COLLEGE OF THE ENVIRONMENT
UNIVERSITY of WASHINGTON

Bridging the Gap:
From Climate Science to Engineering

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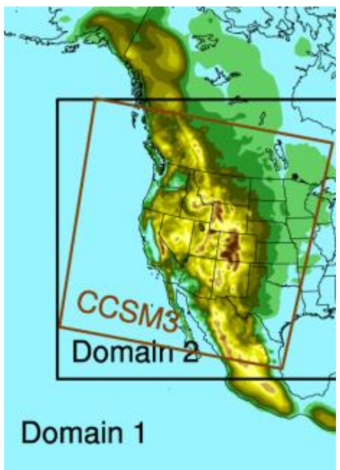
Climate Impacts Group
University of Washington

ASHTO workshop
23 Sept 2015

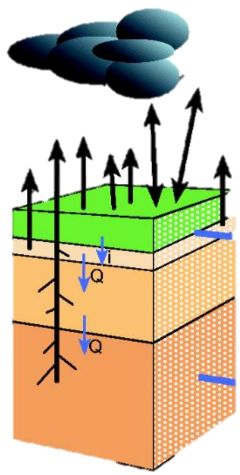
Climate Science in the Public Interest

The Climate Impacts Group

An integrated research and stakeholder engagement team linking climate science and decision making to build climate resilience.

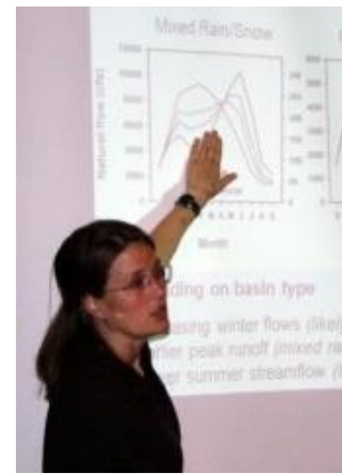


Downscaling global climate models



Macro and fine-scale hydrologic modeling

Impacts assessments



Adaptation planning and outreach

Working since 1995 with a focus on:

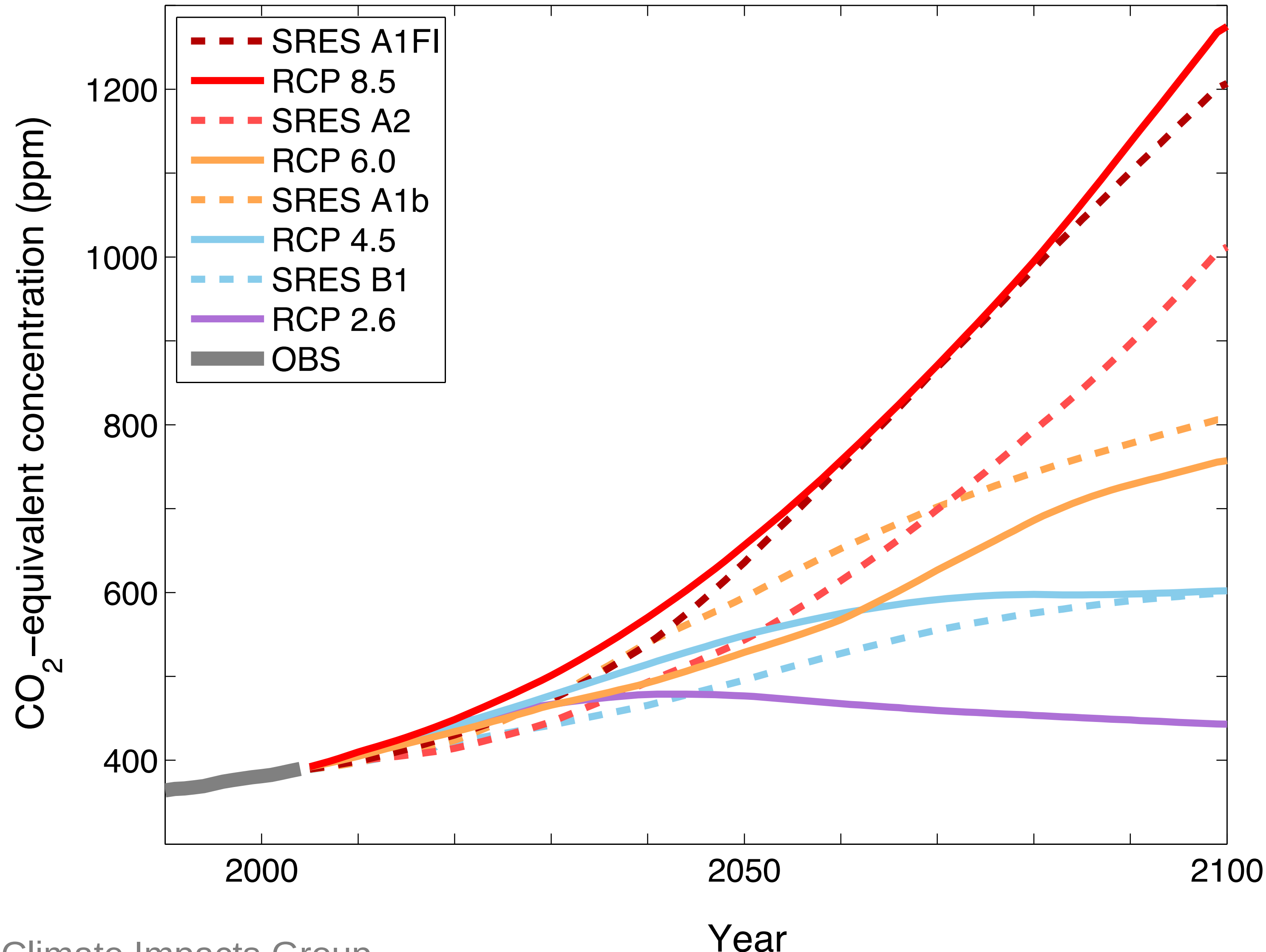
- U.S. Pacific Northwest, Western U.S., Pacific Rim
- Water, forests, fish, coasts, energy, human health, urban areas
- Stakeholders: Private, public & non-governmental actors involved in climate-sensitive policymaking, planning and decision making

Summary

- Combine top-down with bottom-up assessment of climate sensitivities and information needs
- *Key considerations:*
  - *Variables:* Captured directly/indirectly by GCMs?
  - *Spatial resolution:* Downscaling needed?
  - *Emissions scenarios:* Important for long-term
  - *Natural variability:* Important for near-term;
    Use individual GCMs, not average
  - *Model uncertainty:* Span if risk averse
    Rank by skill if using indiv. GCMs

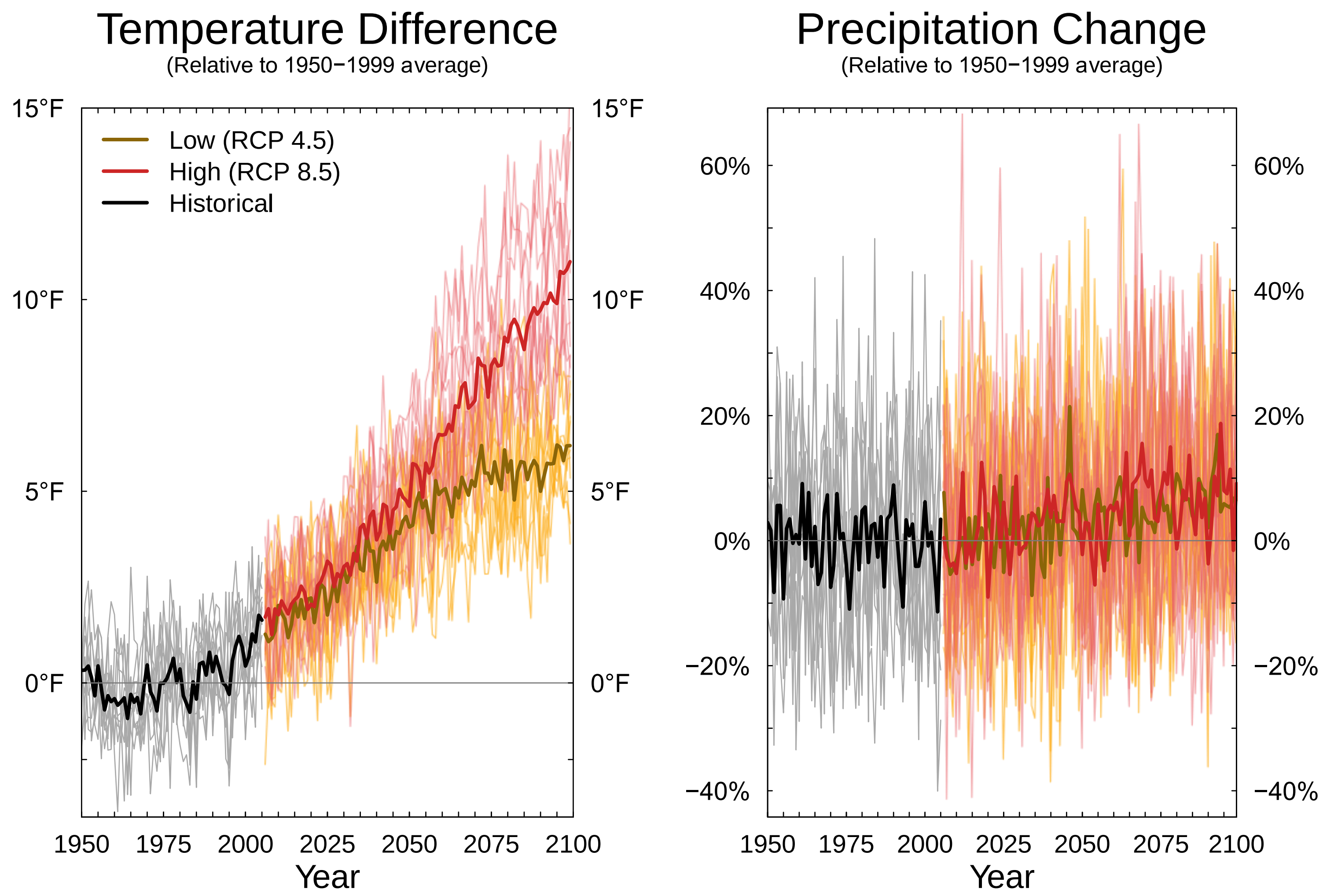
Big Picture

Greenhouse gas "scenarios" are best guesses about future emissions



Source: Climate Impacts Group

All scenarios project warming, no change in Precipitation



Getting specific

Assessing Impacts

Regional – Local Climate Change Scenarios

Global Climate Scenarios

downscaling

Regional Climate Scenarios

Intermediary impacts modeling

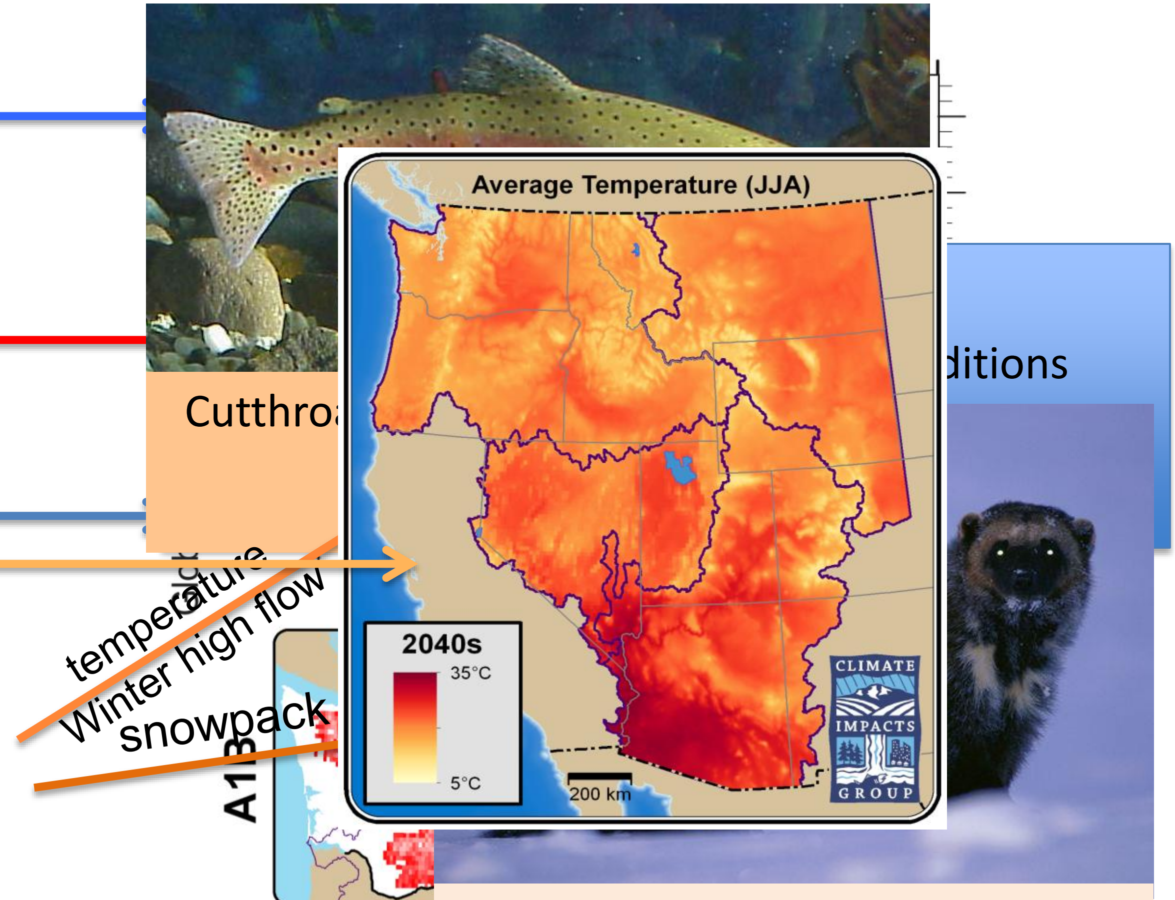
Local Environmental Conditions

biological impacts assessment

Biological Impacts

ESA decision making

Consequences for Management



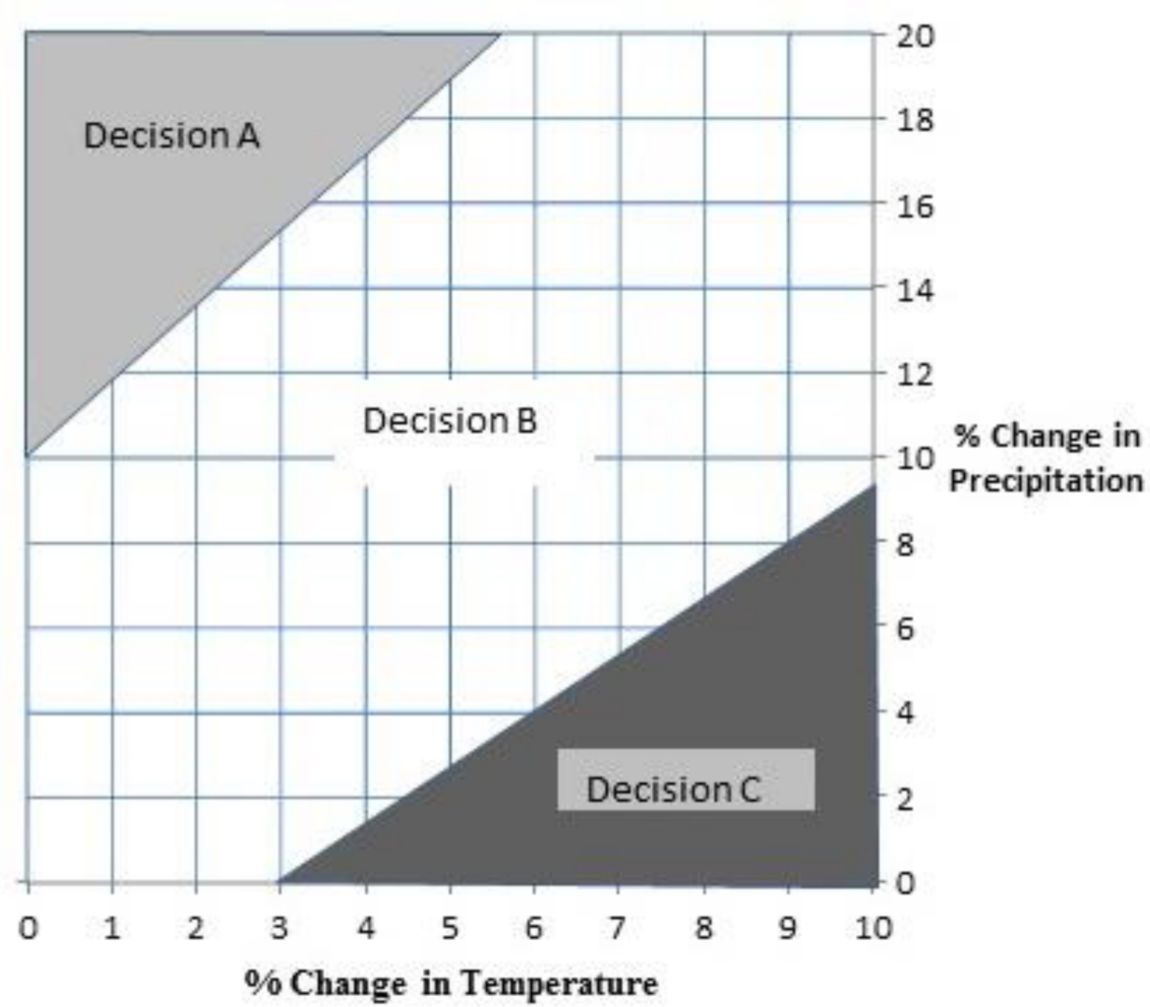
Wolverine habitat contraction
63% by 2080s
(McElvey et al. 2011)
Dec 2010: Wolverine warrants listing

Choosing & Using Scenarios

Information / Context	Expertise
1. Conceptual model: • Understanding of system • Sensitivity to climate	**Manager** **Biologist** **Engineer** **Toxicologist…**
2. Climate science: • Climate effects on system • Able to simulate? • Spatial resolution • Temporal scales (variability v. trends)	**Climate scientist** **Climate impacts scientist**
3. Decision context: • Robust v. most likely • Best vs. worst case • Time horizon	**Policymaker** **Risk assessment**

Source: Snover et al., *Cons. Bio., 2013*

Ultimately, what do we want?



Brown et al. 2012. doi:10.1029/2011WR011212, 2012

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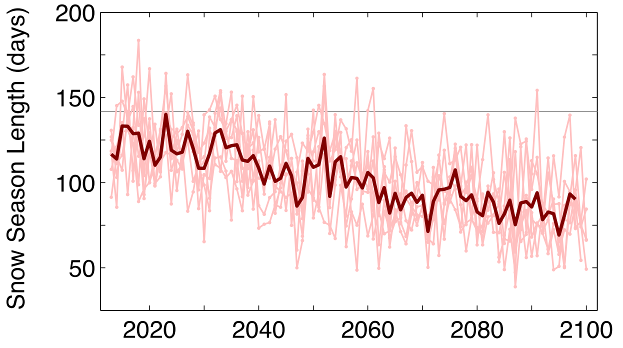
What don’t we know about future climate?



1. **How much we will emit in the future.**

   Greenhouse gas emissions drive climate change

2. **The timing and magnitude of natural climate variations**

   Natural variability will enhance & obscure climate change for decades

3. **Limitations in our modeling of key processes**

   Complex processes: difficult for models to capture.

There will always be a **range of projections** for the future:

- “Scenarios” = storylines of plausible future conditions, not predictions
- Different models, different approaches = different sensitivities

Greenhouse gas scenarios:

If time horizon is before mid-century, then ignore.

(differences in warming are small until after about 2050).

Otherwise…

Greenhouse gas scenarios:

Choose scenarios to match decision criteria.

Risk tolerant:

choose middle scenario or average

Risk averse:

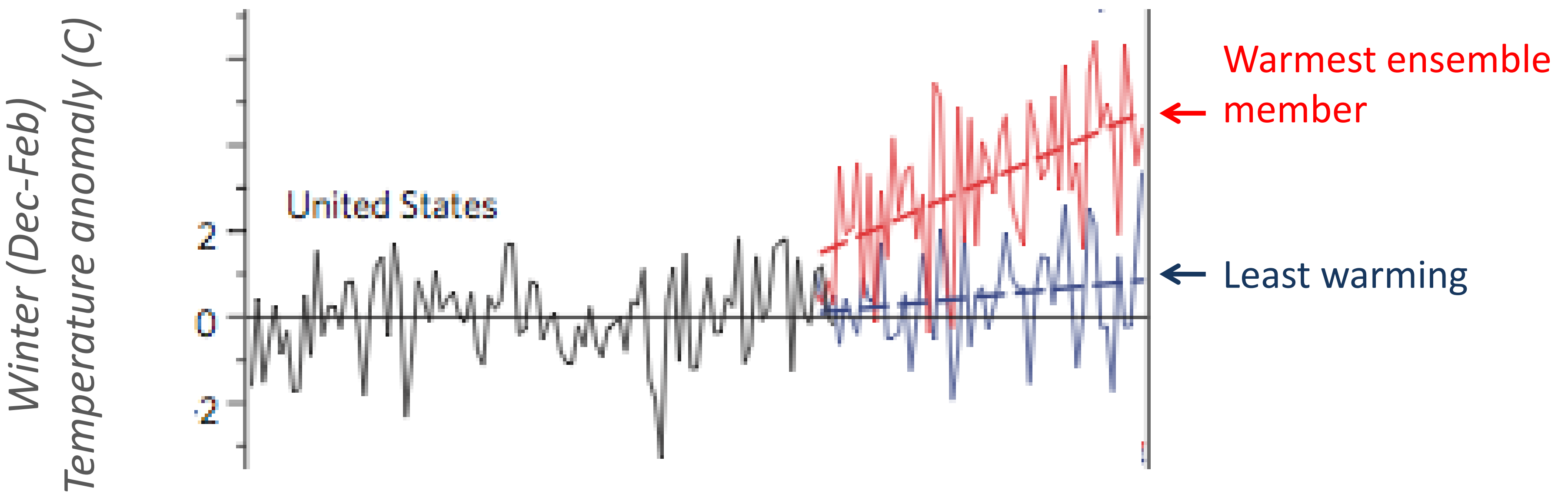
identify worst case scenario(s)

Robust decision:

identify best & worst case scenario(s)

Natural variability

Large for the near-term



Questions: (1) Sensitive on what time scales?

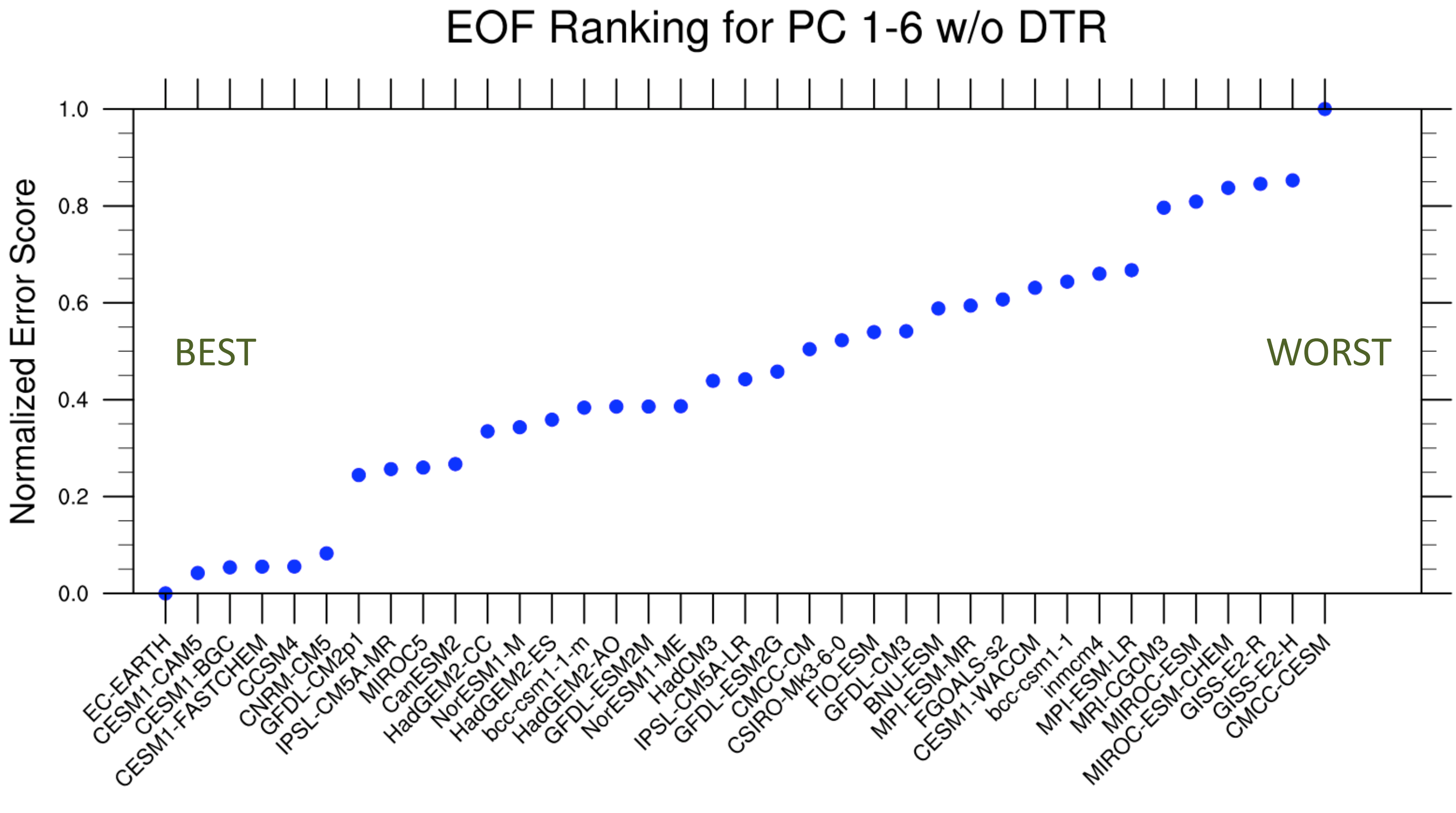
(2) Relative importance of trend vs. variability?

(i.e.: when does the trend emerge from the "noise"?)

Source: Deser et al., 2012

Model selection. Strategies:

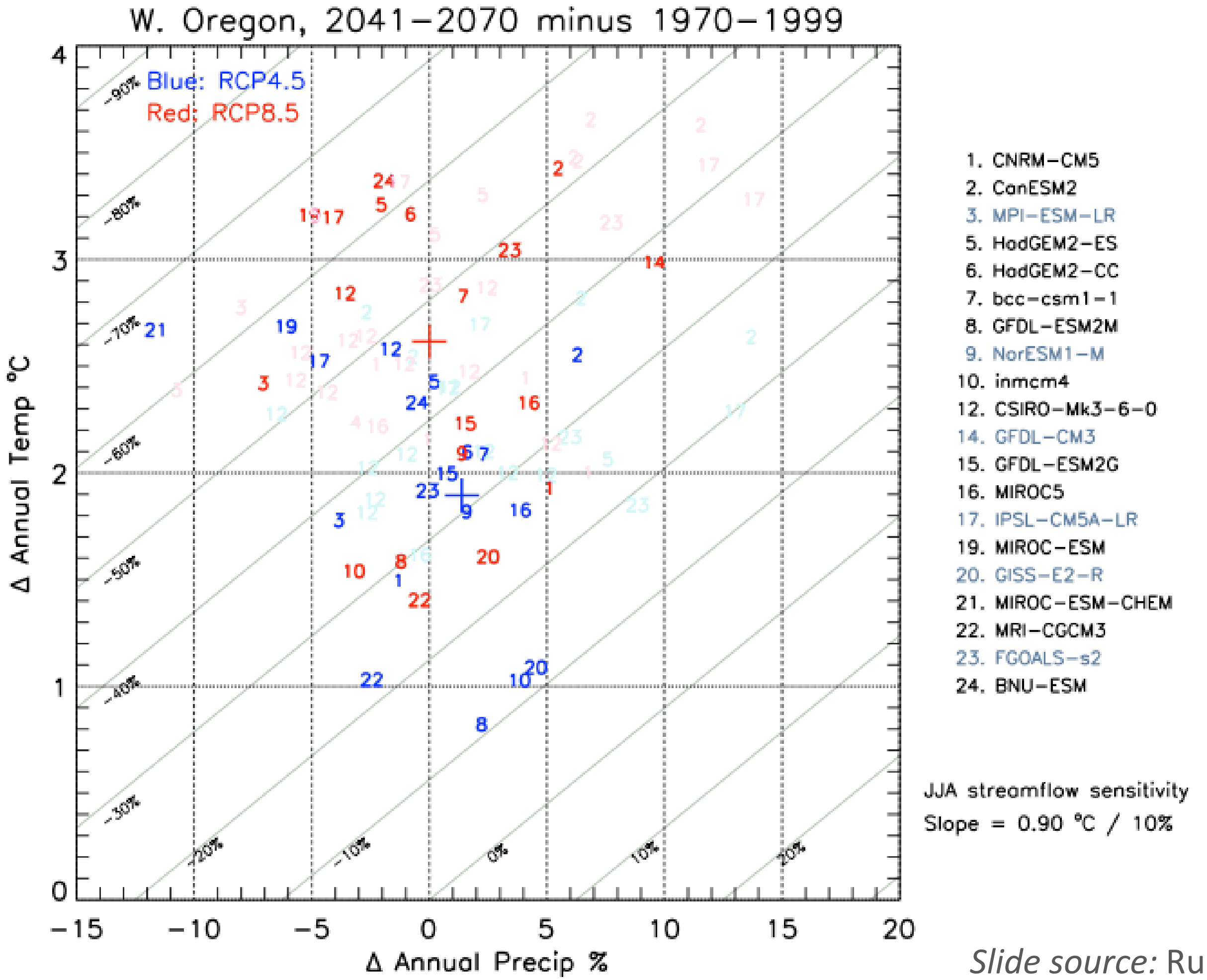
1. Rank models by performance



Source: Rupp et al., 2013

Model selection. Strategies:

2. Choose a range of model projections



Slide source: Rupp & Mote, OSU

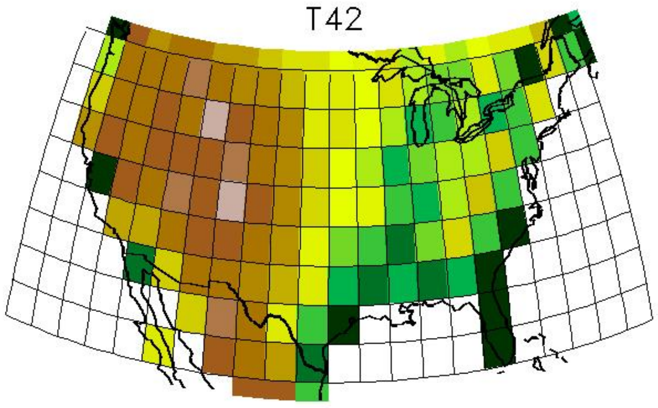
Can I stick to GCMs?

1. GCMs: more than just Temp & Precip

- Do GCMs simulate the relevant variable(s)?
- Other variables that correlate highly?

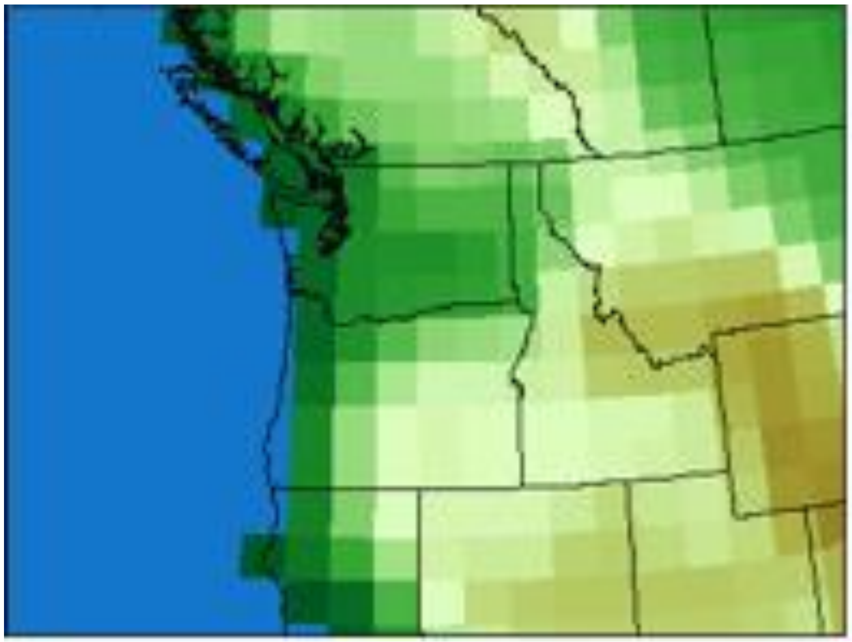
2. Spatial scale

- Sensitive to small- or large-scale climate?



Downscaling: Why?

Resolution matters if you need to consider the effects of topography.



Global Model Resolution
(CCSM4 model)

Statistical and Dynamical downscaling

Statistical:

Apply changes from global model projection to historical observations

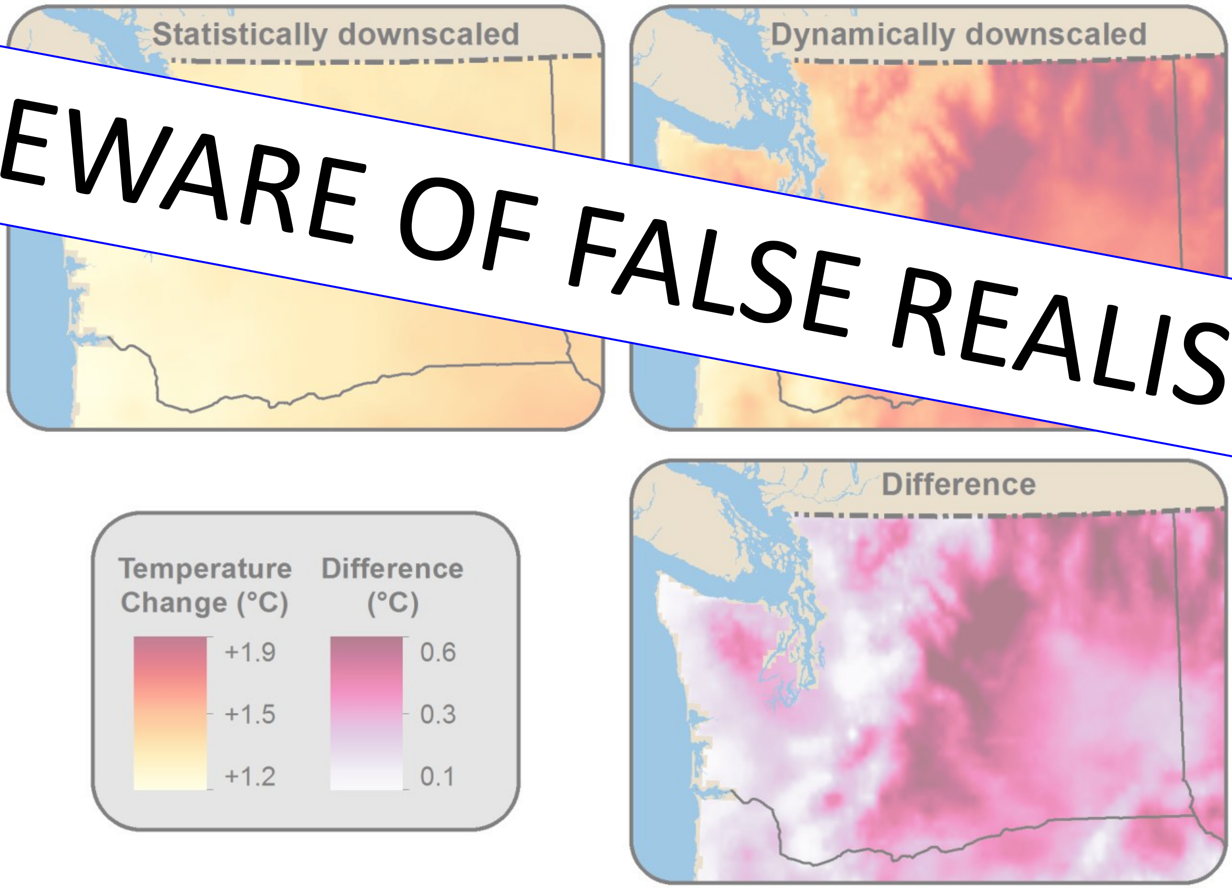
Empirical approach

Dynamical:

Use global model projections to drive a regional climate model

Physics-based approach

Downscaling



BEWARE OF FALSE REALISM

Many options…

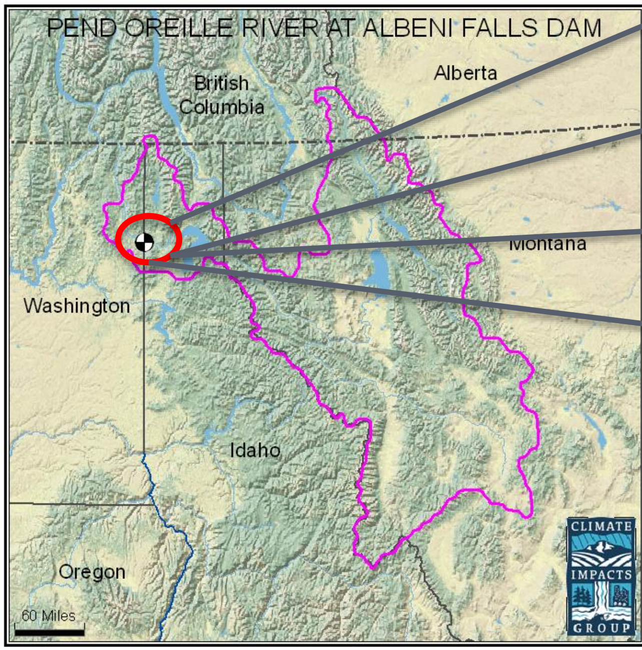
http://www.narccap.ucar.edu/

http://gdo-dcp.ucllnl.org/downscaled_cmip_projections/dcpInterface.html

http://nimbus.cos.uidaho.edu/MACA/

http://warm.atmos.washington.edu/2860/
http://cses.washington.edu/data/wus_csc.shtml
http://cses.washington.edu/data/swe30s.shtml

Site-specific climate change projections

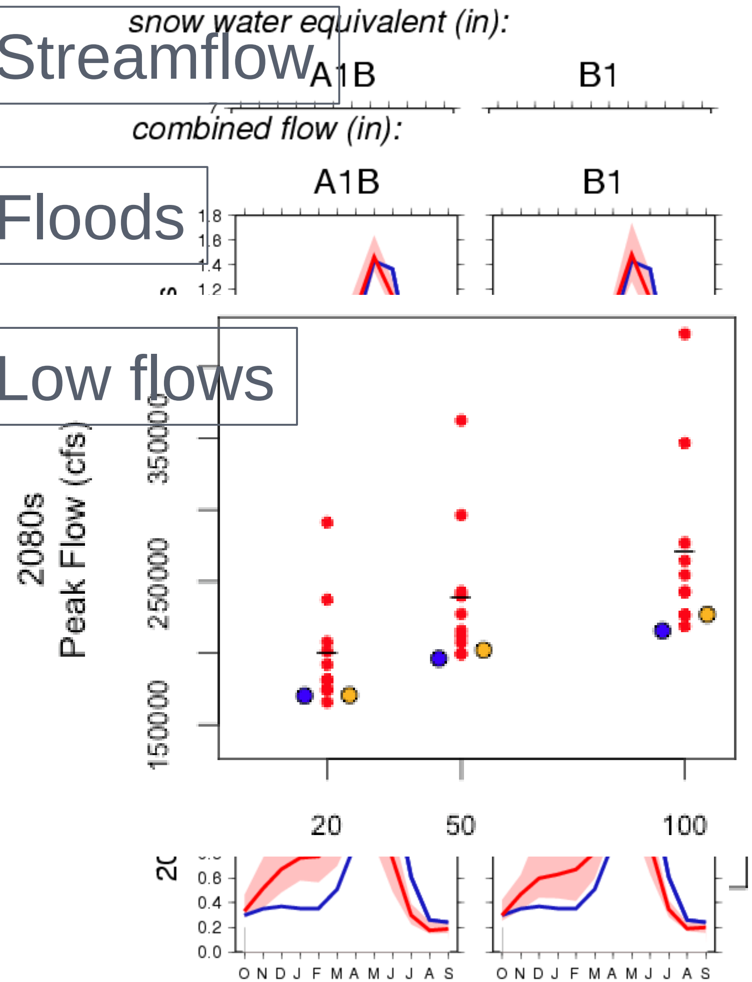


Snowpack

Streamflow

Floods

Low flows



http://warm.atmos.washington.edu/2860

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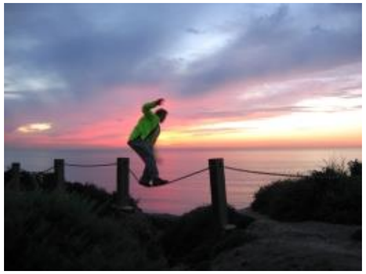

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