Magnitude, Variability and Controls on the Ratio of Particle Export to Primary Production in the Upper Ocean

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The transport of biogenic particles from the surface to the deep ocean is the key driver of the ocean's biological pump. Globally, the magnitude and efficiency of the biological pump will in part modulate levels of atmospheric CO_2, and from the geological paleo-oceanographic record there is evidence of elevated rates of export of POC resulting from changes in the functioning of the pump. Thus there is a need to better understand what are the key determinants of this pump in the present day, and how they might be altered in response to climate change.

This talk will examine the present day relationship between primary production and particulate export in the upper ocean. Recent advances in satellite derived algorithms for primary production lend well to improved global predictions of the rate of C uptake, however our ability to determine particle fluxes is much poorer. A pronounced mismatch between spatial patterns in primary production and the export of carbon to the deep ocean, points to the complex suite of transformations that occur in the upper 300 m of the ocean. The results thus far indicate that the relative rates of C uptake and losses via sinking particles vary as a function of the local food web dynamics. In particular, diatoms appear to play an important role in enhancing the ratio of export:production in the upper ocean. In spite of the recent development of promising modeling approaches to assess export production on global scales (Laws et al., 2000), our understanding of the key processes determining what controls the efficiency of particle transport between the surface and deep ocean remains weak.