



GRANULAR

DATA PROCESSING & DELIVERY

HUMAN DISTURBANCE IN- TENSITY IN 2018 IN EUROPE (HEMEROBY INDEX)

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How to deliver data and metadata

1. Objectives of the dataset

This dataset provides a harmonised map of human disturbance intensity for Europe in 2018, based on the hemeroby concept. It quantifies how far current land cover deviates from potential natural vegetation due to human activities, using a seven-class hemeroby scale from ahemerobic (natural) to metahemerobic (artificial).

The main purpose is to offer a 1 km grid that consistently characterises rural–urban gradients and management intensity across European countries, improving on structural land-cover indicators derived directly from CORINE Land Cover. The dataset is designed for use in GRANULAR analyses of rurality, land-use intensity, and environmental pressures, and for integration with other indicators on the same 1 km reference grid.

2. Input data

The hemeroby index is derived from the following input datasets (see `metadata_hemeroby_inputs` metadata file for details):

- **CORINE Land Cover 2018 (CLC2018), status layer**
 - Provider: Copernicus Land Monitoring Service (European Environment Agency).
 - Format and resolution: raster, 100 m, 44 land cover classes.
 - Coordinate Reference System (CRS): ETRS89 / LAEA Europe, EPSG:3035.
 - Role: provides land cover classes that are reclassified into hemeroby levels following published European hemeroby schemes.
- **JRC ESTAT Census Population Grid 2021 (1 km)**
 - Provider: Joint Research Centre (JRC) and Eurostat.
 - Format and resolution: raster, 1 km grid cells with population counts.
 - CRS: ETRS89 / LAEA Europe, EPSG:3035.
 - Role: provides the reference 1 km grid and population information used to align the hemeroby raster to the GRANULAR 1 km framework.
- **Degree of Urbanisation (DEGURBA) grid, Level 2 (1 km)**
 - Provider: Eurostat / GISCO.
 - Format and resolution: 1 km grid with DEGURBA classes (cities, towns and suburbs, rural areas and subclasses).
 - CRS: ETRS89 / LAEA Europe, EPSG:3035.
 - Role: defines the official 1 km grid used for the output and ensures compatibility with other GRANULAR rural/urban analyses.

All input datasets were used under the terms of their respective EU open data licences; users should consult the original providers for detailed licence conditions.

3. Data processing workflow

The processing is implemented in the R script `hemeroby.R`, using the `terra`, `dplyr` and `ggplot2` packages. Below is a summary of the main steps.

1. Loading and preparing input rasters

The CLC2018 raster (`U2018_CLC2018_V2020_20u1.tif`) and the DEGURBA population/grid raster (`ESTAT_OBS-VALUE-POPULATED_2021_V2.tif`) are loaded as `SpatRaster` objects in R. Both datasets are in ETRS89 / LAEA Europe (EPSG:3035), which is used as the common projection for all processing.

2. Normalising CORINE classes

The CLC2018 raster is converted to numeric codes and reclassified to standard CORINE class codes (e.g. 111, 112, 211, 311, etc.) using an explicit look-up table. A first `reclass_matrix` maps the original coded values to these CLC codes (1–44 and 48 mapped to 111–523), and all other values are set to NA to remove non-land cells.

3. Reclassifying CORINE to hemeroby levels

A hemeroby table is defined which associates each relevant CLC code with a hemeroby level between 1 and 7:

- 7: artificial surfaces (metahemerobic, e.g. CLC 111–124).
- 6: mixed artificial surfaces (polyhemerobic, e.g. 131–142).
- 5: intensive agriculture (α -euhemerobic, e.g. 211–213, 334, 422).
- 4: moderate agriculture (β -euhemerobic, e.g. 221–244).
- 3: semi-natural (mesohemerobic, e.g. 321, 324).
- 2: near-natural (oligohemerobic, e.g. forest and semi-natural classes 311–323, 331, 333, 411–421).
- 1: natural (ahemerobic, e.g. CLC 332, 335, 423).

This scheme follows the European applications of hemeroby for agricultural and landscape monitoring described by Paracchini & Capitani (2011) and Walz & Stein (2014). Using `terra::classify`, CLC codes are reclassified into a raster of integer hemeroby values, with NA for cells without valid CLC information.

4. Aligning hemeroby to the 1 km DEGURBA grid

The geometry of the hemeroby raster is compared with the DEGURBA grid; if they differ in resolution or extent, the hemeroby raster is first reprojected to match the DEGURBA CRS and grid definition. The hemeroby raster is then resampled to the 1 km DEGURBA grid using `terra::resample` with `method = "mode"`, so that each 1 km cell takes the most frequent hemeroby value among overlapping 100 m CLC pixels. The resulting raster is named `hemeroby` and contains a single band of integer values between 1 and 7 over the European 1 km grid.

5. Quality checks and diagnostics

Basic summaries of the hemeroby raster on the DEGURBA grid (min, max, mean, frequency of each class) are computed with `summary()` and `terra::freq`. A bar plot of class frequencies is produced with `ggplot2` to inspect the distribution of hemeroby values and check for unexpected gaps or artefacts.

6. Exporting the output

The final 1 km hemeroby raster is written to GeoTIFF with `terra::writeRaster`, using `overwrite = TRUE`. The output file is named `EU_hemeroby_index_2018.tif` (or a similar name defined in the script) and is ready for sharing through the GRANULAR Zenodo collection.

4. Output data

The main output dataset is:

- **Human disturbance intensity in 2018 in Europe (hemeroby index)**
 - Variable: hemeroby – integer hemeroby level per 1 km grid cell; 1 indicates natural or near-natural conditions, and 7 indicates highly artificial surfaces with strong human disturbance.
 - Spatial coverage: Europe, following the EEA / Eurostat 1 km reference grid in ETRS89 / LAEA Europe (EPSG:3035).

- Temporal reference: The hemeroby classification is based on CLC2018, representing land cover conditions around the reference year 2018.
- Unit: Dimensionless ordinal scale (1–7).

For detailed metadata (file name, format, CRS, resolution, point of contact, abstract), refer to the accompanying metadata file `metadata_hemeroby_output` provided in GRANULAR's metadata template format.