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Graphically speaking

Climate Change and Agriculture: Some Regio

by Richard M. Adams and Brian H. Hurd

Recent evidence indicates that the first eleven months of 1998 were the warmest on record. Even if this is not the "smoking gun" which proves the existence of global warming, it adds fuel to the ongoing debate over the need to control anthropogenic sources of CO_2 and other greenhouse gases (GHG). These debates often focus on agriculture because precipitation and temperature directly affect crop and livestock production. In addition, climate influences pests and diseases, the availability of irrigation water, and the severity of soil erosion.

Over the past decade we have improved our understanding of the physical and economic effects of climate change on agriculture. The consensus of available studies shows that, in the aggregate, moderate warming does not threaten food supplies, either for the United States or globally. However, these studies (for example, IPCC, Schimmelpfennig et al., Adams et al. 1998a) point to shifts in regional patterns of production due to changes in regional comparative advantage.

Computer models of the earth's atmosphere and oceans, known as General Circulation Models (GCMs), provide most of our forecasts of climate changes under increased GHG concentrations. All models forecast higher global temperatures and increased precipitation under increased GHG levels. Regionally, the models forecast differing rates of warming and precipitation. Figures 1 and 2, derived from output from the Hadley Centre GCM (Hulme et al.), show possible temperature ranges under baseline and a future condition for the United States. Figure 1 shows mean annual temperatures for the 1961–90 time period as forecast by the model. Figure 2 presents forecasts of temperatures in 2100 under an assumed doubling of GHG concentrations. Comparison of temperatures between the baseline and 2100 shows warming throughout all regions of the United States, with a generally northward increase in temperatures.

Changes in regional temperature (and precipitation) may trigger economic responses in the form of changes in crop mixes, input use, planting dates, and other cultural practices. These adaptations, plus the possible increase in yields from an enriched atmospheric level of CO_2, are the reason that most economic studies predict little or no economic damage to agriculture under moderate warming (up to 3°C). The adaptations, do, however, alter regional production patterns, as shown in figure 3. Figures 3 illustrates some results from Adams et al. (1998b) on U.S. regional crop production with a regionally uniform 2.5°C increase in temperature and 7 percent increase in precipitation (similar to the global changes

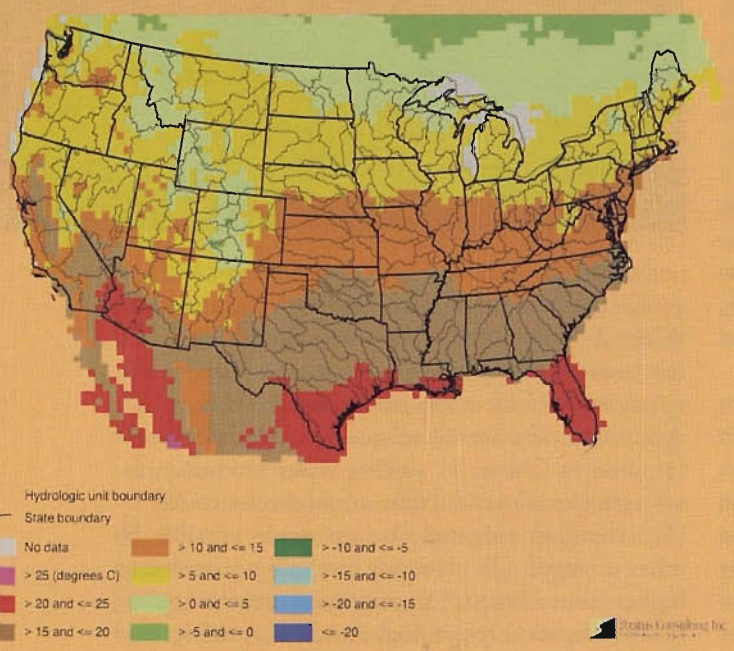

Figure 1. Annual mean temperature (°C), over the period 1961 to 1990

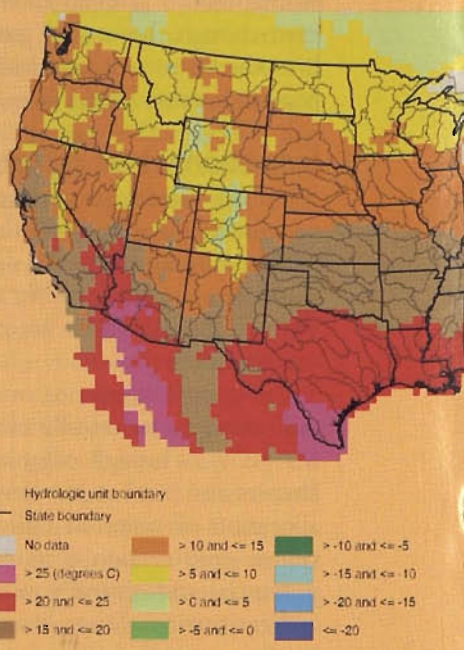

Figure 2. Annual mean temperature (°C), Hadley Ce

al Implications

Richard M. Adams is professor in the Department of Agricultural and Resource Economics at Oregon State University. Brian H. Hurd is a senior associate at Stratus Consulting, Boulder, Colorado.

forecast by Hadley Centre and IPCC over the next 50 to 100 years). The figure shows relative changes in regional crop production from current levels. Under this scenario, crop production generally shifts northward

Shifts in crop production and expansion in irrigated acreage have implications for the environment and natural resources, including water quantity and quality, wetlands, soil, fish and wildlife, and other resources. For example, a northward shift in corn and soybean production may exacerbate the loss of critical prairie wetlands by making drainage and conversion to crop production profitable. A westward shift in the production of these two crops would increase wind and water erosion on fragile soils of the western Great Plains. An increase in irrigated acreage enhances the likelihood of groundwater and surface water depletion and pollution. These potential environmental and offsite effects are only now being investigated.

■ For more information

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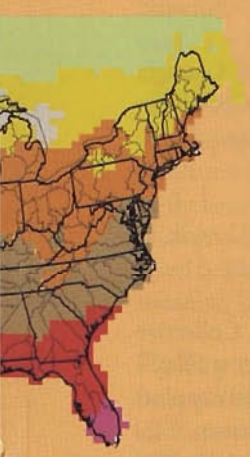
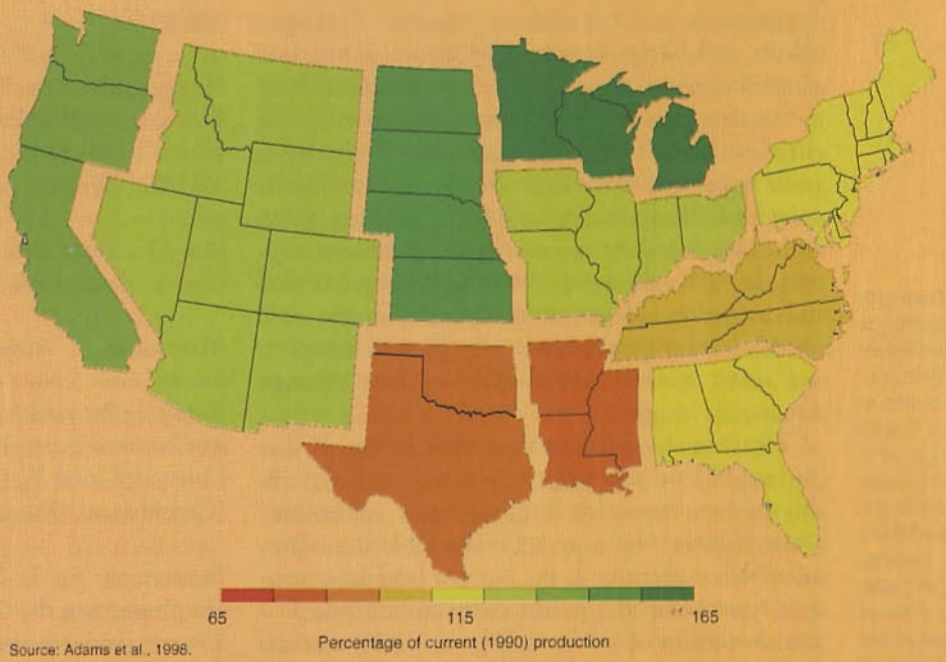


re Model Projection for 2100



Source: Adams et al., 1998.

Figure 3. Modeled crop production effects under climate change: +2.5°C temperature increase, +7% increase in precipitation