

# ISI-MIP 2 workshop

Overview of the agricultural sector

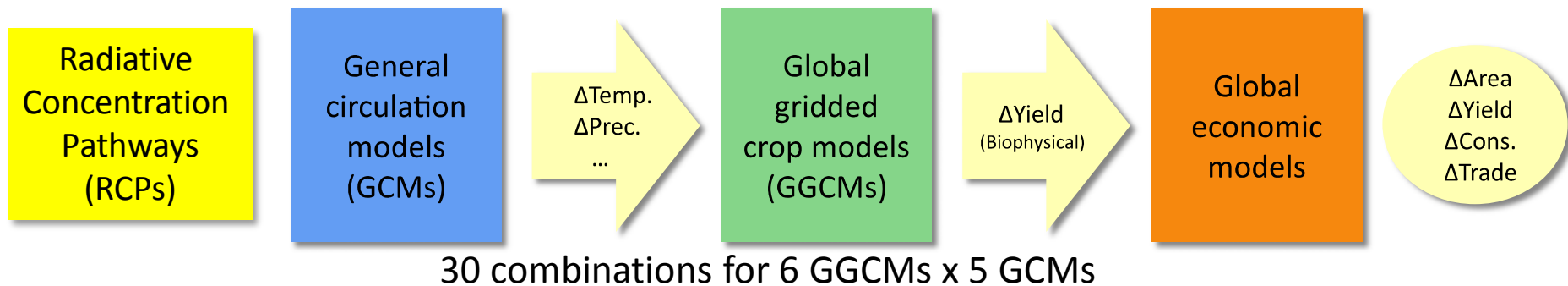
The global gridded crop modeling  
intercomparison initiative phase 1

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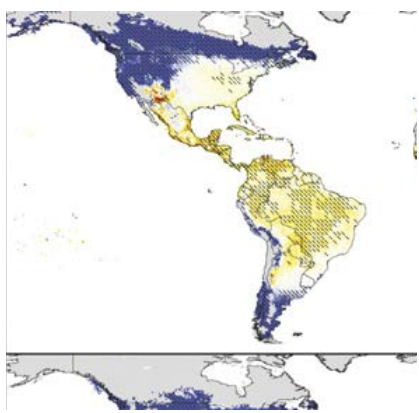
# Phase 0: “Fast-track” gridded crop modelling intercomparison

- 6 global gridded crop models (GGCMs)
- 9 global agro-economic models
- driven by 5 global climate models (GCMs)
- 4 radiative concentration pathways (RCPs)



# Projected impacts on crop yields

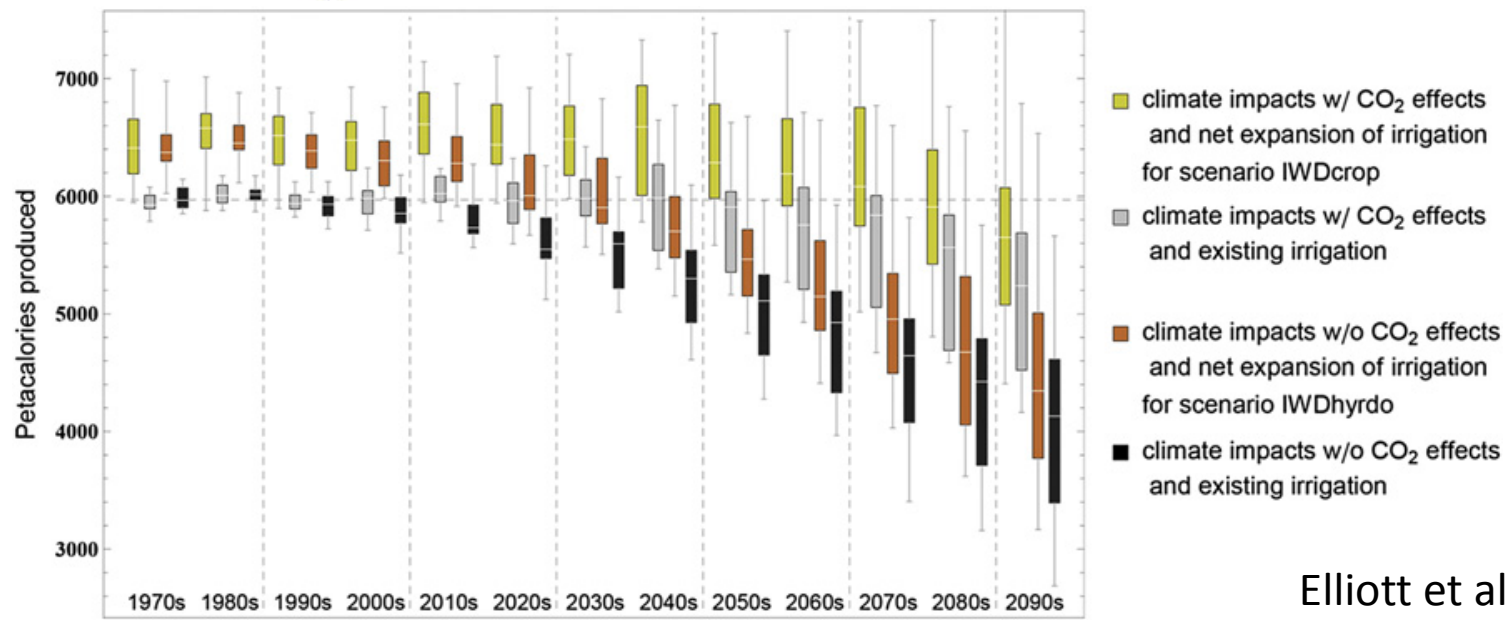
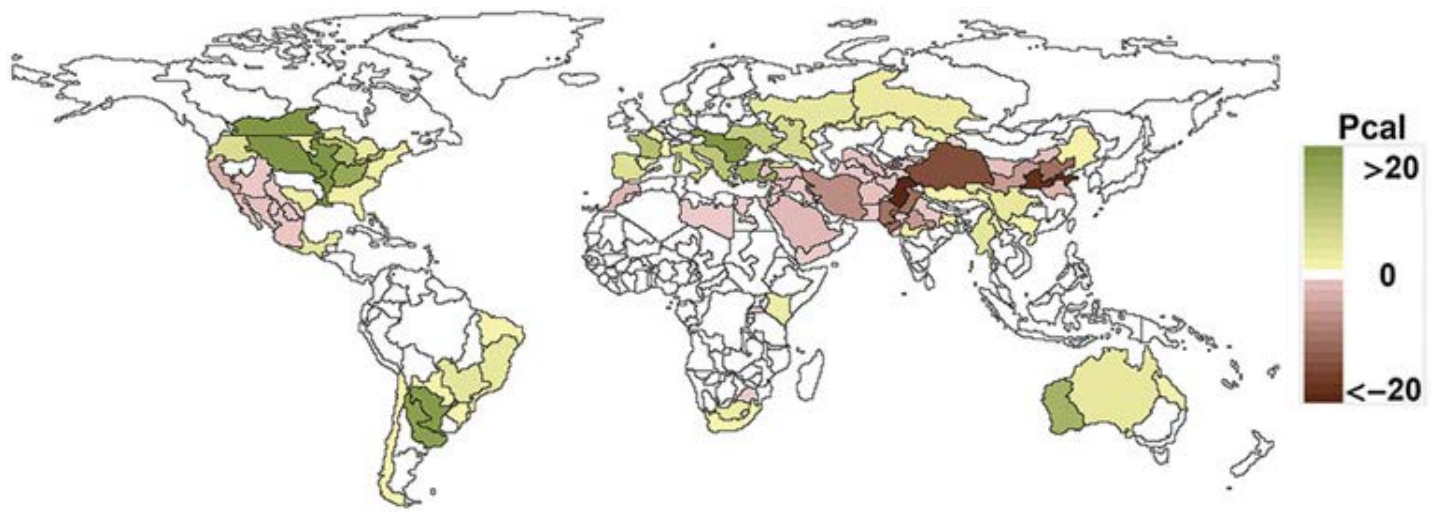
Simulated change in crop yields in 2080 relative to 2000 under RCP 8.5  
CO<sub>2</sub> concentrations double relative to present-day



Rosenzweig et al., 2014

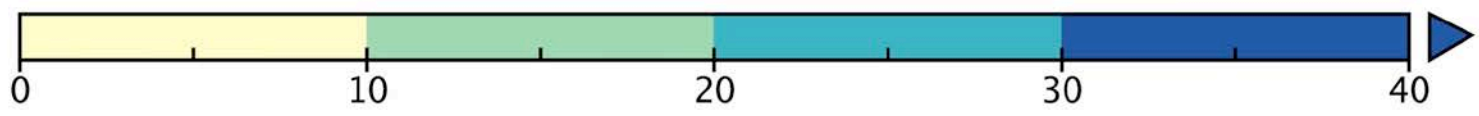
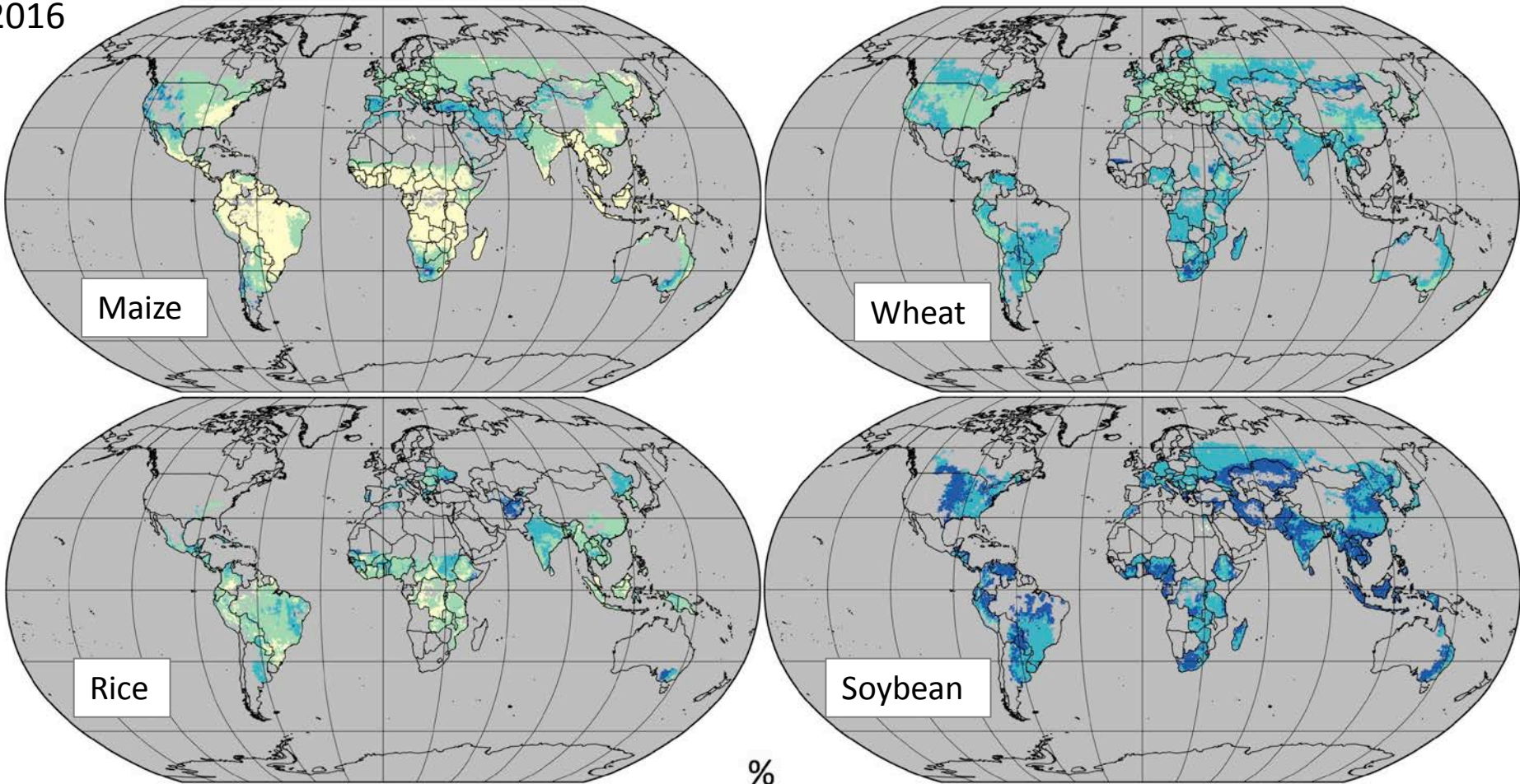
Median across 30 combinations of 6 global crop models and 5 global climate models

# Climate impacts on irrigation water demand and adaptation



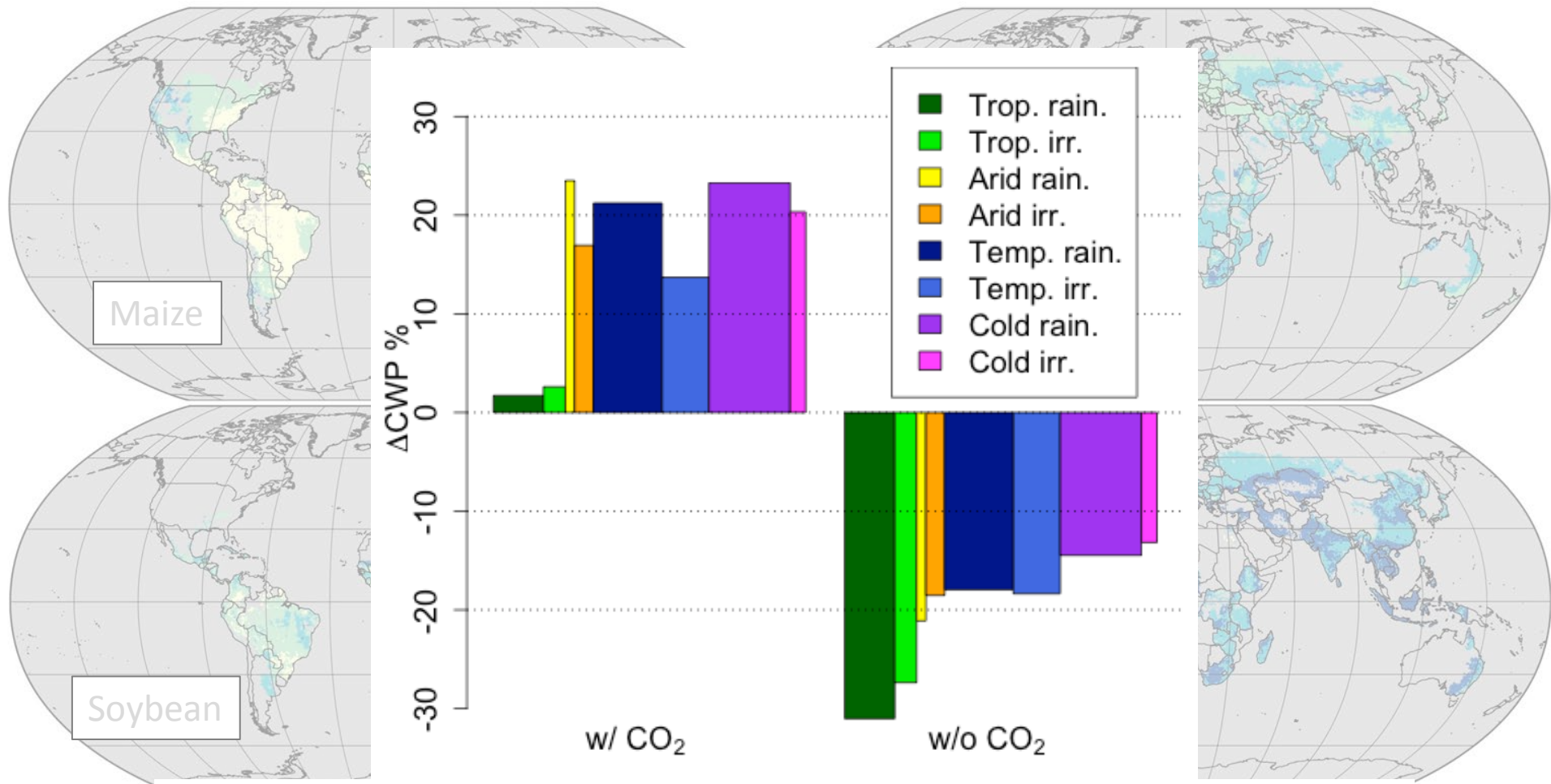
# Assessing the effects of elevated [CO<sub>2</sub>] on crop yield and water use

Deryng et al.,  
2016

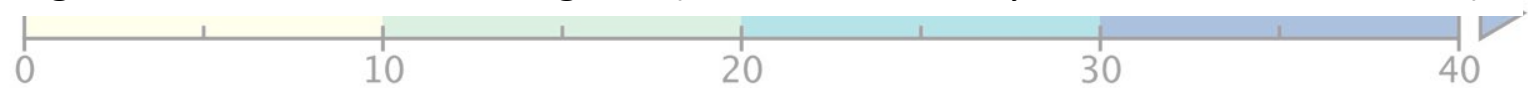


Effects of elevated CO<sub>2</sub> under climate change: % increase in crop water productivity (yield/ET)

# CO<sub>2</sub> effects vary across climatic regions

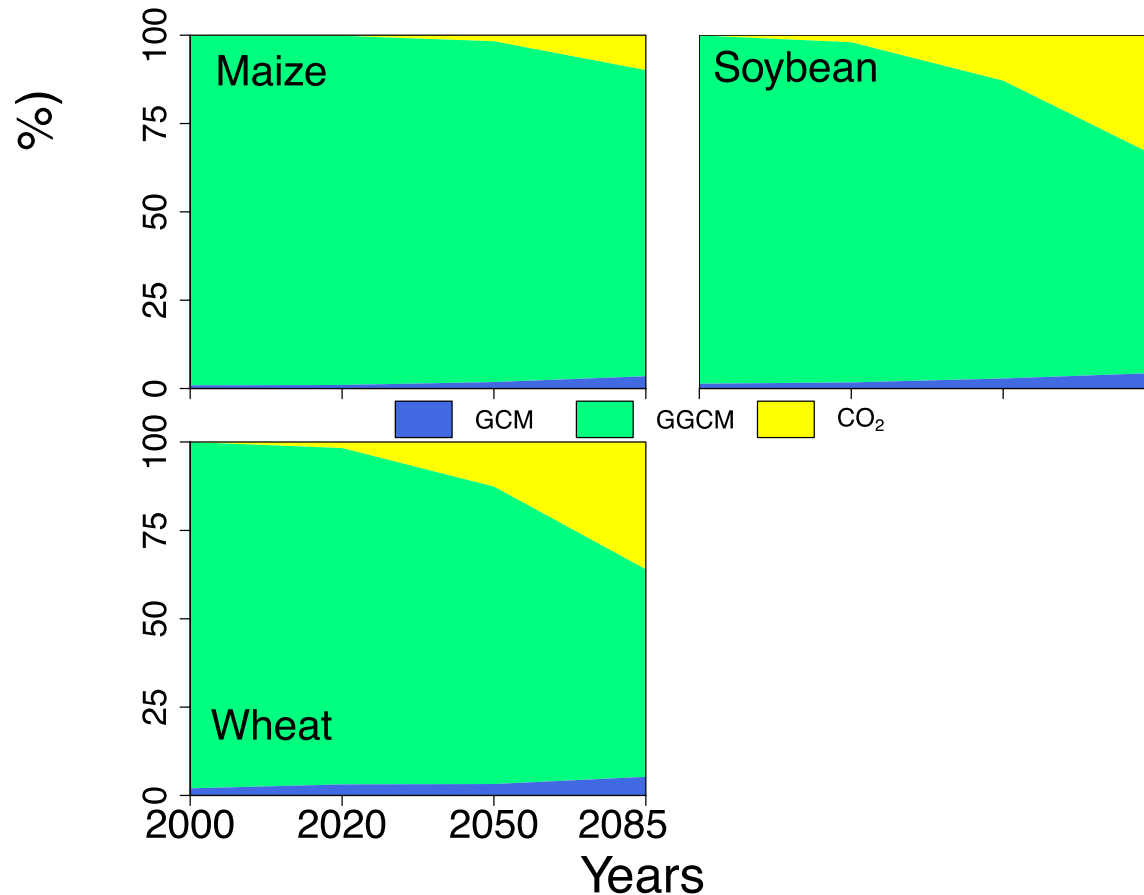


Large benefits in semi-arid regions (CWP increases by 48% for rainfed wheat)



% difference in simulated CWP with and without CO<sub>2</sub>

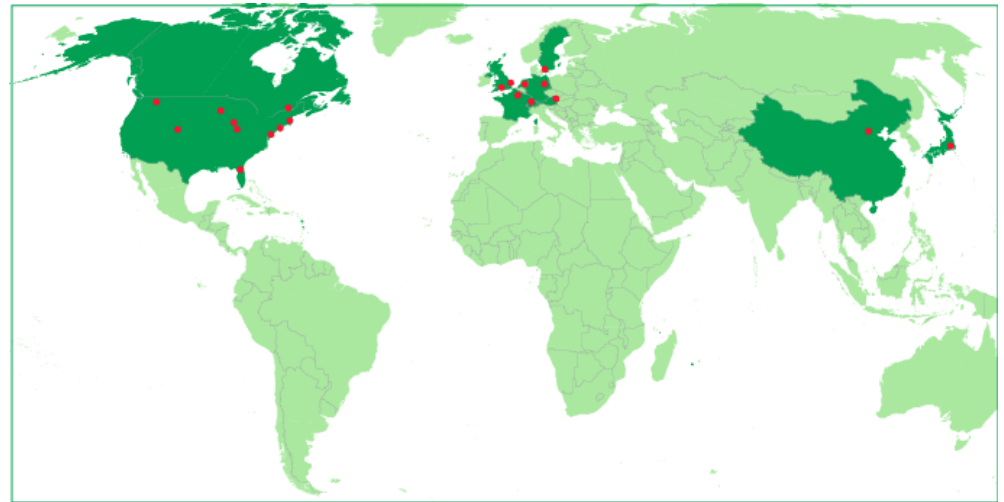
# Source of uncertainties in impacts projections



- Climate signal (climate change projections from GCMs)
- Crop simulation methodology (parameterization, ET equation, nitrogen stress, extreme heat sensitivity, phenology & planting date decision/cultivar choice...)
- CO<sub>2</sub> sensitivity methodology (simple Radiation Use Efficiency vs detailed Photosynthesis-Respiration representation)

# The gridded crop modeling initiative

GGCMI [www.agmip.org/ag-grid/ggcmi](http://www.agmip.org/ag-grid/ggcmi)



Phase 1: model evaluation (against historical data)

Phase 2: sensitivity analysis to assess crop-carbon/temperature/water/nitrogen interactions

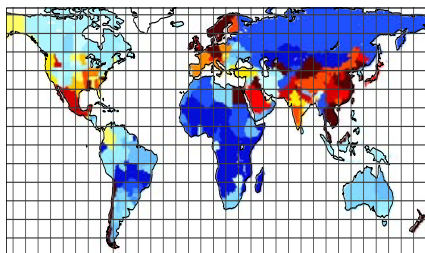
Phase 3a: model improvement

Phase 3b: Implementation and evaluation of adaptation measures

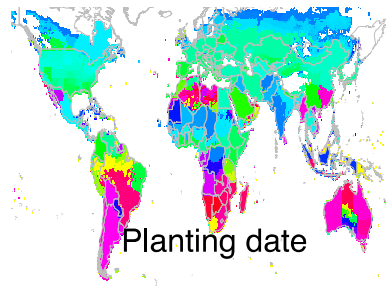


# GGCMI phase 1

- Model evaluation over historical period
- Harmonized inputs (fertilizer application rates, planting dates, cultivars)
- Nine different climate data (downscaled reanalysis data products)
- 14 participating GGCMs

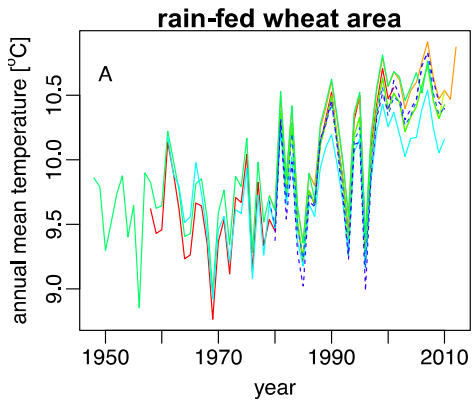


0 150  
N fertiliser (kg/ha/yr)

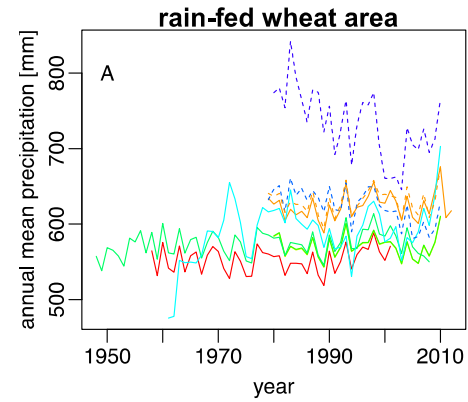


Planting date

# Multiple climate reanalysis data

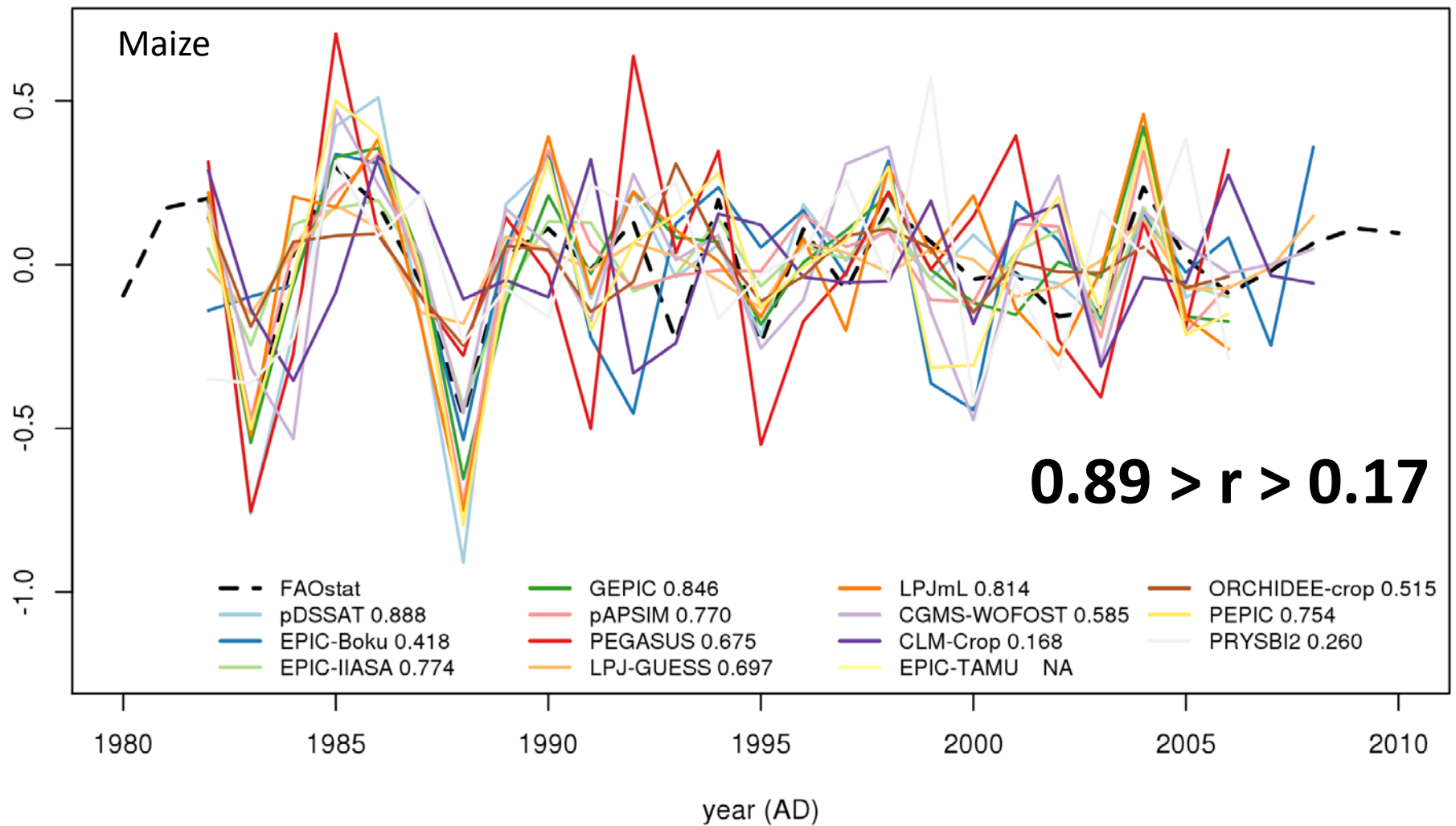


Temperatures

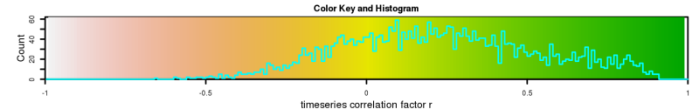


Precipitation

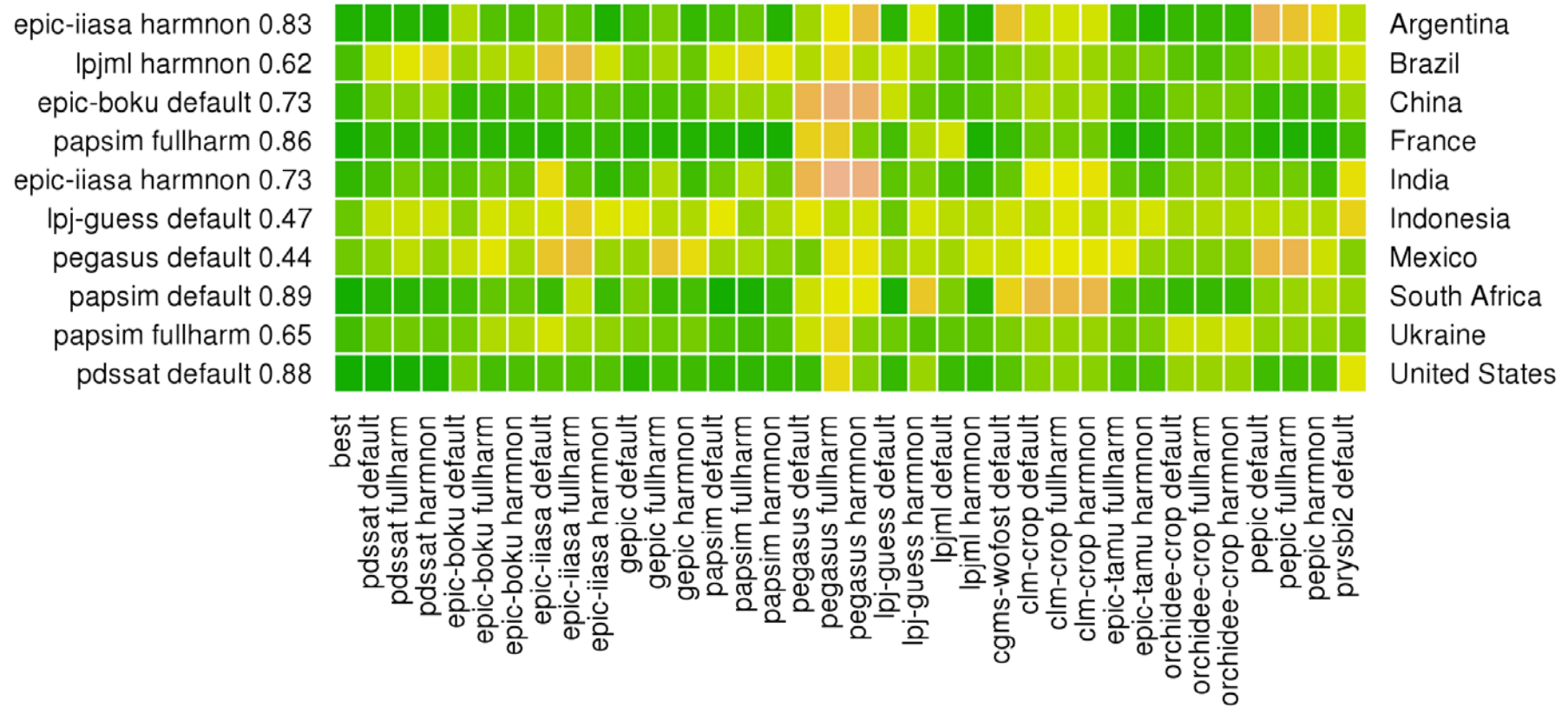
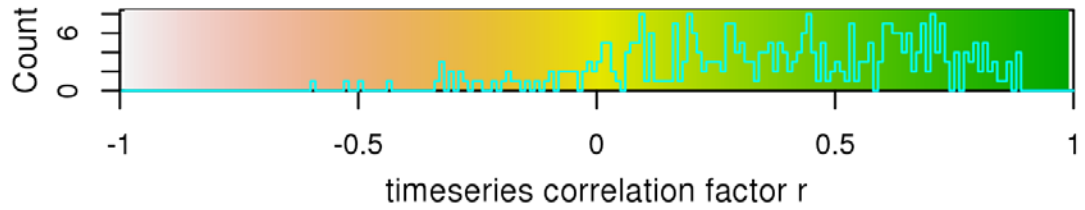
# Mixed skill at global aggregation



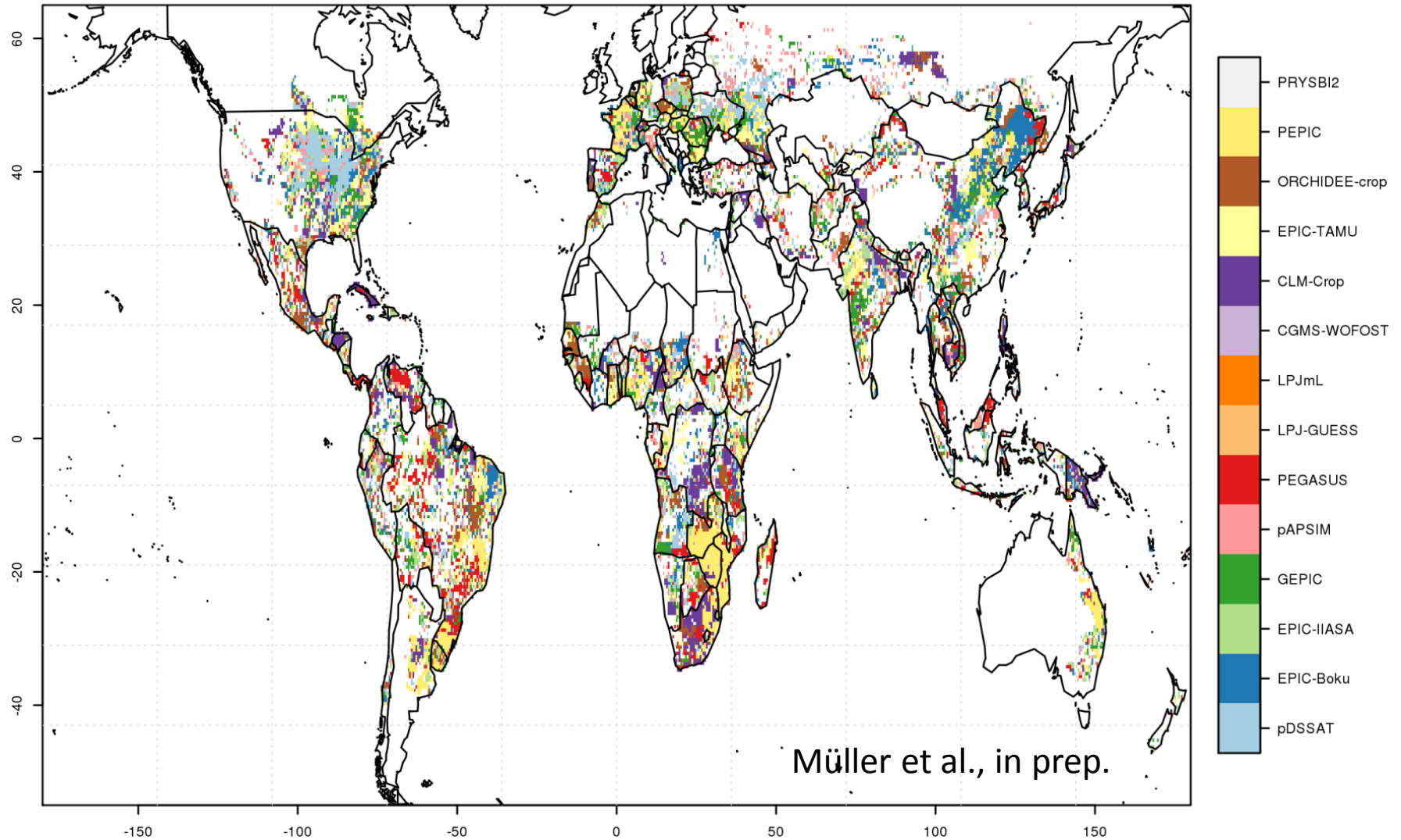
# National scale



Color Key and Histogram



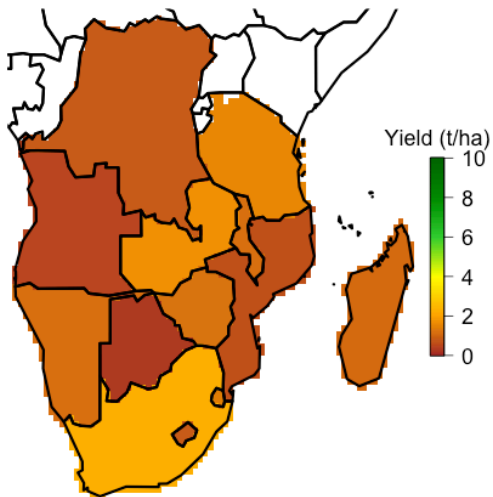
# Model with best correlation



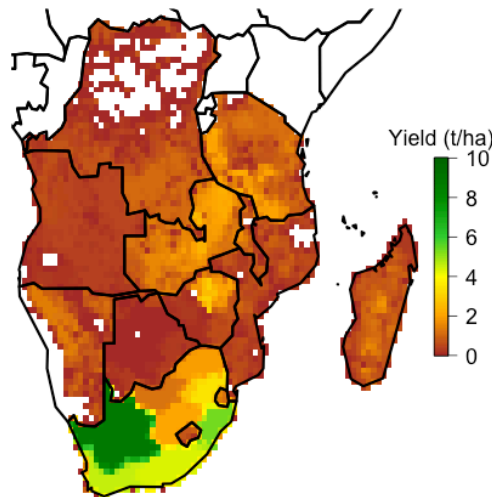
# Regional evaluation

- Southern Africa
  - attribution of source of uncertainties (climate data, agricultural data, crop model)
  - interaction with regional experts (AgMIP-SSAMIIP)

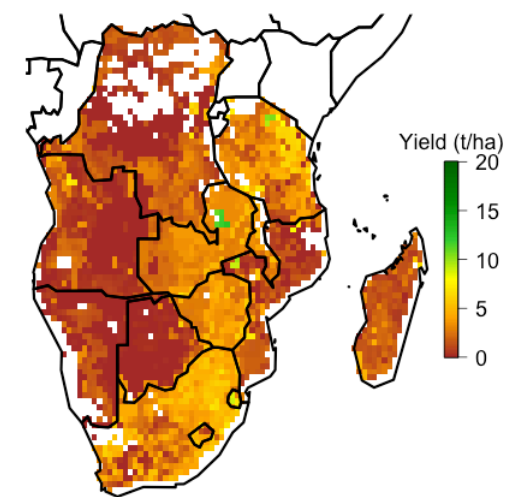
FAOSTAT mean 25yr-overlap



RAY mean 25yr-overlap



papsim agmerra fullharm mean 25yr\_overlap

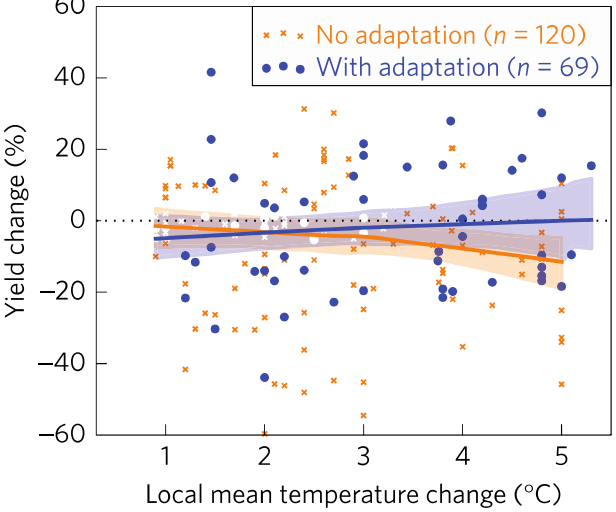


# Gridded regional assessments

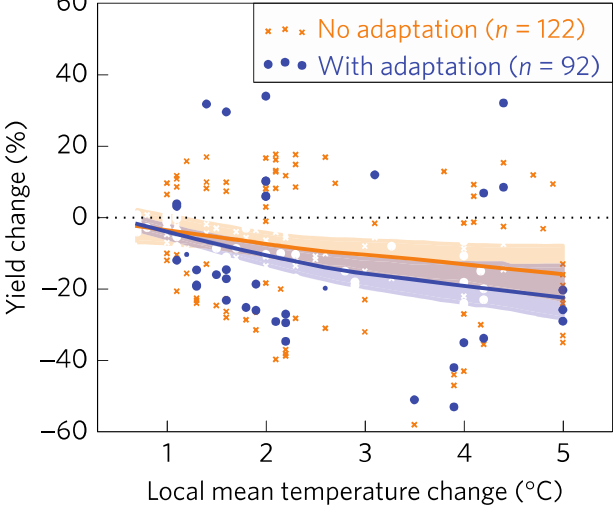
- Southern Africa
  - attribution of source of uncertainties (climate data, agricultural data, crop model)
  - interaction with regional experts (AgMIP-SSAMIIP)
- India
  - South-Asia monsoon dynamic, ground-water depletion
  - develop high-resolution gridded data
  - interaction with regional experts (AgMIP-South Asia)

# Crop yields under climate change & adaptation

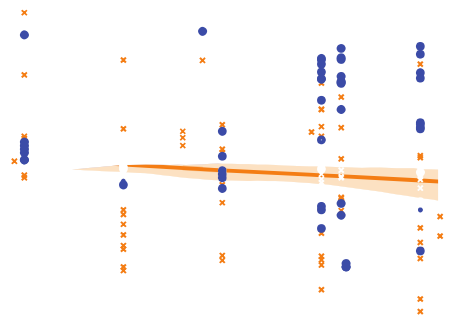
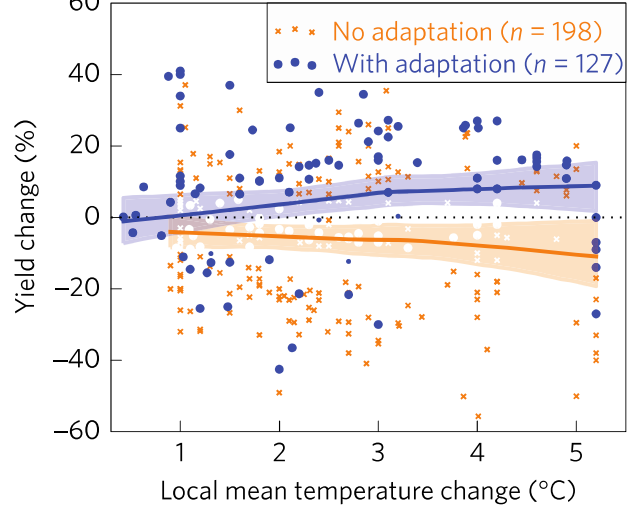
Maize, temperate regions



Maize, tropical regions



Wheat, temperate regions

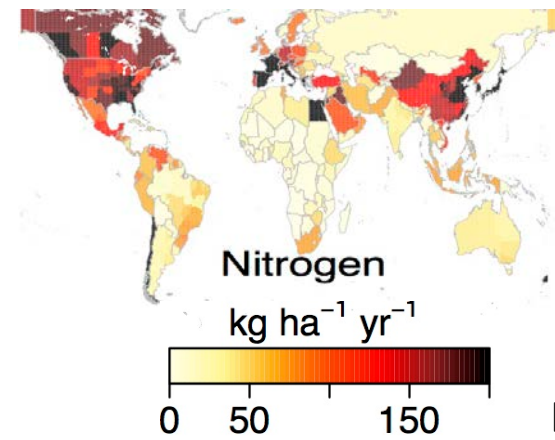
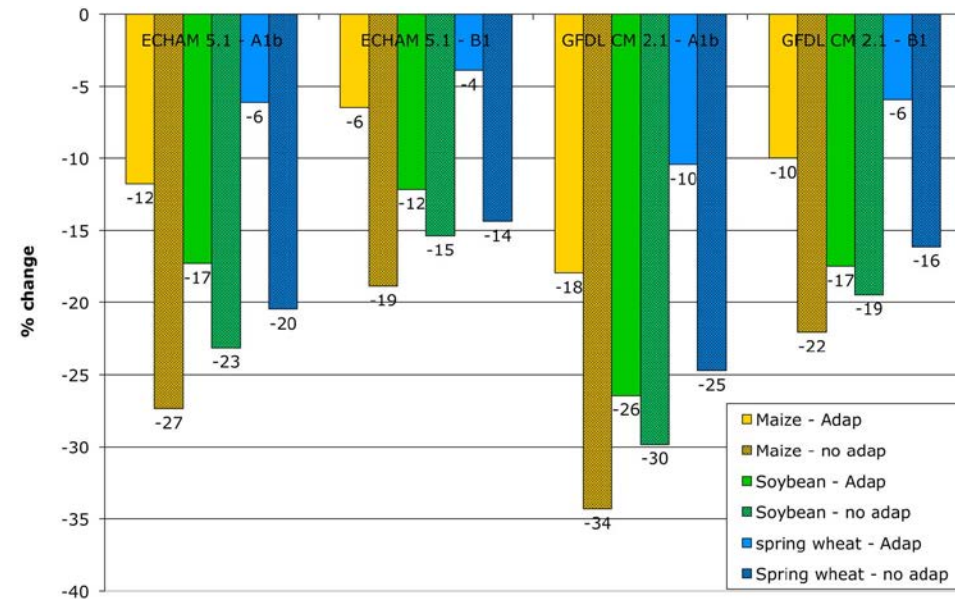




# Crop-level adaptation practices

- Changes in crop cultivars
- shift in planting dates
- Switch crop types
- Increase irrigation
- Increase fertilizer application
- Crop residue management

Deryng et al., 2011



Deryng, 2014

# Parallel activities for the gridded crop modeling initiative

## **Model evaluation and improvement**

**Phase 1-a:** Model evaluation (against historical data)

**Phase 2:** Sensitivity analysis to assess crop-carbon/temperature/water/nitrogen (CTWN) interactions to better understand process and interaction in models to set the necessary basis for model improvement

## **Application of models to examine climate impacts-adaption-vulnerability (IAV) in the ag. sector**

**Phase 1-b:** Regional gridded assessment: India, Southern Africa collaborative work with regional experts

**Phase 3:** Implementation and evaluation of adaptation measures

**Model improvement**



**Model application**

# Thank you!

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Christoph Müller (PIK, Potsdam)

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