The Heidelberg Iterative Cloud Retrieval Utilities (HICRU)

Product Specification Document

SCIAMACHY Release 1.0

Product Description

The Heidelberg Iterative Cloud Retrieval Utilities retrieve effective cloud fraction using the Polarization Monitoring Devices of the SCIAMACHY instrument. Effective cloud fraction means, that one parameter is retrieved, which is sensitive to cloud coverage and -as well- to cloud albedo. The results have to be interpreted as a cloud coverage with respect to a high cloud albedo. Future releases of HICRU will retrieve further cloud parameters.

HICRU data for SCIAMACHY is available for download from 01/2003 – 11/2004 in packages containing one month of HICRU data each. The data can be downloaded free of charge from our website: http://satellite.iup.uni-heidelberg.de. Choose "Data Products" and "HICRU cloud data" on the website. Note, that not all orbits are available during this period. Each package contains ASCII files compressed with the TAR/GZIP program (about 300-1000 MB). We provide cloud fraction for each SCIAMACHY PMD measurement. The cloud fraction is therefore available with a higher spatial resolution than all trace gases. A tool which helps to combine results from trace gas retrievals in ASCII format with HICRU ASCII data is in development. An alpha release of this tool running on MS-Windows is available on request. In the level-1 files some data, like the corner coordinates, is only available for an artificial "geolocation", which contains a set of PMD measurements (typically between 8 and 32 PMD measurements). The corner coordinates of the PMDs are retrieved through linear interpolation between the corner coordinates of the geolocation. The level-1 data offers time at the begin of the state only. The time given in the HICRU output is interpolated using the time at the begin of the state and the PMD read-out time. The order of the corner coordinates is different from ESA. ESA orders the corners by the time of overpass. In the HICRU dataset, the order of the coordinates does not change with respect to the normal projection of the earth: 1. north-west, 2. north-east 3. south-west 4. south-east. After a polcrossing, which means that SCIAMACHY is then measuring in the evening ("night site"), a flag called "polcrossing" is set to 1.

The cloud fraction is set to -1 if there is no cloud fraction available (e.g. persistent ice coverage, solar zenith angle out of range, error in the level-1 data).

Global maps of HICRU cloud fraction are available on request.

HICRU cloud data is available for solar zenith angles lower than 85 degrees only.

Product Format Description

The columns contain the following entries:

1. date of the measurement [day.month.year]

2. interpolated time of the measurement [hour:minute:second]
3. interpolated time: time since midnight [milliseconds]
4. duration of the scan [seconds]
5. ID number of the state
6. number of the geolocation (starts with 0 for each state)
7. number of the PMD (starts with 0 for each geolocation)
8. backscan (0=forescan, 1=backscan)
9. polcrossing (0=regular case, 1=north pole or south pole was crossed, SCIAMACHY on "night-site")
10. corner coordinate, latitude, top left
11. corner coordinate, longitude, top left
12. corner coordinate, latitude, top right
13. corner coordinate, longitude, top right
14. corner coordinate, latitude, down left
15. corner coordinate, longitude, down left
16. corner coordinate, latitude, down right
17. corner coordinate, longitude, down right
18. solar zenith angle (for the centre of the geolocation) [in degrees]
19. line of sight angle (for the centre of the geolocation) [in degrees]
20. line of sight azimuth angle (for the centre of the geolocation) [in degrees]
21. effective cloud fraction (-1 means no cloud data available) [0..1]

Software release history

Version 1.0 (first official release), 05/2005

Version 1.0 is the first release available to the public. Some presentations on conferences before Mai 2005 refer to a preliminary state of the algorithm. The data of the preliminary algorithm was not public available, except for selected people on request.

Implementation details:

see Algorithm document. The time period from 01/2003-11/2004 is used for evaluation. Cloud fraction is retrieved from PMD3 intensities using all calibrations of the SCIAMACHY data processor.

List of known issues and data quality assessment

The validations of the algorithm have shown the reliability of the results. HICRU is able to retrieve accurate cloud fractions also for regions like deserts, which are usually difficult for SCIAMACHY cloud algorithms.

The algorithm fails in the case of ice and snow covered surfaces and in the case of sunglint. The cloud fraction is overestimated in these cases.

HICRU cloud data is limited to solar zenith angles lower than 85 degree.

The errors depend on the surface, on the solar zenith angle and the quality of the level-1 spectra. The current release does not include an error for each measurement, this will be added for the next release. The errors are lower than 0.05, including the results over deserts which are often difficult for SCIAMACHY cloud algorithms. This is concluded in agreement with case studies, the analysis

of the scattering for cloud free scenarios and the theoretically known error sources of the algorithm. For high cloud fractions the error analysis is difficult. Dependent on the conditions the algorithm can be more accurate. For small cloud fractions the error depends on the availability of cloud free measurements for the retrieval of the lower thresholds, the surface albedo and the seasonal variations of the surface albedo. The error is slightly higher for high scan angles.

The cloud fraction is scaled but not forced to the range [0..1]. The cloud fraction can become lower than 0, if the measured intensity is lower then the intensity calculated for the correspondent cloud-free scenario. Cloud fractions lower than 0 due to inaccuracies of the algorithm and should be interpreted as cloud free. Negative cloud fractions should be within the range of known inaccuracies except for pixels inflenced by snow and ice and single measurements which contains the boundary between West-Sahara and Atlantic Ocean.

Cloud fractions higher than 1 are consistent with the concept of an effective cloud fraction and happens if the measured cloud albedo is higher than indirectly assumed through the threshold retrieval. Another similar description is used by the FRESCO algorithm, which use -different from HICRU- an explicit assumption of a fixed albedo (that means the albedo is assumed to be 80% for all measurements). If the measured intensity is higher than assumed for a cloud fraction 1 and a cloud albedo of 80%, the cloud fraction is set to 1 and the cloud albedo is increased (that means, the free parameter is the albedo instead of the cloud coverage). Intercomparisions have shown, that measurements with HICRU cloud fractions higher than 1 correspond to the cases with an assumed FRESCO cloud albedo higher than 80%. References for the FRESCO algorithm are given in the Algorithm Document.