

Climate Change in Washington State:

What is the connection to wildfires & how do we know our climate is changing?

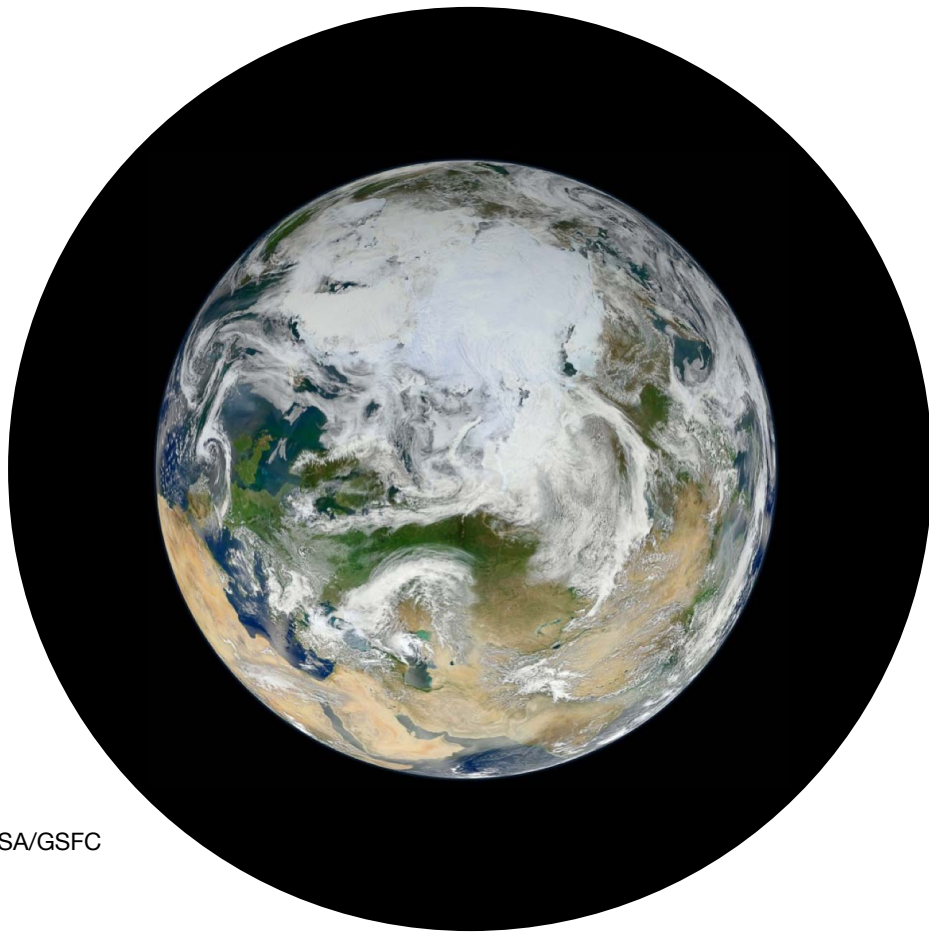


Image: NASA/GSFC



Dr. Heidi Roop
University of Washington
Climate Impacts Group

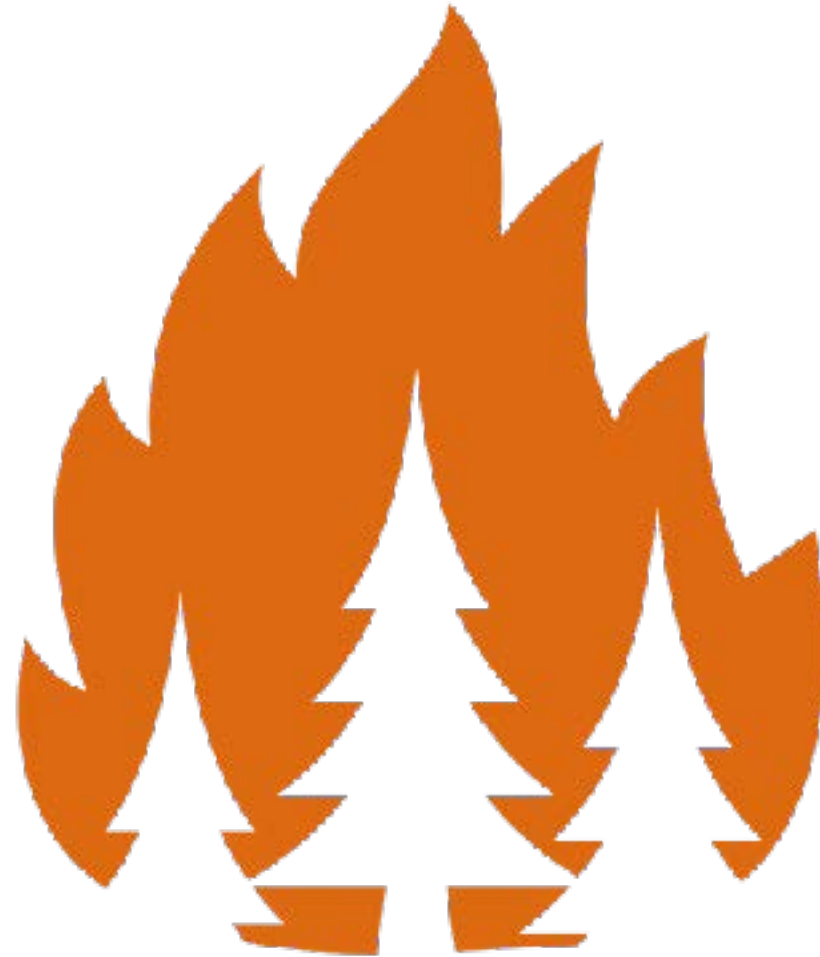




The **Climate Impacts Group** supports the development of climate resilience by ***advancing understanding*** and ***awareness*** of climate risks. We work closely with public & private entities ***to apply*** this information as they act to shape ***society's future.***

Earth Scientist.





A FOCUS ON WILDFIRE

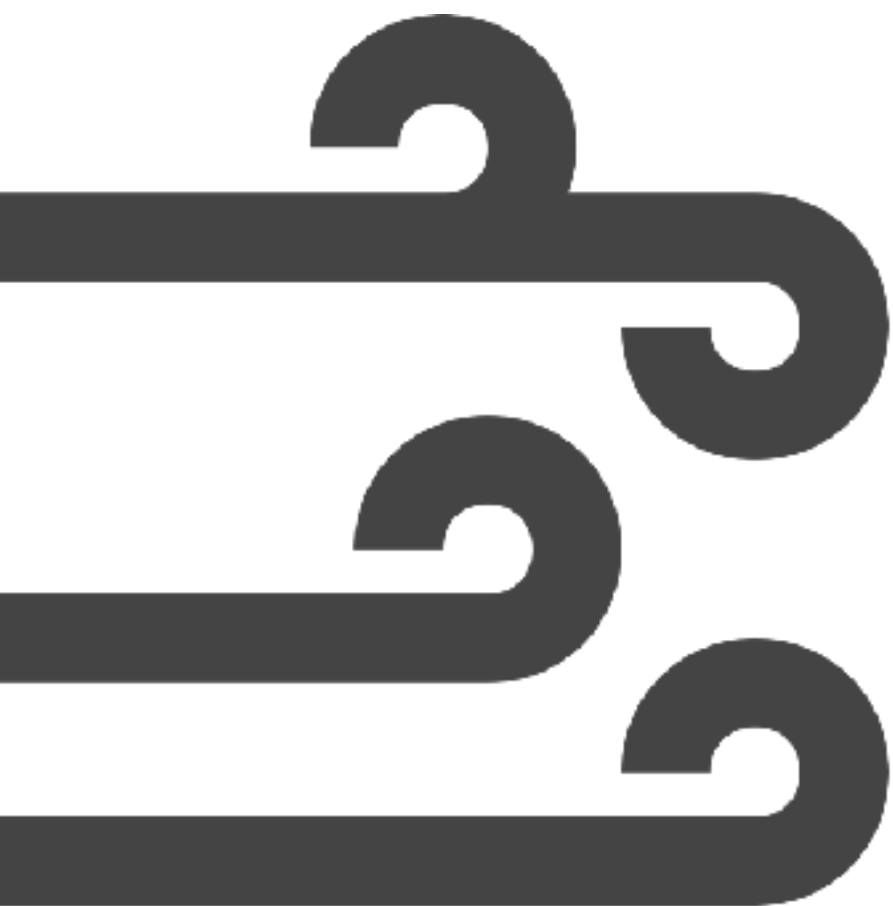
2018 Bofer Canyon Fire:

Fire officials say nearly 5,000 acres were consumed by flames.

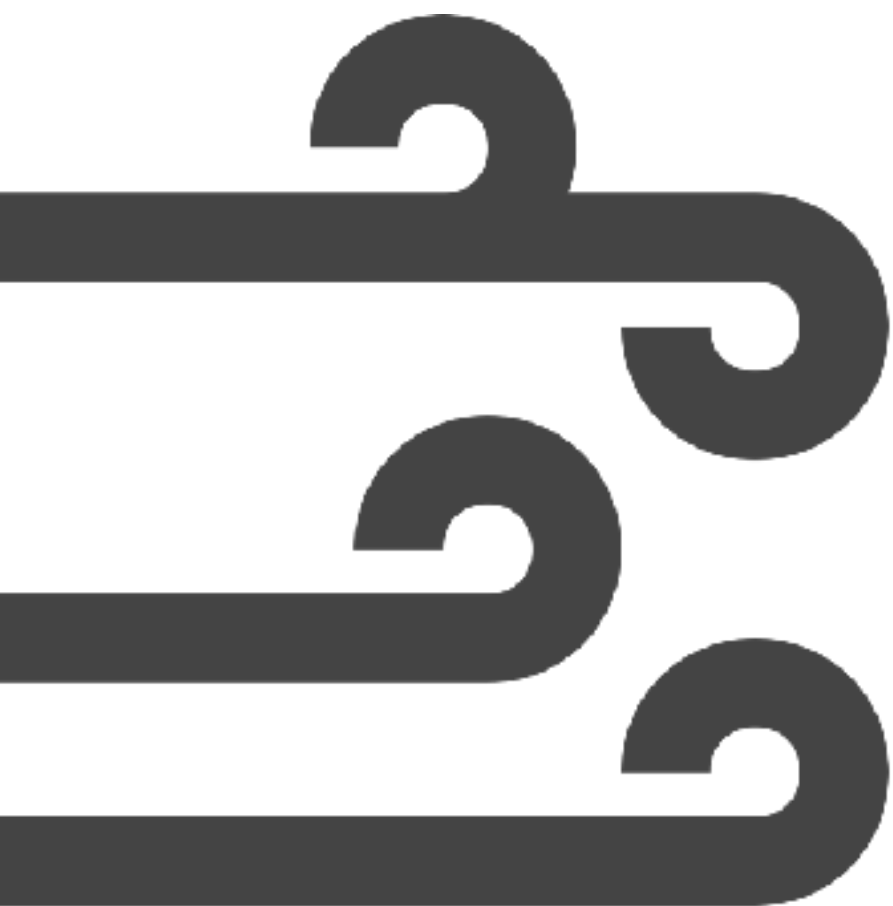


South Green Place in Kennewick.

August 15th, 2018; Bob Brawdy *Tri-City Herald*

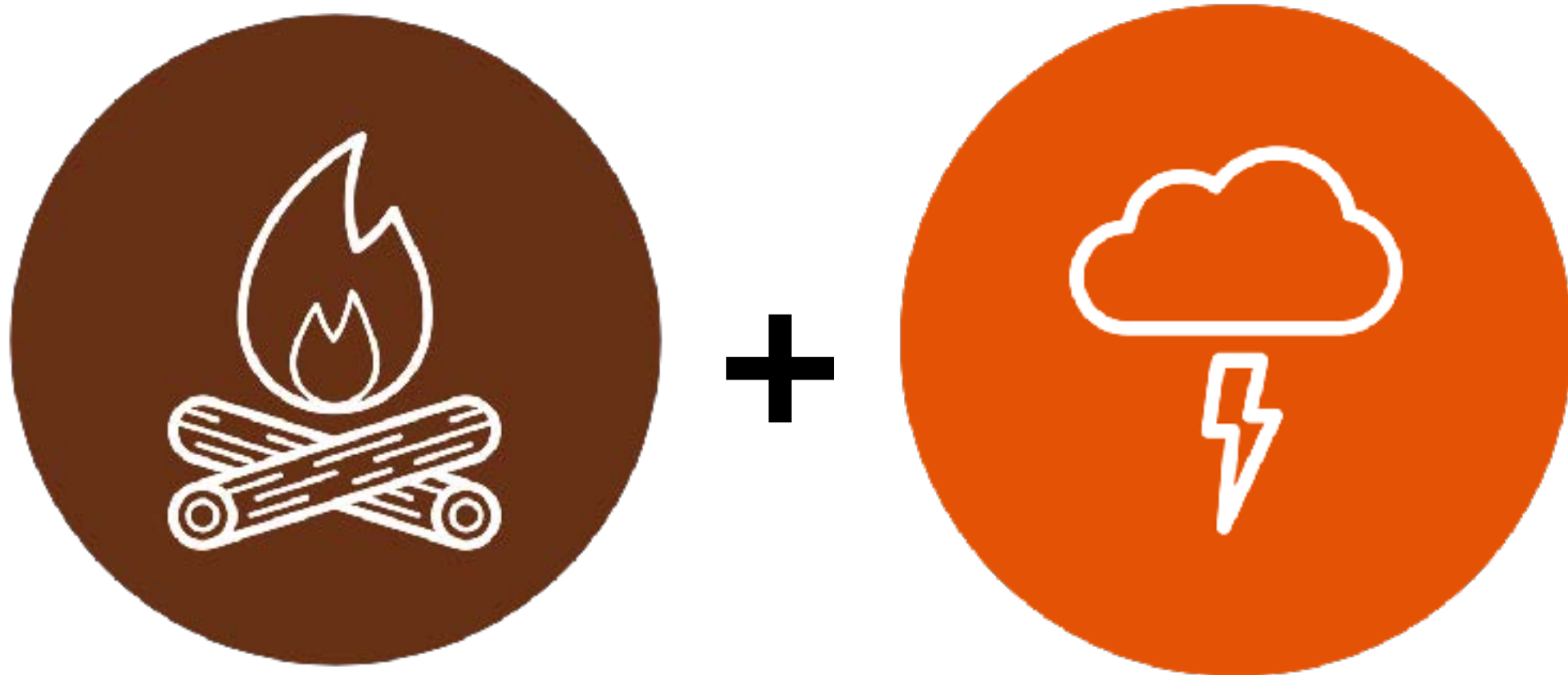


IS THERE A CLIMATE CONNECTION?

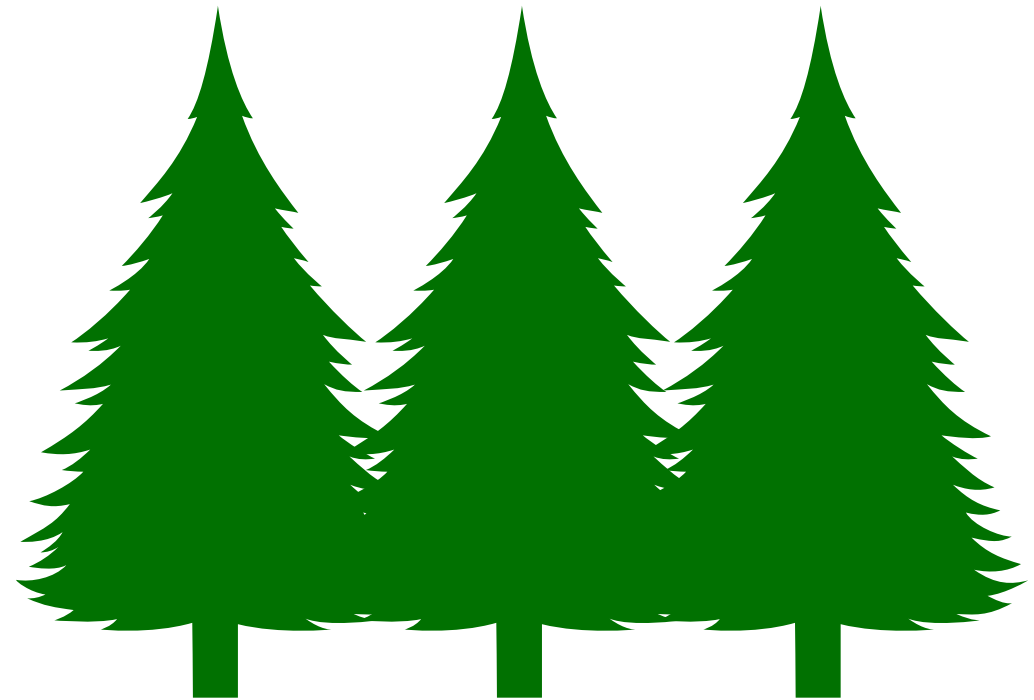


Let's explore.

WILDFIRES ARE CAUSED BY HUMANS & NATURE



FIRE SUPPRESSION & PAST FOREST MANAGEMENT HAVE CONTRIBUTED TO TODAY'S WILDFIRE ISSUES

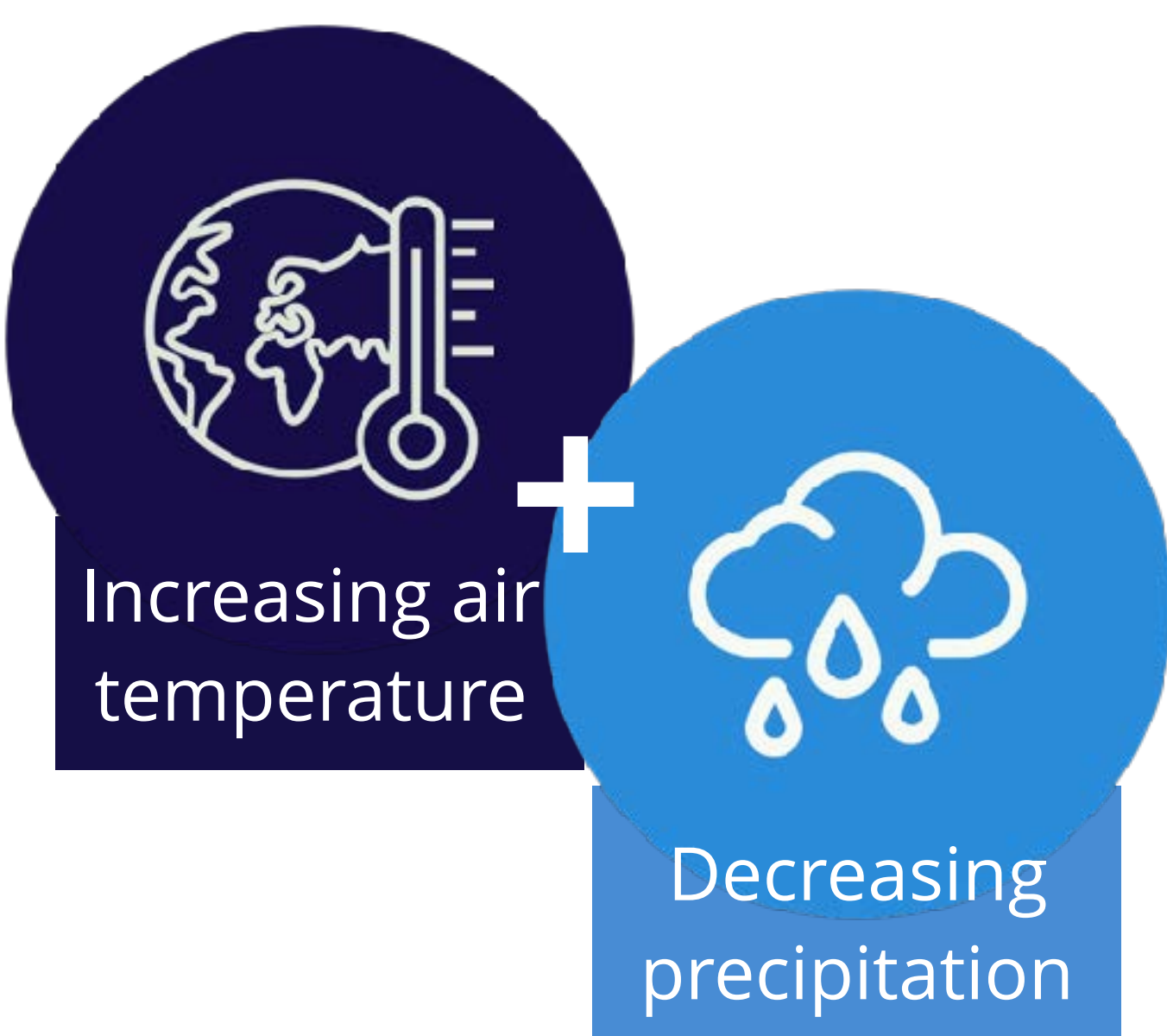


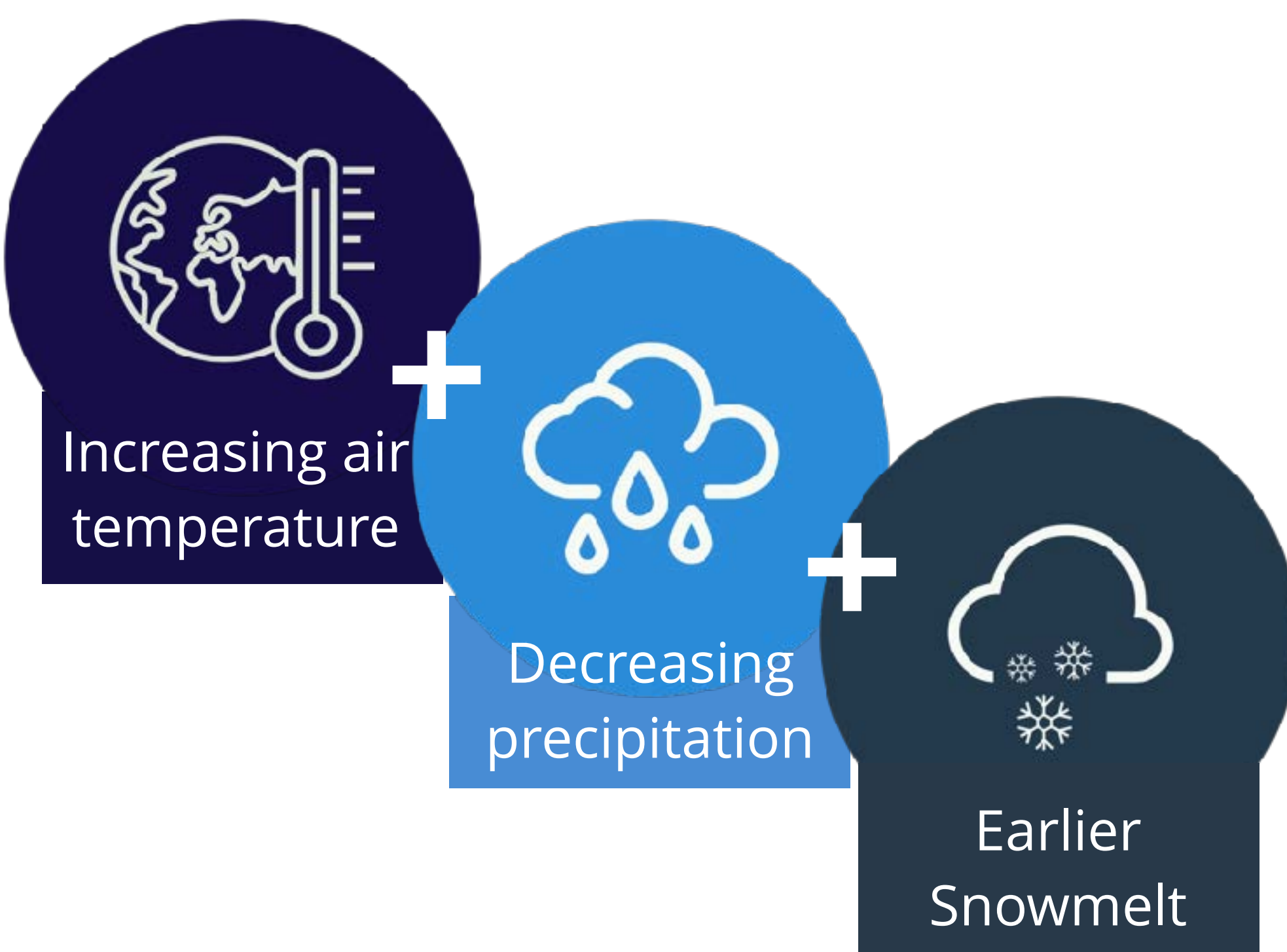
FIRE PLAYS A VITAL ROLE IN FOREST HEALTH





Increasing air
temperature







+



+



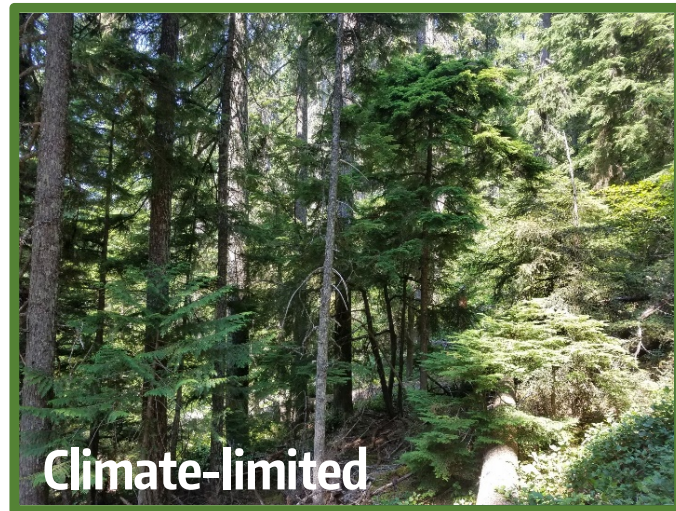
Increasing air
temperature

Decreasing
precipitation

Earlier
Snowmelt

**LEAD TO DRIER
FUEL & FORESTS**

For wildfire, context matters.



Western Cascades, WA

Eastern Cascades, WA



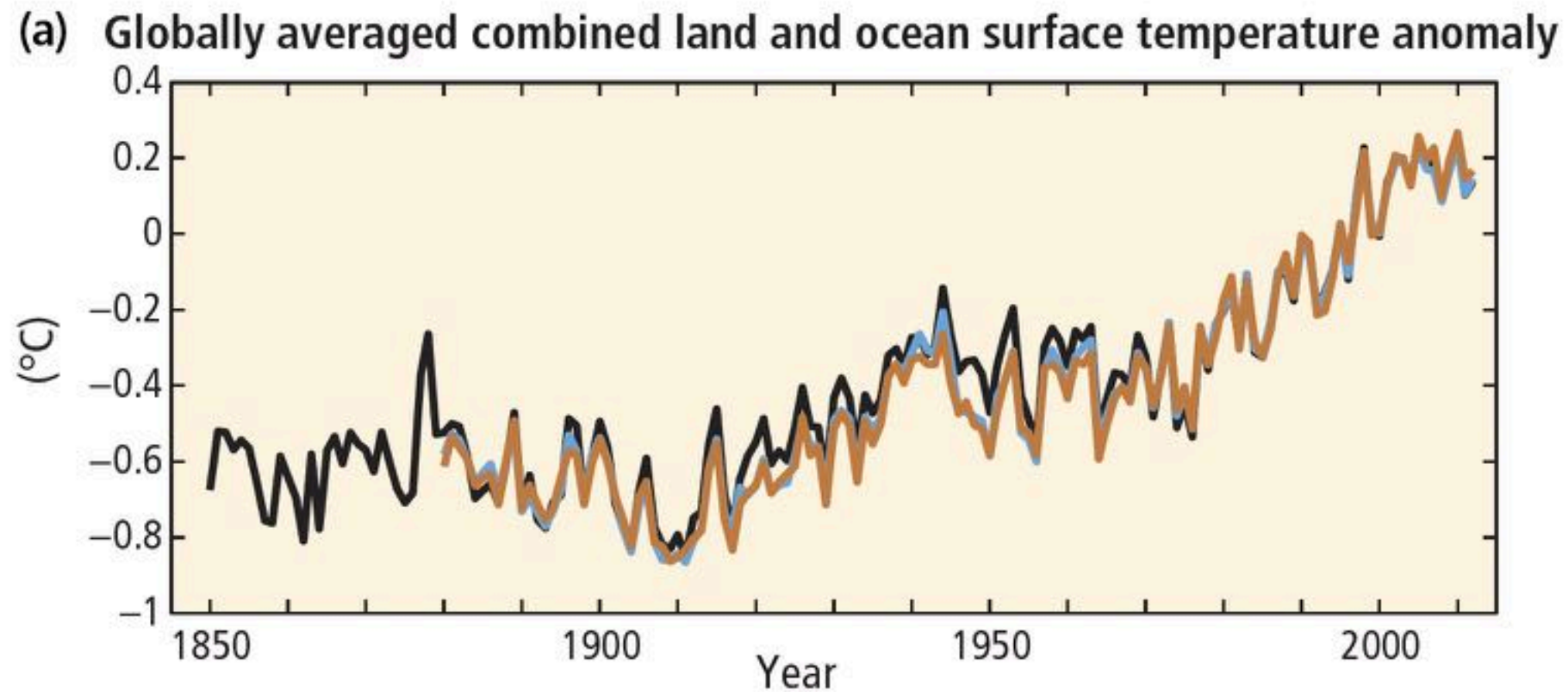
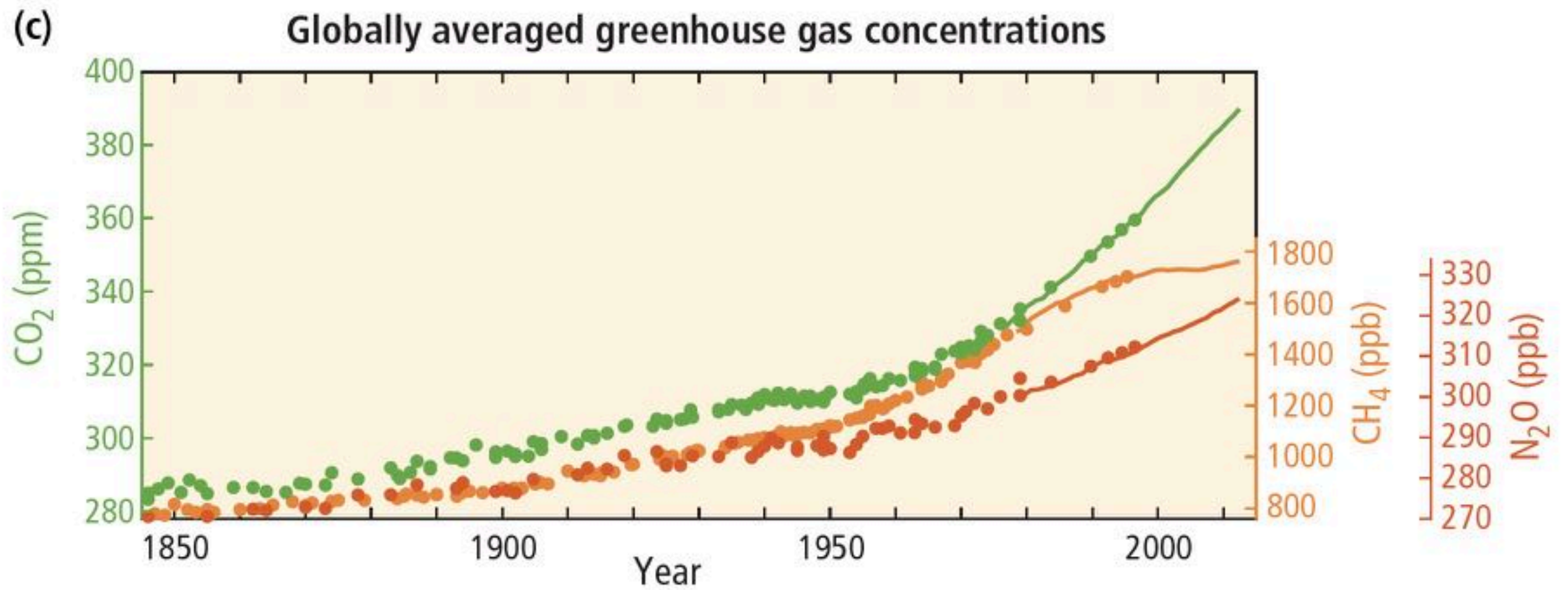
Coastal chaparral, CA



Different landscapes have different sensitivities (& vulnerabilities).

But the context is changing.



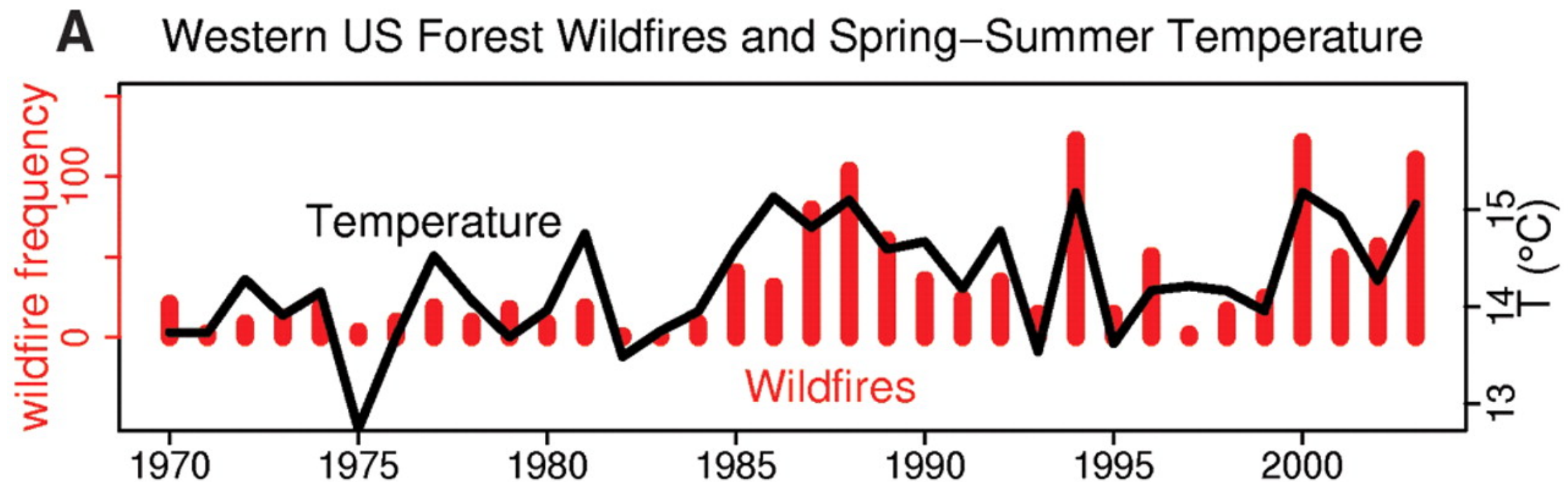


**AVERAGE ANNUAL TEMPERATURE IN WA STATE
HAS RISEN BY 1.8°F SINCE 1900**



“Large wildfire activity (>400ha) [in the Western U.S.] increased markedly in the 1980’s with higher large-wildfire frequency, longer wildfire duration and longer wildfire seasons.”

- Westerling et al., 2006

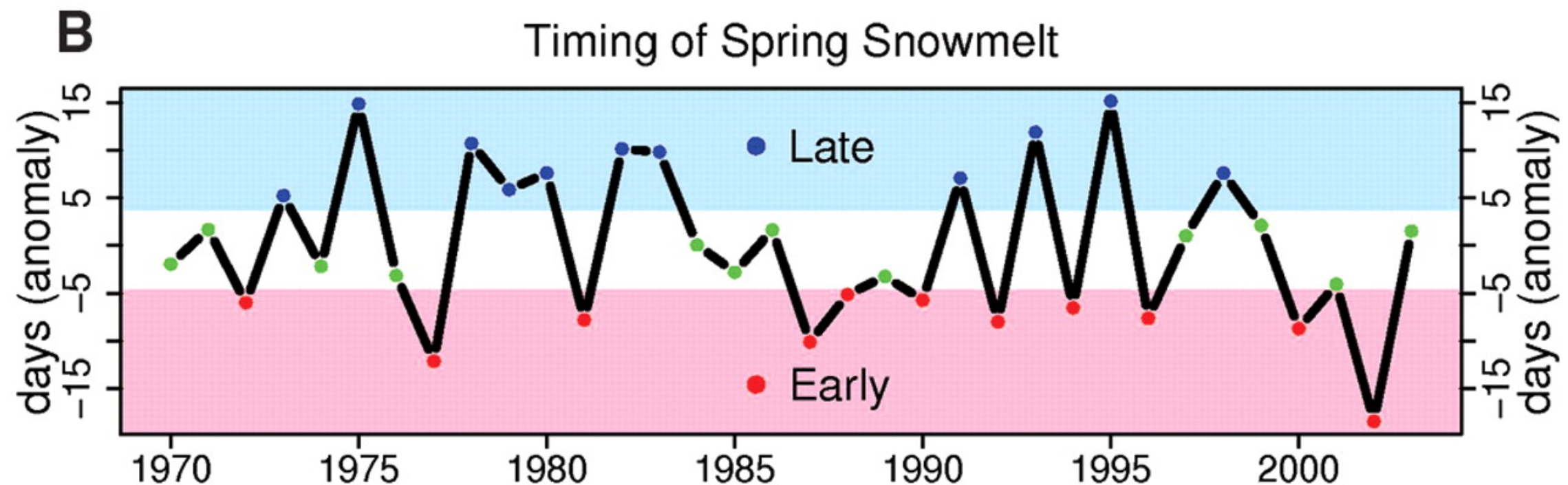


Interannual variability in wildfire frequency is **strongly correlated with spring and summer temperature.**

SPRING PEAK STREAMFLOW HAS SHIFTED EARLIER BY UP TO 20 DAYS



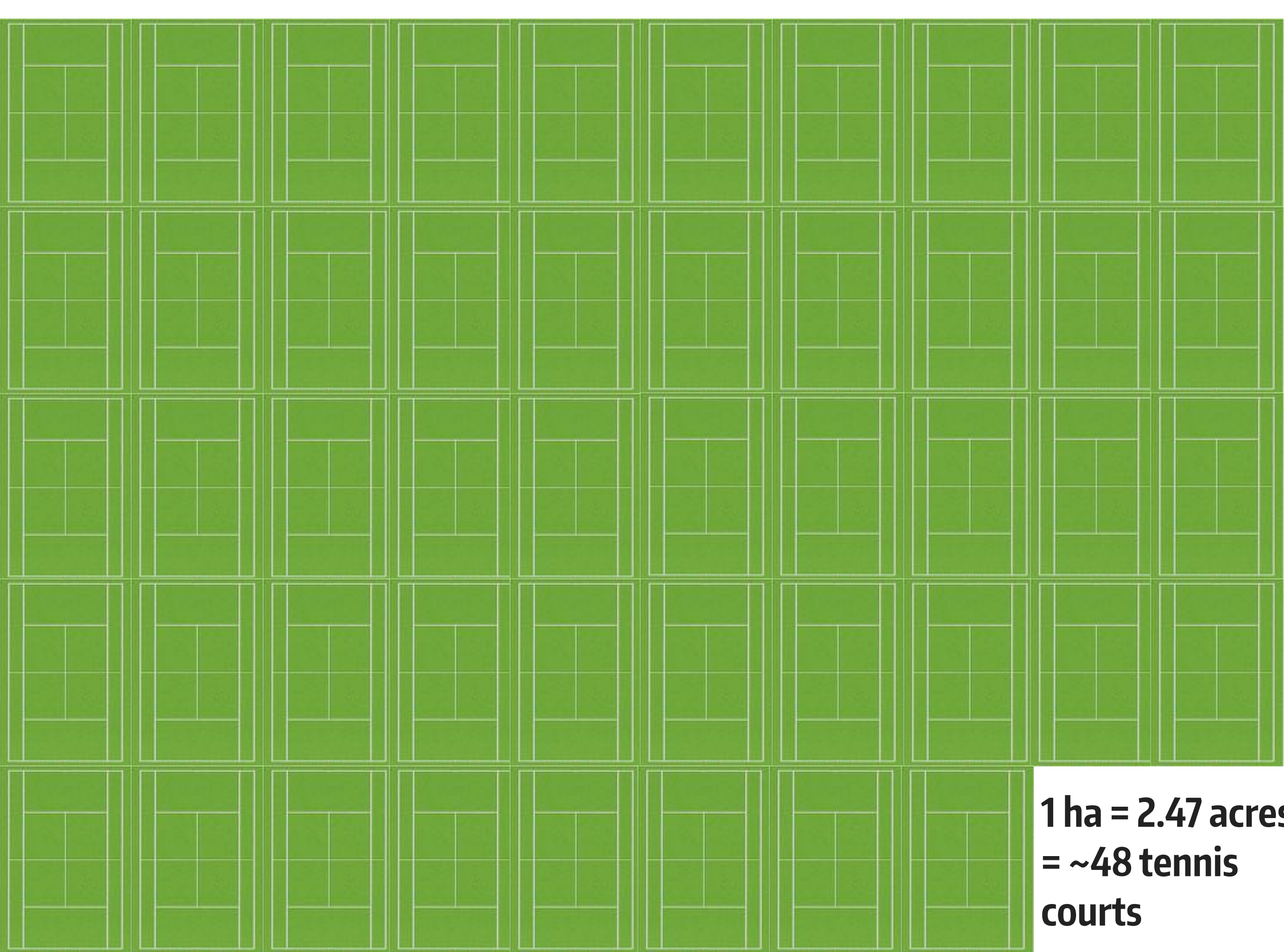
In the Pacific Northwest, total annual streamflow – an indicator of precipitation and water availability – is correlated with the area burned & severity of wildfire.



The timing of spring snowmelt also plays a role in Western U.S. wildfire. Early snowmelt leads to larger fires.

Human-caused climate change contributed an additional 4.2 million hectares area burned by wildfire between 1984-2015.

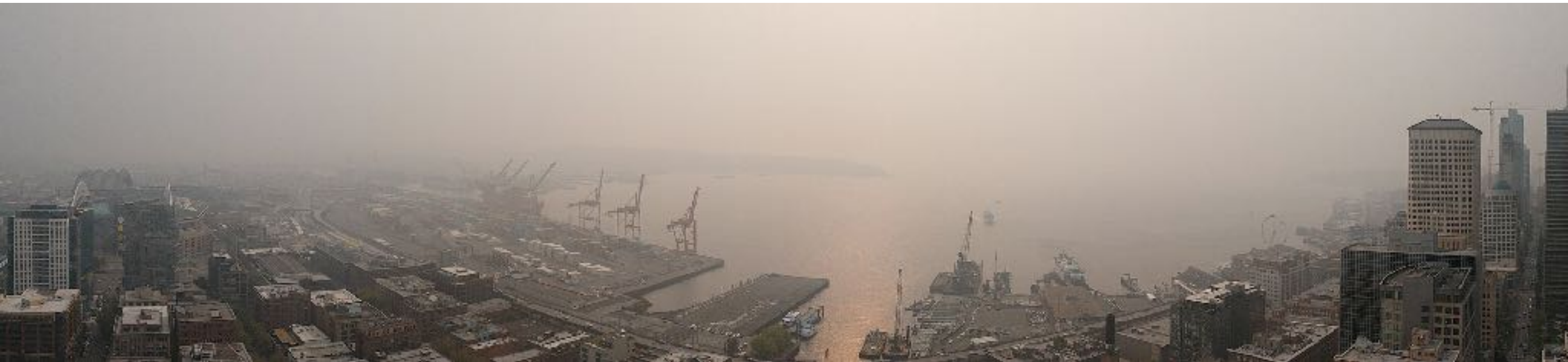




4.2 million hectares....

...50 many tennis courts...

**This is nearly double the forest fire expected
in the absence of human-caused climate
change.**





**Human-caused climate change accounts for
~55% of observed increases in fuel aridity
between 1979–2015.**



WHAT DOES THE FUTURE HOLD?



Hotter summers ahead

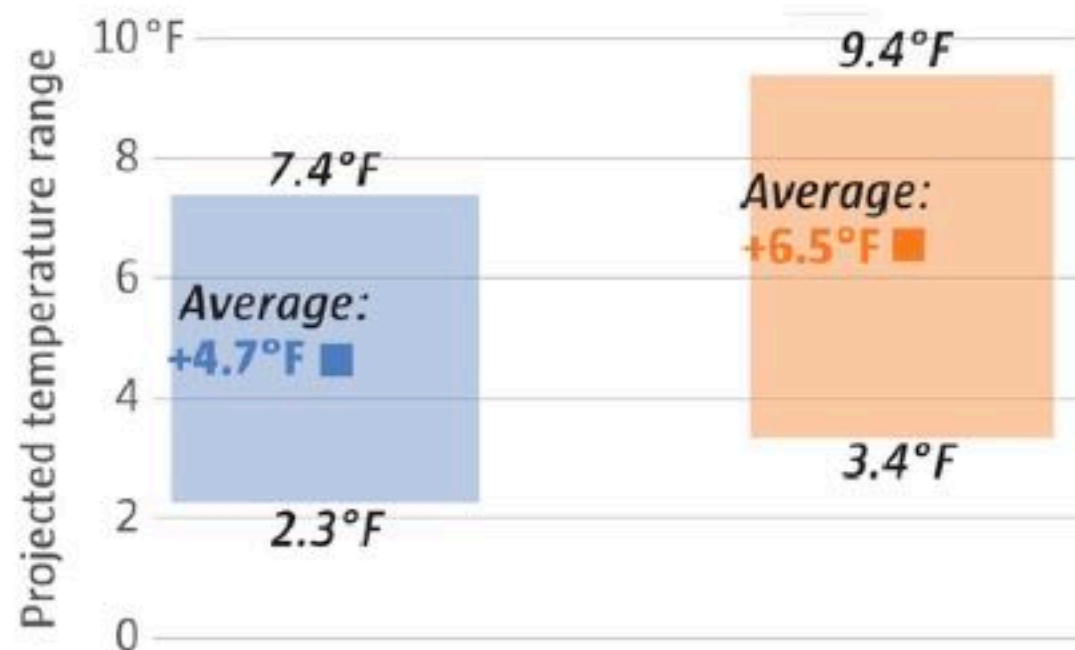
Climate change is projected to ramp up the heat — and increase the fire risk — of Northwest summers.

INCREASE* OF AVERAGE TEMPERATURE PROJECTIONS FOR 2041-2070

■ Low greenhouse-gas emissions scenario

■ High greenhouse-gas emissions scenario

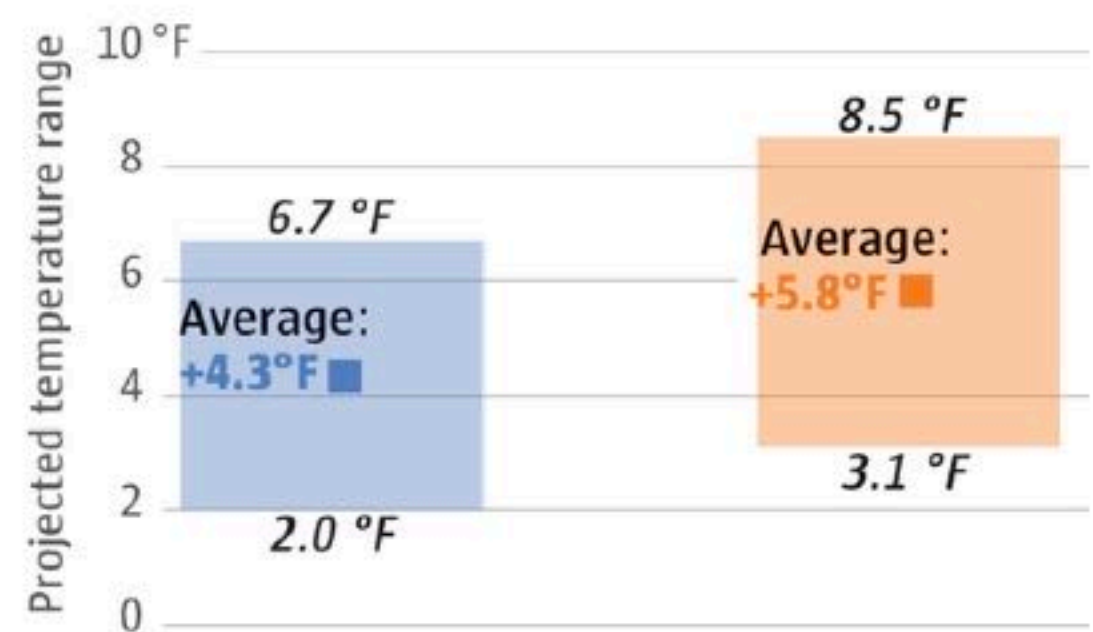
Summer warming in Pacific Northwest



Summer of 2017 saw an increase of 3.6°F above the 1950-1999 average

*Increase relative to the annual average for 1950-1999

Annual warming in Pacific Northwest



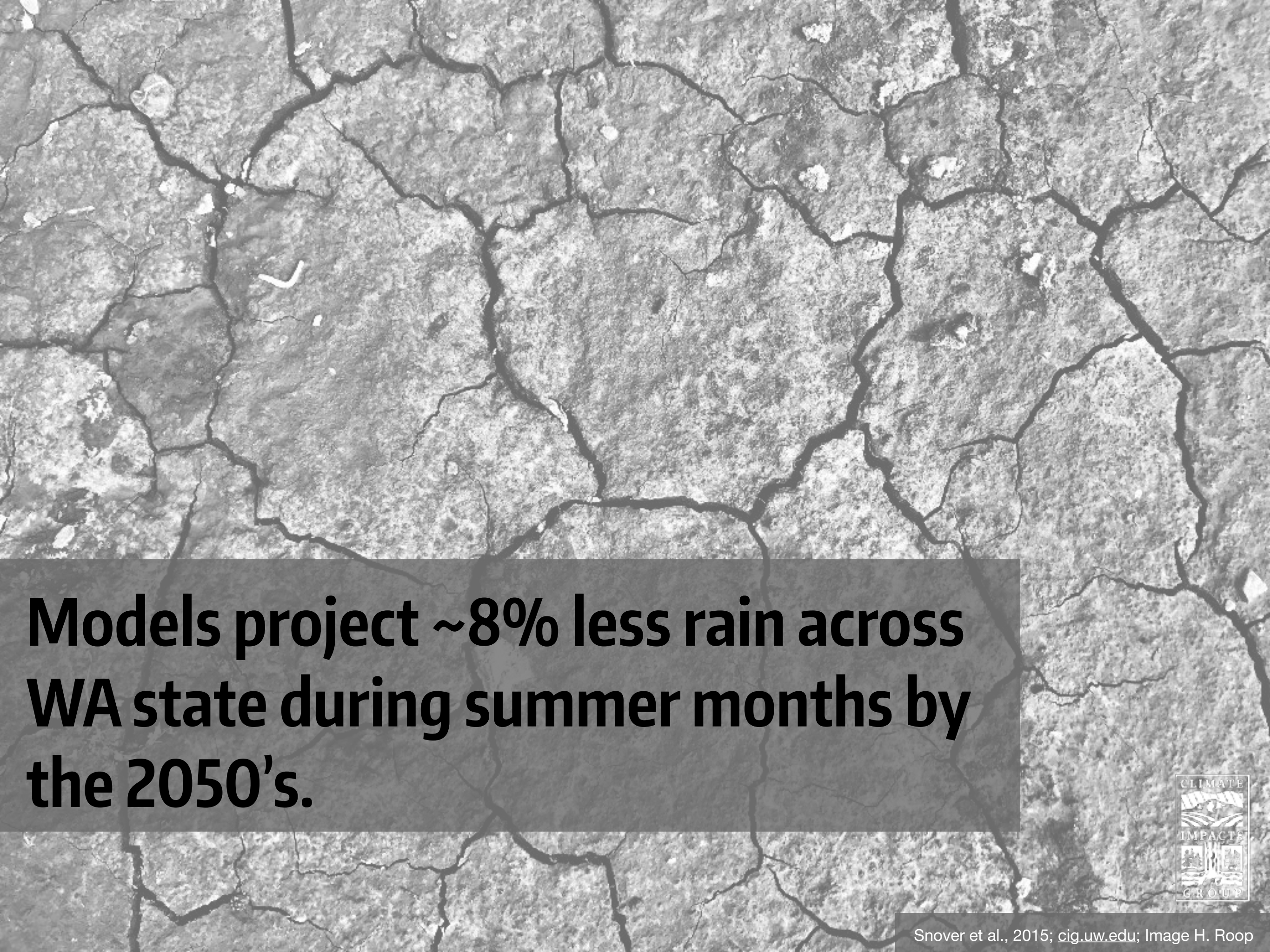
Climate-change projections:

Low-emissions scenario: 39 models analyzed

High-emissions scenario: 36 models analyzed

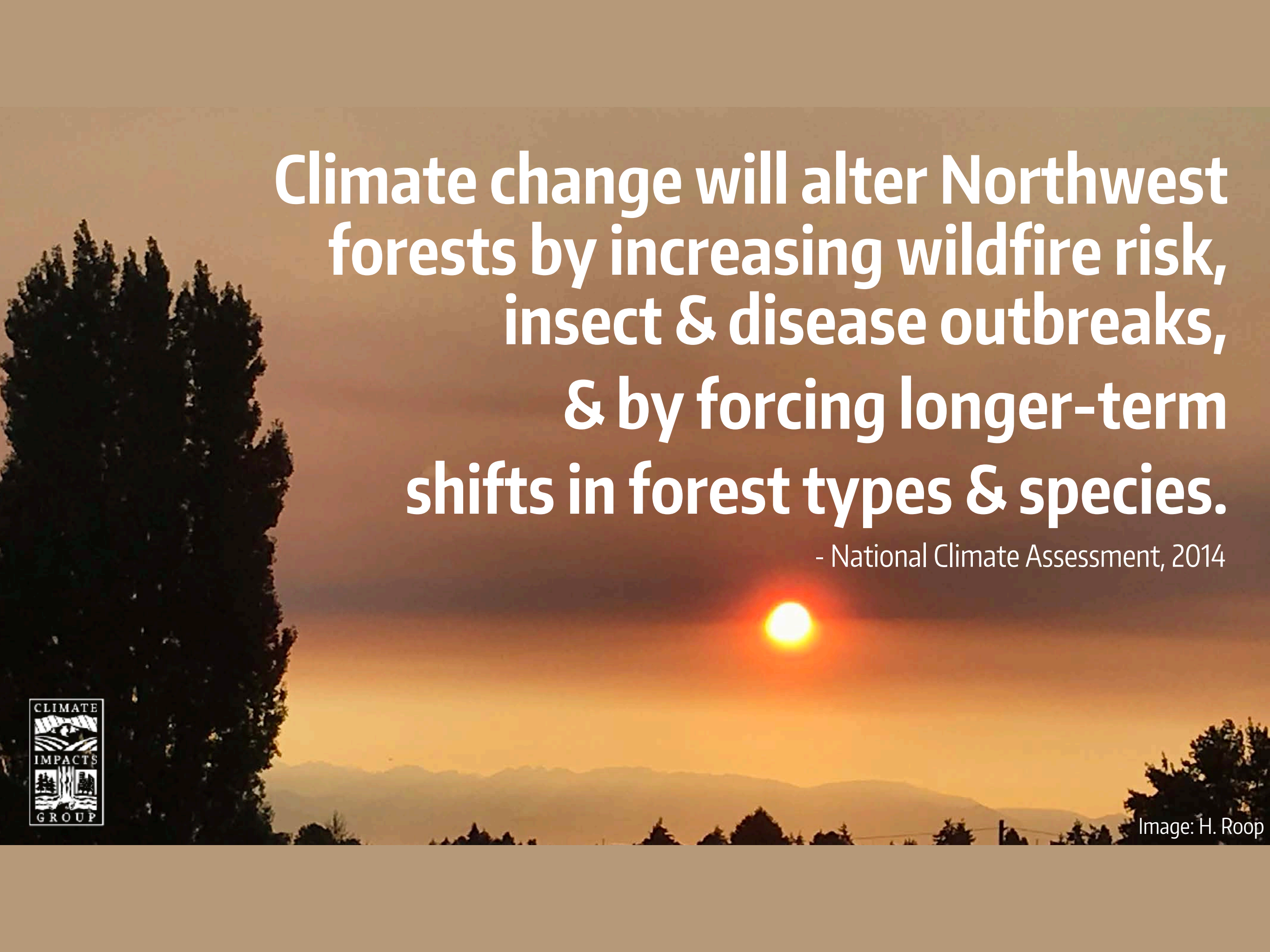
Sources: UW Climate Impacts Group analysis of models, <https://CIG.uw.edu>.
NOAA National Centers for Environmental Information, Climate at a Glance:
U.S. Time Series, Maximum Temperature, published September 2017

MARK NOWLIN / THE SEATTLE TIMES

An aerial photograph showing a vast expanse of dry, cracked earth. The cracks are deep and irregular, forming a network of polygonal shapes across the landscape. The ground is a mix of light and dark brown tones, indicating different soil compositions or moisture levels.

**Models project ~8% less rain across
WA state during summer months by
the 2050's.**





**Climate change will alter Northwest
forests by increasing wildfire risk,
insect & disease outbreaks,
& by forcing longer-term
shifts in forest types & species.**

- National Climate Assessment, 2014



Image: H. Roop



Increases in disease & pests can further stress forests.





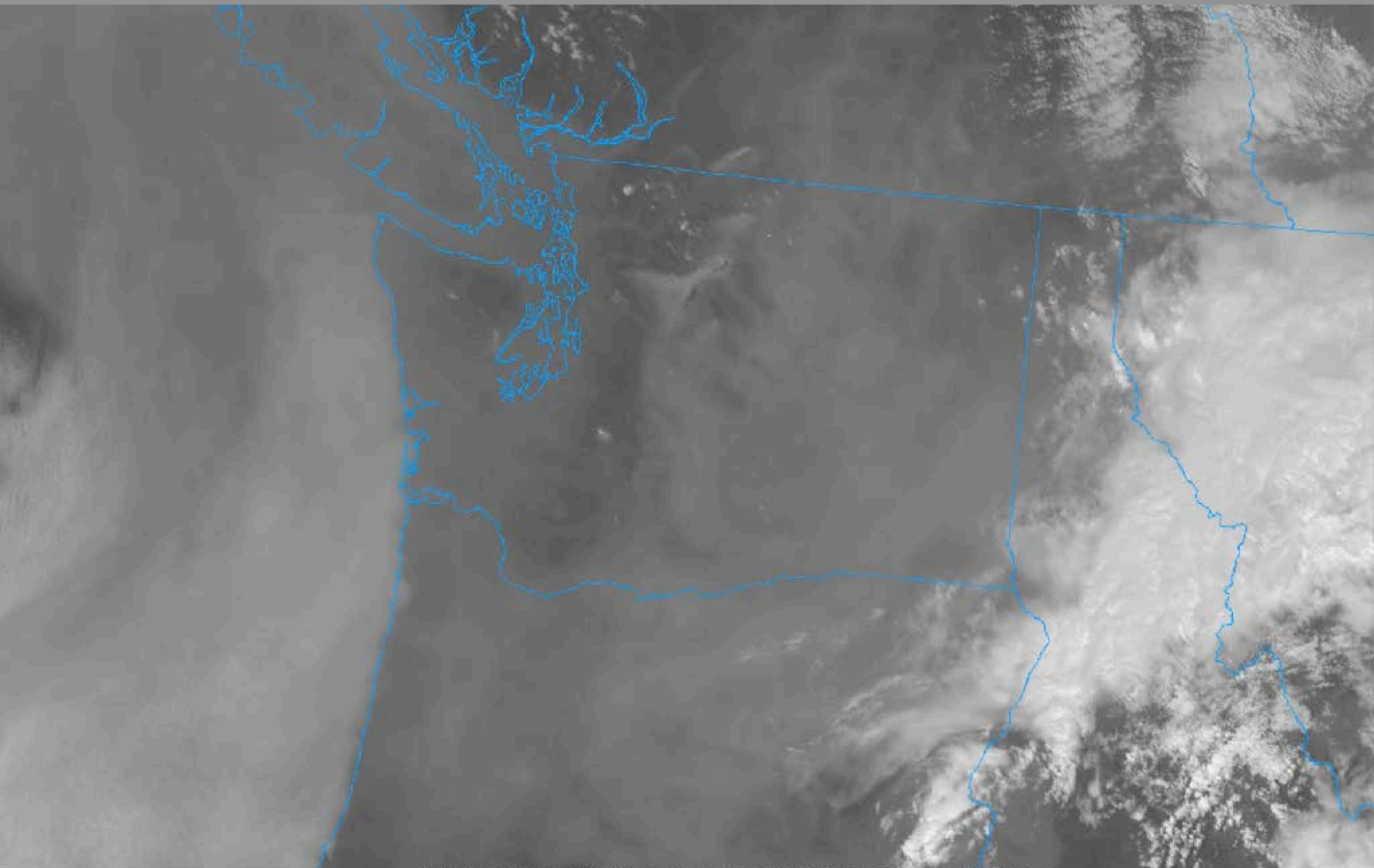
By the 2080s, the median annual area burned in the Northwest could more than double relative to 1916-2006.



Scenario A1B assumes continued increases in emissions through mid-century, then decline. Littell et al., 2010.

Image: H. Roop

Where there is fire...there is smoke.



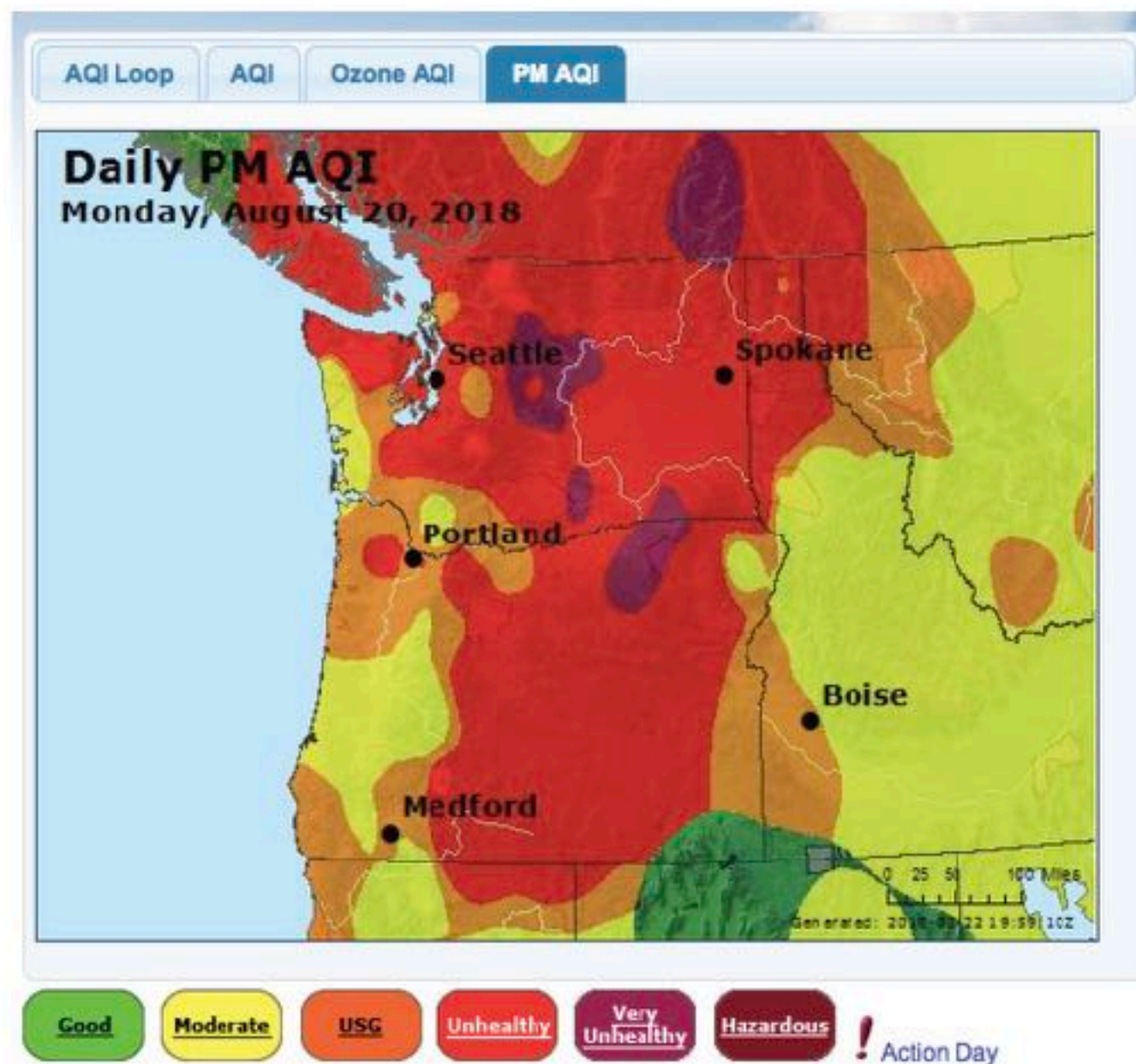
GOES-16 BAND 02 (VISIBLE - RED) 0.5 KM | VALID 20 AUG 18 18:52:32 UTC

Cougar Creek Fire | GOES-16 | 20 August 2018

A satellite image of the Earth showing a large, dark, irregular smoke plume spreading across a significant portion of the landmass. Numerous small red dots are scattered across the image, likely representing fire locations. The text is overlaid in white, bold, sans-serif font.

**“Smoke travels fast...
& needs no passport.”**

- Anna Elza Brady, 2018



WAQQA

WASHINGTON AIR QUALITY ADVISORY

Check air quality conditions at ecology.wa.gov/WAQA



GOOD

Air pollution is so low so there is little health risk.
It's a great day for everyone to enjoy the outdoors!



MODERATE

People with health conditions should limit spending any time outdoors & avoid strenuous outdoor activities.
They may begin to have worsened symptoms.



UNHEALTHY FOR SENSITIVE GROUPS

All of the above &:
All sensitive groups should limit spending any time outdoors. People with health conditions may have worsened symptoms. Healthy people may start to have symptoms.



UNHEALTHY FOR EVERYONE

Everyone, especially sensitive groups, should limit time spent outdoors, avoid strenuous activities outdoors, & choose light indoor activities.



VERY UNHEALTHY FOR EVERYONE

Everyone should stay indoors, avoid all strenuous activity, close windows & doors if it's not too hot, set your AC to recirculate, & use a HEPA air filter if possible.



HAZARDOUS FOR EVERYONE

All of the above &:
People with heart or lung disease, or those who have had a stroke, should consult their healthcare provider about leaving the area & wearing a properly-fitted respiratory mask* if they must go outdoors. Follow burn bans and evacuation orders.

SENSITIVE GROUPS INCLUDE:

- People with health conditions such as:
 - Asthma, COPD, diabetes, & other heart/lung diseases
 - Respiratory illnesses & colds
 - Stroke survivors
- Children under 18 & adults over 65
- Pregnant women
- People who smoke

KNOW THE SYMPTOMS:

- Watery or dry eyes
- Coughing/wheezing
- Throat & sinus irritation
- Phlegm
- Shortness of breath
- Headaches
- Irregular heartbeat
- Chest pain

If you are experiencing serious symptoms, seek immediate medical attention.

Air pollution from dust, vehicles, woodstoves, wildfires, & industries can seriously impact your health.

*For more health information & how to choose the proper respiratory mask, visit doh.wa.gov/smokefromfires.



STEPS TO PROTECT YOUR HEALTH

Smoke from fires can be dangerous for everyone

Take these steps to protect your health



Stay informed on air quality



Visit WA Smoke Blog (www.wasmoke.blogspot.com) for current air quality conditions and smoke forecasts.

Pay attention to local news for health warnings and air quality reports in your area.

Avoid smoky air



People with health conditions, such as lung or heart diseases, diabetes, stroke survivors or have a cold, should limit their time outside, avoid intense physical activities and keep indoor air clean when smoke levels are "moderate."

Babies, children, people over 65, and pregnant women should follow this advice when smoke levels are "unhealthy for sensitive groups."

Everyone else should do this when smoke levels are "unhealthy for everyone."

Keep indoor air clean



Close windows and doors, pay attention to the heat, and stay hydrated.

Use fans or air conditioner (AC) when it's hot, and set your AC to recirculate. If you don't have an AC and it's too hot to stay home, go to a place with AC like a mall or library.

Don't smoke, use candles, or vacuum.

Use an air cleaner with a HEPA filter.

Contact your healthcare provider



If you have heart or lung diseases and your symptoms get worse around smoke, contact your healthcare provider. **Call 911 if you or someone else has serious symptoms**—like trouble breathing.

www.doh.wa.gov/SmokeFromFires

DOH is committed to providing customers with forms and publications in appropriate alternate formats. Requests can be made by calling **800-525-0127** or by email at civil.rights@doh.wa.gov. TTY users dial 711.



دخان الحرائق قد يكون خطرًا على الجميع

اتبع الخطوات التالية لتحمي صحتك

ابق على اطلاع بمستجدات جودة الهواء

تفضل بزيارة مدونة WA Smoke (www.wasmoke.blogspot.com) لمعرفة أحوال جودة الهواء الحالية وتوقعات انبعاث الدخان.

انتبه إلى نشرات الأخبار المحلية لمعرفة التحذيرات الصحية وتقارير جودة الهواء في منطقتك.



تجنب الهواء الملوث بالدخان

ينبغي لمن يعانون من ظروف صحية، مثل أمراض الرئة أو القلب أو السكري أو الناجين من سكتة دماغية أو المصابين بنزلة برد، أن يقللوا فترة بقائهم خارج المنزل، ويتجنبوا الأنشطة البدنية المكثفة، ويحافظوا على نظافة الهواء داخل المنزل عندما تصبح مستويات الدخان "متوسطة".

ينبغي اتباع النصيحة التالية مع الرضع والأطفال ومن تزيد أعمارهم عن 65 عامًا والسيدات الحوامل عندما تصبح مستويات الدخان "غير صحية للمجموعات سريعة التأثير".

وينبغي للجميع اتباعها عندما تصبح مستويات الدخان "غير صحية على الجميع".



حافظ على نظافة الهواء داخل المنزل

أغلق النوافذ والأبواب وانتبه إلى الحرارة وحافظ على شرب الماء.

استخدم المراوح أو مكيف الهواء عندما يكون الجو حارًا، واضبط المكيف على إعادة تدوير الهواء. إذا لم يكن لديك مكيف هواء أو كان الجو حارًا للغاية للبقاء داخل المنزل، فاهذب إلى مكان مكيف، مثل مركز تسوق أو مكتبة.

تجنب التدخين أو استخدام الشموع أو المكنسة الكهربائية.

استخدم منقي هواء مزود بمرشح هوائي للجسيمات عالي الكفاءة (HEPA).



اتصل بمقدم الرعاية الصحية

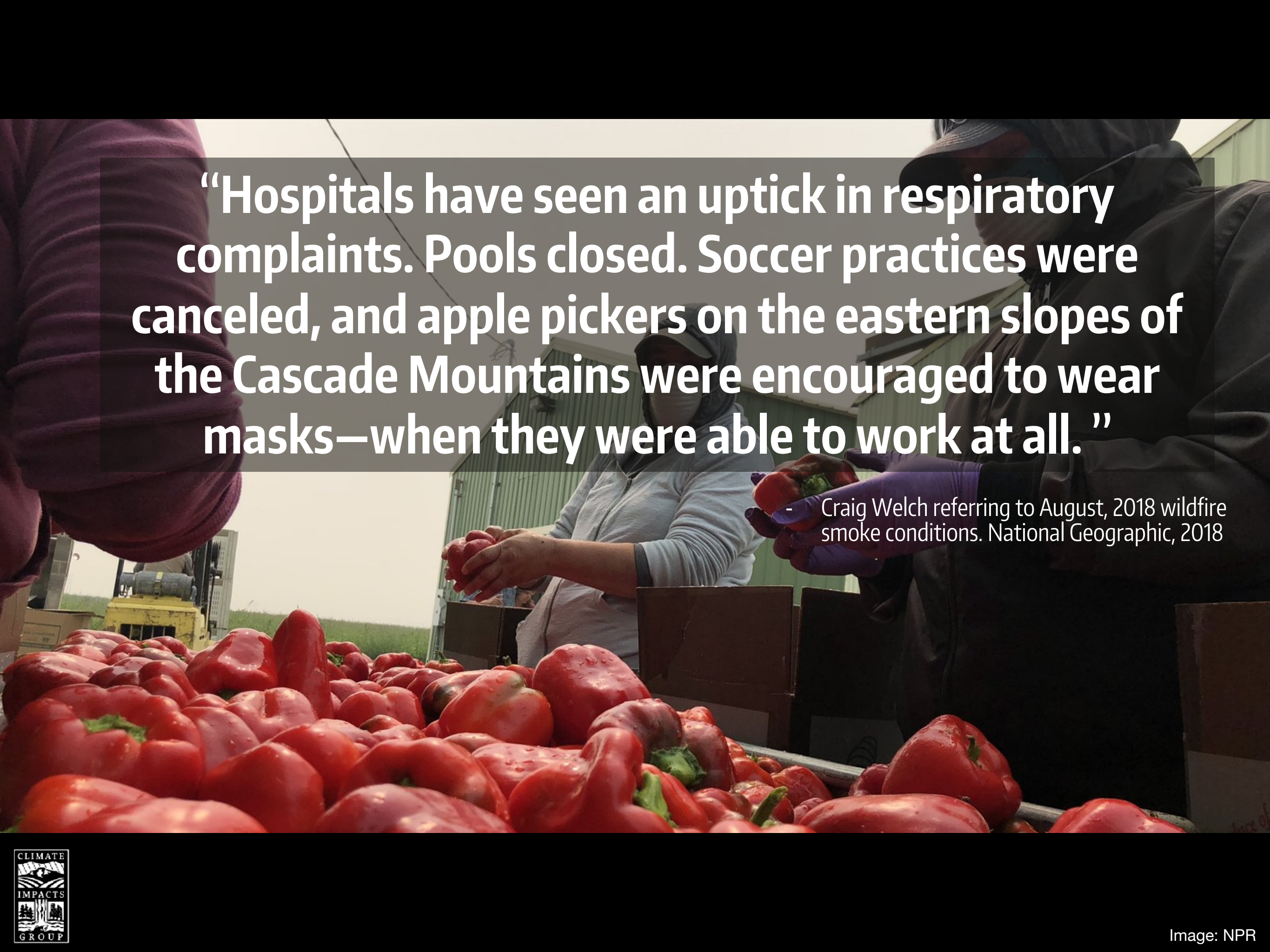
إذا كانوا يعانون من أمراض القلب أو الرئة وساءت الأعراض بالقرب من الدخان، فاتصل بمقدم الرعاية الصحية. اتصل برقم الطوارئ **911 (في الولايات المتحدة)** إذا كنت تعاني أنت أو شخص آخر من أعراض خطيرة، مثل صعوبة التنفس.



www.doh.wa.gov/SmokeFromFires



تلتزم DOH بتزويد العملاء بالنماذج والمطبوعات في تنسيقات بديلة مناسبة. يمكن تقديم طلب عن طريق الاتصال بالرقم **800-525-0127** أو عبر البريد الإلكتروني على العنوان civil.rights@doh.wa.gov. يتصل المستخدمون من ضعاف السمع بالرقم 711.



“Hospitals have seen an uptick in respiratory complaints. Pools closed. Soccer practices were canceled, and apple pickers on the eastern slopes of the Cascade Mountains were encouraged to wear masks—when they were able to work at all.”

- Craig Welch referring to August, 2018 wildfire smoke conditions. National Geographic, 2018

Vulnerability



Lower income



People of color



Health



Language



Exposure



Where you live



Where you work



Risk

Hazards



Fire



Floods



Heat

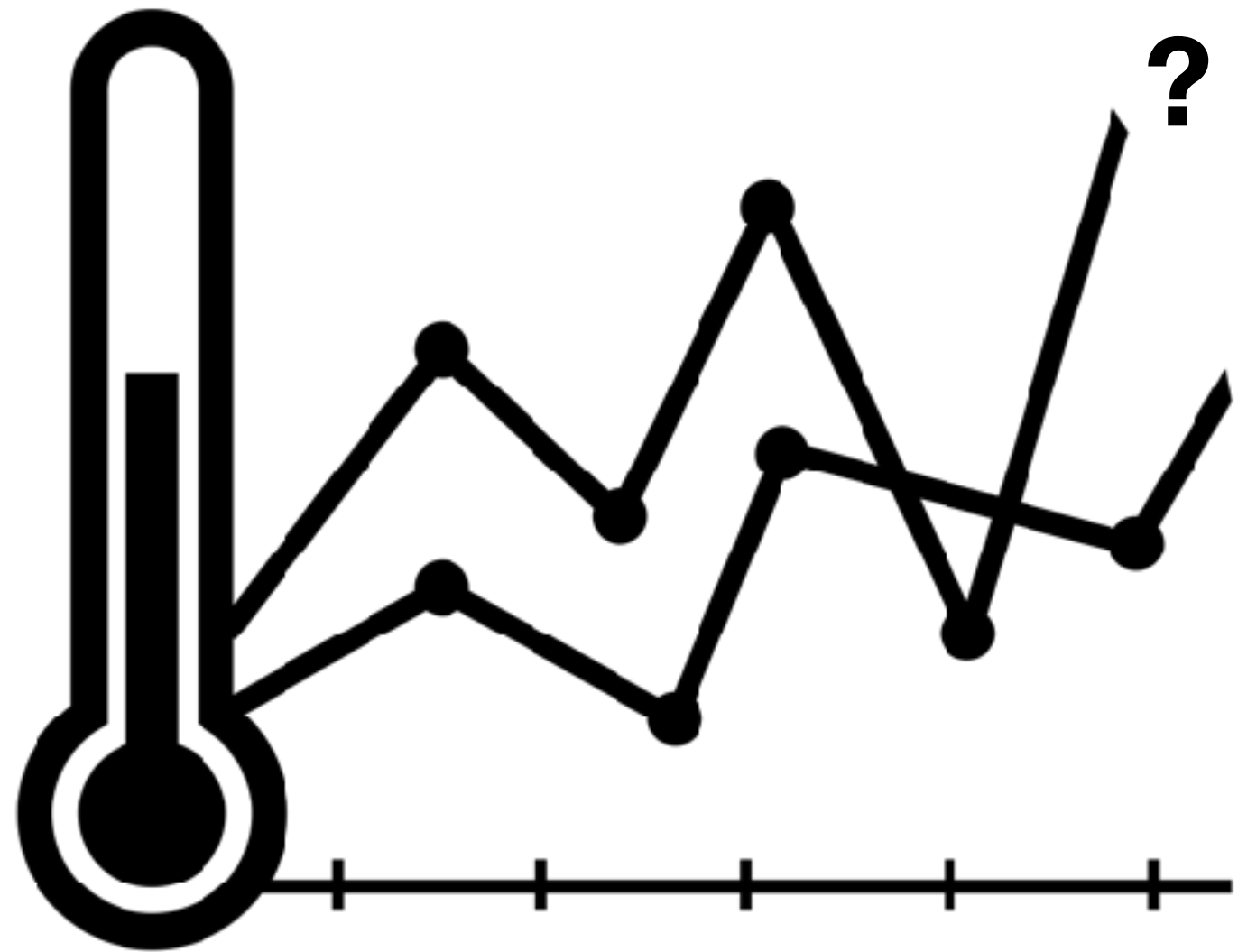


Drought

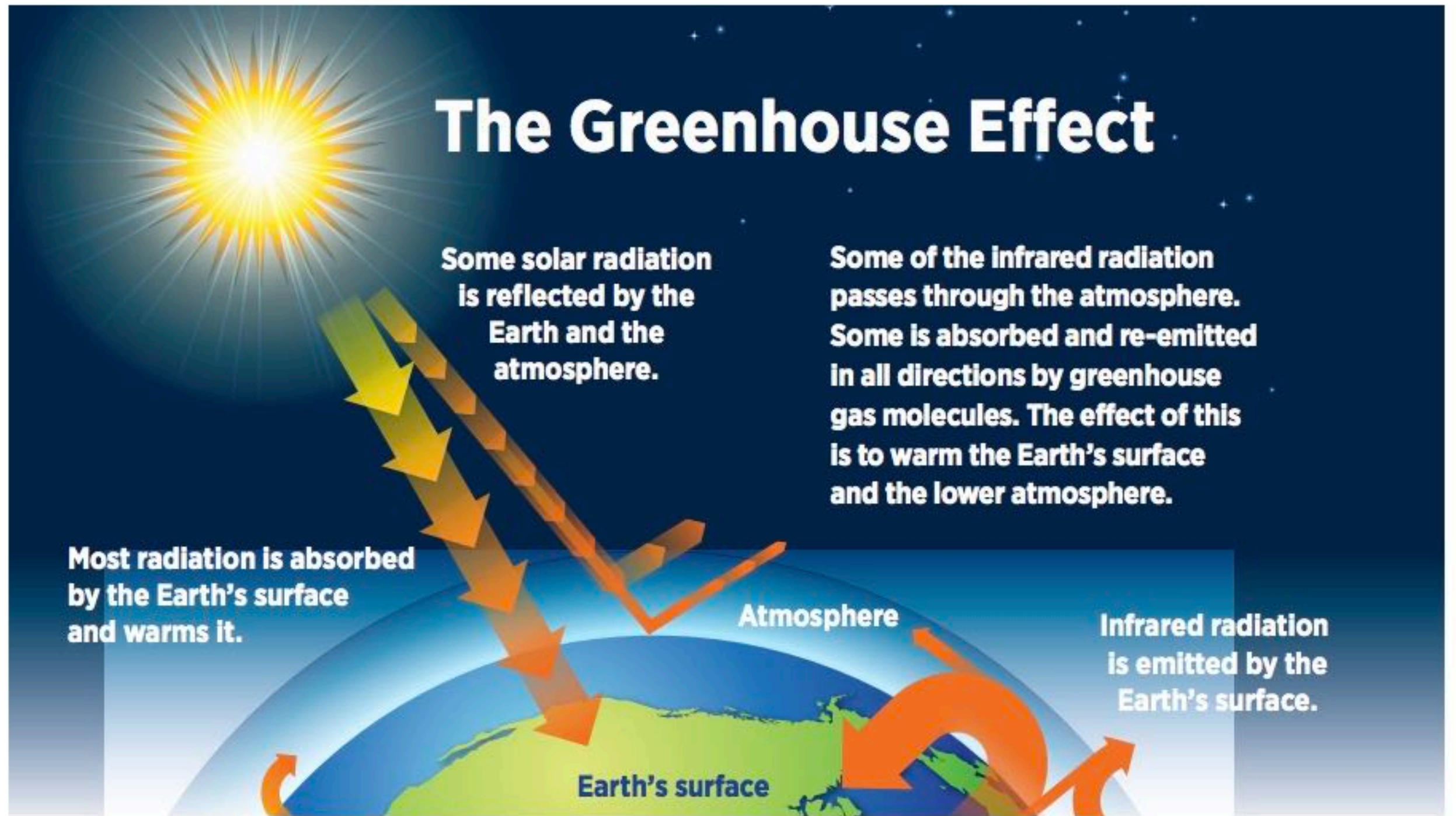
The bottom line: People of color, indigenous peoples, and people with lower incomes frequently face greater risks from climate change.

You can read the complete Unfair Share report at bit.ly/unfairsharereport

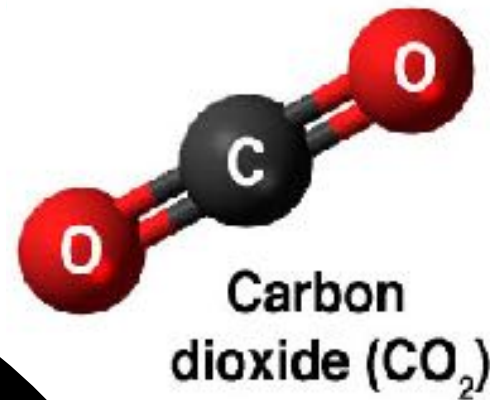
**WHERE DOES THE
HEAT COME FROM?**



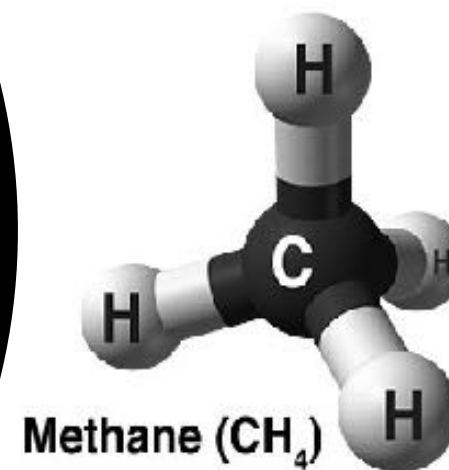
Greenhouse gases create Earth's "duvet".



GHG = Greenhouse Gas



Released through natural (volcanic eruptions) & human activities (deforestation, land use changes & burning fossil fuels).



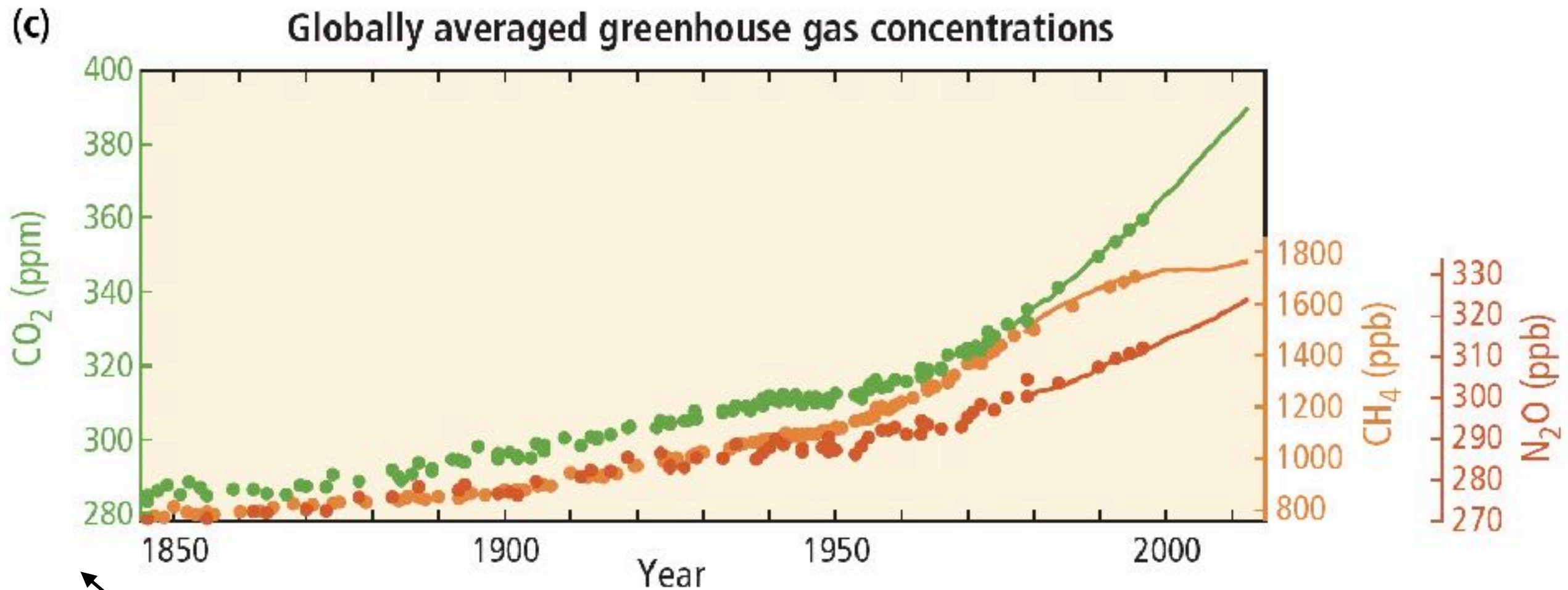
Produced by natural sources & human activities, including the decomposition of waste in landfills, agriculture, rice cultivation, and ruminant digestion.

Nitrous oxide (N₂O) Produced by the use of commercial & organic fertilizers, fossil fuel combustion, nitric acid production & biomass burning.



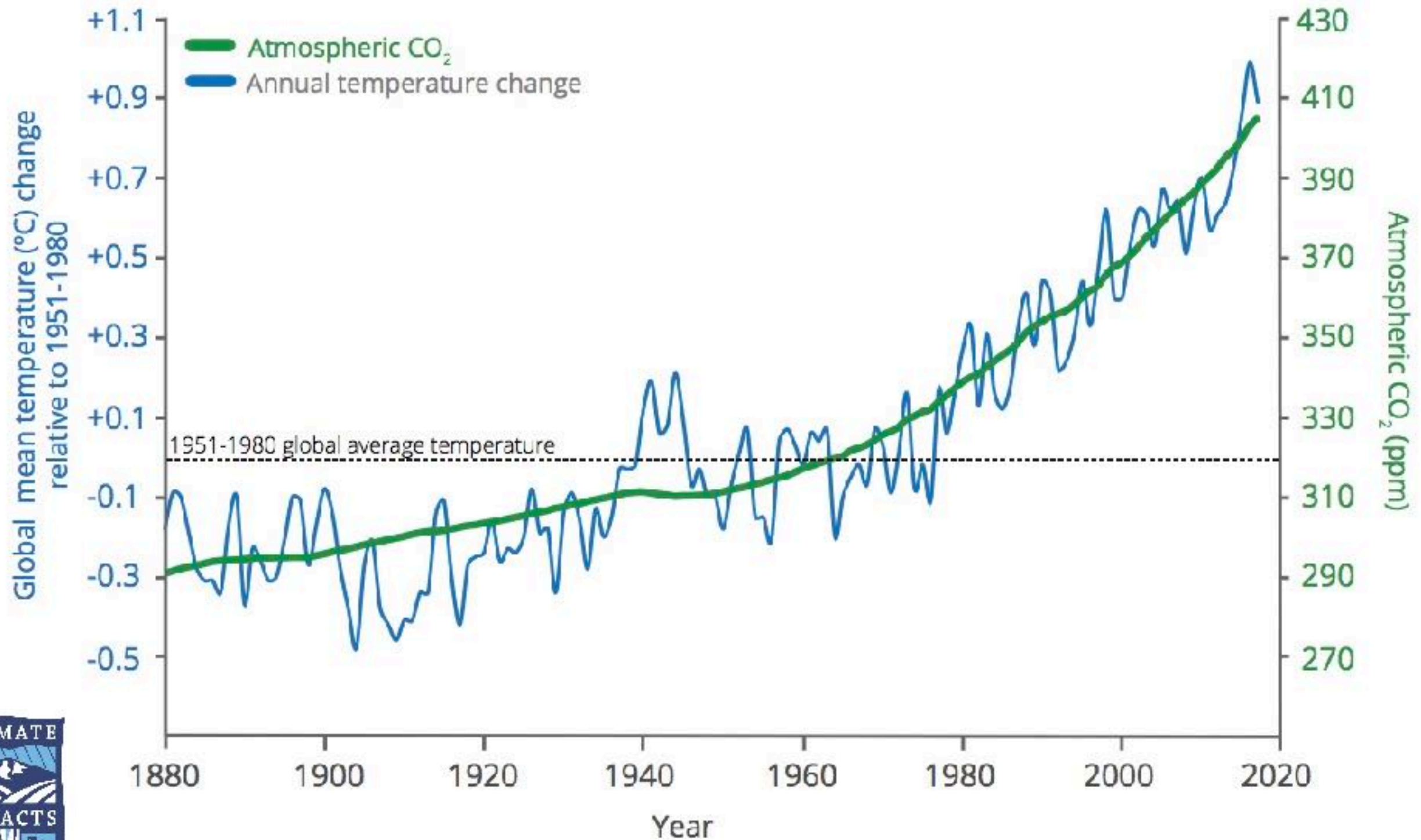
The most abundant GHG. Water vapor increases as the atmosphere warms.

Image:
NASA/GSFC



We are going to back in time too...

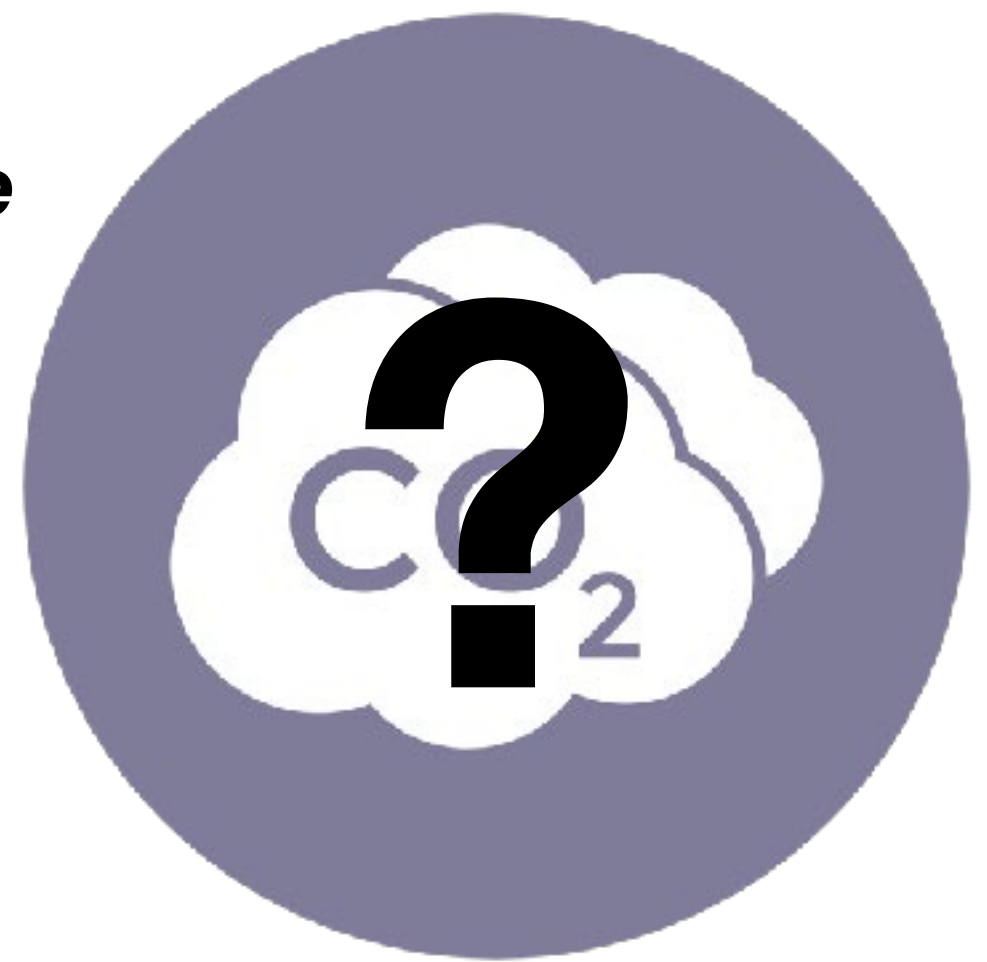
~1.8°F warming globally since the late 1800's



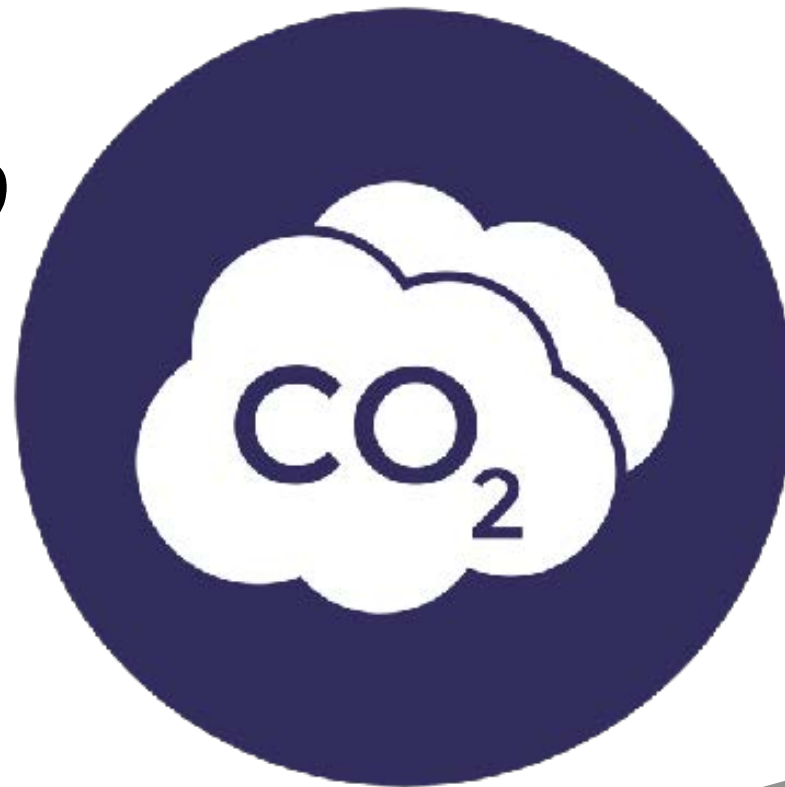


There is high confidence (>95%) that human-produced greenhouse gases have caused much of the observed increase in Earth's temperature over the past 50 years.

Future
Uncertainty = us.

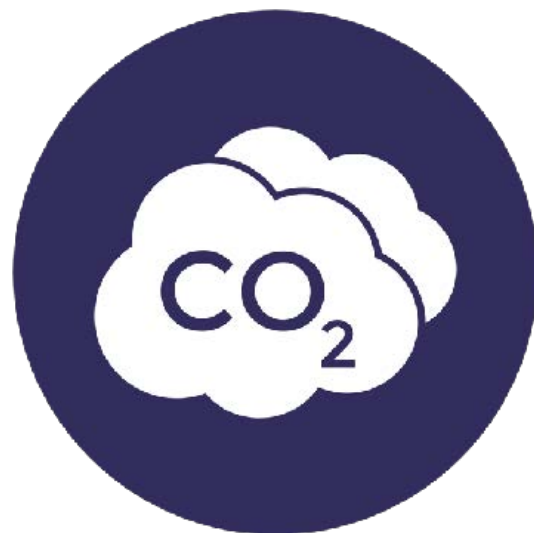


May, 2019

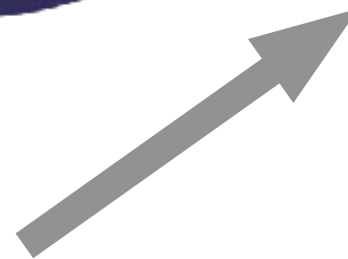


413 ppm

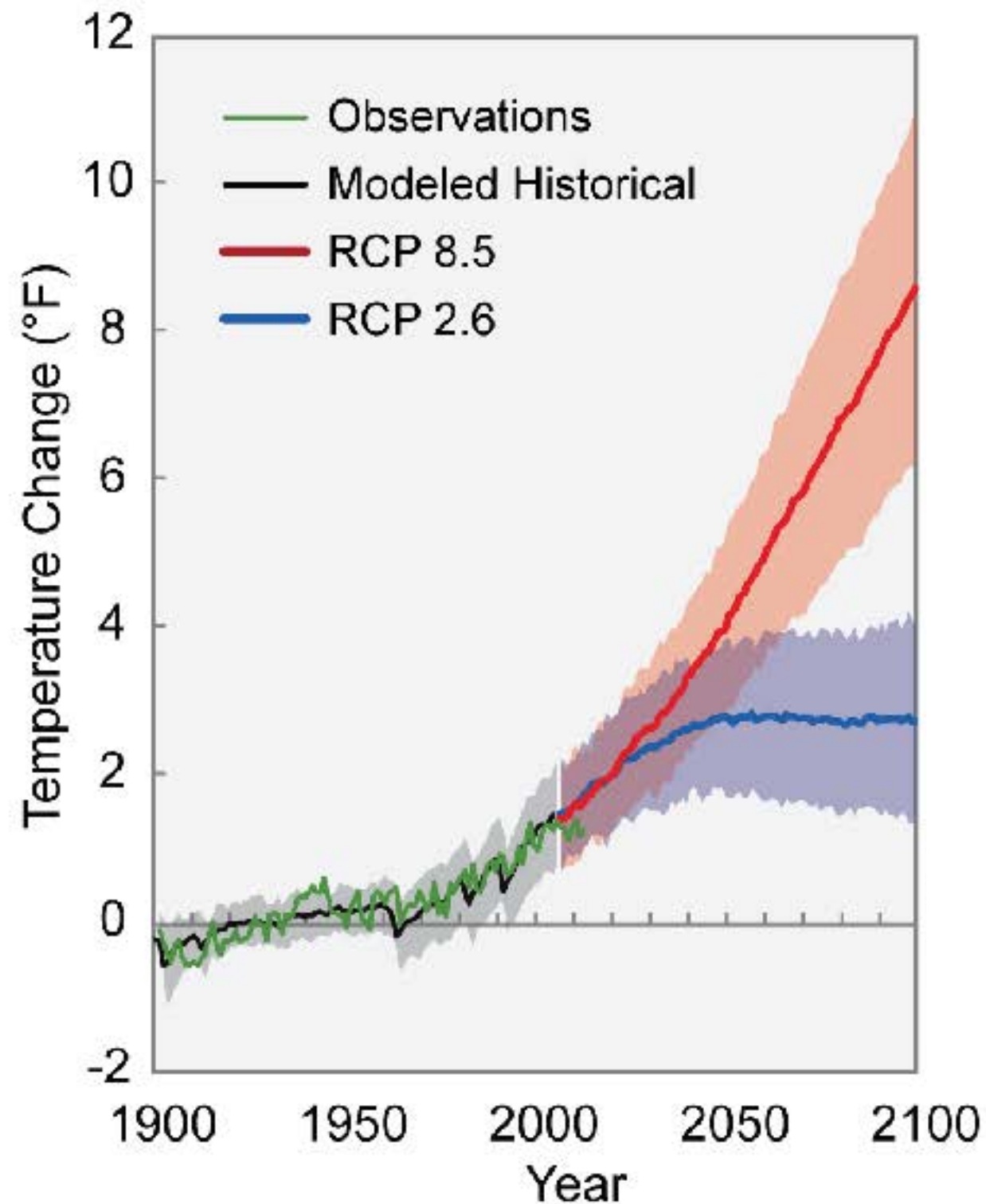
Pre-industrial



280 ppm



Emissions of Greenhouse Gases Determine Temperature Rises



Climate change in our backyard:

Change with 1.5°C



Risks

- Heat-related illness and deaths
- Warmer streams stressing salmon
- More frequent harmful algal blooms



- Reduced water storage
- Irrigation shortages
- Winter and summer recreation losses



- River flooding
- Costly stormwater management and flood protection
- Negative effects on salmon populations

Change with 1.5°C



Risks

- Reduced summer hydropower
- Conflicts over water resources
- Negative effects on salmon populations



- Coastal flooding and inundation
- Damage to coastal infrastructure and communities
- Bluff erosion



2015: A postcard from the future?

2015 

Temperature: ~2.7°C (4.8°F) warmer than pre-industrial
Snowpack: ~70% below normal (1970-1999 average)

FISHERIES

Low summer streamflow & warm waters resulted in fishery closures



Columbia River sockeye salmon died

RECREATION

Low snowpack led to reductions in winter & summer recreation



shorter ski season at Stevens Pass

WILDFIRE

The most severe wildfire season in Washington's recorded history



acres burned

>\$253 million

fire suppression

AGRICULTURE

Warm temperatures & reduced water availability stressed WA agriculture



major crops with reduced yields

\$633-733 million

economic losses





**Lakes &
Ice!**

HOW HAS
CLIMATE
CHANGED?



Ice!

FROM ICE CORES WE HAVE DIRECT MEASUREMENTS OF GREENHOUSE GASES BACK 800,000 years!

May, 2019

CO₂ **413 ppm**



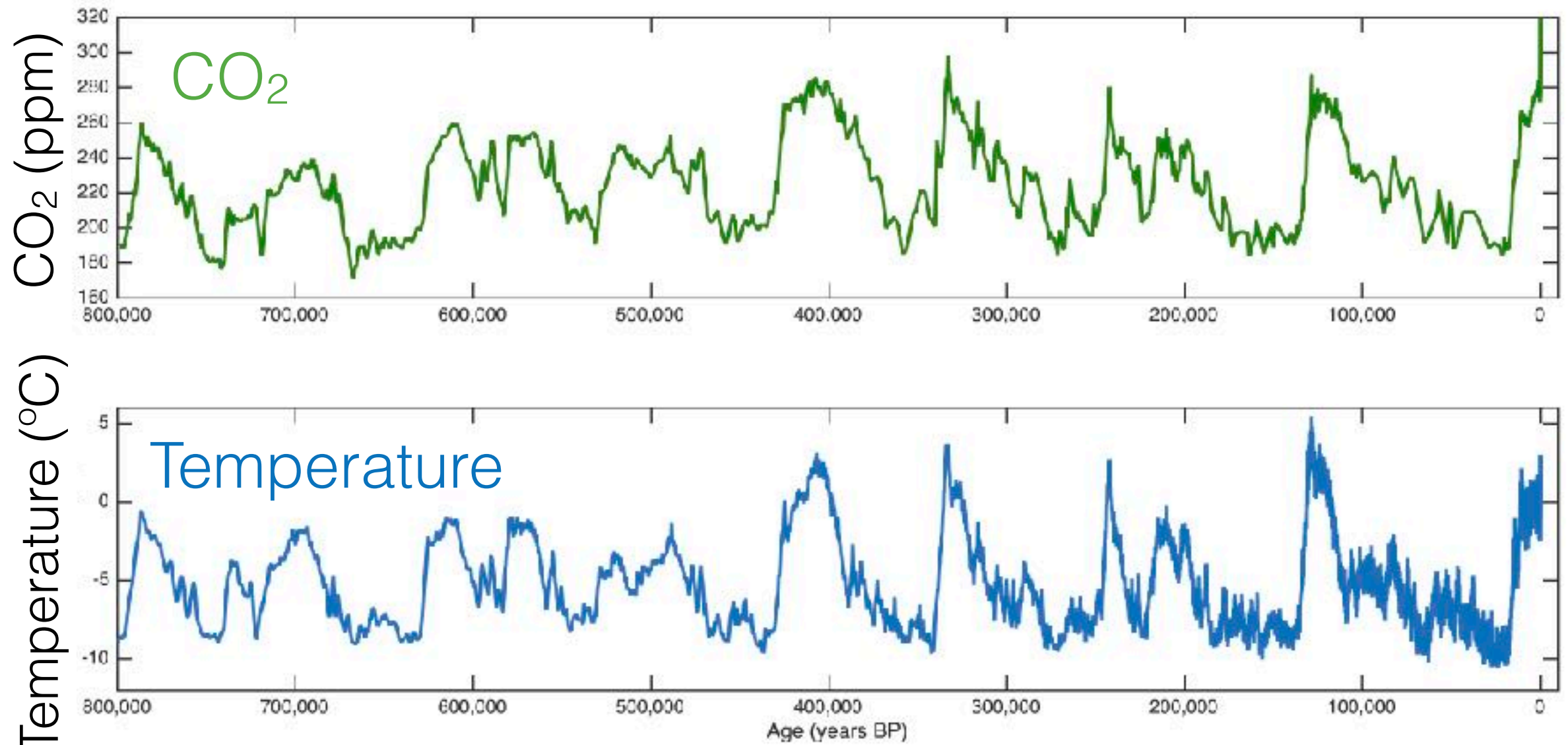
Pre-industrial (late 1800's)

CO₂ **280 ppm**

ppm= parts per million

ANCIENT AIR!

800,000 yrs of CO₂ & Temperature

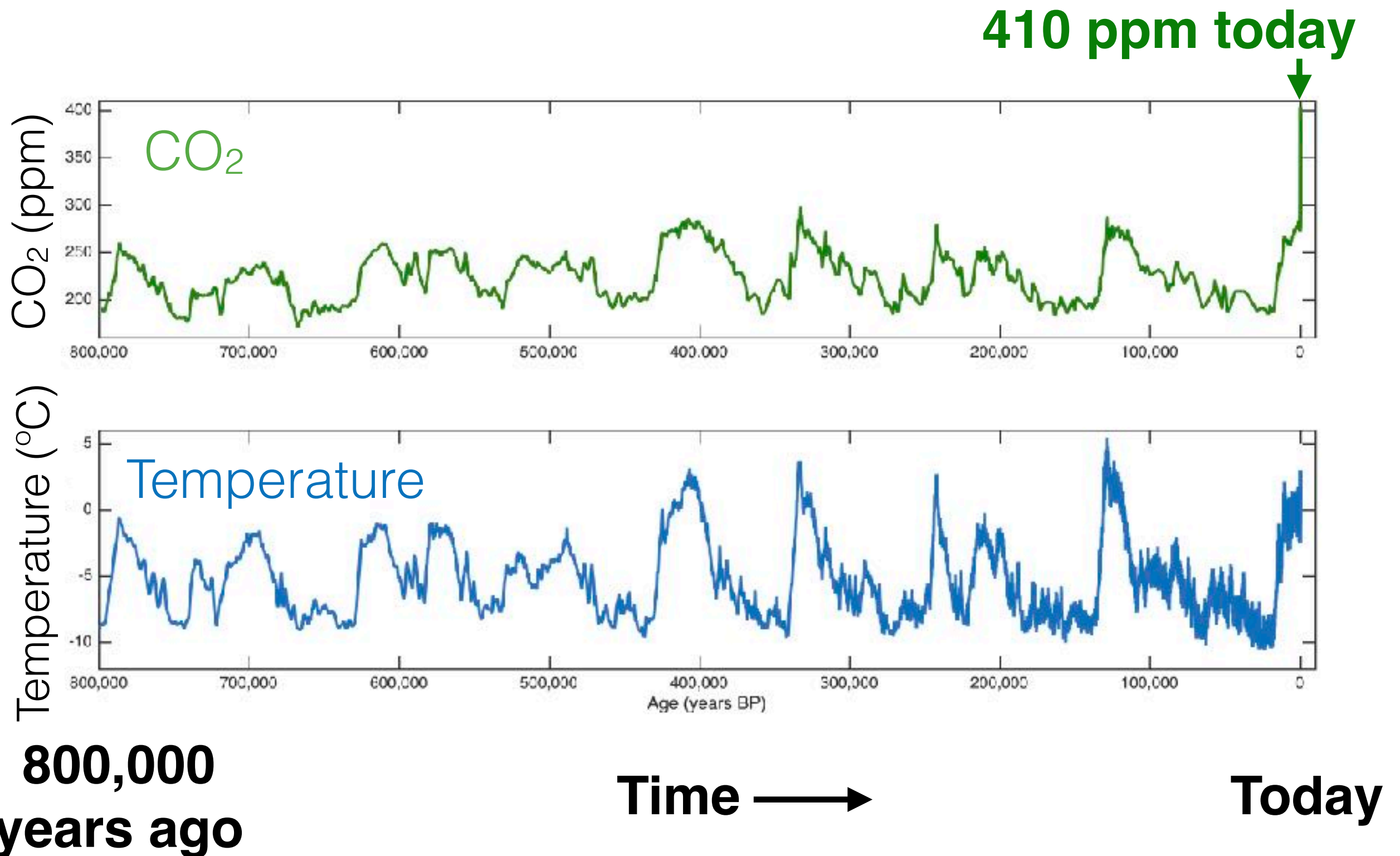


**800,000
years ago**

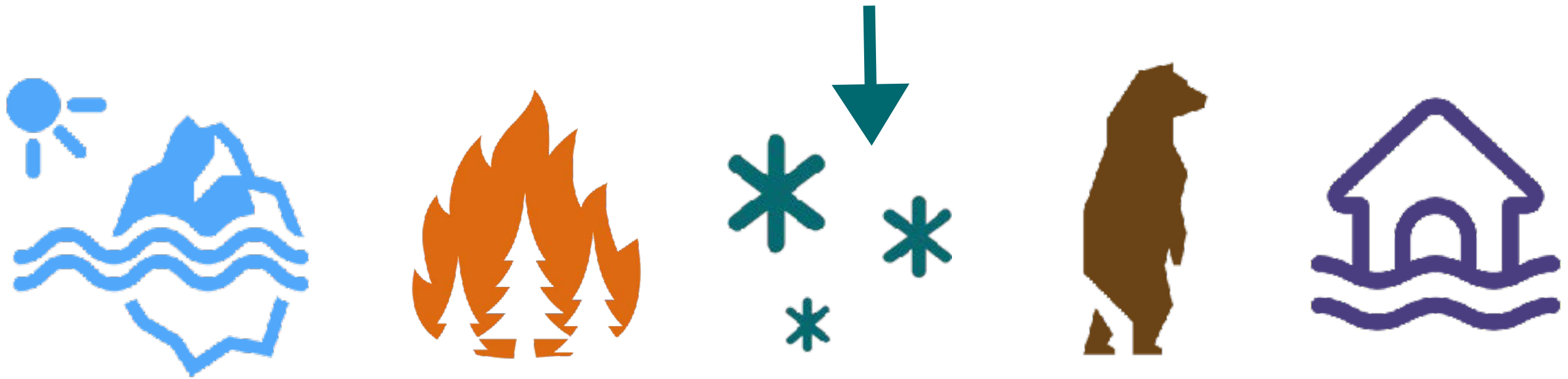
Time →

Today

800,000 yrs of CO₂ & Temperature



**So we have evidence that today is
different.**



What can we do about it?

HOW WE 'FEEL' FUTURE CLIMATE CHANGE DEPENDS ON:

Our actions **now** to
reduce emissions of greenhouse
gases
(*mitigation*)



+ How well we **prepare** our
communities & the systems
we rely on (*adaptation*)



“We need to adapt to climate change even as we seek to mitigate it.”

- Nives Dolsak & Aseem Prakash, 2018



Landscaping Regulations require property owners to manage hazardous vegetation and maintain their properties.

Watershed Management Plans reduce wildfire through fuel treatments, protecting vital water resources.

Forest Management Projects reduce fuels within the wildland-urban interface (WUI).

Building Codes require ignition-resistant construction materials for new developments and retrofits.

Land Preservation Tools encourage agricultural lands to buffer development from wildfires.

Steep Slope Ordinances restrict development within high wildfire-risk areas.

Land Use and Development Codes incentivize developers to plan open space and recreational trails, creating fuel breaks.

Subdivision Design Standards require risk reduction features, such as minimum road widths, secondary access, and adequate water supply.

Local Governments support fire adapted communities through good land use planning.



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cig.uw.edu



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