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

Binbin Wang (1,2), Yaoming Ma (1), Bob Su (2), Xuelong Chen (2), Weiqiang Ma (1), and Massimo Menenti (3)
(1) Institute of Tibetan Plateau Research, Chinese Academy of Sciences, Beijing, China, (2) Faculty of Geo-Information Science and Earth Observation, University of Twente, Enschede, The Netherlands, (3) Delft University of Technology, Delft, The Netherlands

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.