Carbon-Based Proxies of Palaeoenvironmental Records in the Sediments of Two Lakes, the Plitvice Lakes, Croatia

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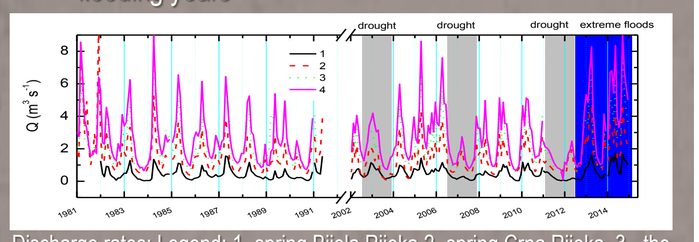
Introduction

1) **What** do we want to study?
How carbon-based proxies in carbonate and organic fractions of recent lake sediments (<100 years) reflect surrounding environment of karst lakes (the Plitvice Lakes) in order to apply the same proxies for further research of older sediments.

2) **Which** parameters do we observe?
- Carbonate and OM fraction
- Mineralogical composition and forms of the carbonate fraction
- C/N ratio in OM fraction
- ^{13}C composition in carbonate and OM
- ^{14}C composition in carbonate and OM

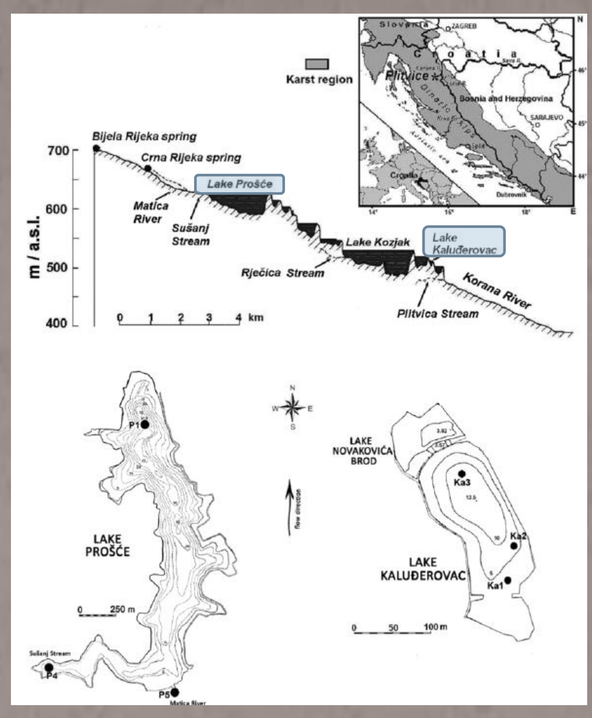
3) **Why** the Plitvice Lakes?
- Fast calcite precipitation and exchange of carbon pools in karst – open lakes
- Protected area isolated from the local human impact (agriculture, urbanization, traffic…)

4) **What** do we already know?
- Conditions of calcite precipitation
- Increase in lake water temperature in the last 30 years ~0.5°C/decade (Sironić et al. 2017)
- Extreme changes in water level – dry years and flooding years



Discharge rates; Legend: 1- spring Bijela Rijeka 2- spring Crna Rijeka, 3 - the river feeding the first L. Prošće, 4 - the outflow from the biggest Lake Kozjak

Position of the Plitvice Lakes, Croatia, with sampling locations

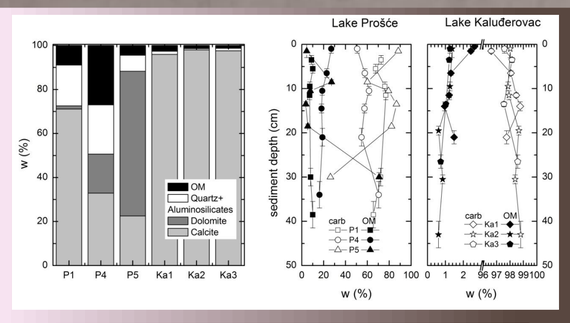


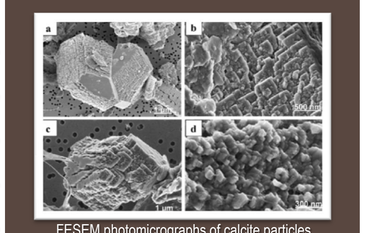
Morphologic characteristics of lakes Prošće and Kaluđerovac, 30-year mean and standard deviations for all measured physical and chemical parameter values of surface water in two lakes (Sironić et al., 2017), and characteristics of sediment sampling locations.

	Lake Prošće	Lake Kaluderovac
Lake area (km²)	0.68	0.02
Altitude (m asl)	636	505
Max water depth (m)	40	14
Temperature (°C)	10.9 ± 5.3	11.9 ± 6.5
pH	8.2	8.3
Conductivity (µS cm⁻¹)	409 ± 10	368 ± 8
$c(HCO_3^-)$ (mmol L⁻¹)	4.4 ± 0.1	3.9 ± 0.1
$c(Ca^{2+})$ (mmol L⁻¹)	1.6 ± 0.1	1.3 ± 0.1
$c(O_2)$ (mmol L⁻¹)	10 ± 1	10 ± 1
O_2 (%)	100 ± 10	100 ± 10

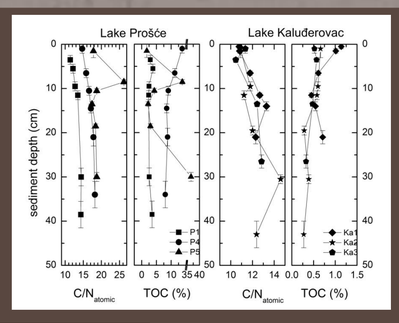
Sediment core	P1	P2	P3	Ka1	Ka2	Ka3
Water depth (m)	42	5	1	1.7	4.2	14.2
Description	The deepest part	Sušanj stream confluence	Matica River confluence	Begining of the Lake	Close to the shore	The deepest part
Core length (cm)	42	37	30	22	46	32

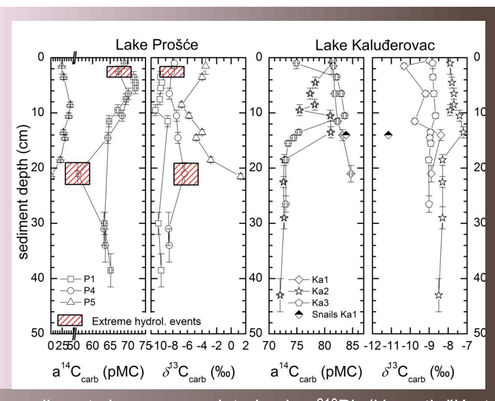
Results

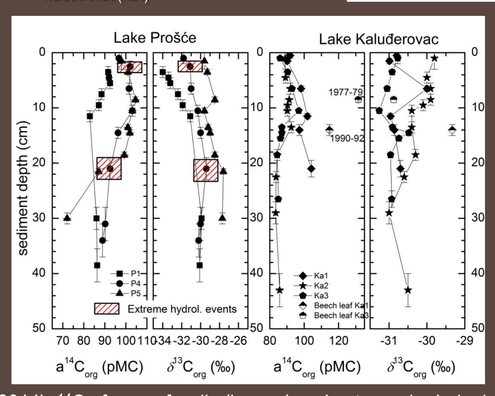




FESEM photomicrographs of calcite particles from: (a, b) Lake Prošće (P1) and (c, d) Lake Kaluđerovac (Ka1)



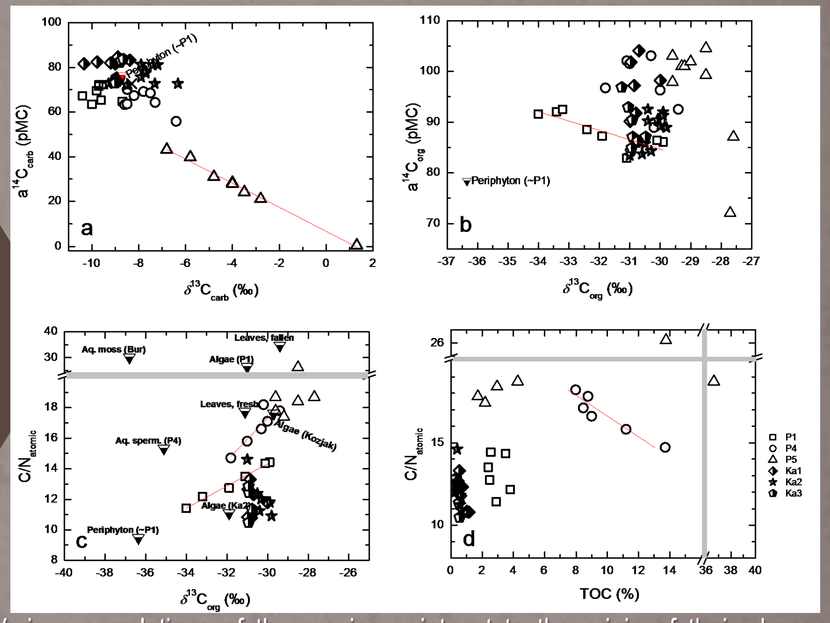




The mixing of alochotnous and terigenous fractions was found in the sediment on the river mouth (P5) and an increase of alochtonous component at deeper parts of the lakes (P1 and Ka3) regardless of the size of the lake.
The ^{14}C bomb peak can be identified in the cores with predominant alochtonous fraction (P1, P5, Ka3, Ka2).

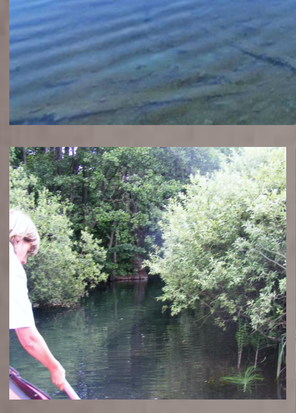
The sediments layers were dated using ^{210}Pb (Horvatinčić et al, 2014), ^{14}C of macrofossils (leaves) and extreme hydrological events

Discussion

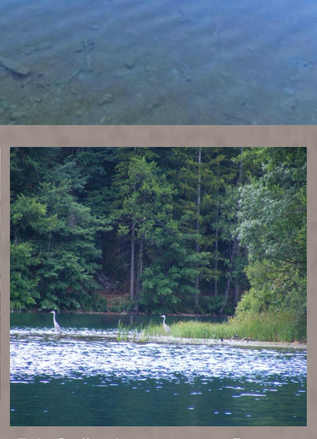


Various correlations of the proxies point out to the origin of their changes along the sediment core; the significant correlations are shown with red line pointing to the mixing of alochtonous and terrigenous material

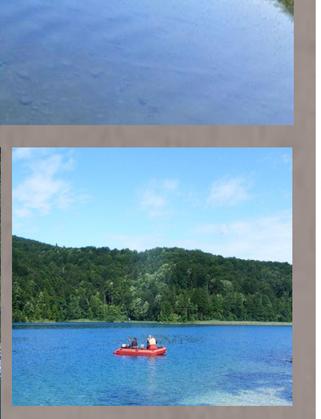
Comparison of the two lakes



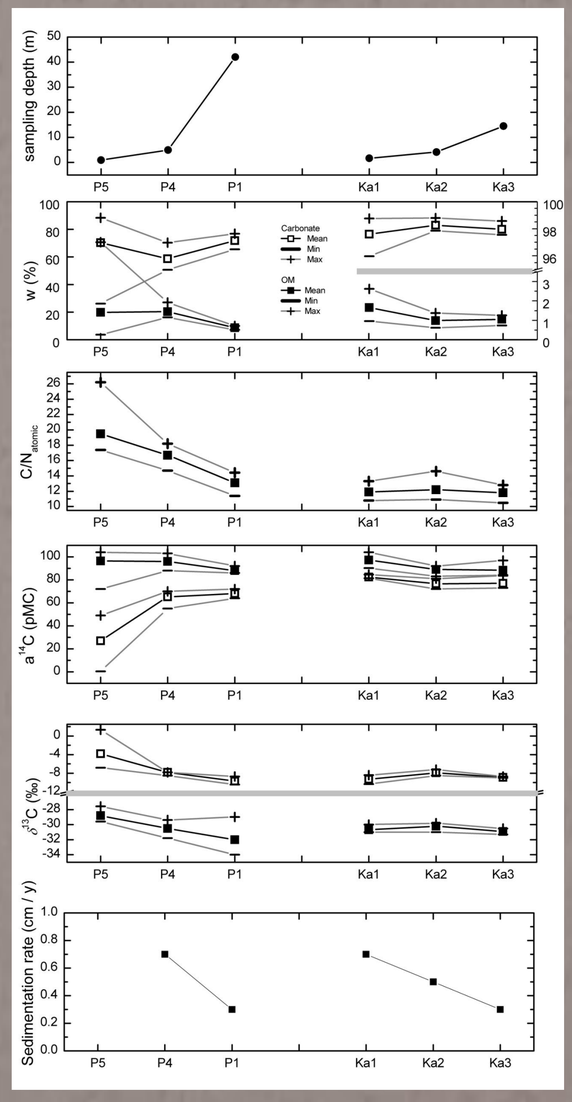
P5, the Matica River confluence (1 m)



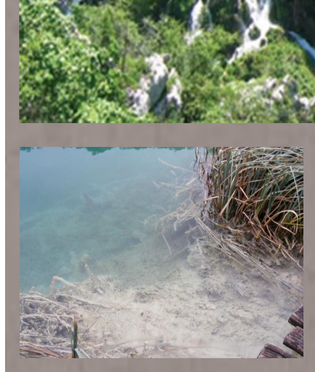
P4, Sušanj stream confluence (Liman bay) (5 m)



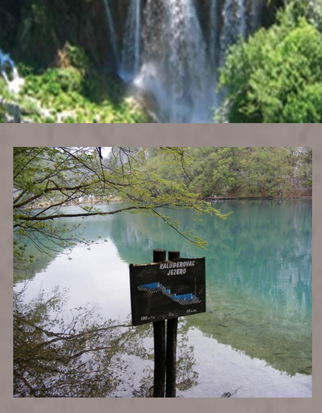
P1, the deepest part (42 m)



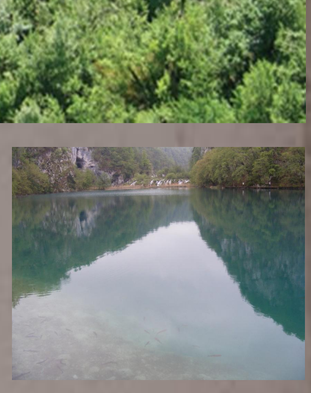
Differences in the two studied lakes through the summarized data



Ka1 (1.7 m)



Ka2 (4.2 m)



Ka3, the deepest part (14.2 m)

Some major conclusions:

➢The response of the lake sediment to the environmental conditions does not depend particularly on the size of the lake, but the surrounding environmental conditions could have great influence on the sediment conditions (type and density of the surrounding vegetation)

➢Extreme hydrological events can be associated with the disturbances in the sediments and confirmed by the carbon proxies

➢Increased bioproductivity in the recent decades was found in Lake Prošće, which can be correlated to the observed increase of the lake water temperature in the last 30 years

This work is presented in details in Horvatinčić et al., 2017.

References:

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