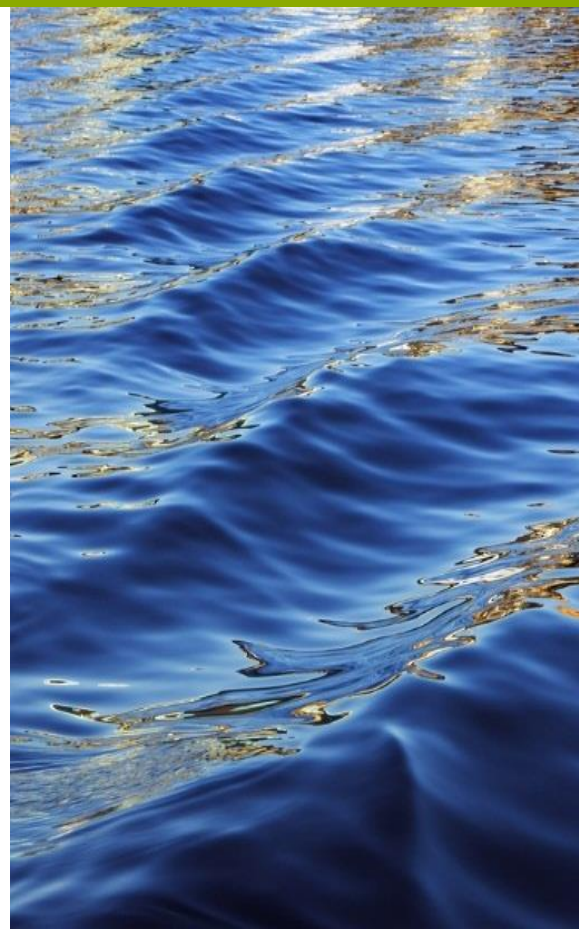
FEW WORKSHOP

Boulder, CO

Amrith (Ami) Gunasekara, PhD
Science Advisor to the Secretary



cdfa CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

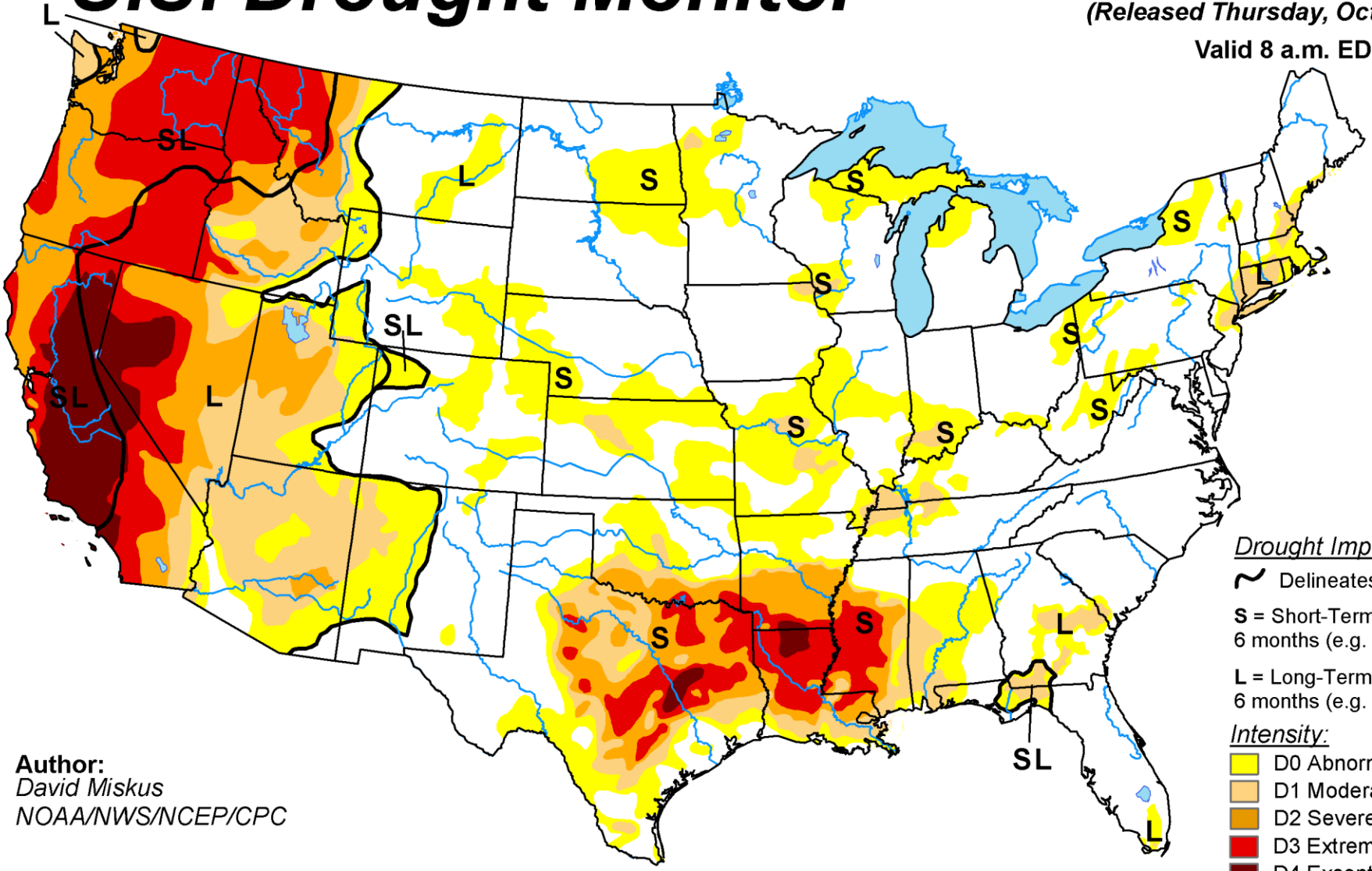
1220 N Street
Sacramento, California

U.S. Drought Monitor

October 13, 2015

(Released Thursday, Oct. 15, 2015)

Valid 8 a.m. EDT



Author:
David Miskus
NOAA/NWS/NCEP/CPC

Drought Impact Types:

~ Delineates dominant impacts

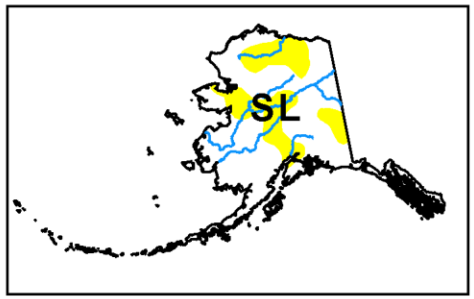
S = Short-Term, typically less than 6 months (e.g. agriculture, grasslands)

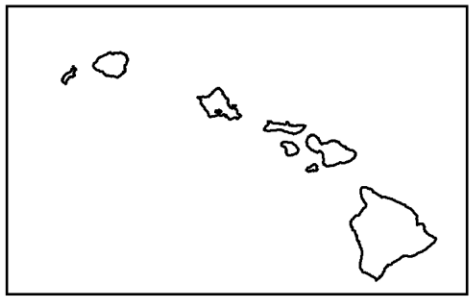
L = Long-Term, typically greater than 6 months (e.g. hydrology, ecology)

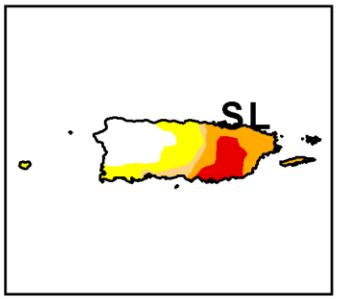
Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.







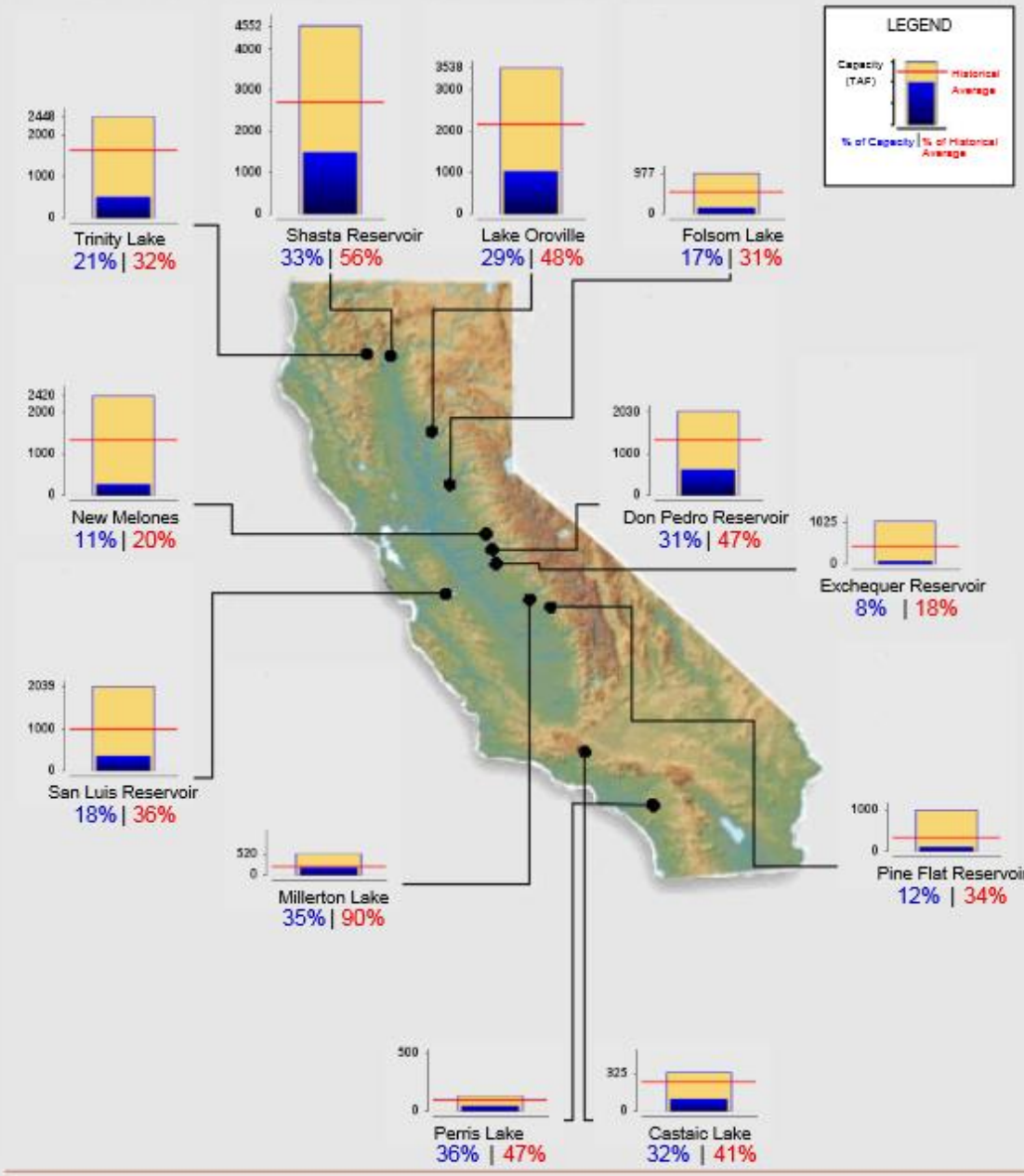
USDA National Drought Mitigation Center

http://droughtmonitor.unl.edu/

Reservoir Conditions

Ending At Midnight - October 14, 2015

CURRENT RESERVOIR CONDITIONS



Graph Updated 10/15/2015 11:15 AM

Fourth year of a historic drought in California!!!!

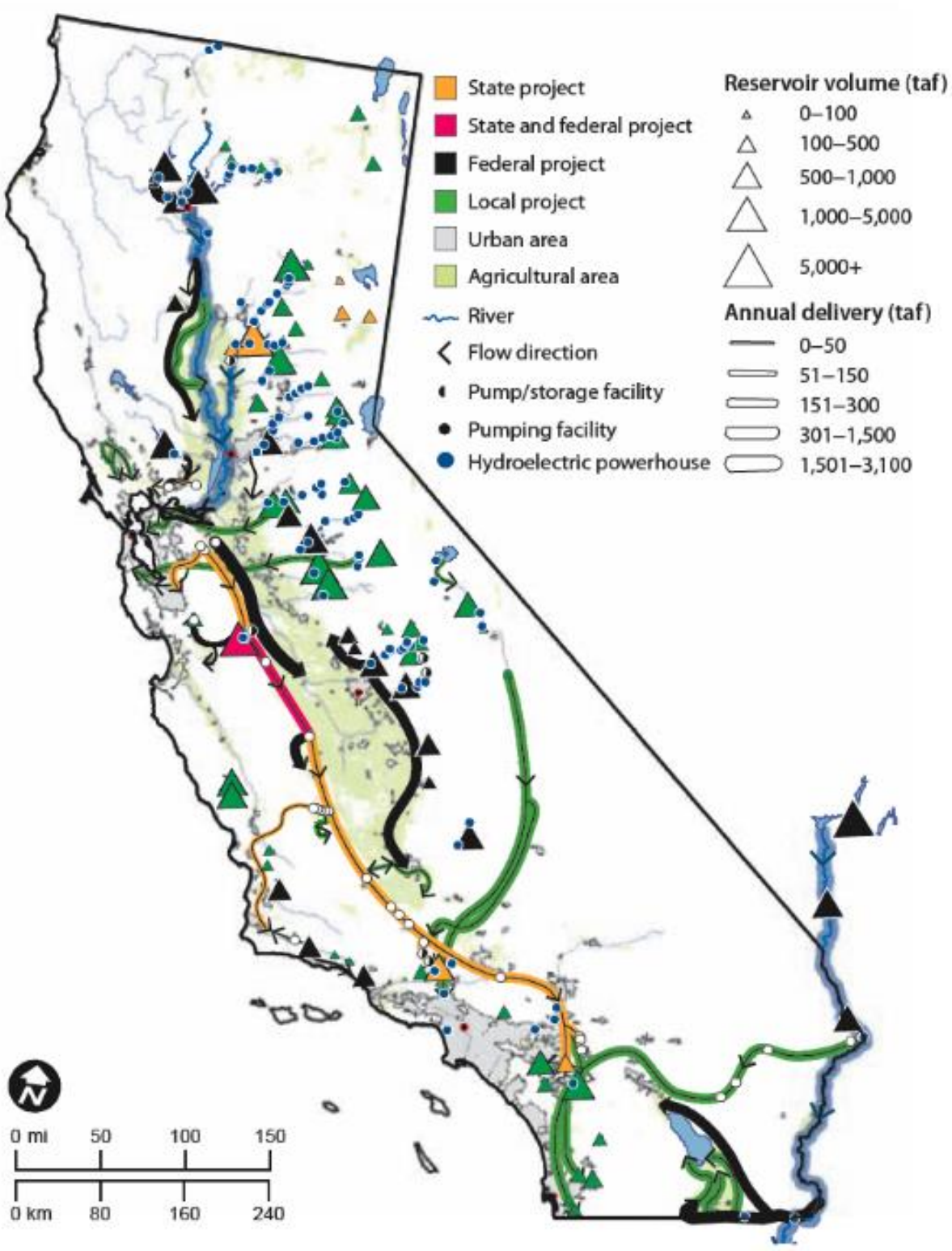
Provided by the California Cooperative Snow Surveys

Data For: **17-Mar-2015**

% Apr 1 Avg. / % Normal for this Date

acquired January 18, 2014

acquired January 18, 2013

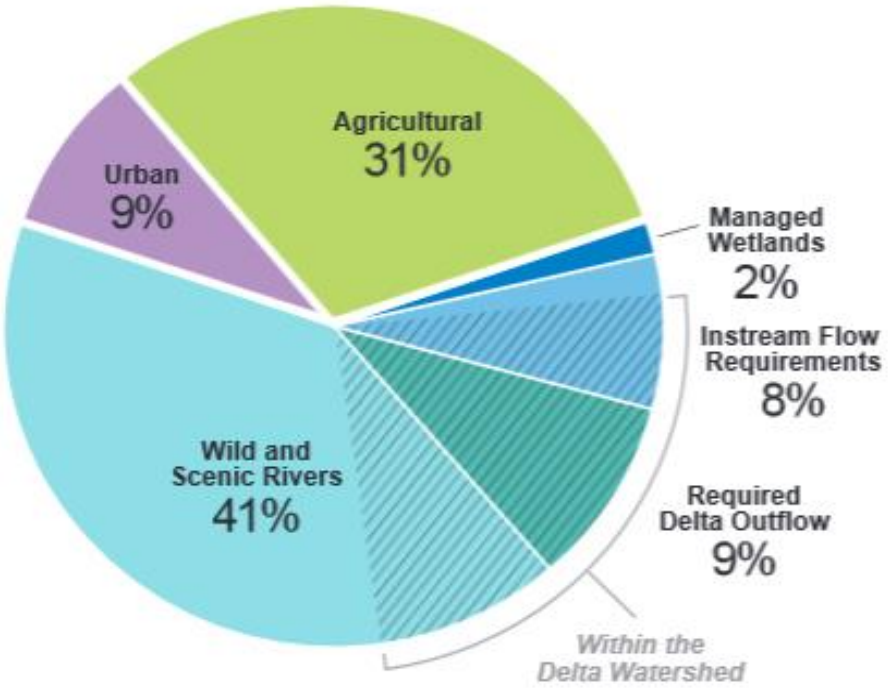


Hanak et al. 2011. Managing California's Water Conflict to Reconciliation.

How Water Is Used in California

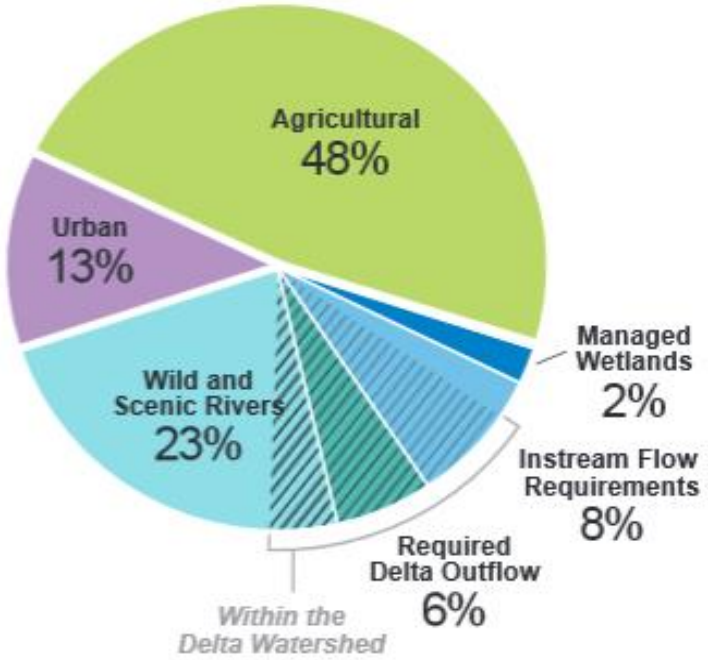
Water Year 2006 (Wet)

108 MAF



Water Year 2007 (Dry)

77 MAF



		Applied Water Use			
		2006 (Wet)		2007 (Dry)	
Water Use	Definition	%	MAF	%	MAF
Urban	*Water for urban purposes, including residential, commercial, institutional, and industrial.*	9%	9.5	13%	9.6
Agriculture	*Water for irrigated agriculture including multi-cropping.*	31%	33.3	48%	36.9
Managed Wetlands	*Water for managed wetland areas.*	2%	1.6	2%	1.6
Minimum Instream Flow Req'ts	*Water within natural waterways as specified in an agreement, water rights permit, court order, FERC license, etc.*	8%	8.5	8%	6.5
Minimum Required Delta Outflow*	*Freshwater outflow from the Sacramento-San Joaquin Delta required by law to protect the beneficial uses within the Delta from the incursion of saline water.*	9%	10.1	6%	4.5
Wild and Scenic Rivers	*Over 2,000 miles of river systems are designated wild, scenic, and recreational under the 1968 National Wild and Scenic Rivers Act and the 1972 California Wild and Scenic Rivers Act.*	41%	44.8	23%	18.1

**Total Delta Outflow is higher than Required Delta Outflow: 2006=41.3 maf and 2007=6.2 maf (pie chart includes Required Delta Outflow only).*

Quantities reflect surface and groundwater supplies.

Source: Department of Water Resources, California Water Plan 2013

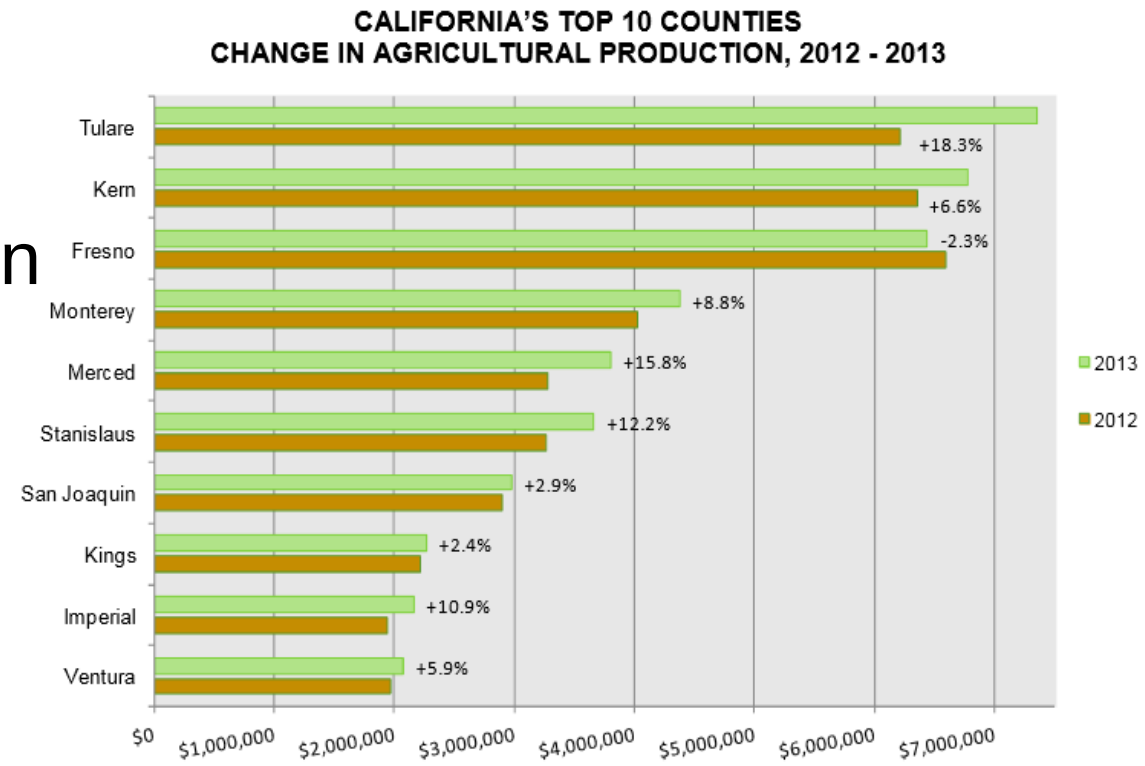
July 2015

Sources: California Department of Water Resources

CALIFORNIA AGRICULTURAL PRODUCTION

- California is the nation's leading agricultural production state and has been for more than 50 years

- The Central Valley counties lead the state in agricultural production; 8 of the 10 leading production counties



Data Source: 2012 Annual Crop Report by USDA NASS

BACKGROUND - AGRICULTURE IN CALIFORNIA

- Year-round production in some regions; lemons, artichokes, avocados, broccoli, cabbage, carrots, cauliflower, celery, lettuce, mushrooms, potatoes, spinach, squash

- The most Specialty Crops in the nation; almonds, artichokes, figs, grapes, raisins, kiwi fruit, olives, peaches, pistachios, walnuts, plums, pomegranates

Specialty Crops are defined as;

"fruits and vegetables, tree nuts, dried fruits, horticulture and nursery crops (including floriculture)"

(USDA Agricultural Marketing Service Definition)

BACKGROUND - AGRICULTURE IN CALIFORNIA

Image Source: USDA Cropscape - Cropland Data Layer

CALIFORNIA "SPECIALTY" CROPS

- Leads the nations in producing 90 commodities

- California is the sole producers (>99% production) of some crops – Almonds, artichokes, dates, figs, grapes (raisins), kiwifruit, olives, clingstone peaches, pistachios, dried plums, pomegranates, walnuts

Data Source: 2012 Annual Crop Report by USDA NASS

IMPACTS TO AGRICULTURE - DROUGHT

What was needed?

Economic impact of drought to agricultural industry

- Water needs for food production
- Crop losses
- Direct jobs
- Indirect jobs
- Impacts to economy

Principal agency dealing with agronomic issues is the California Department of Food and Agriculture (CDFA)

CDFA established contract with UC Davis economists to obtain information for 2014, 2015 and 2016 by;

1. Modeling studies
2. Validation of the model with crop production data

2015 DROUGHT IMPACTS

UC Davis Center for Watershed Sciences Results –

- The agricultural economy continues to grow in this fourth year of severe drought due to the state's vast but declining reserves of groundwater, which will offset about 70 percent of the surface water shortage this year

- The total impact to all economic sectors is an estimated $2.74 billion, compared with $2.2 billion in 2014 (total farm revenue is $46 billion annually)

- The loss of about 10,100 seasonal jobs directly related to farm production, compared with the researchers' 2014 drought estimate of 7,500 jobs.

Sources: UC Davis Economic Impact Report, CDFA News Release and CDFA Planting Seeds Blog

2015 DROUGHT IMPACTS

UC Davis Center for Watershed Sciences

- Surface water shortages will reach nearly 8.7 million acre-feet, which will be mostly offset by increased groundwater pumping of 6 million acre-feet

- Net water shortages of 2.7 million acre-feet will cause roughly 542,000 acres to be idled — 114,000 more acres than the researchers' 2014 drought estimate. Most idled land is in the Tulare Basin.

The scientists noted that new state groundwater regulations requiring local agencies to attain sustainable yields could eventually reverse the depletion of underground reserves.

Sources: UC Davis Economic Impact Report, CDFA News Release and CDFA Planting Seeds Blog

DROUGHT IMPACTS

DROUGHT = CLIMATE CHANGE?

AGU PUBLICATIONS

Geophysical Research Letters

RESEARCH LETTER
10.1002/2015GL064924

Key Points:
- Warming since 1901 caused a significant trend toward drought in California
- Recent drought was naturally driven and modestly intensified by warming
- Warming has rapidly amplified the probability of severe drought

Supporting Information:
- Text S1, Table S1, and Figures S1–S7

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A. P. Williams,
williams@ldeo.columbia.edu

Citation:
Williams, A. P., R. Seager, J. T. Abatzoglou, B. I. Cook, J. E. Smerdon, and E. R. Cook (2015), Contribution of anthropogenic warming to California drought during 2012–2014, *Geophys. Res. Lett.*, 42

Contribution of anthropogenic warming to California drought during 2012–2014

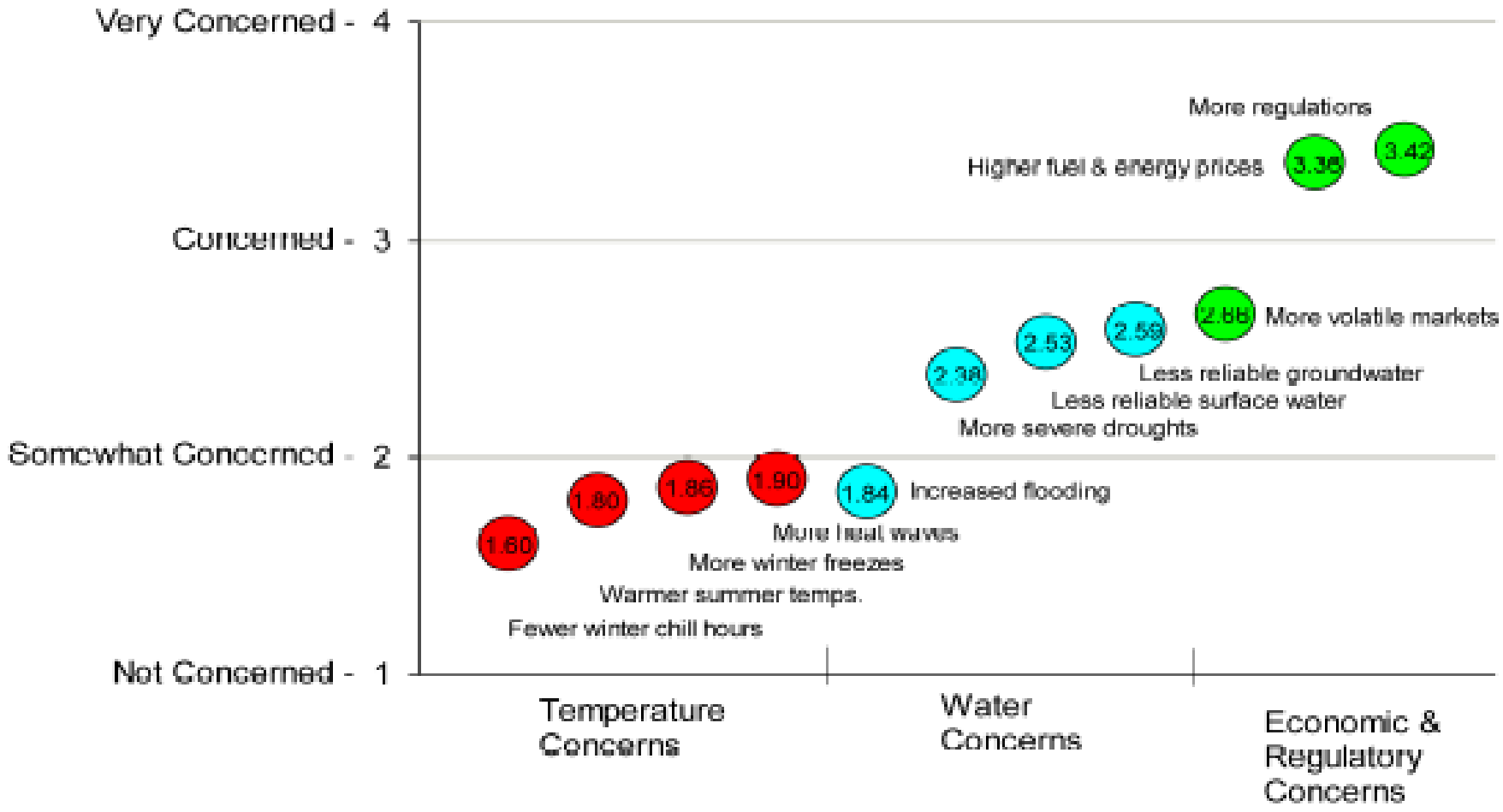
A. Park Williams[1], Richard Seager[1], John T. Abatzoglou[2], Benjamin I. Cook[1,3], Jason E. Smerdon[1], and Edward R. Cook[1]

[1]Lamont–Doherty Earth Observatory, Columbia University, Palisades, New York, USA, [2]Department of Geography, University of Idaho, Moscow, Idaho, USA, [3]NASA Goddard Institute for Space Studies, New York, USA

Abstract A suite of climate data sets and multiple representations of atmospheric moisture demand are used to calculate many estimates of the self-calibrated Palmer Drought Severity Index, a proxy for near-surface soil moisture, across California from 1901 to 2014 at high spatial resolution. Based on the ensemble of calculations, California drought conditions were record breaking in 2014, but probably not record breaking in 2012–2014, contrary to prior findings. Regionally, the 2012–2014 drought was record breaking in the agriculturally important southern Central Valley and highly populated coastal areas. Contributions of individual climate variables to recent drought are also examined, including the temperature component associated with anthropogenic warming. Precipitation is the primary driver of drought variability but anthropogenic warming is estimated to have accounted for 8–27% of the observed drought anomaly in 2012–2014 and 5–18% in 2014. Although natural variability dominates, anthropogenic warming has substantially increased the overall likelihood of extreme California droughts.

Sources: CDFA News Release and CDFA Planting Seeds Blog

ADAPTATION STRATEGIES FOR AGRICULTURAL SUSTAINABILITY IN YOLO COUNTY, CALIFORNIA



Jackson et al. *Adaptation Strategies for Agricultural Sustainability in Yolo Co., California*. CEC report, submitted.

DROUGHT IMPACTS

DROUGHT = CLIMATE CHANGE DISCUSSION

News Release

CALIFORNIA DEPARTMENT OF FOOD AND AGRICULTURE

Media Contacts:
Steve Lyle, CDFA Public Affairs (916) 654-0462 or slyle@cdfa.ca.gov

CDFA TO ESTABLISH CLIMATE CHANGE CONSORTIUM TO HELP SPECIALTY CROP GROWERS PLAN FOR FUTURE IMPACTS

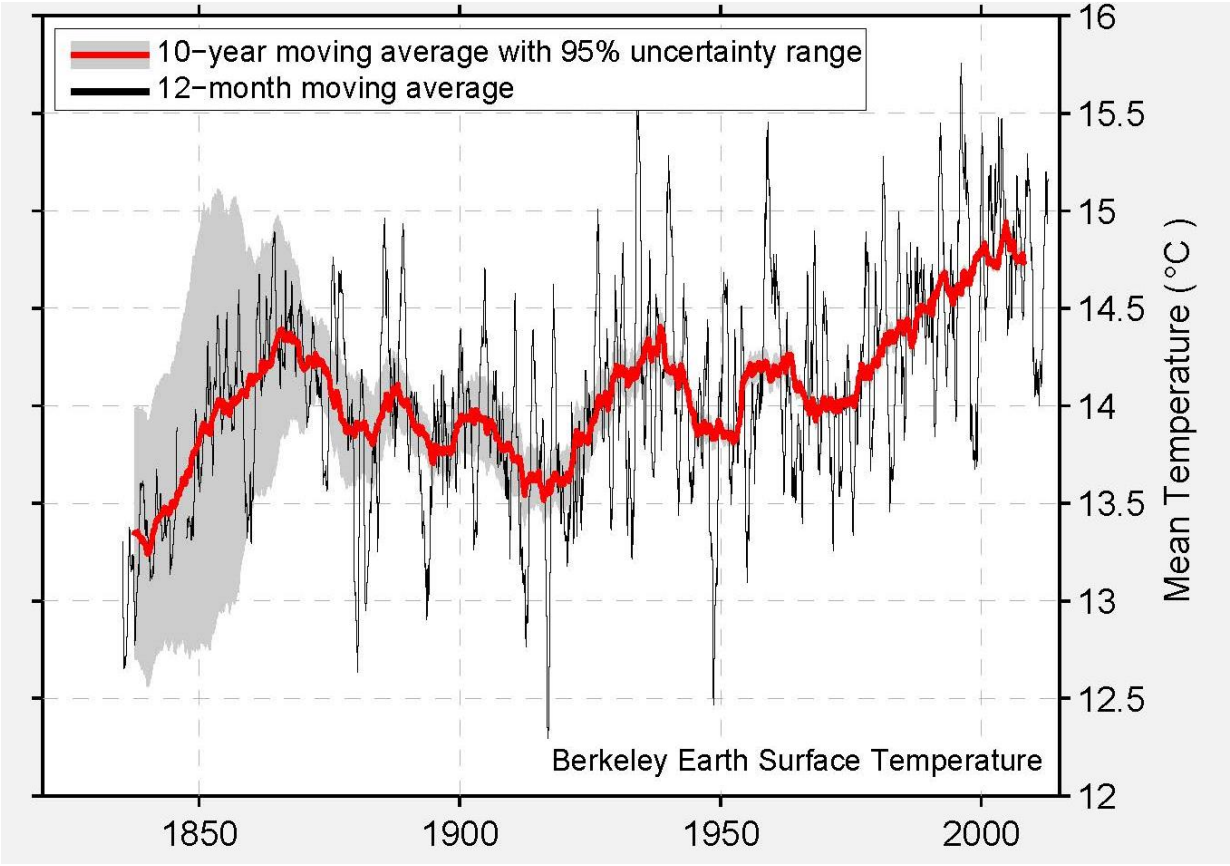
Release #12-029
Print This Release

SACRAMENTO, August 2, 2012- California's specialty crops account for more than half of the nation's fruits, vegetables, and nuts as well as nearly $7 billion dollars of exports worldwide. California's production of diverse specialty crops is threatened by potential climate-related phenomena, including reduced water supplies, increased plant heat stress, decreased chill hours, shifts in pollinator lifecycles and increased influx of invasive species. Addressing these risks to ensure agricultural adaptation to climate change will require a concerted effort and is an objective of California Agricultural Vision: Strategies for Sustainability.

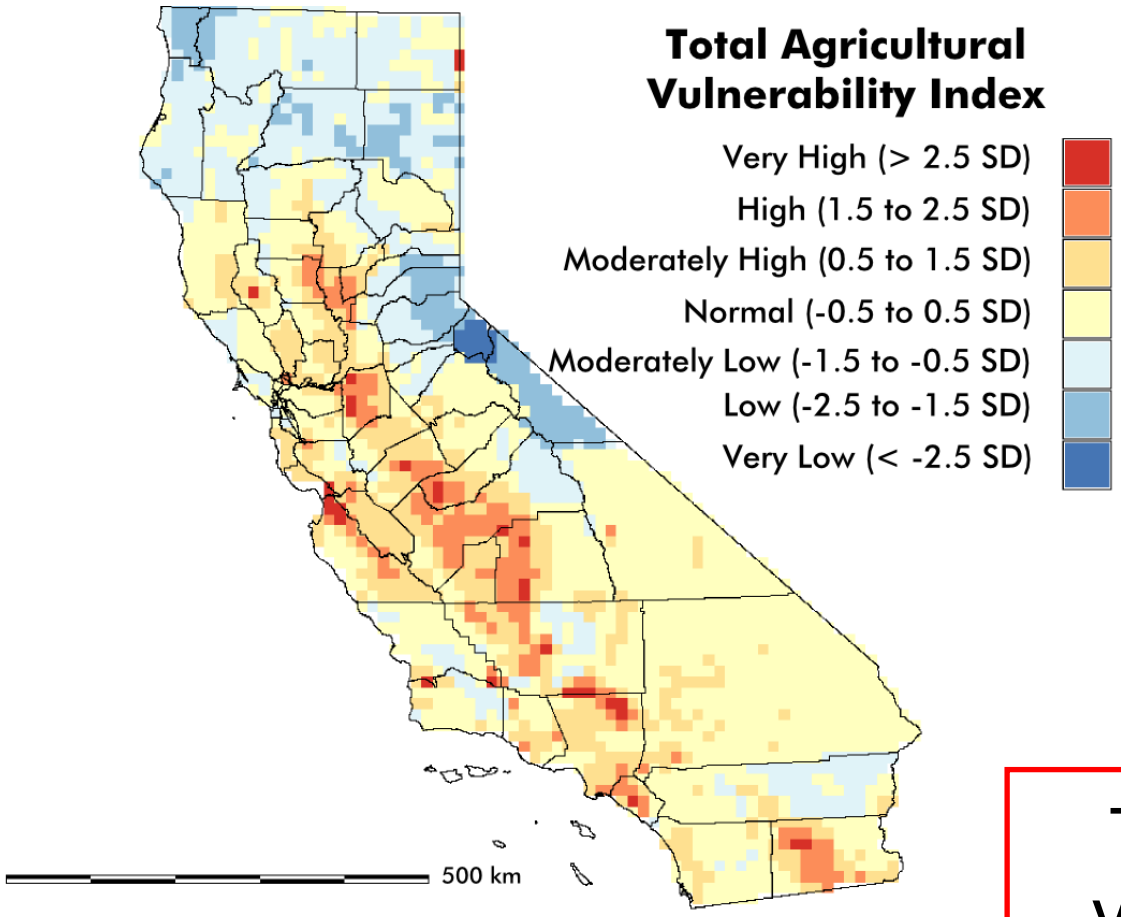
CCC DISCUSSIONS

Example of Information shared - Temperature increase is one variable that is used to measure climate change and need for adaptation

This figure shows the average warming observed in the San Joaquin Valley near Modesto, Merced, and Turlock, California.



CCC DISCUSSIONS



Vulnerability Index uses 4 sub indices:

1. Climate
2. Crop
3. Land use
4. Socioeconomic

Total modeled agricultural vulnerability in some areas of the state is very high

Data Source: Jackson et al. UC Davis. Energy Commission Study. 2012. http://www.energy.ca.gov/2012publications/CEC-500-2012-031/CEC-500-2012-031.pdf

CCC DISCUSSIONS

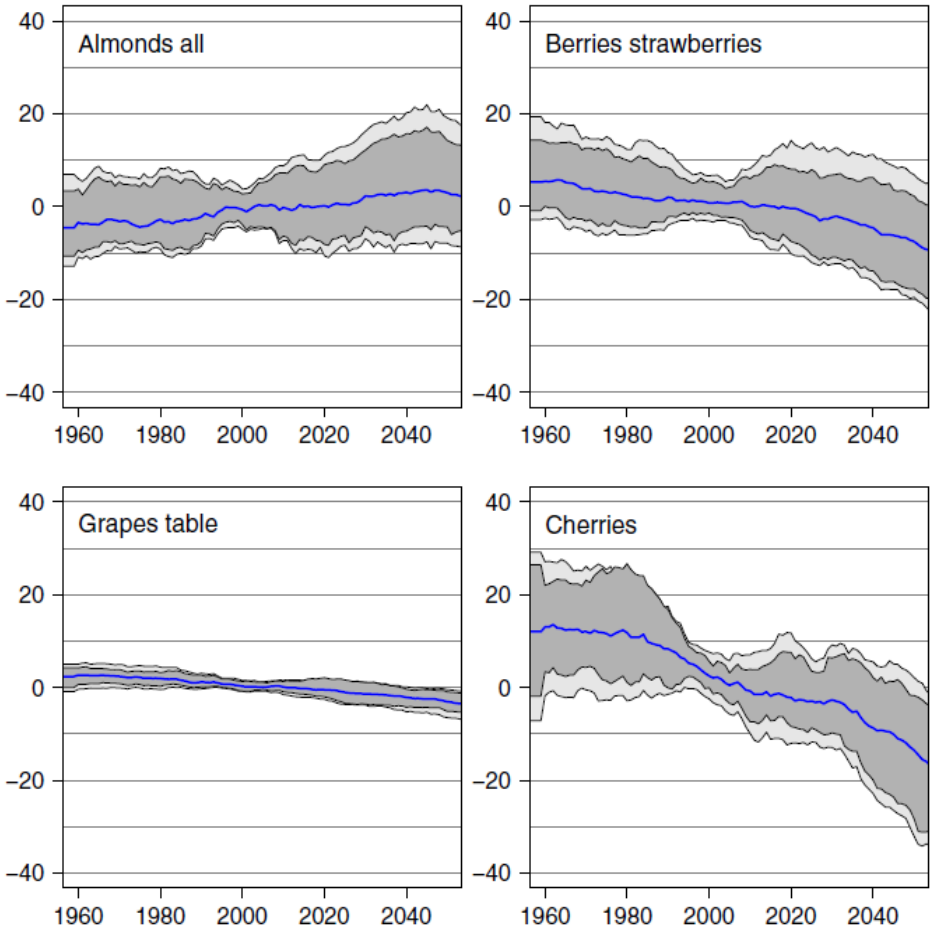


Fig. 9 Simulated change in crop yields for four crops with most reliable crop models. The thick blue line shows the average of all projections, the dark shaded area shows 5%–95% range of projections when using multiple climate models, and the light shaded area shows 5%–95% range when using multiple climate models and multiple crop models (based on bootstrap resampling). The results are presented as percent changes from the 1995–2005 average yields, and as 21-year moving averages in order to emphasize the trend rather than year-to-year variability

Climatic Change (2011) 109 (Suppl 1):S317–S333
DOI 10.1007/s10584-011-0303-6

California perennial crops in a changing climate

David B. Lobell · Christopher B. Field

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e-mail: dlobell@stanford.edu

C. B. Field
Department of Global Ecology, Carnegie Institution, Stanford, CA 94305, USA

Impacts on Specialty Crops will vary by the specific crop and location

A warmer climate will create more degree-days for pests. Some pests will have more generations each year.

Codling moth lifecycles will increase from 2-4 generations per year to 3-5 per year. Navel orange worm, and mites will also increase in generations (Luedeling et al 2011).

Images from UC IPM; http://www.ipm.ucdavis.edu/PMG/PESTNOTES/pn7412.html

CCC RECOMMENDATIONS

1. Research Needs
2. Planning and Resource Optimization
3. Outreach and Education
4. Technology and Innovation

Information from report used in;

- Safeguarding California Report
- Safeguarding California Implementation Plan
- 4th Climate Change Assessment Research
- USDA NRCS Climate Sub-hub discussions
  - Vulnerability report for CA and West of U.S.

EXAMPLE

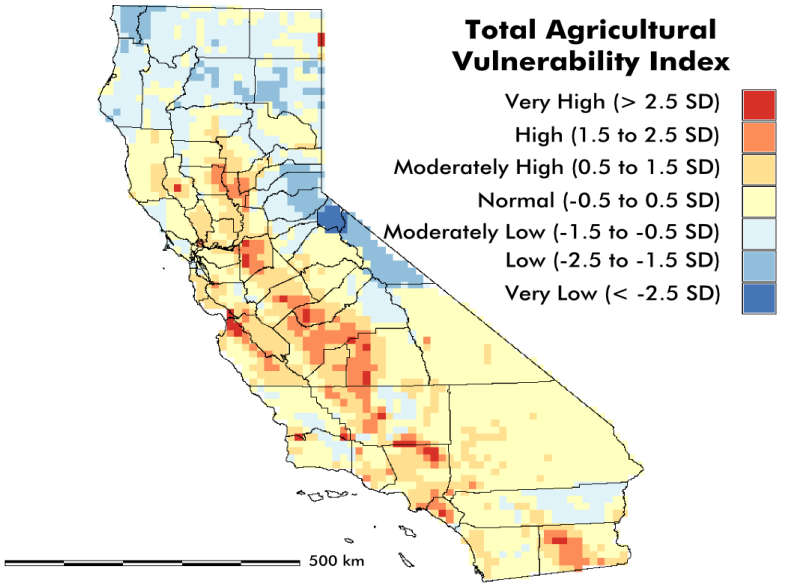
Recommendation

Research Needs

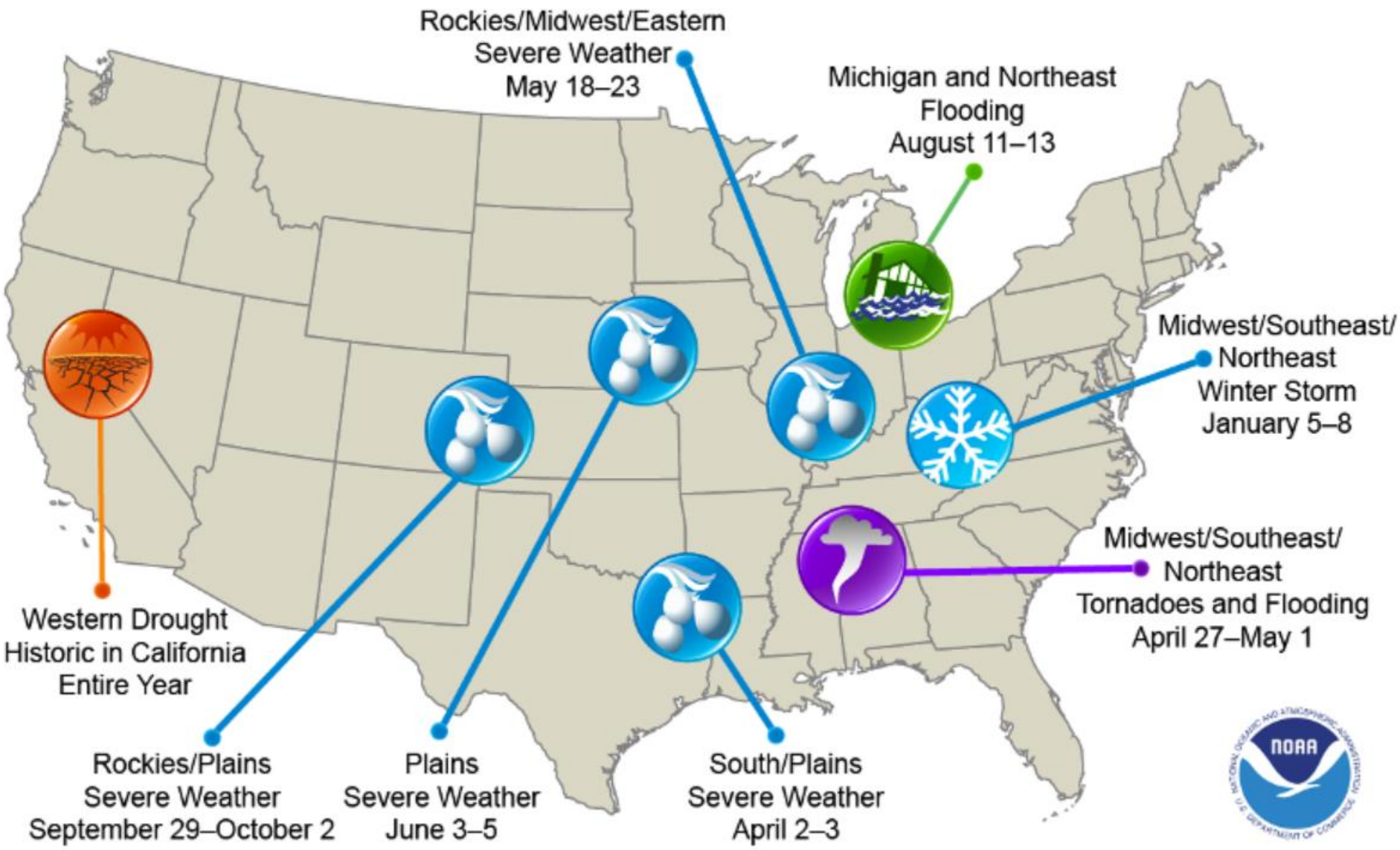
***Economic and Environmental Studies of the Costs, Benefits, and Risks of*:**

- Crop relocation, including infrastructure considerations, and climate analogues; define where crops will be best suited under future climate conditions considering soil type, topography, water availability, and potential hazards;

- This recommendation has been included in the 4th Climate Change Assessment Research request for proposals to begin in 2015



U.S. 2014 Billion-Dollar Weather and Climate Disasters



This map denotes the approximate location for each of the eight billion-dollar weather and climate disasters that impacted the United States during 2014.

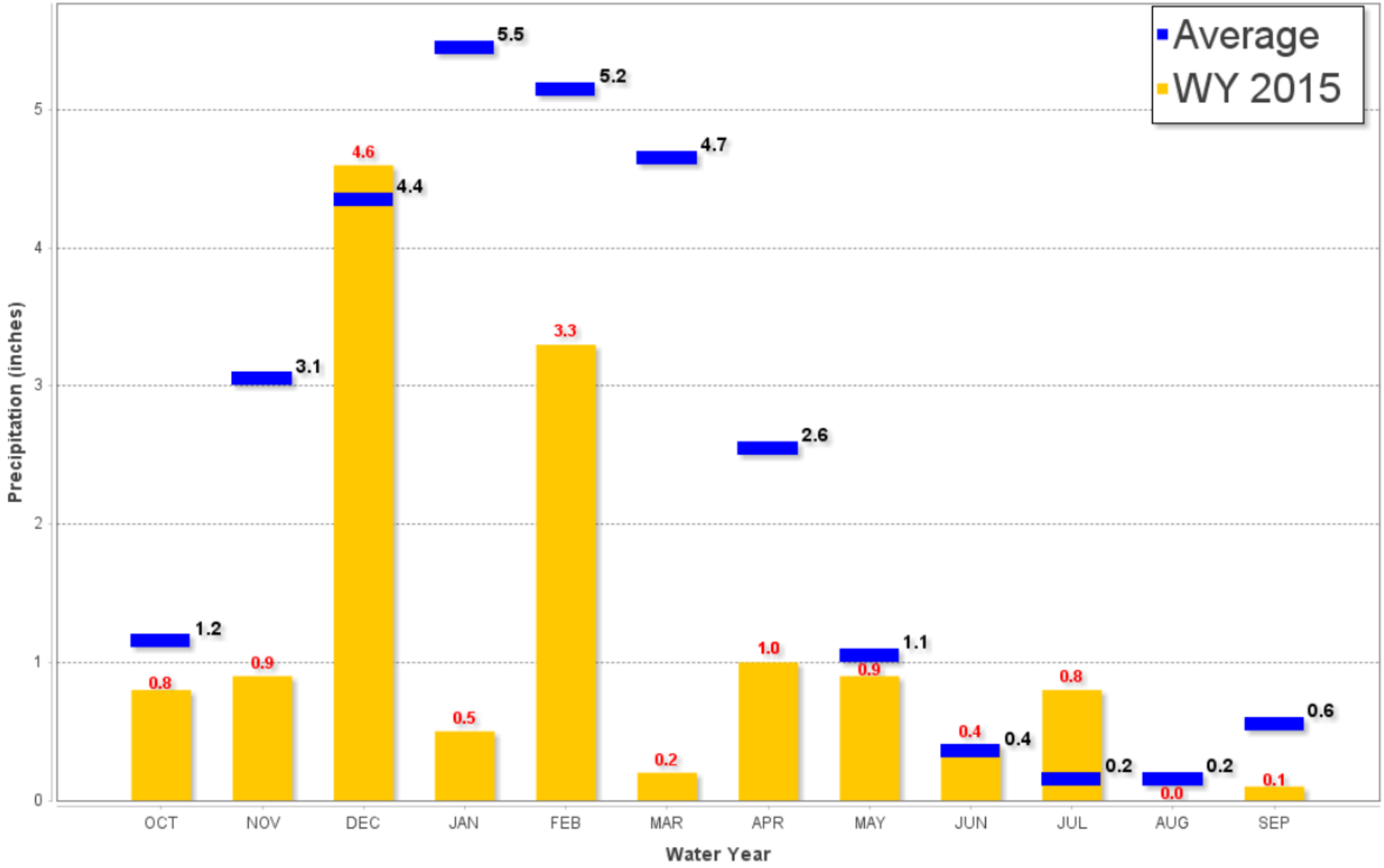
Smith and Katz. http://www.ncdc.no

Tulare Basin 6-Station

Precipitation Index for Water Year 2015 - Updated on September 30, 2015 09:45 PM

Note: Monthly totals may not add up to seasonal total because of rounding

Water Year Monthly totals are calculated based on Daily precipitation data from 12am to 12am PST



University of California Cooperative Extension
KERN VEGETABLE CROPS
Kern County • 1031 S. Mt. Vernon Avenue • Bakersfield, CA 93307 • 661-868-6222

LATE BLIGHT MAY BE AN ISSUE THIS YEAR

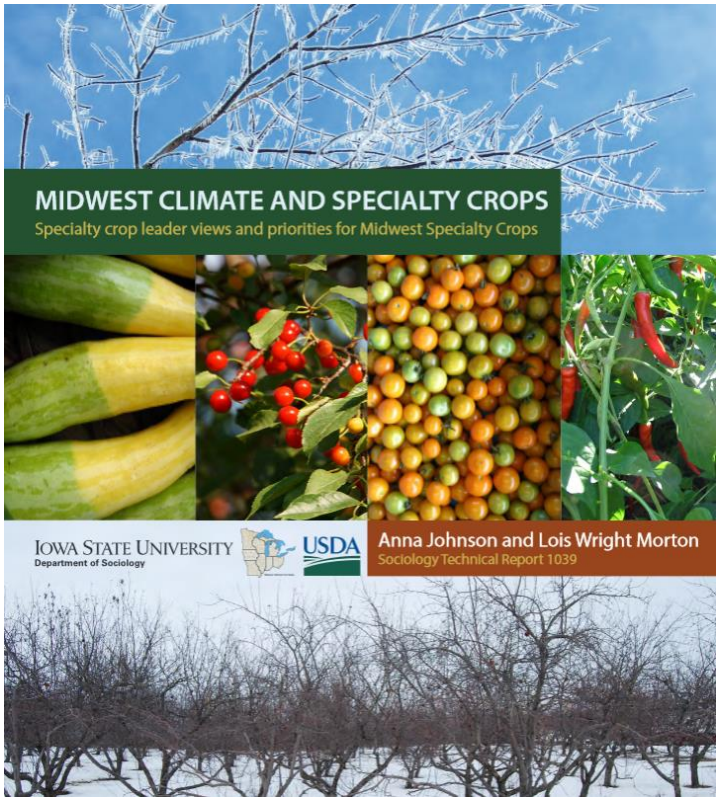
Joe Nunez, UC Cooperative Extension, Kern County

Late blight is a destructive disease of potato and tomato in all growing regions of the world. This disease first gained notoriety 150 years ago as the cause of the "Potato Famine of Ireland and Northern Europe." It was last a major issue in California after the El Niño of winter 1998-1999. Then late blight appeared in many early planted tomato fields and potato fields in Kern County. Late blight is a very explosive disease that can appear suddenly and move through a field or area very quickly. Cool, wet conditions are ideal for late blight to develop. With what appears to be another wet El Niño rainy season tomato and potato growers need to again be on the lookout for this disease.

disease. Kits are available which help quickly confirm or refute whether a questionable lesion is caused by the late blight fungus. Regular field scouting and diagnostic kits are methods of early detection so appropriate action can be taken quickly.

Spot killing infected plants when the disease first appears will slow the spread of spores to other parts of the field. Plants can be quickly destroyed by burning or with the use of a fast acting herbicide. This method of cultural control will only be effective when blight first appears in a field or region. Once late blight is established in an area then the likelihood of influencing the amount spores in that area becomes negligible.

http://www.ncdc.noaa.gov/billions/



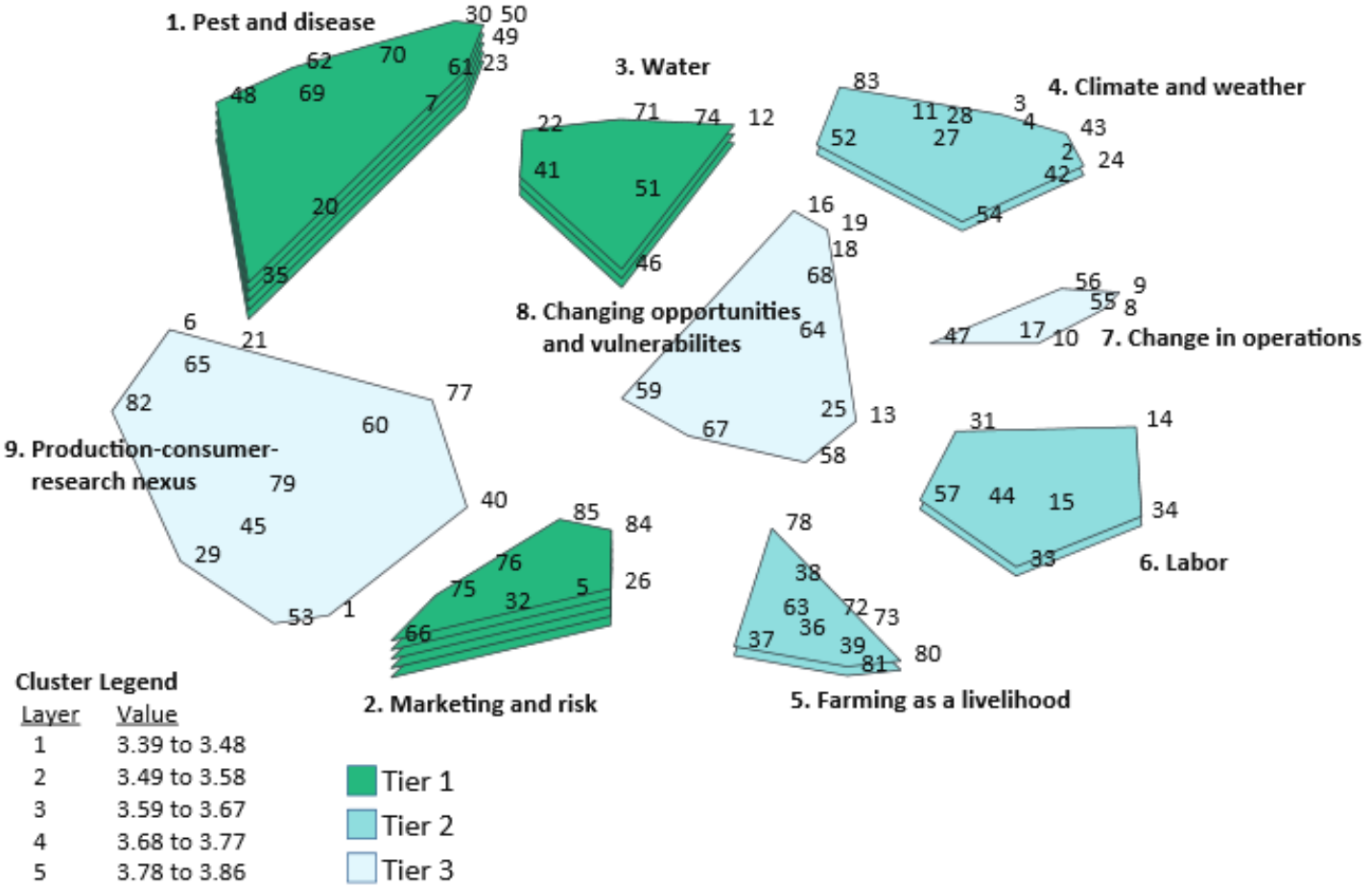
Johnson and Morton. 2015. Sociology Technical Report 1039. Department of Sociology, Iowa State University, Ames, IA. 21 pp

- "A collaborative partnership was initiated in 2014 with the directors of the experiment stations at Michigan State University and The Ohio State University to begin a preliminary exploration to better understand the challenges and concerns of specialty crop growers in the region.

- The directors of the experiment stations and their staff identified a number of key leaders and researchers in the specialty crop industries of Michigan and Ohio.

- These individuals were invited to Toledo, Ohio in October 2014 to talk about changes in weather and climate, how these shifts were affecting them, and their perceptions and expectations of future challenges."

Tier 1. Three of the highest rated clusters, pest and disease; marketing and risk; and water were placed in Tier 1. *Pest and disease*, consisting of 12 statements, was the most spatially dense and highly rated cluster with an overall grand mean rating of highly important (3.86). Within pest and disease, four statements were rated highly important (4) or higher: new invasive insect pests, diseases, and weeds (4.14); increased humidity increases fungal disease pressure (4.11), increase in bacterial diseases (4.09), and increased humidity increases bacterial disease pressure (4.07). The second most highly rated cluster was *marketing and risk* (3.86) containing eight statements. Four statements within this cluster were rated highly important (4) and above: increased need for financial



THANKS……