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Using APEX data to study phytoplankton and macrophytes in inland water ecosystems

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During the last eight years, airborne hyperspectral data were acquired over aquatic ecosystems with APEX, under the umbrella of EU FP7 funding (EUFAR and INFORM projects).
APEX images were collected over shallow freshwater and coastal ecosystems, characterized by joint presence of phytoplankton in high concentrations and macrophytes, namely: Mantua lakes system (Italy), on 21 September 2011 and on 27 September 2014 (5 flight lines, 5 m resolution); Lake Hídvégi (Hungary), on 19 July 2014 (3 flight lines, 5 m resolution); and Curonian Lagoon (Lithuania), on 1 and 2 September 2016 (24 flight lines, 3 m resolution).
Synchronous to airborne acquisitions, radiometric and eco-limnological parameters characterizing the three study sites were collected in situ in order to validate the APEX data and to calibrate reflectance-based models for mapping the biodiversity and abundance of primary producers.
Semi-empirical and bio-optical models were applied to APEX derived surface reflectance images for estimating phytoplankton pigments concentration, such as Chlorophyll-a (Chl-a) and Phycocyanin (PC), and macrophyte coverage and traits.
We derived detailed maps of Chl-a concentration as proxy of phytoplankton abundance and dominant phytoplankton functional type, being Diatoms or Cryptophytes/Cyanobacteria (Giardino et al., 2018). In addition, phytoplankton spatial patchiness was assessed and related to hydrodynamic features of Mantua lakes system (Pinardi et al., 2015), and multi-temporal analysis revealed lake areas characterized by strong Chl-a variation dynamics (Bresciani et al., 2017).
Ecosystem-scale maps of macrophyte morphological traits, in terms of biomass and density, were produced (Villa et al., 2017), and coexistence and interactions between phytoplankton and macrophytes were investigated (Bolpagni et al., 2014).
Our main aim is to aggregate all these results for demonstrating the high potential of airborne hyperspectral imaging platforms in providing high resolution, detailed and reliable information on different primary producers in complex aquatic ecosystems.