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Supporting Information for

**A multi-stable isotopic constraint on water column oxygen sinks in the Pearl River Estuary, south China**

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**Introduction**

This supplement provided within this article includes data supporting the conclusions.

**Data Table S1** The DO concentrations, hydro-chemical parameters and isotopic compositions (δ13C and δ15N) of DIC, POC, NH4+ and NO3− during different cruises in the Pearl River Estuary (blank: surface water; shadow: bottom water)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Seasons | Station | Long.  [°E] | Lat.  [°N]  [°N] | Temp  [°C]  [°C] | Salinity  [psu] | SPM  [mg L-1] | Chl a  [μg L-1] | DO  [mg L-1] | DIC  [μM] | NO3-  [μM] | NH4+  [μM] | δ13DIC  [‰] | δ13POC  [‰] | δ15NO3-  [‰] | δ15NH4+  [‰] | δ15NO2-  [‰] |
| Autumn | ZJ00 | 113.58 | 22.83 | 20.4 | 2.4 | 13.3 | 14.8 | 6.33 | 63.3 | 37.3 | 22.8 | −6.29 | −28.3 | 10.8 | 14.1 | -17.5 |
|  |  |  | 20.3 | 5.9 | 28.0 | 11.6 | 6.37 | 106.9 | 72.7 | 22.3 | −6.50 | −27.9 | 5.6 | 13.3 | -12.9 |
| ZJ01 | 113.62 | 22.77 | 22 | 5 | 14.6 | 8.1 | 5.6 | 51.4 | 61.2 | 16.8 | −6.70 | −28.2 | 6.7 | 12.9 | -12.3 |
|  |  |  | 22.1 | 5.6 | 16.5 | 7.2 | 5.76 | 57.3 | 104.1 | 18.1 | −6.86 | −28.2 | 3.8 | 10.5 | -10.7 |
| ZJ02 | 113.69 | 22.69 | 21.8 | 4.9 | 10.6 | 2.8 | 8.57 | 40.8 | 83.8 | 16.0 | −6.99 | −28.4 | 3.9 | 10.6 | -9.9 |
|  |  |  | 21.8 | 9.2 | 20.4 | 1.7 | 8.32 | 47.7 | 96.5 | 12.9 | −6.35 | −27.1 | 3.1 | 8.4 | -7.7 |
| ZJ03 | 113.72 | 22.6 | 22.1 | 5.9 | 18 | 5.6 | 8.73 | 52.2 | 61.9 | 10.8 | −7.17 | −28.8 | 3.2 | 9.2 | -9.0 |
|  |  |  | 22.2 | 7.0 | 19.5 | 2.6 | 7.96 | 56.2 | 86.3 | 16.9 | −6.57 | −27.8 | 2.6 | 8.7 | -7.0 |
| ZJ04 | 113.75 | 22.52 | 20.8 | 14.7 | 13.6 | 1.6 | 8.04 | 35.8 | 84.7 | 22.6 | −4.29 | −27.5 | 1.7 | 7.8 | -5.5 |
|  |  |  | 21.0 | 13.0 | 19.8 | 1.6 | 8.36 | 37.5 | 89.9 | 25.0 | −4.77 | −26.7 | 0.6 | 9.6 | -5.5 |
| ZJ05 | 113.75 | 22.44 | 20.3 | 17.6 | 51.6 | 0.9 | 8.56 | 41.1 | 71.1 | 23.3 | −3.49 | −26.2 | 5.4 | 9.9 | -3.3 |
|  |  |  | 20.8 | 22.4 | 43.1 | 0.9 | 8.52 | 37.0 | 63.3 | 21.6 | −3.15 | −25.8 | 5.5 | 9.6 | -3.9 |
| ZJ06 | 113.74 | 22.35 | 20.4 | 22.1 | 36.6 | 1.4 | 9.33 | 35.6 | 49.7 | 14.3 | −2.66 | −25.3 | 5.1 | 9.2 | -3.1 |
|  |  |  | 20.6 | 22.6 | 44.0 | 1.6 | 8.08 | 42.5 | 51.1 | 16.2 | −2.51 | −25.1 | 4.5 | 9.7 | 2.6 |
| ZJ07 | 113.74 | 22.25 | 21.8 | 19.8 | 16.4 | 2.9 | 9.38 | 35.3 | 67.8 | 14.7 | −3.64 | −26.4 | 5.3 | 9.0 | -1.3 |
|  |  |  | 22.6 | 21.3 | 26.8 | 1.8 | 8.12 | 31.9 | 34.1 | 10.1 | −2.17 | −24.7 | 5.6 | 7.6 | -1.1 |
| ZJ08 | 113.76 | 22.14 | 22.5 | 18.5 | 16.8 | 2 | 8.85 | 34.3 | 58.8 | 11.8 | −3.25 | −25.0 | 5.3 | 8.0 | -0.8 |
|  |  |  | 22.2 | 26.2 | 26.4 | 1.6 | 7.79 | 28.8 | 26.5 | 6.7 | −0.82 | −24.6 | 6.5 | 8.2 | -0.6 |
| ZJ09 | 113.83 | 22.04 | 22.1 | 32.1 | 18.8 | 1.4 | 8.16 | 23.5 | 9.1 | 1.0 | 0.11 | −24.2 | 4.3 | 6.6 | -10.1 |
|  |  |  | 22.2 | 30.1 | 21.0 | 1.5 | 8.40 | 23.6 | 9.6 | 1.4 | 0.05 | −24.5 | 5.5 | 4.3 | -14.1 |
| Winter | GZ01 | 113.27 | 23.06 | 17.4 | 0.1 | 31 | 21.1 | 5.36 | 213.3 | 201.0 | 169.7 | −8.53 | −28.7 | 9.1 | 20.3 | -30.1 |
| GZ02 | 113.35 | 23.04 | 17.4 | 0.2 | 34.5 | 23.3 | 4.63 | 197.4 | 195.6 | 167.5 | −9.18 | −28.7 | 10.2 | 17.0 | -25.6 |
| GZ03 | 113.41 | 23.05 | 17.3 | 0.2 | 37 | 24.5 | 3.81 | 223.1 | 251.8 | 173.4 | −8.19 | −28.8 | 5.3 | 13.1 | -30.8 |
| GZ04 | 113.47 | 23.07 | 17.6 | 0.8 | 46 | 21.4 | 2.35 | 204.6 | 175.8 | 124.3 | −7.36 | −28.4 | 7.3 | 25.0 | -28.4 |
| HM01 | 113.53 | 22.98 | 16.2 | 3.2 | 9.8 | 3.4 | 4.22 | 58.2 | 75.1 | 23.5 | −6.74 | −30.1 | -0.5 | 36.6 | -20.9 |
|  |  |  | 15.6 | 6.2 | 29.7 | 2.5 | 4.43 | 80.9 | 107.8 | 34.6 | −6.38 | −29.5 | 0.2 | 29.4 | -21.5 |
| HM02 | 113.56 | 22.91 | 16.3 | 4.1 | 12 | 1.8 | 5.16 | 64.1 | 111.1 | 29.0 | −6.75 | −26.8 | -2.2 | 30.0 | -20.9 |
|  |  |  | 15.6 | 8.0 | 18.3 | 1.7 | 5.80 | 56.8 | 70.6 | 24.3 | −5.94 | −26.9 | -1.4 | 26.3 | -21.5 |
| ZJ00 | 113.58 | 22.83 | 16.1 | 5.5 | 14.7 | 2.4 | 6.25 | 62.0 | 30.4 | 20.6 | −6.13 | −26.9 | -0.1 | 26.0 | -21.9 |
|  |  |  | 15.6 | 13.4 | 27.0 | 1.4 | 6.66 | 58.1 | 72.7 | 43.1 | −4.99 | −26.0 | -1.5 | 20.4 | -21.1 |
| ZJ01 | 113.62 | 22.77 | 16.5 | 9.3 | 11.5 | 1 | 7.31 | 43.7 | 60.2 | 27.1 | −5.41 | −26.6 | -0.3 | 22.4 | -21.8 |
|  |  |  | 15.6 | 13.8 | 17.8 | 0.8 | 7.63 | 34.3 | 52.1 | 26.6 | −3.97 | −26.0 | -1.8 | 19.3 | -21.0 |
| ZJ02 | 113.69 | 22.69 | 18.2 | 13.8 | 5.8 | 2.3 | 7.47 | 36.4 | 44.7 | 32.5 | −4.60 | −26.7 | 5.6 | 18.3 | -21.4 |
|  |  |  | 16.7 | 15.6 | 10.2 | 1.8 | 7.63 | 35.8 | 60.2 | 35.6 | −4.28 | −26.2 | 4.0 | 18.1 | -20.3 |
| ZJ03 | 113.72 | 22.6 | 17 | 10.1 | 10.2 | 4.7 | 9.25 | 54.5 | 45.9 | 31.2 | −4.68 | −25.9 | 1.5 | 18.4 | -22.4 |
|  |  |  | 16.1 | 19.5 | 9.8 | 2.4 | 8.73 | 35.7 | 29.8 | 22.9 | −4.18 | −25.4 | -1.3 | 16.4 | -21.9 |
| ZJ04 | 113.75 | 22.52 | 17.4 | 22.7 | 24 | 11.3 | 9.74 | 93.4 | 34.3 | 21.1 | −3.53 | −24.5 | 0.8 | 19.3 | -21.8 |
|  |  |  | 17.1 | 20.9 | 15.3 | 6.3 | 8.52 | 56.2 | 27.9 | 21.7 | −2.25 | −24.6 | 5.6 | 18.8 | -21.3 |
| ZJ05 | 113.75 | 22.44 | 17.7 | 18 | 12.4 | 8.2 | 9.99 | 68.6 | 31.7 | 29.8 | −2.65 | −23.7 | 0.8 | 12.4 | -21.9 |
|  |  |  | 17.5 | 22.4 | 45.3 | 3.7 | 8.85 | 67.4 | 23.0 | 10.5 | −1.71 | −24.1 | 3.8 | 15.3 | -21.7 |
| ZJ06 | 113.74 | 22.35 | 18 | 19.8 | 11.1 | 8.1 | 9.74 | 75.2 | 31.9 | 27.6 | −3.01 | −24.7 | -0.5 | 17.8 | -21.4 |
|  |  |  | 17.3 | 22.4 | 15.1 | 8.4 | 8.93 | 63.1 | 29.8 | 19.7 | −1.94 | −23.6 | 1.5 | 17.5 | -20.2 |
| ZJ07 | 113.74 | 22.25 | 18.4 | 27.7 | 7.2 | 4.2 | 9.17 | 59.7 | 23.7 | 9.7 | −1.42 | −23.3 | 1.5 | 13.9 | -18.7 |
|  |  |  | 18.0 | 22.7 | 8.0 | 3.6 | 9.05 | 51.5 | 17.1 | 27.6 | −1.48 | −24.0 | 3.3 | 18.8 | -18.0 |
| ZJ08 | 113.76 | 22.14 | 17.3 | 25.7 | 20 | 2.6 | 8.48 | 40.4 | 2.4 | 1.4 | 0.08 | −22.0 | 4.3 | 9.4 | -15.5 |
|  |  |  | 16.9 | 32.4 | 6.8 | 3.5 | 8.69 | 36.3 | 3.0 | 1.3 | 0.27 | −21.3 | 5.3 | 8.3 | -15.1 |
| ZJ09 | 113.83 | 22.04 | 16.6 | 33.3 | 4.6 | 1.5 | 8.69 | 37.5 | 2.3 | 0.5 | 0.28 | −23.3 | 8.6 | 7.4 | -14.6 |
|  |  |  | 16.3 | 33.3 | 5.8 | 1.4 | 8.44 | 33.4 | 3.4 | 9.72 | 0.14 | −23.4 | 7.7 | 6.5 | -8.2 |
| Spring | HM01 | 113.53 | 22.98 | 24.1 | 0.1 | 55.3 | 7.8 | 3.63 | 227.6 | 126.1 | 51.9 | −11.29 | −26.5 | 7.4 | 16.5 | -19.9 |
|  |  |  | 23.6 | 0.1 | 107.0 | 8.6 | 3.03 | 374.0 | 100.7 | 44.3 | −11.5 | −25.8 | 7.2 | 16.1 | -20.3 |
| HM02 | 113.56 | 22.91 | 24.0 | 0.1 | 24 | 5.4 | 3.63 | 106.5 | 119.2 | 42.3 | −11.62 | −25.8 | 5.8 | 18.5 | -21.1 |
|  |  |  | 23.6 | 0.1 | 37.3 | 5.5 | 3.43 | 141.5 | 98.4 | 39.1 | −11.79 | −25.8 | 6.0 | 18.2 | -22.1 |
| ZJ00 | 113.58 | 22.83 | 24.1 | 0.1 | 20.5 | 3.2 | 3.55 | 94.8 | 65.0 | 30.0 | −11.22 | −25.9 | 5.4 | 18.6 | -24.8 |
|  |  |  | 23.6 | 0.1 | 48.7 | 6.7 | 3.07 | 159.5 | 117.9 | 32.4 | −11.75 | −25.7 | 4.8 | 15.8 | -25.6 |
| ZJ01 | 113.62 | 22.77 | 24 | 0.3 | 29 | 4.6 | 4.02 | 100.1 | 68.4 | 32.9 | −11.09 | −26.2 | 5.8 | 17.2 | -24.6 |
|  |  |  | 23.7 | 0.3 | 44.7 | 5.4 | 3.82 | 140.3 | 126.2 | 58.5 | −11.19 | −25.6 | 4.9 | 16.5 | -25.3 |
| ZJ02 | 113.69 | 22.69 | 25.4 | 1.6 | 31 | 3.6 | 5.6 | 76.0 | 129.4 | 18.4 | −10.01 | −26.3 | 5.7 | 16.2 | -23.5 |
|  |  |  | 24.9 | 2.0 | 42.5 | 3.3 | 4.97 | 78.4 | 99.6 | 24.6 | −9.65 | −26.0 | 5.8 | 17.3 | -24.2 |
| ZJ03 | 113.72 | 22.6 | 25.5 | 3.2 | 31 | 2.8 | 6.39 | 62.4 | 106.8 | 21.6 | −9.28 | −26.1 | 3.1 | 18.3 | -22.8 |
|  |  |  | 25.1 | 2.6 | 32.0 | 2.3 | 5.64 | 66.5 | 66.7 | 25.6 | −9.19 | −25.4 | 5.1 | 18.8 | -23.2 |
| ZJ04 | 113.75 | 22.52 | 25.5 | 6 | 42.5 | 1.1 | 5.48 | 64.7 | 39.7 | 32.0 | −7.97 | −25.5 | 9.1 | 16.8 | -22.6 |
|  |  |  | 25.1 | 5.6 | 64.0 | 1.1 | 5.52 | 73.0 | 74.4 | 29.2 | −7.77 | −24.8 | 5.6 | 16.9 | -22.7 |
| ZJ05 | 113.75 | 22.44 | 25.8 | 4.5 | 19.5 | 2.2 | 6.54 | 56.2 | 35.2 | 8.8 | −8.59 | −26.5 | 5.0 | 22.5 | -23.1 |
|  |  |  | 25.2 | 10.0 | 36.0 | 0.8 | 5.56 | 54.8 | 43.9 | 20.1 | −6.43 | −24.4 | 5.4 | 17.7 | -21.9 |
| ZJ06 | 113.74 | 22.35 | 25.9 | 4.2 | 23.5 | 2.3 | 5.99 | 56.7 | 57.4 | 15.1 | −8.16 | −25.8 | 4.5 | 20.2 | -19.4 |
|  |  |  | 25.6 | 6.6 | 39.5 | 1.5 | 5.68 | 67.5 | 68.7 | 26.8 | −6.99 | −24.6 | 5.5 | 17.9 | -20.8 |
| ZJ07 | 113.74 | 22.25 | 26.5 | 9.4 | 40 | 1.5 | 6.94 | 64.6 | 63.0 | 14.0 | −6.4 | −24.8 | 4.4 | 17.4 | -19.2 |
|  |  |  | 25.9 | 11.9 | 84.7 | 1.6 | 6.07 | 111.6 | 26.4 | 21.3 | −5.75 | −23.8 | 9.2 | 18.3 | -18.5 |
| ZJ08' | 113.79 | 22.09 | 26.3 | 12.5 | 12 | 4.5 | 7.49 | 42.9 | 53.7 | 18.3 | −4.88 | −24.7 | 5.1 | 18.8 | -20.2 |
|  |  |  | 25.4 | 19.0 | 22.4 | 4.3 | 6.70 | 41.7 | 32.9 | 9.2 | −2.68 | −23.4 | 4.2 | 17.4 | -19.3 |
| ZJ09' | 113.93 | 21.94 | 26.3 | 15.2 | 13.6 | 5.1 | 7.88 | 52.6 | 56.7 | 18.7 | −3.94 | −25.0 | 3.7 | 18.3 | -21.0 |
|  |  |  | 24.8 | 30.1 | 25.2 | 1.6 | 6.46 | 31.5 | 11.4 | 2.9 | −0.63 | −22.7 | 3.8 | 20.4 | -21.5 |
| Summer | HM01 | 113.53 | 22.98 | 31.9 | 0.1 | 19.7 | 30.1 | 7.49 | 115.7 | 108.3 | 23.5 | −9.56 | −29.7 | 9.9 | −8.8 | -4.0 |
|  |  |  | 31.8 | 0.1 | 38.2 | 33.9 | 6.07 | 145.2 | 102.5 | 12.7 | −9.64 | −28.7 | 10.5 | 3.2 | -3.5 |
| HM02 | 113.56 | 22.91 | 31.3 | 0.1 | 39.2 | 40.4 | 6.74 | 205.8 | 119.4 | 15.5 | −8.88 | −30.1 | 8.9 | −3.2 | -15.1 |
|  |  |  | 31.5 | 0.1 | 72.0 | 43.5 | 5.74 | 246.5 | 129.9 | 27.9 | −8.40 | −29.5 | 9.5 |  | -14.5 |
| ZJ00 | 113.58 | 22.83 | 31.4 | 0.1 | 27.8 | 35.1 | 4.73 | 160.7 | 109.9 | 22.6 | −8.88 | −29.6 | 8.3 | −5.9 | -20.9 |
|  |  |  | 31.3 | 0.1 | 34.4 | 39.8 | 4.34 | 139.0 | 114.9 | 14.7 | −8.06 | −29.5 | 8.1 | 4.6 | -22.7 |
| ZJ01 | 113.62 | 22.77 | 31.1 | 0.1 | 20.2 | 31 | 5.53 | 146.0 | 124.2 | 15.7 | −9.24 | −29.5 | 5.8 | 3.4 | -23.4 |
|  |  |  | 31.1 | 0.2 | 23.2 | 25.4 | 4.49 | 135.1 | 123.2 | 15.9 | −9.54 | −29.5 | 5.1 | 4.4 | -23.1 |
| ZJ02 | 113.69 | 22.69 | 31.1 | 2.1 | 18.7 | 8.1 | 4.77 | 55.7 | 38.1 | 5.3 | −9.50 | −28.4 | 5.5 | 3.8 | -15.4 |
|  |  |  | 31.1 | 2.1 | 20.2 | 7.1 | 4.57 | 59.4 | 77.8 | 8.5 | −9.36 | −28.6 | 5.5 | 5.6 | -14.6 |
| ZJ03 | 113.72 | 22.6 | 31.3 | 2.7 | 14.6 | 6 | 5.48 | 49.3 | 71.8 | 2.0 | −8.98 | −28.0 | 6.2 | −1.4 | -13.4 |
|  |  |  | 31.3 | 3.8 | 16.4 | 6.6 | 5.56 | 55.1 | 109.2 | 5.1 | −9.11 | −28.9 | 5.6 | 4.6 | -13.6 |
| ZJ04 | 113.75 | 22.52 | 30.5 | 3.2 | 16.2 | 3.7 | 5.87 | 41.2 | 21.2 | 6.6 | −9.15 | −28.0 | 6.1 | 1.9 | -7.4 |
|  |  |  | 30.2 | 8.8 | 21.6 | 2.3 | 4.57 | 39.1 | 73.4 | 12.1 | −7.86 | −27.2 | 5.6 | 5.5 | 1.0 |
| ZJ05 | 113.75 | 22.44 | 30.4 | 3.9 | 11.1 | 4.2 | 6.19 | 44.6 | 52.1 | 0.8 | −8.59 | −28.0 | 5.5 | 6.1 | -3.2 |
|  |  |  | 30.0 | 9.5 | 16.8 | 3.1 | 5.28 | 38.6 | 84.2 | 12.7 | −7.29 | −27.9 | 5.8 | 1.8 | 0.5 |
| ZJ06 | 113.74 | 22.35 | 30.4 | 3.4 | 7.6 | 3.3 | 6.46 | 36.7 | 78.9 | 1.5 | −8.69 | −27.4 | 5.3 | 1.2 | -0.6 |
|  |  |  | 30.0 | 9.0 | 12.6 | 2.7 | 4.97 | 34.4 | 39.6 | 12.1 | −6.65 | −27.1 | 5.6 | 4.9 | 0.5 |
| ZJ07 | 113.74 | 22.25 | 30.9 | 9.2 | 9.6 | 5.9 | 6.78 | 46.4 | 60.3 | 2.1 | −6.40 | −29.2 | 4.5 | 2.9 | -0.7 |
|  |  |  | 29.8 | 16.5 | 16.4 | 3.8 | 5.56 | 45.8 | 42.5 | 2.6 | −5.28 | −27.4 | 6.4 | 4.7 | -1.1 |
| ZJ08' | 113.79 | 22.09 | 29.9 | 12.1 | 7.4 | 3.7 | 7.33 | 39.8 | 63.1 | 5.9 | −5.42 | −27.5 | 5.7 | 5.1 | -5.3 |
|  |  |  | 28.0 | 22.1 | 14.4 | 2.9 | 4.47 | 32.8 | 22.8 | 2.2 | −2.13 | −24.7 | 5.5 | 6.9 | -4.8 |
| ZJ09' | 113.93 | 21.94 | 30.1 | 16.4 | 10.2 | 5.7 | 7.17 | 64.8 | 29.3 | 8.7 | −2.50 | −24.1 | 6.9 | 4.1 | -8.0 |
|  |  |  | 27.1 | 30.7 | 15.4 | 2.2 | 6.03 | 31.8 | 4.4 | 1.5 | −0.08 | −22.1 | 9.6 | 2.2 | -9.9 |