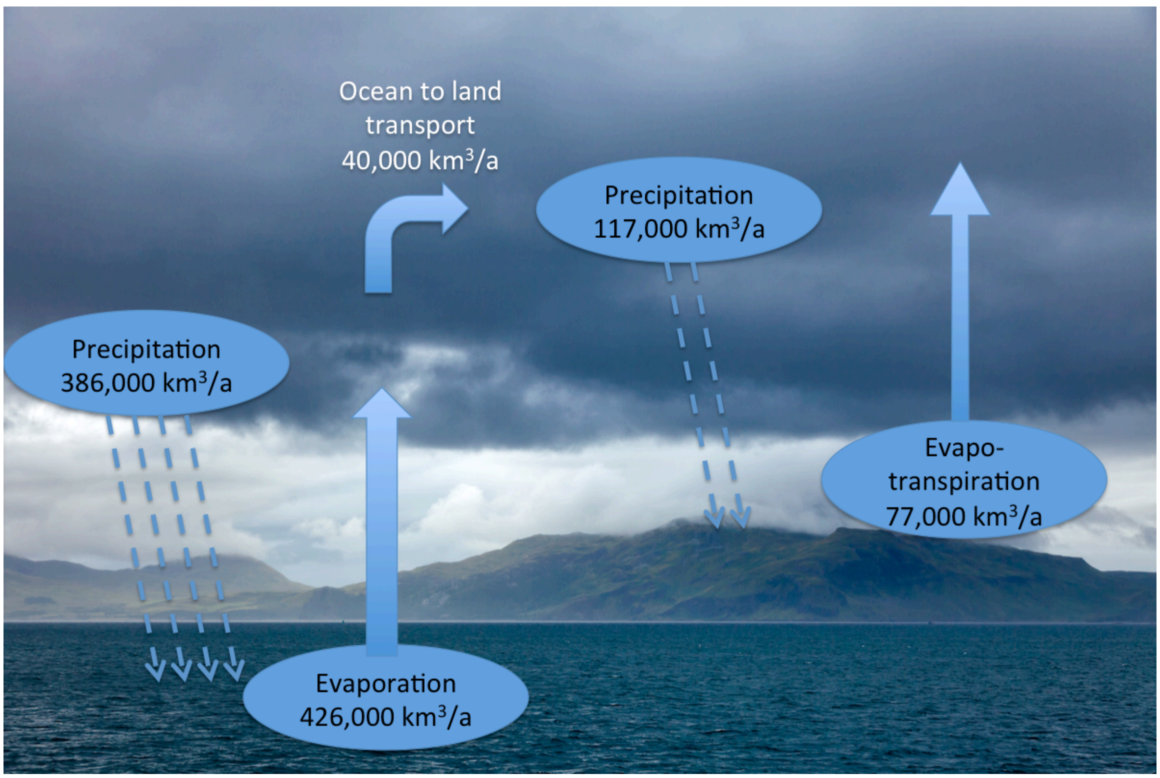
Evaporation to the rescue?

Technically, as used by Trenberth (*) this includes transpiration by plants together with land and sea-surface evaporation. We will just call it evaporation here. Evaporation requires a heat input, as for example when boiling a pan of water. When evaporation takes place at the ocean surface the "latent heat of evaporation" is provided by available heat in the ocean, resulting in a cooling effect. In order to quantify this cooling we need to know the evaporation rate. A summary of global evaporation is given by Schneider et al (**). Over the whole planet the figures are impressively large, with evaporation totaling 503,000 cubic kilometers of water per year (km^3/annum). Evaporation is balanced by precipitation of the same amount, however there is a precipitation deficit relative to evaporation over the oceans and an equal excess of 40,000 km^3/year over land, which mostly returns in rivers.



Knowing the density of water (1000kg/m^3), the latent heat of evaporation of water (2,260 kJ/kg), the area of the Earth (5.1 x 10^{14} m^2) and the number of seconds in a year (π x 10^7 to a good approximation), we quickly find that Q_E = 80W/m^2 is the average rate of removal of heat by evaporation from the Earth's surface, the same number as given by Trenberth (*) on our page 15. ("kJ" = kiloJoules and 1Joule/sec = 1W).

The question is: How does the rate of evaporation change in response to a temperature increase at Earth's surface? Will it increase as expected, and carry more heat away? The answer to this question has taxed climatologists for a few years now. Yes, the vapor pressure of water rises briskly with temperature by 6.5%