ClimeMarine – Climate change predictions for Marine Spatial Planning

SND-ID: 2021-302-1. **Version**: 1. **DOI**: https://doi.org/10.5878/gwas-0254

Download data

Ensemble_Maximum_Rasters.zip *(294.66 MB)*

Ensemble_Median_Rasters.zip *(302.29 MB)*

Ensemble_Minimum_Rasters.zip *(304.62 MB)*

Normalised_Rasters.zip *(26.95 MB)*

Scripts.zip *(21.52 KB)*

Shapefiles.zip *(18.53 MB)*

Associated documentation

Metadata.zip *(26.14 KB)*

Download all files

2021-302-1-1.zip *(~947.1 MB)*

Citation

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Research principal

SMHI - Swedish Meteorological and Hydrological Institute - SMHI - Swedish Meteorological and Hydrological Institute

Principal's reference number

2017-01949

Description

This series is composed of five select physical marine parameters (water salinity and water temperature for surface and near bottom waters and sea ice) for two climate scenarios (RCP 45 and RCP 8.5) and three statistics (minimum, median and maximum) from an ensemble of five downscaled global climate models. The source data for this data series is global climate model outcomes from the Coupled Model Intercomparison Project 5 (CMIP5) published by the Intergovernmental Panel on Climate Change (Stocker et al 2013).

The source data were provided in NetCDF format for each of the downsampled climate models based

on the five CMIP5 global climate models: MPI: MPI-ESM-LR, HAD: HadGEM2-ES, ECE: EC-EARTH, GFD: GFDL-ESM2M, IPS: IPSL-CM5A-MR. The data included monthly mean, maximum, minimum and standard deviation calculations and the physical variables provided with the climate scenario models included sea ice cover, water temperature, water salinity, sea level and current strength (as two vectors) as well as a range of derived biogeochemical variables (O2, PO4, NO3, NH4, Secci Depth and Phytoplankton).

These global atmospheric climate model data were subsequently downscaled from global to regional scale and incorporated into the high-resolution ocean–sea ice–atmosphere model RCA4–NEMO by the Swedish Meteorological and Hydrological Institute (Gröger et al 2019) thus providing a wide range of marine specific parameters. The Swedish Geological Survey used these data in the form of monthly mean averages to calculate change in multi-annual (30-year) climate averages from the beginning and end of the 21st century for the five select parameters as proxies for climate change pressures.

Each dataset uses only source data models based on an assumption of atmospheric climate gas concentrations in line with either the IPCCs representative concentration pathway RCP 4.5 or RCP 8.5. Changes were calculated as the difference between two multiannual (30 year) mean averages; one for a historical reference climate period (1976-2005) and one for an end of century projection (2070-2099). These data were extracted for each of the five downscaled CMIP5 models individually and then combined into ensemble summary statistics (ensemble minimum, median and maximum). In the Ensemble_Maximum/Median/Minimum_Rasters datasets, changes in mean (May-Sept) surface temperature and bottom temperature are given in Degrees Celsia (°C); changes in mean annual surface salinity and bottom salinity are given in Practical Salinity Units (PSU); changes in mean (October-April) sea ice are given in Percentage Points (pp).

In the Normalized_Rasters datasets, the changes are normalized using a linear stretch so that a cell value of zero represents no projected and a cell value of 100 represents a value equal to or above the mean change in Swedish national waters. The values representing 100 are: 4 °C for surface temperature; 3 °C for bottom temperature; -1.5 PSU for surface salinity; -2.0 PSU for bottom salinity; and -40 pp for sea ice. These were also the chosen reference values for determining, via expert review, the sensitivity of ecosystem components to changes in these parameters (for further information refer to the Symphony method).

Notes on interpretation. This dataset does not highlight inter-annual or inter-decadal climate variability (e.g. extreme events) or changes in biochemical parameters (e.g. O2, chlorophyll, secchi depth etc) resulting from change in surface temperature. Areas of no-data inshore were filled using extrapolating from nearby cells (using similar depths for benthic data) so data near the coast and particularly within archipelagos, bays and estuaries is not robust. Users should refer to the associated climemarine uncertainty map for this parameter. The uncertainty map shows the interquatile range from the climate ensemble and the area of no-data as 'interpolated values'. For any application which requires more temporally or spatially explicit information (e.g. at sub/national decision making) it is highly recommended that the user contact SMHI for access to the latest climate model source data (in NetCDF format) which contains much more detail and a far wider selection of parameters. For regional applications (e.g. at the scale of the Baltic Sea) - it should be noted that these data will likely require normalisation to regional rather than national values and that sensitivity scores used may differ.

ClimeMarine was selective in its choice of pressure parameters. SMHI have additional data available for other parameters such as O2, secchi depth and nutrients which could be included in future. This is complicated because many parameters are influenced by riverine discharge and therefore by decisions related to watershed management - disentanglement of impacts from climate vs river basin

management becomes a complication. In a similar way, data on sealevel rise is also available which could be used to estimate impacts on the coast but likewise complicating factors such as isostatic uplift and coastal defence and management policies would need to be considered.

For simplicity and to reduce the amount of datasets to a manageable level for this assessment the source data were further limited and summarised in several ways:

Only the monthly mean averages of seawater temperature, salinity and sea ice (i.e. key physical parameters) were utilized.
For seawater salinity and temperature, the depth dimension (i.e. the water column) was summarised from 56 depth levels to just two: the surface and the deepest (bottom) waters.
Only two of the three climate periods were selected: a historical reference period: 1976-2005 (to represent the current status) and the projected end of century period: 2070-2099.
Only two of the three available emission scenarios were selected detailing the consequence of intermediate and very high climate gas emissions : Representative Concentration Pathway (RCP) 4.5 and 8.5 (see SEDAC 2021).

Each dataset included in the series comes with extensive metadata.

The data processing followed the following steps:

Extraction of data for each parameter from NetCDF to TIFF Rasters for each model, emission scenario, depth level (using scripts in NCO, CDO and R).
Calculation of climate ensemble statistics - Minimum, Mean, Median and Maximum (using Arcpy and Numpy)
Reprojection and resampling from the 2nm NEMO-RCO from Lat/Long WGS84 grid to the 250m ETRS89 LAEA Symphony grid (using Arcpy)
Extrapolation to fill no-data cells based on proximity and similar depths (using Arcpy script and the ArcGIS spatial analyst extension)
Calculation of change for each parameter as the end of century multi-annual mean minus the reference multi-annual mean (using an Arcpy script)
Inversion of if negative (i.e. decreases) to positive (i.e. magnitude of change)
Normalisation as a linear stretch from 0 to 100 where zero equates to no change and 100 equates to the maximum pixel value in Swedish waters from the RCP 8.5 ensemble mean dataset with any values over this pixel value also set to 100 (Arcpy script)

NetCDF source data used in this analysis can be requested from the Swedish Meteorological and Hydrological Institute - kundtjanst@smhi.se

Processing scripts (R and arcpy) and interim raster data can be requested from the Geological Survey of Sweden - kundtjanst@sgu.se

Data contains personal data

No

Language

English

Time period(s) investigated

1975-01-01 – 2099-12-31

Variables

3

Data format / data structure

Geospatial

Software

Geographic spread

Geographic location: Baltic Sea, North Sea

Responsible department/unit

SMHI - Swedish Meteorological and Hydrological Institute

Other research principals

Geological Survey of Sweden

Funding

- Funding agency: FORMAS
- Funding agency's reference number: 2017-01949
- Project name on the application: Integration av klimatförändringseffekter i en ekosystembaserad förvaltning och planering av den svenska marina miljön (ClimeMarine)

Research area

Climate research (Standard för svensk indelning av forskningsämnen 2011)

Environmental sciences (Standard för svensk indelning av forskningsämnen 2011)

Oceanography, hydrology and water resources (Standard för svensk indelning av forskningsämnen 2011)

Climatology / meteorology / atmosphere (INSPIRE topic categories)

Oceans (INSPIRE topic categories)

Environment (INSPIRE topic categories)

Keywords

Sea ice concentration, Nutrients, Salinity, Secchi depth, Climate indicators, Atmospheric/ocean indicators, Sea level rise, Water temperature, Oceanographic geographical features

Publications

Wåhlström, I., Hammar, L., Hume, D., Pålsson, J., Almroth-Rosell, E., Dieterich, C., Arneborg, L., Gröger, M., Mattsson, M., Zillén Snowball, L., Kågesten, G., Törnqvist, O., Breviere, E., Brunnabend, S.-E., & Jonsson, P. R. (2022). Projected climate change impact on a coastal sea—As significant as all current pressures combined. Global Change Biology, 28, 5310– 5319. https://doi.org/10.1111/gcb.16312
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If you have published anything based on these data, please notify us with a reference to your publication(s). If you are responsible for the catalogue entry, you can update the metadata/data description in DORIS.

Polygon (Lon/Lat)

8.56076, 53.440953

26.851088, 53.440953

26.851088, 66.021589

8.56076, 66.021589

8.56076, 53.440953

Accessibility level

Access to data through SND
Data are freely accessible

Use of data

Things to consider when using data shared through SND

License

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Versions

Version 1. 2022-09-29

Homepage

ClimeMarine – Climate change predictions for Marine Spatial Planning (SMHI)

Download metadata

DataCite

DDI 2.5

DDI 3.3

DCAT-AP-SE 2.0

JSON-LD

PDF

Citation (CSL)

File overview (CSV)

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