

Spatial patterns of topsoil grain size in the Negev desert, Israel

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Introduction

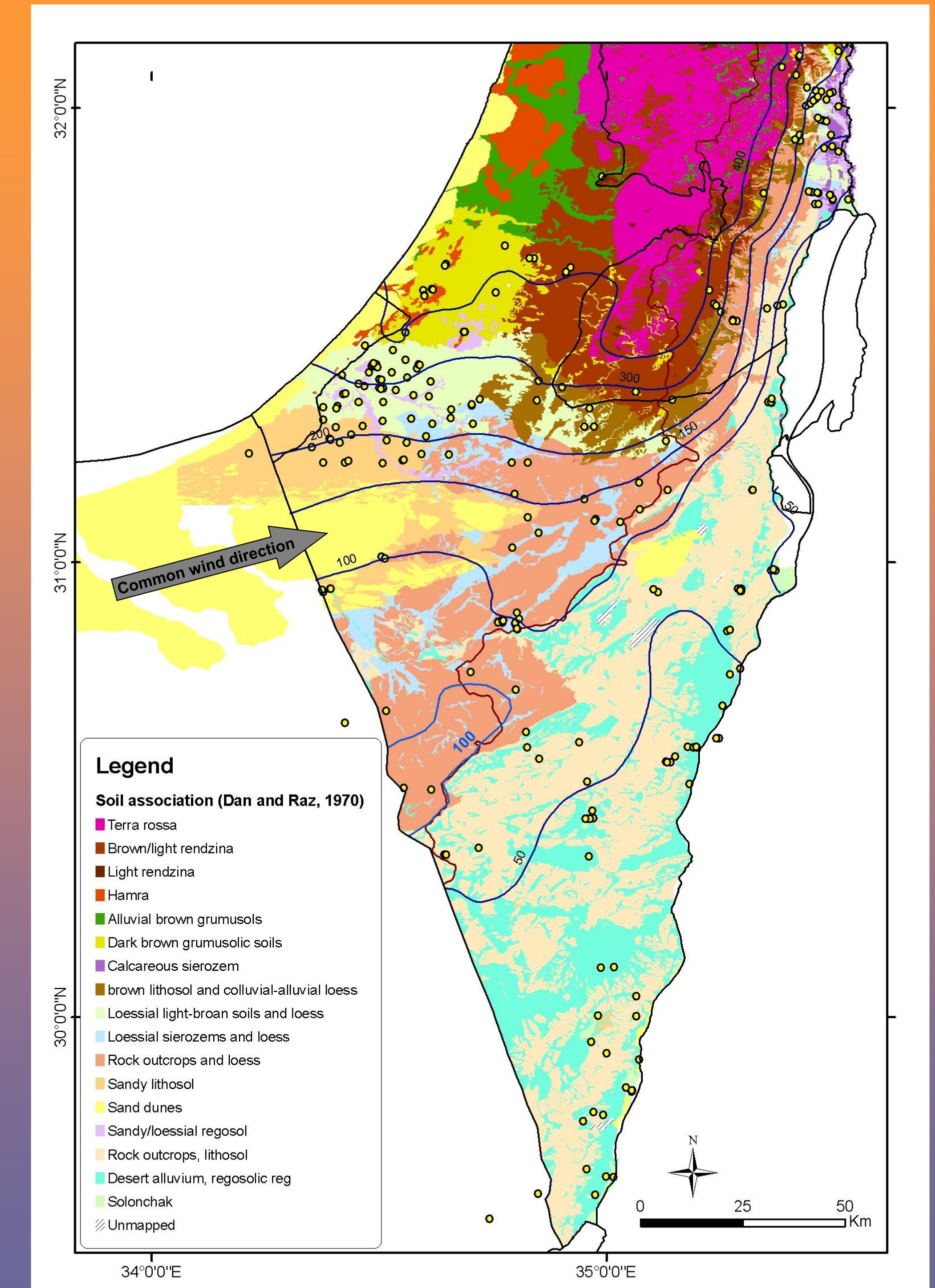
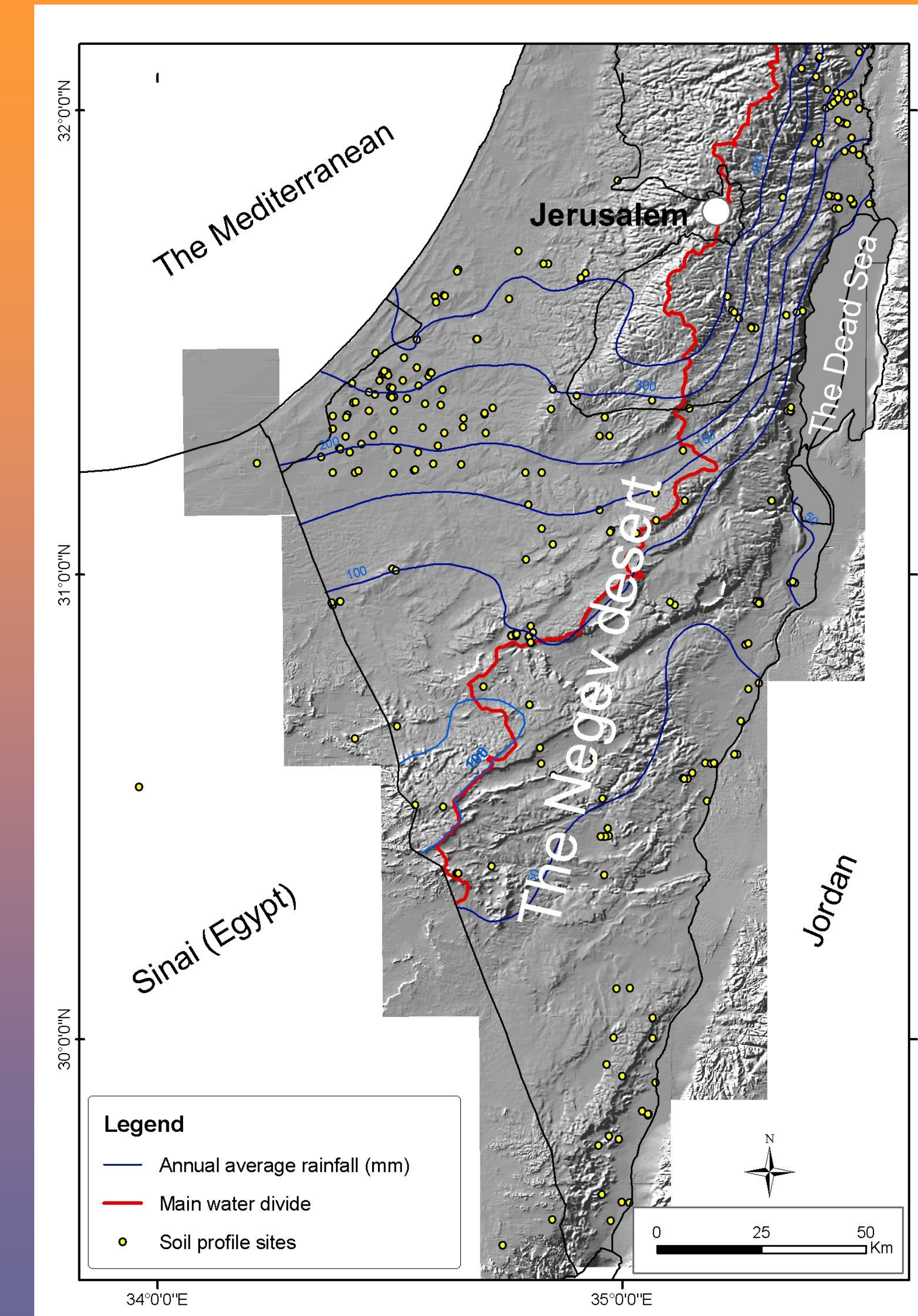
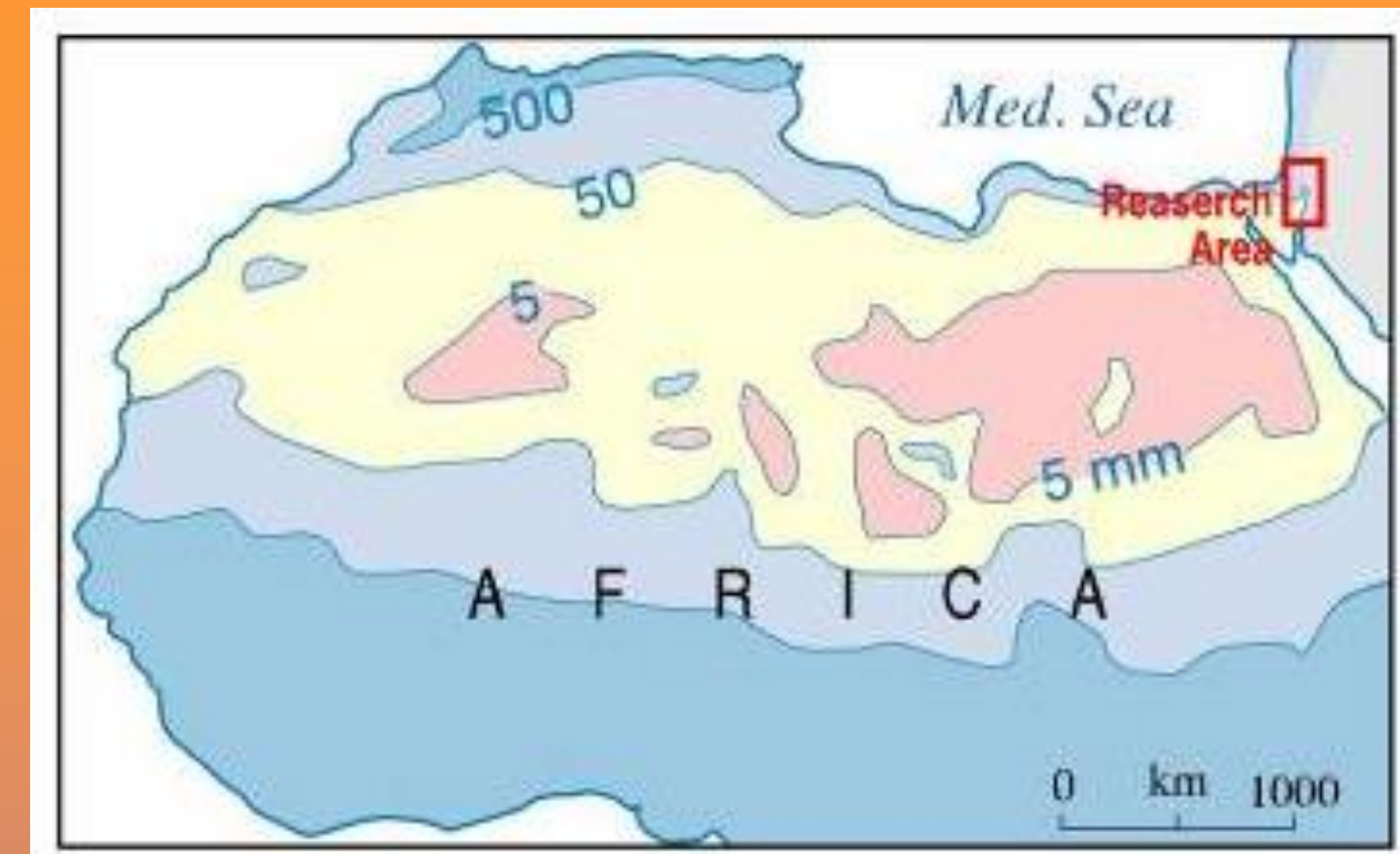
The Negev in southern Israel (29°-31°N) is part of the larger Saharo-Arabian desert belt. The Negev desert covers an area of ~10,000 km² across a steep climatic gradient from semi-arid (~300 mm yr⁻¹) to hyper-arid (<50 mm yr⁻¹) climates. The geomorphology and distribution of soil groups in the Negev are known and mapped (e.g. sand dunes in the northwestern Negev, loess mantle in the central-northern Negev) and are a consequence of complex interactions between Plio-Pleistocene tectonics, bedrock lithology, and climate and its variability (e.g. dust storms, precipitation). However, the understanding of the causes for the spatial patterns of soil characteristics is limited. This problem is common for most of the world's deserts, which lack quantitative data of soil characteristics.

Aim

To map and predict top-soil grain size composition using soil profile database.

Hypothesis

The spatial patterns of topsoil grain size composition reflects Holocene and current dust transport and deposition processes.



Methods

• We established soil profile database composed of > 300 soil profiles gathered from published data and from data collected in field surveys during this study.

• Grain size content (%) was measured using several methods (e.g. sieve-pipette (SP), laser diffraction (LD)) which are not comparable.

• We used the correlations between the SP and LD results (Eshel et al., 2004) to transform all the non-LD methods into LD equivalent values.

• We interpolated the topsoil (A horizon) grain size data using Kriging algorithm (see table).

Fraction	Model	Sill	Nugget	Range (km)
Sand	Circular	28	0.7	16
Silt	Circular	16	1.9	26
Clay	Circular	22	0.4	34

Results

• Sand fraction - highest values in the western Negev (dunes), gradually decreasing northwards, eastwards and southwards to the direction of the loess. High values exist also in southern Negev (igneous and metamorphic lithologies) and in the Jordan valley.

• Silt fraction – almost a mirror image of the sand fraction: lowest values in the dunes, gradually increasing northwards, eastwards and southwards to the direction of the loess, where it exhibit the highest values.

• Clay fraction - highest values in the Judean Mts. Foothills, in the Arava valley and in part of the loess, while lowest values found in the sand dunes. The clay fraction pattern generally follows the rainfall isohyets.

Interpretation and conclusions

• The sand and silt fractions are genetically related. We stress that the silt fraction is formed in situ due to aeolian abrasion of sand grains through local dust storms, and are deposited through dry deposition. Maximal silt values represent the effective distance of the silt grains limited transport, originating in the dune fields.

• The clay fraction is transported from the Sahara through long-distance dust storms, deposited through wet deposition and thus follow the rainfall pattern.

Acknowledgments

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