

Characteristics of Urban-Ecosystem Atmosphere Fluxes of CO₂, CH₄, N₂O, and ET over Denver, Colorado.

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The majority of the world's population exists in urban ecosystems. Although they cover a small percentage of land area in the conterminous United States, these complex ecosystems are rapidly expanding and are the location of strong emissions of key greenhouse gases. In western states, they are likely to be strong source areas of evapotranspiration (ET) as well.

The surface-atmosphere exchanges of carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O) and water vapor were measured over a ~30 km² portion of Denver, Colorado. Flux measurement methodology included a combination of eddy covariance sensors at two levels on a tall (120m) tower and chamber measurements at 33 locations on the soil surface. Measurement of CO₂ flux and ET has been continuous for more than two years. Chamber measurements of CO₂, CH₄, and N₂O fluxes were conducted on selected dates during growing seasons over a shorter period.

There was both strong temporal and spatial heterogeneity of fluxes owing to characteristics of natural and anthropogenic ecosystem components. Although the urban ecosystem was a net CO₂ source (averaged over a day or longer), tower-based eddy covariance measurements showed it to be a net sink during the majority of mid-day summer hours. This may indicate that the vegetative sink for CO₂ was stronger than anthropogenic emissions from heavy traffic on nearby highways in the flux footprint. Over most dry land surfaces with vegetation, CH₄ flux varied from -0.3 to 2.6 mmol/m²/d while the range in N₂O flux was ~0 to 0.2 μmol/m²/d. For both fluxes, the higher values were found over wet soils (>20%, volumetric). However, at certain locations over a landfill (closed more than 30 years ago) that was converted to commercial uses, a park, and a golf course, CH₄ and N₂O fluxes were many orders of magnitude higher than that found anywhere else in the city. Fluxes varied highly over the landfill but, for the majority of the surface, they were near that found elsewhere in the city. Although Denver is in a semi-arid rangeland, daily total ET from the urban ecosystem was found to be of similar magnitude to that of nearby mountain forests.