

# Qualification of OLCI products from S3 for turbid lakes: results from the Lake Trasimeno

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## 1. Aims

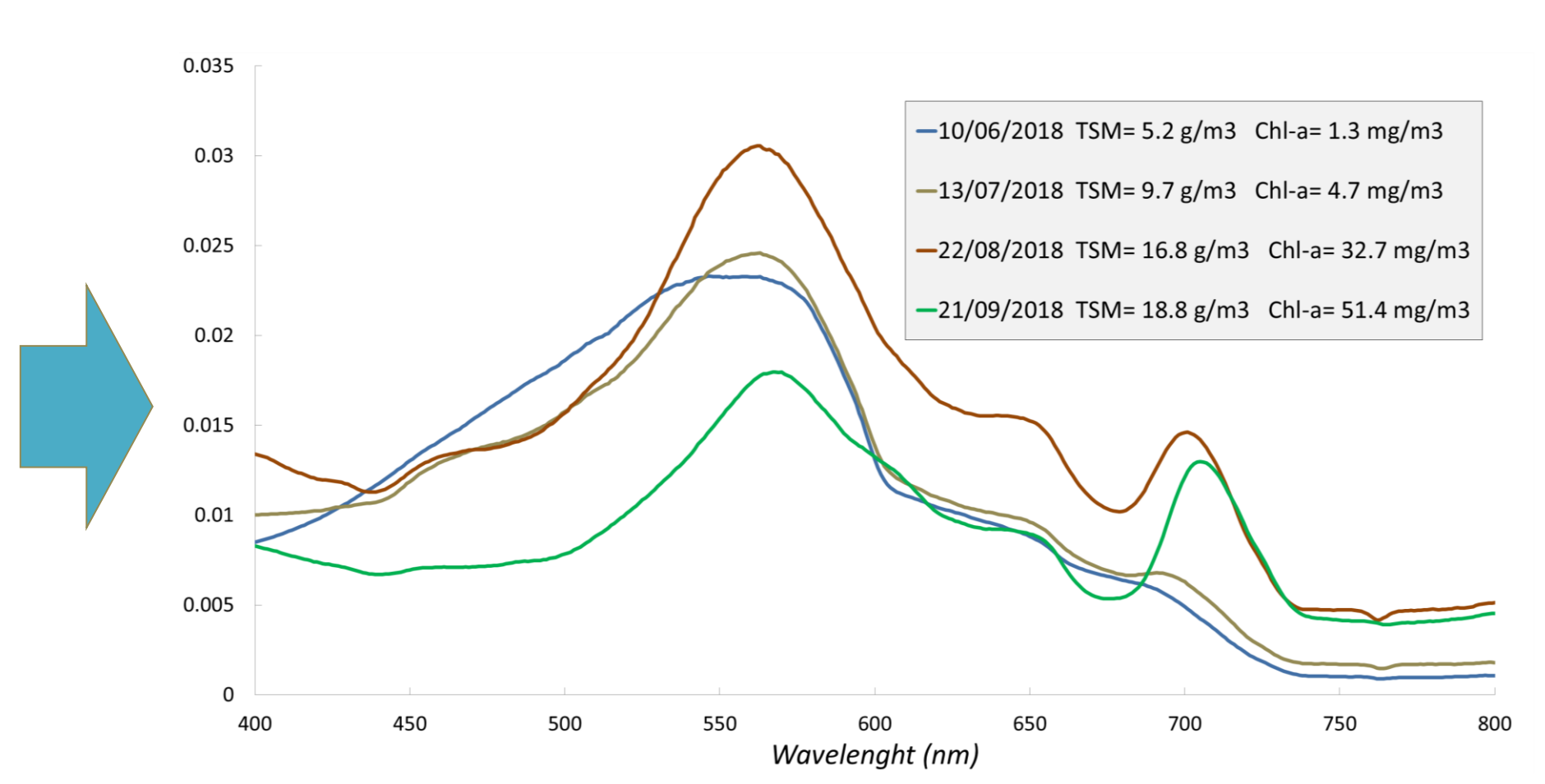
The aim of this work is to evaluate Sentinel-3 OLCI in lake waters to map chlorophyll-a concentrations (Chl-a) and to provide spatial and temporal information on phytoplankton dynamics to support the EU Water Framework Directive (EC/2000/60).

## 2. Study area

Lake Trasimeno is a turbid, meso-eutrophic, unstratified shallow lake (average depth 4.5 m, max depth 6 m) with a size of 124 km<sup>2</sup>. It has three small islands and an open bay colonised by aquatic vegetation with exceptional value for biodiversity. Tourism, agriculture and livestock breeding are the most important activities in its area.



Remote sensing reflectance ( $R_{rs}$ , in  $sr^{-1}$ ) of Lake Trasimeno waters for different yet typical conditions during the season; the peak near 700 nm is always present from mid-July until the end of September; diatoms in spring and cyanobacteria in summer-autumn. The waters are belonging to Optical Water Type (OWT) classes #8 and #12. Concentrations of Chl-a and TSM measured from corresponding water samples are given as reference



## 3. Materials and methods

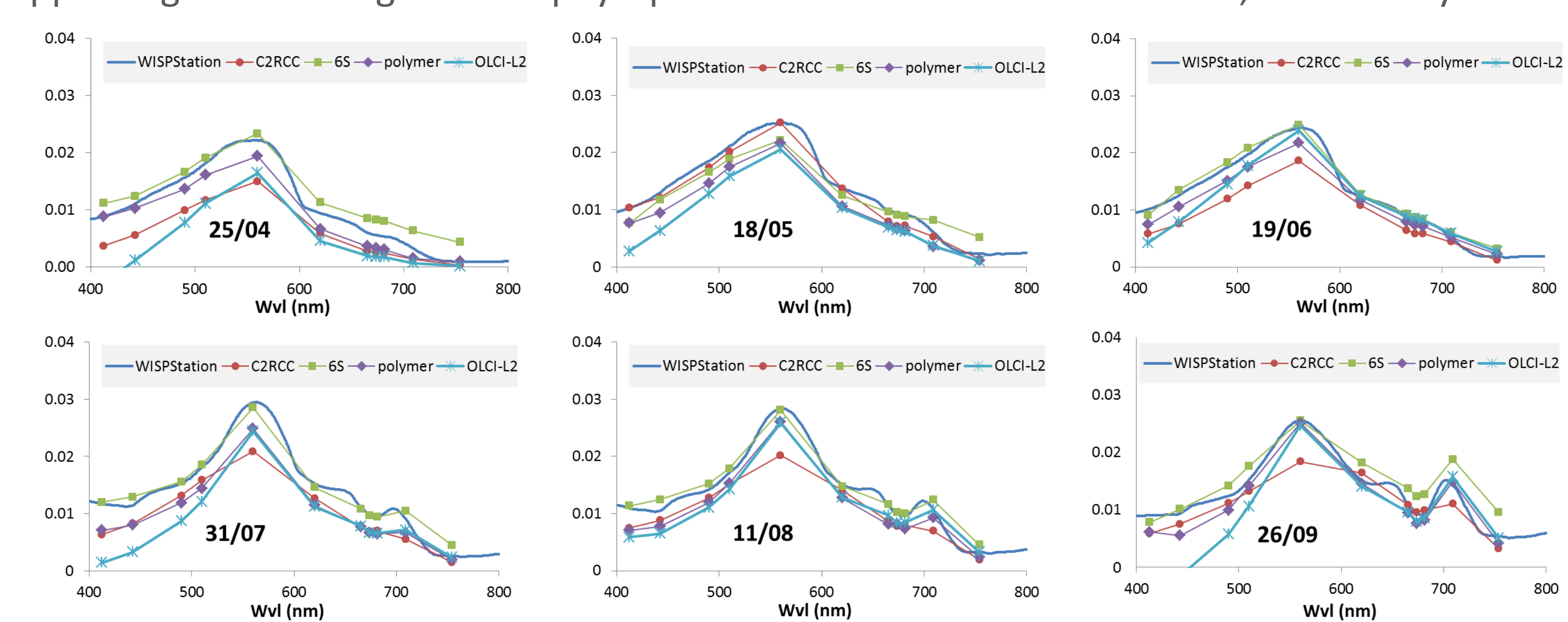
Sentinel 3A and 3B OLCI L1 images acquired in 2018 were converted into  $R_{rs}$  with three atmospheric correction codes: 6S vector version (6S), Polymer and C2RCC. Sentinel 3A and 3B OLCI L2 EUMETSAT images (OLCI-L2) were also included in this study. The OLCI-derived spectra were evaluated thanks to the comparison with continuous *in situ* hyperspectral  $R_{rs}$  data acquired by a WISPStation. The OLCI-derived  $R_{rs}$  products were then converted into Chl-a maps with the bio-optical model, implemented in BOMBER, parametrized with optical properties of Lake Trasimeno.

The WISPStation is a fixed position spectrometer system for measuring  $R_{rs}$  from 350 to 900 nm at 3 nm resolution. The Trasimeno WISPStation (nearby Polvese island) it has been running from 24 April to 3 October 2018, collecting  $R_{rs}$  spectra every 15 min. By using appropriate bio-optical models and algorithms, this system provides data on the intra and inter daily variability on concentrations of water quality parameters



## 4. Results

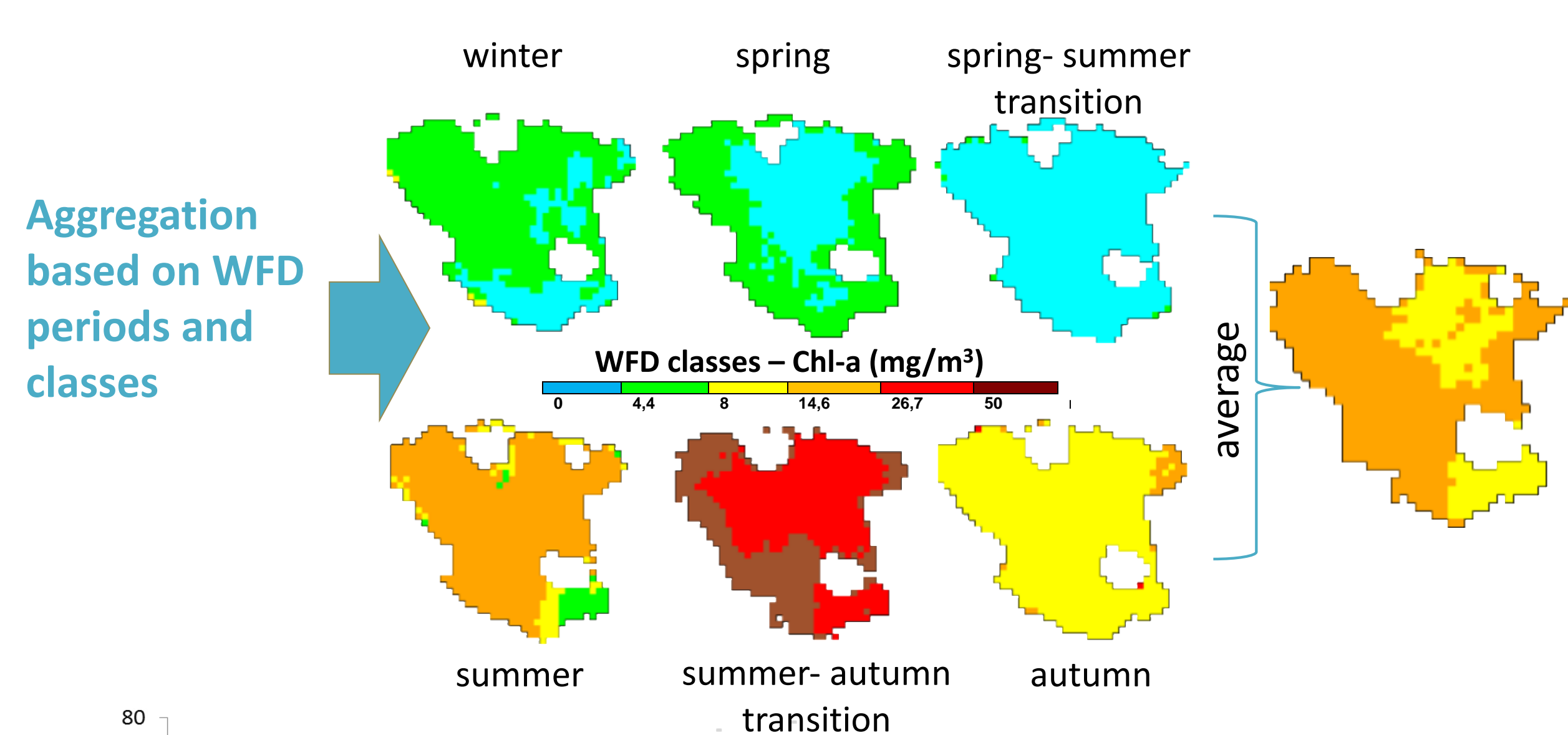
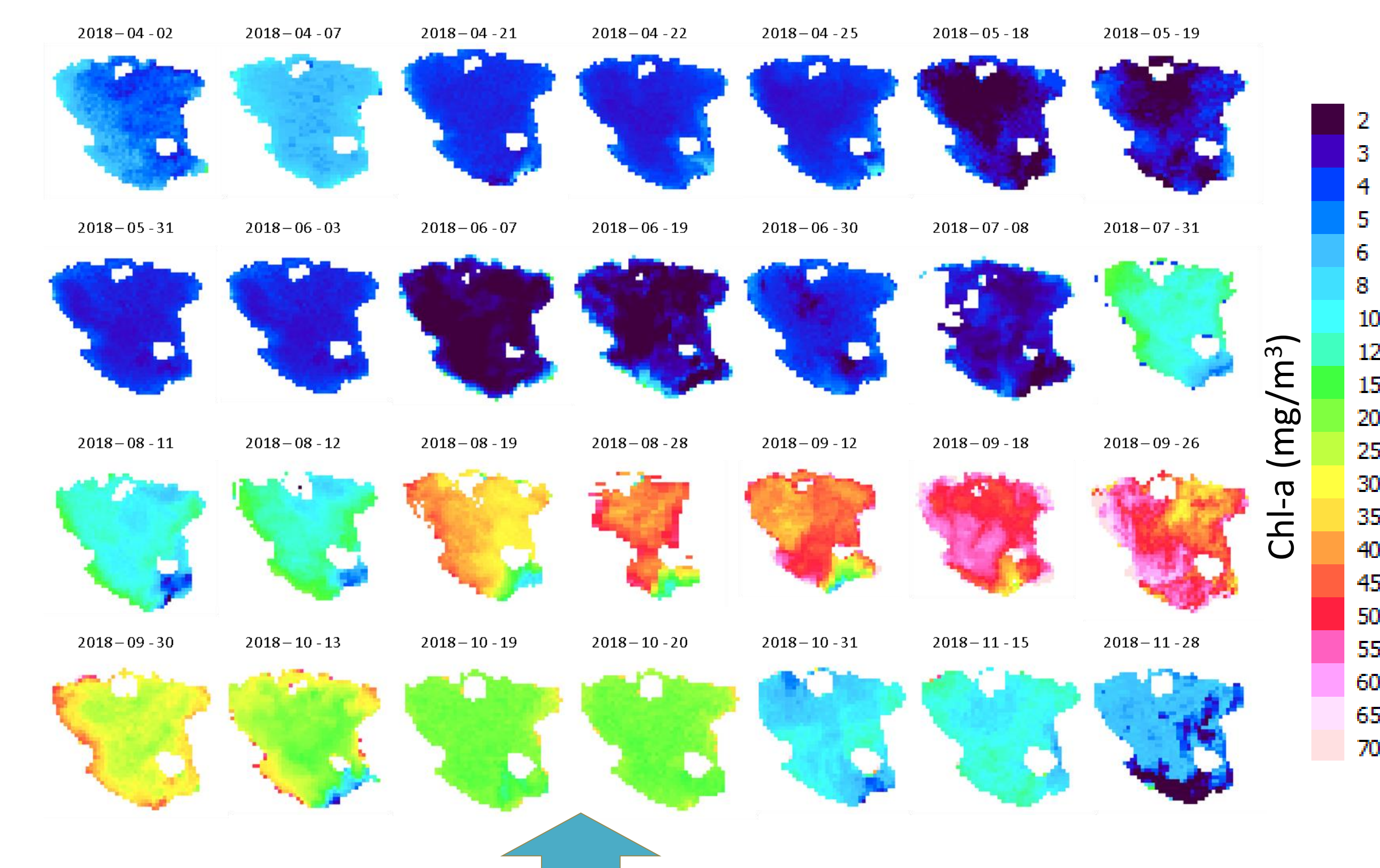
The panel below show  $R_{rs}$  spectra as derived from WISPStation and from Sentinel 3, both OLCI-L2 and Level 1, the latter corrected with 6S, Polymer and C2RCC. Overall all processors are close to WISPStation data; a larger deviation is given by C2RCC and OLCI-L2 when the peak around 700 nm is appearing due to the growth of phytoplankton. Based on the best match, 6S and Polymer were finally adeptly selected to process all 2018 images.



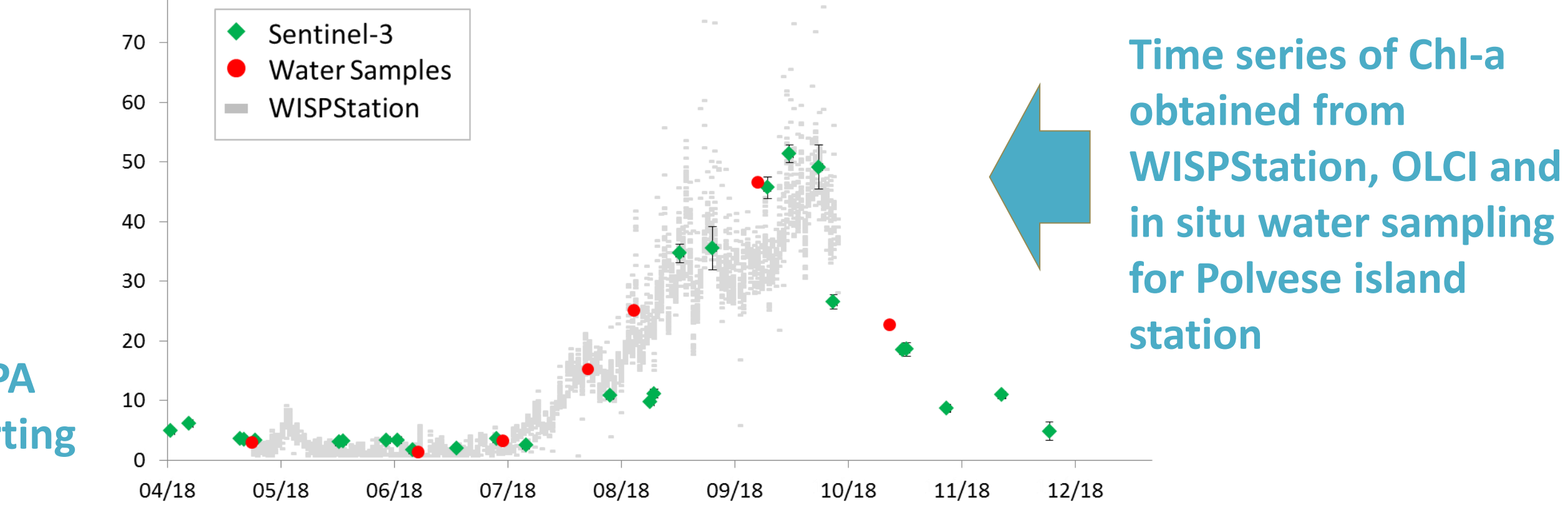
Fitting of  $R_{rs}$  between OLCI products and WISPStation data ( $\pm 15$ min), in terms of  $r$  Person correlation coefficient and relative root mean square error

Wvl (nm)	$r$				RMSE %			
	OLCI-L2	polymer	C2RCC	6S	OLCI-L2	polymer	C2RCC	6S
412.5	0.39	0.57	0.21	0.34	93	19	40	27
442.5	0.40	0.61	0.63	0.59	66	26	25	19
490	0.68	0.80	0.81	0.74	38	20	20	17
510	0.66	0.81	0.60	0.82	27	16	24	14
560	0.66	0.83	0.43	0.75	14	11	21	10
620	0.76	0.83	0.63	0.71	23	20	18	15
665	0.83	0.88	0.60	0.80	28	26	25	16
673.75	0.77	0.90	0.57	0.78	31	28	23	13
681.25	0.80	0.88	0.61	0.77	30	28	24	14
708.75	0.94	0.95	0.87	0.97	29	27	34	24
753.75	0.71	0.95	0.89	0.71	50	36	50	43

The panel below show some examples of OLCI-derived Chl-a products for the needs of the water authority responsible for WFD reporting.



Chl-a maps of 2018; the products were provided to the regional water authority (ARPA Umbria) responsible for supporting Lake Trasimeno management and the WFD reporting



## 5. Conclusions

- OLCI is confirmed to be the prime satellite radiometer for observing water quality in lakes.
- It provides accurate, timely and frequent information to support EU directives.
- This study is supporting the contents of a White Paper on 'Satellite-based Earth observation water quality monitoring, reporting and management for the Water Framework Directive' (to be published by the end of May).