# ASSESSMENT OF ANOMALIES IN DISTRIBUTION OF RARE EARTH ELEMENTS ACROSS SERBIA USING MOSS BIOMONITORING

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## Introduction

In the recent decades, rare earth elements (REEs) are recognised as xenobiotics due to their growing mining and application in agriculture, medicine, high-tech electronics and communication systems. The increasing use of REEs in different areas of human activity has led to environmental contamination and bioaccumulation persist for a long time. Airborne particulate matter is a carrier of many potentially toxic elements including REEs. Mosses have been studied as biomonitors of positive or negative anomalies in REE distribution over large areas induced by deposition of atmospheric particulate matter.

## Experiment

In the samples of moss *Hypnum cupressiforme,* collected across Serbia in 2015/2016, 17 REEs were determined: Sc, Y, La, Ce, Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb and Lu. The measurements were done by ICP-MS. The obtained REE concentrations were normalised to their values in European Shale (EUS), North American Shale Composite (NASC), Post Archean Australian Shale (PAAS) and Upper Continental Crust (UCC). Deviation of the element concentrations from the natural values was estimated by calculating their enrichment (EFs) in the moss samples.

## Results and Discussion

The measured and normalised REE concentrations in the moss samples are present on Figure 1. According to Sc as a reference element, the median EFs showed slightly enrichment of the REEs in the moss samples (Figure 2). The statistically significant correlations were obtained between the REE concentrations in the moss ($R \geq 0.80$, $p < 0.05$), which imply the similar origin of the elements, probably geogenic. Spatial distribution of moss REE concentrations across Serbia (Figure 3) suggesting two areas of the increased element abundance at south and east of the country.

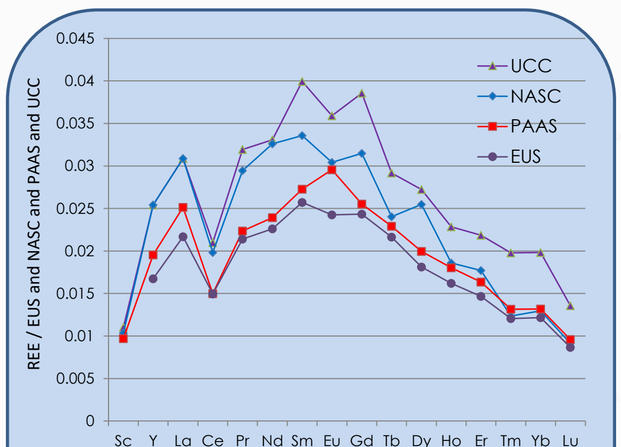


Figure 1. EUS, NASC, PAAS and UCC normalised patterns of REE concentrations in the moss *H. cupressiforme*

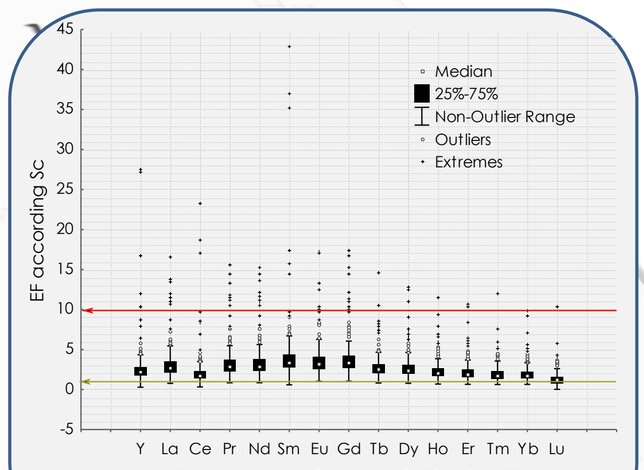


Figure 2. Enrichment factors (EF) of REEs in the moss samples across Serbia according Sc; yellow line: EF=1, red line: EF =10

## Conclusion

Moss can be used in monitoring of rare earth elements, except for Pm. In Serbia, REEs are mainly of geogenic origin.

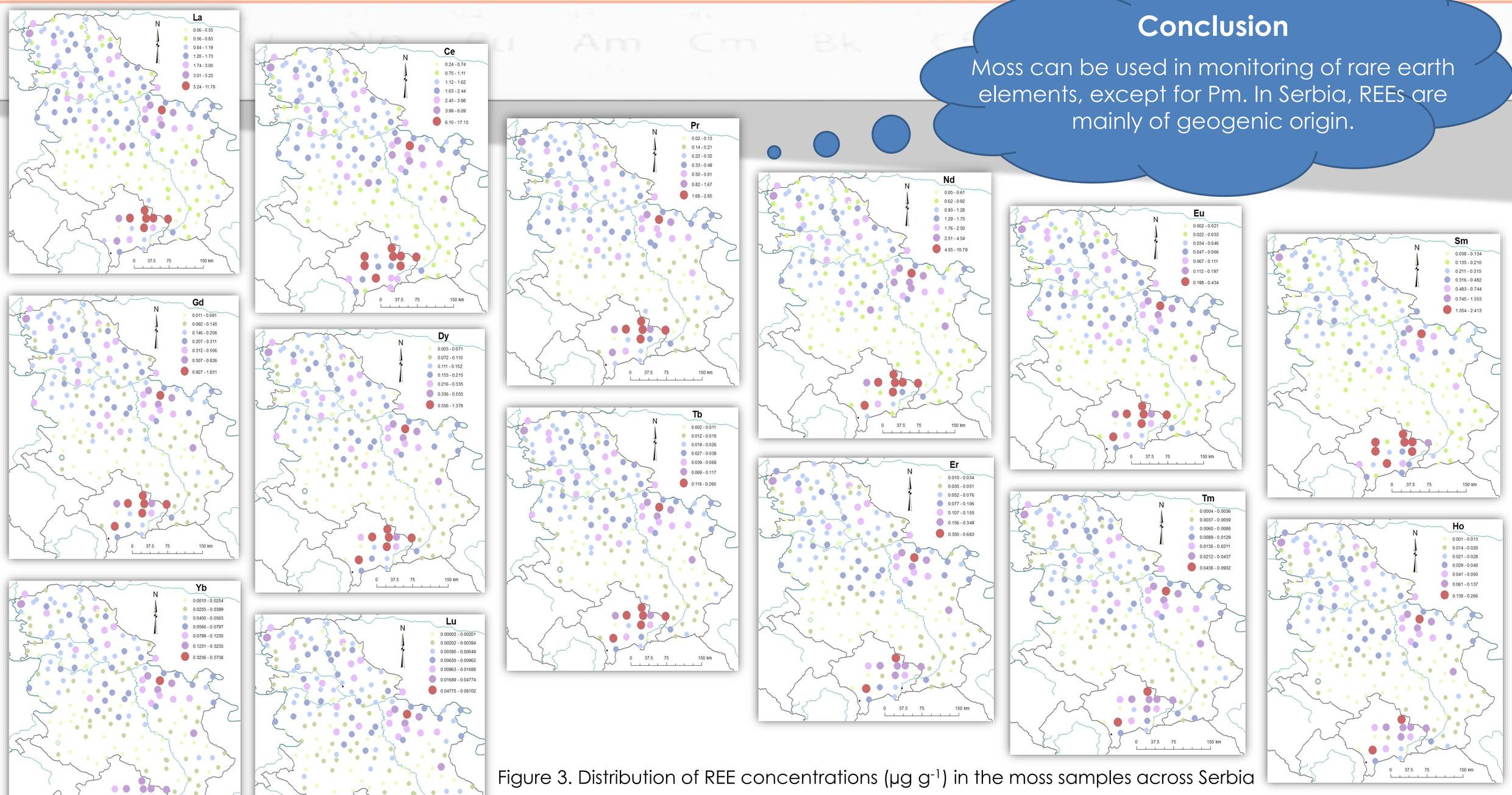


Figure 3. Distribution of REE concentrations (μg $g^{-1}$) in the moss samples across Serbia

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