Surface Energy Balance Closure and its Significance in the Validation of Evapotranspiration Retrieved by Remote Sensing Algorithms

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Abstract:

During the comprehensive observational study of the WATER (Watershed Airborne Telemetry Experimental Research) project, six surface flux stations equipped with eddy-covariance (EC) system and relevant radiation and soil measurements were established in the Heihe River Basin. One to four years data were collected on different surfaces, including highland pasture, spruce forest, oasis cropland, wetland, and Gobi desert, etc. Higher data quality are assured by careful instrument maintenance, periodic calibration, as well as a post field processing for raw turbulent data with an improved procedure of eddy-covariance flux calculation. Footprint climatology analysis has been done for each station. Two Large Aperture Scintillometer (LAS) flux systems were working in the highland pasture and wetland stations respectively, to compare with the point EC flux observation and extend the results to a scale of 1 to a few kilometers.

Surface energy balance closure problem has been analyzed for different flux stations. With careful EC flux calculations (including high and low frequency corrections) and an evaluation of the storage terms in the top soil layer and vegetation canopy, higher than 90% energy balance closure could be reached. Then, assuming the 'scale' deficiency is similar for both sensible and latent heat fluxes, a 'Bowen-ratio similarity' procedure is used to close the surface energy balance terms.

'Surface energy balance closure' has been one of the main difficulties in the validation of remote sensing retrieved evapotranspiration (ET) with surface especially eddy-covariance observations. It is also essential for a basin-scale study of ET distributions (both temporal and spatial) with satellite remote sensing. Different algorithms, such as the 'resistance-energy balance' method and a modified Penman-Monteith method, are used for this purpose, by using satellite data such as TM, ASTER, and MODIS. In a careful calibration with relevant surface observations, the ET remote sensing algorithm, particularly some parameterization schemes, are to be improved. The studies of basin scale water resources and ecological environment would have a better basis when the remote sensing estimation of ET is confidently validated.