

2WIN Comparison with other Nephelometers

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Nephelometer data are used as a quality check on the IMPROVE algorithm



An examination of the algorithm for estimating light extinction from IMPROVE particle speciation data

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ABSTRACT

The Interagency Monitoring of Protected Visual Environments (IMPROVE) network is the basis for monitoring visibility in Class I Areas throughout the United States. Monitoring is conducted by collecting PM_{2.5} and PM₁₀

Important for replacement nephelometer (2WIN) to be consistent with current nephelometer (Optec) to analyze long term trends

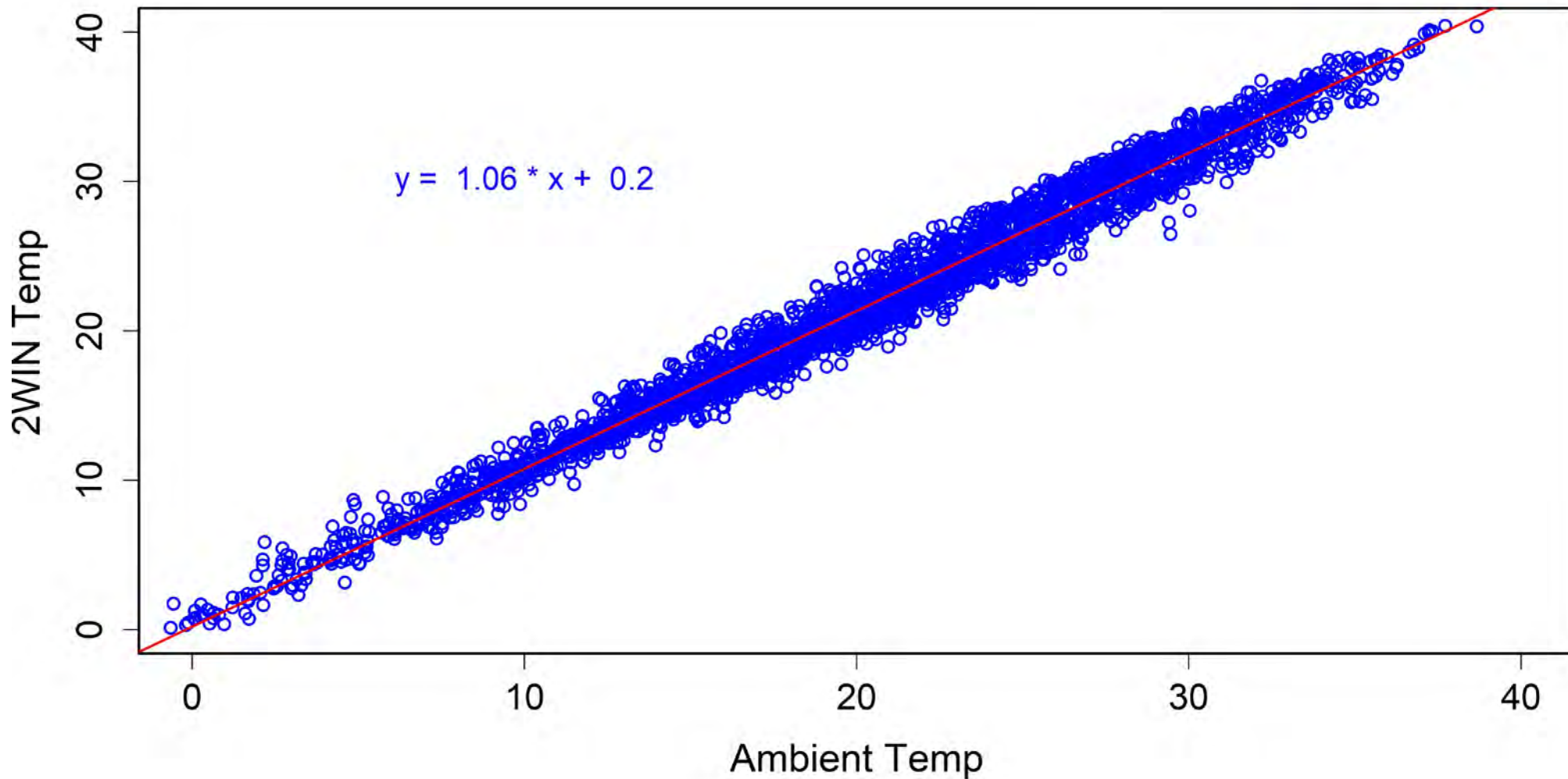
Differences:

2WIN has PM_{2.5} inlet, while Optec is open air

2WIN is run either dry or at near ambient conditions, while Optec is at ambient

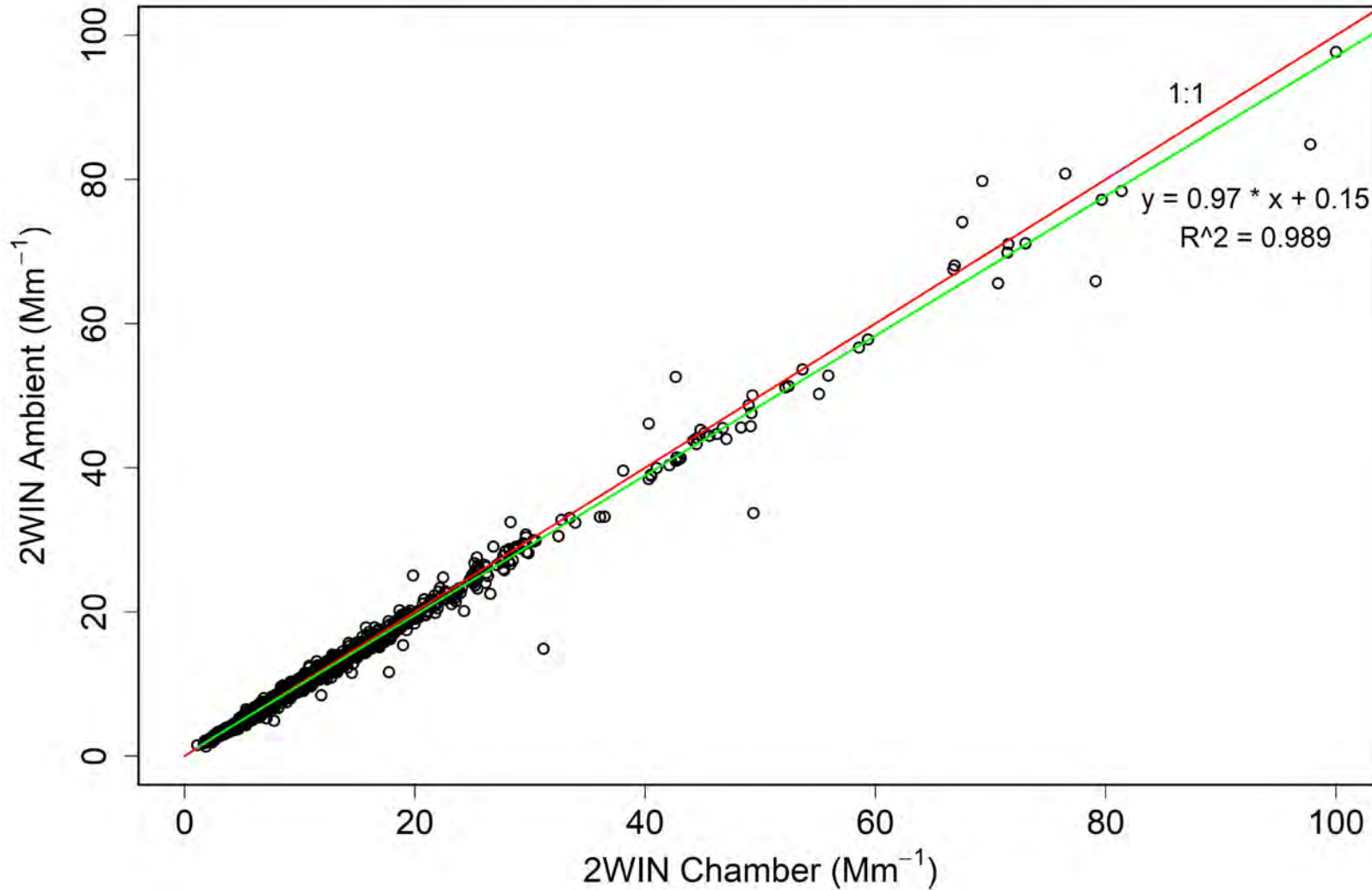
How close are we to ambient temperature?

Fort Collins "Ambient" 2WIN, June-October 2022



Co-located 2WIN instruments

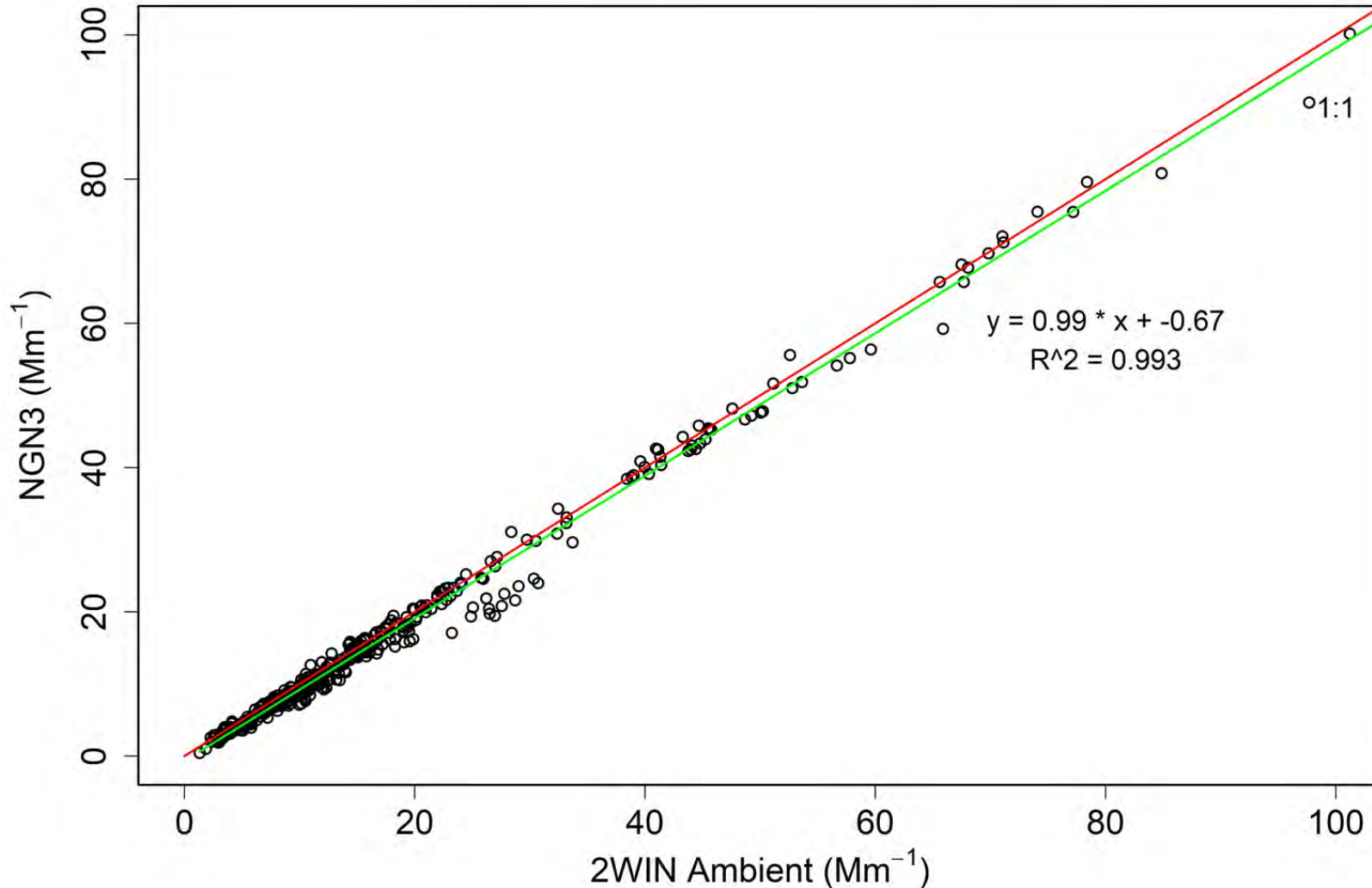
2WIN Chamber vs Ambient, RH<40%



- “Chamber” indicates RH-controlled chamber that feeds multiple instruments.
 - “Ambient” is near-ambient due to heating
 - Co-located for 4 months.
- ➔ Co-located 2WINs show good agreement

Comparison with NGN3 Nephelometer

2WIN Ambient vs NGN3, RH < 40%



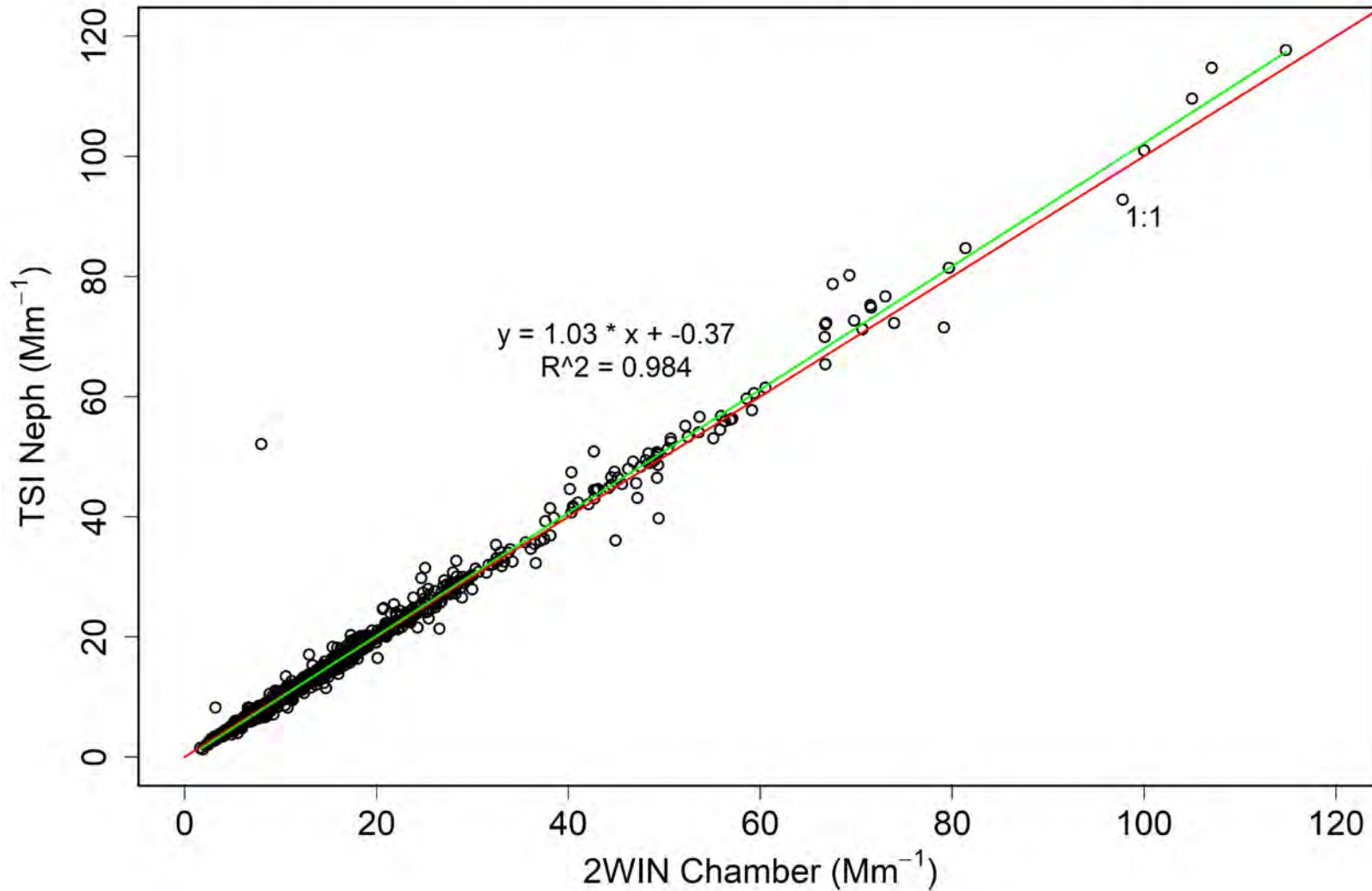
- NGN3 is similar to Optec, but measures $PM_{2.5}$ and is at dry conditions

➔ 2WIN shows good agreement with NGN3

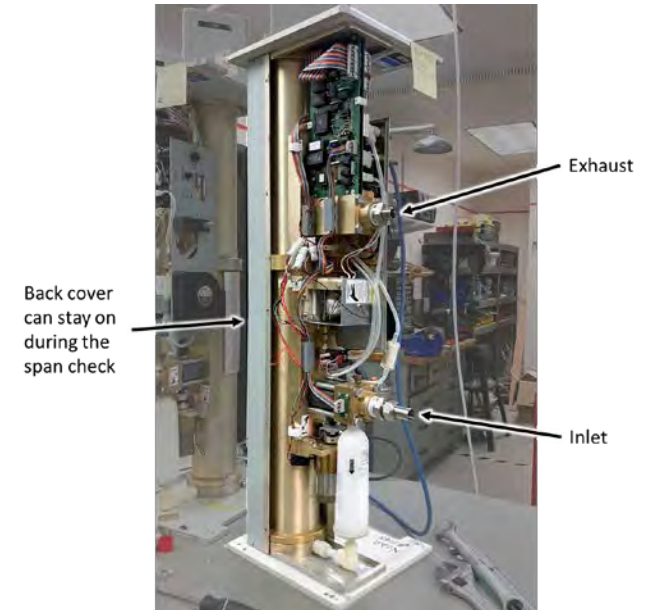


Comparison with TSI Nephelometer

2WIN Chamber vs TSI, All RH, Calculated Angstrom

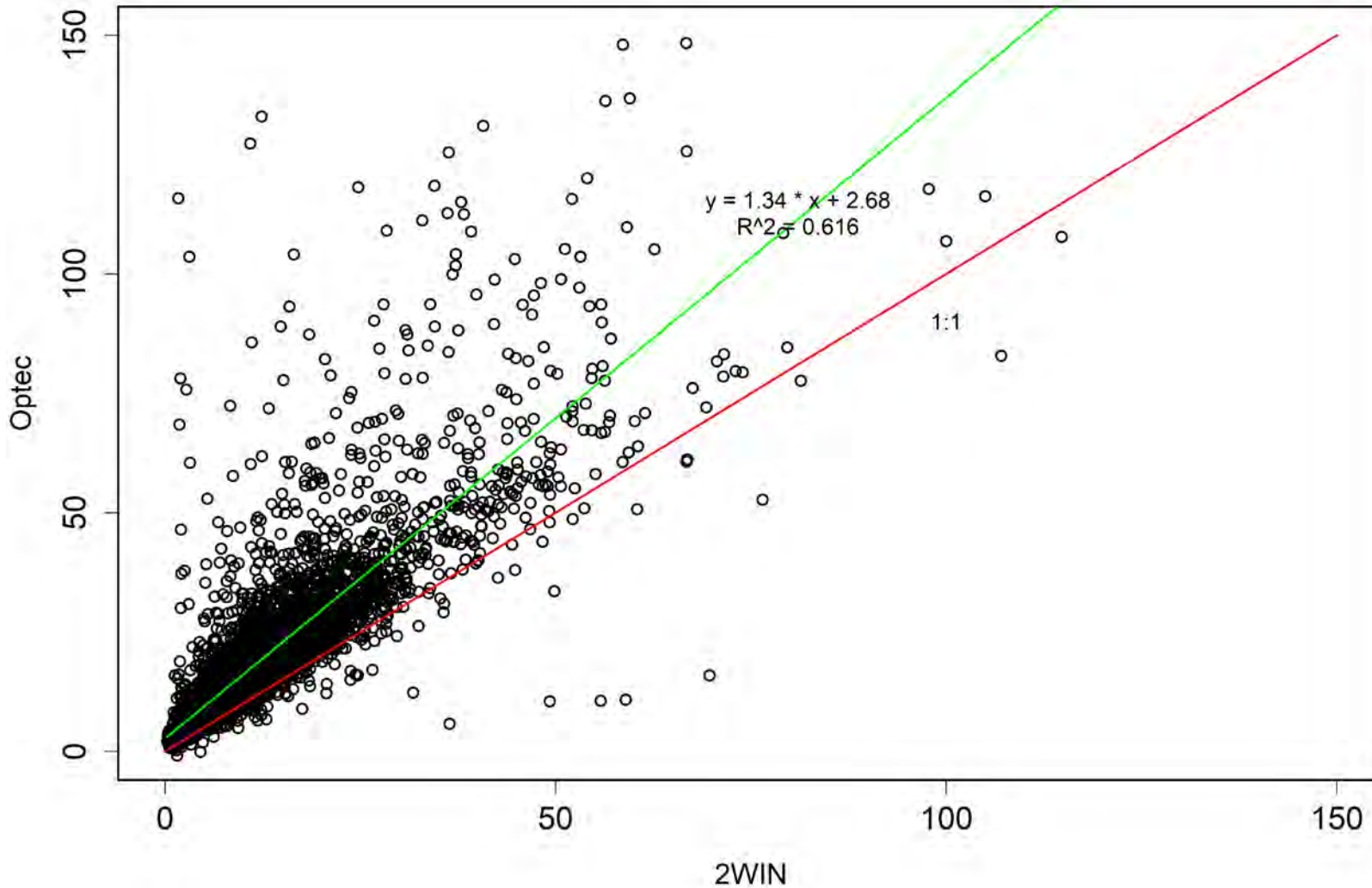


- TSI used at GAW sites (e.g., NOAA network)
 - TSI measures $PM_{2.5}$ at <40% RH
- ➔ 2WIN shows good agreement with TSI



Comparison with Optec NGN2 Nephelometer

Fort Collins 2WIN vs Optec, All humidities

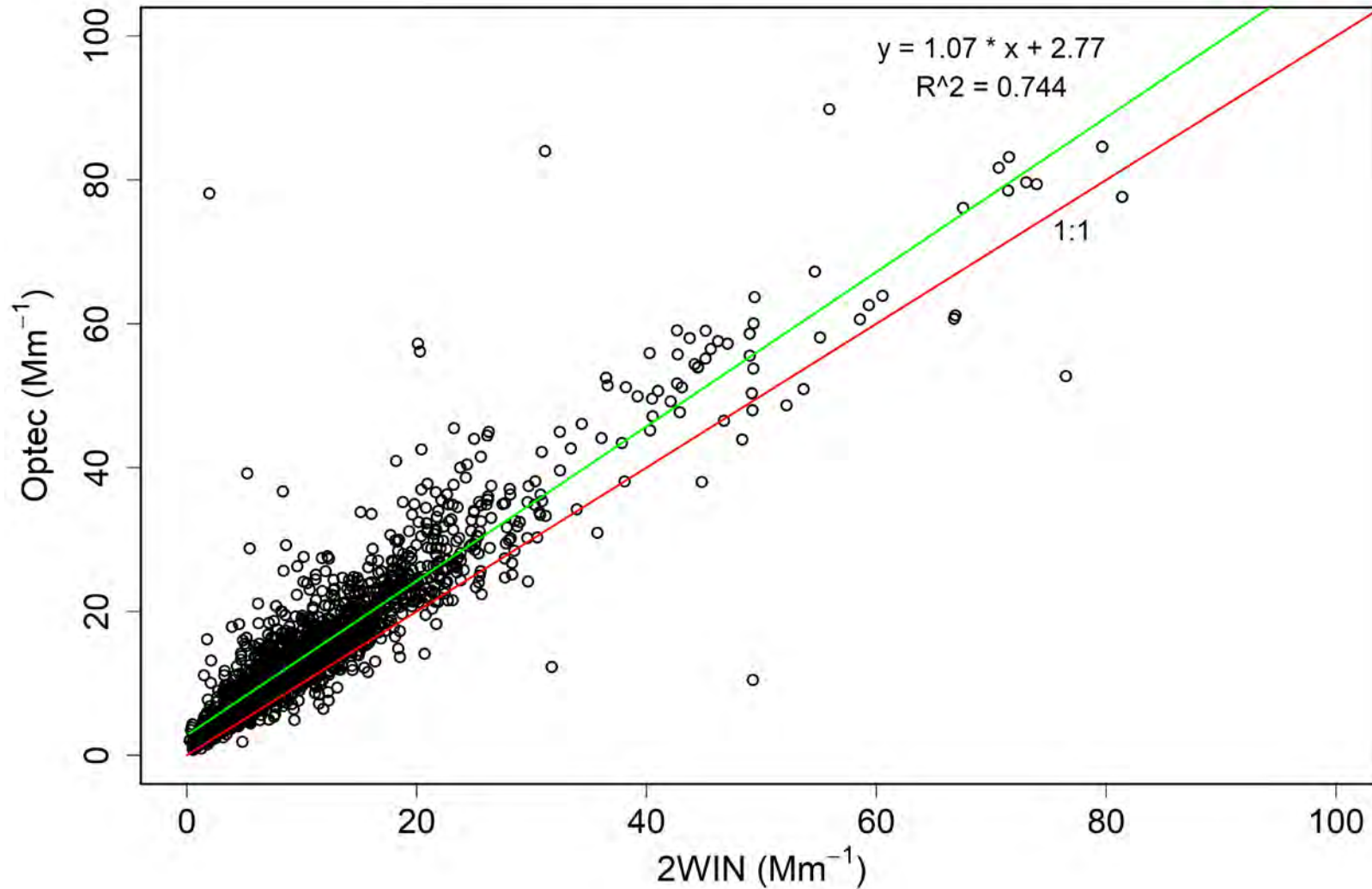


- Optec NGN2 has been used in the network for decades
- No size-cut
- Samples at ambient conditions



Comparison with Optec NGN2 Nephelometer

Christman Optec vs 2WIN, RH < 40%

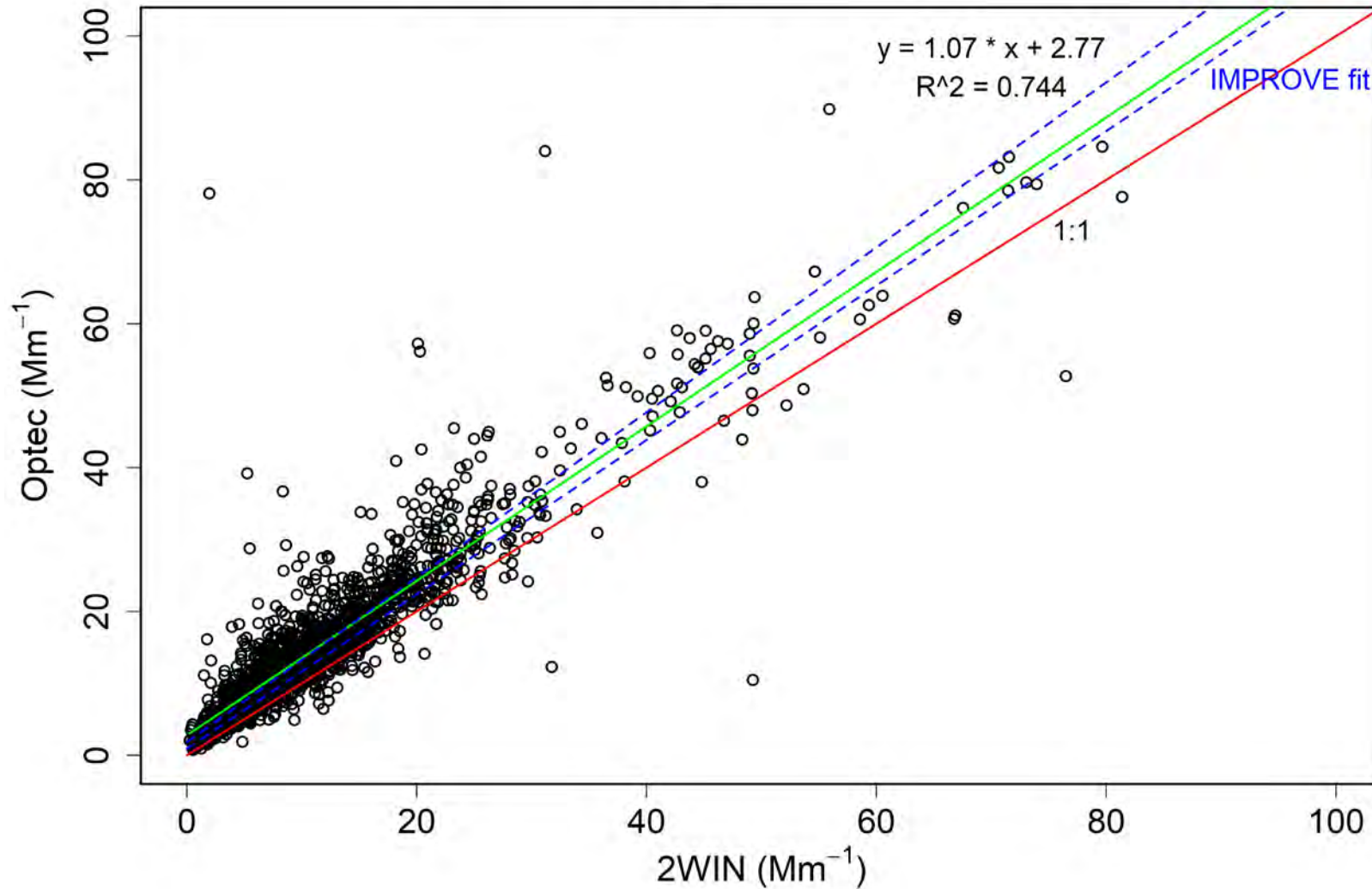


- Optec NGN2 has been used in the network for decades
 - No size-cut
 - Samples at ambient conditions
- ➔ Reasonable agreement at low RH



Comparison with Optec NGN2 Nephelometer

Christman Optec vs 2WIN, RH < 40%

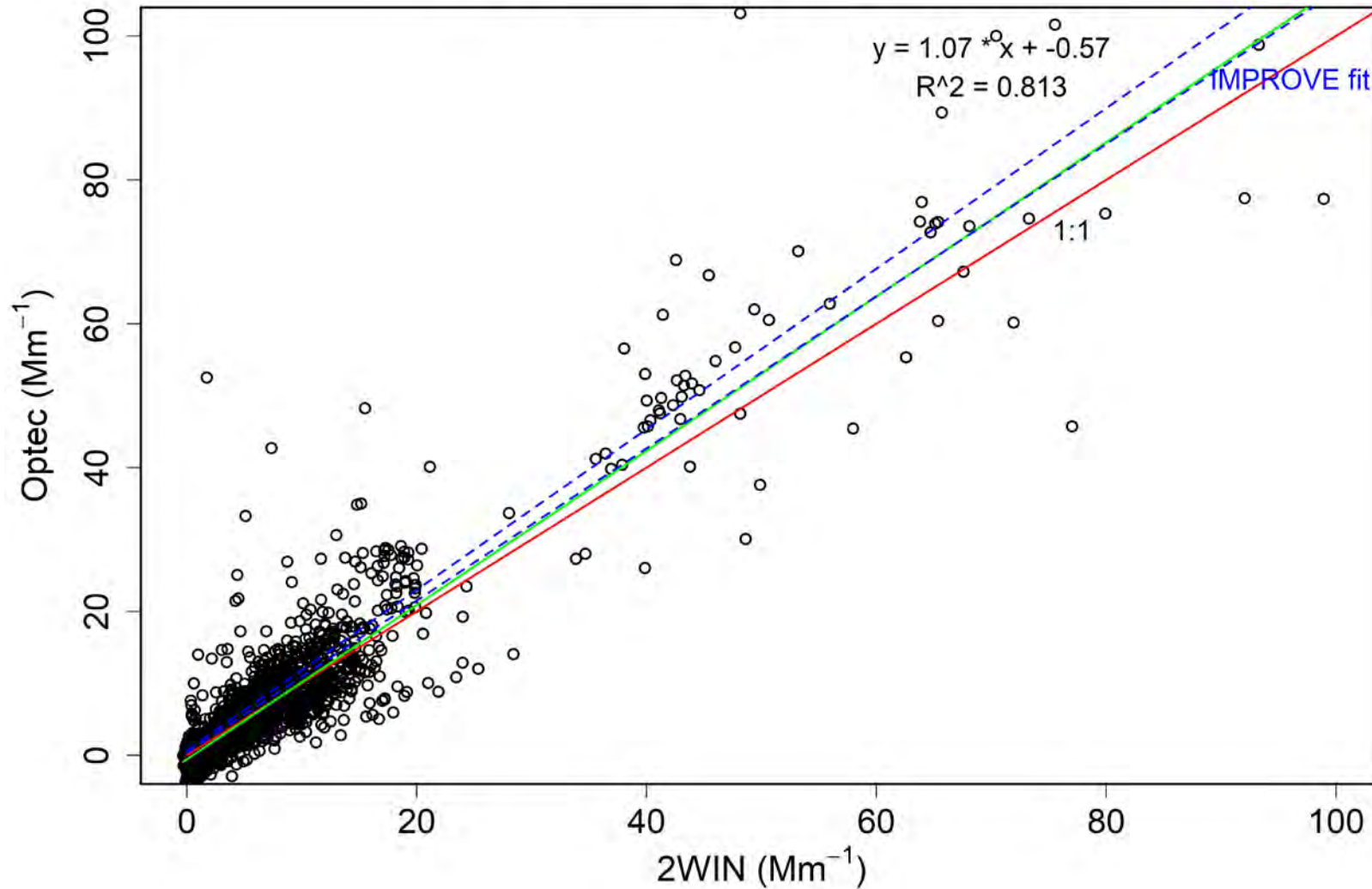


- Using preliminary IMPROVE data, I estimated what fraction of the difference comes from coarse mass.
- ➔ Coarse mass also impacts intercomparison



Comparison with Optec: Rocky Mountain NP

ROMO Optec vs 2WIN, RH < 40%

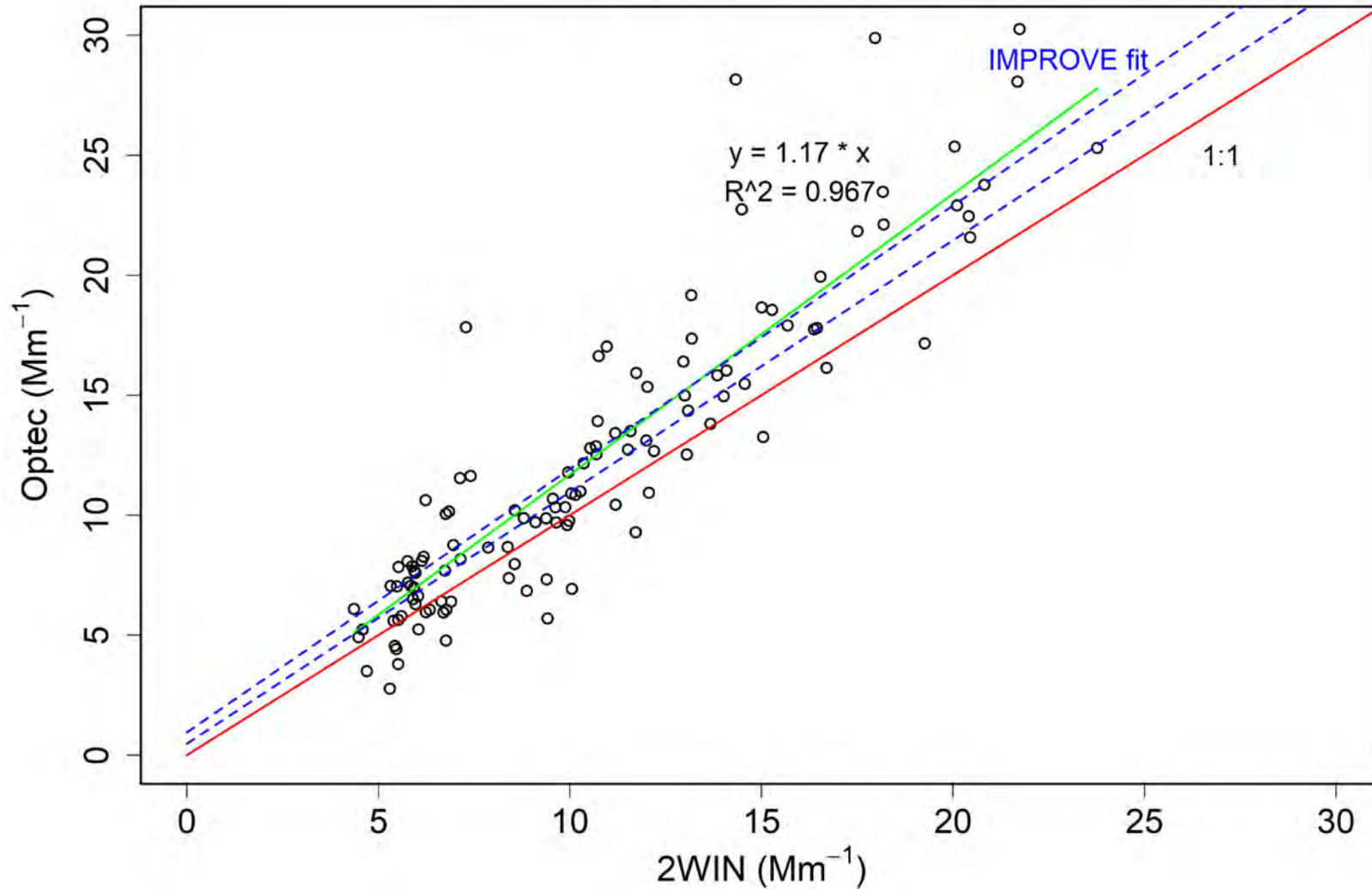


- Generally good agreement at ROMO
- 11 months of data



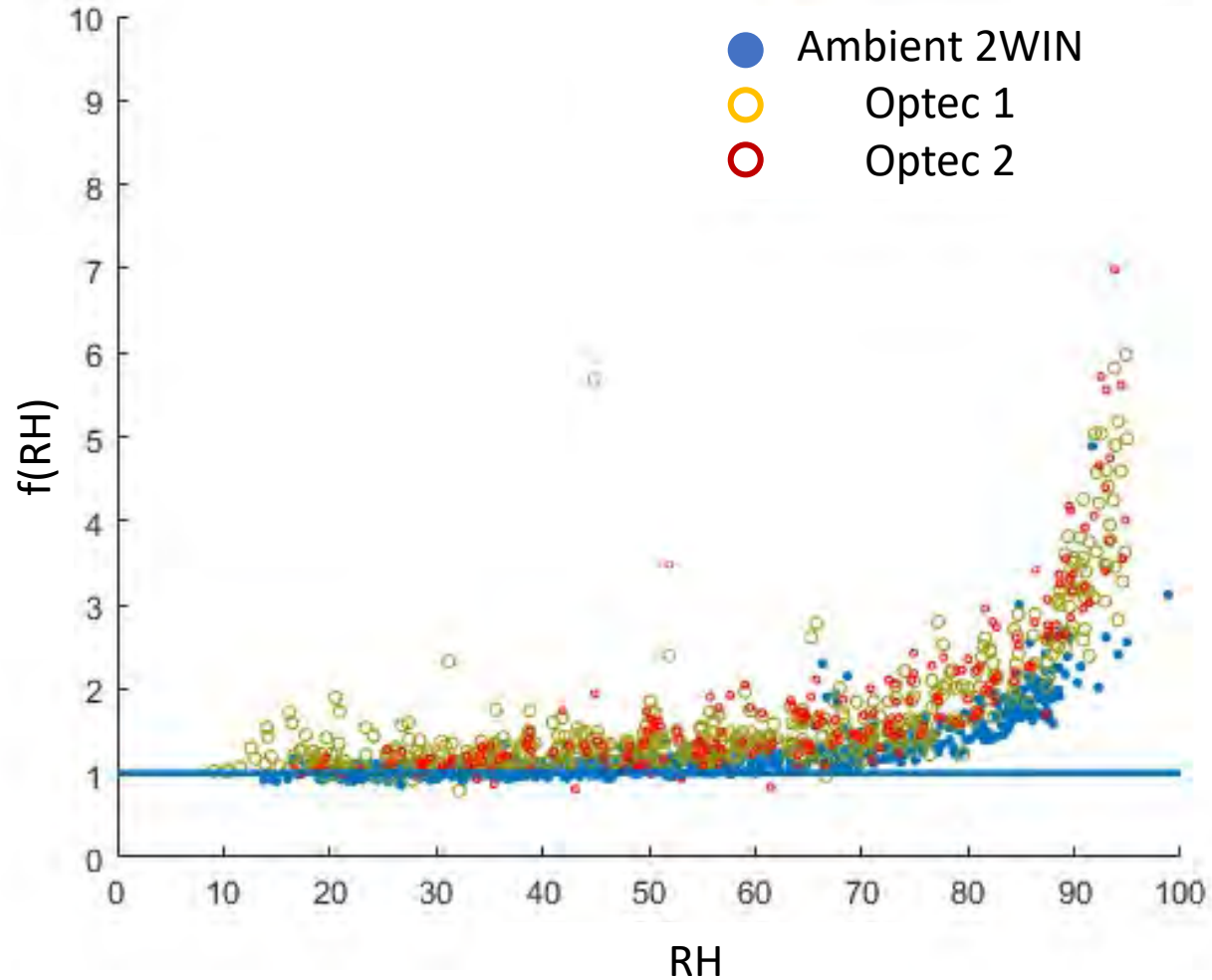
Comparison with Optec: Great Smoky Mountains NP

GRSM Optec vs 2WIN, RH < 40%



- 5 months of data at GRSM
- Few data points below 40% RH
- Offset is applied to the GRSM Optec data
- Fit is forced through zero

Ambient 2WIN captures hygroscopic growth



- Despite small differences in temperature and RH between the Optec and 2WIN, both measure consistent $f(\text{RH})$ curves
- Optec is also impacted by coarse mass

Summary and Conclusions

- The 2WIN nephelometer is a reliable replacement for the Optec
- Moving to the 2WIN will mean limiting measurements to $PM_{2.5}$ and measuring at *near ambient* conditions
- The 2WIN shows excellent agreement with other nephelometers measuring fine mode aerosol at low RH
- The 2WIN captures hygroscopic growth of aerosol
- The differences between the 2WIN and the Optecs can be explained by coarse mass and elevated RH in the Optec
- 2WINs currently at ROMO, GRSM and DINO