

CLAAS-3

The CM SAF MSG-SEVIRI-based cloud property climate data
record

Overview and updates

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Presentation Outline

- Introduction
 - The EUMETSAT CM SAF
 - Importance of clouds
 - Advantages of satellite data
- CLAAS-3: contents and properties
- Previous CLAAS editions and their usage
- CLAAS-3: new features and advantages
- Summary and outlook
- Further information

The EUMETSAT CM SAF



Image credit: CM SAF

- › Production of satellite-derived geophysical parameter data sets suitable for climate monitoring
- › Support of process studies, climate trend and variability analyses, and improvement of models by providing data sets for validation
- › Cloud properties data sets include retrievals from SEVIRI and AVHRR sensors

Why monitoring and studying clouds is important?

Energy budget

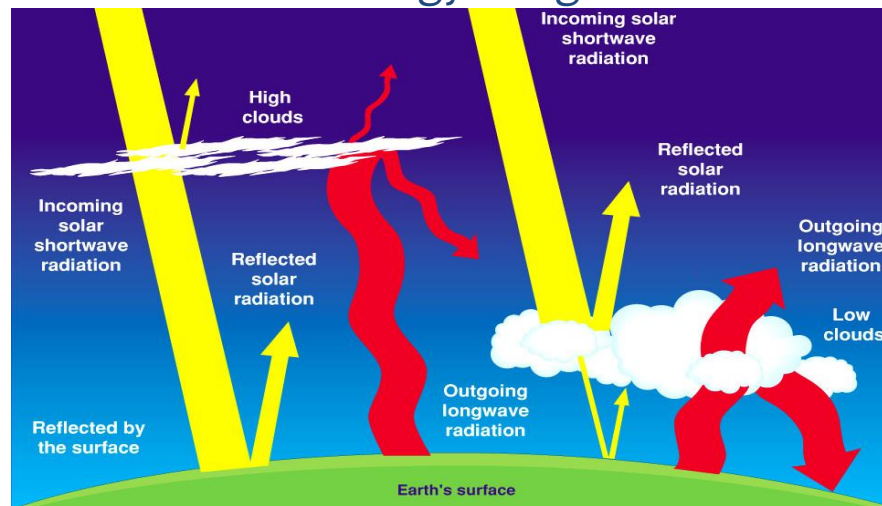
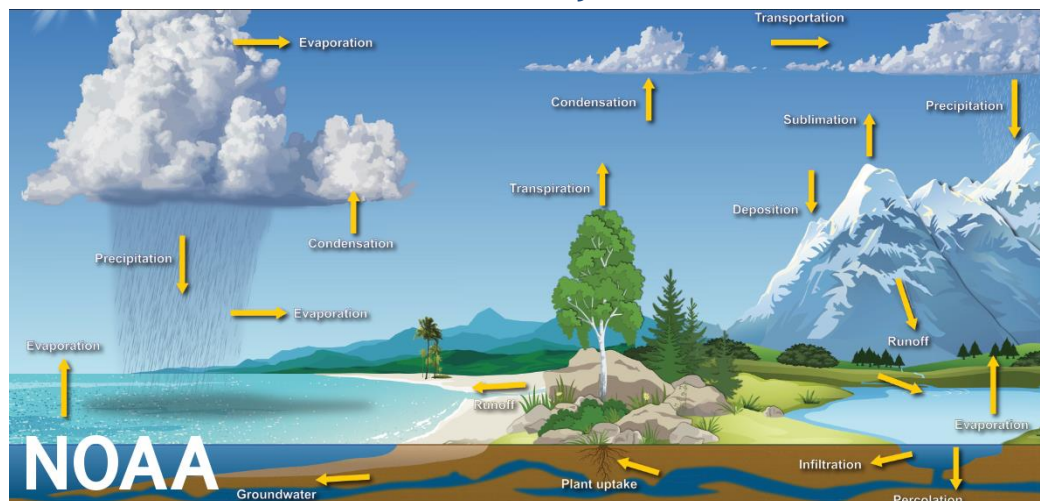


Image credit: NASA

Water cycle



19-4-2023

Image credit: NOAA

EUMETSAT CLAAS-3 Online course

Climate change feedbacks

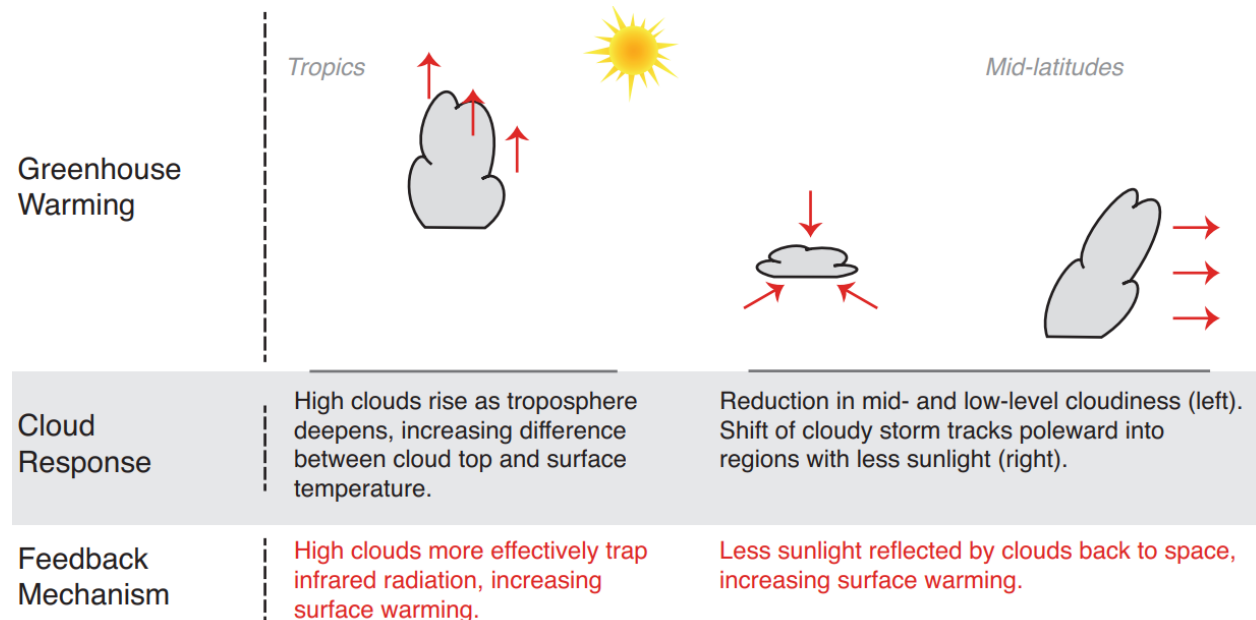


Image credit: IPCC

Why use satellite-based cloud data?

- › Polar-orbiting satellites offer global coverage, including oceans
- › However, global coverage comes with lower measurement frequency compared to ground stations
- › Geostationary satellites provide measurements every few minutes
- › While geostationary coverage is not global, it is adequate for monitoring large areas of the Earth.

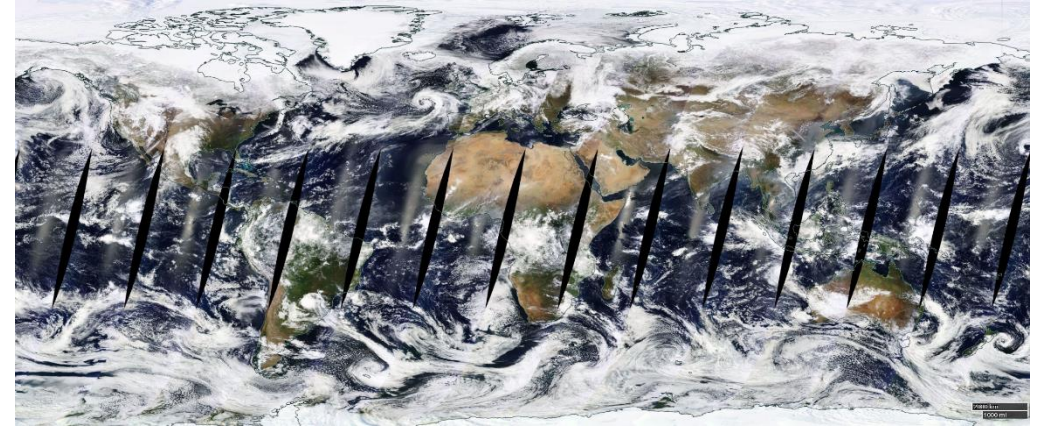
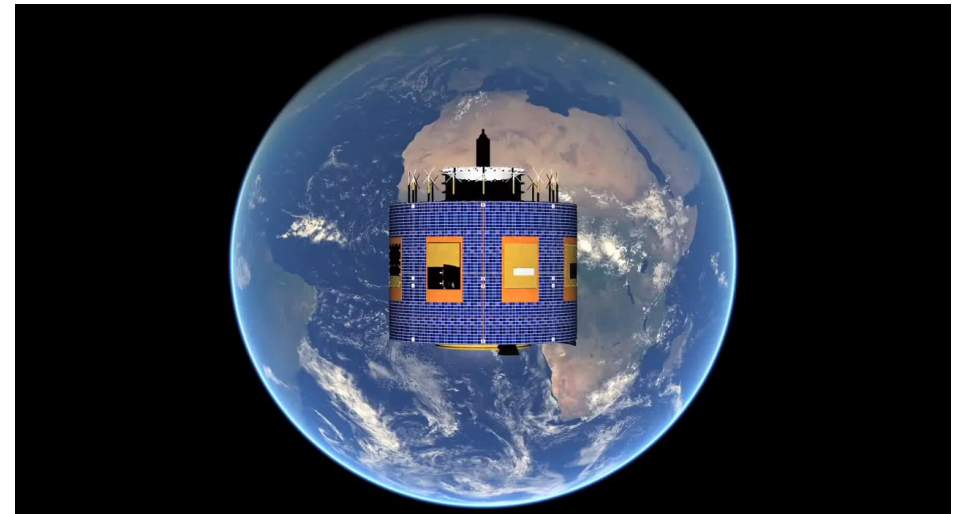


Image credit: NASA Worldview



Video credit: EUMETSAT

Why use satellite-based cloud data?

CLAAS-3 is a Cloud property data set based on SEVIRI, a geostationary imager

- › 12 channels from visible to thermal infrared part of the spectrum
- › Measurements are available every 15 minutes, starting in 2004
- › On board EUMETSAT geostationary satellites Meteosat-8, 9, 10, 11, located over 0.0° latitude and longitude

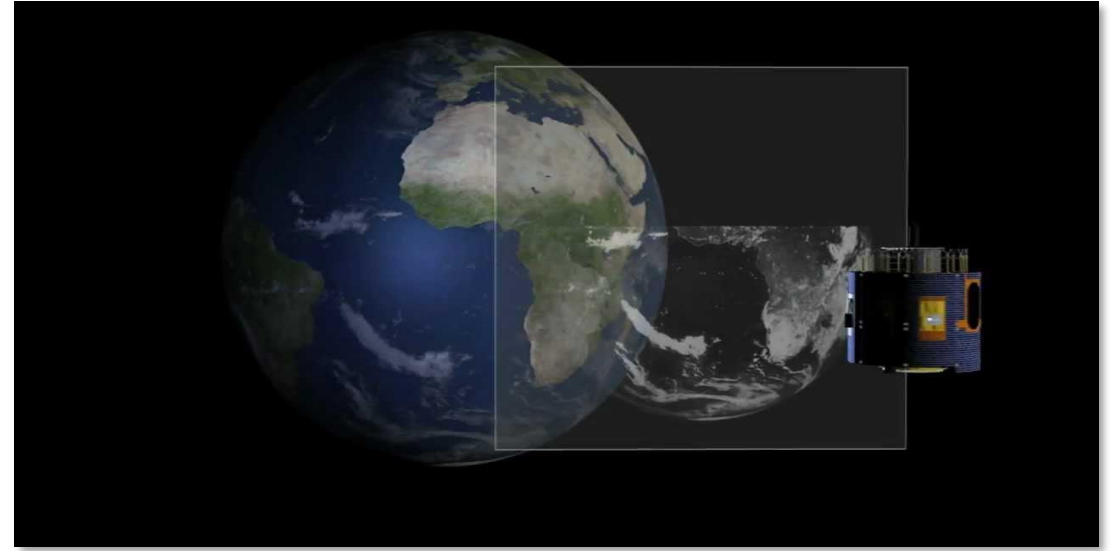
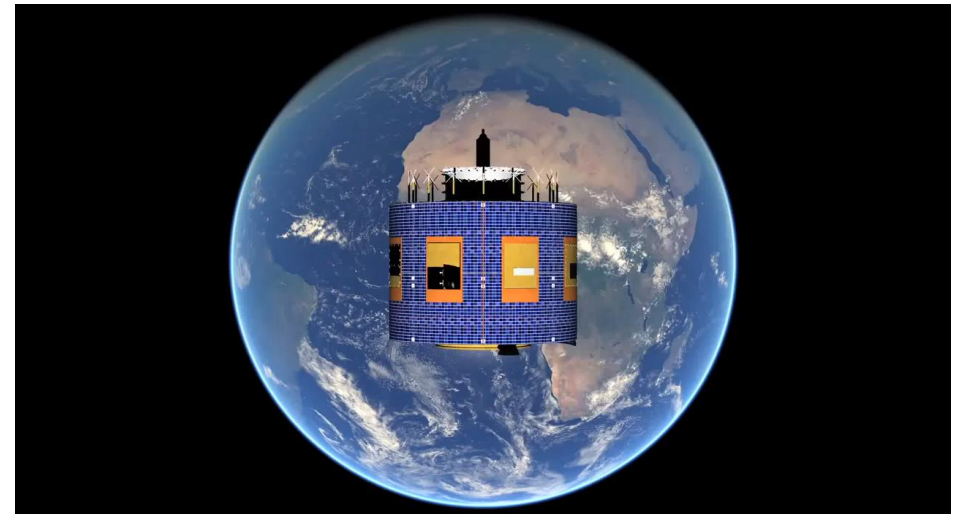
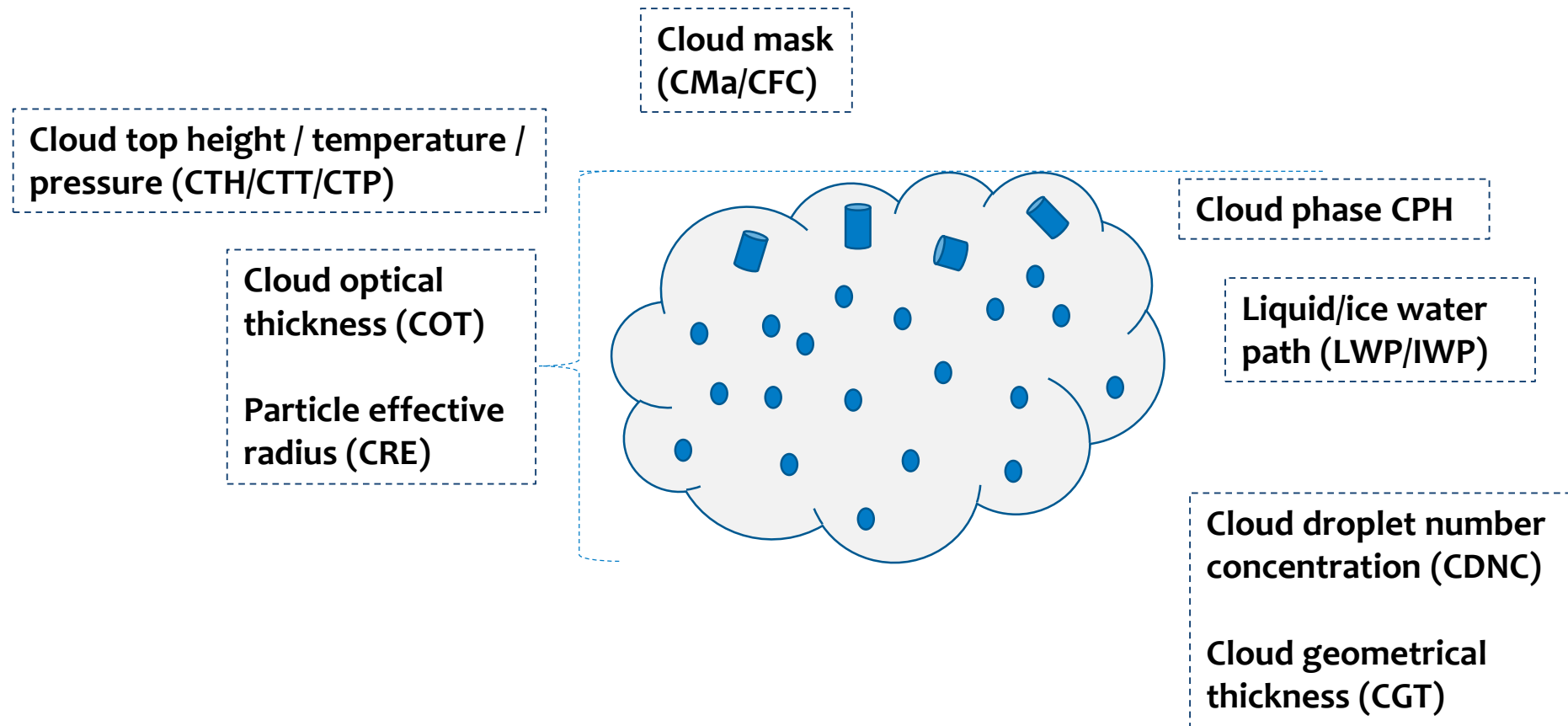


Image credit: EUMETSAT



Video credit: EUMETSAT

Which cloud properties are included in CLAAS-3?



CLAAS-3 temporal and spatial availability

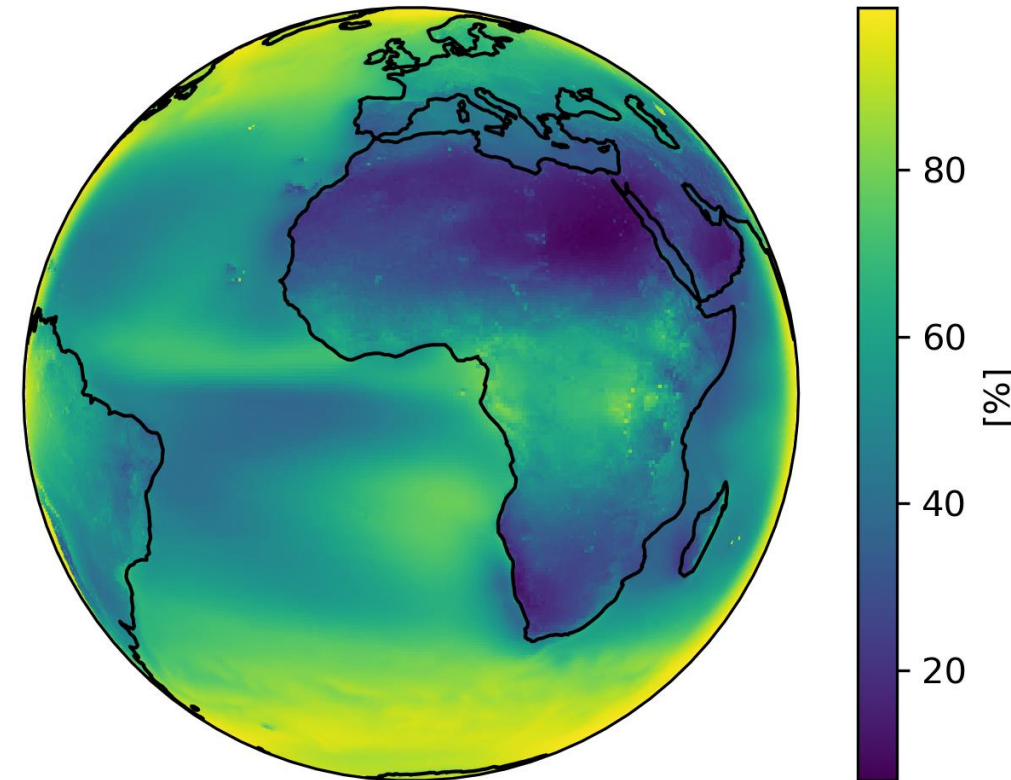
Level 2

- Instantaneous, every 15 min.
- 3 km × 3 km close to nadir (0.0° lat/lon), expanding towards the disk edge

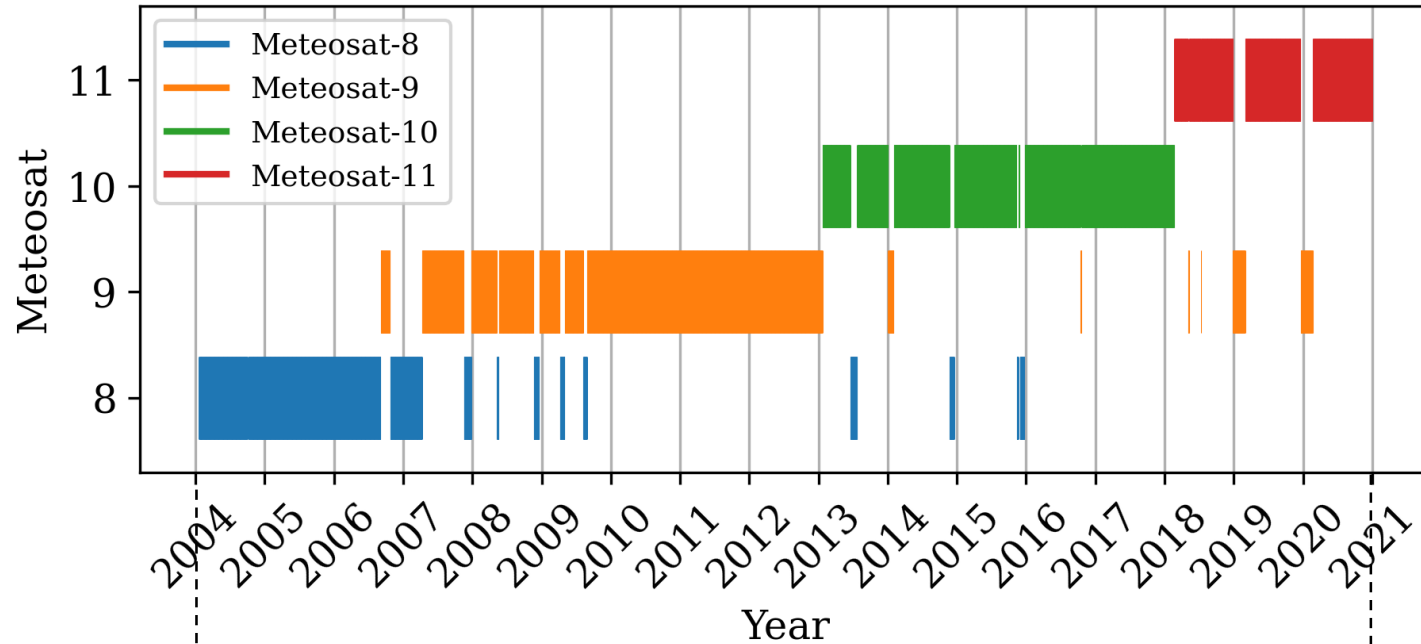
Level 3

- Daily mean at 0.05° × 0.05°
- Monthly mean at 0.05° × 0.05°
- Monthly mean diurnal cycle at 0.25° × 0.25°

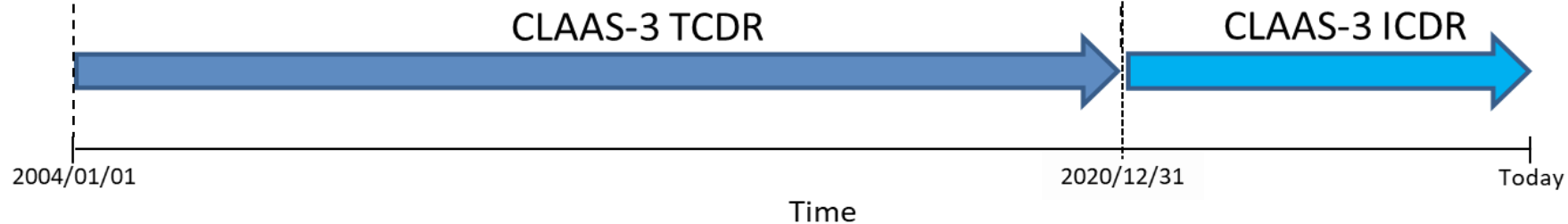
Average cloud fraction in 2004-2020



Editions of the CLAAS data record

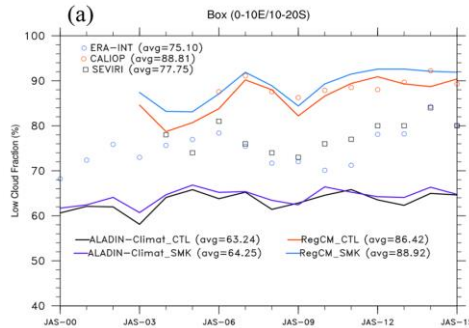


- > CLAAS-1 (Stengel et al., ACP, 2014)
 - 2004 - 2011 (2 satellites)
- > CLAAS-2 (Benas et al., ESSD, 2017)
 - 2004 - 2015 (3 satellites)
 - + extension 2016-2017 (CLAAS-2.1)
 - + ICDR CFC and CTH
- > CLAAS-3 (Benas et al., ESSD, submitted)
 - 2004 - 2020 (4 satellites)
 - + ICDR all variables



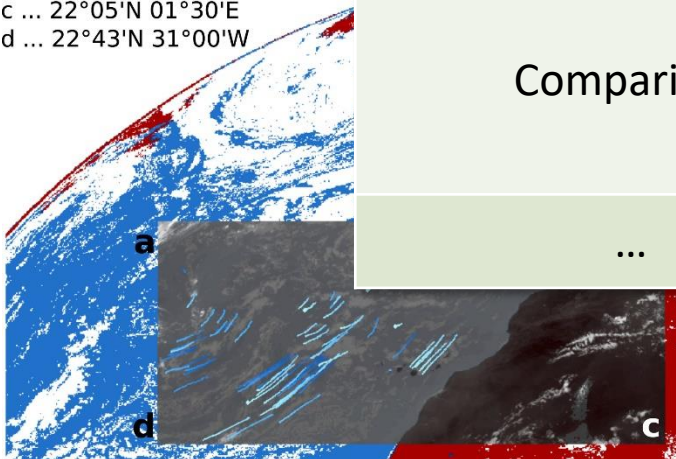
Previous usage of CLAAS data

Evaluation of climate models



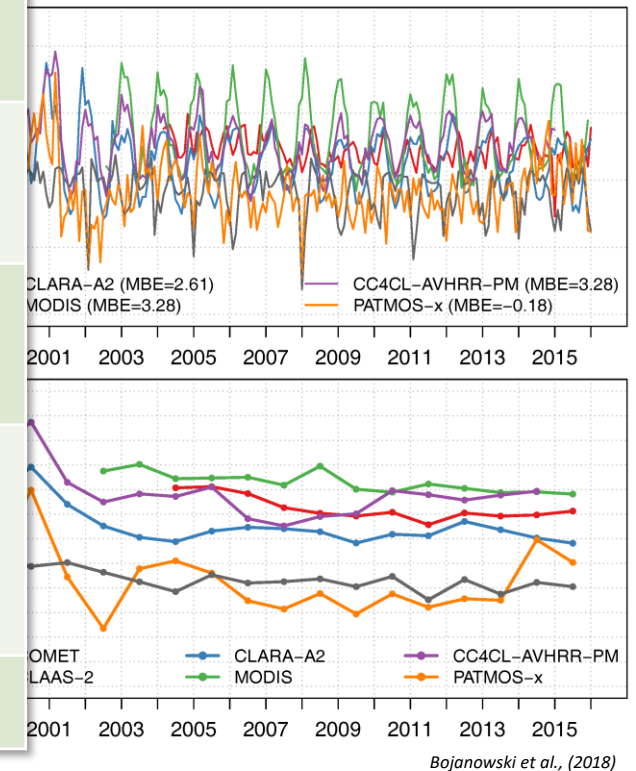
Life cycle of m

- a ... 38°49'N 38°56'W
- b ... 37°13'N 01°47'E
- c ... 22°05'N 01°30'E
- d ... 22°43'N 31°00'W



General Applications	Examples
Model evaluation	Regional, WRF, NWP, ML, NN
Cloud filtering/masking	For other retrievals, input to NN
Characterization and processes	Focus mainly on diurnal cycle
Comparison	With ground-based observations or other satellite data
...	

with other cloud products



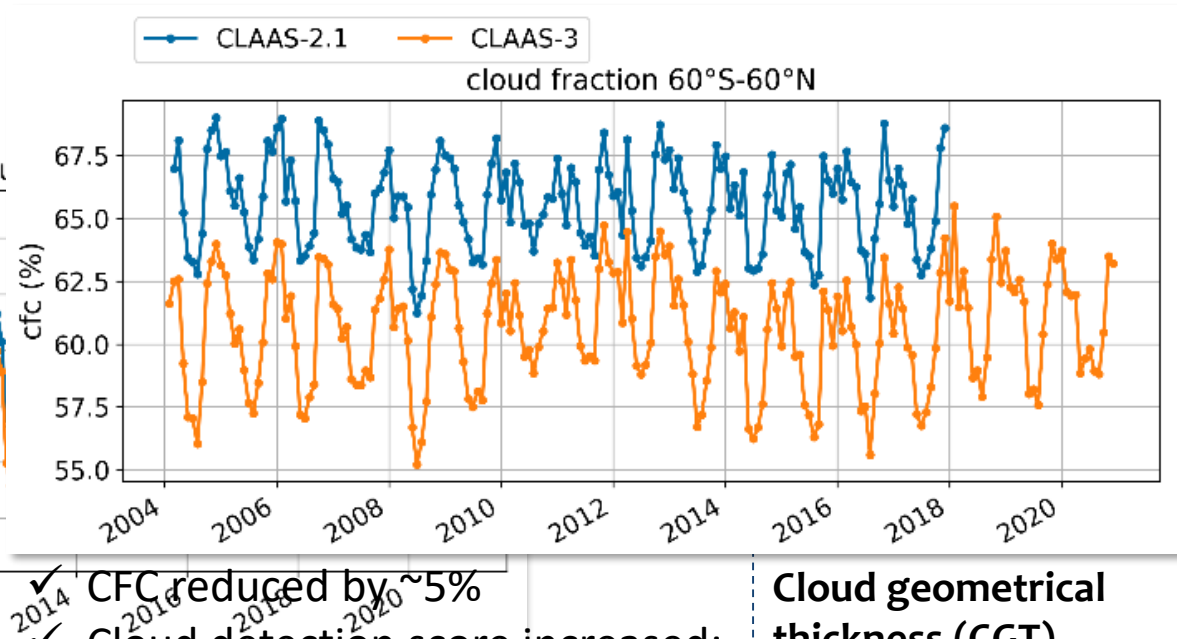
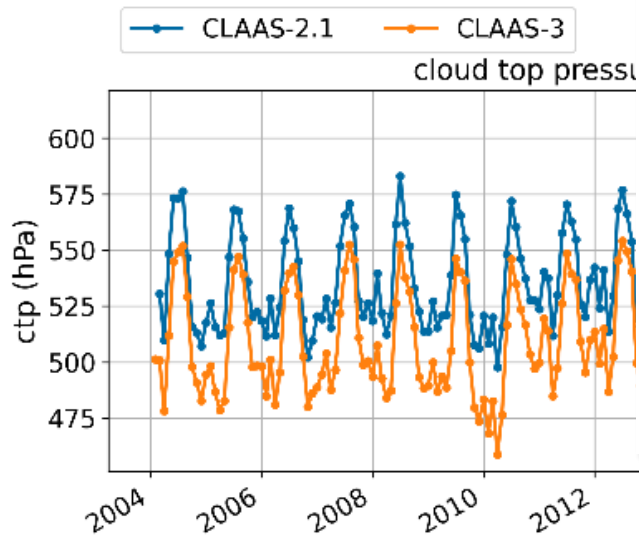
Why use CLAAS-3 and not extend CLAAS-2?

Improved cloud top retrieval based on neural network trained with CALIPSO data

Cloud top height / temperature / pressure (CTH/CTT/CTP)

Cloud mask (CMA/CFC)

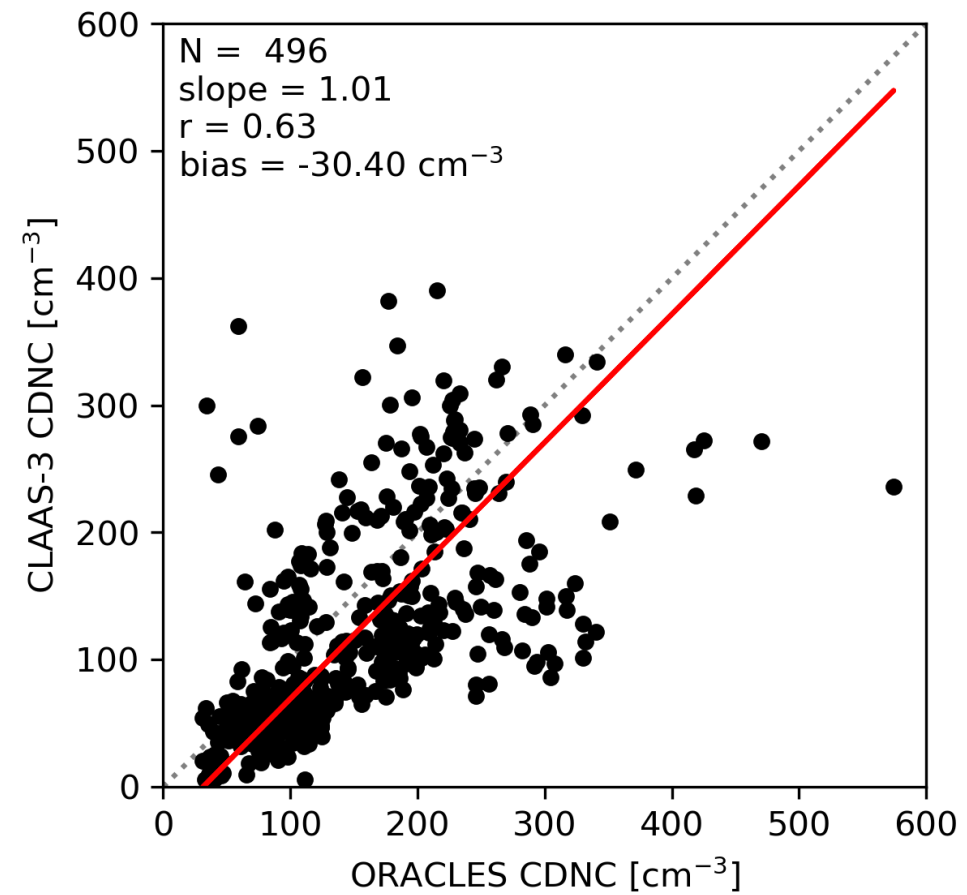
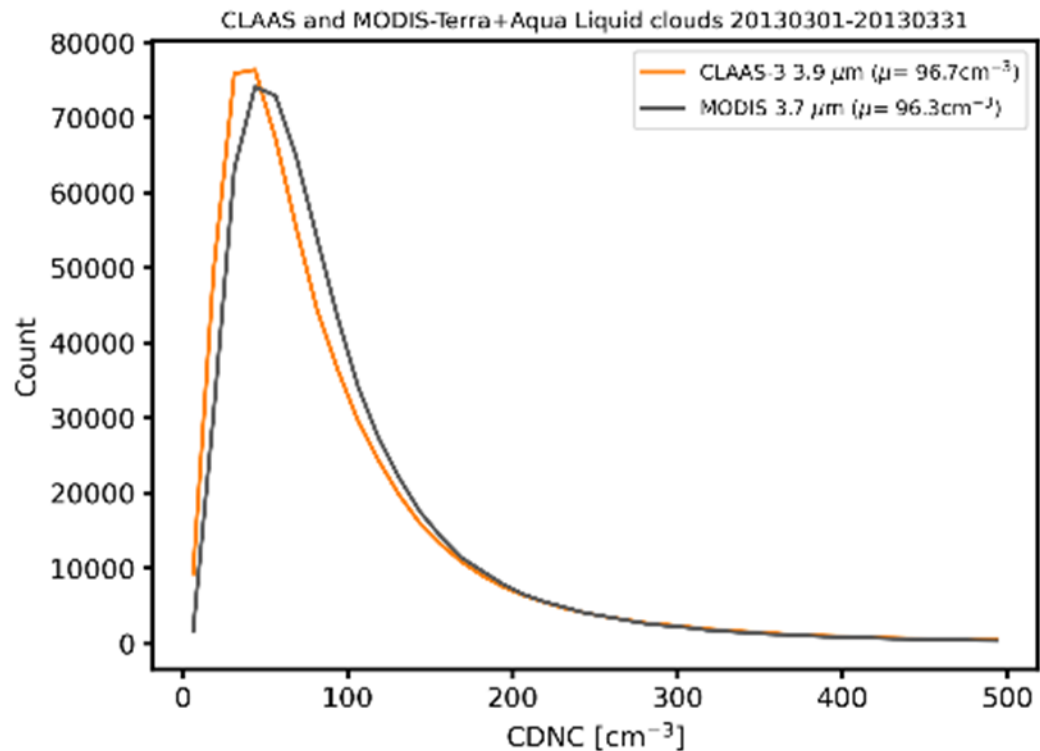
Improved cloud mask algorithm, incl. probabilistic cloud mask



✓ CTH bias reduced: -520 m → 230 m
✓ Cloud detection score increased: 0.57 → 0.67

Cloud geometrical thickness (CGT)

Why use CLAAS-3 an



New cloud products

Cloud geometrical
thickness (CGT)

Summary & outlook

- CLAAS-3, the new climate data record of cloud properties from SEVIRI measurements has been produced.
- CLAAS-3 offers the advantages of geostationary-based data over Earth regions of high interest (Europe, Africa, the Atlantic ocean...) for a long time period: 2004 – present.
- Extensive validation demonstrates improvements compared to previous editions in various respects
- Preparations for successor CLAAS-4 have already started
 - Seamless transition to MTG-FCI
 - Re-calibration of IR channels by EUMETSAT
 - Cloud phase identification based on neural network trained with CALIPSO
 - ...

Further information

- CLAAS-3 is publicly available via the CM SAF website, www.cmsaf.eu:
https://doi.org/10.5676/EUM_SAF_CM/CLAAS/V003.
- The same link contains CLAAS-3 documentation, related publications and links for downloading specific CLAAS-3 cloud variables



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EXTERNAL LINKS



Digital Object Identifier
Entry information for CLAAS_V003

Here you find the details of your selected DOI acronym and the links to order the described products.

Title
CLAAS-3: CM SAF Cloud property dAtaset using SEVIRI - Edition 3

Citation
Meirink, Jan Fokke; Karlsson, Karl-Göran; Solodovnik, Irina; Hüser, Imke; Benas, Nikos; Johansson, Erik; Håkansson, Nina; Stengel, Martin; Selbach, Nathalie; Schröder, Marc; Hollmann, Rainer (2022): CLAAS-3: CM SAF Cloud property dAtaset using SEVIRI - Edition 3, Satellite Application Facility on Climate Monitoring, DOI:10.5676/EUM_SAF_CM/CLAAS/V003, https://doi.org/10.5676/EUM_SAF_CM/CLAAS/V003. [BibTeX entry]

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Author(s)
Meirink, Jan Fokke; Karlsson, Karl-Göran; Solodovnik, Irina; Hüser, Imke; Benas, Nikos; Johansson, Erik; Håkansson, Nina; Stengel, Martin; Selbach, Nathalie; Schröder, Marc; Hollmann, Rainer

Description
The CLAAS-3 record provides cloud properties derived from intercalibrated measurements (Meirink et al., 2013) of the SEVIRI sensor onboard METEOSAT second generation (MSG) satellites. CLAAS-3 is the latest edition of CLAAS with previous editions documented in Stengel et al. (2014) and Benas et al. (2017). CLAAS-3 includes the following cloud properties: cloud mask/type, cloud top temperature/pressure/height, cloud thermodynamic phase, cloud optical thickness, cloud particle effective radius and cloud water path. Additionally, cloud droplet number concentration and cloud geometrical thickness are provided for liquid clouds. All data are available on multiple processing levels spanning level-2 (native SEVIRI resolution, i.e. 15 minutes repeat cycle and 3 km (nadir) spatial resolution) to level-3 (spatio-temporal aggregations such as daily averages, monthly averages and monthly histograms on a 0.05° x 0.05° grid, as well as monthly mean diurnal cycles and joint cloud optical thickness – cloud top pressure histograms on a 0.25° x 0.25° grid). CLAAS-3 covers the time period 2004/01 until 2020/12 as climate data record (CDR), but is operationally extended as interim climate data record (ICDR) to the present with a latency of 10 days. Some key features of CLAAS-3 compared to previous editions are: 1) The ICDR contains the same (full) product portfolio as the CDR, 2) Significant improvements for cloud detection with provision of a cloud probability, 3) Significant improvements for vertical placement of clouds (pressure, temperature, height), 4) New cloud effective radius products using the 3.9 µm in addition to the 1.6 µm channel, 5) New cloud droplet number concentration and geometrical thickness products for liquid clouds, and 6) Full uncertainty portfolio for all level-2 and level-3 products. A comprehensive evaluation was conducted and results are summarized in the Validation Report which composes, along with the Product User Manual and the Algorithm Theoretical Baseline Documents a rich set of CLAAS-3 documentation. With CLAAS-3, regional and large-scale cloud processes at temporal scales of quarter-hours to years can be studied. Furthermore, due to its increasing record length (19 years and growing), CLAAS-3 becomes a suitable source for climate monitoring applications.

Format
NetCDF-4

Version
4.0

Temporal coverage
2004-01-19 - present

Geographic coverage
Latitude: -81.30° S to 81.30° N
Longitude: -81.25° W to 81.25° E

Size
78.3 TiB

Documentation
[Product User Manual \(PUM\) CLAAS-3.0](#)
[Validation Report \(VAL\) CLAAS-3](#)
[Algorithm Theoretical Baseline Document \(ATBD\) CLAAS-3](#)
[Algorithm Theoretical Basis Document \(ATBD\) Cloud Physical Products SEVIRI](#)
[Algorithm Theoretical Basis Document \(An Appendix to the NWC/PPS\) Cloud Probability and Cloud Top Temperature/Height from SEVIRI](#)

Related publications
[Meirink, J. F., Roebeling, R. A., and Stammes, P.: Inter-calibration of polar imager solar channels using SEVIRI, Atmos. Meas. Tech., 6, 2495-2508, <https://doi.org/10.5194/amt-6-2495-2013>, 2013](#)
[Stengel, M., Kniffka, A., Meirink, J. F., Lockhoff, M., Tan, J., and Hollmann, R.: CLAAS: the CM SAF cloud property data set using SEVIRI, Atmos. Chem. Phys., 14, 4297-4311, <https://doi.org/10.5194/acp-14-4297-2014>, 2014](#)
[Benas, N., Finkensieper, S., Stengel, M., van Zadelhoff, G.-J., Hanschmann, T., Hollmann, R., and Meirink, J. F.: The MSG-SEVIRI-based cloud property data record CLAAS-2, Earth Syst. Sci. Data, 9, 415-434, <https://doi.org/10.5194/essd-9-415-2017>, 2017](#)

Auxiliary data
[CLAAS-3 Auxiliary Data User Guide.](#)
[Auxiliary data for Level-2 products.](#)
[Auxiliary data for Level-3 products \(0.05 degree\).](#)
[Auxiliary data for Level-3 products \(0.25 degree\).](#)

Related Data Records
A previous version of this data record is available from here: [DOI:10.5676/EUM_SAF_CM/CLAAS/V001](https://doi.org/10.5676/EUM_SAF_CM/CLAAS/V001).
A previous version of this data record is available from here: [DOI:10.5676/EUM_SAF_CM/CLAAS/V002](https://doi.org/10.5676/EUM_SAF_CM/CLAAS/V002).
A previous version of this data record is available from here: [DOI:10.5676/EUM_SAF_CM/CLAAS/V002_01](https://doi.org/10.5676/EUM_SAF_CM/CLAAS/V002_01).

Comment
The record size refers to the CDR part of the data record (2004-01 until 2020-12).

Data record details and ordering
PRODUCTS FROM METEOSAT SECOND GENERATION (MSG)
Cloud mask (CMA)
Instantaneous (METEOSAT disk)
Cloud phase (CPH)
Monthly mean (METEOSAT full disk), Monthly mean diurnal-cycle (METEOSAT full disk), Daily mean (METEOSAT full disk)
Cloud top parameters CTT, CTP and CTH (CTO)
Monthly mean diurnal-cycle (METEOSAT full disk), Monthly mean (METEOSAT full disk), Monthly histogram (METEOSAT full disk), Daily mean (METEOSAT full disk)
Cloud water path (CWP)
Monthly histogram (METEOSAT full disk)
Fractional cloud cover (CFC)
Monthly mean (METEOSAT full disk), Monthly mean diurnal-cycle (METEOSAT full disk), Daily mean (METEOSAT full disk)
Ice water path (IWP)
Monthly mean (METEOSAT full disk), Monthly mean diurnal-cycle (METEOSAT full disk), Daily mean (METEOSAT full disk)
Instantaneous COT, CPH and CWP (CPP)
Instantaneous (METEOSAT disk)
Instantaneous CTT, CTP and CTH (CTX)
Instantaneous (METEOSAT disk)
Joint cloud property histograms (JCH)
Monthly histogram (METEOSAT full disk)
Liquid water path (LWP)
Monthly mean (METEOSAT full disk), Monthly mean diurnal-cycle (METEOSAT full disk), Daily mean (METEOSAT full disk)