



# Climate Resilient Planning For the Energy System In California

Guido Franco

Team Lead for Climate Change and  
Environmental Research

California Energy Commission

NASA Energy Management  
Stakeholder Ideation Workshop

April 27, 2016

Arlington, VA

# Outline

- Brief introduction about the California Energy Commission (CEC)
- Description about CEC work related to climate adaptation for the energy sector
- Adaptation to climate variability using satellite products

# California Energy Commission

- The CEC is the lead energy planning agency in California.
- The CEC manages the following programs:
  - Permitting of thermal power plants larger than 50 MW.
  - Setting and enforcing of CA energy standards for buildings and appliances.
  - Support of energy efficiency and renewable programs with grants and loans for all the components of the energy sector.
  - Support energy research with a total budget of more than \$200 million a year.

# CEC and Energy Adaptation

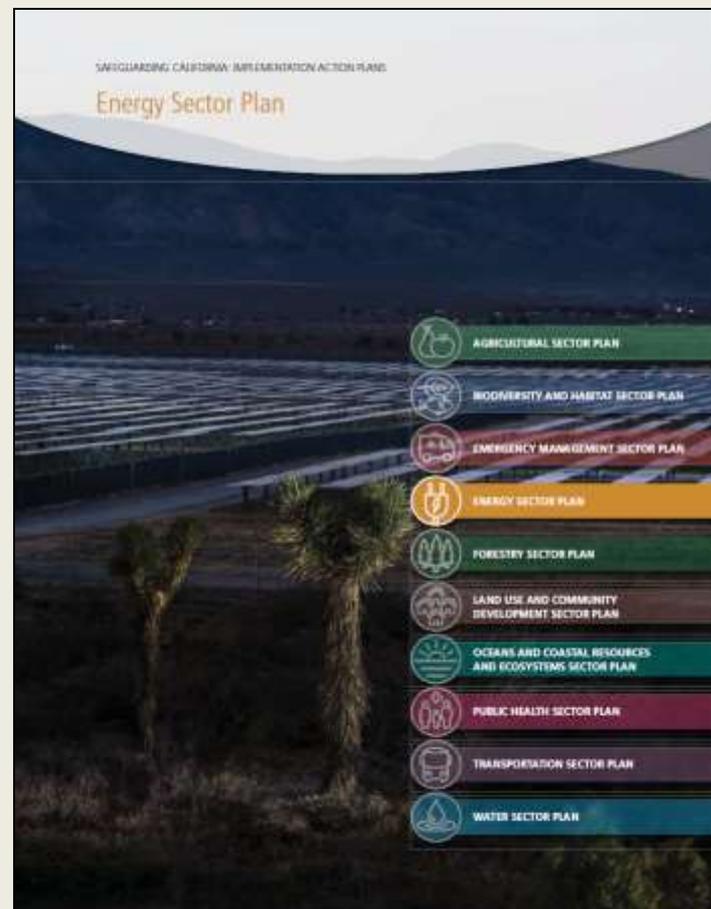
- CEC has been supporting regional climate change science since the early 2000s to complement federal efforts.
- The CEC led the preparation of climate assessments that have been very influential in policy circles in California (e.g., passage of AB32, adaptation work).
- The State is now preparing California's Fourth Climate Assessment



# CEC and Energy Adaptation (cont.)

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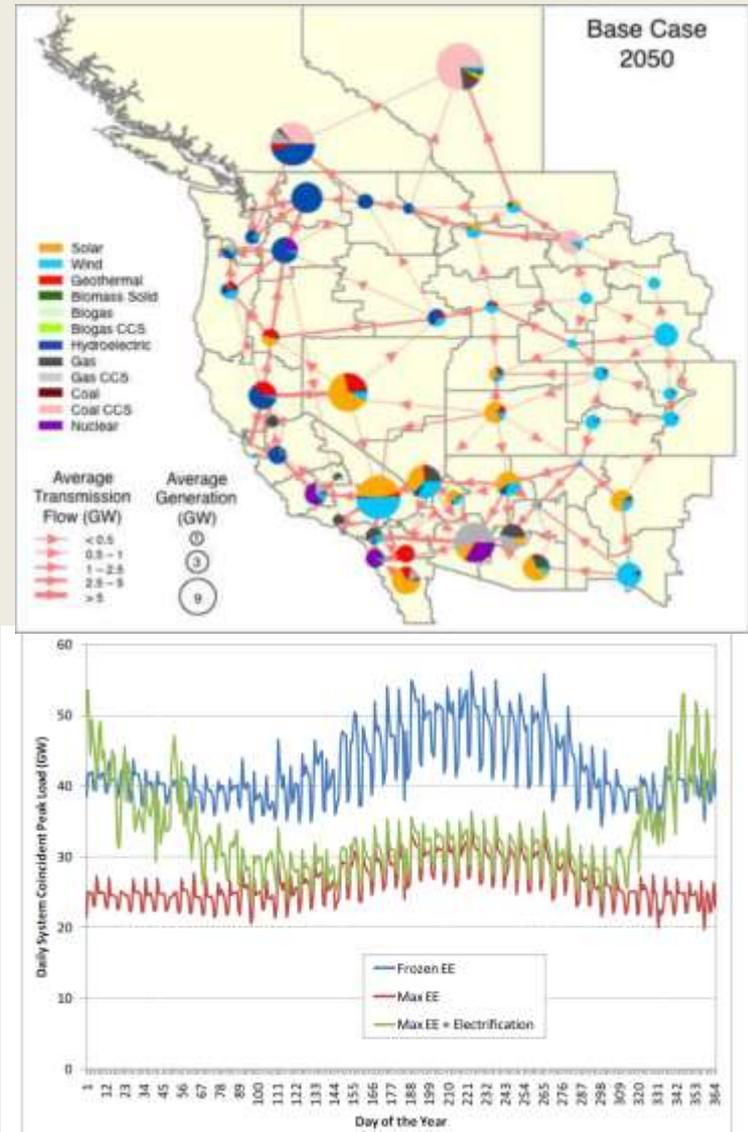
- CEC and CPUC are working very closely on adaptation for the energy sector.
- Formation of Climate Adaptation Working Group by the CEC and CPUC.
- Three adaptation Bills were signed into law by the Governor in late 2015.



# Transformation of the Energy System

- The electricity system is changing very rapidly (e.g., 50% generation from renewables by 2030)
- This represents an opportunity to develop a more climate resilient system using:
  - Microgrids that protect important services/areas
  - Smart grid
  - Distributed generation
  - Other features
- On-going research project with LBNL, UC Berkeley, UC Irvine, and E3 to explore long-term climate scenarios with **deep GHG reductions that are less vulnerable to climate impacts.**

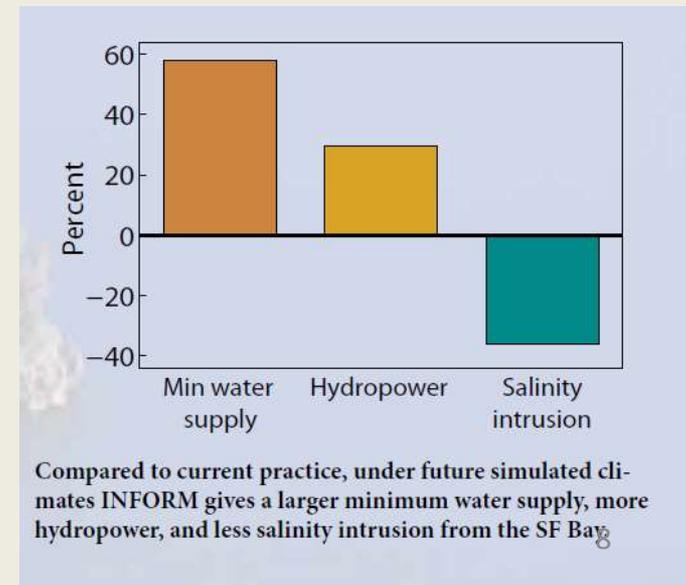
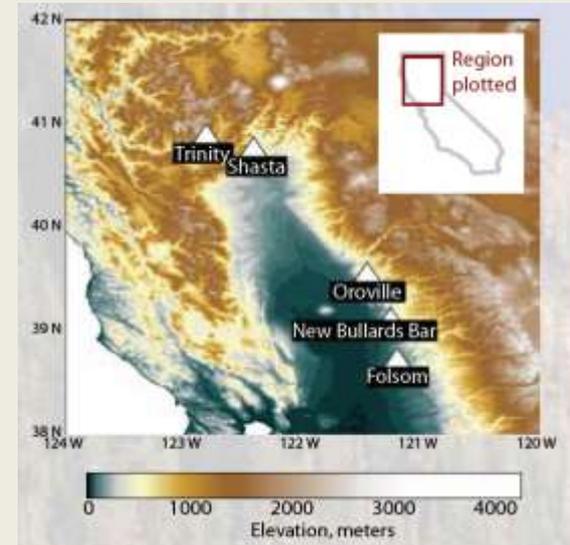
Source: Wei et al., 2012



Adaptation to Climate Variability Now  
is a Good Starting Point to Adapt to  
Climate Change and Potential  
Increases in Climate Variability

# Multipurpose Water Reservoirs

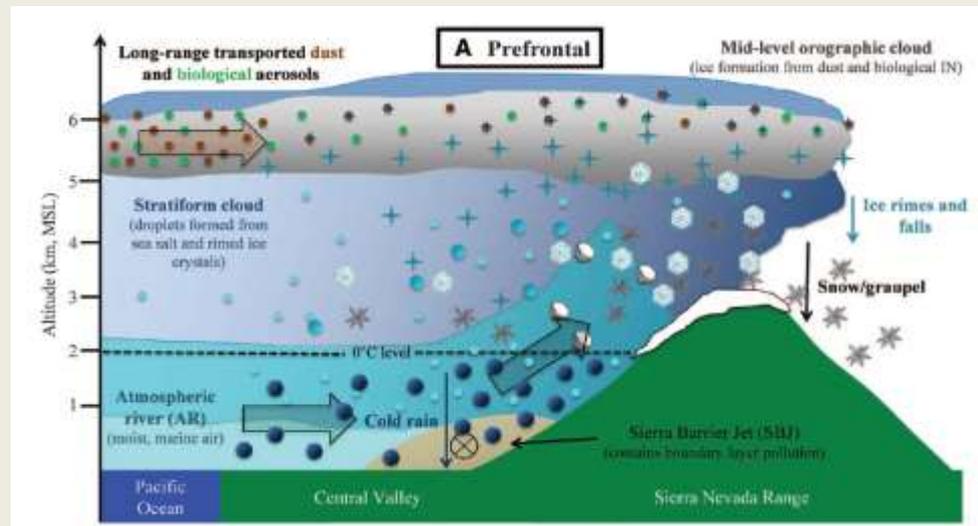
- INFORM, a project supported by NOAA and CEC, conclusively showed that the use of probabilistic forecasts and a modern decision system could significantly improve the management of water resources.
- INFORM was also shown to be an excellent climate adaptation tool
- The problem is the lack of resources to change the existing operating rules.



# Aerosols Play a Significant Role in California's Climate

- CalWater I, a study funded by the CEC, conclusively demonstrated the importance of intercontinental transport of aerosols to precipitation in the Sierra Nevada\*.
- Satellite data was used to track the transport of dust/bacteria, which are excellent ice nuclei.
- Models digesting satellite aerosol data could substantially improve forecasts.
- Regional climate models do not consider the impacts of aerosols in our climate.

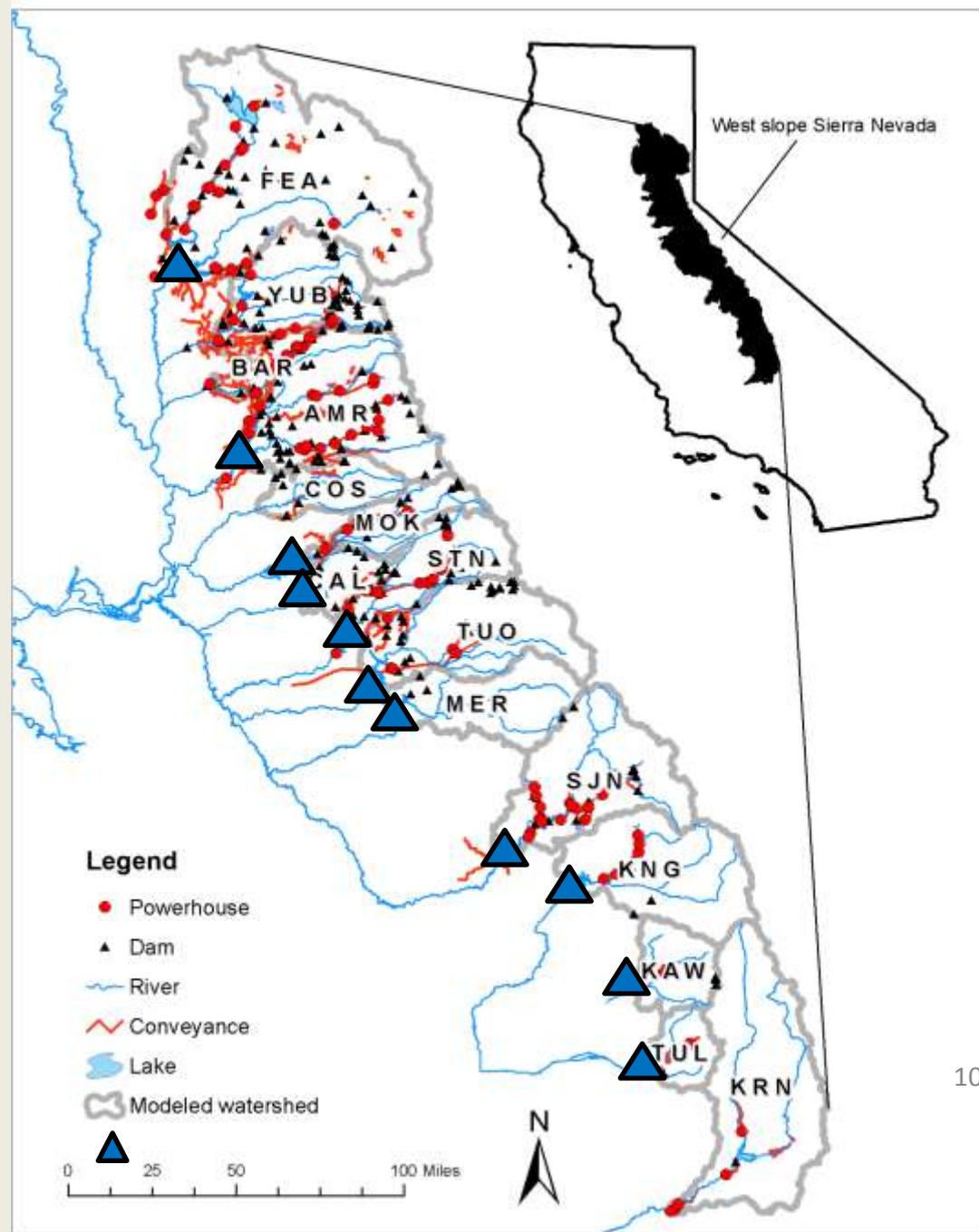
Creamean et al., Science 2013



\*Aerosols of local origin mostly act as CCN

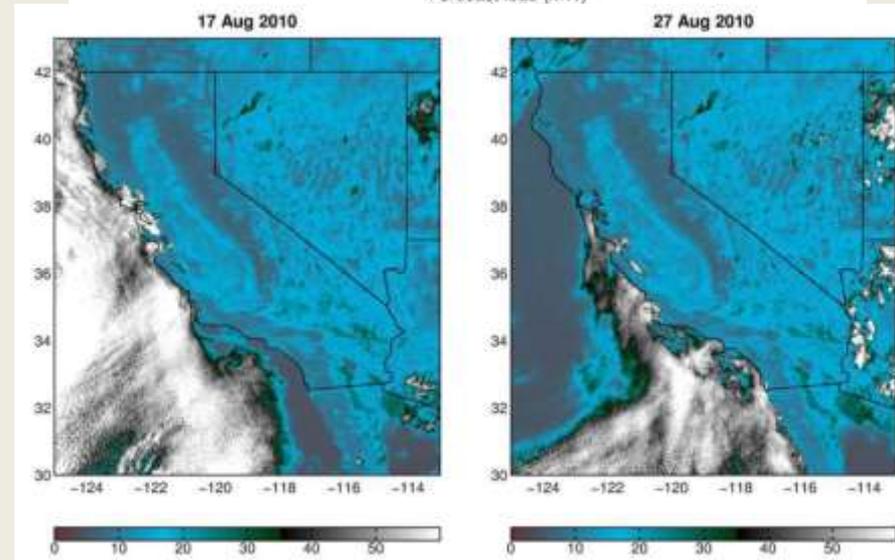
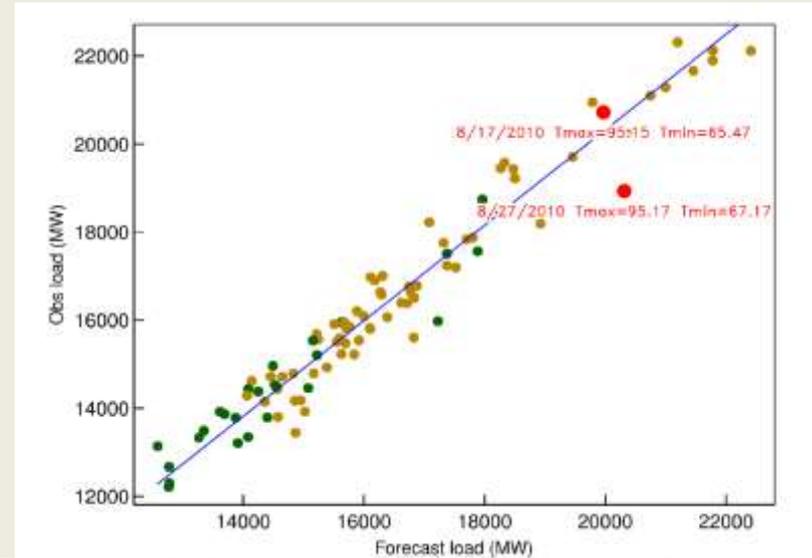
# Hydropower

- **Potential Impacts of Climate Change:**
  - Overall reductions in generation
  - Less generation available in the summer. Shift to generation in the winter
- **Improved forecast will improve the management of high elevation hydropower units**
- **Use of satellite to better estimate the water content in the snowpack could substantially improve the management of water resources and hydropower generation in particular. On-going work with NASA/JPL**



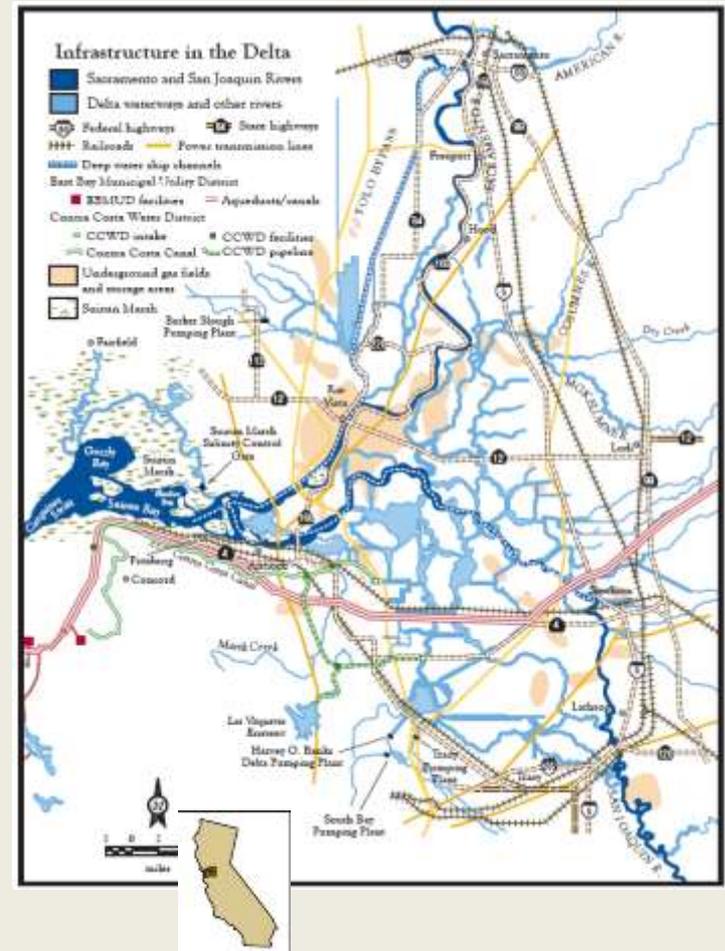
# Errors in Peak Load Forecasting and Clouds

- Some forecast errors of peak electricity demand are due to the presence of low clouds.
- GOES satellite readings can provide early morning observations about low clouds.



# Natural Gas System

- The Sacramento-San Joaquin Delta is protected by levees. Delta islands are below sea level
- Energy Facilities:
  - Underground natural gas reservoirs
  - Transmission lines
  - Natural gas pipelines
- Dr. Ben Brooks (USGS) showed that the levees may be subsiding at rates similar to sea level rise but in the opposite direction, thereby increasing relative water levels.
- Advanced airplane and satellite measurements to track vertical movement of levees.



# Thank you!

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