Dynamic Agroecological Zones for the Inland Pacific Northwest, USA

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Overview

Agroecological zones (AEZs) have similar land uses, capabilities and production methods. The AEZ concept is central to project-wide integration for a USDA NIFA, AFRI, CAP entitled "Regional Approaches to Climate Change for Pacific Northwest Agriculture" (REACCH) and will enable researchers, stakeholders, students, the public, and policymakers to acquire a more holistic understanding of the interrelationships of agriculture, climate change and the development of mitigation and adaptation strategies.

Our approach to defining AEZs assumes that current land uses have emerged from biophysical and socioeconomic drivers. Thus, we explore the concept that AEZs can be derived from the geographic distribution of major agricultural systems (e.g. the grain-fallow zone) in the inland Pacific Northwest. By defining AEZs in this way, we expect to:

❖provide a baseline that delineates boundaries of current AEZs and the capacity to evaluate shifts in AEZs over time;

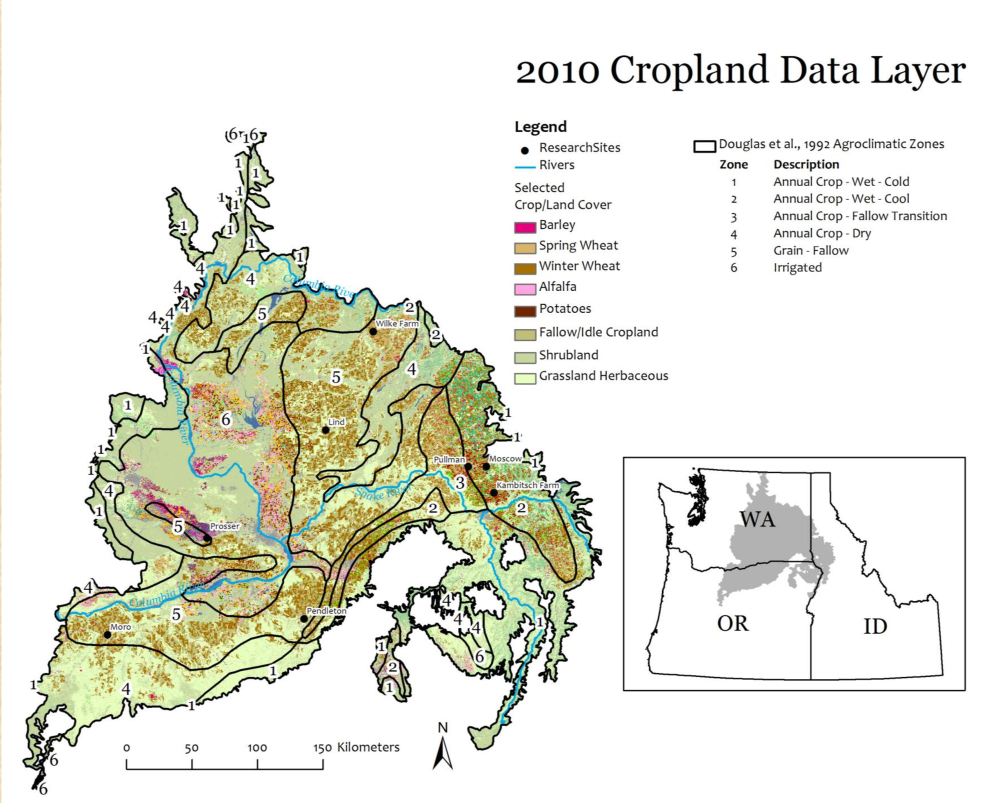
❖assess the biophysical (e.g. climate, soils, terrain) and socioeconomic factors (e.g. commodity prices) that are most useful for predicting AEZs;

❖link climate mitigation and adaptation strategies to relevant AEZs; and

❖integrate biophysical and socioeconomic data sources to pursue a transdisciplinary examination of climate-driven AEZ futures.

Objective

Develop methodology to define major AEZs for the REACCH study area within the Inland Pacific Northwest based on single years of National Agricultural Statistical Service (NASS) cropland data (Fig. 1).



study area (NASS, 2010) and the agroclimatic zones defined by Douglas et al. (1992).

Agroecological Classification of the REACCH Study Region

The USDA created Major land Resource Areas (MLRAs) to subdivide regions into more homogeneous units based on physiography, geology, climate, soils, biological resources and land use. Four MLRAs are represented in the REACCH study region (Fig. 2). Douglas et al. (1992) defined agroclimatic zones for the PNW based on climate and soil variables, establishing six zones (Fig. 1). The MLRAs and agroclimatic zones serve a similar function as AEZs, aiding agricultural planning efforts. Both MRLA and agroclimatic zone boundaries are determined from semi-permanent factors that do not change appreciably over time. If MLRAs and agroclimatic zones represent units formed from the same major drivers that shape agricultural systems, their boundaries should closely correspond to areas where significant shifts in agricultural systems occur.

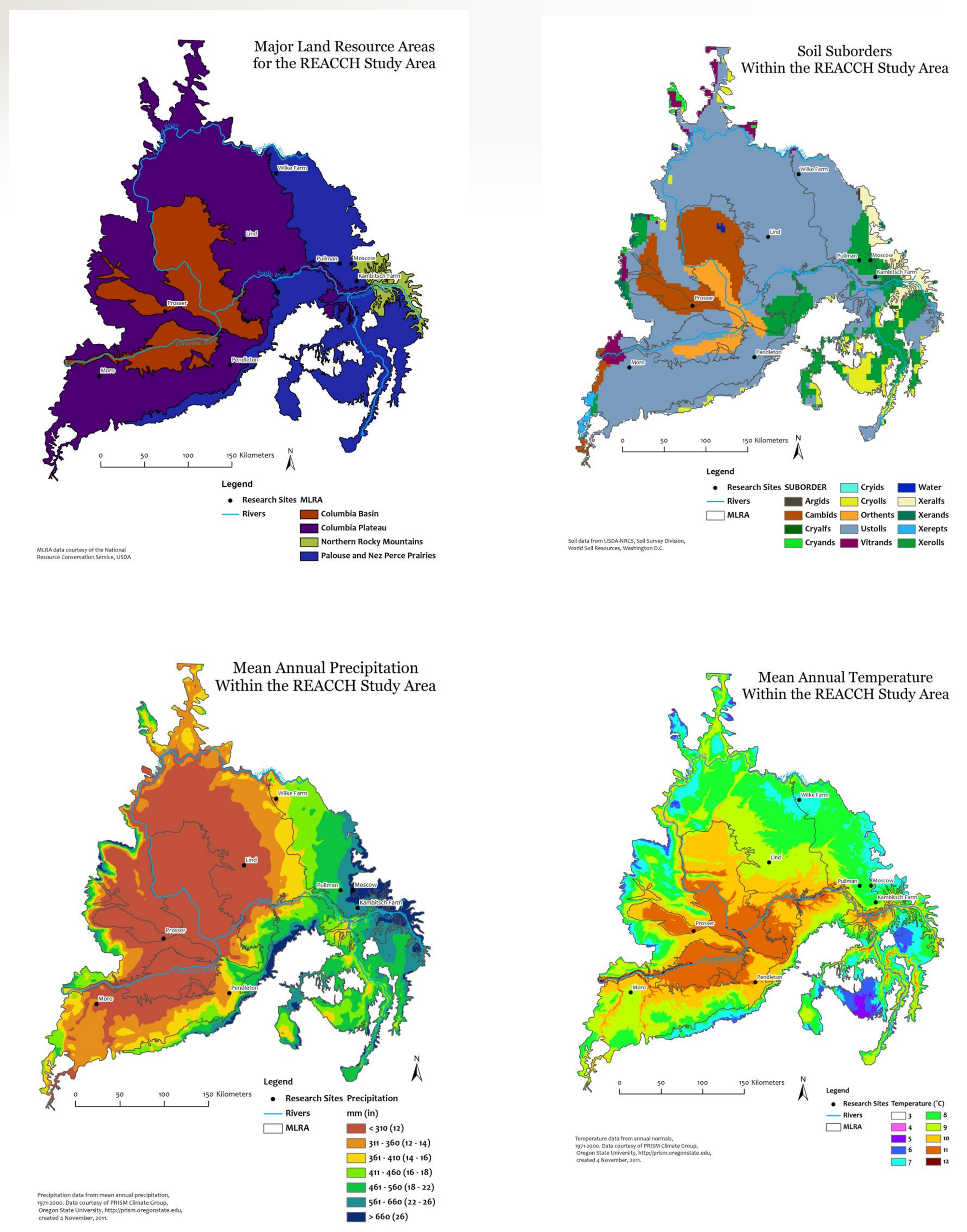


Fig. 2. MLRAs, soil suborders, mean annual precipitation and temperature (1971-2000) for the REACCH study region.

Defining Dynamic AEZs

The NASS cropland use data layer designates land use on an annual basis at a 56-m (3136 m^2) and more recently a 30-m resolution. Major agricultural systems useful for AEZ designation can be derived from fields that are adjacent to one another as long as large enough areas are included. Four agricultural systems were defined for consideration as major AEZs within the REACCH study region: (1) annual cropping (limited annual fallow); (2) annual crop-fallow transition (e.g. 3-yr rotations with fallow every 3rd year); (3) grain-fallow, 2-yr; and (4) irrigated. To determine areas large enough to identify AEZ designation, the proportion of a given area in fallow (not annually cropped) was calculated for increasingly larger areas surrounding each 56-m cell ranging from 1- to 24-km with the expectation that cropland use proportions at an optimal area would enable AEZ designation for every 56-m cell. The proportion of fallow was used to define the dryland farming AEZs where the grain-fallow AEZ was >40% fallow; annual crop-fallow transition AEZ, 10 to 40% fallow, and annual cropping AEZ < 10% fallow. The irrigated AEZ was defined as an annual cropping region (< 10% fallow) where mean annual precipitation was less than 330 mm.

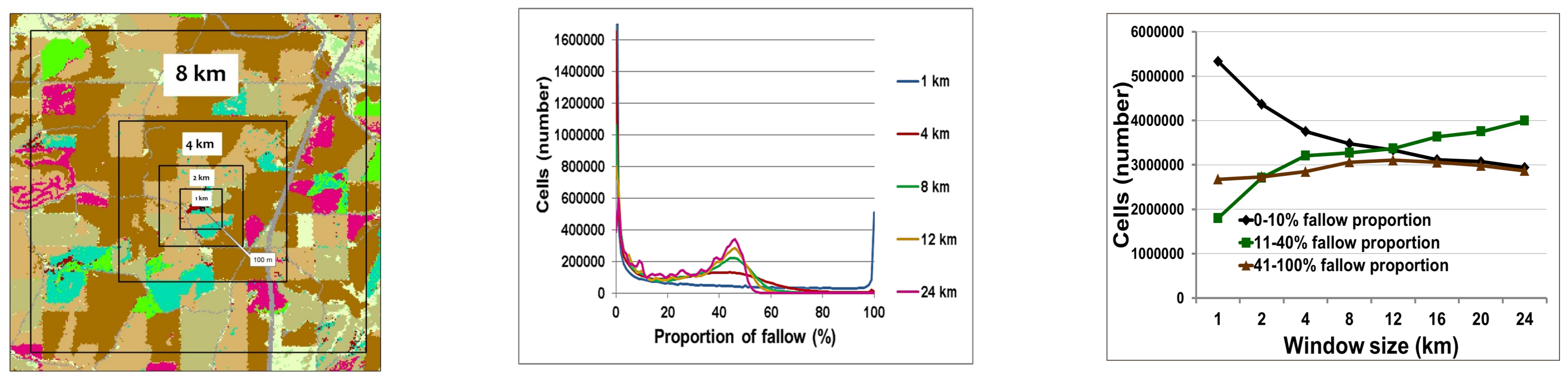


Fig. 3. Number of cells with a specified proportion of fallow at 1- to 24-km scales for the region and identification of optimal window size.

Results and Discussion

❖The AEZs were defined based on the 12-km scale using the proportion of fallow (Fig. 3) for the years 2007-2010 (Fig. 4, only years 2007 and 2009 shown).

❖ Each AEZ was characterized with respect to major crop and fallow proportions (Table 1).

❖ Differences are evident in comparing the dynamic AEZs with MLRAs and Douglas et al. (1992) agroclimatic zones (Figs. 2 and 4 and Table 2).

AEZ	Fallow	Winter wheat	Spring cereal	Grain legume	Alfalfa	Potato	Other
	%						
Annual Crop	3	39	20	21	5	0	12
Crop-Fallow Transition	27	39	20	3	4	0	5
Grain-Fallow	48	45	3	0	1	0	3
Irrigated	9	16	5	4	16	8	42

Table 1. Proportions of crops and fallow by AEZ.

	Dynamic AEZ			
Douglas et al. (1992) AEZ	Annual Crop	Crop - Fallow Transition	Grain - Fallow	Irrigated
	%			
Annual Crop	67	29	4	1
Annual Crop-Fallow Transition	26	65	9	0
Grain-Fallow	2	20	59	18
Irrigated	0	1	20	78

Table 2. Comparison of AEZs and Agroclimatic zones.

❖Defining AEZs and relevant subzones directly from the cropland data layer on an annual basis would enable dynamic AEZ delineation, subject to annual variation in biophysical and socioeconomic drivers (e.g. climate, fuel or fertilizer prices and technological advancements) that impact agricultural systems and AEZ characteristics over time.

❖Defining AEZs based on current cropland use allows further analyses with the goal of relating various biophysical and socioeconomic data layers to AEZs in order to gain an understanding of how multiple factors influence realized AEZs. This includes AEZ variation that can occur at finer temporal and spatial scales than has been possible with previous approaches.

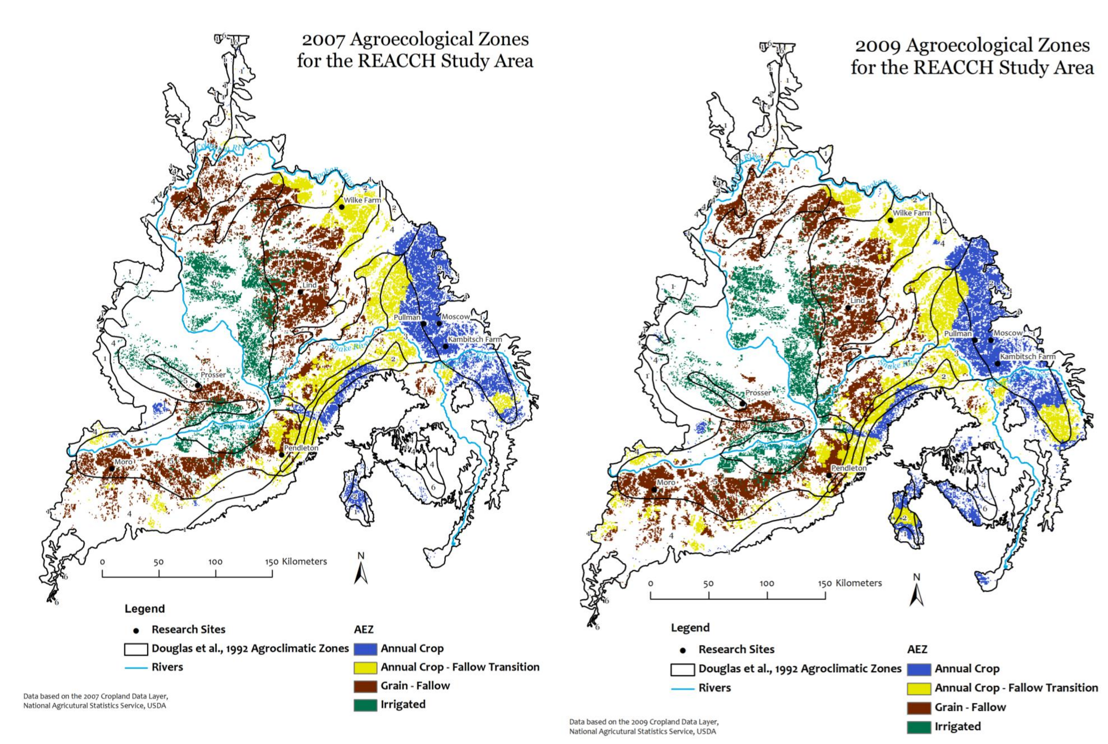


Fig. 4. Geographic distribution of four major PNW AEZs for 2007 and 2009.

Reference:

Douglas, C.L., R.W. Rickman, B.L. Klepper, J.F. Zuzel and D.J. Wysocki. 1992. Agroclimatic Zones for Dryland Winter Wheat Producing Areas of Idaho, Washington, and Oregon. Northwest Science 66: 26-34.

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