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Evaluation and gap-filling of soil NO flux dataset measured at a Hungarian semi-arid grassland

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An Integrated Project ÉCLAIRE (http://www.eclaire-fp7.eu/) started in 2011 among others to study the effect of climate change on air pollution impacts. One of the main measurement tasks of this project was the continuous monitoring of soil NO emission at different kinds of lands (forest, arable, grass). Among the tree grass stations Bugacpuszta (central part of Hungary between the Danube and the Tisza) was selected to monitor and report soil NO fluxes continuously for 17 months on hourly basis. The climate is semi-arid temperate continental, the mean annual temperature is 10.7 °C, and the average annual precipitation is around 550 mm.

Nitric oxide soil emission flux was measured by 2–2 parallel manual and auto dynamic chambers on hourly basis above a semi-arid, sandy grassland between August 2012 and January 2014.

Each chamber was sampled for 10 minutes at a flow rate of 2 L min^{-1} in sequence each hour all together for 40 minutes; in the remaining 20 minutes concentration gradients were measured by a mast at two heights. Soil temperature and moisture were measured a few meters apart from the chambers. A computer controlled valve system was switched the different channels in turn. The output concentrations of nitric oxide and ozone were measured by HORIBA gas monitors through Teflon tubing. Micrometeorological measurements (energy budget components, CO_2 and O_3 fluxes) were also provided.

The initial NO flux datasets covered 43–85% of time period depending on chambers. Measured flux data ranges within 0–6 nmol m^{-2} s^{-1}. We applied a gap-filling method based on multivariable analysis (Sigma Plot) combined with maximum likelihood method using the soil temperature and moisture data. Trend of gap-filled flux dataset shows large peaks mostly in summer and early fall. When soil parameters are far from the optimum (dry, warm conditions) the fluxes are negligible. Application of manual chambers closed for longer period results in substantial positive bias in flux estimation compared to auto chambers a consequence of measurement setup, different temperature and drier soil conditions below the chamber. Mean fluxes applying permanently closed dynamic chambers are approximately three times higher compared with auto chambers, 0.176 $\pm$0.489 nmol m^{-2} s^{-1} and 0.058 $\pm$0.130 nmol m^{-2} s^{-1} respectively from the all measured and gap filled data.