MH0053 / METEOROLOGICAL AND HYDROLOGICAL / Wind-Related

Derecho

Definition

Derechos are fast-moving bands of thunderstorms with destructive winds. The winds can be as strong as those found in hurricanes or even tornadoes. Unlike hurricanes and tornadoes, these winds follow straight lines (NOAA, 2019).

Reference

NOAA, 2019. What is a Derecho? National Oceanic and Atmospheric Administration (NOAA). https://scijinks.gov/derechos Accessed 26 November 2019.

Annotations

Synonyms

Not applicable.

Additional scientific description

A derecho (pronounced similar to 'deh-REY-cho') is a widespread, long-lived wind storm that is associated with a band of rapidly moving showers or thunderstorms. Although a derecho can produce destruction similar to the strength of tornadoes, the damage is typically directed in one direction along a relatively straight swath. As a result, the term 'straight-line wind damage' is sometimes used to describe derecho damage. By definition, if the wind damage swath extends more than 240 miles (about 400 km) and includes wind gusts of at least 58 mph (93 km/h) or greater along most of its length, then the event may be classified as a derecho (NOAA, 2019).

A derecho is a widespread convectively induced straight-line windstorm. Specifically, the term is defined as any family of particularly damaging downburst clusters produced by a mesoscale convective system (AMS, 2012a). Such systems have sustained bow echoes with book-end vortices and/or rear-inflow jets and can generate considerable damage from straight-line winds. Damage must be incurred either continuously or intermittently over a swath of at least 650 km (~400 miles) and a width of approximately 100 km (~60 miles) or more. The term derecho derives from a Spanish word that can be interpreted as 'straight ahead' or 'direct' and was chosen to distinguish between wind damage caused by tornadoes (AMS, 2012b), which have rotating flow, from straight-line winds.

The National Oceanic and Atmospheric Administration Storm Prediction Center reports that the types of Derecho include: serial derechos, progressive derechos, hybrid derechos and low-point derechos (NOAA, 2018).

Metrics and numeric limits

The winds associated with derechos are not constant and may vary considerably along the derecho path, sometimes being below severe limits (57 mph [92 kmh] or less) and sometimes being very strong (from 75 mph [121 kph] to over 100 mph [161 kph]). This is because the swaths of stronger winds within the general path of a derecho are produced by what are called downbursts, and downbursts often occur in irregularly arranged clusters, along with embedded microbursts and burst swaths. Derechos might be said to be made up of families of downburst clusters that extend, by definition, continuously or nearly continuously for at least 250 miles (about 400 km) (NOAA, 2018).

Key relevant UN convention / multilateral treaty

Not identified.

Examples of drivers, outcomes and risk management

Derechos are formed as follows. When the wet air in a thunderstorm meets the drier air surrounding it, the water in the air evaporates. When water evaporates, it cools the air around it. Since the cool air is denser, it rapidly sinks to the ground and creates strong winds. The downburst can suck more dry air into the storm, making even stronger downbursts or clusters of downbursts. Derechos occur when the right conditions for downbursts occur over a wide area (NOAA, 2019). See also NOAA (2018) for more detailed information about derechos.

Because derechos are most common in the warm season, those involved in outdoor activities are especially at risk. Campers or hikers in forested areas are vulnerable to being injured or killed by falling trees, and those at sea risk injury or drowning from storm winds and high waves that can overturn boats. Another reason those outdoors are especially vulnerable to derechos is the rapid movement of the parent convective system. Typically, derecho-producing storm systems move at speeds of 50 mph or more, and a few have been recorded at 70 mph. For someone caught outside, such rapid movement means that darkening skies and other visual cues that serve to identify the impending danger (e.g., gust front shelf clouds) appear at very short notice (NOAA, 2018).

References

AMS, 2012a. Glossary of Meteorology: Mesoscale Convective System. American Meteorological Society (AMS). https://glossary.ametsoc.org/wiki/Mesoscale_convective_system Accessed 25 March 2021.

AMS, 2012b. Glossary of Meteorology: Tornado. American Meteorological Society (AMS). https://glossary.ametsoc.org/wiki/Tornado Accessed 25 March 2021.

AMS, 2019. Glossary of Meteorology: Derecho. American Meteorological Society (AMS). http://glossary.ametsoc.org/wiki/Derecho Accessed 26 November 2019.

NOAA, 2018. About Derechos. Storm Prediction Center, National Oceanic and Atmospheric Administration (NOAA). www.spc.noaa.gov/misc/AbtDerechos/derechofacts.htm#strength Accessed 26 November 2019.

NOAA, 2019. Derecho. National Weather Service, National Oceanic and Atmospheric Administration (NOAA). www.weather.gov/lmk/derecho Accessed 26 November 2019.

Coordinating agency or organisation

World Meteorological Organization (WMO).

MH0054 / METEOROLOGICAL AND HYDROLOGICAL / Wind-Related

Gale (Strong Gale)

Definition

A gale is wind with a speed of between 34 and 40 knots (62–74 km/h, 32–38 mph). Also known as Beaufort scale wind force 8 (WMO, 1992).

Reference

WMO, 1992. International Meteorological Vocabulary. WMO-No. 182. World Meteorological Organization (WMO). https://library.wmo.int/doc_num.php?explnum_id=4712 Accessed on 20 November 2019.

Annotations

Synonyms

Not found.

Additional scientific description

The numerical limits of a gale are defined by the Beaufort Scale which is an empirical measure that relates wind speed to observed conditions at sea or on land (Royal Meteorological Society, 2018). Its full name is the Beaufort wind force scale.

Metrics and numeric limits

A gale is wind with a speed of between 34 and 40 knots (62–74 km/h, 32–38 mph). Also known as Beaufort scale wind force 8 (WMO, 1992).

Key relevant UN convention / multilateral treaty

Not applicable.

Examples of drivers, outcomes and risk management

Human health can be severely affected by windstorms. Direct effects occur during the impact phase of a storm, causing death and injury due to the force of the wind. Becoming airborne, being struck by flying debris or falling trees and road traffic accidents are the main dangers. Indirect effects, occurring during the pre- and post-impact phases of the storm, include falls, lacerations and puncture wounds, and occur when preparing for, or cleaning up after a storm. Power outages are a key issue and can lead to electrocution, fires and burns and carbon monoxide poisoning from gasoline powered electrical generators. In addition, worsening of chronic illnesses due to lack of access to medical care or medication can occur. Other health impacts include infections and insect bites (Goldman et al., 2014).

Many countries have National Alerting Parameters for Gale, including the Philippines (PAGASA, no date), China (China Meteorological Administration, 2012), the Republic of Korea (Korea Meteorological Administration, 2019) and the United States (NOAA, 2019).

References

China Meteorological Administration, 2012. Gale. www.cma.gov.cn/en/WeatherWarnings/WarningSignals/201203/t20120320_166873.html Accessed 20 November 2019.

Goldman, A., B. Eggen, B. Golding and V. Murray, 2014. The health impacts of windstorms: a systematic literature review. Public Health, 128:3-28.

Korea Meteorological Administration, 2019. Criteria for advisory/warning information. https://web.kma.go.kr/eng/weather/forecast/standard_warning_info.jsp Accessed 20 November 2019.

NOAA, 2019. Coastal Warning Display Signals. National Weather Service, National Oceanic and Atmospheric Administration (NOAA). https://www.weather.gov/marine/cwd

PAGASA, no date. Gale Warning. http://bagong.pagasa.dost.gov.ph/marine Accessed on 20 November 2019.

Royal Meteorological Society, 2018. The Beaufort Scale: How is wind speed measured? www.rmets.org/resource/beaufort-scale Accessed 20 November 2019.

WMO, 1992. International Meteorological Vocabulary. WMO-No. 182. World Meteorological Organization (WMO). https://library.wmo.int/doc_num.php?explnum_id=4712 Accessed on 20 November 2019.

Coordinating agency or organisation

World Meteorological Organization (WMO).

MH0055 / METEOROLOGICAL AND HYDROLOGICAL / Wind-Related

Squall

Definition

A squall is an atmospheric phenomenon characterised by a very large variation of wind speed: it begins suddenly, has a duration of the order of minutes and decreases suddenly in speed. It is often accompanied by a shower or thunderstorm (WMO, 2018).

Reference

WMO, 2018. Manual on Codes, International Codes, Volume I.2. WMO-No. 306. World Meteorological Organization (WMO). www.wmo.int/pages/prog/www/WMOCodes/WMO306_vI2/Publications/2015editionUP2018/WMO306_vI2_en_ONLINE.pdf Accessed 13 October 2020.

Annotations

Synonyms

Not identified.

Additional scientific description

The National Oceanic and Atmospheric Administration (NOAA) National Weather Service describes a squall as follows (NOAA, 2019):

- A strong wind characterised by a sudden onset in which the wind speed increases to at least 16 knots and is sustained at 22 knots or more for at least one minute.
- In nautical use, a severe local storm considered as a whole, that is, winds and cloud mass and (if any) precipitation, thunder and lightning.

The American Meteorological Society describes a squall as follows (AMS, 2012):

- A strong wind characterised by a sudden onset, a duration of the order of minutes, and then a sudden decrease in speed. In U.S. observational practice, a squall is reported only if a wind speed of 16 knots or more is sustained for at least two minutes (thereby distinguishing it from a gust).
- In nautical use, a severe local storm considered as a whole, that is, winds and cloud mass and (if any) precipitation, thunder and lightning.

Metrics and numeric limits

Not available.

Key relevant UN convention / multilateral treaty

Not available.

Examples of drivers, outcomes and risk management

Squalls are sudden changes in wind conditions. In general, a squall may not be very strong and may only last for a short time. However, owing to their unpredictability and sudden arrival, squalls pose a threat to marine operations that require a fairly calm sea state (Lu et al., 2018).

Human health can be severely affected by wind-related hazards such as squalls and windstorms. Direct effects occur during the impact phase of a storm, causing death and injury due to the force of the wind. Becoming airborne, being struck by flying debris or falling trees and road traffic accidents are the main dangers. Indirect effects, occurring during the pre- and post-impact phases of the storm, include falls, lacerations and puncture wounds, and occur when preparing for, or cleaning up after a storm. Power outages are a key issue and can lead to electrocution, fires and burns and carbon monoxide poisoning from gasoline powered electrical generators. In addition, worsening of chronic illnesses due to lack of access to medical care or medication can occur. Other health impacts include infections and insect bites (Goldman et al., 2014).

References

AMS, 2012. Glossary of Meteorology: Squall. American Meteorological Society (AMS). http://glossary.ametsoc.org/wiki/Squall Accessed 26 November 2019.

Goldman, A., B. Eggen, B. Golding and V. Murray, 2014. The health impacts of windstorms: a systematic literature review. Public Health, 128:3-28.

Lu, Y., M. Ozaki and R. Wada, 2018. Squalls in sea off coast of Japan and their effects on marine operations based on weather observatory data at remote islands. Journal of Marine Science and Technology, 23:104-121.

NOAA, 2019. National Weather Service Glossary: Squall. National Oceanic and Atmospheric Administration (NOAA). https://forecast.weather.gov/glossary.php?word=SQUALL Accessed 13 October 2020.

Coordinating agency or organisation

World Meteorological Organization (WMO).

MH0056 / METEOROLOGICAL AND HYDROLOGICAL / Wind-Related

Subtropical Storm

Definition

A subtropical storm is a subtropical cyclone in which the maximum sustained surface wind speed (using the U.S. 1-minute average) is 34 kt (39 mph or 63 km/hr) or more (NOAA, 2019).

Reference

NOAA, 2019. Glossary of NHC Terms. National Hurricane Center (NHC) and Central Pacific Hurricane Center, National Oceanic and Atmospheric Administration (NOAA). www.nhc.noaa.gov/aboutgloss.shtml Accessed on 14 October 2020.

Annotation

Synonyms

Not available.

Additional scientific description

Subtropical cyclone: A non-frontal low-pressure system that has characteristics of both tropical and extratropical cyclones. Like tropical cyclones, they are non-frontal, synoptic-scale cyclones that originate over tropical or subtropical waters and have a closed surface wind circulation about a well-defined centre. In addition, they have organised moderate to deep convection, but lack a central dense overcast. Unlike tropical cyclones, subtropical cyclones derive a significant proportion of their energy from baroclinic sources and are generally cold-core in the upper troposphere, often being associated with an upper-level low or trough. In comparison to tropical cyclones, these systems generally have a radius of maximum winds occurring relatively far from the centre (usually above 60 nmi), and generally have a less symmetric wind field and distribution of convection (NOAA, 2019).

Subtropical depression: A subtropical cyclone in which the maximum sustained surface wind speed (using the U.S. 1-minute average) is 33 kt (38 mph or 62 km/hr) or less (NOAA, 2019).

Metrics and numeric limits

Not applicable.

Key relevant UN convention / multilateral treaty

Not applicable.

Examples of drivers, outcomes and risk management

Impacts from sub-tropical storms include storm surges and significant rainfall events which cause flooding. Strong wind gusts and tornadoes may also occur.

Human health can be severely affected by wind-related hazards such as subtropical storms and other windstorms. Direct effects occur during the impact phase of a storm, causing death and injury due to the force of the wind. Becoming airborne, being struck by flying debris or falling trees and road traffic accidents are the main dangers. Indirect effects, occurring during the pre- and post-impact phases of the storm, include falls, lacerations and puncture wounds, and occur when preparing for, or cleaning up after a storm. Power outages are a key issue and can lead to electrocution, fires and burns and carbon monoxide poisoning from gasoline-powered electrical generators. Worsening of chronic illnesses due to lack of access to medical care or medication can also occur. Other health impacts include infections and insect bites (Goldman et al., 2014).

The effects of flooding on health are extensive and significant, ranging from mortality and injuries resulting from trauma and drowning to infectious diseases and mental health problems (acute and long-term). While some of these outcomes are relatively easy to track, ascertaining the human impact of floods is still weak. For example, it has been reported that two-thirds of deaths associated with flooding are from drowning, with the other third are from physical trauma, heart attacks, electrocution, carbon monoxide poisoning and fire. Often, only immediate traumatic deaths from flooding are recorded (WHO, 2013).

Morbidity associated with floods is usually due to injuries, infections, chemical hazards and mental health effects (acute as well as delayed) (WHO, 2013). Hypothermia may also be a problem, particularly in children, if trapped in floodwaters for lengthy periods (WHO, no date). There may also be an increased risk of respiratory tract infections due to exposure (loss of shelter, exposure to flood waters and rain). Power cuts related to floods may disrupt water treatment and supply plants thereby increasing the risk of water-borne diseases but may also affect proper functioning of health facilities, including cold chain (WHO, no date). Floods can potentially increase the transmission of the following communicable diseases: water-borne diseases (such as typhoid fever, cholera, leptospirosis and hepatitis A) and vector-borne diseases (such as malaria, dengue and dengue haemorrhagic fever, yellow fever, and West Nile Fever) (WHO, no date).

The longer-term health effects associated with a flood are less easily identified. They include effects due to displacement, destruction of homes, delayed recovery and water shortages (WHO, 2013).

References

Goldman, A., B. Eggen, B. Golding and V. Murray, 2014. The health impacts of windstorms: a systematic literature review. Public Health, 128:3-28.

NOAA, 2019. Glossary of NHC Terms. National Hurricane Center (NHC) and Central Pacific Hurricane Center, National Oceanic and Atmospheric Administration (NOAA). www.nhc.noaa.gov/aboutgloss.shtml Accessed on 14 October 2020.

WHO, no date. Flooding and communicable diseases fact sheet. World Health Organization (WHO). www.who.int/hac/techguidance/ems/flood_cds/en Accessed 4 October 2020.

WHO, 2013. Floods in the WHO European Region: Health effects and their prevention. Regional Office for Europe, World Health Organization (WHO). https://apps.who.int/iris/handle/10665/108625 Accessed 2 October 2020.

Coordinating agency or organisation

World Meteorological Organization (WMO).

MH0057 / METEOROLOGICAL AND HYDROLOGICAL / Wind-Related

Tropical Cyclone (Cyclonic Wind, Rain [Storm] Surge)

Definition

A tropical cyclone is a cyclone of tropical origin of small diameter (some hundreds of kilometres) with a minimum surface pressure in some cases of less than 900 hPa, very violent winds and torrential rain; sometimes accompanied by thunderstorms. It usually contains a central region, known as the 'eye' of the storm, with a diameter of the order of some tens of kilometres, and with light winds and a more or less lightly clouded sky (WMO, 2017).

Alternative definition: A tropical cyclone is a warm-core, non-frontal synoptic-scale cyclone, originating over tropical or subtropical waters, with organised deep convection and closed surface wind circulation about a well-defined centre (WMO, 2017).

References

WMO, 2017. Manual on Codes, International Codes, Volume I.2, WMO-No. 306. World Meteorological Organization (WMO). https://library.wmo.int/doc_num.php?explnum_id=5831 Accessed 25 November 2019.

Annotations

Synonyms

Typhoon, Hurricane, Cyclone, Severe tropical cyclone.

Note: Typhoon, hurricane, cyclone, and tropical cyclone are different terms for the same weather phenomenon in different geographical regions (WMO, no date):

- In the western North Atlantic, central and eastern North Pacific, Caribbean Sea and Gulf of Mexico, such a weather phenomenon is called a 'hurricane'.
- In the western North Pacific, it is called a 'typhoon'.
- In the Bay of Bengal and Arabian Sea, it is called a 'cyclone'.
- In the western South Pacific and southeast India Ocean, it is called a 'severe tropical cyclone'.
- In the southwest India Ocean, it is called a 'tropical cyclone'.

Additional scientific description

Depending on the maximum sustained wind speed, tropical cyclones are designated as follows (WMO, no date):

- A tropical depression when the maximum sustained wind speed is less than 63 km/h.
- A tropical storm when the maximum sustained wind speed is more than 63 km/h*. It is then also given a name.
- Depending on the ocean basin, either a hurricane, typhoon, severe tropical cyclone, severe cyclonic storm or tropical cyclone when the maximum sustained wind speed is more than 119 km/h*.

*The designation thresholds for storm and hurricane are based on the Beaufort Scale.

Tropical cyclones can be hundreds of kilometres wide and can bring destructive high winds, torrential rain, storm surges and occasionally tornadoes (WMO, no date).

The typhoon season in the western North Pacific region typically runs from May to November. The Americas/Caribbean hurricane season runs from 1 June to 30 November, peaking in August and September. The cyclone season in the South Pacific and Australia normally runs from November to April. In the Bay of Bengal and Arabian Sea, tropical cyclones usually occur from April to June, and September to November. The East Coast of Africa normally experiences tropical cyclones from November to April (WMO, no date).

Metrics and numeric limits

Strength thresholds for tropical cyclone intensity vary according to the geographical regions indicated above. For the hurricane, the Saffir-Simpson Hurricane Wind Scale is used, where hurricane strength varies from Category 1 to 5: Category 1 (maximum sustained wind speeds of 119–153 km/h), Category 2 (maximum sustained wind speeds of 154–177 km/h), Category 3 (maximum sustained wind speeds of 178–209 km/h), Category 4 (maximum sustained wind speeds of 210–249 km/h) and Category 5 (maximum sustained wind speeds exceeding 249 km/h) (NOAA, no date).

Key relevant UN convention / multilateral treaty

Not identified.

Examples of drivers, outcomes and risk management

Meteorologists around the world use modern technology such as satellites, weather radars and computers etc. to track tropical cyclones as they develop. Tropical cyclones are often difficult to predict, because they can suddenly weaken or change their course. However, meteorologists use state-of-art technologies and develop modern techniques such as numerical weather prediction models to predict how a tropical cyclone evolves, including its movement and change of intensity, when and where one will hit land and at what speed. Official warnings are then issued by the National Meteorological Services of the countries concerned (WMO, no date). The impact of a tropical cyclone and the expected damage depend not just on wind speed, but also on factors such as the moving speed, duration of strong wind, storm surge and accumulated rainfall during and after landfall, sudden change of moving direction and intensity, and the structure (e.g., size and intensity) of the tropical cyclone, as well as human response to tropical cyclone disasters (NOAA, no date).

The World Meteorological Organization (WMO) framework allows the timely and widespread dissemination of information about tropical cyclones. As a result of international cooperation and coordination, tropical cyclones are increasingly being monitored from their early stages of formation. The activities are coordinated at the global and regional level by the WMO through its World Weather Watch and Tropical Cyclone Programmes. The Regional Specialised Meteorological Centres with the activity specialisation in tropical cyclones, and Tropical Cyclone Warning Centres, all designated by the WMO, are functioning within its Tropical Cyclone Programme. Their role is to detect, monitor, track and forecast all tropical cyclones in their respective regions. The Centres provide, in real-time, advisory information and guidance to the National Meteorological Services (WMO, no date).

The health impacts of tropical cyclones depend on the number of people living in low-lying coastal areas in the storm's direct path, the built environment including building design, and whether there is sufficient time for warning and evacuation (WHO, 2020).

Tropical cyclones, may directly and indirectly affect health in many ways, for example by: increasing cases of drowning and other physical trauma; increasing risks of water- and vector-borne infectious diseases; increasing mental health effects associated with emergency situations; disrupting health systems, facilities and services, leaving communities without access to health care when it is needed most; and damaging basic infrastructure, such as food and water supplies and safe shelter (WHO, 2020).

When tropical cyclones cause floods and sea surges, the risk of drowning and water- or vector-borne diseases increases. In addition, flood waters may contain sewage and chemicals, hide sharp objects made of metal or glass and electrical lines, or host dangerous snakes or reptiles, which can result in diseases, injuries, electrocution and bites. The greatest damage to life and property is not from the wind itself, but from secondary events such as storm surges, flooding, landslides and tornadoes (WHO, 2020).

The World Health Organization (WHO) works with Member States to build resilient and proactive health systems that can anticipate the needs and challenges during emergencies so that they are more likely to reduce risks and respond effectively when needed. During disasters, such as tropical cyclones, the WHO helps to restore primary care services so that facilities can deliver essential services, including immunisation, basic treatment for common illnesses, acute malnutrition and maternal care while ensuring the ongoing supply of medications for people living with HIV, tuberculosis or diabetes. As the health cluster lead for global emergencies, the WHO also works with partners to ensure appropriate food supplementation; to assemble mobile health teams and outreach; to conduct epidemic surveillance, early warning and response; and to call for emergency funding to support health action (WHO, 2020).

References

NOAA, no date. Saffir-Simpson Hurricane Wind Scale. National Oceanic and Atmospheric Administration (NOAA). https://www.nhc.noaa.gov/aboutsshws.php Accessed 16 April 2021.

WHO, 2020. Tropical cyclones. World Health Organization (WHO). www.who.int/health-topics/tropical-cyclones#tab=tab_3 Accessed 7 October 2020.

WMO, no date. Tropical Cyclone. World Meteorological Organization (WMO). https://public.wmo.int/en/our-mandate/focus-areas/natural-hazards-and-disaster-risk-reduction/tropical-cyclones Accessed 16 April 2021.

Coordinating agency or organisation

World Meteorological Organization (WMO).

MH0058 / METEOROLOGICAL AND HYDROLOGICAL / Wind-Related

Tropical Storm

Definition

A tropical storm is a rapid rotating storm originating over tropical oceans. It has a low pressure centre and clouds spiralling towards the eyewall surrounding the 'eye'. Its diameter is typically around 200 to 500 km, but can reach 1000 km. The related hazards are very violent winds, torrential rain, high waves, storm surges and in some cases tornadoes, causing direct effects such as flash floods, flooding, coastal inundation, and indirect effects such as landslides and mudslides. The winds blow anti-clockwise in the Northern Hemisphere and clockwise in the Southern Hemisphere (WMO, 2020).

The intensity of tropical storms is based on the wind speed. A tropical storm is a tropical cyclone with the maximum sustained winds of 34 knots (17.5 m/s, 63 km/h) to 47 knots (24.2 m/s, 87 km/h) near the centre. When reaching this intensity, they are named in the interests of public safety (WMO, 2021).

References

WMO, 2020. Tropical Cyclone Operational Plans. World Meteorological Organization (WM). https://community.wmo.int/tropical-cyclone-operational-plans

WMO, 2021. Tropical Cyclones. World Meteorological Organization (WM). https://public.wmo.int/en/our-mandate/focus-areas/natural-hazards-and-disaster-risk-reduction/tropical-cyclones

Annotations

Synonyms

Tropical cyclone is a generic term. However, once this weather phenomenon has reached a specific intensity (wind speed exceeding 117 km/h), depending on the region, it can be designated as a hurricane, typhoon, tropical cyclone, cyclonic storm (WMO, 2021).

Additional scientific description

A tropical cyclone originates over tropical oceans from where it draws the energy to develop. In addition to sufficient energy from the ocean, a favourable environment is associated with enough moisture in the atmosphere, low to moderate windshear (difference between winds at low and upper atmospheric levels), and enough Coriolis force (a force associated with the rotation).

They can develop in the North Atlantic, Indian Ocean and Pacific Ocean. Depending on the basin, the terminology for this weather phenomenon differs: hurricane in the North Atlantic, typhoon in the western North Pacific, and tropical cyclone in the Indian Ocean and South Pacific Ocean.

Metrics and numeric limits

Depending on the maximum sustained wind speed, tropical cyclones are designated as follows:

- *Tropical depression*: when the maximum sustained wind speed is less than 63 km/h k or 34 knots
- *Tropical storm*: when the maximum sustained wind speed is more than 63 km/h or 34 knots. It is then also given a name.
- *Hurricane, typhoon, tropical cyclone, cyclonic storm*: when the maximum sustained wind speed exceeds 117 km/h or 63 knots.

Key relevant UN convention / multilateral treaty

Not applicable.

Examples of drivers, outcomes and risk management

References

WHO, 2020. Tropical cyclones. World Health Organization (WHO). www.who.int/health-topics/tropical-cyclones#tab=tab_3 Accessed 7 October 2020.

WMO, 2021. Storm Surge. World Meteorological Organization (WMO). https://public.wmo.int/en/our-mandate/focus-areas/natural-hazards-and-disaster-risk-reduction/storm-surge

https://public.wmo.int/en/our-mandate/focus-areas/natural-hazards-and-disaster-risk-reduction/tropical-cyclones

The Operational Plans of the five WMO Tropical Cyclone Programme regional bodies, and their associated glossaries are available here: https://community.wmo.int/tropical-cyclone-operational-plans

World Meteorological Organization (WMO) Regional Association I - Tropical Cyclone Operational Plan for the South-West Indian Ocean, Tropical Cyclone Programme, report No. TCP-12, WMO-NO 1178

Typhoon Committee Operational Manual, Tropical Cyclone Programme, report No. TCP-23, WMO/TD No.196.

Panel on Tropical cyclones Operational Plan for the Bay of Bengal and the Arabian Sea, report No. TCP-21, WMO/TD-No. 84

(WMO Regional Association IV – Hurricane Operational Plan for North America, Central America and the Caribbean. Tropical Cyclone Programme. WMO-No. 1163.

WMO Regional Association V - Tropical Cyclone Operational Plan for the South Pacific and South-East Indian Ocean, Tropical Cyclone Programme, report No. TCP-24, WMO-NO 1181.

Rappaport, E. (2014). Fatalities in the United States from Atlantic Tropical Cyclones: New Data and Interpretation. Accessible at: https://www.deepdyve.com/lp/american-meteorological-society/fatalities-in-the-united-states-from-atlantic-tropical-cyclones-new-0IJut2urZS. Accessed 13 May 2021.

Coordinating agency or organisation

World Meteorological Organization (WMO).

MH0059 / METEOROLOGICAL AND HYDROLOGICAL / Wind-Related

Tornado

Definition

A tornado is a rotating column of air, extending from the base of a cumuliform cloud, and often visible as a condensation funnel in contact with the ground, and/or attendant circulating dust or debris cloud at the ground (WMO, 2017).

Reference

WMO, 2017. International Cloud Atlas: Tornado. World Meteorological Organization (WMO). https://cloudatlas.wmo.int/tornado.html Accessed 25 November 2019.

Annotations

Synonyms

Twister, Land spout, Cold air funnel, Waterspout, Funnel, Whirlwind.

Additional scientific description

A large tornado in which the condensation funnel is at least as wide horizontally at the ground as it is in height from the ground to the cloud base may be referred to as a wedge tornado. During the dissipation stage of a tornado, the condensation funnel will shrink and narrow in width, becoming rope-like (a rope funnel), and may also become contorted. Some tornadoes may contain secondary vortices within the main circulation (suction vortices or subvortices) (WMO, 2017a).

Metrics and numeric limits

Tornadoes can be classified into the following distinct formation groups (WMO, 2017b): Type I (in association with supercells; WMO, no date), Type II (in association with quasi-linear convective systems), and Type III (localised convective and shear vortices – these comprise landspouts, waterspouts and cold-air funnels).

Definitions for the Type III tornados are as follows (WMO, 2017b):

- *Landspout*: A tornado that does not arise from organised storm-scale rotation and is therefore not associated with a wall cloud (murus) or a mesocyclone.
- *Waterspout:* A tornado occurring over water. It is normally a relatively small, weak rotating column of air over open water below a Cumulonimbus or Cumulus congestus cloud.
- *Cold-air funnel:* A funnel cloud or (rarely) a small, relatively weak tornado that can develop from a small shower or thunderstorm when the air aloft is unusually cold.

The strength of a tornado can be estimated from the degree of damage caused using the Enhanced Fujita scale (Wind Science and Engineering Center, 2004; National Weather Service, no date).

Key relevant UN convention / multilateral treaty

Not identified.

Examples of drivers, outcomes and risk management

Owing to the unpredictable nature of tornados, protecting the public is focused on education and outreach which provide information on the tornado as a threat, how to identify a tornado and practical measures on how individuals can protect themselves, and how to find and watch warning systems that alert the public (CDC, 2020).

Since the advent of Doppler Radar, lead times for tornado warnings have increased from when a tornado first touches the ground to upwards of 14 to 20 minutes or more beforehand (WMO, 2017b; National Geographic, 2019).

References

CDC, 2020. Staying Safe in a Tornado. Centers for Disease Control and Prevention (CDC). www.cdc.gov/nceh/features/tornadosafety/index.html Accessed 25 March 2021.

National Geographic, 2019. What we know – and what we don't – about the science of tornadoes. www.nationalgeographic.com/news/2019/5/140430-tornadoes-meteorology-atmospheric-science-disasters Accessed 2 November 2021.

National Weather Service, no date. The Enhanced Fujita Scale (EF Scale). www.weather.gov/oun/efscale Accessed 25 March 2021.

Wind Science and Engineering Center, 2004. A Recommendation for an Enhanced Fujita Scale (EF Scale). www.spc.noaa.gov/faq/tornado/ef-ttu.pdf Accessed 25 March 2021.

WMO, no date. Glossary: Supercell. World Meteorological Organization (WMO). https://cloudatlas.wmo.int/en/glossary.html#S Accessed 25 March 2021.

WMO, 2017a. International Cloud Atlas Manual on the Observation of Clouds and Other Meteors. WMO-No. 407. World Meteorological Organization (WMO). https://library.wmo.int/index.php?lvl=notice_display&id=5357ICA-New-classifications.html#.YEJrt5vLfIE Accessed 25 November 2019.

WMO, 2017b. Guidelines for Nowcasting Techniques. WMO-No. 1198. World Meteorological Organization (WMO). https://library.wmo.int/doc_num.php?explnum_id=3795 Accessed 2 November 2020.

Coordinating agency or organisation

World Meteorological Organization (WMO).

MH0060 / METEOROLOGICAL AND HYDROLOGICAL / Wind-Related

Wind

Definition

Wind is air motion relative to the Earth's surface. Unless otherwise specified, only the horizontal component is considered (WMO, 1992).

Reference

WMO, 1992. International Meteorological Vocabulary. WMO-No. 182. World Meteorological Organization (WMO). https://library.wmo.int/doc_num.php?explnum_id=4712 Accessed 25 November 2019.

Annotations

Synonyms

Not identified.

Additional scientific description

Wind velocity is an important consideration in relation to, for example, airborne pollution and the landing of aircraft (WMO, 2018). Surface wind is considered mainly as a two-dimensional vector quantity specified by two numbers representing direction and speed (WMO, 2018).

The extent to which wind is characterised by rapid fluctuations is referred to as gustiness, and single fluctuations are called gusts (WMO, 2018).

Metrics and numeric limits

An internationally recognised scale for measuring wind is the Beaufort Scale, which is an empirical measure that relates wind speed to observed conditions at sea or on land. Its full name is the Beaufort wind force scale (Royal Meteorological Society, 2018).

The Beaufort wind force scale has 13 levels including: calm, light air, light breeze, gentle breeze, moderate breeze, fresh breeze, strong breeze, near gale, gale, strong gale, storm, violent storm, and hurricane. Of note, the quoted wind speed is that measured at 10 m above ground, not at the surface (which, at 2 m, may be only 50–70% of these values (Royal Meteorological Society, 2018).

Key relevant UN convention / multilateral treaty

Not identified.

Examples of drivers, outcomes and risk management

Wind is a main or contributing component to a number of hazards such as derecho, tropical cyclone, blizzard, sub-tropical cyclone, subtropical storm, tornado, and tropical storm. Wind is also associated with the dispersal of dust storms, volcanic ash and coastal floods (WMO, 2019).

Human health can be severely affected by windstorms (Goldman et al., 2014). Effects include direct effects, which occur during the impact phase of a storm, causing death and injury due to the force of the wind. Becoming airborne, being struck by flying debris or falling trees and road traffic accidents are the main dangers. Indirect effects, occurring during the pre- and post-impact phases of the storm, include falls, lacerations and puncture wounds, and occur when preparing for, or cleaning up after a storm. Power outages are a key issue and can lead to electrocution, fires and burns, and carbon monoxide poisoning from gasoline powered electrical generators. Worsening of chronic illnesses due to lack of access to medical care or medication can also occur. Other health impacts include infections and insect bites.

References

Goldman, A., B. Eggen, B. Golding and V. Murray, 2014. The health impacts of windstorms: a systematic literature review. Public Health, 128:3-28.

Royal Meteorological Society, 2018. The Beaufort Scale. www.rmets.org/resource/beaufort-scale Accessed 9 November 2020.

WMO, 2018. Guide to Instruments and Methods of Observation. Volume I – Measurement of Meteorological Variables. WMO-No.8. World Meteorological Association (WMO). https://library.wmo.int/?lvl=notice_display&id=12407#.YJ0upiuSk2w Accessed 9 November 2020.

WMO, 2019. Event Types of Hazards and Extreme Events. World Meteorological Association (WMO). www.wmo.int/pages/prog/wcp/wcdmp/meeting/documents/Catalogue_Hazards_Extreme_Events_WMO_091117.pdf Accessed 9 November 2020.

Coordinating agency or organisation

World Meteorological Organization (WMO).