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The OCRA/ROCINN algorithm tandem for the retrieval of cloud properties from UVN missions GOME, SCIAMACHY, GOME-2, EPIC, TROPOMI, GEMS, Sentinel-4 and Sentinel-5: status and challenges

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Sentinel-4, as part of the Copernicus European Earth observation programme, will add a geostationary mission targeting the European continent with focus on atmospheric composition monitoring. Expected to be launched in Q3/2024 on board MTG-S (Meteosat Third Generation-Sounder), it will provide information on air quality over Europe every hour through the retrieval of tropospheric gas columns of different atmospheric constituents, and for which the information on cloud properties is required as *a priori* knowledge. Sentinel-5, to be launched on board EPS-SG in Q1/2025, will continue the data record from TROPOMI/Sentinel-5 Precursor launched in 2017.

For the Sentinel-4 and Sentinel-5 operational cloud product, DLR continues its development of the OCRA/ROCINN algorithm tandem. OCRA (Optical Cloud Recognition Algorithm) estimates the radiometric cloud fraction by means of image analysis from UV measurements. ROCINN (Retrieval of Cloud Information using Neural Networks) uses the information provided by OCRA as *a priori* knowledge and performs a Tikhonov inversion to obtain two cloud properties. Two radiative transfer model implementations are available in ROCINN as cloud model: CRB (Cloud as Reflective Boundaries), in which the cloud is assumed as a Lambertian surface, and for which ROCINN retrieves the cloud effective height and the cloud albedo; and CAL (Cloud As Layers), in which the cloud is modelled as a homogeneous layer of scattering liquid-water droplets following Mie theory, and for which ROCINN retrieves the cloud-top height and the cloud optical thickness. Since the radiative transfer model calls are computationally expensive, artificial neural networks for the clear-sky and cloudy-sky regimes are trained as emulators of the original radiative transfer models [1].

The OCRA/ROCINN algorithm tandem has been used operationally in several LEO missions over the last two decades: GOME/ERS-2, SCIAMACHY/ENVISAT, GOME-2 on MetOp-A/B/C [2] and TROPOMI/S5P [3]. We present the current status of OCRA/ROCINN, as well as its challenges associated to the launch of the Sentinel-4 mission, and for which prototype implementations of this algorithm tandem have been developed and applied to the EPIC/DSCOVR [4] and GEMS/GK2B missions as preparation for the future handling of instruments in non-LEO orbits by OCRA/ROCINN.

Keywords: clouds, retrieval algorithms, neural networks, machine learning, OCRA, ROCINN

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