Optimizing Irrigation Scheduling With Limited Water Using the iCrop Decision Support Tool

Isaya Kisekka

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Departments of LAWR and BAE

UC DAVIS
UNIVERSITY OF CALIFORNIA

iCrop: Integrated Crop Water and Nitrogen Management

UCDAVIS

From Experiments to Models to Decision Support

FIELD RESEARCH

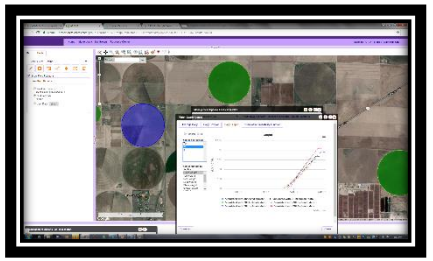
Limited Irrigation

DECISION SUPPORT SYSTEMS

for Farmers, and Crop Consultants

PROCESS MODELS OF AGRICULTURAL SYSTEMS

Explain, predict, & Extend Field Research

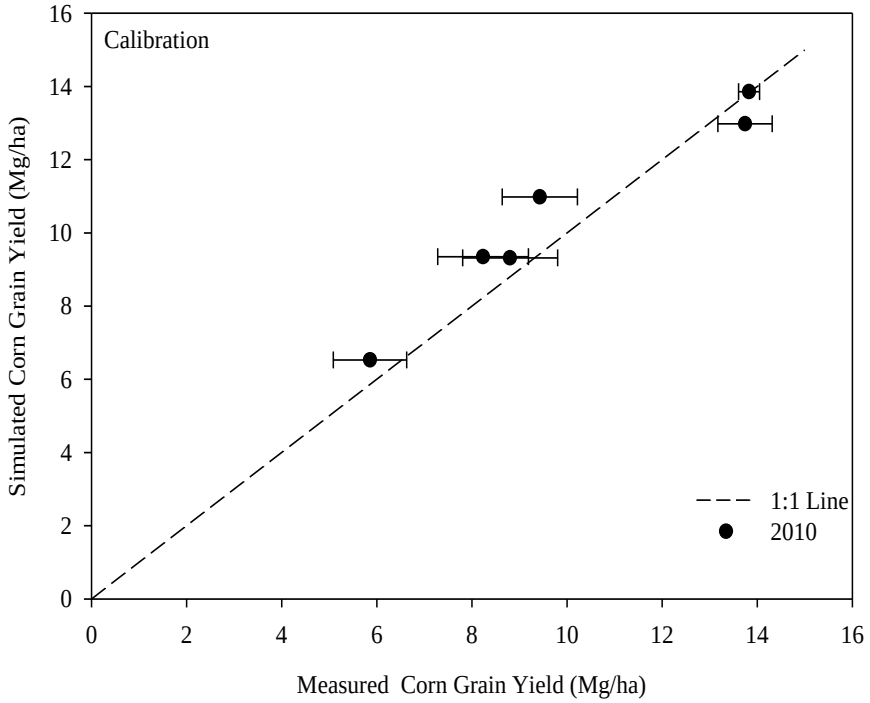


iCrop

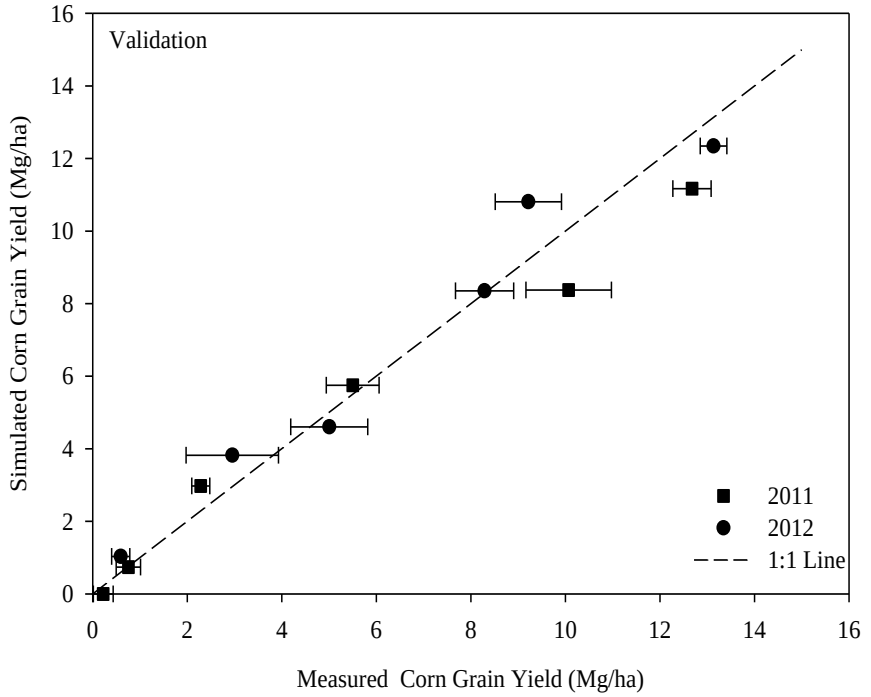
UCDAVIS

DSSAT-CSM CERES-Maize

Calibration



Validation



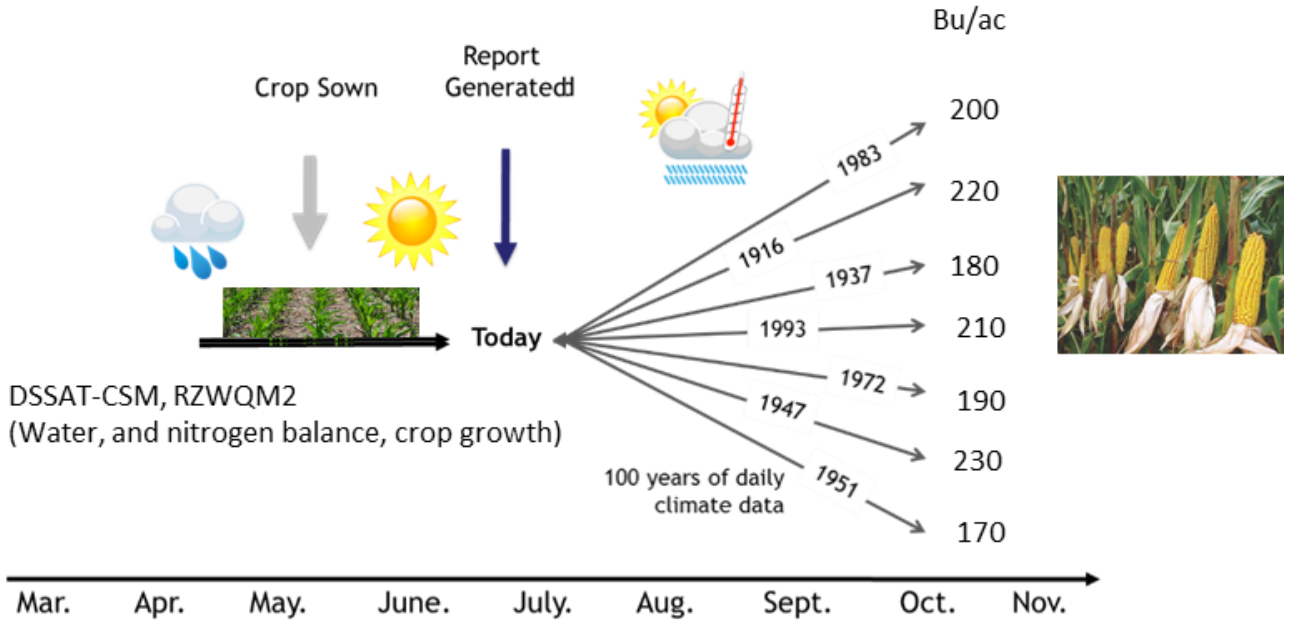
Kisekka et al. 2016

UCDAVIS

iCrop

- **I**ntegrated **C**rop water management model-driven decision support tool.
- Useful for optimizing **strategic** (preseason) and **tactical** (in season) management decisions.
- Examples of potential applications:
  1. Land-water allocation
  2. Hybrid selection and seeding rate
  3. When to initiate irrigation
  4. When to terminate irrigation
  5. Effect of splitting nitrogen applications
  6. etc.

iCrop Conceptual framework



Modified from Yield Prophet: http://www.yieldprophet.com.au/YP/HowItWorks.aspx

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Map | Fields

Select Field: TestK1

Show Field Polygons

Weather Stations

- Weather Stations
  -State Stations (MESONET or CIMIS)
- Gridded Data
  -PRISM
- User Data refresh

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Code.org | Crop-Water-ET Initiat | Decision Tools for Su | eRAMS - Environmen | Exams — Free Online | Fortran | fortran part 2-compil | Getting Started With | GitHub - RDCEP/psin | Golden Plains Credit | Guiter

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Map | Fields

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Gridded Data
-PRISM
User Data refresh

Click on the search button to display a list of weather stations closest to your crop field(s). After collecting, you can click on each station to see its location and related weather information.

If Kansas Mesonet data until Dec 31st 2015 is missing, it will be filled out with PRISM.

Radius: 20 miles

MESONET

Garden City (3.0 mi)
~~Mobile_Station (19.8 mi)~~

Soils Summary

Zoom to: Go

Ulysses
Silt loam
1856:2668829 (27%)

Richfield
Silt loam
1761:1152338 (39%)

Ulysses
Silt loam
1857:2668639 (32%)

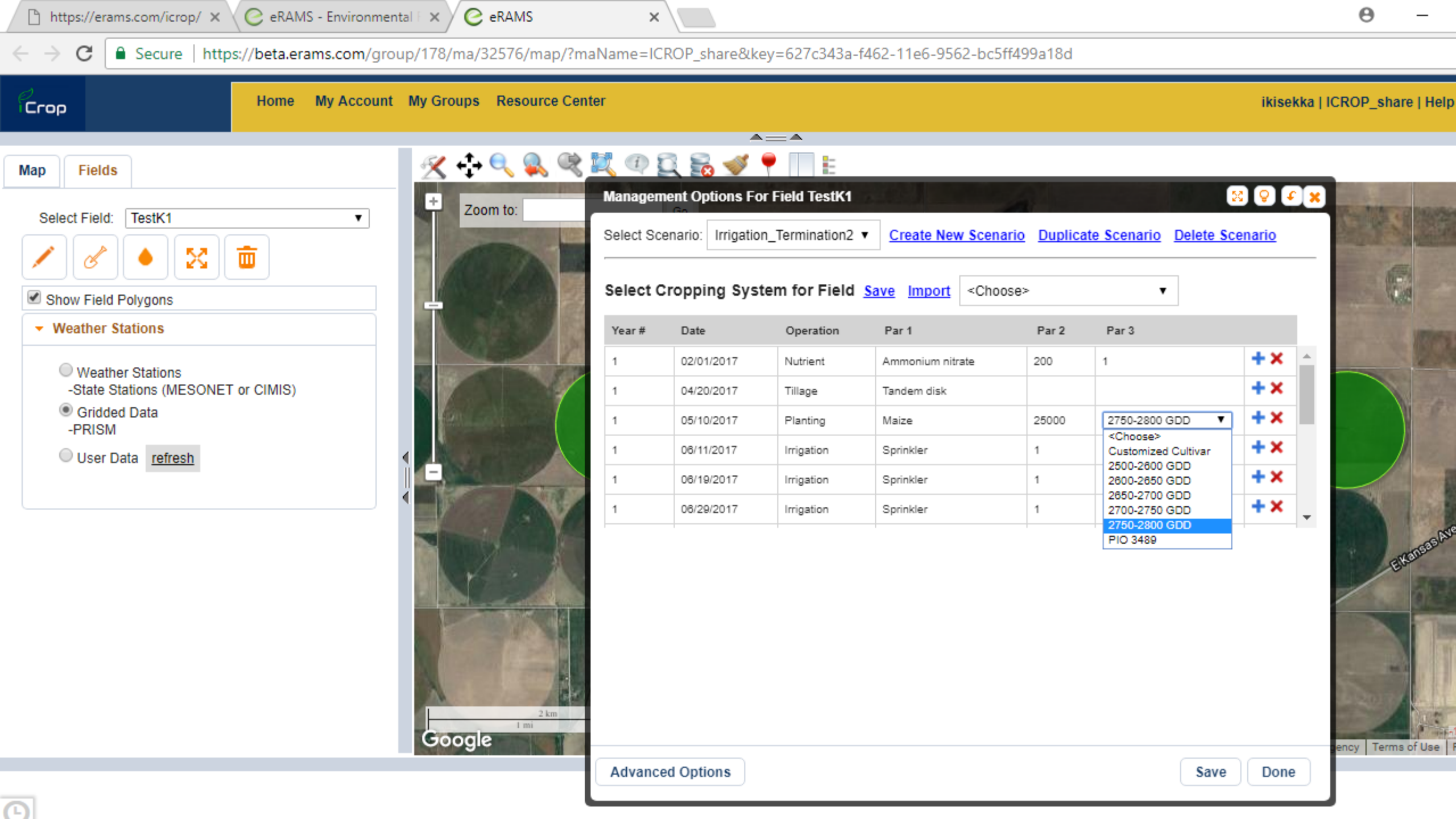
N Farmland Rd

500 m
2000 ft

Google

Map data ©2017 Google Imagery ©2017 , DigitalGlobe, USDA Farm Service Agency | Terms of Use | Report a map error

4:28 PM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Map
Fields
Select Field:
TestK1
Show Field Polygons
Weather Stations
Weather Stations
-State Stations (MESONET or CIMIS)
Gridded Data
-PRISM
User Data
refresh
Zoom to:
Management Options For Field TestK1
Select Scenario:
Irrigation_Termination2
Create New Scenario
Duplicate Scenario
Delete Scenario
Select Cropping System for Field
Save
Import
<Choose>
Year #
Date
Operation
Par 1
Par 2
Par 3
1 02/01/2017 Nutrient Ammonium nitrate 200 1
1 04/20/2017 Tillage Tandem disk
1 05/10/2017 Planting Maize 25000 2750-2800 GDD
1 06/11/2017 Irrigation Sprinkler 1
1 06/19/2017 Irrigation Sprinkler 1
1 06/29/2017 Irrigation Sprinkler 1
<Choose>
Customized Cultivar
2500-2600 GDD
2600-2650 GDD
2650-2700 GDD
2700-2750 GDD
2750-2800 GDD
PIO 3489
Advanced Options
Save
Done
2 km
1 mi
Google
E Kansas Ave
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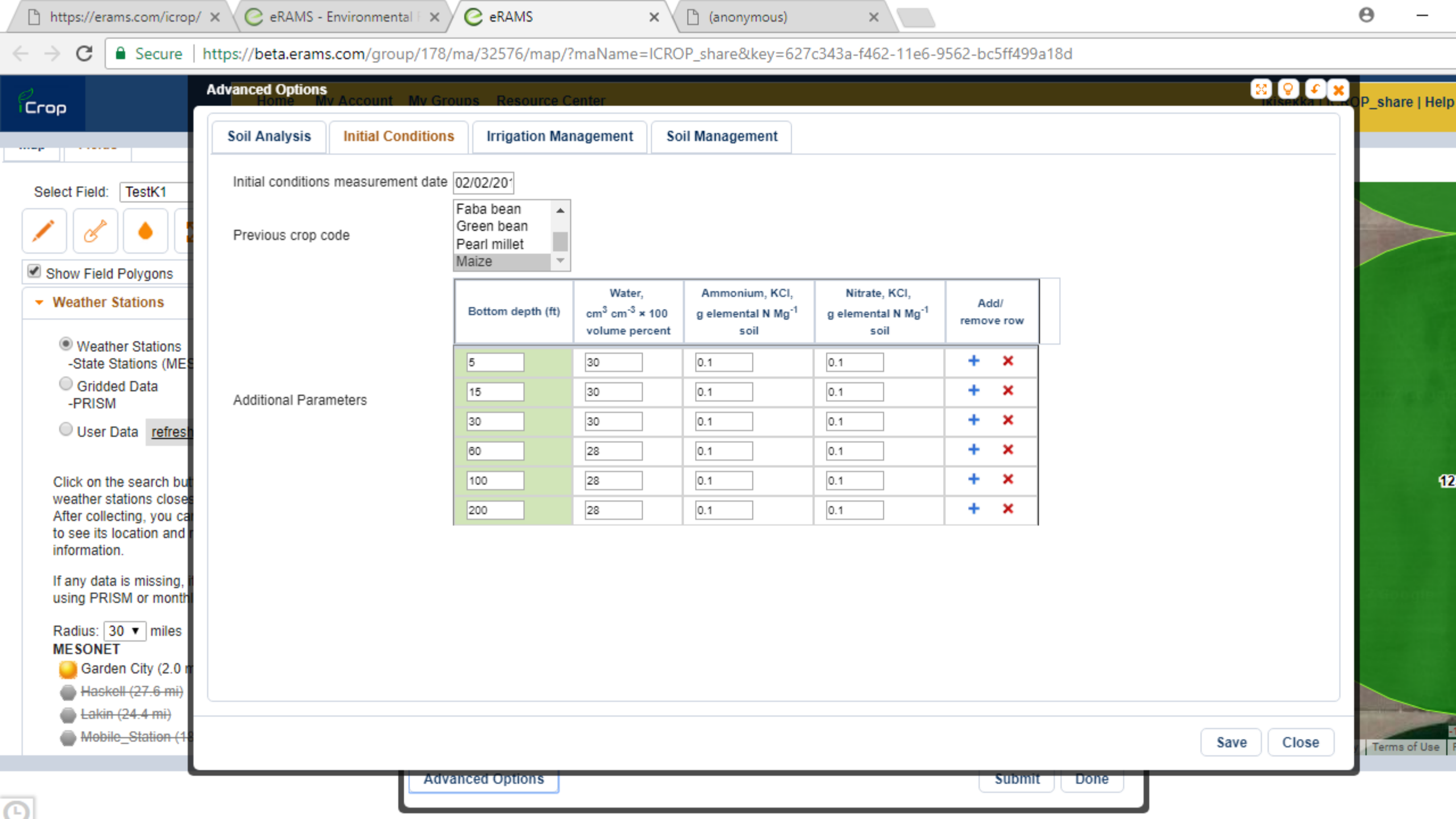
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Help
Select Field:
TestK1
Show Field Polygons
Weather Stations
Weather Stations
-State Stations (MES
Gridded Data
-PRISM
User Data
refresh
Click on the search but
weather stations close
After collecting, you ca
to see its location and
information.
If any data is missing,
using PRISM or month
Radius:
30
miles
MESONET
Garden City (2.0
Haskell (27.6 mi)
Lakin (24.4 mi)
Mobile_Station (1
Advanced Options
Submit
Done
Terms of Use
Advanced Options
Soil Analysis
Initial Conditions
Irrigation Management
Soil Management
Initial conditions measurement date
02/02/20
Previous crop code
Faba bean
Green bean
Pearl millet
Maize
Additional Parameters
Bottom depth (ft)
Water, cm3 cm-3 × 100 volume percent
Ammonium, KCl, g elemental N Mg-1 soil
Nitrate, KCl, g elemental N Mg-1 soil
Add/ remove row
5 30 0.1 0.1
15 30 0.1 0.1
30 30 0.1 0.1
60 28 0.1 0.1
100 28 0.1 0.1
200 28 0.1 0.1
Save
Close

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Map | Fields

Select Field: TestK1

Show Field Polygons

Weather Stations

- Weather Stations
  -State Stations (MESONET or CIMIS)
- Gridded Data
  -PRISM
- User Data refresh

Management Options For Field TestK1

Select Scenario: test for jae | Create New Scenario | Duplicate Scenario | Delete Scenario

Select Cropping System for Field Save | Import | <Choose>

Year #	Date	Operation	Par 1	Par 2	Par 3
1	02/03/2017	Nutrient	Urea	200	1
1	04/20/2017	Tillage	Tandem disk		
1	05/02/2017	Planting	Maiz		2750-2800 GDD
1	07/13/2017	Irrigation	Sprin		
1	07/21/2017	Irrigation	Sprin		
1	07/31/2017	Irrigation	Sprinkler	1	

Running DSSAT

Advanced Options | Submit | Done

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User Data refresh

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If any data is missing, it will be filled out using PRISM or monthly average of data.

Radius: 30 miles

MESONET

Garden City (2.0 mi)

~~Haskell (27.6 mi)~~

~~Lakin (24.4 mi)~~

~~Mobile_Station (18.7 mi)~~

Output

Simulation Period Total | Daily Output | Cumulative Probability | Growth Stage | Management Event

English SI

Select scenarios:

Irrigation_Terminat
Irr_Termination
test for jae

Irrigation_Termination2

Select outputs to display:

Precipitation
Surface Runoff
Evapotranspiration
Total Nitrate
Total Nitrogen

Select years to display:

2010
2011
2012
2013
2014
2015

Close

Advanced Options

Submit Done

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English SI

Select scenarios:

Irrigation_Terminat
Irr_Termination
test for jae

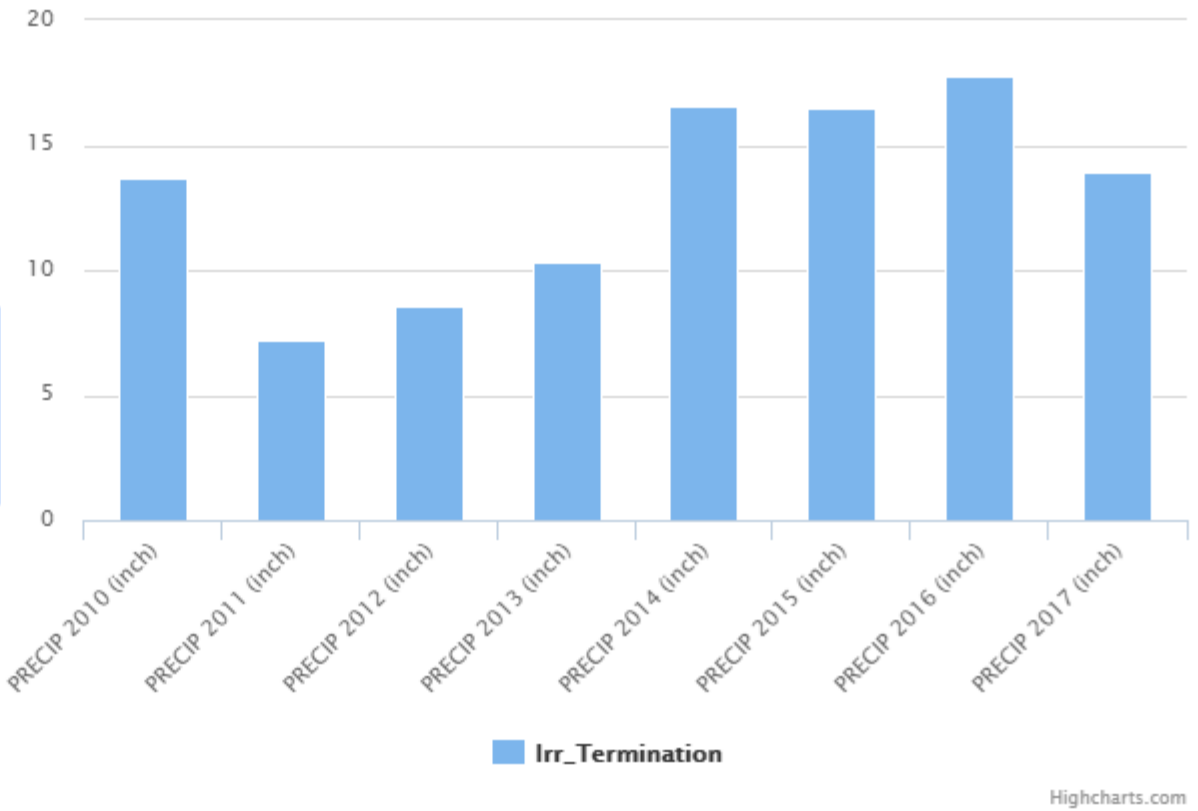
Select outputs to display:

Precipitation
Surface Runoff
Evapotranspiration
Total Nitrate
Total Nitrogen

Select years to display:

2012
2013
2014
2015
2016
2017

Total Output



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Output

Simulation Period Total | Daily Output | Cumulative Probability | Growth Stage | Management Event

English SI

Select Scenarios:

Irrigation_Terminat
Irr_Termination
test for jae

Select outputs to display:

Grain weight
Top weight
H2O stress
N stress
Extractable water
Cumulative irrigati

Output

YLD (KG/HA)

15k
10k
5k
0k

Jun '18 Jul '18 Aug '18 Sep '18

Simulated with observed climate
Simulated with 2013 climate data
Simulated with 2014 climate data
Simulated with 2015 climate data
Simulated with 2016 climate data
Simulated with 2017 climate data

Close

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English SI

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Irr_Termination
test for jae

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Top weight
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Output

Simulation Period Total | Daily Output | Cumulative Probability | Growth Stage | Management Event

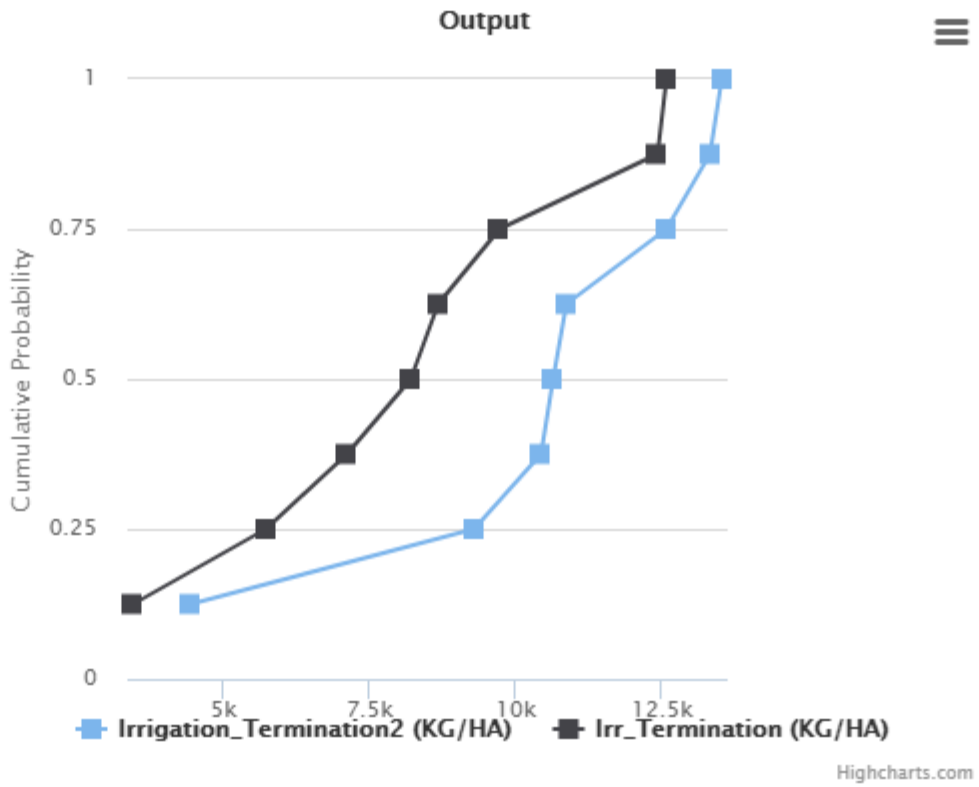
English SI

Select Scenarios:

Irrigation_Terminat
Irr_Termination
test for jae

Select outputs to display:

CPF of Yield
CPF of Top Weigh
CPF of Water Proc



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Output

Simulation Period Total | Daily Output | Cumulative Probability | Growth Stage | Management Event

Select Scenarios:

Irrigation_Terminat
Irr_Termination
test for jae

Select outputs to display:

Management Ever

Climate year:2010

Emergence	Floral Initiation	75% Silking	Phys. Maturity
MAY 23, 2018	JUN 15, 2018	JUL 22, 2018	SEP 10, 2018

Climate year:2011

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~~Lakin (24.4 mi)~~

Output

Simulation Period Total | Daily Output | Cumulative Probability | Growth Stage | Management Event

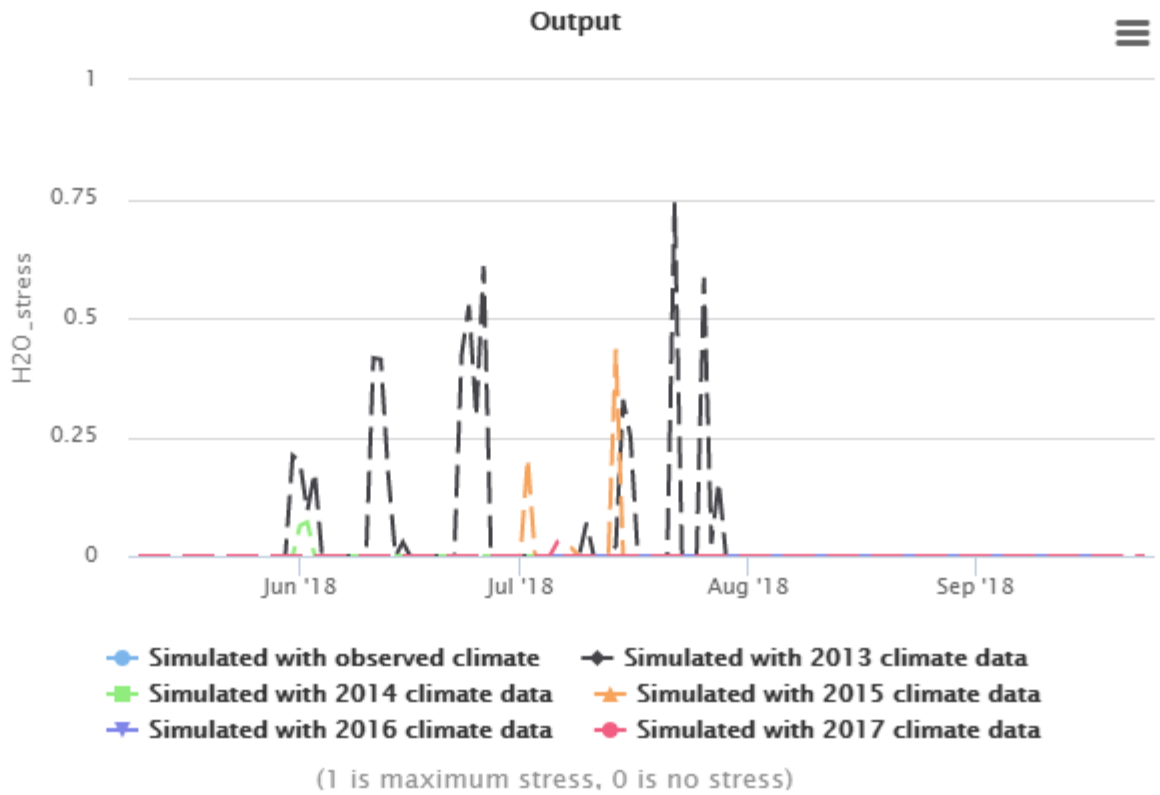
English | SI

Select Scenarios:

- Irrigation_Terminat
- Irr_Termination
- test for jae

Select outputs to display:

- Grain weight
- Top weight
- H2O stress
- N stress
- Extractable water
- Cumulative irrigatio



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Output

Simulation Period Total | Daily Output | Cumulative Probability | Growth Stage | Management Event

English | SI

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Irrigation_Terminat
Irr_Termination
test for jae

Select outputs to display:

Grain weight
Top weight
H2O stress
N stress
Extractable water
Cumulative irrigati

Output

N_stress

0.6
0.4
0.2
0

Jun '18 | Jul '18 | Aug '18 | Sep '18

Sunday, Aug 19, 2018
Simulated with 2016 climate data: 0.017

Simulated with observed climate
Simulated with 2013 climate data
Simulated with 2014 climate data
Simulated with 2015 climate data
Simulated with 2016 climate data
Simulated with 2017 climate data

(1 is maximum stress, 0 is no stress)

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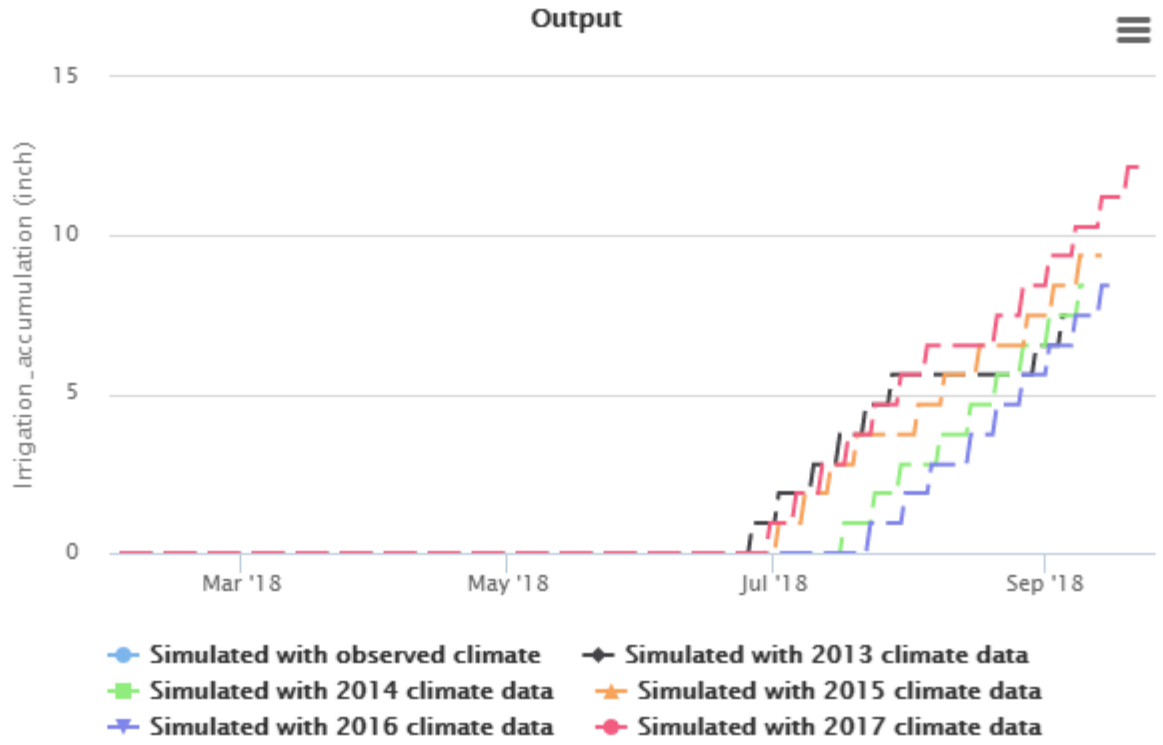
Irr_Termination
test for jae

Select outputs to display:

H2O stress
N stress
Extractable water
Cumulative irrigati
Cumulative draina
Cumulative evapot



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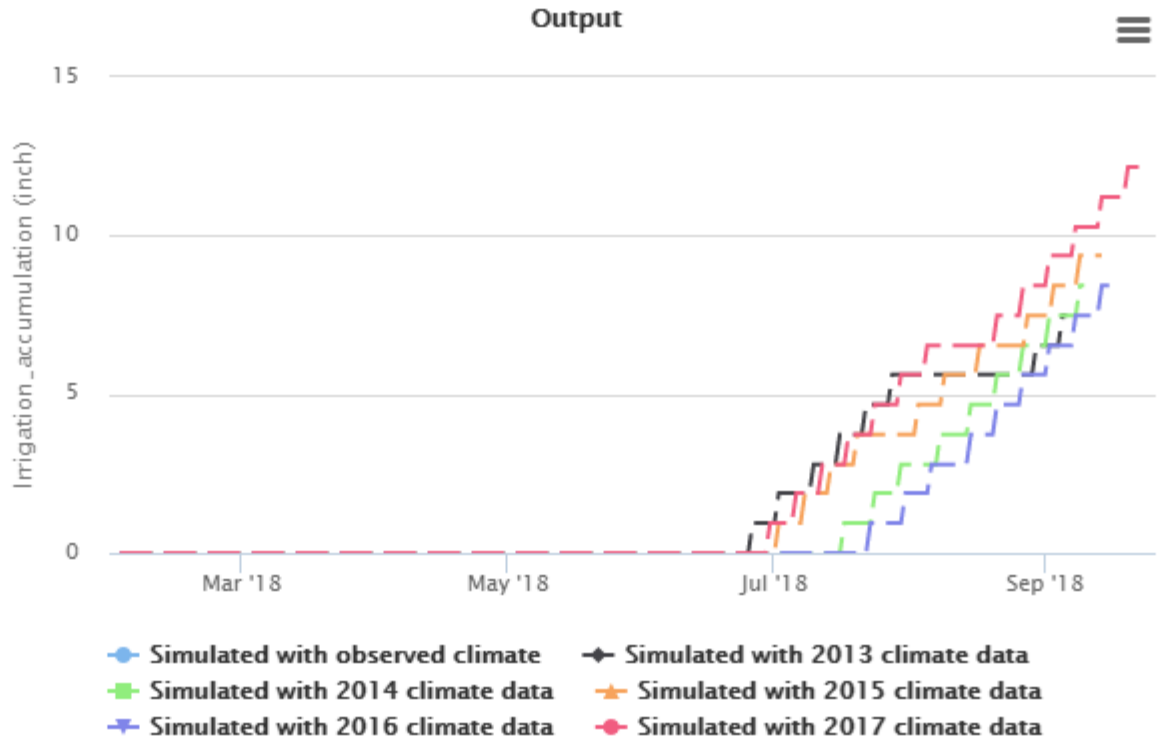
Cumulative draina
Cumulative evapot

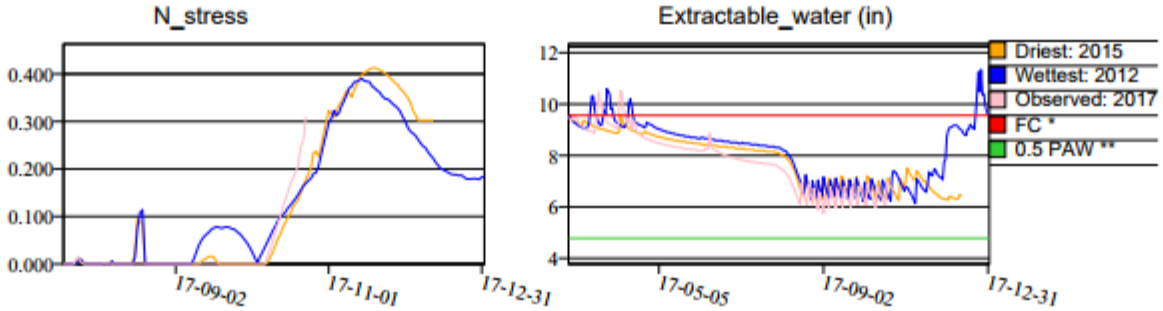


Close

E Kansas Ave

A Farm Service Agency | Terms of Use

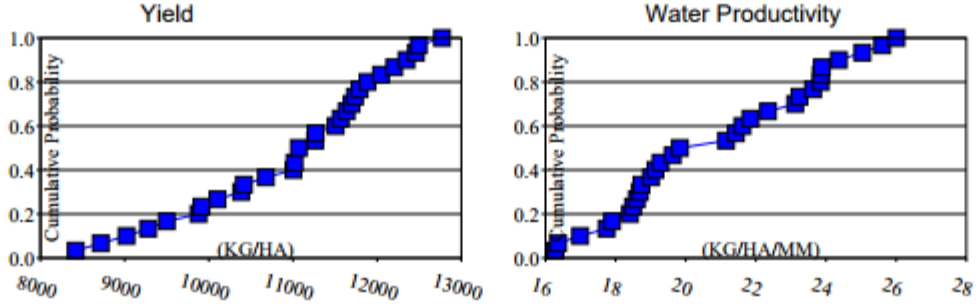
fieldAssessmentRe....pdf



* FC: Extractable Soil Water at Field Capacity

** 0.5 PAW: Extractable Soil Water at 50% Plant Available Water

Cumulative probability output



DASHBOARD / RESEARCH FIELD

Collapse Sensors [Field]

Research Field

Reload Settings Print

WEATHER DATA

64°F

Wind: 31.09 mph
Humidty: 17%
Pressure: 1,026 hPa

FORECAST

Tue	Wed	Thu	Fri	Sat
58°	71°	65°	40°	55°
38°	37°	45°	33°	28°
0"	0"	0"	0.0"	0"

CROP INFORMATION

Crop: Corn
Growth Stage: R6 - maturity
Planting Date: 05/08/2017
Current ET: 0.03
Avg 4 Day ET: 0.03
Estimated GDUs to Maturity: 2800

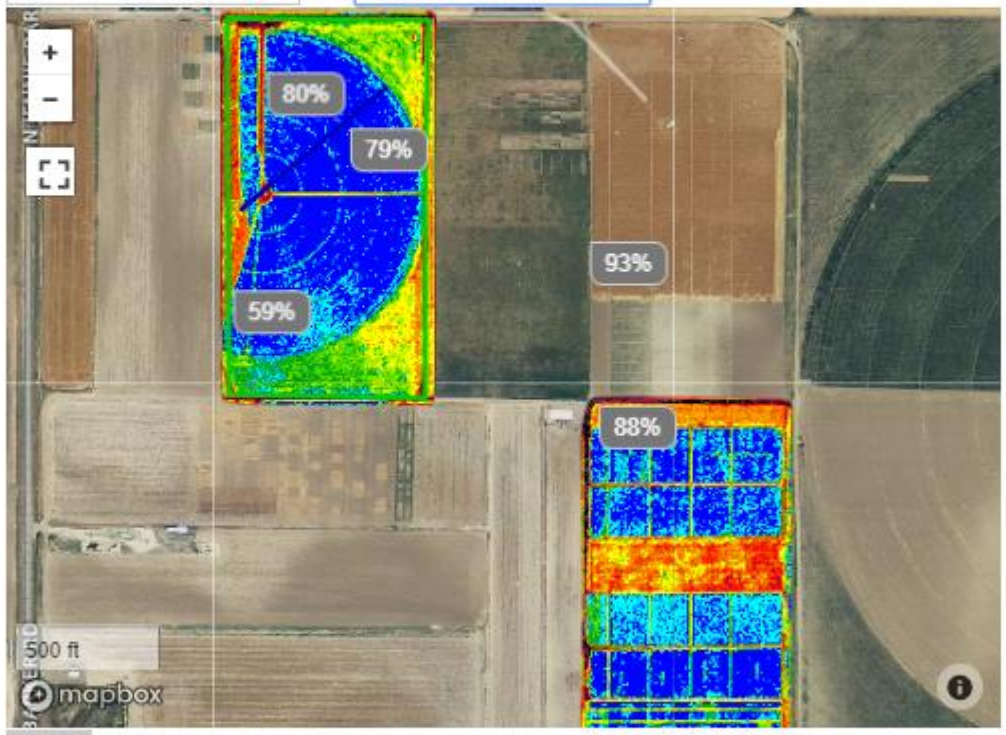
GDUs

PIVOT

October 23, 2017

Power: ON
Pressure: 0.0PSI
Direction of travel: FWD
Angle: 50

Vigor 8/2/2017



Off Pivot History

A. 53428 3RD TOWER DRAGONLINE300

Oct 10 2017 4:40PM
Soil Temp: 68°F
Soil: Silt Loam
59%

B. 53405 3RD TOWER NOZZLES 300

Oct 12 2017 3:26AM
Soil Temp: 61°F
Soil: Silt Loam
53%

C. 53403 2ND TOWER DRAGONLINE300

Oct 11 2017 7:05AM
Soil Temp: 57°F
Soil: Silt Loam
64%

D. 53867 2ND TOWER NOZZLES 300

Oct 10 2017 5:04PM
Soil Temp: 64°F
Soil: Silt Loam
71%

Thank you!