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DATA NOTE

Carbon, nitrogen, and water stable isotopes in plant tissue and soils across a moisture gradient in Puerto Rico

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Abstract

Stable isotopes in the water molecule (^{2}H or D and ^{18}O), carbon, and nitrogen are useful tracers and integrators of processes in plant ecohydrological systems across scales. Over the last few years, there has been growing interest in regional to continental scale synthesis of stable isotope data with a view to elucidating biogeochemical and ecohydrological patterns. Published datasets from the humid tropics, however, are limited. To be able to contribute to bridging the "data gap" in the humid tropics, here, we publish a relatively novel and unique suite of δ^{13}C, δ^{15}N, δ^2H, and δ^{18}O isotope data from three sites across a moisture gradient and contrasting land use in Puerto Rico. Plant tissue (xylem and leaf) samples from two species of mahogany (*Swietenia macrophylla* and *Swietenia mahagoni*) and soil samples down to 60 cm in the soil profile were collected in relatively "wet" (July 2012) and "dry" (February 2013) periods at two sites in northeastern (Luquillo) and southwestern (Susua) Puerto Rico. The same sampling suite is also being made available from a highly urbanized site in the capital San Juan. Leaf samples taken in July 2012 and February 2013 were analyzed for δ^{13}C and δ^{15}N; all xylem and bulk soil samples were analyzed for δ^2H and δ^{18}O. Soil samples taken in July 2012 were analyzed for δ^{13}C and δ^{15}N. Leaf δ^{15}N and δ^{13}C dataset showed patterns that are possibly associated with site differences. While spatial patterns were also apparent in soil δ^{15}N and δ^{13}C dataset, the positively linear δ^{15}N –δ^{13}C relationship tends to weaken with site moisture. Soil depth and site moisture patterns were also observed in the δ^2H and δ^{18}O datasets of bulk soil and xylem samples. The purpose of these datasets is to provide baseline information on soil–plant water (δ^2H and δ^{18}O, N = 319), δ^{13}C (N = 272), and δ^{15}N (N = 269) that may be useful in a wide range of research questions from ecohydrological relations to biogeochemical patterns in soils and vegetation.

1 | METHODS

The site in northeastern Puerto Rico (Luquillo Mountains) sampled was Rio Chiquito near Sabana (18 °19′ N, 65 °43′ W) at an elevation of approximately 160–207 m above sea level (a.s.l.), with mean annual rainfall (1988–2002) of ~3,700 mm. A second study site is located on the southern extreme of the Susua Forest Reserve, along the banks and upper slopes of the Rio Loco (18 °04′ N, 66 °54′ W) at an elevation of 132–172 m a.s.l., with estimated mean annual rainfall of 1,200 mm. Both Luquillo and Susua sites are protected forests. A third site is situated in between the first two sites in the highly urbanized setting of the capital San Juan (18 °23′ N, 66 °03′ W) at an elevation of 10–25 m a.s.l., with mean annual rainfall of 1,798 mm. Samples were collected over two field seasons, during a relatively "wet" (July 2012) and "dry" (February 2013) periods. Rainfall at the Luquillo site is >300 mm/month (between May and October) and <200 mm/month (between January and April) during wet and dry periods, respectively. Rainfall at the Susua site is ~100 mm/month (between May and October) and <30 mm/month (between January and April) during wet and dry periods, respectively. The site in San Juan was sampled only in July 2012 (<170 mm/month between May and October).

Xylem and bulk soil water were extracted using cryogenic vacuum distillation. Extracted water was then analyzed for δ^2H and δ^{18}O on a cavity ring-down spectroscopy (Picarro L2130-i, Santa Clara, CA). Both extractions and isotope analyses were performed at the Stable Isotope Ratio Facility for Environmental Research at the University of Utah, USA. Picarro's Micro-combustion Module was used to eliminate any organic interferences. To address the concerns for potential errors associated with the technique, however, compared to the traditional isotope ratio mass spectrometry (IRMS) technique, we randomly selected samples for comparison of the two methods. The randomly selected samples were compared to a CO_2 equilibration method on the IRMS

(Thermo MAT 253, Waltham, MA, USA). Results of the comparison showed that the values generated from both techniques were not significantly different (values ranged from 0.2–0.6‰ $\delta^{18}O$) for both tree xylem water and bulk soil water samples. Laboratory precision for $\delta^{2}H$ and $\delta^{18}O$ was no greater than 1.1‰ and 0.2‰, respectively.

We also sampled mahogany leaves and soils for $\delta^{13}C$ and $\delta^{15}N$ analyses at Stable Isotope Ratio Facility for Environmental Research. The leaves were taken from the same section of the branch where twig samples were taken for tree xylem water isotope analyses. Soils were sampled down to 30 cm from the surface at 10-cm interval. $\delta^{13}C$ and $\delta^{15}N$ were measured via combustion on an elemental analyzer coupled to an IRMS (Thermo MAT 253, Waltham, MA, USA). Laboratory precision for $\delta^{13}C$ and $\delta^{15}N$ was <0.2‰.

All isotope ratios are expressed in per mil (‰) and reported relative to Vienna-Standard Mean Ocean Water, Vienna-PeeDee Belemnite, and N2-atmosphere standards for $\delta^{2}H$ and $\delta^{18}O$ in soil and xylem water and $\delta^{13}C$ and $\delta^{15}N$ isotope ratios, respectively. In addition to isotopes, weight % N, weight % C, and C:N ratio are also provided as applicable.

2 | RANGE OF APPLICATIONS THAT THE DATA MAY HAVE IN HYDROLOGY

Soil–plant–water relations; soil biogeochemical nutrient cycling and moisture relations; foliar C and N isotopes as integrators of biogeochemical processes and water relations.

3 | CONTRIBUTORS AND OWNERSHIP OF DATA

Samples were collected by J. Evaristo with help from two graduate students (Kaizad Patel and Chennery Fife) of the University of Pennsylvania (UPenn). J. J. McDonnell worked with J. Evaristo in data quality assurance. J. Evaristo retains ownership of data.

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DATA MAY BE ACCESSED AT:

Jaivime Evaristo and Jeffrey McDonnell. 2016. Puerto Rico C, N, water stable isotopes. KNB Data Repository. doi:10.5063/F1W9573R.

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