Appendix IX - Optical Particle Counter (OPC) or Dustsonde Instruments

Optical particle counters (OPCs), or dustsondes, have been in common use for measuring aerosol concentrations and size distributions for over 50 years and their operational properties are well documented in numerous publications (see meta data files for references to specific instrument descriptions). In addition, many short and long term comparison measurements have been made with other sensor types such as lidar and satellite. However, even though the use of OPCs can be considered a valid technique, individual instruments must still be validated to fulfill the requirements of NDACC certification for acceptance in the database.

Quality criteria for the evaluation of new instruments and instrument teams
In general, the validation process requires a complete description of the instrument (preferably appearing in a refereed journal), a description of the data analysis procedure (consistent with NDACC Data Protocol) in sufficient detail that an independent investigator could develop an equivalent algorithm, uncertainty and error analyses (consistent with NDACC Theory and Analysis Protocol), and participation in continuing inter-comparisons with identical and/or similar instruments (following the NDACC Instrument Inter-comparison Protocol).

The following is a guide for the initial and continuing validation of balloon borne OPCs. It is expected that much if not all of the documentation would be covered in refereed journals and in the Meta Data file.

1. An optical description that includes drawings, the range of angles, and/or a table showing the weighted range of angles employed
2. The type of light source and its wavelength distribution as well as the type of light detector and its wavelength sensitivity
3. Theoretical response curves (or tables) for spherical particles of relevant refractive indexes. The calculation should be based on the actual source wavelength distribution and actual weighted angle distribution as well as the color sensitivity of detector(s).
4. A description of the calibration procedure and checks on its repeatability. A standard operating procedure for the calibration should be presented with sufficient detail to enable an independent investigator to conduct a valid calibration.
5. A statement about the effects of shipping on instrument calibration that have been observed when the instrument was previously sent to a field site.
6. Confirmation that instrument operates properly at the ambient low pressures and temperatures expected.
7. If a pulsating pump is employed, the effect of the pulsating air flow should be addressed.
8. Background counting rate (for aerosol free air) needs to be described and

addressed.

9. Sedimentation loss in the intake system needs to be estimated.
10. Possible pollution from the balloon itself or other on-board instruments should be assessed.
11. Reproducibility of closely spaced soundings (or soundings extending over relatively stable atmospheric conditions) should be presented. Multiple OPCs on the same sounding would also be desirable.
12. When possible, ascent and descent comparisons should be made to help evaluate instrument functions and drifts. However, experience has shown that dustsonde descent profiles are typically of low quality and of limited use except for confirmation of unusual layers and structures. Thus, this potentially valuable test may not be generally available.
13. An initial Meta Data file for a new instrument/team should be prepared and submitted for examination by members of the Sonde Instrument Working Group. This file should be up-dated regularly and include:
    - A history of changes in data processing procedures
    - Reports/references of validation exercises
    - History of inter-comparisons with other instruments
    - Table of stations, number of soundings with OPC at the station, and date range
14. When possible, it would be highly useful to include concurrent supporting data such as ozone and humidity/frost point in the same file as the aerosol data. Such additional information has often proven indispensable to the interpretation of aerosols and atmospheric processes. However, if included, a specific statement should appear in the file to indicate whether the data is of validated quality or is provided for supporting information only.

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