= Bounded weak echo region =

The bounded weak echo region , also known as a BWER or a vault , is a radar signature within a thunderstorm characterized by a local minimum in radar reflectivity at low levels which extends upward into , and is surrounded by , higher reflectivities aloft . This feature is associated with a strong updraft and is almost always found in the inflow region of a thunderstorm . It cannot be seen visually . The BWER has been noted on radar imagery of severe thunderstorms since 1973 and has a lightning detection system equivalent known as a lightning hole .

= = Description and attributes = =

The BWER is a nearly vertical channel of weak radar echo , surrounded on the sides and top by significantly stronger echoes . The BWER , sometimes called a vault , is related to the strong updraft in a severe convective storm that carries newly formed atmospheric particulates , called hydrometeors , to high levels before they can grow to radar @-@ detectable sizes . BWERs are typically found at mid @-@ levels of convective storms , 3 kilometres (1 @.@ 9 mi) to 10 kilometres (6 @.@ 2 mi) above the ground , and are a few kilometers in horizontal diameter . Identifying the location of the updraft region is important because it is linked to locations where severe weather normally occurs . The presence of a BWER has been part of a method to diagnose thunderstorm strength as part of the Lemon technique since 1977 . The updraft strength within the BWER supports the growth of large hailstones just above the vault , which can be displaced slightly into the direction of motion of the parent supercell storm .

= = = Detection = = =

The bounded weak echo region (BWER) is a region of low radar reflectivity bounded above by an area of higher radar reflectivity which shows evidence of a strong updraft within mesocyclones . Radar analysts have recognized this phenomenon since at least 1973 , using different elevation scans . Methods of objectively corroborating that a BWER is associated with a mesocyclone is done by using a weather radar with Doppler effect to obtain the precipitations velocities . This have been available operationally in United States since 1997 with the NEXRAD network . When using the lightning detection system , lightning holes (uncovered in 2004) correspond to where a BWER would be seen on radar .

A cross @-@ section of the three @-@ dimensional reflectivity of a thunderstorm shows the vault better . Algorithms were developed by the J.S. Marshall Radar Observatory of McGill University in Canada to locate the overhang region in a thunderstorm by the late 1980s . Its radar uses 24 angles , giving it good vertical resolution . In United States , fewer scanning angles are made within the WSR @-@ 88D radar which makes it more difficult to detect the overhang . Once the overhang is located , it is possible to make a cross @-@ section to view if it is related with a BWER . However , since 1997 algorithms have been developed by the National Weather Service to determine regions of reflectivity gradient in three dimensions and the presence of BWER in convection .

The development of a pronounced BWER can lead to tropical cyclone @-@ like radar signatures over land when located with a low angle plan position indicator (PPI) . When using the lightning detection system , lightning holes (uncovered in 2004) correspond to where a BWER would be seen on radar .