BRC Science Highlight
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Machine Learning Based Estimation of Land Productivity in the Contiguous U.S. Using Biophysical Predictors

Background/objective

Accurate land productivity estimates are vital information for allocating agricultural land for food or bioenergy crop production. Existing models using biophysical factors to estimate land productivity are subject to uncertainty due to low resolution and insufficient data. Here, researchers propose a novel machine learning based approach to estimate the land productivity in the contiguous U.S. (CONUS). The land productivity estimates are then used to identify marginal lands available for bioenergy production.

Approach

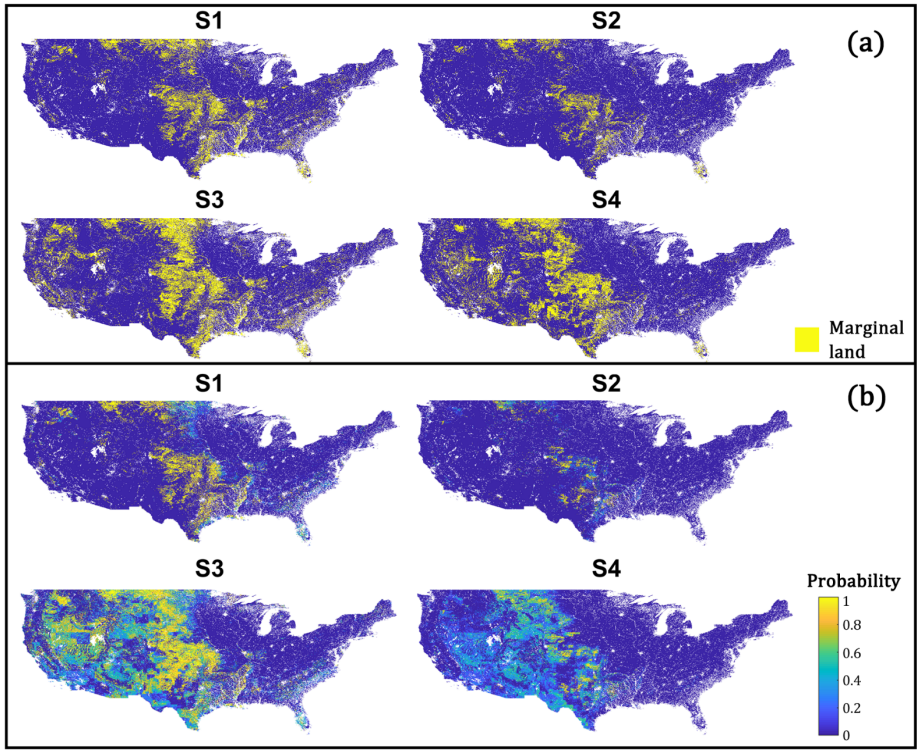
- Crop yield and gross primary productivity data were used to estimate potential crop yields with uncertainty across the CONUS.
- This output was used to estimate land productivity index and marginal land area under four scenarios: currently cultivated land under a higher (S1) and a lower (S2) productivity thresholds, and each of these scenarios expanded to include grass and shrubland (S3 and S4, respectively).
- These results were cross-checked with marginal land areas identified based on economic criteria.

Results

- Total marginal land available for growing bioenergy crops ranges from 55.1-175.6 million ha, depending on which scenario (S1-S4) was used.
- All scenarios identified several common marginal land "hot spots." Similar spatial patterns of marginal land were derived using both biophysical and economic criteria.

Significance

This is the first productivity index to directly link productivity estimates to actual crop yields using advanced machine learning and to provide quantitative uncertainty assessment associated with land productivity and marginal land availability estimates.



(a) Marginal lands identified deterministically according to biophysical criteria S1-S4 and (b) probability of land being marginal given biophysical criteria S1-S4.

Yang et al. 2020. "Machine Learning Based Estimation of Land Productivity in the Contiguous US Using Biophysical Predictors." Environmental Research Letters. DOI: 10.1088/1748-9326/ab865f.

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