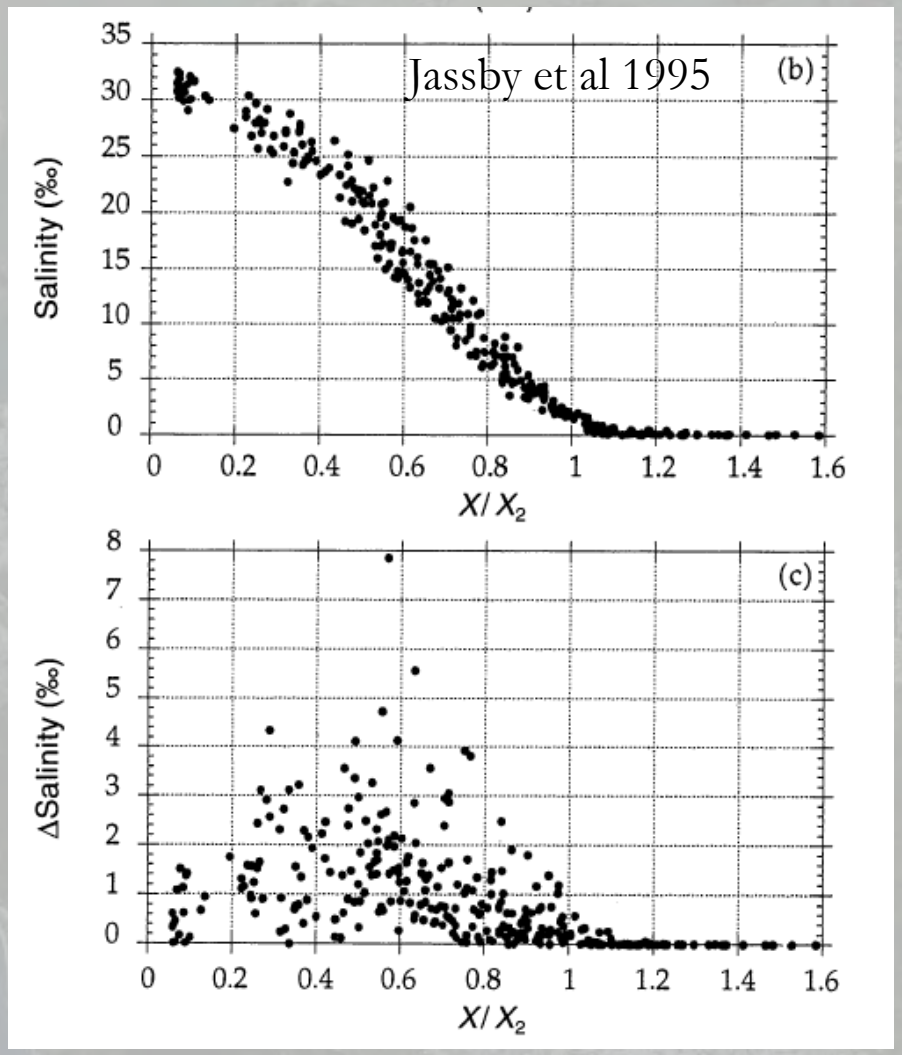
Salinity and flow in Northern San Francisco Bay: Physics and Modeling (SUNTANS)

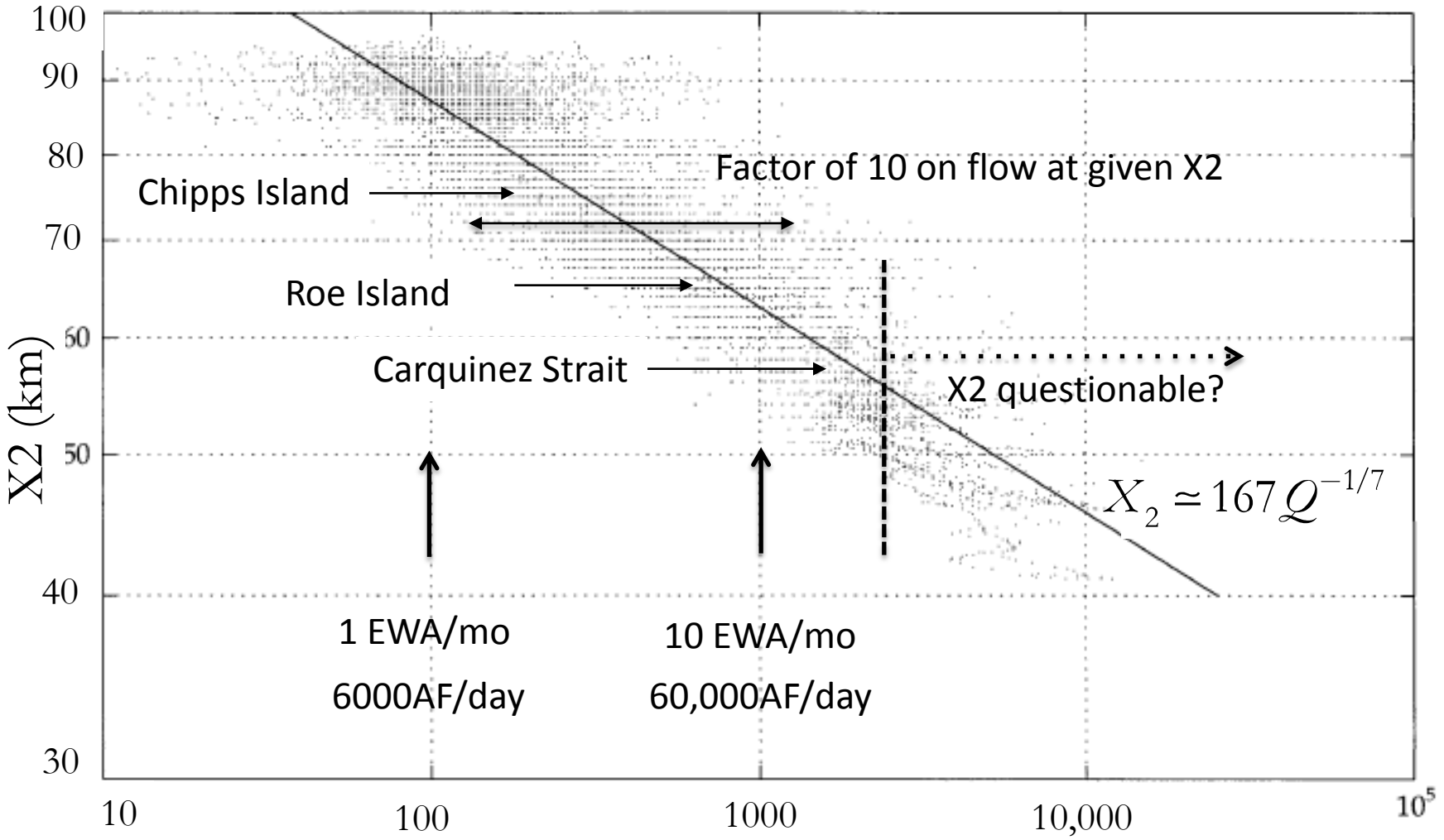


Salinity mostly depends on X2

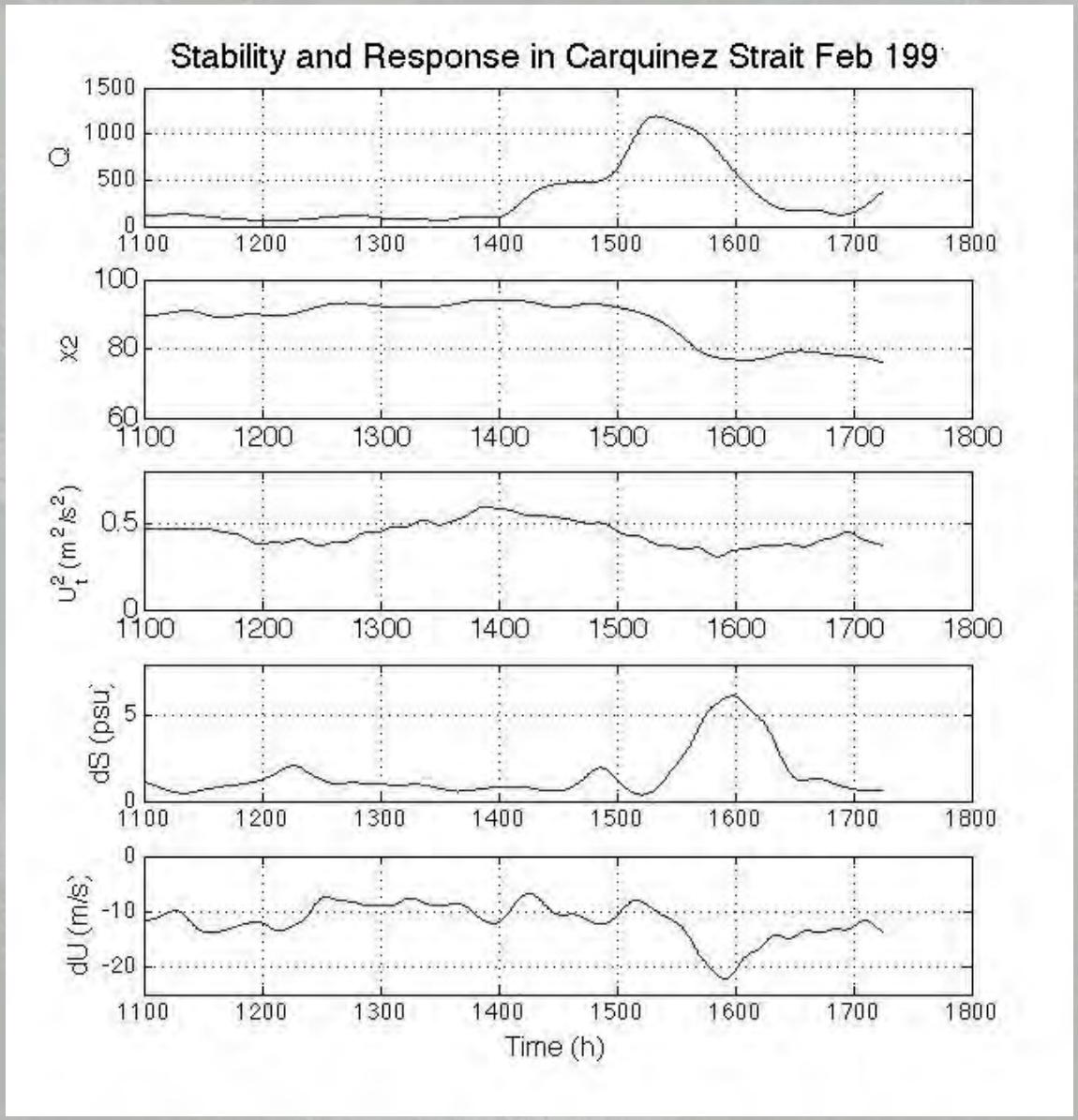
Things we know

Water column stratified downstream of X2

Flow affects X2



An example: Carquinez Strait Feb 1991



Flow

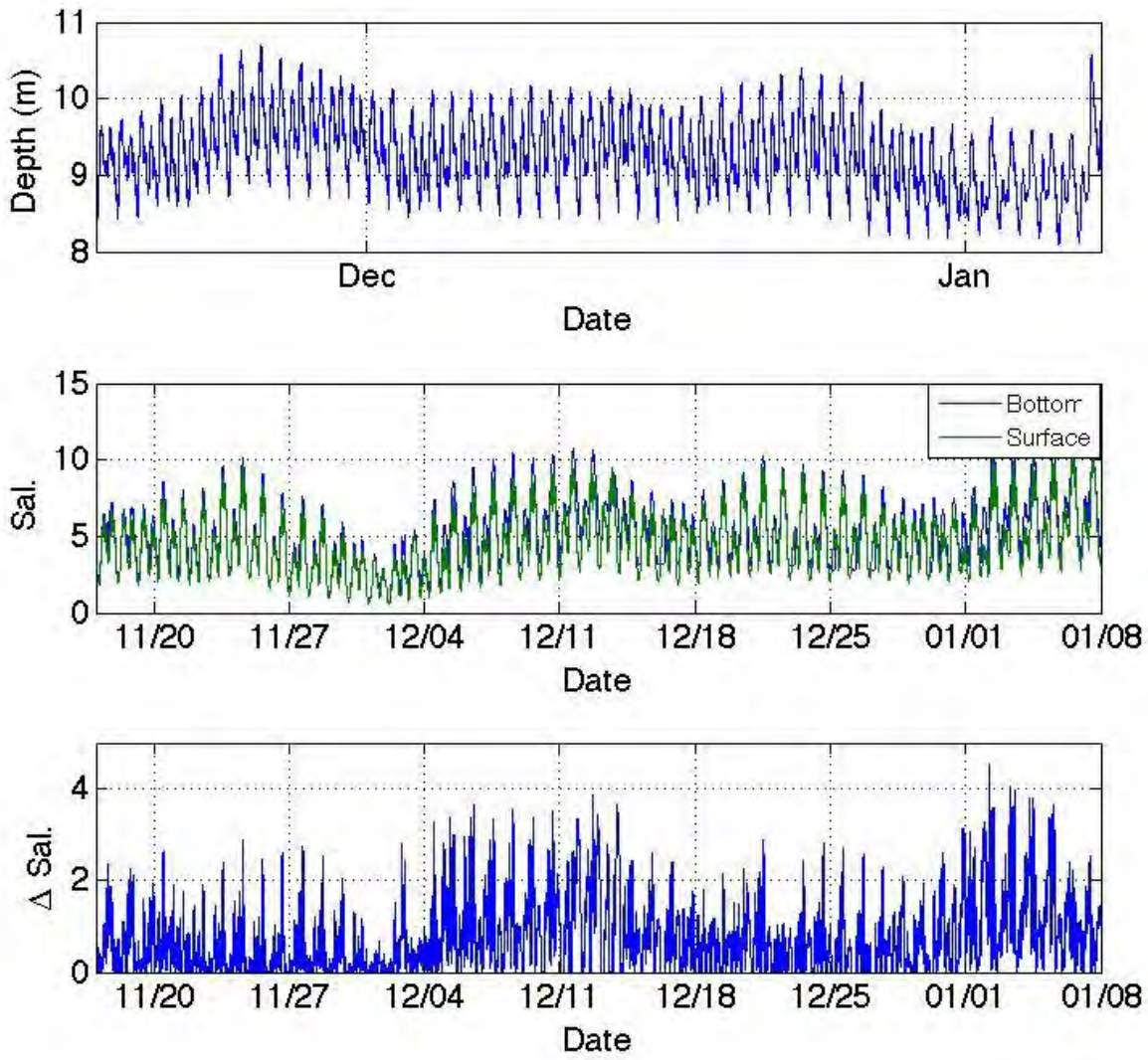
X2

Tidal mixing

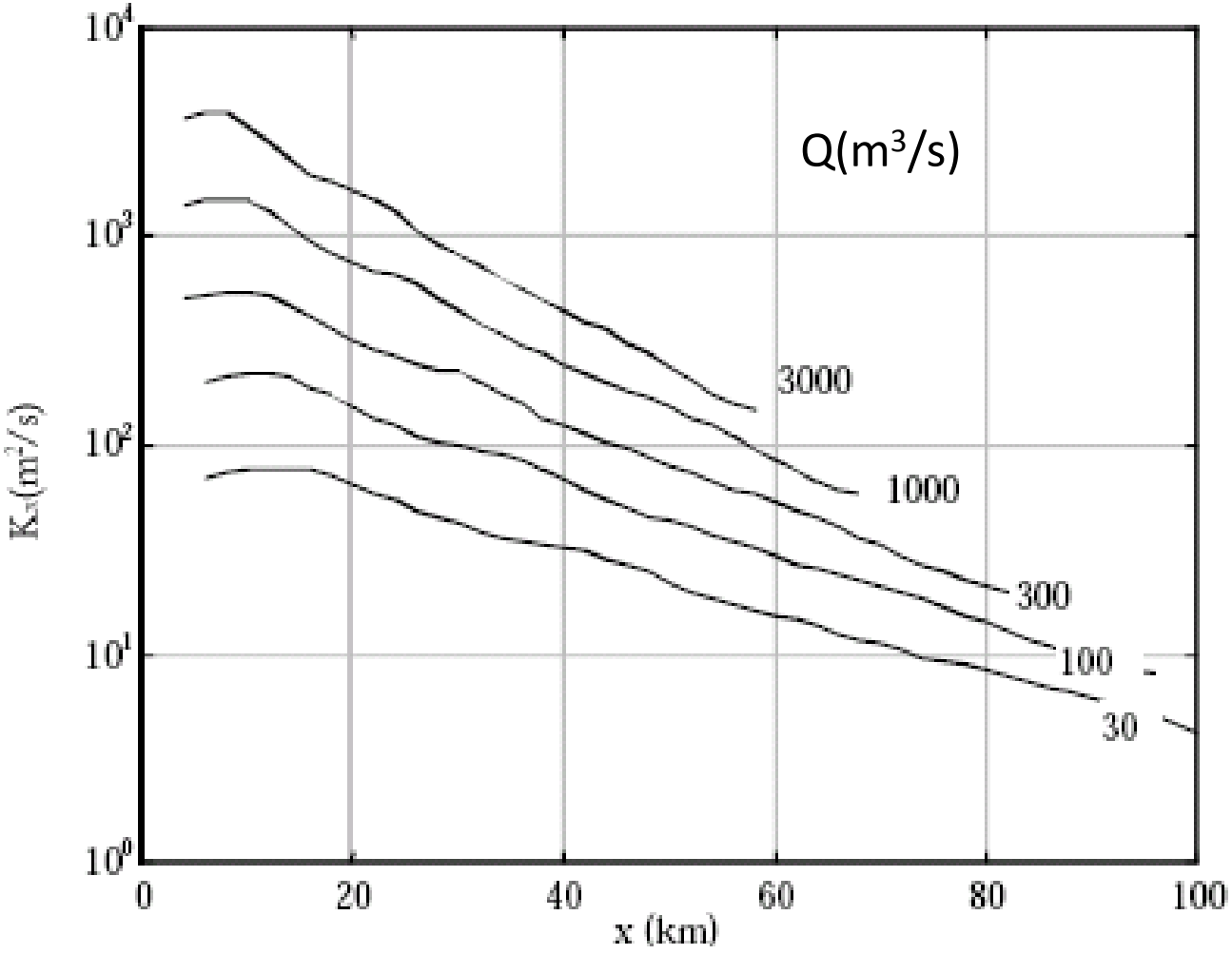
Subtidal stratification

Subtidal shear (GC)

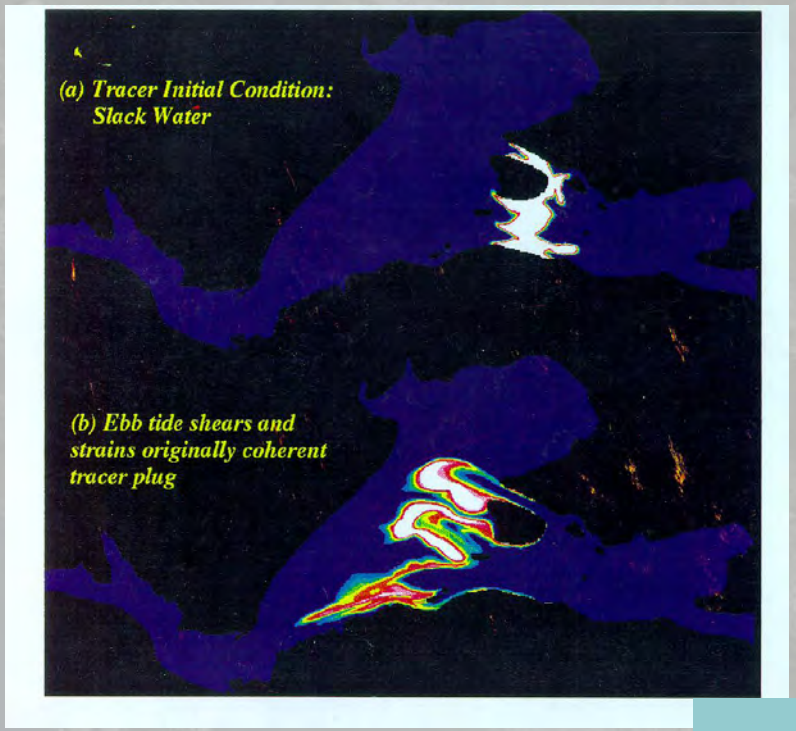
Chipps Island Salinities: Nov 2011-Jan 2012

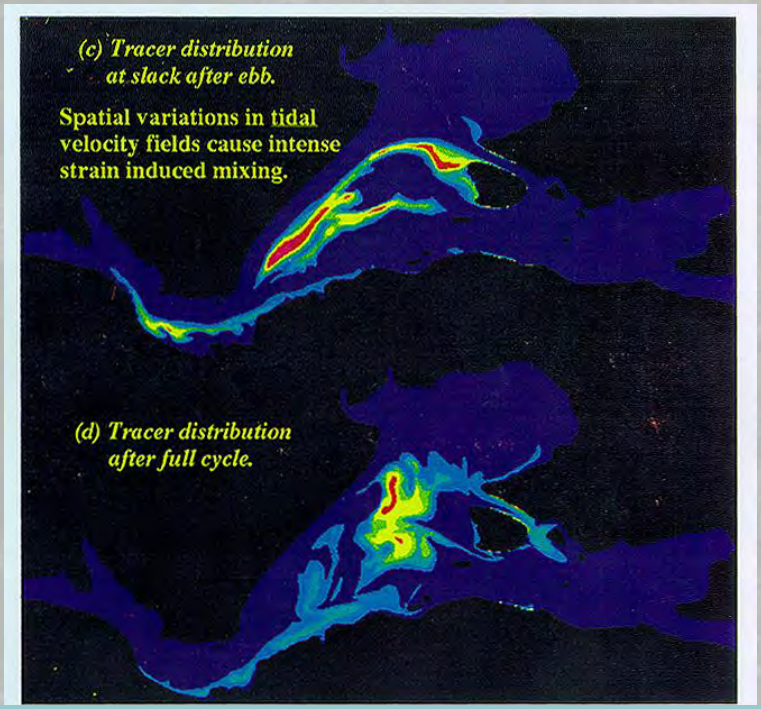


Effect on longitudinal exchange – connectivity?

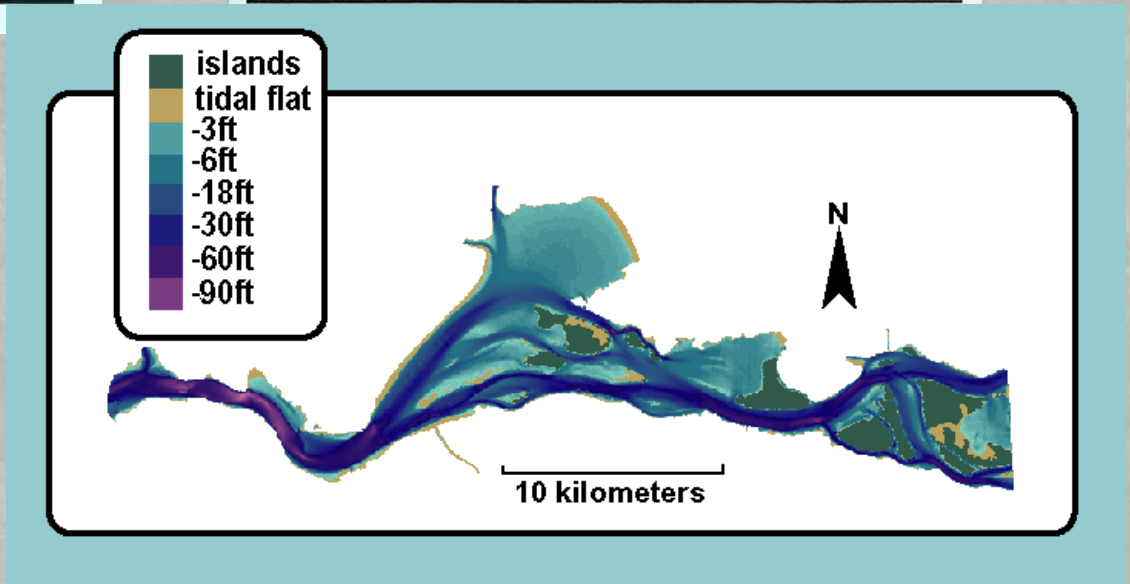


Horizontal mixing in the LSZ (1993)



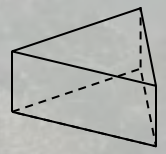


Dispersion via tidal shear in Suisun Bay
(2D calculations by Jon Burau)



High-resolution 3D Bay-Delta modeling using SUNTANS (Fringer et al – OPC/Delta Sci.)

- Three-dimensional, unstructured grid
- Open source (http://suntans.stanford.edu)
- Salt/heat transport
- Nonhydrostatic
- Parallel
- Modules:
  - Coupled waves and currents
  - Cohesive sediment transport
  - Temperature (under construction)



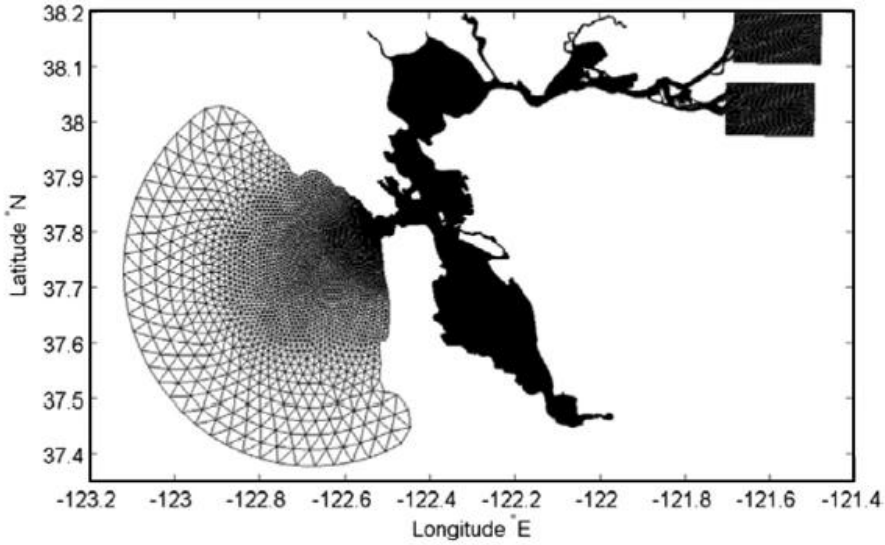
Finite-volume prisms (z-level)

→ Focus is on high-resolution simulation and accurate understanding of physical processes

Examples:

- Cohesive sediment transport modeling in SF Bay
- South Bay Salt Pond Sediment Transport
- High-resolution Delta modeling

Northern SF Bay/Golden Gate (Boundary Conditions)



(a) Entire domain

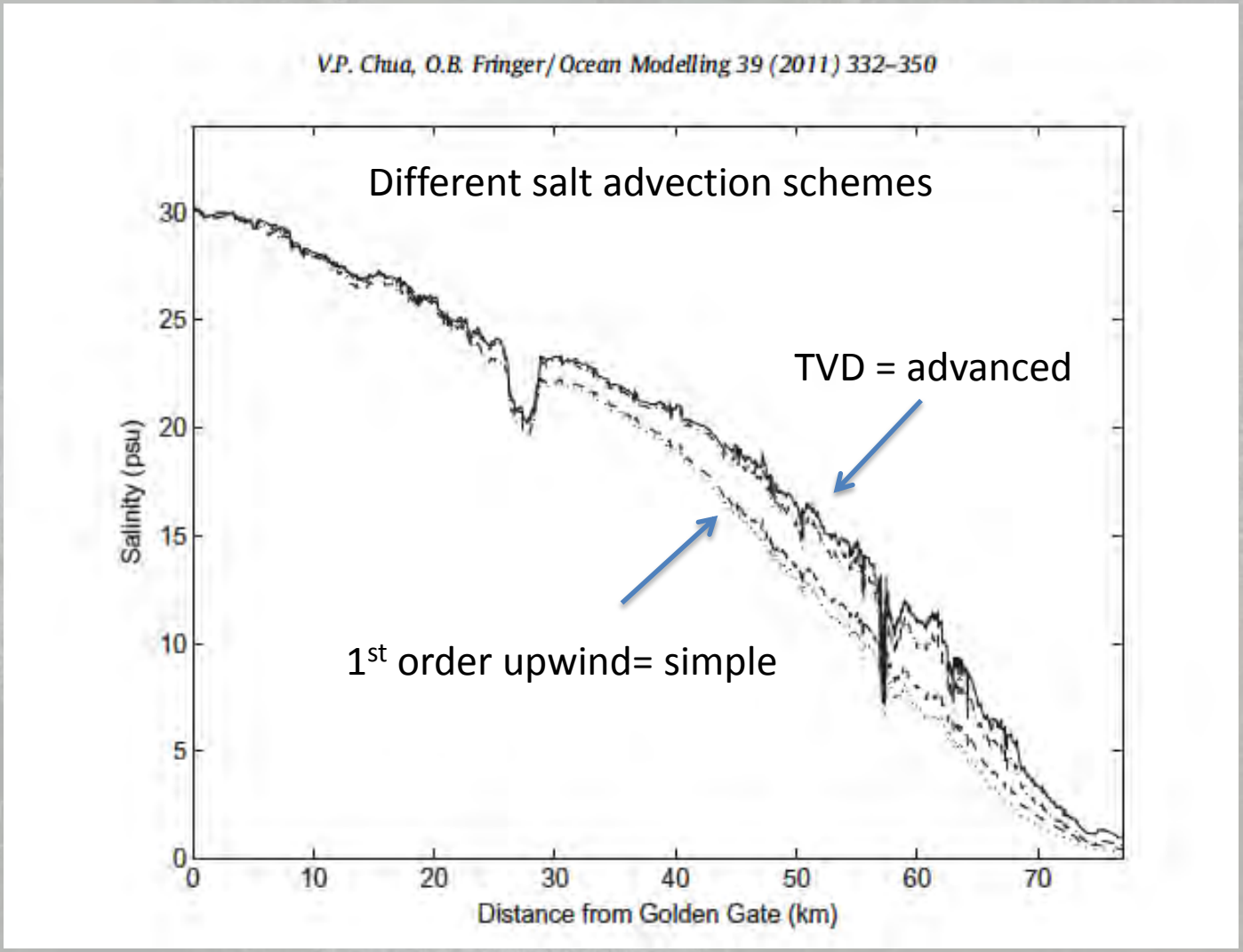
(b) Refinement at Golden Gate

(c) Rectangular "false deltas"

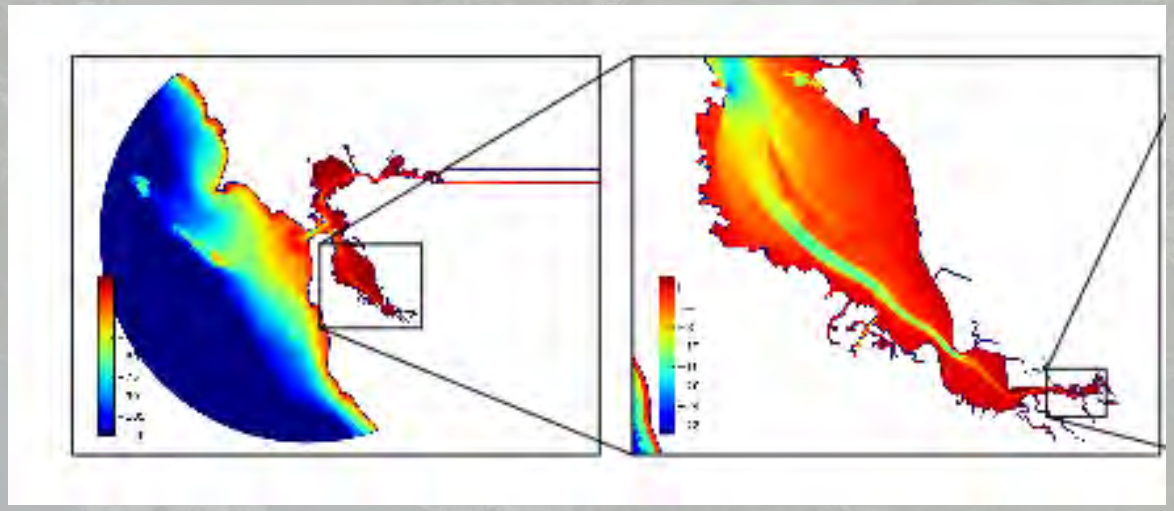
Chua and Fringer (2011)

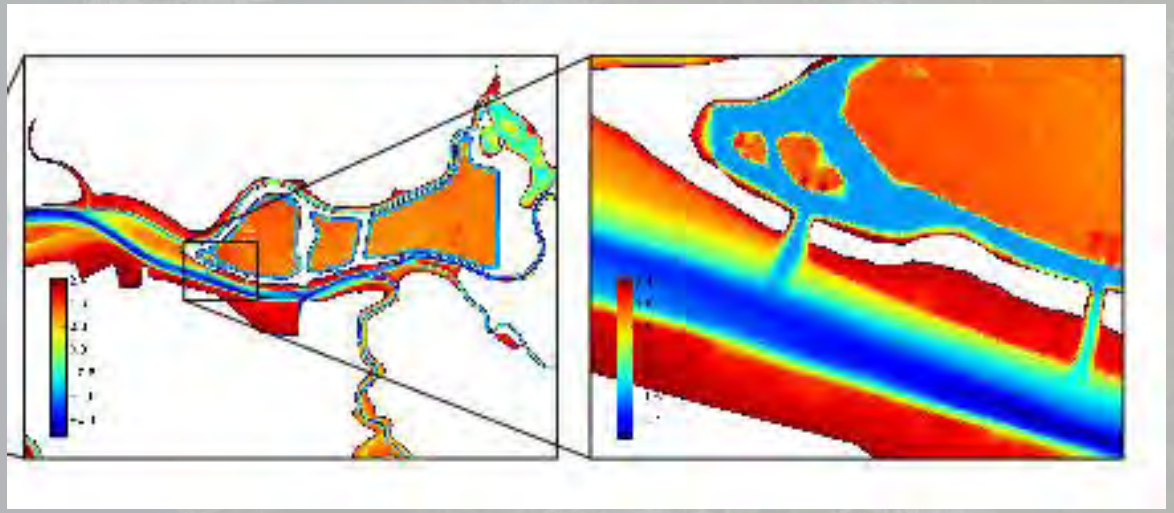
Finest resolution: 10 m
Total number of 3D cells: 2.5 million
Time step size: 10 s
Speedup: 10X faster than real time
Number of processors: 32

Numerical schemes can matter



South Bay Salt Pond sediment dynamics (Hollerman et al)





Finest resolution: 1 m

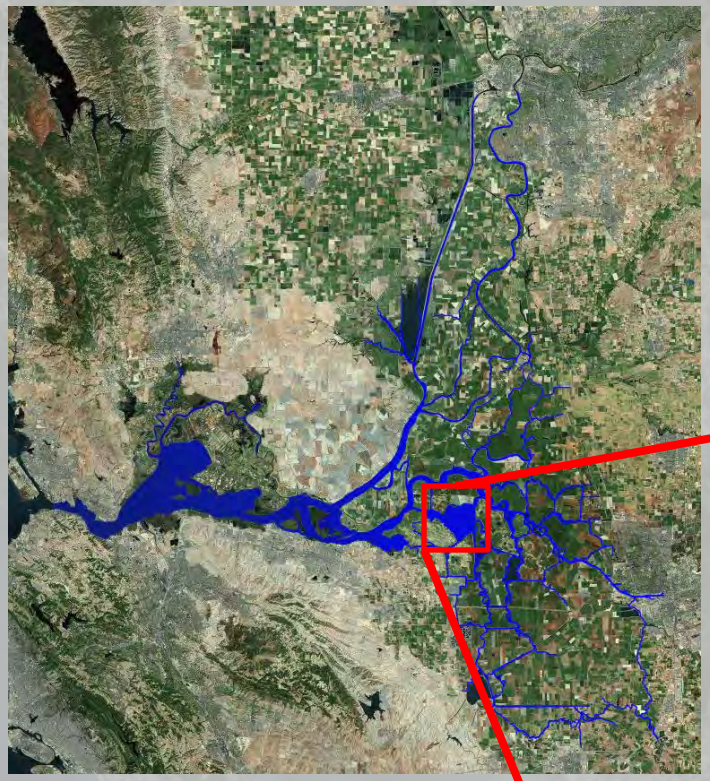
Total number of 3D cells: 5 million

Time step size: 5 s

Speedup: 2X faster than real time

Number of processors: 48

SUNTANS Delta Model (Wolfram et al)



Total number of 3D cells: 4 million
Time step size: 10 s
Speedup: 10X faster than real time
Number of processors: 8

Summary

- LSZ physics involves interactions of tides and salinity field via mixing and turbulence – results are gravitational circulation with feedbacks to X2.
- 3D models capable of representing these processes with reasonable accuracy, esp. with "big" computing, but:
  - Limitations of numerical methods must be recognized
  - Data needs are noteworthy: Boundary conditions/bathymetry/synoptic data for calibration/verification
  - Only tells you about physical environment
  - Need to do more analysis than just plotting stuff to make them useful
- SUNTANS can be an excellent tool for looking at flows etc., esp. to focus on detailed regions for spring-neap time scales