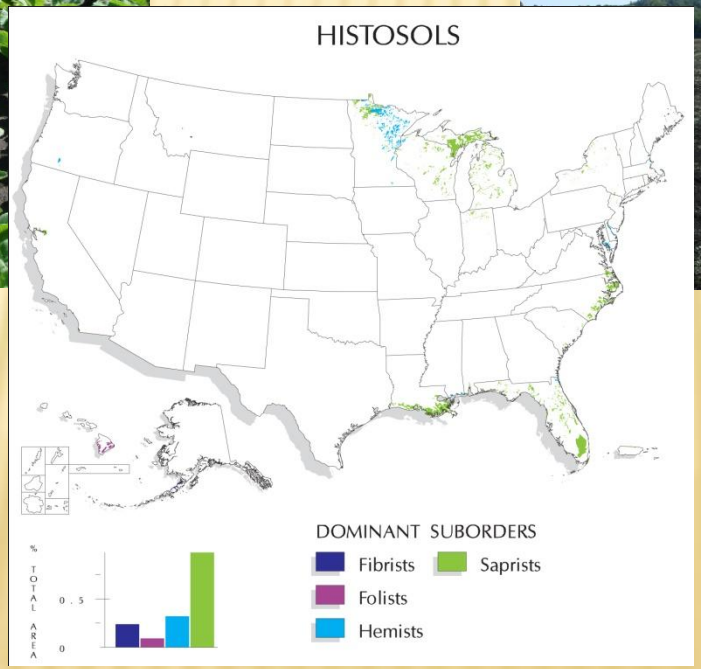
SOIL PROPERTY EFFECTS ON WIND EROSION OF ORGANIC SOILS

Ted M. Zobeck[1], Matthew Baddock[1,4], R. Scott Van Pelt[2], John Tatarko[3], and Veronica Acosta-Martinez[1]

[1]Wind Erosion & Water Conservation Research Unit, USDA-ARS, Lubbock, TX, USA
[2]Wind Erosion & Water Conservation Research Unit, USDA- ARS, Big Spring, TX, USA
[3]Engineering & Wind Erosion Research Unit, USDA- ARS, Manhattan, KS, USA
[4]Dept. of Environmental Sciences, University of Virginia, Charlottesville, VA, USA

WHAT ARE ORGANIC SOILS?

Organic soils,also called Histosols, are dominated by organic material (>20%OM) in half or more of the upper 80 cm.



Total of 21 million ha of Histosols in US

WIND EROSION PREDICTION SYSTEM (WEPS)

WEPS has been developed to simulate wind erosion on agricultural land in the US, including soils with organic soil material surfaces. However, additional field measurements are needed to calibrate and validate estimates of wind erosion of organic soils using WEPS.

We are interested in how soil properties affect wind erosion of organic soils.

Study Site Locations in Michigan

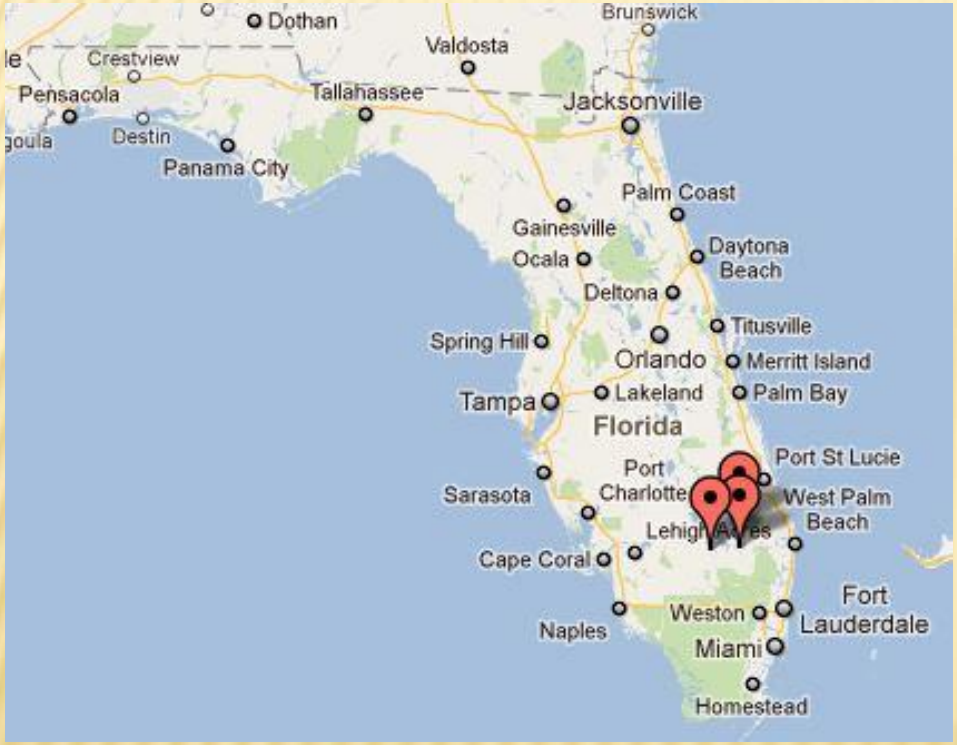
Organic Matter Content

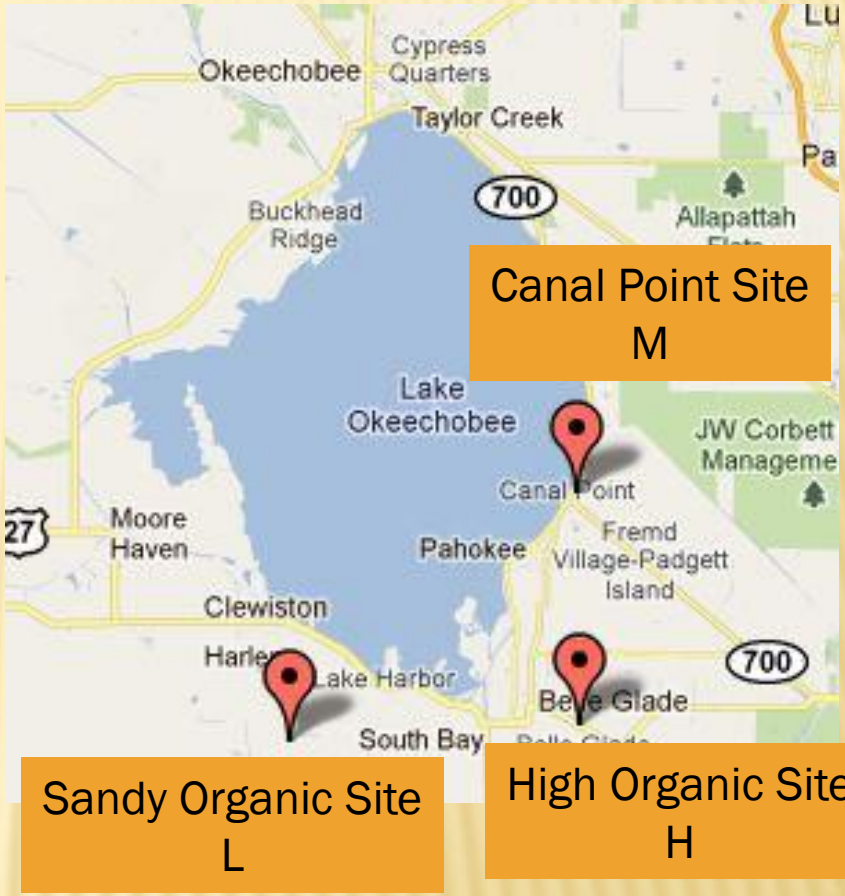
H – 50.5%

M – 43%

L – 19%

Study Site Locations in Florida





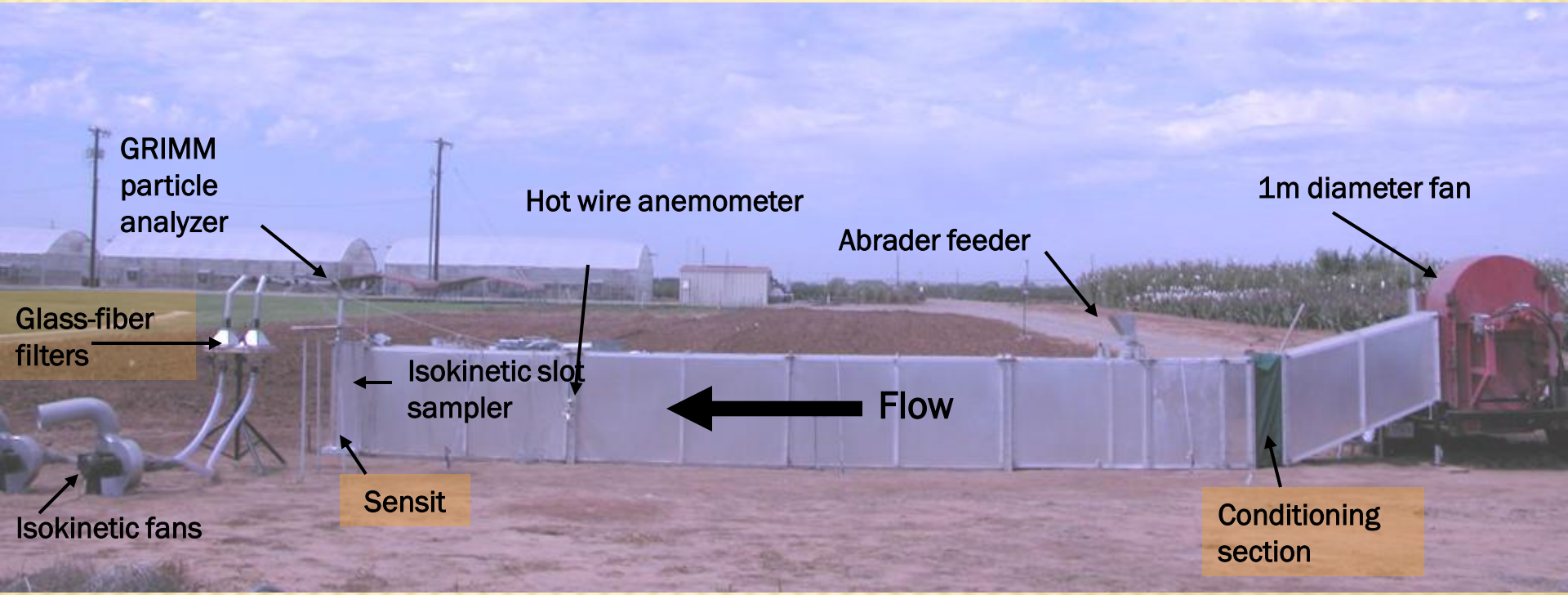
Organic Matter Content

H – 67%

M – 20%

L – 16.5%

ANATOMY OF THE WIND TUNNEL



TYPICAL FIELD WIND TUNNEL SET-UP

Three 6 m x 0.5 m plots (replications) were established for each soil. Each plot was roto-tilled, then raked and finally rolled flat to make surface roughness as similar as possible across all plots

WIND TUNNEL METHOD

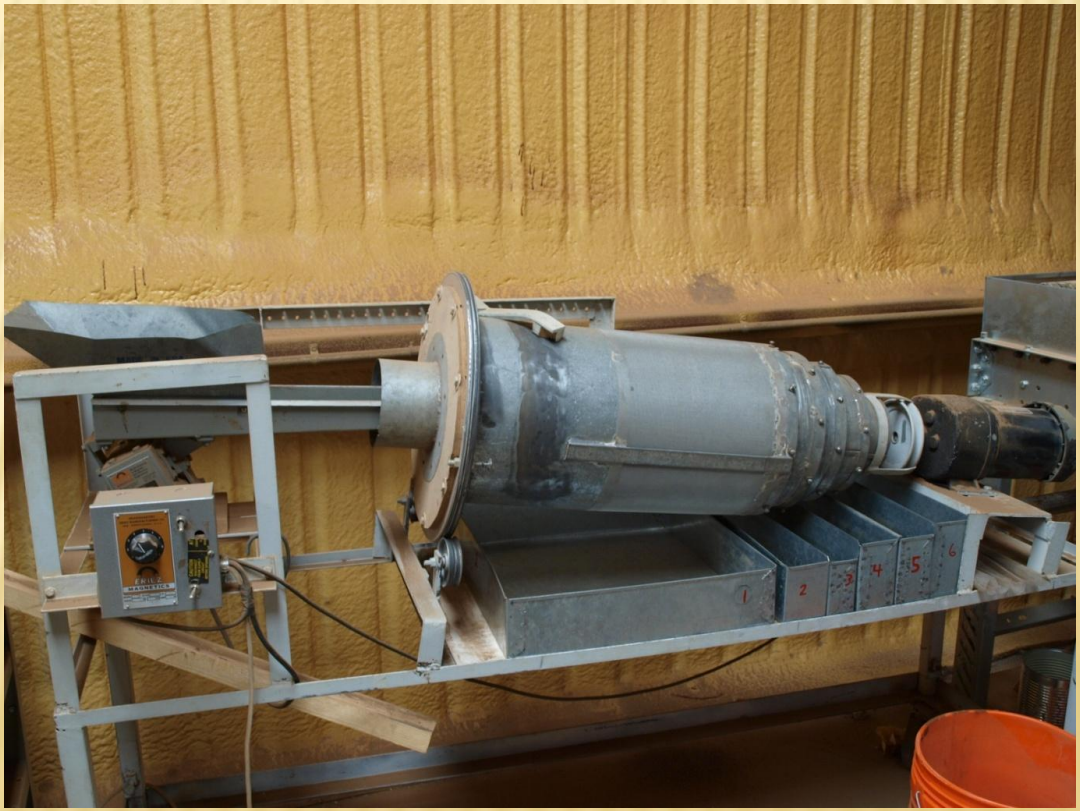
- **Run 0**: a 10 min blow with flow velocity started at 0 and increased to a target 12.6 m s^{-1} at 0.5 m above the surface. This run captured the initial blow-off of sediment.
- **Run 1**: a 20 min blow with dust-free abrader sand (0.03% <PM_{10}) added into the flow to provide saltation bombardment.
- **Run 2**: a final 10 min run with abrader.

SOIL PROPERTIES INVESTIGATED

- Dry Aggregate Size Distribution and Stability
- Wet Aggregate Size Distribution and Stability
- Soil Particle Density
- Organic Matter Content
- Texture

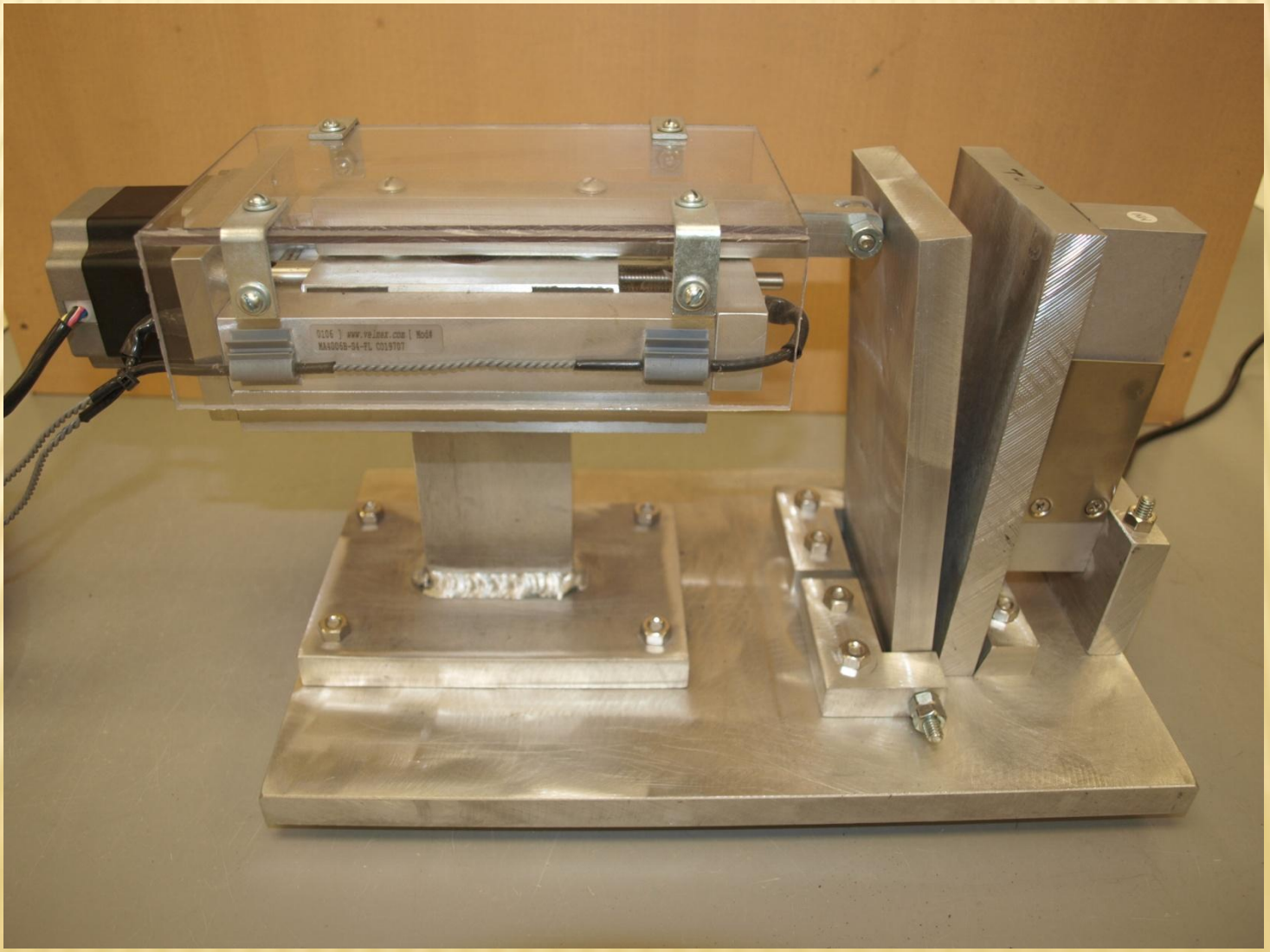
DRY AGGREGATE STABILITY AND PERCENT ERODIBLE MATERIAL

- Mechanical Stability – Measure of breakdown after sieving twice
- Percent Erodible Material (Percent < 0.9 mm)



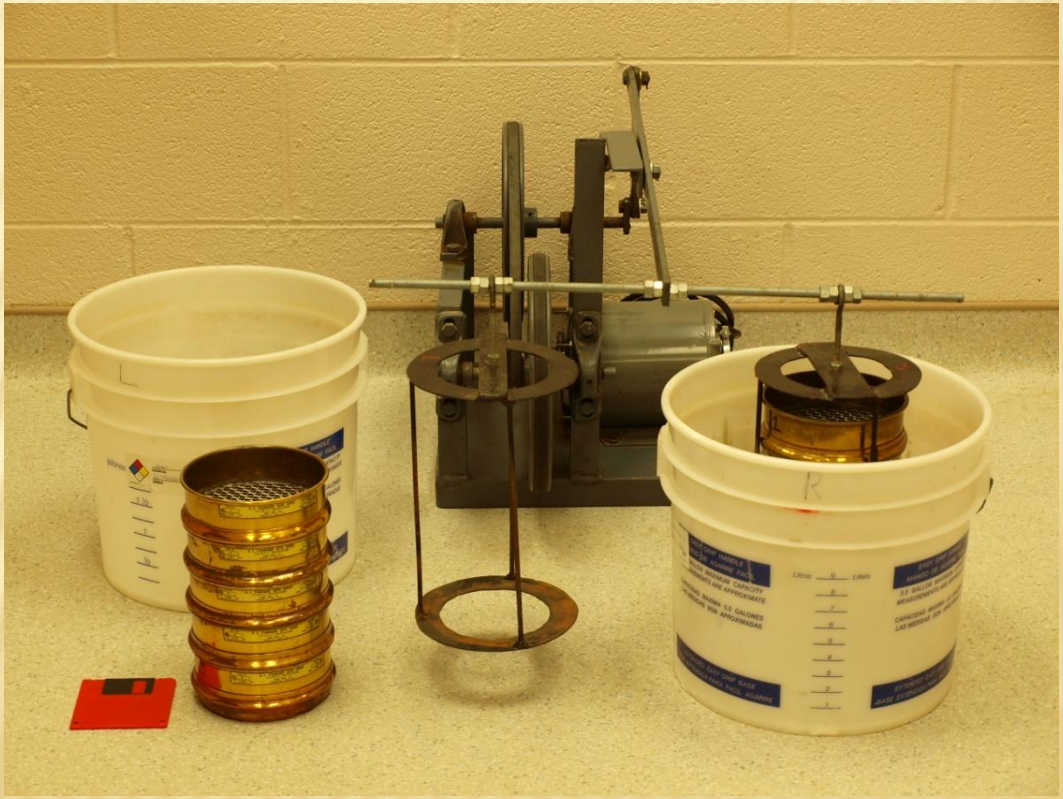
DRY CLOD/AGGREGATE STABILITY

Vertical Soil Aggregate Crushing Energy Meter – V-SACEM



WET AGGREGATE STABILITY AND SIZE DISTRIBUTION

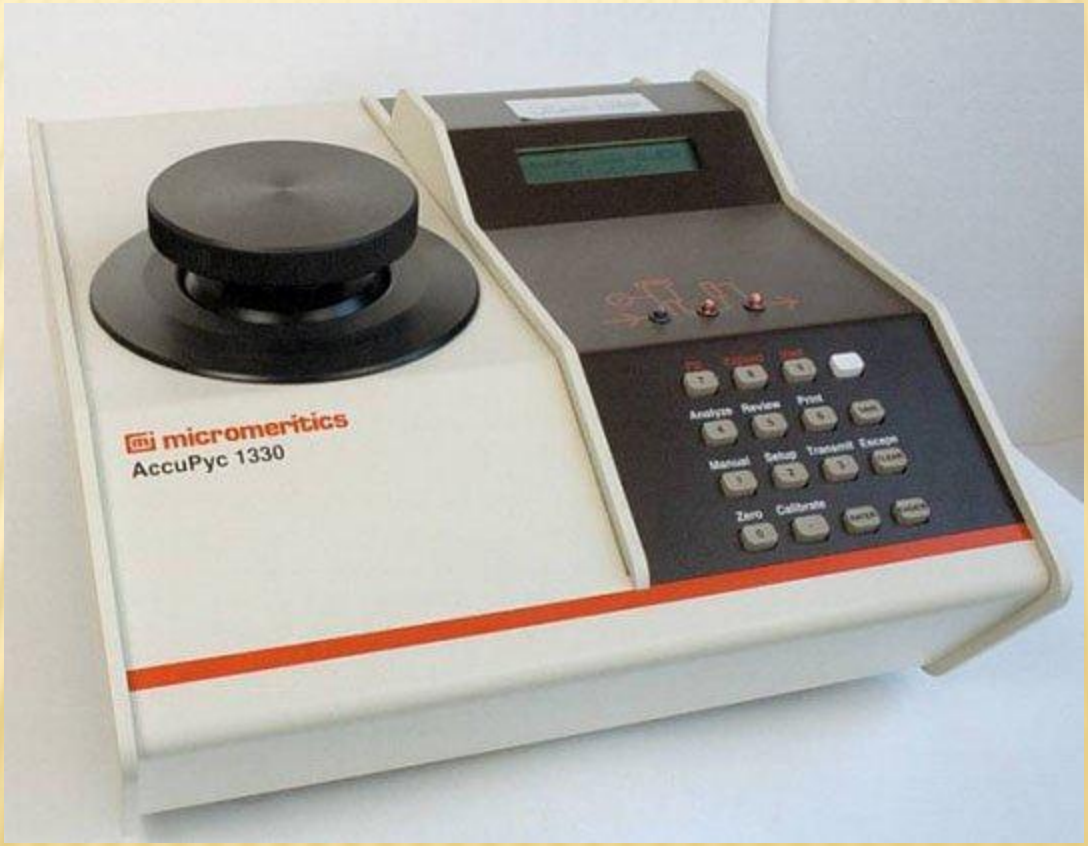
- Fraction Greater Than 250 µm
- Mean Weight Diameter (MWD)



SOIL PARTICLE DENSITY

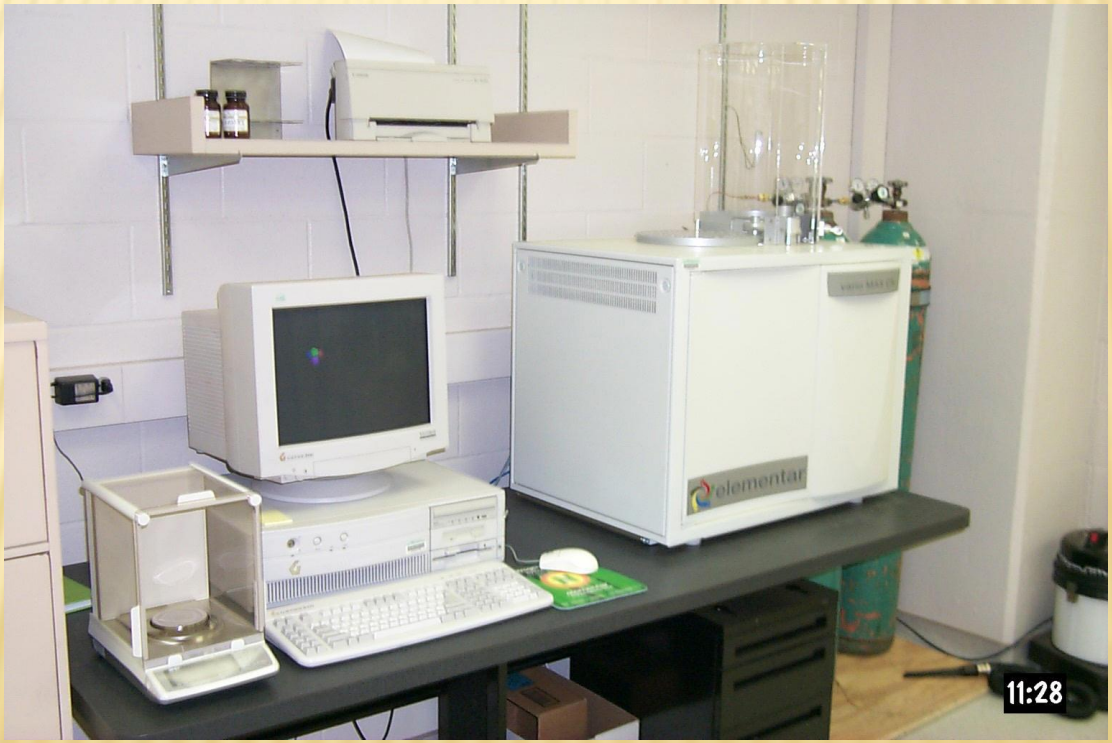
Uses helium as the pycnometric fluid

Measured particles greater than 100 microns



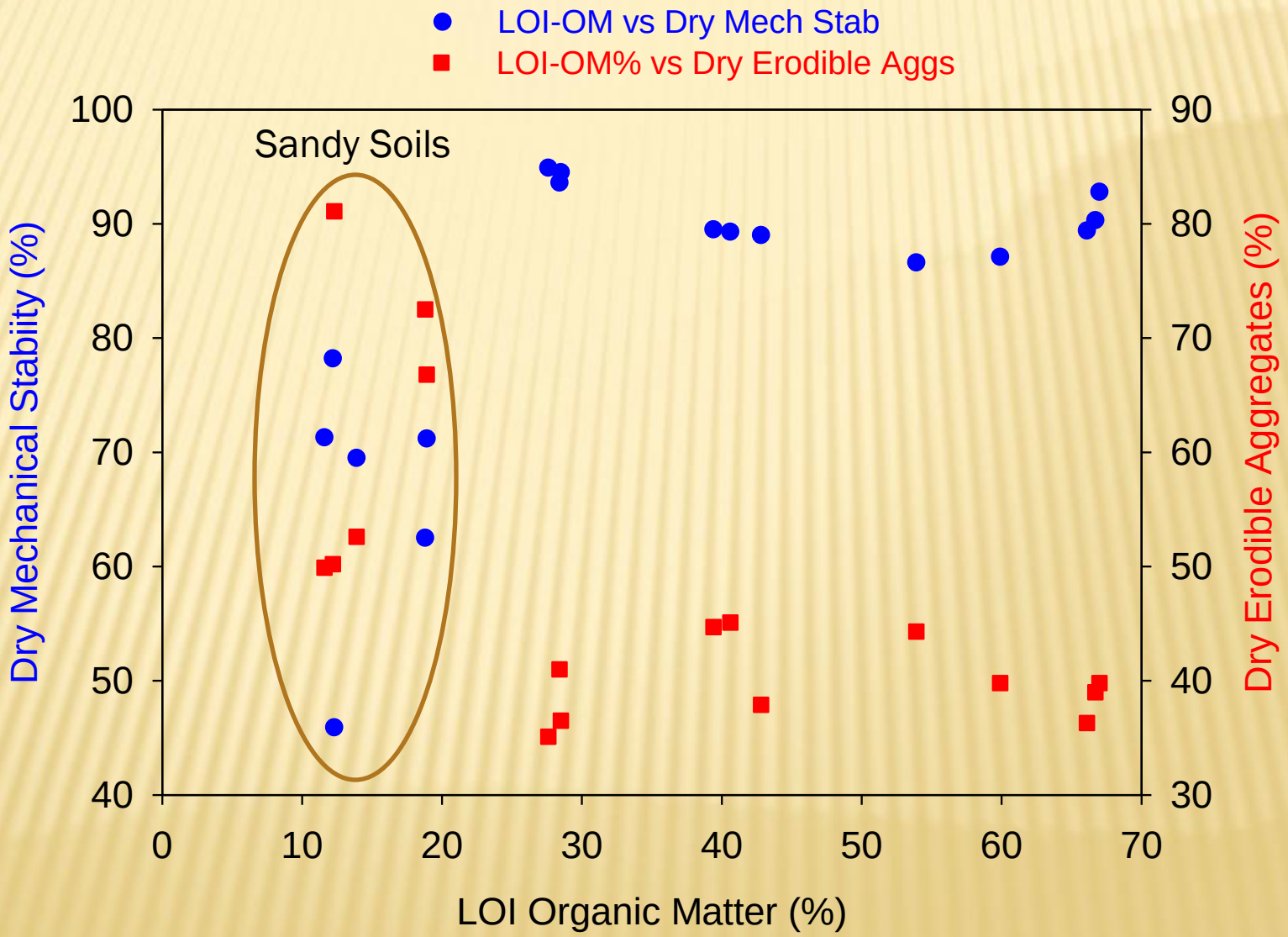
ORGANIC MATTER/ORGANIC CARBON

- Elementar Vario Max - TOC
- Muffle Furnace – Loss on Ignition (400ºC)

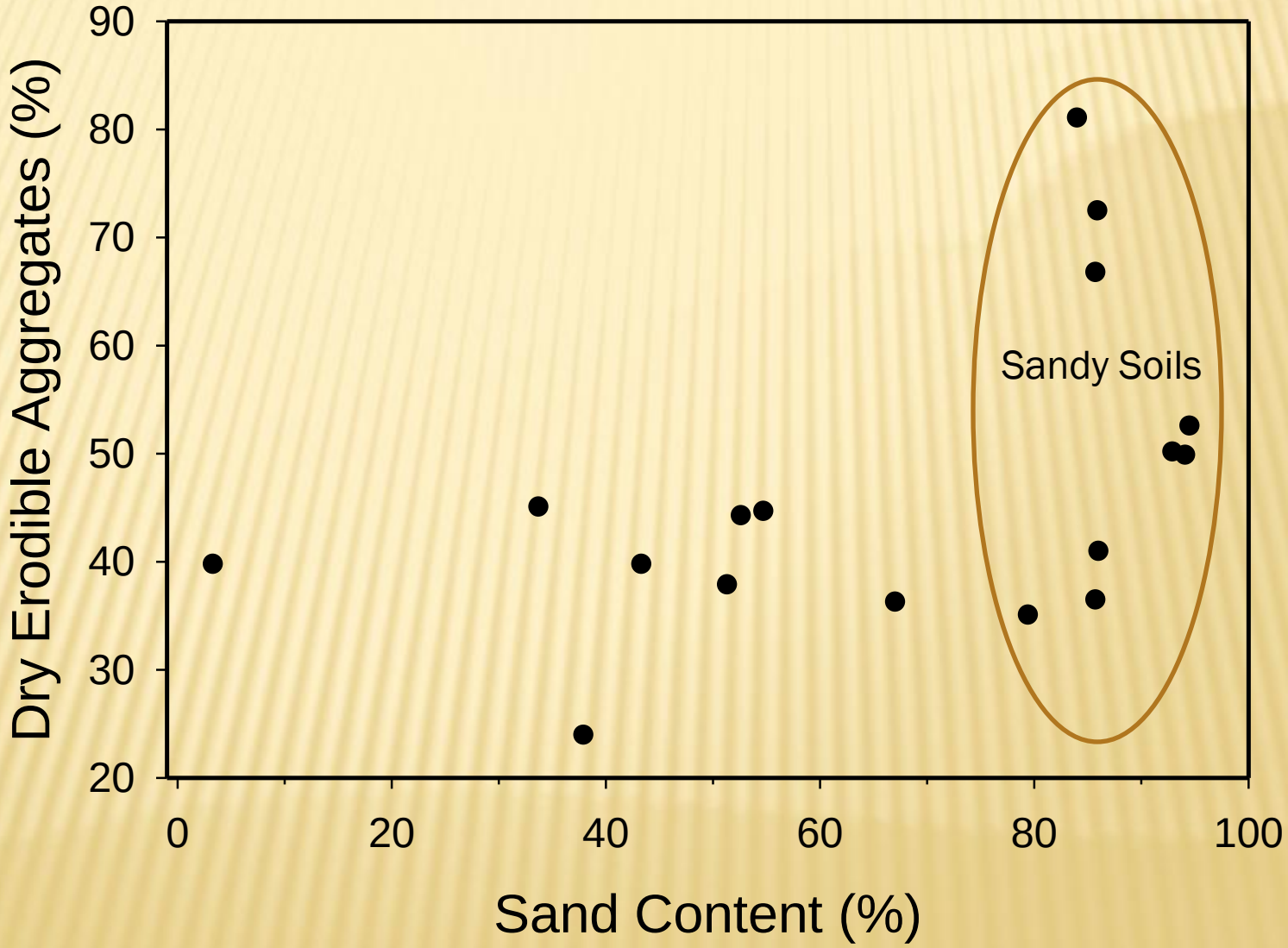


Results and Discussion

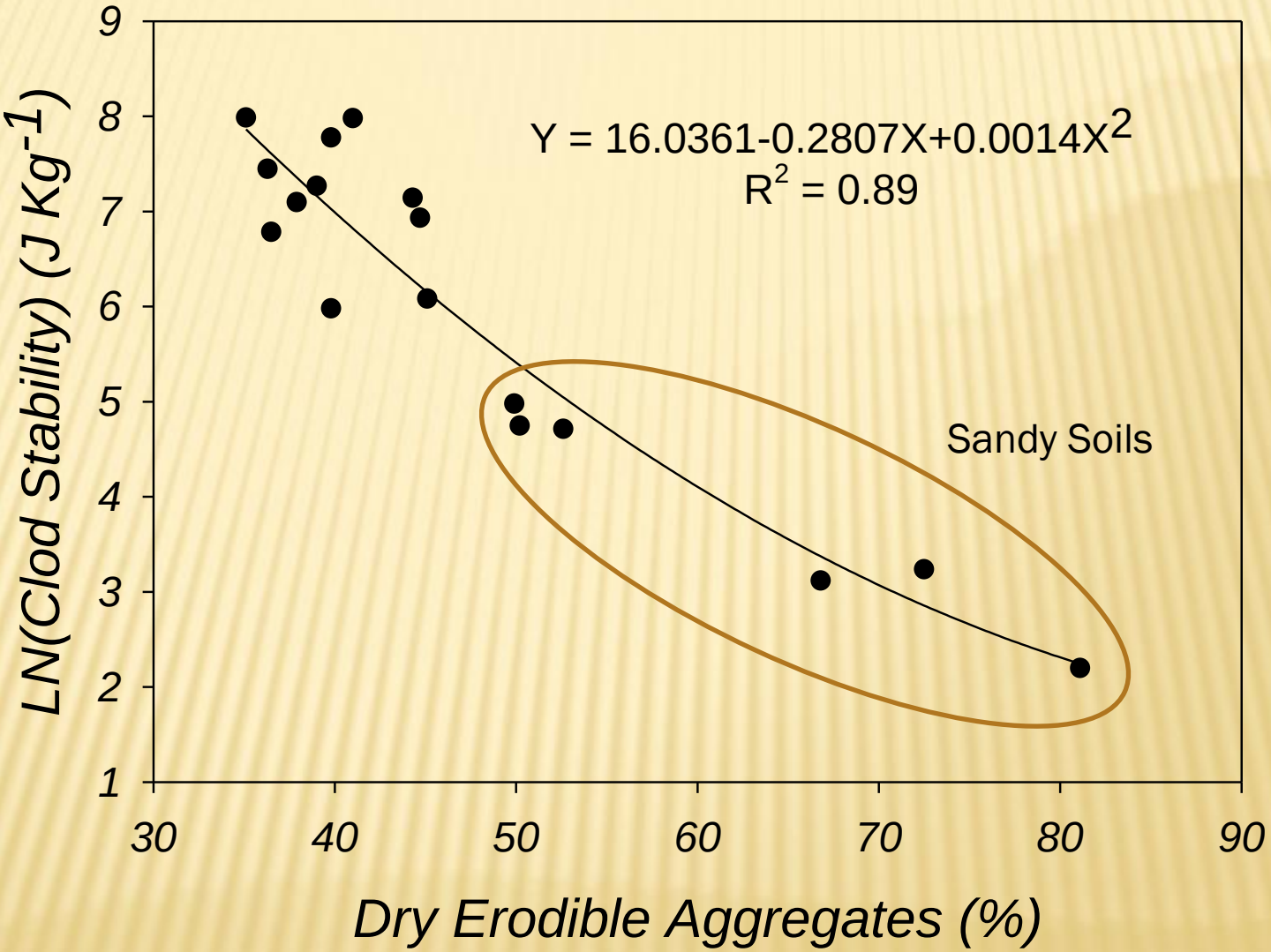
Effect of LOI Organic Matter on Dry Mechanical Stability and Dry Erodible Aggregates



Effect of Sand Content on Erodible Aggregates



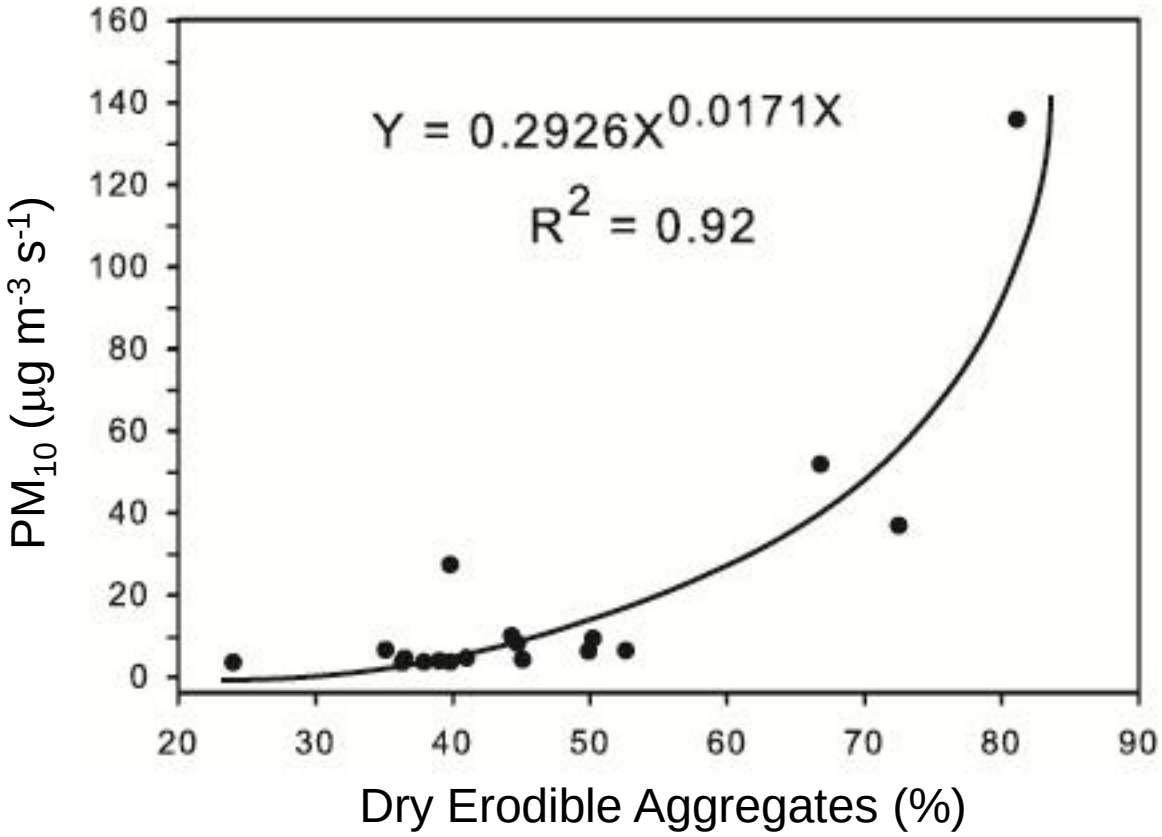
Relationship of Dry Erodible Aggregates and Clod Stability



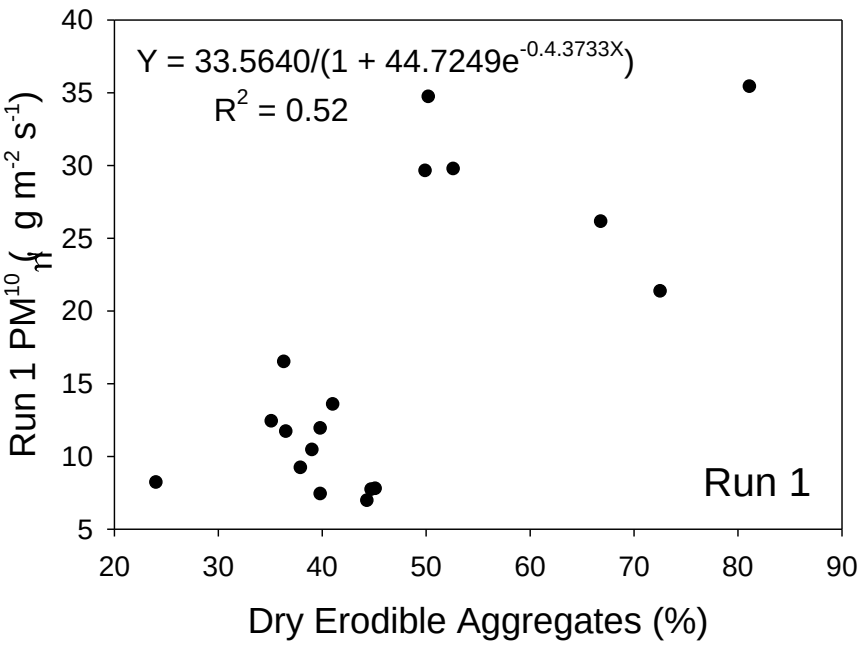
Pearson Correlation Coefficients

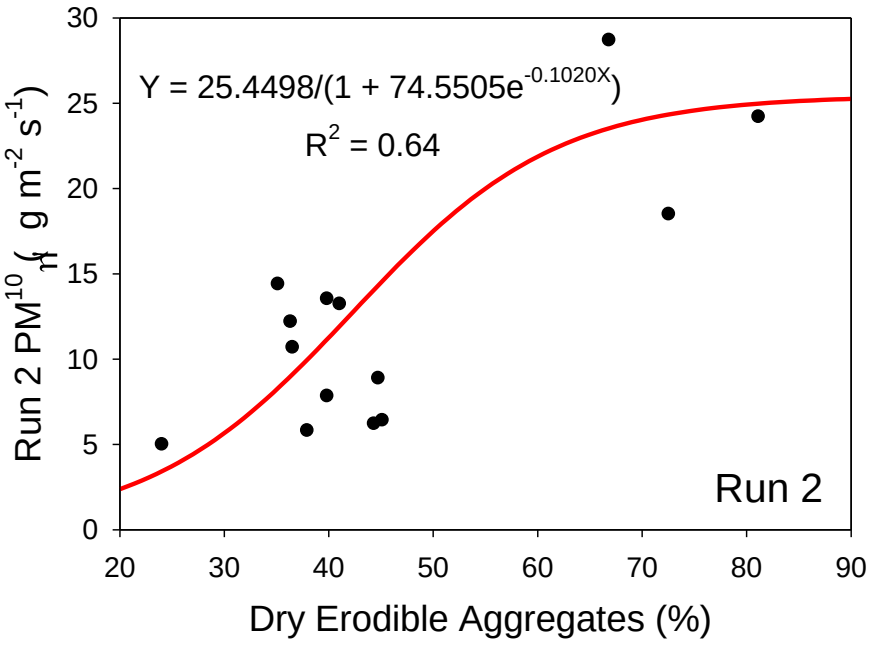
	PM_{10} Flux		
	Run 0	Run 1	Run 2
Soil Sand Content	0.25	0.69	0.62
Dry Mechanical Stability	-0.68	-0.63	-0.40
Percent Dry Erodible Content	0.80	0.71	0.66
Clod Stability	-0.74	-0.76	-0.66
LOI Organic Matter Content	-0.39	-0.76	-0.71
Particle Density	0.48	0.87	0.82

Effect of Dry Erodible Aggregates on Run 0 PM_{10} ($\mu g\ m^{-3}\ s^{-1}$)
Weibull Equation Model

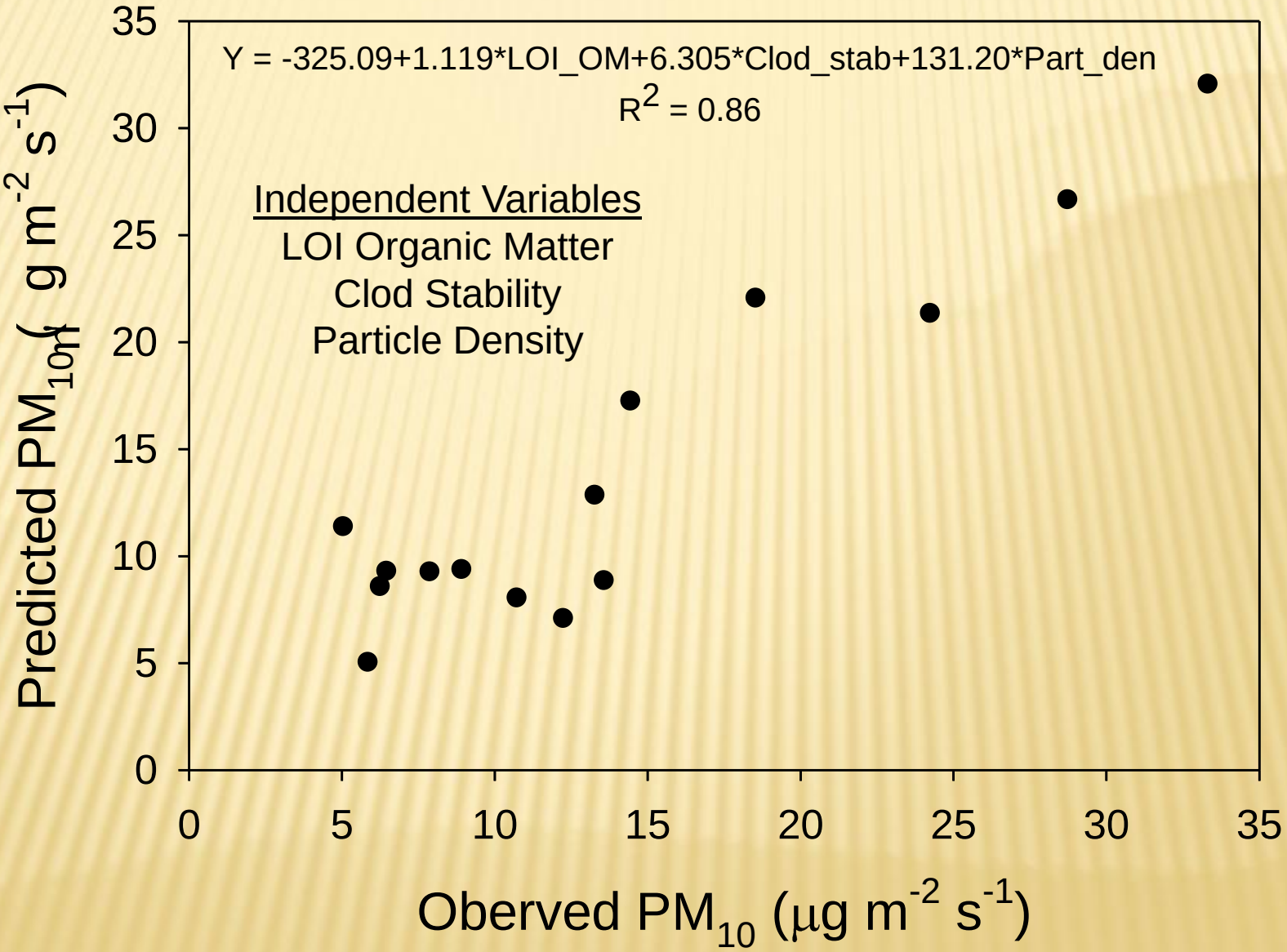


Effect of Dry Erodible Aggregates on Dust Flux Logistic Equation Model

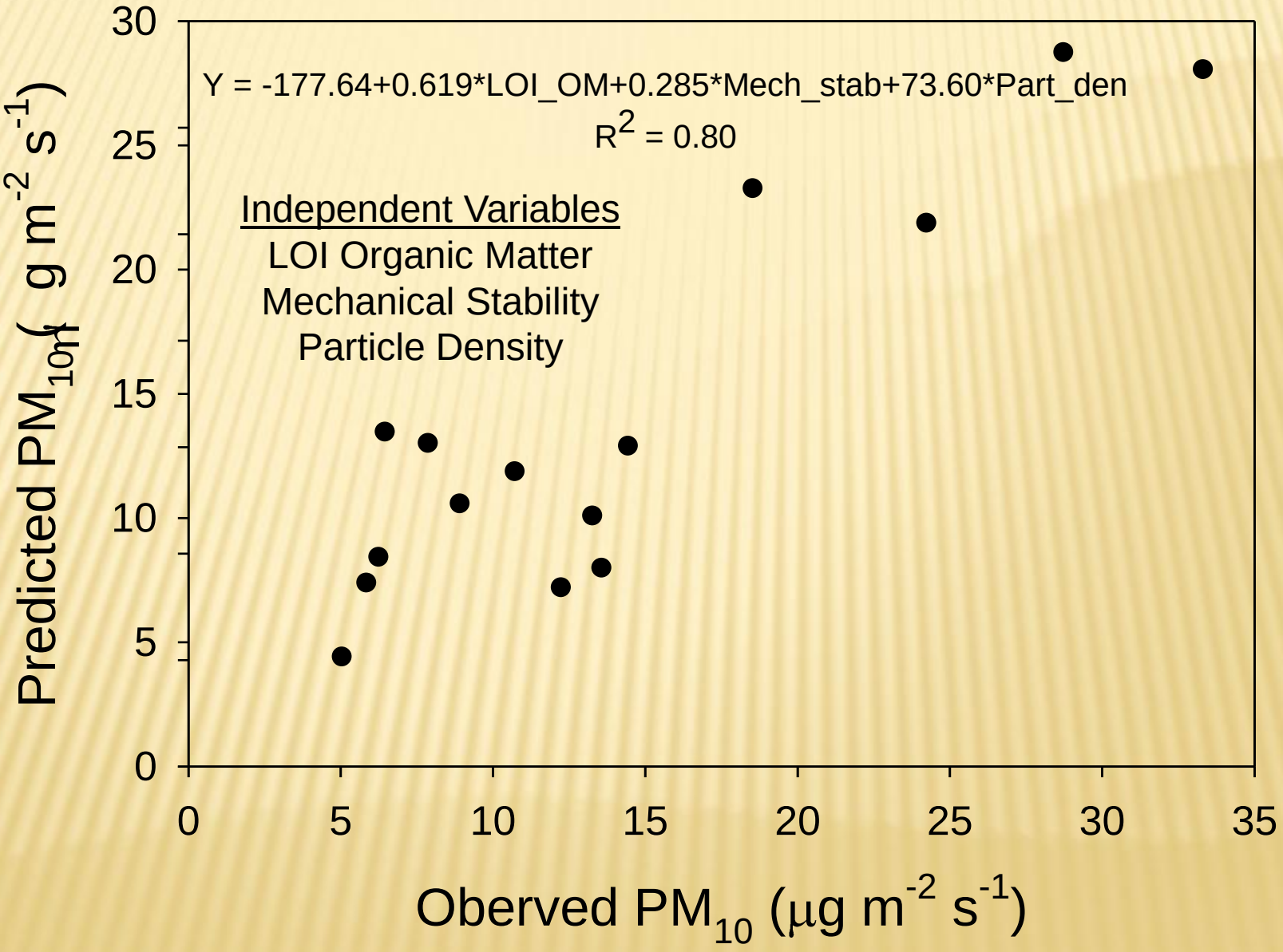




Observed Versus Predicted Run 2 PM_{10} ($\mu g\ m^{-2}\ s^{-1}$)



Observed Versus Predicted Run 2 PM_{10} ($\mu g\ m^{-2}\ s^{-1}$)



CONCLUSIONS

- Organic matter content directly related to measures of dry stability and inversely related to sand content, particle density, and percent erodible material.
- Sand content was directly related to percent erodible material.
- Percent erodible material was inversely related to clod stability.

CONCLUSIONS

- Dust emissions were most directly related to percent dry erodible material and clod stability.
- Examination of multiple linear models revealed organic matter, dry stability and particle density produced good predictive models of dust emissions.

Any Questions?