Weather, Climate, Pollen, & Health:

Stakeholder Perspectives and Preliminary Results

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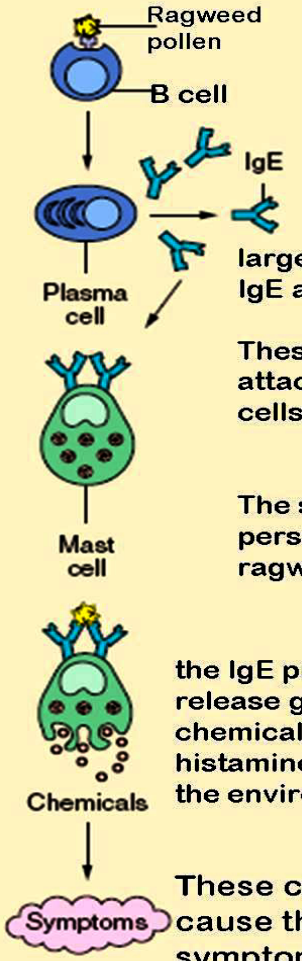
Overview

- Primer on pollen and health
- Review of project objectives
- Stakeholder priorities
- Preliminary results

Pollen and Health: General

- Pollen exposure produces allergic disease (rhinitis, sinusitis, asthma, others) in sensitized individuals
- Risk factors include:
  - Family history of atopy
  - Male sex
  - Birth during pollen season
  - Firstborn status
  - Early use of antibiotics
  - Maternal smoking exposure
    Indoor allergen exposure, e.g. dust mite allergen
- Sensitization age 2; 9% by age 8; 15% by age 12; lifetime incidence 10-30%
- Significant morbidity but low mortality
  - 2.5 % of all clinician visits
  - 2 million lost school days
  - 6 million lost work days
  - 28 million restricted work days per year
- Burden is increasing; allergic rhinitis spending went from $6.2b in 2000 to $11.2b in 2005
- Mediated primarily by IgE antibodies

Etiology



The first time an allergy prone person runs across an allergen such as ragweed

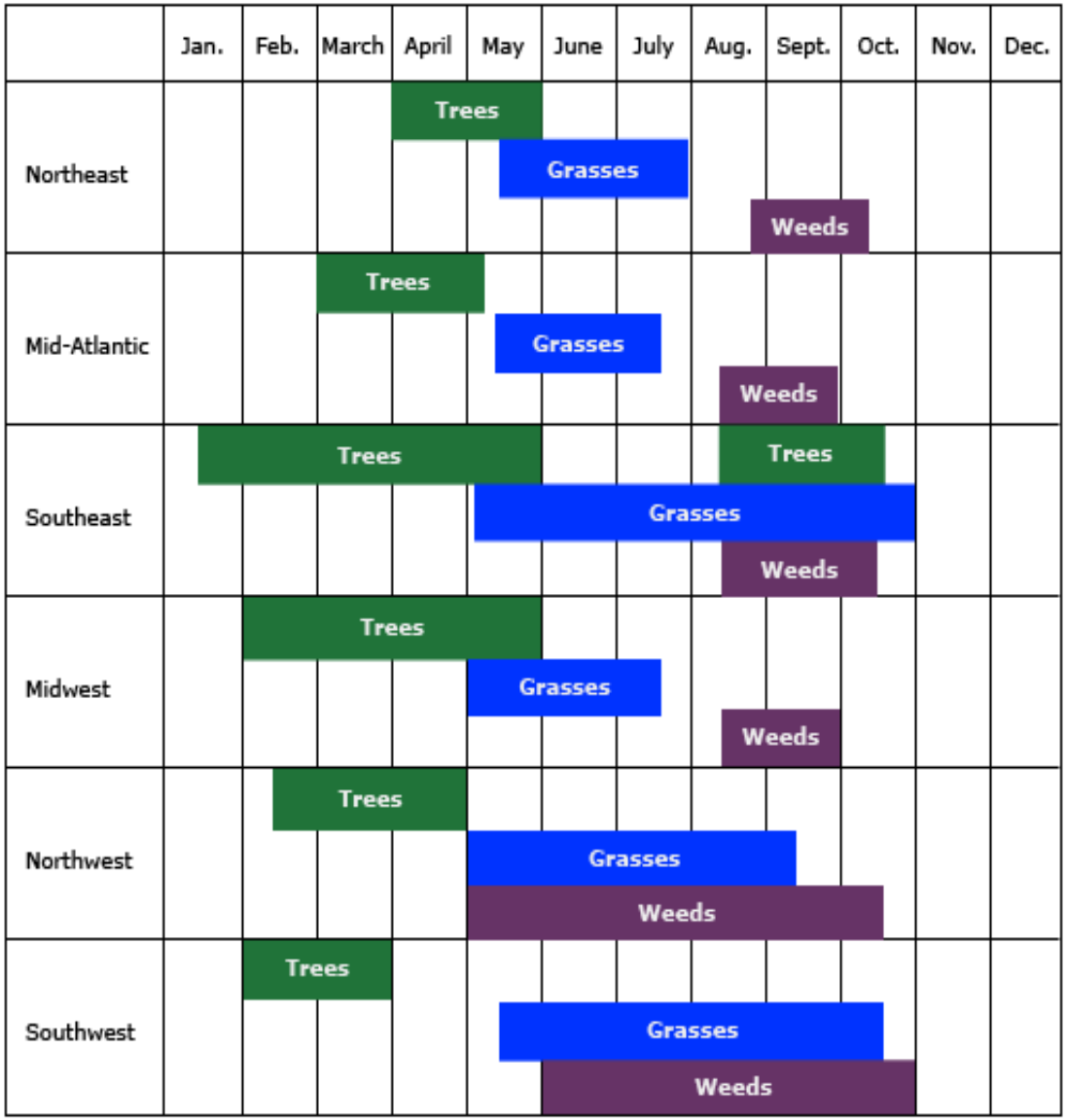
he or she makes large amounts of ragweed IgE antibody.

These IgE molecules attach themselves to mast cells.

The second time that person has a brush with ragweed,

the IgE primed mast cells release granules and powerful chemical mediators, such as histamine and cytokines, into the environment.

These chemical mediators cause the characteristic symptoms of allergy.



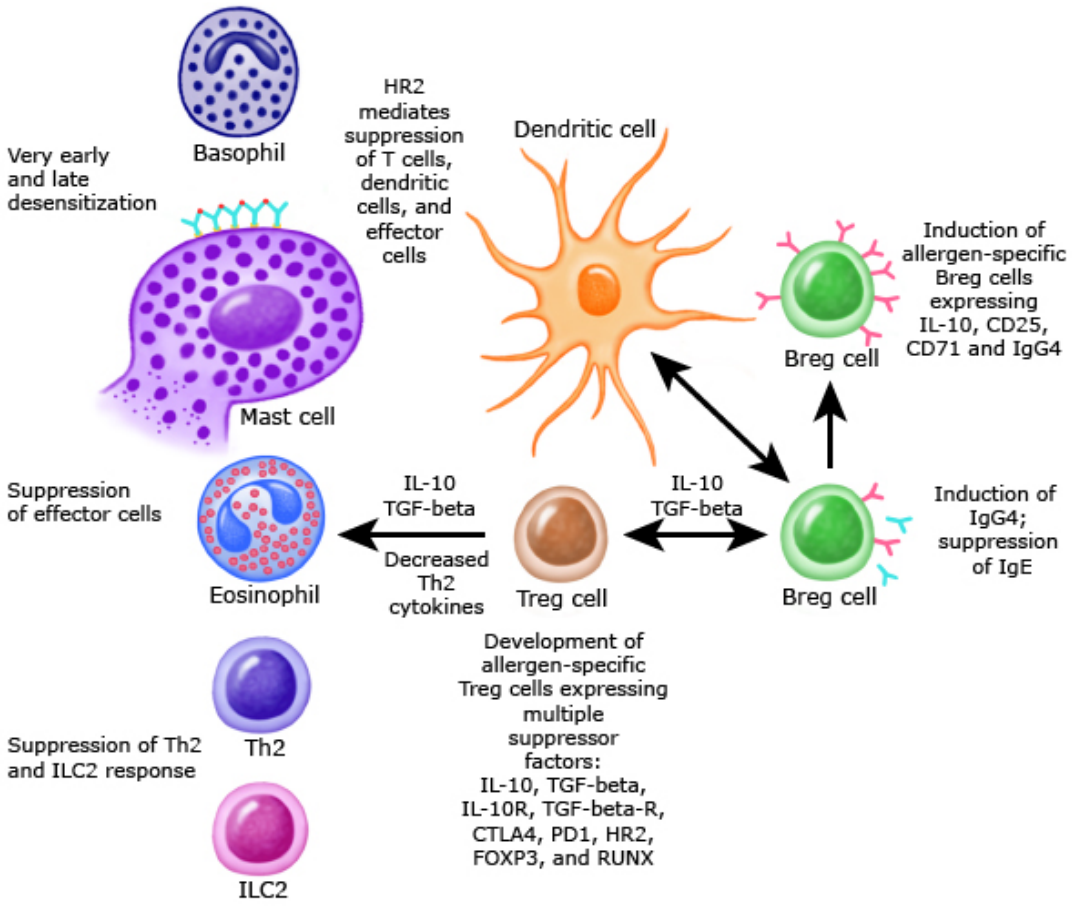
Nowak-Wegrzyn A. Clinical manifestations and diagnosis of oral allergy syndrome (pollen-food allergy syndrome). Up To Date, 2017.

Diagnosis

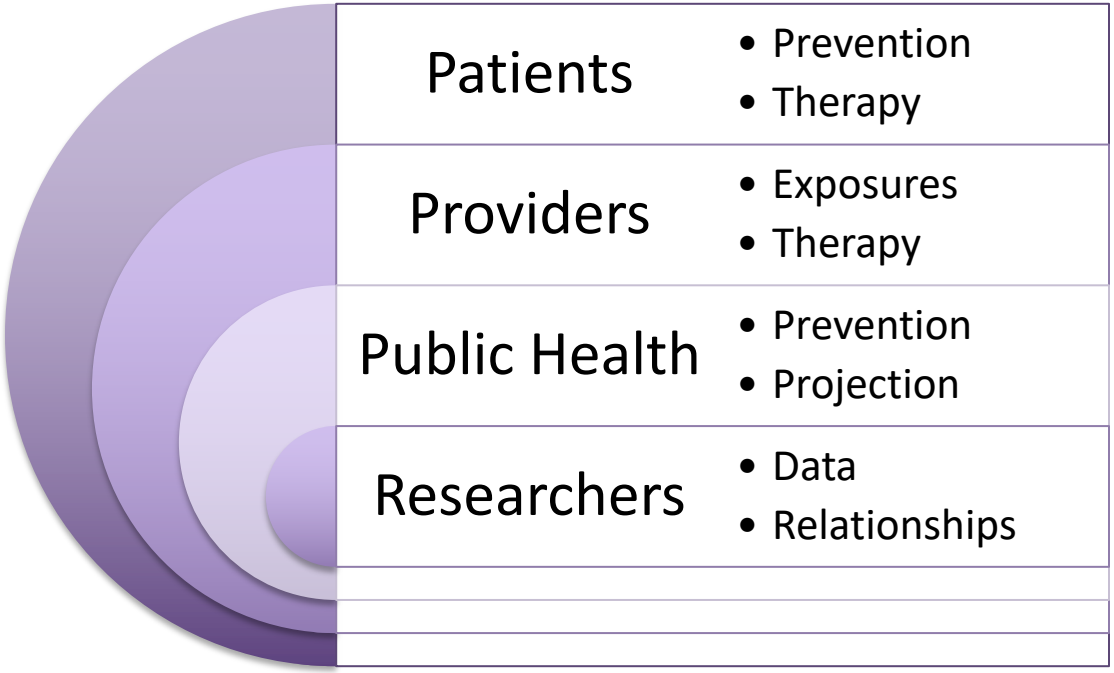
- Diagnosis primarily by clinical syndrome in association with allergic (e.g. pollen) exposure(s)
- Self-diagnosis (and management) are common
- Formal testing
  - More severe or complicated cases
  - Blood testing for specific IgEs
  - Skin prick testing with allergens
- Wide spectrum of symptoms, variable exposure patterns, variable presentation, all complicate recognition, diagnosis, and management

Therapy

- Prevention difficult
- Acute rhinosinusitis
  - Symptomatic therapy with antihistamines, local and systemic steroids, decongestants, irrigation
- Acute asthma
  - Bronchodilators, systemic steroids, preventive therapy with inhaled steroids
- Complicated disease
  - Escalation of therapy as necessary with systemic steroids, antibiotics, epinephrine injections, ventilatory assistance, hospitalization
- Immune modulation therapy
  - Moderately effective
  - Subcutaneous
  - Sublingual
  - Years of treatment



Stakeholders and Their Needs



aafa Asthma and Allergy Foundation of America

AAAAI American Academy of Allergy Asthma & Immunology www.aaaai.org

NAB *of* AAAAI

CSTE™

CDC

Project Goals

1. Determine the climate factors that influence the timing and severity of the allergenic pollen season at a national scale
2. Identify the weather patterns during the pollen season that are related to high pollen count days
3. Determine links between pollen season parameters (e.g. onset, peak, duration) and health outcomes
4. Integrate this information to forecast pollen concentrations and health burden under future climate scenarios

PRELIMINARY RESULTS: ESTIMATING POLLEN SEASON ONSET

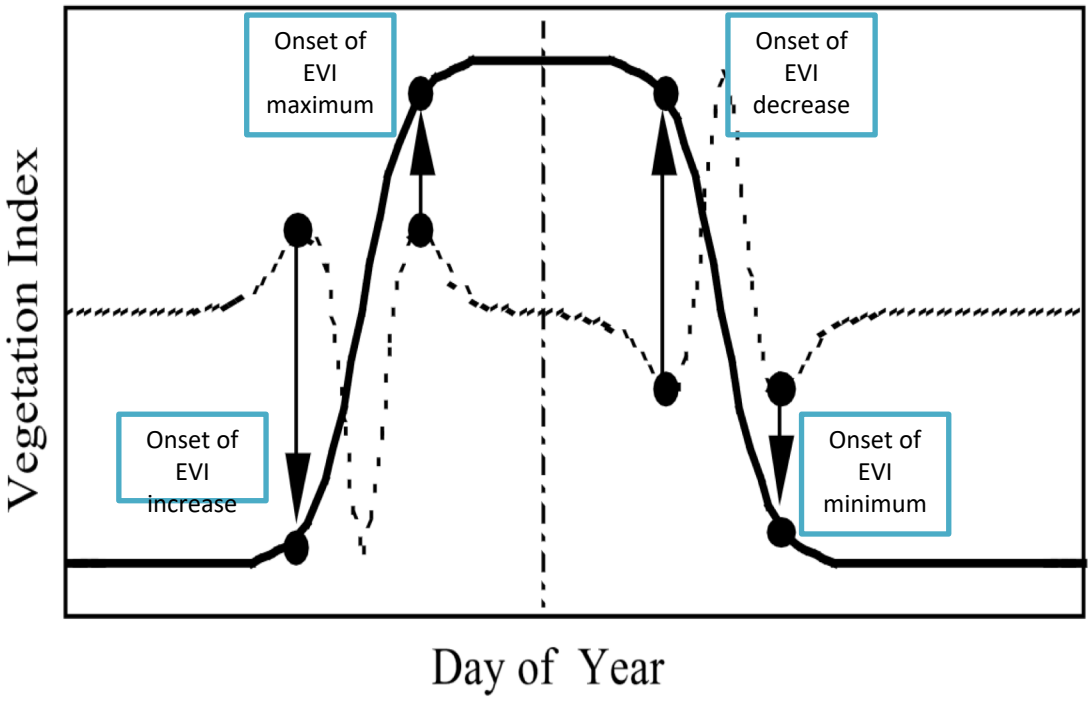
1. MODIS Global Land Cover Dynamics (Phenology)

- Identifies timing of key seasonal changes in vegetation (phenophases) using Enhanced Vegetation Index (EVI)
- 2001-2014
- 500m resolution

MODIS Phenology Product

Phenophases based on logistic functions fit to time series of EVI:

1. Onset of EVI increase (greenup)
2. Onset of EVI maximum (maturity)
3. Onset of EVI decrease (senescence)
4. Onset of EVI minimum (dormancy)



Zhang et al., 2002

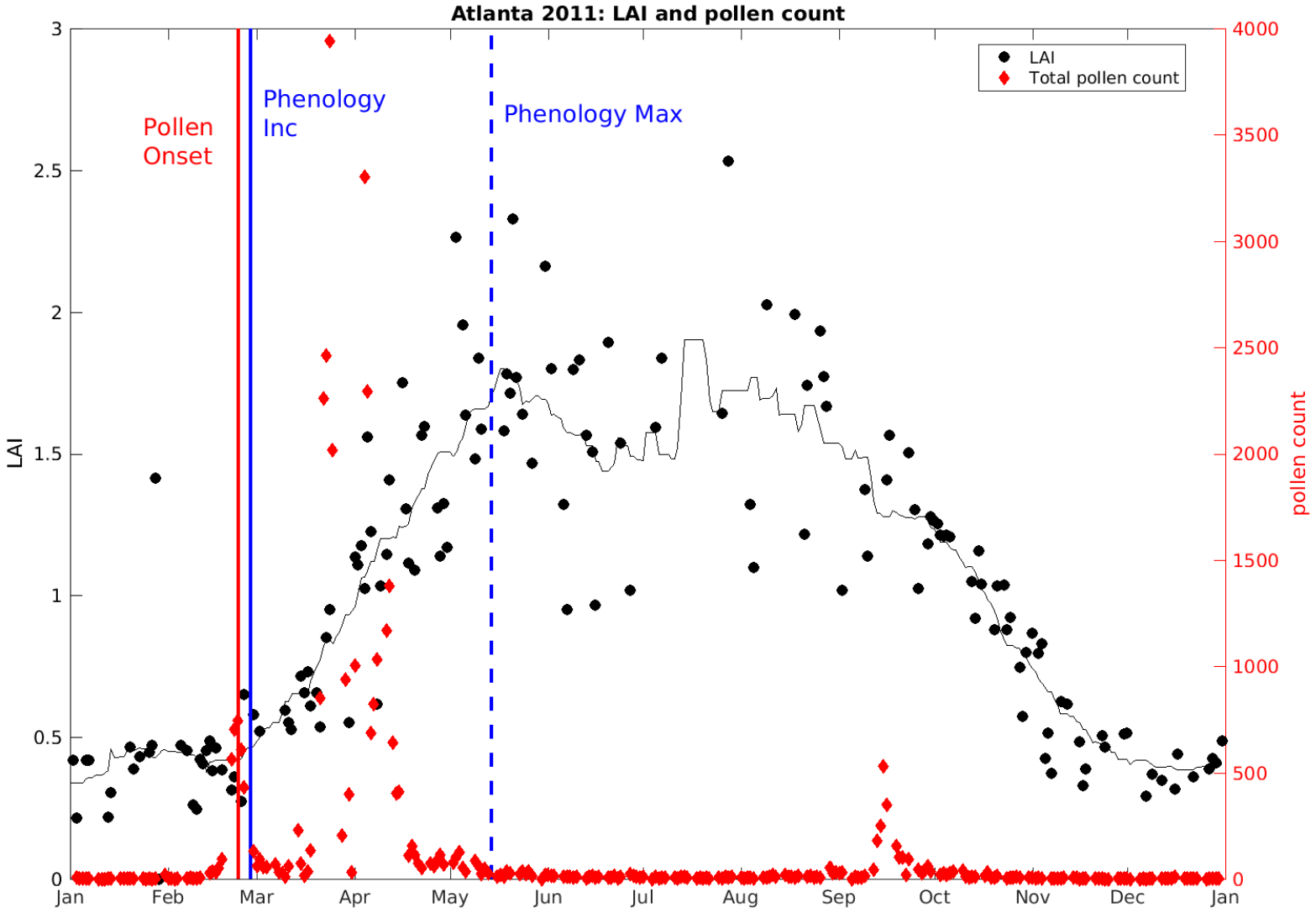
2. NOAA Climate Data Record

- AVHRR daily 0.05^{o}x0.05^{o} grid, 1981-present
- Leaf Area Index (LAI) = one-sided green leaf area per unit ground surface area
- Fraction of Absorbed Photosynthetically Active Radiation (FAPAR) = fraction of the incoming solar radiation in the photosynthetically active radiation spectral region that is absorbed by the plants
- FAPAR is directly related to primary productivity of photosynthesis

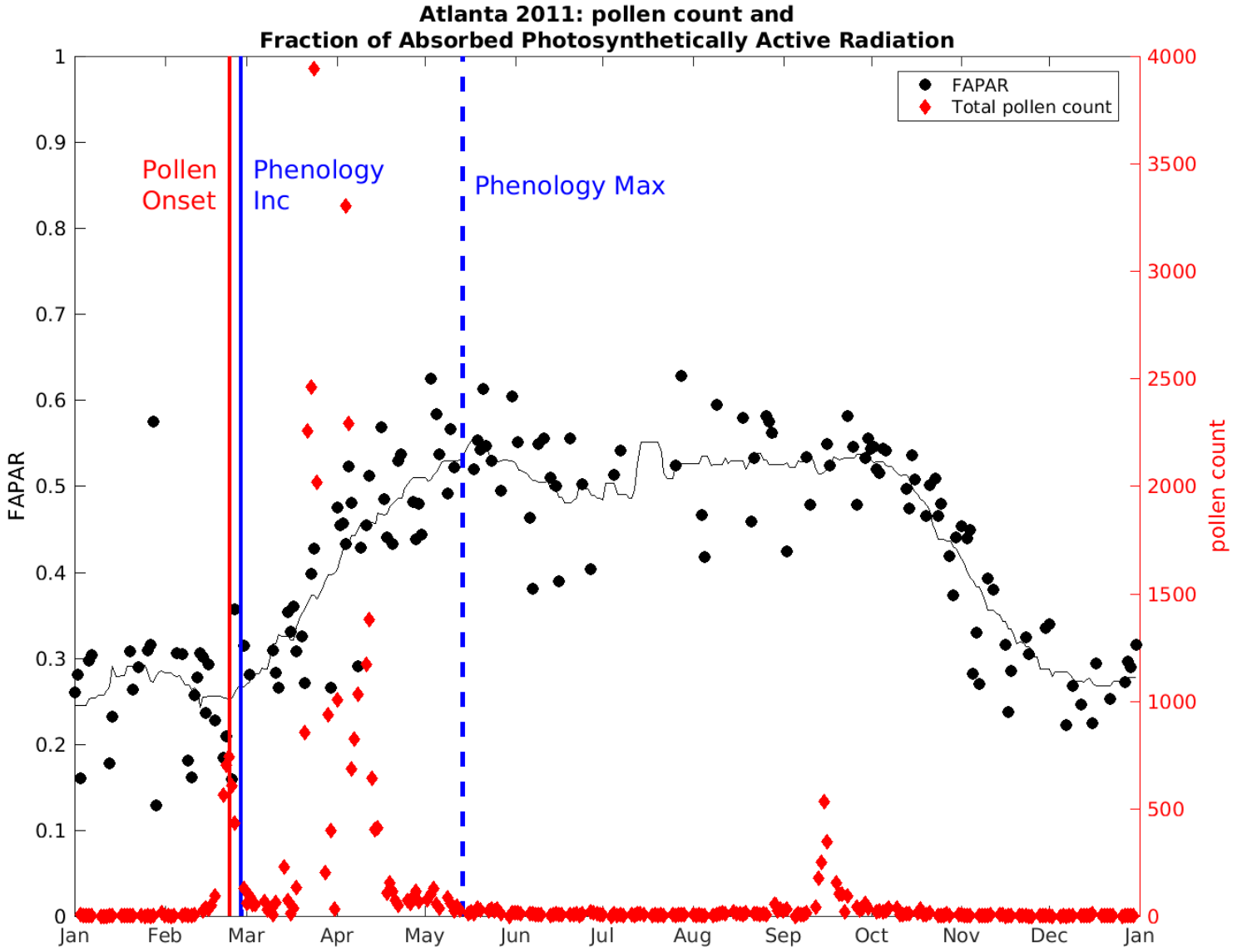
Atlanta Pollen Count Data

- Data from CDC Climate and Health Program and Atlanta Allergy and Asthma
- Daily counts, 1991-2011

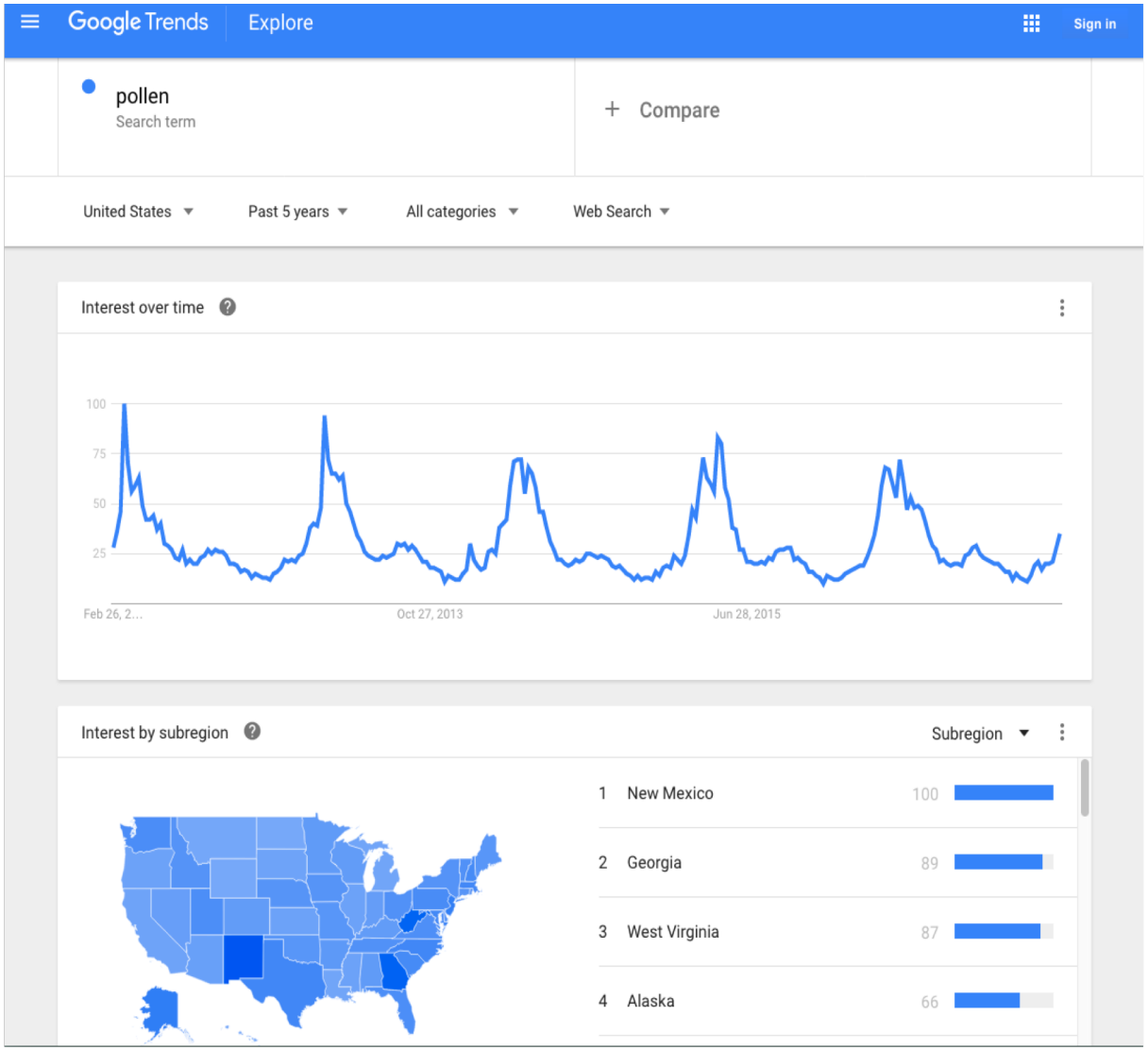
Pollen Season Onset: Phenology, LAI and Pollen Count (Atlanta, 2011)



Pollen Season Onset: Phenology, FAPAR and Pollen Count (Atlanta, 2011)



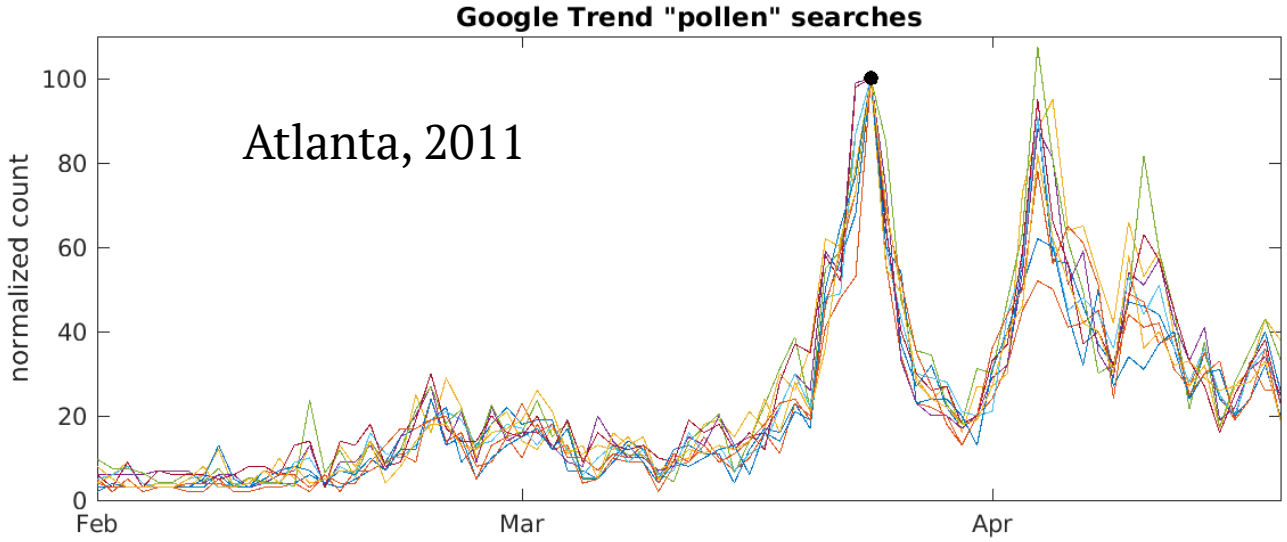
Google Trend Search Data as Proxy for Health Effects



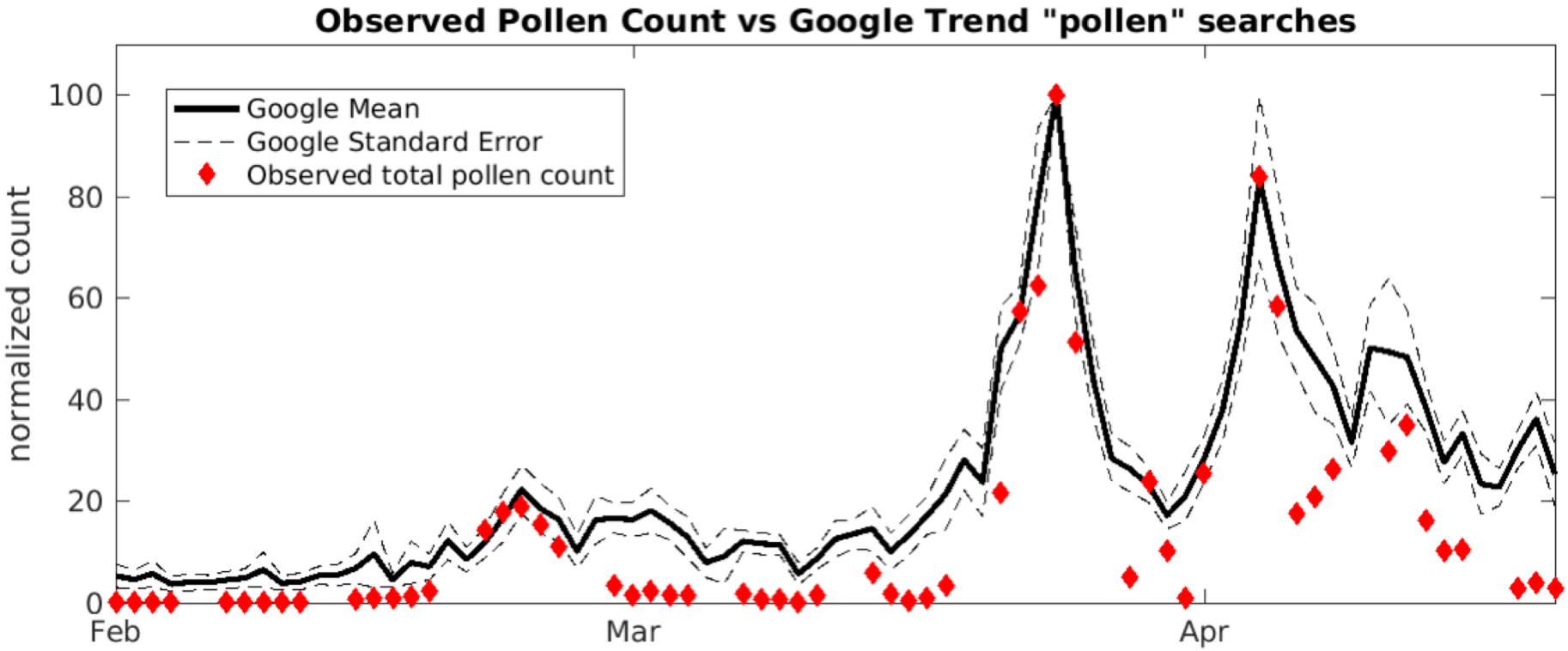
Google Trend Search Data

Limitations of publicly available data:

- Normalized over time period
- daily data only available for time periods of 90days or less
- Random subsample of the total data



Atlanta, 2011



Summary

- Onset of pollen season: LAI, FAPAR and MODIS Phenology Product seem to agree with observed pollen count
- Google Trend search queries coincide with observed pollen count data

Questions?