Title: Food and environmental security in 2050: An application of gridded agricultural economic modelling

Agricultural economic models are indispensable in the analysis of broad issues affecting the farm-food-environment nexus. Many of these models have been designed accordingly to accommodate country and/or regional-level data – for example trade and economic data from the GTAP database as well as agricultural production data from UN FAO. However, it is becoming evident that agricultural economic models are far too aggregated for the analysis of localized agro-climatic issues that have broad consequences on the global farm and food system. This is particularly true for climate change. Climate-driven crop yield projections from gridded crop and climate models are quite heterogeneous within and across countries but instead of using these refined projections researchers are constrained to impose weighting methods to accommodate aggregations in existing agricultural economic models (1) (see Figure 1). This problem is also evident in the assessment of land use change impacts from agriculture wherein regional land supply elasticities are imposed and detailed biomass and soil carbon from gridded global potential vegetation models are aggregated.

In this paper, we illustrate the advantages of using downscaled global model of agriculture using the gridded SIMPLE model. SIMPLE has been designed to capture the key drivers and economic responses at work in driving long run changes in the global farm and food system. The model has been validated by looking at the historical experience (2) and has been used in the assessment of food security (3) and climate change adaptation (4). We take advantage of SIMPLE's flexibility and develop a gridded version of the model wherein crop production activities are defined at the geo-spatial level using agricultural production, area and yield data from Monfreda et al. (5). This allows us to downscale crop production from 16 regions to ~50,000 half-degree grid cells.

In our preliminary work which we illustrate in this abstract, we apply 2006-2050 climate-driven yield shocks in the 2006 economy. Figure 2 shows implications of gridded vs. regional models in the changes in malnutrition and cropland. The rise in food insecurity due to climate changes is relatively lower under the gridded model than in the regional model. We also see greater reduction in cropland use in South America due to favorable impacts of climate change on maize yields for this region. In the coming months, we plan to develop a 2006 2050 baseline wherein consumption is disaggregate by grid using gridded population data (8) and impose price transmission limitation due to market access (9). In addition to climate change impacts we look into the implications of four environmental restrictions on agricultural production aimed at: reducing terrestrial carbon emissions (10), preserving vertebrate biodiversity (11) limiting nitrate leaching (12), and ensuring ground water sustainability (13).

Figure 1. Climate-driven yield impacts for maize (2006-2050) generated from the pDDSAT crop model using HADGEM global climate projections. The gridded results are illustrated on the top while regionally aggregated results weighted by via production are summarized at the bottom. Results are downloaded via the AgMIP tool (7)

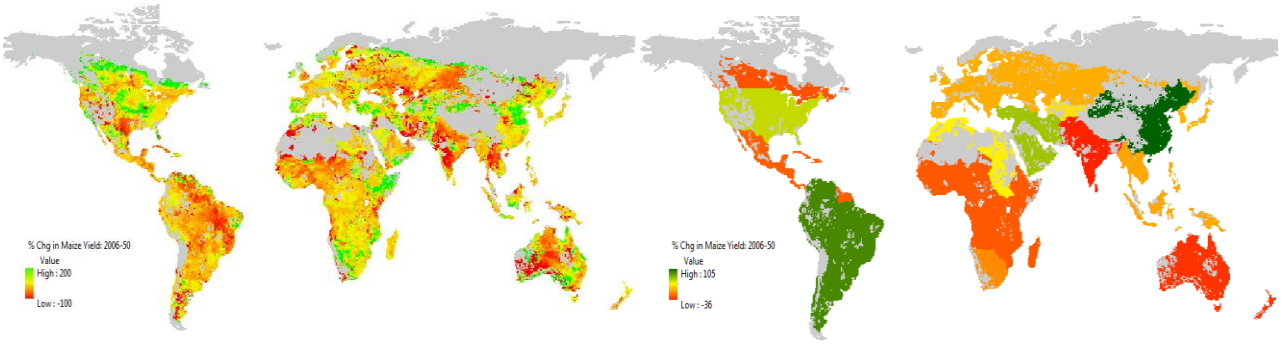
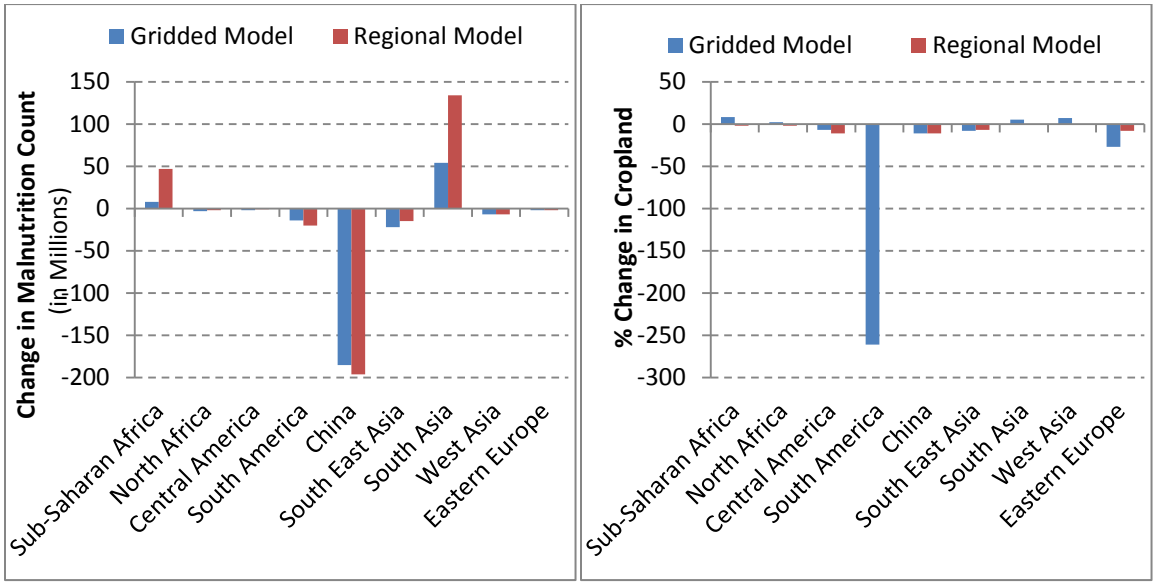


Figure 2. Changes in caloric malnutrition and cropland area given climate-driven yield impacts for maize (2006-2050) generated from the pDDSAT crop model using HADGEM global climate projections.



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