Supporting Information for "Configuration and validation of an oceanic physical and biogeochemical model to investigate coastal eutrophication: case study in the Southern California Bight"

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S17. Summer time 1997-2000 average carbon export at 40 m in the SCB. The map shows hot-spots of intense carbon export in Santa Barbara and Los Angeles coasts.

Ventura/Oxnard								
					Temperature			
	H	Correlation Coefficient	p-value	Cost Function	Percentage Bias	Ratio of Standard Deviations	Nash-Sutcliffe Model Efficiency	Number of observations
Winter	0	0.9501	2.56E-05	0.4336	-0.0473	1.0904	0.7478	469
Spring	0	0.9813	5.19E-07	0.4918	-0.0877	0.8213	0.64	468
Summer	0	0.9674	4.77E-06	0.2367	-0.0371	0.9937	0.9045	468
Fall	0	0.94	5.28E-05	0.3952	-0.0486	0.9739	0.7708	469
All Seasons	0	0.964	7.03E-06	0.3356	-0.0479	1.0101	0.8419	1874
					Oxygen			
	H	Correlation Coefficient	p-value	Cost Function	Percentage Bias	Ratio of Standard Deviations	Nash-Sutcliffe Model Efficiency	Number of observations
Winter	0	0.9783	9.51E-07	0.4175	-0.0965	1.1792	0.7783	469
Spring	0	0.9433	4.24E-05	0.6098	-0.1991	1.0992	0.5408	454
Summer	0	0.9945	4.08E-09	0.3427	0.0715	1.0235	0.8415	468
Fall	0	0.9826	3.96E-07	0.5476	-0.1157	1.3601	0.6115	469
All Seasons	0	0.982	4.52E-07	0.3672	-0.0765	1.1265	0.8353	1860
					Chlorophyll-a			
	H	Correlation Coefficient	p-value	Cost Function	Percentage Bias	Ratio of Standard Deviations	Nash-Sutcliffe Model Efficiency	Number of observations
Winter	0	0.988	8.90E-08	0.3047	-0.1115	0.7709	0.834	469
Spring	0	0.9939	6.04E-09	0.8634	-0.3903	0.5026	-0.4201	468
Summer	0	0.9617	4.91E-06	0.4354	-0.046	0.6978	0.6917	468
Fall	0	0.908	2.80E-04	0.7088	0.2679	0.7467	0.3794	469
All Seasons	0	0.9963	8.02E-10	0.4954	-0.0805	0.6487	0.6311	1874
					pH			
	H	Correlation Coefficient	p-value	Cost Function	Percentage Bias	Ratio of Standard Deviations	Nash-Sutcliffe Model Efficiency	Number of observations
Winter	0	0.9923	1.56E-08	0.5025	0.0042	0.6077	0.4949	455
Spring	0	0.9932	9.53E-09	0.7299	-0.0136	1.5012	0.295	454
Summer	0	0.9691	3.83E-06	0.263	0.0032	1.0817	0.8409	468
Fall	0	0.9851	2.14E-07	0.3564	0.0047	1.3214	0.7207	467
All Seasons	0	0.9828	3.78E-07	0.1939	-4.93E-04	1.0847	0.9414	1844
					Ammonia			
	H	Correlation Coefficient	p-value	Cost Function	Percentage Bias	Ratio of Standard Deviations	Nash-Sutcliffe Model Efficiency	Number of observations
Winter	0	0.823	0.3845	0.4336	-6.30E-04	1.3382	0.6565	11
Spring	0	0.99944	0.0213	3.7219	-3.3631	0.2629	-32.6308	12
Summer	0	0.9295	0.2404	0.363	0.1663	1.4388	0.7813	12
Fall	0	0.9351	0.2306	3.2235	-3.553	0.2904	-21.1213	12
All Seasons	0	0.9221	0.0258	1.1782	-0.8397	0.7368	-1.3224	47

Table 1: S1. Statistical comparison of vertical profiles of temperature, dissolved oxygen, chlorophyll *a*, pH, and ammonium concentration at Ventura/Oxnard monitoring region.

Palos Verdes								
Temperature								
	H	Correlation Coefficient	p-value	Cost Function	Percentage Bias	Ratio of Standard Deviations	Nash-Sutcliffe Model Efficiency	Number of observations
Winter	0	0.9553	1.65E-05	0.2787	-0.0089	1.1041	0.8758	469
Spring	0	0.9369	6.43E-05	0.6933	-0.11	0.7773	0.2361	466
Summer	0	0.7446	2.89E-06	0.1655	0.0114	1.0806	0.9348	466
Fall	0	0.9382	5.92E-05	0.6126	-0.0732	0.7632	0.3868	468
All Seasons	0	0.9543	1.80E-05	0.3167	-0.0374	0.9674	0.8489	1869
Oxygen								
	H	Correlation Coefficient	p-value	Cost Function	Percentage Bias	Ratio of Standard Deviations	Nash-Sutcliffe Model Efficiency	Number of observations
Winter	0	0.9938	6.44E-09	0.1802	0.0333	1.1013	0.9226	469
Spring	0	0.8393	0.0024	0.799	-0.2206	0.9073	0.0398	466
Summer	0	0.9864	1.48E-07	0.5168	0.0847	0.8388	0.6727	466
Fall	0	0.977	1.19E-06	0.2693	-0.0309	0.9936	0.9063	467
All Seasons	0	0.9777	1.05E-06	0.2006	-0.0258	0.8967	0.9362	1868
Chlorophyll-a								
	H	Correlation Coefficient	p-value	Cost Function	Percentage Bias	Ratio of Standard Deviations	Nash-Sutcliffe Model Efficiency	Number of observations
Winter	0	0.76	0.0107	0.6418	0.3323	0.9999	0.9226	469
Spring	0	0.8546	0.0016	0.4268	0.0123	1.063	0.7071	466
Summer	0	0.746	0.0132	0.6851	0.4555	1.5893	0.1706	466
Fall	0	0.9847	2.37E-07	0.3655	0.3253	1.0261	0.8194	468
All Seasons	0	0.9605	1.01E-05	0.4613	0.2879	0.9824	0.7398	1869
pH								
	H	Correlation Coefficient	p-value	Cost Function	Percentage Bias	Ratio of Standard Deviations	Nash-Sutcliffe Model Efficiency	Number of observations
Winter	1	0.9851	2.13E-07	1.8005	-0.0326	1.3957	-2.761	469
Spring	0	0.852	0.0017	0.2725	9.15E-04	1.4929	0.6798	466
Summer	1	0.9881	8.65E-08	1.801	0.0311	1.6202	-2.8273	466
Fall	1	0.972	2.61E-06	1.4692	0.0191	1.3968	-1.5757	468
All Seasons	0	0.9961	1.03E-05	0.2933	0.0047	1.4036	0.7257	1869
Ammonia								
	H	Correlation Coefficient	p-value	Cost Function	Percentage Bias	Ratio of Standard Deviations	Nash-Sutcliffe Model Efficiency	Number of observations
Winter	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
Spring	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
Summer	0	0.8229	0.1771	0.5029	0.1577	1.1088	0.5468	18
Fall	0	0.9153	0.0847	0.499	0.1908	1.0259	0.5897	18
All Seasons	0	0.8874	0.1126	0.4529	0.207	1.1458	0.4584	36

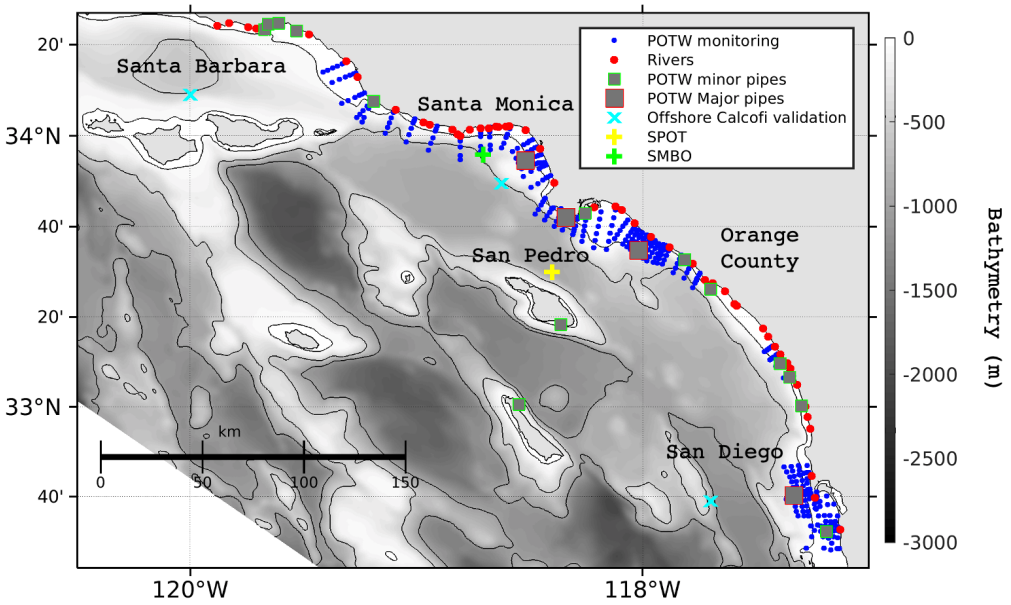
Table 2: S2. Same as Table S1 for Palos Verdes monitoring region.

Orange County								
Temperature								
	H	Correlation Coefficient	p-value	Cost Function	Percentage Bias	Ratio of Standard Deviations	Nash-Sutcliffe Model Efficiency	Number of observations
Winter	0	0.9576	1.35E-05	0.3367	-0.0121	1.2251	0.8516	160
Spring	0	0.9485	2.90E-05	0.5951	-0.1141	0.8358	0.4459	533
Summer	0	0.9911	2.72E-08	0.1347	-0.0159	0.915	0.9678	533
Fall	0	0.9684	4.22E-06	0.2664	-0.0299	1.0673	0.8948	536
All Seasons	0	0.9648	6.43E-06	0.2751	-0.035	1.0442	0.8863	1762
Oxygen								
	H	Correlation Coefficient	p-value	Cost Function	Percentage Bias	Ratio of Standard Deviations	Nash-Sutcliffe Model Efficiency	Number of observations
Winter	0	0.9814	5.14E-07	0.5154	-0.1284	1.0365	0.6531	150
Spring	0	0.8985	4.10E-04	0.6115	-0.166	0.9822	0.484	533
Summer	0	0.9863	1.51E-07	0.4794	0.0804	0.9262	0.7151	534
Fall	0	0.9862	1.55E-07	0.2931	-0.0013	1.2359	0.884	536
All Seasons	0	0.9691	3.85E-06	0.2723	-0.0375	0.9982	0.9009	1753
Chlorophyll-a								
	H	Correlation Coefficient	p-value	Cost Function	Percentage Bias	Ratio of Standard Deviations	Nash-Sutcliffe Model Efficiency	Number of observations
Winter	1	0.9824	4.07E-07	0.8303	0.6852	1.9989	-0.0086	160
Spring	0	0.7529	0.012	0.3621	0.3607	2.1486	0.4429	533
Summer	0	0.9414	4.81E-05	0.9337	0.4737	1.0747	-0.0828	535
Fall	1	0.8947	4.72E-04	1.0123	0.5335	0.9134	-0.3251	536
All Seasons	1	0.9057	3.08E-04	0.6321	0.5208	1.6726	0.2878	1764
pH								
	H	Correlation Coefficient	p-value	Cost Function	Percentage Bias	Ratio of Standard Deviations	Nash-Sutcliffe Model Efficiency	Number of observations
Winter	0	0.9783	9.41E-07	0.2747	-6.21E-05	1.229	0.8937	160
Spring	0	0.7922	0.0063	0.7736	-0.0104	1.3646	0.2406	533
Summer	1	0.9528	2.05E-05	1.3597	0.0186	1.3771	-1.2486	534
Fall	1	0.9839	2.88E-07	1.6476	-0.0305	1.8355	-2.3012	536
All Seasons	0	0.9415	4.78E-05	0.5507	-0.0065	1.3345	0.6301	1763
Ammonia								
	H	Correlation Coefficient	p-value	Cost Function	Percentage Bias	Ratio of Standard Deviations	Nash-Sutcliffe Model Efficiency	Number of observations
Winter	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
Spring	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
Summer	1	0.9757	0.1405	1.443	0.863	4.9489	-2.6939	48
Fall	0	0.703	0.5037	2.9169	-0.0161	0.2753	-14.5478	48
All Seasons	1	0.8126	0.0946	1.218	0.5894	2.0709	-1.3268	96

Table 3: S3. Same as Table S1 for Orange County monitoring region.

San Diego								
Temperature								
	H	Correlation Coefficient	p-value	Cost Function	Percentage Bias	Ratio of Standard Deviations	Nash-Sutcliffe Model Efficiency	Number of observations
Winter	0	0.9837	8.92E-09	0.1767	0.0087	0.9502	0.9563	875
Spring	0	0.933	9.48E-06	0.6435	0.0952	0.7604	0.2865	870
Summer	0	0.9777	4.19E-08	0.2018	0.0099	0.9219	0.9415	872
Fall	0	0.9554	1.29E-06	0.366	0.042	0.8388	0.7412	752
All Seasons	0	0.9776	4.25E-08	0.3034	0.0327	0.8537	0.8537	3369
Oxygen								
	H	Correlation Coefficient	p-value	Cost Function	Percentage Bias	Ratio of Standard Deviations	Nash-Sutcliffe Model Efficiency	Number of observations
Winter	0	0.9901	7.23E-10	0.235	0.0586	1.033	0.9197	875
Spring	0	0.8676	2.56E-04	0.9234	0.2944	0.7858	-0.3415	872
Summer	0	0.9984	8.48E-14	0.4432	0.1531	1.3659	0.7116	872
Fall	0	0.9467	3.11E-06	0.5672	0.1334	1.3846	0.583	752
All Seasons	0	0.9801	2.40E-08	0.4918	0.1273	1.0803	0.7141	3371
Chlorophyll-a								
	H	Correlation Coefficient	p-value	Cost Function	Percentage Bias	Ratio of Standard Deviations	Nash-Sutcliffe Model Efficiency	Number of observations
Winter	1	0.9835	5.43E-08	0.9773	-0.7082	1.7145	-0.2335	868
Spring	0	0.8785	1.69E-04	0.7206	-0.6207	1.4246	0.1742	866
Summer	1	0.9882	1.75E-09	1.333	-0.6907	1.4466	-1.05	870
Fall	1	0.9217	5.51E-05	1.3544	-0.7661	2.0718	-1.3569	728
All Seasons	1	0.9711	1.52E-07	1.2126	-0.6905	1.4832	-0.7492	3332
pH								
	H	Correlation Coefficient	p-value	Cost Function	Percentage Bias	Ratio of Standard Deviations	Nash-Sutcliffe Model Efficiency	Number of observations
Winter	0	0.9956	1.23E-11	0.639	0.0081	1.131	0.5334	875
Spring	1	0.8967	7.78E-05	1.2711	0.0212	1.3149	-0.9033	872
Summer	1	0.9923	2.04E-10	0.7664	0.0168	2.1329	0.1267	844
Fall	1	0.9022	5.98E-05	0.8492	0.0106	1.6647	0.0895	752
All Seasons	1	0.9782	3.75E-08	0.9155	0.0146	1.5082	-0.0285	3343
Ammonia								
	H	Correlation Coefficient	p-value	Cost Function	Percentage Bias	Ratio of Standard Deviations	Nash-Sutcliffe Model Efficiency	Number of observations
Winter	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
Spring	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
Summer	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
Fall	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
All Seasons	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0

Table 4: S4. Same as Table S1 for San Diego monitoring region.



S5

Figure 1: Monitoring stations

S6

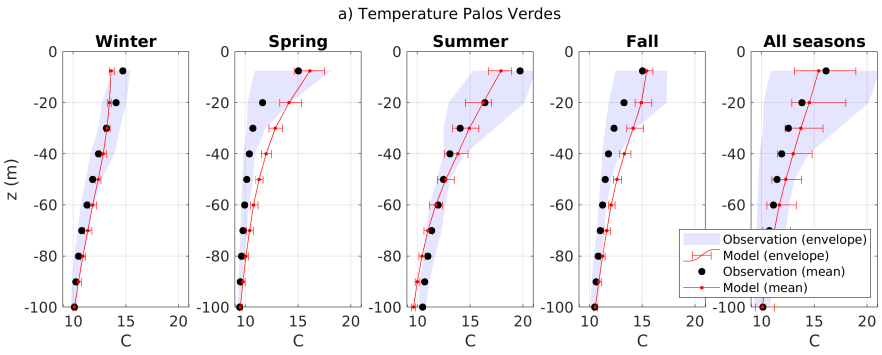


Figure 2: Seasonal profiles of temperature in average in Los Angeles (Palos Verdes). The red line and red bars are the spatial and temporal means and the variability from the model. The black dots and the gray shade are the spatial and temporal mean and the variability from *in situ* data. These profiles are showing agreement on intensity, seasonality and shape of the vertical profile with exceptionally high concentrations at mid-depth.

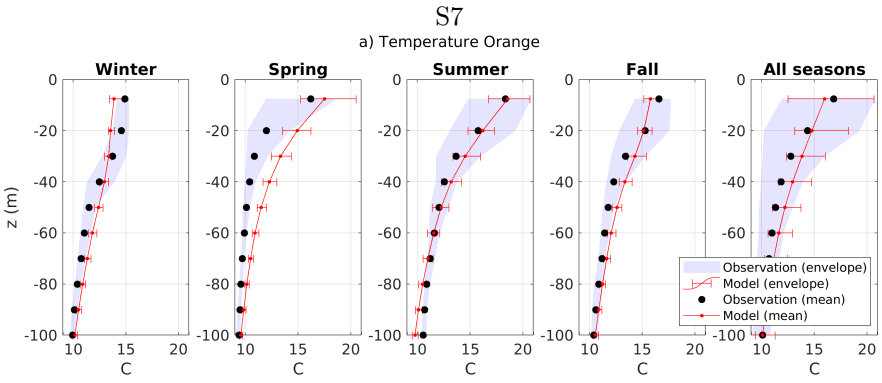


Figure 3: Same as S7 for OCSD.

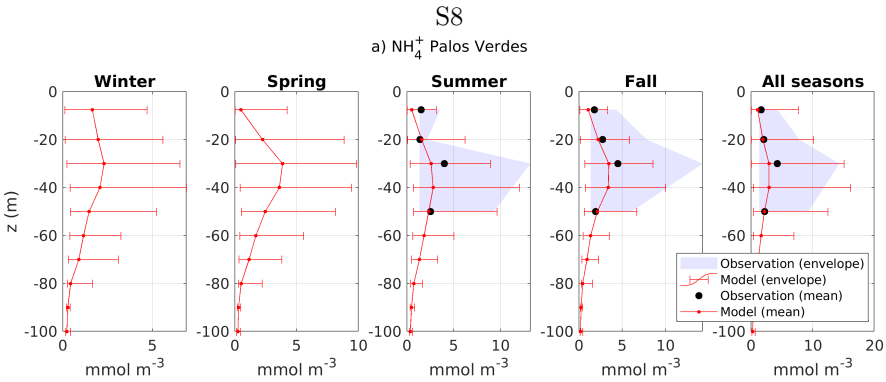


Figure 4: Seasonal profiles of ammonium concentration in average in Los Angeles (Palos Verdes). The red line and red bars are the spatial and temporal means and the variability from the model. The black dots and the gray shade are the spatial and temporal mean and the variability from *in situ* data. These profiles are showing agreement on intensity, seasonality and shape of the vertical profile with exceptionally high concentrations at mid-depth.

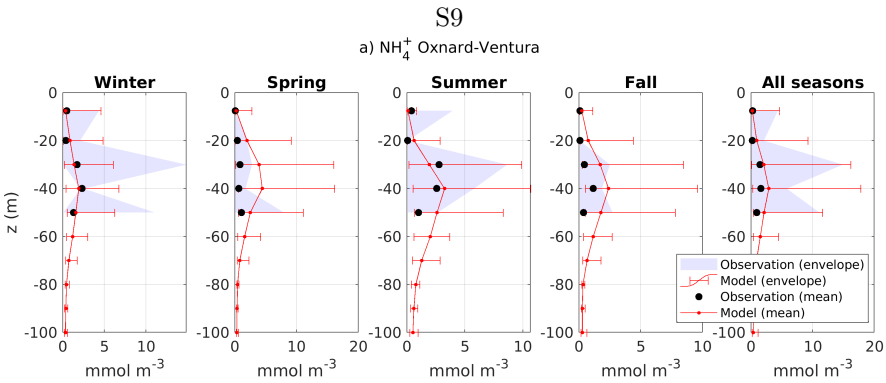


Figure 5: Same as S8 for Ventura/Oxnard

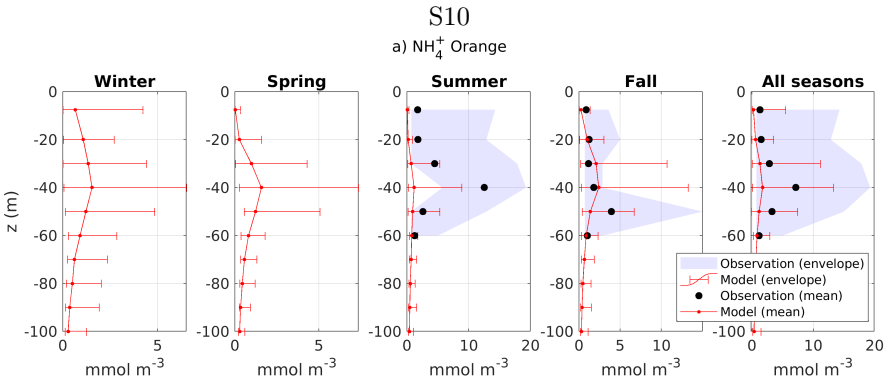


Figure 6: Same as S8 for OCSD.

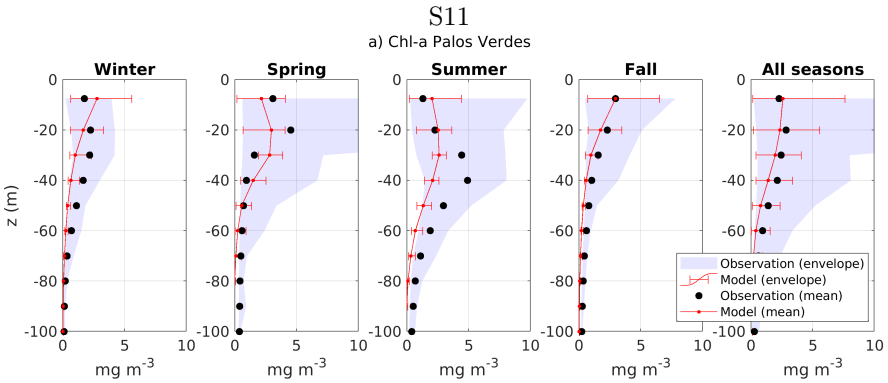


Figure 7: Seasonal profiles of chlorophyll *a* concentration in average in Los Angeles (Palos Verdes). The red line and red bars are the spatial and temporal means and the variability from the model. The black dots and the gray shade are the spatial and temporal mean and the variability from *in situ* data. These profiles are showing agreement on intensity, seasonality and shape of the vertical profile with exceptionally high concentrations at mid-depth.

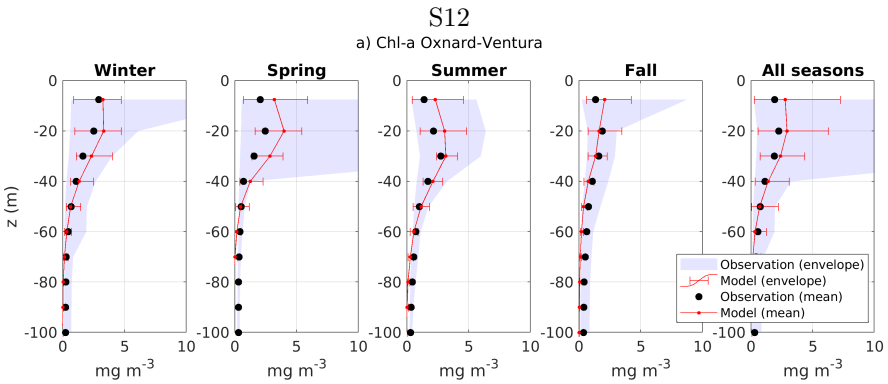


Figure 8: Same as S11 for Ventura/Oxnard

S13

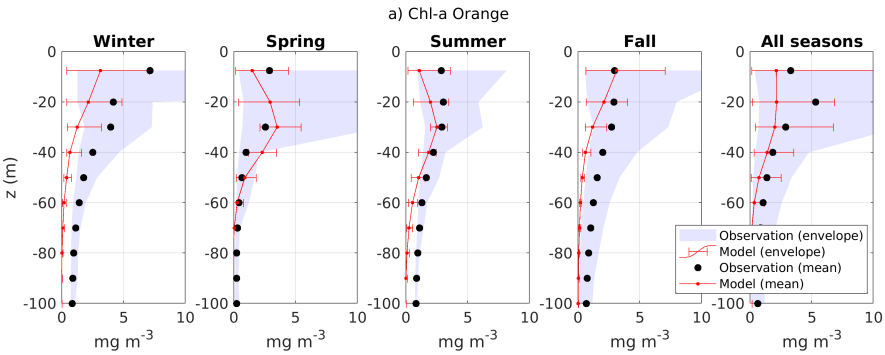


Figure 9: Same as S11 for OCSD.

S14

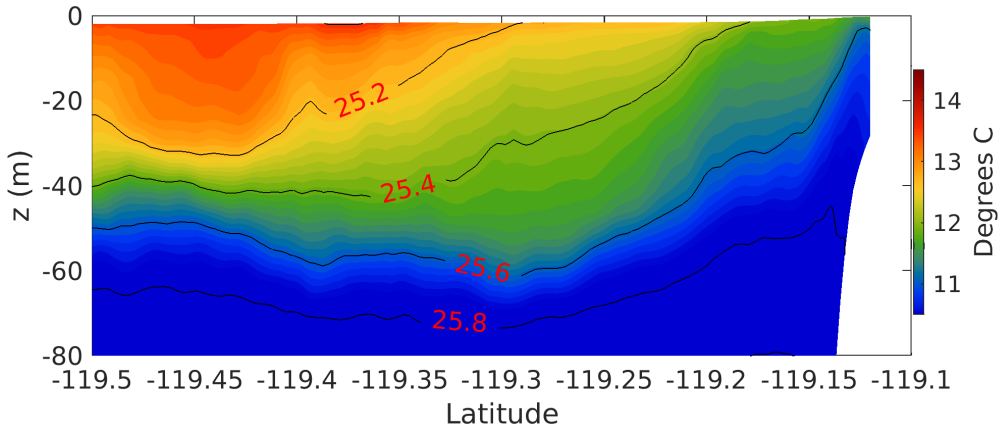


Figure 10: Cross-section of temperature (and potential density iso-lines) perpendicular to Ventura and Santa Barbara coast in Spring 1999. It shows the surfacing of the deep cold waters during and upwelling event.

S15

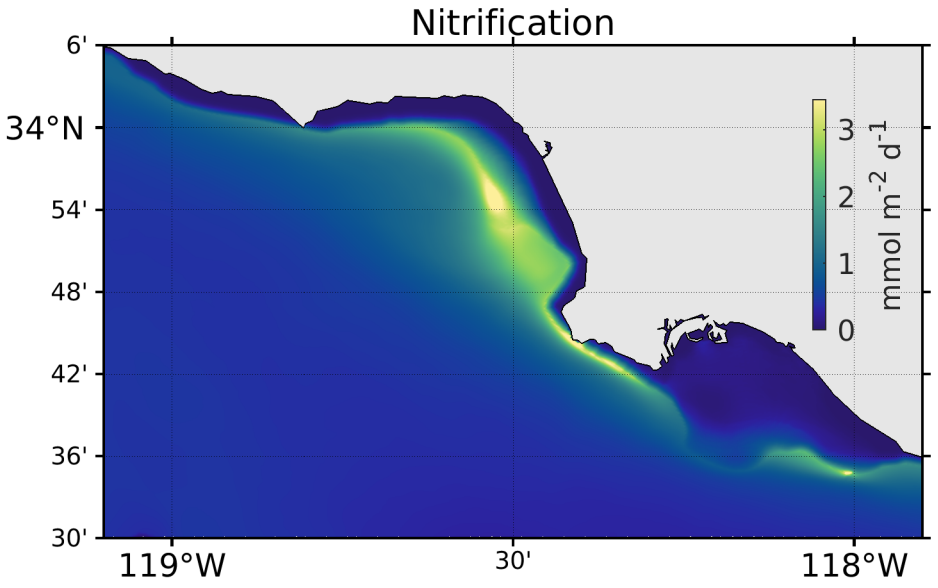


Figure 11: Average nitrification rate in Santa Monica and San Pedro bays. This figure shows the high rates around the locations of the outfalls that results from the release of high concentrations of ammonium below the thermocline.

S16

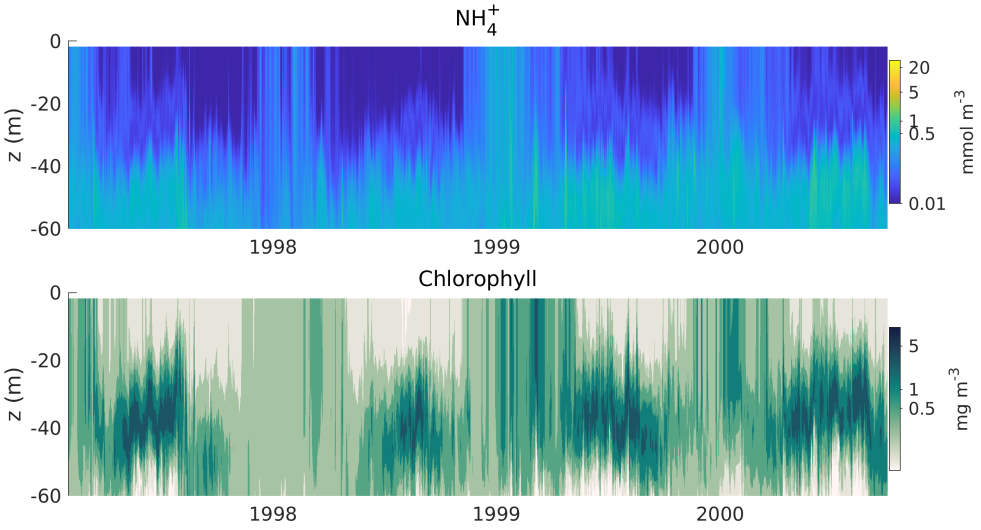


Figure 12: (a) Hovmöller of ammonium concentration at San Pedro Oceanic Time-series (SPOT) located mid-distance between Los Angeles coast and Catalina Island. (b) idem as (b) for chlorophyll *a* concentration. The Hovmöllers show 1) ammonium concentration off Los Angeles coast are not affected by anthropogenic loads. 2) Deep chlorophyll *a* maximum is trapped below at subsurface for 70% of the time and reach concentration of about 2 mmol Chl m^{-3}. Depth of the subsurface chlorophyll *a* maximum shows a seasonal cycle where it varies between 20 and 40m.

S17

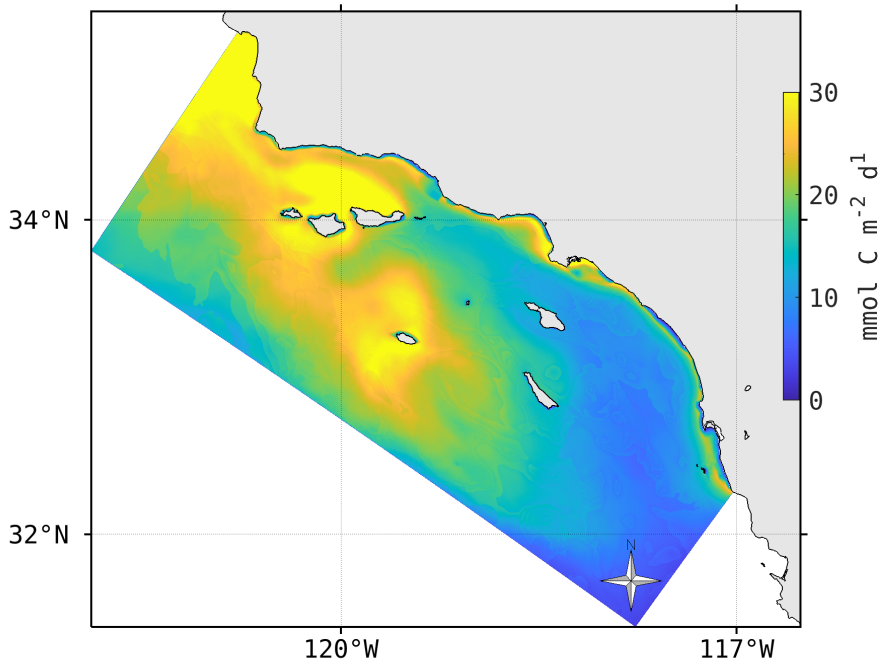


Figure 13: Summer time 1997-2000 average carbon export at 40 m in the SCB. The map shows hot-spots of intense carbon export in Santa Barbara and Los Angeles coasts.