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

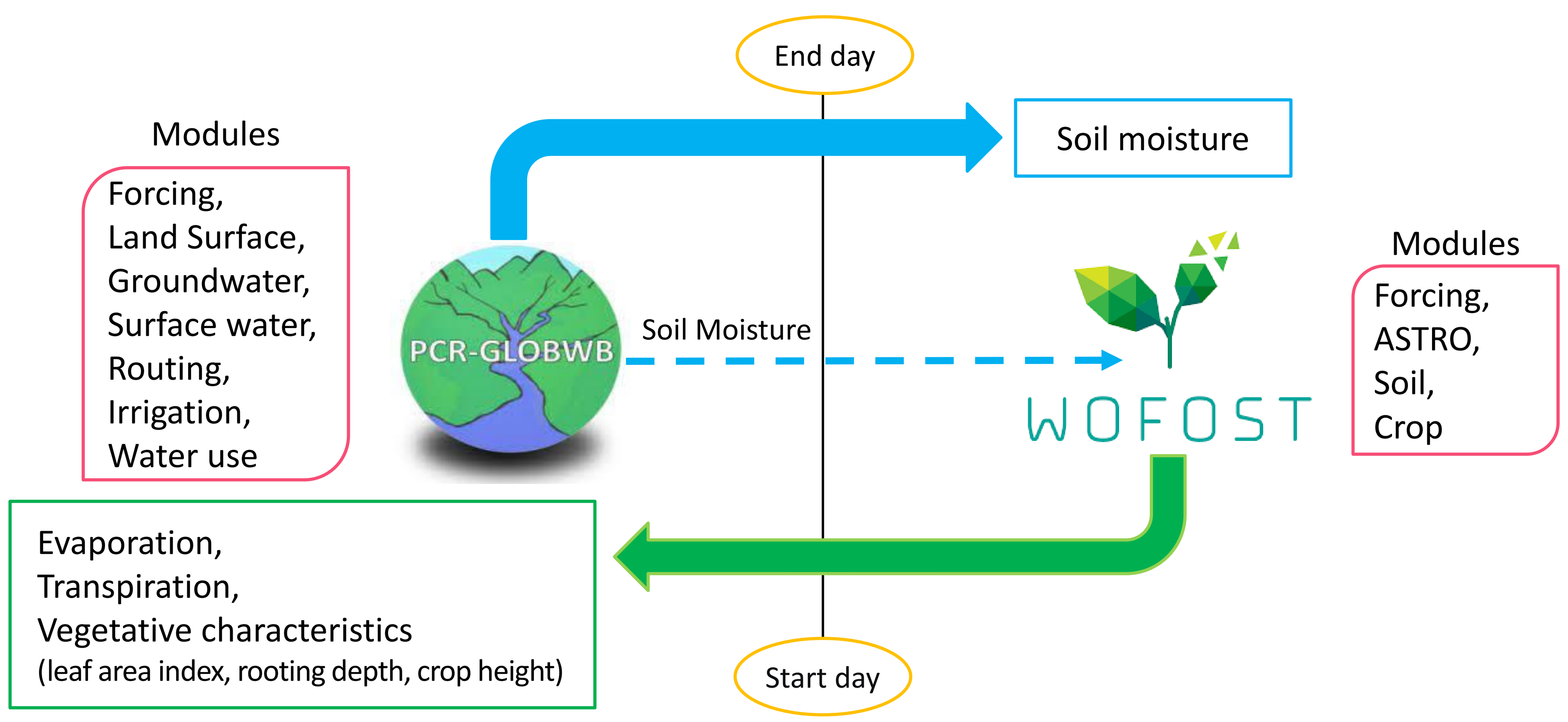

Figure 1. The coupled framework of **PCRGLOBWB2-WOFOST** model**.** The **dotted line** represents the **one-way coupling**, where **soil moisture** from **PCR-GLOBWB2** is used by **WOFOST**. The **solid line** represents the **two-way coupling**. The vegetative dynamics from WOFOST are used by PCR-GLOBWB2 to compute soil moisture and then fed to WOFOST to compute for the next step.

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

4. RESULTS

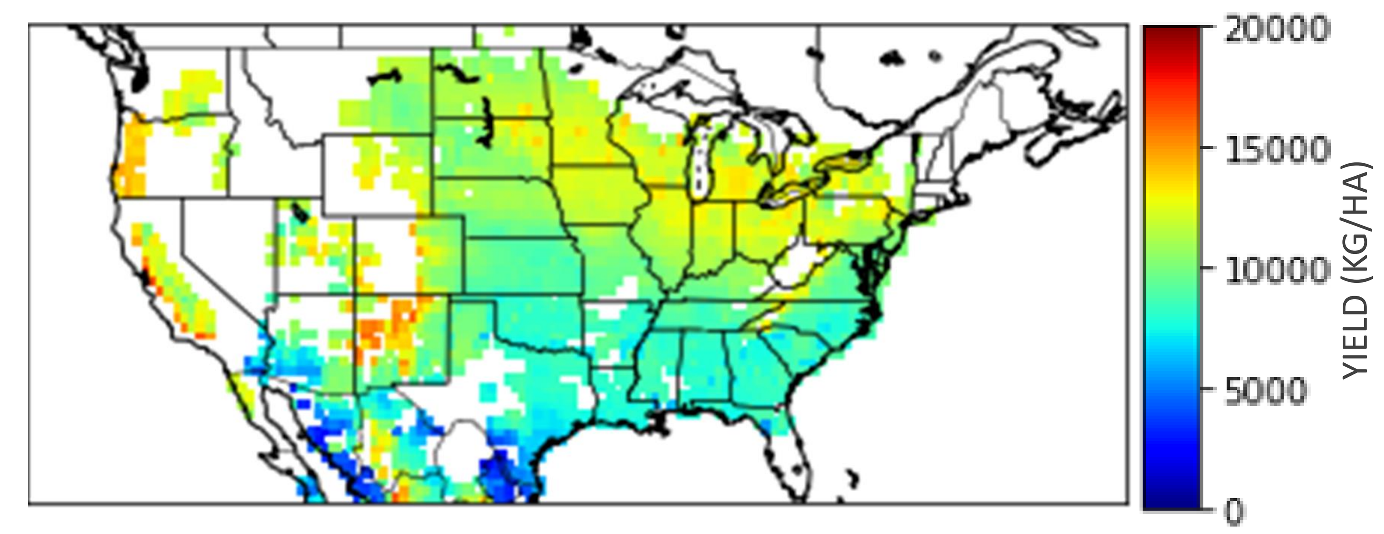

Figure 2. Stand-alone (WOFOST) irrigated yields of maize crop for the 2000 year

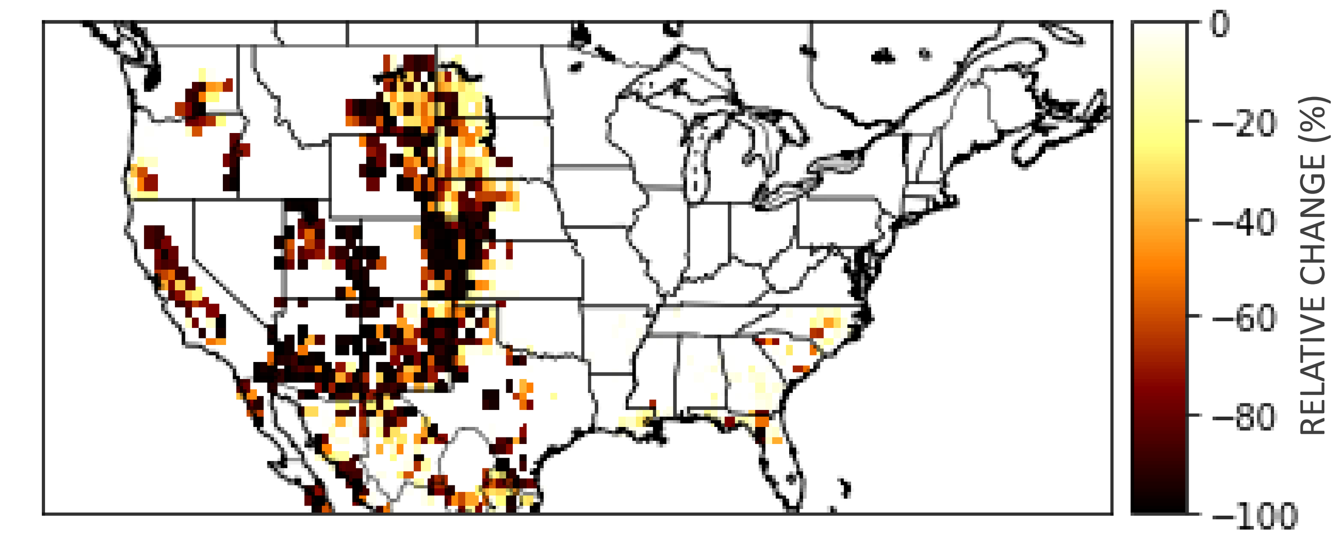

Figure 3. Relative percentage change error for the 2000 year

- **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

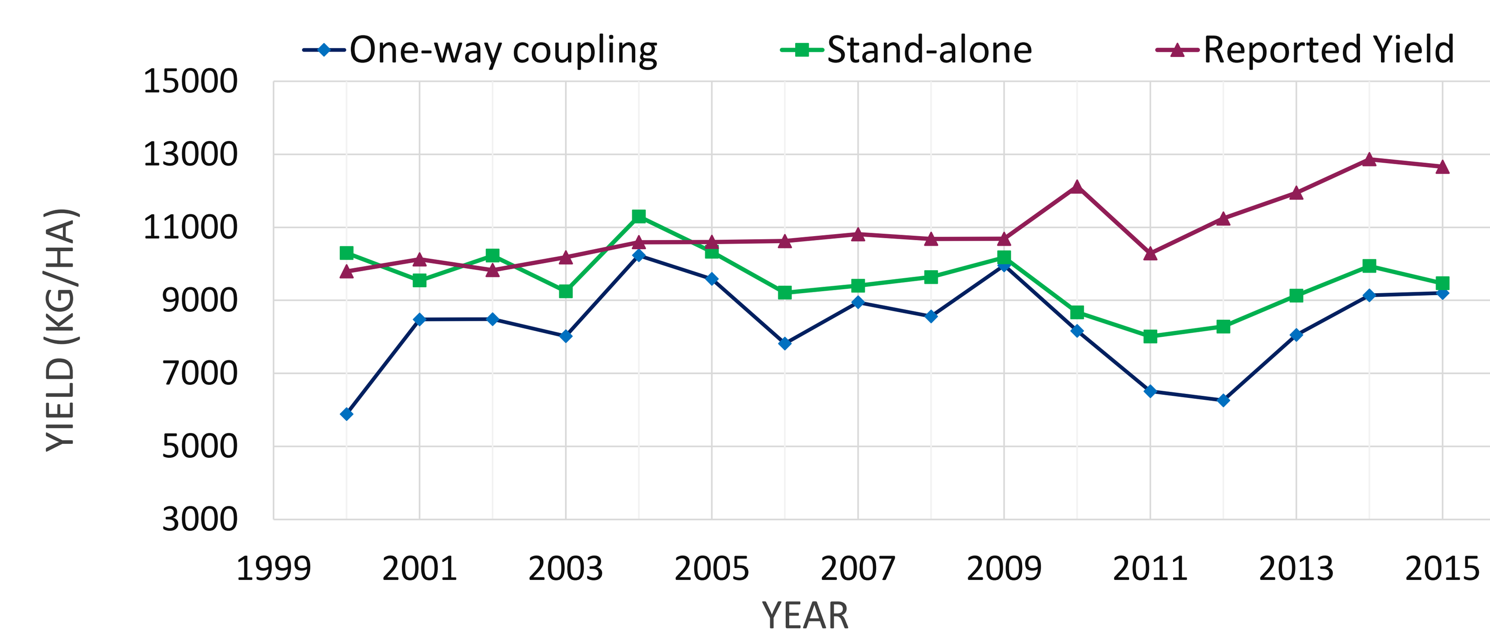

Figure 4. Temporal analysis of irrigated yields of maize crop compared with reported yields

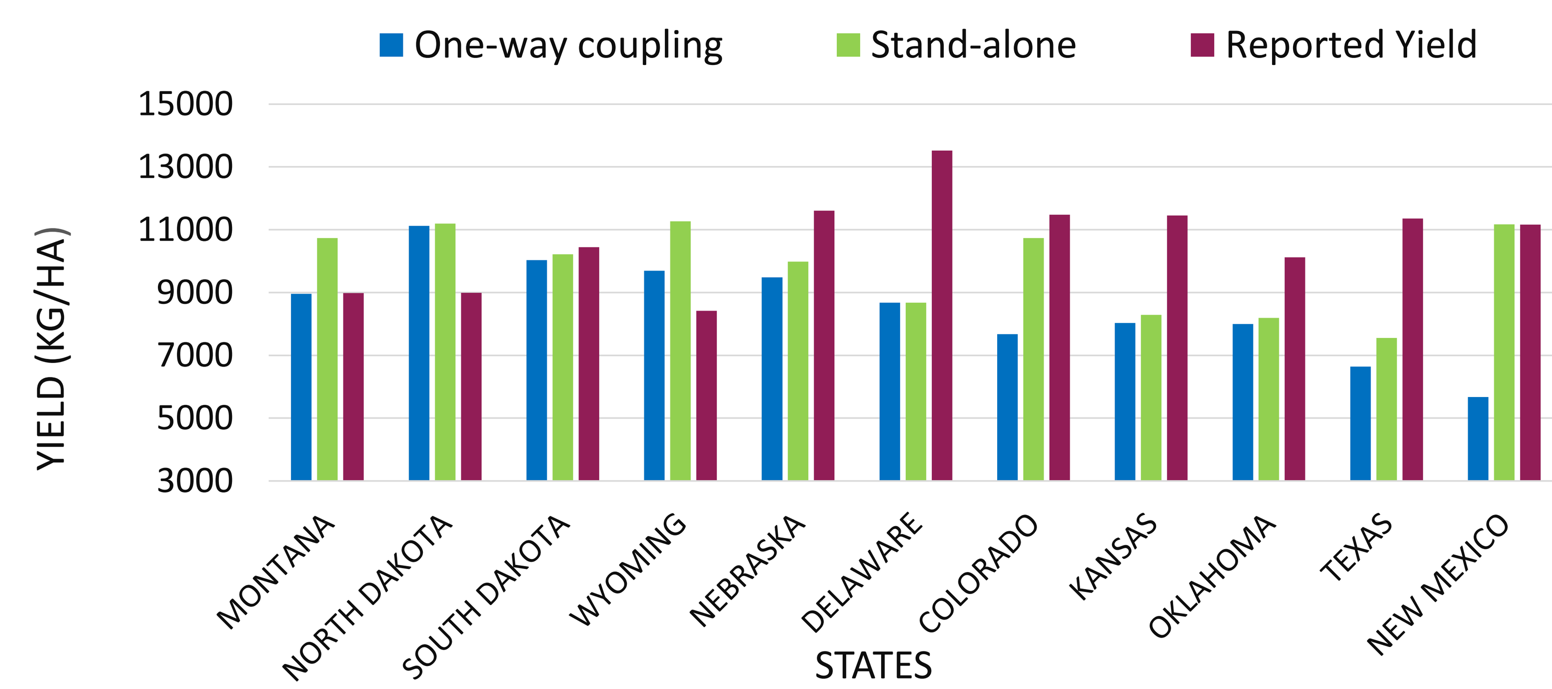

Figure 5. Spatial analysis of irrigated yields of maize crop compared with reported yields

- 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

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