Background

This website provides access to upwelling index databases and analysis tools for the Global Ocean's coastal regions, derived from satellite-based wind products. The offshore component of transport in the upper ocean Ekman Layer (https://en.wikipedia.org/wiki/Ekman_transport) serves as an index for upwelling (and conversely, for downwelling) in coastal regions.

Due to the presence of the coastline, offshore transport at the surface is balanced by upwelling of waters from below. Specifically, the upwelling indices are computed as

$$S_x = \frac{\tau_y}{\rho_0 f}$$

where S_x is the Ekman transport in the offshore direction (x lies along the bathymetric gradient, positive toward deeper water), τ_y is the wind stress component that points in the along-isobath direction (with shallow water to the left), and f is the local Coriolis parameter. The bathymetric gradient is computed from the ETOPO2 global digital elevation model using a 60 km length scale. Wind stress is computed by the bulk formula

$$\tau_y = \rho_{air} C_D U_y |\boldsymbol{U}|$$

where $\boldsymbol{U}=(U_x, U_y)$ is the 10m wind with x and y components as given above and $|\boldsymbol{U}|$ is the wind speed. C_D is a drag coefficient computed using the Large and Pond (1982) quadratic formulation

$$C_D = 10^{-3}|\boldsymbol{U}|^{-1}(2.7 + .142|\boldsymbol{U}| + .0764|\boldsymbol{U}|^2).$$

The seawater density ρ_0 and air density ρ_{air} are computed using variables from the ICOADS monthly climatology.

The upwelling indices are computed using three different wind products:

(1) Cross-Calibrated Multi-Platform (CCMP) Version 1.1 from Remote Sensing Systems (www.remss.com/measurements/ccmp/)

(2) CCMP Version 2.0

(3) Level 2B 25 km Swath data from the SeaWinds scatterometer on the QuikSCAT satellite (available from https://podaac.jpl.nasa.gov). These satellite swath winds are averaged over 50 km bins daily, and the upwelling index time series will contain gaps due to the satellite sampling pattern.