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Carbon dioxide and energy fluxes over a large shallow lake in China

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The turbulent exchange of carbon dioxide and energy between water and atmosphere over lakes differ from those over vegetated surfaces due to high heat capacity of water and different water ecological environment. For a shallow lake, the underlying surface generally changes between water covered and land covered with water level fluctuation, which significantly influences carbon dioxide and energy fluxes. Continuous measurement of the carbon dioxide (CO_2), latent (LE) and sensible (H) heat fluxes was made using the eddy covariance method over the Poyang Lake, the largest fresh lake in China, from August 2013 to December 2015. Results indicated that the surface energy budget has a strong seasonal pattern, with peaks in LE and H observed in early August and September. There was 10 days delay between the net radiation and the latent heat flux. More net radiation (Rn) was allocated to the LE rather than H through the year, with monthly mean LE/Rn of 0.65 and H/Rn of 0.11, which caused Bowen ratio was 0.15 in water-covered period, lower than that in land-covered period. The water heat storage experienced shifting from heat storage to heat release, with maximum heat storage in July and maximum heat release in September. The water heat advection was account for 4% to 10% of Rn and peaked in June. The annual evaporation is 875 mm, 893 mm and 1019 mm in 2013 (from August 2013 to July 2014), 2014 and 2015, which was account for approximately 57% of precipitation in the three years. The large lake acted as a CO_2 source in inundating period and a CO_2 sink in exposure period. The energy fluxes were controlled by environmental factors with timescale dependence. On daily scale, the LE and H were highly correlated with product of wind speed and vapor pressure deficit (UVPD) or wind speed (U) in the water-covered period, and with Rn in the land-covered period. Monthly LE, H and annual H were controlled by Rn, while annual LE was primarily dependent on water depth. Annual CO_2 budget was regulated by duration of inundating period.