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研究论文

基于小波变换的NDVI与地形因子多尺度空间相关分析

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摘要 以西藏高原生态系统的NDVI(Normalized Difference Vegetation Index)及其地形影响因子为分析对象，使用小波变换揭示了其多尺度空间格局。通过小波方差尺度图可以辨识出，在研究区域内NDVI及其地形因子存在着4、12 km和25 km等多尺度变异格局。小波多尺度相关分析是对普通相关的一种拓展，使用小波系数分尺度计算了NDVI及其影响因素的相关系数，并与普通相关进行了比较。结果表明，4种地形因子（海拔高度、坡度、坡向和CTI）不论是正相关还是负相关，在较小尺度上与NDVI的相关系数都比较小，一般情况是尺度增大，相关性增大。这反映了地形因子作为大的宏观制约因素对NDVI起作用。实践证明，小波分析对于揭示自然要素的多尺度空间结构和各向异性是一种强有力的工具。

关键词 小波变换；多尺度空间分析；NDVI；DEM；西藏高原

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Multi-scale spatial analysis on NDVI and topographical factors using wavelet transform

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Abstract It is now widely recognized that ecological analysis results are sensitive to the resolution of the source data. Wavelet transform is a fashionable tool of solving scale transform in geosciences and ecology due to their advantages of multi-resolution. In this study, the wavelet transform was applied to analyze the correlations between NDVI (Normalized Difference Vegetation Index) and topographic factors on different scales in the Tibet Plateau. By discrete wavelet transform for spatial sampling data along longitude 87°E and 90°E, latitude 30°N and 33°N, multi-scale patterns of NDVI and DEM were examined. Daubechies wavelet, a compactly supported wavelet with extremal phase and highest number of vanishing moments, was chosen as a mother function to decompose the NDVI and the geographical factors into multi-scale wavelet coefficients respectively according to the source data pattern. The results of wavelet coefficient variograms show that NDVI spatial patterns exist two dominant scales of 4 km and 25 km, and a co-dominant scale of 12 km in longitude and latitude directions. Topographical indicator DEM exhibits a dominant spatial scale of 12 km in latitude direction, and a dominant spatial scale of 25 km in longitude direction. The fact of synchronous variance peak of 25 km in 93°E suggests that tightly-coupled relationship exists between NDVI and DEM.
Multi-scale correlation relationships among NDVI and geographical factors were also examined by using sampling data of spatial resolution 0.1°. Results suggest that the correlation is scale-dependent, i.e. different scales have different coefficients among the factors. Ihe coefficient values between NDVI and topographical factors such as elevation, CTI (Compound Topographic Index), aspect and slope are larger in coarser scales than those in finer scales, which suggest that topographic

al factors have important roles on controlling NDVI patterns in a larger scale.

Key words wavelet transform； spatial multi-scale analysis； DEM； NDVI； Tibet Plateau

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