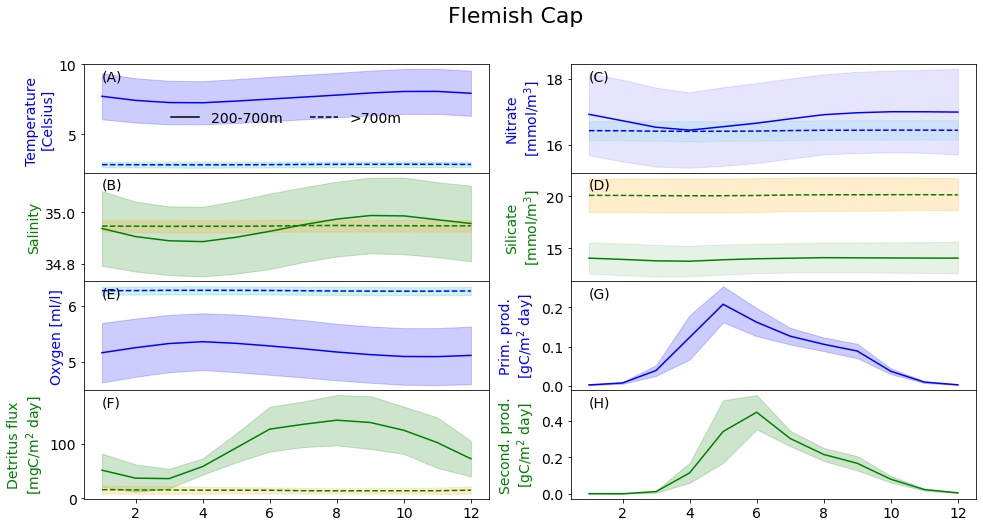
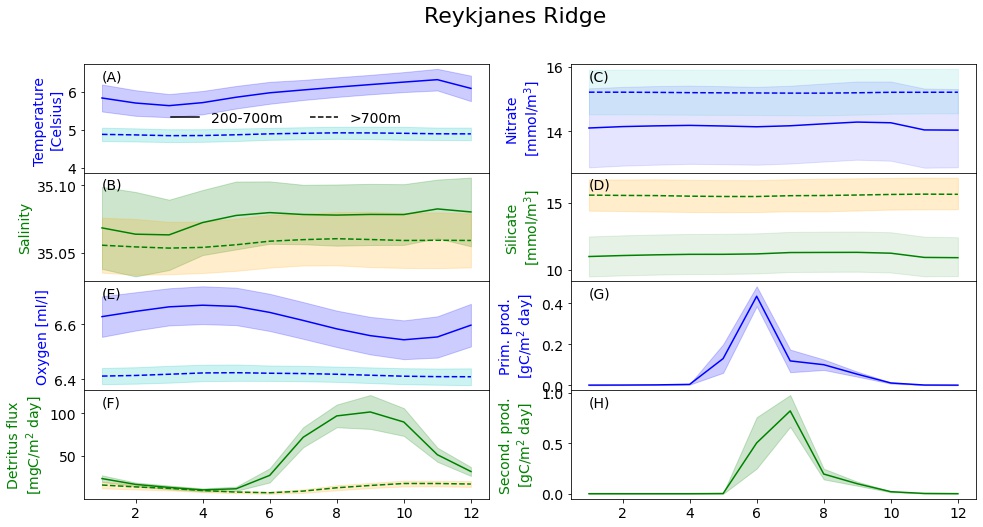
Supplementary Material

# Supplementary Figures and Tables

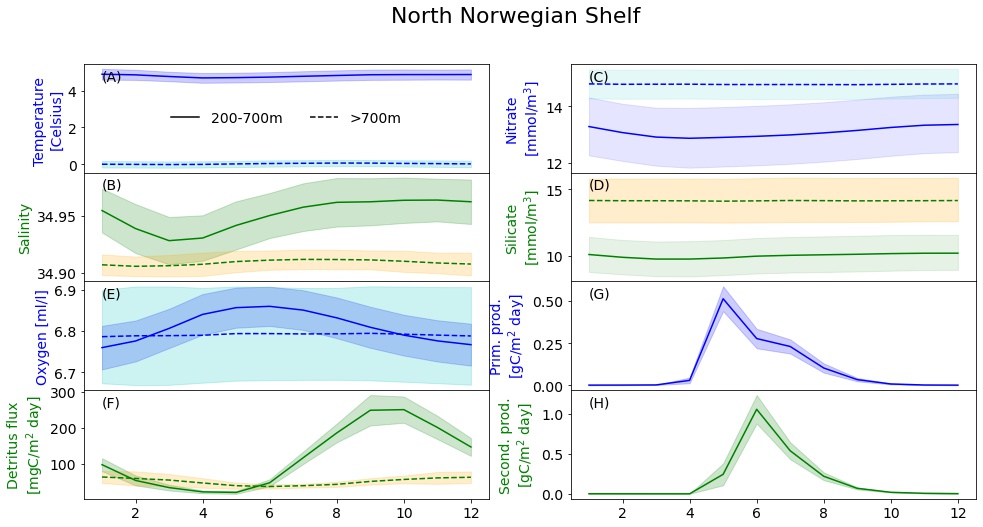
## Supplementary Figures



**Supplementary Figure 1.** The computed annual cycle of temperature, salinity, nitrate, silicate, oxygen, detritus flux to the bottom **Flemish Cap**. The solid lines are in areas with depth between 200 and 700 meters and the dashed lines in areas with bottom depth greater than 700m. (A) temperature, (B) salinity, (C) nitrate, (D) silicate, (E) oxygen, (F) detritus flux.  The shading shows one standard deviation of the variability between years. (G) Primary and (H) secondary (green) production averaged over areas deeper than 200 meters.

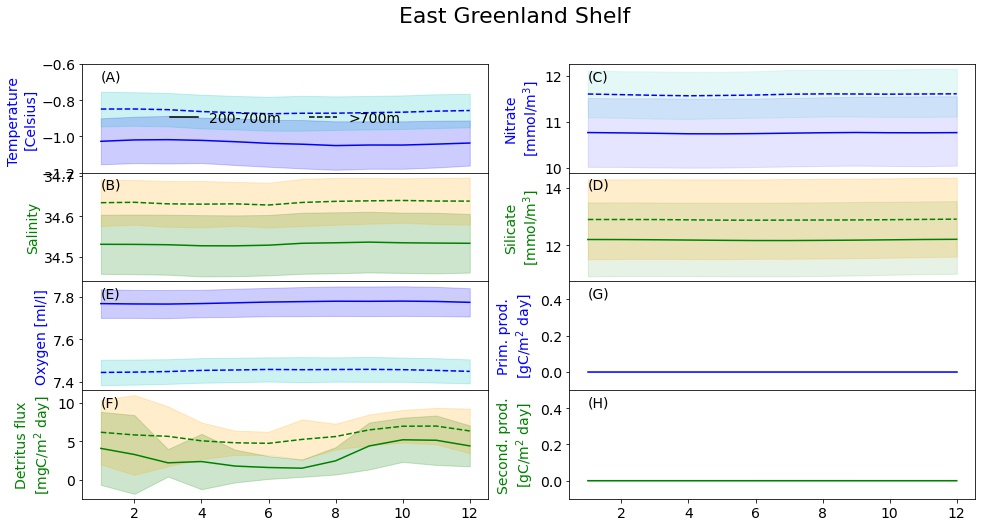


**Supplementary Figure 2.** The computed annual cycle of temperature, salinity, nitrate, silicate, oxygen, detritus flux to the bottom and primary and secondary production at the **Reykjanes Ridge**. The solid lines are in areas with depth between 200 and 700 meters and the dashed lines in areas with bottom depth greater than 700m. (A) temperature, (B) salinity, (C) nitrate, (D) silicate, (E) oxygen, (F) detritus flux.  The shading shows one standard deviation of the variability between years. (G) Primary and (H) secondary (green) production averaged over areas deeper than 200 meters.



**Supplementary Figure 3.** The computed annual cycle of temperature, salinity, nitrate, silicate, oxygen, detritus flux to the bottom and primary and secondary production at the **North Norwegian Shelf**. The solid lines are in areas with depth between 200 and 700 meters and the dashed lines in areas with bottom depth greater than 700m. (A) temperature, (B) salinity, (C) nitrate, (D) silicate, (E) oxygen, (F) detritus flux.  The shading shows one standard deviation of the variability between years. (G) Primary and (H) secondary (green) production averaged over areas deeper than 200 meters.

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**Supplementary Figure 4.** The computed annual cycle of temperature, salinity, nitrate, silicate, oxygen, detritus flux to the bottom and primary and secondary production at the **East Greenland Shelf**. The solid lines are in areas with depth between 200 and 700 meters and the dashed lines in areas with bottom depth greater than 700m. (A) temperature, (B) salinity, (C) nitrate, (D) silicate, (E) oxygen, (F) detritus flux.  The shading shows one standard deviation of the variability between years. (G) Primary and (H) secondary (green) production averaged over areas deeper than 200 meters.

## Supplementary Tables

**Supplementary Table 1.** Validation statistics at the Flemish Cap for temperature [ºC], salinity, oxygen[ml/l], nitrate[mmol/m3], phosphate[mmol/m3], and silicate [mmol/m3].

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Variable/Data set | Number of obs | Mean obs. | Mean model | RMSE | bias |
| Temperature/GLODAP | 68 | 2.48 | 3.39 | 3.48 | 0.91 |
| Temperature/WOD | 1170 | 2.47 | 3.43 | 3.25 | 0.96 |
| Salinity/GLODAP | 68 | 34.51 | 34.56 | 0.32 | 0.05 |
| Salinity/WOD | 1171 | 34.27 | 34.43 | 0.48 | 0.15 |
| Oxygen/GLODAP | 64 | 6.30 | 6.53 | 1.15 | 0.23 |
| Oxygen/WOD | 357 | 6.50 | 6.80 | 1.09 | 0.30 |
| Nitrate /GLODAP | 47 | 14.95 | 14.64 | 1.96 | -0.32 |
| Phosphate/GLODAP | 52 | 1.07 | 0.97 | 0.16 | -0.10 |
| Silicate/GLODAP | 59 | 11.09 | 14.13 | 3.74 | 3.04 |

**Supplementary Table 2.** Validation statistics at the Reykjanes ridge for temperature [ºC] and salinity.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Variable (Data set) | Number of obs | Mean obs. | Mean model | RMSE | bias |
| temperature/WOD (WOD) | 52 | 6.40 | 5.80 | 0.99 | -0.60 |
| salinity/WOD | 52 | 35.11 | 35.09 | 0.08 | -0.03 |

**Supplementary Table 3.** Validation statistics at the North Norwegian Shelf for temperature [ºC],salinity, oxygen[ml/l], nitrate[mmol/m3], phosphate[mmol/m3], and silicate [mmol/m3].

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Variable (Data set) | Number of obs | Mean obs. | Mean model | RMSE | bias |
| Temperature (WOD) | 2899 | 3.96 | 2.78 | 1.79 | -1.18 |
| Salinity (WOD) | 2852 | 35.00 | 34.83 | 0.24 | -0.18 |
| Oxygen (NMDC) | 26 | 6.94 | 7.29 | 0.41 | 0.36 |
| Nitrate (NMDC) | 559 | 11.68 | 13.2 | 2.42 | 1.52 |
| Phosphate (NMDC) | 526 | 0.84 | 0.88 | 0.12 | 0.04 |
| Silicate (NMDC) | 563 | 5.81 | 10.91 | 5.41 | 5.10 |

**Supplementary Table 4.**  Summary of nitrate variability at the four sponge habitats in waters with bottom depth 200-700m: period mean, decadal trend, the maximum change in the monthly mean over a period of 12 months, 36 months and 10 years, and the temporal mean of the spatial standard deviation.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Flemish Cap | Reykjanes Ridge | North Norwegian Shelf | East Greenland Shelf |
| Period mean [mmol/m3] | 16.815 | 14.201 | 13.131 | 10.786 |
| Max annual change [mmol/m3] | 2.967 | 0.453 | 0.993 | 0.484 |
| Max 3-year change [mmol/m3] | 4.034 | 0.649 | 1.398 | 0.814 |
| Max 10-year change [mmol/m3] | 4.635 | 1.418 | 1.918 | 1.170 |
| Spatial standard deviation | 1.966 | 0.073 | 0.505 | 0.322 |

**Supplementary Table 5.**  Summary of nitrate variability at the four sponge habitats in areas with bottom deeper than 700m: period mean, decadal trend, the maximum change in the monthly mean over a period of 12 months, 36 months and 10 years, and the temporal mean of the spatial standard deviation.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Flemish Cap | Reykjanes Ridge | North Norwegian Shelf | East Greenland Shelf |
| Period mean [mmol/m3] | 16.447 | 15.227 | 14.794 | 11.613 |
| Max annual change [mmol/m3] | 0.372 | 0.266 | 0.468 | 0.474 |
| Max 3-year change [mmol/m3] | 0.634 | 0.395 | 0.818 | 0.776 |
| Max 10-year change [mmol/m3] | 0.871 | 0.716 | 1.394 | 0.975 |
| Spatial standard deviation | 1.437 | 1.150 | 1.310 | 0.082 |

**Supplementary Table 6.**  Summary of silicate variability at the four sponge habitats in waters with bottom depth 200-700m: period mean, decadal trend, the maximum change in the monthly mean over a period of 12 months, 36 months and 10 years, and the temporal mean of the spatial standard deviation.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Flemish Cap | Reykjanes Ridge | North Norwegian Shelf | East Greenland Shelf |
| Period mean [mmol/m3] | 14.006 | 11.193 | 10.062 | 12.236 |
| Max annual change [mmol/m3] | 2.247 | 0.776 | 1.008 | 0.397 |
| Max 3-year change [mmol/m3] | 3.661 | 1.008 | 1.537 | 0.678 |
| Max 10-year change [mmol/m3] | 4.064 | 1.979 | 2.038 | 1.413 |
| Spatial standard deviation | 1.821 | 0.105 | 0.748 | 0.202 |

**Supplementary Table 7.**  Summary of silicate variability at the four sponge habitats in areas with bottom deeper than 700m: period mean, decadal trend, the maximum change in the monthly mean over a period of 12 months, 36 months and 10 years, and the temporal mean of the spatial standard deviation.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Flemish Cap | Reykjanes Ridge | North Norwegian Shelf | East Greenland Shelf |
| Period mean [mmol/m3] | 20.163 | 15.615 | 14.186 | 12.946 |
| Max annual change [mmol/m3] | 1.108 | 0.916 | 0.678 | 0.519 |
| Max 3-year change [mmol/m3] | 1.770 | 1.108 | 0.862 | 0.676 |
| Max 10-year change [mmol/m3] | 4.023 | 2.029 | 1.745 | 1.399 |
| Spatial standard deviation | 4.620 | 4.453 | 1.623 | 0.077 |

**Supplementary Table 8.**  Summary of oxygen variability at the four sponge habitats in waters with bottom depth 200-700m: period mean, decadal trend, the maximum change in the monthly mean over a period of 12 months, 36 months and 10 years, and the temporal mean of the spatial standard deviation.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Flemish Cap | Reykjanes Ridge | North Norwegian Shelf | East Greenland Shelf |
| Period mean [ml/l] | 5.214 | 6.614 | 6.810 | 7.774 |
| Decadal trend [ml/l/decade] | 0.167 | -0.015 | 0.013 | -0.002 |
| Max annual change [ml/l] | 1.540 | 0.231 | 0.165 | 0.145 |
| Max 3-year change [ml/l] | 1.979 | 0.305 | 0.237 | 0.206 |
| Max 10-year change [ml/l] | 1.979 | 0.350 | 0.288 | 0.276 |
| Spatial standard deviation | 0.565 | 0.041 | 0.125 | 0.11 |

**Supplementary Table 9.**  Summary of oxygen variability at the four sponge habitats in areas with bottom deeper than 700m: period mean, decadal trend, the maximum change in the monthly mean over a period of 12 months, 36 months and 10 years, and the temporal mean of the spatial standard deviation.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Flemish Cap | Reykjanes Ridge | North Norwegian Shelf | East Greenland Shelf |
| Period mean [ml/l] | 6.268 | 6.416 | 6.792 | 7.454 |
| Decadal trend [ml/l/decade] | 3.503e-04 | -0.006 | -0.007 | 0.003 |
| Max annual change [ml/l] | 0.099 | 0.053 | 0.172 | 0.121 |
| Max 3-year change [ml/l] | 0.165 | 0.086 | 0.303 | 0.193 |
| Max 10-year change [ml/l] | 0.274 | 0.146 | 0.488 | 0.220 |
| Spatial standard deviation | 0.375 | 0.218 | 0.328 | 0.031 |

**Supplementary Table 10.**  Summary of detritus flux variability at the four sponge habitats in waters with bottom depth 200-700m: period mean, decadal trend, the maximum change in the monthly mean over a period of 12 months, 36 months and 10 years, and the temporal mean of the spatial standard deviation.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Flemish Cap | Reykjanes Ridge | North Norwegian Shelf | East Greenland Shelf |
| Period mean [mg C/m2 day] | 93.091 | 45.467 | 118.648 | 3.208 |
| Decadal trend [mg C/m2 day/decade] | 3.987 | -0.085 | 2.365 | 0.047 |
| Max annual change [mg C/m2 day] | 298.266 | 181.166 | 335.737 | 35.831 |
| Max 3-year change [mg C/m2 day] | 353.458 | 182.042 | 337.143 | 35.969 |
| Max 10-year change [mg C/m2 day] | 354.485 | 182.042 | 338.352 | 36.195 |
| Spatial standard deviation | 89.437 | 17.836 | 57.311 | 3.276 |

**Supplementary Table 11.**  Summary of detritus flux variability at the four sponge habitats in areas with bottom deeper than 700m: period mean, decadal trend, the maximum change in the monthly mean over a period of 12 months, 36 months and 10 years, and the temporal mean of the spatial standard deviation.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Flemish Cap | Reykjanes Ridge | North Norwegian Shelf | East Greenland Shelf |
| Period mean [mg C/m2 day] | 14.731 | 13.270 | 51.498 | 5.802 |
| Decadal trend [mg C/m2 day/decade] | 1.538 | -0.389 | 2.650 | 0.316 |
| Max annual change [mg C/m2 day] | 17.191 | 23.667 | 139.384 | 37.417 |
| Max 3-year change [mg C/m2 day] | 24.693 | 24.904 | 139.384 | 38.245 |
| Max 10-year change [mg C/m2 day] | 25.780 | 25.963 | 141.472 | 39.562 |
| Spatial standard deviation | 16.927 | 8.968 | 29.714 | 0.571 |