Extreme Events and Pests

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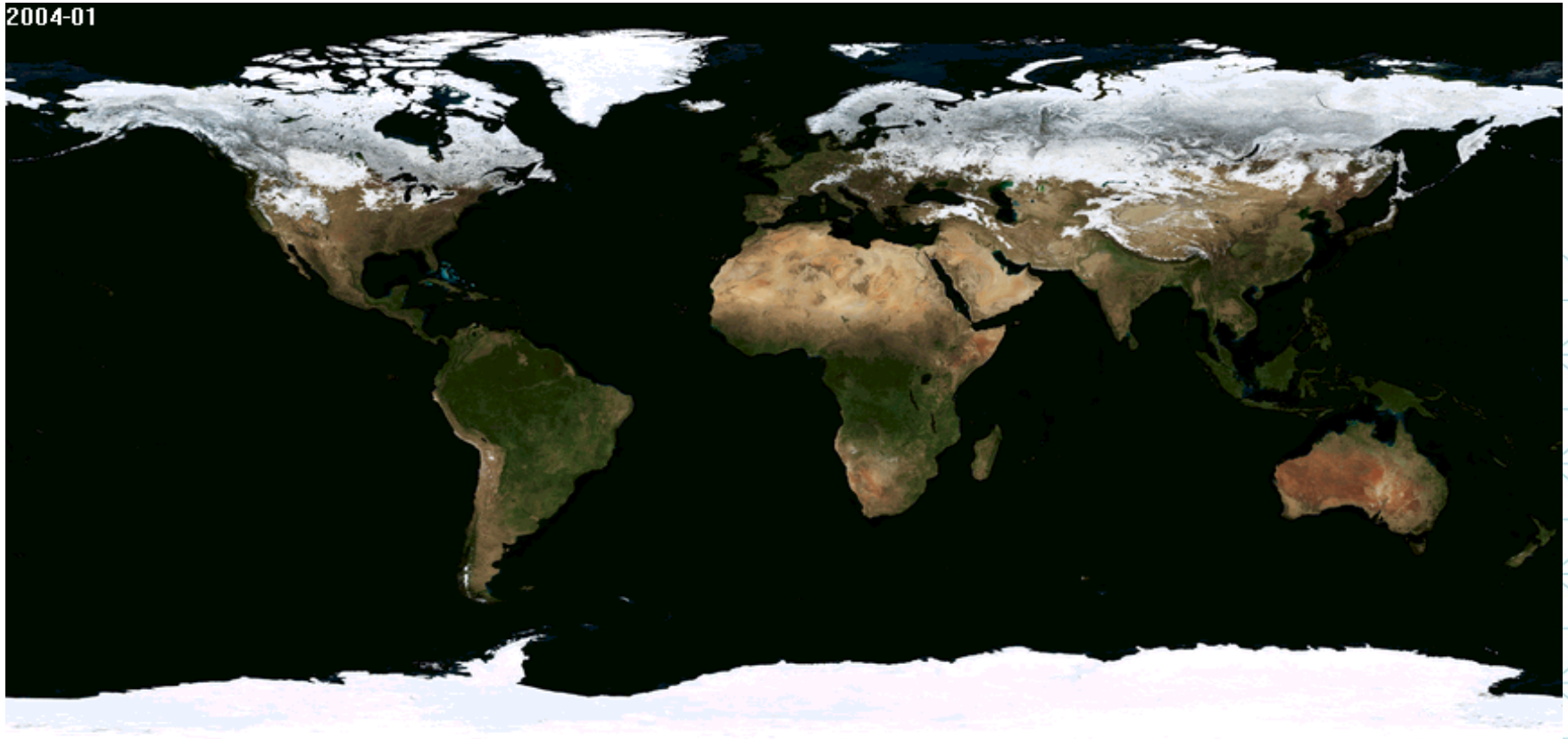
Climate

A measure of the average pattern of variation in temperature, humidity, atmospheric pressure, wind, precipitation, atmospheric particle count and other meteorological variables in a given region over long periods of time.



Monthly global images from NASA Earth Observatory

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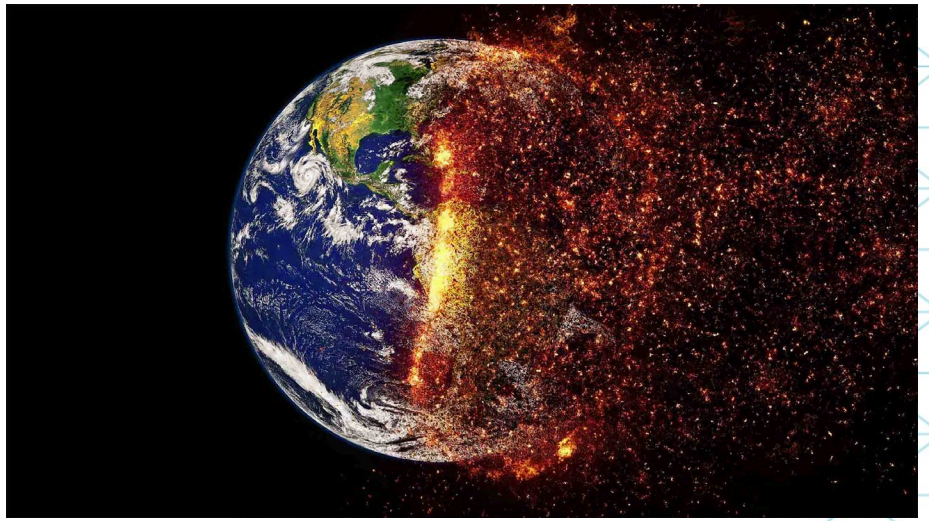
What is climate change?

Climate change refers to a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere, and climate variability observed over comparable time periods.

The composition of earth's atmosphere is undergoing a significant change, largely through increased emissions from

- Energy sector
- Industry sector
- Agriculture sector
- Widespread deforestation
- Fast changes in land use
- Land management practices



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What causes climate change?

- Anthropogenic (caused by human) activities are resulting in an increased emission of active gases, carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O); together, the 'greenhouse gases' (GHGs).

- Global warming is expected to lead to other regional and global changes in climate-related parameters such as rainfall, soil moisture, and sea level.
- Snow cover is also reported to be gradually decreasing.

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Climate Change by 2050

- Temperature increase to be between 2 to 12 °F
- Sea levels to rise about 50 cm (20 inches)
- Greenhouse gases (GHG) to reach almost 685 ppm CO_2 equivalents (currently 400 – 450 ppm)
- Wind speeds to decline by about 15%

IPCC – Intergovernmental Panel on Climate Change
OECD – Organization for Economic Cooperation and Development

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Where are the insects going?

73 historical reports of insect declines from across the globe

"Biodiversity of insects is threatened worldwide."

Sánchez-Bayoa and Wyckhuys, 2019

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https://www.nytimes.com/2018/11/27/magazine/insect-apocalypse.html

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Alarming stats

Renowned Harvard entomologist E.O. Wilson: Declining insect numbers can also have catastrophic ecological repercussions. Without insects the rest of life, including humanity, "would mostly disappear from the land. And within a few months."

A global analysis of 452 species in 2014 estimated that insect abundance had declined 45 percent over 40 years.

81 species of butterflies declined by an average of 33 percent in the last 20 years.

April 2019: 40 percent of all insect species face extinction due to pesticides—particularly neonics, since they're the most widely used insecticide on the planet—but also because of with climate change and habitat destruction.

In the U.S. the numbers of iconic Monarch butterflies has fallen 80 to 90 percent in the last 20 years.

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Effects of climate change on insects

Direct effects

- Temperature
- Carbon dioxide
- Humidity

Indirect effects

- Host physiology
- Host nutritional status
- Competing species
- Human activity
  - *change in varieties*
  - *planting systems*
  - *inter cropping*

DIRECT vs INDIRECT

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Direct effects: Temperature

Insects are cold blooded. Body temperature is variable and dependent on ambient temperature.

As a results, rising temperatures can:

- **Reduce winter mortality**
  - ❑ Decreased snow cover can increase mortality
- **Extend the growing season**
  - ❑ Greater nutrient demands coincide with planting and fruiting of many crops
- **Accelerate insect life cycles**
  - ❑ Greater generation numbers
  - ❑ Faster resistance to insecticides
- **Allow range expansion**
  - ❑ Earlier maturation and migration
  - ❑ Greater winter survival

Slide c/o R. Srygley ,USDA

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Range Shifts of Species

The largest recorded bark beetle outbreak in human history in northern British Columbia where winters used to be too cold for the beetles to survive.

Extreme Weather Events

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Example: Hurricane Katrina 2005

- Made landfall in Louisiana Aug 29 as a Cat 3
  - >1,800 people died
  - 700,000 were displaced
  - 273,00 evacuated to emergency shelters
- Interaction of natural forces and failure of storm and flood protection structures in New Orleans

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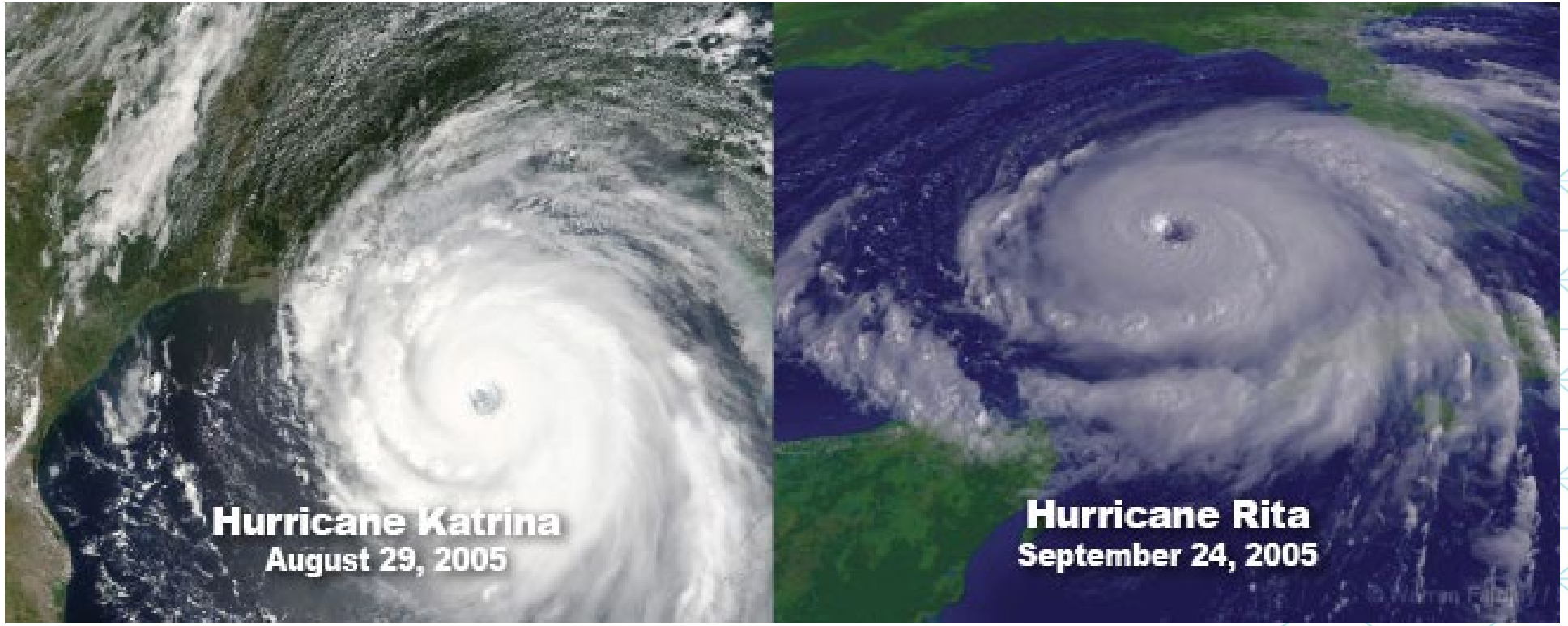
Hurricane Rita 2005

- 26 days later Hurricane Rita
- Cost to New Orleans parish alone $40-50 billion



Response

- Arguments over jurisdiction delayed medical aid
- 40% of residents spent 1st 24 hours “on the street”, 35% trapped in homes (half - several days)
- 48 hours critical-needs assessments
- Within 4 days teams assessed >200 shelters housing nearly 30,000 people, and provided care to about 50,000 displaced people

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What happens to people during extreme events?

- Loss of life
- Disconnected
- Stranded
- **Displaced**
- No access to emergency services
- No access to basic necessities
- Injuries and illness
- **Congregate** where resources exist water, food, shelter, <u>each other</u>

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Plagues and epidemics

- Exposure to dead bodies does not automatically lead to disease, but mass burials ensued
- Misinformation: Public official warned residents about mosquitoes feeding off dead bodies and transmitting diseases – **THIS DOES NOT HAPPEN**
- Excessive pesticide use
- Panic due to bed bugs, and lice in shelters

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But……..

- Extreme events can increase human exposure to disease-carrying pests

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What happens to pests during extreme events?

Actual documented pest outbreaks following extreme events

- Mosquitoes – WNV – WN Fever & WN Neuroinvasive Disease
- Filth flies
- Head lice, body lice, bed bugs, scabies
- Rodents (leptospirosis risk)

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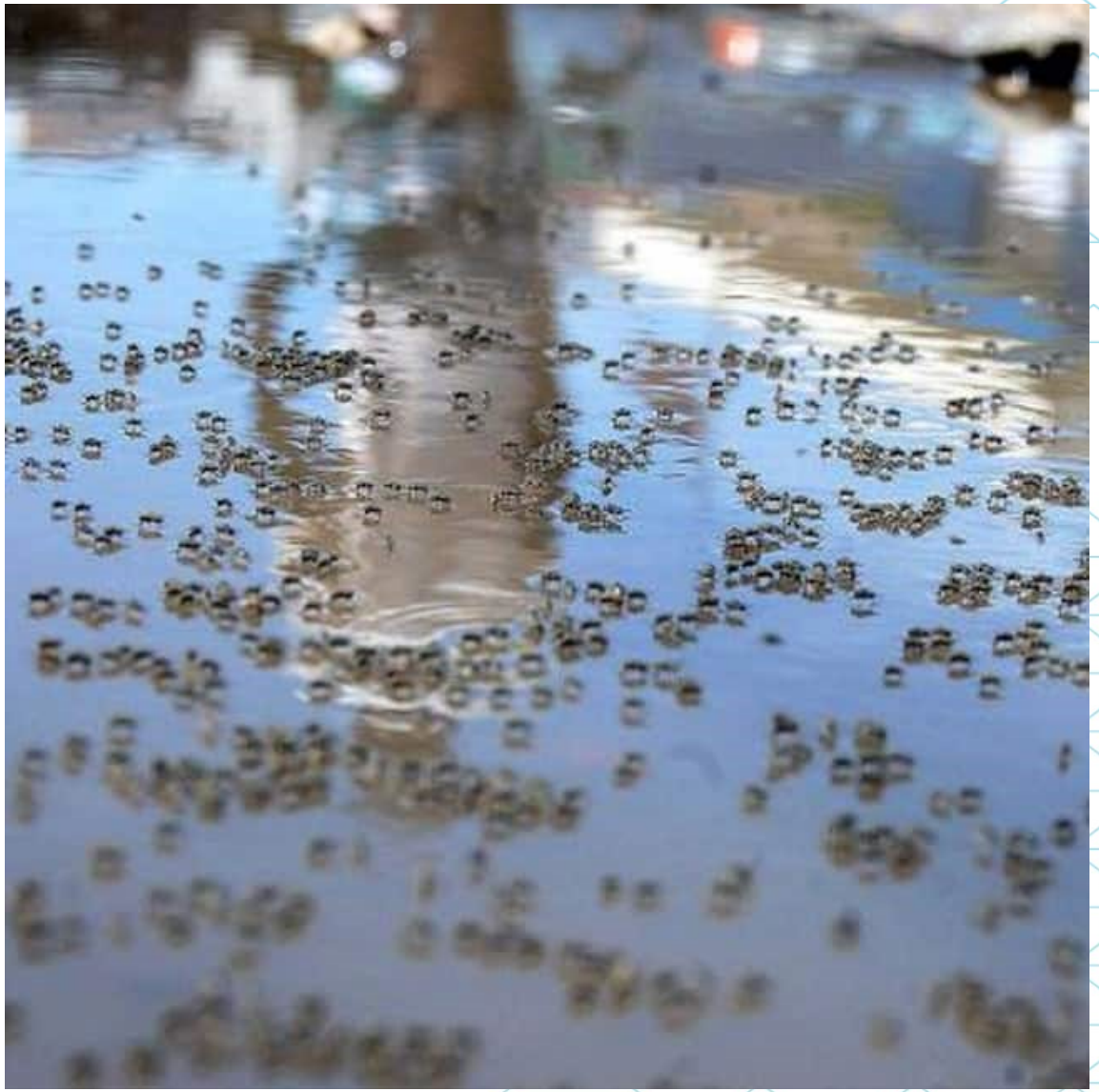
Pests during and after extreme events

- **Mosquitoes** love standing water and only need a few inches of it to breed.
- In addition to irritating the people they bite, mosquitoes can spread harmful diseases like West Nile virus.



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Pests during and after extreme events

- Overturn any empty containers that could fill with water and be sure to clean storm gutters to prevent standing water from accumulating.
- Promptly remove standing water or small puddles around a building.

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Pests during and after extreme events

- Massive increases in populations of **flies** occur – short life cycle, high reproductive capacity.
- This drastically increases the frequency of contact with people, and spreading of potential diseases.

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Pests during and after extreme events

- Receding flood waters often they leave behind many pools of stagnant water and organic debris. These are prime breeding sites for adult mosquitoes and nutrient rich larval habitats.

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Pests during and after extreme events

- **Rodents** will search for higher ground and dry land.
- Damage to a building opens a variety of locations for displaced rodents to call home.
- They can worsen damage to a building and even start fires by chewing on electrical wires.

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Pests during and after extreme events

- Clear and trim any overgrowth or damaged vegetation outside of your facility to limit easy shelter for rodents.
- Clear debris in and around a facility immediately. Cardboard boxes, broken sheetrock, old equipment, and any other damaged materials offer harbors.
- Seal holes and cracks in both interior and exterior walls to keep rats and mice out.

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Pests during and after extreme events

- **Flies and rodents** are opportunistic invaders.
- These are an important group of pests that flourish after an extreme weather event, especially involving flooding.

  - Extended power outages, and damaged, overflowing sewer systems cause drastic landscape changes, leaving behind spilled sewage, spoiled food and rotting vegetation/landscape materials all of which are attractive to both flies (feeding and egg-laying sites) and rodents (feeding and harborage).

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Pests during and after extreme events

- **Cockroaches** are attracted to the trash and litter left behind after a disaster.
- They also love warm, damp, and dark conditions. They are also expert hiders — so seeing one during the day can mean many more are hidden in the walls.

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Pests during and after extreme events

- Drains are a hot spot for roaches, so take measures to prevent food and residue from building up in the kitchen and bathrooms.
- Daily sanitization of buildings can help prevent cockroach populations from building up before a disaster happens.

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Pests during and after extreme events

- **Ants** can move their entire colony when disturbed.

Carpenter ants make their home in wet or rotting wood, often invading their new residence en masse.

Easily burrow their way through damaged fences, fallen tree branches, and any other damaged wood near a facility.

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Pests during and after extreme events

- Fire ants - Seek higher ground to escape the rising waters, but if shelter can’t be found, they can bond together in the thousands to create a floating “raft” to survive the water.
- Fire ant stings are extremely painful, so preventing ant piles from growing around a facility should be a top priority.

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Pests during and after extreme events

- Routinely check yards and grounds for ant mounds. If one is spotted, use safe measures to eliminate a potential encounter.

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Arizona is ranked the 10th most at-risk state due to extreme weather events

- Thunderstorms, flash floods, wildfire, drought and dust storms

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Wildfires and pests

- Arizona wildfire season : May - July-August till the monsoons arrive
- Over the past several years wildfires have started earlier and continue to pose risks year-round.
- **Wildfires are often associated with thinning and dying forests, dry wooded areas and grasslands,**
- **Lots of information relating wildfires to climate change.**
- **What do pests have to do with wildfires? And what do wildfires do to pests?**

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Can pests lead to wildfires?

- **Bark beetles** (*Dendroctonus*, *Ips*, and *Scolytus* spp.).
- Maintain adaptive developmental timing leading to synchronized population emergence and life-cycle timing, which facilitates cold tolerance and avoidance of low-temperature-induced mortality.
- Bark beetle outbreak continues to spread, the weakened and dying trees increase the risk of wildfires.

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Can pests lead to wildfires?

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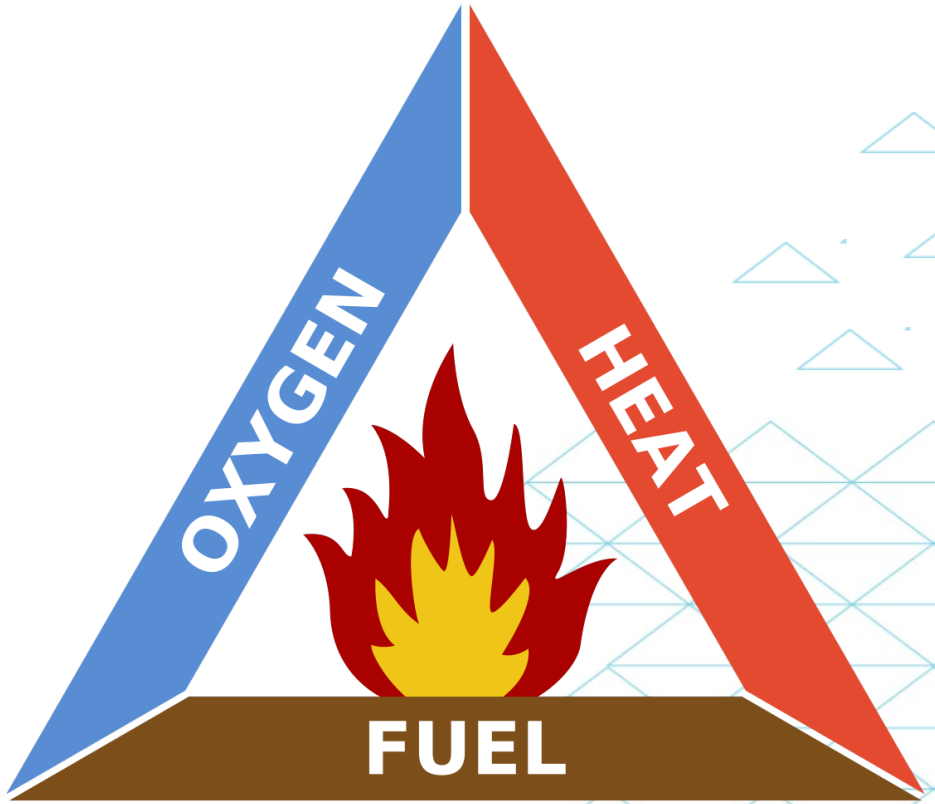
Can pests lead to wildfires?

- Three essential elements needed to start a fire: Fuel, oxygen and heat.
- In a beetle infested forest – fuel (dry, weak trees) and oxygen (thinning canopies allow greater air flow) are abundant.
- As soon as an ignition source occurs (lightning, concentrated sun rays, or human activities using matches), a wildfire can be started.



Can pests lead to wildfires?

- Pests cannot “start” wildfires on their own, but they can alter fuel complexes, species composition, stand structure and densities, which in turn affect fire behavior, intensity, rates of spread and transition from surface to canopy regimes in a forest.

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Can wildfires lead to pest infestations?

- Most of the time, wildfires kill trees, but do not destroy the wood completely.
- Many pests utilize the burnt wood and vegetation because it is weak and has no defenses. Thus, wildfires create opportunities for scavengers and decomposers.
- Some insects are attracted to the smoke that rises during wildfires (e.g. smoke flies), while others are attracted to the heat (e.g., fire beetles)!
- **Thus, wildfires do create opportunities for adding and sustaining the species diversity of insects and other arthropods.**

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Fire beetles

Fire beetles or “fire-chaser beetles” belong to the genus Melanophila, are attracted to forest fires and can sense the heat of the fires from miles away.

Once they arrive on the scene of a wildfire, they mate and lay eggs on freshly burnt wood which serves as food for their larvae.

The adult beetles are about half an inch in length, and can be a nuisance to firefighters when they land on them and take exploratory bites, in their search for burning wood.

Wildfires as pest control agents

- Wildfires can serve as a natural control for many diseases and pests that affect wildlife, forests, livestock, and human populations.
- Early human societies used fire to clear campsites and agricultural lands of pest species.

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Proper management of firewood can help to reduce bark beetle infestations, and in turn reduce wildfire risks.

Read more about firewood and bark beetles in this publication:

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Food for thought

Historically, insects damage larger areas than wildfire, but wildfire is perceived as more significant extreme event. In today's world, insect and fire events are both somewhat irregular and unpredictable, yet the fire events are considered greater catastrophes. Why?

Because fire is an immediate crisis that threatens human life and property, whereas insect outbreaks can be dealt with in due course.

More extreme events

Are these climate-related?

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More extreme events

Are these climate-related?

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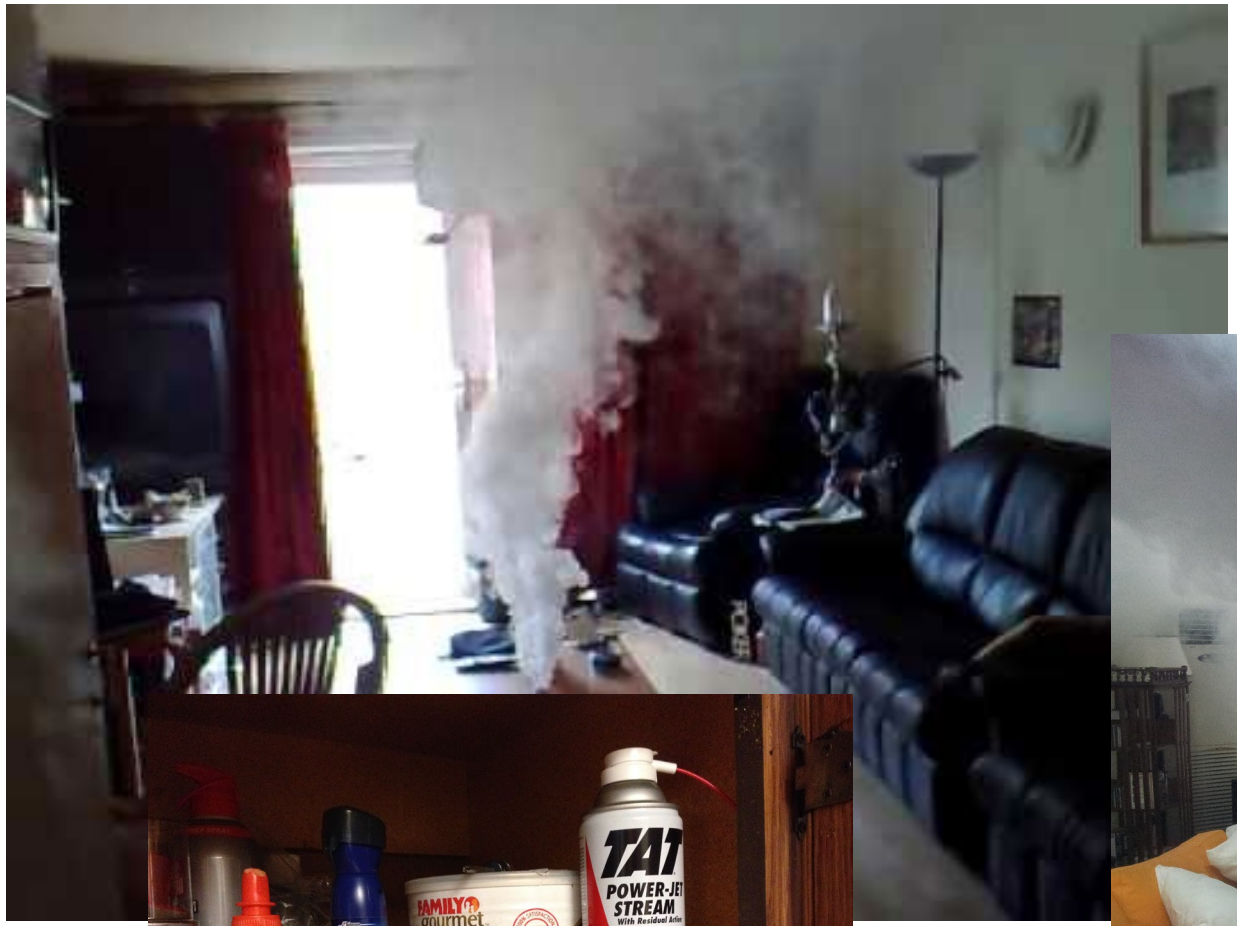
More extreme events



Are these climate-related?

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More extreme events

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How should we prepare for extreme events?

- Having an **integrated pest management (IPM)** program in place is very helpful.
- IPM focuses on exclusion, maintenance, and sanitation as methods to control pest populations, using chemical treatments as a last resort.
- Implementing these strategies can help keep pests out before, during and after a natural disaster.
- Adjust your IPM program based on your location throughout the year, and as the seasons change.

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How should we prepare for extreme events?

- Stress simple behaviors like bagging food-related trash and placing it in sealed bins (every little thing counts when attempting area-wide fly and rodent control).
- Inspect and replace/repair damaged window or door screens and other new openings into buildings/structures.

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How should we prepare for extreme events?

- In case of flooding, ensure that moisture drainage systems are functional.
- Clear debris from drainage systems/canals to help remove standing water in areas and inspect, clean, or repair clogged or damaged gutters.

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How should we prepare for extreme events?

- Installing extra window screening or other “quick fix” exclusion items (plywood, foam sealant, etc.) is helpful and allows people to focus on larger issues.
- Previous control strategies including traps, bait stations and treatments may have been displaced or damaged.
- Expect to replace missing devices and add other equipment to combat the influx of pests.
- Use all the mechanical control tools available (jar/bag traps or mosquito ovitraps, sticky traps, single and multi-catch traps, glueboards, etc.).

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How should we prepare for extreme events?

- **During an extreme event and recovery,** pest management is often the last thing on your mind.
- Keep focused on stressing the basic principles of IPM — cultural, physical and mechanical control prior to using chemical products.
- Encourage sanitation and pest habitat reduction.
- Often the hardest part of the IPM plan under normal conditions; expect cooperation after an extreme event to be even harder.

Contact

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