"Climate-Responsive Crop Selection: Selecting Planting Dates and Crop Varieties in a Warming World"

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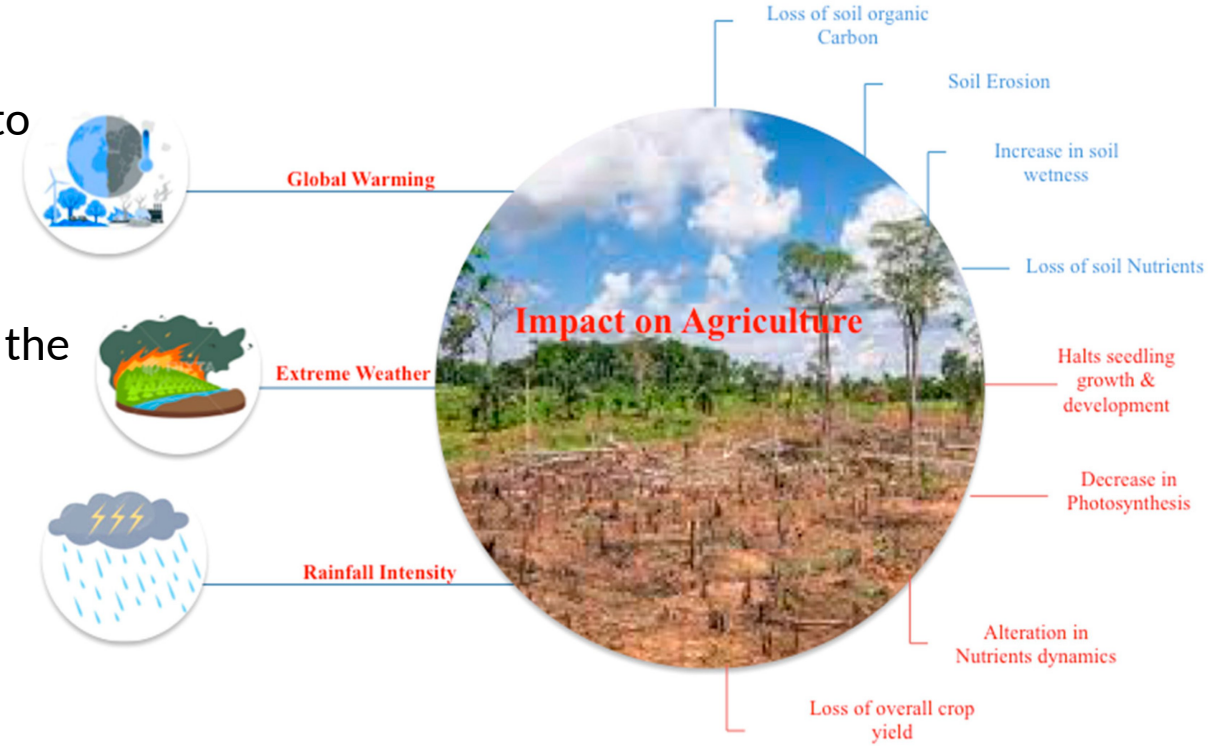
Introduction

- Agriculture sector is one of the most vulnerable sectors to climate change
- Farmers struggle to maintain stable crop production
- Climate change can also alter the timing and duration of the crop growing season
- Water availability is becoming an increasingly pressing concern
- Farmers must adapt to counter any negative impacts of climate change but are confronted with uncertainty.

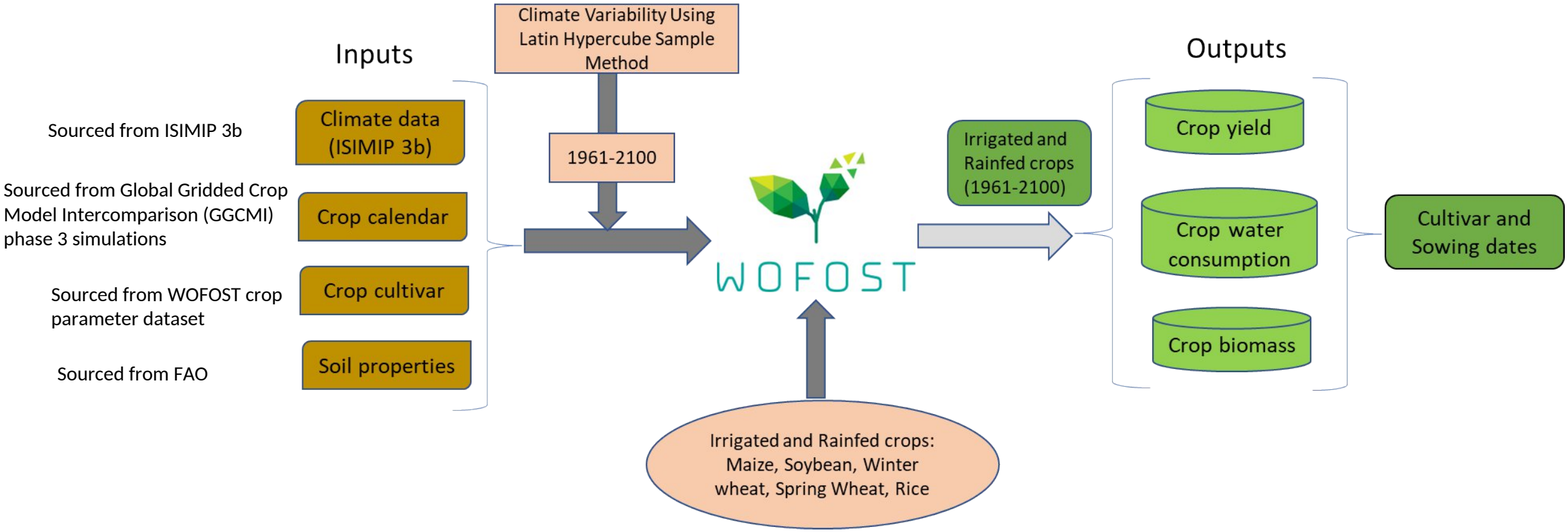


source: Bibi and Rahman (2023)

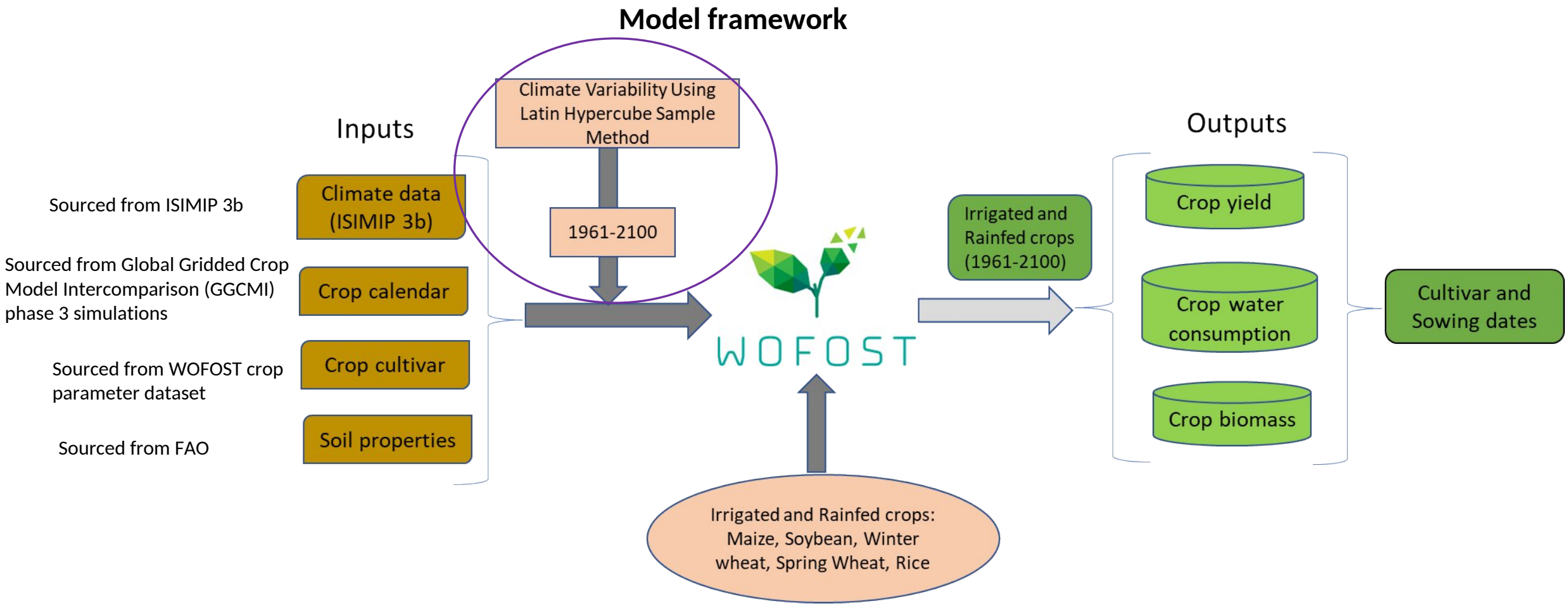
AIM: To develop a **dataset** that evaluates **crop yields** and **consumptive water use** for a large number of current **cultivars** and **planting dates** under **irrigated** and **rainfed** conditions for the **major crops** under different climate scenarios for the 21st century

Methodology

Model framework



Methodology



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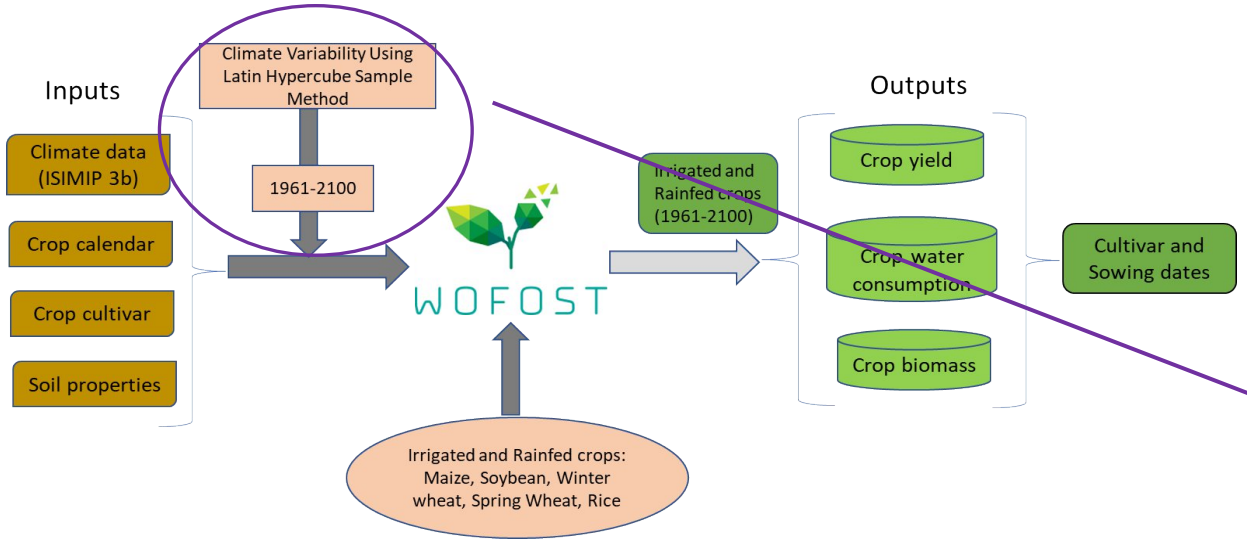

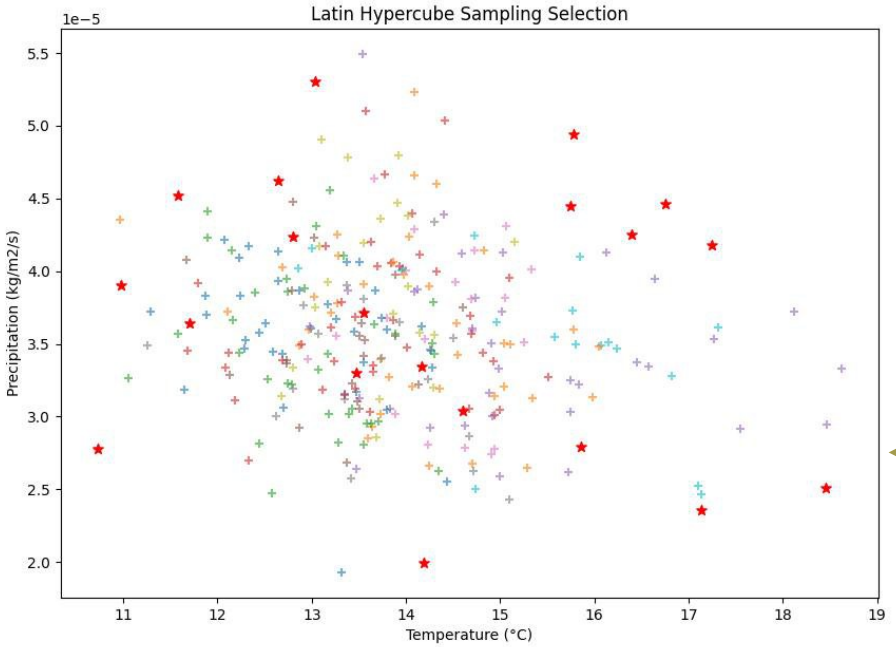

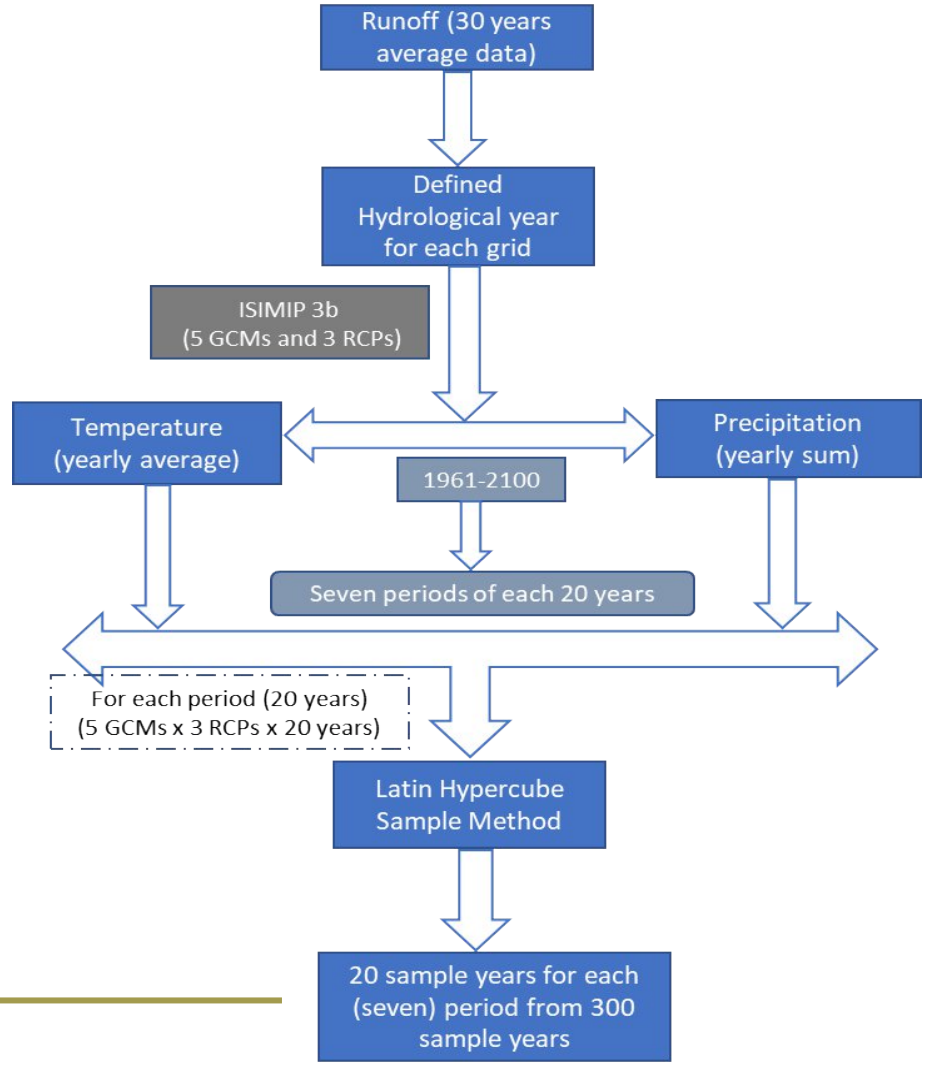

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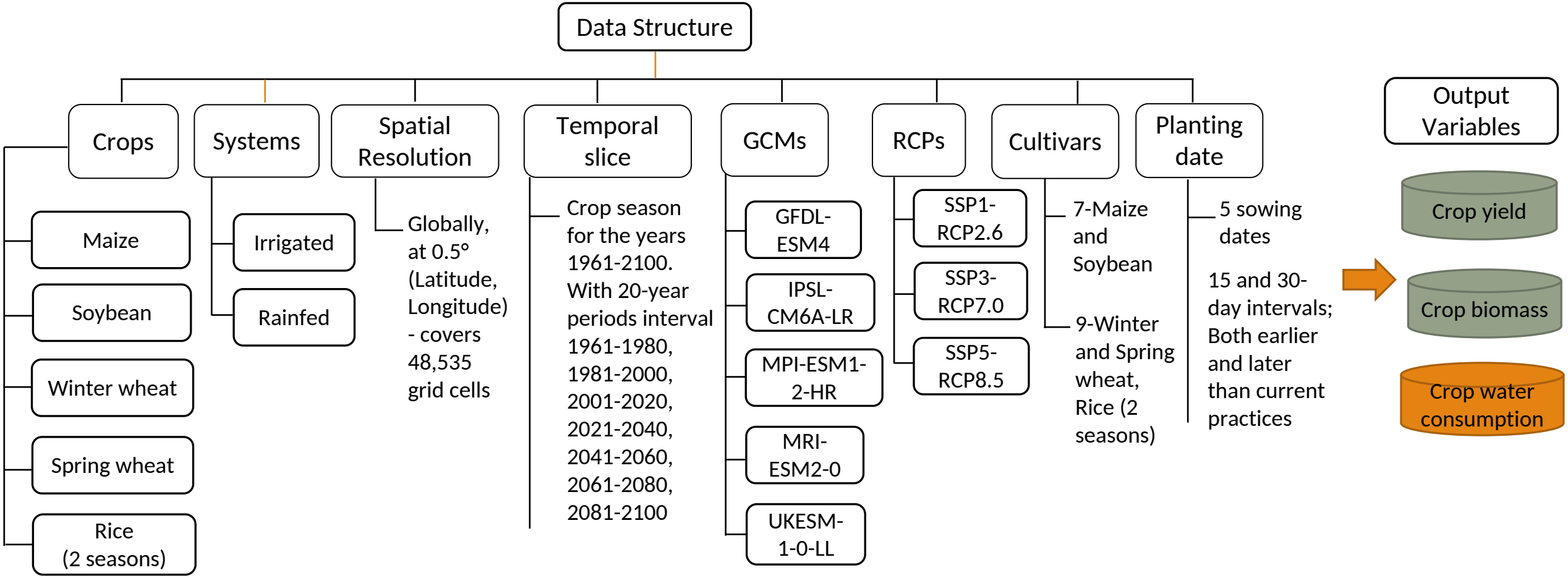


Visualization and Analysis

1. **Data visualization**

a. Comparison of yield and water consumption for all cultivars and sowing dates

b. Contour maps of yield against temperature and precipitation

2. Climate Change Analysis

Three key metrics

Crop yield:

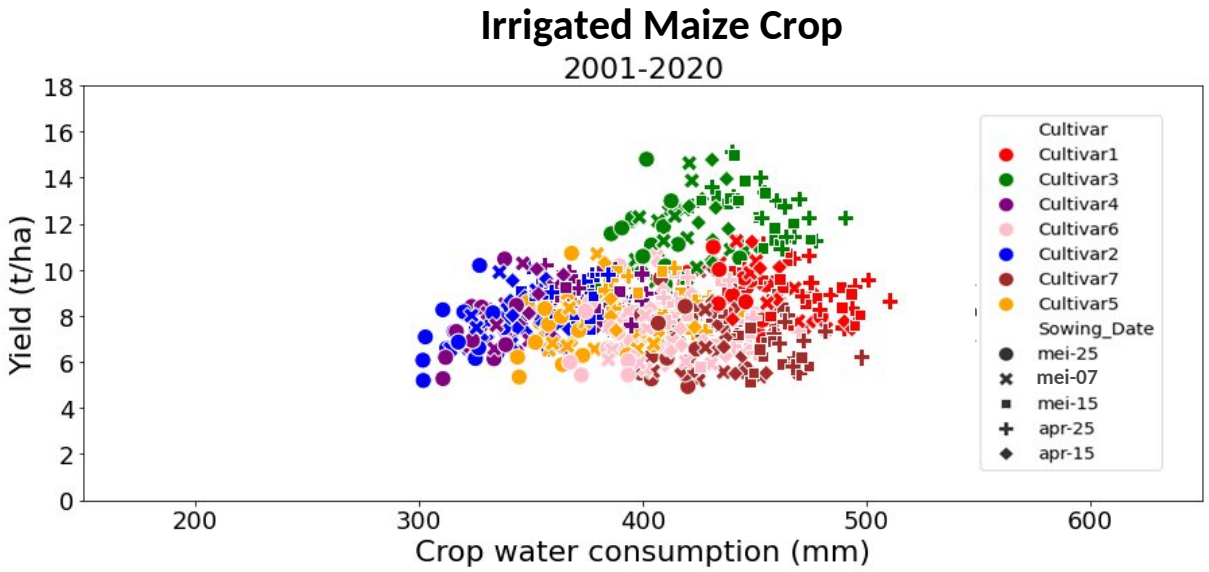
1. Reliability
2. Productivity

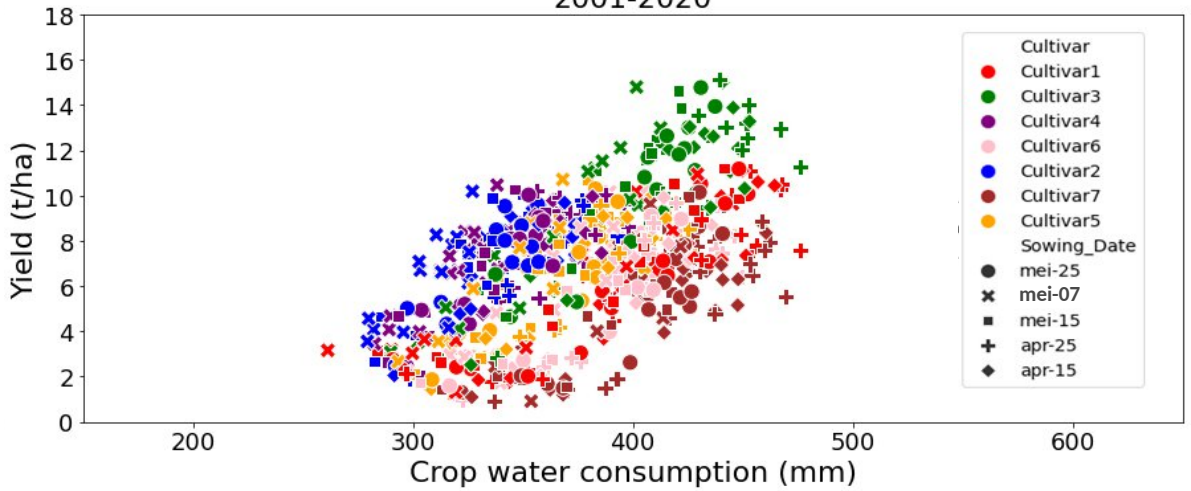
Crop water consumption:

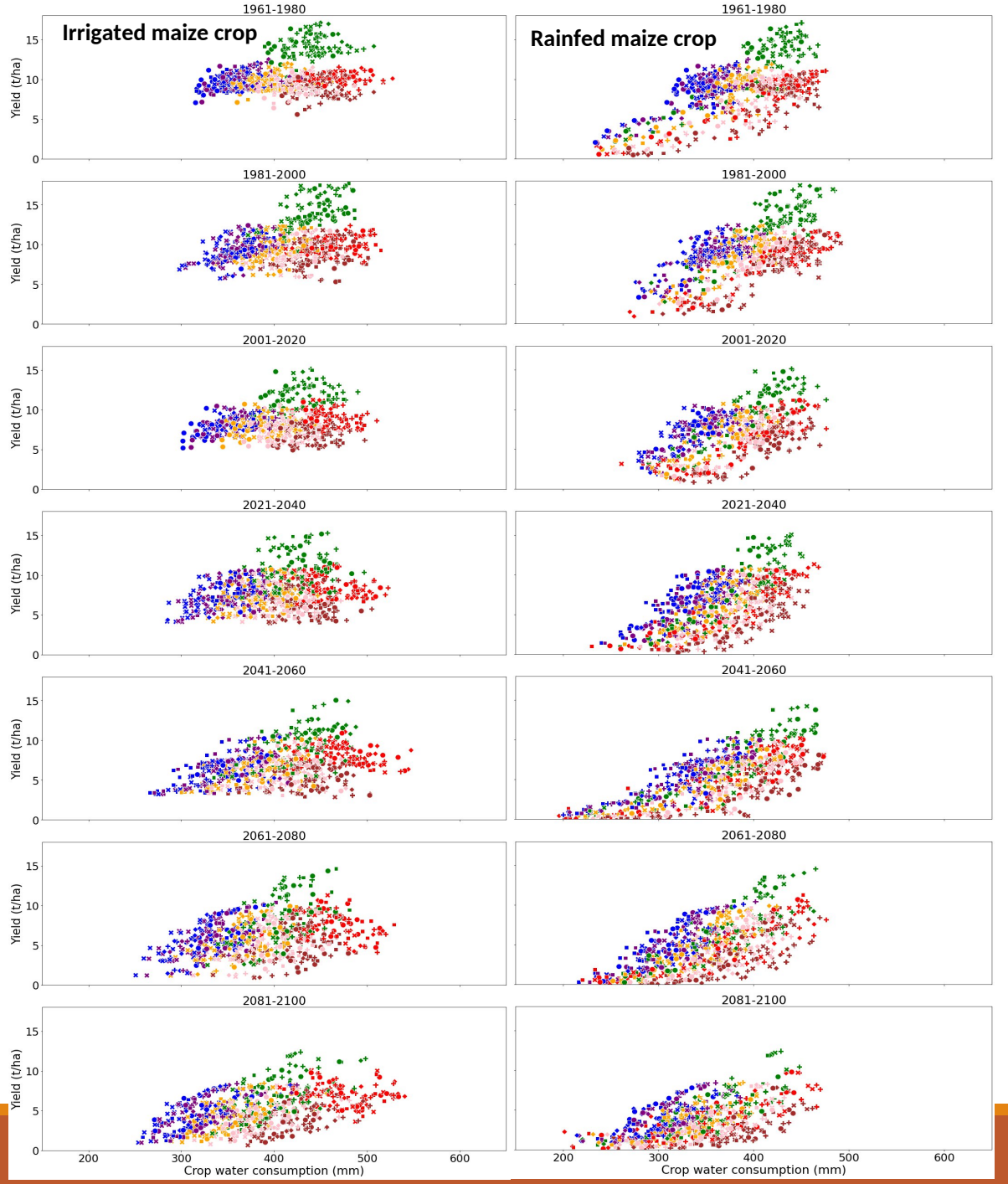
1. Water Use Efficiency

Compared the current period (2001-2020: **2020**) with the future period (2041-2060: **2050**) with no adapt and adapt scenario for Maize crop

Results • Data Visualization • Lat: 40.25 and Lon: -91.75 (Missouri)

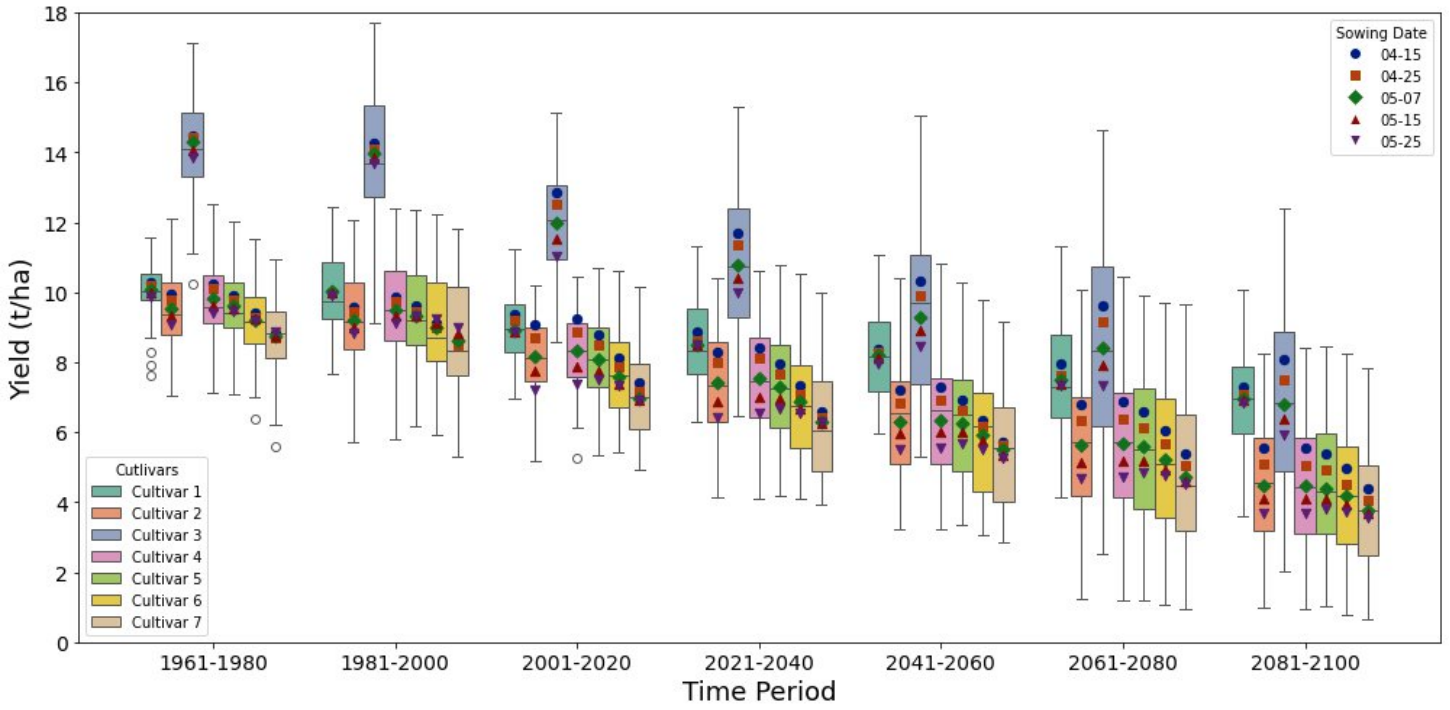






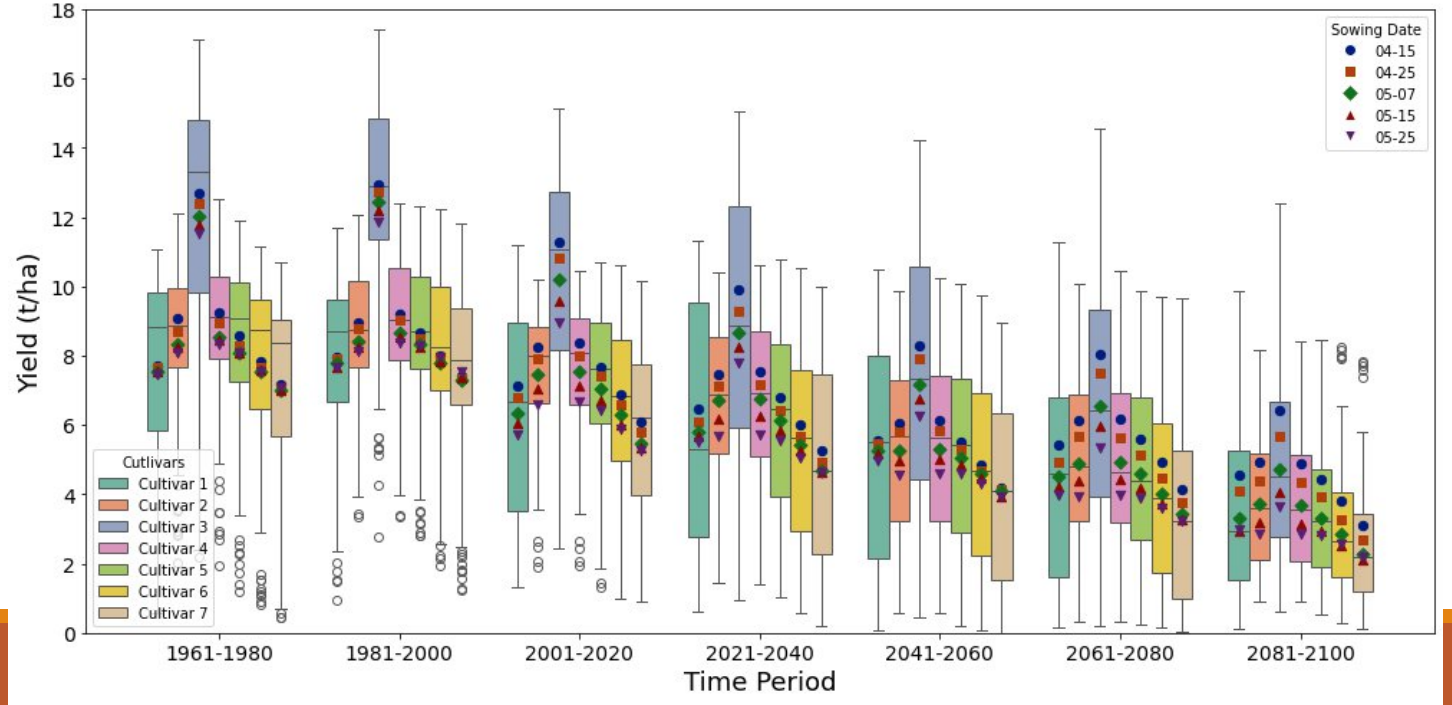
Yield over time per cultivar and in relation to the sowing date

Irrigated maize crop



- Yield decline over time
- Cultivar 3 has higher degree day sums
- Sowing date influence

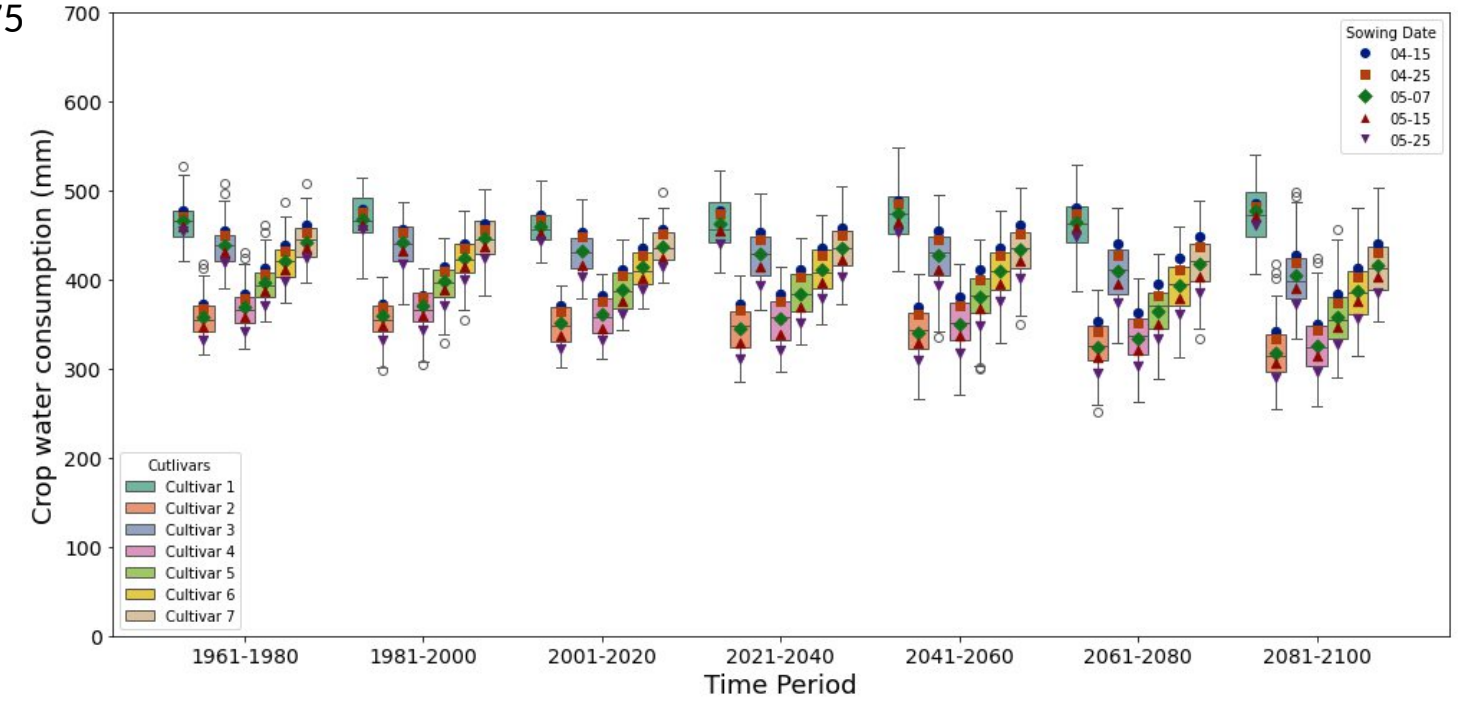
Rainfed maize crop



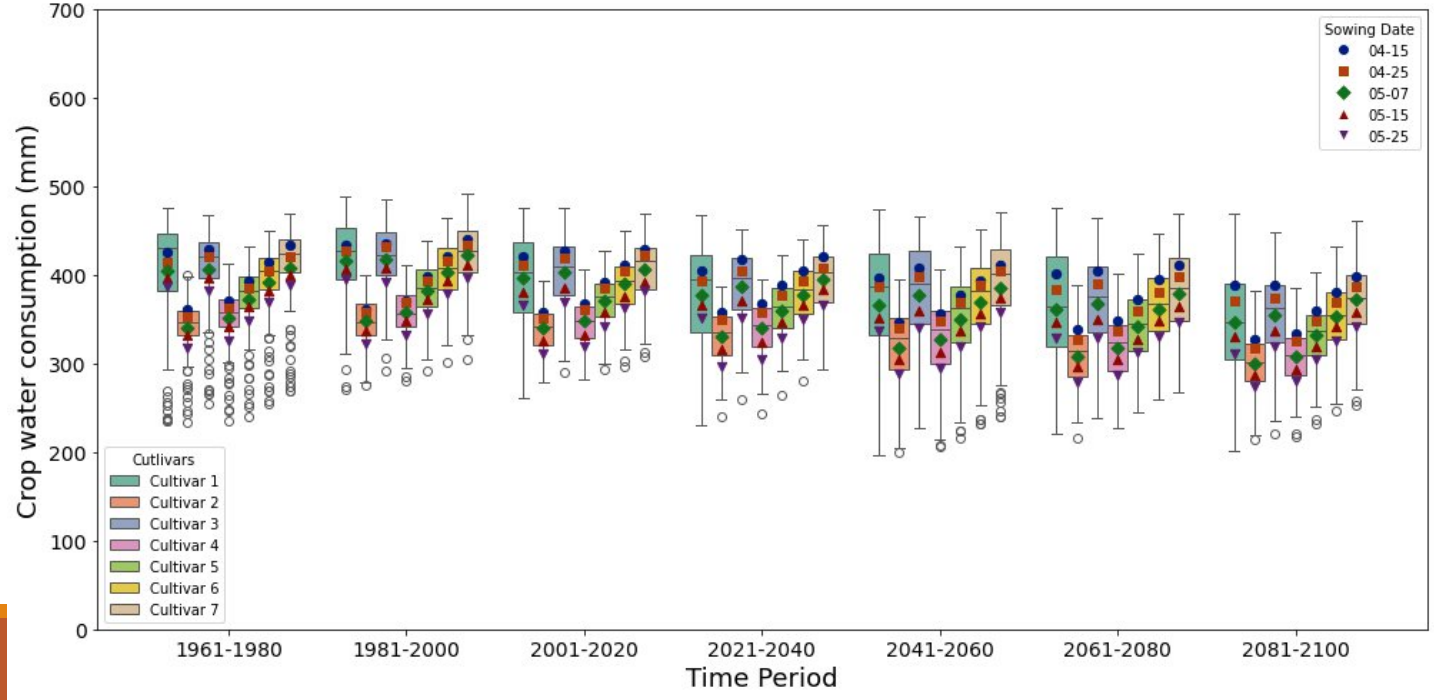
Crop water consumption over time

Irrigated maize crop

- Stable water consumption over time
- Outliers reflect the water stress
- Rainfed crop shows sensitivity
- Future periods show less variability

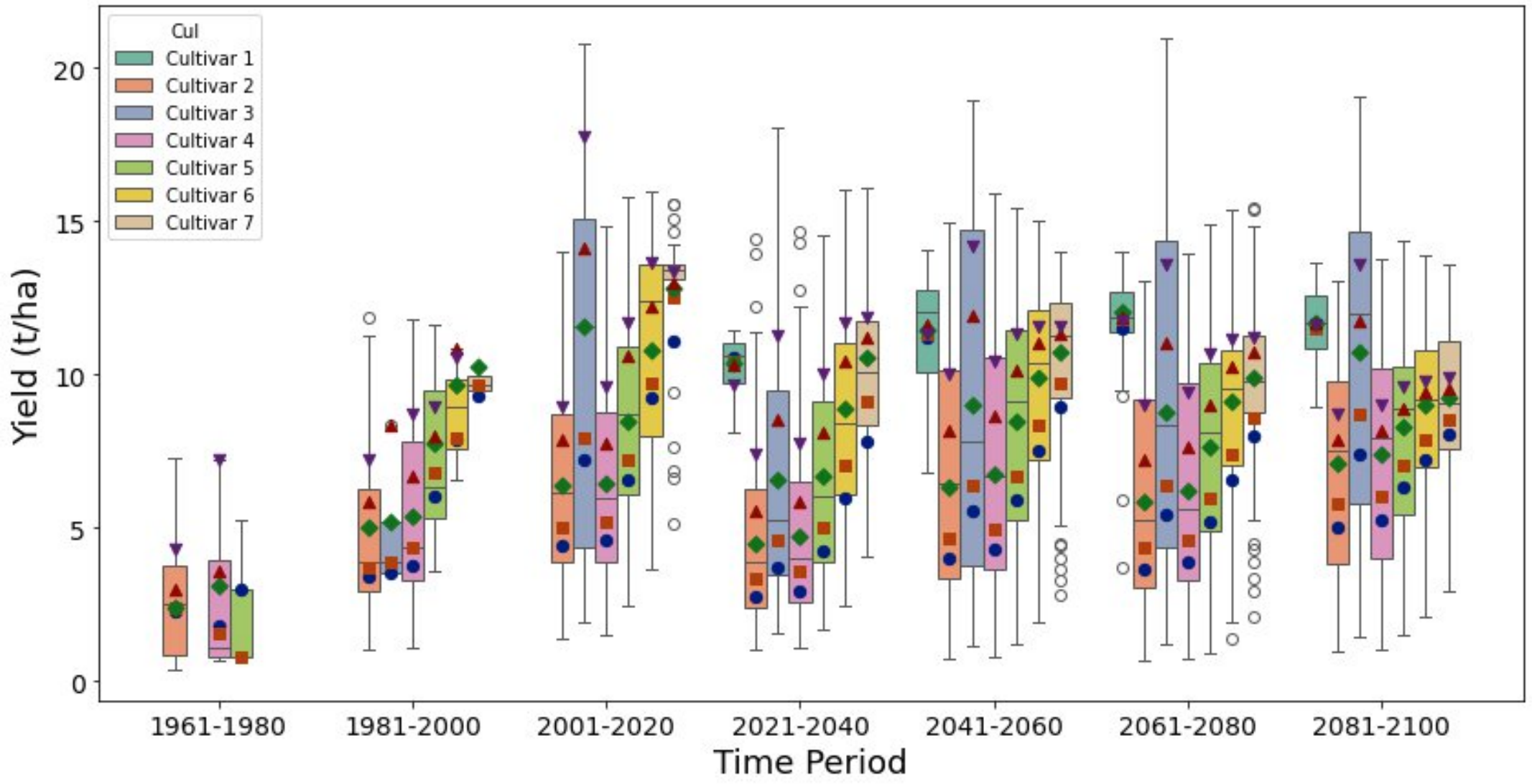


Rainfed maize crop



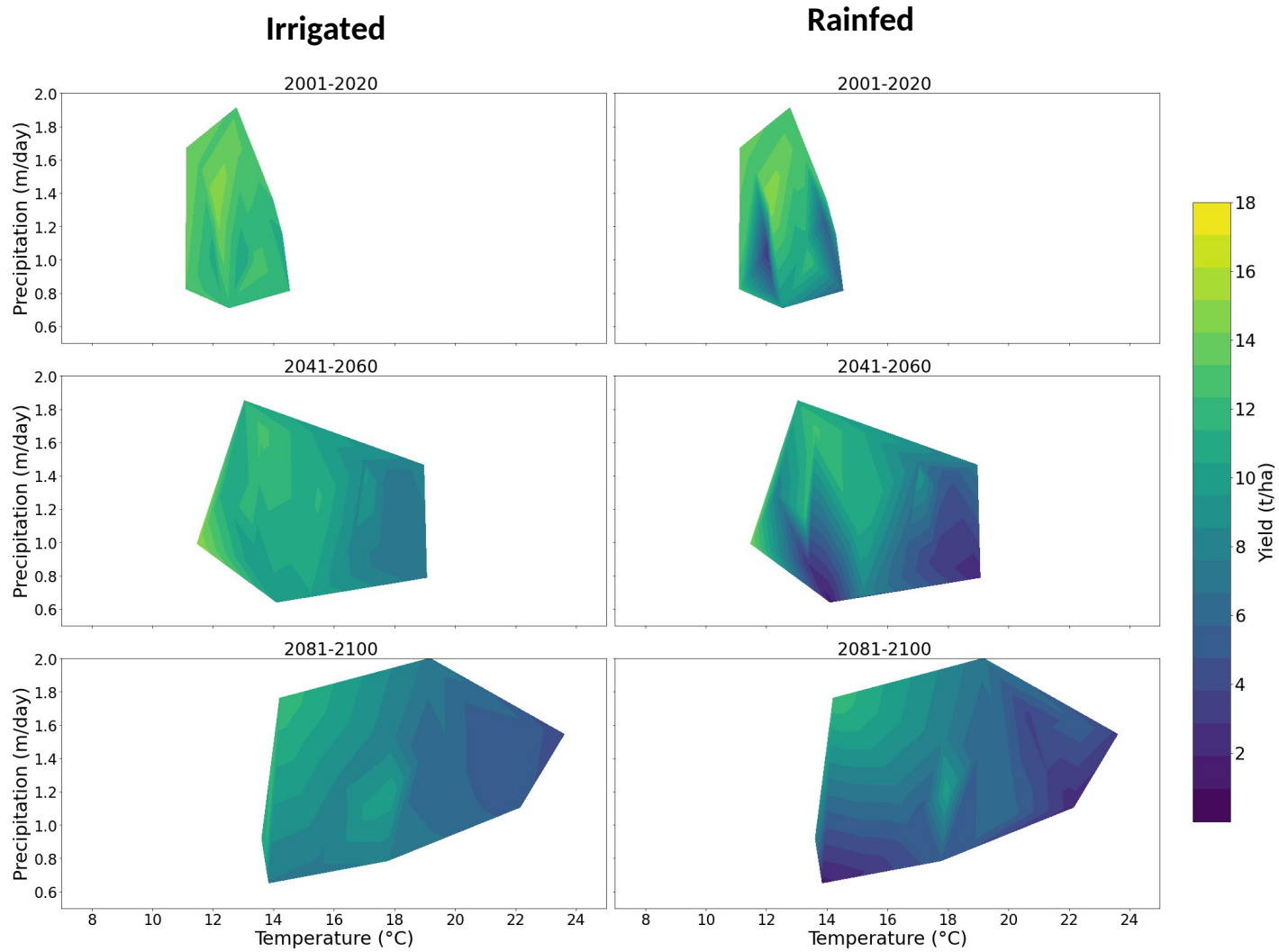
Irrigated maize crop at a grid location (Lat: 33.75 and Lon: -109.25) in Arizona, USA

-> Positive impact on yield in the future due to favorable temperature



Contour maps of yield against temperature and precipitation

- Shown for combination of cultivar and sowing date (Cultivar 3 and April 25th)
- Impact of climate variability on yield response
- Temperature change (DT) = 8 degrees (from 2001-2020 to 2081-2100)



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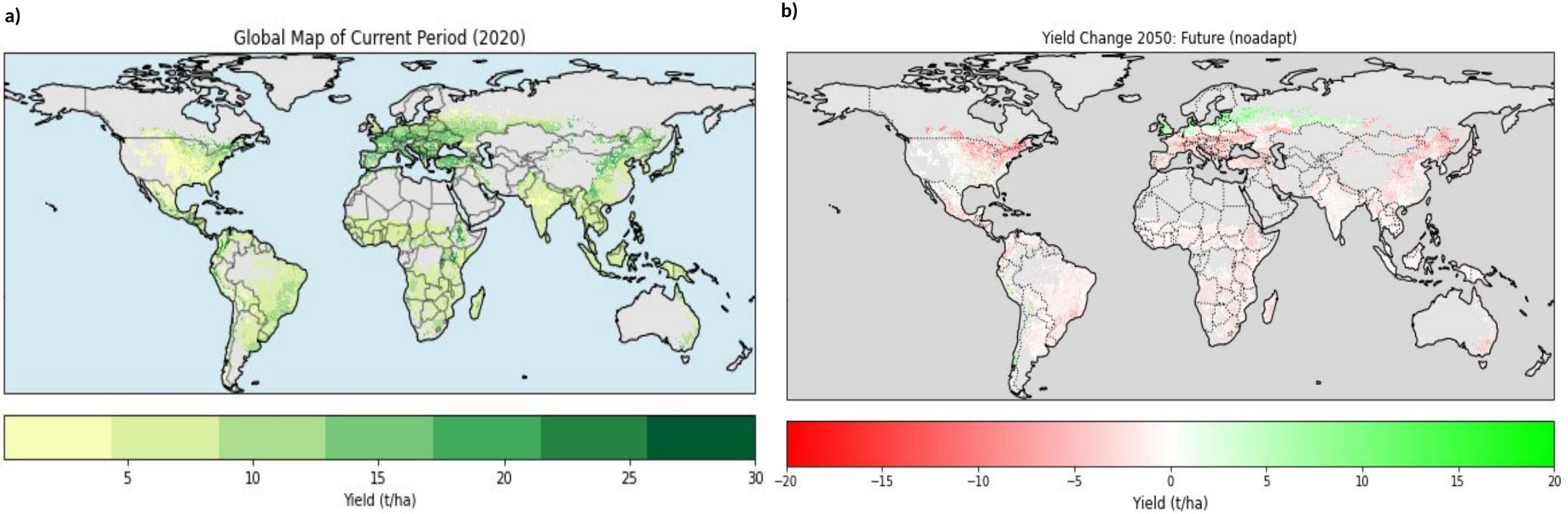
Rainfed Maize Crop

Effect of climate change on crop yield under no-adaptation conditions

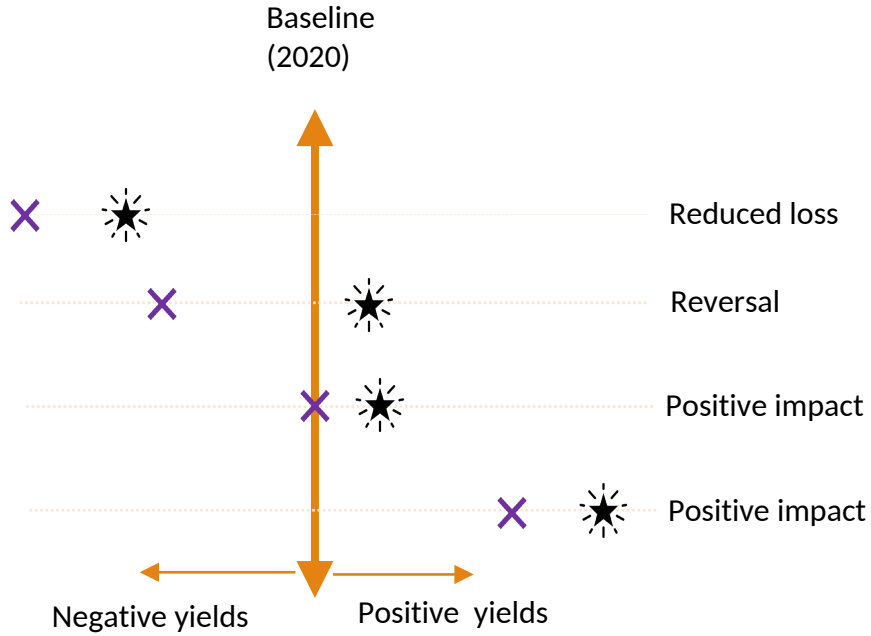


a) Baseline distribution of maize yield in 2020

b) Projected changes in rainfed maize yield by 2050 under a no-adaptation scenario

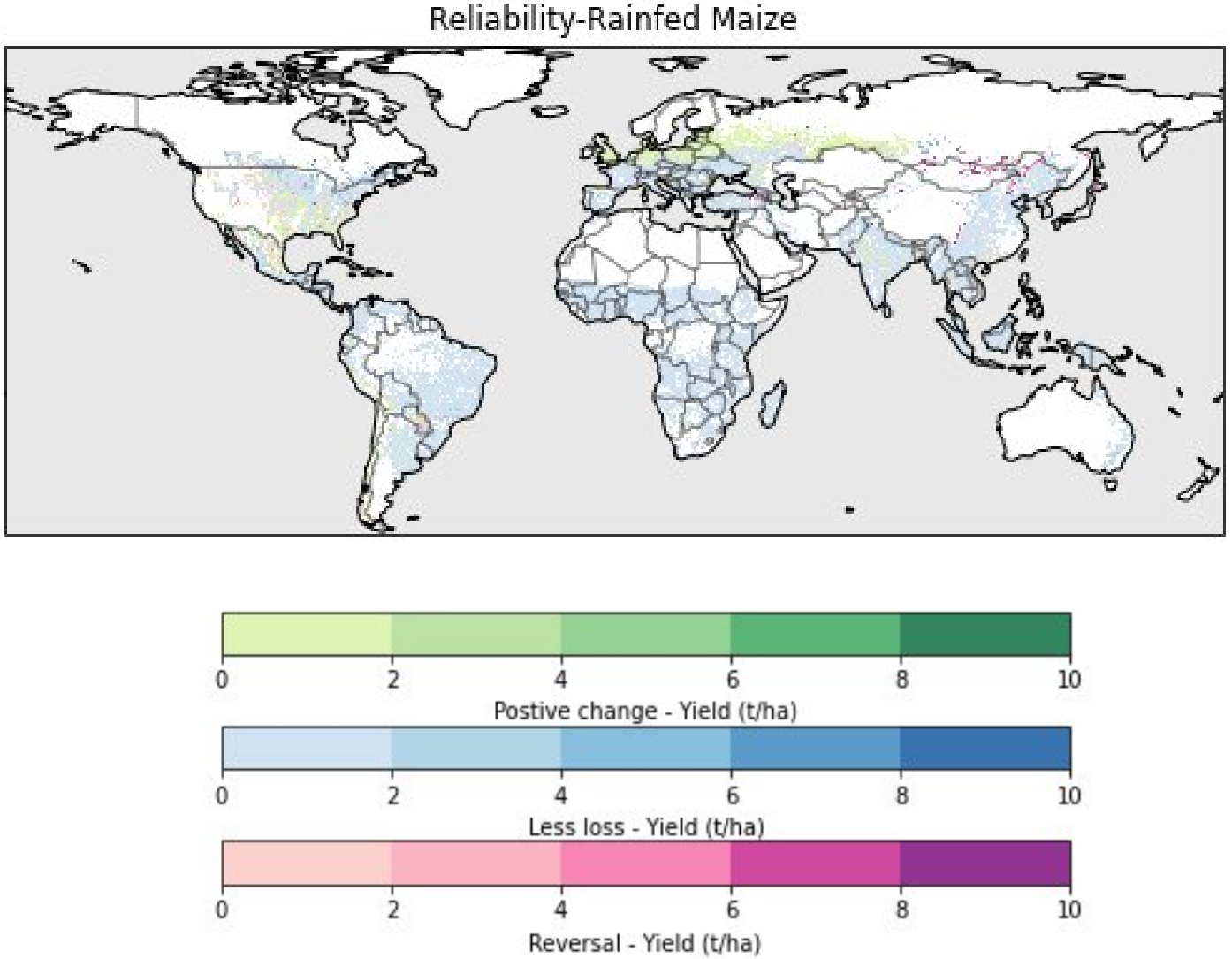
Results • Climate Change Analysis

Evaluating the effect of climate change on crop yield under adaptation and no-adaptation conditions for 2050 from the baseline 2020



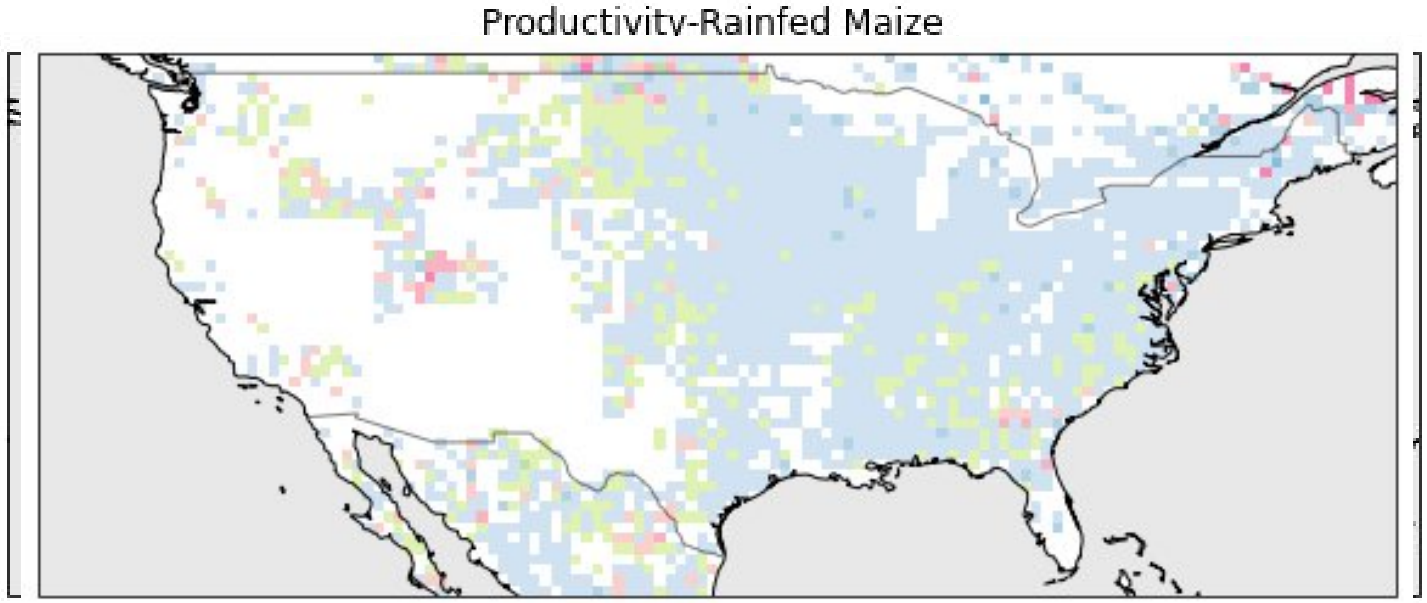
No-Adapt condition (original cultivar and sowing date)

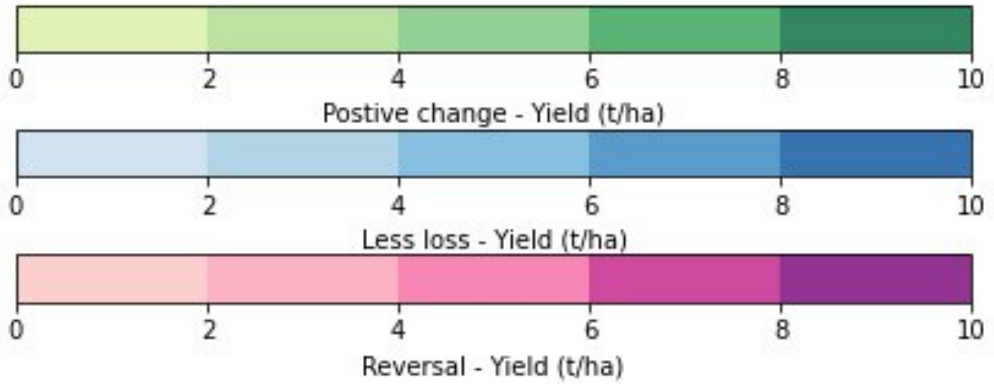
Adapt condition (adapted cultivar and sowing date)



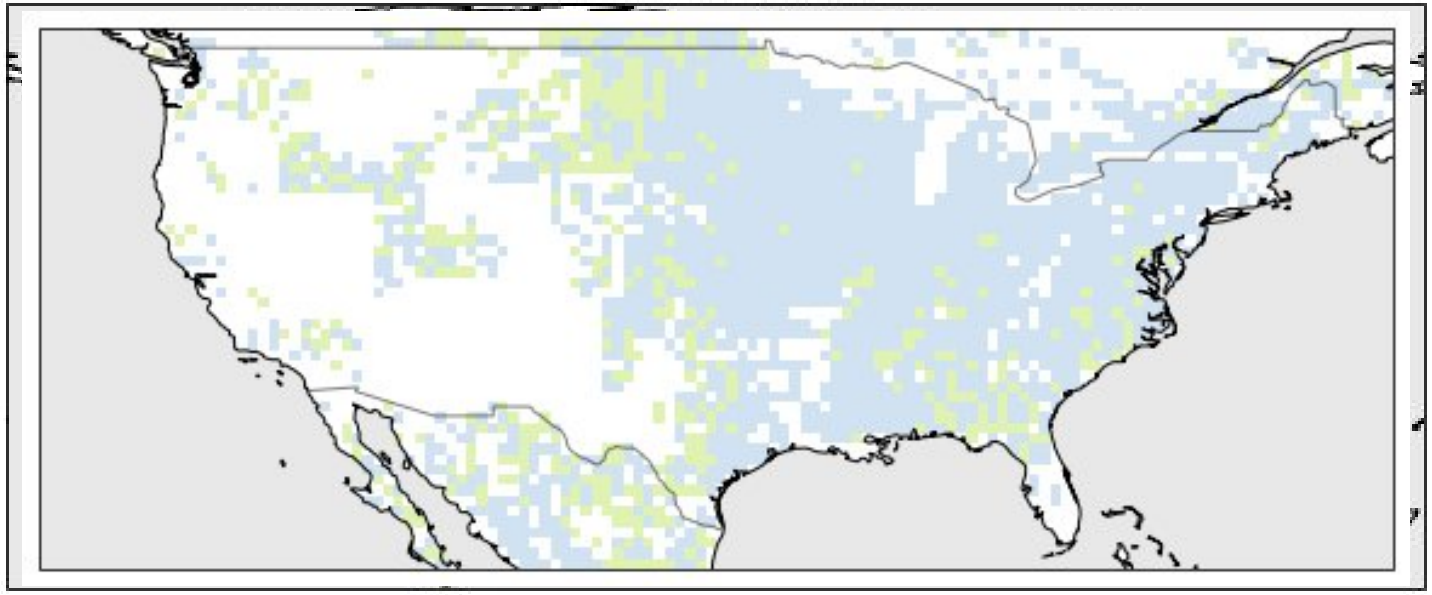
Results • Climate Change Analysis

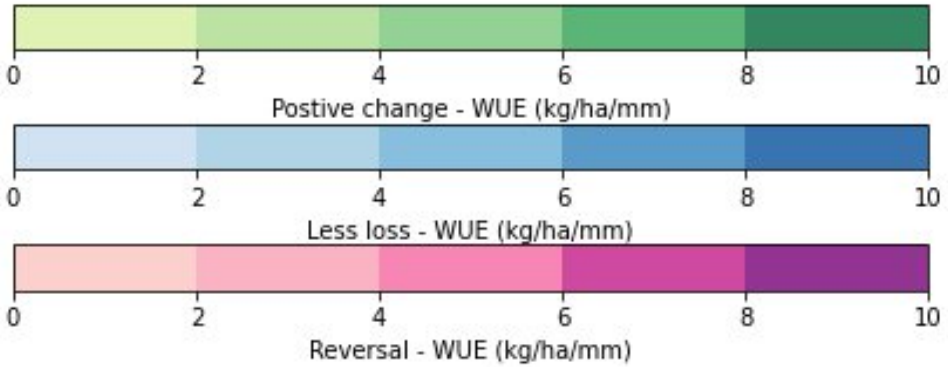
Productivity





Water Use Efficiency





Reflection on using it in other ways

Future projections of agricultural productivity and water use under farmer adaptation

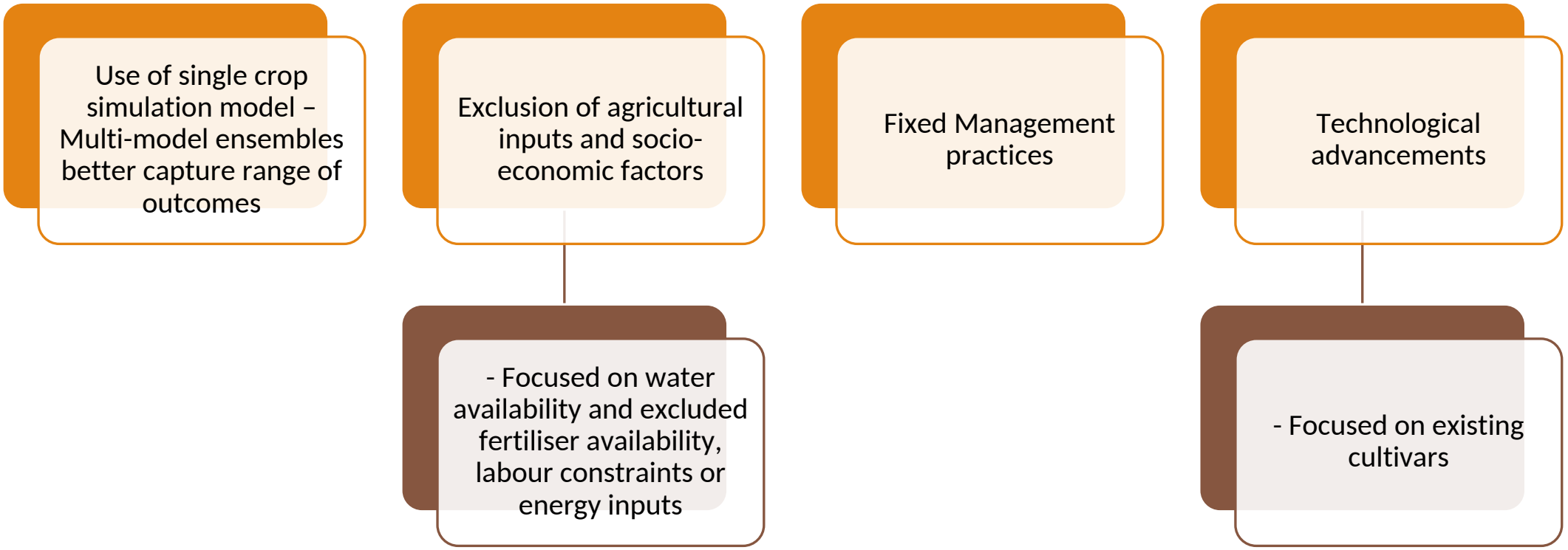
Suitability and opportunity for future production

Exploration of WUE trends across time and regions

Agricultural risk assessment and insurance modelling – offering long-term yield variability

Educator and Data Scientists- Large spatial and temporal coverage
-> Training, scenario analysis and machine learning application

Limitations and Uncertainties



Despite all these, datasets remain a foundational resource for long-term agricultural planning

Take-home message

Dataset provides information on crop yield, biomass and water consumption for five major crops:

- Maize,
- Soybean,
- Winter wheat,
- Spring wheat,
- Rice 1 and Rice 2

For each crop, different cultivars and planting dates are considered for different climate conditions, that include the uncertainty in climate change

Available at the Global level and 0.5-degree resolution - regardless of land cover type

Covers the period of 1961-2100

Irrigated and rainfed systems

Thank you
For Your Attention!

GoNEXUS
Integrated solutions for water, energy, food and ecosystems

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