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Is global hydrological cycle accelerating at the centennial scale? A perspective from land evapotranspiration

N. Ma [a], **Y. Zhang** [a] **and J. Szilagyi** [b]

[a] *Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing, China*
[b] *Budapest University of Technology and Economics, Budapest, Hungary*
Email: ningma@igsnrr.ac.cn

Abstract: Variations in land evapotranspiration (ET) is a key indicator of understanding how hydrological cycle responses to ongoing climate change. Most, if not all, of current global ET trend studies are limited in past few decades (e.g., 1980s onwards), while the trend in ET over a longer period (especially prior to 1980s) remains less understood. Here we used the calibration-free complementary relationship (CR) method to quantify the changes in ET over last century. Multiple-scale validations against basin-scale water balance estimates suggest that the CR is accurate in describing the magnitude and trend in ET at the centennial scale. We show that global ET increased significantly with a rate of 0.09 mm/yr^{-2} during 1901–2014. The increase is more apparent after the mid-1960s, leading to a rate of 0.17 mm/yr^{-2} during 1965–2014, which is triple the one during 1901–1965 (~0.05 mm/yr^{-2}). The faster increase in ET is corresponding to the period during which air temperature (T) increased also at a faster rate. The change rate of ET to T remains 2% °C^{-1} in past 114 years and it varies little until past 45 years. However, the change rate of ET to T increased to >3% in past 35 years, reaching to 5% in past 15 years. The results presented here indicate the hydrological cycle has intensified substantially under a warming climate.

Keywords: *Land evapotranspiration, hydrological cycle, centennial scale*