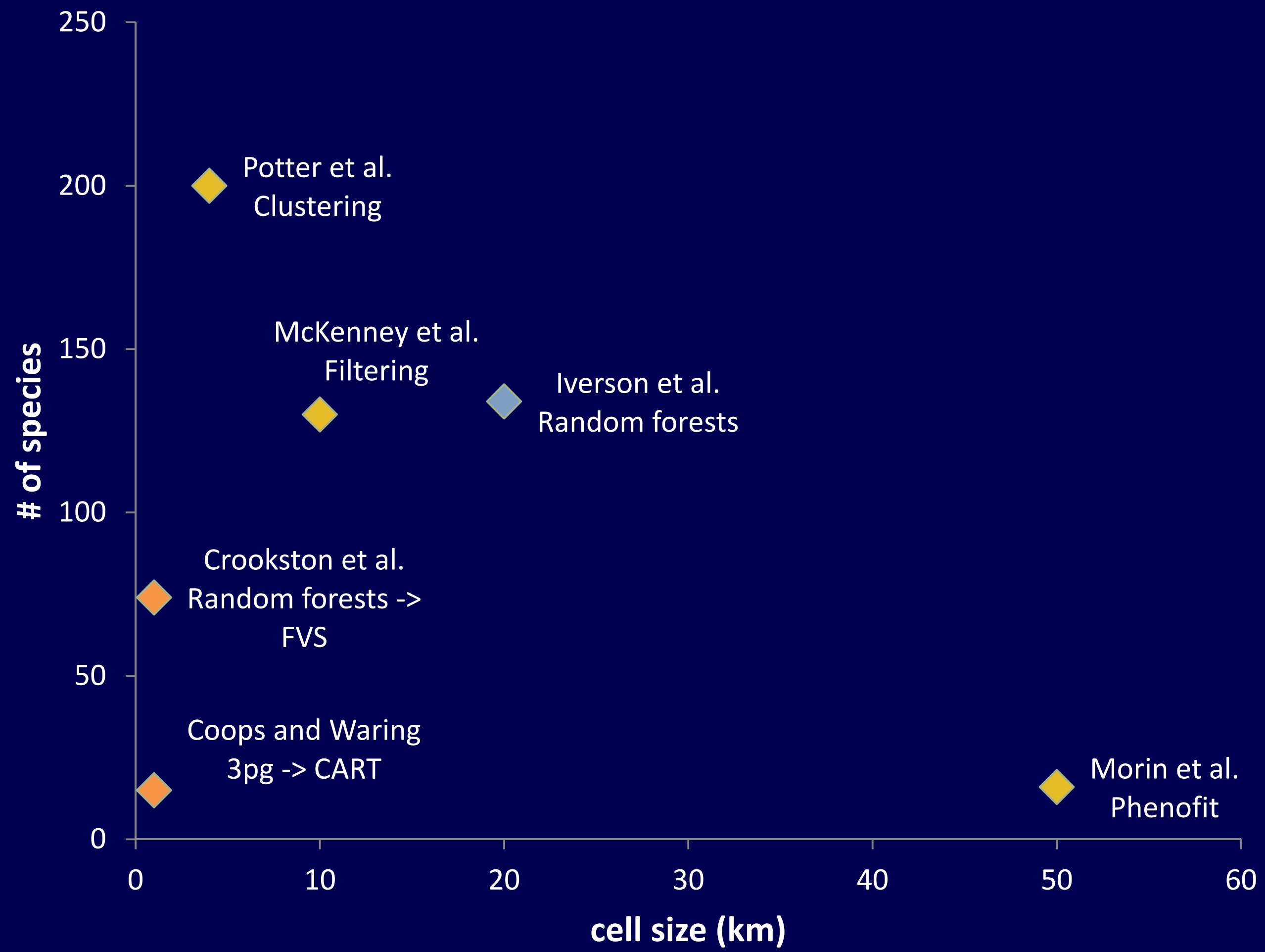
Analyses using existing efforts

- Synthesize results for species and ecological systems
- Identify important habitat factors for species and ecological systems
- Use process model outputs to inform vulnerability

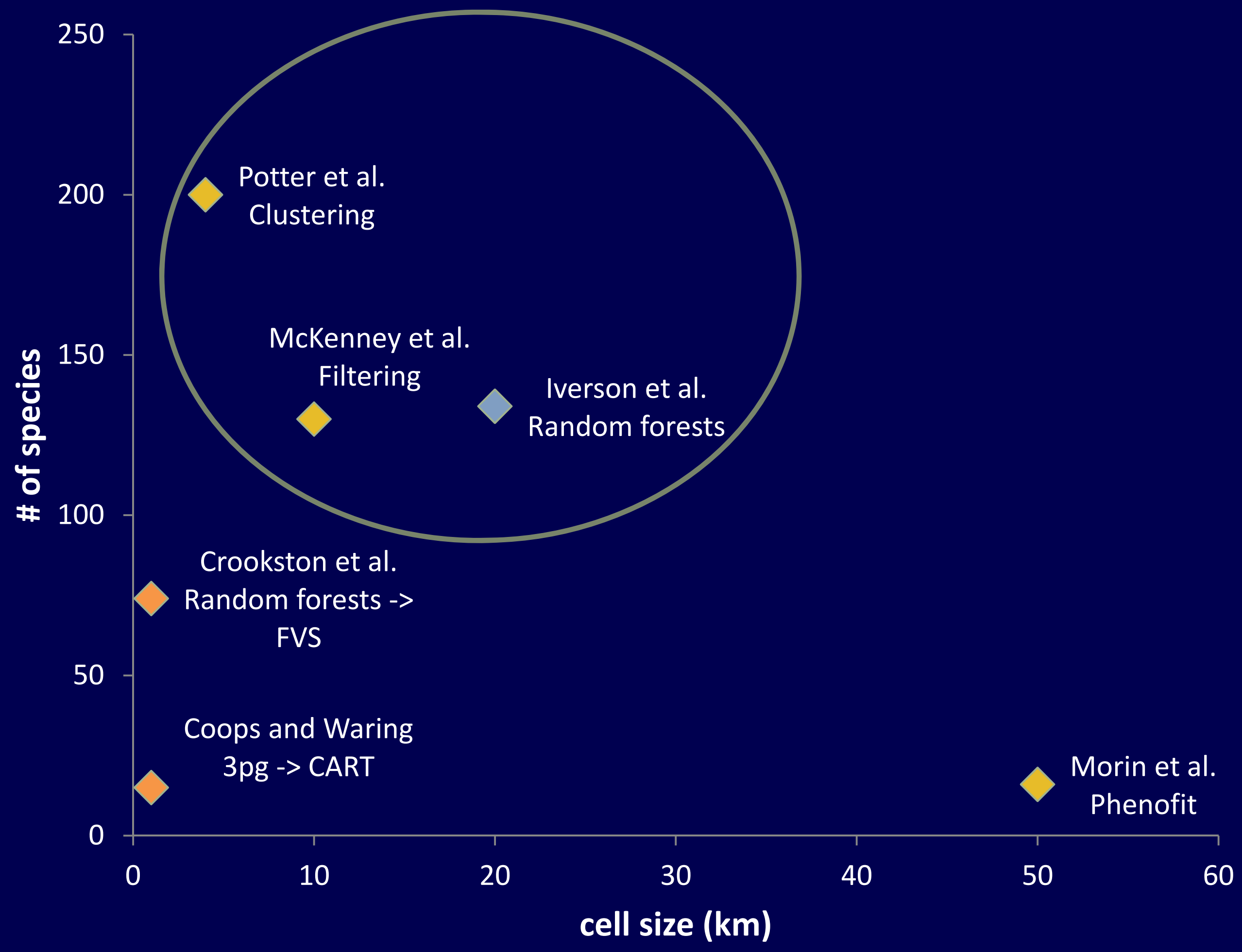
Existing Efforts

"We will focus on the coarser biodiversity levels in order to make initial progress" Land facets, vegetation lifeforms, and ecological system types



Existing Efforts

Potter et al., McKenney et al., and Iverson et al. (maybe Crookston) contain sufficient # of spp. for reasonable aggregation



Existing Efforts

- *South Central Interior Mesophytic Forest*
  - *Acer saccharum (sugar maple), Fagus grandifolia (american beech), Liriodendron tulipifera (tulip poplar), Tilia americana (american basswood), Quercus rubra (red oak), Magnolia acuminata (cucumbertree), and Juglans nigra (black walnut). Tsuga canadensis (eastern hemlock) may be a component of some stands.*

USDA United States Department of Agriculture Forest Service

Climate Change Tree Atlas

Northern Research Station

Atlas Background | Acronyms | Caution! | Atlas Help | Other Links (DropDownMenu)

'ou are here: Climate Change Atlas / Tree Atlas / Combined Species Outputs / Future Forest Types

otential Future Forest Type Changes

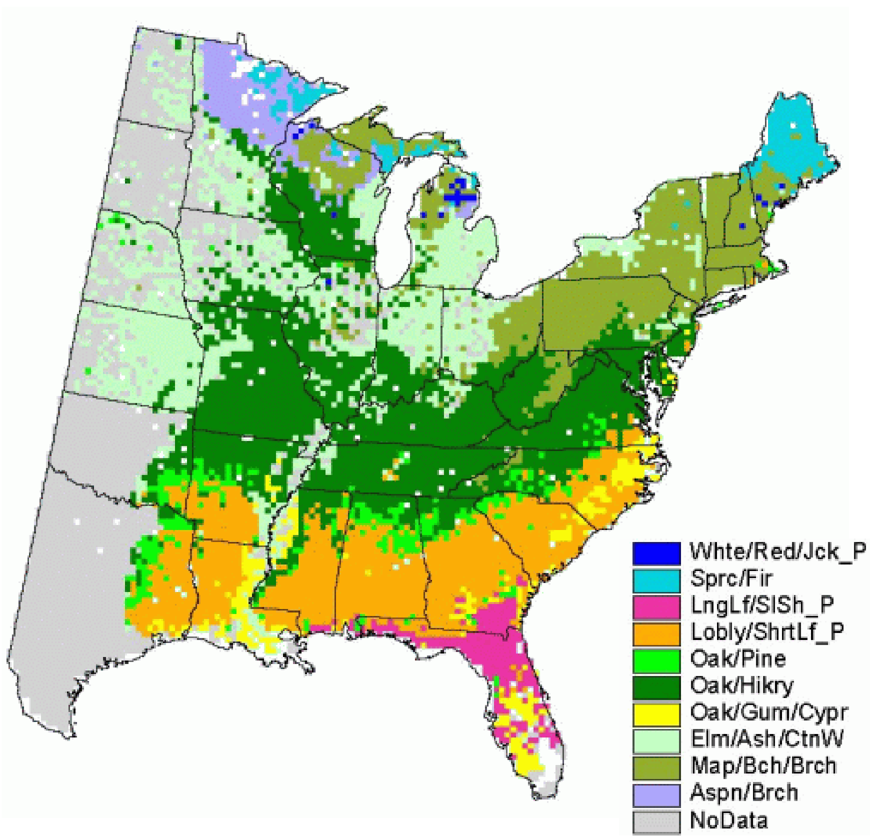
ne links below allow comparison of maps of potential forest-type changes :cording to the various GCM scenarios.
MPORTANT: Make sure you read the help file before interpreting the ianges.

View Summary of Changes

Climate Scenario Menu

Choose Forest Type from Menu

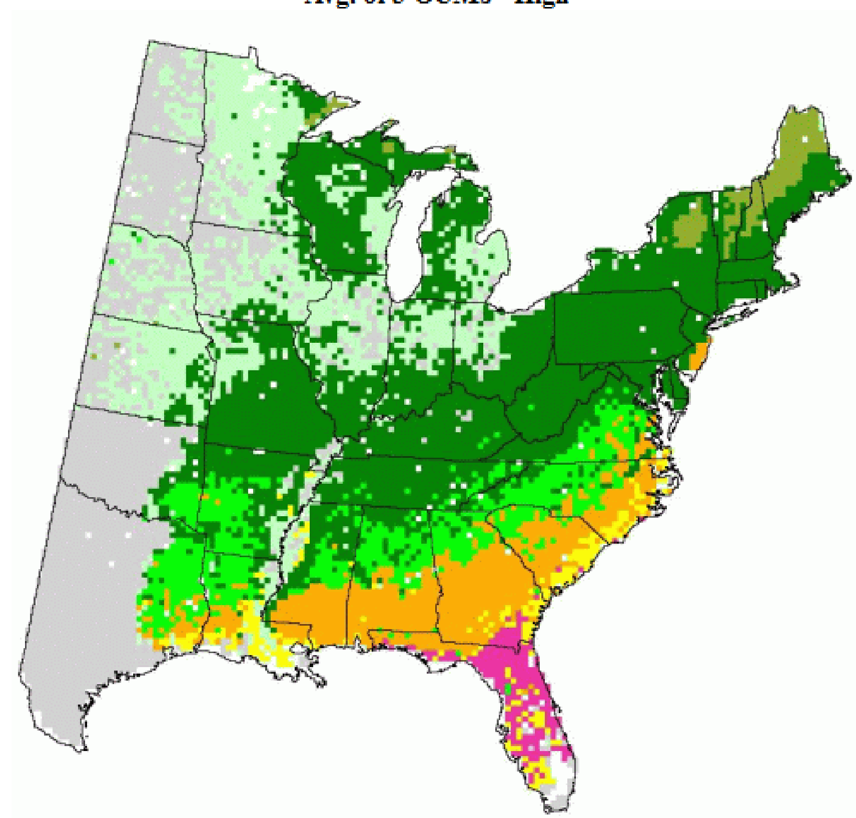
Current Modelled



Climate Scenario Menu

Choose Forest Type from Menu

Avg. of 3 GCMs - High



Existing Efforts

- Quantitative, spatial comparisons and uncertainty assessments will be useful but difficult because of differences in modeling approaches
- Could obtain uncertainty estimates along with spp. distribution maps
- Inter-comparisons probably most defensible if at larger extents
- Data accessibility an issue

Identify important habitat factors for species and ecological systems

- Extend climate envelope models with fine scale habitat information
- Habitat factors as predictors in model or as post modeling masks
- Need to consider the scale of habitat variability as it relates to the ecological requirements of a species or system
  - e.g. in complex terrain, topoclimate varies at a finer spatial scale
- What variables operate at particular scales?

Identify important habitat factors for species and ecological systems

- Geographic Resistance
- Distance from current to new habitat
- Topography
- Land facets
- Vegetation fragmentation
- Land use

Identify important habitat factors for species and ecological systems

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- Distance from current to new habitat
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- Land facets
- Vegetation fragmentation
- Land use

Pearson et al. 2004

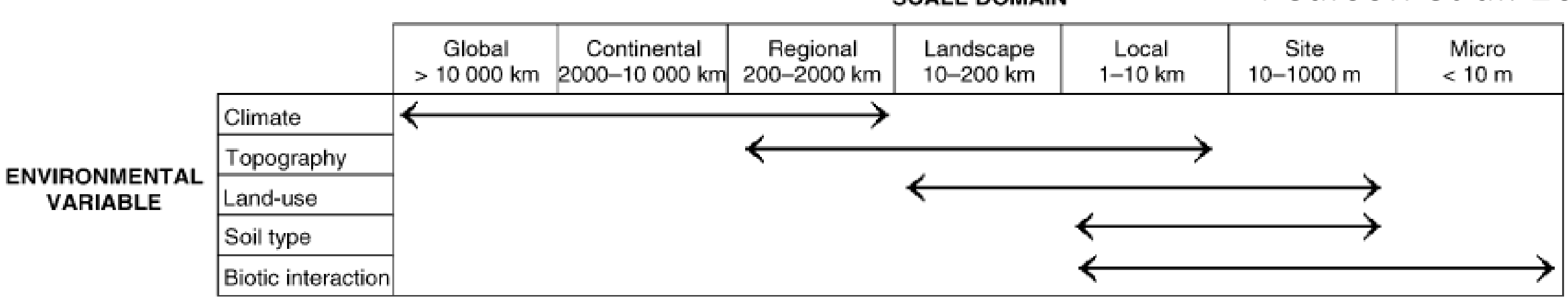


Fig. 5 Schematic example of how different factors may affect the distribution of species across varying spatial scales. Characteristic 'scale domains' are proposed within which certain variables can be identified as having a dominant control over species distributions. Approximate spatial extents have been assigned to categories of scale based in part on Willis & Whittaker (2002). It is assumed that large spatial extents are associated with coarse data resolutions, and small extents with fine data resolutions.

Identify important habitat factors for species and ecological systems

- Field observations could be helpful
  - www.vegbank.org - vegetation plot database of the Ecological Society of America's Panel on Vegetation Classification
  - Landfire public reference database
  - GAP
  - FIA?

vegbank.org/vegbank/views/observation_comprehensive.jsp?view=comprehensive&wparam=10529&entity=observation&params=10529

Comprehensive View of a Plot

click to update datacart

Configure View
Less Plot Detail -- Stems Detail -- Configure data displayed on this page

INW07906

» Citation URL: http://vegbank.org/cite/VB.Ob.10529.INW07906
» Citing info

Plot ID Fields:	
Author Plot Code	INW07906
Author Observation Code	INW07906
Location Fields:	MAP: Google | Yahoo | TopoZone | MapQuest
Confidentiality Status	exact location
Latitude	45.64 °
Longitude	-114.92 °
Location Narrative	Lat/long to second or hundreth second and UTM coordinates to 10 meters
State or Province	Idaho
Country	United States
Named Places	county: Idaho region|state|province: Idaho area|country|territory: United States
Layout Fields:	
Area	400 m²
Permanence	not permanent
Environment Fields:	
Elevation	2438.4 m
Slope Aspect	146 °
Slope Gradient	35 °
Methods Fields:	
Project	Composition and function of vegetation alliances in the Interior Northwest, USA
Observation Start Date	01-Jun-1989
Cover Method	Percentage (%)
Stratum Method	National Park Service
Overall Taxon Cover Values are Automatically Calculated?	no
Plot Quality Fields:	
--no data--	
Overall Plot Vegetation Fields:	
--no data--	
Misc Fields:	
--no data--	

Observation Contributors:
No Observation Contributors found.

Community Classification:

Interpret this plot to a community concept

More	Classification Start Date	Community Concept	Class Fit	Class Confidence	Typal	Contributors
Details		PINUS ALBICAULIS ALLIANCE			no	Jennings, Michael

Taxa occurring on this plot-observation

Change plant label: --Choose a value--

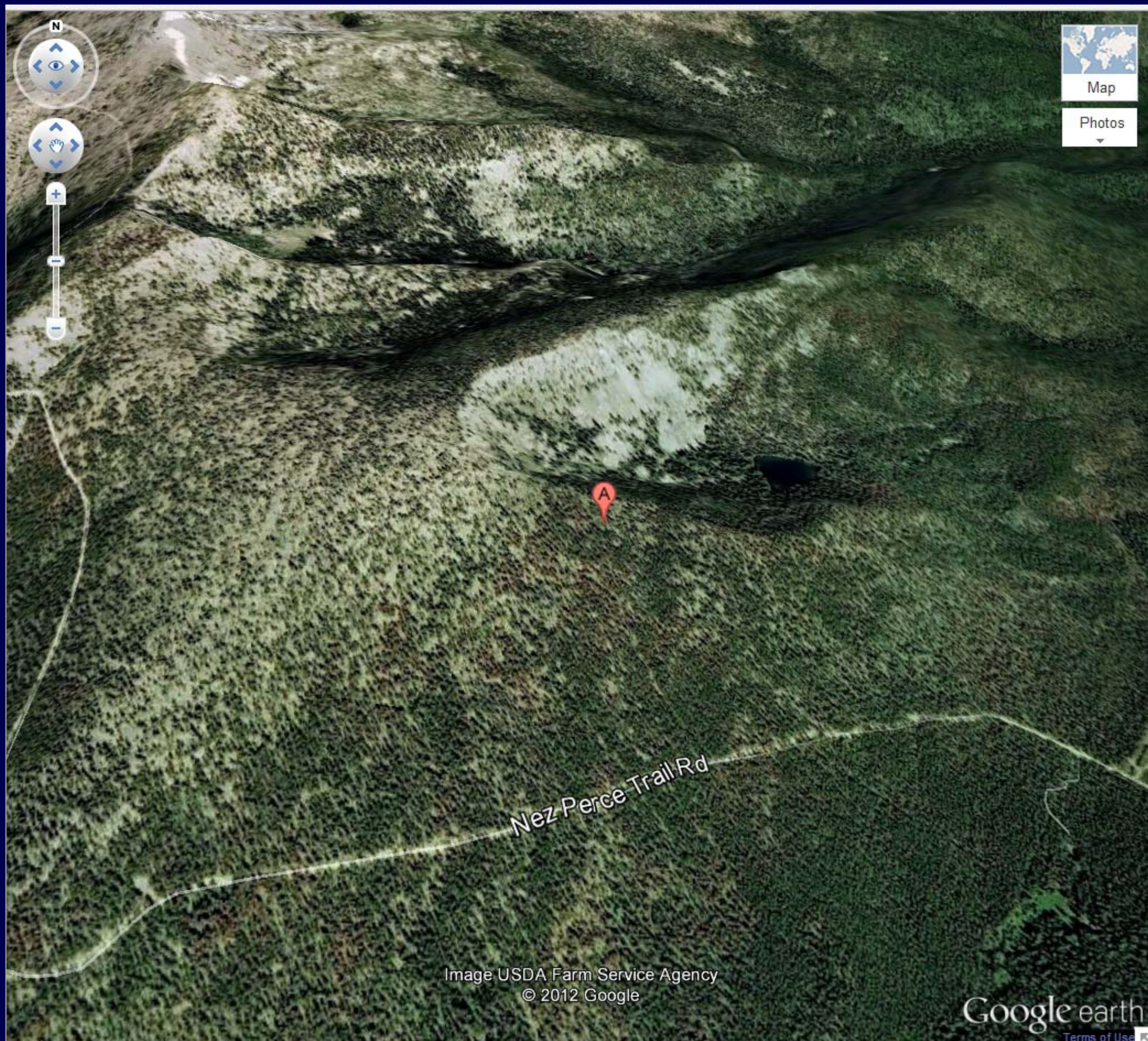
Change Strata Shown: show strata + overall

ord	Current Interpretation, Scientific Name without authors	Stratum	Cover	Original Cover Code	Basal Area	Biomass	Inference Area	Stem Diameters (graphically):
1	Carex geyeri	-all-	10 %					
2	Pinus albicaulis	-all-	10 %					
3	Abies lasiocarpa	-all-	3 %					
4	Xerophyllum tenax	-all-	3 %					
5	Luzula hitchcockii	-all-	3 %					
6	Phlox diffusa	-all-	1 %					
7	Pinus contorta	-all-	1 %					

This table is SORTABLE. Click the headers to sort ascending and descending.

Stratum Definitions:
Sorry, no Stratum Definitions found.

This table is SORTABLE. Click the headers to sort ascending and descending.


N
Map
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A
Nez Perce Trail Rd
Image USDA Farm Service Agency
© 2012 Google
Google earth
Terms of Use

vegbank.org/vegbank/views/observation_comprehensive.jsp?view=comprehensive&wparam=3656&entity=observation&params=3656

Comprehensive View of a Plot

click to update datacart

Configure View
Less Plot Detail -- Stems Detail -- Configure data displayed on this page

GRSM.92

» Citation URL: http://vegbank.org/cite/VB.Ob.3656.GRSM92
» Citing info

Plot ID Fields:	
Author Plot Code	GRSM.92
Author Observation Code	GRSM.92
Location Fields:	MAP: Google | Yahoo | TopoZone | MapQuest
Confidentiality Status	exact location
Latitude	35.653854838 °
Longitude	-83.440043338 °
Author Location	GRSM -- Mt. Leconte Summit
Location Narrative	SE from Leconte lodge, on trail past water tank. Moderately intact fir stand to the left of trail.
State or Province	Tennessee
Country	United States
Named Places	region|state|province: Tennessee quadrangle: Mount Le Conte area|country|territory: United States
Layout Fields:	
Shape	Rectangular
Area	1000 m²
Permanence	permanent plot
Environment Fields:	
Elevation	1950.71999703491 m
Slope Aspect	0 °
Slope Gradient	10 °
Topographic Position	Interfluve
Landform	slope
Landscape Narrative	Forest on gentle slope, organic soils, rocky. On exposed summit of Leconte. N-NW facing. -- Discontinuous stands of fir in the area- interspersed with patches of sedges, fern, solidago glomerata, rubus. Adjacent patches of complete fir death over rubus.
Percent Bedrock	0 %
Percent Rock / Gravel	0 %
Percent Wood	40 %
Percent Litter	40 %
Percent Bare Soil	10 %
Percent Water	0 %
Methods Fields:	
Project	Great Smoky Mountains National Park
Observation Start Date	14-Jul-1998
Observation End Date	14-Jul-1998
Cover Method	NPS CoverMethod
Stratum Method	National Park Service
Stem Size Limit	10 cm
Cover Dispersion	contiguous
Overall Taxon Cover Values are	

Taxa occurring on this plot-observation

Change plant label: --Choose a value--

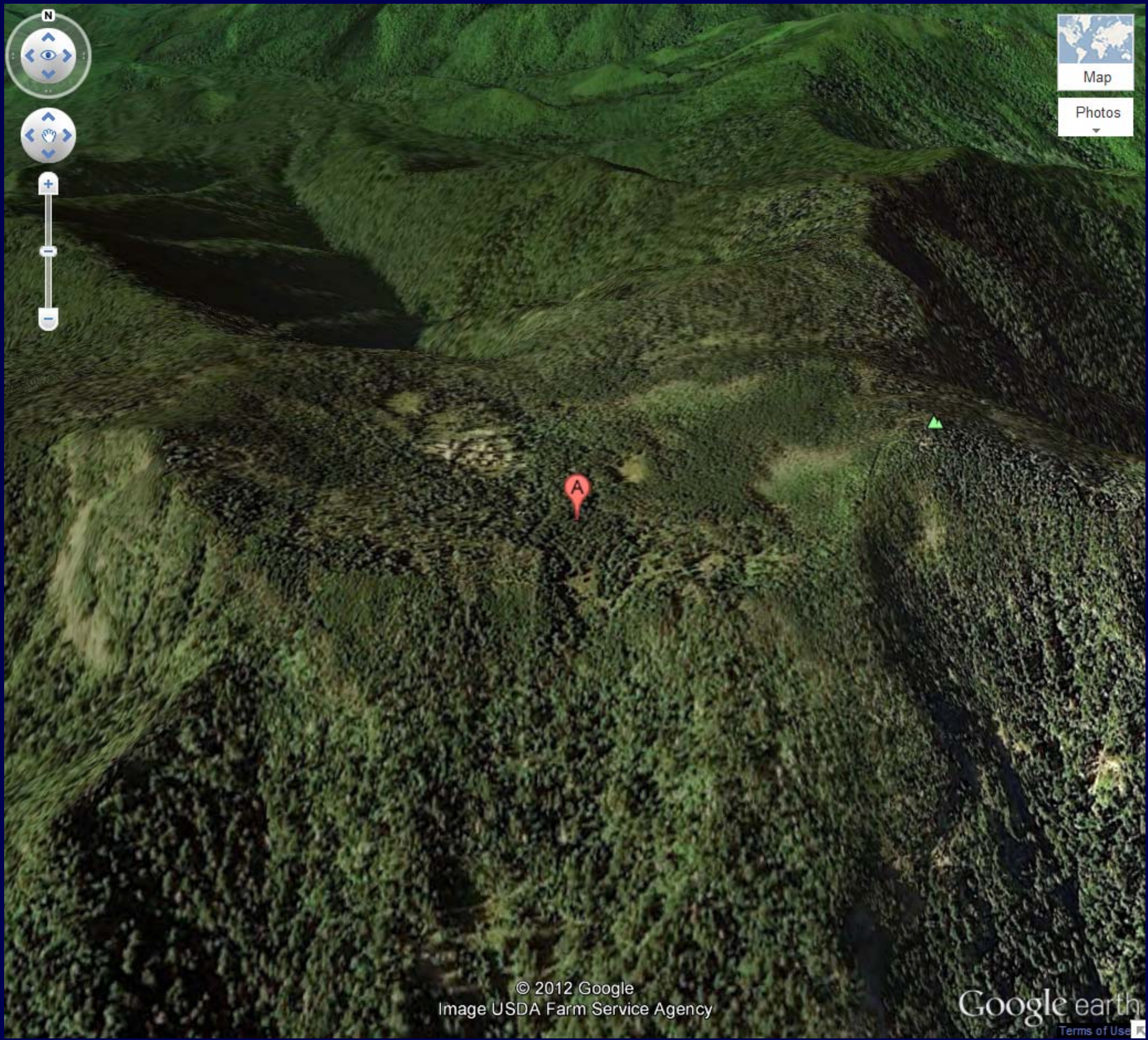
Change Strata Shown: show strata

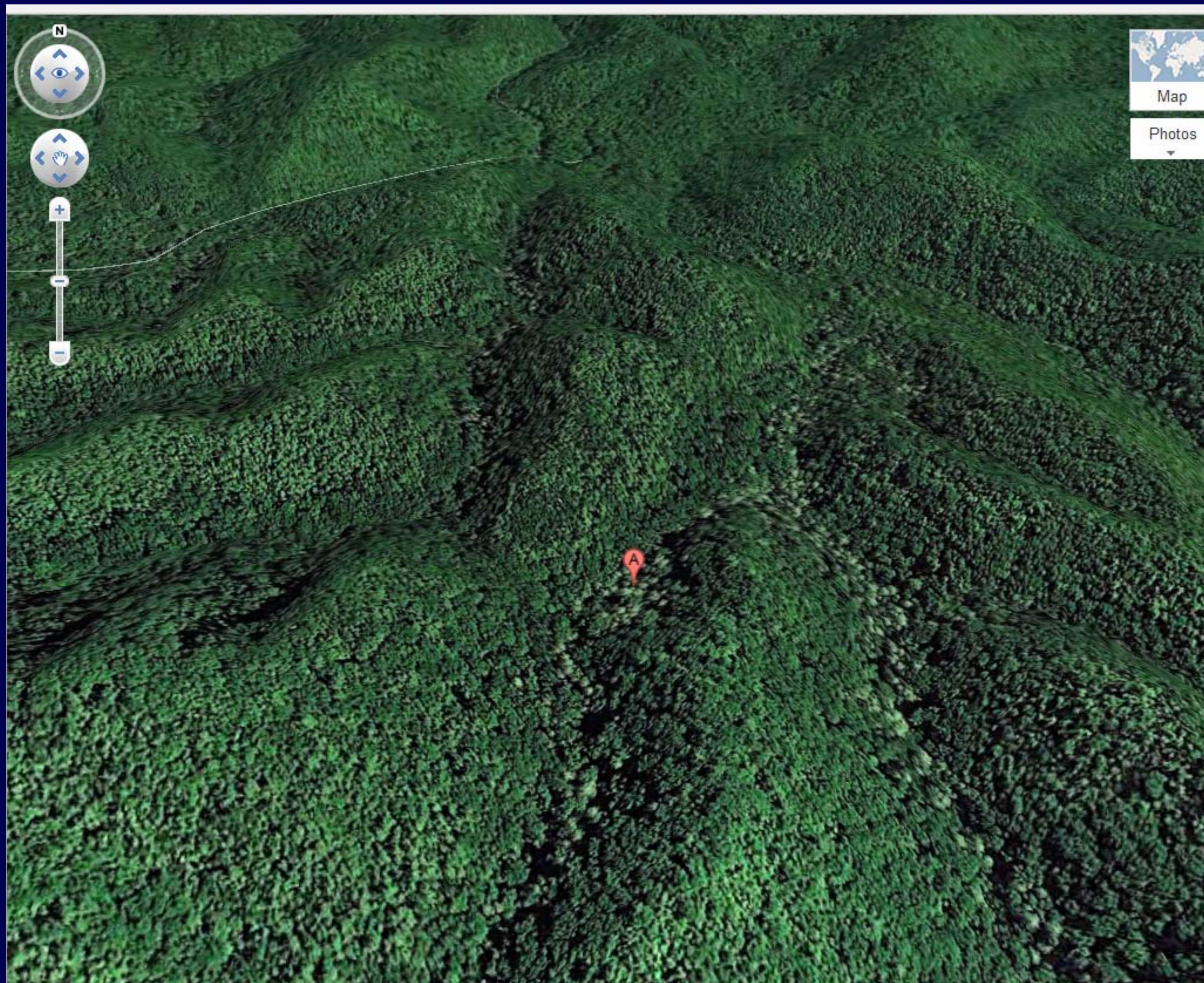
ord	Current Interpretation, Scientific Name without authors	Stratum	Cover	Original Cover Code	Basal Area	Biomass	Inference Area	Stem Diameters (graphically):
1	Abies fraseri	Canopy	85 %	06				
2	Picea rubens	Sub-Canopy	1.5 %	02				
3	Sorbus americana	Sub-Canopy	1.5 %	02				
4	Viburnum lantanoides	Tall Shrub	0.55 %	01				
5	Vaccinium erythrocarpum	Tall Shrub	0.55 %	01				
6	Bryophyta	Nonvascular	1.5 %	02				
7	Aster acuminatus var. acuminatus	Herbaceous	3.5 %	02				
8	Athyrium filix-femina ssp. asplenioides	Herbaceous	1.5 %	02				
9	Dryopteris campyloptera	Herbaceous	1.5 %	02				
10	Carex brunnescens	Herbaceous	1.5 %	02				
11	Clintonia borealis	Herbaceous	0.55 %	01				
12	Oxalis montana	Herbaceous	0.55 %	01				
13	Carex debilis	Herbaceous	0.55 %	01				
14	Prunus pensylvanica	Herbaceous	0.55 %	01				
15	Rubus canadensis	Herbaceous	0.55 %	01				
16	Solidago glomerata	Herbaceous	0.55 %	01				
17	Abies fraseri	Herbaceous	0.55 %	01				
18	Angelica triquinata	Herbaceous	0.05 %	01				
19	Cinna latifolia	Herbaceous	0.05 %	01				

This table is SORTABLE. Click the headers to sort ascending and descending.

Stratum Definitions:

Stratum Type	Stratum Base	Stratum Height	Stratum Cover
Vine/Liana			
Tall Shrub	1 m	2 m	5 %


N
Map
Photos
A
© 2012 Google
Image USDA Farm Service Agency
Google earth
Terms of Use


N
Map
Photos
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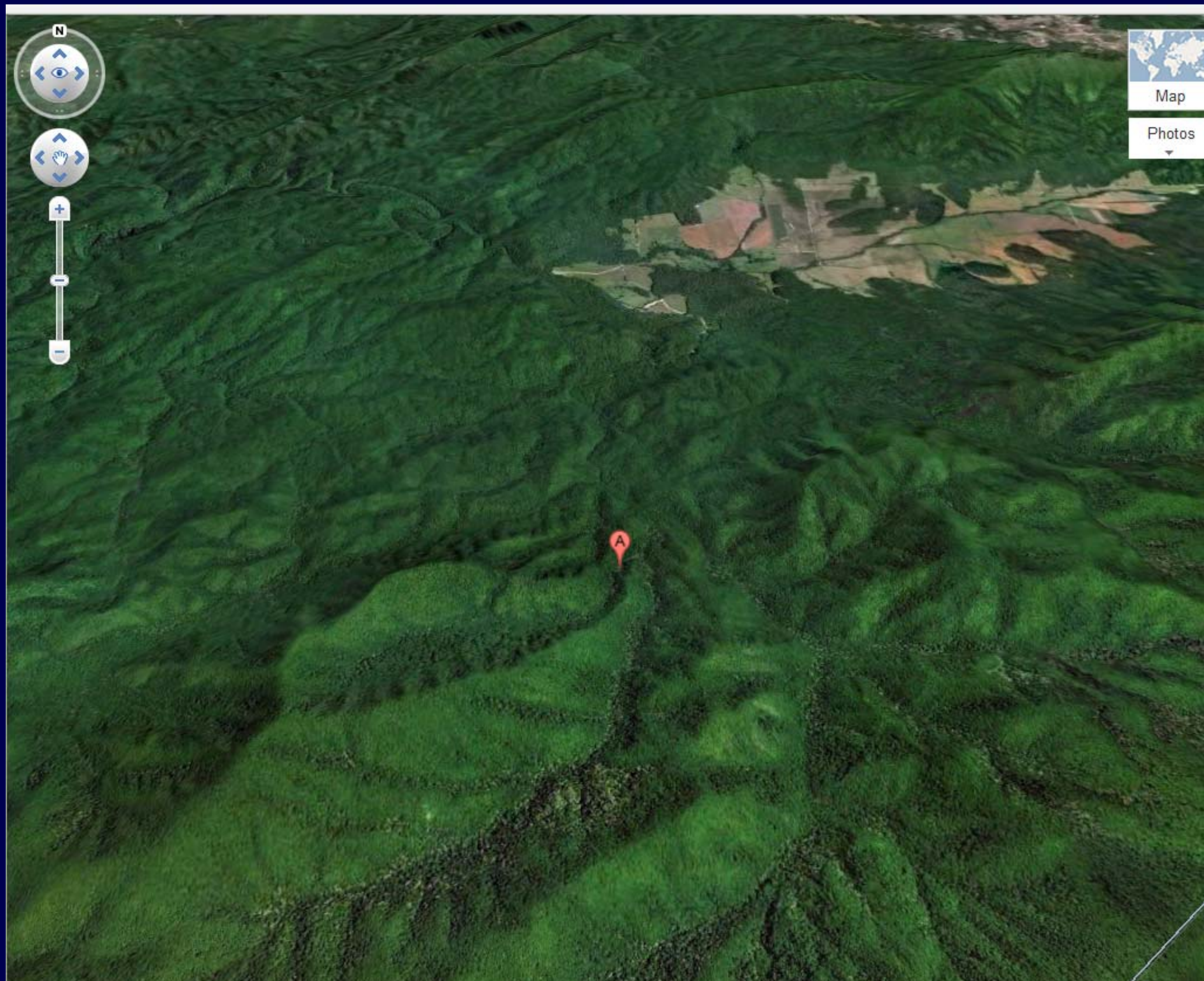
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Map
Photos
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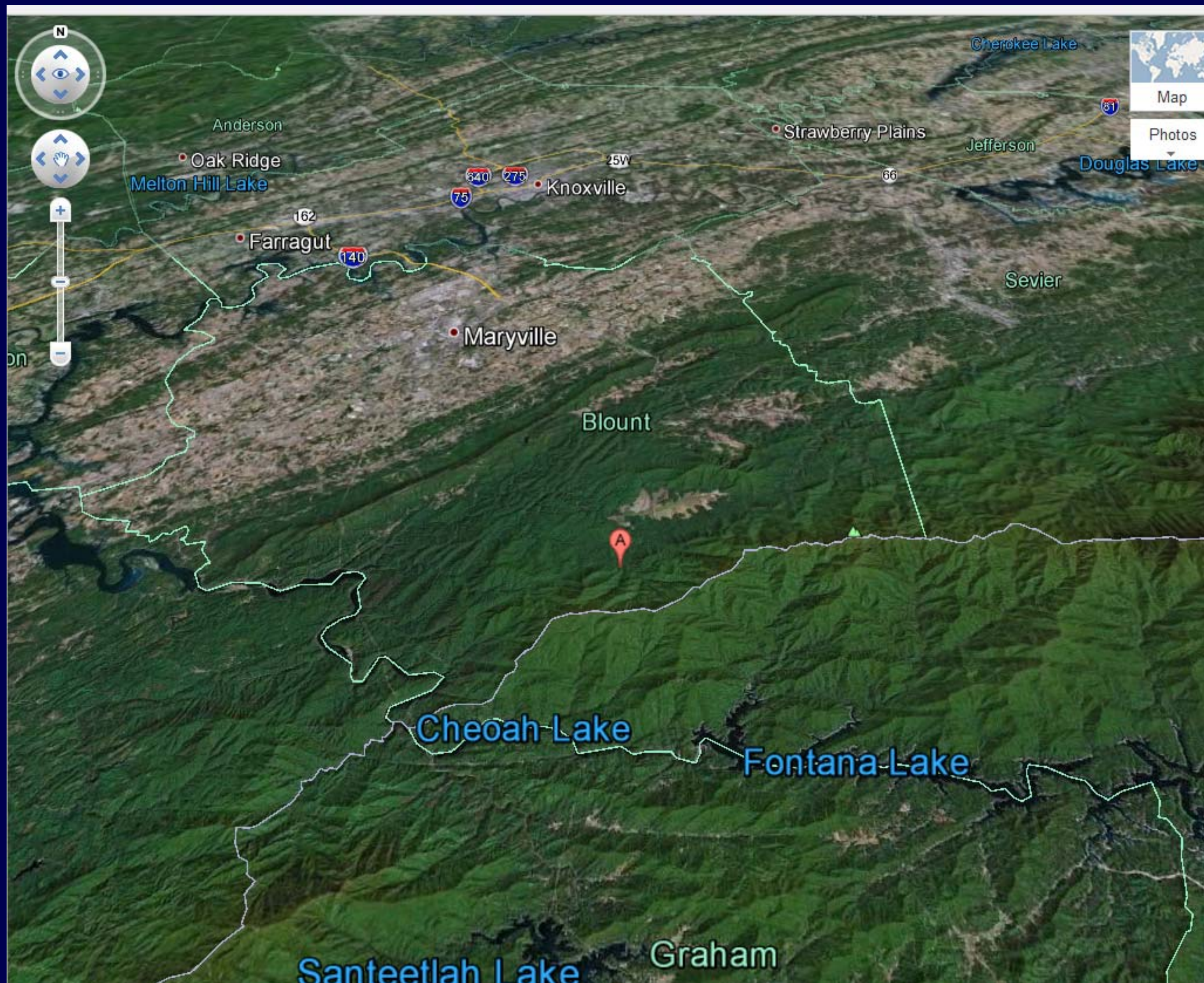
N
Map
Photos
Cherokee Lake
Anderson
Oak Ridge
Melton Hill Lake
Strawberry Plains
Jefferson
Douglas Lake
Knoxville
340
275
75
25W
66
81
162
Farragut
140
Sevier
Maryville
Blount
A
Cheoah Lake
Fontana Lake
Santeetlah Lake
Graham

www.landfire.gov/lfrdb_data.php

LANDFIRE

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- Data Products
- Schedule
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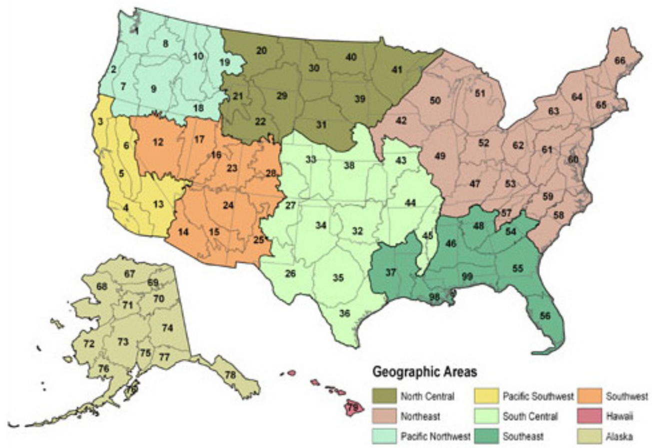
- Documents
- Training

Data Distribution Site

Data Products >> LANDFIRE National >> Download LFRDB

Select a geographic area within the map below to download the associated subset of the LANDFIRE Reference Database.

Users of this database and the data included herein must understand and conform to the specific conditions and limitations explained here.



Back to Reference Database

Access LANDFIRE Data
- Data Distribution Site
- Data Access Tool

IMPORTANT
user information
on Data Products:
Alerts (02/01/12)
Notifications (11/16/11)

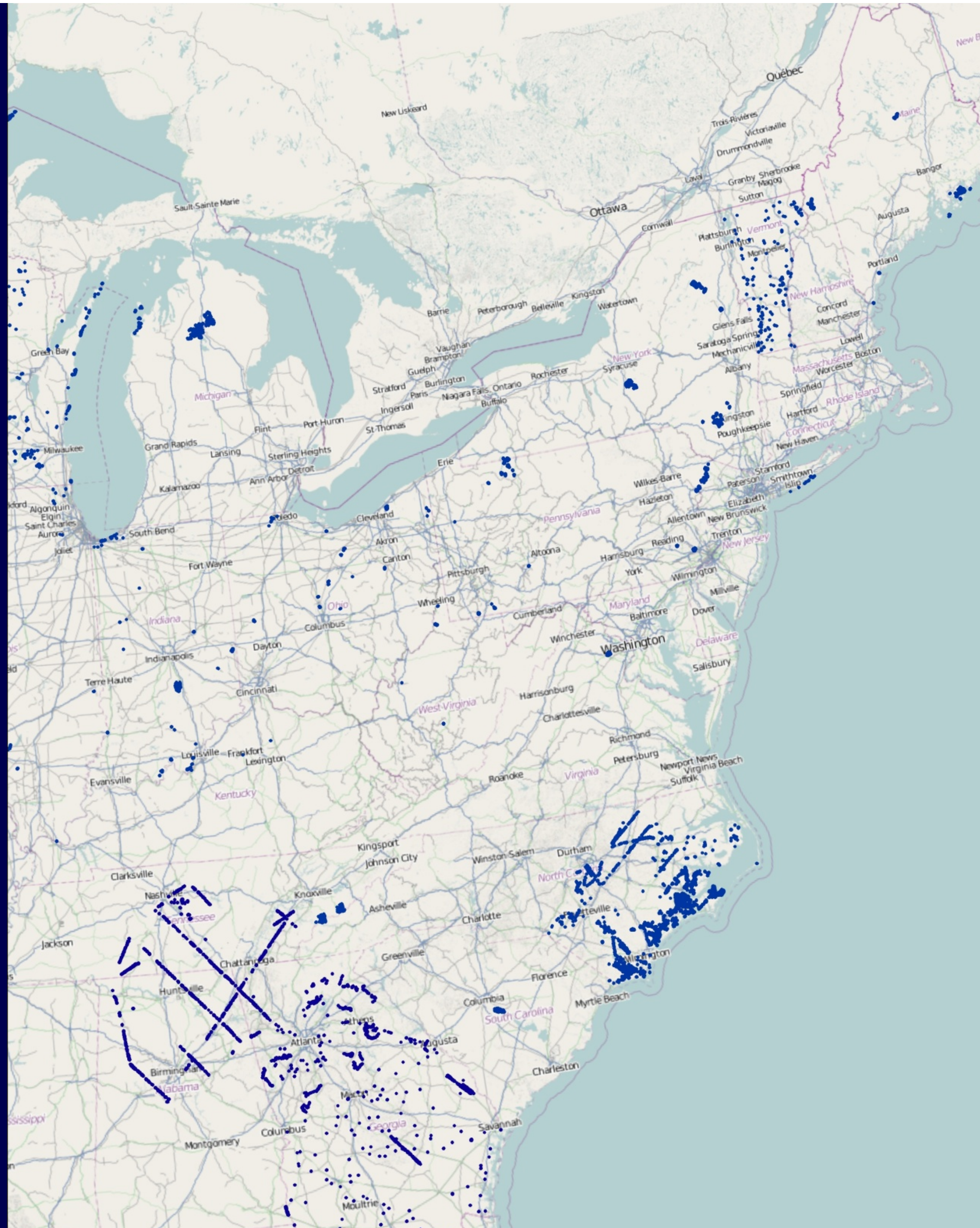
Helpful Tools to assist users of LANDFIRE data

At what scale should LANDFIRE data be used?

Recommendations for evaluating LANDFIRE fuel data products

How do I cite LANDFIRE data products?

Homepage


Québec
New Liskeard
Trois-Rivières
Victoriaville
Drummondville
Granby
Sherbrooke
Magog
Sutton
Laval
Bangor
Maine
Ottawa
Sault-Sainte-Marie
Cornwall
Plattsburgh
Burlington
Vermont
Montpelier
Augusta
Portland
New Hampshire
Concord
Manchester
Lowell
Boston
Worcester
Massachusetts
Kingston
Watertown
Belleville
Peterborough
Barrie
Vaughan
Brampton
Guelph
Burlington
Stratford
Paris
Niagara Falls
Ontario
Buffalo
Rochester
Syracuse
New York
Glens Falls
Saratoga Springs
Mechanicville
Albany
Springfield
Hartford
Rhode Island
Connecticut
New Haven
Poughkeepsie
Stamford
Smithtown
Paterson
Elizabeth
New Brunswick
Trenton
New Jersey
Wilkes-Barre
Hazleton
Allentown
Reading
Pennsylvania
Michigan
Green Bay
Milwaukee
Flint
Port Huron
Ingersoll
St Thomas
Grand Rapids
Lansing
Sterling Heights
Detroit
Ann Arbor
Kalamazoo
Erie
Cleveland
Toledo
South Bend
Algonquin
Elgin
Saint Charles
Aurora
Joliet
Akron
Canton
Fort Wayne
Altoona
Harrisburg
York
Wilmington
Millville
Pittsburgh
Wheeling
Cumberland
Maryland
Baltimore
Dover
Indiana
Ohio
Columbus
Winchester
Washington
Delaware
Salisbury
Dayton
Indianapolis
Terre Haute
Cincinnati
Harrisonburg
West Virginia
Charlottesville
Richmond
Petersburg
Newport News
Virginia Beach
Suffolk
Virginia
Roanoke
Louisville
Frankfort
Lexington
Evansville
Kentucky
Kingsport
Johnson City
Winston-Salem
Durham
Clarksville
Nashville
Knoxville
Asheville
Charlotte
Jackson
Chattanooga
Greenville
Florence
Huntsville
Columbia
South Carolina
Myrtle Beach
Atlanta
Athens
Augusta
Birmingham
Alabama
Charleston
Macon
Georgia
Savannah
Columbus
Montgomery
Moultrie

Use process model outputs to inform vulnerability

- TOPS outputs - Soil moisture / vegetation water stress, Primary productivity GPP/NPP
- Biological factors (Matthews et al. 2010) – CO_2 productivity, CO_2 water use efficiency, shade tolerance, edaphic specificity, env/habitat specificity, dispersal, seedling establishment, vegetative reproduction, fire regeneration
- Disturbance – disease, insect pests, browse, invasive plants, drought, flood, ice, wind, fire topkill, harvest, temperature gradients, pollution

Use process model outputs to inform vulnerability

Table 1 Niche-based models used in this study

Model no.	Abbreviation	Method	References
1.	RF (random forest)	A machine-learning method – a combination of tree predictors such that each tree depends on the values of a random vector sampled independently and with the same distribution for all trees in the forest.	Breiman (2001)
2.	CTA (classification tree analysis)	A classification method – a 50-fold cross-validation to select the best trade-off between the number of leaves of the tree and the explained deviance.	Breiman *et al*. (1984)
3.	GBM (generalized boosting model)	A machine-learning method – combines a boosting algorithm and a regression tree algorithm to construct an 'ensemble' of trees.	Ridgeway (1999)
4.	MARS (multivariate adaptive regression splines)	A nonparametric regression method, mixing CTA and GAM.	Friedman (1991)
5.	GAM (generalized additive model)	A regression method, with 4 degrees of freedom and a stepwise procedure to select the most parsimonious model.	Hastie & Tibshirani (1990)
6.	MDA (mixture discriminant analysis)	A classification method – based on mixture models.	Hastie & Tibshirani (1990)
7.	GLM (generalized linear model)	A regression method, with polynomial terms for which a stepwise procedure is used to select the most significant variables.	McCullagh & Nelder (1989)
8.	ANN (artificial neural networks)	A machine-learning method, with the mean of three runs used to provide predictions and projections.	Ripley (1996)
9.	SER (surface range envelope)	A simple rectilinear envelope, that takes into account the whole range of conditions in which the species is present.	Busby (1991)

Keenen et al. 2010

Use process model outputs to inform vulnerability

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Keenen et al. 2010

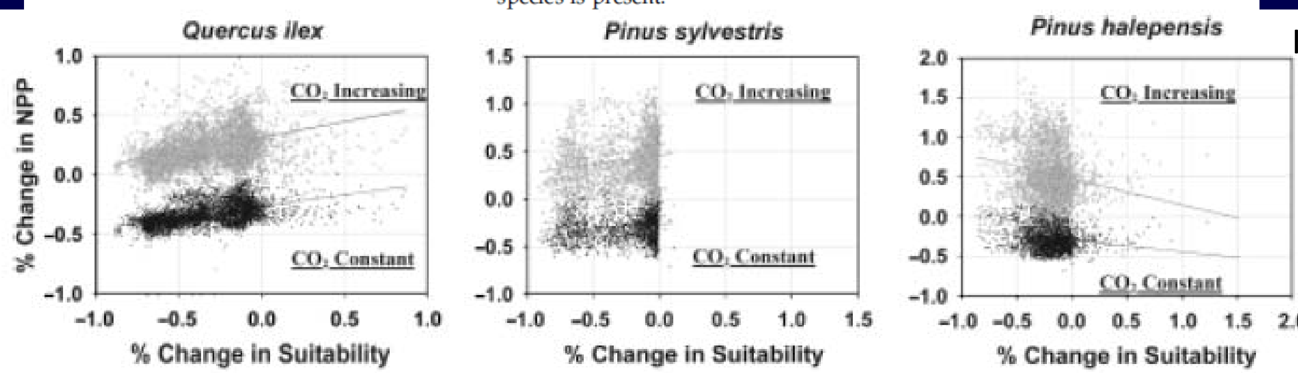

Fig. 6 The spatially explicit change (percentage per pixel) in average per period net primary production (NPP) (GOTILWA +) and estimated Suitability (multi-niche-based model ensemble), between the periods 1950–1980 and 2050–2080, considering both GOTILWA + simulations with (gray) and without (black) an atmospheric CO_2 increment. Lines represent linear regressions.

Conclusions

- Existing efforts include enough spp. and cover enough area to allow aggregation to coarser biological levels and for useful summaries
- Differences in modeling approaches limit our ability to make quantitative comparisons
- Use fine scale habitat info, ecological process outputs, spp. requirements from extensive literature reviews to extend and refine existing efforts

Statistical Models

- GLM – parametric extension of linear regression able to handle non-normally distributed response variables, logit link usually used for SDMs
  - Assumes independent Ys that belong to one of several distributions (gaussian, poisson, binomial, neg. binomial, gamma)
- GAMs – non-parametric smoothing functions replace the coefficients in GLM, can be spatially implemented in GRASP

Machine Learning Approaches

- Decision trees – binary recursive splitting
  - Flexible, hierarchical, non-parametric, results in intuitive rule sets
- Ensemble trees – bagging, boosting, random forests
  - Bagging – sample the data with replacement, developing a tree for each sample, average the predictions for regression, trees cast votes for classification
  - Boosting – bagging with unequal sample probability, higher probability for "problem" observations
  - RFs – construct large number of decorrelated trees using random data samples and random subset of predictor variables, average the predictions

Machine Learning Approaches

- ANN – high start up costs, black box
  - works well for high dimensional problems
- Genetic algorithms – GARP
  - Search for conditional probabilities to generate classification rules which are then subject to “natural selection”, evolving a rule set with high fitness
  - works well with complex relationships between variables

Machine Learning Approaches

- Multivariate adaptive regression splines
  - Relate predictors to response via piecewise linear splines
  - A decision tree like approach is used to place “knots” along a predictor’s range between which splines are estimated
  - Basis functions, i.e. the splines on either side of a knot, that contribute little to model fit are removed
  - Potential advantage is ability to model local variable interactions but can be prone to overfitting

Machine Learning Approaches

- Maxent – works well for presence only
  - Relies on the ratio of the "conditional density of covariates at presence sites" to the "density of covariates across the study area"
  - Provide appropriate background samples
  - Account for sample bias if possible

Elith et al. 2011

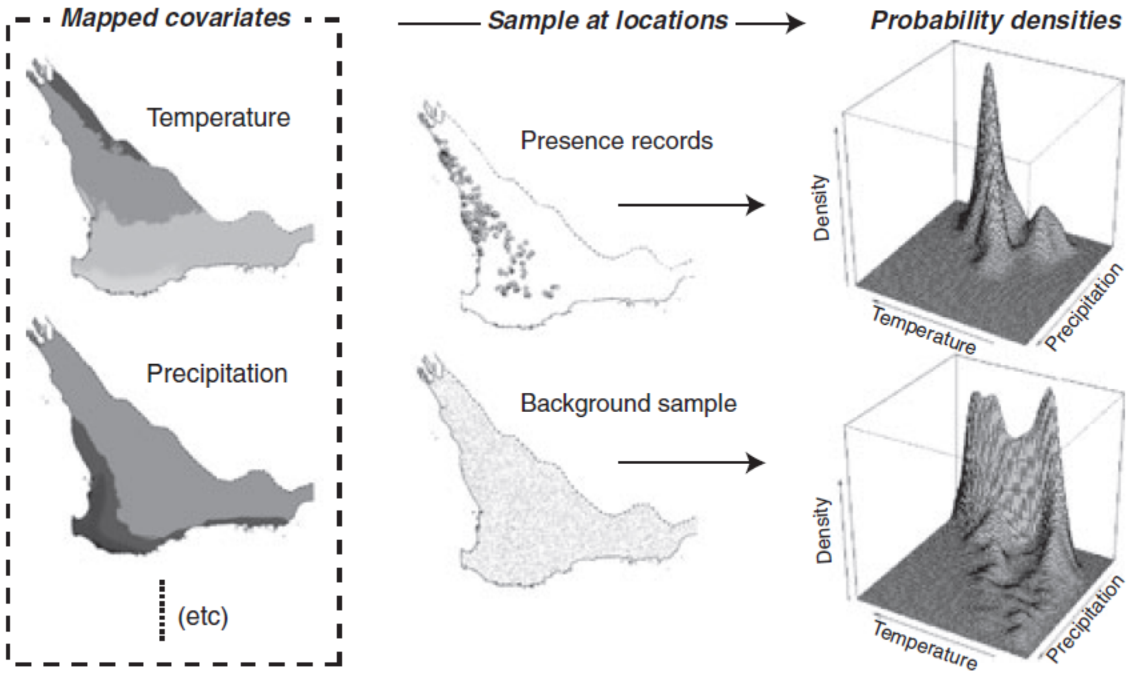

Figure 1 A diagrammatic representation of the probability densities relevant to our statistical explanation, using data presented in case study 1. The maps on the left are two example mapped covariates (temperature and precipitation). In the centre are the locations of the presence and background samples. The density estimates on the right are not in geographic (map) space, but show the distributions of values in covariate space for the presence (top right) and background (bottom right) samples. These could represent the densities $f_1(\mathbf{z})$ and $f(\mathbf{z})$ for a simple model with linear features.

Elith et al. 2011

Machine Learning Approaches

- Support vector machines
  - One class SVMs, e.g. presence only, fit hyperplanes around the data points
  - Has potential but tools for visualization and interpretation are limited

Franklin and Miller 2009

Combining Models

- Ensembles
  - – BIOMOD – implemented in R, includes GLM, GAM, DT, ANN, BRT, combines using PCA
  - – ModEco – SVM, BioClim, Domain, GLM, ML, ANN, Rough Set, Maxent, Classification trees, ensembles
  - – Weighted ensembles using true skill statistic (Keenen et al. 2010)

Other Approaches

- Habitat suitability indices - e.g. geometric means of important factors
- Ecological niche factor analysis
- Environmental distance – e.g. Mahalanobis distance
  - Work best when "organisms are using optimal habitat, are well-sampled in environmental space, and when habitat variables are not dynamic" Franklin and Miller 2009
- Environmental envelope models – e.g. BIOCLIM
- Resource selection functions
- GDM – Generalized dissimilarity modeling

Other Issues

- Need to understand how each algorithm extrapolates outside the data range
  - Maxent extrapolates in a horizontal line from extremes, "clamping"
  - GLM extrapolates along the fitted function (e.g. cubic or quadratic)
  - Decision tree approaches extrapolate at constant values from extremes
- Some approaches can overfit in data sparse regions
  - E.g. GLM, GARP
- Pseudoabsences an active research area

Elith et al. 2011

Other Issues

Abundance vs. presence absence

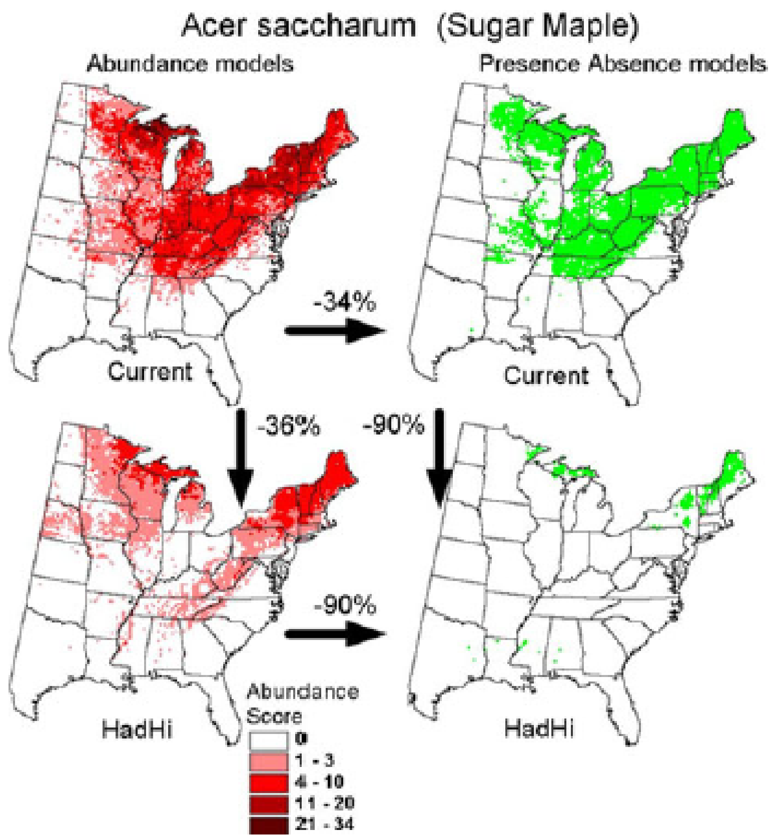

Figure 2. The large disparity of outcomes for sugar maple when comparing abundance-based models to binary (presence/absence) models. "Current" indicates the modeled current abundance or range extent, whereas the "HadHi" maps are based on the HadleyCM3 GCM model (high CO_2 sensitivity) and high emissions (A1fi) scenarios. Abundance score is an importance value based on basal area and number of stems, Iverson and others (2008a, b).

Iverson et al. 2011

Uncertainty

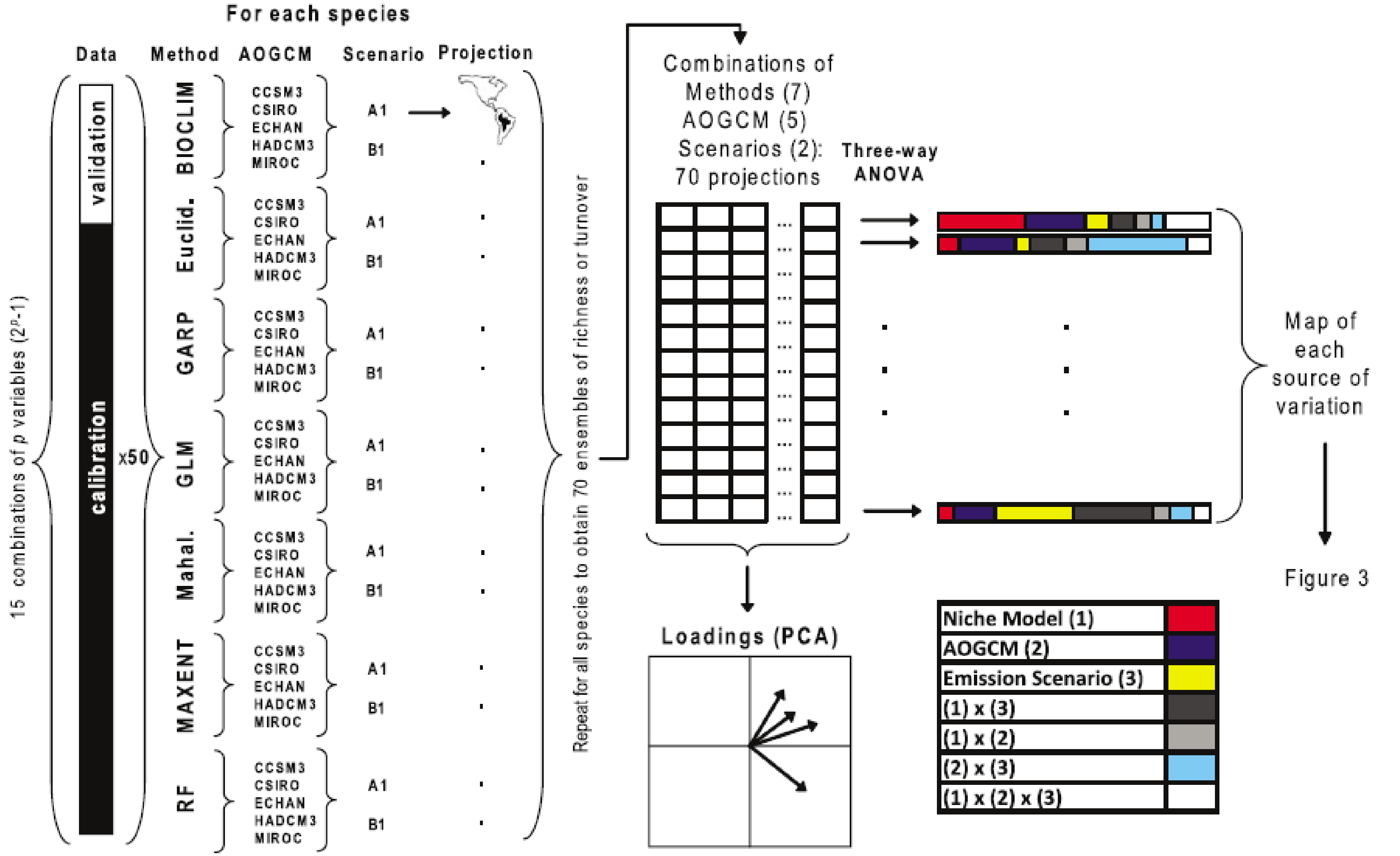

Figure 1. A schematic representation of the analytical framework used to evaluate spatial patterns of uncertainty in ensemble forecasting. Forecasting is generated using 15 combinations of the four bioclimatic variables, based on 50 random replications of calibration/validation datasets, for each method for niche modeling. Projections are based on the five AOGCMs for the two emission scenarios (A1 and B1). Then a three-way ANOVA is applied to each cell and the proportion of the total sum of squares accounted by each source can be mapped. A PCA can be used to evaluate the similarity among the ensemble-based vectors.

Diniz-Fihlo et al. 2009

Uncertainty

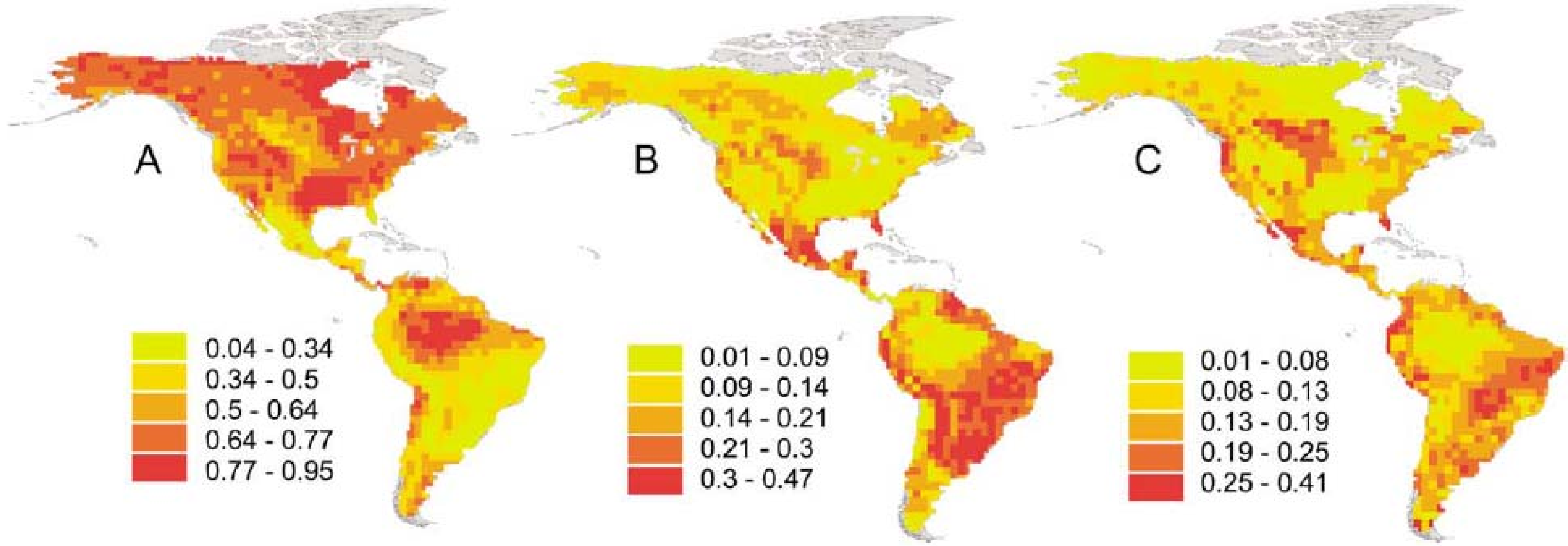

Figure 3. Proportion of the total sum of squares accounted for by SDM (A), AOGCM (B) and the interaction between these factors (C).

Diniz-Fihlo et al. 2009

Uncertainty

- Matthews et al. 2010 – take a different approach
- Biological factors – CO_2 productivity, CO_2 water use efficiency, shade tolerance, edaphic specificity, env/habitat specificity, dispersal, seedling establishment, vegetative reproduction, fire regeneration
- Disturbance – disease, insect pests, browse, invasive plants, drought, flood, ice, wind, fire topkill, harvest, temperature gradients, pollution
- Climate scenarios

Uncertainty

- Eastern Tree Spp.
- Biological factors suggest overall a potential for adaptation,
- Certain factors like shade tolerance important, e.g. for *Acer rubrum* – projected loss of suitable habitat but shade tolerance may explain its current expansion and mitigate predicted changes
- GCM emissions – no clear pattern in variability by species but largest differences in emissions scenarios was at northern range boundaries
- Novel climates – generally emerge in southern portion of the study area
- Long distance dispersal – identified tree species with a large proportion of future suitable climates > 200km from currently suitable areas

Matthews et al. 2010

Spatial Autocorrelation

- Decreased precision of coefficients increase incidence of Type I error
- Variable selection skewed towards auto-correlated predictors
- Broad scale predictors often selected over fine scale predictors
- AIC based model selection will tend toward models with more predictors (because of variance structure of residuals)

Spatial Autocorrelation

- Spatial models my de-emphasize broad scale predictors
- Most spatial models do not explicitly handle non-stationarity
- Spatially correlated residuals may be indicative of model mis-specification rather than autocorrelation
- R package “mboost” – Functional gradient descent algorithm (boosting) for optimizing general risk functions utilizing component-wise (penalised) least squares estimates or regression trees as base-learners for fitting generalized linear, additive and interaction models to potentially high-dimensional data

ALCC Science Needs

Eastern Plant Communities of Concern

Appalachian Highlands Vital Signs Report from 2005

Cliffs/Rock Outcrop Communities

Native Grasslands/Savannas

Grassy balds

Bogs and fens

Spruce-Fir Forest – balsam wooly adelgid

Northern Hardwood/Beech Gaps

Rich Cove Hardwood

Pine-Oak Heath

Hemlock/Acid Cove – hemlock wooly adelgid

Riparian Forests

Tributaries, Streamheads, Seeps & Vernal Pools

Cobblebar Communities

Rare Plants - poaching

ALCC Science Needs

In December of 2011, the Interim Steering Committee of the LCC adopted the **top five ranked science needs** and these are under the general topics of: 1) Ecological Flows, 2) Resource Extraction, 3) GIS/IT Needs, 4) Species and Habitat Distributions, and 5) Vulnerability Assessments. Ten project descriptions were developed to address these top science needs, and **six** of these were selected by the Interim Steering Committee for soliciting Requests for Applications in February of 2012.

ALCC Science Needs

- Ecological flows
- Aquatic habitats
- Terrestrial landscapes
- Energy extraction
- Rare endemics
- Climate change

ALCC Science Needs

- These are fairly general but provide insight into the thinking of folks at the LCC.

- Emphasis on aquatic habitats and populations, hydrologic processes, fine scale mapping, disturbance and succession, habitat structure, dispersal linkages

ALCC Science Needs

- **Ecological Flows**

- **Thematic Area Goal:**

  Quantitatively describe current and future hydrologic and structural habitat conditions and aquatic population trends, and set conservation goals for both, in order to maintain native habitats and endemic aquatic species in their current locations or support these as they migrate with land use and climate changes in the future.

- **Specific Science Support Need**:

  Assemble the necessary scientific information or conduct the necessary studies required to develop a rigorous understanding of the relationships among ecological flows and hydrology (discharge, seasonal, etc.), habitat (temp, geology, physical space, etc.), and aquatic biota/communities in order to assess how alterations to systems will affect their sustainability.

ALCC Science Needs

- **Aquatic Habitats**

- **Thematic Area Goal:**

  Quantitatively describe current and future hydrologic and structural habitat conditions and aquatic population trends, and set conservation goals for both, in order to maintain native habitats and endemic aquatic species in their current locations or support these as they migrate with land use and climate changes in the future.

- **Specific Science Support Need**:

  Assemble the necessary scientific information or conduct the necessary studies required to develop a rigorous understanding of the relationships among ecological flows and hydrology (discharge, seasonal, etc.), habitat (temp, geology, physical space, etc.), and aquatic biota/communities in order to assess how alterations to systems will affect their sustainability.

ALCC Science Needs

- **Terrestrial Landscapes**

- **Thematic Area Goal:**

  Assemble the necessary information or conduct studies necessary to develop and implement comprehensive regional strategies to conserve and manage forest/working forest communities across jurisdictions by inventorying significant regional forest communities, evaluating the condition, importance, and regional threats impacting these communities.

- **Specific Science Support Need**:

  Understanding representative/priority/focal species and population distributions across the region, their habitat relationships, and effective movement/dispersal linkages.

ALCC Science Needs

Terrestrial Landscapes *continued*

- National and regional maps “are often at a resolution too coarse or a precision too inaccurate to be utilized at the scale of on-the-ground habitat conservation delivery”
- “need mapping products with units developed at a resolution necessary to take into account or respond predictably to successional dynamics and disturbance regimes”
- They want products that “identify habitat structural characteristics (e.g., canopy cover, layer stratification)” which “are critical to better understanding habitat condition and determining suitability for specific species”

ALCC Science Needs

- **Energy Extraction**

- **Thematic-Area Goal:**

  Collaboratively identify ways and opportunities to meet economic development and conservation management goals through the understanding of potential land use changes, economic impacts and pressures on the resources of the AppLCC region to improve decision-making and management.

- **Specific Science Support Need:**

  Using a suite of analytical tools, forecast future spatial footprint of energy production, mineral extraction, and associated infrastructure/transmission/transportation in coming decades (in 20 years) in light of changes to demand, technology, policy, and regulation, including econometric models to better understand the impacts on resources (species and habitats).

ALCC Science Needs

- **Rare Endemics**

- **Thematic Area Goal:**

  Assemble the necessary information or conduct studies necessary to develop and implement comprehensive regional strategies to conserve and manage forest/working forest communities across jurisdictions by inventorying significant regional forest communities, evaluating the condition, importance, and regional threats impacting these communities.

- **Specific Science Support Need:**

  Understanding representative/priority/focal species and population distributions across the region, their habitat relationships, and effective movement/dispersal linkages.

ALCC Science Needs

- **Climate Change**

- **Thematic Area Goal:**

  Work with partners and stakeholders to determine climate change adaptation and mitigation strategies that can be implemented and coordinated across multiple scales by applying the best available projections of how the regional climate will change and estimates of the impacts those changes will have on the region's natural and cultural resources.

- **Specific Science Support Need:**

  Support multi-scale vulnerability assessments that incorporate species-specific physiological data to identify habitats and species that would be most vulnerable to climate change in the LCC, especially range-limited/endemic species.

People/Projects Of Interest

- Kevin McGarigal (UMASS Landscape Ecology Lab)

  Assessment of Landscape Changes in the North Atlantic Landscape Conservation Cooperative: Decision-Support Tools for Conservation

  climate change, urban growth, succession and assessing coarse filter (landscape intactness, connectivity) to fine filter (representative species) impacts. Appears to be in the pilot phase right now.

- Mark Anderson (TNC – Dir of Conservation Science, Eastern North America Conservation Division)

  has done a lot of work in the northeast on geophysical correlates of biodiversity (e.g. land facets) and structural connectivity using resistant kernel methods and Circuitscape flow analysis

- Richard Pearson (AMNH)

  co-I on related projects, source of expert advice on SDMs, offered use of amphibian SDM outputs (~40 T+E spp., patch based dynamic population models driven by climate envelope models)