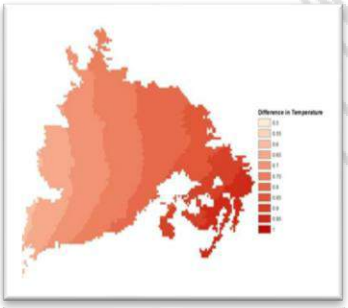
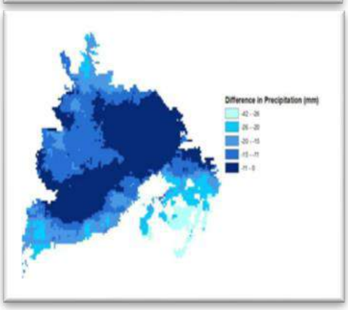
REACCH
Regional Approaches to Climate Change – PACIFIC NORTHWEST AGRICULTURE

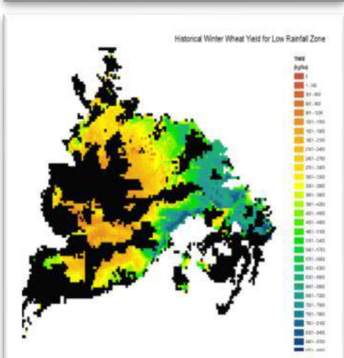
Annual Meeting 2013 *Speed* Science Presentations

Climate Change and Adaptation in PNW Wheat Systems -

John Antle and Hongliang Zhang, OSU





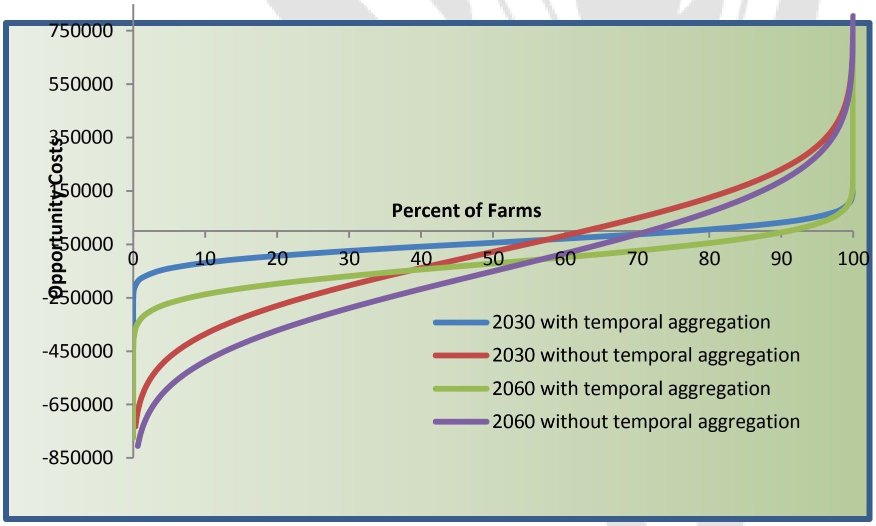


Pictures shown, from top to bottom, are:
1) Future temperature (2006-2035) minus baseline temperature (1979-2010)
2) Future precipitation (2006-2035) minus baseline precipitation (1979-2010)
3) Simulated historical WW yield from C. Stockle CropSyst analysis.

The purpose of this research is to evaluate the economic impact of climate change on cereal production, and to improve our understanding of the adoption of technologies such as direct seeding that may provide useful adaptations to climate change in the Pacific Northwest (PNW).

This analysis will investigate the mean and higher order effects of climate change on distributions of agricultural net returns, and also evaluate the factors affecting adoption of direct seeding technology. These elements will then be incorporated into analysis of climate impact and adaptation using the TOA-MD model, and will compare results obtained from CropSyst simulations and from econometric models.

Preliminary analysis of the winter wheat system using the TOA-MD model and CropSyst simulations suggest that the majority of wheat producers in the PNW are likely to benefit from the combined effects of climate change and CO_2 fertilization (figure below shows percent of farms predicted to gain from climate change without adaptation, under alternative methods of data aggregation).



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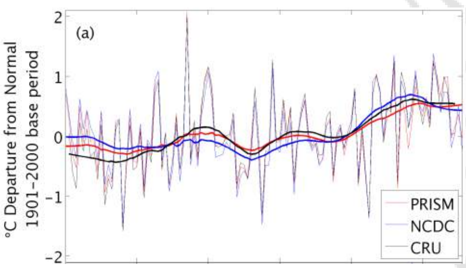
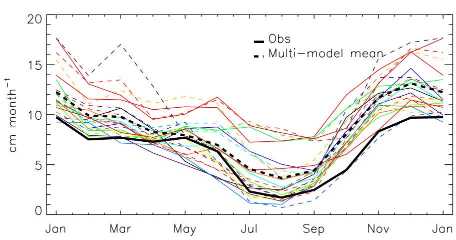
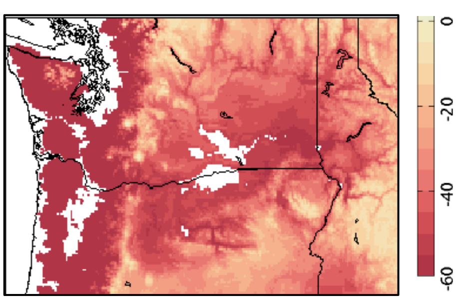
Climate of the Pacific Northwest during the Anthropocene

John Abatzoglou, David Rupp and Philip Mote







(top) Annual mean temperature anomalies 1901-2011 for the Pacific Northwest USA from 3 datasets.

(middle) Monthly mean precipitation from observations and CMIP5 models.

(bottom) Modeled change in percent of precipitation as snow (2031-2060, RCP4.5 vs. 1950-2005) 14 model mean.

How has seasonal climate in the Pacific Northwest changed over the 20th century, what can we attribute to natural and anthropogenic factors and how will climate evolve over the next half-century? Credible answers to these questions are critical in guiding decisions on regional climate adaptation. Observed changes in seasonal temperature examined across three datasets showed positive, albeit non-monotonic trends across, with more subtle changes in seasonal precipitation. Of interest to the agricultural community and stakeholders is the lack of warming during spring in recent decades. Upon removal of the impact of known natural drivers of regional climate variability we identify coherent and accelerated warming trends consistent with anthropogenic drivers. These results suggest that internal climate variability plays a significant role in modulating the pace of regional warming trends across seasons and helps explain the lack of springtime warming since 1980. Projected regional changes in climate were examined using over 25 global climate models (GCMs) run using two enhanced greenhouse experiments through the 21st century. The credibility of GCMs in simulating features of regional scale historical climate fields was examined to identify models appropriate for the region. Overall, GCM projections for the Pacific Northwest include a continuation of accelerated warming with the largest increases during the summer months coincident with decreases in summer precipitation. Despite increases in precipitation during the cool months, significant reductions in snowfall and increased climatic water deficit during the warm season along with warming are likely to have disparate direct impacts on agriculture and indirect impacts on agriculture through modifying suitability for pest, weeds and diseases. Downscaled climate projections for 10 variables at the daily time step are available for integration across REACCH to help model climate impacts and devise adaption strategies to continue agricultural prospects in the Pacific Northwest.

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Climate Impacts on Farming Decisions of Land Allocation in Pacific Northwest: Weather Shocks and Climate Shifts

Jianhong Mu, John Antle, John Abatzoglou; Oregon State University, University of Idaho

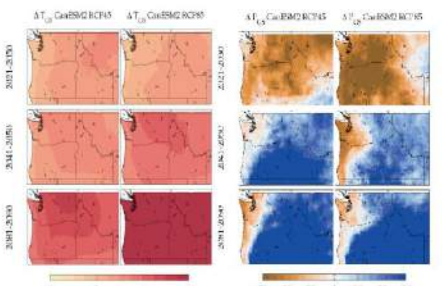

Fig. 1 Changes in mean T and total PPT over the growing season (CanESM2)

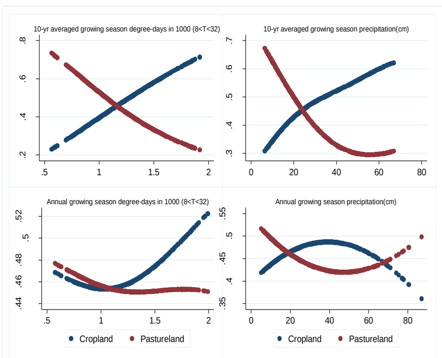

Fig. 2 Marginal effects of 10-yr averaged and annual DD and PPT on land use shares

According to projections from climate models, the Pacific Northwest (PNW) will be warming by 1-4°C by mid-21st Century, and will have slight increase in annual precipitation (Fig.1). These projected climate changes are likely to affect how farmers allocate land between major crop, livestock and non-agricultural uses. Using data from the PNW region, this paper first tests the hypothesis of climate change may affect land use shares, and then simulate the changes in land use share under future climate scenarios.

Our statistical results (Fig. 2) show that: (1) changes in land use shares are affected by net revenues from production; (2) cropland shares are increasing with more precipitation and degree-days (defined as temperature between 8°C and 32°C); (3) climate induces there is a strong substitution between land used for crops and livestock. Using projected climate data from several Global Climate Models (GCMs), we simulated the land use shares under future climate scenarios and find that cropland will increase (Fig.3) and pastureland will decrease (Fig.4) in PNW.

However, the results reported here are based on only one GCM (CanESM2). Next we will assess the implications of other GCMs and then link the results to the economic and environmental impact assessments being carried out with the TOA-MD model.

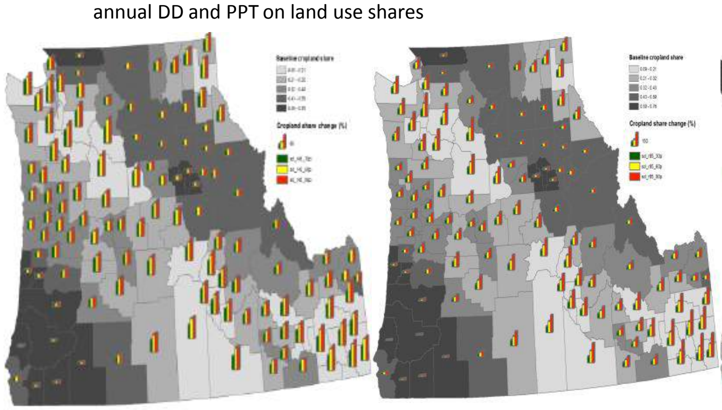

Fig.3 Effects of climate change on cropland shares (CanESM2)

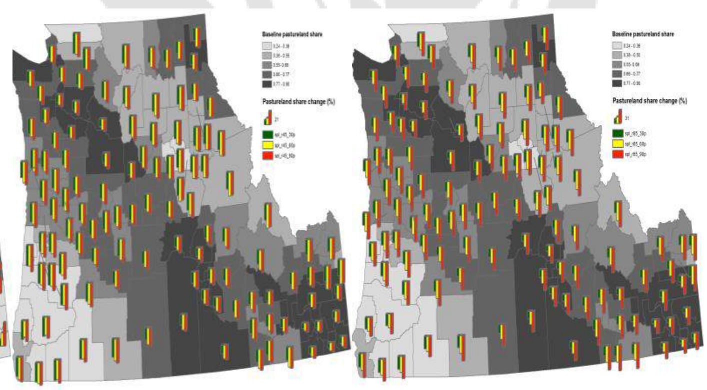

Fig.4 Effects of climate change on pastureland shares (CanESM2)

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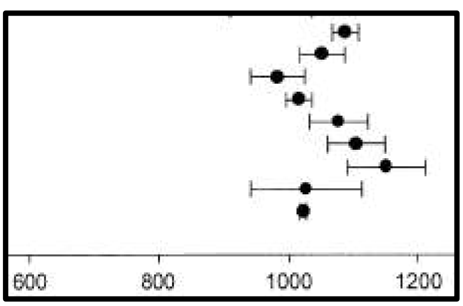
Projected Changes to Downy Brome Herbicide Application Timings

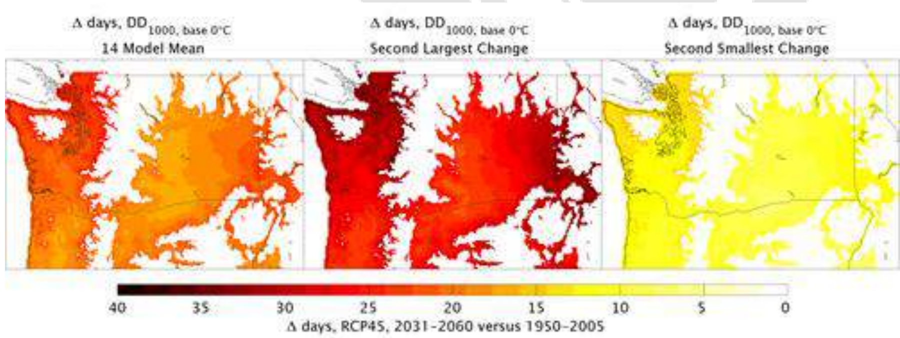
Nevin C Lawrence, Ian C. Burke , Washington State University;
John Abatzoglou, University of Idaho; Dan A. Ball, Oregon State University

$$GDD = (Daily\ Max.Temp. + \text{Daily Min. Temp.}) / 2$$



Pictures and figures, from top to bottom are: downy brome prior to mature seed set, the formula for calculating GDD, GDD required to reach mature seed set in downy brome collected from the PNW (Ball et al. 2004), projected change in the calendar date when 1000 GDD is reached in the PNW in 2031-2060

Downy brome (*Bromus* tectorum) is a widely distributed and problematic weed species in the winter wheat production regions of the PNW. Pairing a previously published downy brome development model based on GDD (Growing Degree Days) with downscaled climate models, the physiological development of downy brome is projected to accelerate in the PNW. This projected development will require earlier applications of spring applied herbicides to achieve effective control of downy brome. In recent years heavy spring rains have prevented timely applications of spring applied herbicides. This may become more pronounced as increased moisture during the winter and spring is projected. Downy brome control currently can be achieved with fall or spring applied herbicide applications. If timing of spring applications becomes more difficult in coming years the importance of fall applied herbicide applications may become more critical.



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