Problem: The ocean plays a dominant role in the global water cycle. It is the center of action for global evaporation and precipitation, and supplies the moisture that falls as continental precipitation. It also acts to some extent as Nature’s rain gauge as sea surface salinity (SSS) integrates the complex multifactorial variations in the water cycle (Fig.1). Despite the evidence of an intensified global water cycle under the global warming, two important questions remain: What is the pattern of the warming-induced intensification of the water cycle? And what is the rate of the intensification? This article provides a synthesis review of recent progress in diagnosing and understanding the changes in both the global water cycle and ocean salinity.

Significance: Given the sensitivity of salinity to freshwater transport into and out of the ocean, the use of ocean salinity observations to fingerprint the changes of the hydrological cycle stands as a logical and practical alternative to satellite-derived rainfall and evaporation estimates. Yet, there remain many unanswered questions regarding the role of ocean dynamical processes in relating SSS to the E–P flux.

Key Points:

(1) Significant uncertainties still remain in the current estimates of $E, P$, in satellite-derived products (OAFlux–GPCP) and the latest atmospheric reanalyses (ERAS5, JRA55, and MERRA2), leading to large uncertainty in their balance over the global ocean and in the length of time series needed for assessing possible long-term trends related to climate warming (Fig.2).

(2) Modeling studies show that the processes responsible for amplification of the ocean salinity pattern are not as straightforward as a simple response to changes in the E–P field as ocean warming and ice melt also play a role (Fig.3).

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