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The interaction of climate change, land cover, and political representation in the USA

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Abstract. The difficulties in tackling climate change are inherently complex and primarily centered on political and social values. This is evident in the United States where political divisions and polarizations are fundamental barriers to advancing national policies, which in turn hinder international agreements, mitigation, and adaptation. Within the United States, the vast majority of agricultural and natural resource lands are projected to incur significant climate departures and are represented by the Republican Party. The resources and economic sectors that will be directly affected by climate change are represented by national leadership that is unlikely to accept policies to prevent or adapt to change. Given the large impact of climate change on ecosystem services, the predominance of political polarizations raises serious concerns about the ability to enhance the resilience of the nation's agricultural and natural resource lands in the face of future change.

Key words: agriculture; conservation; natural resources; polarization; policy.

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THE POLARIZATION PROBLEM

In September 2013 scientists approved the Summary for Policymakers of Working Group I's contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. It reiterates what has been said before, stating that “warming of the climate system is unequivocal” and “it is extremely likely that human influence has been the dominant cause of the observed warming since the mid-20th century” (IPCC 2013). While the summary provides “comprehensive analysis of policy options and the scientific basis for the next round of climate negotiations” it has been criticized as lacking

“political ambition” and has been suggested that “scientists should focus on smaller and more rapid assessments of more pressing questions that have a particular political interest” (Nature Editorial 2013).

In the United States of America climate change is no longer a scientific issue, but a socio-political one that is now largely dominated by political divisions, primarily along party lines (McCright and Dunlap 2011, Fisher et al. 2013, Guber 2013). While environmental issues have historically been split between parties—particularly among the political elite within the U.S. Congress—party affiliation has not been considered a significant variable for explaining environmental concern

among the general public (Dunlap et al. 2001, Guber 2013). This changed during the 1990s as citizens began to follow the political elite and Republican leaders attacked the scientific basis of climate change (Krosnick et al. 2000, McCright and Dunlap 2011). Presently, the divide between the two parties has become even greater as a recent opinion poll indicates that 50% of Republican voters consider there to be no solid evidence of global warming and climate change compared to 10% of Democratic voters (Pew 2013). Previous polls have shown similar trends (e.g., Dunlap and McCright 2008).

Although recognition of this political divide within the United States is not new, it is a fundamental barrier for national policy and action, as well as international standards, mitigation, and adaptation. As a top contributor of global emissions, the United States is viewed as a potential leader in climate change adaptation and its actions influence policies worldwide (Nordhaus 2001). The nation, however, lags behind other governments in developing a national climate action plan—a negligence that ultimately hinders international agreements (Nordhaus 2001, McCright and Dunlap 2003). Instead, the United States has relied on diverse local and state mandates with the objective of meeting specific outcomes and targets (e.g., emission standards, fuel efficiency, etc.; Lutsey and Sperling 2008, Rosenzweig et al. 2010). While the intent of these regulations is in line with recommendations from the international scientific community, imposing new regulations on the general public has been used by the Republican Party as a platform to further frame and manipulate the scientific consensus about climate change (Levendusky 2010), leading to further political distrust and polarization (Fisher et al. 2013, Leiserowitz et al. 2013).

THE GEO-POLITICAL INTERACTION

To further confound the issue, the representation of land area within the United States is not equally distributed across political parties. Republican congressional districts presently represent 397% greater land area than Democratic districts. Furthermore, Republican districts represent 450% and 300% greater agricultural and natural resource lands, respectively (contermi-

nous United States only). When climate change projections are combined with political representation and land cover, a significant concern arises. Based on an ensemble climate model, some of the nation's most important agricultural and natural resources occur in congressional districts and regions projected for significant climate departures by the end of century (Fig. 1; see also Appendix).

The 10 congressional districts with the most agricultural and natural resource lands all have significant temperature departures (greater than 4°C or 7.2°F) and are predominantly represented by the Republican Party (Table 1). Long-held Republican districts in the Midwest and Great Plains, which produce the bulk of the U.S. cash crops, are projected to have the highest temperature departures in the nation (Fig. 1a). Unlike crops that do well at warmer temperatures, the primary grain crops from these regions—corn, wheat, and soybean—are expected to decrease with even modest temperature departures (Hatfield et al. 2008). Republican-dominated districts within the southern Great Plains, which produce the most cattle and cattle income in the United States (National Agricultural Statistics Service 2012), not only experience severe warming but also some of the most significant precipitation decreases (Fig. 1b). This combination can have devastating effects on livestock and ranching productivity. In the state of Texas alone, agricultural losses during the drought of 2011 were estimated to exceed \$5.2 billion, with half attributed to losses in livestock production (Agrilife Today 2011). In the slightly Republican-favored Southwest, increasing temperatures and drought are expected to worsen the already catastrophic losses of forest resources to insects, disease, and wildfire. Already, over one million hectares of forest die-off in the Southwest have been attributed to warming temperatures and increasing drought severity (Allen et al. 2010).

This leads to a significant concern regarding the political polarization of climate change: climate projections predict that lands represented by the Republican Party, which frequently opposes a national climate change policy, are more likely to experience the greatest impacts of climate change. Overall, Republican districts represent more land in the highest projected temperature category (greater than 4°C or 7.2°F)

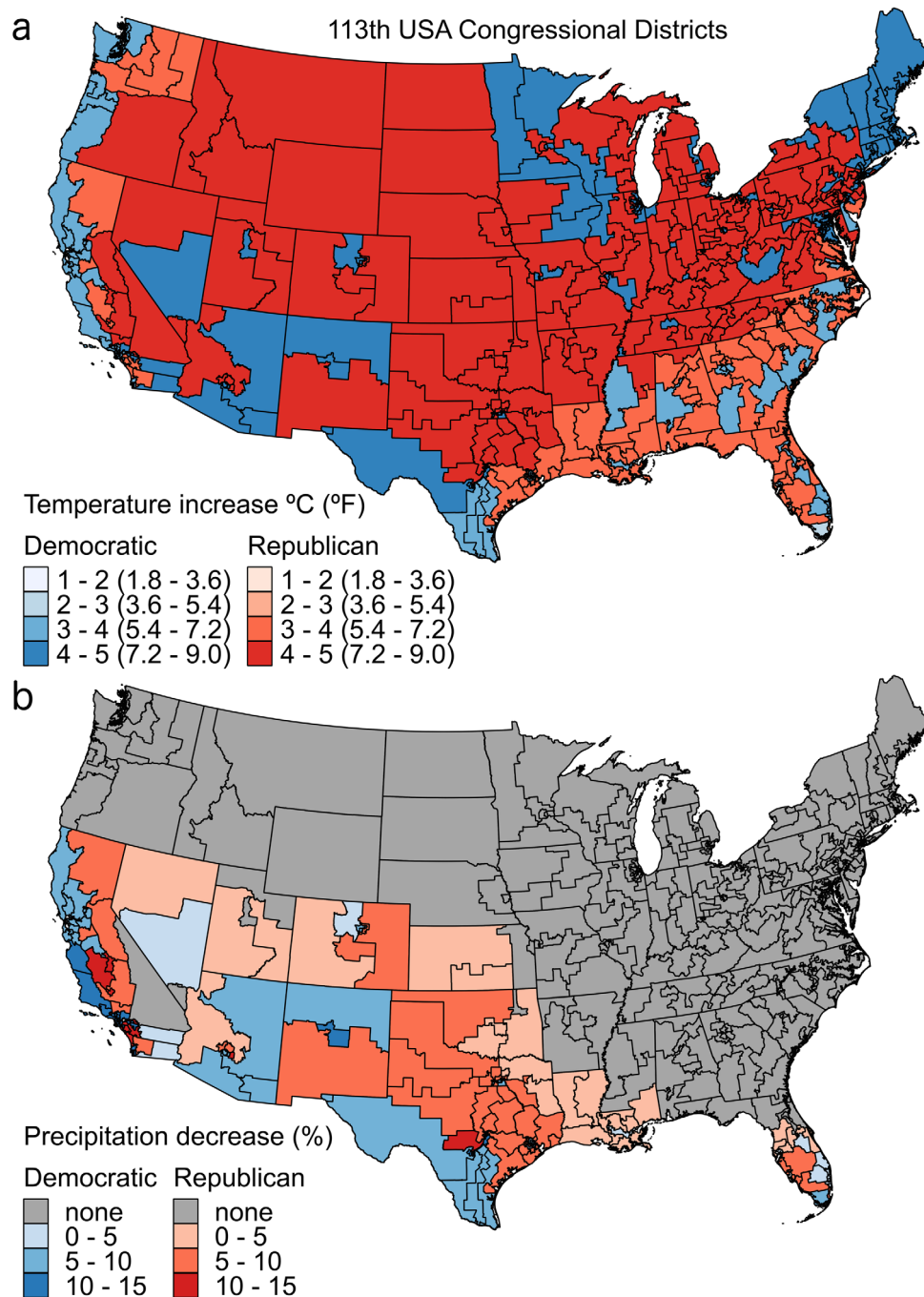


Fig. 1. The geographic interaction of political representation, land cover, and projected temperature and precipitation changes within the conterminous United States. The 113th U.S. congressional districts by party affiliation and (a) projected mean annual temperature increase and (b) projected annual precipitation decrease. The Republican Party represents a large land base and specific congressional districts and geographical regions (e.g., the Midwest, Great Plains, Southwest) are projected to have significant departures. Note that darker colors (both blue and red) represent greater temperature increases and precipitation decreases. All projections used an ensemble, high emissions (A2), end of century scenario; see Appendix for results from additional models.

Table 1. Five congressional districts with the most agricultural and natural resource land area and their projected climate departures.

Congressional district	Representation	Size (million ha)	Temperature increase† (°C (°F))	Precipitation change† (%)
Agriculture				
North Dakota 01	Republican	10.12	4.5 (8.1)	13
South Dakota 01	Republican	7.27	4.5 (8.1)	10
Kansas 01	Republican	7.16	4.7 (8.4)	−3
Montana 01	Republican	6.11	4.2 (7.5)	8
Minnesota 07	Democratic	5.77	4.6 (8.2)	13
Natural Resource				
Montana 01	Republican	30.91	4.2 (7.5)	8
Wyoming 01	Republican	23.96	4.5 (8.1)	3
New Mexico 02	Republican	17.89	4.6 (8.2)	−8
Oregon 02	Republican	16.20	4.0 (7.2)	3
Texas 23	Democratic	14.25	4.4 (7.9)	−8

† Ensemble average projection, high emissions scenario (A2), end of century.

than in all Democratic districts combined, regardless of their increase (Fig. 2a). Republican districts also represent more land with greater projected decreases in precipitation than Democratic districts (Fig. 2b). The apparent disconnect between climate vulnerability and the current political rhetoric is worrisome, as these lands and the economic sectors within them—agriculture and natural resources—are strongly linked to

climate, tying the realities of climate change to the livelihoods of many constituents. Furthermore, national and global food securities are at risk. In 2012, U.S. agricultural products were valued at \$444.3 billion (USD), with \$141.2 billion in exports of primarily soybean, corn, and unmilled wheat (USDA ERS 2013). Finding solutions to adapt to the difficulties caused by climate change will not only sustain these

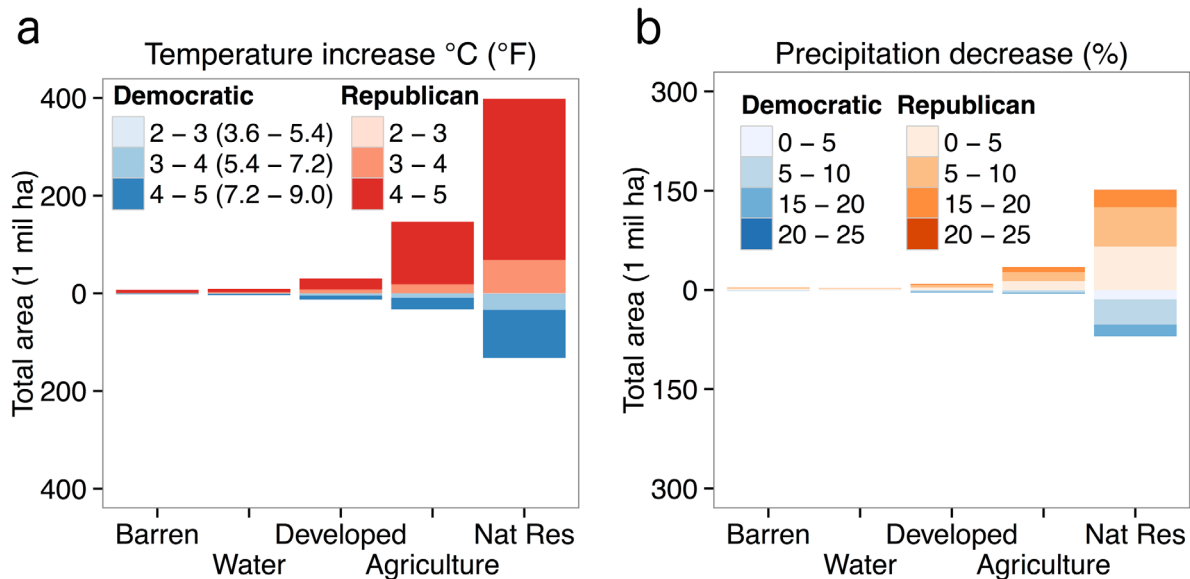


Fig. 2. Area of land cover categories within the conterminous United States separated by party representation, (a) projected temperature increase, and (b) projected precipitation decrease. The Republican Party represents the vast majority of agricultural and natural resources lands and many of these lands have significant climate departures. Note that darker colors (both blue and red) represent greater temperature increases and precipitation decreases. All projections used an ensemble, high emissions (A2), end of century scenario; see Appendix for results from additional models.

important economic sectors, but may also actively engage the political parties and constituencies that will be most affected in those regions.

THE DIFFICULTY MOVING FORWARD

This interaction of climate change, land cover, and political representation highlights that the regions and economic sectors predicted to be the most affected by climate change have political leadership that is presently more likely to resist policies to mitigate or adapt. While the consequences of not acting have been reported repeatedly by natural scientists, the political divide still exists. Why? It is clear that this divide, as well as any potential solution to bridge it, is rooted in the cultural, political, and social values found on both sides.

Numerous explanations have been put forward to explain the polarization, including: the role of media, political organization of industry interests, psychological responses to existential threats, and social organizations of belief systems (list from Moser and Berzonsky 2014). Guber (2013) suggests that polarization over climate change is due to party sorting that occurs as “people acquire information and become familiar with elite cues.” Furthermore, it is when elites disagree that “polarization occurs, and citizens rely on other indicators, such as political party or source credibility, to make up their minds” (McDonald 2009, Brulle et al. 2012). Because of this, initiatives that focus on increased awareness or information are unlikely to succeed (Guber 2013). Outreach efforts that aim to generate concern and advance policy by providing scientific information can ultimately be ineffective or even lead to increased opposition (e.g., Lee 2012, North Carolina General Assembly 2012). Many efforts have also attempted both general and formal education to advance political action, but that too may be ineffective. While concern for climate change increases with education and knowledge for Democratic Party members, it in fact decreases with education among those of the Republican Party (Malka et al. 2009, Hamilton 2011). Furthermore, some states with majority Republican representation have introduced legislation to restrict the teaching of climate change in public classrooms (Kansas Legislature 2013, Oklahoma Legislature 2013).

As climate change is viewed as a socio-political issue, there are always requests for transdisciplinary and transformative approaches that build upon the interdisciplinary infrastructure of academic institutions to find solutions for climate mitigation and adaptation, as well as for advancing policy. One common call is for greater integration of the social and natural sciences as an essential step toward bridging the political divide and advancing policy, as well as the entire challenge of global environmental change (ISSC 2011). Unfortunately, this integration is often in the form of social scientists being asked to help solve problems, as well as evaluate and promote solutions, outlined by the natural scientists towards the end of a project (Fox et al. 2006). This approach has “not served society well,” resulting in the need for “a deeper, more meaningful and constructive form of collaboration” between social and natural scientists (Hackmann and Clair 2012).

The traditional research–outreach model surrounding agriculture and natural resources also faces similar challenges for disseminating scientific information on climate change. This has historically focused on research carried out by land-grant universities and dissemination provided by the cooperative extension service. Yet individuals within these institutions often encounter difficulty addressing and communicating climate change due to their own attitudes and perceptions or the local political atmosphere (Monroe et al. 2014). There are also concerns of a mismatch between the relative importance of climate change in academic research compared to the dissemination of those research findings in strategic outreach programs. For example, while land-grant universities outline climate change as a priority for research, many of the same universities do not include climate change as part of their strategic plans in state or national outreach programs (e.g., APLU 2010a, 2010b) and many do not provide any outreach materials specifically extending climate change research. It may therefore be necessary to reevaluate how interdisciplinary research and scientific outreach are pursued within university systems, in an effort to more effectively address the multiple layers of complexity surrounding the climate change topic.

DEEPER ENGAGEMENT, UNDERSTANDING, AND DIALOGUE

The task of overcoming the partisan divide surrounding climate change is complex and challenging. Science and outreach efforts looking for success via mass communication are unlikely to have an impact; education opportunities can be ineffective or restricted; interdisciplinary research is a step in the right direction, but in general has not been implemented appropriately to yield effective results. So what will work? The answer is not straightforward, and we do not attempt to provide a one-size-fits-all solution, but echo the calls of others: that deeper social engagement, deeper cultural understanding, and perhaps most importantly true dialogue—dialogue which does not debate or tear apart, but instead shares ideas, experiences, and concerns in order to build relationships based on understanding—are all necessary to improve our conversations about climate change and provide real opportunities for adaptation and mitigation (Moser and Berzonsky 2014). For those working with agriculturalists and natural resource managers (e.g., researchers, cooperative extension agents, etc.), a deeper understanding of the intended audience and potential insensitivities, the willingness to change communications efforts (e.g., terminology, conversations, etc.), and the ability to maintain relationships of trust will be necessary to build true dialogue and address climate change issues. The interaction presented here, namely that the majority of our agricultural and natural resources lands—lands upon which millions of people depend and from which they benefit through provided ecosystem services—have significant predicted climate departures and representation that downplays climate change and government intervention, not only adds complexity to the polarization issue, but raises additional concerns about the impact polarization will have on ecosystem services throughout the United States.

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SUPPLEMENTAL MATERIAL

APPENDIX

Mappings of the 113th congressional districts were downloaded from nationalatlas.gov on June 25, 2013. We updated manually the representation for the following districts: Illinois, District 02: Rep Robin Kelly, Democratic; Missouri, District 08: Rep Jason Smith, Republican; South Carolina, District 01: Rep Mark Sanford, Republican.

We downloaded climate models from climatewizard.org (Girvetz et al. 2009). We used models that represent high emissions scenarios (A2) for end of century (2070–2099). Downloaded datasets represent mean annual temperature increase and precipitation change at a 12-km resolution for 2070–2099 as compared to 1961–1990. We randomly chose five models to include in the analysis (Table A1). We also included an ensemble model that is an average of all models available from climatewizard.org. Models only

include the lower 48 states, thus excluding some congressional districts. We spatially intersected congressional districts with projected values and averaged results to obtain one value per district.

Land cover characteristics were determined from the National Land Cover Database 2006 (NLCD; Fry et al. 2011). Due to the size of the NLCD, we reduced the resolution from 30 m to 240 m using the nearest neighbor resampling method. We recognize the limitations of such resampling method, but justify its use to reduce complexity and speed up spatial analysis. We spatially intersected the NLCD with congressional districts and climate models to determine political representation and projected annual temperature increase. We reclassified land cover categories to their most general level: water, developed, barren, natural resources, and agriculture (planted/cultivated). Forest, shrubland, herbaceous, and wetlands were reclassified as natural resources.

Table A1. List of climate models used.†

Model	Source
GFDL-CM2.1	US Department of Commerce/NOAA/Geophysical Fluid Dynamics Laboratory
GISS-ER	NASA/Goddard Institute for Space Studies
INM-CM3.0	Institute for Numerical Mathematics
PCM	National Center for Atmospheric Research
UKMO-HadCM3	Hadley Centre for Climate Prediction and Research/Met Office
Ensemble average	climatewizard.org

† Retrieved June 25, 2013 from climatewizard.org

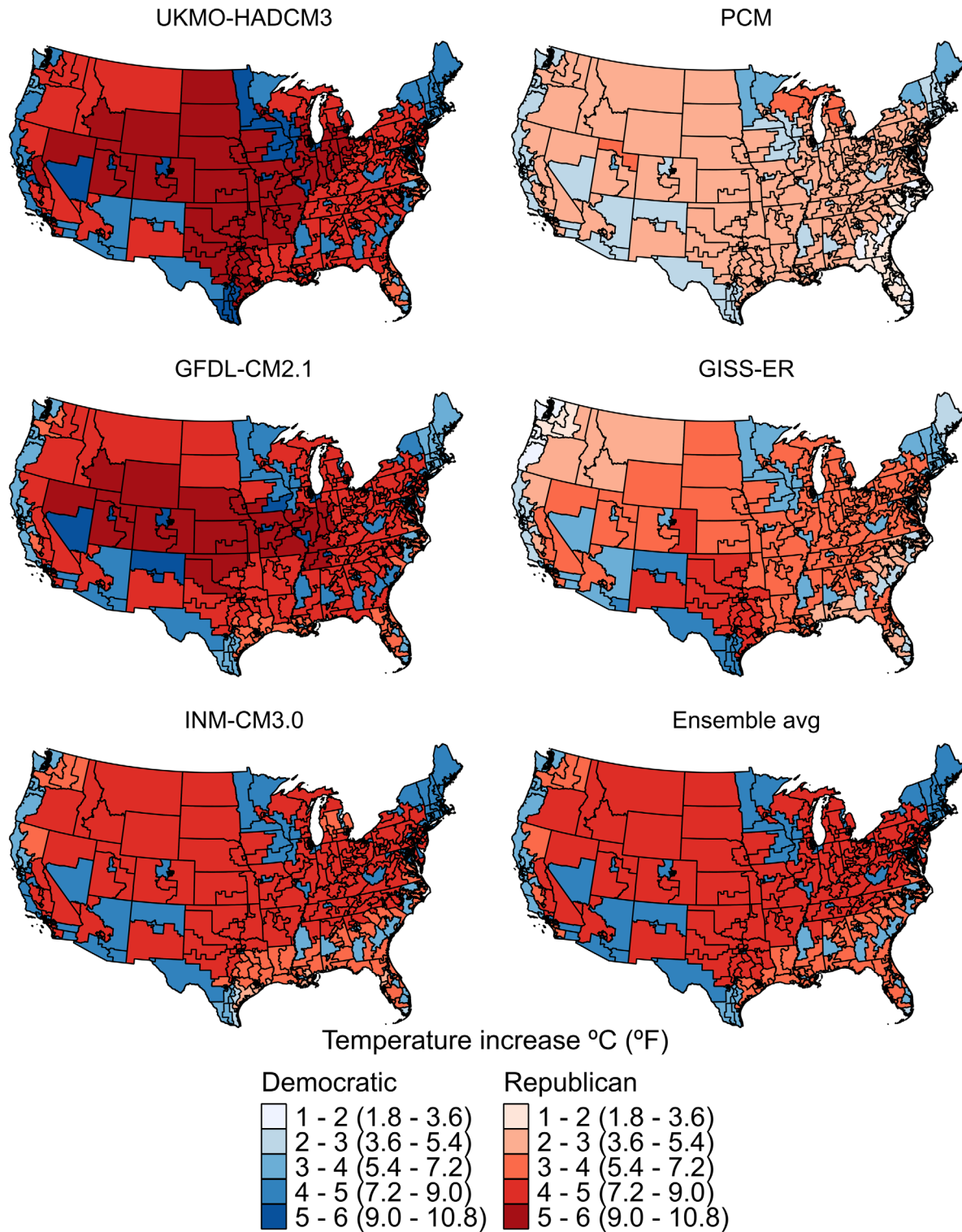


Fig. A1. Maps of 113th conterminous U.S. congressional districts by party affiliation and projected mean annual temperature increase for six climate models.

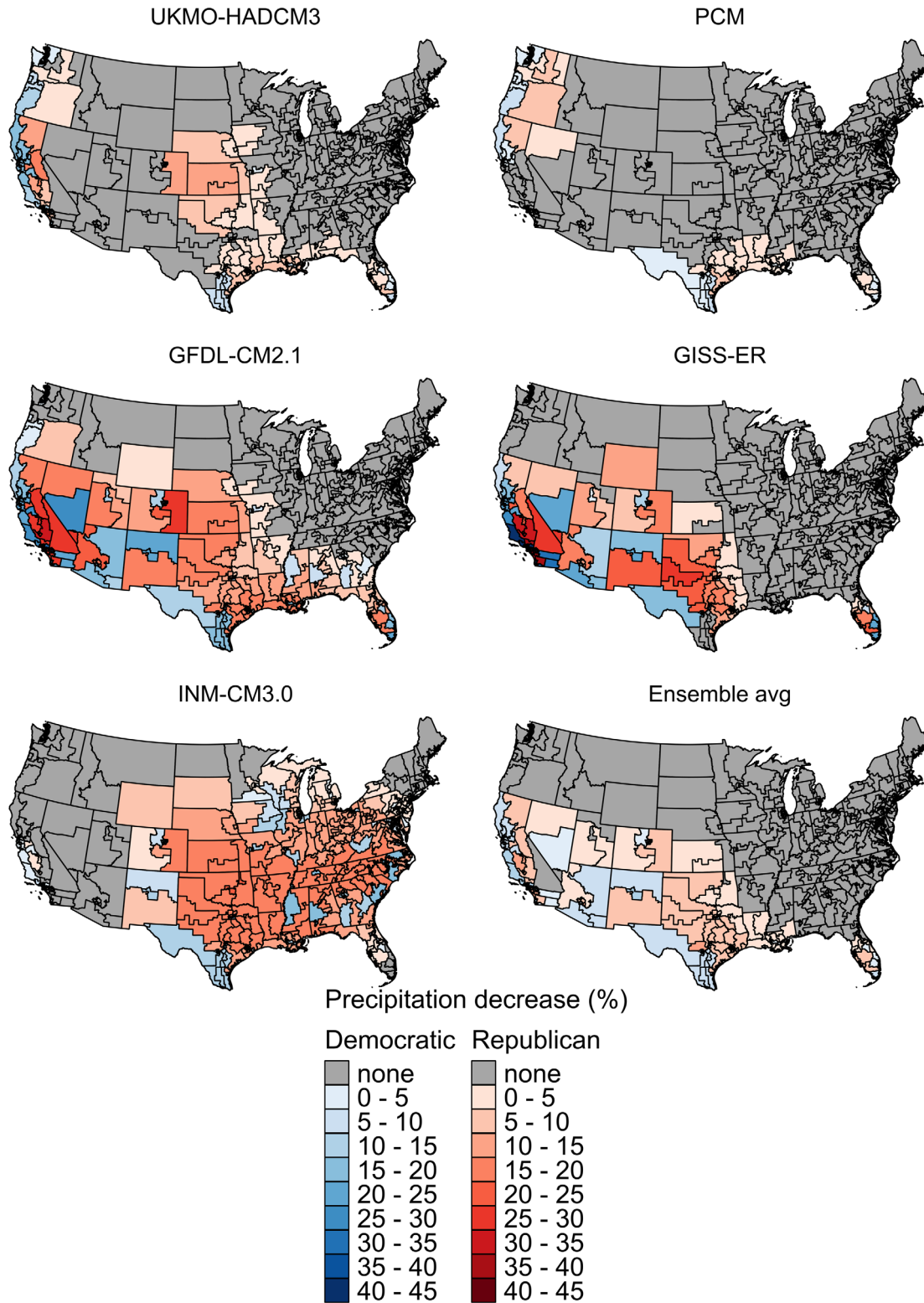


Fig. A2. Maps of 113th conterminous U.S. congressional districts by party affiliation and projected precipitation decrease for six climate models.

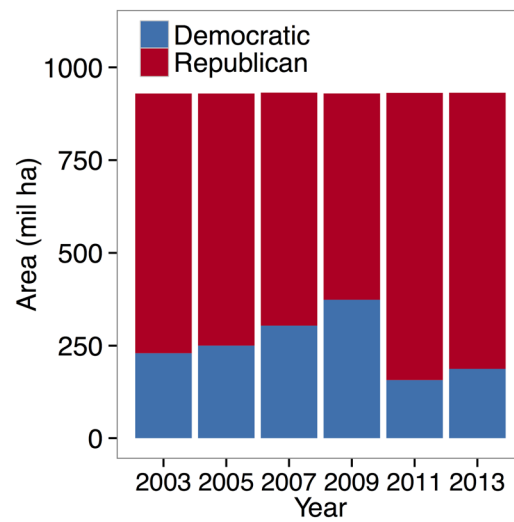


Fig. A3. Cumulative area of U.S. congressional districts from 2003–2013, separated by party representation.

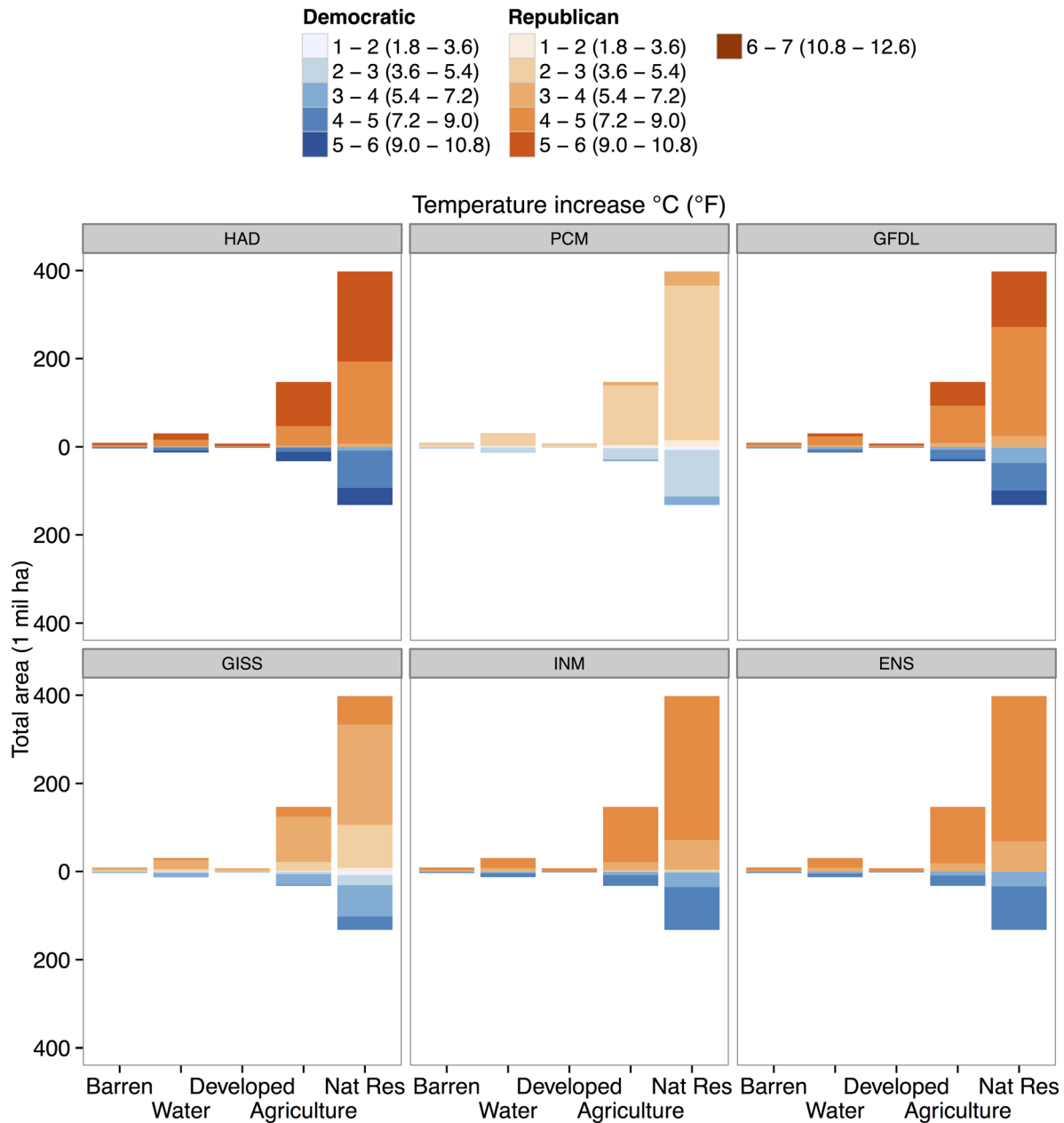


Fig. A4. Area of land cover categories in the conterminous United States relative to temperature increase for each climate model, separated by party representation. Climate models include HAD = UKMO-HadCM3, PCM = PCM, GFDL = GFDL-CM2.1, GISS = GISS-ER, INM = INM-CM3.0, ENS = ensemble average; high emissions scenario (A2); end of century (2070–2099).

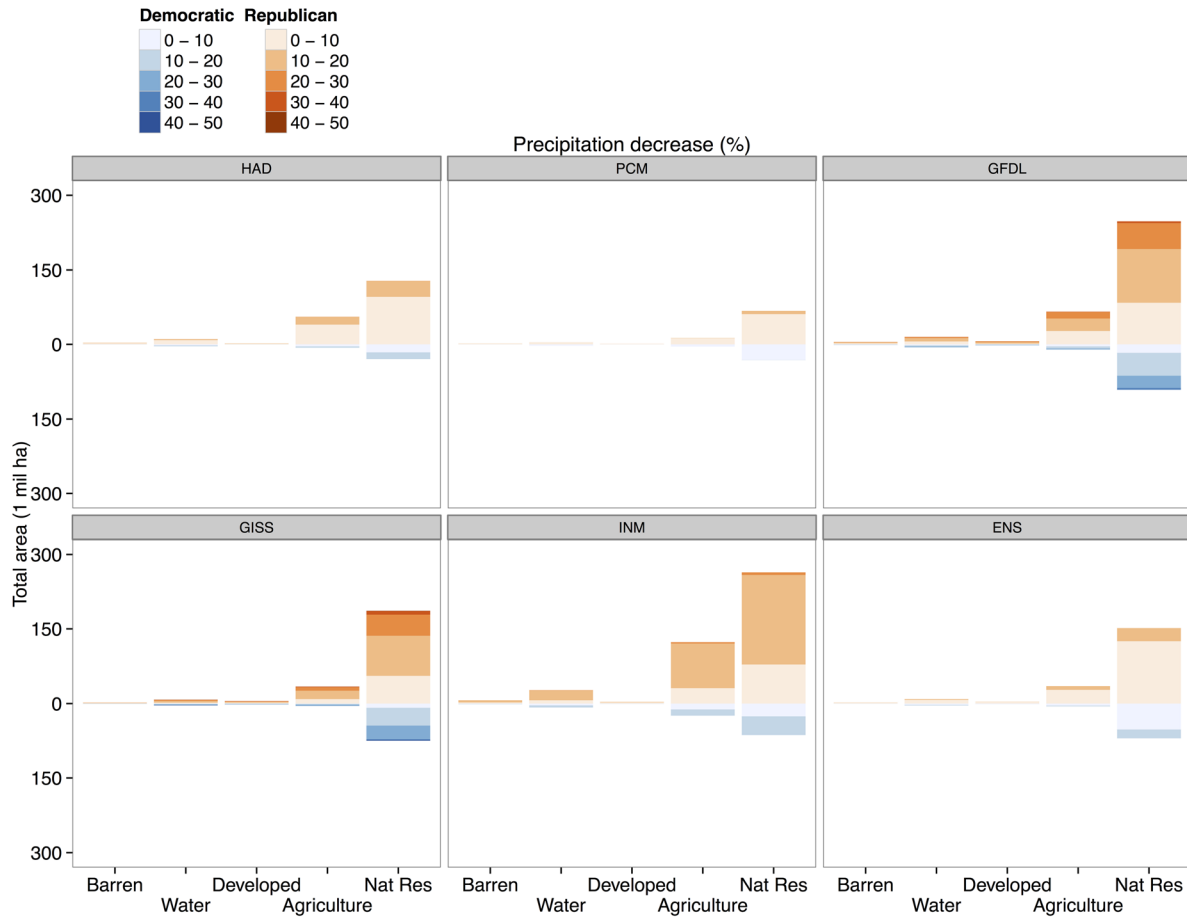


Fig. A5. Area of land cover categories in the conterminous United States relative to precipitation decrease for each climate model, separated by party representation. Climate models include HAD = UKMO-HadCM3, PCM = PCM, GFDL = GFDL-CM2.1, GISS = GISS-ER, INM = INM-CM3.0, ENS = ensemble average; high emissions scenario (A2); end of century (2070–2099).

SUPPLEMENT

Congressional districts and climate change projections (*Ecological Archives* <http://dx.doi.org/10.1890/ES14-00220.1.sm>).