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New insight to niche partitioning and ecological function of ammonia oxidizing archaea in subtropical estuarine ecosystem

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Supplementary Information

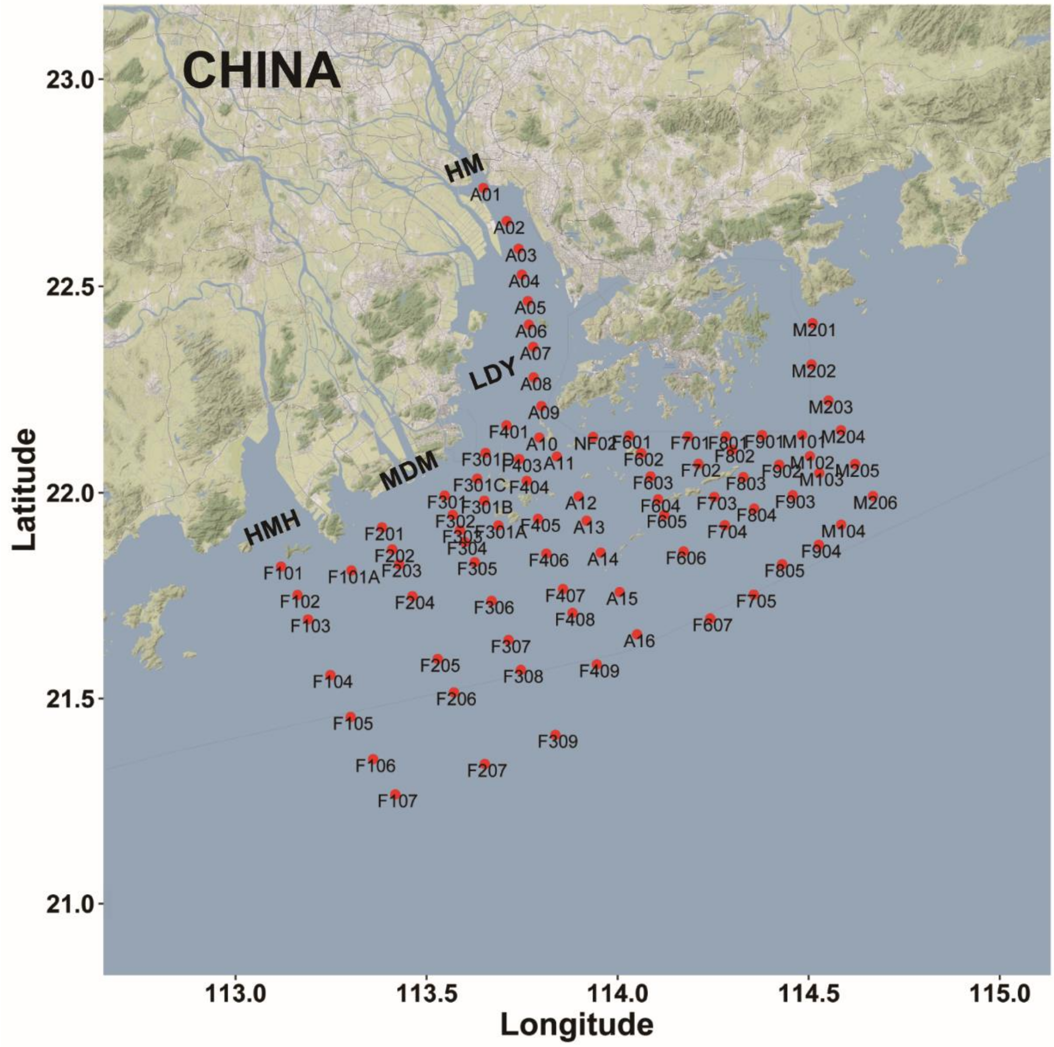

Figure S1. Total sampling stations of 2017 Pearl River estuary summer cruise. The sampling location information was overlaid on Google Maps (© Google Maps) image using "ggmap" with "ggplot2" in R (D. Kahle and H. Wickham, 2013)

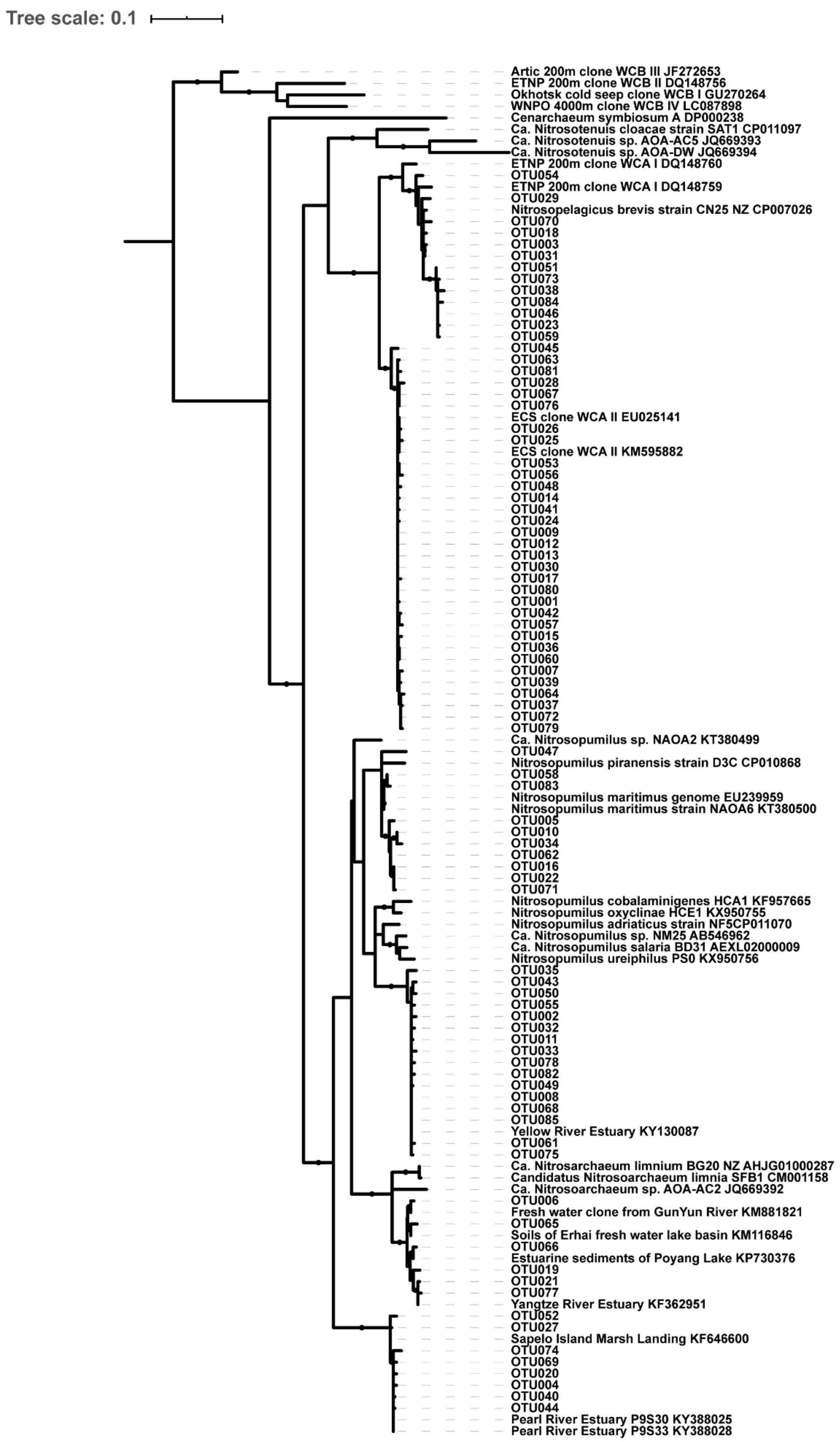

Figure S2. Maximum likelihood phylogenetic tree of *amoA* gene sequence of top 85 OTUs and Nitrosopumilales *spp.* using on T92+G+I model with 1000 bootstrap.

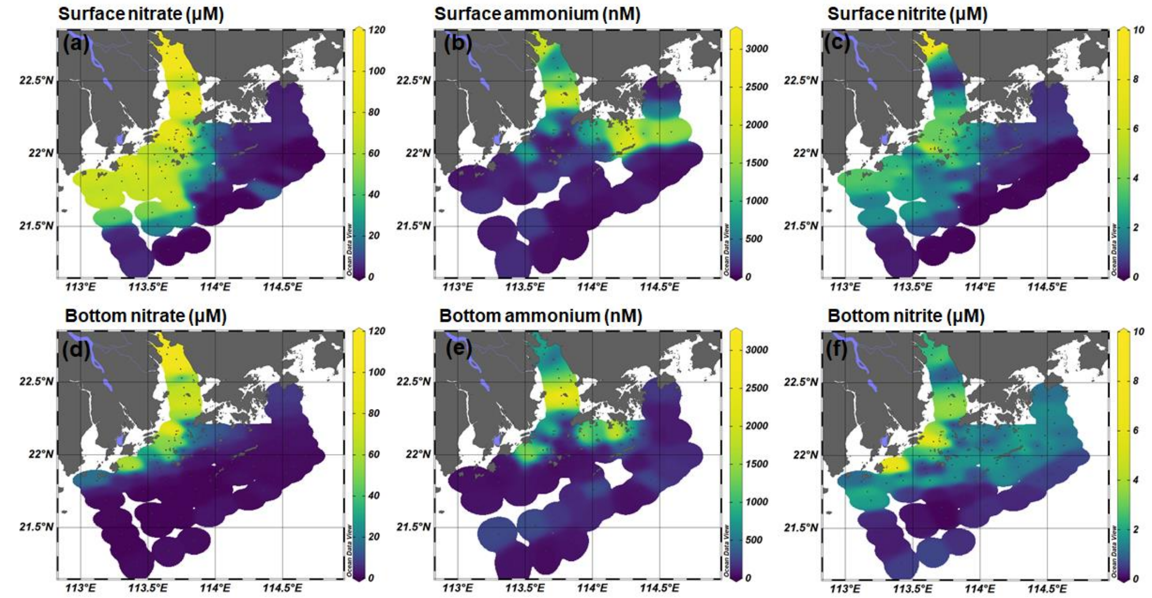

Figure S3. Spatial distribution of (a & d) nitrate, (b & e) ammonium, and (c & f) nitrite concentration at both surface and bottom layer during the 2017 summer cruise in Pearl River estuary. These figures were generated using Ocean Data View v. 5.0.0 (http://odv.awi.de).

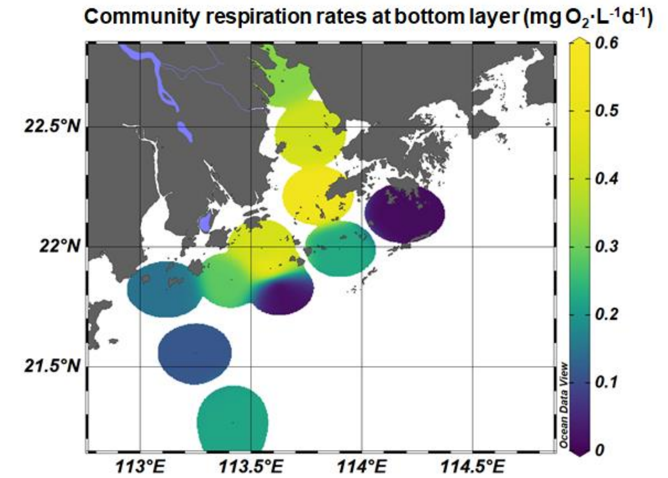

Figure S4. Spatial distribution of community respiration rates at the bottom layer (mg $O_2 \cdot L^{-1} d^{-1}$)

Table S1. Comparison of estuarine ammonia-oxidizing microorganism studies

			DNA based			**RNA based**				
Estuary	**Sample**	**Method**	Abundance of *amoA* gene	AOA Diversity	AOB Diversity	AOA Diversity	Abundance of *amoA*-transcript	**AOA Niche Partition**	**Nitrification rates**	**Reference**
Bahi'a del To'bari, Mexico	Sediment	Clone library	–	+	+	–	–	–	–	Beman and Francis 2006
San Francisco Bay, CA	Sediment	Clone library	+	+	+	–	–	Low-salinity adaptation	–	Mosier and Francis 2008
Barn Island salt marsh, CT	Sediment	Clone library	+	+	+	–	–	–	+	Moin et al., 2009
Westerschelde estuary, The Netherlands	Sediment	Clone library	+	+	+	–	–	–	–	Sahan and Muyzer 2008
Changjiang estuary, China	Sediment	Clone library	–	+	+	–	–	–	–	Dang et al., 2008
Plum Island Sound estuary, MA	Sediment	Clone library	+	+	+	–	–	–	+	Bernhard et al. 2010
Douro River estuary, Portugal	Sediment	Clone library	+	+	–	–	–	–	+	Magalhães et al 2009
Elkhorn Slough Estuary, CA	Sediment	Clone library	+	+	+	–	–	–	+	Wankel et al. 2011
Colne Estuary, UK	Sediment	DGGE	+	+	+	–	–	–	+	Li et al. 2015
Ems estuary, Germany	Sediment	qPCR	+	–	–	–	–	–	+	Sanders and Laanbroek 2018
Derwent Estuary, Australia	Sediment	T-RFLP	+	+	+	+	+	–	–	Abell et al. 2011

Huntington Beach, CA	Water	Clone library	+	+	+	–	–	–	–	Santoro et al., 2008
Pearl River Estuary, China	Water	Clone library	+	+	+	–	–	–	+	Hou et al. 2014
Chesapeake Bay estuary, USA	Water	Clone library	+	+	–	–	–	–	–	Bouskill et al. 2012
Changjiang estuary, China	Water	Clone library	+	+	+	–	–	–	+	Zhang et al. 2014
Hood Canal, USA	Water	qPCR	+	–	–	–	+	–	+	Horak et al. 2013
Costal Baltic Sea	Water	Illumina Miseq	+	+	+	+	+	–	+	Happel et al. 2018
Pearl River Estuary, China	Water	Ion-Torrent	+	+	–	+	+	+	+	This study

* '+' represents data available, '–' represents data not available.

Table S2. Quantitative PCR results at DNA level of both AOA and β-AOB in 23 stations

Station	Lon (E º)	Lat (W º)	Layer	Salinity (PSU)	DO ($mg\cdot L^{-1}$)	Temperature (℃)	Ammonium ($nmol\cdot L^{-1}$)	Nitrification rate ($nmol\cdot L^{-1}\cdot h^{-1}$)	AOA-PA ($Copy\cdot L^{-1}$)	AOA-FL ($Copy\cdot L^{-1}$)	AOB-PA ($Copy\cdot L^{-1}$)	AOB-FL ($Copy\cdot L^{-1}$)
F107	113.42	21.27	S-1m	32.30	4.53	29.07	155.70	0.21	1.54E+04 ± 1.35E+03	7.93E+04 ± 4.04E+03	1.81E+02 ±3.02E+01	8.05E+02 ±1.04E+02
			B-41m	34.51	4.09	22.77	48.64	0.96	3.31E+04 ±7.10E+03	1.22E+08 ±3.06E+06	7.77E+02 ±1.57E+02	3.03E+03 ±2.97E+02
F104	113.25	21.56	S-1m	16.69	6.80	31.01	ND	0.14	2.92E+04 ±8.54E+02	1.27E+05 ±1.27E+04	4.90E+02 ±1.11E+02	7.56E+02 ±1.60E+02
			B-28m	34.45	4.26	24.06	ND	0.33	1.09E+06 ±6.11E+04	1.76E+07 ±3.61E+05	5.17E+03 ±7.73E+02	2.83E+03 ±6.77E+02
F101	113.12	21.82	S-1m	10.20	6.38	29.29	67.03	1.18	4.20E+04 ±5.67E+03	1.19E+06 ±3.79E+04	1.11E+02 ±4.40E+01	2.57E+03 ±1.87E+02
			B-9m	33.73	0.54	24.18	34.78	36.62	2.61E+07 ±2.00E+05	3.95E+08 ±4.51E+06	1.67E+03 ±3.30E+02	2.00E+03 ±3.71E+02
F309	113.84	21.41	S-1m	33.91	4.47	29.74	32.41	ND	1.24E+03 ±6.11E+01	2.67E+05 ±1.08E+04	1.31E+02 ±4.05E+01	1.35E+03 ±4.02E+02
			B-43m	34.51	4.21	22.36	56.68	0.40	1.31E+05 ±2.48E+04	1.10E+08 ±4.61E+06	2.57E+03 ±7.72E+02	2.02E+03 ±4.51E+02
F305	113.63	21.83	S-1m	9.04	7.08	30.52	233.66	1.84	4.83E+04 ±9.26E+02	3.21E+05 ±2.04E+04	4.77E+02 ±5.88E+01	8.42E+02 ±1.01E+02
			B-26m	34.43	3.47	23.80	44.11	1.28	7.27E+07 ±2.47E+06	7.42E+07 ±4.36E+06	1.08E+04 ±9.10E+02	2.80E+03 ±2.97E+02
F303	113.59	21.91	S-1m	7.54	6.82	30.14	104.01	0.48	7.55E+06 ±2.29E+05	6.09E+06 ±1.17E+05	2.89E+04 ±1.95E+03	3.42E+04 ±3.47E+02
			B-18m	34.45	1.44	23.40	42.73	36.37	1.40E+08 ±1.25E+07	1.62E+08 ±3.61E+06	1.65E+04 ±3.31E+03	3.16E+03 ±5.28E+02
F301	113.55	21.99	S-1m	6.70	7.67	29.12	865.79	5.20	5.80E+04	3.29E+04	ND	ND

Station	Lon (E º)	Lat (W º)	Layer	Salinity (PSU)	DO (mg·L^{-1})	Temperature (ºC)	Ammonium (nmol·L^{-1})	Nitrification rate (nmol·L^{-1}·h^{-1})	AOA-PA (Copy·L^{-1})	AOA-FL (Copy·L^{-1})	AOB-PA (Copy·L^{-1})	AOB-FL (Copy·L^{-1})
									±2.19E+03	±3.53E+03		
			B-6m	23.17	2.10	27.25	1423.19	41.94	5.04E+03 ±1.72E+03	3.54E+05 ±3.49E+04	ND	ND
F405	113.79	21.94	S-1m	12.29	6.53	29.05	250.81	1.48	2.48E+05 ±8.02E+03	2.65E+06 ±3.61E+04	9.73E+02 ±3.05E+02	6.54E+03 ±1.14E+03
			B-22m	34.43	2.61	23.65	34.19	1.04	5.88E+07 ±2.47E+06	4.39E+08 ±1.24E+07	1.10E+04 ±2.10E+03	1.08E+04 ±1.94E+03
F403	113.74	22.08	S-1m	7.56	4.11	28.85	24.08	3.07	2.02E+06 ±4.77E+04	3.63E+06 ±1.86E+05	9.57E+03 ±1.94E+03	3.62E+04 ±6.24E+02
			B-8m	22.46	1.31	26.19	24.16	9.91	1.42E+07 ±7.22E+05	3.11E+07 ±1.73E+05	7.75E+03 ±7.65E+02	1.59E+04 ±1.23E+03
A16	114.05	21.66	S-1m	33.67	4.73	29.77	35.32	ND	1.70E+07 ±6.61E+04	1.33E+07 ±6.36E+05	ND	ND
			B-45m	34.52	4.21	22.01	111.37	0.65	3.90E+07 ±2.03E+06	9.95E+07 ±1.32E+06	6.91E+03 ±9.79E+02	2.12E+01 ±7.46E+00
A14	113.96	21.85	S-1m	24.15	5.26	29.98	69.85	0.44	1.20E+05 ±5.63E+03	1.16E+06 ±4.58E+04	ND	4.77E+02 ±8.29E+01
			B-25m	34.39	4.00	24.21	355.19	0.06	5.12E+06 ±1.12E+05	1.50E+07 ±1.73E+05	4.68E+03 ±4.56E+02	1.85E+03 ±2.95E+02
A12	113.90	21.99	S-1m	19.56	6.68	29.82	278.65	0.80	9.21E+05 ±3.39E+04	2.73E+05 ±2.98E+04	1.80E+02 ±5.64E+01	2.25E+01 ±9.03E+00
			B-22m	34.41	2.62	26.63	56.18	1.13	6.00E+07 ±3.05E+06	2.61E+08 ±6.08E+06	3.69E+03 ±7.40E+02	3.37E+03 ±5.25E+02
A11	113.84	22.09	S-1m	13.88	6.37	28.72	47.10	1.13	1.24E+06 ±2.30E+04	6.56E+05 ±4.11E+04	2.69E+01 ±4.30E+00	2.83E+03 ±2.58E+01
			B-13m	32.15	0.97	24.56	120.77	2.64	1.02E+08	2.58E+08	1.49E+03	6.81E+02

Station	Lon (E º)	Lat (W º)	Layer	Salinity (PSU)	DO (mg·L^{-1})	Temperature (ºC)	Ammonium (nmol·L^{-1})	Nitrification rate (nmol·L^{-1}·h^{-1})	AOA-PA (Copy·L^{-1})	AOA-FL (Copy·L^{-1})	AOB-PA (Copy·L^{-1})	AOB-FL (Copy·L^{-1})
									±4.86E+06	±1.42E+07	±6.58E+01	±3.59E+01
A09	113.80	22.21	S-1m	17.52	5.39	27.93	161.39	2.58	1.36E+06 ±7.81E+04	3.50E+07 ±8.62E+05	2.56E+02 ±2.95E+01	2.60E+03 ±1.97E+01
			B-21m	33.36	1.15	24.18	91.45	22.43	4.73E+07 ±2.54E+06	3.85E+08 ±9.50E+06	1.10E+03 ±2.55E+02	8.10E+02 ±1.56E+02
A05	113.77	22.46	S-1m	2.28	3.27	28.68	865.84	1.90	5.07E+06 ±2.33E+05	3.77E+06 ±5.77E+04	6.03E+04 ±7.06E+03	3.52E+04 ±1.39E+03
			B-10m	14.96	2.45	26.79	1673.87	35.10	2.04E+07 ±1.92E+05	2.93E+07 ±3.61E+05	1.92E+04 ±5.36E+02	8.13E+01 ±5.26E+00
A01	113.65	22.74	S-1m	0.11	2.00	28.44	2043.89	94.78	9.76E+06 ±5.80E+05	1.74E+06 ±4.56E+05	8.79E+04 ±2.43E+03	1.92E+04 ±1.42E+03
			B-11m	0.11	1.93	27.46	786.73	17.32	5.08E+07 ±4.06E+06	3.26E+07 ±5.56E+06	4.18E+04 ±3.50E+03	1.04E+04 ±9.35E+02
F607	114.24	21.69	S-1m	32.74	4.88	28.74	61.84	ND	2.08E+03 ±3.57E+02	6.07E+04 ±3.75E+03	3.70E+01 ±7.50E+00	5.30E+02 ±1.88E+02
			B-45m	34.49	4.51	22.52	483.80	1.33	3.32E+05 ±9.85E+03	4.07E+07 ±4.93E+05	7.57E+03 ±5.13E+02	2.97E+03 ±4.89E+02
F605	114.12	21.95	S-1m	30.11	4.64	28.10	ND	1.91	4.98E+03 ±1.16E+03	1.29E+06 ±6.16E+04	1.11E+02 ±3.14E+01	2.07E+03 ±1.56E+02
			B-35m	34.39	2.75	23.90	ND	7.08	1.53E+07 ±3.31E+06	7.23E+07 ±3.15E+06	8.69E+03 ±2.22E+03	4.27E+03 ±2.48E+02
F603	114.09	22.04	S-1m	29.09	4.46	28.30	358.38	1.68	1.78E+03 ±4.75E+02	1.44E+06 ±4.94E+05	5.56E+01 ±1.38E+01	8.82E+02 ±4.80E+01
			B-27m	34.40	2.42	23.74	79.18	2.97	1.13E+07 ±8.58E+05	6.04E+07 ±2.25E+06	2.65E+03 ±9.33E+02	3.12E+03 ±5.23E+02
F602	114.06	22.10	S-1m	27.08	4.86	28.96	ND	0.33	6.10E+03	4.69E+05	6.18E+01	2.17E+02

Station	Lon (E º)	Lat (W º)	Layer	Salinity (PSU)	DO (mg·L^{-1})	Temperature (ºC)	Ammonium (nmol·L^{-1})	Nitrification rate (nmol·L^{-1}·h^{-1})	AOA-PA (Copy·L^{-1})	AOA-FL (Copy·L^{-1})	AOB-PA (Copy·L^{-1})	AOB-FL (Copy·L^{-1})
									±2.52E+03	±1.54E+05	±1.19E+01	±8.47E+01
			B-22	34.27	1.56	23.79	ND	4.36	2.68E+06	6.48E+07	4.47E+03	2.32E+03
									±8.65E+05	±2.35E+06	±1.21E+03	±6.52E+02
F601	114.03	22.14	S-1m	25.32	5.09	28.38	983.39	16.09	3.58E+04	7.92E+04	4.85E+01	1.29E+03
									±1.26E+03	±1.26E+04	±2.16E+01	±1.18E+02
			B-19m	32.98	0.53	24.49	372.06	7.22	1.68E+06	3.04E+08	1.03E+03	2.22E+03
									±3.91E+05	±4.51E+06	±1.03E+02	±1.10E+03
F701	114.18	22.14	S-1m	26.57	4.63	28.54	1682.83	0.51	1.33E+03	4.86E+05	ND	ND
									±5.22E+02	±6.24E+04		
			B-22m	34.16	1.18	23.88	1993.45	19.13	7.90E+05	5.41E+07	ND	ND
									±3.50E+04	±9.33E+06		
F804	114.36	21.96	S-1m	31.78	4.47	28.70	121.59	0.05	2.43E+03	7.00E+05	1.14E+02	1.14E+03
									±8.98E+02	±1.88E+04	±9.51E+01	±1.81E+02
			B-29m	34.47	3.46	22.91	55.20	2.86	1.47E+07	4.71E+07	6.91E+03	3.16E+03
									±1.69E+06	±2.78E+06	±3.15E+02	±2.24E+03

* S-Surface; B-Bottom; PA-Particle attached (> 3 μm); FL-Free-living (3-0.2 μm); ND-Under detection limit.

Table S3. Nitrification, community respiration rates and corresponding oxygen demand

Station	Layer	Nitrification rate ($nmol \cdot L^{-1} \cdot h^{-1}$)	Nitrification oxygen Demand ($mg\ O_2 \cdot L^{-1} \cdot d^{-1}$)	Community respiration rate ($mg\ O_2 \cdot L^{-1} \cdot d^{-1}$)	NOD/CR%
F101	S	1.1770±0.0447	0.0014	1.4400±0.3024	0.094
F101	B	36.6152±0.1790	0.0422	0.1499±0.0021	28.137
F104	S	0.1443±0.0055	0.0002	1.6813±0.2433	0.010
F104	B	0.3277±0.0433	0.0004	0.1146±0.1568	0.330
F107	S	0.2057±0.0121	0.0002	0.2264±0.0722	0.105
F107	B	0.9596±0.0609	0.0011	0.2191±0.1756	0.505
F301	S	5.1961±0.0285	0.0060	1.1372±0.1240	0.526
F301	B	41.9434±0.4959	0.0483	0.4283±0.1175	11.282
F303	S	0.4847±0.0033	0.0006	1.0797±0.1843	0.052
F303	B	36.3678±1.0384	0.0419	0.5141±0.1635	8.150
F305	S	1.8411±0.2199	0.0021	0.6203±0.1090	0.342
F305	B	1.2795±0.3351	0.0015	0.0023±0.0017	64.894
F701	S	0.5144±0.1081	0.0006	0.9343±0.1157	0.063
F701	B	19.1291±1.0963	0.0220	0.0121±0.1519	181.913
A14	S	0.4443±0.058	0.0005	1.0191±0.1596	0.050
A14	B	0.0609±0.0059	0.0001	0.8222±0.2808	0.009
A12	S	0.8040±0.0692	0.0009	0.9928±0.4831	0.093
A12	B	1.1319±0.0479	0.0013	0.2256±0.0743	0.578
A09	S	2.5768±0.1457	0.0030	1.3144±0.2086	0.251
A09	B	22.4347±0.6230	0.0258	0.6340±0.1077	4.525
A05	S	1.9032±0.186	0.0022	0.2582±0.0848	0.849
A05	B	35.0975±2.5993	0.0404	0.4280±0.0347	9.446
A01	S	94.7793±12.3754	0.1092	0.6128±0.1521	17.819
A01	B	17.3175±0.3106	0.0199	0.3231±0.1861	6.175

* S-Surface; B-Bottom.

Table S4. Quantitative PCR results of cDNA (template for RNA level) of AOA and β-AOB in 13 stations

Station	AOA-PA (copy·L^{-1})	AOA-FL (copy·L^{-1})	AOB-PA (copy·L^{-1})	AOB-FL (copy·L^{-1})
A01	3.10E+03 ±1.12E+01	3.08E+03 ±7.11E+02	ND	ND
A01	ND	1.16E+03 ±7.70E+02	ND	ND
A05	8.24E+02 ±4.30E+02	1.02E+04 ±1.84E+03	ND	ND
A05	1.30E+03 ±8.48E+02	6.03E+02 ±3.48E+02	ND	ND
A09	ND	1.18E+05 ±1.06E+04	ND	ND
A09	1.77E+03 ±1.76E+03	1.47E+06 ±1.07E+05	ND	ND
A11	ND	2.56E+03 ±8.36E+02	ND	ND
A11	3.61E+04 ±3.64E+03	1.14E+05 ±1.30E+04	ND	ND
A16	ND	ND	ND	ND
A16	2.62E+04 ±6.64E+03	ND	ND	ND
F101	ND	1.82E+03 ±5.00E+02	ND	ND
F101	7.43E+03 ±1.46E+03	1.87E+04 ±2.70E+03	ND	ND
F104	ND	1.43E+03 ±4.38E+02	ND	ND
F104	1.21E+03 ±7.13E+01	8.26E+03 ±8.37E+02	ND	ND
F107	ND	ND	ND	ND
F107	ND	1.74E+06 ±5.89E+03	ND	ND
F301	2.99E+03 ±1.07E+03	ND	ND	ND
F301	5.09E+03 ±1.15E+02	1.85E+05 ±1.73E+04	ND	ND
F305	ND	8.07E+02 ±5.65E+02	ND	ND
F305	1.05E+04 ±1.44E+03	9.98E+03 ±1.62E+03	ND	ND
F403	6.46E+03 ±1.26E+03	1.18E+05 ±1.78E+04	ND	ND
F403	3.30E+03	1.17E+05	ND	ND

	±1.14E+03	±9.54E+03		
F601	ND	ND	ND	ND
F601	4.28E+03 ±5.20E+02	3.21E+06 ±1.67E+05	ND	ND
F603	ND	3.72E+03 ±3.08E+02	ND	ND
F603	1.03E+03 ±7.51E+01	2.50E+05 ±3.04E+04	ND	ND

* S-Surface; B-Bottom; PA-Particle attached (>3 μm); FL-Free-living (3-0.2 μm); ND-Under detection limit.

Table S5. Basic sample information of sequencing samples and corresponding Shannon index, Margalef richness

Station	Lon (E º)	Lat (W º)	Sample Cat.	Sequence No.	Shannon index	Margalef richness
A01	113.65	22.74	A01RS0.2	4469	4.26	42.06
			A01DB0.2	25484	3.70	39.66
			A01DB3	33527	3.73	37.25
			A01DS0.2	28147	3.64	37.09
			A01DS3	30179	3.68	39.3
A05	113.77	22.46	A05RS0.2	10504	4.21	43.33
			A05DB0.2	32747	3.25	33.3
			A05DB3	28121	4.00	40.49
			A05DS0.2	27297	3.33	35.85
			A05DS3	20389	3.42	33.75
A09	113.80	22.21	A09RB0.2	21803	3.78	39.07
			A09RB3	16585	3.87	41.38
			A09RS0.2	12693	4.14	43.61
			A09DB0.2	21927	4.04	37.99
			A09DB3	21343	3.71	33.55
			A09DS0.2	10794	4.07	29.95
			A09DS3	25603	3.53	37.12
A11	113.84	22.09	A11RB0.2	29345	4.12	43.19
			A11RB3	26206	3.78	39.4
			A11RS0.2	4080	3.26	28.6
			A11DB0.2	24215	3.82	37.84
			A11DB3	22422	3.72	36.47
			A11DS0.2	20568	3.62	38.78
			A11DS3	29216	3.18	34.89
A16	114.05	21.66	A16RB0.2	20644	4.12	40.51
			A16RB3	24676	4.01	41.43
			A16RS0.2	16931	3.88	39.06
			A16DB0.2	30526	3.31	35.74
			A16DS0.2	31112	3.02	31.63
			A16DS3	28739	3.25	35.5
F101	113.12	21.82	F101RB0.2	20949	3.67	38.37
			F101RS0.2	2523	2.61	23.22
			F101DB0.2	20840	3.61	30.87
			F101DB3	15602	3.96	36.95
			F101DS0.2	8348	3.90	35.38
F104	113.25	21.56	F104RB0.2	33200	3.60	32.74
			F104RB3	16037	3.69	31.77
			F104RS0.2	33670	2.22	17.82
			F104DB0.2	30782	2.84	28.32
			F104DB3	30769	2.69	26.59
			F104DS0.2	6990	3.01	30.22

			F107RB0.2	21167	3.89	40.88
F107	113.42	21.27	F107RB3	5633	3.89	38.1
			F107DB0.2	20909	3.90	35.52
			F301RB0.2	17778	3.76	34.19
			F301RB3	16657	3.48	34.53
			F301RS3	5653	4.03	37.6
F301	113.55	21.99	F301DB0.2	22088	3.82	38.42
			F301DB3	3436	4.19	31.49
			F301DS0.2	7823	3.40	27.44
			F301DS3	20310	3.51	26.54
			F305RB0.2	27580	3.35	36.05
			F305RB3	27095	3.20	33.45
F305	113.63	21.83	F305DB0.2	18856	3.96	33.86
			F305DB3	21410	3.78	35.12
			F305DS0.2	7007	4.20	42.21
			F403RB0.2	10000	3.86	37.69
			F403RB3	8858	3.69	38.31
			F403RS0.2	4431	3.57	31.38
			F403RS3	4166	3.04	28.24
F403	113.74	22.08	F403DB0.2	21959	3.91	40.19
			F403DB3	21744	3.85	38.99
			F403DS0.2	19571	4.26	43.7
			F403DS3	20370	3.83	36.83
			F601RB0.2	27041	4.12	43.22
			F601RB3	22320	3.75	38.81
			F601DB0.2	18421	3.82	34.78
F601	114.03	22.14	F601DB3	20092	3.80	33.59
			F601DS0.2	23411	3.70	37.44
			F601DS3	15932	2.94	33.22
			F603RB0.2	30619	3.55	37.54
			F603RB3	9410	3.55	38.81
			F603RS0.2	5859	3.90	39.93
F603	114.09	22.04	F603DB0.2	16912	3.96	40.71
			F603DB3	19693	3.81	35.48
			F603DS0.2	18314	3.78	36.1

* Sample categories: Station ID + D/R (DNA/RNA) + S/B (Surface/Bottom) + 3/0.2 (Particle attached (>3 μm)/Free-living (3-0.2 μm)).

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