Science, Policy, Planning and Competing Goals in River Management

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Water and Environment EPSCoR States - Trivia

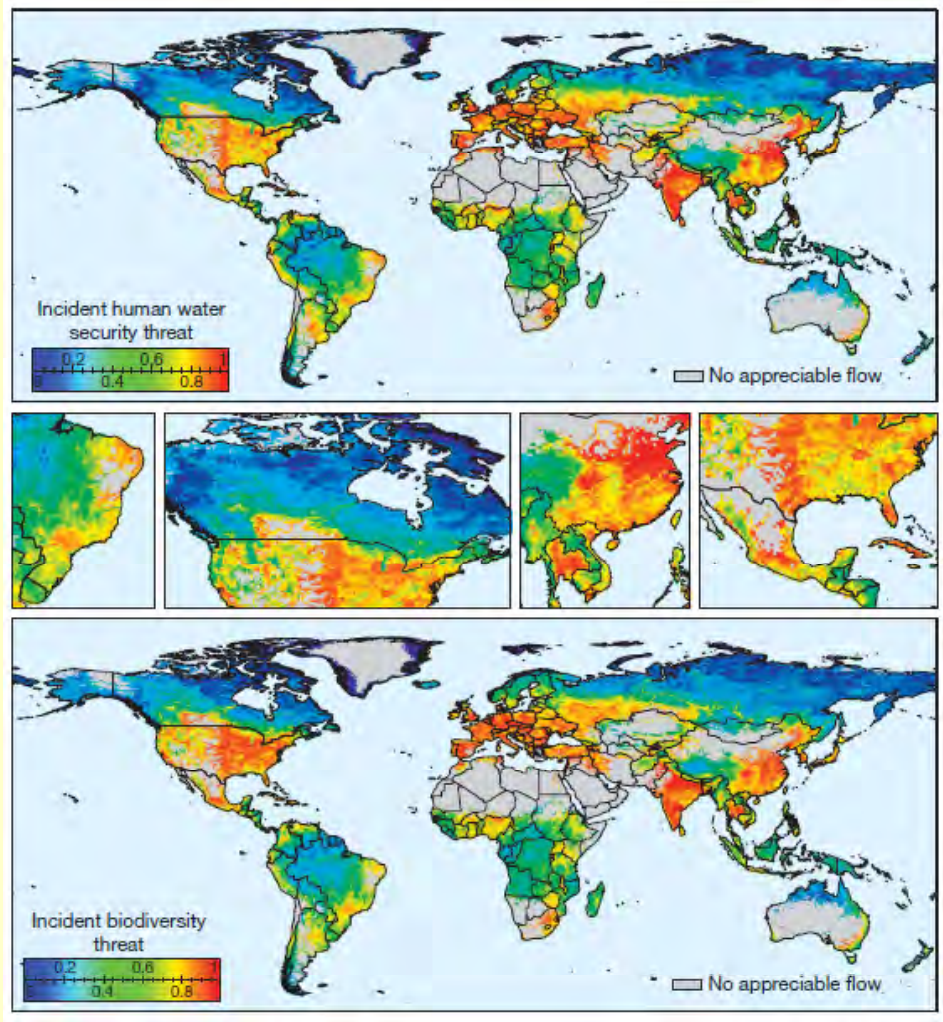
1. Two driest states in US
2. Five states with highest per capita withdrawals
3. Two states with the highest freshwater fish diversity

Water and Environment Plenary Session – October 25, 2011

- **Sharon Nunes – Information technology and sustaining water systems**
- **Breck Bowden – Emerging technologies and approaches in watershed research**
- **Sibel Bargu – Recent discoveries at the land-water interface**
- *Cliff Dahm – River management focusing on science, technology, policy, and competing goals*

Dual Challenge to Rivers Worldwide

- **Rivers are the chief source of renewable freshwater supplies for humans and contain high levels of biodiversity**
- **80% of the world's population is exposed to high levels of threat to water security**
- **65% of riverine habitat is moderately to highly threatened**



Vörösmarty et al. 2010 (*Nature*)

Major Threats to Rivers

- **River Biodiversity**
  - Destruction or degradation of habitat
  - Impacts from overexploitation (overfishing)
  - Invasion by non-native species
  - Water pollution
  - Flow modification
- **Water Supply**
  - Climate change
  - Climate variability
  - Salinization
  - Water pollution

Current NM EPSCoR Project

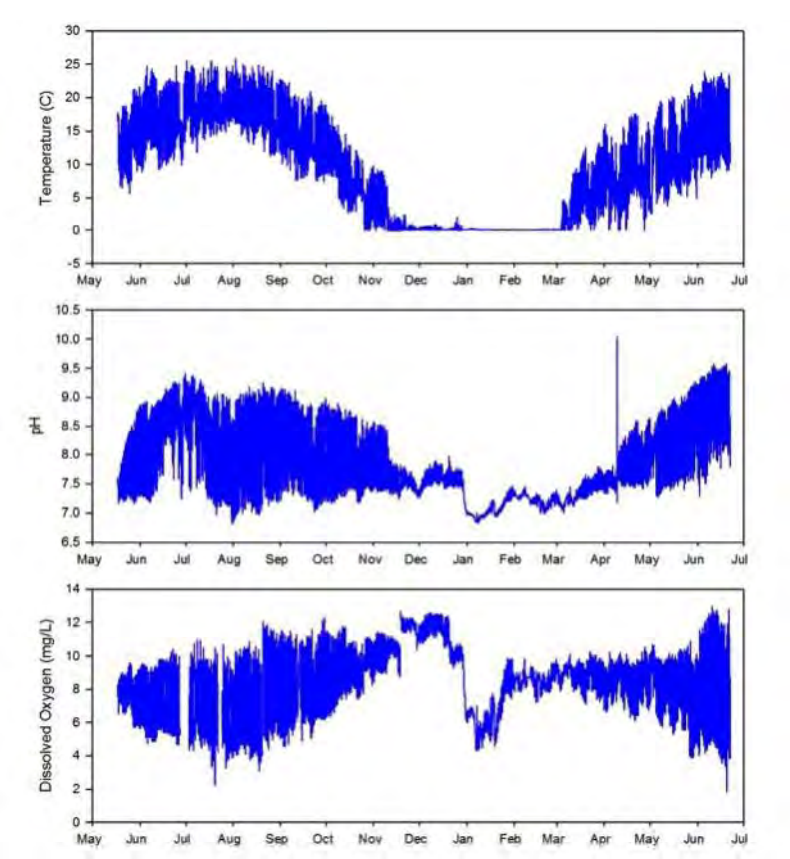
<u>Climate Impacts on New Mexico's Mountain Sources of Water</u>

Climate variability and climate change impacts on water quantity and water quality – catchment effects and feedbacks

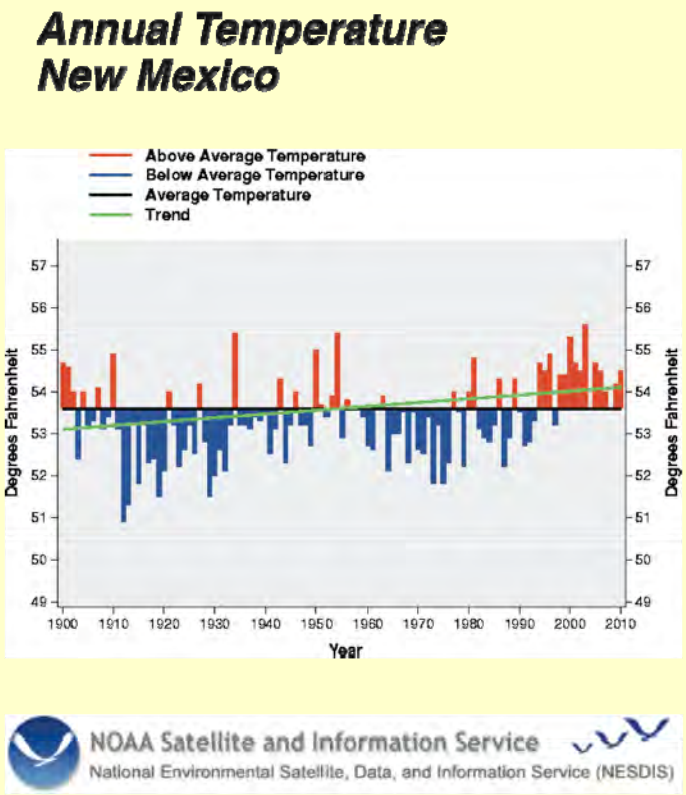
Linking Hydrology and Water Quality

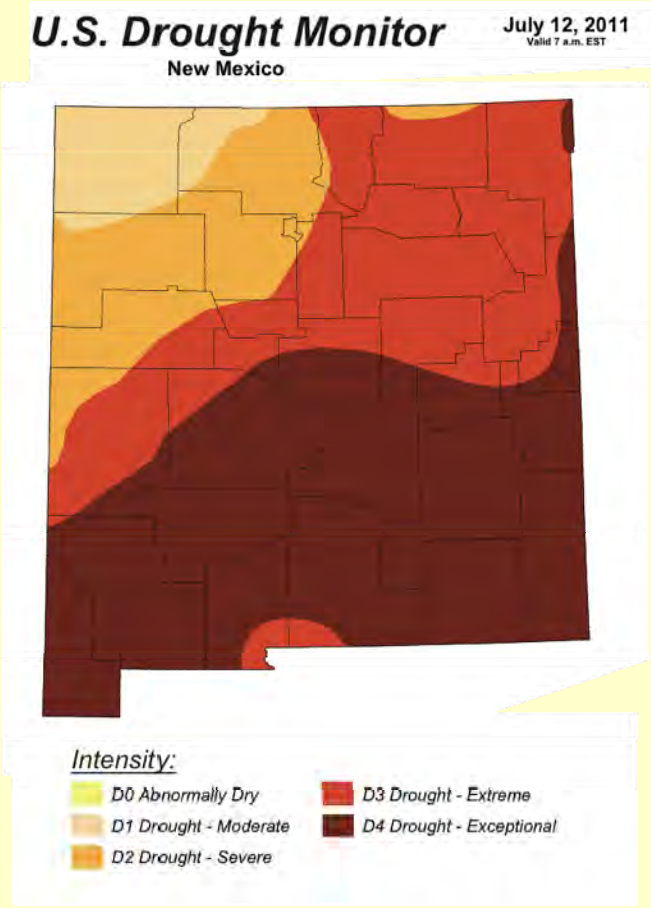
- **Multi-year, year-round, real-time, water quality monitoring in streams and rivers fed by snowmelt**
- **Synoptic sampling of surface water (SW) and groundwater (GW) and to quantify seasonal dynamics of SW/GW exchanges**

East Fork Jemez
Multi-year continuous data (T, pH, and DO)



New Mexico Climate Trends





Las Conchas Fire – New Mexico 2011

Largest recorded NM Fire

High Intensity Forest Fire

Rapid Grassland Recovery

July 6, 2011 **August 3, 2011**

Dramatic Water Quality Effects

Post-fire Summer Monsoon Flows

Flood Effects on River Water

Erosion and Fish Kills

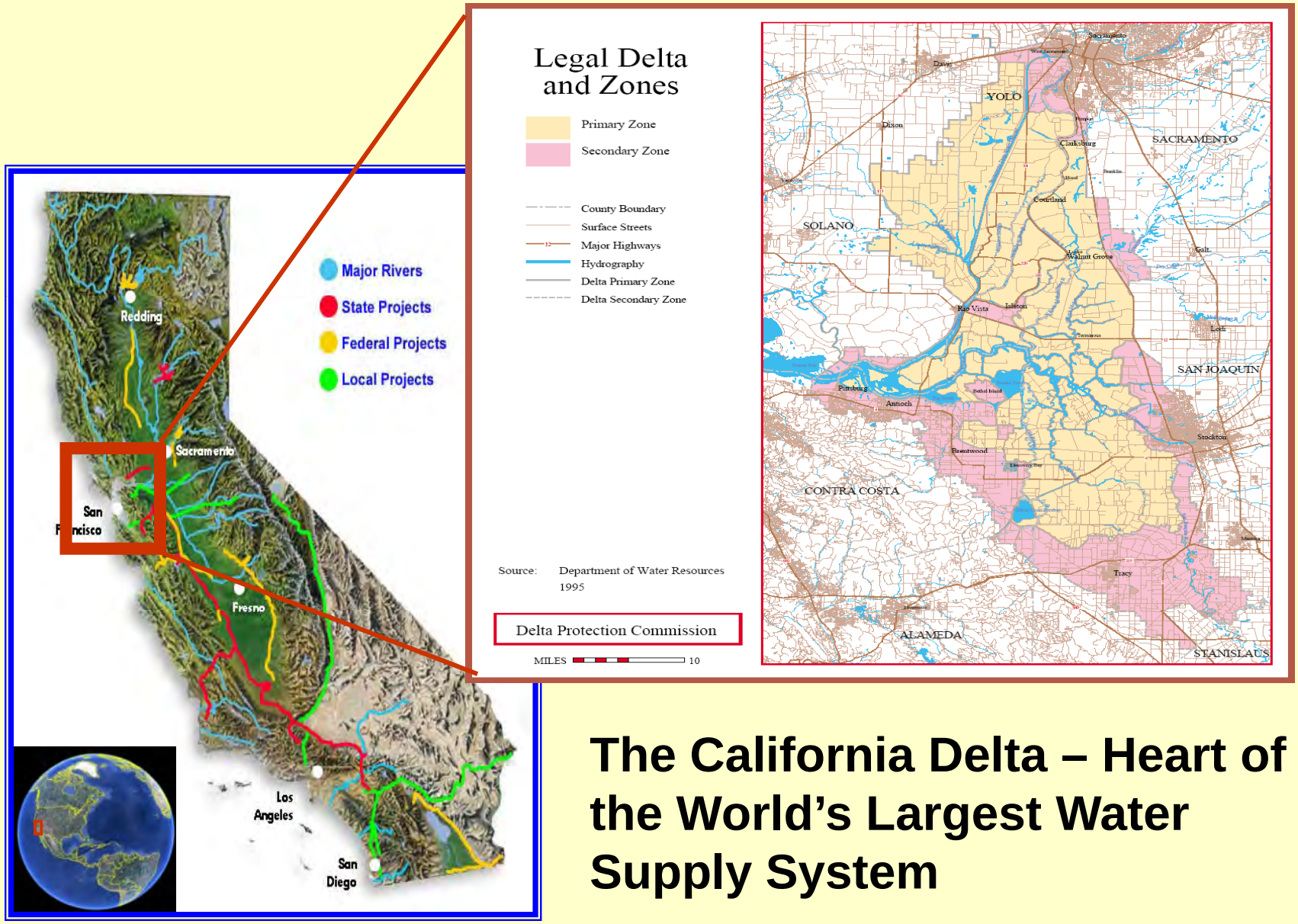
Indios Creek – July 29, 2011

Post-flood Fish Kills

Turning lemons into lemonade – Fire effects on New Mexico's water supply.

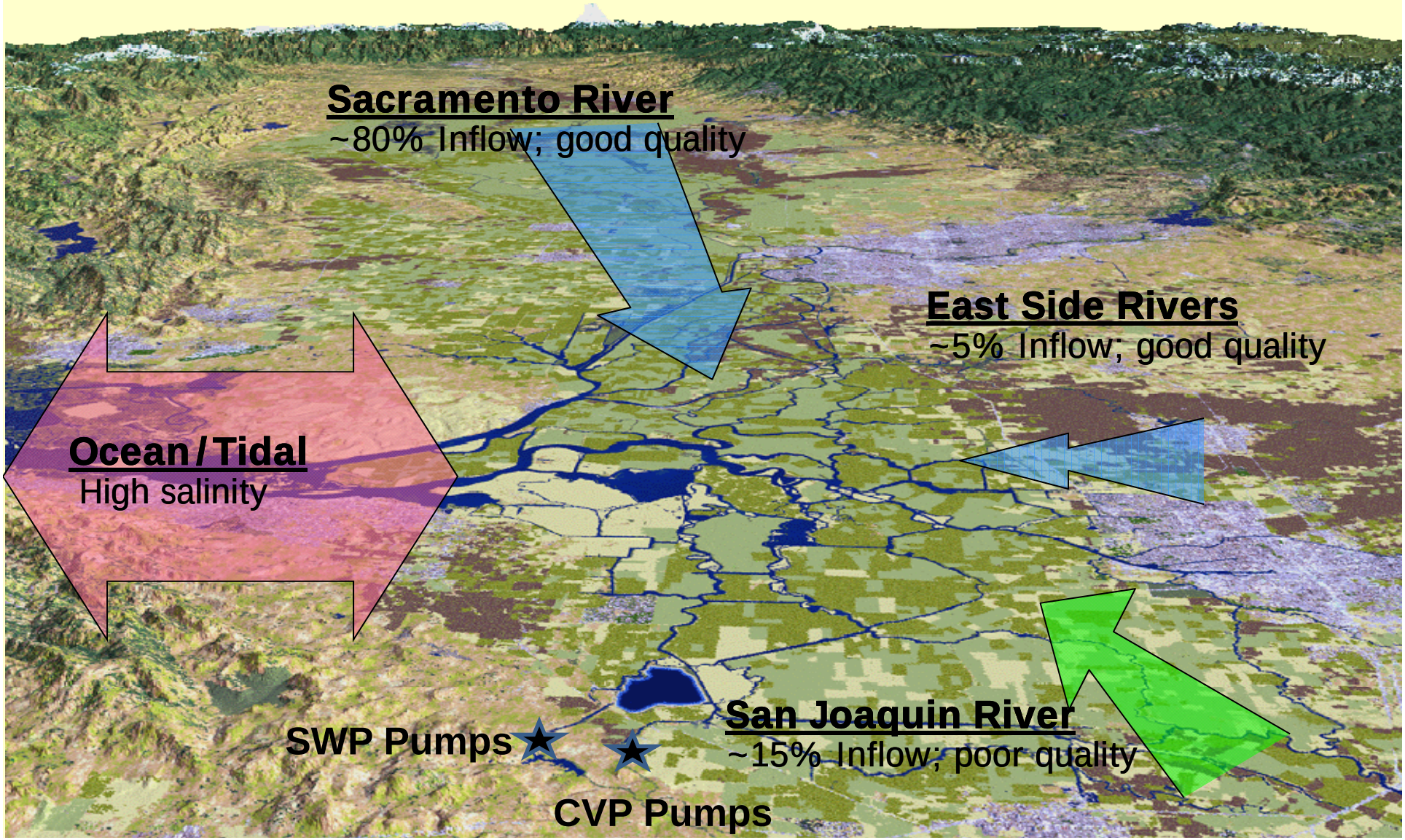
Turning improved research infrastructure and information into public policy.

The California Delta – Science and Policy

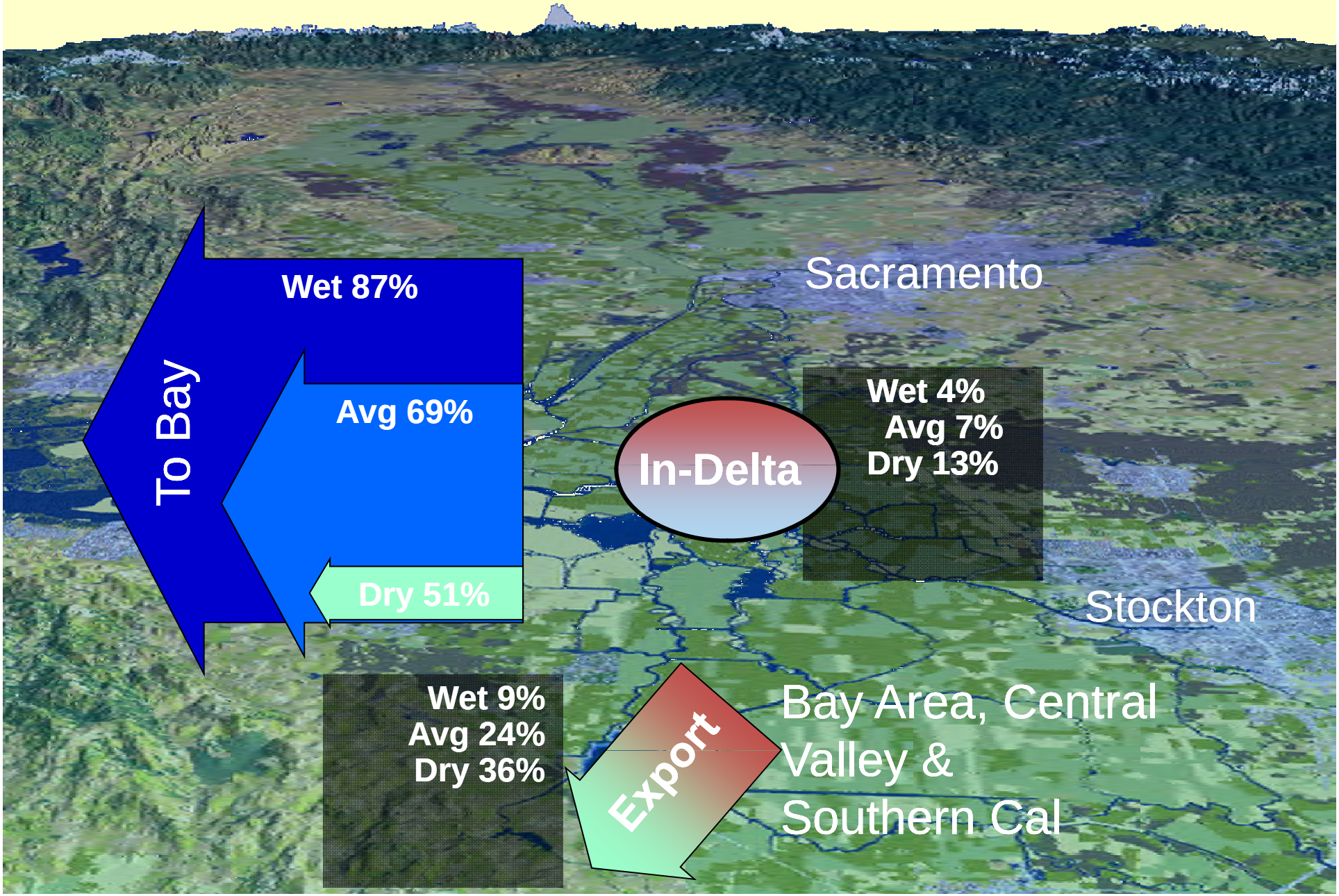


The California Delta – Heart of the World's Largest Water Supply System

Delta Inflow – River Inputs



Delta Outflows

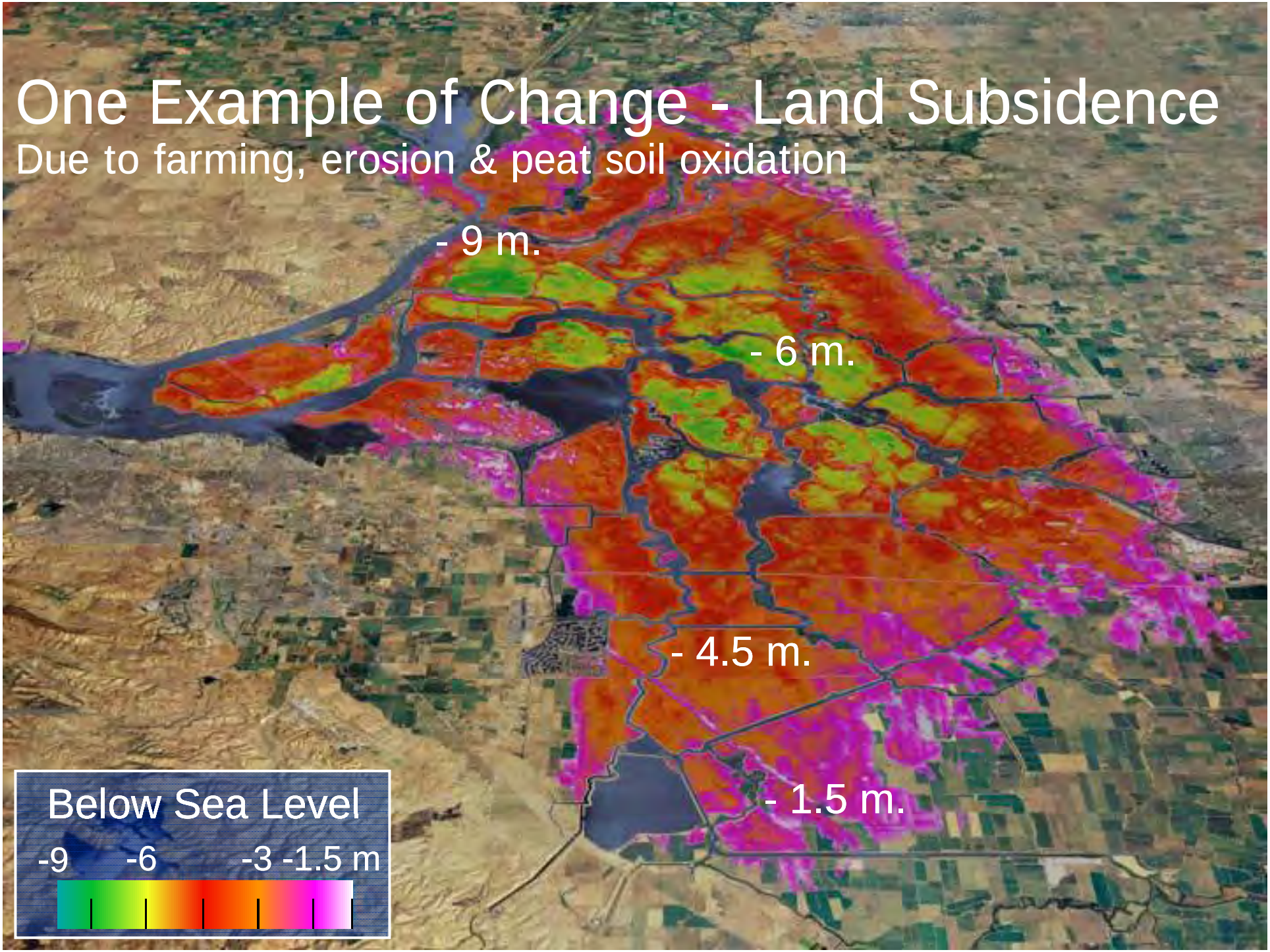


A Changing Delta

- **Six key 'drivers of change' are impacting Delta sustainability:**
  - **Climate Change**
  - **Earthquakes**
  - **Invasive Species**
  - **Land Subsidence**
  - **Population Growth**
  - **Sea Level Rise**

One Example of Change - Land Subsidence

Due to farming, erosion & peat soil oxidation



2009 State of California Legislation
The Coequal Goals

- "'Coequal goals' means the two goals of providing a <u>more reliable water supply</u> for California and <u>protecting, restoring, and enhancing the Delta ecosystem</u>. The coequal goals shall be achieved in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place." *(California Water Code §85054).*

The Delta Stewardship Council

- Created by the state legislature in 2009
- Comprised of seven members
- Supported by independent science experts

Delta Plan

- Legally enforceable policies
- Management plan for the California Delta to 2100
- To be completed by January 1, 2012
- Updated at least once every 5 years

Science in the Delta Plan

- Delta Science Program Contributing to
  - Chapter 2 – Science and Adaptive Management for a Changing Delta
  - Chapter 4 – A More Reliable Water Supply for California
  - Chapter 5 – Restore the Delta Ecosystem
  - Chapter 6 – Improve Water Quality to Protect Human Health and the Environment
  - Chapter 7 – Reduce Risks to People, Property, and State Interests in the Delta

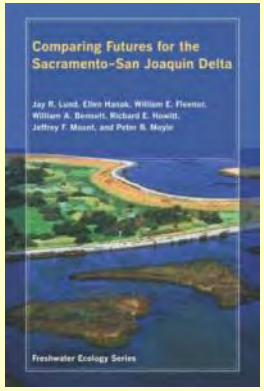
Adaptive Management and the Delta Plan

"Include a **<u>science-based</u>**, **transparent**, and formal **<u>adaptive management</u>** strategy for ongoing ecosystem restoration and water management decisions." (Water Code §85308(f))

"'Adaptive management' means a framework and **flexible** decision-making process for ongoing **knowledge acquisition**, **monitoring**, and **evaluation** leading to **continuous improvements** in management **planning** and **implementation** of a project to achieve specified objectives." (Water Code §85052)

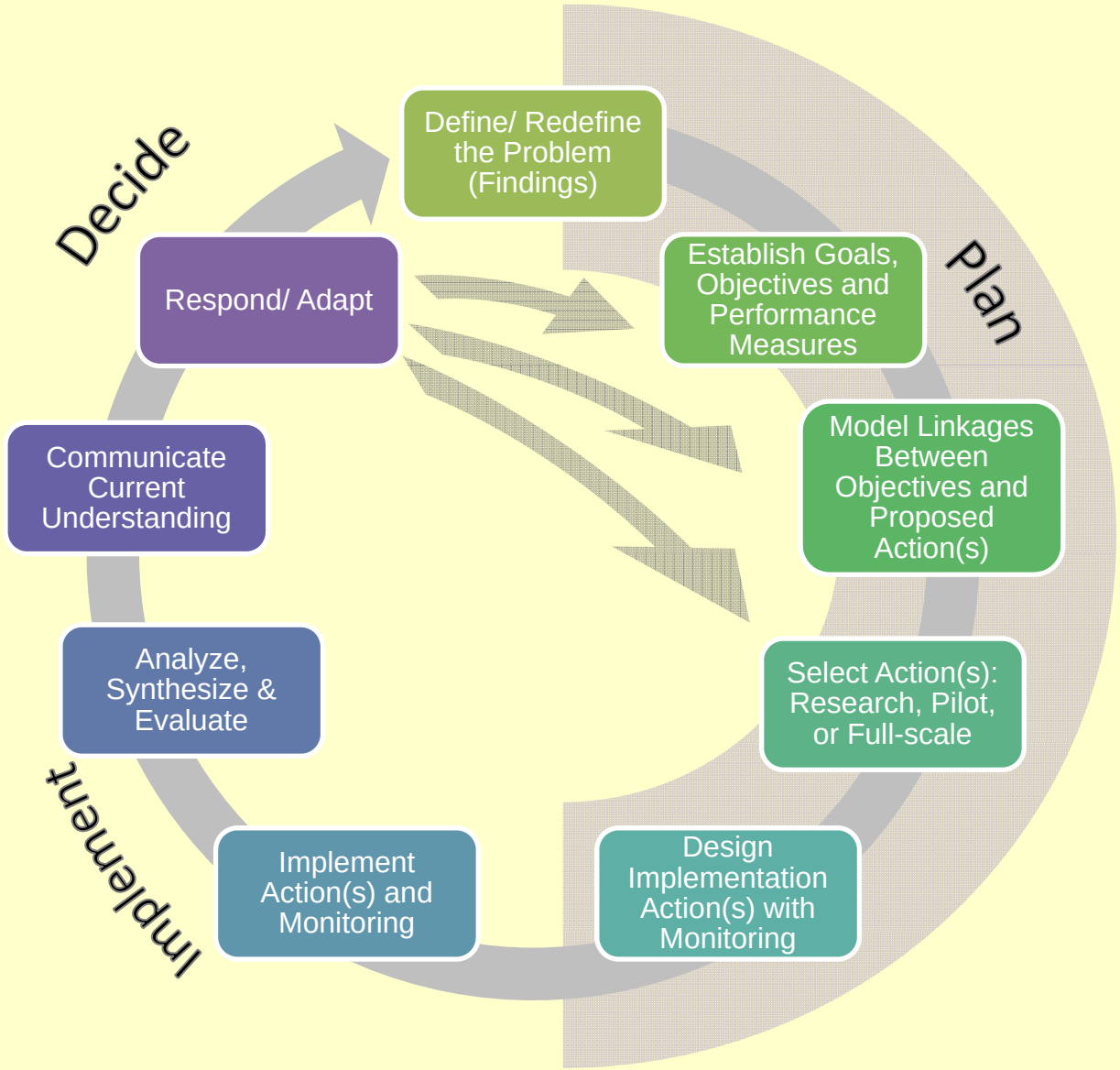
Adaptive Management Definitions

"[A] Framework of on-going **knowledge acquisition**, **monitoring**, and **evaluation** leading to **continuous improvement** in the identification and implementation of management" (Healthy Waterways Initiative 2005)



"A **flexible**, **learning-based** management approach in which natural systems are managed to ensure their **recovery and improvement**, while an **understanding** of how these systems function is developed to **raise the effectiveness** of **future** management actions." (Lund et al. 2010)

Adaptive Management Framework



The role of science in decision making: does evidence-based science drive environmental policy?

- **Likens, G. E. 2010. in Frontiers in Ecology and the Environment 8:E1-E9.**
  - Considerable time may elapse between detecting environmental problems and taking political action
  - Dealing with human-accelerated environmental changes requires better communication among scientists, managers, policy makers, the media, and the public
  - Scientists need to demonstrate ethical behavior and have unassailable data, perseverance, and good communication skills.