

= Squall line =

A squall line is a line of thunderstorms that can form along or ahead of a cold front . In the early 20th century , the term was used as a synonym for cold front . It contains heavy precipitation , hail , frequent lightning , strong straight @-@ line winds , and possibly tornadoes and waterspouts . Strong straight @-@ line winds can occur where the squall line is in the shape of a bow echo . Tornadoes can occur along waves within a line echo wave pattern (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 be present , sometimes associated with a heat burst .

= = Theory = =

Polar front theory was developed by Jacob Bjerknes , derived from a dense network of observation sites in Scandinavia during World War I. This theory proposed that the main inflow into a cyclone was concentrated along two lines of convergence , one ahead of the low and another trailing behind the low . The trailing convergence zone was referred to as the squall line or cold front . Areas of clouds and rainfall appeared to be focused along this convergence zone . The concept of frontal zones led to the concept of air masses . The nature of the three @-@ dimensional structure of the cyclone was conceptualized after the development of the upper air network during the 1940s .

= = = Life cycle = = =

Organized areas of thunderstorms activity reinforce pre @-@ existing frontal zones , and they can outrun cold fronts . This outrunning occurs within the westerlies in a pattern where the upper level jet splits into two streams . The resultant mesoscale convective system (MCS) forms at the point of the upper level split in the wind pattern in the area of best low level inflow .

The convection then moves east and toward the equator into the warm sector , parallel to low @-@ level thickness lines . When the convection is strong linear or curved , the MCS is called a squall line , with the feature placed at the leading edge of the significant wind shift and pressure rise . This feature is commonly depicted in the warm season across the United States on surface analyses , as they lie within sharp surface troughs .

If squall lines form over arid regions , a duststorm known as a haboob may result from the high winds in their wake picking up dust from the desert floor . Well behind mature squall lines , a wake low can develop on the back edge of the rain shield , which can lead to a heat burst due to the warming up of the descending air mass which is no longer being rain @-@ cooled .

Smaller cumulus or stratocumulus clouds , along with cirrus , and , sometimes , altocumulus or cirrocumulus , can be found ahead of the squall line . These clouds are the result of former cumulonimbus clouds having disintegrated , or an area of only minor instability ahead of the main squall line .

As supercells and multi @-@ cell thunderstorms dissipate due to a weak shear force or poor lifting mechanisms , (e.g. considerable terrain or lack of daytime heating) the gust front associated with them may outrun the squall line itself and the synoptic scale area of low pressure may then infill , leading to a weakening of the cold front ; essentially , the thunderstorm has exhausted its updrafts , becoming purely a downdraft dominated system . The areas of dissipating squall line thunderstorms may be regions of low CAPE , low humidity , insufficient wind shear , or poor synoptic dynamics (e.g. an upper level low filling) leading to frontolysis .

From here , a general thinning of a squall line will occur : with winds decaying over time , outflow boundaries weakening updrafts substantially and clouds losing their thickness .

= = = Characteristics = = =

===== Updrafts =====

The leading area of a squall line is composed primarily of multiple updrafts , or singular regions of an updraft , rising from ground level to the highest extensions of the troposphere , condensing water and building a dark , ominous cloud to one with a noticeable overshooting top and anvil (thanks to synoptic scale winds) . Because of the chaotic nature of updrafts and downdrafts , pressure perturbations are important .

===== Pressure perturbations =====

Pressure perturbations around thunderstorms are noteworthy . With buoyancy rapid within the lower and mid @-@ levels of a mature thunderstorm , updraft and downdraft create distinct mesocenters of pressure . As thunderstorms organized in squall lines , the northern end of the squall line is commonly referred to as the cyclonic end , with the southern side rotating anticyclonically (in Northern hemisphere) . Because of the coriolis force , the northern end may evolve further , creating a " comma shaped " wake low , or may continue in a squall @-@ like pattern . The updraft ahead of the line create a mesolow too while the downdraft just behind the line will produce a mesohigh .

===== Wind shear =====

Wind shear is an important aspect of a squall line . In low to medium shear environments , mature thunderstorms will contribute modest amounts of downdrafts , enough to help create a leading edge lifting mechanism ? the gust front . In high shear environments created by opposing low level jet winds and synoptic winds , updrafts and consequential downdrafts can be much more intense (common in supercell mesocyclones) . The cold air outflow leaves the trailing area of the squall line to the mid @-@ level jet , which aids in downdraft processes .

===== Severe weather indicators =====

Severe squall lines typically bow out due to the formation of a stronger mesoscale high pressure system (a mesohigh) within the convective area due to strong descending motion behind the squall line , and could come in the form of a downburst . The pressure difference between the mesoscale high and the lower pressures ahead of the squall line cause high winds , which are strongest where the line is most bowed out .

Another indication of the presence of severe weather along a squall line is its morphing into a line echo wave pattern , or LEWP . A LEWP is a special configuration in a line of convective storms that indicates the presence of a low pressure area and the possibility of damaging winds , large hail , and tornadoes . At each kink along the LEWP is a mesoscale low pressure area , which could contain a tornado . In response to very strong outflow southwest of the mesoscale low , a portion of the line bulges outward forming a bow echo . Behind this bulge lies the mesoscale high pressure area .

===== Depiction on maps =====

Squall lines are depicted on National Weather Service surface analyses as an alternating pattern of two red dots and a dash labelled " SQLN " or " SQUALL LINE " .

===== Variations =====

===== Derecho =====

A derecho (from Spanish : " derecho " meaning " straight ") is a widespread and long @-@ lived , violent convectively induced straight @-@ line windstorm that is associated with a fast @-@ moving band of severe thunderstorms usually taking the form of a bow echo . Derechos blow in the direction of movement of their associated storms , similar to a gust front , except that the wind is sustained and generally increases in strength behind the " gust " front . A warm weather phenomenon , derechos occur mostly in summer , between May and August in the Northern hemisphere . They can occur at any time of the year and occur as frequently at night as in the daylight hours .

The traditional criteria that distinguish a derecho from a severe thunderstorm are sustained winds of 58 miles per hour (93 km / h) during the storm as opposed to gusts , high or rapidly increasing forward speed , and geographic extent (typically 250 nautical miles (460 km ; 290 mi) in length .) In addition , they have a distinctive appearance on radar (bow echo) ; several unique features , such as the rear inflow notch and bookend vortex , and usually manifest two or more downbursts . Although these storms most commonly occur in North America , derechos occur elsewhere in the world . Outside North America they may be called by different names . For example , in Bangladesh and adjacent portions of India , a type of storm known as a " Nor 'wester " may be a progressive derecho .