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D3.2 European Base Layer

Gabriela Popova,  Michael Beckmann, Lena Friedrich, Miene-Marie Gastinger, Anne Paulus, 
Tomáš Václavík, Chunhui Li, Guy Ziv,  Paul Evans



European Base Layer

Deliverable 3.2

28 February 2021

Michael Beckmann¹, Lena Friedrich¹, Miene-Marie Gastinger¹, Anne Paulus¹,
Tomáš Václavík², Jenny Li³, Guy Ziv³, Paul Evans⁴

¹*Helmholtz Centre for Environmental Research - UFZ*

²*Palacký University Olomouc*

³*University of Leeds*

⁴*UK Centre for Ecology and Hydrology*

BESTMAP

**Behavioural, Ecological and Socio-economic Tools for
Modelling Agricultural Policy**



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¹*Helmholtz Centre for Environmental Research - UFZ*
²*Palacký University Olomouc*
³*University of Leeds*
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Preface

This document describes the compilation of the European Base Layer dataset for the H2020 project BESTMAP. It is accompanied by a list of datasets forming this Base Layer. This deliverable is based on the Case Study Base Layer which was created as Deliverable D3.1 in month 15.

This report aims at documenting the process of data compilation and harmonization as well as data management and access. Furthermore, it briefly describes the use of European Base Layer data in various tasks within BESTMAP.

Summary

The European Base Layer, described in this deliverable, is a harmonised geospatial database spanning across Europe. It builds upon the infrastructure created for the Case Study Base Layer (D3.1) and includes geospatial information on climatic and soil conditions, biodiversity, land use/land cover (including crop types) data. It serves as a base for all modeling activities in BESTMAP's WP5 including biophysical ecosystem service (ES) models. Thereby, the European Base Layer will be crucial for mapping Farming System Archetypes (FSAs) and for building a common agent-based modeling (ABM) framework across Europe. This report accompanies the data in Deliverable D3.2 and describes the compilation, harmonization, meta-data structure, secure storage and access of case study Base Layer data using the BESTMAP instance of the UFZ GeoNetwork.

1. Introduction and purpose of the European Base Layer

The European Base Layer, described in this deliverable, is a harmonised geospatial database spanning across Europe. It includes spatial information on climatic and soil conditions, biodiversity, land use/land cover (including crop types), farm structure and socio-economic data. It serves as a base for biophysical ecosystem service (ES) models as well as socio-economic statistical models. These models will feed into the process of mapping Farming System Archetypes (FSAs) and their change across Europe. FSAs will be used for building a common Agent-based Modeling (ABM) framework (see deliverables D1.3 “Guidelines and protocols harmonizing activities across CSs” and D2.2 “BESTMAP Policy Impact Assessment Model Conceptual Framework” for details).

During the process of creating the Case Study Base Layer (D3.1), a list of data requirements (standards in terms of resolution and time periods etc.) was compiled. These requirements have been adapted for creating the European Base Layer as described here. Metadata was added to the BESTMAP instance of the UFZ GeoNetwork (<https://geonetwork.ufz.de>).

1.1. Use of European Base Layer data within BESTMAP

Upscaling from case studies to European level

The European Base Layer serves as the repository of candidate data sets that will be used to upscale and assess transferability of biophysical and ABM models at the European level. As our upscaling strategy relies not only on gridded biophysical data but also on FADN data, FADN regions will be considered as units of analysis. In a large portion of the EU, FADN regions are equivalent to NUTS2 but in places where they are too large, we will use NUTS2 or potentially even NUTS3 regions, using FADN microdata when accessible. Therefore, for gridded European Base Layers, their values will be aggregated (e.g. averaged) over individual FADN polygons.

The transferability of BESTMAP models will be assessed by mapping the similarity of FADN regions across the EU to the study regions of BESTMAP CSs. The plan is to select a list of variables that represent important region attributes we argue control either adoption or impact of AES. Two groups of variables will be considered, representing either farm system (e.g. economic size, farm specialization, area of arable land, field size) or biophysical characteristics (climate, topography, soils). The farm system data are and will continue being collected from either FADN Standard Reports (already online in FADN regions), the temporal trend in some FADN indicators in the last years, and European Social Survey / World Values Survey (coarsened to FADN region via weighted averaging) / Hofstede Culture Compass / Eurostat / FAOStat / Eurobarometers. The biophysical characteristics will include a number of gridded biophysical/climate/pedological sources. However, a different set of EU-wide FADN region-scale variables needs to be defined for the transferability of (a) biophysical models of ecosystem services and of (b) the ABMs of farmers' adoption of AES. The envisioned end result will be a model operating on a subset of FADN regions across Europe, where we consider at least one of BESTMAP case study models to be adequate for transferring ABM and impact models. The final set of variables needed for upscaling from case studies to

European level will be defined in next months. However, the majority of the biophysical variables have been already collected and are included in the European Base Layer.

Biophysical Modelling

The European Base Layer serves as the collection of candidate data files that span the whole extent of Europe that may be used in the BESTMAP project to model ecosystem services across the EU. The EU-wide models will be adapted extensions of the underlying biophysical models that will be run in each of the BESTMAP Case Study (CS) areas. This will be achieved using ecosystem service profiles of the different Farming System Archetypes (FSA), obtained from all of the CS areas, combined with the layers in the European Base Layer, both of which will then be analysed together to determine whether each layer explains a good proportion of the variance or not. If the data layers are shown to be useful, they will then be kept in the European Base Layer list and used in the final EU-wide modelling. If not, they may be removed. The data layers listed include ones that may be used for modelling ecosystem services associated with water quality and quantity (yield), sediment retention, food and fodder, carbon sequestration, and biodiversity.

All data that has already been collected for the biophysical models in BESTMAP has been included in the European base Layer. However, this process is ongoing and more data will be added to the European Base Layer during the course of the project.

Agent-Based Modelling at European scale

The European Base Layer will be used as one of main data sources for the Agent-Based Model (ABM) at the European scale. As it is stated in the conceptual framework in D2.2, the spatial information on soil and terrain characteristics as well as land use/land cover, which determine biophysical characteristics of the landscape, are included in the model as important factors in farmers' decision-making. These biophysical variables in the ABM will be parameterised using the European Base Layer.

Apart from the European Base Layer, FADN data and social surveys will be used as data sources for FSAs variables and behavioural variables in the ABM at the European scale. Because farmers' behavioural data is not available at the EU level, more research will focus on developing methodologies for transferring behavioural data that is collected at the case study level (e.g. from interview campaigns and discrete choice experiments) to the EU level using aggregated information through FADN data and available social survey data, such as the European Social Survey, the World Values Survey, Hofstede Culture Compass, Eurostat, FAOStat or Eurobarometers.

2. Data Compilation, Harmonization, Storage and Use

2.1. Metadata curation

Metadata of European Base Layer datasets are stored in the UFZ GeoNetwork application (<https://geonetwork.ufz.de>). This ensures both efficient data management as also case study Base Layer metadata are included in the GeoNetwork.

The software *GeoNetwork opensource* is a catalogue application to manage spatial data. It contains tools to edit, search and report metadata as well as a web map viewer functionality (<https://geonetwork-opensource.org>). Figure 2 depicts an exemplary excerpt of a metadata record in the UFZ GeoNetwork. Metadata was compiled in accordance with the ISO19139 standard. The record includes information on spatial and temporal extent of the dataset, keywords, a contact person and a download link to the data.

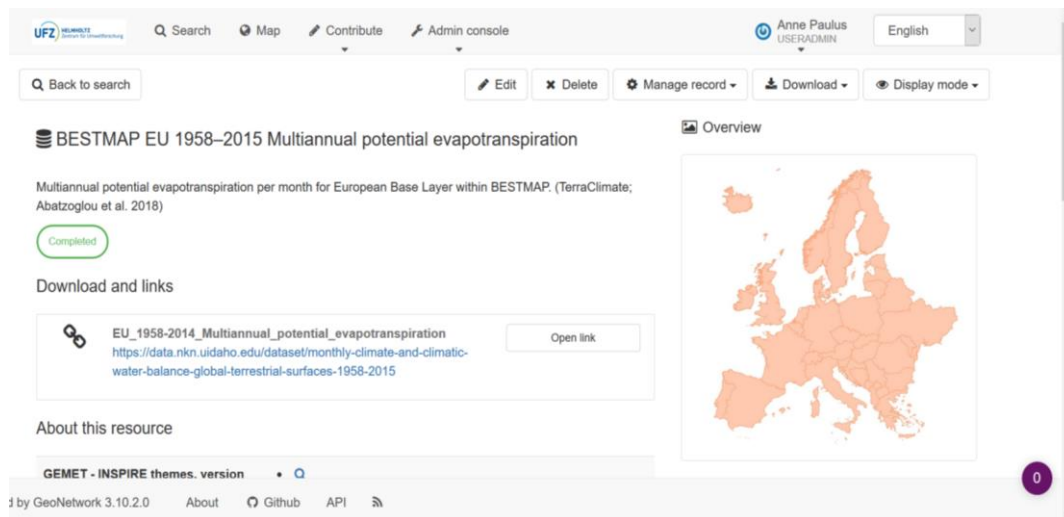


Figure 2: Example of a UFZ GeoNetwork metadata record.

The metadata records follow a consistent naming convention and include a relevant title, a date, an abstract as well as information on spatial and temporal extent (begin date, end date) of the dataset, relevant descriptive keywords, a contact person and a download link to the data (Table 1).

Table 1: Overview of the metadata elements recorded within BESTMAP’s GeoNetwork.

| Metadata element | Description | Example |
|------------------|---|---|
| Dataset Title | Descriptive title of the dataset | BESTMAP EU 1958-2015 Multiannual potential evapotranspiration |
| Date | Generation publication (last) revision | 2018-01-01 |
| Abstract | Short textual description of the dataset | Multiannual potential evapotranspiration per month for European Base Layer within BESTMAP. (TerraClimate; Abatzoglou et al. 2018) |
| Spatial extent | If raster, please also include spatial resolution (pixel size) in meters. | grid spatial resolution : 4000 Coord. system: 4326 |

| | | |
|--------------------|---|---|
| Keywords | Must include “European Base Layer” and a selection of: Soil, Climate, Land Use/Land Cover, Terrain, Biodiversity or Agriculture. | <ul style="list-style-type: none"> • European Base Layer • EU • Climate |
| Contact person | Gives information about the organisation, address and name of the person who is responsible for the creation of the metadata and the construction, attitude and passing on of the designated data | Helmholtz-Zentrum für Umweltforschung - UFZ Point of Contact : Anne Paulus |
| Download link | Download link | https://data.nkn.uidaho.edu/dataset/monthly-climate-and-climatic-water-balance-global-terrestrial-surfaces-1958-2015 |
| Access constraints | It indicates if the database is public accessible or restricted /embargo | none |
| Language | Indicate language | english |

2.2. Data Access, Storage, Use, and Handling

Access to the BESTMAP instance of the UFZ GeoNetwork requires a registered account (to sign up, please contact Anne Paulus, anne.paulus@ufz.de).

After having logged-in, the *Search* element can be used to find all previously created records, e.g. BESTMAP data included in the European Base Layer. Metadata records follow a naming convention and include all elements listed in Table 1. The associated datasets are linked as *Associated resources*. Depending on data rights requirements, there are two ways the datasets are linked within the metadata record: either directly downloadable by logged in users through an URL or by links that refer to limited access storage.

In the latter case, data use licences do not allow sharing datasets with the whole project team but e.g. only a specific project partner. For these datasets, metadata records were created linking to a password protected Google GSuite drive where the actual data are stored. This way, we could ensure that all metadata are retrievable without violating licences of sensitive data.

Depending on the user group an account has been assigned to, users cannot only view and download data but also edit metadata records or create new records.

Using the UFZ GeoNetwork will establish long-time data availability since BESTMAP’s GeoNetwork instance will be continued beyond the running time of the project. Weekly backups ensure data security. Data can be retrieved through UFZ data search and improving discoverability through geonetwork’s API is currently being discussed by UFZ IT staff.

2.3. API usage for direct access to data stored in BESTMAP’s GeoNetwork

BESTMAP's geonetwork can be accessed directly from R or Python using the geonetwork REST API. In order to retrieve data the following code may be used from within R:

```
##### Header - adjust to make this work
username="XXX" # user credentials for geonetwork.ufz.de
password="XXX"
geonetworklink="https://geonetwork.ufz.de/geonetwork/srv/api/0.1/records/XXX"
# Links to data can be found under "Download and links" in each database
entry
filename="XXX.zip" # chose target filename, files will be downloaded into
active working directory
#####

# install.packages ("geonapi", "curl") # run once
library("geonapi", "curl")

# create logged in session for geonetwork.ufz.de
GN <- GNManager$new(
  url = "https://geonetwork.ufz.de/geonetwork", # base URL of the
  Geonetwork
  version = "3.10.2",
  user = username, pwd = password,
  logger = "INFO"
)

# create handle for curl
h<- curl::new_handle()
curl::handle_setopt(
  handle=h,
  httpauth=1,
  userpwd = paste(username, ":"),password, sep=""),
  verbose=FALSE # set TRUE to show detailed outputs
)

# download
curl_download(url=geonetworklink, filename, handle=h)

# in case of zipped archives are downloaded this way you can use unzip() to
proceed from within R
```

3. Data included in the European Base Layer

The European Base Layer combines geospatial data from multiple sources. Table 2 provides an overview of the datasets included.

Table 2: Overview of the geodata catalogued in the UFZ GeoNetwork that form the European Base Layer. More details on the individual datasets can be found in the accompanying file “D3.2 - European Base Layer Metadata Table” and in the metadata entries with BESTMAP’s GeoNetwork instance (Section 2).

| Keyword | Dataset Title |
|---------|--|
| Soil | BESTMAP EU 1950-2017 Soil pH |
| | BESTMAP EU 2013 Topsoil bulk density |
| | BESTMAP EU 2013 Topsoil organic carbon |

| | |
|---------------------|---|
| | BESTMAP EU 2013 Topsoil clay content |
| | BESTMAP EU 2015-present Surface soil moisture |
| | BESTMAP EU 2014 Soil erodibility |
| | BESTMAP EU 2015 Rainfall erosivity index |
| | BESTMAP EU 2018 Soil group (HOST) |
| | BESTMAP EU 2015 Soil group (HOST) |
| | BESTMAP EU 2015 Plant Available Water Content |
| | BESTMAP EU 2012 Root restricting layer depth |
| Climate | BESTMAP EU 1950-2020 Daily precipitation |
| | BESTMAP EU 1958–2015 Multiannual precipitation |
| | BESTMAP EU 1950–2018 Daily minimum temperature |
| | BESTMAP EU 1958–2015 Multiannual minimum temperature |
| | BESTMAP EU 1950–2018 Daily maximum temperature |
| | BESTMAP EU 1958–2015 Multiannual maximum temperature |
| | BESTMAP EU 1958–2015 Multiannual potential evapotranspiration |
| | BESTMAP EU 2007-2016 Solar radiation |
| | BESTMAP EU 2002-2006 Potential evapotranspiration |
| | BESTMAP EU 2020 High resolution climate data for Europe |
| Terrain | BESTMAP EU 2011 Digital terrain model |
| | BESTMAP EU 2012-2018 Forest |
| | BESTMAP EU 2015-2018 Grassland |
| | BESTMAP EU 2017 Digital elevation model |
| | BESTMAP EU 2015-2018 Water & Wetness |
| | BESTMAP EU 2020 River barrier |
| Land Use/Land Cover | BESTMAP EU 2017 Land cover |
| | BESTMAP EU 2004-present OpenStreetMap |
| Biodiversity | BESTMAP EU 2015 Small Woody Features |

3.1. Further data used in European ABM

The European ABM analysis will rely on a broad range of input many, many of which are of non-spatial nature and therefore not included in the European base layer. These data include information on farmer attitude and social capital obtained from surveys and literature

reviews. Farm information, such as economic size, specialization, and previous AES participation will be derived from FADN. The ABM will also take into account member state legislation on AES regulations.

4. Outlook

The European Base Layer will enable all of BESTMAP's modeling activities on the European scale (WP5). The compilation of European-wide geodata will be continued to fulfil potential upcoming data needs. Ultimately, both Case Study and European Base Layers are planned to be used as input layers in BESTMAP's Policy Impact Assessment Dashboard (MS11, due in month 40).

5. Acknowledgements

We thank Andreas Böhme for help to set up the BESTMAP instance of the UFZ GeoNetwork.