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Luminosity with Intracloud-Type Initial Breakdown Pulses and Terrestrial Gamma-ray Flash Candidates

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High-speed video data for three hybrid lightning flashes show luminosity increases at visible wavelengths that are time-correlated with large, intracloud (IC) type initial breakdown (IB) pulses in electric field change (E-change) data. In one case, a diffuse luminosity increase is visible for 280-300 us, apparently centered near 9 km altitude. At the same time, locations of VHF sources and E-change pulses indicate breakdown activity occurring at altitudes of 9.2-10.2 km altitude, and the initial leader was developing rapidly upward. The second case has a diffuse luminosity increase at the time of three large IC-type IB pulses, while the initial leader is advancing upward from about 7 km altitude. In the third example, a series of luminosity bursts are visible at the times of several large-amplitude IC-type IB pulses, although the center of the activity is apparently above the video frame. In all three hybrid flashes, the luminous IC-type IB pulses are relatively complicated and large in E-change amplitude, and most have distinct electrostatic offset at horizontal distances of 20-25 km from a sensor. Such large amplitude IB pulses have been associated with the production of terrestrial gamma ray flashes (TGFs) in prior work [Marshall et al., 2013, doi:10.1002/jgrd.50866]. No satellite or ground-based TGF observations were available for these events, hence it is not known if these TGF candidates produced gammas or other high energy radiation. This presentation describes the video and E-change observations during the intracloud and cloud-to-ground initial breakdown periods of these flashes and implications for TGF production.