Meteorological Measurements To Meet Air Quality Program Needs

MTP 5-HE Vertical Temperature Measurements
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, 3° 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
It’s a Different World

- Filters, Filters, Filters
  - Air Quality Past
- Ozone and AQI
  - Timely reporting to the Public
  - Action calls
- PM 2.5 changed air program needs
  - Forecasts
  - Curtailment calls
  - Momentum is building
Meteorological Measurements

- Largely ignored by the air quality community
- Cost issues
- Old paradigms
  - Climatology for modeling

- Future networks must change!
  - Lower NAAQS
  - Higher enforcement expectation
  - NAAQS determinations and strategy development
NW AIRQUEST - Role

- Develop technical recommendations to Air Directors

- Develop budget requests to address the shortfalls

- Provided leadership via NACAA & WESTAR to influence EPA
  - NCORE sites
  - PAMS Funds
  - PM2.5
PSCAA RASS and RWP system

- Installed in 1994
- Several upgrades and repairs
- Recently completed major upgrade and grooming
  - $130K
  - Extends life ~ 5-8 years
- Need new technology to meet future needs.
New Tools

- Demonstration tests MTP5HE
  - Compared to Vaisala Profiler
  - Hanford Met Tower

- Result were favorable

- Procured two systems
  - ~$130 each
Acceptance Test

- Received MTP5-HE’s – June 08
- Performed inventory and shop tests
- Installed devices at NOAA Campus collocated with Vaisala LAP XM-3000
Technology Comparison

RASS

MTP5-HE
MTP5-HE on Pedestal
Site Installation

MTP5 -HE

Seattle size Rain Gauges
MTP5-HE

Roof Mount

Thermistor
Site view

Devices look to North
MTP5-HE Collocation-29June 2008

SN# 0045 @ 0400/12UTC

SN# 0046 @ 0400/12UTC
Collocated RASS Data

- Virtual Temp
  - ~1.5-2 deg C Warmer

- Coarse resolution
- Lower 150 m missing
- Vertical structure appears correct
MTP5-HE Collocation-29June 2008

SN # 0045 @ 1800/02UTC

SN # 0046 @ 1800/02 UTC
Collocated RASS Data

- Coarse resolution
- Lower 150 m missing
- Vertical structure appears correct
Temperature Profile on June 29, 2008 at 0600PST

PROFILER
MTP5HE SN45
MTP5HE SN46
SN45-PROFILER DIFFERENCE
SN46-PROFILER DIFFERENCE
Temperature Profile on June 29, 2008 at 0900PST
Temperature Profile on June 29, 2008 at 1200PST

Graph showing temperature profiles with different datasets:
- Profiler
- MTP5HE SN45
- MTP5HE SN46
- SN45-Profiler difference
- SN46-Profiler difference

Y-axis: Height in meters
X-axis: Temp °C
Temperature Profile Averaged for A Day on June 29, 2008

Temperature Profile

- MTP5HE SN45
- MTP5HE SN46
- PROFILER
- SN45-PROFILER DIFFERENCE
- SN46-PROFILER DIFFERENCE

Height (m) vs. Temperature (°C)
Temperature Profile on July 3, 2008 at 1500PST

[Graph showing temperature profile with labels for different measurement points and comparison of PROFILER, MTP5HE SN45, MTP5HE SN46, SN45-PROFILER DIFFERENCE, and SN46-PROFILER DIFFERENCE.]
Temperature Profile Averaged for A Day on July 3, 2008
Temperature at 400m

- Temp °C
- MTP5HE SN46
- PROFILER
- MTP5HE SN45

Dates: 28/06/2008 to 7/7/2008
Profiler vs MTP5 at 400m n=528

\[ y = 0.9527x + 0.5156 \]

\[ R^2 = 0.9883 \]
Profiler vs MTP5 at 900m n=528

\[ y = 0.9611x + 2.6371 \]
\[ R^2 = 0.9353 \]

\[ y = 1.0109x + 2.2304 \]
\[ R^2 = 0.9458 \]
SN45 vs SN46 at 900m n=528

y = 0.9529x + 0.3893

$R^2 = 0.9894$
SN45 vs SN46 Ground Level Thermistors
at 10 Minute intervals n=681

\[ y = 0.9763x + 0.487 \]

\[ R^2 = 0.9606 \]
Current Evaluation

- Examine unexpected differences with new units
  - Electronics have changed
  - Radiometer?
  - Calibration
SN 45, 46 and 21

Temperature Profile on August 26, 2008 at 0700 PST

- PROFILER
- MTP5HE SN45
- MTP5HE SN46
- MTP5HE SN21
- SN45-PROFILER DIFFERENCE
- SN46-PROFILER DIFFERENCE
- SN21-PROFILER DIFFERENCE
SN 45, 46 and 21

Temperature Profile on August 25, 2008 at 1400 PST

[Graph showing temperature profiles for SN45, SN46, SN21, and profiler differences at various heights.]
SN 45,46 and 21

Temperature at 400m

- PROFILER
- MTP5HE SN45
- MTP5HE SN46
- MTP5HE SN 21
Summary

- Systems passed initial acceptance testing
- Working to improve calibration of the systems
MTP5 vs Salt Lake City Radiosondes

Temperature at Ground Level

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- MTP5HE
- Radiosonde
MTP5 Vs SLC

Temperature Profile on July 12, 2008 at 1200UTC

- Graph showing temperature profile with heights in meters and temperature in °C.
- Key identifying lines:
  - Radiosonde
  - MTP5HE
  - MTP5HE-Radiosonde Difference
MTP5 Vs SLC radiosondes

Temperature at 550m


Temp °C

MTP5HE

Radiosonde

pscleanair.org
Puget Sound Clean Air Agency
Next steps

- Deploy to air monitoring sites with Air Quality problems.
- Create “mini” network (RASS + MTP 5)
- Develop data path for submission to EPA, Washington State DOE
- Collaborate with NWAIRQUEST for model validation effort.