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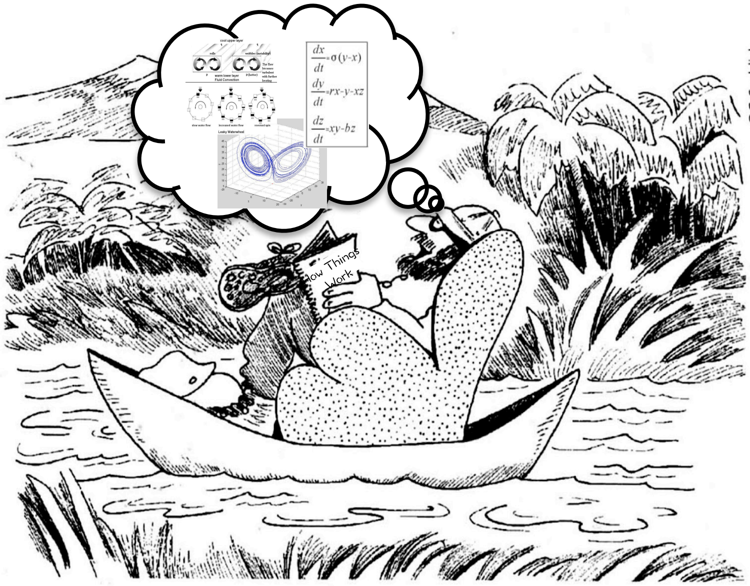
Intersects, Integration, Coordination and Wanderlust: Common Threads?

Kathy Hibbard

Aspen Global Change Institute: Frontiers of Global Change Science
Aspen, CO
18 August, 2014

In the beginning….



Armchair ecologists who thought great thoughts about how the world worked and tested hypotheses with equations and code

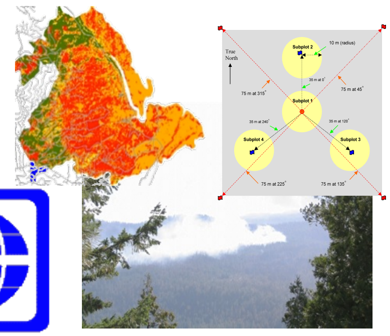
Field ecologists who worked in the 'real' world and measured, observed and catalogued every and any morphological and physiological trait

What about curious hybrids?

A little history

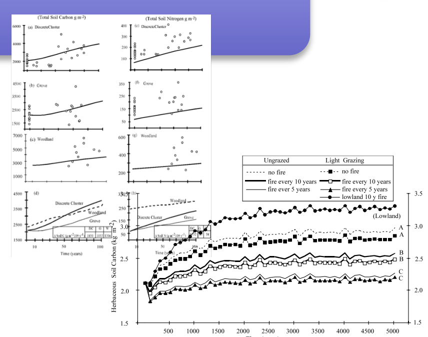
Overarching Theme: How does a system respond to change?


IGBP GAIM

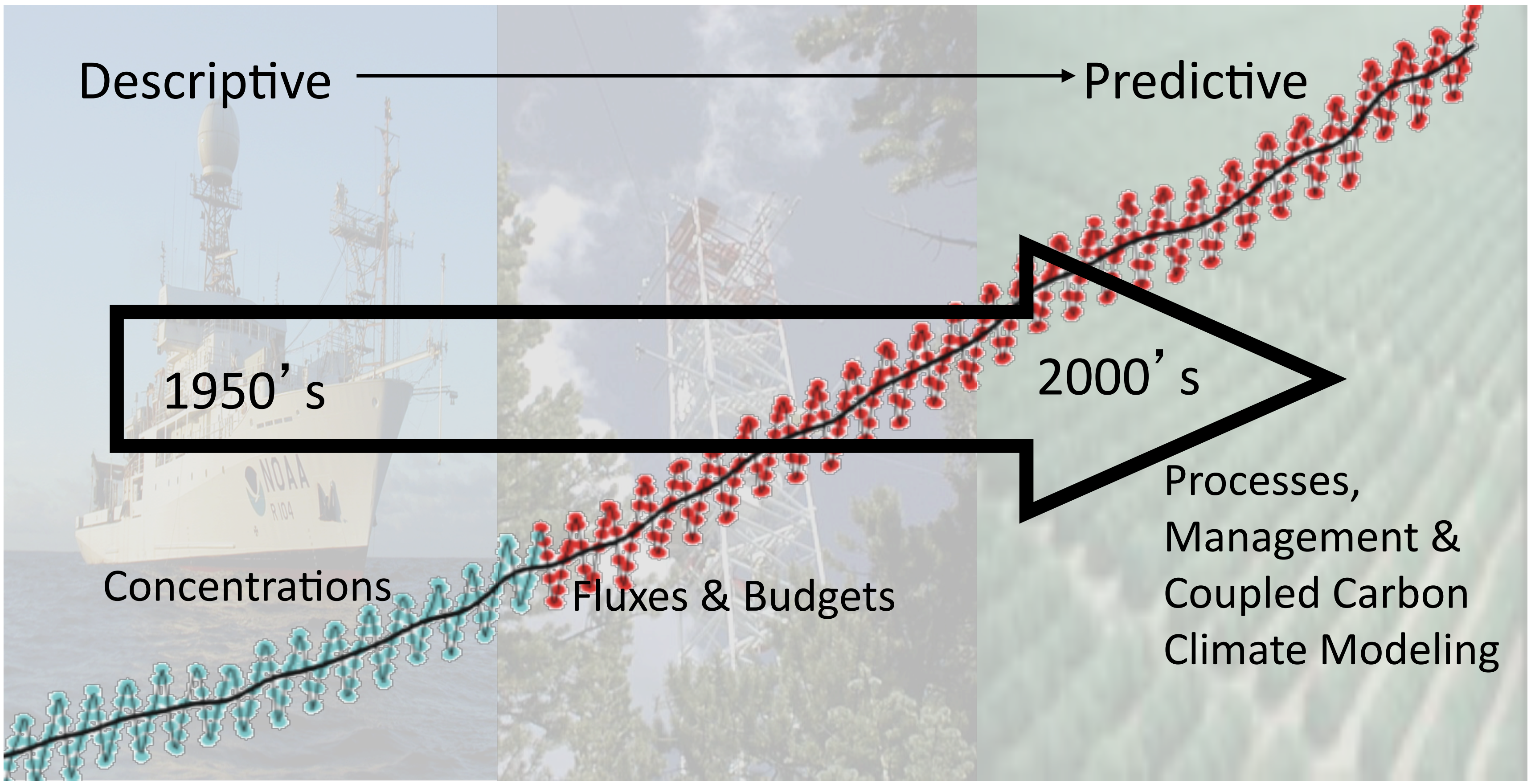



1980's → 1990's → 2000's → 2010's





Evolution of Carbon Cycle Science



With Regards to the Earth System and Models

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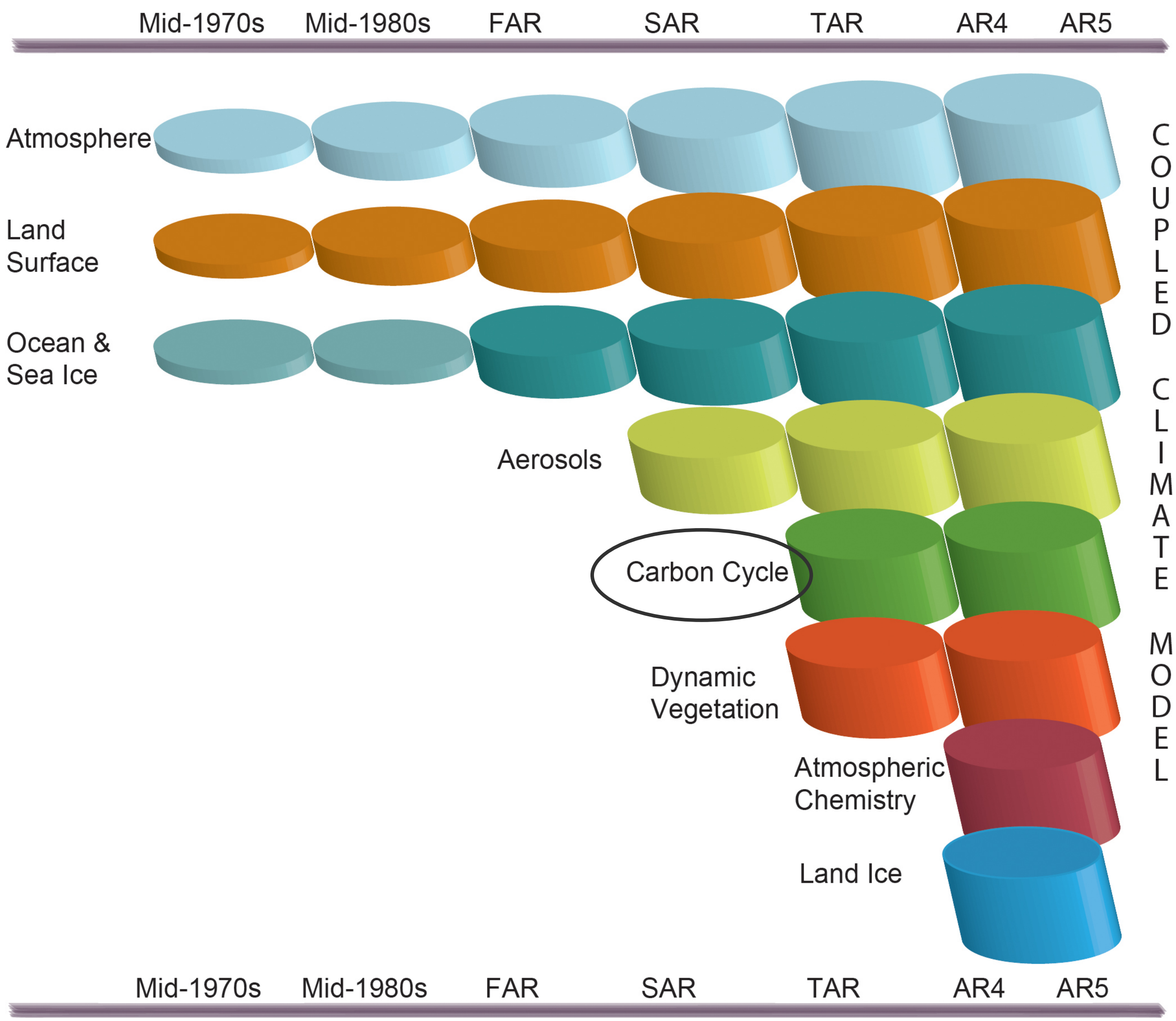

Figure 1.13 from WG1/AR5

It all started with a 'Flying Leap'

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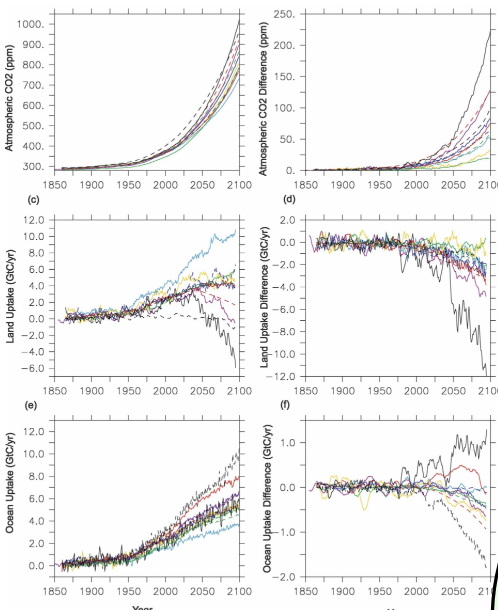
"One should treat the "Flying Leap" as a grand challenge to our understanding of the carbon cycle as well as of carbon-climate interactions. It should be the stimulus to take the models to another level. Glimpses of realism should be hoped for, but their absence should not be causes for despair. Much can be learned during the process of model development, intercomparison and refinement." Fung et al., 2000 IGBP Newsletter #41

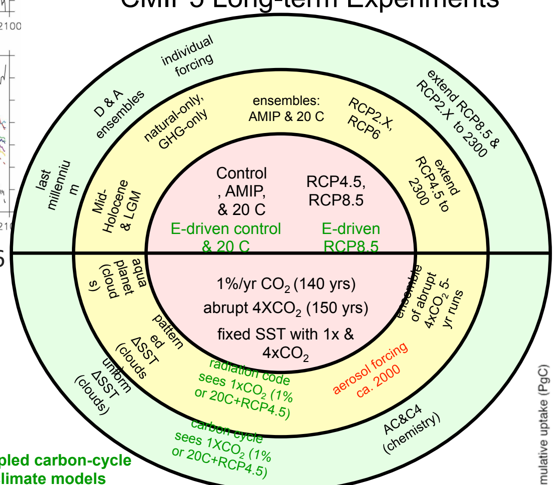
C4MIP in AR4



Friedlingstein et al., 2006

WGCM/AIMES Planning for AR5 in 2008: Formal adoption of coupled carbon cycle experiments

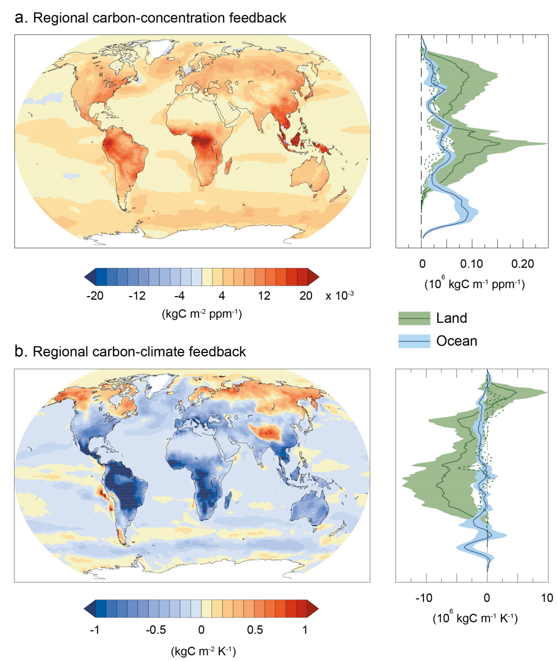
CMIP5 Long-term Experiments

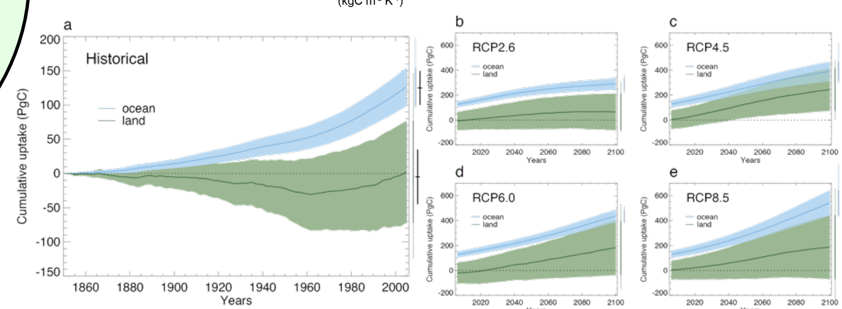


Coupled carbon-cycle climate models

Taylor et al., 2012

CMIP5 Carbon Cycle Insights from AR5





Figures 6.22, 6.24 WGI AR5 (2013)

2000's and Beyond: *Integrated Observations, Models and Technology for Management, Decision Makers and End-to-End Applications*

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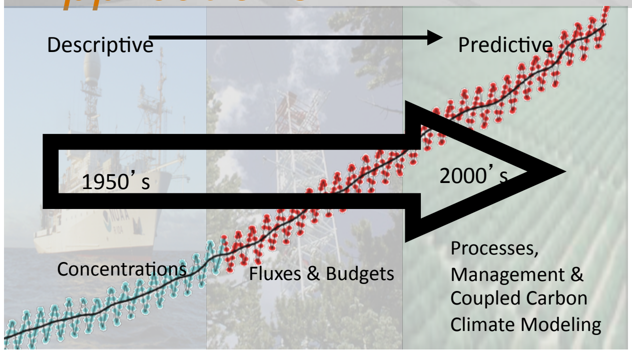
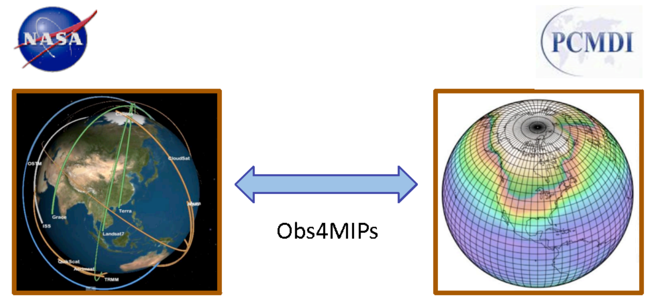
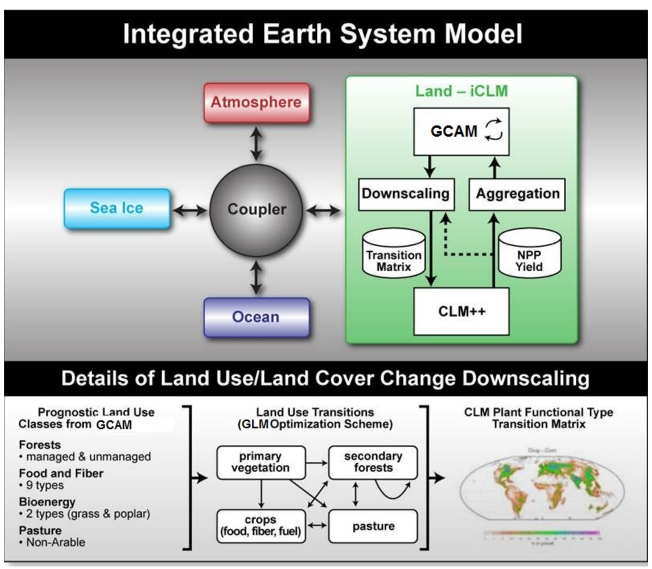
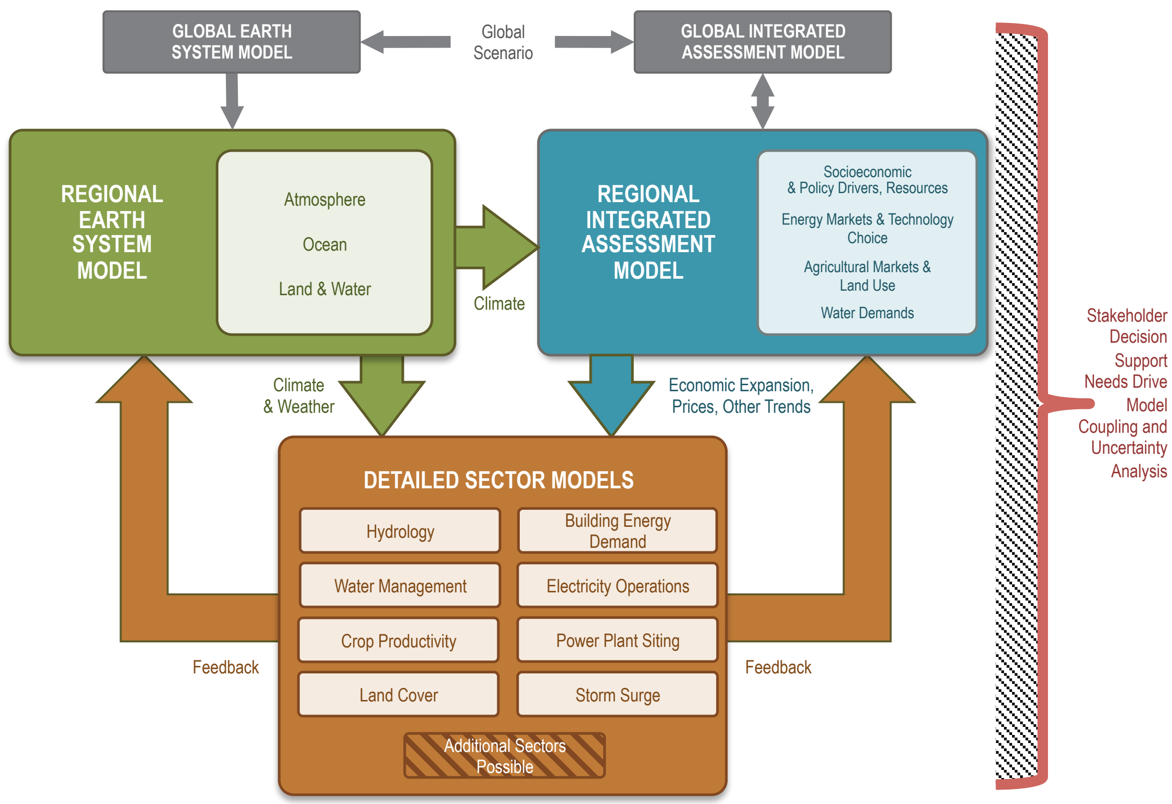


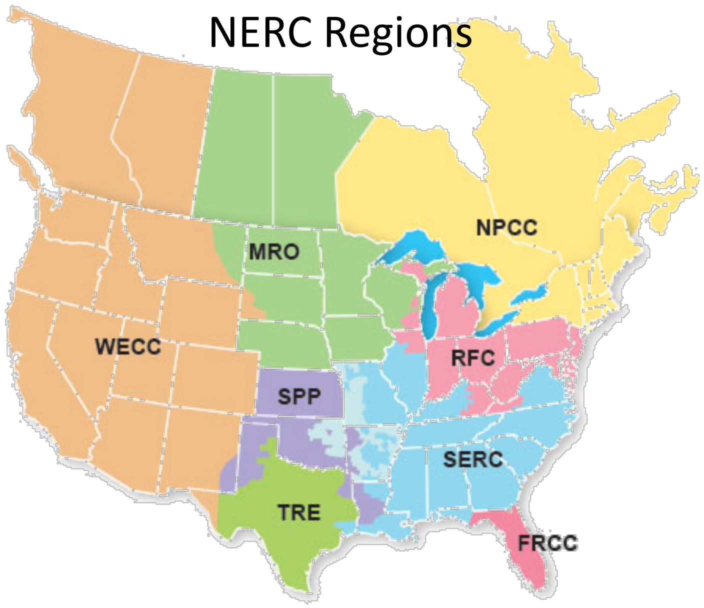






Operational Scales for Electricity Markets

NERC Regions



NWPP – a NERC Subregion

PSRC – a local council

North American Electric Reliability Corporation (NERC)
Western Electricity Coordination Council (WECC)
Northwest Power Pool (NWPP)
Puget Sound Regional Council: (PSRC)

Simulated Electricity Market Areas* and Spatial Downscaling for Electricity Generation: Current Power Plant Locations

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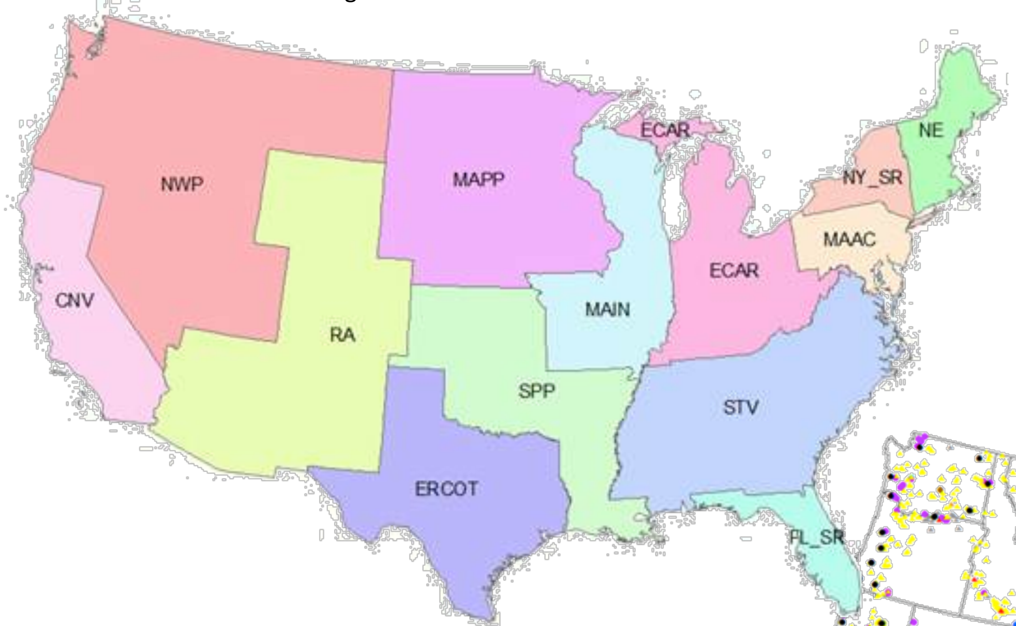
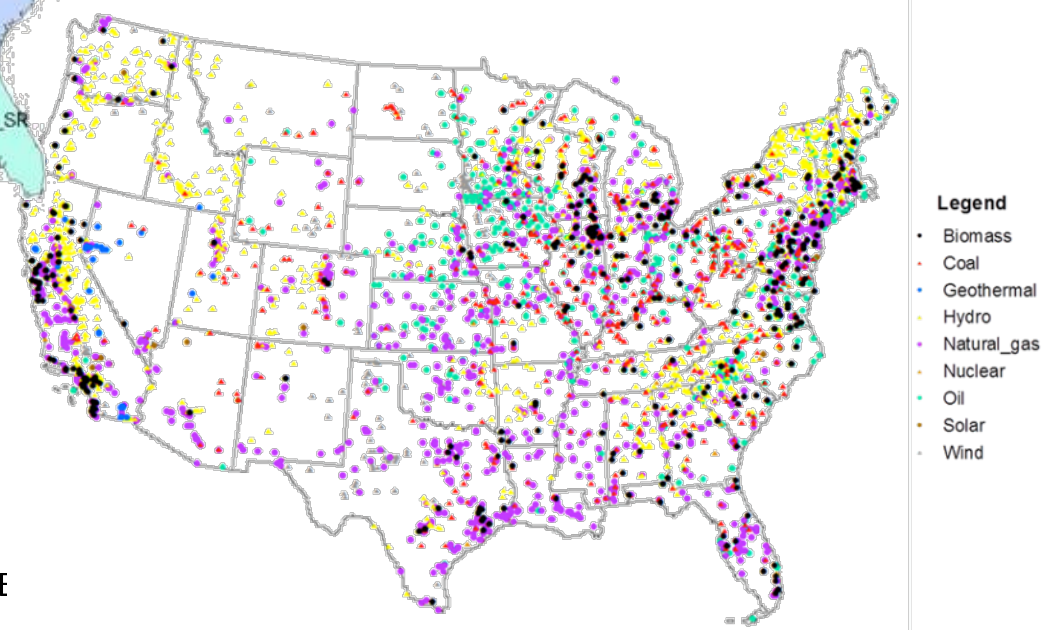
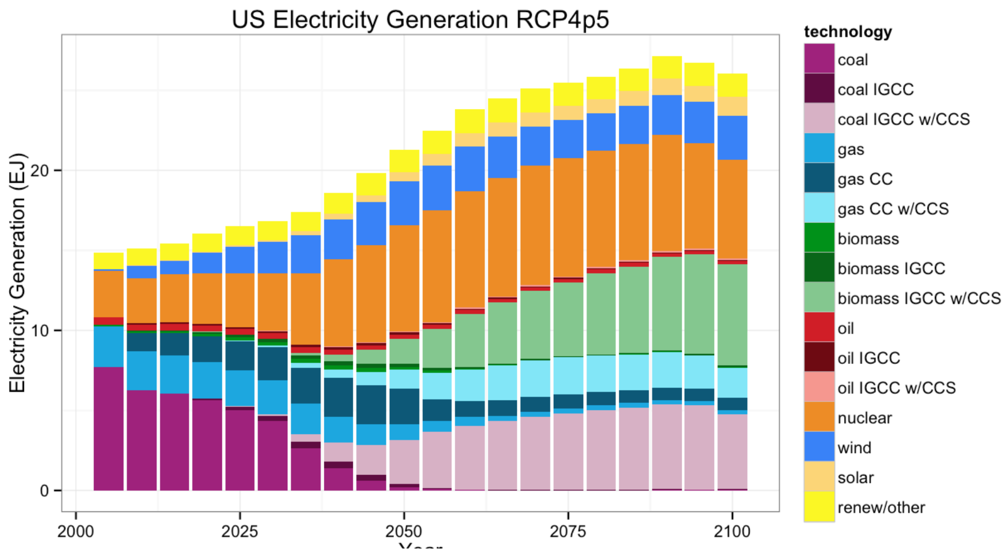
Modeling includes RPS per DSIRE data; RPS assumed to remain in place with or w/o carbon price
*Market areas are EIA NEMS regions matched to state borders

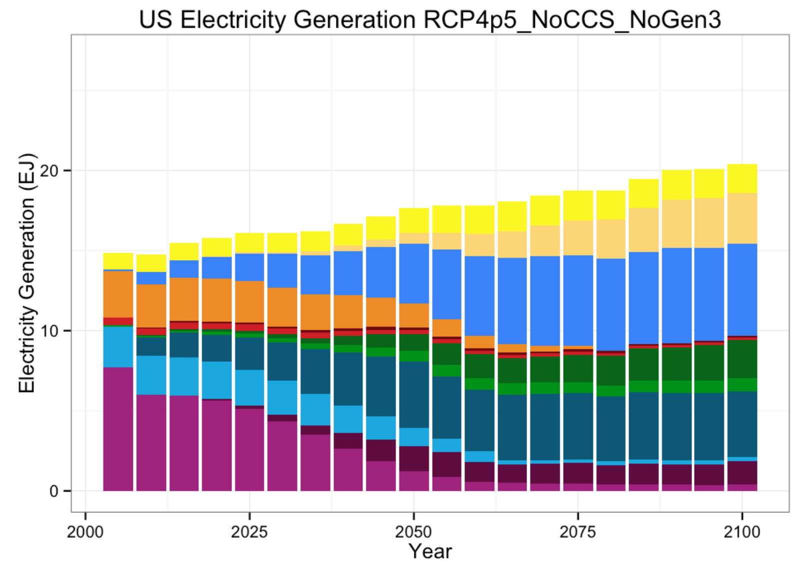


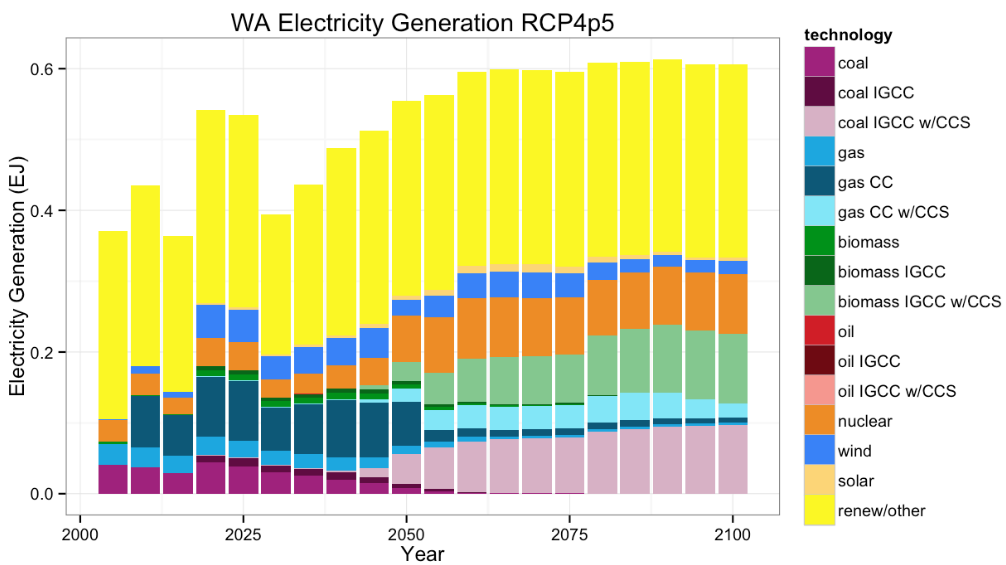


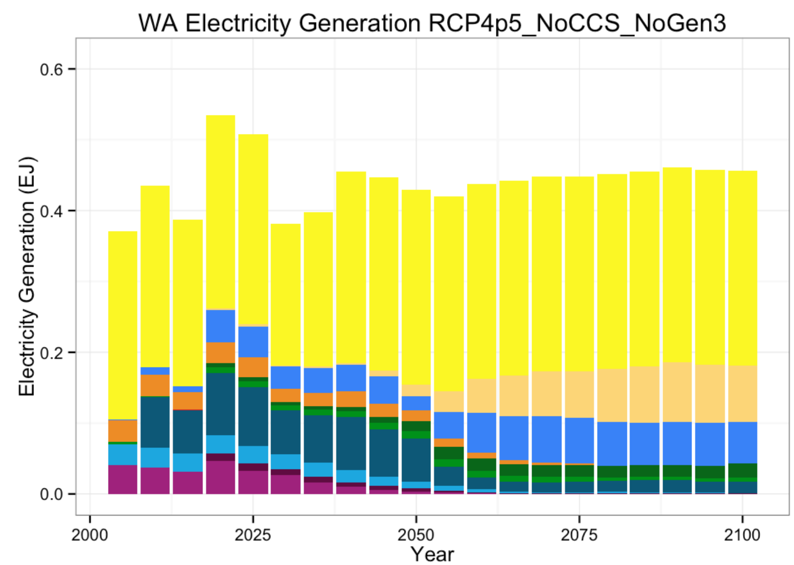
Renewable Portfolio Standards (RPS)
Database of the State Incentives for Renewables and E
Energy Information Administration (EIA)
National Energy Modeling System (NEMS)

What Could Happen if CCS and Advanced Nuclear are Not Available?



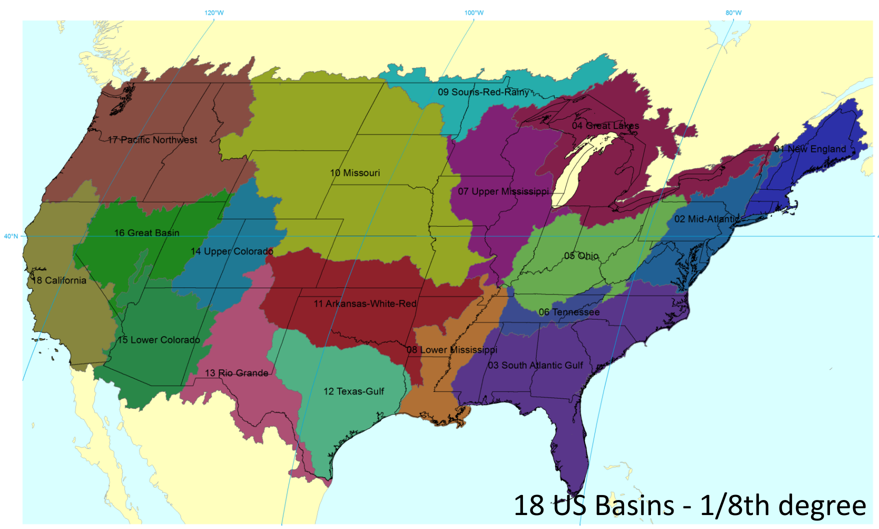




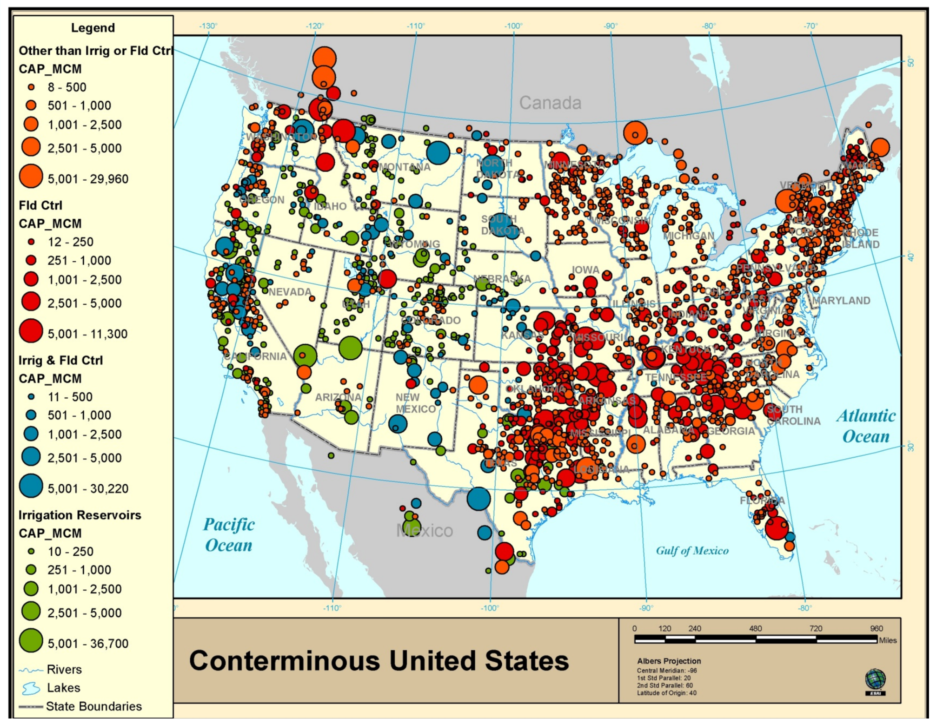


Water Management Modeling & Operations

The reservoir operations take into account irrigation and non-irrigation water demands as simulated by GCAM – Individual operational rules are not applied

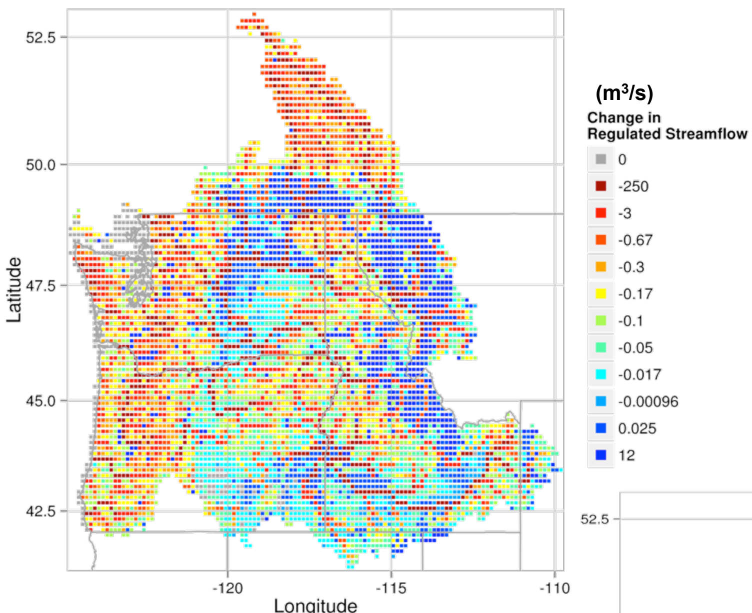


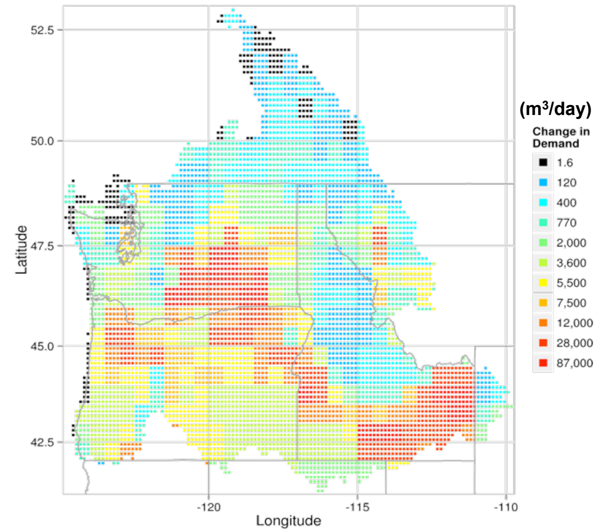
18 US Basins - 1/8th degree

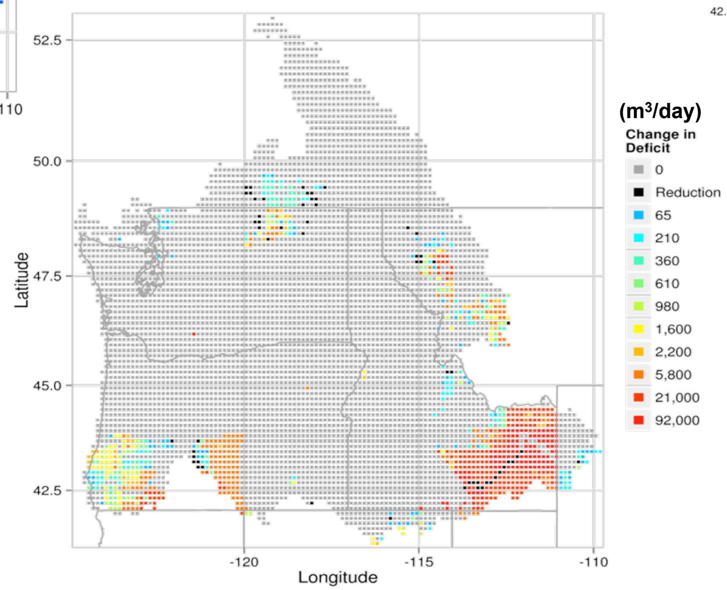


CRB: *Projected Change in Surface Water Supply and Demand*

August Averages: 2020-2039 minus 1985-2004; RCP8.5 scenario (1/8th deg)



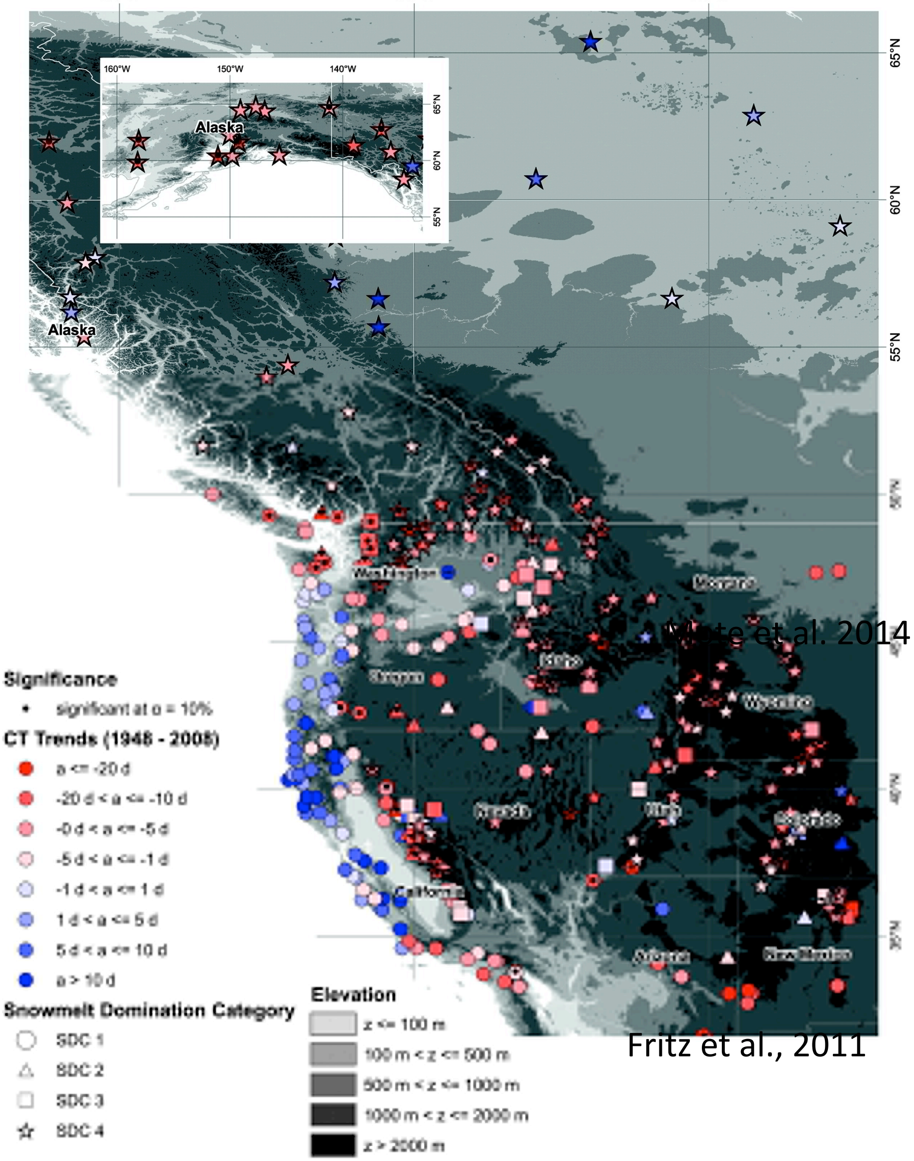




The deficit is the net of the regulated flow and the demand at each grid cell. The regulated flow is a function of the climate/hydrologic modeling and reservoir operating rules that prioritize flood control, followed by non-irrigation demands, then irrigation

Changes in streamflow: Current and projected

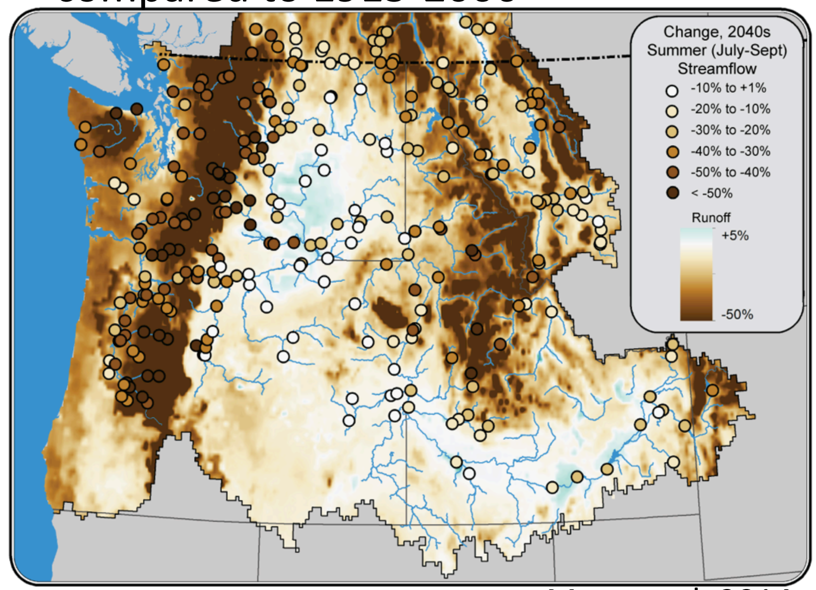
Trends in center of timing for streamflow 1948-2008



Mote et al. 2014

Fritz et al., 2011

Projected summer flows (2040's) compared to 1915-2006



Mote et al. 2014

Rising Sea Levels and Changing Flood Risks in Seattle

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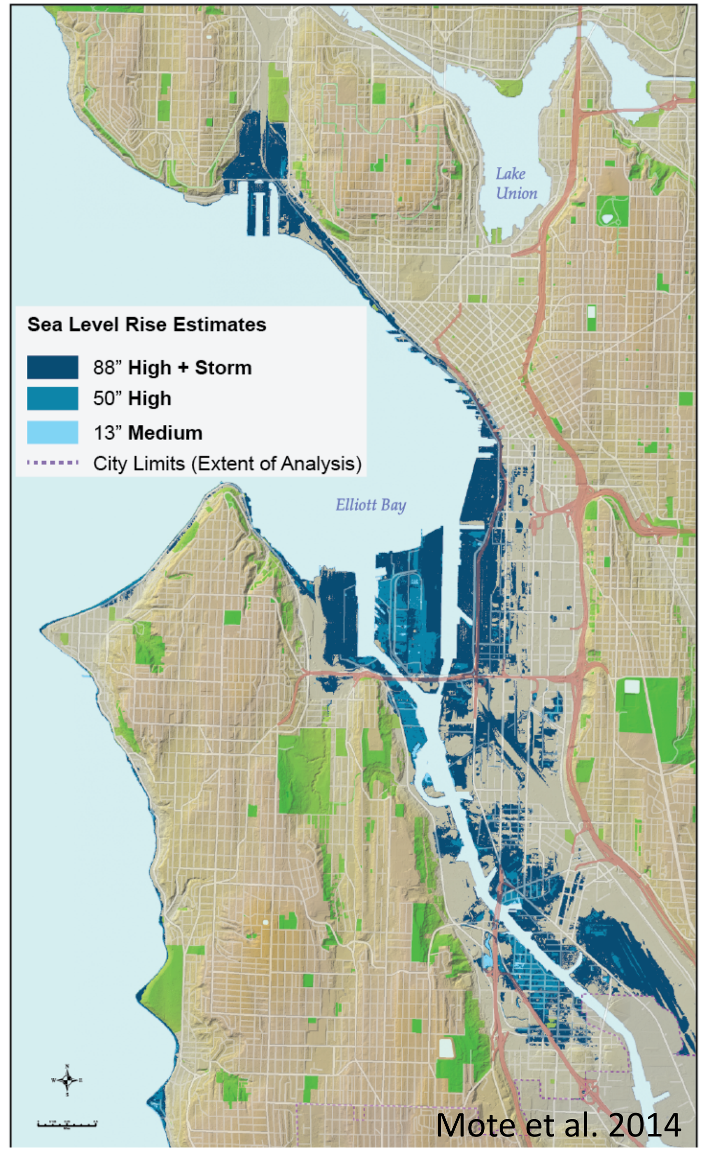
Areas of Seattle projected to be below sea level during high tide assuming no adaptation.

Unconnected inland areas shown to be below sea level may not be inundated, but could experience problems due to areas of standing water caused by a rise in the water table and drainage pipes backed up with seawater.

(Figure source: Seattle Public Utilities).



Mote et al. 2014

Columbia River Treaty: Salmon en Route

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Canada and the United States face tough negotiations
Jun 7th 2014 | OTTAWA | The Economist

US reimbursed CA for extra power generated by new dams in CA
But:

- Farmland flooded, people displaced in CA
- More dependable navigation/irrigation in US
- BC cooperates when US asks to spill for endangered-fish legislation
- Salmon restoration pushed by First Nations on both sides, but migration eliminated by Grand Coulee in 1938

September 16, 2014 for resolution, after which either country can give 10 years notice to terminate.

Water and Energy:
Have we seen this picture before?

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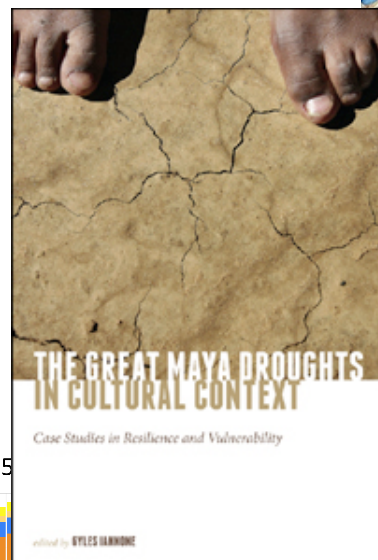
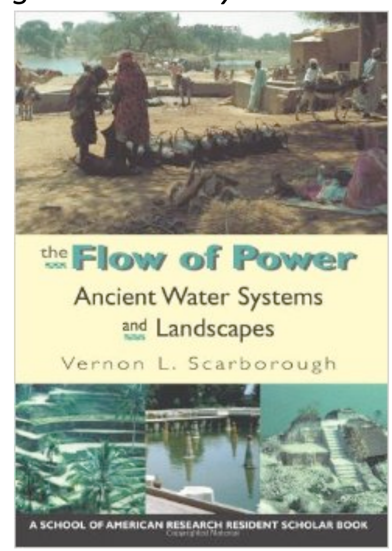
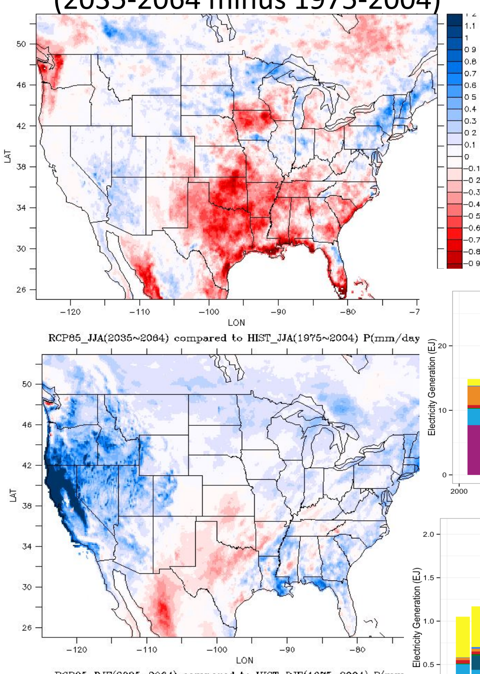


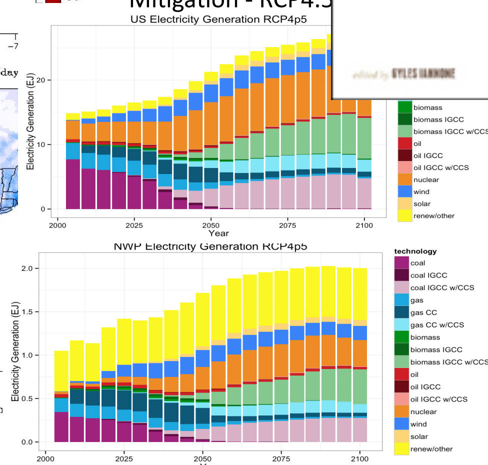
Climate and Culture:
Demise of the Maya kings but the Maya live on
Chase and Scarborough, 2014



RESM RCP 8.5 JJA Precipitation
(2035-2064 minus 1975-2004)



Mitigation - RCP4.5



Summary: 1 of 2

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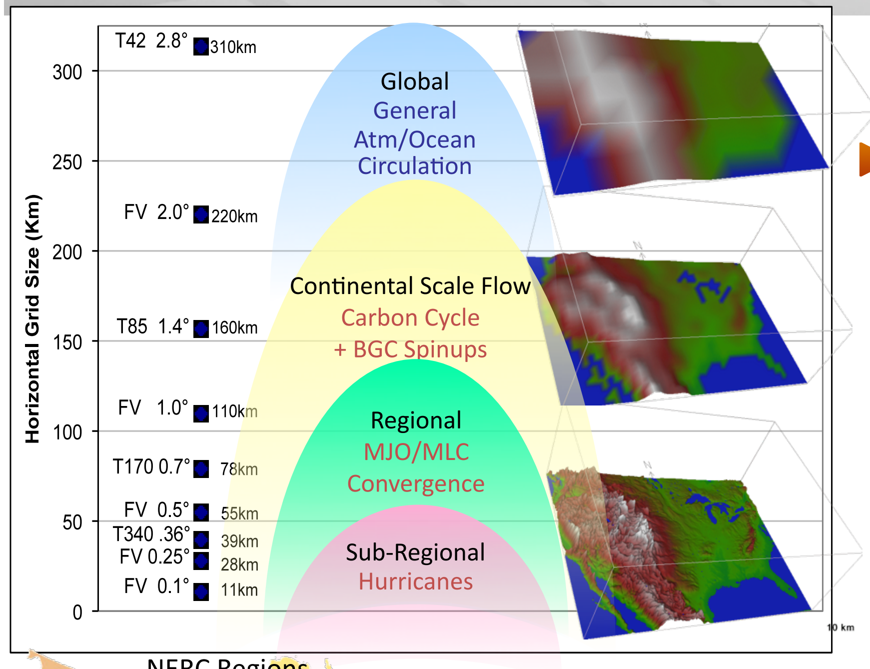
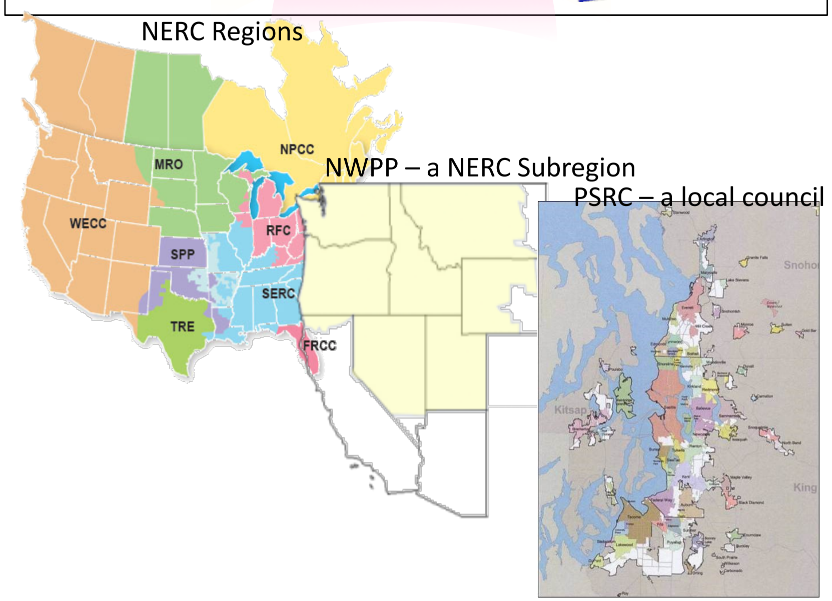
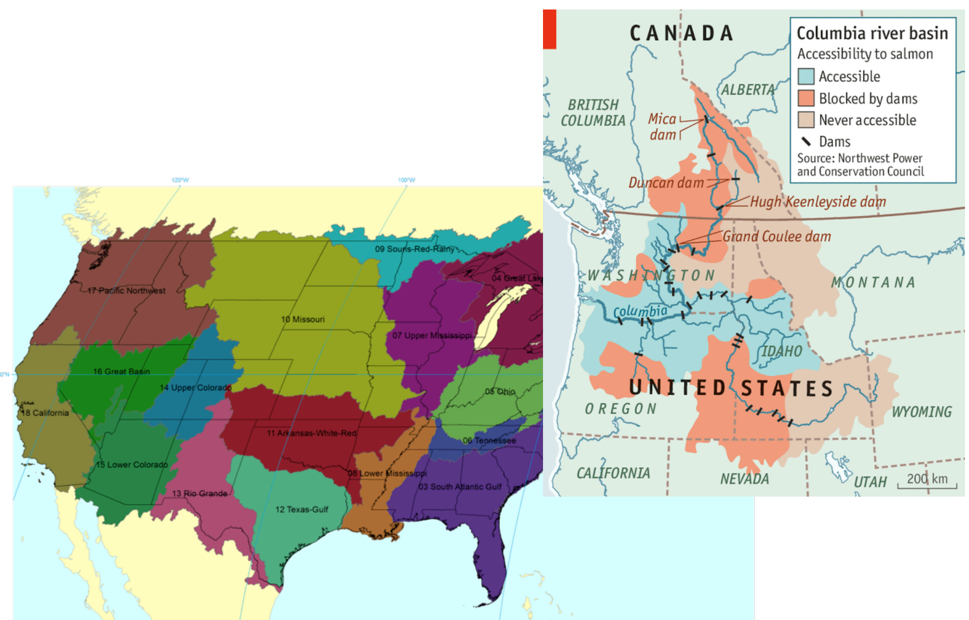


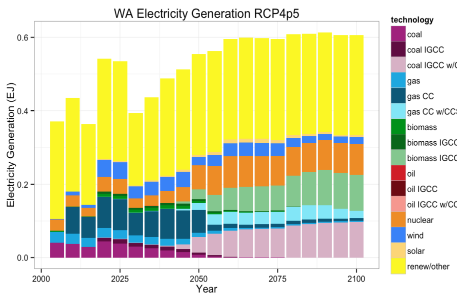
- Multiple scales and phenomenon are operating in our back yard – global, regional, overlapping markets and local constituencies

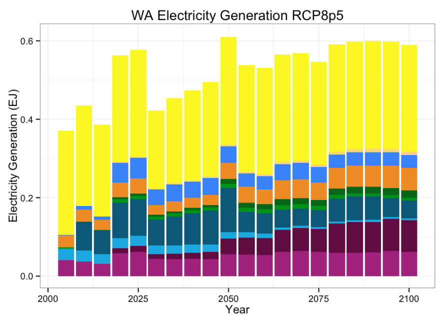


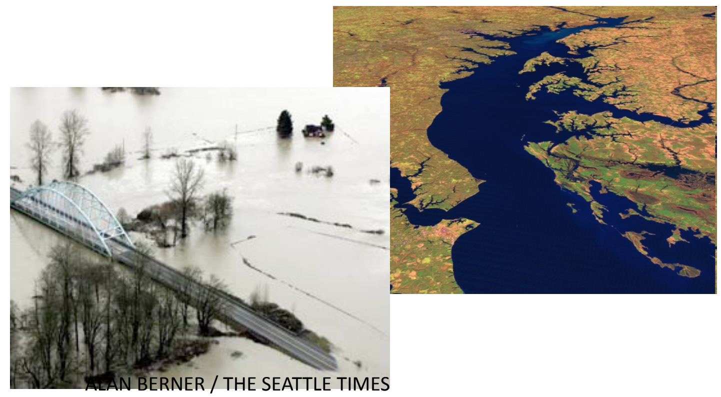


Summary: 2 of 2

- Every region will have its own unique and characteristic suite of challenges and opportunities. Sea level rise, subsidence and changes in the frequency and magnitude of winter events may be the big surprises west of the Cascades – rain on snow and early snowmelt will impact irrigation and economies to the east in the PNW.







- There are no silver bullets or easily solutions. Informed decisions will require an integrated and interdisciplinary understanding of the tradeoffs and consequences to meet objectives
- Stovepiped funding agencies find it difficult to cross boundaries
- Communication across the disciplines, e.g., what is data, what is adaptation science is ongoing, but educating and communicating to the public is in an infancy.

View of Willow Pass from Buckskin Pass