

# **Surface Current Trajectory Observations in the Southern California Bight**

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Acknowledgements: Jeff Lee, Satoshi Mitarai, Peter Niiler, Dave Siegel

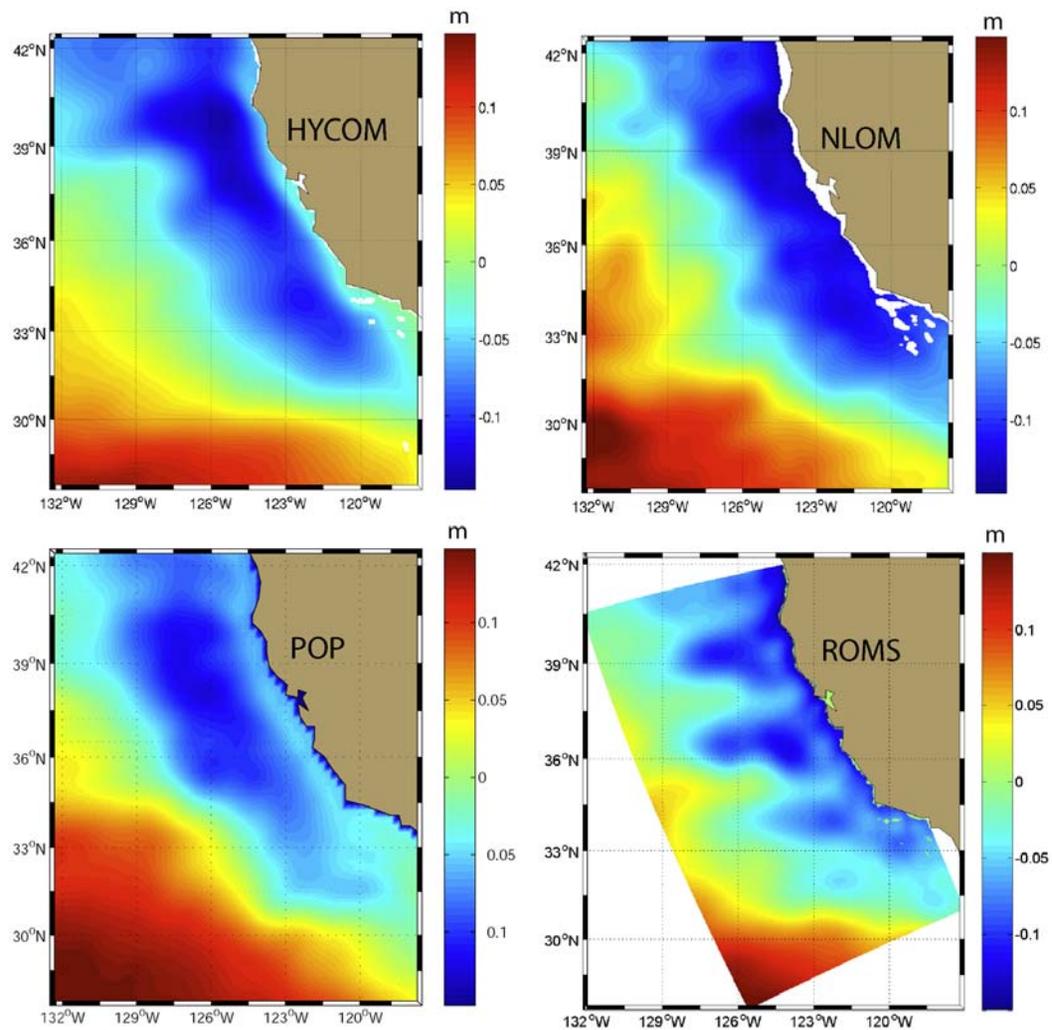
## **Goals**

- demonstrate need to validate model results with data
- show existing drifter data from Southern California Bight
- motivate use of these data with models in SCB MPA studies

## **Outline**

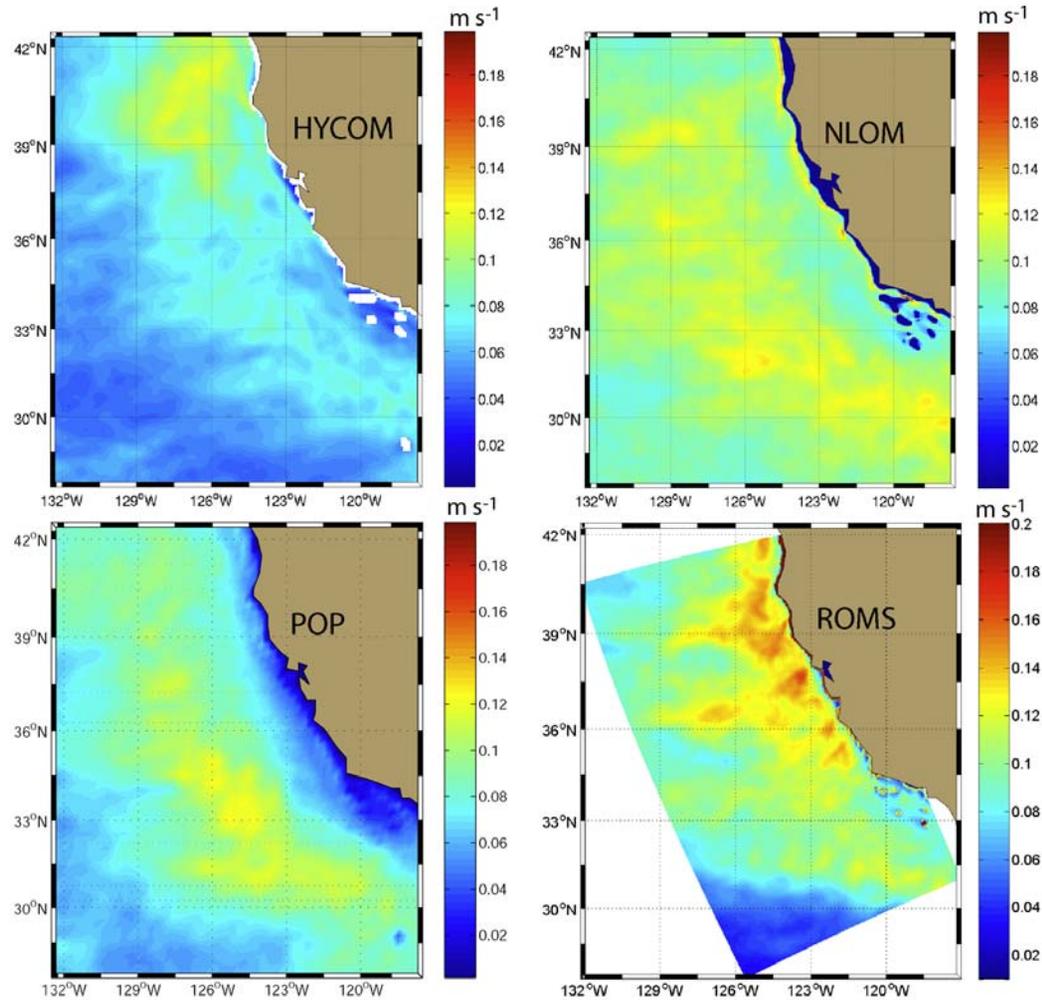
- models - necessary, each typically gives a unique solution
- drifter observations - relevance to connectivity studies
- existing drifter data in SCB - range of time/space scales
- using data with models to enhance understanding of connectivity

# Which model of the mean Sea Surface Height (SSH) is most representative? Why?



**Mean SSH for California Current from four models.** Offsets were applied to make plots with the same color scale. Solutions are averages from 1990 to 2001. Figure from Centurioni, Ohlmann, and Niiler (JPO, 2008).

# Which model of the EKE is most representative? Why?



**Square root of GMEKE from same four models.** Figure from Centurioni, Ohlmann, and Niiler (JPO, 2008).

- data are necessary for interpreting model results
  - thorough model assessment is non-trivial, requiring a quantitative comparison of a number of parameters specific to model configuration, its planned use, the available data, and the circulation
- 

**optimal connectivity patterns require models, data, and thorough model assessment**

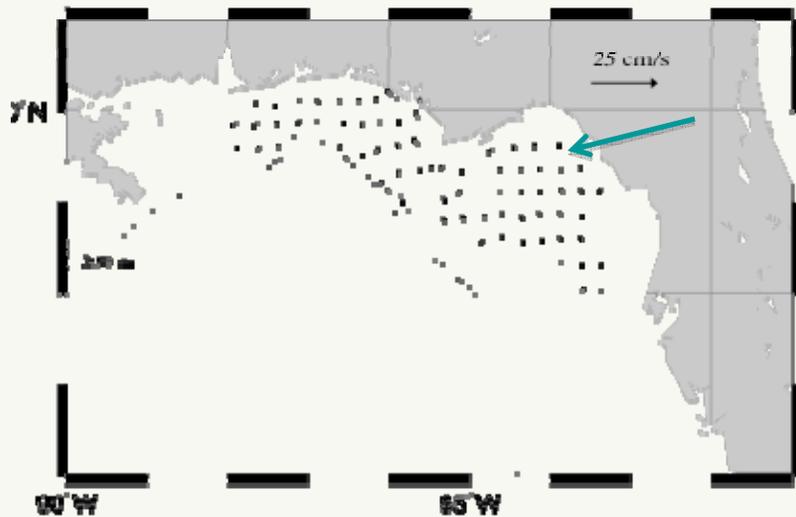
ocean current observations are available from many instruments

**Eulerian** observations give point measurements or time/space means

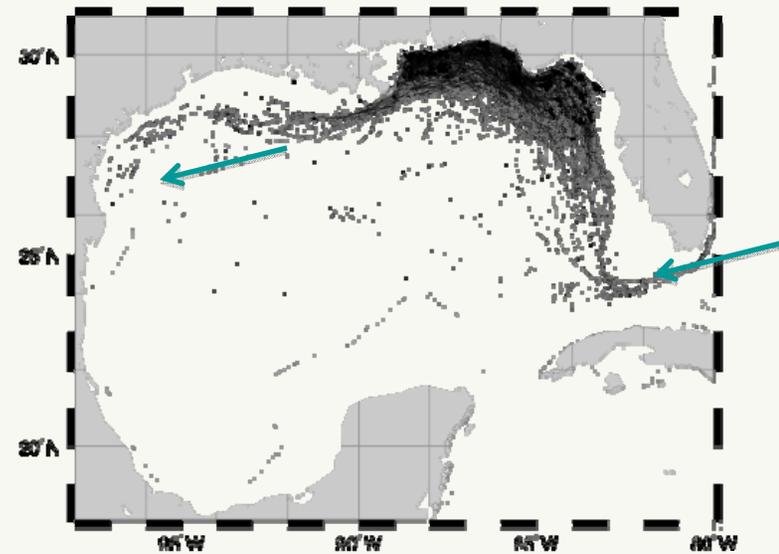
- satellite altimetry
- ship/glider/AUV surveys
- moorings (ADCP)
- high frequency radar

**Lagrangian** observations follow the path of a water parcel

- drifters (surface currents)
- floats (subsurface currents)



**Eulerian** means show velocities near zero

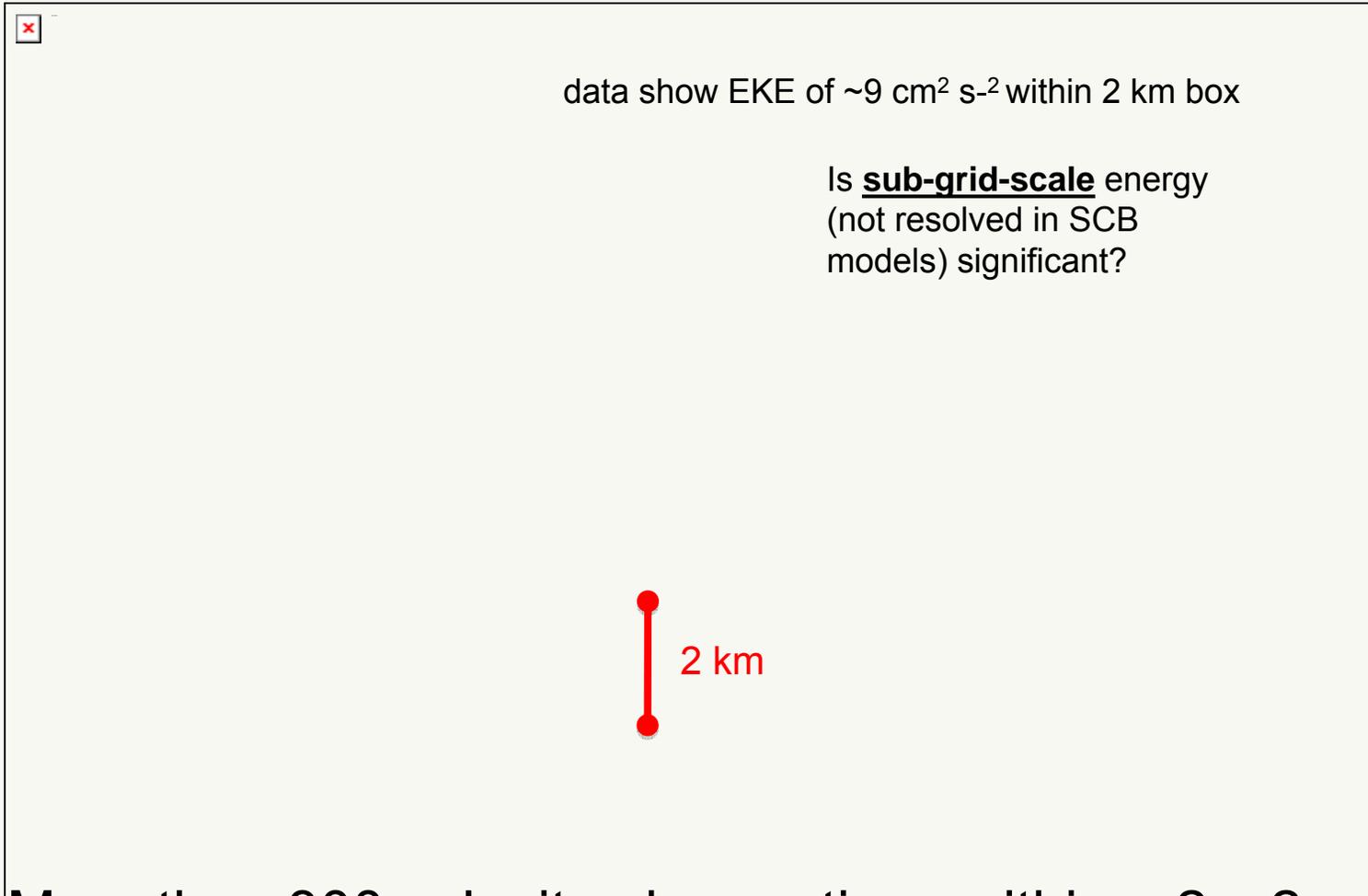


corresponding **Lagrangian** trajectories show significant displacements

## **Lagrangian drifter data are particularly relevant to connectivity**

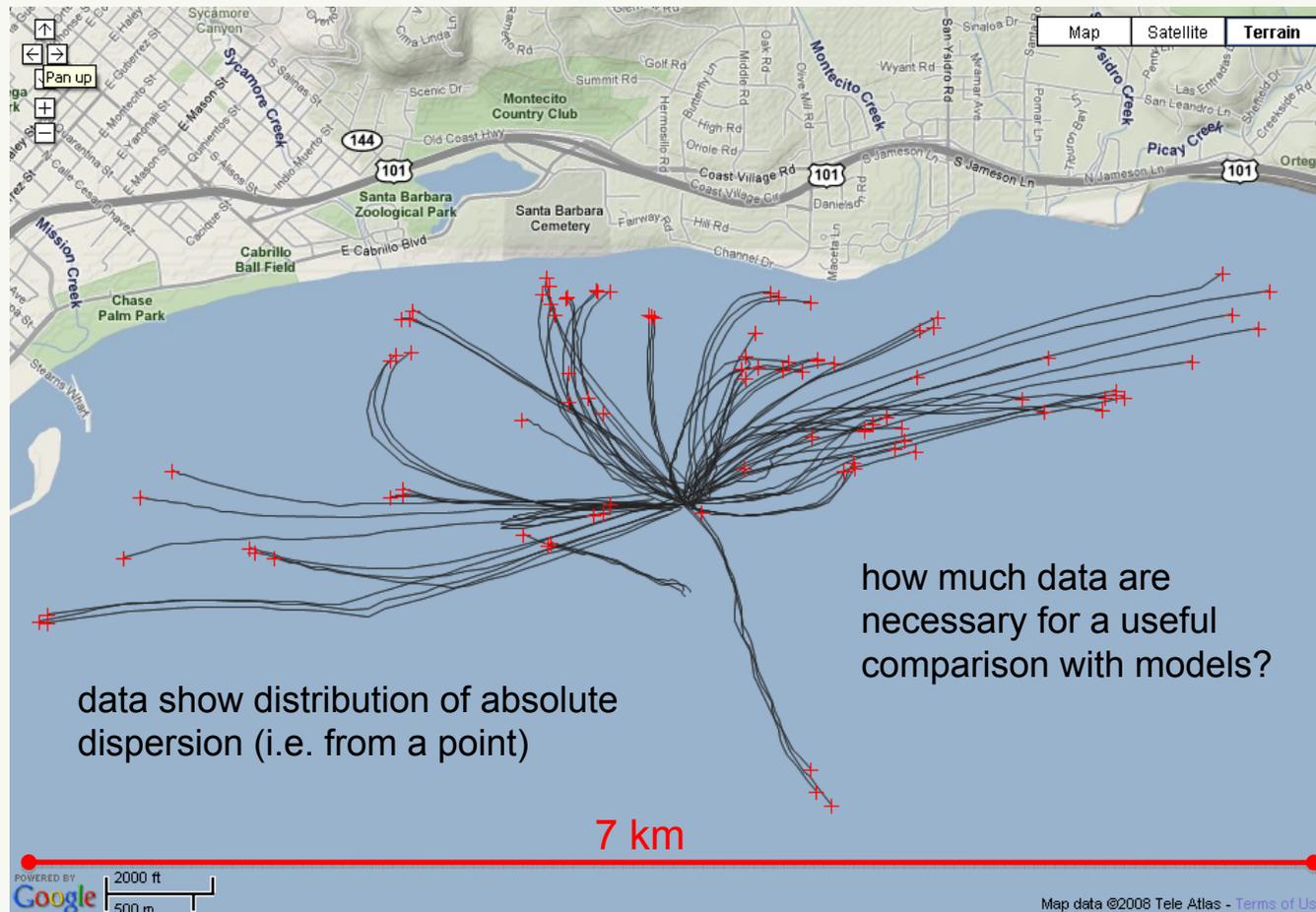
- 1) connectivity is a Lagrangian process
- 2) measure flow evolution in both time and space
- 3) provide independent means of model validation (not easily assimilated)
- 4) directly measure Lagrangian Stochastic Model parameters ( $\sigma^2$ ,  $T_l$ ,  $D_{x,y}$ )
- 5) can resolve a large range of scales (minutes -> years; meters -> 100's of km)
- 6) ~13,500 drifter days of data exist in the SCB region; more coming

# Southern CA Bight drifter data on scales not resolved in regional models



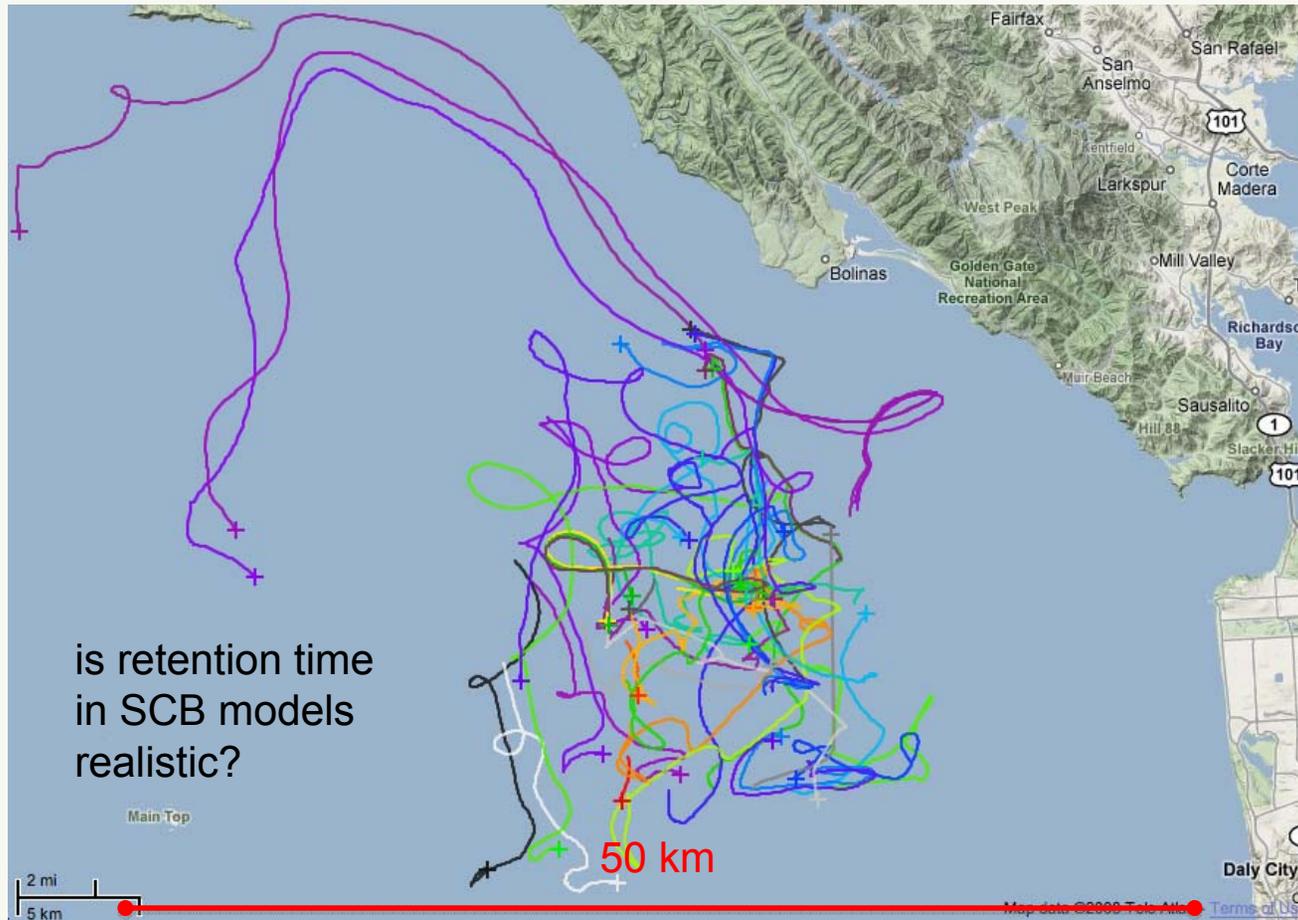
More than 300 velocity observations within a 2 x 2 km grid cell during 5 days to measure sub-grid-scale energy. Data in Ohlmann et al. (2007; JAOT).

# SCB drifter data on scales connecting shelf to intertidal



Drifter triplets deployed weekly at a specific location. Drifters sample for ~6 hours as part of state funded interdisciplinary project. Data collection planned for 52 weeks.

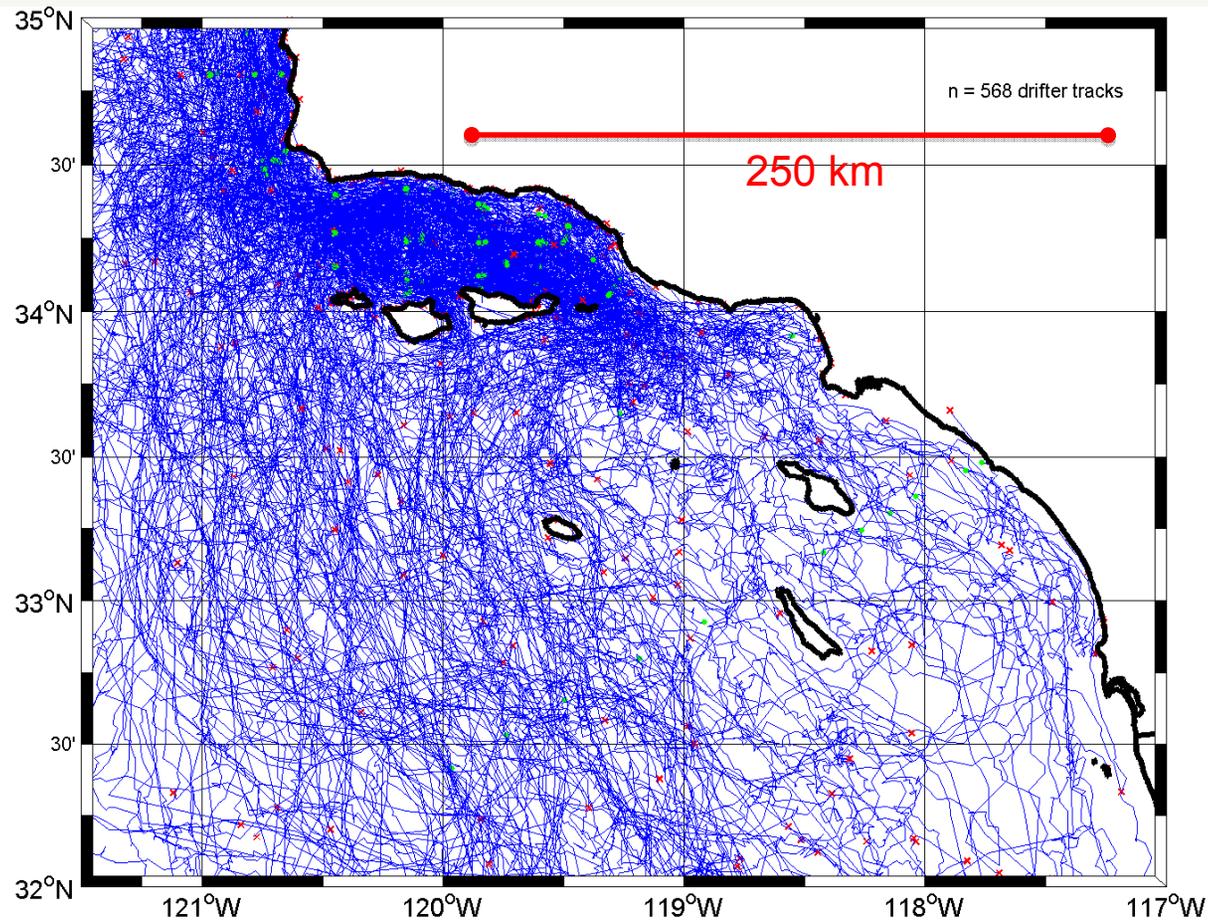
## drifter data on the sub-meso-scale



Drifter sets deployed for 3-4 days just north of San Francisco as part of a validation experiment for oil spill response.

data from Garfield, Largier, Ohlmann, and Paduan

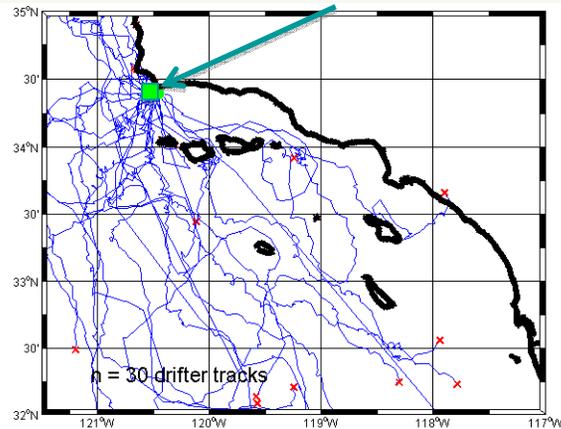
## SCB drifter data on the regional scale



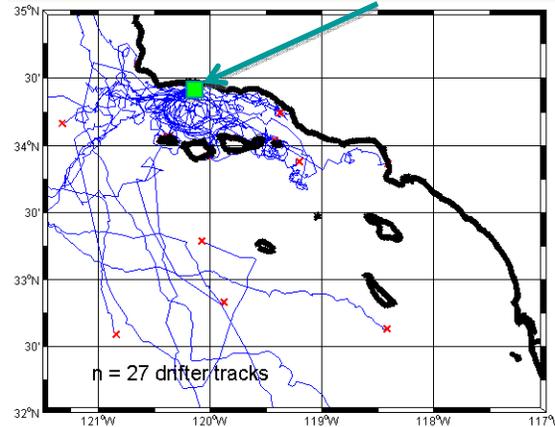
Drifters deployed ~quarterly from 1993 – 1999.  
568 drifters sampling for an average of ~24 days  
give ~13,500 drifter days of data.

Dever et al., 1998

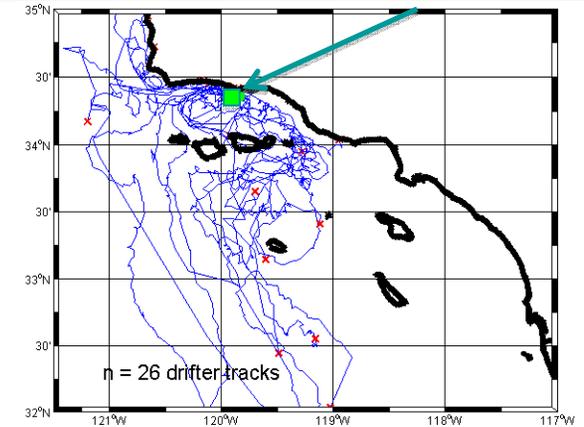
## data show sensitivity to start location



few tracks in SBC



tracks confined to SBC

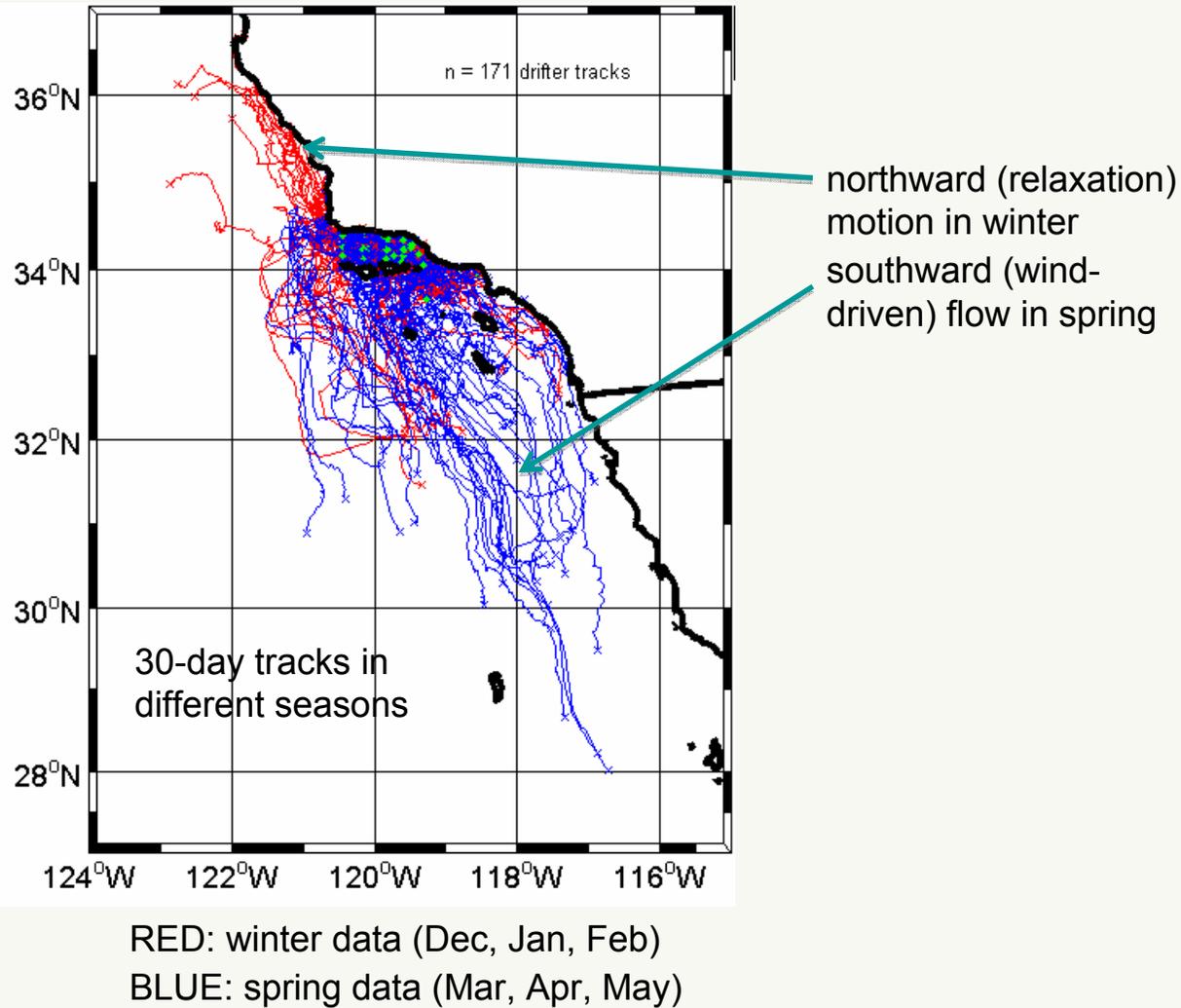


tracks exit SBC to east

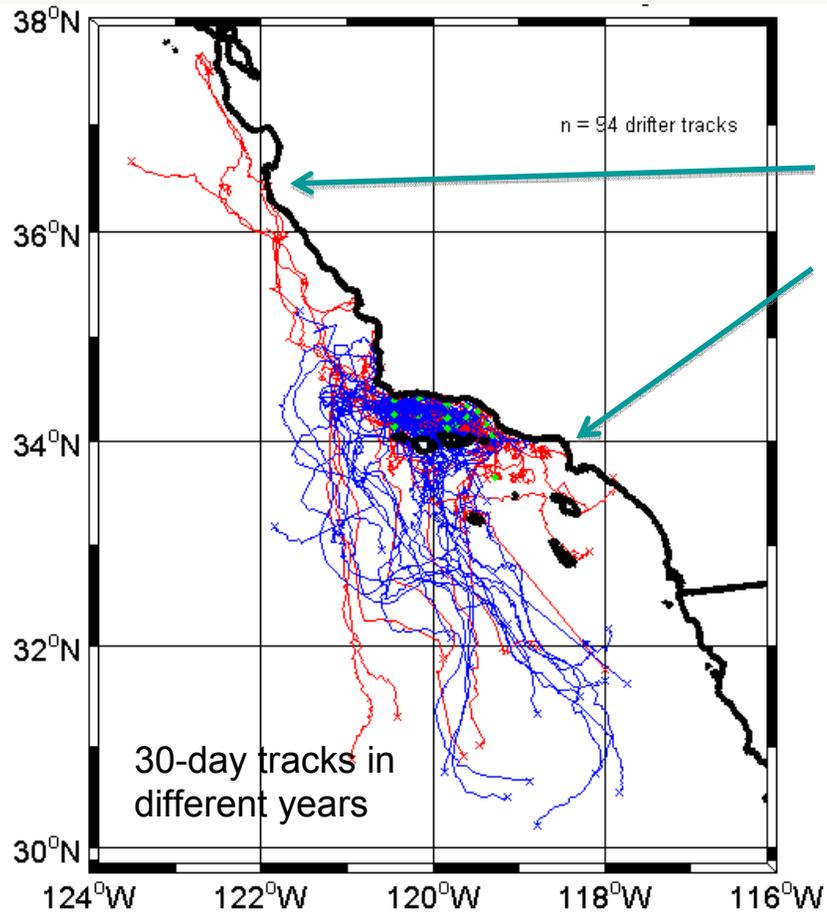
30-day drifter tracks deployed at 3 start locations ( )  
separated by ~40 km

- descriptive patterns “look similar” to ROMS results shown by Satoshi
- must go beyond “look similar” with quantitative assessments

## data show seasonal variations



# data show inter-annual (ENSO) variations



red ENSO tracks go farther north, and move south-east along coast

RED: data from Jan '97 -> June '98  
BLUE: data from July '98 -> Dec '99

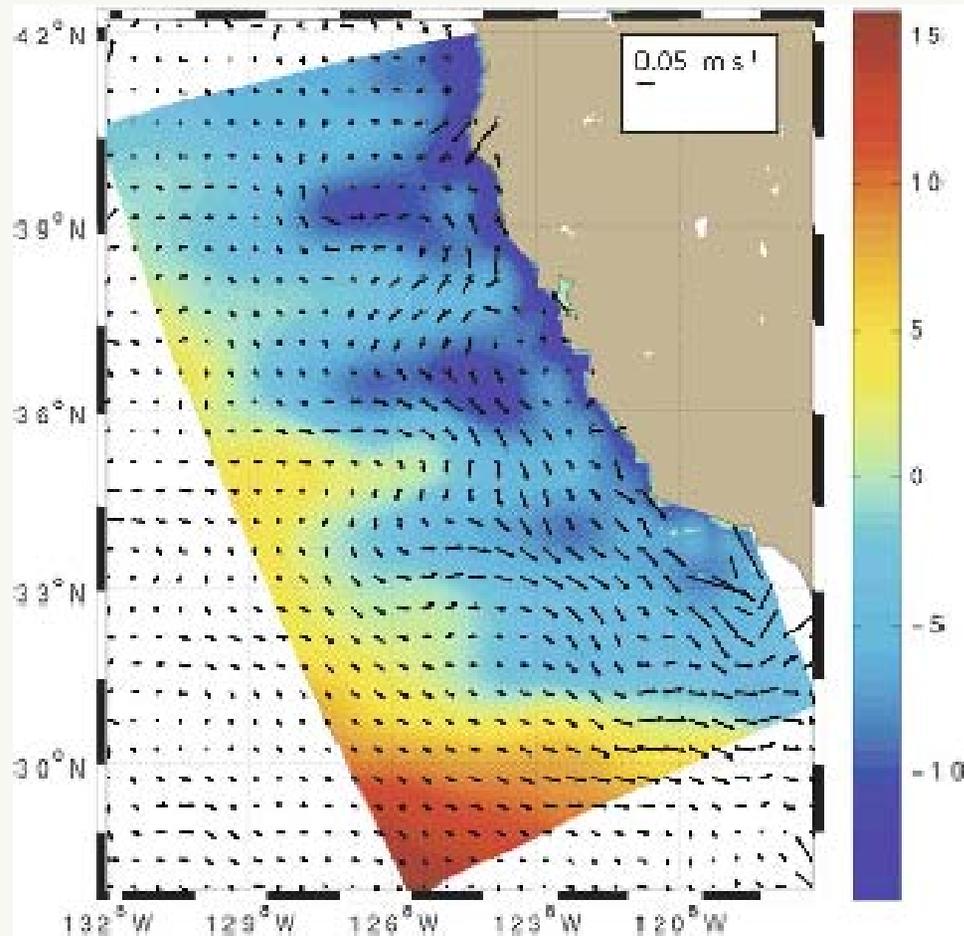
## **Summary**

- connectivity requires models; models require data to assess skill
- drifter data are key (Lagrangian, time-space, scales, not assimilated)
- data exist; more forthcoming; how much are necessary?
- Southern California Bight data suggest sub-grid-scale, seasonal, and inter-annual signals

## **Correct connectivity solutions to a non-trivial problem require:**

- collaborative (models-data) paradigm with thorough assessment
- specific metrics for assessing model skill quantitatively
- “applications-assessment” (?) funding (not “research” or “observations”)
- need patience and persistence; “the devil is in the details”

**Data (overlaid vectors) are necessary to determine model skill.**



Mean SSH from ROMS with the observed unbiased geostrophic velocity field superimposed. Figure from Centurioni, Ohlmann, and Niiler (JPO, 2008).