Weather, Climate, Pollen, & Health: An Update

HAQAST3

Jeremy Hess, MD, MPH; Fiona Lo, MS; Cecilia Bitz, PhD; Shubhayu Saha, PhD; Arie Mananganan, MS; Paul Schramm, MPH; Claudia Brown, MPH; Kris Ebi, PhD; George Luber, PhD; Lewis Ziska, PhD
Goals and Challenges

Goals
• Advance understanding of the climatic and weather factors affecting aeroallergen concentrations;
• Forecast pollen conditions a season in advance;
• Project pollen conditions 10-40 years in the future;
• Generate applications to advance health sector activities.

Challenges
• Both pollen and health data are scarce
• Precise relationships between weather, climate, and pollen are unknown
• Relationships between pollen levels and health outcomes are variable and not well understood
• Health sector activities related to pollen are decentralized and underfunded
Revised Work Plan

• Develop timeseries of speciated pollen counts and perform descriptive analysis: pollenology
• Evaluate associations between pollenology, NDVI, and MERRA-2 weather data
• Evaluate associations between pollen counts, Google web search trends, and health outcomes
• Develop seasonal forecast of pollen counts and allergic disease burden incorporating observed associations
• Project pollen counts and allergic disease burden using scenarios of climate change
Stakeholders and Engagement

- American Academy of Asthma, Allergy, and Immunology (AAAAI)
  - National Allergy Board (NAB)
  - Aerobiology Committee
- Centers for Disease Control and Prevention (CDC)
- Council of State and Territorial Epidemiologists (CSTE)
- Environmental Protection Agency (EPA)
Analyses to Date

- Average total and speciated pollen season parameters by location
- Average relative proportions of speciated pollen counts by location
- Trends in pollen counts over study period
- Associations between pollenology, MERRA-2, and NDVI
- Associations between pollen counts and Google web search trends
Allergenic Trees

- Acer (Maple)
- Ulmus (Elm)
- Quercus (Oak)
- Morus (Mulberry)
- Cupressus (Cypress)
- Alnus (Alder)
Allergenic Weeds

- Urticaceae
- Ambrosia
- Plantago
- Chenopodiaceae/Amaranthaceae
Gramineae/Poaceae

Gramineae / Poaceae 2003-2016 by latitude

Allergenic Grass
Regional Pollenology
Regional Pollen Trends - Counts

- Maximum Pollen Count: 627 grains/m³/yr
- Total Annual Pollen Count: 4467 grains/m³/yr

- Maximum Pollen Count: 220 grains/m³/yr
- Total Annual Pollen Count: 1385 grains/m³/yr

- Maximum Pollen Count: 167 grains/m³/yr
- Total Annual Pollen Count: 1492 grains/m³/yr
Regional Pollen Trends - Indices
Mean Onset and Temperature

Pollen Count Station Onset Date for Total Pollen
Date at which AGDD= 300°C (T_{\text{base}} =0°C)

[Map showing mean onset and temperature across the United States]
Correlation Onset and Temperature

Correlation and Timing Difference between AGDD=300°C and Start Date
2001-2014

Difference (days)
(positive=AGDD300 precedes Start Date)
Mean Onset and NDVI Greenup

Mean Greenup (Modis) and Start Date (pollen station), 2001-2014
Correlation Onset and NDVI Greenup

Correlation and Timing Difference between Greenup and Start Date
2001-2014

Difference (days)
(positive=Greenup precedes Start Date)
Season and Google Searches
Searches and Rhinitis Visits – Atlanta & Seattle
Oak, Total, and Med Refills – Atlanta & Seattle

![Graph of Oak, Total, and Med Refills from 1/1/2008 to 1/1/2015. The x-axis represents the years from 2008 to 2015, and the y-axis represents the number of refills. The graph shows the trend of refills over the years for Atlanta and Seattle.](image-url)
Conclusions

- There are clear associations between weather and pollen; associations are regionally variable.
- Trends over time vary by region.
- There is a relatively good association between average greenup and season start, greenup does not always precede season start.
- Pollen, health effects, and web searches are all correlated, and web searches are likely a good proxy for health effects.
- Relationships likely depend on local proportions of different flora and associated allergenicities.
- Prospects for a regional forecasting platform are good.
Next Steps

• Present weather and pollen findings at AMS (January 2018)
• Present pollenology findings, trend analyses, health associations at AAAAI conference (March 2018)
• Explore additional trend analyses with EPA, other collaborators
• Begin publishing findings
• Develop forecasting platform
• Use forecasting platform to perform climate change projections