

**Project Summary**  
**Rocky Mountains Cooperative Ecosystem Studies Unit**

**Project Title:** GrandTREnds: the Grand Tetons Reactive Nitrogen Deposition Study

**Discipline:** Natural  
**Type of Project:** Technical Assistance  
**Funding Agency:** National Park Service  
**Other Partners/Cooperators:** Colorado State University  
**Effective Dates:** 9/1/2011 - 8/31/2012  
**Funding Amount:** \$499,972

**Investigators and Agency Representative:**

NPS Contact: Tamara Blett, National Park Service, Air Resources Division, P.O. Box 25287, Denver, CO 80225; Tel: (303) 969-2011; Fax: (303)-969-2822; e-mail: Tamara\_Blett@nps.gov

Investigator: Jeffrey Collett, Jr., Atmospheric Science Department, Colorado State University, Fort Collins, CO 80523; Tel: (970)-491-8697; Fax: (970)-491-8449; e-mail: Collett@lamar.colostate.edu

**Project Abstract:** During this project, CSU investigators will complete laboratory analysis of samples collected in the GrandTREnds study, will conduct data analysis of GrandTREnds findings, and will prepare GrandTREnds datasets for use in NPS air quality and source apportionment modeling efforts. CSU investigators will also continue support for the new IMPROVE pilot-scale  $\text{NH}_x$  monitoring effort, continue passive sampling of ammonia and nitric acid in Grand Tetons NP, continue laboratory evaluations of ammonia measurement methods, and work toward publication of key findings from previous reactive nitrogen monitoring efforts in RMNP and the surrounding region. No additional field deployments are planned or budgeted as part of this project. Planned efforts are summarized below:

1. Analyze samples and prepare quality assured data sets from the GrandTREnds study
  - a. Complete analysis of precipitation, denuder, filter, and passive samples collected during GrandTREnds, to include
    - i. Analysis of major inorganic ion species on collected filters
    - ii. Analysis of OC, EC, and ON on quartz Hi-Vol filters
    - iii. Analysis of levoglucosan on quartz Hi-Vol filters
    - iv. Analysis of pH, major inorganic ions, and ON in precipitation samples
    - v. Analysis of  $\text{NH}_4^+$  and  $\text{NO}_3^-$  in extracts of annular denuder and passive samples
  - b. Preparation and quality assurance of continuous data sets collected during GrandTREnds, to include:
    - i. PILS-IC measurements of  $\text{PM}_{2.5}$  ion concentrations
    - ii. Continuous gas measurements of  $\text{NO}_x$ ,  $\text{NO}_y$ , and  $\text{NH}_3$
    - iii. Particle size distributions
    - iv. Aerosol mass spectrometer observations of  $\text{PM}_1$  nitrate, sulfate, ammonium, and organic matter
2. Analyze GrandTREnds project data and begin assessment of reactive nitrogen species concentrations and deposition in the Grand Tetons regions, including:

- a. Determine wet and dry reactive nitrogen deposition budgets for Grand Tetons NP
  - b. Determine spatial and temporal variability in concentrations of reactive nitrogen species. Examine differences between the west and east sides of the park. Examine relationships between concentrations measured at the Targhee core site and local transport conditions.
  - c. Utilize filter and continuous gas measurements to determine the importance of ON contributions to total particle and gas phase reactive nitrogen concentrations
  - d. Use data from denuder, passive sampler, and continuous gas monitors to determine the accuracy of these methods for ambient ammonia measurements
  - e. Use aerosol composition and size distribution data to examine key contributions to visibility impairment in Grand Tetons N.P.
  - f. Use smoke marker measurements to determine the importance of fire as a contributor to aerosol OC concentrations in Grand Tetons N.P.
3. Continue passive sampling of ammonia and nitric acid at Grand Tetons NP following the conclusion of GrandTREnds.
    - a. Sampling will be conducted at the Teton Science School air quality monitoring site. Samplers will be prepared and shipped from CSU and deployed by a local site operator. Following sampling, the operator will ship the passive samples back to CSU for extraction and chemical analysis. Sampling will be conducted fall 2011 through summer 2012.
  4. Continue the IMPROVE NH<sub>x</sub> study. CSU will continue to prepare and deploy filters for, and analyze measurements from, the pilot-scale, 9-site IMPROVE NH<sub>x</sub> study through June 2012.
  5. Continue laboratory evaluation of continuous methods for gaseous ammonia measurement. Measurement accuracy and precision and artifact response of cavity ringdown, ion mobility, and chemiluminescence approaches will be evaluated.
  6. Continue data analysis of findings from reactive nitrogen deposition studies conducted in RMNP in 2008-10. Collaborate with NPS researchers on interpretation of findings and use of measurement data to constrain air quality model simulations.

**Outcomes with Completion Dates:** August 31, 2012

**Keywords:** Colorado State University, NPS-Air Resources Division, Rocky Mountain National Park, GrandTREnds, air quality, nitrogen deposition