Optimal Spectral Decomposition (OSD) for Reconstructing Surface Ocean Circulations from Satellite Altimetry

Chu, Peter C and Chenwu Fan, Naval Postgraduate School, Monterey, California (pcchu@nps.edu, tel: 831-656-3688, fax: 831-656-3686)

Near-real time ocean surface currents derived from satellite altimeter (JASON-1, GFO, ENVISAT) and scatterometer data on $1^o \times 1^o$ resolution for world oceans (59.5^o S to 59.5^o N) posted online as "Ocean Surface Current Analyses – Real Time (OSCAR)", provide invaluable resources online (http://www.oscar.noaa.gov/index.html) for various uses include large scale climate diagnostics and prediction, fisheries management and recruitment, monitoring debris drift, larvae drift, oil spills, fronts and eddies, plus opportunities for search and rescue, naval and maritime operations. The methodology for OSCAR combines geostrophic, Ekman and Stommel shear dynamics, and a complementary term from the surface buoyancy gradient.

A major weakness of the OSCAR dataset is its inability to represent the currents near the lateral boundary. The most evident western boundary currents such as the Gulf Stream and Kuroshio are missing. Besides, the data are quite noisy. To improve the OSCAR data, the optimal spectral decomposition (OSD) method is used to process the OSCAR data. Two-scalar (toroidal and poloidal) spectral representation is used to reconstruct three-dimensional ocean flow from noisy data. The basis functions are the eigenfunctions of the Laplacian operator with the given boundary conditions. A cost function used for poor data statistics is introduced to determine the optimal number of basis functions.

After the OSD analysis, the reconstructed OSCAR data show realistic surface circulations including western boundary currents such as Gulf stream, Kuroshio, Brazilian Currents, Somali Currents, and eastern boundary currents such as California Currents, Peru Currents, etc.. Comparison of the reconstructed OSCAR data to in situ current measurements and OGCM model results is also provided.