ID: W1997537567

TITLE: Seasonal rhythms of net primary production and particulate organic carbon flux to depth describe the efficiency of biological pump in the global ocean

AUTHOR: ['M.J. Lutz', 'Ken Caldeira', 'Robert B. Dunbar', 'Michael J. Behrenfeld']

ABSTRACT:

We investigate the functioning of the ocean?s biological pump by analyzing the vertical transfer efficiency of particulate organic carbon (POC). Data evaluated include globally distributed time series of sediment trap POC flux, and remotely sensed estimates of net primary production (NPP) and sea surface temperature (SST). Mathematical techniques are developed to compare these temporally discordant time series using NPP and POC flux climatologies. The seasonal variation of NPP is mapped and shows regional? and basin?scale biogeographic patterns reflecting solar, climatic, and oceanographic controls. Patterns of flux are similar, with more high?frequency variability and a subtropical?subpolar pattern of maximum flux delayed by about 5 days per degree latitude increase, coherent across multiple sediment trap time series. Seasonal production?to?flux analyses indicate during intervals of bloom production, the sinking fraction of NPP is typically half that of other seasons. This globally synchronous pattern may result from seasonally varying biodegradability or multiseasonal retention of POC. The relationship between NPP variability and flux variability reverses with latitude, and may reflect dominance by the large?amplitude seasonal NPP signal at higher latitudes. We construct algorithms describing labile and refractory flux components as a function of remotely sensed NPP rates, NPP variability, and SST, which predict POC flux with accuracies greater than equations typically employed by global climate models. Globally mapped predictions of POC export, flux to depth, and sedimentation are supplied. Results indicate improved ocean carbon cycle forecasts may be obtained by combining satellite?based observations and more mechanistic representations taking into account factors such as mineral ballasting and ecosystem structure.

SOURCE: Journal of geophysical research

PDF URL: https://onlinelibrary.wiley.com/doi/pdfdirect/10.1029/2006JC003706

PUBLICATION YEAR: 2007

TYPE: article

CONCEPTS: ['Environmental science', 'Sediment trap', 'Flux (metallurgy)', 'Latitude', 'Primary production', 'Atmospheric sciences', 'Climatology', 'Carbon cycle', 'Biological pump', 'Subtropics', 'Water column', 'Oceanography', 'Geology', 'Ecology', 'Ecosystem', 'Materials science', 'Geodesy', 'Metallurgy', 'Biology']