Geochemistry, Geophysics, Geosystems

Supporting Information for

Dynamics of primary productivity in the northern South China Sea over the past 24, 000 years

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Introduction

This supporting information provides figures illustrating the modern primary productivity (PP) variations in the South China Sea (SCS).

The monthly marine PP data used in Figure S1-S3 was obtained from Ocean Productivity website (http://www.science.oregonstate.edu/ocean.productivity) with a spatial resolution of 1/6°×1/6°. The data of surface wind speed and SST used in Figure S1 and S3 are from the ERA-Interim project (http://apps.ecmwf.int/datasets) with a spatial resolution of 0.25°×0.25°. The correlation analysis showed in Figure S3 was performed by MATLAB® with a 12-year successive data ranging from 2003 to 2014.

Figure S1 shows that the winter PP could occupy more 40% of total PP in the northern SCS and the seasonal variations of PP are in the dominate of monsoon system. Figure S2 shows the ENSO events play an important role in the inter-annual variations of PP in the northern SCS. Figure S3 show the correlation coefficients (R) of annual PP and winter wind speed. The PP on the continental shelf seems to have poor relationship with the winter wind speed, which represents the strength of winter monsoon, while the PP in the sea basin and upwelling region show strong positive correlation with winter wind speed. Figure S4 shows the correlation analyses results using different length of windows. Figure S5 shows more correlation results between PP and EAWM beyond Figure 5d.

Table S1 shows the surface sediment and core top sediment in Figure 2, which includes the name of station, latitude (Lat.), longitude (Lon.), water depth (WD), percentage of *Florisphaera profunda* (%Fp) and primary productivity (g C m^{-2} yr^{-1}). Table S2 includes the downcore coccolith data (%FP)

Figure S1.

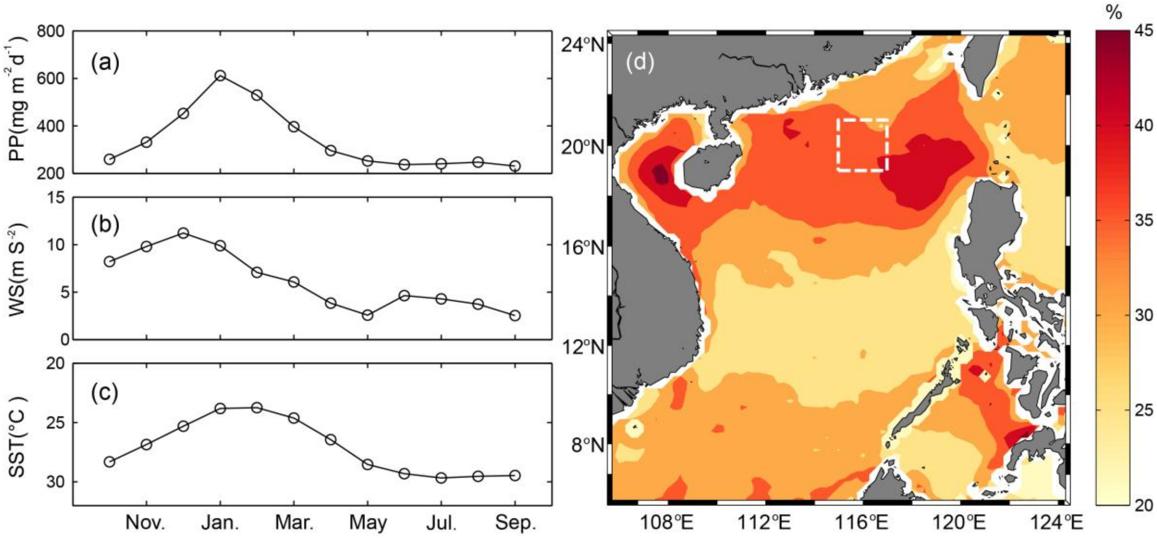

Figure S1. (a-c) indicate modern monthly multi-year average PP, surface wind speed and SST in the region marked in (b). (b) The ratio of winter PP (December January and February) to annual PP in the SCS. The white dotted line in (b) draws the study region (115°W-117°W, 19°N-21°N) around MD12-3428cq.

Figure S2.

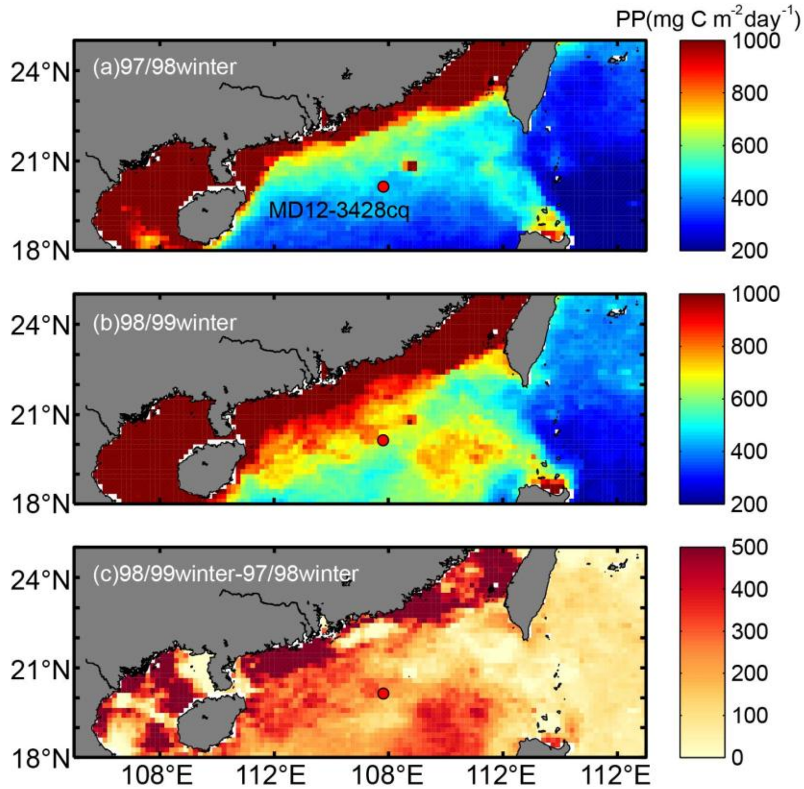

Figure S2. The PP variations during an ENSO event (1997-1998 DJF) and a non-El winter (1998-1999 DJF) in the SCS. (a) The PP from December, 1997 to February, 1998. (b) The PP from December, 1998 to February, 1999. (c) The differences between marine PP of winter of 1997-1998 and 1998-1999. The red dots represent the site of MD12-3428cq. Notice the different scales for (a-b) and (c).

Figure S3.

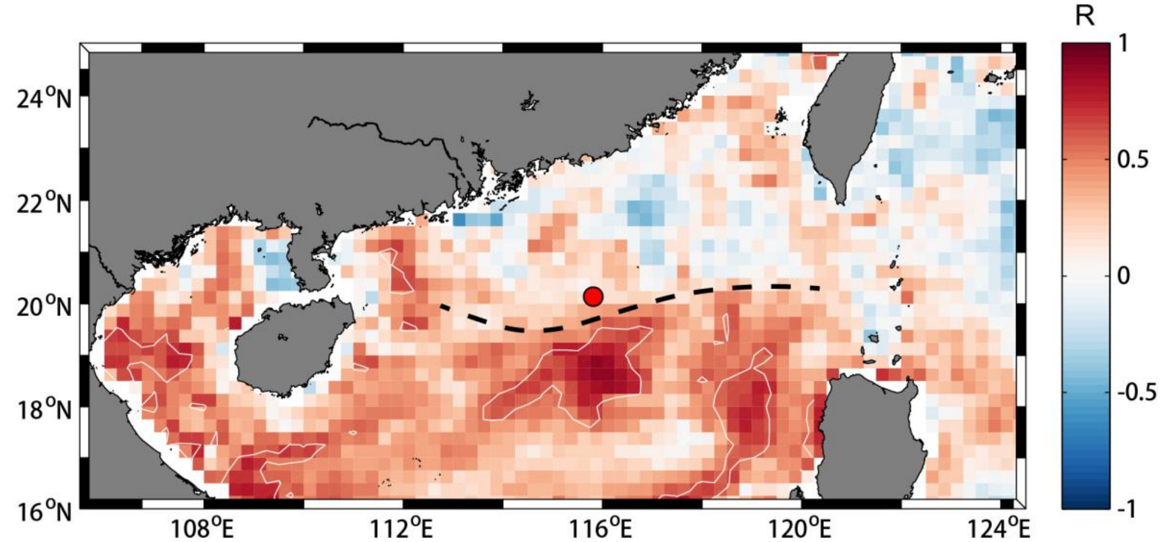

Figure S3. The correlation coefficients (R) of annual PP and winter wind speed in the northern SCS. The white lines are the contour lines of p=0.05. The dark dish line separates out the zone with low R in the northern SCS.

Figure S4.

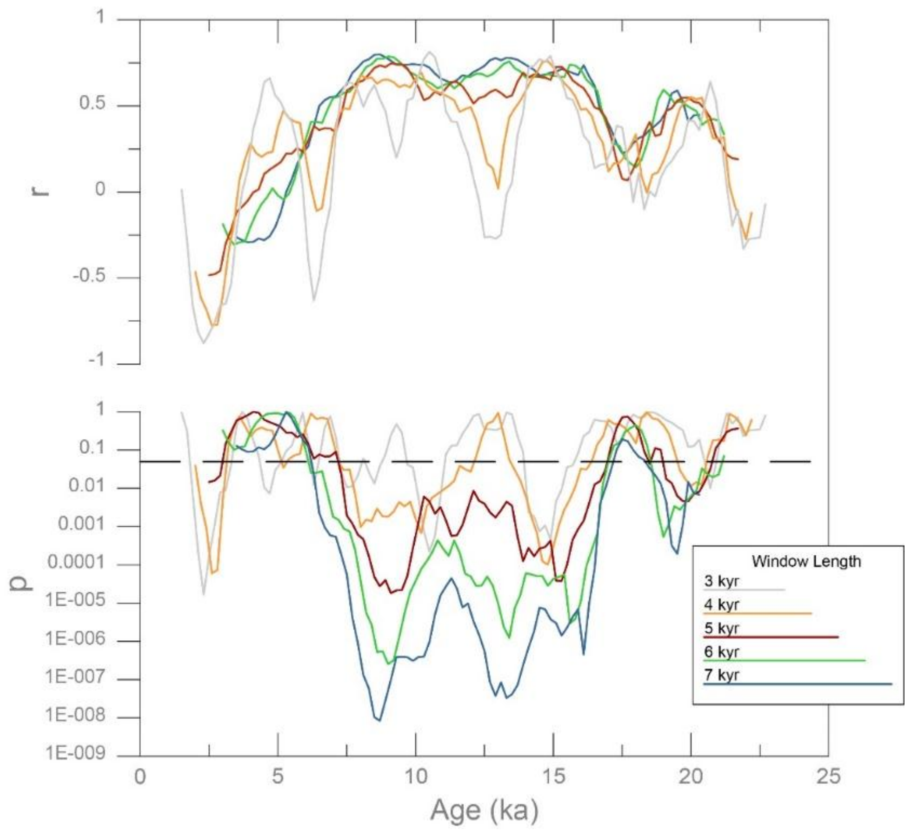

Figure S4. Sliding window analyses of PP and grain size with different window lengths ranging from 3 ka to 7 ka. The dash line marks p = 0.05.

Figure S5.

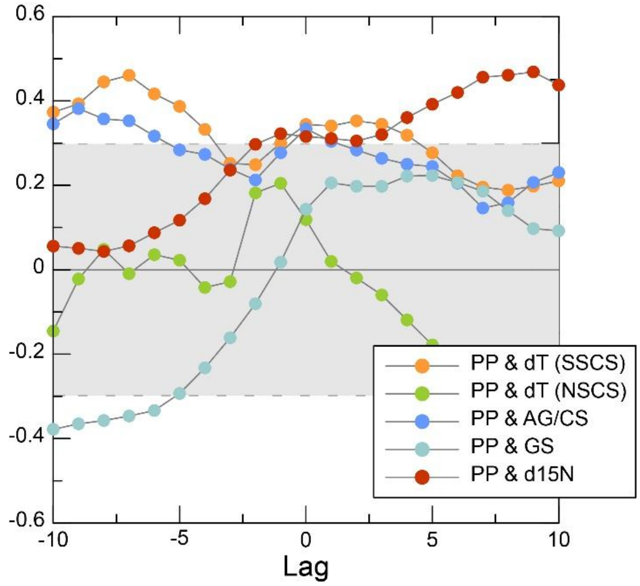

Figure S5. The cross correlation between PP and different winter monsoon proxies: dT (SSCS) [*Huang et al.*, 2011]; dT (NSCS) [*Steinke et al.*, 2011]; AG/CS [*Wang et al.*, 2012]; GS [*Yang and Ding*, 2014]; $d^{15}N$ [*Jia et al.*, 2015]. Note one lag represents 200 years.

Table S1.

Station	Lat.	Lon.	WD(m)	%Fp	PP(gC/m^{2}yr)	Source
17924	19.41	118.73	3438	52.60	140.65	This study
17925-2	19.85	119.05	2980	55.84	141.11	This study
17927-1	17.25	119.45	2800	38.44	93.02	This study
17928	18.27	119.75	2486	62.80	104.46	This study
17929-1	20.68	115.70	371	31.85	145.47	This study
17930	20.33	115.78	629	30.07	136.82	This study
17931-1	20.10	115.96	1005	42.89	134.53	This study
17932-1	19.95	116.04	1365	34.70	132.98	This study
17933-2	19.53	116.23	1972	37.80	128.65	This study
17934-1	19.03	116.46	2665	48.24	124.37	This study
17935-2	18.88	116.53	3143	59.11	122.89	This study
17937-1	19.50	117.67	3428	44.25	134.15	This study
17938-1	19.79	117.54	2835	46.25	135.03	This study
17939-1	19.97	117.46	2473	53.00	136.06	This study
17940-1	20.12	117.38	1728	48.52	136.87	This study
17941-1	21.52	118.48	2201	43.84	130.79	This study
17942-1	19.33	113.20	329	40.39	127.18	This study
17943-1	18.95	117.55	917	35.00	131.64	This study
17944-1	18.66	113.64	1219	50.44	118.22	This study
17945-1	18.13	113.78	2404	43.10	114.26	This study
17946-1	19.25	114.25	3465	47.83	125.25	This study
17949-2	17.35	115.17	2195	50.76	108.90	This study
17951-1	16.29	113.41	2340	50.54	105.31	This study
17955-1	14.12	112.18	2404	59.07	103.08	This study
17956-1	13.85	112.59	3387	55.49	103.54	This study
17957-1	10.90	115.31	2197	74.52	93.76	This study
17958-1	11.62	115.08	2581	57.37	93.24	This study
17959-1	11.14	115.29	1957	58.14	93.45	This study
17960-1	10.12	115.56	1707	59.74	99.87	This study
17961-1	8.51	112.33	1795	52.43	104.80	This study
17962-1	7.18	112.08	1970	45.38	104.33	This study

17963-2	6.17	112.67	1233	53.33	108.08	This study
17964-1	6.16	112.21	1556	52.03	107.28	This study
17965-1	6.16	112.55	889	51.46	108.46	This study
SO132-02	11.93	110.10	2094	52.93	128.89	*Fernando*, 2007
SO132-03	12.68	111.40	2435	51.90	110.00	*Fernando*, 2007
SO132-33	13.20	119.07	3392	68.64	94.12	*Fernando*, 2007
SO132-34	12.89	119.31	2364	54.01	94.12	*Fernando*, 2007
SO132-35	13.62	119.97	3322	50.81	116.24	*Fernando*, 2007
SO132-37	13.91	119.61	2762	57.31	107.27	*Fernando*, 2007
SO132-37A	14.10	119.62	2603	68.64	107.69	*Fernando*, 2007
Station	**Lat.**	**Lon.**	**WD(m)**	**%Fp**	**PP(gC/m^{2}yr)**	**Ref.**
SO132-38	14.25	119.64	2496	59.10	106.50	*Fernando*, 2007
SO132-39	14.31	119.43	2486	64.03	99.39	*Fernando*, 2007
SO132-40	14.58	119.75	2510	68.42	113.32	*Fernando*, 2007
SO132-41	14.64	119.48	2605	53.29	93.82	*Fernando*, 2007
SO132-42	14.91	119.54	2514	59.67	91.68	*Fernando*, 2007
SO132-43	15.21	119.63	2286	83.62	94.80	*Fernando*, 2007
SO132-49	15.46	119.32	3010	68.24	88.08	*Fernando*, 2007
SO132-50	15.42	119.59	2459	66.57	96.41	*Fernando*, 2007
SO140A-03	7.00	107.91	86.2	22.36	120.73	*Fernando*, 2007
SO140A-05	7.18	108.34	98.8	26.28	111.80	*Fernando*, 2007
SO140A-07	7.34	108.74	119.4	33.13	107.82	*Fernando*, 2007
SO140A-08	7.44	108.99	149.7	35.57	106.86	*Fernando*, 2007
SO140A-10	7.53	109.21	283.9	39.75	106.69	*Fernando*, 2007
SO140A-11	7.64	109.49	710.7	41.94	107.57	*Fernando*, 2007
SO140A-12	7.77	109.81	829.1	41.33	108.04	*Fernando*, 2007
SO140A-13	7.86	110.02	73.8	39.94	108.77	*Fernando*, 2007
SO140A-14	7.90	110.13	380.4	44.12	109.23	*Fernando*, 2007
SO140A-15	8.10	110.64	381.6	47.24	109.22	*Fernando*, 2007
SO140A-16	9.14	108.62	108.8	18.53	140.78	*Fernando*, 2007
SO140A-18	9.34	108.68	101.4	20.67	147.45	*Fernando*, 2007
SO140A-20	9.62	108.91	116.1	18.74	143.59	*Fernando*, 2007
SO140A-23	9.99	109.48	280.1	35.56	123.88	*Fernando*, 2007

SO140A-29	12.21	109.53	134.2	18.75	197.47	*Fernando*, 2007
SO140A-32	13.50	109.56	169.1	18.64	176.31	*Fernando*, 2007
SO140A-35	14.08	109.43	134.7	19.11	200.81	*Fernando*, 2007
SO140A-36	14.25	109.34	116.5	12.32	224.65	*Fernando*, 2007
SO140A-43	15.08	109.00	34.6	1.81	336.03	*Fernando*, 2007
SO140A-45	14.75	109.29	97.9	9.57	208.45	*Fernando*, 2007
SO140A-46	14.40	109.31	100	6.70	222.60	*Fernando*, 2007
SO140A-48	14.57	109.19	61.5	3.62	271.62	*Fernando*, 2007
SO140A-51	16.28	108.66	96.5	3.61	242.64	*Fernando*, 2007
SO140A-52	16.48	108.44	91.1	3.76	288.16	*Fernando*, 2007
SO140A-54	16.74	108.46	92.9	12.77	217.31	*Fernando*, 2007
SO140A-56	16.39	109.42	196.6	19.21	122.02	*Fernando*, 2007
SO140A-57	16.35	109.54	756.3	32.34	117.18	*Fernando*, 2007
SO140A-58	11.92	110.02	1906	41.33	133.52	*Fernando*, 2007

Table S2.

Depth (cm)	%FP	Depth (cm)	%FP	Depth (cm)	%FP
0	40.99	84	36.01	168	17.88
2	47.06	86	42.59	170	17.83
4	50.30	88	37.67	172	18.08
6	52.46	90	33.93	174	17.67
8	49.55	92	34.52	176	16.13
10	42.71	94	37.69	178	18.00
12	45.87	96	36.41	180	24.84
14	44.92	98	38.01	182	20.91
16	49.00	100	37.04	184	24.03
18	43.09	102	32.97	186	19.16
20	37.50	104	36.56	188	25.76
22	42.55	106	27.73	190	19.38
24	41.50	108	25.29	192	20.58
26	36.66	110	29.71	194	18.93
28	35.02	112	22.66	196	22.82
30	36.04	114	28.13	198	22.67
32	38.41	116	29.37	200	21.94
34	37.44	118	35.60	202	23.55
36	41.62	120	35.60	204	21.49
38	47.47	122	35.09	206	19.28
40	44.41	124	36.64	208	19.64
42	43.58	126	34.84	210	18.40
44	46.37	128	29.52	212	25.86
46	43.84	130	30.77	214	19.47
48	45.45	132	30.07	216	17.32
50	41.13	134	28.35	218	22.15
52	40.26	136	28.10	220	22.48
54	42.67	138	24.29	222	16.67
56	38.96	140	28.09	224	19.81
58	44.91	142	26.47	226	25.65
60	43.70	144	25.32	228	17.45
62	42.46	146	22.33	230	16.72
64	41.47	148	22.78	232	18.01
66	40.72	150	23.96	234	19.38
68	42.40	152	26.32	236	22.03
70	33.68	154	24.25	238	16.06
72	37.40	156	26.03	240	18.05
74	41.34	158	21.52	242	21.48
76	34.80	160	17.93	244	22.35
78	36.02	162	18.96	246	21.98
80	38.47	164	17.34	248	22.17
82	37.76	166	21.48	250	19.75

Depth (cm)	%FP	Depth (cm)	%FP
252	21.80	338	25.09
254	20.19	340	27.15
256	23.05	342	26.43
258	19.20	344	25.54
260	22.01	346	26.60
262	29.34	348	26.68
264	24.67	350	34.30
266	28.13	352	28.81
268	26.55	354	30.95
270	24.95	356	26.33
272	28.31	358	25.00
274	30.64	360	32.81
276	31.34	362	33.55
278	28.14	364	25.54
280	27.68	366	29.27
282	26.00	368	29.64
284	26.97	370	27.32
286	30.22	372	27.01
288	26.50	374	27.50
290	30.11	376	27.45
292	30.27		
294	26.27		
296	29.20		
298	31.91		
300	37.92		
302	31.36		
304	31.86		
306	33.54		
308	34.06		
310	34.52		
312	36.02		
314	35.93		
316	30.29		
320	27.83		
322	27.18		
324	29.62		
326	31.45		
328	30.57		
330	30.30		
332	28.68		
334	25.70		
336	26.10		

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