European long-term ecosystem, critical zone and socio-ecological systems research infrastructure PLUS

Field Specification for data reporting

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1 Introduction

The following document provides a description of the eLTER Data specification for data reporting and reflects a description of the structure (columns, fields) and content (description) of the data-reporting template. The data-reporting template consists of core fields (basic reporting) and possible extensions (extended reporting) providing additional fields (e.g. aggregation or quality flags).

The data reporting consists of different entities providing the data together with the necessary additional documentation to ensure the use- and re-use of the data:

- DATA – containing the observation values
- STATION – containing information on the location of observation and sampling plots including the reference to the eLTER site
- METHOD – containing descriptions of the variables and the methods and protocols applied
- REFERENCE – containing information on code lists (e.g. taxon names, land cover type, soil type)
- EVENT – containing information observation events (e.g. vegetation relevee, observation campaigns, sampling events), only provided if events or sampling campaigns are documented
- SAMPLE – containing information on samples collected during a sampling event, only provided if samples are collected and stored and the information is provided with the data
- LICENSE – providing information on the data license applied and the usage restrictions

2 Data reporting format

The data-reporting can be provided in simple ASCII format (e.g. csv) or Excel-Format (e.g. xls, xlsx). CSV is recommended, as it ensures better interoperability.

2.1 Text format

Data and descriptive information can be provided as text format (e.g. csv or txt) in UTF-8 encoding. Data and the related metadata (e.g. station, method, references) are provided as separate files and provided as zipped data package, e.g.

AT_ZOEBELBODEN_VEG_SPECCOVER_2015_V20170315.zip

- *AT_ZOEBELBODEN_VEG_SPECCOVER_2015_V20170315.CSV*
- *STATION.CSV*
- *METHOD.CSV*
- *REFERENCE.CSV*
- *EVENT.CSV*
- *SAMPLE.CSV*
- *LICENSE.TXT*

Encoding	UTF-8
Tab-Separator	Tabulator or Semi-colon (;)
Comma-Separator	Comma (,) or dot (.)
File extension	csv, tsv, txt

2.2 Microsoft Excel

Alternatively, the data can also be provided using Microsoft Excel as reporting file format, the different information blocks (e.g. station, method, data, and references) are tables within one spreadsheet.

AT_ZOEBELBODEN_VEG_SPECCOVER_2015_V20170315.xls

- *DATA*
- *STATION*
- *METHOD*
- *REFERENCE*
- *EVENT*
- *SAMPLE*
- *LICENSE*

Encoding	UTF-8
Comma-Separator	Comma (,) or dot (.)
File extension	xls, xslx

2.3 File naming convention

The naming convention for files is:
Template: [2-digit Country code]_[LTER Site Name]_[Data group] _[Variable group]_[Time span]_[Version]
Example: *AT_ZOEBELBODEN_VEG_SPECCOVER_2015_V20170315*

Element	Description	Example
2-digit Country code	Reference to the country of the site as two-digit country code according to ISO 3166-1 alpha-2	AT
LTER Site Code	Name of the site according to DEIMS-SDR, if the name is too long the site name can be shortened	ZOEBELBODEN
Data Topic	Max 5-digit code for data topic or observation programme, e.g. METEO (Meteorology), BIODIV (biodiversity), DEPO (deposition), GHG (Green House gas), SW (Soil water). The abbreviation is defined by the data provider depending on the data.	VEG
Variable group	Optional, list of variables or variable groups contained in the data. The abbreviation is defined by the data provider depending on the data.	SPECCOVER
Time span	Time span covered in the data	2015
Version	Data version in the format “V”YYYYMMDD	V20170315

3 Field description

The different data entities are described in the following chapters. The list of fields provide and overview on the core fields (mandatory) and the possible extension. The extended fields are used for the extended data reporting.

Encoding if required

m … mandatory o … optional c … conditional

The fields used in the **basic data reporting template** are marked with “m” for mandatory fields.

3.1 Station

Definition: A **STATION** is an ***observation entity within a site or platform***. Station in this respect is synonym to plot, observation location, sensor location, etc. and is defined by a location, elevation and installation height (if relevant) which is located within a given LTER site or platform.

Whereas, full documentation on sites can be found on DEIMS-SDR, in general the single stations are not documented there. There, a single station or a group of stations is described as bounding box for the dataset (see https://deims.org/models, dataset) covering normally a range of stations. Therefore, it does not reflect the single stations/plots, which are needed as descriptive information in addition to the data. The additional information on the stations/plots needs to be provided together with the data.

Basic information about the stations is provided in the entity type STATION. Basic information consists of the station code, site reference, location, elevation, and size. If additional information is needed, e.g. installation height, habitat type for vegetation data additional fields (columns) can be used or created if missing. In addition information to retrieve computable geospatial representation of the STATION (e.g. OGC WFS, GeoJSON, WKT) can be provided as geospatial feature.

Usage: conditional

Usage condition: If stations/plots with permanent position are used, the information on STATION needs to be provided. If absolute positions (e.g. occurrence recording) of the observation are used (provided in DATA) and no permanent plots are installed, STATION is omitted.

Template: station.xslx / station.csv

Table 1 STATION – Core fields

m … mandatory o … optional c … conditional

Field name	Description	Example	R
SITE_CODE	***Site code*** *[URL]* – reference to LTER site and LTSER Platform on DEIMS-SDR. Please provide the deims.id for the site or platform	*https://deims.org/site/0ce0d289-9ef9-4232-a981-8f34869db76d*	m
STATION_CODE	***Station code*** or ***Station identifier (ID)*** [UTF-8 character encoding] - Code for the station within the site in UTF-8 character encoding for the text. Special characters should be avoided. A station is any measuring enitity, such as a sampling point, permanent plot, observation plot or a meteorological station, to name just a few. If the station equals the site, meaning that only one station is used within the site, only the site identifier is provided in the data recording sheet. If external identification systems (e.g. WMO Station ID) are existing, this identifier could be used to reference the station. If a DEIMS-SDR UUID for the station exists, this need to be used. Otherwise use the identification of the station within your site	*IP2*	m
STYPE	***Spatial type*** [UTF-8 character encoding] of the station/plot according to a fixed list of values: *PT … single or multiple observation point* *AREA … areal plot* *VLN … vertical transect/profile* *HLN … horizontal transect/profile* If additional codes are needed, this is defined by the data provider.	*AREA*	m
LAT	***Latitude for the reference point*** [decimal number] of the STATION expressed in decimal degree [dec °] WGS84 using at least 6-digits after the decimal separator. Note: The definition of the *reference point* depends on the STYPE: • PT (single/multiple point): is the location of the point itself; • AREA (areal plot): is the centroid of the area; • VLN (vertical profile): is the starting point of the vertical profile • HLN (horizontal transect): is the starting point of the horizontal transect.	*45,340805*	m
LON	***Longitude of the reference point*** [decimal number] of the STATION expressed in decimal degree [dec °] WGS84 using at least 6-digits after the decimal separator. Note: The definition of the *reference point* depends on the STYPE: • PT (single/multiple point): is the location of the point itself;	*7,887495*	m

Field name	Description	Example	R
	• AREA (areal plot): is the centroid of the area; • VLN (vertical profile): is the starting point of the vertical profile HLN (horizontal transect): is the starting point of the horizontal transect.		
ALTITUDE	***Altitude*** [decimal number] of the reference point of the STATION in meter above or below sea level [m a.s.l.]. In terrestrial systems it reflects the elevation of the land surface and in aquatic/marine systems the elevation of the water surface. *Note: offsets from the surface (e.g. for sampling or sensor installations) can be provided by the extended field 'installation height"*	*265*	m
PLOTSIZE	***Plot size*** [integer] is defined as the size surface area covered by the station/plot in [m2]	*25*	o
COMMENT	***Comment*** [UTF-8 character encoding] include any other information related to the location of the station/plot.		o
GEOSPAT_FEATURE	***Geospatial feature*** [UTF-8 character encoding or URL/URI] is the (computable) geospatial representation of the "station". It could also be a WKT, a URI pointing to an online resource (WFS feature, GeoJson, …), or at least a textual description identifying the geometry/spatial feature (like in the case of rivers, roads, trails, toponyms, etc.)		o

Table 2 STATION – Extended fields

Field name	Description	Example	R
SNAME	***Station name*** (UTF-8 character encoding, https://en.wikipedia.org/wiki/UTF-8) provides the name of the station if relevant	*IP1*	o
westBoundingCoordinate	***bounding box*** [decimal number] for a station in decimal degree [dec °] WGS84; if a point is represented east and west bounding coordinates are equal; equals to ***Longitude***	*7,88749*	o
eastBoundingCoordinate	***bounding box*** [decimal number] for a station in decimal degree [dec °] WGS84; if a point is represented east and west bounding coordinates are equal; equals to ***Longitude***	*7,95372*	o
northBoundingCoordinate	***bounding box*** [decimal number] for a station in decimal degree [dec °] WGS84; if a point is represented north and south bounding coordinates are equal; equals to ***Latitude***	*45,34080*	o
southBoundingCoordinate	***bounding box*** [decimal number] for a station in decimal degree [dec °] WGS84; if a point is represented north and south bounding coordinates are equal; equals to ***Latitude***	*45,30056*	o
altitudeMin	***minimum altitude*** [decimal number] in meter above sea level [m a.s.l.] for the observed station,	*265*	o

Field name	Description	Example	R
	negative if below water level; if a single point is represented minimum and maximum are equal		
altitudeMax	***maximum altitude*** [decimal number] in meter above sea level [m a.s.l.] for the observed station, negative if below water level; if a single point is represented minimum and maximum are equal	*270*	o
Country	***Country -*** country code: ISO 3166-1 alpha-2 (https://en.wikipedia.org/wiki/ISO_3166-1_alpha-2), e.g. `AT` for Austria	*AT*	o
OperationPeriodSince	**Operation period since** [ISO date] is the time since the station/plot is operated or when the permanent plot first was established, see ISO 8601: calendar dates as YYYY-MM-DD, time as HH:MM:SS plus a time zone designator (as UTC plus offset) Combined date and time: 2007-04-05T12:30:00-02:00 Any time information • in UTC (e.g. `2017-03-03T11:00+00:00` or `2017-03-03T11:00UTC` or `2017-03-03T11:00Z`), • or local times, if the UTC offset is provided (e.g. `2017-03-03T13:00+02:00`)	`1992-06-01T13:00+02:00`	o
plotDimension	***Plot dimension*** [UTF-8 character encoding] as the length and width in [m] of the STATION	*5x5*	o
numberOfSampleUnit	***Number of sample units*** [integer] - number of elements (e.g. sub-plots) into which the plot is divided along the two dimensions (length x width)		
InstHeight	***Installation height*** [decimal number] – height of the installation of a sensor or device in [cm] measured from the soil surface. Positive and negative values are possible.	*200*	o
Local_Habitat_Type	***Local habitat type*** [UTF-8 character encoding] using local classification (needs to be defined in the method metadata)	*Beech forest*	c
EUNIS_Habitat_Type	***EUNIS habitat type*** [UTF-8 character encoding] using [EUNIS Habitat Classification] identifier	*G2.3*	c
Potential_natural_vegetation	***Potential natural vegetation*** [UTF-8 character encoding] using local syntaxonomic classification schema (needs to be defined in the method metadata)	*Fagetum*	c

If additional information on the stations (e.g. soil type, geology) needs to be provided additional columns are created in the station table, e.g. soilType. A separate reference files containing the reference list should be provided.

3.2 Method

Definition: A **METHOD** describes the procedure to generate and manipulate the data.

The methods are described for each variable used in the data and contains information on the methods applied for the generation and manipulation of the data. The method description should give an overview on the sampling, the field method and the method used in the lab to create the data value.

Basic information consists of summarised descriptions of all method steps and procedures applied. In the extended version detailed information on the different method steps and procedures (e.g. sampling, field method, lab methods, data aggregation methods) are provided in separate columns.

This method description on the level of the variables is in addition to the summarised method description provided in the metadata for the dataset (e.g. on DEIMS-SDR).

Usage: mandatory

Template: method.xslx / method.csv

Table 3 METHOD – Core fields

m … mandatory o … optional c … conditional

Field name	Description	Example	R
VARIABLE	***Variable*** [UTF-8 character encoding] – the observed phenomenon during the observation. The variable/parameter name normally is given as abbreviation e.g. LISTSUB VARIABLE Name DB ALK Alkalinity DB BOD Biochemical oxygen demand DB TC Total carbon If possible, use standard encodings for the variable names (e.g. ICP Integrated Monitoring). Additional variable codes can be defined, but need to be documented in the REFERENCE.	*COVE_F*	m
METH_DESCR	***Method description*** [UTF-8 character encoding] **-** Reference to published methods (e.g. URL, DOI) OR textual description of method including information on spatial, temporal or thematic (e.g. taxonomic aggregation), code lists and taxonomies applied (e.g. taxonomic reference lists, habitat classification) as well as measurement units	*Analysis of ammonium concentration (measurement with spectrophotometry (SP)) in aqueous deposition samples (mg/l) …*	m
UNIT	***Unit of variable observed*** [UTF-8 character encoding]**.** This information needs to be provided together with the methods, if not provided together with the DATA. For the units the SI units (https://physics.nist.gov/cuu/Units/units.html) are used.	*mg/l*	o

Table 4 METHOD – Extended fields

m … mandatory o … optional c … conditional

Field name	Description	Example	R
SAMPLING_DESIGN	***Short method description*** [UTF-8 character encoding] on how the plots were selected from the total population (selection of plots, observation points, etc.)	*Random sampling of spruce stands in the entire area of the site; 5 regularly spaced (10 m) positions on a transect; etc.*	o
FIELD_METHOD	***Short method description*** [UTF-8 character encoding] of the method used in the field either to collect the samples or to do the observation	*Volume weighted mixing from 5 bulk sampler, 2 weeks interval of sampling, cooled transportation of the samples*	o
LAB_METHOD	***Short method description*** [UTF-8 character encoding] on the procedures and methods applied in the lab, e.g. filtering, analysis, etc.	*45µm filtered; ICP-OES*	o
AGG_METHOD	***Short method description*** [UTF-8 character encoding] of the procedure how the values have been aggregated from primary values; for primary data the aggregation procedure is "NONE".	*Weighted mean value*	o

In case the method is sufficiently described by the metadata record in DEIMS, the *METHOD.CSV* file can contain the following information (including the reference to the :

"*For details to the methods applied please refer to the respective metadata record on DEIMS. [https://deims.org/dataset/xxxxxxxxx]*"

3.3 Data

Definition: The **DATA** are defined as the sum of observation values being observed at a station/plot either by sensor, measurement device or human observation.

This chapter contains data on any observation or measurement in the different compartments of the ecosystem. It includes measurements by sensors or via devices (see MEASUREMENTS) and by sensors or human (see MAPPING) observing e.g. species information or the cover of vegetation types.

Usage: mandatory

Template: data.csv / data.xslx (see detailed specifications below)

3.3.1 Environmental observation

Environmental observation is defined as any measurement done by sensors or using devices observing a single measurable property of the ecosystem, e.g. temperature or water level. The value normally is expressed as decimal or integer value.

Template: data_measurement.xlsx / data_measurement.csv

The data reporting can be provided in two ways. Organised either in rows (DATA_ROW) or in columns (DATA_COL). DATA_ROW is the recommended version.

- DATA_ROW - each observation, defined as the combination of location, time, variable and value, is organised in a single row.

SITE_CODE	STATION_CODE	VARIABLE	LEVEL	TIME	VALUE	UNIT	FLAGQUA	FLAGSTA
deims.id	IP1	TEMP	200	2016-03-15	5.5	°C		X
deims.id	IP1	PREC	100	2016-03-03	10.2	MM		S
deims.id	IP1	TEMP	200	2016-02-15	2.5	°C		X
deims.id	IP1	NH4N	100	2016-03	5.5	mg N/l		W
deims.id	IP1	SO4S	100	2016-03	10.2	mg S/l		W
deims.id	IP1	CA	100	2016-03	2.5	Mg/l	L	W
	…	…	…	…	…	…	…	…

- DATA_COL - each observation is organised as spreadsheet with location and time in rows, variables in column and value as cell entry. The method, the unit as well as additional information (like quality flags) for the variable needs to be defined in the METHOD if possible.

SITE_CODE	STATION_CODE	LEVEL	TIME	TEMP	PREC	NH4N	SO4S	CA	TYPE
deims.id	IP1	100	2016-03	5.5	10.2	2.5	5.5	2.5	Forest
deims.id	IP1	100	2016-04	5.2	1.2	2.2	5.8	1.2	Forest
…									

Table 5 DATA – Core fields –Measurements

m … mandatory o … optional c … conditional

Field name	Description	Example	R
SITE_CODE	***Site code*** [URL] –reference the LTER site or LTSER Platform in DEIMS-SDR. Please provide the deims.id issued by DEIMS-SDR (https://deims.org).	*https://deims.org/0ce0d289-9ef9-4232-a981-8f34869db76d*	m
STATION_CODE	***Station code*** [UTF-8 character encoding] – as reference to the observation location (=station) defined in the table STATION. In case of nested plots, the identification of the subplot is provided separated by a dash, e.g. IP2_01. ***Condition 1:*** in case the data refer to the whole area of the SITE and no STATION is identified, the field STATION_CODE is left blank. ***Condition 2:*** in case no permanent plots are installed to be revisited and absolute location (e.g. by GPS device) is provided (see ABS_POSITION), the field STATION_CODE is left blank.	*IP2*	c
ABS_POSITION	***Absolute 3D coordinates*** [decimal number] expressed in decimal degree [dec °] WGS84 using at least 6-digits after the decimal separator of a single observation within the site or station. When a specific location is available in the dataset record (e.g. if the STATION is an area and many	*45.234765, 12.783563, 1230*	c

Field name	Description	Example	R
	observations/records are available within that area, the absolute position is that of the single record). **Condition**: if a ABSOLUTE_POSITION is provided the STATION normally is left empty.		
VERT_OFFSET	***Height of measurement*** [decimal number] in [cm] as vertical offset from the surface level. For terrestrial ecosystems this is above the land surface. For aquatic or marine ecosystems this is the water surface. Values can be positive (offset above surface) or negative (offset below surface).	*-10*	o
HORI_OFFSET	**Horizontal offset** [number] from the reference point of a transect in meter [m].	20	o
VARIABLE	***Code for Variable observed*** [UTF-8 character encoding] for the variable / parameter name as abbreviation *LISTSUB VARIABLE Name* *DB ALK Alkalinity* *DB BOD Biochemical oxygen demand* *DB TC Total carbon* *DB DC Dissolved carbon* *DB DIC Dissolved inorganic carbon* *DB DOC Dissolved organic carbon* *DB DOD Direct oxygen demand* *DB NH3 Ammonia* *DB NH4 Ammonium* *DB NH4N Ammonium as nitrogen* If possible, use standard encodings for the variable names (e.g. ICP Integrated Monitoring). Additional values can be defined, but need to be documented in the REFERENCE	*NH4N*	m
TIME	timestamp of measurement [ISO date] (according to ISO 8601): calendar dates as YYYY-MM-DD, time as HH:MM:SS in UTC plus offset; combined date and time as YYYY-MM-DDTHH:MM*Offset,* e.g. 2007-04-05T12:30:00-02:00 Any time information *in* ***converted to UTC time*** (e.g. 2017-03-03T11:00+00:00 or 2017-03-03T11:00UTC or 2017-03-03T11:00Z) or ***local times***, if the ***UTC offset*** is provided (e.g. 2017-03-03T13:00+02:00) If aggregations are provided the timestamp is provided as the following o annual aggregation – provide only the year as YYYY o monthly aggregations – provide only the month as YYYY-MM o daily aggregations – provide the day as YYYY-MM-DD ***Condition:*** *if the field TIME is used, the columns YEAR, MONTH, DAY, HOUR, MINUTE, SECOND are omitted*	2017-03-03T13:00+02:00 2017 2017-03 2017-03-03	m
VALUE	***Data value*** [[UTF-8 character encoding] or [decimal number]] of the observation. The comma	*25*	m

Field name	Description	Example	R
	separator needs to be consistently used in the data file either being ‘,’ or ‘.’		
UNIT	**Unit** [UTF-8 character encoding] of variable or parameter observed. This information can be provided together with the METHOD or with the DATA. For the units the SI units (https://physics.nist.gov/cuu/Units/units.html) are used. Condition: provided if relevant	*mg/l*	c
FLAGQUA	***Quality flag*** [UTF-8 character encoding] for the data values based on the applied data quality control procedure as provided by the local system. *Examples* *Q quality controlled value* *L less than detection limit* *E estimated from measured value* Additional values can be defined or quality measures according to the local procedure (e.g. % of valid values for aggregation) can be used, but need to be documented in the REFERENCE.		o
FLAGSTA	***Status flag*** [UTF-8 character encoding] for the data defining the level of aggregation of the data value according to the attached list of possible values. If not relevant leave blank. *A Minimum* *Z Maximum* *S Sum* *X Arithmetic average, mean; e.g. monthly average* *W Weighted mean* *XA average monthly minimum* *XZ average monthly maximum* *SZ maximum daily sum* *M Mode* Additional values can be defined, but need to be documented in the REFERENCE.	*X*	o

Field name	Description	Example	R
EVENT_ID	Reference to the **Sampling event** [UTF-8 character encoding] as defined in EVENT ***Condition***: only used, if a sampling event is defined	*P20200912-EA-456*	c
SAMPLE_ID	Reference to the **Sample-ID** [UTF-8 character encoding] as defined in SAMPLE ***Condition***: only used, if a sample is taken and analysed and information on the sample is relevant and provided	*S0001_2020_A*	c

3.3.2 Mapping

Mapping is defined as any observation done by a human or sensor where the occurrence, share or abundance of an entitiy (e.g. species or habitat type) in a given area is estimated or measured. The observed entity is normally described by a concept (e.g. species or habitat) and uses code lists or taxonomies (e.g. species or habitat lists) to describe them.

Template: data_mapping.xlsx / data_mapping.csv

Table 6 DATA – Core fields – Mapping

m … mandatory o … optional c … conditional

Field name	Description	Example	R
SITE_CODE	***Site code*** [URL] –reference the LTER site or LTSER Platform in DEIMS-SDR. Please provide the deims.id issued by DEIMS-SDR (https://deims.org).	*https://deims.org/0ce0d289-9ef9-4232-a981-8f34869db76d*	m
STATION_CODE	***Station code*** [UTF-8 character encoding] – as reference to the observation location (=station) defined in the table STATION. In case of nested plots, the identification of the subplot is provided separated by a dash, e.g. IP2_01. ***Condition 1:*** in case the data refer to the whole area of the SITE and no STATION is identified, the field STATION_CODE is left blank. ***Condition 2:*** in case no permanent plots are installed to be revisited and absolute location (e.g. by GPS device) is provided (see ABS_POSITION), the field STATION_CODE is left blank.	*P0094*	c
ABS_POSITION	***Absolute 3D coordinates*** [decimal number] expressed in decimal degree [dec °] WGS84 using at least 6-digits after the decimal separator of a single observation within the site or station. When a specific location is available in the dataset record (e.g. if the STATION is an area and many observations/records are available within that area, the absolute position is that of the single record). **Condition 1**: if a ABSOLUTE_POSITION is provided the STATION normally is left empty. **Condition 2**: if an ABSOLUTE POSITION is provided the HORIZONTAL OFFSET is left blank.	*45.234765, 12.783563, 1230*	c
VERT_OFFSET	***Height of measurement*** [decimal number] in [cm] as vertical offset from the surface level. For terrestrial ecosystems this is above the land surface. For aquatic or marine ecosystems this is the water surface. Values can be positive (offset above surface) or negative (offset below surface).	*-10*	o
HORI_OFFSET	**Horizontal offset** [number] from the reference point of a transect in meter [m].	20	o
TIME	timestamp of measurement [ISO date] (according to ISO 8601): calendar dates as YYYY-MM-DD, time as HH:MM:SS in UTC plus offset; combined date and time as YYYY-MM-DDTHH:MM*Offset,*	2017-03-03	m

Field name	Description	Example	R
	e.g. 2007-04-05T12:30:00-02:00 Any time information *in* ***converted to UTC time*** (e.g. `2017-03-03T11:00+00:00` or `2017-03-03T11:00UTC` or `2017-03-03T11:00Z)` or ***local times***, if the ***UTC offset*** is provided (e.g. `2017-03-03T13:00+02:00`) ***Condition:*** *if the field TIME is used, the columns YEAR, MONTH, DAY, HOUR, MINUTE, SECOND are omitted*		
VARIABLE	***Code for Variable observed*** [UTF-8 character encoding] described in the METHOD for the variable / parameter name as abbreviation *LISTSUB VARIABLE Name* *IM ABUND Abundance of species* *IM COVE_T species cover tree layer* *IM COVE_S species cover shrub layer* *IM COVE_F species cover field layer* *IM COVE_B species cover bottom layer* *COVER cover in %* *AREA area (e.g. in ha – see unit)* If possible, use standard encodings for the variable names (e.g. ICP Integrated Monitoring). Additional values can be defined, but need to be documented in the REFERENCE	*ABUND*	m
LAYER	***Code for the ecosystem layer addressed*** [UTF-8 character encoding] as letter code. *LEVEL Name* *T Tree layer* *T1 Tree layer 1* *T2 Tree layer 2* *T3 Tree layer 3* *S Shrub layer* *F Field layer* *B Bottom layer* If alternative codings are used, this needs to be specified in the REFERENCE.	*T1*	o
TAXA	***Name of entity observed*** [UTF-8 character encoding] (e.g. species name or habitat type) either defined by a letter code (e.g. genus & species or abbreviation), a number code or the full name. In case of using letter codes or number codes the definition needs to be provided in the REFERENCE.	*FAG SYLV*	m
VALUE	***Data value*** [[UTF-8 character encoding] or [number]] of the observation. The comma separator needs to be consistently used in the data file either being ‘,’ or ‘.’	*5*	m
UNIT	**Unit** [UTF-8 character encoding] of variable or parameter observed. This information can be	*dimles*	c

Field name	Description	Example	R
	provided together with the METHOD or with the DATA. For the units the SI units (https://physics.nist.gov/cuu/Units/units.html) are used. Condition: provided if relevant		
FLAGQUA	***Quality flag*** [UTF-8 character encoding] for the data values based on the applied data quality control procedure as provided by the local system. Additional values can be defined or quality measures according to the local procedure (e.g. % of valid values for aggregation) can be used, but need to be documented in the REFERENCE.		o

Field name	Description	Example	R
EVENT_ID	Reference to the **Sampling event** [UTF-8 character encoding] as defined in EVENT ***Condition***: only used, if a sampling event is defined	*VegRel_45_20200912*	c
SAMPLE_ID	Reference to the **Sample-ID** [UTF-8 character encoding] as defined in SAMPLE ***Condition***: only used, if a sample is taken and analysed and information on the sample is relevant and provided	*S0001_2020_A*	c

3.3.3 Extended fields for Environmental observation and Mapping

Table 7 DATA – Extended fields

m … mandatory o … optional c … conditional

Field name	Description	Example	R
ORG_NAME	Abbreviation or ***name of the organisation*** [UTF-8 character encoding] providing the data	*EAA*	*O*
SUBPROG	Code for the ***sub programme*** [UTF-8 character encoding] for which the data are reported, e.g. BIOCHEM for "biogeochemical data" within the site. This refers to the parameter groups or thematic grouping of data. *BIOCHEM biogeochemistry data* *STRUCTU Structure and function of ecosystems, communities and populations* *HUMANEC human population and economy* *SITECHA site characteristics (land use and land cover)* Additional values can be defined, but need to be documented in the REFERENCE.	*BIOCHEM*	*O*
MEDIUM	***Medium*** [UTF-8 character encoding] – as the code for the sampled medium (feature of interest) in the observation procedure, e.g. *AIR air including meteorology* *SOIL soil* *SOILWAT soil water*	*AIR*	*O*

Field name	Description	Example	R
	WATER runoff and groundwater *SEDIMENT sediments in aquatic environments* *LITTER litter fall* *BIOCOM biological communities* *HUMPOP human population* *SITECHAR site characteristics (as habitat or landscape structure)* Additional values need to be defined in the REFERENCE.		
LISTMED	***Reference list medium*** [UTF-8 character encoding] – as reference to the list used. Use the code 'ADD' if the code is defined by the user. Otherwise use reference to the reference list.	*ELTER*	*o*
MAX_LEVEL	***Upper measurement level*** [number] in [cm] if a range for the observation is provided; the land/water surface is the zero level; values below the surface are provided as negative values (e.g. -20), values above the surface are provided as positive values (e.g. 20).	*-15*	*o*
MIN_LEVEL	***Lower measurement level*** [number] in [cm] if a range for the observation is provided; the land/water surface is the zero level; values below the surface are provided as negative values (e.g. -20), values above the surface are provided as positive values (e.g. 20)	*-5*	*o*
SIZE	***Size of the sampling plot*** [number] in [m²] where the observation takes place or the size of the area for which the aggregated values are representative (e.g. the site or part of the site such as the forested area)	*100*	*o*
YEAR	***Year*** [YYYY] of the measurement or the year for which the measurements were aggregated the year of an observation (e.g. plants) **Alternative**: ***Time stamp*** as [ISO date], see ISO 8601: calendar dates as YYYY-MM-DD, time as HH:MM:SS plus a time zone designator (as UTC plus offset), e.g. *2007-04-05T12:30:00-02:00* Any time information ○ in UTC (e.g. *2017-03-03T11:00+00:00* or *2017-03-03T11:00UTC* or *2017-03-03T11:00Z*), ○ or local times, if the UTC offset is provided (e.g. *2017-03-03T13:00+02:00*)	*2017* *2017-03-03T13:00+02:00*	*o*
MONTH	*Month [MM]* of the measurement or aggregation. Leave blank if not relevant → see notes Year for aggregated time information	*08*	*o*
DAY	*Day [DD]* of the measurement or the aggregation. Leave blank if not relevant → see notes Year for aggregated time information	*01*	*o*
HOUR	*Hour [HH]* of the measurement or the aggregation. Leave blank if not relevant	*12*	*o*

Field name	Description	Example	R
	→ see notes Year for aggregated time information		
MINUTE	*Minute [mm]* of the measurement or the aggregation. Leave blank if not relevant → see notes Year for aggregated time information	*30*	*o*
SECOND	*Second [ss]* of the measurement or the aggregation. Leave blank if not relevant → see notes Year for aggregated time information	*05*	*o*
SPOOL	***Spatial pool*** *[number]* as the number of spatial entities (e.g. sensors, plots) used to calculate the data value If not relevant or described in METHOD, leave blank.	*5*	*o*
TPOOL	***Temporal pool*** *[number]* as the number of observations used to calculate the data value If not relevant or described in METHOD, leave blank.	*10*	*o*
TLEVEL	***Temporal level of aggregation or observation*** [UTF-8 character encoding] *HOUR hourly values (60 min)* *DAY daily values (24 hrs)* *WEEK weekly values (7 days)* *MONTH monthly values* *SEASON seasonly values (e.g. spring)* *HYEAR half yearly values (6 month)* *6 month* *YEAR yearly values (12 month)* Additional values can be defined, but need to be documented in the REFERENCE.		*o*
LISTTAXA	Reference to the ***taxonomic list*** [UTF-8 character encoding] used for the observations	*Flora of Austria (2005)*	*o*
LISTSUB	***Reference to the code*** [UTF-8 character encoding] list of substances and parameter names, e.g. EnvThes or other vocabularies. Use ADD if defined by the user.	*IM*	*o*
FLAGSTA	***Status flag*** [UTF-8 character encoding] for the data defining the level of aggregation of the data value according to the attached list of possible values. If not relevant leave blank. *A Minimum* *Z Maximum* *S Sum* *X Arithmetic average, mean; e.g. monthly average* *W Weighted mean* *XA average monthly minimum* *XZ average monthly maximum* *SZ maximum daily sum*	*X*	o

Field name	Description	Example	R
	M Mode Additional values need to be defined in the REFERENCE.		

3.4 Reference

Definition: The **REFERENCE** is the listing and description of additional codes used in the data provision. In order to enhance the re-usability of the data, information on the coding used e.g. for variable names or taxa, is needed. This can either refer to existing vocabularies used (e.g. by referencing to an URL) or by user defined definitions.

If using text file template, the references are provided as separate text file (e.g. csv) where files are named following the naming convention.

If using the Microsoft Excel template, the reference lists are provided in separate tables within the spreadsheet, following the naming convention e.g. Reference_TAXA.

Usage: conditional

Usage condition: if additional codes are defined a REFERENCE needs to be provided.

Template: reference.xslx / reference.csv

Naming convention: Reference_[FIELD_NAME], e.g. *Reference_TAXA, Reference_VARIABLE or Reference_LAYER.*

Table 8 Reference – Core fields

m … mandatory o … optional c … conditional

Field name	Description	Example	R
FIELD_NAME	***Name of the field*** [UTF-8 character encoding] in the data reporting documents as reference	*TAXA*	*m*
CODE	***Code of the entry*** [UTF-8 character encoding] defined as abbreviation of the term, e.g. parameter name	*FAG SYLV*	*m*
NAME	***Full name*** [UTF-8 character encoding] *defined as the full name of the term,e.g. full species name*	*Fagus sylvatica L.*	*m*
DEFINITON	***Definition*** [UTF-8 character encoding] of the term used, in order to allow the user to understand the data.		*o*
LIST_CODE	***Name or reference [URL] of the code list***; if referring to an existing code list the name of the code list is provided (e.g. DB, EnvThes). If the code is defined by the user, use 'ADD' as identification	*http://www.catalogueoflife.org/col/*	*o*
CODE_URL	Reference to the URL or persistent identifier	*http://www.catalogueoflife.org/col/details/species/id/1f4cac67d34e7473fb5092f2fa66f4d2*	*o*

If additional fields are needed, please add them to the reference table.

3.5 Event

Definition: An **EVENT** is defined as activity to observe or collect information on the ecosystem characteristic of interest. This can be either e.g. a sampling event (e.g. soil water sample) or the recording of species abundance (e.g. vegetation relevee). Basic information on the event is given.

The description of the event is also taking in account definitions provided by Darwin Core Event (DwC Event)[1].

Usage: conditional

Usage condition: if sampling events (e.g. field campaign, sampling campaign) are provided and relevant for the data, EVENT needs to be provided.

Template: event.xslx / event.csv

Table 9 Event – Core fields

m … mandatory o … optional c … conditional

Field name	Description	Example	R
SITE_CODE	***Site code*** [URL] –reference the LTER site or LTSER Platform in DEIMS-SDR. Please provide the deims.id issued by DEIMS-SDR (https://deims.org).	*https://deims.org/0ce0d289-9ef9-4232-a981-8f34869db76d*	m
STATION_CODE	***Station code*** [UTF-8 character encoding] – as reference to the observation location (=station) defined in the table STATION	*IP2*	m
EVENT_ID	An identifier [UTF-8 character encoding] for the set of information associated with an Event (something that occurs at a place and time). May be a global unique identifier or an identifier specific to the data set. This either can be a sample number or the number of a vegetation relevee. Note: reference to the location (STATION_CODE) is given in the data and is not repeated in the EVENT.	*SW0045ZOE_20200912 or VegRel_45_20200912*	m
TIME_FROM	timestamp of starting the event [ISO date] (according to ISO 8601): calendar dates as YYYY-MM-DD, time as HH:MM:SS in UTC plus offset; combined date and time as YYYY-MM-DDTHH:MM*Offset,* e.g. 2007-04-05T12:30:00-02:00 Any time information *in* ***converted to UTC time*** (e.g. `2017-03-03T11:00+00:00` or `2017-03-03T11:00UTC` or `2017-03-03T11:00Z`)	`2017-03-03T13:00+02:00`	m

[1] See https://tools.gbif.org/dwca-validator/extension.do?id=dwc:Event

Field name	Description	Example	R
	or ***local times***, if the ***UTC offset*** is provided (e.g. `2017-03-03T13:00+02:00`)		
TIME_TO	timestamp of ending the event [ISO date] (according to ISO 8601): calendar dates as YYYY-MM-DD, time as HH:MM:SS in UTC plus offset; combined date and time as YYYY-MM-DDTHH:MM*Offset,* e.g. 2007-04-05T12:30:00-02:00 Any time information *in* ***converted to UTC time*** (e.g. `2017-03-03T11:00+00:00` or `2017-03-03T11:00UTC` or `2017-03-03T11:00Z`) or ***local times***, if the ***UTC offset*** is provided (e.g. `2017-03-03T13:00+02:00`)	`2017-03-03T13:00+02:00`	m
METH_DESCR	***Short description of the method*** [UTF-8 character encoding] applied in the sampling campaign, e.g. on how the plots were selected from the total population (selection of plots, observation points, etc.) and the observation was done ***Condition:*** Please provide, if not contained in METHOD.	*Random sampling of spruce stands in the entire area of the site; 5 regularly spaced (10 m) positions on a transect; etc.*	*c*
EVENT_EFFORT	A numeric value [number] for a measurement of the effort taken (time duration, length, area, or volume) in a sampling event.	*25*	o
UNIT	**Unit** [UTF-8 character encoding] of variable of the sampling effort. For the units the SI units (https://physics.nist.gov/cuu/Units/units.html) are used.	*m2*	o
PHYS_SAMPLE	***Physical sample*** [Boolean; 0/-1] taken and stored. A SAMPLE is the representative part or a single item from a larger whole or group. Please, provide a information if you have taken and stored a physical sample and you can provide details on ***Condition***: if yes [-1] a description in SAMPLE needs to be provided.	0	m
NOTES	Notes [UTF-8 character encoding] on of a) an indicator of the existence of, b) a reference to (publication, URI), or c) the text of notes taken in the field about the Event.		

Table 10 Event – Extended fields

m … mandatory o … optional c … conditional

Field name	Description	Example	R
PARENT_EVENT_ID	An event identifier [UTF-8 character encoding] for the super event which is composed of one or more sub-sampling events. The value must refer to an existing EVENT_ID. If the identifier is local it must exist within the given dataset. May be a globally unique	*SW0045ZOE_20200912 or VegRel_45_20200912*	o

Field name	Description	Example	R
	identifier or an identifier specific to the data set. This either can be a sample number or the number of a vegetation relevee. Note: reference to the location (STATION_CODE) is given in the data and is not repeated in the EVENT.		
SAMP_EFFORT	The amount of effort [UTF-8 character encoding] expended during an Event.	*"40 trap-nights", "10 observer-hours; 10 km by foot; 30 km by car"*	o
HABITAT_TYPE	***Habitat type*** [UTF-8 character encoding] in which the Event occurred using local or existing classification or reference to a code list (as defined in REFERENCE).	*Beech forest*	o
SOIL_TYPE	Soil type [UTF-8 character encoding] in which the Event occurred using local or existing classification or reference to a code list (as defined in REFERENCE).		o

Additional fields for an EVENT can be provided by the data provider.

3.6 Sample

Definition: A **SAMPLE** is the key observational units in environmental sciences, i.e. ecology, geosciences, biogeochemistry, and hydrobiology, and are essential to document and further analyse biological communities in laboratories (e.g., phytoplankton communities in water samples, benthic communities in sediments, etc.). In general, a sample is a limited quantity of something which is intended to be similar to and represent a larger amount of that thing(s). The things could be countable objects such as individual items available as units for sale, or an uncountable material. Even though the word "sample" implies a smaller quantity taken from a larger amount, sometimes full biological or mineralogical specimens are called samples if they are taken for analysis, testing, or investigation like other samples.

Usage: conditional

Usage condition: A SAMPLE description only needs to be provided if samples are stored and the information is relevant for the DATA. Many different datasets could refer to the same sample, as in the case of a sediment core: the sample description is provided once and all the datasets can refer to that same document).

Template: sample.xslx / sample.csv

Table 11 Event – Core fields

m … mandatory o … optional c … conditional

Field name	Description	Example	R
SITE_CODE	***Site code*** [URL] –reference the LTER site or LTSER Platform in DEIMS-SDR. Please provide the deims.id issued by DEIMS-SDR (https://deims.org).	*https://deims.org/0ce0d289-9ef9-4232-a981-8f34869db76d*	m
STATION_CODE	***Station code*** [UTF-8 character encoding] – as reference to the observation location (=station) defined in the table STATION	*IP2_LYS01*	m
EVENT_ID	An identifier [UTF-8 character encoding] for the set of information associated with an Event (something that occurs at a place and time). May be a global unique identifier or an identifier specific to the data set. This either can be a sample number or the number of a vegetation relevee. Note: reference to the location (STATION_CODE) is given in the data and is not repeated in the EVENT.	*SW0045ZOE_20200912*	o
SAMPLE_ID	***Sample identifier*** [UTF-8 character encoding or PID] as the reference to the sample taken and stored during a sampling campaign	*Z12A35*	m
MEDIUM	***Sampled medium*** [UTF-8 character encoding] – as the code for the sampled medium in the observation procedure *AIR* *air including meteorology* *SOIL* *soil* *SOILWAT* *soil water* *WATER* *runoff and groundwater* *SEDIMENT* *sediments in aquatic environments* *LITTER* *litter fall* *BIOCOM* *biological communities* *HUMPOP* *human population* *SITECHAR* *site characteristics (as habitat or landscape structure)* Additional values need to be defined in the REFERENCE.	*SOILWAT*	o
TIME_FROM	timestamp start time when sample was taken [ISO date] (according to ISO 8601): calendar dates as YYYY-MM-DD, time as HH:MM:SS in UTC plus offset; combined date and time as YYYY-MM-DDTHH:MM*Offset,* e.g. 2007-04-05T12:30:00-02:00 Any time information *in* ***converted to UTC time*** (e.g. `2017-03-03T11:00+00:00` or `2017-03-03T11:00UTC` or `2017-03-03T11:00Z`) or ***local times***, if the ***UTC offset*** is provided (e.g. `2017-03-03T13:00+02:00`)	`2017-03-03T13:00+02:00`	m
TIME_TO	timestamp end time when sample was taken [ISO date] (according to ISO 8601): calendar dates as YYYY-MM-DD, time as HH:MM:SS in UTC plus offset; combined date and time as	`2017-03-03T13:00+02:00`	m

Field name	Description	Example	R
	YYYY-MM-DDTHH:MM*Offset,* e.g. 2007-04-05T12:30:00-02:00 Any time information *in* ***converted to UTC time*** (e.g. `2017-03-03T11:00+00:00` or `2017-03-03T11:00UTC` or `2017-03-03T11:00Z`) or ***local times***, if the ***UTC offset*** is provided (e.g. `2017-03-03T13:00+02:00`)		
METH_DESCR	***Short description of the method*** [UTF-8 character encoding] applied in the sampling campaign, e.g. on how the plots were selected from the total population (selection of plots, observation points, etc.) and the observation was done ***Condition:*** Please provide, if not contained in METHOD.	*Lysimeter station …*	c
SAMP_SIZE	A numeric value [number] for a measurement of the size (e.g. length, area, or volume) of a sample in a sampling event.	*25*	o
UNIT	**Unit** [UTF-8 character encoding] of variable or parameter observed. This information can be provided together with the METHOD or with the DATA. For the units the SI units (https://physics.nist.gov/cuu/Units/units.html) are used. Condition: provided if relevant	*ml*	o
NOTES	Notes on [UTF-8 character encoding] of a) an indicator of the existence of, b) a reference to (publication, URI), or c) the text of notes taken in the field about the Event.		

3.7 License

In addition to the data and documentation a textual description of the conditions to use for the data, e.g. data usage document can be provided. This preferable should be provided in pdf-format.

4 Examples

4.1 Example station description

File: station.xslx / station.csv

SITE_CODE	STATION_CODE	STYPE	LAT	LON	altitude	PLOTSIZE	COMMENT
https://deims.org/0ce0d289-9ef9-4232-a981-8f34869db76d	IP1	PT	45,340805	7,887495	265	25	
…							

4.2 Example method description

File: method.xslx / method.csv

VARIABLE	METH_DESCR	UNIT
NH4N	Analysis of ammonium concentration (measurement with spectrophotometry (SP)) in aqueous deposition samples (mg/l) …	Mg/l
ABUND	Species abundance according to Braun-Blanquet in vegetation plots layed out in a fixed raster of 100m in the study area. Abundance is recorded according the different layers in the vegetation.	Dimles
…		

4.3 Example data - environmental observation

File: data_measurement.xlsx / data_measurement-csv

- DATA_ROW - each observation, defined as the combination of location, time, variable and value, is organised in a single row.

SITE_CODE	STATION_CODE	VARIABLE	LEVEL	TIME	VALUE	UNIT	FLAGQUA	FLAGSTA
deims.id	IP1	TEMP	200	2016-03-15	5.5	°C		X
deims.id	IP1	PREC	100	2016-03-03	10.2	MM		S
deims.id	IP1	TEMP	200	2016-02-15	2.5	°C		X
deims.id	IP1	NH4N	100	2016-03	5.5	mg N/l		W
deims.id	IP1	SO4S	100	2016-03	10.2	mg S/l		W
deims.id	IP1	CA	100	2016-03	2.5	Mg/l	L	W
	…	…	…	…	…	…	…	…

- DATA_COL - each observation is organised as spreadsheet with location and time in rows, variables in column and value as cell entry. The method, the unit as well as additional information (like quality flags) for the variable needs to be defined in the METHOD if possible.

SITE CODE	STATION CODE	LEVEL	TIME	TEMP	PREC	NH4N	SO4S	CA	TYPE
deims.id	IP1	100	2016-03	5.5	10.2	2.5	5.5	2.5	Forest
deims.id	IP1	100	2016-04	5.2	1.2	2.2	5.8	1.2	Forest
…									

4.4 Example data - mapping

File: data_mapping.xlsx / data_mapping.csv

SITE_CODE	STATION_CODE	VARIABLE	TIME	LAYER	TAXA	VALUE	UNIT
deims.id	1	ABUND	2016-06-25	T	FAG SYLV	3	
deims.id	1	ABUND	2016-06-25	T	PIC ABIE	3	
deims.id	1	ABUND	2016-06-25	S	FAG SYLV	1	
deims.id	1	ABUND	2016-06-25	B	OXA ACET	2	
	…	…	…		…	…	

4.5 Example reference list description

File: reference.xslx / reference.csv

FIELD_NAME	CODE	NAME	DEFINITION	LIST_CODE	CODE_URL
VARIABLE	NOXN	atmosphere_mass_content_of_nox_expressed_as_nitrogen	"Content" indicates a quantity per unit area. The "atmosphere content" of a quantity refers to the vertical integral from the surface to the top of the atmosphere. For the content between specified levels in the atmosphere, standard names including content_of_atmosphere_layer …	https://cfconventions.org/standard-names.html	
VARIABLE	NOYN	atmosphere_mass_content_of_noy_expressed_as_nitrogen	"Content" indicates a quantity per unit area. The "atmosphere content" of a quantity refers to the vertical integral from the surface to the top of the atmosphere. For the content between specified levels in the atmosphere, standard names including content_of_atmosphere_layer are used. "Noy" describes a family …	https://cfconventions.org/standard-names.html	
…	…	…	…	…	

FIELD_NAME	CODE	NAME	DEFINITION	LIST_CODE	CODE_URL
TAXA	FAGSYLV	Fagus sylviatica L.		http://www.catalogueoflife.org/col/	http://www.catalogueoflife.org/col/details/species/id/1f4cac67d34e7473fb5092f2fa66f4d2
…					

4.6 Example event description

File: event.xslx / event.csv

SITE_CODE	STATION_CODE	EVENT_ID	TIME_FROM	TIME_TO	METH_DESCR	PHYS_SAMPLE	SAMP_SIZE	UNIT	NOTES
deims.id	GRP_0064	VegRl_64_2020	2020-09-20	2020-09-20	Braun-Blanquet …	0	25	M2	none
…									

4.7 Example sample description

File: sample.xslx / sample.csv

SITE_CODE	STATION_CODE	EVENT_ID	SAMPLE_ID	MEDIUM	TIME_FROM	TIME_TO	METH_DESCR	SAMP_SIZE	UNIT	NOTES
deims.id	IP2_LYS01	SW0045ZOE_20200912	Z12A35	SOILWAT	2020-09-20	2020-09-27	Lysimeter …	250	ML	none
…										

5 Annexes

5.1 Substance code / variable names

Examples for standardised variable names

CF Convention	https://cfconventions.org/standard-names.html
ICP Integrated Monitoring	https://www.syke.fi/en-US/Research__Development/Nature/Monitoring/Integrated_Monitoring/Manual_for_Integrated_Monitoring/Annexes_to_Manual/Annex_2_Code_List_DB(16824)

5.2 Species name

Catalogue of Life	http://www.catalogueoflife.org/annual-checklist/2019/