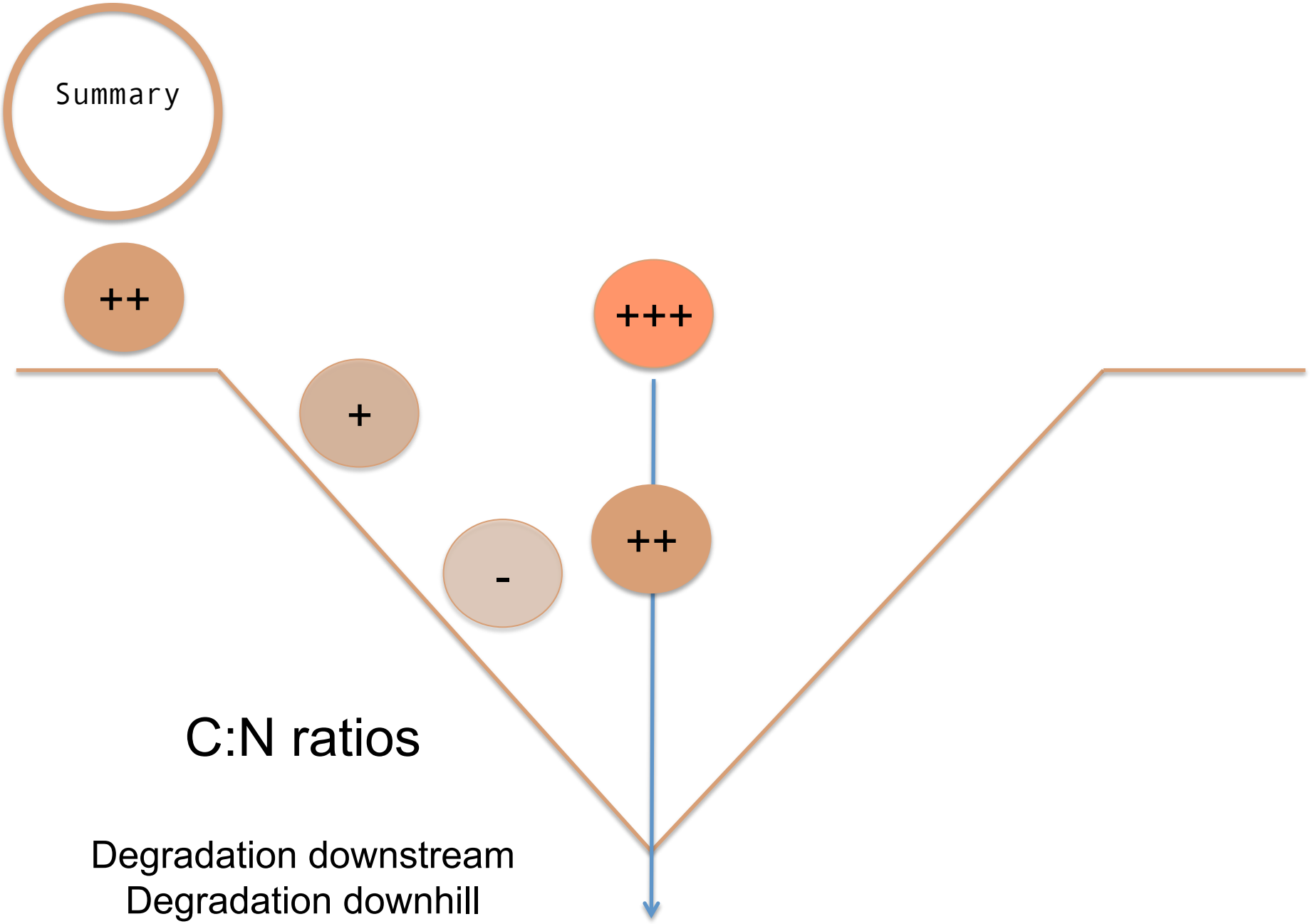
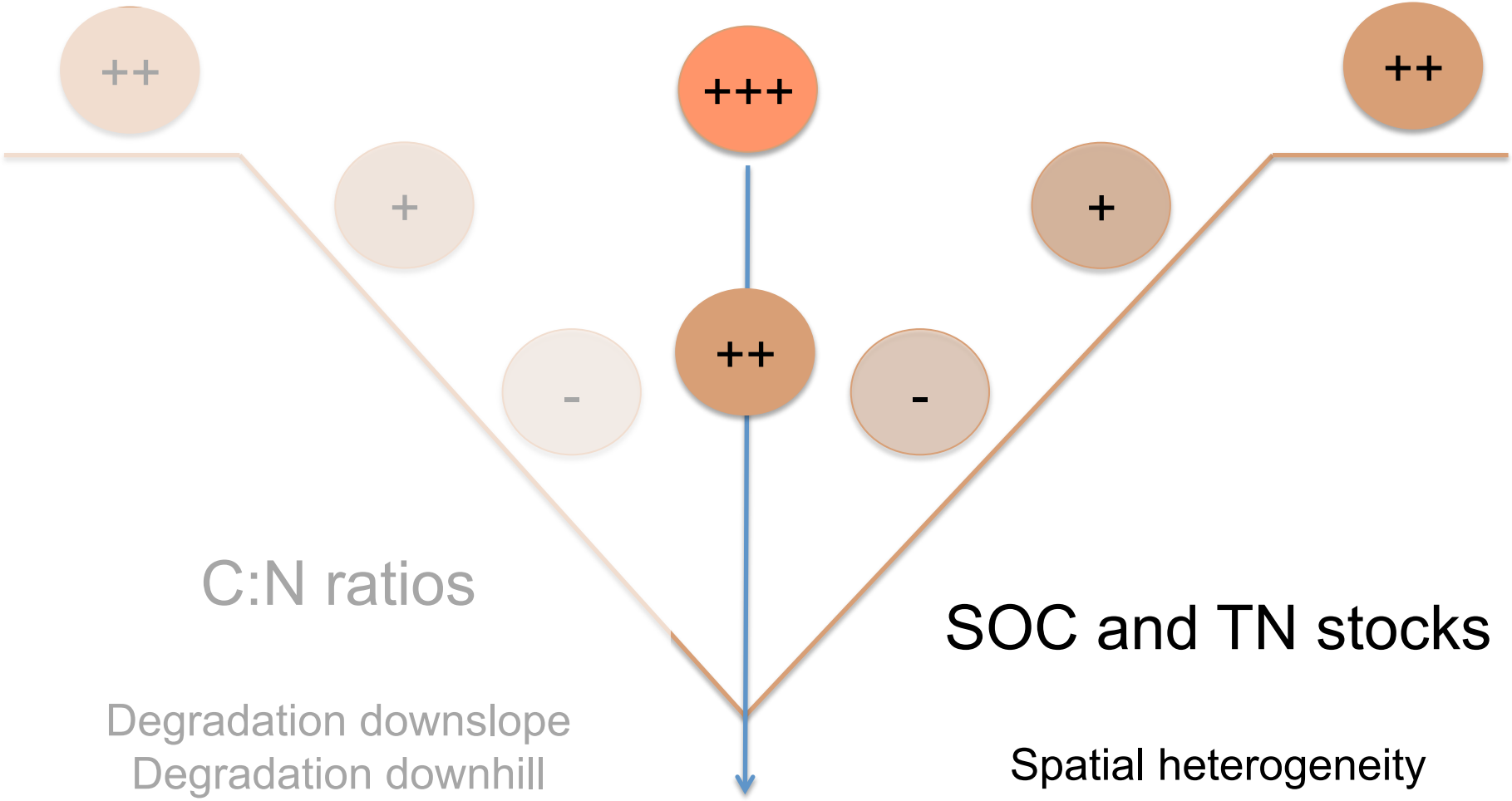


C:N ratios

Degradation downstream
Degradation downhill

Summary



C:N ratios

Degradation downslope
Degradation downhill

SOC and TN stocks

Spatial heterogeneity

Acknowledgments

Thanks! Merci !

BIG THANK TO MY COLLEAGUES WHO HELPED ME DIG ALL SOIL PROFILES MANUALLY IN 2015!

Jan Kahl
Samuel Stettner
George Tanski
Anna Irrgang
Hugues Lantuit
Gustaf Huguelius
Saskia Ruttor
Isabel Eischeid