

Applications of soil component proxy to dust model validation

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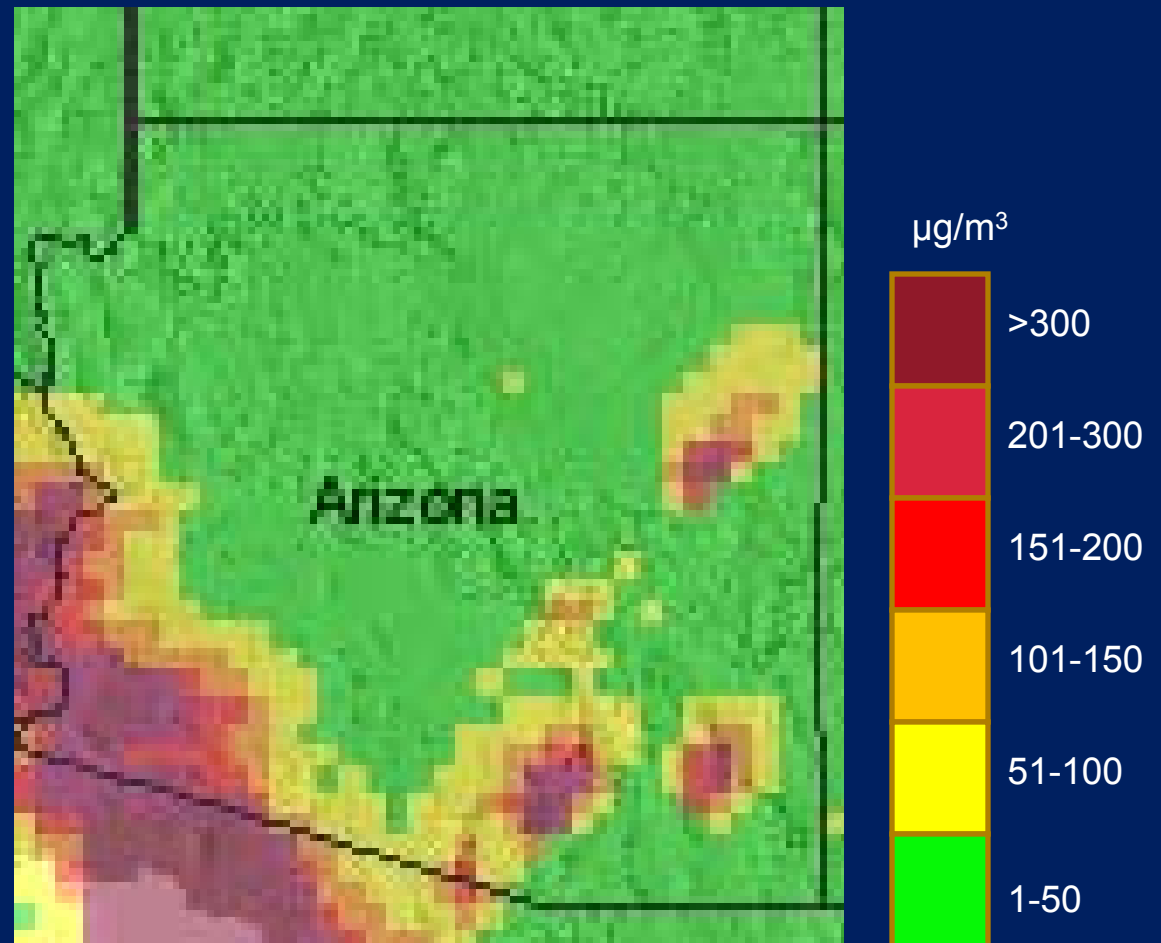
(Tucson Mts from Tyndall garage)

Outline

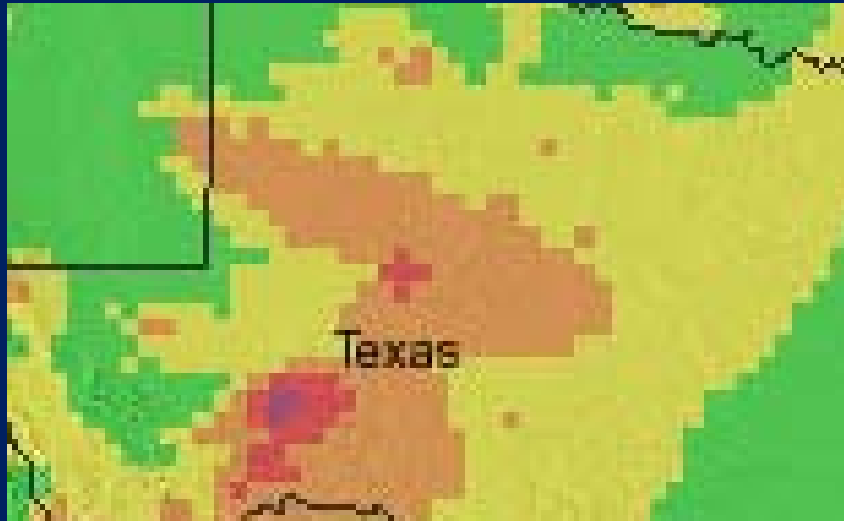
- Overview of speciation data set
- Description of species components
- Application to model validation
- Preliminary results with DREAM
- Goals for the future

Dust Regional Atmospheric Model

- Public health and transportation
- Dust transport nested in Eta weather model
- Satellite derived soil texture land cover
- Parameterized saltation process
- ONLY windblown soil, NOT ambient aerosols



DREAM PM10 3/21/2007



DREAM PM2.5 2/24/07



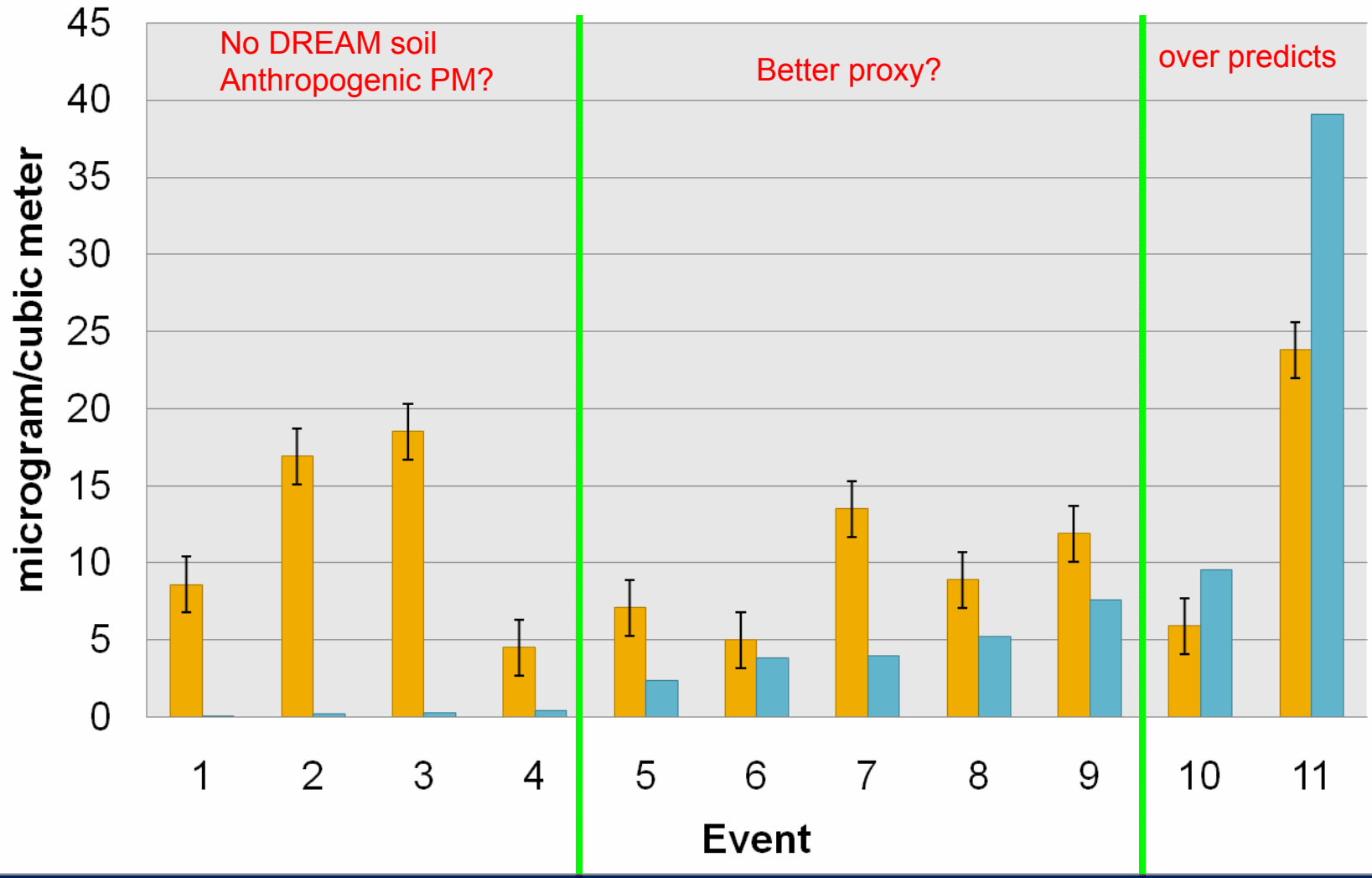
MODIS (500m)

Validation Frequency

- EPA National Speciation Network data
- Every 3rd day 24 hour average
- Must average DREAM output to match

DREAM and PM2.5

■ PM2.5 ■ DREAM



Speciation

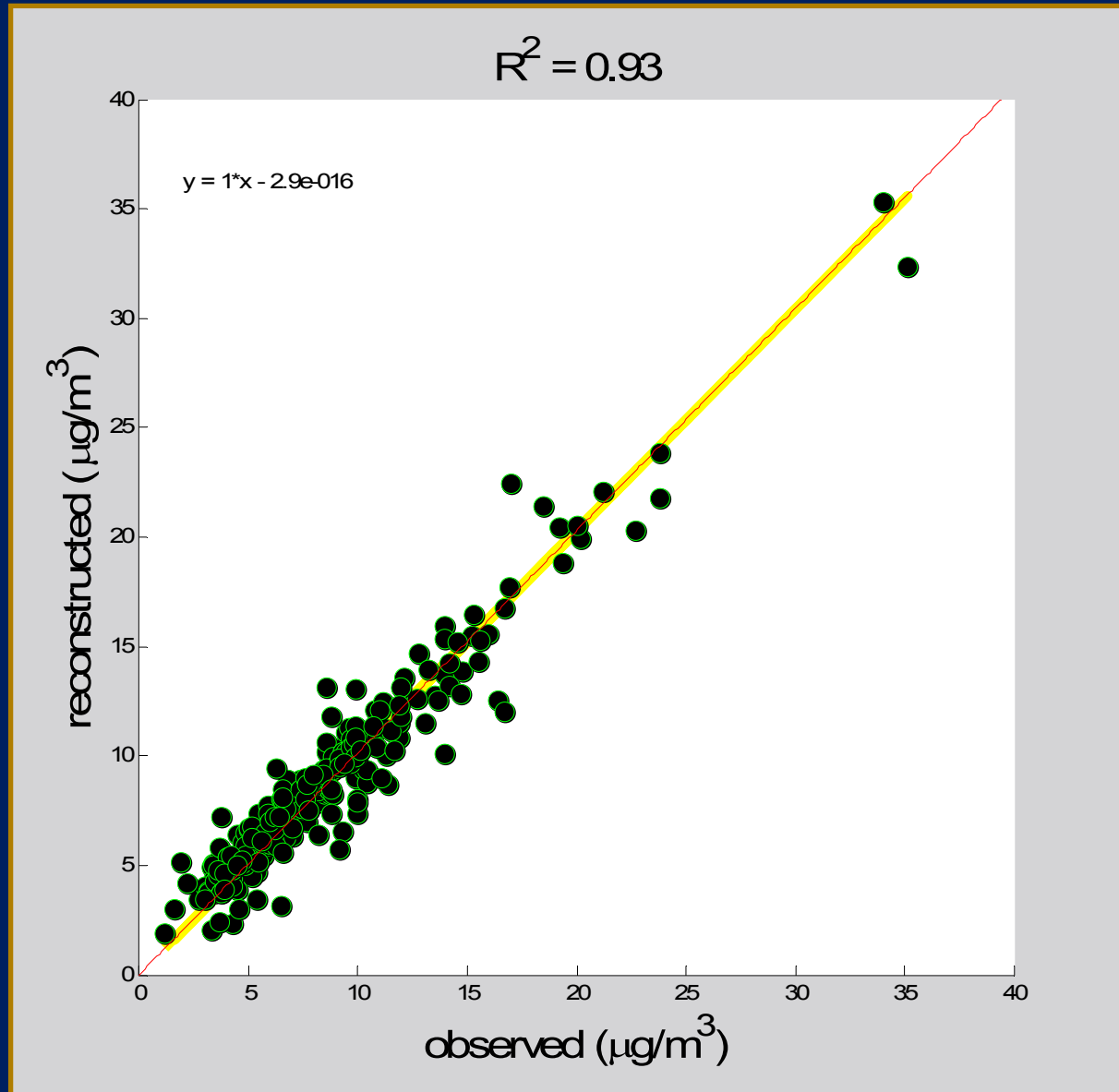
- Concentrations of more than 55 aerosol species
- Collocated PM_{2.5} filters:
 - Total mass – gravimetric
 - Heavy metals – XRF
 - Ions – IC
 - Carbon – TOT
- Not real time - analyzed in lab, reported months later



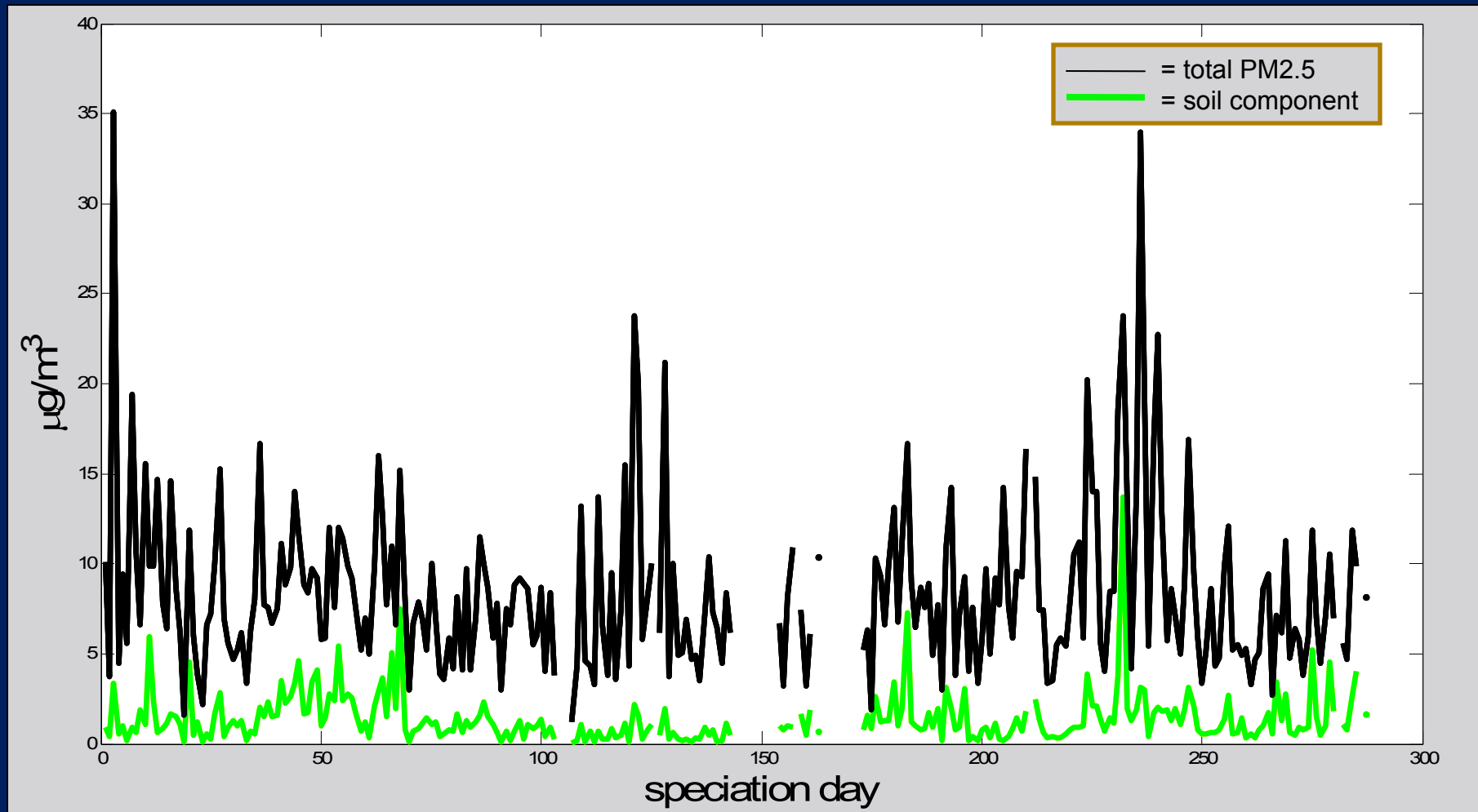
Component Equations

- Elemental Carbon
- Organic Carbon – 1.4 hydrocarbon factor
- Soil – oxide mass weightings
$$[\text{soil}] = 1.89[\text{Al}] + 2.14[\text{Si}] + 1.4[\text{Ca}] + 1.66[\text{Mg}] + 1.43[\text{Fe}] + 1.67[\text{Ti}]$$
- 'others' – proportioned sulfate/nitrate ions
- Trace metals – everything else
- Reconstruction should sum to total PM_{2.5}
$$\text{reconstruction} = [\text{EC}] + 1.4*[\text{OC}] + [\text{soil}] + [\text{others}] + [\text{trace}]$$

Reconstruction = $\Sigma(\text{components})$



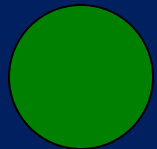
Total PM2.5 & Soil Component



(El Paso, TX EPA data 2004 – 2006)

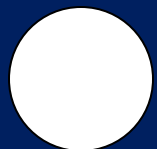
PM 2.5 Categories

El Paso, TX



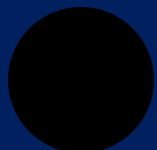
Organic Carbon (OC)

$\sim 4 \mu\text{g}/\text{m}^3$ ($\sim 45\%$)



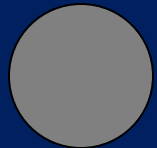
Ammonium Sulfate/Nitrate

$\sim 2.1 \mu\text{g}/\text{m}^3$ ($\sim 24\%$)



Elemental Carbon (EC)

$\sim 0.8 \mu\text{g}/\text{m}^3$ ($\sim 9\%$)



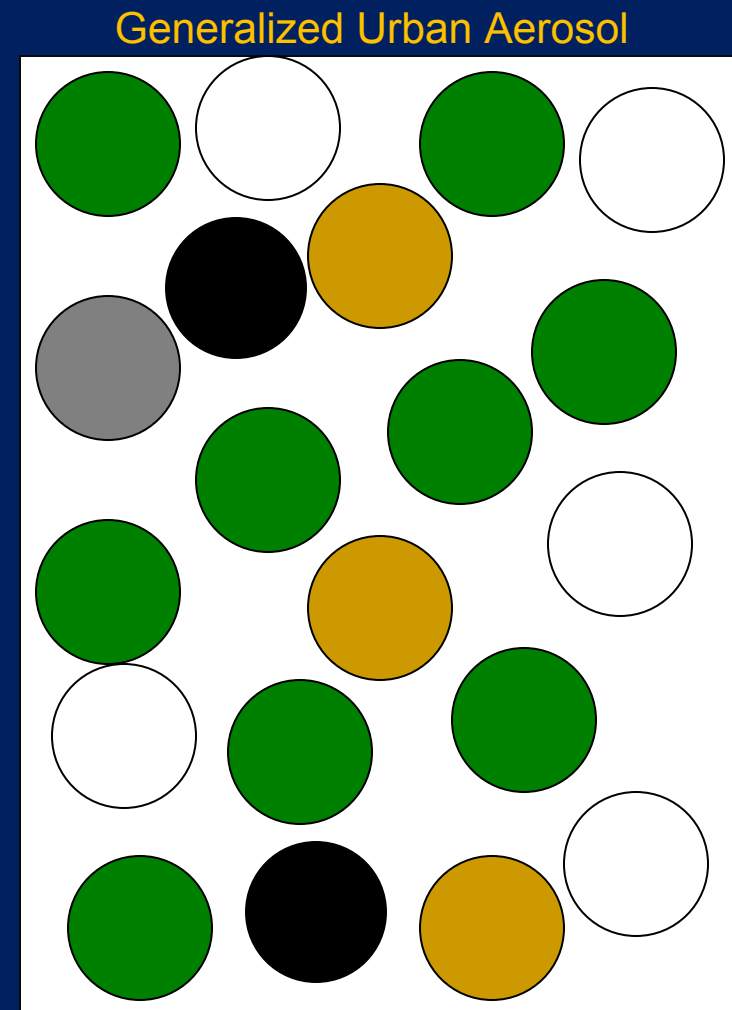
Trace Metals

$\sim 0.4 \mu\text{g}/\text{m}^3$ ($\sim 5\%$)



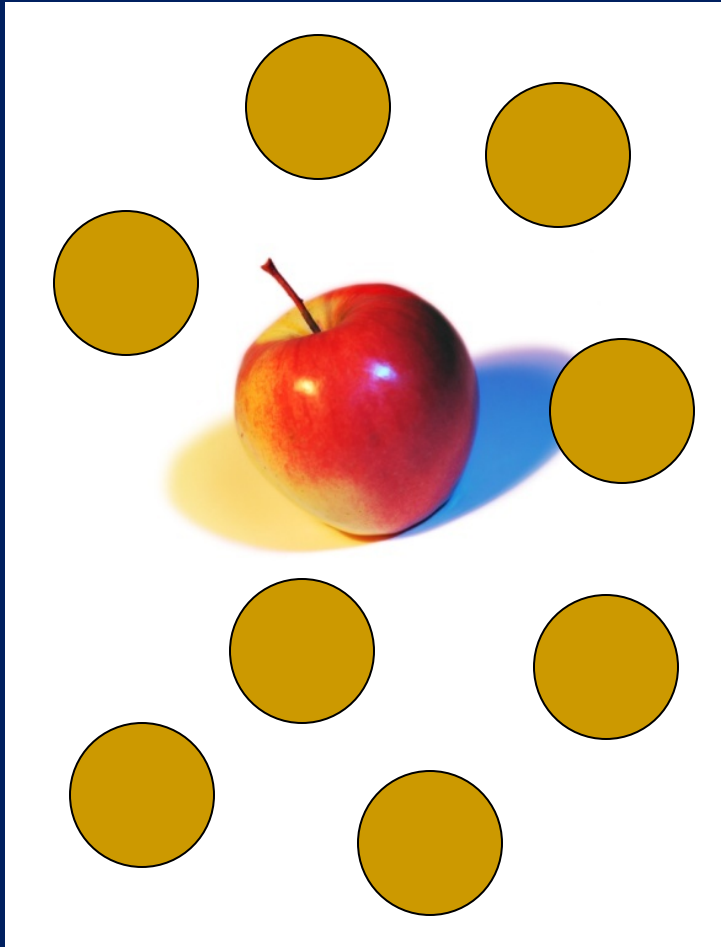
Soil Component

$\sim 1.4 \mu\text{g}/\text{m}^3$ ($\sim 16\%$)

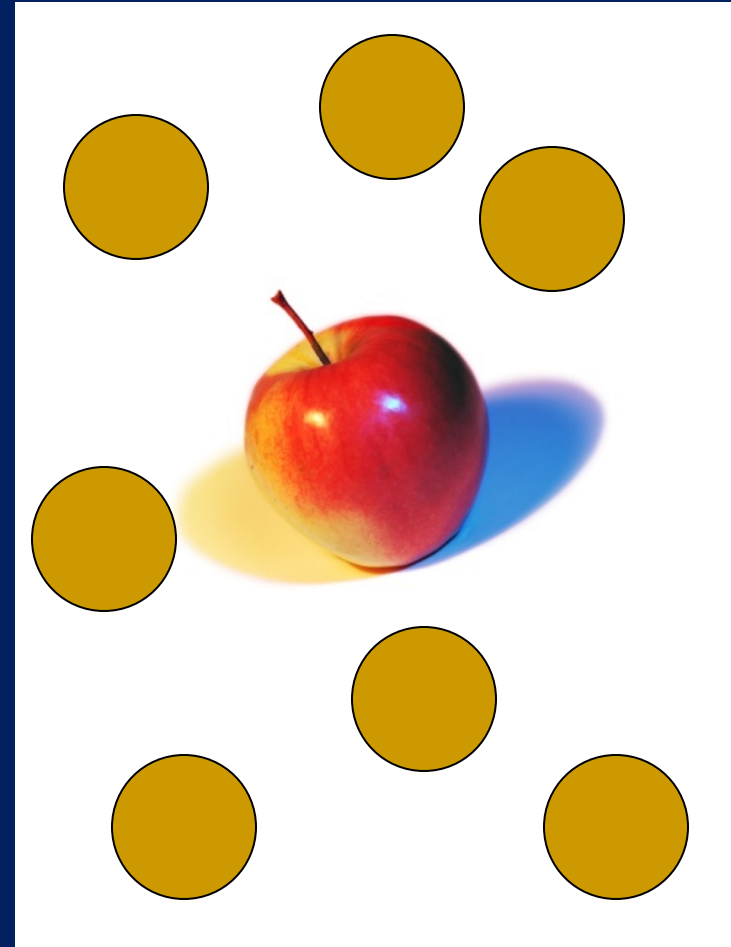


A Better Comparison

Observed Soil Component

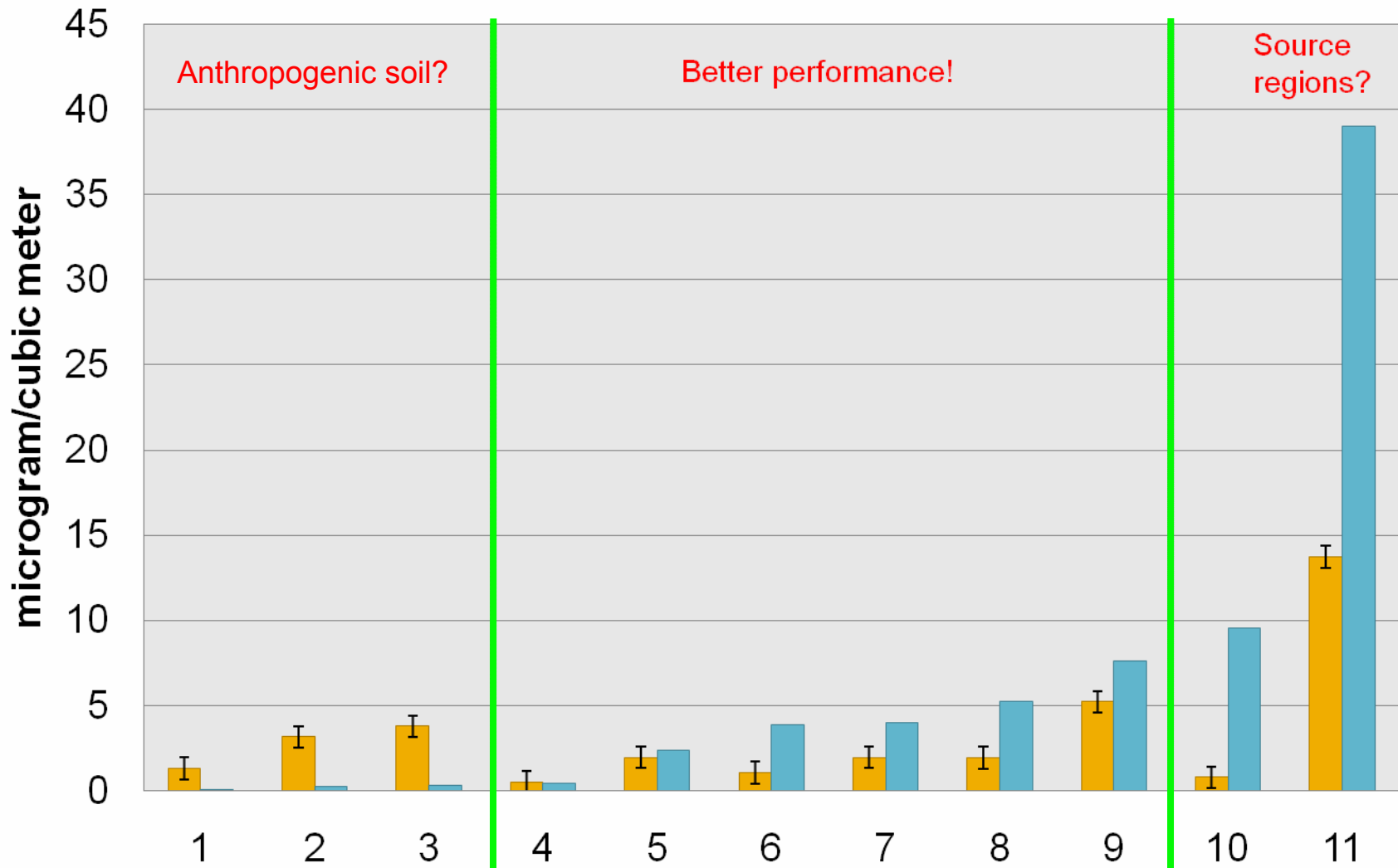


Modeled



DREAM and Soil Component

■ soil ■ DREAM



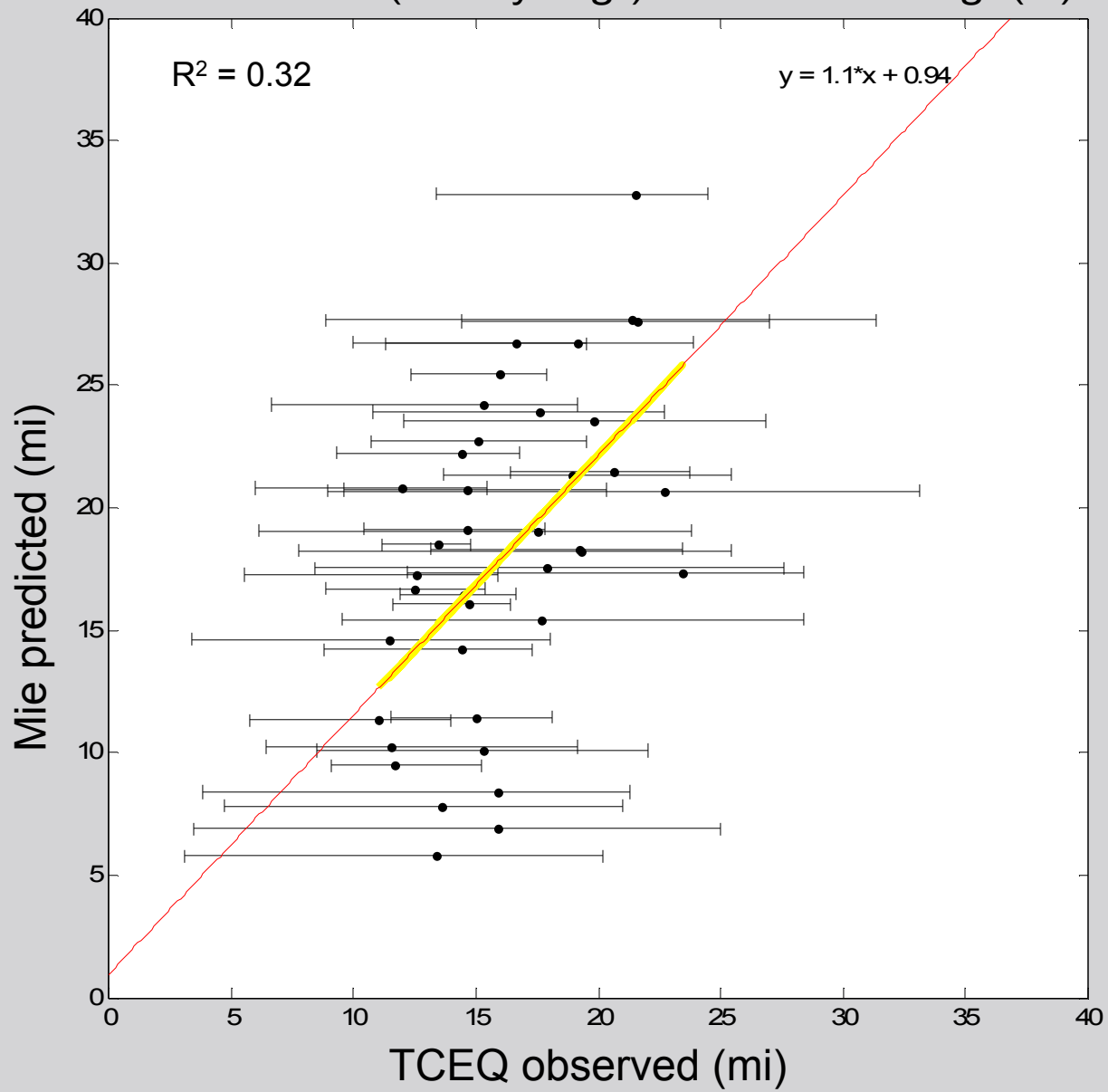
Conclusions

- Sum of components reconstructs total mass
- Soil component validation better qualitatively than total PM_{2.5}
- Still need more frequent validation proxies

Future - Visual Range Proxy?

- Visual range Mie theory
 - Normal conditions speciation
 - Clear day distribution statistics
- Works for daily averages
- Generalize into hourly validation?
 - Hourly DREAM soil output into Mie code
 - Compare with observed visual range

Mean Observed (+/- daily range) and Mie Visual Range (mi)



Thank You

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References

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