Reconstruction of paleoenvironmental changes using geochemical data from South Carpathian Mountains

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Aim of the study

- This study applied bulk sediment geochemistry to reconstruct lateglacial and early Holocene climatic changes in a glacial lakes (Lake Brazi, 1740 m a.s.l. and Lake Lia, 1910 m a.s.l.) in the Retezat Mts. (South Carpathians, Romania).

- We studied how the changes of chemical element concentration in the sediment can indicate environmental changes, climate variations and human effects.

- Our aim was to develop analytical methods, which may complement the methodology of routinely applied paleoenvironmental methods and can be used to identify environmental changes in the past and help us reconstruct local and regional processes.

Study site

- Retezat Mts., Southern Carpathians, Romania- more than hundred glacial lakes were formed after the last glaciation

- 2007-2008 sediment cores were obtained from small and shallow lakes:

  Lake Brazi 1740 m a.s.l., 0.5 ha, 1.1 m maximum water depth

  Lake Lia 1910 m a.s.l., 1.26 ha, average water depth 0.8 m

Materials and methods

- Samples for radiocarbon dating were prepared at ICER Laboratory, Atomki and measured by the EnvironMICADAS accelerator mass spectrometer.
  For more details see: *Hubay et al. 2018 DOI: 10.1016/j.quaint.2016.09.019*

- The total organic matter in the sediment (LOI_{550}) followed standard procedures (Heiri et al., 2001) for determining loss-on-ignition parameters.

  Samples were prepared for the major element geochemical analysis according to protocol after Wheal et al. (2011) with some modification and measured by ICP-OES.
  For more details see: *Hubay et al. 2018 DOI: 10.1016/j.quaint.2018.02.024*

Atomki, Debrecen, HU

MICADAS AMS, Debrecen, HU

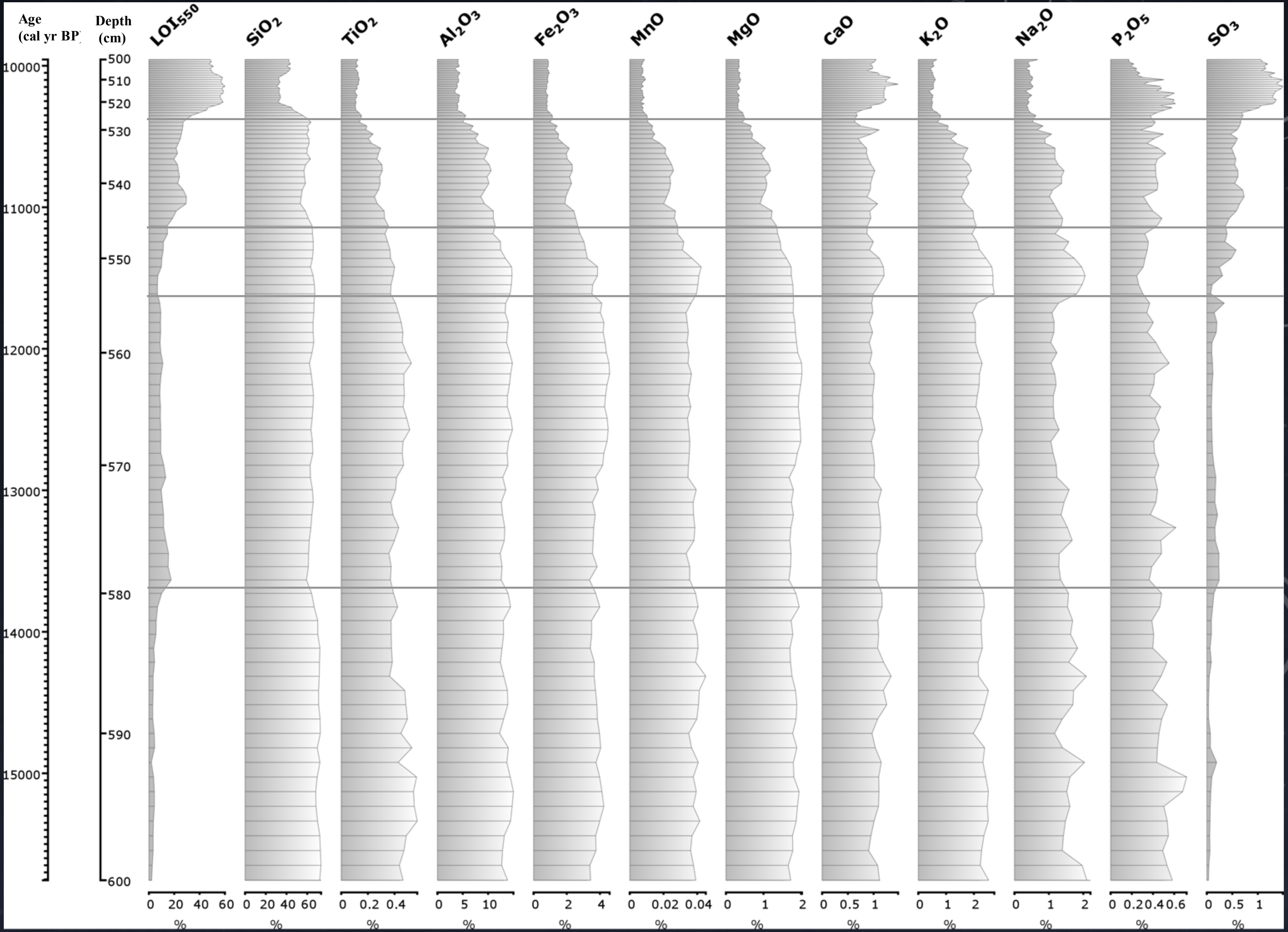
Vertical profile of bulk geochemistry and organic matter (LOI_{550})- Lake Brazi

- relative abundance plots of the studied elements expressed as concentration of oxides per sediment volume

- Al_2O_3, Fe_2O_3, TiO_2, MnO,MgO, K_2O and Na_2O showed consistently high values in the lowermost part of the section, between 601 and 554.5 cm depth (15,750-11,610 cal BP)

-minerogenic element concentrations decreased considerably in the topmost fine gyttja layer (527-550 cm), while CaO and LOI_{550} increased.

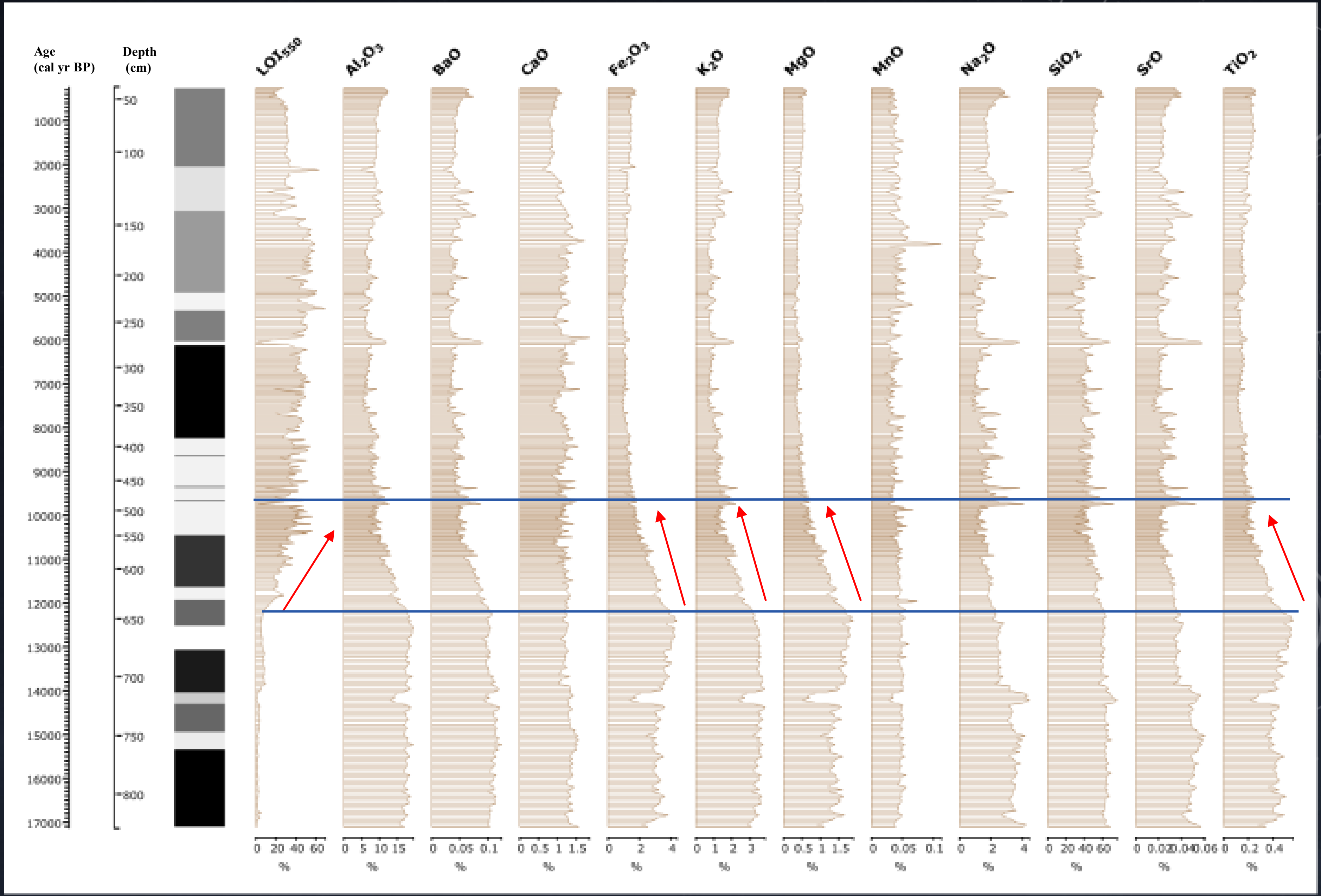
For more see: *Braun et al. 2012*
DOI: 10.1016/j.quaint.2012.03.025



Elemösszetétel változások az üledékben Lia-tó

Vertical profile of bulk geochemistry and organic matter (LOI_{550})- Lake Lia

-relative abundance plots of the studied elements expressed as concentration of oxides per sediment volume



Discriminant analysis

The classical linear discriminant analysis (LDA) was applied
Our aim was to find a discriminant function, a parameter that allows for the optimal separation or grouping of data based on their main characteristics.

Variables (c_j): Concentration of elements (logaritmic transformation of oxide %)
Observation units: 1 cm subsamples
Groups: According to Dansgaard et al., 1993; Johnsen et al., 1997

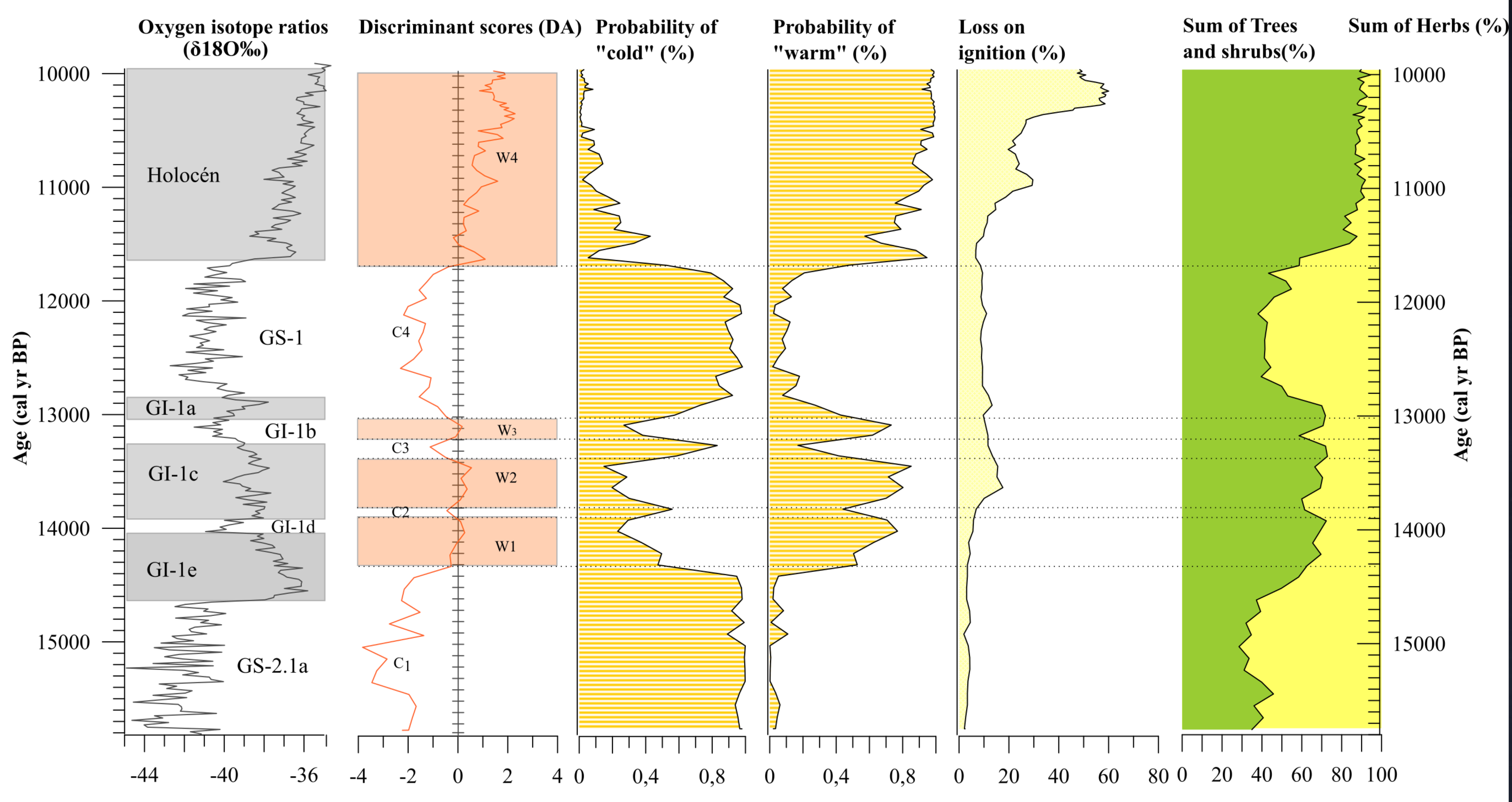
Subsamples from the core were „a priori” labeld as „cold” and „warm” groups respectively, according to their age and evidence of cold and warm events in the record, as suggested by proxy correlation with the LG event stratigraphy of NGRIP

$$\mathbf{D_i = w_1 c_{1,i} + w_2 c_{2,i} + \ldots + w_j c_{j,i} + \ldots + w_p c_{p,i}}$$

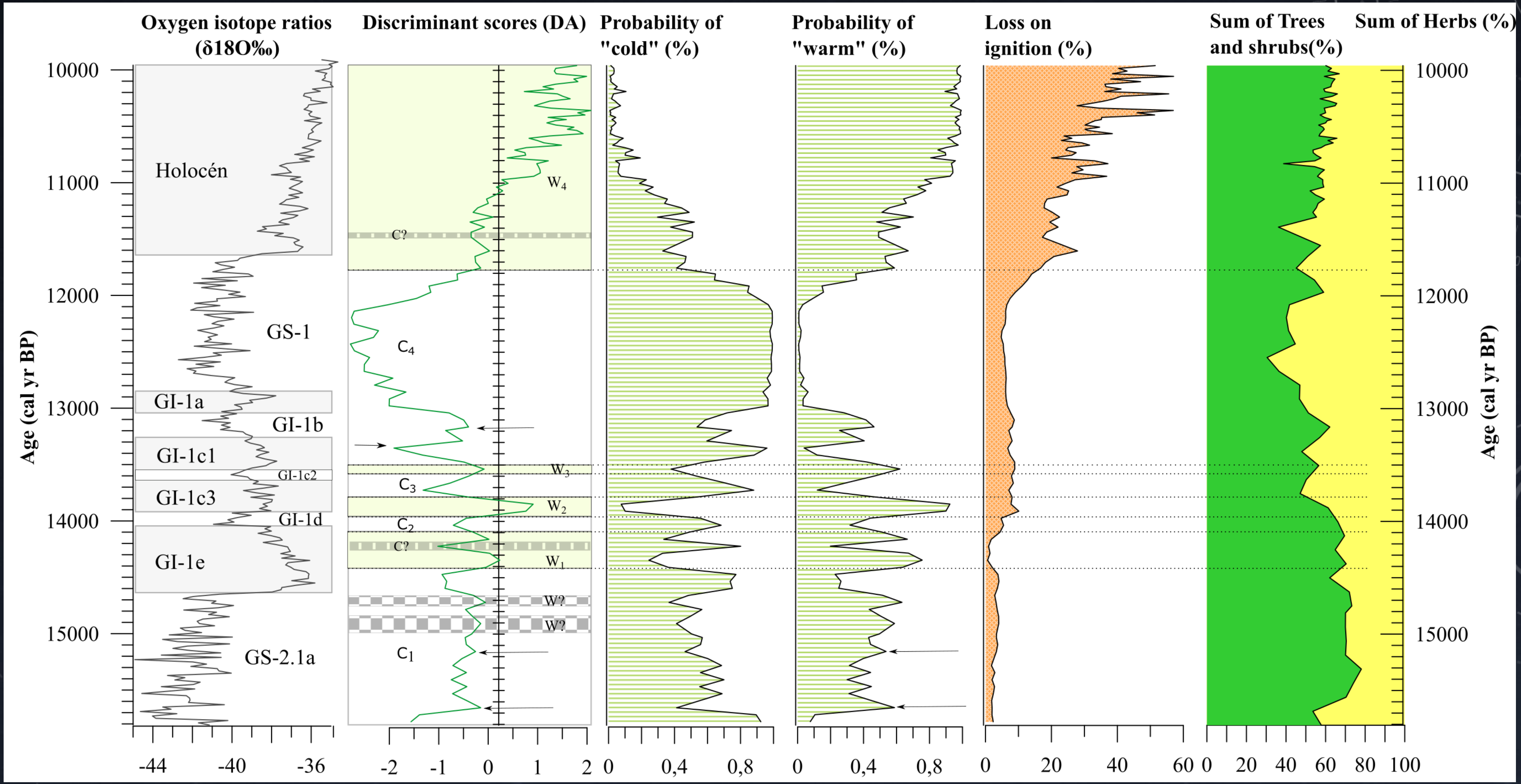
$\mathbf{D_i}$ discriminant scores
$\mathbf{w_j}$ discriminant coefficients
$\mathbf{c_{i,j}}$ logtransformed concentration of elements
i= 1, 2, … n number sediment samples
j= 1, 2, … p number of elements (Al_2O_3, CaO, …)

For more see: ***Braun et al. 2012 DOI: 10.1016/j.quaint.2012.03.025***

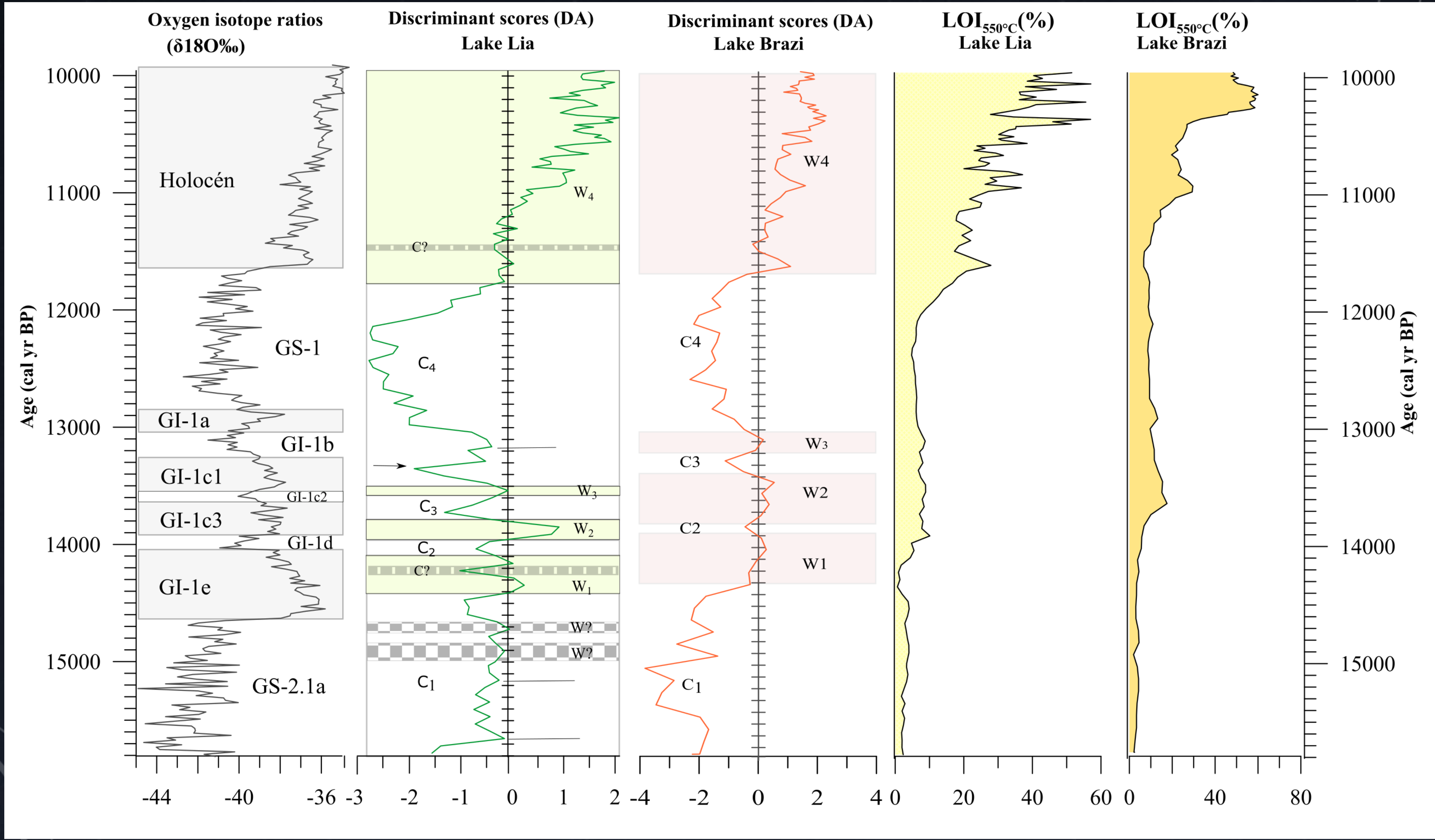
Comparison of discriminant scores and posterior probabilities with oxygen isotopes and climatic events recorded in the NGRIP ice core, and to loss-on-ignition and pollen results-Lake Brazi



Comparison of discriminant scores and posterior probabilities with oxygen isotopes and climatic events recorded in the NGRIP ice core, and to loss-on-ignition and pollen results-Lake Lia



Comparison of discriminant scores from Lake Lia and Brazi with oxygen isotopes and climatic events recorded in the NGRIP ice core, and to loss-on-ignition results



Summary

The calculated discriminant values are good indicators of changes in sediment caused by climate change, as their values give the cold and warm directions.

The “a posteriori” groups can be used to determine the period during which local changes differed from the climate changes in the North Atlantic region.

The chemical composition of sediments deposited during the “cold” and “warm” periods shows differences in both sediments.

The discriminant scores showed strong correlation with the NGRIP $\delta^{18}O$ data and with the pollen percentage sum of trees and shrubs.

Discriminant analyses of bulk sediment major oxide chemical data may be a useful tool to identify the impact of climate events upon the nature and composition of materials delivered to a lake basin.

Acknowledgement

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