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Analysis of the Temporal-Spatial Characteristics of Cloud Parameters and the Relationship with the Precipitation over Qilian Mountains Area in Northwest China

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Qilian mountains, located in the arid and semi-arid region of Northwest China, has more amount of natural precipitation than that on both north and south sides, with unique geographical environment and abundant water vapor supply. It is a very important water resource for the surrounding areas. To deeper understand the features of cloud over the areas is significant for the utilization of cloud water resources and sustainable development in this region. In this article, based on MOD08-M3 data, grid ground precipitation data and FY-2 series satellite cloud parameter inversion products, the spatial and temporal features of cloud macro/micro physical parameters, such as Cloud Amount [CA], Cloud Water Path [CWP], Cloud Top Temperature [CTT], Cloud Top Pressure [CTP], Cloud Optical Depth [COD] and Cloud Particle Effective Radius (CPE) over Qilian Mountains area were analyzed, as well as the relationship between the precipitation and cloud parameters. The results are as follows:

- (1) The regional average values of CA, CWP, CTP, COD and CPE in Qilian Mountains area are 55.50 %, 148.95 g/m², -21.13 °C, 456.56 hPa, 12.64 and 21.04 μm, respectively. From 2006 to 2015, CA, CWP, COD and CPE decreased by 2.3 %, 21 g/m², 0.68 and 0.51 μm, respectively. CTT and CTP increased by 1.9 °C and 65.2 hPa, respectively. Cloud water resources over the area are abundant.
- (2) There is the richest cloud water resource over the main area of Qilian Mountains, and the cloud parameter condition in Wushaoling area is the best for precipitation. The high value areas of CA in four seasons are distributed in Xining and surroundings, main and south part of mountain range, and Lenghu area, respectively. The high value areas of CWP in four seasons are located in the northeast, north-middle the main part of mountain area and the eastern side of Subei, respectively. The high value areas of COD are located in the east of Subei in winter and in the southeast of the study area in other seasons. The high value areas of CPE in spring are located in the region except Hexi Corridor. In other seasons they are located between Lenghu and Subei, Subei and Tuole, and in the northeast of range, respectively.
- (3) The monthly precipitation is positively correlated with CA, CWP, COD, but negatively correlated with CTT and CTP. The relationship between CPEs and precipitation is positive in January, April, July, November and December, but negative in other months. CA and CPEs are

most correlated with precipitation in May and September, respectively. while the correlation between other cloud parameters and precipitation are the highest in January.

- (4) When the values of COD and CPER are too small or too large, the actual precipitation will be limited.

Key words: Cloud physical parameters; Precipitation; Water resource; Qilian Mountains