

ISEO: Improving the lake Status from Eutrophy towards Oligotrophy



fondazione
cariplo

Partner presentation CNR-IREA

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Presentation outline

Field campaigns

EO data & processing

Validation

Products

Dissemination

Future activities



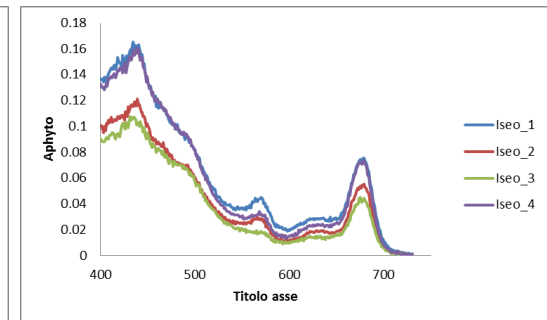
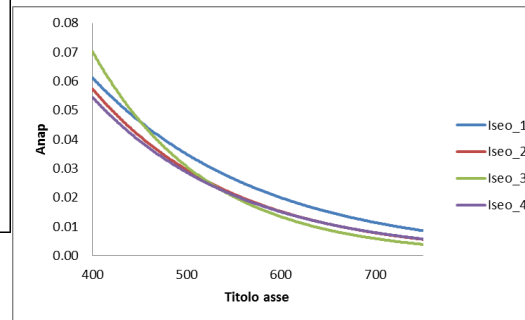
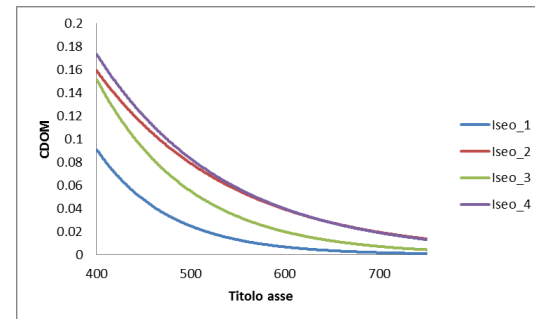
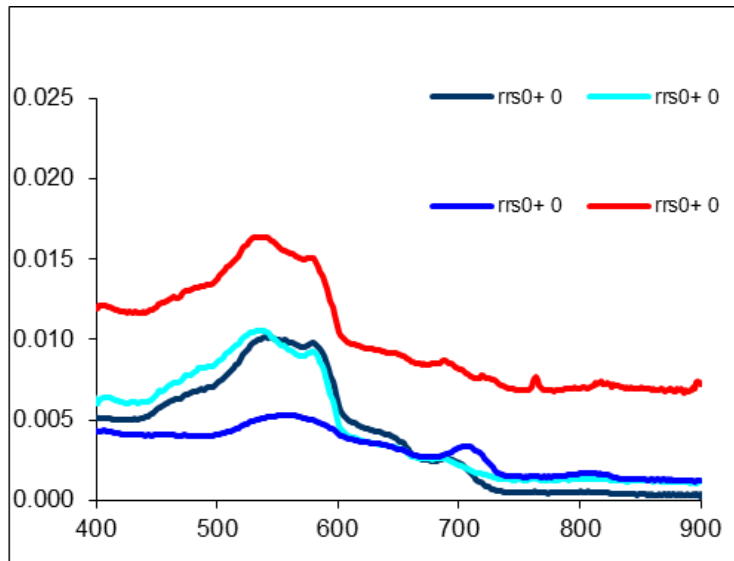
Field campaigns

The aims of that field campaign is collected in situ data to:

- calibrate satellite data,
- Validate algorithms, that will be used to obtain a water quality and macrophytes coverage from satellite products,
- validate a processing (radiometric and atmospheric correction) of satellite data.

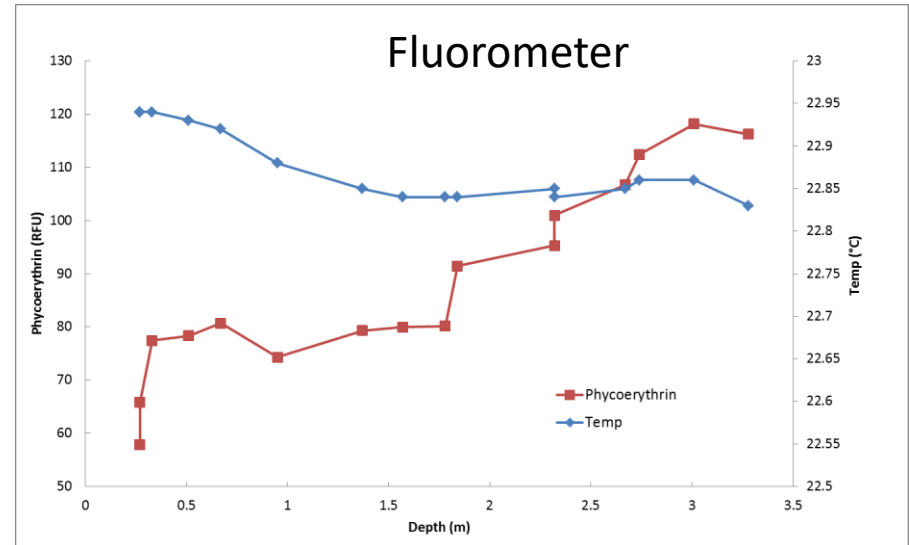


AOP & IOP



WQ & macrophytes

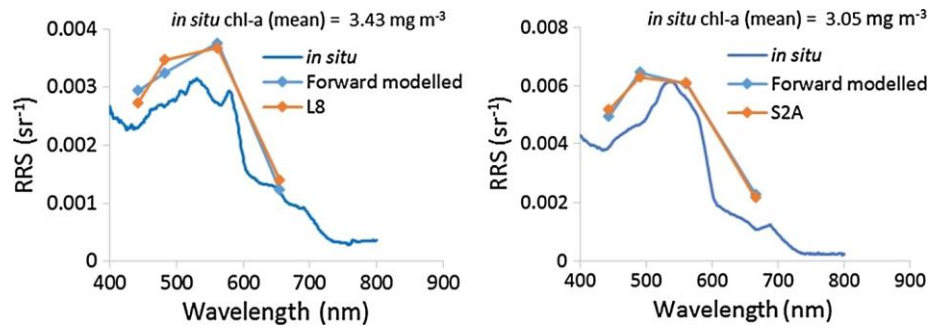
	TSM	SPOM	SPIM%	Chla	Anap	CDOM
	mg/L	%	%	$\mu\text{g} / \text{L}$	(m-1)	(m-1)
ISEO_1	3.07	85%	15%	0.9	0.049	0.054
ISEO_2	2.20	73%	27%	2.3	0.044	0.120
ISEO_3	3.20	73%	27%	2.5	0.050	0.101
ISEO_4	2.53	100%	0%	3.8	0.042	0.129



EO data & processing

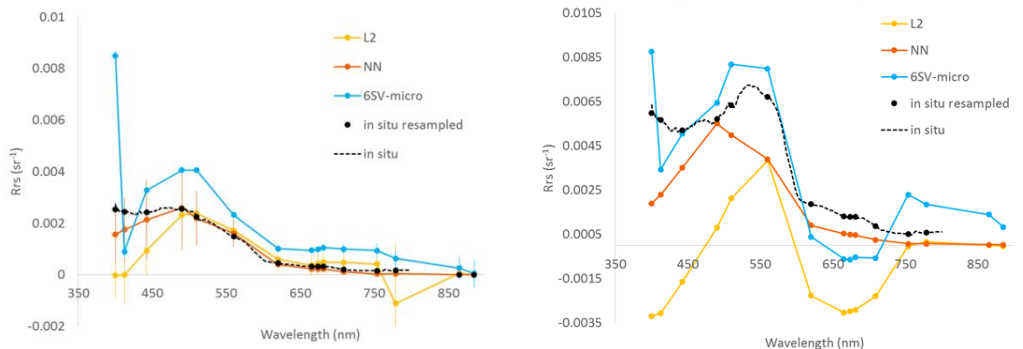
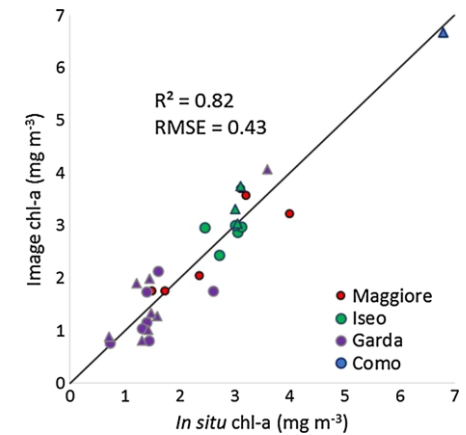
- **Landsat-8** (water quality, surface temperature) 2017-2018
(19 images) (same of previos year)
- **Sentinel-2** (water quality, SAV) 2017
(12 images) (same of previos year)
- **Sentinel-3** OLCI (water quality) 2017-2018
(~ 100 images) (testing different atm-corr + Bio optical model and Neural Network)
- **Sentinel-3** SLSTR (water quality) 2017-2018
(~ 150 images) (EUMETSAT products)
- **MERIS** (water quality time series) 2003-2011

Validation



In situ measurements, BOMBER simulation and Remote Sensing products of RRS, from L8 image of Lake Maggiore on 24/9/2015 (a) and from S2A image of Lake Iseo on 26/9/2016 (b)

Chl-a concentration measured in situ (x-axis) and estimated from remote sensing data (y-axis), RMSE and Coefficient of determination R^2 . Triangles and circles indicate, respectively, S2A and L8 products. Solid line is the bisector of the first quadrant



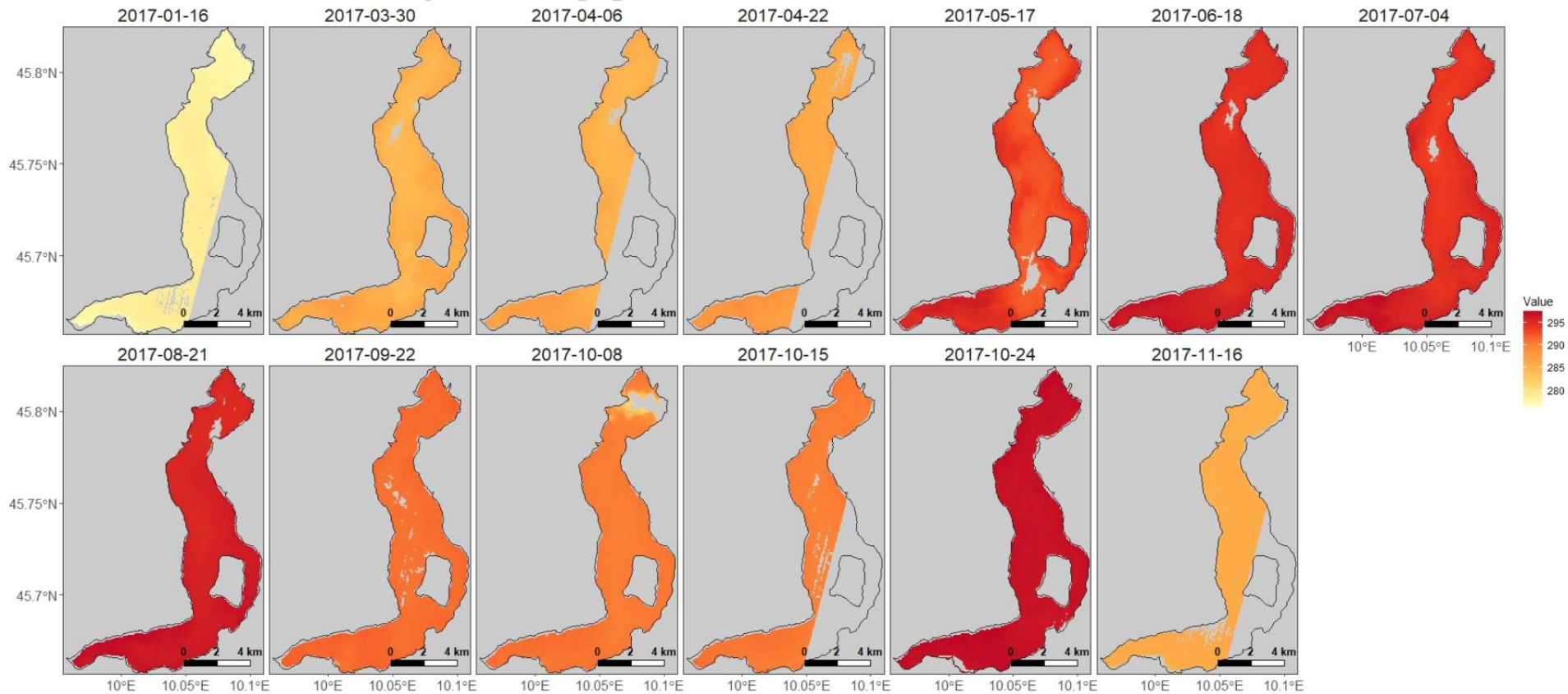
Comparison of different methods of atm corr for S3-OLCI

Validation

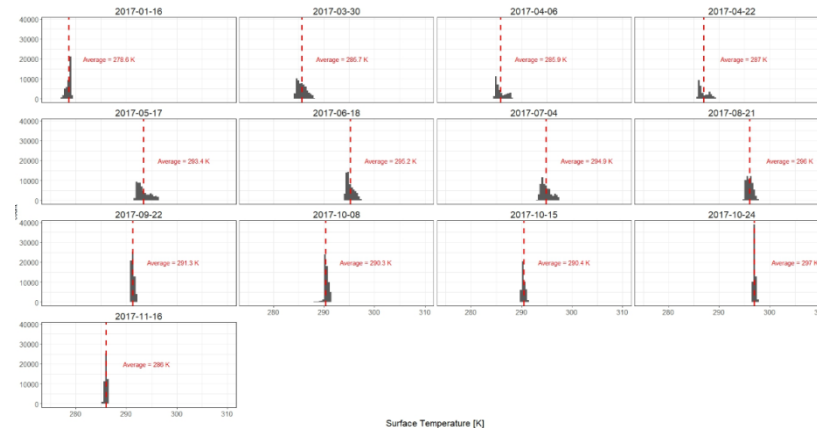
	emerged macrophytes	submerged macrophytes	deep water	bottom without macrophytes	TOT
emerged macrophytes	12	1			13
submerged macrophytes		16	1	1	18
deep water			8	1	9
bottom without macrophytes				6	6
TOT	12	17	9	8	46

Confusion matrix depicting the agreement of EO classified data with respect to in situ surveys. As the number of { pairs is limited the computation of the overall accuracy coefficient is not relevant.

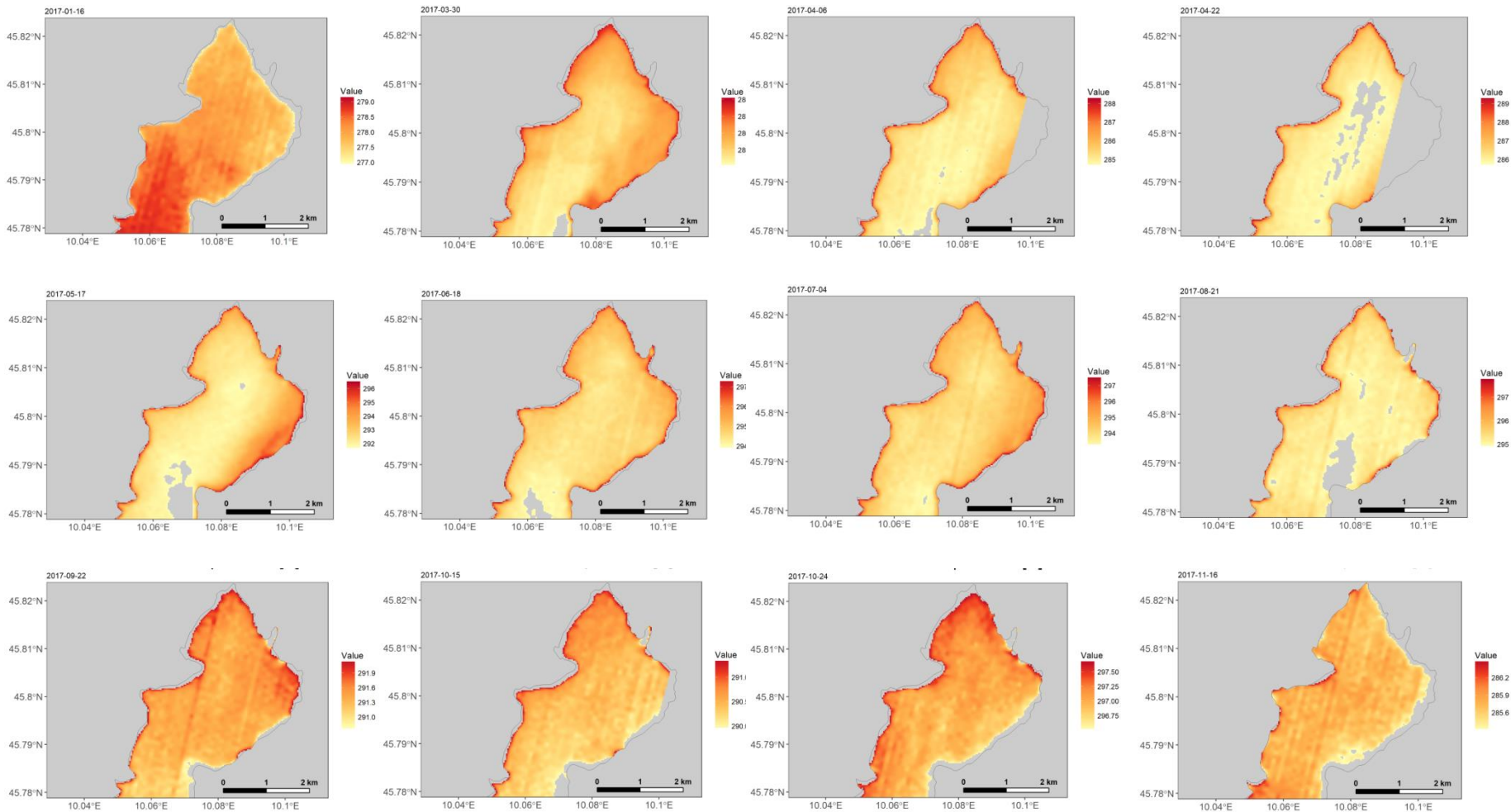
Landsat Surface Temperature [K]



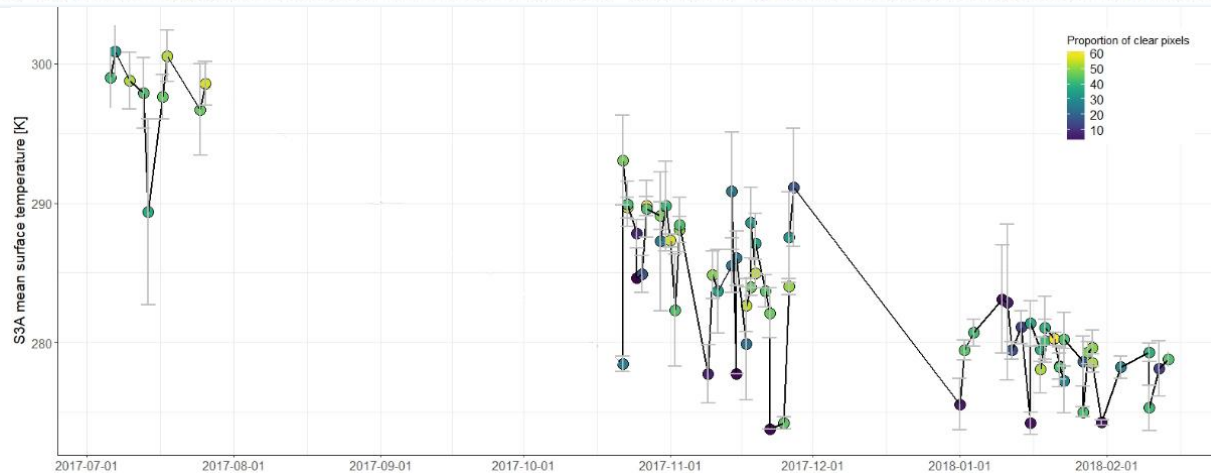
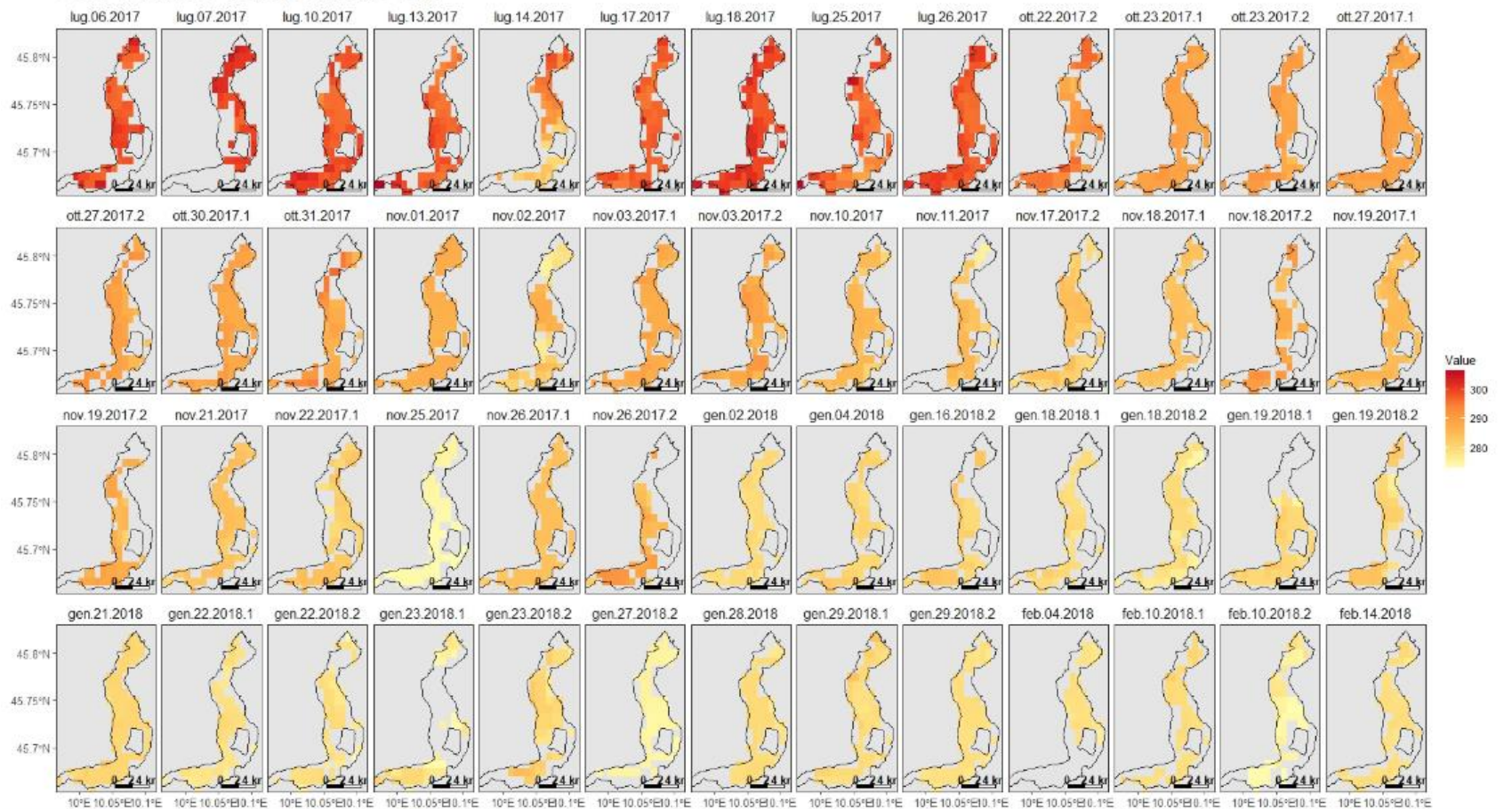
After radiometric and atmospheric corrections we remove all the pixel with noise and uncertainty values



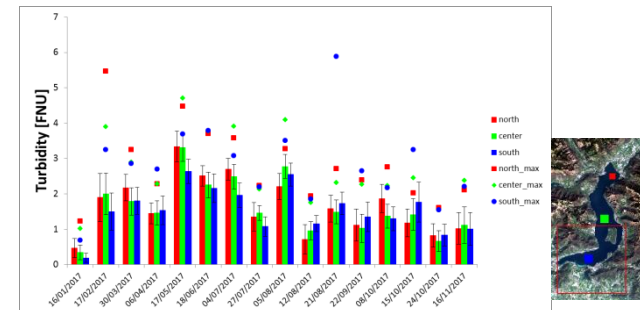
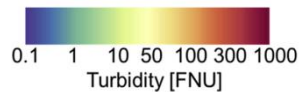
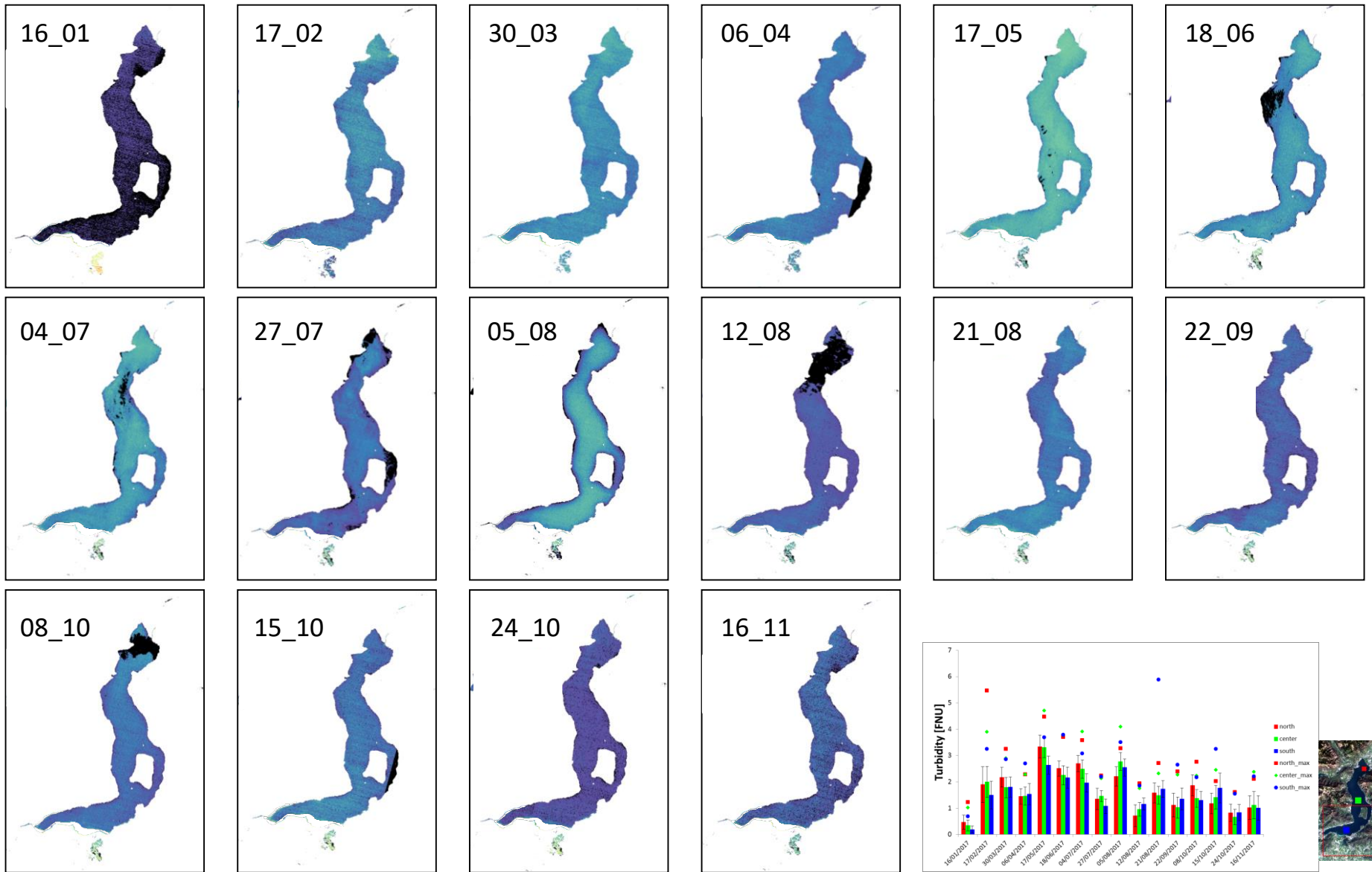
Landsat Surface Temperature [K]



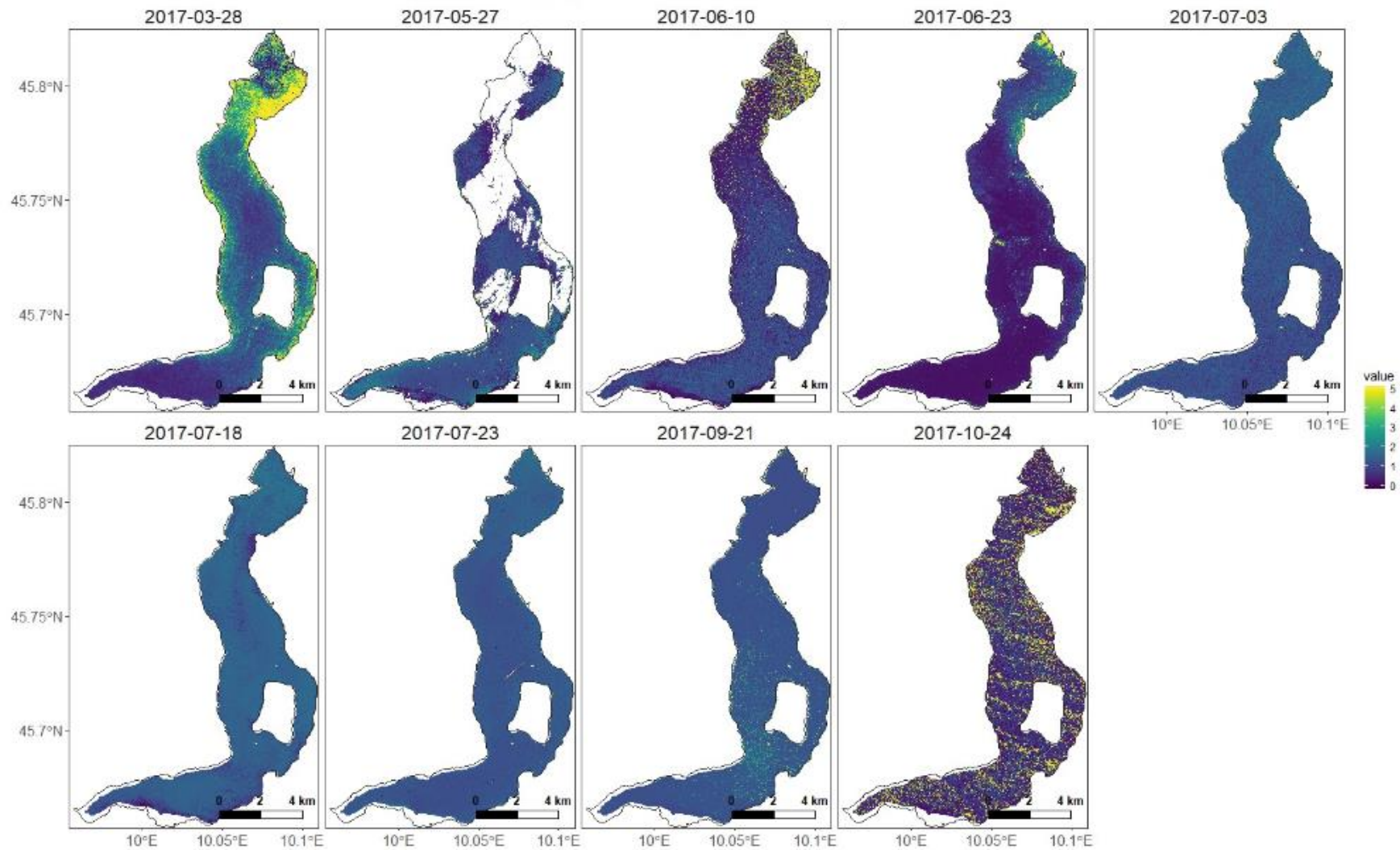
S3A Surface Temperature [K]



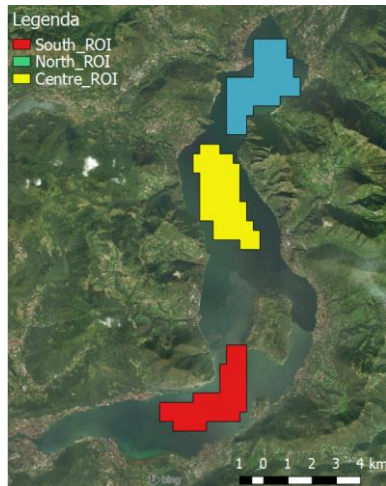
2017 Turbidity from Landsat 8



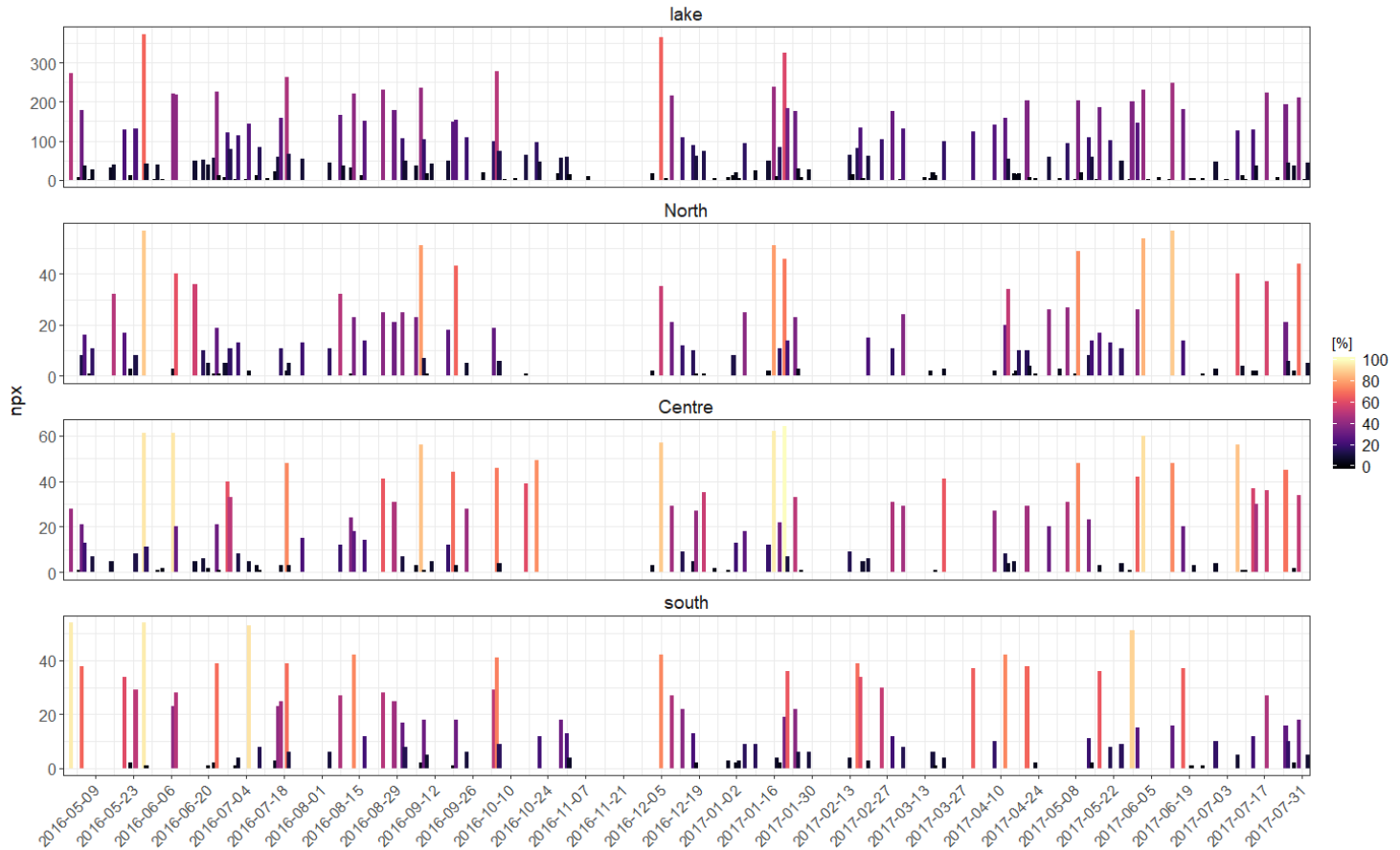
2017 Chl-a from Sentinel-2



Sentinel-3 OLCI analysis

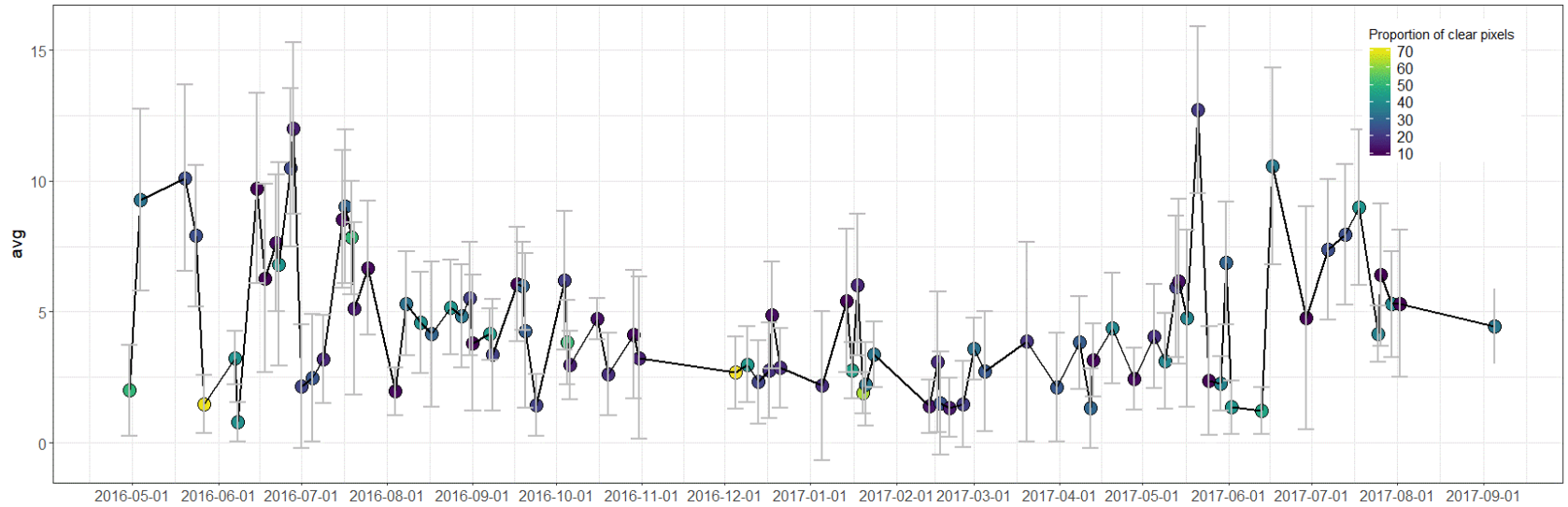


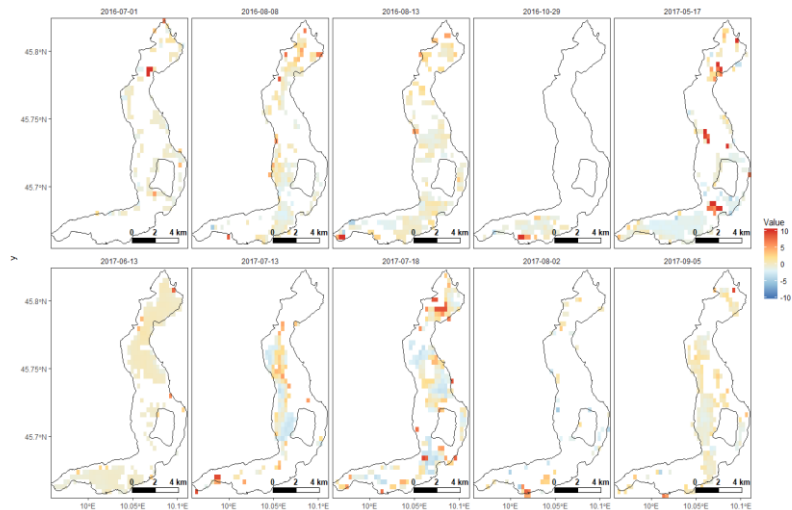
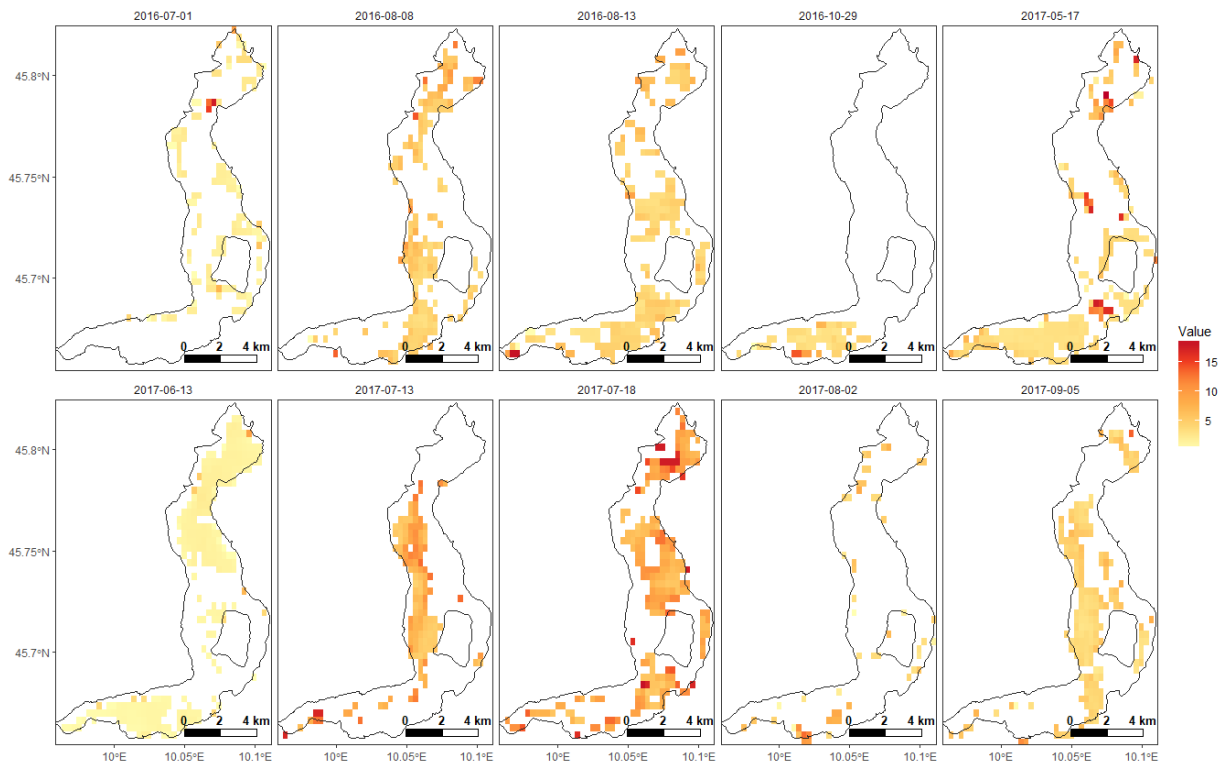
(30/04/2016 –
05/09/2017)



NUMBER OF VALID PIXELS WITHIN EACH ROI FOR EACH DATE OF THE AVAILABLE DATASET. THE PROPORTION WITH RESPECT TO THE SIZE OF THE ROI IS GIVEN BY THE COLOR.

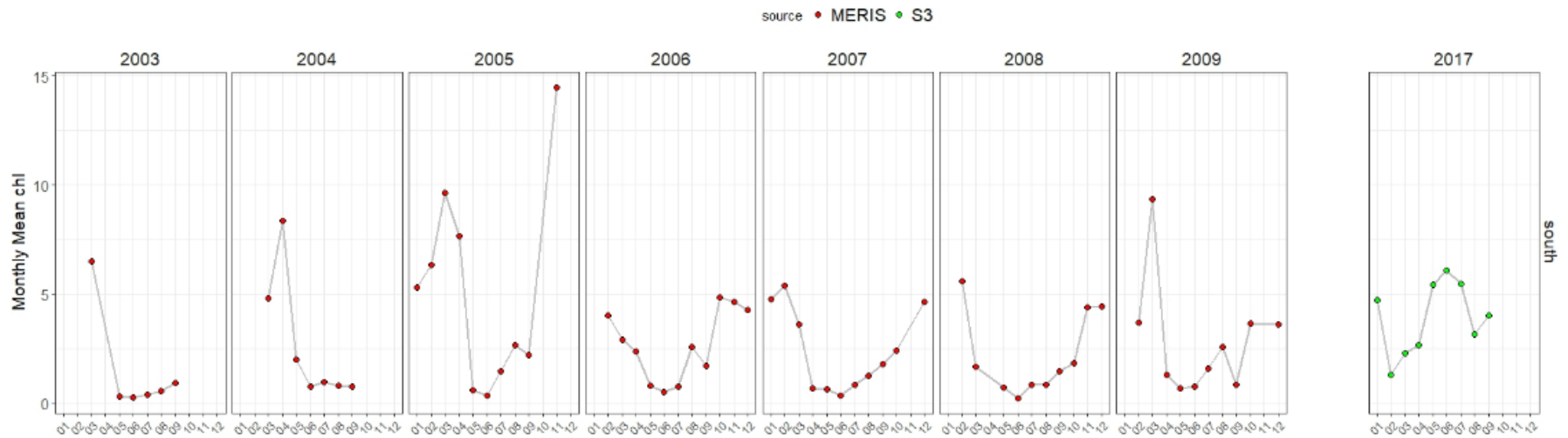
Chl-a (Sentinel-3 OLCI)



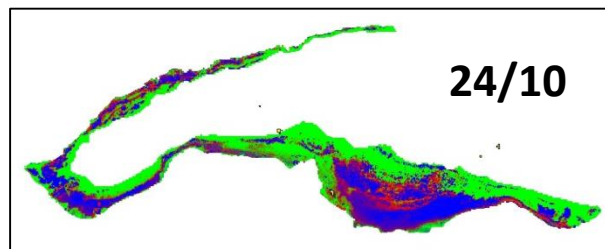
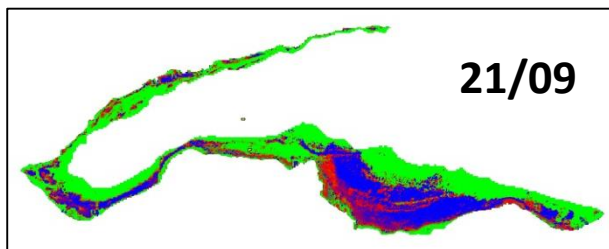
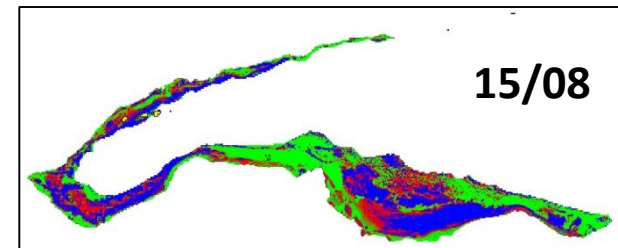
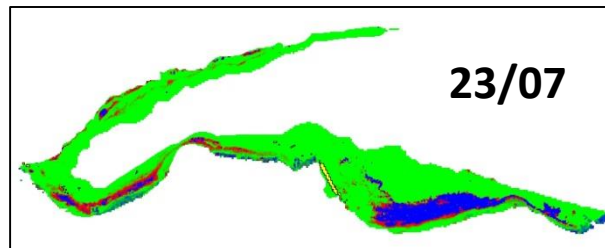
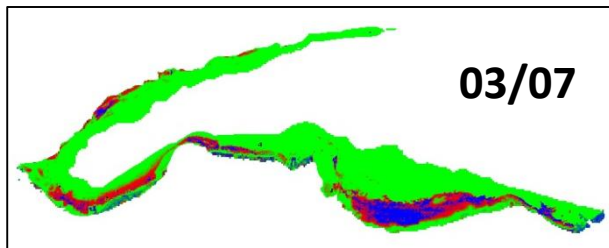
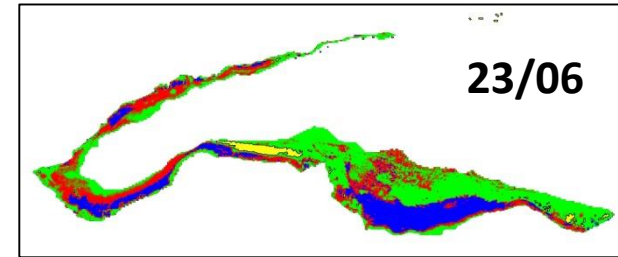
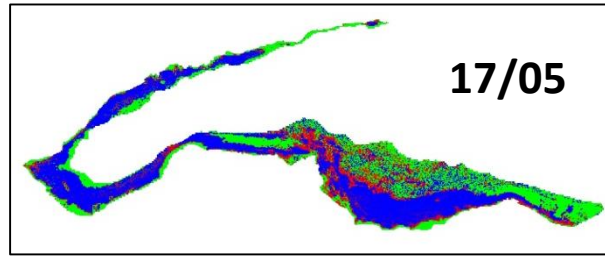
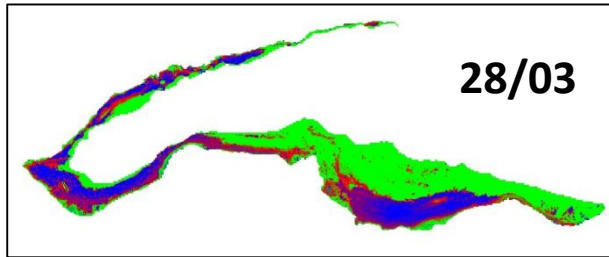


DIFFERENCE TO THE AVERAGE VALUE FOR EACH DATE OF
CHLOROPHYLL CONCENTRATIONS ON LAKE ISEO FOR THE
INDICATED DATES

Chl-a Time series integration (Sentinel-3 OLCI & MERIS)



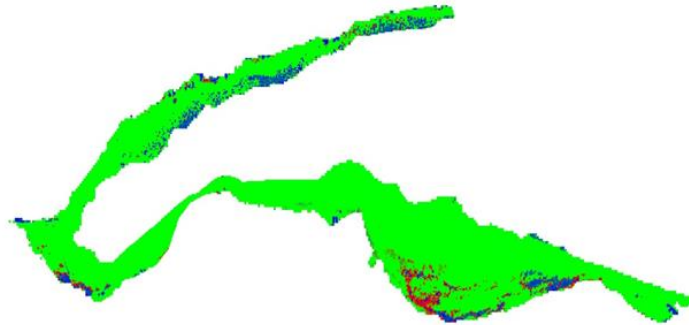
2017 Macrophytes dynamics (Sentinel-2)



- b1 = Macrophytes dense
- b2 = Macrophytes rade
- b0 = Bottom without macrophytes
- floating uprooted macrophytes

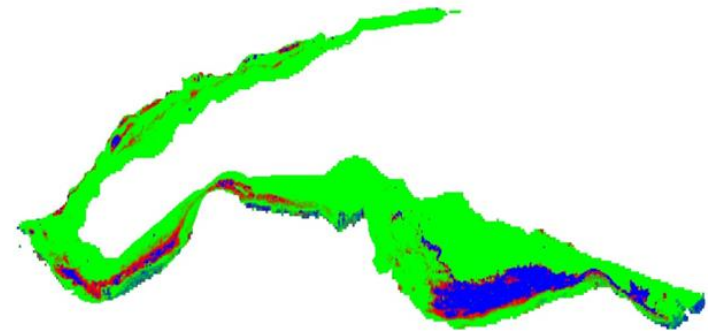
03/08/2015

0 1 2 3 km



23/07/2017

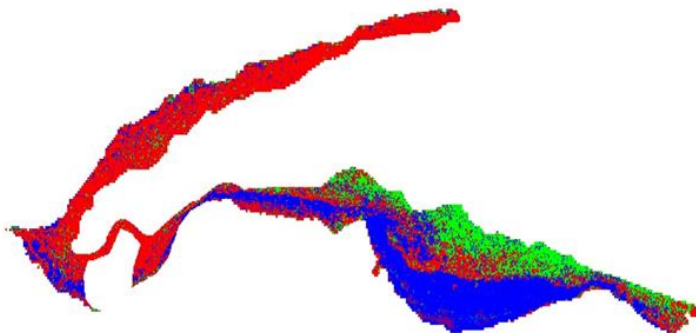
0 1 2 3 km



- b1 = Macrophytes dense
- b2 = Macrophytes rade
- b0 = Bottom without macrophytes
- floating uprooted macrophytes

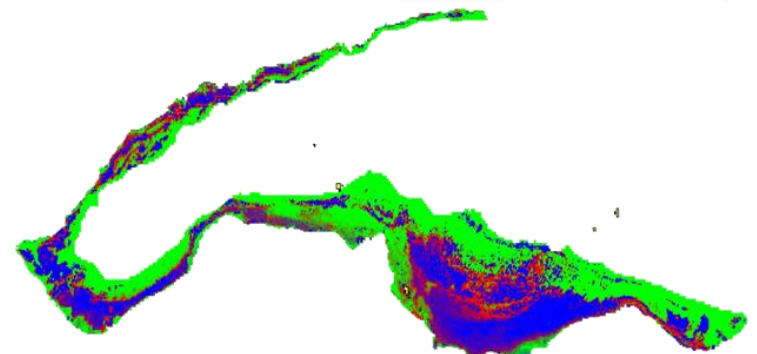
22/10/2015

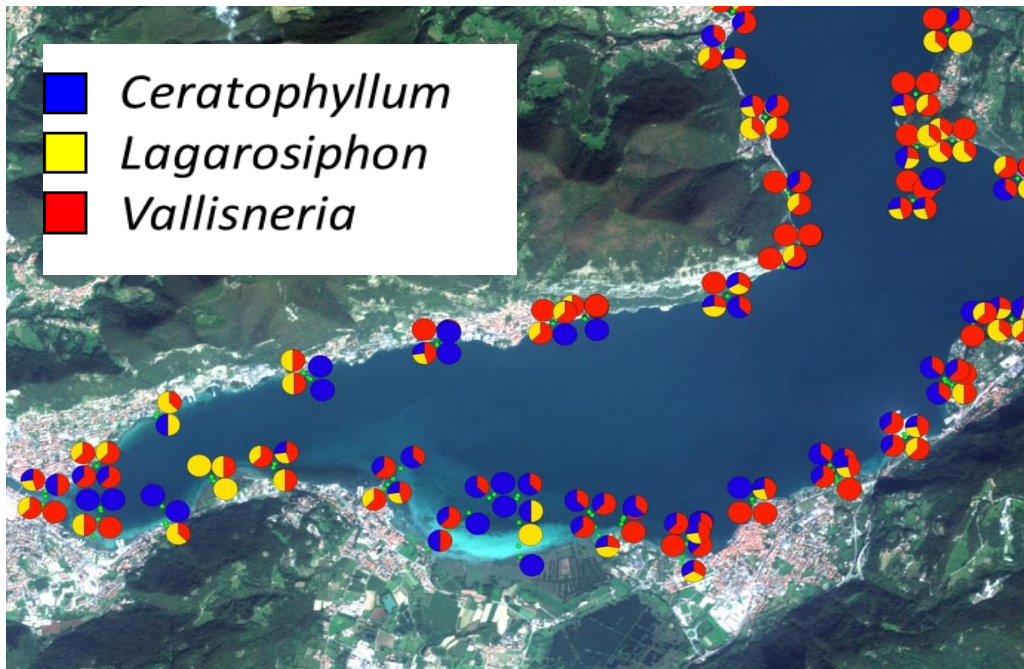
0 1 2 3 km



24/10/2017

0 1 2 3 km

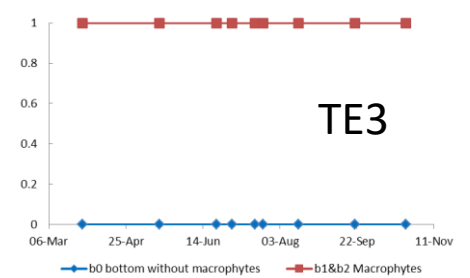
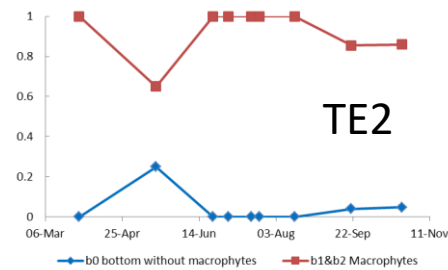
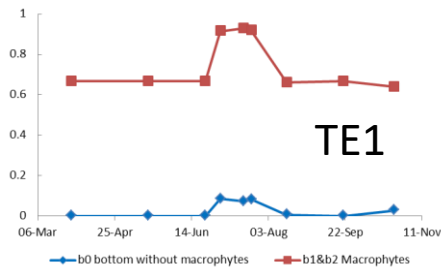
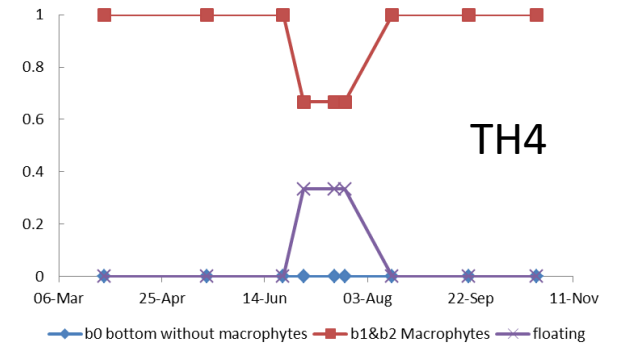
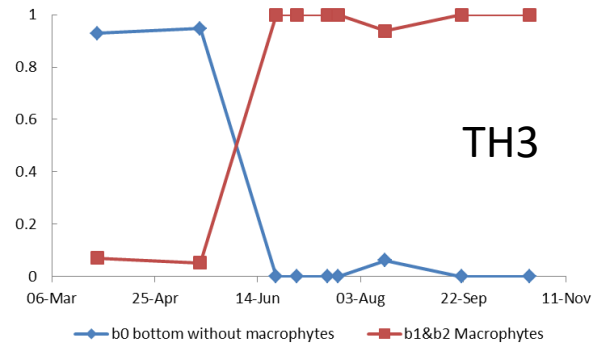
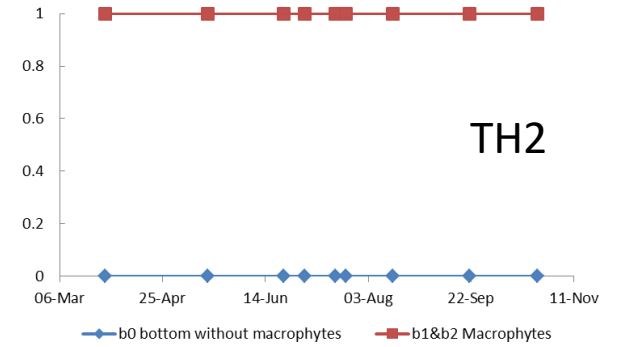
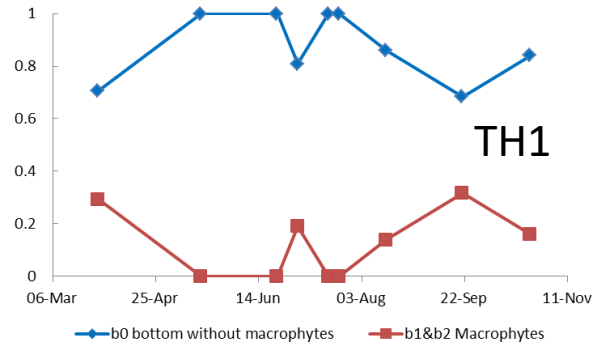
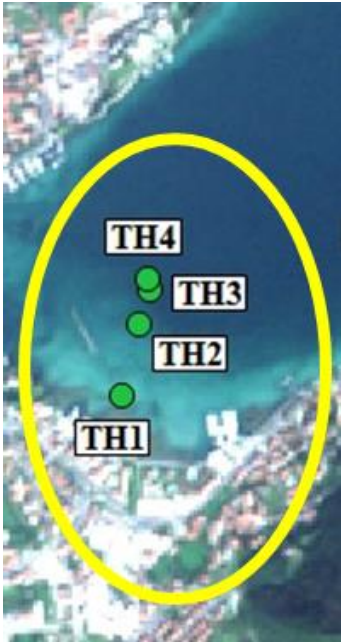




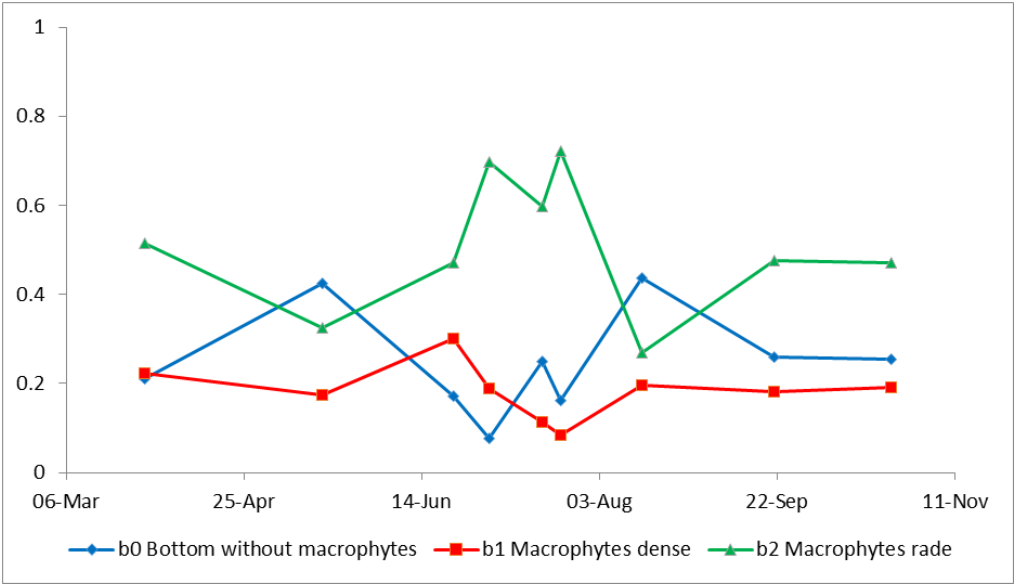
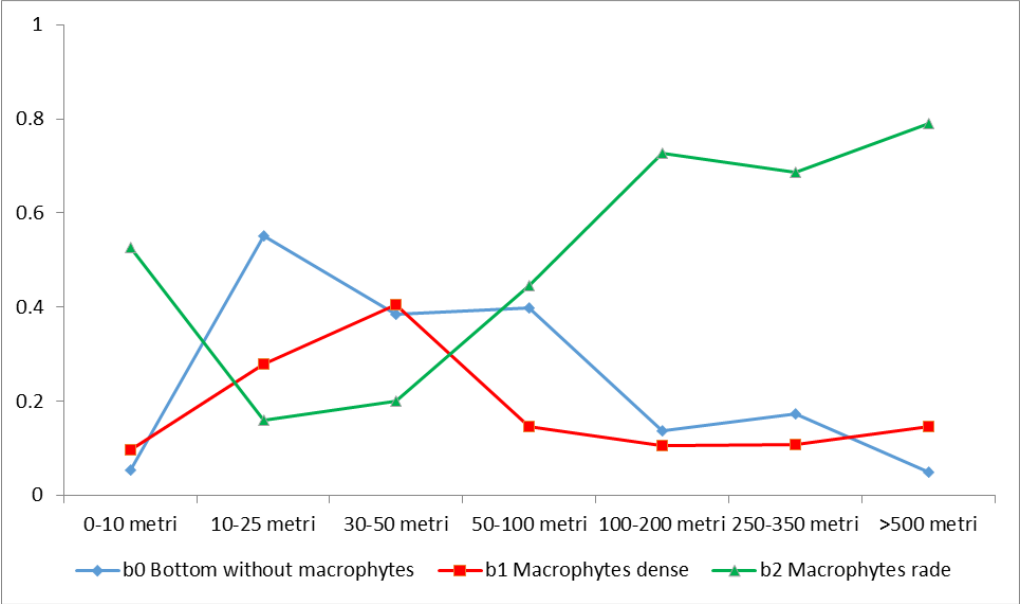
ARPA survey



Creation of ROI in satellite products



Average values



Paper

- Bresciani M., Cazzaniga I., Austoni M., Sforzi T., Buzzi F., Morabito G., Giardino C. (2018). Mapping phytoplankton blooms in deep subalpine lakes from Sentinel-2A and Landsat-8. *Hydrobiologia* <https://doi.org/10.1007/s10750-017-3462-2>
- Pilotti, M., Valerio, G., Giardino, C., Bresciani, M. and Chapra, S.C., (2018). Evidence from field measurements and satellite imaging of impact of Earth rotation on Lake Iseo chemistry. *Journal of Great Lakes Research*, 44(1), pp.14-25.

Conference

- XXII National Conference ASITA 27-29 November, 2018, Bolzano
- ELLS-IAGLR “Big Lakes - Small World” 23-28 September, 2018 Evian (France)

Education

- Thesis of Nicola Ghirardi; Supervisor Bartoli M., Co-supervisor Bresciani M. University of Parma
- PhD thesis of Ilaria Cazzaniga, *Processing and analysis of last generation satellite data for monitoring optically complex waters*; Tutor: prof. R. Colombo, Co-tutor: dott.ssa C. Giardino. PhD in Chemical, Geological and Environmental Sciences, XXXI cycle, University of Milan-Bicocca

Future activities

- Processing all satellites 2018 data-set (Landsat-8, Sentinel 2 and 3) to finish
Water quality and Surface temperature products
- Complete the analysis of macrophytes results (write a paper related to this topic)
- Another field campaign to increase the robustness of algorithms and the
validation for the new sensors (Sentinel-3)