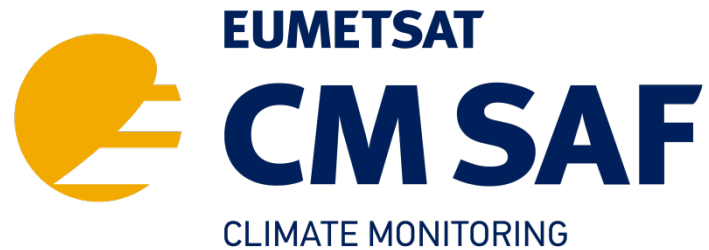


**EUMETSAT Satellite Application Facility on Climate Monitoring**



**CLARA-3 Auxiliary Data User Guide**

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| 1.1                | 05.07.2023 | SAF/CM/DWD/AUX/CLARA/CLD | Revised version - adding polar grid definitions/files for SAL polar products |

## Reference Documents

| Reference | Title  | Code                           |
|-----------|--|--------------------------------|
| RD 1      | Product User Manual CM SAF Cloud, Albedo, Radiation data record AVHRR-based, Edition 3 (CLARA-A3), Cloud Products              | SAF/CM/DWD/PUM/CLARA/CLD, v3.1 |
| RD 2      | Product User Manual CM SAF Cloud, Albedo, Radiation data record AVHRR-based, Edition 3 (CLARA-A3), Surface Albedo              | SAF/CM/FMI/PUM/GAC/SAL, v3.1   |
| RD 3      | Product User Manual CM SAF Cloud, Albedo, Radiation data record AVHRR-based, Edition 3 (CLARA-A3), Surface Radiation           | SAF/CM/DWD/PUM/CLARA/RAD, v3.1 |
| RD 4      | Product User Manual CM SAF Cloud, Albedo, Radiation data record AVHRR-based, Edition 3 (CLARA-A3), Top-of-Atmosphere Radiation | SAF/CM/RMIB/PUM/GAC/TOA, v1.2  |

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## 1 Introduction

The third edition of CM SAF's CLARA climate data record (CLARA-A3) provides cloud, radiation and albedo properties derived from the AVHRR imager on board polar orbiting satellites operated by NOAA and EUMETSAT (Karlsson et al., 2023).

Three categories of products are available:

- **Level 2b:** global composite on a regular 0.05°x0.05° latitude/longitude grid
- **Level 3 - global:** Daily and monthly averages on a regular 0.25°x0.25° latitude/longitude grid. Joint cloud histogram on a regular 1°x1° grid
- **Level 3 - polar:** Northern and Southern polar regional on a 25 km x 25 km EASE-Grid or EASE-Grid 2.0

For detailed information about the CLARA-A3 product suite, see the respective Product User Manuals (RD 1, RD 2, RD 3, RD 4)

## 2 Static auxiliary data

In order to facilitate work with the CLARA-A3 dataset, we provide the following auxiliary data for the different grids and areas:

**Table 2-1:** Available static auxiliary data and corresponding netCDF variable names

| Parameter/<br>Product<br>category | Level 2b<br>0.05°x0.05°<br>global | Level 3<br>0.25°x0.25°<br>global | Level 3<br>1°x1°<br>global | Level 3<br>25km x 25km EASE<br>(EASE 2.0) grid<br>polar areas*                           |
|-----------------------------------|-----------------------------------|----------------------------------|----------------------------|--|
| <i>Latitude</i>                   | lat(lat)                          | lat(lat)                         | lat(lat)                   | lat(y, x)  |
| <i>Longitude</i>                  | lon(lon)                          | lon(lon)                         | lon(lon)                   | lon(y, x)  |
| <i>Land Fraction<br/>(LSM)</i>    | lsm(lat,lon)                      | lsm(lat,lon)                     | lsm(lat,lon)               | lsm(y,x)   |
| <i>Altitude<br/>(ALT)</i>         | alt(lat, lon)                     | alt(lat, lon)                    | alt(lat, lon)              | alt(y,x)   |
| <i>Land use data<br/>(LUS)</i>    | lus(lat, lon)                     | lus(lat, lon)                    | lus(lat, lon)              | lus(y,x)   |
| <i>Dimensions</i>                 | lat=3600,lon=7200                 | lat=720,lon=1440                 | lat=180,lon=360            | x,y=361 (360) for<br>Northern hemisphere<br><br>x,y=321 (320) for<br>Southern hemisphere |

\* *EASE-Grid is valid for CLARA-A3 cloud polar products. EASE-Grid 2-0 is valid for CLARA-A3 SAL polar products.*

The land fraction (LSM) and land use data (LUS) are based on the 1km global land cover characterisation database by the United States Geological Survey (USGS, DOI: [10.5066/F7GB230D](https://doi.org/10.5066/F7GB230D)) (see Anderson et al., 1976 and Eidschink and Faundeen, 1994).

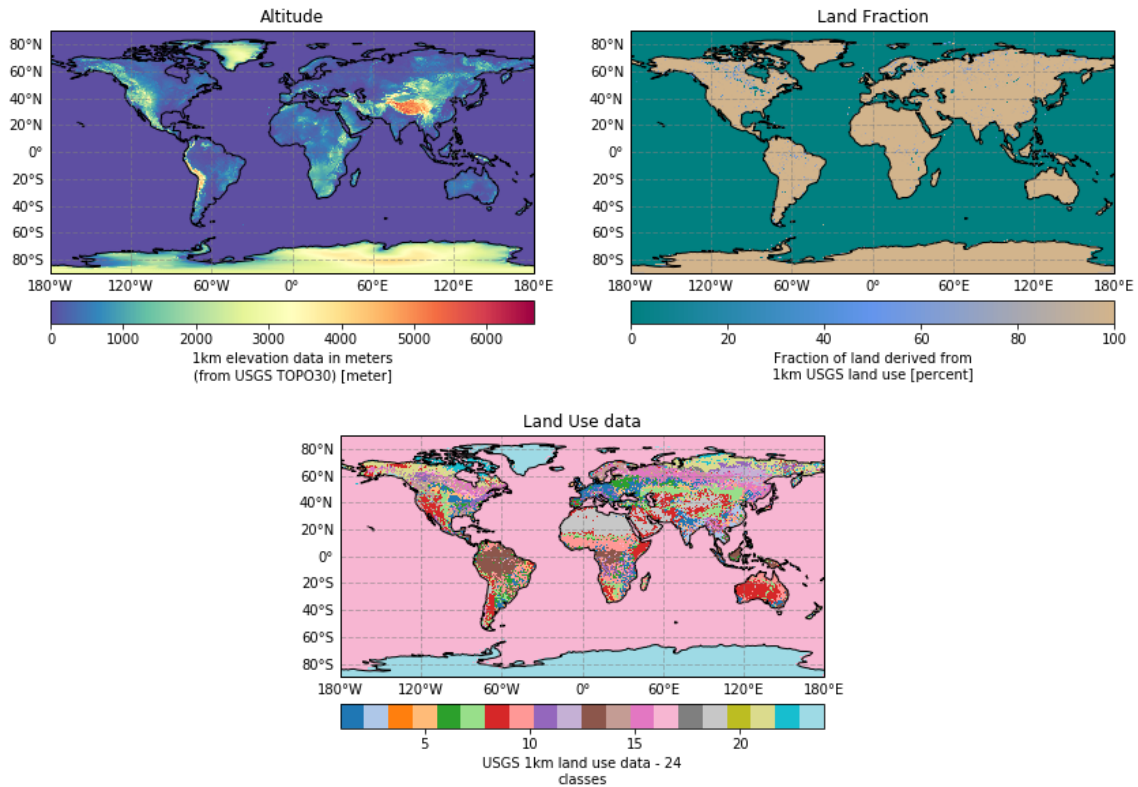
The digital elevation model (DEM) data is derived from the Global 30 arc seconds topography database, GTOPO30 (DOI: [10.5066/F7DF6PQS](https://doi.org/10.5066/F7DF6PQS)).

The native elevation and land-use data are mapped onto the resolution and projection of CLARA-A3 Level 2b and Level 3 global products as well as the respective grids for the Polar areas.

The auxiliary data are stored in the following netCDF4 files:

|   |  |
|---|--|
| Level 2b, global:                       | clara3_level2b_aux_data_005deg.nc      |
| Level 3, global 0.25°x0.25°:            | clara3_level3_aux_data_025deg.nc       |
| Level 3, global 1°x1°:                  | clara3_level3_aux_data_1deg.nc         |
| Level 3, Clouds, Northern Polar Region: | clara3_level3_aux_data_polar_nh.nc     |
| Level 3, Clouds, Southern Polar Region: | clara3_level3_aux_data_polar_sh.nc     |
| Level 3, SAL, Northern Polar Region:    | clara3_sal_level3_aux_data_polar_nh.nc |
| Level 3, SAL, Southern Polar Region:    | clara3_sal_level3_aux_data_polar_sh.nc |

Satellite/solar zenith angle data associated with Level 2b products can be provided via the [CM SAF User Help Desk](#) on request.



**Figure 2-1:** Example plots of available Level 3 auxiliary data on the 0.25°x0.25° grid.

Figure 2-1 shows examples of the elevation, fraction of land and land use auxiliary data for the global 0.25°x0.25° latitude/longitude grid auxiliary data.

Table 2-2 lists the different USGS Land Use/Land Cover Characterization classes given in the auxiliary data (example shown in bottom plot of Figure 2-1).

**Table 2-2:** USGS Land Use/Land Cover Characterization

| Value | Class Name  |
|-------|---|
| 0     | INTERRUPTED AREAS (GLOBAL GOODES HOMOLOGOSINE PROJECTION) |
| 1     | Urban and Built-Up Land                                   |
| 2     | Dryland Cropland and Pasture                              |
| 3     | Irrigated Cropland and Pasture                            |
| 4     | Mixed Dryland/Irrigated Cropland and Pasture              |
| 5     | Cropland/Grassland Mosaic                                 |



| Value | Class Name                   |
|-------|------------------------------|
| 6     | Cropland/Woodland Mosaic     |
| 7     | Grassland                    |
| 8     | Shrubland                    |
| 9     | Mixed Shrubland/Grassland    |
| 10    | Savanna                      |
| 11    | Deciduous Broadleaf Forest   |
| 12    | Deciduous Needleleaf Forest  |
| 13    | Evergreen Broadleaf Forest   |
| 14    | Evergreen Needleleaf Forest  |
| 15    | Mixed Forest                 |
| 16    | Water Bodies                 |
| 17    | Herbaceous Wetland           |
| 18    | Wooded Wetland               |
| 19    | Barren or Sparsely Vegetated |
| 20    | Herbaceous Tundra            |
| 21    | Wooded Tundra                |
| 22    | Mixed Tundra                 |
| 23    | Bare Ground Tundra           |
| 24    | Snow or Ice                  |
| 100   | NO DATA                      |

## 2.1 Python Example

An example for reading the auxiliary data using Python is given in the section below:

```
import xarray # for reading the data

# --- Read aux data ---
ds = xarray.open_dataset('clara3_level3_aux_data_025deg.nc')
clara_a3_aux_DEM = ds['dem']
```

```
clara_a3_aux_LSM = ds['lsm']
clara_a3_aux_LUS = ds['lus']

# --- Choose specific conditions ---
# Choose areas with land cover type 'snow or ice'
snow_ice_area = clara_a3_aux_LUS.where(clara_a3_aux_LUS==24)
# Choose areas higher than 2000 m
high_area = clara_a3_aux_DEM.where(clara_a3_aux_DEM>2000)
# Choose land areas (Fraction of Land = 100%)
land_area = clara_a3_aux_LSM.where(clara_a3_aux_LSM==100)
```

### 3 References

Anderson, J., Hardy, E., Roach, J., and Witmer, R., 1976. A land use and land cover classification system for use with remote sensor data. Technical report, U.S. Geological Survey.

Eidenshink, J. and Faundeen J., 1994. The 1 km AVHRR global land data set-first stages in implementation. *International Journal of Remote Sensing* 15(17), 3443-3462.

Karlsson, Karl-Göran; Riihelä, Aku; Trentmann, Jörg; Stengel, Martin; Solodovnik, Irina; Meirink, Jan Fokke; Devasthale, Abhay; Jääskeläinen, Emmihenna; Kallio-Myers, Viivi; Eliasson, Salomon; Benas, Nikos; Johansson, Erik; Stein, Diana; Finkensieper, Stephan; Håkansson, Nina; Akkermans, Tom; Clerbaux, Nicolas; Selbach, Nathalie; Schröder, Marc; Hollmann, Rainer (2023): CLARA-A3: CM SAF cCloud, Albedo and surface RAdiation dataset from AVHRR data - Edition 3, Satellite Application Facility on Climate Monitoring, DOI:10.5676/EUM\_SAF\_CM/CLARA\_AVHRR/V003.

## 4 Glossary

|          |   |
|----------|---|
| AUX      | Auxiliary   |
| AVHRR    | Advanced Very High Resolution Receiver                                  |
| CLARA-A  | CM SAF cLoud, Albedo & RAdiation dataset - AVHRR-based                  |
| CLD      | Cloud products  |
| CM SAF   | Satellite Application Facility on Climate Monitoring                    |
| DEM      | Digital Elevation Model   |
| DOI      | Digital Object Identifier   |
| DWD      | Deutscher Wetterdienst<br>(German Meteorological Service)               |
| EASE     | Equal-Area Scalable Earth Grid  |
| EUMETSAT | European Organisation for the Exploitation of Meteorological Satellites |
| GAC      | Global Area Coverage  |
| LAT      | Latitude  |
| LON      | Longitude   |
| LSM      | Land Fraction   |
| LUS      | Land use data   |
| NOAA     | National Oceanic & Atmospheric Administration                           |
| PUM      | Product User Manual   |
| RAD      | Surface RAdiation Product   |
| RD       | Reference Document  |
| SAL      | Surface ALbedo  |
| SMHI     | Swedish Meteorological and Hydrological Institute                       |
| USGS     | U.S. Geological Survey  |