Potato Irrigation Scheduling Using Satellite Imagery

James Han
Data Scientist
Lindsay Corporation
Jan 15th, 2020

Potato Irrigation Scheduling Using Satellite Imagery

James Han, PhD

Data Scientist

Lindsay Corporation

Jan 15th, 2020

LINDSAY™ CORPORATION

ZIMMATIC™ BY LINDSAY

FIELDNET™ BY LINDSAY

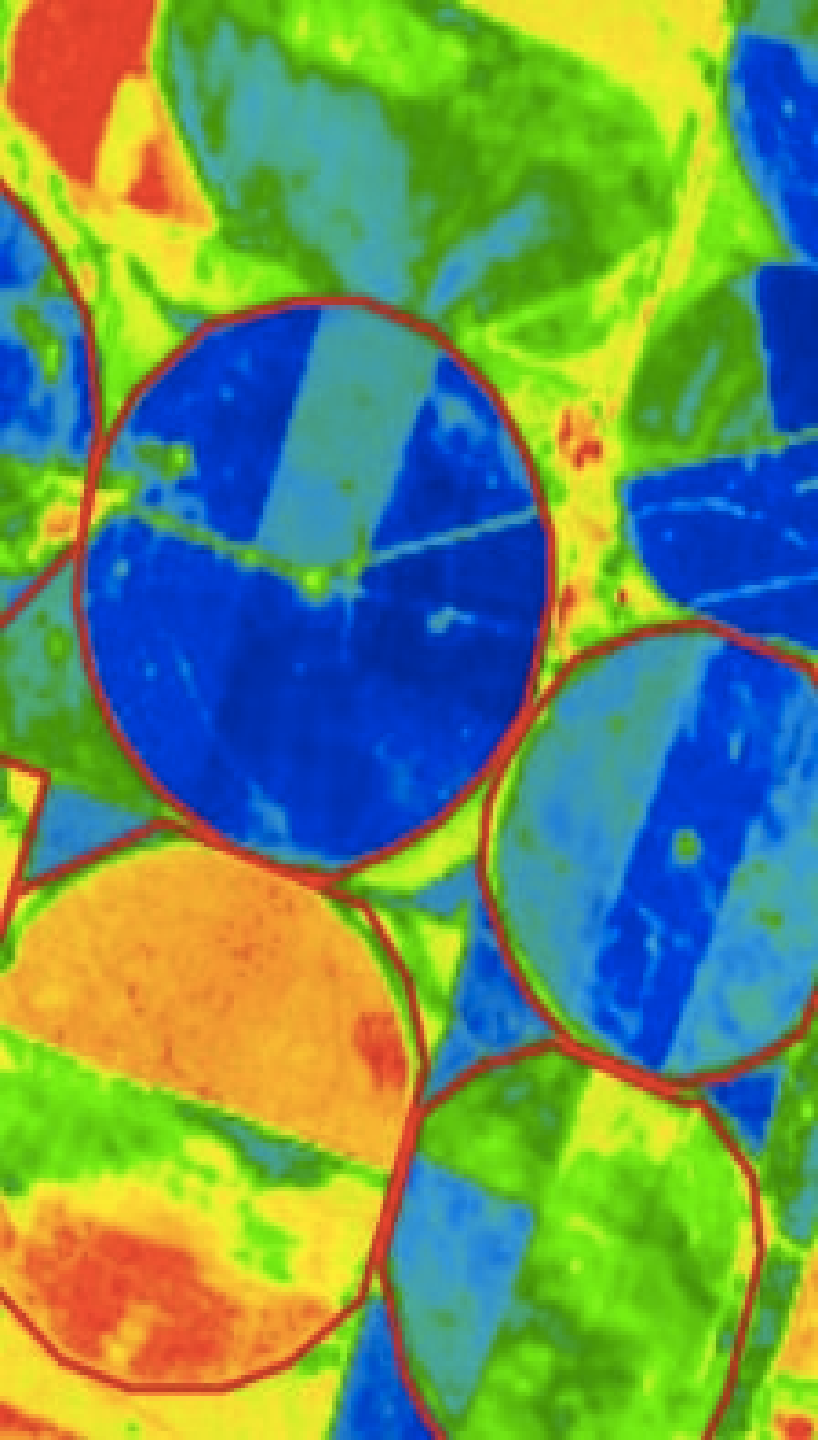
Agenda

- Review common methods and key challenges with irrigation scheduling today
- Access the accuracy of current potato growth models
- Evaluate the use of satellite imagery to improve irrigation scheduling
- Recap the key takeaways

Challenges

- Conventional potato irrigation decision making:
  - Real-time field observation (e.g., hand feel soil)
  - Soil moisture probe
  - Water balance method using virtual weather or weather station

- Satellite imagery:
  - Traditional imagery-based irrigation scheduling is a reactive rather than proactive approach
  - Relies on detection of crop water stress, which means crop should have been irrigated days earlier



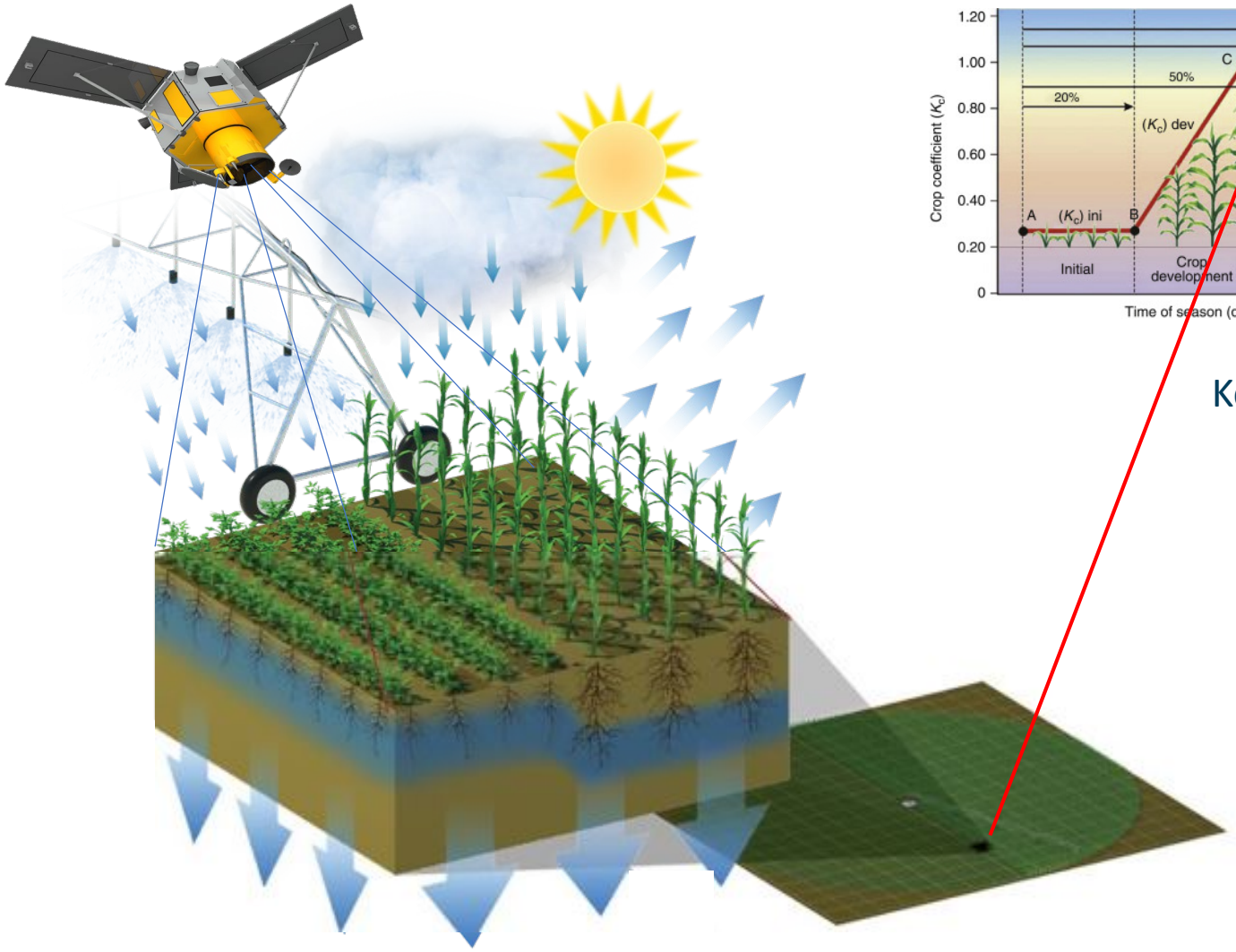
Imagery sources

Satellite	Resolution	Frequency
Landsat 8	30 meters	16 days*
Sentinel 2A/2B	10 meters	5 days*
High resolution	3 meters	1 day (multiple)

*Frequency may vary depending on the location of the field

Opportunities

A proactive approach to the use of satellite imagery to facilitate irrigation decision making



Kc, Crop Coefficient

The equation to calculate crop coefficient

$$K_c = \frac{ET_c}{ET_o}$$

Where:

ETc is actual evapotranspiration

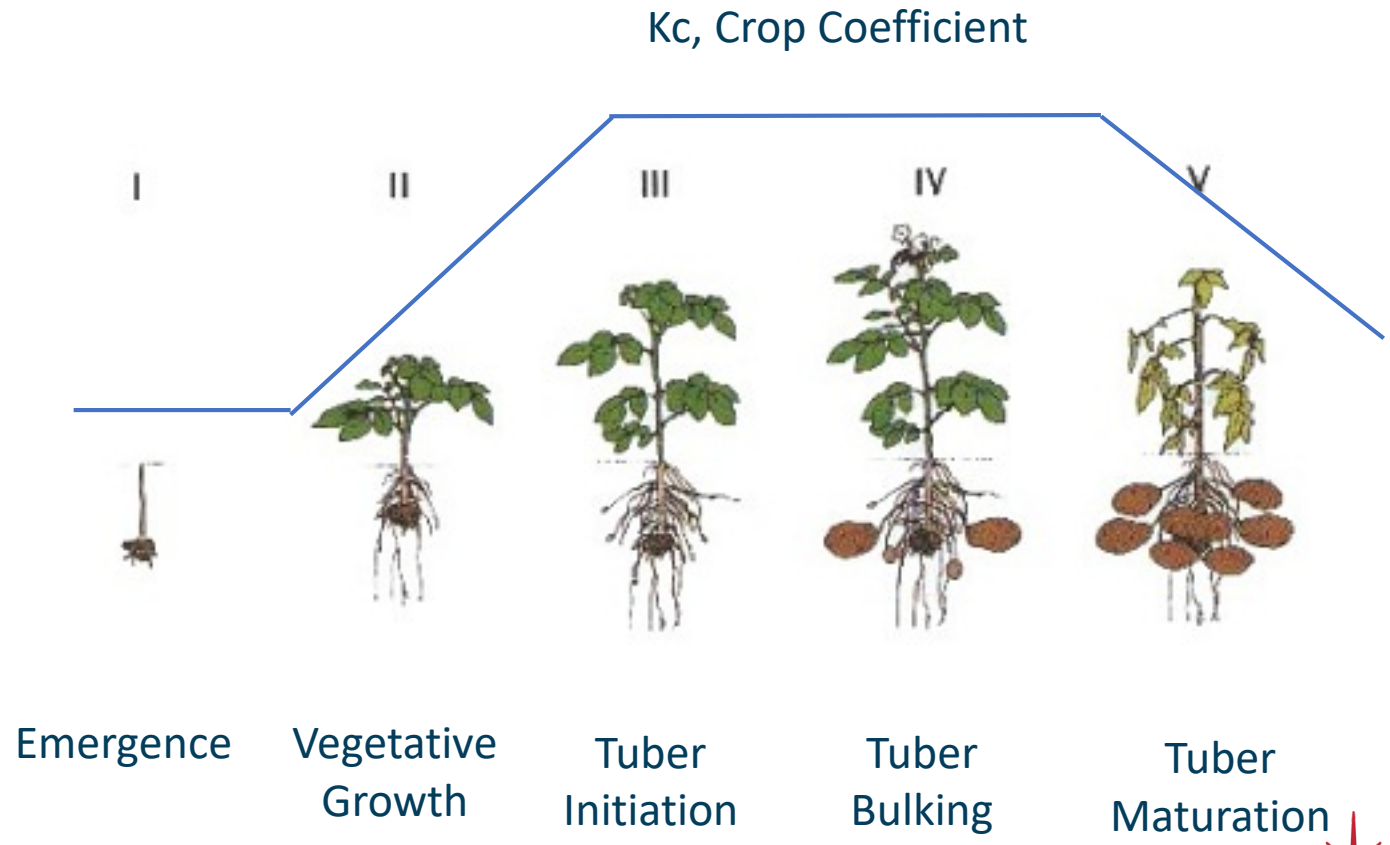
ETo is reference evapotranspiration

Kc is the “crop coefficient”

Thus, the crop coefficient (K_C) is the factor used to convert the evapotranspiration of a reference crop to that of the actual field crop

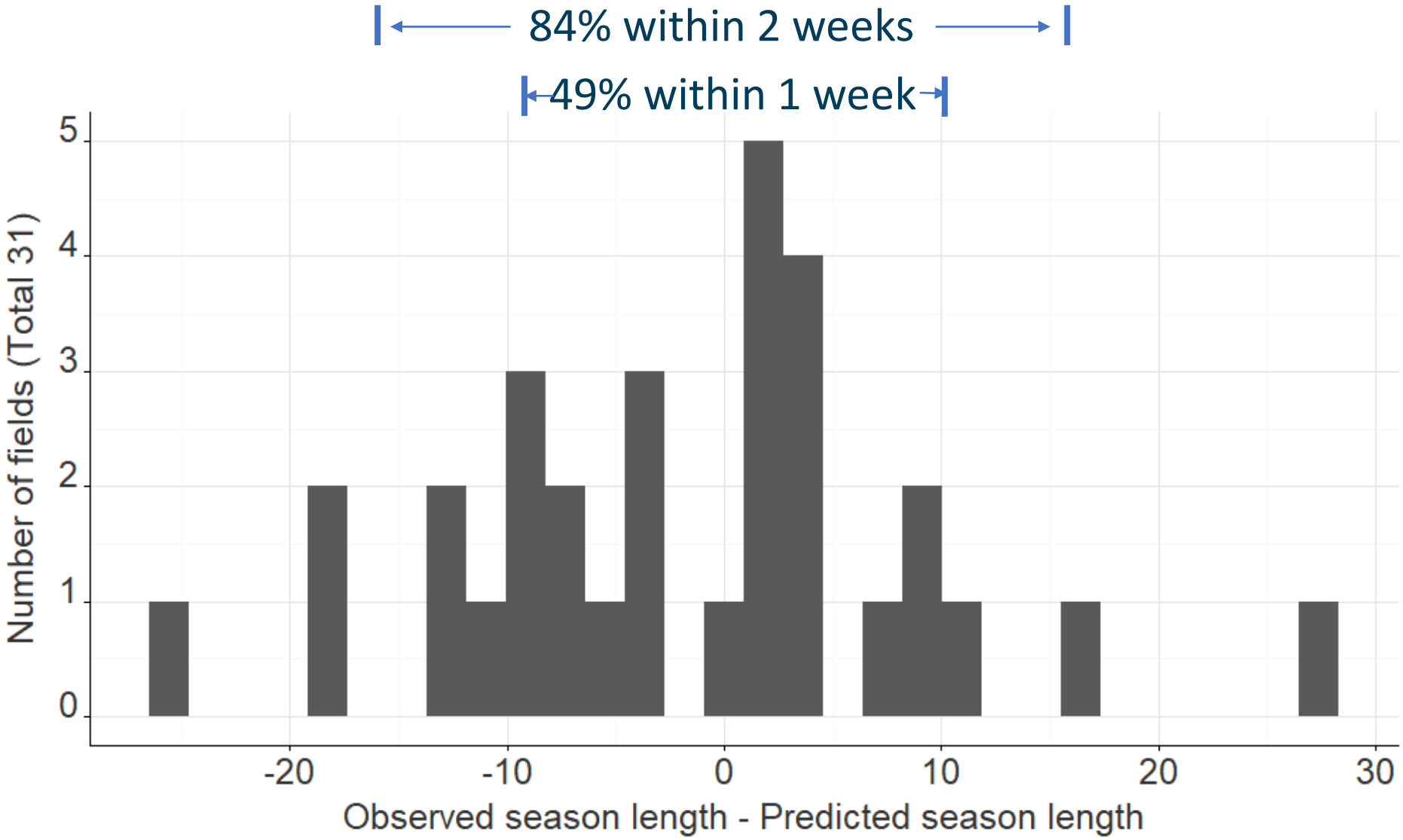
2019 field study: Material and methods

- Two geographic regions:
  - Pacific NW
  - Midwest
- More than five potato varieties included
- Includes data from >90 commercial potato fields

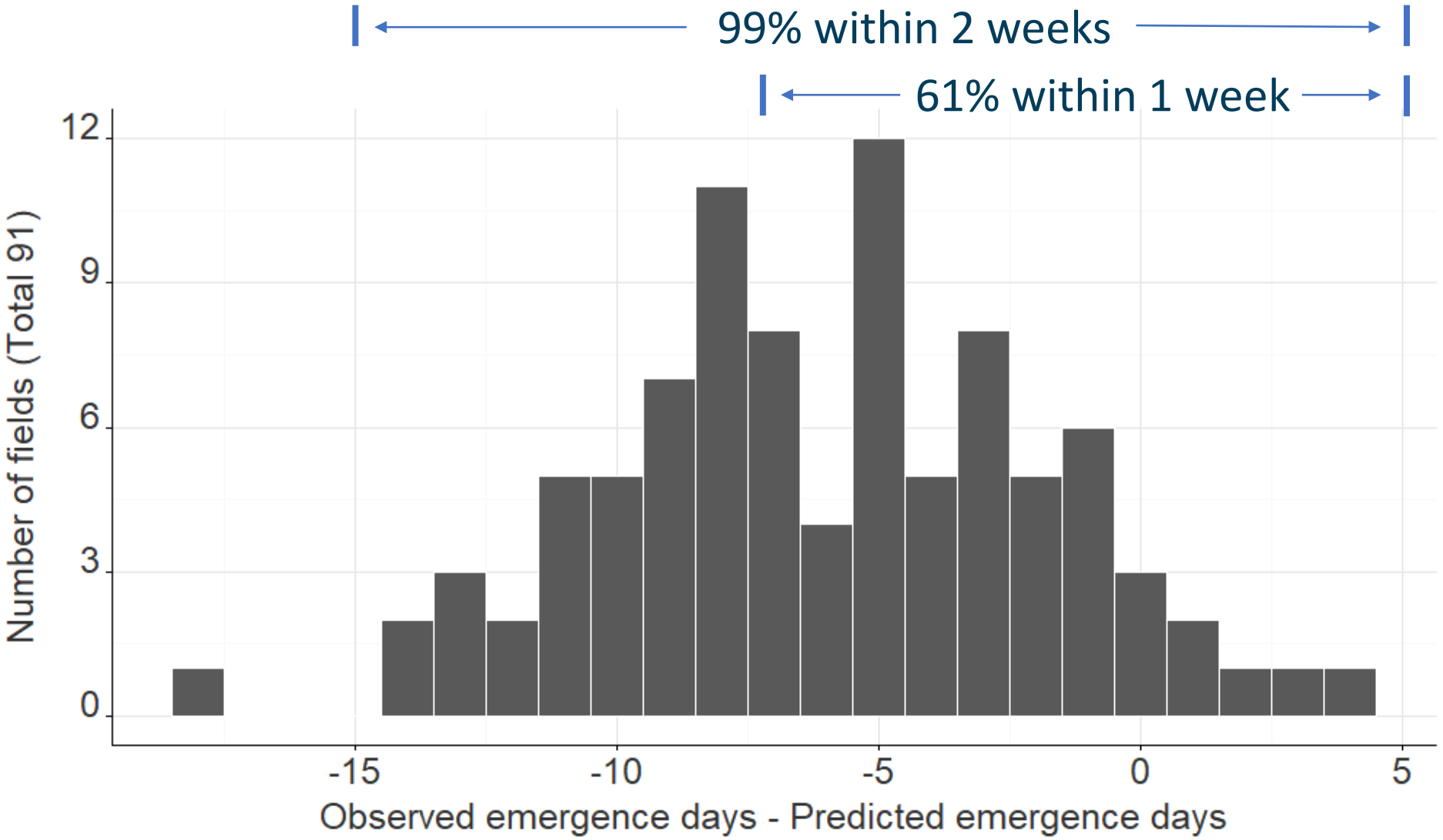


Demonstrate the Accuracy of Potato Growth Model

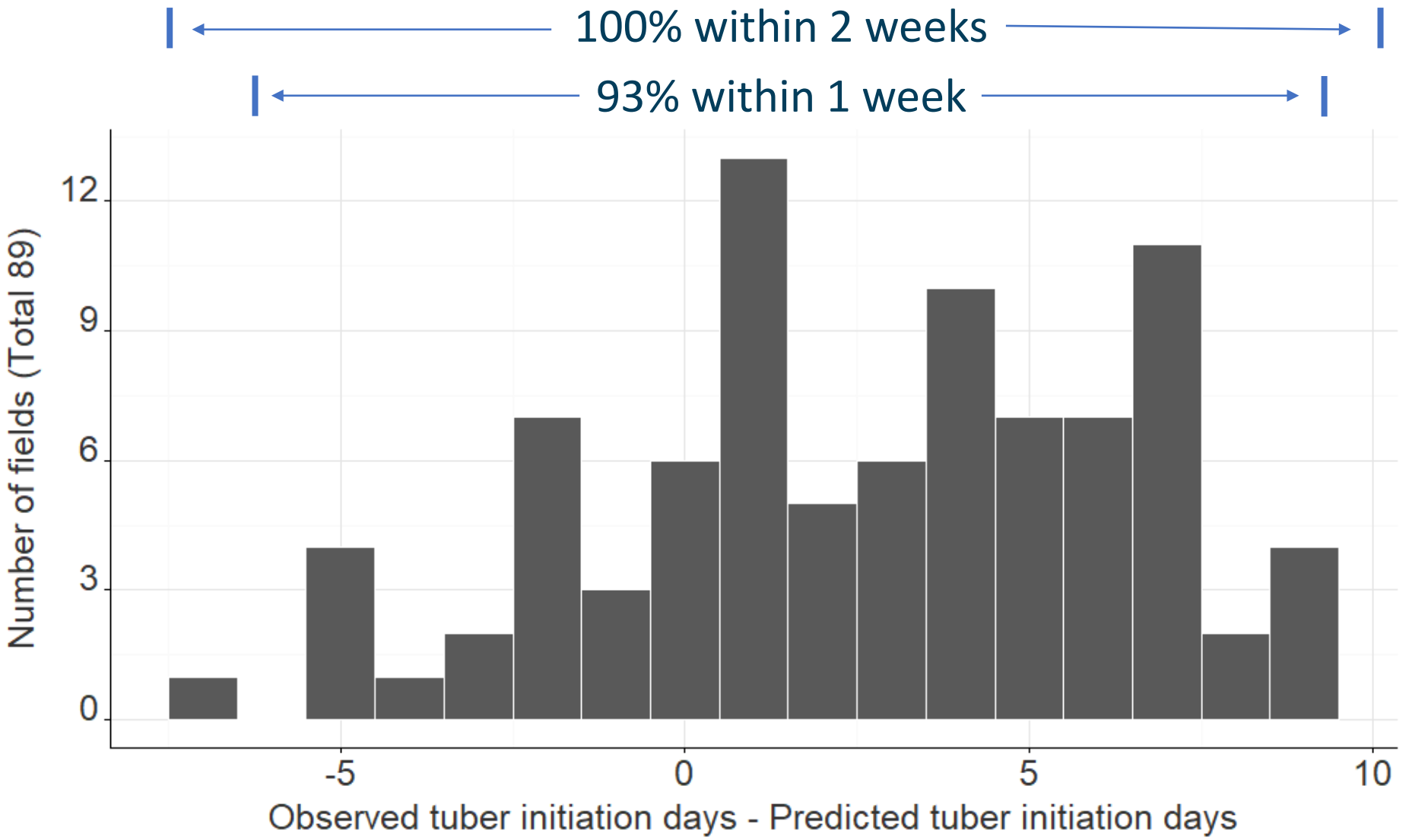
Accuracy of the predictive model on the potato season length



Accuracy of the predictive model on the potato emergence

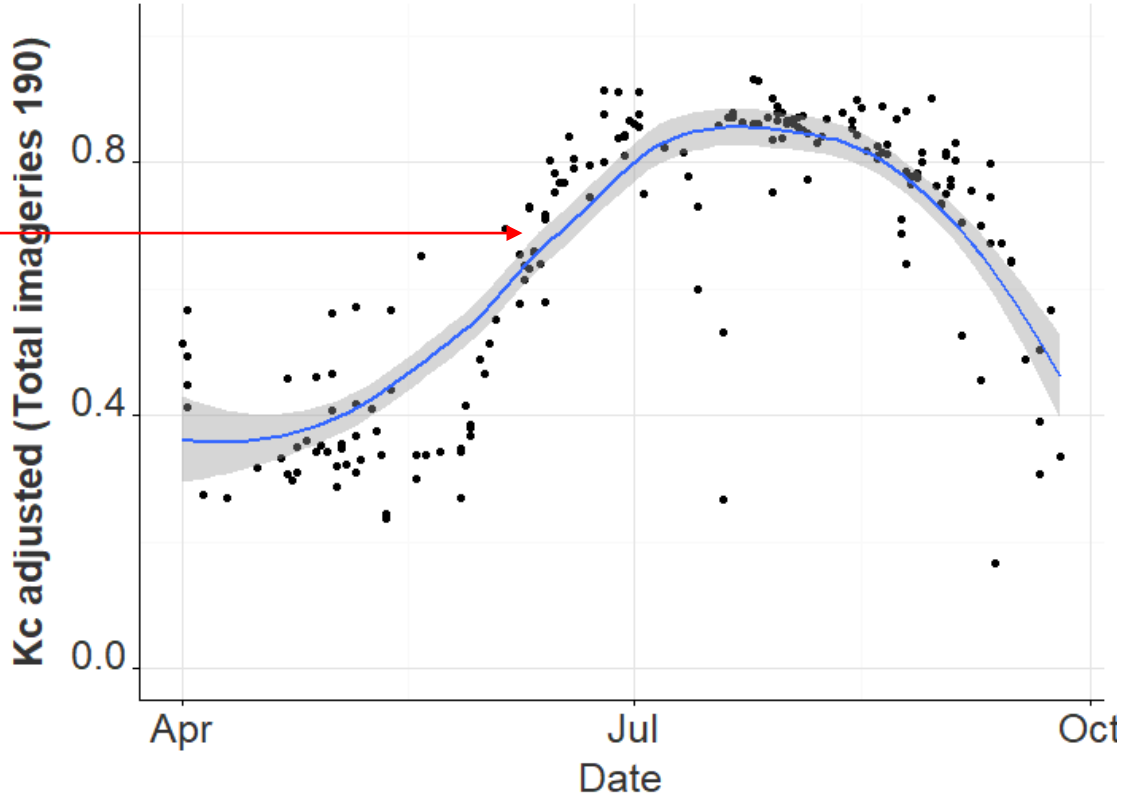


Accuracy of the predictive model on the potato tuber initiation



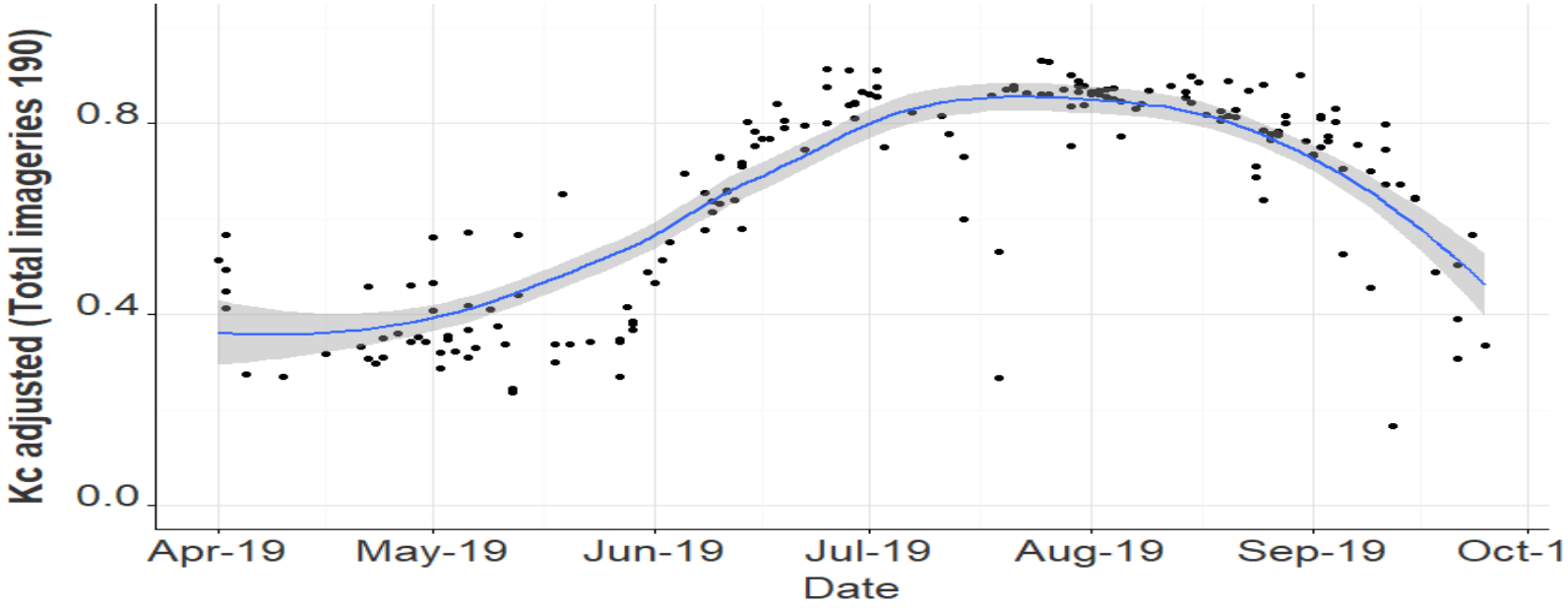
Use satellite imagery to adjust crop coefficient Kc

Using satellite imagery to adjust Kc for irrigation

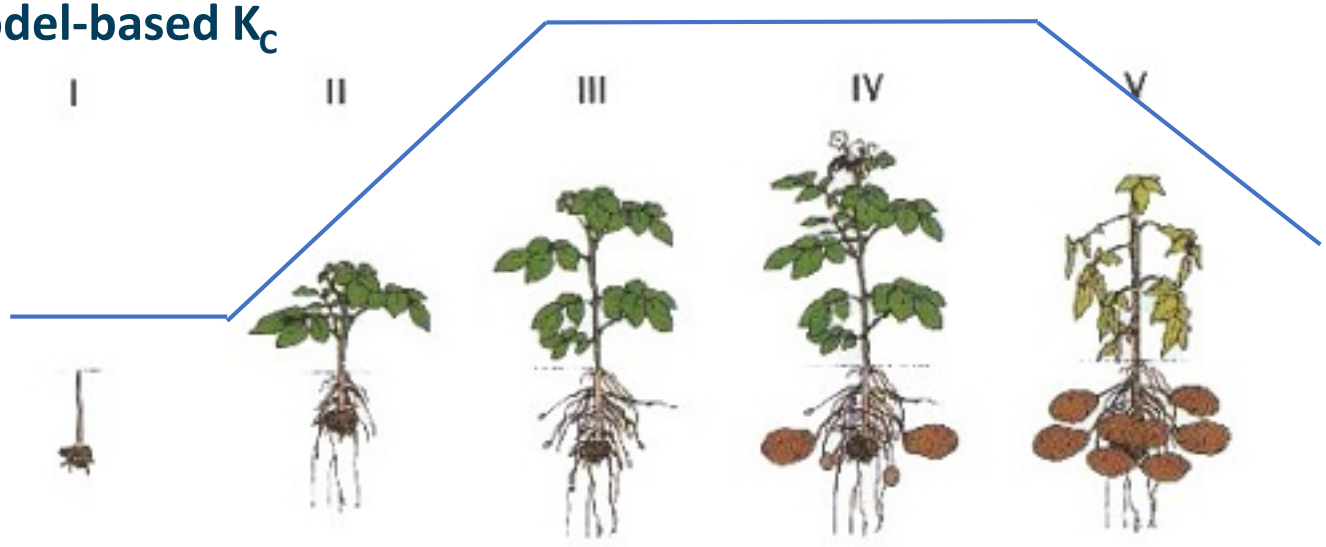


Comparison of satellite imagery-based K_c and FAO56 approach K_c

Satellite imagery-based K_c



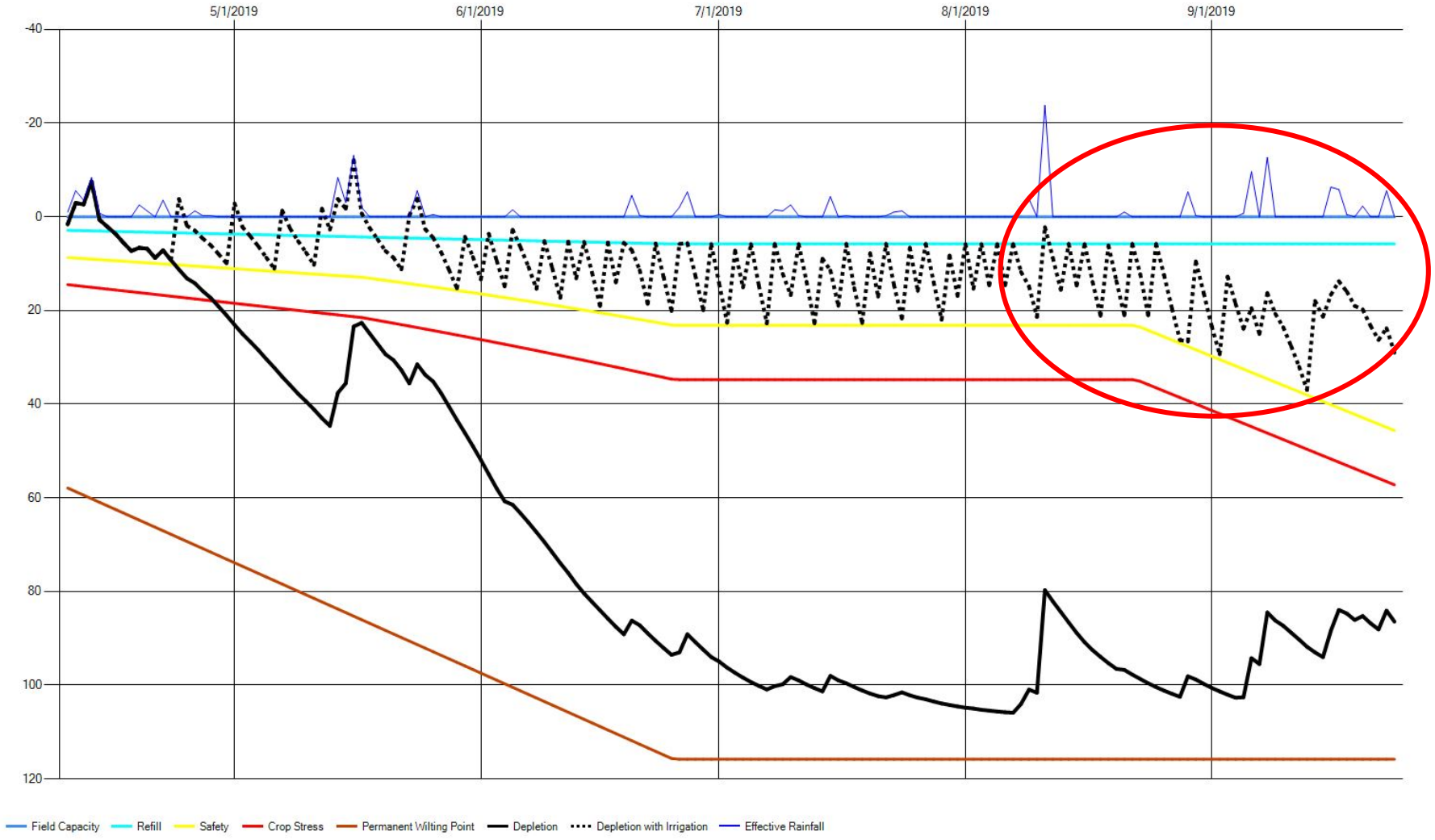
FAO 56 model-based K_c



Key insight:

The satellite imagery-based Kc follows the FAO 56 trend, but more closely tracks the crop's actual, non-linear development

Irrigation schedule before and after adjusting peak K_c from 1.15 to 1.05 based on imagery corrections



Before vs. after adjusting K_C for irrigation recommendations

- Before adjusting K_C:
  - Total irrigation forecast: 32.6 inches
  - Total Crop ET: 35.3 inches
- After adjusting K_C:
  - Total irrigation forecast: 31.6 inches
  - Total Crop ET: 34.1 inches

After adjusting the K_C values based on the satellite imagery, the irrigation requirement was reduced by 1-inch.

Key takeaways:

- Potato growth stage prediction using FAO 56 is reasonably accurate today – ~70% of fields were accurately predicted within 1-week

- Kc is the most consistent, reliable solution, but "calibrating" with quality satellite imagery has the potential to improve irrigation forecasting and scheduling accuracy.

- However, solely relying on satellite imagery for irrigation recommendations is not yet proven and the quality of the imagery will affect accuracy (e.g., cloud cover, revisit frequency)

Questions?

LINDSAY™ CORPORATION

ZIMMATIC™ BY LINDSAY

FIELDNET™ BY LINDSAY

WELCOME TO Fabulous LAS VEGAS POTATO EXPO 2020