The Rocky Mountain National Park Air Quality Initiative: 
Partnership to Reduce Nitrogen Impacts

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January 16, 2018 
Mountain Sentinels
RMNP AQ Initiative: Background

- Petition from Environmental Defense and Colorado Trout Unlimited - Sept 2004
  - ID's adverse impacts from air pollution
- Interagency effort addresses air pollution issues in RMNP
  - Focus on nitrogen deposition
- “Weight of the evidence” approach considers:
  - Monitoring/trends
  - Attribution studies
  - Planned reductions
- Nitrogen Deposition Reduction Plan (2007)
- Contingency Plan (2010)
Critical Load

- Large body of evidence indicates nitrogen deposition has affected and continues to cause harmful effects on sensitive ecosystems within the park.
  - Current wet deposition monitored at ~3.2 kg N/hectare/year (rolling 5-year average - 2011-2015)
  - Natural background estimated at 0.2 kg N/hectare/year

- Specific, published (peer-reviewed) research has shown that wet deposition levels at the time harmful effects started to occur was ~1.5 kg N/ha/yr.

- Continuing research on this front
Rocky Mountain National Park: Continuum of Impacts to Ecological Health

- **Current N deposition in Rocky Mtn. NP**: 3.2/4.9
- **Natural background N deposition**: 0.2/0.5
- **Target Load: Park Natural Resource Goal**: 1.5/2.3
- **Potential future ecosystem impacts if N deposition increases**

- **“Weight of evidence” of ecosystem health decline on east side of park**

- **Change in alpine plant species**
  - CL = 3.0 kg/ha/yr total N
- **Increases in “weedy” lichen species**
  - CL = 3.1 kg/ha/yr total N
- **Change in aquatic plant species composition**
  - CL = 1.5 kg/ha/yr wet N
- **Soil N saturation/leaching**
  - 4.0 kg/ha/yr total N
- **Forest decline (acidification effects on trees)**
  - CL = 8.0 kg/ha/yr total N

- **Effects on aquatic animals (episodic acidification) begins**
  - CL = 4.0 kg/ha/yr total N

Solid line text box = observed effects; Dotted line text box = potential effects

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Nitrogen Deposition Reduction Plan & Contingency Plan

- Original NDRP endorsed by NPS, EPA and CDPHE and the Colorado Air Quality Control Commission on August 16, 2007
  1) Management approach based on collaborative process
  2) Voluntary approach, no mandatory requirements or standards
  3) Sets long-term (25-year) resource management goal
  4) Sets timeline and interim (5-year) milestone goals intervals to achieve nitrogen reduction goal by 2032
  5) Strategies to achieve goal
  6) Identifies options that can be implemented on a voluntary basis

- Contingency Plan endorsed by NPS, EPA and CDPHE and the Colorado Air Quality Control Commission on June 22, 2010
  ❖ Adaptive management approach consisting of 5 elements
    1) Data Tracking Plan
    2) Triggering Mechanism
    3) Recommending & Implementing Contingency Measures
    4) List of Potential Contingency Measures
    5) Public Outreach & Participation
Monitoring & Tracking

• Wet nitrogen deposition has stabilized in both the long- and short-term

• Long-Term Statistical Trend (1984-2015*):
  • Wet nitrogen deposition increased at RMNP Loch Vale until 2010 and is now stable, although it continues to increase at RMNP Beaver Meadows
  • Ammonium is increasing at all 5 sites
  • Nitrate is decreasing at 2 sites

• Short-Term 5 or 7 year Statistical Trends (2011-2015 or 2009-2015):
  • Wet nitrogen deposition is stable at all sites
  • Ammonium is increasing at 3 sites
  • Nitrate is decreasing at 1 sites

• Loch Vale Co-located site (2009 - 2013)
  • Provided QA/QC support for trends
  • Basis for confidence intervals

*Site records vary between 1980 and 1987

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alpha = 0.10  
When the measured value = the glidepath,  
90% confident that N deposition will exceed the lower bound.  
10% chance that the true deposition is greater than the upper bound.
Agricultural Best Management Practices:
Helping to Reduce Nitrogen Impacts at Rocky Mountain National Park
Agency efforts with Colorado Agriculture

- What does success look like with CO Agriculture?
  - reduced nitrogen deposition contributions
  - ongoing collaboration
  - filling data gaps
  - demonstrated implementation of BMPs
  - Increasing participating producers
  - Early Warning System implementation

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Colorado Agriculture discussions

- Focus our efforts on what matters most geographically, by industry, or size of operation.
  - Improve understanding of the agricultural community's role to help inform reduction strategies and the next milestone decision.
  - Establish “S.M.A.R.T” indicator(s) of ammonia emissions (specific, measurable, achievable, relevant, time-bound). (e.g., beef production vs manure), and key data sources.
  - Use “S.M.A.R.T” indicator(s) to determine trends in agricultural ammonia emissions.
  - Evaluate efficacy of the Early Warning System followed roll-out as warranted.
Monitoring & Research Projects

- Mobile ammonia measurements in NE Colorado (June 2016) (CDPHE)
- Analysis of real-time data for evaluation of Early Warning System and source analysis (CSU)
- Comparison with Satellite Observations (CSU)
- Comparison with CAMx Model Simulations (CSU)
Questions?

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RMNP Website: www.colorado.gov/cdphe/rmnpinitiative