Green Central Asia

Enhancing environment, climate and water resilience

Climate (change) impacts on the Agricultural Production in Central Asia

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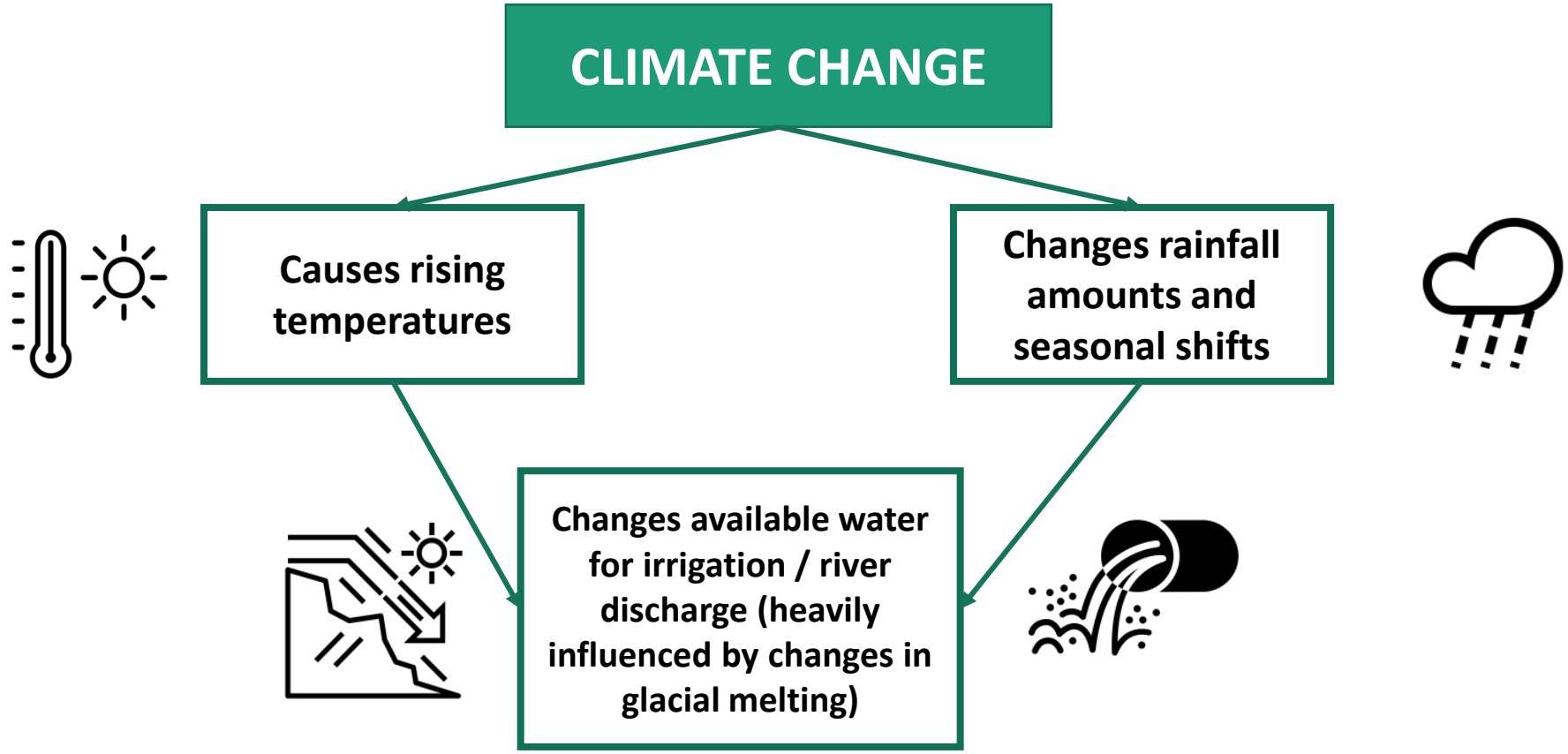
01 | Influence of Climate on Crop Production

Climate Change



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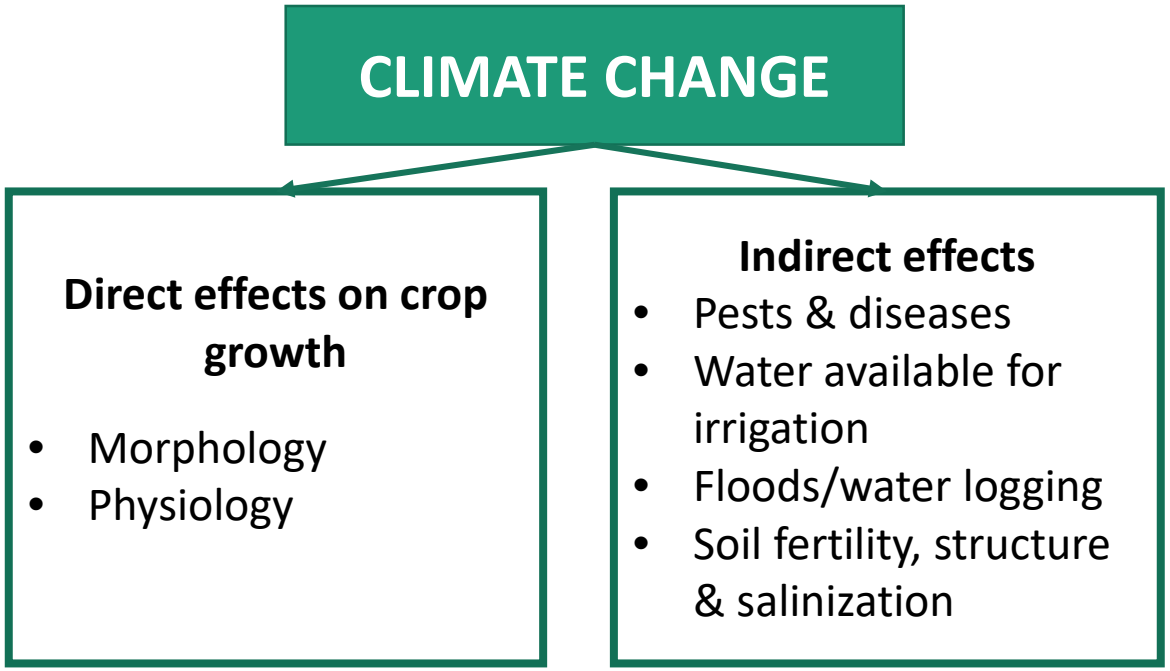
Impacts on Agricultural Production



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02 | Direct effects of Climate Change on Cotton

Optimum Climate Needs of Cotton

Growth stage	Planting	Vegetative growth	1st Square	Reproductive growth	Peak bloom	1st Open poll	Maturation
Ideal average daily temperature	>21°C	21-27°C	21-27°C	27-32°C	27-32°C	27-32°C	21-32°C
Daily crop water need	>0 mm	1-2 mm	2-4 mm	3-8 mm	8 mm	8-4 mm	4 mm

Freeland et al., 2006

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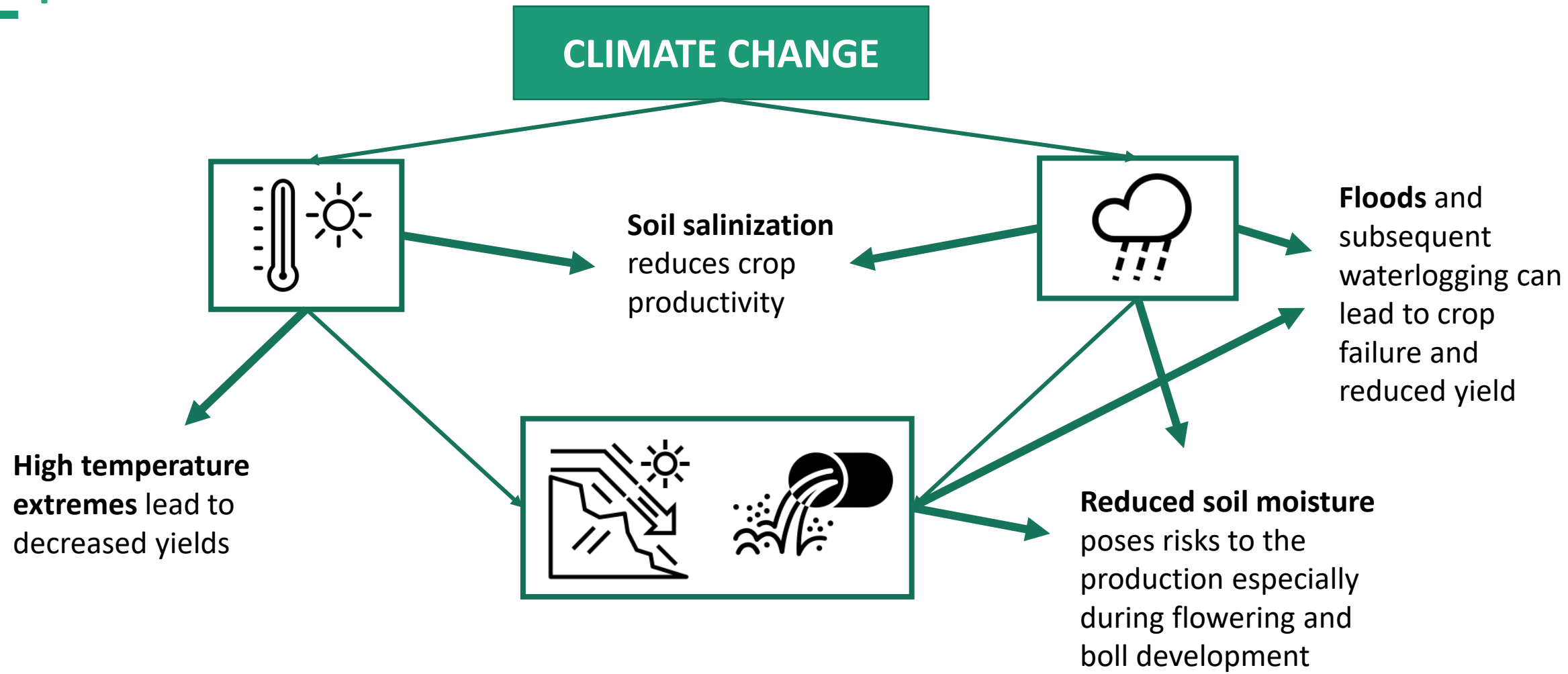
Impacts on Cotton



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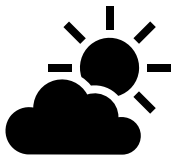
03 | Crop modelling: Data and Methods

We use crop yield and weather data on *rayon* level

We use crop yield data on *rayon* level from 2000 to 2018, provided by WUEMOCA. We consider **irrigated** cotton, rice and wheat.

We use ERA5 weather data, remapped from 0.25° to rayon level. We consider temperature (mean/min/max), precipitation and solar radiation on monthly resolution.



We use growing seasons as defined by MIRCA2000 (Portmann et al., 2010), on national level.

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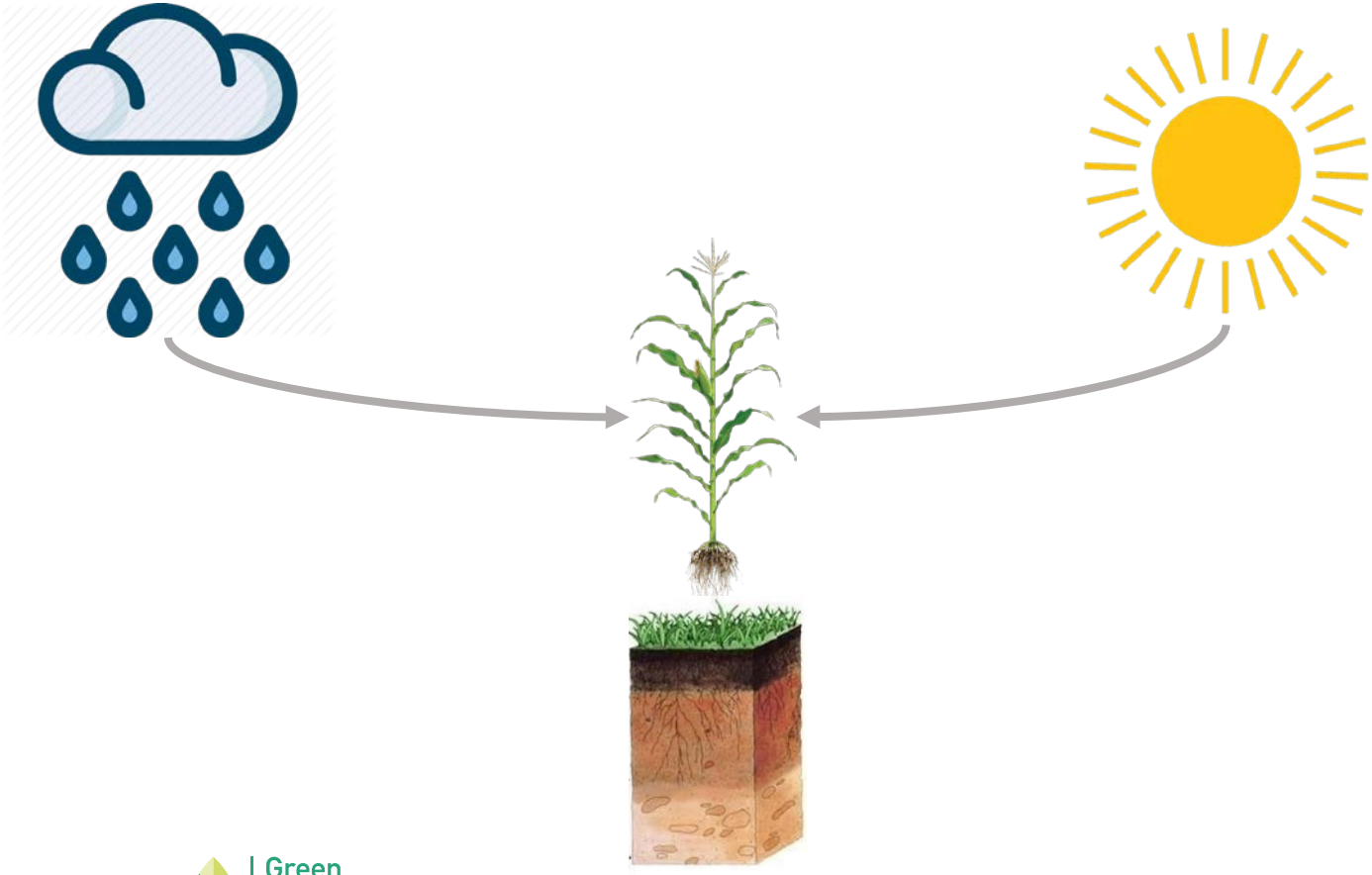
Model (1/2): We use a statistical model called AMPLIFY

The model uses linear and non-linear effects of radiation, temperature, and precipitation to account for the dependence of primary production on climate variables.



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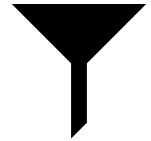
Model (2/2): We apply a LASSO regression with out-of-sample validation

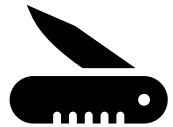
We detrend yields with LOESS and only consider yield **anomalies** (i.e. variations around trend).

We study weather impacts on crop growth separately for each crop and rayon, using a LASSO regression (**L**east **A**bsolute **S**hrinkage and **S**election **O**perator).

LASSO performs cross-validated variable selection and regression simultaneously.



To avoid overfitting, we apply a two-out-of-sample validation, where each pair of years is omitted from model estimation in turn.



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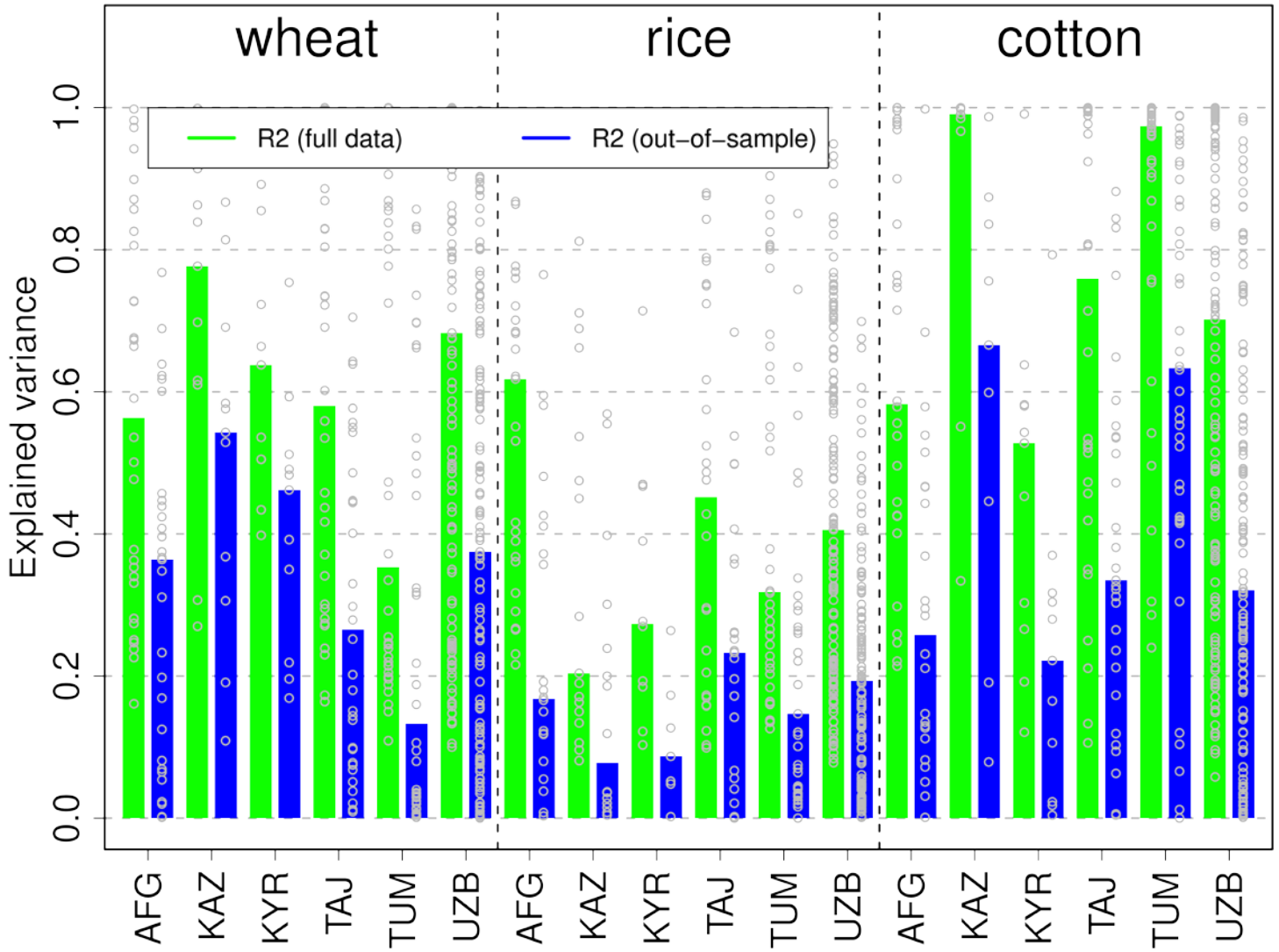
04 | Crop modelling: Results

Weather explains a large share of crop yield variation in Central Asia

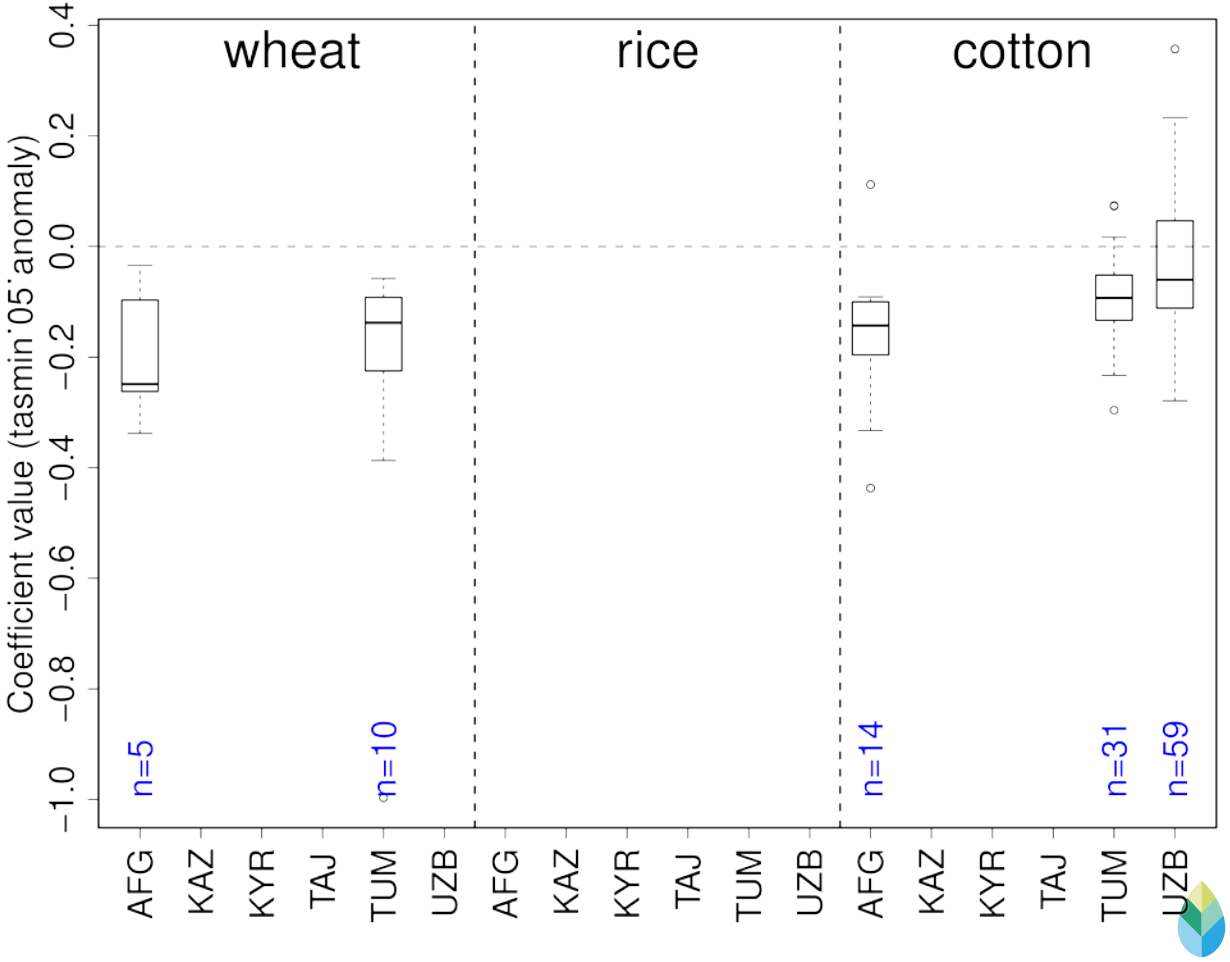


For each crop and country, the explained variance (R^2) is shown for the full and the out-of-sample model. The grey circles represent individual rayons; the colored bars are the national averages of the circles.

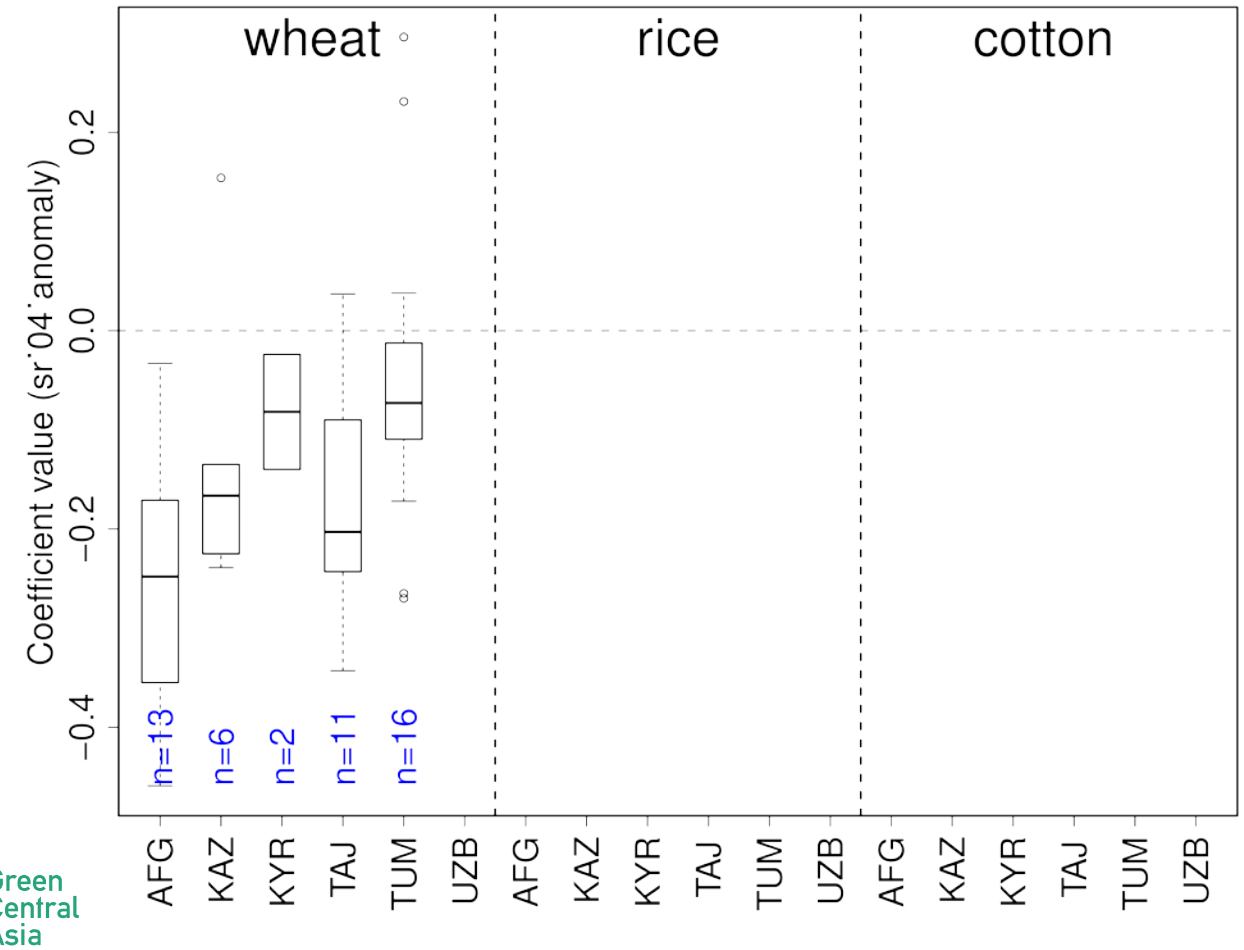
The share of variation not related to weather (at least according to our model) is likely due to changes in management (fertilizer, herbicides, pesticides etc.) or soil attributes.

Weather influences on crop growth differ by crop and region

Minimum temperature in May



Solar radiation in April



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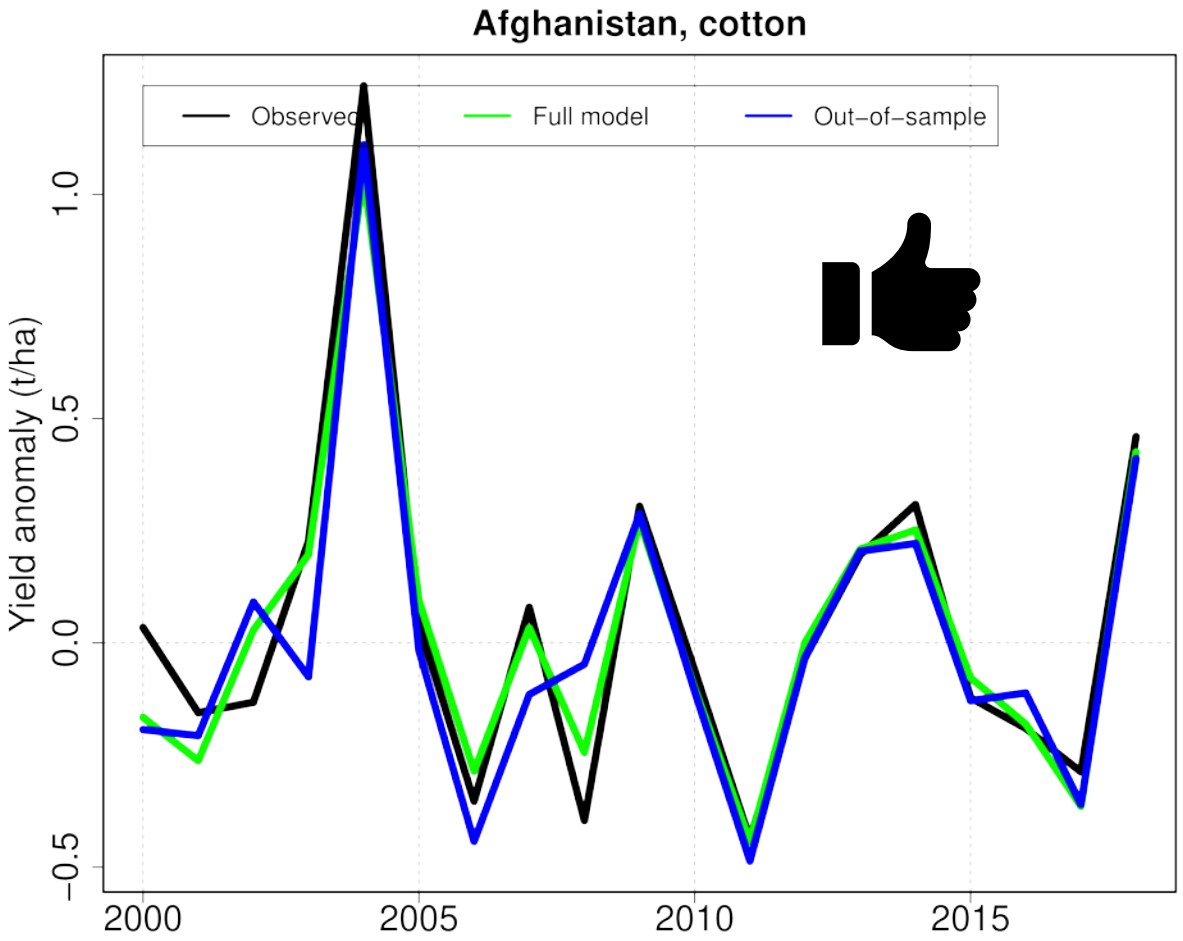
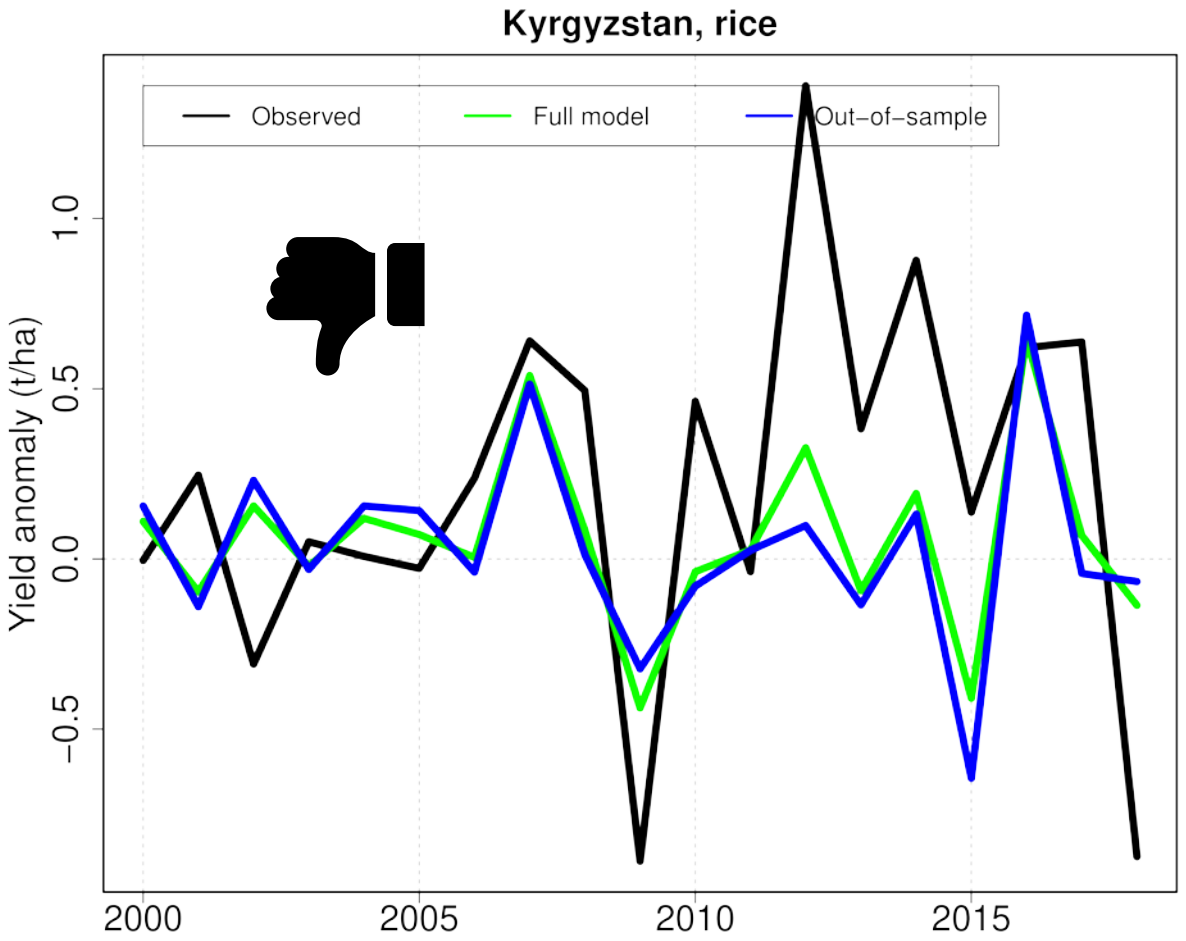
Modelled and observed time series often agree well (but not always)





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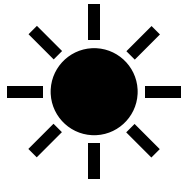
05 | Conclusion and next steps

Conclusion

There is a strong impact of weather on crop growth in Central Asia, differing by regions. Climate change may amplify effects.



There are differences in the impacts of single weather parameters.

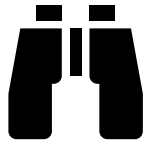
Out-of-sample validation is crucial to avoid overfitting and to gauge uncertainty.

...and next steps

Better understand weather impacts and compare with literature.

Use different input data (weather, seasons) and merge into an ensemble analysis.

Try forecasting crop yields before harvest.



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Thank you.

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