Climate, Food, and Data
Fall 2015

Instructors: Peter Huybers

Teaching Fellow (proposed): Marena Lin

1st meeting: Haller Hall Tuesday, January 27th at 10am.

Time: Mondays, 1:00-4:00pm

Location: Shaler Room, 4th floor of the Geology Museum

Web: https://canvas.harvard.edu/courses/5032

Course Description: Global population is expected to increase in coming decades along with the resources required for most diets. Because most arable land is developed, these demographic shifts imply a need to produce more food per unit cropland. At the same time, temperature and precipitation patterns are expected to change, with consequences for the productivity of cropland. We will explore the implications of these interacting trends for food security. The course begins with some review of how population and food production interact. After this introductory framing, focus shifts to data-driven exploration of food security through analysis of weather, climate, demographics, and yield. Specific questions that we will empirically address are how temperature and precipitation influence yield outcomes? Can agriculture be adapted to a changed climate? How will demographics and diet shift in the coming decades? Will the green revolution continue to yield steady increases? Can we predict famine in the coming months — and in the coming decades? The course consists of 3 hours per week of in-class meetings, where attendance is required, as well as outside reading and analysis. Students will form teams that are responsible for presenting original analysis from particular datasets.

(Last updated September 21, 2015)
Administrative

Presentations: Groups of three students will be responsible for preparing and making three presentations regarding a particular topic: past climate-crop interactions, demographic and diet changes, forecasting famine, and future food security. The first two presentations will be drawn from provided reading material and augmented with additional material. These presentations are ~20 slides long and are used during the discussion. The purpose of this presentation is to guide and excite discussion, rather than to lecture. The final presentation is based group’s own research and analysis of provided data sets, as well as additional materials that the group will identify. This presentation should be described through tables, figures, and appropriate text. Results should be placed into context with and compared against the published literature considered in the first two presentations.

Readings and position paper: If not part of the group making a full presentation in a given week, students are asked to bring a one-page position statement (12pt single space) to class based upon the assigned reading. Statements should outline the overall topics and then provide a critical analysis.

Data analysis lab: Each class will be supplemented with a data analysis lab run jointly by Prof. Huybers and a teaching fellow. Labs will help bring students up to speed in the mechanics of data analysis, provide familiarity with relevant datasets, and aid the process of exploring data, developing hypotheses, and testing them.

Grading: Based on analysis and presentations (60%), discussion and participation (20%), and position papers (20%). If you must miss class, which obviously makes participation impossible, please obtain our permission ahead of time.
Schedule

1. 02 September
   **Course introduction, overview, and logistics**
   - Reading: Malthus (1798) and excerpts from Boserup (1965)
   - Before class: Critique Malthus and Boserup arguments regarding how increased population will either lead to food scarcity or a change in the means of production and higher yield.
   - Data analysis: primer on regression; input, output, and display of data.

2. 14 September
   **Climate and yield: part 1, temperature and precipitation**
   - Reading: Schlenker and Roberts (2009) for how temperature variations associated with weather influence maize; Chapters of Lambers et al. (2008) on heat stress, C3 and C4 plants production.
   - Data analysis: Regression of temperatures against maize yield (Carbon Dioxide Information Analysis Center, 2015; United States Department of Agriculture, 2015).

3. 21 September
   **Climate and yield: part 2, adaptation**
   - Reading: Butler and Huybers (2012) for a critique of Schlenker and Roberts (2009); Chapters of Lambers et al. (2008), photosynthesis and water stress.
   - Data analysis: Compare sensitivity of yield variations to temperature anomalies against climatology.

4. 28 September
   **The Green Revolution: will it continue?**
   - Reading: Ray et al. (2013) (additional: Lin and Huybers (2012); Grassini et al. (2013)).
   - Data analysis: global yield data-sets, Food and Agriculture Organization of the United Nations. FAOSTAT (Database) (2015) and Ray et al. (2013).

5. 05 October
   **The Green Revolution part II: Nitrogen (Nathan Mueller leading)**
   - Reading: Lassaletta et al. (2014); Food and Agriculture Organization of the United Nations et al. (2014);
• Data analysis: Nitrogen application dataset.

6. 19 October
Population, dietary trends, and feeding the world
• Reading: Tilman and Clark (2014); Food and Agriculture Organization of the United Nations et al. (2014);
• Data analysis: World Bank population data sets.

6. 26 October
Causes of food insecurity
• Reading: Sen (1993); Maystadt et al. (2014)
• Data analysis: Analysis of famines relative to weather, food production, and social upheaval.

7. 02 November
Realtime prediction of famine (FEWS NET)
• Reading: USGS et al. (2015) background materials
• Data analysis: Using satellite measurements of fluorescence and greenness for realtime analysis of crops in Sub-Saharan Africa (Ganter et al., 2012; Carroll et al., 2015).

8. 09 November
Future climate
• Reading: IPCC (2013), IPCC report on climate trends.
• Model analysis: Evaluate changes in temperature and precipitation in the CMIP5 model ensemble (Taylor et al., 2012).

9. 16 November
Future food production
• Reading: Smith et al. (2014), IPCC Working Group III on agriculture.
• Data and model analysis: Predict changes in food production with and without accounting for adaptation, and then factoring in different models for intensification.

10. 23 November
Groups 1 and 2 presents on past climate-crop interactions, yield and demographic trends
11. 30 November
   Group 3 and 4 presents on forecasting famine; future food security

References


