



High-speed video observations of Gigantic Jets and negative sprites in Colombia

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Over the last 10 years the UPC lightning research group has conducted observations of transient luminous events (TLE) and lightning in Colombia and Curaçao, with various detection systems hosted on a semi-permanent basis by local universities.

These systems include the San Andrés island monitoring camera (2009-2013) later moved to Santa Marta (2015-2019+); the Santa Marta 6-station 3D Lightning Mapping Array (2015-2018) which was relocated last year to Barrancabermeja; and the intensified high-speed camera system which was operational at the weather service of Curaçao (2014-2018), monitoring northwestern Venezuela and Catatumbo. It is currently installed in Barranquilla.

25 gigantic jet events were recorded in Colombia from mid 2016 to late 2018, including those recorded during two intensive observation campaigns.

The first campaign, July 29 to August 23, 2017 near Santa Marta, used a camera running at 900-1200 frames per second, triggered via UFOCaptureHD software by a sensitive 1920x1200 resolution camera. 4 gigantic jets were recorded, of which 2 successfully captured by the high-speed camera. Another interesting capture was a series of secondary negative-upward TLE of different morphologies occurring under large sprites.

The second campaign ran from 2 October to 29 November 2018 and was conducted again from various Airbnb apartments, this time in Barranquilla and Cartagena in hope to be closer to gigantic jet events. 8 events were recorded, 3 with high-speed camera at 5000 frames per second. Unexpectedly common were also sprite events triggered by negative polarity cloud-to-ground flashes, which are very rare in mid-latitudes.

Another focus was to get matching events during overpasses of the Atmosphere-Space Interactions Monitor active on the International Space Station since spring 2018. This proved more difficult because of orbit intervals, local cloudiness, absence of flashes during the 3-minute window, or daylight at the ISS. One flash was recorded at 5000 fps and shows remarkable luminosity correspondence with the ASIM MMIA 777.4 nm photometer.

High-speed video of the jets showed a very weakly luminous leading jet stage, with only 1-2 segments of about 3 km size at 10 ms intervals before a final development from a bidirectional node at 38-42 km moving continuously upward to the ionosphere at 90 km, while branching and brightening dramatically. Late branches bent and connected under right angles to the first arriving ones. The fully developed jet was followed by darker interval, a slow brightening of the trailing jet, where the bright bead-like top (45-57 km) slowly retraced previous streamers. The jets of 2017 ended with a bright cloud leader up to 23 km, which was 20 km at the start of the events. One event (2018) developed three upward branches well separated in space and time.