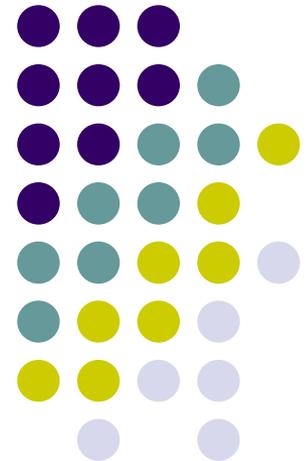


# Reactive N monitoring in RMNP and NE Colorado August 2014 status update

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# Monitoring Objectives



- NE Colorado
  - Monitor and track changes in ammonia concentration in the Front Range/NE CO
  - Help separate contributions from agriculture and other activities to Front Range/NE CO ammonia
- Rocky Mountain NP
  - Monitor and track changes in total reactive N deposition at RMNP
  - Apportion total deposited N to oxidized ( $\text{HNO}_3$ ,  $\text{NO}_3^-$ ), reduced ( $\text{NH}_3$ ,  $\text{NH}_4^+$ ) and organic N compounds
  - Support apportionment of contributions of source regions and source sectors to N deposition

# Reactive N monitoring strategy



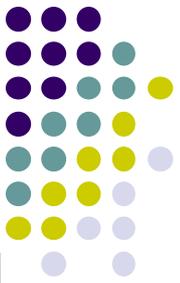
- Should include concentrations in source and receptor regions
- Should capture N species concentrations at timescale relevant to transport and deposition
  - Hourly to daily
- Should quantify major reactive N species
  - $\text{NH}_3$  gas
  - $\text{NH}_4^+$  particles
  - $\text{HNO}_3$  gas
  - $\text{NO}_3^-$  particles
  - Wet deposited  $\text{NH}_4^+$ ,  $\text{NO}_3^-$ , and Organic N
- Should be cost effective and practical for multi-year deployment

# Reactive N monitoring status

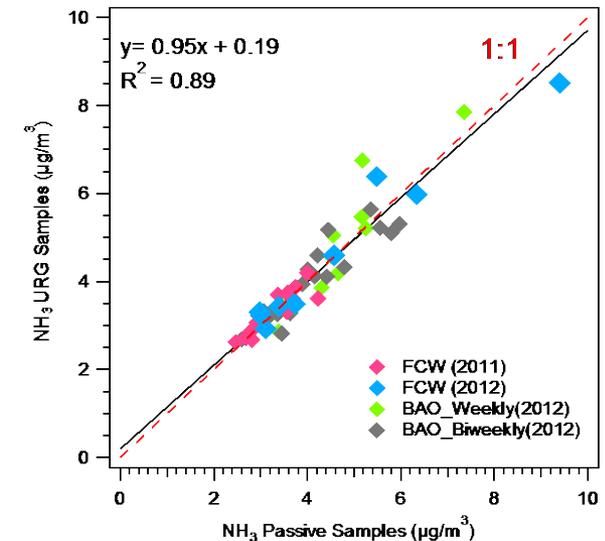
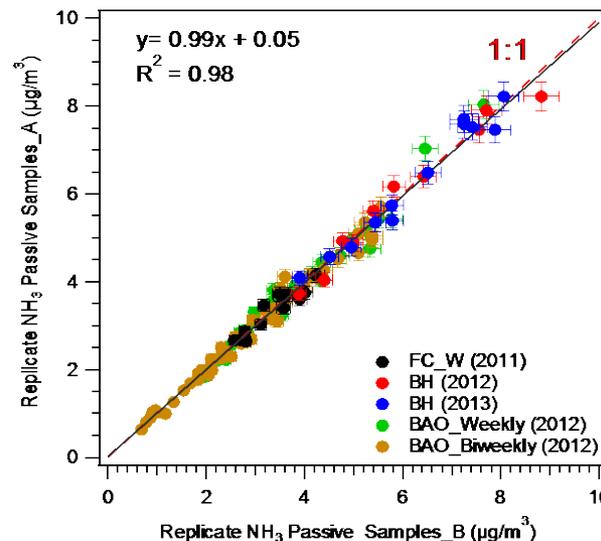
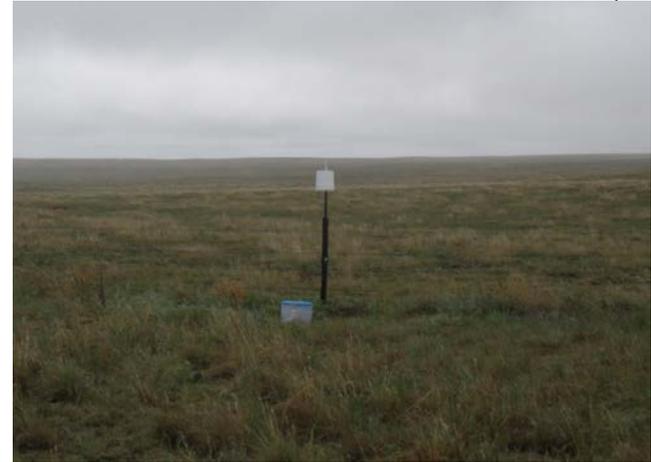


- Ammonia in NE Colorado (mid-March – mid-Oct)
  - NE CO passive NH<sub>3</sub> weekly monitoring network (funded 2014+ by CSU Ag Expt. Station/USDA)
  - High time resolution (~minutes) NH<sub>3</sub> monitor to examine concentration vs. wind direction
    - Site operating in Greeley (funded through 2015 by EPA and CDPHE)
    - 2<sup>nd</sup> site desired near foothills (funding needed)
- Oxidized and reduced nitrogen gases, particles, and wet deposition in RMNP (mid-March – mid-Oct)
  - 24 hr samples of gaseous ammonia and nitric acid and fine particle ammonium and nitrate (funded 2014/15 by NPS)
  - ~48 hr wet deposition samples of ammonium, nitrate and organic nitrogen (funded 2014/15 by NPS)
  - Continuous measurement option (funding needed)

# Passive ammonia monitoring

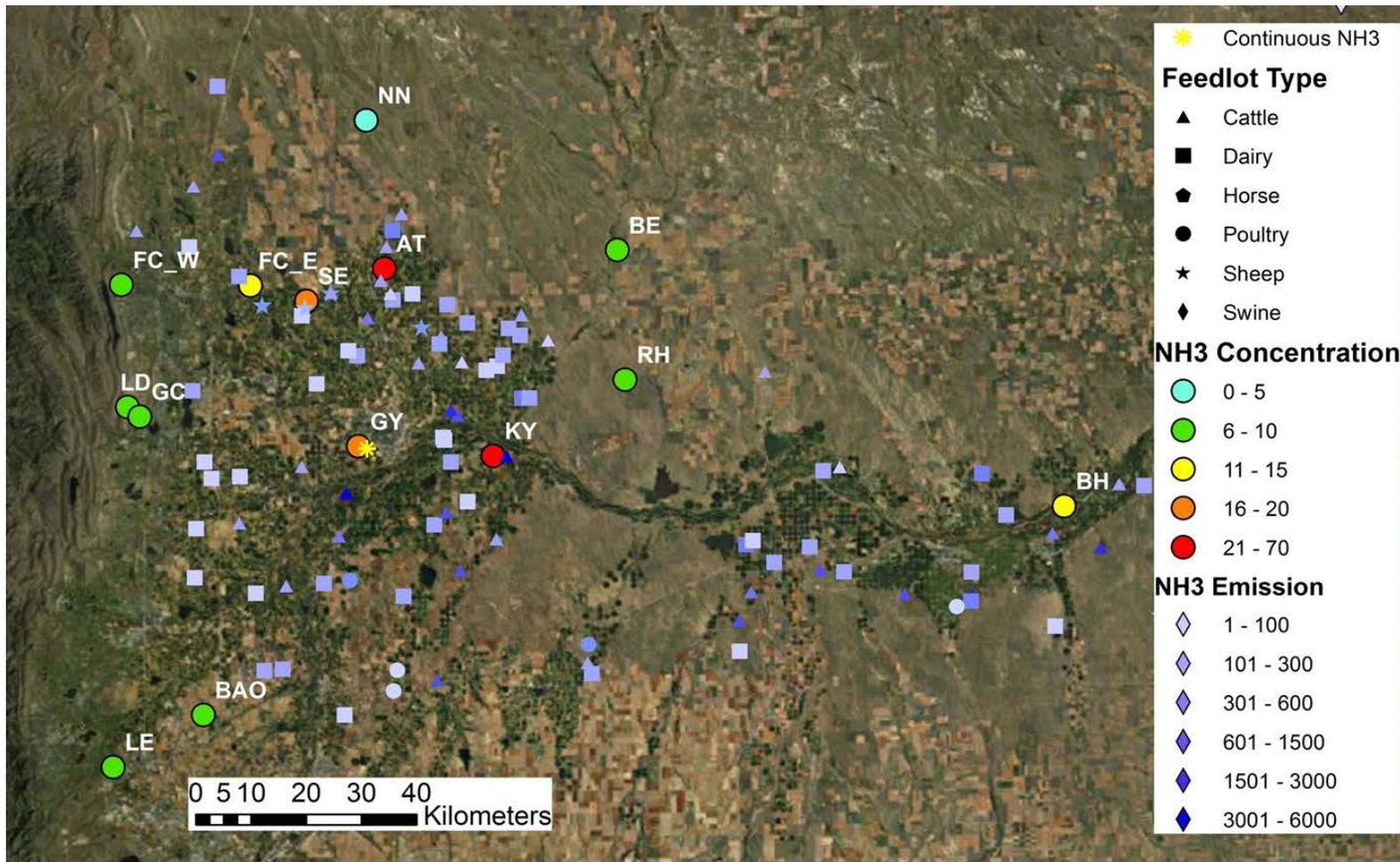
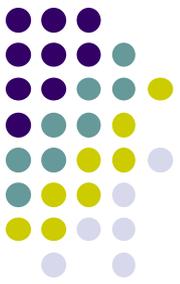


- Coated cartridges collect  $\text{NH}_3$  by diffusion
  - No power required
  - Inexpensive
- Allow greater spatial coverage
- Weekly time resolution
- Excellent precision and good accuracy

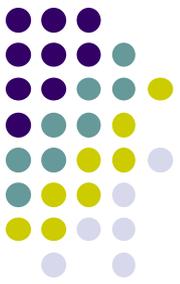


# NE Colorado passive ammonia

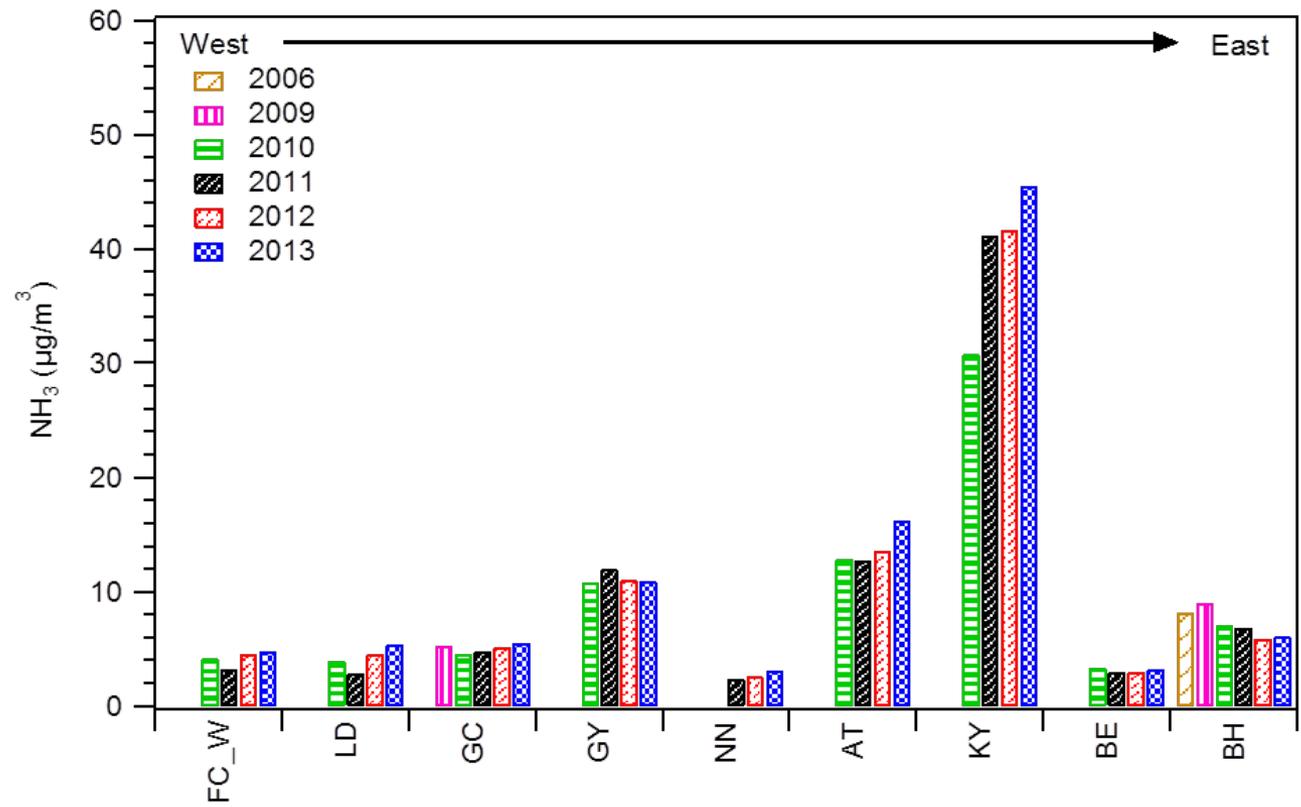
Summertime average  $\text{NH}_3$  concentrations (ppbv)



# NE Colorado passive ammonia



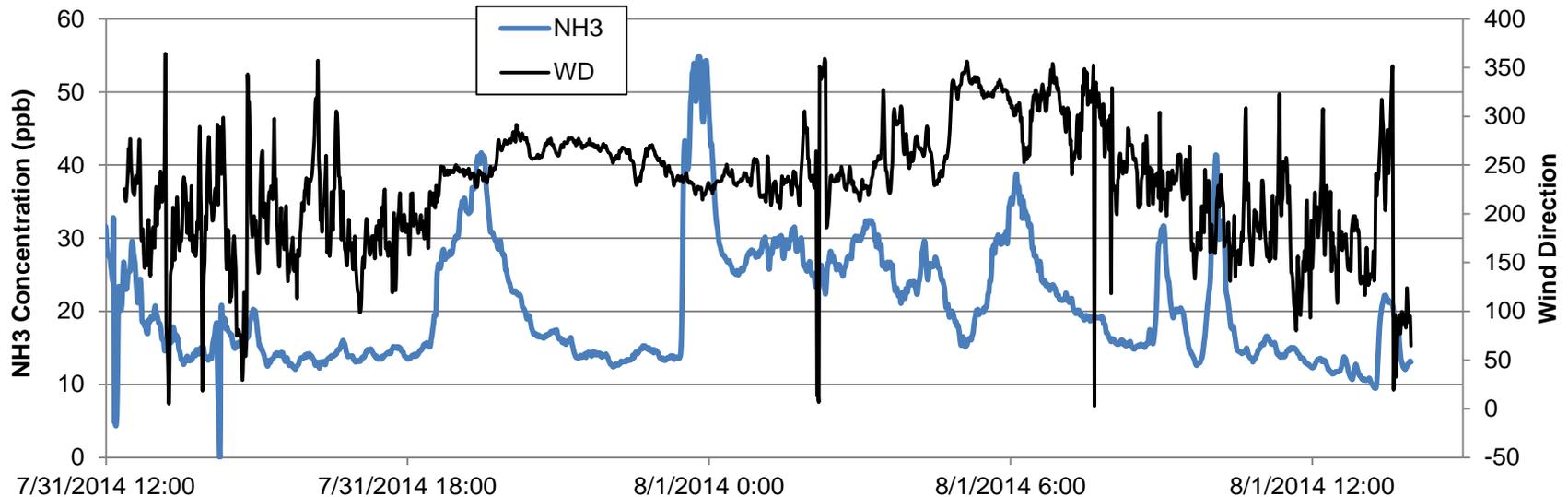
- Interannual monitoring provides insight into long-term ammonia concentration trends



# Greeley ammonia monitoring



- High time resolution measurements at CDPHE Greeley shelter provide insight into transport and source locations



# RMNP daily reactive N monitoring



Benedict et al., 2013a

