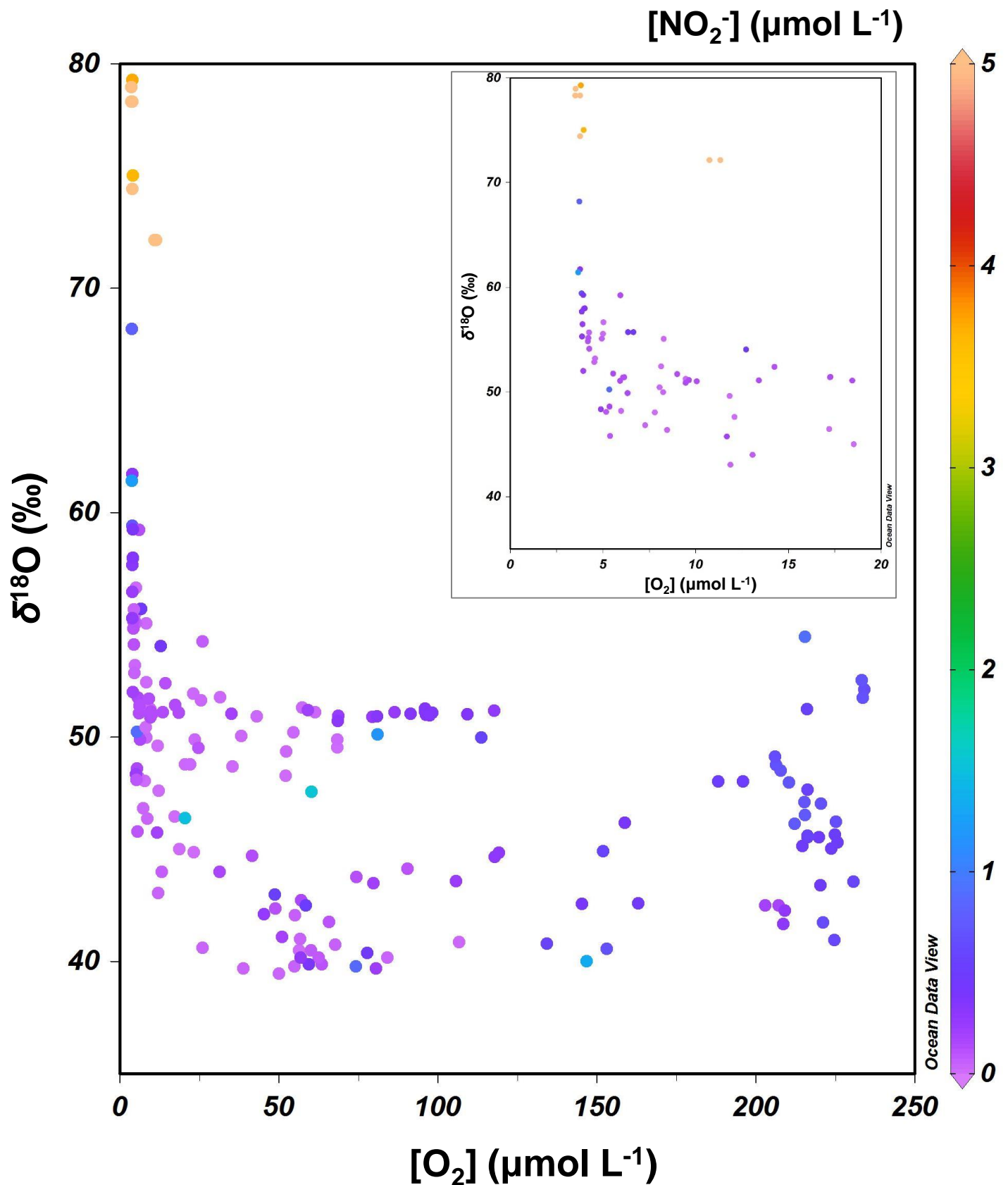


**Figure S1** Linear regression of  $\text{N}_2\text{O}$  isotopomers vs. inverse  $\text{N}_2\text{O}$  concentrations at four different water bodies (see table 1 for descriptions of water bodies).



**Figure S2** Dissolved oxygen concentrations vs.  $\delta^{18}\text{O}$ - $\text{N}_2\text{O}$  and associated nitrite concentrations from samples collected in October 2015.

| Station<br>(depth range) | Year /<br>Month | Latitude | Longitude | Reference               |
|--------------------------|-----------------|----------|-----------|-------------------------|
| A<br>(0 – 1000 m)        | 2015 / 10       | 0        | 85.50°W   | This study              |
|                          | 2012 / 11       | 0        | 85.83°W   | Kock et al., 2016       |
| B<br>(0 – 800 m)         | 2015 / 10       | 2.50°S   | 85.50°W   | This study              |
|                          | 2012 / 11       | 2.00°S   | 85.83°W   | Kock et al., 2016       |
| C<br>(0 – 800 m)         | 2015 / 10       | 9.51°S   | 80.31°W   | This study              |
|                          | 2012 / 11       | 9.93°S   | 80.25°W   | Kock et al., 2016       |
| D<br>(0 – 70 m)          | 2015 / 10       | 12.25°S  | 77.08°W   | This study              |
|                          | 2011 / 10       | 12.05°S  | 77.29°W   | Baustian et al., 2012   |
| E<br>(0 – 100 m)         | 2015 / 01       | 13.50°S  | 76.60°W   | Ji, unpublished data    |
|                          | 2009 / 01       | 13.50°S  | 76.46°W   | Löscher et al., 2012    |
| F<br>(0 – 250 m)         | 2015 / 01       | 16.30°S  | 73.90°W   | Ji, unpublished data    |
|                          | 1985 / 02       | 16.38°S  | 74.67°W   | Friederich et al., 1985 |

**Table S1** Data sources for water column N<sub>2</sub>O distributions between El Niño (shaded rows) and normal years. All the data can be downloaded from MEMENTO database (doi:10.1029/2015EO023665)

## References

- Baustian**, Tina, Graco, M., Bange, H. W., Flores, G., Ledesma, J., Sarmiento, M., Leon, V., Robles, C. and Moron, O. (2012). Nitrous Oxide Time Series Measurements off Peru – a collaboration between SFB 754 and IMARPE – Annual Report 2011. GEOMAR Report, N. Ser. 002 . GEOMAR Helmholtz-Zentrum für Ozeanforschung, Kiel, Germany, 17 pp. DOI 10.3289/GEOMAR\_REP\_NS\_2\_2012.
- Friederich**, G. E., Kelly, P. J., Codispoti, L. A., Spinrad, R. W., Kullenberg, G., Elkins, J. W., Kogelschatz, J., Packard, T. T., Lipschultz, F., Glover, H. E., Ward, B. B., and Smith, A. E. (1985) Microbial nitrogen transformations in the oxygen minimum zone off Peru., Bigelow Laboratory for Ocean Sciences, East Boothbay, ME
- Kock**, A., Arévalo-Martínez, D. L., Löscher, C. R., and Bange, H. W. (2016). Extreme N<sub>2</sub>O accumulation in the coastal oxygen minimum zone off Peru, *Biogeosciences*, 13, 827-840, 10.5194/bg-13-827-2016, DOI:10.5194/bg-13-827-2016
- Löscher**, C. R., Kock, A., Kanneke, M., LaRoche, J., Bange, H. W., and Schmitz, R. A. (2012). Production of oceanic nitrous oxide by ammonia-oxidizing archaea, *Biogeosciences*, 9, 2419-2429, 10.5194/bg-9-2419-2012, DOI,10.5194/bg-9-2419-2012