Evaluation of PRISMA and DESIS data for water quality mapping: a focus on PrimeWater project study areas

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New generation hyperspectral sensors are rapidly entering the remote sensing landscape for aquatic applications, and new products are informing water quality monitoring [1]. This study presents an overview of the potentialities of PRISMA and DESIS hyperspectral sensors with a focus on PrimeWater project basins [2]. Firstly, Level 2 (L2) products, provided by the automatic processors of PRISMA (constantly being updated) and DESIS, were evaluated in terms of Remote sensing reflectance, considering imagery data representative of globally distributed inland and coastal waters. To perform this evaluation, hyperspectral satellite data were compared with in-situ multispectral data provided by the global network AERONET-OC, and with multispectral satellite data provided by Sentinel-2 (S2) and Sentinel-3 OLCI. When the quality of L2 data was low and the statistical agreement with the reference measures was not good, an independent atmospheric correction process was also carried out using the scheme implemented in the ATCOR software. Subsequently, the capabilities of PRISMA and DESIS to retrieve water quality and bio-geochemical parameters were finally demonstrated in three out of four sites defined in PrimeWater project: Lake Mulargia (IT), Lake Hume (AU) and Lake Harsha (US). The bio-optical model BOMBER [3] was run for water quality parameters retrieval because of its good performances in a very wide range of water types. The maps of water quality obtained using PRISMA and DESIS products were compared with the ones provided by EOMAP and generated from S2 and Landsat 8 images, which are already providing unique data for monitoring in aquatic environments. In addition, a chromaticity analysis was performed in the tanks of the fourth site, Western Treatment Plant (WTP) (AU), a historically and culturally significant area that sustainably treats half of Melbourne's wastewater which also serves as a thriving ecosystem. This analysis provided as output the dominant wavelength - divided into water colour categories using the Forel-Ule scale [4] - for each tank in the area.

In the case of PRISMA L2 data, a good statistical agreement with the reference data was assessed, particularly when considering products with the most updated processor versions. Instead, in case of DESIS products, after performing an independent atmospheric correction process, there was better agreement with the reference data. The comparison in terms of water quality products demonstrated the ability of PRISMA and DESIS to capture the variability of Chlorophyll-a (Chl-a) (Fig.1, c) and illustrated how the integration of the available datasets allowed to increase the number of weekly information for the characterisation of Total Suspended Matter (TSM) in the water column (Fig.1, a). Moreover, the acquisition at different times allowed to obtain information on Chl-a concentration in areas of the lakes where clouds had prevented information from S2 image (Fig.1, b). The results of water colour analysis at WTP site (Fig.1, d) showed once again the ability of the sensors to map the variability of the most turbid waters and clearer waters, consistent with the typical water characteristics of the area.

In general, the products have highlighted the great scientific potential of hyperspectral data, in addition to the standard advantages of satellite imagery products (e.g., synoptic view, multi-temporal data). Finally, these data have also shown that can provide valuable and complementary information when used in synergy with established and existing multispectral missions.

Acknowledgements: Part of this work was supported by EU Horizon 2020 programme with the project PrimeWater (ga no. 870497). PRISMA and DESIS data were used upon agreement of respective licenses to use. We are very grateful to E. Lopinto from ASI and to N. Pinnel and U. Heiden from DLR for relevant discussion on PRISMA and DESIS missions.

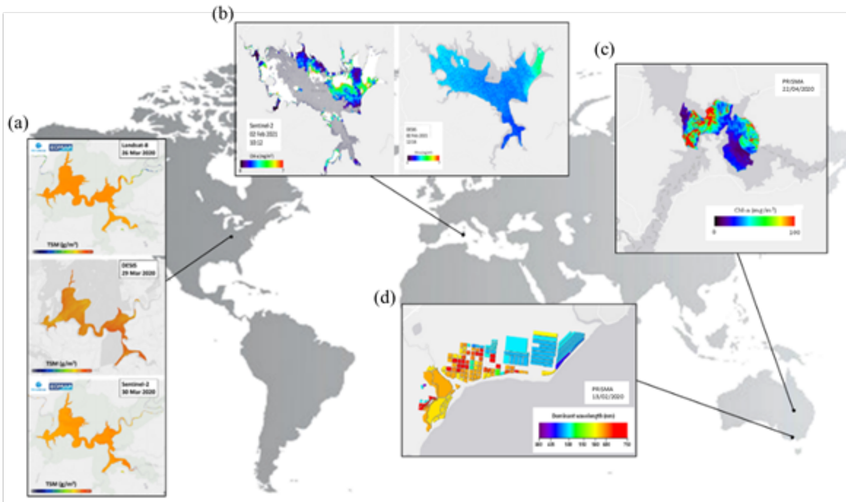

Figure 1 Water quality products generated for Lake Harsha (a), Lake Mulargia (b), Lake Hume (c), WTP Melbourne (d).

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