Neue Studie: Durch Ozean-Erwärmung sollte eigentlich Wasserdampf zunehmen – aber dieser nimmt seit 2008 ab

geschrieben von Chris Frey | 4. März 2025

Kenneth Richard

„Unsere Ergebnisse sind unerwartet: Trotz steigender Meerestemperaturen hat die globale Eo [Ozeanverdunstung/Wasserdampf] im letzten Jahrzehnt abgenommen.“ – Ma et al. (2025)

Eine 2024 in PNAS veröffentlichte Studie bestätigte erneut, dass Klimamodelle nicht simulieren können, was in der realen Welt in Bezug auf grundlegende Variablen des Klimawandels wie Wasserdampf geschieht, dem wichtigsten Treibhausgas der Erde (aufgrund seiner angeblich wärmeverstärkenden „Rückkopplungs“-Kapazität).

Nach den neuesten Klimamodellen sollte die spezifische Luftfeuchtigkeit (SH) als Folge der CO_2-induzierten globalen Erwärmung zunehmen. 40 Jahre Beobachtungen (1980-) zeigen jedoch keinen zunehmenden SH-Trend über ariden/semi-ariden Regionen.

Nach modernen Klimamodellen sollte die relative Luftfeuchtigkeit (RH) als Folge der CO_2-induzierten globalen Erwärmung relativ konstant bleiben, wenn nicht sogar leicht abnehmen. Doch 40 Jahre Beobachtungen (1980-) zeigen keinen leicht abnehmenden Trend, sondern einen abnehmenden Trend, der „im Durchschnitt um eine Größenordnung stärker ist als in den Modellen.“ Mit anderen Worten: Die Klimamodelle liegen um den Faktor 10 daneben.

Die Autoren haben die Tragweite dieser Klimamodellfehler nicht unterschätzt:

„Dies stellt eine große Lücke in unserem Verständnis und in der Klimamodelltreue dar, die so schnell wie möglich verstanden und behoben werden muss, um zuverlässige Hydroklima-Projektionen für aride/semi-aride Regionen in den kommenden Jahrzehnten zu liefern.“

PNAS RESEARCH ARTICLE | EARTH, ATMOSPHERIC, AND PLANETARY SCIENCES

Observed humidity trends in dry regions contradict climate models

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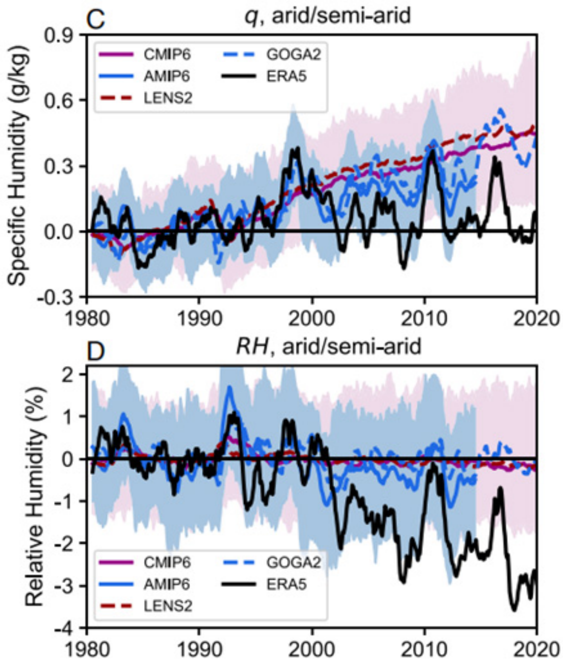
In association with this rise in temperature, atmospheric specific humidity increases in the models (Fig. 5C), and only a very small decline in relative humidity occurs (Fig. 5D). This is in sharp contrast to the observation-based record, where specific humidity has not risen and relative humidity has declined by about an order of magnitude more than the models on average.

Here, we have demonstrated a major discrepancy between observation-based and climate model-based historical trends in near-surface atmospheric water vapor in arid and semi-arid regions. Climate models suggest that water vapor should have increased over arid/semi-arid regions at a rate that is close to that expected from Clausius–Clapeyron scaling, on average. In reality, atmospheric water vapor over arid and semi-arid regions has essentially remained constant over the last four decades on average, which is strongly at odds with our model-based expectations.

This represents a major gap in our understanding and in climate model fidelity that must be understood and fixed as soon as possible in order to provide reliable hydroclimate projections for arid/semi-arid regions in the coming decades.



Quelle: Simpson et al., 2024

Nun hat eine neue Studie erneut bestätigt, dass es seit 2008, dem Jahr des „Wendepunkts“ (TP), einen „unerwarteten“ Rückgang der Ozeanverdunstung (die für 85 % der Ableitung des globalen atmosphärischen Wasserdampfs verantwortlich ist) gegeben hat.

Diese robusten Ergebnisse, die einen Rückgang der Ozeanverdunstung (Eo) oder des Wasserdampfs auf zwei Dritteln der Erde – hauptsächlich auf der Südhalbkugel – bestätigen, finden sich in allen vier für die Studie verwendeten Satellitendatensätzen.

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Recent Decline in Global Ocean Evaporation Due To Wind Stilling

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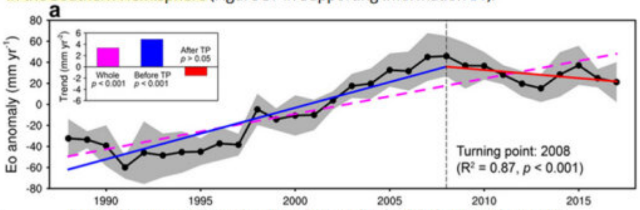
Accurately understanding changes in the hydrological cycle has profound implications not only for the scientific community but also for all life on the Earth. This is especially true for the ocean evaporation (E_o), the largest component of global hydrological cycle. Basic physics teaches us that evaporation rates tend to increase as the water heats up, so it seems logical to assume that global E_o would also increase in a warming world. However, recent studies have found a slowdown in the growth of global water vapor since roughly 2000s, calling for a closer look at recent E_o trends. Here, our study marks an important advancement by employing state-of-the-art satellite-based E_o estimates to explicitly quantify and attribute the global E_o tendencies in different periods. Our findings are unexpected: despite rising sea surface temperatures, global E_o has decreased in the most recent decade. This phenomenon is due primarily to the reduction in wind speed, likely linked to changes in atmospheric circulation patterns associated with Earth's decadal climate variability. These results offer a deeper understanding of the complex ways climate change is reshaping the planet's water cycle.

In a warming climate, it has been widely reported that global E_o strongly increased over the past three decades (Tang et al., 2024; Yu, 2007; Yu et al., 2020). However, recent studies found a weakened increase in global water vapor since roughly 2000s (O'Gorman et al., 2011; Wang et al., 2016; Xu et al., 2024; Yuan et al., 2019). For example, the latest Atmospheric Infrared Sounder instrument version 7 showed a marginal change in the global specific humidity at 400 hPa from 2002 to 2020 (Allan et al., 2022). As more than 85% of atmospheric water vapor is replenished by E_o (Oki & Kanae, 2006; Rodell et al., 2015), this phenomenon necessitates a re-examination of recent E_o changes.

The observed amplification of global E_o over the past three decades is not a surprise given the remarkable climate warming, as can be also seen from significant increase in *SST* (Figure S5 in Supporting Information S1). However, a decline in global E_o is evident in the most recent decade (Figure 1a). The piecewise linear regression of the global E_o time series identifies a statistically significant ($p < 0.001$, $R^2 = 0.87$) TP at 2008 (Figure 1a), after which global E_o slightly decreased ($p > 0.05$). This reversal, evident in the MEM of four satellite products, is robust, as similar contrasting tendencies are also observed in each individual satellite product (Figure S6 in Supporting Information S1), despite slight difference in the exact timing of TP. Notably, while the SeaFlux has a somewhat later TP (Figure S6b in Supporting Information S1), its E_o trend during 2008–2017 is negative too.

The spatial pattern of E_o trends across global ocean after the TP (i.e., 2008–2017, Figure 1d) differs markedly from the trends observed over the entire period of 1988–2017 (Figure 1b) and over the period before the TP (i.e., 1988–2008, Figure 1c). During 2008–2017, approximately two-thirds of the global ocean experienced declines in E_o (Figure 1d), mainly in the Southern Hemisphere (Figure S7 in Supporting Information S1).

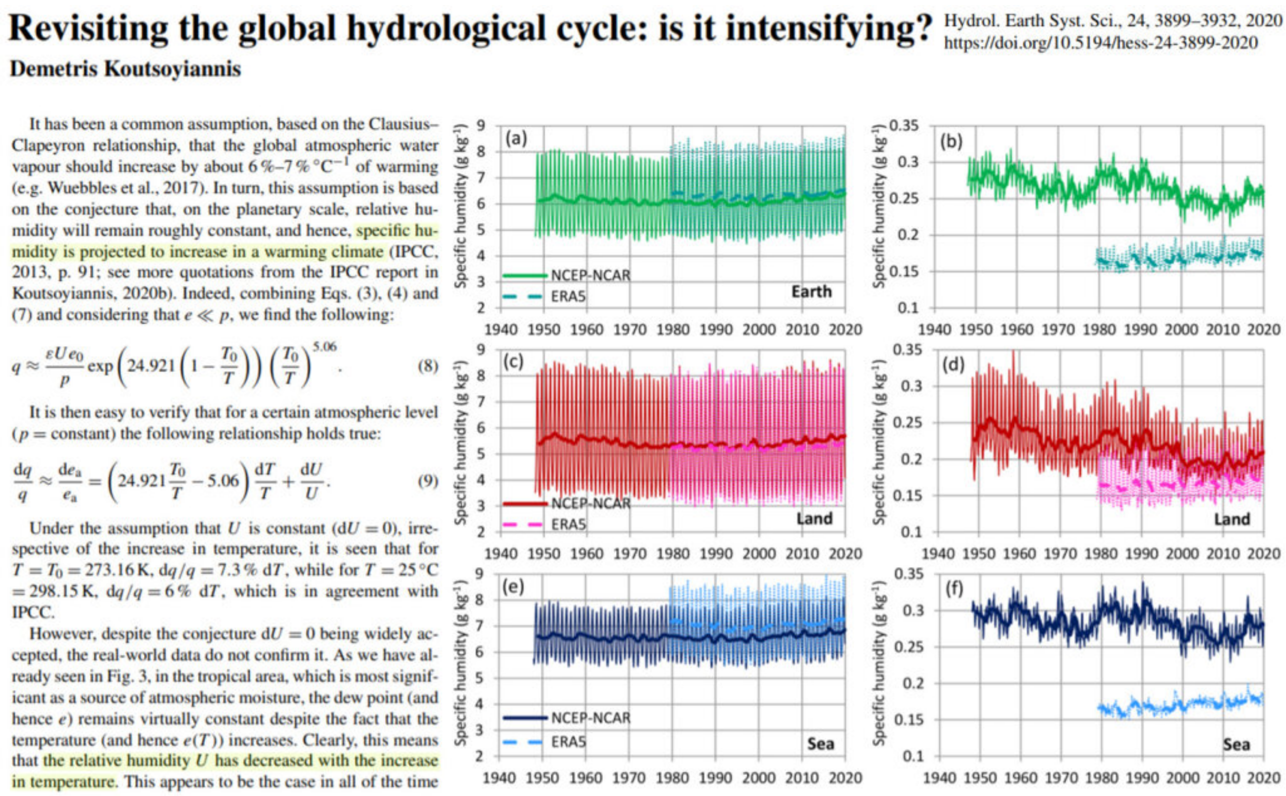


Reversal in ocean evaporation (E_o). (a) Anomalies in global-averaged annual E_o during 1988–2017. The black dot-line represents the ensemble mean of four satellite products, while the gray shading indicates ±1 standard deviation across these products. A statistically significant turning point (TP) in 2008 (vertical dash line) was detected by the piecewise linear regression. Trends for the whole period of 1988–2017 (magenta) and for the periods before (1988–2008, blue) and after TP (2008–2017, red) are illustrated.

Quelle: Ma et al., 2025

Es sei darauf hingewiesen, dass Dr. Koutsoyiannis im Jahr 2020 eine Studie veröffentlicht hat, aus der hervorgeht, dass das Ausbleiben eines vom Modell erwarteten Anstiegs der globalen spezifischen Luftfeuchtigkeit nicht erst seit 2008 oder 1980, sondern bereits seit Ende der 1940er Jahren zu beobachten ist.

Die Beobachtungen scheinen nicht in Einklang zu stehen mit dem Narrativ der „Wasserdampf-Rückkopplung“.



Revisiting the global hydrological cycle: is it intensifying?

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Demetris Koutsoyiannis

It has been a common assumption, based on the Clausius–Clapeyron relationship, that the global atmospheric water vapour should increase by about 6 %–7 % °C^{-1} of warming (e.g. Wuebbles et al., 2017). In turn, this assumption is based on the conjecture that, on the planetary scale, relative humidity will remain roughly constant, and hence, specific humidity is projected to increase in a warming climate (IPCC, 2013, p. 91; see more quotations from the IPCC report in Koutsoyiannis, 2020b). Indeed, combining Eqs. (3), (4) and (7) and considering that $e \ll p$, we find the following:

$$q \approx \frac{\varepsilon U e_0}{p} \exp\left(24.921\left(1-\frac{T_0}{T}\right)\right)\left(\frac{T_0}{T}\right)^{5.06}. \qquad (8)$$

It is then easy to verify that for a certain atmospheric level ($p =$ constant) the following relationship holds true:

$$\frac{dq}{q} \approx \frac{de_a}{e_a} = \left(24.921\frac{T_0}{T} - 5.06\right)\frac{dT}{T} + \frac{dU}{U}. \qquad (9)$$

Under the assumption that U is constant ($dU = 0$), irrespective of the increase in temperature, it is seen that for $T = T_0 = 273.16$ K, $dq/q = 7.3\,\%\ dT$, while for $T = 25\,°C = 298.15$ K, $dq/q = 6\,\%\ dT$, which is in agreement with IPCC.

However, despite the conjecture $dU = 0$ being widely accepted, the real-world data do not confirm it. As we have already seen in Fig. 3, in the tropical area, which is most significant as a source of atmospheric moisture, the dew point (and hence e) remains virtually constant despite the fact that the temperature (and hence $e(T)$) increases. Clearly, this means that the relative humidity U has decreased with the increase in temperature. This appears to be the case in all of the time

Quelle: Koutsoyiannis, 2020

Link:
https://notrickszone.com/2025/02/24/new-study-ocean-warming-is-supposed-to-increase-water-vapor-but-its-been-declining-since-2008/

Übersetzt von Christian Freuer für das EIKE