Understanding and Using Climate-Adaptation-Related Spatial Data in Regional Conservation Planning

https://adaptwest.databasin.org

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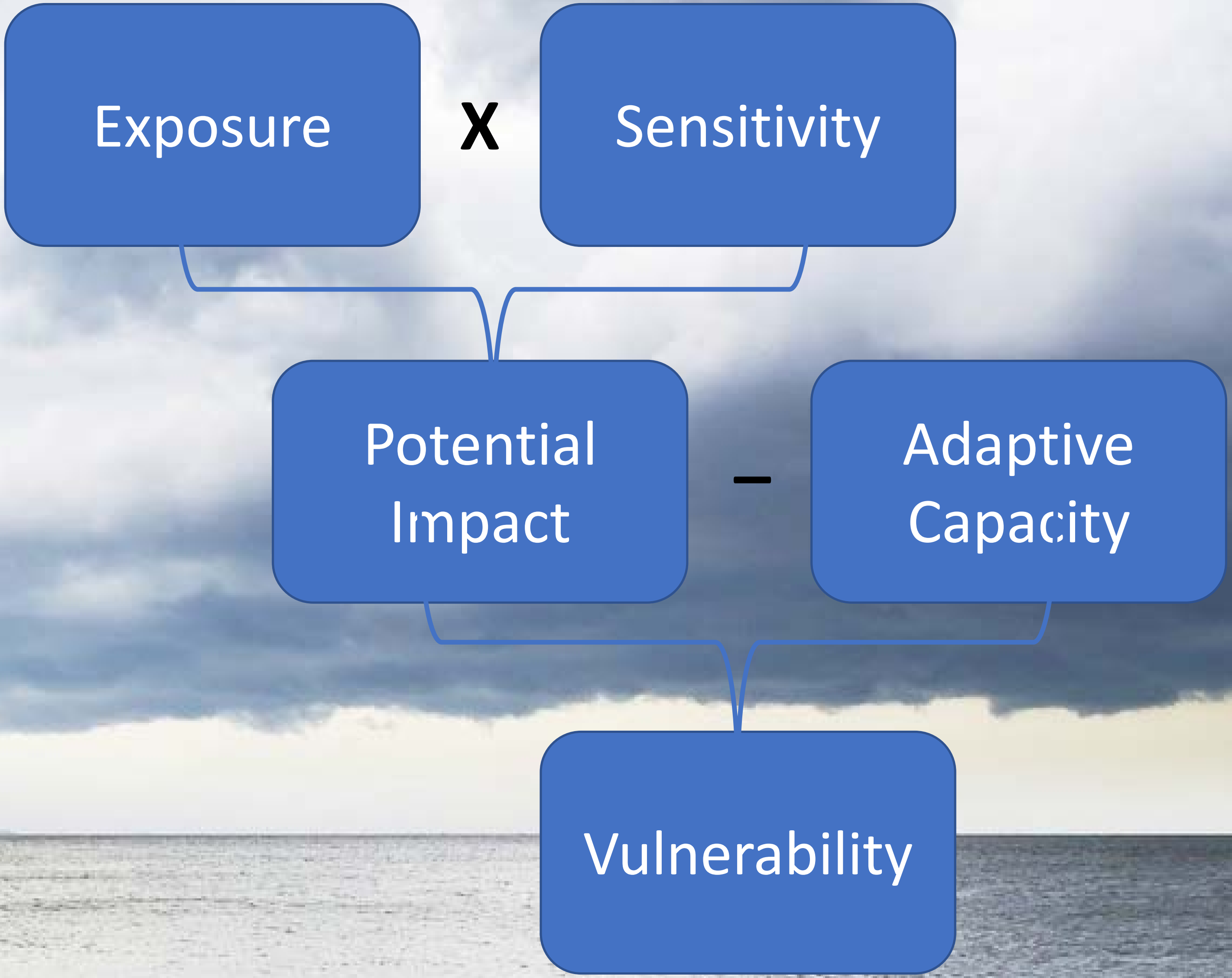
Assessing and Addressing Landscape-Level Vulnerability to Climate Change

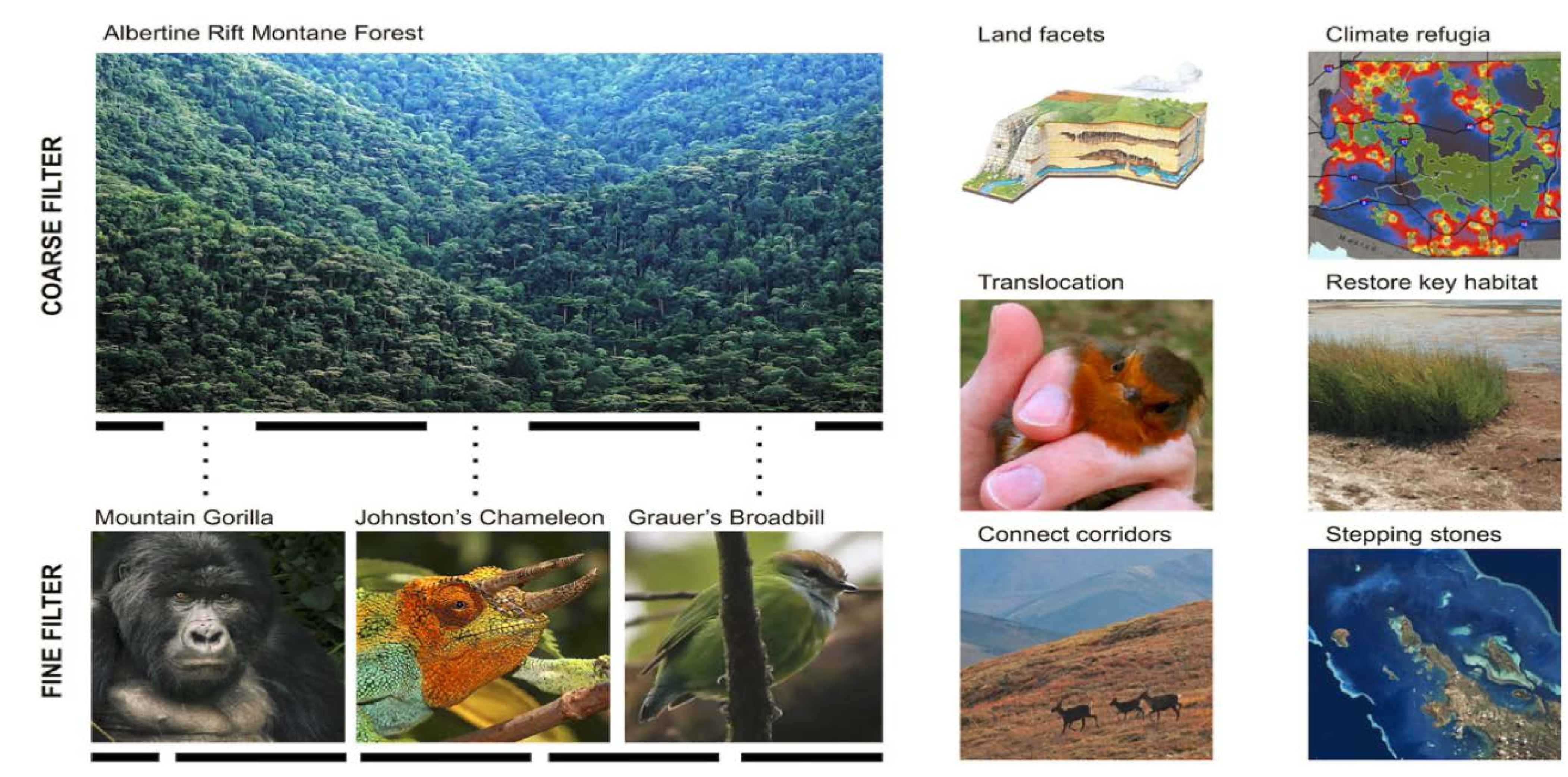
The ultimate goal of landscape-level conservation planning under climate change is to facilitate persistence of species and ecosystem processes by increasing the adaptive capacity of landscapes and regions.

The ESAC framework, developed by the IPCC ([McCarthy et al. 2001]()), proposes that climate Exposure and Sensitivity interact and are mediated by Adaptive Capacity, resulting in the degree of Vulnerability of the system to climate change.

Most of the data considered here are measures of climate **exposure**. Data, such as the location of climate refugia for individual species, which incorporates information on a species' climatic tolerances or niche, also addresses climate **sensitivity**. The ultimate goal of providing such information to planners is to support conservation management that, by protecting key areas identified by the data, increases the **adaptive capacity** of the landscape and its ability to support native species and ecosystems into the future.



A diversity of conservation strategies are needed to address climate change adaptation challenges

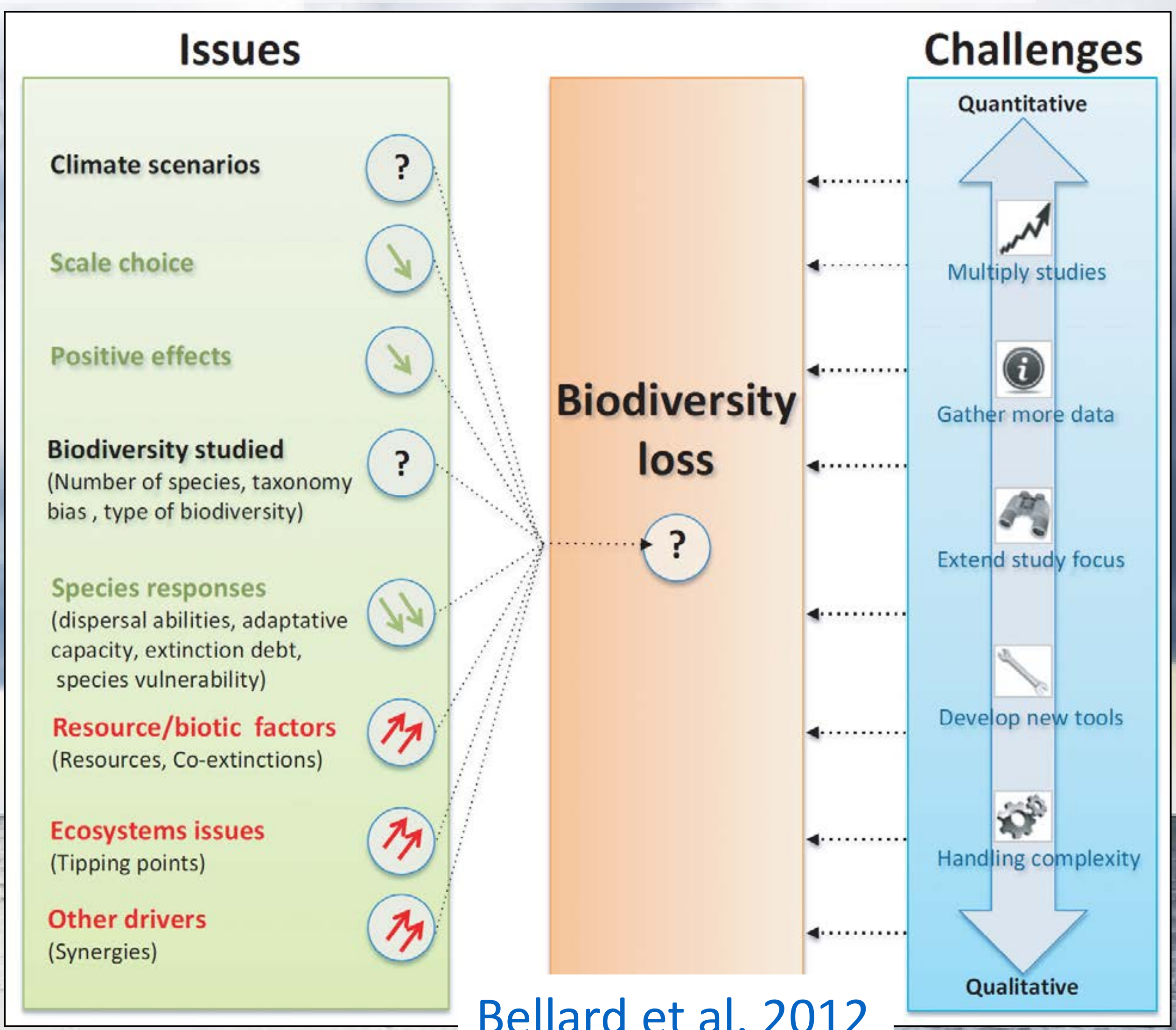


Tingley et al. 2014

Making sense of diverse metrics and linking them to ecological processes

<u>Three key issues:</u>

- Spatial scale
- Coarse- vs. fine-filter metrics
- Diverse ways in which climate change exposure influences biodiversity



Bellard et al. 2012

Issue 1: What spatial scale(s) are relevant?:
Macro-scale and micro-scale metrics can be complementary

TABLE 2 Spatial scale of the physical and ecological factors related to refugia value and adaptive capacity, and their influence on alternative metrics

		Diversity						
		Elevational	**HLI**	**Ecotype**	**Facet**	**Climate**	**Climatic velocity**	**Biotic velocity**
Cold air pooling	100 m							
Water accumulation								
Variation in insolation with aspect			×					
Temperature lapse rate with elevation		×		×	×		×	×
Orographic lift and rain shadow	1 km			×		×	×	×
Climatic thresholds driving ecotype transitions				×				×
Soil/geologic transitions					×			
Coastal proximity/maritime effects	10 km					×	×	×
Current broad-scale circulation patterns						×	×	×
Future shifts in circulation patterns							×	×
Latitudinal variation in insolation						×	×	×
Biogeographic barriers	>100 km							×

Carroll et al. 2017

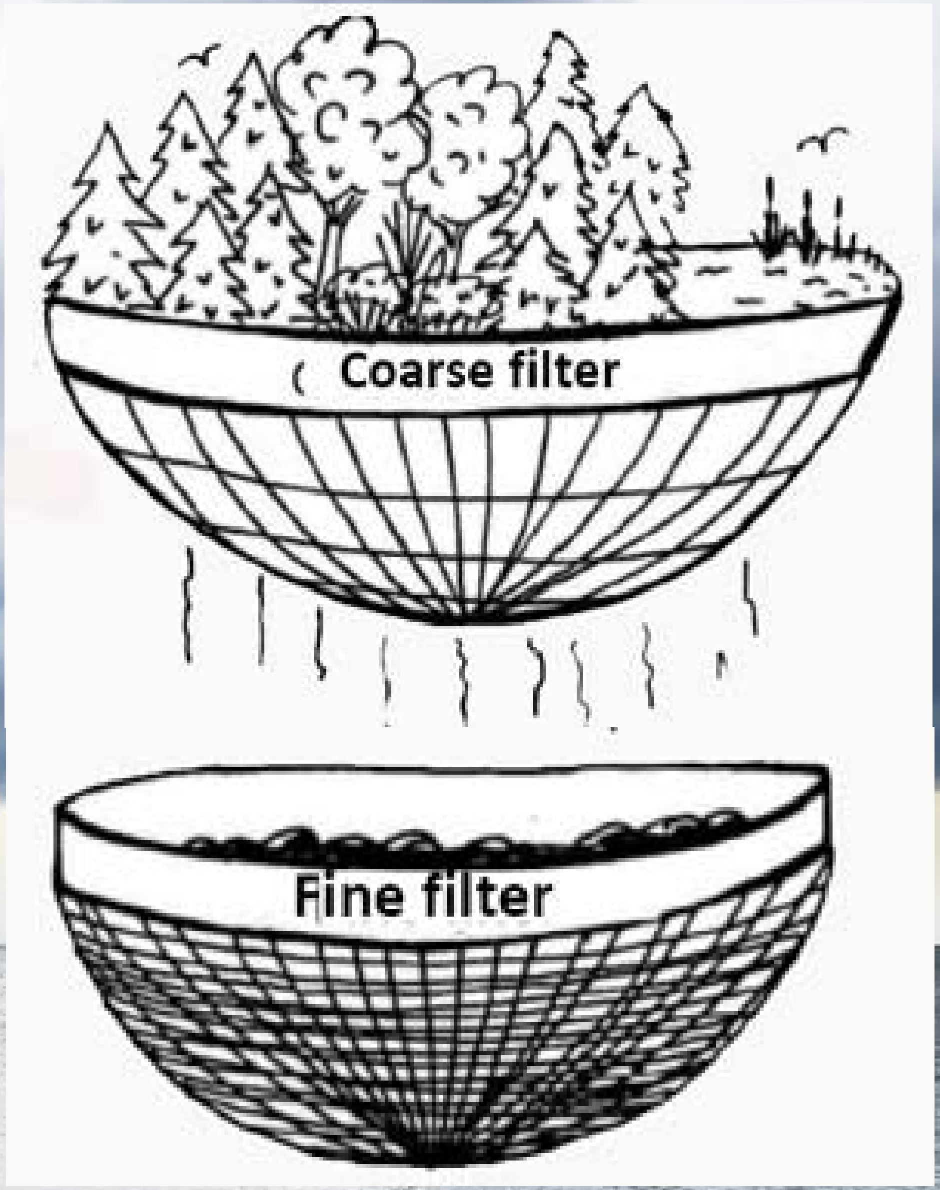
Issue 2: How much species-specific information is needed? Coarse-filter vs. fine-filter metrics

Why use coarse-filter targets?

Lack of information about most species.

Why use fine-filter targets?

Coarse-filter surrogates imperfectly protect individual species (Noss 1987).



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ANNALS OF THE NEW YORK ACADEMY OF SCIENCES
Issue: *The Year in Ecology and Conservation Biology*

Fine- and coarse-filter conservation strategies in a time of climate change

Tingley et al. 2014

Morgan W. Tingley,[1] Emily S. Darling,[2] and David S. Wilcove[1,3]

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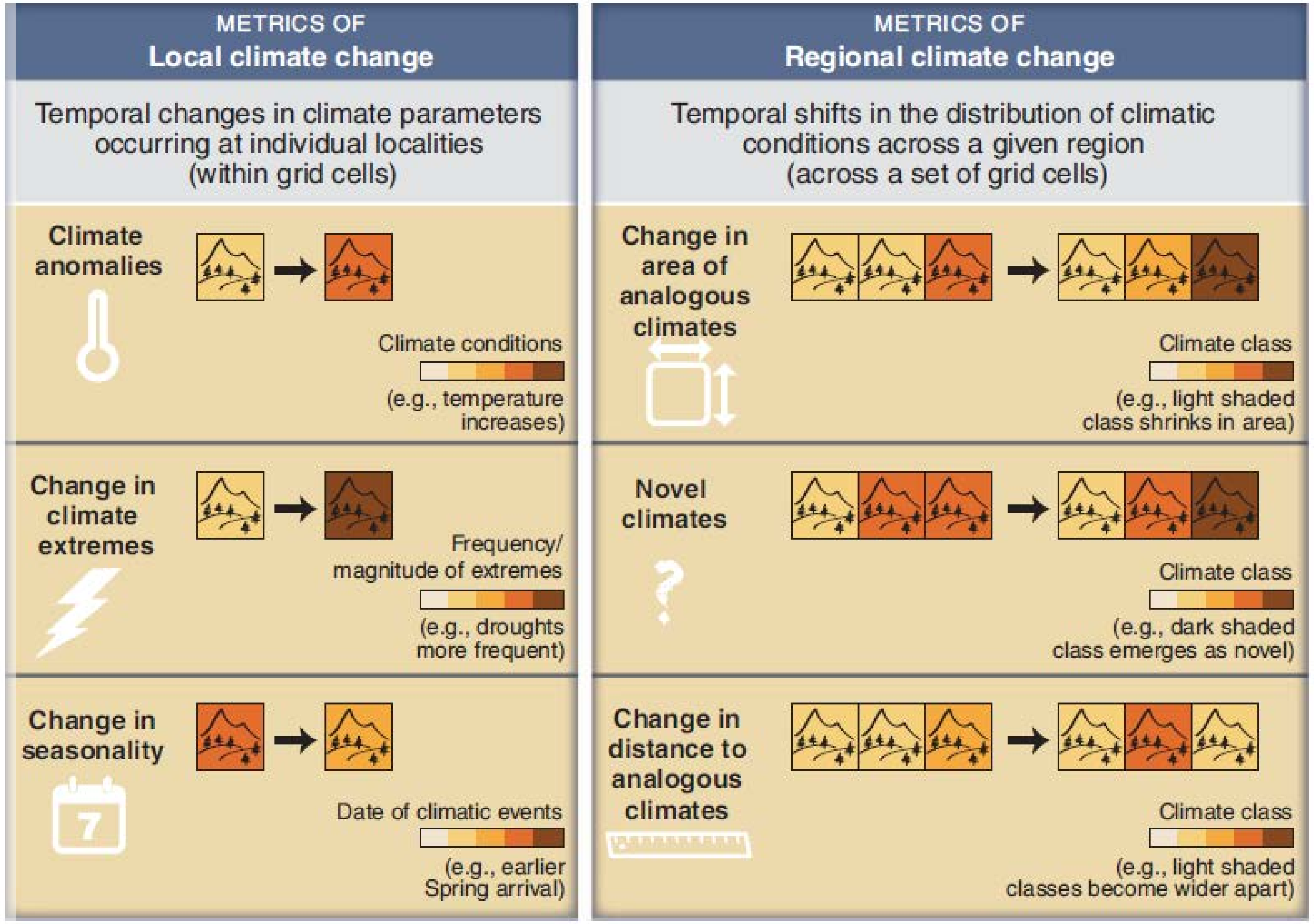
Issue 3: Multiple dimensions of climate change exposure create diverse stressors by which climate change influences biodiversity

AdaptWest data represent multiple dimensions of climate exposure,
but is primarily

- **Macro-scale**

- **Coarse-filter**

(with some fine-filter, species-specific data layers).



Garcia et al. 2014

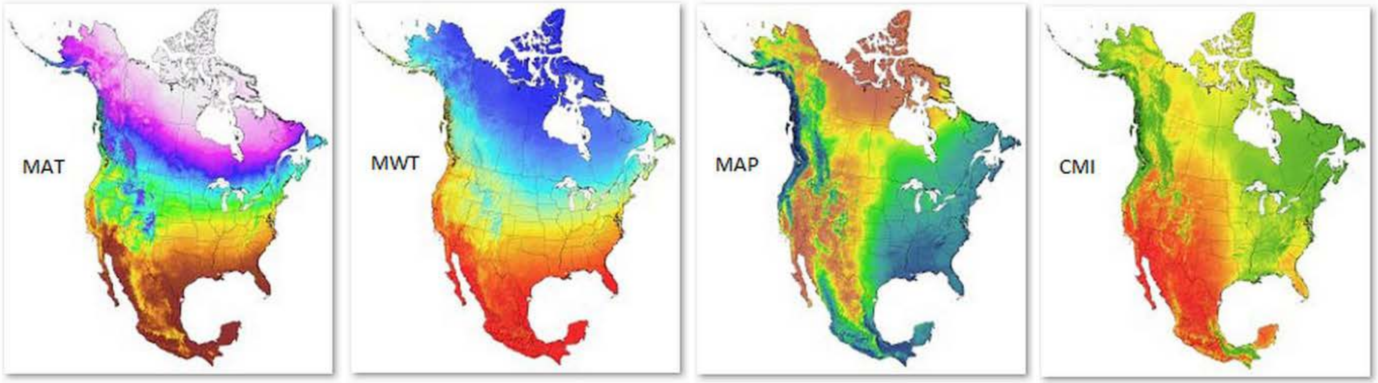
AdaptWest provides downscaled data on current and projected future climate developed via the ClimateNA software

Get Started | Browse Data | Create | Community | My Workspace

ADAPTWEST | CURRENT AND PROJECTED CLIMATE DATA FOR NORTH AMERICA (CLIMATENA)

Current and projected climate data for North America (ClimateNA)

This dataset was created by Diana Stralberg, Xianli Wang, and Andreas Hamann. It is based on the Parameter Regression of Independent Slopes Model (PRISM) interpolation method for current climate, and the Coupled Model Intercomparison Project phase 3 (CMIP3) database corresponding to the 4th IPCC Assessment Report for future projections.
The thumbnails below are images of mean annual temperature (MAT), mean winter temperature with inversions in northern mountain valleys (MWT), mean annual precipitation with leeward rainshadows (MAP), and Hogg's climate moisture index (CMI):



RESEARCH ARTICLE

Locally Downscaled and Spatially Customizable Climate Data for Historical and Future Periods for North America

Tongli Wang[1]*, Andreas Hamann[2], Dave Spittlehouse[3], Carlos Carroll[4]

[Wang et al. 2016, PLOS ONE]

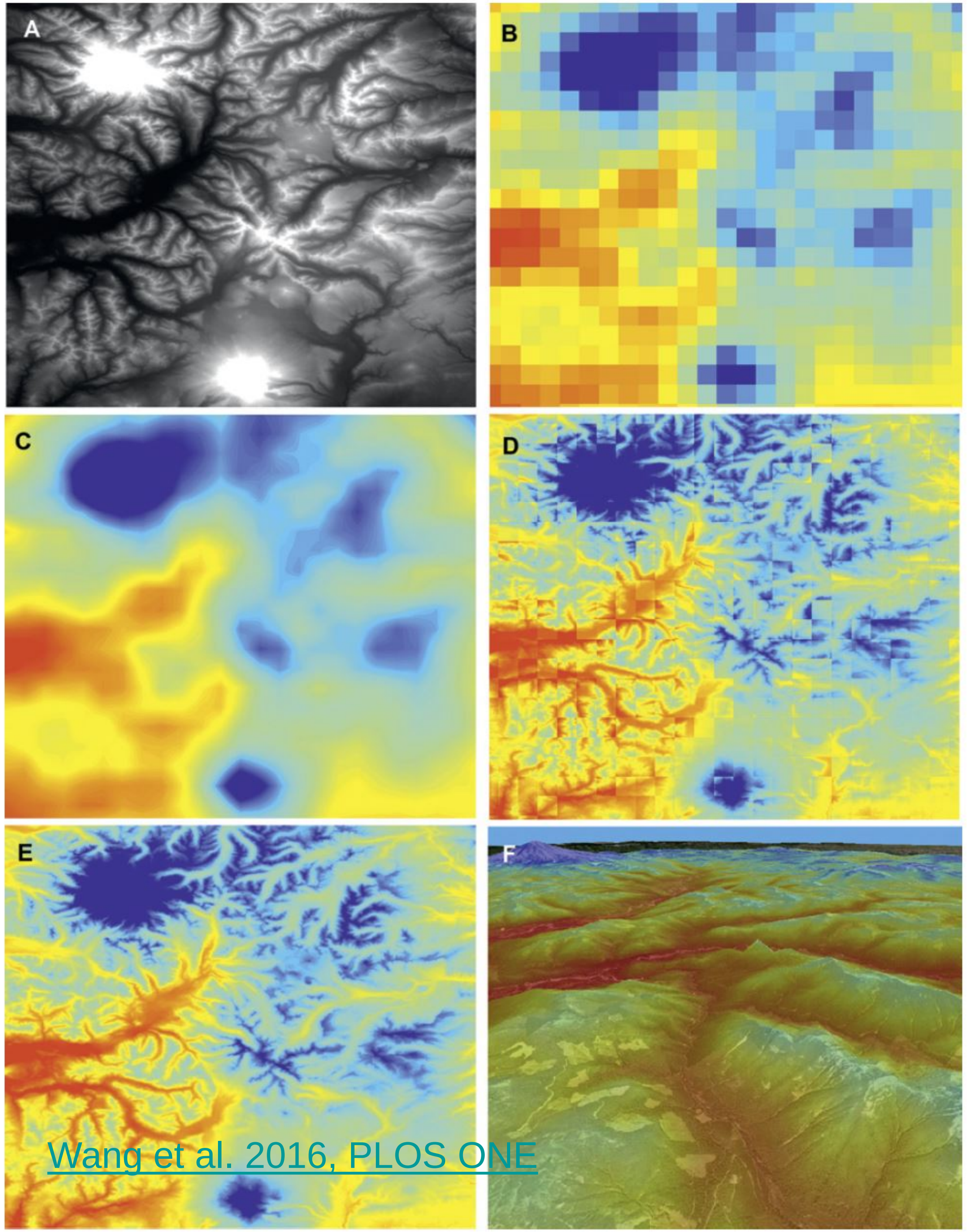
These [downscaled data] are then the source of most AdaptWest climate exposure metrics

Understanding the strengths and limitations of ClimateNA's statistical downscaling approach

Dynamic local downscaling using:

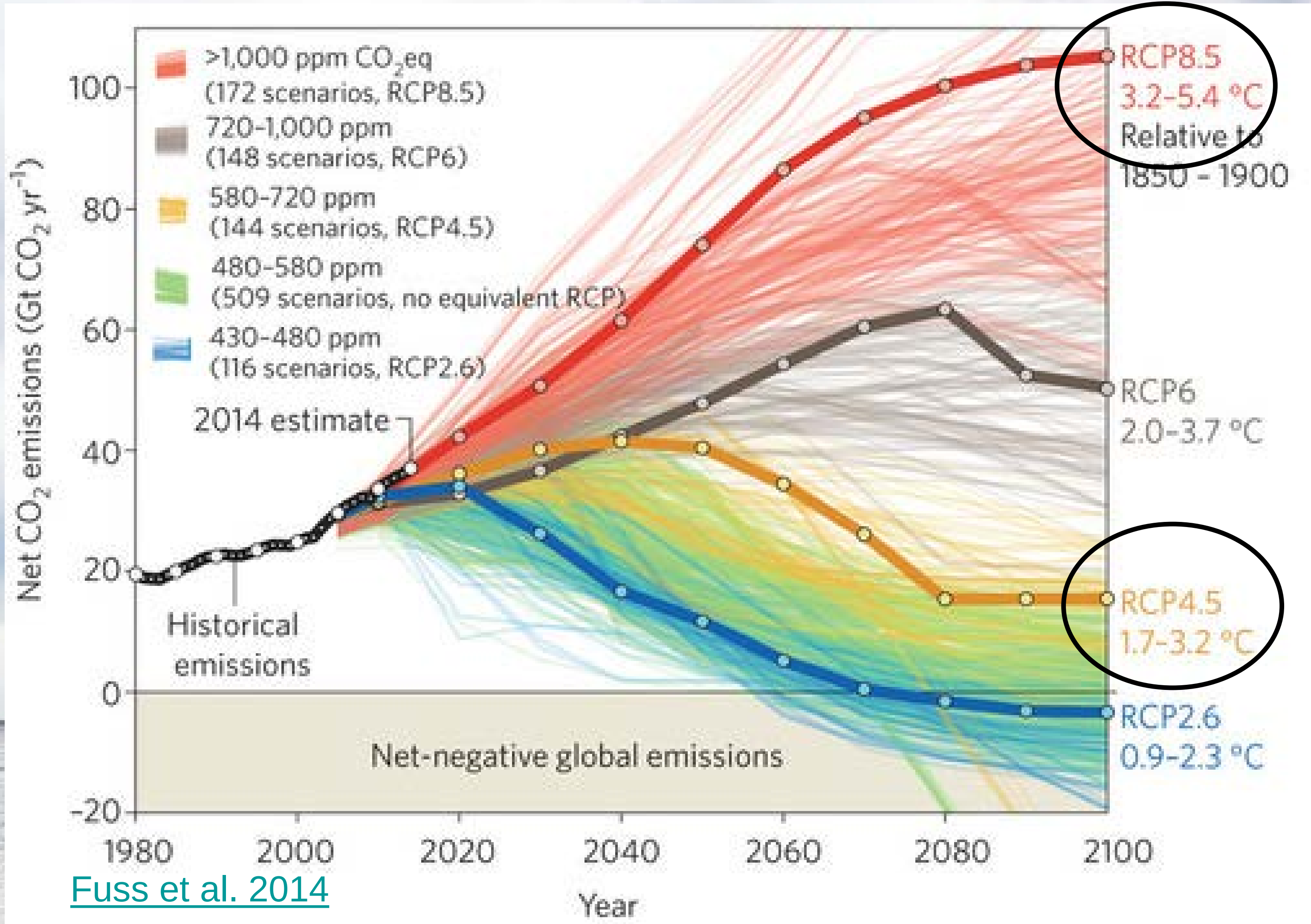
- Local regression of elevation on PRISM current climate base layer;
- Addition of downscaled GCM projections to base layer as anomalies (delta method).

Also calculates bioclimatic variables.



Wang et al. 2016, PLOS ONE

AdaptWest includes future projections for 2050s and 2080s
2 CMIP5 RCPs x 8 GCMs + Ensemble



Fuss et al. 2014

Building on initial climate projections: Bioclimatic variables and principal components analysis (PCA)

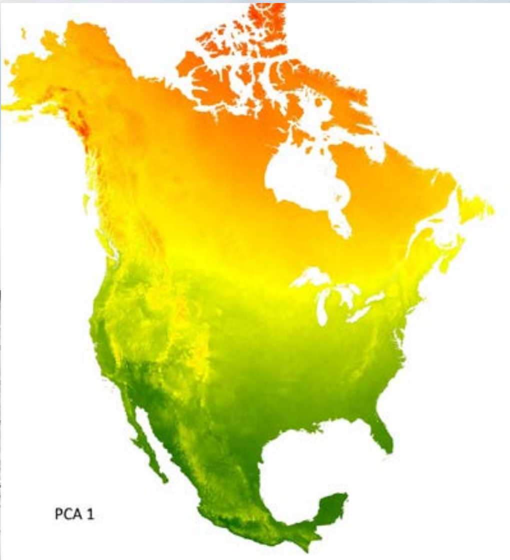
Temperature shifts are only one dimension of climate change. Most climate exposure metrics provided on the AdaptWest site are measured in terms of multivariate climate characteristics, via a principal components analysis (PCA) of 11 biologically-relevant temperature and precipitation variables. PCA provides multivariate representation of climate change while retaining the low dimensionality that facilitates development of computationally-complex metrics such as climatic velocity.

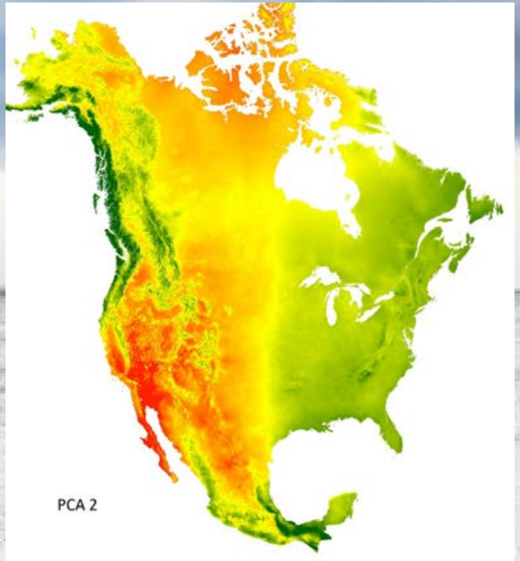
What do the PCA results represent?

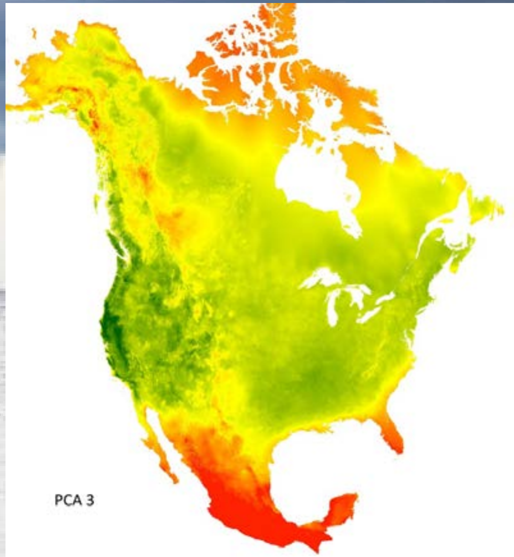
Annual temperature dominates the first PCA axis (PCA1).

Annual precipitation dominates PCA2.

Seasonality of temperature and precipitation dominate PCA3 & PCA4, respectively.



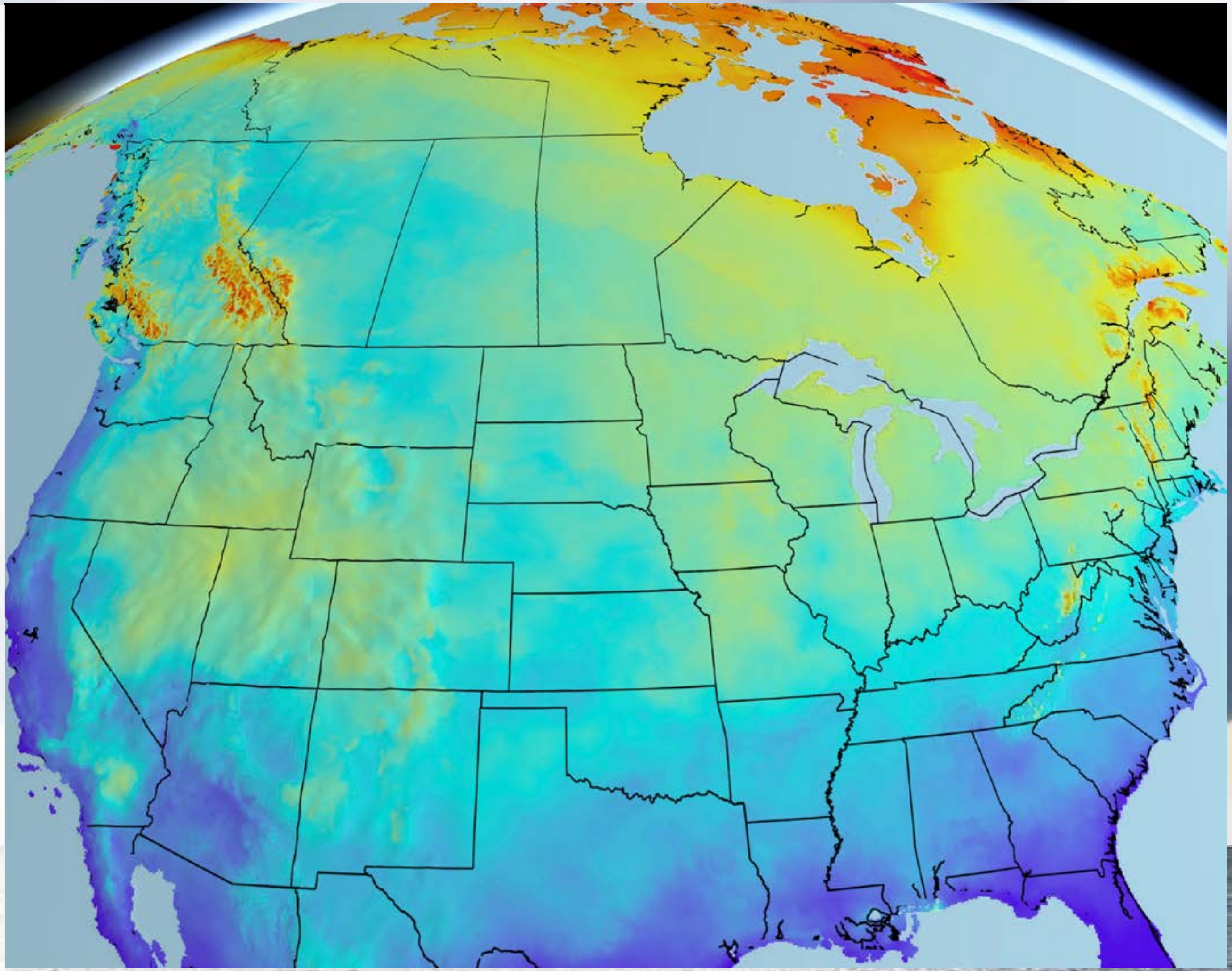




Climatic dissimilarity

The most fundamental measure of exposure to climate change is ***climate dissimilarity***, i.e., how different will the future climate at a location be from its current climate? When measured in terms of mean annual temperature, we see the well-known pattern of more rapid warming (amplification of the pace of climate change) at high latitudes.

The map on the right shows the pace of climate change in multivariate climate space (PCA1 and PCA2). As in almost all of the maps in this presentation, areas with lower values (less change) are shown in blue, and those with higher values in orange and red. The pattern of rapid warming at high latitudes is evident. Rapid change in alpine areas of the Rocky Mountains and Pacific Coast is caused by changes in both temperature and precipitation.

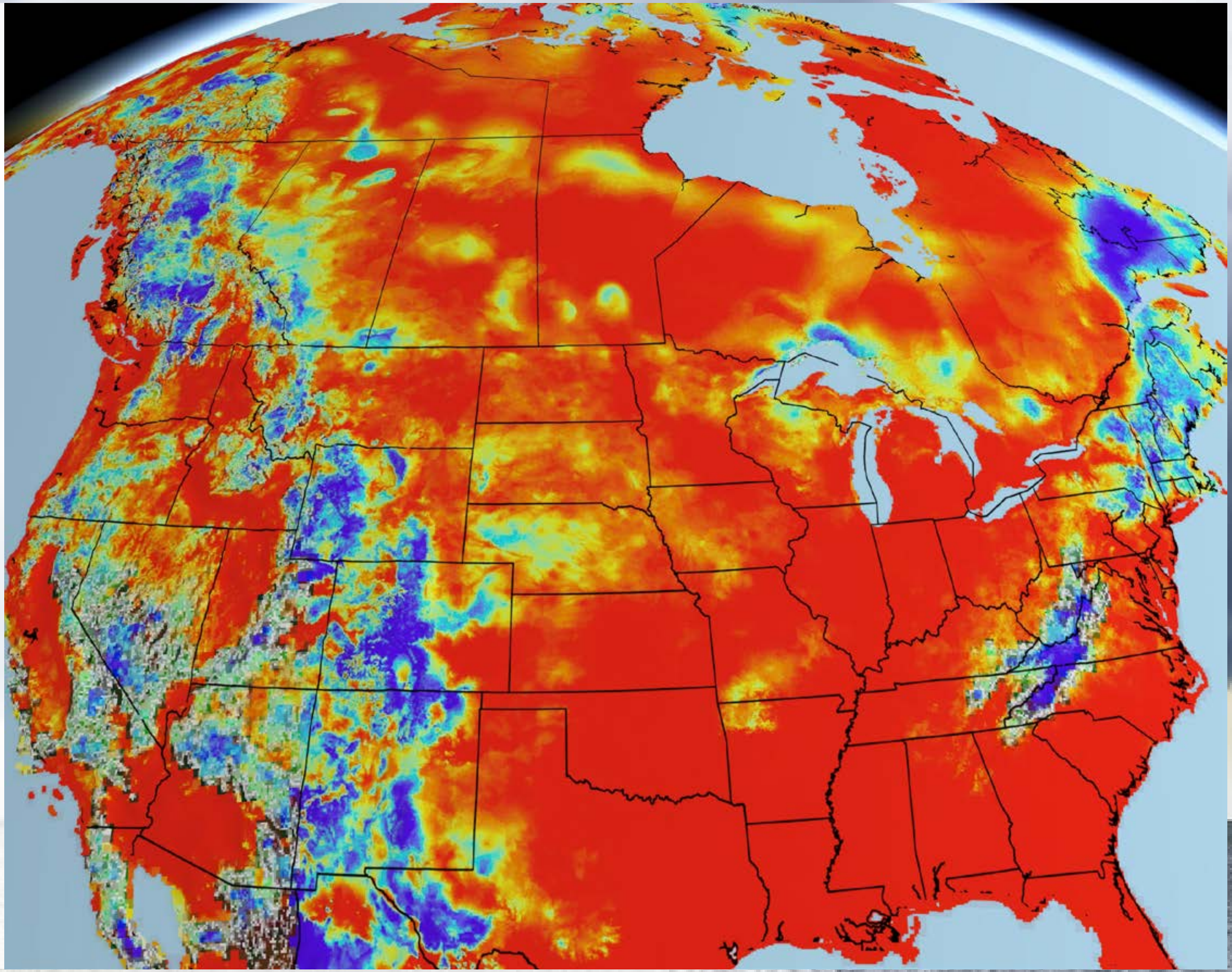


Relative climatic dissimilarity

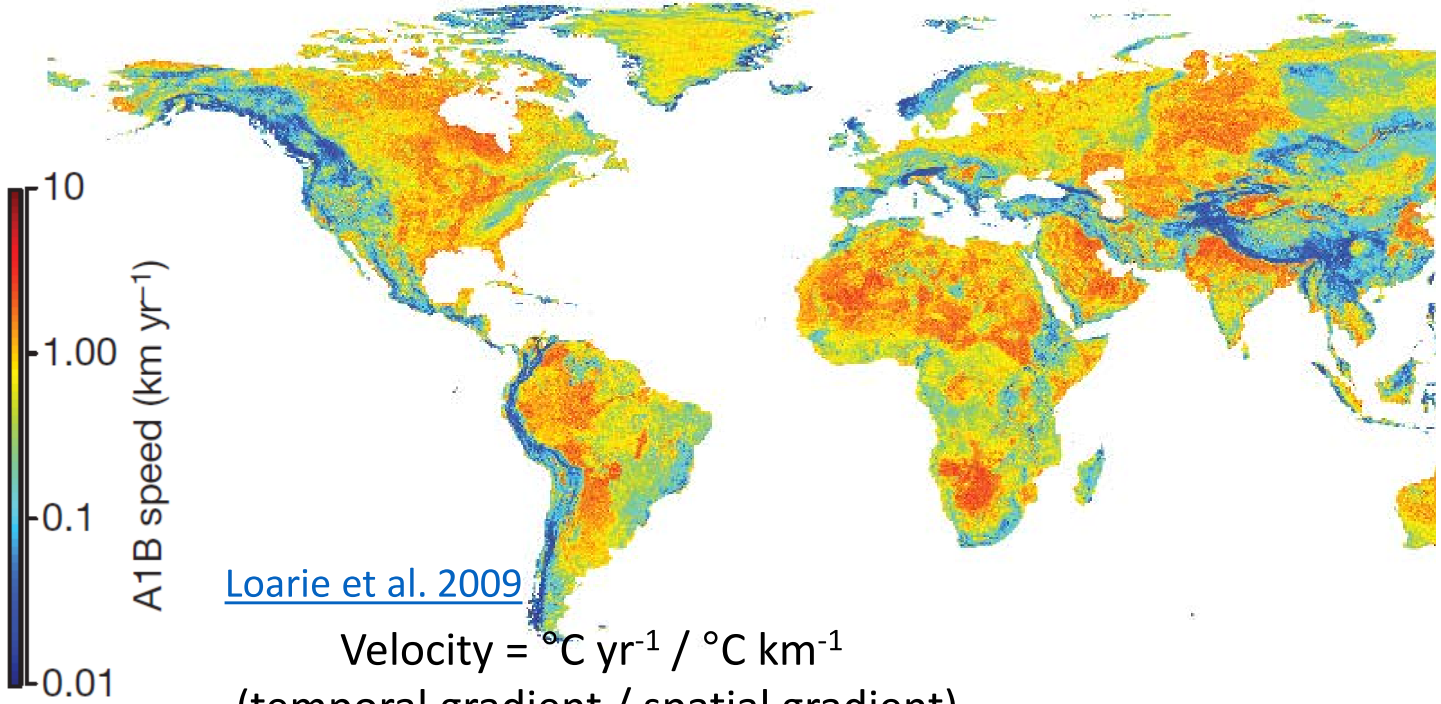
Climate dissimilarity, although the most basic climate exposure metric, has complex aspects. Recent studies have proposed that in addition to the **absolute** magnitude of dissimilarity between current and future climates at a location, it is also relevant to understand how that dissimilarity compares to the year-to-year (interannual) variation in climate at that location in the recent past. If the biota in an area was adapted to large interannual climate variations, it might be less sensitive to future climate change.

The map on the right shows data on relative climatic dissimilarity developed by [Mahony et al. 2017](). As in the previous map, low values are in blue and high values in orange/red. Montane areas experience high interannual climate variation and thus have lower **relative dissimilarity**. Conversely, because areas of the southeastern US now experience low climate variability between years, they will in the future experience relatively low **absolute dissimilarity** but high **relative dissimilarity**. Relative dissimilarity does not show the strong pattern of increasing values at high latitudes that was evident in the previous map.

Absolute and relative dissimilarity describe different aspects of climate exposure and should be seen as complementary.

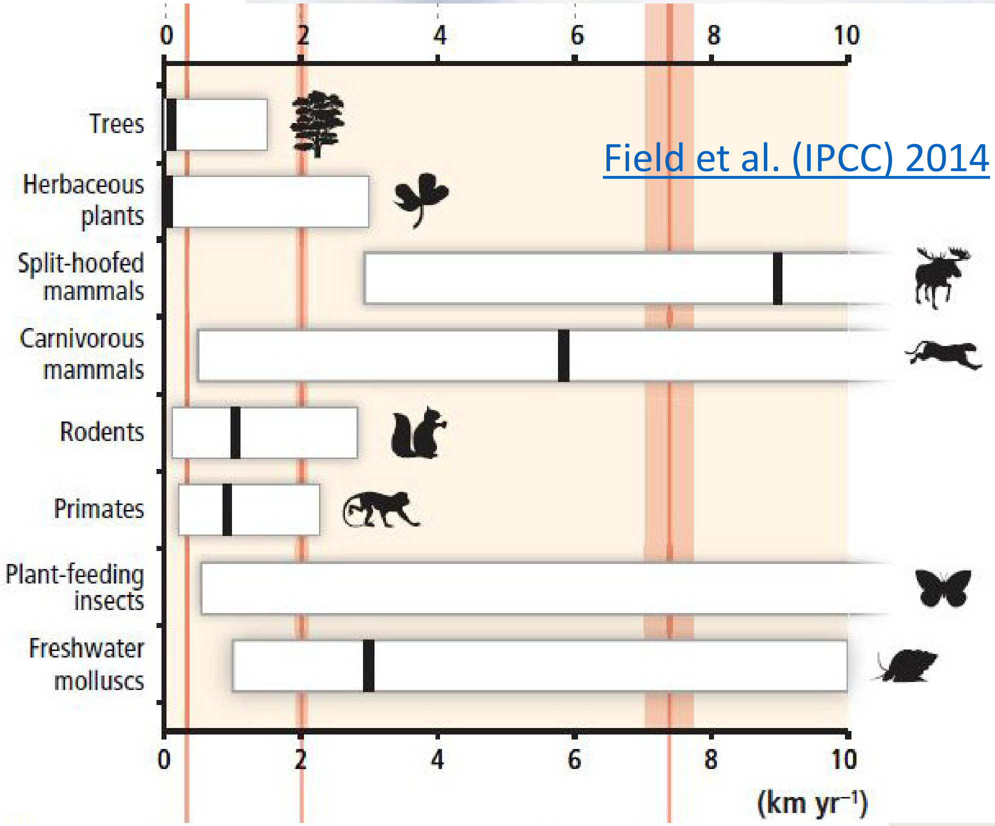


Climate velocity is the speed that an organism needs to travel to keep pace with climate



Loarie et al. 2009

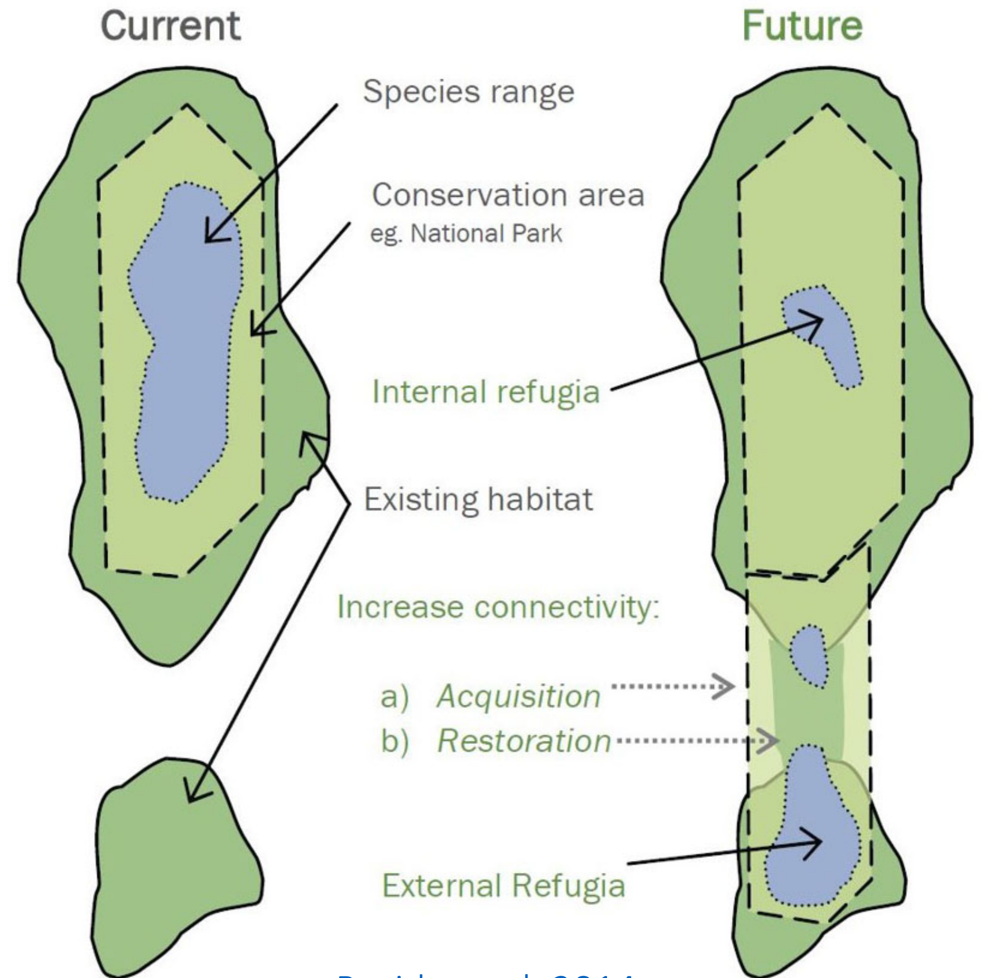
Velocity = °C yr^{-1} / °C km^{-1}
(temporal gradient / spatial gradient)



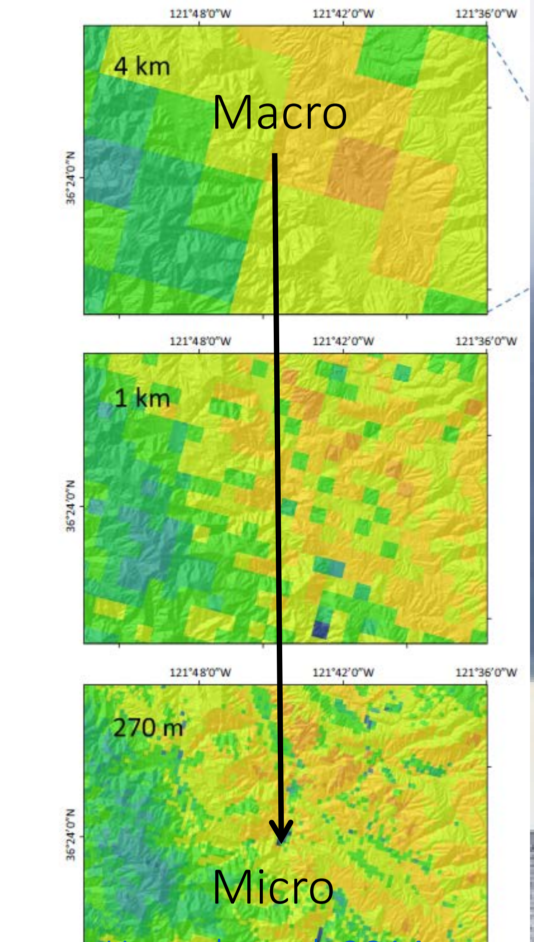
Field et al. (IPCC) 2014

A species can track climate if climate velocity is less than its potential dispersal rate.

Climate refugia (areas of species persistence during climate change) are areas of "low enough" velocity



Reside et al. 2014

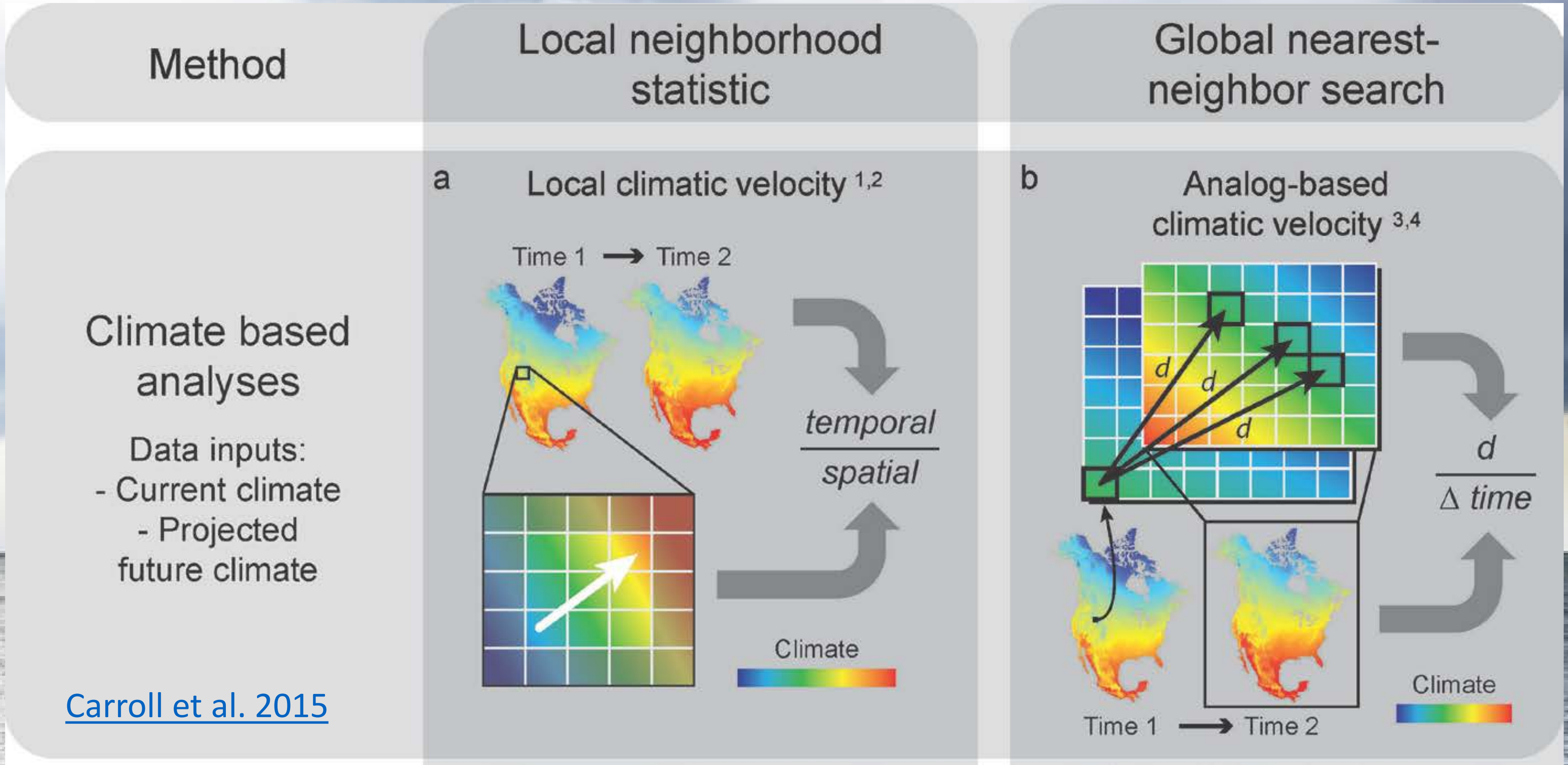


Hannah et al. 2014

Analog-based climatic velocity

To calculate analog-based **climatic velocity**, climate is categorized into types, and the straight-line distance is measured between a site and the nearest site with the same climate type in a different time period.

Influenced by processes at several scales
- Local topography
- Regional topographic position
- Location on continent
- Location in relationship to global climate circulation patterns

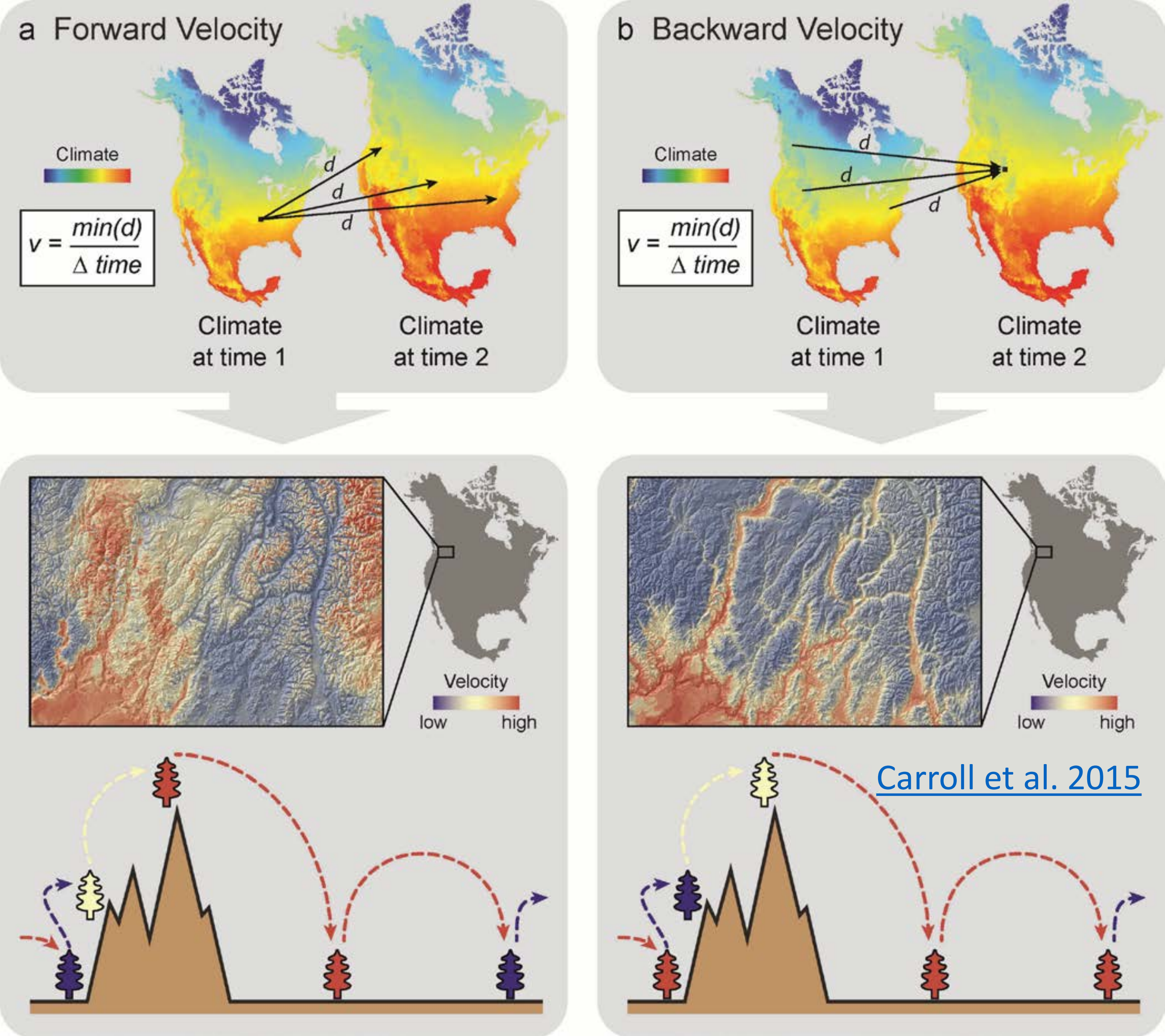


Carroll et al. 2015

Forward vs. backward climatic velocity

Forward climatic velocity measures the straight-line distance between a site’s current climate type and the nearest site with the same climate type under future climates. This represents the rate at which an organism currently at a location must move to find future suitable climate.

Backward climatic velocity measures the straight-line distance between a site’s future climate type and the nearest site with the same climate type under current climates. This represents the rate at which organisms adapted to a location’s future climate will need to move to colonize that location.



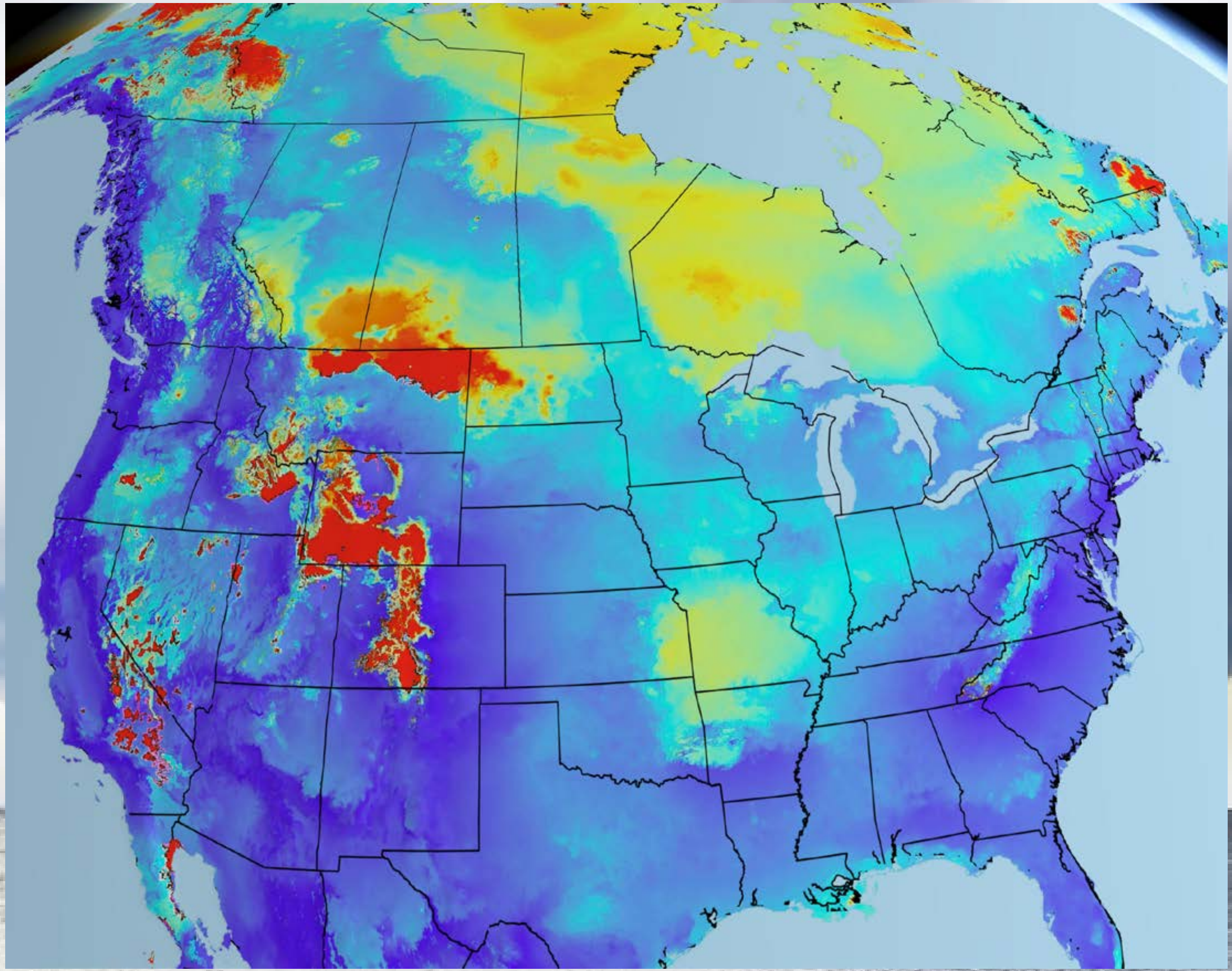
Carroll et al. 2015

Forward climatic velocity

Forward climatic velocity provides information on the ability of resident species and ecosystems to persist regionally.

Forward velocity will often be high in alpine areas because reaching the nearest analogous future climate may require dispersal to distant higher elevation mountaintops.

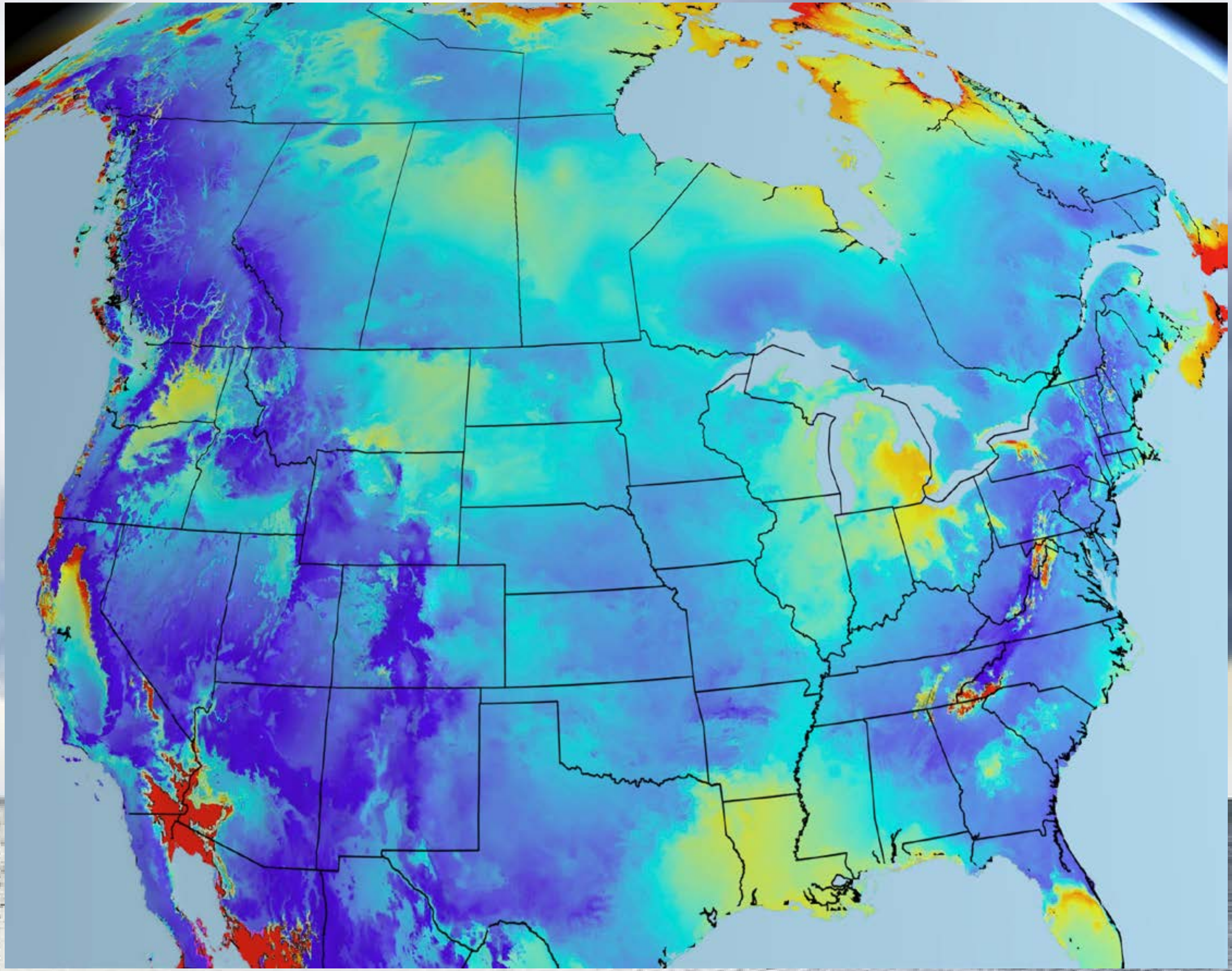
Data available here.



Backward climatic velocity

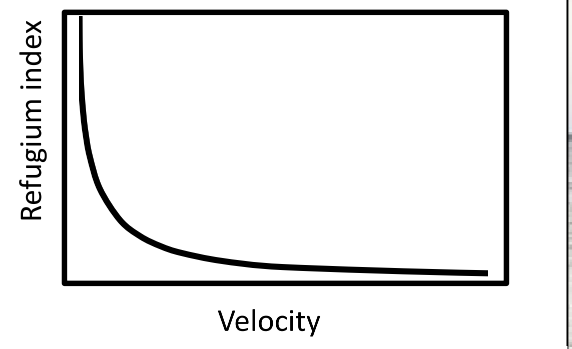
Backward velocity represents the distance and rate at which organisms adapted to a location's future climate will need to move to reach that location, and reflects a location's ability to serve as a refugium for species and ecosystems.

Backward velocity (data available here) is generally low in alpine areas, because adapted organisms can reach the site from nearby downslope locations. Values are often high in valley bottom habitat because organisms must travel longer distances to colonize these locally new habitat conditions.

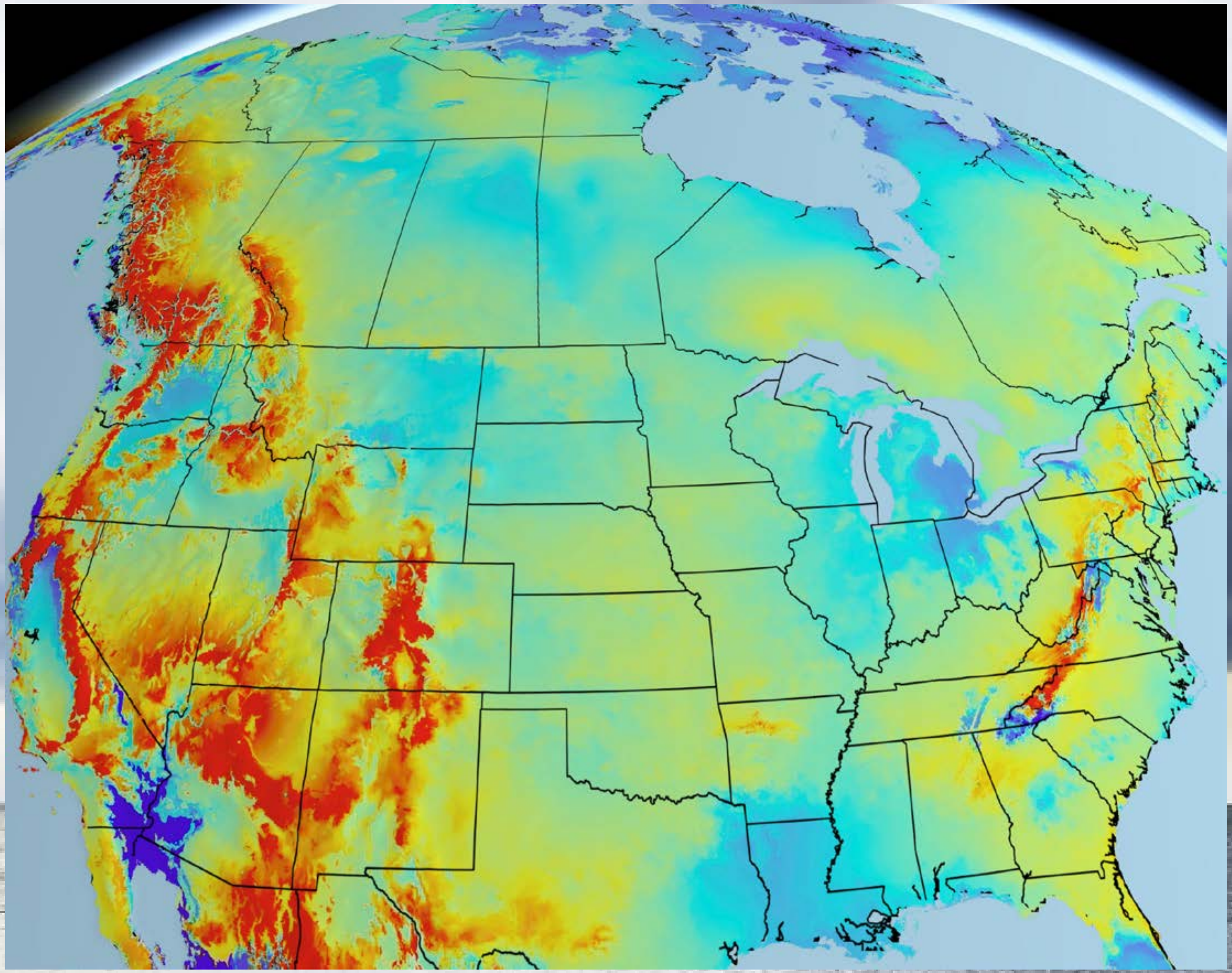


Climatic-velocity-based refugia

Areas with low backward climatic velocity will have higher values as refugia, so we transform velocity values to a refugia index by multiplying the log transformation of velocity by negative 1. A log transformation is used because we are most interested in variation in the index at relatively low velocity values.

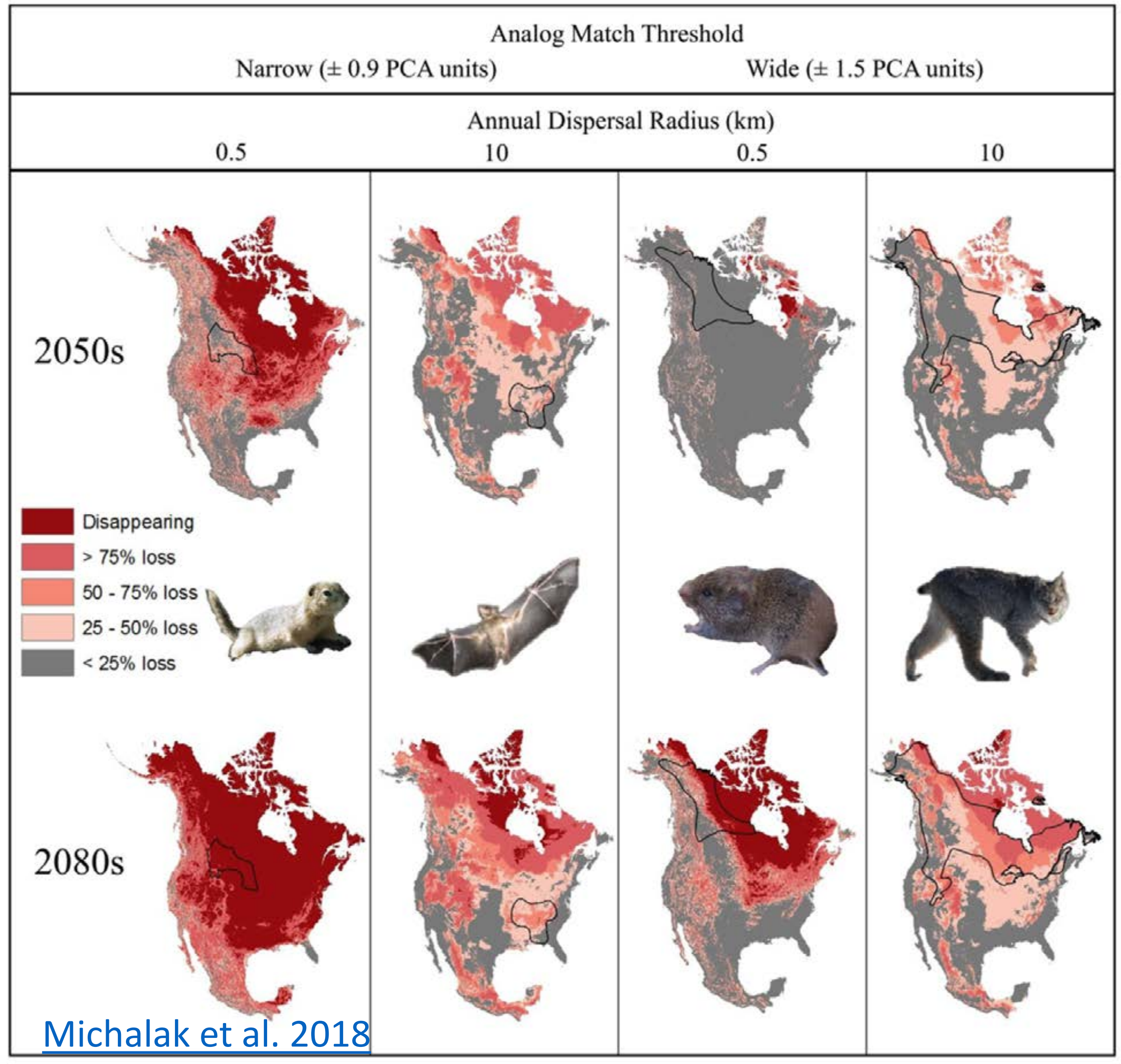


Carroll et al. 2017, Stralberg et al. 2018



Coarse-filter refugia informed by ecological parameters

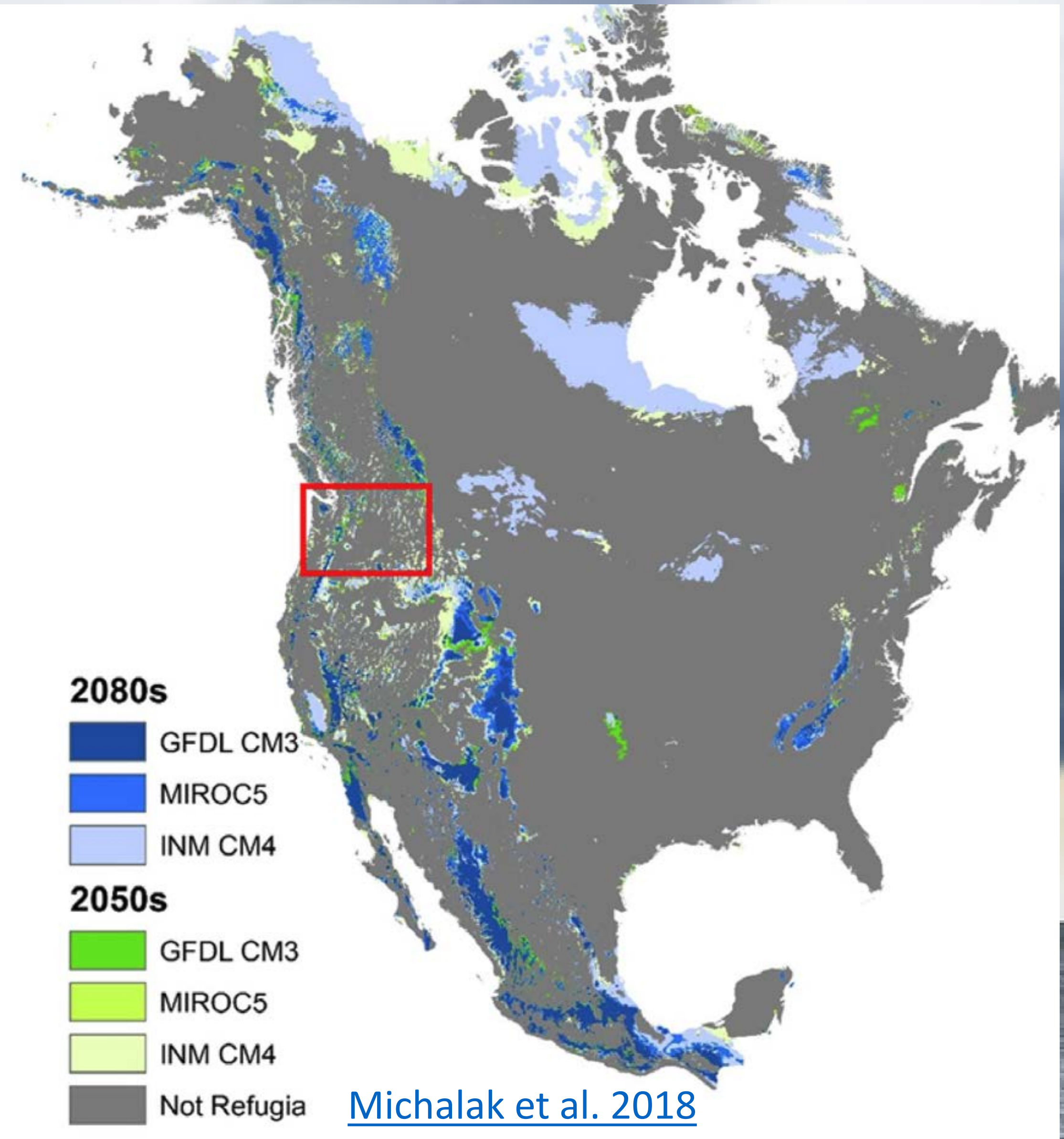
Michalak et al. 2018 used biologically derived thresholds to define climate types based on average climate niche widths for a large group of species. The study also limited the maximum distance at which matching climate types could occur to be considered in refugia calculations, based on dispersal rates for 4 example species types.



Michalak et al. 2018

Coarse-filter refugia informed by ecological parameters

Refugia extent varied depending on the analog threshold, dispersal distance, and climate projection. However, in all cases refugia were concentrated at high elevations and in topographically complex regions. This is an example of a hybrid approach using coarse-filter methods that are informed by fine-filter information summarized from groups of species. Data are available here.

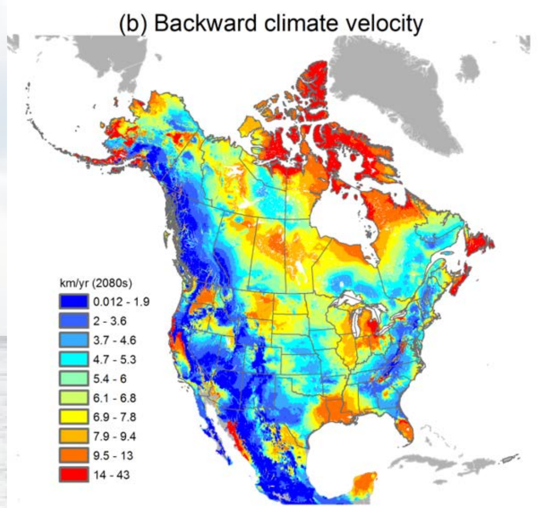


Michalak et al. 2018

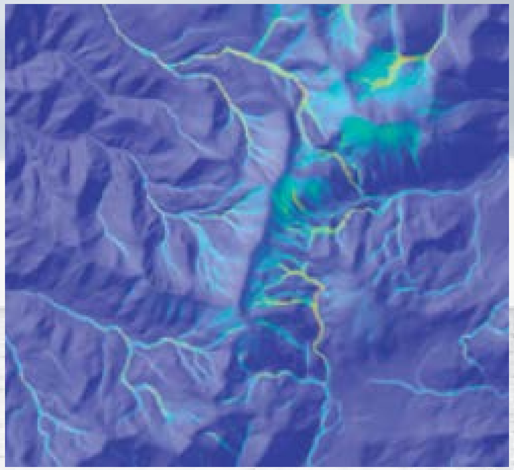
Refugia (areas of species persistence under climate change) span a range of spatial scales

Refugia characteristics

Macro-scale	Micro-scale
In-situ or Ex-situ	In-situ
Long-term	Transitional

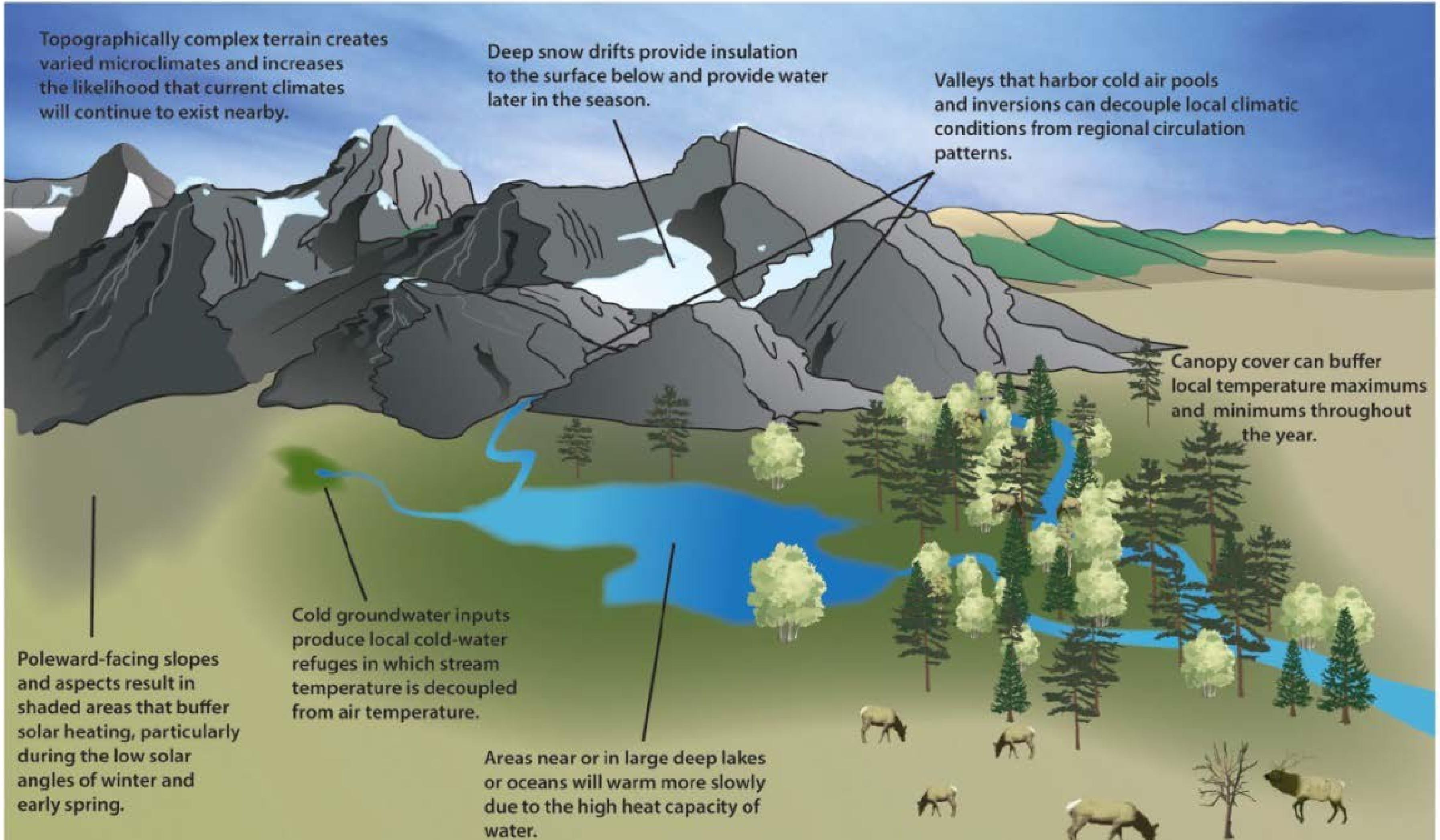


Carroll et al. 2017

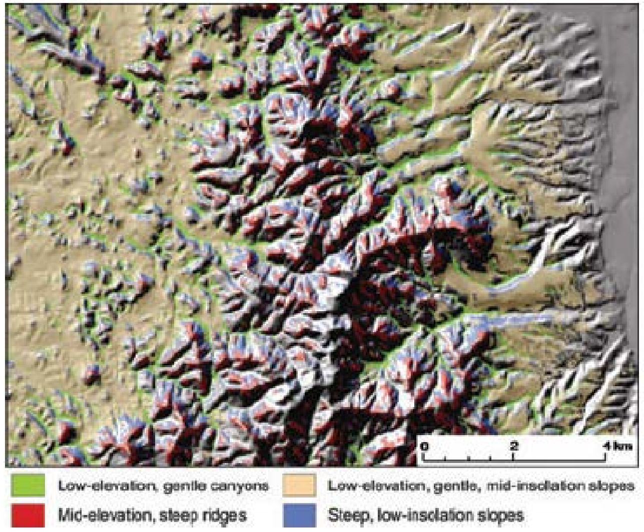


Dobrowski 2011

Micro-scale climate refugia driven by terrain-related factors

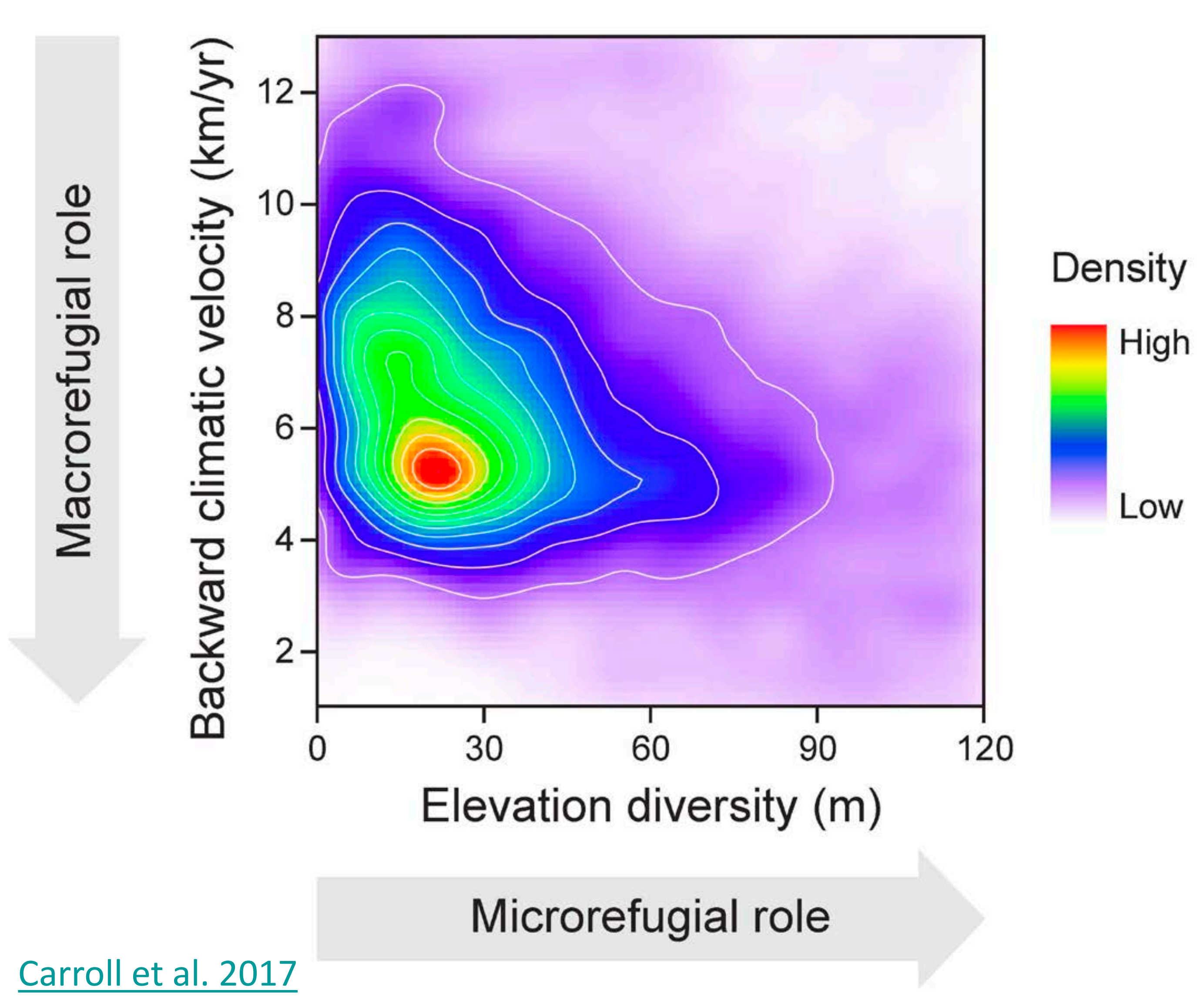


Morelli et al. 2016



Beier and Brost 2010

Microrefugia occur both within and outside of macro-refugia (areas of lowest climate velocity)

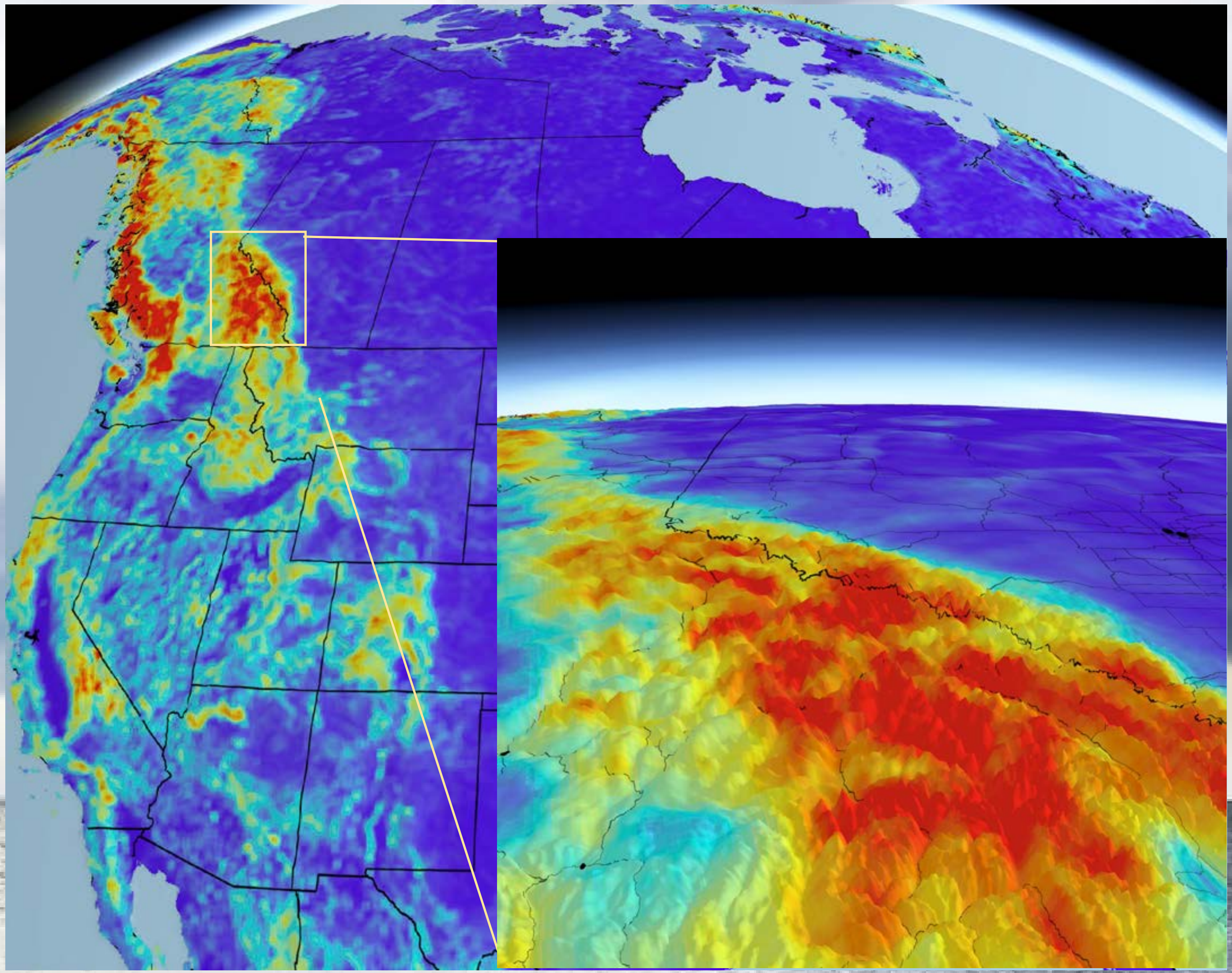


Carroll et al. 2017

Topographic and environmental diversity as a proxy for microrefugia

Species distributions, communities, ecosystems, and broader patterns of biodiversity are known to be influenced by abiotic drivers such as soils, geology, and topography.

Topographic diversity (**topodiversity**) data are useful for identifying areas where a heterogeneous physical environment (e.g., steep elevation gradients or diverse aspects) increases the likelihood that species will be able to find nearby suitable habitat as climate changes. Data available here.



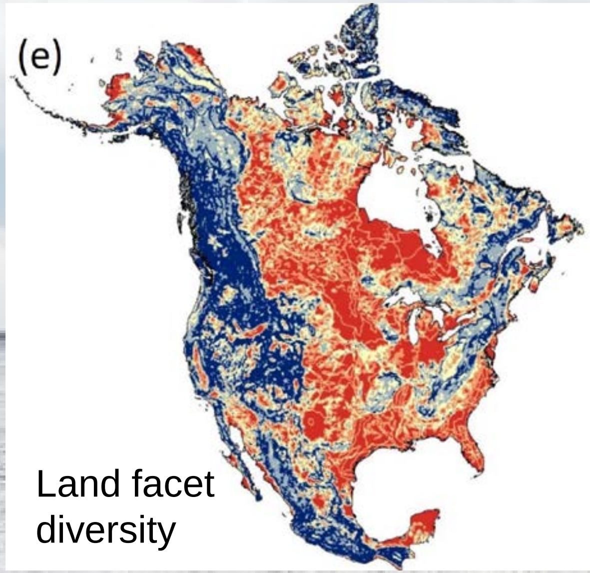
Topodiversity

Land facets and topofacets

Land facets are habitat types derived from soils and topography data. The “Conserving Nature’s Stage” or “Enduring Features” approach seeks to protect a diversity of physical habitat types in order to foster a diversity of biota in the future

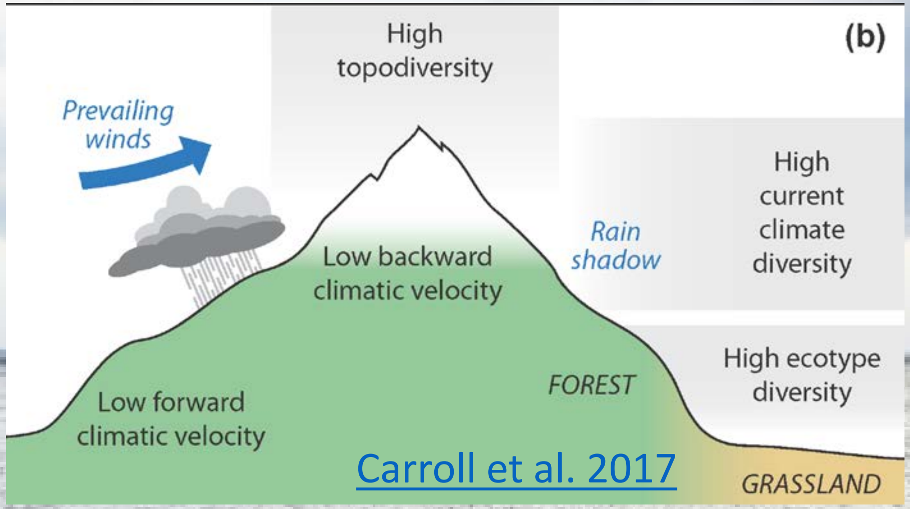
AdaptWest facet data for North America at 100m resolution (data available here) are based on landform, heatload index, and elevation (topofacets) with the addition of soils and geologic data for landfacets.

Facet-based environmental diversity metrics (data available here) show the number of facet types within a spatial neighborhood, via the Gini-Simpson diversity index.

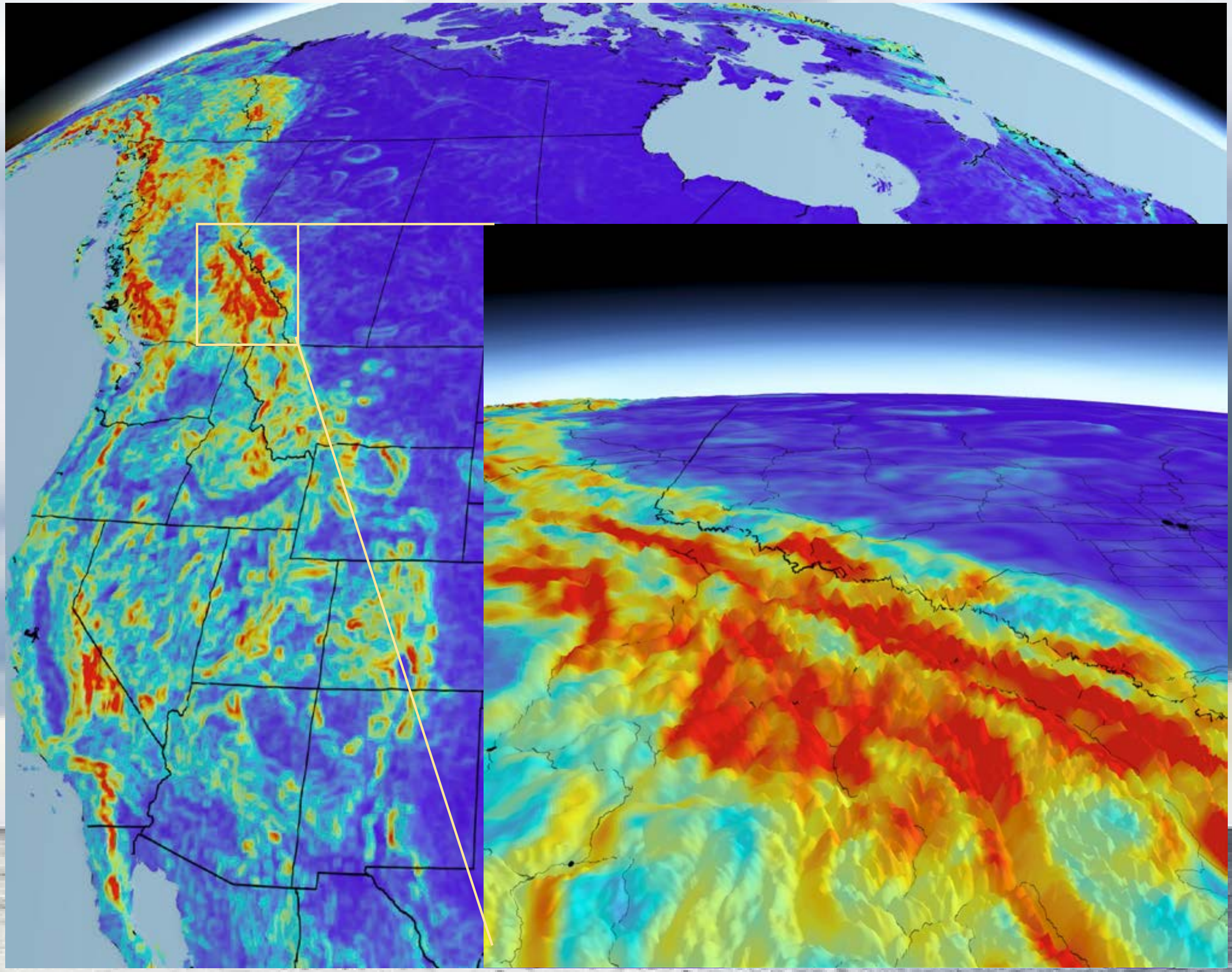


Climatic environmental diversity

Local **climatic diversity** additionally highlights areas (such as in the southwest US) with strong precipitation gradients (rainshadows) and other effects from global circulation systems. These gradients are extrapolated from the network of local weather observation data based on ClimateNA's local regression functions and PRISM modeling of the influence of terrain on climate. Thus, in contrast to topodiversity, climatic diversity is influenced by both macro- and micro-scale factors. Data available here.

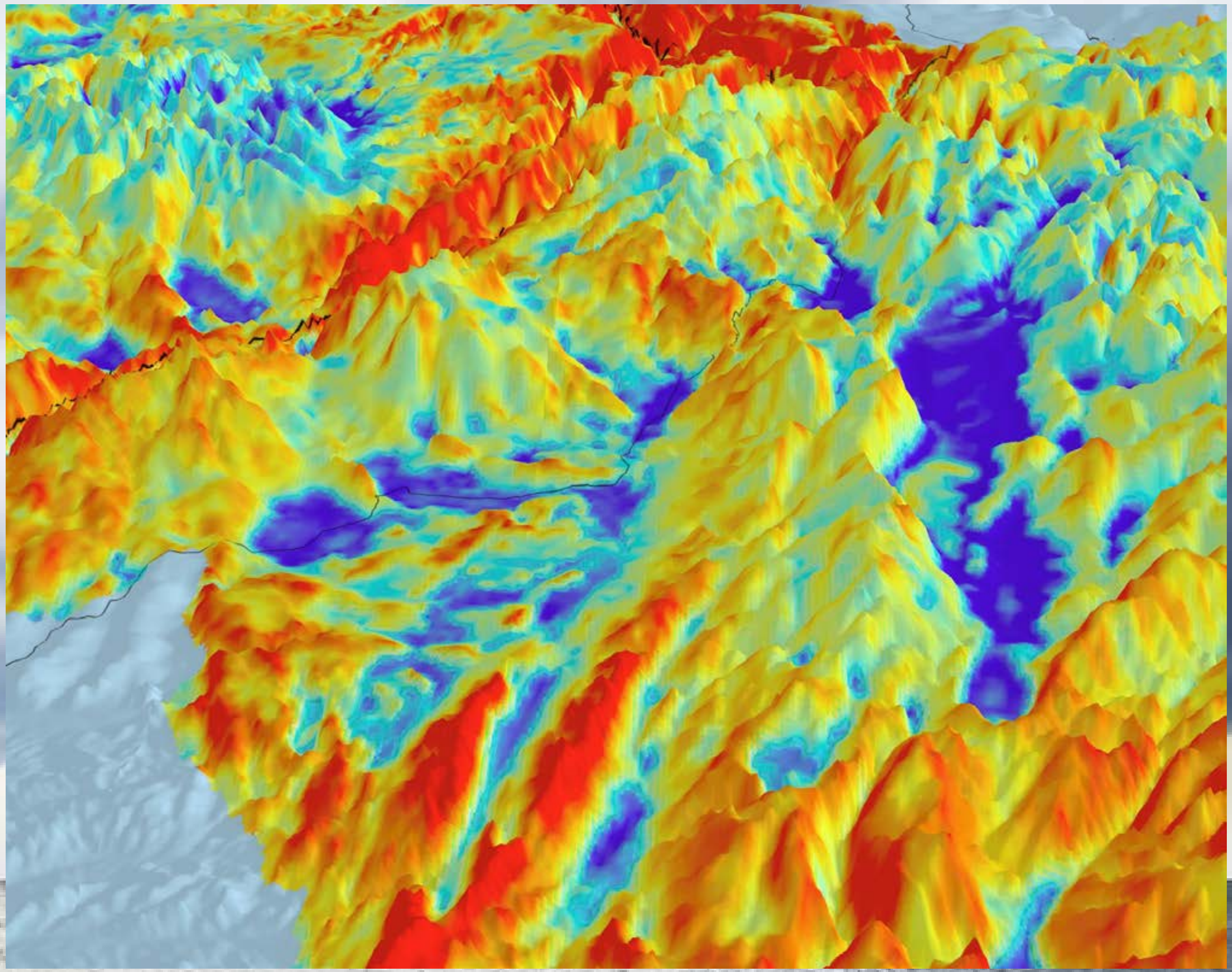


Carroll et al. 2017



Fine-scale modeling of microclimate

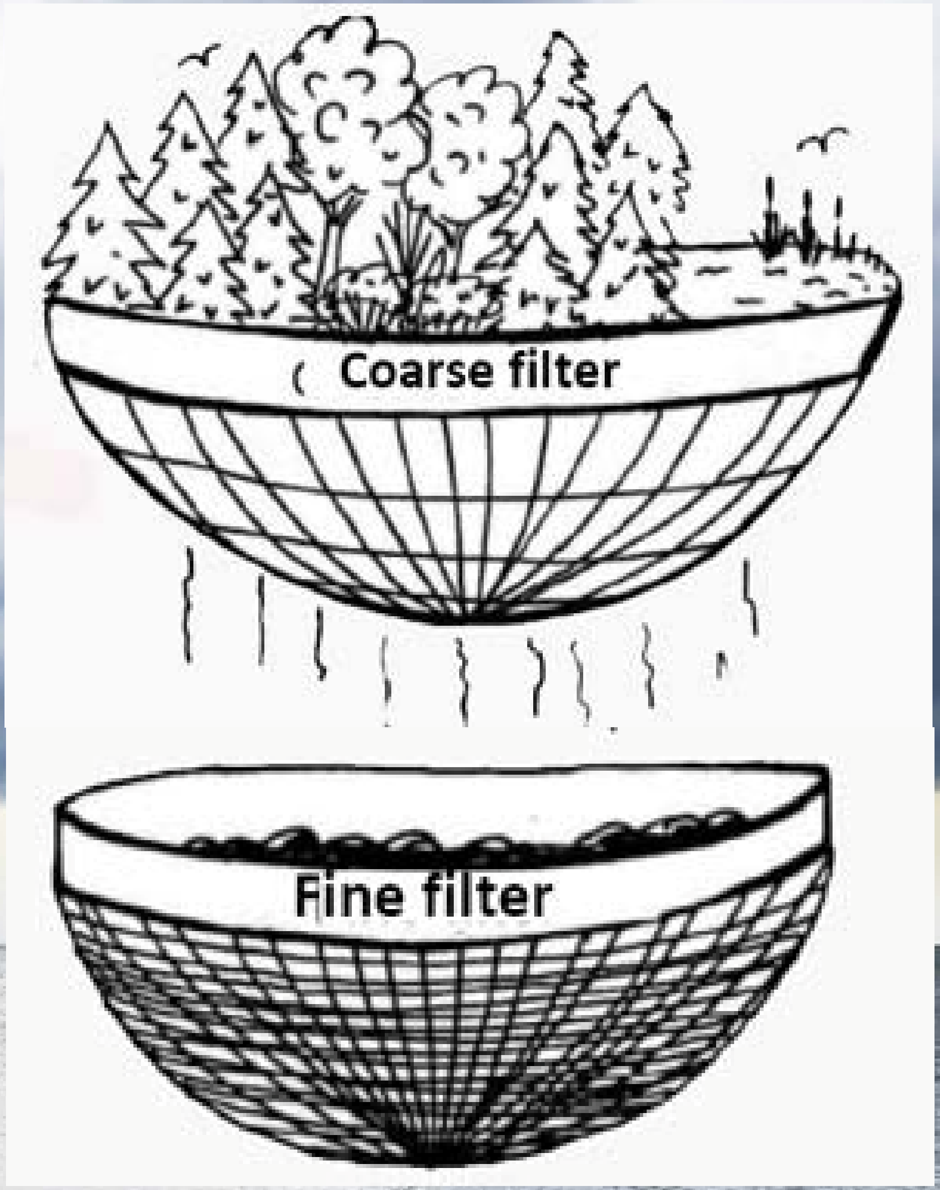
Even when high-resolution topographic data are available for downscaling of climate projections, the regression models used by ClimateNA and PRISM cannot fully capture the complex microclimatic patterns that determine the location of microrefugia. Researchers at the University of Montana (Oyler et al. 2016, Dobrowski 2010) have developed more complex statistical models to predict microrefugia location. Additionally, as higher-resolution remotely-sensed land surface temperature data become available, it will be more feasible to directly map microrefugia.



Coarse-filter and fine-filter metrics

<u>Why use coarse-filter targets?</u>
Lack of information
about most species

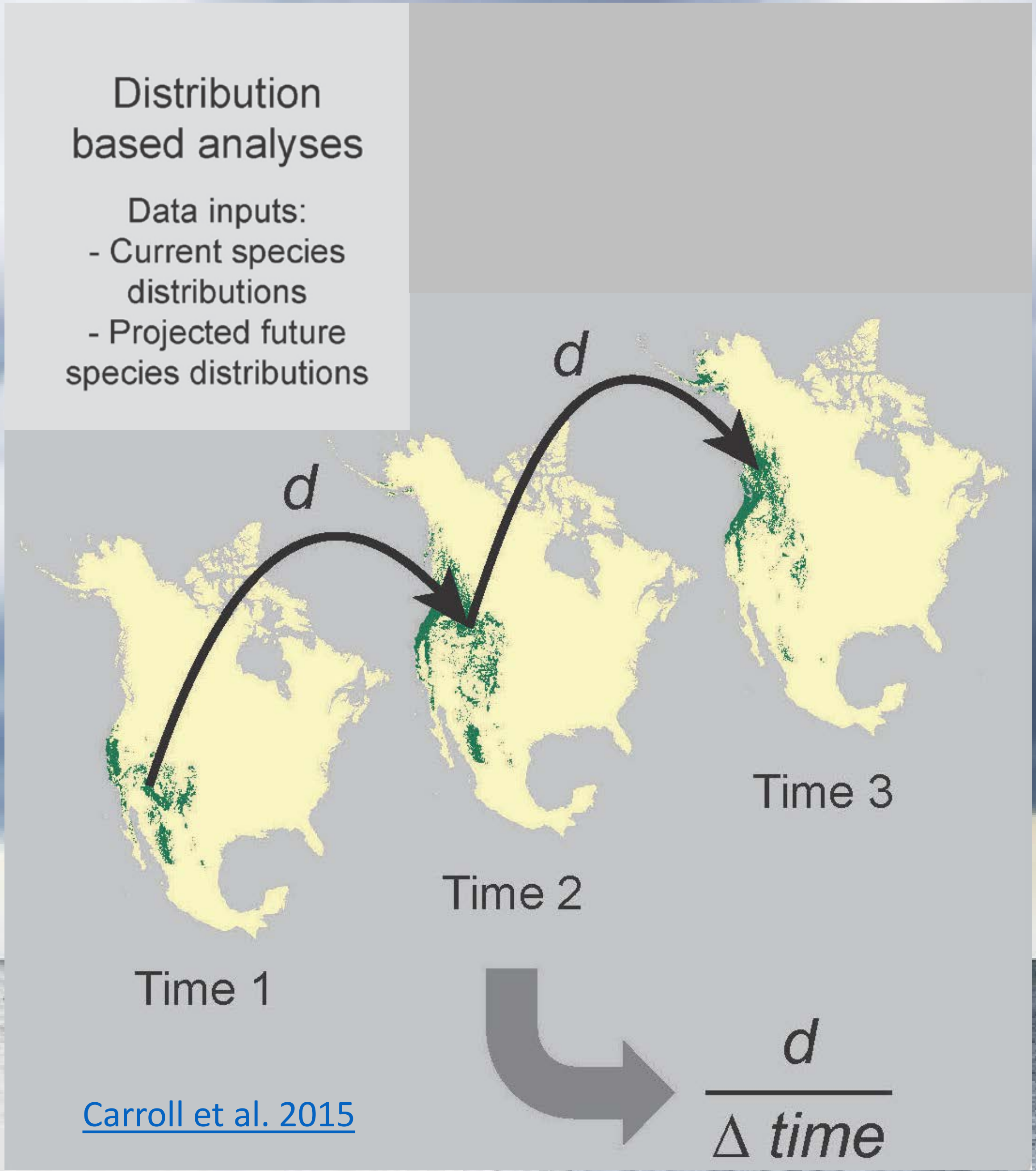
<u>Why use fine-filter targets?</u>
Coarse-filter surrogates
imperfectly protect
individual species



Biotic velocity

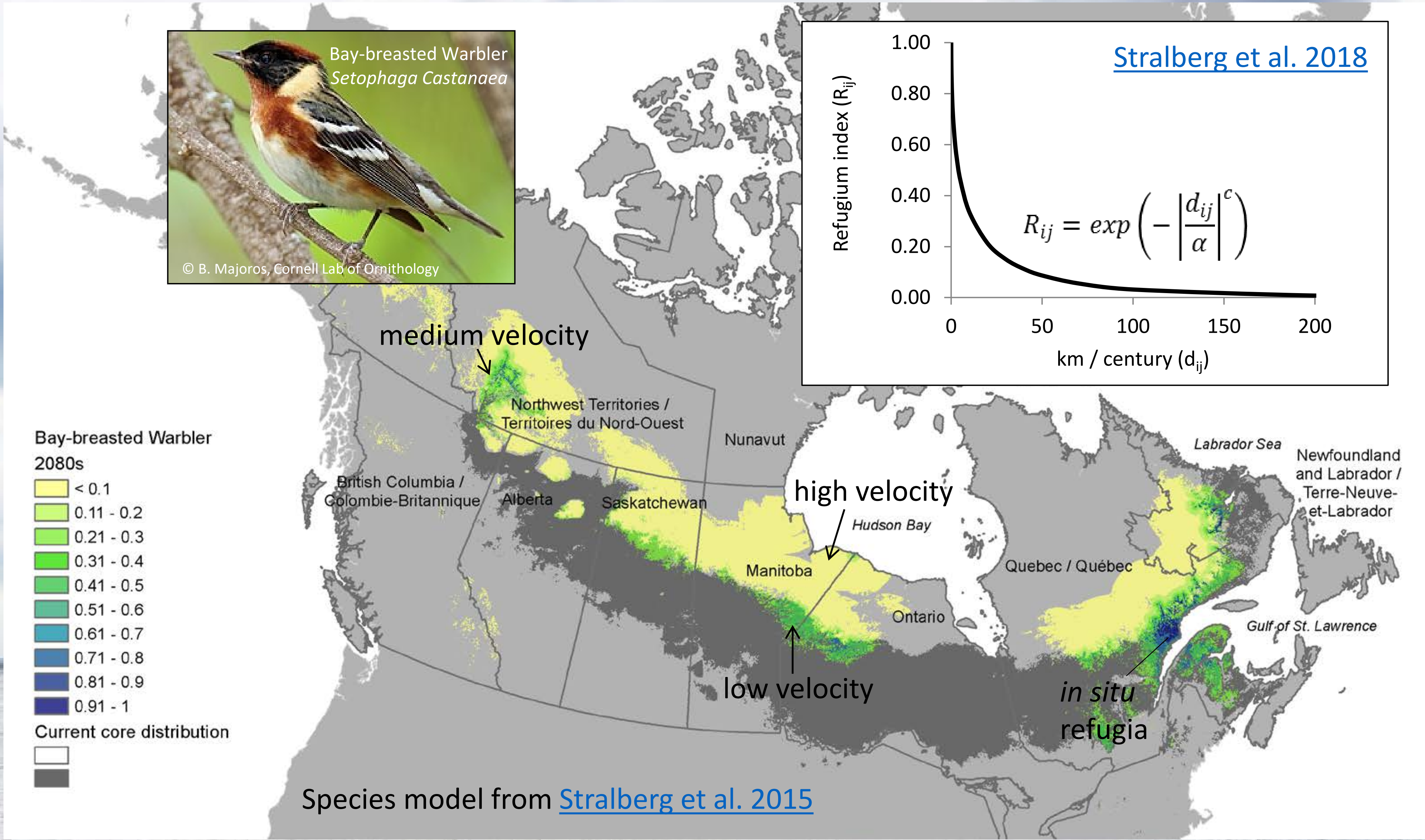
Biotic velocity is a metric that combines data from climate projections with data on the distributions of individual species. Climatic niche models based on correlations between species distributions and current climatic conditions are then projected forward to predict distribution under future climates. Biotic velocity represents the distance between a site and the nearest site projected to be climatically suitable for the species under future projected climates.

Biotic velocities provide a lower estimate of migration requirements than does climatic velocity because the metric assumes local populations can adapt to any climatic conditions found within the full range of the species current distribution. The metric can be reported on a per-species basis or averaged across a taxa group.



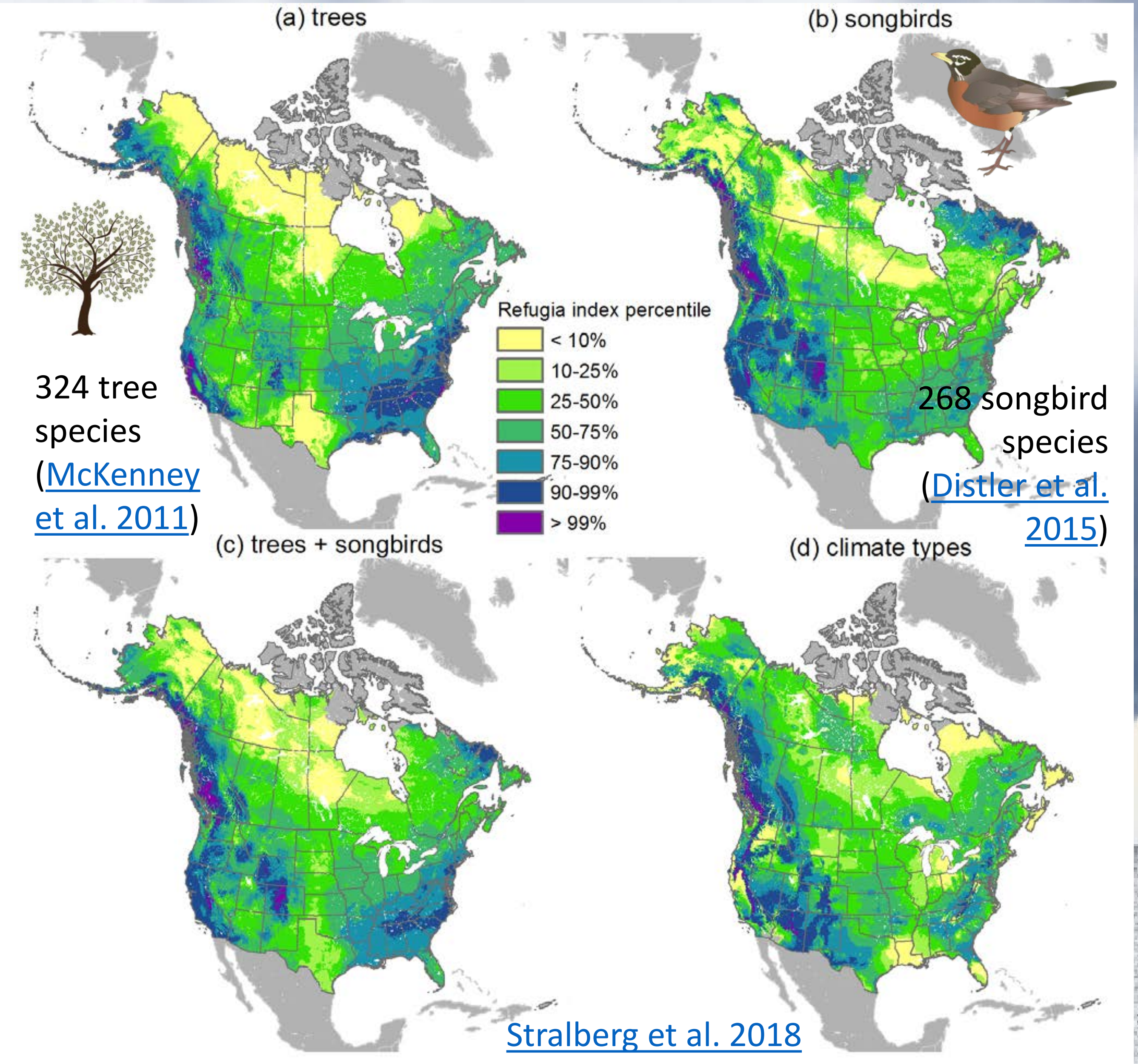
Carroll et al. 2015

Backward biotic velocity provides a species-specific refugia index



Species model from Stralberg et al. 2015

Refugia locations vary between trees and songbirds

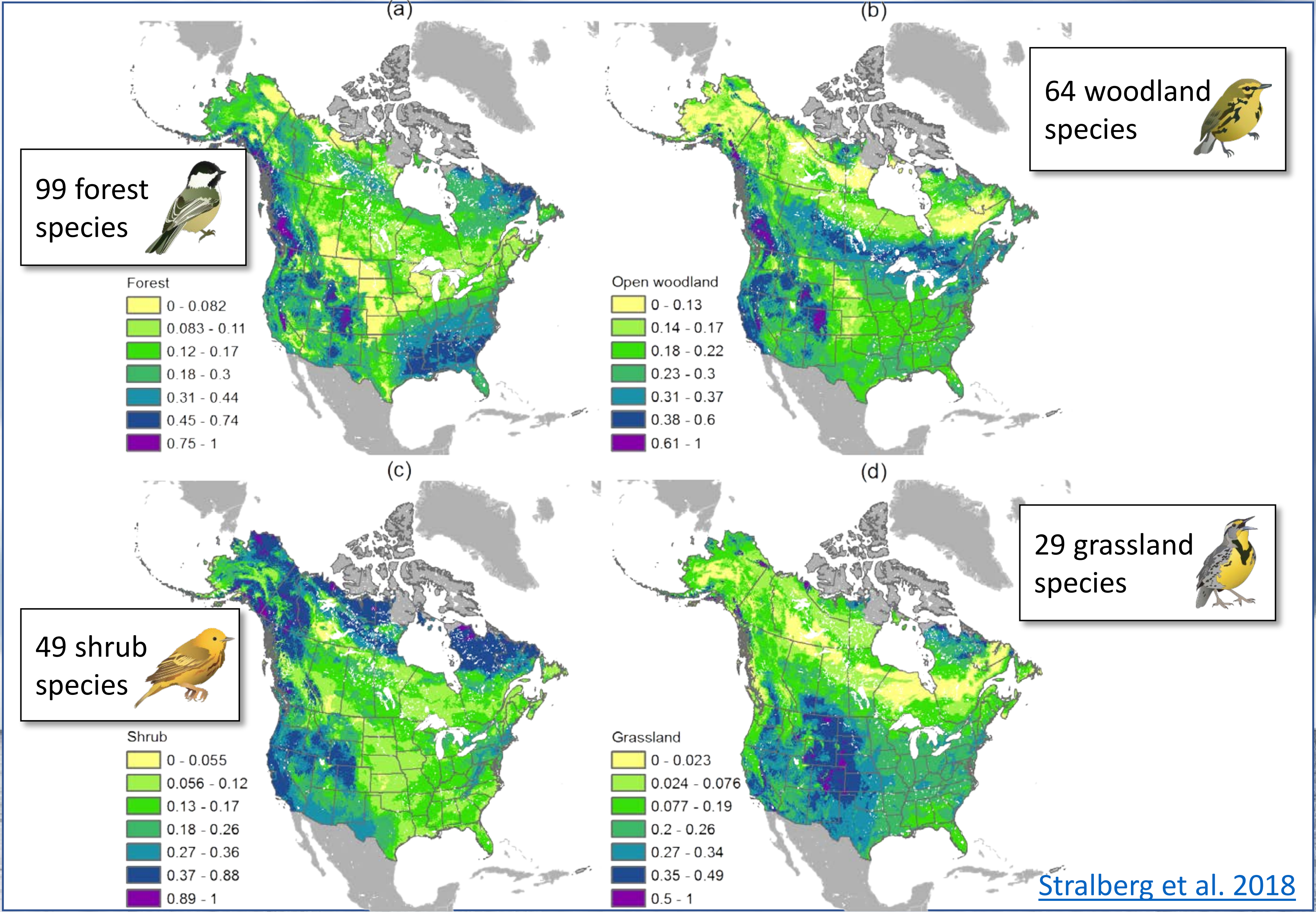


324 tree species ([McKenney et al. 2011](#))

268 songbird species ([Distler et al. 2015](#))

[Stralberg et al. 2018](#)

And between different songbird habitat groups

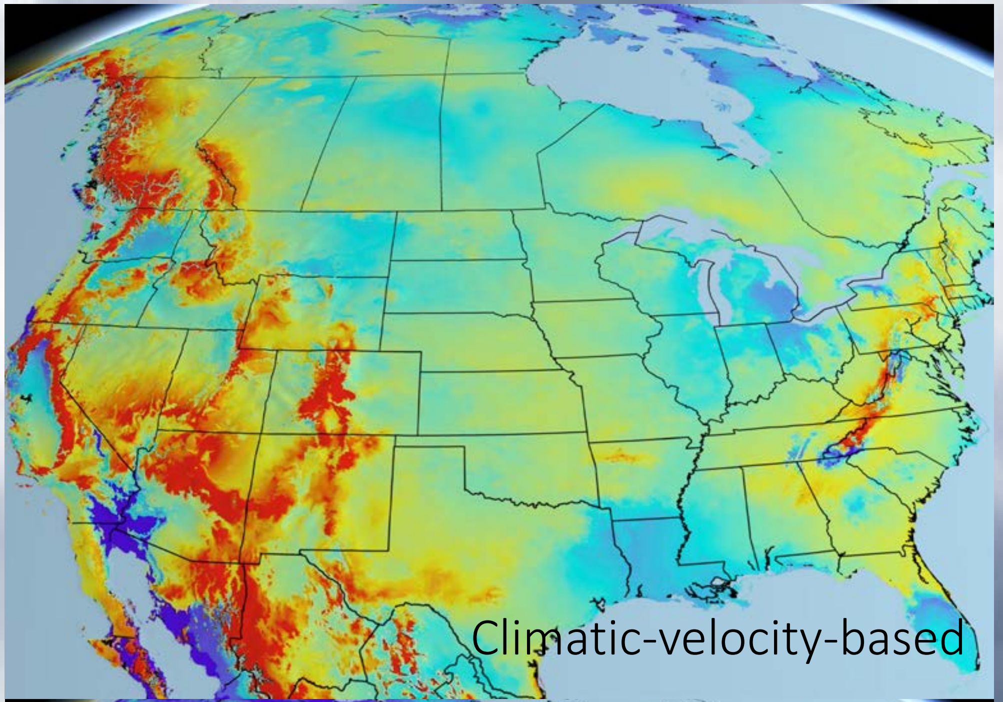


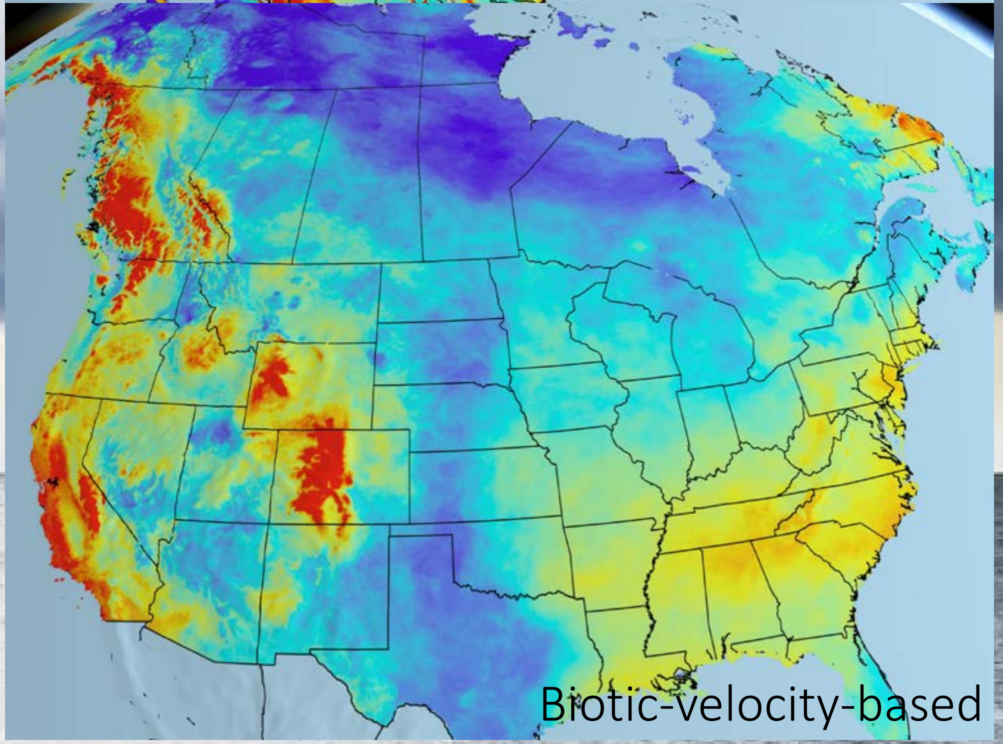
Stralberg et al. 2018

Climatic- vs biotic-velocity-based refugia

When compared to refugia defined by low climatic velocity, biotic velocity highlights the influence of biogeographic factors (including past refugia locations) which have made certain regions, such as California and the southern Appalachians, more biodiverse than expected based on climate alone.

Biotic-velocity-based refugia vary depending on the species considered. They are shown here as based on the 592 songbird and tree species analyzed in Stralberg et al. 2018.

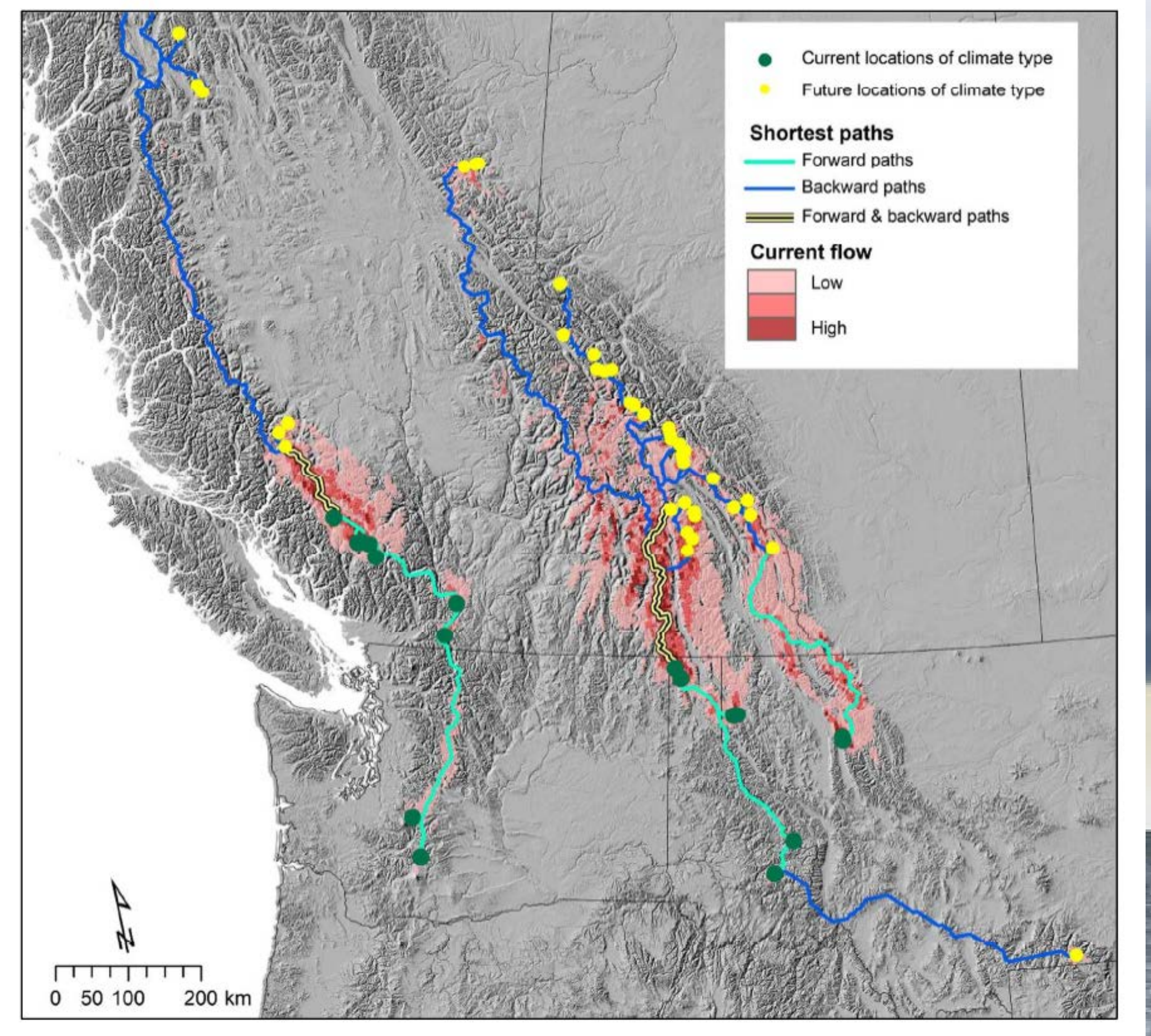




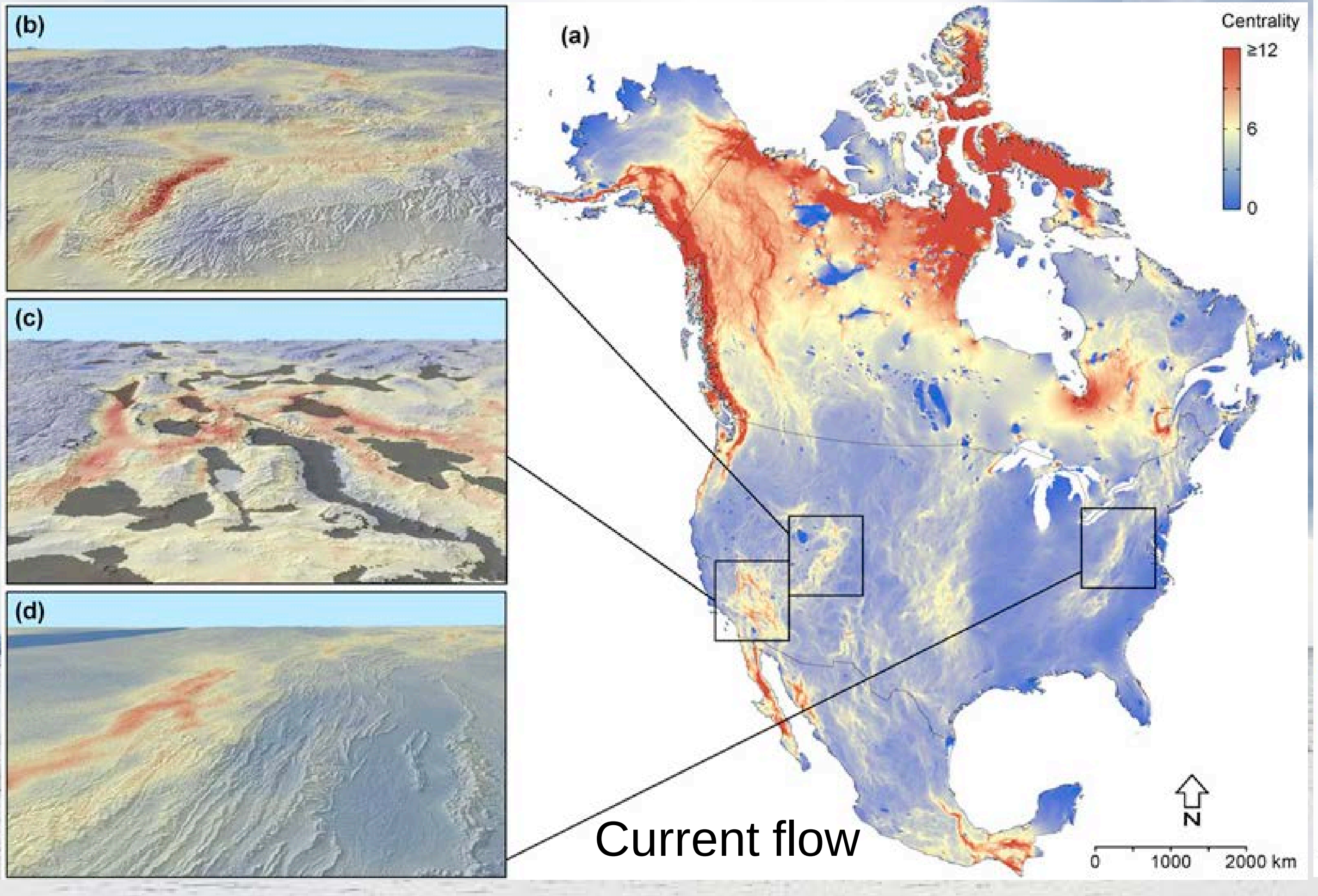
Climatic connectivity - protecting areas needed for movement in response to climate change

The persistence of many species under climate change will depend areas that facilitate dispersal to newly climatically suitable habitat. Climate connectivity areas are distinct from refugia and thus poorly captured by many existing conservation strategies.

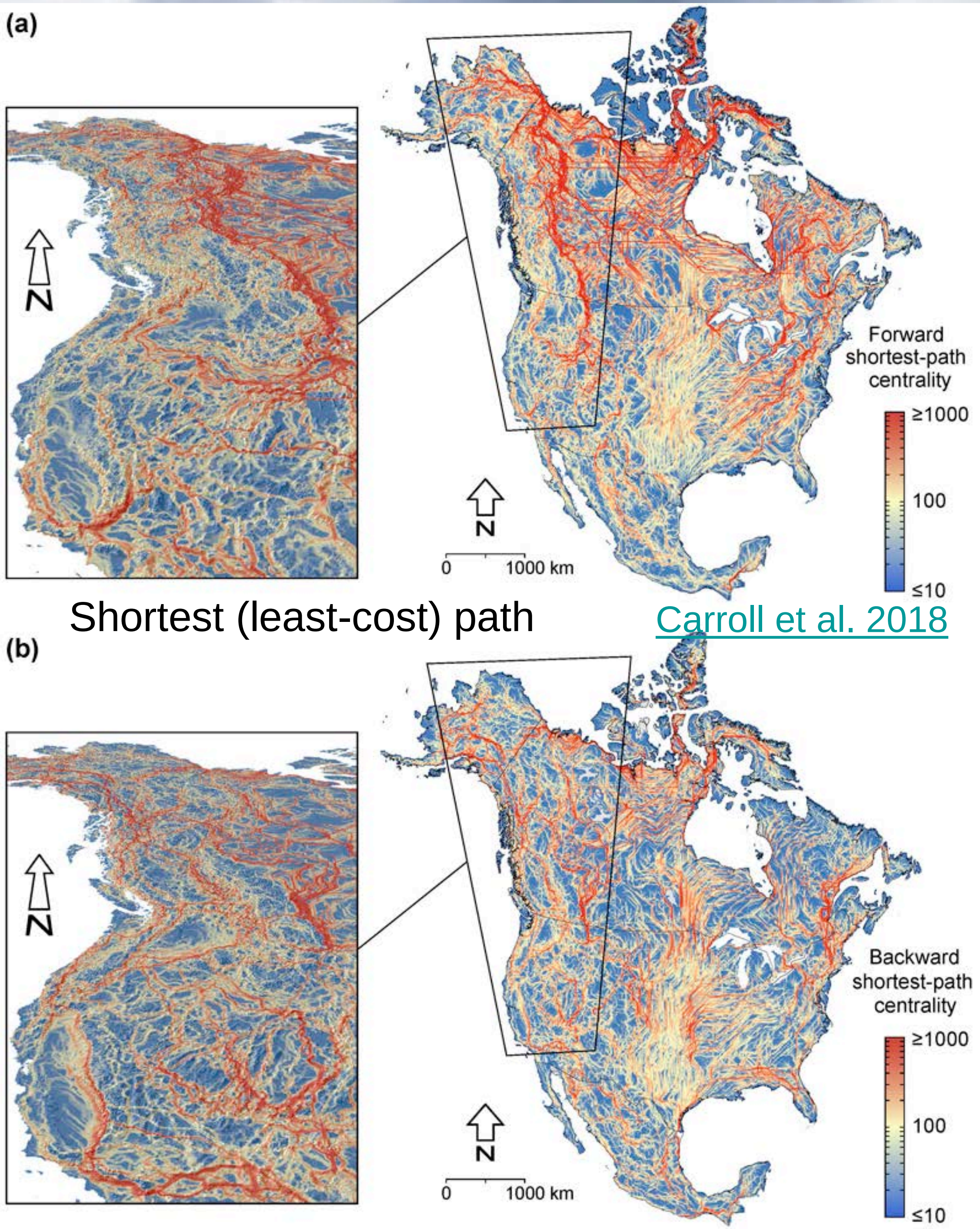
[Carroll et al. 2018]used *centrality* metrics to identify areas where many potential dispersal paths overlap.



Several methods exist for identifying climate corridors



Current flow



Shortest (least-cost) path

[Carroll et al. 2018]

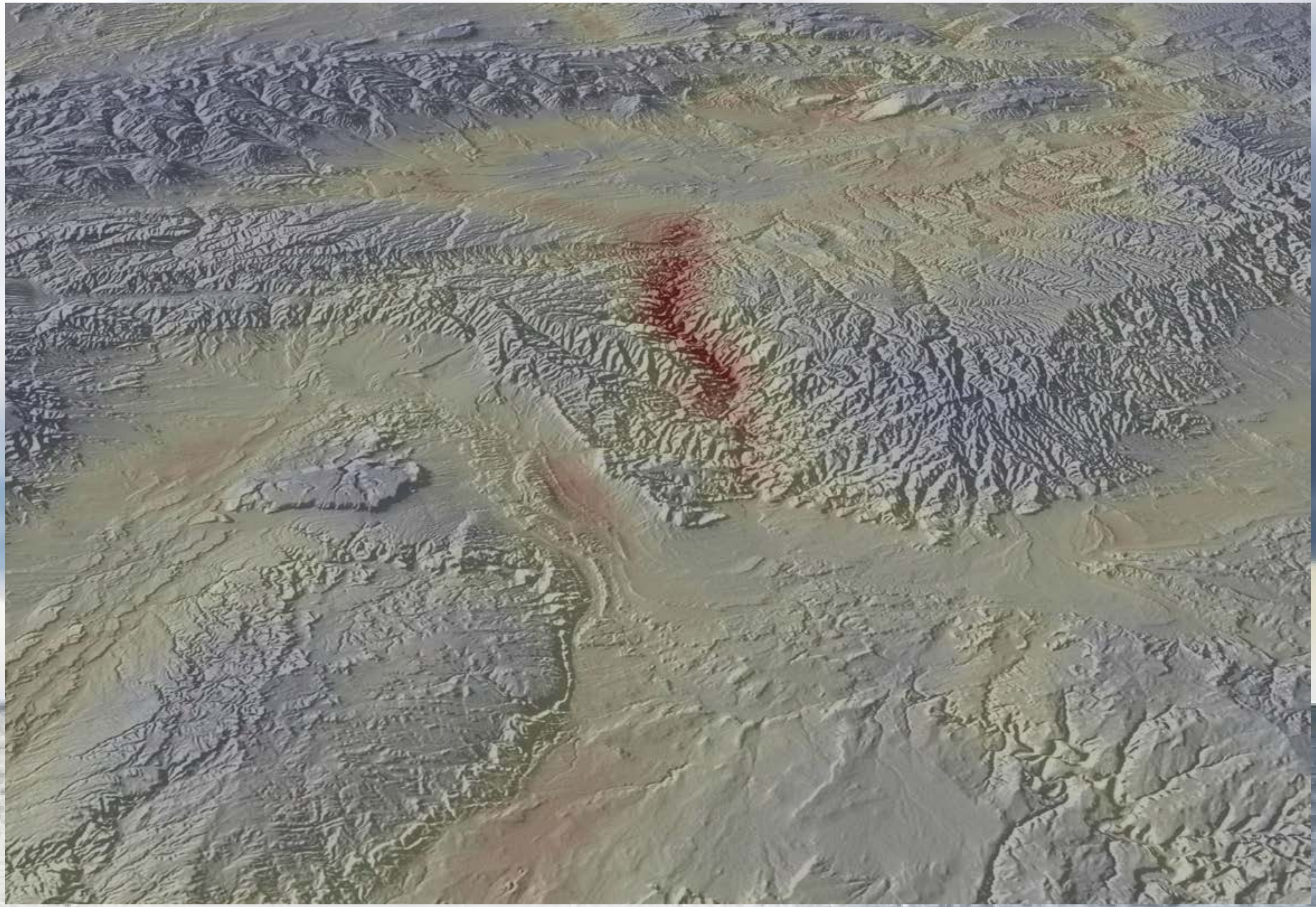
Broad-scale topography and climate influence connectivity paths

Dispersal paths are often funneled by topography into north-south trending passes and valley systems, such as the pass on the right in northern Utah.

Climate connectivity paths also tend to avoid areas of novel and disappearing climates.

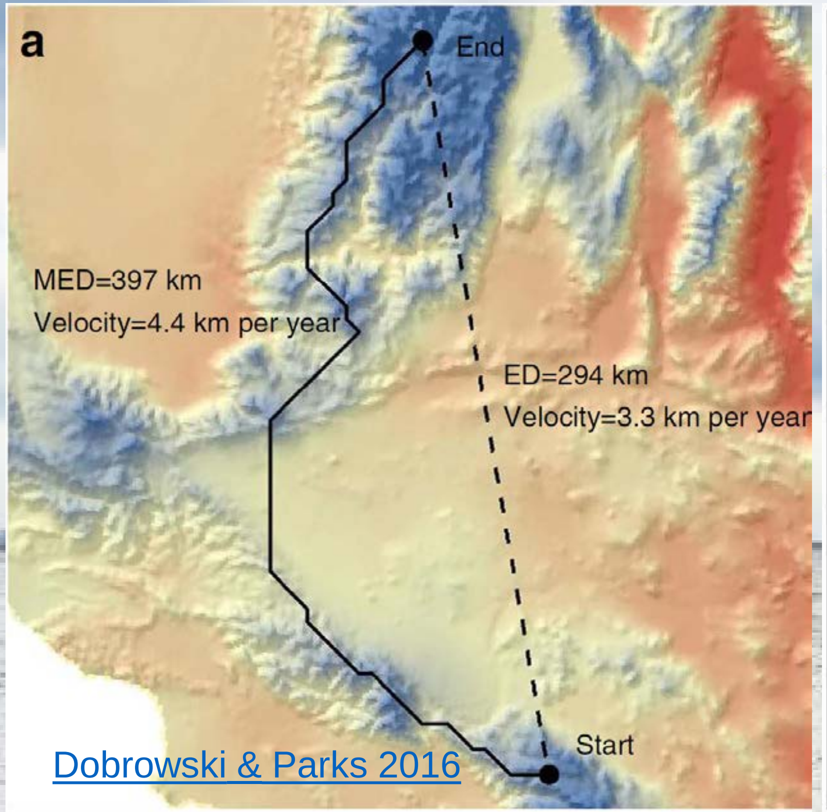
Human landuses may further constrain the ability of species to disperse through these areas.

Data available here.

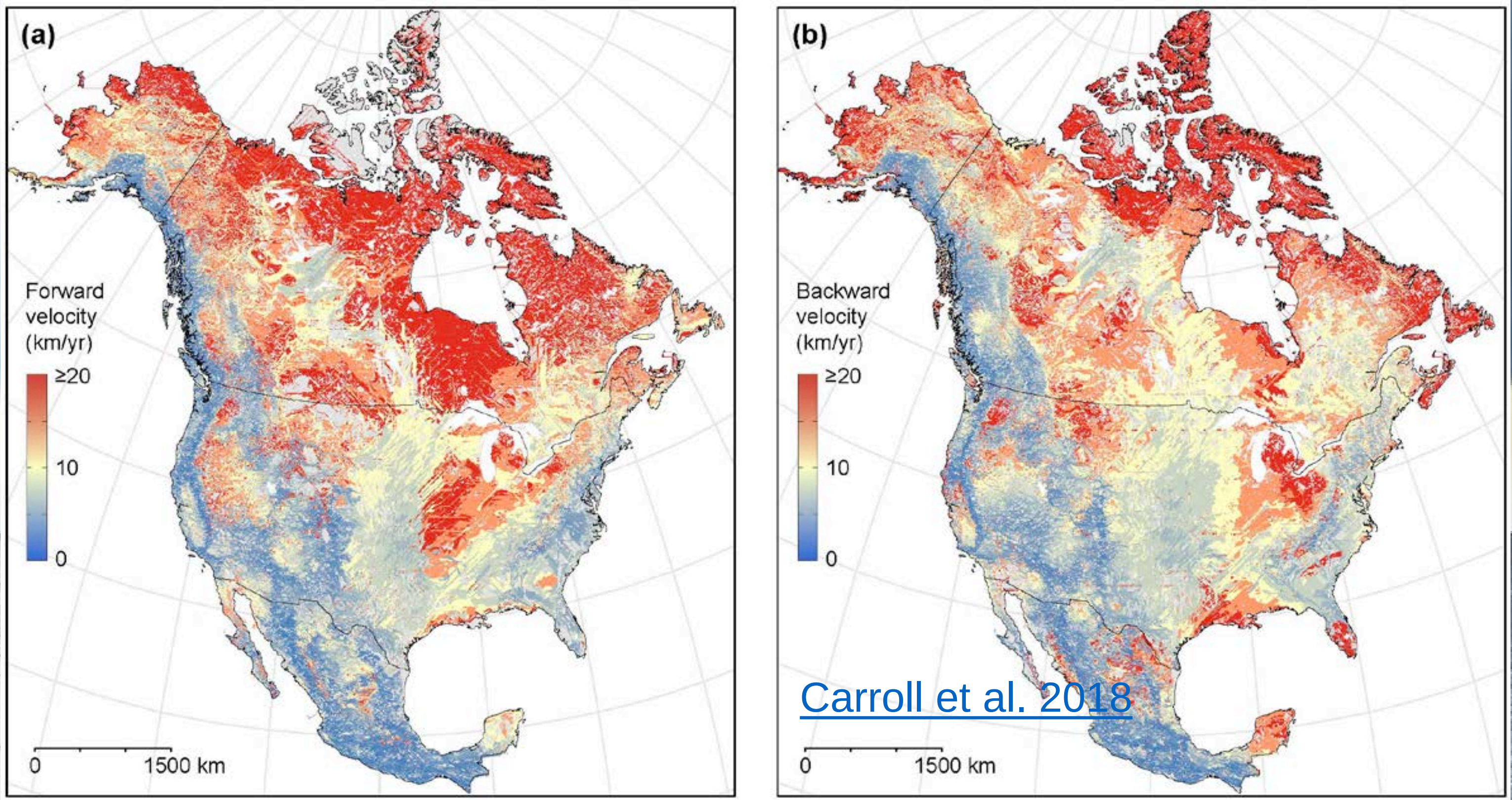


Least-cost-path-based climate velocity

Dispersal routes between current climate types and where those climates will occur in the future will rarely be straight-line paths, as is assumed when measuring standard climatic velocity. Because organisms will need to avoid hostile climates, these routes will often be circuitous. Dobrowski and Parks 2016 developed a more realistic measure of climatic velocity that is based on this circuitous route rather than a straight-line path (data here).



Dobrowski & Parks 2016



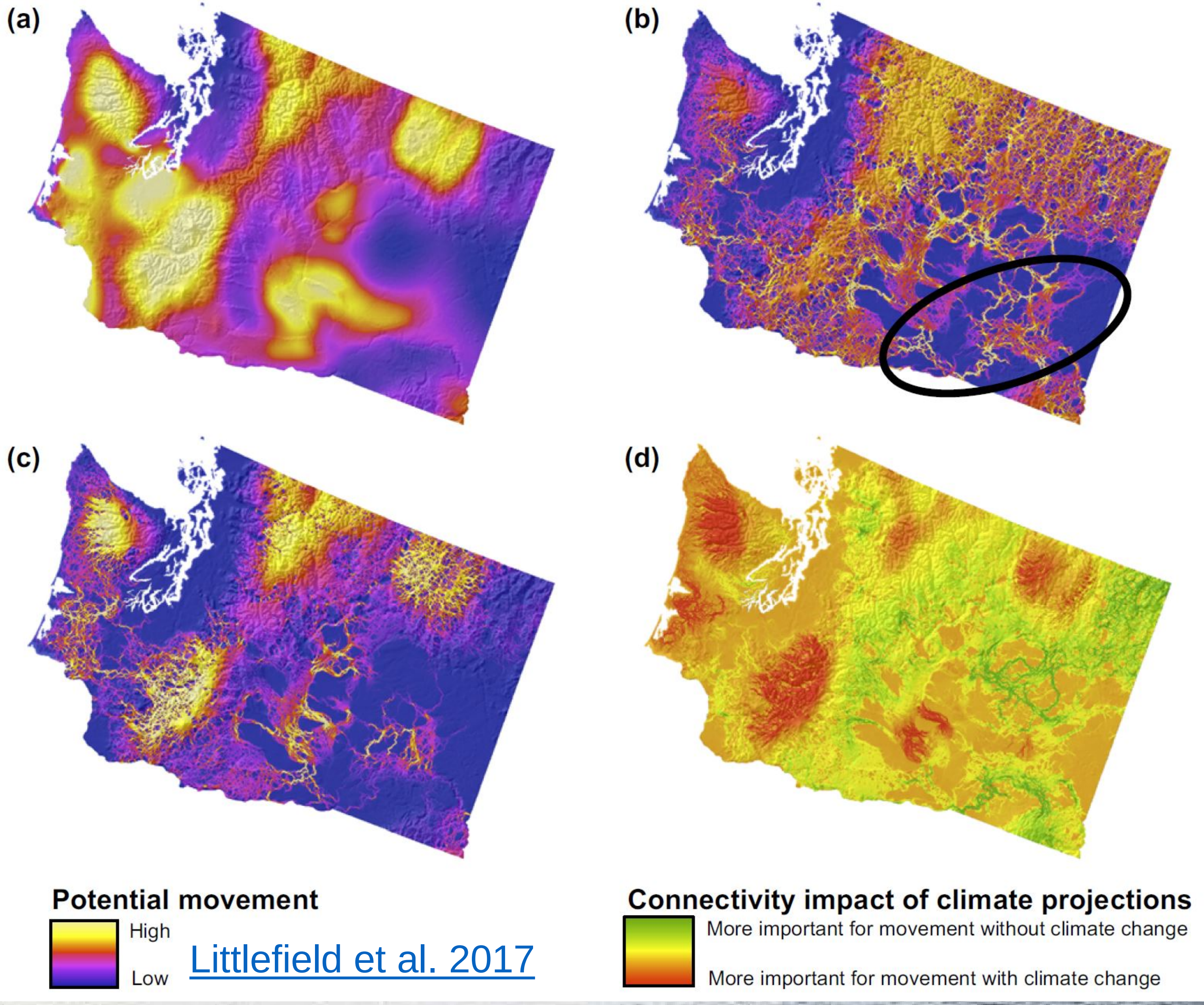
Carroll et al. 2018

An alternative approach for mapping climate connectivity areas

Littlefield et al. 2017 built on the work of Michalak et al. 2018 (discussed above) to define climate connectivity areas. In contrast to the centrality-based approach, this method limits dispersal distance based on ecological information, but increases climate type width to better reflect a "typical" species' niche.

The results however are similar in demonstrating that consideration of climate change alters priorities for connectivity conservation.

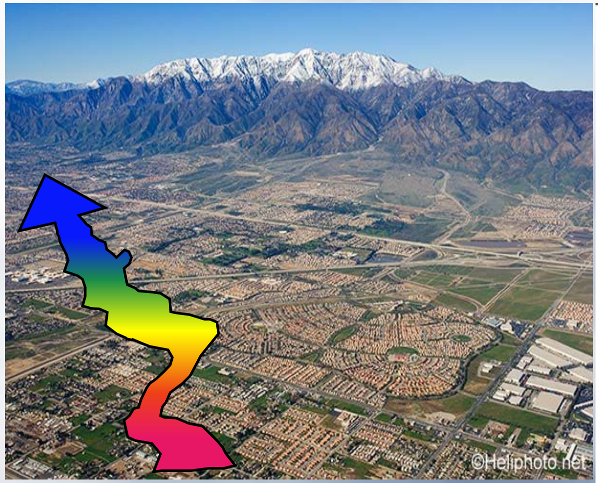
Data available here.

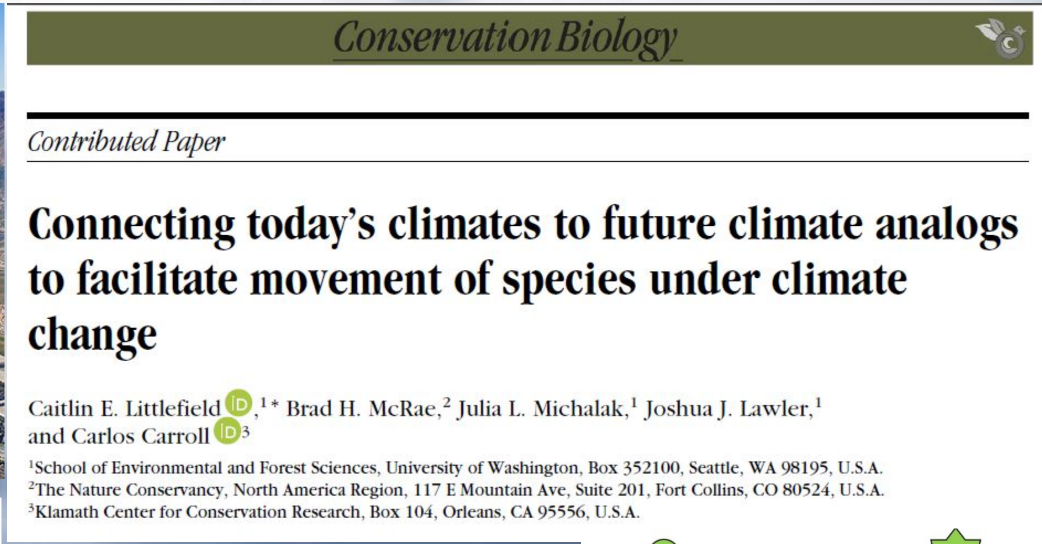


Littlefield et al. 2017

Climate connectivity software in development

The Omniscape software developed for use in Littlefield et al. 2017 is available in beta stage code, but is being further developed by researchers collaborating with The Nature Conservancy and Google.





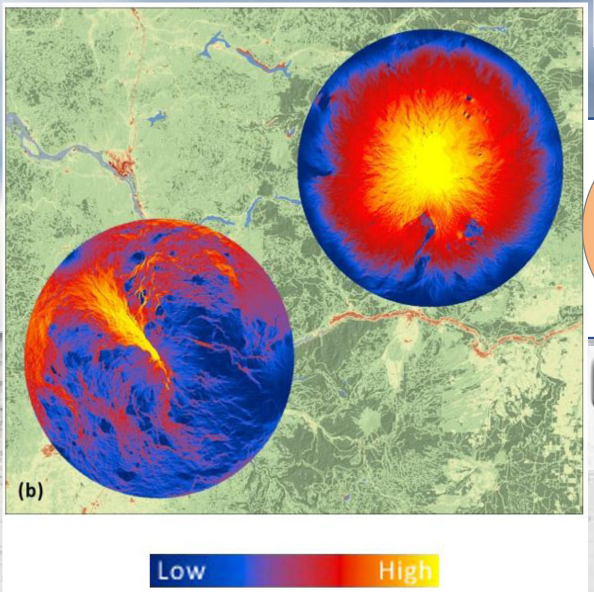
Conservation Biology

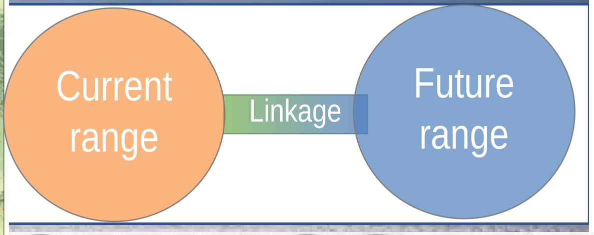
Contributed Paper

Connecting today's climates to future climate analogs to facilitate movement of species under climate change

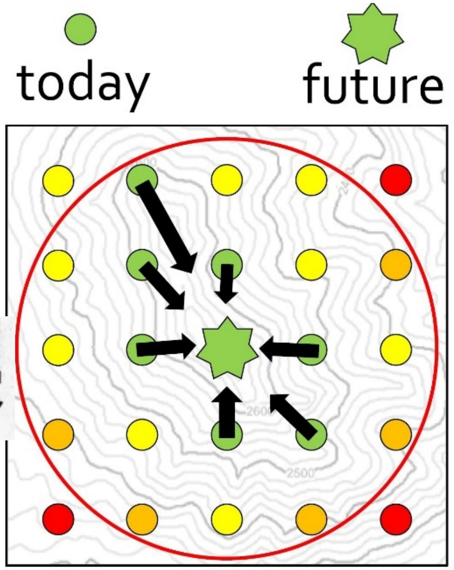
Caitlin E. Littlefield,[1*] Brad H. McRae,[2] Julia L. Michalak,[1] Joshua J. Lawler,[1] and Carlos Carroll[3]

[1]School of Environmental and Forest Sciences, University of Washington, Box 352100, Seattle, WA 98195, U.S.A.
[2]The Nature Conservancy, North America Region, 117 E Mountain Ave, Suite 201, Fort Collins, CO 80524, U.S.A.
[3]Klamath Center for Conservation Research, Box 104, Orleans, CA 95556, U.S.A.





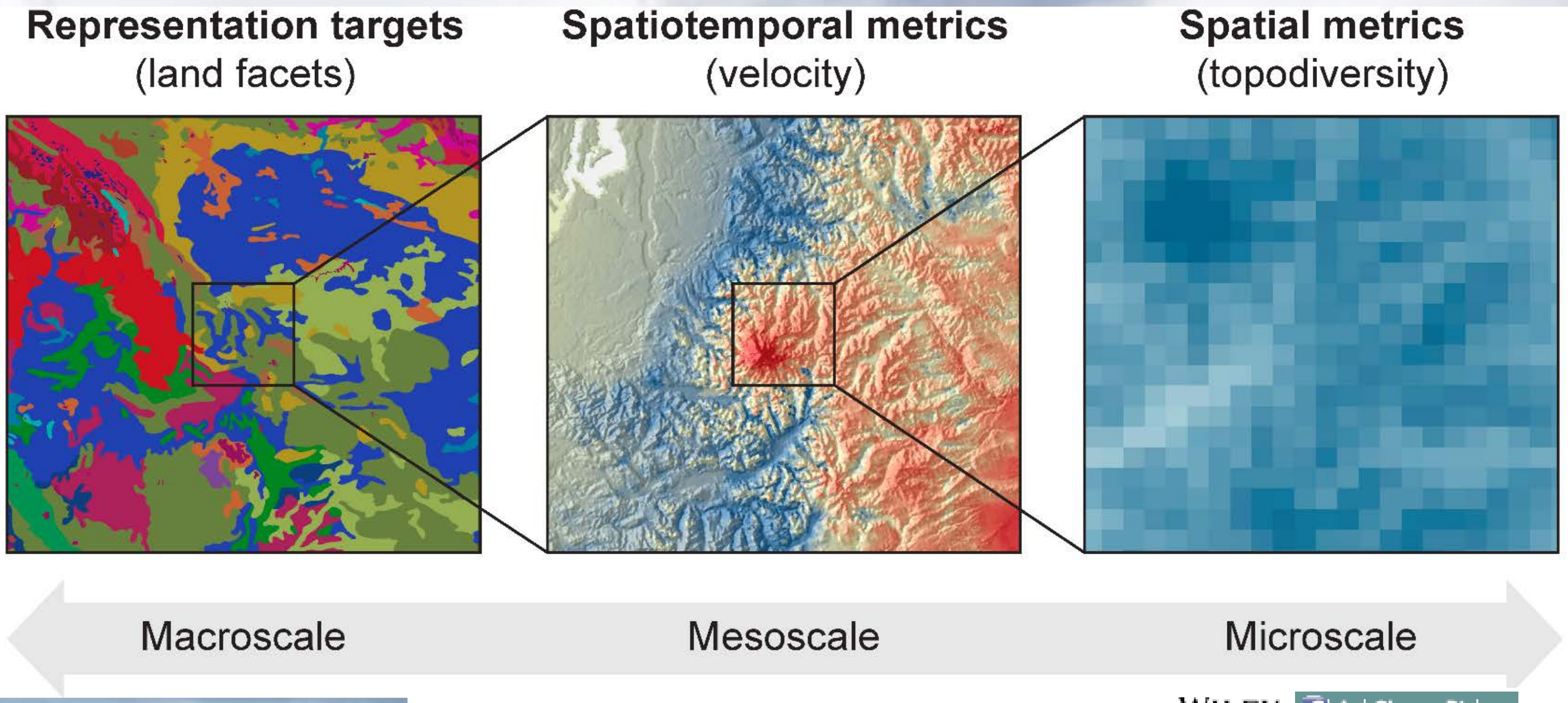
OMNISCAPE



Integrating metrics across spatial scales

The wide variety of climate exposure and refugia metrics can seem confusing. However, there are several ways to integrate information from diverse metrics.

Coarse-resolution velocity metrics can be combined with fine-resolution diversity metrics in order to leverage the respective strengths of the two groups of metrics as tools for identification of potential macro- and microrefugia that in combination help maximize both transient and long-term resilience to climate change.



PRIMARY RESEARCH ARTICLE

WILEY Global Change Biology

Scale-dependent complementarity of climatic velocity and environmental diversity for identifying priority areas for conservation under climate change

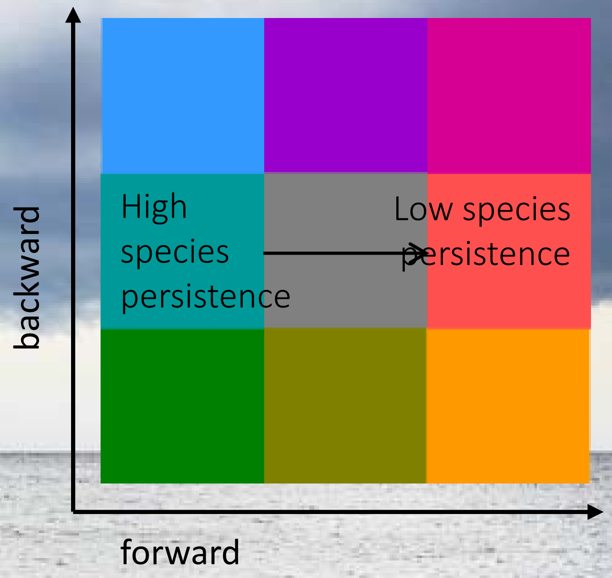
Carlos Carroll[1] | David R. Roberts[2] | Julia L. Michalak[3] | Joshua J. Lawler[3] | Scott E. Nielsen[4] | Diana Stralberg[4] | Andreas Hamann[4] | Brad H. Mcrae[5] | Tongli Wang[6]

Carroll et al. 2017

Integrating multiple metrics at the same scale: Velocity-based vulnerability assessment

Climatic velocity metrics can inform:

- Ability of resident species and ecosystems to persist locally or regionally
- Locations of climatic refugia for species and ecosystems
- Likely degree of community turnover / displacement



Integrating multiple metrics: Velocity-based vulnerability assessment

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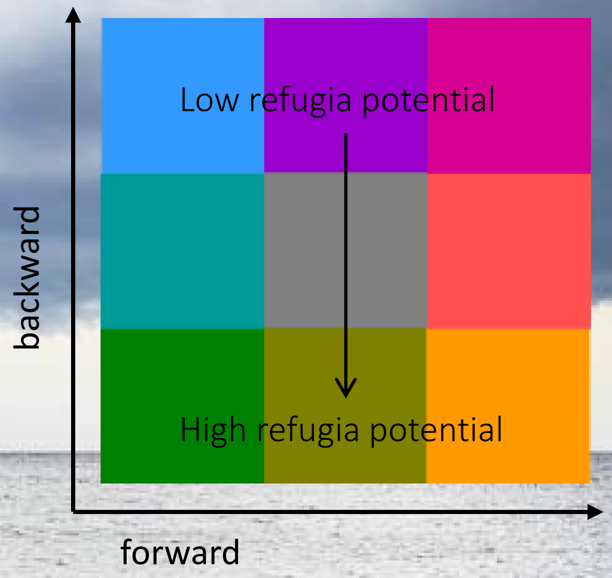

Integrating multiple metrics: Velocity-based vulnerability assessment

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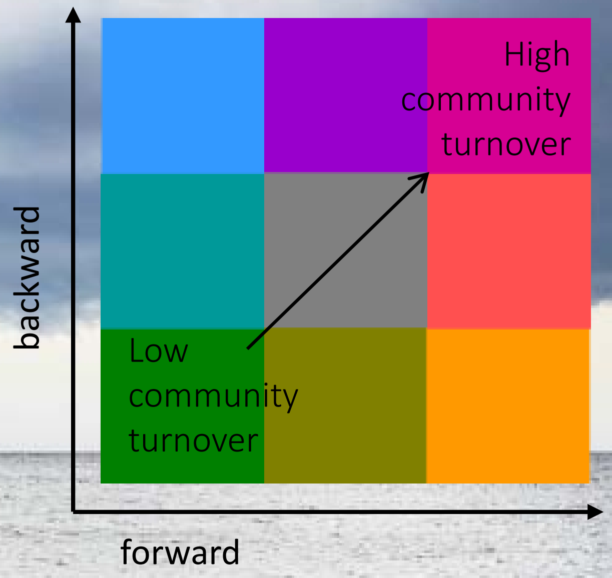
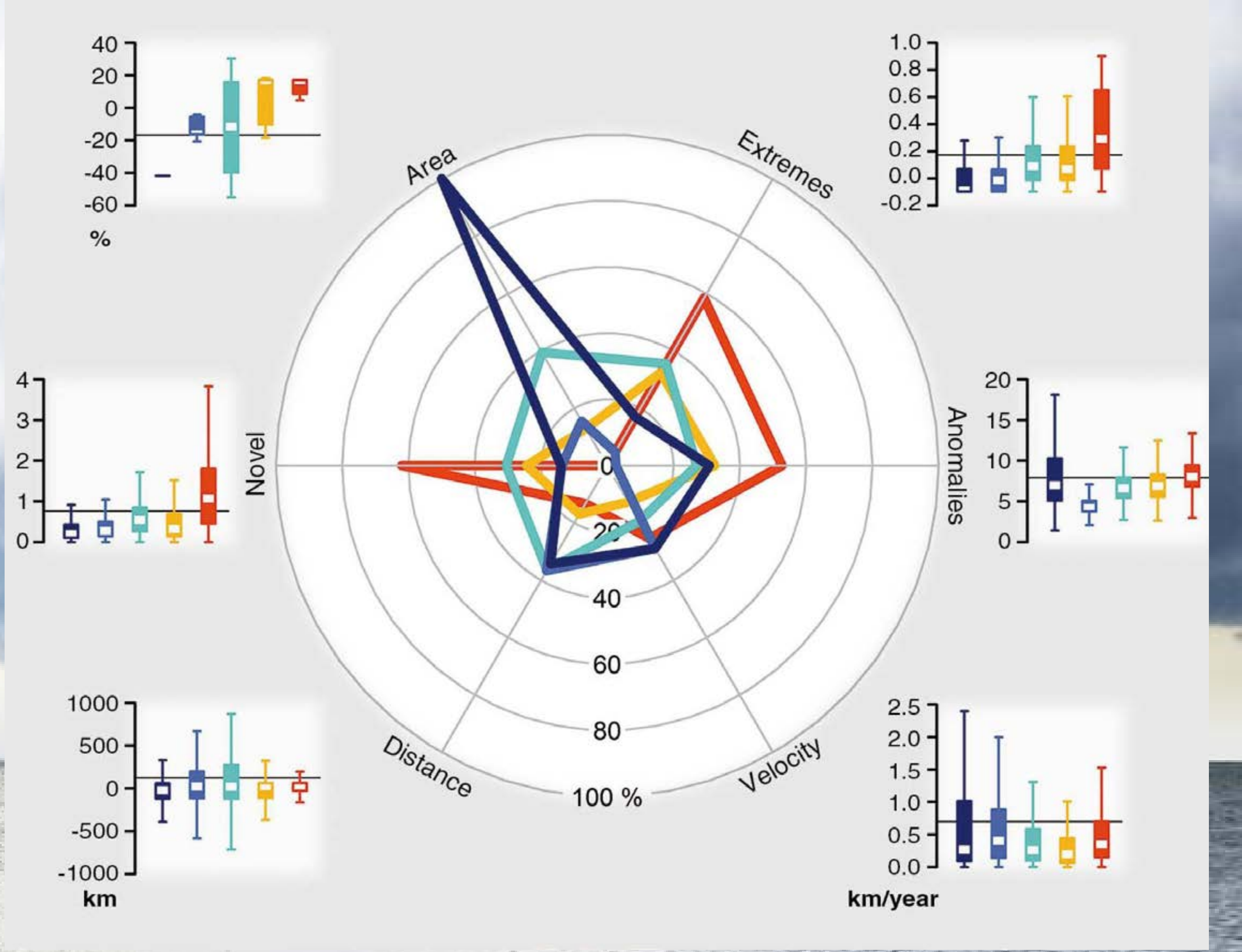
- Likely degree of community turnover / displacement



Integrating multiple metrics: The “fingerprint” of climate exposure

Garcia et al. 2014 developed the concept of using a star plot to show the varying magnitudes of different climate metrics.

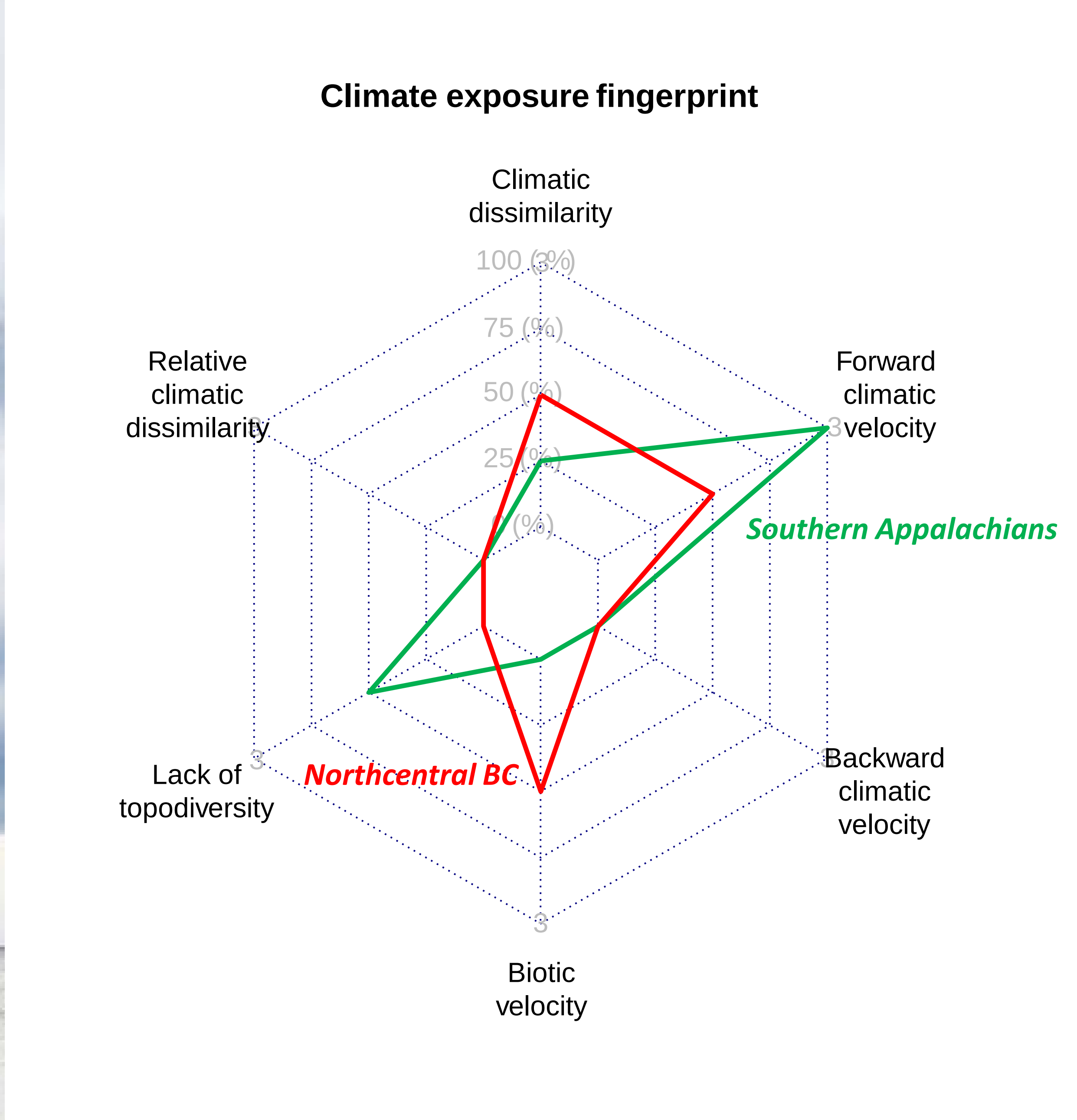
A star plot provides a compact way to communicate contrasts between the intensity of different climate exposure stressors in a region.



Example of climate exposure fingerprint analysis: Southern Appalachians

Characterized by high endemism.

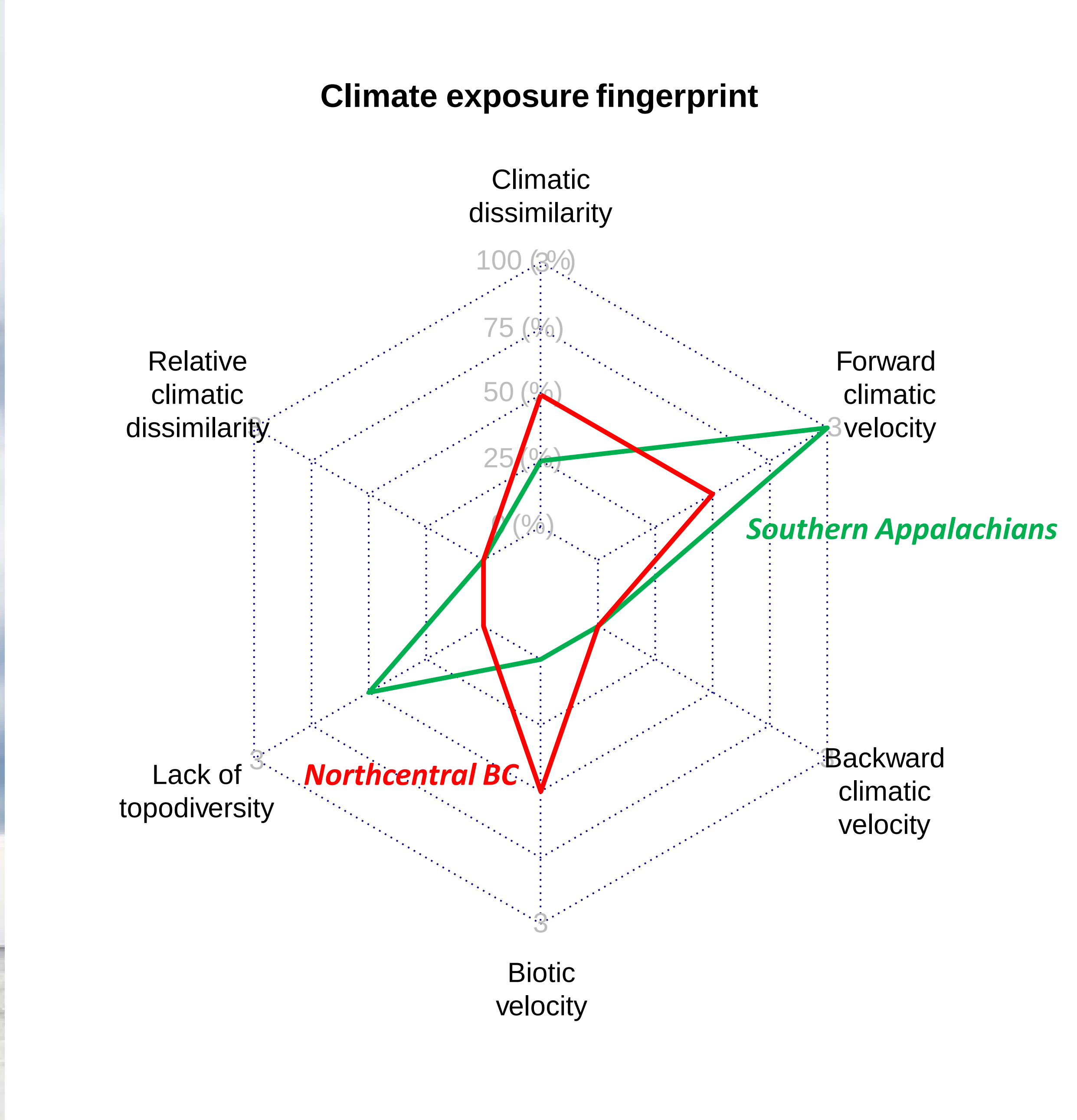
Alpine areas showing high tree mortality due to non-native insect.



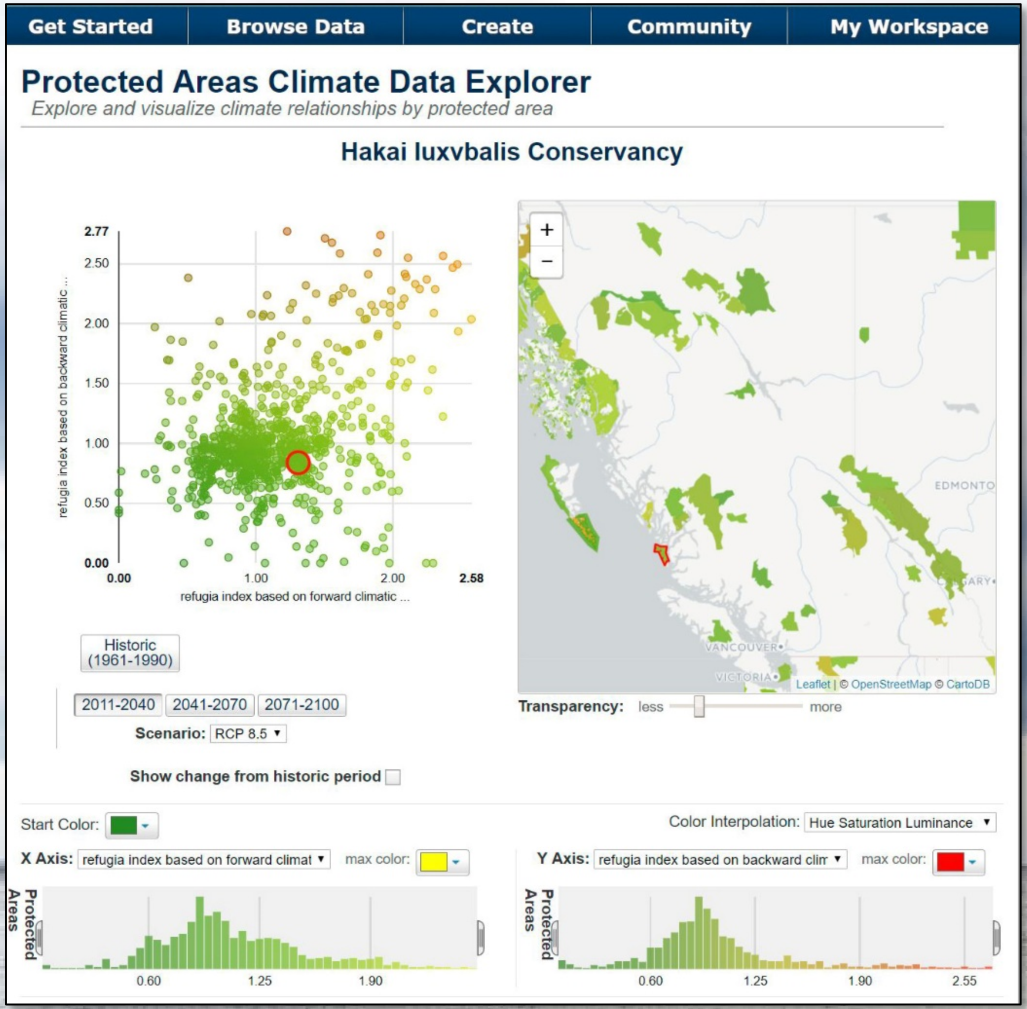
Example of climate exposure fingerprint analysis: Northcentral BC

High microrefugia potential due to complex topography.

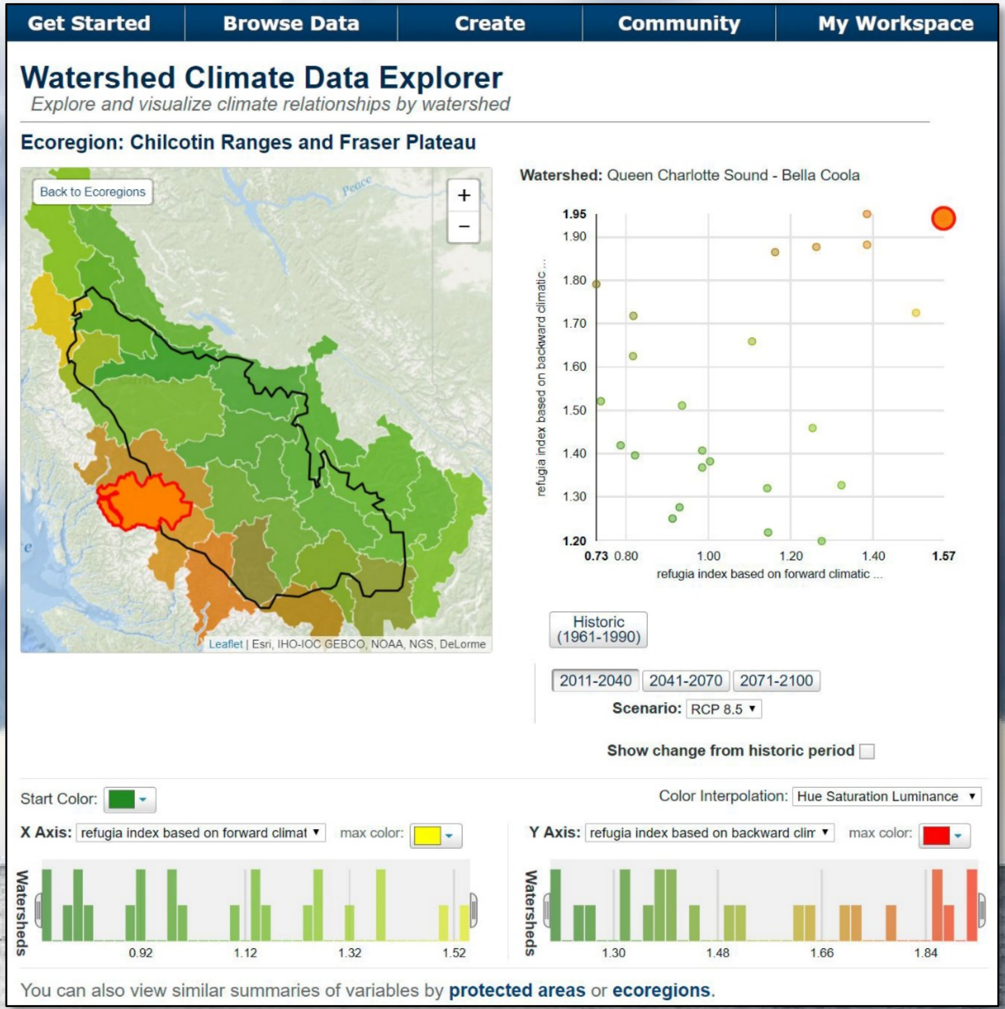
High absolute but low relative climatic dissimilarity.



Integrating multiple metrics: AdaptWest's interactive data viewers

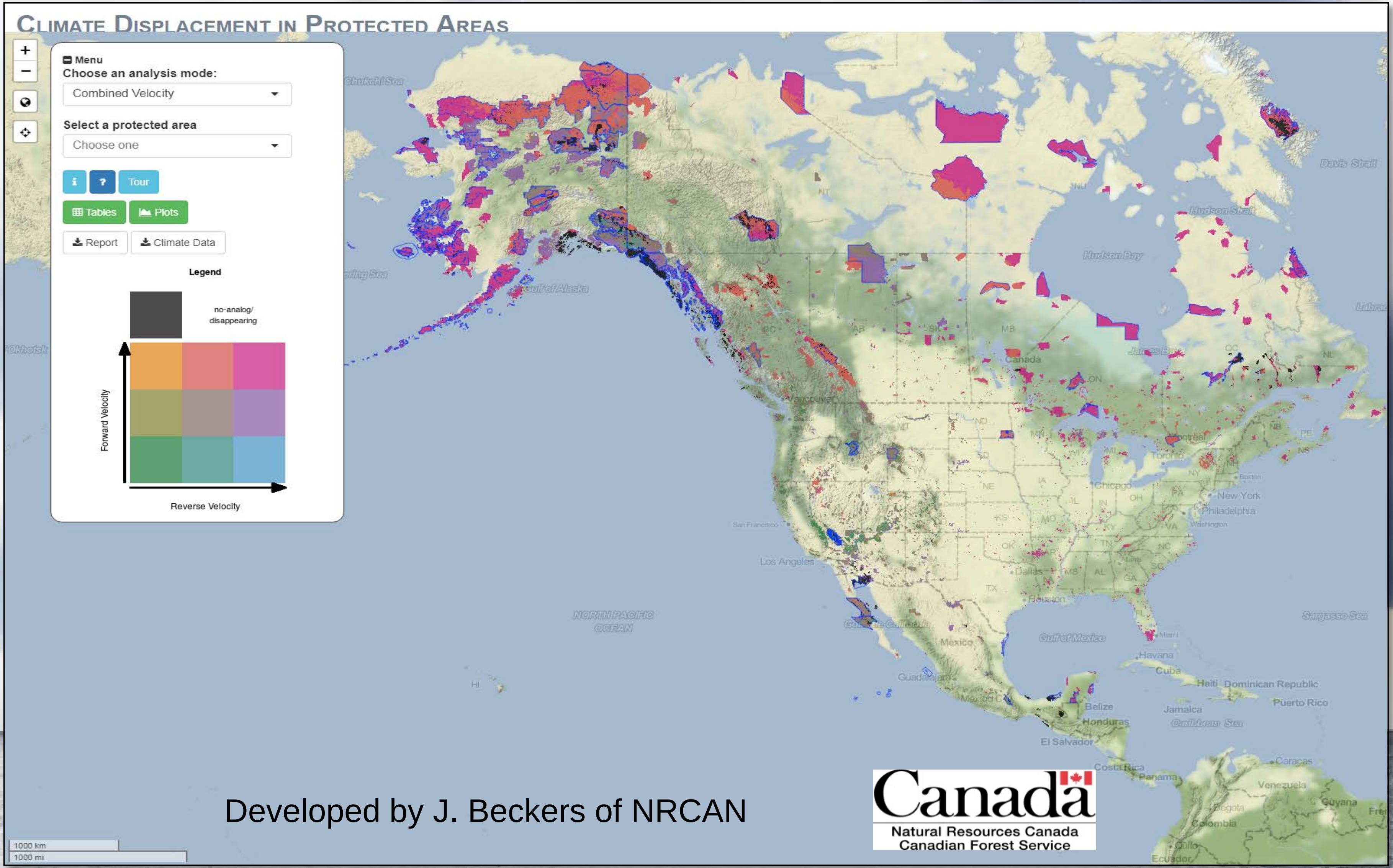


[Link to viewer]



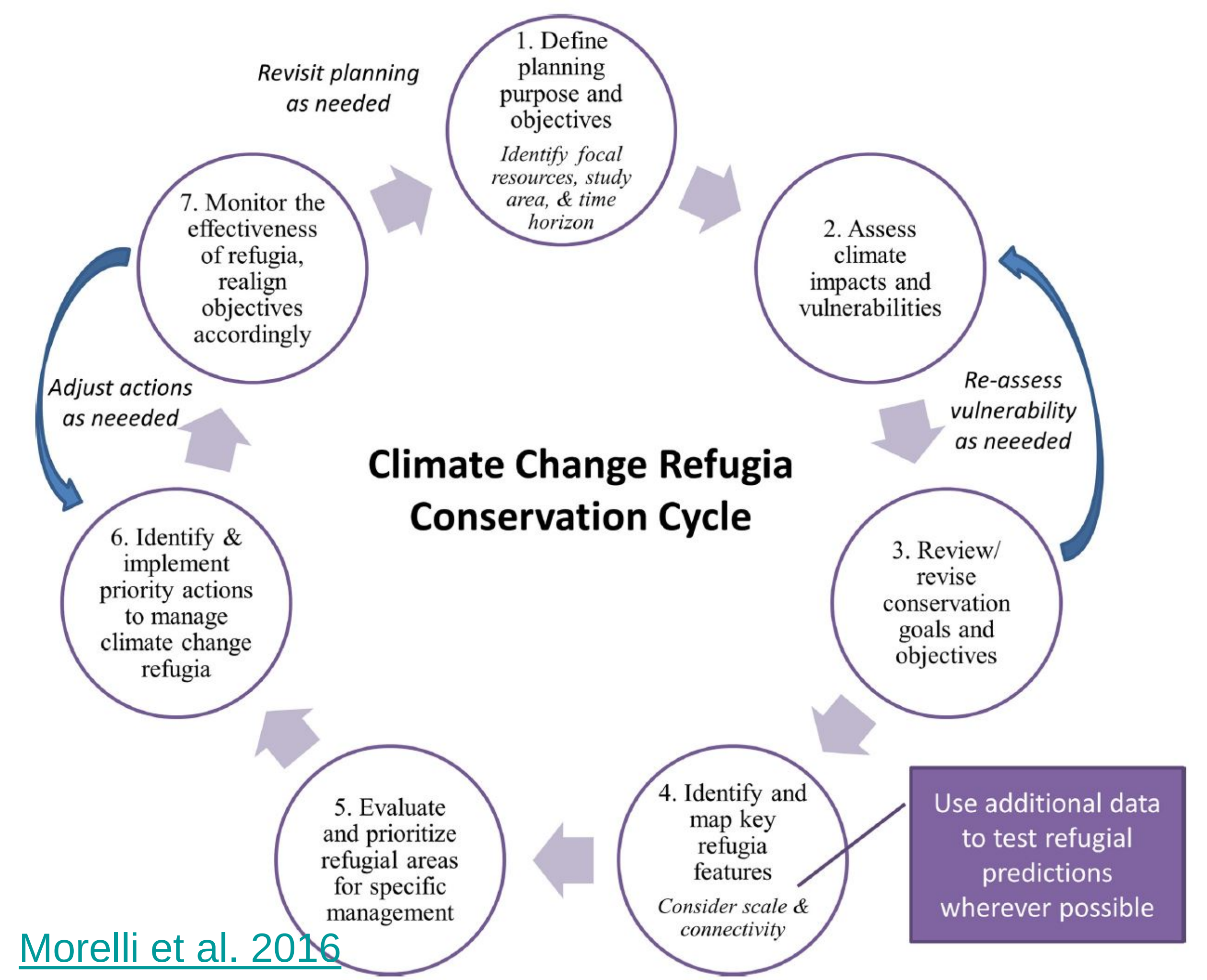
[Link to viewer]

Integrating multiple metrics:
AdaptWest Shiny app generates reports for individual protected areas



[Link to app]

Case studies:
Incorporating information into the planning process



Morelli et al. 2016

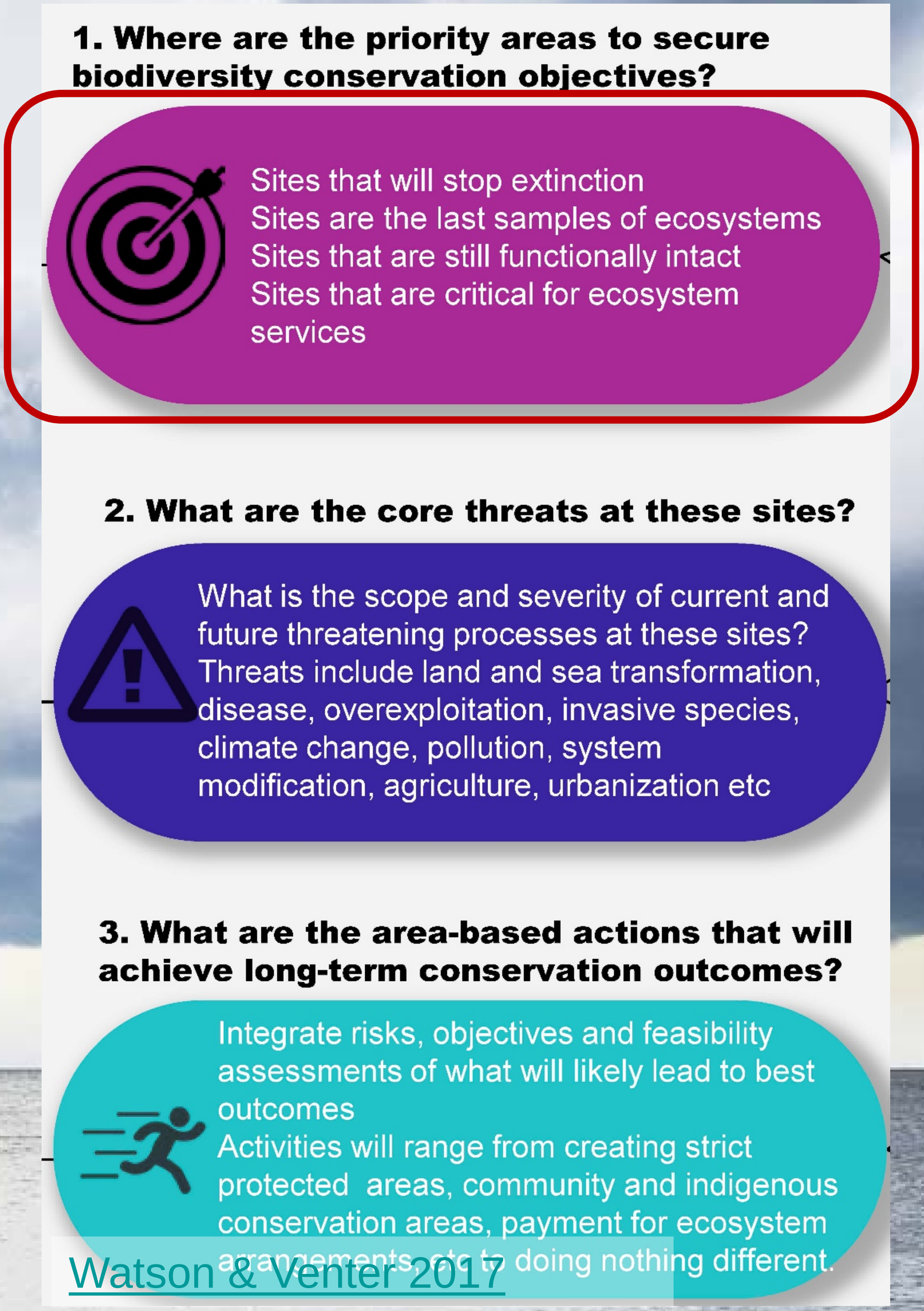
Fig 3. Climate change refugia conservation cycle. See Table 1 for examples.

Three types of applications

Prioritization

Vulnerability assessment (sites or species)

Management strategies

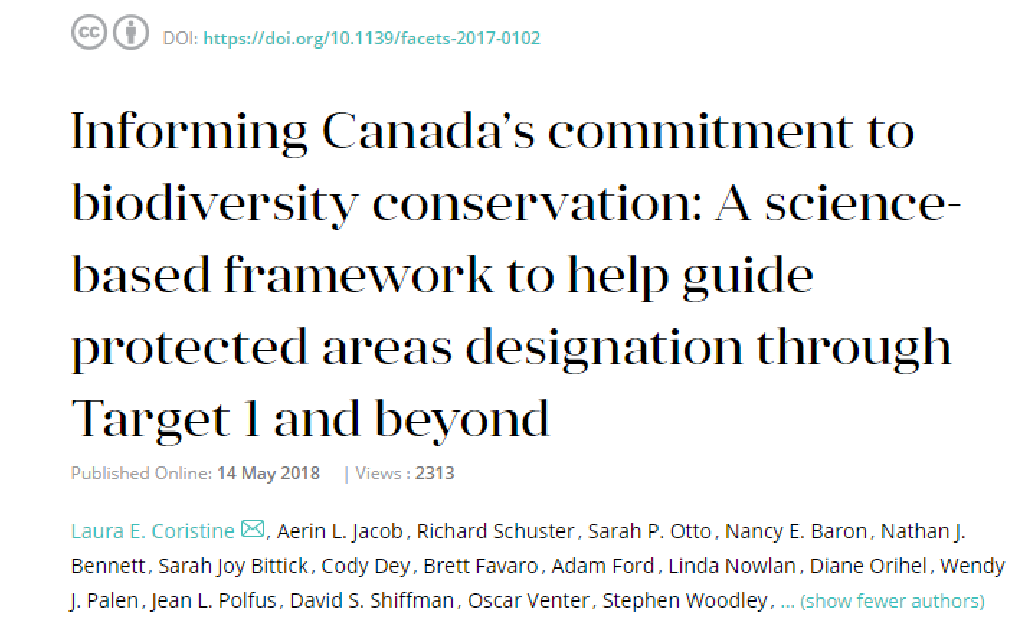


Watson & Venter 2017

Key principles of biodiversity conservation

1. Protect species at risk
2. Represent ecosystem diversity
3. Conserve remaining wilderness
4. **Ensure connectivity and resilience**
5. **Preserve climate refugia**

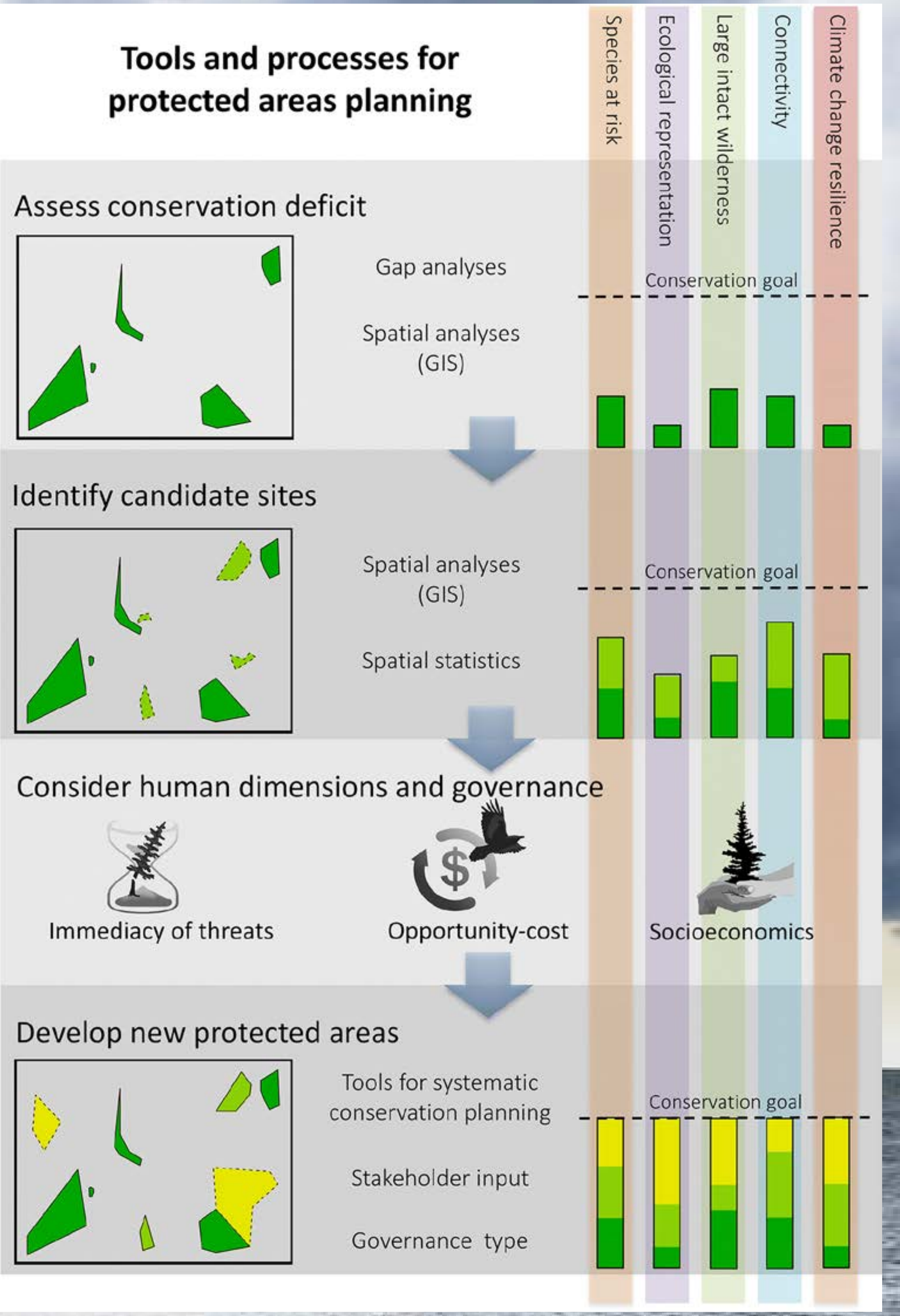
Coristine et al. 2018


DOI: https://doi.org/10.1139/facets-2017-0102

Informing Canada's commitment to biodiversity conservation: A science-based framework to help guide protected areas designation through Target 1 and beyond

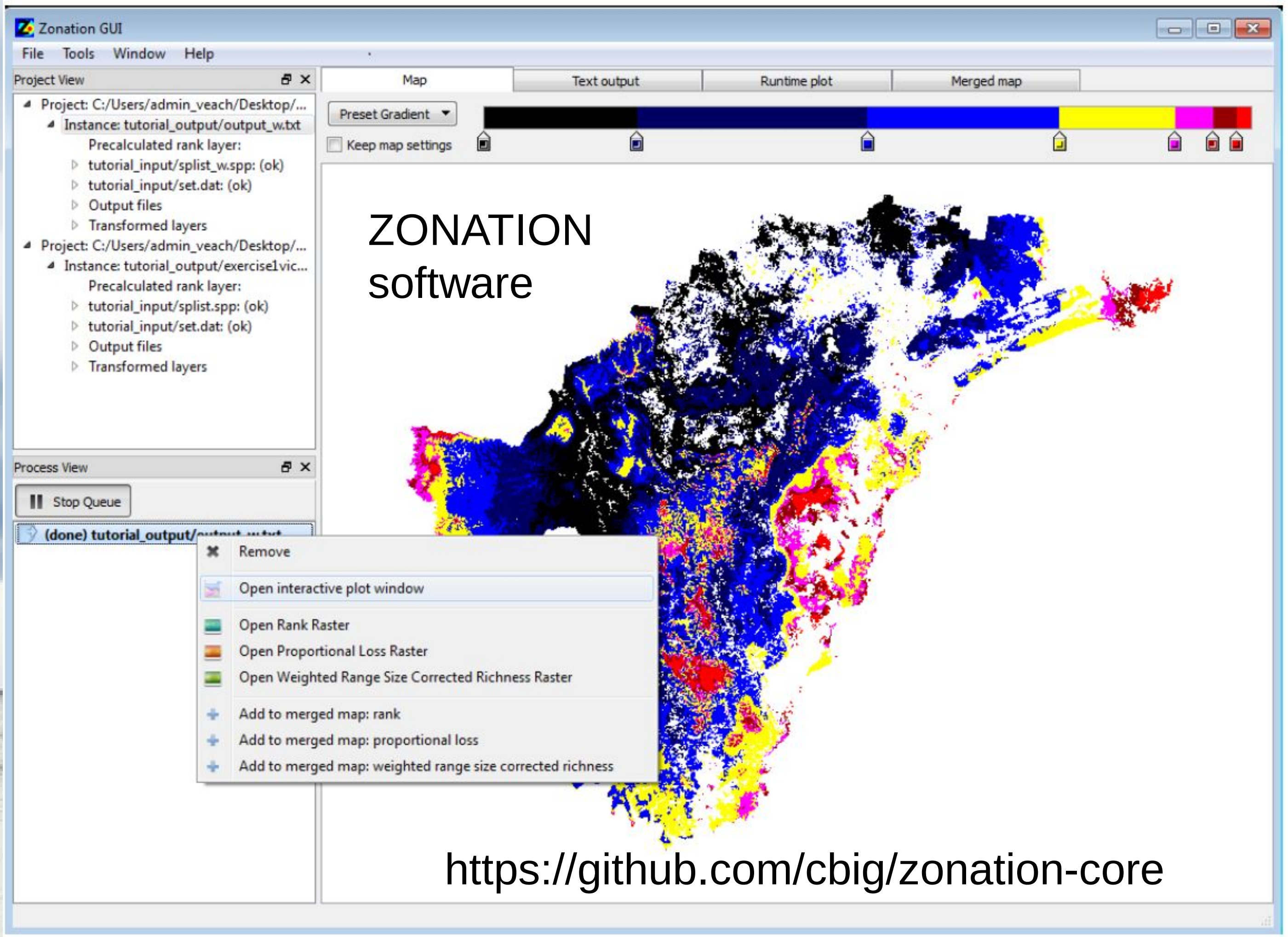
Published Online: 14 May 2018 | Views : 2313

Laura E. Coristine, Aerin L. Jacob, Richard Schuster, Sarah P. Otto, Nancy E. Baron, Nathan J. Bennett, Sarah Joy Bittick, Cody Dey, Brett Favaro, Adam Ford, Linda Nowlan, Diane Orihel, Wendy J. Palen, Jean L. Polfus, David S. Shiffman, Oscar Venter, Stephen Woodley, ... (show fewer authors)

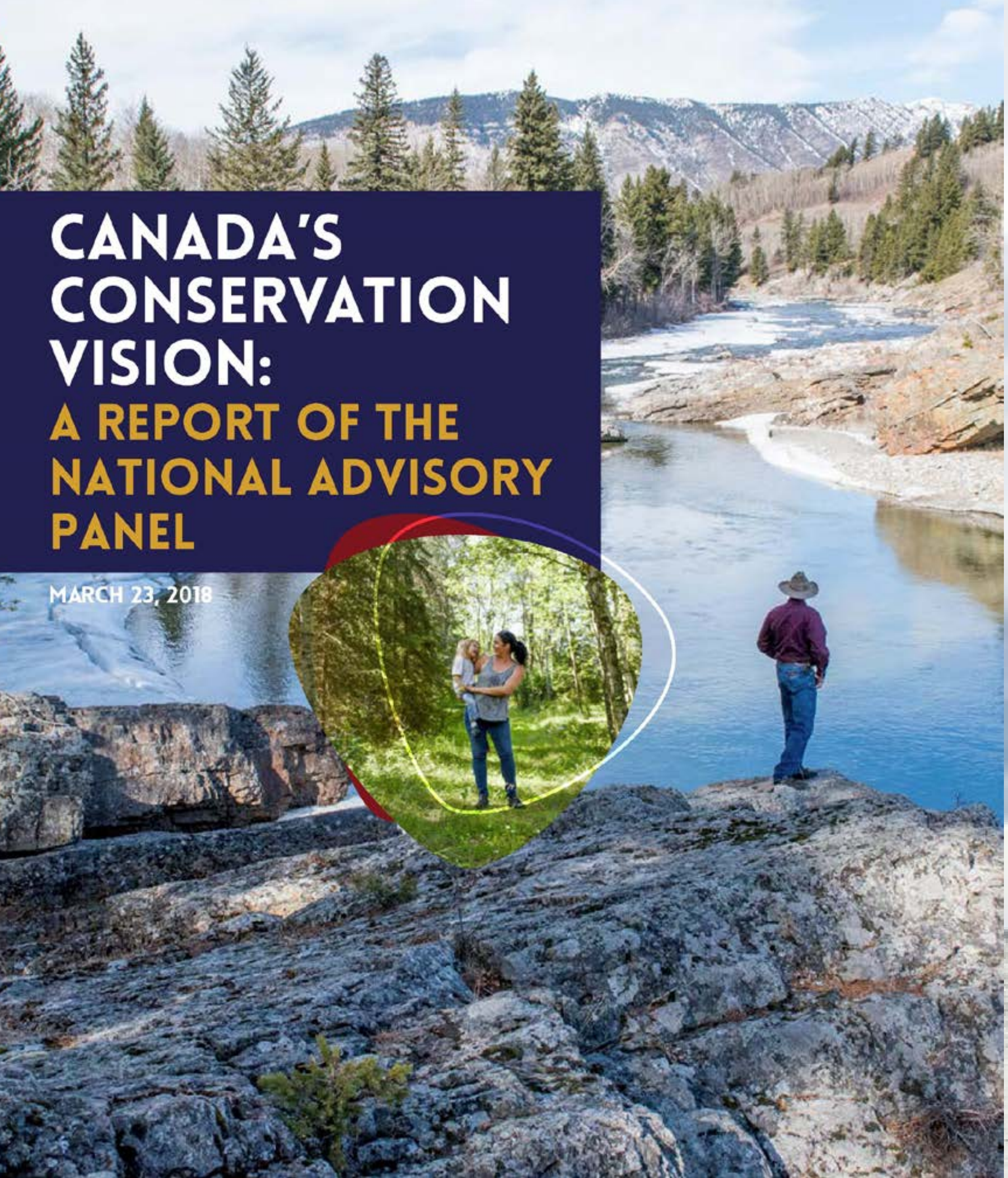


Prioritization based on multiple conservation metrics requires systematic conservation planning tools

Such tools and software are based on the principle of **complementarity**;
a measure of the extent to which an area contributes unrepresented features to an existing area or set of areas.



Canada’s Target 1 Process



Pathway to Canada Target 1
En route vers l'objectif 1 du Canada

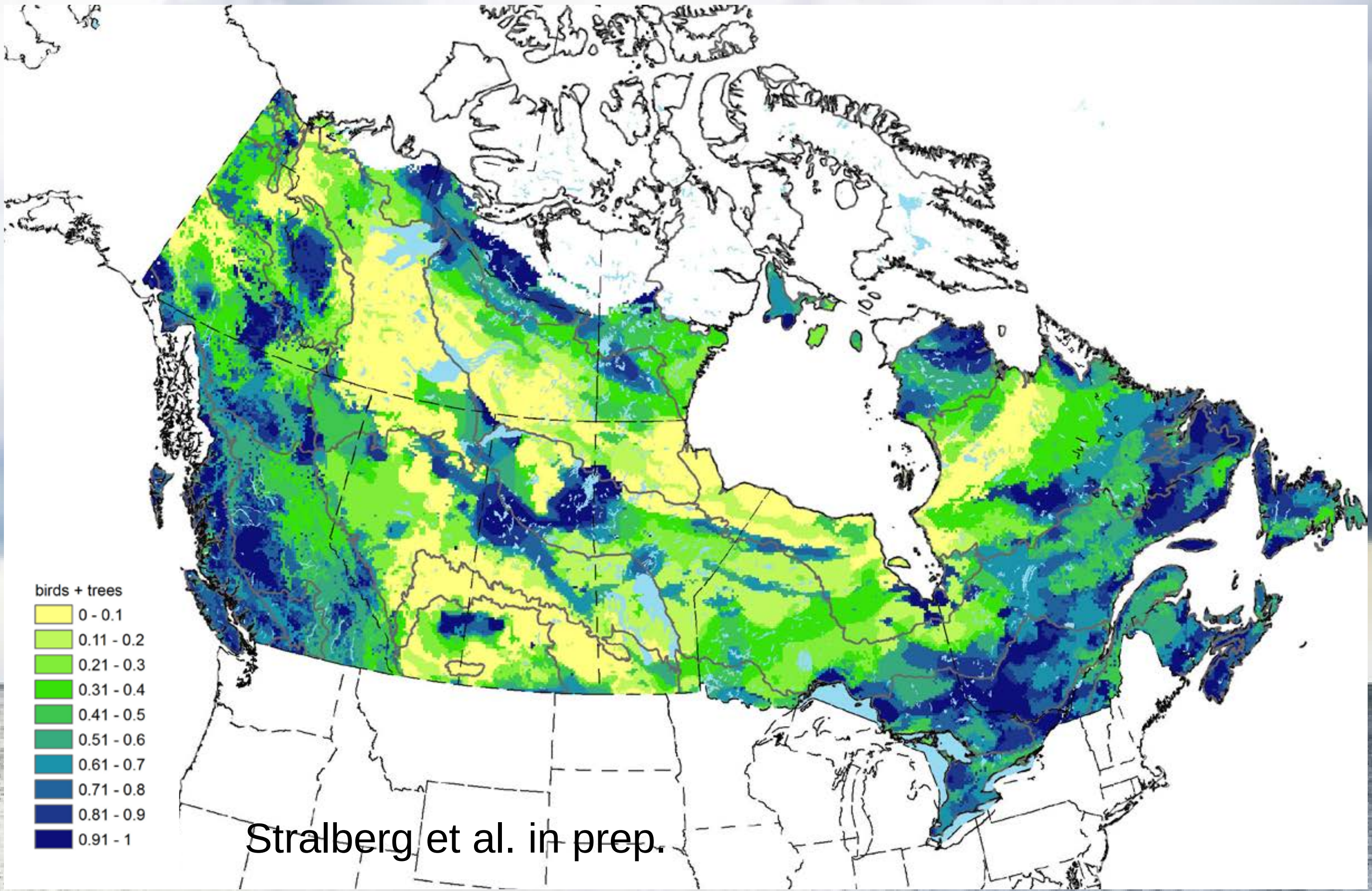
Recommendation 37
We recommend ..an objective of completing **networks** of well-connected protected areas and OECMs **that contain climate change refugia.**

Recommendation 14
We recommend that the federal government lead the development, by 2020, of a nationwide **ecological connectivity strategy** [that will] **…reflect climate change considerations**.

Recommendation 10
We recommend…**a gap analysis**..to inform the identification of future protected areas and OECMs needed to fulfill the **representation, connectivity, and key areas for biodiversity** elements of Aichi Target 11-Canada Target 1…

Canada's Target 1 Process: Protect 17% of the terrestrial landscape

Zonation results based on complementarity between refugia for >600 songbird and tree species. These types of results can form one of several types of information which assists in Canada's Target 1 prioritization process.



Three types of applications

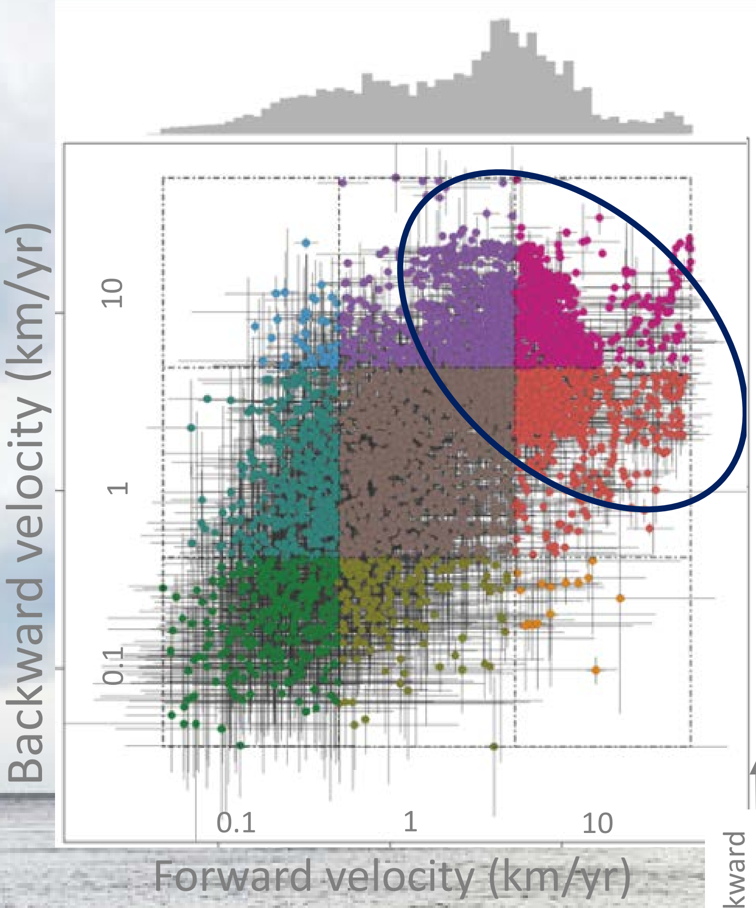
Prioritization

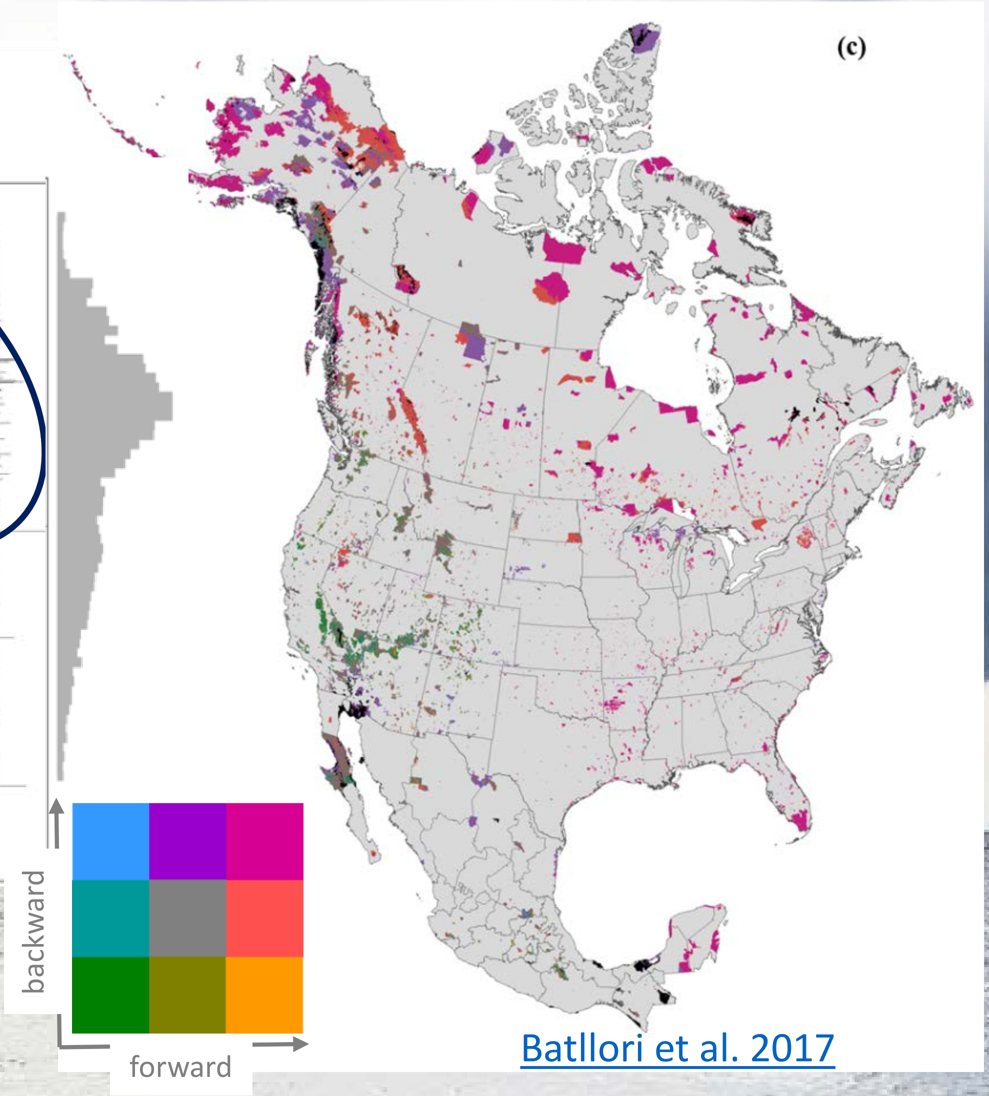
Vulnerability assessment (sites or species)

Management strategies

Watson & Venter 2017

Majority of North America's protected area network exposed to very high rates of climate displacement





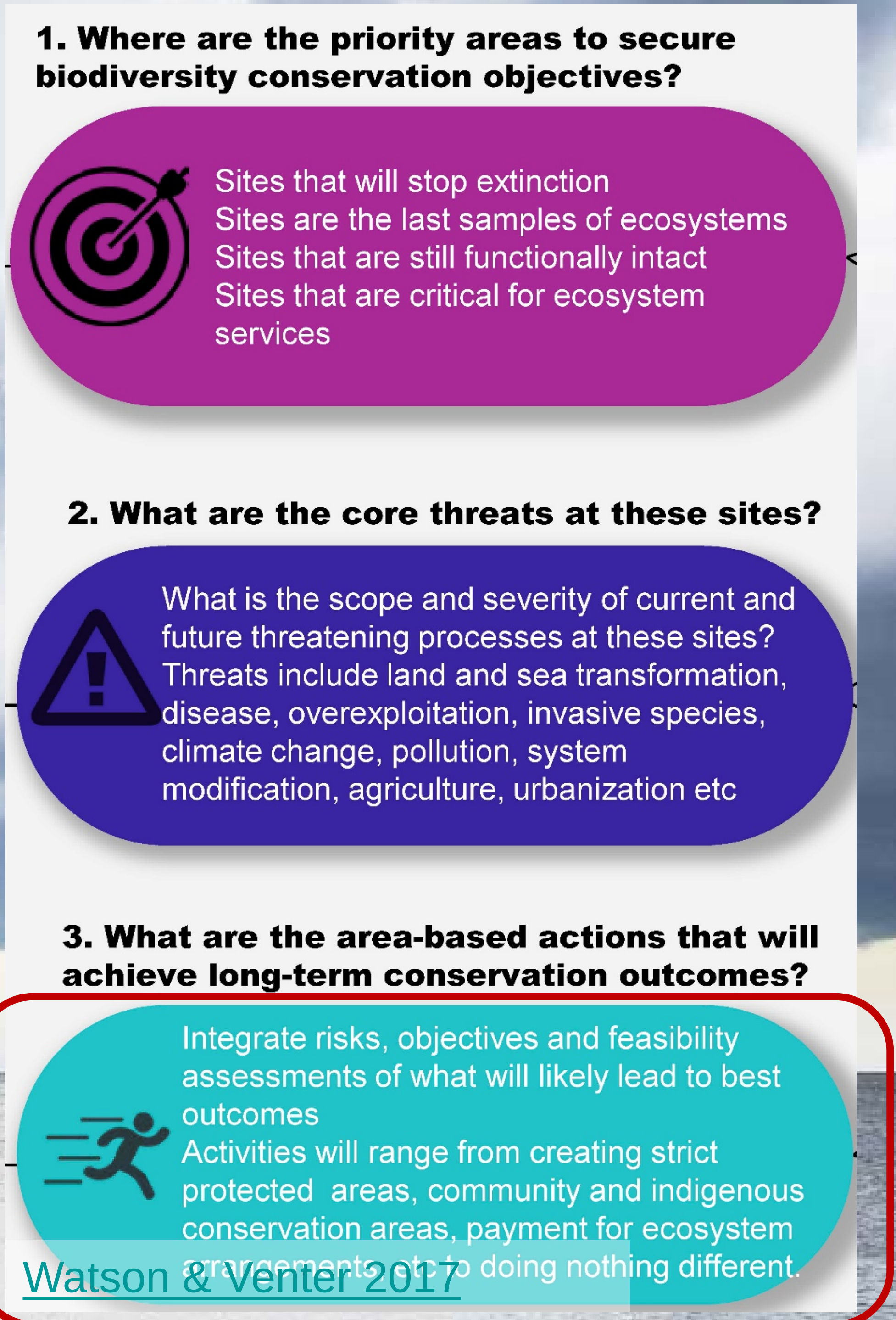
Batllori et al. 2017

Three types of applications

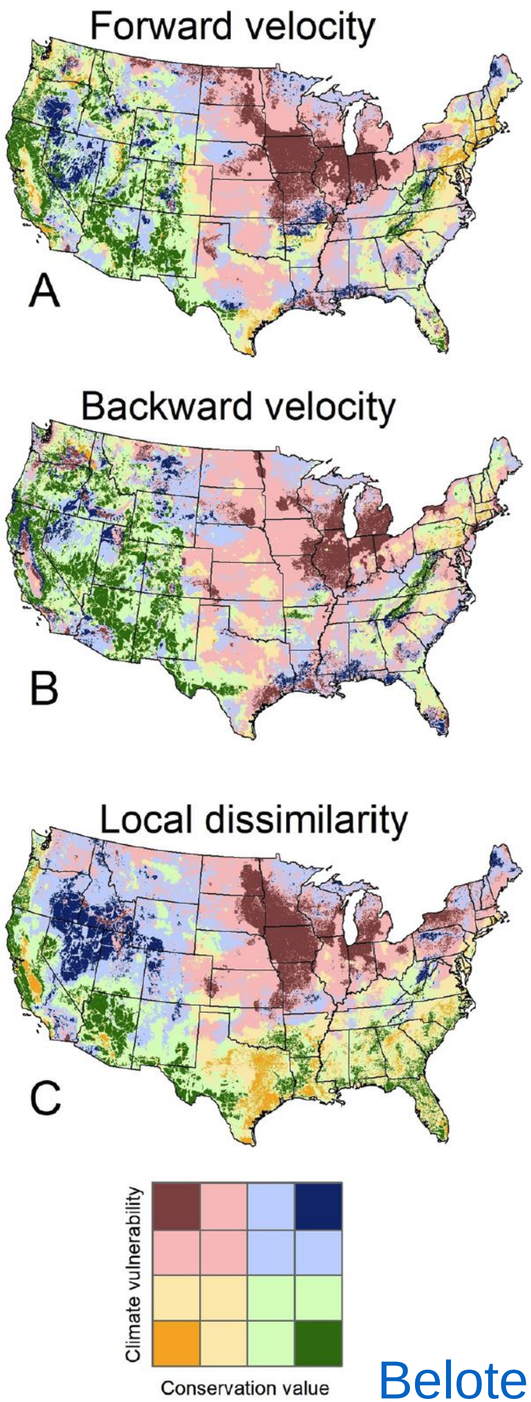
Prioritization

Vulnerability assessment (sites or species)

Management strategies



Watson & Venter 2017



[Belote et al. 2017]

Evaluation of the US National Wilderness System

Belote and colleagues with The Wilderness Society (a US-based NGO) have evaluated existing and proposed wilderness areas based on a) their conservation value in terms of ”traditional” objectives (i.e., to what extent an area contributes to creating an ecologically representative and connected network, etc.) and b) climate vulnerability. they propose alternative management foci depending on where an area falls on these 2 axes. Data available [here]. See also [Belote et al. 2017b] and [Belote et al. 2018].

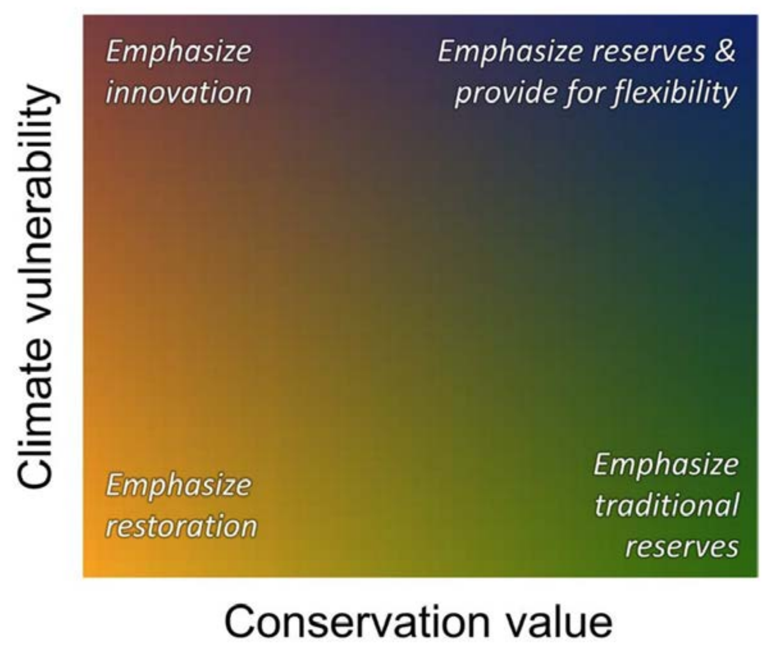
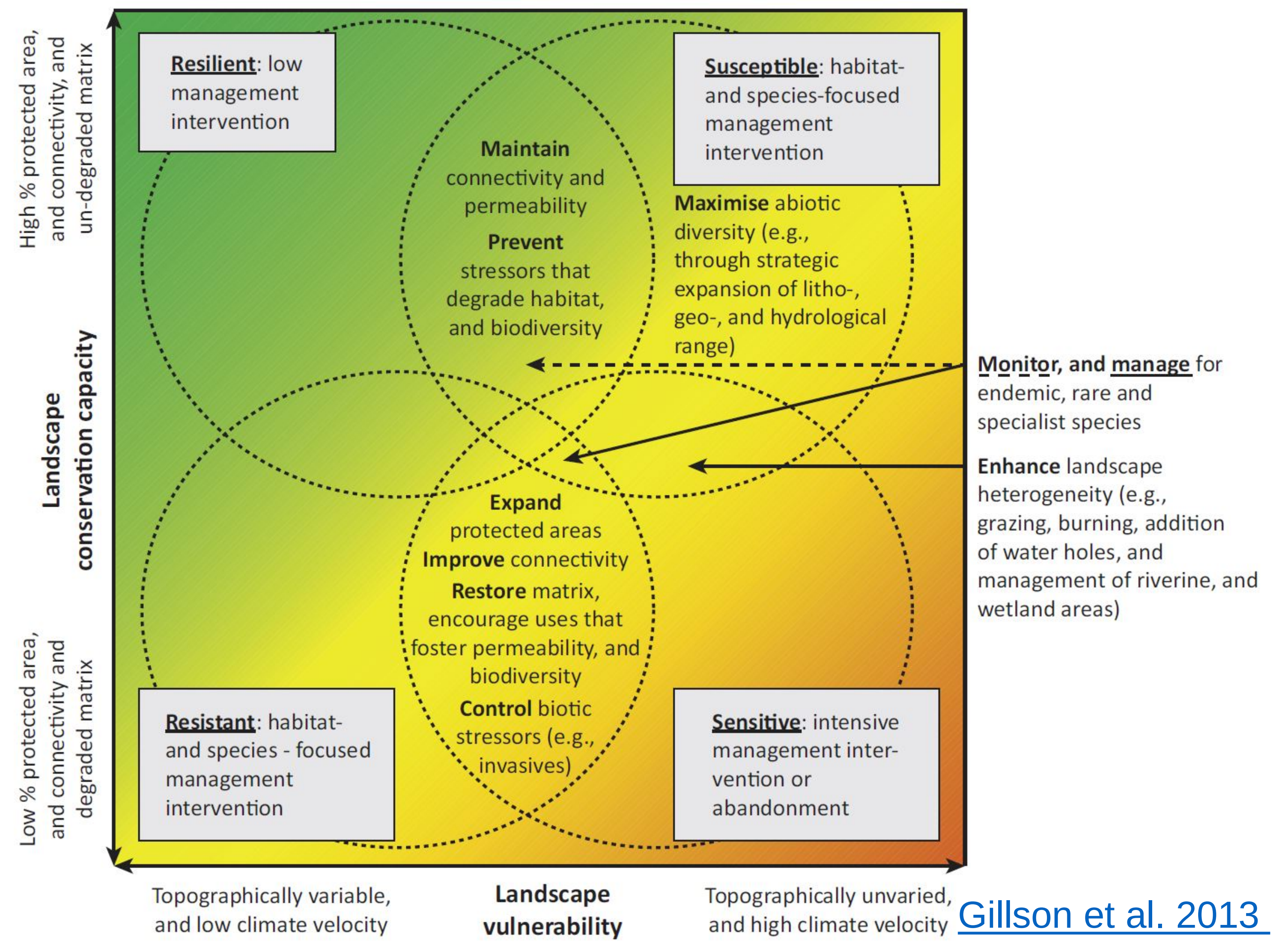


Figure 1. Conceptual framework proposed by Belote *et al.*[17]

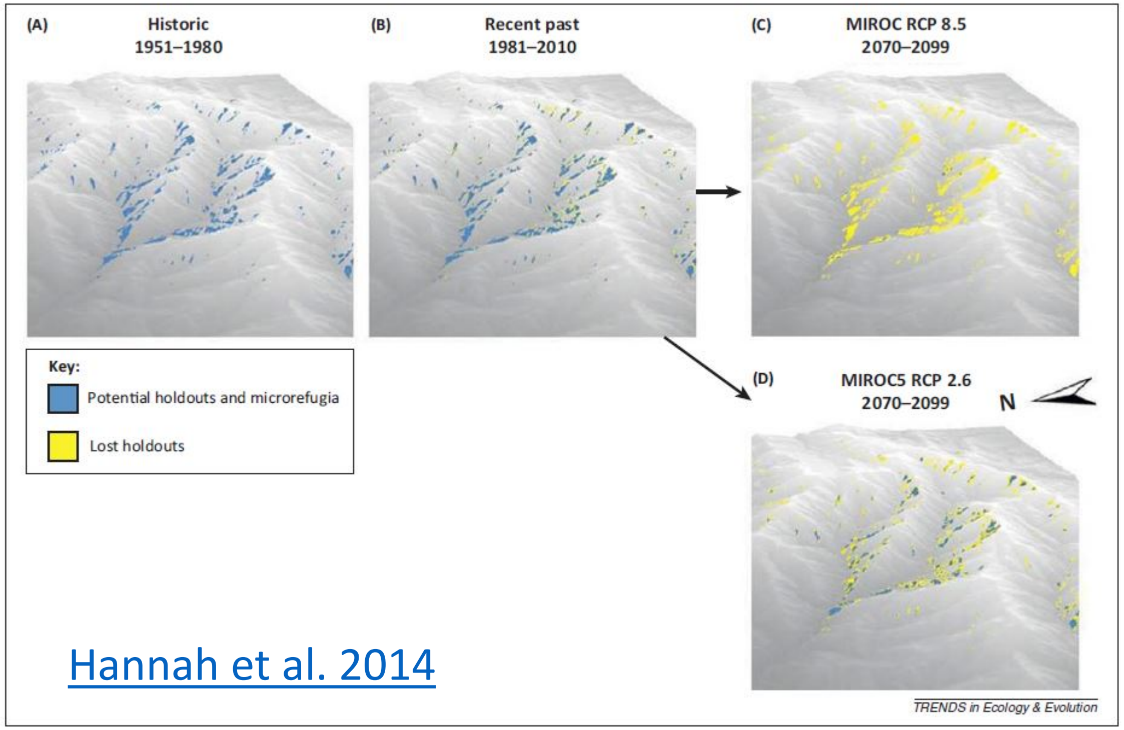
A similar system categorizes management approaches based on an area's conservation value and vulnerability



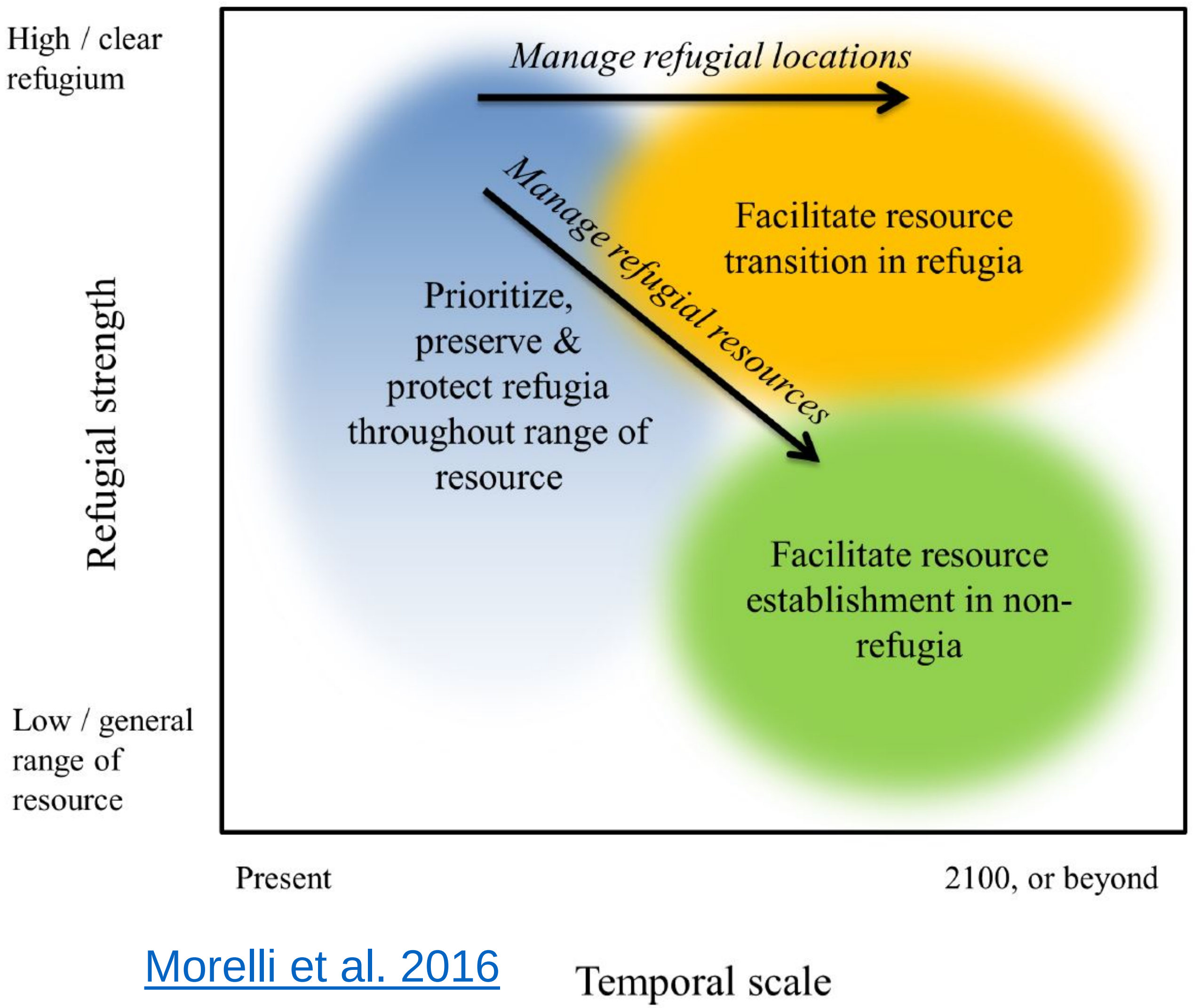
[Gillson et al. 2013](#)

The time horizon for planning

Long-term refugia vs stepping-stone habitat

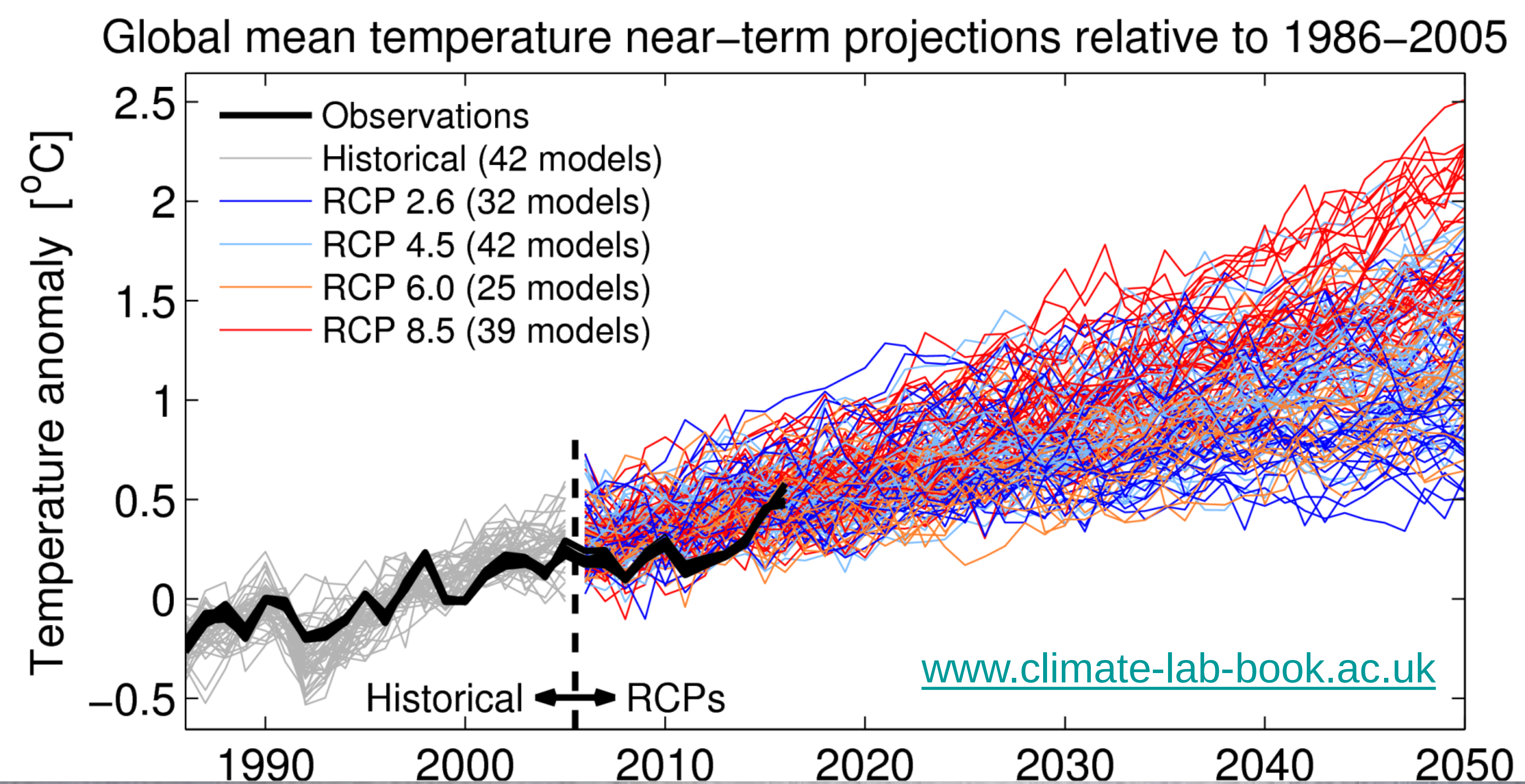


Hannah et al. 2014



Morelli et al. 2016

How do we plan for an uncertain future?



Climate model projections vary between models and emissions scenarios

Applying different management strategies under uncertainty

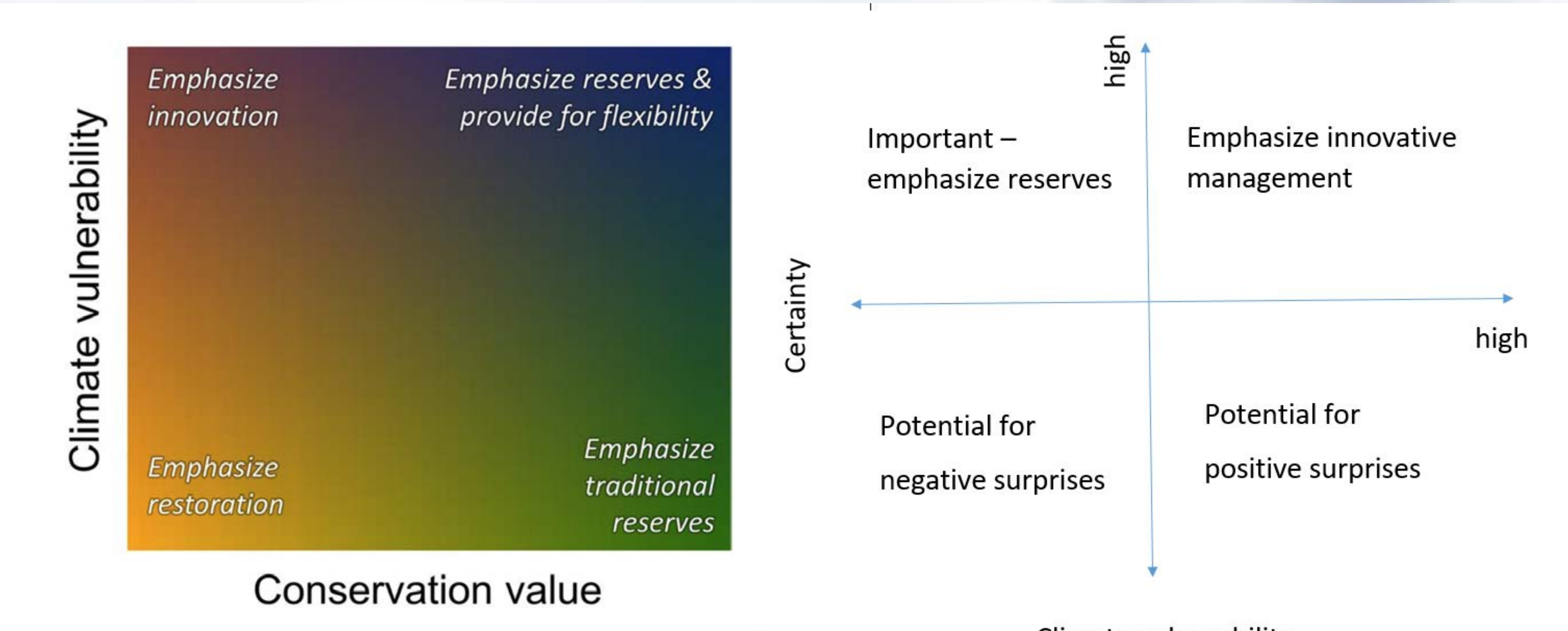


Figure 1. Conceptual framework proposed by Belote *et al.*[17]

Belote et al. 2017

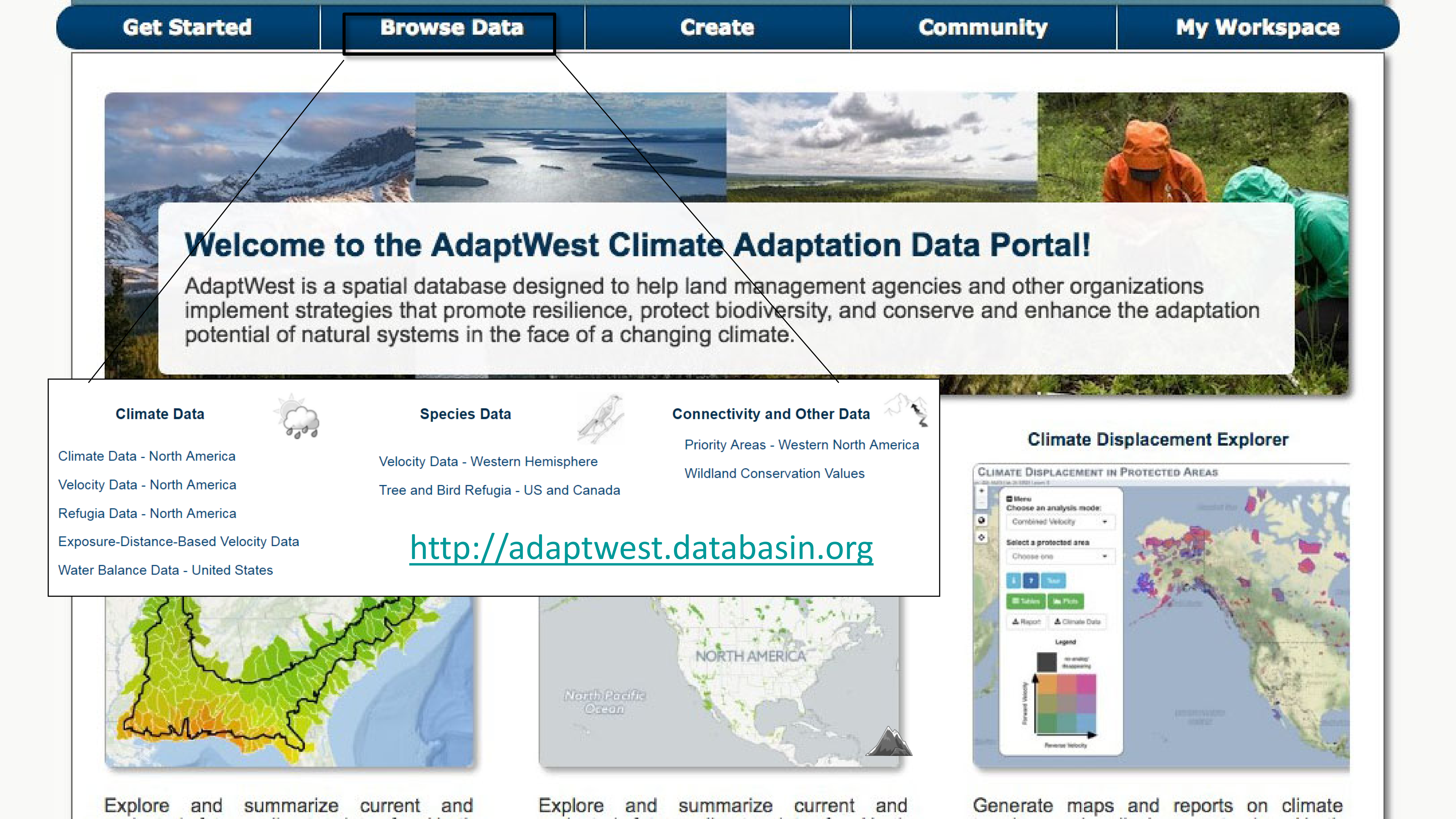
	Low value		High value	
	Low uncertainty	High uncertainty	Low uncertainty	High uncertainty
High vulnerability	Emphasize innovation	Emphasize innovation and prepare for surprises	Emphasize reserves and provide for management flexibility	Emphasize reserves and plan for experimental approach
Low vulnerability	Emphasize restoration	Emphasize restoration and prepare for surprises	Emphasize traditional reserves	Emphasize reserves and provide for management flexibility

Placing the data in context

- What does each type of data tell us?

- Do different datasets suggest similar or contrasting priorities?

- Qualitative insights on processes are as important as what specific places are identified.


Get Started
Browse Data
Create
Community
My Workspace
Welcome to the AdaptWest Climate Adaptation Data Portal!
AdaptWest is a spatial database designed to help land management agencies and other organizations implement strategies that promote resilience, protect biodiversity, and conserve and enhance the adaptation potential of natural systems in the face of a changing climate.
Climate Data
Climate Data - North America
Velocity Data - North America
Refugia Data - North America
Exposure-Distance-Based Velocity Data
Water Balance Data - United States
Species Data
Velocity Data - Western Hemisphere
Tree and Bird Refugia - US and Canada
Connectivity and Other Data
Priority Areas - Western North America
Wildland Conservation Values
http://adaptwest.databasin.org
Climate Displacement Explorer
Climate Displacement in Protected Areas
NORTH AMERICA
North Pacific Ocean
Explore and summarize current and
Explore and summarize current and
Generate maps and reports on climate

The AdaptWest Project team

- Carlos Carroll, Klamath Center for Conservation Research
- Diana Stralberg, University of Alberta
- Scott Nielsen, University of Alberta
- Andreas Hamann, University of Alberta
- Dave Roberts, University of Alberta
- Josh Lawler, University of Washington
- Julia Michalak, University of Washington
- Caitlin Littlefield, University of Washington

Other collaborators: Travis Belote (TWS), Sean Parks (USDA FS), Solomon Dobrowski (UM), Marc Parisien and Justin Beckers (NRCAN).

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For more information:

- Visit http://adaptwest.databasin.org
- Follow @adaptwest on Twitter for updates on newly available data and webinars
- Contact via email: carlos (at) klamathconservation.org

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