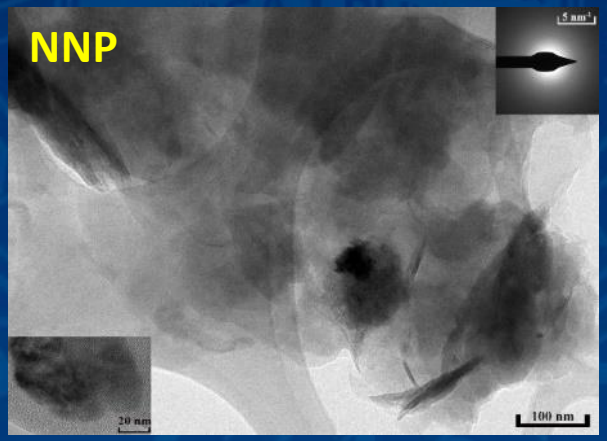
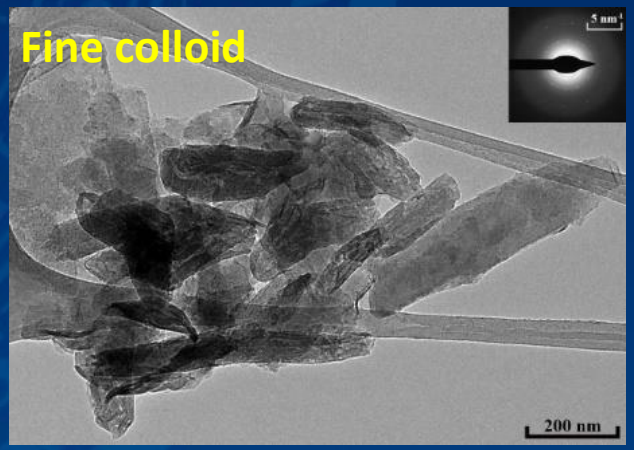
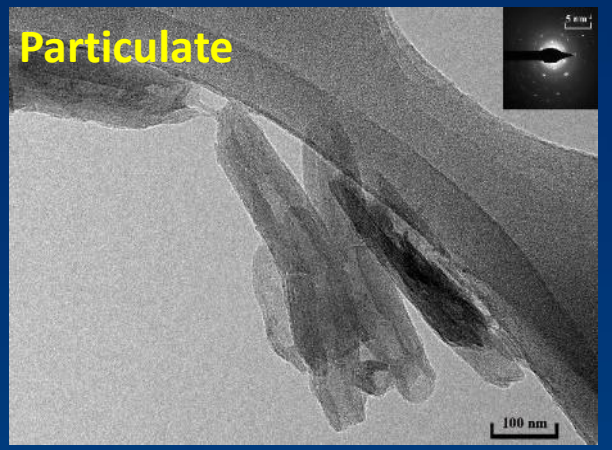
Size-dependent Organo-mineral Interactions and Dynamics in a Seasonally-flooded Wetland







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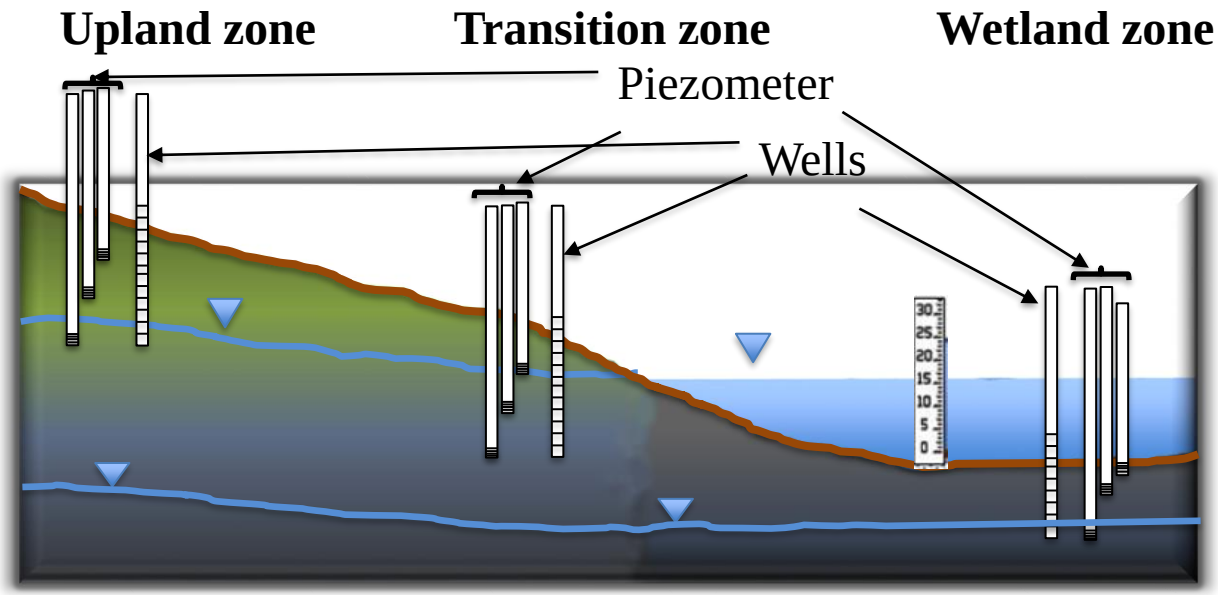
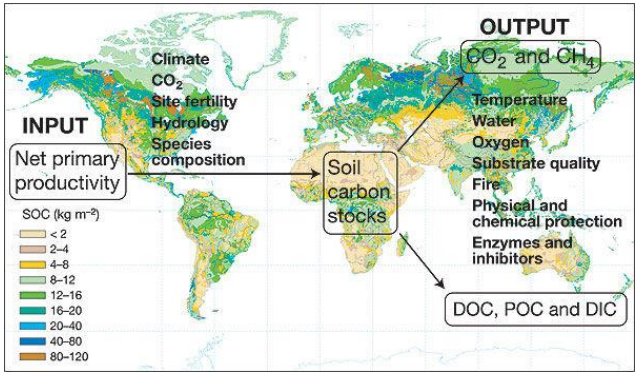
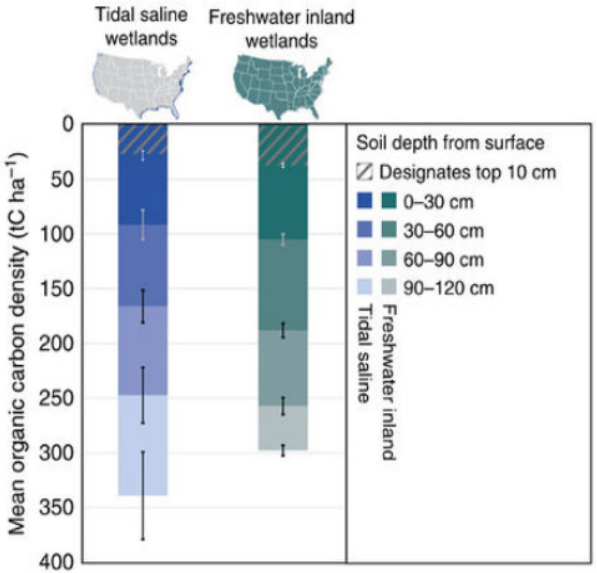
Depressional Wetlands and Dynamics of SOC





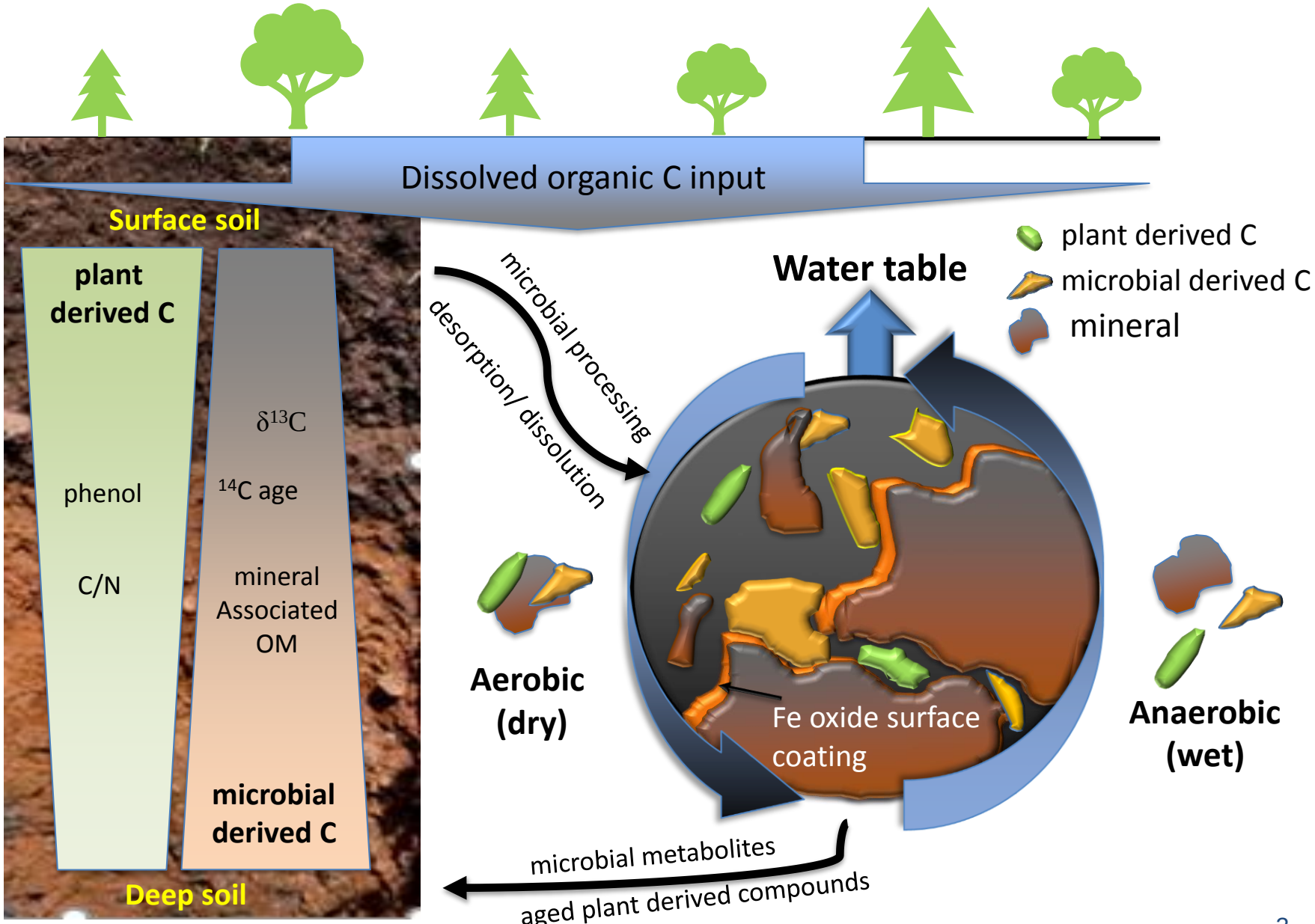
Davidson and Janssens, Nature, 2006

- Wetland: Highest store of SOC
- DOM: 20-55 Mg ha^{-1} in mineral soil (19-50% of total soil OC)
- Depressional wetland: Metabolically highly active; precipitation and GW driven
- Water table fluctuations modify the redox potential of the soil
- Redox ladder: $O_2 < NO_3^- < Mn^{2+} < Fe^{2+} < SO_4^{2-} < CO_2$



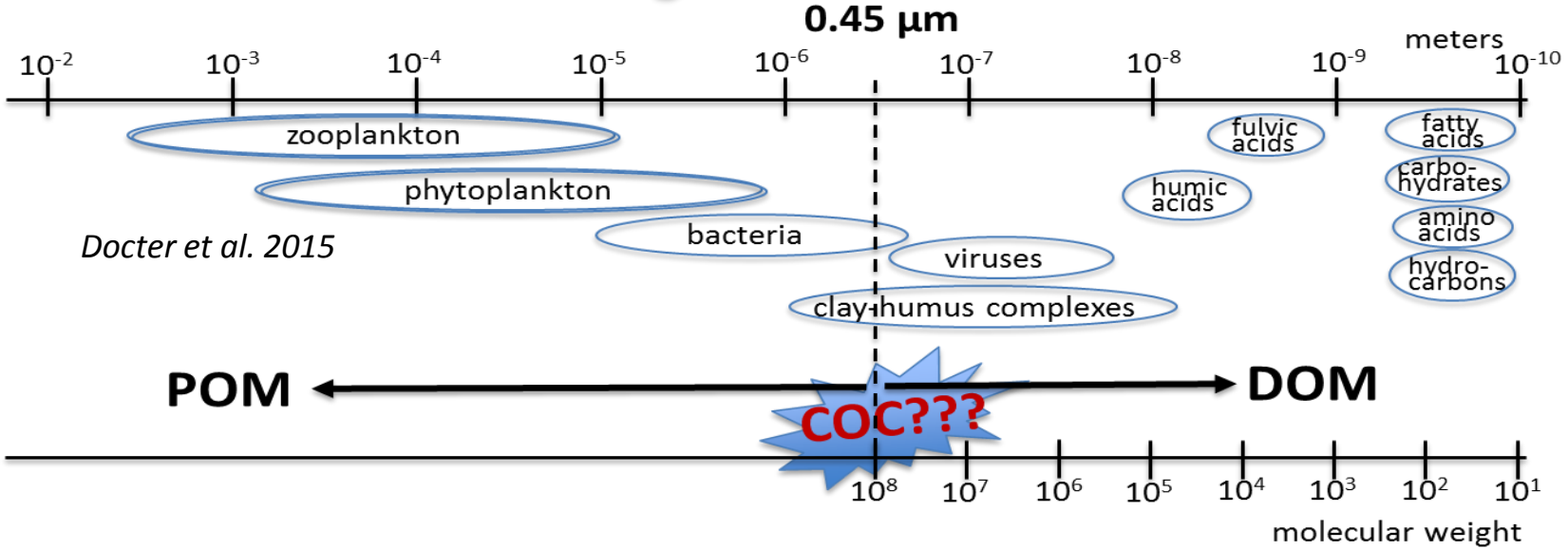
(Nahlik and Fennessy, Nat. Comm., 2016)

Downward cycling of SOM

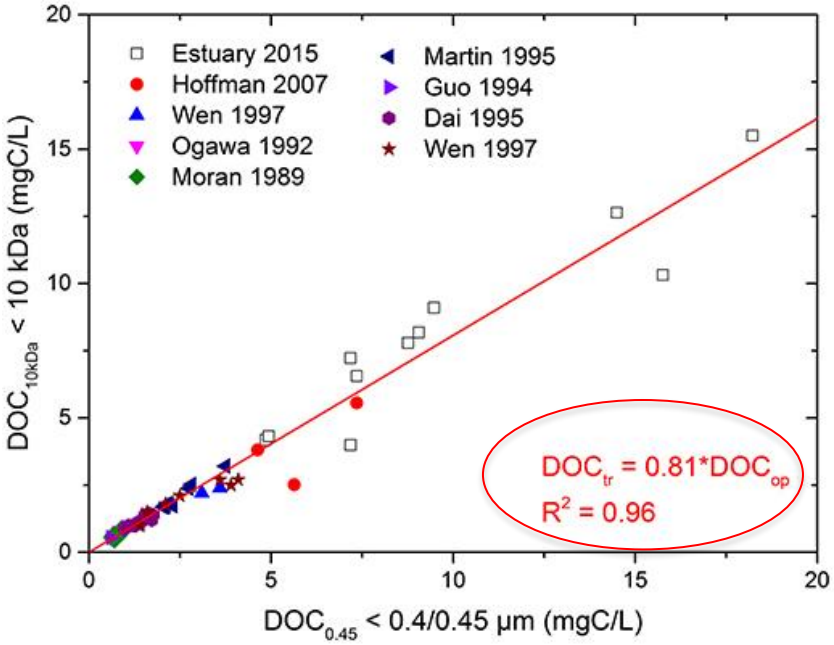


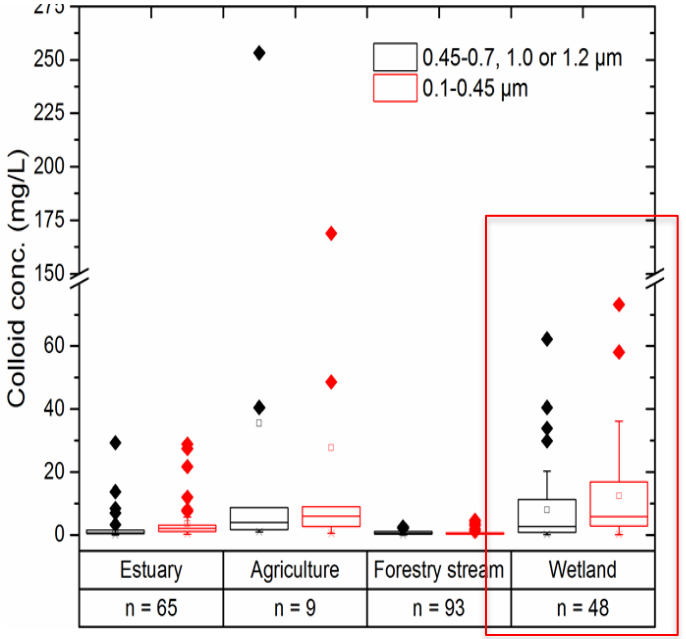
Kaiser and Kalbitz, SBB, 2012

Particulate and Dissolved Organic Matter



Docter et al. 2015





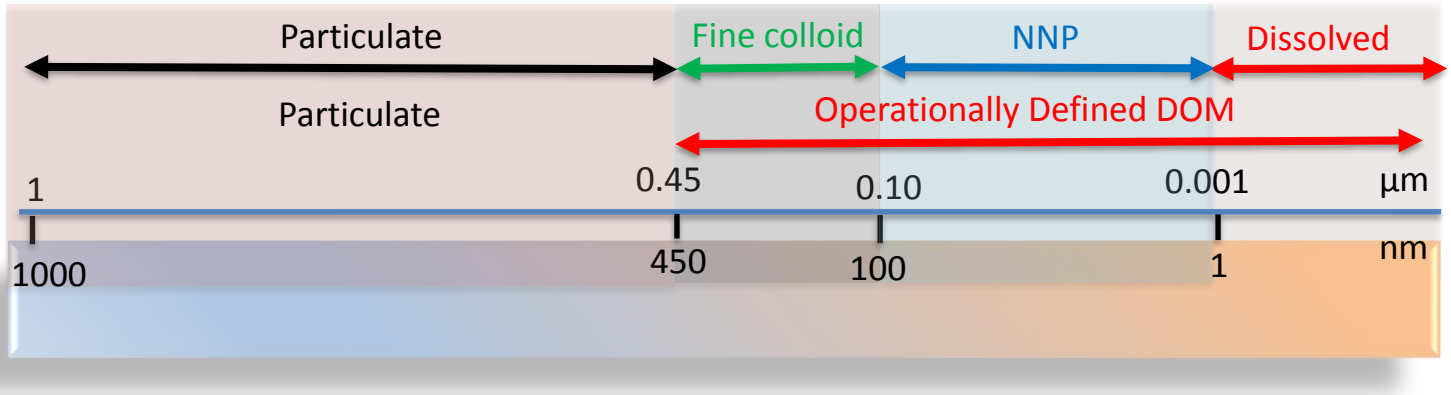
(Yan et al., 2018)

Hypothesis

Concentration and molecular composition of size-fractionated colloids and COC may vary widely within colloidal size range

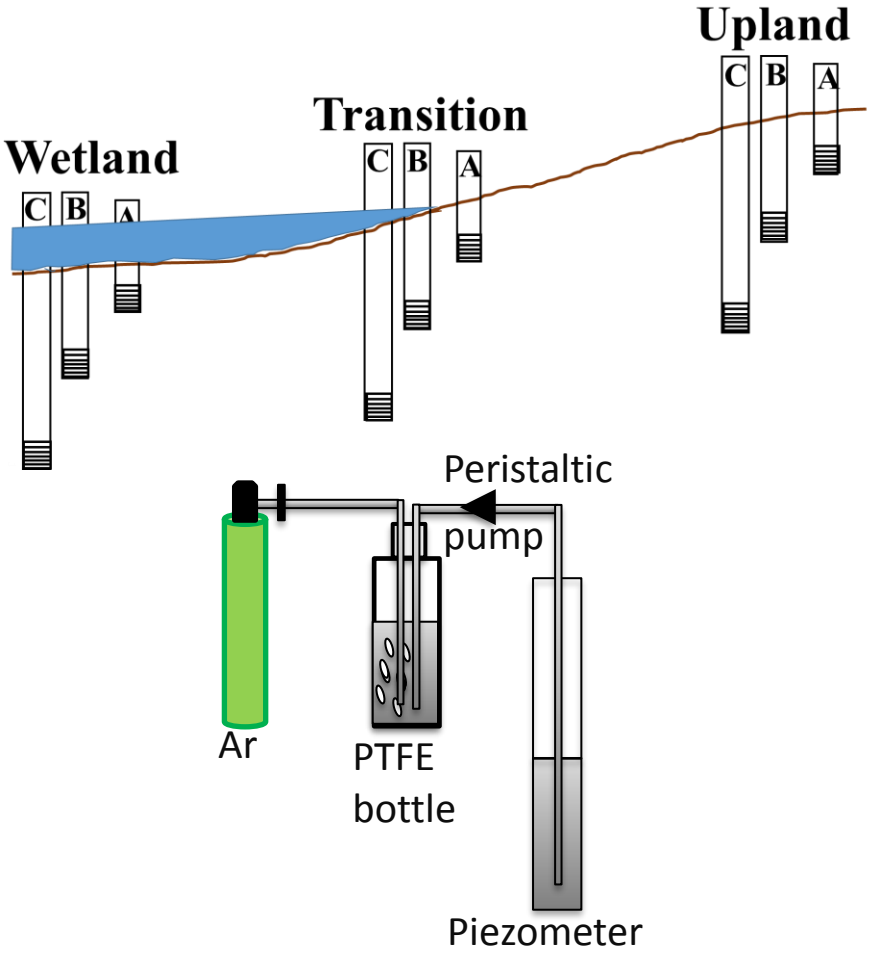
Research Questions

- What is the contribution of COC to the operationally defined “dissolved” pool?
- How the molecular composition of colloids and associated OC varies among different size fractions?
- How wetland hydrology influence the composition of organo-mineral associations in depressional wetland?



Materials and Methods

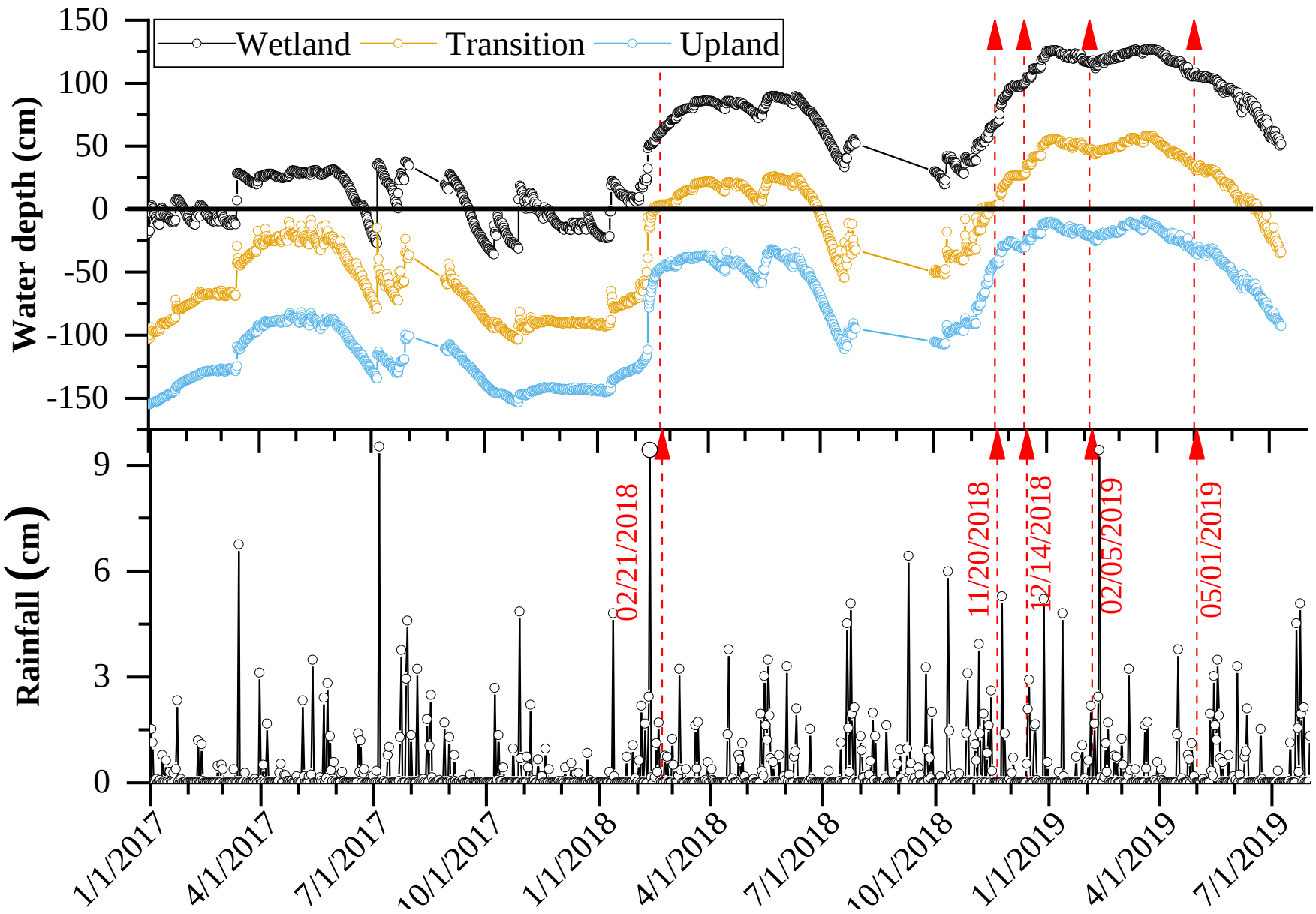
Study site and sample collection



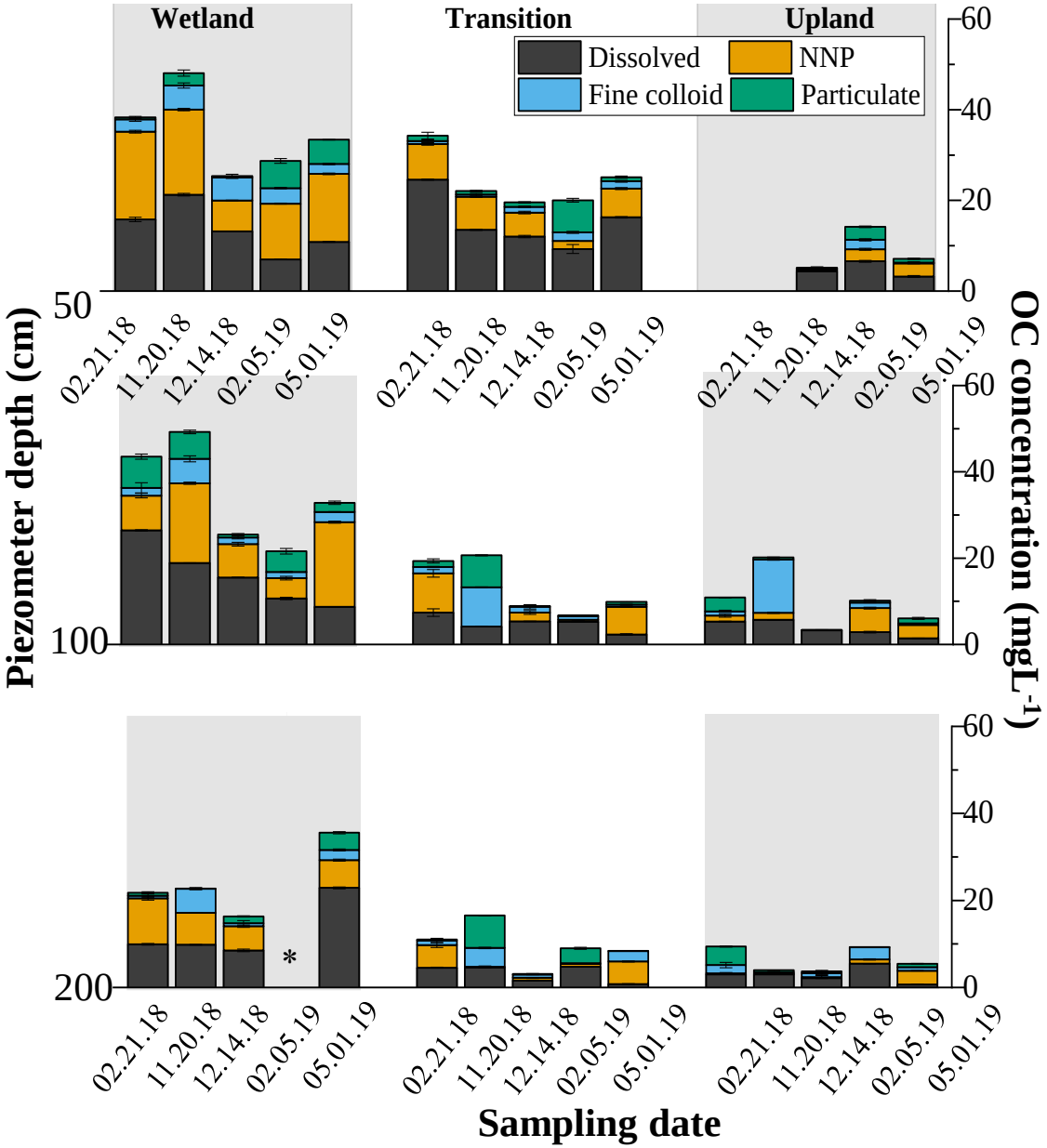
- Delmarva Bay depressional wetland
- 3 Piezometers: 50 cm, 100 cm, and 200 cm
- Sampling date: 2017- Aug.
  2018- Feb., Nov., and Dec.
  2019- Feb. and May

Analyses: C concentration (TOC analyzer), $\delta^{13}C$ and $\delta^{15}N$ (IRMS-EA)

Wetland hydrology

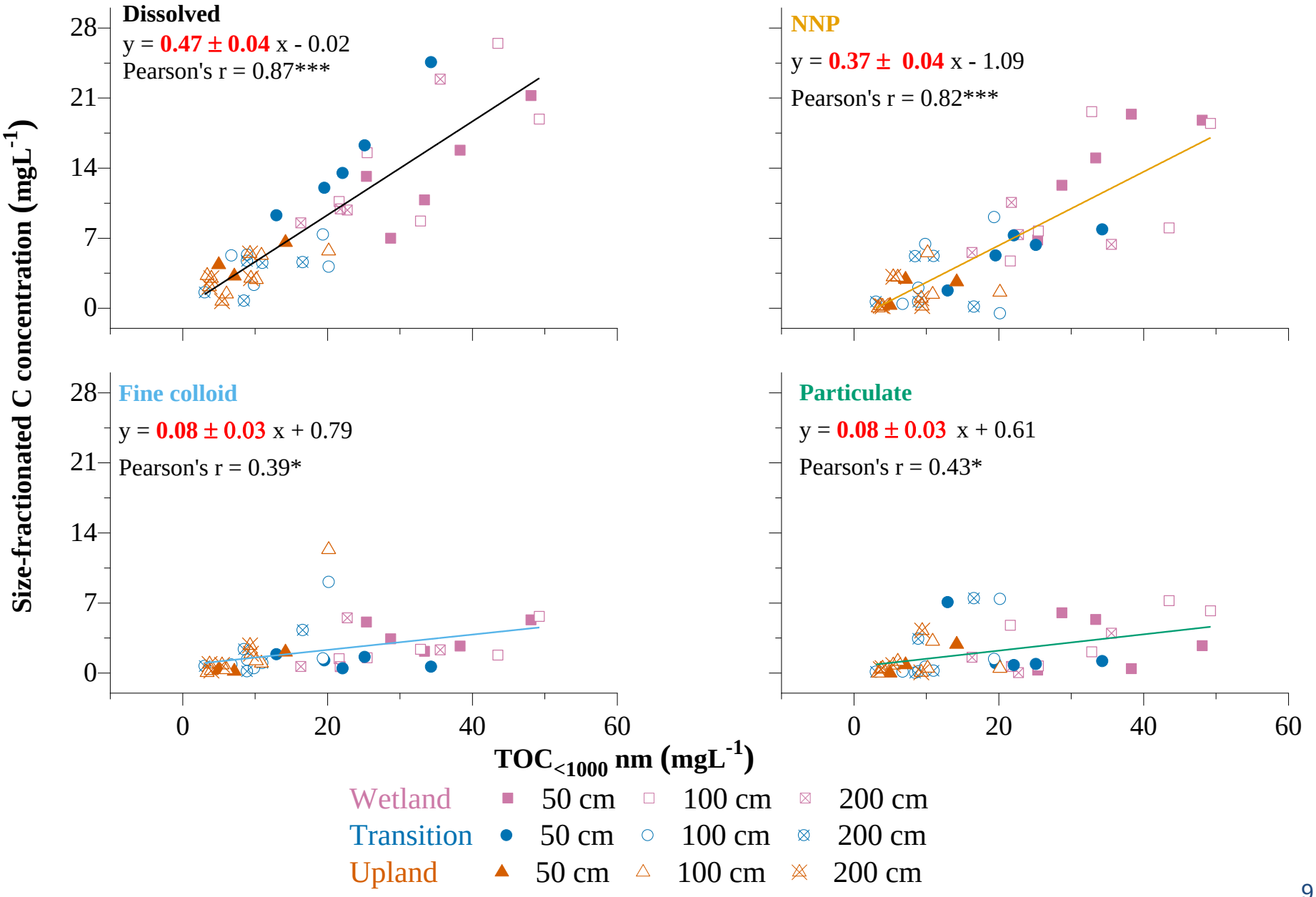


Dissolved & COC Concentration

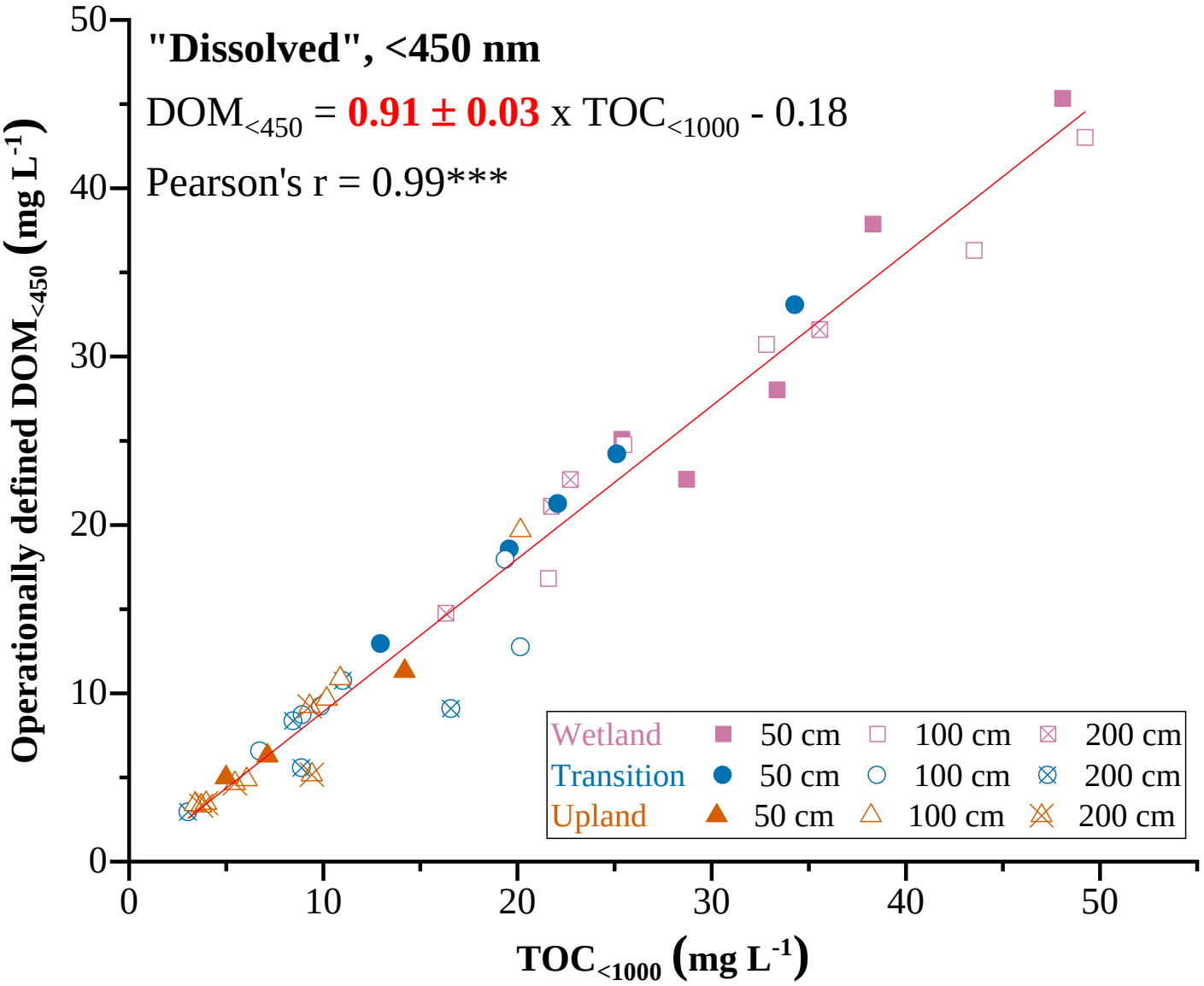


- OC conc. depends on **hydrologic condition**
- **Wetland** had the highest OC conc.
- **Dissolved and NNP- C** are comparable

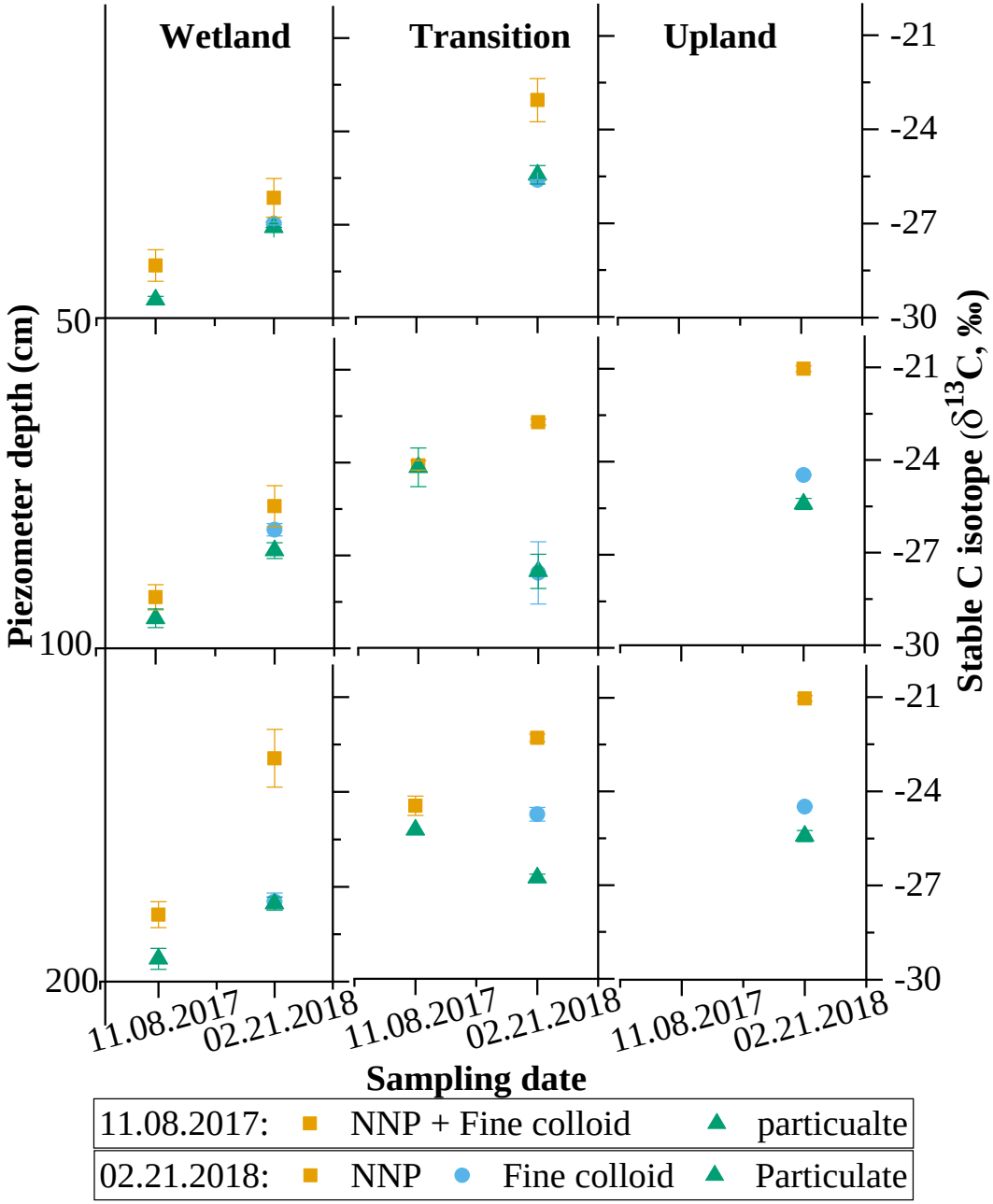
Significance of NNP and Fine Colloids



Operationally Defined "Dissolved" Fraction



Stable $\delta^{13}C$ Isotope Signature



- $\delta^{13}C$ enriched SOM in
  - upland than wetland
  - NNP size fractions
- More microbial derived C in upland and at NNP size fraction
- More recalcitrant OC in wetland than upland

Summary & Conclusion

- ❑ Substantial size-dependent heterogeneity in COC concentration
- ❑ NNP: ~37% of total OC (<1000 nm), more microbial derived C
- ❑ More recalcitrant OC in Wetland than in upland
- ❑ COC should be considered as a separate phase in global C cycling, modeling, and management strategies for wetland ecosystems