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Impact of Changes in Barometric Pressure on Landfill Methane Emission

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Landfill methane emissions were measured continuously using the eddy covariance method from June to December 2010. The study site was located at the Bluff Road Landfill in Lincoln, Nebraska USA. Methane emissions strongly depended on changes in barometric pressure; rising barometric pressure suppressed the emission, while falling barometric pressure enhanced the emission. Emission rates were systematically higher in December than during the summer period. Higher methane emission rates were associated with changes in barometric pressure that were larger in magnitude and longer in duration in winter than in summer, and with lower mean temperatures, which appeared to reduce methane oxidation rates. Sharp changes in barometric pressure caused up to 35-fold variation in day-to-day methane emissions. Power spectrum and ogive analysis showed that continuous measurements over a period of at least 10 days were needed in order to capture 90% of total variance in the methane emission time series at our site. Our results suggest that point-in-time methane emission rate measurements taken at monthly or even longer time intervals using techniques such as the tracer plume method, the mass balance method, or the closed-chamber method may be subject to large variations because of the strong dependence of methane emissions on changes in barometric pressure. Estimates of long-term integrated methane emissions from landfills based on such measurements will inevitably yield large uncertainties. Our results demonstrate the value of continuous measurements for quantifying total annual methane emission from a landfill.