Supporting information

Table S1 RDA analysis of the relationship between the environmental factor and community composition (bacteria, diatoms, and protists)

|               | Bacteria          | RDA1     | RDA2     | $r^2$ | $Pr(>r)$ |
|---------------|-------------------|----------|----------|-------|----------|
| NO$_2$       | -0.00304          | 1.00000  | 0.08     | 0.391 |          |
| NO$_3$       | -0.0861           | 0.99629  | 0.0681   | 0.447 |          |
| NH$_4$       | -0.99995          | 0.00997  | 0.0178   | 0.815 |          |
| Nmin         | -0.0885           | 0.99608  | 0.0695   | 0.444 |          |
| PO$_4$       | 0.29137           | 0.95661  | 0.0351   | 0.675 |          |
| SIO$_3$      | 0.06997           | 0.99755  | 0.0387   | 0.633 |          |
| TP           | 0.98132           | -0.1924  | 0.1246   | 0.258 |          |
| SA           | -0.79613          | -0.60512 | 0.1628   | 0.142 |          |
| depth        | -0.99703          | -0.07699 | 0.1905   | 0.108 |          |

|               | Diatoms           | RDA1     | RDA2     | $r^2$ | $Pr(>r)$ |
|---------------|-------------------|----------|----------|-------|----------|
| NO$_2$       | -0.48244          | 0.87593  | 0.074    | 0.318 |          |
| NO$_3$       | -0.54491          | 0.8385   | 0.036    | 0.444 |          |
| NH$_4$       | 0.83326           | -0.55288 | 0.0033   | 0.968 |          |
| Nmin         | -0.53714          | 0.84349  | 0.0382   | 0.431 |          |
| PO$_4$       | -0.39966          | 0.91666  | 0.1065   | 0.271 |          |
| SIO$_3$      | -0.44607          | 0.895    | 0.2011   | 0.09  |          |
| TP           | 0.91289           | -0.4082  | 0.1968   | 0.106 |          |
| SA           | -0.44603          | -0.89502 | 0.0954   | 0.327 |          |
| depth        | -0.23664          | -0.9716  | 0.3416   | 0.014*|          |

|               | Protist           | RDA1     | RDA2     | $r^2$ | $Pr(>r)$ |
|---------------|-------------------|----------|----------|-------|----------|
| NO$_2$       | 0.81643           | 0.57745  | 0.073    | 0.326 |          |
| NO$_3$       | 0.68693           | 0.72672  | 0.0486   | 0.442 |          |
| NH$_4$       | -0.3476           | 0.93764  | 0.1929   | 0.097 |          |
| Nmin         | 0.67858           | 0.73453  | 0.0524   | 0.432 |          |
| PO$_4$       | 0.96071           | 0.27756  | 0.0531   | 0.442 |          |
| SIO$_3$      | 0.88207           | 0.47112  | 0.0692   | 0.405 |          |
| TP           | -0.42886          | -0.90337 | 0.0788   | 0.381 |          |
| SA           | -0.8641           | 0.50332  | 0.0544   | 0.495 |          |
| depth        | -0.9847           | 0.17425  | 0.1288   | 0.244 |          |

*, a significant level at 0.05. $r^2$, the square of the correlation index. $Pr(>r)$, the $p$-value (number of permutations: 999). SA, salinity. TP, total phosphorus. Nmin, total inorganic nitrogen.
Table S2 RDA analysis of the relationship between the environmental factor and community composition (bacteria, diatoms, and protists) in Pearl River estuary (PR) and Beibu Gulf regions (BG)

| Bacteria PR | RDA1 | RDA2 | r² | Pr(>r) |
|-------------|------|------|----|--------|
| NO2         | -0.95612 | 0.29296 | 0.1697 | 0.426 |
| NO3         | -0.90746 | 0.42014 | 0.1826 | 0.429 |
| NH4         | 0.3193 | 0.94765 | 0.0331 | 0.846 |
| Nmin       | -0.89566 | 0.44473 | 0.1641 | 0.474 |
| PO4         | -0.21967 | -0.97557 | 0.3987 | 0.063 |
| SIO3        | -0.93344 | -0.35873 | 0.194 | 0.331 |
| TP          | 0.74912 | -0.66243 | 0.0688 | 0.694 |
| SA          | -0.06893 | 0.99762 | 0.4365 | 0.048* |
| depth       | -0.52616 | 0.85039 | 0.0216 | 0.901 |

| Bacteria BG | RDA1 | RDA2 | r² | Pr(>r) |
|-------------|------|------|----|--------|
| NO2         | -0.96128 | 0.27556 | 0.106 | 0.747 |
| NO3         | -0.43697 | 0.89948 | 0.0279 | 0.956 |
| NH4         | 0.10849 | -0.9941 | 0.0076 | 0.982 |
| Nmin       | -0.61241 | 0.79054 | 0.0238 | 0.953 |
| PO4         | 0.51153 | 0.85927 | 0.1946 | 0.548 |
| SIO3        | 0.98432 | 0.17641 | 0.0431 | 0.881 |
| TP          | -0.97306 | 0.23055 | 0.0415 | 0.901 |
| SA          | -0.34998 | 0.93676 | 0.0317 | 0.925 |
| depth       | 0.35317 | 0.93556 | 0.0819 | 0.784 |

| Diatoms PR | RDA1 | RDA2 | r² | Pr(>r) |
|------------|------|------|----|--------|
| NO2        | -0.81031 | 0.586 | 0.048 | 0.748 |
| NO3        | -0.98299 | 0.18366 | 0.0577 | 0.711 |
| NH4        | 0.48022 | 0.87715 | 0.0461 | 0.821 |
| Nmin      | -0.94875 | 0.31604 | 0.0464 | 0.747 |
| PO4        | 0.67619 | -0.73673 | 0.207 | 0.25 |
| SIO3       | -0.60198 | -0.79851 | 0.0539 | 0.732 |
| TP         | 0.96833 | -0.24969 | 0.0555 | 0.749 |
| SA         | -0.41618 | 0.90928 | 0.5283 | 0.041* |
| depth      | -0.11938 | 0.99285 | 0.074 | 0.668 |

| Diatoms BG | RDA1 | RDA2 | r² | Pr(>r) |
|------------|------|------|----|--------|
|     | NO2   | NO3   | NH4   | Nmin  | PO4   | SIO3  | TP    | SA    | depth |
|-----|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|     | -0.82084 | 0.57116 | 0.4989 | 0.132 | 0.77895 | -0.89541 | 0.94152 | 0.99022 | 0.99729 |
|     | 0.72427 | 0.68952 | 0.3151 | 0.324 | 0.80804 | 0.72427 | 0.77895 | 0.77895 | 0.77895 |
|     | 0.31949 | -0.94759 | 0.3136 | 0.341 | -0.77895 | 0.31949 | -0.94759 | 0.94759 | -0.94759 |
|     | 0.80804 | 0.58913 | 0.2174 | 0.489 | -0.77895 | 0.31949 | 0.94759 | 0.94759 | 0.94759 |
|     | 0.89541 | 0.44524 | 0.6751 | 0.029* | 0.89541 | 0.89541 | 0.44524 | 0.44524 | 0.44524 |
|     | 0.89541 | 0.44524 | 0.6751 | 0.029* | 0.89541 | 0.89541 | 0.44524 | 0.44524 | 0.44524 |
|     | 0.94152 | -0.33695 | 0.7168 | 0.016* | 0.94152 | 0.94152 | -0.33695 | -0.33695 | -0.33695 |
|     | 0.99022 | -0.13951 | 0.7294 | 0.02*  | 0.99022 | 0.99022 | -0.13951 | -0.13951 | -0.13951 |
|     | 0.99729 | 0.07358 | 0.6888 | 0.033*  | 0.99729 | 0.99729 | 0.07358 | 0.07358 | 0.07358 |

| Protist PR | RDA1 | RDA2 | r²   | Pr(>r) |
|------------|------|------|------|--------|
| NO2        | -0.8152 | 0.57917 | 0.0279 | 0.859  |
| NO3        | -0.85973 | -0.51076 | 0.0075 | 0.962  |
| NH4        | -0.90989 | -0.41484 | 0.059  | 0.745  |
| Nmin       | -0.94112 | -0.33809 | 0.0103 | 0.944  |
| PO4        | -0.56182 | 0.82726  | 0.0777 | 0.634  |
| SIO3       | -0.66569 | -0.74623 | 0.0017 | 0.99   |
| TP         | 0.44497  | -0.89554 | 0.2951 | 0.171  |
| SA         | -0.99815 | 0.06081  | 0.3438 | 0.122  |
| depth      | -0.7042  | 0.71     | 0.0172 | 0.933  |

| Protist BG  | RDA1 | RDA2 | r²   | Pr(>r) |
|-------------|------|------|------|--------|
| NO2         | -0.33336 | -0.9428 | 0.5054 | 0.082  |
| NO3         | 0.01211  | -0.99993 | 0.5367 | 0.059  |
| NH4         | 0.84324  | -0.53754 | 0.3724 | 0.23   |
| Nmin        | 0.10333  | -0.99465 | 0.5856 | 0.06   |
| PO4         | -0.98304 | 0.18338  | 0.2125 | 0.552  |
| SIO3        | -0.66342 | -0.74825 | 0.3848 | 0.224  |
| TP          | 0.33286  | 0.94298  | 0.3124 | 0.324  |
| SA          | 0.29056  | 0.95686  | 0.3297 | 0.292  |
| depth       | -0.0077  | 0.99997  | 0.4375 | 0.155  |

* a significant level at 0.05. \( r^2 \), the square of the correlation index. \( Pr(>r) \), the \( p-value \) (number of permutations: 999). SA, salinity. TP, total phosphorus. Nmin, total inorganic nitrogen.
| Category                        | Bin1 | Bin99 | Bin114 | Bin159 | Bin168 | Bin265 | Bin275 | Bin292 | Bin326 | Bin330 | Bin338 | Bin353 | Bin378 | Bin380 |
|--------------------------------|------|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Aging                          | 10   | 7     | 7      | 12     | 8      | 14     | 7      | 12     | 6      | 13     | 6      | 8      | 7      | 22     |
| Amino acid metabolism          | 177  | 33    | 207    | 194    | 221    | 306    | 344    | 259    | 179    | 290    | 220    | 329    | 162    | 328    |
| Biosynthesis of other secondary metabolites | 14   | 5     | 30     | 22     | 28     | 30     | 28     | 23     | 25     | 30     | 12     | 30     | 20     | 32     |
| CanCancer: Overview            | 17   | 4     | 8      | 9      | 10     | 21     | 19     | 11     | 9      | 17     | 14     | 21     | 6      | 20     |
| CanCancer: Specific types       | 3    | 1     | 2      | 2      | 2      | 2      | 0      | 2      | 2      | 1      | 3      | 1      | 1      | 3      |
| Carbohydrate metabolism        | 235  | 82    | 167    | 206    | 211    | 307    | 321    | 212    | 162    | 390    | 289    | 364    | 368    | 358    |
| Cardiovascular diseases         | 2    | 0     | 1      | 0      | 0      | 1      | 2      | 1      | 0      | 0      | 0      | 0      | 0      | 0      |
| Cell growth and death          | 25   | 12    | 10     | 17     | 14     | 23     | 23     | 17     | 8      | 13     | 7      | 22     | 11     | 18     |
| Cell motility                  | 31   | 10    | 46     | 0      | 6      | 24     | 11     | 4      | 6      | 4      | 15     | 66     | 2      | 87     |
| Circulatory system             | 3    | 2     | 4      | 0      | 0      | 4      | 3      | 3      | 0      | 0      | 1      | 5      | 1      | 3      |
| Digestive system               | 1    | 0     | 2      | 1      | 1      | 2      | 0      | 0      | 1      | 2      | 0      | 2      | 2      | 1      |
| Drug resistance                | 22   | 8     | 39     | 24     | 19     | 16     | 12     | 28     | 13     | 14     | 4      | 32     | 11     | 36     |
| Endocrine and metabolic diseases| 7    | 4     | 7      | 3      | 3      | 9      | 8      | 6      | 3      | 8      | 8      | 11     | 4      | 8      |
| Endocrine system               | 16   | 4     | 14     | 15     | 13     | 26     | 14     | 14     | 10     | 28     | 28     | 12     | 9      | 18     |
| Energy metabolism              | 113  | 50    | 99     | 121    | 100    | 163    | 151    | 110    | 83     | 160    | 109    | 162    | 86     | 189    |
| Environmental adaptation       | 2    | 0     | 4      | 3      | 2      | 1      | 2      | 2      | 2      | 1      | 2      | 6      | 1      | 4      |
| Excretory system               | 0    | 0     | 0      | 1      | 1      | 0      | 1      | 1      | 1      | 1      | 2      | 1      | 1      | 0      |
| Folding, sorting and degradation| 39  | 17    | 36     | 41     | 35     | 43     | 34     | 36     | 28     | 45     | 23     | 60     | 31     | 49     |
| Global and overview maps       | 1010 | 285   | 1076   | 1156   | 1078   | 1402   | 1526   | 1164   | 908    | 1588   | 993    | 1722   | 741    | 1723   |
| Glycan biosynthesis and metabolism| 22  | 6     | 31     | 35     | 57     | 26     | 34     | 28     | 25     | 25     | 10     | 44     | 27     | 34     |
| Immune diseases                | 1    | 0     | 2      | 2      | 1      | 1      | 0      | 2      | 1      | 3      | 0      | 2      | 1      | 2      |
| Immune system                  | 0    | 0     | 2      | 2      | 2      | 0      | 1      | 2      | 2      | 2      | 0      | 2      | 2      | 2      |
| Infectious diseases:           |      |      |        |        |        |        |        |        |        |        |        |        |        |        |
| Bacterial                      | 14   | 6     | 19     | 12     | 10     | 13     | 13     | 11     | 6      | 13     | 11     | 21     | 7      | 35     |
| Infectious diseases:           |      |      |        |        |        |        |        |        |        |        |        |        |        |        |
| Parasitic                      | 4    | 0     | 3      | 0      | 2      | 4      | 3      | 1      | 2      | 3      | 0      | 2      | 3      | 3      |
| Infectious diseases:           |      |      |        |        |        |        |        |        |        |        |        |        |        |        |
| Viral                          | 3    | 0     | 0      | 0      | 1      | 0      | 7      | 3      | 1      | 0      | 0      | 1      | 0      | 0      |
| Lipid metabolism               | 51   | 15    | 67     | 78     | 55     | 94     | 86     | 77     | 51     | 76     | 106    | 97     | 40     | 66     |
| Membrane transport             | 39   | 23    | 60     | 62     | 34     | 51     | 149    | 71     | 28     | 158    | 26     | 191    | 27     | 186    |
| Metabolism of cofactors and vitamins | 99  | 21    | 99     | 117    | 98     | 112    | 135    | 102    | 83     | 112    | 65     | 164    | 60     | 174    |
| Category                                    | 0  | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 |
|--------------------------------------------|----|----|----|----|----|----|----|----|----|----|----|
| Metabolism of other amino acids            | 53 | 7  | 49 | 34 | 43 | 75 | 76 | 45 | 29 | 46 | 47  |
| Metabolism of terpenoids and polyketides   | 31 | 4  | 23 | 37 | 28 | 45 | 41 | 31 | 26 | 28 | 38  |
| Nervous system                             | 0  | 2  | 3  | 2  | 4  | 2  | 6  | 1  | 8  | 2  | 5   |
| Neurodegenerative diseases                 | 16 | 8  | 16 | 7  | 7  | 15 | 21 | 20 | 6  | 2  | 4   |
| Nucleotide metabolism                      | 83 | 23 | 74 | 86 | 93 | 110| 106| 87 | 82 | 118| 48  |
| Replication and repair                     | 74 | 20 | 59 | 66 | 72 | 68 | 64 | 70 | 88 | 92 | 22  |
| Signal transduction                        | 58 | 17 | 77 | 59 | 36 | 65 | 64 | 61 | 27 | 62 | 43  |
| Signaling molecules and interaction        | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 1  | 0  | 0  | 1   |
| Substance dependence                       | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0  | 0  | 0   |
| Transcription                              | 4  | 2  | 1  | 4  | 3  | 8  | 5  | 3  | 1  | 6  | 4   |
| Translational                              | 70 | 66 | 55 | 75 | 75 | 94 | 71 | 51 | 56 | 100| 59  |
| Transport and catabolism                   | 5  | 3  | 5  | 7  | 11 | 7  | 10 | 11 | 6  | 8  | 5   |
| Xenobiotics                                | 48 | 1  | 23 | 79 | 31 | 89 | 97 | 80 | 20 | 47 | 85  |

Number: the number of genes
Table S4 The sampling information

| Location | Region | Lab ID | S.depth | Num. | 18S ID  | 16S ID | Metagenome ID |
|----------|--------|--------|---------|------|---------|---------|---------------|
| ZS1      | Pearl River estuary | ZJK-S1 | 0m      | 3    | ZS1-0-1 | ZS1-0-2 | ZS1-0-3       | ZS1-0       |
| ZS1      | Pearl River estuary | ZJK-S1 | 7m      | 3    | ZS1-20-1| ZS1-20-2| ZS1-20-3      | ZS1-20      |
| ZS4      | Pearl River estuary | ZJK-S4 | 0m      | 3    | ZS4-0-1 | ZS4-0-2 | ZS4-0-3       | ZS4-0       |
| ZS4      | Pearl River estuary | ZJK-S4 | 20m     | 3    | ZS4-20-1| ZS4-20-2| ZS4-20-3      | ZS4-20      |
| ZF1      | Pearl River estuary | ZJK-F1 | 0m      | 3    | ZF1-0-2 | ZF1-0-3 | ZF1-0-4       | ZF1-0       |
| ZF2      | Pearl River estuary | ZJK-F2 | 16m     | 3    | ZF1-20-1| ZF1-20-2| ZF1-20-3      | ZF1-20      |
| ZF2      | Pearl River estuary | ZJK-F2 | 20m     | 3    | ZF2-20-1| ZF2-20-2| ZF2-20-3      | ZF2-20      |
| ZF3      | Pearl River estuary | ZJK-F3 | 0m      | 3    | ZF3-0-1 | ZF3-0-2 | ZF3-0-3       | ZF3-0       |
| ZF3      | Pearl River estuary | ZJK-F3 | 20m     | 3    | ZF3-20-1| ZF3-20-2| ZF3-20-3      | ZF3-20      |
| ZF4      | Pearl River estuary | ZJK-F4 | 0m      | 3    | ZF4-0-1 | ZF4-0-2 | ZF4-0-3       | ZF4-0       |
| ZF4      | Pearl River estuary | ZJK-F4 | 20m     | 3    | ZF4-20-1| ZF4-20-2| ZF4-20-3      | ZF4-20      |
| ZF5      | Pearl River estuary | ZJK-F5 | 0m      | 3    | ZF5-0-1 | ZF5-0-2 | ZF5-0-3       | ZF5-0       |
| ZF5      | Pearl River estuary | ZJK-F5 | 20m     | 3    | ZF5-20-1| ZF5-20-2| ZF5-20-3      | ZF5-20      |
| ZF6      | Pearl River estuary | ZJK-F6 | 0m      | 3    | ZF6-0-1 | ZF6-0-2 | ZF6-0-3       | ZF6-0       |
| ZF6      | Pearl River estuary | ZJK-F6 | 20m     | 3    | ZF6-20-1| ZF6-20-2| ZF6-20-3      | ZF6-20      |
| ZF7      | Pearl River estuary | ZJK-F7 | 0m      | 3    | ZF7-0-1 | ZF7-0-2 | ZF7-0-3       | ZF7-0       |
| ZF7      | Pearl River estuary | ZJK-F7 | 20m     | 3    | ZF7-20-1| ZF7-20-2| ZF7-20-3      | ZF7-20      |
| ZF8      | Pearl River estuary | ZJK-F8 | 0m      | 3    | ZF8-0-1 | ZF8-0-2 | ZF8-0-3       | ZF8-0       |
| ZF8      | Pearl River estuary | ZJK-F8 | 20m     | 3    | ZF8-20-1| ZF8-20-2| ZF8-20-3      | ZF8-20      |
| ZF9      | Pearl River estuary | ZJK-F9 | 0m      | 3    | ZF9-0-1 | ZF9-0-2 | ZF9-0-3       | ZF9-0       |
| ZF9      | Pearl River estuary | ZJK-F9 | 20m     | 3    | ZF9-20-1| ZF9-20-2| ZF9-20-3      | ZF9-20      |
| JN5      | Beibu Gulf,       | JH-F1  | 0m      | 3    | JF1-0-1 | JF1-0-2 | JF1-0-3       | JF1-0       |
| JN5      | Beibu Gulf,       | JH-F1  | 20m     | 3    | JF1-20-1| JF1-20-2| JF1-20-3      | JF1-20      |
| JN9      | Beibu Gulf,       | JH-F6  | 0m      | 3    | JF6-0-1 | JF6-0-2 | JF6-0-3       | JF6-0       |
| JN9      | Beibu Gulf,       | JH-F6  | 20m     | 3    | JF6-20-1| JF6-20-2| JF6-20-3      | JF6-20      |
| JS2      | Beibu Gulf,       | JH-F8  | 0m      | 3    | JF8-0-1 | JF8-0-2 | JF8-0-3       | JF8-0       |
| JS2      | Beibu Gulf,       | JH-F8  | 20m     | 3    | JF8-20-1| JF8-20-2| JF8-20-3      | JF8-20      |
| JS9      | Beibu Gulf,       | JH-S9  | 0m      | 3    | JF9-0-1 | JF9-0-2 | JF9-0-3       | JF9-0       |
| JS9      | Beibu Gulf,       | JH-S9  | 20m     | 3    | JF9-20-1| JF9-20-2| JF9-20-3      | JF9-20      |
| JN22     | Beibu Gulf,       | JH-N22 | 0m      | 3    | JN22-0-1| JN22-0-2| JN22-0-3      | JN22-0      |
| JN22     | Beibu Gulf,       | JH-N22 | 20m     | 3    | JN22-20-1| JN22-20-2| JN22-20-3     | JN22-20     |
| JA6      | Beibu Gulf,       | JH-A6  | 0m      | 3    | JA6-0-1 | JA6-0-2 | JA6-0-3       | JA6-0       |
| JA6      | Beibu Gulf,       | JH-A6  | 20m     | 3    | JA6-20-1| JA6-20-2| JA6-20-3      | JA6-20      |
| JA9      | Beibu Gulf,       | JH-A9  | 0m      | 3    | JA9-0-1 | JA9-0-2 | JA9-0-3       | JA9-0       |
| JA9      | Beibu Gulf,       | JH-A9  | 20m     | 3    | JA9-20-1| JA9-20-2| JA9-20-3      | JA9-20      |
| JD1      | the west Guangdong waters | JH-D1 | 0m     | 3    | JD1-0-1 | JD1-0-2 | JD1-0-3       | JD1-0       |
| JD1      | the west Guangdong waters | JH-D1 | 20m     | 3    | JD1-20-1| JD1-20-2| JD1-20-3      | JD1-20      |
| JD6      | the west Guangdong waters | JH-D6 | 0m     | 3    | JD6-0-1 | JD6-0-2 | JD6-0-3       | JD6-0       |
| JD6      | the west Guangdong waters | JH-D6 | 20m     | 3    | JD6-20-1| JD6-20-2| JD6-20-3      | JD6-20      |
| JD9  | the west Guangdong waters | JD9  | 0m   | 3    | JD9-0-1 | JD9-0-2 | JD9-0-3 | JD9-0 | JD9-0 |
|------|---------------------------|------|------|------|---------|---------|---------|-------|-------|
| JD9  | the west Guangdong waters | JD9  | 20m  | 3    | JD9-20-1| JD9-20-2| JD9-20-3| JD9-20 | JD9-20 |
| JH1  | the east Guangdong waters | JH1  | 0m   | 3    | JH1-0-1 | JH1-0-2 | JH1-0-3 | JH1-0 | JH1-0 |
| JH1  | the east Guangdong waters | JH1  | 20m  | 3    | JH1-20-1| JH1-20-2| JH1-20-3| JH1-20 | JH1-20 |
| JH6  | the east Guangdong waters | JH6  | 0m   | 3    | JH6-0-1 | JH6-0-2 | JH6-0-3 | JH6-0 | JH6-0 |
| JH6  | the east Guangdong waters | JH6  | 20m  | 3    | JH6-20-1| JH6-20-2| JH6-20-3| JH6-20 | JH6-20 |
| JH9  | the east Guangdong waters | JH9  | 0m   | 3    | JH9-0-1 | JH9-0-2 | JH9-0-3 | JH9-0 | JH9-0 |
| JH9  | the east Guangdong waters | JH9  | 20m  | 3    | JH9-20-1| JH9-20-2| JH9-20-3| JH9-20 | JH9-20 |

S.depth, sampling depth. Num, the number of samples.
| Sample ID  | F-barcode | R-barcode |
|------------|-----------|-----------|
| 16S        |           |           |
| J6-0       | ATCGTA    | TCTACC    |
| J6-20      | GGTTGT    | CGATGT    |
| J9-0       | CCACAA    | GCCAAT    |
| J9-20      | TCGAAG    | AGTGGAA   |
| JD1        | AGTCC     | TGATGAG   |
| JD1-20     | GTACTT    | CCAAGTC   |
| JD6-0      | CAGATC    | GTGAAA    |
| JD6-20     | TAATCG    | ACTGGA    |
| JF1-0      | CTCACA    | GCCCTA    |
| JF1-20     | TGACCA    | ATCCAGC   |
| JF6-0      | AGTCC     | TGAATG    |
| JF6-20     | TAATCG    | ACTGGA    |
| JF8-0      | CAGATC    | GTGAAA    |
| JF8-20     | TAATCG    | ACTGGA    |
| JH1-0      | CCGGTG    | GAGTGGG   |
| JH1-20     | TCGCAG    | ATCCAGA   |
| JH6-0      | ATCGTA    | TCTACC    |
| JH6-20     | GGTTGT    | CGATGT    |
| JH9-0      | CCACAA    | GCCAAT    |
| JH9-20     | TCGAAG    | AGTGGAG   |
| JN22-0     | CCGGTG    | GAGTGG    |
| JN22-20    | TCGCAG    | AGTCCAG   |
| JN2-0      | ATCGTA    | TCTACC    |
| JN2-10     | TCGAAG    | AGTGGAG   |
| JZ1-0      | ATCGTA    | TCTACC    |
| JZ1-20     | GAGATA    | ATCCAGT   |
| JZ2-0      | CCGGTG    | GAGTGG    |
| JZ2-10     | TCGAAG    | AGTGGAG   |
| JZ3-0      | ATCGTA    | TCTACC    |
| JZ3-20     | GGTGGAG   | ATCCAGT   |
| JZ4-0      | CCACAA    | GCCAAT    |
| JZ4-20     | TCGAAG    | AGTGGAG   |
| JZ5-0      | ACAGTG    | TCGGAC    |
| JZ5-20     | GGTGGAG   | ATCCAGT   |
| JZ6-0      | TCGCAG    | ATCCAGA   |
| JZ7-0      | TCGGCG    | ATCCAGA   |

| Sample ID  | F-barcode | R-barcode |
|------------|-----------|-----------|
| 18S        |           |           |
| ZF1-0      | CAGATC    | GTGAAA    |
| ZF1-20     | ATCGTA    | TCTACC    |

| Sample ID  | F-barcode | R-barcode |
|------------|-----------|-----------|
| ZF2-0      | CAGATC    | GTGAAA    |

| Sample ID  | F-barcode | R-barcode |
|------------|-----------|-----------|
| ZF3-0      | ATCGTA    | TCTACC    |
| ZF3-20     | GGTGGAG   | ATCCAGT   |
| ZF4-0      | CCACAA    | GCCAAT    |
| ZF4-20     | TCGAAG    | AGTGGAG   |
| ZF5-0      | ACAGTG    | TCGGAC    |
| ZF5-20     | GGTGGAG   | ATCCAGT   |
| ZF6-0      | TCGCAG    | ATCCAGA   |
| ZF7-0      | TCGGCG    | ATCCAGA   |

Table S5 The barcode sequences for each sample in this study
| ZF7-20 | CTGCTG | GTGGCC | JF1-20-1 | GGTGTT | CGATGT | ZF8-0-1 | CGCGGT | GAGTGG | ZS4-20-1 | GGTGTT | CGATGT |
|-------|--------|--------|----------|--------|--------|----------|--------|--------|----------|--------|--------|
| ZF8-0 | TAACGA | ATATGT | JF1-20-2 | CCACAA | GCCAAT | ZF8-0-2 | TGGGCA | AGTCAA | ZS4-20-2 | CCACAA | GCCAAT |
| ZF8-20 | AGAGTA | TTAGGC | JF1-20-3 | TCGAGG | AGTGGG | ZF8-0-3 | ATGTTA | TCTACC | ZS4-20-3 | TCGAGG | AGTGGG |
| ZF9-20 | GGAAGA | CTCAGA | ZF2-0-1 | ACAGTG | TTCAGA | JF8-20-1 | TCCCGA | ATGTCA | JS9-0-1 | CTGCTG | GTGGCC |
| ZS1-0 | AGTCCG | TAACGA | ZF2-0-2 | GGTGAA | CACGTA | JF8-20-2 | CGGAAT | GGTAGC | JS9-0-2 | TAACGA | ATATGT |
| ZS1-20 | GTACCT | CCAGCT | ZF2-0-3 | CGTAGG | GCGCGG | JF8-20-3 | GTTGGG | TTTACC | JS9-0-3 | AGAGTA | TTAGGC |
| ZS4-0 | CAGATC | GTGAAA | ZF2-20-1 | TCCCCG | ATGTCA | ZF8-20-1 | GGTGTT | CGATGT | JS9-20-1 | GGAAGA | CTCAGA |
| ZS4-20 | TAATCG | ACTTGA | ZF2-20-2 | CGGAAT | GGTAGC | ZF8-20-2 | CCACAA | GCAAT | JS9-20-2 | CTTCCA | GCCTTA |
| ZF2-20-3 | GGTGCG | ATGAGA | ZF8-20-3 | TCGAGG | AGTGGG | JS9-20-3 | TGACCA | ATGCTT |
Figure S1 The PCA clustering analysis on the samples from 24 collecting site based on the Bray-Curtis distance using environmental factors measured in this study. 10, water depth at 10m. 40, water depth at 40m. 100, water depth at 100m. 200, water depth at 200m. In the left hierarchical tree, each shape represented one average sample in each sample collecting site in this study.
Figure S2 Water-depth patterns for bacteria, diatoms, and protists in alpha diversity in Pearl River estuary region. The relationships between water depth and alpha diversity were modeled using the linear and quadratic models. The better model was selected based on the lower value of Akaike's information criteria (Yamaoka, et al. 1978).
Figure S3 Water-depth patterns for bacteria, diatoms, and protists in alpha diversity in Beibu Gulf region. The relationships between water depth and alpha diversity were modeled using the linear and quadratic models. The better model was selected based on the lower value of Akaike's information criteria (Yamaoka, et al. 1978).
Figure S3 The significant relationship (spearman) between the diatoms and environmental factors. Green line, positively significant (0.05). Red line, negatively significant (0.05).
Figure S4 The heatmap of the main diatom species in this study. 10, water depth at 10m. 40, water depth at 40m. 100, water depth at 100m. 200, water depth at 200m. In the left hierarchical tree, each node represented one average sample in each sample collecting site in this study.
Figure S5 The significant relationship (spearman) between the bacteria and environmental factors. Green line, positively significant (0.05). Red line, negatively significant (0.05).
Figure S6 The heatmap of the main bacteria genera in this study. 10, water depth at 10m. 40, water depth at 40m. 100, water depth at 100m. 200, water depth at 200m. In the left hierarchical tree, each node represented one average sample in each sample collecting site in this study.
Figure S7 The significant relationship (spearman) between the protists and environmental factors. Green line, positively significant (0.05). Red line, negatively significant (0.05).
References
Yamaoka K, Nakagawa T, Uno T. 1978. Application of Akaike’s information criterion (AIC) in the evaluation of linear pharmacokinetic equations. Journal of pharmacokinetics and biopharmaceutics 6:165-175.