Water extractable DOC and DON in urban soils: Effects of exposure time to sodium

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Introduction

Urbanization has been increasing dramatically in recent years and has been shown to change soil chemistry. Addition of sodium to urban soils is hypothesized to change the composition of water extractable soil dissolved organic matter (DOM). Sodium sources include deicing salts, seas salt deposition and high sodium irrigation water. As sodium increases in the soil it replaces cations potentially resulting in anionic DOM loss to balance electro-neutrality of soil solution and runoff. An indication of high soil sodium is increased pH which will solubilize the humic acid fraction of DOM. The objective of this study was to examine the effect of sodium source and a soils exposure time on water extractable DOC and DON.

Methods

Experimental Design:

Samples were taken from Frederick, MD (n=36) where soils are exposed to deicing salts, Bryan-College Station, TX (n=34) where soil is exposed to sodic irrigation water, and Galveston, TX (n=35) where soils are exposed to sea salt deposition. Samples were collected from (1) single family homes and (2) roadside for exposure times of 1) 0-5 years, 2) 6-10 years, 3) 11-20 years, 4) 21-30 years and 5) > 30 years.

Soil Processing

Soil samples of 15 cm depth were collected, air dried and sieved (2 mm). 30 mL ultrapure water was added to 3 g of soil and shaken for 2 hours. Samples were centrifuged at 19,000 g-force for 15 minutes

Chemical Analysis:

Electro-conductivity, and pH were recorded and DOC and DON were analyzed using the filtered supernatant.

Statistical Analysis:

Univariate analysis of variance was performed with DOC and DON as dependent variables and sodium source, landscape position and exposure time as independent factors.

Results and Discussion

- In BCS and Frederick DOC desorption from soil continued at an increasing rate until soil age of 21-30 yrs when the rate begins to decline.
- In Frederick less DOC was desorped from soil, potentially because of lower soil pH
- Galveston DOC concentrations increased linearly, possibly due to lower inputs of sodium from oceanic deposition

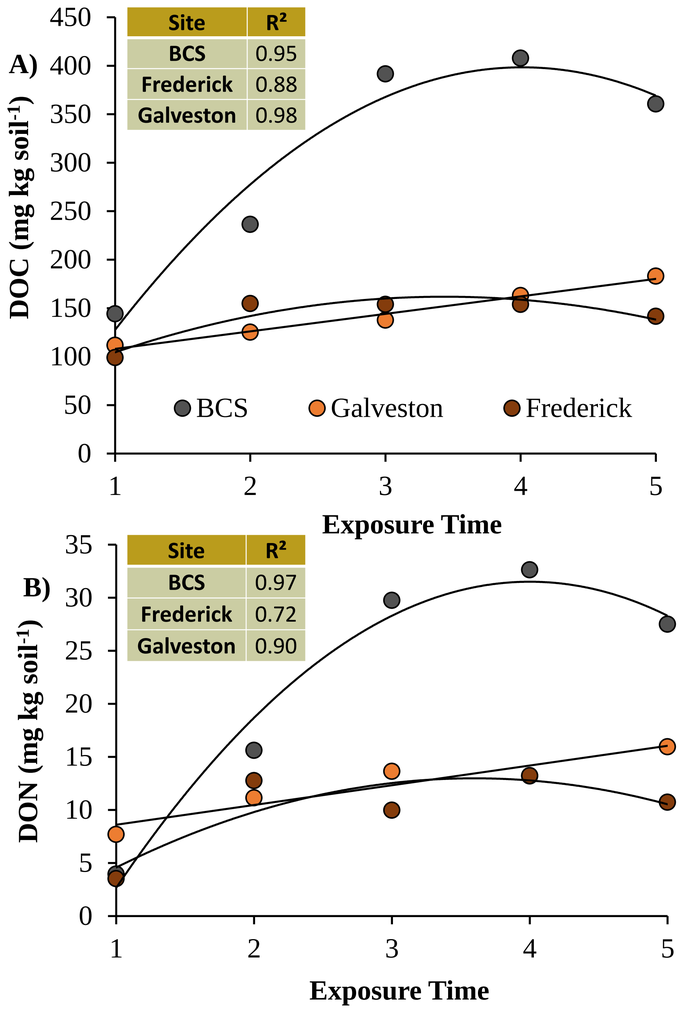

Figure 1. A) Water extractable DOC and B) DON with differing exposure times to sodium.

- DOC and DON concentrations are positively correlated with pH
- DOC and DON are strongly and significantly related

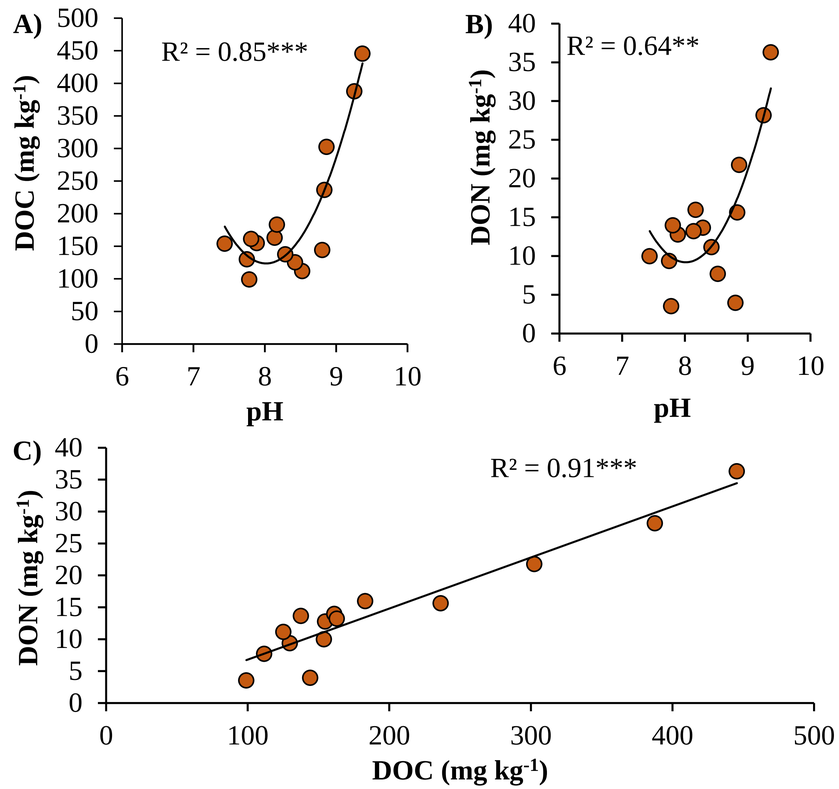

Figure 2. A) Relationship between water extractable DOC and pH B) DON and pH and C) DOC and DON. Each point is the mean of each exposure time (n=5) for each city (n=3)

Conclusion

- Water extractable DOC and DON loss decreases after 30 years. This could be due to most soluble forms being mobilized from soil or a stabilization of soil chemistry.
- Sodium concentrations have not yet been measured, but sodium increases soil pH by changing ion dominance of CEC. With DON and DOC being positively correlated with sodium, it is likely that sodium as it replaces other cations including H^+ on soil exchange sites increases pH which increases the solubility of the humic acid fraction of DOC, decreasing DOM in soil and increasing runoff of DOC, DON, Mg and K in surface water..