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Identifying the scale-specific and localized multivariate control relationships in distribution of soil organic matter based on multiple wavelet coherence

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Obtaining the relationships between soil organic matter (SOM) and environmental factors are essential for mapping the distribution of SOM and reducing the uncertainty in modelling terrestrial carbon cycle. Previous studies have explored scale- and location- dependent relationships between SOM and individual factors. However, the SOM formation is controlled by a suit of environmental variables, and studies on multivariate control relationships in SOM spatial distribution are rare, especially in large area. In our study, multivariate controls of SOM at different scales and locations along two long transects (northeast transect and north transect) in China were identified using bivariate wavelet coherency and multiple wavelet coherence. The performance of individual factor and factor combinations in revealing scale-specific and localized SOM variations was assessed by the average coherence (AC) and percent area of significant coherence relative to the whole wavelet scale-location domain (PASC). It was found that daily land surface temperature (LST_D) with a greatest value of AC (0.38) and PASC (4.20) is the best individual factor for explaining SOM variations along the northeast transect. Along the north transect, topographic wetness index (TWI) is the best (AC=0.39 and PASC=18.65). Multiple wavelet coherence identified a combination of LST_D, slope and mean annual precipitation (MAP) was the best at explaining SOM variations along the northeast transect with an dramatically increase in AC and PASC at different scales and locations (i.e. AC increased to 0.80 and PASC to 10.00 at all scales). The combination of combination of TWI and net primary production (NPP) and slope was the best along the north transect (AC=0.73 and PASC=15.54). The results indicated that combined and localized effects of environmental factors on SOM distribution at different scales and locations in large area, and provided a way in better understanding the multivariate controls in SOM distribution concurrently.