Effects of Global Warming in the Pacific Northwest

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Main points

Global climate is changing under human influence
Some effects are already being observed
Future effects a mix of bad and good, and depend on policy decisions now
Solar output varies - but not much
Variations of the Earth’s surface temperature

Global mean temperature: 14.0°C

Global air temperature:
- 2004 anomaly +0.45°C
- (4th warmest on record)

Annual CO₂
Carbon dioxide: up 32%
The earth is warming -- abruptly

source: Mann et al., EOS
Evidence of warming

Ice is melting everywhere
The South Cascade glacier retreated dramatically in the 20th century.

Courtesy of the USGS glacier group.
Trend in SFE/P, 1949-2004

Knowles et al., J Climate 2005
Declining April 1 snowpack, 1950-1997

a. Observations

b. VIC
1950-1997 relative trends in April 1
SWE vs DJF temperature

Cascades

DJF Temp

% change

Obs
VIC
Natural Climate Influence

Human Climate Influence

All Climate Influences
Light Percentiles
% Change per century in:
Intensity of precipitation

Heavy

Karl et al.
What about the future?
January 2053...

I DON'T CARE WHAT THEY SAY, THIS GLOBAL WARMING SCARE IS JUST A BUNCH OF LOONY LEFT-WING ENVIRONMENTALIST ANTI-GROWTH HYPE!

SO, IS THIS YOUR FIRST WINTER HERE IN JUNEAU?
Temperature change, 2071-2100 minus 1961-1990
The main impact:
less snow

Snoqualmie Pass 3022 ft

4100 ft (Future)
3000 ft (Present)

} for a ~ 2 C warming
April 1st Snowpack simulations based on a low-end warming scenario

1950-99  2050’s  2090’s

Provided by Dennis Lettenmaier and Andy Wood, UW Civil Engineering
Accelerated Climate Prediction Initiative, a UW-SIO-PNNL collaboration
Snake River at Ice Harbor

Three changes

- Reduced summer flows
- Earlier peak in runoff
- Increased winter/spring flows

Three changes
Runoff patterns are temperature and elevation dependent.

Puget Sound Precip

Skagit

Puyallup

Skokomish

Oct         Feb         Jun

Puget Sound Precip

Oct            Feb            Jun

1900’s

Skagit

a warmer climate

Skagit River near Concrete

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Skokomish

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As the West warms, winter flows rise and summer flows drop.

Figure by Iris Stewart, Scripps Inst. of Oceanog. (UC San Diego)
Western snowfed streamflow has been arriving earlier in the year in recent decades.

Figure by Iris Stewart, Scripps Inst. of Oceanog. (UC San Diego)
Implications

flooding likely to increase in most basins
hydropower production shifts from
spring/summer to winter
less water available in summer for
agriculture, instream flows for fish
Adding up the threats across the life-cycle of salmon

Salmon Life Cycle

- Eggs in stream gravel hatch in 1-3 months
- Fish spawning in freshwater stream
- Timing of migration to spawning grounds depends on species and race
- Fish spend 1-4 years in ocean
- Alevins in stream gravel 1-5 months
- Fry emerge in spring or summer
- Juvenile fish in fresh water a few days to 4 years, depending on species and locality
- Smolt migration to ocean usually in spring or early summer
Adding up the threats across the life-cycle of salmon

HABITAT DEGRADATION INCLUDING GLOBAL WARMING

HARVEST PRACTICES

HATCHERY PRACTICES
Washington’s Forests

CO2 fertilization: transient impact
Longer dry season: reduced regeneration, increased vulnerability to fires and pests
Shifts in species ranges
Climate has played a key role in recent increases in area burned in the West
Climate Change and Surprises

Thresholds
Interactions - competition, synergies, phenologies
Biology is complicated!
Example: Mountain Pine Beetle
Mountain Pine Beetle

Massive outbreak in BC has killed 250 million m³ (100 billion board feet)
Low temperatures (< -10°F) limit MPB activity
Choices now

Reduce emissions - makes a big difference beyond 2050
Prepare for impacts - anticipating enhances benefits, minimizes risks
  e.g., city water supply
Main points

Global climate is changing under human influence
Some effects are already being observed
Future effects a mix of bad and good, and depend on policy decisions now
Recommended Reading

Climate Solutions: actions to slow global warming
http://climatesolutions.org

The Intergovernmental Panel on Climate Change
http://www.ipcc.ch

The UW Climate Impacts Group
http://cses.washington.edu/cig

RealClimate -- a “no spin zone” on climate science
http://realclimate.org