UHSAS in HIPPO

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HIPPO WORKSHOP 2011

Data Quality
Calibration
Examples of Performance
Plans

Instrument Description
Instrument Problems

UHSAS: Ultra-High Sensitivity Aerosol Spectrometer
(for reference)

Instrument Characteristics

Measurement:	Particle size distribution, $0.076 - 1.0$ μm diameter
Sizing:	100 channels, approx log spaced
Sampling:	Under-wing canister, internal air samples
Method:	Light scattering from individual particles
Limitation:	Maximum counting rate 3000/s (ca 4000 cm^{-3})
Sample Rate:	10 Hz, sampling about 0.7 standard cm^3/s
Flow Control:	Mass flow controller
Output:	Ambient concentration (not at standard conditions)

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Performance Problems

1. Manufacturer (DMT) specs: $\geq$-40°C and <12 km altitude
   - high-altitude problems:
     noise in first channels or anomalously low values
   - effects not seen in HIPPO data

2. A new instrument; evolving:
   - HIPPO-1: Mostly usable but with special bins used
   - HIPPO-2: Not recoverable
     size distributions not archived
     some total-concentration measurements archived
   - HIPPO-3: data quality good (few brief problems, RF01)

3. The main problem: Merger of four different size ranges
   - Ranges used to span six decades in scattering-signal strength:
     Two detectors with different sensitivities, two gain circuits each
   - Instrument selects the appropriate signal to use for sizing
   based on the pulse heights

Calibration by Polystyrene Latex Spheres
(for reference)

- Several sizes are used spanning the size range of the instrument
- Theoretical arguments suggest (for particle diameter < 0.3 μm) signals should vary as the sixth power of the diameter, and calibrations confirm this:
  $\Rightarrow$ the latex spheres determine one absolute calibration value
- Relative calibrations among the four ranges of the instrument are then set by using the ratio of signals measured for single particles in pairs of ranges to adjust the relative calibration of the two ranges
- The recommended procedure for the laboratory version of this instrument is to run a program periodically that adjusts the gains.
  - in HIPPO-1 and HIPPO-2, this was not possible
  - the result: drifts caused data anomalies at the transitions

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HIPPO-1
HIPPO-3

HIPPO-1 Performance

Typical Measurements

- note the three transitions
- at large size:
  counting-statistics noise

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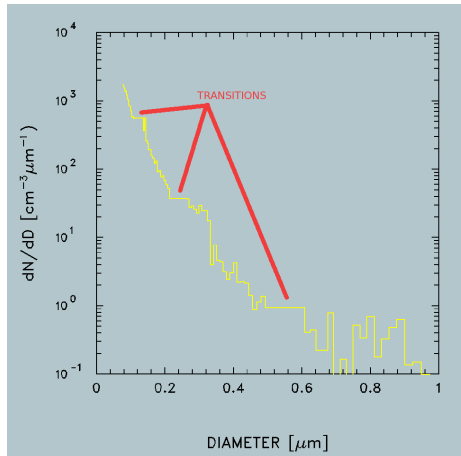
HIPPO-1
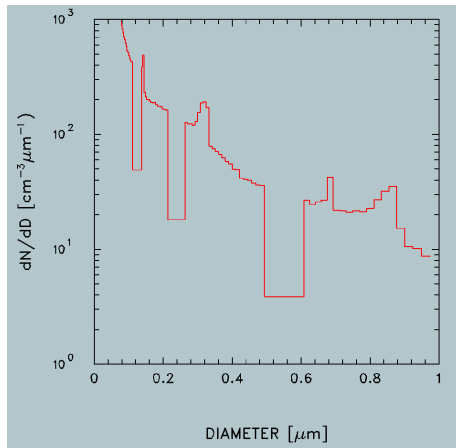HIPPO-3

HIPPO-1 Performance

Typical Measurements
- note the three transitions
- at large size:
  counting-statistics noise

Problem Just Found
processing error in latest run:
- bins at gaps about 10% of correct values
- only affects summer 2010 processing

will be corrected

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HIPPO-1
HIPPO-3

Changes for HIPPO-3

Probe Changes:

1. Amplifiers replaced by ones less sensitive to temperature
2. Gain resistors changed to increase overlap among stages
3. PC board cleaned of residual solder flux
4. Detectors replaced

Controlling Laptop Installed

- data from probe split and sent both to aircraft-data recorder and to laptop
- laptop could adjust gains to achieve best agreement in overlap regions

Result: Much Improved Performance, HIPPO-3

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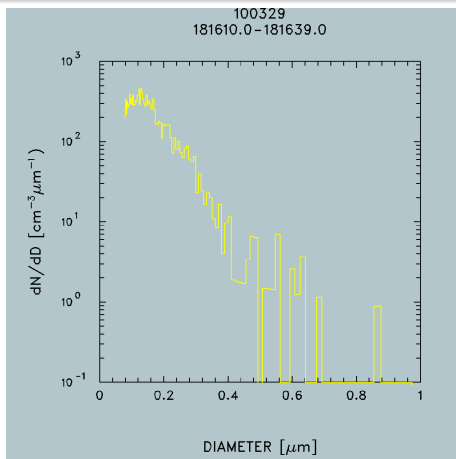4. Detectors replaced

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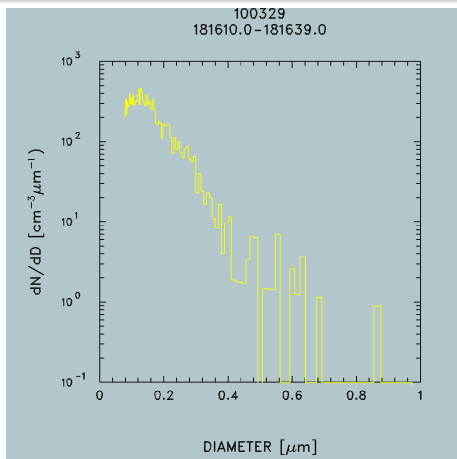**Examples of Performance**
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HIPPO-1
HIPPO-3

HIPPO-3 Performance

- typical example:
  (note absence of
  transition effects)

- More information in a
  note on the field catalog
  (Mar 2010)
  http://catalog.eol.ucar.edu/
    hippo3/other
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PLANS

HIPPO-4 and HIPPO-5

Plan to operate as in HIPPO-3

Continue to Address Problems

- will correct HIPPO-1 archive
- altitude limitation is a remaining concern (but probably not for HIPPO)