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Relationships between soils and elevation along toposequence in east Cache valley

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Introduction

Soils have important roles in ecosystem. The one of the role is as carbon pools. In developing country, soil maps are unavailable. To estimate and manage the soils, soil maps are very useful but there are many things to do to make soil map. In USA, we can access national soil map and elevation data set easily and freely. To get relationships between soil properties and elevation data is very helpful to make new soil maps in developing country. At first, objective of this project was to find good correlation with soils and elevation data in Cache valley. But I could not find good data because of the too much variation of data. In this report, I focused on just one line from a lake terrace to a river to decrease complexness. Along the line, I got soil data, elevation, water table depth, solar radiation amount, flow accumulation data.

Data

The USGS National Elevation Dataset (NED) provides elevation data at a 10 m spatial resolution. From this dataset the data following terrain attributes are derived at a 10 m spatial resolution. SSURGO was used as soil map. From Utah AGRC, geological units map was used to determine difference of parent rock. Brief Soil Description (UT), Chemical Soil Properties and Physical Soil Properties were obtained from SSURGO data.

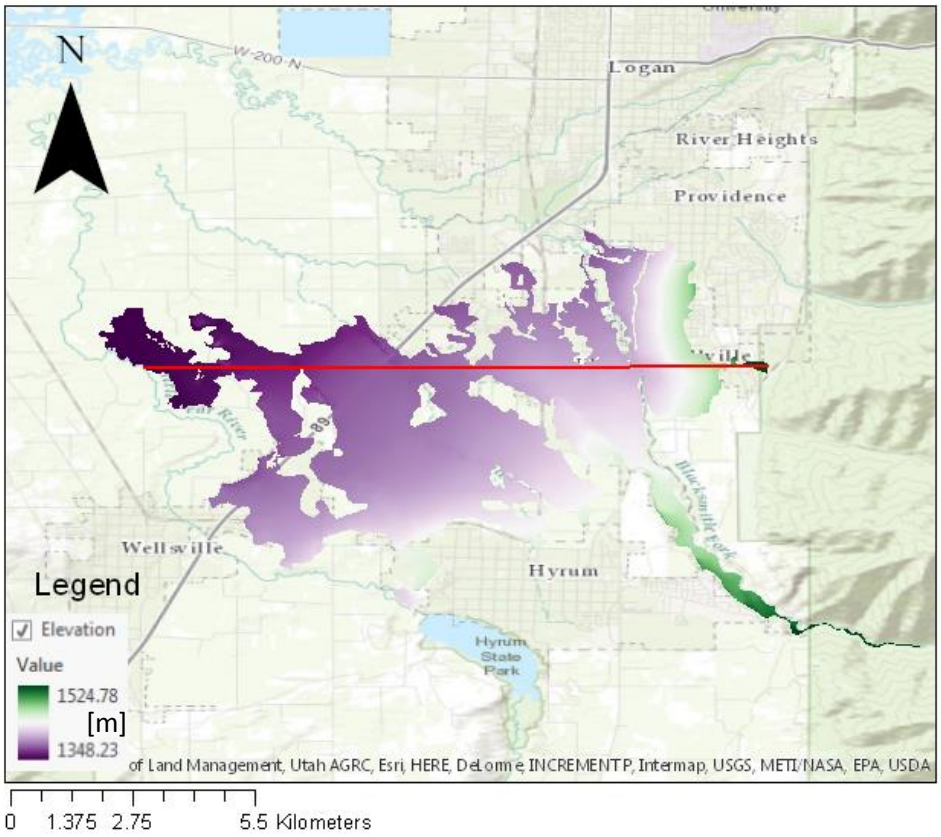

Figure 1. Study area and its elevation map with line that I chose.

Methods

Along line which was from (-111.8028634, 41.67706537) to (-111.92890288, 41.67668593), stack profile for elevation, water table depth and solar radiation. For each points along line every 10 m, the MUSYM and geological units were decided manually with Arc map. From elevation data, amounts of solar radiation was calculated with function of area solar radiation and flow accumulation with flow direction function and flow accumulation function.

Results

Numbers of determined MUSYM were 19. Only two parent material was found along this line that were Provo formation and Main-stream alluvium. The most frequent MUSYM was NcA. GsA and Ck were second and third. NcA was NIBLEY SILTY CLAY LOAM, 0 to 3 percent slopes, GsA was GREENSON LOAM, 0 to 3 percent slopes, and Ck was COLLETT SILTY CLAY LOAM. The place where had alluvium parent material, Lr and Wn were dominant. Lr was LOGAN SILTY CLAY LOAM, Wn was WINN SILT LOAM.

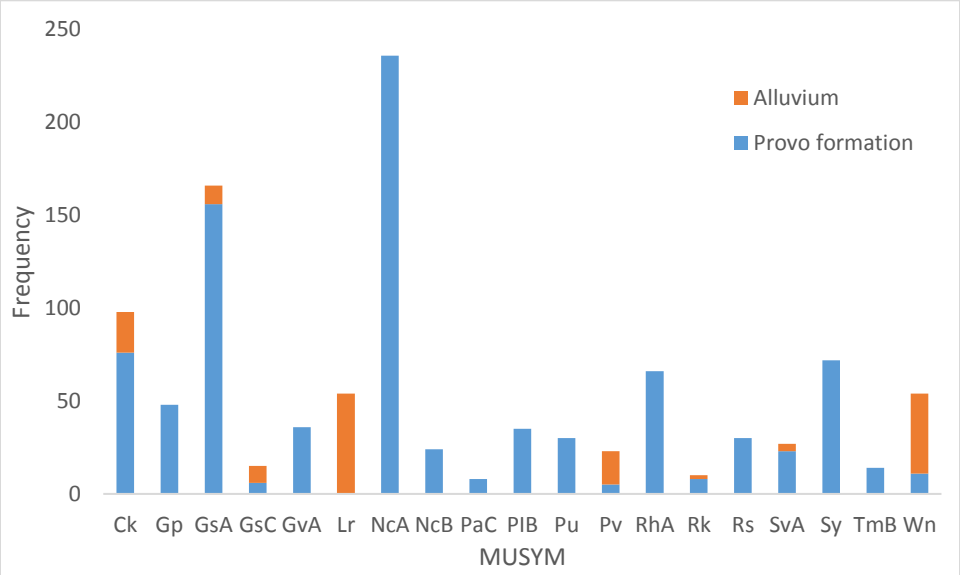

Figure 2. Relationship between parent material and MUSYM

Table 1. General properties of each soil

Soil	Thickness A	Bk thick	Bt thick	Surface pH	Surface texture	Surface clay	Surface OC	Surface CEC	Start Bk horizon
Ck	30.48	43.18	0	7.6	Silty clay loam	32.5	3	30	43.18
Gp	0	0	0	Null	Gravel	0	0	0	0
GsA	40.64	71.12	0	7.6	Loam	22.5	3	18.5	58.42
GsC	40.64	71.12	0	7.6	Loam	22.5	3	18.5	58.42
GvA	40.64	71.12	0	7.6	Loam	22.5	3	18.5	58.42
Lr	33.02	33.02	0	7.9	Silty clay loam	35	6	30	33.02
NcA	33.02	58.42	48.26	7.2	Silty clay loam	37.5	2.5	25	50.8
NcB	33.02	58.42	48.26	7.2	Silty clay loam	37.5	2.5	25	50.8
PaC	20.32	93.98	48.26	7.2	Silt loam	22.5	2	15	78.74
PIB	27.94	22.86	15.24	7.2	Silt loam	20	2	12.5	53.34
Pu	33.02	119.38	0	7.6	Loam	22.5	2	17	33.02
Pv	33.02	119.38	0	7.6	Gravelly loam	22.5	2	17	33.02
RhA	22.86	40.64	0	7.2	Gravelly loam	12.5	2.5	11.5	35.56
Rk	0	0	0	Null	Sand to gravell	0	0	0	0
Rs	20.32	68.58	0	8.45	Silt loam	12.5	5	12	20.32
SvA	43.18	0	0	7.9	Gravelly loam	22.5	2.5	17	0
Sy	0	0	0	0	0	0	0	0	0
TmB	22.86	73.66	22.86	7.2	Silt loam	12.5	2.5	14	33.02
Wn	45.72	0	0	7.9	Silt loam	19	6	27.5	0

From this table, Wn, SvA, GsA, GsC, GvA , Lr, NcA, NcB, Ck had thick A horizon that was over 30 cm. Pu and Pv had the thickest Bk horizon that was over 100 cm. NcA, NcB and PaC had thick Bt horizon. Gp and Rk and Sy did not have soil description because they were too gravelly or stony. Through this line, most soil's surface texture was loam to silty clay loam and surface organic carbon content was 2 to 6%. Almost soils had relatively alkaline pH. Surface clay content were 20 – 35 % in most of soils.

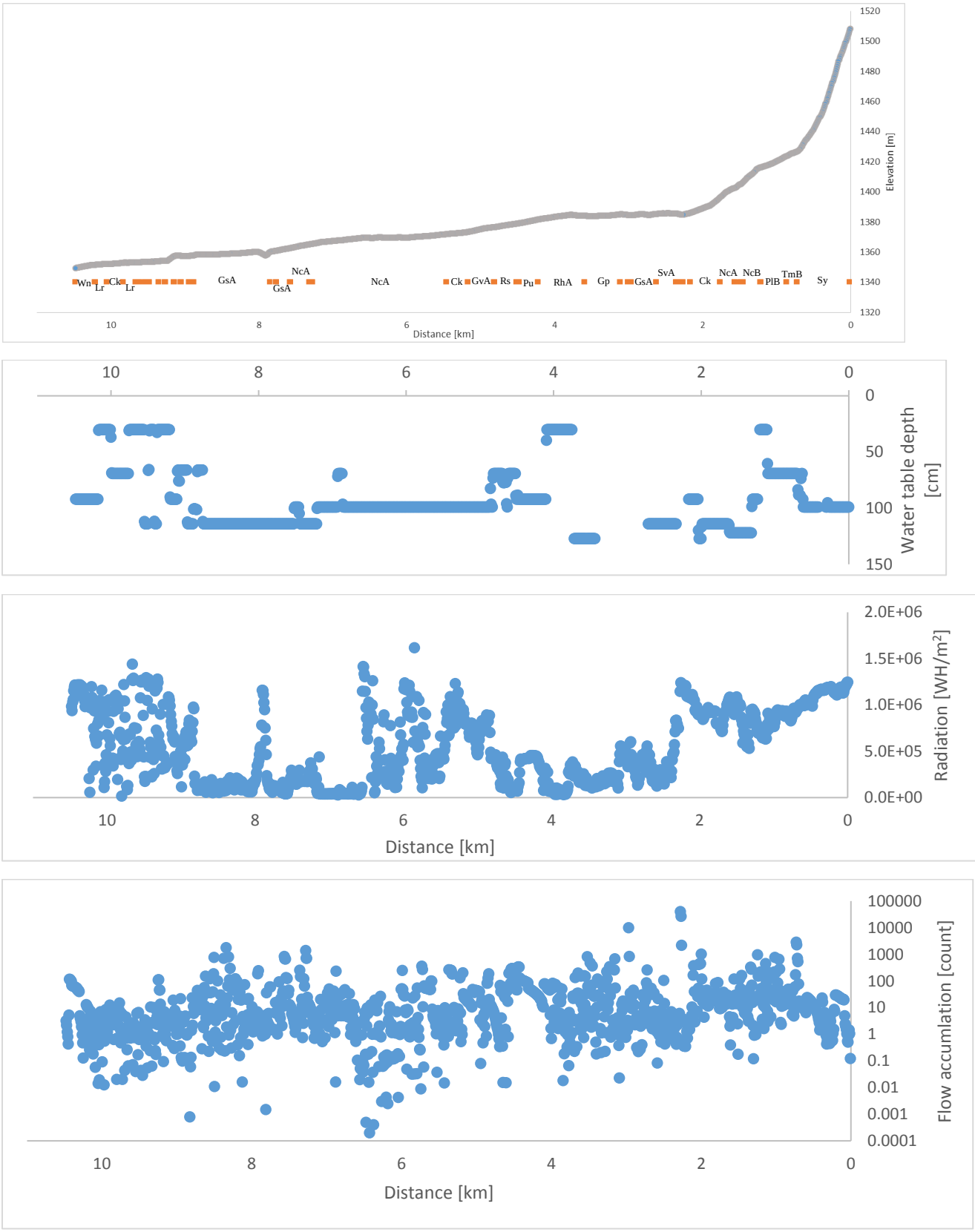

Figure 3. The data calculated from NED

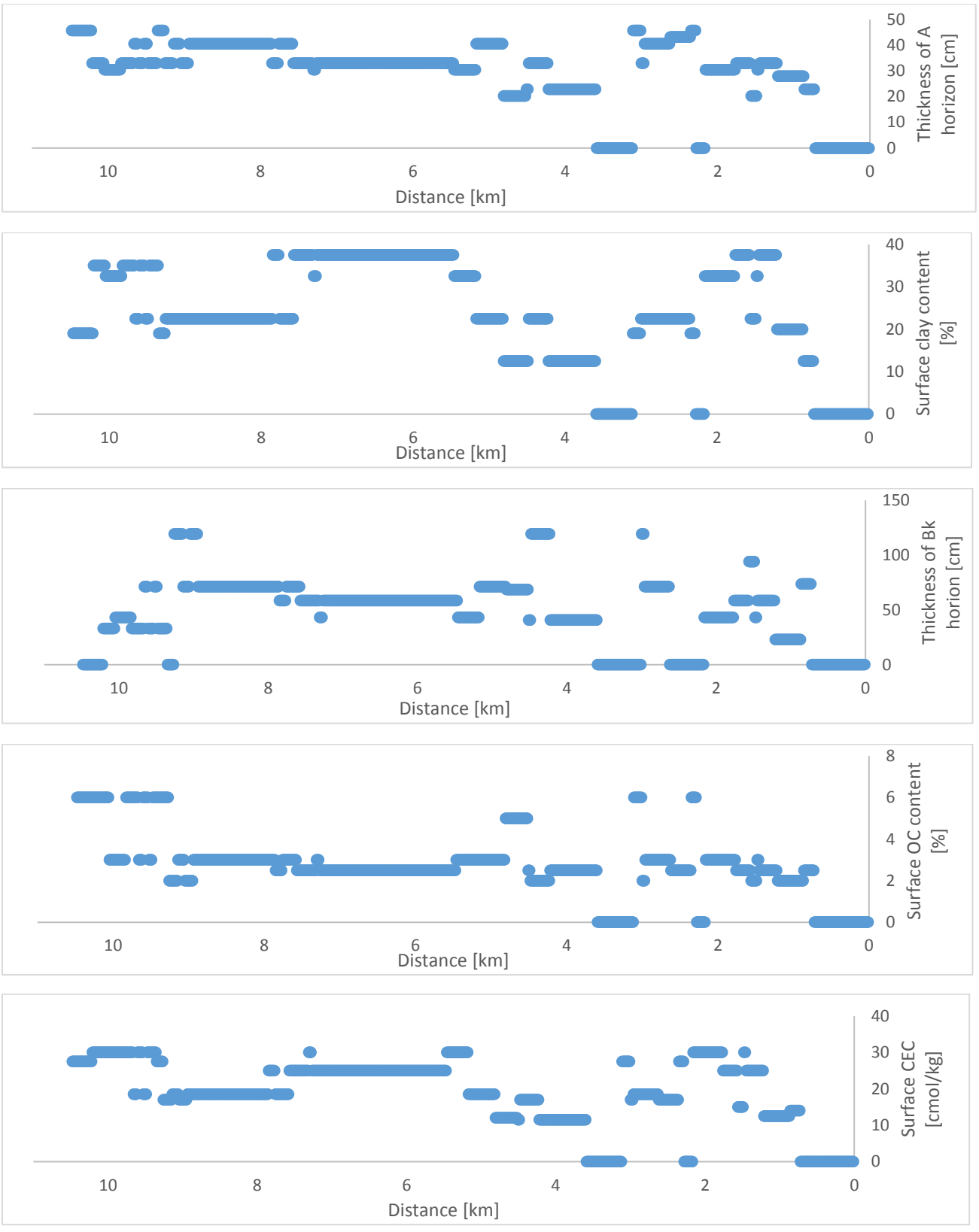

Figure 4. Soil properties along line

Discussion

As decreasing elevation, thickness A horizon, surface clay content, surface CEC increased at first downslope point. From about 3.5 km, to 4.5 km, thickness of A horizon, surface clay content, thickness of Bk horizon, surface OC content and surface CEC increased. From about 5.5 km to 9 km that was water table almost stable, thickness of A horizon, thickness of Bk horizon, surface clay content showed similar shape and a little increased, however, surface clay content and CEC a little decreased. Around 10 km, water table became shallower from 100 cm to 30 cm, and thickness of Bk horizon decreased but surface clay content, surface OC content and surface CEC increased.

Conclusion

In general, there are relationship to increase thickness of A horizon as decreasing elevation increase and increasing flow accumulation. But in this report, we could find there were more complex relationship between elevation and soils. From these results, we have to be more careful to estimate and manage data to get information we really want to know. As future work, I should increase numbers of lines to get another parent materials and water table depth.

References [data]

1. Soil data USDA Natural resources Conservation Service
http://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx Tabular and spatial complete data accessed on 7 Nov. 2016

Cache valley area, Parts of Cache and box elder counties, Utah/ UT603/ Tabular and Spatial, complete

Survey Area: Version 8,
Aug 4, 2014
Tabular: Version 8,
Aug 4, 2014
Spatial: Version 3,
Dec 16, 2013

USGS

https://viewer.nationalmap.gov/basic/#productSearch

2.USGS NED 1/3 arc-second n42w113 1 x 1 degree ArcGrid 2016
Published Date: 2016-10-17
Metadata Updated: 2016-11-07
Format: ArcGrid (198.72 MB), **Extent:** 1 x 1 degree