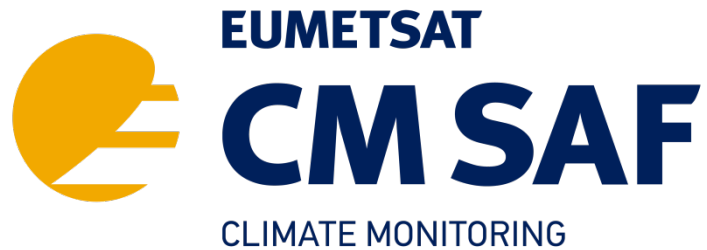


**EUMETSAT Satellite Application Facility on Climate Monitoring**




**CLARA-2.1 Auxiliary Data User Guide**

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## Document Change Record

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## Reference Documents

Reference	Title	Code
RD 1	Product User Manual CM SAF Cloud, Albedo, Radiation data record AVHRR-based, Edition 2.1 (CLARA-A2.1), Cloud Products	SAF/CM/SMHI/PUM/GAC/CLD, v2.6
RD 2	Product User Manual CM SAF Cloud, Albedo, Radiation data record AVHRR-based, Edition 2.1 (CLARA-A2.1), Surface Albedo	SAF/CM/DWD/PUM/GAC/SAL, v2.3
RD 3	Product User Manual CM SAF Cloud, Albedo, Radiation data record AVHRR-based, Edition 2.1 (CLARA-A2.1), Surface Radiation	SAF/CM/DWD/PUM/GAC/RAD, v2.4

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## 1 Introduction

The second edition of CM SAF's CLARA-A2.1 provides cloud, radiation and albedo properties derived from the AVHRR imager on board polar orbiting satellites operated by NOAA and EUMETSAT. 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

For detailed information about the CLARA-A2.1 product suite, see the respective Product User Manuals (RD 1, RD 2, RD 3)

## 2 Static auxiliary data

In order to facilitate work with the CLARA-A2.1 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/ Product category	Level 2b, 0.05°x0.05°, global	Level 3, 0.25°x0.25°, global	Level 3, 25 km x 25km EASE grid, polar areas
<i>Latitude</i>	lat(lat)	lat(lat)	lat(y, x)
<i>Longitude</i>	lon(lon)	lon(lon)	lon(y, x)
<i>Land Fraction (LSM)</i>	lsm(lat,lon)	lsm(lat,lon)	lsm(y,x)
<i>Altitude (DEM)</i>	dem(lat, lon)	dem(lat, lon)	dem(y,x)
<i>Land use data (LUS)</i>	lus(lat, lon)	lus(lat, lon)	lus(y,x)
<i>Dimensions</i>	lat=3600,lon=7200	lat=720,lon=1440	x,y=361 (Northern hemisphere)  x,y=321 (Southern hemisphere)

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 Eidenshink 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-A2.1 L2b and L3 global products as well as the respective grids for the Polar areas.

The auxiliary data are stored in the following netCDF4 files:

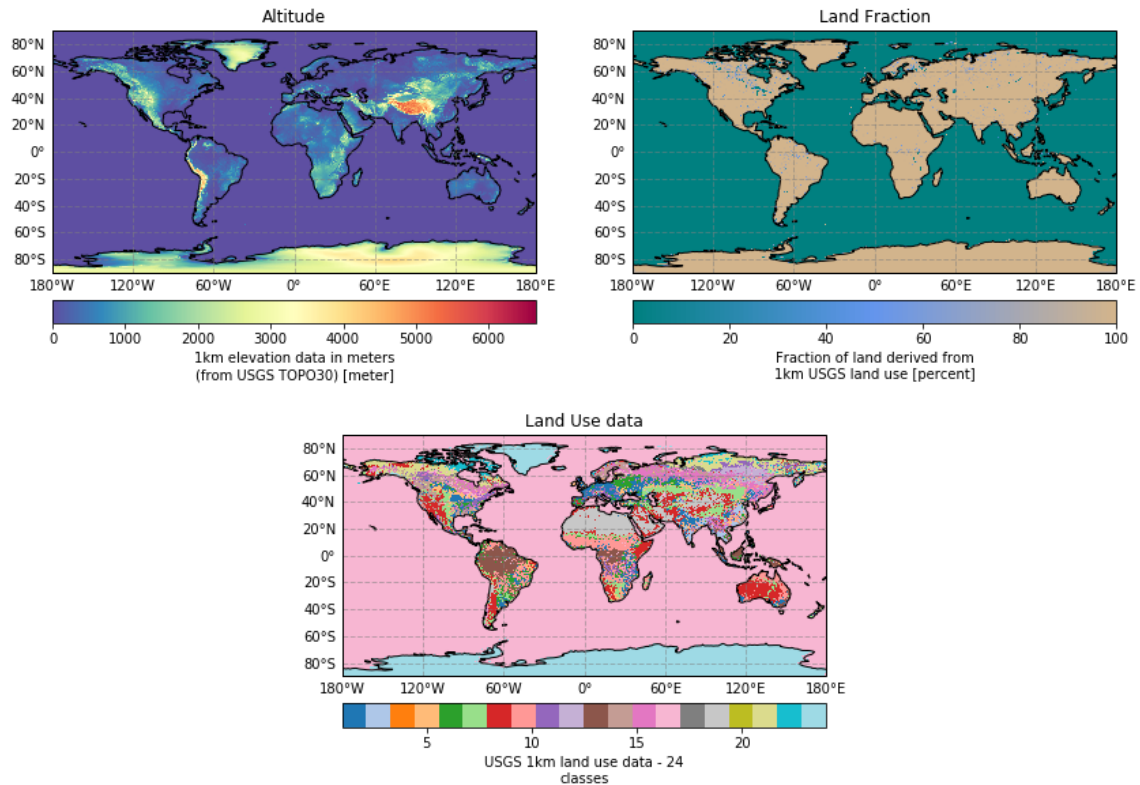
Level 2b, global: Aux\_file\_CM\_SAF\_AVHRR\_GAC\_L2b\_0.05deg.nc

Level 3, global: Aux\_file\_CM\_SAF\_AVHRR\_GAC\_L3\_0.25deg.nc

Level 3, Northern Polar Region: Aux\_file\_CM\_SAF\_AVHRR\_GAC\_NH.nc

Level 3, Southern Polar Region: Aux\_file\_CM\_SAF\_AVHRR\_GAC\_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
6	Cropland/Woodland Mosaic
7	Grassland



Value	Class Name
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('Aux_file_CM_SAF_AVHRR_GAC_L3_0.25deg.nc')
clara_a2_aux_DEM = ds['dem']
clara_a2_aux_LSM = ds['lsm']
clara_a2_aux_LUS = ds['lus']
```

```
# --- Choose specific conditions ---  
# Choose areas with land cover type 'snow or ice'  
snow_ice_area = clara_a2_aux_LUS.where(clara_a2_aux_LUS==24)  
# Choose areas higher than 2000 m  
high_area = clara_a2_aux_DEM.where(clara_a2_aux_DEM>2000)  
# Choose land areas (Fraction of Land = 100%)  
land_area = clara_a2_aux_LSM.where(clara_a2_aux_LSM==100)
```

	<p align="center"><b>CLARA-2.1 Auxiliary Data User Guide</b></p>	<p>Doc. No: SAF/CM/DWD/AUX/CLARA/CLD Issue: 1.0 Date: 10.06.2021</p>
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### 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; Anttila, Kati; Trentmann, Jörg; Stengel, Martin; Solodovnik, Irina; Meirink, Jan Fokke; Devasthale, Abhay; Kothe, Steffen; Jääskeläinen, Emmihenna; Sedlar, Joseph; Benas, Nikos; van Zadelhoff, Gerd-Jan; Stein, Diana; Finkensieper, Stephan; Håkansson, Nina; Hollmann, Rainer; Kaiser, Johannes; Werscheck, Martin (2020): CLARA-A2.1: CM SAF cCloud, Albedo and surface RAdiation dataset from AVHRR data - Edition 2.1, Satellite Application Facility on Climate Monitoring, DOI:[10.5676/EUM\\_SAF\\_CM/CLARA\\_AVHRR/V002\\_01](https://doi.org/10.5676/EUM_SAF_CM/CLARA_AVHRR/V002_01).

## 4 Glossary

AUX	Auxiliary
AVHRR	Advanced Very High Resolution Receiver
CLARA-A	CM SAF cCloud, 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 (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