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Meteorological Conditions Causing Jet-Engine Poweloss Events: Current Understanding

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The aviation industry is currently investigating a regular occurrence of jet engine-powerloss events which have now been attributed to the ingestion of atmospheric ice particles, usually in the vicinity of deep convection. There is a limited amount of information on the cloud microphysical properties near the cores of deep convection due to the potential hazards of flying in these areas, and due to the fact that it is a very challenging environment for current instrumentation. Most of the information that has been used to deduce the details of the conditions that cause engine powerloss has been extracted from the event-aircraft flight data recorders, pilot interviews, ground radar and satellite, a series of flight test programs in the 1950s and again in the 1990s, and the most recently available limited data from the cloud physics community. These have led to the conclusion that engine events occur due to flight through high mass concentrations of ice particles, probably with ice water contents (IWCs) in excess of 2 grams per cubic meter, and perhaps as high as 8. The limited microphysical data available has been used to suggest a median mass diameter of the ice particles of $\sim$200 microns, with some evidence that it may be as low as 40 microns. These small particle sizes in the presence of high mass concentration is consistent with the lack of radar echoes > 20 dBZ observed on the pilot's radar, a consistent observation during engine events.

The Engine Harmonization Working Group, an industry/regulator/government committee investigating engine powerloss, has concluded that the level of understanding of the properties of these clouds is inadequate to provide guidance to industry for engine design and testing. In order to address this issue, NASA and Environment Canada are planning to instrument an aircraft to make measurements in high IWC regions of tropical monsoon and continental convection. There is also a significant effort to upgrade and develop new instrumentation to measure this hostile environment, as our past experience has shown that current instrumentation is inadequate.

A summary of the information used to deduce the meteorological conditions in powerloss events will be given. Future plans to collect a dataset for characterization of high-IWC regions of tropical convection will be summarized.