



## **Long term concentration gradient measurements of trace gases (ozone, nitrogen oxides and ammonia) for flux calculation; results and uncertainties**

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Hourly  $O_3$ -NO-NO<sub>x</sub> concentration profile measurements above a semiarid grassland (Bugacpuszta, NitroEurope IP, Level3) were analysed on the basis of four year measurements (2006–2010). Yearly, seasonal and mean daily variations of concentration gradients and fluxes were investigated in the lower 4 m layer using measurements at 4 levels with 5 min time average. Surface layer turbulence parameters (momentum, sensible and latent heat fluxes) were calculated from eddy covariance measurements. The daily macro-circulation catalog of Péczely is used for macrosynoptic weather types.

The limitations of gradient measurements (non- monotonic profiles, type of universal functions, time shift of concentration measurements in different levels, areal and temporal fluctuations of concentrations, advection, etc.) were also investigated. Negative ozone gradients were detected many times above 1-3 m from surface in summer accompanied by high radiation. Relatively high NO<sub>x</sub> and very low NO concentrations (in most cases close to detection limit) were measured, therefore the NO flux calculation was uncertain.

Results of ammonia concentration and flux measurements with a novel photoacoustic instrument (WaSul-Flux – developed at the University of Szeged) are also summarized. These results include long term concentration data obtained at Bugacpuszta together with a few seasonal gradient data; as well as results of three measurement campaigns (Easter bush, Scotland, Choryn, Poland and Bjerringbro, Denmark). Uncertainty and limitation of gradient and flux calculation were also investigated