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Estimating Air Temperature over the Tibetan Plateau Using MODIS Data

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Abstract Time series of MODIS land surface temperature (LST) data and normalized difference vegetation index (NDVI) data, combined with digital elevation model (DEM) and meterological data for 2001-2012, were used to estimate and map the spatial distribution of monthly mean air temperature over the Tibatan Plateau (TP). Time series and regression analysis of monthly mean land surface temperature (Ts) and air temperature (Ta) were both conducted by ordinary liner regression (OLR) and geographical weighted regression (GWR) methods. Analysis showed that GWR method had much better result (Adjusted R^2 > 0.79, root mean square error (RMSE) is between 0.51˚C and 1.12˚C) for estimating Ta than OLR method. The GWR model, with MODIS LST, NDVI and altitude as independent variables, was used to estimate Ta over the Tibetan Plateau. All GWR models in each month were tested by F-test with significant level of α=0.01 and the regression coefficients were all tested by T-test with significant level of α=0.01. This illustrated that Ts, NDVI and altitude play an important role on estimating Ta over the Tibetan Plateau. Finally, the major conclusions are as follows: (1) GWR method has higher accuracy for estimating Ta than OLR (Adjusted R^2=0.40∼0.78, RMSE=1.60∼4.38˚C), and the Ta control precision can be up to 1.12˚C. (2) Over the Northern TP, the range of Ta variation in January is -29.28 ∼ -5.0˚C, and that in July is -0.53 ∼ 14.0˚C. Ta in summer half year (from May to October) is between -15.92 ∼ 14.0˚C. From October on, 0˚C isothermal level is gradually declining from the altitude of 4∼5 kilometers, and hits the bottom with altitude of 3200 meters in December, and Ta is all under 0˚C in January. 10˚C isothermal level gradually starts rising from the altitude of 3200 meters from May, and reaches the highest level with altitude of 4∼5 kilometers in July. In addition, Ta in south slope of the Tanggula Mountains is obviously higher than that in the north slope. Ta in east of Qinghai-Tibet Railway is higher than that in the west, and Ta shows an increasing tendency from northwest to southeast. (3) Over the Northern TP, the variation range of the difference between surface and air temperature (DT) in January is -6.52∼6.0˚C, and that in July is -6.32∼6.0˚C. DT in summer half year (from May to October) is between -6.34∼8.0˚C, and DT along Qinghai-Tibet Railway is greater than that in the east and west areas of Qinghai-Tibet Railway. However, except of the southeastern area of the Northern TP, where DT is under 0˚C, DT values in other areas are all more than 0˚C in winter half year. In summer half year, the altitude of the area lower than 0˚C rises to 4∼5 kilometers, and DT in south of the Tanggula Mountains is between -2.0˚C and 0˚C.