# NSF PIRE Water and Food Security Celebration -Student Presentation

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# My main goal for joining PIRE project

- Improve my research ability
- Improve my communication ability
- Participate in a meaningful work

# My major findings during time as researcher

I. Calibrated a crop model and analyzed the yield trend of major cereal crops and climate impacts

II. Developed a linked hydro-crop model and analyzed the impact of soil moisture on yield

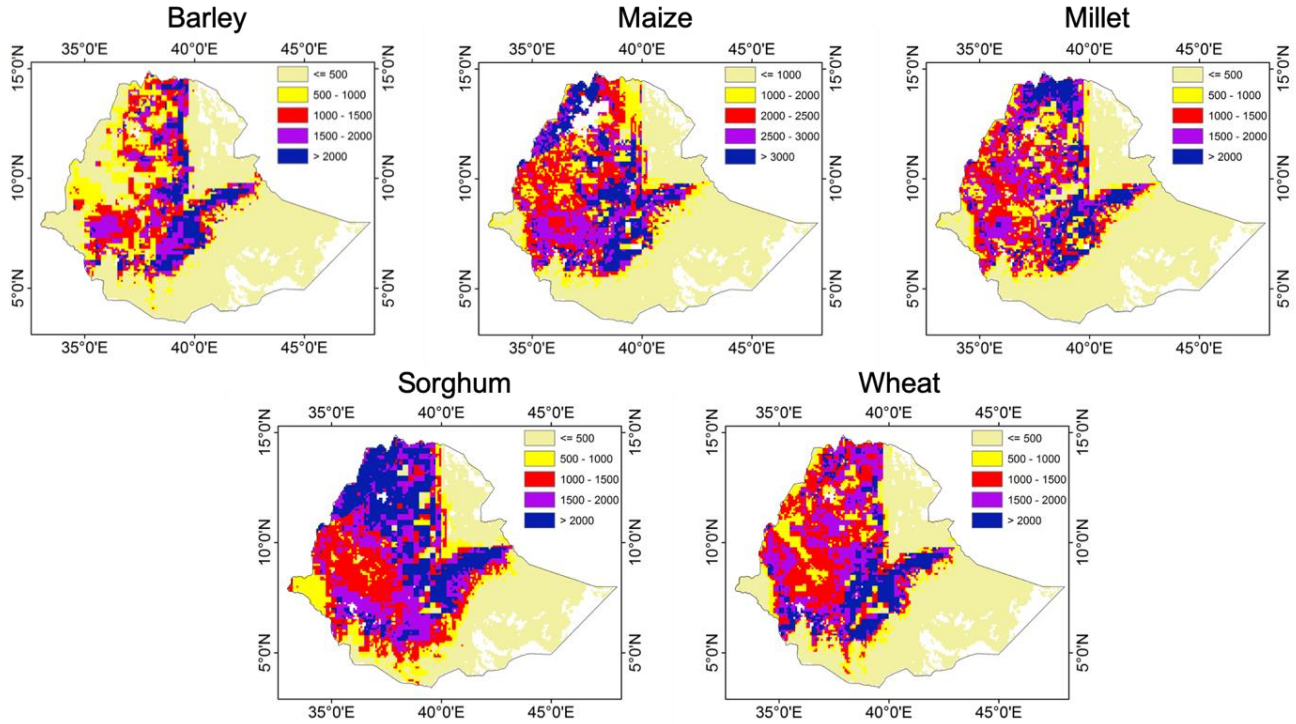
III. Developed a seasonal crop yield forecast approach based on the knowledge from above findings

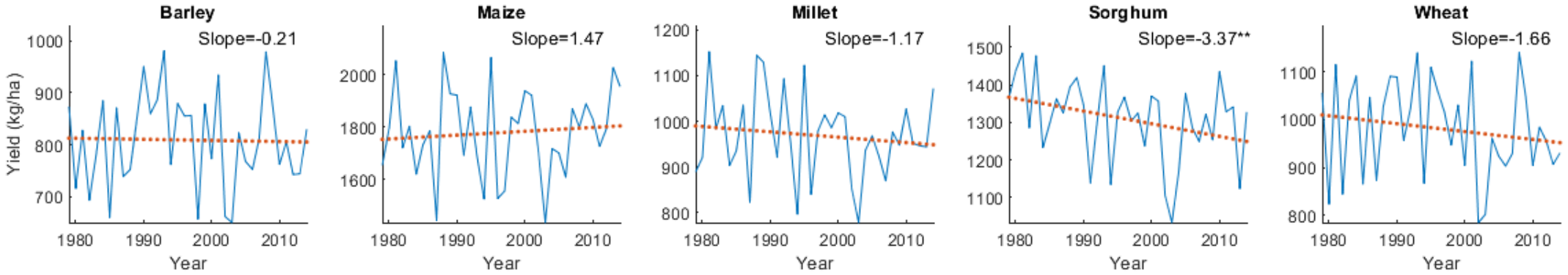
IV. Projected long-term crop yield and analyzed the impact of environmental stressors

# Spatial and temporal pattern of crop yields

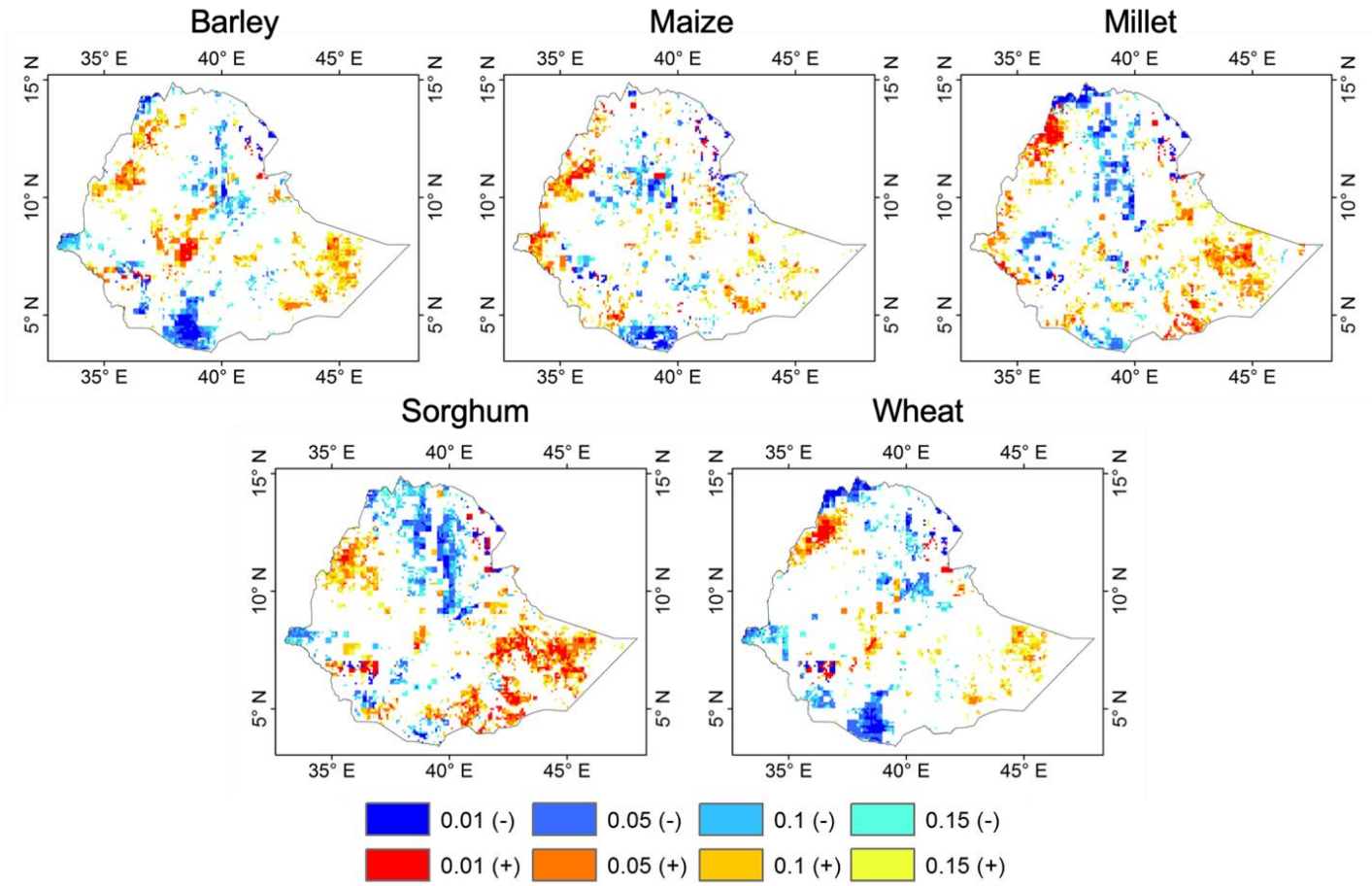
Yield for all five crops increased with elevation.

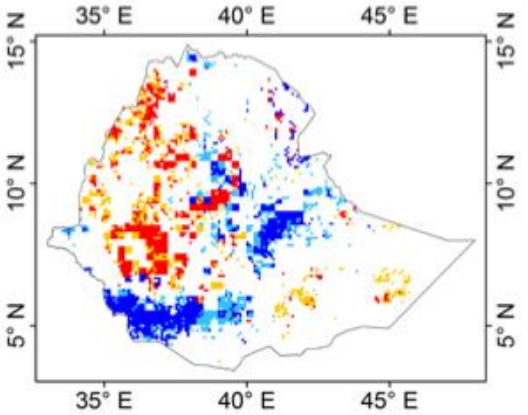
Climate variability and change caused a decreasing trend for all crops but maize, although most of the trends (except for sorghum) are not significant yet.



# Trend significance for the study crops




Over most of the areas where yield is negatively correlated with temperature, crop yield in the model shows a decreasing trend. This indicates that climate change may have already had an adverse effect in some of the most productive regions of Ethiopia.

Unshaded areas: insignificant trend or lack of harvest

# Link DSSAT with CREST

## Soil moisture simulation scheme

### DSSAT

Tipping bucket approach

### CREST

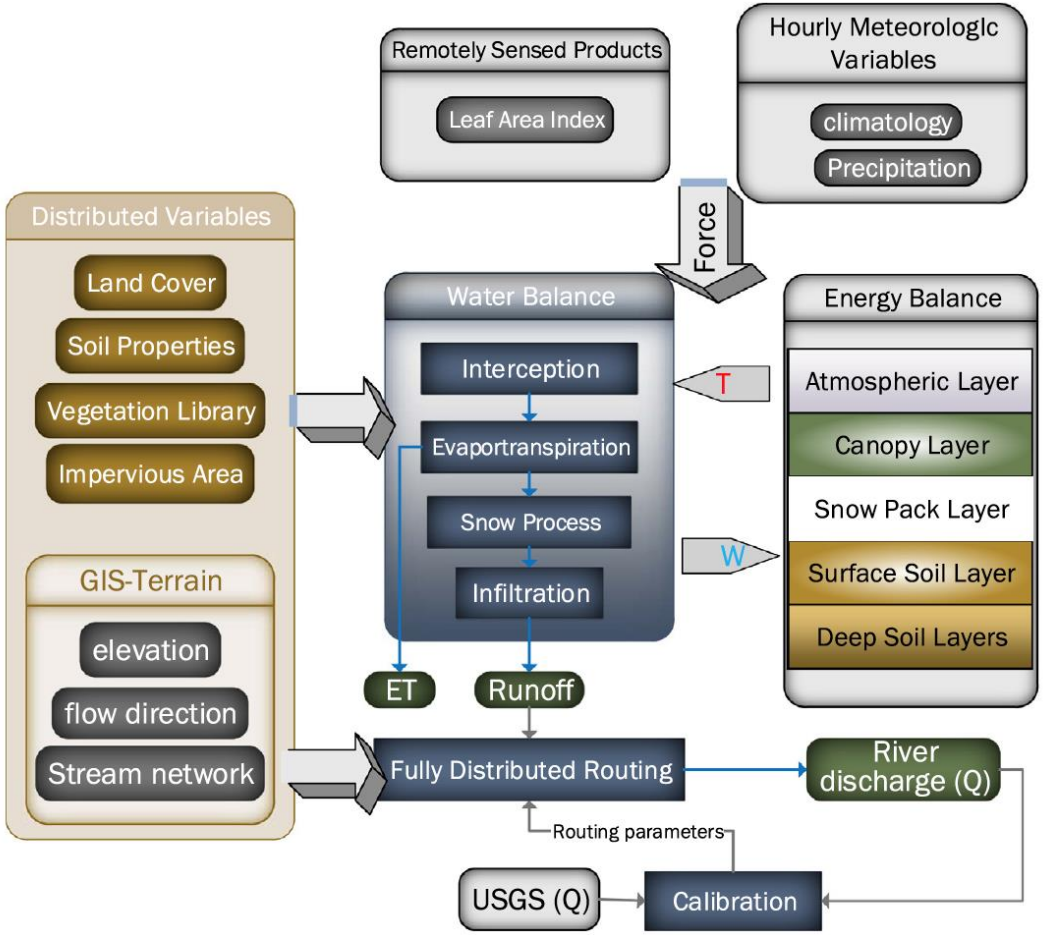
Infiltration within a layer:
Green-Ampt Model

Percolation from upper to lower layer:

$$w_{perc,ly} = SW_{ly,excess} \cdot \left[1 - exp\left(\frac{-\Delta t}{TT_{perc}}\right)\right]$$

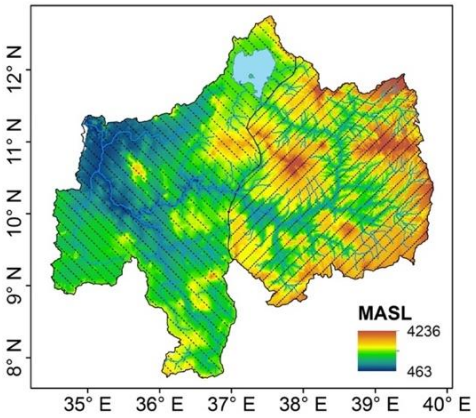
Replace DSSAT daily soil moisture with CREST daily soil moisture

## Structure of CREST model



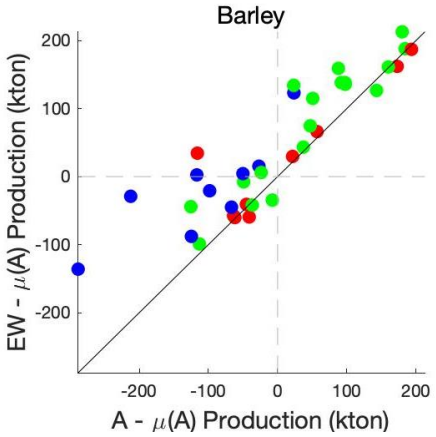
# Effectiveness of planting time irrigation in improving crop yield

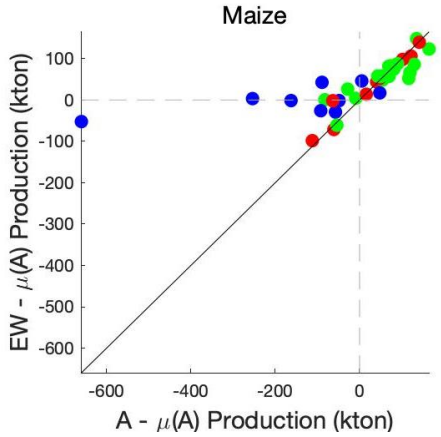
## Basin division

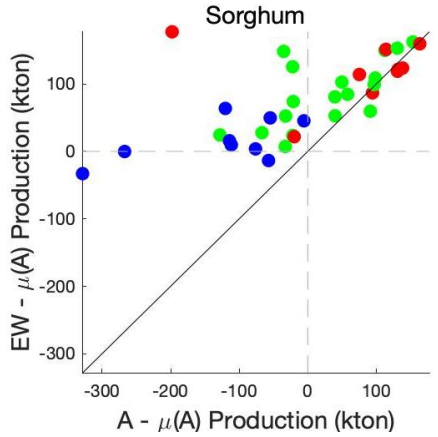


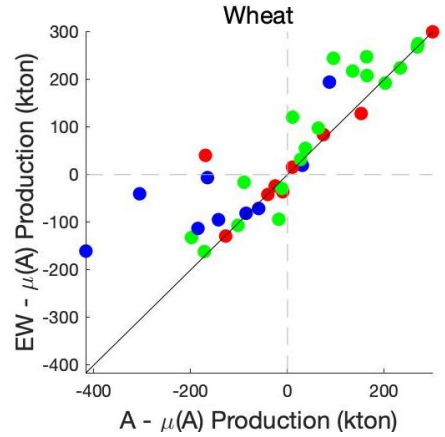

- Dry year
- Normal year
- Wet year

## East basin

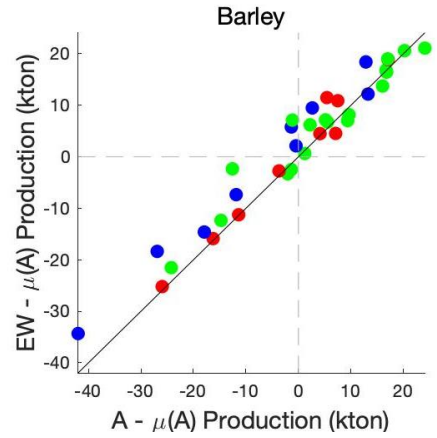


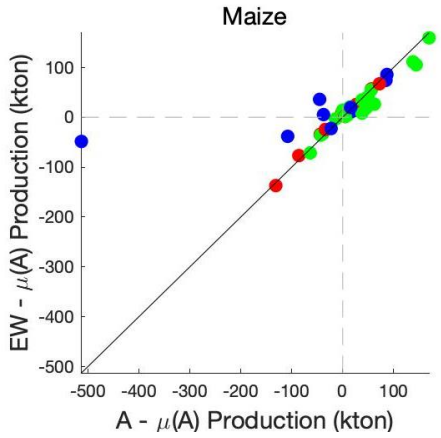



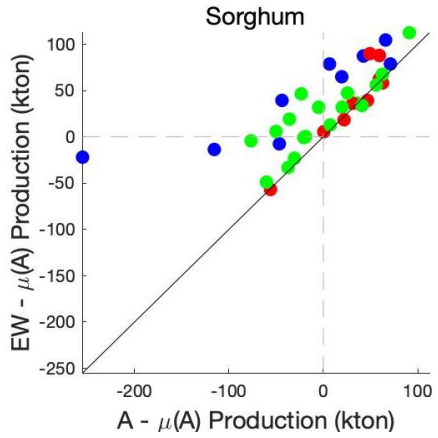



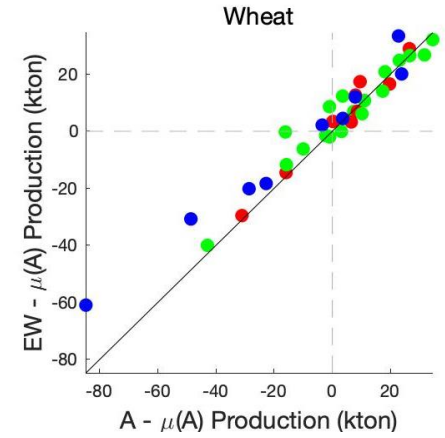




## West basin



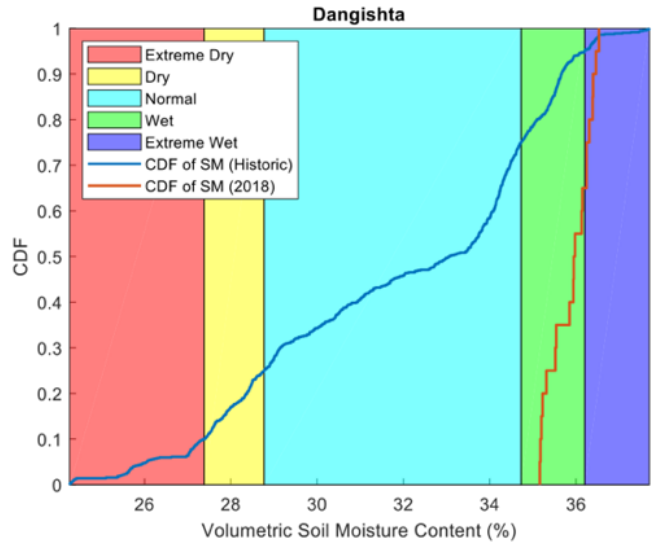
# Development of analog approach forecast system

Analog approach involves identifying analog years with conditions similar to the target year.

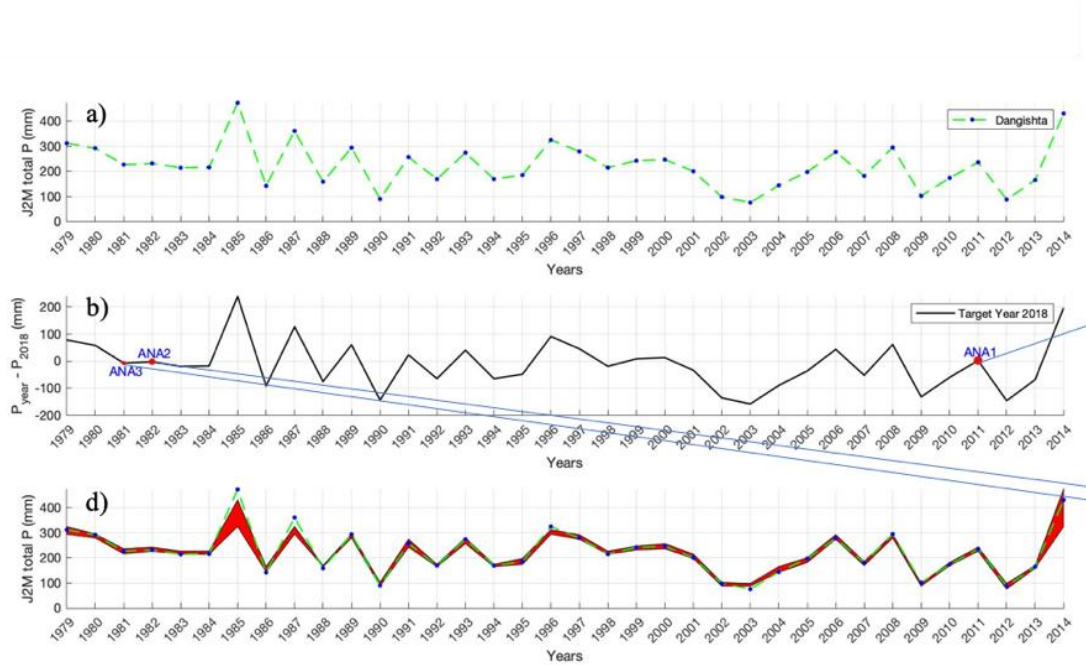
The seasonal climate was forecasted by NOAA-CFS

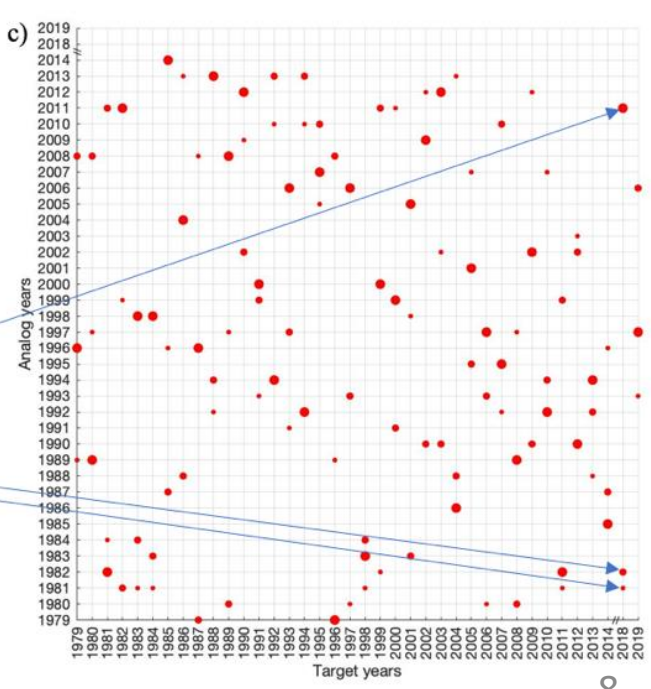
Get analog yield at the corresponding ISM level based on the top 3 analog years

Identify initial soil moisture level



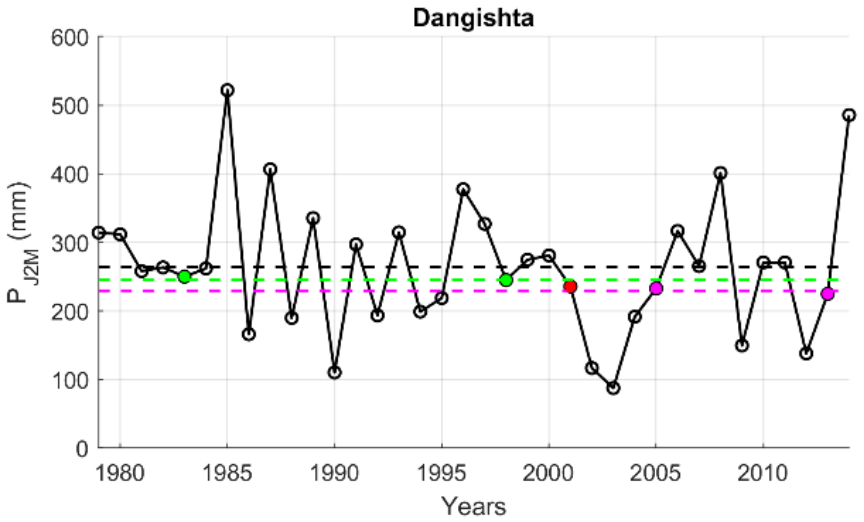

Find analog years



# Seasonal forecast using 2018 and 2019 as examples

Selection of top 3 analog years for 2018 and 2019

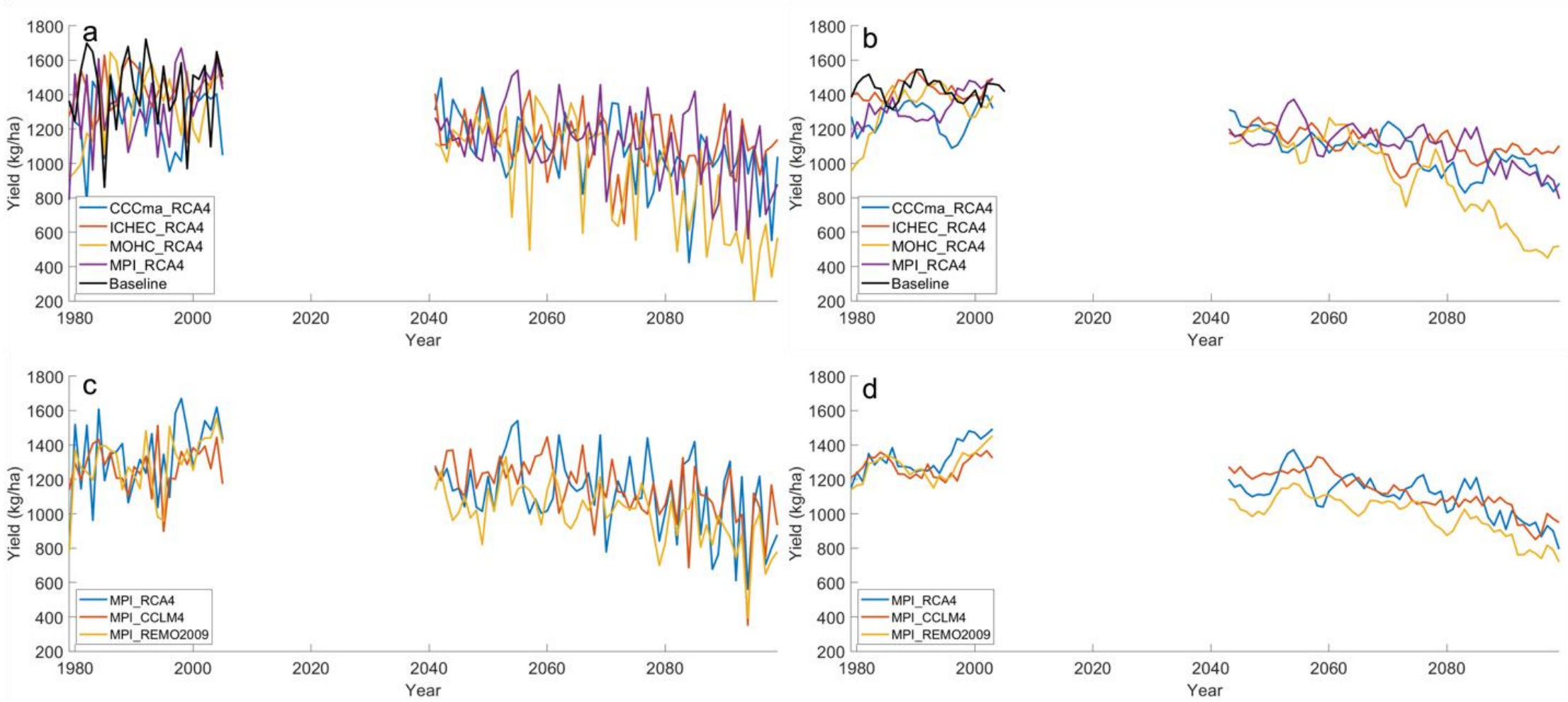



Initial soil moisture and maize yield forecasts in 2018 and 2019

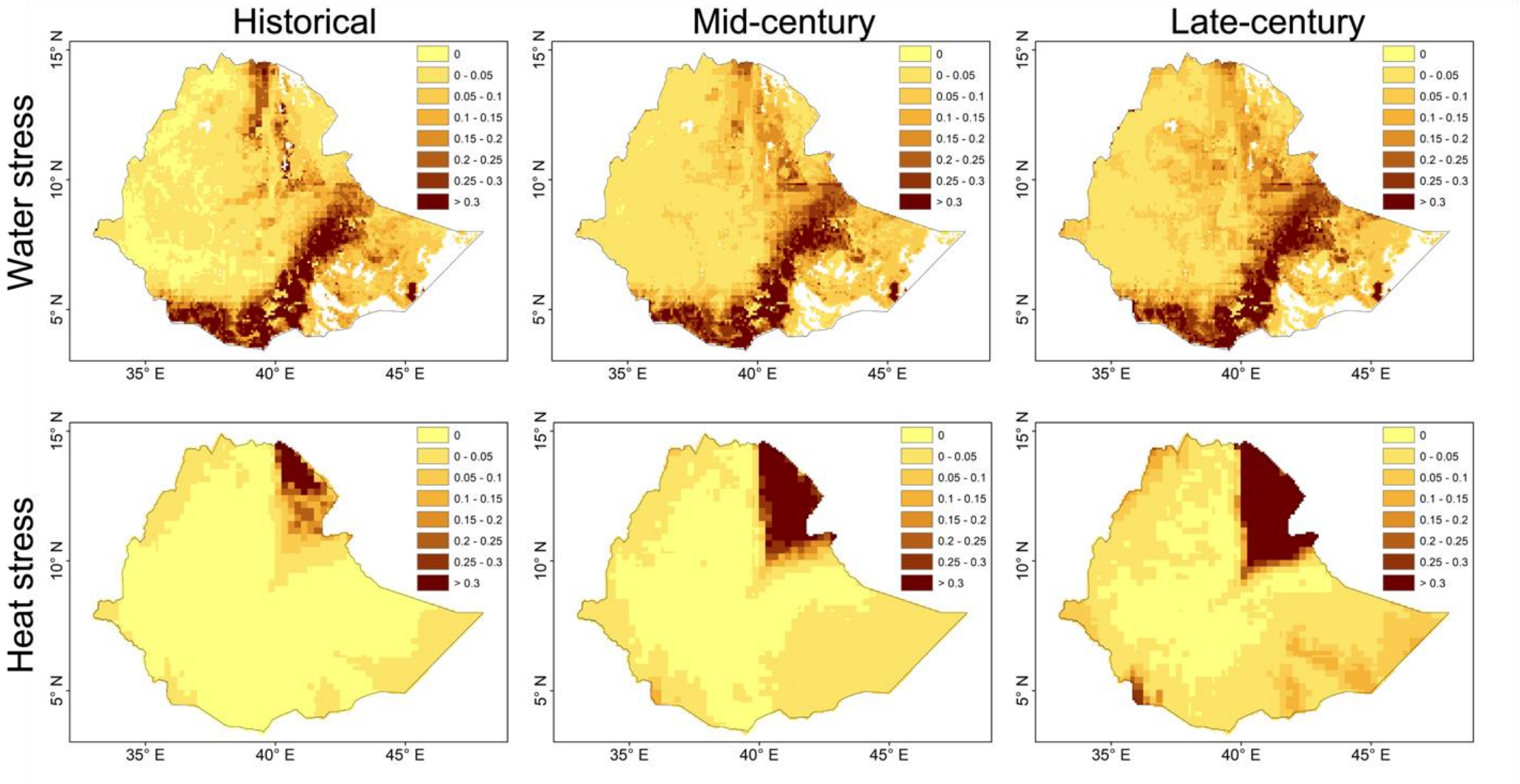
| | | Dangishta | Kudmi | Reem | Gaita |
|---|---|---|---|---|---|
| 2018 | Forecasts | 3255 - Normal (3137, 3145, 3482) | 2445 - Normal (2318, 2470, 2546) | 2673 - Normal (2548, 2555, 2915) | 4048 - High (3641, 4083, 4420) |
| | Observations | 3697 - Normal | 2851 - Normal | 2851- Normal | 3697- Normal |
| 2019 | Forecasts | 2806 - Very low (2616, 2666, 3135) | 2488 - Normal (2381, 2416, 2666) | 2603 - Normal (2302, 2734, 2773) | 3759 - Normal (3589, 3697, 3990) |
| | Observations | 2396 - Very low | 2668 - Normal | 2668 - Normal | 2396 - Very low |

# Project the trend and variability of mean maize yield for the whole country

From historical (1979-2005) to mid-century (2040-2069) and late-century (2070-2099)



# Spatial distribution of water and heat stresses in different time periods



# How the interdisciplinarity shaped my research?

- Interdisciplinarity is the key to identify problems and get inspirations.
- Interdisciplinarity accelerated my research progress and enriched my knowledge.
- Interdisciplinarity makes scientific research applicable and meaningful.

# My current post-graduation job

- Post-doc associate at the College of Agriculture and Life Sciences, Cornell University

- Current project: Integrating multiscale remote sensing data for enhancing data-driven predictive analytics in crop breeding and management

# How PIRE helped me in my current job and career/research aspiration?

- The knowledge and skills I obtained in PIRE is the fundamental of performing my current research work.

- Through PIRE, I've had a clear picture of my research field and get to know what are the key scientific questions to be answered.

- The relationship with PIRE fellows is my lifelong wealth.

# Cheers!