Supplementary Material

Mobile Colloidal Organic Carbon: an Underestimated Carbon Pool in Global Carbon Cycles?

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# Supplementary Data

Data Sheet 1 (excel): Raw data of colloid and COC concentration summarized from this study and literature

# Supplementary Tables

**Table S1.** Sample time for colloid and TOC determination for different sites

|  |  |  |
| --- | --- | --- |
| Samples | Sample Time | |
| Colloid conc.\* | Colloid and TOC conc.† |
| Agricultural Field | Mar 10th, 2015T | N/A |
| Forest stream | Nov 28th, 2013; Mar 11th, Apr 16th, 2014T | Aug 14th, 29th, Sep 23rd, 2013G |
| Wetland | N/A | Apr 1st, 3rd, 13th, May 14th, 28th, June 3rd, 2015T |
| Estuary | Aug 26th, 2013, Jun 4th, Aug 25th, 2014T | Jun 15th, 2015T |

\* Only colloid concentration was determined for these samples

† Both colloid and TOC concentration were determined

T, G Colloid concentration determined by turbidity (T) or gravimetrically (G)

**Text S1. Descriptions of sampling sites**

Water samples were collected from an agricultural field, forest streams, a freshwater wetland and an estuary (AG, FS, WL, ES), representing varied hydrological and physicochemical conditions. The locations and detailed descriptions of the study sites are presented as followed.

The agricultural site is located at the University of Maryland Eastern Shore (UMES) Research Farm in Princess Anne, MD (38° 12’ N and 75° 40’ W). The UMES farm is part of the Manokin River Watershed and is approximately 10 km from the Chesapeake Bay. This farm has a series of small field ditches (0.3-1.0 m deep) that drain into larger ditches (1.0-3.0 m deep) and ultimately drain into the Manokin River and the Chesapeake Bay (Vadas et al., 2007). The mean annual precipitation is 1110 mm and mean annual temperature is ~13 °C (Kibet et al., 2016; Kleinman et al., 2007). The soils are mainly fine-loamy, mixed, active, mesic Typic Endoaquults. The field site is managed with conventional tillage and planted with corn and soybeans since its purchase by the UMES in 1997. Prior to 1997, the site had been a commercial broiler operation for more than 20 years. As a result, excessive concentrations of soil phosphorus (Mehlich-3 P > 60 mg/kg) were measured due to continuous application of poultry litters (Kleinman et al., 2007). This site was chosen to represent the environmental system under long-term agricultural activities. Water samples were collected from both 0.6 and 1.2 m piezometers and from surface water within ditches on the same sampling day.

The forest streams are located in the Fair Hill Natural Resources Management Area (FH-NRMA) in Cecil County, MD (39°42’ N, 75°50’ W), and are part of an ongoing study on organic matter (Dhillon & Inamdar, 2014; Inamdar et al., 2011). The FH-NRMA is managed and protected by the State of Maryland's Department of Natural Resources after its purchase from Mr. William duPont, Jr. since 1975. Prior to 1975, this site had been used for both farming and recreational hunting. The FH-NRMA is part of the Big Elk River Watershed and streams of FH-NRMA ultimately drain into the northeastern portion of the Chesapeake Bay. The mean annual precipitation is ~1200 mm and mean annual temperature is ~12 °C. The soils are mainly coarse loamy, mixed, mesic, Lithic and Oxyaquic Dystrudepts. The study area is mostly covered with deciduous forest, including Fagus grandifolia, Liriodendron tulipifera, and Acer rubrum (Dhillon & Inamdar, 2014; Levia, Stan, Mage, & Kelley-Hauske, 2010). This site was chosen to represent a natural forestry system without substantial recent agricultural perturbations. Surface water samples were directly collected from streams at the outlets of 12 and 76 ha catchment. More details of sampling locations and site descriptions can be founded in Dhillon and Inamdar (2013) and Inamdar et al. (2011).

The freshwater wetland is located in Blackbird State Forest in New Castle County, DE (39°20’ N 75°40’ W). It is part of the Blackbird Creek watershed that drains into Blackbird Creek and ultimately flows into the Delaware Bay. The mean annual precipitation and mean annual temperature in this area are ~1200 mm and ~14 °C. This wetland is a seasonally-saturated mineral soil flat wetland, where inundation mostly occurs outside of the growing season. For most of the growing season the water table is below 30 cm, however, the water table depth fluctuates often in response to major precipitation events. Water is supplied directly through precipitation and also by groundwater flow through a sand lens. The soils are mainly fine-loamy, mixed, active, mesic, Typic Endoaquults. The dominant trees include Nyssa sylvatica, Liquidambar styraciflua, Acer rubrum, Quercus phellos, and Quercus lyrata. This site was chosen to represent an environmental system that is under dynamic redox conditions, and which is indirectly affected by anthropogenic perturbations. Water samples were collected from shallow (0-40 cm), deep (64-127 cm) and sand lens (130-203 cm) wells along the transect from inlet to outlet (upland, soil mineral flat, depression wetland, and wetland outlet).

The estuary site, a coastal tributary named East Creek, is part of the lower Chesapeake Bay watershed on the eastern shore of the Delmarva Peninsula in Somerset County, MD (38°03’ N, 75°78’ W). The upper part of the watershed is primarily occupied by poultry operations and agricultural fields with corn-soybean rotations, while the lower part of the watershed is mainly surrounded by brackish tidal marsh (Upreti et al., 2015). The mean annual precipitation and mean annual temperature in this area is ~1000 mm and ~15 °C, respectively. The creek is approximately 10 km long, primarily drains from the open ditches in agricultural and poultry farms, and ultimately drains into the Chesapeake Bay. Because of the long-term poultry operation and the over-application of inorganic fertilizer and manures on the agricultural farms in surrounding areas (Sims et al., 2000), the upper region has been significantly impacted by agricultural activities. These agriculture fields are interspersed with small patches of forest area. The southern part of the watershed is mainly surrounded by brackish wetlands which are either fully or partially saturated during storm events and high tide. This site was chosen to represent an environmental system in the estuarine or coastal region. Water samples were collected along the creek from a drainage ditch near an agricultural farm to the mouth of the creek at the Chesapeake Bay. More details of sampling locations and site descriptions can be founded in Upreti et al. (2015) and Stout et al. (2015).



**Figure S1.** Location of sampling sites

![A close up of a map

Description generated with very high confidence]()

![A close up of a map

Description generated with very high confidence]()

**Figure S2.** The histogram of frequency distribution of colloid conc. and fitted normal distribution curves for samples collected agricutlral field (AG), esturay (ES), forest streams (FS), and freshwater wetland (WL) in different size fractions and results combined from all sites in same size fracttions (0.1-0.45; 0.45-0.7/1.0; 0.1-0.7/1.0 µm)

![A close up of a map

Description generated with very high confidence]()![A close up of a map

Description generated with high confidence]()

**Figure S3.** The histogram of frequency distribution of colloid conc. and fitted normal distribution curves for samples collected from esturay (ES), forest streams (FS), and freshwater wetland (WL) in different size fractions and results combined from all sites in same size fracttions (0.1-0.45; 0.45-0.7/1.0; 0.1-0.7/1.0 µm)

A screenshot of a cell phone

Description automatically generated

**Figure S4.** Ratio of DOC0.1 to DOC0.45 from this study and literature

A close up of a map

Description automatically generated

(a)

A close up of a map

Description automatically generated

(b)

**Figure S5**. Relationships between (a) < 10kDa DOC10kDa and < 0.2/0.22 µm DOC0.22, and (b) < 10kDa DOC10kDa and < 0.2-0.45 µm DOC0.45 altogether.

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