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**Spatial soil information as a proxy for archaeological predictive modelling in arid regions: the Selevani plain example (Kurdistan, Iraq). CAA Conference, Amsterdam, 03-06 April 2023.**

MATHIAS BELLAT<sup>1,2,\*</sup>, BENJAMIN GLISSMANN<sup>1,3</sup>, RUHOLLAH TAGHIZADEH-MEHRJARDI<sup>1,2</sup>, TOBIAS RENTSCHLER<sup>1,2,4,5</sup>, PAOLA SCONZO<sup>3,6</sup>, PETER PFÄLZNER<sup>1,3</sup>, THOMAS SCHOLTEN<sup>1,2,4</sup>

<sup>1</sup> CRC 1070 ResourceCultures, Eberhard Karls University of Tübingen, Germany

<sup>2</sup> Chair of Soil Science and Geomorphology, Department of Geosciences, Eberhard Karls University of Tübingen, Germany

<sup>3</sup> Institute for Ancient Near Eastern Studies (IANES), Eberhard Karls Universität Tübingen, Germany

<sup>4</sup> Cluster of Excellence Machine Learning „New Perspectives for Science“, Eberhard Karls Universität Tübingen, Germany

<sup>5</sup> Digital Humanities Center, Eberhard Karls Universität Tübingen, Germany

<sup>6</sup> Department of Culture and Society, University of Palermo, Italy

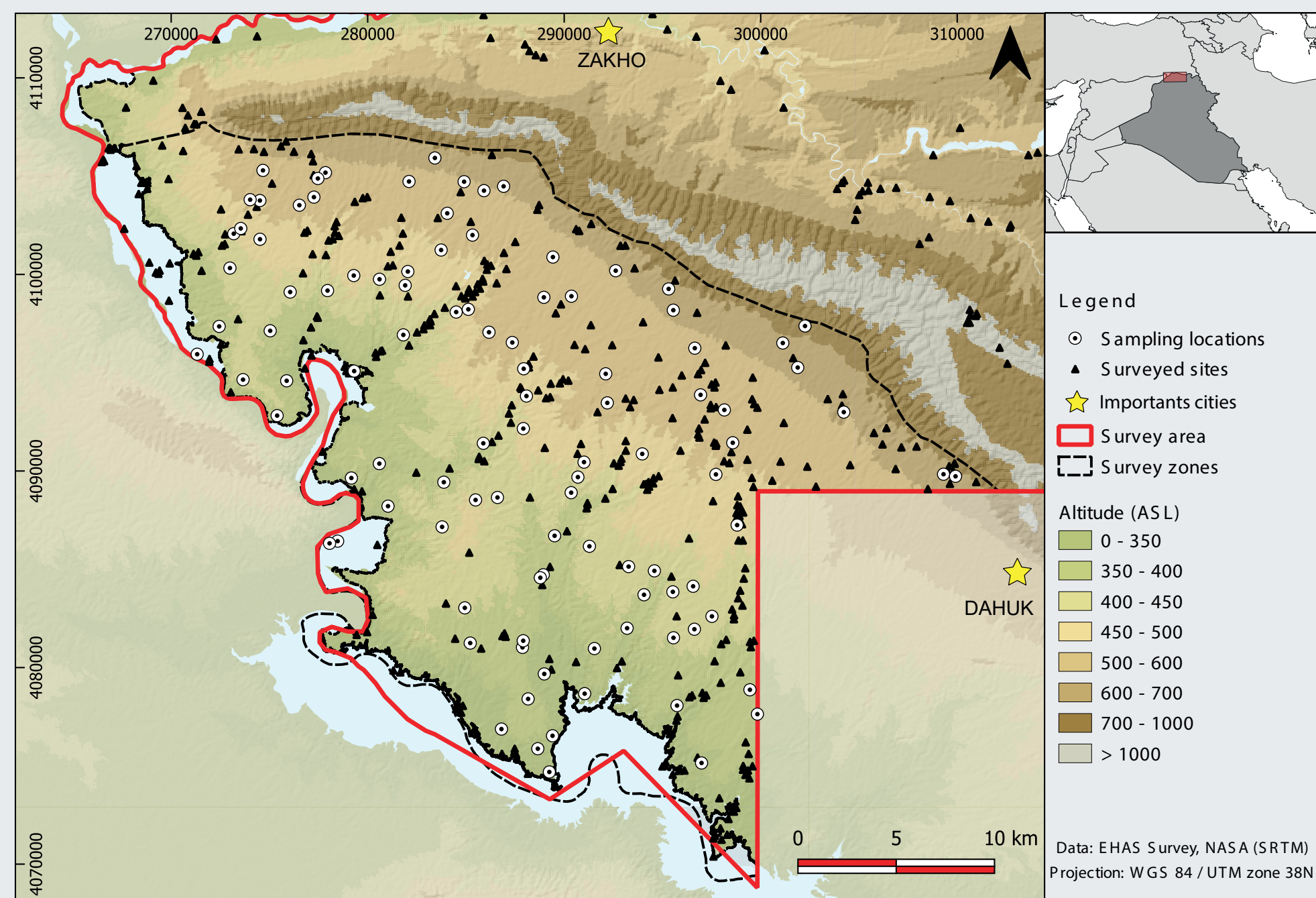


Fig. 1: Study area with samples location and survey sites

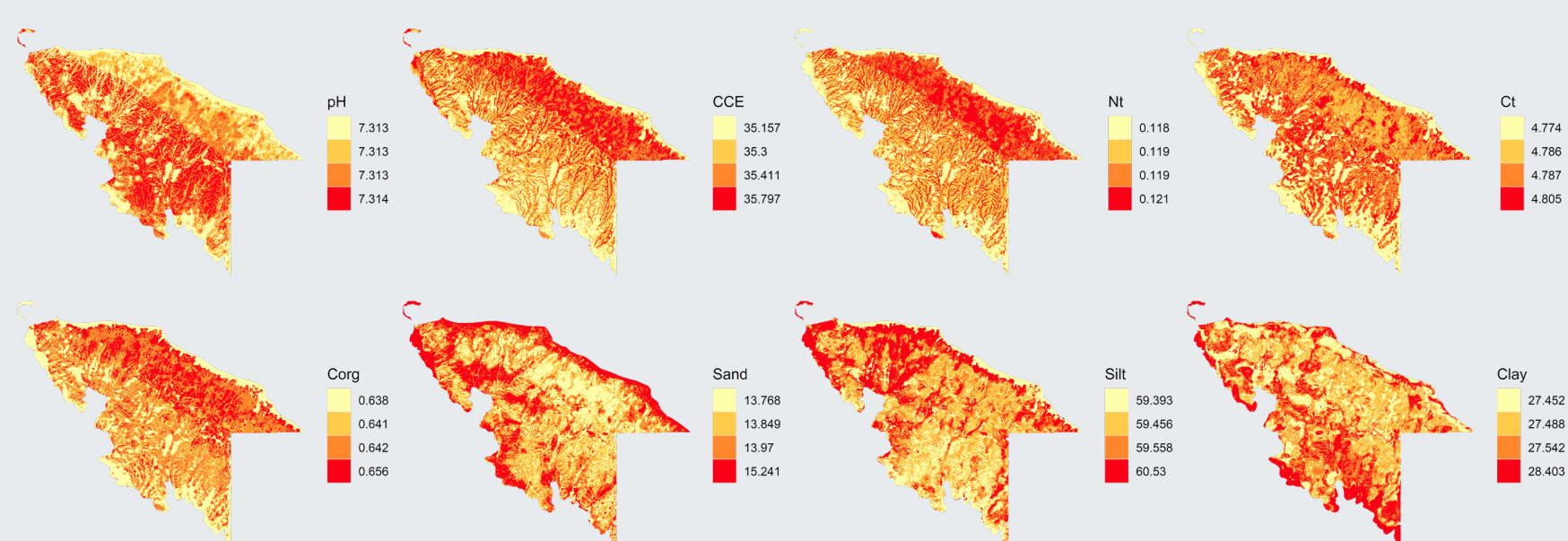


Fig. 2: Maps of different soil informations

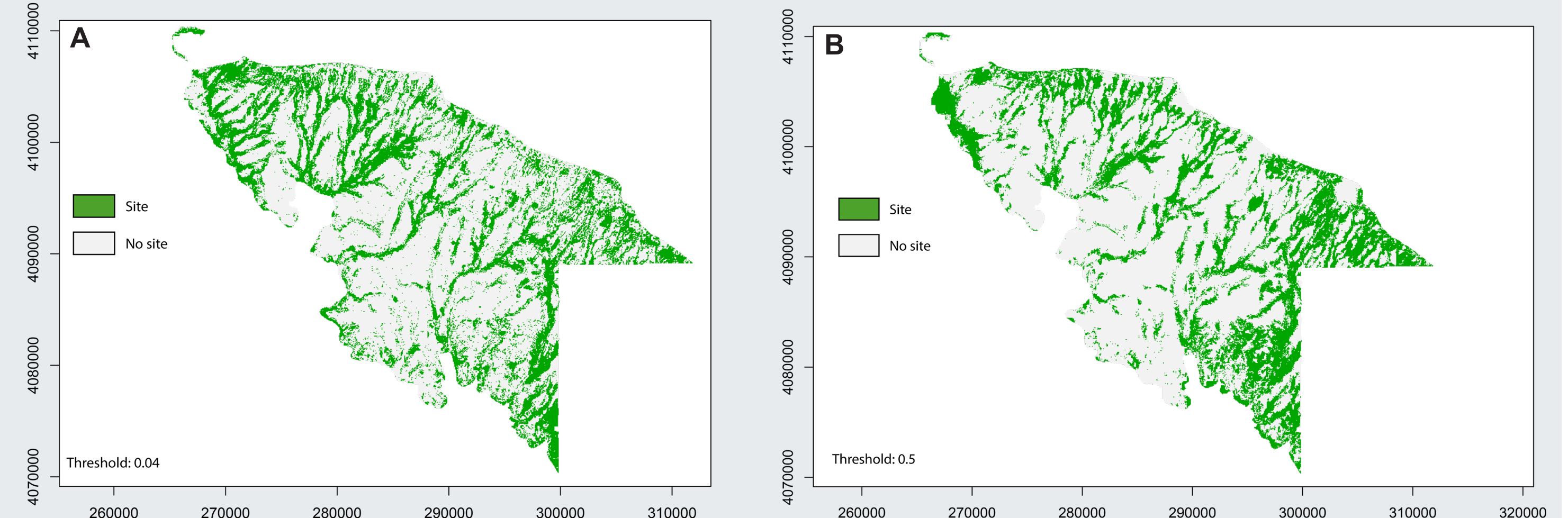


Fig. 3: Archaeological binary prediction maps: RF (left), GLM (right)

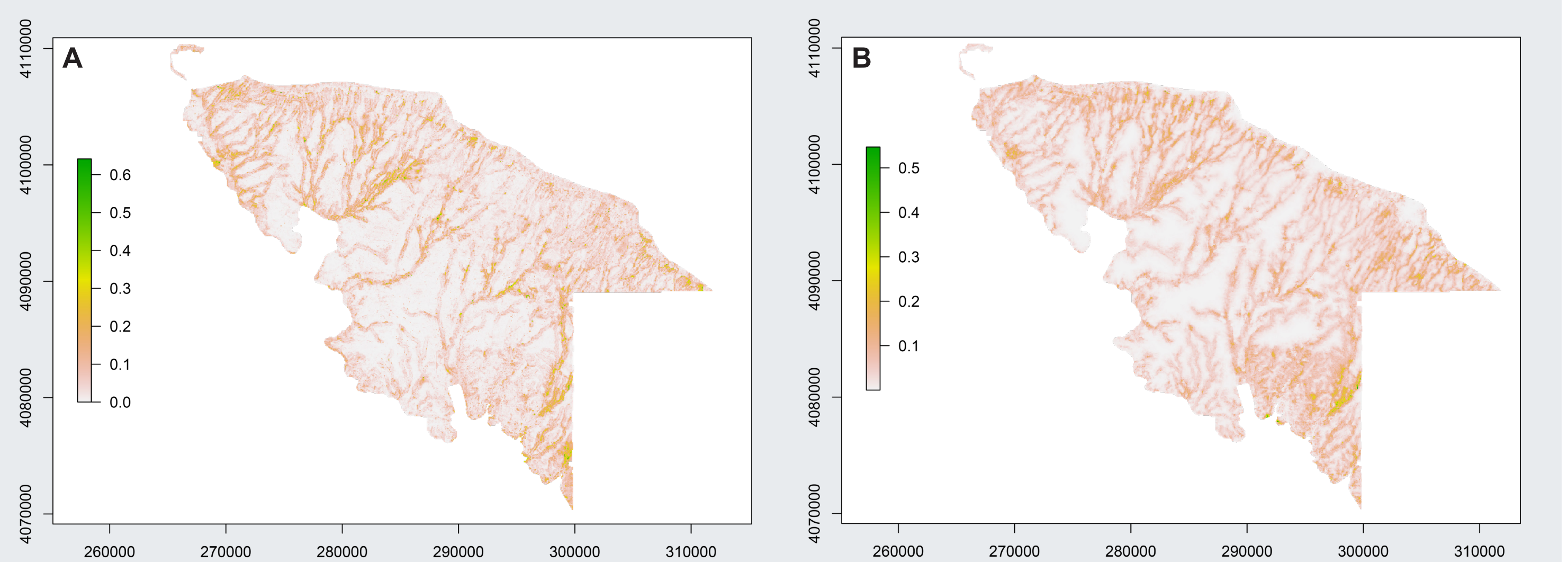


Fig. 4: Archaeological prediction rate maps: RF (left), GLM (right)

## 1. INTRODUCTION

- Based on the concept of „ResourceComplexes“ and „ResourceCultures“ (SCHADE et al. 2021), we aim to investigate the links between communities and their living environment and mobility from the Bronze Age until the Sasanian period.
- An intensive survey was conducted in the Selevani plain from 2013 to 2019 (SCONZO *in press*), that led to the discovery of 340 new sites and features dating from the Palaeolithic to the Late Islamic period. During the summer 2022 we collected samples from 101 locations (Fig. 1). Only top-soil samples were used for this study.
- Archaeological predictive models (APM, YAWORSKY et al., 2020) are a powerful tools for understanding the distribution of settlements toward time and space. We aimed to try different models based on several soil properties and

**Our question was:** Are soil data good predictors for archaeological predictive models?

## 2. MATERIEL AND METHODS

### DATA

Area size	Archaeological sites	Samples number	Predictors tested
800 km <sup>2</sup>	336	101	53

### METHODS

- Soils have been analyzed with classical wet chemistry methods, and additional data were predicted from the mid-infrared spectra (MIR).
- Maps of soil properties (Fig. 2) were predicted from environmental data (precipitation, temperature...). Soil Quality Ranking index (SQR) was then computed based on HAZELTON and MURPHY (2016).
- APM models based on a machine learning, Random Forest model (RF) and a statistical model, Generalized Linear Model (GLM). We used 10 predictors and the 7 additional soil data maps (Fig. 3) in 4 K-fold.

## 3. RESULTS

- The six soils properties have a strong correlation among themselves. According to the correlation matrix, 19 values are over the threshold of 0.65.
- For the GLM model (Fig. 3b, Fig. 4b), carbon total (Ct) and water vapor from Sentinel 2 B9 band are the two main contributors to the model (Fig. 5a).
- In the RF model (Fig. 3a, Fig. 4a), calcium carbonate equivalent (CCE) and, again, the water vapor band from sentinel 2 are the two most significant predictors. However, total nitrogen (Nt) and silt content are also important contributors (Fig. 5b).
- For the two models, SQR was never identified as a major predictor.

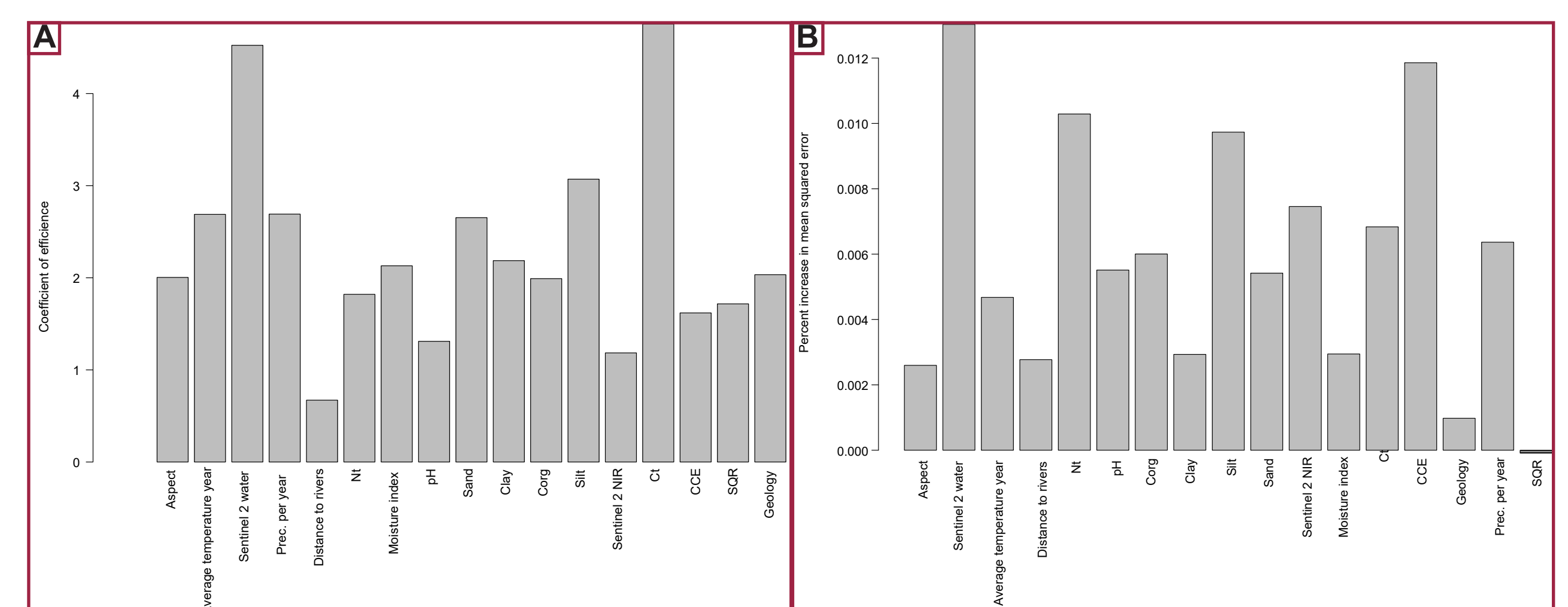


Fig. 5: Evaluation on the contribution of each predictor in the GLM model (left) and RF model (right)

## 4. DISCUSSION AND CONCLUSION

- Individually soil properties are valuable predictors for APM, specially Ct and CCE.
- Simple soil rating indices like SQR do not contribute to the APM significantly. One reason can be its narrow range that does not describe the regional high resolution of soil properties in our study area adequately.
- Futur work will focus on improving the models and testing others'.
- Establishing a link between the variables of the models and their uses by past communities.

## ACKNOWLEDGMENTS

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## CONTACT

\*Mathias Bellat

mathias.bellat@uni-tuebingen.de



## ABBREVIATIONS

APM: Archaeological predictive model  
SQR: Soil quality ranking  
RF: Random forest  
GLM: Generalized linear model  
CCE: Calcium carbonate equivalent  
Ct: Carbon total  
Nt: Nitrogen total

## FURTHER READINGS

T. Schade, B. Schweizer, S. Teuber, et al. (ed.) (2021). *Exploring resources: on cultural, spatial and temporal dimensions of ResourceCultures*. Tübingen University Press, Tübingen. P. Hazelton, B.W. Murphy, (2016). *Interpreting Soil Test Results What Do All the Numbers Mean?*, 3th Edition, CSIRO Publishing, Clayton South. P. M. Yaworsky, K. B. Vernon, J. D. Spangler, et al. (2020). "Advancing predictive modeling in archaeology: An evaluation of regression and machine learning methods on the Grand Staircase-Escalante National Monument", *Plos One*, 15(10).