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A geographically weighted regression model for geothermal potential assessment in mediterranean cultural landscape

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Geothermal heat can be used directly in many applications (agro-industrial processes, sanitary hot water production, heating/cooling systems, etc.). These applications respond to energetic and environmental sustainability criteria, ensuring substantial energy savings with low environmental impacts. In particular, in Mediterranean cultural landscapes the exploitation of geothermal energy offers a valuable alternative compared to other exploitation systems more land-consuming and visual-impact. However, low enthalpy geothermal energy applications at regional scale, require careful design and planning to fully exploit benefits and reduce drawbacks.
We propose a first example of application of a Geographically Weighted Regression (GWR) for the modeling of geothermal potential in the Apulia Region (South Italy) by integrating hydrological (e.g. depth to water table, water speed and temperature), geological-geotechnical (e.g. lithology, thermal conductivity) parameters and land-use indicators. The GWR model can effectively cope with data quality, spatial anisotropy, lack of stationarity and presence of discontinuities in the underlying data maps. The geothermal potential assessment required a good knowledge of the space-time variation of the numerous parameters related to the status of geothermal resource, a contextual analysis of spatial and environmental features, as well as the presence and nature of regulations or infrastructures constraints. We create an ad hoc geodatabase within ArcGIS 10 collecting relevant data and performing a quality assessment. Cross-validation shows high level of consistency of the spatial local models, as well as error maps can depict areas of lower reliability.
Based on low enthalpy geothermal potential map created, a first zoning of the study area is proposed, considering four level of possible exploitation. Such zoning is linked and refined by the actual legal constraints acting at regional or province level as enforced by the regional plan for the protection of the landscape ("Piano Urbanistico Territoriale Tematico Paesaggio"), the regional plan for the protection of water and groundwater ("Piano di Tutela delle Acque"), the regional plan of hydrogeological risk ("Piano di Assetto Idrogeologico") and the province level master-plan for the development ("Piano Territoriale di Coordinamento Provinciale").
We believe our results can be a substantial contribution for the ongoing regional debate on the exploitation of geothermal potential as well as an important knowledge base for the integration of such topic in the new regional energetic and environmental plan ("Piano Energetico Ambientale Regionale").