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Application of Sentinel-2A/B satellites to retrieve turbidity in the Guadalquivir estuary (Southern Spain)

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Due to climate change, contamination, and diverse anthropogenic effects, water quality monitoring is intensifying its importance nowadays. Remote sensing techniques are becoming an important tool, in parallel with fieldwork, for supporting the cost-effective accomplishment of water quality mapping and management. In the recent years, Sentinel-2A/B twin satellites of the European Commission Earth Observation Copernicus programme emerged as a promising way to monitor complex coastal waters with higher spatial, spectral and temporal resolution. However, atmospheric and sunglint correction for the Sentinel-2 data over the coastal and inland waters is one of the major challenges in terms of accurate water quality retrieval. This study aimed at evaluating the ACOLITE atmospheric correction processor in order to develop a regional turbidity model for the Guadalquivir estuary (southern Spain) and its adjacent coastal region using Sentinel-2 imagery at a 10 m spatial resolution. Two settings for the atmospheric correction algorithm within the ACOLITE software were applied: the standard dark spectrum fitting (DSF) and the DSF with an additional option for sunglint correction. Turbidity field data were collected for calibration/validation purposes from the monthly Guadalquivir Estuary-LTER programme by Andalusian Institute of Agricultural and Fisheries Research and Training (IFAPA) using a YSI-EXO2 multiparametric sonde for the period 2017-2020 at 2 fixed stations (Bonanza and Tarfia) sampling 4 different water masses along the estuary salinity gradient. Several regional models were evaluated using the red band (665 nm) and the red-edge bands (i.e. 704, 740, 783 nm) of the Sentinel-2 satellites. The results revealed that DSF with glint correction performs better than without glint correction, especially for this region where sunglint is a major concern during summer, affecting most of the satellite scenes. This study demonstrates the invaluable potential of the Sentinel-2A/B mission to monitor complex coastal waters even though they were not designed

for aquatic remote sensing applications. This improved knowledge will be a helpful guideline and tool for the coastal managers, policy-makers, stakeholders and the scientific community for ensuring sustainable ecosystem-based coastal resource management under a global climate change scenario.