An Overview of Collaborative Approaches for Integrated Modeling: What We have Learned

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with selected slides from Peter Goodwin and Tetratech

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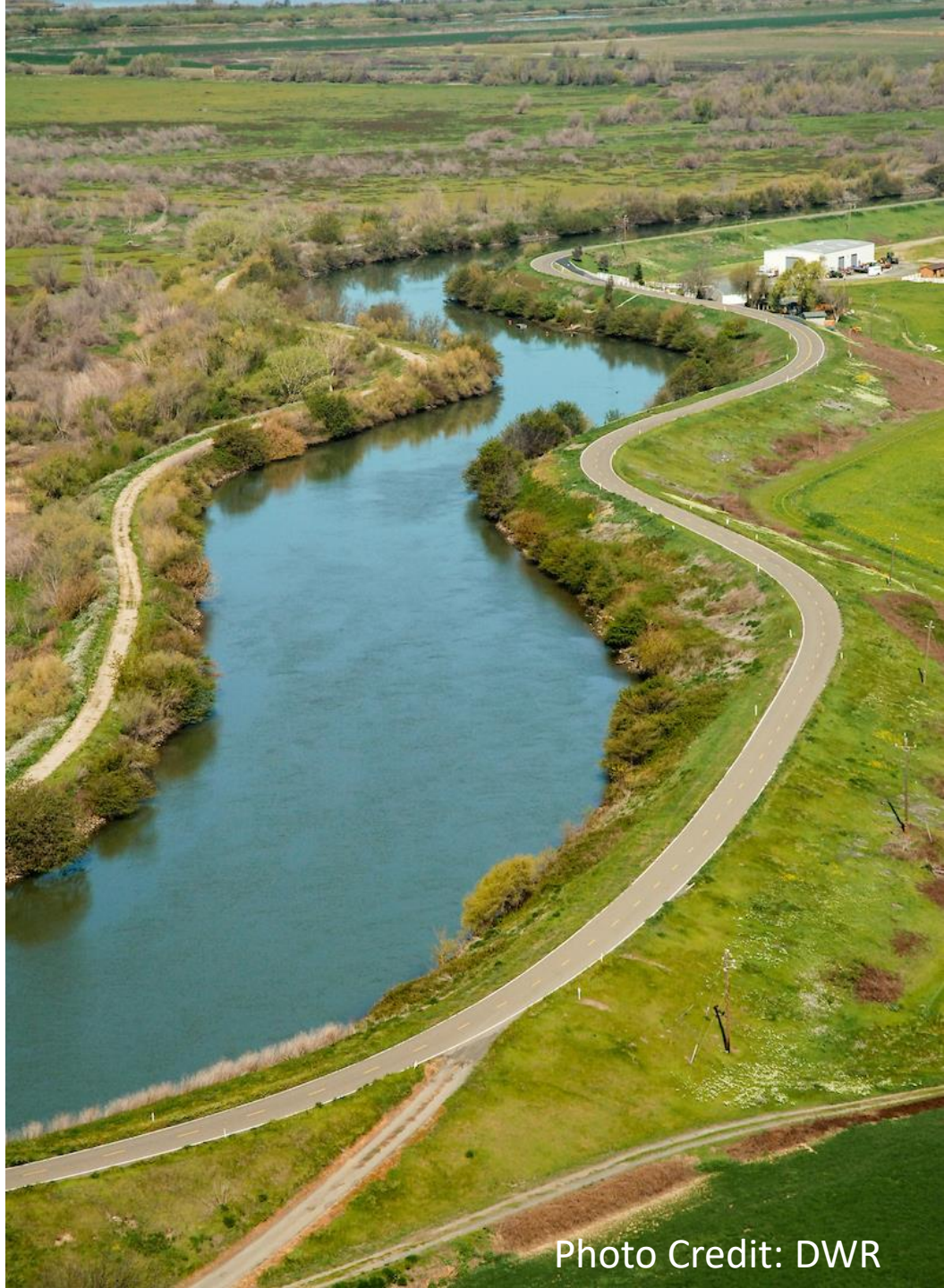
UCMERCED NSF TETRA TECH UCDAVIS CENTER FOR WATERSHED SCIENCES UC MERCED WATER SYSTEMS MANAGEMENT LAB

Integrated Modeling: Motivation and Initial Efforts

- Complexity of estuarine systems that are highly disturbed and dynamic.
- Modeling efforts have improved understanding of physical, biological and chemical aspects
- Multiple disciplines and institutions have steered management towards fragmentation
- Integrated modeling allows interdisciplinary cooperation and better decision-making.
- A workshop convened by UC Davis CWS, in collaboration with CWEMF, NSF, DSC in May 2015
  - Academia, Agencies, NGOs, industry, practitioners
  - Community modeling, public domain, integrated modeling



Integrated Modeling Workshop Findings

1. Estuaries involve many processes, objectives, disciplines and interests, which makes their **analysis difficult technically and institutionally.**

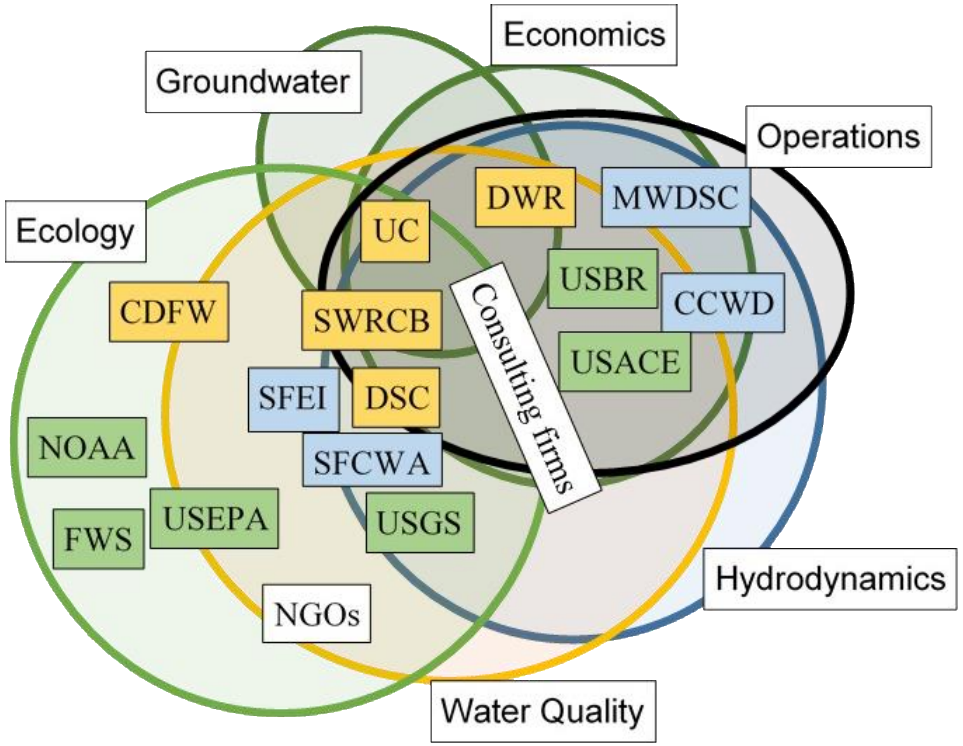
2. **Modeling frameworks are helpful** for understanding individual processes and aspects in estuaries, and for organizing information and discussions

3. **Newer technical and institutional approaches** are available to model more complex models, and may **reduce disciplinary and institutional fragmentation** of science, management, and policy discussions.

4. Problems of management and policy for estuaries usually must involve many interests and disciplines**. No single discipline or model is sufficient.**

5. Several **approaches** are available for developing and **interdisciplinary framework for estuarine policy and management** problems.

Major modeling organizations and areas of activity and interest



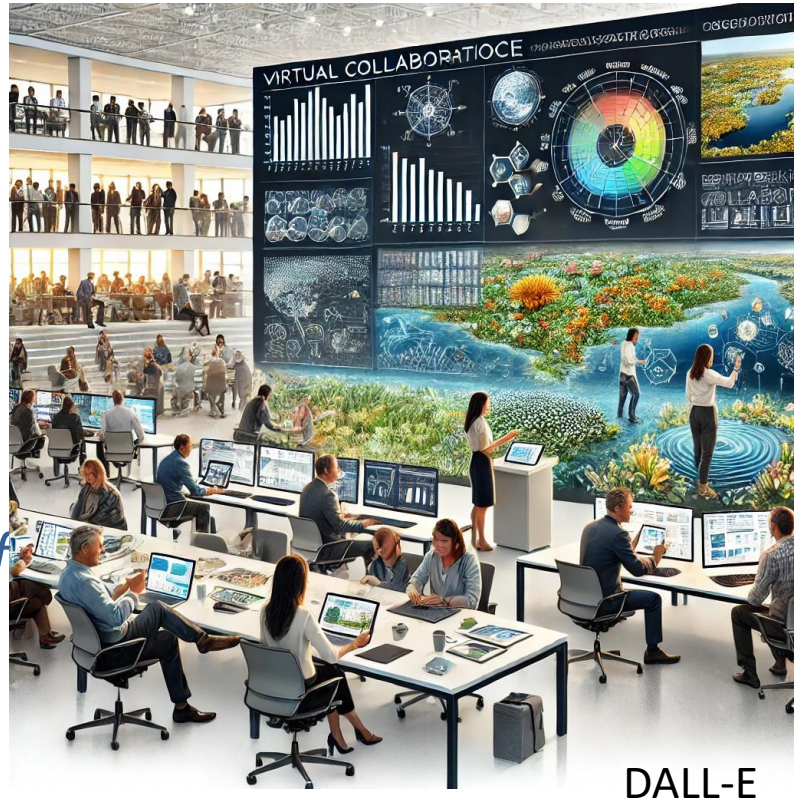
(Federal- orange, State – brown, Local – blue, Other – white)

Courtesy of Peter Goodwin

A Collaboratory Approach

A mechanism for experts to jointly develop and evaluate algorithms, explore vexing issues, quantify uncertainty (including running different models in parallel), conduct peer review and deliver predictions of alternative futures with associated uncertainty estimates.

*The **Collaboratory** provides the resources and time for creative thinking, innovation, enhanced transparency of the modeling enterprise, communication tools and mentoring or early career modelers.*



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Requires:

- Funding, leadership and
- Collaborative governance
- Physical Infrastructure
- Business capability
- IP policy for models and data
- Staff

Courtesy of Peter Goodwin

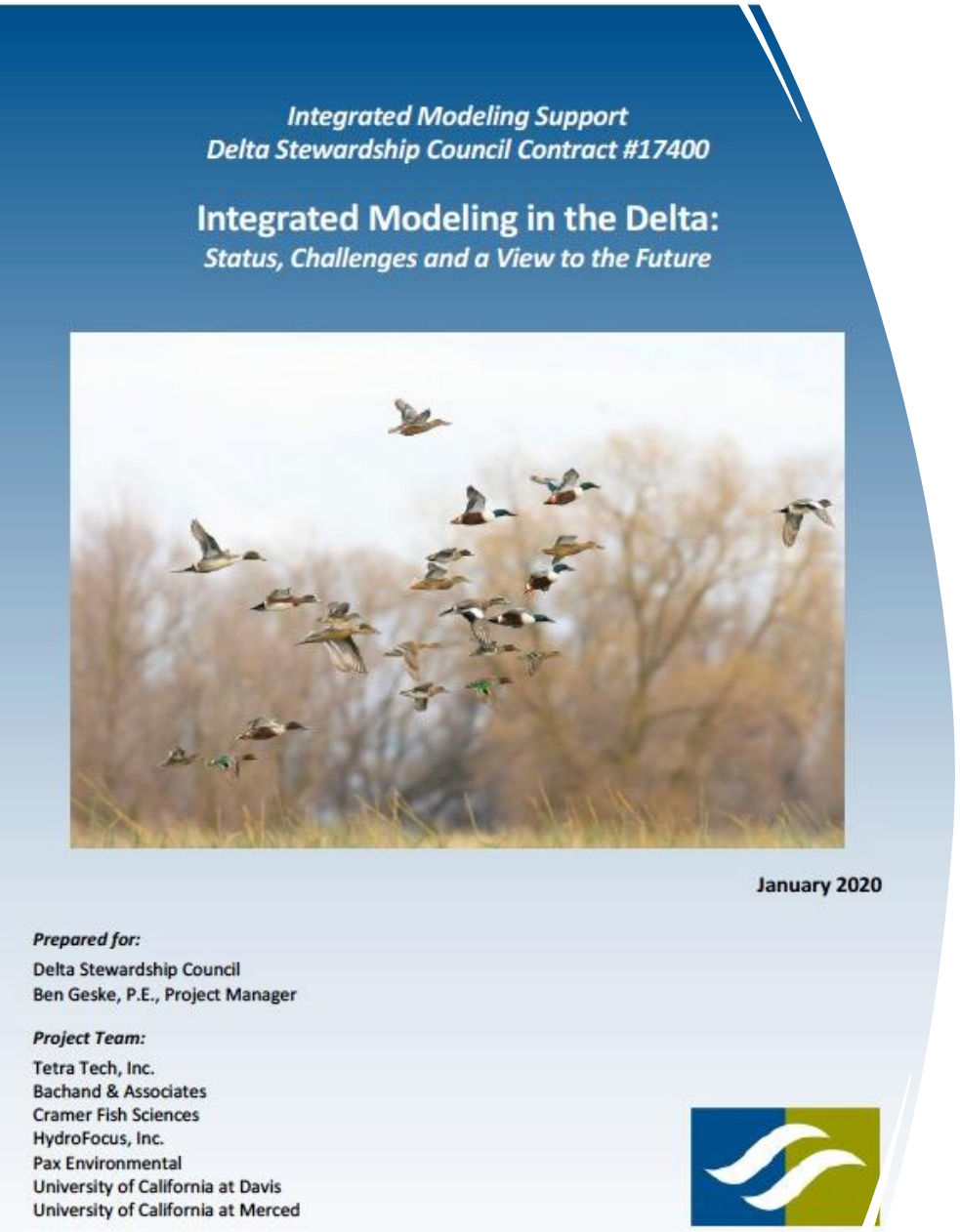
Delta Science Program
DELTA STEWARDSHIP COUNCIL

What the Collaboratory is NOT

- A single universal model, uber-database or a single approved model
- An automated decision support system
- A diminishing of agency modeling capacity or responsibilities
- A time sink of key modelers in an organization

Per Rosemary Hartman

Courtesy of Peter Goodwin



Integrated Modeling in the Delta (Geske, Tetra Tech et al. 2020)

- **Challenges** and potential solutions:
  - Institutional silos, competing needs, project driven, specialized training, funding
  - Technological compatibility, purpose, level of development, data availability, accessibility, computation, error and uncertainty analysis
- **Motivation**: regulation
- **Success**: organic, co-development, transparency
- A *tiered* Collaboratory: status quo, enhanced cooperation, virtual and physical venues

Institutional and Technological Approaches

Institutional	Technological
• Institutional commitment and funding • Community Development • Education	• Documentation and standards • Interfaces • Model data and exchange standards • Uncertainty analysis • Emulators • Big Data Analysis


Photo Credit: DWR

Integrated Modeling Cases

- Out of California
  - Chesapeake Bay
    - Long Island Sound Study
  - Center for Integrated Modeling and Analysis of Gulf Ecosystem
  - Great Lakes Restoration Initiative
  - National Marine Service
- California
  - WaterFix, Levee Assessment,
  - Socioeconomic
  - Bay Delta Water Quality
  - Water Rights Consumptive Use
  - Delta Smelt
  - Central Delta
  - EcoRestore
  - Yolo Bypass
  - CASCADE
  - Climate Vulnerability
  - FlooDMAR

Elements, Institutional structure, use in decision making, Stakeholder involvement, software and data management, time and budget, challenges in integration, future needs.

Some recent efforts and accomplishments

- Sponsored open access visualizations
  - Shiny Application
  - Delta Science tracker
- Theme-based workshops
- Inclusion of Social Science and EJ aspects
- Upcoming Integrated modeling strategy document: *A Collaboratory to Support Decision Making for Adaptive Stewardship in the Sacramento-San Joaquin River System*

Future Directions and Data Infrastructure

Better data infrastructure, long-term observational databases, and shared data platforms.

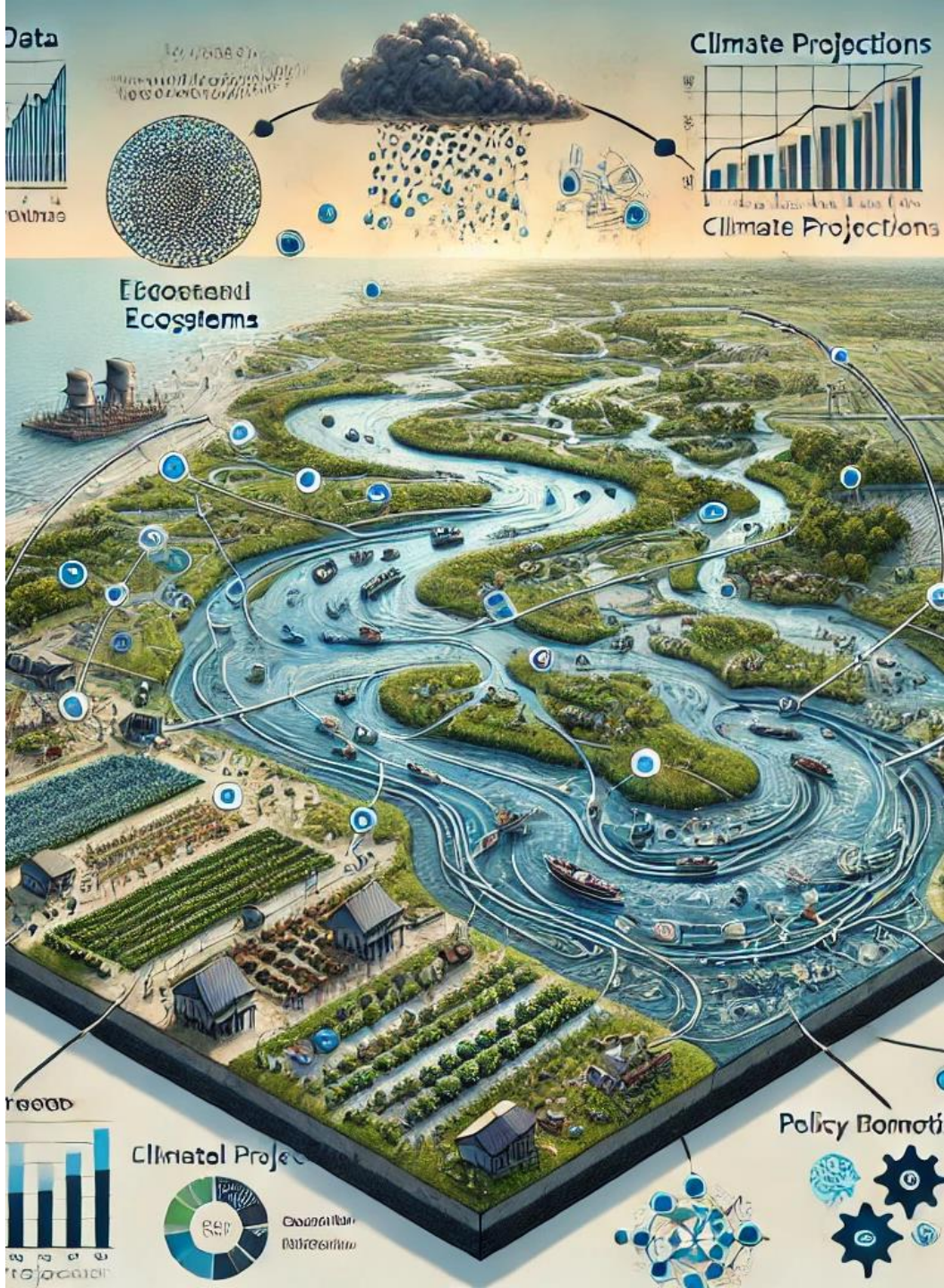
Adaptive management through real-time data.

Interdisciplinary training and user-friendly decision-support tools.

Participatory Science and Modeling

Social Sciences and EJ Considerations

Artificial Intelligence



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