In the past year, I pursued two research projects: (1) examining the suitability of simple streamflow models across the United States, and (2) studying the effect of deforestation on soybean agricultural productivity in Brazil.

Project 1: Suitability of simple streamflow models across California

I began the fellowship period with a suitability study of simple streamflow models. This study was motivated by the fact that these simple frameworks for predicting annual streamflow statistics (such as the flow duration curve) are powerful tools for understanding the first-order dynamics that occur between natural systems and anthropogenic processes. However, these frameworks derived under restrictive assumptions about climate, catchment storage dynamics, and streamflow generation processes. Extensive validation of these frameworks across catchments with varying degrees of conformity to these assumptions had not yet been done, but would inform the more widespread use of these models. I performed a set of model suitability analyses to determine whether the idealized assumptions implied by these frameworks are appropriate for a variety of climate typologies across California. In each suitability analysis, the stringent assumptions about climate and storage dynamics are relaxed for variations on the stochastic framework, potentially broadening their applicability. The intellectual merit of this work is the insight into the accuracy of these minimalistic frameworks. The broader impacts of this work are the establishment of these models’ utility in studies of natural-human system feedbacks, with implications for improving water management practices.

Project 2: Deforestation’s effect on soybean productivity in Brazil

In the second part of the fellowship period, I joined an effort to study the effect of land use change in Brazil on agribusiness. Previous studies have shown that deforestation to make way for agriculture will affect local climate in the form of increased surface temperatures and changes in rainfall patterns and energy budget partitioning. The physical climate change resulting from deforestation has, in turn, been shown to alter agricultural productivity through changes in the frequency of extreme heat, surface water dynamics, and dry spells in the rainy season. My part in this undertaking is to identify how varying degrees of deforestation impact soybean yield in different regions of Brazil. Additionally, I will examine how deforestation creates feedbacks to hydrological processes such as surface water dynamics and evapotranspiration. The relationships that I find will then be used to determine the levels of deforestation that might begin to adversely impact soybean agribusiness, thereby causing actors to cease deforestation activities, and how these “decision thresholds” may vary across Brazil. Finally, I hope to extend this notion of land use change – climate feedback to existing socio hydrologic models, which typically do not incorporate this additional (and potentially very important) piece of feedback. This project will be the subject of my dissertation. The intellectual merit of this project lies in the explicit connection between deforestation and agricultural productivity through local climate change feedback, and the broader impacts of this work will be in informing agribusiness stakeholders in Brazil about the long-term economic consequences of deforestation.