

# Feedback between Water Availability and Crop Growth using a Coupled Hydrological- Crop Production model

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## 1. INTRODUCTION

- Increases in **extremes**, such as heatwaves and droughts, threaten **crop production** and **food security**.
- Irrigation** is used to secure stable yields, increasing the **competition** with other sectors.
- Biophysical** models - understand the **dependencies** of sectors
- Incorporating **feedback** allowing us to understand the impacts of **hydroclimatic extreme** changes .



## 2. OBJECTIVE

To quantify the **mutual feedback** between **crop production** and **hydrology** under **climate extremes** (i.e., droughts and heatwaves) in various regions globally

## 3. METHODOLOGY

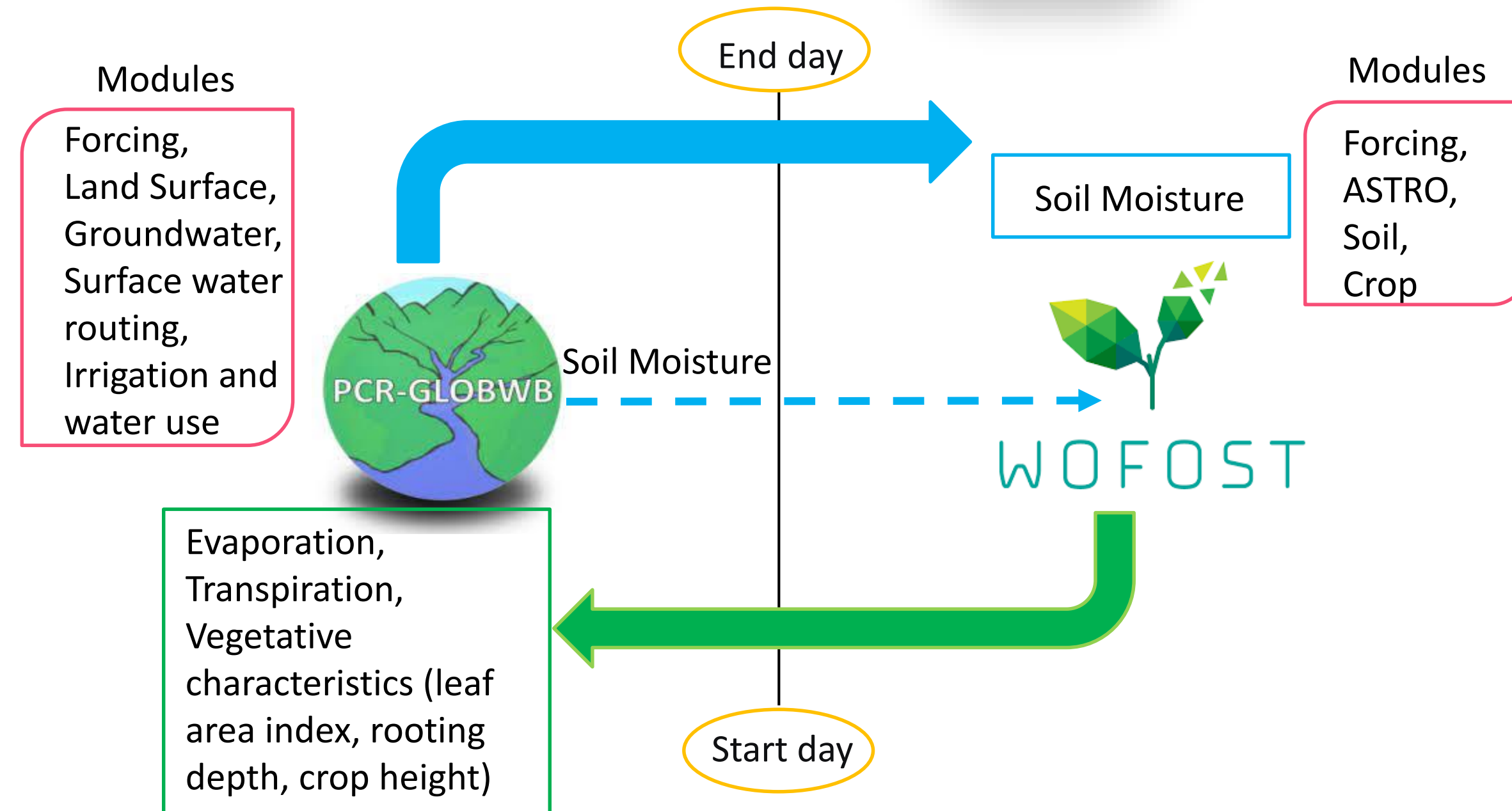


Figure 1. The coupled framework of PCR-GLOBWB2-WOFOST model. The dotted line represents the one-way coupling, where soil moisture from PCR-GLOBWB2 is used by WOFOST. The solid line represents the two-way coupling. The vegetative dynamics from WOFOST were used by PCR-GLOBWB2 to compute soil moisture and then fed to WOFOST to compute for the next step.

<b>Spatial &amp; Temporal</b>	30 arc minutes & 2000-2015
<b>Crops</b>	Maize, Soybean, Wheat, and Rice
<b>Analysis</b>	Irrigation and Rainfed analysis
<b>Model runs</b>	Stand-alone, One-way, and Two-way coupled PCR-GLOBWB2 and WOFOST models
<b>Validation</b>	Reported statistics, Soil Moisture (SM), Discharge and Irrigation withdrawals

## 4. RESULTS

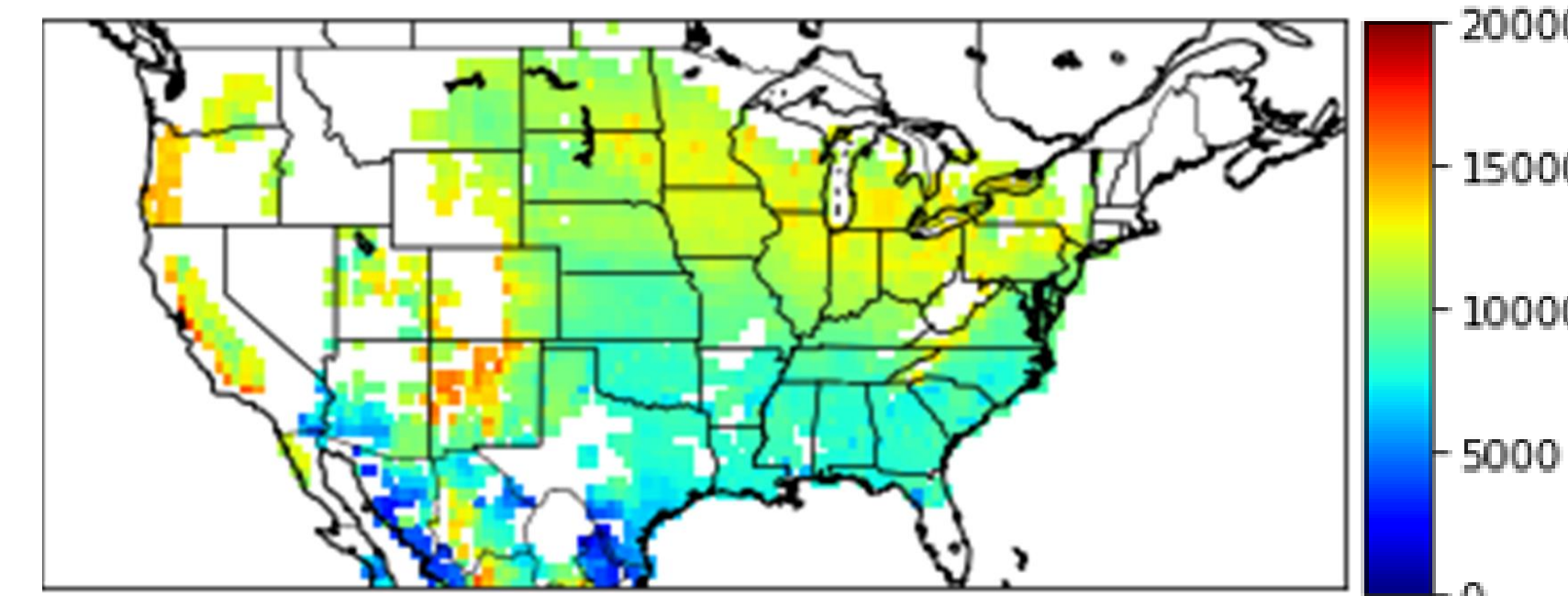


Figure 2. Stand-alone (WOFOST) irrigated yields of maize crop for the 2000 year

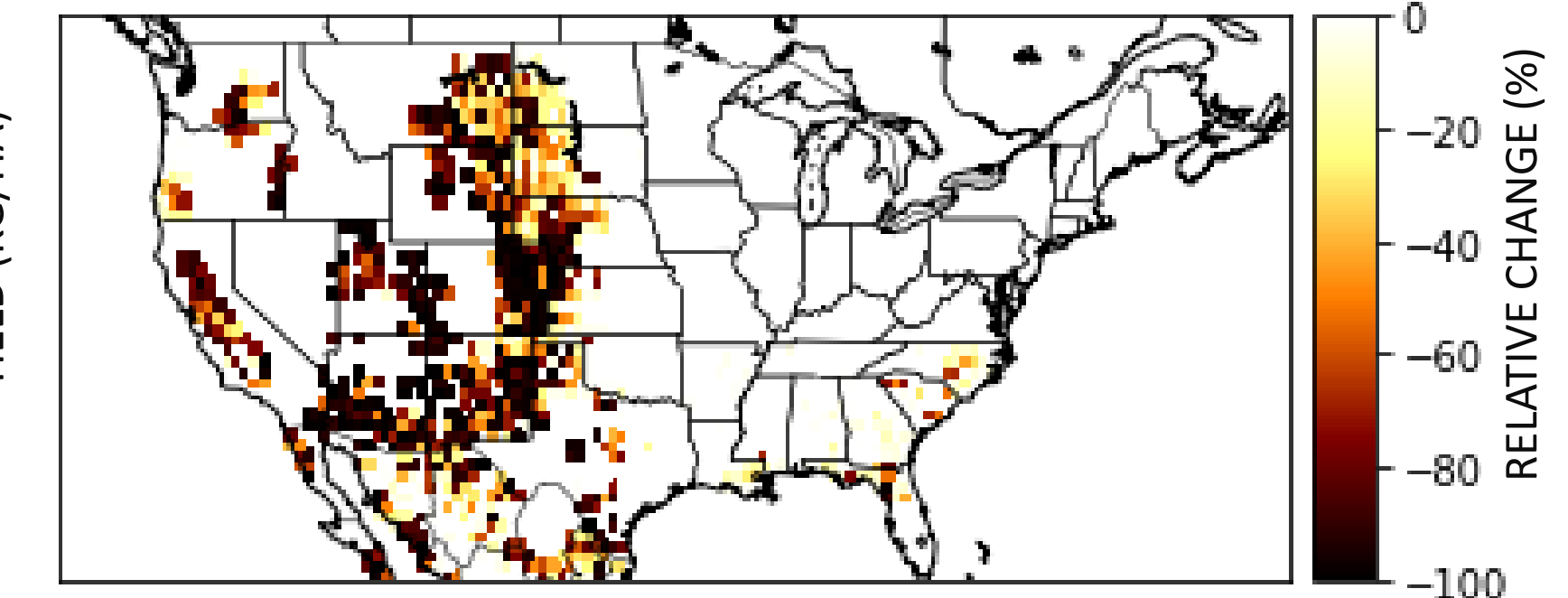


Figure 3. Relative percentage change error of stand-alone and one-way coupling irrigated maize yields for the 2000 year

- Potential yields – WOFOST
- Temperature effect is accounted
- One-way coupling- both **temperature** and **precipitation (SM)** effects are accounted
- Drought years: **2011-13**
- Yields are comparatively **low** in those drought years

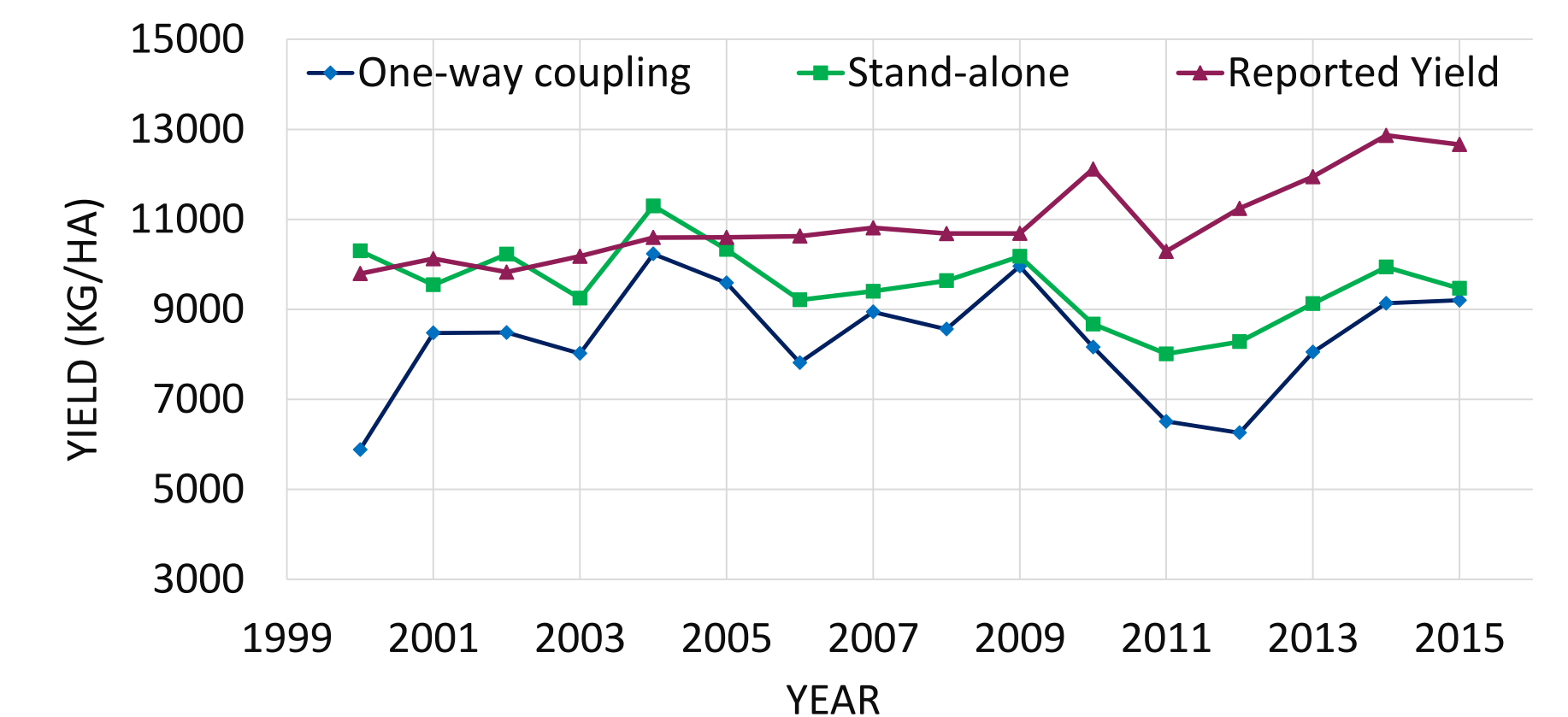


Figure 4. Temporal analysis of irrigated yields of maize crop compared with reported yields

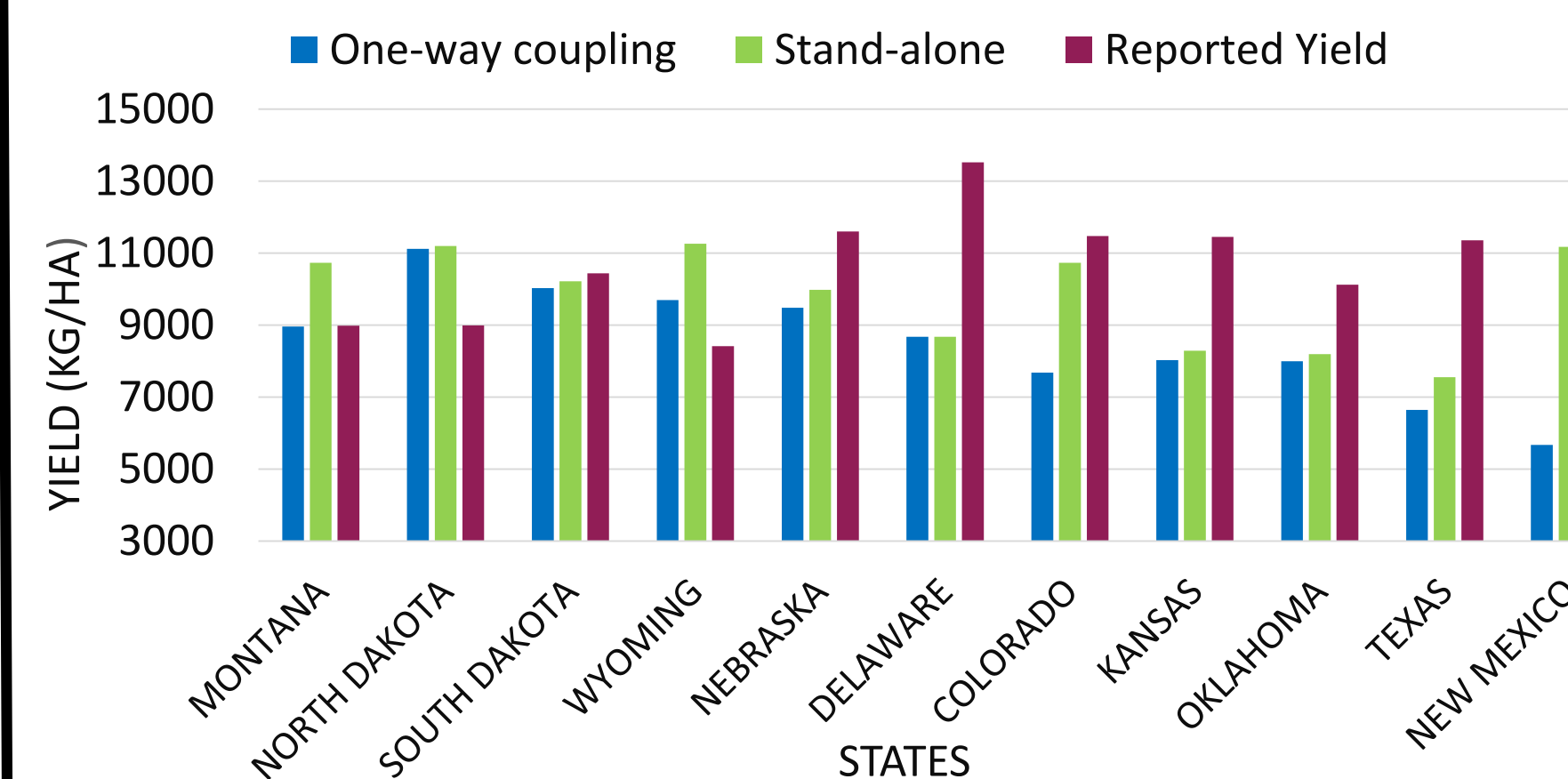


Figure 5. Spatial analysis of irrigated yields of maize crop compared with reported yields

- Soil Moisture is **over/underestimated**
- Texas, New Mexico recorded consecutive **droughts** during **2011-2013**
- Vegetative dynamics** provides a better understanding

## 5. NEXT STEPS

- Two-way coupling
- Scale up globally
- Downscale to 5 arc minutes
- Droughts and Heatwaves

