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Spatio-temporal dynamics of submerged aquatic vegetation in a deep lake: Multi-approach investigation combing remote sensing with structural and elemental data

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In the framework of the project funded by the CARIPLO Foundation "ISEO: Improving the lake Status from Eutrophy towards Oligotrophy", a multi-approach characterization of the submerged aquatic vegetation (SAV) of a large deep lake (Iseo Lake; northern Italy) was carried out. Based on a systematic revision of available data, mainly collected in the frame of WFD monitoring activities performed by ARPA Lombardy, a standardized protocol – based on a Bio-Optical Model – was developed to map the spatio-temporal gradients of SAV and to estimate their contribution to littoral metabolism.
During the period 2015–2018, based on satellite data (Sentinel 2 A-B) and in-situ measurements, we mapped the extent and density of SAV, largely dominated by Vallisneria spiralis, Najas marina and Lagarosiphon major. We focused to the southern sector of the lake (between Iseo and Clusane villages) that includes the shallowest littorals and the most developed macrophyte communities. In total, more than 80 sampling sites were identified for six different macrophytes (V. spiralis, N. marina, Ceratophyllum demersum, L. major, Myriophyllum spicatum, Chara globularis) for each of which biomass samples were collected using known surface frames by SCUBA diving or by modified rakes. In addition, a series of random samplings (n = 12 per year for the 2015-2017 period) were carried out aimed at measuring the species' elemental content of nitrogen, phosphorous, and carbon. Samples were analyzed in laboratory for determining fresh and dried biomass and nutrient content using standard procedures. 22 Sentinel-2A and -2B were atmospherically corrected with 6SV code. The BOMBER bio-optical modelling has been applied to atmospheric corrected images with the specific inherent optical properties of subalpine lakes for estimating the substrate coverage (bare sediment, dense stands of macrophytes with high albedo and sparse stand of macrophytes with low albedo).
Here we presented the main outputs of the work, discussing the reliability of satellite-derived maps, biomass evaluation and the role of macrophytes in regulating the lacustrine nutrient cyclization. Summarizing, our findings corroborate the existence of marked inter- and intra-annual variations and apparently stochastic trends in lacustrine SAV' spatial patterns and coverage. We also recorded intense uprooting phenomena mainly affecting V. spiralis, a species considered instead as a highly plastic pioneer taxon. This could be possible assuming the existence of fast-developing SAV, or drastic phenomena associated to the rapid disappearance of well-structured submerged communities. Our findings corroborate the existence of marked inter- and intra-annual fluctuations and apparently stochastic trends in lacustrine SAV' spatial patterns and coverage. We also recorded intense uprooting phenomena mainly affecting V. spiralis, a species considered instead as a highly plastic pioneer taxon. This could be possible assuming the existence of fast-developing SAV, or drastic phenomena associated to the rapid disappearance of well-structured submerged communities.

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