



Ball lightning risk to aircraft

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Lightning is a rare but regular phenomenon for air traffic. Aircraft are designed to withstand lightning strikes. Research on lightning and aircraft can be called detailed and effective. In the last 57 years, 18 reported lightning aviation disasters with a fatality figure of at least 714 persons occurred. For comparison, the last JACDEC ten-year average fatality figure was 857. The majority encountered lightning in the climb, descent, approach and/or landing phase.

Ball lightning, a metastable, rare lightning type, is also seen from and even within aircraft, but former research only reported individual incidents and did not generate a more detailed picture to ascertain whether it constitutes a significant threat to passenger and aircraft safety. Lacking established incident report channels, observations were often only passed on as “air-travel lore”.

In an effort to change this unsatisfactory condition, the authors have collected a first international dataset of 38 documented ball lightning aircraft incidents from 1938 to 2001 involving 13 reports over Europe, 13 over USA/Canada, and 7 over Russia. 18 (47%) reported ball lightning outside the aircraft, 18 (47%) inside, 2 cases lacked data. 8 objects caused minor damage, 8 major damage (total: 42%), only one a crash. No damage was reported in 18 cases. 3 objects caused minor crew injury. In most cases, ball lightning lasted several seconds. 11 (29%) incidents ended with an explosion of the object. A cloud-aircraft lightning flash was seen in only 9 cases (24%) of the data set.

From the detailed accounts of air personnel in the last 70 years, it is evident that ball lightning is rarely, but consistently observed in connection with aircraft and can also occur inside the airframe. Reports often came from multiple professional witnesses and in several cases, damages were investigated by civil or military authorities.

Although ball lightning is no main air traffic risk, the authors suggest that incident and accident reporting is expanded and in particular damage cases are routinely assessed and published. Aircrews should know that most ball lightning-aircraft-events require thunderstorm conditions, but not necessarily a cloud-aircraft lightning flash. With nearly 50% of inside-airframe ball lightning cases, safety precautions for airline passengers should be discussed and operationalized to minimize further risk.