Impact Analysis of Climate Change and Agricultural Management Practices on Multiple Food Crops

Tzu-Shun Lin

University of Illinois, Urbana, IL 61801

tslin2@illinois.edu

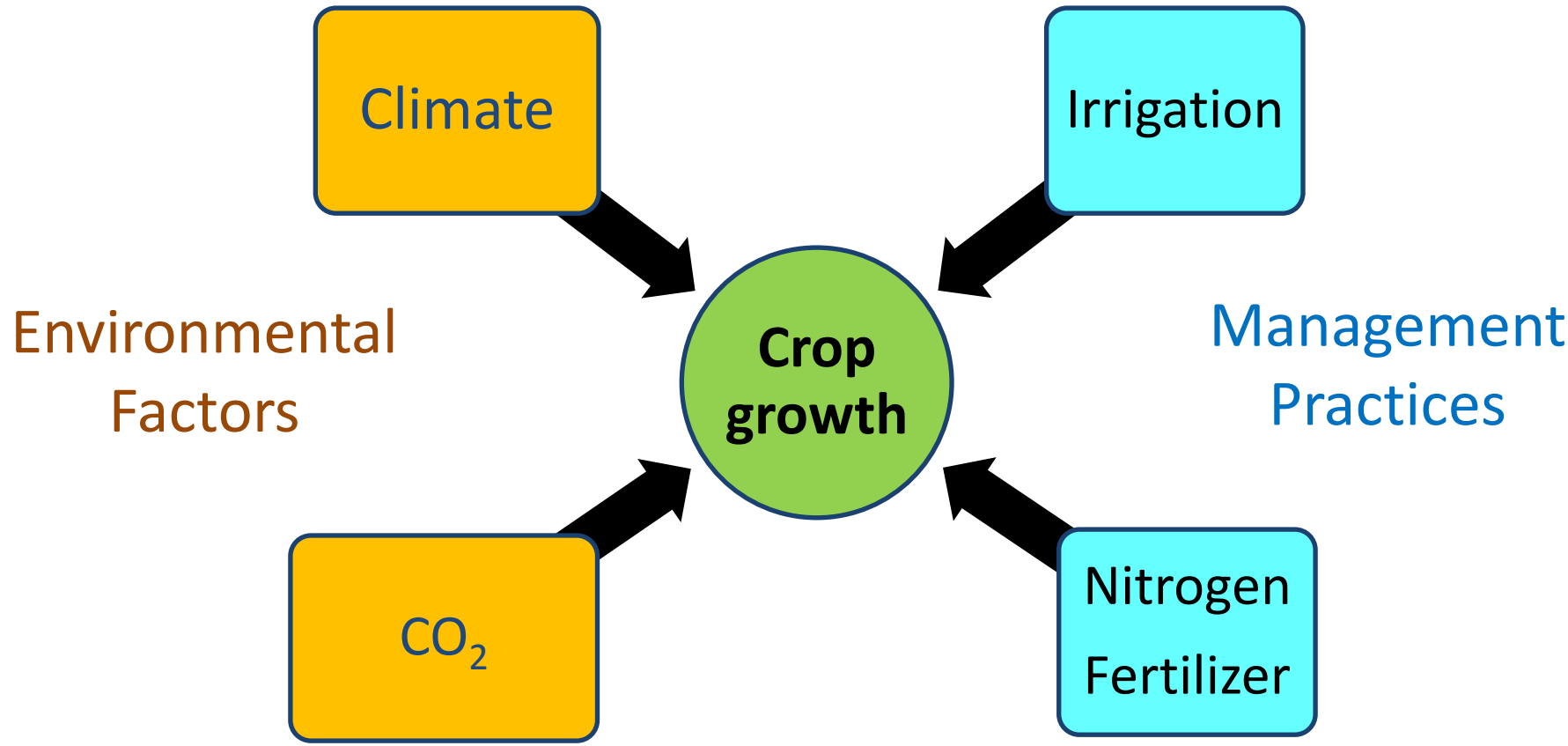
Acknowledgements

Shijie Shu and Atul Jain

ILLINOIS

UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

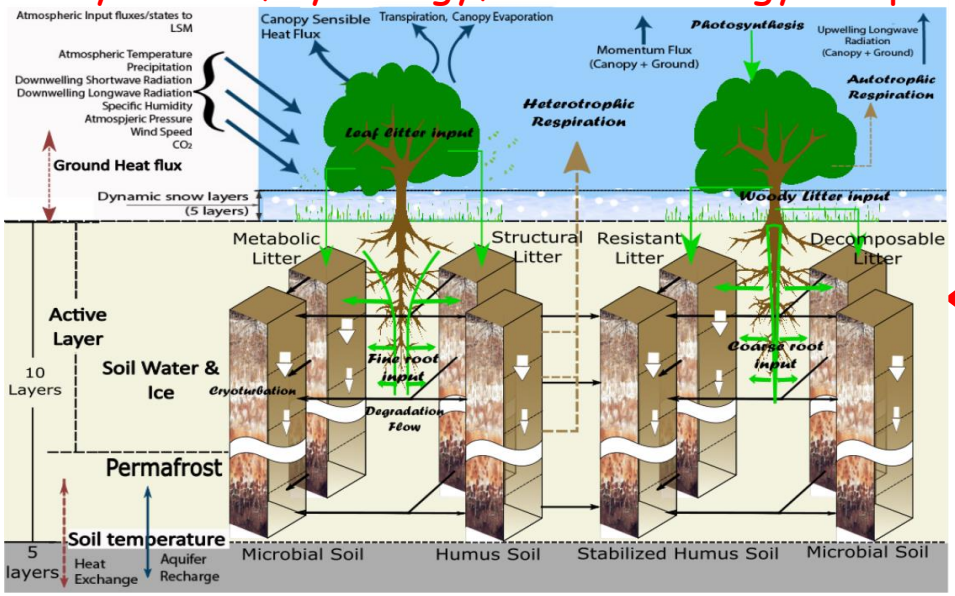
Interactions of Environmental Factors and Management Practices with Crop Production/yield



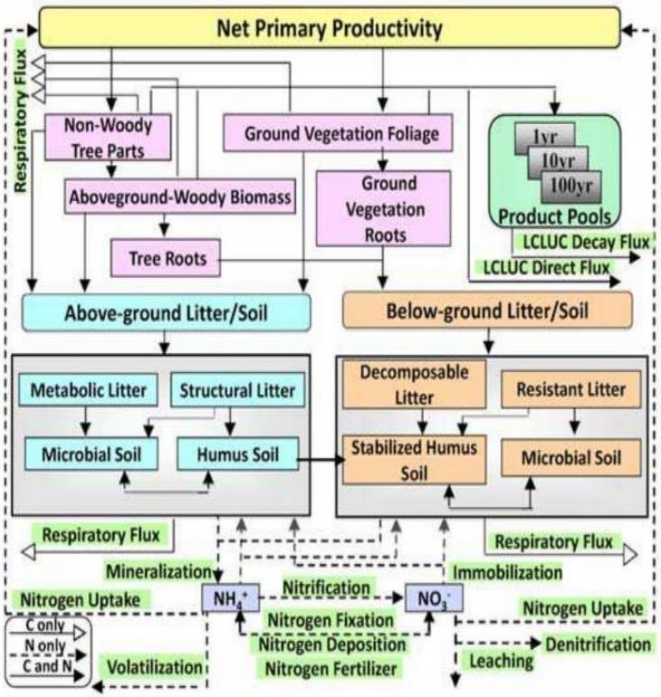
- What are the relative contribution of climate, CO_2, irrigation, and nitrogen fertilizer on crop yield?
- What are the non-interactive effects and interactive effects of environmental factors and land management on crop yield?

Integrated Science Assessment Model

Photosynthesis, hydrology, soil and energy components



Biogeochemistry (Carbon and nitrogen)



Dynamic growth of food & bioenergy crops

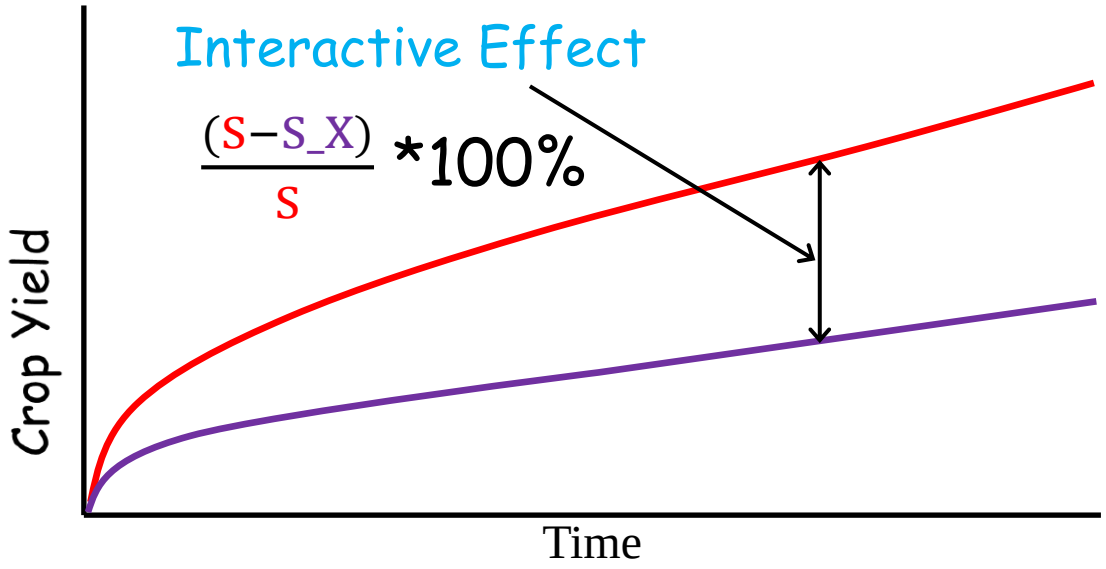
Phenology	•Carbon-gain based phenology •Better accounts for the effects of extreme environmental condition on LAI
Carbon & Nitrogen allocation	•Better accounts for light, water and nutrient stresses while allocating the assimilated carbon
Vegetation structure	•LAI, canopy height, root depth and distribution •Better simulates water uptake and transpiration

- Season-to-interannual variability
- Four row crops (maize, soybean, rice and wheat) and three perennial grass (Miscanthus, Cave-in-Rock and Alamo)
- 1 hourly temporal scale
- 0.5 degree spatial resolution

(Yang et al. 2009; Yang et al. 2013; El-Masri et al. 2013; Barman and Jain, 2016; Shu et al. 2018)

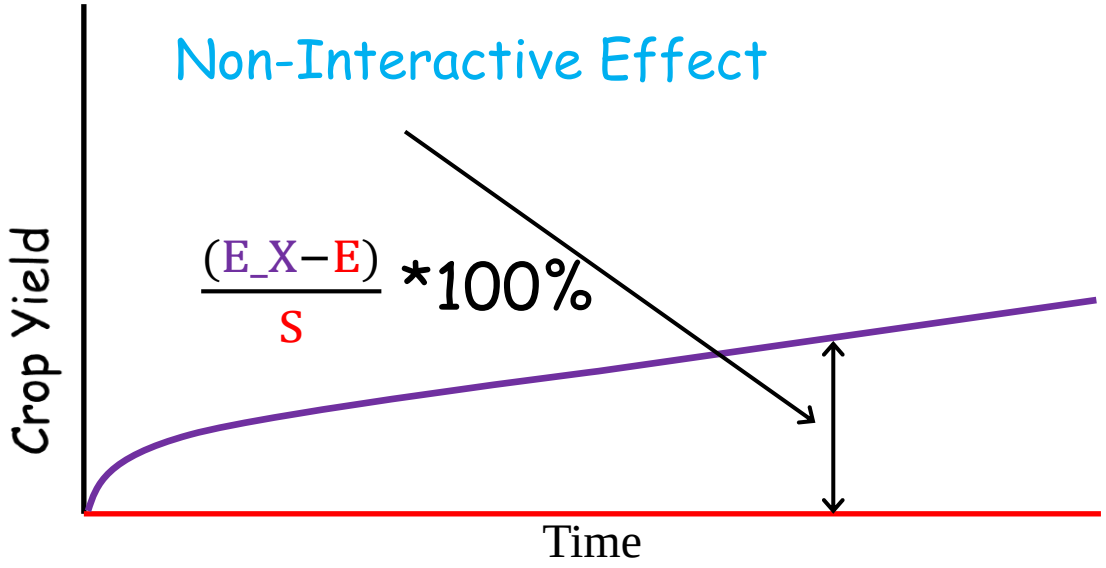
Experiments design

Factors (X): CO_2,Climate, N fertilizer, Irrigation



Base Case (S): All factors change over time

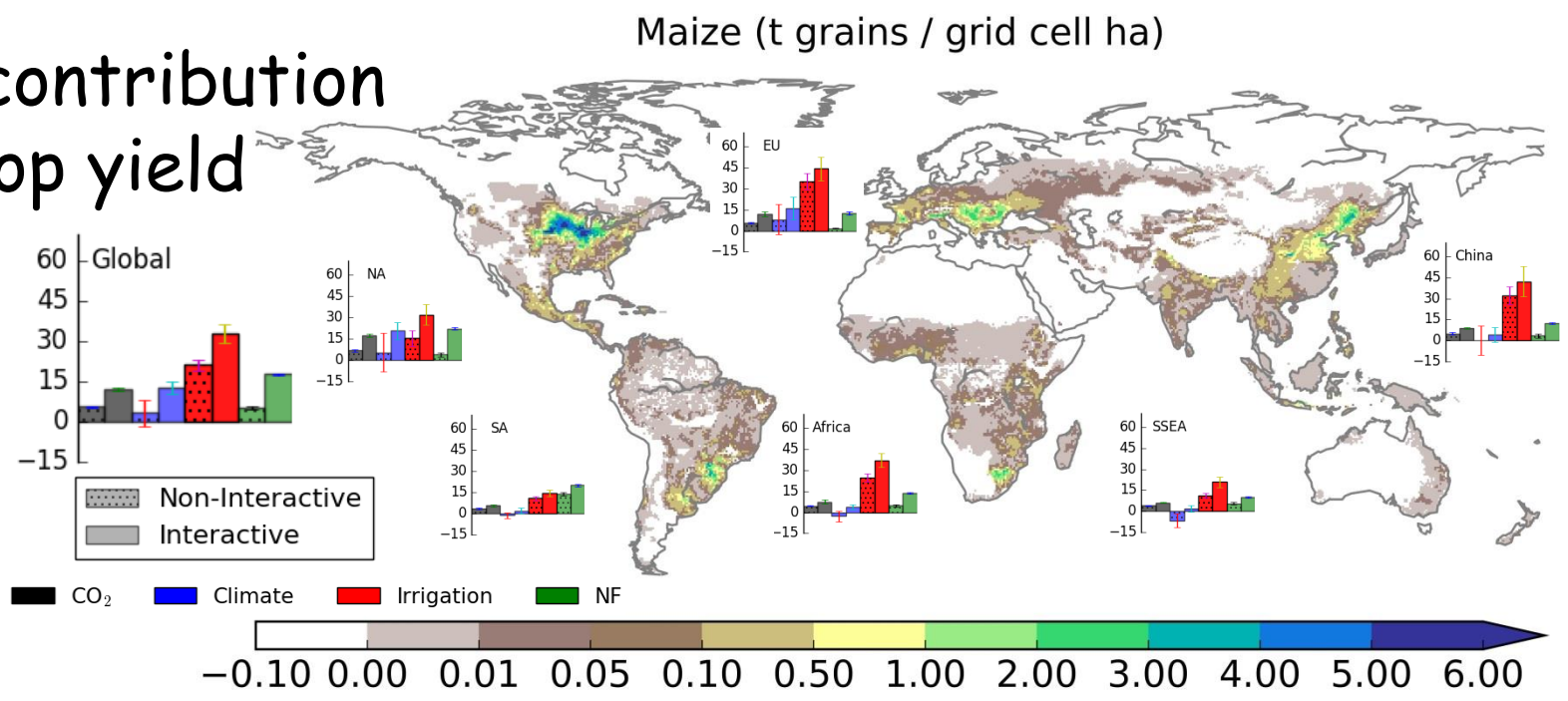
Same as Base Case, but one factor remains constant at the steady state level (S_X)

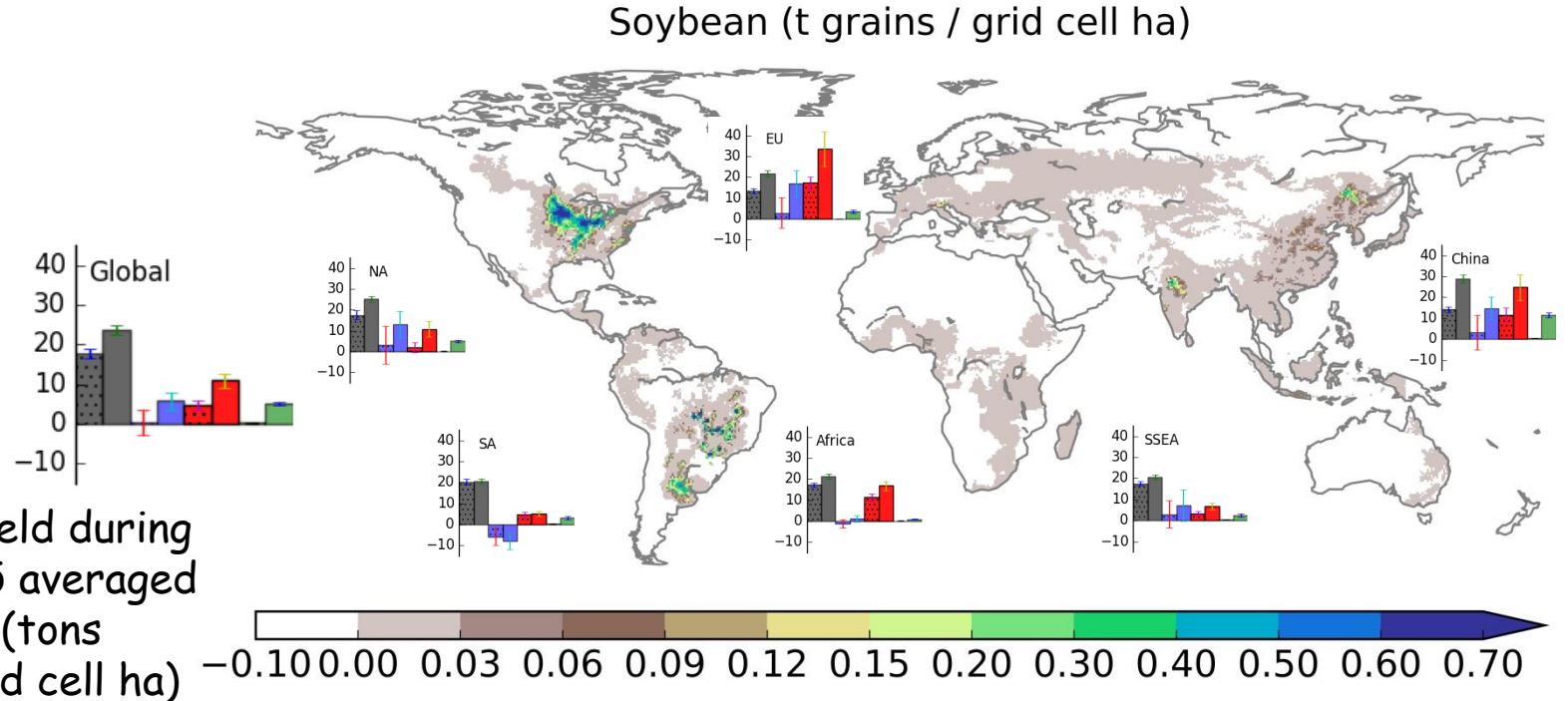


Same as Base Case, but one factor change over time (E_X)

Base Case (E): All factors remain constant at steady state level

Relative contribution to crop yield

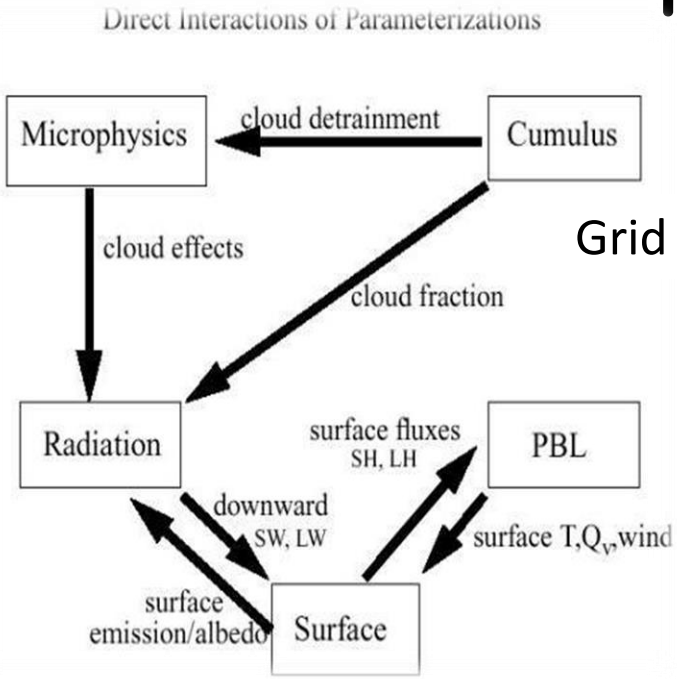




Shaded: crop yield during year 1996-2005 averaged from base case (tons grains / 0.5° grid cell ha)

Future plans

Weather Research and Forecasting (WRF) - ISAM coupled Modeling System



Grid aggregation / disaggregation