DIRECT CONTINUOUS MEASUREMENTS OF METHANE EMISSIONS FROM A LANDFILL

Method, Station and Latest Results

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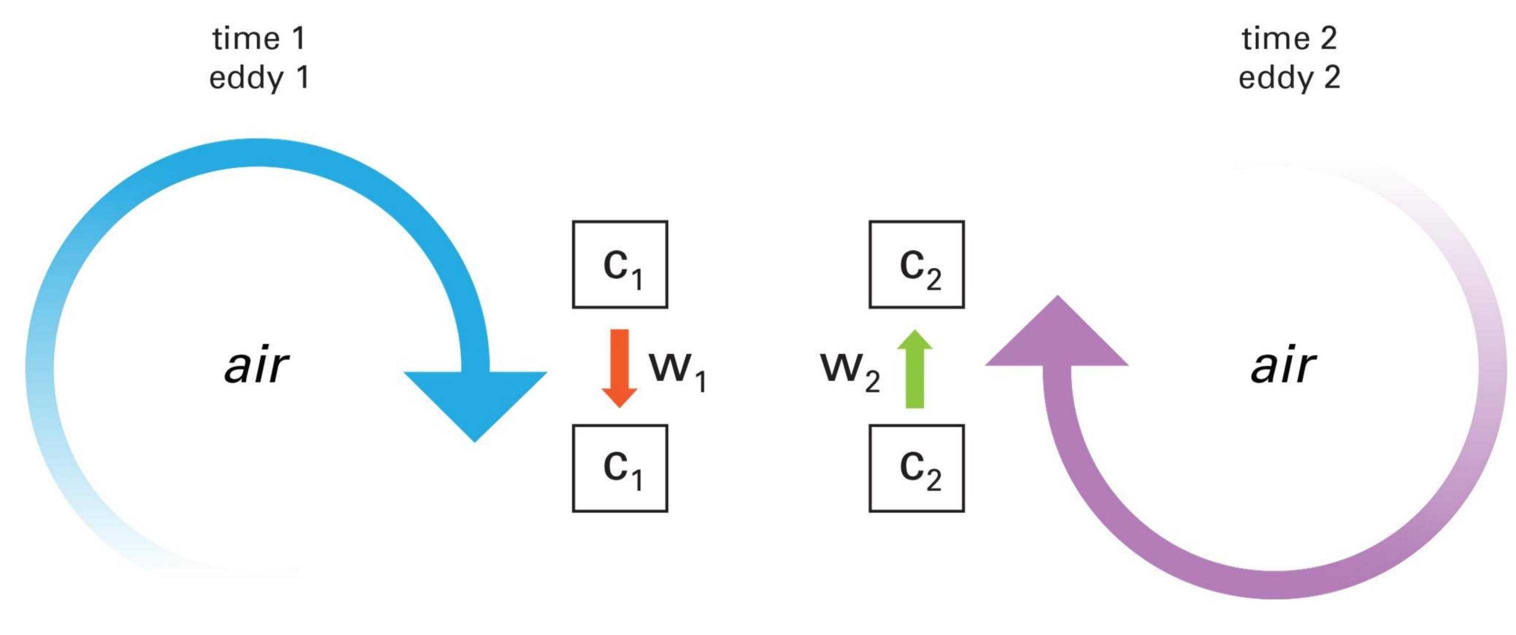
INTRODUCTION

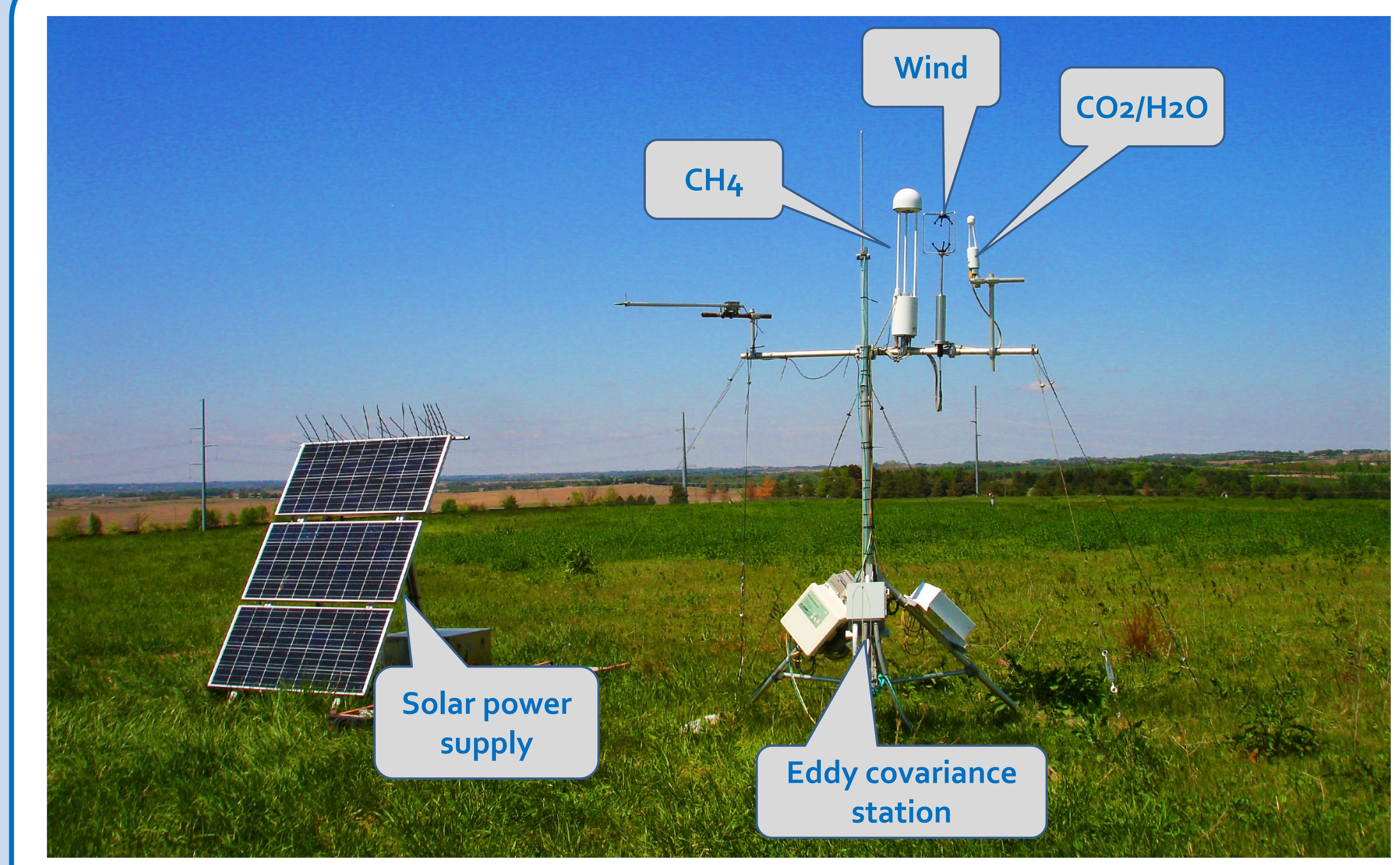
- Majority of year-round ecosystem-level CO_2, CH_4, and H_2O emissions measurements are presently done using eddy covariance method [1-3], with over 600 stations operating in over 120 countries, providing:
  - ✓ accurate measurements with high temporal resolution
  - ✓ time scales from hourly to daily and multi-year periods
  - ✓ detection of any rapid changes due to weather or human events
  - ✓ simultaneous detection of seasonal and yearly dynamics
- These features can be very helpful when investigating CH_4 emissions from landfills which historically have been greatly understudied [4-8]:
  - ✓ highly dynamic nature of actively filled landfill
  - ✓ intermittent and indirect nature of typical landfill measurements
  - ✓ widely variable results and conclusions
- Here we describe latest results from an eddy covariance CH_4/CO_2/H_2O station continuously operating for over 4 years in the center of a city landfill near Lincoln, Nebraska [9]

METHOD



- Wind moves air across the surface, creates turbulent vortices, or eddies
- 3D anemometer measures wind and gas analyzer measures gas content
- Covariance of wind and gas content describes the emission or flux rate
- Such measurements from landfills can help answer the key questions:
  - ✓ how large are direct emissions?
  - ✓ how variable are the emissions?
  - ✓ why do the emissions change?

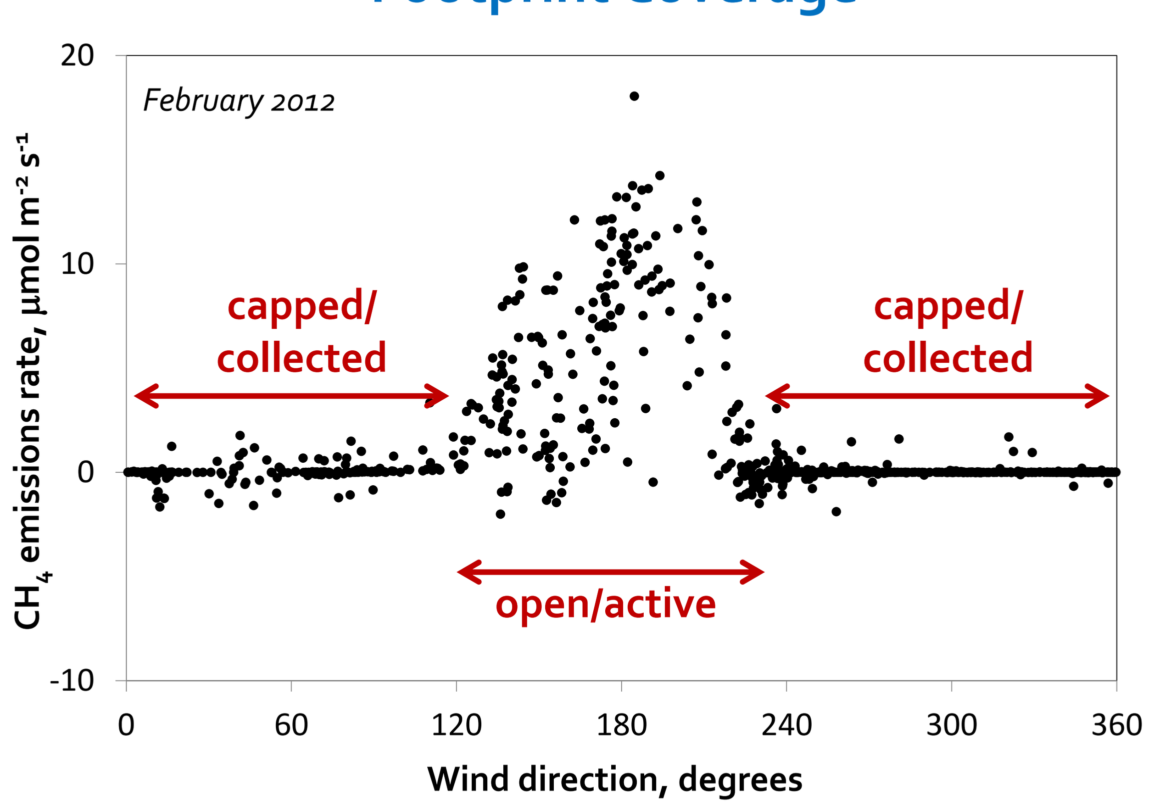
STATION



- Solar-powered wireless station positioned in the center of a landfill
- Automated online flux processing and quality control are used [10]
- Full access to raw data and final fluxes is provided from the office
- This approach helps gather novel results rapidly and with relative ease

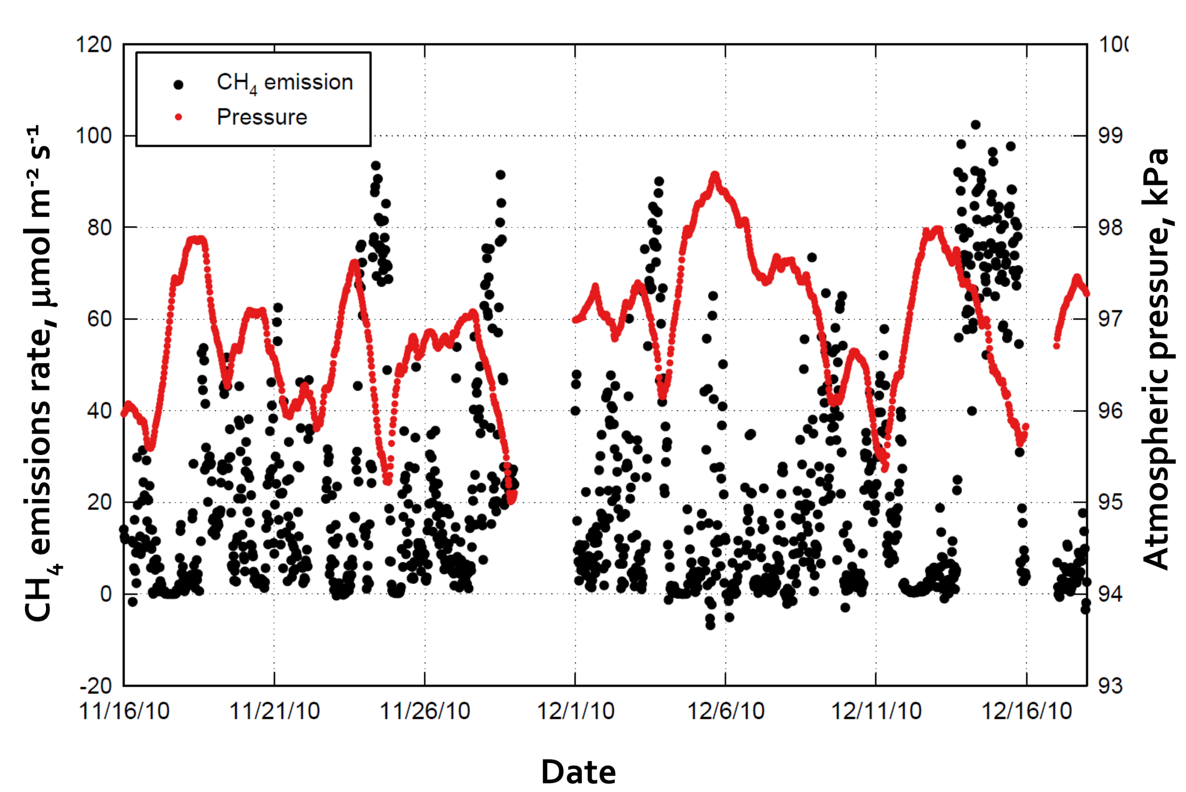
LATEST RESULTS

Footprint Coverage



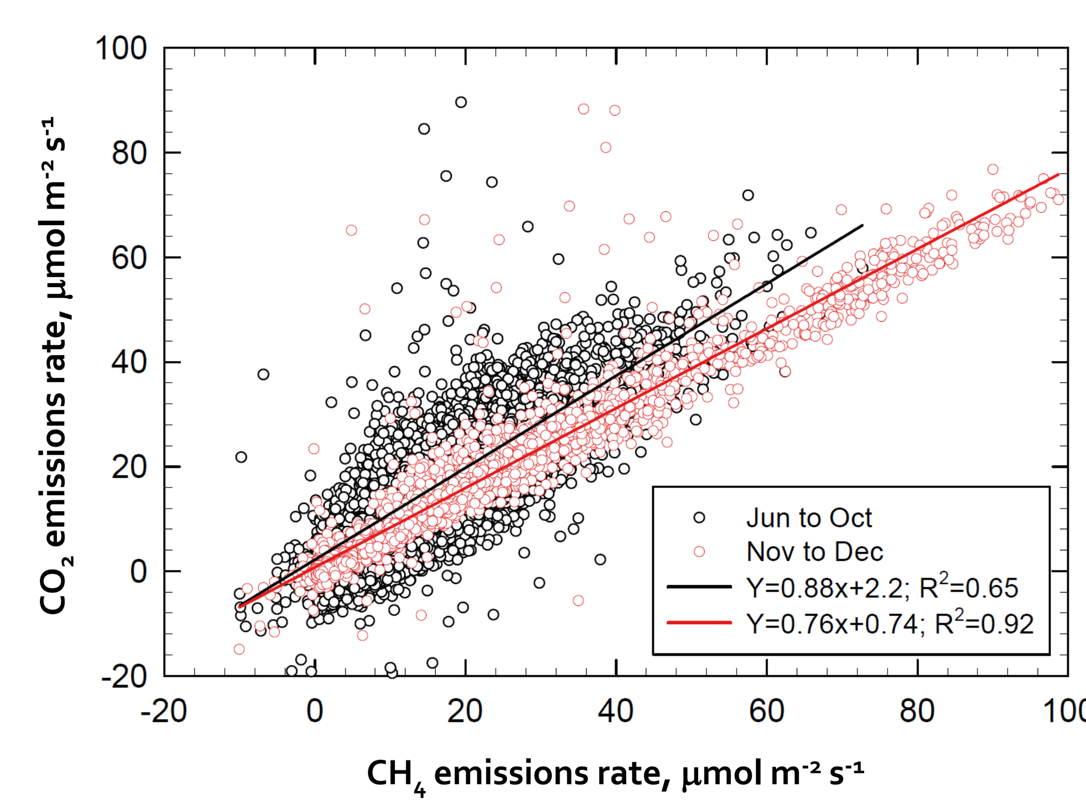
- Natural shifts in the wind direction allow effectively "scan" different parts of landfill at different times
- Effects of landfill capping are clearly evident when winds come from the capped area
- Fluxes from the capped area are reduced by orders of magnitude, from 10-20 μmol m^{-2} s^{-1} to near-zero

Pressure Effects



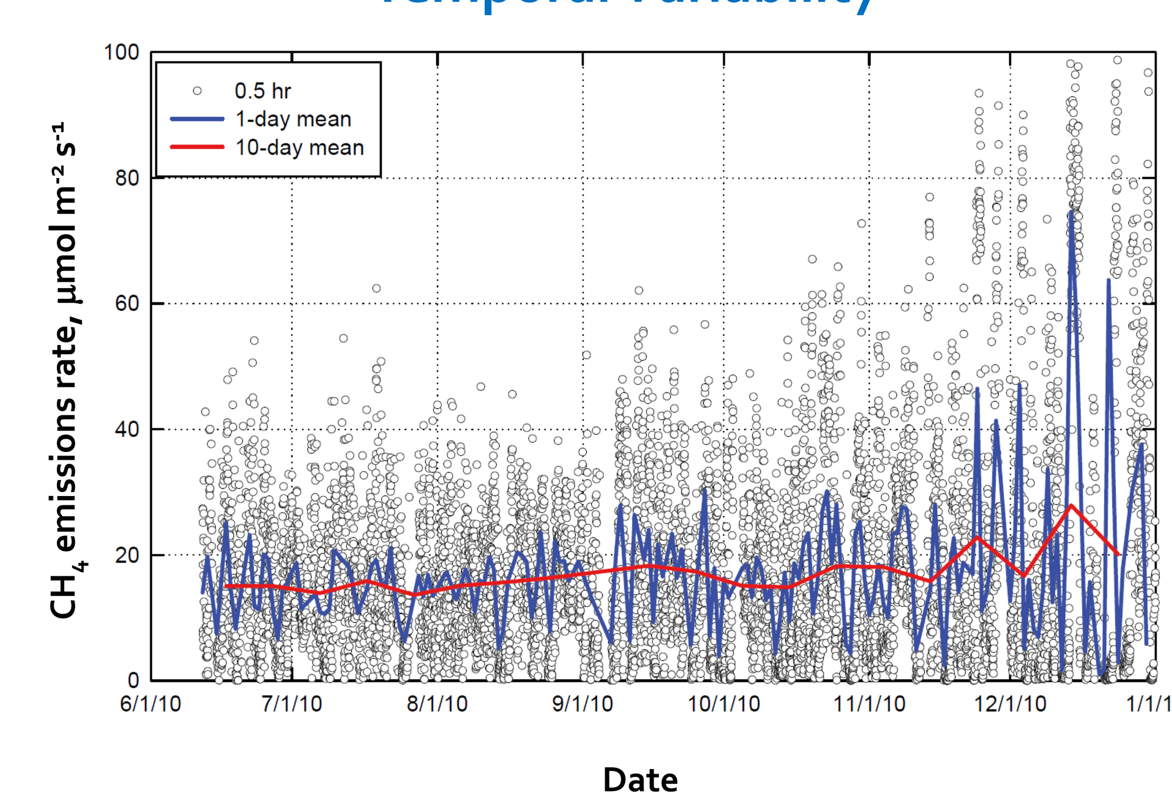
- Continuous measurements show what happens at variable atmospheric pressure
- Effects of changes in atmospheric pressure for this landfill is seen clearly in the plot above
- When pressure increases, fluxes are reduced orders of magnitude, from 60-100 μmol m^{-2} s^{-1} to near-zero

Oxidation Rates



- Concurrent CO_2 and CH_4 measurements allow a glimpse into oxidation process and rates
- Oxidation rates deduced from these data vary from near-zero in winter matching [11], to 7% in summer
- These results are specific to this landfill; results are quite different for a landfill in a different area [12]

Temporal Variability



- Continuous measurements show the extent of temporal variably in CH_4 landfill emissions
- At least 10 days of continuous measurements are needed for each state of weather or a season
- Occasional sporadic measurements of emitted CH_4 can easily be off by a few to tens orders of magnitude

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