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Classifying airborne radiometry data with Agglomerative Hierarchical Clustering : a tool for geology and regolith mapping

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In highly weathered environment, it is crucial that geological maps provide information concerning both the regolith and the bedrock. For the purpose of societal needs such as land-use, mineral or water resources management, geologists are often facing the challenge of upgrading existing maps whereas relevant information concerning weathering processes and pedogenesis are currently missing. In rugged areas in particular, where access to the field is difficult, only very partial ground observations are available, and need therefore to be complemented using methods based on remotely-sensed data. For this purpose, we discuss the use of Agglomerative Hierarchical Clustering (AHC) on airborne gamma-ray spectrometry gridded data (U, K and Th). The AHC process allows primarily to segment the geophysical maps into zones having coherent U, K and Th contents. The analysis of these contents in terms of lithological attribution of classes, as well as the use of a dendrogram which gives indications on the hierarchical relations between classes, are discussed. The unsupervised classification maps performed by AHC can be considered as spatial models of the distribution of the radioelement content in the sub-surface. The source of gamma-rays emanating from the ground is related to the geochemistry of the bedrock and to modifications of the radioelement distribution by weathering and other secondary mechanisms. The interpretation of the obtained predictive maps, U, K, Th contents, and dendrogram, in light of available geological knowledge, allows to separate signatures related to regolith and solid geology. Consequently, classification maps can be integrated within GIS and used by the geologist as a support, for mapping the lithologies and alteration.

Use of the method is illustrated in the region of Cayenne (French Guiana), based on high resolution airborne radiometric data recorded in 1996. Despite the vegetal cover,

classification of the radiometric data is globally concordant with existing 1:100.000-scale geological map. In addition, using the radioelement contents and relations between classes at different levels of classification, additional relevant information concerning weathering effects, unexpected lithological differences, or transfer by erosion, are evidenced.