# Glossary

## General

Albedo – a measure of an object’s broadband reflectivity. Simply, how much solar radiation is reflected by a surface; snow (bright, more reflective) can cause an increase, fire scars (dark, more absorbing) can cause a decrease

Anvil region – “An anvil is the flat cloud formation at the top of the storm. An anvil forms when the updraft (warm air rising) has reached a point where the surrounding air is about the same temperature or even warmer. The cloud growth abruptly stops and flattens out to take the shape of an anvil.” (*Severe Weather 101: Thunderstorm basics*)

ATBD – Algorithm Theoretical Basis Document

CAPE – convective available potential energy – (Chen et al., 2021)

Carnegie Curve – “The Earth’s fair weather atmospheric electric field shows, in clean air, an average daily variation which follows universal time, globally independent of the measurement position. This single diurnal cycle variation (maximum around 19UT and minimum around 03UT) is widely known as the Carnegie curve,” (Harrison, 2012)

Cirrus clouds – high wispy clouds, often look like streaks or fibrous due to being made of ice crystals (*Learn about cirrus clouds: High, wispy streaks* 2022)

CMIP5 – Climate Model Intercomparison Project Phase 5 – an intercomparison project among all the world’s major climate models (e.g., Chen et al., 2021)

Cloud-to-ground discharges – lightning that does contact the ground

Contiguous – bordering, next to, touching, adjacent to

Electrified shower clouds – ESCs – clouds with electric currents but no lightning (Peterson et al., 2017)

ENSO and anti-ENSO - El Nino Southern Oscillation and La Nina - events in the tropical Pacific often result in significant changes in the frequency and movement of storm tracks, precipitation patterns, and cloud cover (Christian et al. 2000)

ESM – Earth system model (e.g., Chen et al., 2021)

Extratropics – the mid-latitudes beyond the tropics

FOV – field of view – the extent of the observable space from an instrument

Global Electric Circuit – GEC – “a series of electrical connections that describe the large-scale flow of electricity within the atmosphere and serve to maintain the electrical potential of the ionosphere relative to the Earth's surface.” (Peterson et al., 2017)

GHG emissions – Greenhouse gas emissions

Graupel – precipitation that “forms when super-cooled droplets of water collect and freeze on the surface of falling snowflakes,” and results in the creation of 0.08-0.2 inch snow pellets or soft hail balls (Migiro, 2018)

IFOV – instantaneous field of view (Christian et al. 2000)

Ionosphere -  “the ionosphere overlaps the mesosphere, thermosphere, and exosphere. It’s a very active part of the atmosphere, and it grows and shrinks depending on the energy it absorbs from the sun.” “Gases in these layers are excited by solar radiation to form ions.” “Parts of the ionosphere overlap with Earth’s magnetosphere.” “In the ionosphere, charged particles are affected by the magnetic fields of both Earth and the sun.” (*Ionosphere* 2019)

Intertropical Convergence Zone (ITCZ) – “The Intertropical Convergence Zone, or ITCZ, is the region that circles the Earth, near the equator, where the trade winds of the Northern and Southern Hemispheres come together. The intense sun and warm water of the equator heats the air in the ITCZ, raising its humidity and making it buoyant. Aided by the convergence of the trade winds, the buoyant air rises. As the air rises it expands and cools, releasing the accumulated moisture in an almost perpetual series of thunderstorms.” (Levy, 2000)

Intracloud discharges – lightning that does not contact the ground (aka cloud to cloud discharge)

Magnetosphere – “The area around the Earth where charged particles feel Earth’s magnetic field.” (*Ionosphere* 2019) “That area of space, around a planet, that is controlled by the planet's magnetic field. The shape of the Earth's magnetosphere is the direct result of being blasted by solar wind. The solar wind compresses its sunward side,” (Zell & Kaase, 2017)

MCS – Mesoscale convective system –“Mesoscale convective systems (MCSs) are the largest of the convective storms. They form when clouds occurring in response to convective instability amalgamate and organize upscale into a single cloud system with a very large upper cirriform cloud structure and rainfall covering large contiguous rain areas.” - or mesoscale convective complex – can evolve into a cyclone (Houze, 2004)

Mesoscale – “mesoscale meteorology pertains to weather features with an "intermediate"spatial scale,” “mesoscale weather features are smaller than most of the large-scale weather features (high- and low-pressure systems, etc.), but larger than really small features that span only a few kilometers. What kinds of weather features fit into the mesoscale? Thunderstorms, lake-effect snow, terrain-induced wind circulations, and sea / lake breezes all fall under the umbrella of mesoscale meteorology.” (Babb, 2019)

NIR – near infrared

PCT – polarization-corrected temperatures (Peterson et al., 2017)

Permafrost – ground with a temperature of at most 0 degrees all year where the water contained in the soil is permanently frozen

PR – precipitation radar (Peterson et al., 2017)

Sferics - sferics are radio frequencies emitted by lightning (particular emfs) (Christian et al. 2000)

Stratiform clouds – “A cloud-type extending a long, low, gray layer with an almost uniform base with extensive coverage at different altitudes. There are three groups of stratiform clouds: high level (above 20,000 ft.), middle level (6,500-20,000 ft.), and low level (below 6,500 ft.).” (*Stratiform or stratus clouds*)

Subtropics – the areas between roughly 35 degrees N and the Tropic of Cancer and between the Tropic of Capricorn and 35 degrees S. The extent depends on continental influence. (*Subtropics* 2012)

Tropics – region between the latitude lines of the Tropic of Cancer (23.5 degrees north) and the Tropic of Capricorn (23.5 degrees south) around the equator of the earth, (Rutledge et al., 2012)

Troposphere – The troposphere is the part of the atmosphere closest to the surface and is between 8 and 14 km thick depending where you are on Earth. (*Troposphere* 2019)

Updraft – an air current moving in an upwards direction

UTC – coordinated universal time – the time of day at 0 degrees longitude and not adjusted for daylight savings time and the successor to Greenwich Mean Time (*Current UTC, Time Zone (coordinated universal time)* 2022)

Validation – the process of verifying and tuning the performance of an instrument and its retrieval algorithms

Wilson currents – conduction currents, part of the global electric field (Peterson et al., 2017)

## Satellites, Platforms, and Instruments

GLM – Geostationary Lightning Mapper – an optical lightning measuring device on the GOES-R satellite (Peterson et al., 2017)

ISS – International Space Station

LIS – Lightning Imaging Sensor – an optical lightning sensor. LIS has flown on board TRMM, collecting data from 1997 to 2015; another version of LIS flies on the ISS (Peterson et al., 2017)

MODIS – Moderate Resolution Imaging Spectroradiometer – a satellite detection device used to detect wildfires and land use change. Two MODIS instruments are currently operating: one on the Terra satellite and one on the Aqua satellite (Ying, L. et al. 2019)

NASA ER–2 aircraft – an aircraft used by NASA to conduct overflights of storms and electrified shower clouds which can gather data relating to the movements of currents within clouds/storms (Peterson et al., 2017)

OTD - Optical Transient Detector – an optical lightning sensor (Peterson et al., 2017) OTD can be viewed as a LIS prototype and is based on the LIS instrument for TRMM (Christian et al. 2000)

TMI – TRMM Microwave Imager (Peterson et al., 2017)

TRMM – Tropical Rainfall Measuring Mission – a satellite observatory (Christian et al. 2000)

TROPOMI – Tropospheric Monitoring Instrument – observes Earth in the ultraviolet and visible range (UV-Vis) for the purposes of measuring various air quality metrics, including ozone and nitrogen oxides (Goldberg, D. L. et al. 2021)

VIIRS - Visible Infrared Imaging Radiometer Suite

VIIRS/NPP – aka VNP – VIIRS instrument aboard the National Polar-orbiting Partnership (NPP) satellite

VIRS – Visible and Infrared Scanner, one of the instruments aboard TRMM (Peterson et al., 2017)

## Specific to Lightning Imaging Sensor (LIS)

Event – the basic unit of data from the LIS, it is a single pixel exceeding the background threshold (due to lightning or a false alarm) (Christian et al. 2000)

Group – “one or more simultaneous events (i.e., events that occur in the same time integration frame) that register in adjacent (neighboring or diagonal) pixels in the focal plane array.” Events in the same “picture” are grouped (Christian et al. 2000)

Flash – generally, what we assume to be a case of lightning occurring but officially: “a set of groups sequentially separated in time by no more than 330 ms and in space by no more than 5.5 km” “A flash may include as few as one group with a single event or it may consist of many groups, each containing many events.” “Note that there is no absolute time limit to a flash. That is, as long as subsequent groups are produced in an area within the 330 ms time windows, all groups will be assigned to a single flash.” (Christian et al. 2000)

Area – what we assume to be a thunderstorm, although it can be made up of multiple storms or a single storm could be split into multiple areas “a near contiguous region on the surface of the earth that has produced lightning (defined as a set of LIS flashes) during a single orbit of the LIS. An area thus defined consists of a set of flashes separated in space by no more than 16.5 km (approximately 3 pixels).” (Christian et al. 2000)

Orbit - the data granule for the LIS, (aka one spin mostly around the earth) “Since dividing the LIS data at the equatorial crossing would often split storms, the LIS orbit granule is defined to begin and end at the latitude of the southernmost part of the orbital path.” (Christian et al. 2000)

View time - how long a particular location was viewed by the LIS instrument, can be very short or up to 80 s (Christian et al. 2000)

One second data - a series of one second snapshots of internal and external instrument parameters (Christian et al. 2000)

Parent data – data that belongs to the one higher order of data (i.e., a group’s parent data is the flash it belongs to) (Christian et al. 2000)

Child data – data that belongs to the one lower order of data (i.e., an area’s child data is the flashes within it) (Christian et al. 2000)

Latitude – describes the North-South location on Earth

Longitude – describes the East-West location on Earth

HDF – Hierarchical Data Format - orbit granule data storage structure, there are two for each orbit; one contains the science data (SC) and the other contains the background data (BG) (Christian et al. 2000)

HDF Naming scheme – platform (TRMM or ISS)\_instrument name (LIS)\_file type (SC or BG).version number. revision number\_YEAR. DAY.ORBIT (Christian et al. 2000)

EOS HDF SDF – Science Data Format - HDF organization scheme – “The actual data are stored in Vsets and Vgroups. Indexes are maintained within the Vgroups to link the various Vsets.” (Christian et al. 2000)

SDS – Scientific Data Sets (Christian et al. 2000)

Metadata – a text description of LIS parameters unique to a particular orbit granule (Christian et al. 2000)

NLEs – Non Lightning Events (Christian et al. 2000)

RTEP – Real Time Event Processor (Christian et al. 2000)

ICF – Illuminated Cloud Feature (Peterson et al., 2017)

Artifacts – in this case, events recognized due to flaws in data gathering rather than lightning

Noise – data due to random energetic particles which tend to produce temporally and spatially random groups of events (Christian et al. 2000)

Dedupe – a filter than eliminates duplicate events (Christian et al. 2000)

Ghost – a filter that corrects for the sensor version of retina burn (Christian et al. 2000)

Lollypop – a filter that accounts for when bright pulses overload the CCD array. “When there is a bright lightning pulse, vertical streaks (i.e., a set of pixels with the same “y” coordinate) are attached to the top and bottom of the bright pulse.” (Christian et al. 2000)

Track – a filter that removes lines of false readings due to energetic particles (Christian et al. 2000)

Blast – a filter that removes data due to “blasts” (when a significant fraction of the array has events, like 20 groups in the same 2 ms) (Christian et al. 2000)

Ephemeris filtering – a filter that removes anomalous artifacts (Christian et al. 2000)

Particle filtering / noise filtering – a filter that eliminates flashes that do not cluster as they are more likely to be due to charged particles (Christian et al. 2000)

Putback algorithm – a filter that reintroduces flashes that were thought to be noise in the previous filters (Christian et al. 2000)

Contrast filters – a filter that eliminates data due to non-random artifacts such as regions with high brightness contrasts (Christian et al. 2000)

Contrast – a filter that eliminates data due to the LIS FOV moving across a boundary between a light dark boundary (Christian et al. 2000)

Glint filters – a filter that remove data due to solar reflections (Christian et al. 2000)

Johnny Jumper – eliminates an artifact triggered in the 127th row of the pixel array (Christian et al. 2000)

Guilt by association filter – a filter that removes the remaining pixels if 95% in an area are identified as artifacts (Christian et al. 2000)

Single filter – removes remaining single group areas (Christian et al. 2000)

Pre-launch calibration – “These activities include: (1) D.C. uniformity, linearity and false alarm rate tests, (2) field-of-view (FOV) test, (3) A.C. response test, (4) detection efficiency, and (5) spectral test. (Christian et al. 2000)

Post-launch calibration – re-calibration of the LIS if the detection efficiency and false alarm rate are drifting (Christian et al. 2000)

Detection efficiency – “defined as the percentage of lightning flashes occurring in the FOV of the instrument that are detected by the sensor.” (Christian et al. 2000)

False alarm rate – “defined as the percentage of total detected flashes that are not attributable to lightning.” (Christian et al. 2000)

Congo – lightning capital of the world (Christian H. J. et al. 2003)

RPF – radar precipitation features – “contiguous raining areas based on TRMM PR reflectivity data. They are typically storm-scale features, but often reach the mesoscale in certain regions and storm types.” (Peterson et al., 2017)

DMSP satellites – Defense Meteorological Satellite Program satellites - observed lightning with various optical sensors (Christian et al. 2000)

South Atlantic Anomaly (SAA) – a region in the South Atlantic in which charged particles tend to produce noise for satellites like the LIS due to the configuration of the earth’s magnetic field (Christian et al. 2000)

Charge coupled device (CCD) array – 128X128 on the LIS (Christian et al. 2000)

Temporal resolution – resolution with respect to time, within 2 ms for the LIS (Christian et al. 2000)

Viewtime – the length of the observation time (Christian et al. 2000)

Multiple scattering – blurs, delays and time-broadens, the optical signal produced by lightning (Christian et al. 2000)

Conservative scatterer – clouds tends not to absorb lightning’s optical signals but scatter them so most optical energy escapes (Christian et al. 2000)

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