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On the Nature of Cloud Lightning

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Studies of lightning discharges generally deal with electrical activities that occur both inside thunderclouds (IC) and may involve a ground connection (CG). Even though CG has been studied more extensively than IC, it is known that the two types of discharges are accompanied by emission of qualitatively similar radiation. Less well recognized is the observation that relatively strong strokes are produced not only in connection with CG, but also by discharge processes that do not connect to ground. These IC strokes tend to exhibit somewhat smaller field amplitudes than CG strokes, but they produce thunder and the field records often resemble the ones known from CG. In fact, the number of these IC-strokes is large enough to allow efficient monitoring of cloud activity with the same technique as one applies for CG detection (VLF/LF). Very frequently, IC-strokes are produced during the initial breakdown phase, whereby initiation is probably caused by electron runaway processes that extend over hundreds of meters. Further prominent discharge phases can be effectively observed, most important are stepped leaders with copious emission of VHF radio signals. Experimental data for the various cloud processes are discussed and evaluated with respect to theoretical and practical significance. Open questions on the production mechanisms are elucidated, and the relative occurrence of IC versus CG strokes is illustrated.