Summary of Atmospheric Deposition Studies and Nitrogen Loading Results for Tampa Bay, Florida

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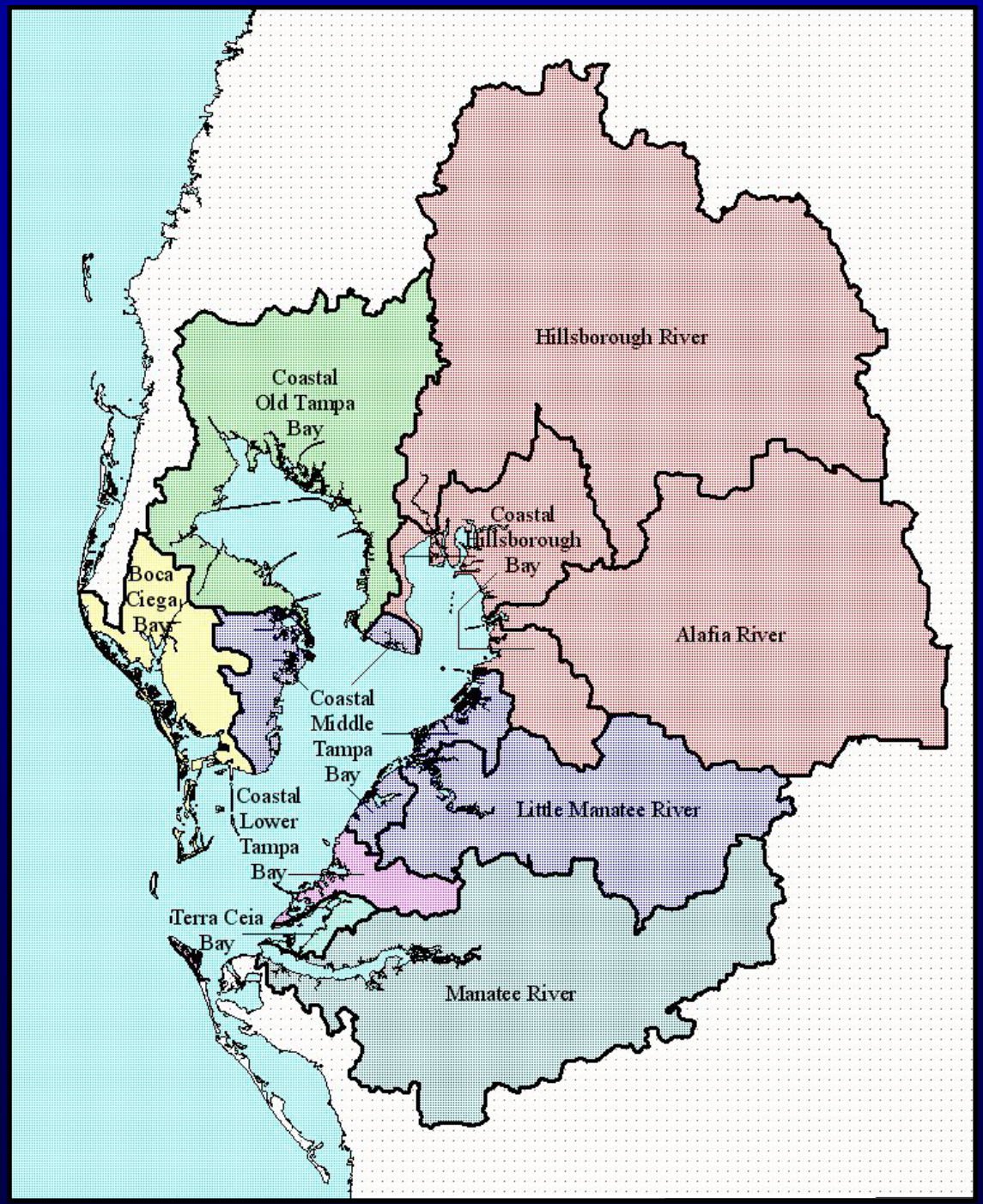
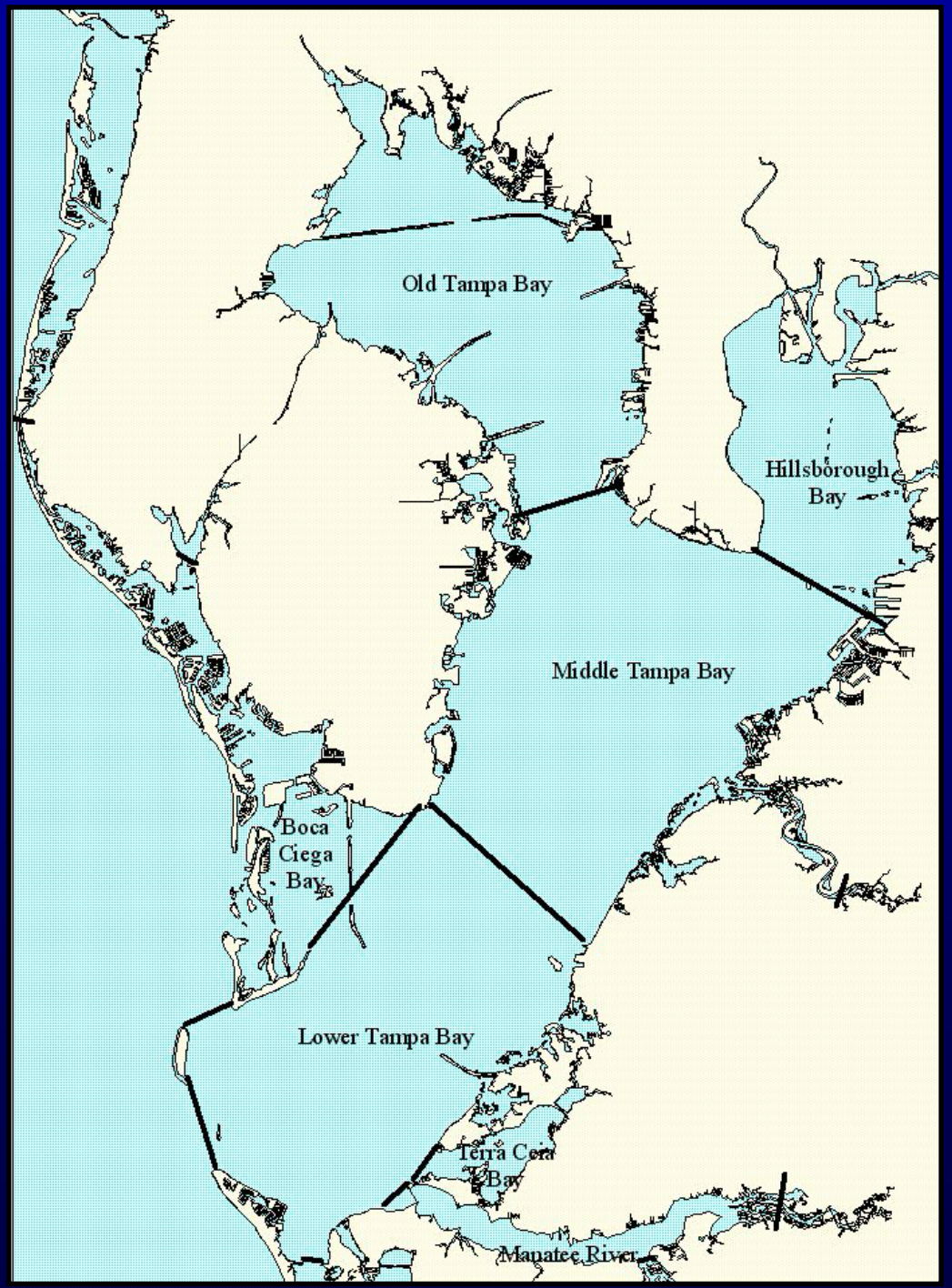
Presentation Outline

- Background
- Estimates of Nitrogen Load via Atmospheric Deposition
- Source Apportionment
- Future work

Tampa Bay Watershed and Major Basins



Tampa Bay Segments



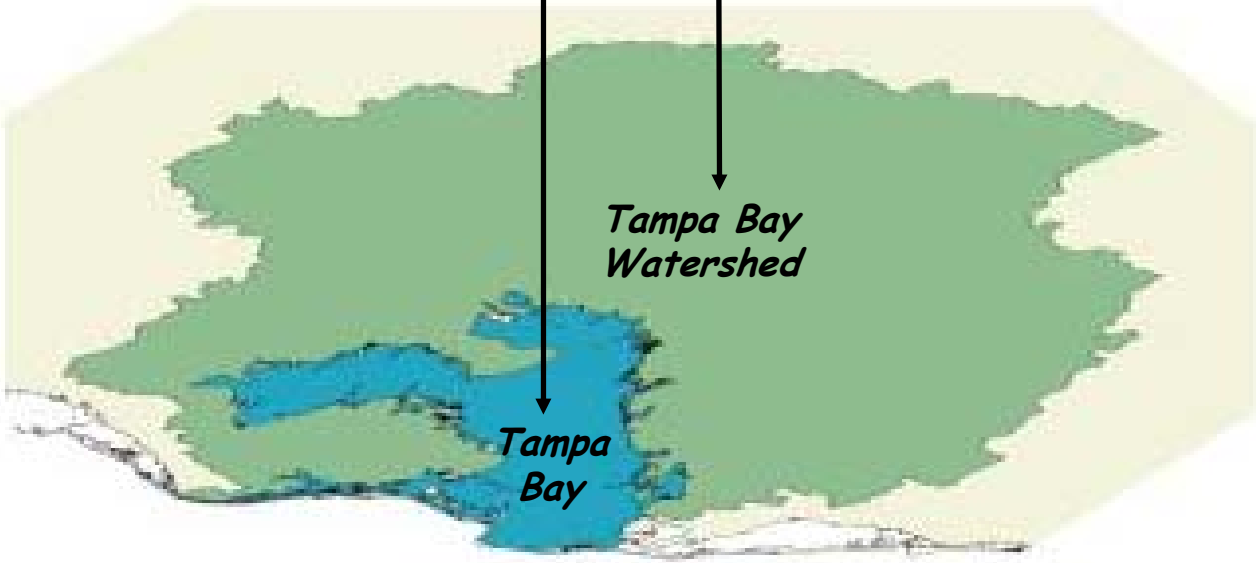
ATMOSPHERIC DEPOSITION
- Wet Deposition
- Dry Deposition

POLLUTANT CONCENTRATIONS

METEOROLOGY
- Precipitation
- Wind Direction
- Wind Speed

EMISSIONS
- Anthropogenic
- Biogenic

SURFACE CHARACTERISTICS



Estimates of TN Loading

- TN Concentration in Precipitation from National Atmospheric Deposition Program Verna Wellfield Site (South of Tampa Bay in Sarasota County)
- TP Concentration in Precipitation from Tampa National Urban Runoff Program
- Dryfall:Wetfall from Florida Acid Deposition Study – 2:1

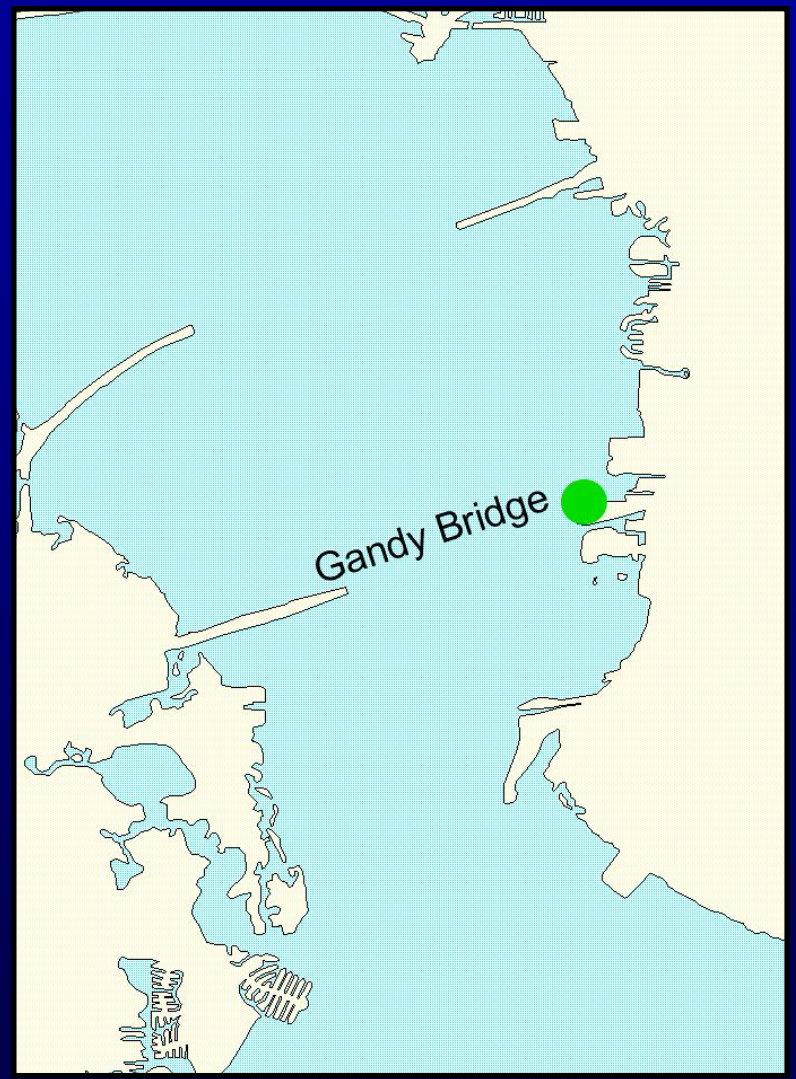
Estimates of TN Loading

Load Directly to Surface of Tampa Bay
from Atmospheric Deposition
~30% of total TN and TP Load to Bay

Estimates of TN Loading

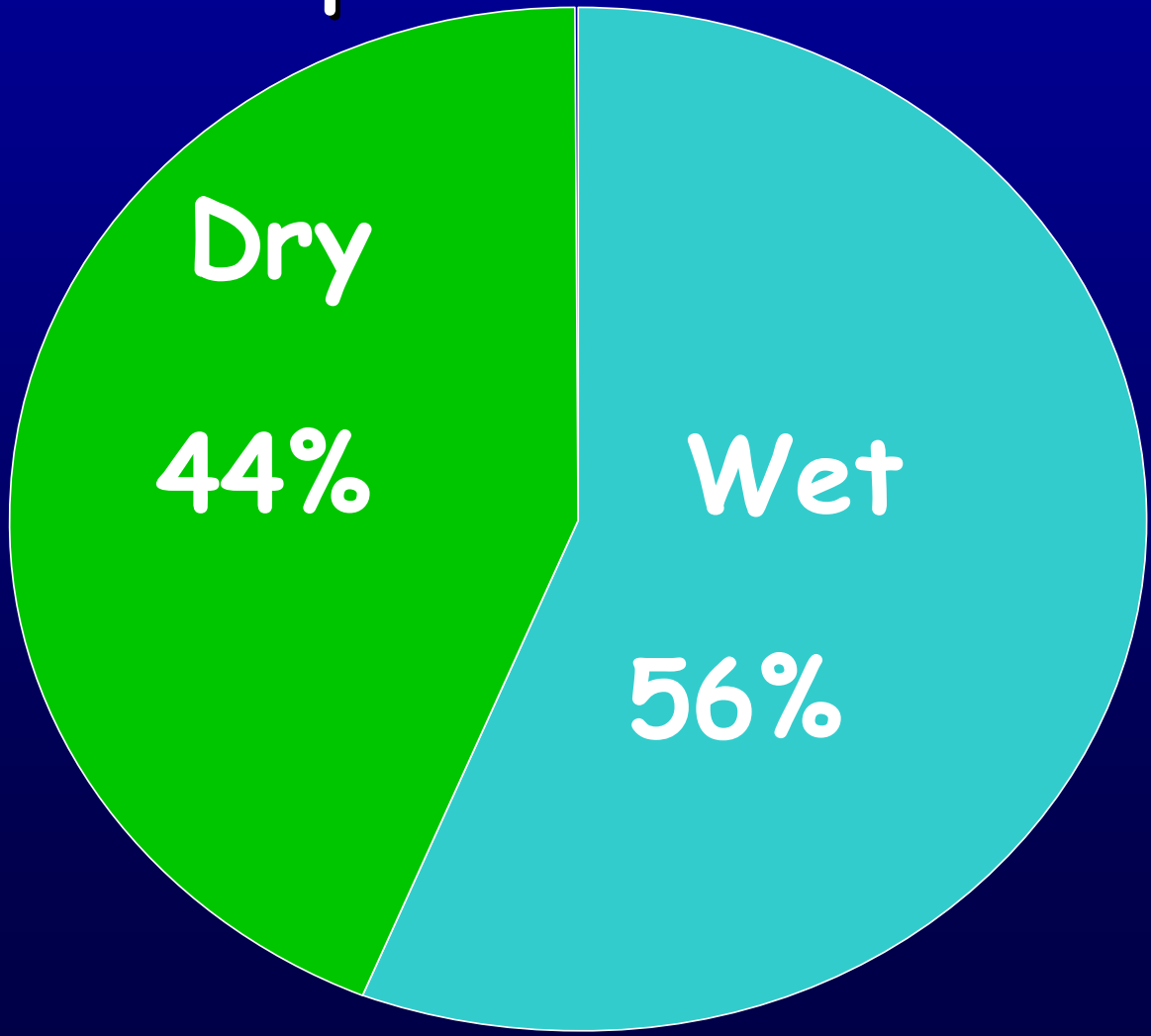
Tampa Bay Atmospheric Deposition Study

TBEP data collected from August 1996-August 1999 at the Gandy Bridge site



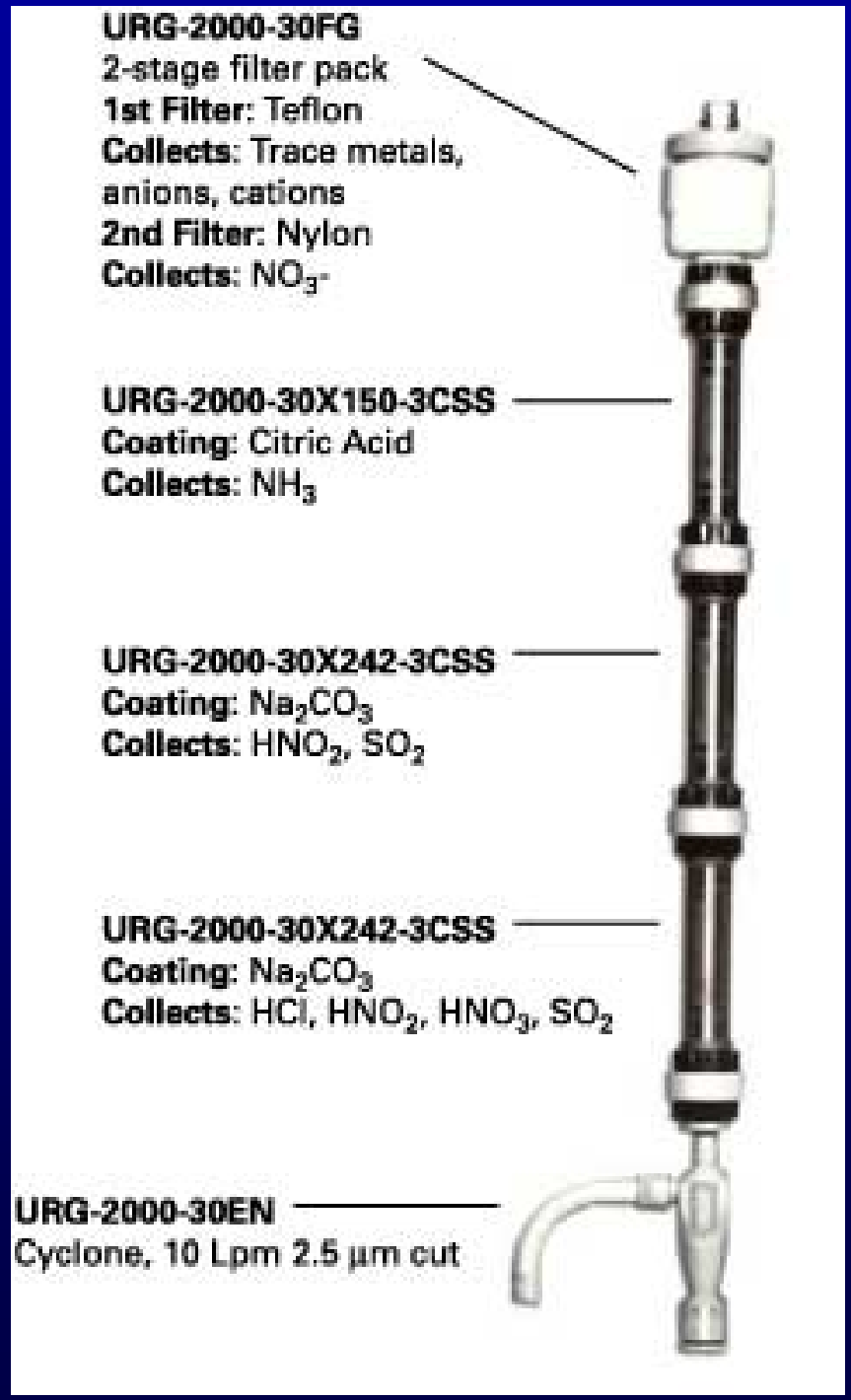
- Wet and Dry Estimates
  - 7.3 kg-N ha-1 yr-1
  - 760 metric tons-N yr-1
  - ~20% to 30% of the TN load to the bay, depending on rainfall

Estimates of TN Loading Wet and Dry Nitrogen Deposition Rates



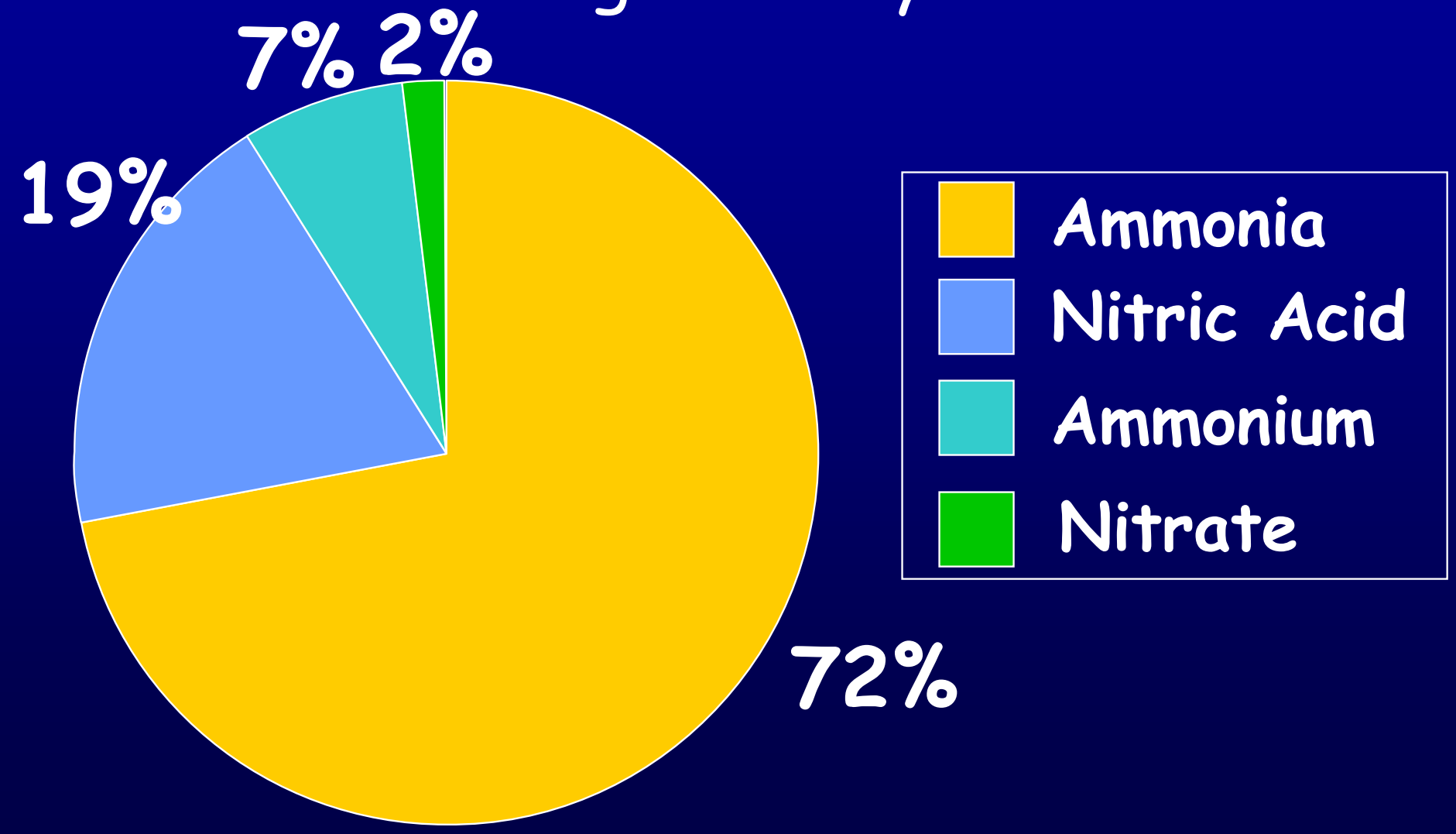
Estimates of TN Loading

Annular Denuder for Atmospheric Nitrogen



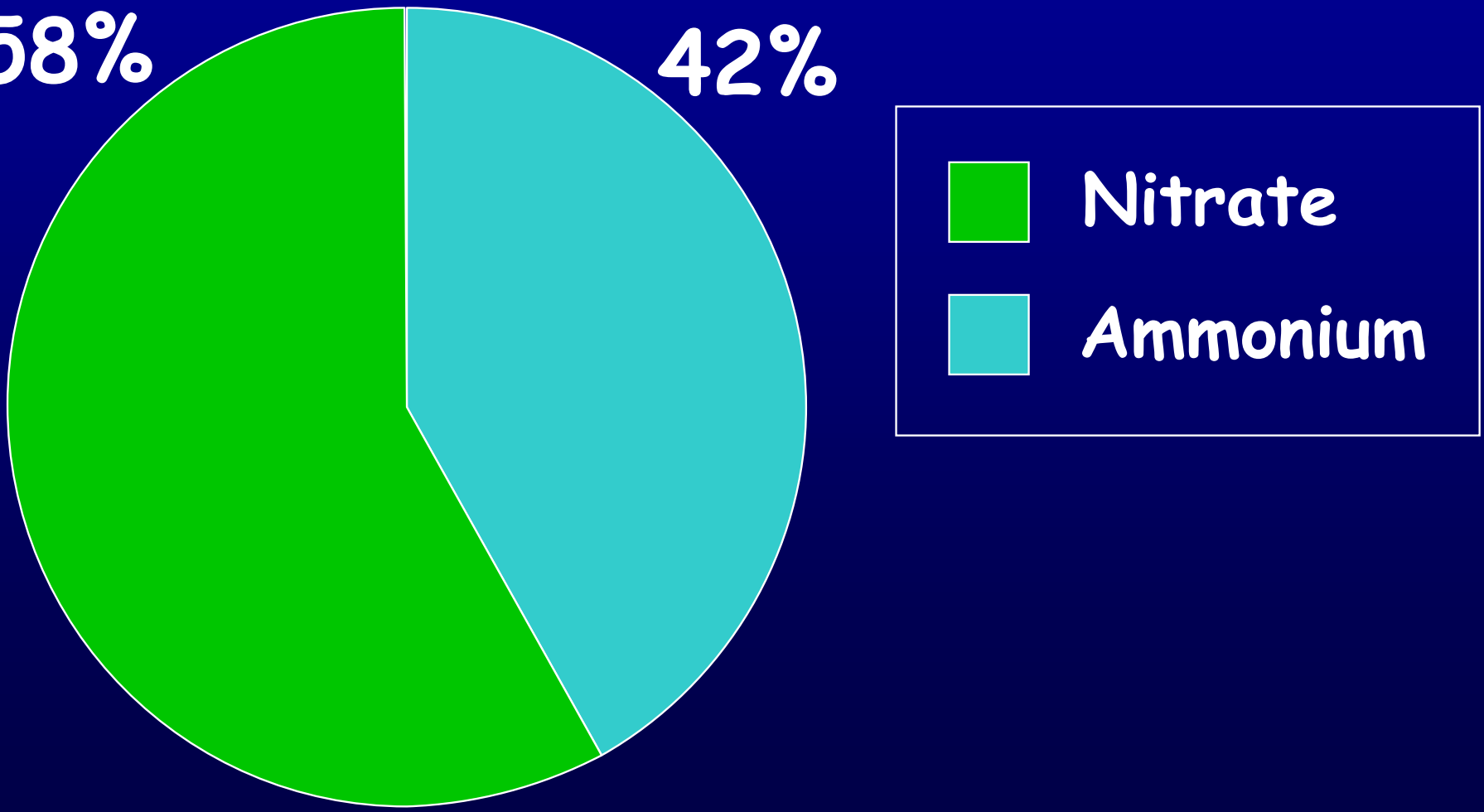
Estimates of TN Loading Wet Deposition

Estimates of TN Loading
Dry Deposition Rate
3.2 kg-N ha^{-1} yr^{-1}



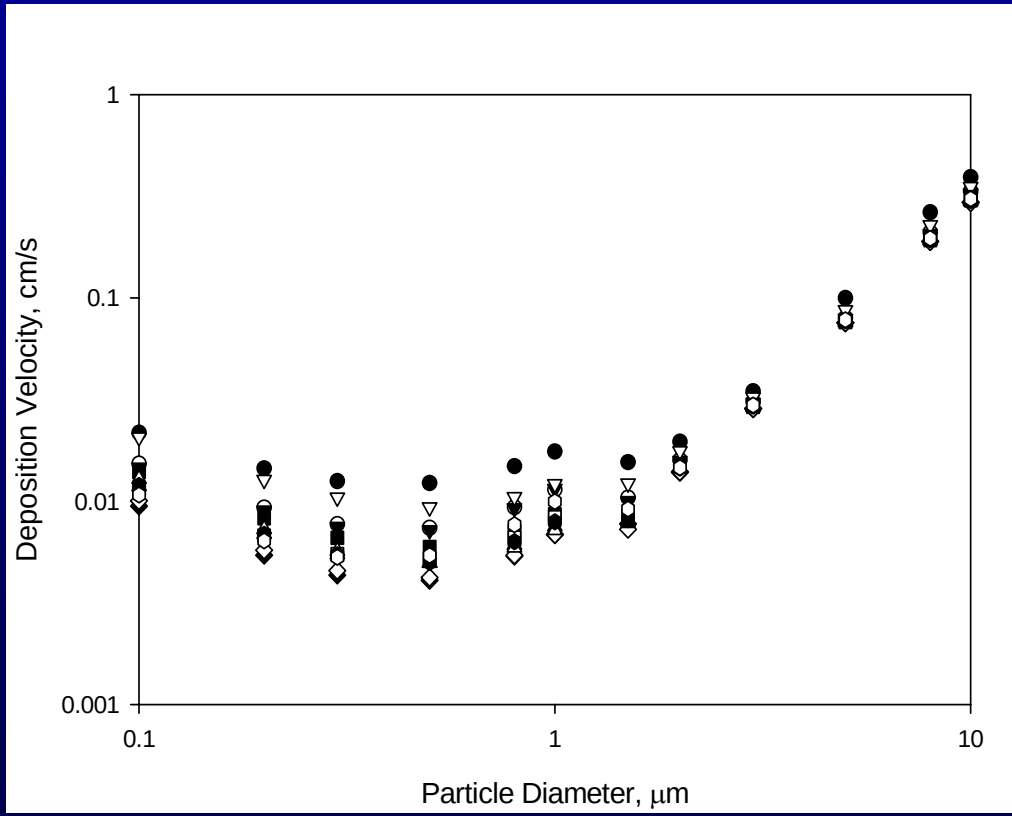
Estimates of TN Loading
Wet Deposition Rate

4.1 kg-N ha^{-1} yr^{-1}



Estimates of TN Loading – Dry Modeled Deposition Velocities

- Gas and particle deposition velocities
- Requires wind speed, air temperature, water temperature, relative humidity
- Lower estimates of fine particle nitrogen deposition rates

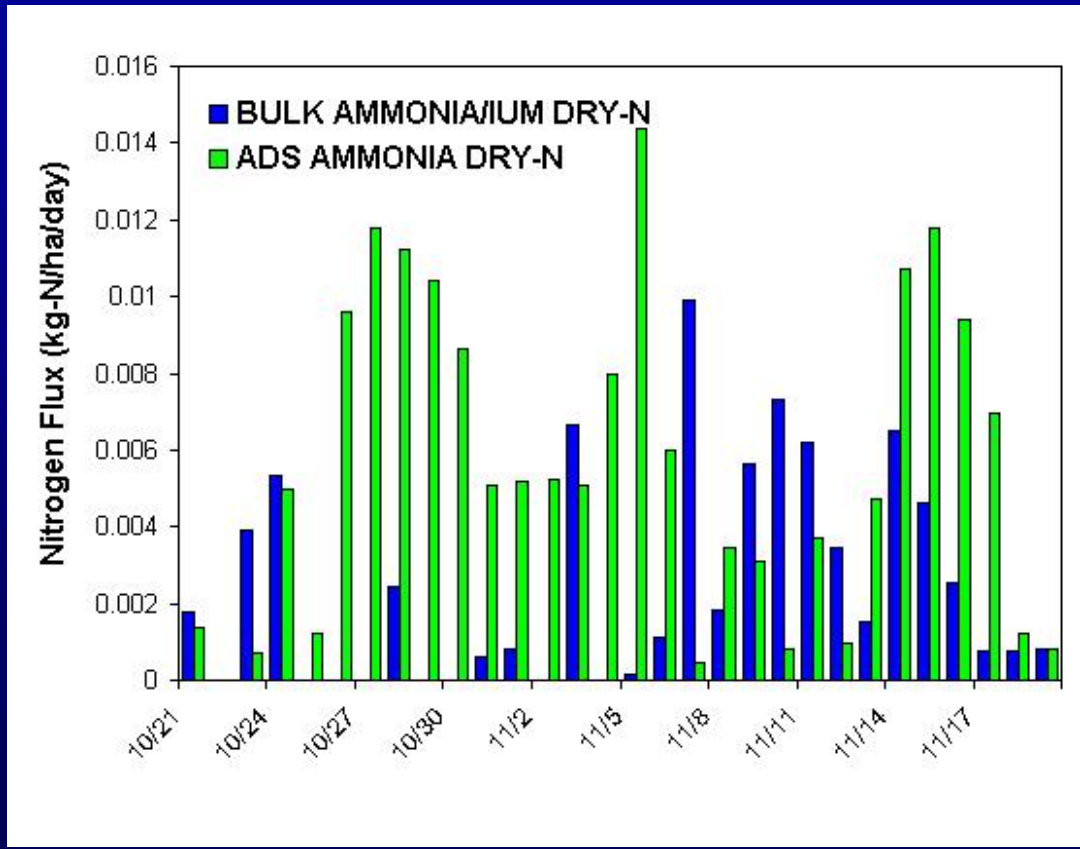


Estimates of TN Loading Bulk Deposition Rate

- May 1999 – December 2000 at Gandy
- Weekly sampling
- "Clear" samples only
- 20% higher than wet+dry deposition rate calculated for the same period
- Organic nitrogen, coarse particulates

Estimates of TN Loading Ammonia/ium Dry Deposition Rate

- Oct – Nov 2001
- Daily sampling
- 70% organic
- Bulk ammonia/ium deposition significantly lower than predicted by inferential modeling with ambient air concentrations



Estimates of TN Loading Confounding Factors Particle Deposition

- Sea salt interactions
  - Coarse particle nitrate, (nitric acid+sea salt)
  - Fine particle ammonium
  - Increase dry nitrogen deposition rate by 5%

- Aerosol equilibrium modeling
  - Predicts coarse particle nitrate and fine particle ammonium
  - Qualitatively agrees with measurements

Source Apportionment

- CALPUFF Modeling of Nitrogen Oxides
- Ammonia inventory
- Ammonia measurements with passive sampling devices (PSDs)
- Nitrogen isotope study

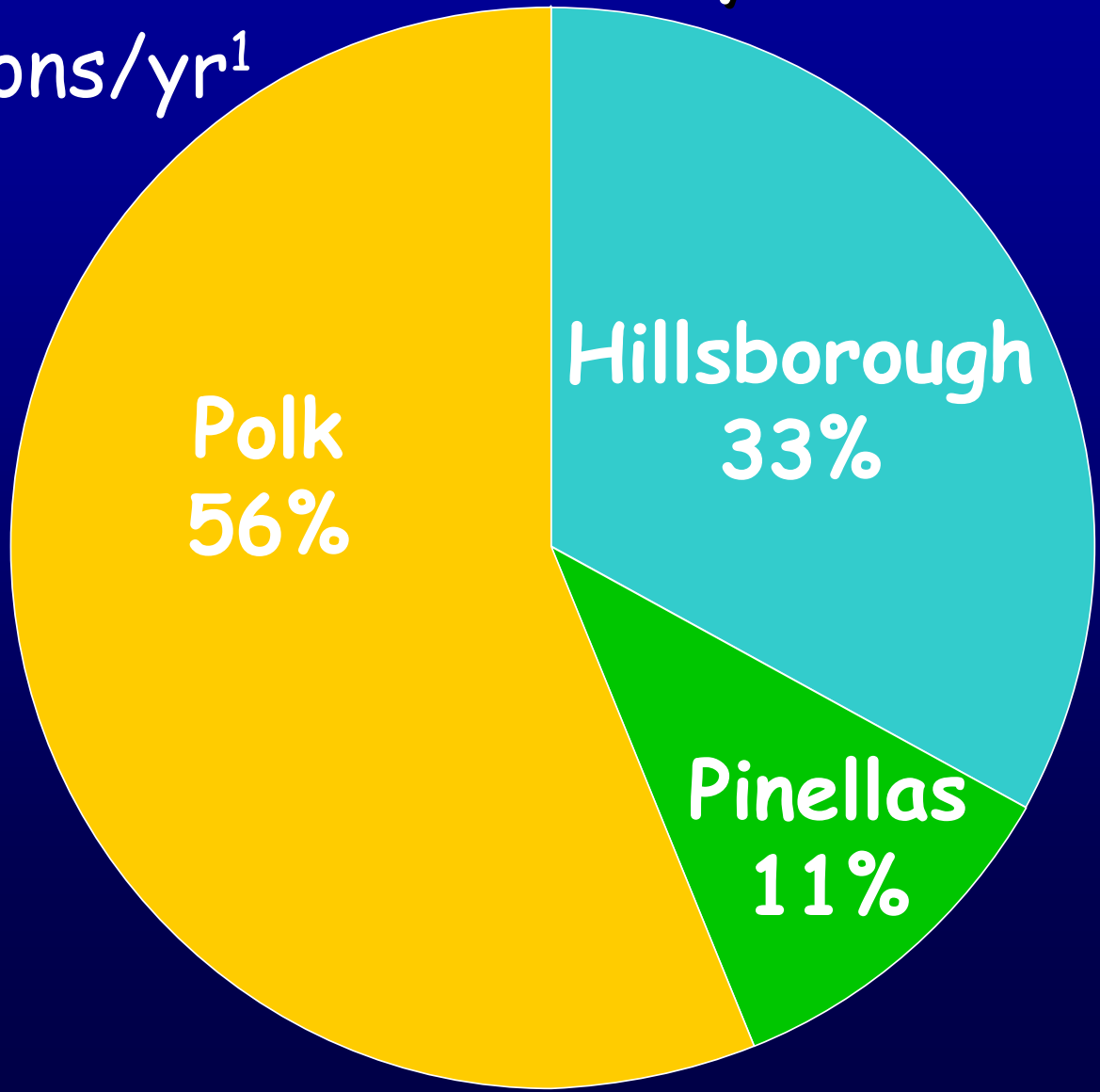
Source Apportionment CALPUFF

- 2000 NOx Emissions Inventory (USEPA NET)
  - 59,000 tons NOx/year from TECO coal-fired plants
  - 42,000 tons NOx/year from motor vehicles

- Deposition of ~300 tons-N/year Nitric Acid/Nitrate
  - ~30 tons-N/year from TECO coal-fired plants
  - ~130 tons-N/year from motor vehicles

Source Apportionment Ammonia Inventory

14,000 metric tons/yr[1]

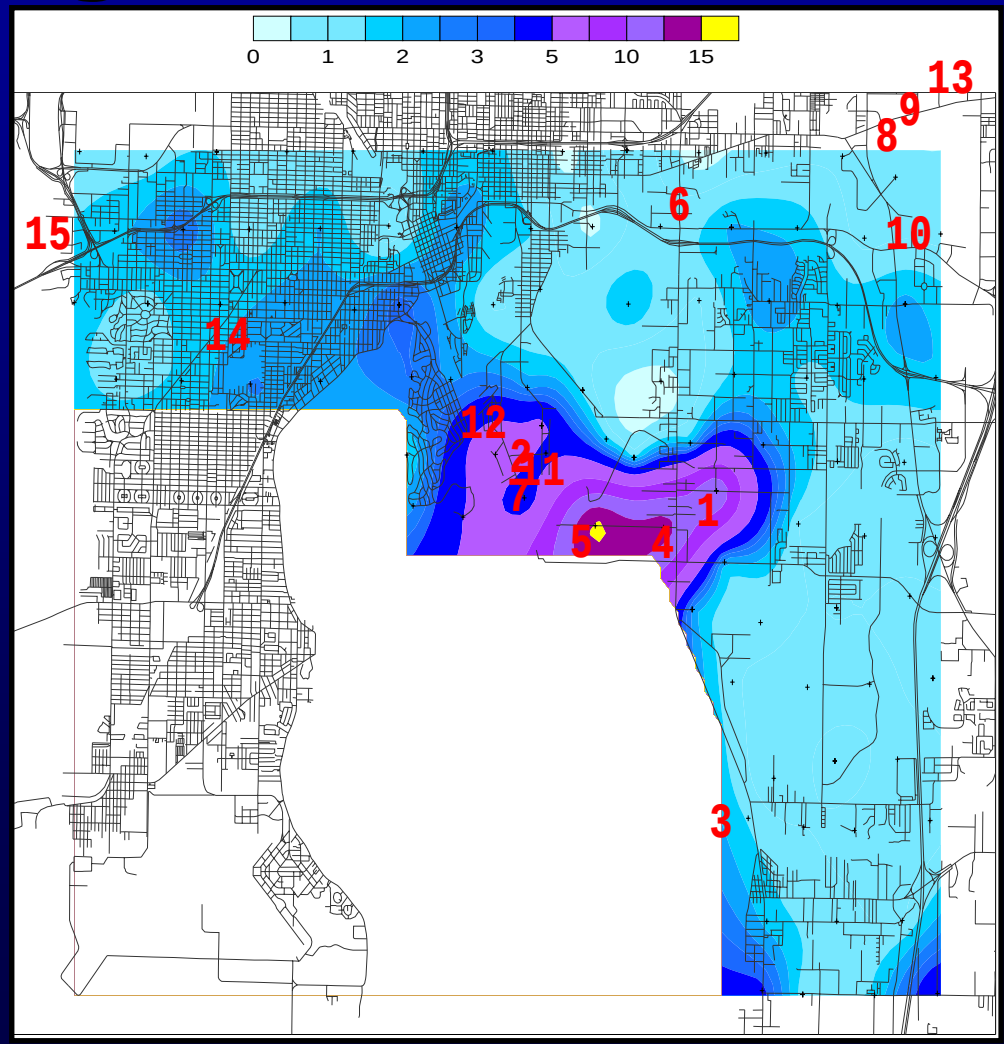


Source Apportionment Ammonia Measurements with a Passive Sampling Device (PSD)

- 90 PSDs
- Placed around Hillsborough Bay, urban, industrial, phosphate industry, highway, coal-fired power plant
- 15 sources from inventory

Source Apportionment Ammonia Measurements with a Passive Sampling Device (PSD)

- Min= 0.06 $\mu g\ m^{-3}$
  Max= 15 $\mu g\ m^{-3}$
  Mean= 2.0 $\mu g\ m^{-3}$
- Location of hot spots agreed with largest toxic release inventory facilities



Source Apportionment Nitrogen Isotope Study

- Higher $\delta^{15}N$ associated with non-anthropogenic sources

- Most positive NH_4^+ $\delta^{15}N$ and lowest NH_4^+ concentration associated with rainfall from an air mass approaching from south of Florida—cleanest "marine" air?

- More negative NH_4^+ $\delta^{15}N$ associated with higher dissolved NH_4^+ in rainwater and an air mass crossing Florida—impact of agriculture?

Future Work

- Recent studies of contribution of AD to bay via watershed
- Collection of additional data for improving deposition models
- Further work on source apportionment

BOTTOM LINE

Make appropriate management decisions regarding AD in the future