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New type of electric discharges from aircraft.

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Lightning interaction with aircraft becomes an increasingly important research topic due to the recent advancements in aviation industry and pressure put on it from climate regulations. A flying aircraft can interact with three known types of discharges, (i) aircraft-intercepted lightning, (ii) aircraft-triggered lightning, and (iii) electrostatic discharges.

Aircraft-intercepted lightning is a remotely initiated lightning discharge that attaches to the aircraft. Such events are relatively rare and constitute only a few percent of all lightning strikes to aircraft.

Aircraft-triggered discharge is a lightning that is initiated from the aircraft. These events happen when the aircraft polarizes and enhances the ambient electric field to the magnitude sufficiently high for triggering a bi-directional leader from opposite sharp extremities. More than 95% of all lightning strikes to aircraft are of this type.

Electrostatic (EST) discharges can be considered as another type of aircraft discharges but excluded from the above statistics because they can happen without presence of a thundercloud, lightning or strong ambient electric field. They happen when the aircraft collects significant charge on its surface by collisions with ice particles. Such discharges are usually associated with a noise in analog radiocommunication. It is not completely clear if the surface charge is necessary or the EST discharges can be initiated only by polarization of the aircraft in ambient electric field. Remarkably, EST discharges have been reported in association with positron annihilation signatures inside a thundercloud [1].

In this work we report yet another type of discharge that was recently observed developing from an airplane. These discharges start from the aircraft in response to the electric field change caused by a nearby lightning flash. The remote lightning flash can redistribute the ambient electric field in such a way that the local electric field near the aircraft exceeds the breakdown threshold. We call them a "lightning-triggered discharge". Similar initiation mechanism is proposed for the high-altitude sprite discharges.

The lightning-triggered discharges from aircraft have not been studied and characterized before. They were observed and reported in [2] but were not identified as a separate type of aircraft discharges. As will be demonstrated, they are very likely to be underreported by pilots due to their often attachment to wings and relatively low current.

The Remote Lightning Damage Assessment System (www.reldas.no) has been developed with the purpose to identify and systematically collect data on lightning strikes to aircraft. Besides other discharges, the system collected records of the aircraft-triggered discharges and their characteristics. Examples of such discharges will be shown with the photographs and current measurements.

References

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2. Kochkin, P., et al. "In-flight observation of gamma ray glows by ILDAS." *Journal of Geophysical Research: Atmospheres* 122.23 (2017): 12-801.