



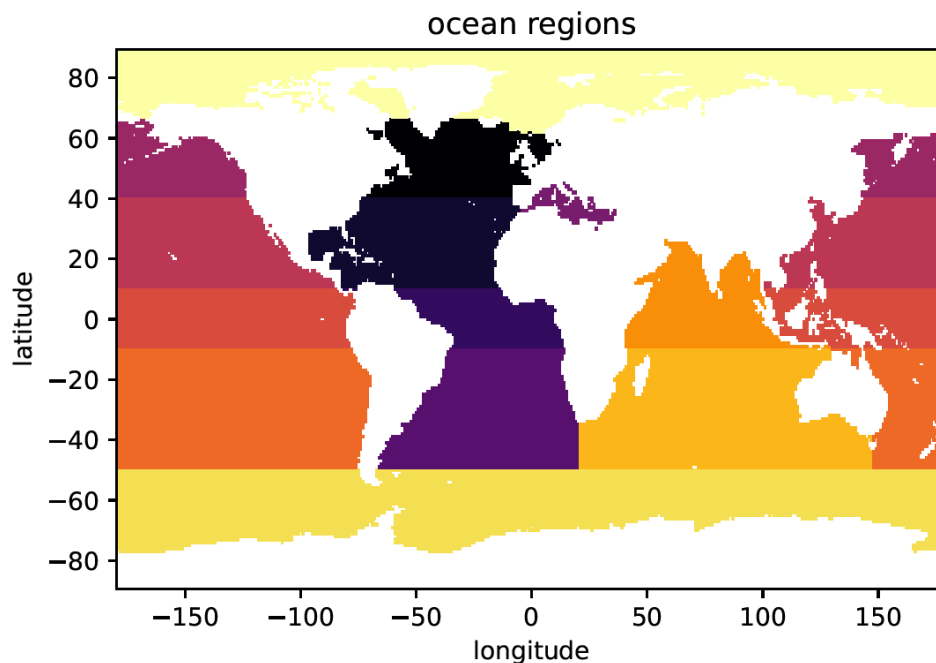
*Supplement of*

## **Underestimation of multi-decadal global O<sub>2</sub> loss due to an optimal interpolation method**

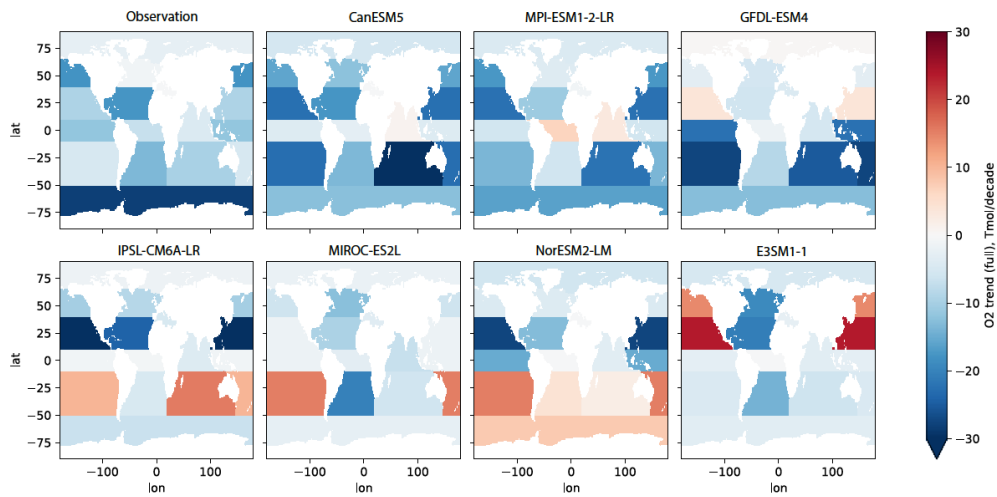
**Takamitsu Ito et al.**

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**Figure S1.** Ocean regions used in the inventory calculations. The global ocean is divided into 13 regions including [1] Subpolar North Atlantic (SPNA), [2] Subtropical North Atlantic (STNA), [3] Equatorial Atlantic (EQAT), [4] Subtropical South Atlantic (STSA), [5] Mediterranean Sea (MED), [6] Subpolar North Pacific (SPNP), [7] Subtropical North Pacific (STNP), [8] Equatorial Pacific (EQPA), [9] Subtropical South Pacific (STSP), [10] Equatorial Indian Ocean (EQID), [11] Subtropical South Indian Ocean (STSI), [12] Southern Ocean (SO), [13] Arctic Ocean (AO).

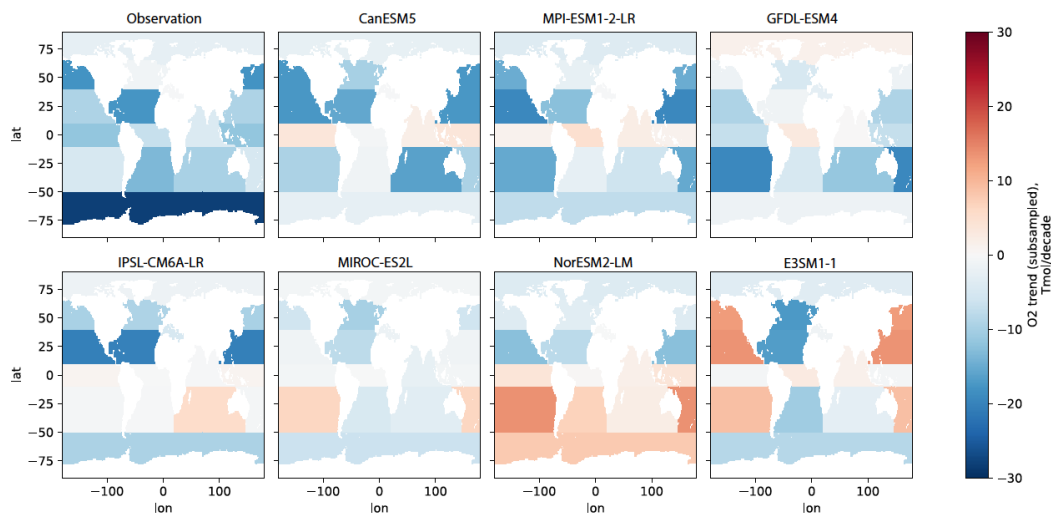


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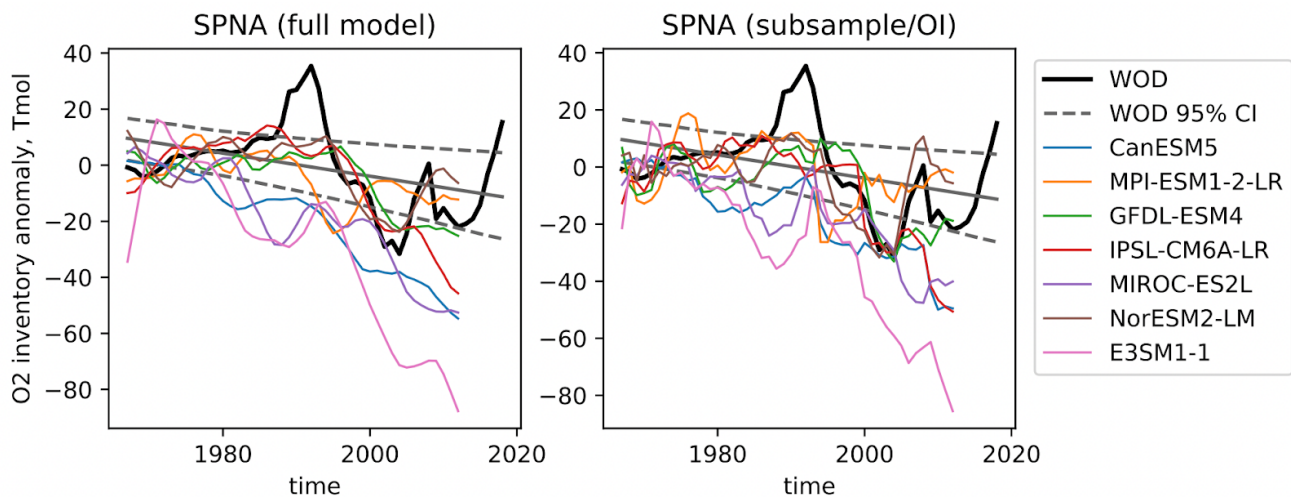
**Figure S2.** Observed and modeled basin-wise linear trend of the O<sub>2</sub> inventory from 1967 to 2014 from the observations and full model output. The global ocean is divided into 13 regions including Subpolar North Atlantic (SPNA), Subtropical North Atlantic (STNA), Equatorial Atlantic (EQAT), Subtropical South Atlantic (STSA), Mediterranean Sea (MED), Subpolar North Pacific (SPNP), Subtropical North Pacific (STNP), Equatorial Pacific (EQPA), Subtropical South Pacific (STSP), Equatorial Indian Ocean (EQID), Subtropical South Indian Ocean (STSI), Southern Ocean (SO), and Arctic Ocean (AO).

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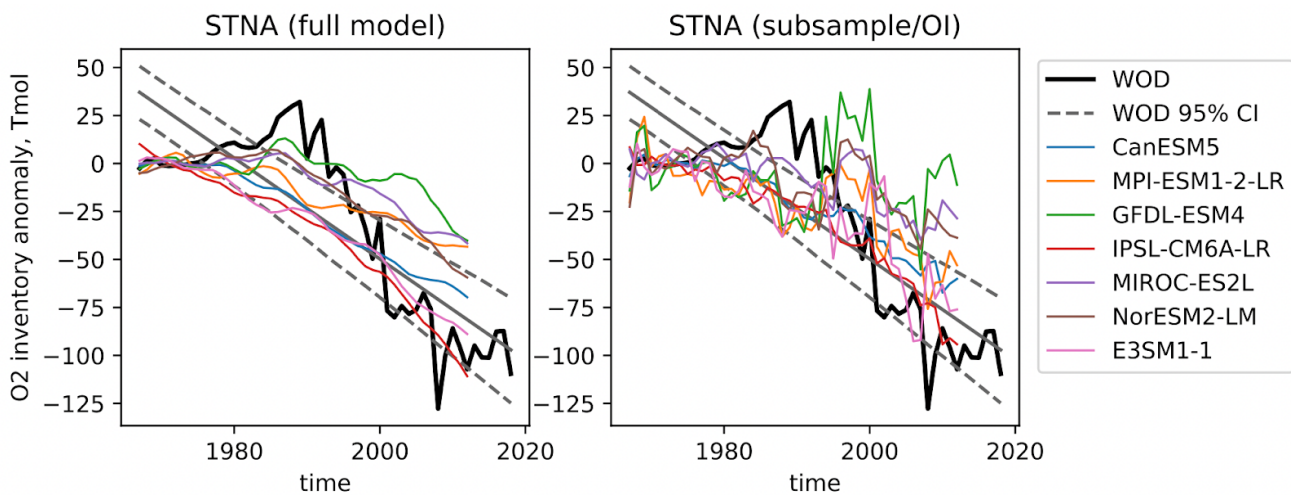


**Figure S3.** Same as Figure S2 but for the trend reconstructed from optimal interpolation of sub-sampled model output.

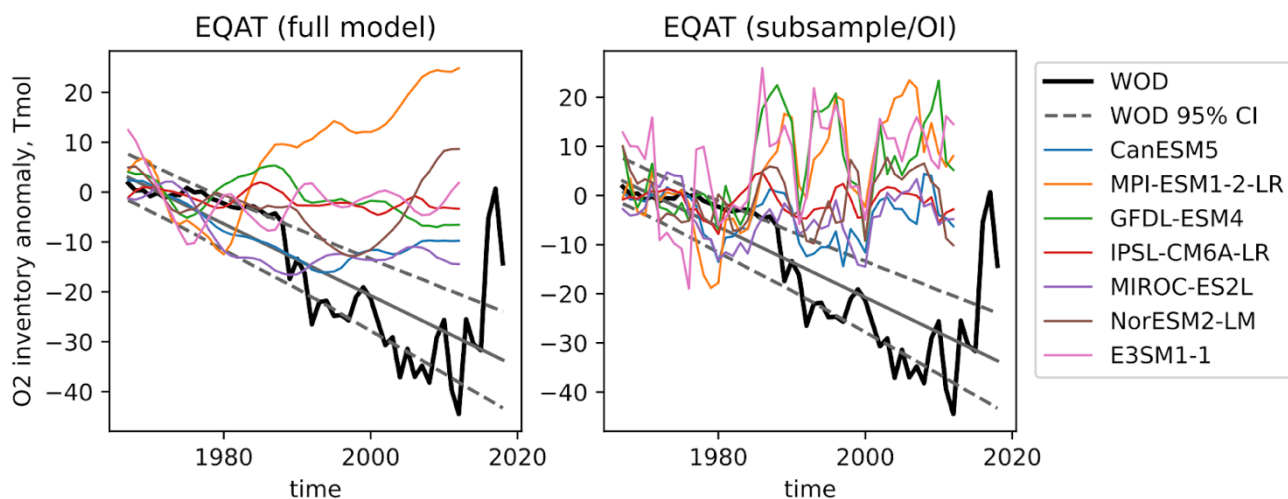
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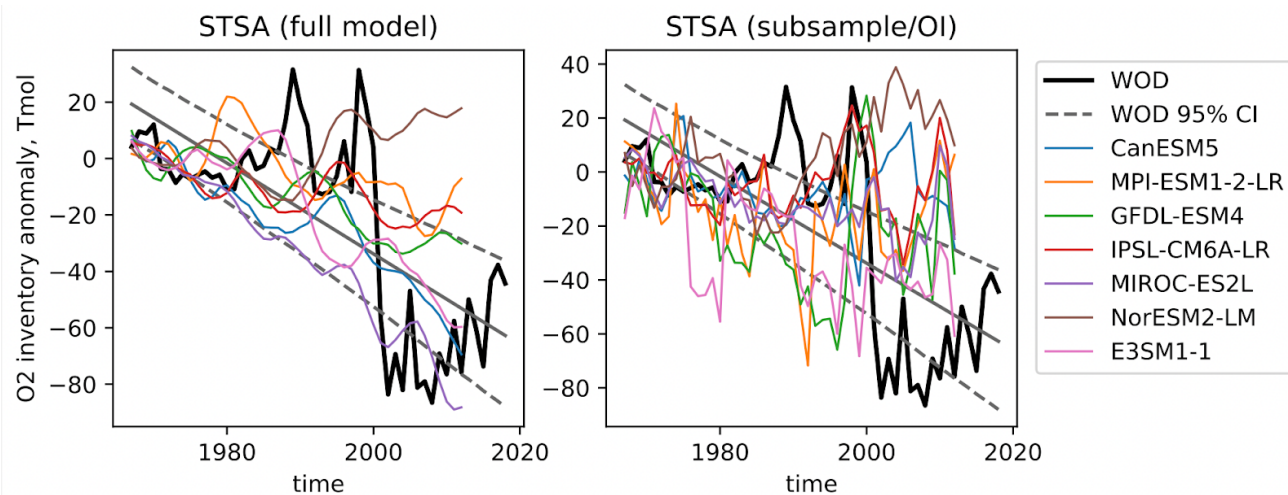
45 **Figure S4.** Time series of Subpolar North Atlantic (SPNA) upper ocean (0-1,000m) column O<sub>2</sub> inventory from World Ocean Database 2018 (black solid) and CMIP6 models (color) from (left) full model output and (right) subsampled and optimally interpolated model output.



50 **Figure S5.** Time series of Subtropical North Atlantic (STNA) upper ocean (0-1,000m) column O<sub>2</sub> inventory from World Ocean Database 2018 (black solid) and CMIP6 models (color) from (left) full model output and (right) subsampled and optimally interpolated model output.

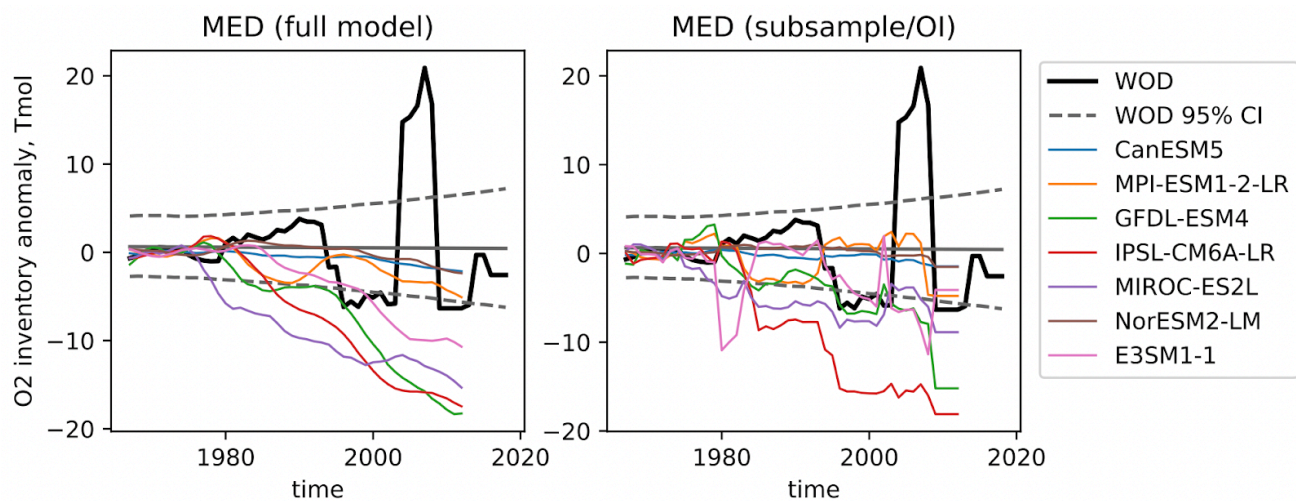


**Figure S6.** Time series of Equatorial Atlantic (EQAT) upper ocean (0-1,000m) column  $O_2$  inventory from World Ocean Database 2018 (black solid) and CMIP6 models (color) from (left) full model output and (right) subsampled and optimally interpolated model output.

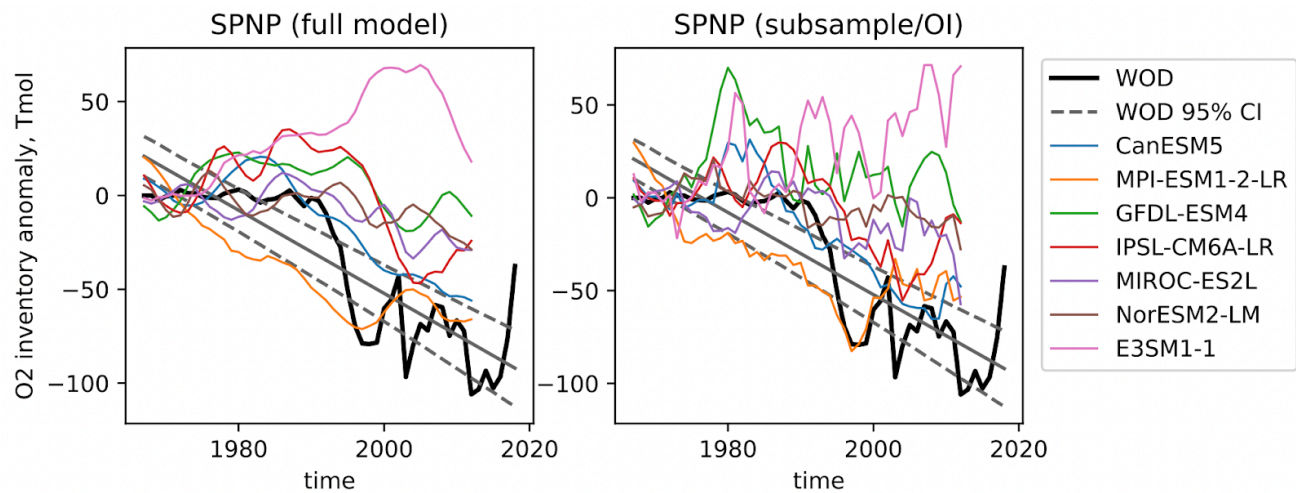


**Figure S7.** Time series of Subtropical South Atlantic (STSA) upper ocean (0-1,000m) column  $O_2$  inventory from World Ocean Database 2018 (black solid) and CMIP6 models (color) from (left) full model output and (right) subsampled and optimally interpolated model output.

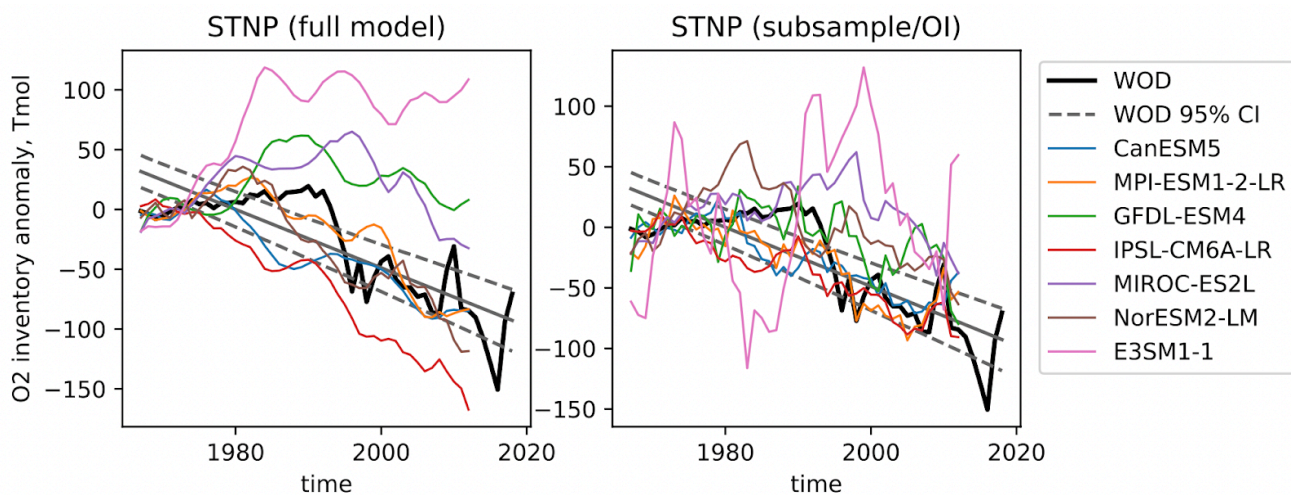




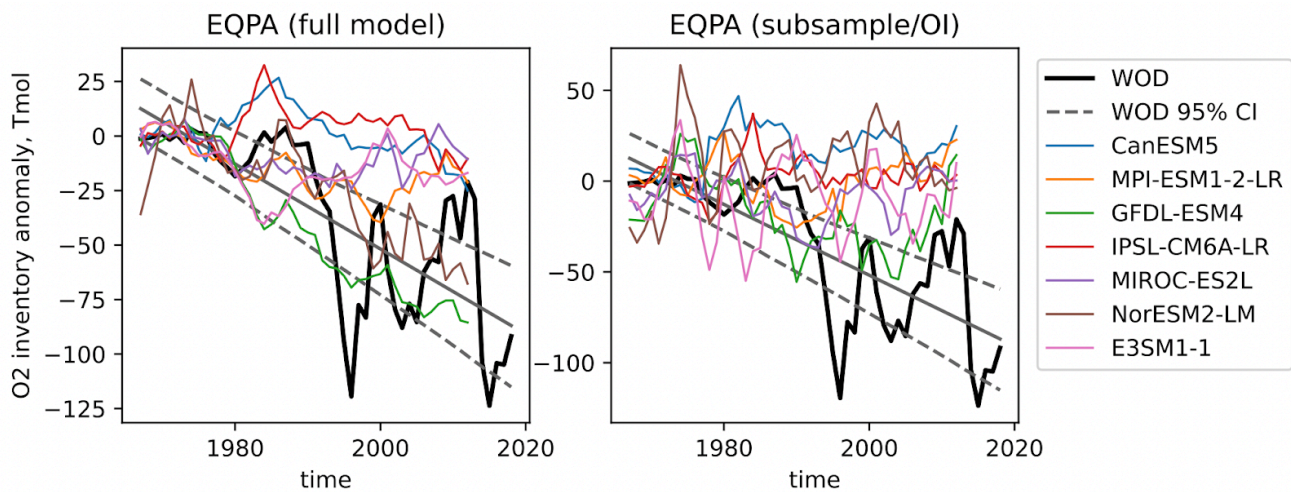
**Figure S8.** Time series of Mediterranean (MED) upper ocean (0-1,000m) column  $O_2$  inventory from World Ocean Database 2018 (black solid) and CMIP6 models (color) from (left) full model output and (right) subsampled and optimally interpolated model output.



**Figure S9.** Time series of Subpolar North Pacific (SPNP) upper ocean (0-1,000m) column  $O_2$  inventory from World Ocean Database 2018 (black solid) and CMIP6 models (color) from (left) full model output and (right) subsampled and optimally interpolated model output.

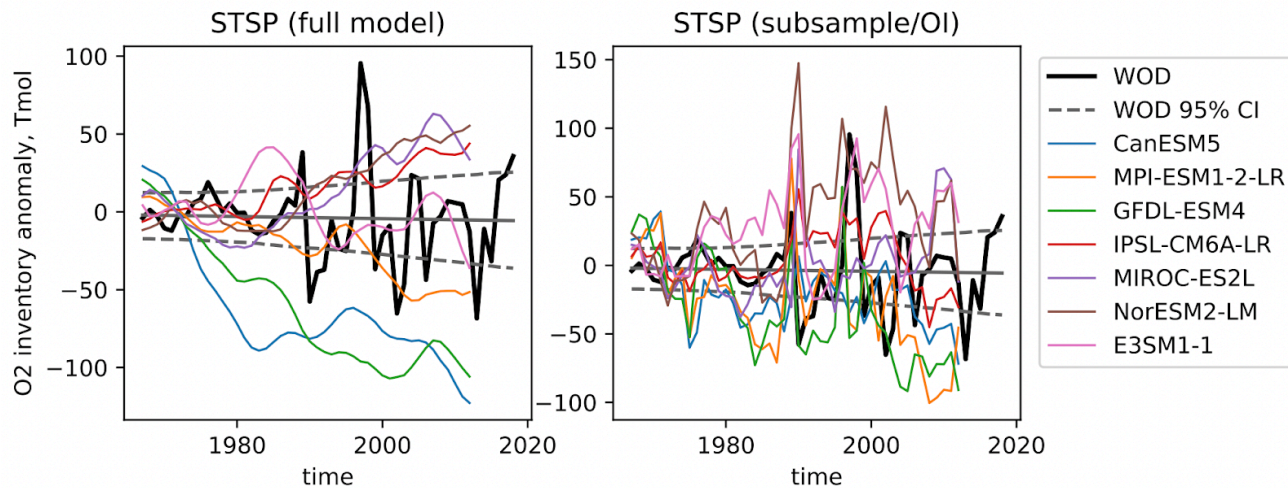


**Figure S10.** Time series of Subtropical North Pacific (STNP) upper ocean (0-1,000m) column O<sub>2</sub> inventory from World Ocean Database 2018 (black solid) and CMIP6 models (color) from (left) full model output and (right) subsampled and optimally interpolated model output.

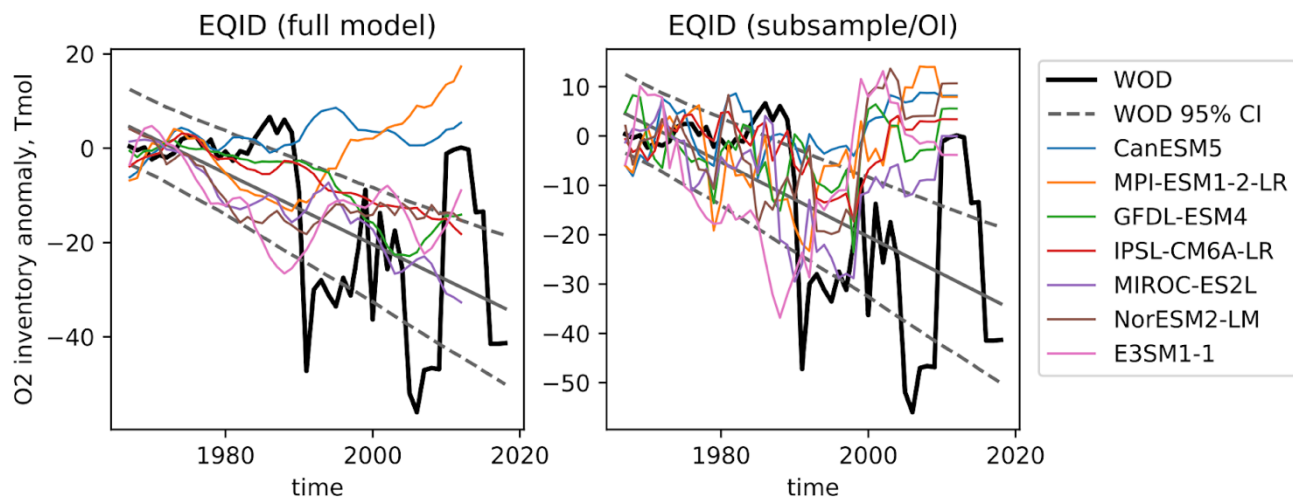


**Figure S11.** Time series of Equatorial Pacific (EQPA) upper ocean (0-1,000m) column O<sub>2</sub> inventory from World Ocean Database 2018 (black solid) and CMIP6 models (color) from (left) full model output and (right) subsampled and optimally interpolated model output.



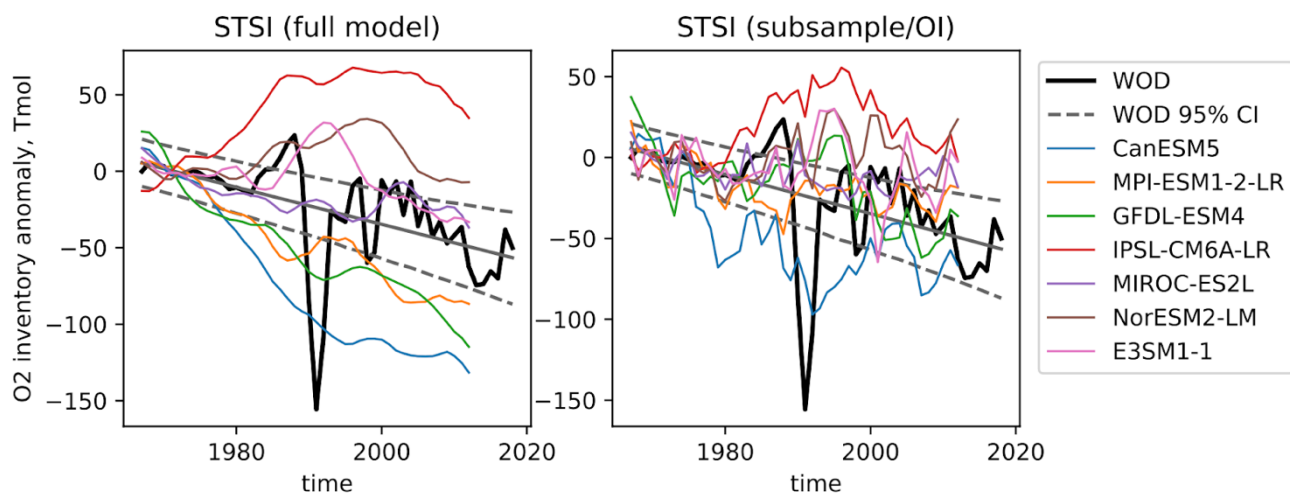


100 **Figure S12.** Time series of Subtropical South Pacific (STSP) upper ocean (0-1,000m) column O<sub>2</sub> inventory from World Ocean Database 2018 (black solid) and CMIP6 models (color) from (left) full model output and (right) subsampled and optimally interpolated model output.

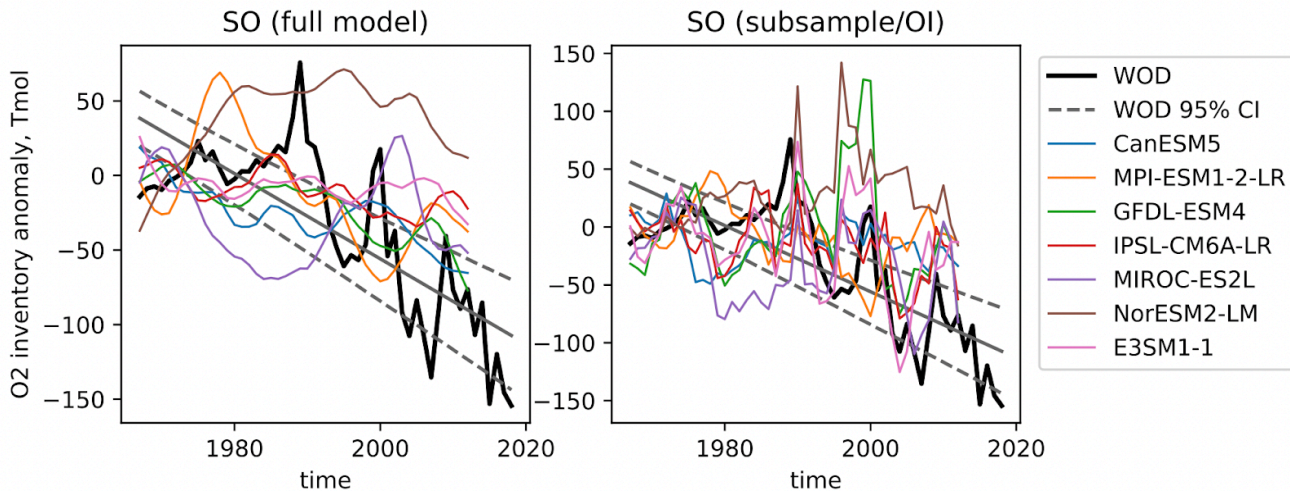


105 **Figure S13.** Time series of Equatorial Indian (EQID) upper ocean (0-1,000m) column O<sub>2</sub> inventory from World Ocean Database 2018 (black solid) and CMIP6 models (color) from (left) full model output and (right) subsampled and optimally interpolated model output.

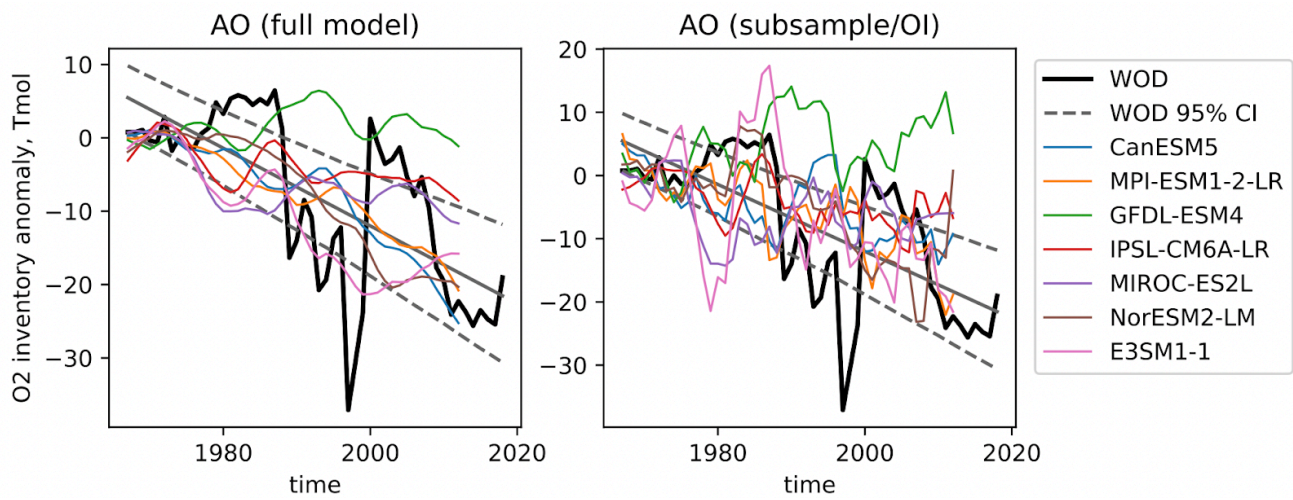




**Figure S14.** Time series of Subtropical South Indian (STSI) upper ocean (0-1,000m) column O<sub>2</sub> inventory from World Ocean Database 2018 (black solid) and CMIP6 models (color) from (left) full model output and (right) subsampled and optimally interpolated model output.



**Figure S15.** Time series of Southern Ocean (SO) upper ocean (0-1,000m) column O<sub>2</sub> inventory from World Ocean Database 2018 (black solid) and CMIP6 models (color) from (left) full model output and (right) subsampled and optimally interpolated model output.



**Figure S16.** Time series of Arctic Ocean (AO) upper ocean (0-1,000m) column O<sub>2</sub> inventory from World Ocean Database 2018 (black solid) and CMIP6 models (color) from (left) full model output and (right) subsampled and optimally interpolated model output.

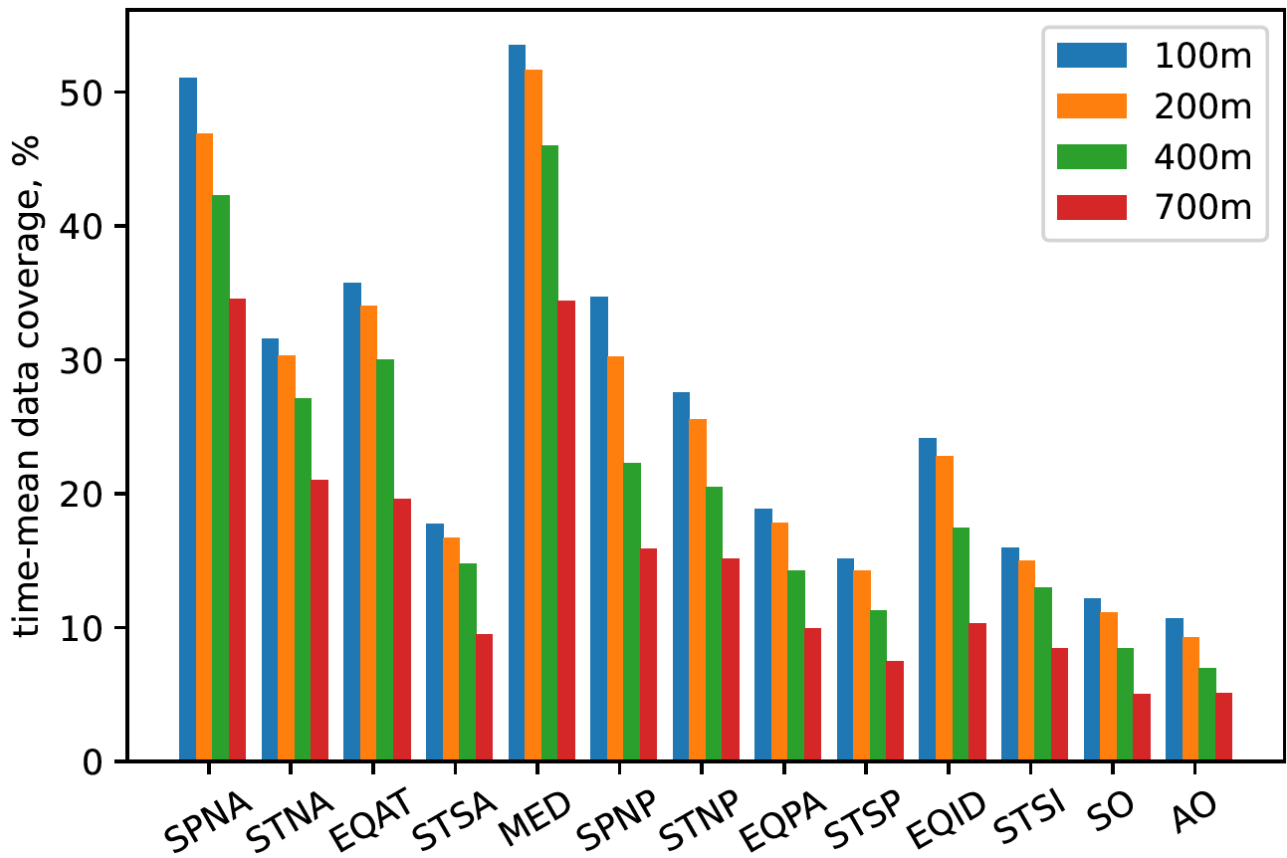


Figure S17. Time-mean data coverage for each basin at the depths of 100, 200, 400 and 700m.