Geophysical Research Abstracts
Vol. 18, EGU2016-3670, 2016
EGU General Assembly 2016

Analysis of lake-air heat and water transfer processes in a high-altitude shallow lake on the Tibetan Plateau

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With an estimated 32,843 total lakes on the Tibetan Plateau, lakes play an important role in the water cycle and energy budget of the "Third Pole" area. Due to a lack of observational data and adequate modelling systems, lake-air momentum, heat and water vapour transfer process is poorly understood for high-altitude lakes on the Tibetan Plateau. By using eddy covariance observation data in a high-altitude shallow small lake from April 2012 to October 2014, lake-air energy and mass transfer process is carefully analysed and simulated. Our main findings are as follows: (1), our observations are dominated by unstable and near neutral atmosphere conditions, corresponding to the observed large temperature gradients and strong winds;(2), the bulk transfer coefficient and roughness length for water are higher than those for heat, and free convection gives a square root dependence of latent heat flux on wind speed; (3), the influencing factors for latent heat flux and sensible heat flux under different atmosphere stability is different; (4), the shape of the lake can influence the roughness length for momentum through the difference in its lake depth or fetch length;(5) the commonly-used roughness length for momentum with sea parameters will cause an underestimation of lake-air latent and sensible heat flux simulation, and the appropriate Charnock coefficient and roughness Reynolds number are estimated to be 0.031 and 0.54, respectively, by our observation.