



ISI-MIP 2 workshop Overview of the agricultural sector The global gridded crop modeling intercomparison initiative phase 1 Delphine Deryng deryng@uchicago.edu

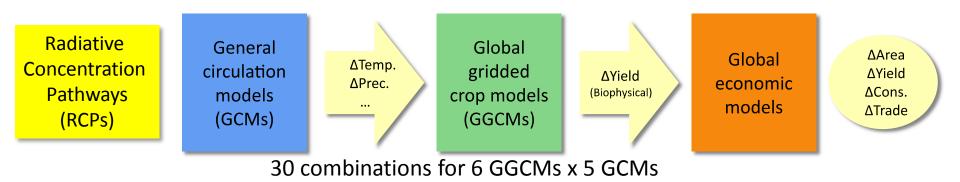
University of Chicago & NASA Goddard Institute for Space Studies, USA





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)

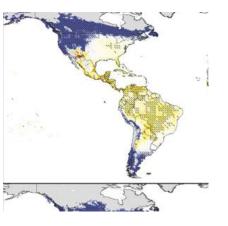


Ref. Rosenzweig et al., 2014, Elliot et al., 2014, Nelson et al., 2014, Deryng et al., 2016

Fast-track

Projected impacts on crop yields

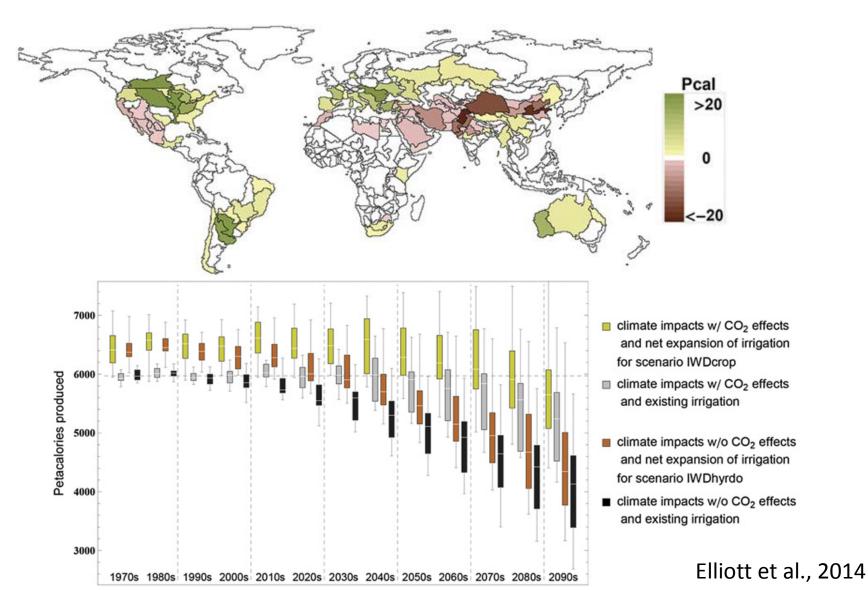
Simulated change in crop yields in 2080 relative to 2000 under RCP 8.5 CO₂ concentrations double relative to present-day



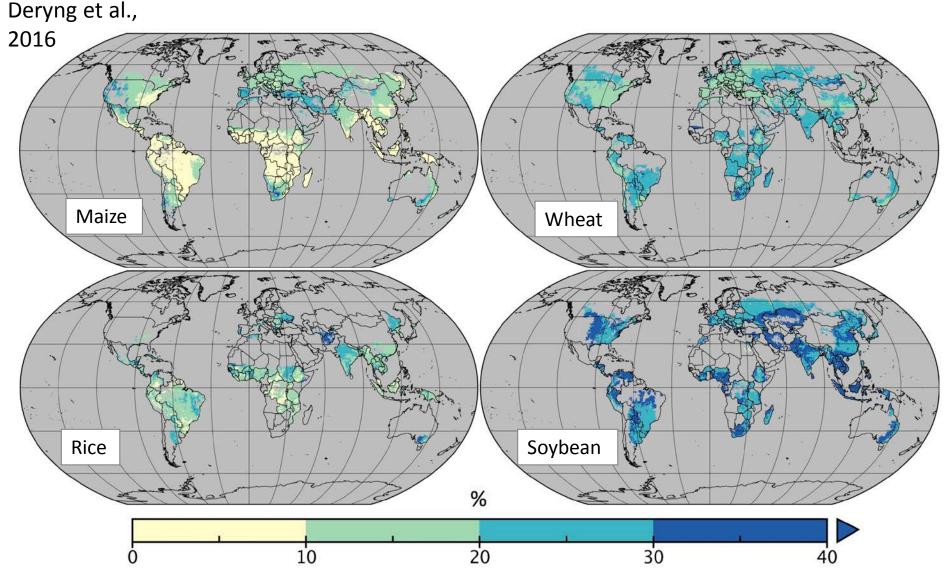
Rosenzweig et al., 2014

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

Fast-track Climate impacts on irrigation water demand and adaptation

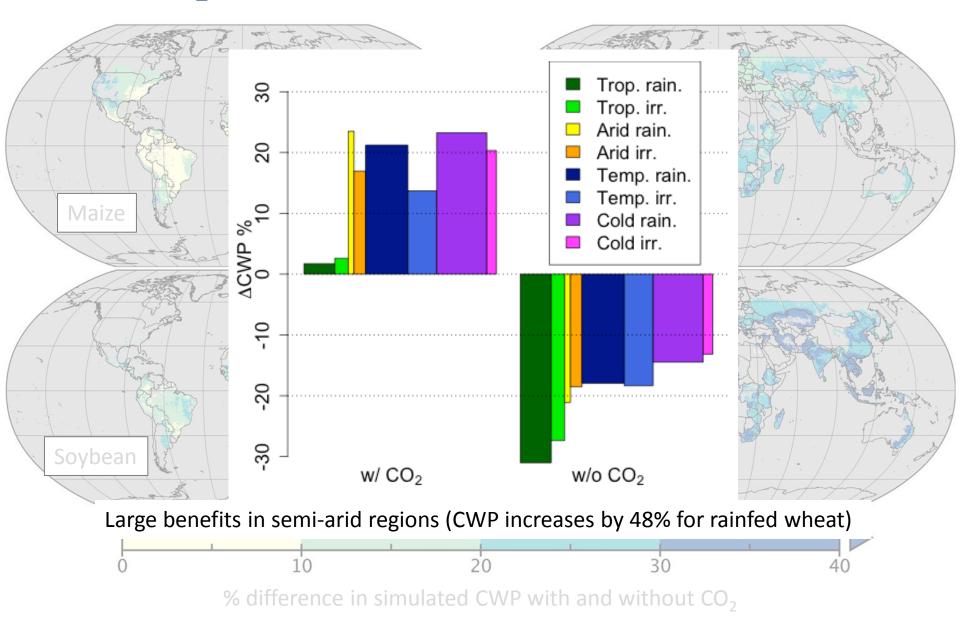


Fast-track Assessing the effects of elevated [CO₂] on crop yield and water use



Effects of elevated CO₂ under climate change: % increase in crop water productivity (yield/ET)

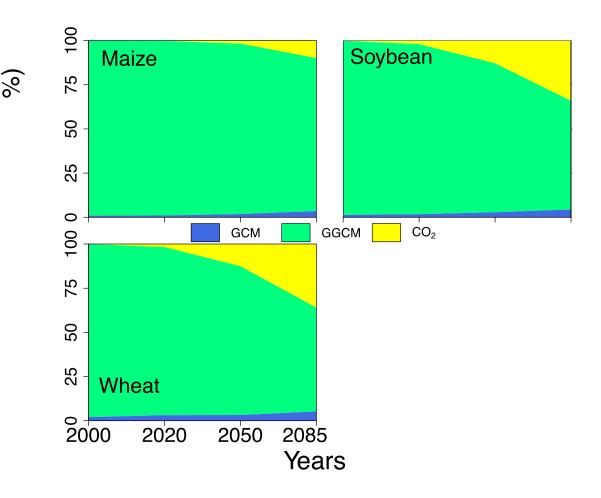
Fast-track CO₂ effects vary across climatic regions



[CO₂] levels correspond to year 2050 under RCP 8.5 - median across the GGC Deryngletrale, 2016

Fast-track

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...)
- CO₂ sensitivity methodology (simple Radiation Use Efficiency vs detailed Photosynthesis-Respiration representation)

Deryng et al., 2016

The gridded crop modeling initiative

GGCMI www.agmip.org/ag-grid/ggcmi



Phase 1: model evaluation (against historical data)

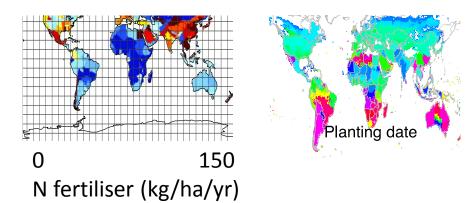
Phase 2: sensitivity analysis to assess crop-carbon/temperature/water/nitrogen interactions

Phase 3a: model improvement

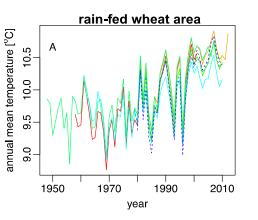
Phase 3b: Implementation and evaluation of adaptation measures

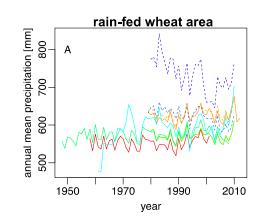
GGCMI phase 1

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



Multiple climate reanalysis data



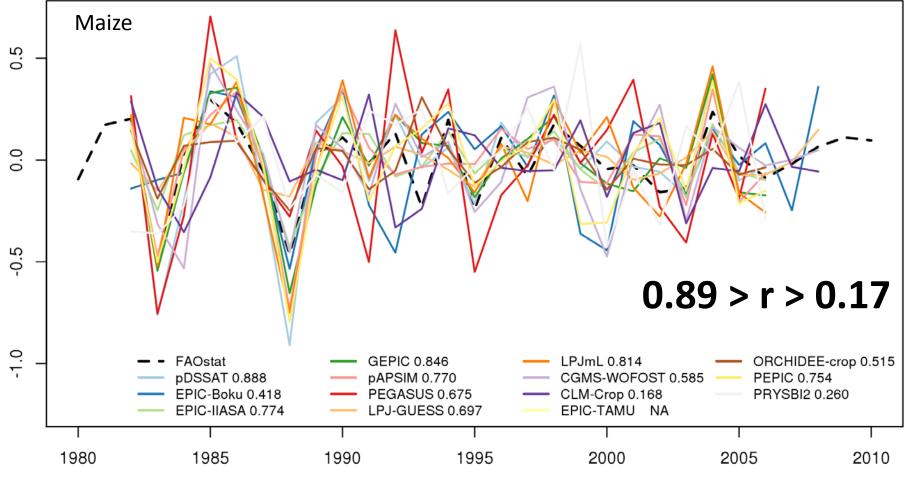


Temperatures

Precipitation

Can current crop model capture extreme conditions observed in the past? Elliott et al., in prep.

Mixed skill at global aggregation



year (AD)

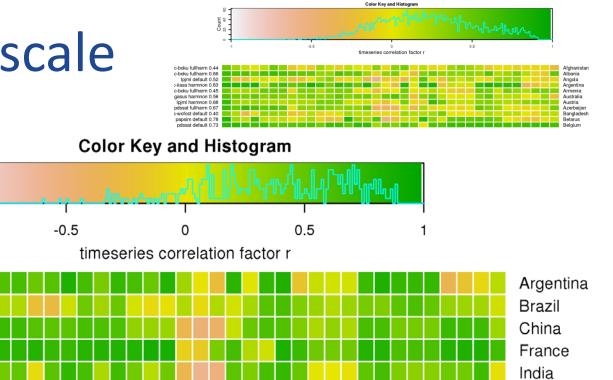
Müller et al., in prep.

National scale

Count 9

0

-1

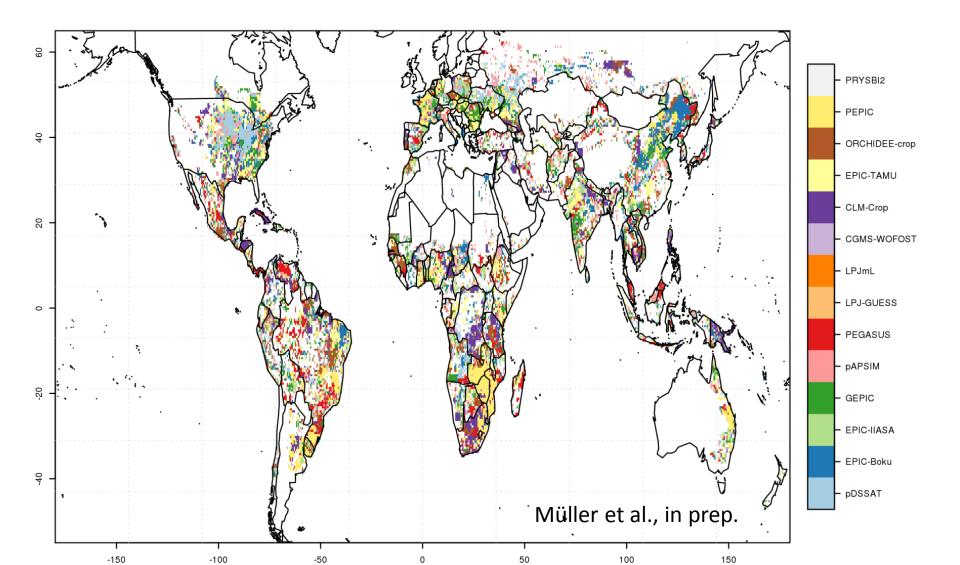


epic-iiasa harmnon 0.83 lpiml harmnon 0.62 epic-boku default 0.73 papsim fullharm 0.86 epic-iiasa harmnon 0.73 lpj-guess default 0.47 pegasus default 0.44 papsim default 0.89 papsim fullharm 0.65 pdssat default 0.88

Indonesia Mexico South Africa Ukraine United States best pdssat default

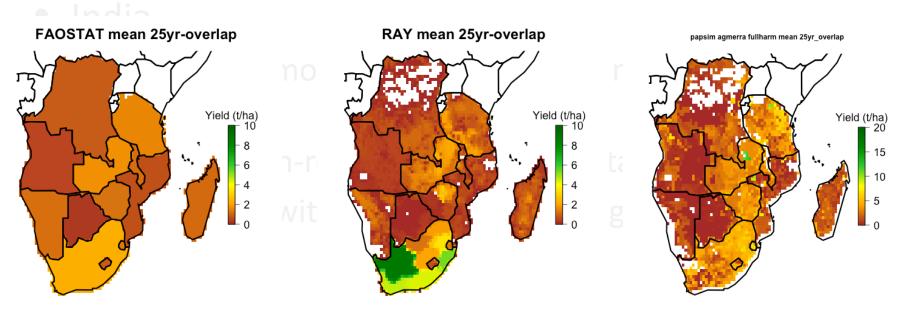
pepic harmnon prysbi2 default odssat fullharm pdssat harmnon epic-boku defauli epic-boku harmnor epic-iiasa defauli epic-iiasa harmnor orchidee-crop fullharm orchidee-crop harmnor pepic fullharm epic-boku fullharm fullharm gepic defaul gepic fullharm gepic harmnor papsim defaul papsim fullharm papsim harmnor pegasus defaul pegasus fullharm harmnor lpj-guess defaul pj-guess harmnor piml defaul cgms-wofost defaul clm-crop defaul clm-crop harmnor epic-tamu fullharm epic-tamu harmnor defaul lpiml harmnor fullharn defaul pepic nidee-crop epic-iiasa clm-crop pegasus S

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)

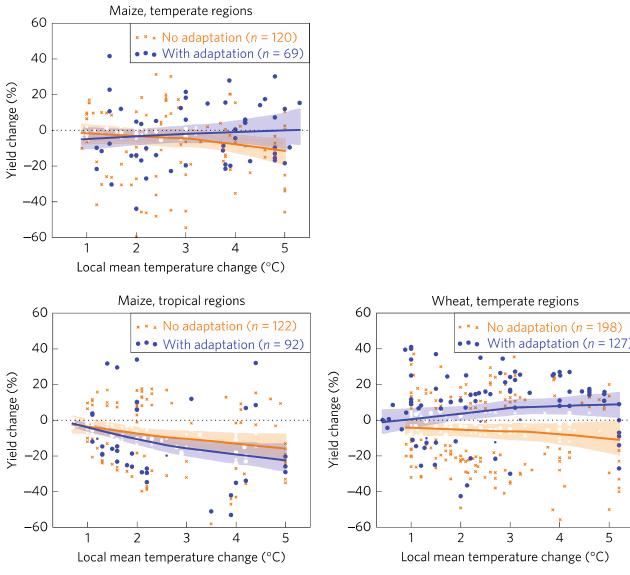


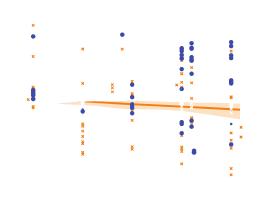
Deryng et al., in prep.

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)

Phase 3 Crop yields under climate change & adaptation





IPCC AR5 WG2, Chap7 (2014) & Challinor et al., 2014

Crop-level adaptation practices

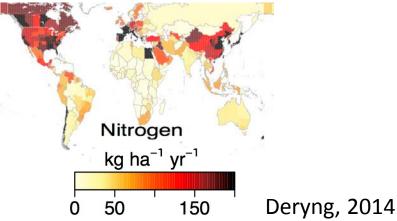
- Changes in crop cultivars
- shift in planting dates

- Switch crop types
- Increase irrigation

GFDL -5 -10 -10 -10 -12 -12 -15 -14 -15 % change -18 -20 -19 -20 -22 -23 -25 -25 -26 Maize - Adap -27 -30 Maize - no adap -30 Soybean - Adap Soybean - no adap -35 -34 spring wheat - Adap Spring wheat - no adap -40

Deryng et al., 2011

- Increase fertilizer application
- Crop residue management



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-adaptionvulnerability (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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