Bioclimatic Predictors of Dryland Agroecological Classes and Projected Shifts under Climate Change

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REACH Agroecological Classes (AECs)

Land use classification often relies on biophysical variables hypothesized to be key drivers or determinants of land use/cover. Weak relationships, however, can occur between delineated land use classification and actual land use. On the other hand, classification based on land use/cover that has emerged as a consequence of determinants may be advantageous as the actual land use can then be used for identifying important driving variables.

Huggins et al., 2011 developed a methodology to delineate the REACCH (“Regional Approaches to Climate Change for Pacific Northwest Agriculture”) study area into four major agroecological classes (AECs) using National Agricultural Statistical Service (NASS) cropland data. Farming AECs (Table 1). The irrigated AEC was defined as an annual cropping system (e.g. rotations with fallow every 3rd year) used in the present study to identify the key predictors of REACCH AECs.

Results and Discussion

Table 2. Number of pixels (4 × 4 km) classified in each AEC for present and future scenarios.

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**Table 1. Percentage of fallow as criterion to delineate AECs.**

The same methodology is used every year to classify each 30-m pixel into one of the four AECs (Fig. 2) and to detect spatial changes in AECs over time. Thus, the actual land use classification derived from the cropland data layer was used in the present study to identify the key predictors of REACCH AECs.

**Objectives**

- Identify important bioclimatic predictors which can discriminate between current dryland AECs and;  
- Use identified bioclimatic predictors with future climate scenarios to predict potential shifts in dryland AECs.

Defined AECs, representing actual land use information, were used in the statistical variable selection process to identify bioclimatic variables that significantly affect actual land use. Identified AEC bioclimatic predictors were then used to predict future land use under different climate change scenarios. Dryland AECs from year 2007 to 2013 were used in this study.

Fig. 2. Agroecological Classes for years 2007 and 2013.

**Methodology**

Geographic information system software (ArcGIS) was integrated with statistical software “R” to process the AEC and climate data. The methodology is explained in the following steps:

**Climate data processing**

Climate layers (Abatzoglou, 2012) of precipitation, maximum and minimum temperature (4 × 4 km) from 1981-2010 were used to calculate 38 bioclimatic predictors (Peinado et al., 2012). AEC data processing

Conversion of AECs to climate data scale

Subcategorizing AECs into stable and dynamic AECs (Fig. 3) and dryland AECs and;

**Future climate data extraction**

Future climate data from 14 different Global Climate Models were used to calculate the identified variables for three different time periods (2026-2035, 2056-65 and 2086-2095) and two different climate change scenarios (Representative Concentration Pathway) RCP 4.5 and RCP 8.5 (Abatzoglou and Brown, 2012).

**Prediction of AECs under different future scenarios**

Selected discriminant models with significant bioclimatic predictors were used to predict shifts in stable and dynamic AECs under different future climate change scenarios.

**Dynamic/ Stable REACCH Agroecological Classification**

**Fig. 3. Agroecological Classes for years 2007 through 2013.**

Overall cross-validated misclassification error was 6% and 25% for stable and dynamic AECs, respectively. Preliminary analysis showed that Annual Crop AEC area would decrease and convert into Annual Crop-Fallow Transition AEC. The relatively stable Grain-Fallow AEC, would be less affected by climate change than other dryland AECs (Table 2; Fig. 5).

**References:**


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