

= Mesoscale convective system =

A mesoscale convective system (MCS) is a complex of thunderstorms that becomes organized on a scale larger than the individual thunderstorms but smaller than extratropical cyclones , and normally persists for several hours or more . A mesoscale convective system 's overall cloud and precipitation pattern may be round or linear in shape , and include weather systems such as tropical cyclones , squall lines , lake @-@ effect snow events , polar lows , and Mesoscale Convective Complexes (MCCs) , and generally form near weather fronts . The type that forms during the warm season over land has been noted across North America , Europe , and Asia , with a maximum in activity noted during the late afternoon and evening hours .

Forms of MCS that develop within the tropics use either the Intertropical Convergence Zone or monsoon troughs as a focus for their development , generally within the warm season between spring and fall . One exception is that of lake @-@ effect snow bands , which form due to cold air moving across relatively warm bodies of water , and occurs from fall through spring . Polar lows are a second special class of MCS which form at high latitudes during the cold season . Once the parent MCS dies , later thunderstorm development can occur in connection with its remnant mesoscale convective vortex (MCV) . Mesoscale convective systems are important to the United States rainfall climatology over the Great Plains since they bring the region about half of their annual warm season rainfall .

= = Definition = =

Mesoscale convective systems are thunderstorm regions which may be round or linear in shape , on the order of 100 kilometres (62 mi) or more across in one direction but smaller than extratropical cyclones , and include systems such as tropical cyclones , squall lines , and Mesoscale Convective Complexes (MCCs) , among others . MCS is a more generalized term which includes systems that do not satisfy the stricter size , shape , or duration criteria of an MCC . They tend to form near weather fronts and move into areas of 1000 @-@ 500 mb thickness diffluence , which are areas where the low to mid level temperature gradient broadens , which generally steers the thunderstorm clusters into the warm sector of extratropical cyclones , or equatorward of warm fronts . They can also form along any convergent zones within the tropics . Their formation has been noted worldwide , from the Mei @-@ Yu front in the far East to the deep tropics . Mesoscale convective systems are important to the United States rainfall climatology over the Great Plains since they bring the region about half of their annual warm season rainfall .

= = Types = =

= = = Mesoscale Convective Complex = = =

A mesoscale convective complex (MCC) is a unique kind of mesoscale convective system which is defined by characteristics observed in infrared satellite imagery . Their area of cold cloud tops exceeds 100 @, @ 000 square kilometres (39 @, @ 000 sq mi) with temperature less than or equal to ? 32 ° C (? 26 ° F) ; and an area of cloud top of 50 @, @ 000 square kilometres (19 @, @ 000 sq mi) with temperature less than or equal to ? 52 ° C (? 62 ° F) . Size definitions must be met for six hours or greater . Its maximum extent is defined as when the cloud shield , or the overall cloud formation , reaches its maximum area . Its eccentricity (minor axis / major axis) is greater than or equal to 0 @. @ 7 at maximum extent , so they are fairly round . They are long @-@ lived , nocturnal in formation as they tend to form overnight , and commonly contain heavy rainfall , wind , hail , lightning and possibly tornadoes .

= = = Squall line = = =

A squall line is an elongated line of severe thunderstorms that can form along and / or ahead of a cold front . In the early 20th century , the term was used as a synonym for cold front . The squall line contains heavy precipitation , hail , frequent lightning , strong straight line winds , and possibly tornadoes and waterspouts . Severe weather , in form of strong straight @-@ line winds can be expected in areas where the squall line itself is in the shape of a bow echo , within the portion of the line which bows out the most . Tornadoes can be found along waves within a line echo wave pattern , or LEWP , where mesoscale low pressure areas are present . Some bow echoes which develop within the summer season are known as derechos , and they move quite fast through large sections of territory . On the back edge of the rain shield associated with mature squall lines , a wake low can form , which is a mesoscale low pressure area that forms behind the mesoscale high pressure system normally present under the rain canopy , which are sometimes associated with a heat burst .

= = = Tropical cyclone = = =

A tropical cyclone is a fairly symmetric storm system characterized by a low pressure center and numerous thunderstorms that produce strong winds and flooding rain . A tropical cyclone feeds on the heat released when moist air rises , resulting in condensation of water vapour contained in the moist air . It is fueled by a different heat mechanism than other cyclonic windstorms such as nor'easters , European windstorms , and polar lows , leading to their classification as " warm core " storm systems .

The term " tropical " refers to both the geographic origin of these systems , which form often in tropical regions of the globe , and their formation in Maritime Tropical air masses . The term " cyclone " refers to such storms ' cyclonic nature , with counterclockwise rotation in the Northern Hemisphere and clockwise rotation in the Southern Hemisphere . Depending on their location and strength , tropical cyclones are referred to by other names , such as hurricane , typhoon , tropical storm , cyclonic storm , tropical depression , or simply as a cyclone . Generally speaking , a tropical cyclone is referred to as a hurricane (from the name of the ancient Central American deity of wind , Huracan) in the Atlantic and eastern Pacific oceans , a typhoon across the northwest Pacific ocean , and a cyclone across in the southern hemisphere and Indian ocean .

Tropical cyclones can produce extremely powerful winds and torrential rain , as well as high waves and damaging storm surge . They develop over large bodies of warm water , and lose their strength if they move over land . This is the reason coastal regions can receive significant damage from a tropical cyclone , while inland regions are relatively safe from the strong winds . Heavy rains , however , can produce significant flooding inland , and storm surges can produce extensive coastal flooding up to 40 kilometres (25 mi) from the coastline . Although their effects on human populations can be devastating , tropical cyclones can also relieve drought conditions . They also carry heat and energy away from the tropics and transport it toward temperate latitudes , which makes them an important part of the global atmospheric circulation mechanism . As a result , tropical cyclones help to maintain equilibrium in the Earth 's troposphere , and to maintain a relatively stable and warm .

Many tropical cyclones develop when the atmospheric conditions around a weak disturbance in the atmosphere are favorable . Others form when other types of cyclones acquire tropical characteristics . Tropical systems are then moved by steering winds in the troposphere ; if the conditions remain favorable , the tropical disturbance intensifies , and can even develop an eye . On the other end of the spectrum , if the conditions around the system deteriorate or the tropical cyclone makes landfall , the system weakens and eventually dissipates . A tropical cyclone can become extratropical as it moves toward higher latitudes if its energy source changes from heat released by condensation to differences in temperature between air masses ; From an operational standpoint , a tropical cyclone is usually not considered to become a subtropical cyclone during its extratropical transition .

= = = Lake @-@ effect snow = = =

Lake @-@ effect snow is produced in the winter in the shape of one or more elongated bands when cold winds move across long expanses of warmer lake water , providing energy and picking up water vapor which freezes and is deposited on the lee shores . The same effect over bodies of salt water is called ocean effect snow , sea effect snow , or even bay effect snow . The effect is enhanced when the moving air mass is uplifted by the orographic effect of higher elevations on the downwind shores . This uplifting can produce narrow , but very intense bands of precipitation , which is deposited at a rate of many inches of snow per hour and often brings copious snowfall totals . The areas affected by lake @-@ effect snow are called snowbelts . This effect occurs in many locations throughout the world , but is best known in the populated areas of the Great Lakes of North America .

If the air temperature is not low enough to keep the precipitation frozen , it falls as lake @-@ effect rain . In order for lake @-@ effect rain or snow to form , the air moving across the lake must be significantly cooler than the surface air (which is likely to be near the temperature of the water surface) . Specifically , the air temperature at the altitude where the air pressure is 850 millibars (or 1 @.@ 5 kilometres (0 @.@ 93 mi) altitude) should be 13 ° C (24 ° F) lower than the temperature of the air at the surface . Lake @-@ effect occurring when the air at 850 millibars is 25 ° C (45 ° F) colder than the water temperature can produce thundersnow , snow showers accompanied by lightning and thunder (due to the larger amount of energy available from the increased instability) .

= = = Polar low = = =

A polar low is a small @-@ scale , symmetric , short @-@ lived atmospheric low pressure system (depression) that is found over the ocean areas poleward of the main polar front in both the Northern and Southern Hemispheres . The systems usually have a horizontal length scale of less than 1 @,@ 000 kilometres (620 mi) and exist for no more than a couple of days . They are part of the larger class of mesoscale weather systems . Polar lows can be difficult to detect using conventional weather reports and are a hazard to high @-@ latitude operations , such as shipping and gas and oil platforms . Polar lows have been referred to by many other terms , such as polar mesoscale vortex , Arctic hurricane , Arctic low , and cold air depression . Today the term is usually reserved for the more vigorous systems that have near @-@ surface winds of at least 17 metres per second (38 mph) .

= = Where they form = =

= = = Great Plains of the United States = = =

The time period in the Plains where thunderstorm areas are most prevalent ranges between May and September . Mesoscale convective systems develop over the region during this time frame , with a bulk of the activity occurring between 6 and 9 p.m. local time . Mesoscale convective systems bring 30 to 70 percent of the annual warm season rainfall to the Plains . A subset of these systems known as mesoscale convective complexes lead to up to 10 % of the annual rainfall across the Plains and Midwest . Squall lines account for 30 % of the large thunderstorm complexes which move through the region .

= = = Europe = = =

While most form over the continent , some MCSs form during the second half of August and September over the western Mediterranean Sea . MCS triggering over Europe is strongly tied to mountain ranges . On average , a European MCS moves east @-@ northeast , forming near 3 p.m. local solar time , lasts 5 @.@ 5 hours , dissipating near 9 p.m. LST . Around 20 % of the MCSs over Europe do not form during maximum heating . Their average maximum extent is around 9 @,@ 000 square kilometres (3 @,@ 500 sq mi) .

== = Tropics == =

Mesoscale convective systems , which can evolve into tropical cyclones , form along areas such as tropical waves or easterly waves which progress westward along monsoon troughs and the Intertropical Convergence Zone in regions of ample low level moisture , convergent surface winds , and divergent winds aloft . This typically occurs north of the equator from Africa across the Atlantic and eastern Pacific oceans , as well as across the northwest and southwest Pacific oceans , from Australia eastward into Oceania , the Indian ocean , Indonesia , and from southeast Brazil into the southern Atlantic ocean . It is also noted on occasion in the southeast Pacific ocean mild to cool ENSO years , outside of El Niño . More intense systems form over land than water .

== = Lee of warm water bodies in the winter == =

In the cases of Lake @-@ effect snow and polar lows , the convective systems form over warm water bodies when cold air sweeps over their surface and leads to an increase in moisture and significant vertical motion . This vertical motion leads to the development of showers and thunderstorms in areas of cyclonic flow on the backside of extratropical cyclones .

== Their remnants ==

A mesoscale convective vortex-- (MCV) --is a mid @-@ level low @-@ pressure center within an MCS that pulls winds into a circling pattern , or vortex . Once the parent MCS dies , this vortex can persist and lead to future convective development . With a core only 30 miles (48 km) to 60 miles (97 km) and up to 8 kilometres (5 @. @ 0 mi) deep , an MCV can occasionally spawn a mesoscale surface low pressure area which appears on mesoscale surface weather analyses . But an MCV can take on a life of its own , persisting for up to several days after its parent MCS has dissipated . The orphaned MCV will sometimes then become the seed of the next thunderstorm outbreak . An MCV that moves into tropical waters , such as the Gulf of Mexico , can serve as the nucleus for a tropical storm or hurricane .