Weather, Climate, Pollen, & Health: An Update

HAQAST3

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

UNIVERSITY *of* WASHINGTON

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

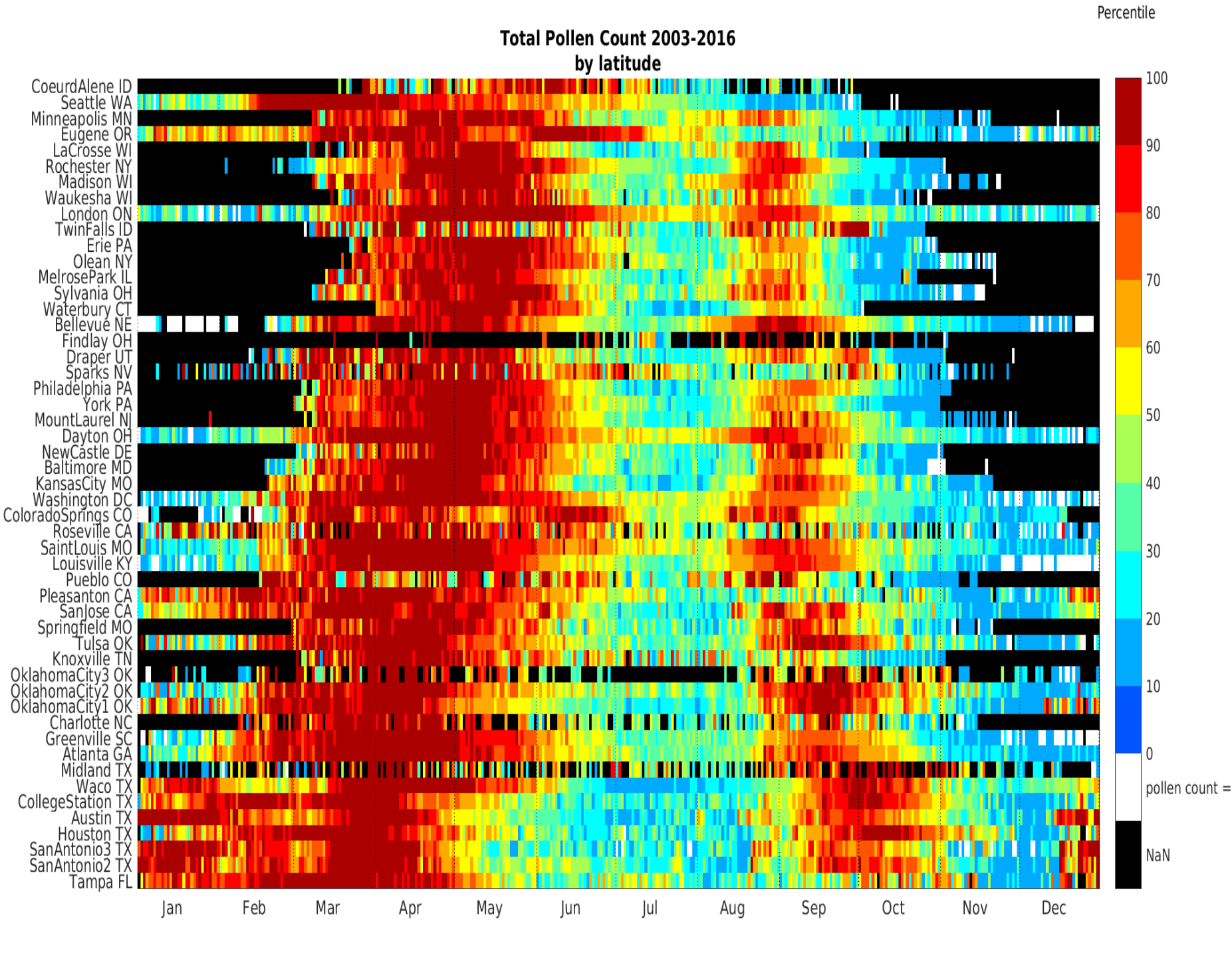
- Develop timeseries of speciated pollen counts and perform descriptive analysis: pollenology
- Evaluate associations between pollenology, NDVI, and MERRA-2 weather data
- Evaluate associations between pollen counts, Google web search trends, and health outcomes
- Develop seasonal forecast of pollen 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)

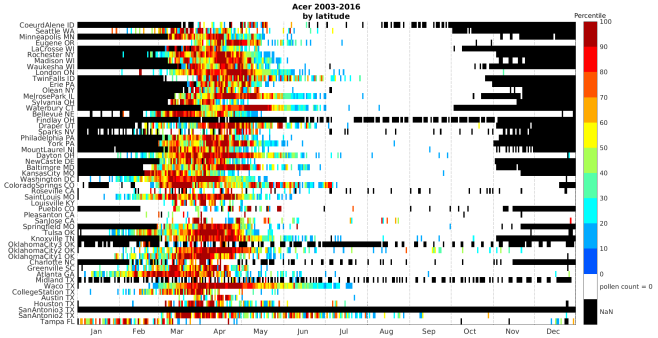
Analyses to Date

- 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

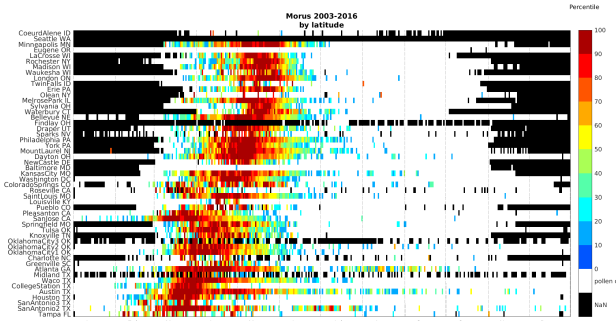

Total Pollen Count 2003-2016
by latitude
Percentile
100
90
80
70
60
50
40
30
20
10
0
pollen count =
NaN
CoeurdAlene ID
Seattle WA
Minneapolis MN
Eugene OR
LaCrosse WI
Rochester NY
Madison WI
Waukesha WI
London ON
TwinFalls ID
Erie PA
Olean NY
MelrosePark IL
Sylvania OH
Waterbury CT
Bellevue NE
Findlay OH
Draper UT
Sparks NV
Philadelphia PA
York PA
MountLaurel NJ
Dayton OH
NewCastle DE
Baltimore MD
KansasCity MO
Washington DC
ColoradoSprings CO
Roseville CA
SaintLouis MO
Louisville KY
Pueblo CO
Pleasanton CA
SanJose CA
Springfield MO
Tulsa OK
Knoxville TN
OklahomaCity3 OK
OklahomaCity2 OK
OklahomaCity1 OK
Charlotte NC
Greenville SC
Atlanta GA
Midland TX
Waco TX
CollegeStation TX
Austin TX
Houston TX
SanAntonio3 TX
SanAntonio2 TX
Tampa FL
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

Allergenic Trees

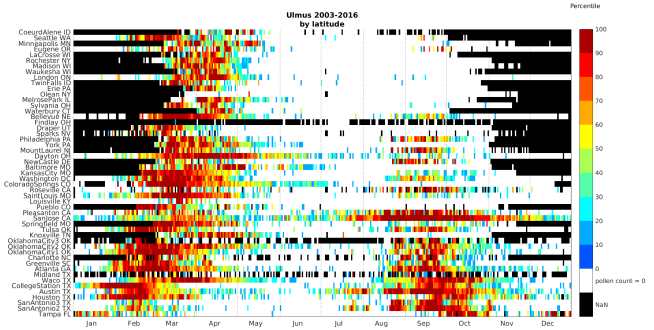
Acer (Maple)



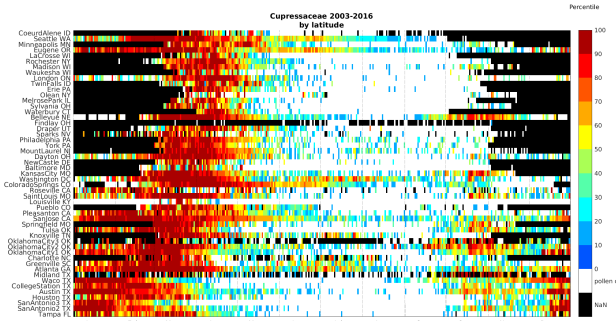
Morus (Mulberry)



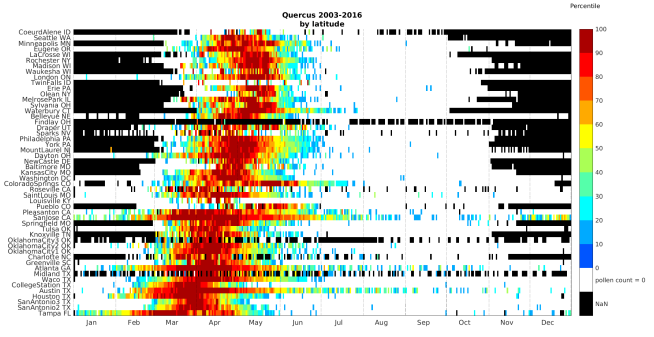
Ulmus (Elm)



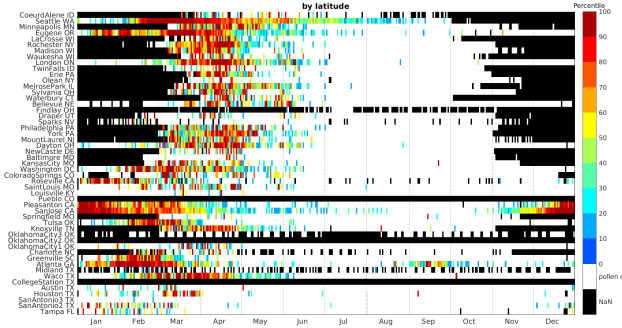
Cupressus (Cypress)



Quercus (Oak)

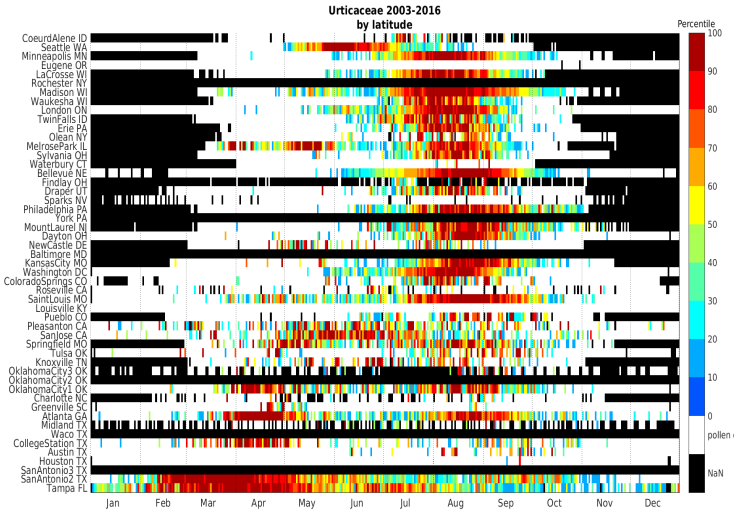


Alnus (Alder)

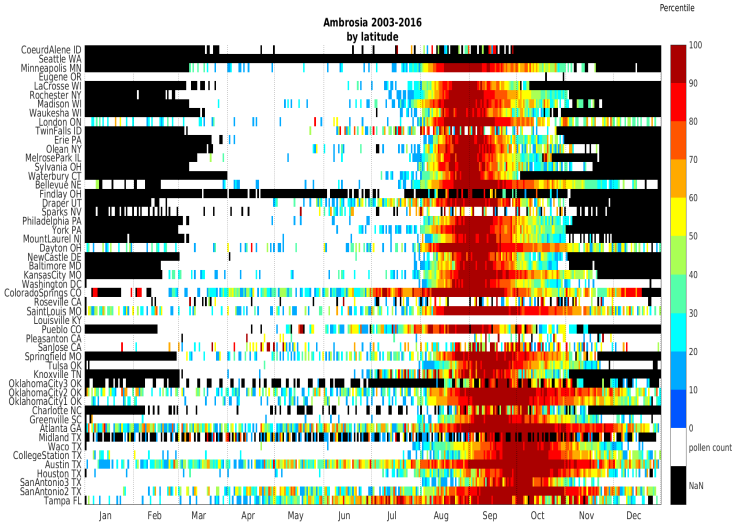


Allergenic Weeds

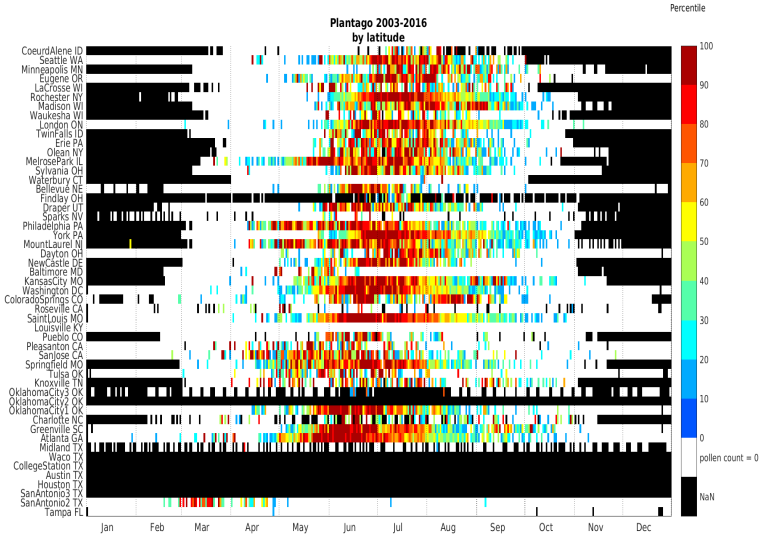
Urticacae



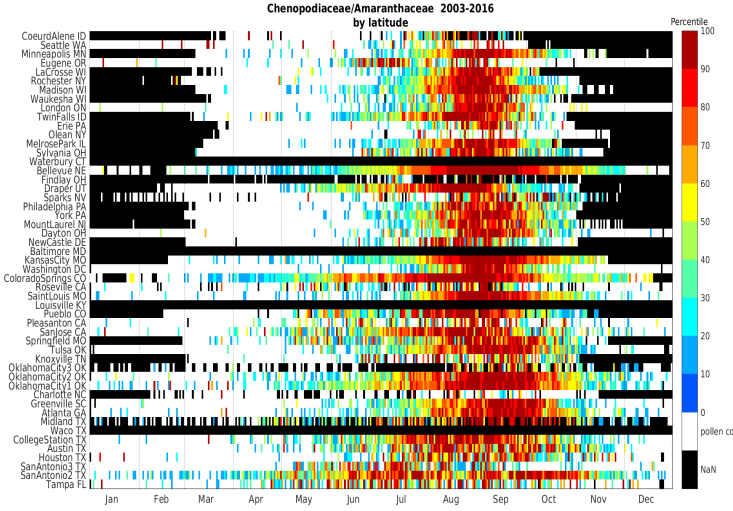
Ambrosia



Plantago

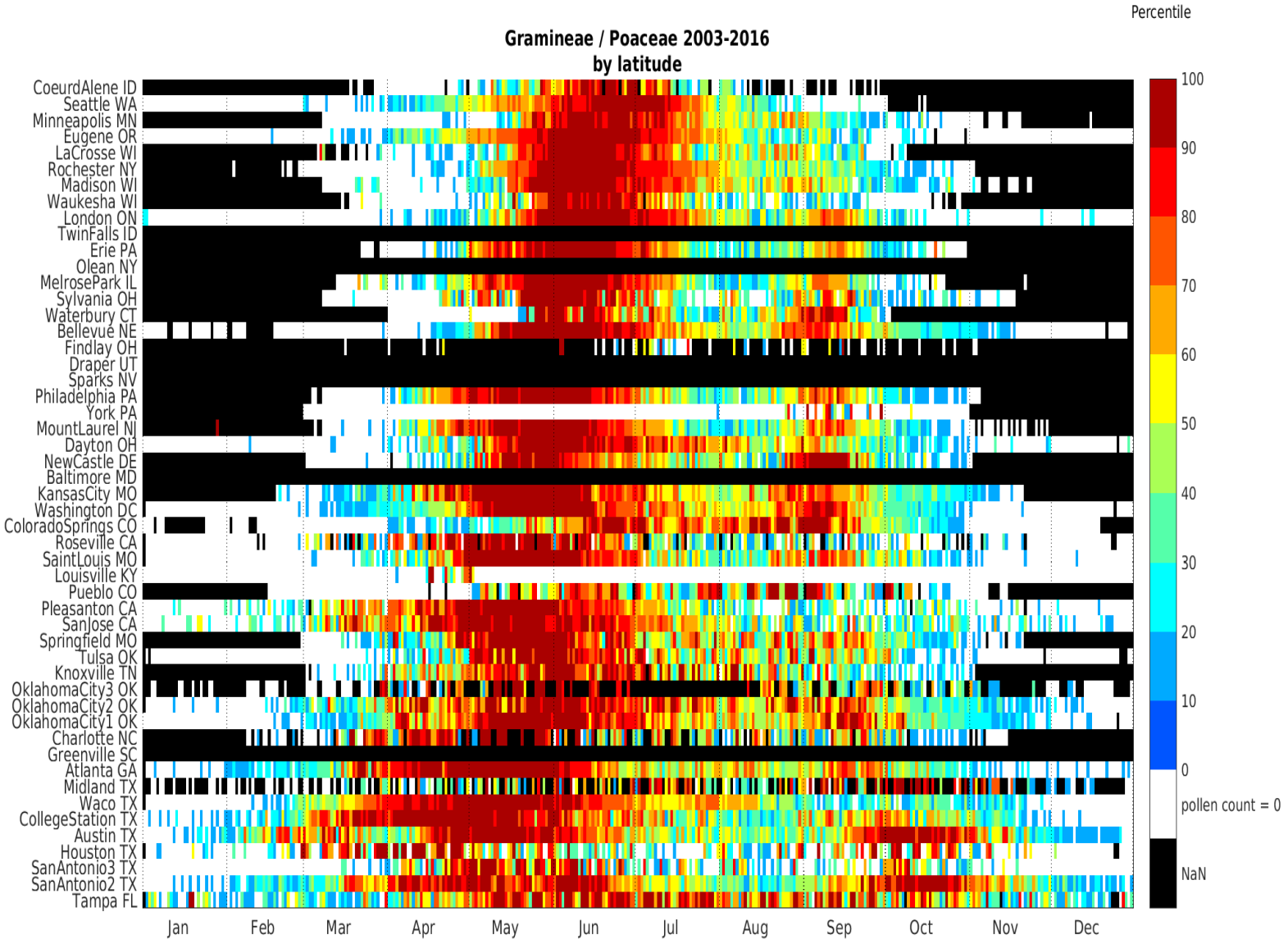


Chenopodiaceae/Amaranthacae

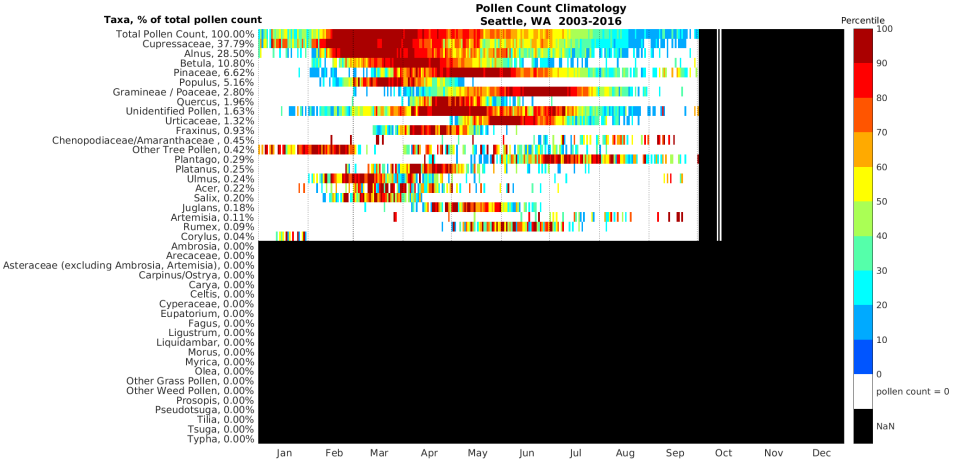


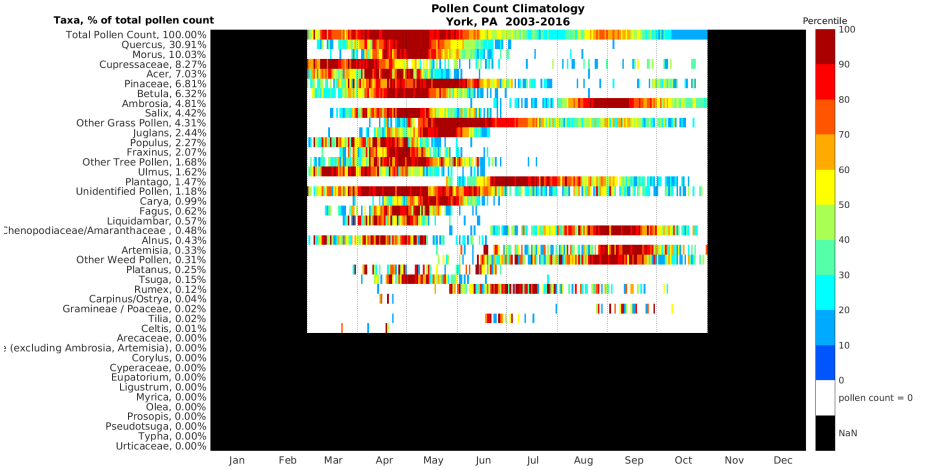
Allergenic Grass

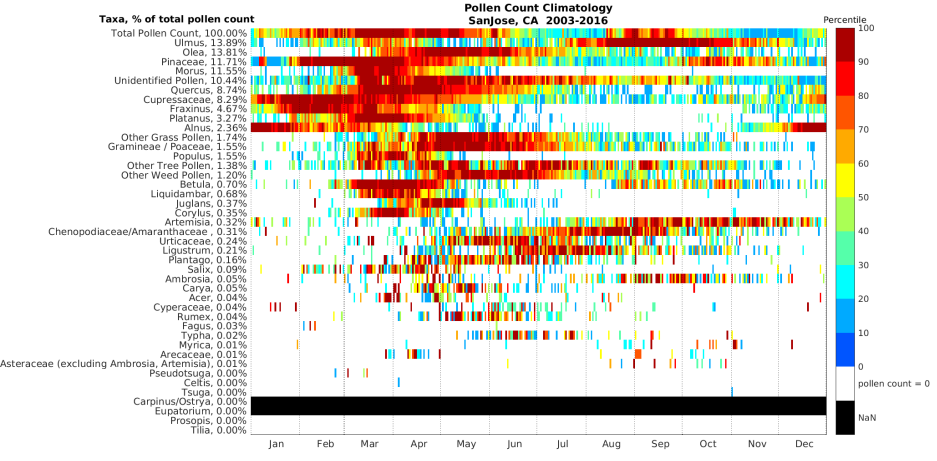
Gramineae/Poaceae

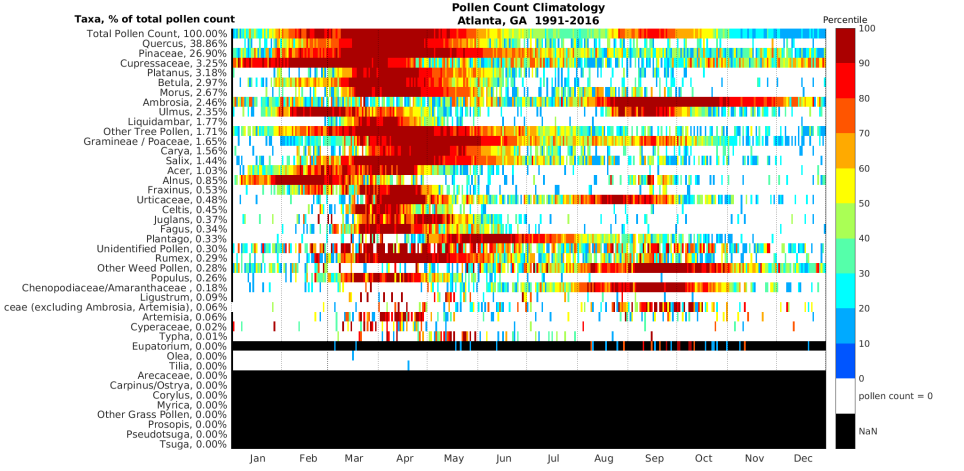


Regional Pollenology

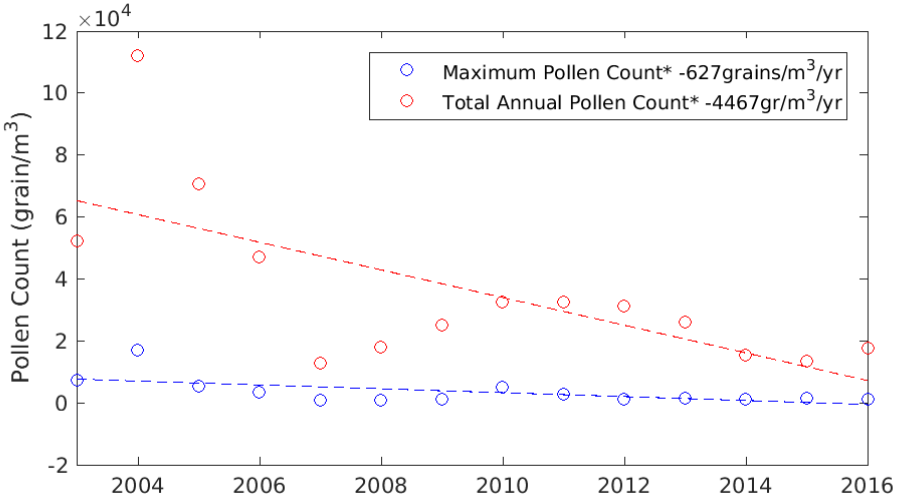


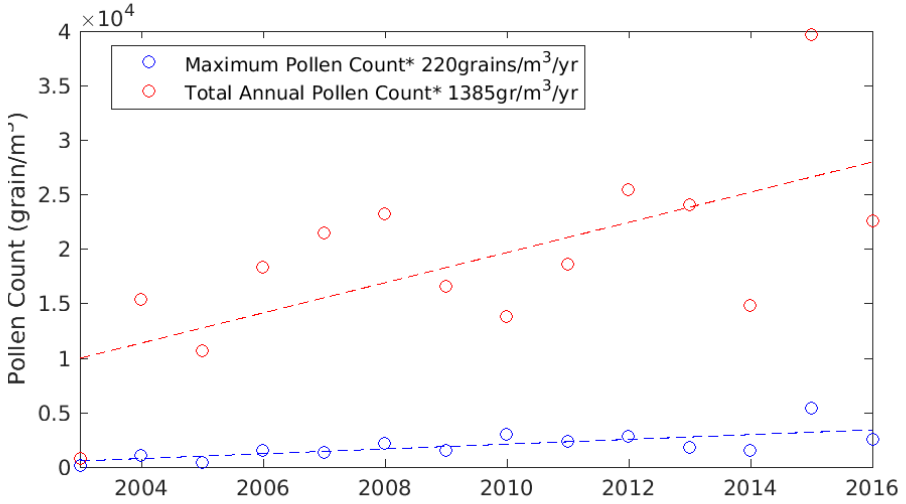


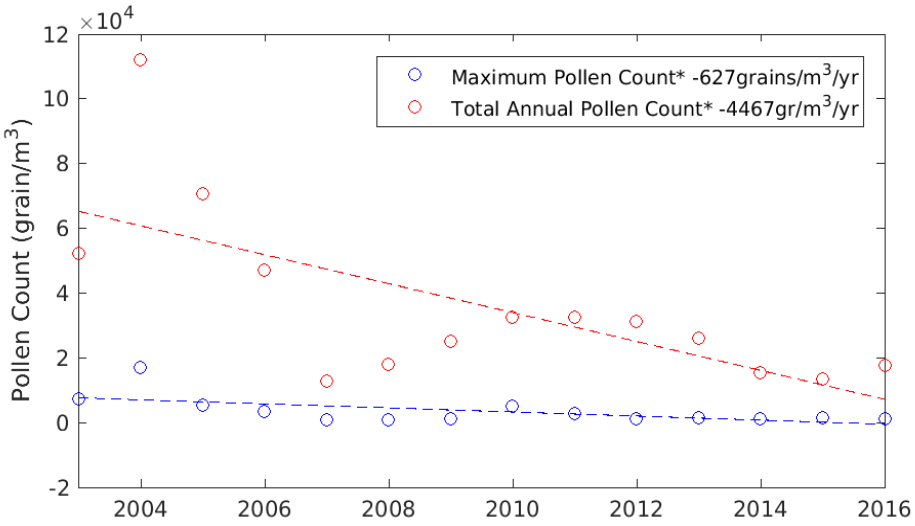


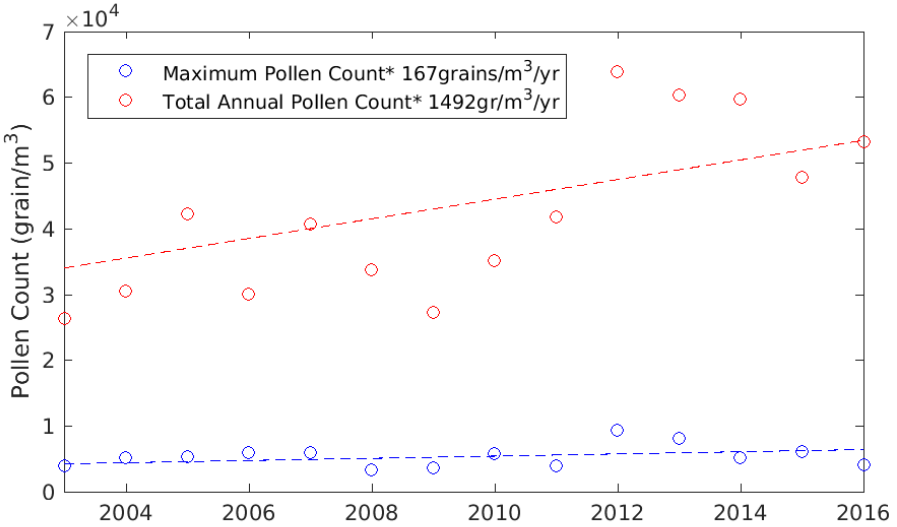


Regional Pollen Trends - Counts

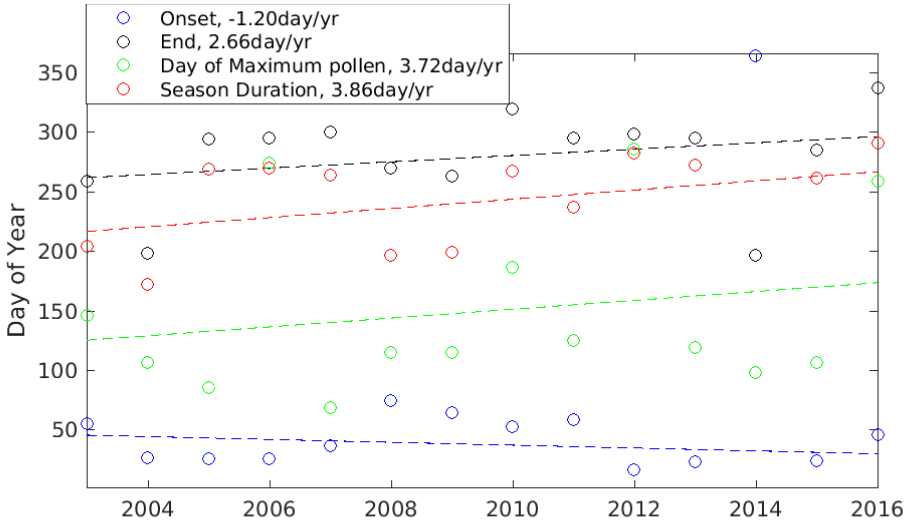


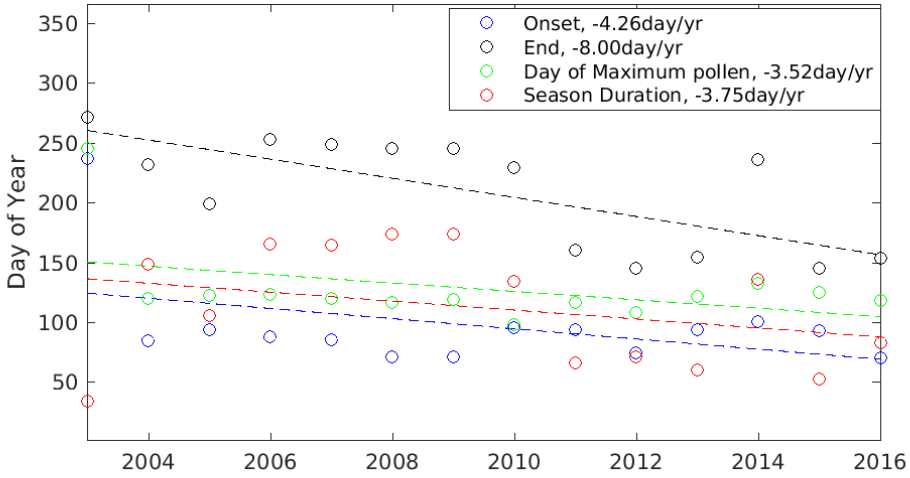


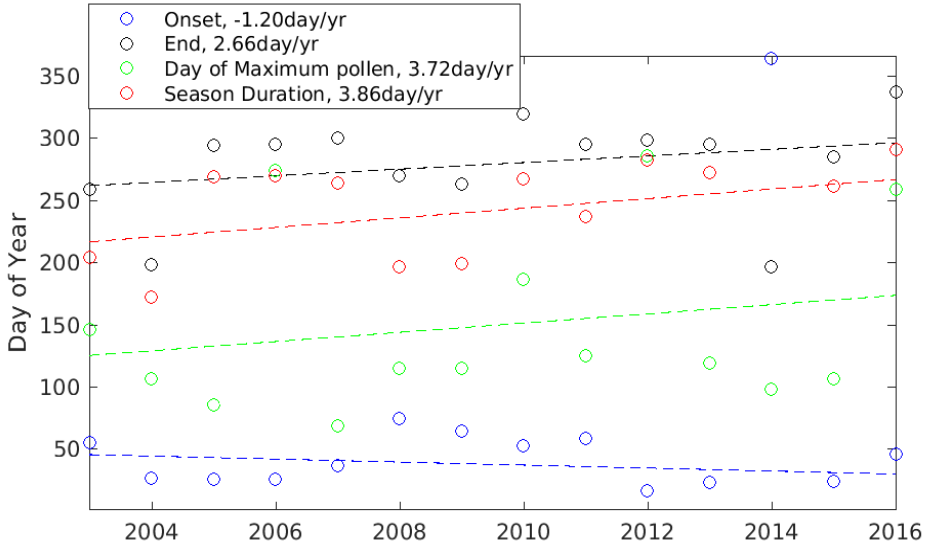


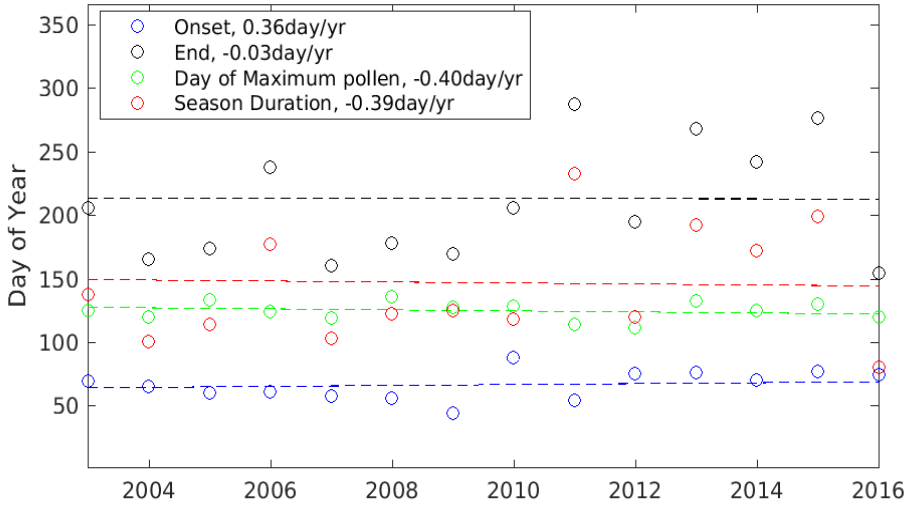


Regional Pollen Trends - Indices

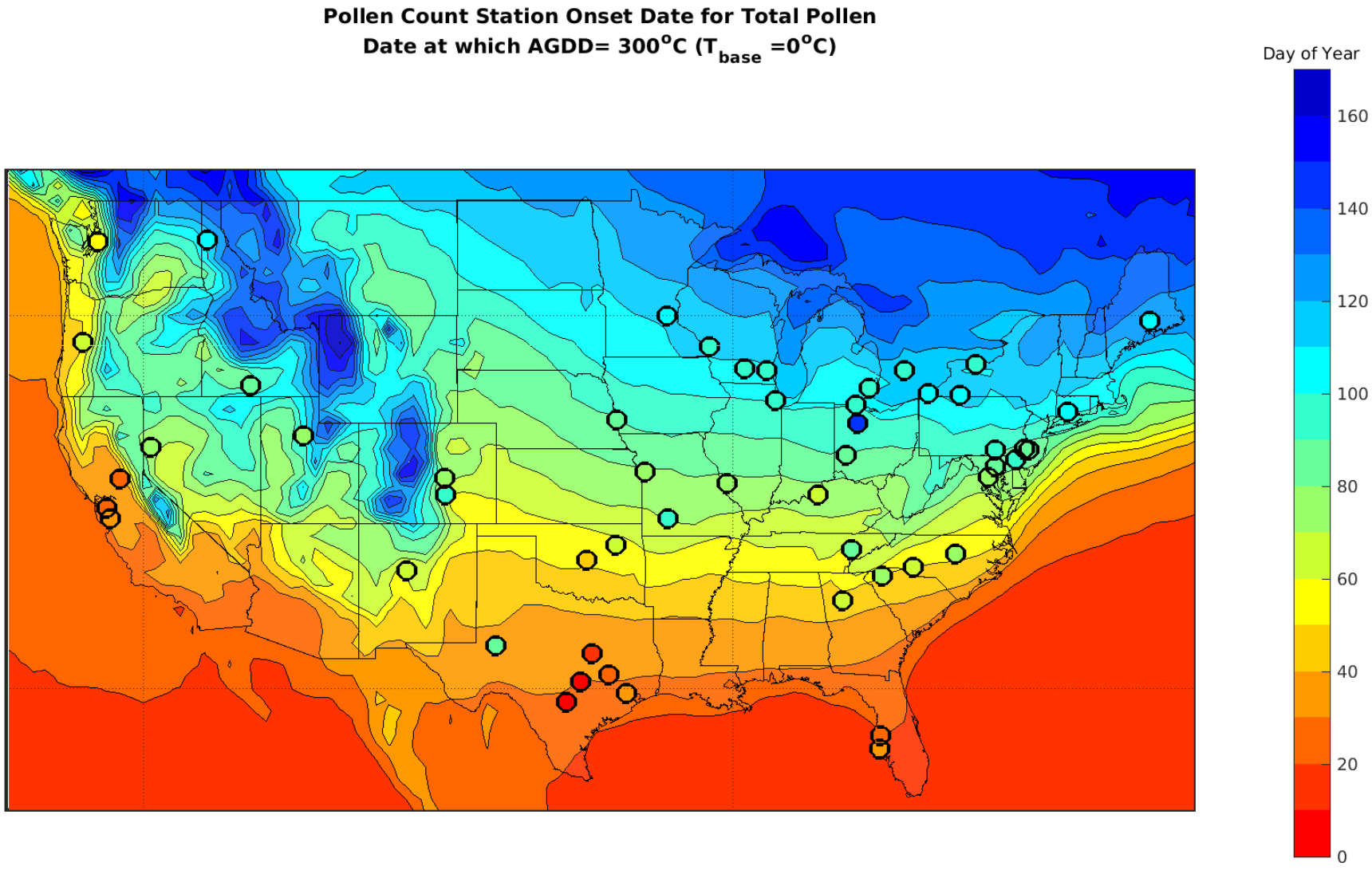




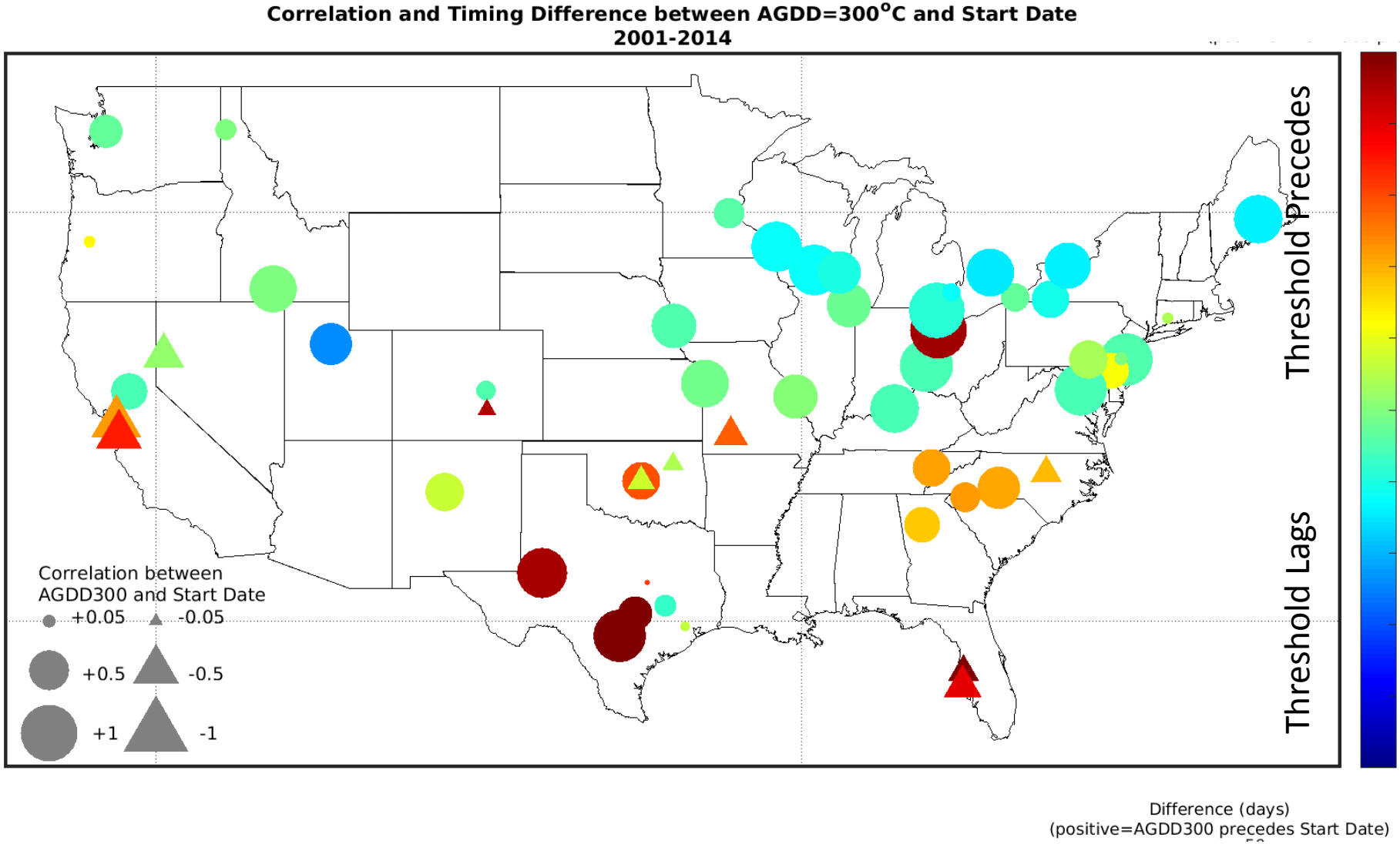




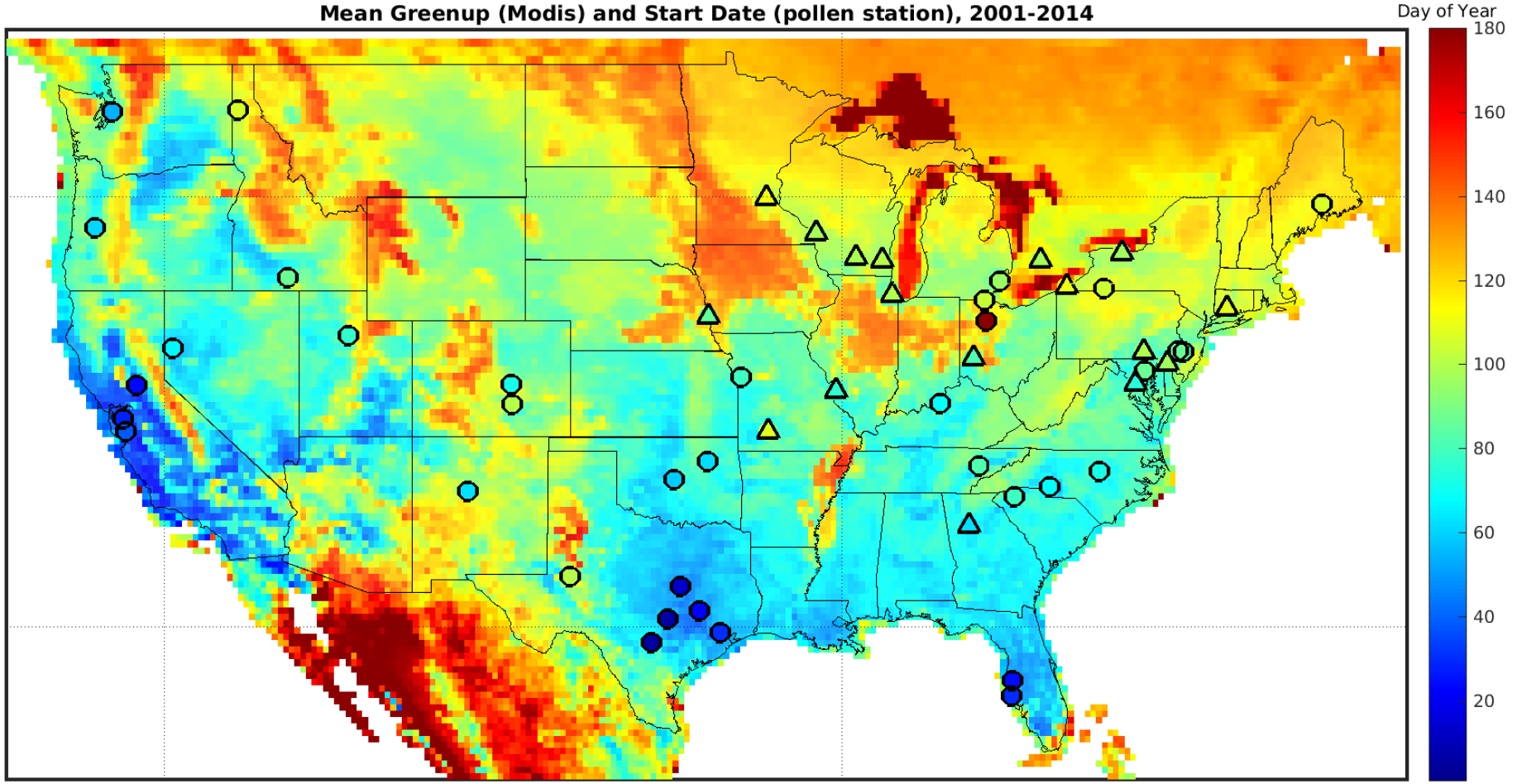
Mean Onset and Temperature



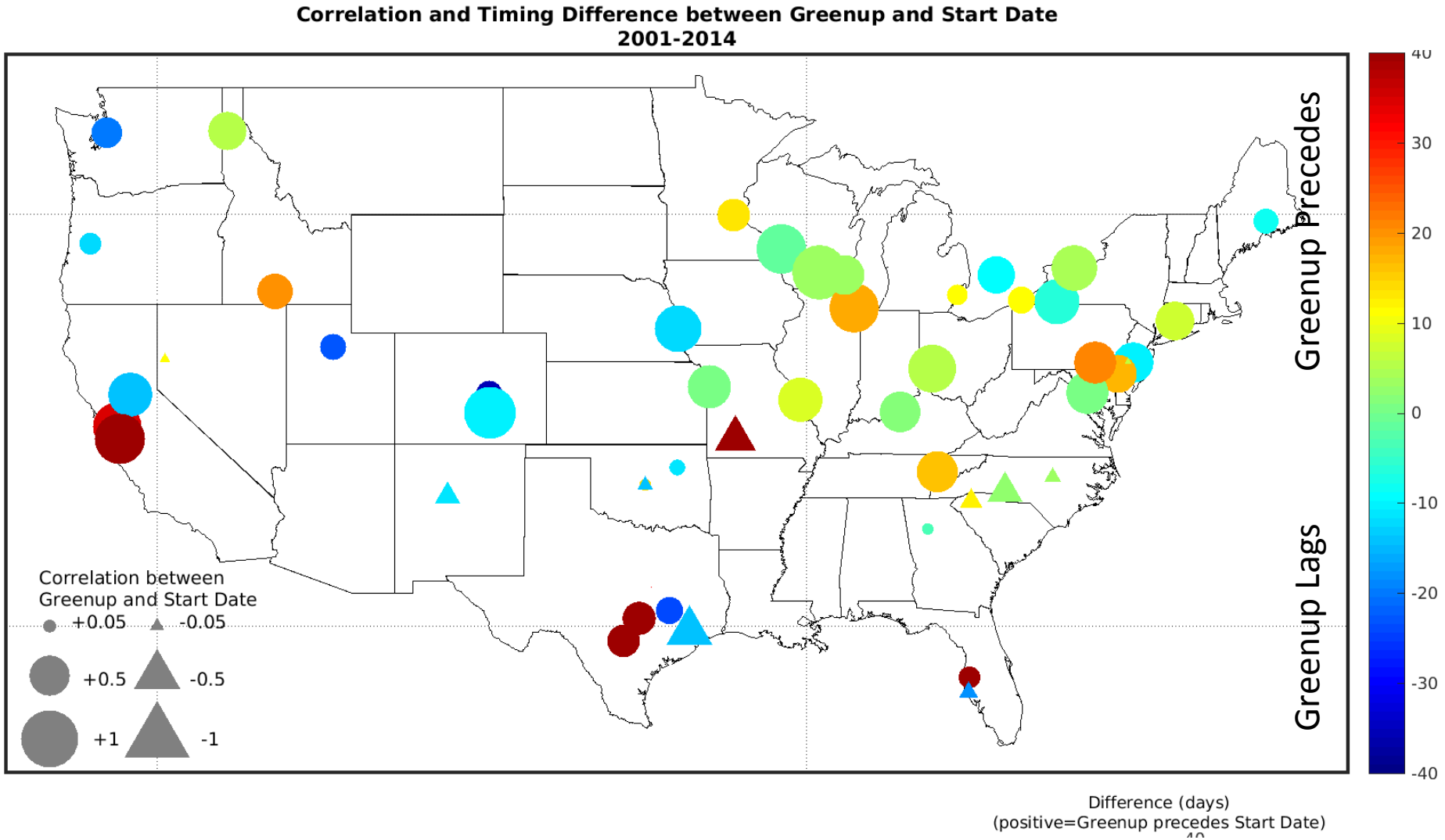
Correlation Onset and Temperature



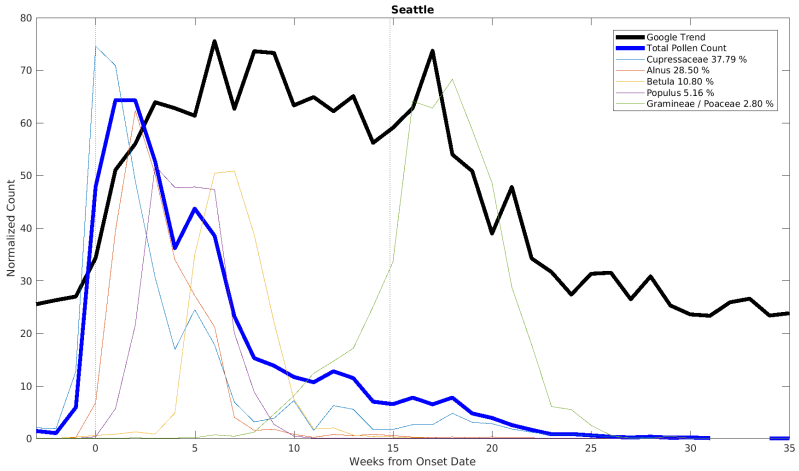
Mean Onset and NDVI Greenup

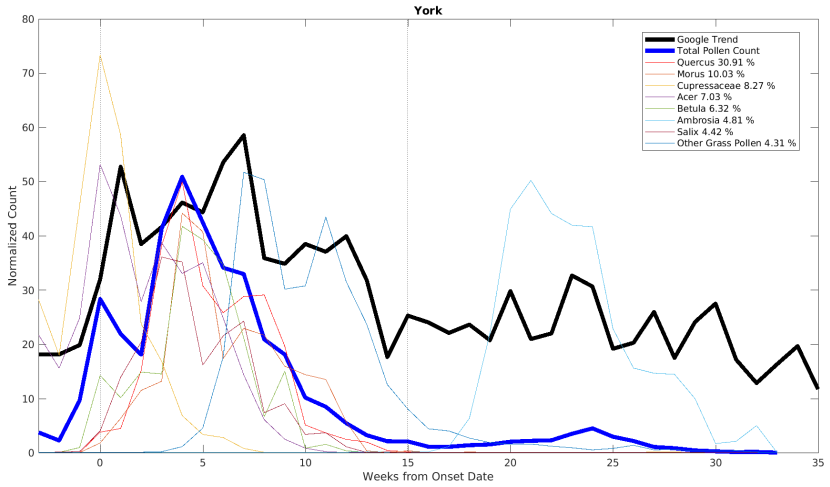


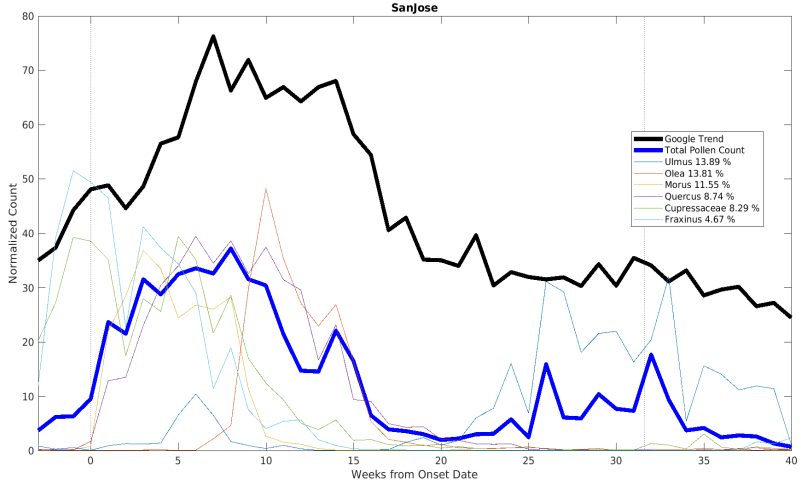
Correlation Onset and NDVI Greenup

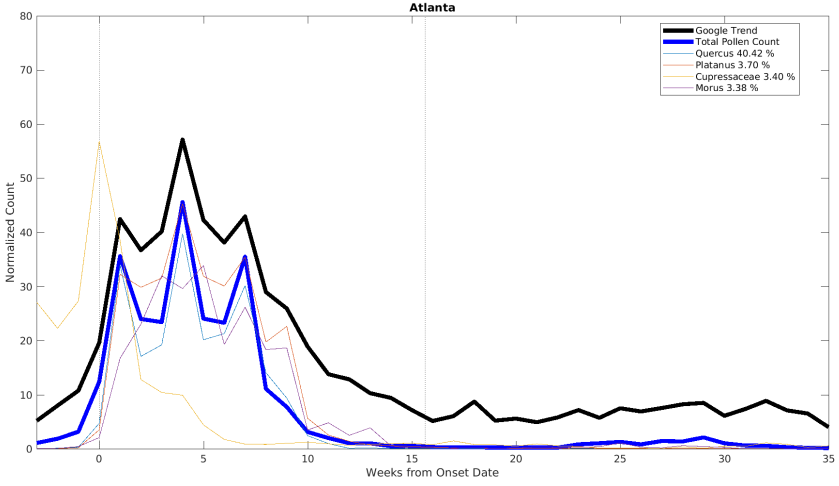


Season and Google Searches

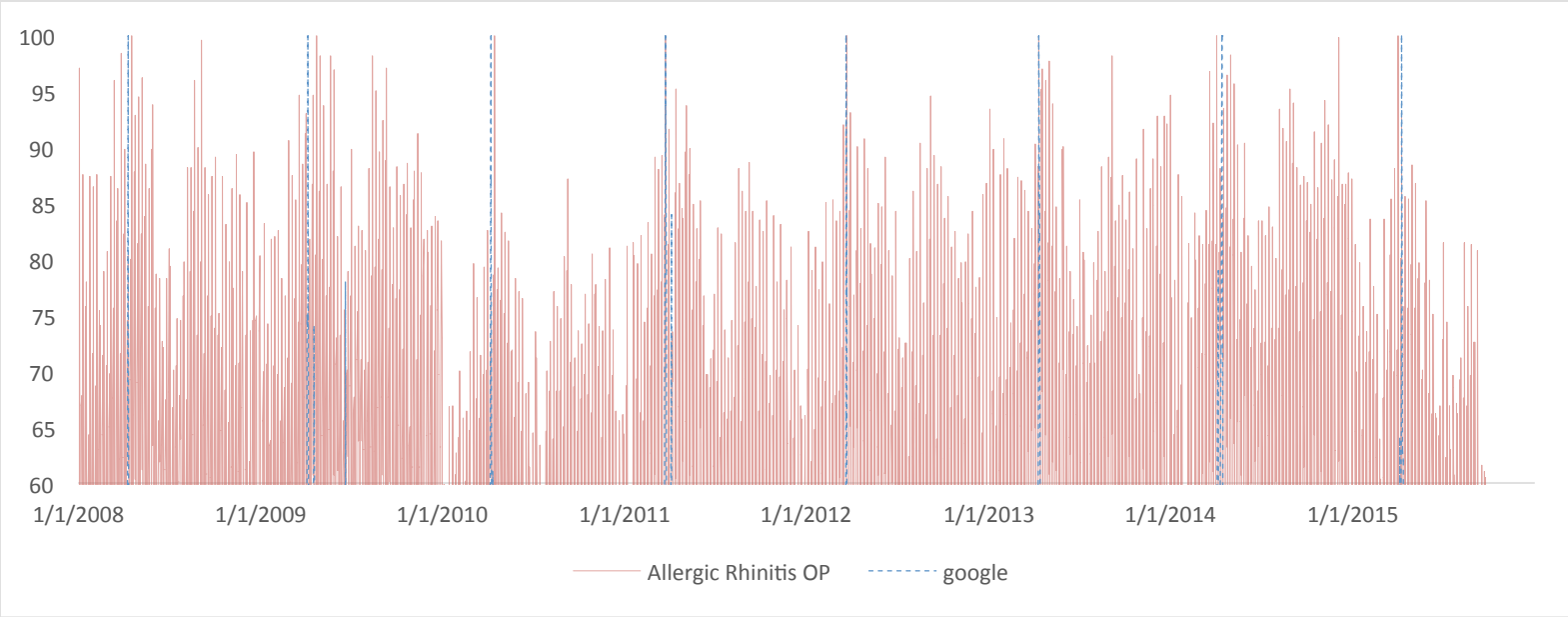


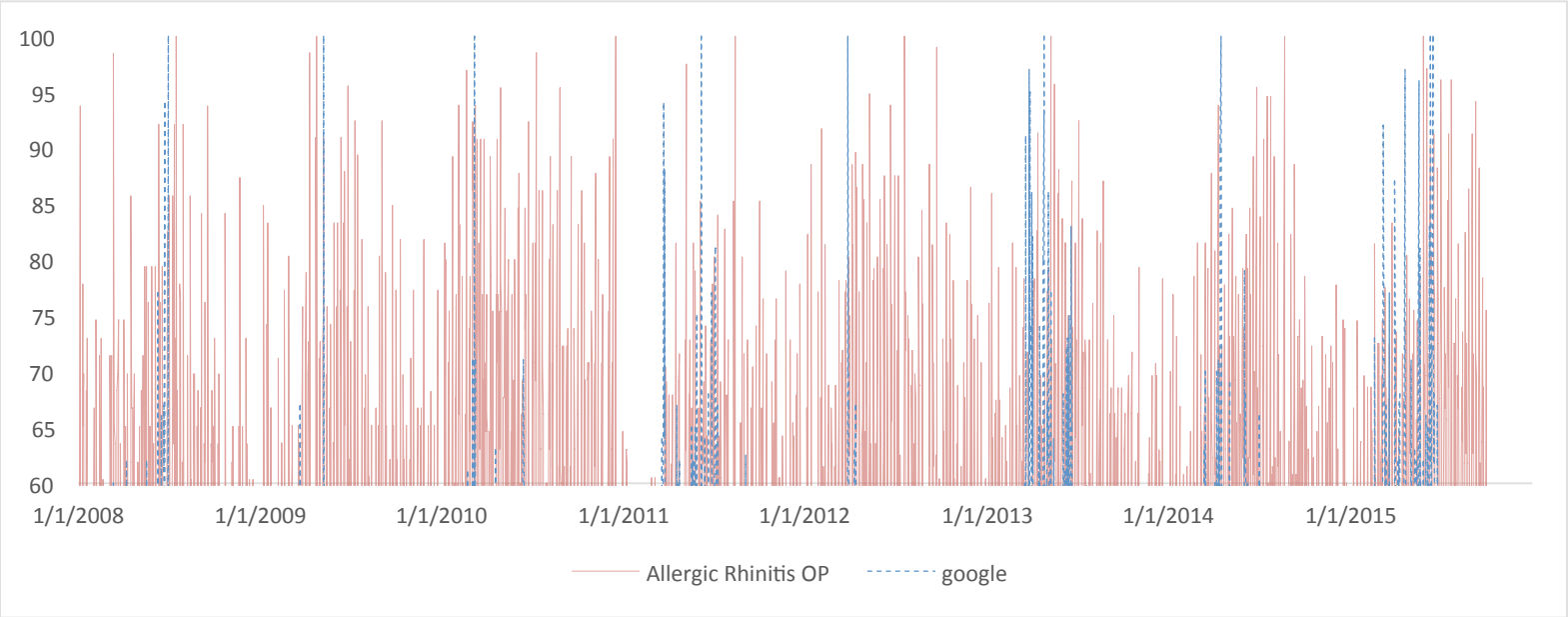




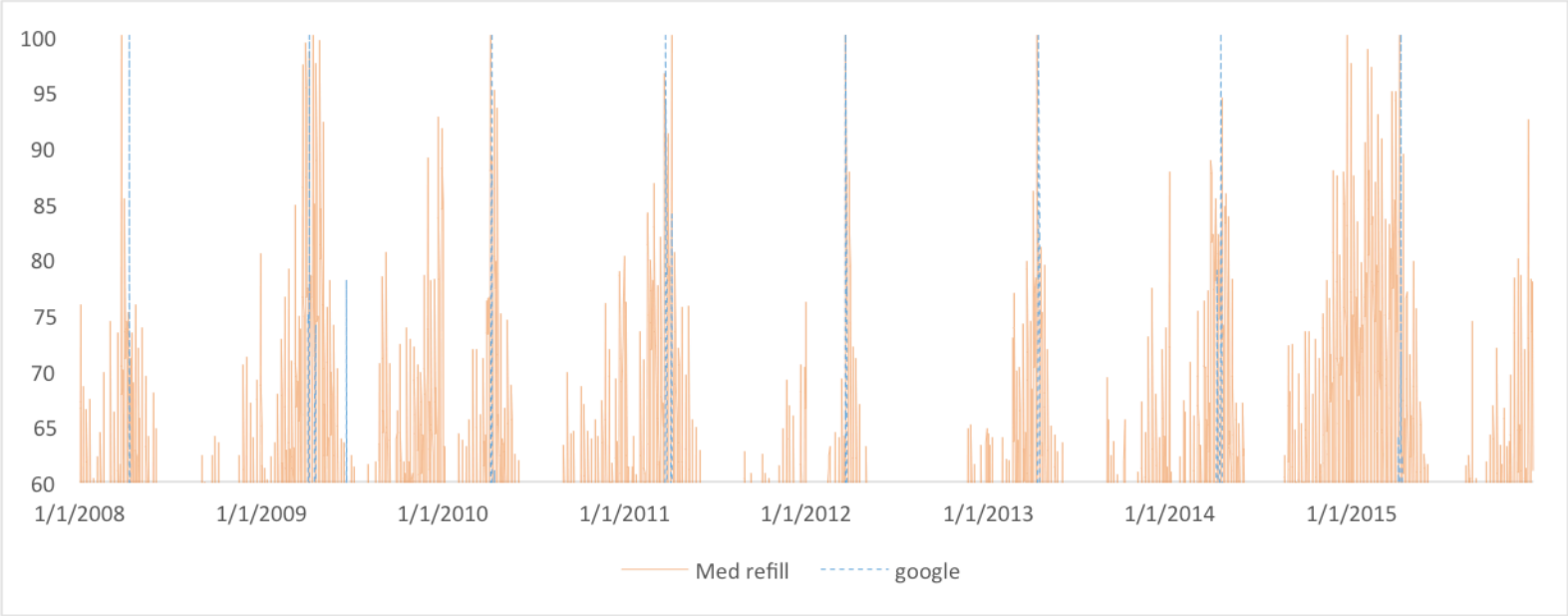


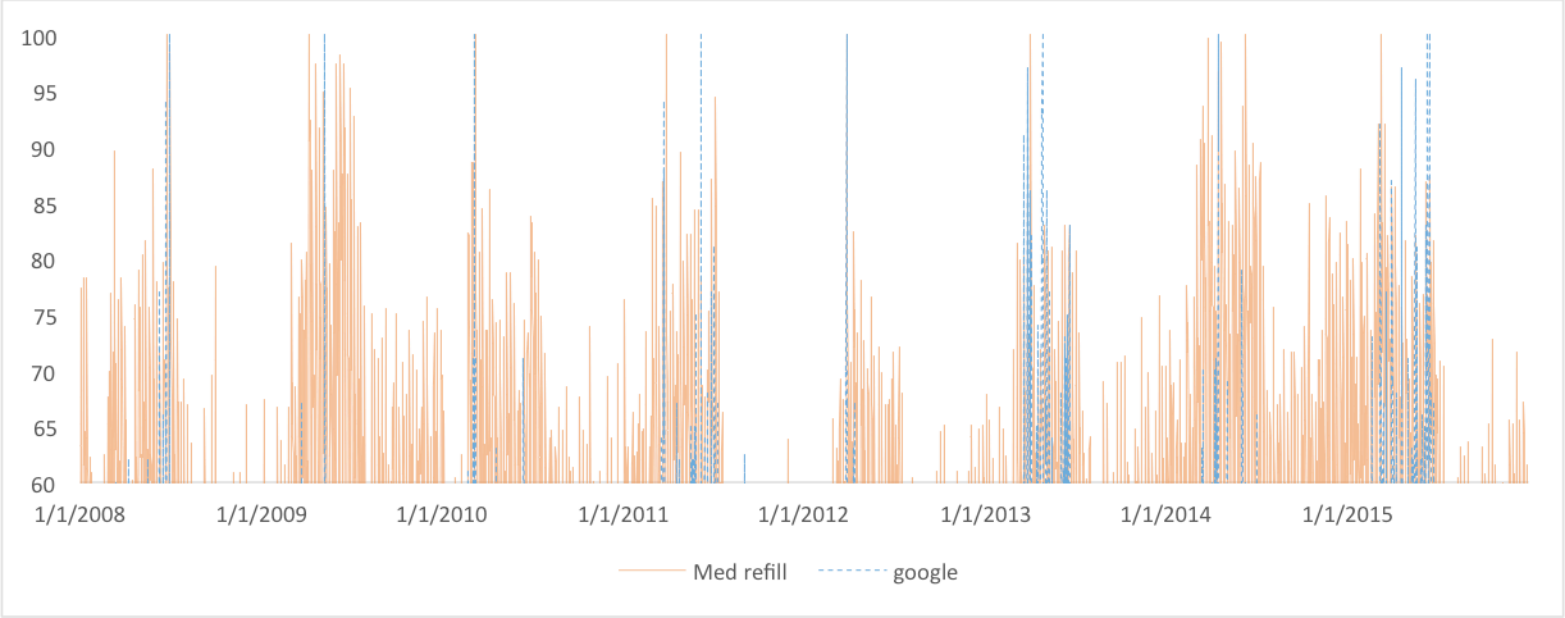
Searches and Rhinitis Visits –Atlanta & Seattle



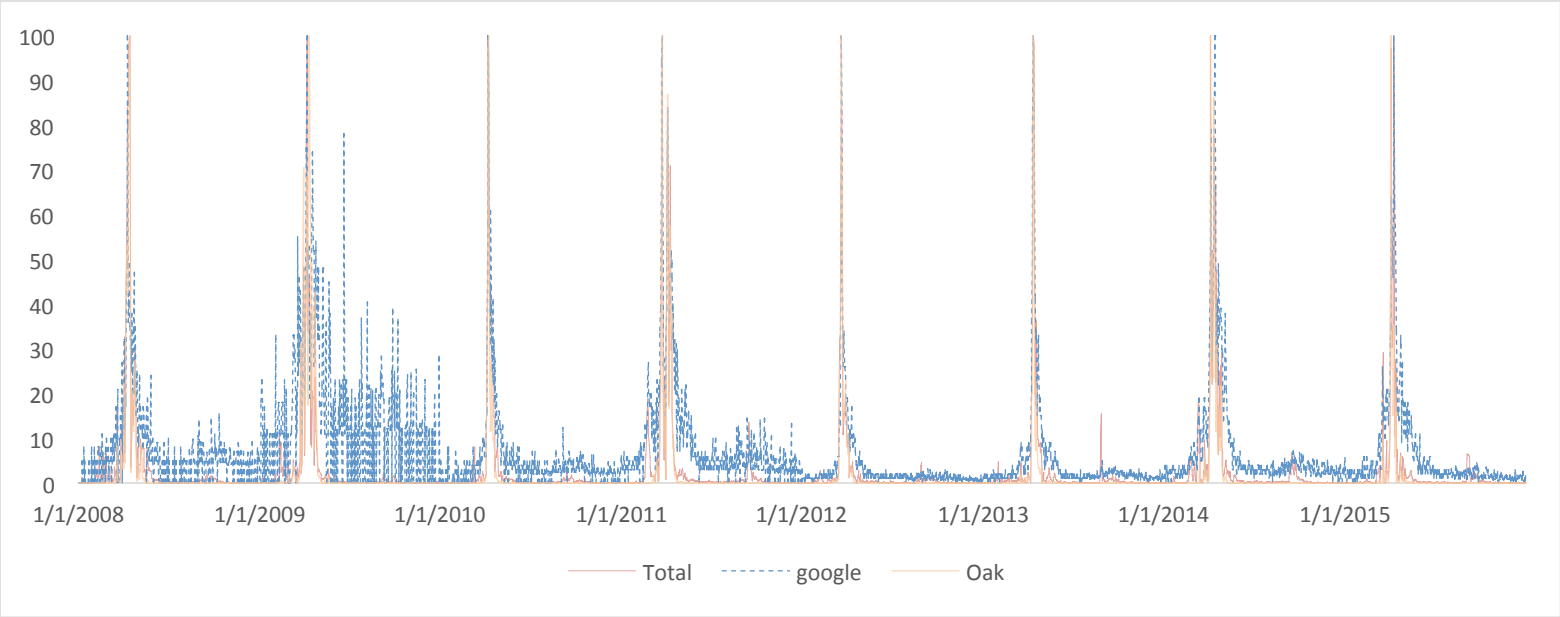


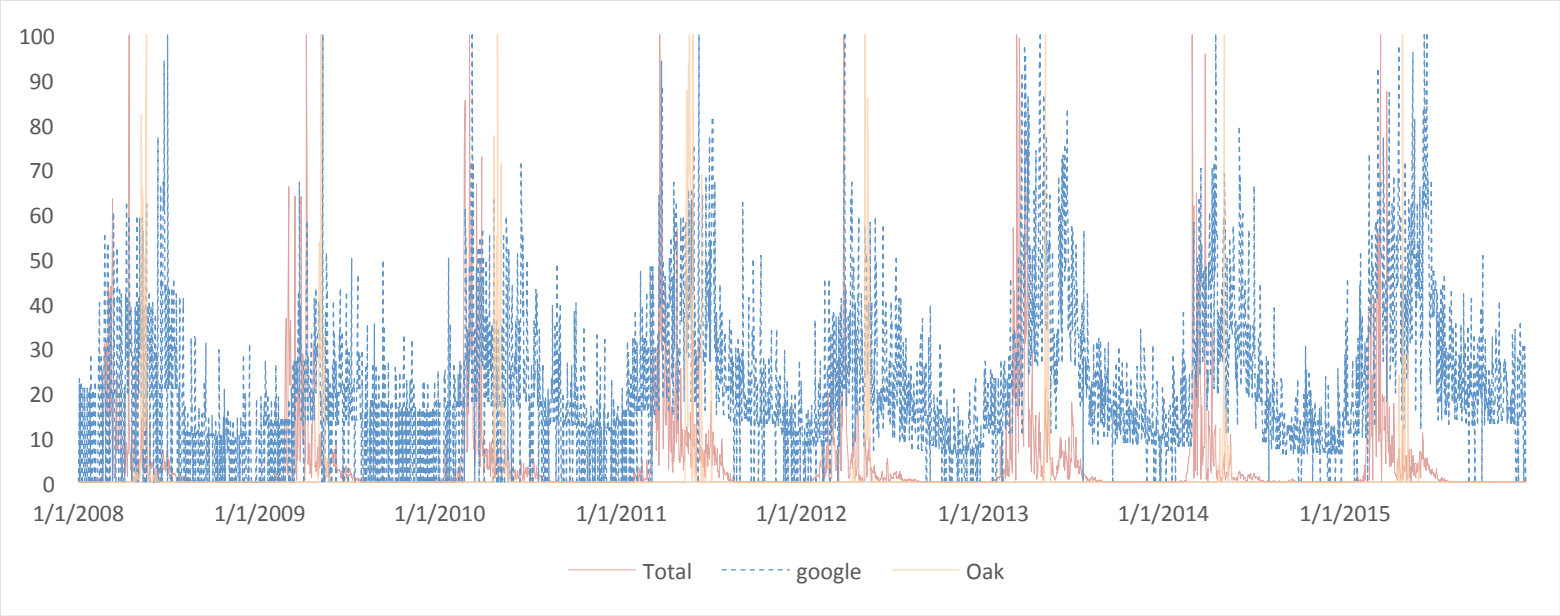
Searches and Med Refills – Atlanta & Seattle





Oak, Total, and Med Refills – Atlanta & Seattle





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