Enhancement of mesopelagic sinking particle fluxes due to upwelling, aerosol deposition, and monsoonal influences in the northwestern South China Sea

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Time-series data from a sediment trap at approximately 1000 m depth in the northwestern South China Sea, July 2012 to April 2013, were used in combination with remote sensing and shipboard physical and biogeochemical data to quantify the effects of multiscale physical processes on sinking particle fluxes and the function of the local biological carbon pump. Total mass flux (TMF) and the fluxes of its primary components — particulate organic carbon, calcium carbonate, opal, and lithogenic matter — exhibited similar temporal trends, with three conspicuous high-flux events. These events occurred in the summer, autumn, and winter, attributable to upwelling, aerosol deposition, and the northeast monsoon, respectively. Together, these events accounted for only 40% of the total time but approximately 80% of the 10-month TMF (21% during the one-month upwelling event, 23% during the one-month aerosol event, and 36% during the two-month northeast monsoon event). Each event contributed its own unique biogeochemical overprint. For example, Calcareous phytoplankton benefited from both the upwelling and aerosol deposition events, but siliceous phytoplankton benefited more than calcifiers during the upwelling conditions. The biogenic sinking particles were primarily marine authigenic, while the lithogenic matter was mainly resuspended sediment from the neighboring slope. The high flux of lithogenic matter was due to scavenging by sinking organic matter and the ballasting effect, especially during the high-flux periods. This study illustrates that episodic intra-seasonal physical processes are as important as the most common major seasonal event — the northeast monsoon — in modulating the strength of the South China Sea biological carbon pump.