Title: In-situ Aircraft Observations for Atmospheric Research

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Abstract: Water and energy availability is an important issue facing society today. Atmospheric processes interconnect fresh water and energy production. Energy production methods typically require the use of large amounts of water and can produce pollution that affects cloud properties and precipitation processes. The availability of abundant water and energy is an inter-disciplinary problem that requires scientific understanding of atmospheric processes. Advancing scientific understanding requires measurements on global scales down to the nanometer scale of aerosols. Satellites sensors and radars provide large-scale measurements, while surface stations and airborne observations are necessary for small-scale measurements. In-situ measurements on research aircraft provide a critical tool for obtaining necessary measurement to study atmospheric processes, especially cloud processes. Research aircrafts are able to obtain detailed observations that advance our understanding and enable modeling of important processes. However, obtaining useful aircraft measurements is difficult due to the complexity of the required instruments, the logistics of obtaining observations, and the advanced software tools required. Hence, aircraft measurements are typically made during a limited duration intensive operational period. Field projects are designed to achieve the objectives of a science plan that defines the atmospheric process or processes to be investigated. An operations plan is typically written to provide details on how the field project will obtain required measurements. I suggest that field project plans should include synthetic analysis plots that illustrate in detail the analysis that is planned using the field project data set. The Polarimetric Cloud Analysis and Seeding Test (POLCAST) field projects illustrates the importance of advanced instrumentation and software tools. A recently published POLCAST paper provides an example of the full cycle of planning, executing, analyzing and publishing in-situ aircraft observations. On-going research projects with NASA, the U.S. Navy and private companies provide examples of the many tasks scientists are required to conduct to complete a successful aircraft field project. Advanced software tools are critical to enable efficient quality control of instruments and quality assurance of data. While in-situ aircraft observations are expensive and difficult due to the complexity of tools involved, they have a large impact on advancing scientific understanding of important atmospheric processes.