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Soil thickness approaching to adapt the COP method for groundwater vulnerability mapping to humid tropical karst

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In geosciences, the direct application of methodologies developed in temperate climates do not always apply to tropical environments. One example is the application of the COP methodology created to assess the intrinsic vulnerability to contamination of carbonate aquifers when applied directly in a tropical country, such as Brazil. This methodology considers to estimate the vulnerability the properties related to the C=Concentration flow, O=Overlaying layers and P=Precipitation. In the parameter O, where the layers of soil and rock of vadose zone are used to measure the protection given to the aquifer, there is a significant difference between European karst and Brazilian tropical humid karst. Among main differences, we can mention thickness, texture and soil mineralogy. Whereas in European karst the soil thickness rarely exceeds 1,0 m, with predominantly clay minerals 2:1 and clayey silt texture, in tropical Brazilian humid karst soil layers are frequently thicker than 1,0 m with predominantly 1:1 clay minerals and strongly homogeneously textured clay. To evaluate these differences, simulations were performed for a study area located approximately 50 km from the city of Belo Horizonte (southeast region of Brazil) where the soil thickness of original methodology (Os subfactor) was multiple by 10X, 20X, 30X and 40X. In this way, other factors that could influence the protection of the aquifer were eliminated. With this, the same parameters for calculations in original methodology (varying only thickness) were considered. The purpose of these simulations was to demonstrate the influence of large soil thicknesses found in Brazillian tropical humid karst in comparison to the soil thickness found in European karst. The results showed considerable differences from the original methodology. The area is characterized predominantly by soils of the class Oxisol and clayey alteration material that directly cover the Proterozoic limestones of the Bambuí Group, belonging to the Sete Lagoas Formation. Stratigraphically, over the limestones are the metapelites of the Serra de Santa Helena Formation and Tertiary and Quaternary sediments. The simulations for the original methodology showed that the protection given by the soil layer will always be high due to a clayey texture characteristic (>30% of clay) and thickness greater than 1,0 m, as shown in the calculation of the subfactor Os. In fact, accounting for different soil thicknesses as a factor of modification from the original methodology, the results showed that there is a gradation of the high protection class for the moderate protection class. These simulations showed the need for modification of the original methodology for application in tropical environments. The direct application of the original methodology to tropical areas can lead to errors of protection class, which directly impacts the vulnerability assessment of an aquifer.