Long Term Monitoring of Wind Erosion Induced Changes to Soil Properties in Western Kansas

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Introduction

Wind erosion selectively removes smaller and lighter particles, leaving coarser and denser particles behind. These smaller and lighter particles typically represent the more fertile fraction of the soil and includes organic matter. As a result of this sorting, limited research indicates that surface soil textures becomes coarser and organic matter decreases over time. The selective removal and changes in soil components over time affect soil quality. The objective of this ongoing study is to determine the long term changes in soil constituents resulting from wind erosion in western Kansas, an area historically prone to wind erosion.

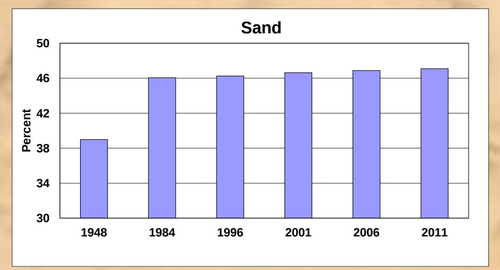
Methods

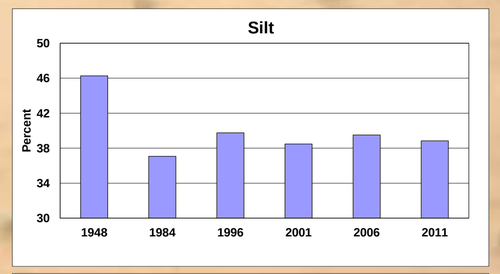
The surface soils of ten locations in western Kansas (see map) were sampled in 1948 by wind erosion researchers and analyzed for particle size and organic matter. Based on original location descriptions, these same locations were re-sampled in 1984 and again in 1996, 2001, 2006, and 2011. Samples were analyzed for particle size distribution (texture) and organic matter content in the surface. Land managers were surveyed to determine management history of each site and possible effects of land use on long term soil changes.

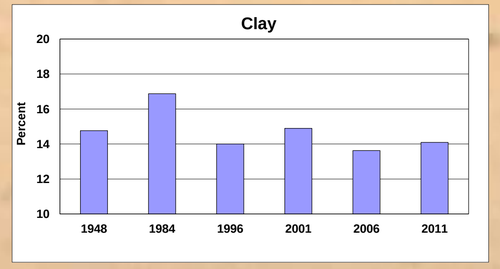
Results

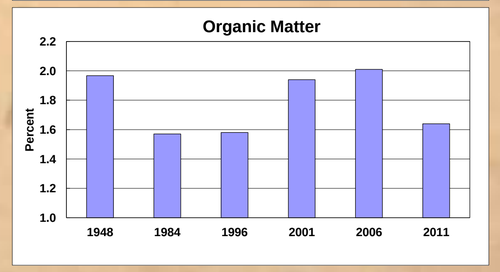
Site ID County	Silt %						Sand %						Organic Matter %					
	1948	1984	1996	2001	2006	2011	1948	1984	1996	2001	2006	2011	1948	1984	1996	2001	2006	2011
C-14 Lane	72.4	69.4	74.2	68.9	75.1	74.9	8.9	11.1	12.0	10.1	8.6	11.9	2.8	3.2	2.7	2.7	3.0	2.9
C-16 Grant	60.4	49.2	55.8	53.6	53.2	54.8	23.8	28.3	25.7	26.3	30.9	28.7	2.3	1.9	1.5	2.4	3.6	2.3
C-18 Morton	60.9	55.8	66.2	62.1	63.4	63.0	13.0	17.3	13.4	18.3	16.8	14.6	2.2	1.8	1.7	2.0	2.1	1.7
C-21 † Morton	30.2	9.2	14.3	12.8	11.2	8.6	61.7	81.2	74.8	76.9	80.3	84.7	1.3	0.7	0.8	1.5	1.3	0.9
C-25 Morton	35.9	31.8	28.3	29.3	30.0	29.6	49.7	49.4	57.6	54.1	54.6	50.4	1.1	0.9	1.0	1.5	1.7	1.1
C-30 Ellis	69.1	64.5	65.2	64.4	68.6	67.5	5.8	7.5	7.7	8.7	7.5	8.7	3.3	2.0	2.1	2.7	2.7	2.6
C-33 Ford	71.9	65.0	66.4	70.9	72.4	68.9	8.6	9.6	14.1	8.9	8.5	8.1	2.5	1.6	2.2	2.9	2.1	1.7
C-36 ‡ Stafford	31.6	13.5	12.4	6.6	4.2	5.1	56.9	81.0	83.0	90.3	91.2	92.3	2.5	1.8	1.7	1.7	1.4	1.3
C-39 Stafford	12.0	2.3	4.4	4.6	5.0	3.3	85.0	94.7	93.0	92.7	91.0	93.4	0.9	0.5	0.7	0.6	0.9	0.8
C-42 Stafford	18.2	9.9	10.3	11.8	11.9	12.7	76.4	80.3	81.2	79.8	79.3	78.0	1.0	1.2	1.4	1.4	1.3	1.1
Average	46.3	37.1	39.8	38.5	39.5	38.8	39.0	46.1	46.2	46.6	46.9	47.1	2.0	1.6	1.6	1.9	2.0	1.6

† - Site C-21 planted to CRP grass in 1987.
‡ - Site C-36 has ~3% slope and went to center pivot irrigation in 1970's. – some water erosion expected.









Result show that changes in the measured properties are related to management on the ten study sites. The 1948 and 1984 samples showed an average increase in sand content of 7.1% and clay 2.1% on the sites while silt content had an average decrease of 9.2%. Organic matter also decreased on 0.4% on the sites studied. Since water erosion is not a problem on these nearly level sites and because the study area has historically experienced severe wind erosion during the Dust Bowl, soil property changes were assumed to be primarily a result of selective removal by wind erosion. In addition, clean tillage was practiced by most of the land managers during the period which leaves little protective vegetative material on the surface. It should also be noted that severe wind erosion occurred in western Kansas in the 1950's and 1970's. Beginning in the late 1980's to the mid 1990's, management histories show a transition to better residue management including undercutting, mulch tillage, and even one site going into continuous grass (CRP). Following these changes in management, sand contents have stabilized while silt contents and organic matter contents generally increased. Again, note that severe wind erosion occurred in western Kansas in the mid-990's.

Conclusions

Wind erosion was likely causing a decline in silt and organic matter in these soils in the decades between 1948 and 1984, with potentially detrimental effects on soil structure, nutrient availability, and water-holding capacity. Subsequent adoption of conservation tillage and residue management appears to have stabilized or reversed this trend in soil texture and organic matter.