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Downscaling land surface temperature by using a multivariable random forest model: a case study for various land cover in China

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Land surface temperature (LST), described as one of the most important environmental parameters in regional and global scales, has played an essential role on material cycle and energy exchange in terrestrial ecosystem. However, as the trade-off between spatial and temporal resolution of the remote sensed LST products, many downscaling algorithms have been proposed to generate the LST products with both high spatial and temporal resolution. The typical downscaling models, usually trained on specific area, are often region-restricted, which cannot be applied to other study areas or may show a disappointed result. In this paper, a multivariable random forest (MRF) model is developed to downscale the LST product of MODIS from 1km to 100m in China. This MRF model is trained with multi-type predictor variables, including reflectance, terrain factors, spectral indices, land cover types and local climate variables. Multi-type regions in China such as mountains, flatlands, wetlands as well as metropolis will be used to evaluate the performance of the developed MRF model. The LST of any kind of regions can be downscaled from 1km to 100m with pretty good accuracy. It is worth mentioning that the introduction of NCEP/NCAR reanalysis data as the local climate variables helps depict the difference of land surface basic characteristics so that the MRF model becomes more regionally robust. The result shows that: (1) The MRF model achieves more satisfactory accuracies than typical algorithms like TsHARP in specific region. (2) With a large number of multiple samples being trained, the fitting accuracy, the prediction accuracy of the model, as well as the correlation coefficient have been improved significantly. The predicted LSTs yield the accepted accuracies even for the regions with complicated land cover types, such as downtown areas, which cannot be achieved absolutely by TsHARP method.