Global ocean colour trends in biogeochemical provinces

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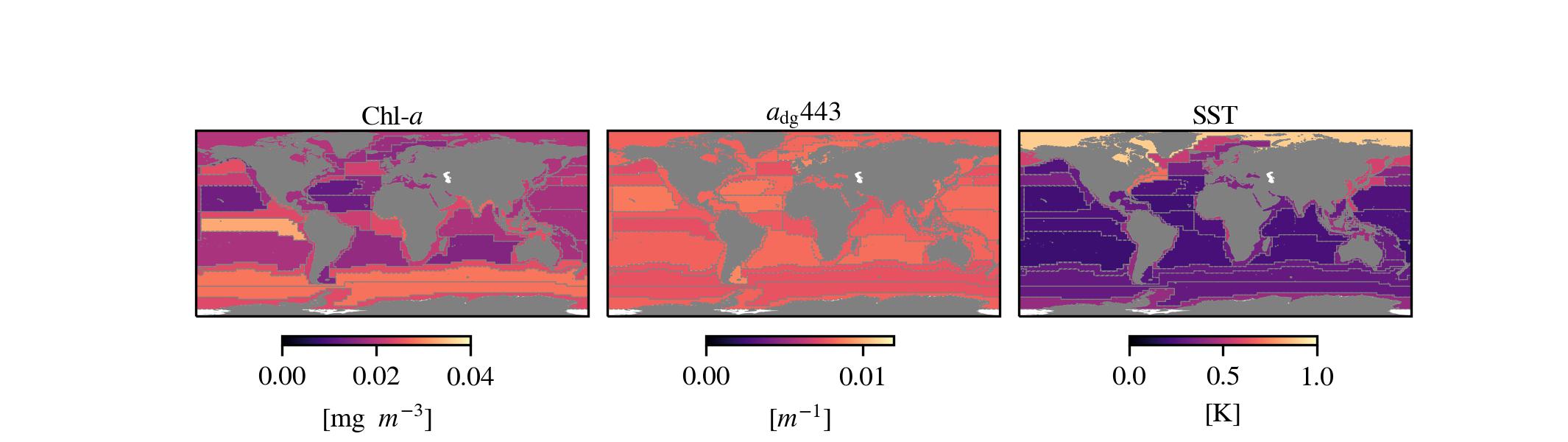
# Appendix

Table A1 | Description of the Longhurst biogeochemical provinces with associated province codes, biomes, and oceans.

|  |  |  |
| --- | --- | --- |
| Province Description | Province Code | Ocean |
| Polar biome | | **Atlantic** |
| Boreal Polar Province (POLR) | BPLR |
| Atlantic Arctic Province | ARCT |
| Atlantic Subarctic Province | SARC |
| Westerly winds biome | |
| N. Atlantic Drift Province (WWDR) | NADR |
| Gulf Stream Province | GFST |
| N. Atlantic Subtropical Gyral Province (West) (STGW) | NASW |
| Mediterranean Sea, Black Sea Province | MEDI |
| N. Atlantic Subtropical Gyral Province (East) (STGE) | NASE |
| Trade winds biome | |
| N. Atlantic Tropical Gyral Province (TRPG) | NATR |
| Western Tropical Atlantic Province | WTRA |
| Eastern Tropical Atlantic Province | ETRA |
| South Atlantic Gyral Province (SATG) | SATL |
| Caribbean Province | CARB |
| Coastal biome | |
| NE Atlantic Shelves Province | NECS |
| Canary Coastal Province (EACB) | CNRY |
| Guinea Current Coastal Province | GUIN |
| Guianas Coastal Province | GUIA |
| NW Atlantic Shelves Province | NWCS |
| Brazil Current Coastal Province | BRAZ |
| SW Atlantic Shelves Province | FKLD |
| Benguela Current Coastal Province | BENG |
| Trade winds biome | | **Indian** |
| Indian Monsoon Gyres Province | MONS |
| Indian S. Subtropical Gyre Province | ISSG |
| Coastal Biome | |
| E. Africa Coastal Province | EAFR |
| Red Sea, Persian Gulf Province | REDS |
| NW Arabian Upwelling Province | ARAB |
| E. India Coastal Province | INDE |
| W. India Coastal Province | INDW |
| Australia-Indonesia Coastal Province | AUSW |
| Polar biome | | **Pacific** |
| N. Pacific Epicontinental Province | BERS |
| Westerly winds biome |  |
| Pacific Subarctic Gyres Province (East) | PSAE |
| Pacific Subarctic Gyres Province (West) | PSAW |
| Kuroshio Current Province | KURO |
| N. Pacific Polar Front Province | NPPF |
| N. Pacific Subtropical Gyre Province (West) | NPSW |
| Tasman Sea Province | TASM |
| Trade winds biome |  |
| S. Pacific Subtropical Gyre Province | SPSG |
| N. Pacific Tropical Gyre Province | NPTG |
| N. Pacific Equatorial Countercurrent Province | PNEC |
| Pacific Equatorial Divergence Province | PEQD |
| W. Pacific Warm Pool Province | WARM |
| Archipelagic Deep Basins Province | ARCH |
| Coastal biome | |
| Alaska Downwelling Coastal Province | ALSK |
| California Upwelling Coastal Province | CCAL |
| Central American Coastal Province | CAMR |
| Chile-Peru Current Coastal Province | CHIL |
| China Sea Coastal Province | CHIN |
| Sunda-Arafura Shelves Province | SUND |
| East Australian Coastal Province | AUSE |
| New Zealand Coastal Province | NEWZ |
| Westerly winds biome | | **Antarctic** |
| S. Subtropical Convergence Province | SSTC |
| Subantarctic Province | SANT |
| Polar biome | |
| Antarctic Province | ANTA |
| Austral Polar Province | APLR |

Table A2 | Mean, standard deviation, and linear regression lines of Chl-*a*, *a*dg443 SST, and SSS per Longhurst province. The optimal TGDM window length and amount of data kept are also displayed. One asterisk (\*) is shown in the regression line formula if the confidence is larger than 95%, two asterisks (\*\*) are shown when the confidence is larger than 99.5%, when no asterisk is shown, the trend is not significant. When the trend is smaller than the inherent dataset bias (SSS not included), then the regression formula is grey, as opposed to black.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Province  Code | Window  Length  [day] | Data  Kept   [%] | Chlorophyll*-a* concentration (Chl-*a*)  [mg m-3] | | Non-algal absorption (*a*dg443)  x 102 [m-1] | | Sea Surface Temperature (SST)  [C°] | | Sea Surface Salinity (SSS)  [PSU] | |
|  | Linear regression line  [decade-1] | Mean±  SD | Linear regression line  [decade-1] | Mean±  SD | Linear regression line  [decade-1] | Mean±  SD | Linear regression line  [decade-1] | Mean±  SD |
|  |  |  |
| BPLR | 13 | 16 | 0.123 (±0.026) + 1.14 \*\* | 1.13±1.37 | 1.154 (±0.356) + 9.35 \*\* | 9.35±0.23 | 0.113 (±0.007) + -1.42 \*\* | -1.27±  1.18 | 0.019 (±0.017) + 30.12 \* | 30.13±4.95 |
| ARCT | 73 | 85 | 0.083 (±0.014) + 0.56 \*\* | 0.63±0.38 | 0.823 (±0.154) + 2.65 \*\* | 3.70±0.03 | 0.132 (±0.043) + 4.41 \*\* | 4.53±  3.23 | -0.019 (±0.009) + 34.68 \*\* | 34.66±1.39 |
| SARC | 37 | 74 | 0.04 (±0.019) + 0.73 \*\* | 0.76±0.49 | 0.56 (±0.158) + 3.6 \*\* | 4.28±0.04 | 0.207 (±0.048) + 6.96 \*\* | 7.17±  3.94 | -0.038 (±0.009) + 35.01 \*\* | 34.95±1.09 |
| NADR | 101 | 97 | 0.033 (±0.008) + 0.42 \*\* | 0.46±0.23 | 0.396 (±0.056) + 2.07 \*\* | 2.63±0.01 | -0.187 (±0.056) + 13.28 \*\* | 13.00±  4.98 | -0.057 (±0.008) + 35.4 \*\* | 35.33±1.10 |
| GFST | 23 | 75 | 0.011 (±0.007) + 0.36 \*\* | 0.38±0.23 | 0.251 (±0.052) + 1.95 \*\* | 2.35±0.02 | 0.338 (±0.072) + 18.9 \*\* | 19.28±  5.21 | -0.028 (±0.017) + 35.71 \*\* | 35.68±0.98 |
| NASW | 13 | 60 | -0.003 (±0.002) + 0.09 \*\* | 0.09±0.06 | 0.035 (±0.009) + 0.74 \*\* | 0.79±0.00 | 0.258 (±0.045) + 23.07 \*\* | 23.35±  11.24 | -0.006 (±0.011) + 36.71 | 36.71±1.24 |
| NATR | 17 | 56 | 0.0 (±0.002) + 0.1 | 0.10±0.14 | 0.055 (±0.012) + 0.73 \*\* | 0.82±0.01 | 0.077 (±0.044) + 25.76 \*\* | 25.84±  11.55 | 0.018 (±0.01) + 36.51 \*\* | 36.52±1.11 |
| WTRA | 29 | 51 | 0.004 (±0.003) + 0.18 \*\* | 0.18±0.17 | 0.099 (±0.02) + 1.13 \*\* | 1.27±0.01 | 0.128 (±0.046) + 27.28 \*\* | 27.42±  12.68 | 0.036 (±0.016) + 35.56 \*\* | 35.60±0.85 |
| ETRA | 101 | 91 | -0.003 (±0.004) + 0.23 | 0.23±0.17 | 0.054 (±0.031) + 1.44 \*\* | 1.54±0.01 | 0.182 (±0.053) + 26.04 \*\* | 26.28±  12.72 | 0.076 (±0.013) + 35.3 \*\* | 35.39±0.92 |
| SATL | 75 | 98 | 0.002 (±0.001) + 0.13 \*\* | 0.13±0.12 | 0.069 (±0.007) + 0.82 \*\* | 0.92±0.01 | 0.128 (±0.025) + 21.42 \*\* | 21.61±  9.33 | -0.025 (±0.008) + 36.19 \*\* | 36.16±2.49 |
| NECS | 27 | 82 | 0.011 (±0.015) + 1.59 | 1.60±1.47 | 0.134 (±0.209) + 9.48 | 9.76±0.13 | 0.224 (±0.068) + 10.27 \*\* | 10.53±  4.70 | -0.042 (±0.012) + 25.25 \*\* | 25.19±13.19 |
| CNRY | 101 | 97 | 0.001 (±0.02) + 1.01 | 1.03±1.27 | 0.308 (±0.107) + 5.17 \*\* | 5.52±0.06 | 0.014 (±0.071) + 20.28 | 20.29±  3.70 | -0.064 (±0.007) + 36.08 \*\* | 36.01±0.78 |
| GUIN | 57 | 51 | -0.013 (±0.014) + 0.63 | 0.61±1.01 | 0.074 (±0.094) + 3.57 | 3.72±0.08 | 0.15 (±0.059) + 26.34 \*\* | 26.53±  3.50 | 0.266 (±0.031) + 32.98 \*\* | 33.35±2.41 |
| GUIA | 19 | 51 | 0.043 (±0.011) + 0.8 \*\* | 0.86±1.80 | 0.521 (±0.103) + 4.98 \*\* | 5.75±0.16 | 0.12 (±0.037) + 27.72 \*\* | 27.90±  2.57 | 0.092 (±0.038) + 33.76 \*\* | 33.87±4.43 |
| NWCS | 97 | 98 | 0.044 (±0.008) + 0.81 \*\* | 0.87±1.15 | 0.451 (±0.096) + 4.58 \*\* | 5.28±0.10 | 0.271 (±0.069) + 11.14 \*\* | 11.41±  8.51 | 0.088 (±0.018) + 32.72 \*\* | 32.81±2.54 |
| MEDI | 11 | 78 | -0.012 (±0.004) + 0.35 \*\* | 0.33±0.68 | -0.001 (±0.026) + 1.98 | 2.02±0.04 | 0.342 (±0.051) + 19.02 \*\* | 19.41±  7.08 | 0.095 (±0.007) + 34.09 \*\* | 34.22±7.76 |
| CARB | 13 | 55 | 0.002 (±0.003) + 0.31 | 0.32±0.89 | 0.074 (±0.029) + 1.85 \*\* | 1.97±0.07 | 0.17 (±0.036) + 27.01 \*\* | 27.21±  13.73 | 0.129 (±0.016) + 35.36 \*\* | 35.57±1.23 |
| NASE | 13 | 51 | 0.003 (±0.002) + 0.15 \* | 0.16±0.12 | 0.069 (±0.017) + 1.05 \*\* | 1.15±0.01 | 0.08 (±0.042) + 19.84 \*\* | 19.90±  9.00 | -0.039 (±0.008) + 36.57 \*\* | 36.51±0.62 |
| BRAZ | 47 | 97 | 0.026 (±0.013) + 0.78 \*\* | 0.81±1.72 | 0.313 (±0.222) + 6.75 \* | 7.26±0.31 | 0.12 (±0.049) + 21.5 \*\* | 21.70±  5.71 | 0.062 (±0.012) + 34.76 \*\* | 34.84±4.23 |
| FKLD | 11 | 69 | 0.084 (±0.017) + 0.94 \*\* | 1.06±0.87 | 1.09 (±0.104) + 4.69 \*\* | 6.12±0.08 | 0.046 (±0.057) + 8.55 | 8.66±  3.55 | -0.043 (±0.005) + 34.06 \*\* | 34.02±0.23 |
| BENG | 97 | 99 | -0.027 (±0.013) + 0.88 \*\* | 0.85±1.11 | 0.184 (±0.091) + 4.31 \*\* | 4.56±0.06 | 0.074 (±0.061) + 17.88 \* | 17.99±  2.57 | -0.015 (±0.006) + 35.45 \*\* | 35.44±0.27 |
| MONS | 25 | 62 | -0.003 (±0.002) + 0.17 \* | 0.17±0.10 | 0.076 (±0.014) + 1.01 \*\* | 1.12±0.01 | 0.167 (±0.032) + 28.26 \*\* | 28.50±  10.41 | -0.033 (±0.012) + 34.7 \*\* | 34.66±1.87 |
| ISSG | 17 | 50 | -0.0 (±0.001) + 0.1 | 0.10±0.06 | 0.047 (±0.006) + 0.7 \*\* | 0.77±0.00 | 0.209 (±0.028) + 22.78 \*\* | 23.06±  9.59 | -0.081 (±0.009) + 35.44 \*\* | 35.34±2.50 |
| EAFR | 39 | 96 | -0.001 (±0.003) + 0.26 | 0.26±0.44 | 0.081 (±0.021) + 1.5 \*\* | 1.64±0.03 | 0.065 (±0.031) + 24.23 \*\* | 24.34±  10.59 | -0.003 (±0.01) + 35.22 | 35.22±0.75 |
| REDS | 25 | 82 | 0.003 (±0.008) + 0.46 | 0.47±0.46 | 0.103 (±0.045) + 2.44 \*\* | 2.59±0.02 | 0.183 (±0.065) + 27.38 \*\* | 27.62±  3.75 | 0.058 (±0.012) + 37.95 \*\* | 38.01±1.44 |
| ARAB | 11 | 56 | -0.016 (±0.01) + 0.45 \*\* | 0.44±0.39 | 0.094 (±0.064) + 2.4 \*\* | 2.52±0.02 | 0.14 (±0.053) + 26.91 \*\* | 27.14±  11.16 | 0.015 (±0.009) + 36.0 \*\* | 36.00±0.56 |
| INDE | 69 | 92 | 0.014 (±0.009) + 0.53 \*\* | 0.55±1.09 | 0.091 (±0.075) + 3.79 \* | 3.94±0.11 | 0.139 (±0.039) + 28.18 \*\* | 28.36±  2.47 | -0.118 (±0.035) + 31.37 \*\* | 31.21±3.45 |
| INDW | 101 | 98 | -0.054 (±0.019) + 0.97 \*\* | 0.90±1.61 | -0.699 (±0.164) + 7.88 \*\* | 7.06±0.22 | 0.188 (±0.049) + 27.7 \*\* | 27.96±  2.23 | -0.011 (±0.033) + 35.2 | 35.16±1.37 |
| AUSW | 101 | 99 | -0.004 (±0.004) + 0.31 | 0.31±0.48 | 0.041 (±0.027) + 1.71 \*\* | 1.81±0.04 | 0.117 (±0.043) + 23.11 \*\* | 23.29±  8.11 | -0.011 (±0.014) + 34.97 | 34.96±0.99 |
| BERS | 73 | 87 | 0.062 (±0.011) + 0.87 \*\* | 0.95±0.93 | 0.566 (±0.131) + 4.85 \*\* | 5.76±0.10 | 0.352 (±0.051) + 4.23 \*\* | 4.66±  4.45 | 0.048 (±0.009) + 32.33 \*\* | 32.38±1.42 |
| PSAE | 101 | 91 | 0.018 (±0.006) + 0.42 \*\* | 0.44±0.26 | 0.307 (±0.053) + 2.07 \*\* | 2.52±0.02 | 0.389 (±0.099) + 7.73 \*\* | 8.20±  4.03 | -0.049 (±0.008) + 32.63 \*\* | 32.55±0.49 |
| PSAW | 101 | 80 | 0.032 (±0.01) + 0.5 \*\* | 0.55±0.37 | 0.362 (±0.078) + 2.47 \*\* | 3.08±0.02 | 0.274 (±0.062) + 6.13 \*\* | 6.47±  3.68 | 0.009 (±0.012) + 32.85 | 32.87±0.56 |
| KURO | 21 | 52 | 0.002 (±0.003) + 0.26 | 0.26±0.37 | 0.08 (±0.025) + 1.49 \*\* | 1.61±0.02 | 0.201 (±0.058) + 20.26 \*\* | 20.45±  9.16 | 0.032 (±0.009) + 34.07 \*\* | 34.11±0.57 |
| NPPF | 101 | 95 | -0.0 (±0.003) + 0.25 | 0.25±0.14 | 0.053 (±0.022) + 1.48 \*\* | 1.57±0.01 | 0.477 (±0.059) + 14.4 \*\* | 14.98±  8.32 | 0.001 (±0.01) + 33.65 | 33.64±1.21 |
| NPSW | 19 | 62 | -0.003 (±0.0) + 0.06 \*\* | 0.06±0.03 | 0.029 (±0.004) + 0.44 \*\* | 0.48±0.00 | 0.136 (±0.038) + 25.91 \*\* | 26.06±  10.66 | -0.034 (±0.01) + 34.86 \*\* | 34.83±1.91 |
| TASM | 15 | 58 | 0.005 (±0.005) + 0.3 | 0.30±0.16 | 0.14 (±0.034) + 1.54 \*\* | 1.77±0.01 | 0.219 (±0.058) + 17.51 \*\* | 17.80±  2.67 | -0.015 (±0.007) + 35.54 \*\* | 35.51±0.34 |
| SPSG | 21 | 52 | 0.001 (±0.001) + 0.09 \*\* | 0.09±0.07 | 0.056 (±0.005) + 0.59 \*\* | 0.66±0.00 | 0.036 (±0.021) + 22.72 \*\* | 22.81±  6.62 | -0.037 (±0.006) + 35.5 \*\* | 35.47±0.85 |
| NPTG | 23 | 55 | -0.004 (±0.001) + 0.08 \*\* | 0.07±0.03 | 0.025 (±0.006) + 0.58 \*\* | 0.61±0.00 | 0.292 (±0.046) + 23.38 \*\* | 23.77±  10.35 | -0.117 (±0.01) + 34.88 \*\* | 34.72±1.93 |
| PNEC | 37 | 65 | -0.019 (±0.006) + 0.22 \*\* | 0.20±0.16 | 0.034 (±0.029) + 1.17 \* | 1.22±0.01 | 0.172 (±0.065) + 27.52 \*\* | 27.74±  13.54 | -0.066 (±0.017) + 33.98 \*\* | 33.88±1.14 |
| PEQD | 59 | 94 | -0.006 (±0.003) + 0.21 \*\* | 0.20±0.08 | 0.092 (±0.015) + 1.16 \*\* | 1.28±0.00 | 0.0 (±0.113) + 25.96 | 26.05±  10.91 | -0.027 (±0.01) + 35.06 \*\* | 35.00±1.97 |
| WARM | 77 | 97 | -0.005 (±0.002) + 0.11 \*\* | 0.10±0.07 | 0.05 (±0.01) + 0.59 \*\* | 0.66±0.00 | 0.194 (±0.036) + 28.98 \*\* | 29.18±  11.58 | 0.038 (±0.019) + 34.41 \*\* | 34.48±1.55 |
| ARCH | 21 | 60 | -0.002 (±0.001) + 0.16 \*\* | 0.16±0.16 | 0.061 (±0.01) + 0.96 \*\* | 1.05±0.01 | 0.153 (±0.038) + 26.46 \*\* | 26.69±  13.72 | 0.021 (±0.019) + 34.46 \* | 34.49±1.67 |
| ALSK | 75 | 92 | 0.048 (±0.021) + 1.0 \*\* | 1.03±0.69 | 0.677 (±0.166) + 5.37 \*\* | 6.22±0.09 | 0.15 (±0.099) + 8.17 \*\* | 8.35±  3.27 | 0.038 (±0.016) + 31.49 \*\* | 31.53±1.50 |
| CCAL | 101 | 100 | -0.003 (±0.005) + 0.3 | 0.30±0.48 | 0.1 (±0.026) + 1.68 \*\* | 1.82±0.03 | 0.26 (±0.104) + 16.37 \*\* | 16.69±  4.84 | -0.024 (±0.013) + 33.0 \*\* | 32.96±1.34 |
| CAMR | 101 | 98 | -0.062 (±0.017) + 0.63 \*\* | 0.57±0.80 | -0.003 (±0.069) + 3.06 | 3.05±0.05 | 0.175 (±0.055) + 27.14 \*\* | 27.36±  3.60 | -0.024 (±0.04) + 33.25 | 33.18±1.65 |
| CHIL | 41 | 89 | 0.027 (±0.011) + 0.71 \*\* | 0.74±0.88 | 0.494 (±0.066) + 3.23 \*\* | 3.94±0.05 | -0.025 (±0.073) + 16.11 | 16.16±  4.98 | -0.017 (±0.009) + 34.15 \*\* | 34.12±0.69 |
| CHIN | 75 | 93 | 0.019 (±0.018) + 1.47 \* | 1.51±1.87 | -0.301 (±0.196) + 12.66 \*\* | 12.39±0.27 | 0.158 (±0.067) + 19.08 \*\* | 19.25±  7.51 | 0.011 (±0.019) + 31.46 | 31.50±3.56 |
| SUND | 21 | 52 | -0.005 (±0.004) + 0.5 \* | 0.49±0.86 | 0.062 (±0.03) + 2.85 \*\* | 2.93±0.09 | 0.143 (±0.038) + 28.62 \*\* | 28.82±  11.83 | 0.045 (±0.031) + 33.2 \* | 33.28±1.44 |
| AUSE | 17 | 75 | 0.012 (±0.003) + 0.24 \*\* | 0.26±0.31 | 0.142 (±0.02) + 1.32 \*\* | 1.54±0.02 | 0.159 (±0.05) + 23.57 \*\* | 23.81±  3.60 | -0.053 (±0.014) + 35.53 \*\* | 35.46±0.29 |
| NEWZ | 101 | 99 | 0.025 (±0.007) + 0.37 \*\* | 0.41±0.26 | 0.221 (±0.043) + 1.88 \*\* | 2.26±0.02 | 0.295 (±0.061) + 11.69 \*\* | 12.12±  3.30 | -0.0 (±0.009) + 34.59 | 34.60±0.43 |
| SSTC | 101 | 99 | 0.011 (±0.002) + 0.25 \*\* | 0.27±0.18 | 0.153 (±0.017) + 1.36 \*\* | 1.59±0.01 | 0.164 (±0.021) + 13.5 \*\* | 13.73±  6.25 | -0.019 (±0.004) + 34.79 \*\* | 34.77±2.30 |
| SANT | 101 | 93 | 0.017 (±0.002) + 0.23 \*\* | 0.26±0.18 | 0.163 (±0.014) + 1.3 \*\* | 1.56±0.01 | 0.109 (±0.015) + 6.98 \*\* | 7.12±  3.22 | -0.025 (±0.008) + 34.2 \*\* | 34.18±2.14 |
| ANTA | 71 | 60 | 0.027 (±0.004) + 0.21 \*\* | 0.24±0.18 | 0.23 (±0.029) + 1.21 \*\* | 1.45±0.01 | 0.019 (±0.021) + 0.3 | 0.36±  1.15 | -0.02 (±0.003) + 33.98 \*\* | 33.95±7.18 |
| APLR | 49 | 24 | 0.093 (±0.03) + 0.44 \*\* | 0.53±0.74 | 1.164 (±0.162) + 1.91 \*\* | 3.03±0.05 | 0.016 (±0.005) + -1.53 \*\* | -1.50±  0.56 | 0.031 (±0.006) + 33.78 \*\* | 33.81±6.33 |



**Figure A1 | The inherent monthly averaged uncertainties (or bias) of the Chl-a, adg443, and SST data sets compiled by the CCI groups per Longhurst region between 9/1997-6/2022.**