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Opinion Wind energy neither green nor renewable

Are the climatic effects of wind power utilization underestimated?

An often repeated narrative in connection with extreme rainfall is: "Warm air can absorb more water vapor, which increases the potential for heavy precipitation." But does evaporation really increase or can something that sounds coherent and seems physically correct also be wrong?

The sun, wind and clouds play crucial roles in the Earth's water cycle. Human intervention in this system is not without consequences *Photo: wirbnbrinf/iStock*

By Manfred Brugger| January 25, 2025

The Global Water Monitor Summary Report 2024 is a statistical compilation of data on the global water cycle. As expected, the researchers point to climate change and rising temperatures as the cause of extreme weather events such as regional droughts or heavy rainfall.

However, they forgot the wind. While heat leads to the evaporation of water, the wind is the motor of the water cycle that distributes the invisible water vapor.

Everything in interaction

Depending on its energetic state, water exists in solid (ice), liquid (water) and gaseous (steam) states. The effect of evaporation and the need for a continuous supply of energy are familiar to everyone from the cooking pot.

In nature, the process of evaporation or vaporization takes place in a similar way, with the sun playing the role of the stove. Although the sun's energy fluctuates slightly, it is constant on average and is defined as a fixed value in the solar constant.

Water also evaporates at lower temperatures, as is known from drying laundry in the air. This also requires energy, which is referred to as heat of evaporation. At 15 degrees Celsius, it amounts to 2,460 kilojoules per kilogram (kJ/kg) of water. When bathing in a windy environment, the effect of evaporative cooling can be easily felt on wet skin.

The enthalpy of vaporization required for water is therefore around 2,500 times higher than the energy required to heat the same amount of air. This means that if water or moisture is available for evaporation, the air heats up more slowly.

Greater evaporation lowers temperatures

Plants use evaporation to regulate their temperature. This is why it is always cool in forests at high temperatures. Only when there is no more water available for evaporation through the leaves does the plant dry out and die.

Evaporation requires large amounts of energy. So, if the narrative mentioned at the beginning is to be true, then the energy required to heat the air and evaporate the water at the same time must come from somewhere.

However, since the sun's energy does not change, the narrative cannot be true. After all, we have had the situation with higher solar radiation around the intra-tropical convergence zone around the equator for centuries.

Due to the higher evaporation, temperatures are constant almost all year round and the evaporating water rains down over the rainforests. Higher temperatures therefore do not fit into the narrative, because more water means higher evaporation heat and therefore the temperature should fall. But this is not the case in our latitudes.

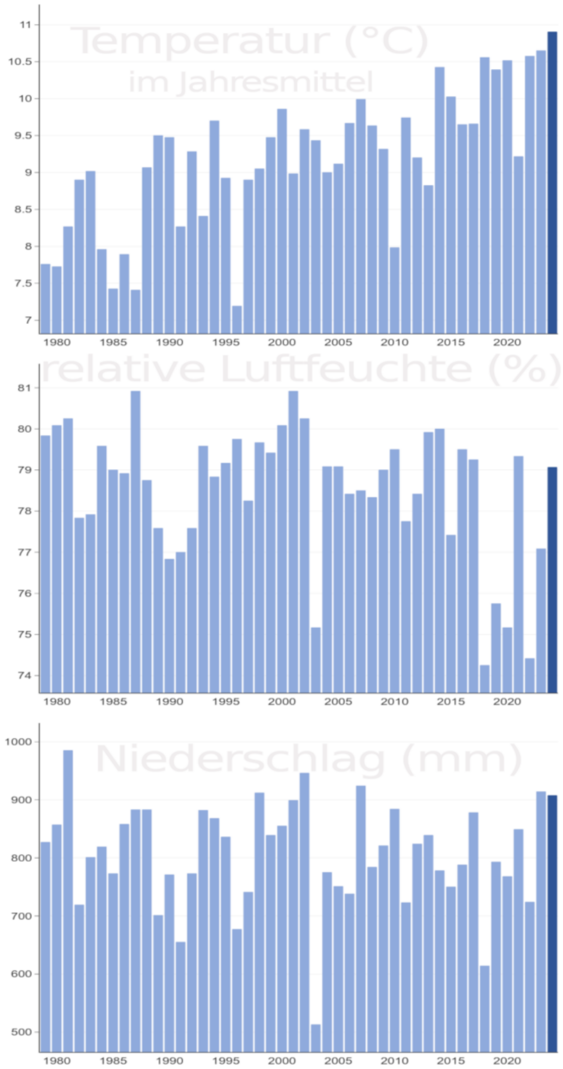
In our concrete-covered cities with paved and asphalted squares, where trees, green spaces and water are often completely absent, heating and heat build-up inevitably occur. Heat and drought are therefore always linked.

More water in the atmosphere?

It is generally known that warm air can absorb considerably more water vapor than cold air. The amount of maximum water vapor content in the air (saturation) is given as absolute humidity in grams per kilogram.

However, air is not usually saturated. The ratio of the current absolute humidity to the maximum possible humidity is expressed as a percentage as relative humidity. The relative humidity also changes with the temperature.

On the Global Water website, values can be generated from the data records for each country, starting from 1979. The development of temperatures, relative humidity and precipitation over Germany since then is as follows:



Rising temperatures and falling relative humidity indicate a constant amount of atmospheric water.

Photo: ts/Epoch Times after Global Water Project / Australian National University

Where does the energy for evaporation come from?

As warm, humid air rises into the cooler atmosphere, the clouds that form become more water-rich and denser. The increasing cloud formation and increasing reflection of solar radiation on the upper cloud surface reduces the supply of heat to the earth and evaporation stagnates.

The annual evaporation rate is around 430,000 cubic kilometers (km³) of water over the oceans and around 70,000 km³ over land. The atmospheric water is circulated around 38 to 39 times. The associated heat transfer from the earth's surface (evaporation) to the outer troposphere (condensation) amounts to 1.25 million exajoules.

This figure is remarkable because, compared to the 3.8 million exajoules of solar energy irradiated onto the earth each year, around a third of the total energy is dissipated through the water cycle alone. And it has worked like this for centuries.

So, if as is often claimed, there is more water in the air, then the question must be allowed as to where this energy suddenly comes from that pumps this additional water into the atmosphere? The answer is quite simple, this energy does not exist.

The sun provides the energy for evaporation. It also provides the energy for the wind. The wind transports and distributes the water vapor. Energy cannot be generated; it can only be converted. In photovoltaics, the energy of light quanta is used; in wind energy utilization, flow energy - kinetic energy of the flowing air mass - is extracted from the tropospheric system, converted into mechanical energy via the turning rotor and this into electrical energy in the generator.

Withdrawal of flow energy means deceleration. Wind energy is therefore also not renewable and the term is used incorrectly here.

Wind turbines slow down flying rivers

What this means for water vapor transport is explained here using the example of a Vestas V172-7.2 MW turbine with a rotor diameter of 172 meters and a rated output of 7.2 MW:

The area covered by the rotor is around 23,200 m². At a wind speed of 14 m/s (50 km/h, wind force 7), around 325,000 cubic meters of air flow through this area every second (23,200 m² * 14 m/s = 324,800 m³/s). Under the realistic assumption that the wind speed is halved by the turbine from 14 to 7 m/s, the volume of air is also halved - as is the volume of water transported.

With a water vapor content of around 15 g/m³ of air, this means that - per second - almost 2,500 liters of water are no longer transported (162,400 m³ * 15 g/m³ = 2,436,000 g = 2,436 kg). This corresponds to a volume of 146 m³ per minute or 8,770 m³ per hour.

A single wind turbine therefore theoretically influences the natural distribution of water vapor with almost 9,000 m³ of water per hour or more than 200,000 m³ of water per day. It is not for nothing that Brazilian scientists named the flowing wind flying rivers.

Prematurely rained off water is missing elsewhere

Due to the wind conditions, the turbines only run at full load around a fifth of the time. But it is precisely when a lot of air is moving and flowing that they extract the most energy from the wind and therefore cause the most damage. Incidentally, it does not matter where or at what height the energy is tapped, as wind systems must be regarded as circulating systems.

So, if there is no more water in the air, this can only mean that the water vapor is no longer evenly distributed. The reason for this can probably be found in the withdrawal of energy from the tropospheric system because of wind energy extraction.

As a result, backwater or downpour occurs in front of the turbines and shortly afterwards, like that on mountain slopes. It is hardly surprising that such weather events have increased in frequency and intensity in recent years and decades. In the areas in the lee, there is a lack of water for the supersaturation required for condensation, resulting in droughts.

Wind energy use can therefore neither be described as regenerative nor as green energy. It is the most massive intervention in the tropospheric system in living memory.

About the author:

Dipl.-Ing. (FH) Manfred Brugger works in plant engineering for public drinking water supplies and has been observing developments and changes in the natural water cycle for 38 years. In his book "Wind mania", published by novum Verlag in 2024, he describes the climatic consequences of using wind power. The book is available as an eBook in all bookstores (Apple, Google, Amazon).

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