Climatic and Watershed Controls of Dissolved Organic Matter (DOM) Variation in Streams across a Gradient of Agricultural Land Use

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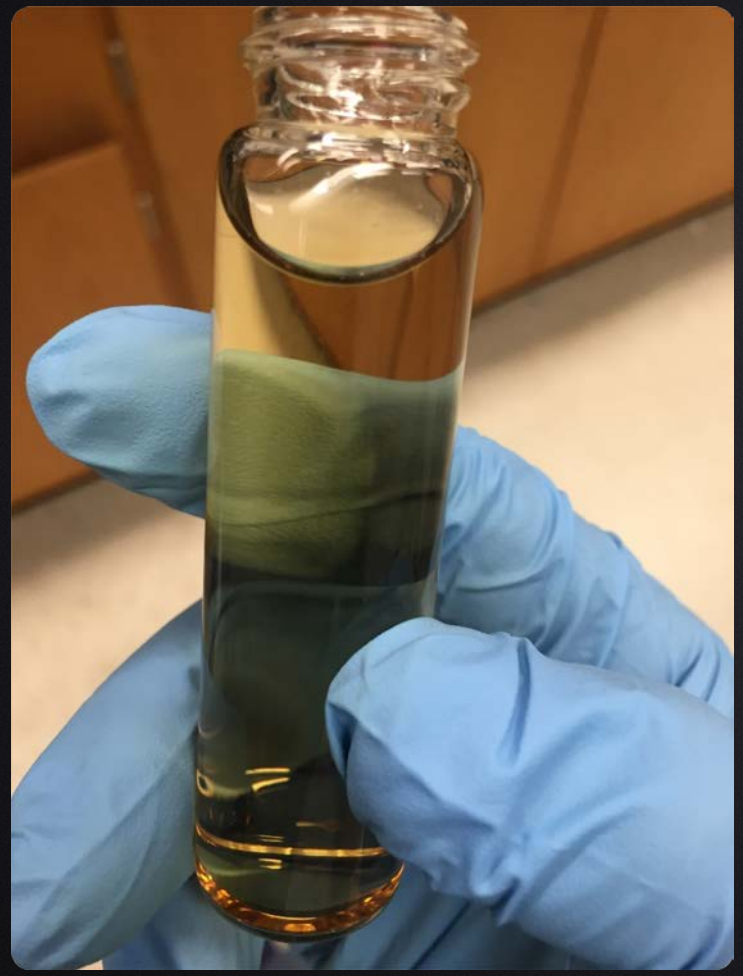
Importance and Objective



What dissolved organic matter (DOM) is:

✓Assemblage of organic compounds with diameters less than 0.7μm

Why DOM in streams:

Primary carbon pool

✓ Accounting for around 60% of the total carbon load in rivers (Findlay and Sinsabaugh, 2003)

Ecosystem service

✓ Absorb UV-B; Buffer pH

✓ Support aquatic food web as food and energy

Water quality

✓ Influence pollutant and metal transport

✓ Induce DBP (Disinfection by-product) formation

✓ Decrease DO (creating dead zones)

Importance and Objective

Contrast findings of agricultural land use on DOM:

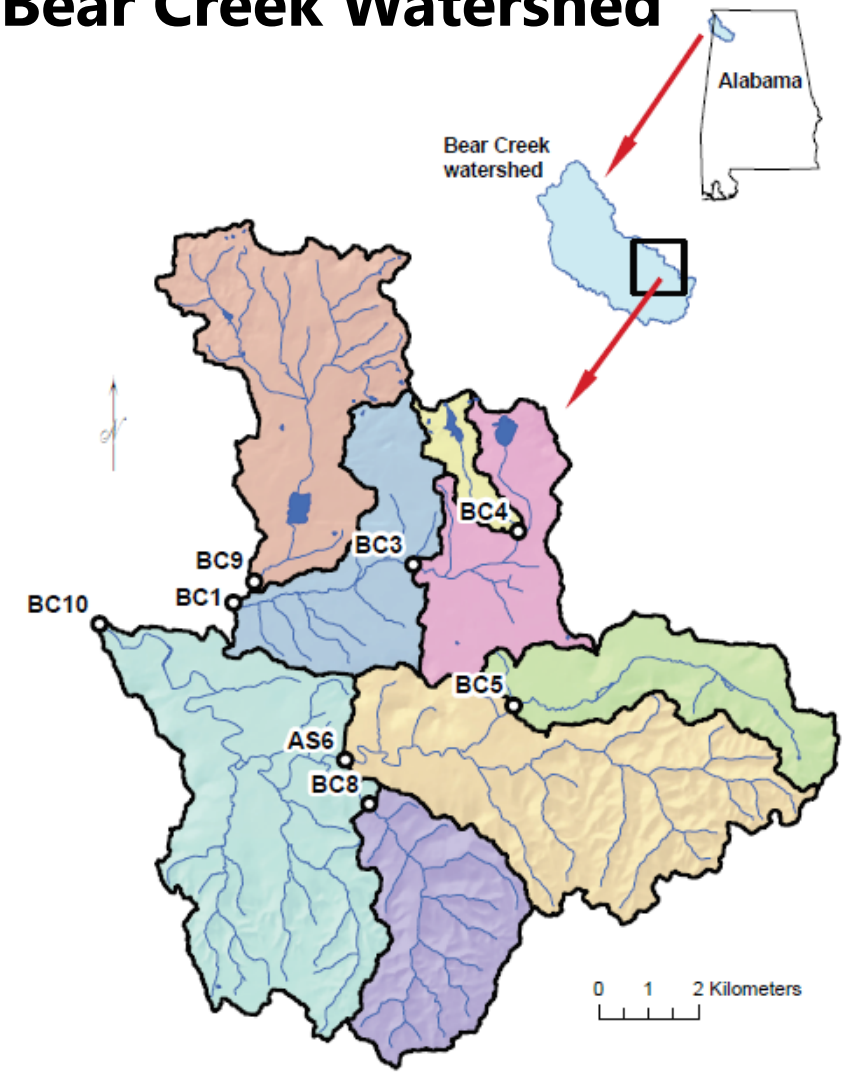
- ✓ Agricultural land use will not influence DOM (DOC) concentration in streams, and %humic-like DOM is lower in agricultural streams (Wilson and Xenopoulos, 2008; Lu et al., 2014)

- ✓ DOM(DOC) concentration and %humic-like DOM are higher in agricultural lands than in forest (Graeber et al., 2012; Shang et al., under review)

- ✓ "Although DOM change in agricultural streams and associated ecological consequences are expected to be widespread, current understanding and relevant data needed to manage affected systems are surprisingly scarce" (Stanley et al.,2012)

Methods

Bear Creek Watershed



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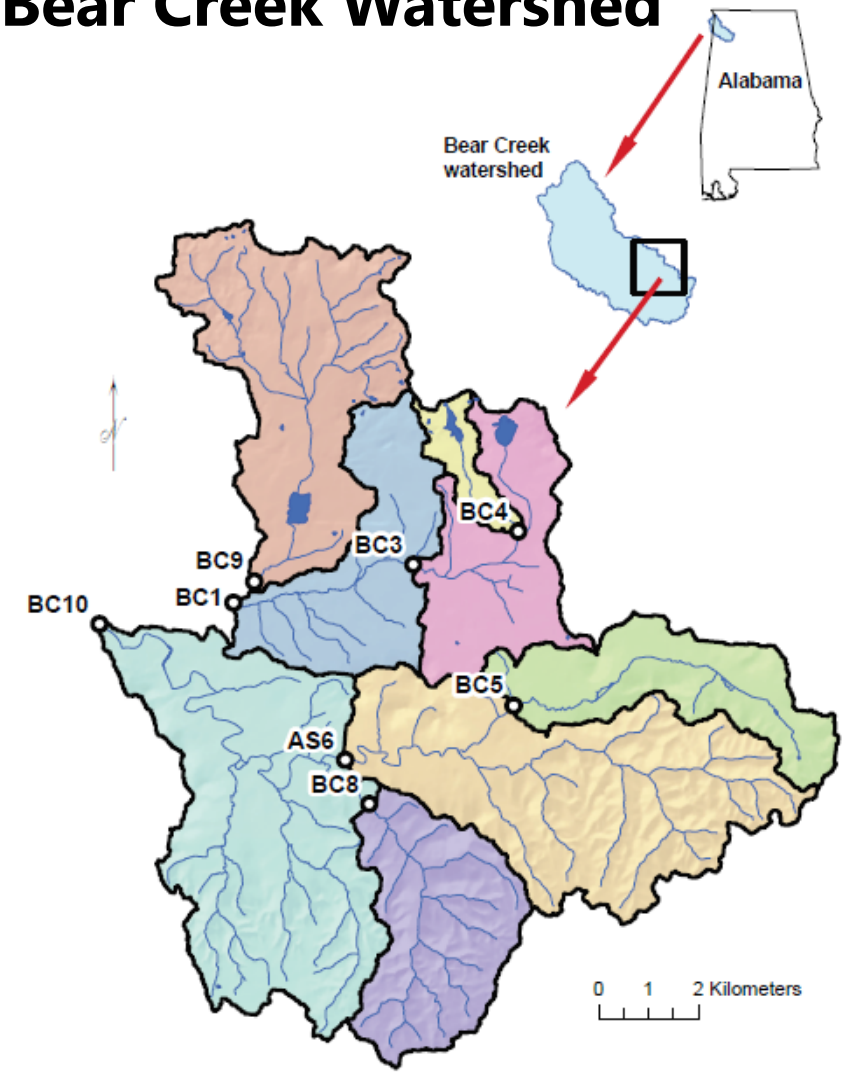
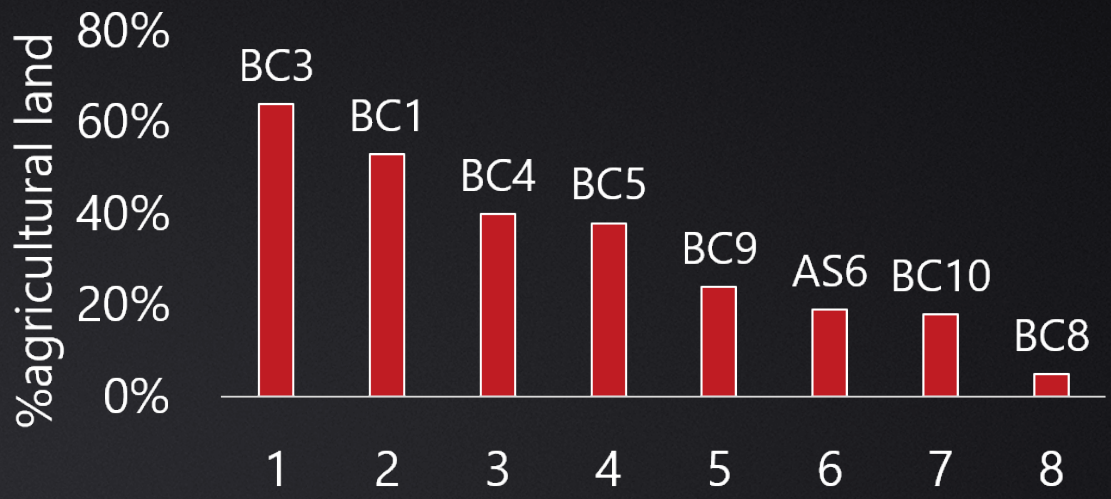


Methods

Land use information:

- ✓ Delineated using Streamstats
- ✓ National Land Cover Database (2011) for land composition

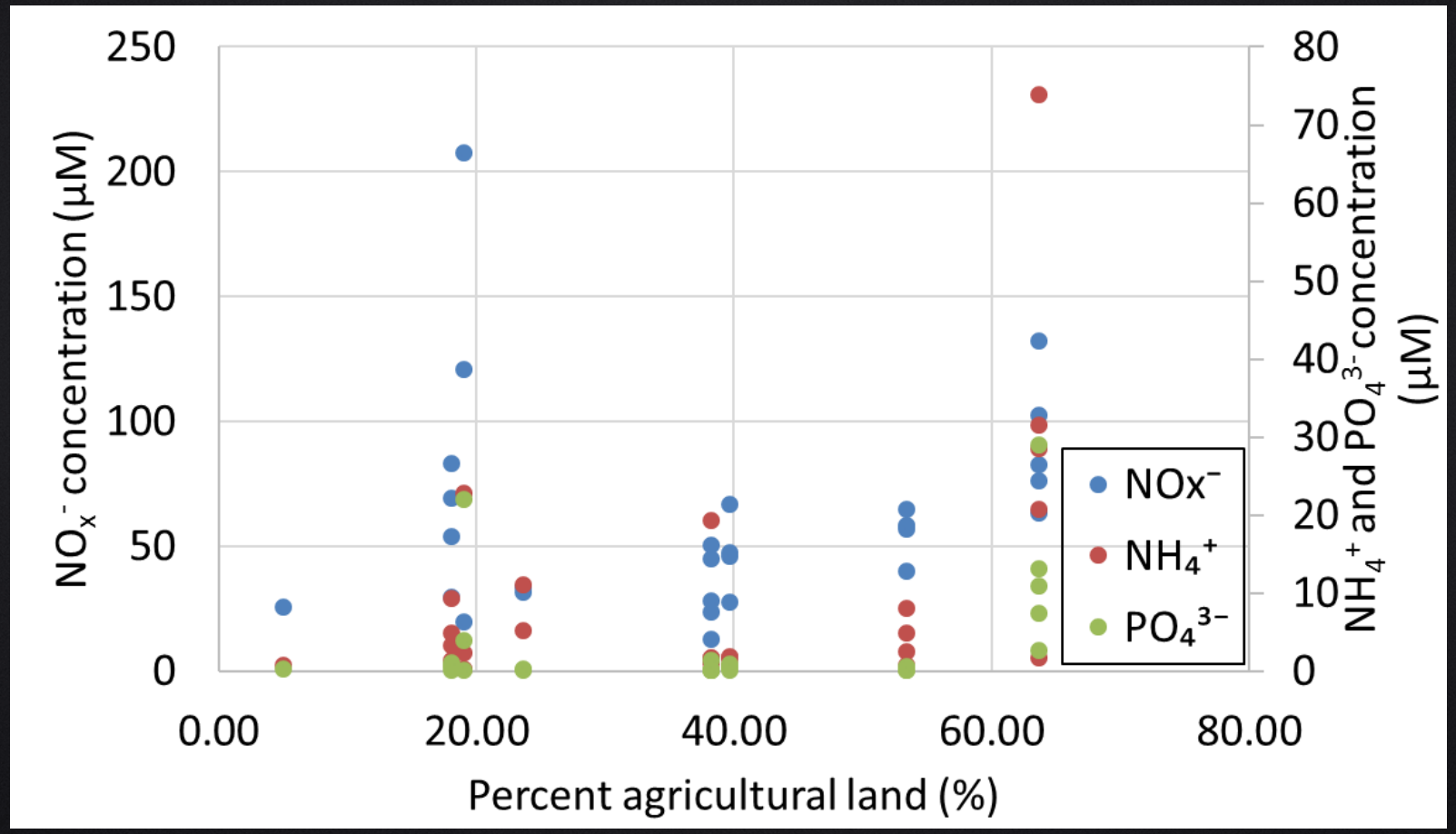


Parameters/proxies used:

- ✓ DOM quantity (DOC concentration)
- ✓ DOM quality (UV/Vis absorbance; 3D fluorescence; Biodegradable DOC)
- ✓ Climate (15-day average air temperature; 15-day Antecedent Precipitation Index)
- ✓ Land use (%agricultural land; %forested land)
- ✓ Water chemistry (cations; nutrients)

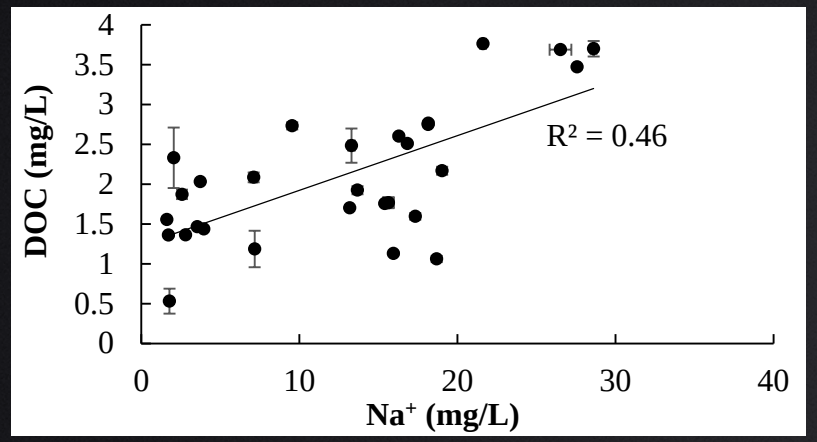
Result and Discussion

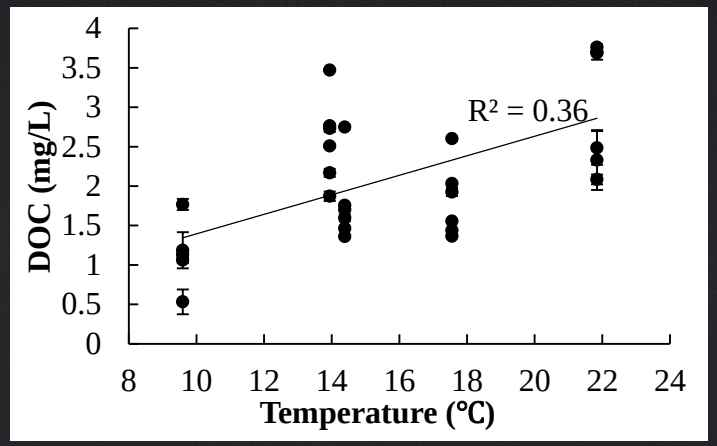
Background information

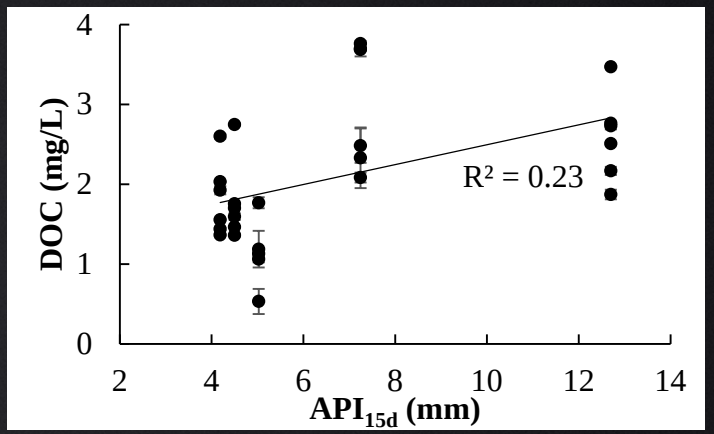


Result and Discussion

DOM quantity







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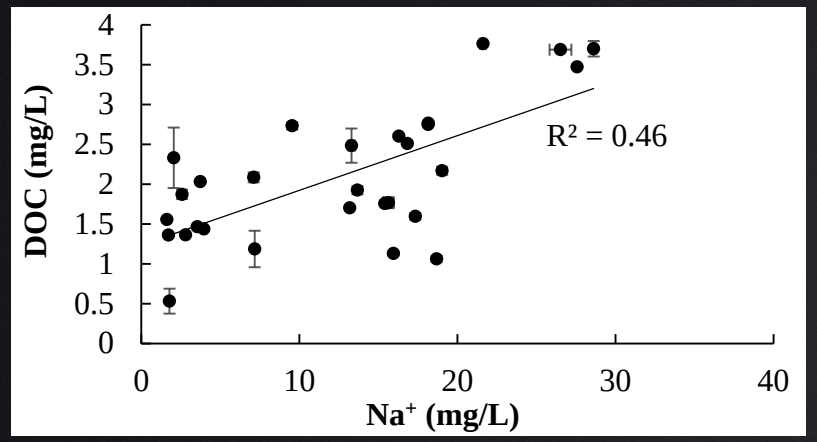
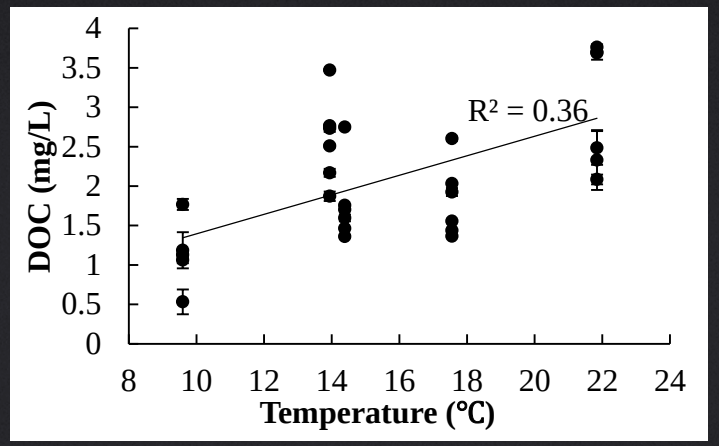
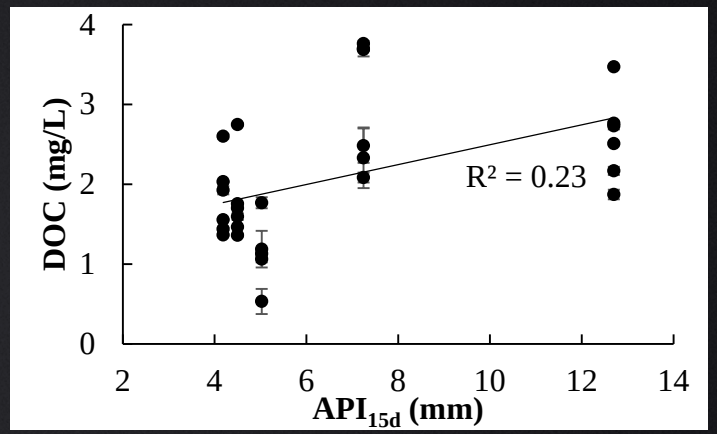
Result and Discussion

DOM quantity







DOC concentration = -0.952 + 0.054(**Na⁺**) + 0.115(**temperature**) + 0.085(**API_{15d}**)

(R^2=0.851; P<0.001; Stepwise)

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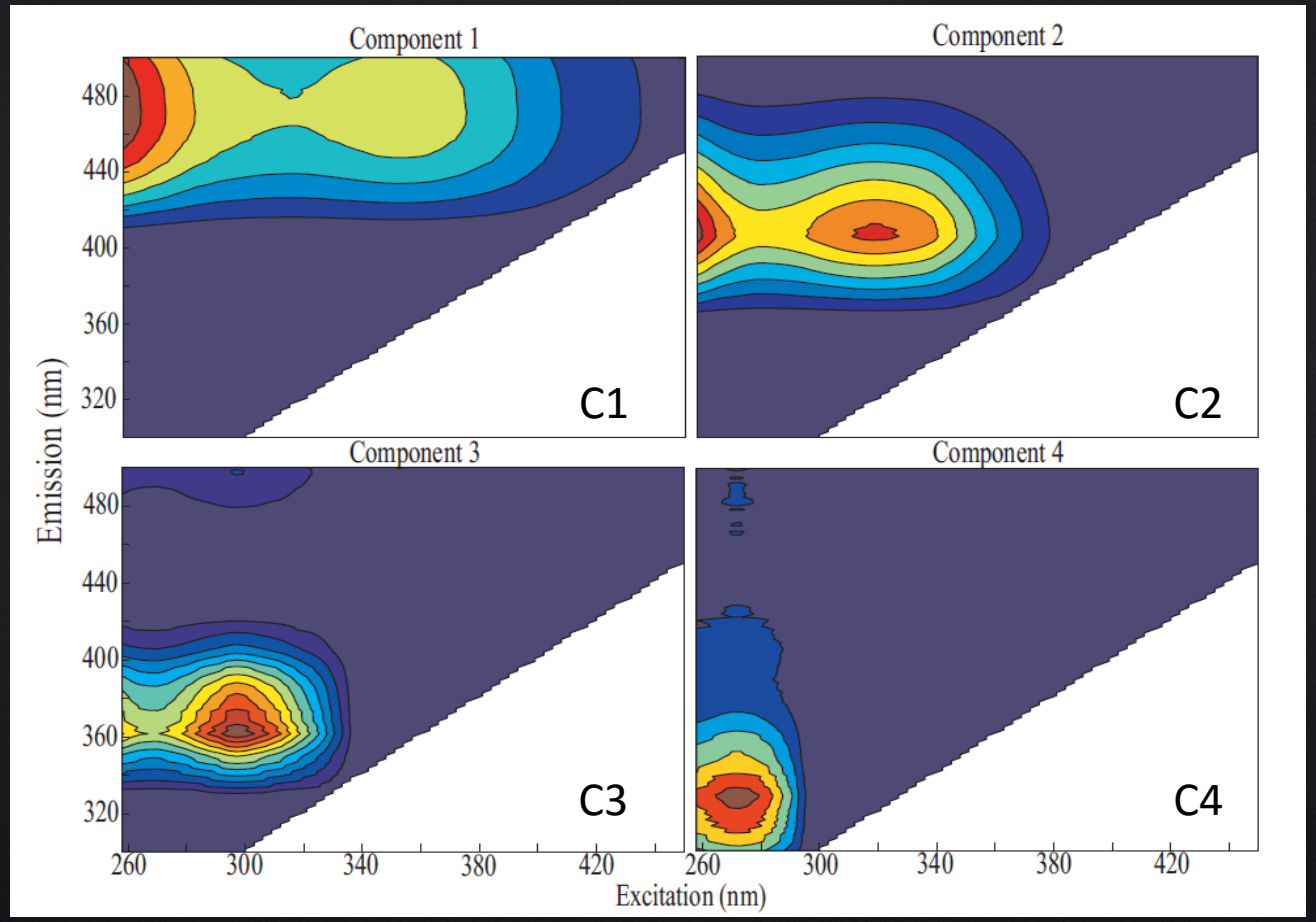
Result and Discussion

DOM quality

Terrestrially derived humic-like DOM

Microbially derived humic-like DOM



Terrestrially derived humic-like DOM

Protein-like DOM

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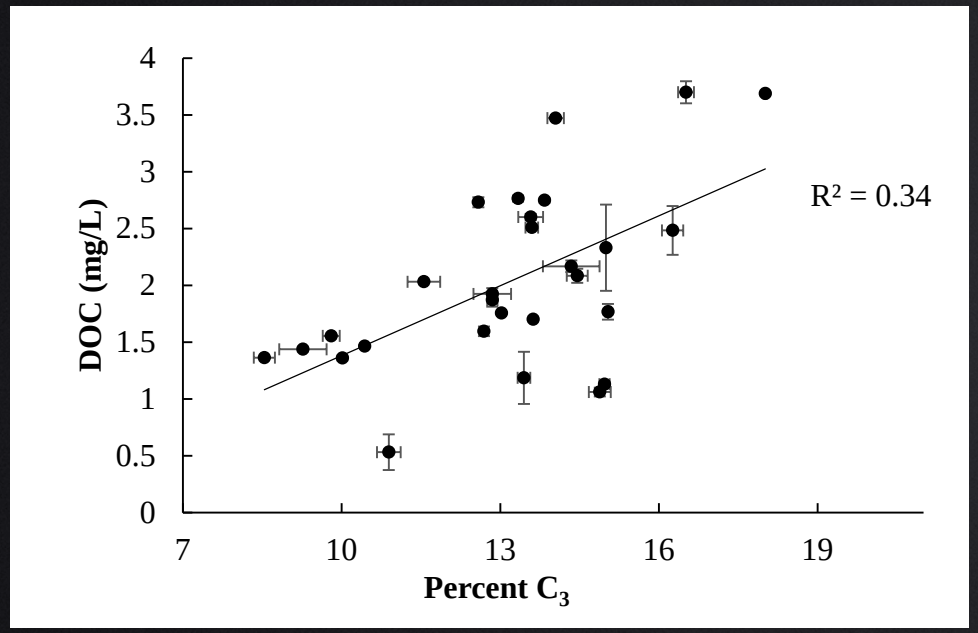
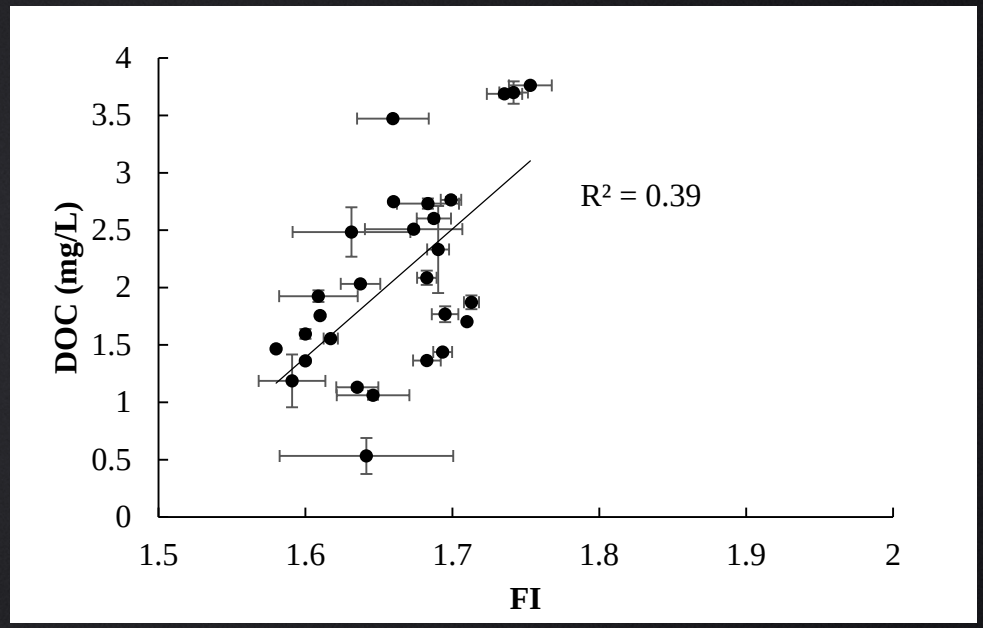
Result and Discussion

DOC enrichment is primarily from microbial DOM





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Result and Discussion

Microbial DOM is controlled by temperature and soil moisture (API)

- ✓ **FI** = 1.550 + 0.005(**temperature**) + 0.006($\mathbf{API_{15d}}$) **($\mathbf{R^2}$=0.851; P<0.001; Stepwise)**

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Result and Discussion

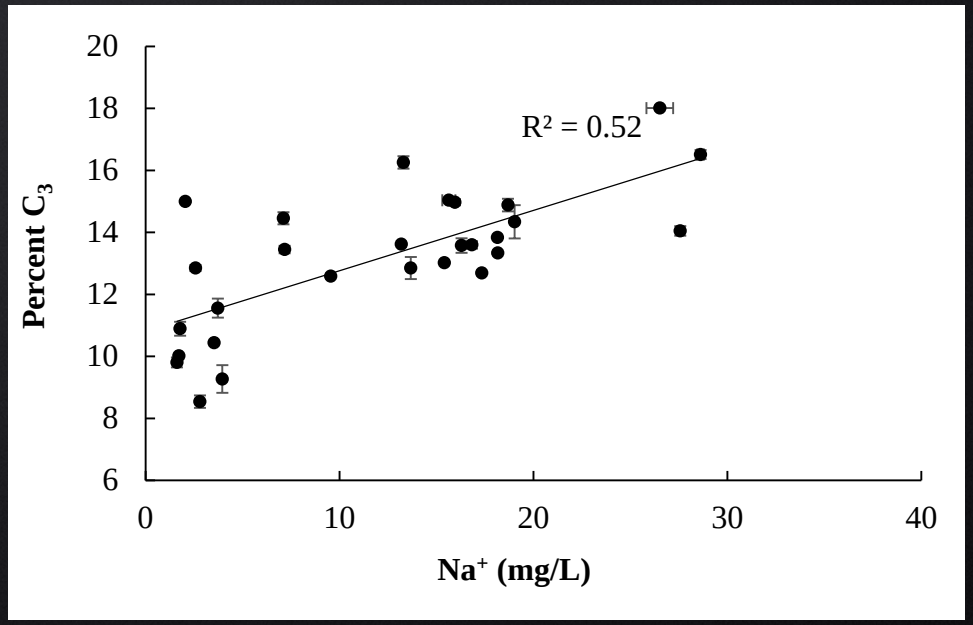
Microbial DOM is controlled by temperature and soil moisture (API)

- ✓ **FI**=1.550+0.005(**temperature**)+0.006($\mathbf{API_{15d}}$) **($\mathbf{R^2}$=0.851; P<0.001; Stepwise)**

Microbial DOM is derived from soil

- ✓ **%$\mathbf{C_3}$**=10.814+0.195($\mathbf{Na^+}$)

($\mathbf{R^2}$=0.519; P<0.001; Stepwise)



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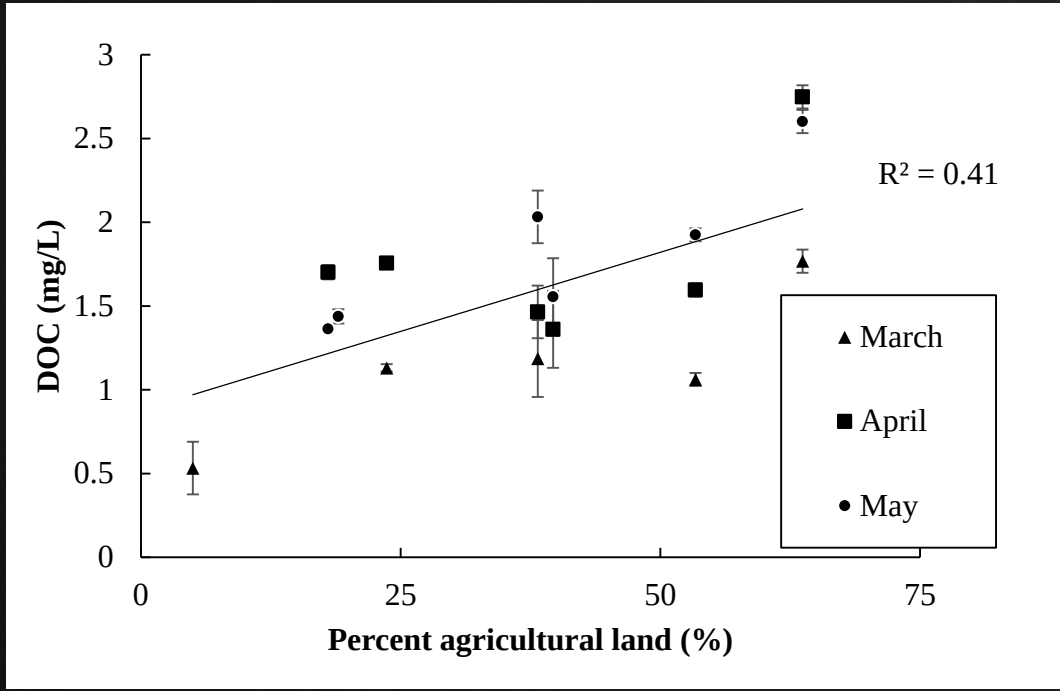
Result and Discussion

Agricultural land use in DOC concentration



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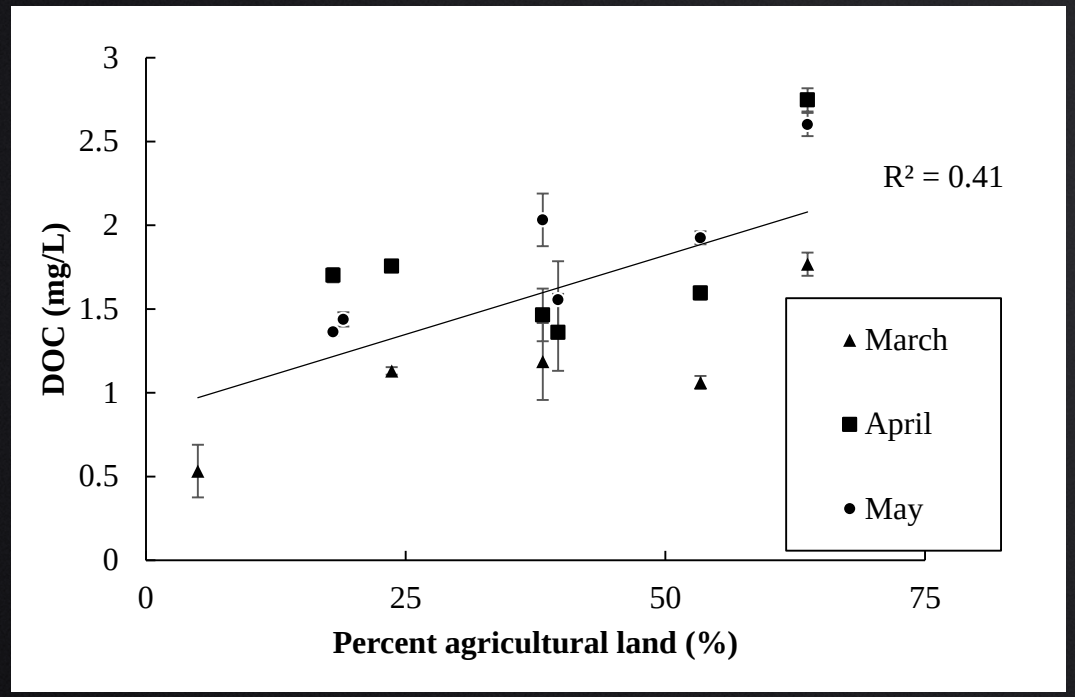

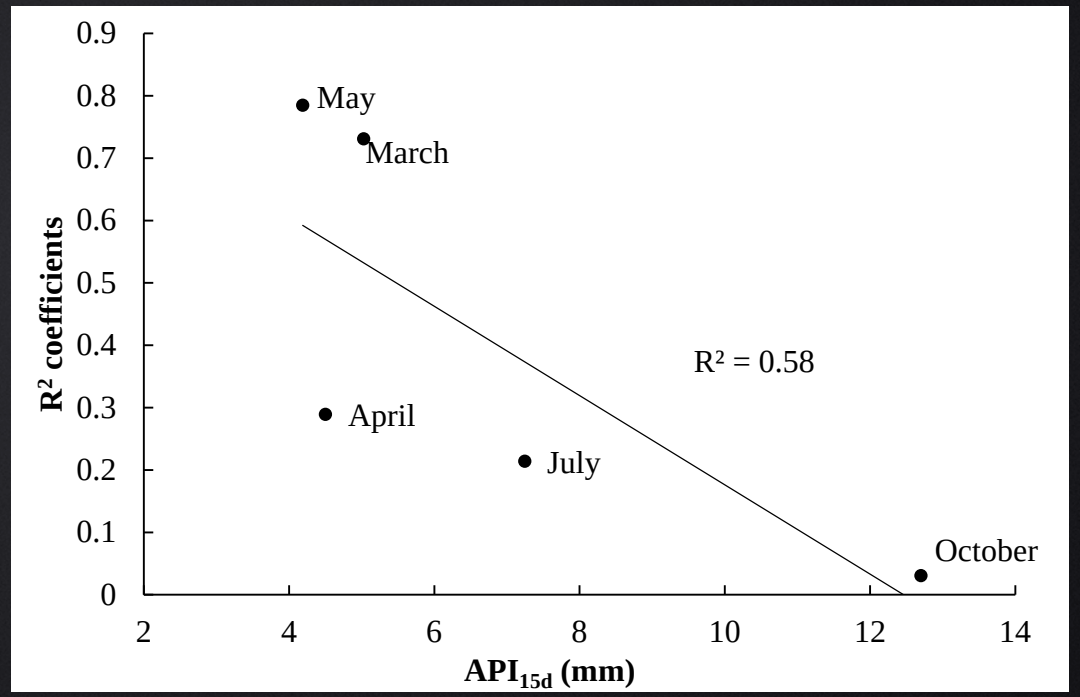

More significant under low API

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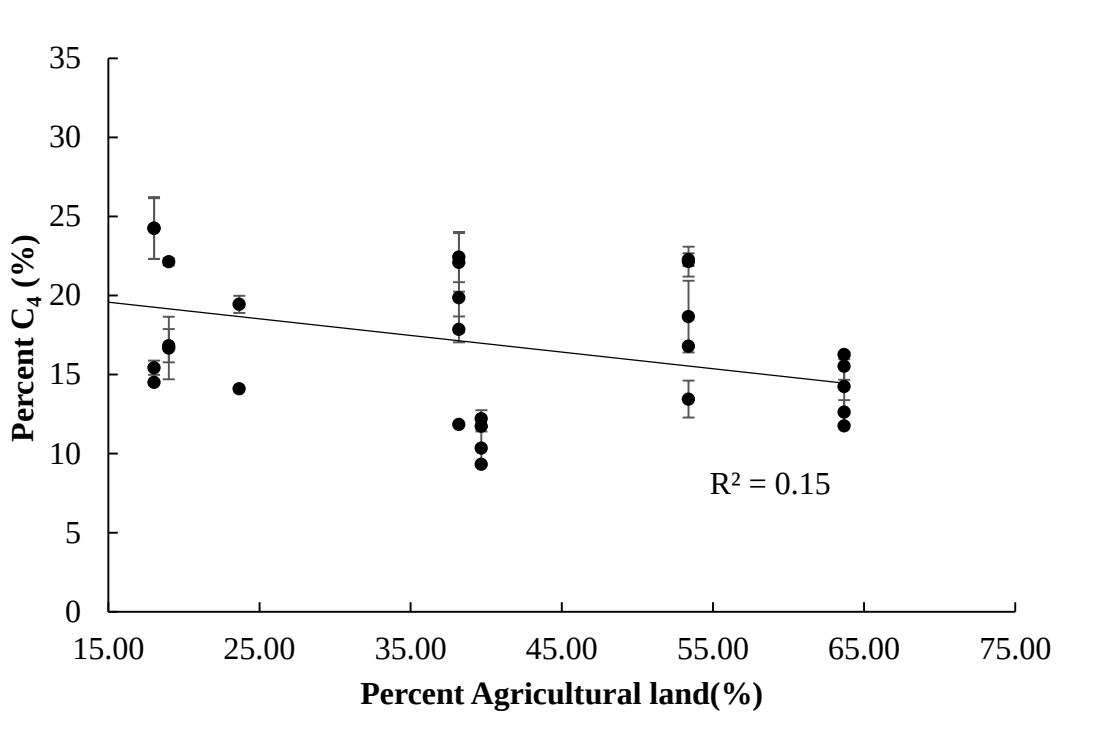
Result and Discussion

Agricultural land use in DOM composition



$\%C_4$=21.270-0.107(**%Ag land**)

(R^2=0.155; P=0.035; Enter)

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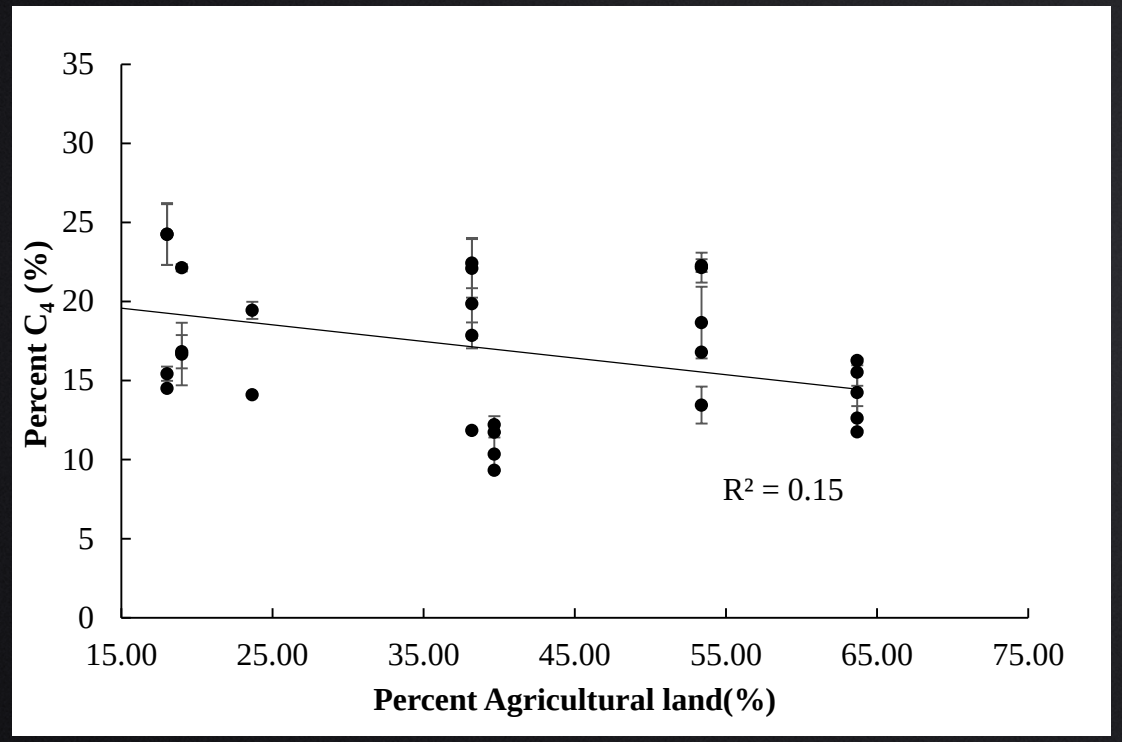
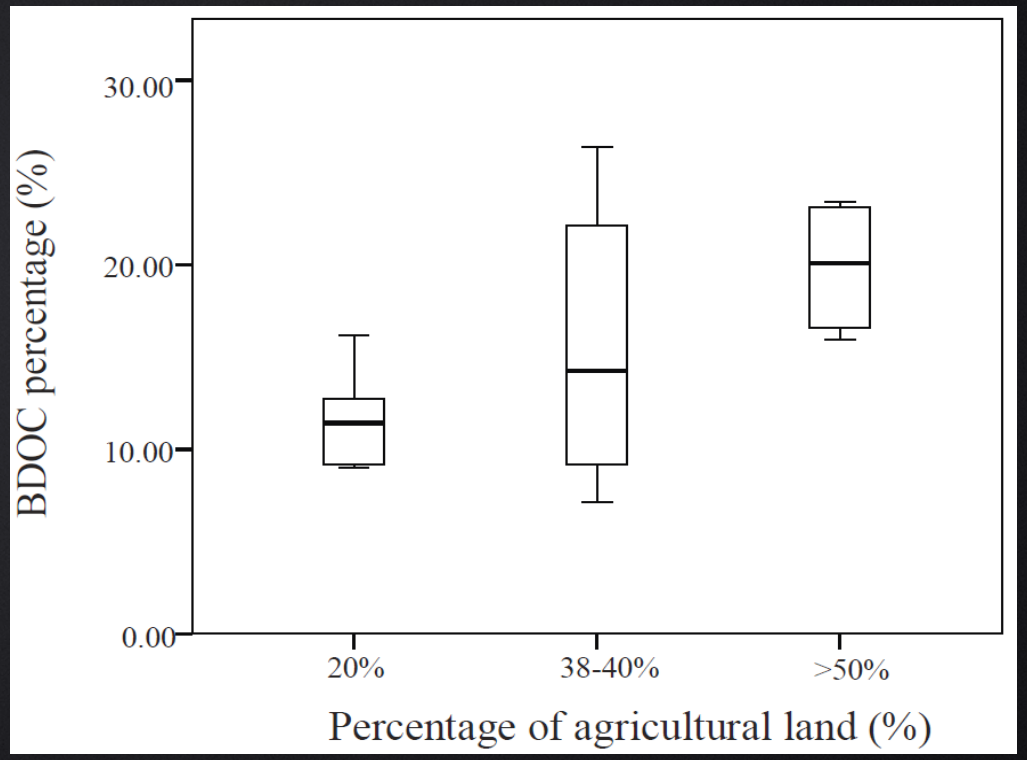
Result and Discussion

Agricultural land use in DOM composition





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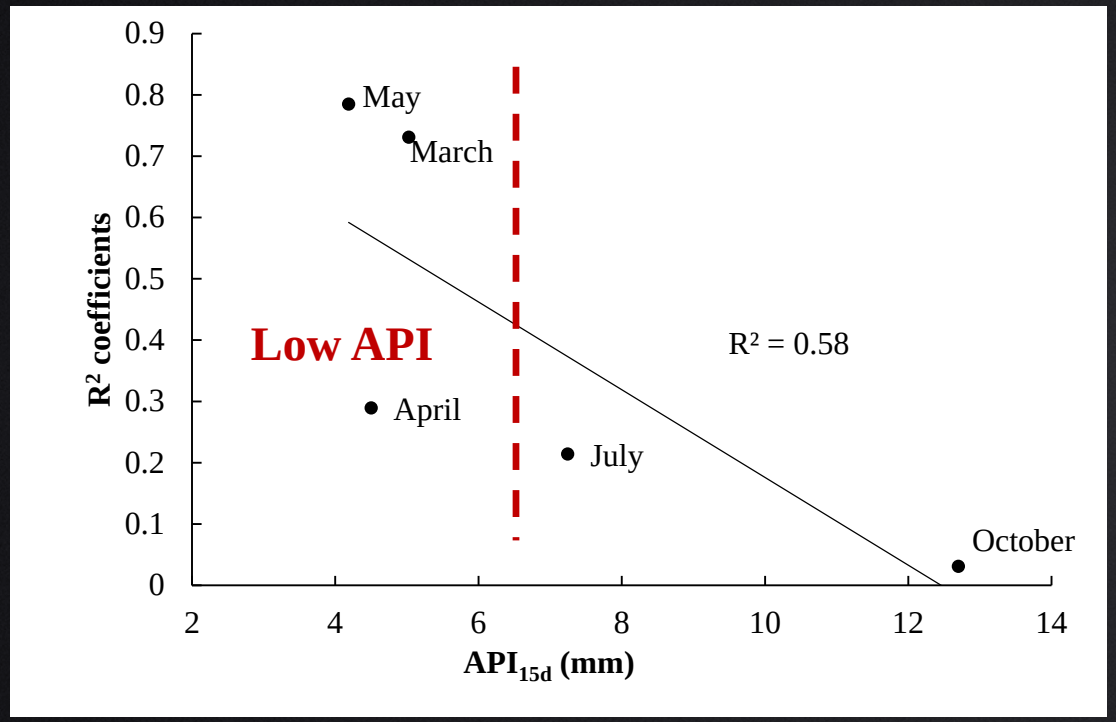
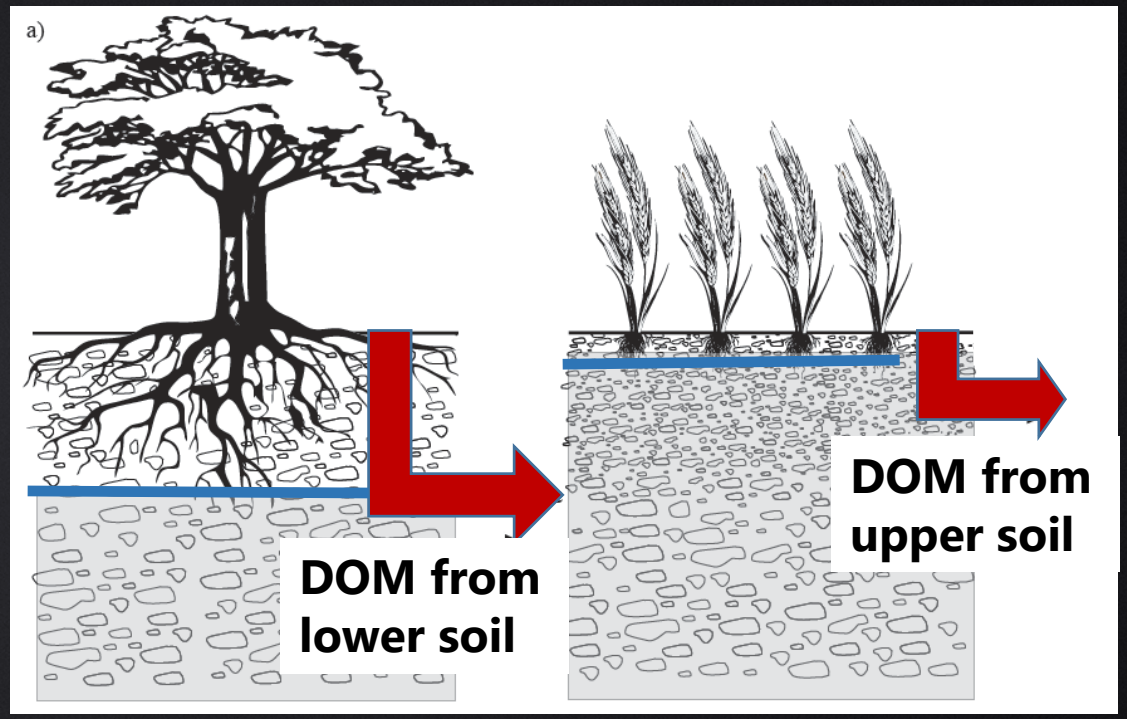


Low precipitation



↑%humic-like DOM ↓%Protein-like DOM ↑DOC concentration ↑%BDOC

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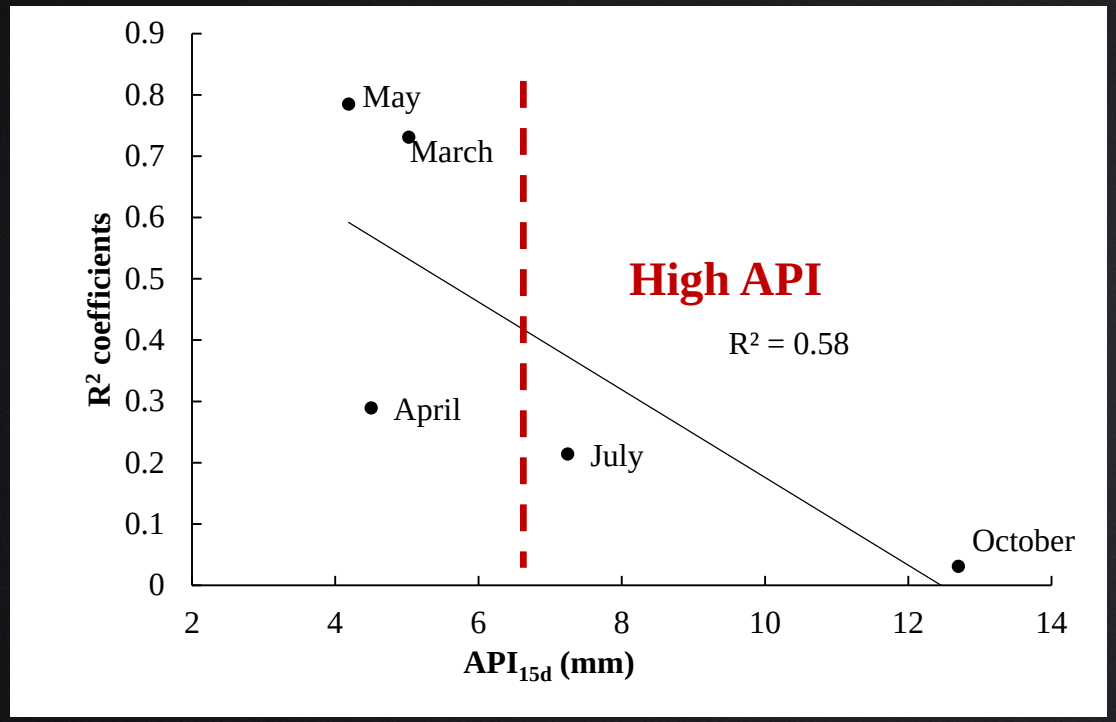
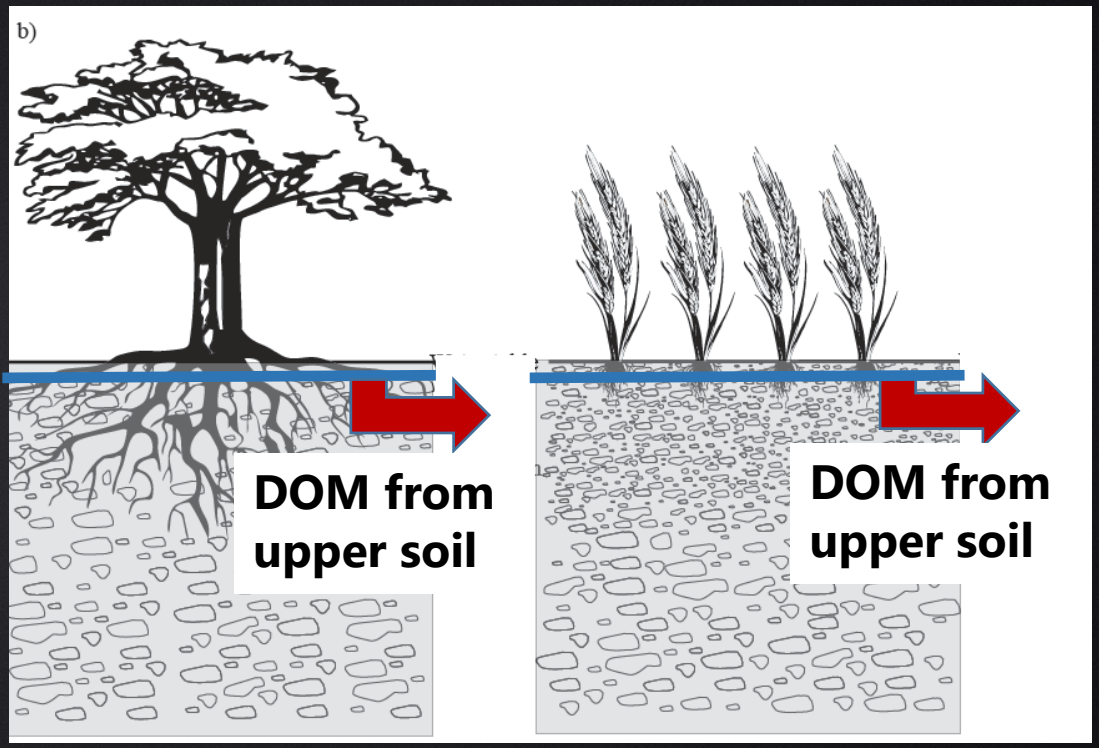
Result and Discussion



High precipitation



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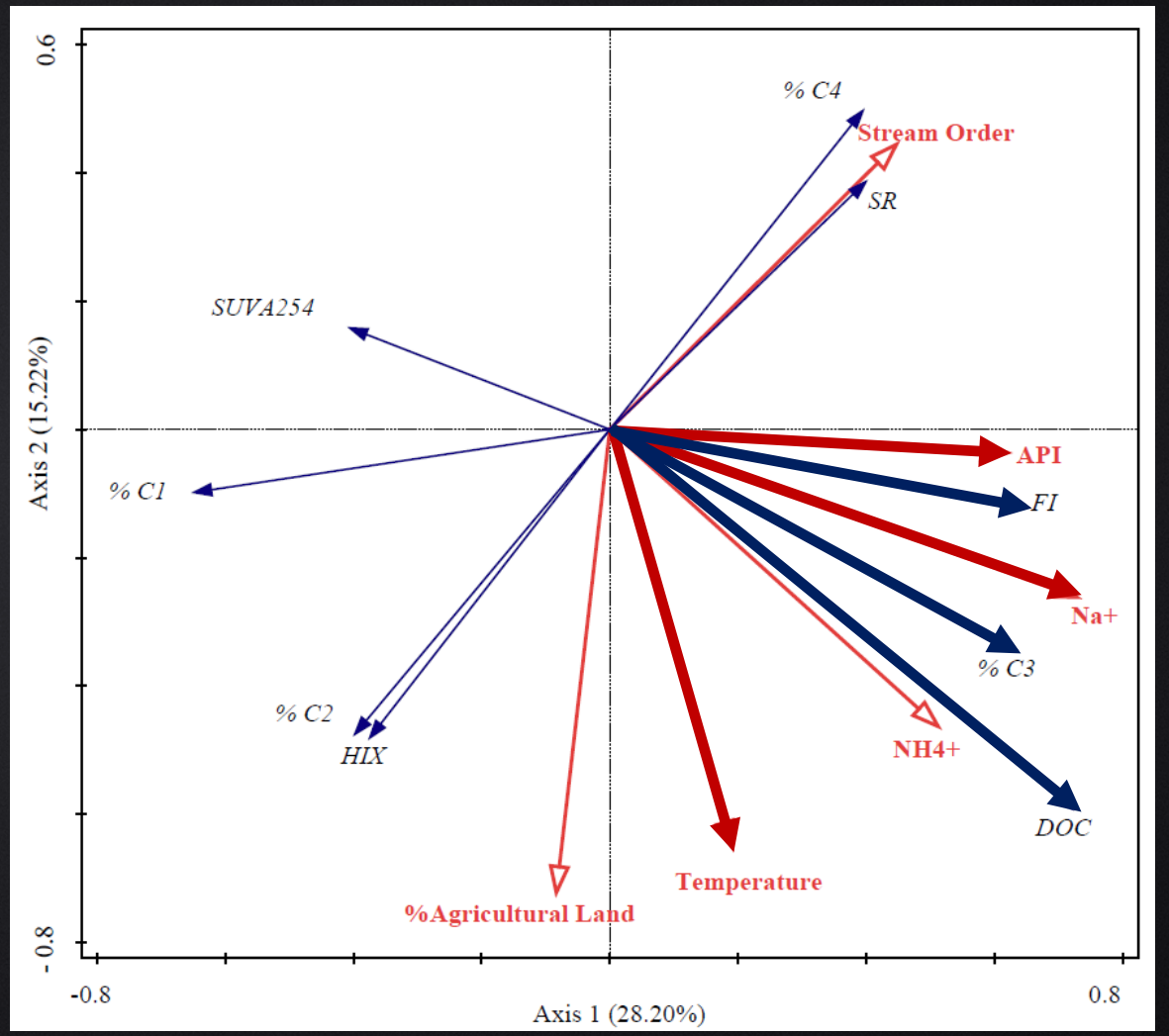
Result and Discussion

Redundancy analysis (RDA)

- ✓ Climate influence
- ✓ Land use influence



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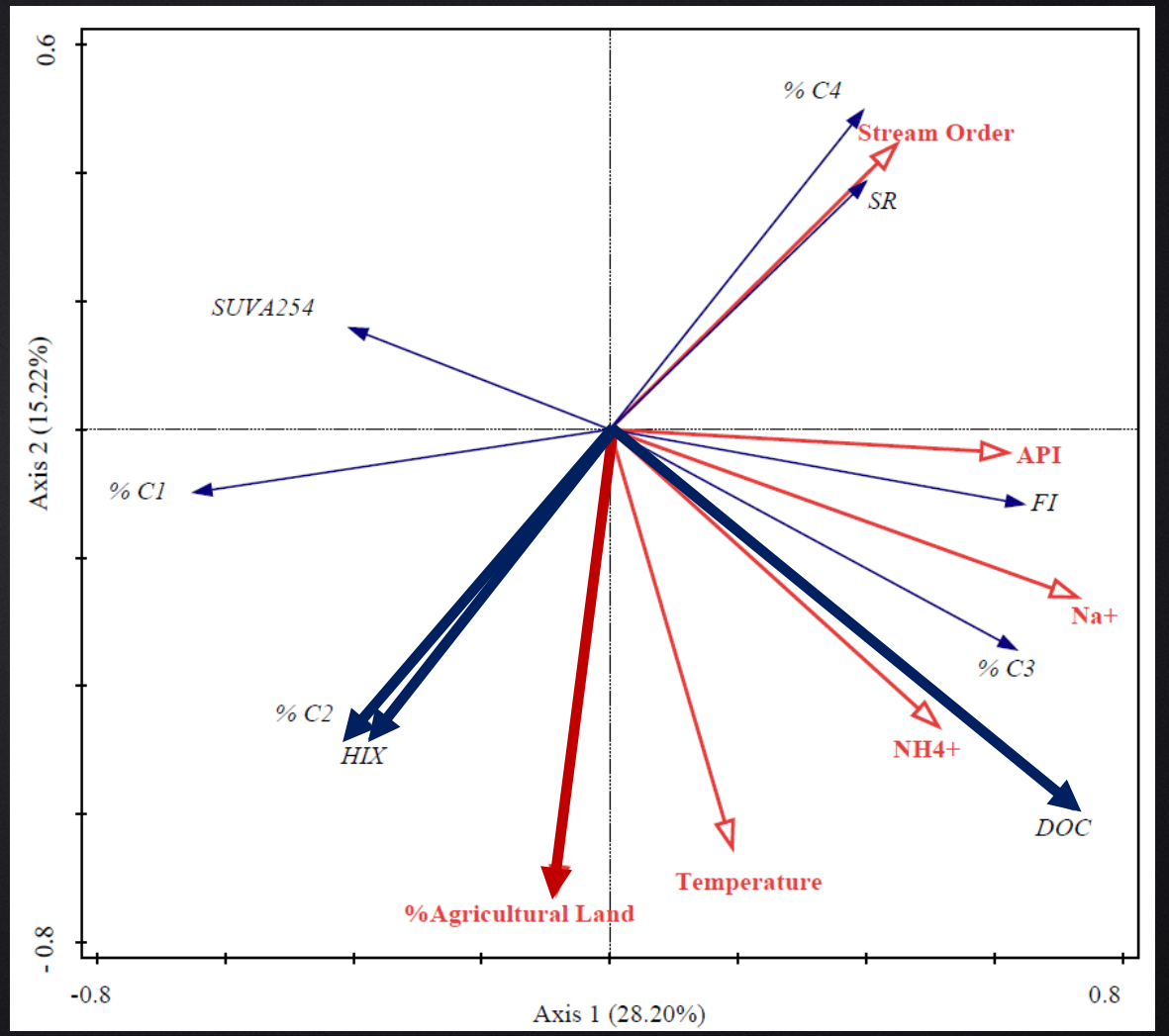

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Conclusion

- ✓ Temperature and precipitation are the primary drivers
  - Positively influence DOC concentration
  - Positively influence contribution of microbially-derived DOM from soil
- ✓ Agricultural land use plays a second role in DOM properties by influencing soil-to-stream flowpath
  - Higher DOC concentration
  - Higher %humic-like DOM and more fresh DOM from soil (high %BDOC)

Acknowledgements

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