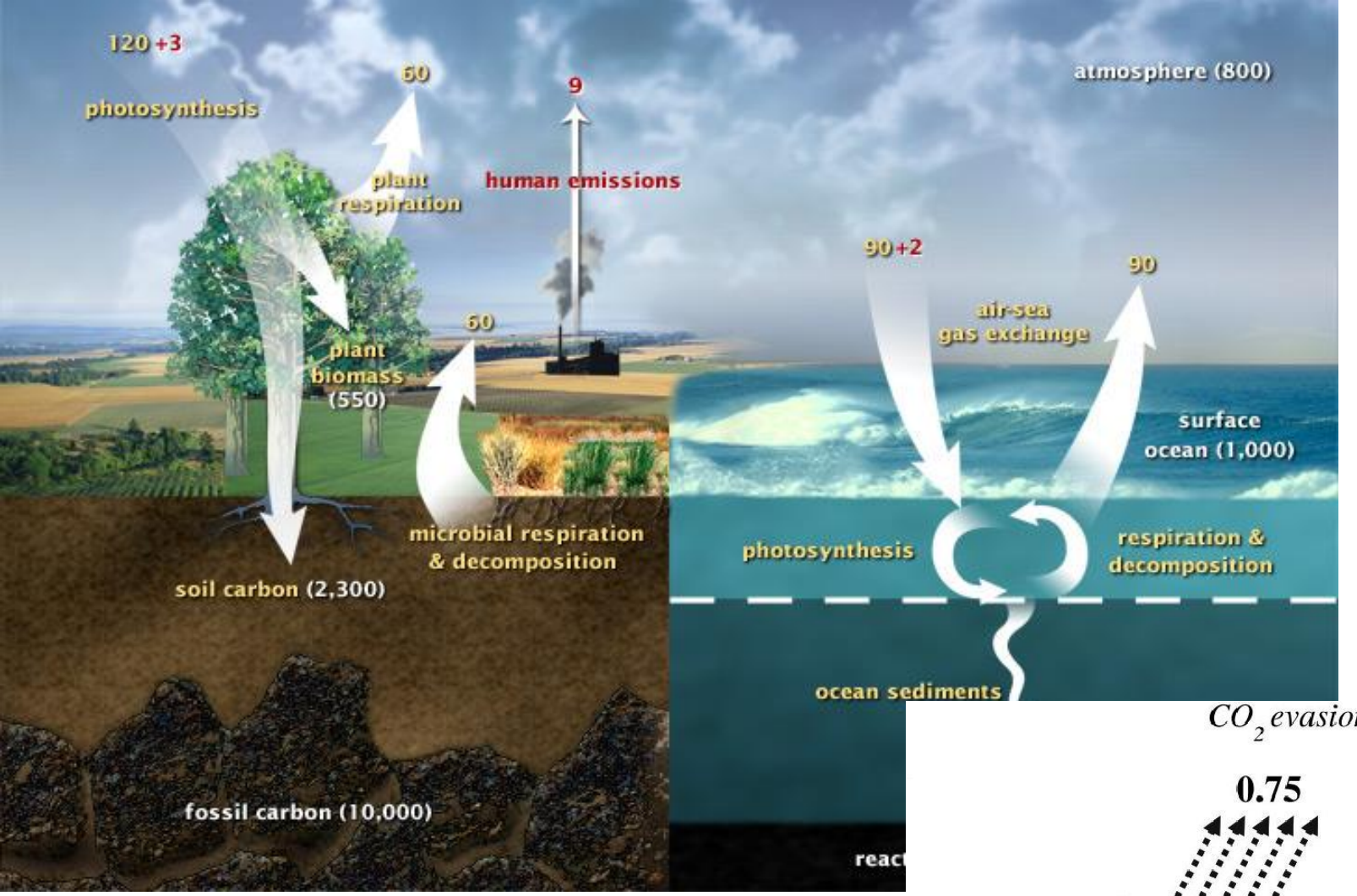
Does the quality of litter inputs affect dissolved organic carbon (DOC) biochemistry in H.J. Andrews Andisols?

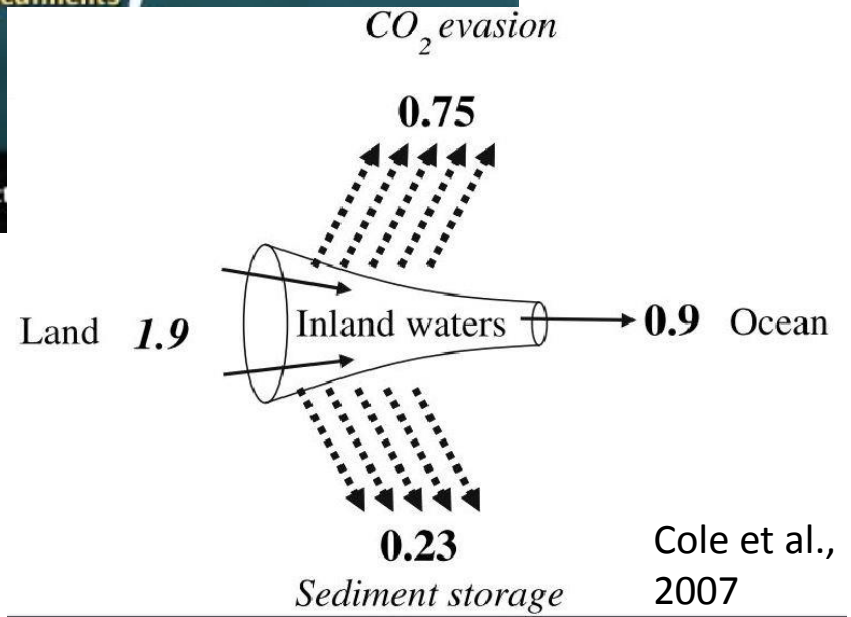
April Strid

28 April 2015

NASA, 2012



Global C cycle; units in Pg C

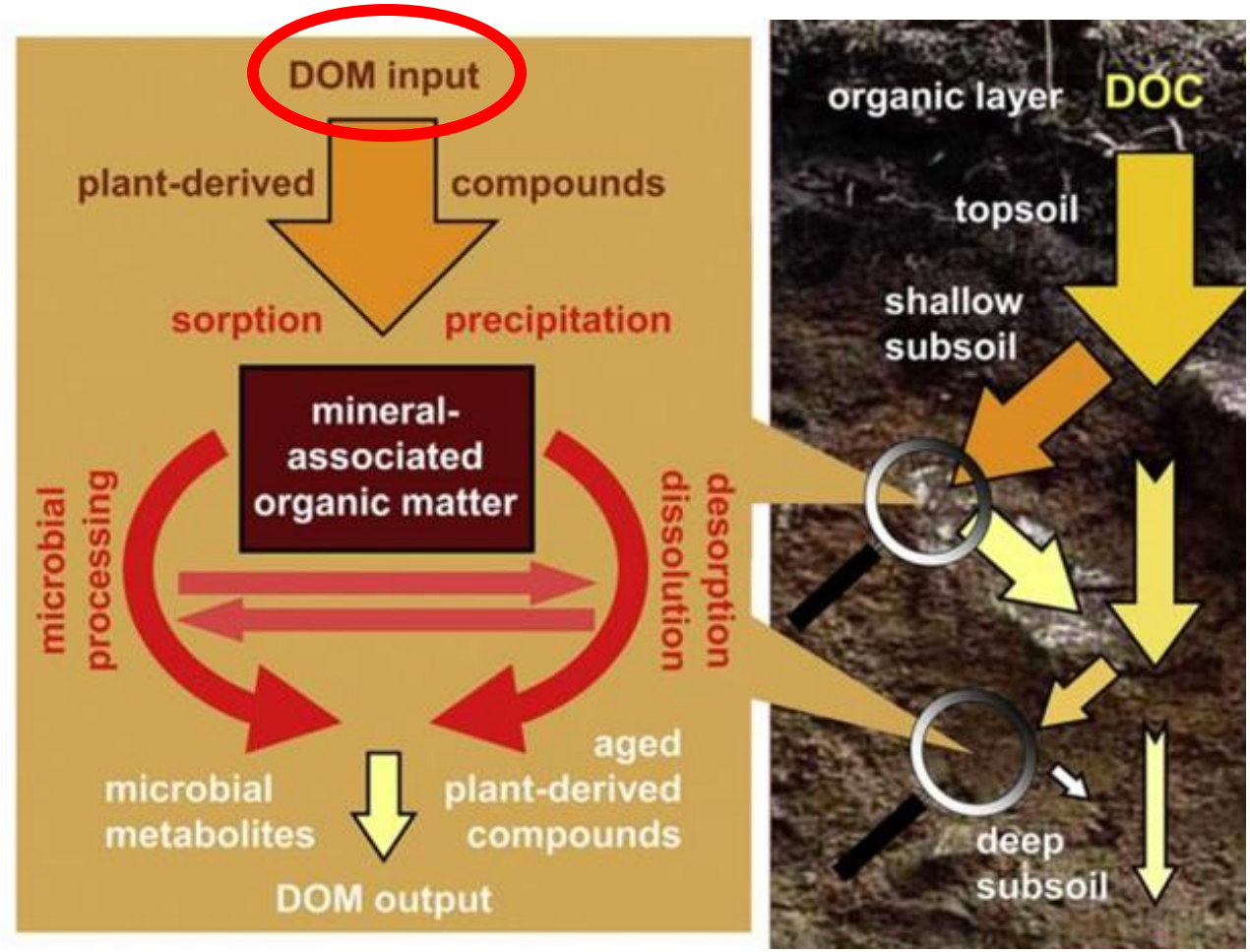


Cole et al., 2007

What is soil DOC?

- Heterogeneous mixture of high and low molecular weight organic compounds
- Originates from soil organic matter, root biomass or leachate from aboveground litter inputs

Cycling Downwards

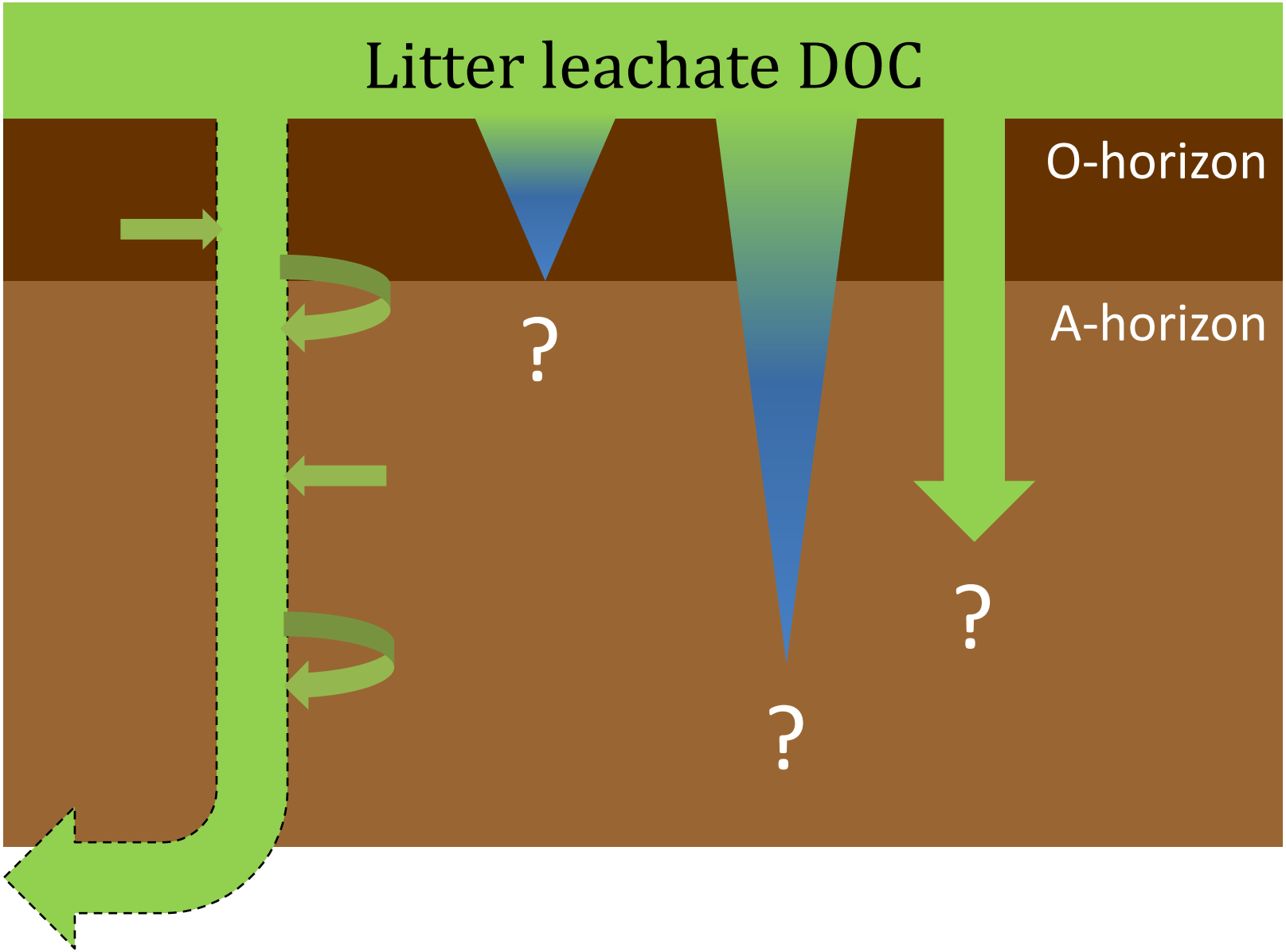


Adapted from Kaiser and Kalbitz, 2012

Research Question #1

Do litter inputs affect the chemistry of DOC in the soil below?

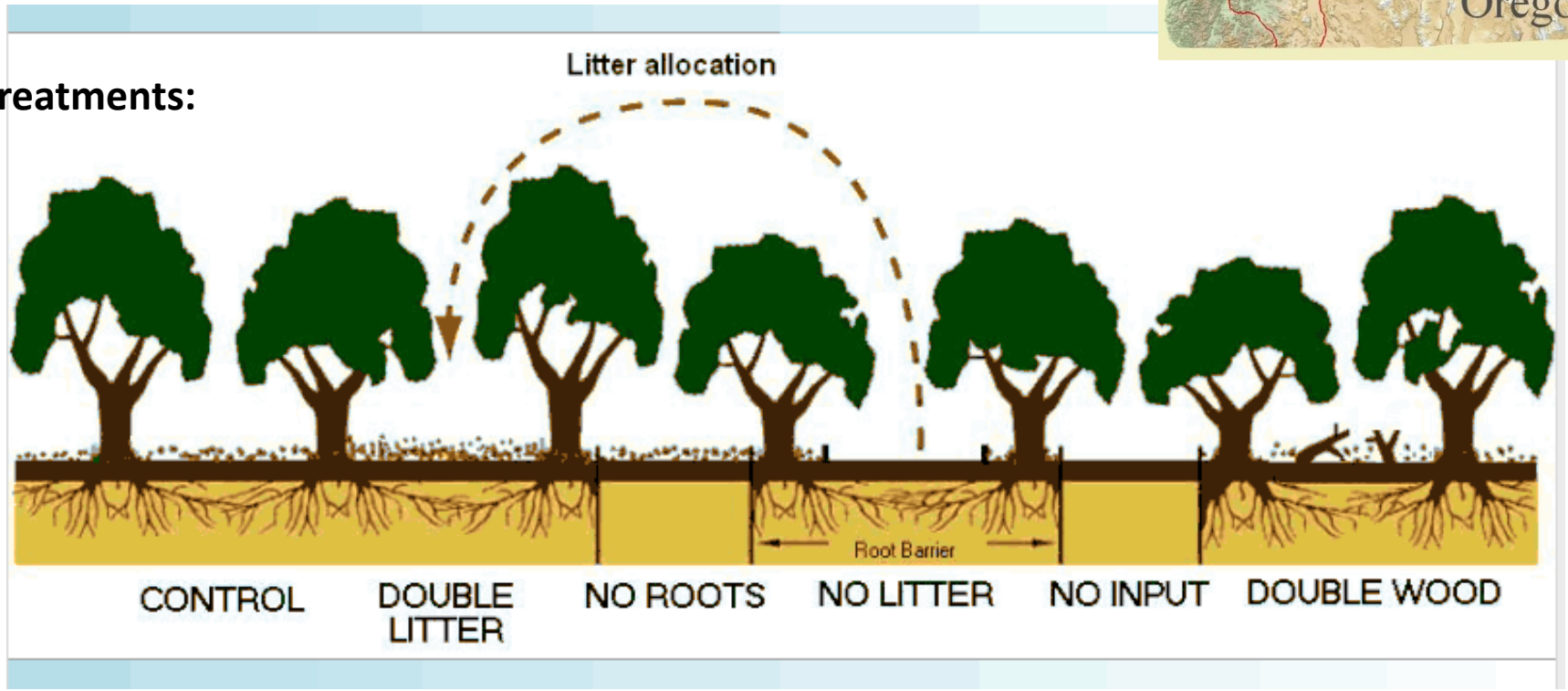
Do litter inputs affect the chemistry of DOC in the soil below?
Litter includes **needles** and **wood** of different decomposition classes



DIRT (Detrital Input and Removal Treatment)

H.J. Andrews DIRT plots est. 1997

6 Treatments:



Research Goal #2

Evaluate UV-Vis and fluorescence spectroscopy as a tool to study differences in DOC biochemistry based in source materials

Methods

Off-plot sampling

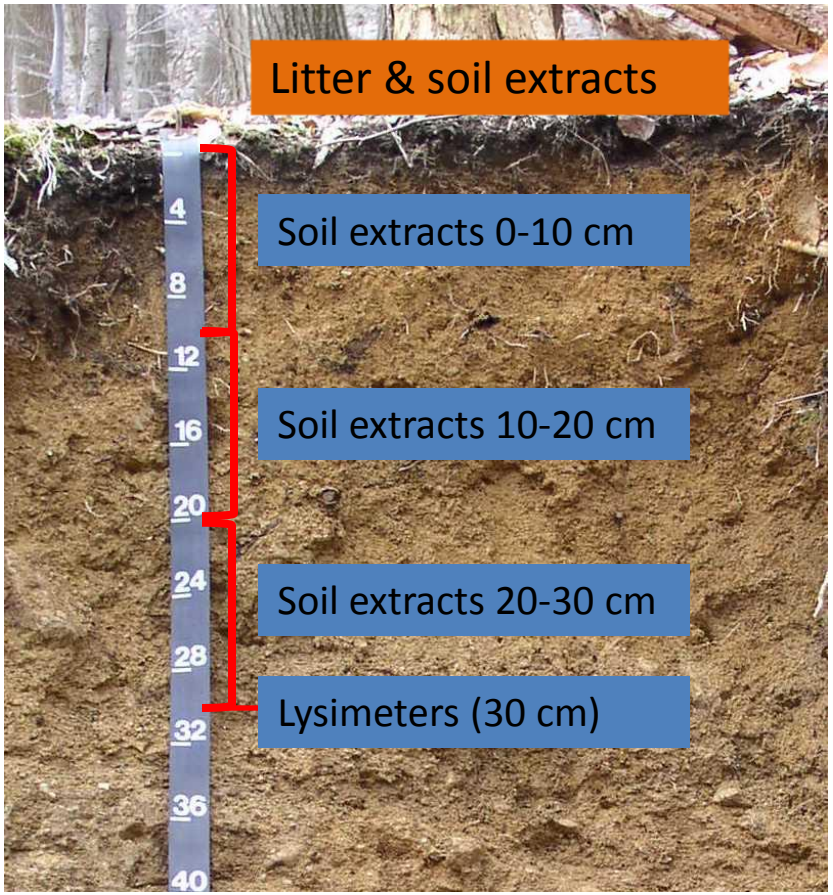
DIRT treatment sampling

Litter and Soil Extracts

- Needles
- Wood decomposition Class 2, Class 3, Class 5
- O-horizon
- A-horizon (0-5 cm)

DIRT Treatment Sampling

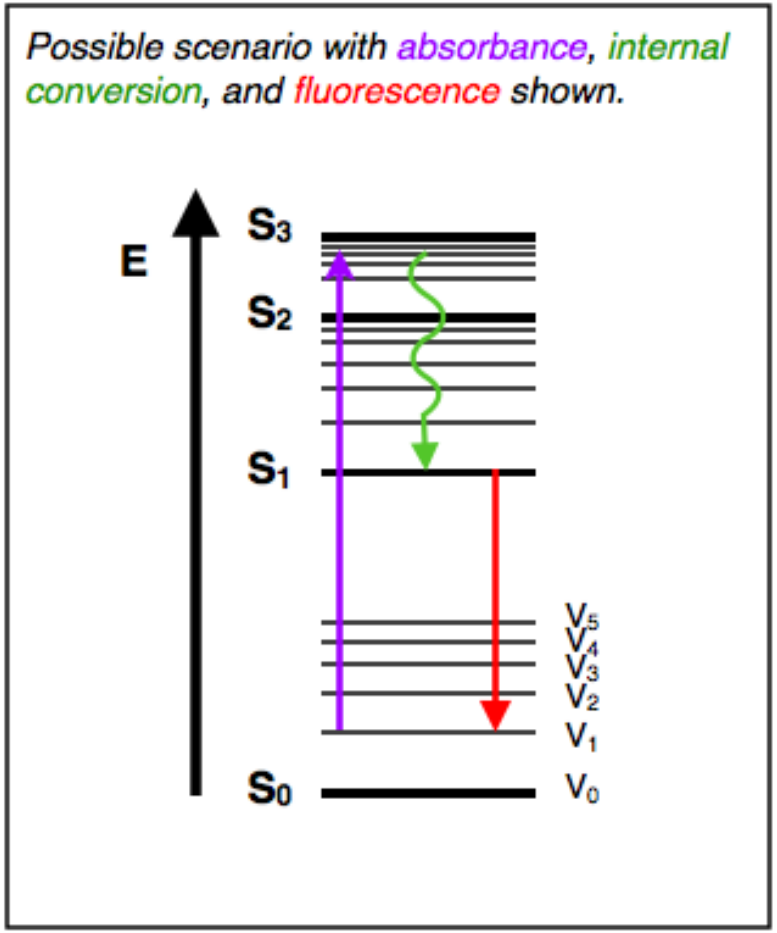
- Lysimeters 30 cm
- Soil extracts



Sollins, 1982

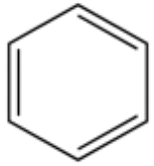
UV and Fluorescence Spectroscopy

1. Absorbance
2. Internal conversion
3. Fluorescence



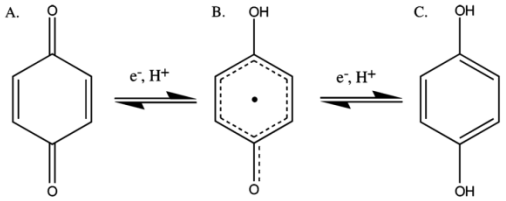
What material fluoresces?

Aromatics

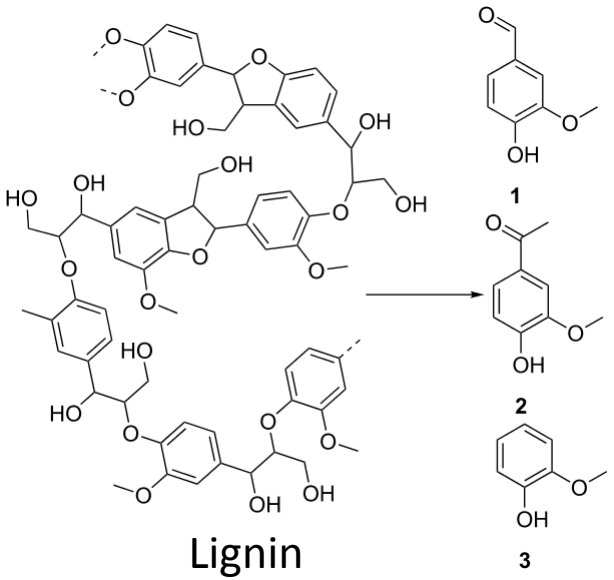


270-310 nm

Benzene



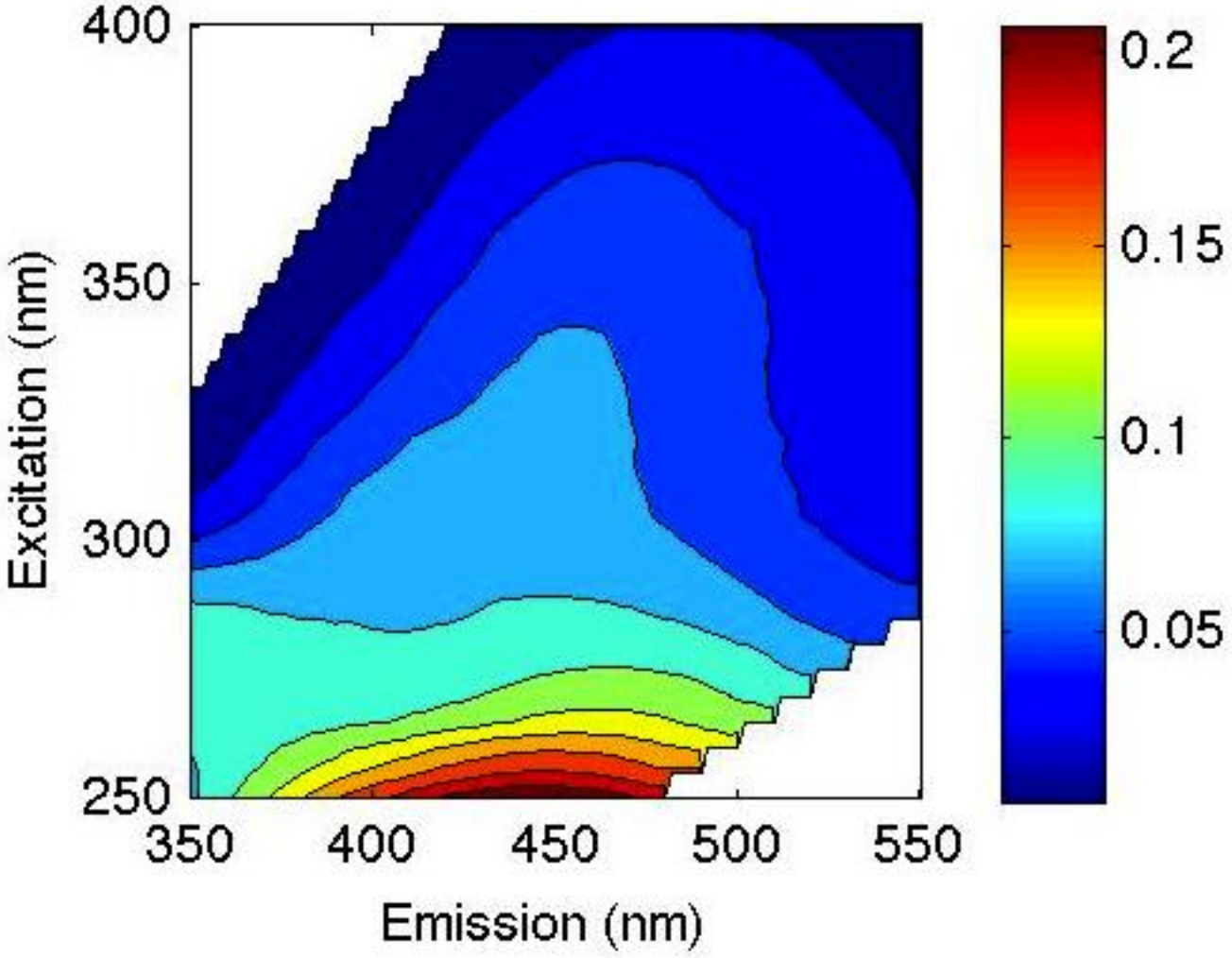
Oxidation of benzoquinone



Lignin

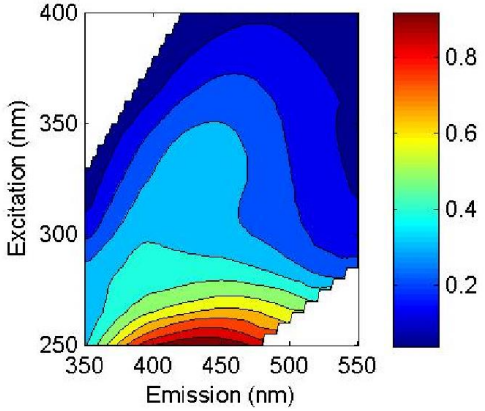
Schmitt et al., 2015

Visualizing Results: Excitation-Emission Matrix (EEM)

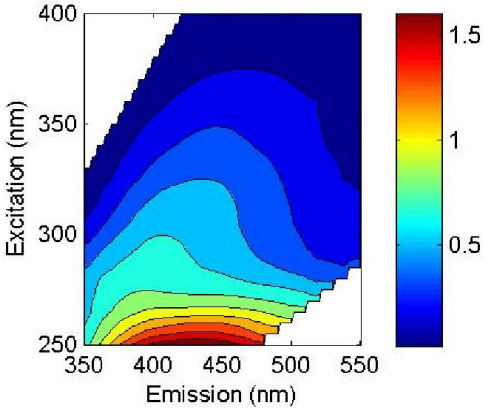


Interpreting Fluorescence Results

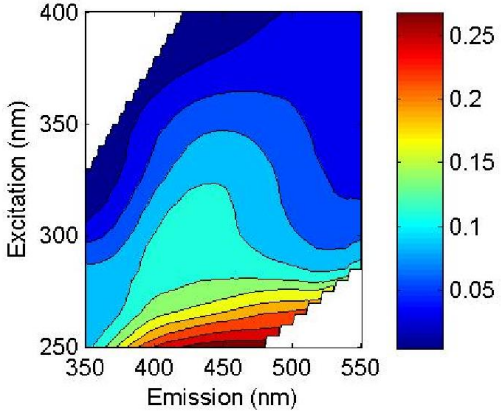
A-Horizon



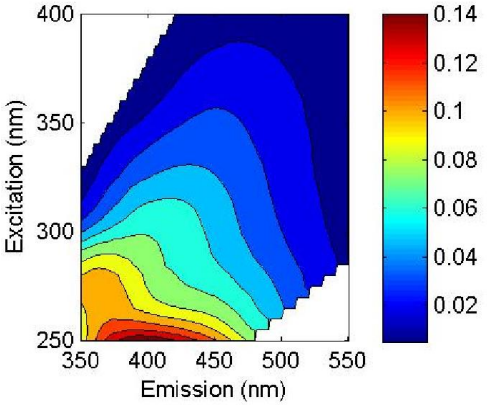
O-Horizon



Class 5 Wood

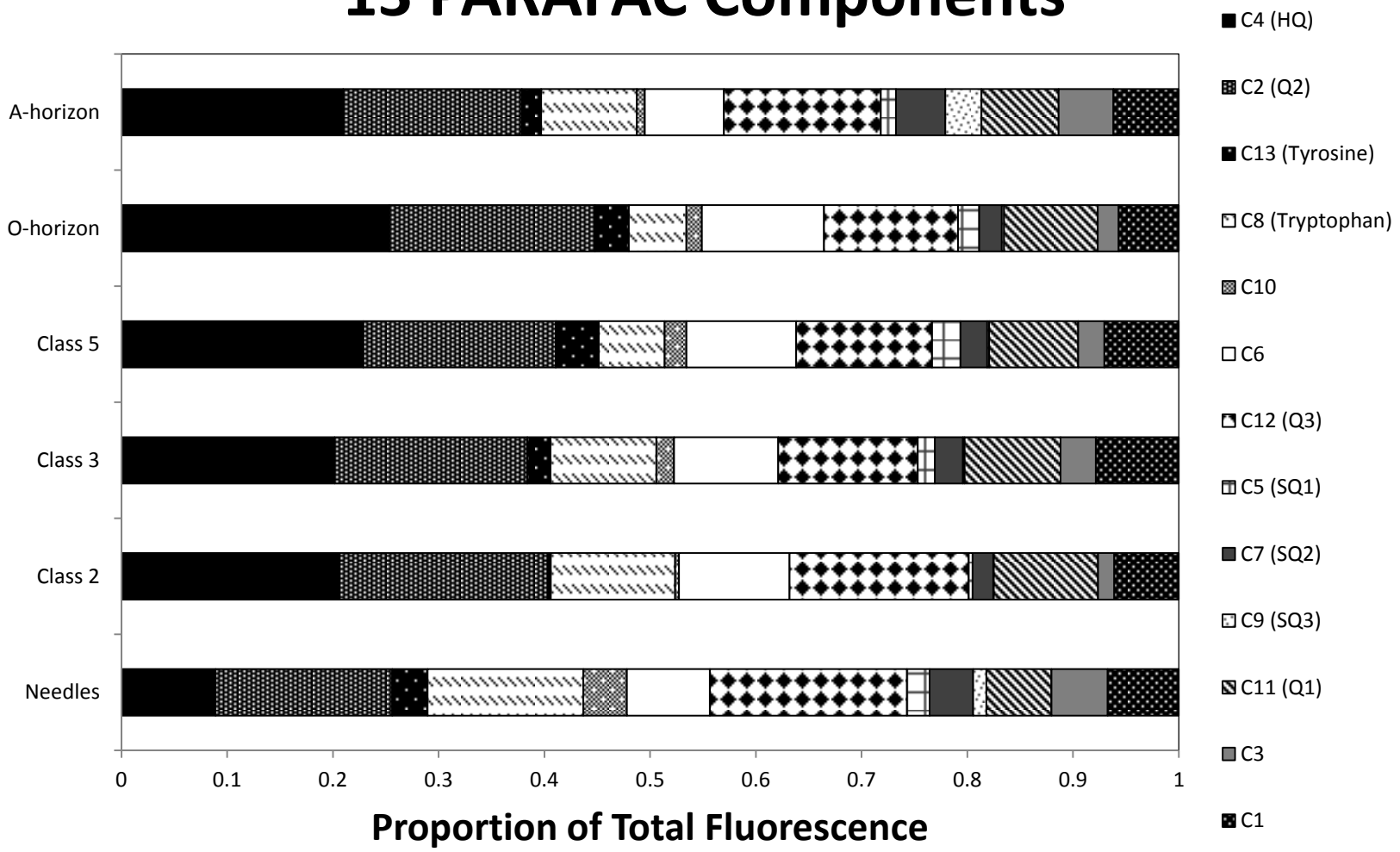


Needles

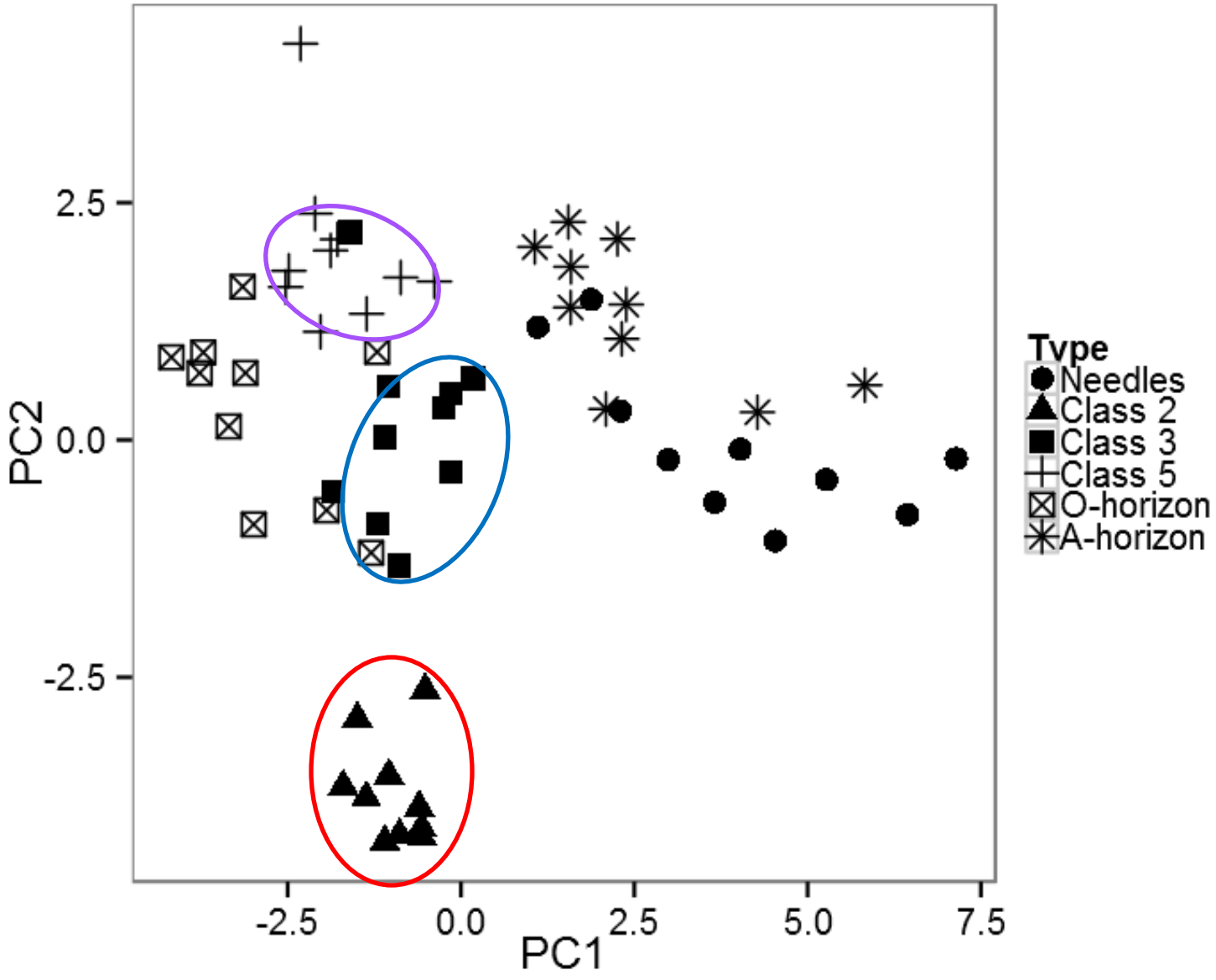


- Difficult to differentiate unique signatures
- Use Cory & McKnight (2005) parallel factor analysis (PARAFAC) model to resolve 13 different fluorescing moeities out of matrices

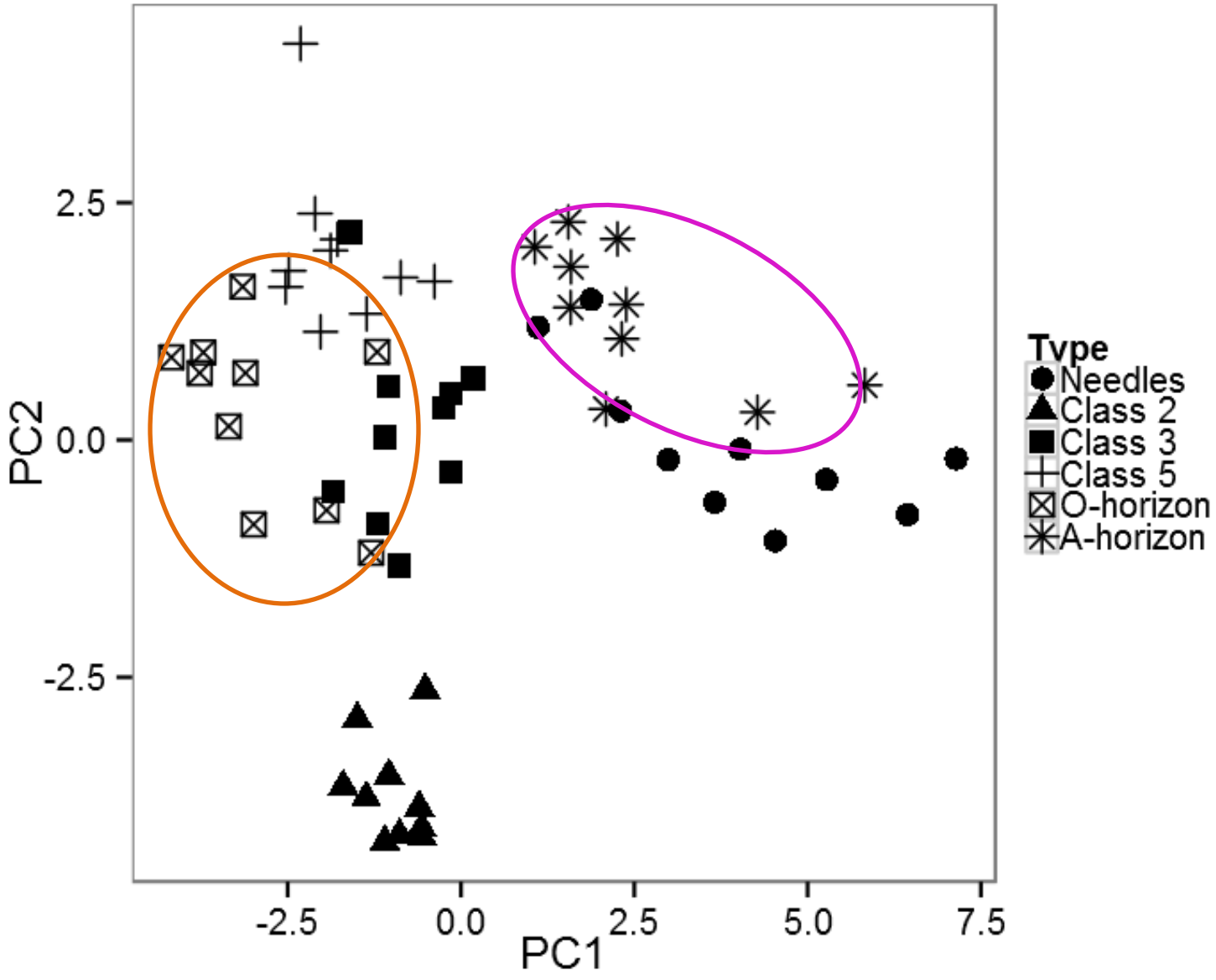
Litter and Soil Extracts
13 PARAFAC Components



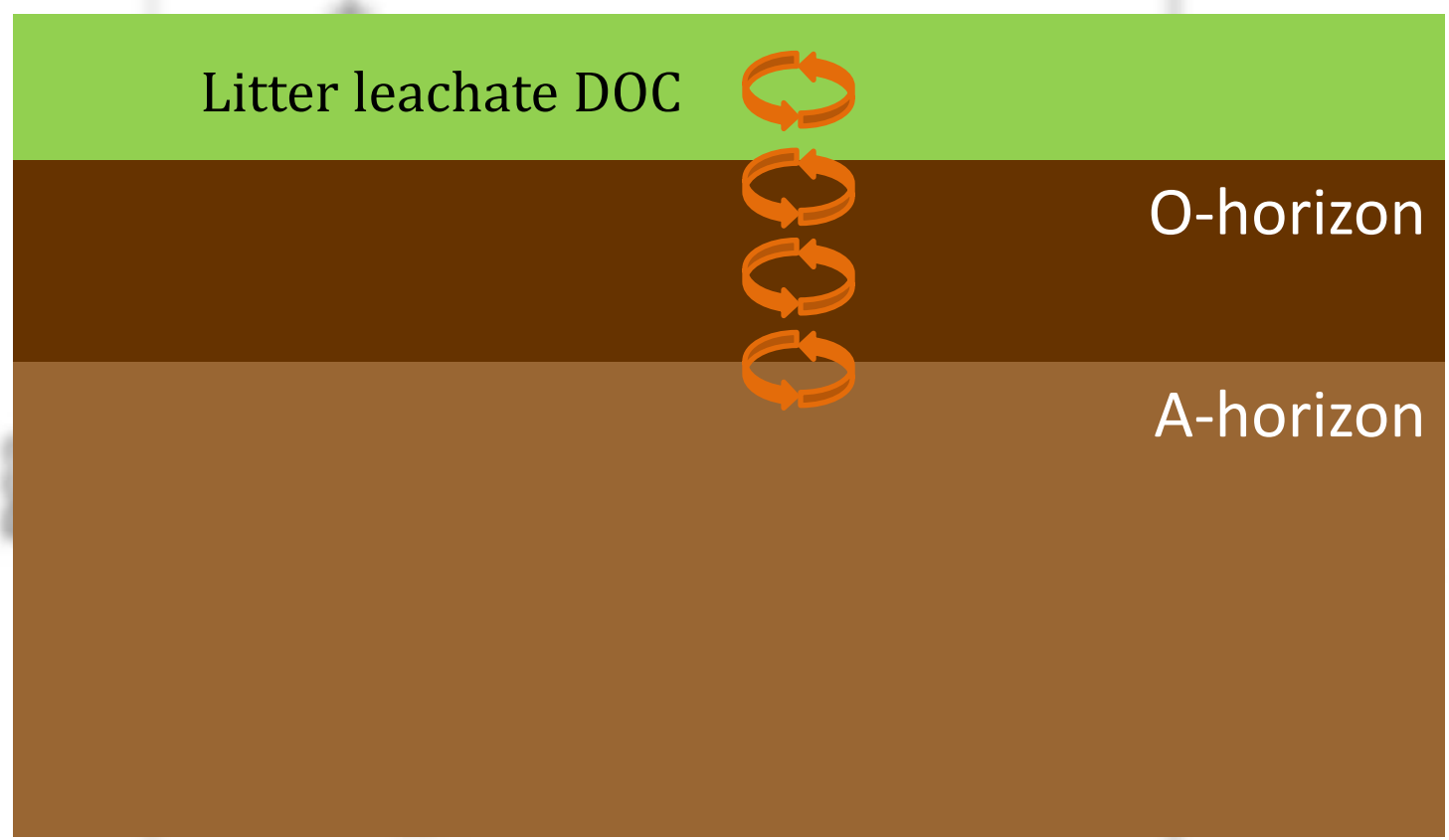
Litter and Soil Extract



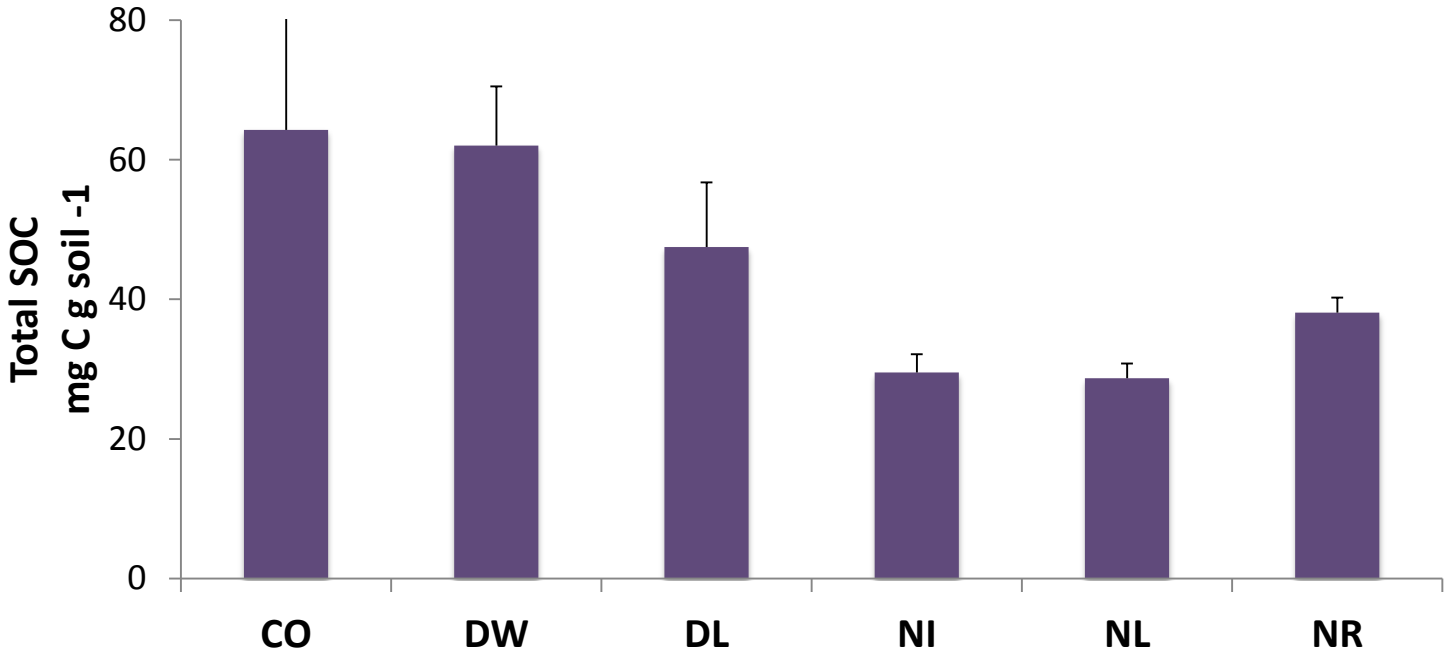
Litter and Soil Extract



Litter and Soil Extract

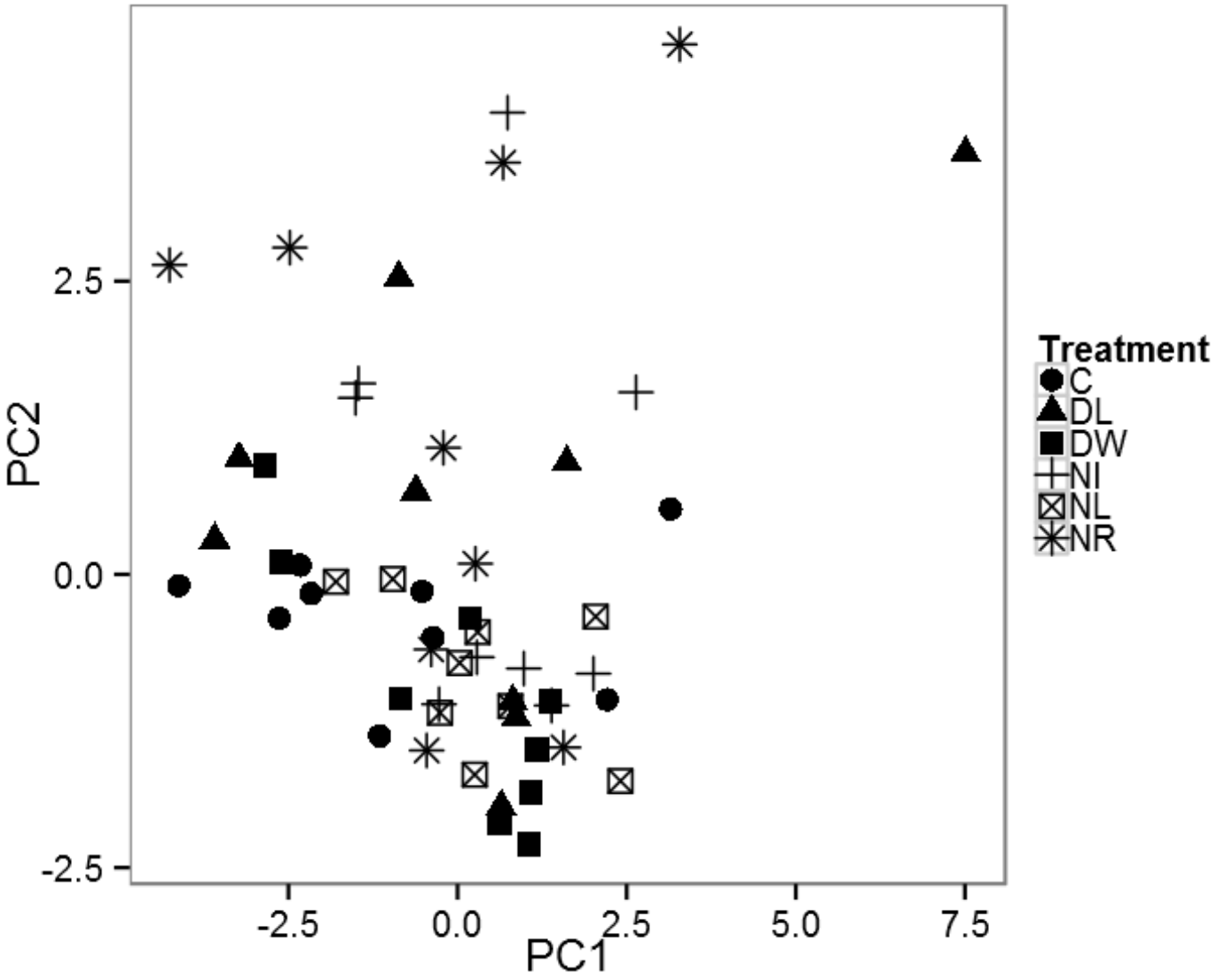


Change in total soil organic carbon in H.J. Andrews DIRT treatment soils

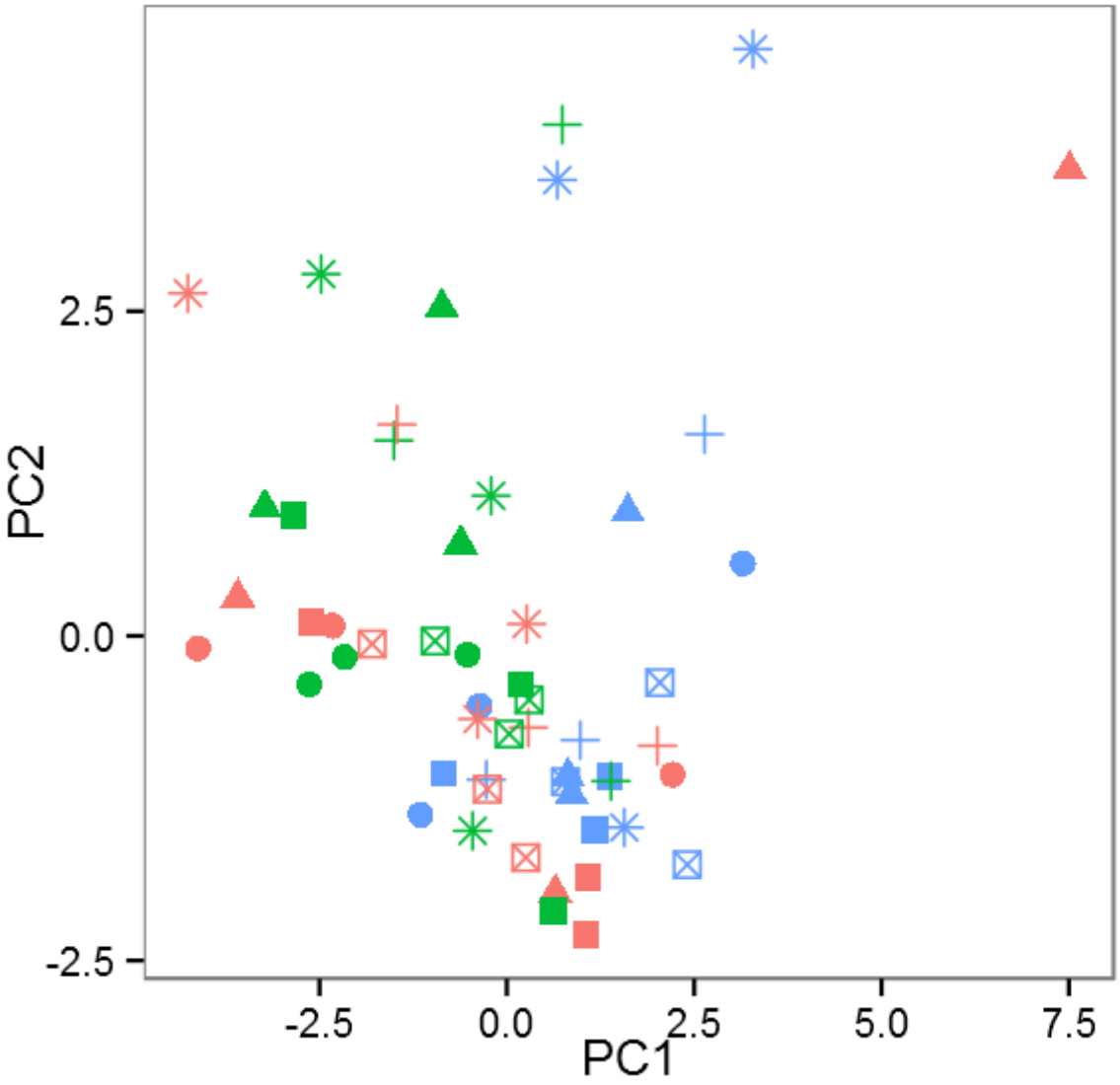


Total C (mg C · g soil $^{-1}$) in H.J. Andrews DIRT soils after 10 years

DIRT Treatment Soil Extracts

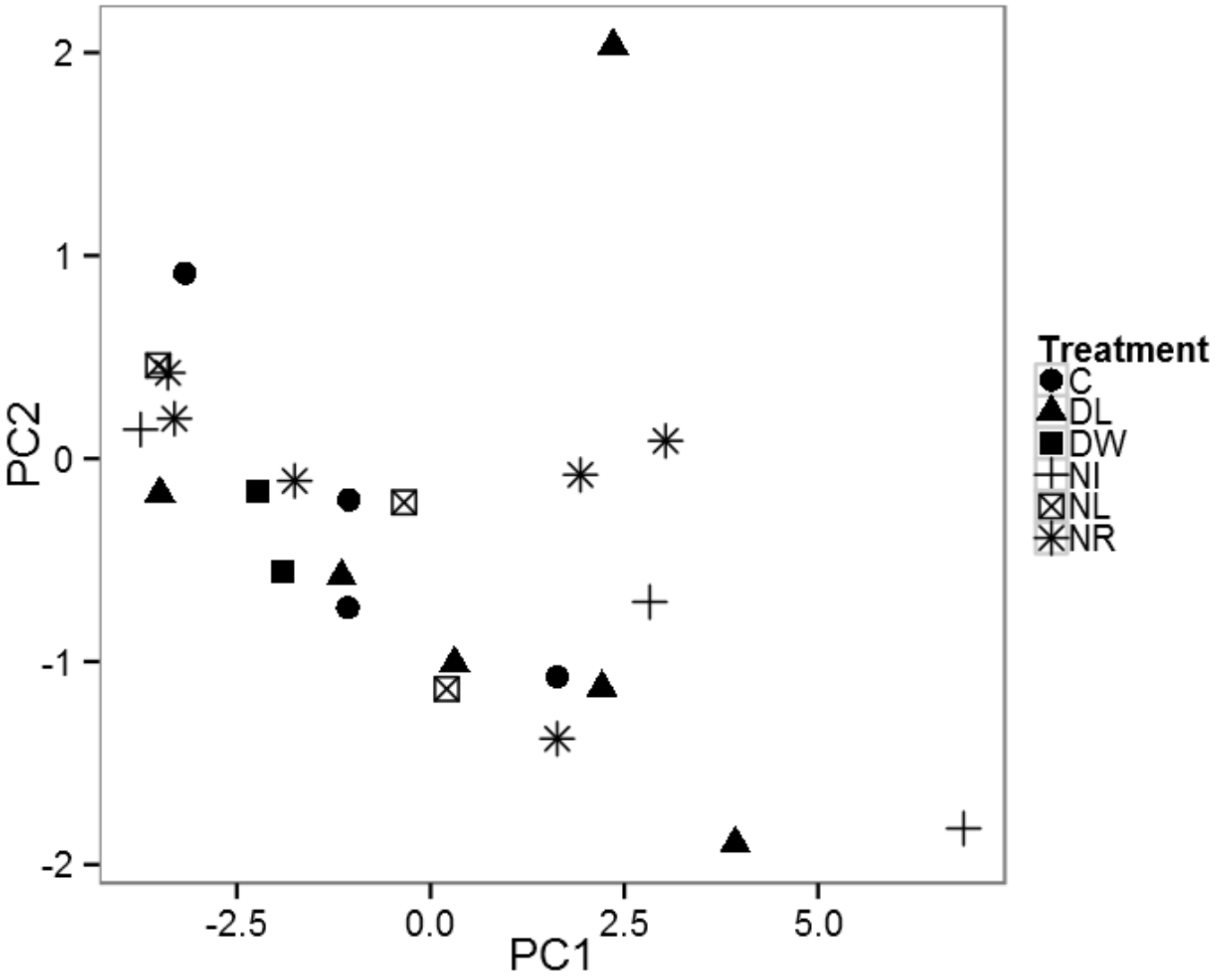


DIRT Treatment Soil Extracts: Color by Depth



A = 0-10 cm
B = 10-20 cm
C = 20-30 cm

DIRT Treatment Lysimeter Solutions (30 cm)



Conclusions

- *Lack* of differences in DOC chemistry in soils experiencing 18 years of litter manipulations is suggestive of a “blender hypothesis”

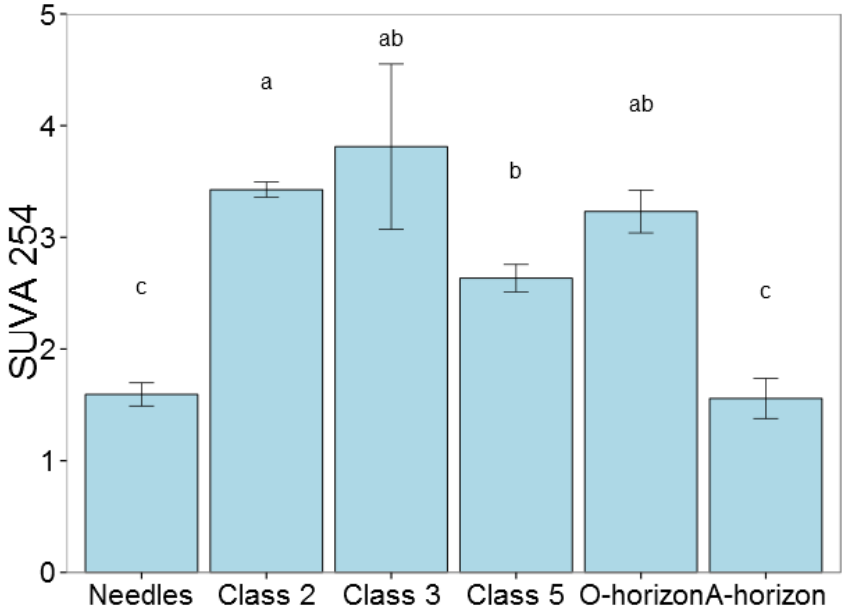
- Biotic and abiotic processes are responsible for homogenization of DOC mobilized from different litter sources

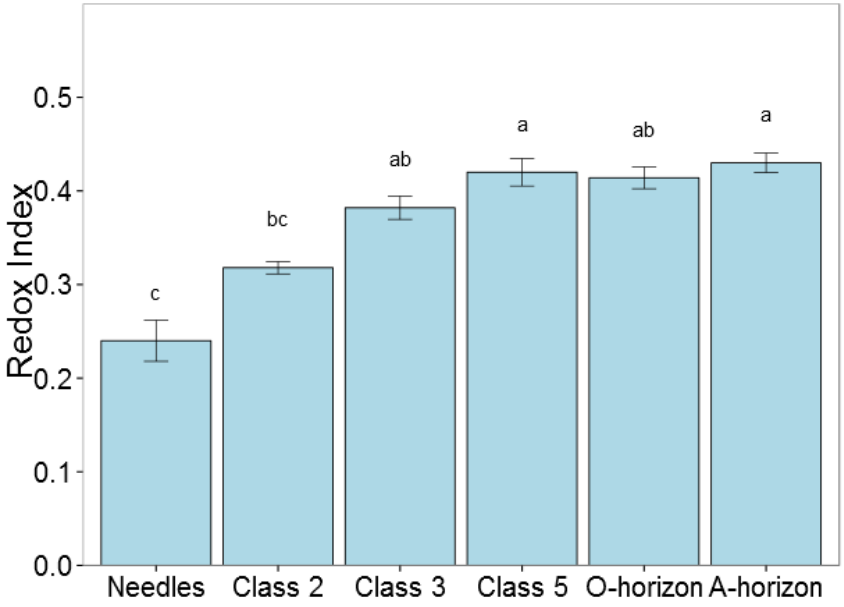
- UV-Vis and fluorescence spectroscopy are viable fingerprinting techniques for soil DOC chemistry

Acknowledgements

- Kate Lajtha
- Baek Soo Lee
- Katie Watkins-Brandt
- H.J. Andrews
- Lajtha lab crew
- Soils graduate students


Questions?


SUVA 254
0
1
2
3
4
5
c
a
ab
b
ab
c
Needles
Class 2
Class 3
Class 5
O-horizon
A-horizon


Redox Index
0.0
0.1
0.2
0.3
0.4
0.5
c
bc
ab
a
ab
a
Needles
Class 2
Class 3
Class 5
O-horizon
A-horizon