earthcarekit: A Python package to simplify working with EarthCARE satellite data

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earthcare kit

…is an open-source Python package offering comprehensive and flexible tools for downloading, reading, analysing and visualizing data from the ESA-JAXA EarthCARE satellite.

The software is being actively developed at the Leibniz Institute for Tropospheric Research (TROPOS) and aims to be continuously expanded with additional features based on user needs and contributions in order to support diverse calibration/validation (cal/val) and scientific efforts.

Data Download

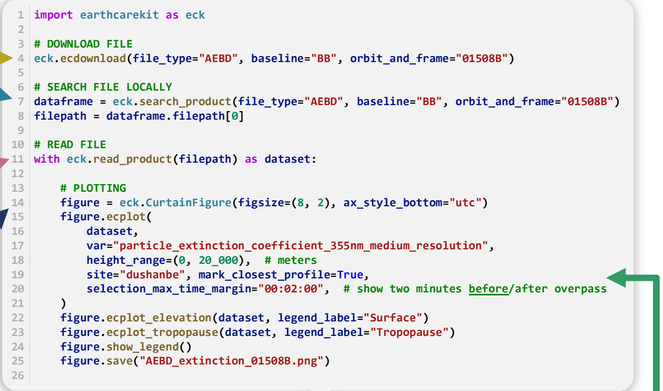
Access data from ESA's dissemination services **OADS or MAAP** via the command line or your Python scripts using the integrated **ecdownload** tool. Search queries can be refined by using various search criteria, including:

- Lists and ranges of orbit numbers and/or frame IDs
- Single timestamps or time ranges
- Geographic area defined by radius or bounding box

For example, you may download data from the command-line:

```
$ ecdownload  AEBD:BB --orbit_and_frame 01508B
```

Or, download files from your Python scripts



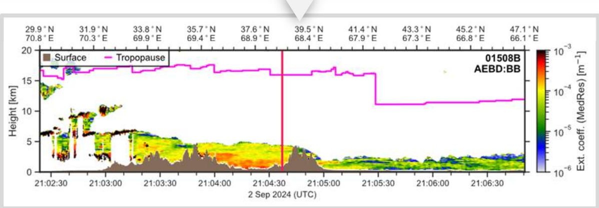
```python
import earthcarekit as eck

# DOWNLOAD FILE
eck.ecdownload(file_type="AEBD", baseline="BB", orbit_and_frame="01508B")

# SEARCH FILE LOCALLY
dataframe = eck.search_product(file_type="AEBD", baseline="BB", orbit_and_frame="01508B")
filepath = dataframe.filepath[0]

# READ FILE
with eck.read_product(filepath) as dataset:

    # PLOTTING
    figure = eck.CurtainFigure(figsize=(8, 2), ax_style_bottom="utc")
    figure.ecplot(
        dataset,
        var="particle_extinction_coefficient_355nm_medium_resolution",
        height_range=(0, 20_000),  # meters
        site="dushanbe", mark_closest_profile=True,
        selection_max_time_margin="00:02:00",  # show two minutes before/after overpass
    )
    figure.ecplot_elevation(dataset, legend_label="Surface")
    figure.ecplot_tropopause(dataset, legend_label="Tropopause")
    figure.show_legend()
    figure.save("AEBD_extinction_01508B.png")
```

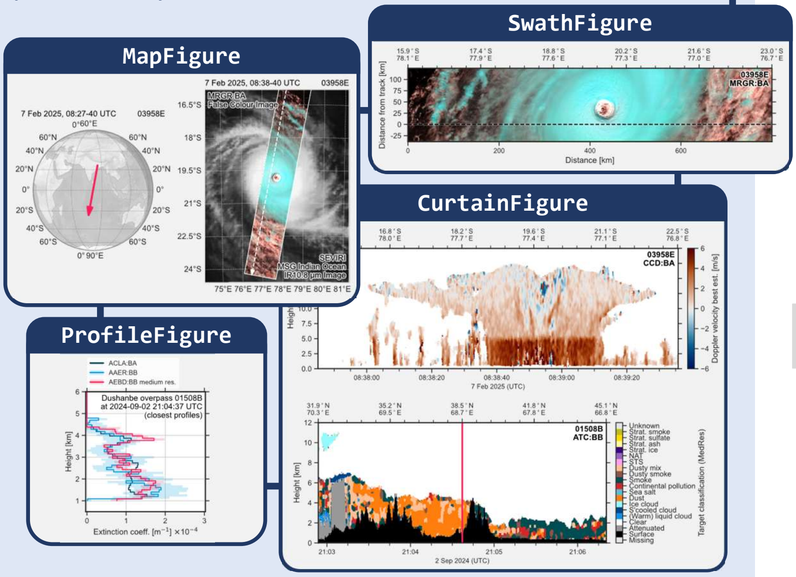


Data I/O, Processing and Visualisation

Local files can be quickly **searched** using metadata (e.g., file type, orbit number, time, etc.) with a syntax similar to the **ecdownload** tool.

Reading datasets is streamlined by standardized naming for common dimensions (e.g., along-track, across-track, and vertical) and auxiliary variables – such as surface elevation, land flag, layer temperature, and tropopause height – which simplifies data handeling across different EarthCARE products.

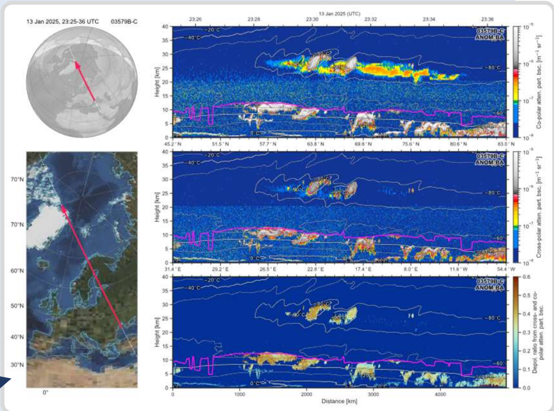
A range of specialized yet customizable figure objects facilitates the creation of **publication-ready visualizations:**



Quicklooks

Fast preview visualisations for EarthCARE products can be generated via the console or scripting using the **ecquicklook** tool.

Also, functions for domain-specific quicklooks are provided, e.g., for deep convection events or **polar stratospheric clouds (PSCs).**



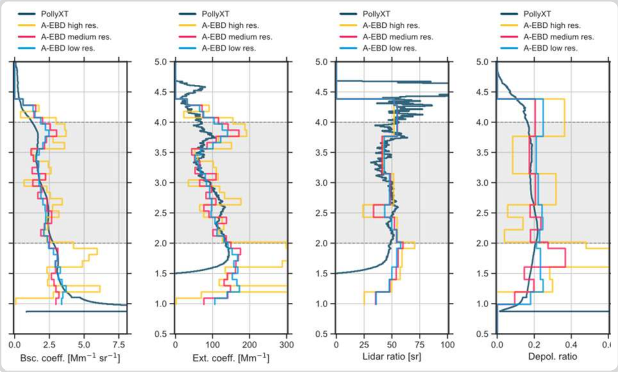
Use Case: ATLID Cal/Val

Many of the currently available utilities and plotting tools offer advanced options designed specifically for cal/val activities and the analysis of case studies.

For example, preset or user-defined ground sites can be specified when plotting to filter data relevant for comparisons.

Other examples include functions such as:

- **filter_radius()**, which extracts the closest or all profiles within a radius around a ground site.
- **compare_bsc_ext_lr_depol()**, which is used to plot ATLID Lidar profiles and ground measurements (e.g., PollyXT data) and to create data frames with layer and comparison statistics in defined height ranges.



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