Creating Essential Biodiversity Cubes with R: the ebvcube package

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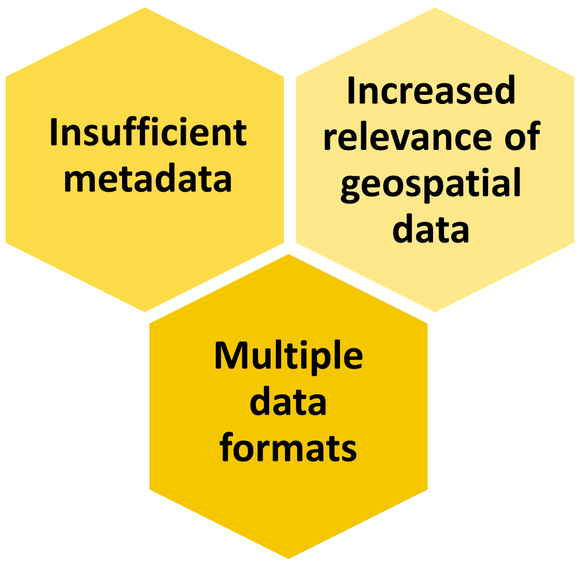
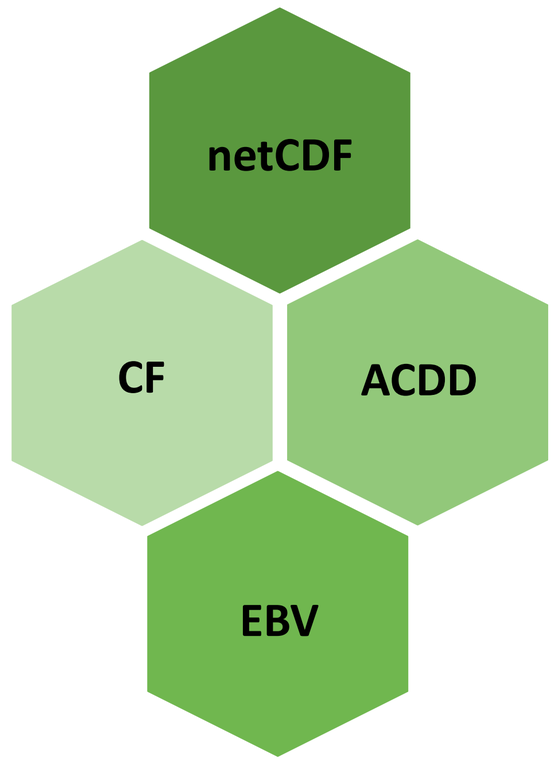
1. Background



Aim: Introducing an interoperable data structure for rasterized geospatial biodiversity data based on the Essential Biodiversity Variables (**EBV**)[3] concept.

2. Concept



File type:
- The data sets are created using the Network Common Data Form (**netCDF**)[4].

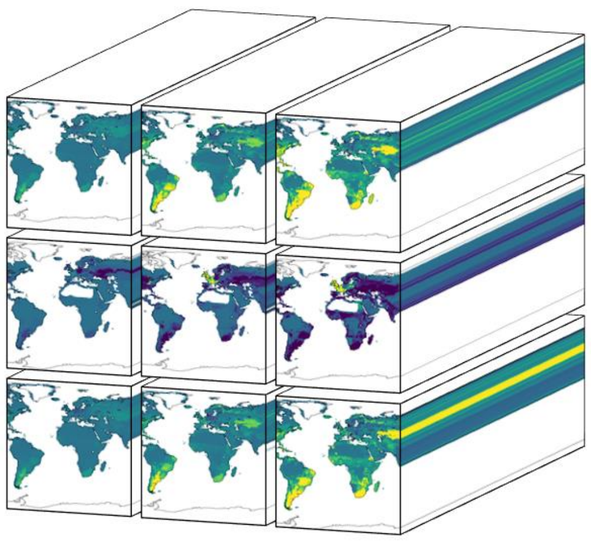
Conventions:
- Internal data structure and metadata terms are based on the Climate and Forecast Convention (**CF**)[2].
- Additional metadata terms are added based on the Attribute Convention for Data Discovery (**ACDD**)[1].

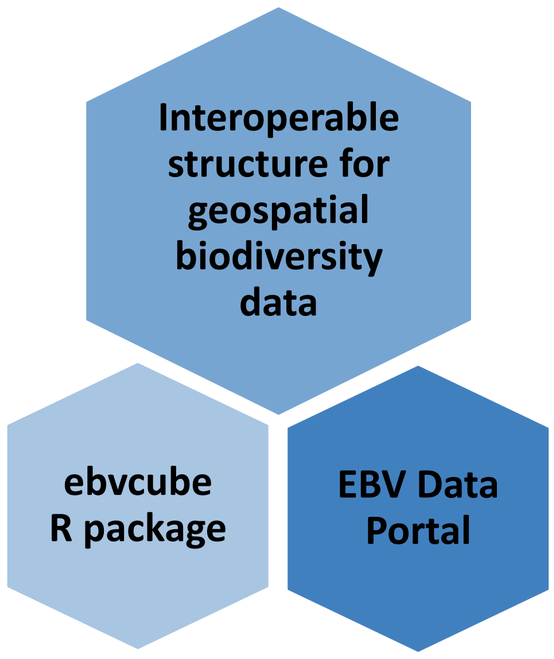
Additional Terms:
- New metadata terms belonging to the **EBV** concept are introduced.

3. EBV netCDF

3.1 EBV-Cube dimensions

longitude, latitude, time and entity





3.2 Hierarchical structure

```
ebv-dataset
├─ global attributes
├─ dimensions [lon, lat, time, entity]
├─ (coordinate) variables
├─ scenario_1
│  ├─ group attributes
│  ├─ metric_1
│  │  ├─ group attributes
│  │  └─ ebvcube [lon, lat, time, entity]
│  │     └─ datacube attributes
│  ├─ metric_2
│  │  └─ ...
│  └─ ...
├─ scenario_2
│  └─ ...
└─ ...
```

The EBV-Cubes have four dimensions: longitude, latitude, time and entity (e.g., different species). The usage of hierarchical groups allows for the coexistence of multiple EBV-Cubes. The first level are scenarios. The second level are metrics. All metrics are repeated per scenario, if any are present.

4. The ebvcube R package functionality

Basic Access
- ebv_datacubepaths: Return all available EBV-Cubes
- ebv_properties: Collect all the metadata
- ebv_download: Download from the EBV Data Portal

Data Creation
- ebv_create: Create a new EBV netCDF
- ebv_add_data: Add data to the new netCDF
- ebv_attribute: Change attribute values

Data Access
- ebv_read: Read the data
- ebv_read_bb: Read a spatial subset (bounding box)
- ebv_read_shp: Read a spatial subset (Shapefile)
- ebv_write: Write data to disc
- ebv_analyse: Return basic measurements
- ebv_resample: Resample the pixel size and alignment

Data visualization
- ebv_map: Plot a map
- ebv_trend: Plot trend over time

GitHub repository: github.com/LuiseQuoss/ebvcube

References:
[1]Earth Science Information Partners. (2020). Attribute Convention for Data Discovery 1-3. https://wiki.esipfed.org/Attribute Convention for Data Discovery 1-3
[2]Eaton, B. et al. (2020). NetCDF Climate and Forecast (CF) Metadata Conventions - Version 1.8. https://cfconventions.org/Data/cf-conventions/cf- conventions-1.8/cf-conventions.html
[3]GEOBON. (2021). What are EBVs? https://geobon.org/ebvs/what-are-ebvs/
[4]Unidata. (2021). Network Common Data Form (NetCDF). Boulder, CO: UCAR/Unidata Program Center. https://doi.org/10.5065/D6H70CW6

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