Precipitation and Management Effects on Wind Erodibility of Organic Matter Dominated Soils

J. Tatarko[1], A. Wright[2], J. Crum[3]

[1]USDA-ARS, Ft. Collins, CO; [2]University Florida, Ft. Pierce, FL; [3]Michigan State University, East Lansing, MI

ABSTRACT:
Wind erosion is a problem on organic matter dominated soils (ODS, i.e., Histosols). Soil surface properties that affect wind erosion (e.g., roughness, aggregation, etc.) change over time as affected by weathering (e.g., precipitation & freeze-thaw) and management (e.g., tillage & planting) processes. Daily process-based wind erosion models such as the Wind Erosion Prediction System (WEPS) require an understanding of these changes. A field study was conducted on ODS to determine the effects of soil intrinsic properties, climate, and management on temporal changes in wind erodibility properties, including ridge height (RH), surface random roughness (RR), and aggregate size distribution (ASD). Three field sites were established in both Palm Beach County, Florida and Clinton County, Michigan on soils with organic matter ranging from 10 to 80% to represent low, medium, and high organic matter content (Fig. 1 & Table 1). At each sampling site, three replicate samples or measurements were taken approximately every two weeks, from fall to spring, to capture seasonal changes in erodibility parameters. Parameters analyzed included RH by tape measure, RR by roughness pin-meter, and ASD by rotary sieve. Changes in measured values are modeled in WEPS as first-order equations driven by precipitation and freeze-thaw cycles. Measured values were also compared to WEPS simulated values to evaluate the model performance. Results will be used to better model changes in WEPS of organic soils over time as affected by weather, tillage, management, and organic matter content.

METHODS

Figure 1. Example sites in Michigan (left) and Florida (right).

- Three field sites in both Palm Beach County, Florida and Clinton County, Michigan were selected to give a range in organic matter content (e.g., ~10 to 80%). See Figure 1 and Table 1.
- The sampling period (November through July) was chosen to be just prior to and during the seasons when erosion can occur (i.e., spring). The study continued through two cropping seasons with samples taken approximately every two weeks in three replicates. Managements were decided by individual land owner.
- Approximate 1 to 2 kg samples of aggregates were taken with a flat bottom scoop for ASD which were analyzed using a rotary sieve.
- RR was determined using a pin-meter consisting of 101 pins spaced 1 cm apart for a total 1 m surface measurement length. The pins were lowered to the surface conforming the surface and a digital photograph of the pin tops were analyzed for "Allmaras" roughness (i.e., standard deviation of pin heights, mm).
- RH (mm) was measured using a ruler and a tape measure.
- Types and dates of management operations were recorded.
- The WEPS model was used to simulate the measured parameters.
- Simulated vs. measured results were compared to evaluate WEPS ability to simulate wind erodible soil properties on ODS.

RESULTS

Table 1. Sampling locations, organic content, and particle size distribution for the study.

State	Site	Site ID*	Organic Matter	Clay	Silt	Sand	Rock >2mm
					%		
Florida	Belle Glade	FL-H	79.2	18.9	63.3	17.8	0.0
Florida	Lake Harbor	FL-M	33.4	66.0	18.5	15.5	1.0
Florida	Canal Point	FL-L	31.7	82.7	15.7	1.6	0.0
Michigan	East Lansing	MI-H	77.1	27.9	51.7	20.4	0.0
Michigan	East Lansing	MI-M	67.3	22.6	49.9	27.5	3.0
Michigan	East Lansing	MI-L	11.0	8.8	15.3	76.0	6.3

* H = high, M = medium, and L = low relative organic matter content.

Figure 2. Selected measured values and regressions for ridge height, random roughness, and geometric mean diameter on organic matter dominated soils (Florida - upper row and Michigan - lower row) where fitted equations are for greater than three consecutive measurements without soil disturbing tillage.

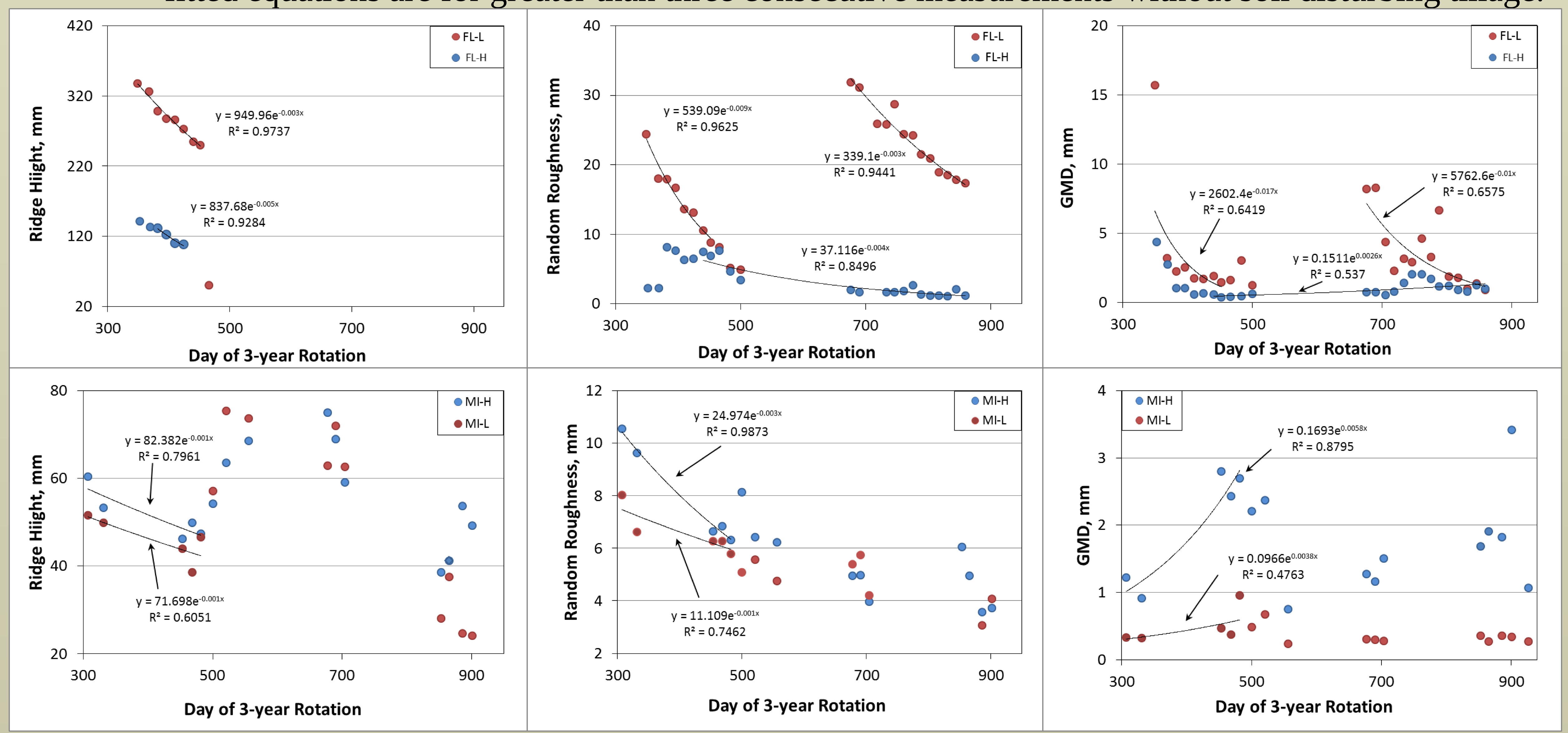
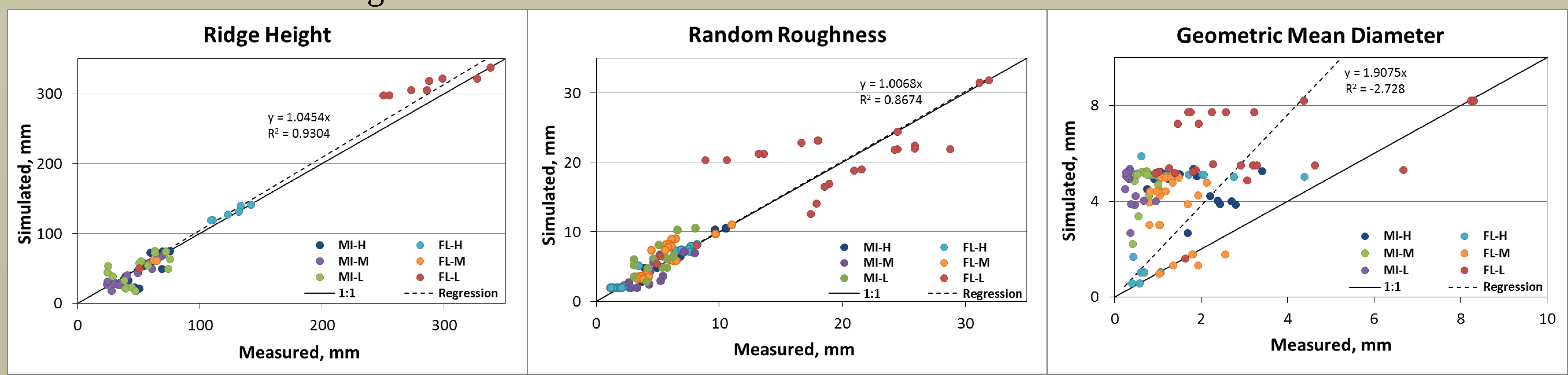


Figure 3. WEPS simulated vs. measured values for ridge height, random roughness, and geometric mean diameter on organic matter dominated soils.



CONCLUSIONS

- Measured values of ridge height and random roughness followed an exponential decay over time in response to precipitation and freeze-thaw cycles. GMD exhibited either an increase or decrease in values over winter (Fig. 2).

- Simulated ridge height had the closest fit to measured values (R^2 = 0.9304) followed by random roughness (R^2 = 0.8674), with geometric mean diameter showing no correlation (R^2 = -2.728) and an overall overestimation compared to measured values (Fig. 3).