The TROPOMI/Sentinel-5P Cloud product and comparisons against VIIRS/S-NPP

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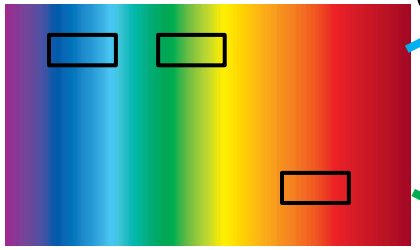
ESA Living Planet 2022
Bonn, Germany
23 May 2022

The TROPOMI L2_CLOUD product

OCRA & ROCINN – Algorithm Overview

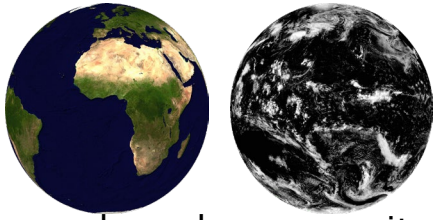
OCRA
Optical Cloud Recognition Algorithm



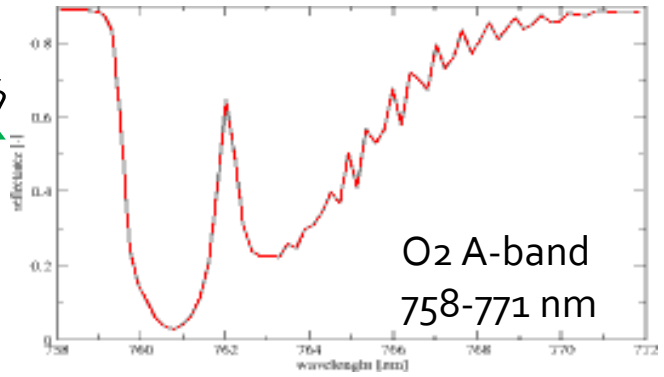
ROCINN
Retrieval of Cloud Information using Neural Networks

color space approach

neural network approach

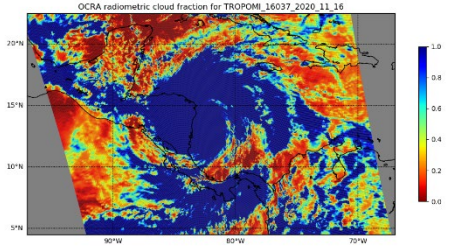


clear-sky composite

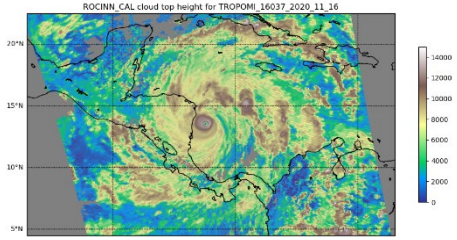


CAL
Clouds as layers

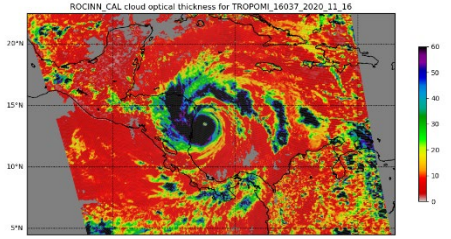
CRB
Clouds as reflecting boundaries



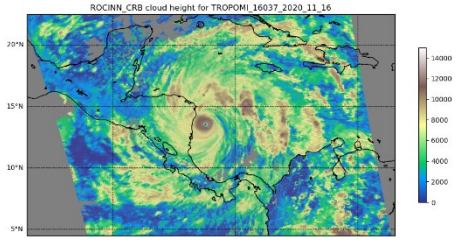
Radiometric cloud fraction



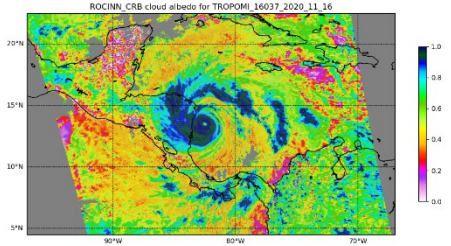
cloud top height



cloud opt. thickness



eff. cloud height



cloud albedo

Hurricane Iota
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OCRA & ROCINN – recent improvements (I)

- OCRA clear-sky maps are updated to include 3 years of TROPOMI data and a L1 degradation correction
  → operational since version 2.1

- 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)
  → operational since version 2.1

FP_ILM algorithm applied to UVN sensors for the retrieval of GE_LER climatologies for UV/VIS trace gases and clouds Speaker

Date: 23.05.2022 , Time: 17:21 | Topic: Poster Session

by Ana del Águila (DLR)

OCRA & ROCINN – recent improvements (II)

- ROCINN ice cloud parameterisation is under development
  → not operational yet

Retrieval of water and ice cloud properties for TROPOMI/Sentinel-5P Speaker
Date: 27.05.2022 , Time: 12:23 | Topic: Poster Session
by Ana del Águila (DLR)

- ROCINN neural networks have been updated
  → not operational yet, but implemented in version 2.4

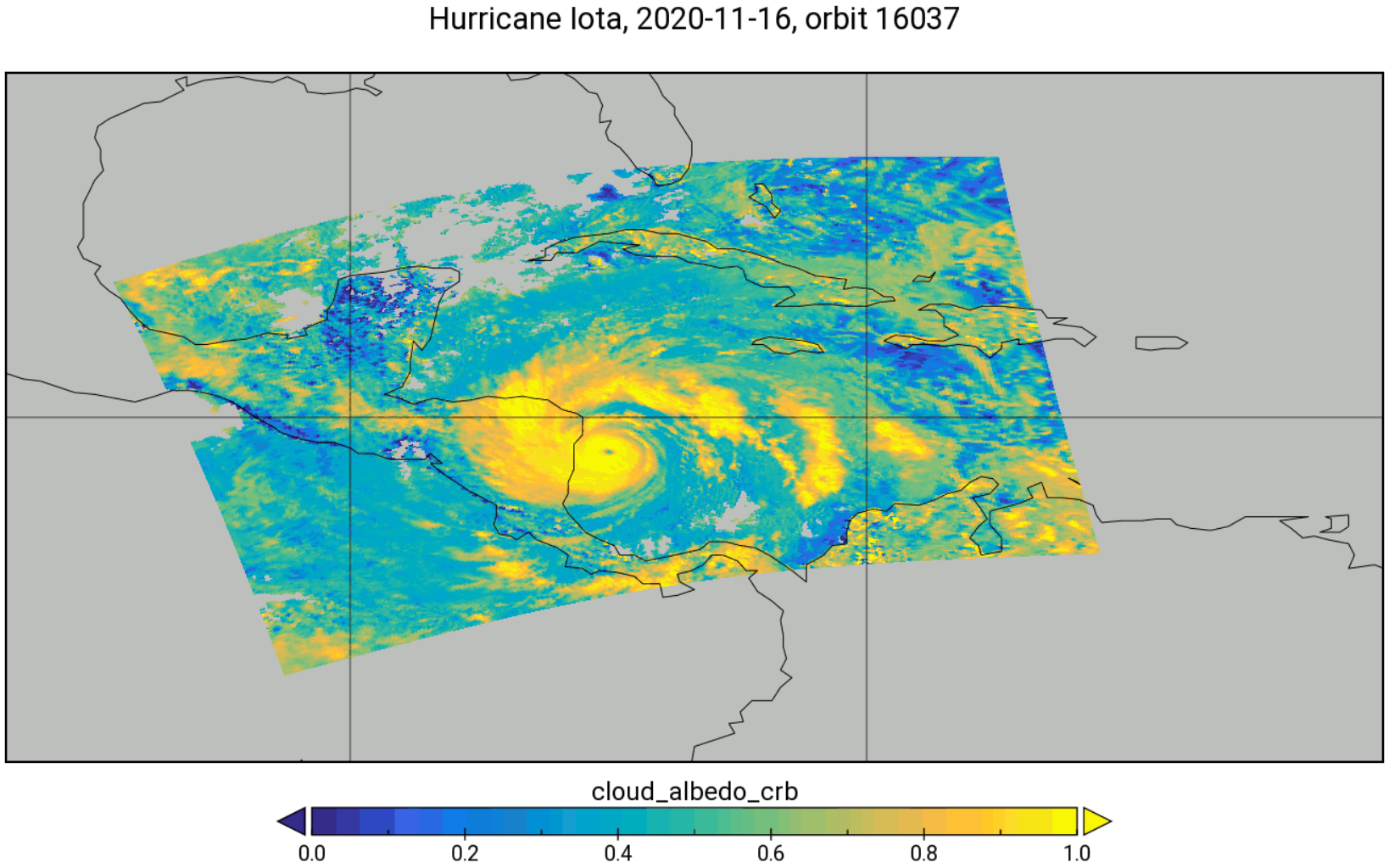
Two approaches for the application of deep neural networks to retrieve cloud properties for Sentinel-4 (S4) and TROPOMI / Sentinel-5 Precursor (S5P) Speaker
Date: 26.05.2022 , Time: 11:55 | Topic: Enable the Earth Observation Digital Transformation
by Fabian Romahn (DLR)

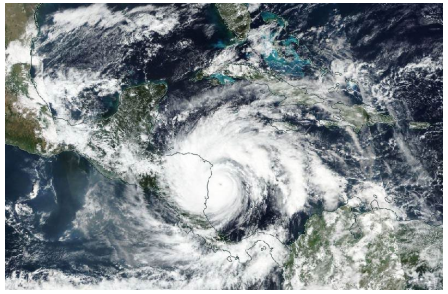
- OCRA/ROCINN applied to EPIC/DSCOVR

Retrieval of cloud macrophysical properties from deep space: application of OCRA/ROCINN algorithms to EPIC/DSCOVR measurements Speaker
Date: 27.05.2022 , Time: 12:23 | Topic: Poster Session
by Víctor Molina García (DLR)

TROPOMI L2_CLOUD product examples

S5P – operational cloud products





Hurricane Iota
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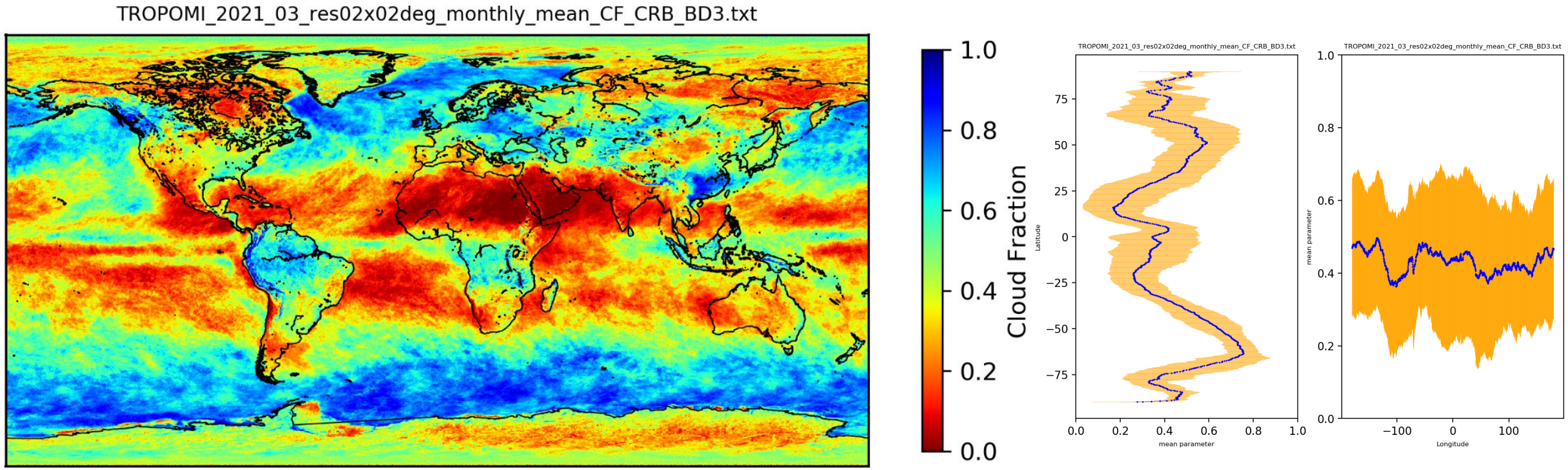
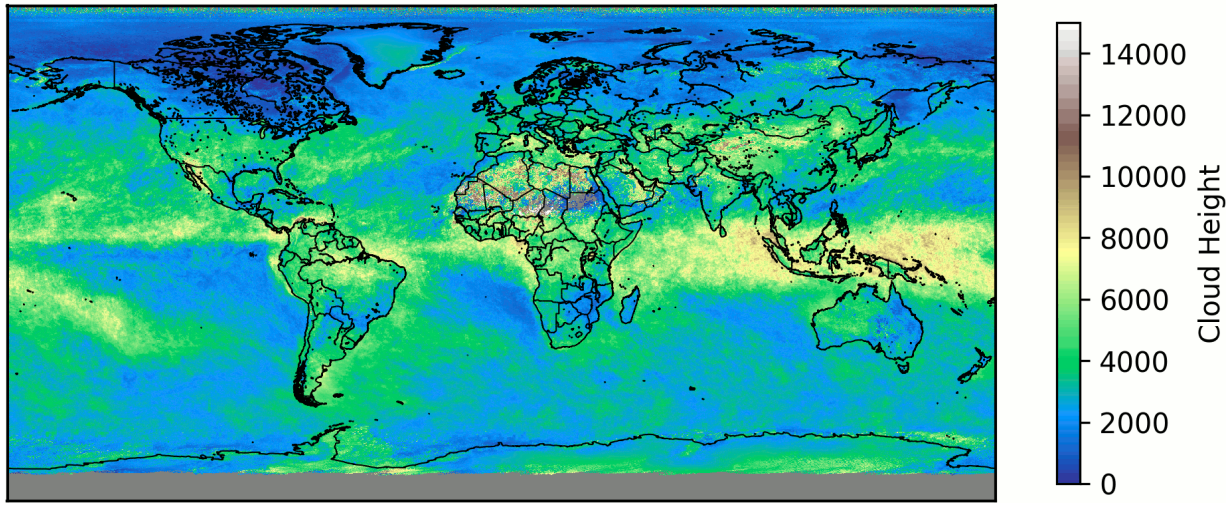
S5P – monthly mean maps and zonal/meridional means



ROCINN CRB radiometric cloud fraction

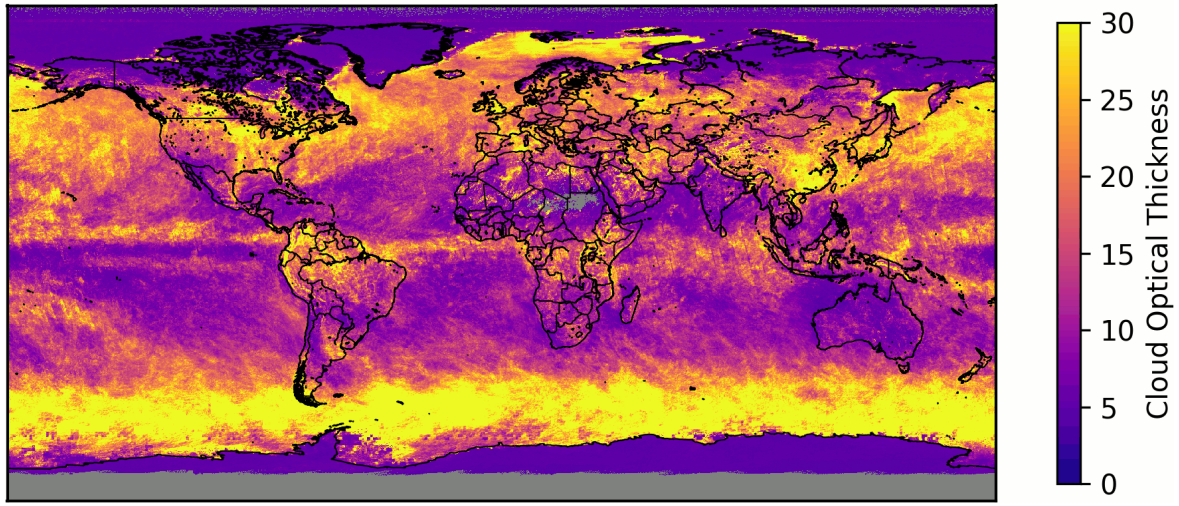
S5P – yearly temporal evolution

TROPOMI_2018_04_res02x02deg_monthly_mean_CTH_CAL.txt



ROCINN CAL cloud top height

TROPOMI_2018_04_res02x02deg_monthly_mean_COT_CAL.txt



ROCINN CAL cloud optical thickness

Validation of the TROPOMI L2_CLOUD product

Routine validation with ground based data

- Routine validation of the TROPOMI L2_CLOUD product is performed with ground based CLOUDNET data in the S5P MPC framework (now ATM MPC)

Latest Results of the Operational Validation of Sentinel-5p TROPOMI Speaker

Date: 23.05.2022 , Time: 14:00 | Topic: Understand Earth Systems **by Jean-Christopher Lambert (BIRA)**

VDAF validation facility: https://mpc-vdaf.tropomi.eu/index.php/clouds

Compernolle et al.: Validation of the Sentinel-5 Precursor TROPOMI cloud data with Cloudnet, Aura OMI O2–O2, MODIS, and Suomi-NPP VIIRS, Atmos. Meas. Tech., 14, 2451–2476, https://doi.org/10.5194/amt-14-2451-2021, 2021

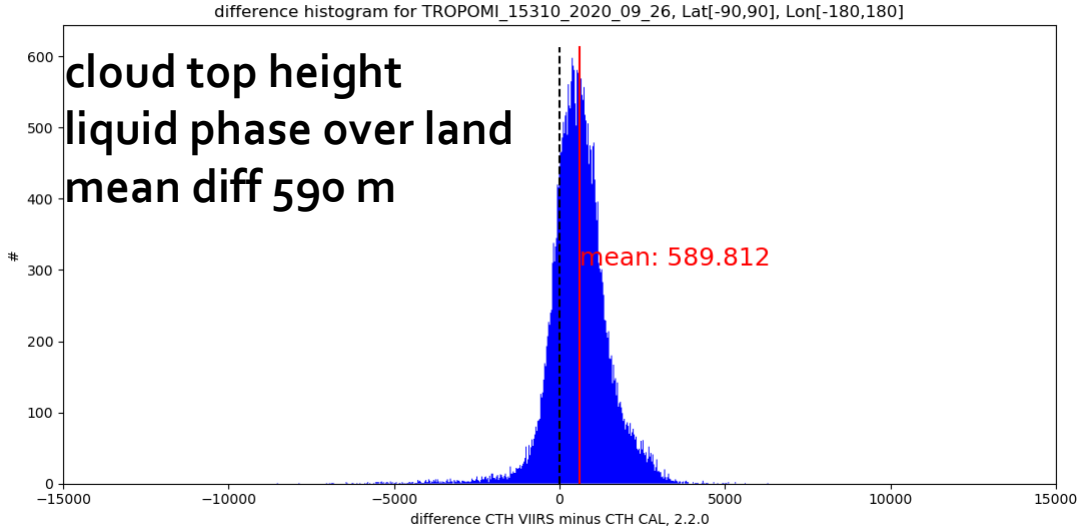
Comparison of the TROPOMI L2_CLOUD product with satellite data

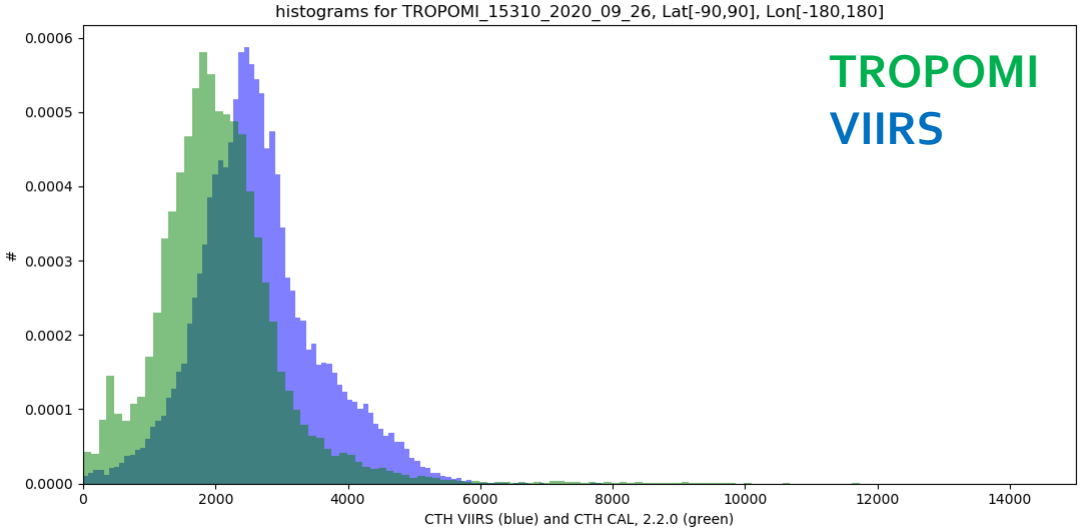
Comparison with satellite data from VIIRS/S-NPP

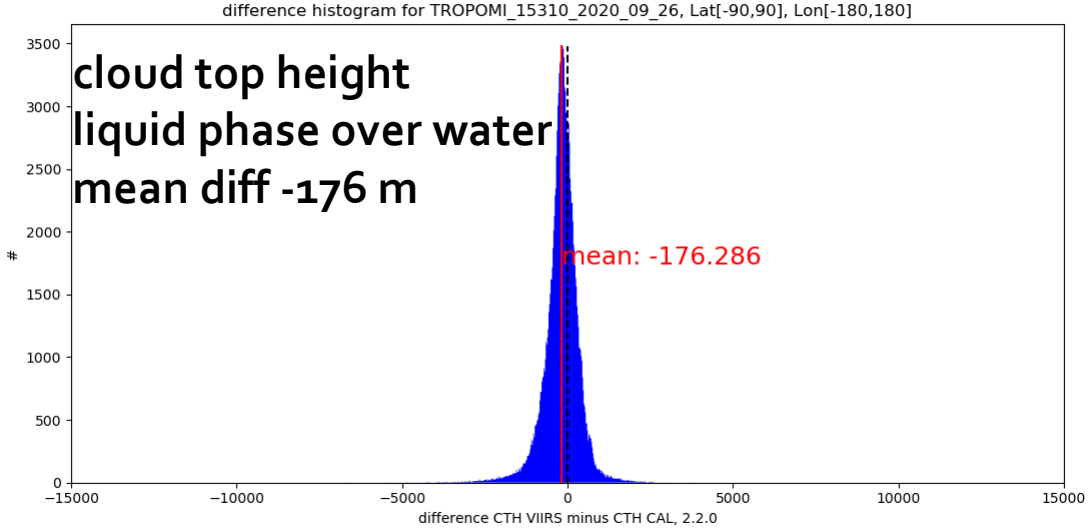
- close formation with S5P allows for reasonable spatio-temporal comparability
- Re-gridded VIIRS cloud test products have been generated by RAL in the framework of the S5P MPC
- Test data from 11 September 2020, orbits 15091 to 15104

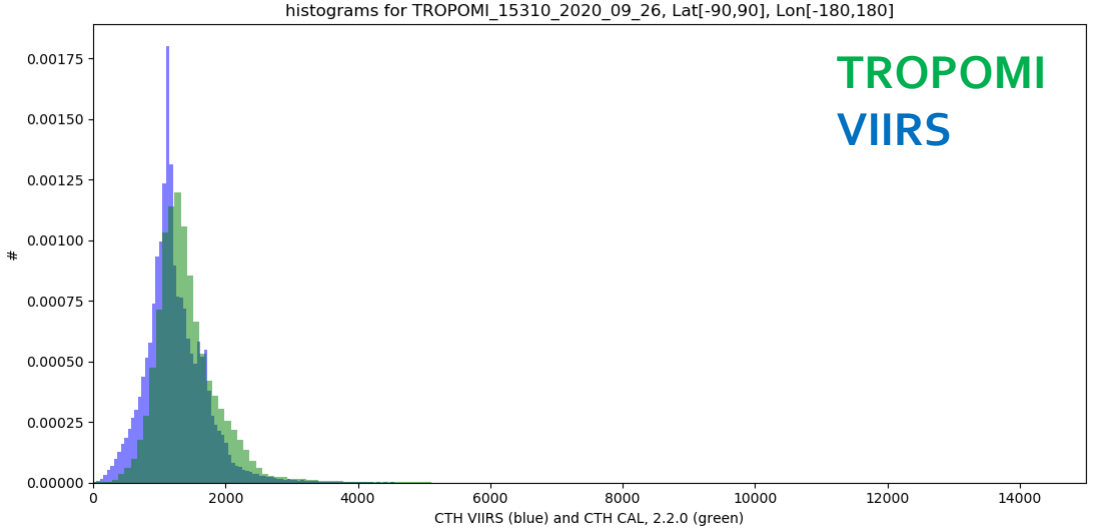
  - Compare ROCINN_CAL CTH with VIIRS CTH
  - Consider different data subsets based on
    - Surface condition: land only, water only
    - Cloud phase: liquid phase only

Comparison with satellite data from VIIRS/S-NPP – Global

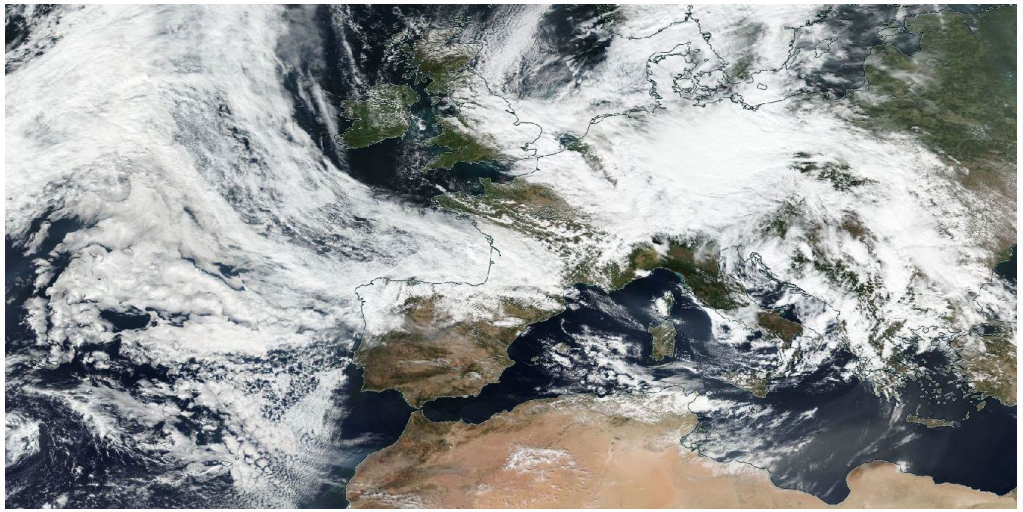


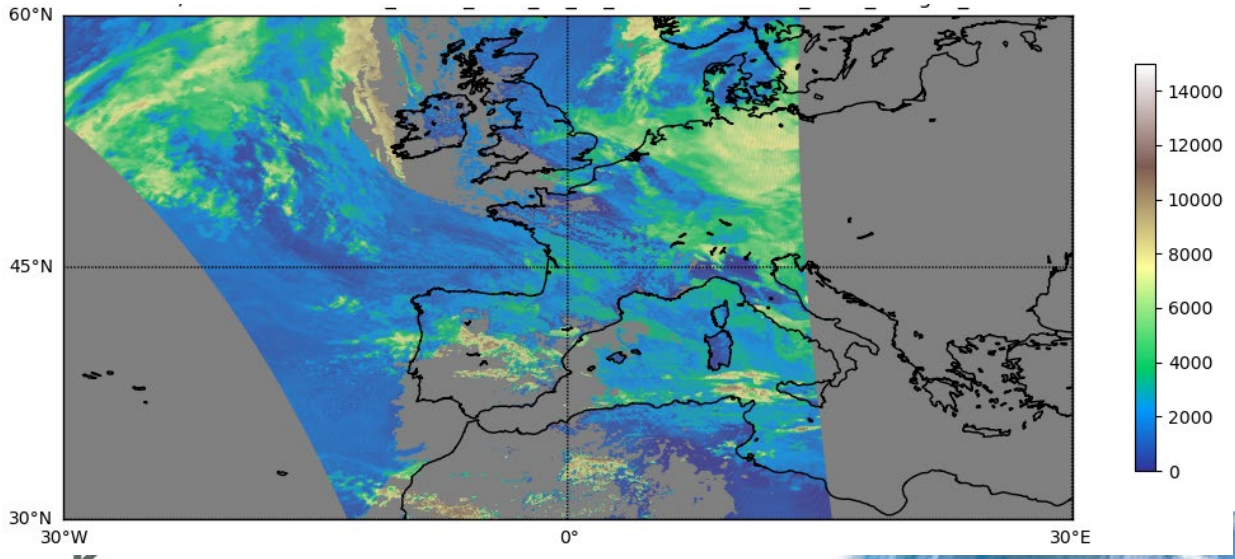


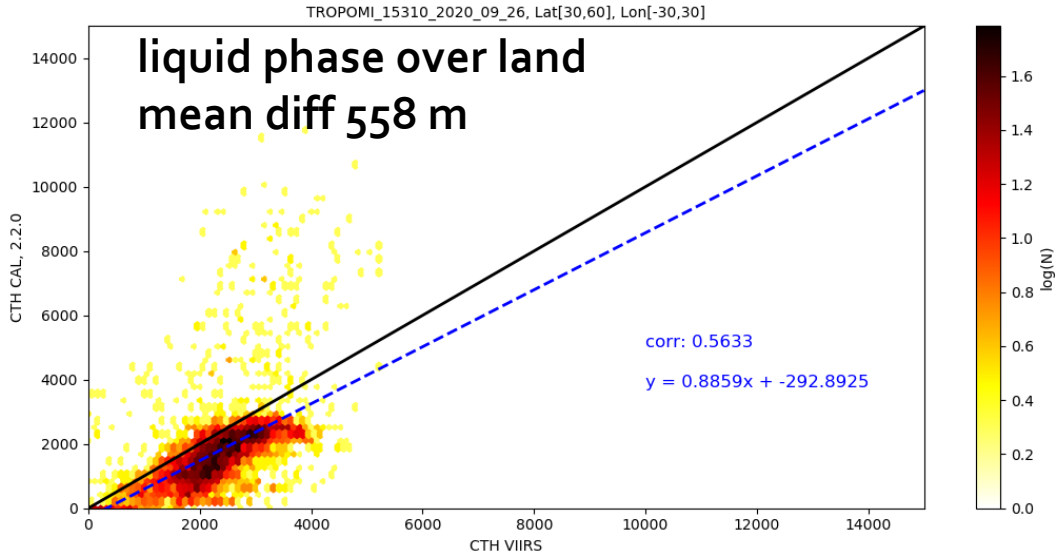


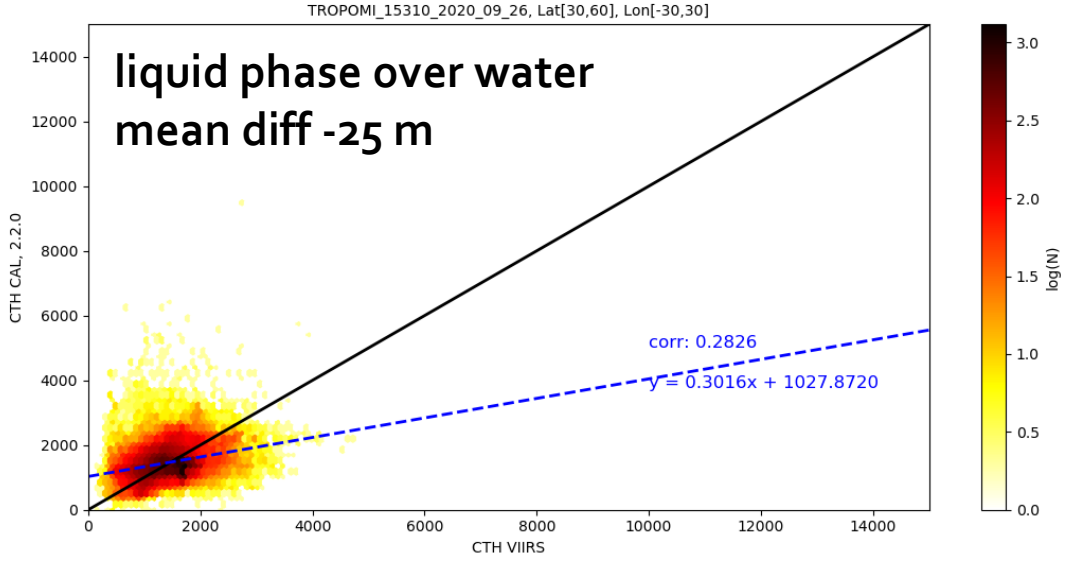


Comparison with satellite data from VIIRS/S-NPP – Regional: Europe

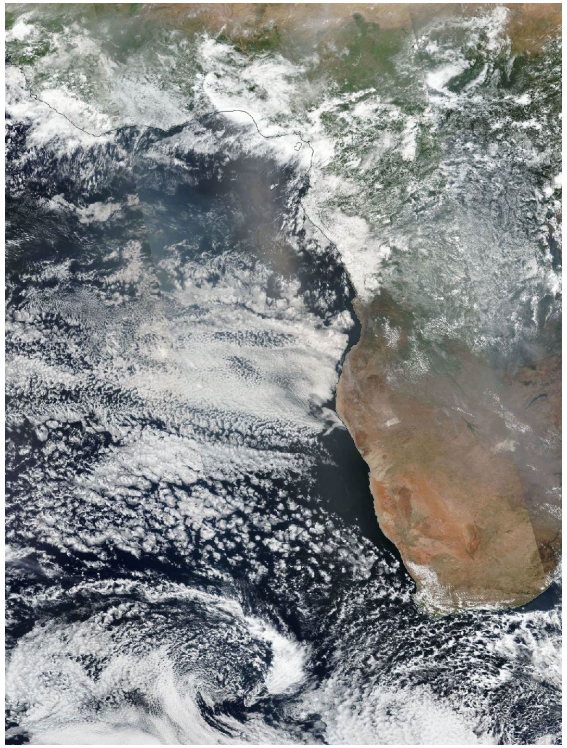


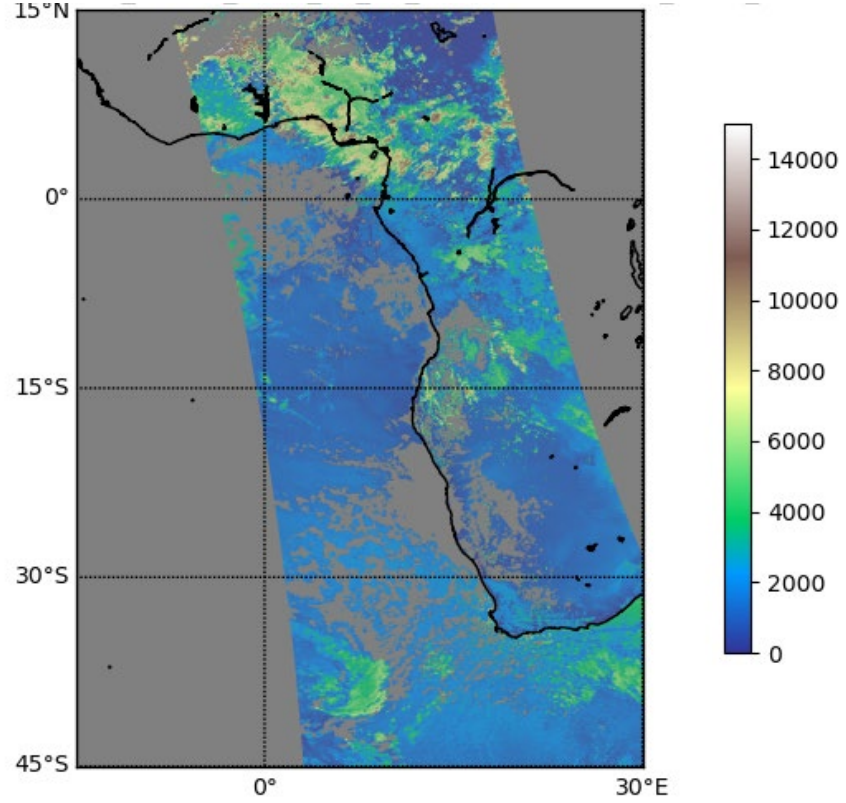


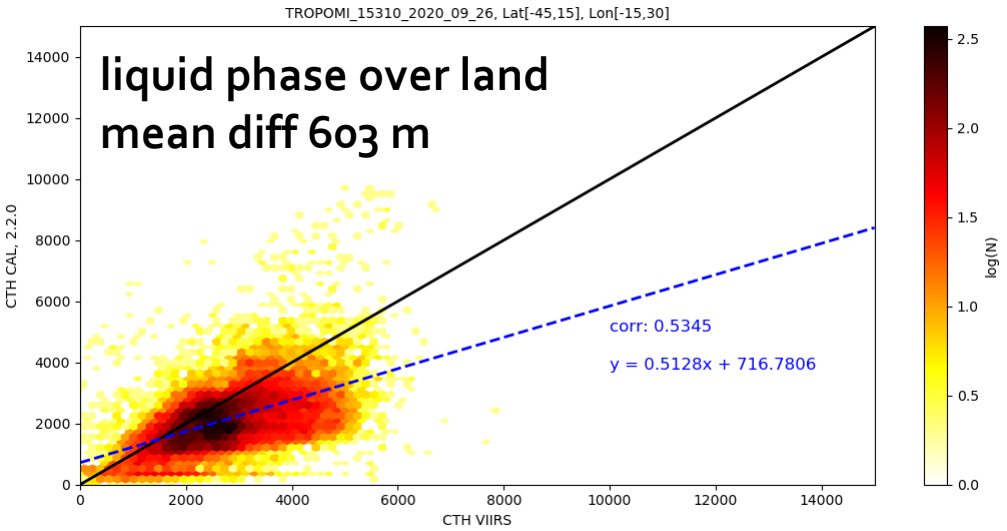


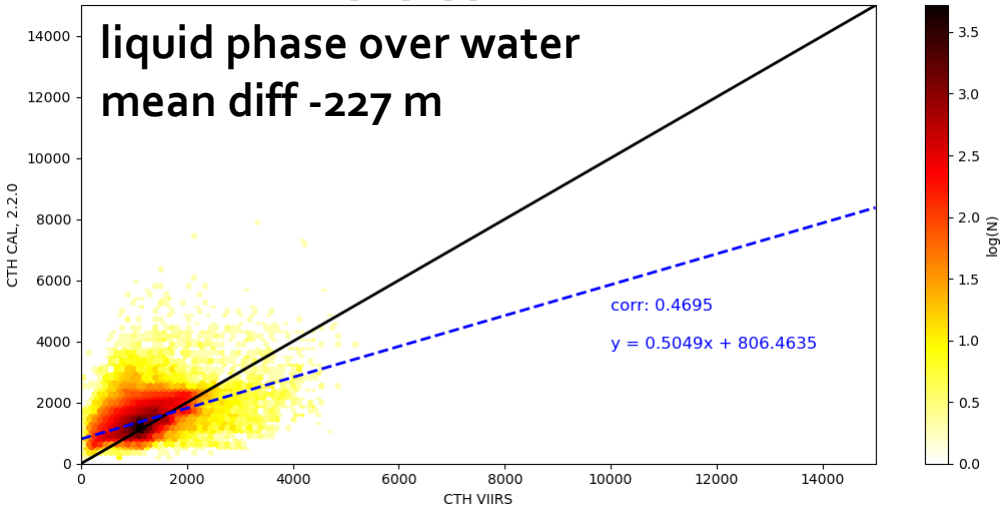


Comparison with satellite data from VIIRS/S-NPP – Regional: Africa









Comparison with satellite data from VIIRS/S-NPP – Cloud masking

Compare OCRA/ROCINN and VIIRS cloud fractions as tool for cloud masking:

Assumption "clear": CF < 0.05

Assumption "cloudy": CF >= 0.05

For the global data, we find an agreement in **88%** of the cases assuming the threshold 0.05

Cloud fraction threshold 0.05	TROPOMI clear	TROPOMI cloudy
VIIRS clear	24% True Positives	5% False Negatives
VIIRS cloudy	7% False Positives	64% True Negatives

Conclusion and Outlook

Conclusion

– Cloud top heights agree better over water than over land. Mean differences VIIRS minus TROPOMI are:

	Global	Regional (Europe)	Regional (Africa)
liquid phase over land	590 m	558 m	603 m
liquid phase over water	-176 m	-25 m	-227 m

– Cloud fractions agree well when used for cloud masking:

✓ Agreement in 88% of the cases for a 0.05 cloud fraction threshold

Outlook

– Extend comparisons to cloud optical thickness
– Extend comparisons to ice phase clouds once the proper parameterisation has been added to ROCINN_CAL

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/