Reproducing Instrumental Ozone Flux Measurements in the Harvard Forest Using A Trace Gas Method

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Tropospheric ozone (O3) is a pollutant that causes atmospheric haze, poses a threat to human health, and damages plants. The Harvard Forest research facility has a short instrumental ozone flux (FO3) record from October 1992-December 2001, and past studies have used these measurements to study diurnal and seasonal FO3 cycles. However, long term and inter-annual processes controlling patterns of flux are still uncertain. We attempted to reproduce these reliable instrumental “eddy covariance” flux measurements of ozone using the Modified Bowen Ratio, or trace gas equation, to reconstruct a 30 year record to identify long-term, inter-annual trends. Assuming all gases move together, the equation, calculates an unknown flux (FO3) from a known flux of a different gas (FCO2) and the above canopy concentrations from both gases (Δ[O3] and Δ[CO2]). All data used was collected in the Harvard Forest in Petersham, MA. This reproduced an approximation of the instrumental hourly diurnal cycle of FO3 for the growing season (July and August) as well as the seasonal cycle for the 10-year period. However, on a yearly scale, only some years matched in magnitude and pattern, with some underestimating flux, bearing noise, or large (+-100 e-6 mol/m2 s) uncertainty. The study is still in progress, and we use a method based in air dynamics to calculate fluxes for non-growing season months. Since the 1980’s, the threat of tropospheric O3 from anthropogenic sources has lessened significantly (not entirely), so removal of ozone through deposition in forests is much more significant in understanding how ozone levels fluctuate now, and how they may change in the future.