

LEVEL 2 ECOSYSTEM PRODUCTS DESCRIPTION

Class1 and Class2 ICOS Stations

The Level2 production

The ETC produces Level2 products using different type of raw:

- 10 or 20 Hz EC files from the eddy covariance system
- 1 second ST file with storage measurements
- 10 to 60 seconds measurements from meteorological sensors
- Metadata about sensors, station, team and other information
- Digital Hemispherical Photos and Ceptometer measurements for the GAI calculation
- Field Map files for the trees inventory
- Other ancillary data such species, biomass, litter-fall and others
- Soil and Vegetation samples for the chemical analysis of the content

All these files, data and information are processed in different ways in order to obtain the Level2 products that are of two different type:

- Timeseries, where values are reported continuously at a resolution typically of 30 minutes. These are ASCII files comma separated with dot as decimal indicator and one line of header with the variable names. The first two columns are the timestamp of start and end of the averaging period, in local solar time.
- Sporadic values are reported using the BIF (BADM Interchangeable Format, a standard in the international community) where information are provided together with a timestamp and a number of parameters. The BIF format consists of a csv file with 5 columns: site ID, group ID, variable group name, variable name, and data value. A variable group is a set of variables that are reported together (e.g. a variable value, the date it was collected, and the method used to collect it). Sites may report multiple instances of the same variable group associated with different measurements collected over time method, location, etc. The group ID uniquely identifies the data belonging to the same instance of a reported variable group. The variable names and data value provide the details of the reported data within a variable group.

Both the timeseries and BIF format are Level2 products to be distributed.

Specific Level2 files produced

In order to simplify the use of the large number of variable produced, the Level2 data are distributed using different files (Table 1) that includes variables/information that are coherent and designed for specific type of users. The files have one of the three formats described above (Timeseries, BIF, or Processing parameters). Here below the description of each single file produced.

Table 1. Files produced and distributed with the Level2 product

File	Type	Content	Notes
ICOSETC_CC-###_FLUXES	data	Eddy covariance fluxes, all the quality tests results, storage fluxes and footprint information calculated starting from the raw data.	Halfhourly
ICOSETC_CC-###_METEO	data	Meteorological variables with values aggregated spatially (e.g. one single soil temperature value per layer).	Halfhourly
ICOSETC_CC-###_METEOSENS	data	Meteorological variables for each single sensor, aggregated from raw data	Halfhourly
ICOSETC_CC-###_FLUXNET	data	Fluxes and meteo data processed with the standard FLUXNET2015 procedure.	Five different temporal resolutions (HH, DD, WW, MM, YY).
ICOSETC_CC-###_VARINFO	BIF	Basic metadata for each variable, including units, height/depth, sensor type and data averaged	One file for each continuous data file produced.
ICOSETC_CC-###_INST	BIF	Information about all the sensors used at the station and the variables generated	It is linked to the VARINFO BIF file, see scheme at the end.
ICOSETC_CC-###_SITEINFO	BIF	General information about the station, including location, UTC offset, team, references etc.	
ICOSETC_CC-###_ANCILLARY	BIF	Ancillary data and related metadata (methods description) including all the biological measurements such species composition, trees number, LAI, biomass, litter etc. calculated starting from the raw measurements	

FLUXES: it contains the output of the eddy covariance measurements, including the quality check and filtering and the storage component. It has also the footprint information.

- File name structure: ICOSSETC_CC-###_FLUXES_VP.csv (where CC-### is the official site code and VP is a two digits value that identifies the version of the processing)
- Variables description: ICOSSETC_FLUXES_description.pdf, Vitale et al. 2020 (Biogeosciences)
- Format: Timeseries
- Time resolution: 30 minutes
- Date coverage: from the date of labelling to the end of the year before release.

METEOSENS: it contains the meteorological variables of each single sensors aggregated at 30 minutes time resolution starting from the raw data.

- File name structure: ICOSSETC_CC-###_METEOSENS_VP.csv (where CC-### is the official site code and VP is a two digits value that identifies the version of the processing)
- Variables description: ICOSSETC_METEO_description.pdf
- Format: Timeseries
- Time resolution: 30 minutes
- Date coverage: from the date of labelling to the end of the year before release.

METEO: it contains the meteorological variables aggregated spatially (one value per variable and vertical layer) at 30 minutes time resolution.

- File name structure: ICOSSETC_CC-###_METEO_VP.csv (where CC-### is the official site code and VP is a two digits value that identifies the version of the processing)
- Variables description: ICOSSETC_METEO_description.pdf
- Format: Timeseries
- Time resolution: 30 minutes
- Date coverage: from the date of labelling to the end of the year before release.

FLUXNET: it is a set of 7 files that contain fluxes and meteorological variables processed using the FLUXNET methodology (ONEFlux code, like the one used for FLUXNET2015, including gapfilling and partitioning) at different time resolution (halfhourly, daily, weekly, monthly and yearly) and two additional files with auxiliary information about the processing. Note: this product is not always present because the processing is not designed to be applied in specific sites (water, urban)

- Files name structure: the five measurement files have names ICOSSETC_CC-###_FLUXNET_TT_VP.csv where CC-### is the official site code, TT is the time resolution (HH, DD, WW, MM, YY) and VP is a two digits value that identifies the version of the processing. The two auxiliary files have name structures ICOSSETC_CC-###_FLUXNET_AUXMETEO_VP.csv

and ICOSETC_CC-###_FLUXNET_AUXNEE_VP.csv where CC-### is the official site code and VP is a two digits value that identifies the version of the processing.

- Variables and method description: Pastorello et al. 2020 (<https://doi.org/10.1038/s41597-020-0534-3>)
- Format: Timeseries
- Time resolution: 30 minutes, daily, weekly, monthly, yearly
- Date coverage: from the date of labelling to the end of the year before release.

VARINFO: it contains the information about how the single sensor measurements are combined to obtain the spatially aggregated variables. Includes also information about the units and the height/depth of measurement. It is created for each of the continuous data files.

- File name structure: ICOSETC_CC-###_VARINFO_YYYY_VP.csv (where CC-### is the official site code, YYYY the continuous file described and VP is a two digits value that identifies the version of the processing)
- Variables description: ICOSETC_BIF_description.pdf and Pastorello et al. 2020 (<https://doi.org/10.1038/s41597-020-0534-3>)
- Format: BIF
- Time resolution: none
- Date coverage: same as the data products described.

INST: it contains information about the model, location, maintenance and disturbances, variable measured and installation/modification date for all the sensors used in the station.

- File name structure: ICOSETC_CC-###_INST.csv (where CC-### is the official site code)
- Variables description: ICOSETC_BIF_description.pdf
- Format: BIF
- Time resolution: sporadic
- Date coverage: same as the data products described.

SITEINFO: it contains all the general information station, including location, team, references, UTC Offset and many other basic info.

- File name structure: ICOSETC_CC-###_SITEINFO.csv (where CC-### is the official site code)
- Variables description: ICOSETC_BIF_description.pdf
- Format: BIF
- Time resolution: sporadic

- Date coverage: from the date of labelling to the end of the year before release.

ANCILLARY: it contains all the ancillary measurements collected at the station, such species, biomass, trees number, LAI etc. all calculated starting from, raw data and measurements (DHP, single collections etc.)

- File name structure: ICOSETC_CC-###_ANCILLARY_VP.csv (where CC-### is the official site code and VP is a two digits value that identifies the version of the processing for the variables calculated by the ETC)
- Variables description: ICOSETC_BIF_description.pdf
- Format: BIF
- Time resolution: sporadic
- Date coverage: data collected during the labelling and until the end of the year before release.

Scheme to summarize the link of metadata info. The variables reported in the same colors are the one linking the different groups. The VAR_INFO and VAR_AGG Groups are in the VARINFO file, the INST, INSTOM and INSTPAIR Groups are in the INST file. All is in the BIF format.

