NASA SBIR/STTR Technologies

S1.08-9813 - Volcanic Ash Detection Using Raman LIDAR: "VADER"

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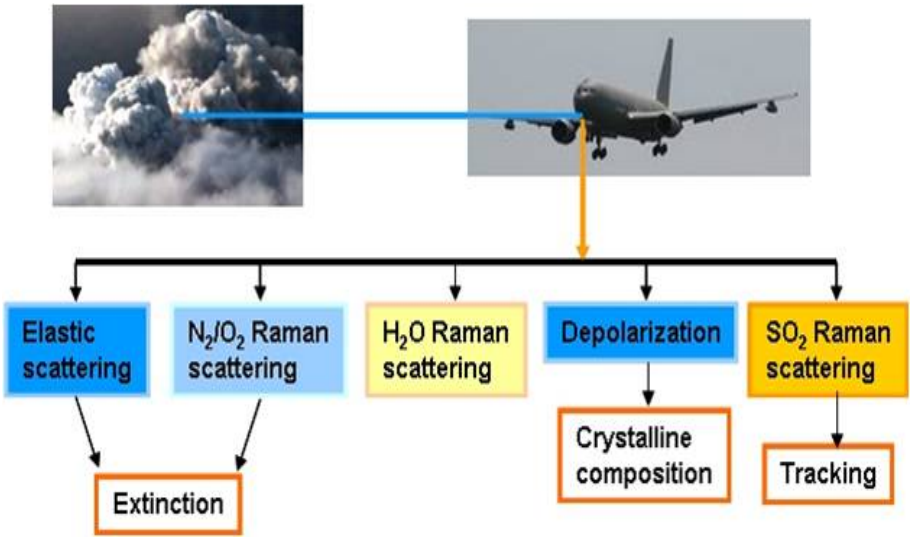
Identification and Significance of Innovation

Volcanic ash is a significant hazard to aircraft engine and electronics and has caused damage to unwary aircraft and disrupted air travel for thousands of travelers, costing millions of dollars. Michigan Aerospace Corporation (MAC) proposes to demonstrate the concept feasibility of a Raman Light Detection and Ranging (LIDAR) system to obtain real-time information from volcanic ash clouds, to be named VADER (Volcanic Ash DEtection Raman LIDAR). The instrument will be designed to operate from an airborne platform, and as such, will be compact and light weight. This approach benefits from returning realtime measurements, in contrast to sampling methods (impactors) that require postmission analysis. This project will utilize MAC's extensive heritage of rugged LIDAR system design and construction.



Estimated TRL at beginning and end of contract: (Begin: 3 End: 4)

Technical Objectives and Work Plan

Technical Objectives:
--Objective 1: Determine the operational envelope of the sensor and the resulting requirements.
--Objective 2: Perform trade studies and photon budgets using models to determine the design parameters of the instrument.
--Objective 3: Design the instrument for fabrication in Phase 2.
Work Plan:
--Scope: The design of a Raman LIDAR to detect the presence of volcanic ash and assess the volcanic aerosol load; the multi-channel system will measure elastic backscatter using the Rayleigh channel, extinction through the Raman channel, depolarization, and the presence of water vapor and SO2, as needed.
--Task 1: Requirements Definition: Define all instrument requirements and flow down.
--Task 2: Sensor Performance Trade Studies: Model the instrument for transmitter and receiver size, and determine photon budget and SNR.
--Task 3: System Design: Components selection and mechanical layout. Selection of opto-electronics components.
--Task 4: Demonstration Plan for Phase II: Design plan to demonstrate the instrument performance.
--Management task includes risk assessment and mitigation plan and reporting, including final report with Phase II recommendations.

NASA Applications

An airborne volcanic ash detection/characterization system, such as VADER, will have wide applications in the study of the threat volcanic ash poses to aircraft and for other scientific study of volcanic plumes. Studies carried out with VADER will allow NASA to study volcanic ash in the atmosphere and provide the data required to refine models of how it is distributed. Combination with MAC's optical air data and turbulence-detection systems would produce a unified hazard/air data system.

Non-NASA Applications

Other civil (NOAA, FAA, etc.) and military (US Air Force, etc.) organizations will have similar uses for this technology as NASA for scientific study. They also will be able to use VADER as a sensor to determine if a given airway is safe enough for civil or military aircraft to use during an eruption, allowing commercial and military aviation to continue and be re-routed as necessary.

Firm Contacts

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