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Combining moving inlets for measuring gradients of reactive trace gases and thoron measurements for the determination of near surface fluxes -first results from the Amazon rain forest-

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For many compounds of interest no fast response sensors for the determination of eddy covariance fluxes are available. Therefore, flux-gradient relationships are used. The most common are the aerodynamic gradient method and the modified Bowen ratio method. For those approaches some assumptions have to be made which restrict their use. An alternative approach to calculate these fluxes might be given by the “thoron clock” method. The radon isotope Thoron (220Rn) is exhaled from the soil and has a half life time of 56 seconds. Therefore, it exists in measureable amounts only close to the ground and is hardly advected. Its only source is the radioactive decay of Thorium in soil. As it is a noble gas Thoron is not influenced by biochemical processes in air. Consequently, its concentration profile only depends on vertical mixing and the radioactive decay which is a physical constant. According to Lehmann et al. (1999) and Plake and Trebs (2013) a transport-time can be directly calculated from two heights thoron concentration/activity for the layer in-between without further assumptions. From this transport time the transfer velocity is derived which is then applied to calculate the fluxes of other (reactive) trace gases. A major advantage of the method is that the transport-time is known and using the measured concentration profile the chemical loss of a compound can be directly calculated and corrected for.
We have applied this method for a first time in the Amazon rainforest during a field campaign at the ATTO site 150 km North East of Manaus in the dry season of 2014. We measured gradients of NO, NO_2, O_3, HONO and VOCs by using a movable inlet on a lift system close to the forest floor (0.19 m, 0.52 m and 1.59 m). A Thoron profile was measure in parallel at the lower two heights. First results of the gradients, the transport times and some preliminary flux values will be presented.

References:

Lehmann, B.E., Lehmann, M., Neftel, A .: 220 Radon calibration of near-surface turbulent gas transport, Geophysical Research Letters, 5, 607–610, 1999.

Plake, D. and Trebs, I.: An automated system for selective and continuous measurements of vertical thoron profiles for the determination of transport times near the ground, Atmos. Meas. Tech., 6, 1017-1030, doi:10.5194/amt-6-1017-2013, 2013.