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An Analysis of the Spatial Scaling Property of Land Surface Fluxes over a Typical Underlying Surface in the Northern Tibetan Plateau

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The influence of spatial scales on surface fluxes is an interesting but not a fully investigated question. This paper presents an analysis of the influence of spatial scales on surface fluxes in the north Tibetan Plateau based on in situ measurement and remote sensing. The analysis shows that sensible heat fluxes calculated with large aperture scintillometer data (H_LAS) agree reasonably well with sensible heat fluxes calculated with eddy covariance data (H_EC) in the rain and dry seasons. The agreement between H_EC and H_LAS is influenced by the agreement of land surface conditions of EC and LAS footprints. A significant relationship between the difference in footprint-weighted averages of land surface temperature (LST) and the difference in H_EC and H_LAS suggests that the spatial heterogeneity in LST at two spatial scales is a reason for the differences in H_EC and H_LAS and that LST has a positive correlation with the differences in H_EC and H_LAS. A significant relationship between the footprint-weighted averages of NDVI and the ratio of sensible heat fluxes at two spatial scales to net radiation (H/Rn) in the rain season supports the analysis that the spatial heterogeneity in canopy at two spatial scales is another reason for differences in H_EC and H_LAS and that canopy has a negative correlation with (H/Rn). The spatial scaling of land surface conditions is analyzed with high spatial resolution LandSat Images and simple aggregation method. An analysis of the scaling property of land surface conditions reveals that the mean leaf area index (LAI) and mean land surface temperature (LST) of different spatial scales change significantly as the spatial scale increases. The analysis also indicates that the standard deviations of LAI and LST vary greatly at small spatial scales and become relatively stable at large spatial scales in rainy and dry seasons. An analysis of the scaling property of surface fluxes indicates that differences exist between the surface fluxes at different spatial scales, suggesting that the mismatch of spatial scales may introduce significant uncertainty in the validation of surface fluxes. The comparison between two kinds of upscaling surface fluxes indicates that simple aggregation is capable of producing reliable surface fluxes. The results from this study are helpful for further understanding the energy and water cycle over large areas of the Tibetan Plateau.