Title Spatial and Temporal Patterns in Atmospheric Deposition of Dissolved Organic Carbon

How are terrestrial carbon and atmospheric carbon related to deposition of dissolved organic carbon?

What is the role of atmospheric deposition in terrestrial carbon cycling globally? Are there spatial or temporal patterns in the deposition of dissolved organic carbon (DOC)? The researchers examined data collected for at least one year at 70 sites ranging from 40° S to 66° N. They evaluated seasonal and interannual patterns, whether patterns differed with latitude, and the relationships between DOC deposition and precipitation and between DOC deposition and potential sources of atmospheric carbon.

Does DOC concentration differ between wet and bulk deposition measurements?

- Results from two sites where both wet and bulk deposition were measured show that DOC concentrations are higher in dry deposition than in wet deposition.

Are there latitudinal differences in DOC concentration or deposition?

- Both mean DOC concentration in bulk collectors and mean annual carbon deposition were significantly higher at low latitude tropical sites than at high latitude temperate sites. This is likely because of higher precipitation and significantly higher concentrations of carbon.

Does carbon deposition vary seasonally?

- All sites at which rainfall patterns were strongly seasonal had strongly seasonal DOC concentrations, which were negatively correlated to precipitation. Tropical sites with little seasonality in rainfall patterns had little variability in DOC concentrations. However, temperate sites with no seasonal precipitation pattern had seasonally elevated DOC concentrations.

What are the likely sources of atmospheric carbon?

- The seasonal, temporal, and latitudinal patterns in carbon deposited via precipitation are most consistent with patterns in magnitude and timing of atmospheric input by biomass burning and biogenic, plant-produced, volatile organic compounds (VOCs).
- Declines in DOC concentration were likely caused by decreases in anthropogenic carbon emissions.

How may DOC deposition change over time and what aspects need further research focus?

- Human activities have changed precipitation chemistry over the past century, which has changed ecosystem nutrient dynamics. Anthropogenic activity will continue to change, which will continue to impact precipitation chemistry and DOC deposition.
- The role of DOC deposition and precipitation chemistry in ecosystem processes, as well as precipitation pH, carbon chemistry, and interactions with other solutes should be investigated more fully.
- Deposition of DOC at tropical sites should be more fully investigated by increasing the number and density of long-term collection sites in low latitudes.

How can these findings be used going forward?

- Both wet and dry deposition should be combined to determine the total deposition at each site.
- Global estimates of carbon deposition should use different values for temperate and tropical regions because DOC concentrations are significantly higher in tropical latitudes.
- Atmospheric deposition of DOC may be an important factor for understanding ecosystem dynamics because it tends to have a high proportion of low molecular weight material that is thought to be readily bioavailable.

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Keywords dissolved organic carbon, atmospheric deposition, terrestrial carbon influx, precipitation chemistry, carbon cycling, global synthesis

Images

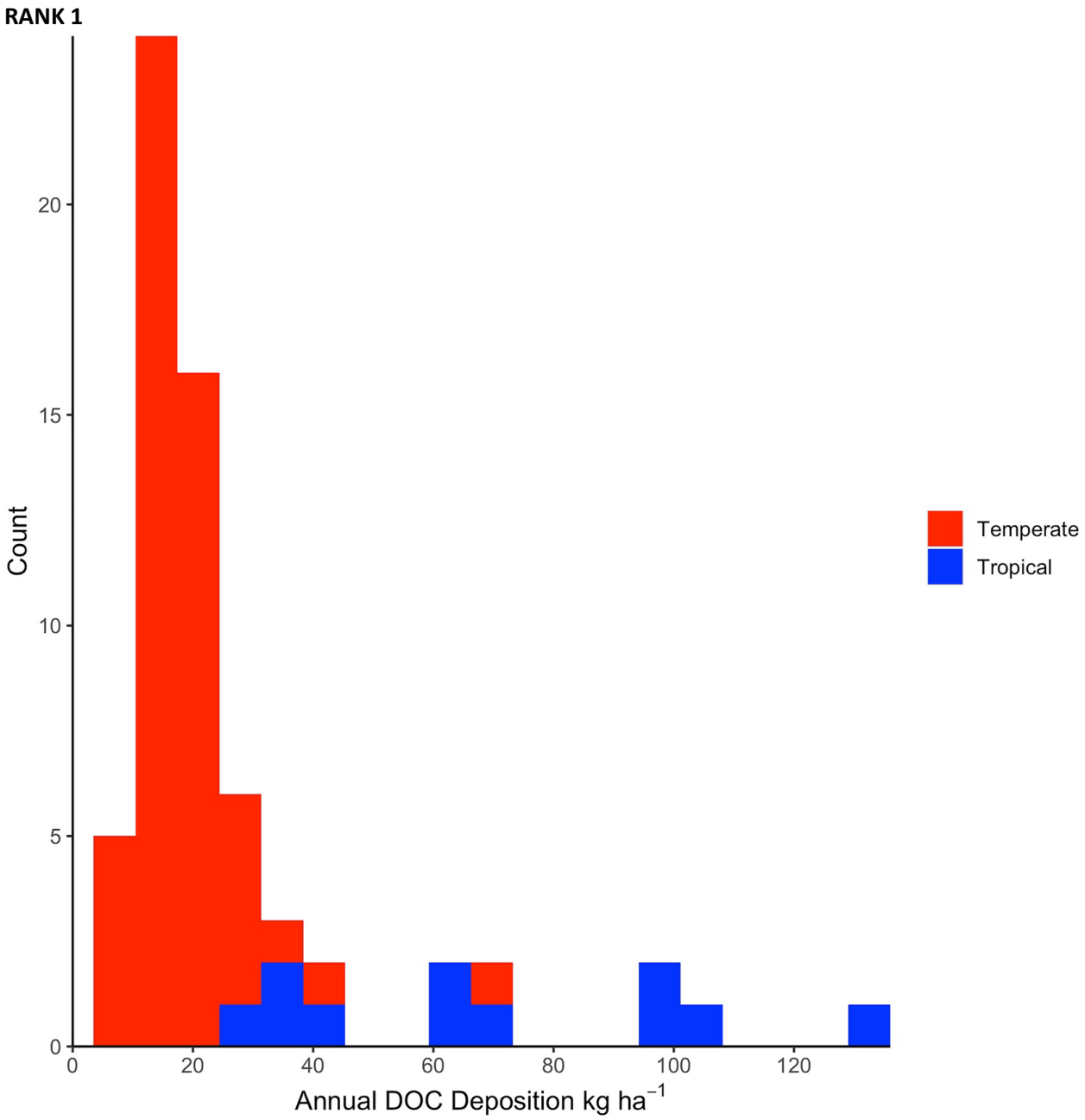

Figure 2 from paper. Histogram of annual dissolved organic carbon (DOC) deposition (kg ha −1) by site for sites with bulk deposition collectors.

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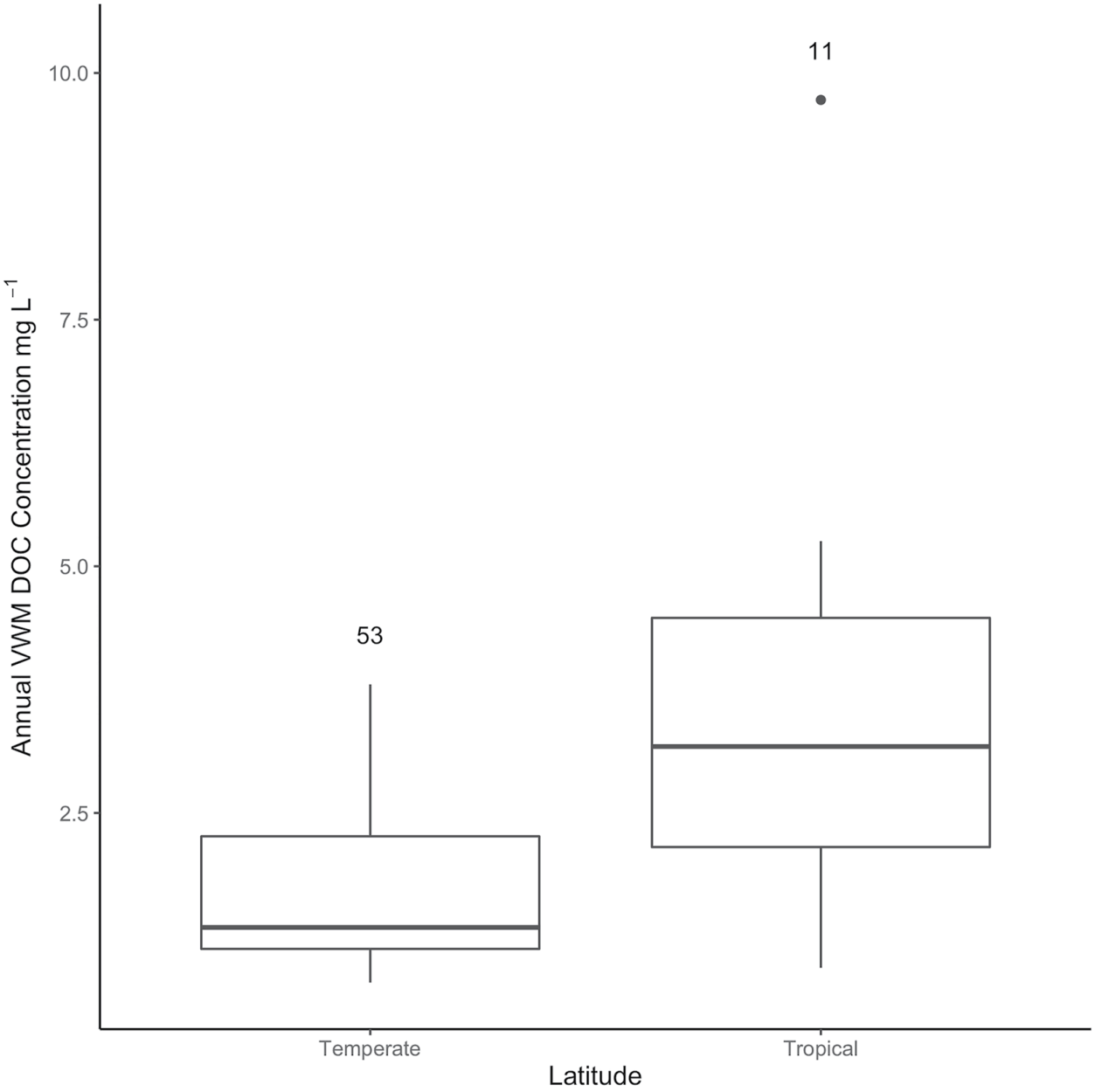

Figure 4 from paper. Boxplot of site-level volume weighted mean (VWM) dissolved organic carbon (DOC) concentration at sites with bulk deposition collectors at temperate (>25°) or tropical (<25°). The central line is the median, the upper and lower edges of box are 75th and 25th percentile, the whiskers are the whole range, excluding outliers, and points are outliers. Numbers above the boxplots are the count of sites in each boxplot.

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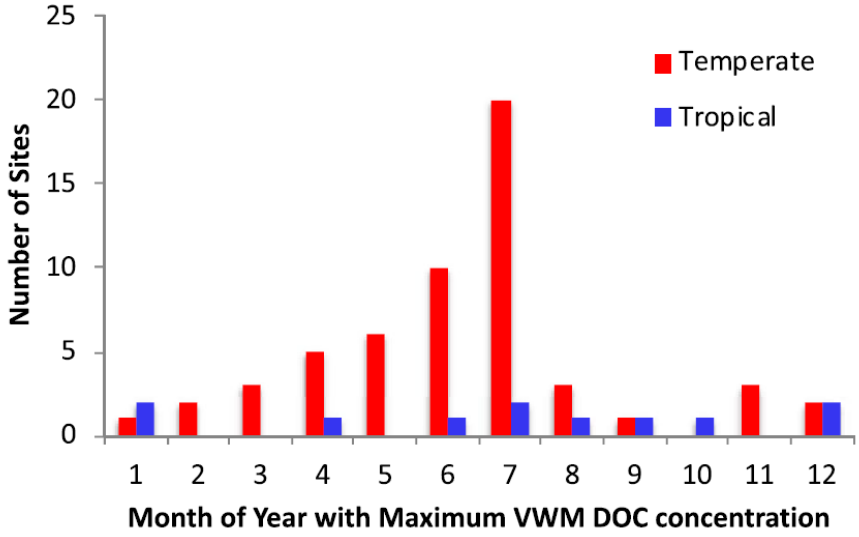

Figure 6 from paper. Histogram of the monthly maximum site-level volume weighted mean (VWM) dissolved organic carbon (DOC) concentration for tropical and temperate sites.

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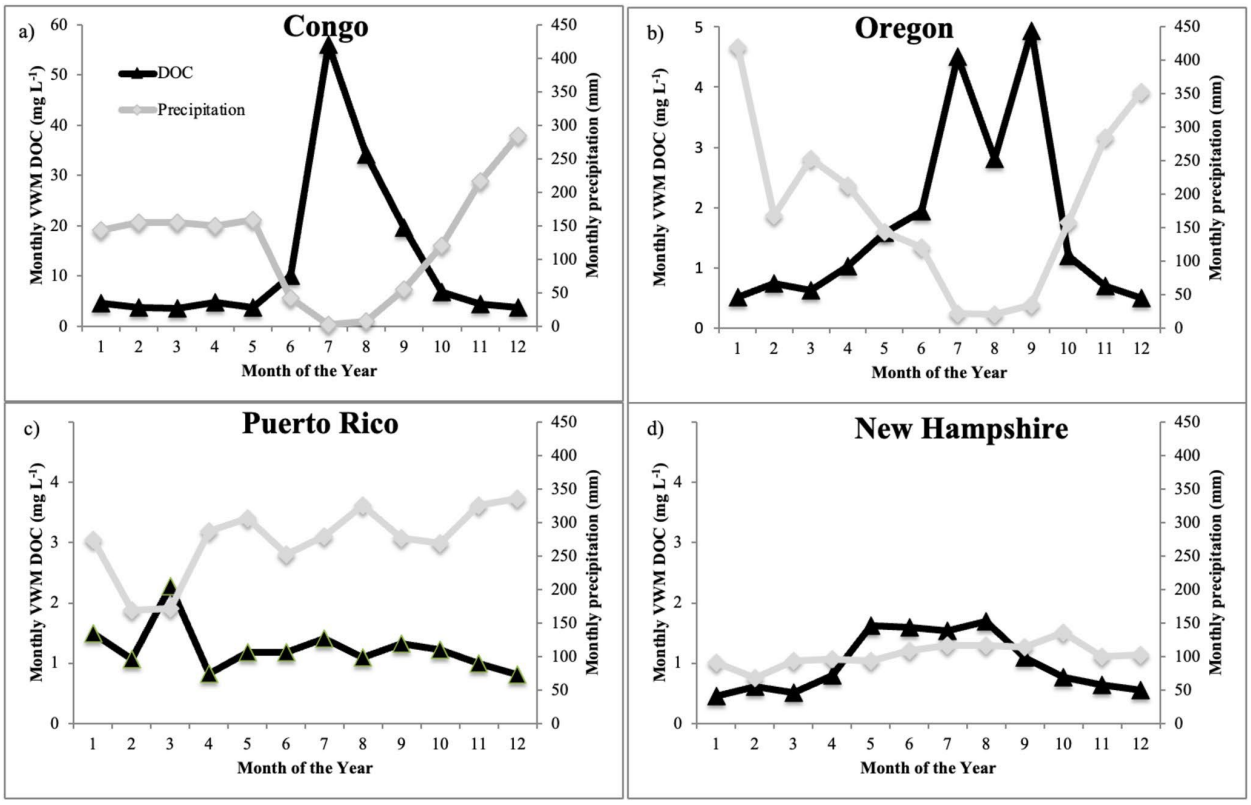

Figure 5 from paper. Volume weighted mean (VWM) monthly dissolved organic carbon (DOC) concentrations in bulk deposition and monthly precipitation for two tropical (a, c) and temperate (b, d) and strongly seasonal (a, b) and weakly seasonal (c, d) in terms of precipitation. Further information about these sites is vailable in Table S1. Both vertical axes are scaled the same on all plots except for VWM DOC concentrations in plot a.