



# Citizen Science as a tool to support local scale seasonal forecasting of water availability and crop yield in the Upper Blue Nile region of Ethiopia

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## INTRODUCTION



Data scarcity and highly variable agricultural-based region making it a prime candidate to benefit from seasonal forecasting



Citizen scientists selected from participating communities to collect in-situ hydrological values and participate in collegiate activities at Bahir Dar University



Recorded measurements used by engineers to calibrate models and students create social capital for positive feedback loop

What is the quality, limitations, nuances and impact of this data?

## WHY SOCIOLOGY & ENGINEERING

- Both sociology and engineering answer the question of *how is this possible?*
- Engineers are studying the physical environment such as soil, groundwater and potential crop yield. The physical potential is merely dormant if the agricultural agents and their social world are not understood as well, this is what the sociologists are studying. Citizen science could serve as a bridge between the engineering, sociological and economic world if the contributed local data improves model forecasts or secondarily increased adoption of technology by farmers.

## POTENTIAL BARRIERS BETWEEN CITIZEN SCIENTISTS AND ENGINEERS

- Political instability
- Lack of resources
- Unreliable and/or poor internet connection
- Cancelled meetings
- Extreme rainfall restricting transportation
- Flooding
- Mistakes
- Inexperience
- Communication barriers
- Insufficient time
- Travel restrictions for U.S. engineers to visit site

## SITE BACKGROUND

### Who is involved from Ethiopia?

- 4 high schools
- 10 high school students
- 4 high school teachers
- 4 graduate students and
- 3 faculty from Bahir Dar University
- Farmers from 4 local communities, south of Lake Tana

### What are the citizen scientists doing?

- Interacting with college students
- Participating in unique extra-curricular activity
- Getting connected to bright fellow students from the area

### Collecting hydrological data on:

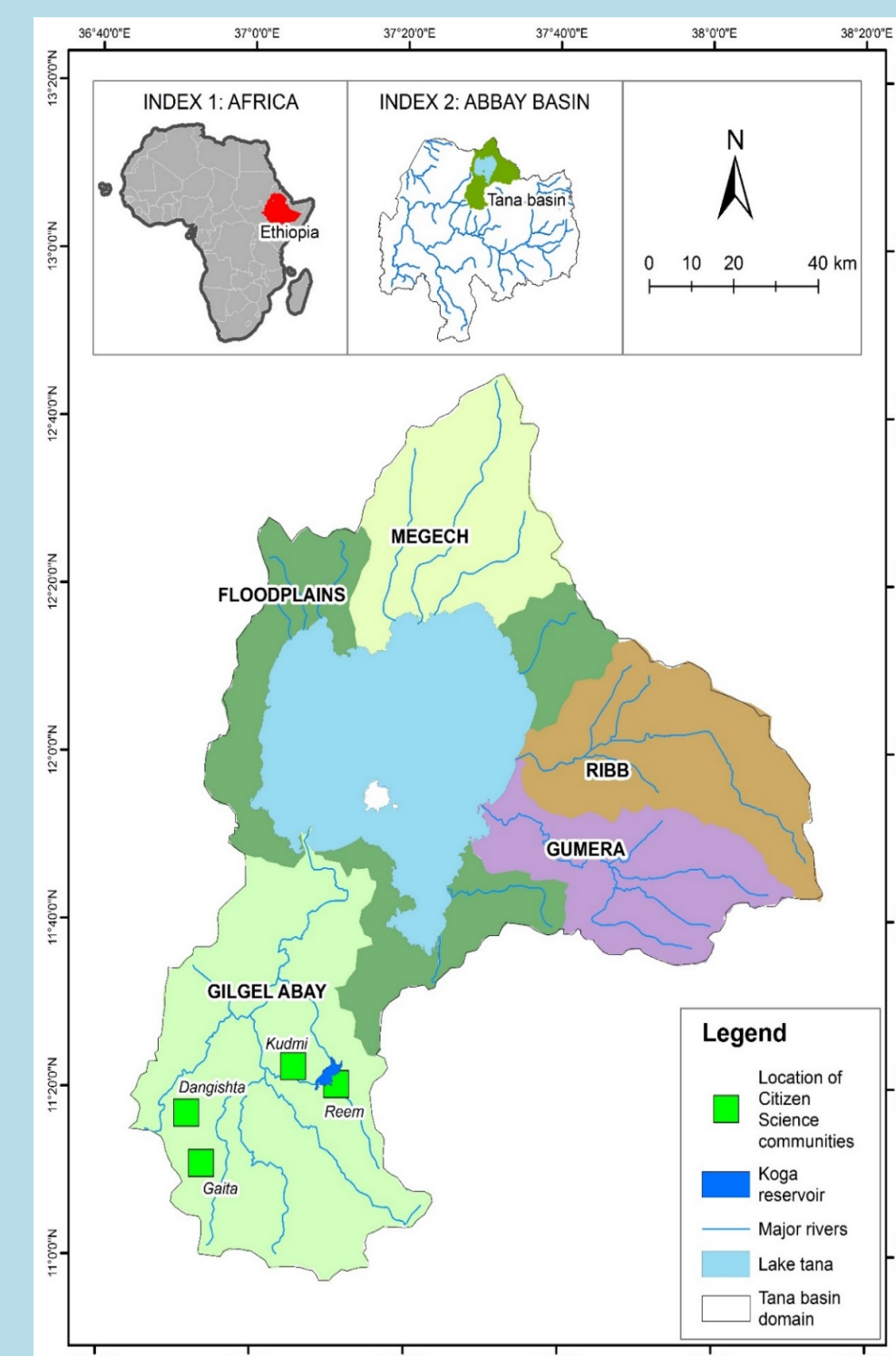
- river stage
- soil moisture and
- groundwater levels

### Why is this important?

- Retrieve data from a data scarce region to inform hydrological models
- Empowerment and social capital

### Map of Involved Communities

- Two rain-fed (Gaita and Dangishta) and
  - Two irrigated communities (Kudmi and Reem)
- All sites are located in the Gilgel Abay sub-basin



## FIELD VISIT

University of Connecticut engineering undergraduate students visit sites guided by sociology graduate students in the capital, Addis Ababa, Bahir Dar and citizen science communities.



<https://www.thepeninsulagator.com/article/28/06/2019/Amid-Ethiopia-unrest,-Amhara-political-party-spokesman-arrested>

My interview of high school citizen scientists was rendered impossible due to political conflict, the Bahir Dar uprising shortened my field visit by two valuable weeks.



Undergraduate UConn engineering students meet Ethiopian sociology undergraduates at Addis Ababa University

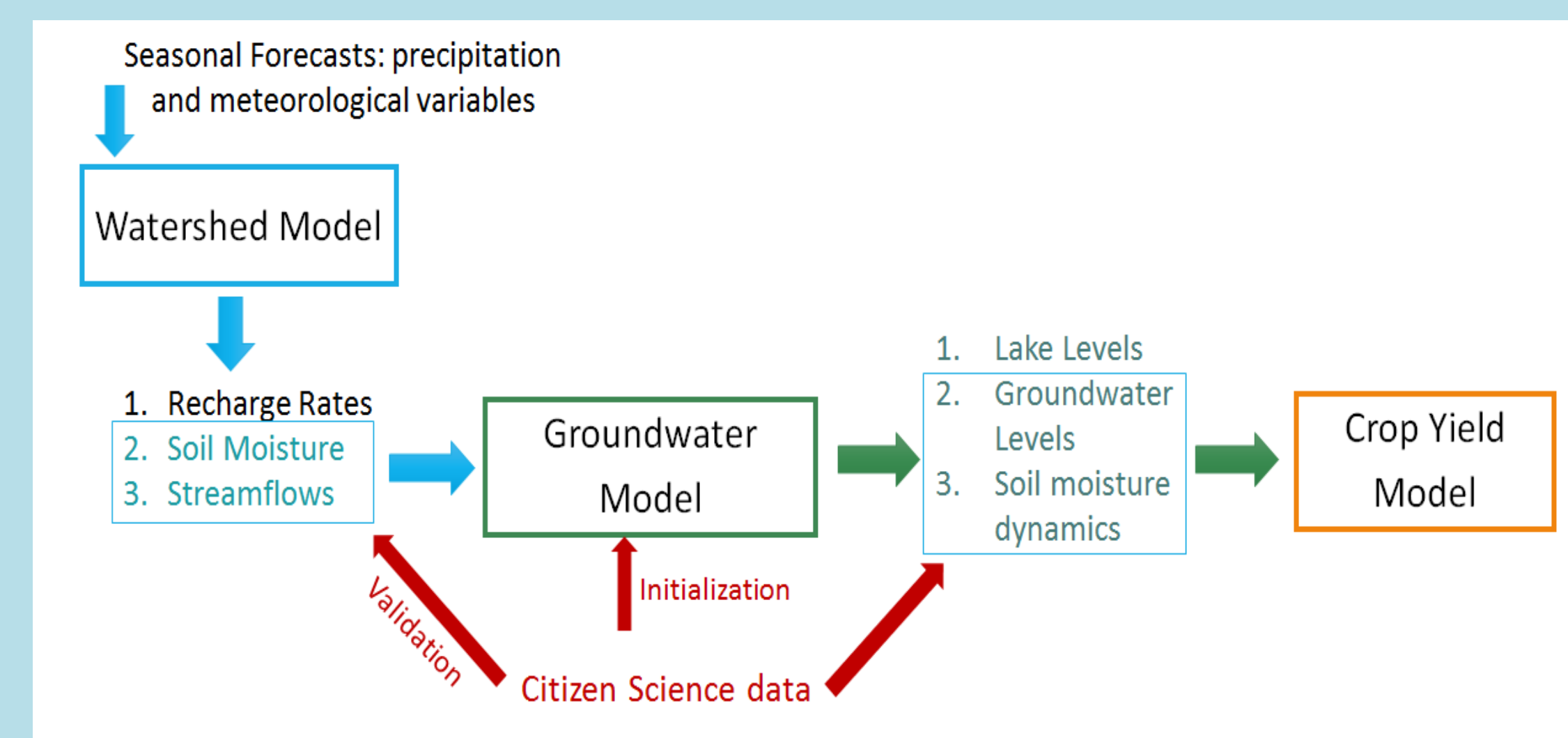


UConn students receive tour from community farmer showing irrigation in Gaita

## DATA INTEGRATION: HOW CITIZEN SCIENCE HELPS

Water & Food Security PIRE Researchers (Engineers) are integrating the data into their modeling for:

- Initialization of the hydrological models for the dry season
- Validation of model predictions (soil moisture, streamflows and groundwater levels) made each wet season 2018 through 2022



Bahir Dar engineering graduate students are using the data as the basis of their Master thesis work. Social scientists are participating and observing the project in 2019 and 2020

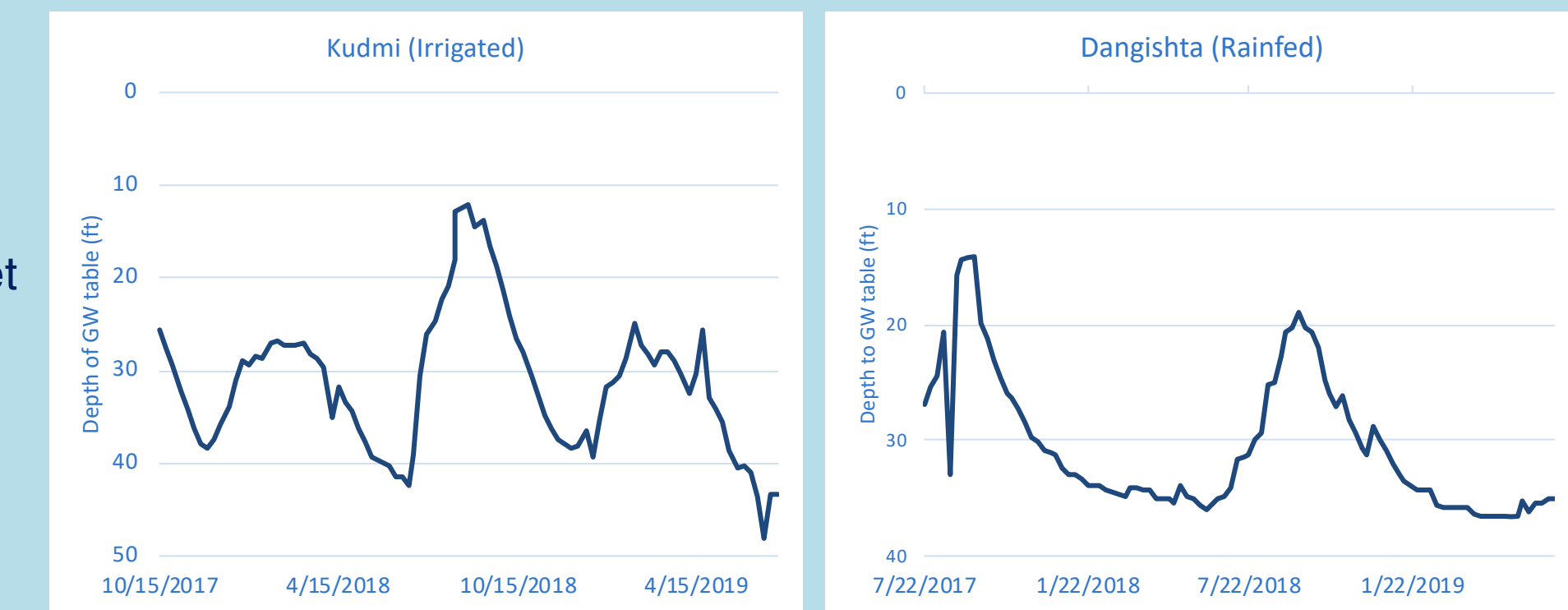
## GUIDING QUESTIONS

- How effective is citizen science in developing and transmitting in situ data?
- Is the quality of the citizen science data at the level to be assimilated into models?
- What barriers exist between citizen science and engineers?
- Are citizen scientists impactful and effective transmitters of scientific information?

## FEATURES CAPTURED BY THE CITIZEN SCIENCE DATA

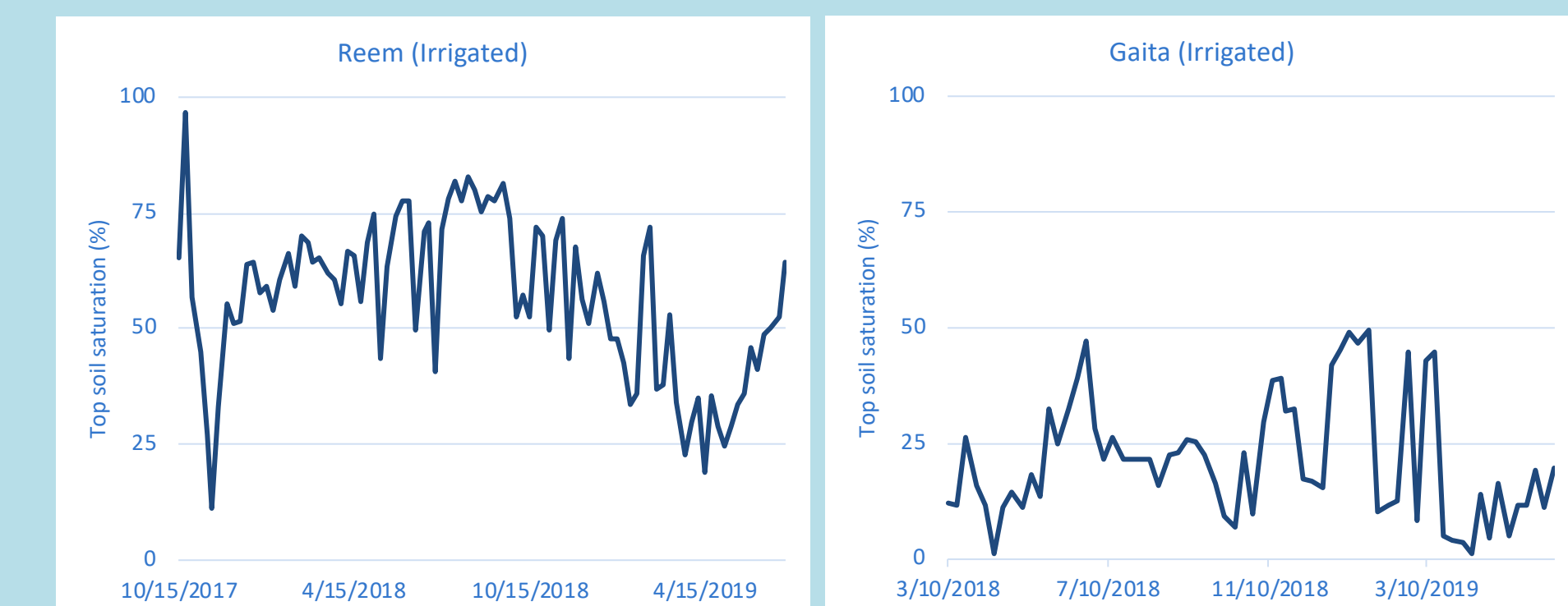
### IRRIGATED vs RAINFED

The effect of irrigation can be highlighted by looking into the groundwater well depths of a rainfed site (Dangishta with 1 wet season peak) vs an irrigated site (Kudmi, showing 2 peaks)



### SIZE OF IRRIGATION

Koga is a large irrigation scheme (7000 ha), which experiences higher soil saturation against Gaita irrigation scheme area (~250 ha)

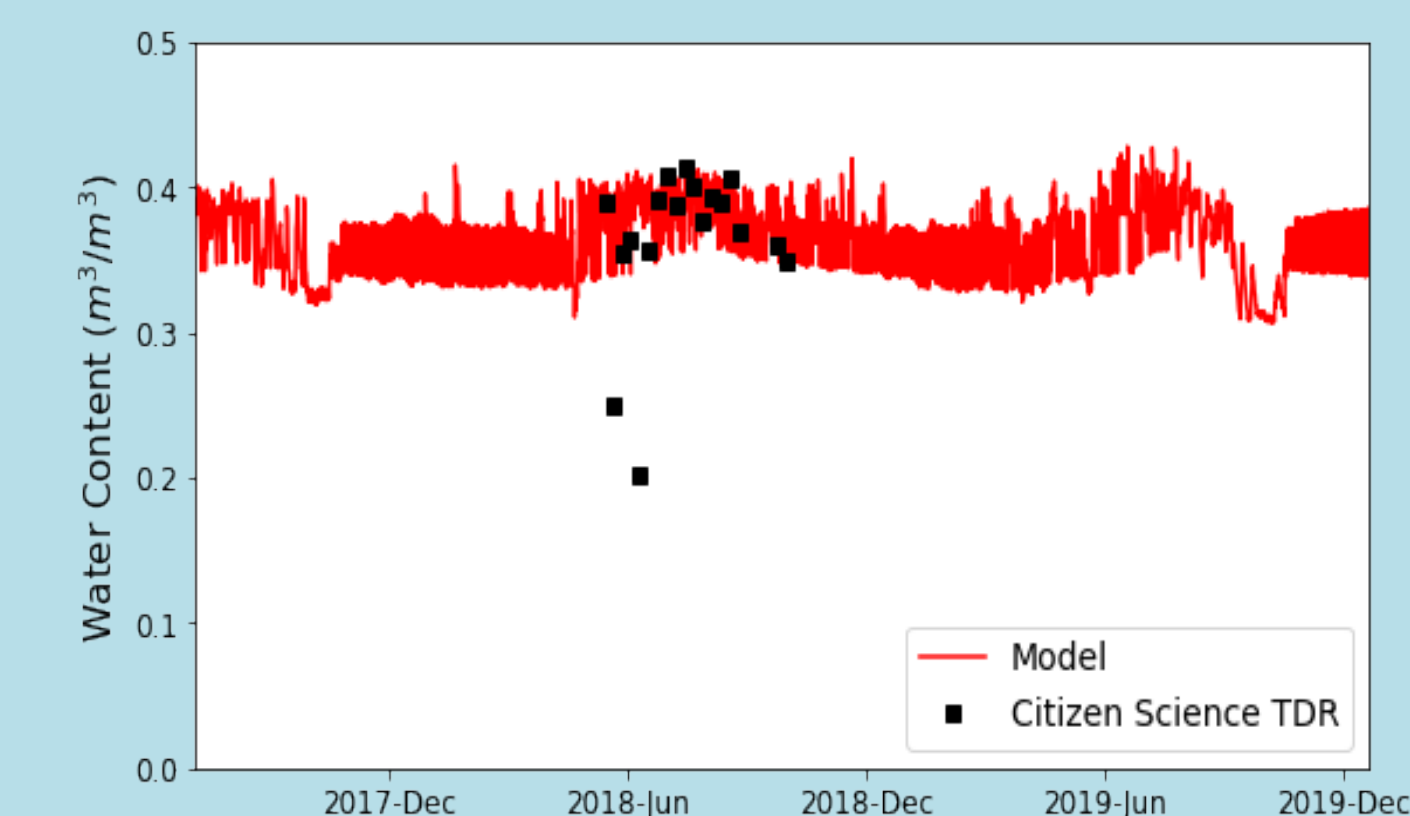


### LOCAL HYDROLOGY

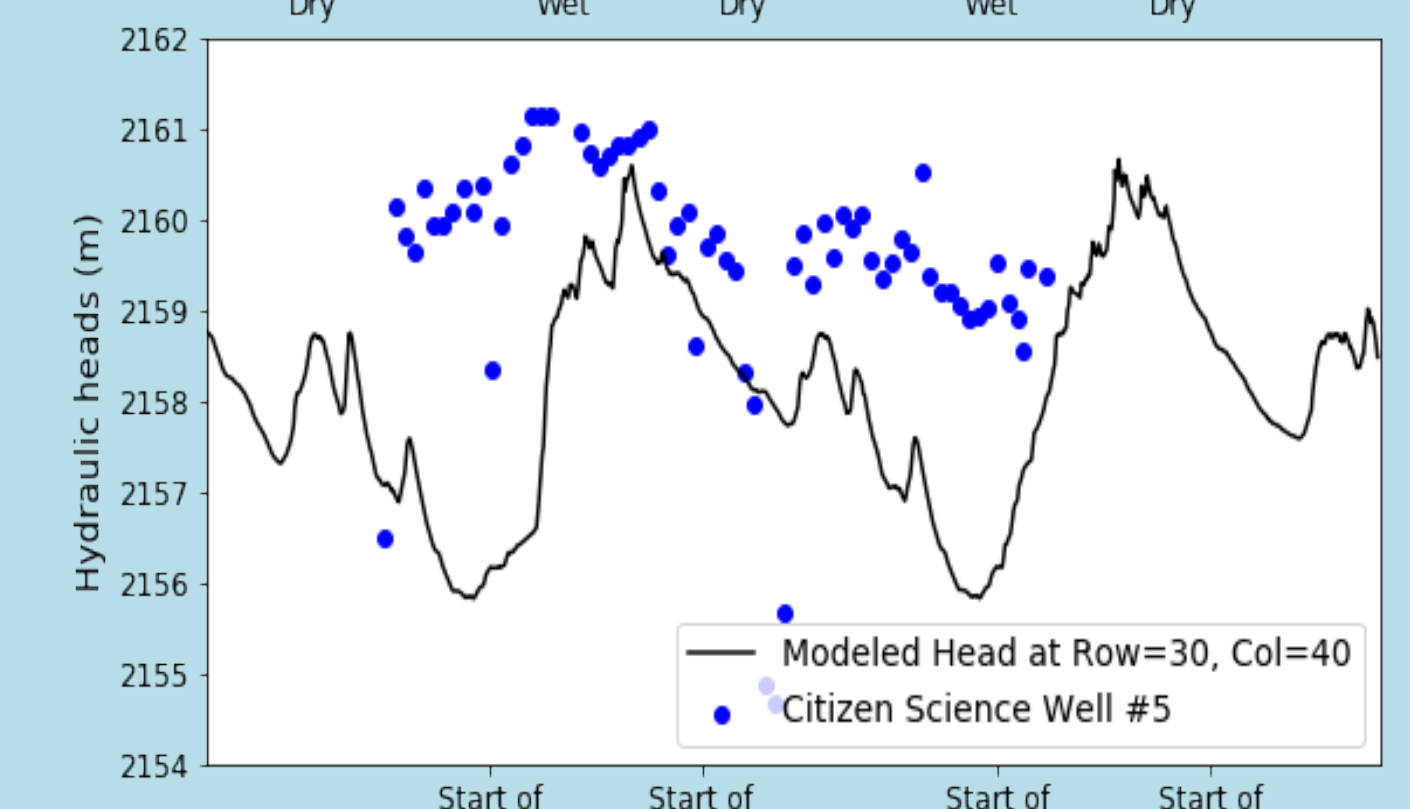
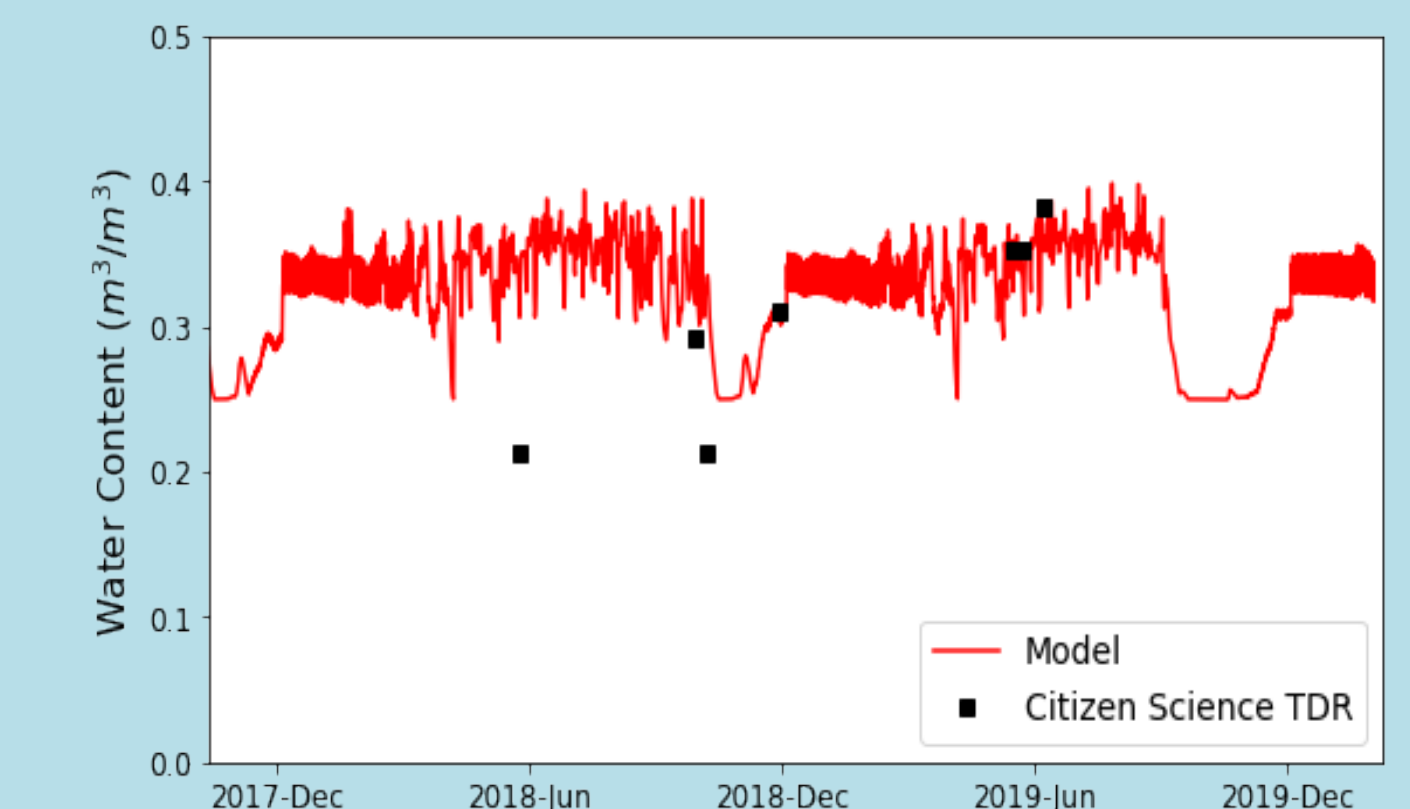
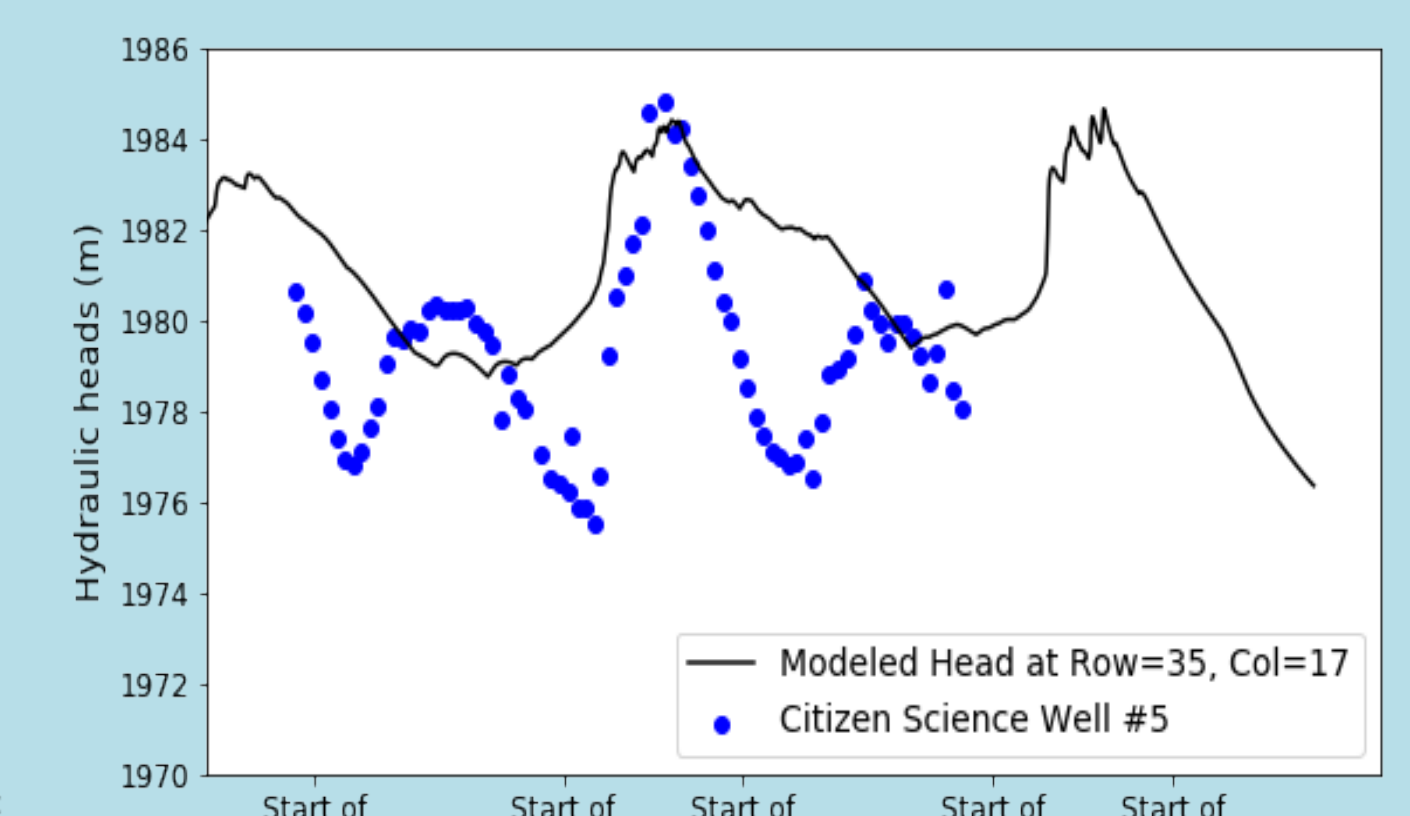
Kudmi being close to the reservoir experiences high water table variability

## HOW CITIZEN SCIENCE IS USED TO VALIDATE ROBUST MODELS: WHICH ARE THEN USED FOR THE WATER - FOOD FORECAST

### Soil Moisture



### Groundwater Table Depth



## IMPACT

- Inform scientific community of benefits of citizen science
- Calibrate hydrological models using citizen science data

## FUTURE STEPS

- Work with sociology team to understand how citizen scientists communicate with engineers
- Extend citizen science initiative into other data scarce locations of the Upper Blue Nile

## ACKNOWLEDGMENTS



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