**Supplementary information 3**

**Reliability of data layers estimated with cross-validation**

Table 1. Accuracy of marine data layers per depth range (Cor: Pearson’s correlation; RMSE: root mean square error; MAE: mean absolute error; additional estimates per depth in Supplement 3) assessed with in situ quality-control data. Bold values indicate the average accuracy across all depths.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Variable** | **Depth [from]** | **Depth [to]** | **MAE** | **RMSE** | **Cor** | **Cor. p-value** | **n** |
| Temperature | 0 | 24 | 0.096 | 0.934 | 0.996 | 0 | 70802 |
| Temperature | 25 | 49 | 0.189 | 1.059 | 0.996 | 0 | 32256 |
| Temperature | 50 | 74 | 0.189 | 1.114 | 0.995 | 0 | 31699 |
| Temperature | 75 | 99 | 0.160 | 1.065 | 0.995 | 0 | 24399 |
| Temperature | 100 | 149 | 0.176 | 1.083 | 0.994 | 0 | 44605 |
| Temperature | 150 | 199 | 0.095 | 0.939 | 0.993 | 0 | 31615 |
| Temperature | 200 | 249 | 0.227 | 1.004 | 0.991 | 0 | 25915 |
| Temperature | 250 | 499 | 0.048 | 0.728 | 0.991 | 0 | 103276 |
| Temperature | 500 | 999 | 0.034 | 0.556 | 0.983 | 0 | 133876 |
| Temperature | 1000 | 2499 | 0.082 | 0.252 | 0.988 | 0 | 196493 |
| Temperature | 2500 | 4999 | 0.258 | 0.314 | 0.979 | 0 | 128595 |
| **Temperature** | **0** | **4999** | **0.141** | **0.823** | **0.991** | **-** | **823531** |
| Salinity | 0 | 24 | 0.045 | 0.685 | 0.937 | 0 | 71442 |
| Salinity | 25 | 49 | 0.048 | 0.437 | 0.959 | 0 | 32249 |
| Salinity | 50 | 74 | 0.009 | 0.265 | 0.978 | 0 | 31698 |
| Salinity | 75 | 99 | 0.008 | 0.227 | 0.977 | 0 | 24395 |
| Salinity | 100 | 149 | 0.004 | 0.215 | 0.975 | 0 | 44589 |
| Salinity | 150 | 199 | 0.003 | 0.181 | 0.975 | 0 | 31613 |
| Salinity | 200 | 249 | 0.002 | 0.161 | 0.972 | 0 | 25915 |
| Salinity | 250 | 499 | 0.005 | 0.102 | 0.980 | 0 | 103268 |
| Salinity | 500 | 999 | 0.000 | 0.067 | 0.985 | 0 | 133903 |
| Salinity | 1000 | 2499 | 0.001 | 0.035 | 0.988 | 0 | 196506 |
| Salinity | 2500 | 4999 | 0.002 | 0.014 | 0.993 | 0 | 128595 |
| **Salinity** | **0** | **4999** | **0.012** | **0.217** | **0.974** | **-** | **824173** |
| Silicate | 0 | 24 | 2.795 | 10.177 | 0.860 | 0 | 45186 |
| Silicate | 25 | 49 | 3.797 | 11.361 | 0.873 | 0 | 23691 |
| Silicate | 50 | 74 | 2.864 | 11.107 | 0.891 | 0 | 23606 |
| Silicate | 75 | 99 | 2.433 | 11.317 | 0.915 | 0 | 18868 |
| Silicate | 100 | 149 | 0.470 | 9.849 | 0.914 | 0 | 35207 |
| Silicate | 150 | 199 | 0.658 | 9.742 | 0.927 | 0 | 24910 |
| Silicate | 200 | 249 | 1.034 | 9.747 | 0.933 | 0 | 20543 |
| Silicate | 250 | 499 | 0.499 | 9.647 | 0.949 | 0 | 80183 |
| Silicate | 500 | 999 | 1.080 | 9.621 | 0.970 | 0 | 105331 |
| Silicate | 1000 | 2499 | 1.632 | 5.796 | 0.995 | 0 | 159154 |
| Silicate | 2500 | 4999 | 2.117 | 5.957 | 0.994 | 0 | 108816 |
| **Silicate** | **0** | **4999** | **1.762** | **9.484** | **0.929** | **-** | **645495** |
| Phosphate | 0 | 24 | 0.062 | 0.215 | 0.937 | 0 | 42838 |
| Phosphate | 25 | 49 | 0.059 | 0.225 | 0.940 | 0 | 22547 |
| Phosphate | 50 | 74 | 0.023 | 0.234 | 0.939 | 0 | 22211 |
| Phosphate | 75 | 99 | 0.007 | 0.246 | 0.938 | 0 | 17773 |
| Phosphate | 100 | 149 | 0.009 | 0.272 | 0.930 | 0 | 33866 |
| Phosphate | 150 | 199 | 0.019 | 0.295 | 0.925 | 0 | 23590 |
| Phosphate | 200 | 249 | 0.003 | 0.300 | 0.924 | 0 | 19666 |
| Phosphate | 250 | 499 | 0.015 | 0.274 | 0.936 | 0 | 76907 |
| Phosphate | 500 | 999 | 0.018 | 0.187 | 0.965 | 0 | 100809 |
| Phosphate | 1000 | 2499 | 0.044 | 0.084 | 0.995 | 0 | 149725 |
| Phosphate | 2500 | 4999 | 0.043 | 0.069 | 0.995 | 0 | 102271 |
| **Phosphate** | **0** | **4999** | **0.028** | **0.218** | **0.948** | **-** | **612203** |
| Oxygen | 0 | 24 | 0.051 | 18.103 | 0.964 | 0 | 46596 |
| Oxygen | 25 | 49 | 0.680 | 21.192 | 0.950 | 0 | 20959 |
| Oxygen | 50 | 74 | 4.376 | 25.662 | 0.916 | 0 | 21253 |
| Oxygen | 75 | 99 | 4.936 | 28.425 | 0.893 | 0 | 16287 |
| Oxygen | 100 | 149 | 7.236 | 31.013 | 0.890 | 0 | 31140 |
| Oxygen | 150 | 199 | 8.903 | 33.765 | 0.895 | 0 | 22136 |
| Oxygen | 200 | 249 | 8.154 | 33.936 | 0.900 | 0 | 18312 |
| Oxygen | 250 | 499 | 6.180 | 32.985 | 0.918 | 0 | 73767 |
| Oxygen | 500 | 999 | 6.422 | 25.869 | 0.955 | 0 | 93847 |
| Oxygen | 1000 | 2499 | 4.632 | 17.054 | 0.980 | 0 | 131748 |
| Oxygen | 2500 | 4999 | 5.868 | 14.127 | 0.973 | 0 | 82675 |
| **Oxygen** | **0** | **4999** | **5.222** | **25.648** | **0.930** | **-** | **558720** |
| Nitrate | 0 | 24 | 0.650 | 2.876 | 0.939 | 0 | 45083 |
| Nitrate | 25 | 49 | 0.822 | 3.261 | 0.934 | 0 | 23519 |
| Nitrate | 50 | 74 | 0.311 | 3.350 | 0.937 | 0 | 23340 |
| Nitrate | 75 | 99 | 0.028 | 3.547 | 0.936 | 0 | 18631 |
| Nitrate | 100 | 149 | 0.426 | 3.702 | 0.932 | 0 | 35300 |
| Nitrate | 150 | 199 | 0.659 | 3.975 | 0.931 | 0 | 24696 |
| Nitrate | 200 | 249 | 0.564 | 4.294 | 0.922 | 0 | 20582 |
| Nitrate | 250 | 499 | 0.354 | 4.014 | 0.930 | 0 | 80493 |
| Nitrate | 500 | 999 | 0.000 | 2.679 | 0.959 | 0 | 105595 |
| Nitrate | 1000 | 2499 | 0.632 | 1.204 | 0.995 | 0 | 157765 |
| Nitrate | 2500 | 4999 | 0.691 | 1.002 | 0.995 | 0 | 107129 |
| **Nitrate** | **0** | **4999** | **0.467** | **3.082** | **0.946** | **-** | **642133** |

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Fig S1. Spatial distribution of the error of ocean temperature (ºC) shown as the average difference between the interpolated and *in situ* data (aggregated to a 2.5º resolution for better visualization). White cell represents areas for which no *in situ* data is available.

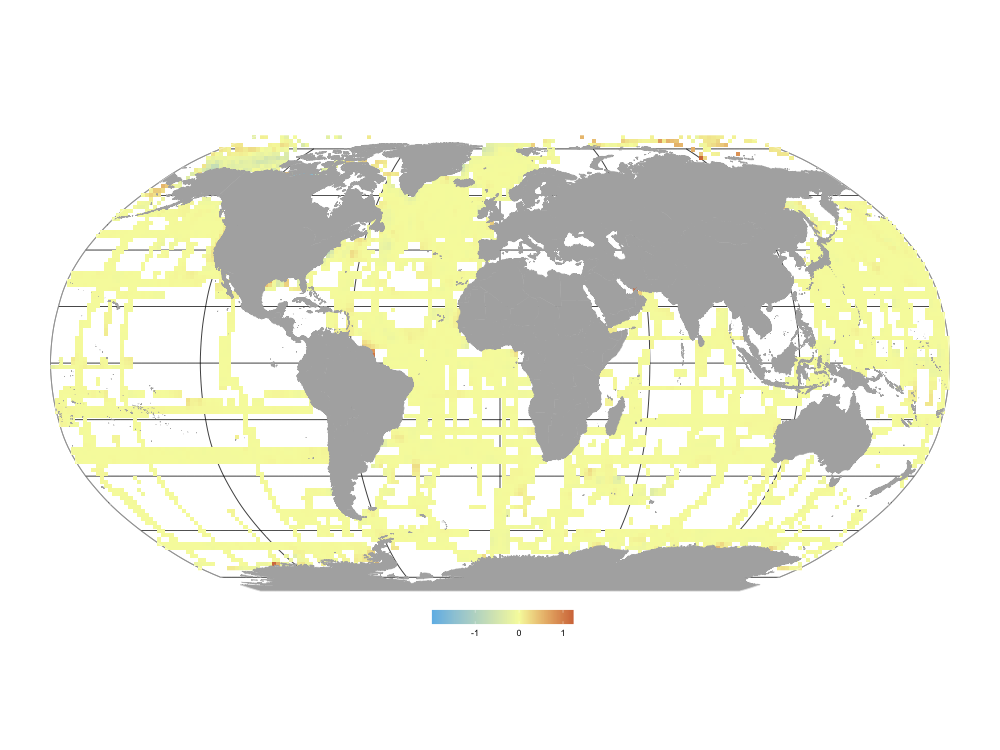


Fig S2. Spatial distribution of the error of salinity shown as the average difference between the interpolated and *in situ* data (aggregated to a 2.5º resolution for better visualization). White cell represents areas for which no *in situ* data is available.

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Fig S3. Spatial distribution of the error of silicate (mmol . m-3) shown as the average difference between the interpolated and *in situ* data (aggregated to a 2.5º resolution for better visualization). White cell represents areas for which no *in situ* data is available.

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Fig S4. Spatial distribution of the error of phosphate (mmol . m-3) shown as the average difference between the interpolated and *in situ* data (aggregated to a 2.5º resolution for better visualization). White cell represents areas for which no *in situ* data is available.

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Fig S5. Spatial distribution of the error of oxygen (mmol . m-3) shown as the average difference between the interpolated and *in situ* data (aggregated to a 2.5º resolution for better visualization). White cell represents areas for which no *in situ* data is available.

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Fig S6. Spatial distribution of the error of nitrate (mmol . m-3) shown as the average difference between the interpolated and *in situ* data (aggregated to a 2.5º resolution for better visualization). White cell represents areas for which no *in situ* data is available.