According to Lobell and Asner (1), the atypical summer cooling trend from 1982 to 1998 increased U.S. yields of corn and soybeans during the same period. However, three potential problems with their analysis bring their results and conclusion into question.

The first concern relates to selective use of data in (1). To estimate climatic and nonclimatic contributions to recent trends in U.S. corn and soybean production, Lobell and Asner used only data that exhibited significantly negative correlations between summer (June to August) temperature anomalies and corn and soybean yield anomalies (1). By doing so, they guaranteed that there would be a temperature effect on the yield trends of these two crops. To demonstrate this, I adopted several key assumptions made by Lobell and Asner (1) to randomly construct an artificial data set of crop yields and air temperatures for 1500 hypothetical locations over a 17-year period (2) and analyzed this artificial data set using the same method. I found that if data from all locations were included in the analysis, there was no statistical relationship between yield trends and temperature trends (Fig. 1A). However, if the locations were ranked based on correlation coefficients between temperature anomalies and yield anomalies and if only those locations with positive correlations between the anomalies of the two variables were included, yield trends increased with temperature trends (Fig. 1B). Conversely, if only locations with negatively correlated temperature and yield anomalies were used, yield trends decreased with temperature trends (Fig. 1C).

Clearly, this negative correlation between yield trends and temperature trends was the result of selective use of my artificial data set. Lobell and Asner (1) used this method of analysis, which, by the same token, could have led to data with biased temperature-yield relationships, although the authors stated that their selected subsets were “representative of total national production” [supporting note S2 in (1)].

A second concern lies in the treatment of effects of precipitation and solar radiation trends on yield trends. Lobell and Asner (1) found that yield trends were not significantly influenced by precipitation or solar radiation trends, but they drew that conclusion by analyzing the selected subset of the data that had previously been filtered according to correlations between yield anomalies and temperature anomalies. Had the authors treated precipitation and solar radiation in the same manner they treated temperature, their results might have been different. In other words, if they had selected their data based on correlations between yield anomalies and precipitation or solar radiation anomalies, they might have found that yield trends were indeed correlated with precipitation or solar radiation trends. In addition, with this differently filtered data set, they might not have found that temperature trends contributed to yield trends.

The third concern—perhaps minor compared with the first two—is the application of a linear model to calculate contributions of climate effects versus nonclimate effects (for example, management, technology, increased atmospheric CO2 concentrations) to observed trends in corn and soybean yields (1). Using a linear model assumes that the nonclimate contribution is constant over time. If the nonclimate contribution were to increase or decrease gradually, however, this second-order trend would be miscalculated as a temperature contribution to the yield trend.

Because of the problems identified above, the results obtained by Lobell and Asner (1) are not substantiated by their method of analysis, and their conclusion regarding the effects of climate on food production should be reevaluated.

Lianhong Gu
Environmental Science Division
Oak Ridge National Laboratory
Oak Ridge, TN 37830, USA
E-mail: lianhong-gu@ornl.gov

References and Notes
2. I used the following functions to describe the changes of temperature (T) and yield (y) with time (t), where t is the number of years from an initial year (1982, for example):

\[ T = a + s_1 T_{t-1} + b T, \quad y = c + d + s_2 T_{t} + r_y, \]

where \( s_1 \) and \( s_2 \) are sign parameters and can both take values of either +1 or –1, randomly; \( T_r \) and \( r_y \) are random numbers uniformly generated from the ranges of \([-2.5, 2.5], \{15, 17\}, \{50, 50\}, \) respectively, \( a, b, c, \) and \( d \) have arbitrary values of 20.
0.01, 1.0, and 1.5, respectively. The values of these numbers are not important, but the patterns between temperature and yield that result from the use of these random numbers are important for the purpose of illustrating potential problems in the method of analysis used by Lobell and Asner (1). Eqs. 1 and 2 were applied to 1500 locations [analogous to counties in (1)]. According to information in (1), summer temperature decreased in most of the counties where corns and soybeans were cultivated from 1982 to 1998. I therefore randomly chose to set $S_T$ to $-1$ in about 80% of the 1500 locations. In the remainder of the locations, $S_T$ was set to $+1$. For the $S_y$ parameter, about half of the locations were set to have a value of $+1$, and the other half were set to $-1$. For each location, I generated an artificial time series of temperature and yield for 17 years (from 1982 to 1998). In this artificial data set, yield and temperature fluctuated each year but both had a tendency to change linearly with time. The temporal variations in different locations were independent from each other. These were some key assumptions implied by Lobell and Asner (1).

3. I appreciate candid exchanges with D. B. Lobell regarding his paper. I thank W. M. Post, P. J. Hanson, S. D. Wullschleger, R. L. Graham, M. A. Huston, R. J. Norby, and T. O. West for discussions and comments. This study was carried out with support from the U.S. Department of Energy, Office of Science, Biological and Environmental Research, Terrestrial Carbon Program. ORNL is managed by UT-Battelle, LLC, for the U.S. Department of Energy under the contract DE-AC05-00OR22725.

26 February 2003; accepted 17 April 2003