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The relationship between air mass type and pollen levels in central North Carolina from 2003-2012

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Objectives

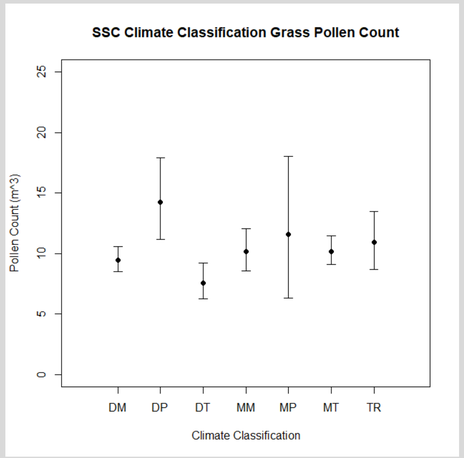
Identify any relationships between air mass type and pollen levels using different synoptic classification schemes. Compare any found relationships for grass and ragweed pollen.

Background

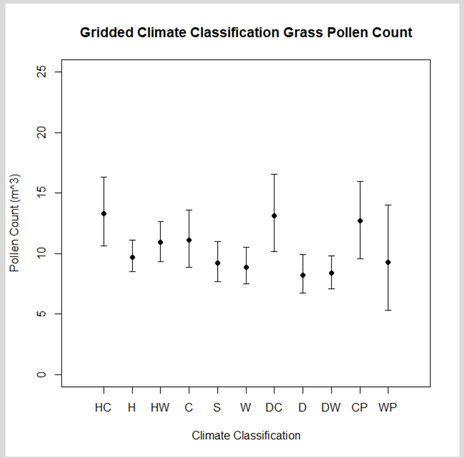
- It is estimated that 50 million people in the United States are affected by allergies (Asthma and Allergy Foundation of America).
- Some of the most common outdoor allergy triggers are tree, grass and weed pollen (Asthma and Allergy Foundation of America).
- The most common symptoms associated with allergies are nasal congestion, nasal itching, sneezing and poor sleep patterns (Kim et al, 2011).
- Many studies, such as Fuhrmann et al. (2016) have focused on how individual weather elements impact pollen count, but a synoptic climatological approach had yet to be taken.

Methods

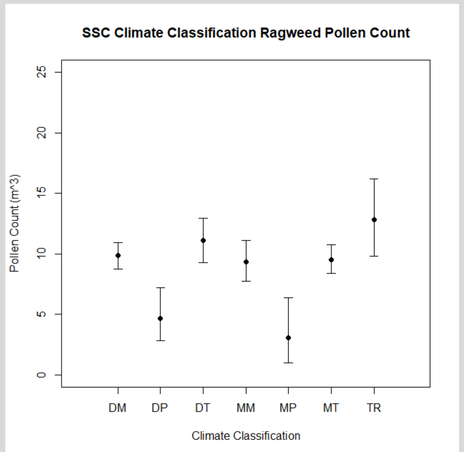
- Daily Airborne grass and ragweed pollen data (2003-2012) were obtained from the Division of Air Quality (DAQ) at the North Carolina Department of Environment and Natural Resources.
- Only the peak pollen seasons for grass (May through September) and ragweed (August through October) were examined.
- The Spatial Synoptic Classification (SSC) and Gridded Weather Typing Classification (GWTC) were utilized to identify daily air mass/weather types.
- The Raleigh-Durham International Airport (KRDU) in Morrisville, NC was used as the base location/grid point for the air mass/weather type classification.
- Ninety-five percent bootstrap confidence intervals of mean daily pollen concentrations for each air mass/weather type were created to determine if statistically significant differences existed.
- Ratios were calculated using the percentage of days with low, moderate, high, and very high pollen, and the overall percentage of occurrence of a particular SSC type.
  - Values > 1 indicated that a synoptic category was more likely to be present on days with a particular concentration of pollen.



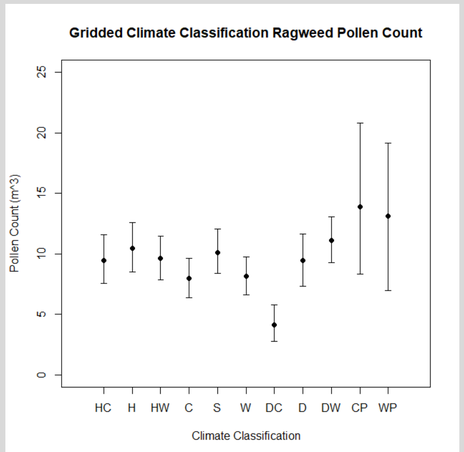
95% Bootstrap confidence intervals of the mean grass pollen count for each SSC type, 2003-2013



95% Bootstrap confidence intervals of the mean grass pollen count for each GWTC type, 2003-2013



95% Bootstrap confidence intervals of the mean ragweed pollen count for each SSC type, 2003-2013



95% Bootstrap confidence intervals of the mean ragweed pollen count for each GWTC type, 2003-2013

Spatial Synoptic Classification Ratio Table	Ragweed Pollen				Grass Pollen			
	Low Ratio (< 4)	Moderate Ratio (4 to 7.05)	High Ratio (7.05 to 28.49)	Very High Ratio (> 28.49)	Low Ratio (< 5.13)	Moderate Ratio (5.13 to 8.33)	High Ratio (8.33 to 66)	Very High Ratio (> 66)
Dry Moderate	0.82	1.14	1.17	0.76	1.01	0.96	0.94	0.71
Dry Polar	1.59	1.13	0.47	0.42	0.56	1.22	1.52	0.00
Dry Tropical	0.89	0.89	1.11	1.25	1.34	0.83	0.63	1.26
Moist Moderate	1.21	0.81	0.84	1.17	1.06	0.95	0.96	1.11
Moist Polar	2.27	0.00	0.19	0.59	1.14	0.74	0.99	0.00
Moist Tropical	0.93	1.13	1.02	1.07	0.92	1.12	1.06	1.19
Transitional	0.82	0.94	1.10	1.57	0.81	1.18	1.18	0.00
Moist Tropical (+)	0.90	1.27	1.13	0.47	0.90	0.90	1.22	0.89
Moist Tropical (++)	N/A	N/A	N/A	N/A	0.46	1.92	1.29	12.64

Discussion & Conclusions

- For grasses and ragweed, different relationships were found between pollen count and air mass types.
- The relationships identified remained fairly consistent using both the SSC and GWTC.
- For grasses, the Dry Polar (SSC) and Dry Cool (GWTC) classifications led to increases in pollen counts. Dry Tropical (SSC) and Dry Warm (GWTC) classifications resulted in decreases in airborne grass pollen counts.
- For ragweed, Dry Tropical (SSC) and Dry Warm (GWTC) classifications were associated with higher pollen counts, while Dry Polar (SSC) and Dry Cool (GWTC) were associated with lower pollen counts.
- Furthermore, both synoptic classification schemes found that frontal passages (TR, CP, WP) resulted in some of the highest counts of ragweed pollen.
- Ratio analysis using the Spatial Synoptic Classification supported the relationships identified in the confidence interval bootstrap plots for ragweed pollen. For grasses, the ratios showed that Dry Tropical (DT) air masses were associated with low and very high pollen counts.

Future Work

- Similar research should be conducted for different geographical areas in order for comparisons to be made. Based on the different relationships found in this research, future work should focus on other species of plant life.
- In the future, a pollen forecasting model based on the synoptic environment could be developed.

References

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