# Evaluating role of dissolved organic carbon and iron on influencing water color in a fine-scale agricultural watershed

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## Introduction

- Surface water color is increasing in the Northern Hemisphere due to increasing dissolved iron (Fe) and organic carbon (DOC) which are the main contributors to water color in large scale watersheds (Temnerud et al. 2014).
- Increasing water color deteriorates drinking water quality by forming carcinogenic compounds and increases the cost of pretreating drinking water (Richdson et al. 2007).
- Land use influences Fe and DOC concentrations through podsolization from soil processes (Dillon and Molot 1997) and thus impacts surface water color (Temnerud et al. 2014).
- The effect of land use influence on surface water color in fine-scale agricultural watershed is largely unknown.

## Objectives

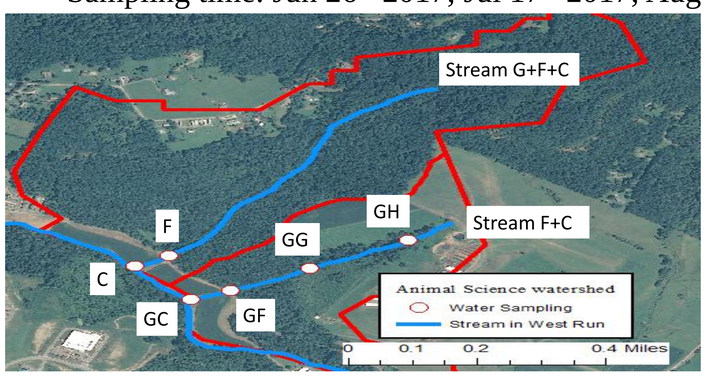
1)Determine how water color changes in a fine-scale agricultural watershed as influenced by land use management.

2)Determine Fe and DOC concentrations and quantify their contribution to water color.

## Materials and methods

### Sampling site

- Sampling time: Jun 26th 2017; Jul 17th 2017; Aug 21th 2017.




Monongalia county, WV

| | Stream G+F+C (Grass + forest + crop land) | Stream F+C (Forest + crop land) |
|---|---|---|
| Forest | 27.5% | 76.9% |
| Developed | 7.9% | 10.5% |
| Grass | 53.2% | 2.1% |
| Cropland | 11.5% | 10.5% |

### Laboratory analysis

- Samples were filtered through 0.45um filters.
- DOC concentrations were determined with a Shimadzu TOC-V.
- Total dissolved Fe was determined by ICP-OES.
- Absorbance:

  Absorbance spectra from 230-600nm at 1nm intervals was collected.

  $A_\lambda$ are expressed here as $m^{-1}$.

  $A_{420}$ was used to assess stream water color.

  S ratio was calculated as the ratio the spectral slope at 350-400nm and at 275-300nm (Helms et al., 2008).
- Fluorescence:

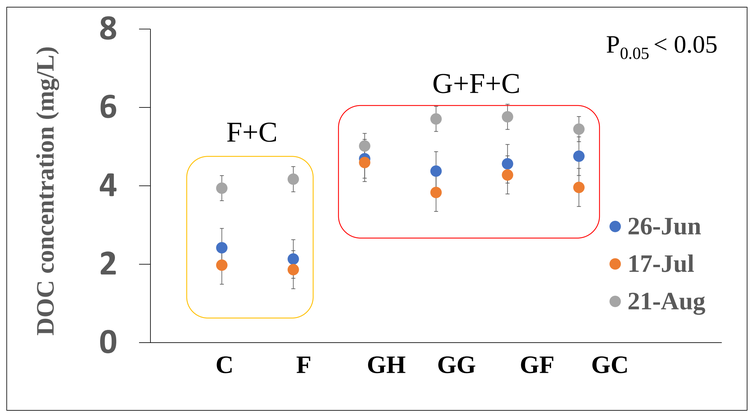
  Freshness index (β:α) was measured as the ratio between intensity at $\lambda_{em}$ 380 nm over $\lambda_{em}$ maximum between 420 nm and em 435 nm at 310 nm (Huguet et al., 2009).

## Statistical analysis

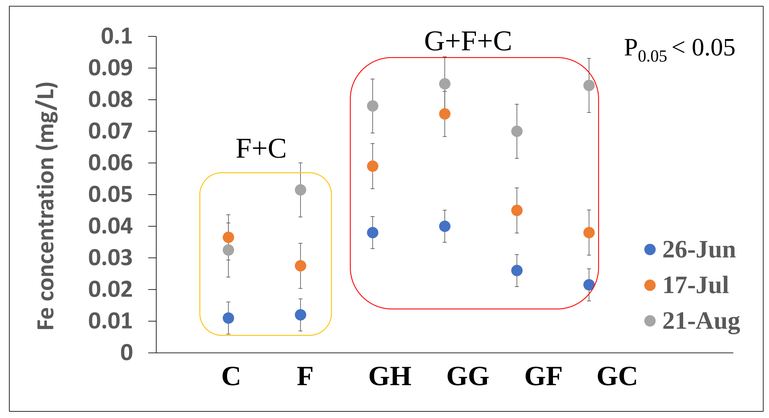
- Linear relationship including DOC, Fe and color, relative contribution of DOC and Fe, S ratio and Fe was developed using JMP®, Version 13.0. SAS Institute Inc., Cary, NC, USA.
- ANOVA analysis of DOC and Fe concentrations were performed using the same software.

## The influence of quantity of Fe and DOC on water color

### Doc concentration

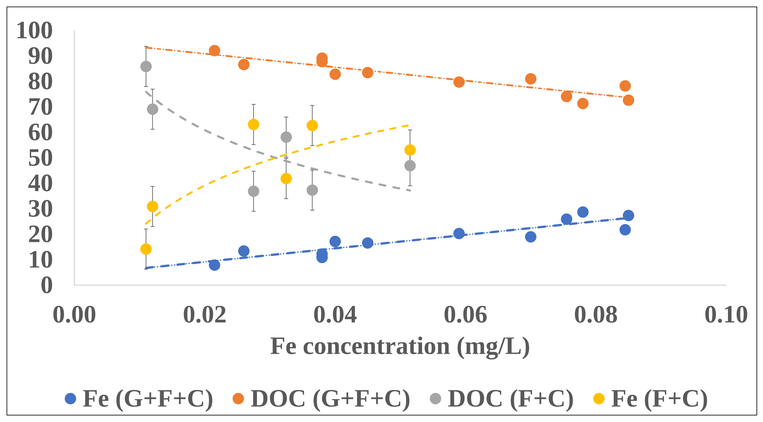



### Fe concentration




The Fe and DOC concentration in stream influencing by G+F+C is much higher than that influencing by F+C.

### Percentage contribution of iron and DOC




### Estimated linear regressions for DOC, Fe and water color

| Model | Model equation | $r^2$ |
|---|---|---|
| 1 | $A_{420}$ = 0.3762*DOC - 0.3276 | 0.58 |
| 2 | $A_{420}$ = 18.121*Fe + 0.2743 | 0.56 |
| 3 | $A_{420}$ = 0.239*DOC + 5.341*Fe | 0.64 |

| | Regression relationship* | $r^2$ |
|---|---|---|
| Fe (G+F+C) | percentage = 264.67 Fe + 3.865 | 0.827 |
| DOC (G+F+C) | percentage = -264.67 Fe + 96.134 | 0.827 |
| Fe (F+C) | percentage = 25.076 ln(Fe) + 137.21 | 0.66 |
| DOC (F+C) | percentage = -25.076 ln(Fe) + 37.206 | 0.66 |

* means percentage contribution from model 3.

Both DOC and Fe contributed to water color. The contribution of DOC to water color was much larger than Fe in G+F+C stream water. However, when the Fe concentration was less than 0.03mg/L, the contribution of DOC was larger than Fe in F+C stream water. When Fe concentration was more than 0.03mg/L, the contribution of Fe was larger than DOC.

## The influence of quality of DOC on water color

### The estimated linear regression for Fe and S ratio




### The Freshness index




S ratio decreased with increasing iron concentration suggesting that higher molecule weight DOC was present with higher Fe concentration in G+F+C stream water. The higher freshness index in G+F+C stream water suggests more microbial DOC which would indicate intense microbial alteration of DOC.

## Conclusions

- The concentration of DOC and Fe showed significant differences. They both positively correlated with water color. DOC contributed more to water color compared to Fe in G+F+C while Fe contributed more than DOC when Fe concentration was larger than 0.03mg/L in F+C.
- The quality of DOC was different which was shown by changes in S ratio and β:α,. S ratio decreased with increasing concentration which indicated increasing interaction between high molecule weight DOC with increasing Fe concentration. β:α index showed high microbial alternation of DOC in G+F+C water.
- All this information indicated very different interactions between DOC and iron in stream water under different land use management.