A Digital Twin of the Global Water and Food System

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Background

- Regional **food security** can be affected by a **complex interplay** of compound risks from climate, socio-economic and political drivers, with local food security often influenced by events **elsewhere**.

- Being able to provide **continuously updated**, **and easily accessible** projections of high resolution food and water security risks, allows for **early warning**, **awareness raising** and potential **adaptive responses**.

Objective

1. To develop a prototype 'Digital Twin of the global water and food system', being able of **simulating** the dynamics of the global water and food system for **real time** and for the **near** and **far future**.

2. To better understand and project **risks for water and food security**, caused by climate variability (as a result of climate change), and (disturbed) trade flows.

Approach

The project contains three steps:

1. Build the Digital Twin: real time climate data, updated monthly, calibrate with FAO reported production
2. Validate and improve the Digital Twin by simulating recent climate events
3. Combine the Digital Twin with seasonal and long-term forecasting and trade flows

Results – Digital Twin up and running

The Digital Twin simulates the yield, water use and other food and water related variables for the 12 different crop groups for all countries, including a projection of the current year

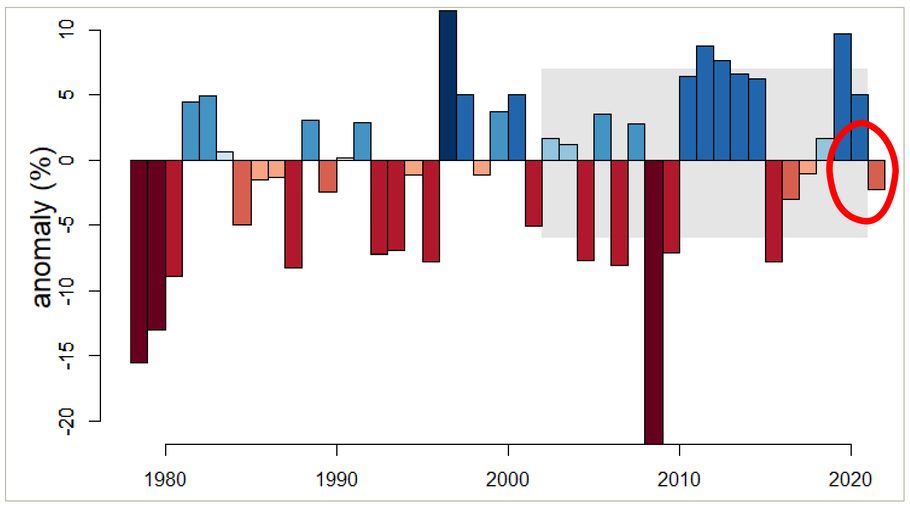

Figure 1. Interannual variability in (irrigated) wheat production in India compared to the mean of 2002 until 2021, including projection for 2022 (simulated, preliminary)

Results – Improving the Digital Twin

- Inter-annual variability is important to understand and capture to analyse the effect of climate on the food and water system
- With FAO data the Digital Twin is validated and variance explained by the Digital Twin is calculated (Figure 2) and improved with updated sowing dates (Figure 3)

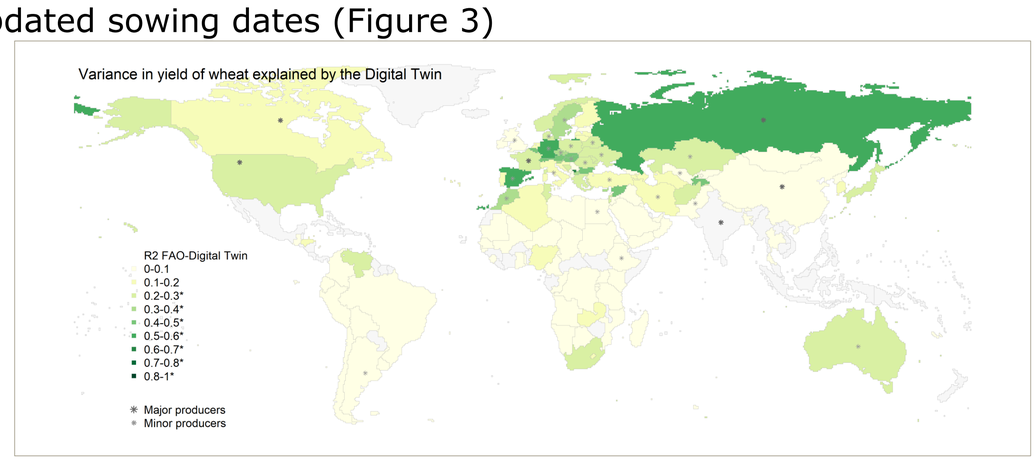

Figure 2. Variance in yield of wheat explained by the Digital Twin when comparing it with observed data from FAO stat (taken the mean of 1980 – 2019)

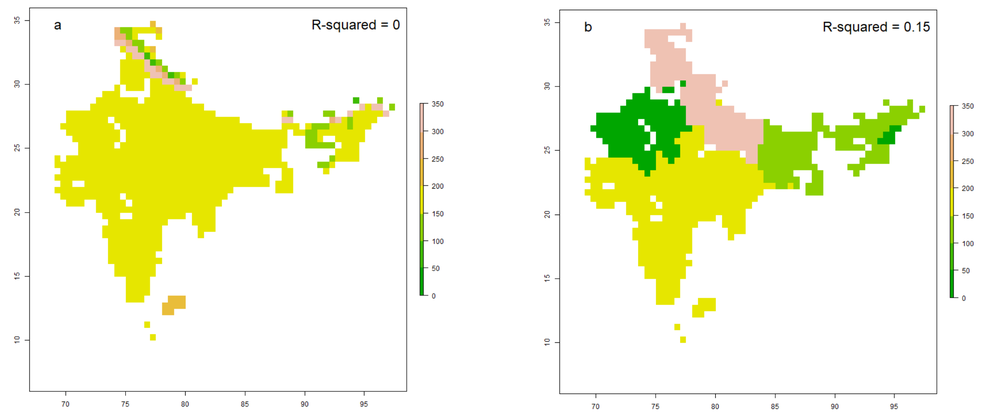

Figure 3. Default sowing dates (a) and improved sowing dates (b) for wheat in India in days with corresponding area

What does this mean?

- A lower production due to climate does not only affect the country itself but affects other countries as well

- Explaining food security risk therefore requires thorough understanding of not only climate impacts on crops, but also international dependencies and trade

Figure 4. Wheat exports from India to other countries in $mn (source: Commerce Department)

Conclusions

- Digital twin prototype is running real time (monthly update)
- Validating and optimizing the Digital Twin is ongoing
- Seasonal forecasting will be implemented next months
- Combine yield projections with trade flows to understand the impact

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