Field Evaluation
Dylos - DC1100 PRO

South Coast AQMD

AQ-SPEC
Air Quality Sensor Performance Evaluation Center

Background

- From 11/14/2014 to 01/09/2015 three Dylos particle counters (model DC1100 PRO) were deployed at one of our monitoring stations in Rubidoux, CA, and run side-by-side with two different Federal Equivalent Method (FEM) instruments for measuring particulate matter (PM) mass concentrations

- Dylos (*3 units tested*):
  - Optical particle counter (non-FEM)
  - Measures 3 different size fractions including $PM_{(0.5\text{-}2.5)}$ (used as an estimate of $PM_{2.5}$)
  - Cost: ~$300
  - Time resolution: 1-min

- MetOne BAM (*reference method*):
  - Beta-attenuation monitor (FEM)
  - Measures $PM_{2.5}$
  - Cost: ~$20,000
  - Time resolution: 1-hr

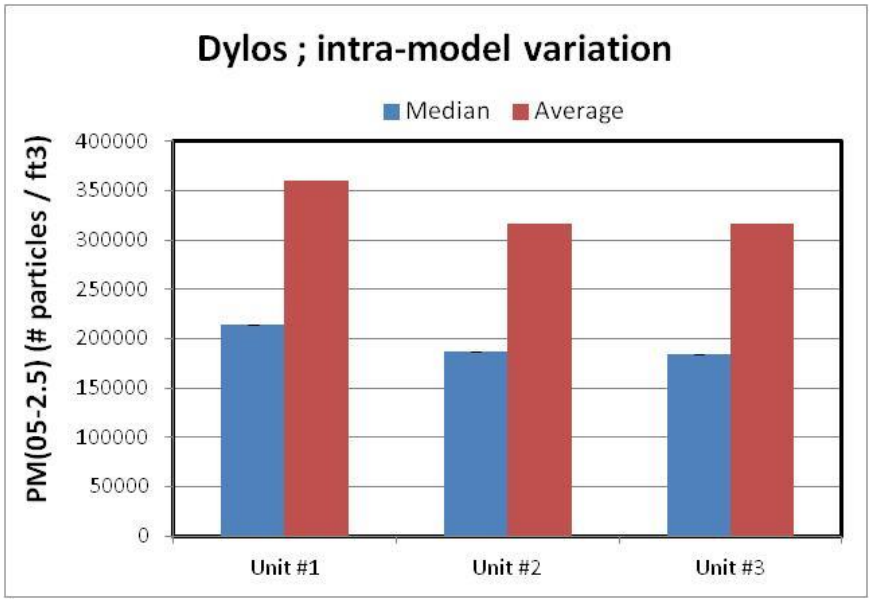
- GRIMM (*reference method*):
  - Optical particle counter (FEM)
  - Uses proprietary algorithms to calculate total PM, $PM_{2.5}$, and PM_1 from particle number measurements
  - Cost: ~$25,000 and up
  - Time resolution: 1-min

Data validation & recovery

- Basic QA/QC procedures were used to validate the collected data (i.e., obvious outliers, negative values, and invalid data-points were eliminated from the data-set)
- Data recovery: Dylos (~100%) > GRIMM (~99%) > BAM (~84%)

Dylos; intra-model variability

- Overall, measurement variations between the three Dylos units were small

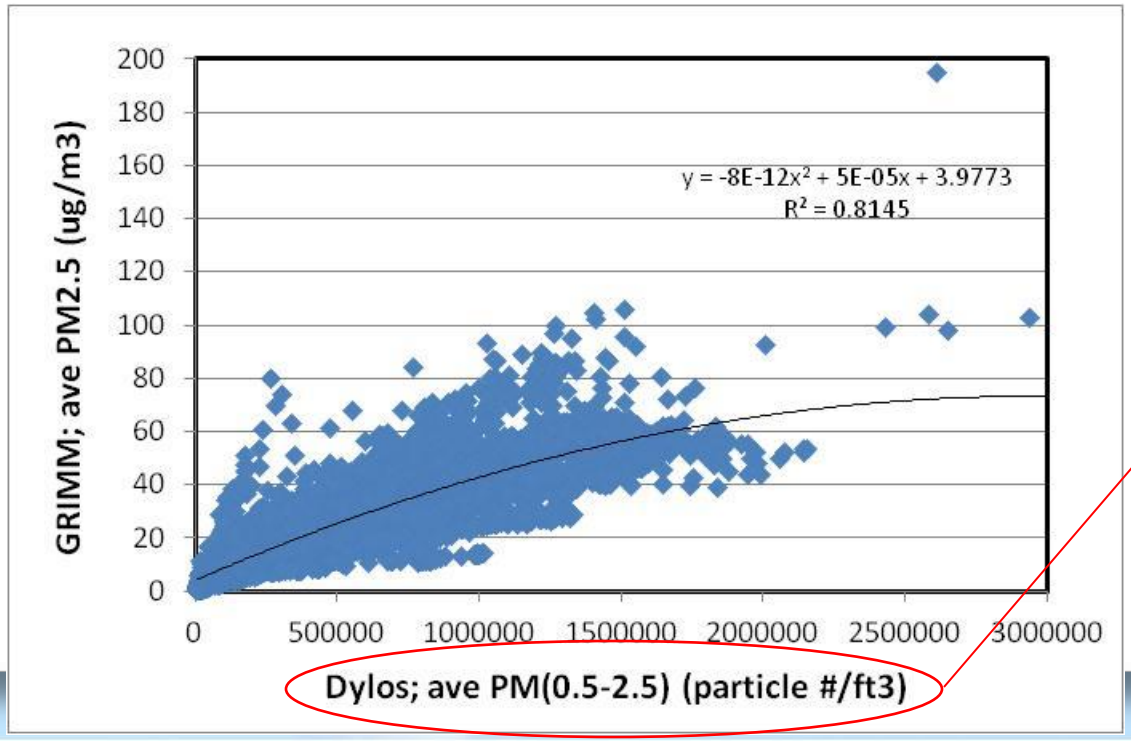


	Dylos; ave PM(0.5-2.5) (#/ft3)		
	Unit #1	Unit #2	Unit #3
Min	8212	7235	7868
Max	2019607	1841400	1914433
Average	360754	315984	316673
Median	214175	186945	184713
5 %-ile	17126	7235	16001
95 %-ile	1183609	1040678	1054886

Dylos vs GRIMM (5-min ave. data)

- Very good agreement between 5-min ave. Dylos and GRIMM measurements (R^2=0.81). This correlation is substantially higher than that found by EPA during a similar evaluation study (R^2 = 0.55; *http://cfpub.epa.gov/si/si_public_record_Report.cfm?dirEntryId=297517*)

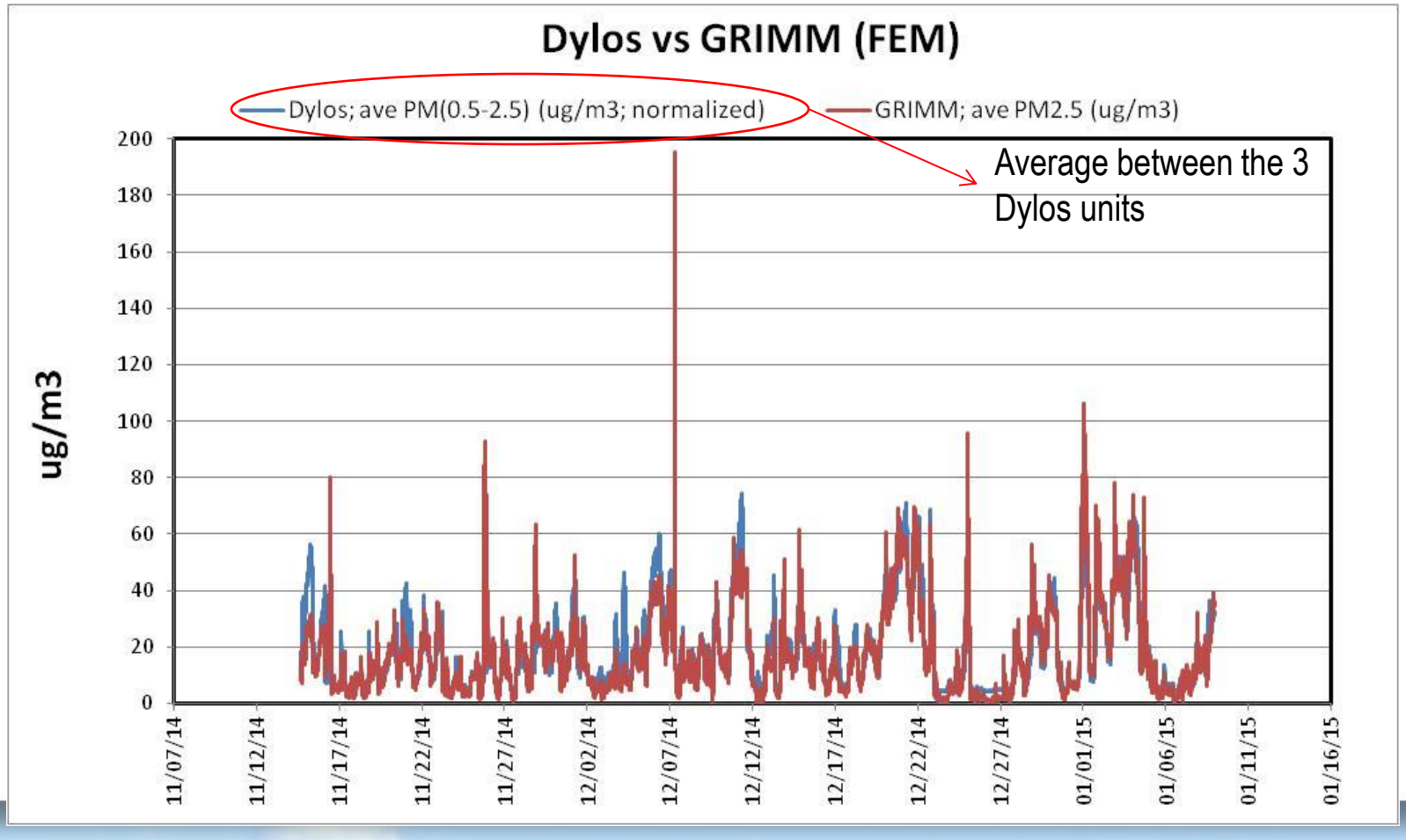
- A polynomial regression equation was used to "convert" Dylos particle count measurements to PM mass concentrations (ug/m^3)



Average between the 3 Dylos units

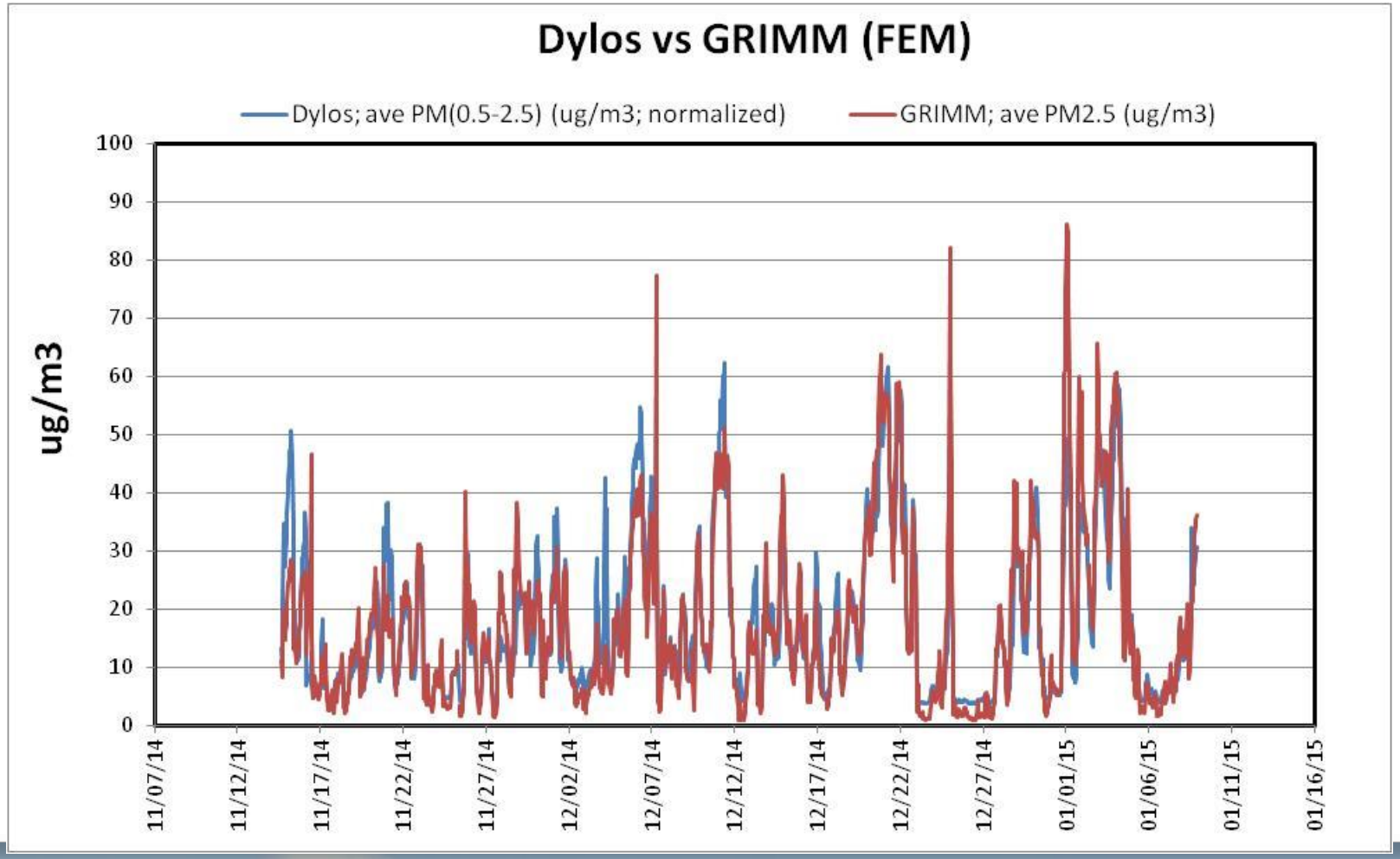
Dylos vs GRIMM (5-min ave. data)

- Very good agreement between 5-min ave. Dylos and GRIMM measurements (R^2=0.81)



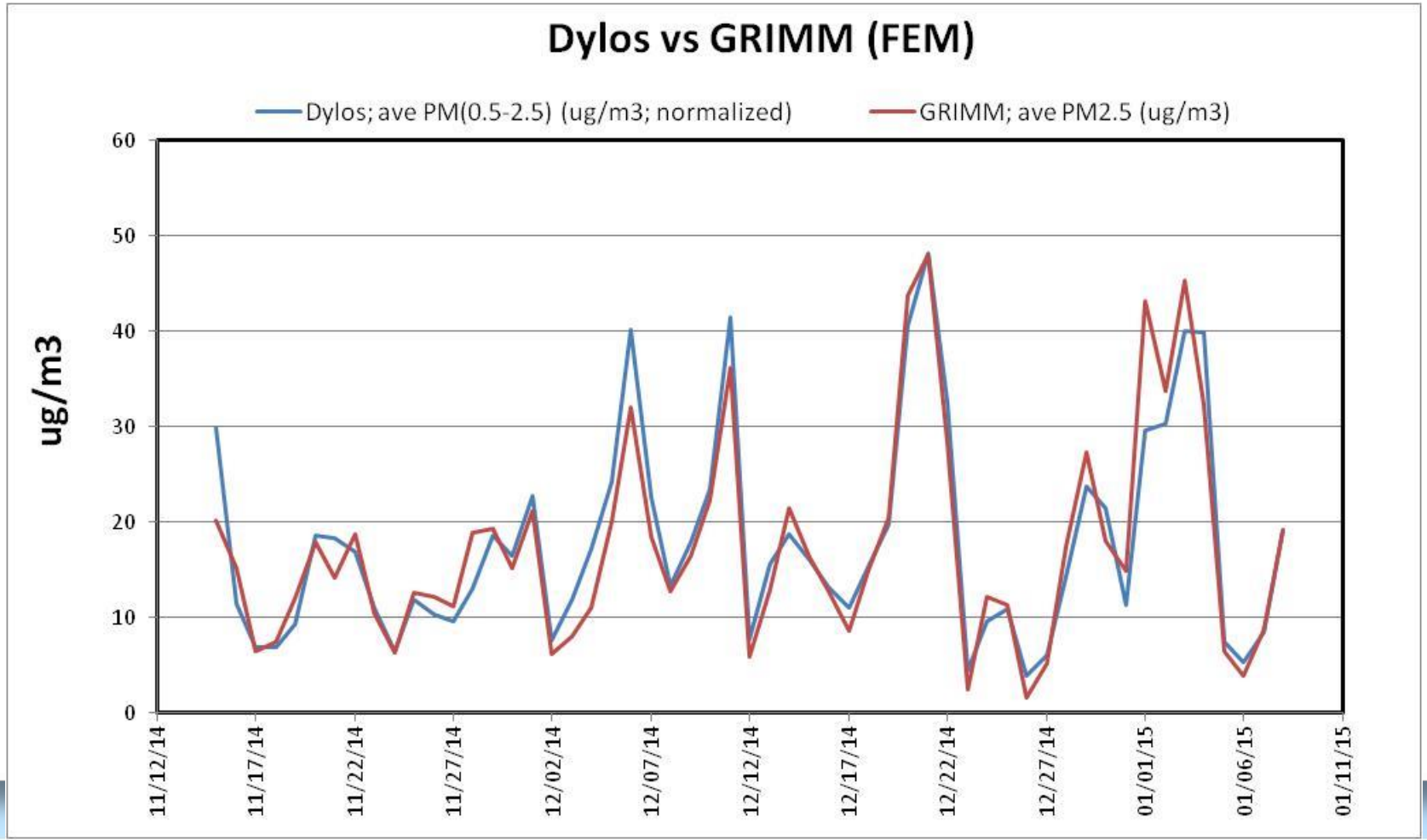
Dylos vs GRIMM (1-hr ave. data)

- R^2=0.83



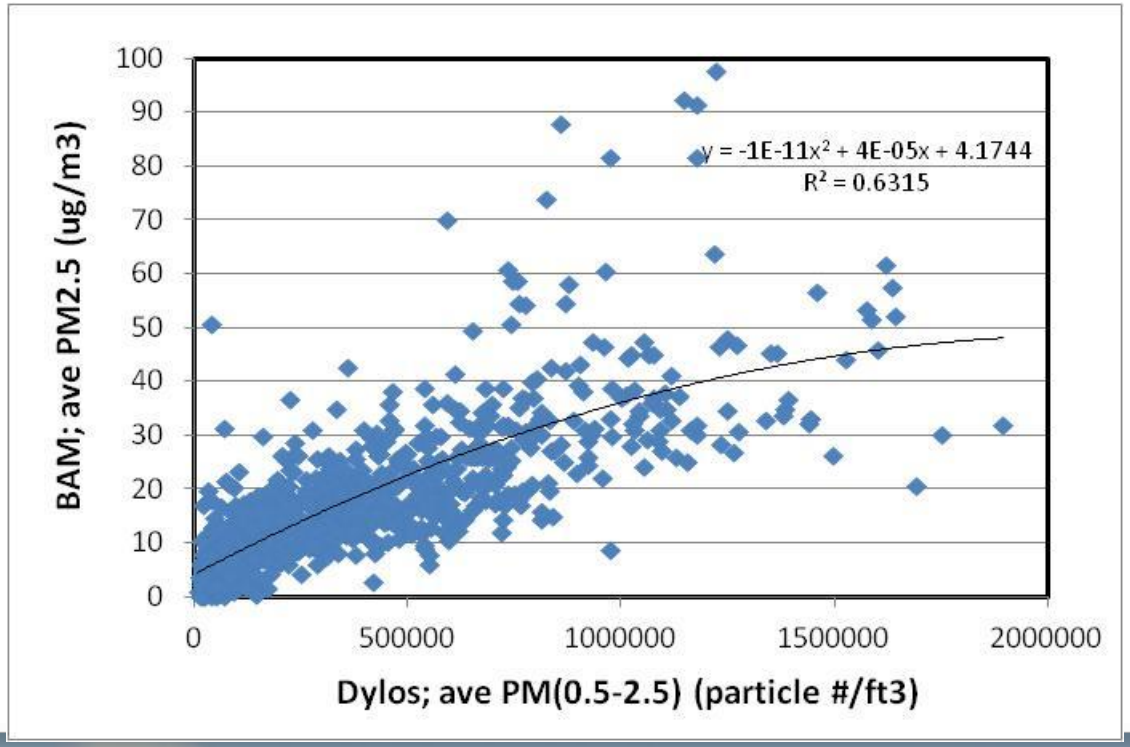
Dylos vs GRIMM (24-hr ave. data)

- R^2=0.89
- The corresponding PM2.5 FRM data is not available yet



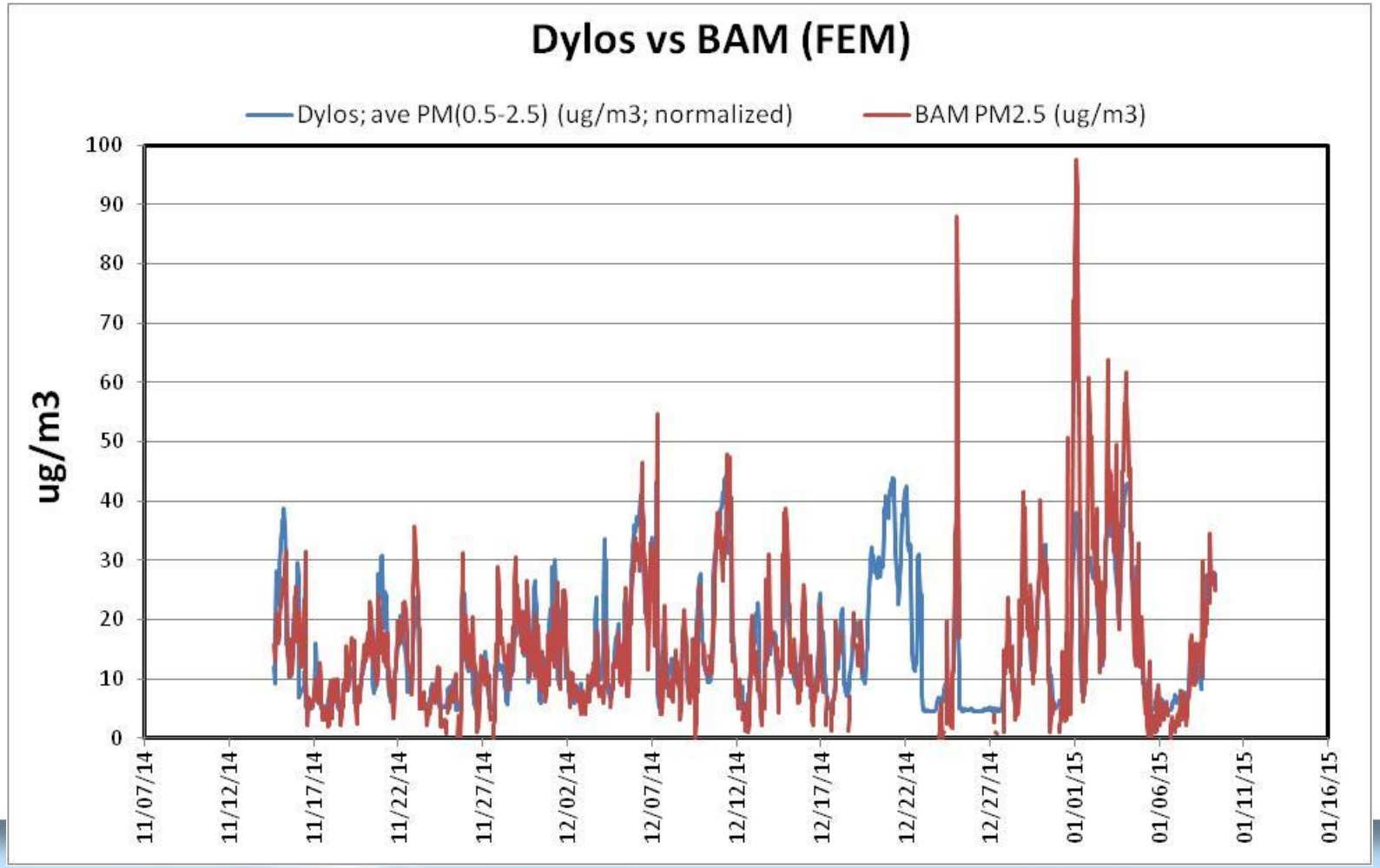
Dylos vs BAM (1-hr ave. data)

- Decent agreement between 1-hr ave. Dylos and BAM measurements (R^2=0.63)
- A polynomial regression equation was used to "convert" Dylos particle count measurements to PM mass concentrations (ug/m^3)



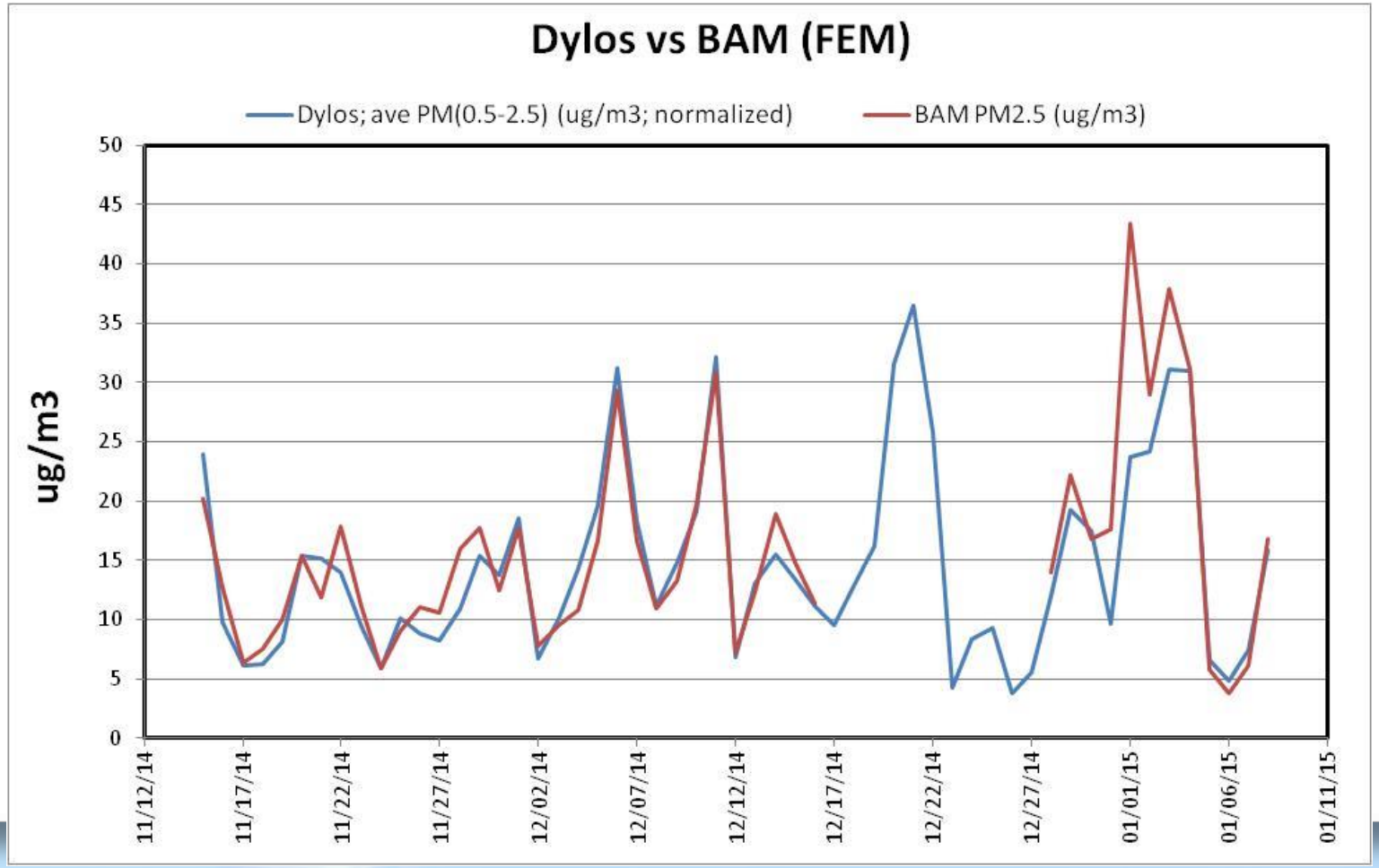
Dylos vs BAM (1-hr ave. data)

- R^2=0.63



Dylos vs BAM (24-hr ave. data)

- R^2=0.81



Discussion

- Overall, the three Dylos units performed well and showed:
  - No down time over a period of almost two months
  - Minimal intra-model variability
  - Good correlation to two different (and substantially more expensive) FEM instruments
- The Dylos showed no correlation with temperature and minimal correlation with relative humidity (data not shown)
- Some of the discrepancies between the Dylos and the two reference methods are probably due to the fact that the former instrument does not measure particles less than 0.5 µm in diameter, and that the equations used to convert particle counts to ug/m^3 did not account for variations in particle size distribution and particle density
- These equations / conversion factors are probably time- and location-dependent
- Chamber testing is necessary to fully evaluate the performance of the Dylos over different / more extreme environmental conditions

- All results are still preliminary