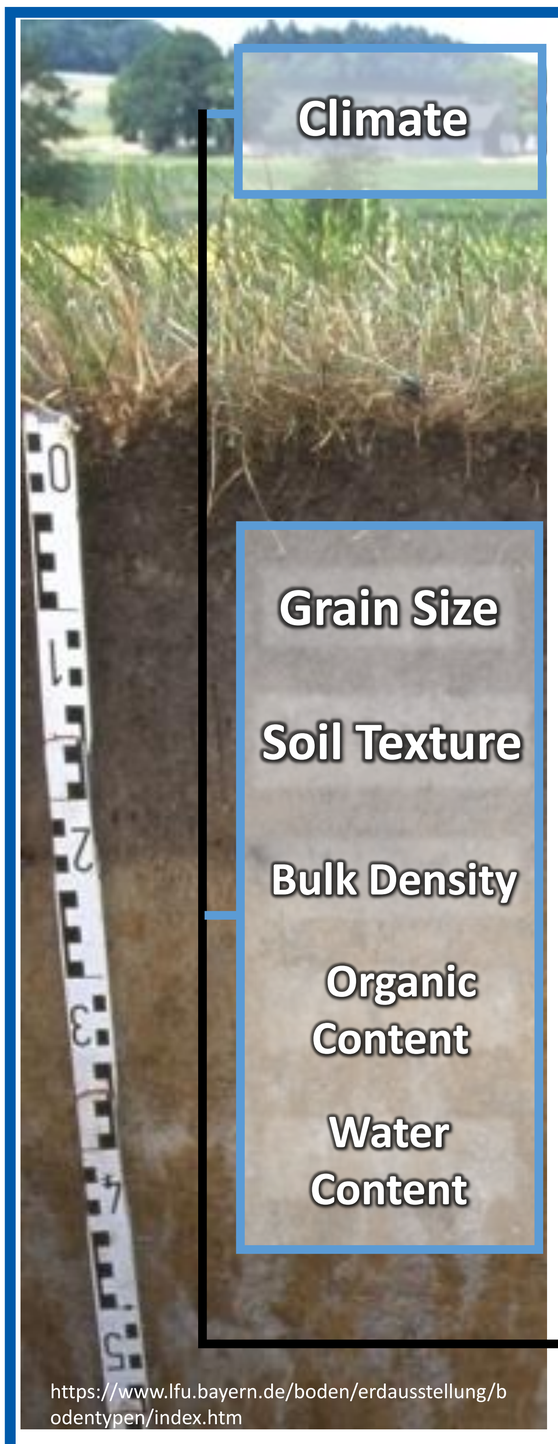
AESMT'21

Mapping of Very Shallow Geothermal Potentials in Rural Areas: a Case Study of Bavaria (Germany)

Shallow geothermal energy is a renewable source for heating and cooling systems and buildings, and it could cover a significant part of the rising energy demand if it were in widespread use. Especially in rural areas, even very shallow geothermal systems are easy to instal due to the availability of large, unsealed areas.

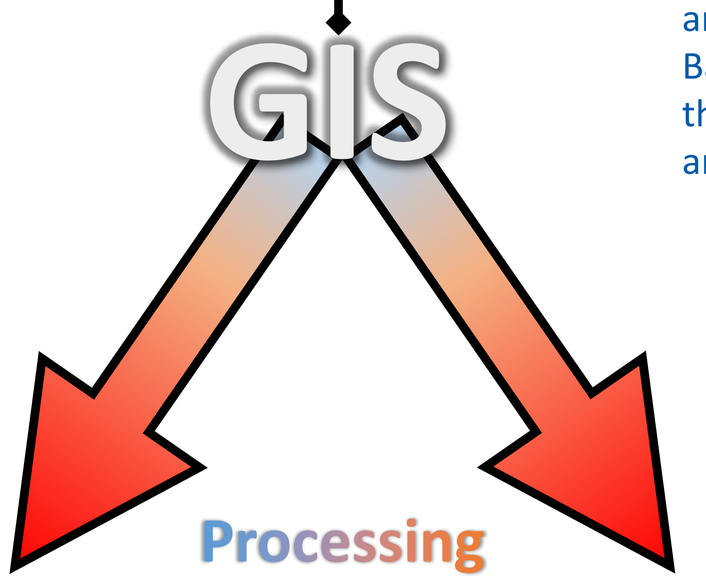
The aim of the study was to generate maps describing the geothermal potential for very shallow horizontal systems in rural areas of Bavaria (Germany). These maps not only offer planning assistance to engineers and municipalities, but also to private investors, and consequently should increase the use of shallow geothermal energy. The relevant soil parameters used for calculating the geothermal potential were implemented as areal data in a geographical information system (GIS). A soil map of Bavaria (scale 1:5000), which includes crucial parameters such as soil texture, provided the basis for mapping. Additionally, climate data, based on degree-day numbers for characteristic regions, was included. By combining these inputs, an algorithm for the calculation of very shallow geothermal potentials (vSGP) was developed.

The results are presented in two categories: thermal conductivity on the one hand (Map 1); and heat extraction on the other (Map 2). Heat conductivity is the general parameter that describes local geothermal potential, depending on soil texture, bulk density, and water content, while heat extraction is given as a system-specific characteristic. This research focused on four different shallow geothermal systems: horizontal ground heat collectors; capillary tube mats; geothermal baskets; and trench collectors. Heat conductivity is a relevant factor for planners of heating and cooling systems but cannot directly represent the efficiency of a possible geothermal system. However, heat extraction (in W/m^2) expresses efficiency more clearly, as it actually defines the theoretical performance of different systems.

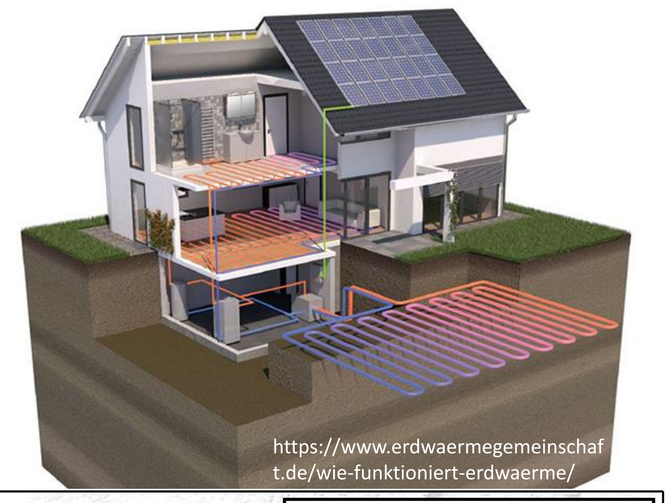


https://www.lfu.bayern.de/boden/erdausstellung/bodentypen/index.htm

In general, the vSGPs for the utilisation of horizontal geothermal systems in Bavarian rural areas are favourable. Villages on mountain slopes may have unfavourable conditions due to their steep gradients, which interfere with the installation of systems, but these areas can be identified and disqualified by an application of the digital elevation model. In fact, the compilation process is easy to transfer to other regions all over the world, just by using their respective soil maps and climatic data.



The vSGP maps were validated by obtaining soil data from selected case study municipalities using information from geotechnical surveys, as well as from sampled and analysed soils. Seven rural municipalities from different Bavarian regions (see maps) were involved in the study, thereby achieving appropriate geographic distribution and results for different soil configurations.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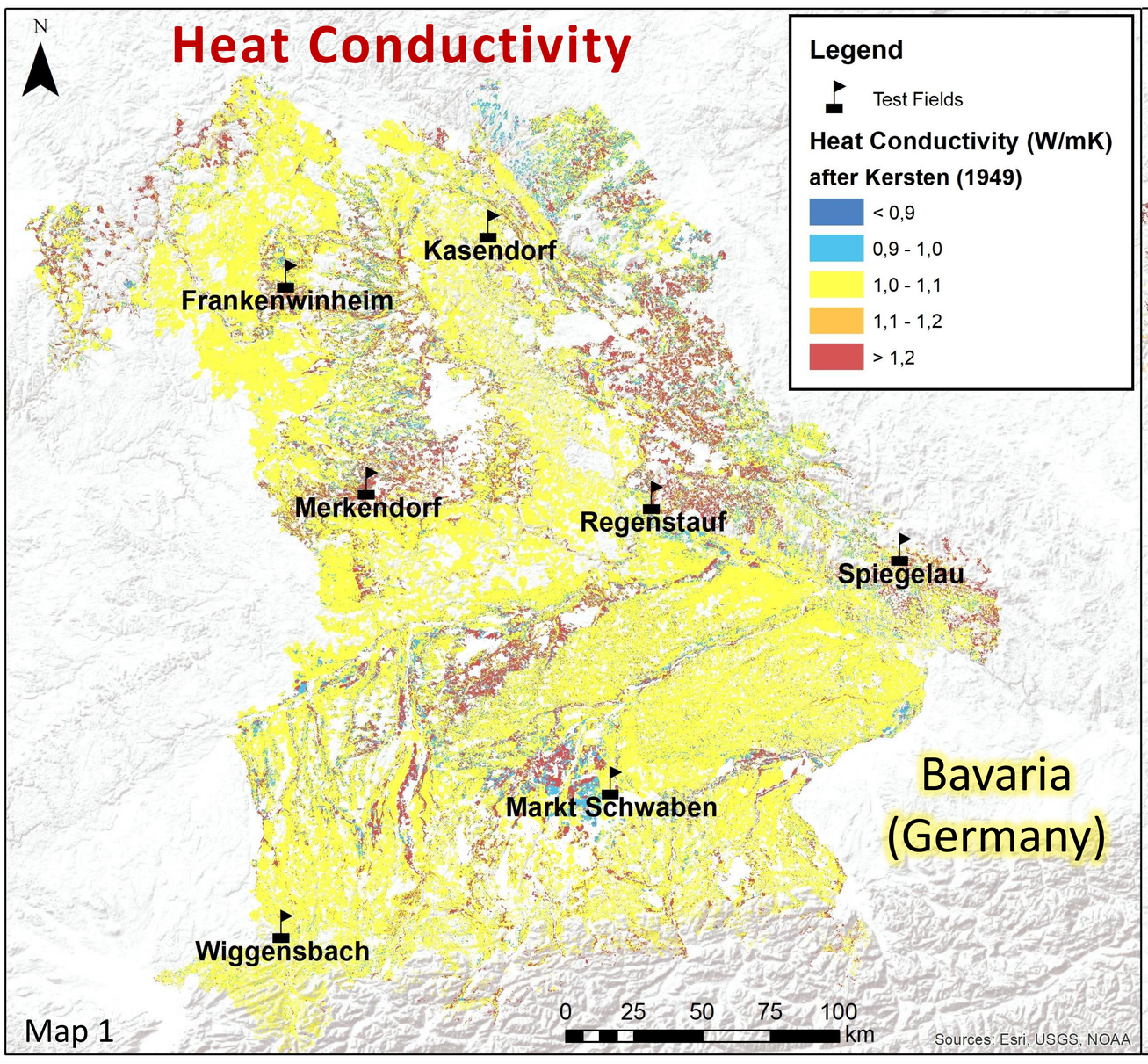
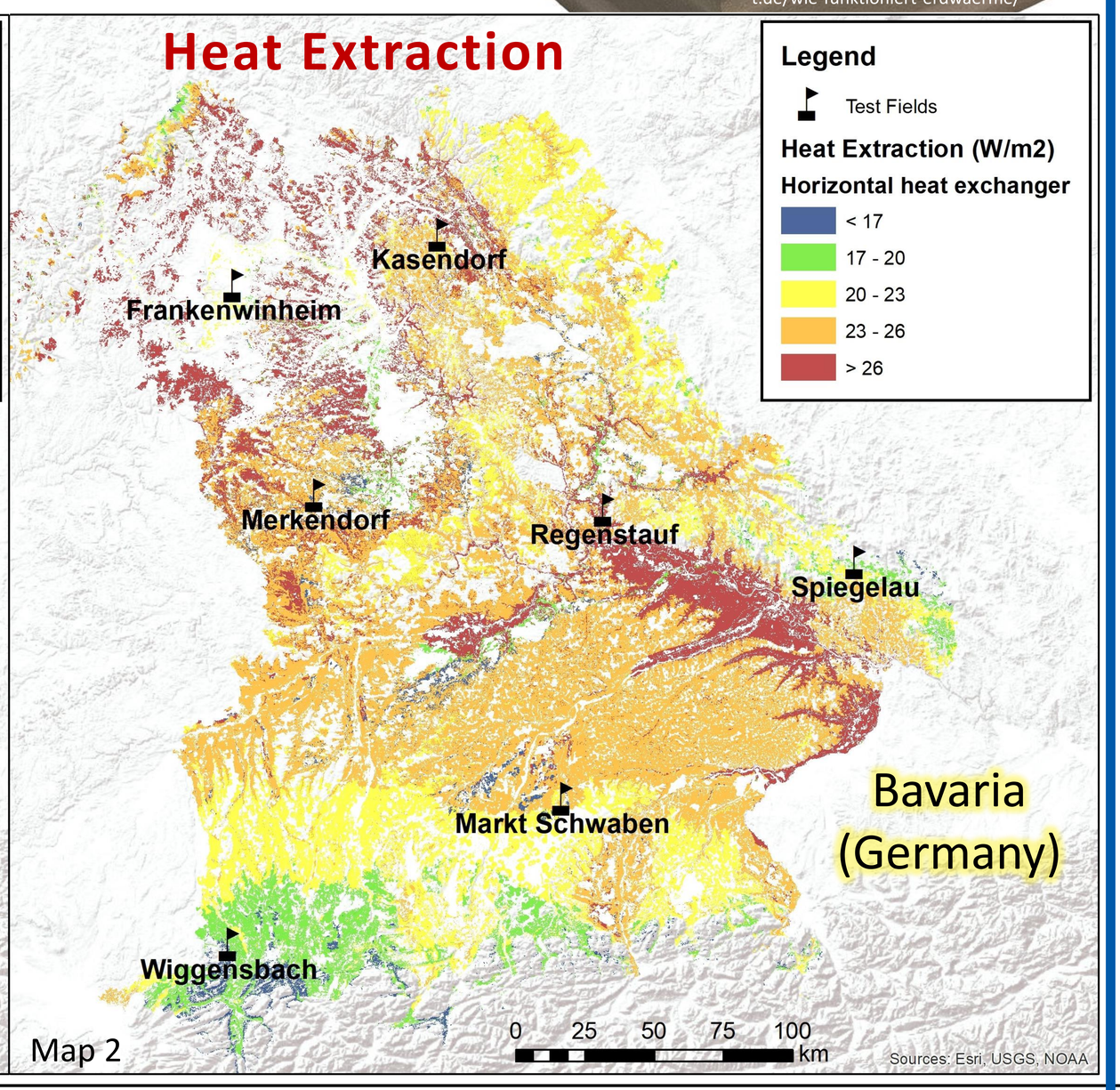


Map 1



Map 2

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