Supplementary Material

## Supplementary Figures



**Supplementary Figure 1.** Bathymetric profile of the South Sandwich Islands from north (left) to south (right). Profile follows shallowest line between each island and is derived from the Leat et al. (2016) digital elevation model.



**Supplementary Figure 2.** Importance of environmental variables for predicting distributions of 21 benthic functional groups (see Table 2). Importance was calculated by weighting the functional group-level predictor importance by the functional group R2 and then averaging. For descriptions of environmental variables see Supplementary Table 1.

**Supplementary Figure 3.** Environmental characterisation of the 12 mapping clusters shown in Figure 7. In each box plot the middle line represents the median; the upper and lower extent of the box represent the first and third quartile.

**Chart

Description automatically generated with medium confidenceSupplementary Figure 4.** Faunal characterisation of the 12 mapping clusters shown in Figure 7. Plots show the ratio of presences (black) to absences (grey) of 21 functional groups (Table 1) for each mapping cluster.

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| **Environmental Variables** | **Description** | **Source** | **Unit** | | **Scale** | | |
|  |  |  |  |  | | | |
| **Depth** | Digital elevation model (DEM) of the South Sandwich Islands, South Sandwich Trench and East Scotia Ridge. | Leat et al. (2014) | m | | 200m | | |
| **Slope** | A first derivative of DEM representing the rate of change in depth from one cell to its neighbours. | Derived from Leat et al. (2014) | ° | | 200m | | |
| **Rugosity** | A measure of rugosity calculated as the ratio of the three-dimensional DEM surface area to the two-dimensional planar area of a cell. | Derived from Leat et al. (2014) | - | | 200m | | |
| **Profile curvature** | A second derivative of DEM measuring the rate of change in the slope gradient. | Derived from Leat et al. (2014) | - | | 200m | | |
| **Topographic Position Index (TPI)** | A measure of whether a cell is positioned on a topographic peak, in a depression on in a region of constant gradient. | Derived from Leat et al. (2014) | - | | 200m | | |
| **Channel Network Base Level** | Used to distinguish topographic highs and lows using a channel network attributed with a Strahler order. The channel network base level is an interpolated elevation surface connecting the channel elevations | Derived from Leat et al. (2014) | m | | 200m | | |
| **Channel Network Distance** | The channel network distance is calculated as the vertical distance between the depth DEM elevation and the channel network base level elevation | Derived from Leat et al. (2014) | m | | 200m | | |
| **Valley Depth** | Valley depth is calculated as the vertical distance to the lowest elevation of source flow | Derived from Leat et al. (2014) | m | | 200m | | |
| **LS-Factor** | The LS-factor, a combination of slope length and steepness (gradient over the length). It reflects the potential stability of sediment deposits and hence the likelihood of exposed hard substrata. | Derived from Leat et al. (2014) | m | | 200m | | |
| **Net primary productivity** | 5-year (2014–2018) mean net primary productivity calculated using VGPM, a global "chlorophyll-based" model that estimate net primary production from chlorophyll. | Behrenfeld and Falkowski (1997) Data available from Oregon State | mg C/m2/day | | 1/12° | | |
| **Maximum primary productivity** | 5-year (2014–2018) peak primary productivity calculated using VGPM. | Behrenfeld and Falkowski (1997) Data available from Oregon State | mg C/m2/day | | 1/12° | | |
| **Sea ice extent** | Number of sea ice coverage days per year calculated from median daily sea ice extent between 1981 and 2010. | National Snow and Ice Data Centre (NSIDC). | Days/year | | - | | |
| **Sea surface mean temperature** | Two-year mean sea surface temperature (2016-2019) for summer (Dec – Feb) and winter (Jun-Aug). | The Operational Mercator global ocean analysis and forecast system based on the NEMO ocean model. Accessed through the Copernicus. | °C | | 1/12° | | |
| **Seafloor mean temperature** | Two-year mean seafloor temperature (2016-2019) for summer (Dec – Feb) and winter (Jun-Aug). | The Operational Mercator global ocean analysis and forecast system | °C | | 1/12° | | |
| **Seafloor annual temperature range** | Two-year mean temperature differential between summer and winter seafloor temperature. | The Operational Mercator global ocean analysis and forecast system | °C | | 1/12° | | |
| **Seafloor current speed** | Two-year mean seafloor current speed (2016-2019) for summer (Dec – Feb) and winter (Jun-Aug). | The Operational Mercator global ocean analysis and forecast system | m/s | | 1/12° | | |
| **Seafloor salinity** | Two-year mean seafloor salinity (2016-2019) for summer (Dec – Feb) and winter (Jun-Aug). | The Operational Mercator global ocean analysis and forecast system | PSU | | 1/12° | | |
| **Latitude** | Decimal degrees recorded at the centroid of each raster | - | Decimal Degrees | | Continuous | | |
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## Supplementary Tables

**Supplementary Table 1**. Summary of environmental variables included in landscape mapping and gradient forest analysis