



Solar effect on water level change of Hulun lake at northeast of China

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Water level measurements of Hulun lake, from 1961 to 2010, were taken to carry out correlation analysis with solar activity indices. It was found that 11 years smoothed sun spot number has a positive relationship with the water level of the lake. The relation coefficient reached its maximum, 0.75, when water level serial was shifted 8 years forward. According to literature records, the water level time serial was extended back to 1905. For the extended water level serial, a more remarkable solar effect was found with a relation coefficient up to 0.86. Also, other solar activity indices like F10.7, total solar insolation (TSI) and cosmic ray flux show similar correlation with the water level change, indicating that on decadal scale stronger solar activity leads to higher water level. Wavelet analysis shows both the solar activity and the water level change of Hulun lake have an apparent component with period of 80~90 years. Meteorologic data from the catchment indicates solar activity had affected local precipitation that subsequently determining the run off of the two inflow rivers of Hulun lake, eventually lead to fluctuation of water level. Meteorologic data also show that the regional precipitation in summer and that in winter changed in a negative relationship pattern. Southern oscillation index (SOI) and northern Atlantic oscillation index were taken to do relation analysis. A resulting plus relation coefficient for SOI and minus relation coefficient for NAOI unveiled the mechanism behind the relationship between solar activity and water level of Hulun lake. The lake, located at brim of domains of both westerly and east Asia monsoon, is very sensitive to multiple climate systems. In winter, westerly is dominant in Hulun lake region. While in summer, east Asia monsoon brings most precipitation to the region. Strong solar activity usually brings southern oscillation index (SOI) into positive phases. Subsequently more intense east Asia monsoon and more summer precipitation can be expected. On the other hand, strong solar activity brings northern Atlantic oscillation index into negative phases, that leads to weaker westerly and less winter precipitation in the region. Since summer precipitation is absolutely dominant within a year, stronger solar activity will lead to more precipitation, higher water level of Hulun lake.