Quality Assurance Methods for Ground-Based Meteorological Remote Sensors

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Overview

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

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Remote Sensing Systems

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

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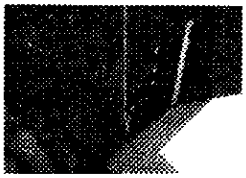

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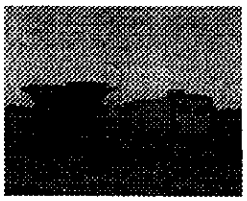

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QA Methods Development

- ⇨ "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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- ***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)

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Site-Specific Meteorological Monitoring Guidance for Regulatory Modeling Applications (1999)

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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

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System Audits

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

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System Audits

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- **Have SOPs been developed?**
- **Are they being implemented?**
- **Are there deviations from the SOPs?**

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System Audits

- ⇨ SOP verification
- ⇨ **Hardware connection verification**
- ⇨ Antenna alignment
- ⇨ Transmit pulse
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- ⇨ Background frequency spectra measurement
- ⇨ Vista table preparation

- ⇨ **Cable routing**
- ⇨ **Proper cable locations**
- ⇨ **Connector corrosion**

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- ⇨ 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**

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- ⇨ 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**

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- ⇨ SOP verification
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- ⇨ 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**

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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 the of sodar**

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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**

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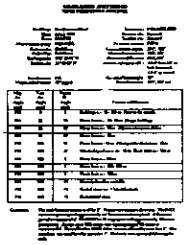

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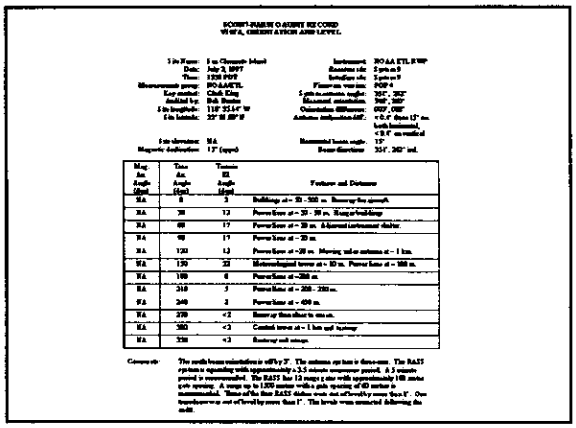

System Audits (continued)

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

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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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Performance Audits

- **Comparison vs. audit**
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- **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
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- **Tall tower**
- **Radiosonde**
- **Sodar**
- **Tethersonde**
- **Anemometer kite**

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Performance Audits

- Comparison vs. audit
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- **Audit devices**
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- **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**
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- ⇨ **Acoustic device such as the Acoustic Pulse Transponder**
- ⇨ **Reduces the need for comparisons to gain confidence in the proper instrument operation**

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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

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