

Climate change promotes declines in sagebrush ecological integrity



Martin Holdrege
Daniel Schlaepfer
Lief Wiechman
John Bradford



Kyle Palmquist



Bill Lauenroth

Yale

Kevin Doherty
John Tull



Tom Remington



Michele Crist



Megan Creutzberg



Chad Boyd



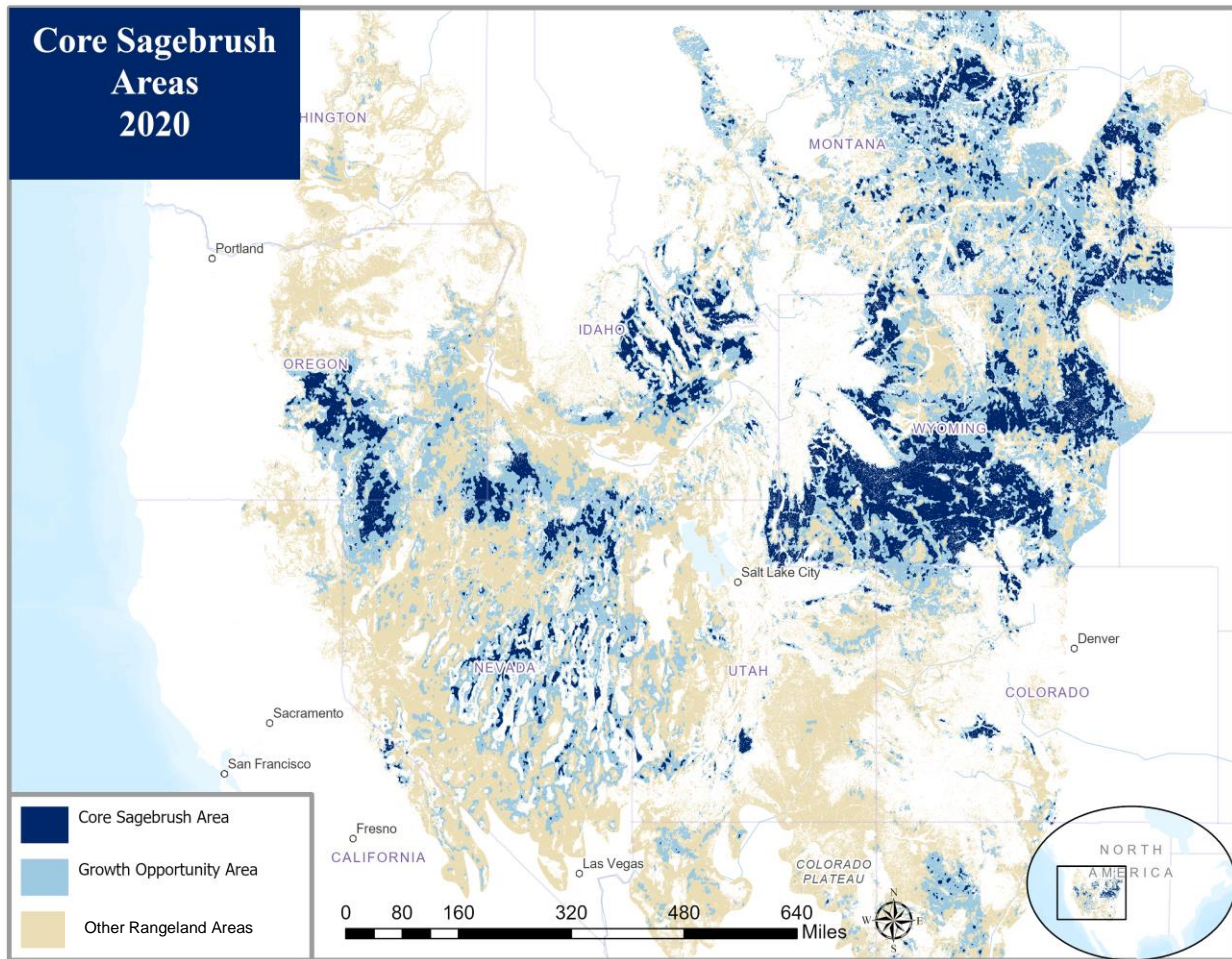
Support:



ECOSYSTEMS



Understanding the future of sagebrush rangelands in the context of climate change



- Current sagebrush ecological integrity is now well mapped
- It is critically important to understand the trajectories of these ecosystems with climate change
- Prioritize where to 'defend and grow the core'
- Inform climate adaptation decisions (e.g., RAD)

Research Questions

The background image is a landscape photograph of a sagebrush steppe. The foreground and middle ground are filled with dense, low-lying green shrubs. In the distance, a range of mountains is visible under a cloudy sky. The mountains have some snow or light-colored patches on their peaks. The overall scene is a natural, open landscape.

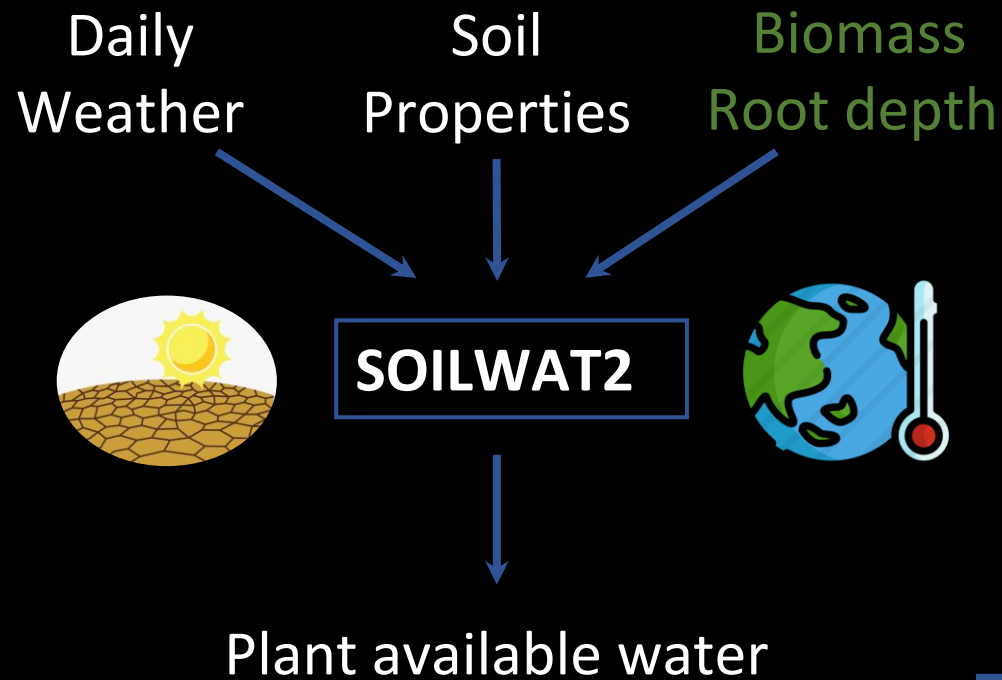
How will the abundance of sagebrush ecological integrity classes change in the future?

How consistent are these changes across future climate uncertainty?

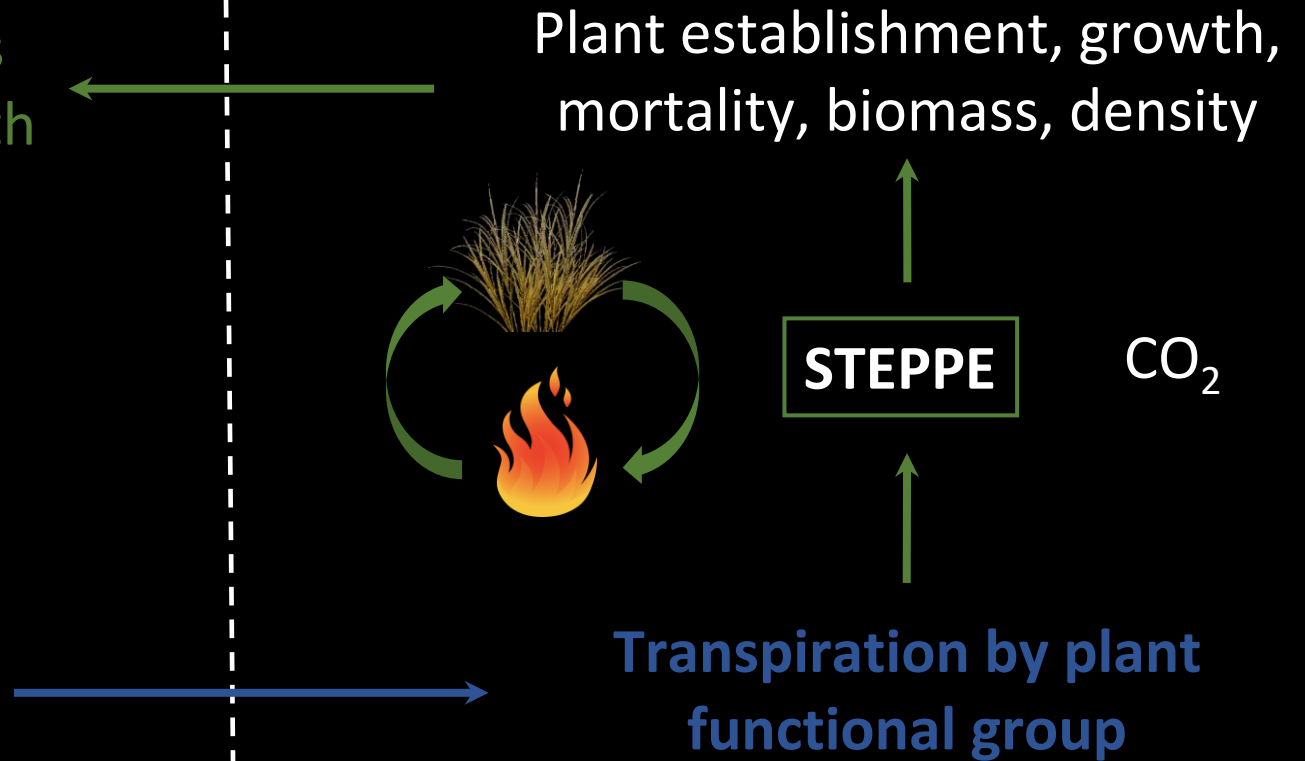
What plant functional types are driving shifts in ecological integrity, and what are the implications for managing wildfire and invasive annual grasses?

Modelling approach (STEPWAT2)

Water balance



Plant community

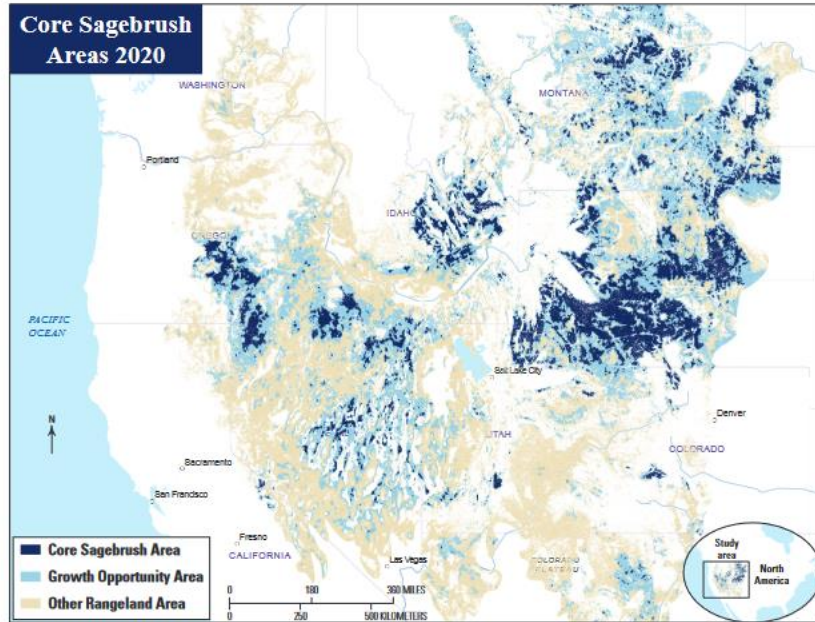


Sagebrush Ecological Integrity



Prepared in cooperation with the Western Association of Fish and Wildlife Agencies and the U.S. Fish and Wildlife Service

A Sagebrush Conservation Design to Proactively Restore America's Sagebrush Biome



Open-File Report 2022-1081

U.S. Department of the Interior
U.S. Geological Survey



*SEI ~ Sagebrush (+), Perennial grasses (+),
Annual grasses (-), Conifers (-), Human modification (-)*

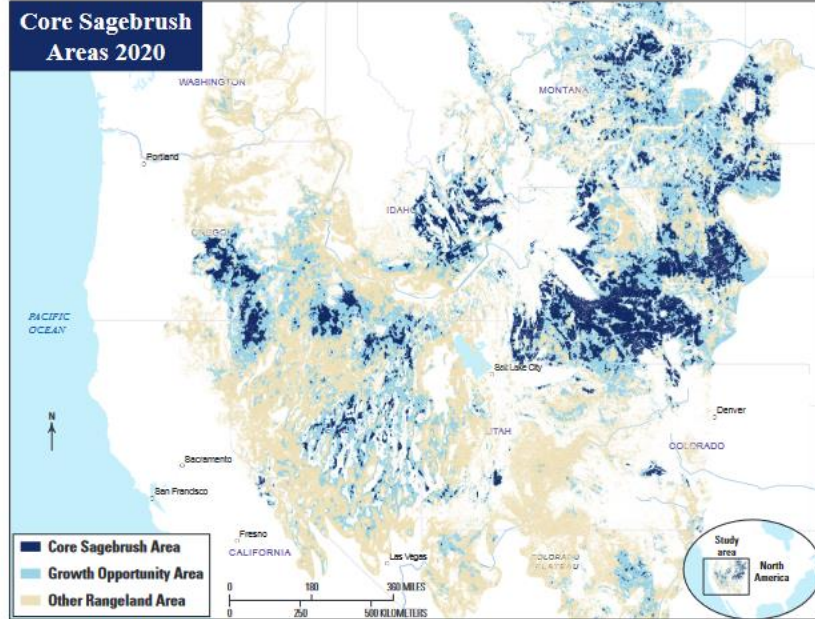


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(Δ = simulated change
in cover from STEPWAT2)



*Future SEI ~ Sagebrush * Δ (+), Perennial grasses * Δ (+),
Annual grasses * Δ (-), Conifers (-), Human modification (-)*



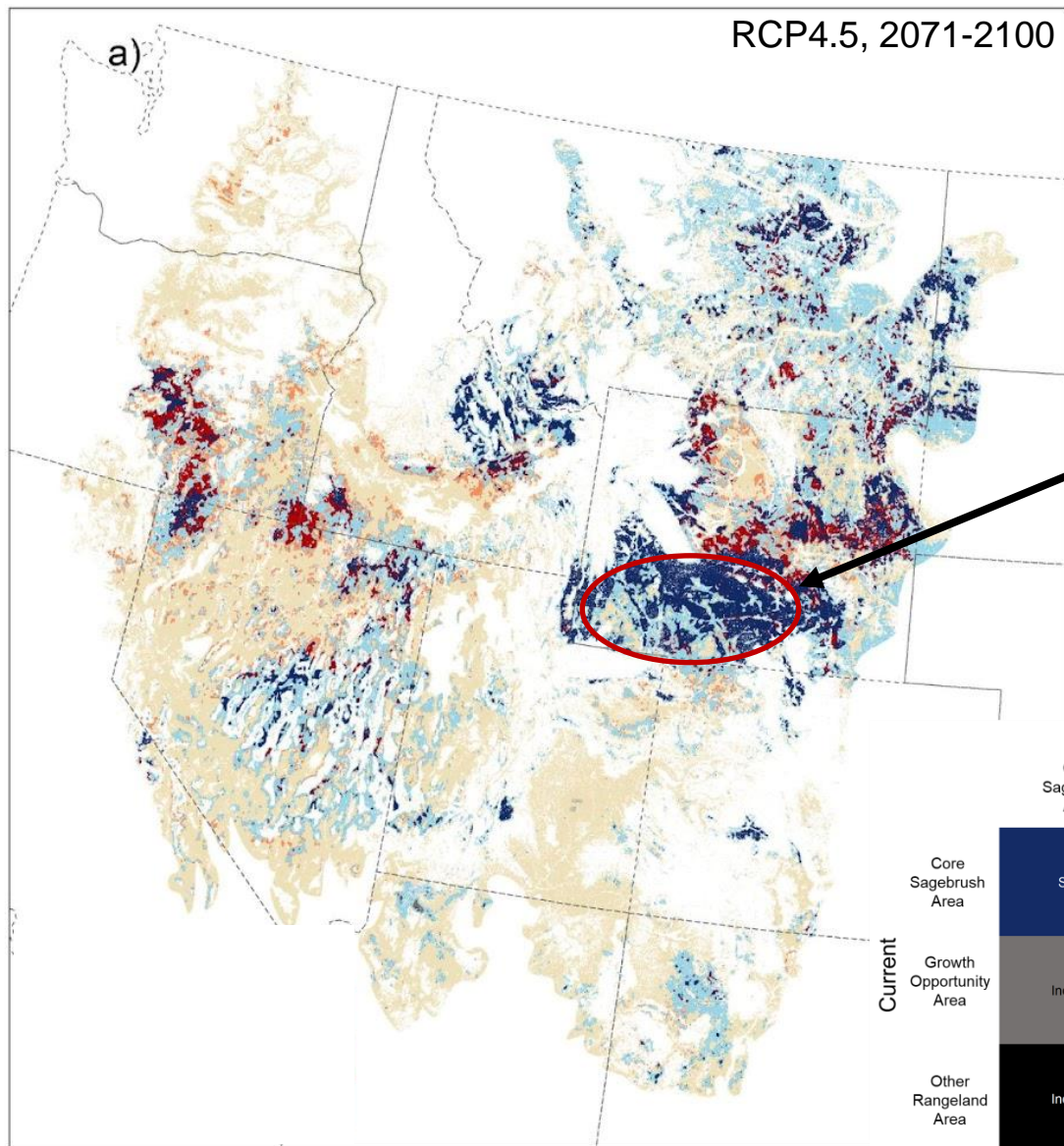
Results: Change in Classification

		Future		
		Core Sagebrush Area	Growth Opportunity Area	Other Rangeland Area
Current	Core Sagebrush Area	Stable	Decline	Decline
	Growth Opportunity Area	Increase	Stable	Decline
	Other Rangeland Area	Increase	Increase	Stable

Question 1: How will the abundance of sagebrush ecological integrity classes change in the future?



Results: Change in Classification



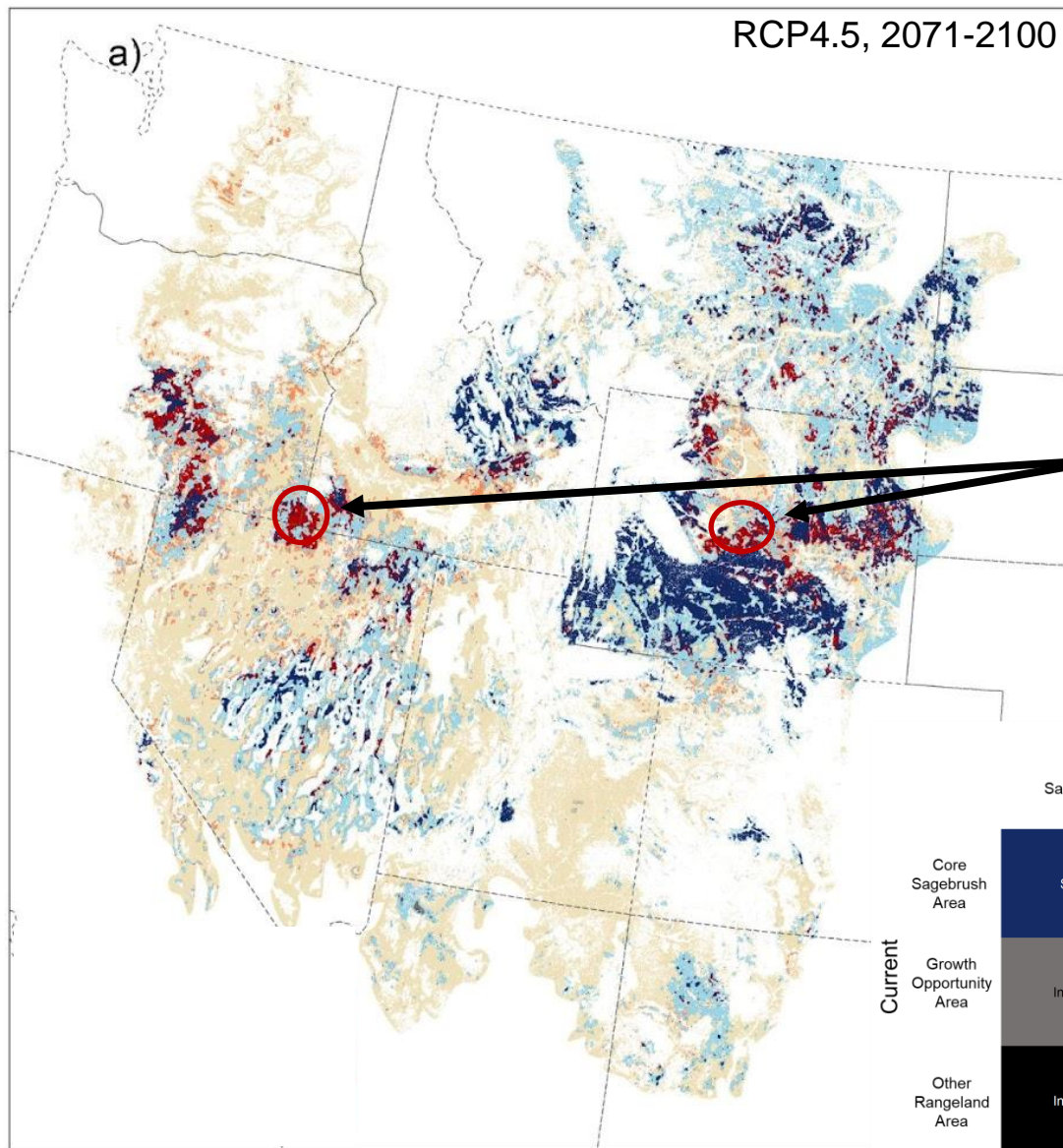
stable Core Sagebrush Area

Question 1: How will the abundance of sagebrush ecological integrity classes change in the future?

	Future		
	Core Sagebrush Area	Growth Opportunity Area	Other Rangeland Area
Core Sagebrush Area	Stable	Decline	Decline
Growth Opportunity Area	Increase	Stable	Decline
Other Rangeland Area	Increase	Increase	Stable



Results: Change in Classification

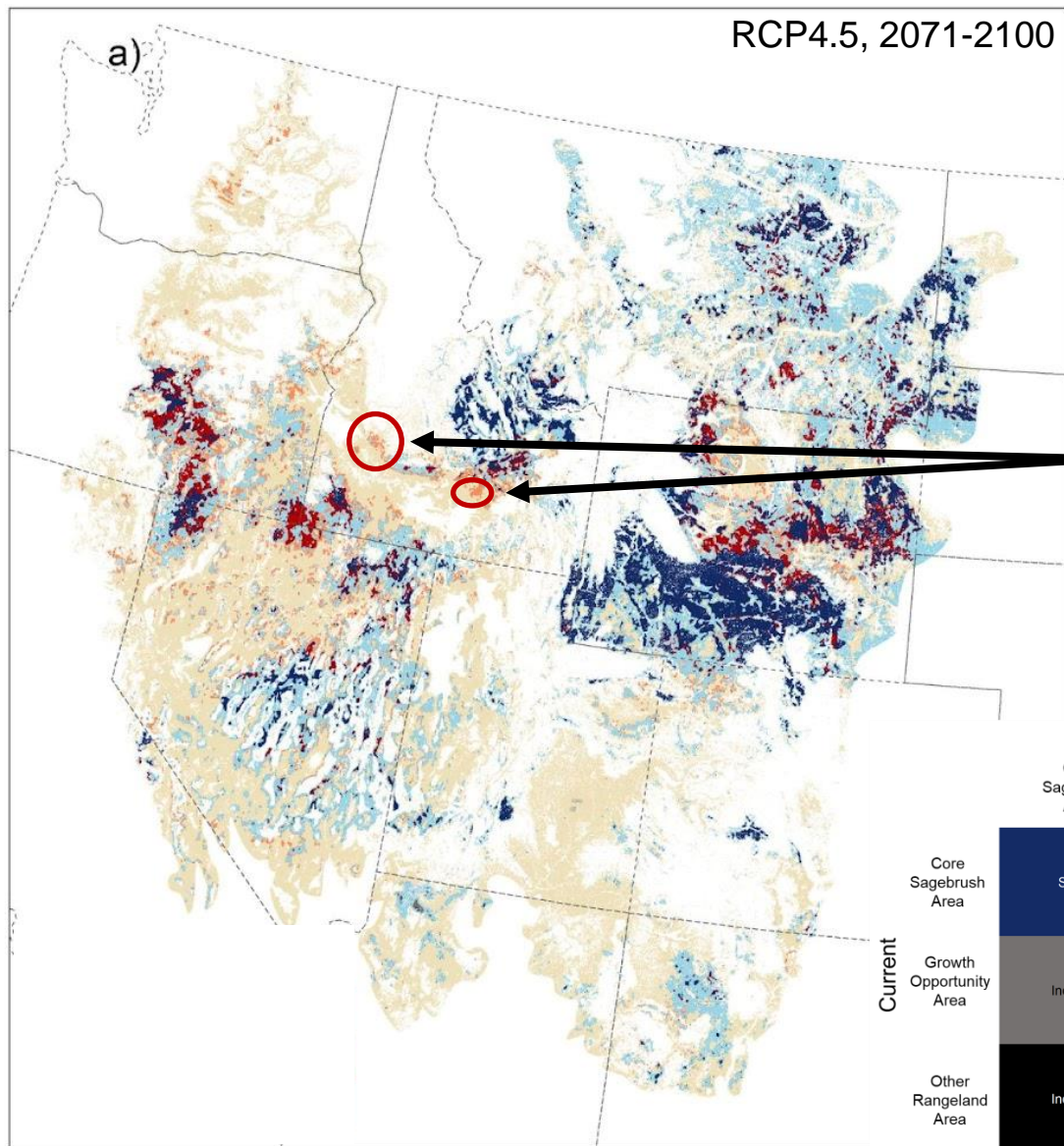


Question 1: How will the abundance of sagebrush ecological integrity classes change in the future?

	Core Sagebrush Area	Future Growth Opportunity Area	Other Rangeland Area
Core Sagebrush Area	Stable	Decline	Decline
Growth Opportunity Area	Increase	Stable	Decline
Other Rangeland Area	Increase	Increase	Stable



Results: Change in Classification



Growth
Opportunity Area
becomes Other
Rangeland Area

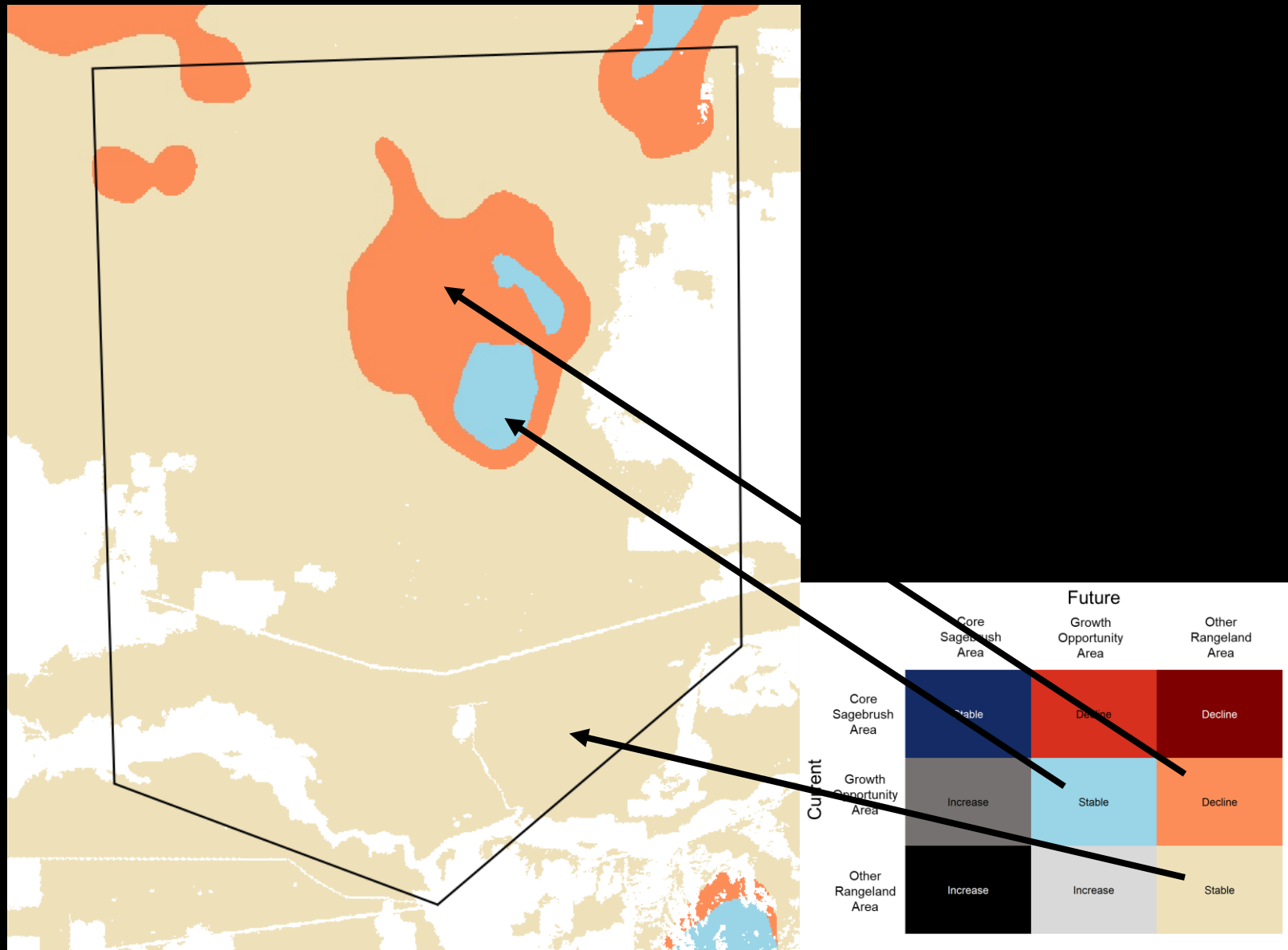
	Future		
	Core Sagebrush Area	Growth Opportunity Area	Other Rangeland Area
Core Sagebrush Area	Stable	Decline	Decline
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Question 1: How will the abundance of sagebrush ecological integrity classes change in the future?



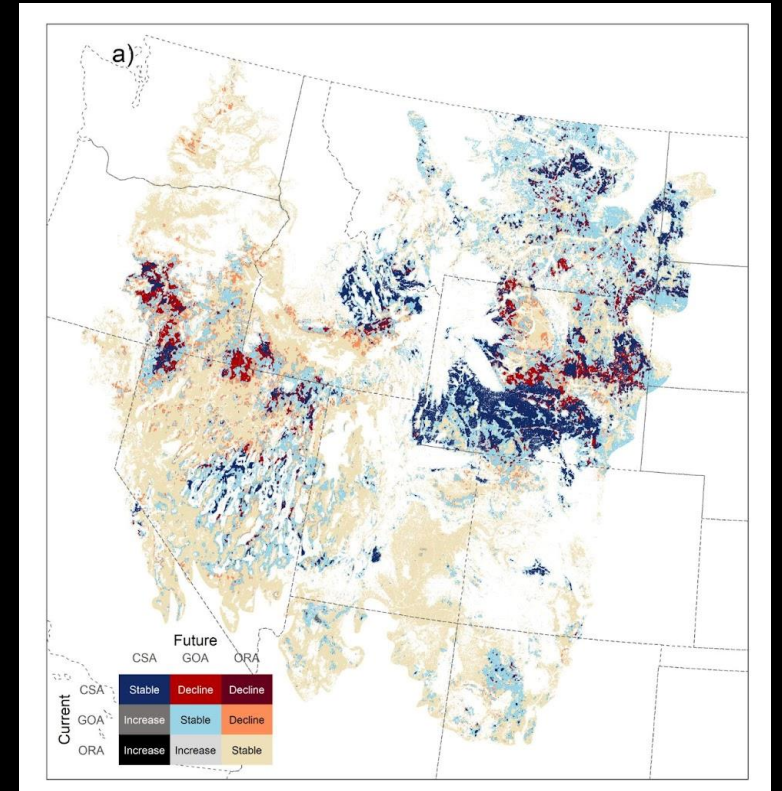
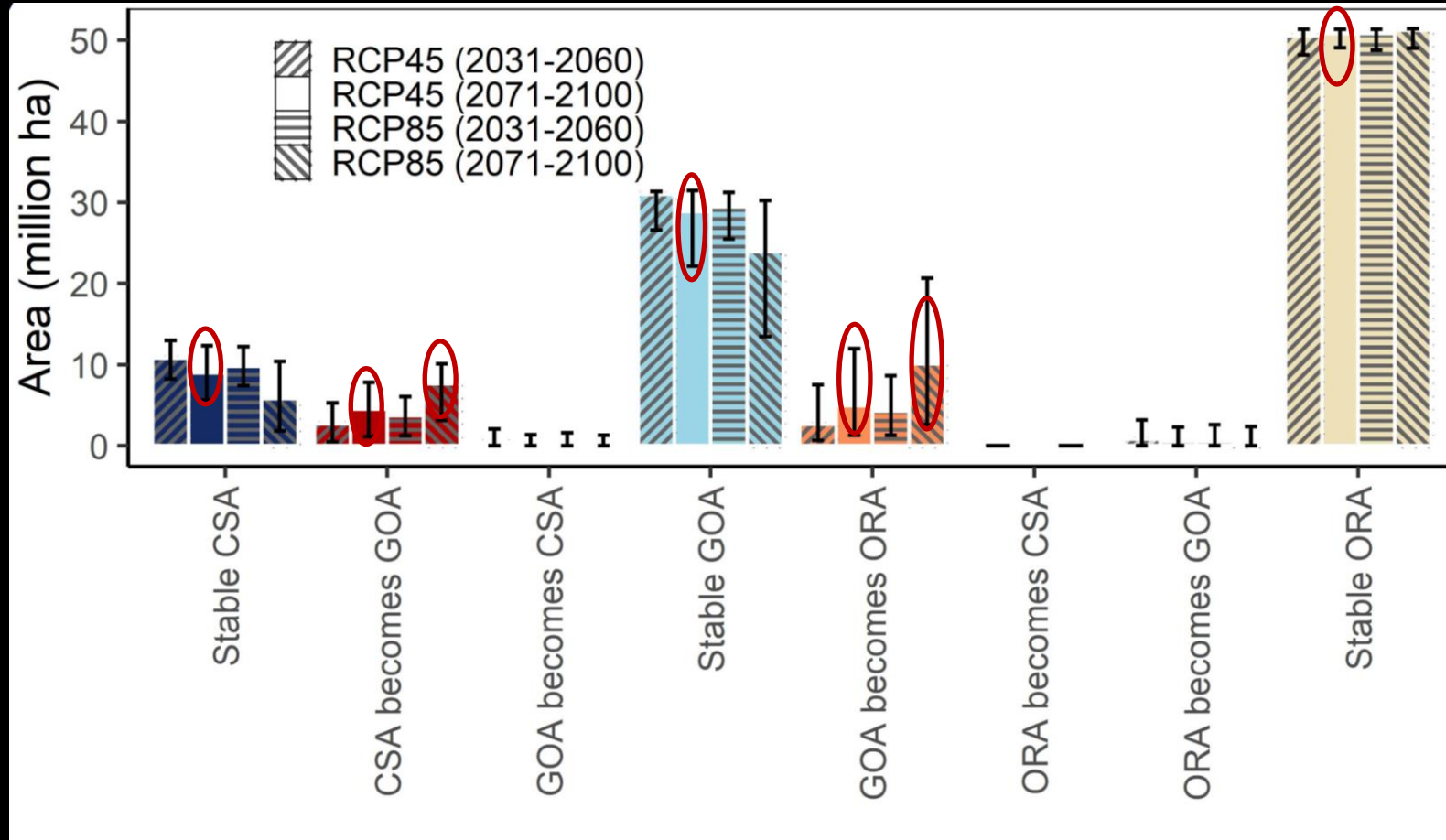
Results: Change in Classification

Question 1: How will the abundance of sagebrush ecological integrity classes change in the future?

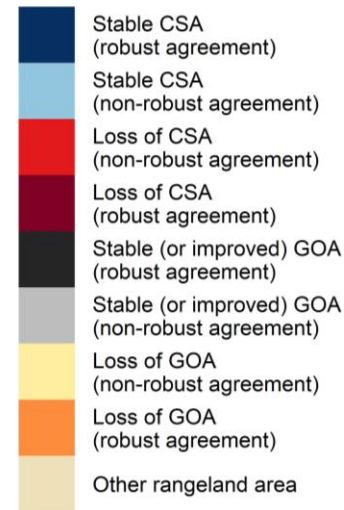
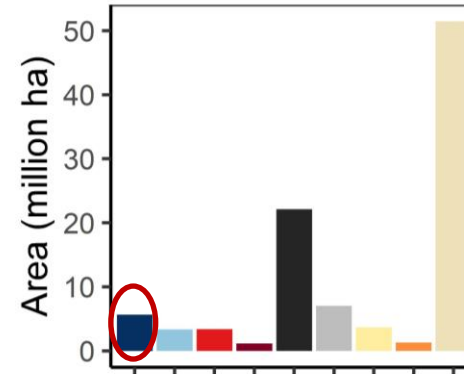
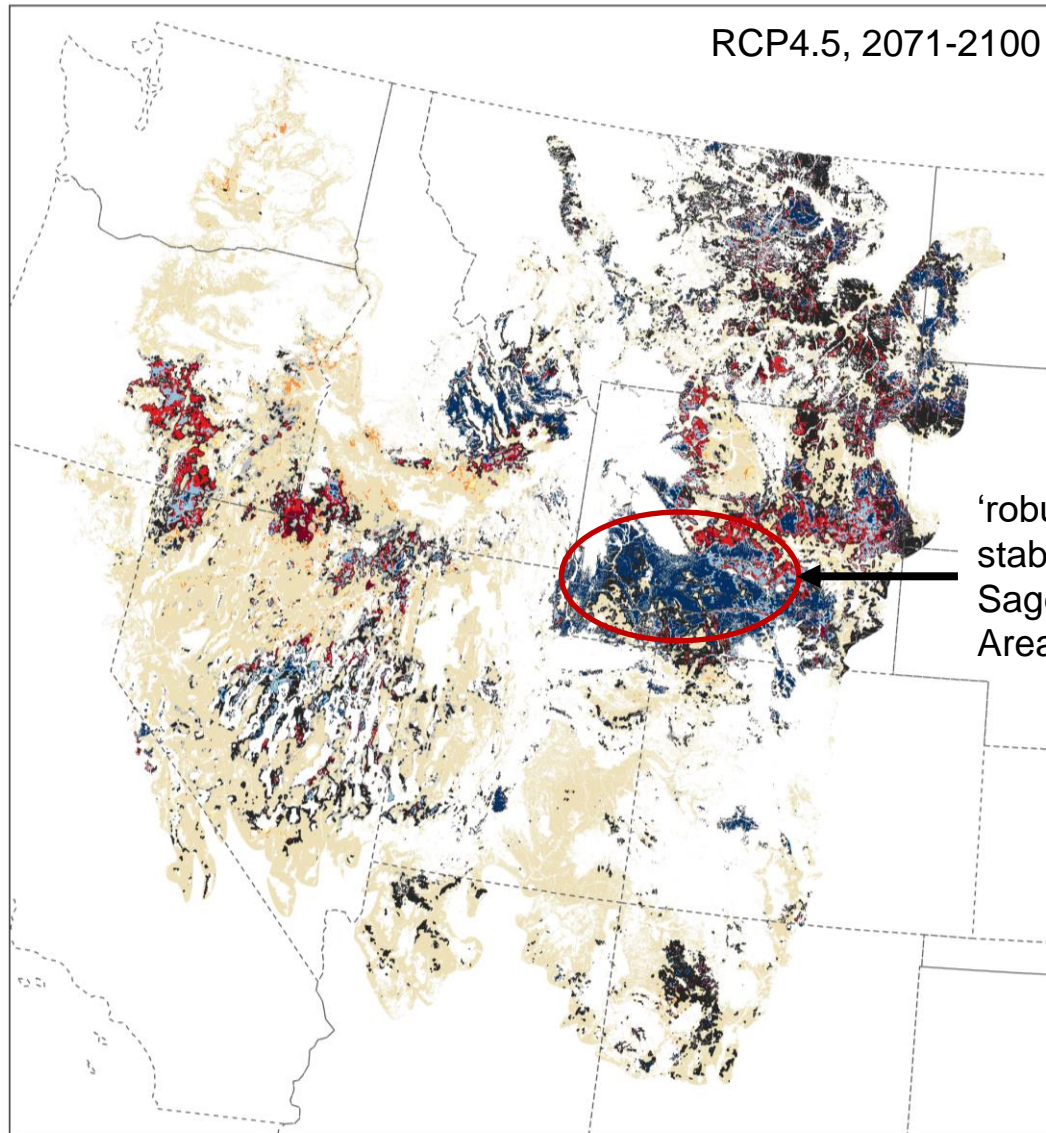


Results: Climate Uncertainty

Question 2: How consistent are these changes across climate scenarios?



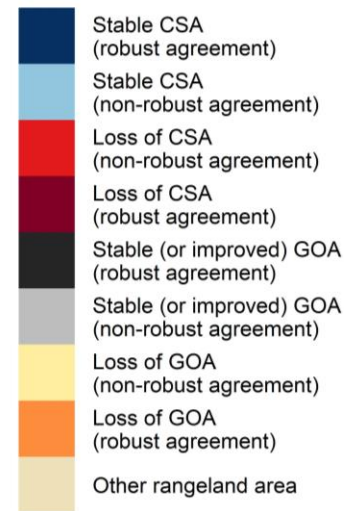
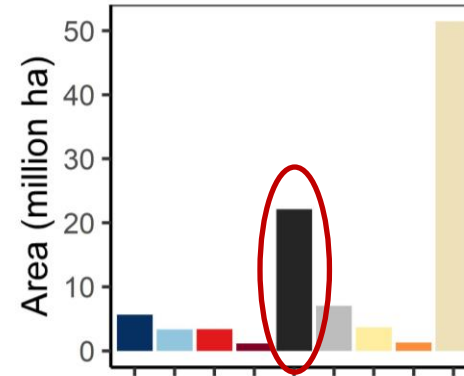
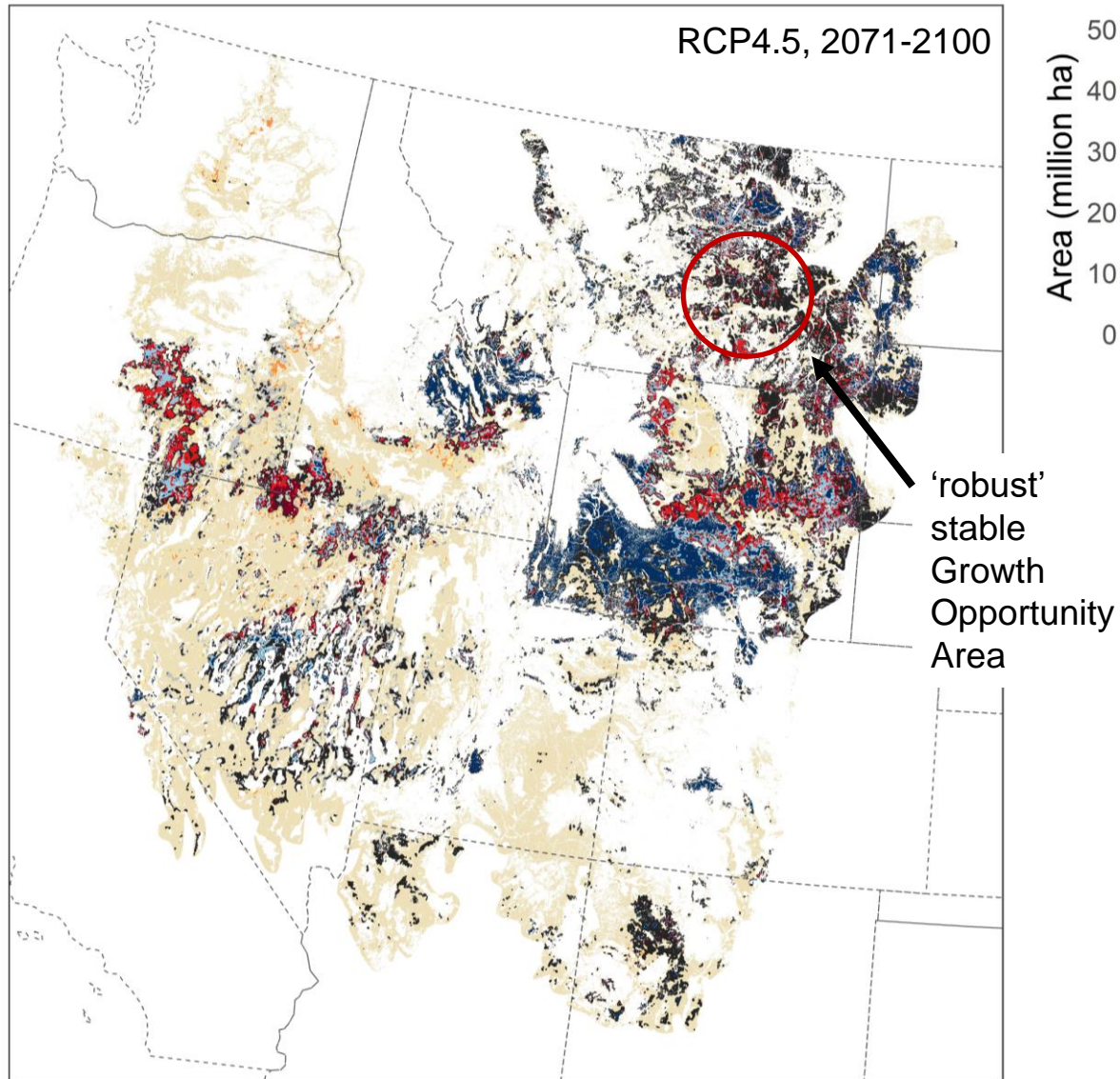
Results: Climate Uncertainty



Question 2: How consistent are these changes across climate scenarios?



Results: Climate Uncertainty

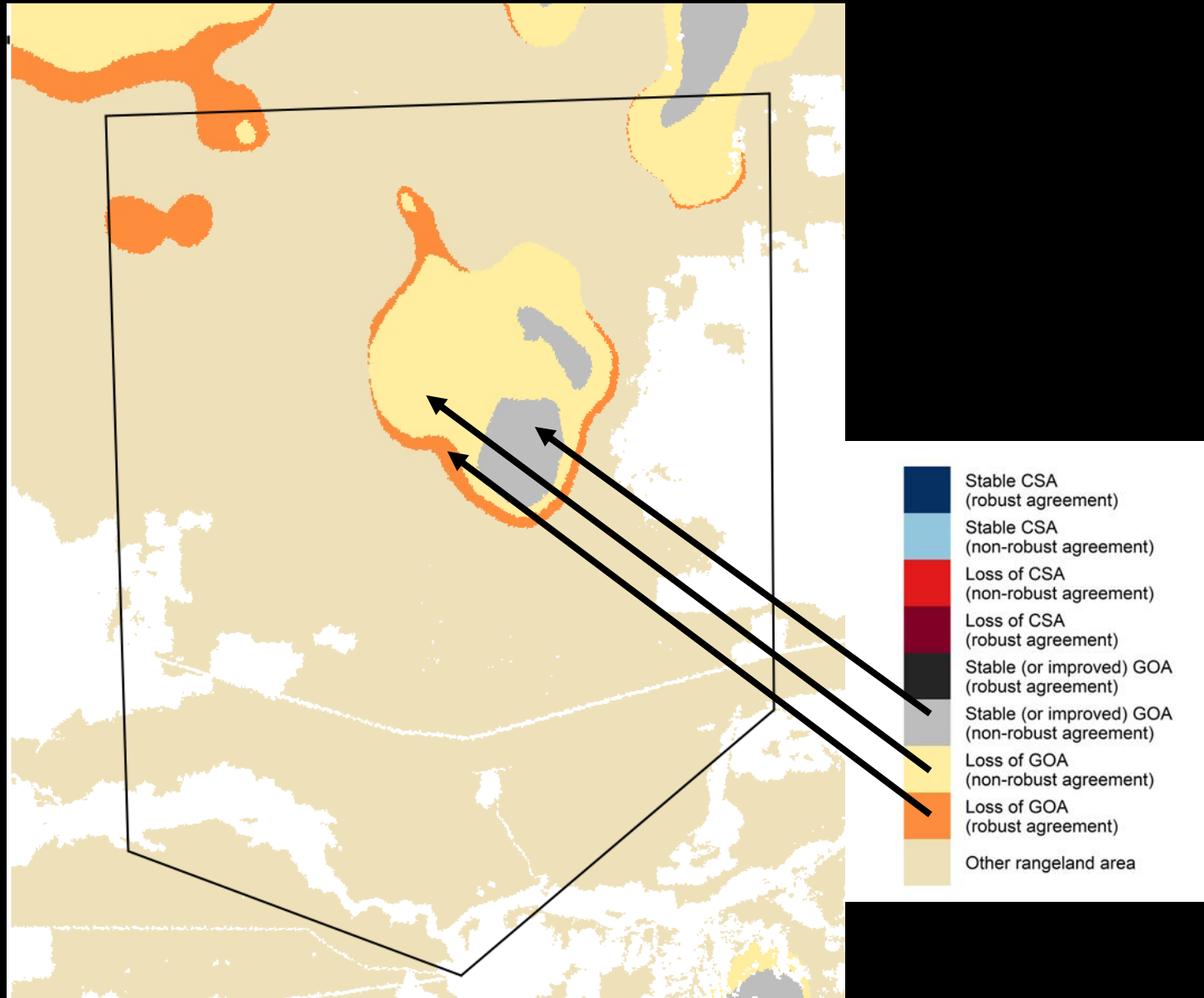


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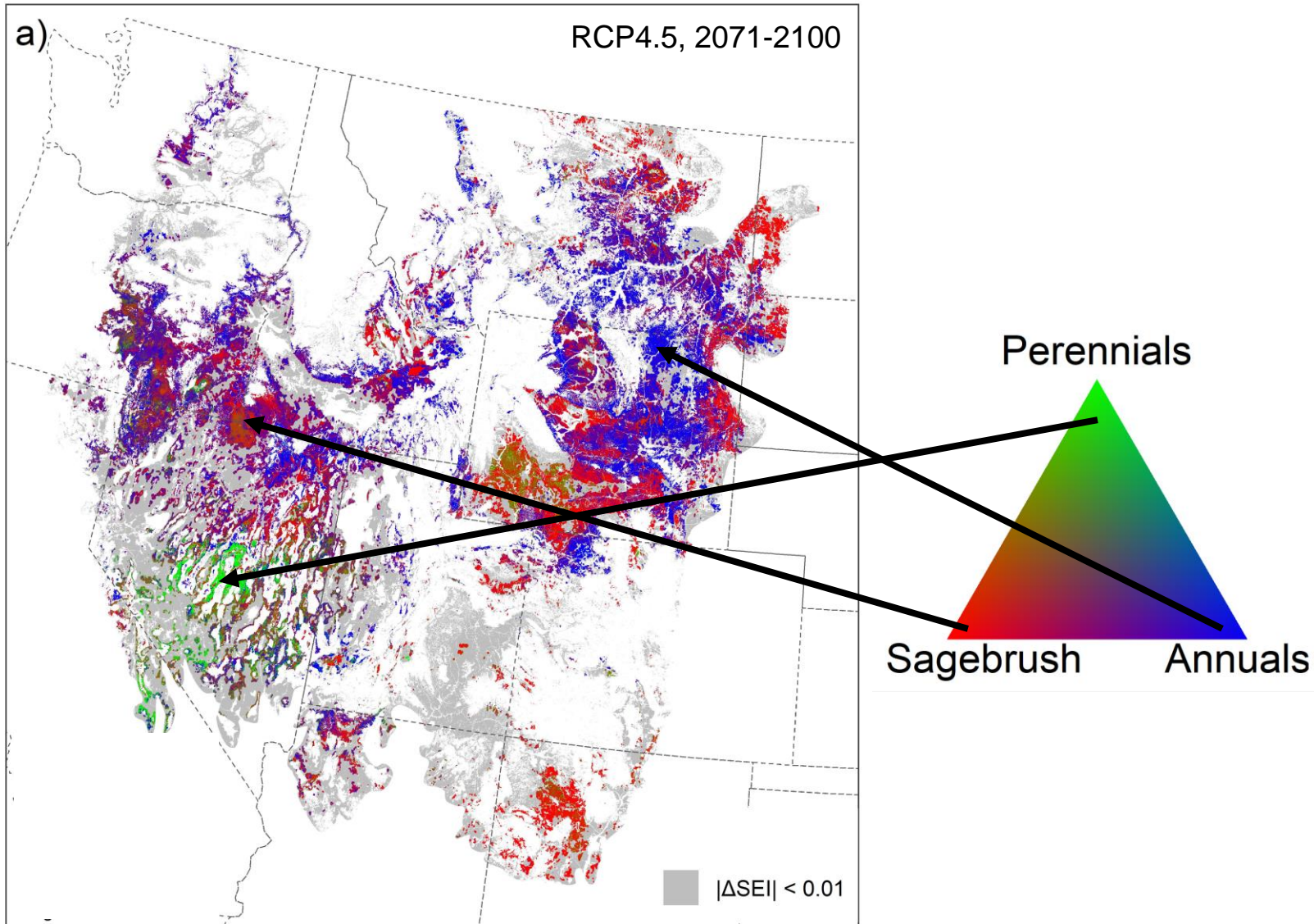


Results: Climate Uncertainty

Question 2: How consistent are these changes across climate scenarios?



Results: Drivers of change



Question 3: What plant functional types are driving shifts in sagebrush ecological integrity?

Loss of core driven by decreased sagebrush and/or increased annuals

Conclusions

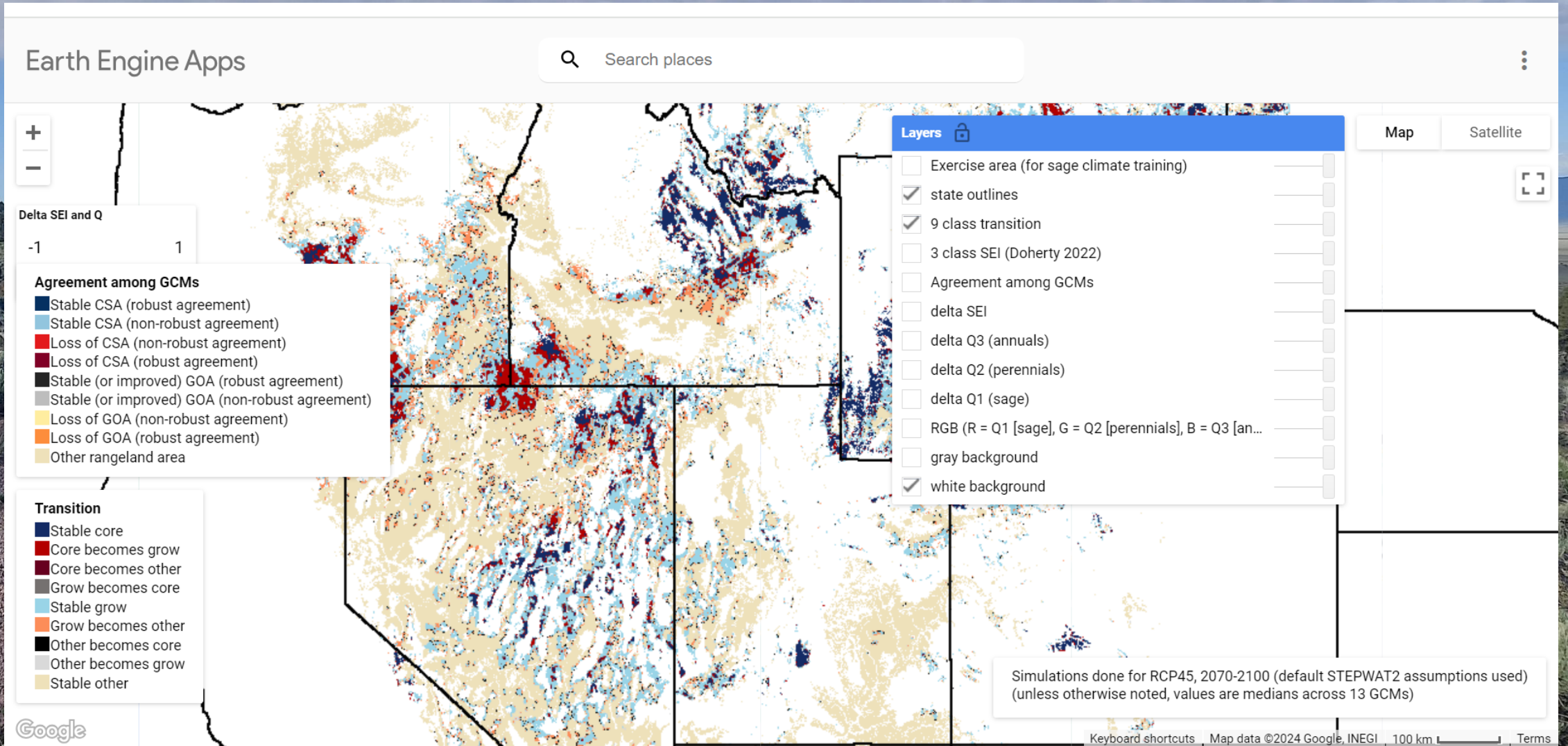
Climate change amplifies ongoing declines in sagebrush ecological integrity, and climate driven losses of core sagebrush areas are likely in some areas

Many core sagebrush areas are likely to remain climatically suitable

Prioritize 'defend and grow' strategies in core areas that are likely to remain climatically suitable. 'Accept' or 'direct' approaches may be necessary in areas of low ecological integrity where climatic suitability is projected to get worse

Data availability?

<https://bit.ly/3QOvolg>



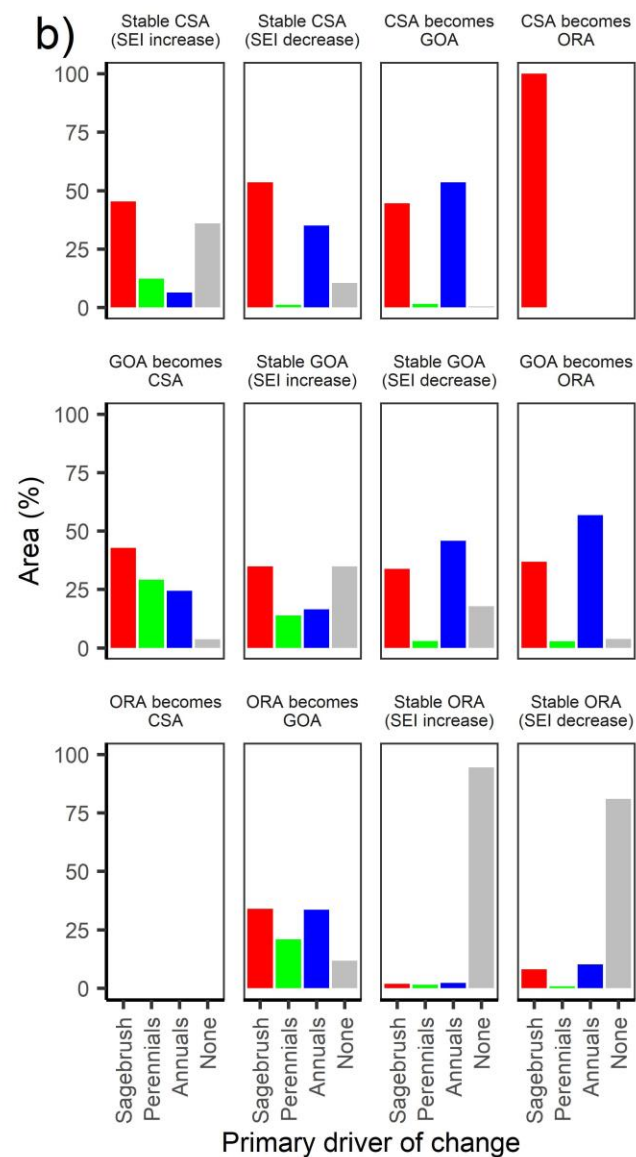
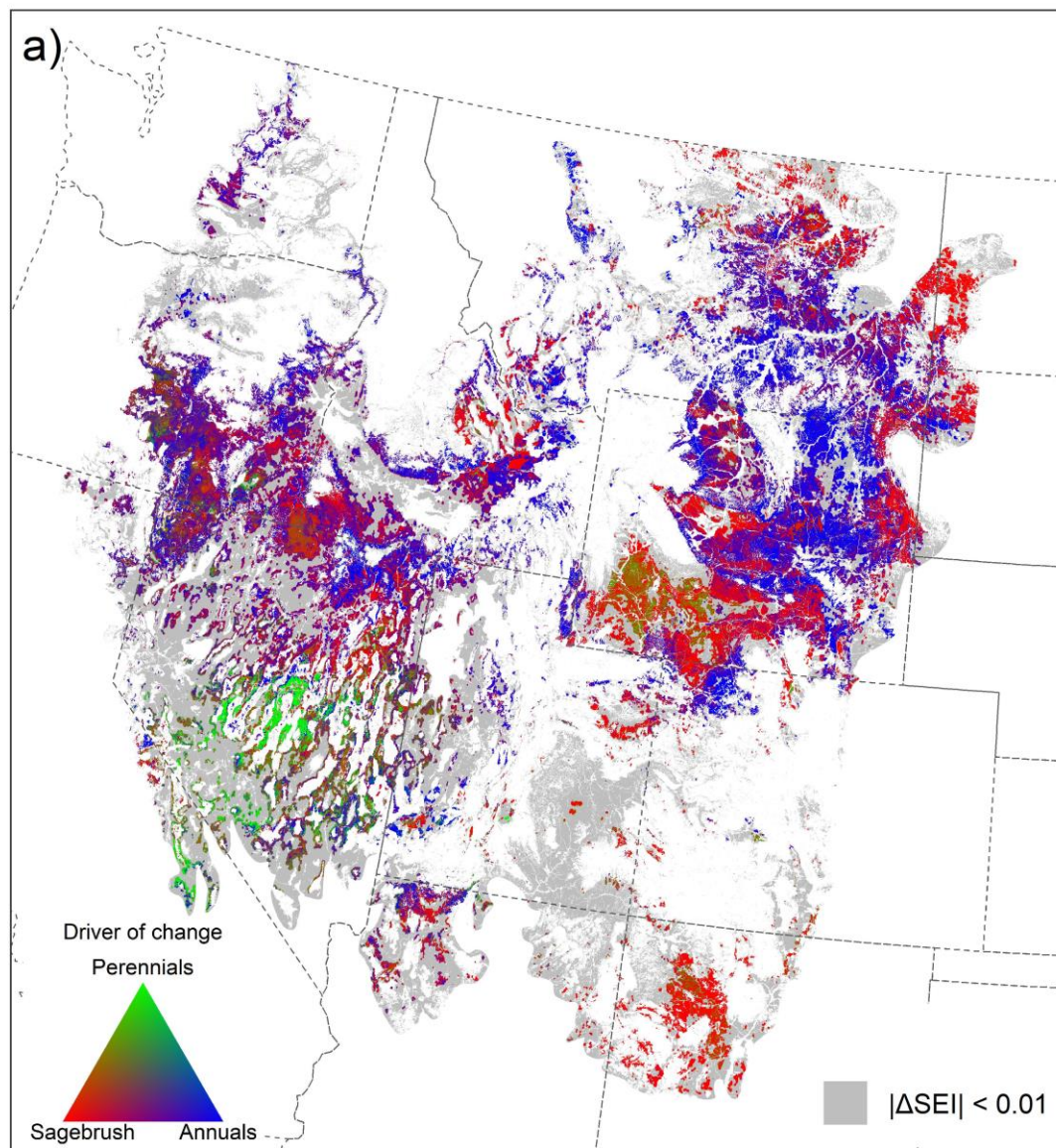
Questions?

mholdrege@usgs.gov

Data availability

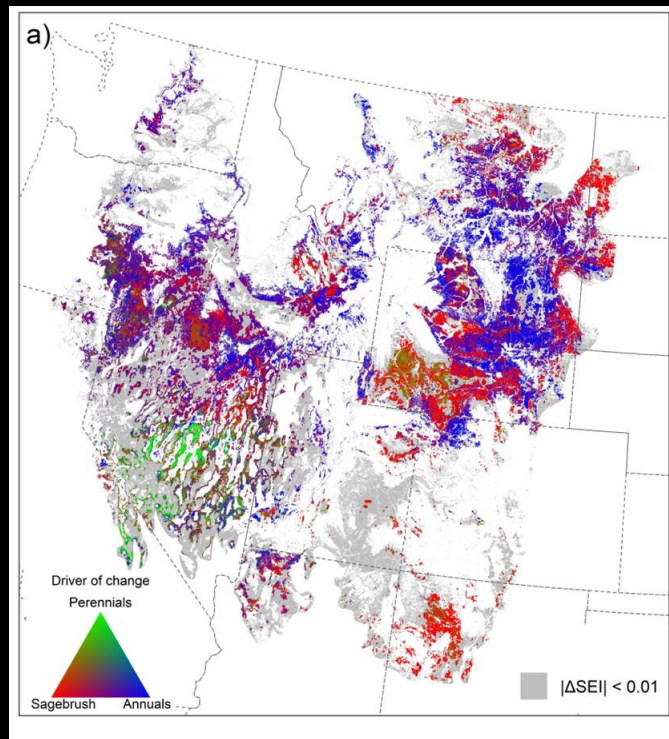
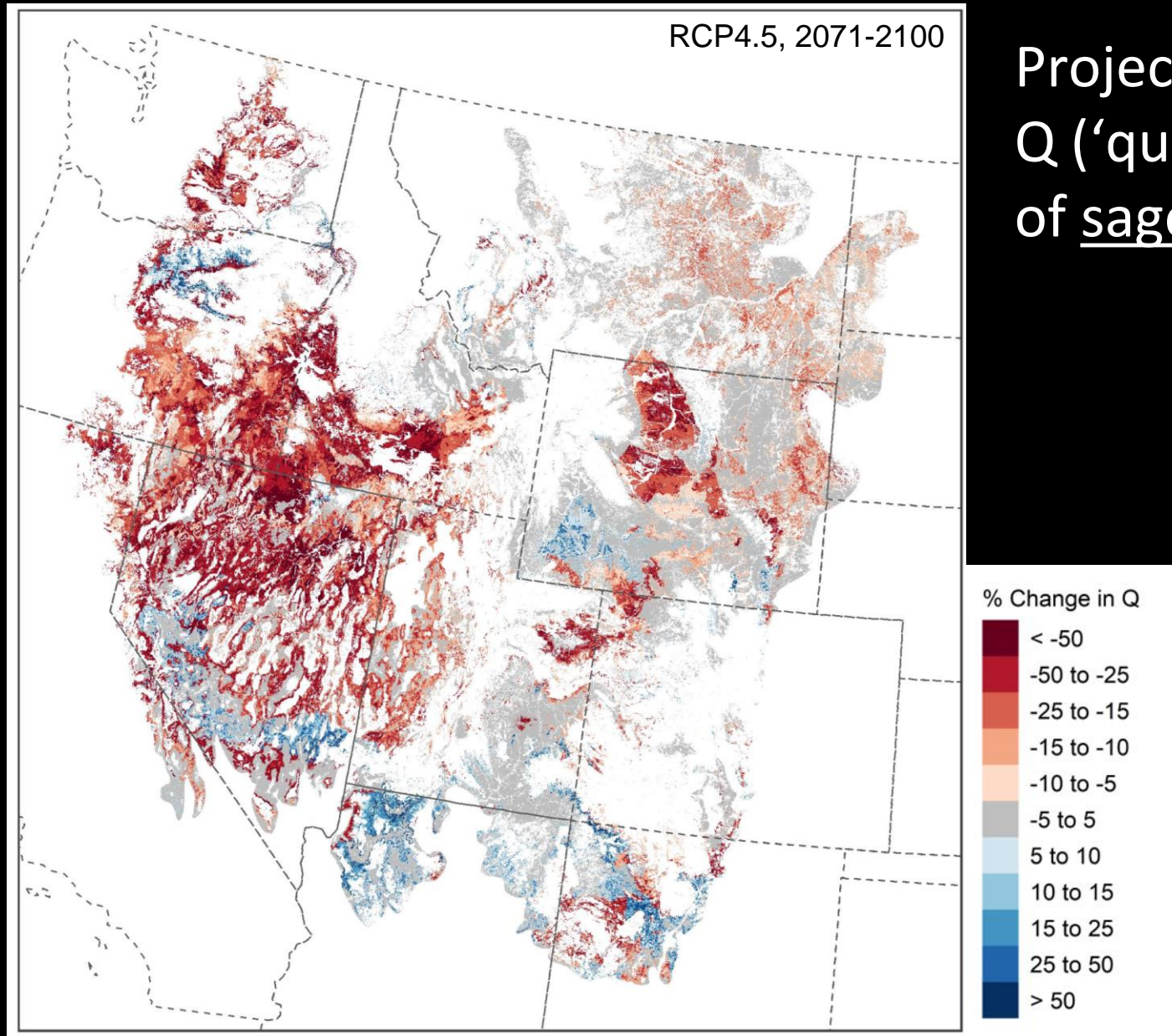
- Data layers will be published on science base
- Key layers will be made available on the on the FWS Sagebrush Geospatial Layer Visualizations site
- For this training data can be viewed here: <https://bit.ly/3QOvolg>
(<https://ee-martinholdrege.projects.earthengine.app/view/sage-climate-training>)

Results: Drivers of change



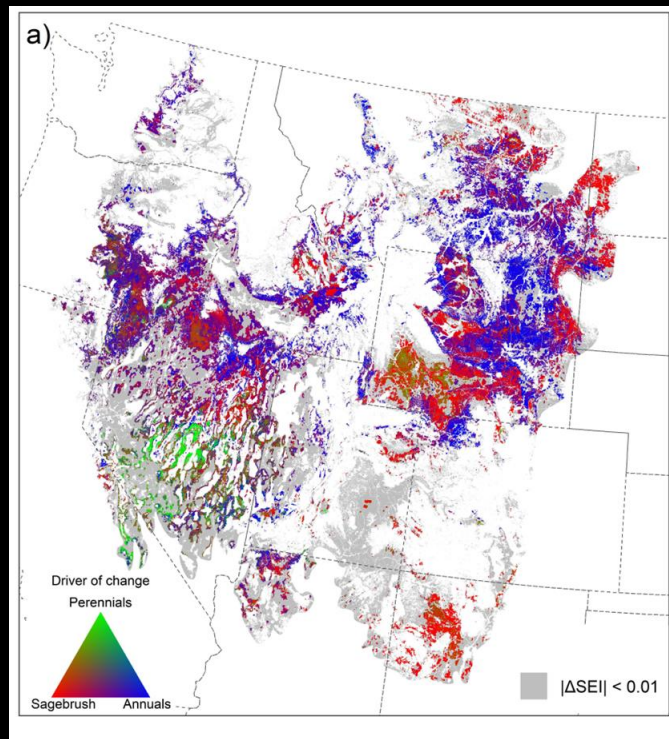
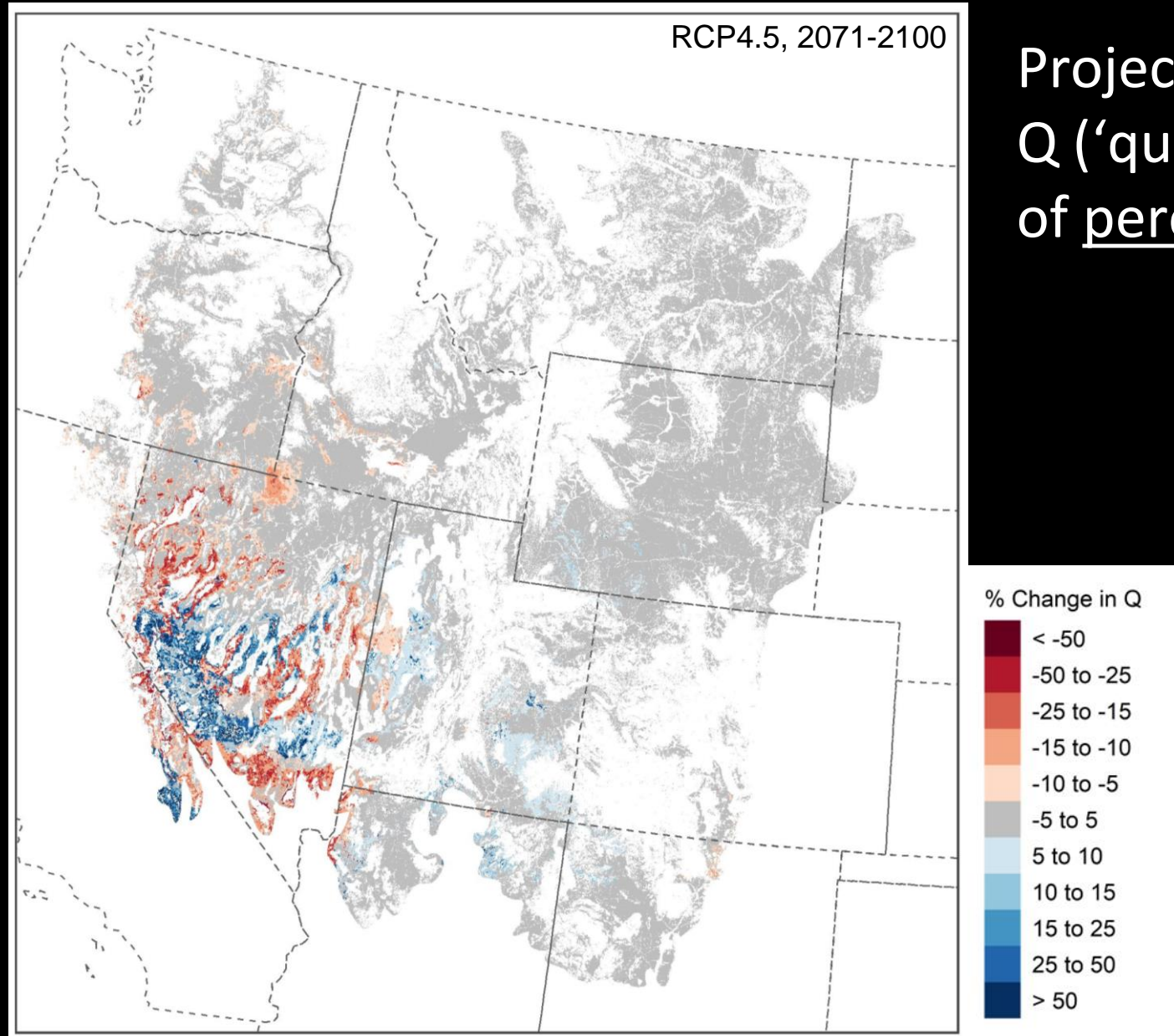
Results: Drivers of change

Projected changes in
Q ('quality') scores
of sagebrush



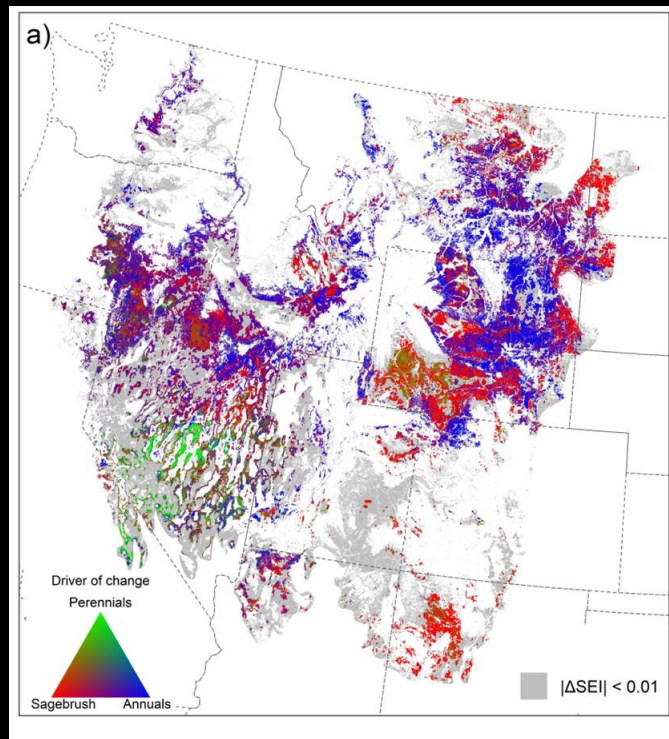
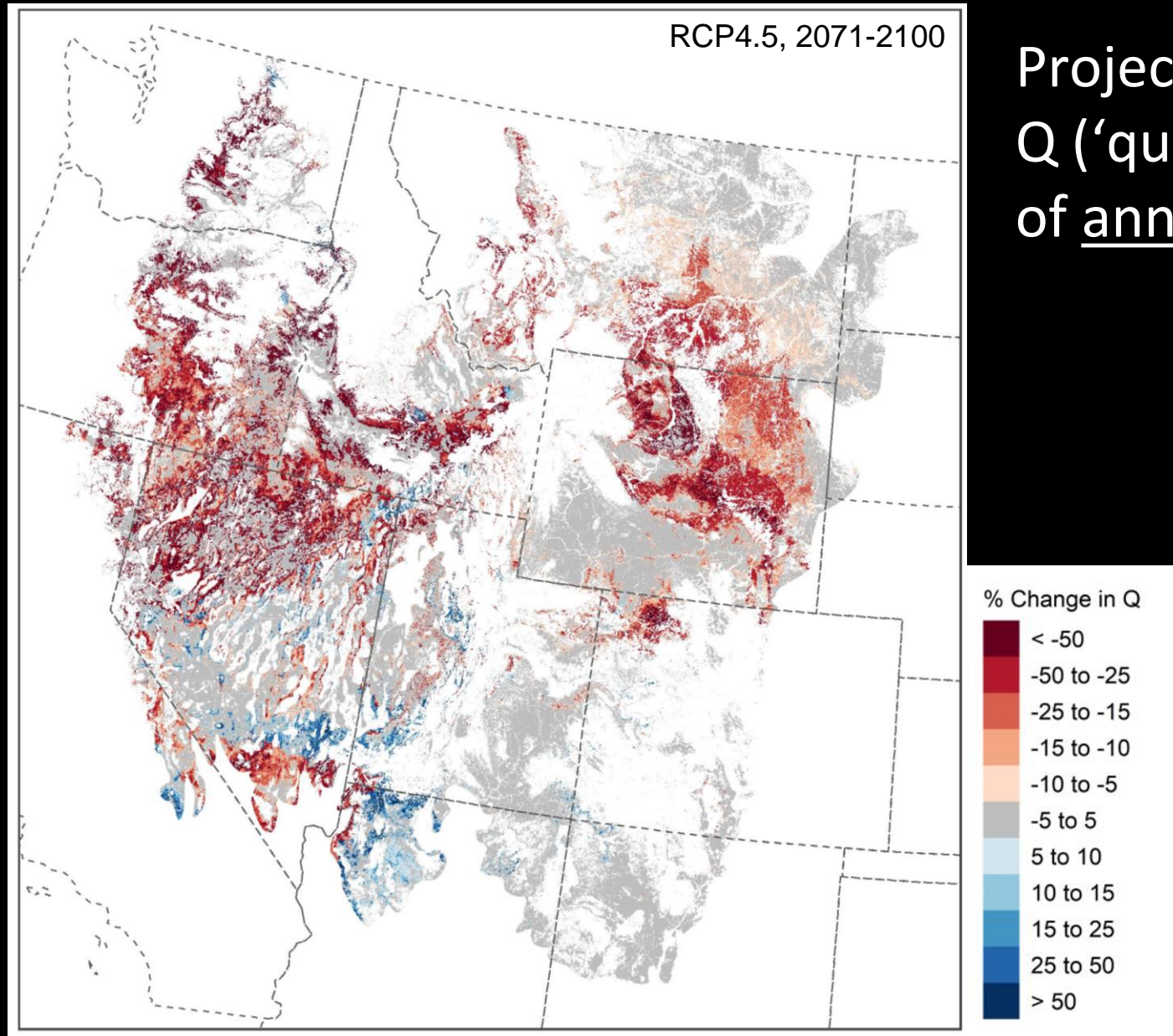
Results: Drivers of change

Projected changes in Q ('quality') scores of perennials

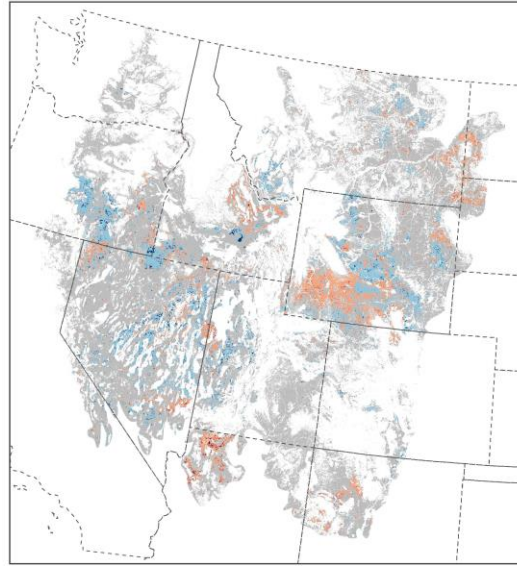


Results: Drivers of change

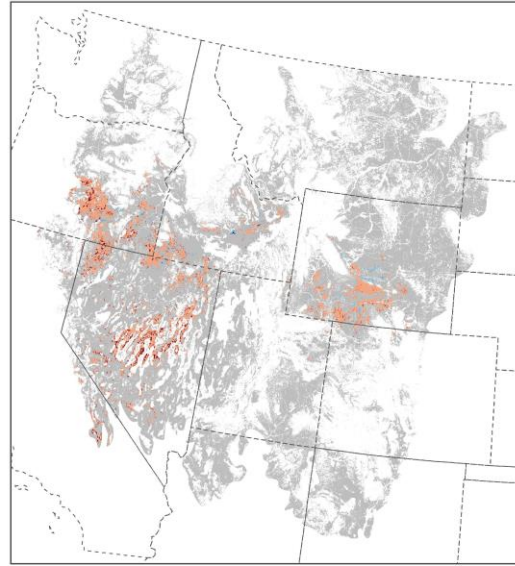
Projected changes in
Q ('quality') scores
of annuals



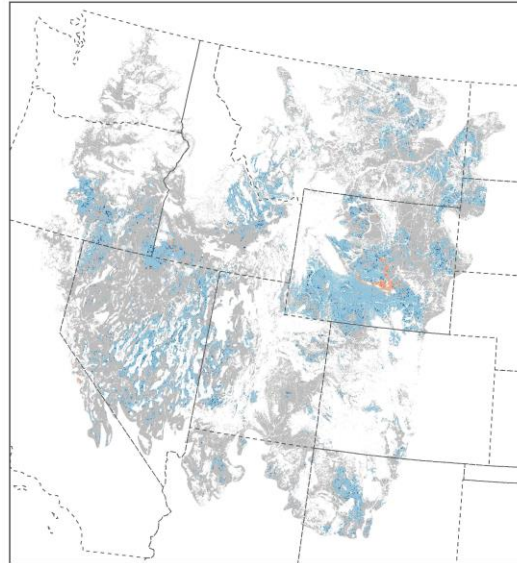
a) No fire



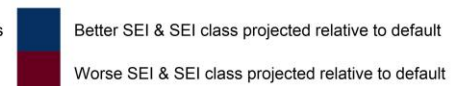
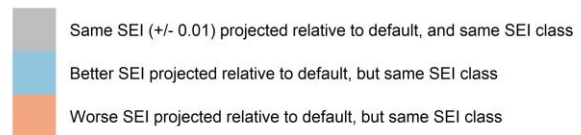
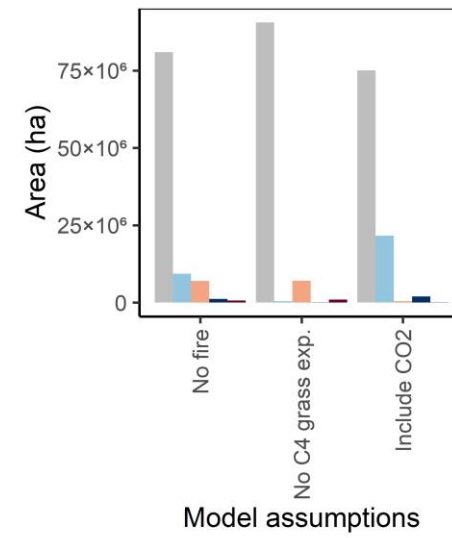
b) No C4 grass expansion

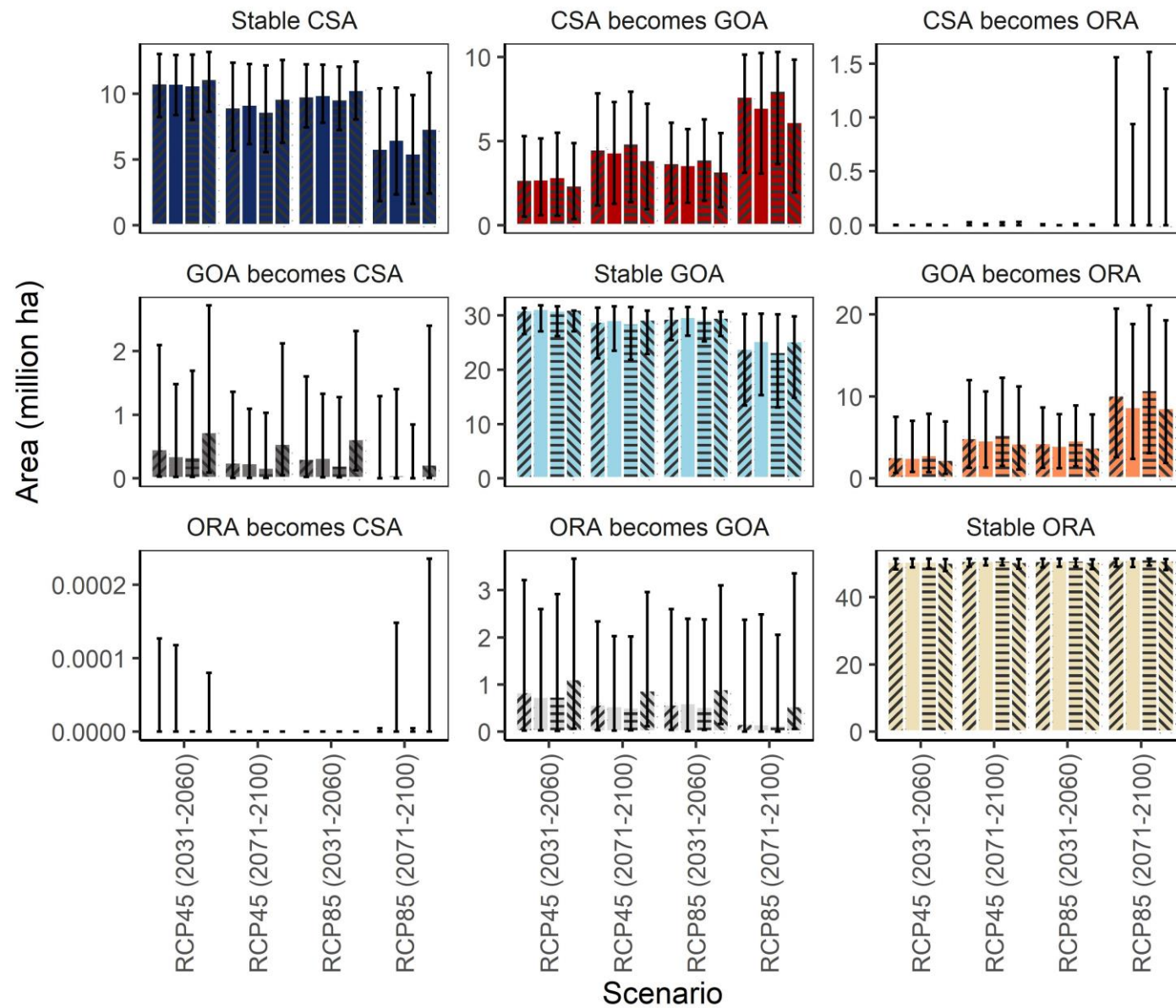


c) Include CO2 fertilization

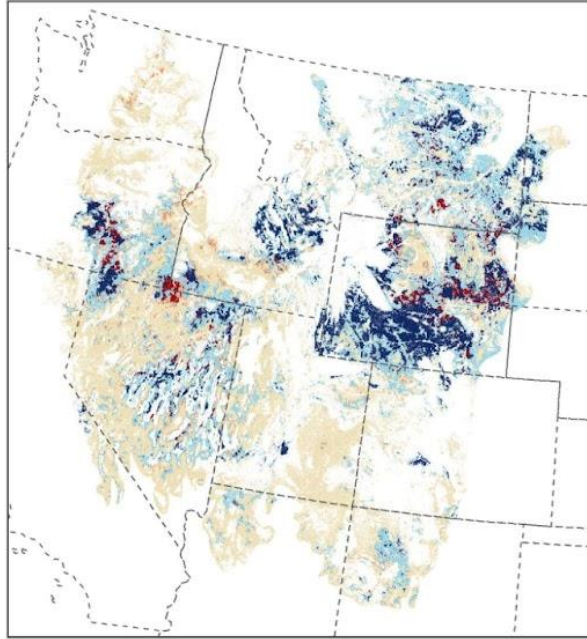


d)

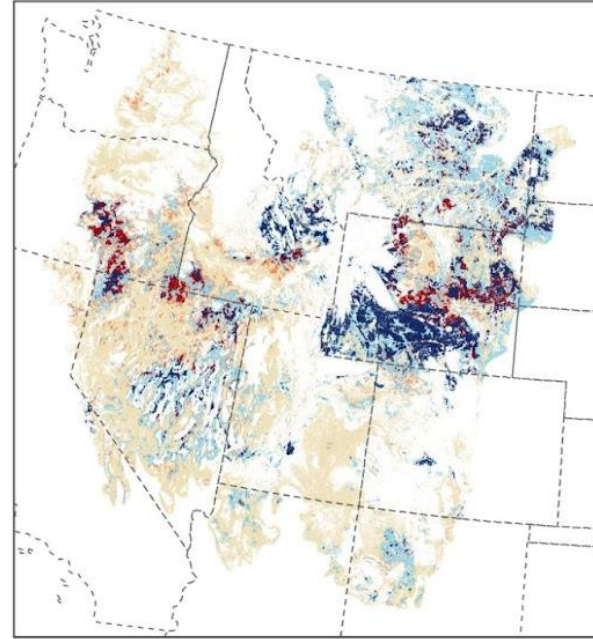




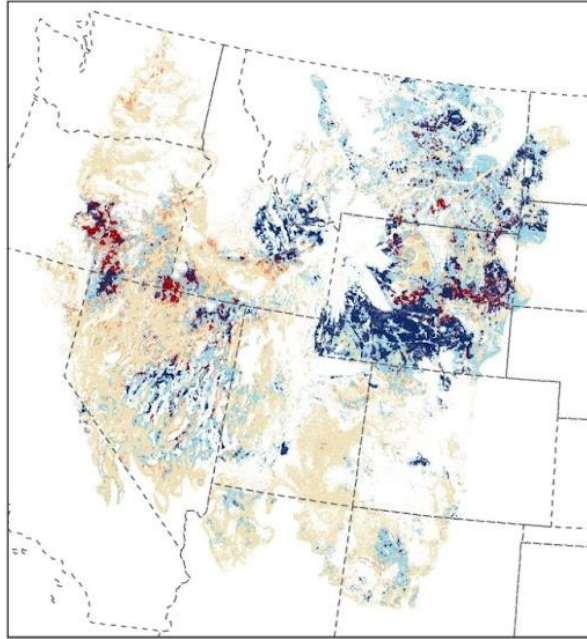
a) RCP45 2030-2060



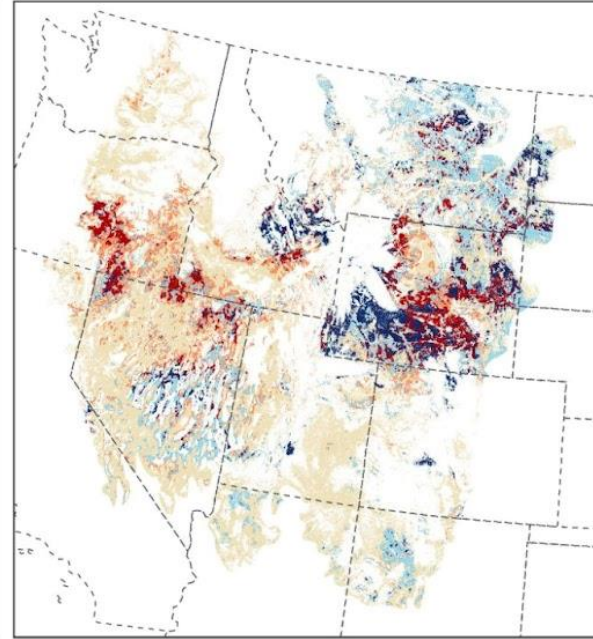
b) RCP45 2070-2100



c) RCP85 2030-2060



d) RCP85 2070-2100



			CSA stable	CSA becomes GOA	CSA becomes ORA	GOA stable	GOA becomes CSA	GOA becomes ORA	ORA stable	ORA becomes CSA	ORA becomes GOA	
Current (2017-2020) (1000 ha)			13504			34120			51402			
RCP4.5	2031- 2060	Area (1000 ha)	Low SEI	8206	5295	3	26576	27	7518	51382	0	20
			Median SEI	10797	2706	0	31025	461	2634	50555	0	847
			High SEI	13006	497	0	31360	2093	667	48189	0.1	3213
		% of Current Area	Low SEI	61	39	<0.1	78	<0.1	22	100	0	<0.1
			Median SEI	80	20	0	91	1	8	98	0	2
			High SEI	96	4	0	92	6	2	94	<0.1	6
	2071- 2100	Area (1000 ha)	Low SEI	5643	7833	27	22125	9	11987	51371	0	31
			Median SEI	8979	4525	<0.1	28915	254	4951	50817	0	585
			High SEI	12348	1156	0	31464	1360	1296	49068	0	2334
		% of Current Area	Low SEI	42	58	0.2	65	<0.1	35	100	0	<0.1
			Median SEI	66	34	<0.1	85	0.7	15	99	0	1
			High SEI	91	9	0	92	4	4	95	0	5
RCP8.5	2031- 2060	Area (1000 ha)	Low SEI	7420	6077	7	25466	26	8629	51366	0	36
			Median SEI	9803	3701	0	29485	314	4322	50822	0	580
			High SEI	12225	1278	0	31225	1601	1294	48806	0	2596
		% of Current Area	Low SEI	55	45	<0.1	75	<0.1	25	100	0	<0.1
			Median SEI	73	27	0	86	0.9	13	99	0	1
			High SEI	91	9	0	92	5	4	95	0	5
	2071- 2100	Area (1000 ha)	Low SEI	1807	10135	1561	13448	0	20673	51402	0	0
			Median SEI	5838	7654	12	23945	36	10140	51226	0	176
			High SEI	10396	3108	0	30248	1292	2580	49029	<0.1	2373
		% of Current Area	Low SEI	13	75	12	39	0	61	100	0	0
			Median SEI	43	57	<0.1	70	0.1	30	100	0	0.3
			High SEI	77	23	0	89	4	8	95	<0.1	5