

**Responses to Anonymous Referee #1's *Interactive comment on*
"Inter-annual variation of chlorophyll in the northern South China
Sea observed at the SEATS Station and its asymmetric responses to
climate oscillation" by K.-K. Liu et al.**

General Comments

Using the satellite and SEATS station data, the authors carefully analyzed the seasonal and interannual variability of Chl in the northern SCS and attributed the asymmetric responses of Chl to the structural differences. During El Nino events, weaker wind leads to shallower pycnocline, less nutrients in and thus suppressed phytoplankton production, whereas during La Nina events weakened throughflow leads to thicker surface layer, which results in less effective nutrient pumping (Fig. 13) and thus damped recoveries of Chl. The analyses are rather straightforward and the paper is well written. However, the paper could be strengthened if the followings were included.

RESPONSE: We are grateful for the reviewer's appreciation of our work and for the specific comments, which are carefully heeded.

Specific Comments

1. Is it possible to conduct a quantitative analysis of the surface layer heat budget to determine how much reduction of the throughflow can account for a deepening of the thermocline by 20-30m in January 2000? Is there any contribution from the stronger wind mixing (positive wind anomaly) at the time?

RESPONSE: These are excellent suggestions. There are at least seven different datasets on the surface ocean heat content in the South China Sea, among which some are better than others, when compared to recent field observations. We plan to use the better datasets for the surface ocean heat content analysis to explore changes in the South China Sea throughflow. We also plan to examine the sea surface height (SSH) variation in relation to the Philippine-Taiwan Oscillation (Chang and Oey, 2012) and use the change in SSH to infer the

change in thermocline depth. Regarding the wind effect, we plan to use a 1D model to estimate the relative contributions of stronger wind and deepened thermocline to the observed deviation of Chl-a from the climatology.

2. Are there concurrent profiles of Chl or phytoplankton biomass as the T/S and NO₃ in Figure 13 so it can be sure that nutrient pumping is ineffective during La Nina events despite the stronger wind rather than that the surface Chl concentration is diluted because of deeper mixing?

RESPONSE: Again this is an excellent suggestion. We have data of Chl-a profiles at the SEATS site from Januarys of 2000 (La Niña) and 2003 (El Niño), which will be shown in the revised version. Fig. 5 shows that the observed sea surface Chl-a in Jan. 2003 was about double that in Jan. 2000. In 2003 the Chl-a maximum was at the surface and the top 30 m had elevated Chl-a concentration, while the Chl-a maximum was at 60 m below surface in 2000 and the top 30 m was low in Chl-a, indicating ineffective nutrient pumping during the 1999-2000 La Niña.

3. P6917, line 1-10: It is suggested that the peak Chl value in December 1999 was due to a cyclonic eddy, but this isn't supported by SSHA (Fig. 9c). Is there any other evidence to show the occurrence of a cyclonic eddy near SEATS station at that time?

RESPONSE: This is a very good question. The SSHA indicates the deviation of sea level from the climatology of that specific month. A positive SSHA at the SEATS site does not necessarily mean that the sea level at the SEATS site was not at a depression (meaning a cyclonic eddy) relative to its surroundings. We have gotten weakly SSH data in November and December 1999 and January 2000 in the South China Sea, which will be shown in the revised version. The SSH maps show that there was indeed a depression in the vicinity of the SEATS site in the second half of December 1999, indicating the passing of a cyclonic eddy. Therefore, the positive SSHA in the time-series suggests that the sea level of the whole region was elevated at that time with respect to the "normal"

years, reflecting the regional enrichment of upper ocean heat content, but this does not preclude the possible occurrence of a cyclonic eddy, which was a depression in the spatial distribution.

References:

Chang, C.-Y. and Oey, L.-Y. (2012) The Philippines-Taiwan Oscillation: Monsoonlike Interannual Oscillation of the Subtropical-Tropical Western North Pacific Wind System and Its Impact on the Ocean. *Journal of Climate* 25, 1597-1618.