Climate and elevation

Indicator name

Monthly Climate statistics and Virtual Elevation profiles

Indicator unit

Climate statistics provide monthly rainfall averages (mm) and monthly mean, maximum and minimum temperatures (C°) for the terrestrial part and monthly mean sea surface temperatures (C°) for the marine part of protected areas. Elevation statistics (minimum, maximum, mean, standard deviation and median) are given in meters.

Area of interest

The climate and the elevation statistics are computed for each protected area of size ≥ 25 km^2.

Related targets

Sustainable Development Goal 14 on life below water

Sustainable Development Goal 15 on life on land

Aichi Biodiversity Target 11 on protected areas

Aichi Biodiversity Target 12 on species

Policy question

How vulnerable is an area to climate change? If protected areas are geographically fixed, their environment can be subject to many changes. As ecosystems and species distributions are largely characterized and influenced by the relief and bioclimatic parameters, a better understanding of the local environment is essential. Providing monthly average statistics about rainfall and temperature or sea surface temperature combined with information about the relief of each protected area can contribute to our understanding of the abiotic and biotic environment and of the potential vulnerability of the area to climate change (Thomas *et al.*, 2004; Carpentar *et al.*, 2008; Dawson *et al.*, 2011).

Use and interpretation

Each protected area can be characterized by a set of environmental parameters which help understanding the potential variety of ecosystems and species it is hosting (Holdridge, 1947). Generally speaking, hot and humid areas are known to be the places in the world hosting the greatest diversity of species while dry areas, whether cold or hot, tend to support fewer species. Similarly, protected areas with a complex topography are also more likely to host a greater diversity of species, the best example being coastal areas or ‘reef to ridge’ protected areas which bring together marine and terrestrial environments.

While protected areas with strong seasonal climate variability often play an essential role in the context of species migrations, those with lower climatic variability are, in general, more likely to be most affected by climate change as the species associated to such areas may not be able to adapt to new conditions and may not find inside the protected area the room to survive to changes. In DOPA, we present monthly climate and sea surface temperature statistics as averaged values over time (Figure 1) and such trend data can be used to assess current anomalies which can be identified by their strength, their temporal deviation (e.g. late/early rainy seasons) and by their duration.

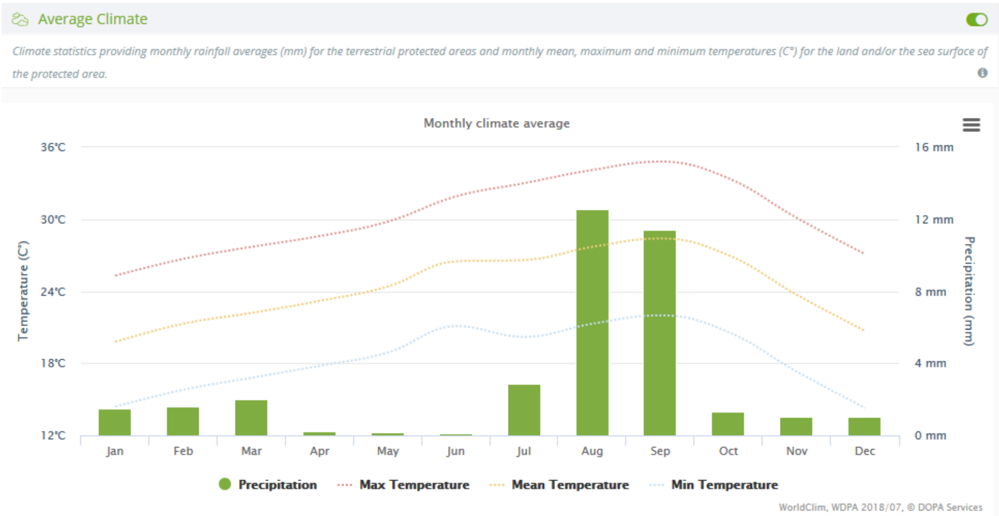

Figure 1. Chart of monthly temperature (lines) and rainfall (bars) statistics for the terrestrial part of the coastal National Park of Banc d'Arguin (Mauritania). Minimum and maximum temperatures are indicated in red and blue, respectively. Mean temperature values are in yellow. The chart above highlights a dry season from March to June (no rainfall on average).

The presentation of a virtual elevation profile of the protected area (Figure 2) will further help to assess the variability of the environment because monthly climate statistics might not be representative of the full spectrum of climatic parameters in the case of very large areas or for areas presenting complex topology such a mountainous or coastal areas.

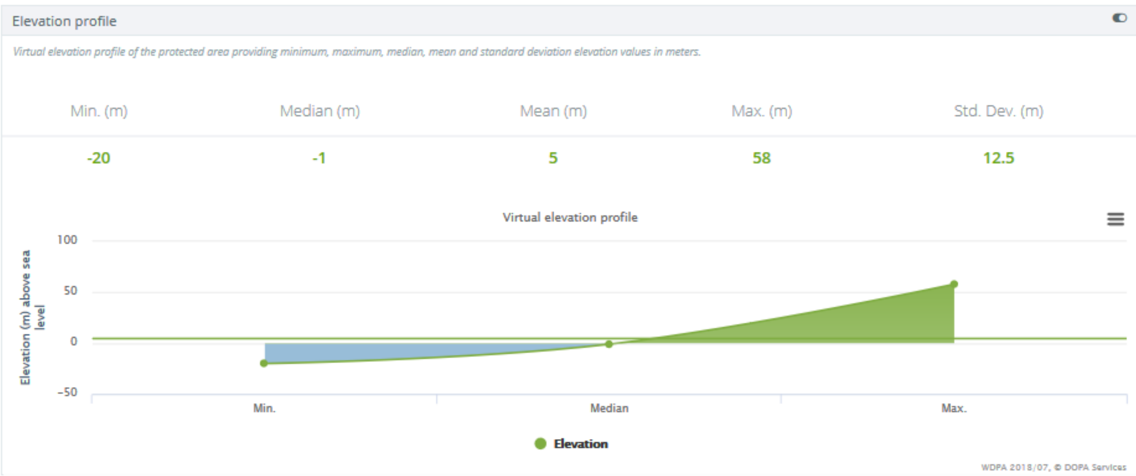

Figure 2. Virtual elevation profile for the coastal protected area of Banc d'Arguin National Park, Mauritania). Topography below sea level is highlighted in blue.

Protected areas with complex topography and higher climatic variability are likely to be more resilient to climatic changes but may also require more resources for the management than those with a more homogenous environment.

Key caveats

Protected areas with climatic information will often report the climate of low altitudes for terrestrial areas and of the sea surface for marine areas. Computing average monthly values for the whole area might circumvent this bias to some extent for terrestrial areas. Still, a single set of average monthly climatic variables computed over the whole surface of a large protected area cannot capture the full complexity of the area. Hence, by providing an elevation profile of the protected area we highlight the potential complexity of the relief and the associated climatic conditions. The same applies for marine areas for which only sea surface temperature is provided.

Indicator status

Published in peer reviewed papers (Dubois *et al.*, 2015) and technical reports (Dubois *et al.*, 2016). Standard statistics, no modeling involved.

Available data and resources

Data available

The DOPA Explorer website provides at http://dopa-explorer.jrc.ec.europa.eu/ the following downloadable data:

- Monthly rainfall averages (mm) and monthly mean, maximum and minimum temperatures (C°) computed over the period 1970-2000 for each terrestrial and coastal protected area ≥ 25 km^2.
- Monthly mean, minimum and maximum sea surface temperatures (C°) computed over 10 years (2007-2016) for each marine and coastal protected area ≥ 25 km^2.
- Elevation statistics (minimum, maximum, mean, median and standard deviation) in meters for each protected area ≥ 25 km^2. Negative values correspond to the bathymetry, the elevation below the sea level.

For coastal protected areas, DOPA Explorer provides only climate data for the terrestrial part of the area.

Data updates

Planned with each update of DOPA.

Codes

The python codes used to generate the climate and elevation statistics can be found in Documentation section of the DOPA web site at http://dopa.jrc.ec.europa.eu/

Methodology

Methodology

A 30 arc-sec (≈ 1 km^2) gridded global elevation data set of the world (GEBCO 2014) is used to calculate, for each protected area of size ≥ 25 km^2, a virtual elevation profile by computing the minimum, maximum, mean and median values over the area delineated by the boundaries of the protected area.

UNESCO Biosphere Reserves have been discarded as well as protected areas with known areas but undefined boundaries.

The same applies for monthly climate data from WorldClim 2 available globally on a 30 arc-sec (≈ 1 km) grid as well as for the sea surface temperature (0.25° ≈ 28 km) grid from the Copernicus Marine Environment Monitoring Service. Monthly average rainfall values and minimum, maximum and mean temperature values where computed over the period 1970-2000 for the terrestrial components of the protected areas. Monthly sea surface temperatures (min, max, mean) where computed over 10 years (2007-2016) for the marine parts of the protected areas using data from the Copernicus Marine Environment Monitoring Service.

Input datasets

The statistics have been produced using the following input datasets:

Protected Areas

- WDPA of July 2018 (UNEP-WCMC & IUCN, 2018).
    - Latest version available from: www.protectedplanet.net

Temperature and precipitations

- WorldClim 2, Release 1, June 2016 (Fick & Hijmans, 2017)
    - Latest version available from: www.worldclim.org/version2

Sea Surface Temperature

- Global monthly data distributed by the Copernicus Marine Environment Monitoring Service (Product identifier: SST_GLO_SST_L4_NRT_OBSERVATIONS_010_001) where extracted for the period January 2007- December 2016 (Donlon *et al.*, 2012).
    - Latest version available from: http://marine.copernicus.eu

Elevation (bathymetry and topography)

- GEBCO 2014 Grid (Weatherall *et al.*, 2014)
    - Latest version available from: http://www.gebco.net/data_and_products/gridded_bathymetry_data/

References

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Weatherall, P., *et al.* (2014). A new digital bathymetric model of the world's oceans. *Earth and Space Science*, 2, https://doi.org/10.1002/2015EA000107

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