ISEO: Improving the lake Status from Eutrophy towards Oligotrophy

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fondazione cariplo

Welcome in Brescia

Project Executive Summary: Work-Packages

1. WP1 - Quantification of the P load entering the lake from the main tributaries.
2. WP2 - Quantification of the P load from overflows of the combined sewer along the lake
3. WP3 - Quantification of the P fluxes from the sediments
4. WP4 – Remote monitoring of the lake surface
5. WP5 - Sewage modelling
6. WP6 – Lake modelling
7. WP7 - Project dissemination
8. WP8 - Project management

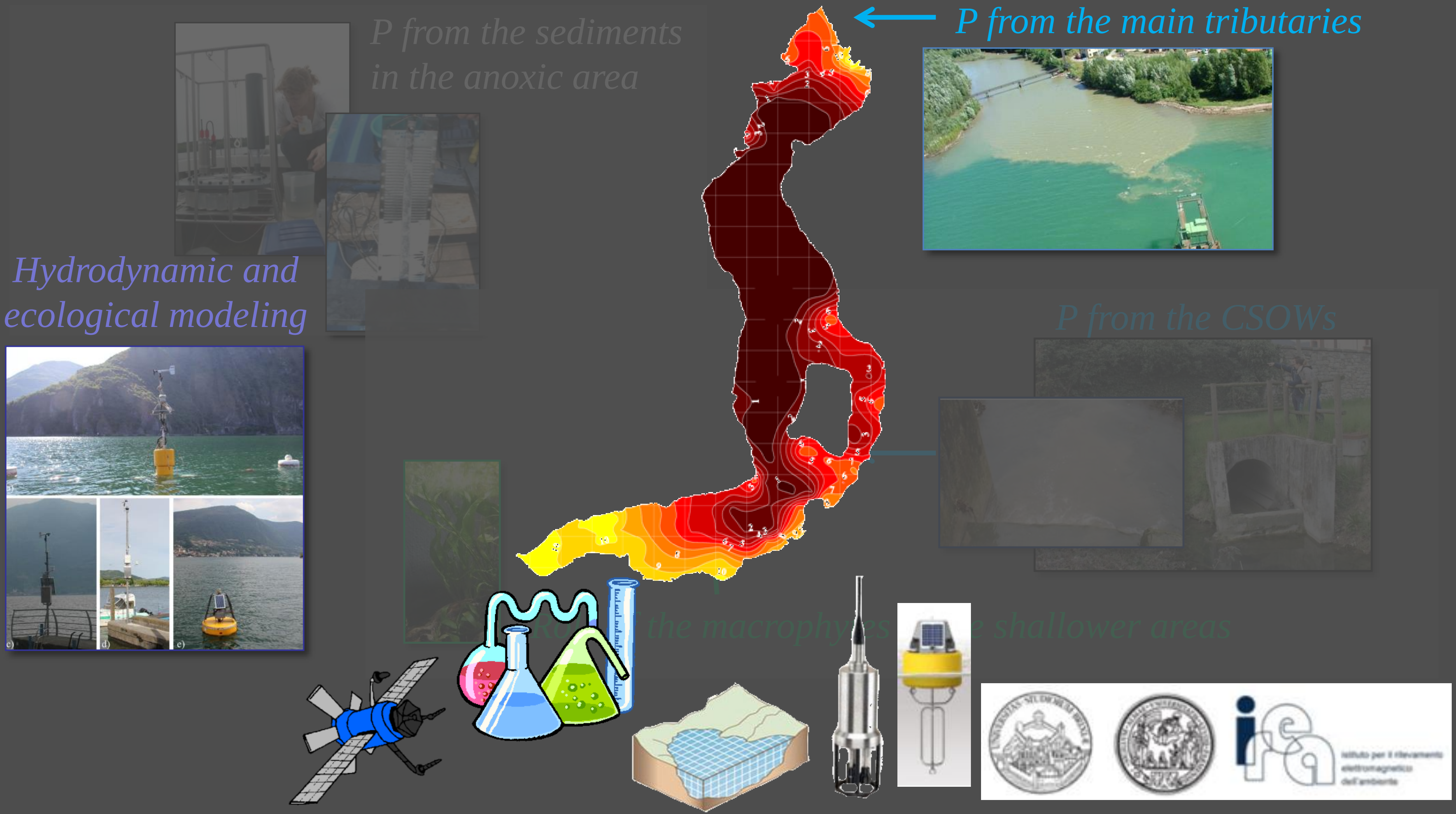
	Università di Brescia	IREA	Università di Parma	IGB
WP1	R			
WP2			R	
WP3				R
WP4		R		
WP5	R			
WP6	R			
WP7	R			
WP8	R			

	2016						2017					2018				
	kick-off meeting	I	II	III	IV	intermediate meeting	I	II	III	IV	intermediate meeting	I	II	III	IV	final presentation of results
WP1																
WP2																
WP3																
WP4																
WP5																
WP6																
WP7																
WP8																

UniBS Activities

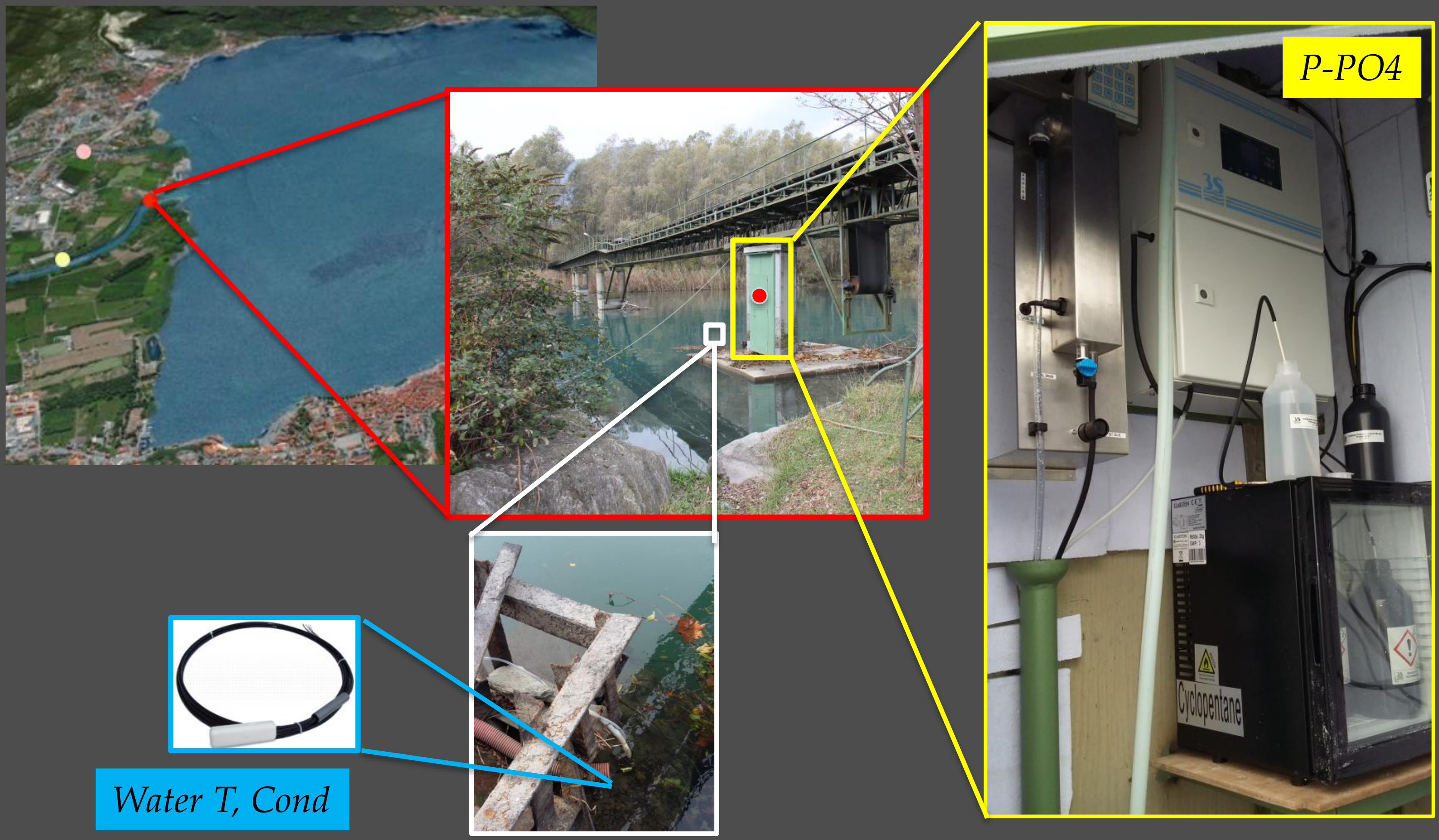
WP1 and WP4 – Impact of the load by the tributaries

What is the impact of the incoming tributaries on the phosphorous content of the lake? What is the actual time variability of the concentrations? What are the area of the lake mostly affected by the river waters?



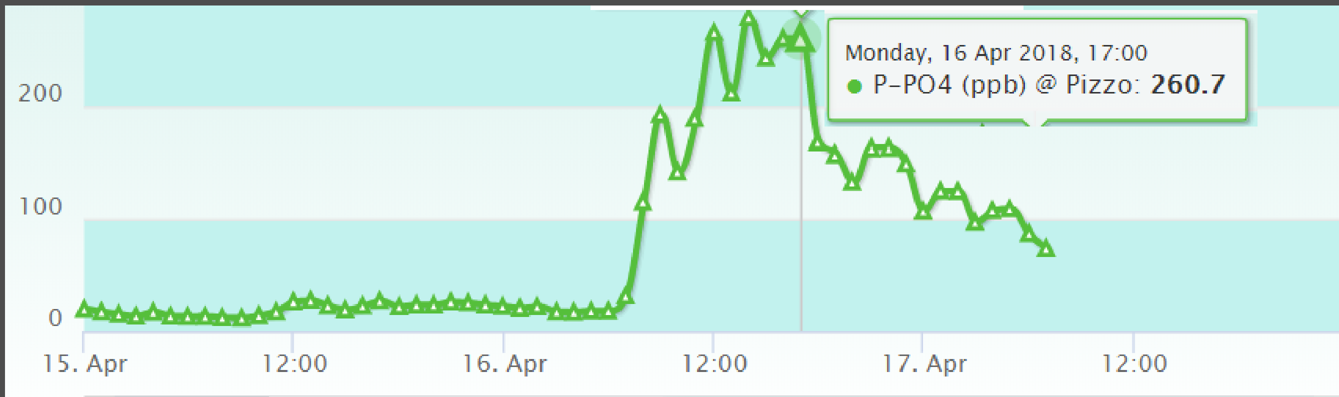
WP1 - Quantification of the P load from the tributaries

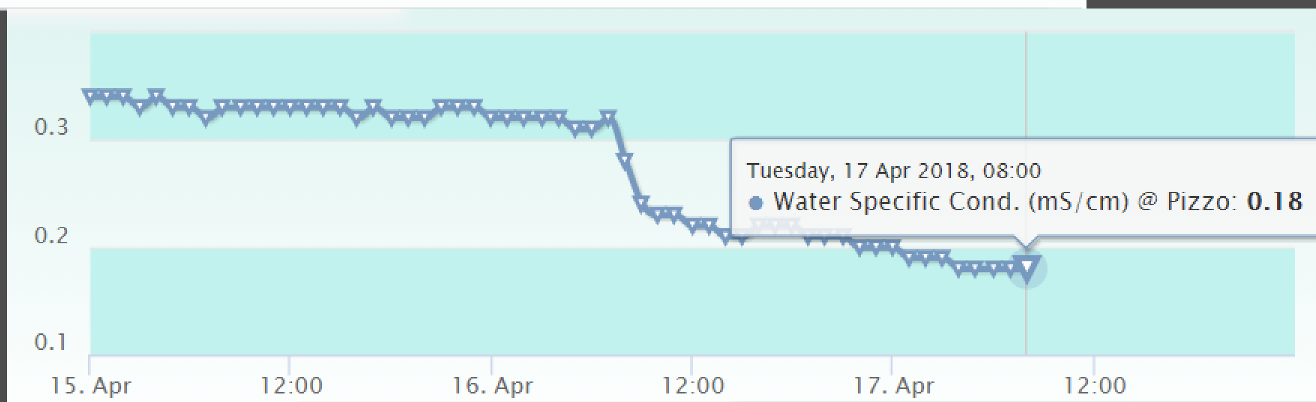
✓ In 2017: real time monitoring of P, conductivity and temperature at the entrance of Oglio river in Lake Iseo

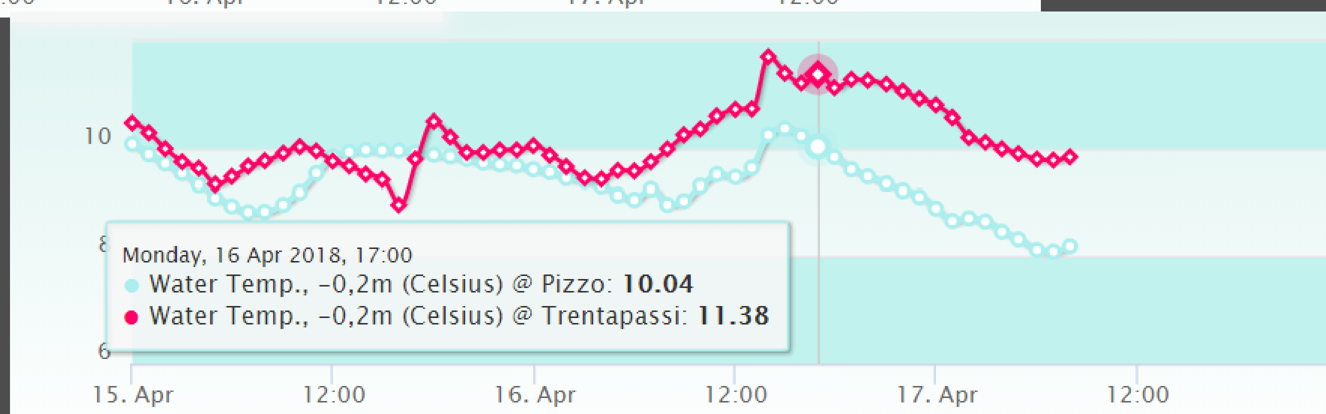


WP1 - Quantification of the P load from the tributaries

❖ Now on the web

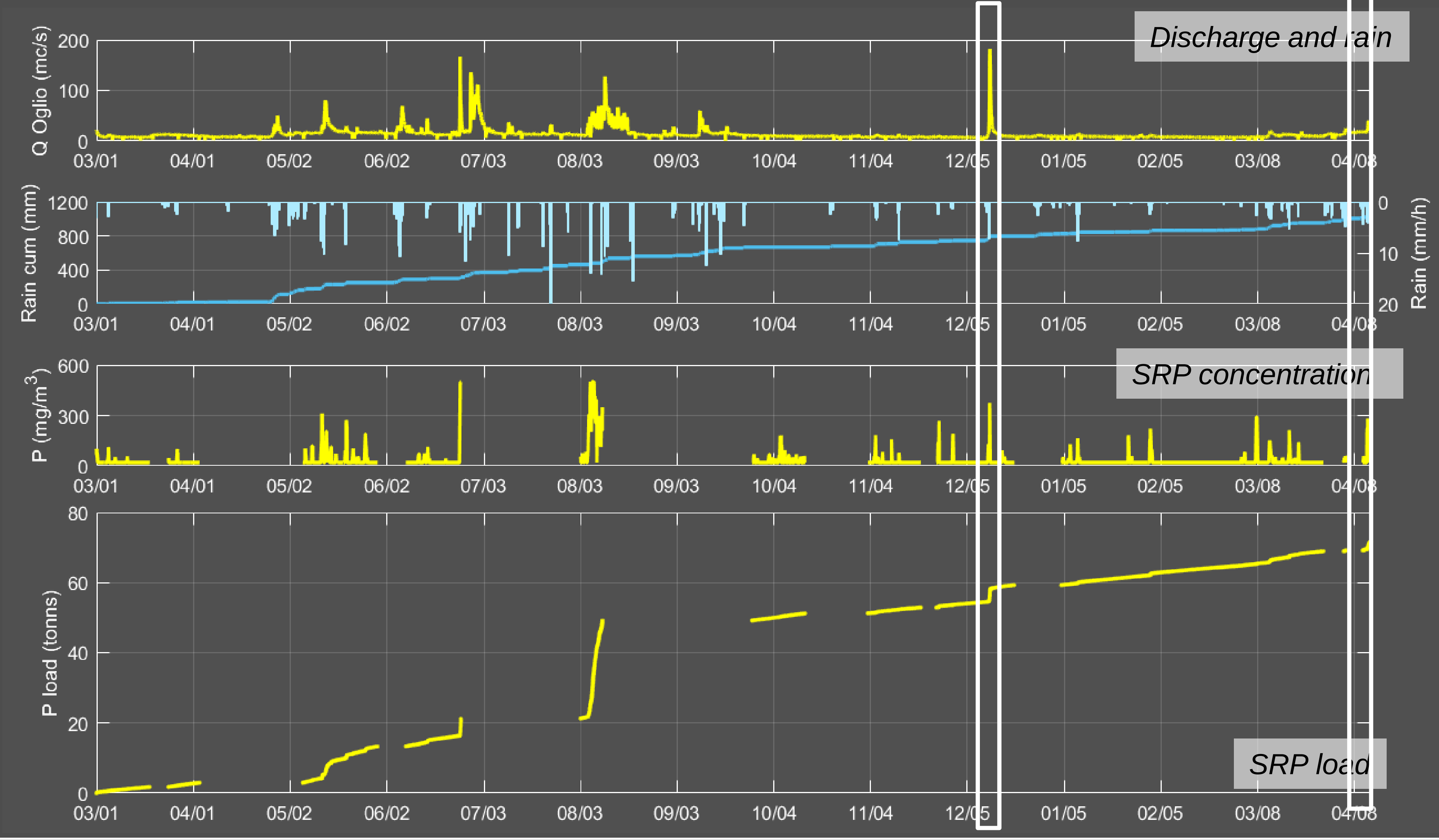






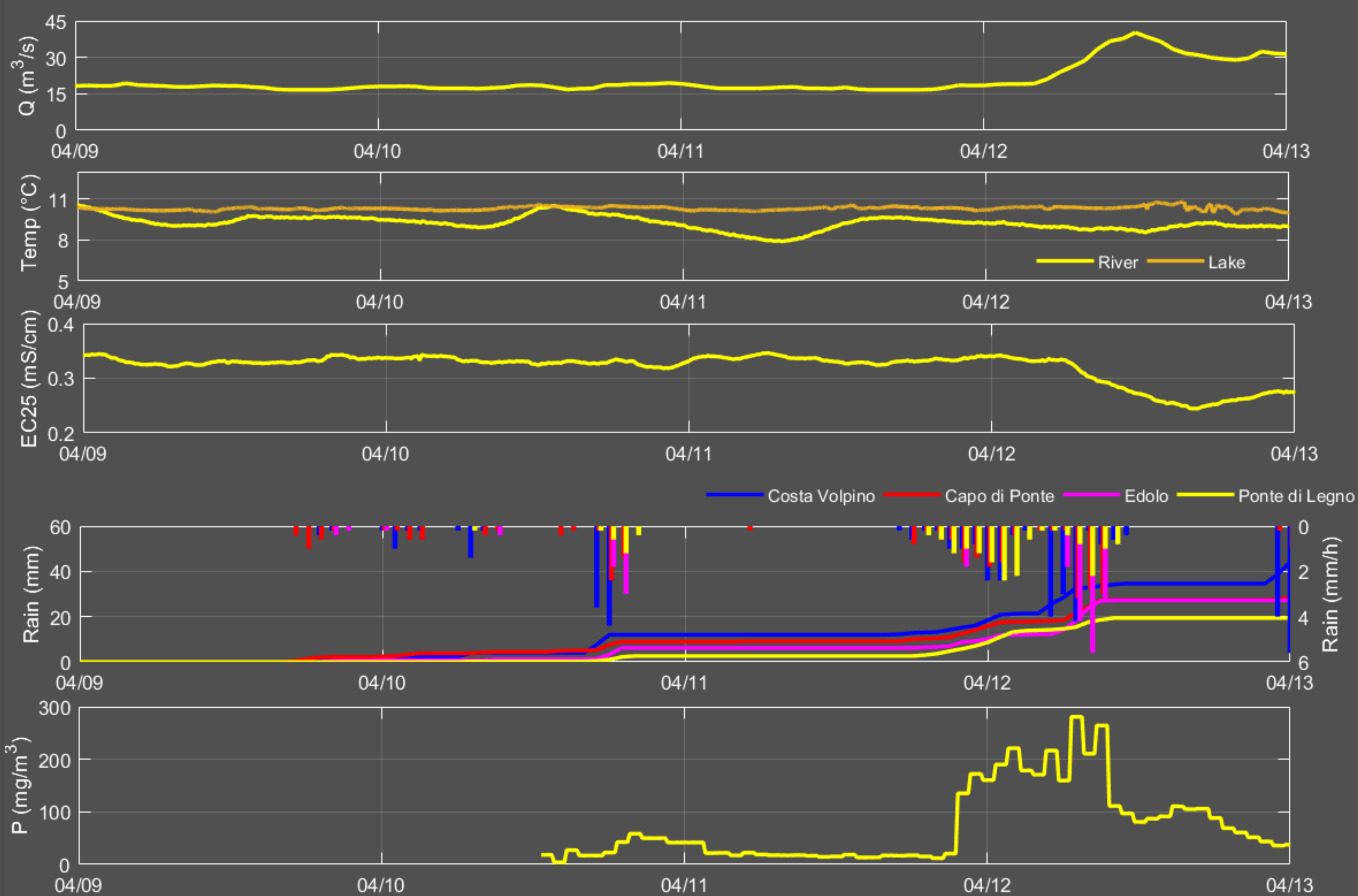
WP1 - Quantification of the P load from the tributaries

❖ Statistical analysis showing the impact of the rainy events on the overall load to the lake



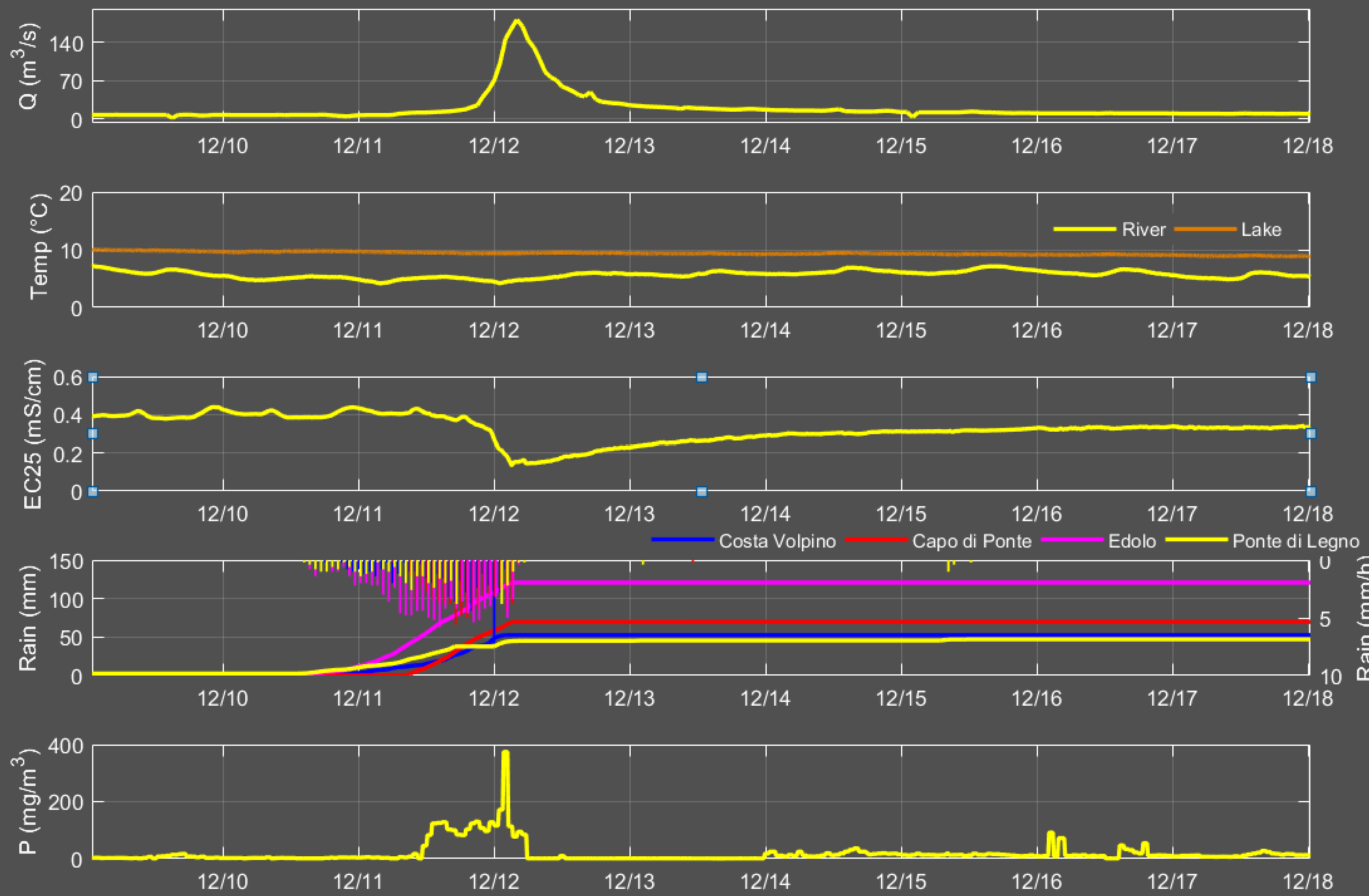
WP1 - Quantification of the P load from the tributaries

- Example of the more recent event



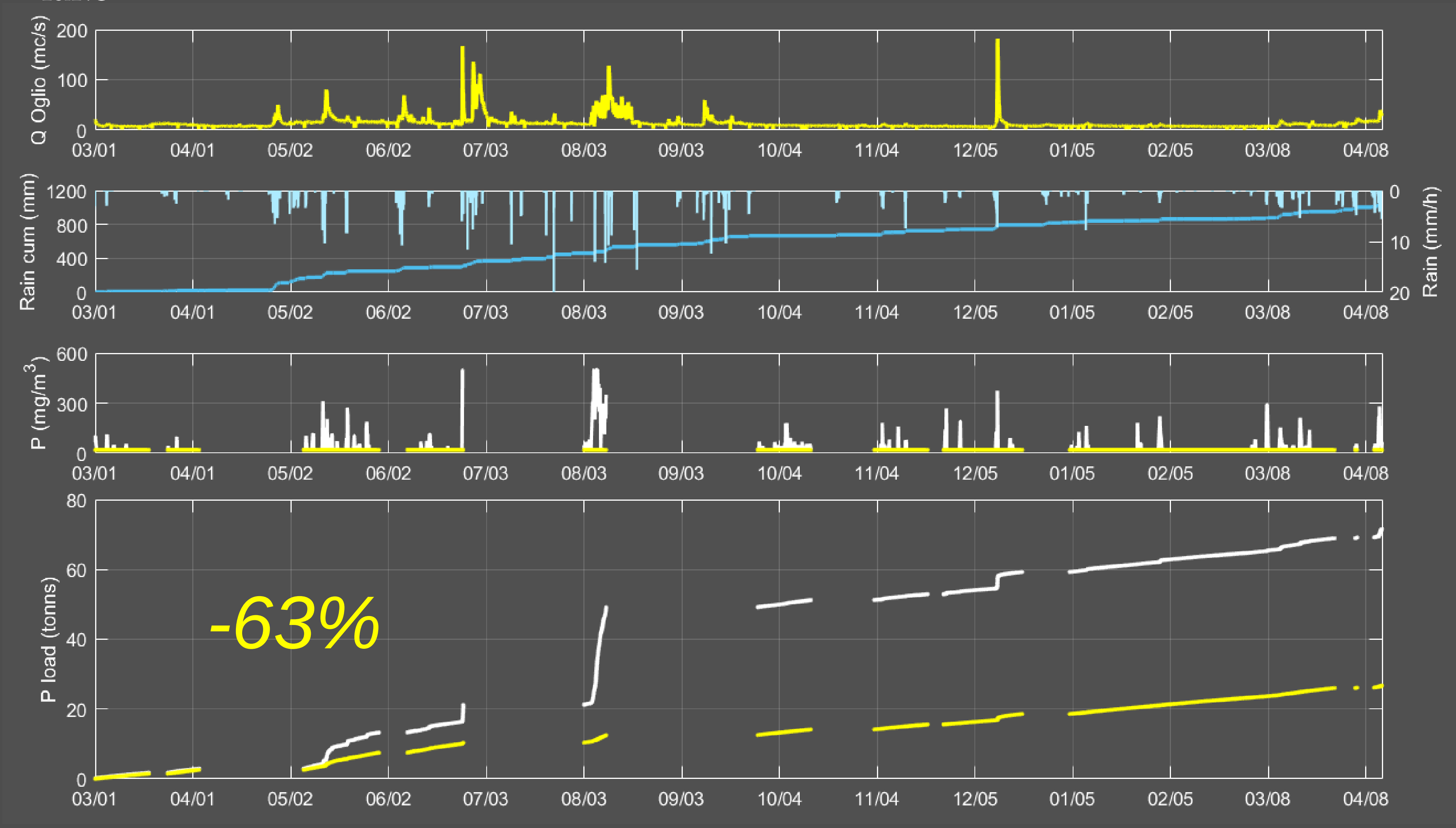
WP1 - Quantification of the P load from the tributaries

❖ Example of a flood events

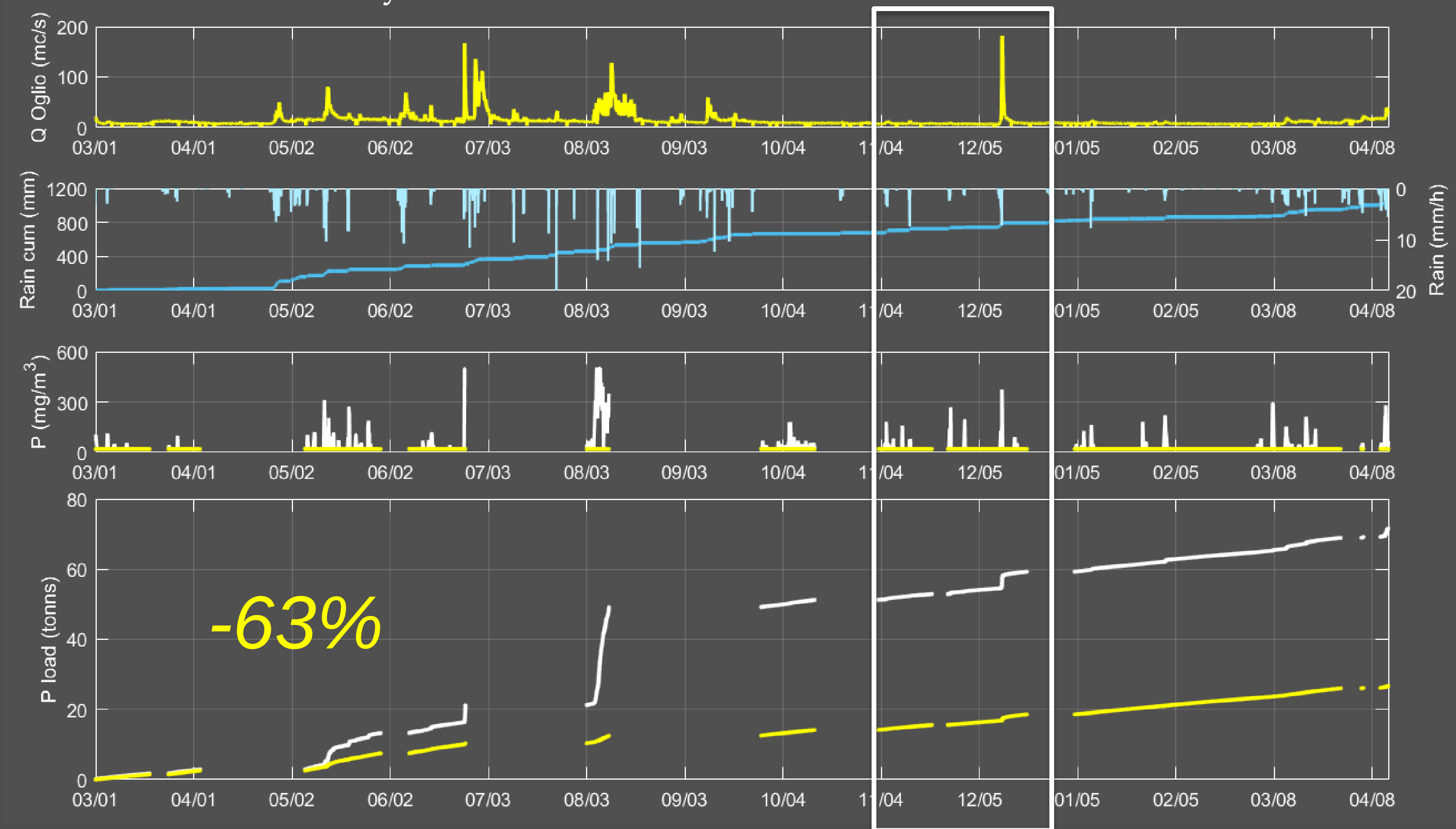


WP1 - Quantification of the P load from the tributaries

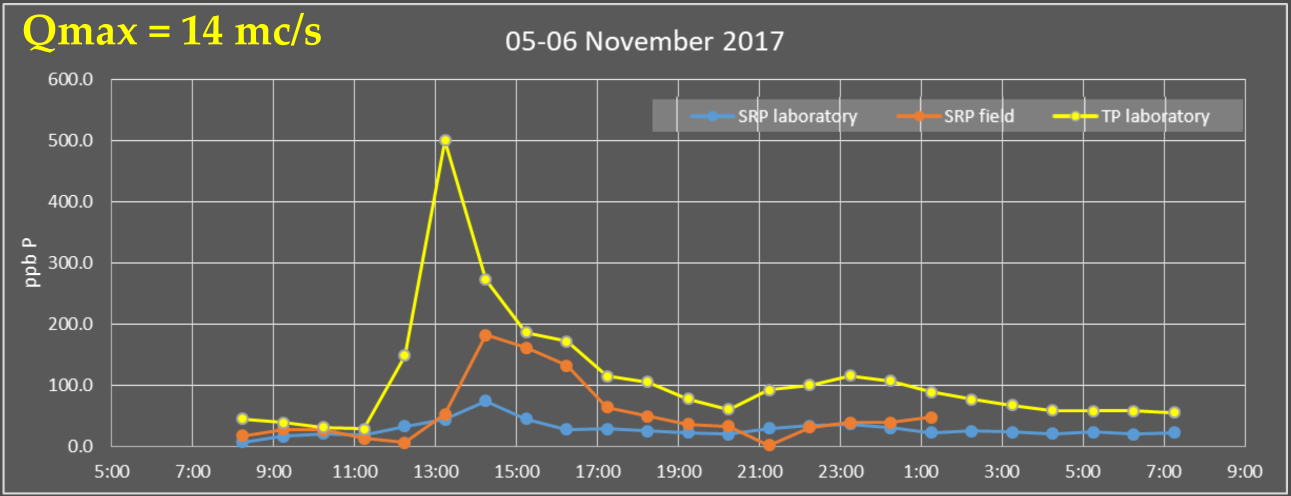
- Statistical analysis showing the impact of the rainy events on the overall load to the lake

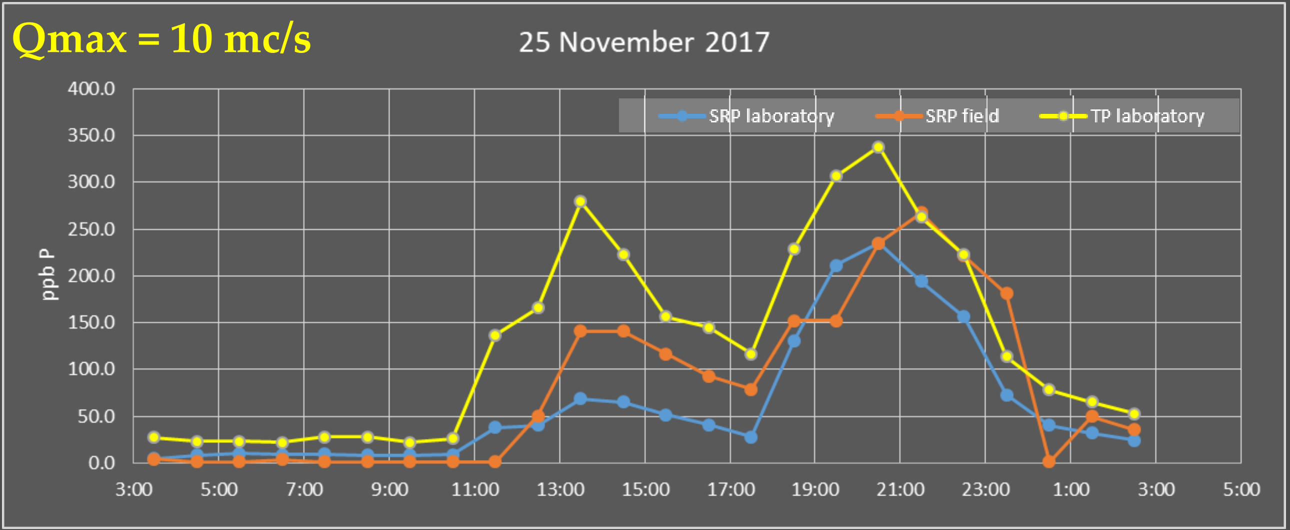


- Installation of an autosampler for cross-comparison of the measured data with the lab measurements by Parma

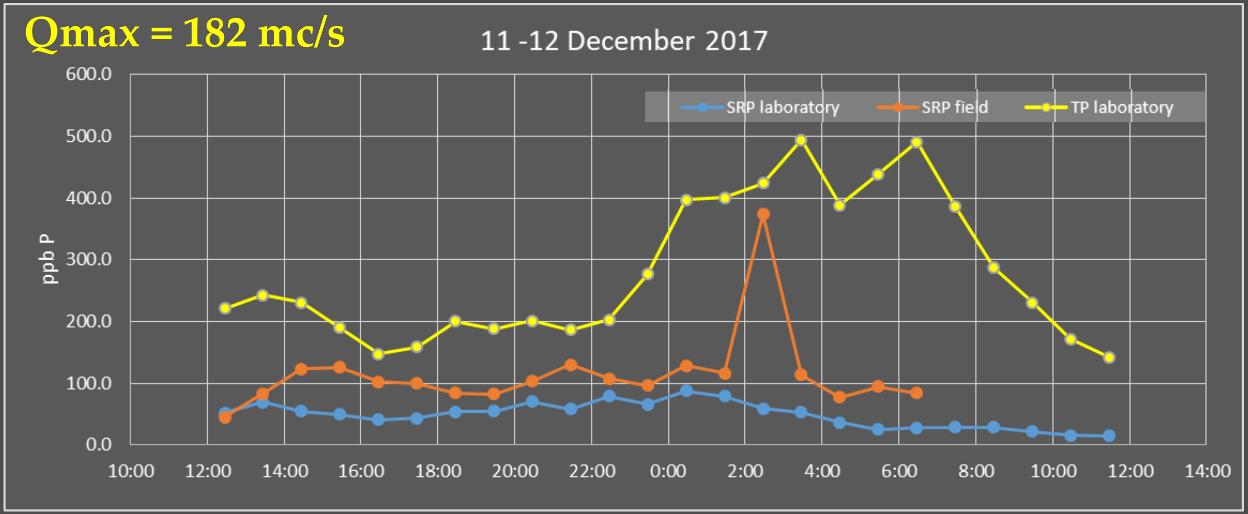


WP1 - Quantification of the P load from the tributaries





WP1 - Quantification of the P load from the tributaries



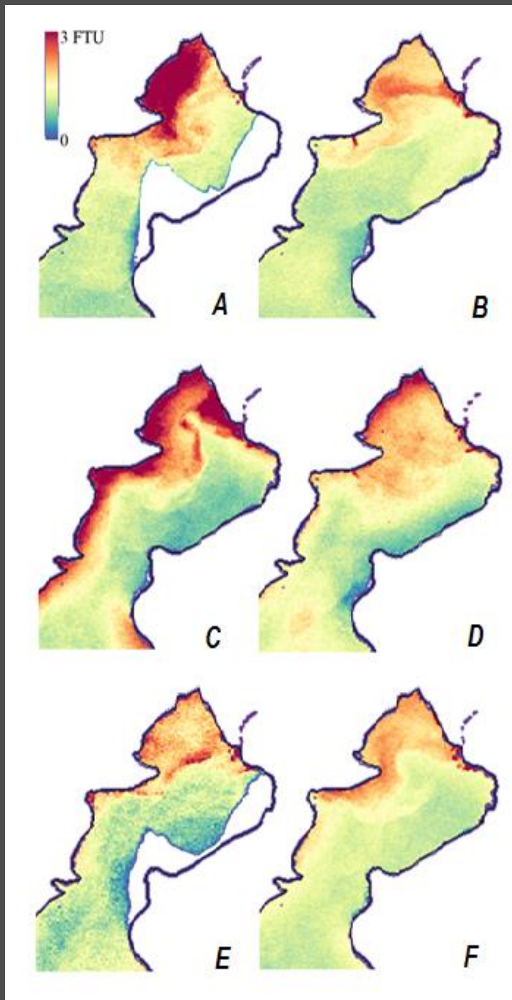
- Reasonable good estimation during rainy events not associated with high river discharges
- Load underestimation during floods due to high particulate P

What determines the conductivity variations in the river?

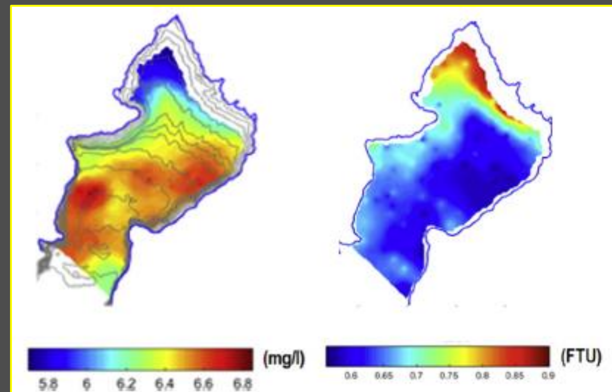
What about the contribution of the Canale? Next autumn at the same time in Canale and in Oglio river?

WP4 - Remote monitoring of the lake

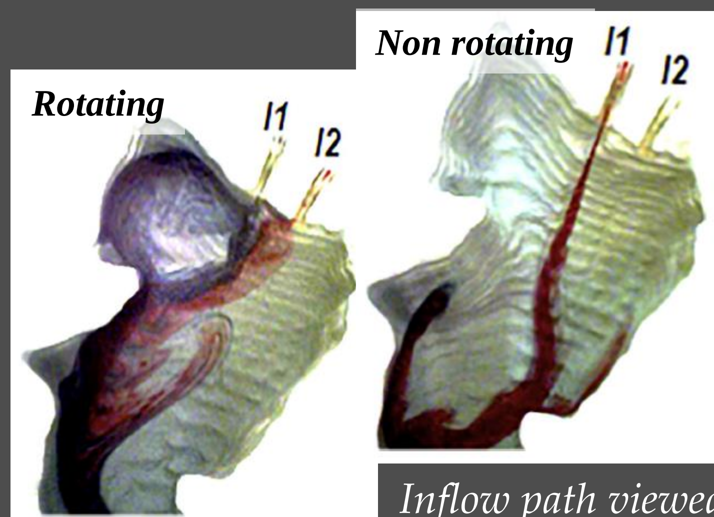
- ✓ In 2017: Identification of the inflow's path affected by the Earth's rotation



Turbidity data from satellite images



Results of a field campaign



Inflow path viewed in a physical model

Webcam images

WP4 - Remote monitoring of the lake

❖ Now published and confirmed by recent webcam images

ELSEVIER

Journal of Great Lakes Research
Volume 44, Issue 1, February 2018, Pages 14-25

Evidence from field measurements and satellite imaging of impact of Earth rotation on Lake Iseo chemistry

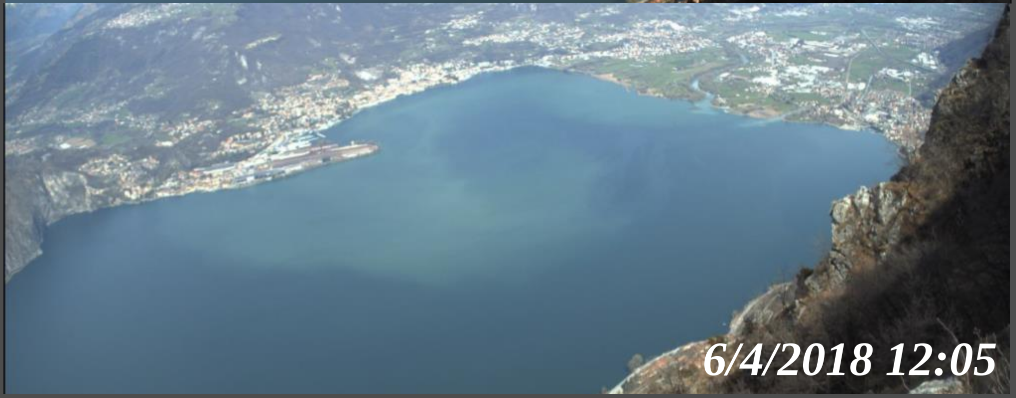
Marco Pilotti [a], Giulia Valerio [a], Claudia Giardino [b], Mariano Bresciani [b], Steven C. Chapra [c]

⊞ Show more

https://doi.org/10.1016/j.jglr.2017.10.005 Get rights and content

Abstract

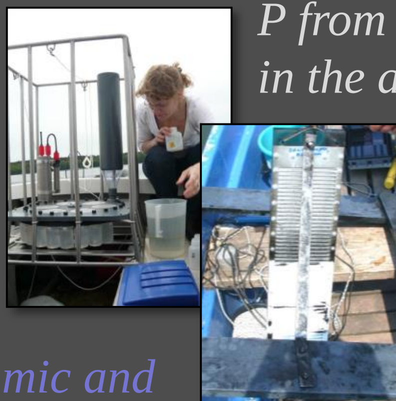
During an initial field survey in 2012, we observed an unexpected asymmetry of dissolved oxygen distribution between the western and eastern side in northern Lake Iseo. Motivated by this apparent anomaly, we conducted a detailed field investigation, and we used a physical model of the northern part of the lake to understand the influences that might affect the distribution of material in the northern section of the lake. These investigations suggested that the Earth's rotation has significant influence on the inflow of the lake's two main tributaries. In order to further crosscheck the validity of these results, we conducted a careful analysis at a synoptic scale using images acquired during thermally unstratified periods by Landsat-8 and Sentinel-2 satellites. We retrieved and post-processed a large set of images, providing conclusive evidence of the role exerted by the Earth's rotation on pollutant transport in Lake Iseo and of the greater environmental vulnerability of the north-west shore of this lake, where important settlements are located. Our study confirms the necessity for three-dimensional hydrodynamic models including Coriolis effect in order to effectively predict local impacts of inflows on nearshore water quality of medium-sized elongated lakes of similar scale to Lake Iseo.



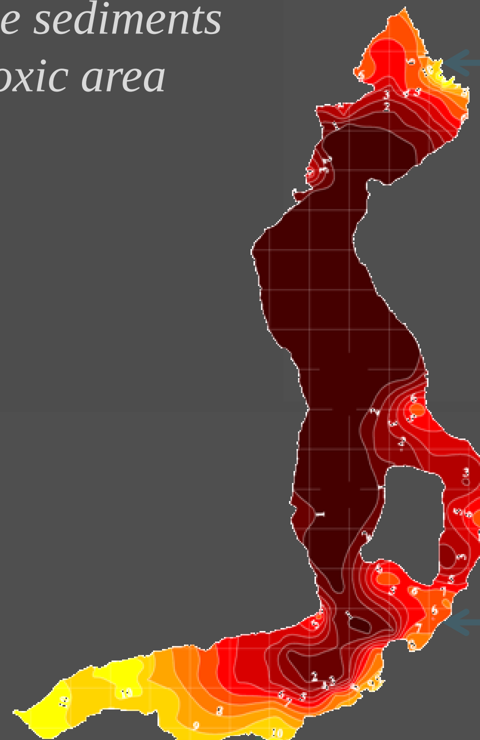
WP3 and WP6: Study of the impact of the lake's hydrodynamics and sediments' chemistry

What are the effects of the internal waves on the release of the P from the sediments in the monimolimnion?

P from the sediments in the anoxic area



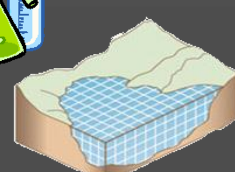
Hydrodynamic and ecological modeling



P from the main tributaries

P from the CSOWs

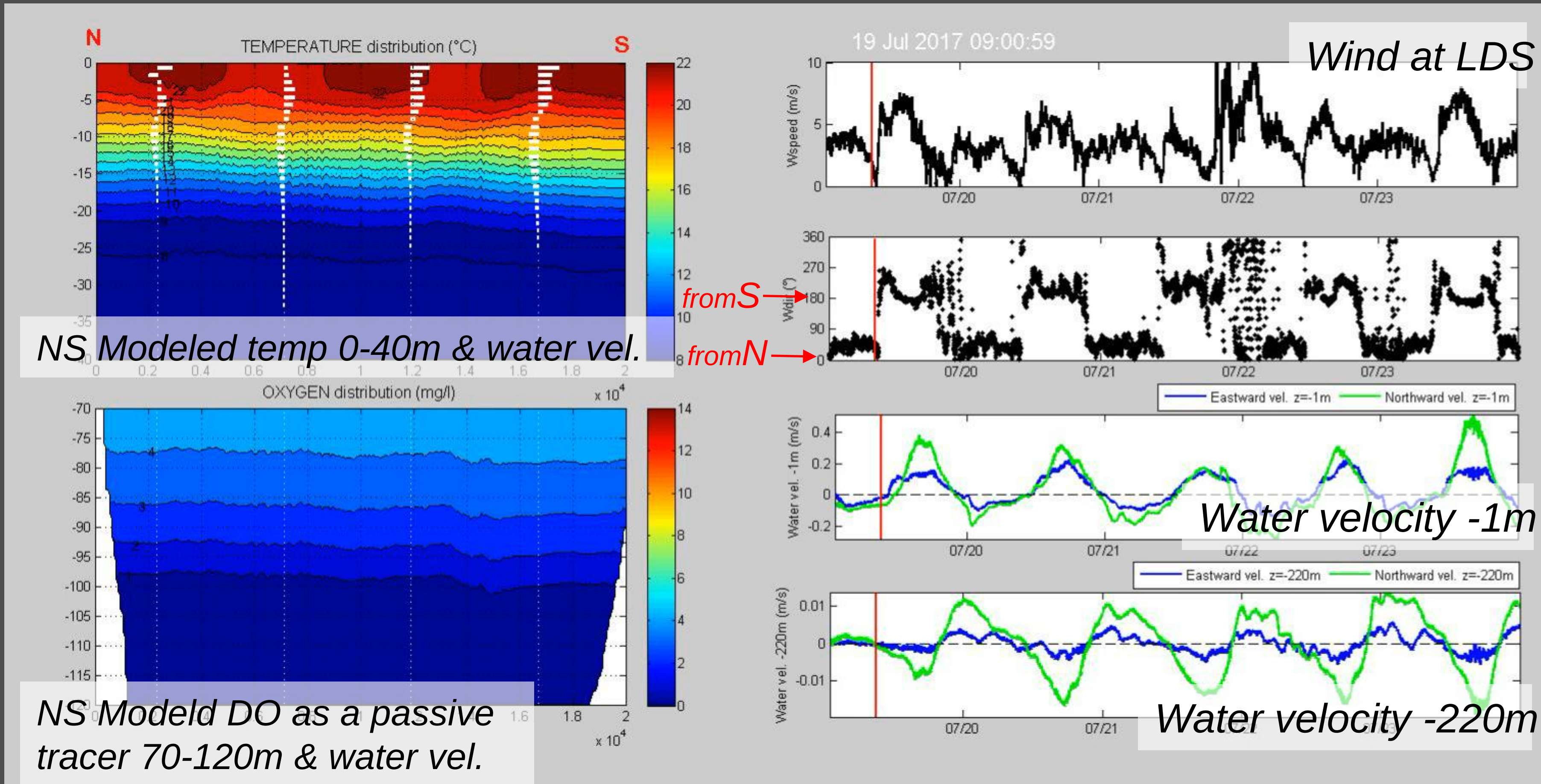
Role of the macrophytes in the shallower areas

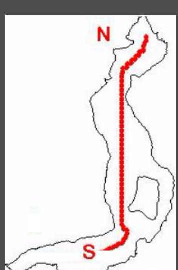


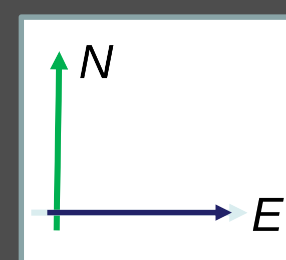
IGB Leibniz-Institute of Freshwater Ecology and Inland Fisheries

WP3 and WP6 – Internal waves study

see Valerio et al. 2012 L&O, Valerio et al. 2017 WRR

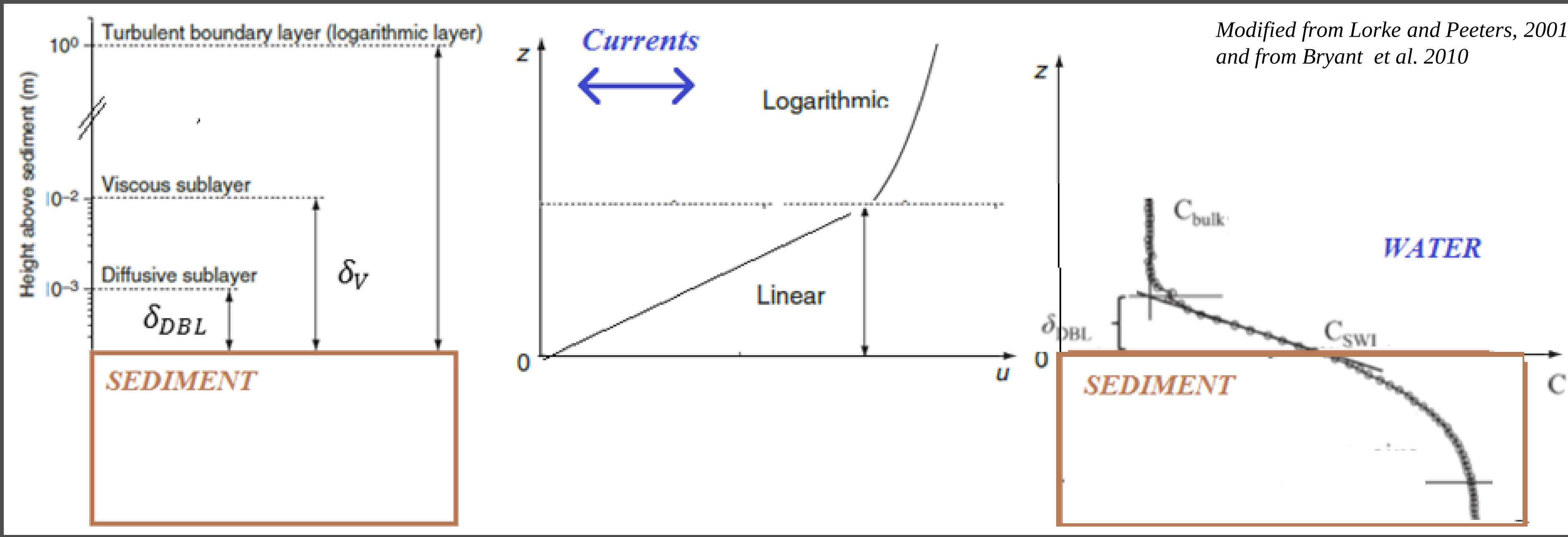






WP3 and WP6 – our hypotesis

- Internal waves induce temporal variations of the shear stress at the top of the bbl in the monimolimion



$$\delta_V \cong 8.6\upsilon/U^* = O(1cm)$$

$$\delta_{DBL} \cong Sc^{0.5}\,\delta_V = O(1mm)$$

$$Sc = \upsilon/D$$

$$F = D\frac{(C_{bulk} - C_{SWI})}{\delta_{DBL}} = k(C_{SWI} - C_{bulk})$$

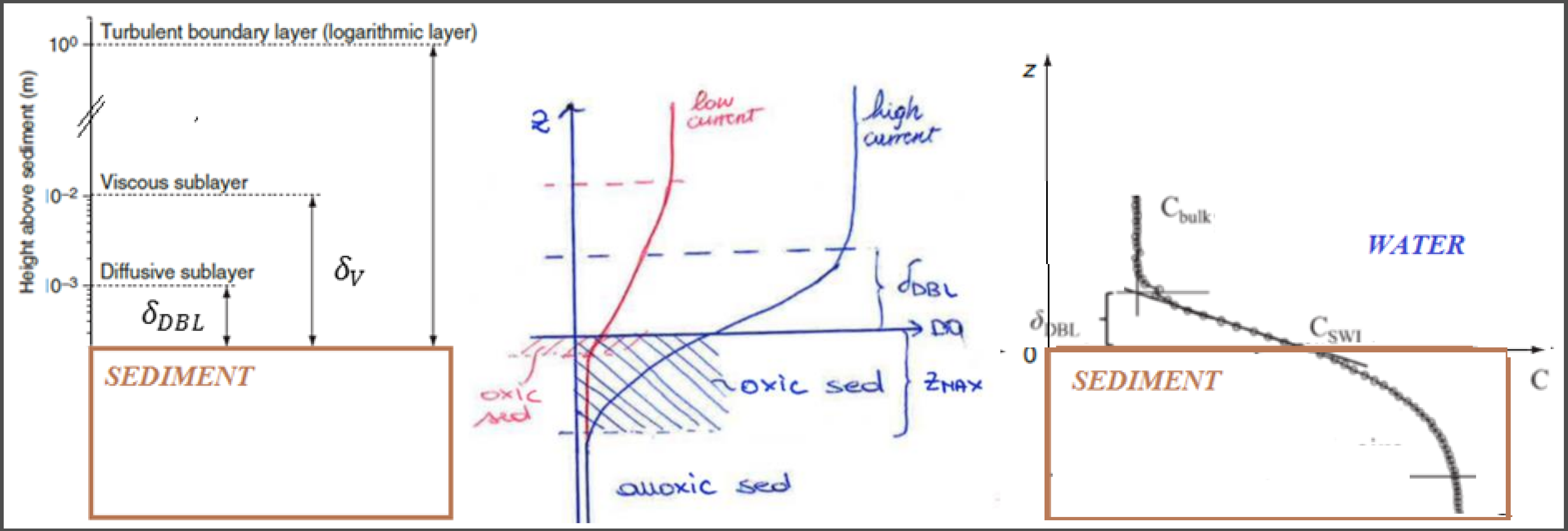
F=F(t)

$$\begin{cases} k = \dfrac{(\varepsilon\upsilon)^{0.25}}{2\pi} Sc^{-0.5} = \dfrac{1}{2\pi}\left(\dfrac{D^2}{\upsilon}\varepsilon\right)^{0.25} \\ \varepsilon = \varepsilon(\delta_V) \end{cases}$$

$$\begin{cases} \varepsilon(z) = \dfrac{U^*}{kz} \\ k = \dfrac{U^*}{9} Sc^{-0.5} = \dfrac{U^*}{9}\left(\dfrac{\upsilon}{D}\right)^{-0.5} \end{cases}$$

WP3 and WP6 – our hypotesis

❖ Internal waves induce temporal variations of the redox conditions across the oxycline



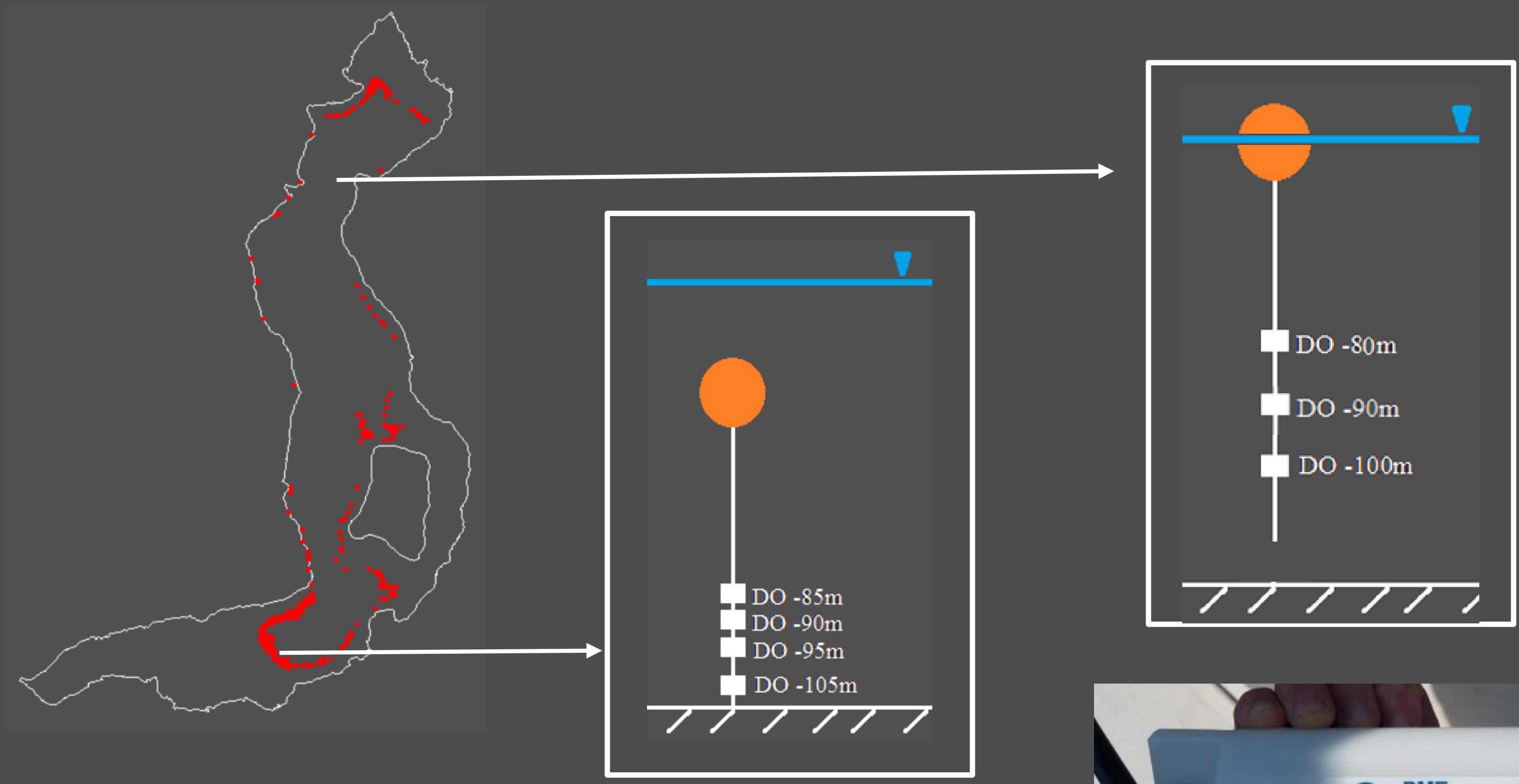
See e.g. Bryant et al. 2010 L&O
Hupfer et al. 2007 Aquat Microb Ecol

Fluctuating redox conditions could imply:

- *Oxic conditions: higher mineralisation of organic bound P and temporary fixation at FeOOH*
- *Anoxic conditions: strong release of P due to reductive dissolution of Fe(III)*

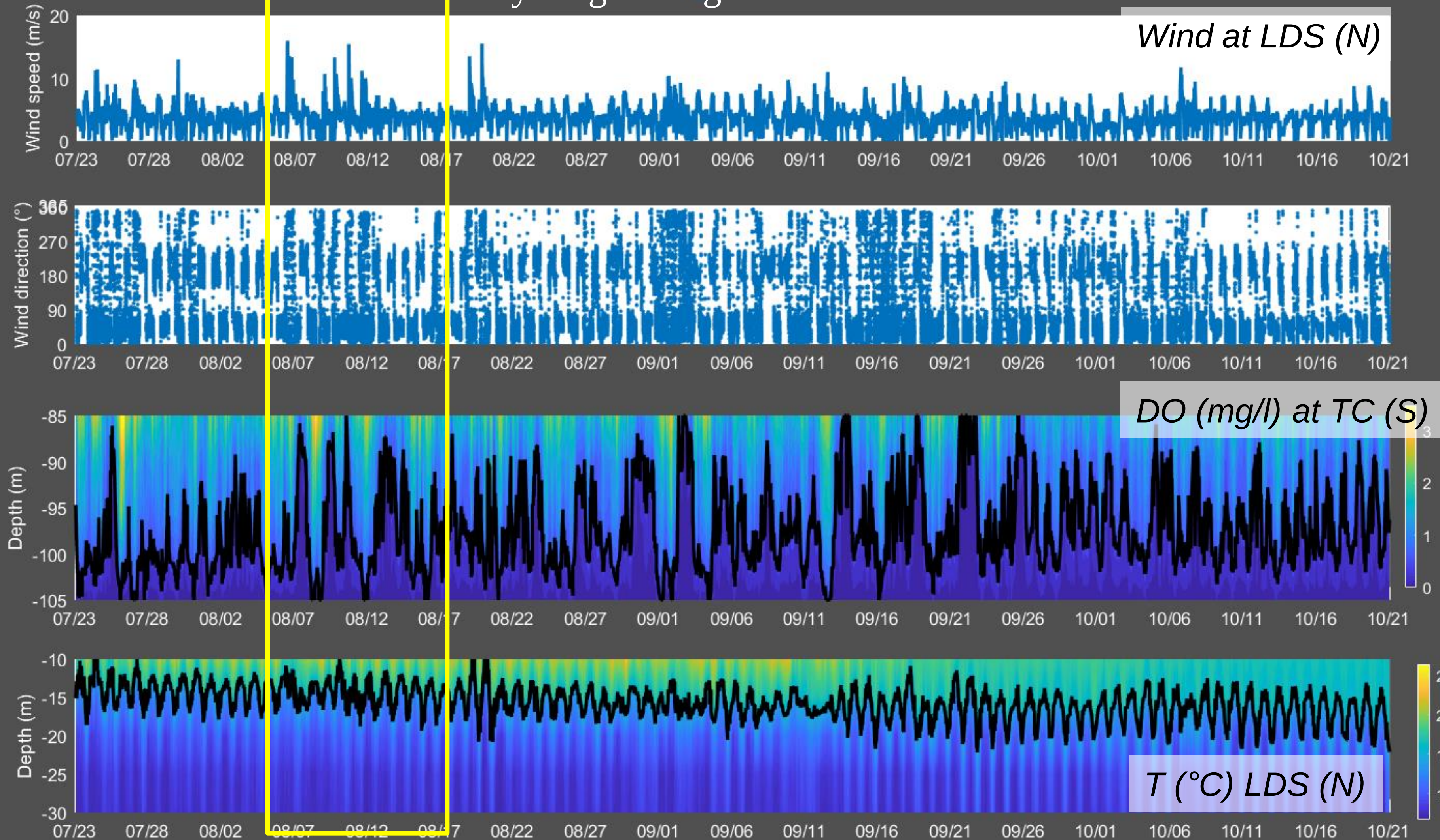
WP3 and WP6 – Field measurements

❖ Monitoring oxygen just above the sediments and at the same depths in the nothern chain

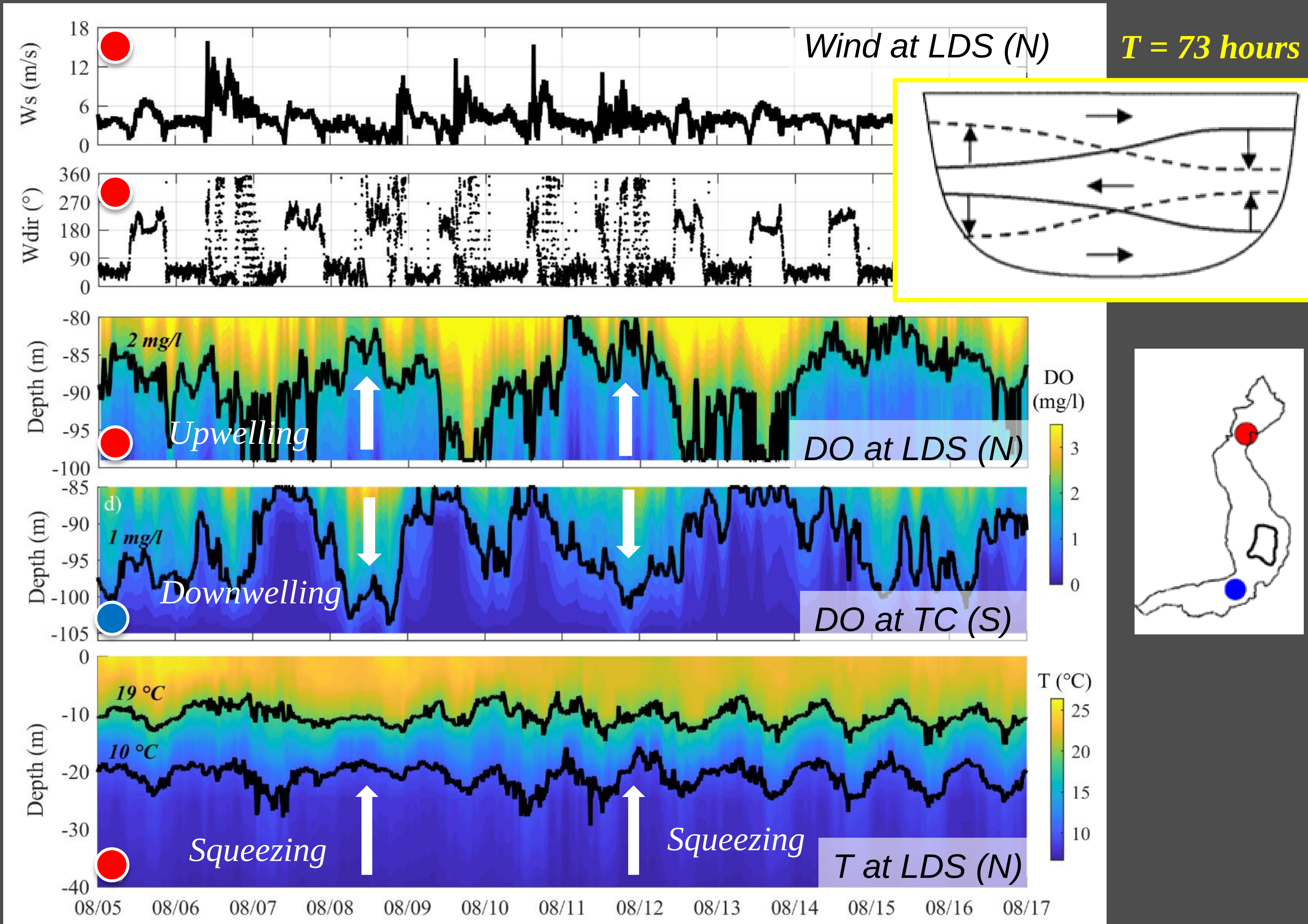


WP3 and WP6 – Measured oxygen dynamics at the lake bottom

❖ Strong temporal dynamics of the oxycline at -90m: Dominant V1H1 mode in resonance with the wind and occasional V2H1 by long-lasting wind

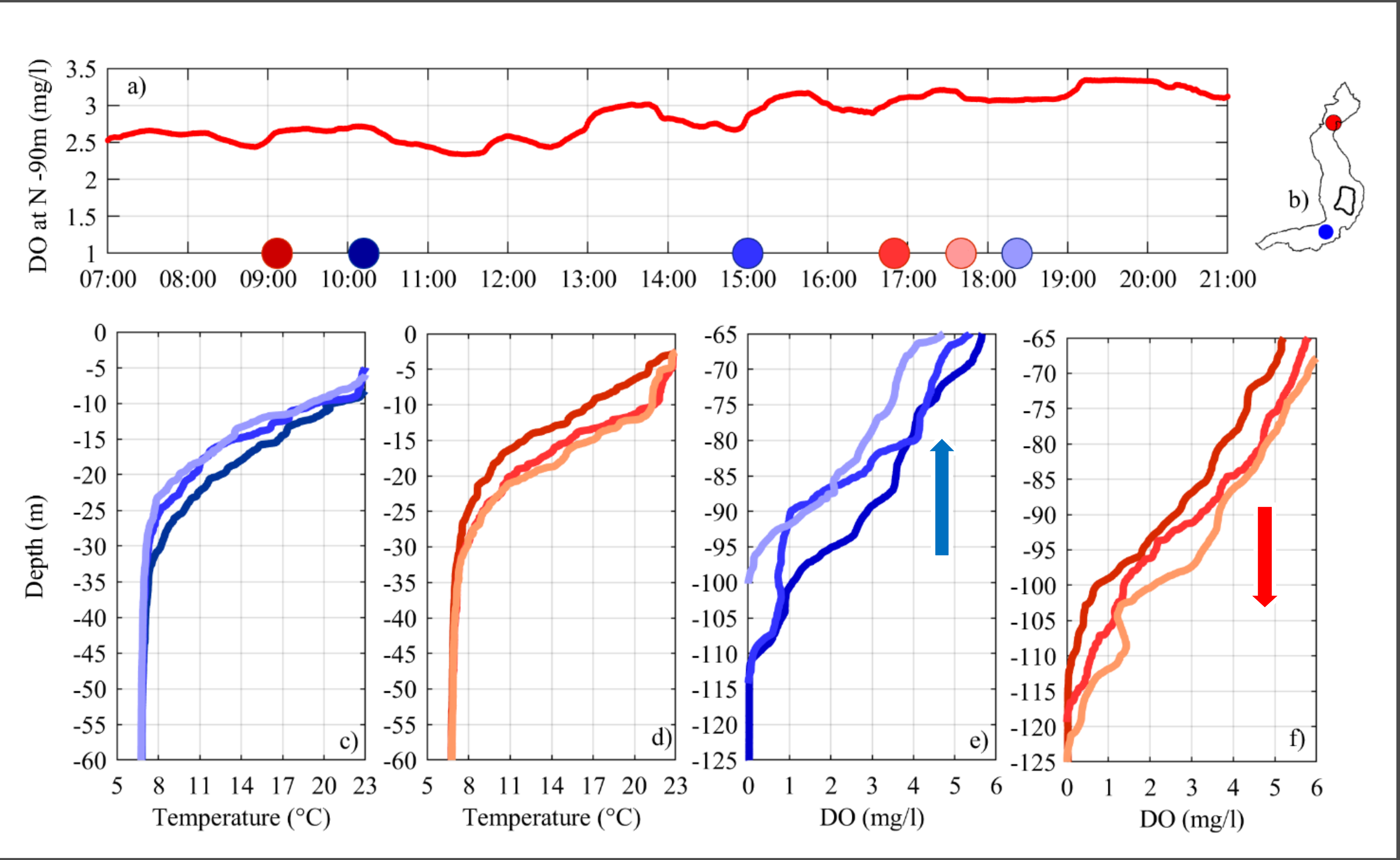


WP3 and WP6 – Measured oxygen dynamics at the lake bottom



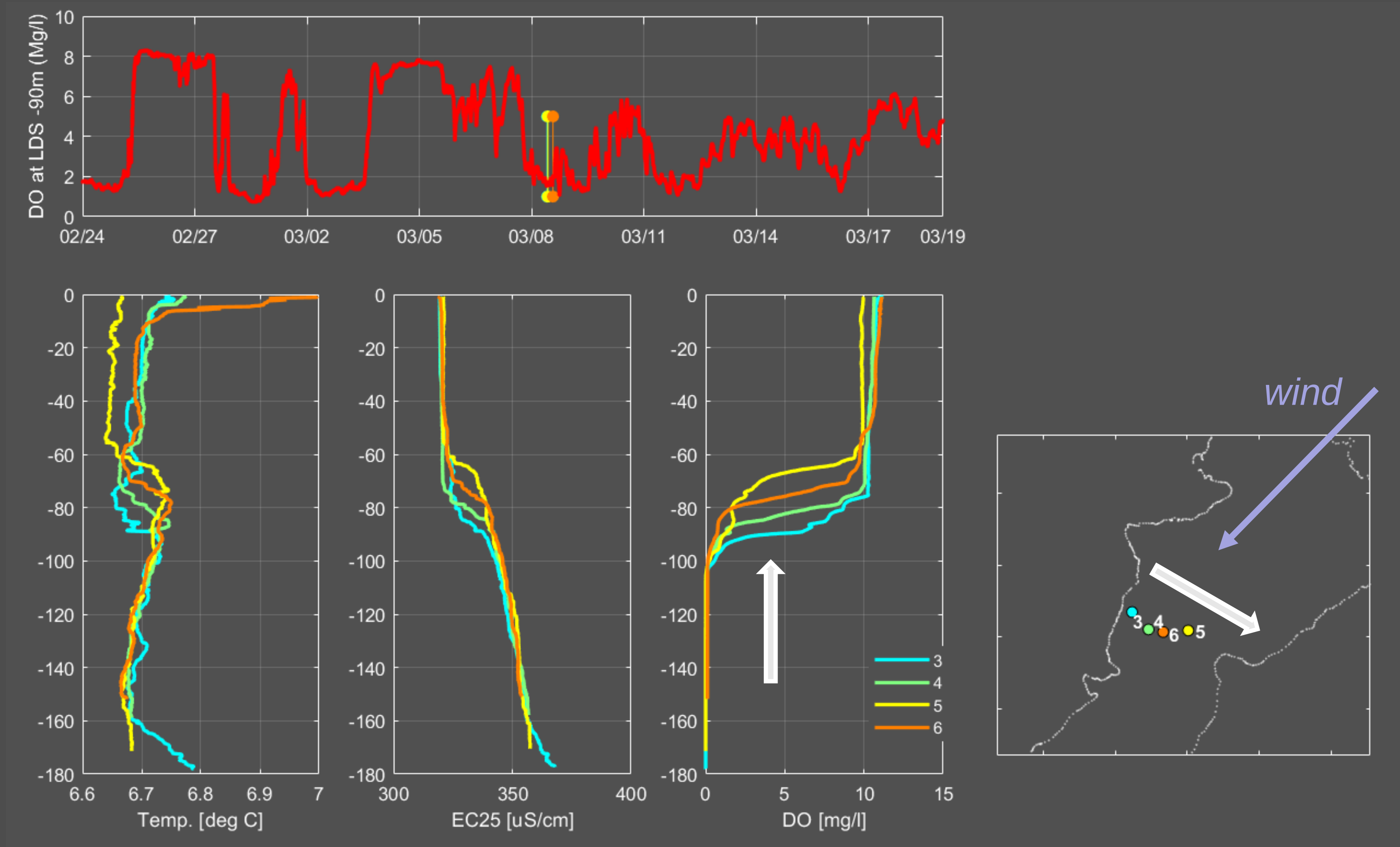
WP3 and WP6 – Measured oxygen dynamics at the lake bottom

❖ Confirmed NS gradient of the oxycline by the profiles (summertime)

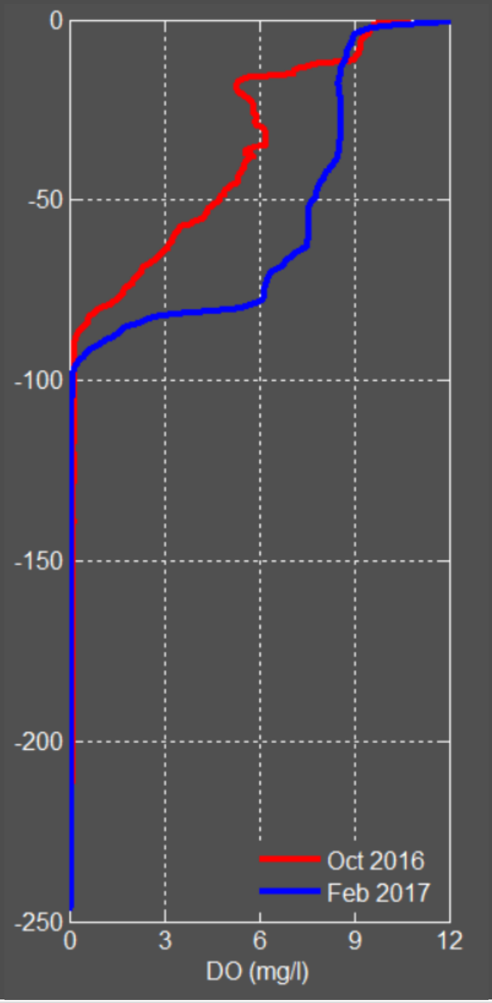


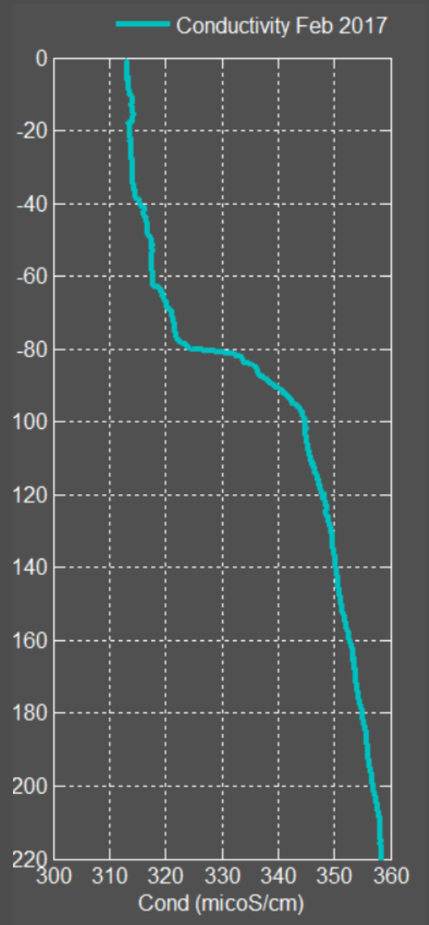
WP3 and WP6 – Measured oxygen dynamics at the lake bottom

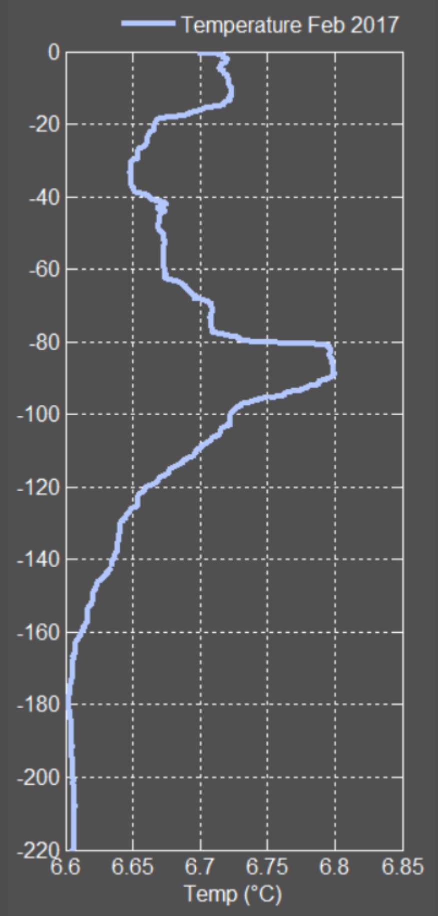
- Interesting EW gradient of the oxycline in northern part of the lake (wintertime)



- ✓ Winter sampling in 2017
  - interesting to follow the deoxygenation process after Feb 2017
  - mixing depth controlled by salts

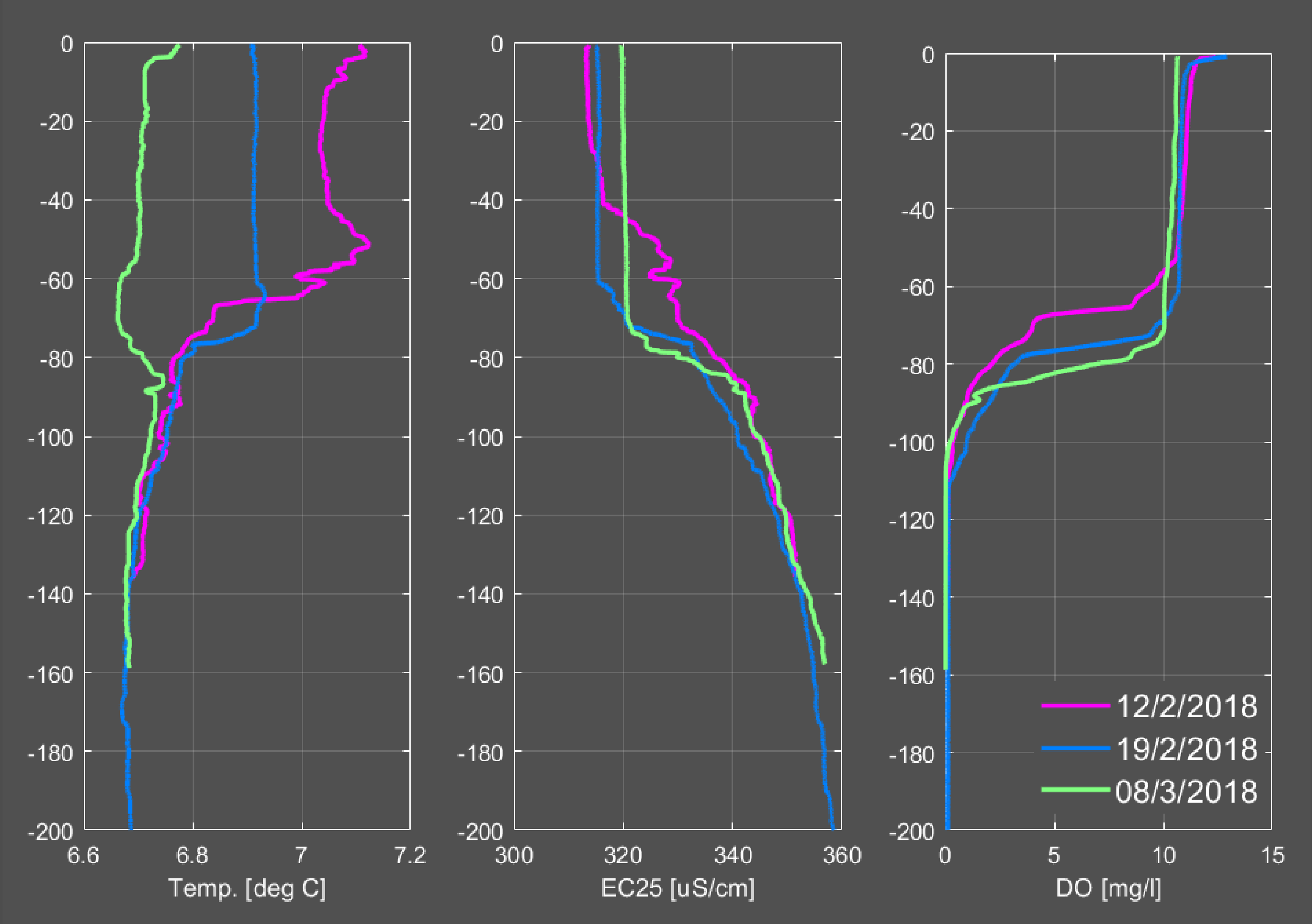






WP6 – Lake Modeling

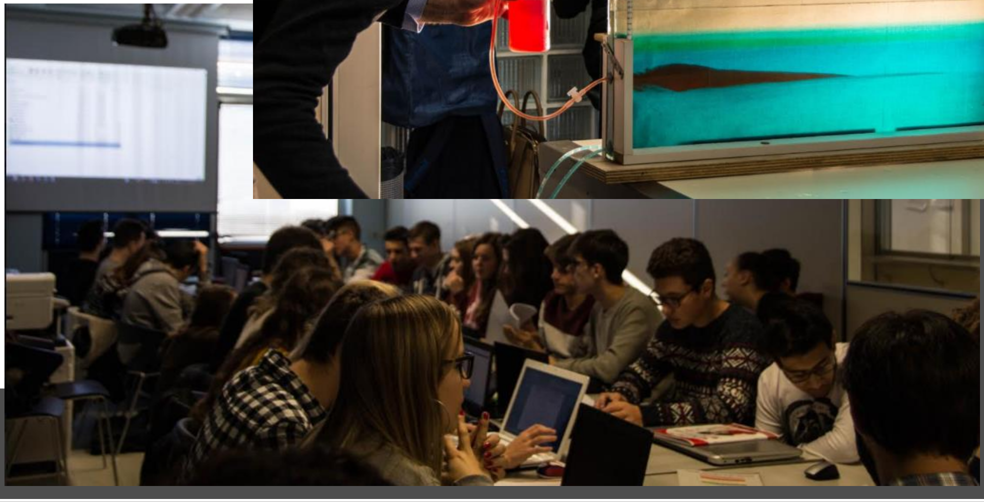
❖ Similar mixing behavior (< 80m)



Project dissemination: WP7

❖ Project “alternanza scuola-lavoro” in the High school ’I.I.S. “Antonietti”: 60 hours course for 2 classes, including seminars, physical experiments, numerical classworks and field activity.

- Seminario1: Introduzione al progetto e agli utilizzi delle risorse idriche
  - Presentazione Seminario_1
  - File .xls contentenete il questionario per il calcolo del consumo idrico diretto ed indiretto. Prima della compilazione si suggerisce consultare il file word con le istruzioni per la sua compilazione.
  - Esercizio per l’elaborazione dei dati relativi al consumo idrico: Esercizio1.1_xls
  - Articolo di National Geographic: Hidden_water
- Seminario2: esperimento di svuotamento di un serbatoio
  - Presentazione Seminario_2
  - File2.1 .xls per il calcolo della velocità di efflusso
  - File2.2 .xls per il calcolo del tempo di svuotamento
  - Filmato dello svuotamento (luce diametro 8mm ben raccordata)
- Seminario3: esperimento di ricambio dell’acqua di un serbatoio
  - Presentazione Seminario_3
  - File3.1 .xls per il calcolo del tempo di ricambio
  - Filmato dell’esperimento
- Seminario4: ruolo della stratificazione in un lago
  - Presentazione Seminario_4
- Seminario5: elementi di programmazione in Pascal
  - Presentazione Seminario 5
- Seminario6: il bilancio energetico di un lago
  - File6.1 .xls per l’analisi dei dati di temperatura
  - File6.2 .xls per il calcolo dell’evoluzione termica di un lago
  - Presentazione Seminario_6
  - Lettura in lingua inglese How to get heat from the bottom of a lake
- Seminario7: alcune dinamiche dell’ecosistema lago
  - File7.1 per la modellizzazione della crescita delle popolazioni
  - Presentazione Seminario7
  - Ascolto di filmati in lingua inglese relativi al problema dell’eutrofizzazione



Future opportunity for our group

"Traditional Projects" under the LIFE sub-programme for Environment

Indicative timetable for "Traditional Projects" under the LIFE sub-programme for Environment

Date or period	Activity
Mid April 2018	Call publication
Mid-June 2018	Deadline for applicants to submit concept notes to the Contracting Authority
October 2018	Notification to the applicants, shortlisted applicants invited to submit full proposal
January 2019	Deadline to submit full proposals
January 2018 to June 2019	Evaluation and revision of the proposals
July 2019	Signature of individual grant agreements
1 July 2019	Earliest possible starting date