Atmospheric Nitrogen Research

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Goal

- Provide sound scientific information on the emission, transformation, and air-surface exchange of nitrogen compounds in the air.
“Cascading” Effects of Nitrogen in the Environment

(Galloway et al., 2003)

Soil acidification

Eutrophication

Tropospheric Ozone

The Nitrogen Cascade

(NH₃, NOₓ, NO₃, N₂O, N₂O (terrestrial, aquatic))
Approach

- Short-term Research Intensives
  - Fast-response and integrated trace gas measurements
  - Extensive collaboration in major process studies to better understand the cycling of nitrogen compounds
TexAQSII Radical and Atmospheric Measurement Project (TRAMP)

- Summertime air quality study in Houston in 2006
- Emissions from mobile sources and numerous electrical generation units, petrochemical facilities and other industrial sources

View of downtown Houston from Moody Tower under clear and polluted conditions.
TRAMP Study

Luke et al., 2010
Study of Houston Atmospheric Radicals Project (SHARP)

![Diagrams showing [NOx] (ppb) over hours for 2006 and 2009]
NO₂ Detection Techniques

- Characterization of a commercial NO₂ detector
  - University of Maryland commercial spectrometer
  - ARL custom-built chemiluminescence detector

Castellanos et al., 2009
CalNex 2010 Study

Ammonia concentration (ppb)

0.5 m  2.5 m

Urea Fertilization
Ammonia in East Tennessee Study

- Ammonia concentrations were slightly higher in winds emanating from the direction of the interstate highway.
- Complex topography in the Tennessee Valley channels winds and limits influx from certain directions.

Allen et al., 2011
Atmospheric Deposition of Ammonia Study

- Day of Year
- Ammonia (µg m⁻³)
- Wind Speed (m s⁻¹)

88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105

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Drivers for Ammonia Air-Surface Exchange

\[ y = 14.712 \ln(x) - 35.555 \]
\[ R^2 = 0.7242 \]

- Friction Velocity (cm s\(^{-1}\))
- NH\(_3\) Deposition Velocity (cm s\(^{-1}\))

Myles et al., 2010
Indicators of Success

- **Publications**
  - Recent papers in peer-reviewed journals
  - Invited commentary and review articles
- **Datasets**
  - Historic air-surface exchange measurements
    - Atmospheric Integrated Research Monitoring Network (AIRMoN)
  - Research intensives and collaborative projects
- **Improved Measurement Techniques**
  - Evaluation of cavity-ring down spectroscopy
  - Custom-built chemiluminescence detector
Collaborators
Future Directions

- **Products**
  - Communication of findings to collaborators and the public
  - Accessible historical datasets

- **Measurement studies**
  - Determine suitability of real-time sensors for long-term air-surface exchange research
  - Conduct research intensives in coastal ecosystems
  - Investigate contribution of organic nitrogen to the reactive nitrogen budget and possible effects on regional air quality