Aircraft Measurements of Air Pollutants and Greenhouse Gases in the Mid-Atlantic States

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Motivation

- Mid-Atlantic states occasionally experience severe air smog in summer.
- Urban greenhouse gas (GHG) emissions contribute to the majority (~70%) of the anthropogenic GHG emissions.
- Quantification of urban greenhouse gas (GHG) emissions is important for establishing scientifically sound and cost-effective policies for mitigating GHGs.

Measurements

- GPS Position (Sat, Lat, Altitude)
- MER (E, N, P, wind speed/direction)
- Trace gases:
  - O₃: UV Absorption, modified TEOC
  - NOₓ: Laser Fluorescence, modified TEOC
  - CH₄/CO₂/CO/NOₓ: Cavity Ringdown, Plasmas
- NOₓ: Cavity Ring Down, Las Gases
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A Typical Air Quality & Mass Balance Flight

- Afternoon flight (~2:30-5:30 PM) on 7/2/2018
- Ozone and CH₄ plume downwind of NYC.

Time series of Alt, Ozone, CO₂, CH₄, and CO

- Afternoon flight on July 2, 2018

Results

- Air Quality Flight in Maryland on 8 Sept. 2016
- Traditional westerly/easterly flight pattern

Comparison with CO₂ emission models

- Observed: 5.18 ppb CH₄/ppb CO₂
- EDGAR CO and CH₄ emissions may be good.

Summary and Future Work

- Aircraft mass balance approach is a valuable tool for estimating urban GHG emissions.
- CO & CO₂ emission obs. agree with emission models in general. The discrepancies may be explained by uncertainties in mass balance approach and emission models.
- The EDGAR Inventory may underestimate CH₄ emissions by a factor of 2-3.

Future work

- More flights will be conducted over Mid-Atlantic and NYC in the future to reduce uncertainties
- Biosphere CO₂ uptake/emissions and inversion modeling
- NOₓ (NO, NO₂) emissions and compare to GEO-TASO and satellites

Acknowledgments

Gridded CH₄ and CO₂ emissions from EDGAR v4.3.2 for 2012

Gridded CO & NOx emissions in EDGAR v4.3.2 for 2012