A remote sensing and climate based CVP temperature model

Eric Danner
University of California Santa Cruz
NMFS Fisheries Ecology Division

Background

NASA Earth Sciences – improve existing Decision Support System (DSS) – use of NASA data

CVP OCAP, BA, BO – water management decisions regarding anadromous fish

- Temperature models
- Fish mortality models

Increase the resolution of the existing water temperature and fish mortality models

Improving Stream Temperature Predictions for River Water Decision Support Systems

Eric Danner, UC Santa Cruz, PI
Steven Lindley, NOAA NMFS SWFSC, Co-I
Rama Nemani, NASA Ames Research Center, Co-I
Balaji Rajagopalan, University of Colorado, Co-I
Forrest Melton, CSUMB / NASA Ames, Co-I

NASA Applied Sciences Program

Scheduled to begin in this spring

Our model selection

Increase the temporal and spatial resolution of the current water temperature models

Real-time simulations and predictions for water releases - distant compliance points

- water management decisions

CVP: model temperatures over large areas at relatively fine scales

Approach demonstrated by Bravo (1993)

- Hot water releases from a power plant
- Prediction of temperatures at compliance points downstream

State-Space Approach

Two separate multivariate time series are modeled

1. The state: evolves over time according to a state transition process that captures the important dynamics

2. The observations: which are typically made with error and evolve in parallel to the state

State-Space Approach

1. The state: water temperatures and temperature gradients at 1km intervals along the river

2. The observations: (forcing terms) water temperature at reservoir release points, water flow, climatological variables

Kalman filter

(adjusts and updates the estimates of the state model)

Kalman Filter

Optimal estimate of the state

Assimilation of the observational data

Provides the likelihood of the data

Allows for estimates of unknown parameters (if needed)

Model

One-dimensional model of heat dispersion: advection, diffusion, and environmental heat exchange

- Physically based
- One-dimensional
- Hourly / sub-hourly time step
- 1km / 500m spatial resolution
- No reservoir component – just as inputs
- All managed rivers in CVP

Dependent (state) variables

T (temperature)
TX (the spatial gradient of *T*)

Independent variables

Flow geometry
Flow velocities
Fluid characteristics
Diffusion coefficients
Meteorological variables
Geographic location
Time

ECOCAST

Monitoring, Modeling, and Forecasting Ecosystem Change

Home | Images | Data | TOPS | Projects | Applications | Education | Pubs | People

NASA Ames Ecological Forecasting Lab

Welcome to the Ecological Forecasting Lab at NASA Ames Research Center. Our mission is to use the Terrestrial Observation and Prediction System (TOPS) to develop nowcasts and forecasts of ecosystem conditions for use in a range of applications.

TOPS is a data and modeling software system designed to seamlessly integrate data from satellite, aircraft, and ground sensors with weather/climate and application models to produce operational nowcasts and forecasts. TOPS operates at a variety of spatial scales, ranging from individual vineyard blocks to global monthly assessments of vegetation net primary production.

MODIS Aqua Image of San Francisco Bay, 13-Nov-2007

browse images & data

View Images

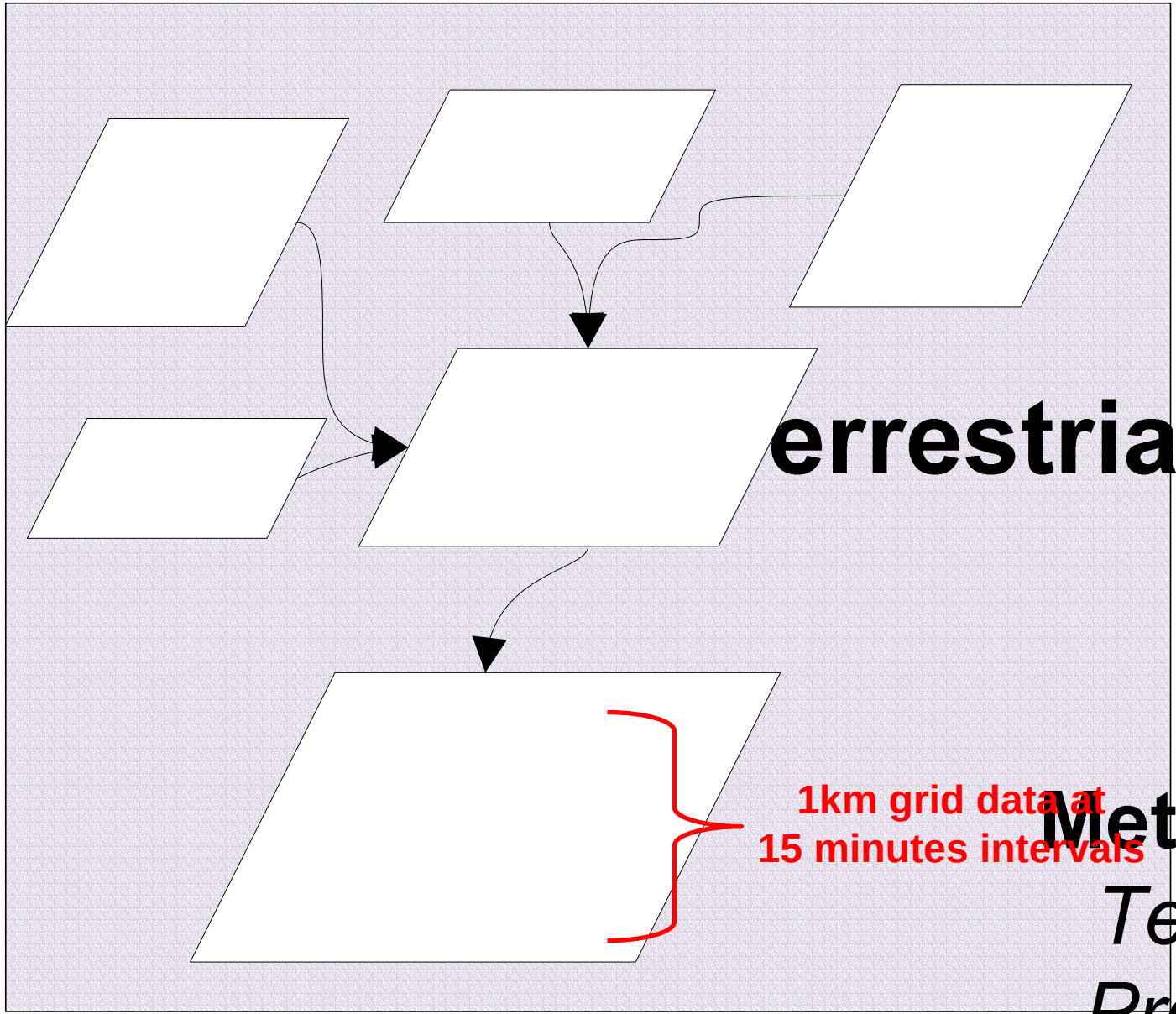
View daily updates of biospheric parameters. See below for a selection of available regions or view images here.

Regions

- Overview
- Global
- Continental U.S.
- California
- Yosemite

NASA Official: Ramakrishna R. Nemani
Curator: Forrest Melton
Privacy Statement

Last Updated: Jan 3, 2007
© 2003-2007, NASA



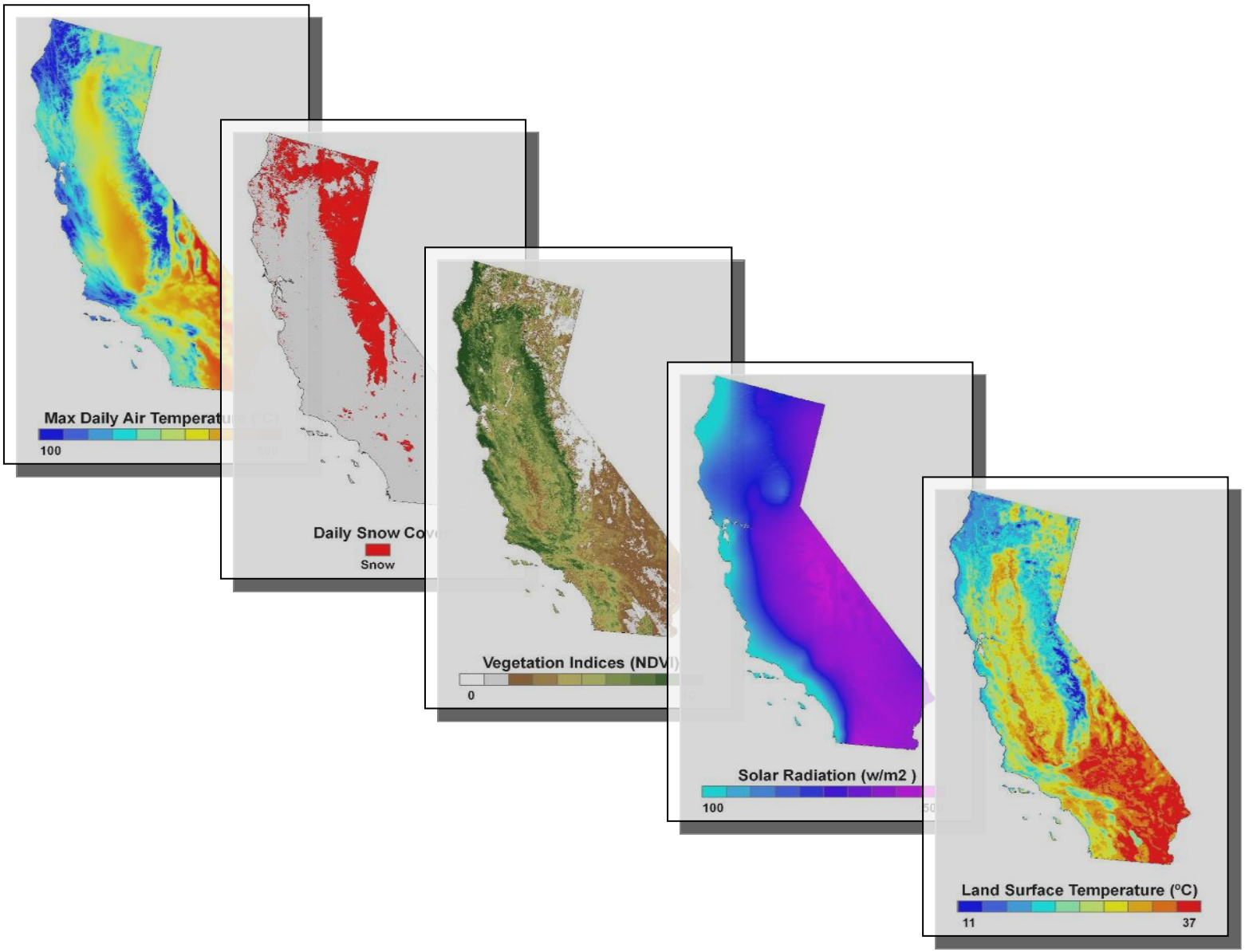
errestrial Ob

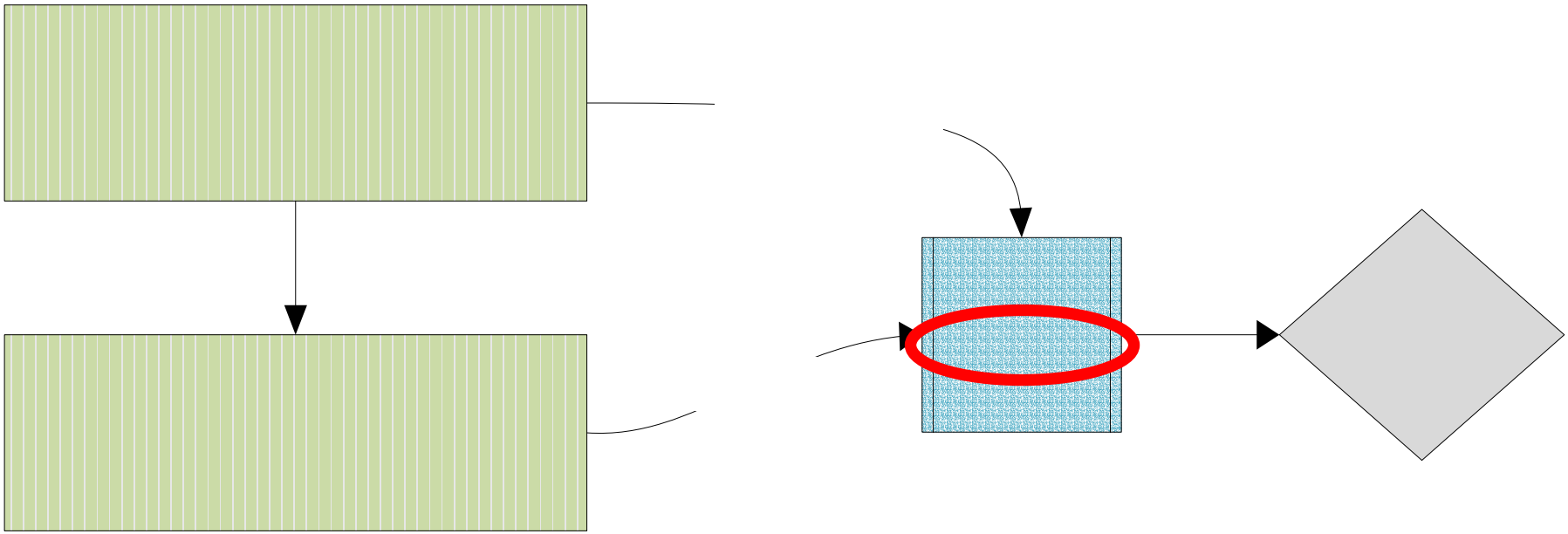
Met Obs

Temp

Precip

VPD


Max Daily Air Temperat
100
Daily Snow Co
Snow
Vegetation Indices (NDV
0
Solar Radiation (w/m2)
100
Land Surface Temperature (ºC)
11
37



History Charter Governance Science Plan Meetings Selected Readings Presentations Committees Home

Home

PACOOS: Providing ocean information for the sustained use of the California Current Large Marine Ecosystem under a changing climate

An immediate need exists to measure the effects of human activities on marine ecosystems and to forecast the effects of climate fluctuations on the benefits, products and services we derive from them. A sustained **Integrated Ocean Observing System(IOOS)**, benefiting all sectors of society that use or are influenced by the ocean, is the central requirement for this capability. Planning for an IOOS is underway in the U.S., with benefits ranging from improved security, public health and safety, to improving the sustained use of marine resources, and protecting species and ecosystems.

As part of this nationwide effort, **NOAA,** academic partners, foundations, state fisheries agencies, and other organizations are developing an integrated Pacific Coast Ocean Observing System, (PaCOOS) for the California Current Large Marine Ecosystem. The system shall provide the information needed for management of fishery resources, protected marine mammals, marine birds, and turtles, and to forecast the ecosystem consequences of fisheries removals, environmental variability and climate change. It is the ecosystem observing backbone of IOOS for the California Current Large Marine Ecosystem. The geographic focus is the U.S. Exclusive Economic Zone off the coasts of California, Oregon and Washington with international links to the portion of the California Current Ecosystem occurring in Canadian and Mexican waters. PaCOOS is administered by a Board of Governors and two coordinators.

NOAA Ship Activities in PaCOOS Region

PaCOOS West Coast Habitat Server

PaCOOS West Coast Habitat Portal

Related links:

National Ocean Observing System (NOOS)

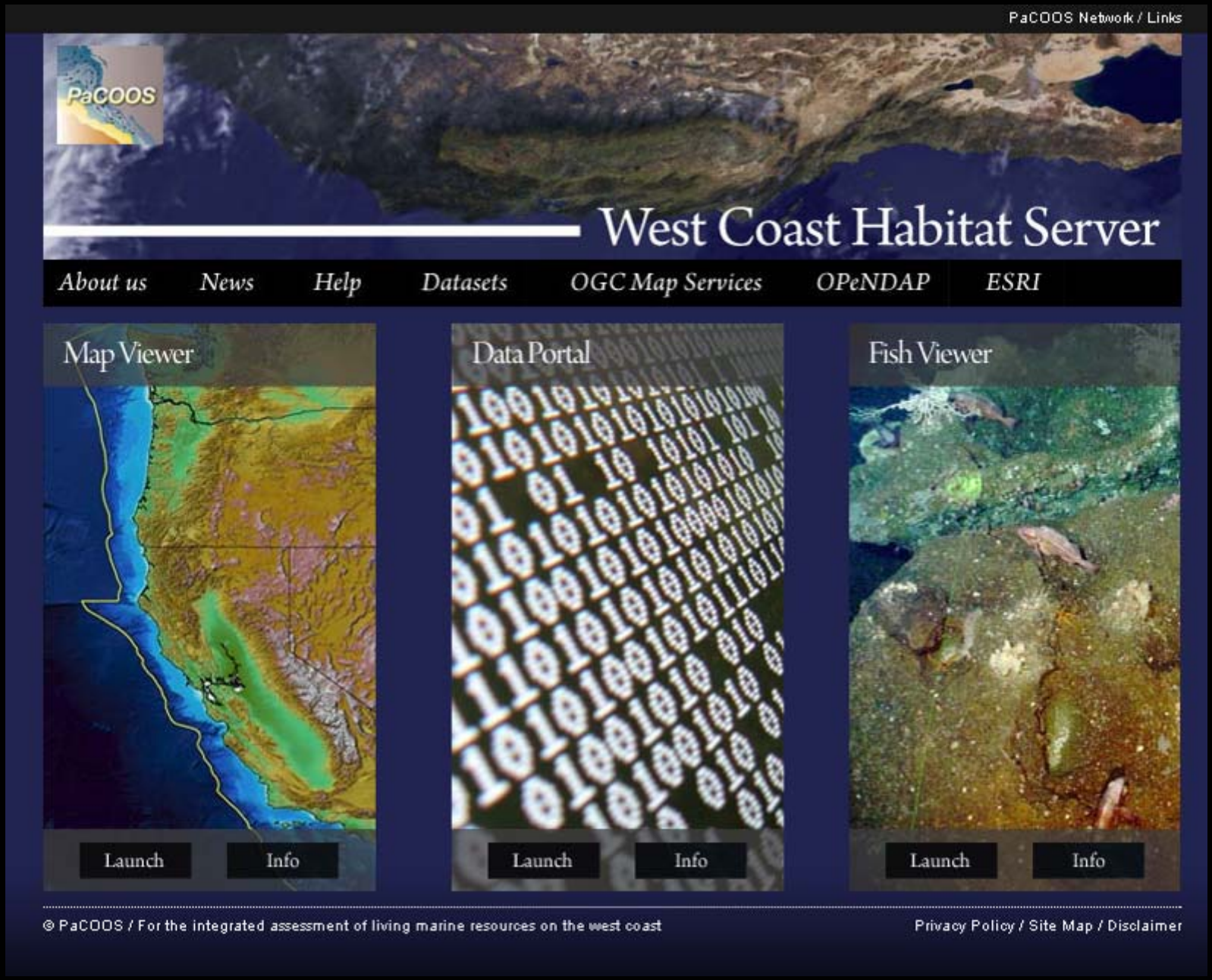
Regional Ocean Observing System (ROOS)

If you have any questions please contact the PaCOOS Coordinator **Rosa Runcie**

NOAA Pacific Coast Ocean Observing System (PaCOOS)

"…operational data system to distribute stream temperature and fish mortality forecast products to fishery managers, water managers, and other potential users of the data"

Environmental Research Division, SWFSC


PaCOOS Network / Links
PaCOOS
West Coast Habitat Server
About us
News
Help
Datasets
OGC Map Services
OPeNDAP
ESRI
Map Viewer
Launch
Info
Data Portal
Launch
Info
Fish Viewer
Launch
Info
© PaCOOS / For the integrated assessment of living marine resources on the west coast
Privacy Policy / Site Map / Disclaimer

Timeline

Year 1 (2008):

Develop first iteration of temperature model
Compile time series of high resolution climate data

Year 2 (2009):

Develop prototype DSTs for PaCOOS
Validate and verify temperature model results
Develop fish mortality models

Year 3 (2010):

Verify and validate all model results
Finalize PaCOOS DSTs

Summary

- Existing mechanistic temperature models and applying them to the state-space form

- Assimilates high spatiotemporal resolution observational data

- Allows for accounting of uncertainty due to model assumptions and simplifications and errors in the model inputs and observations

Summary

- Allows for real-time simulations and predictions regarding distant compliance points

- Improved spatiotemporal temperature model outputs
  - Improved fish mortality models

- Overall improvement in the DSTs for the OCAP

This project is supported by

NASA Earth-Sun Science
Applied Sciences Program

National Marine Fisheries Service
Fisheries Ecology Division
Southwest Fisheries Science Center