

## The Service Learning Concept

In the spring of 2011, 60 students in the Applied Environmental Statistics Course at the Rubenstein School of Environment and Natural Resources partnered with the Vermont Monitoring Cooperative in a service learning partnership with the express purpose of using many minds to explore and examine the large archive of environmental data housed within the VMC database.

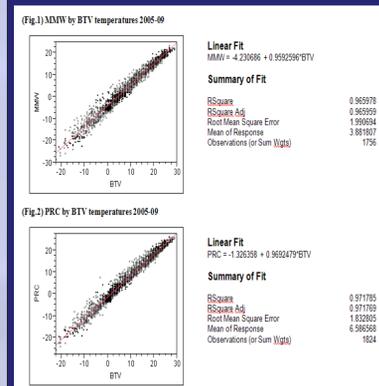
### The goals of setting students loose on VMC's data were to:

- Provide students with experiential education to maximize engagement with course materials
- Challenge students to apply their knowledge and skills to real world data
- Harness the creativity and innovation of bright environmental minds in order to.....
  - Identify new avenues of research for VMC partners.
- Better train and prepare the next generation of environmental leaders



AIR FOREST SOIL WATER WILDLIFE

### Predicting Air Temperatures from Burlington Airport Data

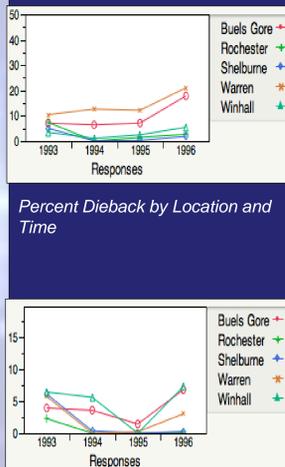


Average daily temperatures at Mount Mansfield (MMW) and the Proctor Maple Research Center (PRC) could accurately be predicted from Burlington Airport (BTV) data. These predictions were better in summer months.

Maintaining weather recording stations is costly and sometimes temperamental. Our group wanted to test the ability to predict average daily air temperatures at two VMC study sites (Mt. Mansfield western slope (MMW) and Proctor Research Center (PRC) based on air temperature data collected by XXX at Burlington Airport (BTV). Using data from 2005 to 2009, we conducted a linear regression and found that temperatures could be predicted to within 1.83°C. While the regression equations differed, accuracy for PRC and MMW were similar. During summer the RMSE was just around 1.1 while during the winter the model differed by around 2.5°C. This may suggest more extreme temperature differences between sites in the winter, making modeling more difficult. The accuracy and parameters of these models vary by season and should be considered if using BTV data to fill in missing VMC air temperature data.

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### Assessing Red Spruce Health at Five Different Locations in Vermont



For both percent dieback and discoloration there were significant differences over time and between locations. For example,

• Discoloration was lowest in 1995 for all locations, but spiked significantly in 1996 only at Rochester and Buels Gore.

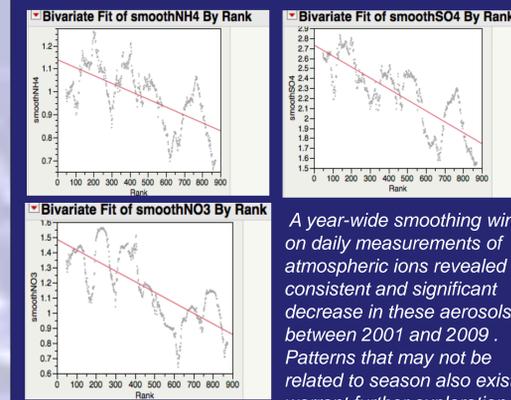
• Dieback was similar among locations in 1993, but decreased at Shelburne and Winhall while remaining constant or increasing at Buels Gore and Rochester.

• These results indicate that while some locations can recover quickly from stress events, others are not as resilient over time.

Red spruce trees (*Picea rubens*) are a high elevation and long-lived coniferous tree that dominates the upper transitional and lower boreal forests of Vermont. Throughout its natural range, the red spruce has displayed high levels of mortality, crown dieback, and annual losses in basal area resulting from climate change and acid deposition. By studying percent dieback and discoloration for red spruce, and how it varies over time and across locations, we looked for differences in decline dynamics. A repeated measures ANOVA revealed that there are significant differences between severity and trajectory of decline and location between 1993-1996. Understanding this variability in red spruce decline is vital to form a management plan to protect this resource.

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### A Study of Trends in the Concentration of Atmospheric Ions in the Burlington Area between 2001 and 2009

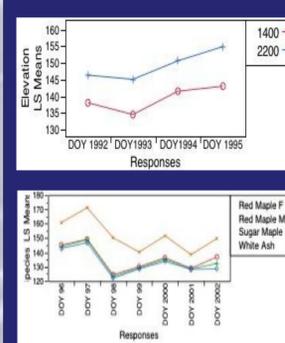


A year-wide smoothing window on daily measurements of atmospheric ions revealed a consistent and significant decrease in these aerosols between 2001 and 2009. Patterns that may not be related to season also exist and warrant further exploration.

Recent research shows that high concentrations of atmospheric pollutants can lead to environmental problems such as acid rain, which is detrimental to forest and wetland ecosystems. This study examined temporal trends in levels of atmospheric SO<sub>4</sub>, NH<sub>4</sub>, and NO<sub>3</sub> in Burlington, Vermont from 2001 to 2009. The slope of a linear regression model fit to daily data, smoothed over the year, to remove seasonality was used to identify a positive or negative trend in ion concentrations over time. This statistical analysis concluded that there was a negative trend of sulfate, ammonium, and nitrate concentrations over the nine-year period. It also suggests the existence of patterned fluctuations, perhaps beyond the effects of seasonality, that influence ion concentration levels. Continued monitoring in addition to further analysis of the data are required to ensure future progress and a better understanding of the changes that are occurring.

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### An Analysis of the Change in Bud Development Timing by Elevation and Tree Species on Mount Mansfield

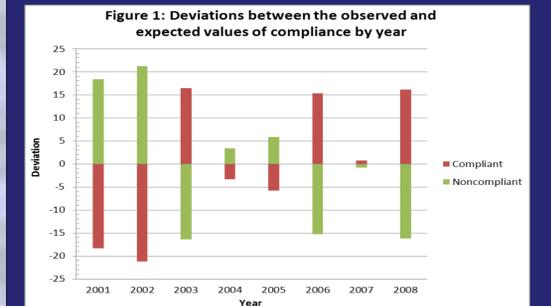


While differences in the timing of bud development are significant between elevations and across species, we saw no significant trend over the seven years of this study. However, there is a significant interaction between species and time, indicating that the rate of change in bud development over time varies by species.

Changes in the timing of phenological events are among the first indicators that a changing climate is effecting natural ecosystems. We hypothesized that the impact of a changing climate would vary by species and elevation. While a repeated measures ANOVA showed significant differences in bud development across species and elevation, there was no significant trend over time overall. However, our analyses did show significant interaction between time and species. This indicates that the manner in which trees respond to environmental changes may not be uniform across all species. While the species in our study appeared to change uniformly for most years, there were a few years where the bud development timing for different species changed in different directions or at different rates. These species-specific changes in bud burst timing data may be related to stressful weather events that occurred in late winter or early spring during the years of interest.

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### A Comparison of Ambient Air Pollutants and their Vermont Standards



While NO<sub>3</sub> never exceeded state regulation at either of the three monitoring sites, SO<sub>4</sub> emissions were exceeded in Burlington. The proportion of non-compliant measurements also differed by season and by year, indicating that SO<sub>4</sub> pollution is a "moving target."

This project sought to assess whether the aerosol concentrations of nitrate and sulfate in Burlington, Lye Brook, and Underhill, VT were in compliance with state regulation over the XX year period they have been routinely monitored. To do this we compared the frequency of noncompliance across locations, years and seasons. We found that nitrate never exceed regulations at any of the sites.. However, there were significant differences for sulfate across all of the site, season and year categories examined. We suggest that more research needs to be done to clarify/corroborate our results. On the whole, the state of Vermont is in very good compliance with its nitrate emission standards, as not a single one of our observations exceeded these standards. For the sulfate emissions, our data analysis showed that there were significant trends for Burlington having significantly more days with sulfate emissions above the state standards, as well as higher sulfate emissions being shown during the summer.