

Quality Assurance Methods for Ground-Based Meteorological Remote Sensors

Robert A. Baxter, CCM
Parsons Engineering Science
Pasadena, California



Overview

- ⇒ Remote sensing systems
- ⇒ Methods development
- ⇒ Quality assurance program elements
- ⇒ Applications of methods



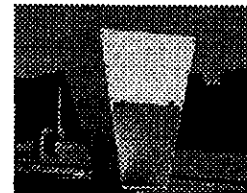
Remote Sensing Systems

- ⇒ Sodar
 - mini sodar
 - phased array
 - "standard sodar"
- ⇒ Radar wind profiler
- ⇒ Radio acoustic sounding systems (RASS)



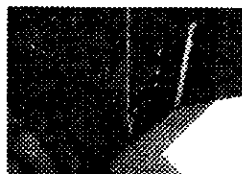
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QA Methods Development

- ⇒ "Pre-regulatory guidance"
- ⇒ Original "On-Site" guidelines
- ⇒ QA handbook volume IV
- ⇒ BAO sodar characterization study
- ⇒ PAMS upper air guidance
- ⇒ "On-Site" guidance revisions

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- ⇒ Dealt primarily with sodars
- ⇒ Reprove the technology
- ⇒ Remote sensing met with significant skepticism

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**On-Site
Meteorological
Program Guidance for
Regulatory Modeling
Applications (1995)**

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**Quality Assurance
Handbook for Air
Pollution
Measurement
Systems Volume IV:
Meteorological
Measurements (1995)**

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QA Methods Development

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 - ⇒ "On-Site" guidance revisions
- ⇒ **Quality Assurance of Remote Wind Profilers during the 1995 EPA Sodar Characterization Study (Baxter 1996)**
 - ⇒ **Various papers and publications by Crescenti**



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- ⇒ **Draft Guidelines for the Quality Assurance and Management of PAMS Upper-Air Meteorological Data (1995)**



QA Methods Development

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 - ⇒ "On-Site" guidance revisions
- ⇒ **Site-Specific Meteorological Monitoring Guidance for Regulatory Modeling Applications (1999)**



Site-Specific Guidance QA Methods

- ⇒ Calibration methods
- ⇒ System and performance audits
- ⇒ Standard operating procedures
- ⇒ Operational checks and preventive maintenance
- ⇒ Corrective action and reporting
- ⇒ Common problems in remote sensing



System Audits

- ⇒ SOP verification
- ⇒ Hardware connection verification
- ⇒ Antenna alignment
- ⇒ Transmit pulse
- ⇒ Background noise level measurement
- ⇒ Background frequency spectra measurement
- ⇒ Vista table preparation



System Audits

- ⇒ SOP verification
 - ⇒ Hardware connection verification
 - ⇒ Antenna alignment
 - ⇒ Transmit pulse
 - ⇒ Background noise level measurement
 - ⇒ Background frequency spectra measurement
 - ⇒ Vista table preparation
- ⇒ **Have SOPs been developed?**
 - ⇒ **Are they being implemented?**
 - ⇒ **Are there deviations from the SOPs?**



System Audits

- ⇒ SOP verification
- ⇒ Hardware connection verification
- ⇒ Antenna alignment
- ⇒ Transmit pulse
- ⇒ Background noise level measurement
- ⇒ Background frequency spectra measurement
- ⇒ Vista table preparation
- ⇒ Cable routing
- ⇒ Proper cable locations
- ⇒ Connector corrosion



System Audits

- ⇒ SOP verification
- ⇒ Hardware connection verification
- ⇒ Antenna alignment
- ⇒ Transmit pulse
- ⇒ Background noise level measurement
- ⇒ Background frequency spectra measurement
- ⇒ Vista table preparation
- ⇒ Orientation of individual antennas or array
- ⇒ Level of array
- ⇒ Tilt angle of horizontal beam antennas
- ⇒ Level of RASS sources



System Audits

- ⇒ SOP verification
- ⇒ Hardware connection verification
- ⇒ Antenna alignment
- ⇒ Transmit pulse
- ⇒ Background noise level measurement
- ⇒ Background frequency spectra measurement
- ⇒ Vista table preparation
- ⇒ Single frequency
- ⇒ Multi-frequency
- ⇒ Quality of pulse
- ⇒ Pulse sequencing



System Audits

- ⇒ SOP verification
- ⇒ Hardware connection verification
- ⇒ Antenna alignment
- ⇒ Transmit pulse
- ⇒ Background noise level measurement
- ⇒ Background frequency spectra measurement
- ⇒ Vista table preparation
- ⇒ General broadband noise (sodar)
- ⇒ Assess effect on data collection
- ⇒ Effect of instrument noise on neighbors



System Audits

- ⇒ SOP verification
- ⇒ Hardware connection verification
- ⇒ Antenna alignment
- ⇒ Transmit pulse
- ⇒ Background noise level measurement
- ⇒ Background frequency spectra measurement
- ⇒ Vista table preparation
- ⇒ Audio frequency spectra in the range of sodar



System Audits

- ⇒ SOP verification
- ⇒ Hardware connection verification
- ⇒ Antenna alignment
- ⇒ Transmit pulse
- ⇒ Background noise level measurement
- ⇒ Background frequency spectra measurement
- ⇒ Vista table preparation
- ⇒ Audio frequency spectra in range of sodar
- ⇒ Radio frequency spectra in range of radar using a scanner



System Audits

- ⇒ SOP verification
- ⇒ Hardware connection verification
- ⇒ Antenna alignment
- ⇒ Transmit pulse
- ⇒ Background noise level measurement
- ⇒ Background frequency spectra measurement
- ⇒ Vista table preparation

STATION DATA SHEET

Station No.	Station Name	Station Class	Station Type	Station Status
101	STATION 101	STATION 101	STATION 101	STATION 101
102	STATION 102	STATION 102	STATION 102	STATION 102
103	STATION 103	STATION 103	STATION 103	STATION 103
104	STATION 104	STATION 104	STATION 104	STATION 104
105	STATION 105	STATION 105	STATION 105	STATION 105
106	STATION 106	STATION 106	STATION 106	STATION 106
107	STATION 107	STATION 107	STATION 107	STATION 107
108	STATION 108	STATION 108	STATION 108	STATION 108
109	STATION 109	STATION 109	STATION 109	STATION 109
110	STATION 110	STATION 110	STATION 110	STATION 110

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SCMPS-PARSONS STATION RECORD

1 to Name: 1 to Client: M&T
 Date: July 7, 1997
 Time: 12:00 PM
 Measurement group: SCMPS-PARSONS
 Log number: 001
 Station No.: 101
 Station Name: STATION 101
 Station Class: STATION 101
 Station Type: STATION 101
 Station Status: STATION 101

Mag. Int.	Dir. Az.	Time	Remarks
RA	30	12	Power level at -20 m. Range building
RA	40	13	Power level at -20 m. A normal continuous data
RA	50	14	Power level at -20 m. Moving out of antenna at -1 km.
RA	120	12	Power level at -20 m. Moving out of antenna at -1 km.
RA	150	20	Power level at -20 m. Power level at -100 m.
RA	180	6	Power level at -200 m.
RA	210	7	Power level at -200 m.
RA	240	8	Power level at -400 m.
RA	270	+2	Power level at -400 m.
RA	300	+3	Control level at -1 km and beyond
RA	330	+3	Control level at -1 km and beyond

Comments: The south beam calibration is off by 2°. The antenna system is down. The BAST system is operating with approximately a 2.5 minute coverage period. A 3 minute period is recommended. The BAST has 12 rows of data with approximately 100 rows per row. A range up to 1000 meters with a pulse spacing of 40 meters is recommended. Some of the data BAST data may not be exactly every 200 m. The data may be out of order by more than 1°. The data was collected during the audit.

System Audits (continued)

- ⇒ Operational mode verification with SOP
- ⇒ Review of station operations
- ⇒ Physical inspection of hardware
- ⇒ Processing of data collection intervals
- ⇒ Review of recent collected data

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System Audits (continued)

- ⇒ Operational mode verification with SOP
- ⇒ Review of station operations
- ⇒ Physical inspection of hardware
- ⇒ Processing of data collection intervals
- ⇒ Review of recent collected data
- ⇒ Verify instrument settings and ranges against the SOP
- ⇒ Recommend potential changes if modes if operations would improve

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System Audits (continued)

- ⇒ Operational mode verification with SOP
- ⇒ Review of station operations
- ⇒ Physical inspection of hardware
- ⇒ Processing of data collection intervals
- ⇒ Review of recent collected data
- ⇒ Observe site technician in normal site check and operations
- ⇒ Review site and equipment logs

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System Audits (continued)

- ⇒ Operational mode verification with SOP
- ⇒ Review of station operations
- ⇒ Physical inspection of hardware
- ⇒ Processing of data collection intervals
- ⇒ Review of recent collected data
- ⇒ Check antennas for integrity and weathering
- ⇒ If needed, recommend changes in maintenance intervals

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System Audits (continued)

- ⇒ Operational mode verification with SOP
- ⇒ Review of station operations
- ⇒ Physical inspection of hardware
- ⇒ **Processing of data collection intervals**
- ⇒ Review of recent collected data
- ⇒ **Review processing techniques and means of combining sub-hourly intervals in hourly**

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System Audits (continued)

- ⇒ Operational mode verification with SOP
- ⇒ Review of station operations
- ⇒ Physical inspection of hardware
- ⇒ Processing of data collection intervals
- ⇒ Review of recent collected data
- ⇒ **Review collected data for meteorological reasonableness**
- ⇒ **Note any noise interference problems**

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Performance Audits

- ⇒ Comparison vs. audit
- ⇒ Comparison devices
- ⇒ Audit devices
- ⇒ Sodar comparisons
- ⇒ Sodar audits
- ⇒ Radar wind profiler
- ⇒ RASS

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- ⇒ Comparison vs. audit
- ⇒ Comparison devices
- ⇒ Audit devices
- ⇒ Sodar comparisons
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- ⇒ Radar wind profiler
- ⇒ RASS
- ⇒ **Comparison uses another measurement method that is not necessarily a "standard" to assess the level of agreement between the two methods**
- ⇒ **Audit uses a device that provides a known input into the instrument being audited to check the accuracy of the instrument response to the known input**

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Performance Audits

- ⇒ Comparison vs. audit
- ⇒ **Comparison devices**
- ⇒ Audit devices
- ⇒ Sodar comparisons
- ⇒ Sodar audits
- ⇒ Radar wind profiler
- ⇒ RASS
- ⇒ **Tall tower**
- ⇒ **Radiosonde**
- ⇒ **Sodar**
- ⇒ **Tethersonde**
- ⇒ **Anemometer kite**

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Performance Audits

- ⇒ Comparison vs. audit
- ⇒ Comparison devices
- ⇒ **Audit devices**
- ⇒ Sodar comparisons
- ⇒ Sodar audits
- ⇒ Radar wind profiler
- ⇒ RASS
- ⇒ **Instrument that produces known frequencies at known time intervals**
- ⇒ **Acoustic Pulse Transponder and others**

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Performance Audits

- ⇒ Comparison vs. audit
- ⇒ Comparison devices
- ⇒ Audit devices
- ⇒ **Sodar comparisons**
- ⇒ Sodar audits
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Performance Audits

- ⇒ Comparison vs. audit
- ⇒ Comparison devices
- ⇒ Audit devices
- ⇒ Sodar comparisons
- ⇒ **Sodar audits**
- ⇒ Radar wind profiler
- ⇒ RASS
- ⇒ **Acoustic device such as the Acoustic Pulse Transponder**
- ⇒ **Reduces the need for comparisons to gain confidence in the proper instrument operation**



Performance Audits

- ⇒ Comparison vs. audit
- ⇒ Comparison devices
- ⇒ Audit devices
- ⇒ Sodar comparisons
- ⇒ Sodar audits
- ⇒ **Radar wind profiler**
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Where We Go From Here

- ⇒ Defined requirements and procedures
- ⇒ Reduced reproving of the technology
- ⇒ Needed guidance is emerging in a usable form
- ⇒ Education of users and regulators in remote sensing technologies is needed
- ⇒ Proper implementation of the methods

