



Stable isotope composition of surface and deep waters from Plitvice Lakes



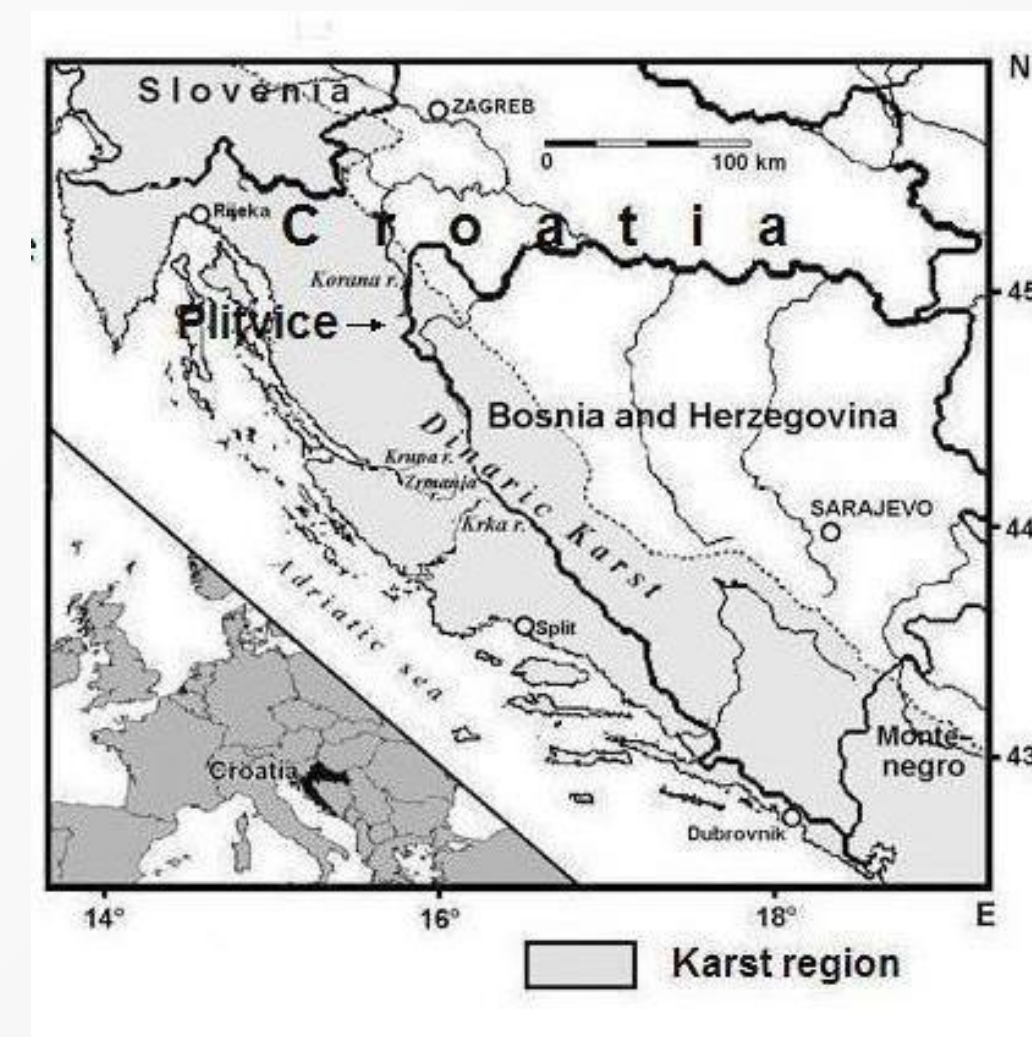
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INTRODUCTION

Various isotopic data for water, tufa, lake sediments and atmosphere were collected in the period from April 2011 to April 2014 in the area of National park Plitvice Lakes, Croatia. Here we present isotopic composition ($\delta^2\text{H}$ and $\delta^{18}\text{O}$) of surface and deep waters.

All surface and deep water samples measured at the JOANNEUM, Graz, Austria.

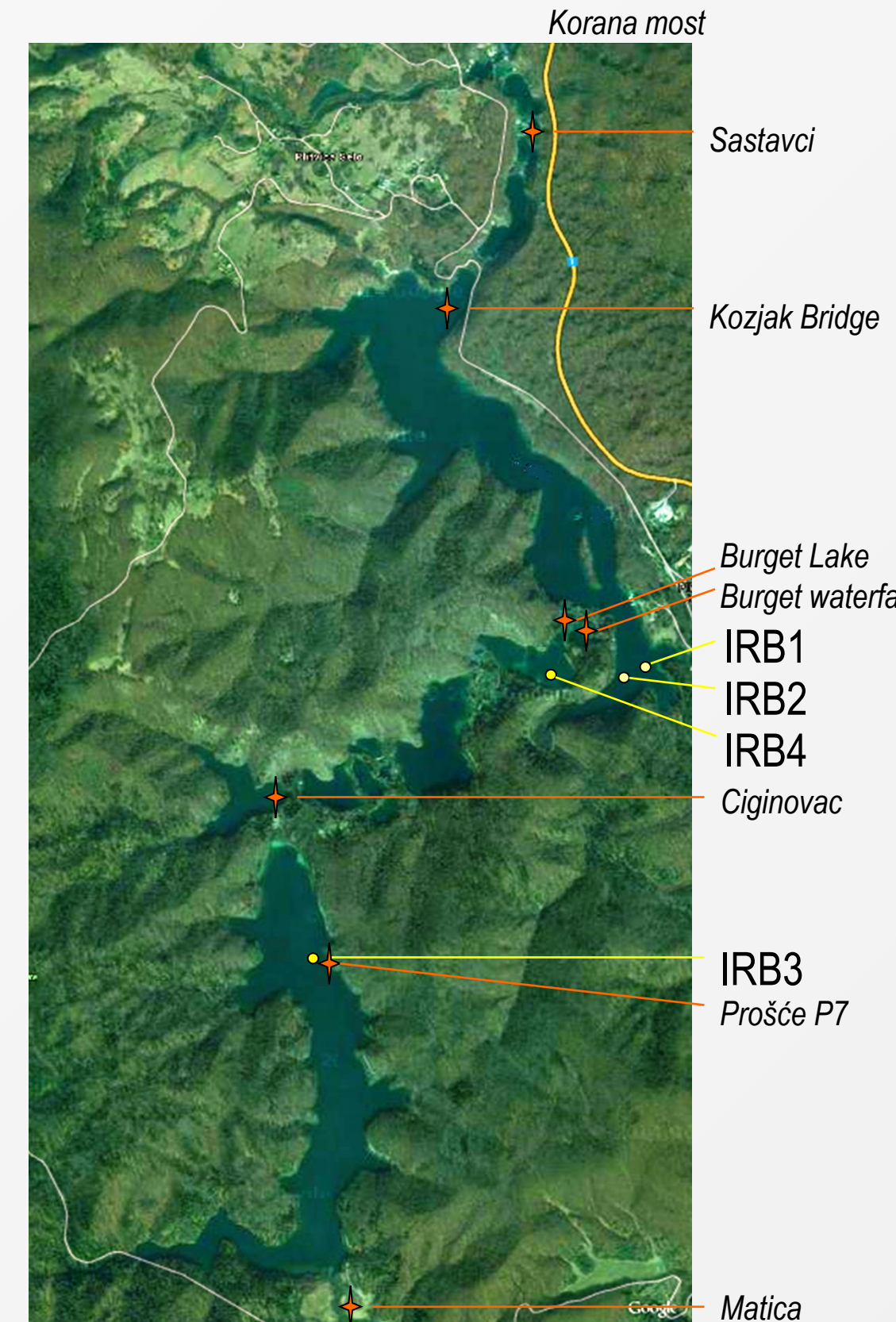


Map of Croatia

Sampling location.

Yellow – deep waters

Orange – surface waters



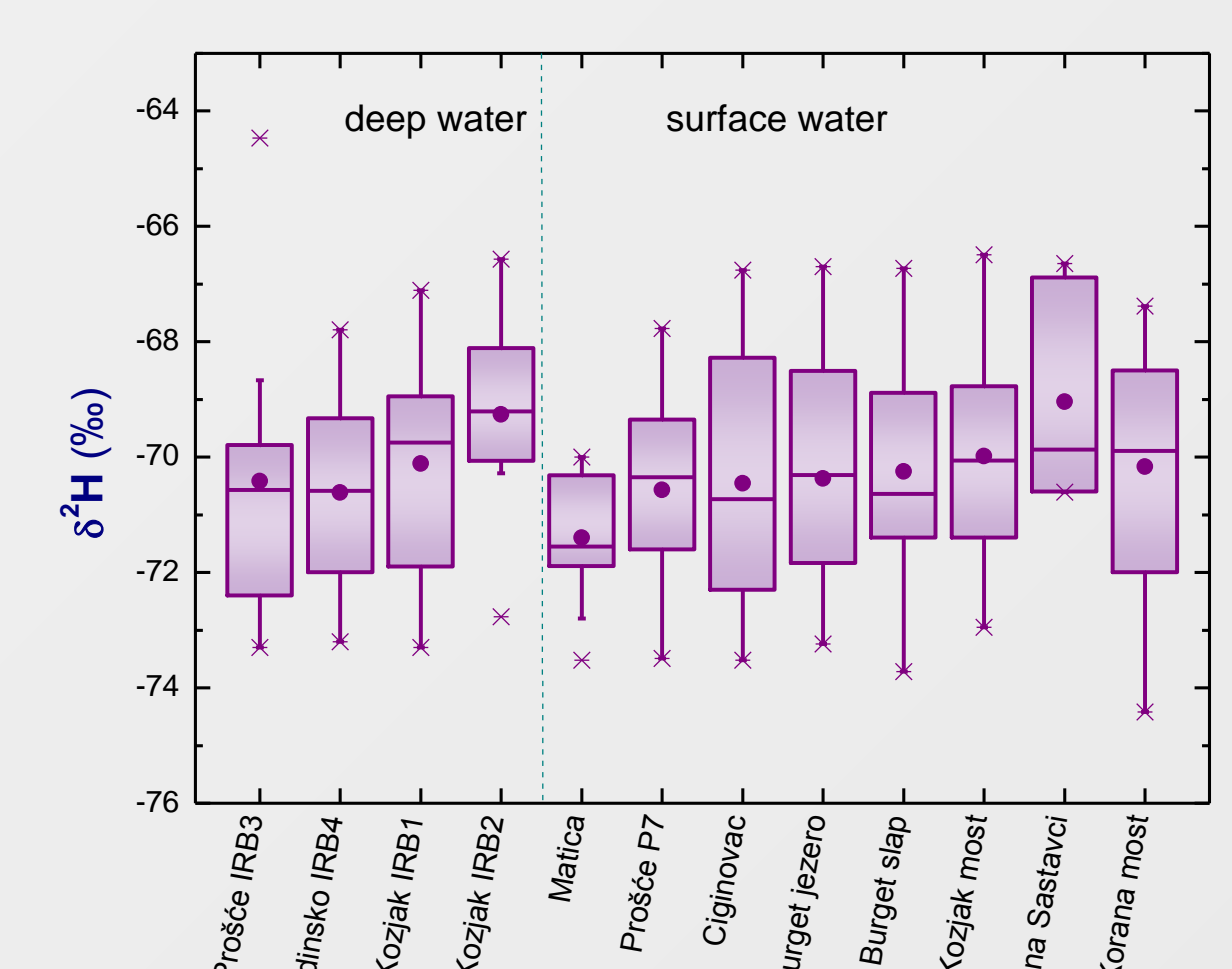
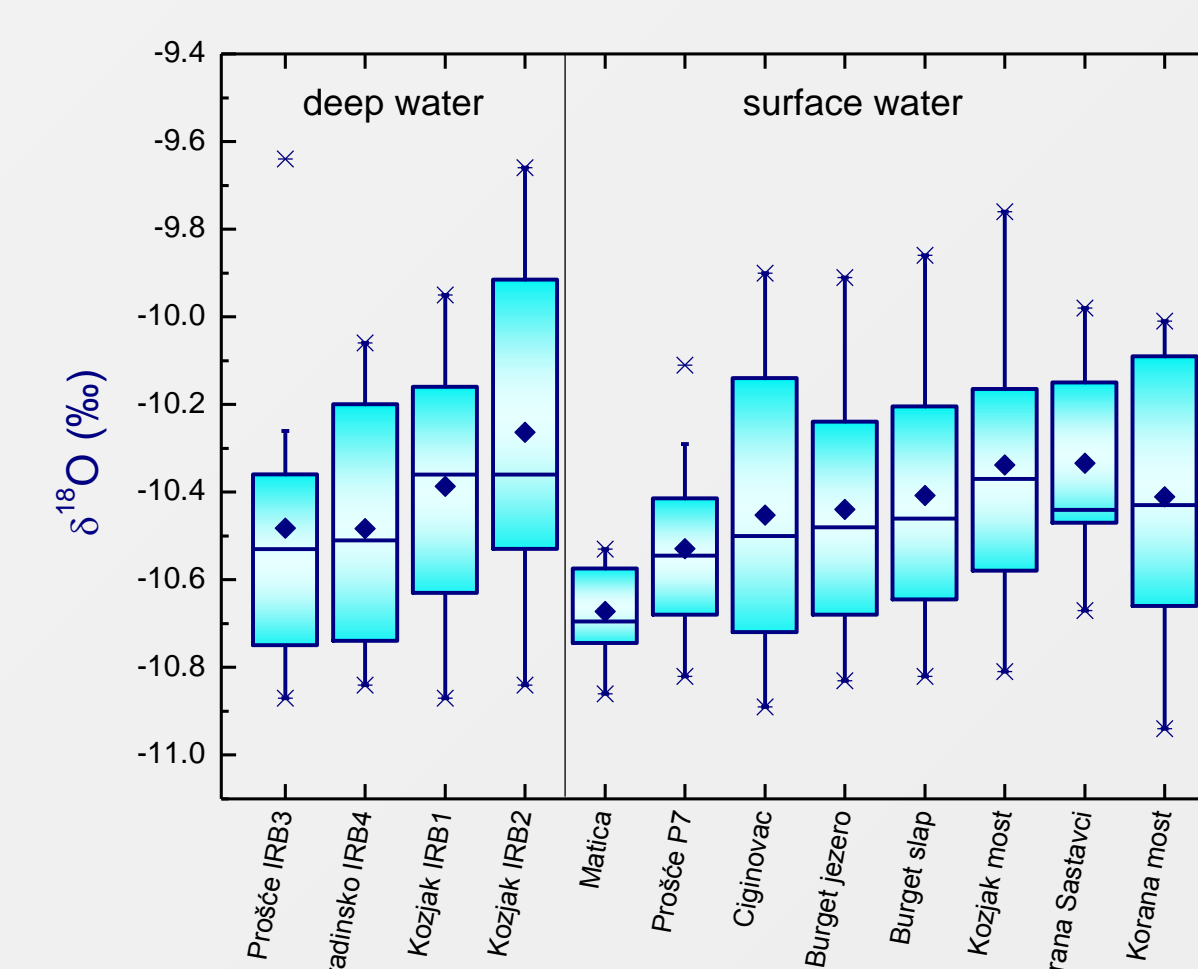
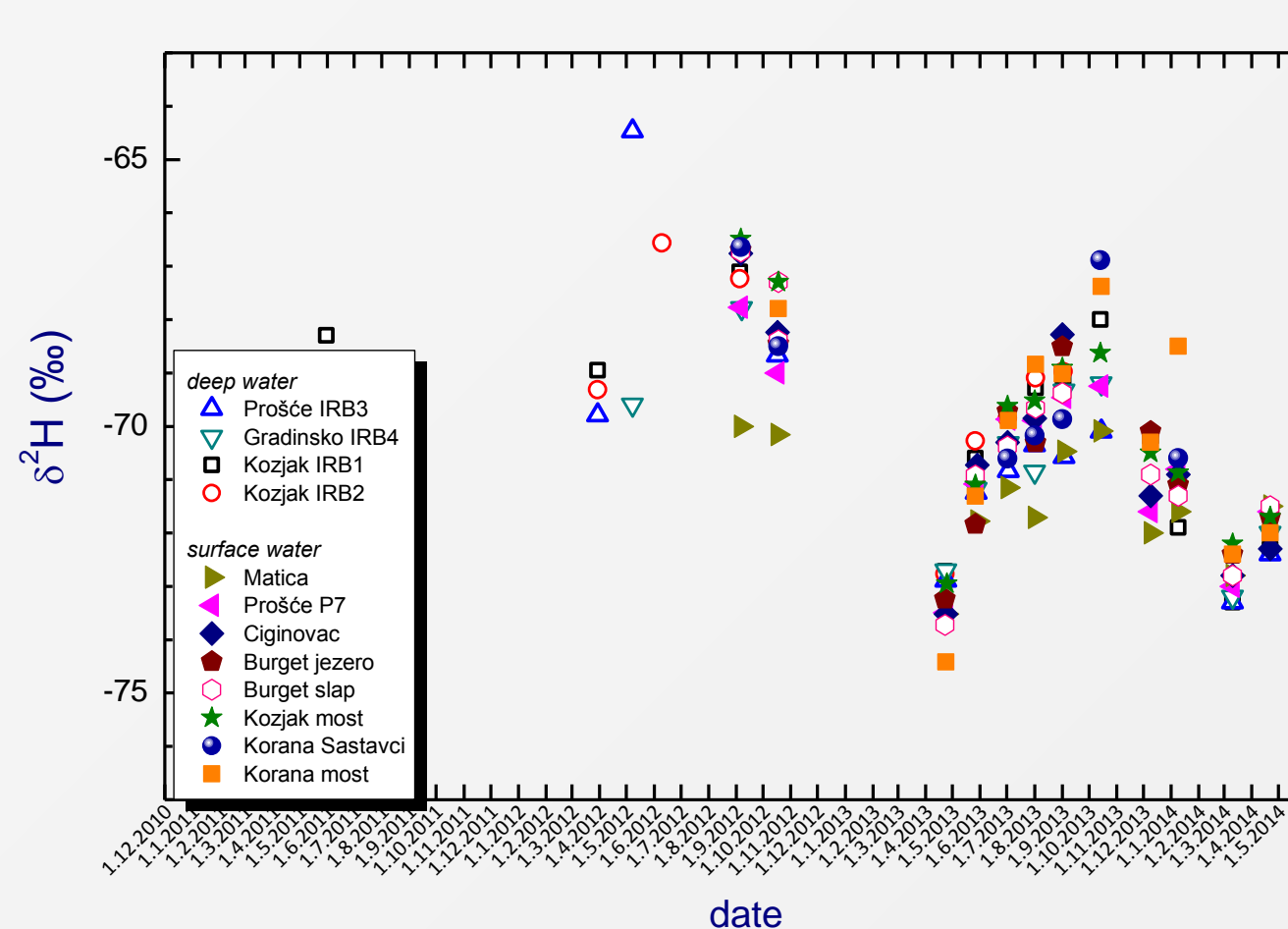
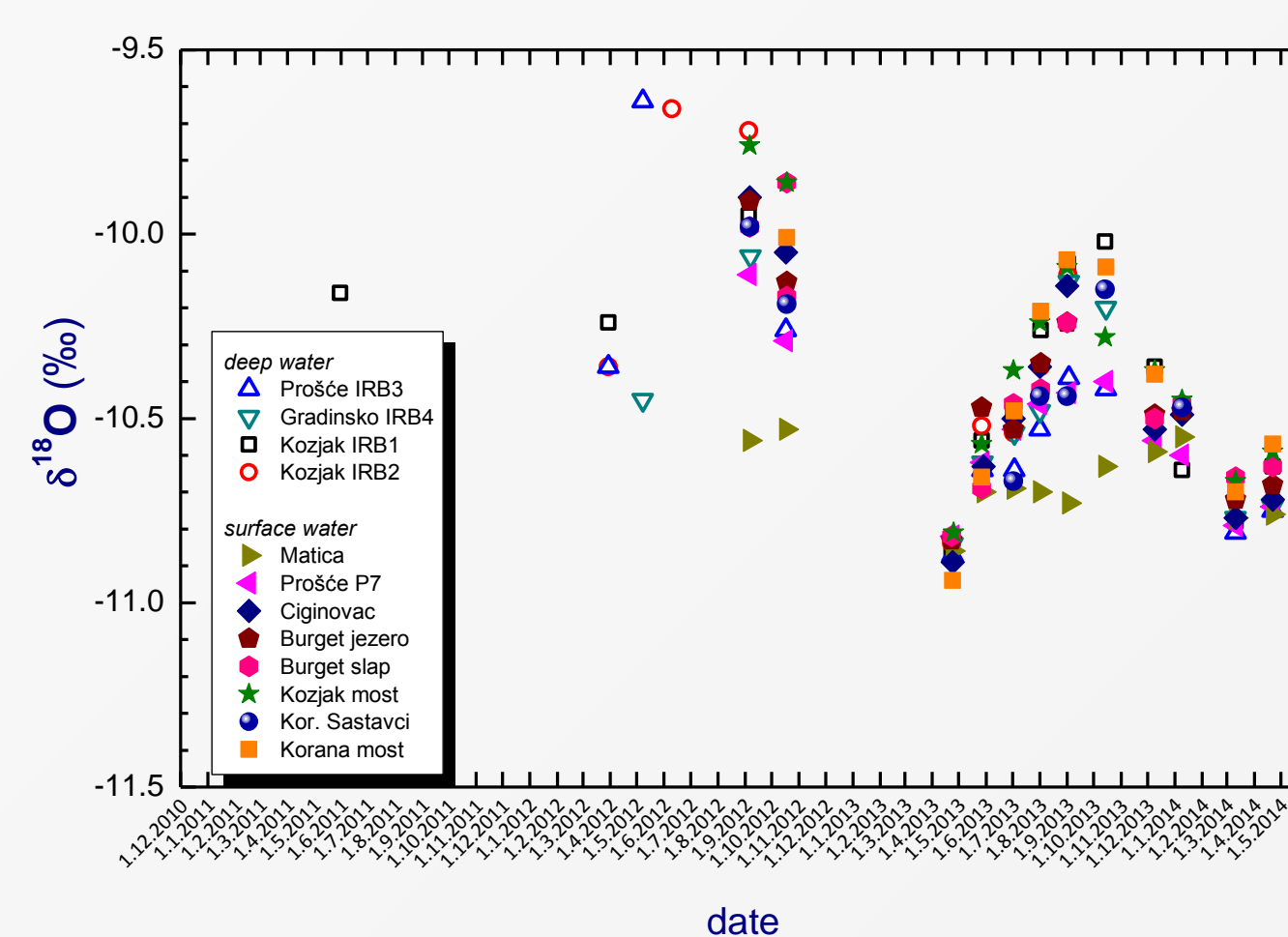
SAMPLING SITE

The study area was the Plitvice Lakes system of 16 lakes separated by tuffa barriers and interconnected by waterfalls.

Surface water was collected at 8 locations along the water course in length of ~10 km from Matica (the main stream feeding the lakes) to the Korana River (the outflow from the lake system).

Deep water was collected at 4 sediment traps in different lakes (IRB1 and IRB2 in Lake Kozjak at water depth 6 m and 8 – 10 m, respectively, IRB3 in Lake Prošće at 6 m, IRB4 in Gradinsko Lake at 2 m).

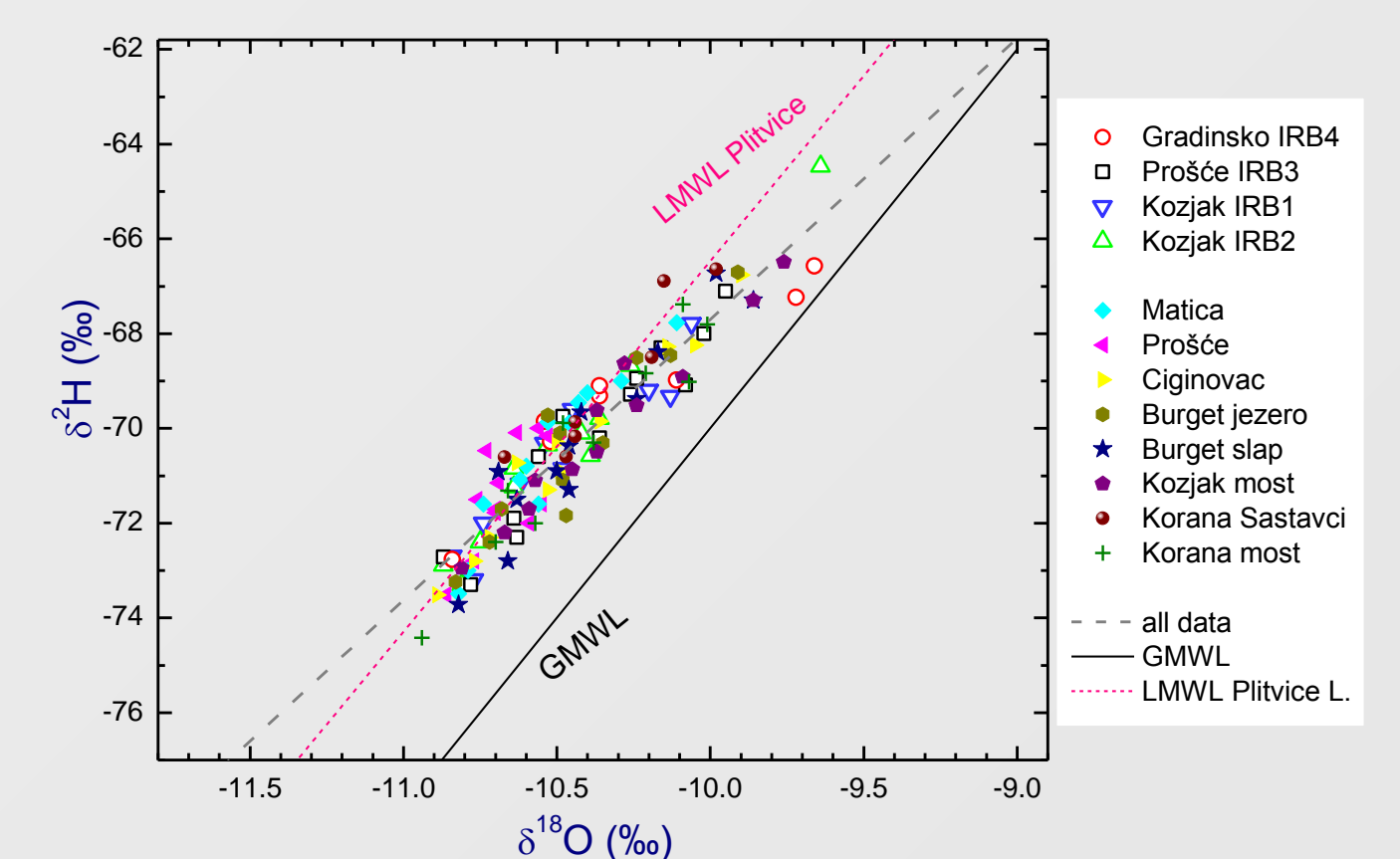
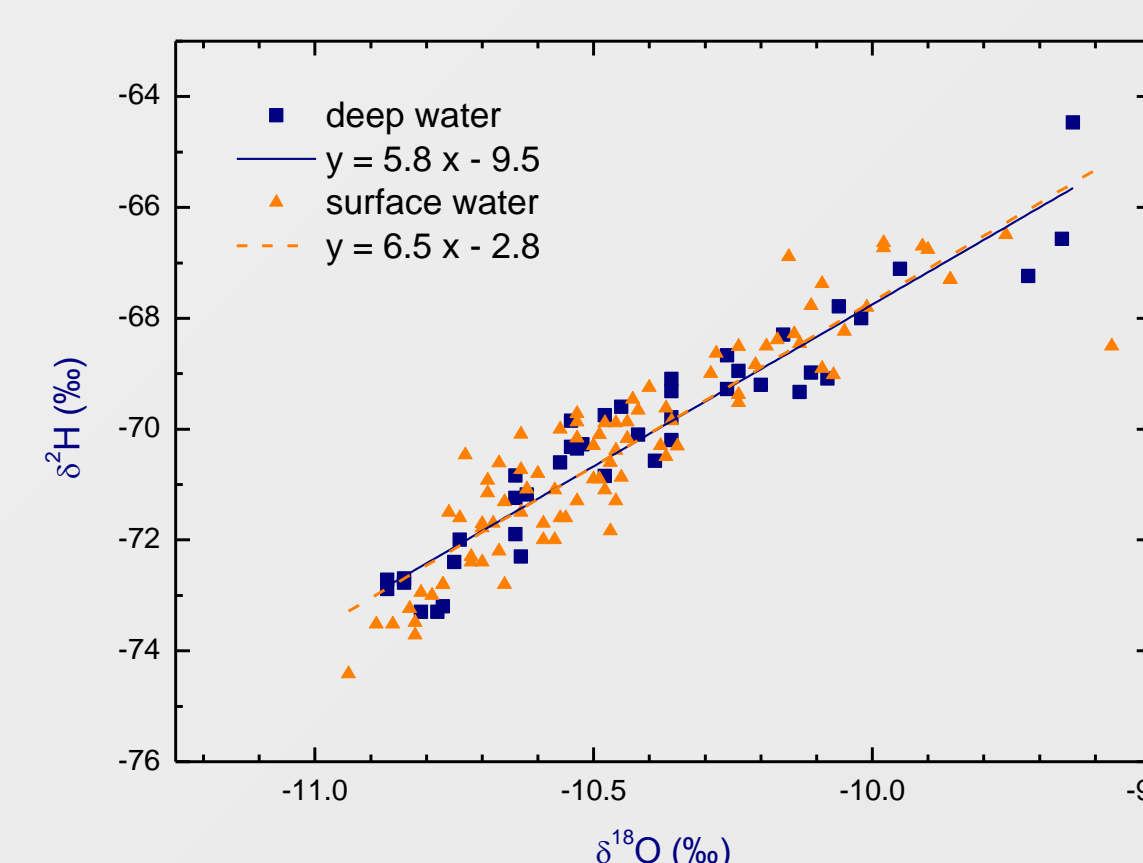
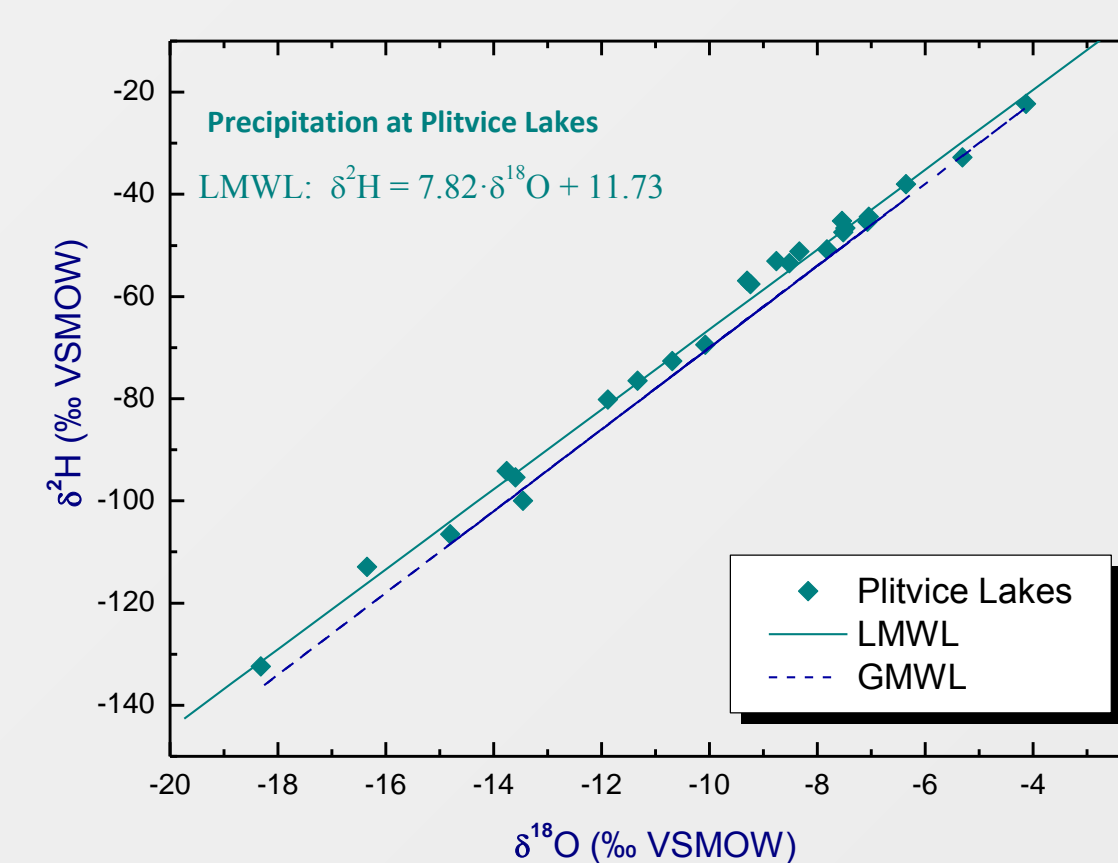
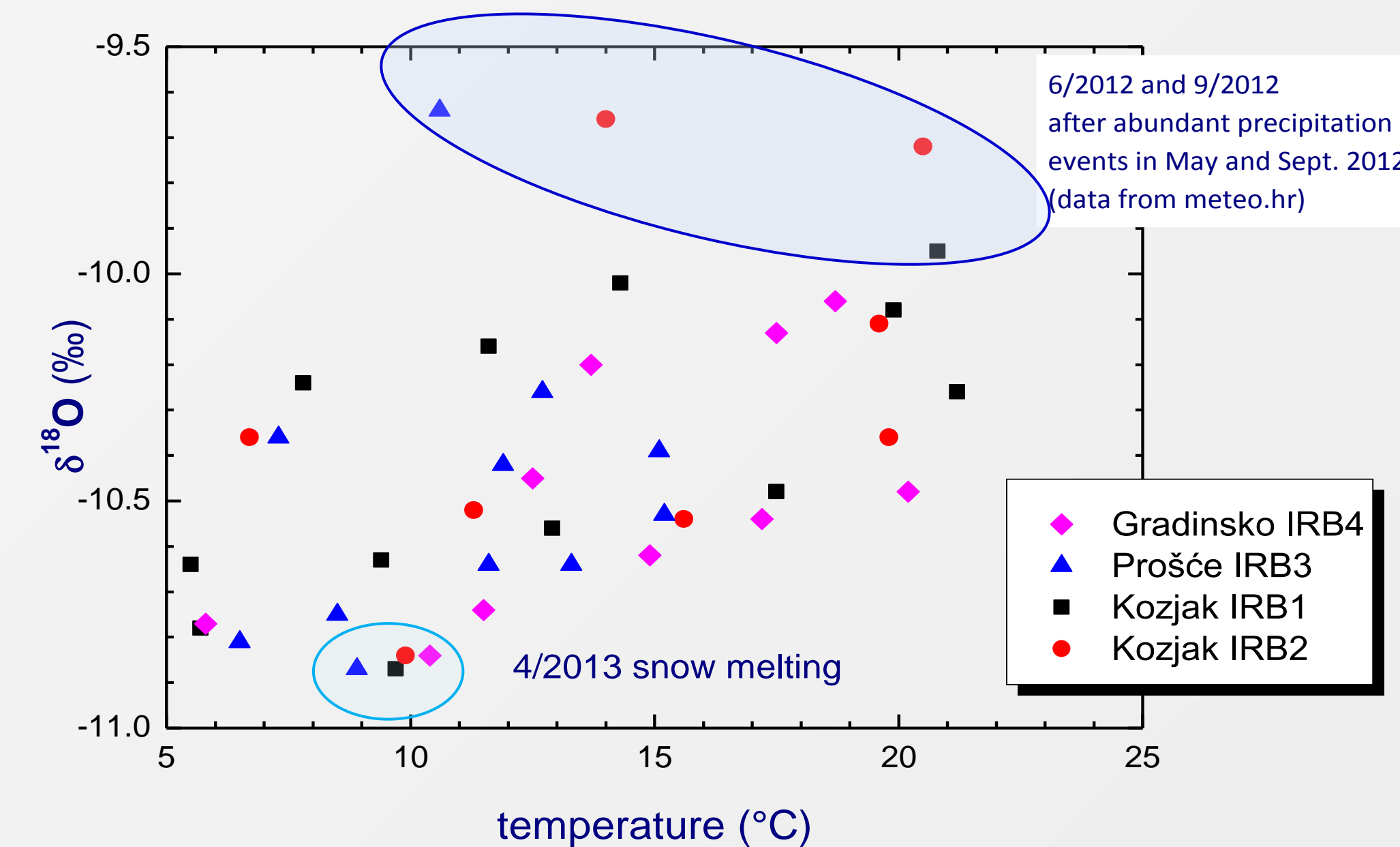
RESULTS



Both $\delta^2\text{H}$ and $\delta^{18}\text{O}$ of water show seasonal variations with higher values during summer, but the seasonal variations ($<1.4\text{‰}$ in $\delta^{18}\text{O}$, $<9\text{‰}$ in $\delta^2\text{H}$) are much smaller than in precipitation of the area ($\delta^{18}\text{O}$ in precipitation varied from -16‰ to -2‰ , and $\delta^2\text{H}$ from -120‰ to -10‰ [1] confirming that the waters of the system are well mixed.

No difference between deep and surface waters is observed if the mean values are concerned.

A slight increase in both mean $\delta^2\text{H}$ and $\delta^{18}\text{O}$ values and their seasonal variations is observed for locations along the water course: $\delta^{18}\text{O}$ increases from $-10.7 \pm 0.1\text{‰}$ at Matica to $-10.3 \pm 0.3\text{‰}$ at the Korana River.



The LMWL for the Plitvice Lakes precipitation is $\delta^2\text{H} = 7.8 \delta^{18}\text{O} + 11.7$ [1].

All surface waters in this study lie on the line $\delta^2\text{H} = (6.5 \pm 0.3) \delta^{18}\text{O} - (2.8 \pm 3.0)$, $R^2 = 0.88$, and the deep water on the line $\delta^2\text{H} = (5.8 \pm 0.3) \delta^{18}\text{O} - (9.5 \pm 3.0)$, $R^2 = 0.91$.

Lower slopes and intercepts of both relations compared to the LMWL indicate influence of evaporation of surface waters that is more pronounced in big lakes, and also more pronounced in deep that in surface waters.

Influence of heavy summer rains and snow melting was observed by slight increase and decrease, respectively, in $\delta^{18}\text{O}$ values compared to the average/"normal" values in both surface and deep waters.

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Reference

[1] Babinka S, Obelić B, Krajcar Bronić I, Horvatinčić N, Barešić J, Kapelj S, Suckow A. In: Advances in Isotope Hydrology and its Role in Sustainable Water Resources Management (IHS-2007). Proceedings of a Symposium, Vol. 1, STI/PUB/1310. IAEA, 2007. 327-336