Hailstorm with Very Low Vertical Wind Shear and tilt over Trivandrum
By

P. Kumar,
Department of Core Engineering and Engineering Sciences
MIT College of Engineering, Pune
India

Strong vertical wind shear of the order of 70-100 kt between 850 to 200hPa and tilted angle of ≈ 25^0 (Cheng 1989) is commonly considered helpful for the formation of hailstones in cumulonimbus clouds due to taking away of detrained air from the top of the cloud which in turn helps in removing the heat of fusion caused due to the hail formation. Moreover, tilt in vertical prevents the high concentration of precipitation that might overload the updraft and cause it to decay by limiting the time of residence in the region of growth. But the hailstorm on 17 May 1984 reported at Trivandrum(8° 29' N, 76° 59 E) located on coastal Kerala in south India was different. T-Φ gram of Trivandrum indicated very weak vertical wind shear of 22 kt between 850 to 200 hPa. Very poor detrainment or negligible removal of heat of fusion could be logically expected. Equilibrium level could be marked close to 15 Km a.m.s.l. Hailstones of size ≈ 1.0 Cm were reported over a wide area with hailpath of 10-15 Km. Small vertical tilt of ≈ 10^0 only persisted. Formation of hailstones despite poor ventilation provided by the weak top level wind could be attributed to very high top of the cumulonimbus. This provided quite large internal volume of the cloud for the dispersal of latent heat of fusion, released during hail formation, preventing any heating effect to reverse freezing process. However, low vertical tilt did not support the re-entry of the particles grown in the first ascent to re-grow. Hence only small size hailstones (≈ 1.0 Cm) could form.

It is concluded that though vertical wind shear is helpful condition for the growth of hailstones in cumulonimbus but they could still form in cumulonimbus with very weak wind shear (≈ 20-25 kt between 850 to 200 hPa) provided the top of the cloud is tall enough; of the order of 15 km or more. Size of the hailstone would remain small if vertical tilt is also small.

Reference:

Cheng M.D. (1989), 'Effect of cloud downdraft and mesoscale convective organization on the heat and moisture budgets of tropical cloud cluster. Part i : a diagnostic cumulus ensemble model j. Atmos Sci. 46 1517 –1538.