Thoughts for the Future:
Flow Control, Meteorology, PM Sensors, & MAIA

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Flow Control

The Current Situation

- GAST pump much larger than needed due to flow control orifice
- Flow control is passive so flow rate decreases as filter loads
- Volume flow rate is measured but PM10 and PM2.5 cut points change with flow rate
- End of day may have lower flow rate so not represented as well

Why Change?

- BrushLess DC (BLDC) motors (also called electronically commutated motors) have made it cheap and easy to adjust motor power and speed to a given need
- Obtain constant flow rate which provides more reliable PM2.5 and PM10 cuts
- Reduce energy consumption since the pump is much smaller
- Increase pump life since it is operating at lower load

What’s the cost?

- Old: $400 for the pump, in quantity, plus $160/yr in power
- New: $260 for pump and controller, in quantity, plus power savings
- And controller and database programming costs
- And some electronics to interface pump to controller
Meteorology

The Current Situation

• No meteorology at the sites
• Do not know key factors governing PM concentration, composition and visibility factors

Why Change?

• RH dependence is key to visibility
• Wind direction and speed can point to the source location
• New controller and internet to collect and transmit data home

What’s the cost?

• NPS supported development of drag sphere anemometer
  • No moving parts to wear out
  • No places for insects or birds to find a home
• Cost is less than $100 per site
• RH, Temperature, and Barometric Pressure can be obtained with Bosch BME280 chip (see next slide)
• And controller and database programming costs
Real-Time PM1, PM2.5 and PM10

The Current Situation
• We collect 24-hour data, 1 in 3 days

Why Change?
• Plumes may move through on time scales less than a day
• New, low-cost, real-time sensors coming on the market
• Accuracy is not so hot but we have a gold standard with our 24-hour gravimetric measurements, so can calibrate/adjust

What’s the cost?
• $189 per site for a PurpleAir, in quantity, includes 2-PM sensors, RH, Temperature, Barometric Pressure
• And will incur programming costs to ingest data and calibrate using PM2.5 and PM10 gravimetric data from filters
• AQ-SPEC data from South Coast Air Quality Management District here
MAIA (Multi-Angle Imager for Aerosols)

The Current Situation

• We do not have focused help from satellites
• NASA does not have ground truth synchronized with overflights

Why Change?

• IMPROVE provides mass and composition data with generally low spatial gradients
• NASA will be launching MAIA whose goal is PM2.5 composition

What’s the cost?

• NASA pays for
  • X Module on a schedule synchronized with overflights
  • 24 hour samples on PTFE
  • PurpleAir or similar to get better time resolution
Network Reinvestment

Our priorities – Your thoughts, funding, timing?
1. Flow control
2. Real-time PM1, PM2.5, PM10, T, RH, BP
3. Wind Direction and Speed
4. OK to use X module for MAIA ground truth if NASA pays?