UTILIZING SATELLITE DATA TO ESTIMATE CORN EMERGENCE IN KANSAS

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INTRODUCTION

Large-scale monitoring of crops becomes a key topic under a climate change scenario. Plant emergence is a relevant indicator of early seasonal performance. Conventionally, emergence rate progress is reported by NASS-USDA based on an extensive network of regional agents. Satellite data may assist emergence rate monitoring over broad regions by reducing time and cost of retrieving critical information of in-seasonal crop field status.

OBJECTIVES

Workflow implementation for monitoring emergence in two Crop Reporting Districts (CRDs) of Kansas, South East (SE) and North East (NE) for 2016 and 2017 growing seasons.
Main goal: enable the use of satellite data to assist early season crop monitoring.

MATERIALS AND METHODS

The selection of the satellite data is based on NASS-USDA progress reports between March 1 to June 16, 2016 and 2017.
Materials: - 8 PROBA-V 5D TOC 100m full coverage of both regions *(ESA, 2017).*
- CONUS layer *(Yan L., Roy D.P., 2016)*
- Counties layers *(https://www.kansasgis.org/)*
- Field survey 2017.

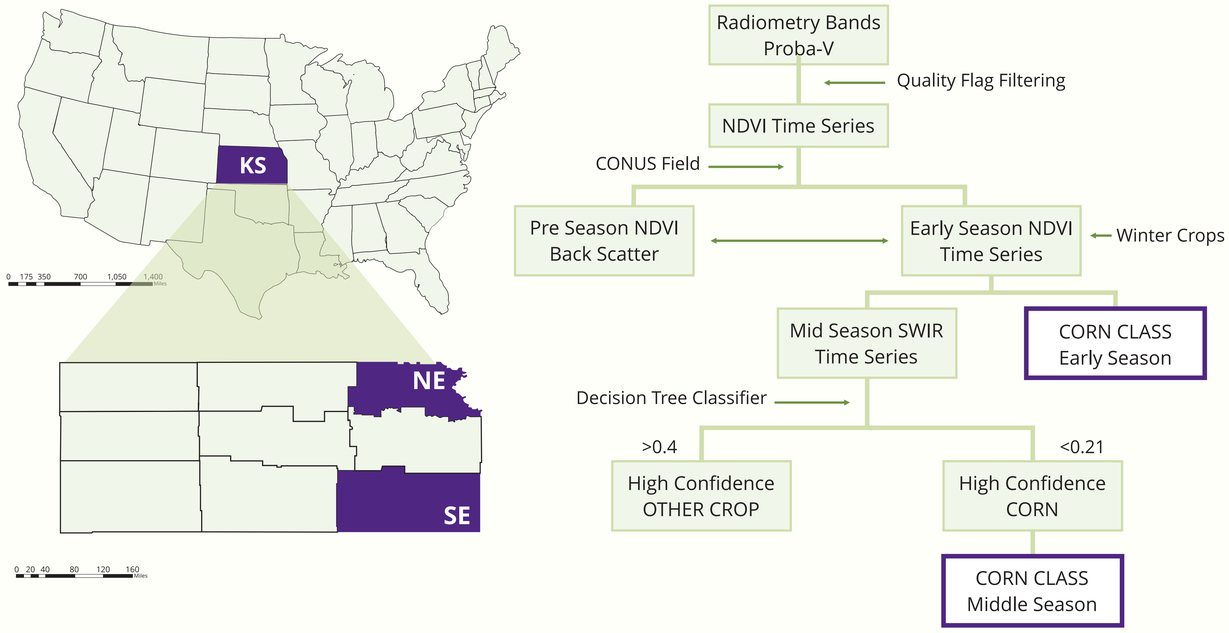

Figure 1. Left: Location of Crop Reporting Districts (CRDs) in Kansas. Right: Workflow implemented for corn emergence detection.

The developed workflow utilizes the temporal delay of NDVI and SWIR reflectance response to detect corn emergence.

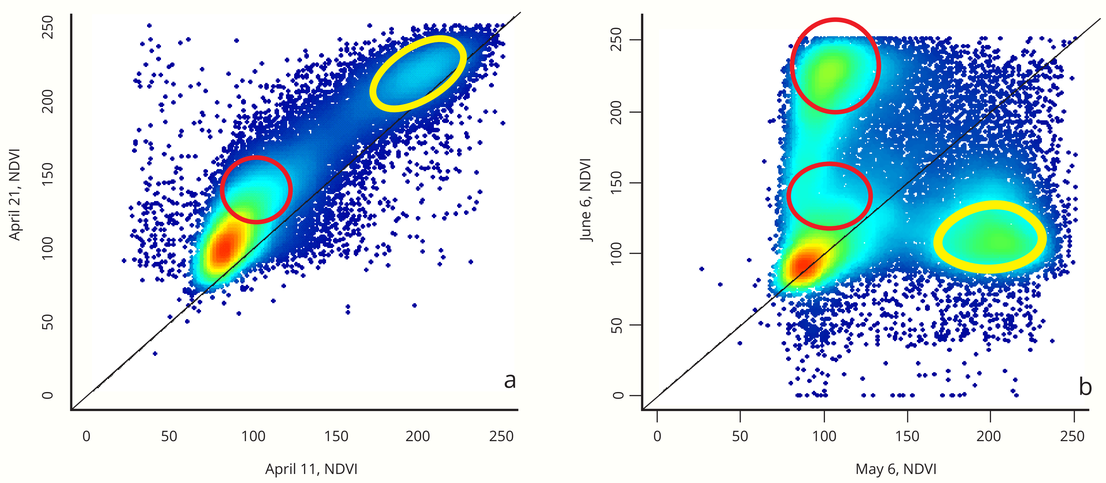

Figure 2. NDVI temporal frequency distribution of fields in SE CRD. Blue-red scale = low to high frequency of fields. a) NDVI change during April: High density of fields with low NDVI response before emergence. b) NDVI change between early May-June. Yellow circles includes alfalfa and winter crops.

RESULTS

Ground-truth data on 2017.
150 fields were revisited 2 times. First visit of fields at V2-V4 stage was included for validation. *(Abendroth, L.J., R.W. Elmore, M.J. Boyer, and S.K. Marlay, 2011).*

Table 1. Validation of emergence detection, 144 fields included between V2-V4 stage on June 6 SE and NE.

Predicted	Actual	
	Emerged Corn	Non-emerged Corn
Emerged Corn	57 (TP)	14 (FP)
Non-emerged corn	8 (FN)	65 (TN)
Precision: 0.80 Recall: 0.88 Accuracy: 0.85		

TP: True positive
FN: False negative
FP: False positive
TN: True negative

$\frac{TP}{TP+FP}$ = Precision

$\frac{TP}{TP+FN}$ = Recall

$\frac{TP+TN}{TOTAL}$ = Accuracy

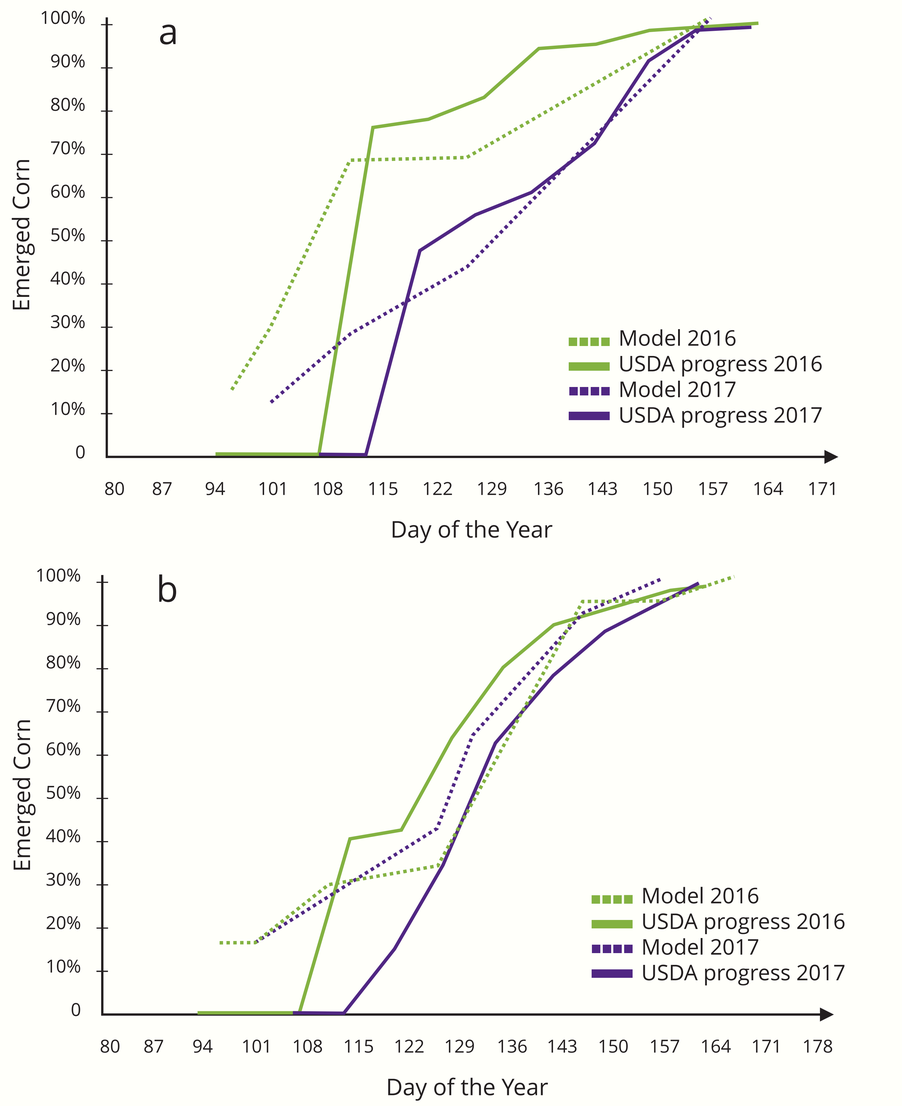

Figure 4. Emergence rate in two CRDs of Kansas. a) USDA progress report and model output for SE CRD. b) USDA progress report and model output for NE CRD.

Model and USDA reports follow a similar increasing trend on emergence rate. The implemented workflow is able to detect emergence 15 days earlier than the one reported by NASS-USDA. A delay of 10% rate was found in 2016 during early season (108-136 days) and gets reduced when reaching full emergence (after 150 days).

CONCLUSIONS

- Outcomes evidence adequated performance on emergence detection, overall Precision: 80% Recall: 88% Accuracy: 85%.
- The model is able to detect earlier seasonal emergence than NASS-USDA report.