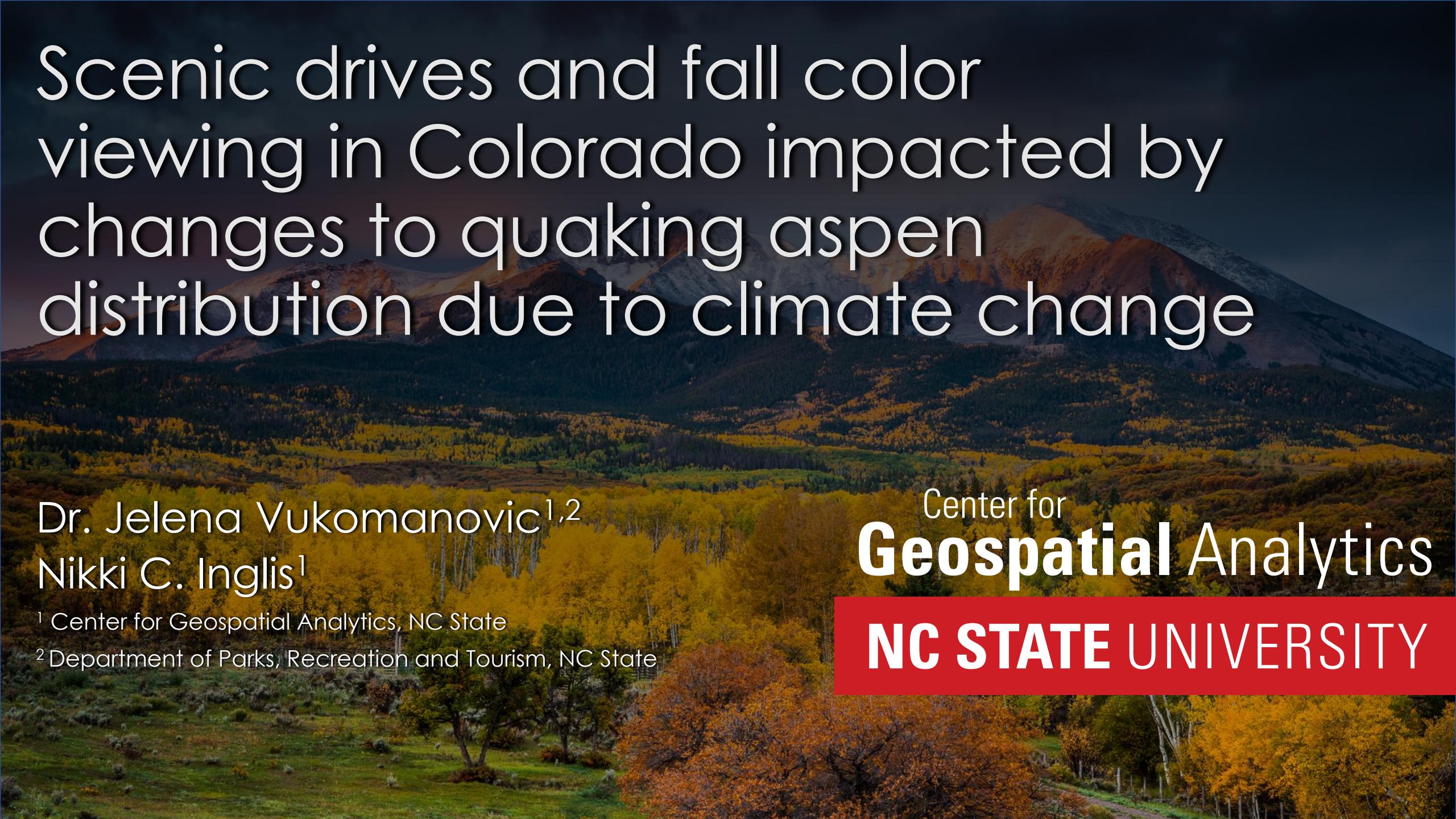


Scenic drives and fall color viewing in Colorado impacted by changes to quaking aspen distribution due to climate change



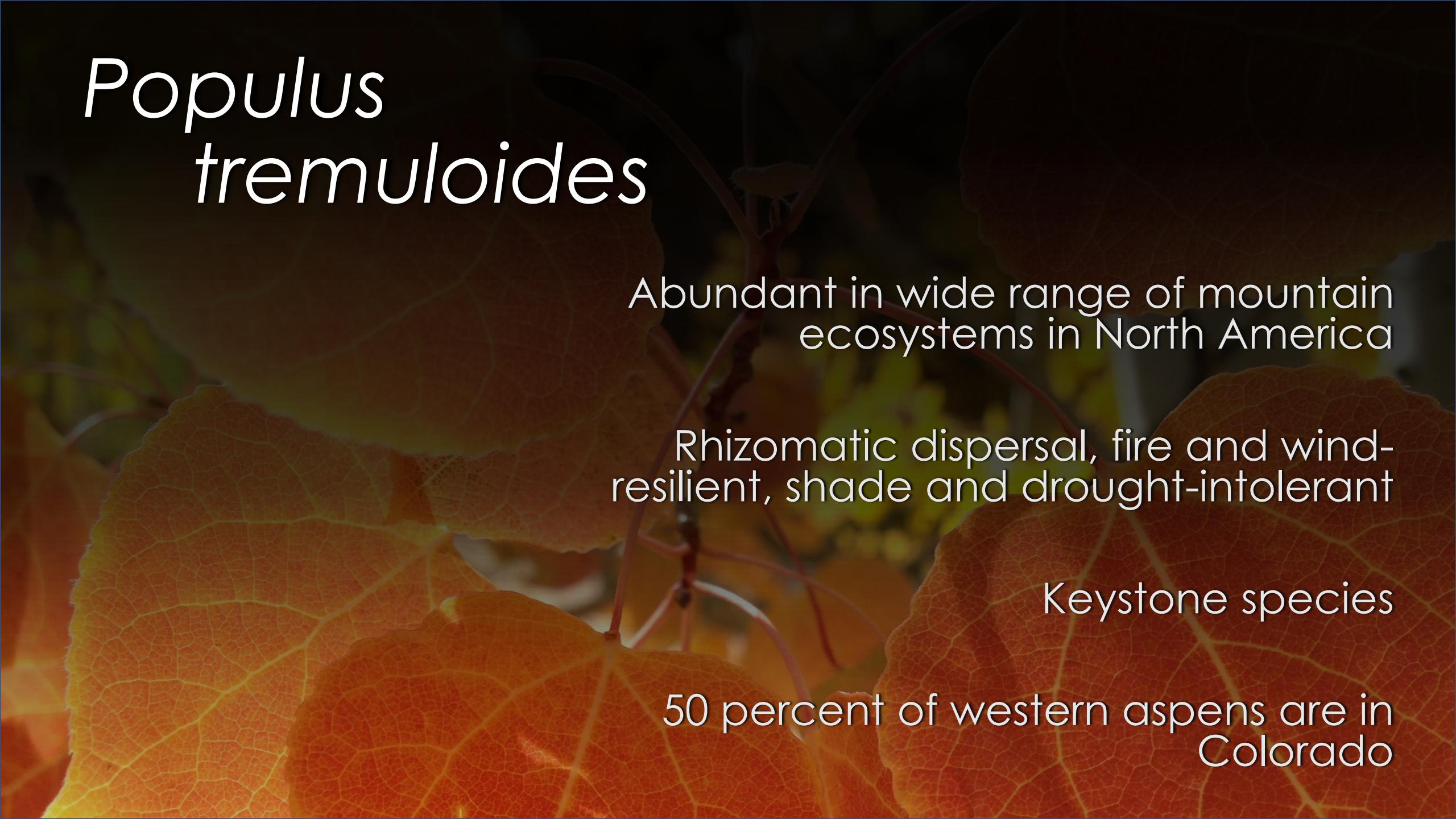
Dr. Jelena Vukomanovic^{1,2}
Nikki C. Inglis¹

¹ Center for Geospatial Analytics, NC State

² Department of Parks, Recreation and Tourism, NC State

Center for
Geospatial Analytics
NC STATE UNIVERSITY

Populus tremuloides

A close-up photograph of several aspen leaves, showing vibrant orange and yellow autumn colors. The leaves have prominent veins and some are slightly curled or crumpled. The background is dark, making the bright leaves stand out.

Abundant in wide range of mountain ecosystems in North America

Rhizomatic dispersal, fire and wind-resilient, shade and drought-intolerant

Keystone species

50 percent of western aspens are in Colorado

Populus tremuloides

Cultural value

Mythology

Symbolism (family, change of seasons)

Landscape aesthetics

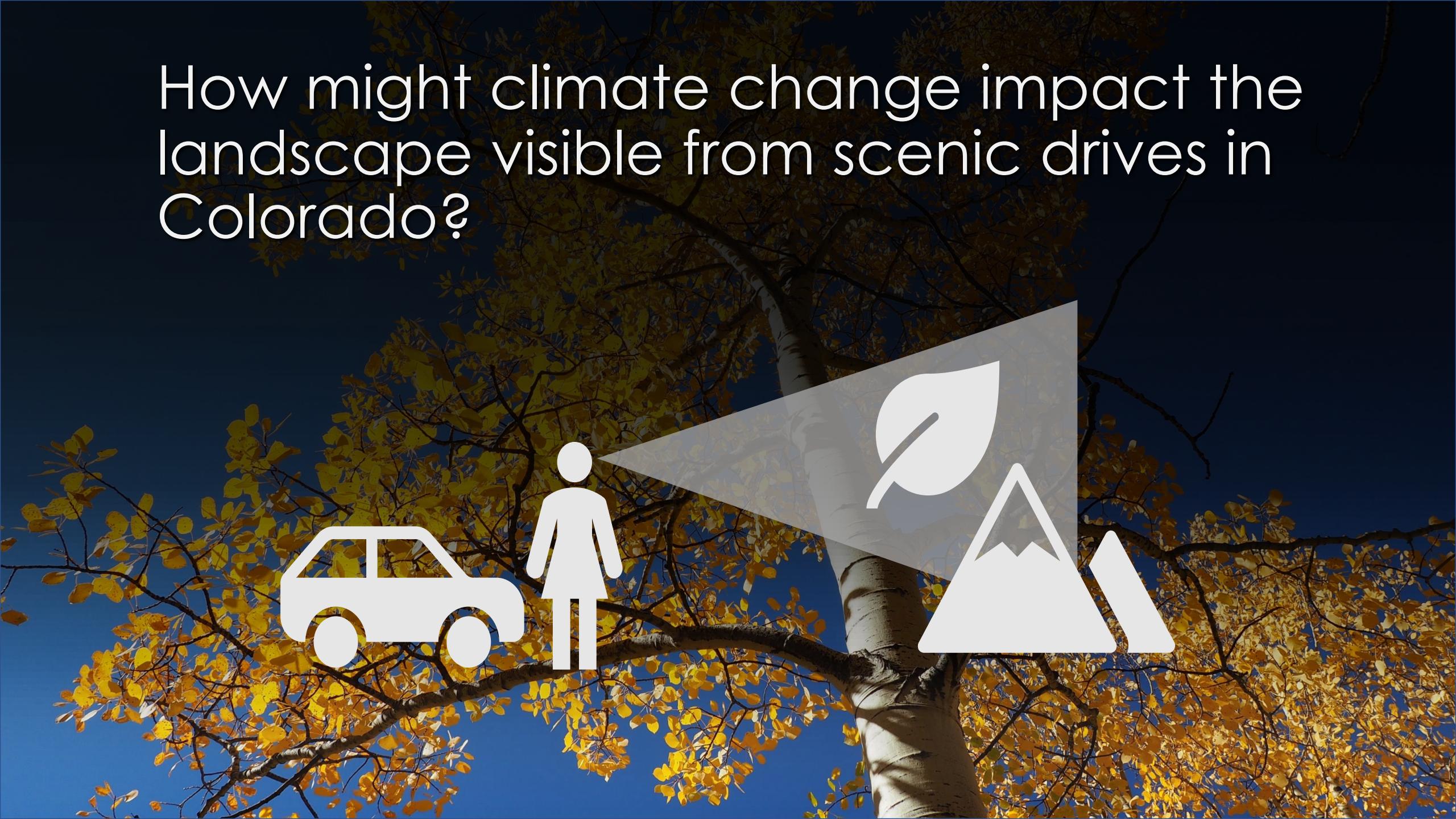
Colorado tourism

\$20 billion tourism industry

20% of visitors spend time on scenic drives

Populus tremuloides



A photograph of a scenic drive through a forest. The foreground features a large tree trunk with white, papery bark and branches covered in bright yellow autumn leaves against a clear blue sky.

How might climate change impact the landscape visible from scenic drives in Colorado?

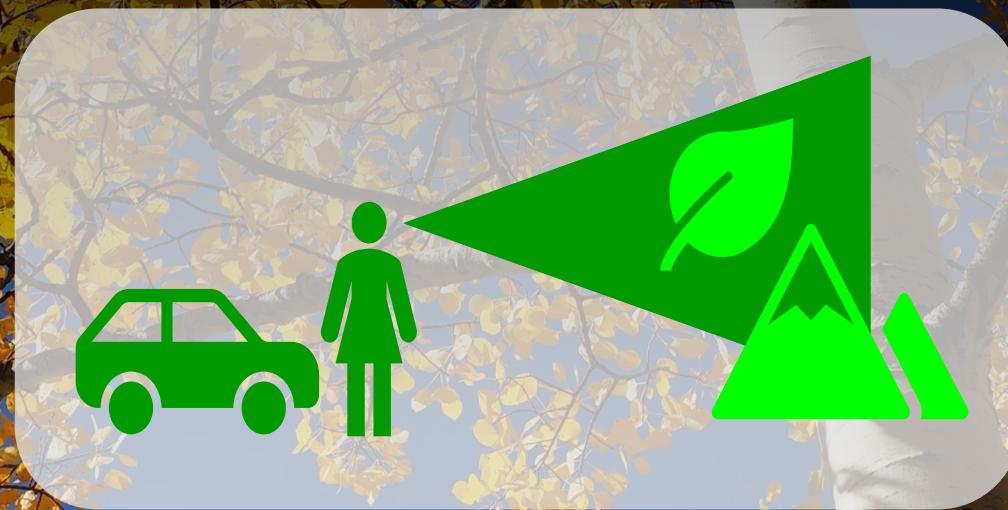


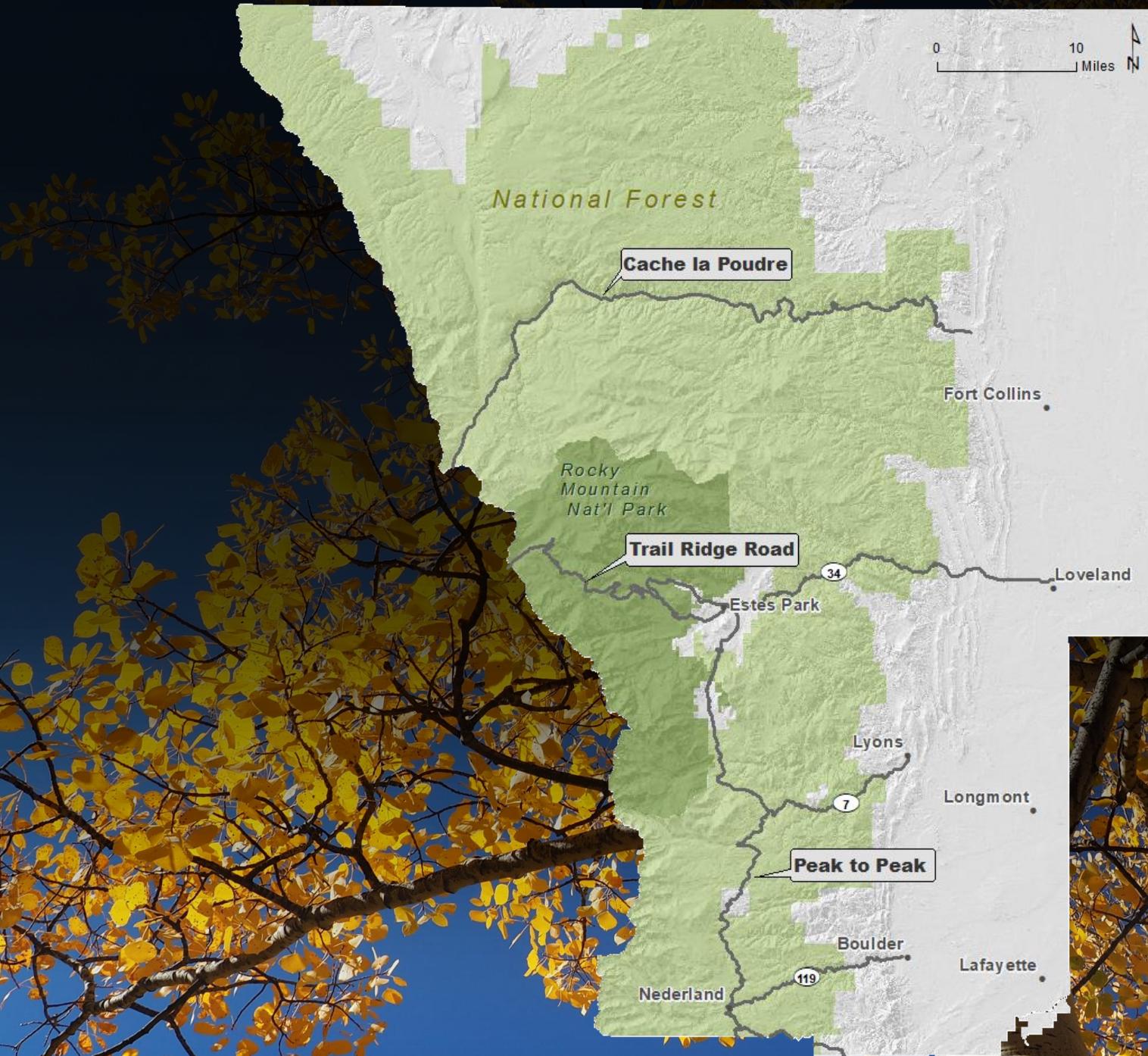


LANDIS-II model



Viewscape analysis

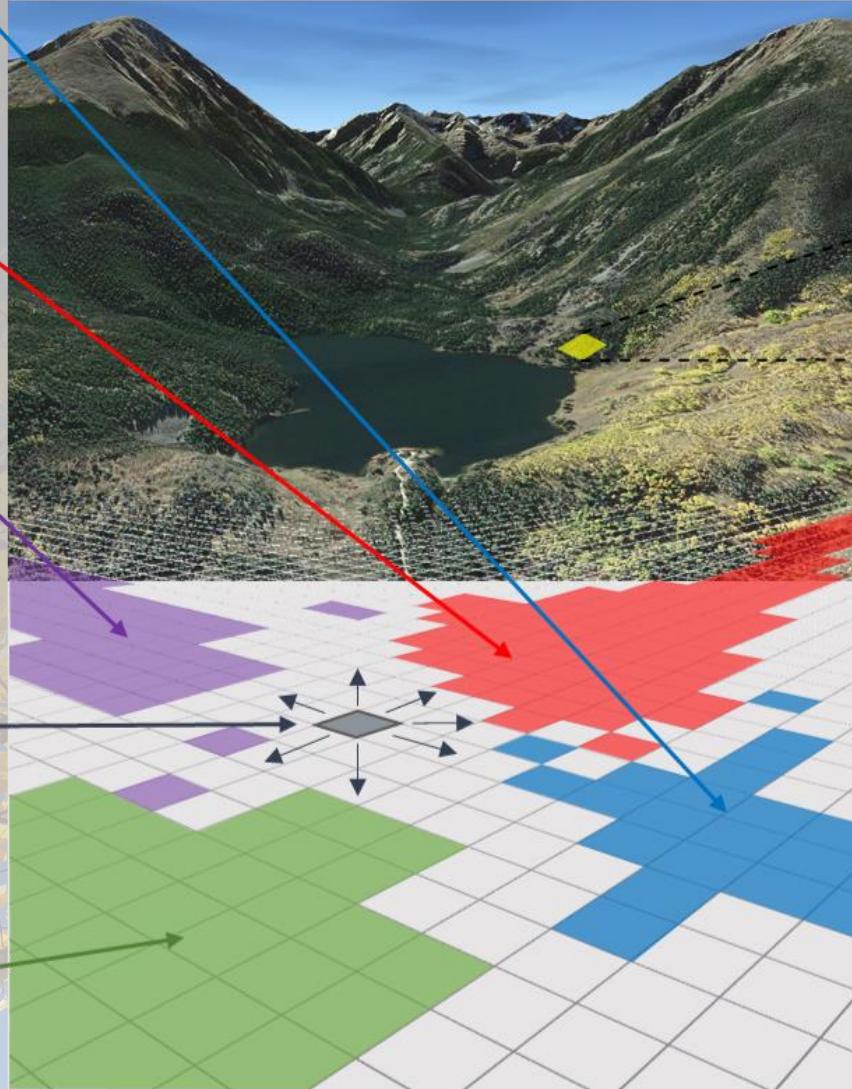




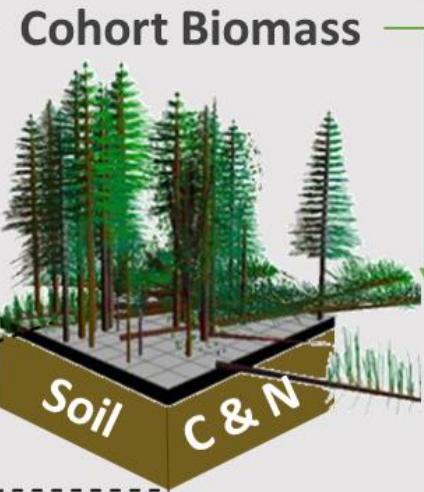
LANDIS-II

<http://www.landis-ii.org/>

Landscape-scale Processes



Spatially Interactive Landscape



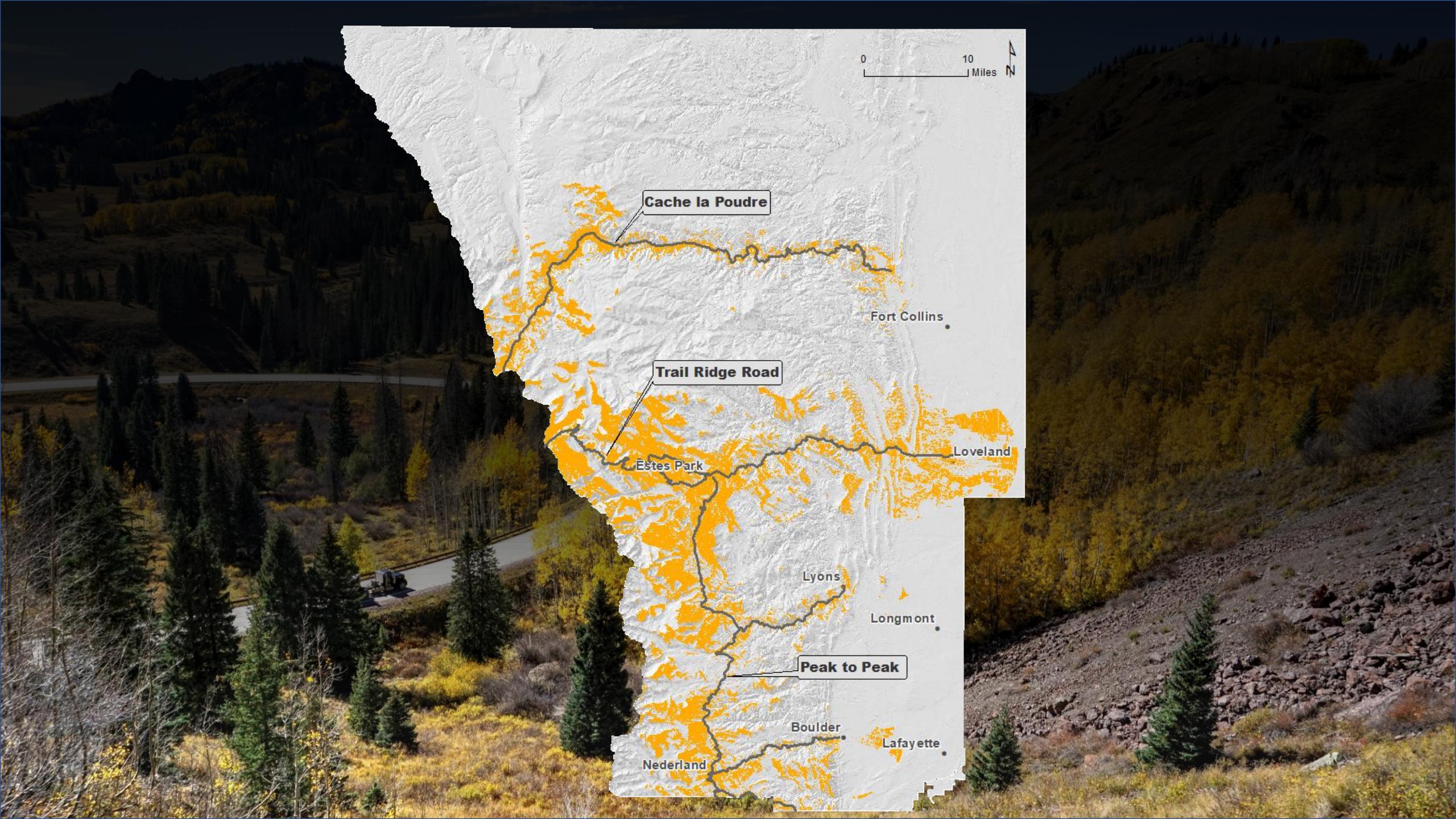
Stand-scale Processes



Species-scale Processes

Natural and human-made **vertical features** affect viewscapes and the visibility of landscape elements with which people form a connection





0 10 Miles N

Cache la Poudre

Trail Ridge Road

Estes Park

Fort Collins

Loveland

Lyons

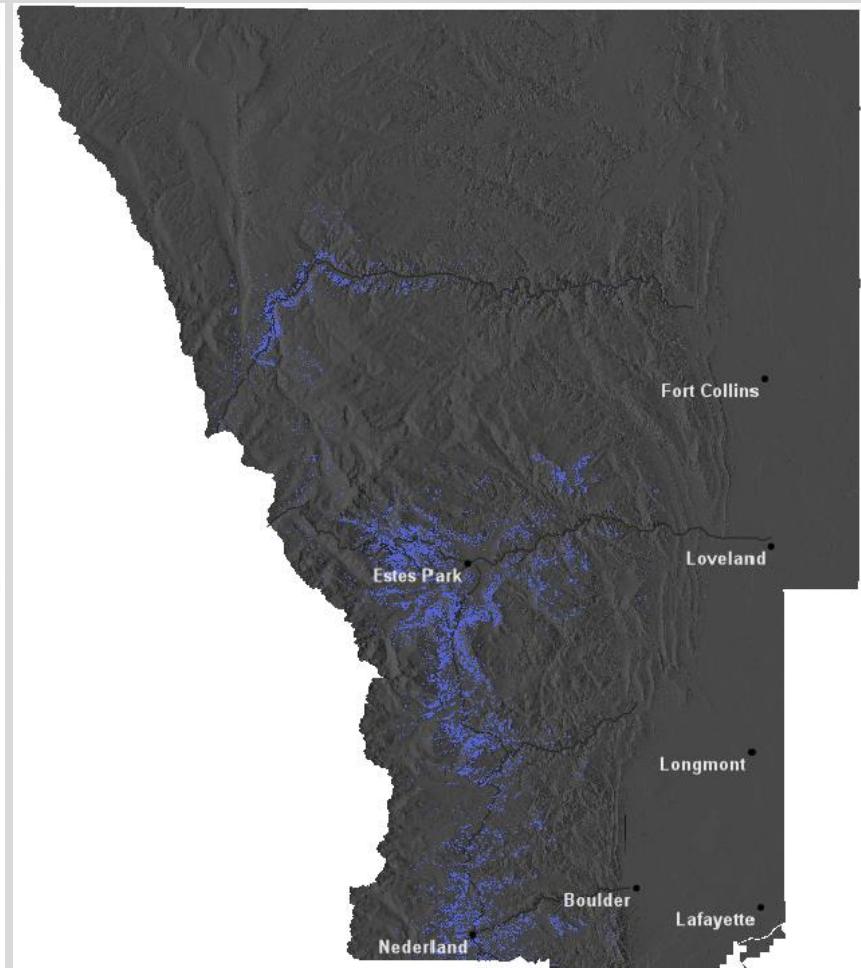
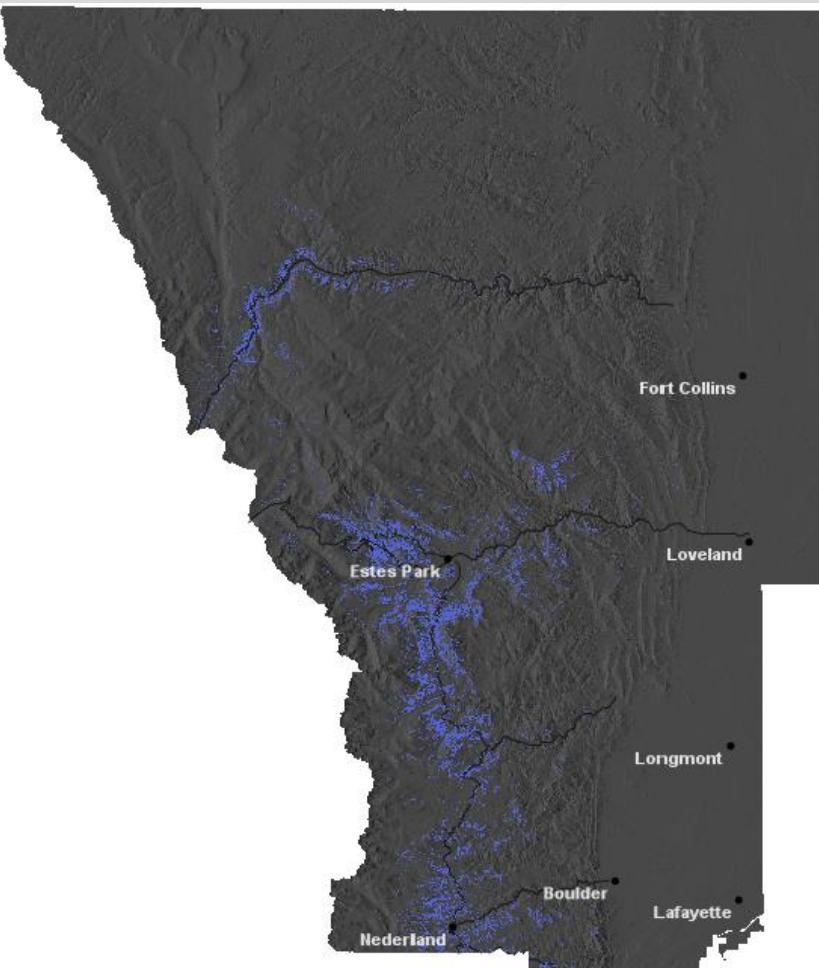
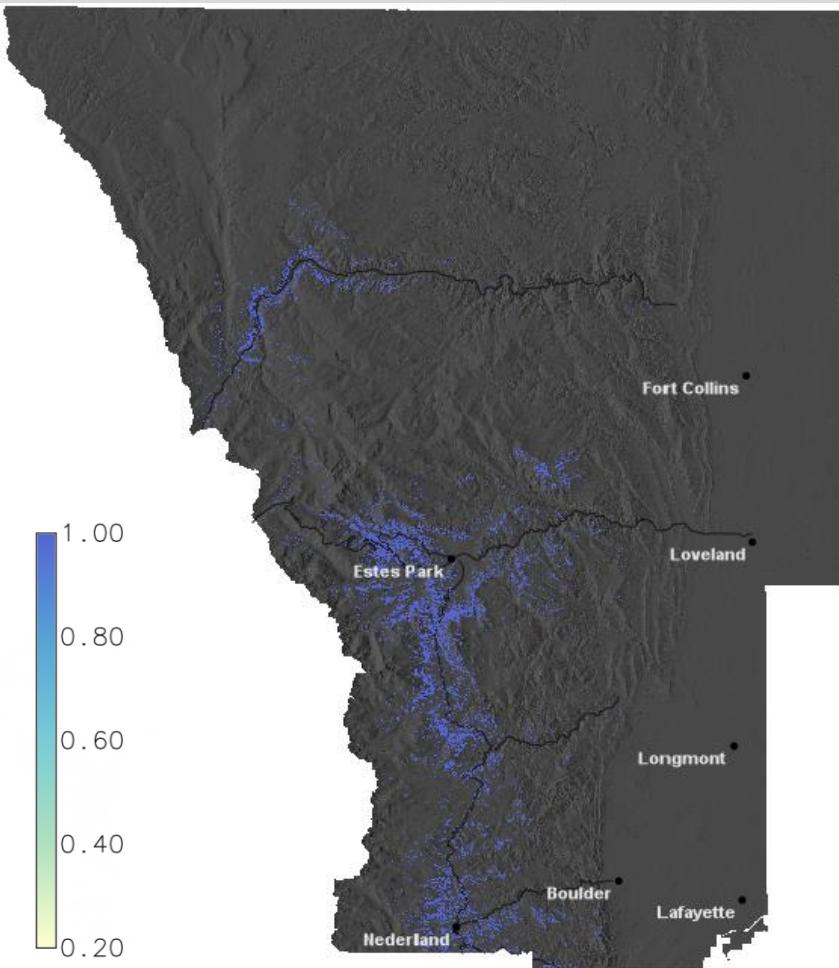
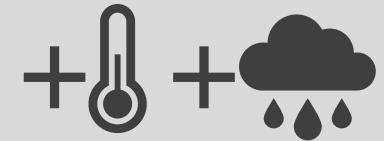
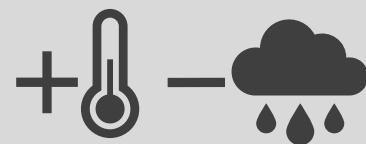
Longmont

Peak to Peak

Boulder

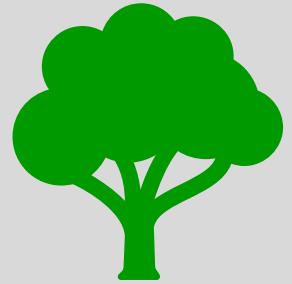
Lafayette

Nederland



Probability of aspen presence

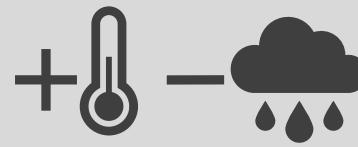
Average probability within viewscapes increases



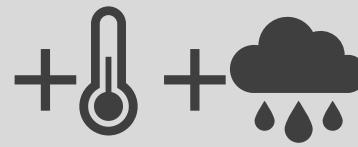
18.5%



20.5%

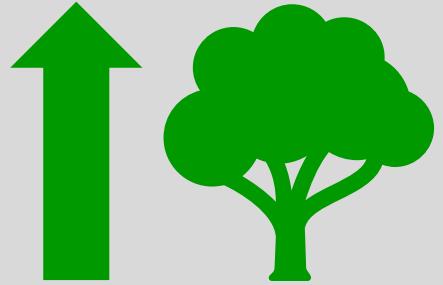


24.5%

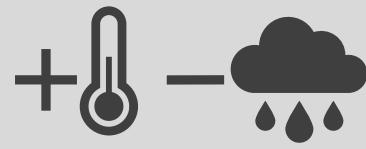
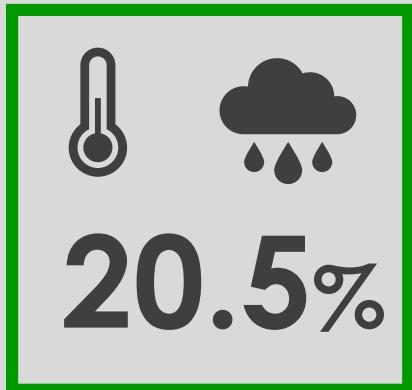


24.5%

Average probability within viewscapes increases



18.5%

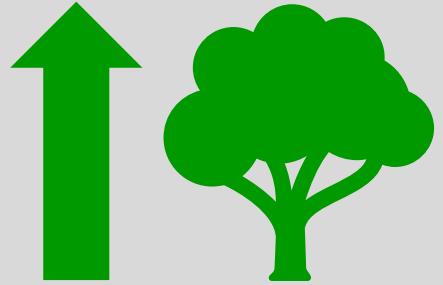


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24.5%

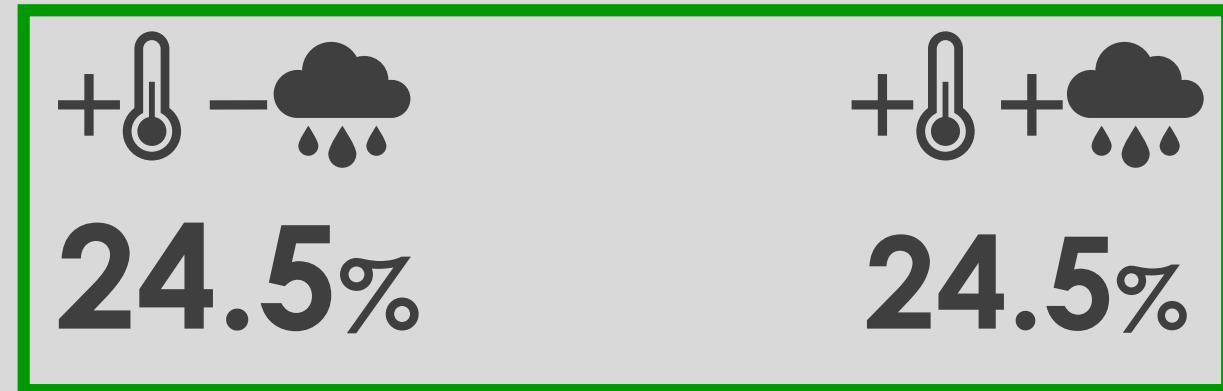
Average probability within viewscapes increases

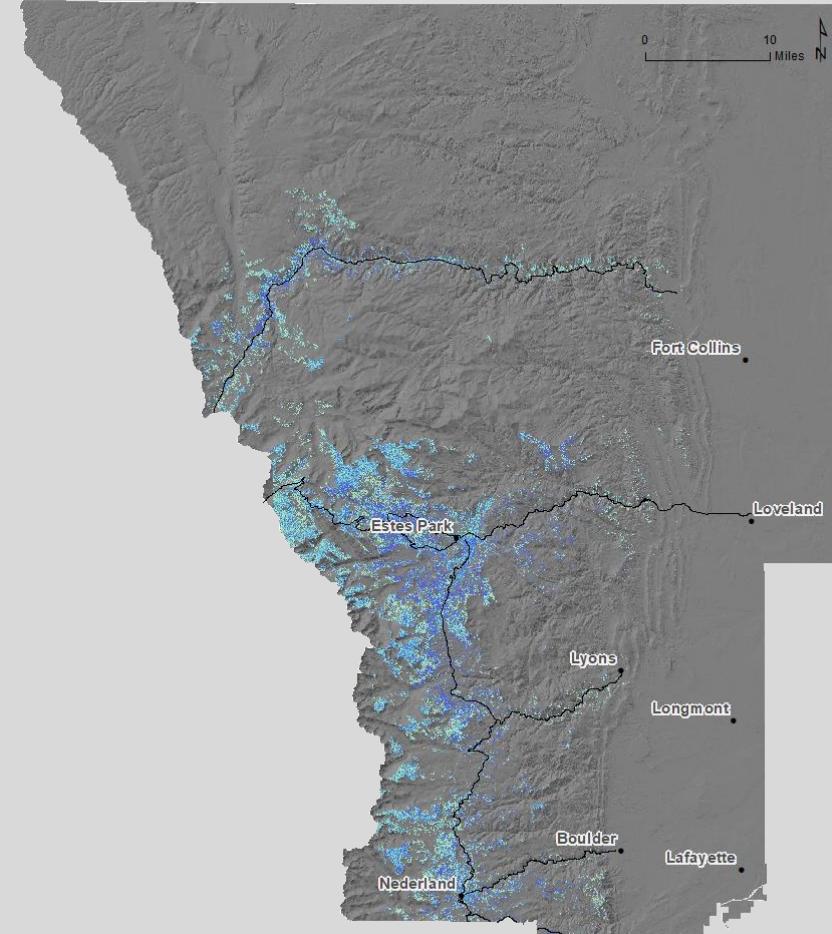
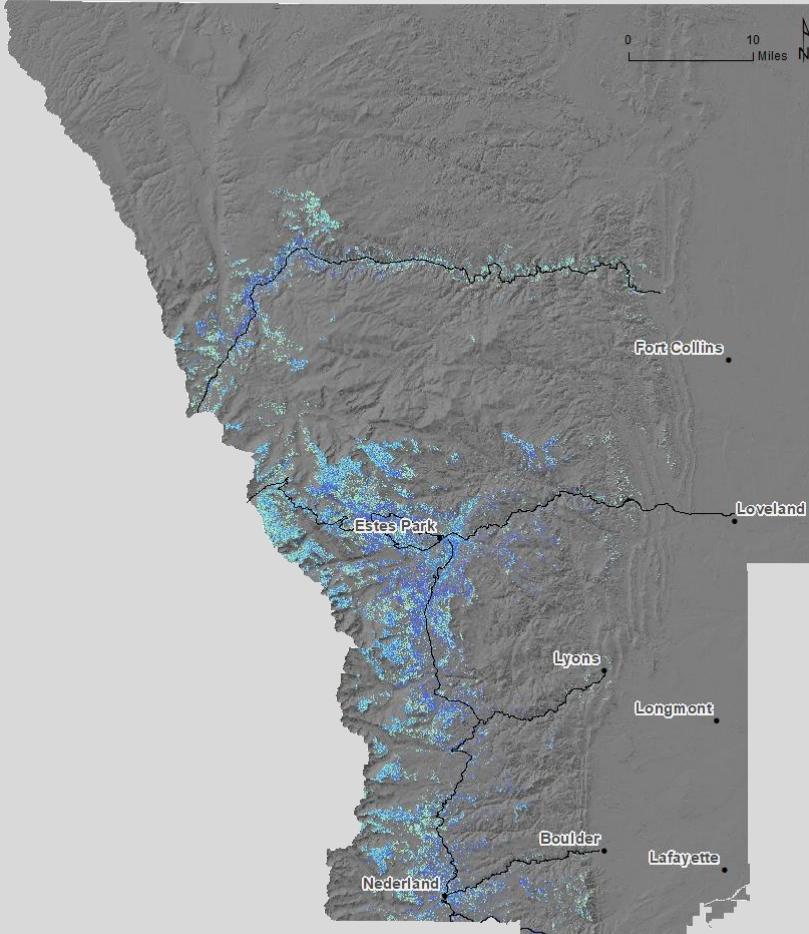
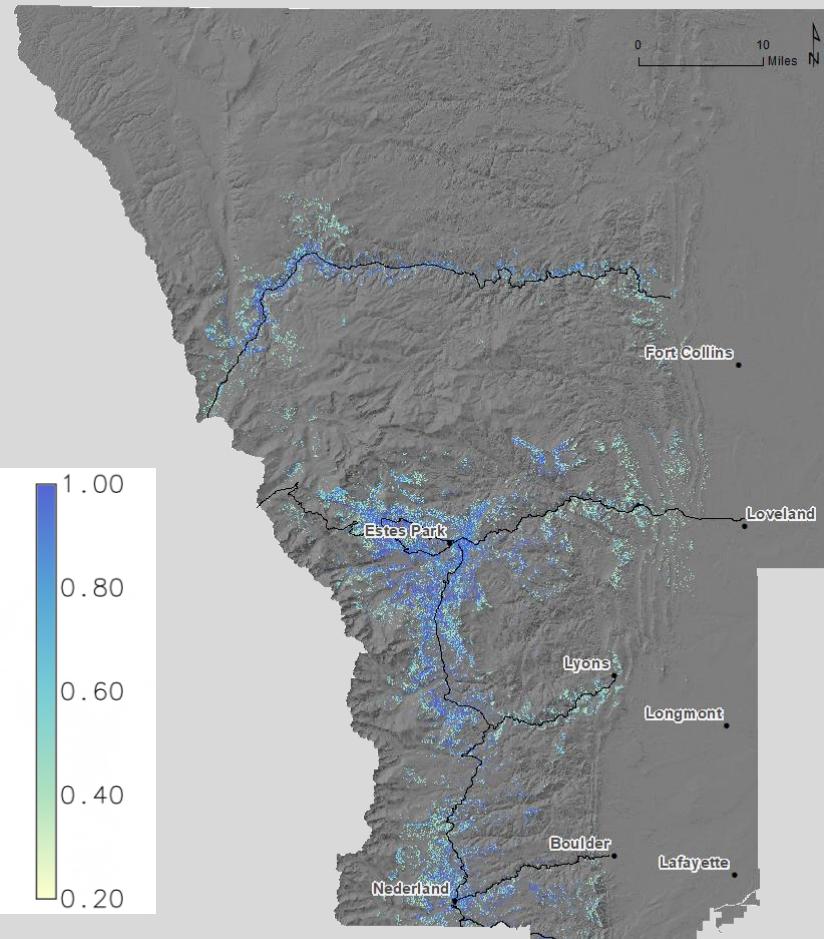
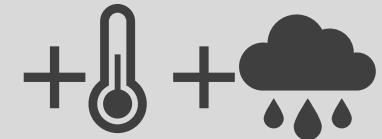
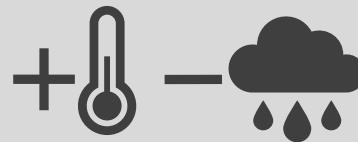


18.5%



20.5%





Large scale distribution shifts of aspen reflected in a crucial landscape

Planning and policy-making: road improvements and amenity planning

Developing sustainable, resilient tourism centers



Next steps

Weighted viewscapes

Suitability study



Acknowledgements

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Dr. Josh Gray

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Center for
Geospatial Analytics

NC STATE UNIVERSITY

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Model	Elevation		Slope	
	β	<i>p</i>	β	<i>p</i>
Beginning	-0.00005	0.00019 *	0.00266	0.00001
Current climate	-0.00008	<0.00001 *	0.00037	0.44911
Warming - precip	0.00003	0.00005 *	0.00088	0.08825
Warming + precip	0.00002	0.00415 *	0.00083	0.09534

