Model Robustness in Estimating Larval Transport and Connectivity in the Coastal Ocean

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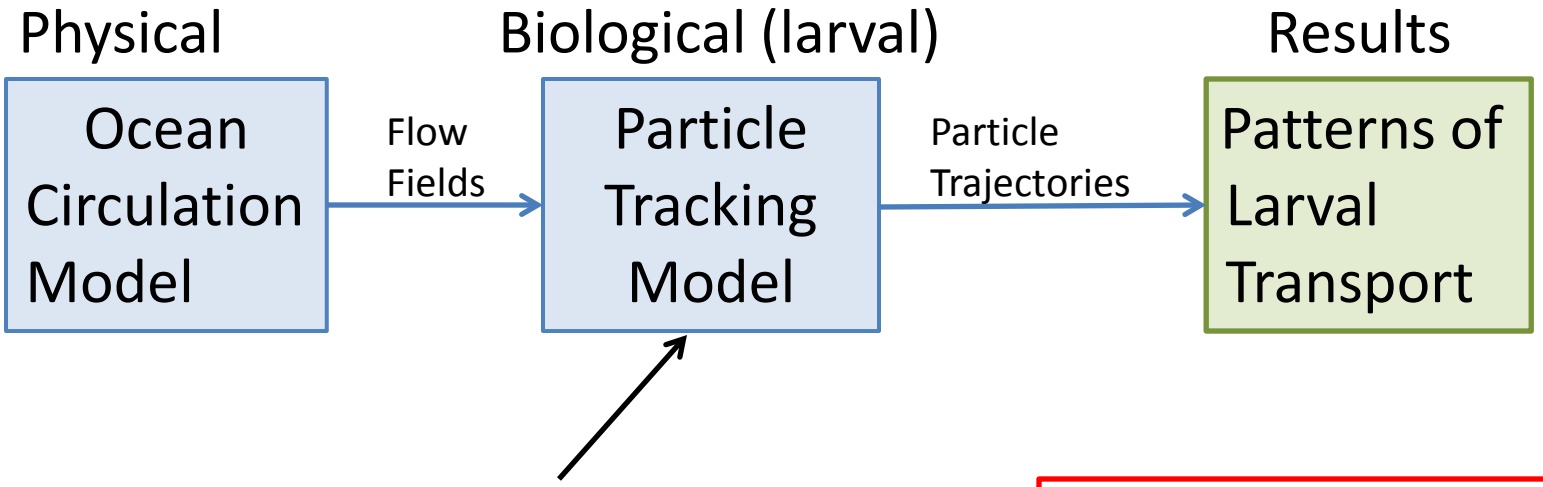
Biophysical Models

- Widely used to predict larval transport in estuaries and oceans



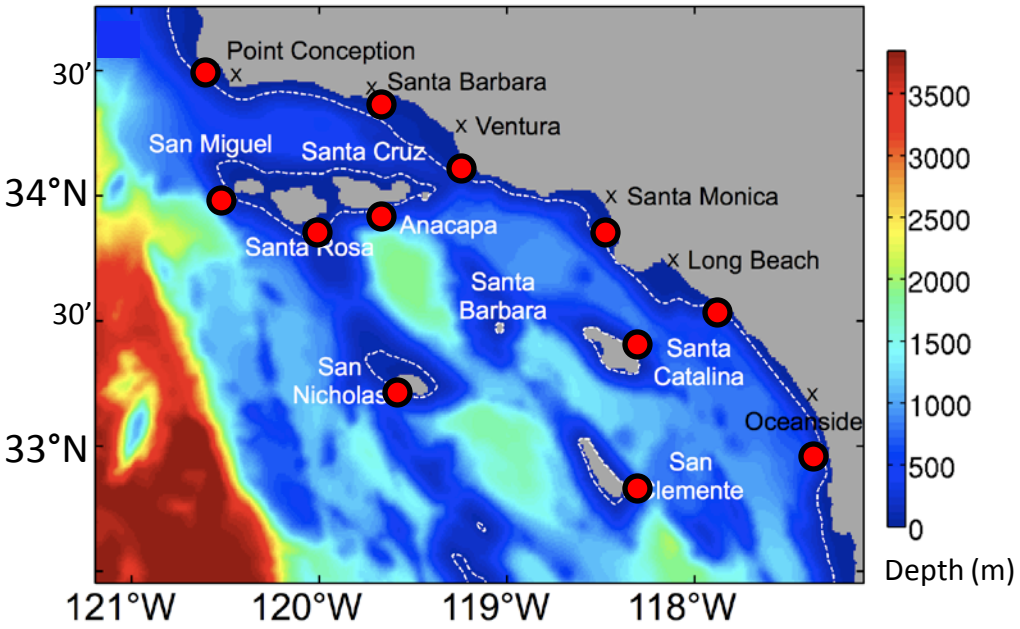
Required Input Parameters:

1) Number of Particles Released
2) Particle Release Depth
3) Particle Advection Time

How **sensitive** are results to the input parameters?

Model Domain and Set-Up

Southern California Bight



Physical Model:
3D ROMS offline solutions
1 km grid
(Dong & Mc Williams, UCLA)

Biological Model:
3D Particle Tracking Model
Pure Lagrangian
Subgrid scale interpolation

● 12 Particle Release Sites (71-79 grid points/site)

Reference: Mitarai S, Siegel DA, Watson JR, Dong C, McWilliams JC (2009) Quantifying connectivity in the coastal ocean with application to the Southern California Bight. Journal of Geophysical Research-Oceans 114

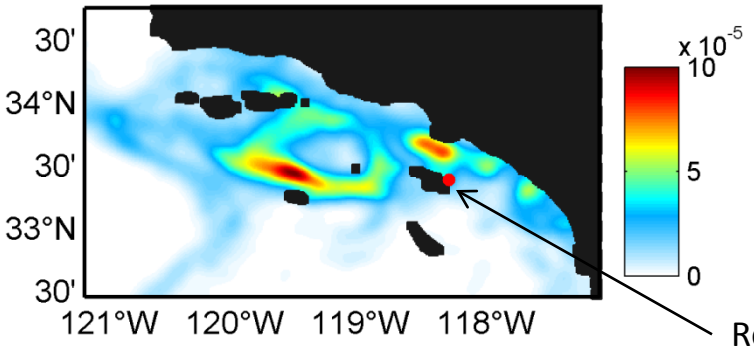
Sensitivity Testing

- Create 2D matrix or **density distribution** (called *pdf* in Mitarai et al. 2009):

  At a specified time after particle release,

  1) Sum the number of particles in each grid cell
  2) Divide grid by total number of particles released
  3) Filter matrix with isotropic Gaussian filter

Example Density Distribution



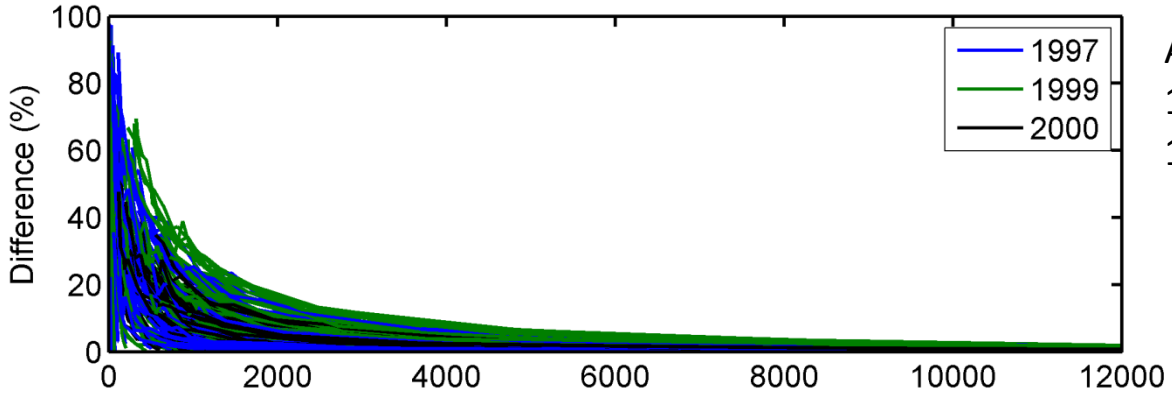
May 1999
Advection Time 15 days

Quantifying difference between two density distributions:
Difference (%) = $(1 - r^2)*100$
r = linear correlation coefficient

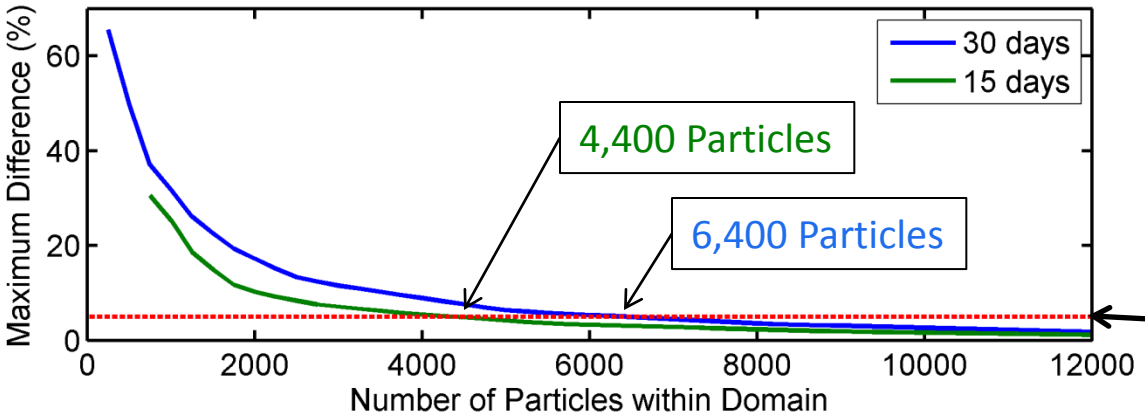
- Density distributions produced for one site for one month of release
- Simulations produced for 12 sites, 5 months (Jan, Apr, May, Jun, and Dec) over three years (1997, 1999 and 2000)

Parameter 1: Number of Particles Released

- Particles released at different frequencies (1.5 – 48 hr) to vary the number of particles in the domain
- Reference density distribution is the one produced with greatest number of particles (1.5 hr frequency)
- All particles released at depth of 5 meters



Advection Time = 30 days
12 sites
1 line = 1 site & 1 month

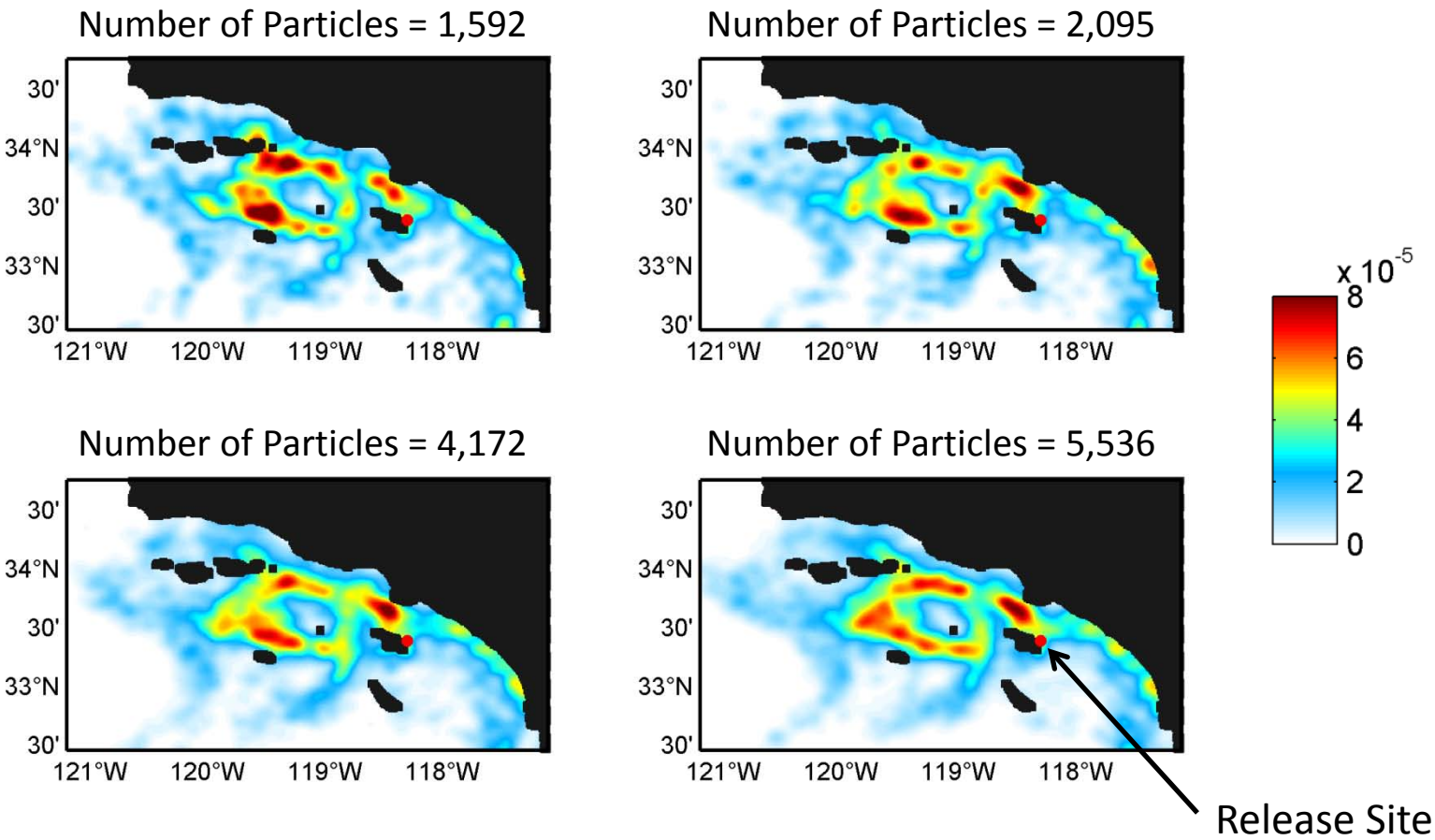


5% Difference

Parameter 1: Number of Particles Released

Density distributions

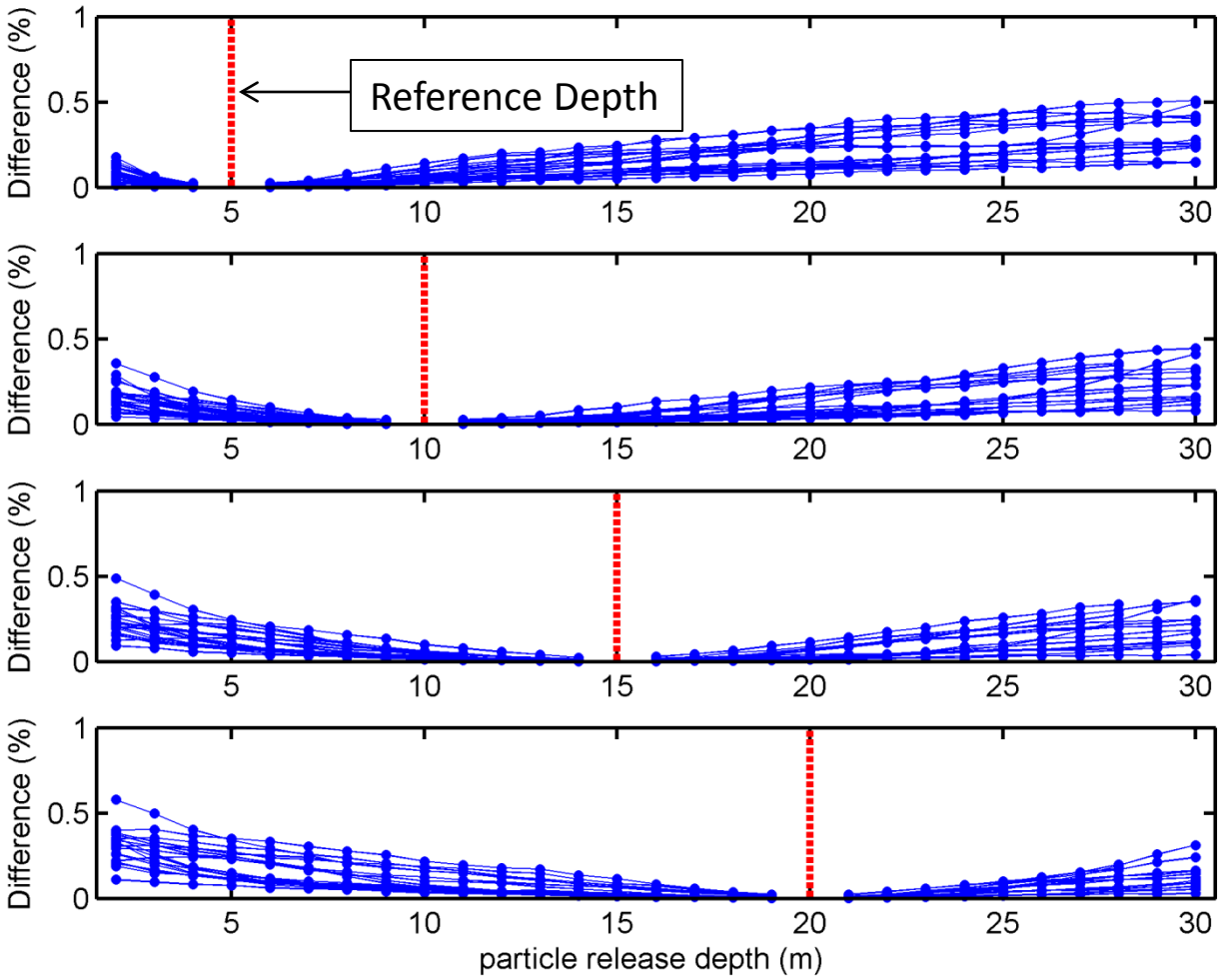
Release of May 1999 with Advection Time of 15 days



Difference < 5 %: 4,400 particles

Parameter 2: Particle Release Depth

- For each site and month, a series of 29 simulations were produced with release depths of 2-30 m (1 depth/simulation)
- Density distributions compared to a range of reference depths

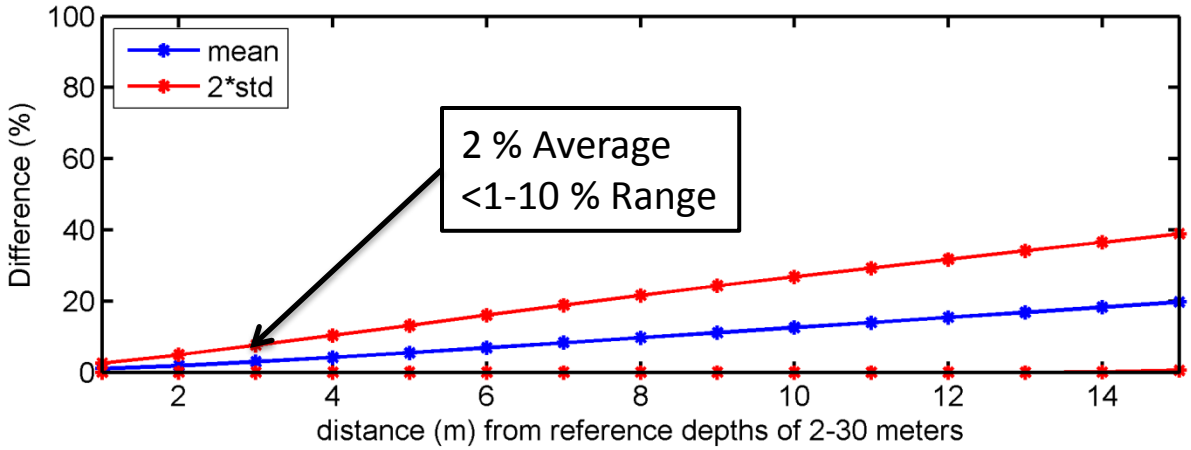


January 1999 and 2000
Advection Time 15 days

Parameter 2: Particle Release Depth

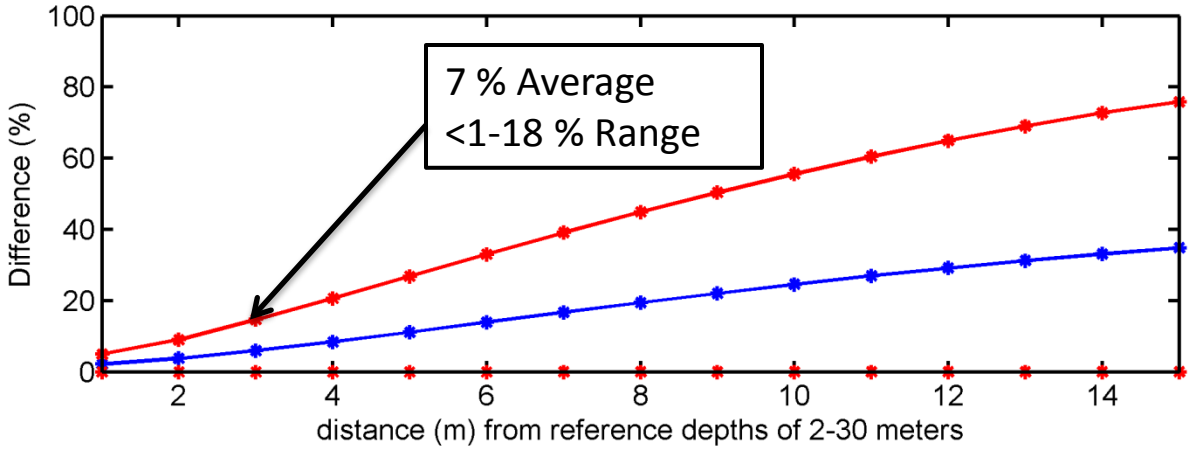
- Seasonal comparison
- % difference between density distributions with particles released 1-15 m apart averaged over all release depths (2-30 m)

Winter Months No Upwelling (January)



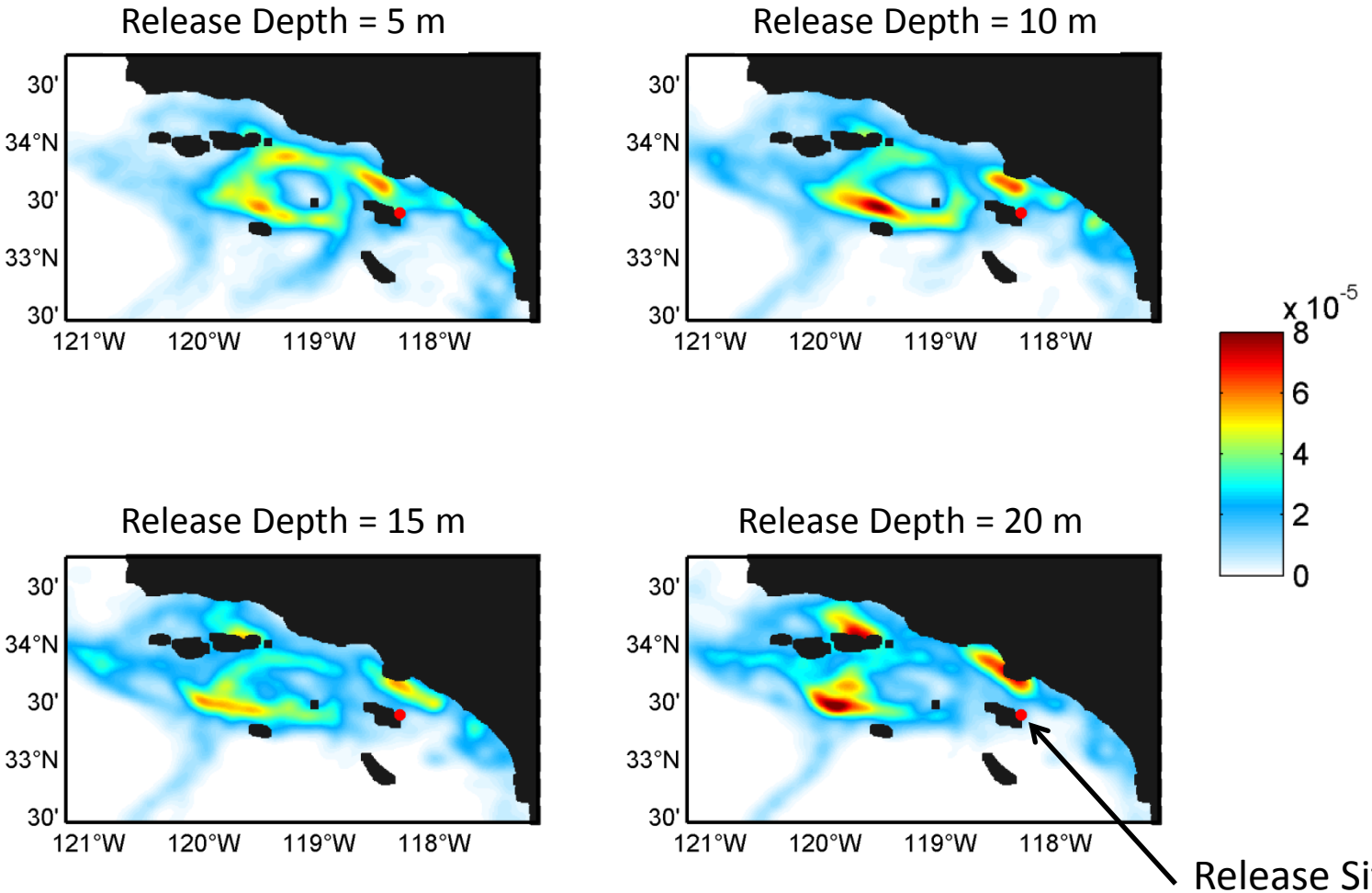
Advection Time 15 days

Spring Months Upwelling (May)



Parameter 2: Particle Release Depth

Density Distributions for May 1999 with Advection Time of 15 days

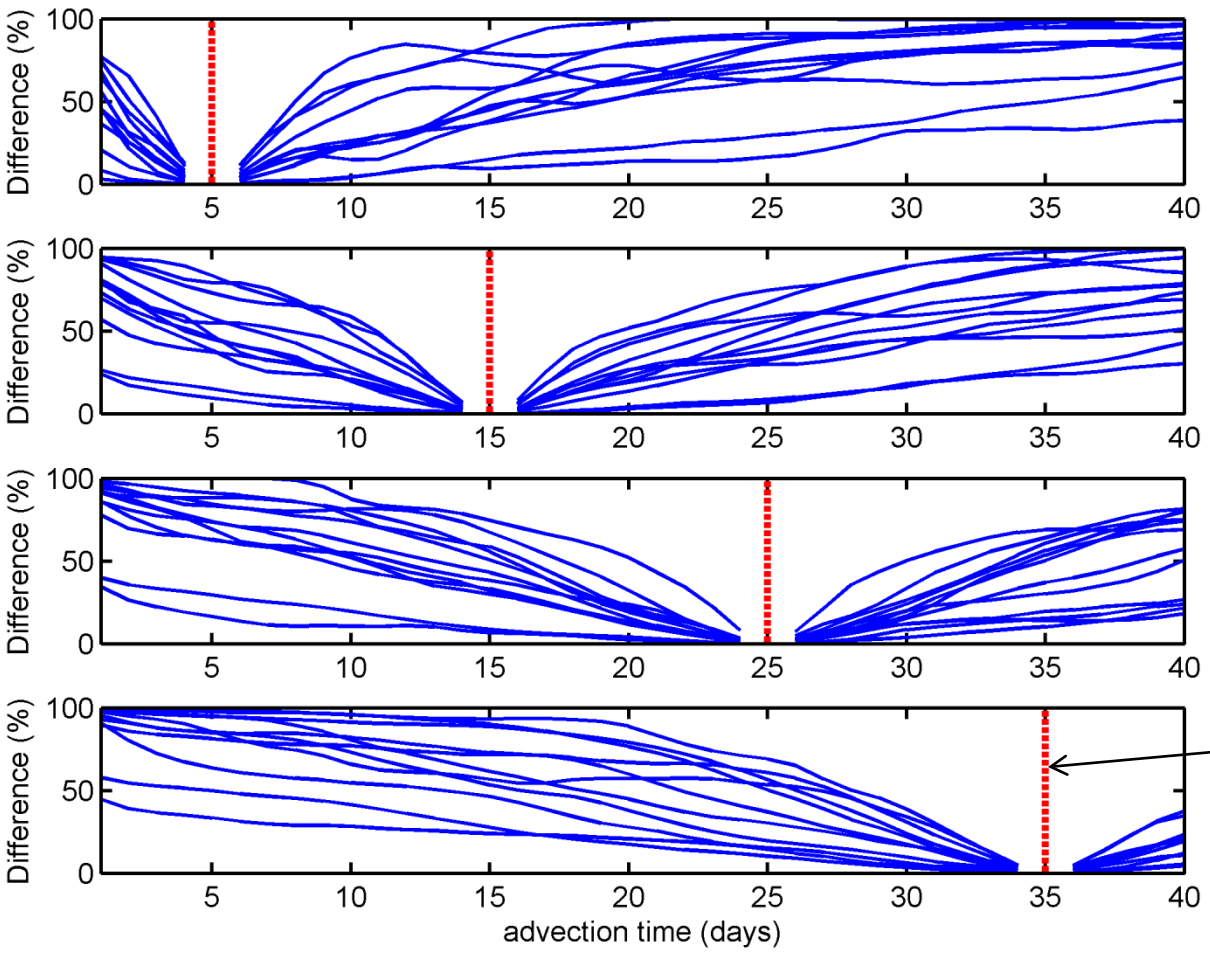


Number of particles above threshold value of 4,400

Parameter 3: Particle Advection Time

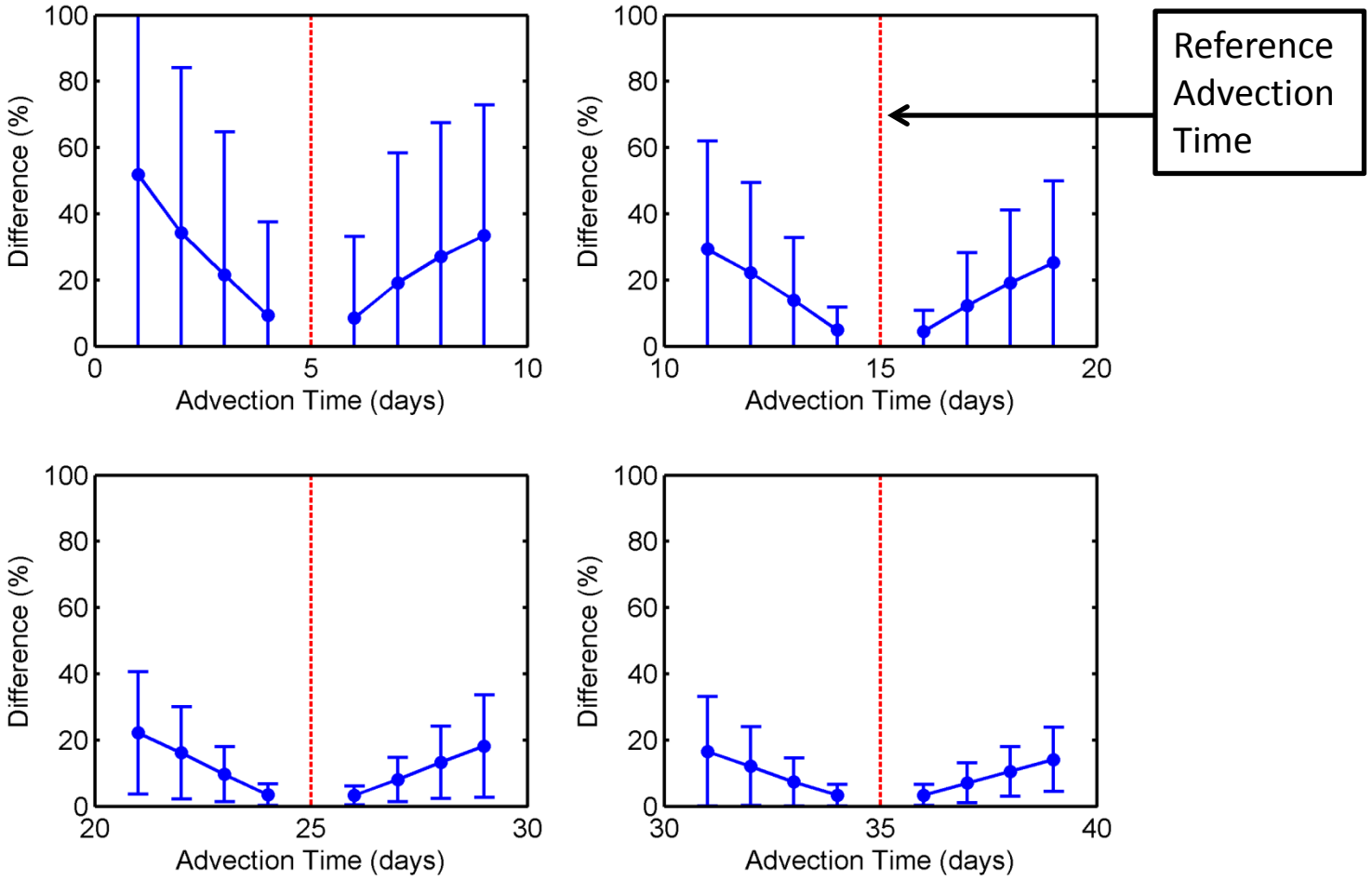
- For each site and month, all particles advected for 40 days
- Density distributions compared to range of reference days

January Releases (3 years)



Parameter 3: Particle Advection Time

- Density distributions compared to reference advection times of 5 days, 15 days, 25 days, and 35 days
- Averaged over all months, years and sites



Talk Summary

- Larval transport results can be influenced by the selection of input parameters for particle tracking models.
- We have developed a methodology to quantify the influence of input parameters on results.
- For the number of particles released, a threshold number was determined beyond which the number of particles did not influence the results. The threshold values were 6,400 particles for an advection time of 30 days and 4,400 particles for an advection time of 15 days
- When particles were released from different depths (even only a few meters apart), the results changed. The average percent difference between density distributions was 2-3% per meter apart that the particles were released.
- A few days difference in advection times produced different results. This effect lessened with increasing advection times.