IMPROVE Particle Monitoring Network: Quality Assurance – Field Audits

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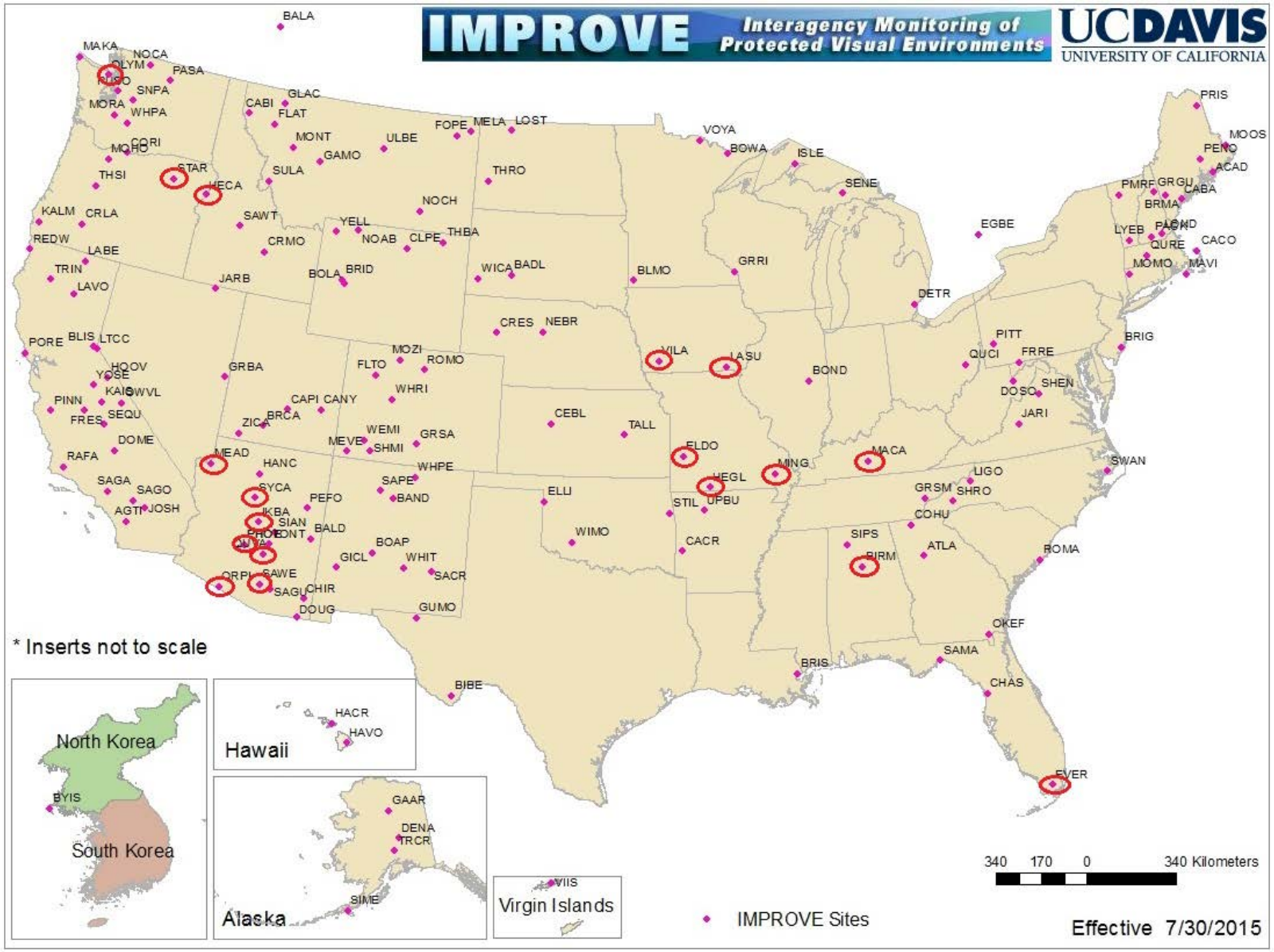
External Sampling Audits

- EPA (Dennis Crumpler) hosted an auditor training event in October 2014
  - Jose Mojica, our Field Manager, attended
  - Concerns about hands-on time for auditors
- At Steering Committee meeting last year, observed bias in EPA audits
  - We spent some time trying to understand bias between our audit devices and the EPA audit devices
- As of April 2015, Jose Mojica has taken over coordination of the audit program

2014 Independent Field Audits



Audit Summary for 2014

- 24 field site audits conducted in 2014
  - Differences between sampler and audit device flow rate exceeded 10% limit in six audits
  - Differences between actual and nominal flow rate exceeded 10% limit in four audits
  - Details on following slides
- Worse failure rate than in past years
  - Related to reduced maintenance frequency
    - Maintenance was performed on only half the sites in 2013

Everglades, FL: 6/17/14

- A module flow rate higher than audit device by 16% and flow rate lower than nominal set point by 16%
  - UCD follow-up tests revealed leak in A module
  - A module was replaced
- X module flow rate lower than nominal set point by 14%
  - UCD follow-up flow check measured X module nominal flow as 7% low
  - X module was recalibrated

Birmingham, AL, 9/3/14

- A module flow rate higher than audit device by 11% and flow rate lower than nominal set point by 12%
  - UC Davis follow-up tests showed A module agreement within 4% of former calibration for both values
- Difference was discussed with auditor
- No remedial action taken

Mammoth Caves, KY, 10/15/14

- C module flow rate higher than audit device by 12%
  - UC Davis follow-up tests showed C module agreement within 1% of former calibration
- Difference was discussed with auditor
- No remedial action taken

Viking Lake, IA, 10/28/14

- A module flow rate was lower than the nominal set point by 11% according to audit device
  - UC Davis made no follow-up adjustments
- Sampler passed next audit on 1/29/15 (agreement within 3% for nominal flow).

Ike's Backbone, AZ, 11/5/14

- A & C modules measured flow rate higher than audit device by 12% and 11%
  - UC Davis follow-up flow checks showed 3% agreement for both modules and flow rate was higher than the nominal flow rate by 7% for both B & C modules
- B & C module flow rates were adjusted and re-calibrated

Phoenix, AZ: 11/26/14 Collocated Sampler

- C module flow rate higher than audit device by 16%
- UCD follow-up flow check by operator showed flow rate calibration to agree within 6% of current equations
- C module equations were invalidated and former equations from 1/22/13 were reinstated

Phoenix1, AZ, 12/9/14

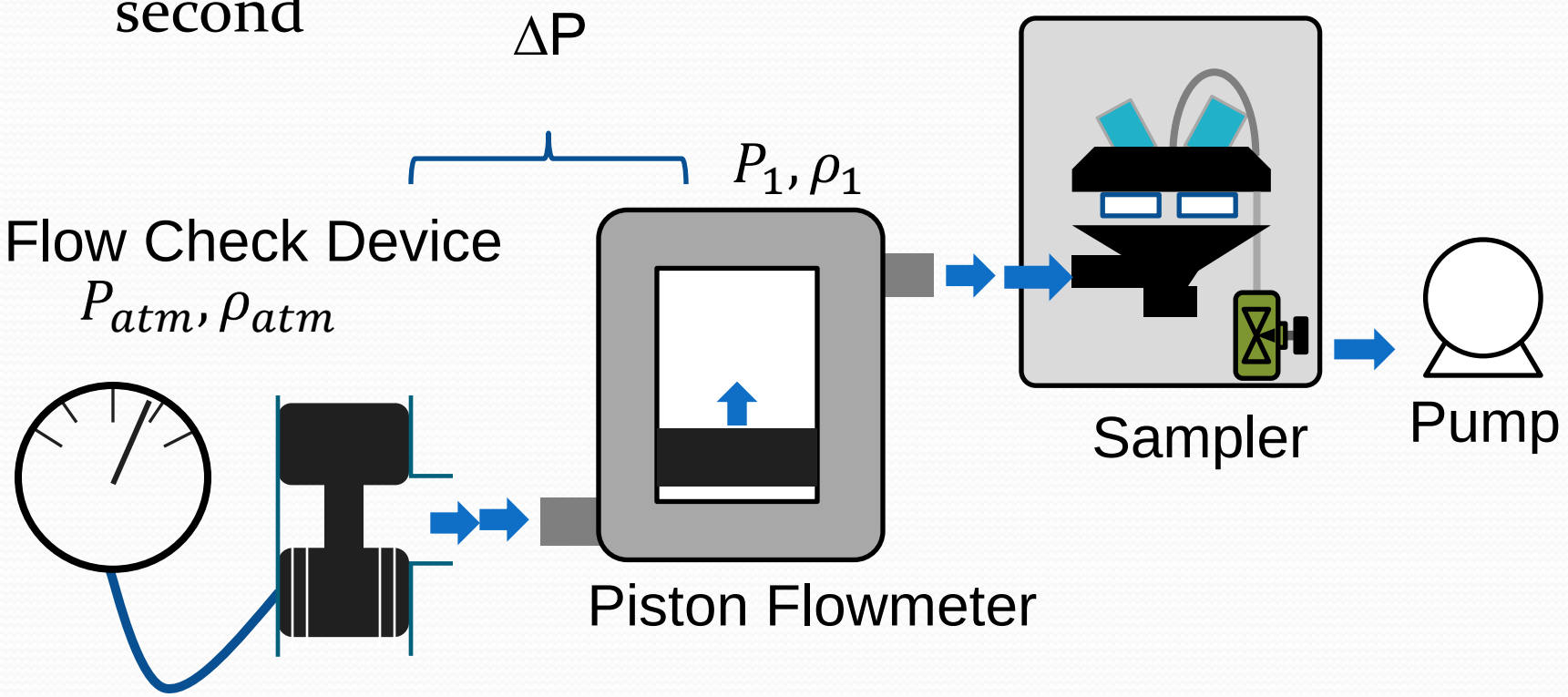
- Flow rate lower than nominal set point
  - A module: 12%
  - B module: 15%
  - D module: 11%
- UC Davis follow-up tests showed nominal flow rate to be within 8, 6, and 7% respectively
- Modules A, B, and D flow rates were adjusted and re-calibrated

Bias in Flow Calibration

- UCD does not routinely bring primary flowmeter into the field
  - use a transfer standard which measures pressure drop across a restriction at the sampler inlet
- In the past two years, a high precision primary standard flowmeters used at field sites to test new equipment: prototype e-box and critical ruby orifices
  - Noted a difference of approx. 3% in flow compared to expected flow from typical field flow check devices
  - This along with the biases in the outside audits, led to re-evaluation of how field flow-check devices (transfer standards) are calibrated

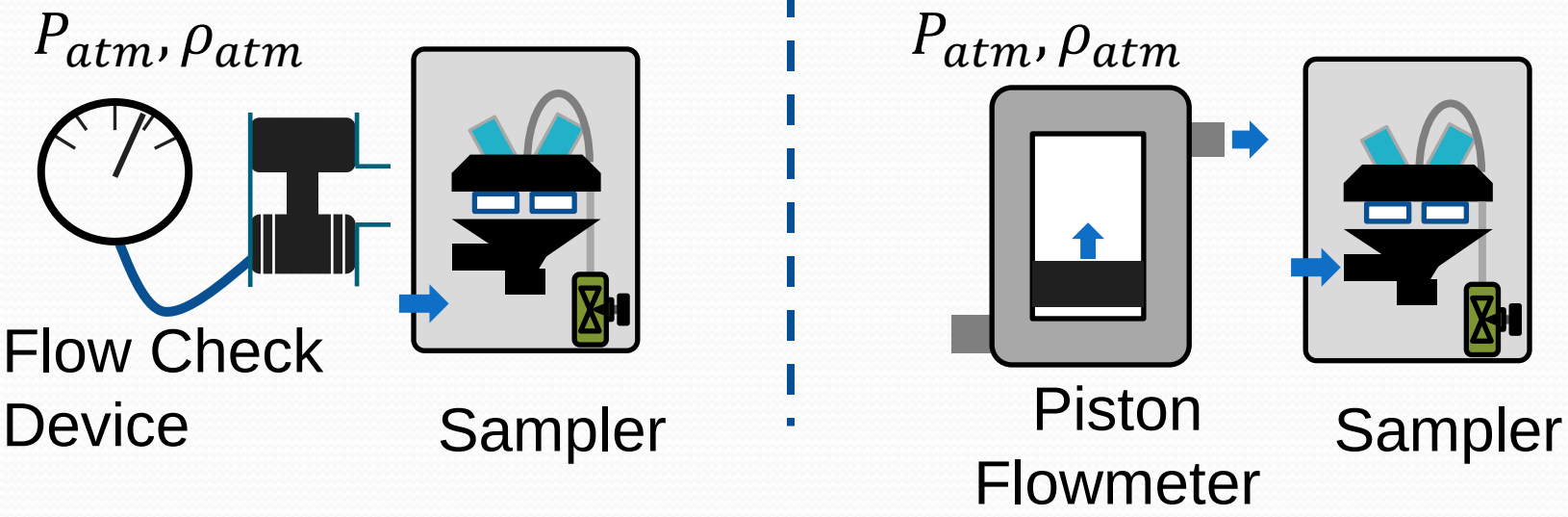
Old Flow Check Device Calibration Method

- Previous method was to calibrate the flow-check device in series with the primary standard
- Pressure drop across first device affects reading on second



New Flow Check Device Calibration Method

- Flow is set and then checked with one device at a time
- Monitoring of pressure at downstream orifice transducer indicates negligible flow change between devices



Audit Summary for 2015

- 30 field site audits conducted in 2015 so far
- One site failed
  - Tonto, AZ, 5/13/15
    - Auditor found D-module measured flow 12% higher than audit device and actual flow rate 12% lower than nominal set point
    - Our follow-up flow check showed D-module flow 5% high and actual flow rate 5% lower than nominal set point
    - Module flow rate was adjusted and re-calibrated
- Undercuts my hypothesis on 2014. Improvements may be related to
  - better maintenance procedures since 2013 and/or
  - renewed emphasis after 2014 Steering Committee meeting

Calib			Temp	Time	A Module			B Module			C Module			D Module	
Type	Site	Audit Date	(deg C)	(min)	Nominal	Vac	Mag	Nominal	Vac	Mag	Nominal	Vac	Mag	Nominal	Vac
Old	LASU2	1/16/2015	1.2	-2.0	-1%	1%	4%	-2%	2%	2%	-2%	2%	-1%	-1%	0%
Old	QUVA1	1/22/2015	1.9	2.0	-10%	9%	9%	-7%	8%	9%	-9%	7%	7%	-9%	8%
Old	DOUG1	1/28/2015	0.8	0.0	-5%	2%	2%	-1%	4%	7%	-4%	2%	3%	-5%	4%
Old	VILA1	1/29/2015	1.8	3.0	-3%	-10%	7%	5%	3%	5%	-1%	2%	5%	-2%	1%
Old	SIAN1	3/11/2015	0.9	0.0	-4%	2%	5%	-3%	3%	6%	-2%	2%	5%	-5%	3%
Old	HEGL1-X	4/13/2015	3.0	721.0	-5%	5%	9%	3%	5%	7%	4%	-1%	0%	-1%	1%
Old	LASU2	4/16/2015	1.2	1.0	0%	0%	1%	-1%	1%	2%	0%	1%	0%	0%	0%
New	ORPI1	4/22/2015	2.9	1.0	-2%	3%	3%	1%	1%	2%	0%	1%	2%	1%	1%
Old	TONT1	5/13/2015	1.4	5.0	-5%	2%	5%	0%	2%	1%	-6%	5%	3%	-12%	12%
Old	MING1	5/28/2015	2.0	2.0	-2%	1%	5%	-1%	3%	7%	-3%	7%	9%	-7%	7%
Old	ELDO1	6/3/2015	2.3	0.0	-1%	2%	5%	8%	0%	-2%	5%	-2%	2%	1%	-1%
Old	MEAD1	6/10/2015	0.2	4.0	-5%	8%	6%	0%	5%	4%	-2%	7%	4%	-6%	7%
Old	VILA1	6/10/2015	0.6	9.0	1%	-4%	-1%	3%	-6%	-3%	3%	-3%	7%	3%	0%
Old	GRSA1	7/6/2015	4.7	5.0	-8%	5%	7%	-5%	4%	7%	-7%	7%	8%	-8%	6%
Old	SHMI1	7/7/2015	0.2	1.0	-4%	2%	-3%	-2%	2%	4%	-2%	39%	4%	-6%	5%
Old	WEMI1	7/7/2015	1.6	7.0	-5%	3%	5%	-2%	2%	5%	-4%	2%	0%	-5%	4%
New	SAWE1	7/8/2015	2.1	0.0	-4%	6%	5%	-1%	6%	6%	-2%	4%	4%	-2%	4%
Old	MEVE1-X	7/9/2015	0.7	9.0	-5%	4%	6%	-2%	5%	6%	-3%	2%	86%	-4%	5%
Old	LASU2	7/16/2015	0.7	0.0	-1%	2%	1%	0%	2%	0%	0%	2%	-1%	-1%	0%
Old	ROMO2	7/16/2015	2.3	4.0	-5%	4%	5%	-2%	4%	6%	-4%	4%	7%	-4%	4%
Old	VILA1	7/24/2015	1.5	1.0	-2%	0%	3%	0%	-4%	-1%	-2%	-1%	10%	0%	2%
New	WHRI1	8/26/2015	1.5	1.0	-3%	3%	4%	-2%	2%	2%	-3%	2%	3%	-6%	4%
Old	BALD1	8/27/2015	0.6	6.0	-5%	4%	6%	-6%	9%	8%	-5%	7%	9%	-10%	7%
New	SHMI1	8/27/2015	1.0	0.0	-3%	3%	6%	-2%	2%	6%	-2%	41%	5%	-4%	3%
New	WEMI1	8/27/2015	3.0	0.0	-3%	2%	4%	-5%	2%	5%	-2%	2%	3%	-4%	-2%
New	MOZI1	9/8/2015	2.3	0.0	-5%	2%	2%	-2%	2%	3%	-5%	2%	2%	-2%	-1%
Old	SYCA1	9/16/2015	0.1	1.0	-3%	3%	3%	-1%	4%	3%	0%	2%	4%	-4%	4%
New	FLTO1	9/25/2015	0.4	0.0	-2%	0%	-1%	-3%	0%	2%	-4%	0%	1%	-4%	2%

2015 EPA Audit Results Distinguished by Old and New Calibration Methods