Climate Impacts Projections:

Where the numbers come from and how to put them in context

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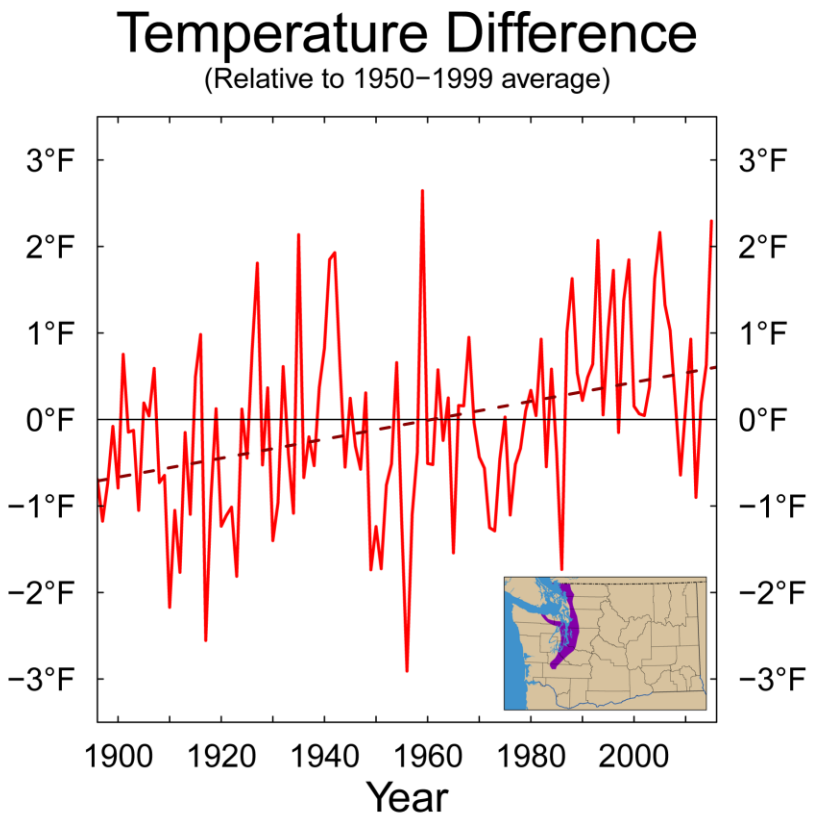
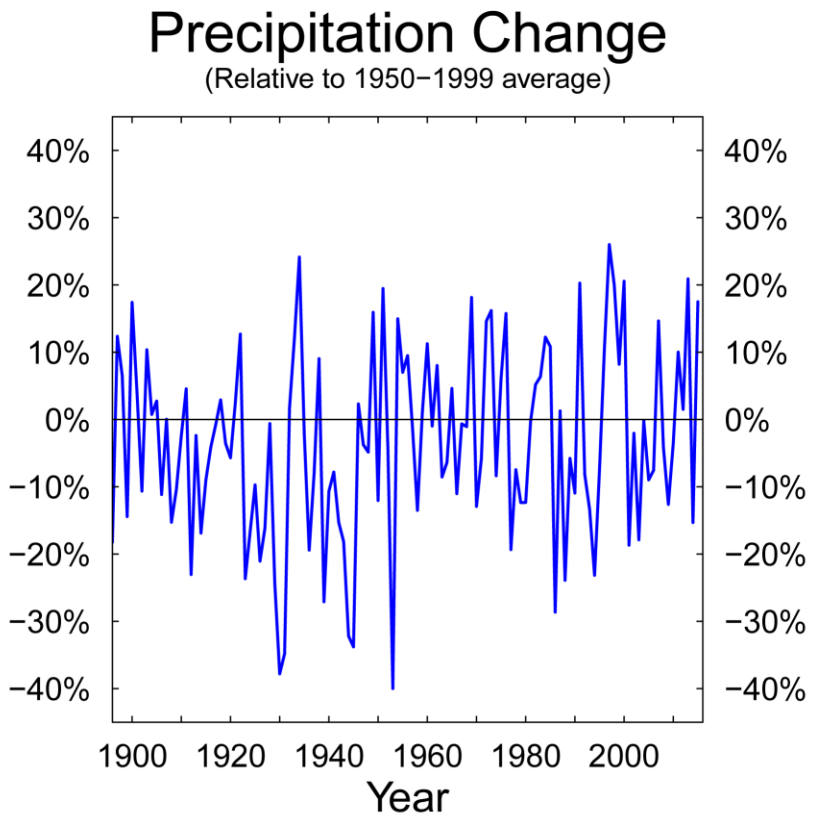
CLIMATE IMPACTS GROUP

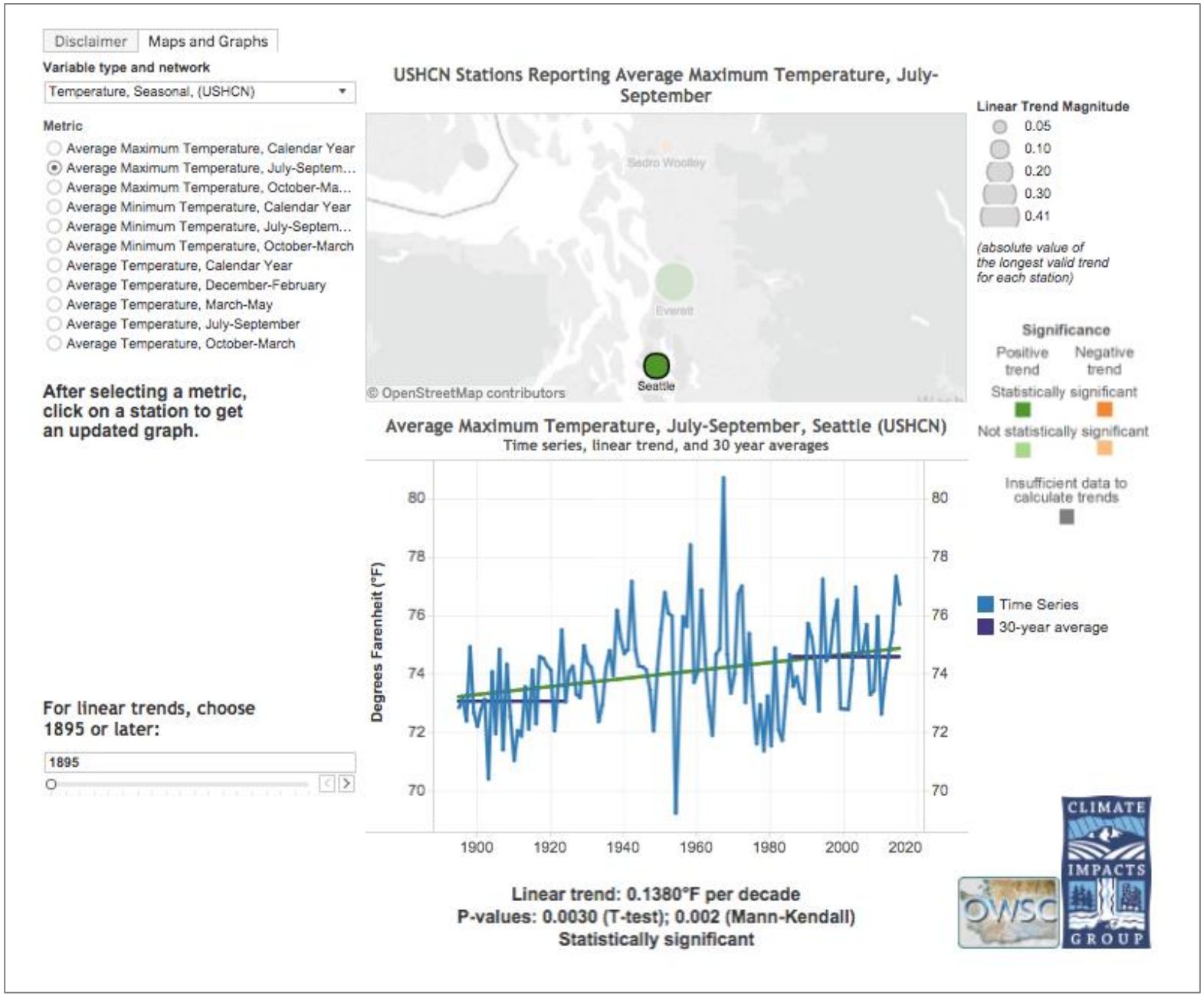
Climate Science in the Public Interest

Long-term Warming, Short-term Variability



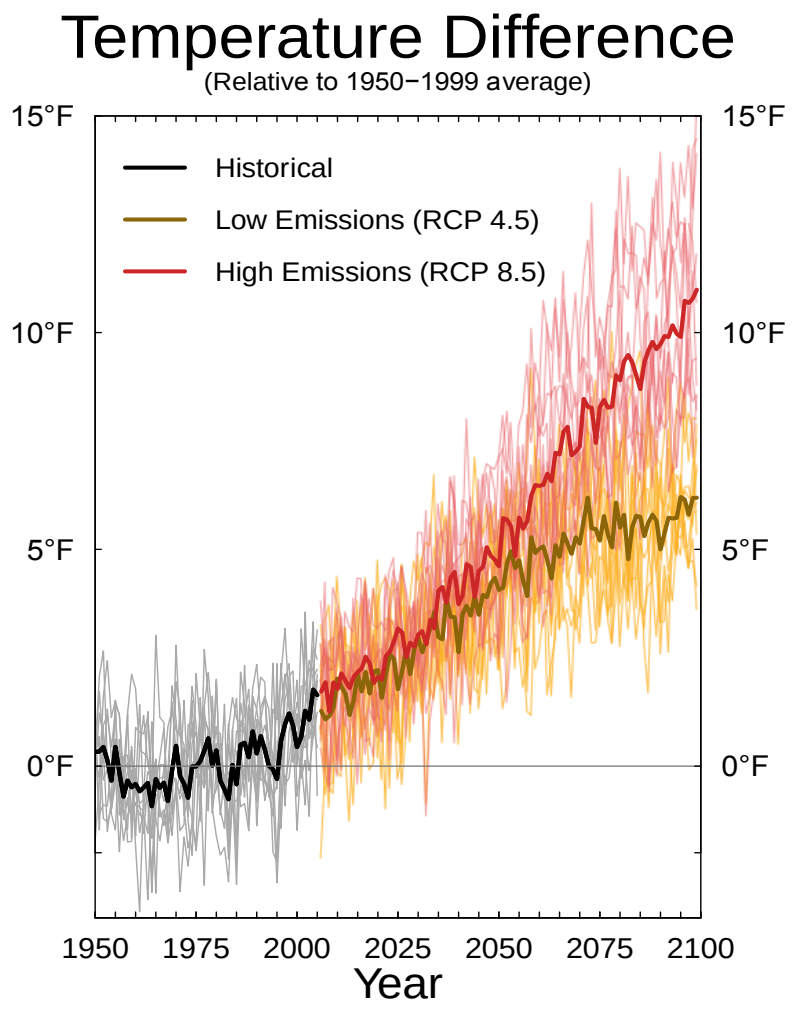


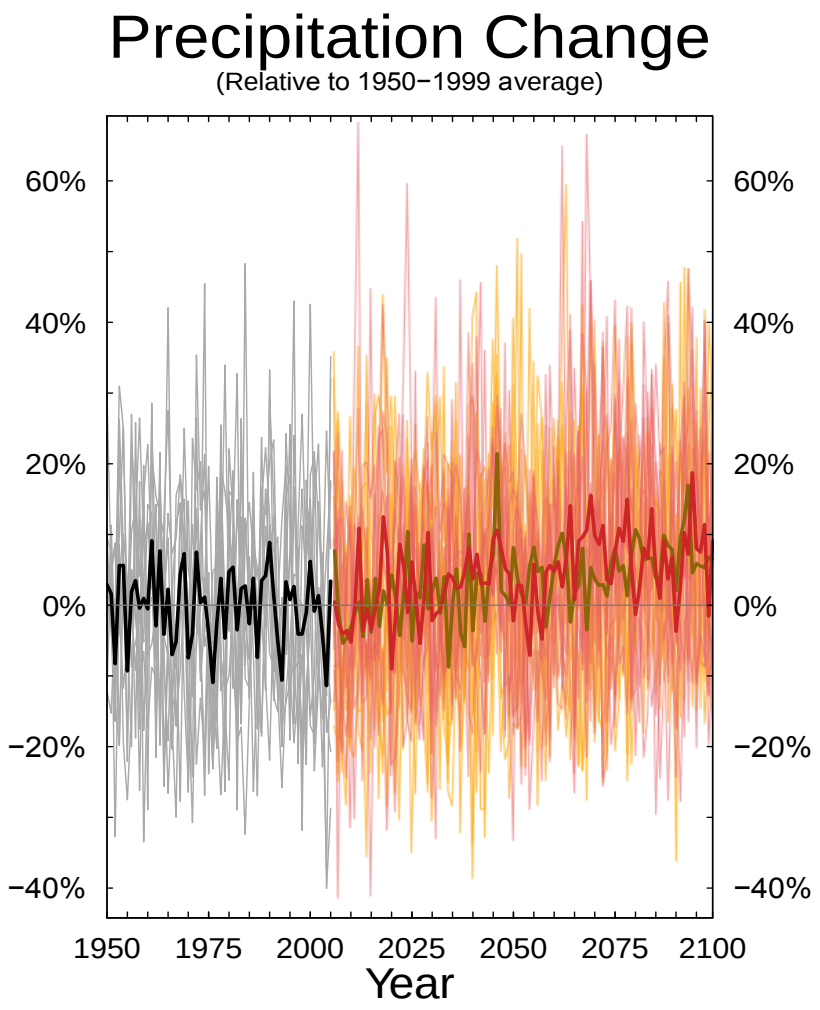
All but six of the years from 1980-2014 were warmer than the 20th century average.



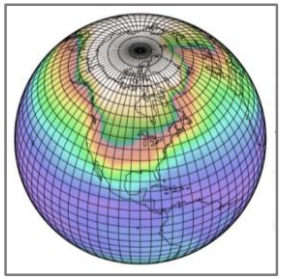
https://cig.uw.edu/resources/analysis-tools/seattle-city-light-trends/

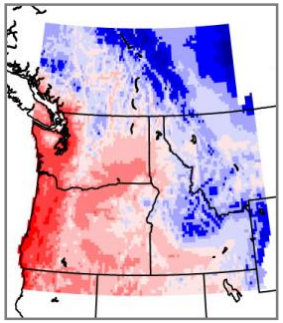
Same story, but much more warming

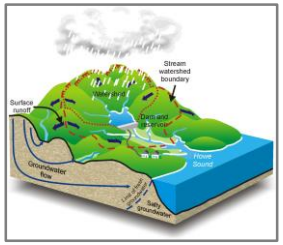




Quantifying Climate Impacts



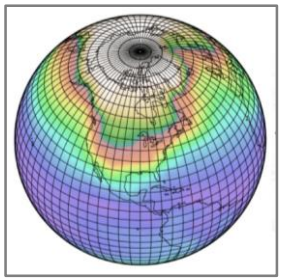


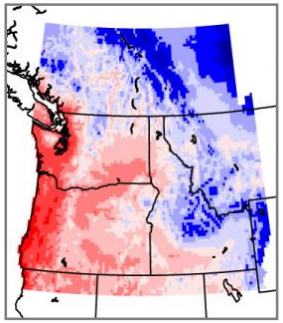


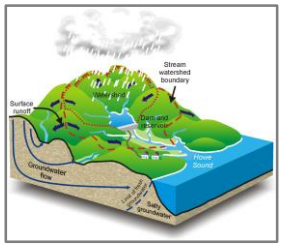
Global Climate Scenarios → Regional Climate Scenarios → Impacts Modeling → Monitoring, Assessment, Planning

(i.e.: "downscaling")

Quantifying Climate Impacts



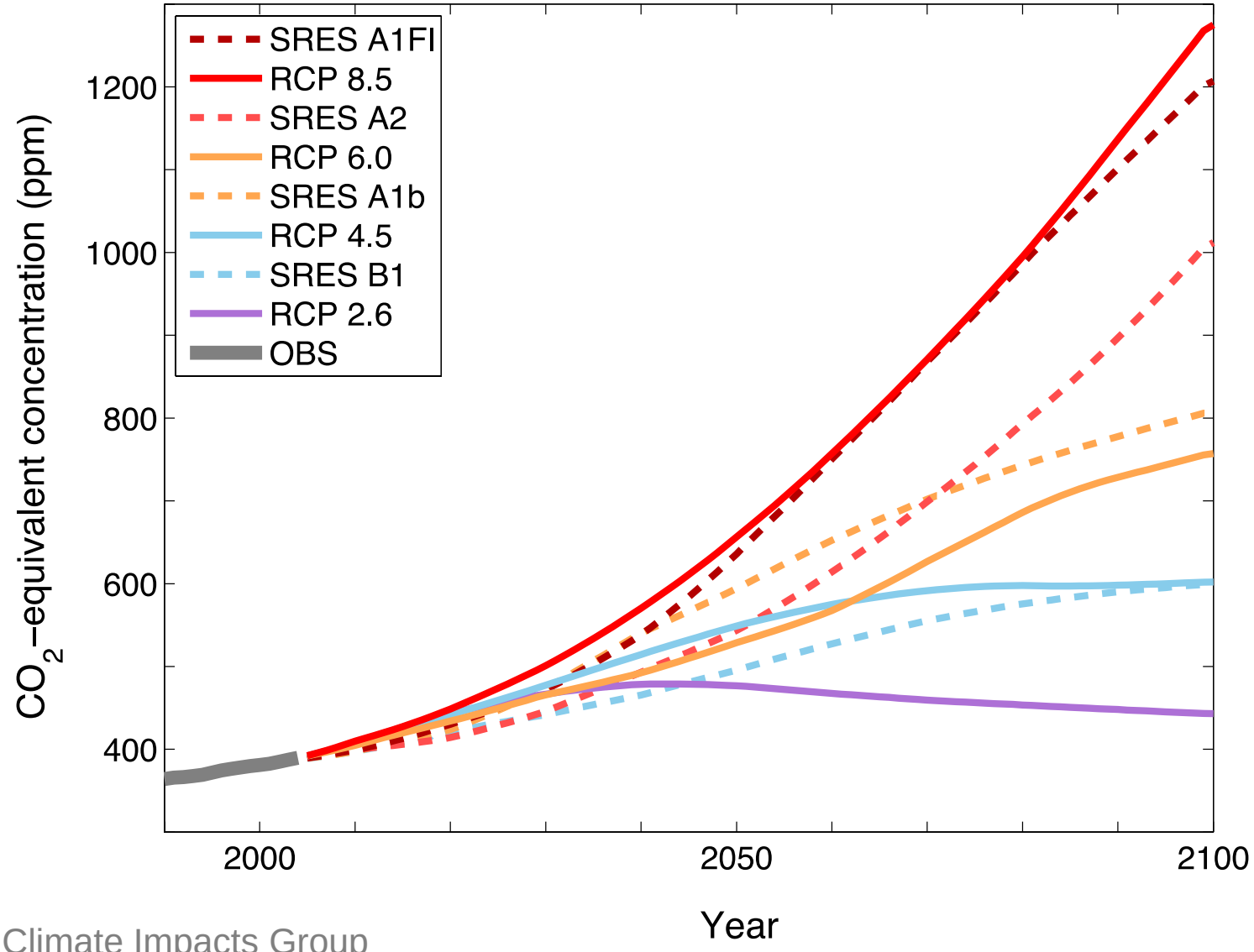




Global Climate Scenarios → Regional Climate Scenarios → Impacts Modeling → Monitoring, Assessment, Planning

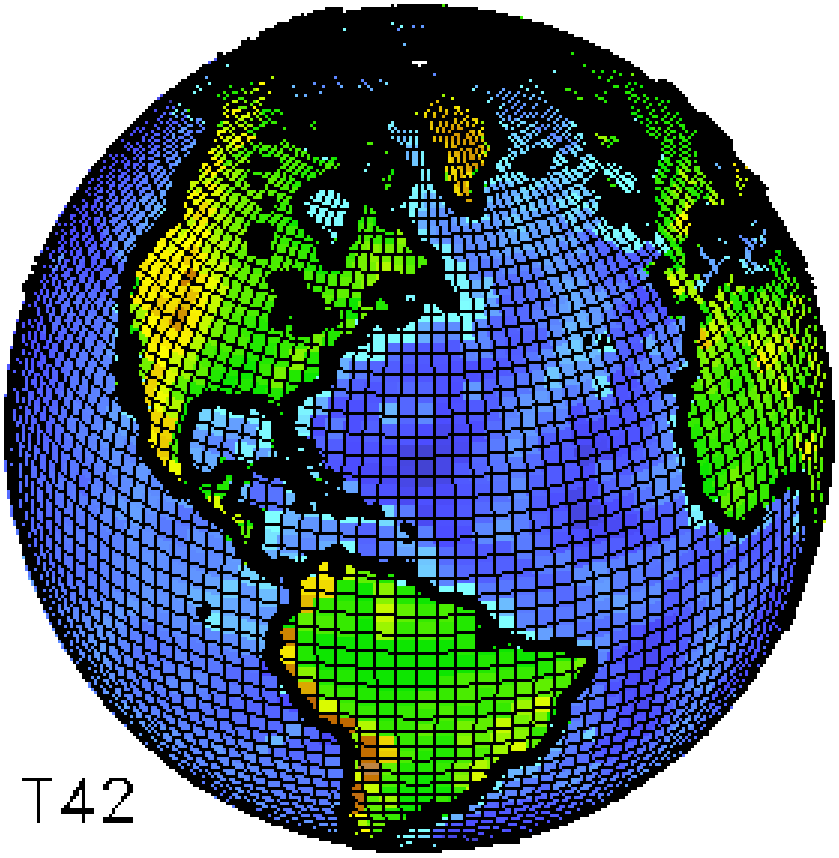
(i.e.: "downscaling")

Greenhouse gas “scenarios” are best guesses about future emissions



Source: Climate Impacts Group

Global Climate Models (GCMs)

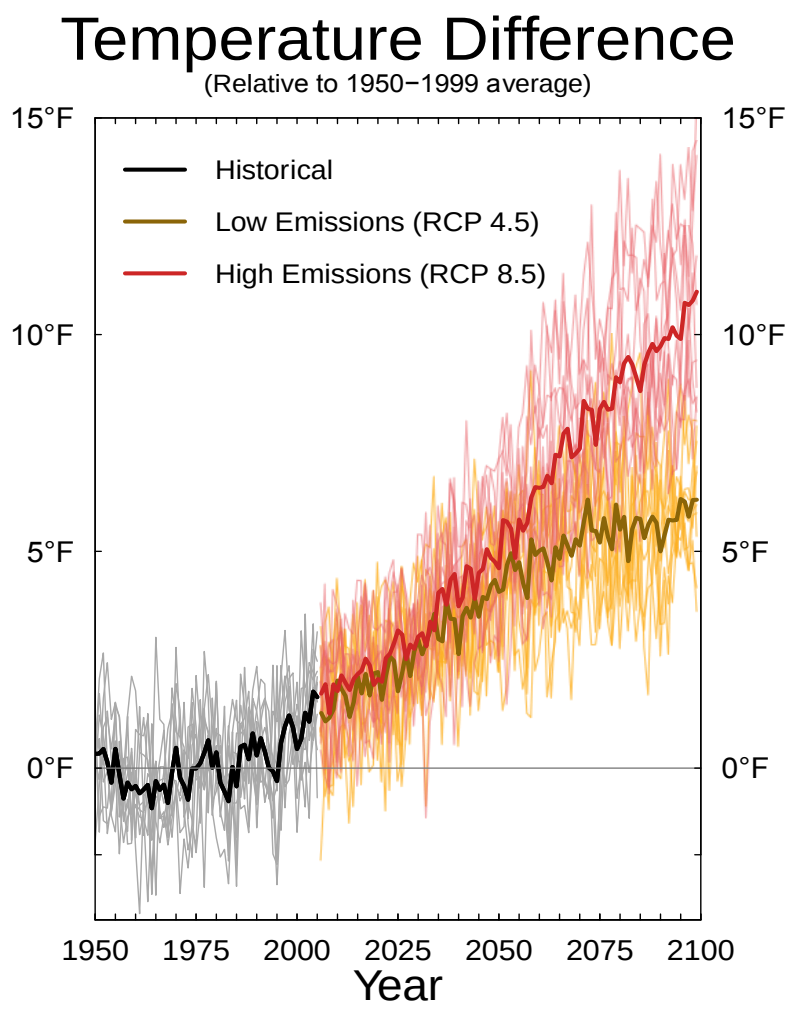


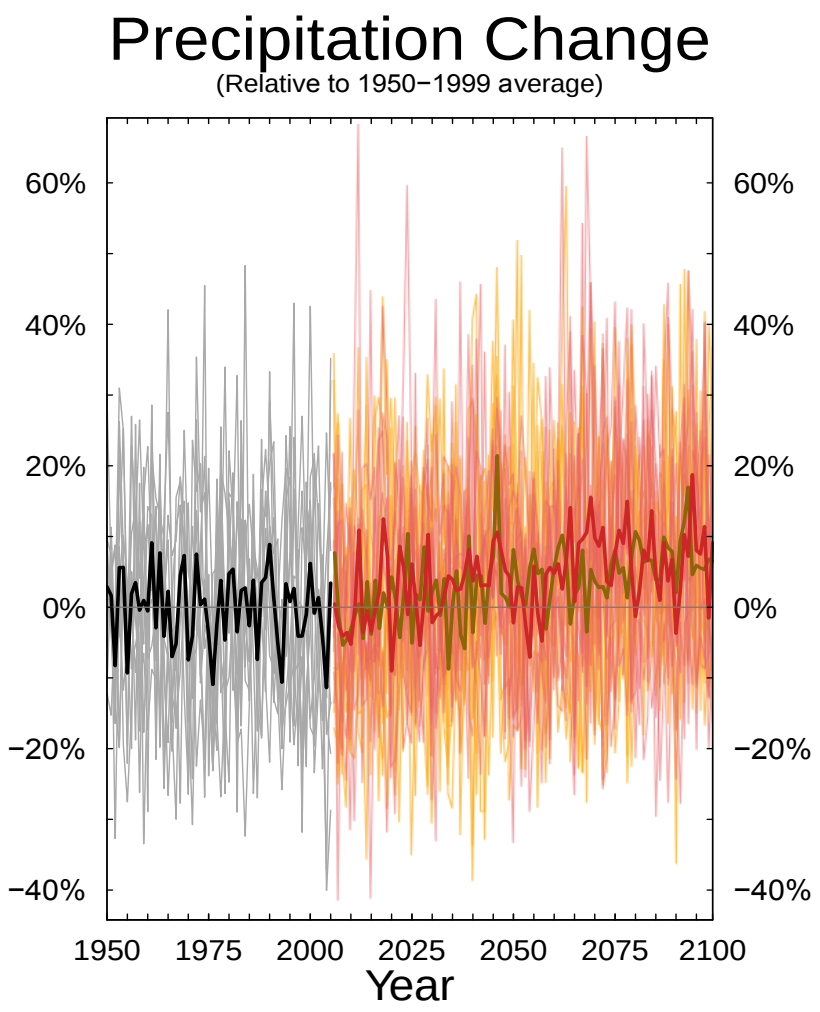
GCMs break the world into boxes (“grid cells”, each ~50 to 200 km on a side)

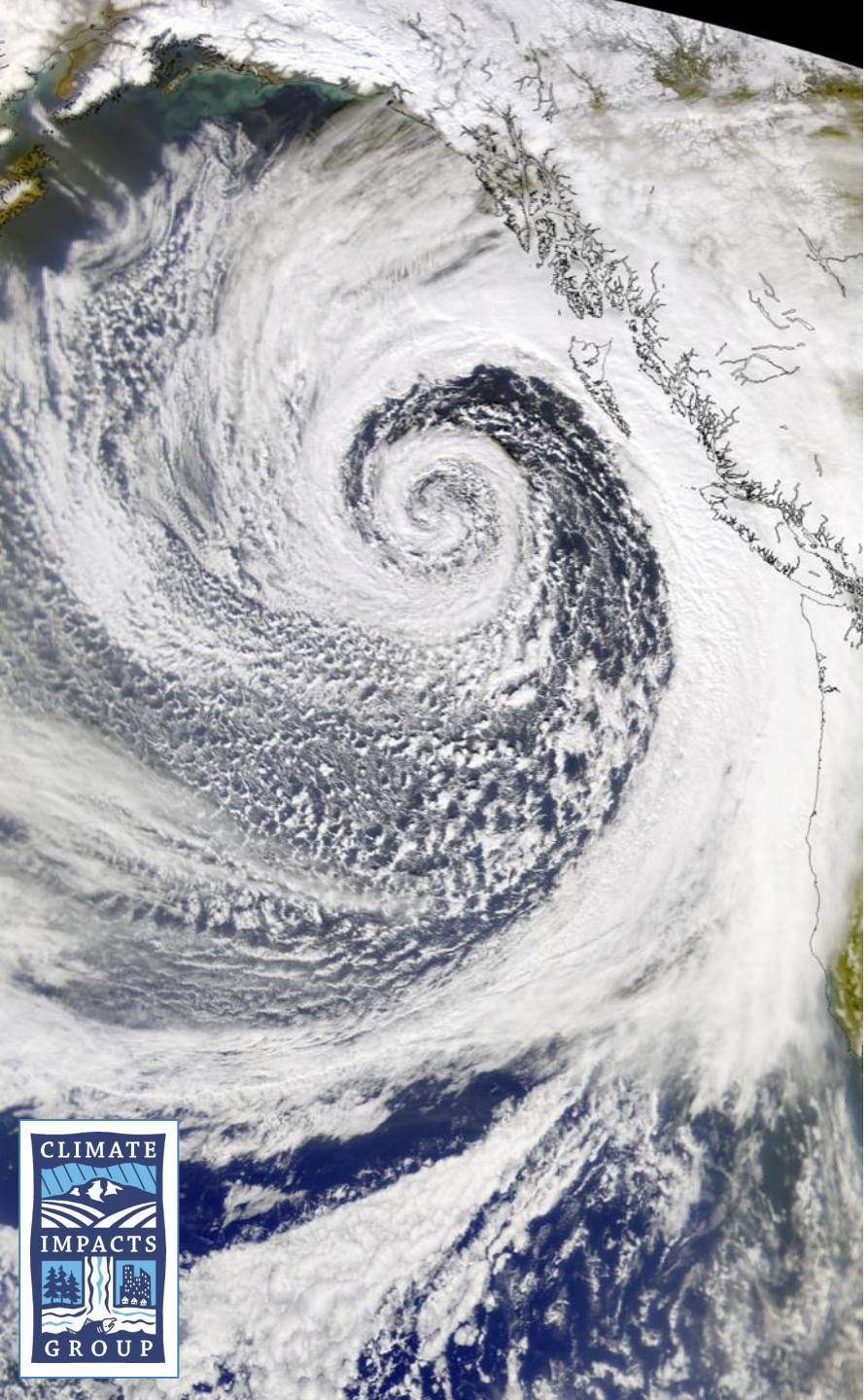
State of the art, highly complex models

Most are “coupled”: they simulate interactions among the land surface, ocean, sea ice, and atmosphere.

Ex: Annual Temperature & Precipitation







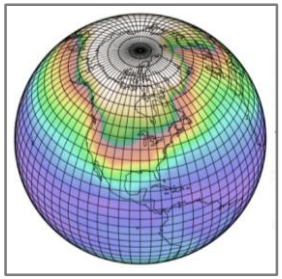
More Intense Heavy Rains

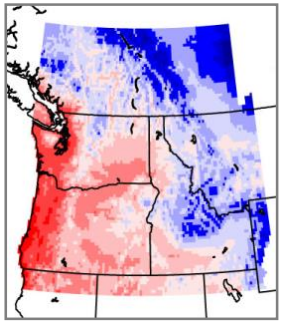
Heaviest rain events are projected to become **+22% more intense** (*range:* +5 to +34%) by the 2080s.

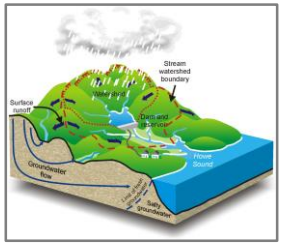
Changes in Winter Atmospheric Rivers along the North American West Coast in CMIP5 Climate Models

Warner, Mass, Salathé, J Hydromet, 2014

Downscaling







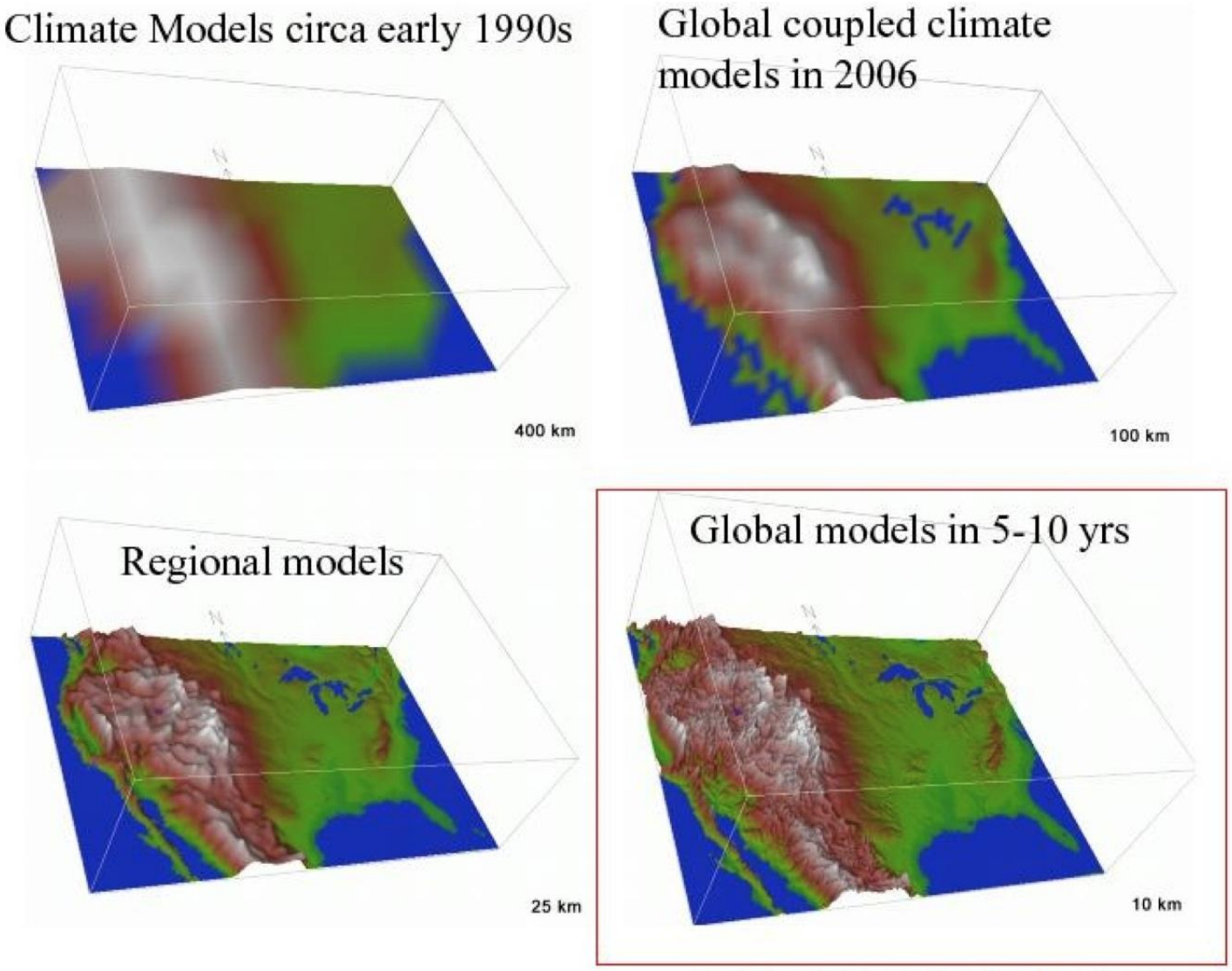
Global Climate Scenarios

Regional Climate Scenarios

Impacts Modeling

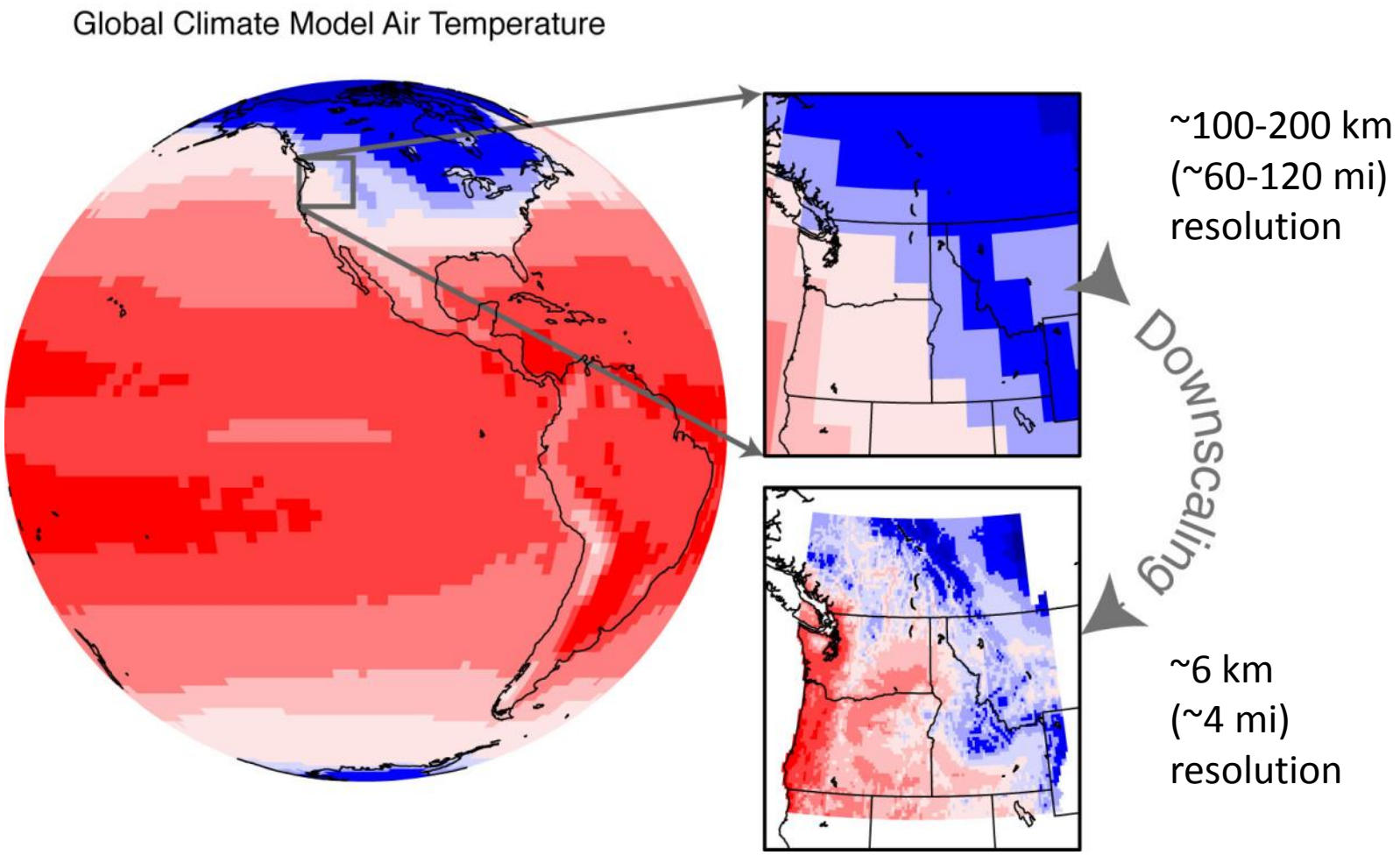
Planning & Design

Model Scale:

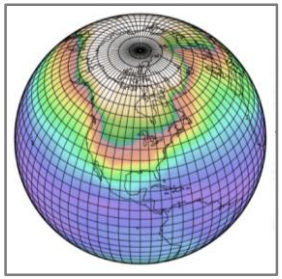


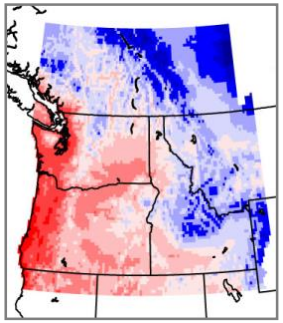
Source: Strand, UCAR

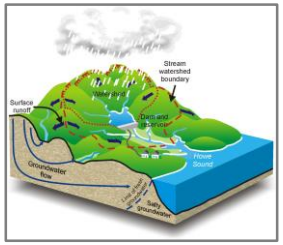
Downscaling relates the large to the small



Impacts Modeling







Global Climate Scenarios

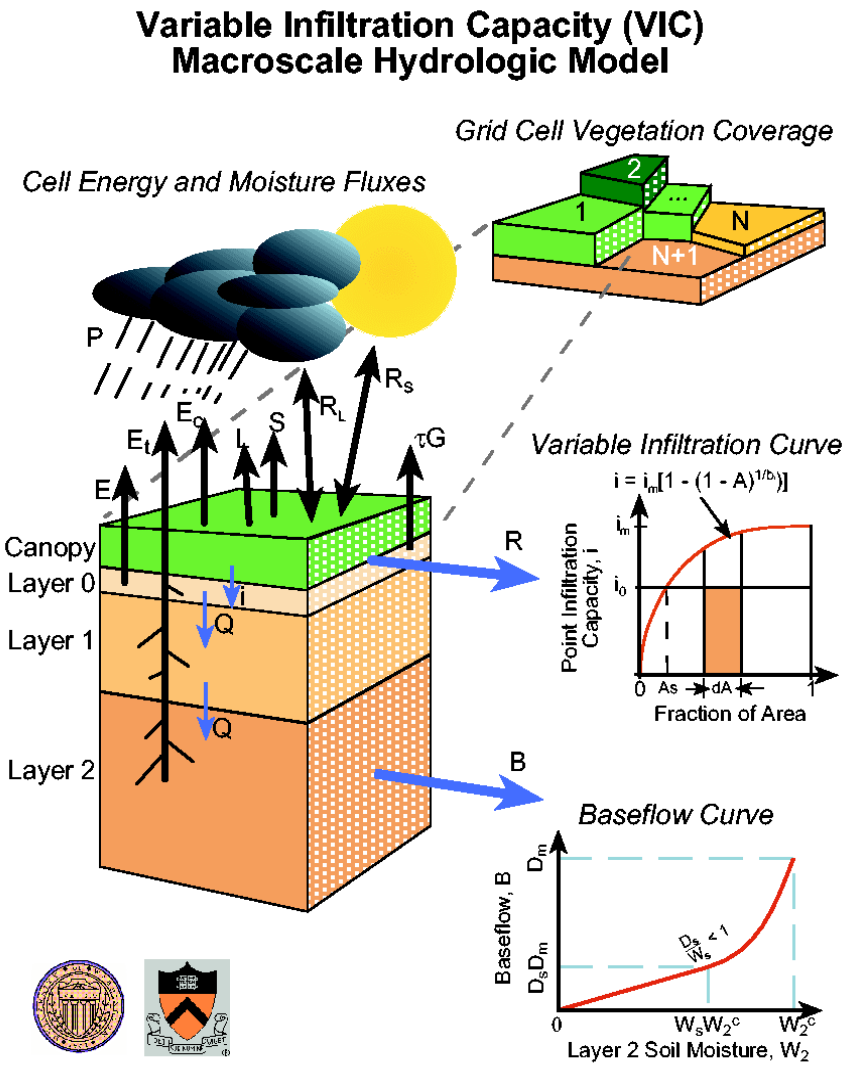
Regional Climate Scenarios

Impacts Modeling

Planning & Design

ex: Hydrologic Modeling

Translation from climate to water impacts

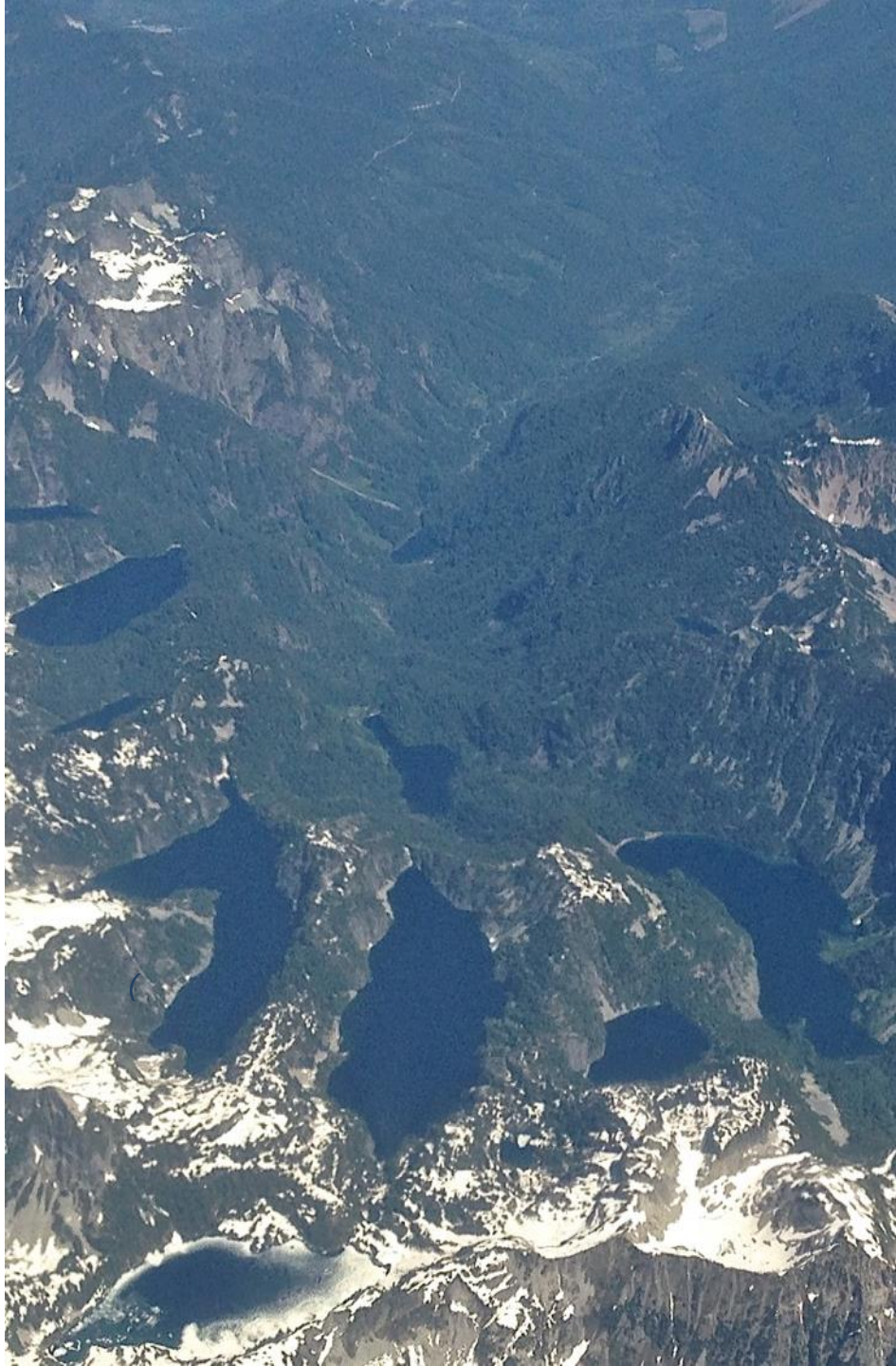


Snow

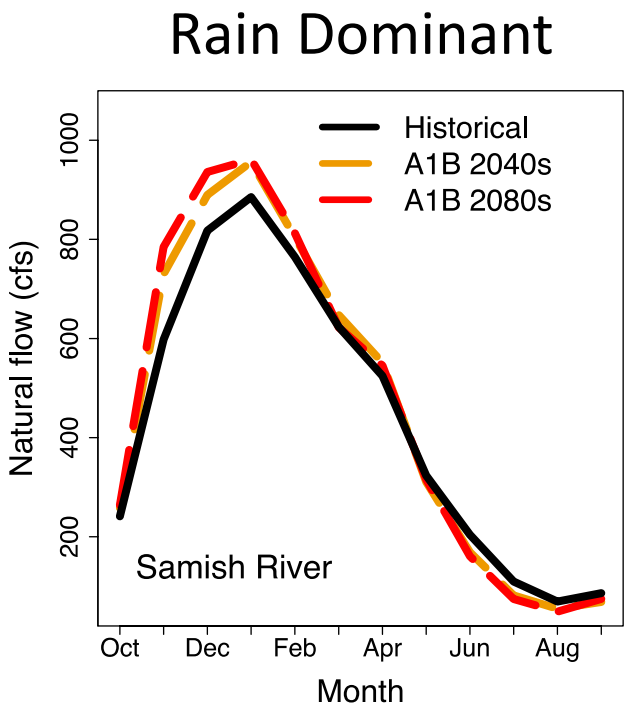
Our primary mechanism for storing water – snow – is sensitive to warming.

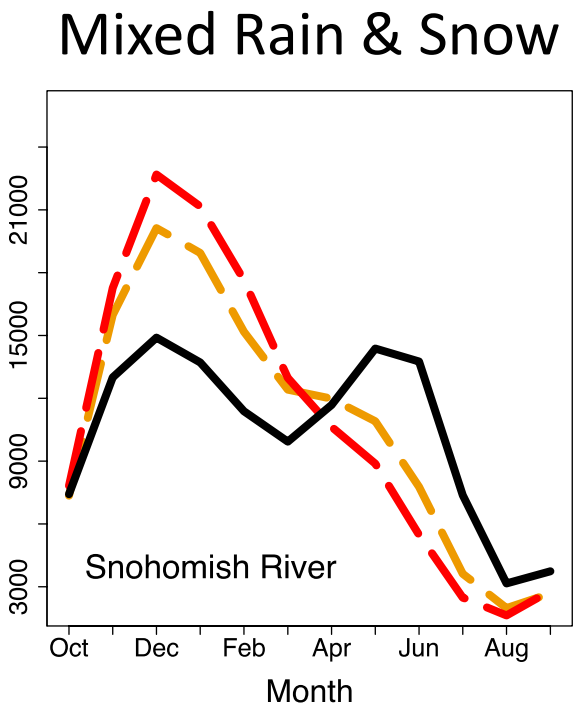
The Cascade and Olympic Mountains have the highest fraction of “warm snow” (snow falling between 27-32°F) in the continental U.S.

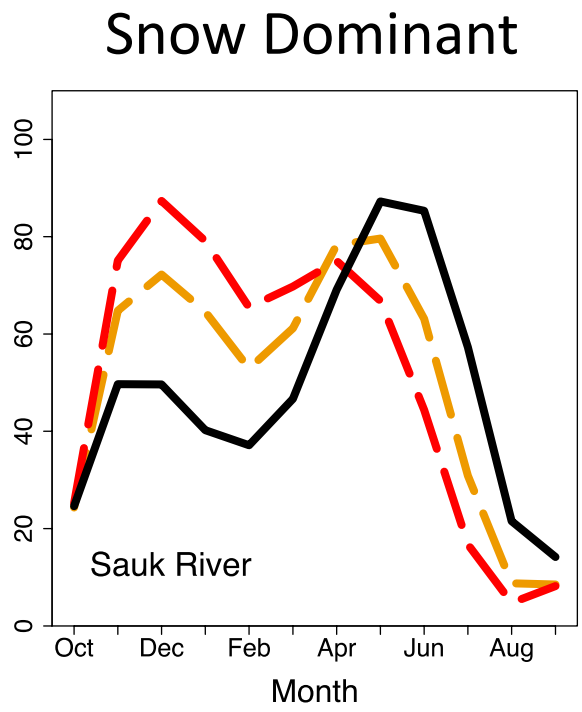
(Mote et al. 2008)



Implications of losing snowpack

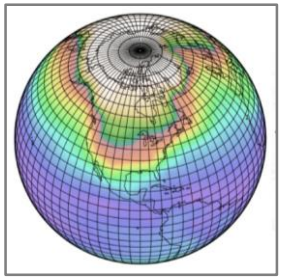


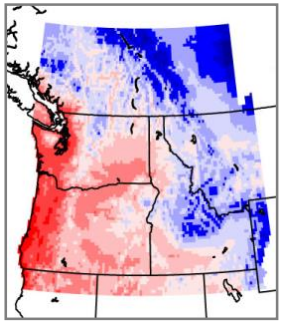


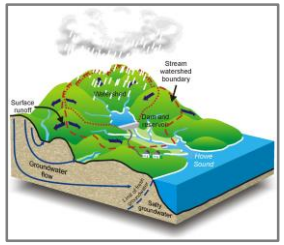


(these projections do not include changes in heavy rain events)

Doing Something







Global Climate Scenarios → Regional Climate Scenarios → Impacts Modeling → Planning & Design

At its core, planning for climate change is about *risk management*

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**
3. Decision context: • Robust v. most likely • Best vs. worst case • Time horizon	**Policymaker** **Risk Tolerance**

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

Take-Homes

- **There will always be a range of projections:** some uncertainties are irreducible. Best to consider a variety of approaches.
- **Downscaling relates the large to the small:** different approaches needed for different applications.
- **Translating from climate change to impacts:** additional modeling is often needed to do this.
- **Context determines what matters**: Sensitivity to climate change, time frame, risk tolerance.

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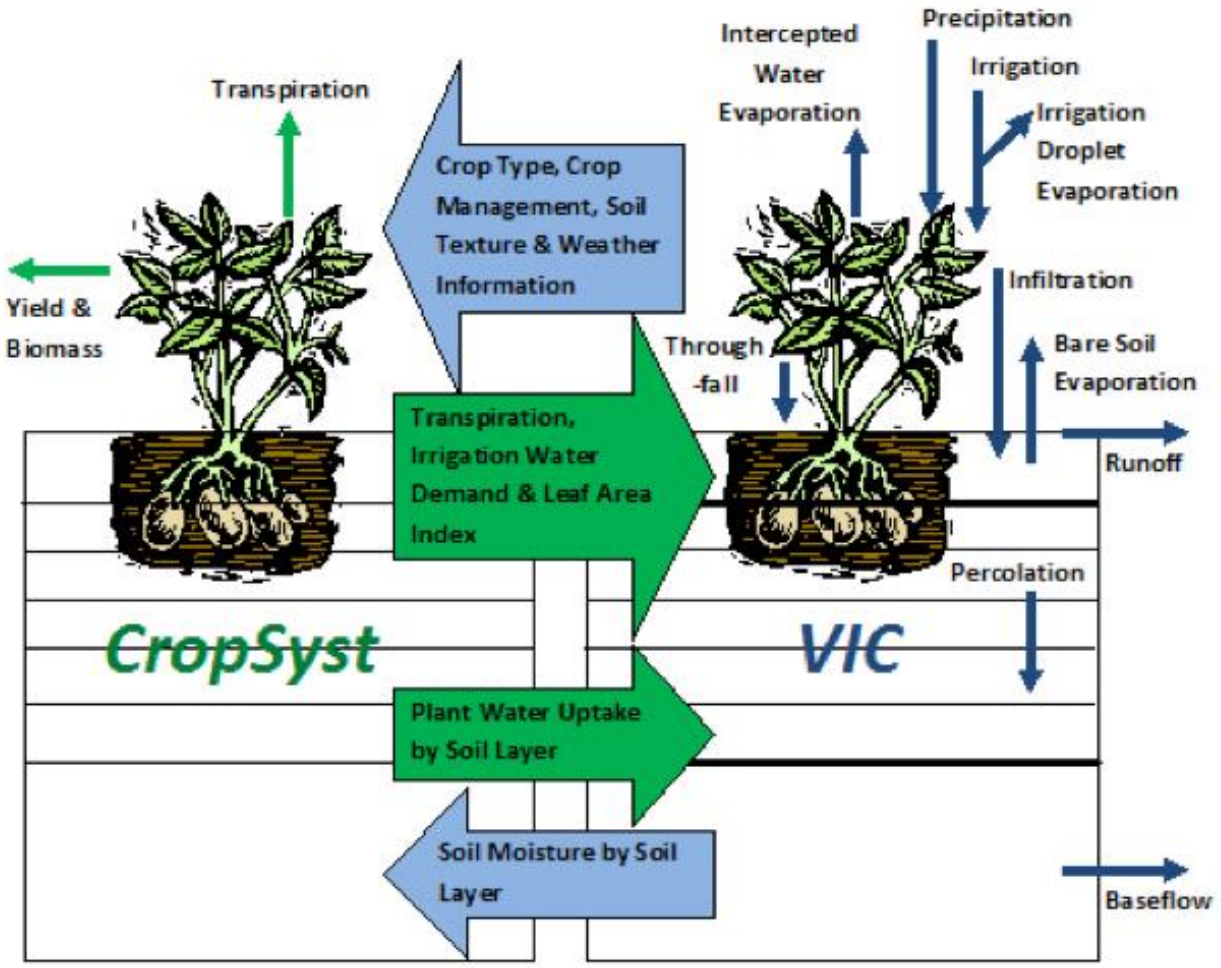
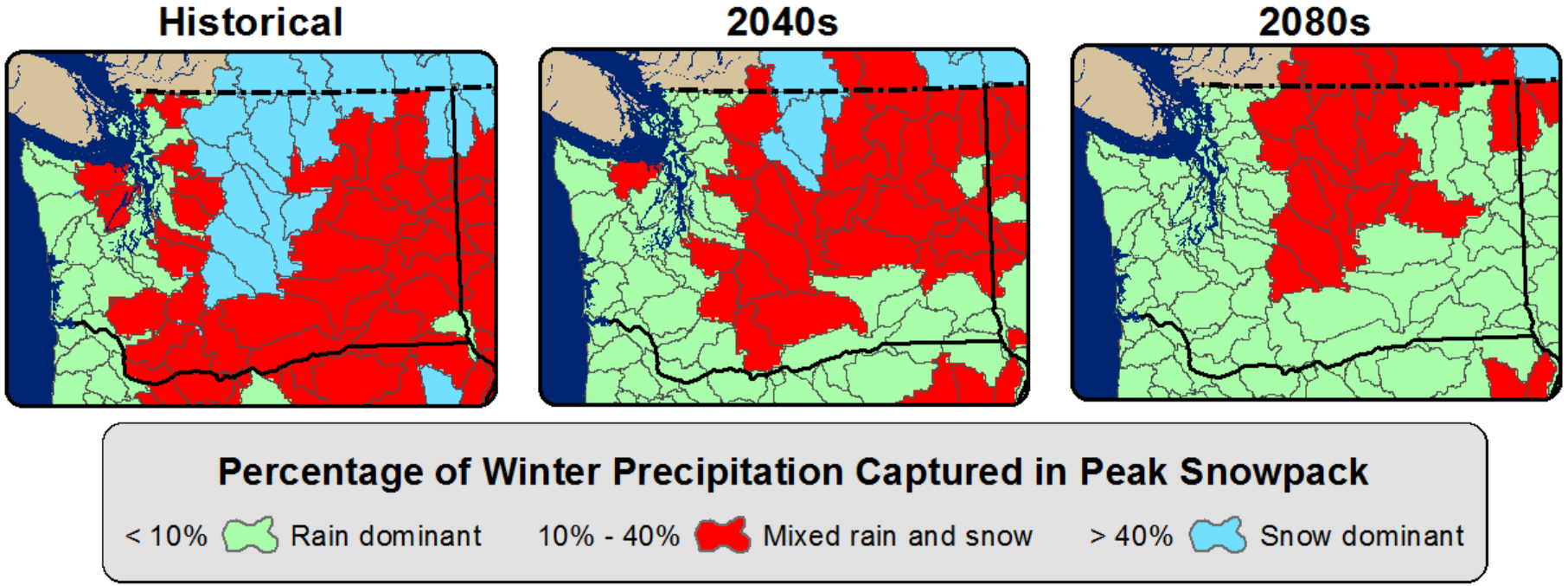
ex: Crop Modeling

Translation from climate to ag production



Ex: Hydrologic Projections



Remember that all models are wrong;
the practical question is how wrong do they have to be to not be useful.

Source: Box and Draper, *Empirical Model-Building*, p. 74

Good questions to ask:

- What are the inputs, outputs, internal equations, limitations, assumptions?
- Are there competing models? How do they differ?
- What parts of the model are certain?
- How good are the inputs?
- What is the range of possible outputs given known uncertainties in the model?

Slide adapted from Ashley Steel, US Forest Service Seattle

Ex: Annual Temperature & Precipitation