Inner Shelf Dispersion and Dilution of Creek Runoff

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Runoff from coastal streams can provide inorganic nutrients, organic matter, and sediments to coastal ecosystems. Similarly, pollutants from stormwater runoff can have direct impacts to society. This study's goal is to characterize dispersion and dilution of freshwater and passive tracers from small creek runoff. We present numerical simulations of stormwater runoff in the Santa Barbara Channel near Mohawk reef. The Regional Ocean Modeling System (ROMS) was nested in a one-way coupled configuration. Downscaling from 5 km horizontal resolution down to a 100 m with a sequence of 4 nested grids. All model runs include tidal forcing, realistic surface fluxes from the Weather Research Forecast (WRF) model, and discharge fluxes at the land/sea interface. Freshwater discharge is only introduced in the highest resolution domain. It is enabled at two creeks, each on either side of Mohwak Reef. Model simulations were initialized from existing spun up solutions forced with climatology for 15 years and subsequently forced with realistic atmospheric forcing and outer boundary conditions from Simple Ocean Data Assimilation (SODA) for 9 years or more. This numerical study is unique by focusing on the far-field of small-scale rivers (creek) discharging into a turbulent submesoscale flow (rather than discharging into a quiescent ocean).

Two seasons are simulated: 1) Winter 2004/2005 and 2) Winter 2007/2008, which include the largest runoff events between the years 2002 and 2009. Each wet season had on average 4 significant discharge events (8 runoff events in total). We present a characterization of the dispersion and dilution of the stormwater runoff, including statistical analyses of freshwater fraction and passive tracer concentration. Runoff events are typically short-lived, lasting for 12 hr to about 2 days. Freshwater plumes are generally trapped near coast, dispersing along-shelf roughly 10 faster than cross-shelf. Surface winds are generally non-stationary, modulating the cross-shelf extent of the freshwater plumes, where offshore winds lead to offshore spreading of the plume (and vice versa). Numerical experiments are used to assess the sensitivity of the results to changes on the hydrological fluxes and wind forcing. The results will be used to developing simple rules or models describing the dilution field from freshwater runoff with respect to the discharge, tracer loading, ocean currents (including shear, and variability), winds, background stratification, and depth of the surface and bottom boundary layers.