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Analysis of a gigantic jet in southern China: morphology, meteorology, storm evolution, lightning and narrow bipolar events

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At about 22:43:30 BJT (Beijing Time = UTC + 8) on 13 August 2016, two amateur astronomers in Shikengkong, Guangdong province, and Jiahe County, Hunan province, respectively, fortunately captured a gigantic jet (GJ) event simultaneously and the GJ exact location could be triangulated. The parent thunderstorm was in a very humid environment [Precipitable Water (PWAT) in excess of 60 mm], featuring high convective available potential energy (CAPE) and weak 0-6 km vertical wind shear. The GJ occurred in the region with the coldest cloud top brightness temperature of -64°C , suggesting the GJ was associated with strong vertical development of the thunderstorm. Vertical cross sections of radar reflectivity also show that the GJ occurred near the thunderstorm strong convection region as indicated by the results that a region of 25 dBZ (and 35 dBZ) in excess of the local tropopause (overshooting top in the parent thunderstorm) during a time window containing the GJ. The negative cloud-to-ground flashes dominated during the thunderstorm evolution. Three positive narrow bipolar events (NBEs) were detected within 30s before and after the GJ. It indicates that the NBEs were distributed between 11 and 13 km and occurred in the upper and middle layers of thunderstorm with radar reflectivity of 30-35 dBZ.