QUALITY ASSURANCE PROJECT PLAN (QAPjP) and QA Report for Pacific 2001

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- **Date:**

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1. **Principal Investigator**
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2. **Team Members**
   Michael Harwood (CARE), Marc Lilley(McGill University), Michael Travis (CARE)

3. **Measurement Program**
   Aircraft Lidar: 1064 nm simultaneous upward/downward lidar (including depolarization channels) measurements of PM vertical profiles
   Scanning Lidar: 1064 nm lidar to measure PM scanning profiles of the troposphere

4. **Measurement Species and Units**
   Lidar measures Backscatter coefficient ($m^{-1}sr^{-1}$) results are usually presented as a Backscatter Ratio (unitless)

5. **Representative Size Range (if PM)**
   Measures optical quantity of particles present within a defined scattering volume.

6. **Measurement Platform (surface, airborne)**
   Aircraft lidar: CV580 platform
   Scanning lidar: Lidar mobile lab

7. **Measurement Sites (surface only)**
   Scanning lidar: Langley

8. **Measurement Objective(s)**
9. **Measurement Details**
   - **9.1. Field Measurements**
     - **9.1.1. Measurement Principle**
       The principle of lidar (LIght Detection And Ranging) is analogous with radar. A Nd:YAG pulsed laser operating at the fundamental wavelength of 1064 nm emits a burst of photons. The photons backscattered from atmospheric particulate as the pulse propagates through the atmosphere is measured by a telescope and detector package. The resolution of the lidar is variable but typically set to 3 m along the axis of propagation.

     - **9.1.2. Instrumentation (Manufacturer/Model)**
       Aircraft/Scanning lidar:
       Nd:YAG laser :Continuum (NY-61 –scanner, Surelite II – airborne)
       14” Telescope : Celestron
       log detectors : Optech Inc.
       12 bit digitizer cards : GAGE 12100
       All other components custom. (too numerous to list here)

9.1.3. Flow System
N/A

9.1.4. Inlet Height Above Ground (if surface)
N/A

9.1.5. Nominal Flow Rate
N/A

9.1.6. Flow Measurement/Control
N/A

9.1.7. Flow Temperature and Pressure
N/A

9.1.8. Sampling Times/Period/Frequency
Aircraft lidar: (20 Hz laser)
Horizontal average : ½ second or 1 second
Scanning lidar: (10 Hz laser)
Data collected every shot (10 Hz data), high resolution elevation scan – approx. 3 minutes.

9.1.9. Sampling Methods
N/A

9.1.10. Filter Type/Coating Type/Reagent Type
N/A

9.1.11. Planned Changes to Instruments or Methods During Study
None planned.

9.2. Laboratory Measurements (If Applicable)

9.2.1. Laboratory Name and Address
N/A

9.2.2. Analytical Method(s)
N/A

9.2.3. Sample Extraction or Work-up
N/A

9.2.4. Analytical Detection Limits
N/A

10. Quality Assurance/Quality Control

10.1. Field Quality Assurance/Quality Control

10.1.1. Traceability

N/A

10.1.2. Calibration

Lidar instrument calibration will be determined by obtaining measurements of “clear air”. Laser output power is monitored during data acquisition.

10.1.3. Zeros and spans

N/A

10.1.4. Blanks

N/A

10.1.5. Field Quality Control procedures

All optics will be kept prestine during lidar operation. This requires routine cleaning (usually the beginning of each day). Laser power monitored and flashlamp changes done when required.

10.1.6. Precision determination

N/A

10.1.7. Comparison with other measurements

Scanning lidar : optical closure obtained by comparing AOD with CIMELsunphotometer at Langley

10.1.8. Inspections and Audits

N/A

10.2. Laboratory Quality Assurance/Quality Control

10.2.1. Traceability

N/A

10.2.2. Calibration procedures

N/A

10.2.3. Blanks

N/A

10.2.4. Other lab QC

N/A

10.2.5. Precision determination

N/A

10.2.6. Comparison with other methods
N/A

10.2.7. Audits
N/A

11. Data Management and Quality Control

11.1. Raw Data Recording
All data collected and stored is raw data obtained from the digitizer cards. Additional information is stored in the header file (including detector ID's, telescope ID's, block ID's etc.)

11.2. Final Data Reporting
Aircraft data: The aircraft data is merged with the nav. Data obtained form the Convair. A time sync. Is used to merge in Lat/Long , pitch, roll angle. Calibration factors are determined for each channel.

11.3. Data Quality Control and Validation
see above

11.4. Validity Flags
N/A

11.5. Below Method Detection Limit Values
Lidar software can eliminate data below a certain noise threshold if required.

11.6. Derived Parameters
Backscatter ratio plots are a first product. For aircraft data this will include time/height as well as Lat/Long / height plotted simultaneously. A number of products are also available (eg. PBL heights, AOD (variable extinction/backscatter ratios, average profile data, cloud height, etc.)

11.7. Explanation of Zero or Negative Data
N/A

12. Data Quality Objectives (Pre-Study)

12.1. Accuracy
Backscatter ratio – 15%
Derived heights – 3 m vertical resolution

12.2. Precision
N/A

12.3. Comparability
N/A

12.4. Representativeness
Airborne lidar: flight tracks selected to maximize coverage of LFV. Provides a snapshot in time. Staggering east/west runs will help determine variability during flight.
Scanning lidar: scans will be taken in three different directions (North, West, East) for approx. 16 hours a day (weather dependent).

12.5. Completeness
Generally only weather dependent. System quite reliable.

12.6. Other Quality Information
N/A

End of Pre-Study QAPjP

Start of Post-Study QA Report

13. Significant Changes to Site, Instruments or Methods During Study

14. Post-study Data Quality Indicators (DQIs)

    14.1.1. Accuracy

    14.1.2. Precision

    14.1.3. Comparability

    14.1.4. Representativeness

    14.1.5. Completeness

    14.2. Blank correction (describe whether done and method used):

    14.3. Other Quality Information

15. References: