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The progress on the study of land surface heat fluxes over heterogeneous landscape of the Tibetan Plateau

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The Tibetan Plateau is often called the "Third Pole" of the earth due to its significance parallel with Antarctica and the Arctic. As a unique geological and geographical unit, the Tibetan Plateau dramatically impacts the world's environment and especially controls climatic and environmental changes in China, Asia or even in the Northern Hemisphere. Due to its heterogeneous topographic characteristics, the plateau surface absorbs a large amount of solar radiation energy, and undergoes dramatic seasonal changes of surface heat and water fluxes. The lack of quantitative understanding of interactions between the land surface and atmosphere makes it difficult to understand the complete energy and water cycles over the Tibetan Plateau and their effects on global climate change with numerical models. The study on the regional distribution of land surface heat fluxes is of paramount importance for the study of interactions between the land surface and atmosphere over heterogeneous landscape of the Tibetan Plateau. How can we determine the regional heat fluxes over heterogeneous landscape of the Tibetan Plateau?

One way is to install as many fluxes measurement instruments as possible in the different land surfaces. The Institute of Tibetan Plateau Research (ITP) of the Chinese Academy of Sciences (CAS) is establishing a Tibetan plateau Observation and Research Platform (TORP) for the study of land surface and atmospheric processes on the Tibetan Plateau. At same time the CAMP/Tibet (CEOP (Coordinated Enhanced Observing Period) Asia-Australia Monsoon Project (CAMP) on the Tibetan Plateau, 2001-2010) stations (sites) are also working continually over the Tibetan Plateau area. Firstly, the establishing and monitoring plan of long-term scale (5-10 years) of the TORP and three new comprehensive observation and study stations will be introduced here. Some results on the local land surface fluxes partitioning (diurnal variation, inter-monthly variation, inter-yearly variation and vertical variation etc) over the three new stations and the stations of the CAMP/Tibet will also be presented.

Another way is to use satellite remote sensing. In this study, parameterization methods based on satellite data (NOAA/AVHRR, Landsat-7 ETM, ASTER and MODIS) and Atmospheric Boundary Layer (ABL) observations have been proposed and tested for deriving surface reflectance, surface temperature, NDVI, MSAVI, vegetation coverage, LAI, net radiation flux, soil heat flux, sensible heat flux and latent heat flux over heterogeneous landscape. As cases study, the methods were applied to the experimental area of the CAMP/Tibet (CEOP (Coordinated Enhanced Observing Period) Asia-Australia Monsoon Project (CAMP) on the Tibetan Plateau), which located at the central Tibetan Plateau and the whole Tibetan Plateau area. Five scenes of Landsat-7 ETM data, four scenes of NOAA/AVHRR data, four scenes of MODIS data and three scenes of ASTER data were used in this study. To validate the proposed methods, the ground-measured surface reflectance, surface temperature, net radiation flux, soil heat flux, sensible heat flux and latent heat flux are compared to satellite derived values. The results show that the derived surface variables and land surface heat fluxes over the study area are in good accordance with the land surface status. These parameters show a wide range due to the strong contrast of surface features. And the estimated land surface variables and land surface heat fluxes are in good agreement with ground measurements, and all their absolute percent difference is less than 10% in the validation sites. It is therefore concluded that the proposed methods are successful for the retrieval of land surface variables and land surface heat fluxes over the heterogeneous landscape of the Tibetan Plateau area.