

Report to Congress – Potential Climate Change Impacts on Federal Hydropower

Shih-Chieh Kao

Oak Ridge National Laboratory
kaos@ornl.gov ; (865) 576-1259

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Effects of Climate Change on Federal Hydropower

SECURE Water Act Section 9505 – Evaluate the potential effects of climate change on water availability for federal hydropower generation marketed by power marketing administrations (PMAs).

The Challenge

Water availability for hydropower generation can be affected in the projected future climate. However, global climate models cannot provide sufficient resolution and accuracy for hydropower evaluation. Further hydro-climate simulation is required.

Partners

PMAs – Bonneville (BPA), Western Area (WAPA), Southwestern Power Administration (SWPA) and Southeastern Power Administrations (SEPA).

Federal hydropower owner/operator – Bureau of Reclamation (Reclamation) and U.S. Army Corps of Engineers (USACE)

Next-Generation Hydropower (HydroNEXT)

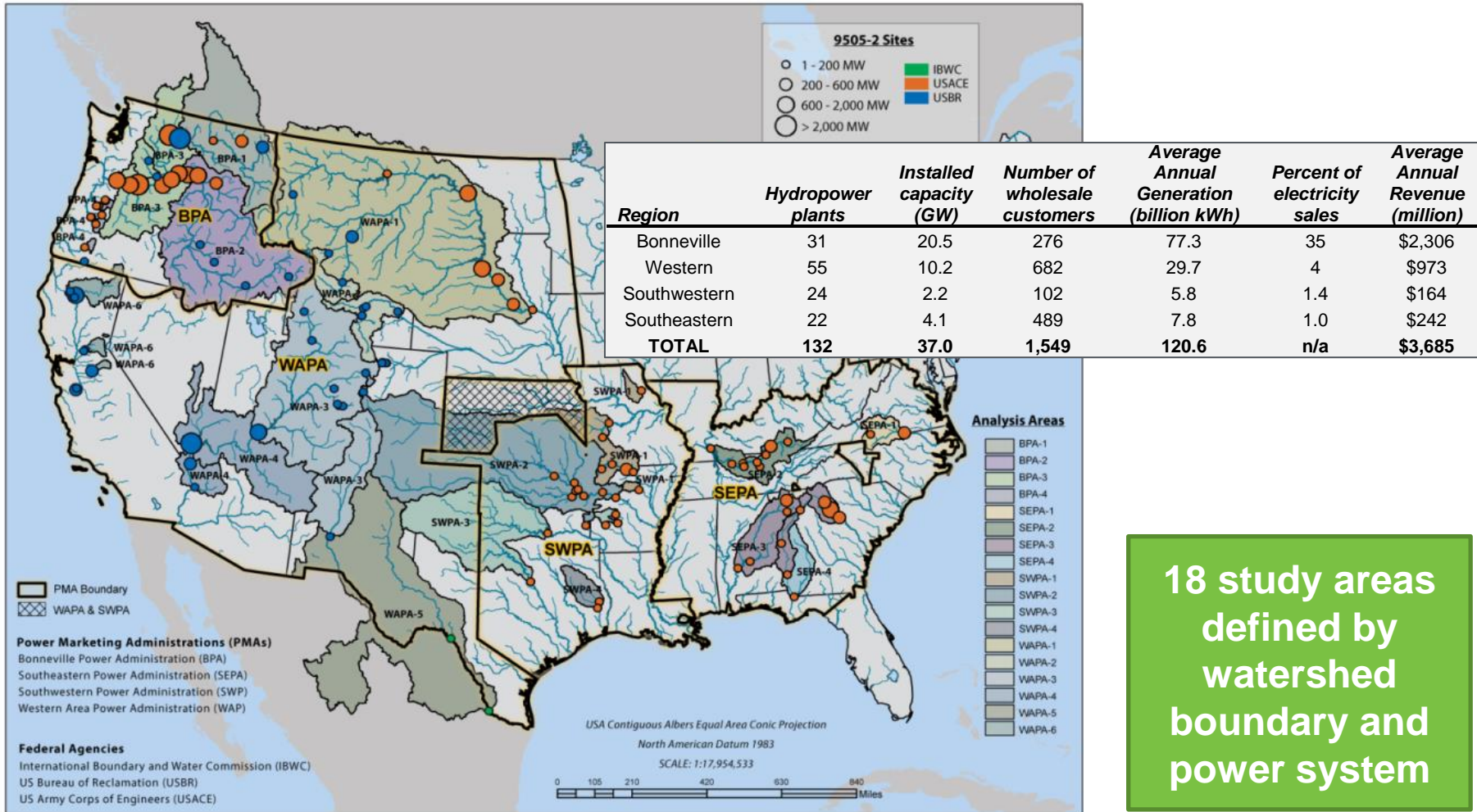
Sustainability

- Design new hydropower systems that minimize or avoid environmental impacts.
- Support development of new fish passage technologies and approaches.
- Develop technologies, tools, and strategies to evaluate and address environmental impacts.
- **Increase resilience to climate change.**

The Impacts

- Quantify the potential risk of climate change on water availability for hydropower generation.
 - Impacts of earlier snowmelt
 - Change of rainfall and runoff seasonality
- Identify regions that are more sensitive to change of streamflow variability and extreme event frequency
- Provide best-available, downscaled future hydro-climate projections to support resource and mitigation planning.

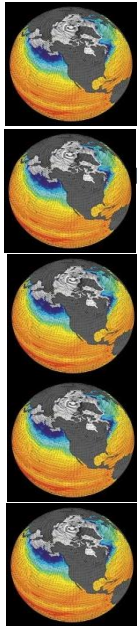
132 Federal Power Plants in 18 Study Areas



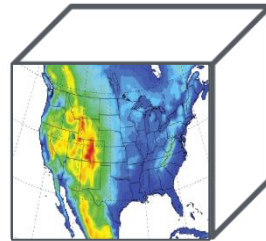
18 study areas defined by watershed boundary and power system

High-resolution Multimodel Simulation

CMIP5 GCM
Projections



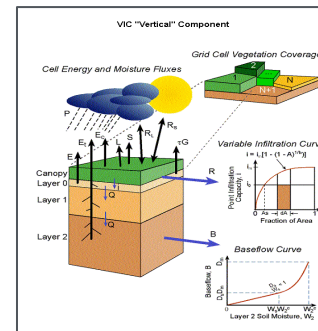
~150 km grid
resolution



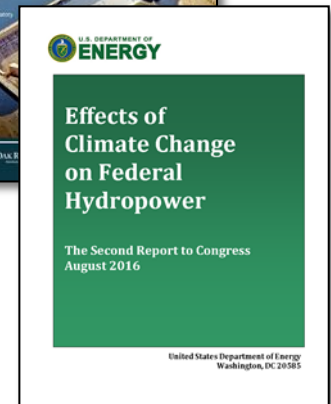
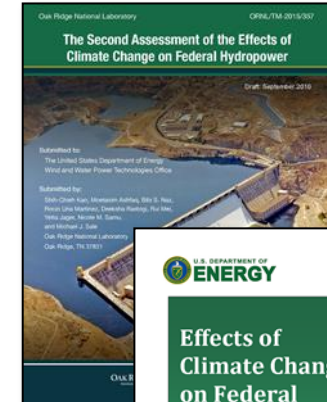
Regional
Dynamical
Downscaling
(RegCM4)

~18 km grid
resolution

Hydrological
Simulation and
Calibration (VIC)



~4 km grid
resolution

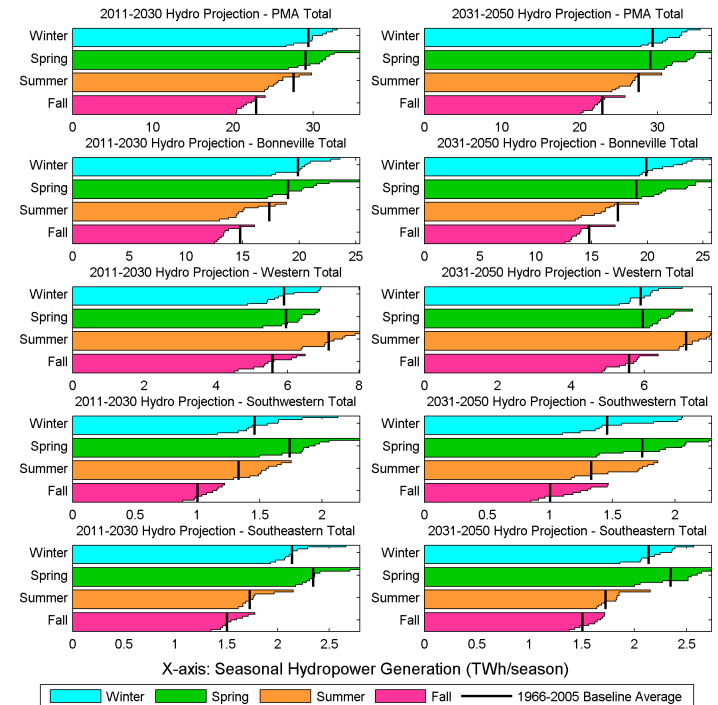


Future Hydropower
Projection

Assessment at each
hydropower study area

10 sets of CMIP5/RegCM4/VIC hydro-climate projections were used.

- Published a detailed assessment report with rigorous technical review that involved more than 40 external reviewers
- Prepared a draft DOE report to Congress jointly with PMAs (currently under DOE concurrence review)
- Provided future water availability scenarios for *Hydropower Vision* Study
- Developed a new regional hydropower model to simulate seasonal hydropower generation for each PMA study area (new modeling capability)
- Published two journal papers supporting the credibility of hydro-climate projections
- Provided hydro-climate projection data to support other hydropower–water use studies (e.g., BPA RMJOC2).



	FY2014	FY2015	FY2016
Q1	Initiation of the 2nd 9505 Assessment	Development of the Full Assessment Report	DOE Concurrence Review of Report to Congress
Q2	Initial Coordination Meeting with Partners		
Q3		Coordination Meeting and Early Review with PMAs	
Q4	Workshop on 9505 Methodology Development	External Peer Review of the Full Technical Assessment	

- Main phases of the project
 - FY2014: Methodology development
 - FY2015: Development of assessment report and external review
 - FY2016: DOE concurrence review
- Go/No-Go decision points
 - FY2014 methodology workshop: methods accept and proceed
 - FY2015 external peer review: report contents accept and proceed

Budget History

FY2014		FY2015		FY2016	
DOE	Cost-share	DOE	Cost-share	DOE	Cost-share
\$761K	\$0K	\$648K	\$0K	\$313K	\$0K

- Cost in each FY:
 - FY14: methodology development and interagency workshop
 - FY15: preparation of full technical assessment report and external peer review
 - FY16: preparation of report to Congress, support of concurrence review, and scoping of future assessment
- Computational resource
 - Oak Ridge Leadership Computing Facility, no-cost
- Additional financial support
 - The development of hydro-climate projections leveraged the Laboratory Directed Research and Development support (\$800K) from ORNL.

Partners

Power marketing administrations – BPA, WAPA, SWPA, and SEPA
Federal hydropower owner/operator – Reclamation and USACE

Subcontractors

Dr. Michael J. Sale (BCS Incorporated)
Dr. Alisha Fernandez (McKeown & Associates LLC)

Collaborators

Dr. Martyn Clark and Dr. Andy Wood (National Center for Atmospheric Research)
Dr. Bart Nijssen (University of Washington)
Dr. David Rupp (Oregon State University)

Communications and Technology Transfer

Conference presentations at the American Geophysical Union (AGU), American Society of Civil Engineers (ASCE) Environmental and Water Resources Institute (EWRI) meetings, and BPA River Management Joint Operating Committee (RMJOC) meetings

Future Assessment Need

- SECURE Water Act Section 9505 directs 5-year assessment until 2023 (same with Reclamation's 9503 assessment)
 - FY18: Initial methodology development
 - FY19: Simulation and analysis
 - FY20: Report development and external review
 - FY21: DOE concurrence review
 - March 2021: deadline for the third report to Congress.
- ORNL to continue the coordination with Reclamation, USACE, and other partners through the federal Climate Change and Water Working Group for further hydro-climate research activities.