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Modeling upwelling and Primary Productivity at the Costa Rica Dome

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Several physical processes have major impact on the ecosystem in the northeast tropical Pacific, among them the open ocean upwelling at the Costa Rica Dome (CRD). A medium complexity, nitrogen-based ecosystem model is developed in order to simulate the ecosystem in the northeast tropical Pacific. The ecosystem model is run "offline", using a realistic physical ocean model hindcast as input. The physical model is a subdomain of the global Navy Coastal Ocean Model, which is a hybrid sigma-z level model and assimilates temperature, salinity, and altimeter data. The ecosystem model includes two nutrients (nitrate and ammonium), two size-classes of phytoplankton, two size-classes of zooplankton, and detritus. The model is run for 4 years from 1999 to 2002 and validated with SeaWiFS data and ship-based observations from the STAR-cruises of 1999 and 2000. At the CRD upwelling at the surface is causes by Ekman upwelling during the summer, although the dome is thought to be present at depth throughout the year. A mass-balance budget is calculated at the CRD, and the horizontal and vertical fluxes are related to the abundance of plankton at the dome. There is upwelling (7.2X10-2 Sv) at the dome throughout the year, but around the location of the dome (90˚ W, 9˚ N) the upwelling is largest in the winter. Further west, input of nutrients from below is larger in the summer and fall. The results suggest that about 80% of the nitrate that is supplied to the dome during summer is actually brought up to the west of the dome and transported eastward by the North Equatorial Counter Current.