Wind speed

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Wind speed, or wind flow velocity, is a fundamental atmospheric quantity.

An anemometer is commonly used to measure wind speed.

Wind speed is caused by air moving from high pressure to low pressure, usually due to changes in temperature.

Wind speed affects weather forecasting, aircraft and maritime operations, construction projects, growth and metabolism rate of many plant species, and countless other implications.[1]

Wind speed is now commonly measured with an anemometer but can also be classified using the older Beaufort scale which is based on people's observation of specifically defined wind effects.

Contents

Factors affecting wind speed

Wind speed is affected by a number of factors and situations, operating on varying scales (from micro to macro scales). These include the pressure gradient, Rossby waves and jet streams, and local weather conditions. There are also links to be found between wind speed and wind direction, notably with the pressure gradient and terrain conditions.

Pressure gradient is a term to describe the difference in air pressure between two points in the atmosphere or on the surface of the Earth. It is vital to wind speed, because the greater the difference in pressure, the faster the wind flows (from the high to low pressure) to balance out the variation. The pressure gradient, when combined with the Coriolis effect and friction, also influences wind direction.

Rossby waves are strong winds in the upper troposphere. These operate on a global scale and move from West to East (hence being known as Westerlies). The Rossby waves are themselves a different wind speed from what we experience in the lower troposphere.

Local weather conditions play a key role in influencing wind speed, as the formation of hurricanes, monsoons and cyclones as freak weather conditions can drastically affect the flow velocity of the wind.

Highest speed

The fastest wind speed not related to tornadoes ever recorded was during the passage of Tropical Cyclone Olivia on 10 April 1996: an automatic weather station on Barrow Island, Australia, registered a maximum wind gust of 408 km/h (220 kn; 253 mph; 113 m/s).[2] The wind gust was evaluated by the WMO Evaluation Panel who found that the anemometer was mechanically sound and the gust was within statistical probability and ratified the measurement in 2010. The anemometer was mounted 10 m above ground level (and thus 64 m above sea level). During the cyclone, several extreme gusts of greater than 300 km/h (160 kn; 83 m/s) were recorded, with a maximum 5-minute mean speed of 176 km/h (95 kn; 49 m/s), the extreme gust factor was in the order of 2.27–2.75 times the mean wind speed. The pattern and scales of the gusts suggest that a mesovortex was embedded in the already strong eyewall of the cyclone.[3]

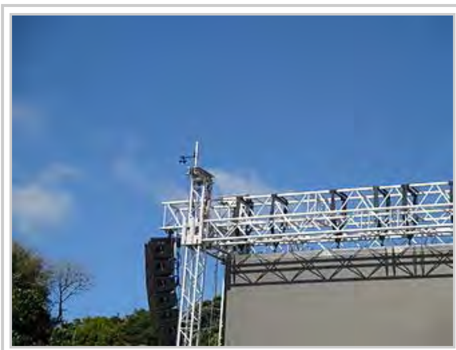

The original anemometer that measured The Big Wind in 1934 at Mount Washington Observatory

The now second highest surface wind speed ever officially recorded is 372 km/h (231 mph; 103 m/s) at the Mount Washington (New Hampshire) Observatory: 6,288 ft (1917 m) above sea level in the US on 12 April 1934, using a heated anemometer. The anemometer, specifically designed for use on Mount Washington was later tested by the US National Weather Bureau and confirmed to be accurate.[4]

Wind speeds within certain atmospheric phenomena (such as tornadoes) may greatly exceed these values but have never been accurately measured. Directly measuring these tornadic winds is rarely done as the violent wind would destroy the instruments. Another method of estimating is to use Doppler on Wheels to sense the wind speeds remotely.[5] The figure of 486 km/h (302 mph; 135 m/s) during the 1999 Bridge Creek–Moore tornado in Oklahoma on 3 May 1999 is often quoted as the highest-recorded surface wind speed.[6] However, another figure of 512 kilometres per hour (318 mph) has also been quoted for the same tornado.[7] Yet another number used by the Center for Severe Weather Research for that measurement is 486 ± 32 km/h (302 ± 20 mph).[8] However, speeds measured by Doppler radar are not considered official records.[7]

Design of structures

Wind speed is a common factor in the design of structures and buildings around the world. It is often the governing factor in the required lateral strength of a structure's design.


Anemometer on an outdoor stage set, to measure wind speed

In the United States, the wind speed used in design is often referred to as a "3-second gust" which is the highest sustained gust over a 3-second period having a probability of being exceeded per year of 1 in 50 (ASCE 7-05). This design wind speed is accepted by most building codes in the United States and often governs the lateral design of buildings and structures.

In Canada, reference wind pressures are used in design and are based on the "mean hourly" wind speed having a probability of being exceeded per year of 1 in 50. The reference wind pressure (q) is calculated in Pascals using the following equation (ref: NBC 2005 Structural Commentaries - Part 4 of Div. B, Comm. I): $q=(1/2)pV^2$ where p is the air density in kg/m^3 and V is wind speed in m/s.

Historically, wind speeds have been reported with a variety of averaging times (such as fastest mile, 3-second gust, 1-minute and mean hourly) which designers may have to take into account. To convert wind speeds from one averaging time to another, the Durst Curve (Ref: ASCE 7-05 commentary Figure C6-4, ASCE 7-10 C26.5-1) was developed which defines the relation between probable maximum wind speed averaged over t seconds, V_t, and mean wind speed over one hour V_{3600}.

See also

- Beaufort scale
- Fujita scale and Enhanced Fujita Scale
- Prevailing wind
- Saffir–Simpson Hurricane Scale
- TORRO scale
- Wind direction
- Knot (unit)
- International Building Code (promulgator of NBC 2005)
- American Society of Civil Engineers (promulgator of ASCE 7-05)

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References

1. C.Michael Hogan. 2010. *Abiotic factor*. Encyclopedia of Earth. eds Emily Monosson and C. Cleveland. National Council for Science and the Environment (http://www.eoearth.org/article/Abiotic_factor?topic=49461). Washington DC
2. "World record wind gust". World Meteorological Association. Retrieved 26 January 2010.
3. "Documentation and verification of the world extreme wind gust record: 113.3 m s–1 on Barrow Island, Australia, during passage of tropical cyclone Olivia" (PDF). Australian Meteorological and Oceanographic Journal.
4. "The story of the world record wind". Mount Washington Observatory. Retrieved 26 January 2010.
5. "Massive Okla. tornado had windspeed up to 200 mph". *CBS News*. 20 May 2013. Retrieved 17 May 2014.
6. "Historical Tornadoes". National Weather Service.
7. "Highest surface wind speed-Tropical Cyclone Olivia sets world record". *World Record Academy*. 26 January 2010. Retrieved 17 May 2014.
8. Wurman, Joshua (2007). "Doppler On Wheels". Center for Severe Weather Research.