



Our ref.: CLW/CLPA/RES9

GENEVA, 20 June 2016

Annexes: 3 (available in English only)

Subject: Implementation of Resolution 9 (Cg-17)

Action required: Request the presidents of WMO technical commissions and regional associations to provide oversight on the standardization of hazard information for loss and damage assessment

Dear Sir/Madam,

In its seventeenth session, the World Meteorological Congress (Cg-17, 25 May to 12 June 2015, Geneva, Switzerland) decided to standardize weather, water, climate, space weather and other related environmental hazard information, including the development of identifiers for cataloguing extreme and high-impact events (Resolution 9, (Cg-17) Annex 1). These measures will promote interoperability among datasets and facilitate Members' efforts to assess risks and track climate-related loss and damage. When fully implemented, WMO will be able to offer its Members and the international community a standardized, continuously updated, global dataset of hazard and extreme event occurrences.

Accordingly, an initial list of approximately 70 event types, with which losses and damage are potentially associated, has been compiled, along with references and resource materials, including the WMO Commissions and Programmes that would seem to be the most authoritative on each event type (Annex 2). In this regard, I would kindly request the following actions:

- (1) Validate the list of event types in Annex 2, adding or deleting as appropriate, focusing on those with which losses and damage are potentially associated;
- (2) For the resulting list, verify the focal points indicated and request them, or another expert(s) if more appropriate, to provide the information described below;
- (3) That the focal points or experts provide, or validate:
 - Authoritative dictionary definitions for each event type (e.g. "a drought is ..."); and
 - Indexes/metrics used or recommended for the characterization of each type of event (in terms of how the magnitude, location, timing and duration of each type of event are monitored and recorded). The latter can be provided by citing appropriate references, if available.

To: Presidents of technical commissions (P.TC-1752)
Presidents of regional associations (P.RA-1770)

A short set of illustrative examples is also attached for your reference (Annex 3). Many of the definitions cited in Annex 2 come from WMO publications Nos. 407 (http://library.wmo.int/pmb_ged/wmo_407_en-v1.pdf) and 385 (http://www.wmo.int/pages/prog/hwarp/publications/international_glossary/385_IGH_2012.pdf), and from METEOTERM (http://www.wmo.ch/pages/prog/lsp/meteoterm_wmo_en.html). Definitions for event types found in WMO-No. 407 and WMO-No. 385 should be considered current and changes proposed only if absolutely necessary. METEOTERM definitions, on the other hand, are currently under review, and any updates to them would be candidates to be subsequently incorporated.

Any additional comments or input you may have would, of course, be welcome. The information received will be compiled and recorded in a working paper. You are requested to kindly send the materials before 1 December 2016 to:

Mr Michel Jean
CBS Coordinator for Disaster Risk Reduction
Canadian Centre for Meteorological and Environmental Prediction
Meteorological Service of Canada
Environment Canada
E-mail: Michel.Jean2@canada.ca

Please copy your responses to Mr Alasdair Hainsworth (ahainsworth@wmo.int), Mr James Douris (jdouris@wmo.int), Mr Omar Baddour (obaddour@wmo.int) and Ms Nadia Oppliger (noppliger@wmo.int).

Thank you very much in advance for your cooperation.

Yours faithfully,



(E. Manaenkova)
for the Secretary-General

Resolution 9 (Cg-17)

IDENTIFIERS FOR CATALOGUING EXTREME WEATHER, WATER AND CLIMATE EVENTS

THE WORLD METEOROLOGICAL CONGRESS,

Noting:

- (1) The increasing frequency and magnitude of extreme weather, water and climate events and their impacts on different socioeconomic sectors, lives and livelihoods,
- (2) The calls for reducing the losses associated with extreme events in the Sendai Framework for Disaster Risk Reduction 2015–2030, the United Nations Framework Convention on Climate Change Warsaw international mechanism for loss and damage associated with climate change impacts, and the United Nations draft sustainable development goals,

Noting further:

- (1) That developing identifiers for cataloguing weather, water and climate extreme events in cooperation with institutions having competences about possible impact of those weather events can provide an unambiguous reference for associated losses and damages and can promote consistency in the characterization of extreme events,
- (2) That more consistent event characterization in terms of type of event, location, duration, magnitude and timing would allow for better evaluation of the types of losses and damages associated with different types of events, and the most damaging events and thresholds, and trends,

Considering:

- (1) That many National Meteorological and Hydrological Services have developed and are maintaining historical catalogues of extreme events,
- (2) That many countries have established disaster loss and damage accounting systems that could help in monitoring the implementation of the Sendai Framework and other international policies,
- (3) That technical commissions, regional associations and technical programmes are at different stages in addressing the different aspects of extreme weather, water, climate and space weather events such as methodologies and standards for defining the events, indices, and creating web portals for event databases, and that there is a need for better understanding their roles in addressing this issue,
- (4) That an identifier and cataloguing system is an important prerequisite for the Atlas of Mortality and Economic Losses from Weather, Climate and Water Extremes and the United Nations Office for Disaster Risk Reduction Global Assessment Reports on Disaster Risk Reduction, and that it could greatly assist the Global Framework for Climate Services by bringing a standardized approach of National Meteorological and Hydrological Services to the analysis and recording of extreme hydrometeorological events in national databases, and by supporting the international exchange and validation of these data,

Decides to standardize weather, water, climate, space weather and other related environmental hazard and risk information and develop identifiers for cataloguing weather, water and climate extreme events;

Requests the Executive Council to provide oversight on the standardization of hazard information for loss and damage assessment;

Requests the Commission for Basic Systems to develop, in collaboration with all technical commissions and regional associations, a proposal on standardized identifiers for cataloguing hazardous events for consideration by the Executive Council;

Requests the Secretary-General to take the necessary actions, within the available budgetary resources, to facilitate the work on this important issue.

**EVENT TYPES AND METRICS FOR CHARACTERIZATION OF HAZARD AND EXTREME
EVENT INFORMATION FOR LOSS AND DAMAGE ASSESSMENT**

The Seventeenth Session of the World Climate Congress (Cg-17) decided to standardize hazard and extreme event information, including the creation or adoption of a system of assigning a unique identifier to each event so that events can be catalogued and linked to data on associated damages and losses.

Information will be validated with all relevant Commissions and Programmes, the Executive Council Working Group on Disaster Risk Reduction (ECWG-DRR), and by Members as appropriate and submitted to the EC-68/9 and Cg-18.

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I. Weather

Constituent body: Commission for Basic Systems (CBS)

Secretariat focal point: Alice Soares (asoares@wmo.int)

Subsidiary body: Open Programme Area Groups on Data-Processing and Forecasting System
(OPAG-DPFS)

Subsidiary body focal point: Ken Mylne and Yuki Honda

Sub-subsidiary body: Expert Team on the Operational Weather Forecasting Process and Support
(ET-OFPS)

Sub-subsidiary body focal point: David Richardson (david.richardson@ecmwf.int)

Associated programme: Severe Weather Forecasting Demonstration Project (SWFDP)

Blizzard

Meteoterm definition 1: Violent winter storm, lasting at least 3 hours, which combines below freezing temperatures and very strong wind laden with blowing snow that reduces visibility to less than 1 km. (*source: International Meteorological Vocabulary, WMO-No. 182*)

Meteoterm definition 2: A severe snow storm characterized by poor visibility, usually occurring in high-latitude and mountainous regions. (*source: Manual on marine meteorological services (WMO-No. 558, App. 1.2)*)

Alternative definition: Blizzards are violent storms combining below-freezing temperatures with strong winds and blowing snow. They are a danger to people and livestock. They cause airports to close and bring havoc to roads and railways. (*source: https://www.wmo.int/pages/themes/hazards/index_en.html*)

Downburst

Meteoterm definition: Violent and damaging downdraught reaching the surface, associated with a severe thunderstorm. (*source: International Meteorological Vocabulary, WMO-No. 182*)

Dry spell

Meteoterm definition: Period of abnormally dry weather. Use of the term should be confined to conditions less severe than those of a drought. (*source: International Meteorological Vocabulary, WMO-No. 182*)

Alternative definition: A period of unusually dry conditions (*) of at least five consecutive days with daily precipitation less than 1mm.(*) i.e. to exclude usually dry periods, such as during dry seasons in arid or semi-arid areas. (*source: Sena's appendix*)

Fog

Meteoterm definition 1: Suspension of very small, usually microscopic water droplets in the air, generally reducing the horizontal visibility at the Earth's surface to less than 1 km. (*source: International Meteorological Vocabulary, WMO-No. 182*)

Meteoterm definition 2: A suspension of very small, usually microscopic water droplets in the air, reducing visibility at the Earth's surface. (*source: Manual on marine meteorological services (WMO-No. 558, App. 1.2) and [International Cloud Atlas, Volume I – Manual on the Observation of Clouds and Other Meteors](#)*)

Alternative definition 1: Fog consists of minute water droplets suspended in the atmosphere to form a cloud at the Earth's surface. Fog droplets have diameters from about 1 to 40 µm and fall velocities from less than 1 to approximately 5 cm.s⁻¹. In fact, the fall speed of fog droplets is so low that, even in light winds, the drops will travel almost horizontally. When fog is present, horizontal visibility is usually less than 5 km; it is rarely observed when the

temperature and dewpoint differ by more than 2°C. (source: [Guide to Meteorological Instruments and Methods of Observation, WMO-No. 8](#))

Alternative definition 2: The suspension in the air of very small water droplets, which reduces horizontal visibility to less than 1 000 m. (source: [Aerodrome Reports and Forecasts, A Users' Handbook to the Codes, WMO-No. 782](#))

Hoar frost

Meteoterm definition 1: Deposit of ice, which generally assumes the form of scales, needles, feathers or fans and which forms on objects whose surface is sufficiently cooled, usually by nocturnal radiation, to bring about the direct sublimation of the water vapour contained in the ambient air. (source: *International Meteorological Vocabulary, WMO-No. 182*)

Meteoterm definition 2: A deposit of ice, which generally assumes the form of scales, needles, features or fans and which forms on objects the surface of which is sufficiently cooled, generally by nocturnal radiation, to bring about the direct sublimation (passage from the gaseous to the solid state) of the water vapour contained in the ambient air. (source: *International Cloud Atlas, Vol. I, WMO-No. 407*)

Meteoterm definition 3: Deposit of ice crystals forming on objects whose surface is sufficiently cooled to cause the sublimation of the water vapour contained in the ambient air. (source: *International Glossary of Hydrology, WMO/UNESCO, 2011*)

Alternative definition 1: Hoar frost (commonly called frost) forms when air with a dew-point temperature below freezing is brought to saturation by cooling. Hoar frost is a deposit of interlocking ice crystals formed by direct sublimation on objects, usually of small diameter, such as tree branches, plant stems, leaf edges, wires, poles, and so forth. (source: [Guide to Meteorological Instruments and Methods of Observation, WMO-No. 8](#))

Alternative definition 2: Hoar-frost is a deposit of ice having a crystalline appearance generally assuming the form of scales, needles, feathers or fans, produced in a manner similar to dew, but at a temperature below 0°C. (source: [WMO solid precipitation measurement intercomparison, Final report, WMO-TD No. 872](#))

Alternative definition 3: Temperature of the upper layer of the soil of less than 0°C. May cause damage to vegetation, occurring when the water that is part of the cell structure of the plant solidifies, bursting cells walls and deteriorating the plant materials. (source: *Sena's appendix*)

Alternative definition 4: A deposit of ice on objects generally crystalline in appearance, and produced by the direct "sublimation" of water vapour from the surrounding air. (source: [International Cloud Atlas, Volume I – Manual on the Observation of Clouds and Other Meteors](#))

Gale

Meteoterm definition 1: Wind with a speed between 34 and 40 knots (Beaufort scale wind force 8). (source: *International Meteorological Vocabulary, WMO-No. 182*)

Meteoterm definition 2: Sustained winds within the range 63 to 117 km/h (39 to 73 miles per hour) (34 to 63 knots). (source: *RA IV/TD-No. 494 (1995)*)

Alternative definition: Wind speed greater than or equal to 34 knots or 18 m/s. (source: <http://severe.worldweather.wmo.int/galedoc.html>)

Hail

Meteoterm definition: Precipitation of either transparent, or partly or completely opaque particles of ice (hailstones), usually spheroidal, conical or irregular in form and of diameter very generally between 5 and 50 millimetres, which falls from a cloud either separately or agglomerated into irregular lumps. (source: *International Meteorological Vocabulary, WMO-No. 182 and Manual on marine meteorological services (WMO-No. 558, App. 1.2)*)

Alternative definition 1: Precipitation of transparent, or partly or completely opaque, particles of ice (hail- stones), which are usually spherical, conical or irregular in form and have a diameter generally between 5 and 50 mm (smaller particles of similar origin may be classified either as small hail or ice pellets), and fall either separately or agglomerated into irregular lumps. Hail always occurs in the forms of showers and is generally observed during heavy thunderstorms. (source: [Guide to Meteorological Instruments and Methods of Observation, WMO-No. 8](#))

Alternative definition 2: Transparent or partly or completely opaque pieces of ice (hailstones) with a diameter generally between 5 mm and 50 mm. Very large stones weighing 1 kg or more

have been observed. (source: [Aerodrome Reports and Forecasts, A Users' Handbook to the Codes, WMO-No. 782](#))

Haze

Meteoterm definition 1: Suspension in the atmosphere of extremely small, dry particles which are invisible to the naked eye but numerous enough to give the sky an opalescent appearance. (source:

International Meteorological Vocabulary, WMO-No. 182)

Meteoterm definition 2: A suspension in the air of extremely small, dry particles invisible to the naked eye and sufficiently numerous to give the air an opalescent appearance. (source: *Manual on marine meteorological services, WMO-No. 558, App. 1.2* and [International Cloud Atlas, Volume I – Manual on the Observation of Clouds and Other Meteors](#))

Alternative definition 2: The suspension in the air of extremely small dry particles invisible to the naked eye and sufficiently numerous to give the air an opalescent appearance with a reduction in horizontal visibility to 5 000 m or less. (source: [Aerodrome Reports and Forecasts, A Users' Handbook to the Codes, WMO-No. 782](#))

Heavy precipitation

Alternative definition: A marked precipitation event occurring during a period of time of 1h, 3h, 6h, 12h, 24h or 48 hours with a total precipitation exceeding a certain threshold defined for a given location. (source: *Sena's appendix*)

Heavy rain

Meteoterm definition 1: Rain with a rate of accumulation exceeding a specific value, e.g. 7.6 mm h⁻¹. (source: *International Meteorological Vocabulary, WMO-No. 182*)

Meteoterm definition 2: Rainfall of high intensity. (source: *International Glossary of Hydrology, WMO/UNESCO, 2011*)

Alternative definition: Rainfall or snowfall greater than or equal to 50 mm in the past 24 hours. (source: <http://severe.worldweather.wmo.int/raindoc.html>)

Ice storm

Meteoterm definition: Intense formation of ice on objects by the freezing, on impact, of rain or drizzle. (source: *International Meteorological Vocabulary, WMO-No. 182*)

Snowstorm

Meteoterm definition: Meteorological disturbance giving rise to a heavy fall of snow, often accompanied by strong winds. (source: *International Meteorological Vocabulary, WMO-No. 182*)

Squall

Meteoterm definition 1: Atmospheric phenomenon characterized by an abrupt and large increase of wind speed with a duration of the order of minutes which diminishes rather suddenly. It is often accompanied by showers or thunderstorms. (source: *International Meteorological Vocabulary*, WMO-No. 182)

Meteoterm definition 2: Atmospheric phenomenon characterized by a very large variation of wind speed: it begins suddenly, has a duration of the order of minutes, and decreases its speed quickly. It is often accompanied by showers or storms. (source: *RA IV/TD-No. 494, Hurricane Operational Plan (1995) - Manual on marine meteorological services*, WMO-No. 558, App. 1.2)

Alternative definition 1: A strong wind that rises suddenly, generally lasting for at least 1 min. It is distinguished from a gust by its longer duration. The sudden increase in wind speed is at least 16 kt (8 m/s), the speed rising to 22 kt (11 m/s) or more and lasting at least 1 min. Squalls are often associated with large cumulonimbus clouds and violent convective activity, extending some kilometres horizontally and several thousands of feet vertically. (source: [Aerodrome Reports and Forecasts, A Users' Handbook to the Codes, WMO-No. 782](#))

Alternative definition 2: Atmospheric phenomenon characterized by a very large variation of wind speed: it begins suddenly, has a duration of the order of minutes and decreases rather suddenly in speed. It is often accompanied by a shower or thunderstorm. (source: [Manual on Codes, International Codes, Volume I.2, WMO-No. 306](#))

Storm

Meteoterm definition 1: (1) An atmospheric disturbance involving perturbations of the prevailing pressure and wind fields, on scales ranging from tornadoes (1 km across) to extratropical cyclones (2000-3000 km across). (2) Wind with a speed between 48 and 55 knots (Beaufort scale wind force 10). (source: *International Meteorological Vocabulary*, WMO-No. 182)

Meteoterm definition 2: Any disturbed state of the atmosphere. (source: *Standard Dictionary of Meteorological Sciences*, by G-J. Proulx, Canada)

Strong gale

Meteoterm definition: Wind with a speed between 41 and 47 knots (Beaufort scale wind force 9). (source: *International Meteorological Vocabulary*, WMO-No. 182)

Thunderstorm

Meteoterm definition 1: Sudden electrical discharges manifested by a flash of light (lightning) and a sharp or rumbling sound (thunder). Thunderstorms are associated with convective clouds (Cumulonimbus) and are, more often, accompanied by precipitation in the form of rainshowers or hail, or occasionally snow, snow pellets, or ice pellets. (source: *International Meteorological Vocabulary*, WMO-No. 182)

Meteoterm definition 2: One or more sudden electrical discharges, manifested by a flash of light (lightning) and a sharp or rumbling sound (thunder). (source: *Manual on marine meteorological services* (WMO-No. 558, App. 1.2) and [International Cloud Atlas, Volume I – Manual on the Observation of Clouds and Other Meteors](#))

Meteoterm definition 3: One or more sudden electrical discharges manifested by a luminous flash (lighting) and a sharp or noisy sound (thunder). (source: *RA IV/TD-No. 494 (1995)*)

Alternative definition: One or more sudden electrical discharges, manifested by a flash of light (lightning) and a sharp or rumbling sound (thunder). Thunderstorms are associated with convective clouds (cumulonimbus) and are usually accompanied by precipitation. The associated cumulonimbus has vertical updraughts that may reach 30 m/s in the more vigorous cells. Downdraughts also occur, especially in the later stages of development, with speeds of about half of those for updraughts. (source: [Aerodrome Reports and Forecasts, A Users' Handbook to the Codes, WMO-No. 782](#))

Wet spell

Meteoterm definition: A period of a number of consecutive days on each of which precipitation exceeding a specific minimum amount has occurred. (*source: International Meteorological Vocabulary, WMO-No. 182*)

Alternative definition: A period of at least five consecutive days with daily precipitation exceeding 1 millimeter. (*source: Sena's appendix*)

Constituent body: Regional Associations

Secretariat focal point: Taoyong Peng (tpeng@wmo.int)

Subsidiary body: WMO/ESCAP Panel on Tropical Cyclones, RA I Tropical Cyclone Committee, RA V Tropical Cyclone Committee

Subsidiary body focal point: Sunil H Kariyawasam, **Mike Bergin**

Sub-subsidiary body focal point: Arif Mahmood, Imran Akram

Associated programme: Tropical Cyclone Programme (TCP)

Cyclone

Meteoterm definition: An area of low pressure, with the lowest pressure at the centre. Commonly referred to as Low. (*source: RA IV/TD-No. 494 (1995)*)

Alternative definition: A tropical cyclone (*source: [Typhoon Committee Operational Manual, report No. TCP-23](#)*)

Tropical cyclone

Meteoterm definition 1: Generic term for a non-frontal synoptic scale cyclone originating over tropical or sub-tropical waters with organized convection and definite cyclonic surface wind circulation. Tropical disturbance: light surface winds with indications of cyclonic circulation. Tropical depression: wind speed up to 33 knots. Tropical storm: maximum wind speed of 34 to 47 knots. Severe tropical storm: maximum wind speed of 48 to 63 knots. Hurricane: maximum wind speed of 64 knots or more. Typhoon: maximum wind speed of 64 knots or more. Tropical cyclone (South-West Indian Ocean): maximum wind speed of 64 to 90 knots. Tropical cyclone (Bay of Bengal, Arabian Sea, South-East Indian Ocean, South Pacific): maximum wind speed of 34 knots or more. (*source: International Meteorological Vocabulary, WMO-No. 182*)

Meteoterm definition 2: (1) Generic term for a non-frontal synoptic scale cyclone originating over tropical or sub-tropical waters with organized convection and definite cyclonic surface wind circulation. The term is also used for a storm in the South-West Indian Ocean in which the maximum of the sustained wind speed is estimated to be in the range of 64 to 90 knots and in the South Pacific and South-East Indian Ocean with the maximum of the sustained wind speed over 34 knots. (2) It is the generic term that includes tropical depression, tropical storms, cyclones, hurricanes or typhoons. A tropical cyclone in which the maximum of the average wind speed is estimated to be in the range of 118 to 165 km/h (64 to 90 knots, within wind force 12 in the Beaufort scale). (3) A non-frontal cyclone of synoptic scale developing over tropical waters and having a definite organized wind circulation with average wind of 34 knots (63 km per hour) or more surrounding the centre. (4) A non-frontal cyclone of synoptic scale, developing over tropical or subtropical waters and having a definite organized surface circulation. (*source: 1. RA I/TCC-XI/Doc. 6 2. RA I-No. 618 (1994) 3. RA V/TD-No. 292 (1995) 4. RA IV/TD-No. 494 (1995)*)

Alternative definition 1: Generic term for a warm-core non-frontal synoptic scale cyclone originating over tropical or sub-tropical waters with organized deep convection and closed cyclonic surface wind circulation. The term is also used for a storm in the South-West Indian Ocean in which the maximum sustained wind speed ¹is estimated to be in the range of 64 to 90 knots and in the South Pacific and South-East Indian Ocean with the maximum sustained surface wind speed greater than 33 kn. (*source: [Seventh Tropical Cyclone RSMCs/TCWCs](#)*,

¹ Average wind speed. Average period of one, three or ten minutes is depending upon the regional practices. (*source: [Seventh Tropical Cyclone RSMCs/TCWCs, Technical Coordination Meeting, WMO, 2012, appendix VIII and Typhoon Committee Operational Manual, report No TCP-23](#)*)

[Technical Coordination Meeting, WMO, 2012, appendix VIII and Typhoon Committee Operational Manual, report No .TCP-23\)](#)

Alternative definition 2: A warm-core, non-frontal synoptic-scale cyclone, originating over tropical or subtropical waters, with organized deep convection and closed surface wind circulation about a well defined centre. (source: [Hurricane Operational Plan, Report No. TCP-30, WMO-TD No. 494](#) and <http://severe.worldweather.wmo.int/tc/cnp/acronyms.html#GTC>)

Alternative definition 3: Tropical cyclones are areas of very low atmospheric pressure over tropical and sub-tropical waters which build up into a huge, circulating mass of wind and thunderstorms up to hundreds of kilometres across. Surface winds can reach speeds of 200 km/h or more. The combination of wind-driven waves and the low-pressure of a tropical cyclone can produce a coastal storm surge—a huge volume of water driven ashore at high speed and of immense force that can wash away everything in its path. A massive storm surge left 300 000 people dead in the coastal wetlands of Bangladesh in 1970. About 80 tropical cyclones form every year. Their names depend on where they form: typhoons in the western North Pacific and South China Sea; hurricanes in the Atlantic, Caribbean and Gulf of Mexico, and in the eastern North and central Pacific Ocean; and tropical cyclones in the Indian Ocean and South Pacific region.

(source: https://www.wmo.int/pages/themes/hazards/index_en.html)

Alternative definition 4: Tropical cyclones are areas of low atmospheric pressure that form over warm tropical or sub-tropical waters, eventually building up into a huge, circulating mass of wind and thunderstorms up to hundreds of kilometres in diameter. Surface winds can reach speeds of 200 kilometres an hour, although the “eye” at the centre, usually just a few dozen kilometres in diameter, is relatively calm. (source: [Water and disasters: be informed and be prepared, WMO-No. 971](#))

Alternative definition 5: Cyclone of tropical origin of small diameter (some hundreds of kilometres) with minimum surface pressure in some cases 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 more or less lightly clouded sky. (source: [Manual on Codes, International Codes, Volume I.2, WMO-No. 306](#))

Sub-tropical cyclone

Meteorological definition: A low pressure system, developing over subtropical waters which initially contains few tropical characteristics. With time the subtropical cyclone can become tropical. (source: RA I/TCC-XI/Doc. 6 RA IV/TD-No. 494 (1995), [Seventh Tropical Cyclone RSMCs/TCWCs, Technical Coordination Meeting, WMO, 2012, appendix VIII and Typhoon Committee Operational Manual, report No TCP-23](#))

Alternative definition 1: A non-frontal low pressure system that has characteristics of both tropical and extratropical cyclones.

- The most common type is an upper-level cold low with circulation extending to the surface layer and maximum sustained winds generally occurring at a radius of about 100 miles or more from the centre. In comparison to tropical cyclones, such systems have a relatively broad zone of maximum winds that is located farther from the centre, and typically have a less symmetric wind field and distribution of convection.
- A second type of subtropical cyclone is a mesoscale low originating in or near a frontolyzing zone of horizontal wind shear, with radius of maximum sustained winds generally less 30 miles. The entire circulation may initially have a diameter of less than 100 miles. These generally short-lived systems may be either cold core or warm core.

(source: <http://severe.worldweather.wmo.int/tc/cnp/acronyms.html#SGTC>)

Alternative definition 2: 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 welldefined center. In addition, they have organized 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 center (usually greater than 60 n mi), and generally have a less symmetric wind field and distribution of convection. (source: [Hurricane Operational Plan, Report No. TCP-30, WMO-TD No. 494](#))

Extra-tropical cyclone

Meteoterm definition 1: Low-pressure system which develops in latitudes outside the tropics. (source: *International Meteorological Vocabulary*, WMO-No. 182 and [Typhoon Committee Operational Manual, report No. TCP-23](#))

Meteoterm definition 2: A large-scale (of order 1000 km) storm in the middle or high latitudes having low central pressure and fronts with strong horizontal gradients in temperature and humidity. A major cause of extreme wind speeds and heavy precipitation especially in wintertime. (source: *IPCC 5th Assessment Report, WG 1 Glossary*)

Alternative definition: A former tropical cyclone that has gone through extra-tropical transition and lost its initial tropical characteristics. (source: [Seventh Tropical Cyclone RSMCs/TCWCs, Technical Coordination Meeting, WMO, 2012, appendix VIII](#))

Constituent body: Regional Association IV

Secretariat focal point: Taoyong Peng (tpeng@wmo.int)

Subsidiary body: RA IV Hurricane Committee

Subsidiary body focal point: Richard Knabb

Associated programme: Tropical Cyclone Programme (TCP)

Hurricane

Meteoterm definition 1: (1) Name given to a warm core tropical cyclone with maximum surface wind of 118 km/h (~1 (64 knots, 74 mph) or greater (hurricane force wind) in the North Atlantic, the Caribbean and the Gulf of Mexico, and in the Eastern North Pacific Ocean. (2) A tropical cyclone with hurricane force winds in the South Pacific and South-East Indian Ocean. (source: *International Meteorological Vocabulary*, WMO-No. 182)

Meteoterm definition 2: (1) A tropical cyclone with hurricane force winds. (2) A warm core tropical cyclone in which maximum average surface wind (one-minute mean) is 118 km/h (74 mph) (64 knots) or greater. (source: 1) RA V/TD-No. 292 (1995) 2) RA IV/TD-No. 494 (1995))

Alternative definition 1: A warm core tropical cyclone in which maximum average surface wind (one-minute mean) is 118 km/h (74 mph) (64 knots) or greater. (source: <http://severe.worldweather.wmo.int/tc/cnp/acronyms.html#HTC>)

Alternative definition 2: A tropical cyclone in which maximum average surface wind (one-minute mean²) is 119 km/h (74 mph) (64 knots) or greater. (source: [Hurricane Operational Plan, Report No. TCP-30, WMO-TD No. 494](#))

² For converting the wind speeds of different averaging periods such as 1-min, 2-min, 3-min and 10-min, WMO Tropical Cyclone Programme recommends to follow the guidelines as shown in the ATTACHMENT 1-B

Constituent body: None

Secretariat focal point: Taoyong Peng (tpeng@wmo.int)

Subsidiary body: ESCAP/WMO Typhoon Committee

Sub-subsidiary body focal point: Jixin Yu, Clarence Fong, Jinping Liu

Associated programme: Tropical Cyclone Programme

Typhoon

Meteoterm definition 1: Name given to a tropical cyclone with maximum sustained winds of 64 knots or more near the centre in the western North Pacific. (*source: International Meteorological Vocabulary, WMO-No. 182*)

Meteoterm definition 2: A hurricane occurring along the western margins of the Pacific Ocean. (*source: source: [Manual on marine meteorological services, WMO-No. 558, App. 1.2](#)*)

Meteoterm definition 3: Name given to hurricanes in the China Sea and, more commonly, in the north-west Pacific Ocean. (*source: RA IV/TD-No. 494 (1995)*)

Alternative definition: A tropical cyclone with the maximum sustained winds of 64 knots (32.7 m/s, 118 km/h) or more near the centre. (*source: [Typhoon Committee Operational Manual, report No. TCP-23](#)*)

Constituent body: Regional Association IV

Secretariat focal point: Taoyong Peng (tpeng@wmo.int)

Associated programme: Tropical Cyclone Programme (TCP)

Severe tropical storm

Meteoterm definition: A tropical cyclone in which the maximum of the average wind speed is estimated to be in the range 89 to 117 km/h (48 to 63 knots, wind force 10 or 11 in the Beaufort scale). (*source: RA I-No. 618 (1994)*)

Alternative definition: A tropical cyclone with the maximum sustained winds of 48 knots (24.5 m/s, 89 km/h) to 63 knots (32.6 m/s, 117 km/h) near the centre. (*source: [Typhoon Committee Operational Manual, report No. TCP-23](#)*)

Subtropical Storm

Meteoterm definition: A subtropical cyclone in which the maximum sustained surface wind is 63 km/h (39 mph) (34 knots) or greater. (*source: RA IV/TD-No. 494 (1995)*)

Tornado

Meteoterm definition: A severe rotating windstorm of small diameter and great destructive power. It is the most violent natural meteorological phenomenon. With certain frequency they can occur within hurricanes circulation. Although tornadoes occur over land areas in many parts of the world associated with several weather situations, they are relatively frequent in the forward portion of the hurricane periphery. (*source: RA IV/TD-No. 494 (1995)*)

Alternative definition: A violently rotating storm of small diameter; the most violent weather phenomenon. It is produced in a very severe thunderstorm and appears as a funnel cloud extending from the base of a Cumulonimbus to the ground. (*source: Sena's appendix*)

Tropical storm

Meteoterm definition: A well-organized warm-core tropical cyclone in which the maximum average surface wind (one-minute mean) is in the range 63-117 km/h (39-73 mph) (34-63 knots) inclusive. (*source: RA IV/TD-No. 494 (1995)*)

Alternative definition 1: A tropical cyclone with the maximum sustained winds of 34 knots (17.2 m/s, 62 km/h) to 47 knots (24.4 m/s, 88 km/h) near the centre. (*source: [Typhoon Committee Operational Manual, report No. TCP-23](#)*)

Alternative definition 2: A well organized tropical cyclone in which the maximum average surface wind (one-minute mean) is in the range 63-118 km/h (39-73 mph) (34-63 knots) inclusive. (*source: [Hurricane Operational Plan, Report No. TCP-30, WMO-TD No. 494](#)*)

II. Climate

Constituent body: Commission for Climatology (CCI)

Secretariat focal point: Omar Baddour (obaddour@wmo.int)

Subsidiary body: OPACE 2 – Climate Monitoring and Assessment

Subsidiary body focal point: Fatima Driouech (driouechfatima@yahoo.fr), Manola Brunet (manola.brunet@urv.cat)

Sub-subsidiary body: Task Team on Definitions of Extreme Weather and Climate Events (TT-DEWCE) "Provide guidance to Members on the methodologies and standards for defining extreme weather and climate events and assessing their attribution and return periods, and advise on adequate computational tools for the assessment"

Sub-subsidiary body focal point: Panmao Zhai (pmzhai@cma.gov.cn), Ahira Sánchez-Lugo (ahira.sanchez-lugo@noaa.gov)

Associated programme: World Climate Services Programme (WCSP)

Cold wave

Meteoterm definition: Marked cooling of the air, or the invasion of very cold air, over a large area. (source: *International Meteorological Vocabulary*, WMO-No. 182)

Alternative definition 1: A marked and unusual cold weather characterized by a sharp and significant drop of air temperatures near the surface (Max, Min and daily average) over large area and persisting below certain thresholds for at least two consecutive days during the cold season. (source: *Sena's appendix*)

Heatwave/heat wave

Meteoterm definition 1: Marked warming of the air, or the invasion of very warm air, over a large area; it usually lasts from a few days to a few weeks. (source: *International Meteorological Vocabulary*, WMO-No. 182)

Meteoterm definition 2: A period of abnormally and uncomfortably hot weather. (source: *IPCC 5th Assessment Report, WG 1 Glossary*)

Alternative definition 1: Periods of unusually hot and dry or hot and humid weather that have a subtle onset and cessation, a duration of at least two to three days and a discernible impact on human activities. (source: [Heatwaves and Health: Guidance on Warning-System Development, WMO-No. 1142](#))

Biometeorological Indices: heat index, humidex, net effective temperature, wet-bulb globe temperature, apparent temperature, excess heat index, heat-budget models, standard effective temperature, predicted mean vote, perceived temperature, physiological equivalent temperature, universal thermal climate index

Holistic approach: health-related assessment of the thermal environment, Heat Stress Index, Excess Heat Index-acclimatization, Excess heat factor

Alternative definition 2: A marked unusual hot weather over a region persisting at least two consecutive days during the hot period of the year based on local climatological conditions, with thermal conditions recorded above given thresholds. (source: *Sena's appendix*)

Constituent body: Commission for Agricultural Meteorology (CAgM)

Secretariat focal point: Robert Stefanski (rstefanski@wmo.int)

Subsidiary body: Focus area 3, Natural Hazards and Climate Change/Variability in Agriculture

Subsidiary body focal point: Roger Stone (roger.stone@usq.edu.au), Ray Desjardin

Sub-subsidiary body: ET 3.1 - Expert Team on Drought

"Make a comprehensive review of drought and its complexities in definition, scale, duration, onset and recovery; review indexes used to identify and monitor drought with an emphasis on agriculture"

Sub-subsidiary body focal point: Allan Howard (allan.howard@agr.gc.ca)

Associated programme: Integrated Drought Management Programme (IDMP)

Drought

Meteoterm definition 1: (1) Prolonged absence or marked deficiency of precipitation. (2) Period of abnormally dry weather sufficiently prolonged for the lack of precipitation to cause a serious hydrological imbalance. (*source: International Meteorological Vocabulary, WMO-No. 182*)

Meteoterm definition 2: In general terms, drought is a 'prolonged absence or marked deficiency of precipitation', a 'deficiency that results in water shortage for some activity or for some group', or a 'period of abnormally dry weather sufficiently prolonged for the lack of precipitation to cause a serious hydrological imbalance' (Heim, 2002). Drought has been defined in a number of ways. Agricultural drought relates to moisture deficits in the topmost 1 metre or so of soil (the root zone) that affect crops, meteorological drought is mainly a prolonged deficit of precipitation, and hydrologic drought is related to below-normal streamflow, lake and groundwater levels. A megadrought is a long-drawn out and pervasive drought, lasting much longer than normal, usually a decade or more. (*source: IPCC 4th Assessment Report, WG 1 Glossary*)

Meteoterm definition 3: A period of abnormally dry weather long enough to cause a serious hydrological imbalance. Drought is a relative term; therefore any discussion in terms of precipitation deficit must refer to the particular precipitation-related activity that is under discussion. For example, shortage of precipitation during the growing season impinges on crop production or ecosystem function in general (due to soil moisture drought, also termed agricultural drought), and during the runoff and percolation season primarily affects water supplies (hydrological drought). Storage changes in soil moisture and groundwater are also affected by increases in actual evapotranspiration in addition to reductions in precipitation. A period with an abnormal precipitation deficit is defined as a meteorological drought. A megadrought is a very lengthy and pervasive drought, lasting much longer than normal, usually a decade or more. (*source: IPCC 5th Assessment Report, WG 1 Glossary*)

Alternative definition 1: A prolonged period of anomalously low moisture availability as a consequence of prevailing hydro-meteorological conditions, including precipitation, temperature, evapotranspiration rates, soil moisture retention and runoff. (*source: anonym*)

Alternative definition 2: Drought is an insidious natural hazard that results from lower levels of precipitations than what is considered normal. When this phenomenon extends over a season or a longer period of time, precipitation is insufficient to meet the demands of human activities and the environment. (*source: [Standardized Precipitation Index User Guide, WMO-No. 1090](#)*)

Alternative definition 3: Prolonged absence or marked deficiency of precipitation. (source: [International Glossary of Hydrology, WMO/UNESCO, WMO-No. 385](#))

Alternative definition 4: Drought is a protracted period of deficient precipitation resulting in extensive damage to crops, further resulting in loss of yield. (source: [Drought Assessment and Forecasting, 2005](#))

Drought indices: percent of normal, deciles, palmer drought severity index, surface water supply index, standardized precipitation index

Alternative definition 5: A prolonged dry period in the natural climate cycle that can occur anywhere in the world. It is a slow-onset phenomenon caused by rainfall deficit. (source: [Atlas of health and climate, WMO-No. 1097](#))

Alternative definition 6: The primary cause of any drought is deficiency of rainfall. Drought is different from other hazards in that it develops slowly, sometimes over years, and its onset can be masked by a number of factors. Drought can be devastating: water supplies dry up, crops fail to grow, animals die and malnutrition and ill health become widespread. (source: https://www.wmo.int/pages/themes/hazards/index_en.html)

Alternative definition 7: Drought is a natural hazard originating from a deficiency of precipitation that results in a water shortage for some activities or groups. It is the consequence of a reduction in the amount of precipitation over an extended period of time, usually a season or more in length, often associated with other climatic factors - such as high temperatures, high winds and low relative humidity - that can aggravate the severity of the event. (source: [Climate and Land Degradation, WMO-No. 989](#))

Alternative definition 8: Drought can be characterized as a normal, recurring feature of climate and it occurs in almost all climatic regimes, in areas of high as well as low rainfall. It is a temporary anomaly, in contrast to aridity, which is a permanent feature of the climate and is restricted to areas of low rainfall. Drought is the consequence of a natural reduction in the amount of precipitation received over an extended period of time, usually a season or more in length. Drought is also related to the timing (i.e. main season of occurrence, delays in the start of the rainy season, occurrence of rains in relation to primary crop growth stages) and to the intensity and number of rainfall events. Thus, each drought is unique in its climatic characteristics and impacts. (source: [Climate and Land Degradation, WMO-No. 989](#))

Alternative definition 9: The phenomenon that exists when precipitation has been significantly below normal recorded levels, causing serious hydrological imbalances that adversely affect land resource production systems. (source: [IPCC, Climate Change 2001, Synthesis Report, 3rd Assessment Report, Contribution of WG I, II and III](#))

Note: The absence of a precise and universally accepted definition of drought contributes to the confusion about whether or not a drought exists and, if it does, its degree of severity. Realistically, definitions of drought must be made on a regional and impact-specific basis (agricultural, water resources, etc.). Drought impacts are spread over a larger geographical area than damages that result from other natural hazards such as the impacts of floods and hurricanes. For these reasons, the quantification of impacts and the provision of disaster relief are far more difficult tasks for drought than they are for other natural hazards. (source: [Climate and Land Degradation, WMO-No. 989](#))

Alternative definition 10: A marked unusual period of abnormally dry weather characterized by prolonged deficiency below a certain threshold of precipitation over a large area and persisting for timescales longer than a season. (source: *Sena's appendix*)

Hydrological drought

Meteorological definition: Period of abnormally dry weather sufficiently prolonged to give rise to a shortage of water as evidenced by below normal streamflow and lake levels and/or the depletion of soil moisture and a lowering of groundwater levels. (source: [International Glossary of Hydrology, WMO/UNESCO, 2011](#) and [International Glossary of Hydrology, WMO/UNESCO, WMO-No. 385, 2012](#) and [Technical Regulations, Volume III: Hydrology, WMO-No. 49](#))

Alternative definition 1: Hydrological drought occurs when there is sustained and extensive occurrence of below-average natural water availability, in the form of rainfall, river runoff or groundwater. (source: [Guide to Agricultural Meteorological Practices, WMO-No. 134](#))

Alternative definition 2: Hydrological drought is associated with the effects of periods of precipitation (including snowfall) shortfalls on surface or subsurface water supply (i.e., streamflow, reservoir and lake levels, groundwater). The frequency and severity of hydrological drought is often defined on a watershed or river basin scale. (source: [Drought Assessment and Forecasting, WG on Hydrology, RA VI, 2005](#))

Drought indices: percent of normal, deciles, palmer drought severity index, surface water supply index, standardized precipitation index

Meteorological drought

Meteoterm definition: Prolonged absence or marked deficiency of precipitation. (source: *International Glossary of Hydrology, WMO/UNESCO, 2011*; [Guide to Agricultural Meteorological Practices, WMO-No. 134](#) and [International Glossary of Hydrology, WMO/UNESCO, WMO-No. 385, 2012](#))

Alternative definition 2: Meteorological drought is usually defined on the basis of the degree of dryness (in comparison to some "normal" or average amount) and the duration of the dry period. Definitions of meteorological drought must be considered as specific to a region since the atmospheric conditions that result in deficiencies of precipitation are highly variable from region to region. (source: [Drought Assessment and Forecasting, WG on Hydrology, RA VI, 2005](#))

Drought indices: percent of normal, deciles, palmer drought severity index, surface water supply index, standardized precipitation index

III. Water

Constituent body: Commission for Hydrology (CHy)

Secretariat focal point: Paul Pilon (ppilon@wmo.int)

Thematic area 4: OPACHE III - Hydrological Forecasting and Prediction

Thematic area 4 focal points: Johnson Muturi Maina (director@meteo.go.ke),
Yuri Simonov (Simonov@mecom.ru)

Associated programme: Associated Programme on Flood Management (APFM)

Annual flood

Alternative definition: (1) Highest peak discharge in a year. (2) Flood level which has been equalled or exceeded once a year. (source: [International Glossary of Hydrology, WMO-No. 385](#))

Coastal flood

Alternative definition: Storm surges and high winds coinciding with high tides are the most frequent cause of this type of flooding. The surge itself is the result of the raising of sea levels due to low atmospheric pressure. In particular configurations, such as major estuaries or confined sea areas, the piling up of water is amplified by a combination of the shallowing of the seabed and retarding of return flow. Major deltas such as the Mississippi and Ganges are prone to this type of flooding when affected by hurricanes (cyclones). Another sensitive area is the southern North Sea in western Europe as a result of particular tracks of winter depressions. If the surge takes place near the mouth of a river issuing into the sea, the river flow will be obstructed due to the surge, resulting in severe flooding over and near the coastal areas. Tsunamis resulting from sub-seabed earthquakes are a very specific cause of occasionally severe coastal flooding. (source: [Manual on flood forecasting and warning, WMO-No. 1072](#))

Estuarine flood

Alternative definition: Estuaries are inlet areas of the coastline where the coastal tide meets a concentrated seaward flow of fresh water in a river. The interaction between the seaward flow of river water and landward flow of saline water during high tides may cause a build-up of water or inland-moving tidal bore. Frequently, the funnel shape characteristic of many estuaries causes an increase in high water levels in the upper, narrowing reaches of the associated river. These types of floods are mostly experienced in deltaic areas of rivers along the coasts, for example the Mouths of the Ganges. They are more frequent and less severe in terms of inundated depth and area than flooding caused by storm surges. (source: [Manual on flood forecasting and warning, WMO-No. 1072](#))

Flash flood

Meteoterm definition: A flood that rises quite rapidly with little or no advance warning, usually as a result of an intense rainfall over a small area or, possibly, an ice jam, a dam failure, etc. (source: *International Meteorological Vocabulary*, WMO-No. 182)

Alternative definition 1: These floods are frequently associated with violent convection storms of a short duration falling over a small area. Flash flooding can occur in almost any area where there are steep slopes, but is most common in mountain districts subject to frequent severe thunderstorms. Flash floods are often the result of heavy rains of short duration. This particular type of flooding commonly washes away houses, roads and bridges over small streams and so has a critical impact on communities and transport in these often remote areas. Flash flooding can also occur in localized areas when ground has been baked hard by a long, dry period. (source: [Manual on flood forecasting and warning, WMO-No. 1072](#))

Alternative definition 2: Flood of short duration with a relatively high peak discharge. (source: [International Glossary of Hydrology, WMO/UNESCO, WMO-No. 385, 2012](#))

Alternative definition 3: Flood of short duration with a relatively high peak discharge in which the time interval between the observable causative event and the flood is less than four to six hours. (source: [Technical Regulations, Volume III: Hydrology, WMO-No. 49](#))

Alternative definition 4: All floodplains are vulnerable and heavy storms can cause flash flooding in any part of the world. Flash floods can also occur after a period of drought when heavy rain falls onto very dry, hard ground that the water cannot penetrate. (source: https://www.wmo.int/pages/themes/hazards/index_en.html)

Flood

Meteoterm definition: The overflowing of a river or the temporary rise in the level of the sea or a lake which results in the inundation of dry land. (source: *anonym*)

Alternative definition 1: (1) Rise, usually brief, in the water level of a stream or water body to a peak from which the water level recedes at a slower rate. (2) Relatively high flow as measured by stage height or discharge. (3) Rising tide. (source: [International Glossary of Hydrology, WMO/UNESCO, WMO-No. 385, 2012](#))

Alternative definition 2: Floods can occur anywhere after heavy rain events. Floods come in all sorts of forms, from small flash floods to sheets of water covering huge areas of land. They can be triggered by severe thunderstorms, tornadoes, tropical and extra-tropical cyclones (many of which can be exacerbated by the El Niño phenomenon), monsoons, ice jams or melting snow. (source: https://www.wmo.int/pages/themes/hazards/index_en.html)

Flooding

Meteoterm definition: (1) Overflowing by water of the normal confines of a watercourse or other body of water. (2) Accumulation of drainage water over areas which are not normally submerged. (3) Controlled spreading of water for irrigation. (source: *International Glossary of Hydrology, WMO/UNESCO, 2011* and [International Glossary of Hydrology, WMO/UNESCO, WMO-No. 385, 2012](#))

Alternative definition 1: The effects of a flood as distinct from the flood itself, is defined as: Overflowing by water of the normal confines of a stream or other body of water, or accumulation of water by drainage over areas that are not normally submerged. (source: [Manual on flood forecasting and warning, WMO-No. 1072](#))

Alternative definition 2: Flooding occurs when rainwater or snowmelt accumulates faster than soils can absorb it or rivers carry it away. (source: [Climate and Land Degradation, WMO-No. 989](#))

Alternative definition 3: Excessive rainfall events either produced by thunderstorms, hurricanes and typhoons, or mid-latitude low-pressure systems, can produce a large amount of water in a short period of time across local areas. This excess of water overwhelms the local watershed and produces river flooding. River flooding occurs in all climates, but it is in dryland areas where the problem is most acute. (source: [Climate and Land Degradation, WMO-No. 989](#))

Fluvial (riverine) flood

Alternative definition: Fluvial flooding occurs over a wide range of river and catchment systems. Floods in river valleys occur mostly on flood plains or wash lands as a result of flow exceeding the capacity of the stream channels and spilling over the natural banks or artificial embankments. Flash floods are often more damaging, occurring in narrow, steep and confined valleys, characterized as the name implies by the rapidity of formation following rainfall and high flow velocities. The rapidity makes them particularly dangerous to human life. (source: [Manual on flood forecasting and warning, WMO-No. 1072](#))

Ice and debris-jam flood

Alternative definition: In areas that experience seasonal melting, if this is rapid ice floes can accumulate in rivers, forming constrictions and damming flows, causing river levels to rise upstream of the ice jam. A sudden release of the "ice jam" can cause a flood wave similar to that caused by a dam break to move downstream. Both meltwater and heavy rainfall in steep areas can cause landslips and debris flows. As these move downstream, major constrictions can build up. When these collapse or are breached, severe flooding can result. Both of these phenomena are very difficult to predict. (source: [Manual on flood forecasting and warning, WMO No. 1072](#))

Landslide/Mudslide

Meteoterm definition: A mass of material that has slipped downhill by gravity, often assisted by water when the material is saturated; the rapid movement of a mass of soil, rock or debris down a slope. (source: *IPCC 4th Assessment Report, WG 2 Glossary*)

Alternative definition 1: Mudslides and landslides are local events and usually unexpected. They occur when heavy rain or rapid snow or ice melt or an overflowing crater lake sends large amounts of earth, rock, sand or mud flowing swiftly down mountain slopes, especially if these are bare or burnt by forest or brush fires. They can reach speeds of over 50 km/h and can bury, crush or carry away people, objects and buildings. In Venezuela in 1999, after two weeks of continuous rain, landslides and mudflows shot down a mountain, washing away towns and killing an estimated 15 000 people. (source: https://www.wmo.int/pages/themes/hazards/index_en.html)

Alternative definition 2: Landslides happen when heavy rain or rapid snowmelt sends large amounts of earth, rock, sand or mud flowing swiftly down mountain slopes, especially if bare or burnt by forest or brush fires. They tend to worsen the effects of any floods stemming from the same extreme weather. Earthquakes or volcanoes can also set them off, but the most common culprit is water seepage. (source: [Water and disasters: be informed and be prepared, WMO-No. 971](#))

Mudflow

Meteoterm definition: Flow of water so heavily charged with sediment and debris that the flowing mass is thick and viscous. (source: *International Glossary of Hydrology, WMO/UNESCO, 2011*)

Alternative definition: Mudflows and the coarser debris flows are essentially wet, fast-moving landslides that form when masses of loose, wet debris or volcanic deposits become unstable due to saturation from rainfall, melting snow or ice, or an overflowing crater lake. The result is a flowing river of mud or "slurry". Mudflows usually start on steep hillsides as shallow landslides and can reach speeds of over 50 kilometres an hour. (source: [Water and disasters: be informed and be prepared, WMO-No. 971](#))

Multiple event flood

Alternative definition: These result from heavy rainfall associated with successive weather disturbances following closely after each other. On the largest scale, these include for example floods in the Indo-Gangetic plains and central Indian regions often caused by the passage of a series of low-pressure areas or depressions from the Bay of Bengal, more or less along the same path. Multiple event floods can also affect large basins in mid-latitude areas in winter, when sequences of active depressions occur, for example over Western Europe. (source: [Manual on flood forecasting and warning, WMO No. 1072](#))

Seasonal flood

Alternative definition: These are floods that occur with general regularity as a result of major seasonal rainfall activity. The areas of the world subject to a monsoonal type climate are typically the areas most affected and critical situations arise when "normal" flooding is replaced by extended or high-runoff floods. Flooding is frequently a basin-wide situation that can last for periods of several weeks. Within active monsoon conditions, a number of individual peak events can occur during a flood season. Seasonal floods can also result from high water levels in lakes in the upper reaches of a river basin, for example Lake Victoria and the River Nile. Another type of seasonal flood can result from wet conditions in an upper portion of a catchment, which experiences a different climate regime from the lower, affected areas. The Nile and Yangtze rivers are good examples. (source: [Manual on flood forecasting and warning, WMO No. 1072](#))

Single event flood

Alternative definition: This is the most common type of flooding, in which widespread heavy rains lasting several hours to a few days over a drainage basin results in severe floods.

Typically, these heavy rains are associated with cyclonic disturbances, mid-latitude depressions and storms, with well-marked synoptic scale frontal systems. (source: [Manual on flood forecasting and warning, WMO No. 1072](#))

Snowmelt flood

Meteorological definition: Significant flood rise in a river caused by the melting of snowpack accumulated during the winter. (source: *International Glossary of Hydrology, WMO/UNESCO, 2011* and [International Glossary of Hydrology, WMO/UNESCO, WMO-No. 385, 2012](#))

Alternative definition: In upland and high-latitude areas where extensive snow accumulates over winter, the spring thaw produces meltwater runoff. If temperature rises are rapid, the rate of melting may produce floods, which can extend to lower parts of river systems. The severity of meltwater floods will increase if the thaw is accompanied by heavy rainfall and can be further exacerbated if the subsoil remains frozen. Although a seasonal occurrence where major snowfields exist in headwaters, which may produce beneficial flooding in downstream areas, severe effects can occur on smaller scales, especially in areas subject to changes between cold and warmer rainy winter weather. (source: [Manual on flood forecasting and warning, WMO No. 1072](#))

IV. Other related environmental phenomena

Constituent body: Commission for Atmospheric Sciences (CAS)

Secretariat focal point: Alexander Baklanov (abaklanov@wmo.int)

Subsidiary body: Sand and Dust Storm Warning Advisory
and Assessment System Steering Committee (SDS-WAS SC)

Subsidiary body focal point: Enric Terradellas (eterradellasj@aemet.es)

Associated programme: Sand and Dust Storm Warning Advisory
and Assessment System (SDS-WAS) Programme

Duststorm

Alternative definition: Particles of dust energetically lifted by a strong and turbulent wind. Dust storms are usually associated with hot, dry and windy conditions, especially just ahead of vigorous cold fronts that can be cloud free. Dust particles typically have a diameter of less than 0.08 mm and consequently can be lifted to far greater heights than sand. (source: [Aerodrome Reports and Forecasts, A Users' Handbook to the Codes, WMO-No. 782](#))

Sand haze

Meteoterm definition: Haze caused by the suspension in the atmosphere of small sand or dust particles, raised from the ground prior to the time of observation by a sandstorm or duststorm. (source: *International Meteorological Vocabulary*, WMO-No. 182)

Sandstorm

Alternative definition: An ensemble of particles of sand energetically lifted by a strong and turbulent wind. The forward portion of the sandstorm may have the appearance of a wide and high wall. The height to which sand is raised will increase with increasing wind speed and instability (source: [Aerodrome Reports and Forecasts, A Users' Handbook to the Codes, WMO-No. 782](#))

Sandstorm/Duststorm

Meteoterm definition: An ensemble of particles of sand energetically lifted to great heights by a strong and turbulent wind. (source: *Manual on marine meteorological services*, WMO-No. 558, App. 1.2 and [Manual on the Observation of Clouds and other Meteors, WMO-No. 407](#))

Alternative definition 1: Duststorms and sandstorms are ensembles of particles of dust or sand lifted to great heights by strong and turbulent wind. They occur mainly in parts of Africa, Australia, China and the USA. They threaten lives and health, especially of persons caught in the open and far from shelter. Transportation is particularly affected as visibility is reduced to only a few metres. (source: https://www.wmo.int/pages/themes/hazards/index_en.html)

Alternative definition 2: A dust storm or sandstorm is a meteorological phenomenon common in arid and semi-arid regions and arises when a gust front passes or when the wind force exceeds the threshold value where loose sand and dust are removed from the dry surface. In desert areas dust and sand storms are most commonly caused by either thunderstorm outflows, or by strong pressure gradients which cause an increase in wind velocity over a wide area. Drought and wind contribute to the emergence of dust storms, as do poor farming and grazing practices by exposing the dust and sand to the wind. (source: [WMO Sand and Dust Storm Warning advisory and Assessment System \(SDS-WAS\), 2012](#))

Constituent body: Commission for Atmospheric Sciences (CAS)

Secretariat focal point: Silvina Carou (scarou@wmo.int)

Subsidiary body: Scientific Advisory Group for Total Atmospheric Deposition (GAW SAG TAD)

Subsidiary body focal point: Ariel Stein (ariel.stein@noaa.gov)

Associated programme: Global Atmospheric Watch Programme (GAW)

Acid rain

Meteorological definition: Rain which in the course of its history has combined with chemical elements or pollutants in the atmosphere and reaches the Earth's surface as a weak acid solution. (source: *International Glossary of Hydrology, WMO/UNESCO, 2011*)

Alternative definition 1: Acid precipitation, which threatened natural ecosystems and forests over Europe and North America; resulting from industrial emissions of sulphur dioxide, which is photo-oxidised to form sulphate. Although sulphur emissions have been reduced, acidity is still a problem with the growing contribution of nitrogen compounds from industry and vehicles to acidity, and the SO₂ and NO_x from ships. (source: [The changing atmosphere, an integrated global atmospheric chemistry observation theme for the IGOS partnership, Report GAW No. 159, WMO/TD No. 1235](#))

Alternative definition 2: Deposition of acid substances by precipitation, resulting from the long-range atmospheric transport of pollutants which enhanced environmental acidification when reaching the Earth's surface. (source: *Sena's appendix*)

Black carbon

Meteorological definition 1: Operationally defined aerosol species based on measurement of light absorption and chemical reactivity and/or thermal stability; consists of soot, charcoal and/or possible light-absorbing refractory organic matter. (source: *IPCC 4th Assessment Report, WG 1 Glossary*)

Meteorological definition 2: Operationally defined aerosol species based on measurement of light absorption and chemical reactivity and/or thermal stability. It is sometimes referred to as soot. (source: *IPCC 5th Assessment Report, WG 1 Glossary*)

Alternative definition: Operationally defined aerosol species based on measurement of light absorption and chemical reactivity and/or thermal stability. Black carbon is formed through the incomplete combustion of fossil fuels, biofuel, and biomass, and is emitted in both anthropogenic and naturally occurring soot. It consists of pure carbon in several linked forms. Black carbon warms the Earth by absorbing heat in the atmosphere and by reducing albedo, the ability to reflect sunlight, when deposited on snow and ice. (source: [Integrated Assessment of Black Carbon and Tropospheric Ozone, WMO-No. 1073](#))

Brown clouds

Alternative definition: Elevated black carbon concentrations in areas with high solar radiation are a major contributor to the so-called brown clouds covering large regions, for instance in Asia. Brown clouds have led to dimming of the Earth's surface, warming of the atmosphere and perturbation of the hydrological cycle, possibly affecting the monsoon. (source: [The carbonaceous aerosol – a remaining challenge, WMO Bulletin, Volume 58\(1\) – January 2009](#))

Pollen pollution episodes

No WMO definition

Polluted air

Meteorological definition: Air containing dust, smoke, micro-organisms or gases different from those which normally compose it. (source: *International Meteorological Vocabulary, WMO-No. 182*)

Radioactive contamination

No WMO definition

Sulphur rain

Meteoterm definition: Rain coloured yellow by particles of pollen, yellow dust, etc. (*source: International Meteorological Vocabulary, WMO-No. 182*)

Constituent body: Commission for Basic Systems (CBS)

Secretariat focal point: Alice Soares (asoares@wmo.int)

Subsidiary body: Open Programme Area Groups on Data-Processing and Forecasting System
(OPAG-DPFS)

Subsidiary body focal point: Ken Mylne and Yuki Honda

Sub-subsidiary body: Expert Team on the Operational Weather Forecasting Process and Support
(ET-OFPS)

Sub-subsidiary body focal point: David Richardson (david.richardson@ecmwf.int)

Associated programme: Severe Weather Forecasting Demonstration Project (SWFDP)

Avalanche

Meteoterm definition 1: Mass of snow and ice falling suddenly down a mountain slope and often taking with it earth, rocks and rubble of every description. (*source: International Meteorological Vocabulary, WMO-No. 182*)

Meteoterm definition 2: Mass of snow and ice suddenly sliding down a mountain-side and often taking with it earth, rocks and rubble. (*source: International Glossary of Hydrology, WMO/UNESCO, 2011*)

Alternative definition 1: An avalanche is a large mass of snow and ice that moves rapidly down the steeper slopes of mountains or hills, at speeds of up to hundreds of kilometres an hour. (*source: [Water and disasters: be informed and be prepared, WMO-No. 971](#)*)

Alternative definition 2: An avalanche is a mass of snow and ice falling suddenly down a mountain slope, often taking earth, rocks and rubble with it. Avalanches can be highly destructive, moving at speeds in excess of 150 km/h. (*source: https://www.wmo.int/pages/themes/hazards/index_en.html*)

Smog

Meteoterm definition 1: Fog having a high pollution content. (From SMOke and fOG.) (*source: International Meteorological Vocabulary, WMO-No. 182*)

Meteoterm definition 2: A mixture of smoke and fog, the atmosphere being chemically reducing. (*source: Standard Dictionary of Meteorological Sciences, by G-J. Proulx, Canada*)

Meteoterm definition 3: A dense, discoloured radiation fog containing large quantities of soot, ash and gaseous pollutants such as sulphur dioxide and carbon dioxide. (*source: anonym*)

Constituent body: Commission for Aeronautical Meteorology (CAeM)

Secretariat focal point: Dimitar Ivanov (divanov@wmo.int)

Sub-subsidiary body: Volcanic Ash Scientific Advisory Group (VASAG)

Sub-subsidiary body focal point: Andrew Tupper, Larry G. Mastin

Associated programme: Aeronautical Meteorology Programme (AeMP)

Volcanian eruption

Alternative definition: A type of volcanic eruption characterized by the short duration, violent explosive ejection of fragments of lava. Vulcanian eruption columns may attain heights of 45 000 ft (14 km) or more. (source: [Manual on Volcanic Ash, Radioactive Material and Toxic Chemical Cloud, ICAO, Doc. 9691](#))

Indice: Volcanic Explosivity Index

Volcanic ash

Alternative definition 1: Atmospheric dust or particles varying considerably in size, originating from active volcanoes. The small particles often penetrate the stratosphere and remain suspended for a long period. Larger particles remain within the troposphere and can be carried by the wind to different regions of the Earth. Scavenging by rainfall and gravity eventually leads to the removal of volcanic ash from the atmosphere. Larger particles, or a concentration of smaller ones, can considerably damage aircraft, including their engines. (source: [Aerodrome Reports and Forecasts, A Users' Handbook to the Codes, WMO-No. 782](#))

Alternative definition 2: Dust or particles emitted by a volcano during an eruption. They may remain suspended in the atmosphere for long periods and be carried by the winds to different regions of the Earth. (source: *Sena's appendix*)

Hawaiian eruption

Alternative definition: An eruption characterized by the non-explosive eruption of fluid lava of basaltic composition. Hawaiian eruptions generally pose no threat to aviation safety. (source: [Manual on Volcanic Ash, Radioactive Material and Toxic Chemical Cloud, ICAO, Doc. 9691](#))

Indice: Volcanic Explosivity Index

Plinian eruption

Alternative definition: A large explosive eruption that ejects a steady, turbulent stream of fragmented magma and magmatic gas to form an eruption column that may reach altitudes in excess of 100 000 feet (30 km). (source: [Manual on Volcanic Ash, Radioactive Material and Toxic Chemical Cloud, ICAO, Doc. 9691](#))

Indice: Volcanic Explosivity Index

Strombolian eruption

Alternative definition: An eruption consisting of short, discrete explosions which may eject pyroclasts for a few tens to a few hundreds of feet into the air. Each explosion may last for only a few seconds and there may be pauses of tens of minutes between explosions. (source: [Manual on Volcanic Ash, Radioactive Material and Toxic Chemical Cloud, ICAO, Doc. 9691](#))

Indice: Volcanic Explosivity Index

	0	1	2	3	4	5	6	7	8
General description	Non-explosive	Small	Moderate	Moderate-Large	Large	Very Large			
Volume of tephra (m ³)	1×10^4	1×10^6	1×10^7	1×10^8	1×10^9	1×10^{10}	1×10^{11}	1×10^{12}	
Cloud column height (km)									
Above crater	<0.1	0.1-1	1-5	3-15	10-25	>25			
Above sea level									
Qualitative description	"Gentle,"	"Effusive"	"Explosive"	"Cataclysmic,"	"Severe,"	"Violent,"	"Terrific"	"Paroxysmal"	"Colossal"
Eruption type									
Duration (continuous blast)									
CAWVmax explosivity (most explosive activity listed in CAWV)									
Tropospheric injection	Negligible	Minor	Moderate	Substantial					
Stratospheric injection	None	None	None	Possible	Definite	Significant			
Eruptions (total in file)	699	845	3477	869	278	84	39	4	0

Criteria used in assignment of Volcanic Explosivity Index (VEI) from Simkin and Siebert

Table 5. Classification of volcanic eruptions. V: ejecta volume; EC: eruption classification; D: description; PH: plume height; FE: frequency of eruption; O: known/estimated occurrences in the Holocene.

VEI	V	EC	D	PH	FE	O
0	< 10,000 m ³	Hawaiian	Effusive	< 100 m	Persistent	Many
1	> 10,000 m ³	Hawaiian/Strombolian	Gentle	100–1,000 m	Daily	Many
2	> 1,000,000 m ³	Strombolian/Vulcanian	Explosive	1–5 km	Weekly	3,477
3	> 10,000,000 m ³	Vulcanian/Peleian	Severe	315 km	Few months	868
4	> 0.1 km ³	Peleian/Plinian	Cataclysmic	1,025 km	≥1 yr	421
5	> 1 km ³	Plinian	Paroxysmal	2,035 km	≥10 yrs	166
6	> 10 km ³	Plinian/Ultra-Plinian	Colossal	> 30 km	≥ 100 yrs	51
7	> 100 km ³	Ultra-Plinian	Super-colossal	> 40 km	≥ 1,000 yrs	5*
8	> 1,000 km ³	Supervolcanic	Mega-colossal	> 50 km	≥10,000 yrs	0

* plus two suspected.

(source: [Extreme Geohazards: Reducing the Disaster Risk and Increasing Resilience, A community Science Position Paper, European Science Foundation, GHCP, GEO](#))

V. Marine

Constituent body: Joint WMO-IOC Technical Commission for Oceanography and Meteorology (JCOMM)

Secretariat focal point: Nadia Pinardi, Johan Stander

Subsidiary body: Services and Forecasting Systems Program Area (SFSPA)

Subsidiary body focal point: Ming Ji

Sub-subsidiary body: Expert Team on Waves and Coastal Hazards Forecasting Systems (ETWCH)

Sub-subsidiary body focal point: Kevin Horsburgh

Associated programme: Marine Meteorology and Oceanography Programme (MMOP)

Storm surges

Meteoterm definition 1: The difference between the actual water level under influence of a meteorological disturbance (storm tide) and the level which would have been attained in the absence of the meteorological disturbance (i.e. astronomical tide). (*source: International Meteorological Vocabulary, WMO-No. 182 and [Hurricane Operational Plan, Report No. TCP-30, WMO-TD No. 494](#)*)

Meteoterm definition 2: The temporary increase, at a particular locality, in the height of the sea due to extreme meteorological conditions (low atmospheric pressure and/or strong winds). The storm surge is defined as being the excess above the level expected from the tidal variation alone at that time and place. (*source: IPCC 4th Assessment Report, WG 1 Glossary and IPCC 5th Assessment Report, WG 1 Glossary*)

Meteoterm definition 3: (1) The difference between the actual water level under influence of a meteorological disturbance (storm tide) and the level which would have been attained in the absence of the meteorological disturbance (i.e. astronomical tide). (2) The difference between the actual water level as influenced by a meteorological disturbance (i.e., the storm tide) and the level which would have been attained in the absence of the meteorological disturbance (i.e. astronomical tide). (Storm surge results from the shoreward movement of water combined with the comparatively minor effects of low barometric pressure). (3) The difference between the actual sea level under the influence of a meteorological disturbance (storm tide) and the normal astronomical tide. (*source: 1. RA I/TCC-XI/Doc. 6 RA IV/TD-No. 494 (1995) 2. RA I-No. 618 (1994) 3. RA V/TD-No. 292 (1995)*)

Meteoterm definition 4: Rise in sea or estuary water level caused by the passage of a low pressure centre. (*source: International Glossary of Hydrology, WMO/UNESCO, 2011*)

Alternative definition 1: Storm surges are oscillations of the water level in a coastal or inland body of water in the time range of a few minutes to a few days, resulting from forcing from atmospheric weather systems. (*source: [Guide to Storm Surge Forecasting, WMO No. 1076, 2011, first edition](#)*)

Alternative definition 2: The difference between the actual water level under the influence of a meteorological disturbance and the level which would have occurred in the absence of the meteorological disturbance. (*source: [Technical Regulations, Volume III: Hydrology, WMO No. 49](#)*)

Alternative definition 3: The difference between the actual water level under the influence of a meteorological disturbance (storm tide) and the level which would have been attained in the absence of the meteorological disturbance (i.e. astronomical tide). (*source: <http://severe.worldweather.wmo.int/tc/cnp/acronyms.html#SSU>*)

Alternative definition 4: In coastal areas, storm surge caused by tropical cyclones, tsunamis, or rivers swollen by exceptionally high tides can cause flooding.

(source: https://www.wmo.int/pages/themes/hazards/index_en.html)

Alternative definition 5: The difference between the actual water level under the influence of a meteorological disturbance (storm tide) and the level which would have been attained in the absence of the meteorological disturbance (i.e. astronomical tide). Storm surge results mainly from the shoreward movement of water under the action of wind stress. A minor contribution is also made by the hydrostatic rise of water resulting from the lowered barometric pressure.

(source: [Typhoon Committee Operational Manual, report No. TCP-23](#))

Alternative definition 6: A storm surge forms when tropical cyclones move over a continental shelf. A combination of strong onshore winds and low atmospheric pressure creates the surge — a giant dome of seawater some 60 to 80 kilometres across and 2 to 5 metres high. (source: [Water and disasters: be informed and be prepared, WMO-No. 971](#))

Constituent body: Joint WMO-IOC Technical Commission for Oceanography and Meteorology (JCOMM)

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Subsidiary body: Services and Forecasting Systems Program Area (SFSPA)

Subsidiary body focal point: Ming Ji

Sub-subsidiary body: Expert Team on Waves and Coastal Hazards Forecasting Systems (ETWCH)

Sub-subsidiary body focal point: Kevin Horsburgh

Associated programme: Marine Meteorology and Oceanography Programme (MMOP)

Tsunami

Meteoterm definition 1: A rapidly moving and often large seawave generated by submarine earthquakes, landslides or volcanic activity. (source: [Manual on marine meteorological services, WMO-No. 558, App. 1.2](#))

Meteoterm definition 2: A large wave produced by a submarine earthquake, landslide or volcanic eruption. (source: *IPCC 4th Assessment Report, WG 2 Glossary*)

Meteoterm definition 3: Long, high wave in the ocean caused by an earthquake or other disturbance, travelling at great speed and with enough height and force to flood coastal areas. (source: *International Glossary of Hydrology, WMO/UNESCO, 2011* and [International Glossary of Hydrology, WMO/UNESCO, WMO-No. 385, 2012](#))

VI. Space weather

Constituent body: Commission for Basic Systems (CBS) and
Commission for Aeronautical Meteorology (CAeM)

Secretariat focal point: Jérôme Lafeuille (jlafeuille@wmo.int)

Subsidiary body: WMO Inter-programme Coordination Team on Space Weather
(WMO ICTSW)

Subsidiary body focal point: Terry Onsager, Xiaoxin Zhang

Associated programme: WMO Space Programme

Note: Hazardous space weather situations can result of eruptive solar events consisting of Solar Flares and Erupting Prominences, Coronal Mass Ejections, associated streams of charged particles and high-speed particle streams from Coronal Holes. These eruptions are driving geomagnetic storms, ionospheric storms, and radiation storms in near-Earth space, with hazardous impacts.

Coronal mass ejections

Alternative definition: A Coronal Mass Ejection is literally an eruption of a huge volume of the solar outer atmosphere, the Corona, which blows into space billions of tons of plasma. When propagating towards the Earth, CMEs perturb the Earth's magnetic field, causing the strongest magnetic storms. CMEs may take hours to fully erupt from the Sun. A typical travel time for a CME from the Sun to Earth may range from less than 1 day, to more than 4 days. (source: [Space Weather Effects in Regard to International Air Navigation, ICAO](#) and review of experts)

Geomagnetic storms

Alternative definition: Geomagnetic storms, which are caused primarily by CMEs or by high-speed particle streams interacting with the magnetosphere, are strong temporary disturbances of the Earth's magnetic field. Geomagnetic storms can last several hours. They may cause major damage to power grids through geomagnetically induced currents (GIC). Geomagnetic storms and disturbances are highly variable in space and time.

Different indices are used to describe geomagnetic storm activity. The planetary three-hour range Kp index, provided by the Helmholtz Centre, Potsdam (<http://www.gfz-potsdam.de/en/section/earths-magnetic-field/data-products-services/kp-index/>) is often used as an approximation for the geomagnetic activity caused by solar particle radiation. Other indices include for instance the A index, Disturbance Storm Time (Dst), the Auroral Electrojet (AE) or the delta-B index. (source: [The potential role of WMO in space weather, WMO/TD-No. 1482](#) and [Space Weather Effects in Regard to International Air Navigation, ICAO](#) and review of experts)

Ionospheric storms

Meteorological definition: Turbulence in the F region of the ionosphere, usually due to a sudden burst of radiation from the Sun. (source: *International Meteorological Vocabulary*, WMO-No. 182)

Alternative definition Geomagnetic storms are often associated with ionospheric storms which are characterized by enhanced electron currents in the ionosphere, turbulence and wave activity in the ionospheric plasma. The clustering of the electrons leads to scintillation and attenuation of radio signals. This is particularly problematic for GNSS signals which can result in positioning errors or loss of signal lock. Like geomagnetic storms, ionospheric storms are highly variable in space and time. (source: [The potential role of WMO in space weather, WMO/TD-No. 1482](#) and [Space Weather Effects in Regard to International Air Navigation, ICAO](#) and review of experts)

Radio blackout

Alternative definition: X-ray and EUV bursts from a solar flare cause an ionization, increasing the number of free electrons, in the atmosphere below 90 km on the sunlit side of the Earth. The enhanced electron density increases the amount of radio energy lost as radio waves pass through this region. During a large flare event the amount of radio energy lost is sufficient to make the return signal from the ionosphere too small to be useful with normal radio receivers. The net effect of this process is the radio blackout – no signal – for HF transmissions. Radio blackouts primarily affect HF (3-30 MHz) although detrimental effects may spill over to VHF (30-300 MHz) and beyond in fading and diminished ability for reception. (source: [The potential role of WMO in space weather, WMO/TD-No. 1482](#) and [Space Weather Effects in Regard to International Air Navigation, ICAO](#) and review of experts)

Solar energetic particles

Alternative definition: A Solar Energetic Particles event (SEP) is a sudden release of particles (protons, electrons and heavy ions) with energy ranging from a few tens of keV to GeV. These events are generally associated with Solar Flares or Coronal Mass Ejections.

High-speed particle streams, in particular electrons, are also emitted by Coronal Holes, which are persistent large-scale features of the solar corona that appear dark in EUV and X-ray images. (source: [The potential role of WMO in space weather, WMO/TD-No. 1482](#) and [Space Weather Effects in Regard to International Air Navigation, ICAO](#) and review of experts)

Solar flares

Meteor term definition: Bright eruption from the Sun's chromosphere. Solar flares are classified in terms of the area of chromosphere affected, the duration of the phenomenon, and the width of the H α line of hydrogen, on a scale ranging from 1- (minor eruption) to 3+ (very large eruption). (source: *International Meteorological Vocabulary*, WMO-No. 182)

Alternative definition: Solar flares are the biggest explosions in the solar system, driven by reconnection of the magnetic field lines at the surface of the Sun. Solar Flares are characterized by a very bright flash-phase, which may last for a few minutes, followed by a period of 30-60 minute decay. Flares can emit at all frequencies across the electromagnetic emission spectrum, from gamma rays to radio.

X-ray and EUV bursts from a solar flare cause an ionization in the atmosphere below 90 km on the sunlit side of the Earth. The enhanced electron density increases the attenuation of radio waves and may lead to total radio black-out during an extreme flare event. It primarily affects HF (3-30 MHz) although detrimental effects may spill over to VHF (30-300 MHz) and beyond in fading and diminished ability for reception.

In the most severe Solar Flare class the X-ray flux measured by the GOES geostationary satellite in the 0.1-0.8 nm range exceeds $2 \cdot 10^{-3} \text{ W} \cdot \text{m}^{-2}$. Despite that Solar Flares are most likely to occur near the peak of the 11-year solar cycle, even very intense flares can occur at any phase of the solar cycle.

Intense solar emissions in the radio frequency range are called Solar Radio Bursts. Very intense Solar Radio Bursts in the L-band can disturb the operation of GNSS receivers and augmentation systems for tens of minutes in the whole sunlit side of the Earth. Severe interferences can be experienced by L-band radars as well. (source: [Space Weather Effects in Regard to International Air Navigation, ICAO](#) and review of experts)

Solar radiation storm

Alternative definition: Solar radiation storms occur when large quantities of charged particles, primarily protons, accelerated by eruptive processes at or near the Sun are reaching the near-Earth environment.

The Earth's magnetic field and atmosphere generally protect from this particle radiation, but that shielding depends on latitude, magnetic field strength and direction. In the Polar Regions the magnetic field lines intersecting the Earth's surface allow the particles to penetrate into the atmosphere. Solar radiation storms thus often take the form of Polar Cap Events (PCA), which occur in limited areas around geomagnetic poles; they may last more than a week.

A factor of criticality of a radiation storm is the energy spectrum of the solar protons. High-energy protons cause single event upsets in spacecraft or aircraft electronics and increase the harmful radiation dose of exposed human beings, e.g. in manned spaceflights or cross-polar aircraft flights. Lower energy protons have a severe impact on the polar ionosphere and affect HF propagation at high latitude. The severity of radiation storms can thus be characterized by the flux of charged particles (typically in 5-minute average) above a given energy threshold such as 10 or 100 MeV. For example the NOAA scale characterizes a radiation storm as extreme when the 5-min flux above 10 MeV exceeds $10^5 \text{ particles} \cdot \text{s}^{-1} \cdot \text{sr}^{-1} \cdot \text{cm}^{-2}$. In large magnitude solar eruptions, high-energy events may last only a few hours while low-energy events may last up to one week. (source: [*The potential role of WMO in space weather, WMO/TD-No. 1482*](#) and [*Space Weather Effects in Regard to International Air Navigation, ICAO and review of experts*](#))

Short set of illustrative examples

Heatwave: Periods of unusually hot and dry or hot and humid weather that have a subtle onset and cessation, a duration of at least two–three days, usually with a discernible impact on human and natural systems.

Reference:

WMO, 2015: *Heatwaves and Health: Guidance on Warning-System Development*, WMO-No. 1142 (page xi and pages 16-21, sections 3.3.1 to 3.3.4)
http://www.who.int/globalchange/publications/WMO_WHO_Heat_Health_Guidance_2015.pdf?ua=1

Drought: Insufficient precipitation to meet the demands of human activities and the environment which extends over a season or a longer period of time.

Reference:

WMO, 2012: *Standardized Precipitation Index User Guide*, WMO-No. 1090 (page 3)
http://www.droughtmanagement.info/literature/WMO_standardized_precipitation_index_user_guide_en_2012.pdf

Flooding: (1) Overflowing by water of the normal confines of a watercourse or other body of water. (2) Accumulation of drainage water over areas which are not normally submerged. (3) Controlled spreading of water for irrigation.

References:

- WMO/UNESCO, 2012: *International Glossary of Hydrology*, WMO-No. 385 (page 126)
http://www.wmo.int/pages/prog/hwrr/publications/international_glossary/385_IGH_2012.pdf
 - WMO, 2013: *Integrated Flood Management Tools Series, Flood Mapping*, issue 20 (page 23)
http://www.apfm.info/publications/tools/APFM_Tool_20.pdf
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