Wind: Another Forgotten Weather Variable

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Introduction

Wind is the most consistent entry in the Daily Journals of the Hudson's Bay Company. People who were all trained as mariners but did not necessary command ships maintained the journals. They used a standard logging technique developed by Dr James Jurin in 1722 and recorded the wind to 32 points of the compass. At no time in the record did they actually measure wind speed, rather they used a subjective scale similar to that developed by Admiral Beaufort. Accurate measurement of wind speed in the modern form doesn't occur until the introduction of an anemometer in 1846, although some earlier instruments existed from about 1450.
http://inventors.about.com/od/astartinventions/a/Anemometer.htm

Direction and speed of wind was critical for sailing and this continued with the advent of flying. It still determines direction of takeoff and landing as well as ground speed while airborne. It is not as critical as it was because of the power of jet engines and the ability to fly at great altitude above such global winds as the Jet Stream. It was the ability to fly at altitude due to pressurized aircraft that led to the discovery of the Jet stream during WWII. It is less of a factor for many people because in most countries the majority of the populations now live in urban areas. Wind speeds are significantly reduced in urbanized areas by the roughness factor of the buildings.

Some segments of society are concerned about the wind, such as irrigators, but it is generally the most ignored weather variable especially for climate research. Like many other factors in determining weather and climate it is sidelined by temperature and more recently the narrow focus on CO2. This problem came to my attention when looking at drought patterns on the Great Plains and Canadian Prairies. Many studies exist but to my knowledge none considered the wind as a contributing and exacerbating factor. It was a different story whenever I spoke with seniors who had lived through the horrendous wind and dust storms. Figure 1 is a picture of such an event from Regina, Saskatchewan taken by a company hired to document the impact of the "dirty thirties".

Figure 1: Photograph taken at Regina on Sunday, April 14, 1933.
Source: Western Canada Pictorial Index.

There are so many ways and scales on which the wind influences weather and therefore climate so this article will only examine wind right at the surface, particularly its importance in determining the amount of water and water vapor in the atmosphere.

Advection

Convection is the vertical movement of air, advection is the horizontal movement but both are created by a difference in pressure between two locations. Air moves from high to low in a constant attempt to equalize pressure. The speed of air movement is determined by the difference in pressure between the high and the low as a function of distance. Think of it like the steepness of the slope between high and low ground. Like on a topographic map the closer the contour lines the steeper the slope on a weather map the closer the isobars the stronger the wind.

An extremely important function of the wind is in transporting heat, which it does when warm air moves into a cold region. The least known and understood but most important is as latent heat.

Evaporation is the process of molecules of water reaching escape velocity and breaking free from the surface of the water into the air. This can increase in three ways, a) an increase of water temperature b) an increase in air temperature or c) an increase in wind speed. The most important of the three is an increase in wind speed.

The energy used to increase the escape velocity of a water molecule is not lost; rather it is within the molecule as latent heat. The molecule changes from liquid to gas in the escape. When condensation occurs the water as gas goes back to liquid and the latent heat is released to warm the atmosphere. This is why air temperature increases when rain or snow occurs.

Moisture is also put into the air through plants in a process called transpiration. This also varies with heat and wind speed. The volumes of moisture are prodigious The United States geological Survey say, *An acre of corn gives off about 3,000-4,000 gallons (11,400-15,100 liters) of water each day, and a large oak tree can transpire 40,000 gallons (151,000 liters) per year.* No wonder there is a considerable difference between cleared and forested slopes at the Coweta Experiment Station (Figure 2.)

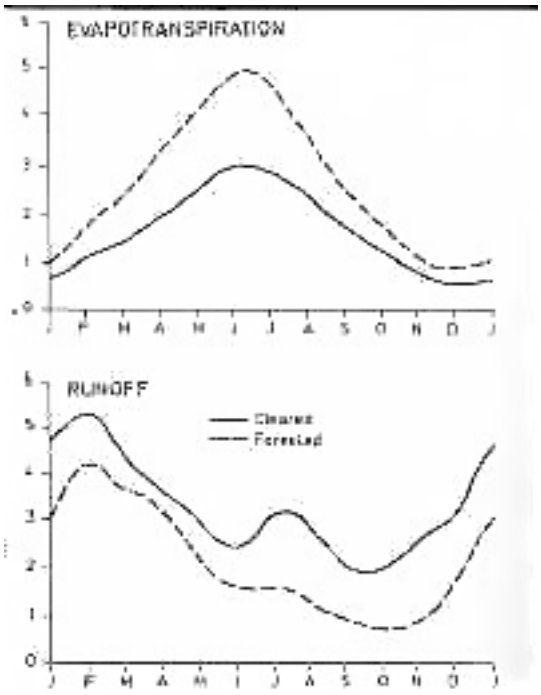

Figure 2. Comparison of evaporation and run off from cleared and forested slopes.

There are global wind patterns and I will examine how they function and change with climate change in future articles. Here I have just touched on the critical role of wind in evaporation and transpiration. Here are a list of questions that require consideration if even minimal understanding and modeling of weather and climate are to occur.

1. What is the global average wind speed?
2. What is the average wind speed for different ecological zones?
3. How does even a minimal change in the speed affect rates of evaporation and transpiration and therefore moisture in the atmosphere?
4. If the cooling that began in 2000 continues how much will vegetation be reduced globally and how will that affect global moisture?
5. How much is moisture going to the atmosphere from sublimation reduced?

Richard Courtenay spent two years trying to get accurate measures of the microclimate over an ocean surface with no success. He found that even very small ripples made measurements impossible. It is interesting to speculate on how wind changes the roughness of the oceans and lakes and the resulting changes in the total evaporative surface.

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