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Multi-scale analysis of the spatial variability of the snow water equivalent (SWE) over Eastern Canada

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Snow cover is a key factor in the climate system and the hydrologic cycle in Eastern Canada (Quebec and Labrador). Snow survey network still the main source of data on snow in this vast territory. However, data from stations are only representative of local phenomena. In addition, the density and spatial distribution of the network are not optimal. Therefore, in its current configuration, the network offers a fragmentary view of the phenomenon and does not adequately represent its spatial variability at the regional scale. Indeed, the characteristics of the spatial variability of snow cover (spatial scales, spatial structures and spatial discontinuities) are often non-linear and complex to model. This is an important source of error in spatialisation of physical parameters of snow cover (density, thickness and snow water equivalent). It is therefore fundamental to a better estimation, integrating the characteristics of the spatial variability in spatial modelling of snow physical parameters. Moreover, due to the fragmentary knowledge of the phenomenon, it is recommended to adopt a functional approach that integrates the underlying processes that control its spatial variability. Indeed, the spatial variability of snow cover is under the influence of environmental factors (local and regional). The latter, commonly available in all parts of the territory, are responsible for the underlying processes that generate spatial structures. They are thus responsible for the existence of homogeneous spatial units forming a strong contrast with the spatial structures surrounding areas. The main objective of this study is to analyze the multi-scale spatial variability of SWE. First, the spatial variability of SWE compared to regional environmental factors (latitude, longitude, altitude and distance to the ocean) and local (slope, curvature slopes, solar radiation, orientation, etc.) was analyzed. Local indices to characterize different spatial structures were also calculated. Subsequently, the geographical areas with homogeneous spatial structures were delineated using a segmentation approach multi-spatial resolutions, integrating the weight of explanatory factors. The weight factors were determined by multivariate statistical analysis. The results of segmentation were validated using nonparametric statistical test (Kruskal-Wallis) applied to the data of the EEN of each pair of adjacent geographic areas. At the regional level, spatial segmentation has identified six geographic zones distinguished by the disposition of large relief. At the local level, spatial segmentation has highlighted the role of physiographic factors in the spatial variability of snow cover (slope, curvature and occupation of land).