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High-speed video and electric field observation of upward flashes in Brazil

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Upward flashes from tall towers in Brazil have been observed since January 2012. They have been responsible for damages on equipment installed nearby tall structures that caused their initiation. Almost all upward flashes were observed with high-speed cameras and electric field sensors; a combination of measurements that provides a very accurate classification and characterization of their properties. Although present during all seasons, upward flashes are predominant during summer. They are almost always initiated by a preceding positive cloud-to-ground flash. This study is based on an up-to-date database of 86 upward flashes observed during the last three years. The main characteristics described in this work are: time interval between triggering event and the upward leader initiation, characteristics of the triggering +CG flashes, upward leader characteristics (polarity, presence of recoil leaders and branching), initial continuous current (duration, presence of pulses and recoil leaders), flash duration and presence of subsequence of return stroke.