The Operational Cloud Products for Sentinel-5 Precursor and Sentinel-4 and comparisons with GEMS

Ronny Lutz, Victor Molina García, Fabian Romahn, Ana del Aguila, Diego Loyola

German Aerospace Center (DLR)
Earth Observation Center (EOC)
Remote Sensing Technology Institute

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Sentinel-5 Precursor and Sentinel-4

Orbit
sun-synchroneous polar / geostationary

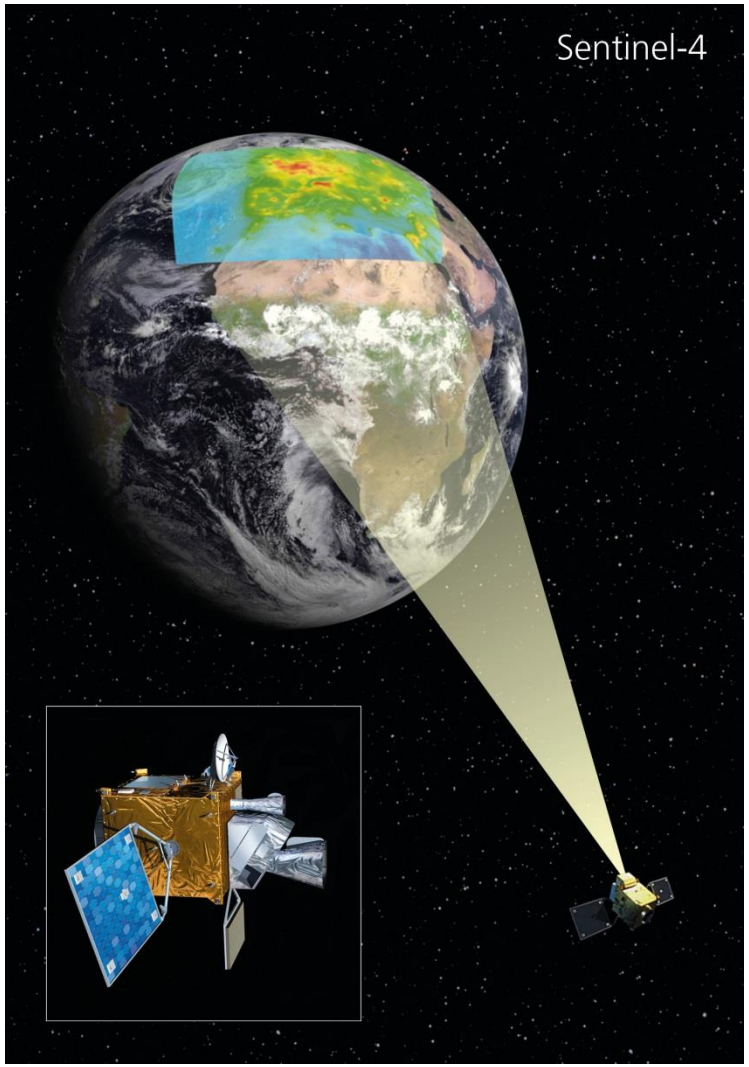
Temporal resolution and coverage
daily global / hourly Europe

Instrument name
TROPOMI / UVN

Spatial resolution
3.5 x 5.5 km² / 8 x 8 km²

Spectral coverage
UV-VIS-NIR-SWIR / UV-VIS-NIR

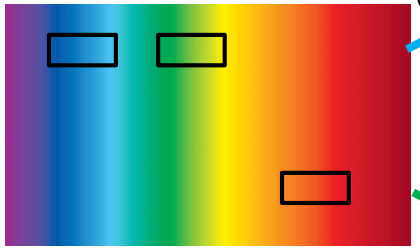
Spectral resolution in the UVN
0.25-0.5 nm / 0.12-0.5 nm



The operational S5P and S4 CLOUD products
-
OCRA & ROCINN algorithms

OCRA & ROCINN – Algorithm Overview

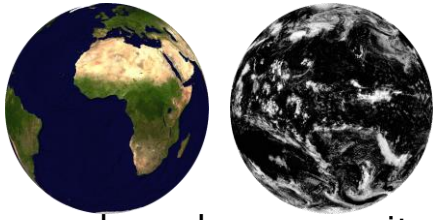
OCRA
Optical Cloud Recognition Algorithm



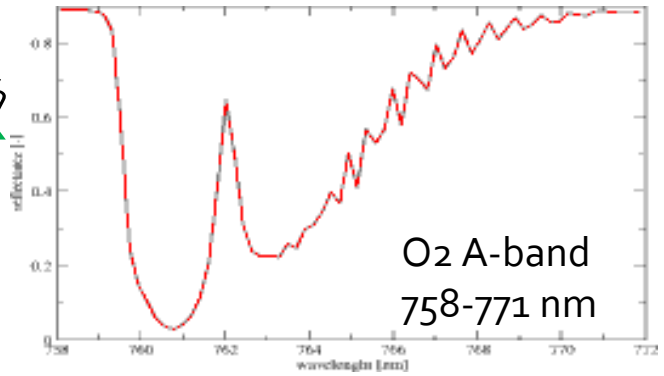
ROCINN
Retrieval of Cloud Information using Neural Networks

color space approach

neural network approach

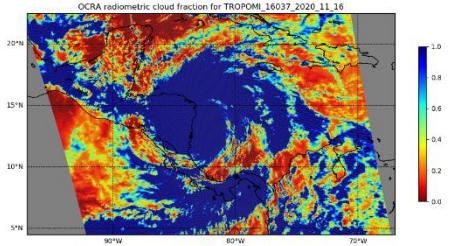


clear-sky composite

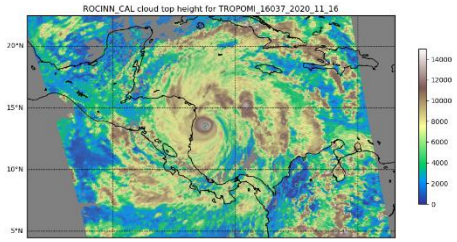


CAL
Clouds as layers

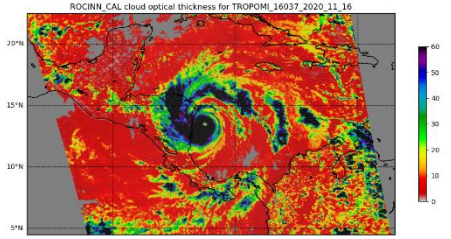
CRB
Clouds as reflecting boundaries



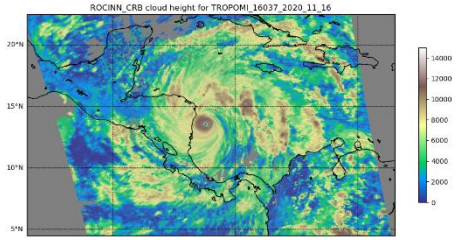
Radiometric cloud fraction



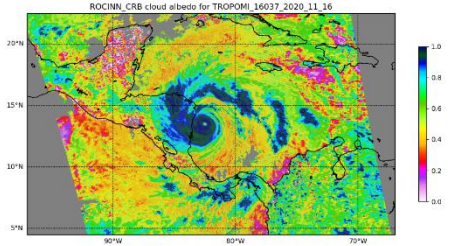
cloud top height



cloud opt. thickness



eff. cloud height



cloud albedo

Hurricane Iota
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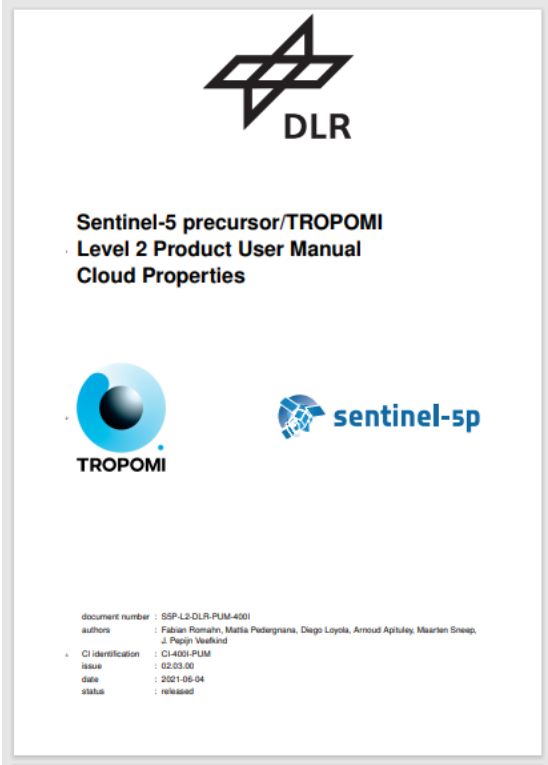
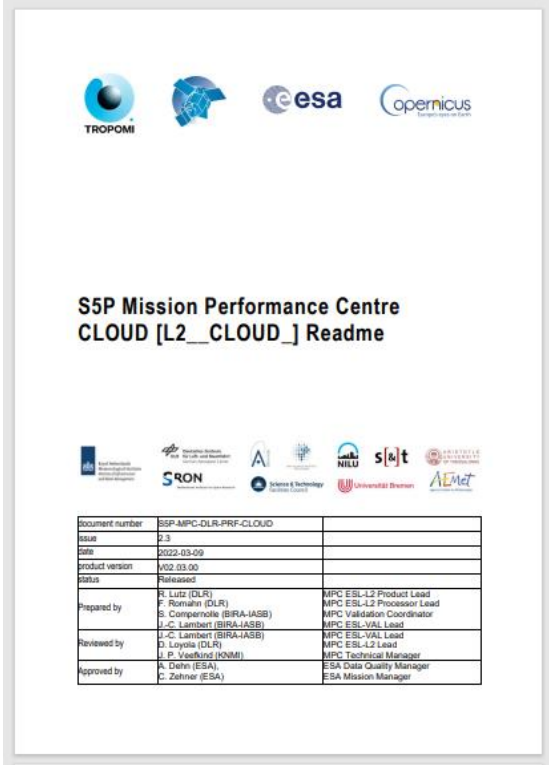
OCRA & ROCINN – documentation

https://sentinel.esa.int/web/sentinel/technical-guides/sentinel-5p/products-algorithms
https://mpc-vdaf.tropomi.eu/index.php/clouds

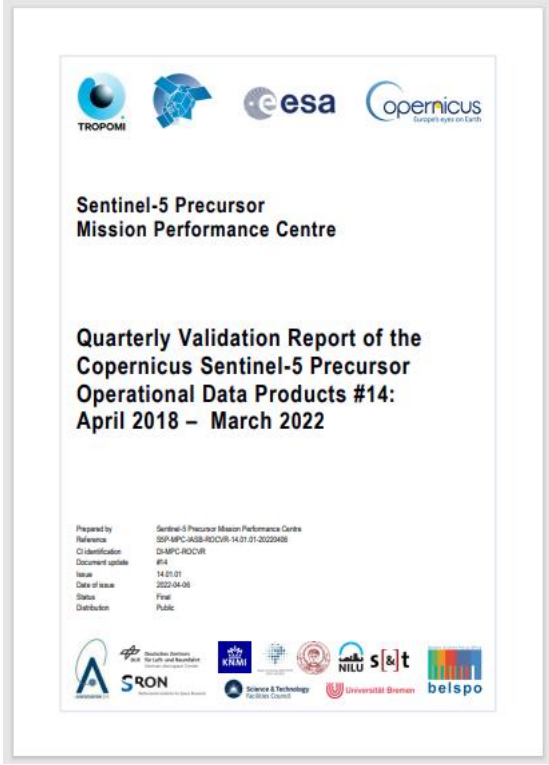
ATBD



PUM



PRF



ROCVR

OCRA & ROCINN – recent improvements (I)

- OCRA clear-sky maps have been generated based on EPIC/DSCOVR data as preparation for Sentinel-4

- ROCINN surface albedo climatology is replaced by daily surface albedo retrieval (GE_LER) using TROPOMI measurements and surface albedo map is updated on a daily basis (G3_LER)

- ROCINN ice cloud parameterisation is under development

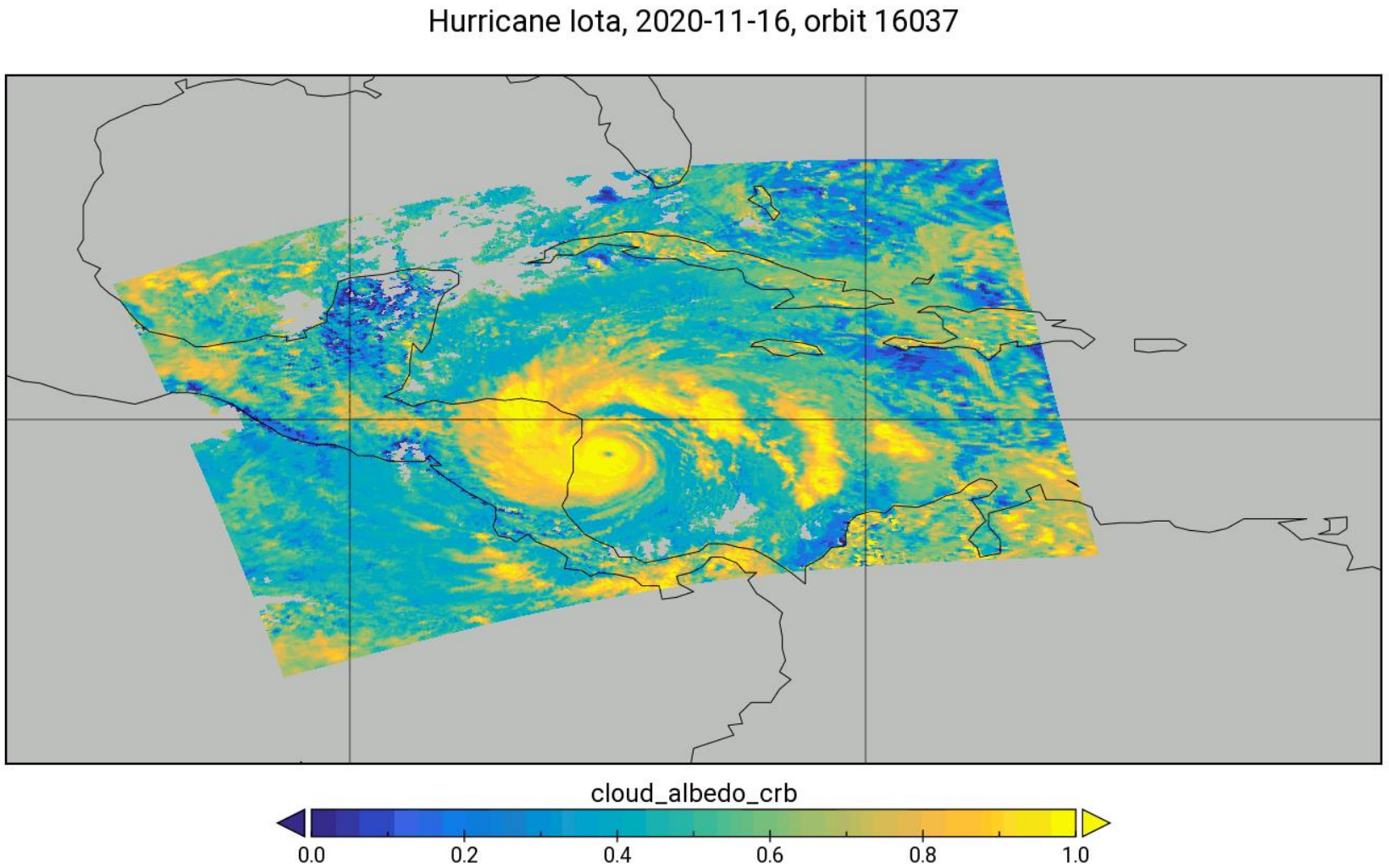
  EGU22-9552 | Presentations | AS3.3
  Retrieval of Ice Cloud Properties from Sentinel-5 Precursor and Sentinel-4 Measurements
  Ana del Águila, Ronny Lutz, Víctor Molina García, Fabian Romahn, and Diego Loyola
  Fri, 27 May, 08:35–08:45 Room M1

- ROCINN neural networks have been updated

  EGU22-11043 | Presentations | ITS2.6/AS5.1
  Framework for the deployment of DNNs in remote sensing inversion algorithms applied to Copernicus Sentinel-4 (S4) and TROPOMI/Sentinel-5 Precursor (S5P)
  Fabian Romahn, Victor Molina Garcia, Ana del Aguila, Ronny Lutz, and Diego Loyola
  Tue, 24 May, 14:08–14:14 Room N1

S5P L2_CLOUD product examples

S5P – operational cloud products



Hurricane Iota
©NASA worldview

OCRA application to GEMS

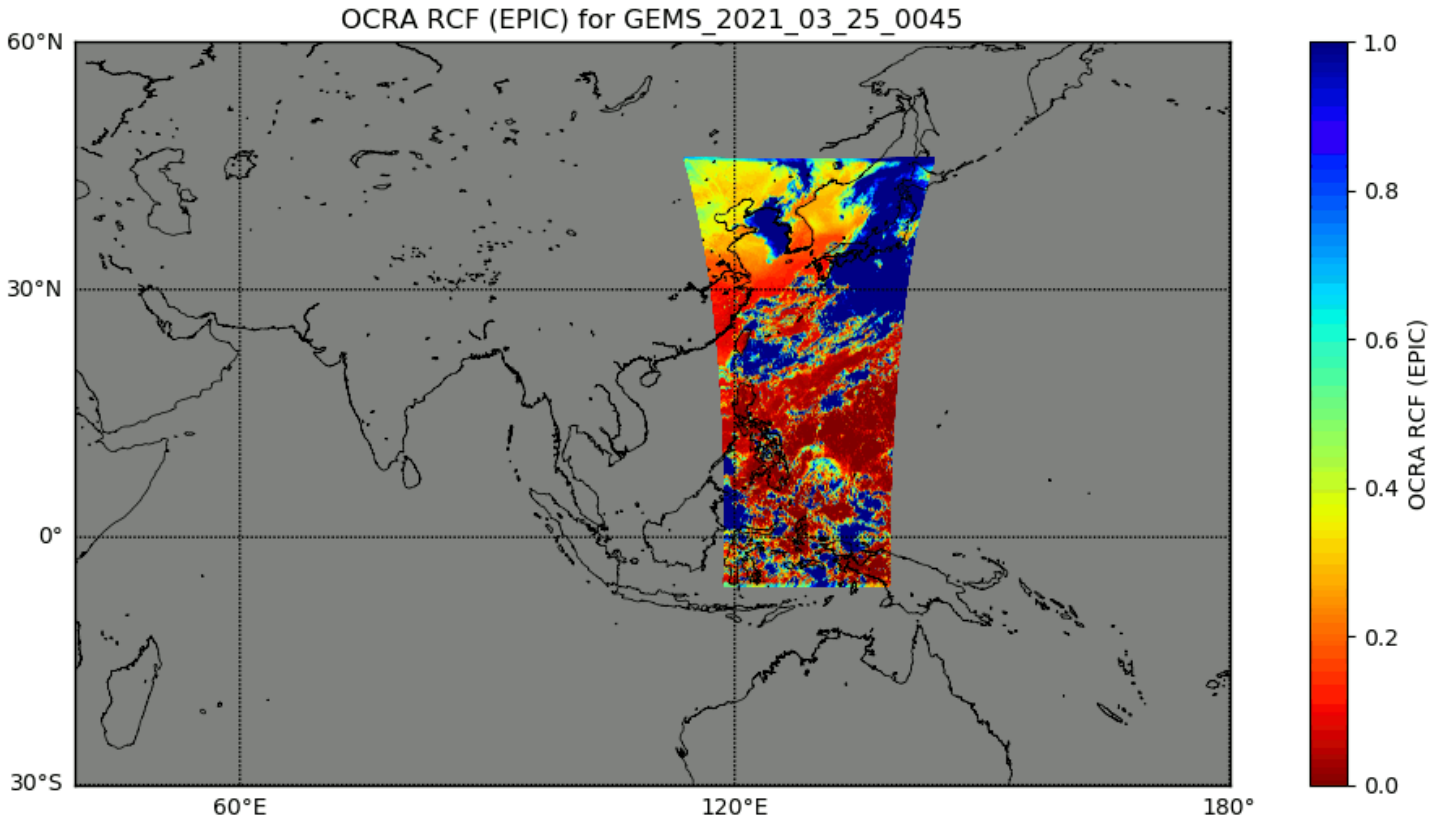
OCRA clear-sky maps based on EPIC/DSCOVR

- Aggregation of daily maps in intervals of +/- 14 days with 0.2 deg resolution

Clear-sky maps for EPIC channels (780, 551, 388) nm

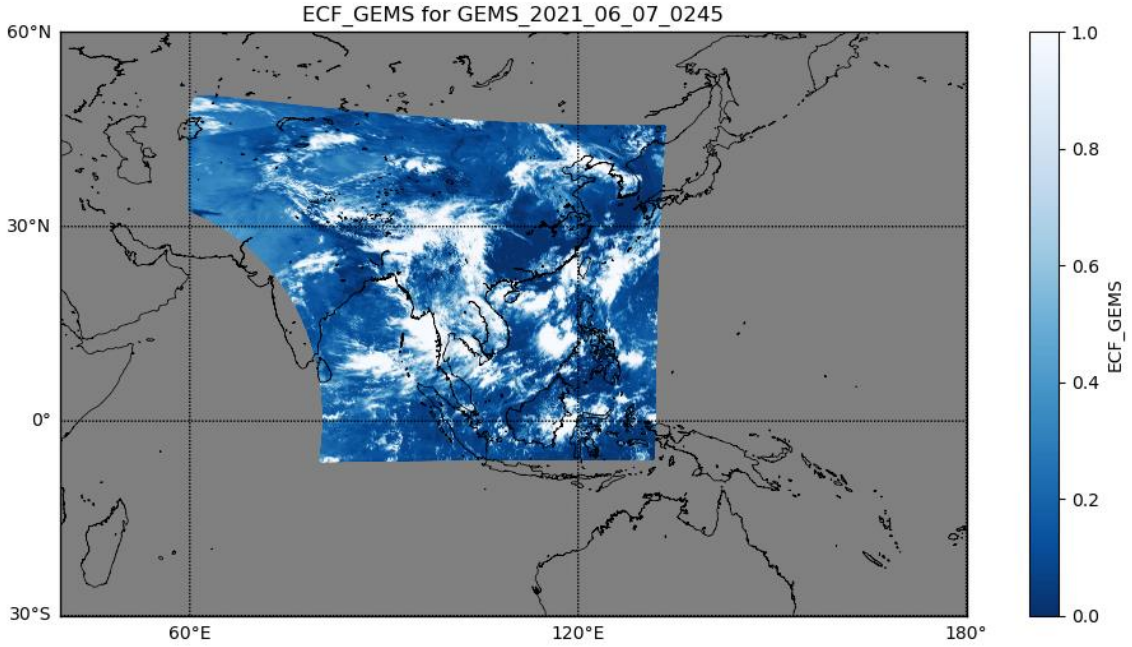
OCRA adaptation to GEMS using the EPIC clear-sky maps

2021-03-25

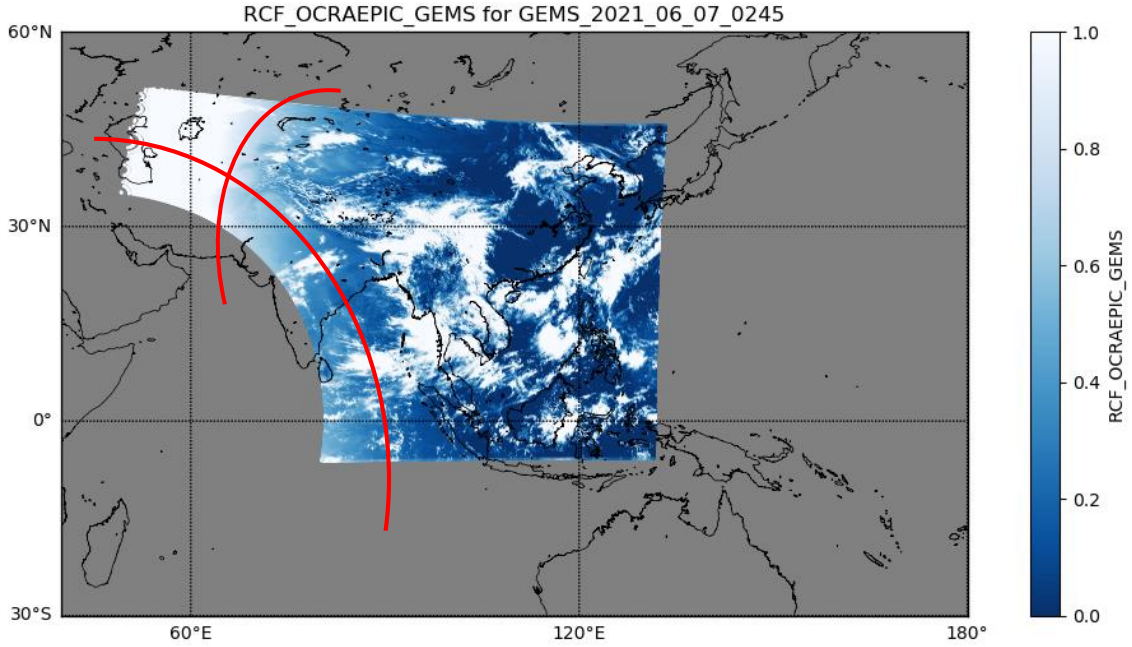


Intercomparisons of cloud fraction – GEMS L2 versus OCRA application

GEMS L2 Cloud product

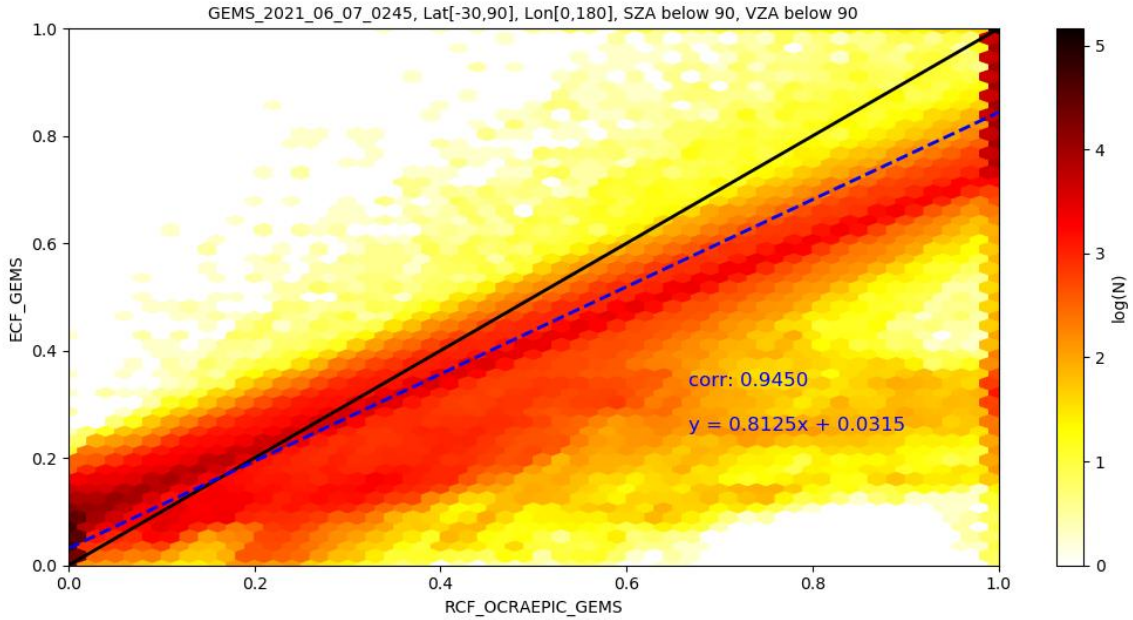


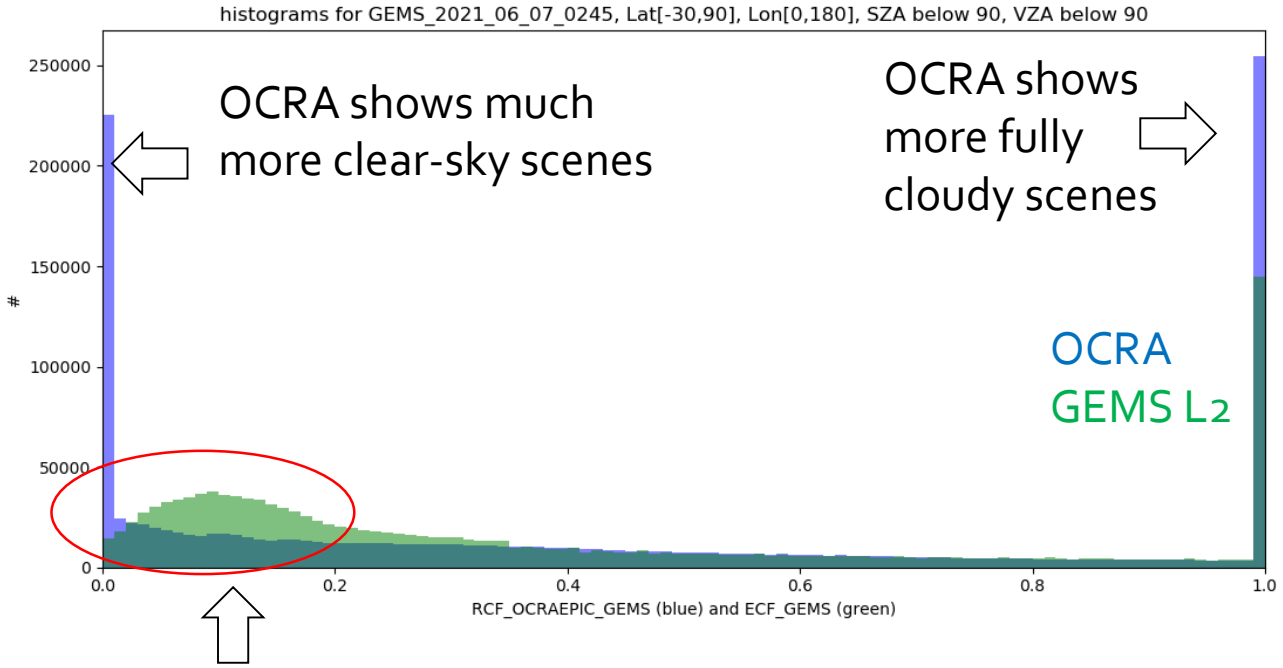
OCRA adapted to GEMS L1



enhanced CFs appear only at high SZA/VZA, which are outside of the applicable scenario constraints

Intercomparisons of cloud fraction – GEMS L2 versus OCRA application





- correlation coefficient 0.95
- mean difference 0.047

GEMS L2 shows very few clear scenes, but a pronounced peak around 0.1

Summary and Conclusion

- Operational S5P and S4 Cloud products
  - Based on the well established OCRA & ROCINN algorithms
  - S5P products are well documented and validated routinely
  - Improvements including ice cloud parameterzation are under development

- Application of OCRA to GEMS L1C data looks very promising
  - Good agreement between OCRA and GEMS L2 CLOUD product for most scenes
  - Future work includes generation of clear-sky maps based on GEMS data and improvements at high SZA/VZA

Thank you for your attention!

DLR-Atmos:
https://atmos.eoc.dlr.de/calendar

Interested in quicklooks and L3 data?
Check the INPULS project:
https://atmos.eoc.dlr.de/inpuls/