Soil salinity assessment using satellite thermal images

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Background

Soil salinity is a serious environmental problem

Inhibits growth of crops

Is a consequence of natural and anthropogenic processes

1/3 of all agricultural lands are becoming saline

100+ countries affected by the problem

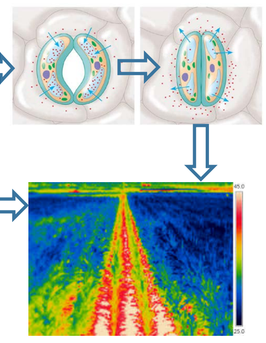
Figure 1. Highly salinized field

Introduction

Soil salinity cause decrease in stomatal conductance

Stomatal closure leads to significant changes in canopy temperature

The use of satellite thermography to detect these changes is not yet investigated



Our **objective** is to investigate the potential of satellite thermography as a tool for soil salinity assessment of cropped areas

The **study area** is the Syrdarya province of Uzbekistan, salt affected agricultural area in semi arid zone of Central Asia

Figure 2. Location of the study area in Uzbekistan

Results

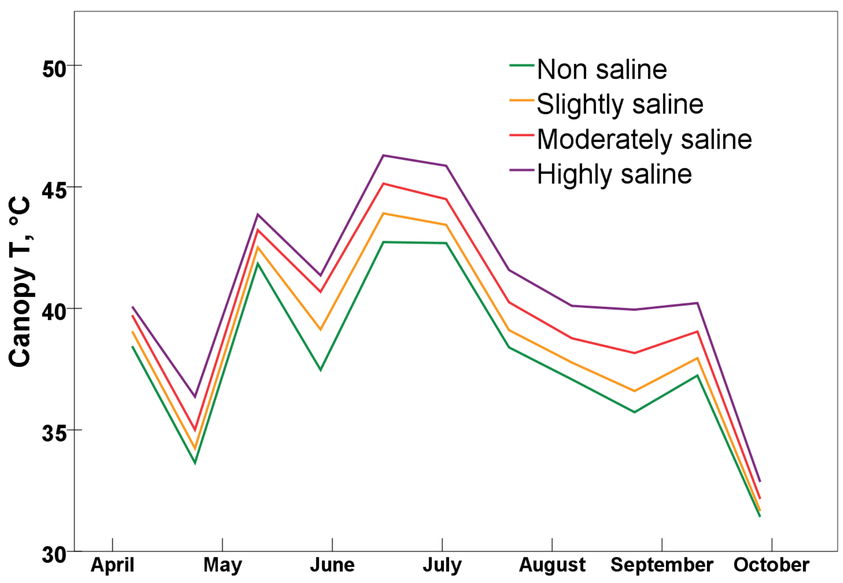


Figure 3. Time series of canopy temperature for Syrdarya province in Uzbekistan (averaged for the whole study area)

Clear and consistent difference between salinity classes

Higher salinity – higher canopy temperature

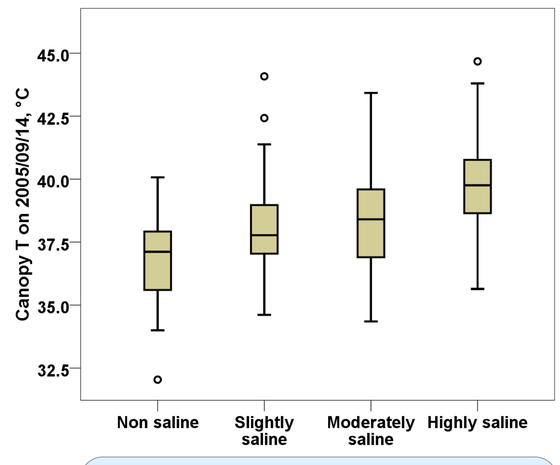
Table 1. F-values of ANOVA tests between Soil salinity map and MODIS thermal imagery, NDVI, EVI for Syrdarya province in Uzbekistan (all p-values are less than 0.01, except for elevation data)

Date	22/04	10/05	28/05	12/06	25/06	11/07	28/07	13/08	30/08	14/09	30/09
Canopy T	18.6	27.4	16.3	29.6	36.1	25.1	37.6	30.4	39.0	41.7	20.5
NDVI	8.9	17.6	19.4	20.8	23.1	33.7	37.1	39.4	27.3	34.0	21.9
EVI	5.9	16.2	12.1	7.9	13.3	20.2	29.2	27.9	23.4	26.2	12.9
Elevation	0.3 (p-value = 0.87)										

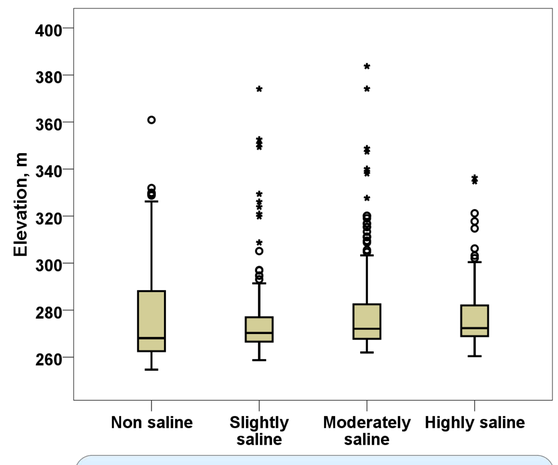
End-July to mid-September data shows highest relation between T and soil salinity

That is the cotton season in Uzbekistan and a moment of vegetative peak for cotton plants

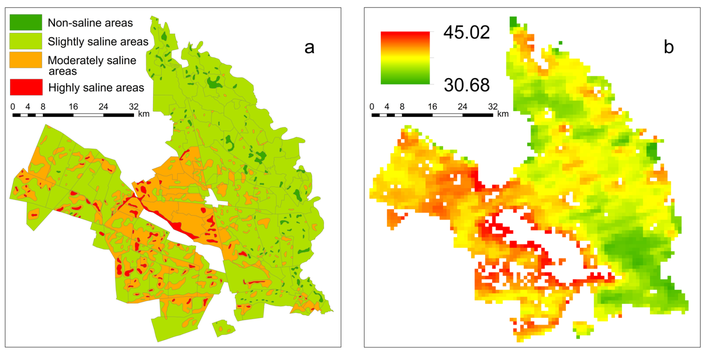
T data F-values are higher than of vegetation indices



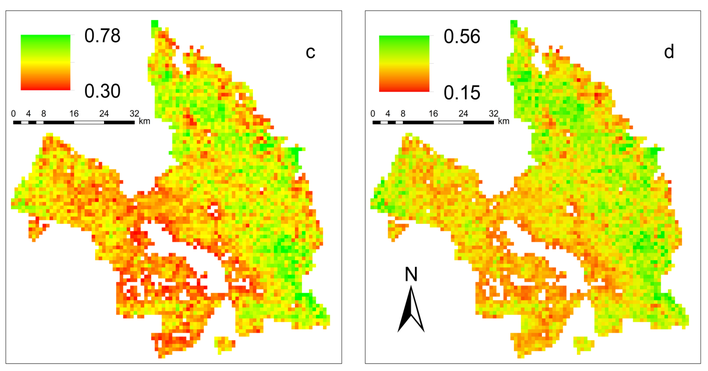
Mean temperatures between salinity classes are significantly different



Terrain properties show no influence on soil salinity



Similar spatial patterns between soil salinity map and T-map (a and b)



NDVI and EVI maps (c and d) elucidate random, noisy patterns which are less pronounced on the thermal map

Conclusions

Satellite thermography data is significantly related with soil salinity

The moment of maximum vegetation development after the dry season is the best time for monitoring

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