

Impacts of our Changing Climate on Allergic Respiratory Disease

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Impacts of our Changing Climate on Allergic Respiratory Disease

What are allergies and allergic respiratory conditions?

Is the warming of our planet affecting allergic respiratory disease?

- Pollens
- Beyond pollens

Special considerations

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Common use:

The term *allergies* refers to strong or excessive reactions that occur upon exposure to substances in the environment.

Medical definition:

An *allergic reaction* is a hypersensitivity response by the *immune system* to a substance that generally poses no threat.

We distinguish *allergic* reactions, such as eye itching/watering due to grass pollen exposure, from *irritant* reactions, such as sneezing upon exposure to airborne pepper.

Global population:

10-30%, allergic rhinitis

300 million, asthma

Peak atmospheric grass pollen levels = ER visits for asthma and wheeze

Anemophilous
(wind)
Pollination

Entomophilous
(insect)
Pollination



Photos by Gundling

Pawankar, et al., 2011

WHO

Darrow, et al., 2012

A blue-tinted photograph of a cat and a stuffed animal. The cat is on the left, lying down with its head resting on the floor. The stuffed animal is on the right, sitting upright. The background is a plain wall with a vent visible in the upper left.

Examples of respiratory allergens:

Pollens from trees, weeds, grasses

Dust mites

Molds

Furry animals

Cockroaches

January

December

Cedar/Cypress/Juniper

Oak/Birch

Rye grass

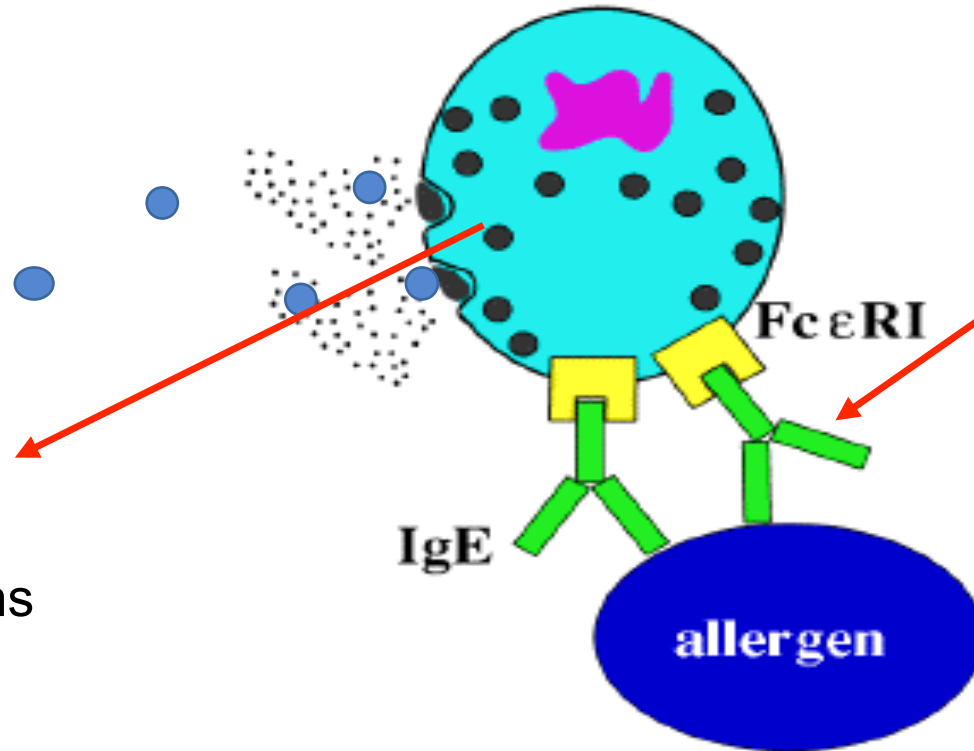
Ragweed

Dust mites, Cat, Dog, Rodents, Cockroaches, Molds

Mechanism of the Allergic Reaction

Mast Cell

Sensitization Exposure
(Allergen - Dog)



Cough
Nasal drainage
Wheeze
Itching
Hives
Swelling

Histamine
Tryptase
Prostaglandins
Leukotrienes
Etc.

Repeat Exposure

Examples of Allergic Conditions

Allergic rhinitis (“hay fever”) – facial allergy symptoms
nasal congestion, drainage, itching, throat clearing

Sinusitis – drainage, facial pain, headache, recurrent sinus infections,

Conjunctivitis – itching, drainage, sometimes swelling of the eyes

Asthma – wheezing, cough, shortness of breath, mucus production

Food allergy – hives, abdominal pain, nausea/vomiting

Stinging insects – hives, swelling, shortness of breath

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People with allergies know that daily weather determines symptoms

Whether it is...

Raining

Snowing

Warm

Dry

Humid

Windy

And symptoms vary by season, depending on our specific allergies, our geographic location, whether we are indoors or outdoors, and what is pollinating

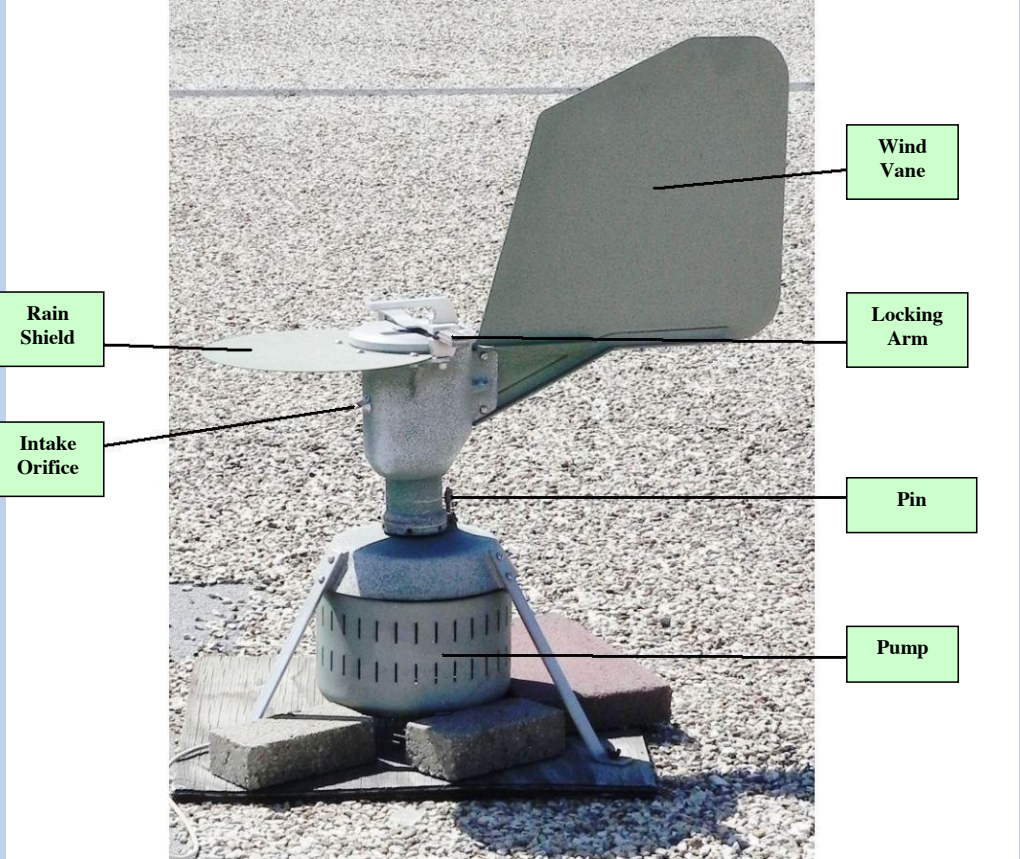
...so how can we determine if global warming is causing changes in how we experience allergic respiratory disease?

Can we measure pollen levels?

Can we compare pollen levels over time?

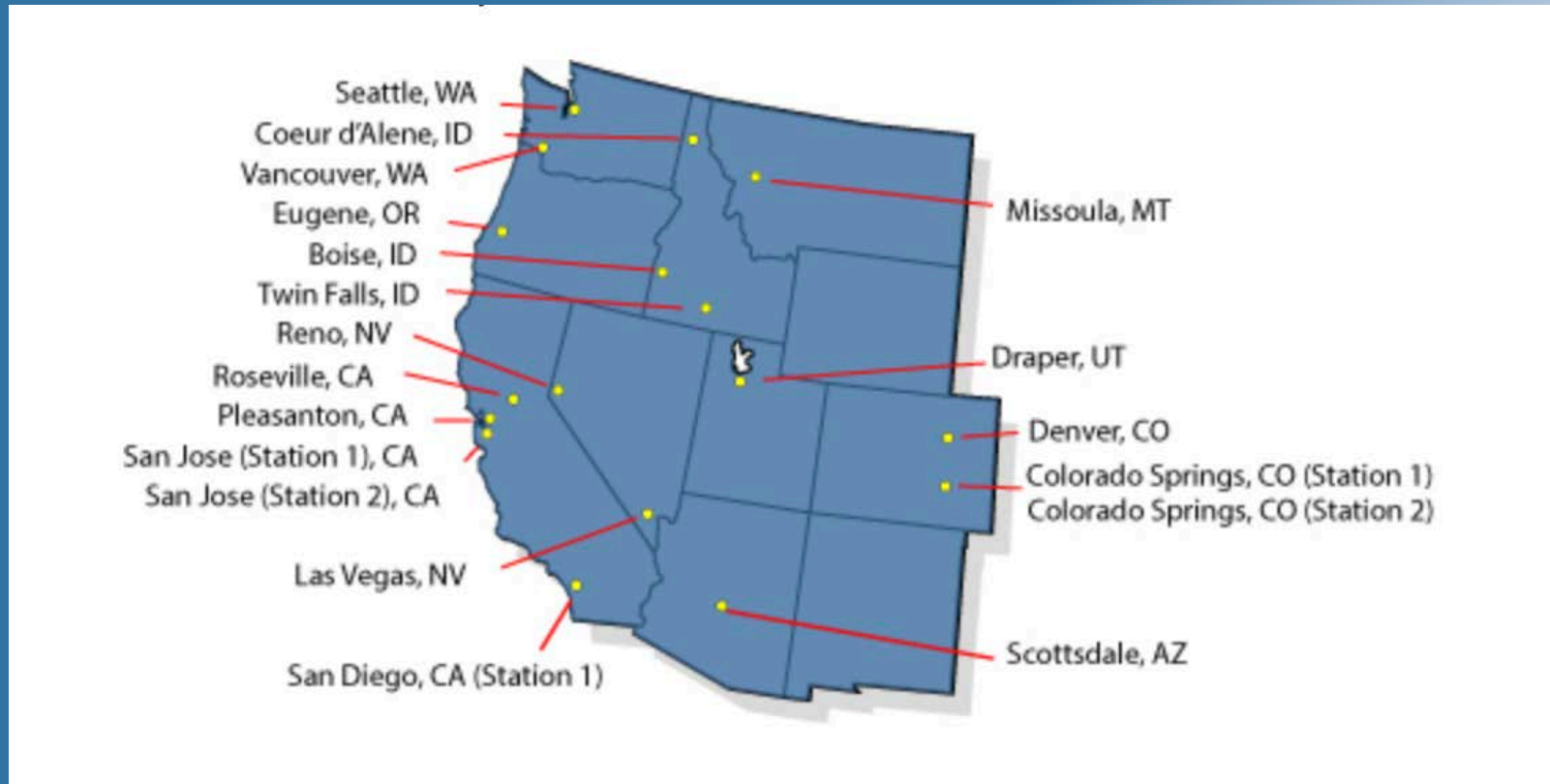
Can we use measurements of temperature, humidity, frost days, etc., over time or possibly as proxies for predicting changes to pollen exposure?

Burkard Pollen and Mold Spore Counter



Estelle Levetin, PhD
AAAAI.org

Pollen counting stations in the western US



Saskatoon, Canada has seen
ragweed season increase from
44 to 71 days over 15 years,
with delayed frost

Poole, et al. 2019



Gundling

European studies indicate:

Earlier start dates to birch and oak pollen seasons

Rising pollen concentrations

associated with increasing temperature:

Switzerland

Finland

Denmark

Germany

Spain

Turkey

(Garcia-Mozo et al. 2006; Frei, Gassner 2008; Erkan 2010; Yli-Panula et al. 2009; Rasmussen 2002; Estrella et al. 2006)

This makes intuitive sense:

Increasing temperatures:

➡ fewer cold nights, warmer days

➡ earlier spring, later fall

➡ longer pollen season

➡ more pollen exposure

➡ ***more allergies and asthma***

But does it hold up elsewhere?

US pollen trends more variable

Over time, comparing 1994-2000 to 2001-2011, at different pollen counting stations,

Birch and oak pollen *seasons* starting earlier in most locations

Birch and oak pollen *levels* trending higher in most locations

Season lengths are different for birch and oak pollen across the different pollen counting stations

Zhang Y et al. 2014

Significant regional variations of climate change

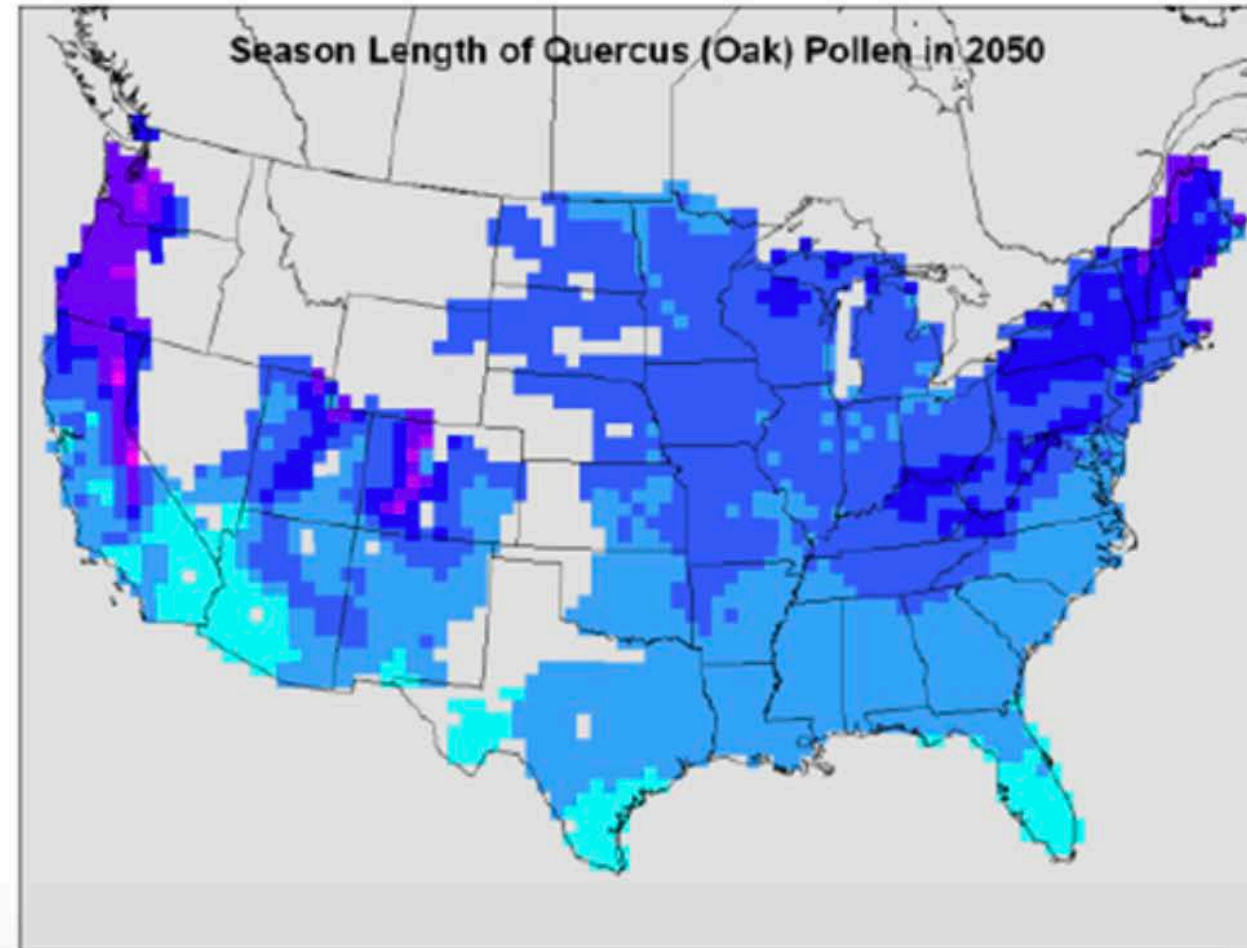
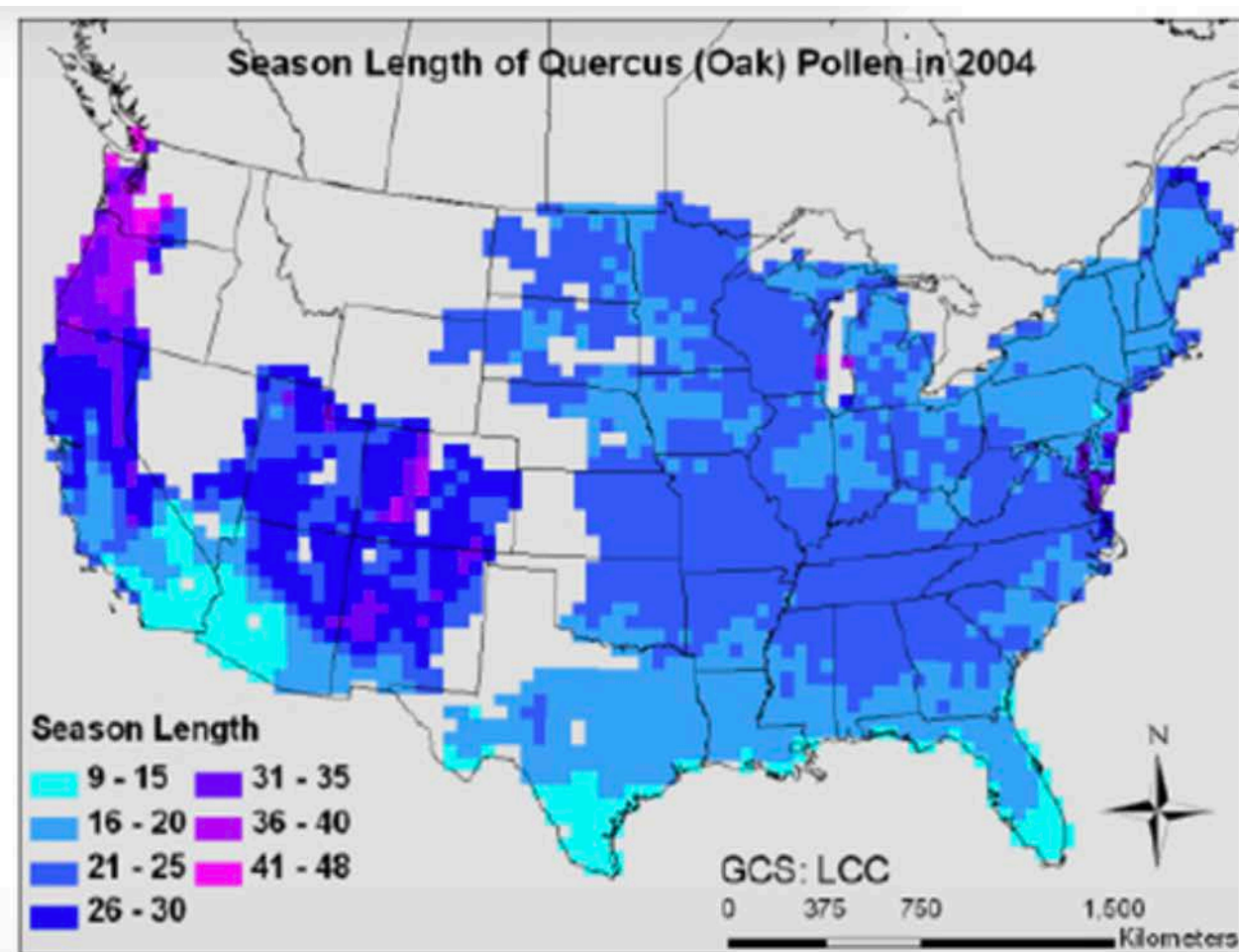
The Intergovernmental Panel on Climate Change (IPCC):

Land surface warming likely to be higher in regions with high latitudes and altitudes

Oak Pollen Season Length Projection (Zhang, 2014)

2004

2050



As with much of science and nature,
there are complicating circumstances

Precipitation

Humidity

Migration

New or changing varieties of trees, weeds and grasses

Does atmospheric CO2 affect pollen levels?

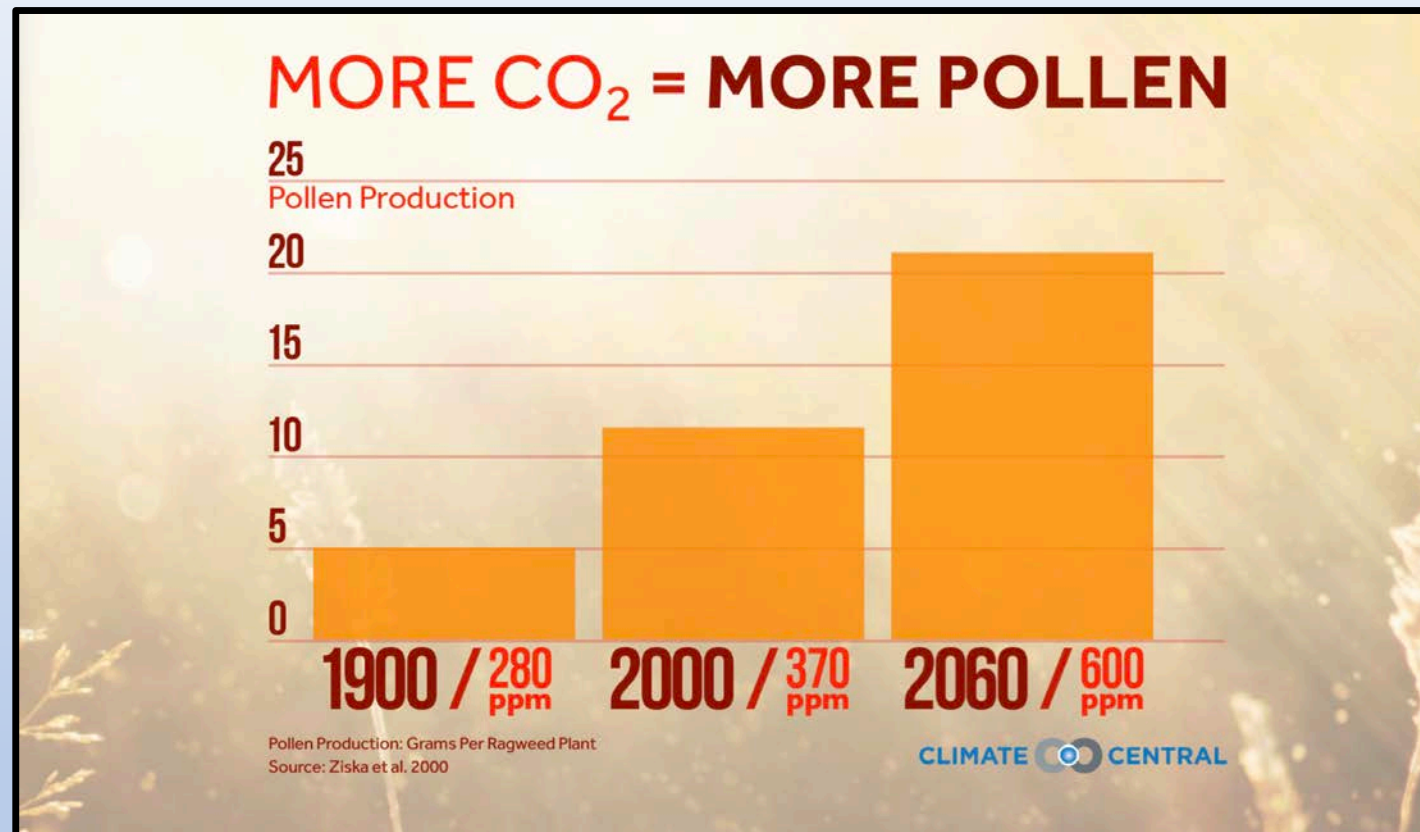
By one estimate (conducted in experimental conditions), airborne **Timothy grass pollen** is estimated to increase by 200% with projected increases of CO2.

Albertine J et al., PLoS One 2014



Wikipedia

Higher atmospheric CO₂ levels
equate with higher ragweed pollen levels



More observations

Air pollution augments allergic (immunologic) reactions



Higher ambient temperatures may create more allergenic (**more potent**) pollen due to modified IgE binding

“**Thunderstorm asthma**” is increasing in conjunction with more severe and frequent weather systems.

Summary regarding *pollens* and allergic respiratory disease on our heating planet

Many locations are experiencing higher pollen counts and longer pollen seasons

The effect may be larger in higher latitudes

Increasing atmospheric CO₂ is associated with higher pollen levels

Increasing temperature may cause pollen to be more potent

There is significant variability from one location to the next, depending on many factors

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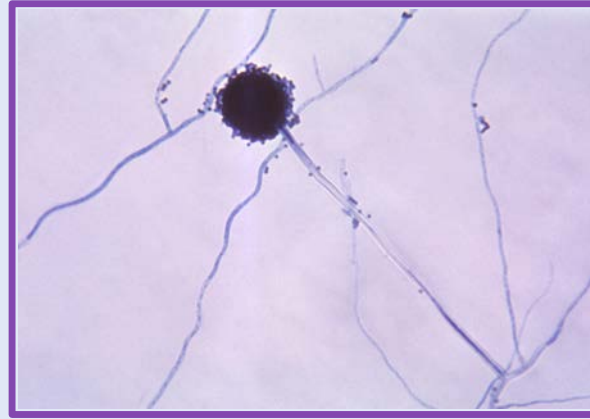
Mold allergens can cause severe asthma and respiratory symptoms, such as those seen with rising sea levels, after hurricanes, or with increasing humidity.

Aspergillus

Alternaria

Cladosporium

Penicillium



cdc

Mold can also serve as an *irritant*, or produce *mycotoxins*

Changing weather patterns can alter *exposure* to indoor allergens such as *dust mites, cockroaches and mice*.

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Children under 5 years of age are particularly vulnerable:

Lung growth and development

Higher metabolic demands

Immature immune systems

Higher respiratory rates

Greater time outdoors, increasing exposures to heat, pollution, insects

Many are economically disadvantaged

People with pre-existing respiratory conditions

Workers with increased exposures due to their occupations

Homeless people

Patients who cannot afford air conditioning, appropriate medications, the ability to move out of polluted zones or poor housing situations

Older adults (decreased ability to compensate for physical stresses)

Good news: Solutions to climate change are also solutions to improve health disparities and allergic respiratory disease

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