Impact of strong El Niño events on sinking particle fluxes in the 10°N thermocline ridge area of the northeastern equatorial Pacific

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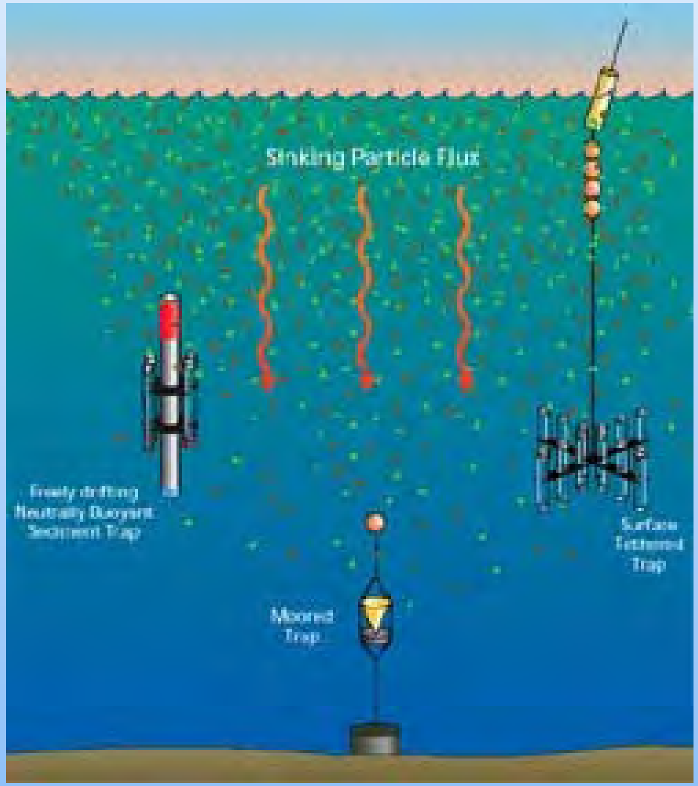
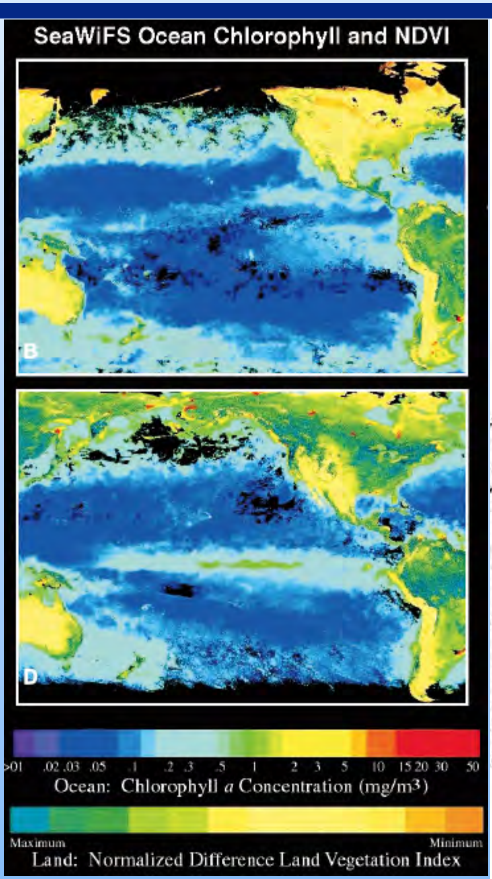
What is a sediment trap and why do we use it?

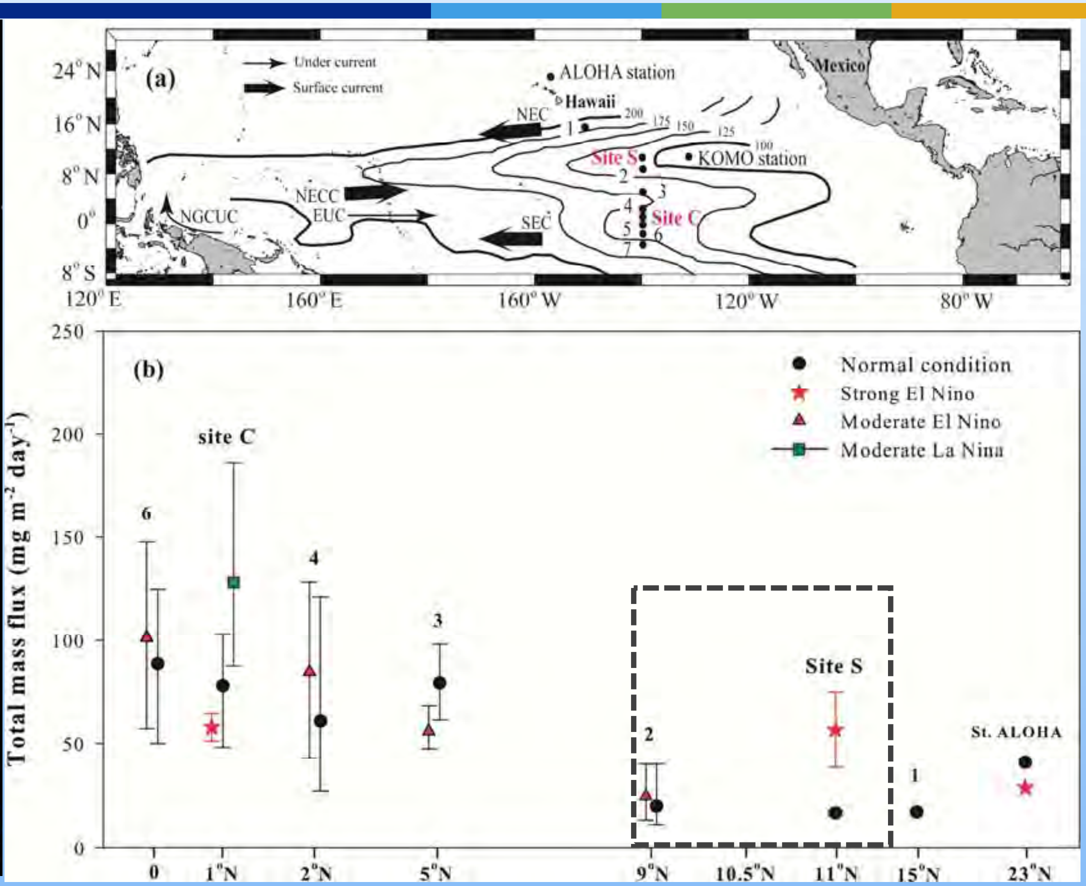


- Sediment traps collect particles falling to the deep-sea floor
- Allows to monitor the natural variations in sinking particle fluxes and surface productivity

➢ Help to understand the carbon and nutrient cycling in the Ocean’s interior

El Niño Southern Oscillation and particle fluxes

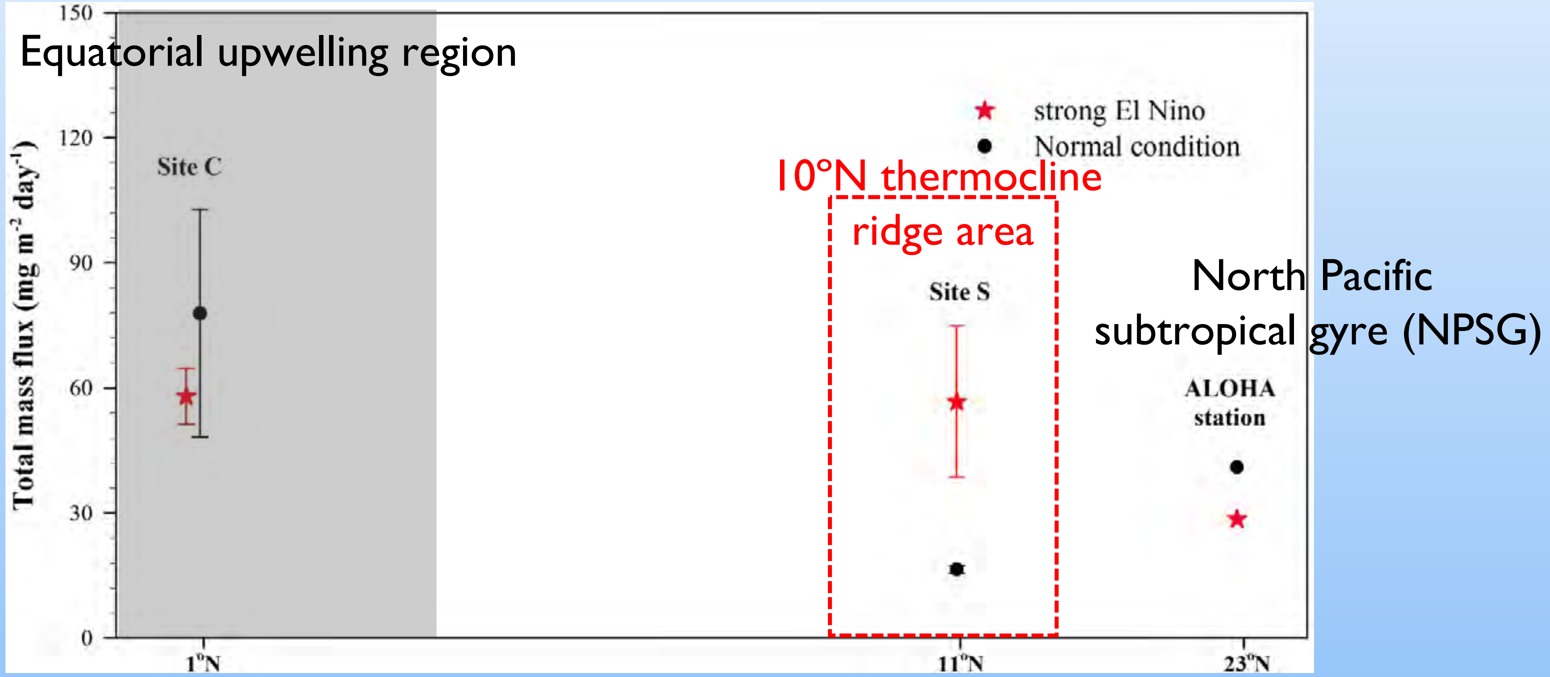




- **La Niña** increases sinking particle fluxes.
- **El Niño** decreases sinking particle fluxes.

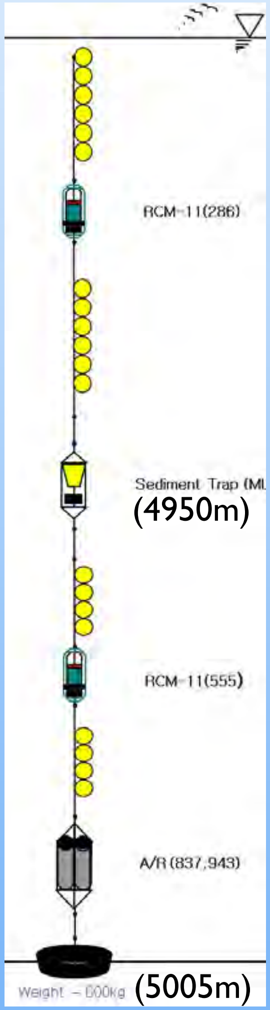
- An exception to the general trend was reported at site S located at 11°N and 140°W.

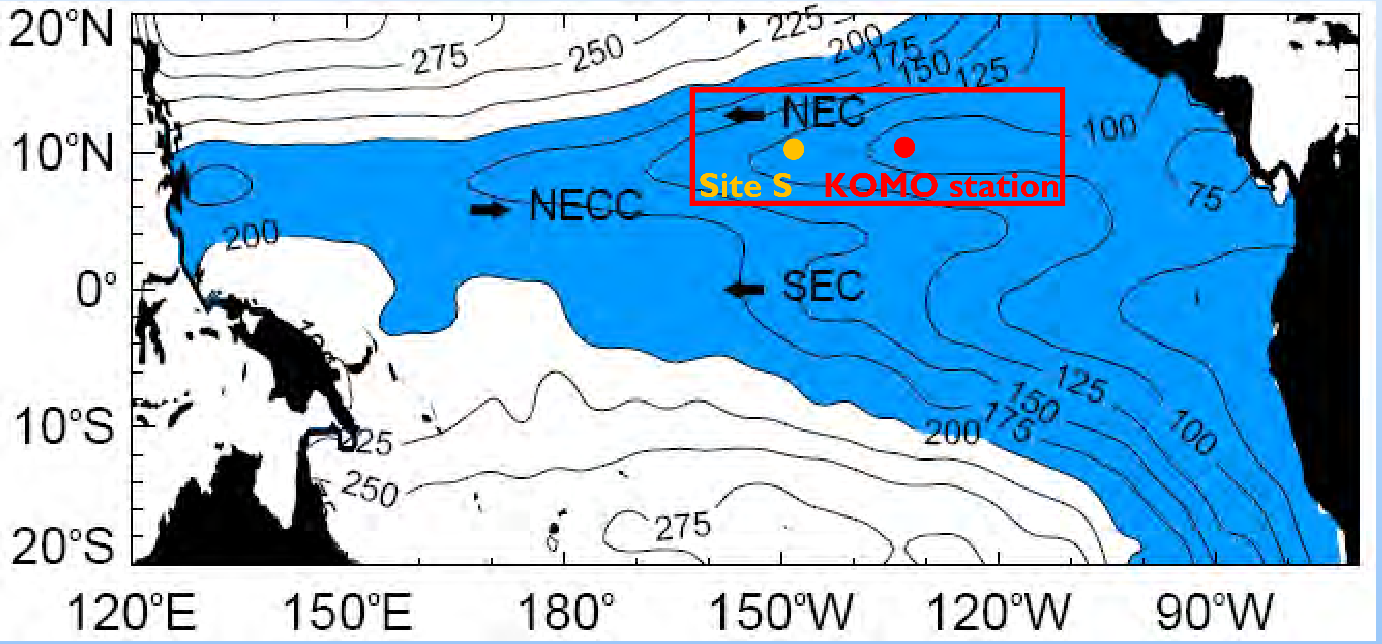
Unexpected high fluxes at site S in the 10°N thermocline ridge area



- Dymond and Collier (1988) reported a two- to fourfold increase in particle fluxes, compared with those of the post-El Niño season, at site S.
- In contrast, site C experienced a significant reduction in particle fluxes during same EN event.
- The mechanism is not fully understood, because these particle flux measurements are the only data available for the strong El Niño event in this region.
- It is not possible to test the significance of these results without additional particle flux measurement

KOMO station in the 10°N thermocline ridge area



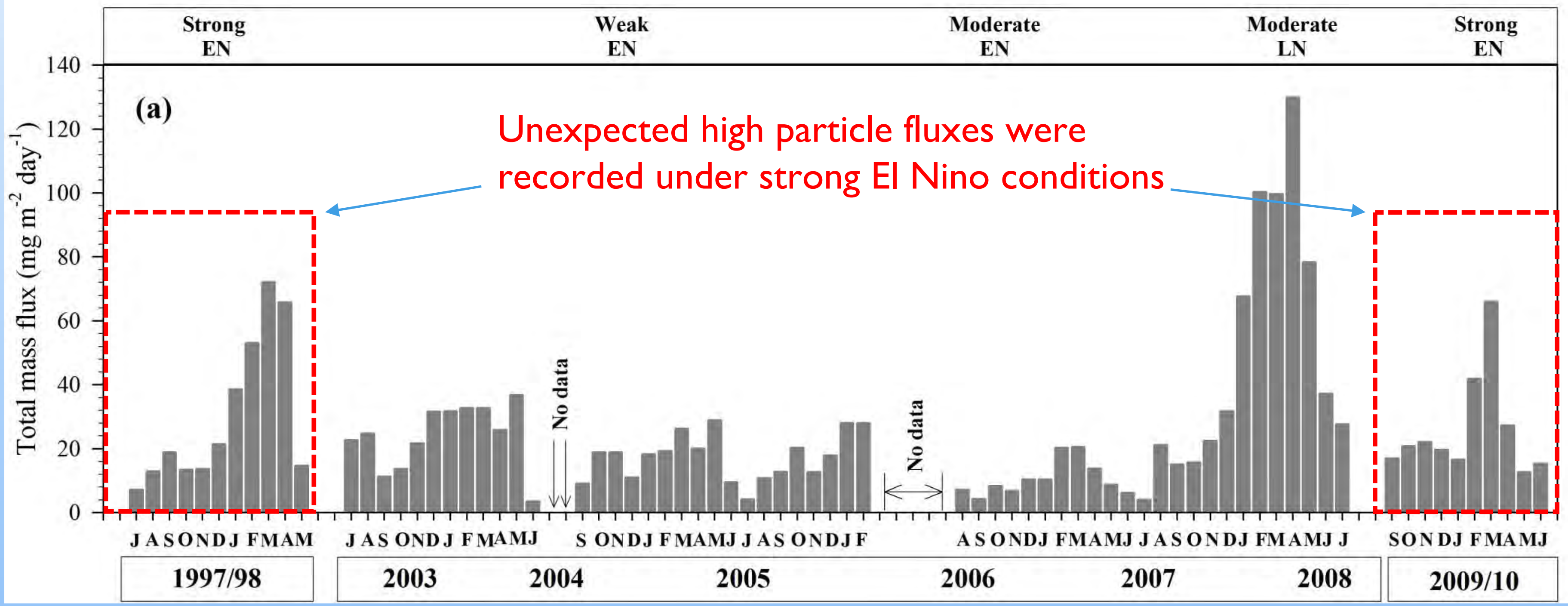


▪ The KIOST has been operating a time-series sediment trap at KOMO station in the 10°N thermocline ridge area for 8 years
(July 1997 – May 1998, July 2003 – June 2010)

▪ Monitoring the sinking particle flux variations during the 1997/98 and 2009/10 strong El Niño events

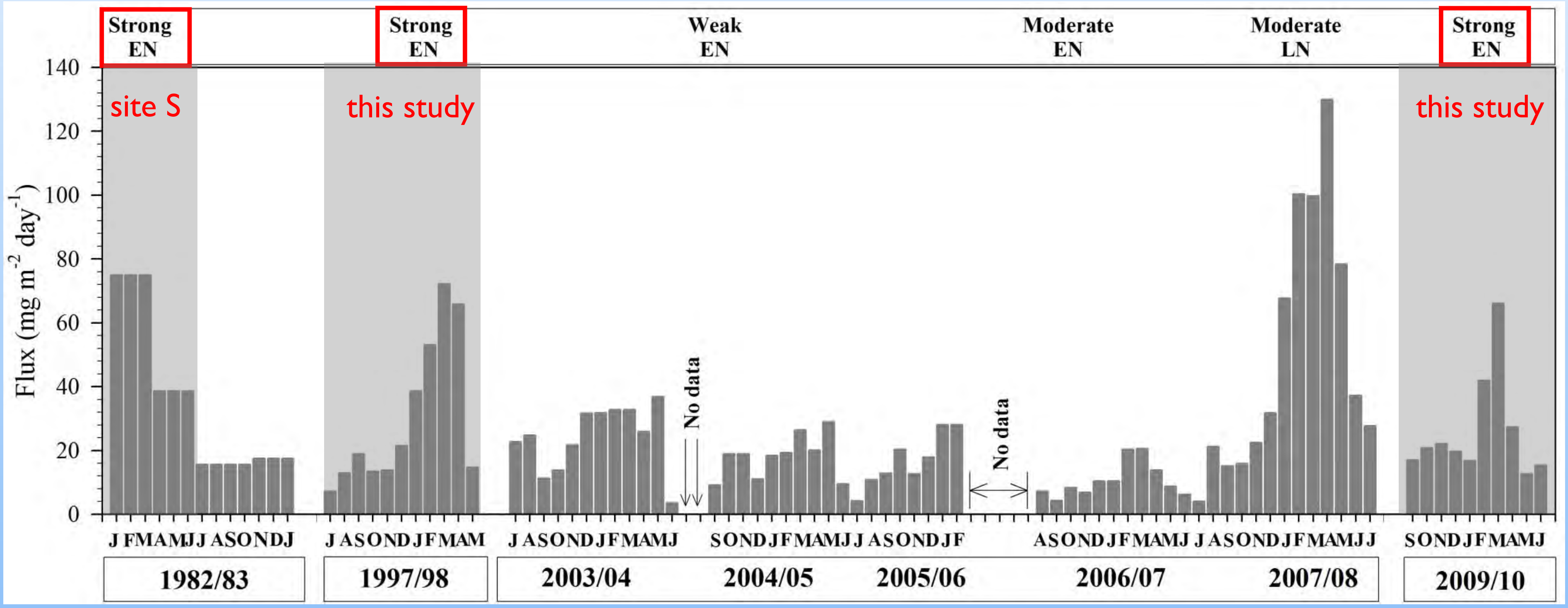
▪ These data provide insight into the effect of strong El Niño event on sinking particle fluxes in this region.

Natural variability in sinking particle fluxes at KOMO station over the monitoring period



- Five ENSO events during the monitoring period
- Total mass fluxes showed distinct seasonal fluctuation, with high value in winter-spring and low value in summer-fall season
- Moderate LN event was associated with an increase in particle fluxes
- Moderate EN was accompanied by a significant reduction in sinking particle fluxes

1982/83, 1997/98, and 2009/10 strong El Nino events

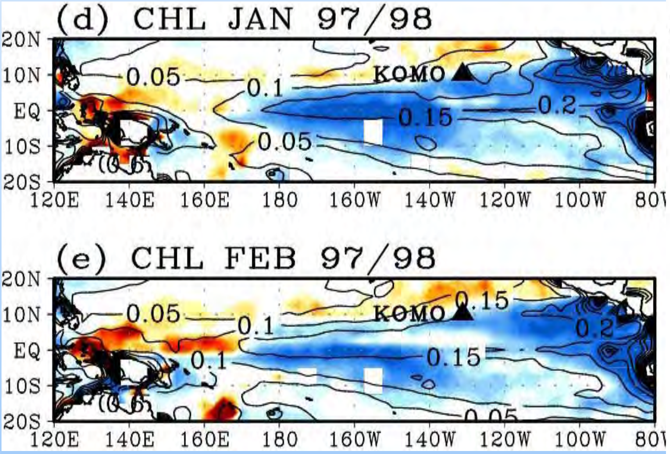


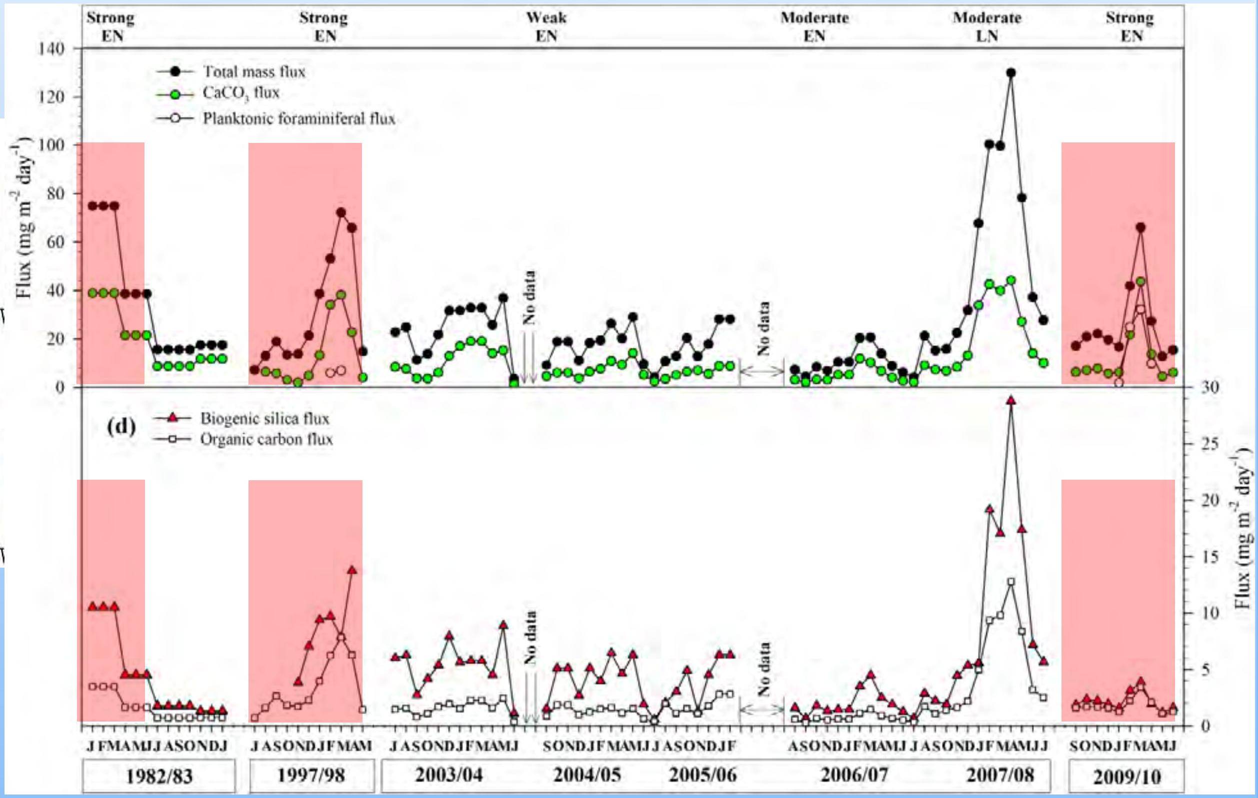
Kim et al. (2012)

- The enhanced particle fluxes during two strong El Niño events are consistent with the 1982/83 results from site S.

- These results suggest that strong El Niño-modulated oceanic condition promotes biological productivity in the 10°N thermocline ridge area.

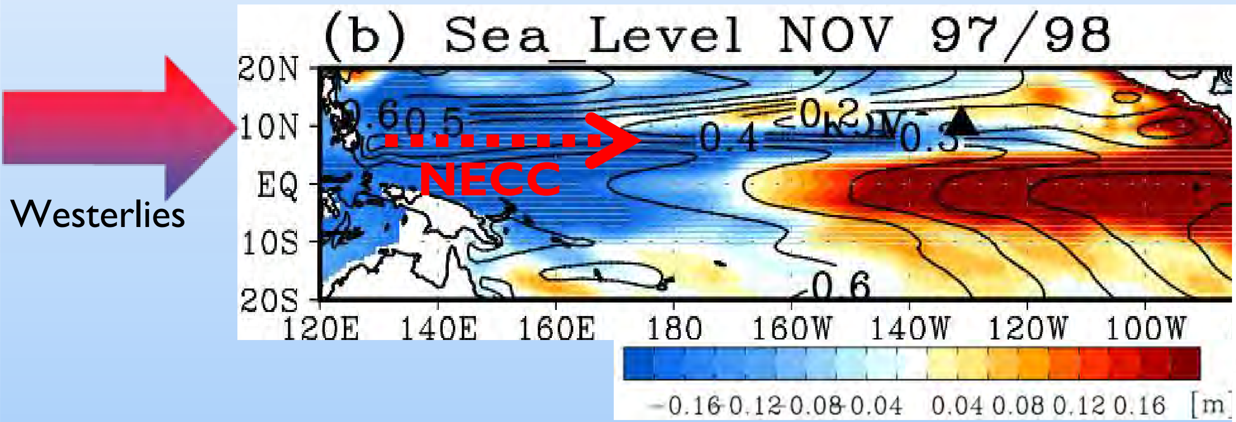
Strong El Nino-modulated oceanic condition promotes surface biological productivity

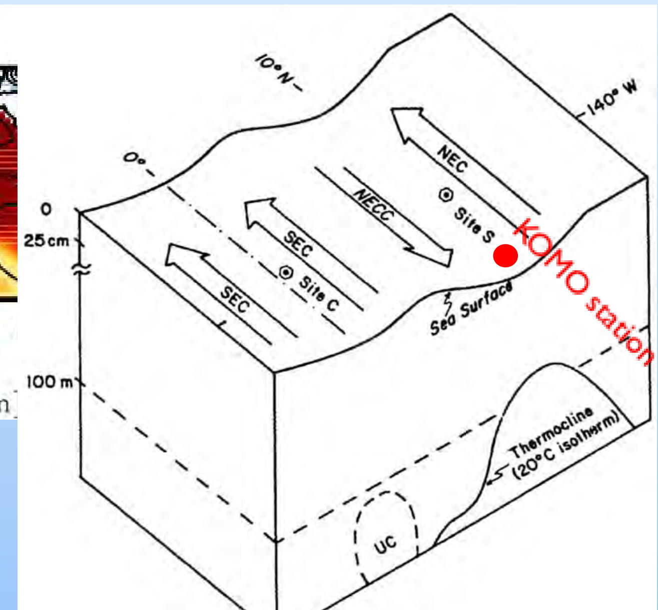




- The increase in biogenic particle fluxes synchronized with the increase of chl-a concentration
- Our particle flux data suggest that the three- to fourfold increase in surface productivity support the satellite-based evidence

What caused the enhanced biological productivity under strong EN condition?





Dymond and Collier (1988)

- Negative SLH anomaly band, indicating upwelling, develops under the strong El Nino condition.
- This negative anomaly band indicates that strong upwelling had occurred along the NECC path.
- Strengthen of NECC, supported by direct current measurement, and resulting upwelling of nutrient-enriched subsurface water along its path increased biological productivity and sinking particle fluxes during the strong El Nino season.

Conclusion

- The 1997/98 and 2009/10 strong El Niño events, at KOMO station in the 10°N thermocline ridge area, caused three-fold increase of sinking particle fluxes compared to the background flux.
- The increased biogenic particle fluxes are attributed to increased surface productivity.
- This is due to a strengthening of the NECC, which causes the upwelling of nutrient-enriched subsurface water along its path.
- Increasing particle fluxes during strong EN would be regarded as a common phenomenon in the 10°N thermocline ridge area.

Detailed information therein,

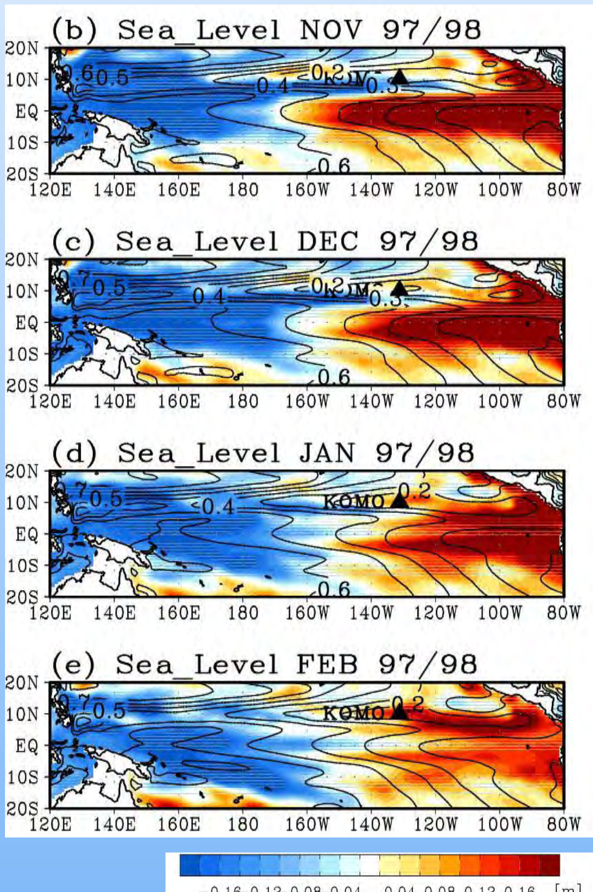
Kim et al. (2010)

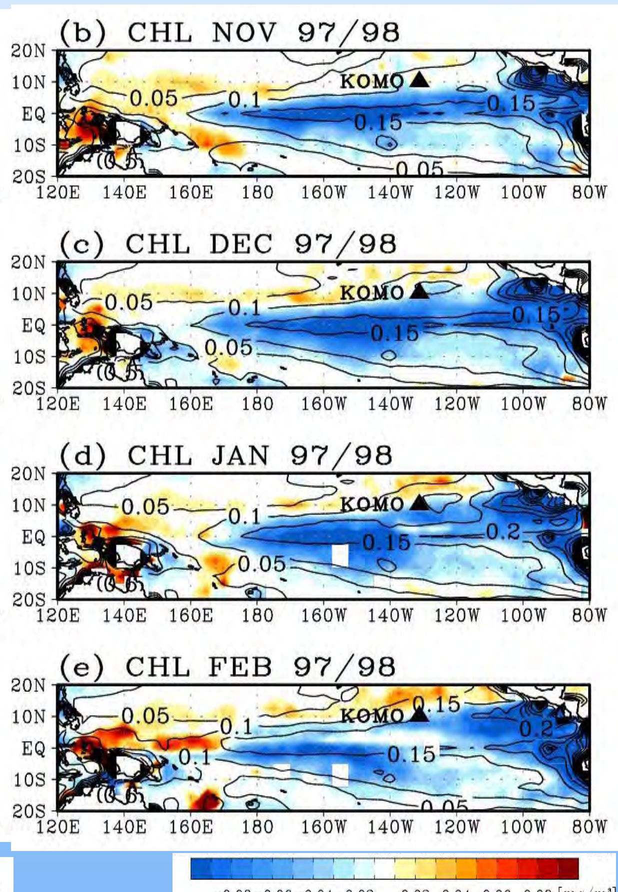
Kim et al. (2011)

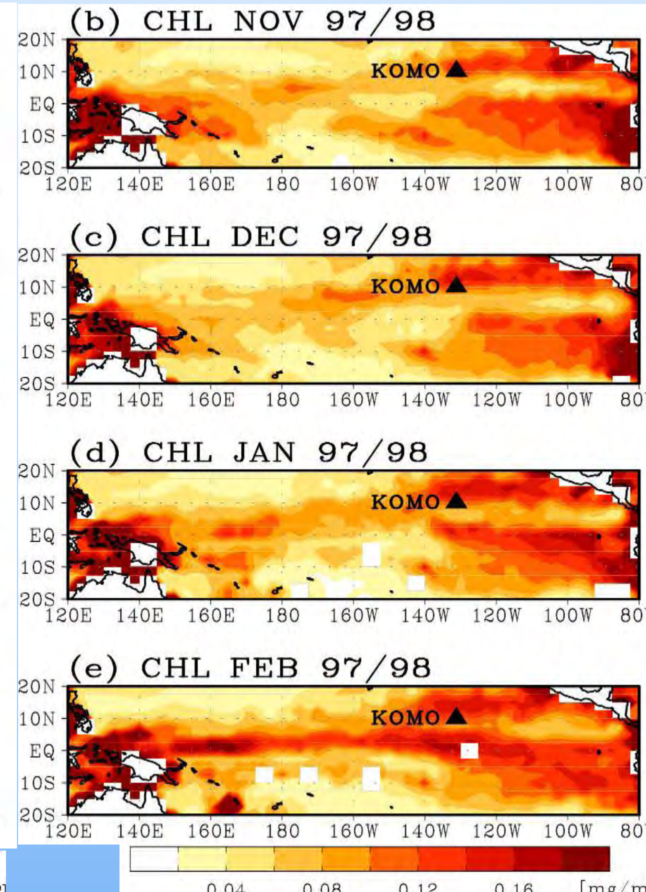
Kim et al. (2012)

1997/98 강한 엘니뇨 시기의 해양학적 특성

- NECC 강화와 수온약층 shoaling, 엽록소 농도의 증가, 침강입자 플럭스 증가
- Dymond and Collier (1988) 의 가설과 일치







- Dymond and Collier (1988)

Satellite data의 한계

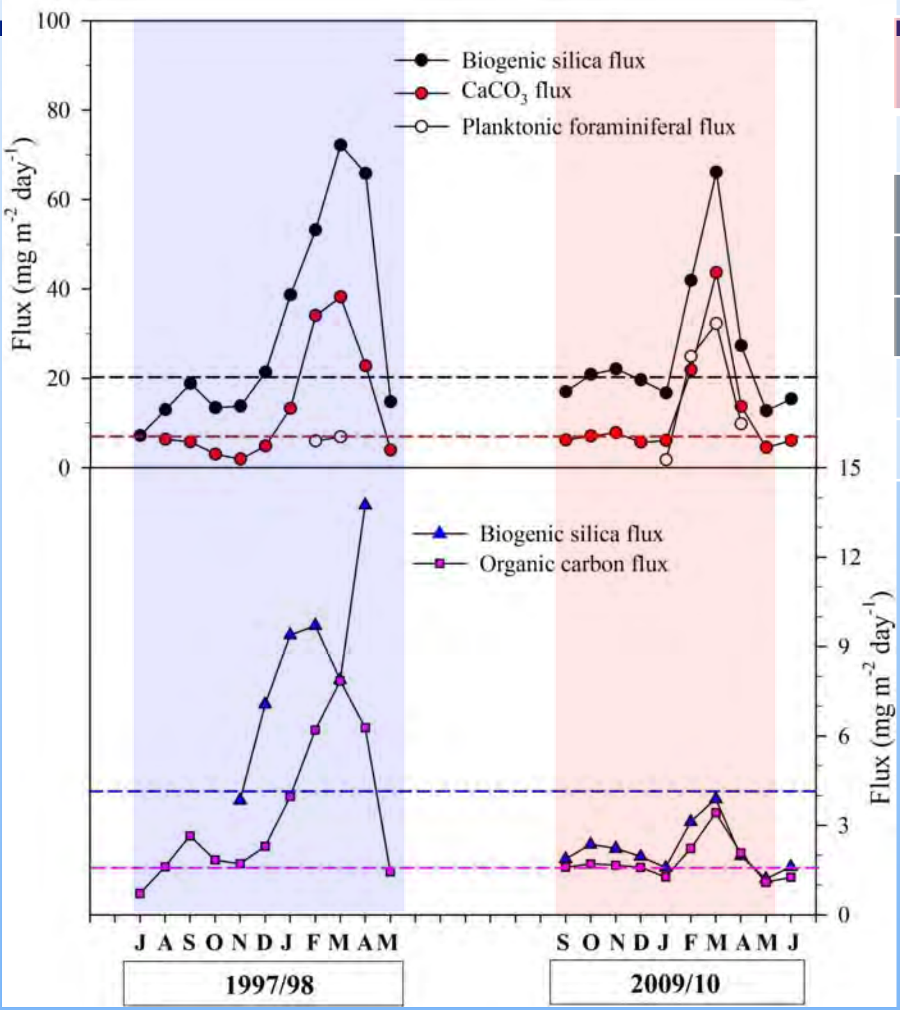
수심 30m 이하 관측 어려움

- 이전 연구자료와 같은 형식

Murtugudde et al. (1999)

Wilson and Adamec (2001)

1997/98과 2009/10 엘니뇨, 침강입자 구성 성분의 차이



	1997/98 EP type	2009/10 CP type
T.M.F	유사	유사
$CaCO_3$ flux		
Foram. flux	18%	75%
Cocco. flux	82%	25%
BSi flux	300-400%	평상시기와 유사
O.C. flux	400%	150-200%

- - - - - - 평상시기 평균 플럭스

❖ **1997/98 EP type** 강한 엘니뇨

: 규조류, 인편모조류등 일차생산성 증가

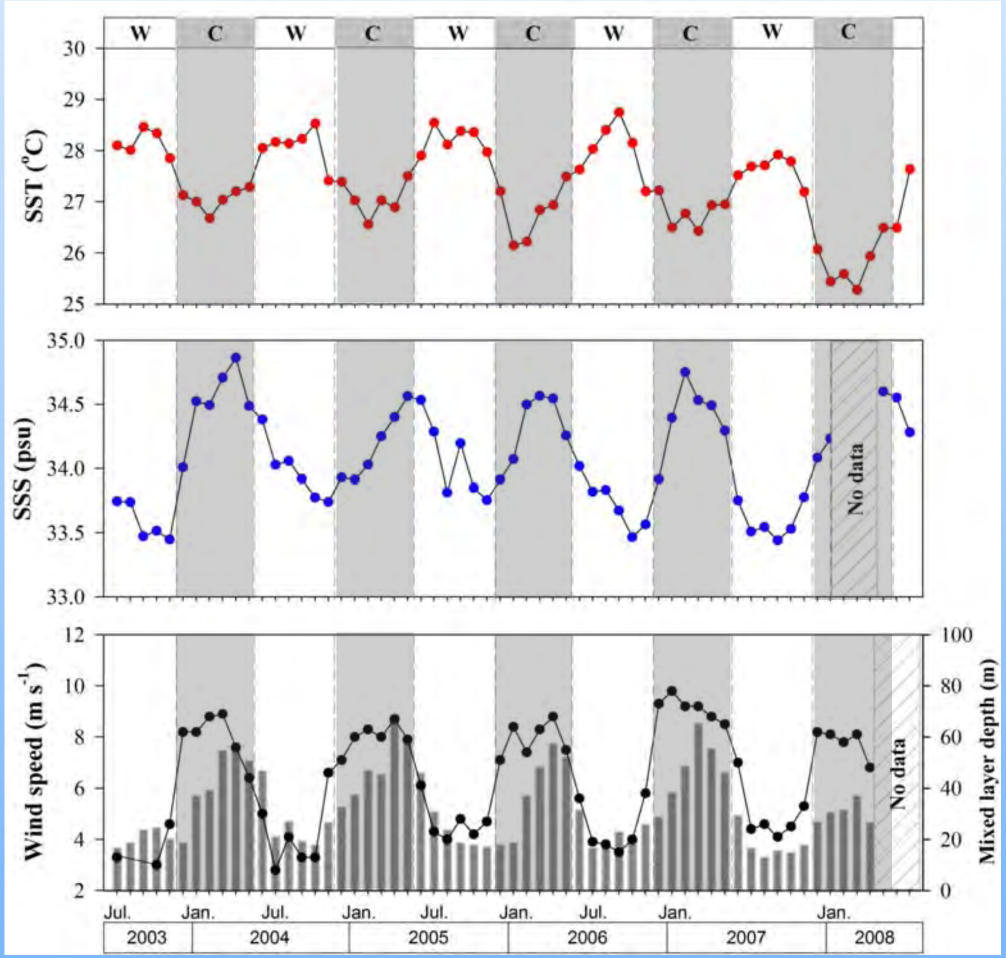
: 침강입자 플럭스 증가

❖ **2009/10 CP type** 강한 엘니뇨

: 부유성 유공충등 동물플랑크톤 증가

: 침강입자 플럭스 증가

Surface environmental properties in the 10°N thermocline ridge area



- Surface environmental properties were closely correlated to the seasonal movement of the ITCZ
- Low SSTs, high SSSs, strong wind speed, and deepening mixed layer were found during winter-spring
- The opposite trend is found during summer-fall
- The ITCZ bring a heavy rainfall

"W" and "C" denote the warm (Summer-Fall) and cold season (Winter-Spring)