Supplement of Biogeosciences, 17, 6207–6218, 2020
https://doi.org/10.5194/bg-17-6207-2020-supplement

Biogeosciences Open Access EGU

Supplement of

Seasonality, drivers, and isotopic composition of soil CO_2 fluxes from tropical forests of the Congo Basin

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1 Method supplement

1.1 δ^{13}C measurement of air samples with the Gasbench

Carbon isotopic composition of CO_2 in gaseous samples were measured with a modified Gasbench II periphery (Finnigan MAT, Bremen, D) coupled to an isotope ratio mass spectrometer (Delta^{plus}XP; Finnigan MAT; modification as described by Zeeman et al. (2008)). In short, the modification of the Gasbench comprised the replacement of the GC-type split by a ConFlo III-like split and the addition of a home-built cold trap (1/10" SS capillary filled with Ni-wire, Goodfellow GmbH, Bad Nauheim, D) instead of the standard sample loop of the 8-port valve inside the Gasbench II. The gas mixture in the exetainer was transferred to the cold trap after piercing the septum with a vendor-supplied double-holed needle connected to two capillaries (fused silica and 1/32" steel capillaries). The feed capillary delivered pure He allowing a pressure build-up in the exetainer which flushed the sample gas at a rate of about 0.5 mL/min over Nafion dryers to the cold trap where condensible gases (mainly CO_2 and N_2O) were frozen out with liquid nitrogen. The cold trap was connected to a pressurized Dewar vessel and equipped with a computer-controlled automatic refill unit (Zeeman et al., 2008) allowing automatically refilling of the cold-trap. After diverting the non-consensible gases to a vent, the cold trap was thawed and the content of the cold trap was automatically injected on a GC column (Poraplot Q 25 m x 320 mm i.d. (Varian, Walnut Creek, USA) held at 24°C) to allow separation of the isobar gases CO_2 and N_2O. Post-run off-line calculation and drift correction for assigning the final δ^{13}C values on the V-PDB scale were done following the "IT principle" as described by Werner and Brand (2001). The δ^{13}C- (and δ^{18}O-) values of the laboratory air standards were determined at the Max-Plack-Institute for Biogeochemstry (Jena, D) according to Werner et al. (2001). The linking of the measured δ^{13}C (and δ^{18}O) values of CO_2 gas isolated from air samples relative to the carbonate V-PDB scale was done via the Jena Reference Air Standard (JRAS), perfectly suited to serve as a primary scale anchor for CO_2–in-air measurements. The measurement of the aliquots of the laboratory standards was routineously better than 0.15 ‰.

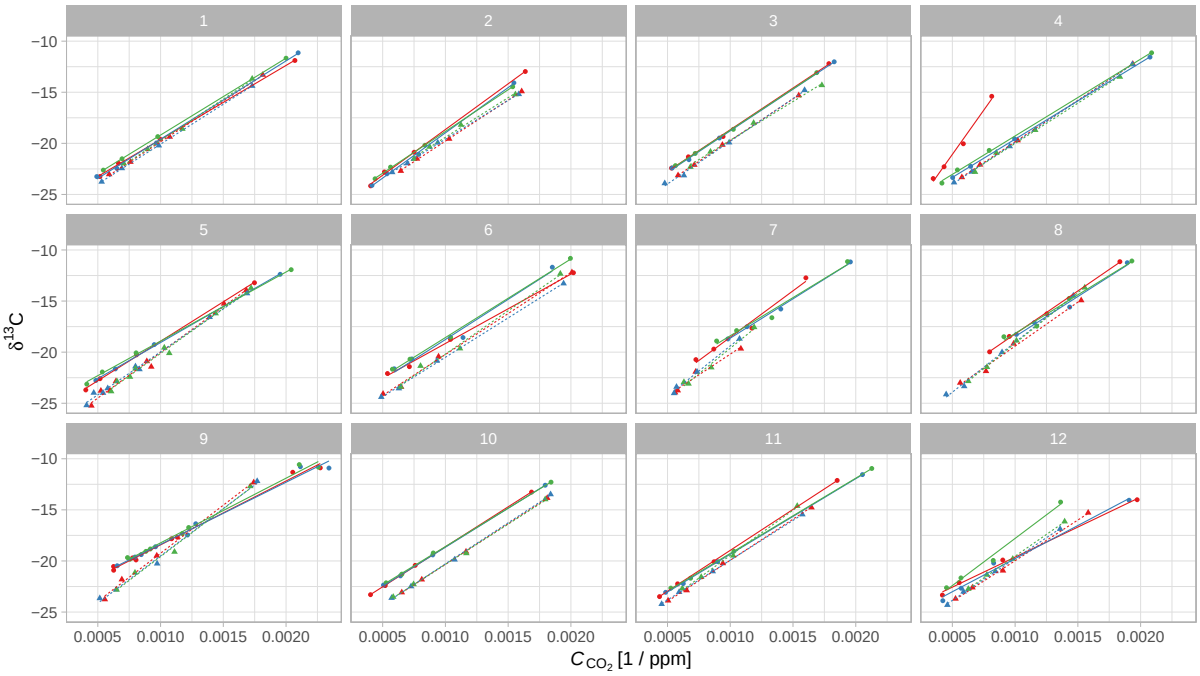

Figure S1. Shown are all individual Keeling plots for each chamber replicate (coloured, n = 3) per site and per month of Kahuzi-Biéga (circles, solid lines) and Yoko (triangles, dashed lines) forest sites.

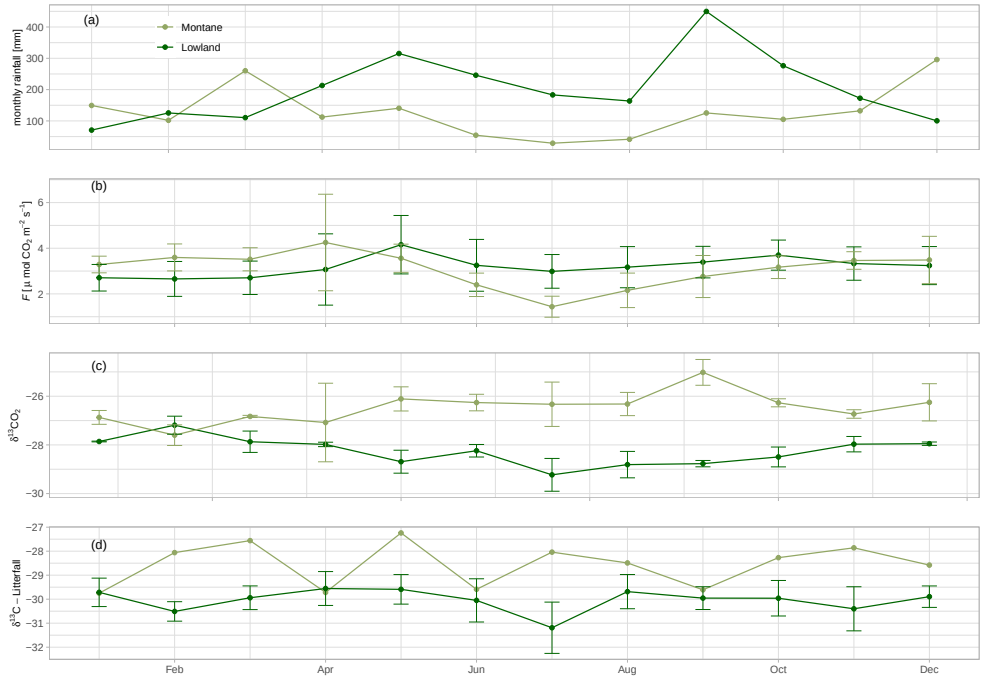

Figure S2. a) Monthly rainfall in mm at a lowland site in Yangambi and in Bukavu near the montane site. b) Monthly median CO_2 fluxes in the lowland and montane forests. c) Monthly median $\delta^{13}C$ values of the soil respired CO_2. d) Monthly $\delta^{13}C$ of litter in montane and lowland forests. Error bars indicating standard deviation.

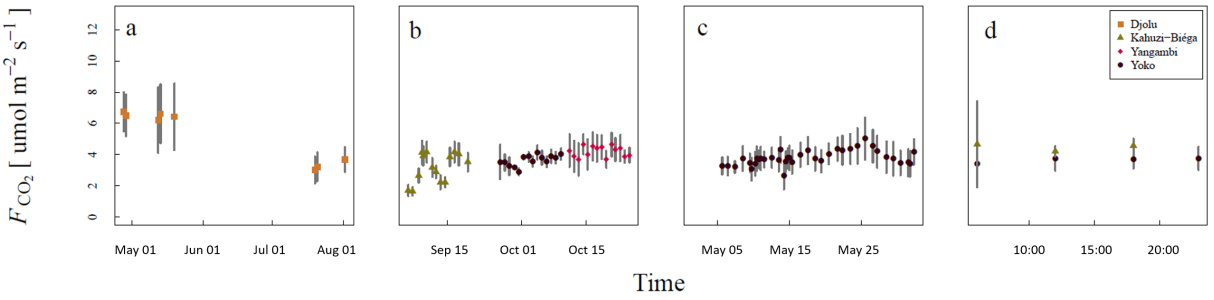

Figure S3. Median CO_2 fluxes with errorbars indicating standard deviation. a) Sampling campaign in a lowland forest in Djolu between May and August 2016. b) Sampling campaign in Kahuzi-Biéga (montane forest) Yoko and Yangambi (lowland forests) in September and October 2016. c) Sampling campaign in Yoko in May 2017. d) Sub-daily sampling in Kahuzi-Biéga and Yoko. x-Axis shows the hour of the day.

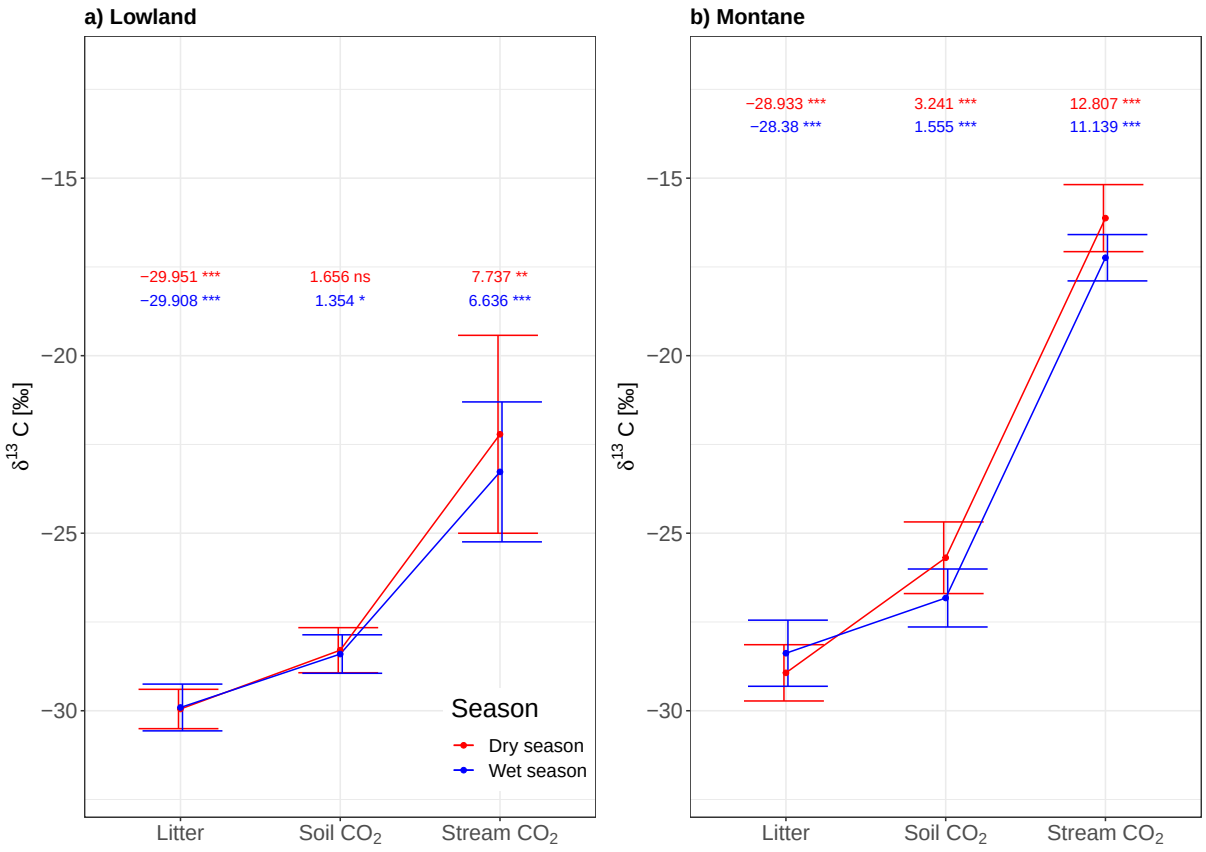

Figure S4. Seasonality of δ^{13}C values from different compartements in the lowland forest (a) and montane (b) forest. Plot showing mean values with errorbars indicating the standard deviation. Soil δ^{13}C values are not included, as they were not sampled in different seasons. Numbers on top indicate the effect sizes of the two separate (wet and dry season) linear mixed effects models. Left numbers are intercept, all subsequent numbers - soil CO_2 and stream CO_2 - are effect estimates relative to the litter.

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