Global Climate Change Impacts in the Western United States

Presented by Katharine Hayhoe, Frank Niepold, and Peg Steffen

Thursday, November 5, 2009
CLIMATE CHANGE
WHAT DOES IT MEAN FOR THE WEST?

KATHARINE HAYHOE
TEXAS TECH UNIVERSITY
What is happening to our planet?

PART ONE
How important is the issue of global warming to you personally?

[Place clip art on the continuum below]

<table>
<thead>
<tr>
<th>Extremely</th>
<th>Very</th>
<th>Somewhat</th>
<th>Not too important</th>
<th>Not at all important</th>
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Personally, how well informed do you feel you are about the different consequences of global warming?

[Place clip art on the continuum below]

<table>
<thead>
<tr>
<th>Very well informed</th>
<th>Fairly well informed</th>
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<th>Not very well informed</th>
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<th>Not at all informed</th>
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[Place clip art on the continuum below]
When do you think global warming will start to harm people in the United States?

[Place clip art on the continuum below]

<table>
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<th>They are being harmed now</th>
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<td>In 10 years</td>
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<tr>
<td>In 25 years</td>
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<td>In 50 years</td>
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<tr>
<td>In 100 years</td>
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<td>Never</td>
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</table>
The Earth is getting warmer...

11 out of the last 12 years have been the warmest on record.
... despite recent claims of "cooling"
It’s happening faster and faster

<table>
<thead>
<tr>
<th>Period</th>
<th>Rate</th>
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<tr>
<td>Years</td>
<td>°C per decade</td>
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<tr>
<td>25</td>
<td>0.177±0.052</td>
</tr>
<tr>
<td>50</td>
<td>0.128±0.026</td>
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<tr>
<td>100</td>
<td>0.074±0.018</td>
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<tr>
<td>150</td>
<td>0.045±0.012</td>
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Estimated actual global mean temperatures (°C)
Glaciers are melting

1913

Shepard Glacier, Glacier National Park, USA
Glaciers are melting

Shepard Glacier, Glacier National Park, USA

By 2030, Glacier National Park could be glacier-free.
Why do we care:

1 billion depend on glacier melt for water supply
Lima’s water supply is disappearing

1 billion depend on glacier melt for water supply
Poll Question

What are ways that you have noticed climatic changes in your lifetime?

A) Milder climate in your home region
B) More Rainfall
C) Smaller Snowpack
D) Increasing Number and size of Wildfires
Plant hardiness zones moving north

Most locations in US now feel like it used to about 200 miles south—just 20 yrs ago.
Extreme rainfall more frequent

Increases in average number of days with very heavy precipitation (1958 to 2007)
Shrinking spring snowpack

(1958 to 2006)
Larger & more damaging fires in the West

![Graph showing damages (acres per fire) over time from 1985 to 2005 with a 5-year average trend.](image)

- Damages (acres per fire)
- 5-year average
More frequent weather-related electricity outages
Let’s Pause Two Minutes for Questions from the Audience
How do we know it's us?

PART TWO
Poll Question

Assuming global warming is happening, do you think it is *Caused mostly by human activities.*

- ✔ Yes
- ❌ No
How do we know this warming is unusual?
How do we know this warming is unusual?
Conditions today are unusual in the context of the last 2,000 years ...
... and even the last 800,000 years.
Why is this happening?

THE NATURAL GREENHOUSE EFFECT naturally increases Earth’s temperature by 70°F.
Why is this happening?

**THE NATURAL GREENHOUSE EFFECT**

naturally increases Earth’s temperature by 70°F

**THE ENHANCED GREENHOUSE EFFECT**

has artificially increased Earth’s temperature by 1.4°F
Why is this happening?

Human production of heat-trapping gases
Where do these gases come from?
Who is responsible?

Contribution to Global Carbon Dioxide Emissions 1900–2002

- <0.01%
- 0.01% to 0.1%
- 0.1% to 1%
- 1% to 7%
- 8% (China, Russia)
- 30% (USA)
How do we know these gases are causing the warming?
How do we know these gases are causing the warming?
Modeling the climate system
Quantifying the human influence

“Earth with no people”

observations

models
Quantifying the human influence

"Earth with people"

observations

models
Isn’t it just because of the urban heat island effect?
How do we know it’s not the sun?

Changes relative to 1961–1990 in:
- Earth’s temperature (°F)
- Sun’s magnetic field (%)
- Energy from the sun (x1000%)

no match between solar activity and temperature
What about the record cold weather they’ve been having in Walla Walla?

WEATHER: How conditions change from day to day or even year to year.
What about the record cold weather they’ve been having in Walla Walla?

WEATHER: How conditions change from day to day or even year to year.

CLIMATE: The long-term average of weather over decades.
Warming of the climate system is now evident from observations. Most of the increase is very likely (>90%) due to the observed increase in heat-trapping gas concentrations due to human activities [including burning fossil fuels].

Climatic change is being brought about by human-induced increases in the concentration of atmospheric carbon dioxide, primarily through the processes of combustion [burning] of fossil fuels.
Warming of the climate system is now evident from observations. Most of the increase is very likely (>90%) due to the observed increase in heat-trapping gas concentrations due to human activities [including burning fossil fuels].

**The United Nations Intergovernmental Panel on Climate Change, 2007**

Climatic change is being brought about by human-induced increases in the concentration of atmospheric carbon dioxide, primarily through the processes of combustion [burning] of fossil fuels.

“The Artificial Production of Carbon Dioxide and Its Influence on Temperature”

Guy Callendar, 1938
Let’s Pause Two Minutes for Questions from the Audience
I have personally experienced the effects of global warming.

[Place clip art on the continuum below]

<table>
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<th>Strongly agree</th>
<th>Somewhat agree</th>
<th>Somewhat disagree</th>
<th>Strongly disagree</th>
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What can we expect in the future?

We’re already concerned about this
What can we expect in the future?

But this is what’s coming next.
The magnitude of future change depends on our near-term choices.
Reality check: where are we now?
Reality check: where are we now?

Above even the highest future scenario
... and in context of the last 800,000 yrs
Observed and Projected Average Change °F
from 1961 - 1979 Baseline

Global Climate Change Impacts on the United States
Global Climate Change Impacts on the United States
Observed and Projected Average Change °F
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Observations
Present-Day
1993 - 2008
Lower Emissions Scenario
Mid-Century
2040 - 2059
Higher Emissions Scenario
Mid-Century
2040 - 2059
Averaged Emissions Scenario
Near-Term
2010 - 2029
Lower Emissions Scenario
End-of-Century
2080 - 2099
Higher Emissions Scenario
End-of-Century
2080 - 2099

Global Climate Change Impacts on the United States
Extreme Heat: Days > 100°F

1961-1979
Extreme Heat: Days > 100°F

Lower Emissions: 2070-2099
Extreme Heat: Days > 100°F

Higher Emissions: 2070-2099
Wildfire frequency in California

- **Historical Average (1961-1990)**
- **2070-2099**
  - **Lower Warming Range**
    - Wetter Climate
    - 11% increase
  - **Medium Warming Range**
    - Drier Climate
    - 55% increase

**Probability of a large wildfire (more than 200 hectares)**

- 0
- 0.06
- 0.12
- 0.19
- 0.25

NSTA Web Seminars
Shrinking habitat for freshwater fish
Increasing risk of drought

Change in March-April-May precipitation for 2080-2099 compared to 1961-1979
Shrinking snowpack and water resources
Increasing potential for water supply conflicts

- regions where water supply conflicts are likely to occur by 2025
- based on population trends & potential endangered species
- *analysis does not factor in climate change*
Small things matter

stop using this

start using this
Ultimately we need a fundamental change

stop using this  

start using this
What can we do about it?

“We basically have three choices: mitigation, adaptation, and suffering. We’re going to do some of each. The question is what the mix is going to be. The more mitigation we do, the less adaptation will be required and the less suffering there will be.”

John Holdren
President of the American Association for the Advancement of Science; Harvard University
Let’s Pause Two Minutes for Questions from the Audience
When do you think global warming will start to harm people in the United States?

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What climate change means for the places we care about …

PDF & educational materials free online at:
www.globalchange.gov/usimpacts
A Climate for Change

Global Warming Facts for Faith-Based Decisions

Why climate change is happening, and how it is affecting our world ...

Free preview at:

www.katharinehayhoe.com
Resources 3

Grade 10
Climate Change Unit

Nelson Education

Basic climate science for high school students

Free online ebook available at:

www.nelson.com/scienceperspectives/10/uniflip2/unitD/
Resources 4

Climate Change, Wildlife and Wildlands Toolkit for Formal and Informal Educators

Helps educators teach about climate change impacts and how to become a “climate steward”

http://globalchange.gov/resources/educators/toolkit/
THE END

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WWW.GLOBALCHANGE.GOV/USIMPACTS
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Dr. Francis Q. Eberle, Executive Director
Zipporah Miller, Associate Executive Director
Conferences and Programs
Al Byers, Assistant Executive Director e-Learning

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