Met One Instruments BAM-1020 Improvements

Herbert Schloesser, Ph.D.
David Gobeli, Ph.D.
Met One Instruments

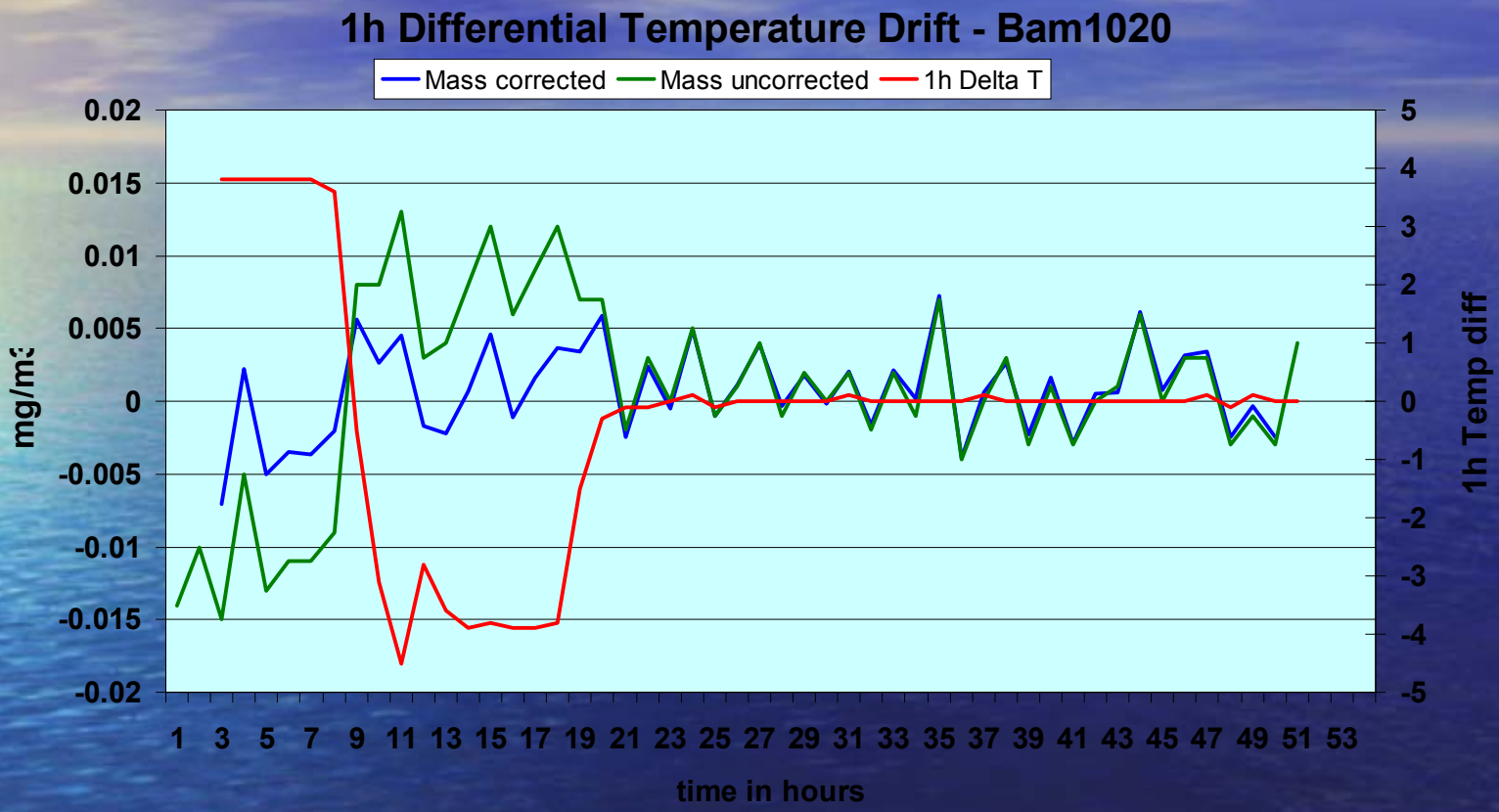
List of Improvements

- Temperature sensor for compensating Temperature gradient during 1h Measurement
- New Filter tape
- 8 min Sample without loosing sample time
- Geometry Improvements
- Electronic Improvements
- How to upgrade conclusion

Additional Temperature Sensor

- What happens if air temperature or barometric pressure changes ??
- Air mass between detector and source changes.
- Small effect because only the delta T and delta P during 1 hour counts.
- But Measurement relies on stable temperature during 1 h
- Solution: measure delta T with additional sensor (delta P is already measured)
- Only needed if setup suffers from higher temp gradients

Additional Temperature Sensor



- Effect is about 2 ug/m^3 per degree C
- Typical temperature drifts seen in the order of 2 degrees C
- -> Effect within the detection limit but systematic

New Filter tape

- The standard glass fiber filter tape is about 5 mg/cm^2
- New fiber backed Teflon membrane filter tape is about 1 mg/cm^2
- Beta absorption measurements with the BAM 1020 can be improved by use of the thinner filter material
- Tests show considerable improvement

New Filter tape

- Problems to solve
  - Does calibration change? (no)
  - Does thin tape work with current transport mechanism? (yes)
  - Does tape seal reliably well with current transport mechanism? (no)
  - Does Tape work with high concentration levels? (no)
    - Max load is about 400 ug -> 1h ambient ok

New Filter tape

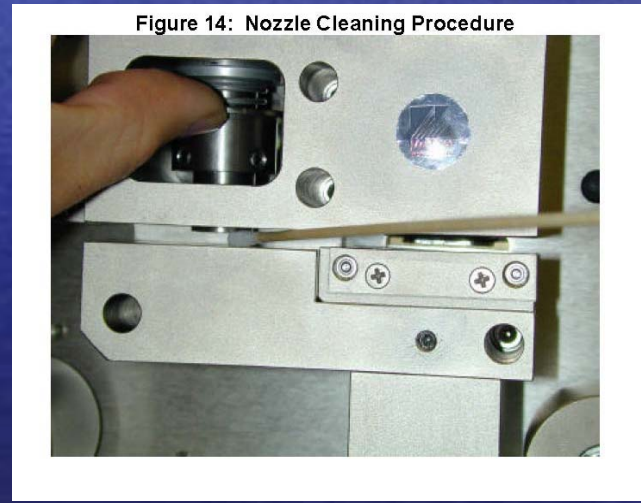
- Dirk Felton Data – Field testing
- Tests show considerable improvement

New Filter tape

- Issue with Air Flow Rate
  - Tape has a potential to produce leakage using current design
  - That is why Met One worked to improve nozzle geometry
  - More down force needed to seal reliably
  - Solution requires mechanical change of nozzle.
  - Best done as factory upgrade

Geometry Improvements

- Reduce gap between detector and source
  - less delta T effect
  - More efficient use of beta counts
  - Better detection limit
  - Easy to do
  - But changes calibration slightly !!



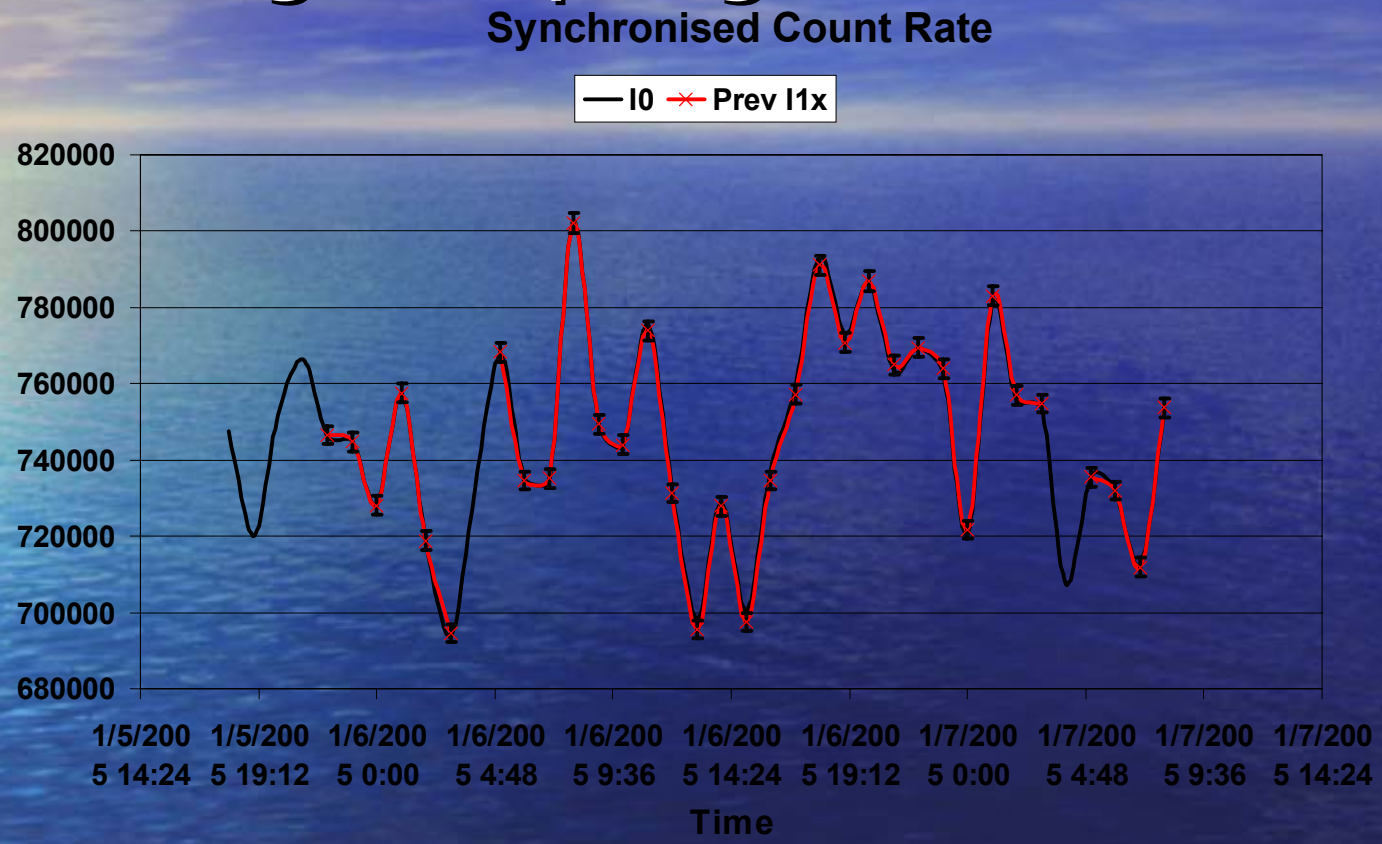
Electronic Improvements

- Flow control motor upgrade available
  - Problems with newer motors (some newer control motors have had changed Spec's with higher needed current)
  - Current was limited for older motor thus unit would not move motor with higher resistance.
  - New Upgrade fixes this Problem
- Photomultiplier module shows drifts in dark counts with bigger temperature changes
  - Upgrade fixes this behavior

Increasing Count time without reducing sampling time.

- Idea: improve count statistics by counting 8 minutes instead of 4 per measurement
  - Increase of Count rate by factor of 2 delivers a gain in detection limit by $\sqrt{(2)} = 1.41$
- But counting 2 times 8 min would reduce Sampling time to less than 45 min
- Idea: using sampling time to measure next Zero filter value

Increasing Count time without reducing sampling time.



- Bam 1020 measures I1X stability count
  - 4 h time delay gives good match in count rates between I0 and I1X.
  - Proves accurate positioning of the Bam 1020 and gives possibility for further improvement

Increasing Count time without reducing sampling time.

- Further investigations on statistics are on the way
- Method would allow to use previous Count as zero measurement and use longer time to measure loaded filter.
- Need stability over 4 hours → additional Temperature sensor needed to account for T and P changes
- Little issues
  - Additional filter spot at midnight must go
  - The first 4 hours after power up have to be conventional
- Software change needed

How to Upgrade ??

- Field upgrade
- Factory Upgrades

Field upgrades

- New Temperature sensor can be done if hole in front panel is there.
- Flow Controller upgrade for Bam1020 with serial# < D4488 can be done if BX961 is installed
- Geometry upgrades can be done in field with appropriate kit (overall Calibration adjustment must be made to the k factor of unit) - Met One Field Service
- 8 min Software upgrade upon availability

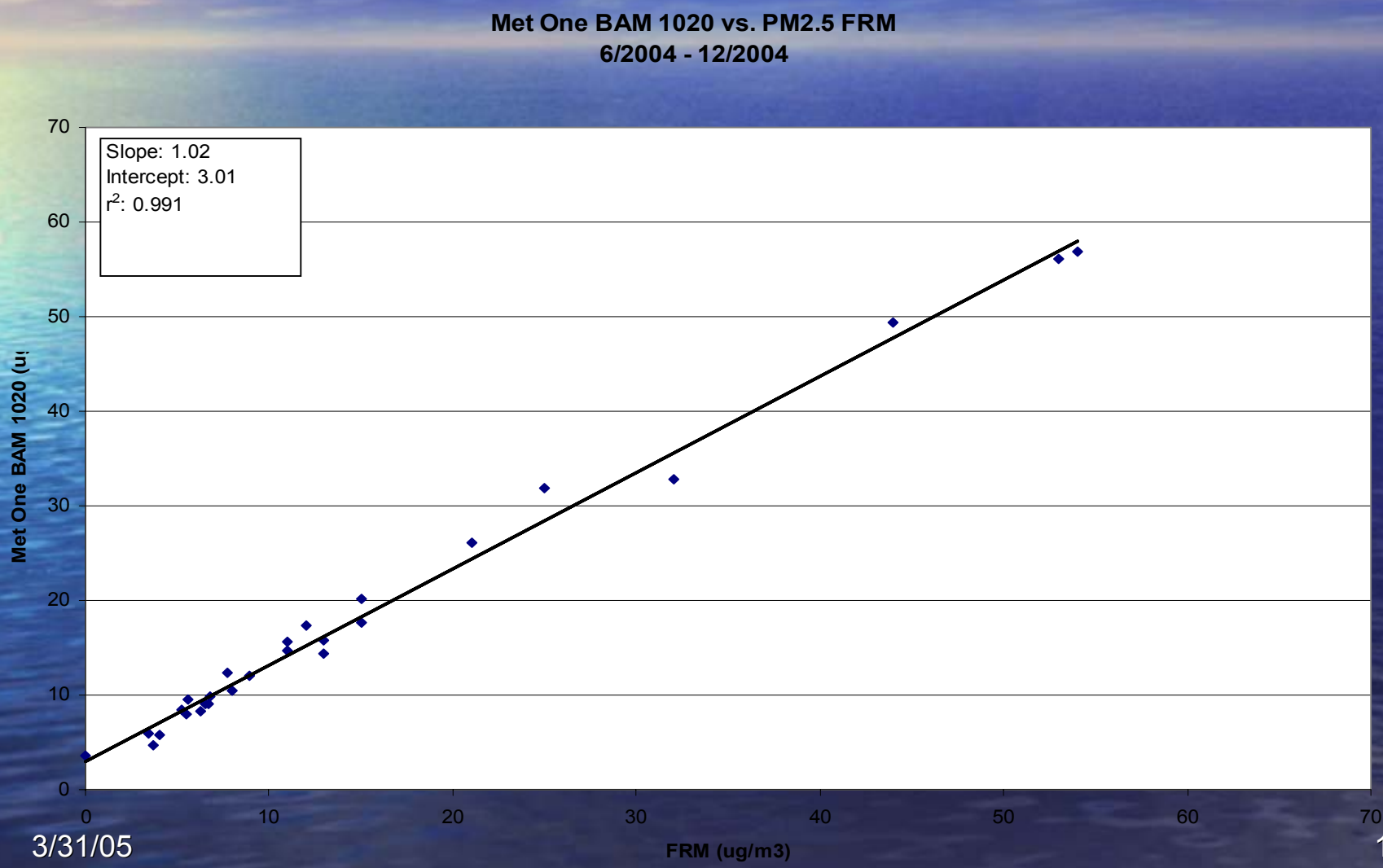
Factory Upgrades

- Mechanics for new Filter tape.
  - Factory Upgrades will be available in the later part of this year
- Photomultiplier module
- All other mentioned improvements can also be done together in a one shot Performance upgrade.
- Turn around in 10 business days

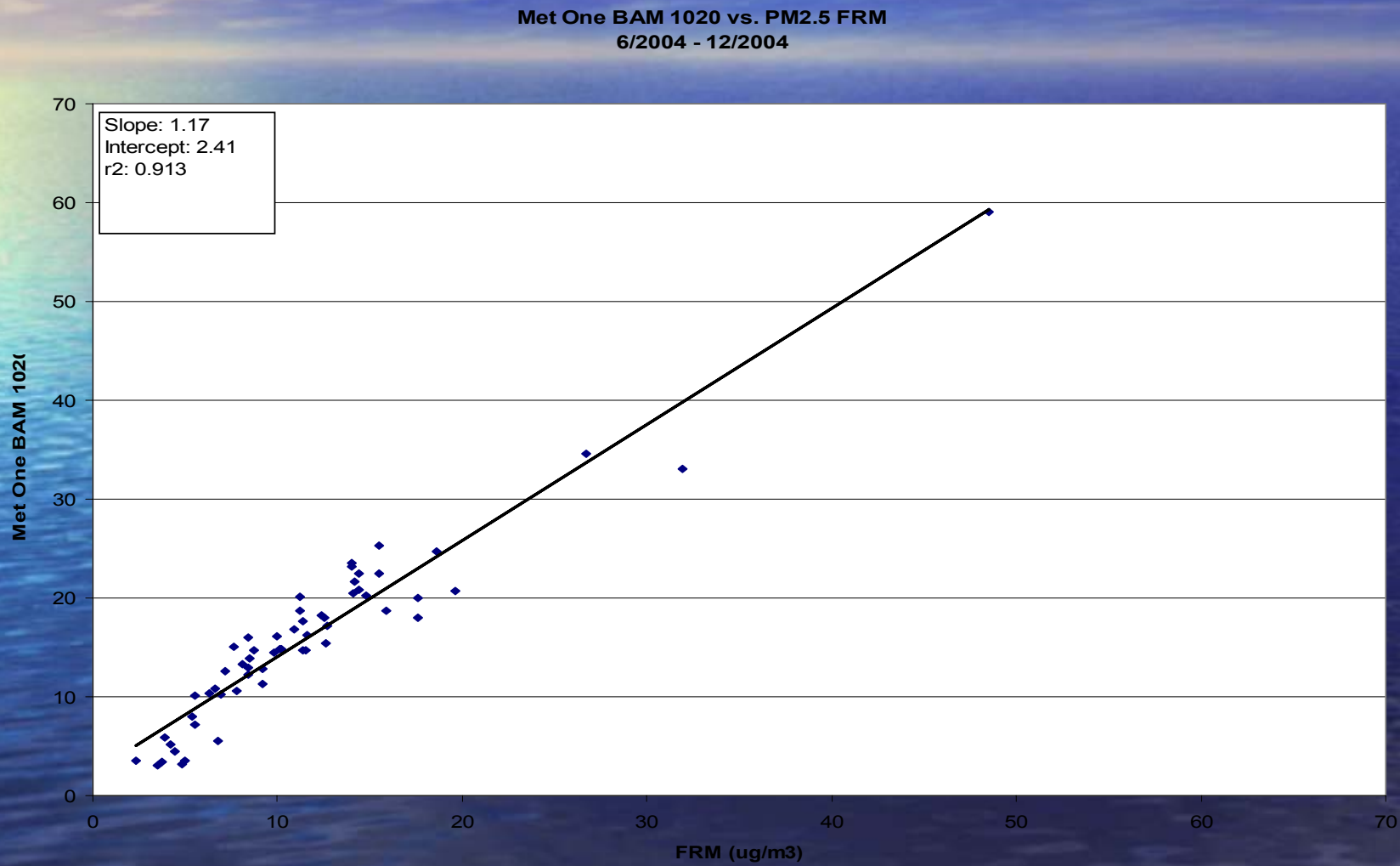
Why Upgrade ??

- New Filter tape is big step in improvement
- Together with the mentioned performance upgrade Package the detection limit of the Bam 1020 will be improved by more than a factor of two
- Stability of Bam 1020 will be further enhanced.

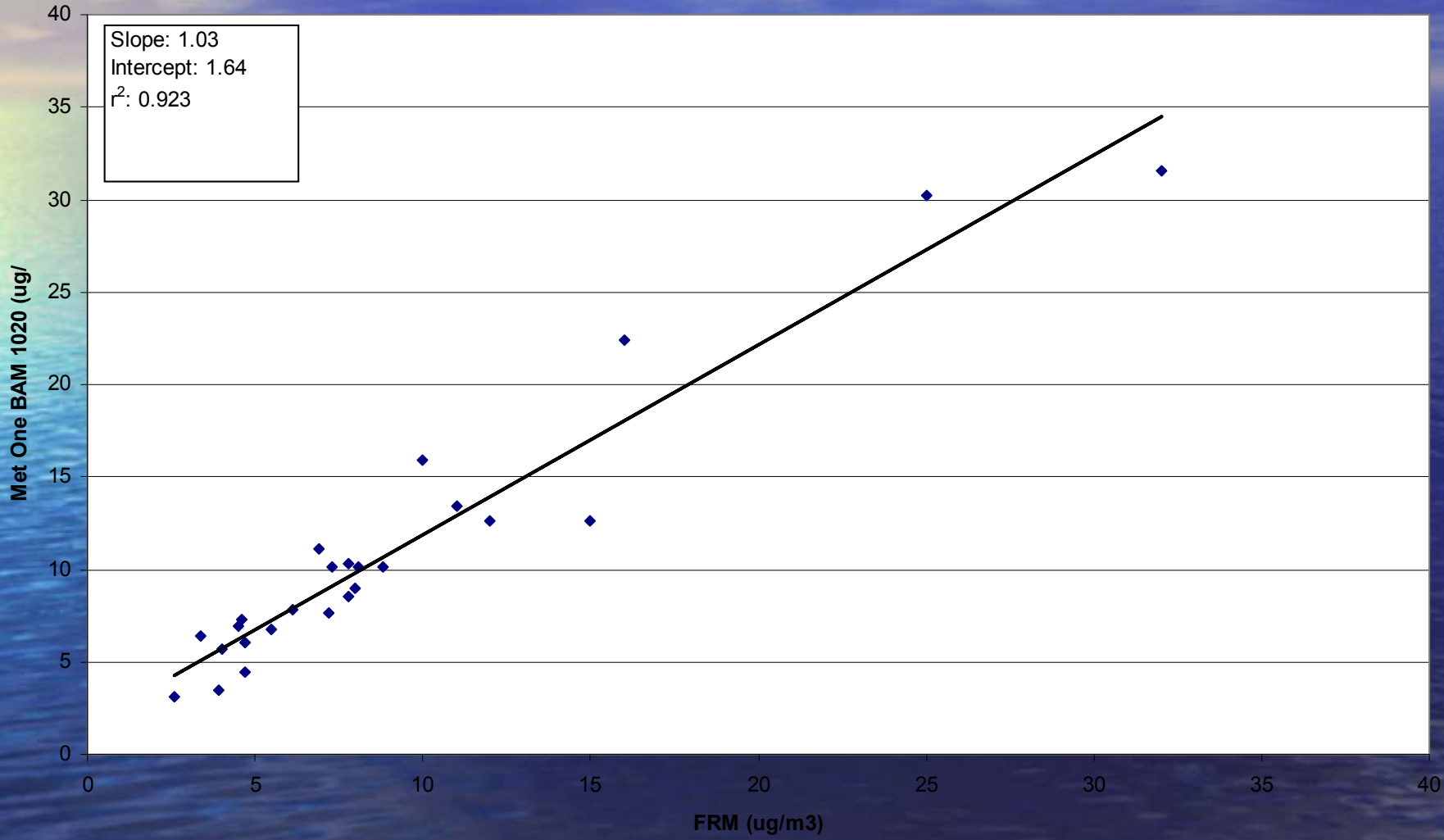
CARB – BAM vs. FRM Best

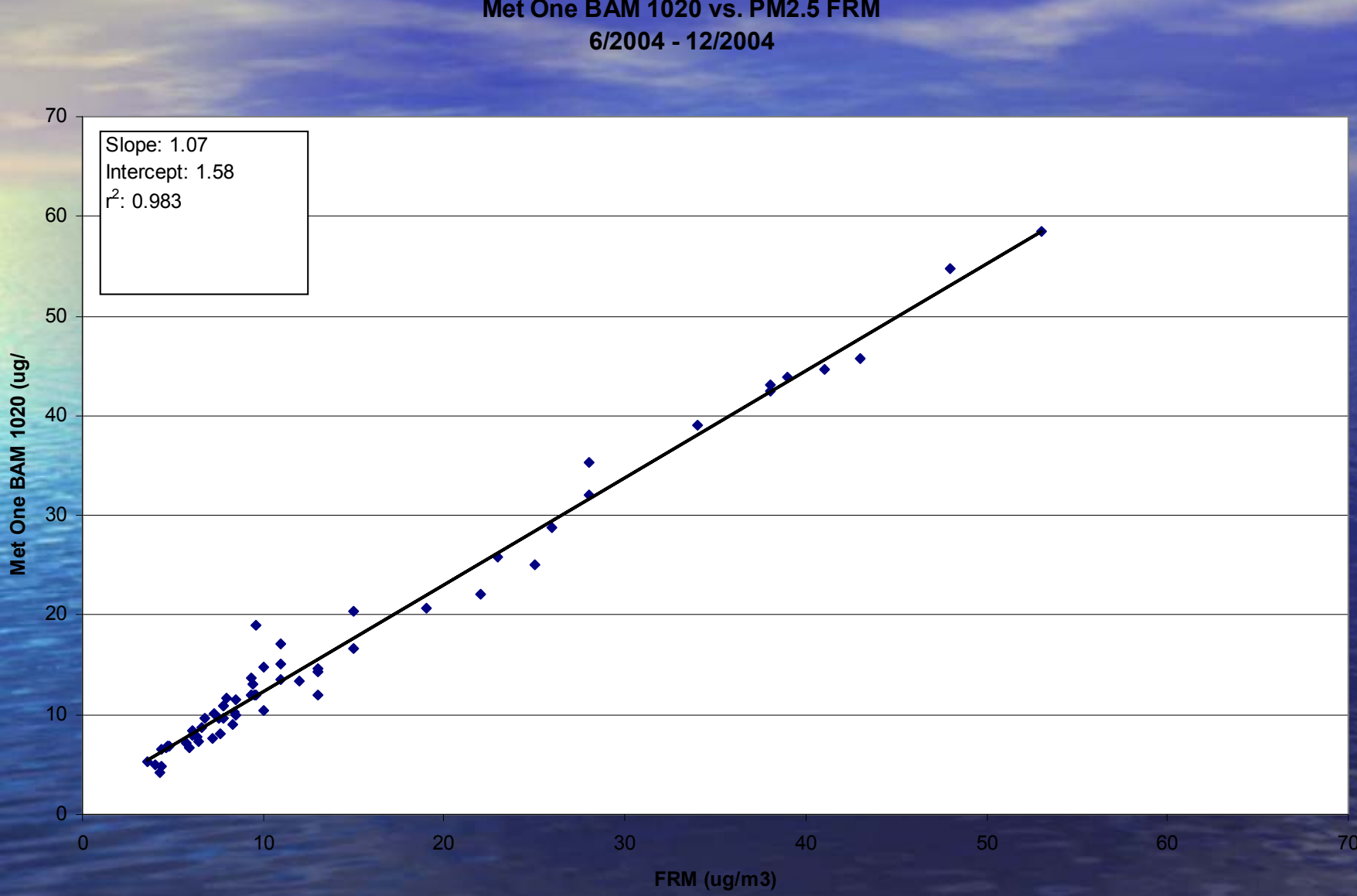


CARB BAM vs. FRM Worst



Met One BAM 1020 vs. PM2.5 FRM
6/2004 - 12/2004




Met One BAM 1020 vs. PM2.5 FRM
6/2004 - 12/2004
Slope: 1.07
Intercept: 1.58
r2: 0.983
Met One BAM 1020 (ug/
FRM (ug/m3)
0
10
20
30
40
50
60
70