A New Future in Meteorological Measurements

Incorporating Quality Checks into Vertical Temperature and Wind Measurements
Vertical Temperature and Wind Measurements in networks

- Every air quality network must have boundary layer information to understand daily variations in pollution levels.

- Many networks do not have suitable measurements

- New more affordable and portable technologies are now available and the opportunity to improve networks is real.
Systems Menu

- A number of choices exist:

- **Fixed RASS and RWP systems**
  - Vaisala
  - MiniSodar
  - others

- **Portable Temperature profilers**
  - Kipp & Zonen MTP (series)
  - Radiometrics

- **Radiosonde systems**
  - InterMet
  - Vaisala
  - others
MTP 5-HE
Harsh, Extended range

- Height range up to 1,000 m
- Height resolution varies from 50 m to 120 m
- Frequency 56.7 GHz, 3º view, narrower bandwidth, Single Side-Band (SSB)
- Improved specification of radiometer to maintain signal to noise performance
- Mist, cloud and heavy rain slightly degrades accuracy of temperature measurement
MTP5-HE on Pedestal
Technology Comparison

RASS

MTP5-HE
MTP5-HE

Roof Mount

Thermistor
Quality Checks for vertical measurement systems

Radiosondes are the gold standard!

- Long considered too hard and costly
  - Labor intensive
  - Can’t capture temporal details well
- Audit vs. QC?
  - What criteria?
  - Qualitative based on DQO’s

- What do you do with the results
  - How do stimulate corrective action?
- Bottom line is we have to do something.
Tools to perform QA/QC Checks

- Lessons Learned
  - Conducted a calibration test in Feb 09
  - Kipp & Zonen arranged for radiosondes to compare

- Procured a tool to support QC and Special Studies
  - Affordable
    - < $10K for the down station and software
  - Cost effective
    - Each flight is only $ 250

- Operational considerations
  - No FAA concerns- small payload
  - One person operation
  - Portable and set up is less than 1 hour.
  - Immediate access to data
What we bought

iMet-3050

- Redesigned in 2009 to significantly reduce costs while maintaining complete functionality
- Suitable for fixed synoptic installations or field research
- Includes iMetOS meteorological operating system
- Differential GPS available as a system option, but not required by most users
- Compatible with any Windows PC (user supplied)
- Compatible with iMet-1 family of radiosondes
- Meets all WMO specifications
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<th>WMO Std.</th>
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Radiosondes

- iMet-1
  - State of the art performance exhaustively tested by U.S. National Weather Service
  - Lightweight, easy to use
  - Available with or without solid state pressure sensor
  - For research or synoptic use
  - Only radiosonde built in the U.S.A
iMet-1 Radiosonde

Component
Temperature Sensor
Humidity Sensor
Pressure Sensor (optional)
GPS Receiver
De-Reeler (optional)
Batteries
Protective case
Signal processor
Transmission type
Data Rate
Preflight and Balloon Inflation

- Easy to use software interface
  - Site information

200 gram Balloon

- Easy and quick inflation
- Helium Bottle
  - ~ 4 Flights per bottle

Radiosonde Train

- Power on for initialization
- Easy connection to balloon, parachute, and dereeler

Onsite to Flight

- Less than 30 minutes
Radiosonde Release

C:\Users\MikeG\Desktop\Radiosonde-100709 002.AVI

C:\Documents and Settings\ltripca\Desktop\Wednesday\Radiosonde-100709 002.AVI
Data results

Note:
• RASS is virtual temp
• Darrington is 70 miles away
Data Results

Multiple Station Vertical Temperature

- Sand Point Mtp46 9/23/09 12:30 PM
- Sand Point RASS 9/23/09 12:30 PM
- Sand Point Sonde 9/23/09 12:30 PM

Collocated Systems
iMetOS Software

- Flight Management, Graphical Displays & Standard Reports
  - One second data for analysis
  - Real time output during flight
  - Data editing capabilities
  - Compatible with all Windows peripherals

Complete demo available at www.intermetsystems.co
iMetOS Software
iMetOS Software
iMetOS Software
iMetOS Software
InterMet
International Met Systems

View Physical Values

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Logistics

- Versatile and mobile
  - Universal PC type power supply, 110 – 220 VAC
  - System carried in three cases making it easy to transport and secure
  - iMetOS can be run on any Windows 2000 + PC* including Netbooks
    - Windows 7 (?)
  - Easy data access for reporting and analysis
  - 200gram balloons don’t need much helium
    - ~ $ 190.00 per standard bottle
iMet-3150 Portable

- Lost-cost, handheld sounding system for reduced range applications (< 50 km slant range)
- Suitable for boundary layer research, remote sensor calibration, tropical observations
- Up to 90 km range with optional whip antenna
- Full-function iMetOS operating system with complete data output
- Compatible with iMet-1 family of radiosondes
- Compatible with any Windows PC
- Ultra portable
iMet-3150
InterMet
International Met Systems

Diagram of system components:
- iMET-1 Radiosonde
- Decoder
- System Computer
- Receiver
- AC Adapter

pscleanair.org
Puget Sound Clean Air Agency
iMet-1-RS
Special Purpose Research Sonde

- Designed for integration with any atmospheric sensor
- Includes Serial Data Port that allows custom sensors to transmit data over the sonde’s data stream
- User programmable functions
- Successfully used with Ozone, Particulates and Frost Point Hygrometers
- Can be integrated with UAV and glider applications
Great site.

QA for wind folding

http://madis.noaa.gov/madis_qc.html
Summary

- Include Meteorological measurements in your network assessment!

- Portable radiosonde systems can easily and affordably support QA/QC activities
  - Must now develop what that looks like for national consistency
  - What criteria, how often?

- Special studies, emergency response may now be supported more effectively
Special Study- Winter 2009

- EPA Region 10
  - Found funds to buy an inventory of balloons and Radiosondes
  - Helium provided by Washington State Department of Ecology
  - Hardware and Training provided by PSCAA

- Eastern Washington high PM
  - Winter
  - Uncertainty regarding boundary layer
  - Adjacent to Yakama Nation lands

- EPA Region 10 and Yakima Clean Air Agency
  - Using InterMet radiosondes and MTP5 He
    - Conduct ~8 flights over a two day period
  - Compare to predicted mesoscale boundary layer predictions
Recommendations

- EPA should provide grant funds for procurement
  - Special application, not necessarily via 105/103
  - Provide resources for consumables for long term operation

- Encourage procurement of profilers to provide more detailed and efficient data collection

- Establish a goal of one system per region
  - QA operation, special studies, emergency response

- Expect meteorological measurements to be included in 5 year assessments
Thanks

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