Comparison of water temperatures. Observed during the R/V Polaris cruise of 14 June 2011 (upper panel) and the corresponding model result (lower panel).

SALT INTRUSION AND TEMPERATURE DYNAMICS IN SAN FRANCISCO BAY

Grid on Google Earth base map

The San Francisco Bay-Delta estuarine system covers a large area of 200 by 400 km². It is surrounded by urbanised embankments, rocky outcrops and dike systems protecting marshes and agricultural hinterland. The aim of the CASCaDe project is to assess the impact of predicted climate change as well as possible adaptive management strategies to safeguard the estuary's sustainable development. Modelling tools that integrate hydrodynamics and water quality dynamics are essential to unravel dominant processes on various spatial and temporal scales for different climate change and management scenarios.

A Delft3D Flexible Mesh model was developed for San Francisco Bay. The large amounts of data available allowed for the detailed calibration and validation of water levels, velocities, flows, salinity and water temperature on a high-resolution mesh of around 50 metres. The multi-domain model ran at the facilities of the San Diego Supercomputer Center at the University of California San Diego, and the Texas Advanced Computing Center (TACC) at the University of Texas.

The results show that the model produces accurate predictions of salt intrusion and temperature dynamics in surface water for a range of years with different river flows. Sensitivity tests with the calibrated and validated model revealed pure thermal stratification in North San Francisco Bay enhanced by salinity stratification. The water temperature of the upstream, freshwater delta area is captured well in 2D mode, although stratification may be important locally and temporally. The impact of upstream river-flow temperature and atmospheric forcing on water temperatures varies throughout the delta.
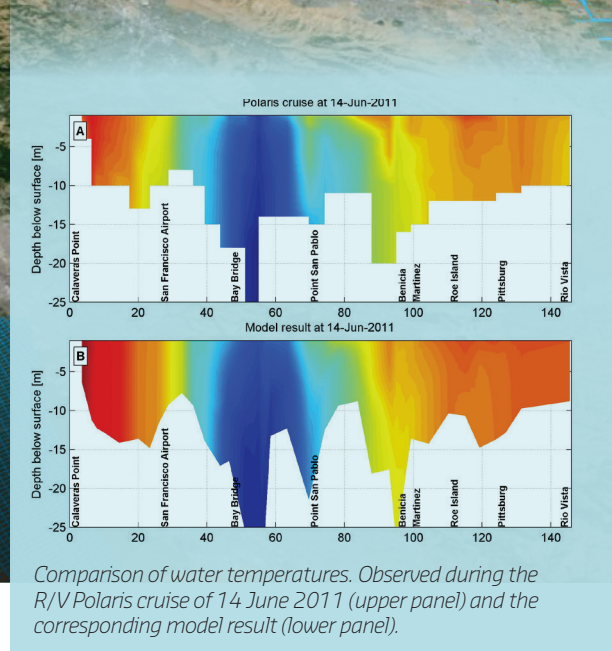
The San Francisco Bay-Delta community model is available to the public on www.d3d-baydelta.org. The web-based infrastructure supports active development by third parties, securing availability and enhancing the continuous development of the Delft3D Flexible Mesh model of the San Francisco Bay-Delta system. Parties are authorised to run, amend, copy and distribute the San Francisco Bay-Delta Model under the conditions of the Creative Commons Attribution-ShareAlike 4.0 International License. The open source Delft3D Flexible Mesh environment and the community model concept encourage cooperation and enhance the exchange of knowledge about the Bay-Delta system.

It is our hope that the San Francisco Bay-Delta community model will further scientific cooperation and knowledge sharing by providing a sound and continuous basis for future scientific or operational projects. We hope both users and developers will contribute to the further optimisation of model performance in multidisciplinary studies related to salinity intrusion, water quality, contaminants, morphodynamics, flooding and interaction with groundwater flow.

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Further reading:
Vroom et al. (2017) https://doi.org/10.1002/2016WR020062