Specifying remote sensing data product characteristics for forest management applications

Arjan J.H. Meddens

Assistant professor

Washington State University

2022 OLI Meeting – April 6th

Acknowledgements: Michelle Steen-Adams (WSU), Andy Hudak (USFS), Jacob Strunk (USFS), Maureen Duane (OSU), Francisco Mauro (OSU), Paige Byassee (WSU)

Outline

1. Introduction/Objectives: Why are we doing this?
2. Methods: Online survey and in-person workshop
3. Results: Some bar graphs!
4. Discussion/Next steps

Introduction

Climate change, population growth, lumber prices, pollution, urbanization of WUI, forest disturbances all affect:

Natural resources –> Management

Increased data need (and availability) for accurate geospatial information

HOWEVER: Key uncertainty –>

Data characteristics most useful to our clients (e.g., managers)

© Elnur/Fotolia

Introduction

Hudak et al. NASA CMS Phase II (NASA-sponsored project; 2020-2023)

Sub-Objective 5: *Map management-relevant forest attributes across the western US to engage stakeholders*

→ But what are these attributes?

→ What are the relevant data characteristics that are useful?

Objectives

Overall objective was to investigate:

(1) Which geospatial metrics/attributes
(2) What data characteristics

are preferred for natural resource professionals to monitor and manage forests and fuels across large landscapes

Methods

1) Online survey

2) In-person workshop

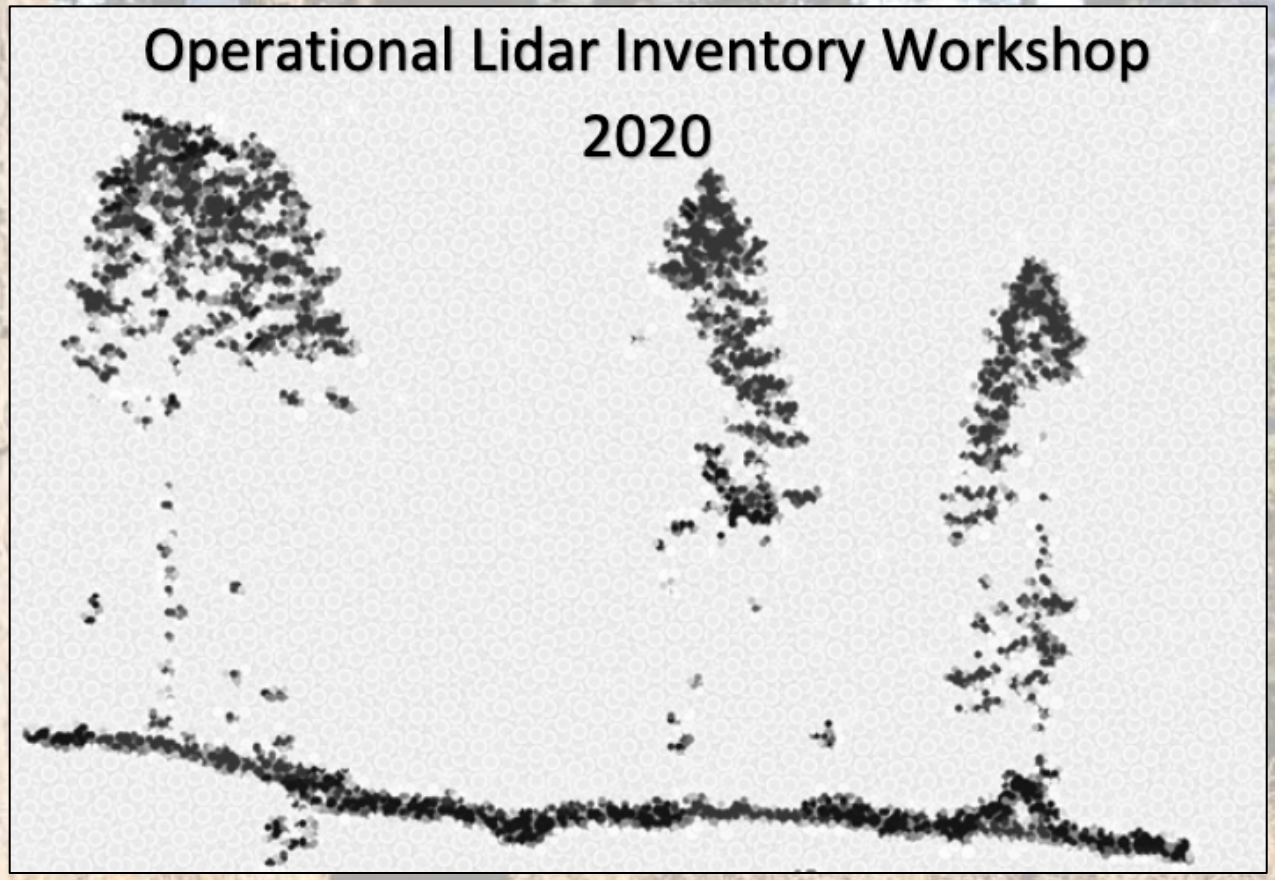
Methods

1) Online survey

- As part of registration

- 25 Questions

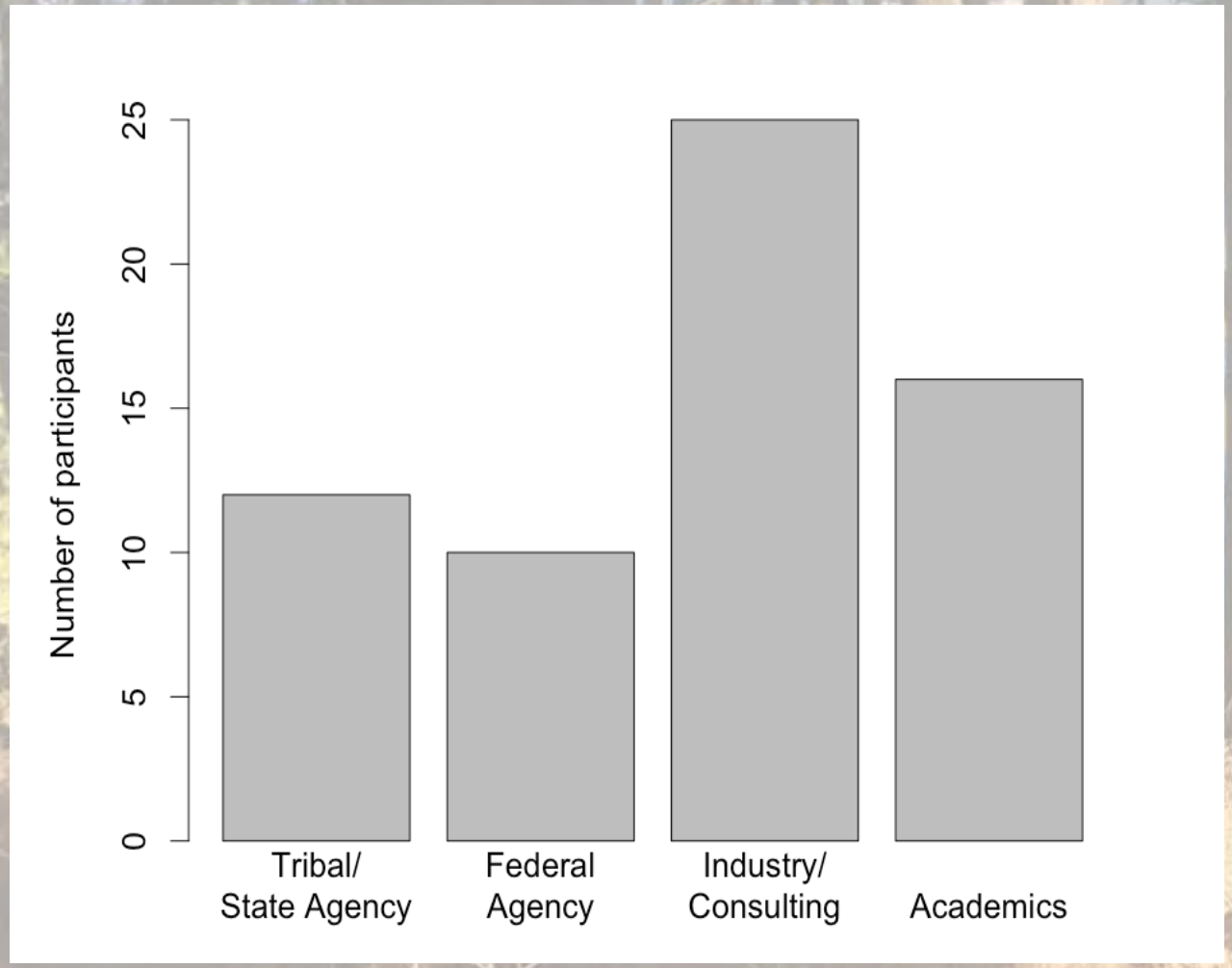
- 69 respondents

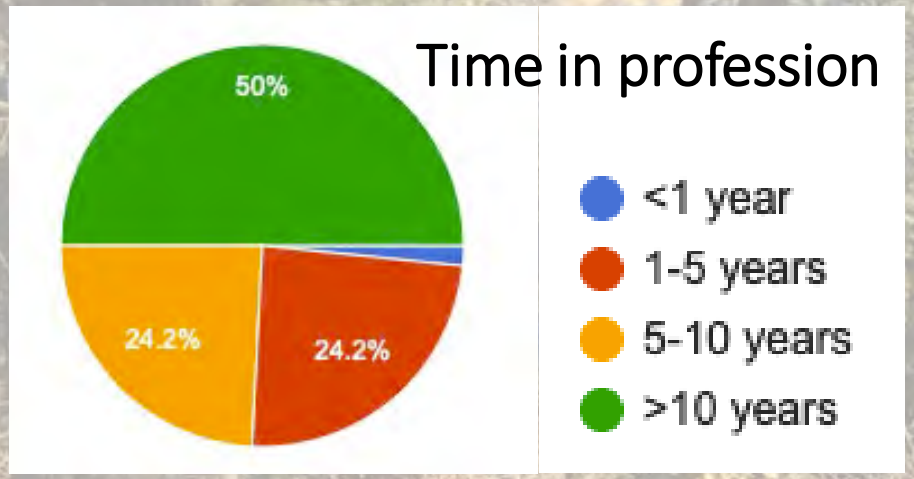


- Likert scale → 1: Not Useful / 2: Somewhat Useful / 3: Useful / 4: Very Useful

Methods

Participants:





Methods

2) In-person workshop

Agenda:
14:15 – CMS Interactive: *Breakout Session – Group Discussion*
15:05 – CMS Interactive: *Present Findings & Central Discussion*
15:35 – CMS Interactive: *Summary & Next Steps*

2) In-person workshop

- 6 groups (6 – 8 persons)
- Each group the same poster
- Questions divided into 4 management applications: 1: Timber, 2: Wildlife, 3: Fuels, 4: Biomass
- Discuss and vote by stickers
- Computed %votes averaged them over the groups

CMS Workshop #1: Utility of fuels and forest structure attribute data

Group No.: _____

Present question: ____

Workshop packet: Please work through the questions during the break-out session and report back to the group after 50 min.

Note: For the tables in Q1, Q2, Q3, Q4, and Q5 every group member gets to vote by posting stickers in the Table.

Question 1: Data sets

Introduction: Imagine that you are managing a tract of forest for the different management applications listed in the columns below. **Use the provided colored dots (12/person) to indicate which lidar/Landsat derived spatial metrics would be most useful for you and discuss your choices.**

Metric	Management application			
	Timber	Wildlife	Wildland fuels	Biomass
Mean vegetation height				
Basal area				
Crown bulk density				
Crown base height				
Mean diameter				
Total dry biomass				
Coarse woody debris (1000hr)				
Fine woody debris (1hr-100hr)				
Total Volume				
LAI**				
Tree location**				
Species composition**				
Canopy cover (%)**				
Successional stage**				

*** These metrics were identified as important during the questionnaire.*

Question 2: Spatial resolution

Introduction: We are going to prepare data at various spatial resolutions. 30 by 30m is the common pixel resolution of our data products, matching the Landsat spatial resolution. However, we also make use of aerial imagery (e.g., NAIP), higher-resolution lidar data, and high-resolution satellite imagery, making it possible to produce some data at much higher spatial resolution. On the other hand, we have the ability to aggregate data to stand level, county level as well.

Use the provided colored dots (4/person) to indicate which spatial resolution would be most useful for you and discuss your choices.

Spatial Resolution	Management application			
	Timber	Wildlife	Wildland fuels	Biomass
250m				
30m				
20m				
10m				
3m				
1m				
Sub-meter				
Tree-level				
Stand-level				
County-level				

Question 3: Temporal resolution

Introduction: We can prepare data at various temporal intervals. Oftentimes, lidar acquisitions are only acquired once, whereas Landsat imagery is acquired every 16 days. We currently generate annual fits from Landsat imagery, but we have the ability to produce data more or less often.

Use the provided colored dots (4/person) to indicate which temporal resolution would be most useful for you and discuss your choices.

Temporal Resolution	Management application			
	Timber	Wildlife	Wildland fuels	Biomass
Daily				
Weekly				
Monthly				
Yearly				
Every 3-5 years				
Every 10 years				

Question 4: Extent and data volume

Introduction: As part of our NASA Carbon Monitoring Systems project we can provide data in various formats, resolutions, and extents. However, sometimes we must make trade-offs on whether to either (a) make all data available over large extents once a project is complete or (b) make smaller subsets of data available earlier over smaller extents.

Use the provided colored dots (2/person) to indicate what ideal data extent and data volume would be most useful and discuss your choices.

Spatial Extent	Approximate data volume	Most useful
Western US	> 100 TB	
Individual States	~ 50 TB	
Regional (national forest, county level)	~ 10 TB	
Watershed level	~ 1 TB	
Project level	~ 10 GB	
Landscape-level	~ 1 GB	

Question 5: Data formats

Introduction: We can prepare data in various formats including geotiffs, esri grids, shapefiles, and/or ENVI binary files.

Use the provided colored dots (2/person) to indicate which format you would like to receive the data and discuss your choices.

Data format	Most useful
GeoTiffs (.tif)	
ESRI grids	
ENVI binary (.hdr)	
Shapefiles (.shp)	
Erdas Imagine format (.img)	
NetCDF (.nc)	

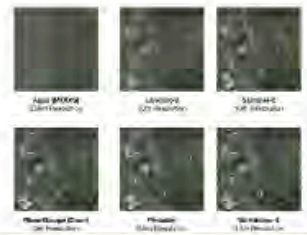
Question 6: The perfect data set

Introduction: We are interested in how to best serve our stakeholders into the future.

Imagine that we would have an unlimited amount of resources to spend on developing a dataset. Discuss with your group what the ideal dataset would look like. If time is limited, choose only one of the applications.

Note the main points of the discussion below:

Management application			
Timber	Wildlife	Wildland fuels	Biomass



2022 Operational Lidar Inventory Meeting Secret Word:

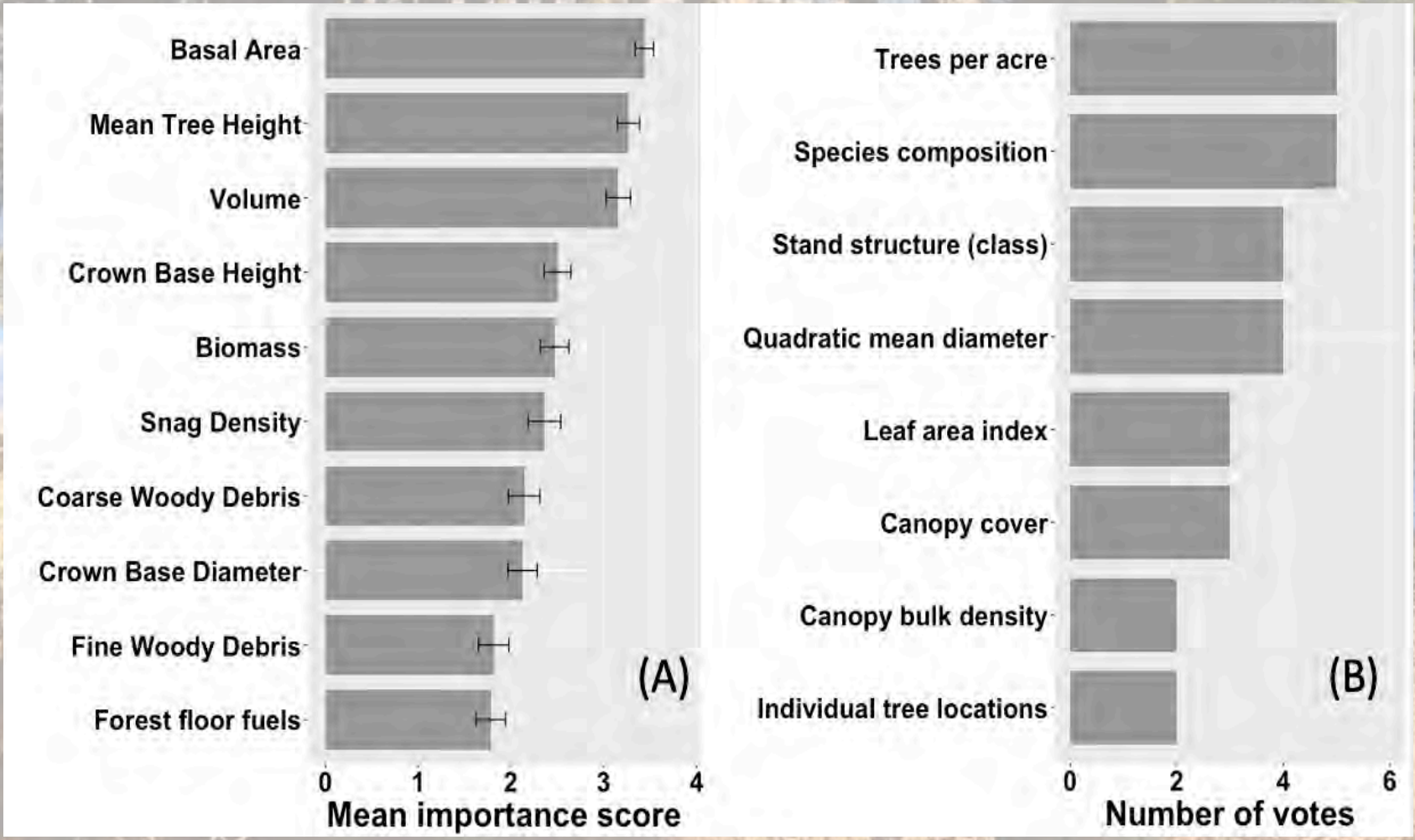
multispectral

Enter the secret word by 11:00pm on Wednesday, April 6th.

Use this link: https://www.surveymonkey.com/r/2022OLIcredits

Results - Survey

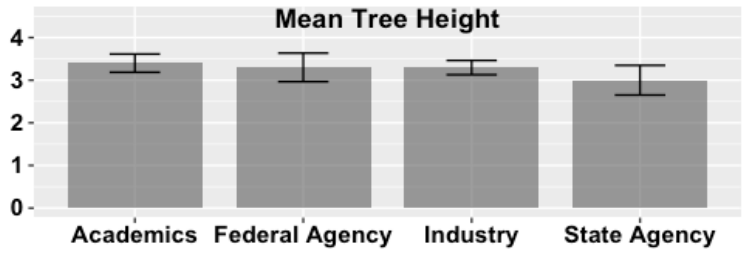
Preference of geospatial metrics:

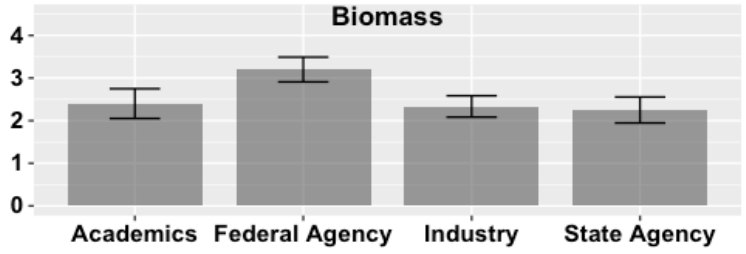


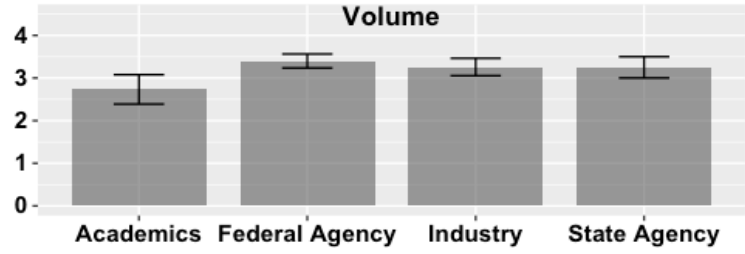
Additional metrics (# of times indicated as important additional metric)

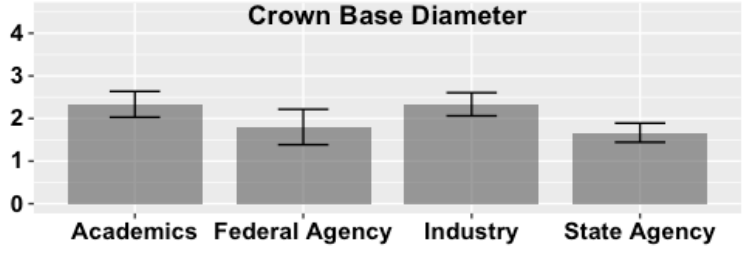
Results - Survey

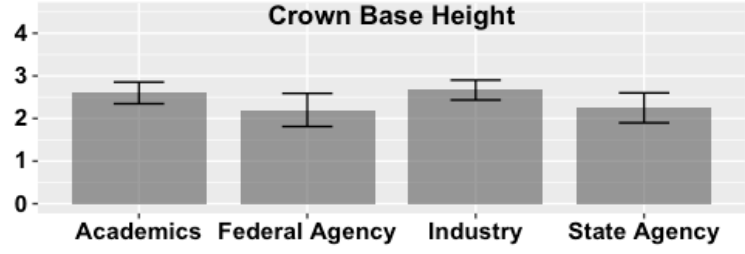
- Mean tree height and basal area important
- Biomass more important by federal agency employees?!?
- Timber volume less important by academics?!?
- Snag density less important by industry/consultant?!?

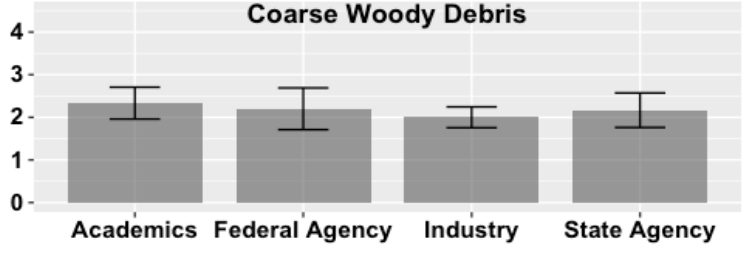


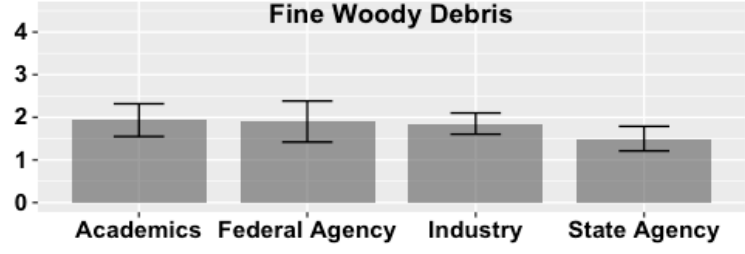


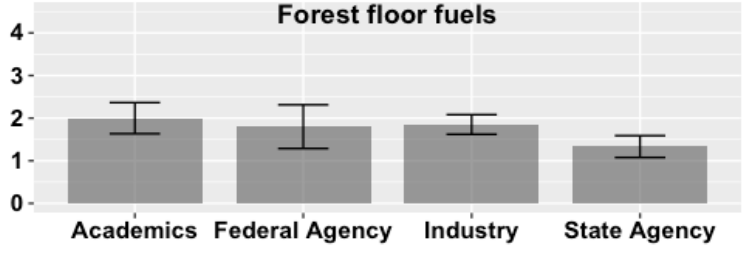


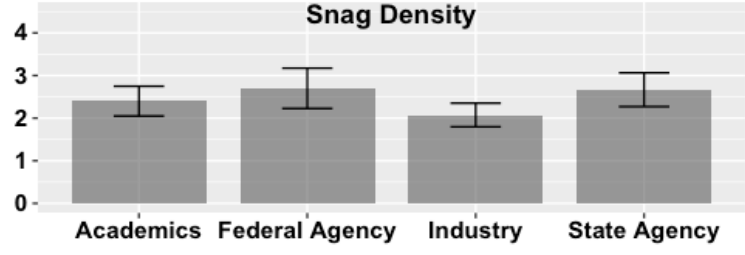






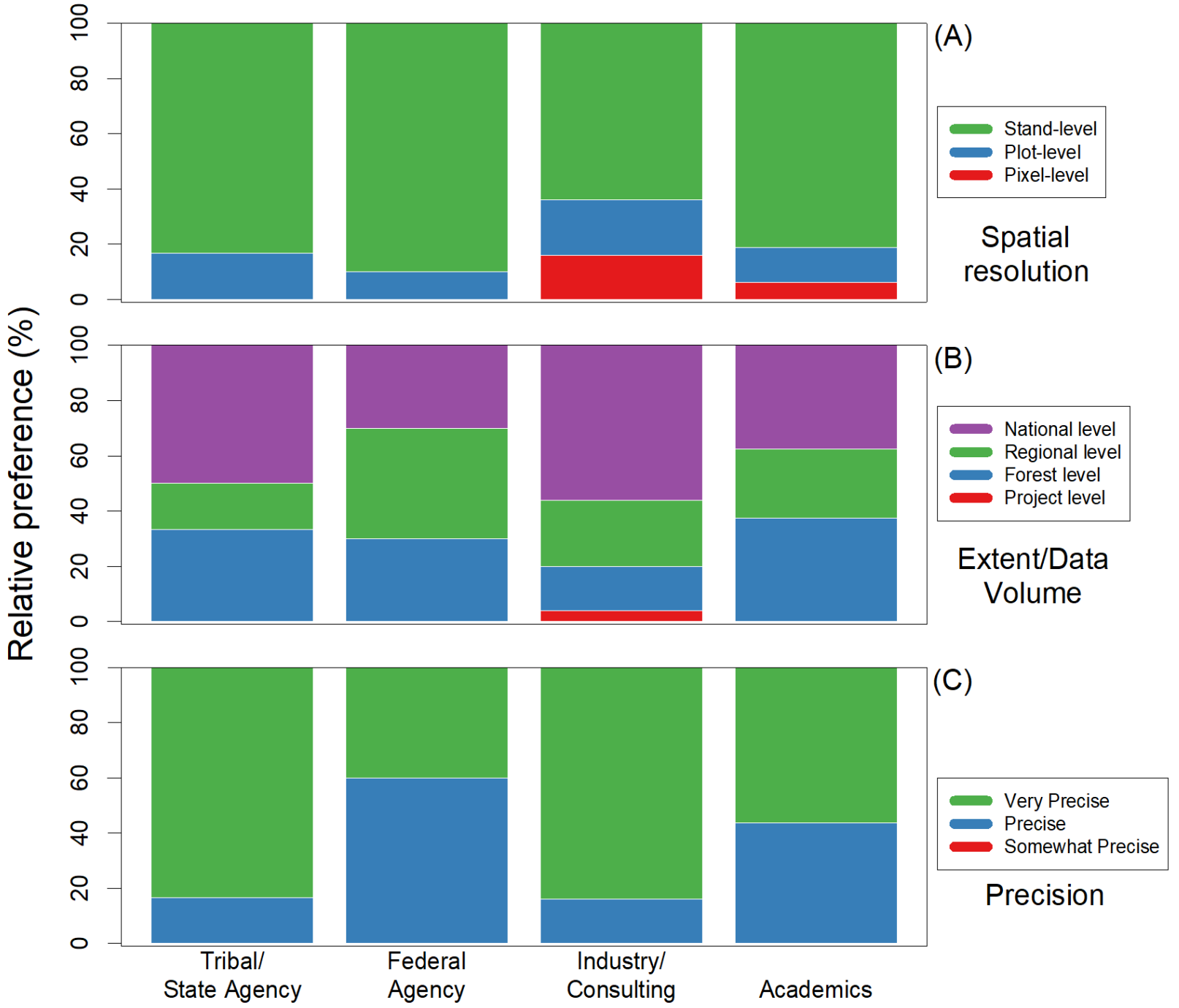






Results – Survey

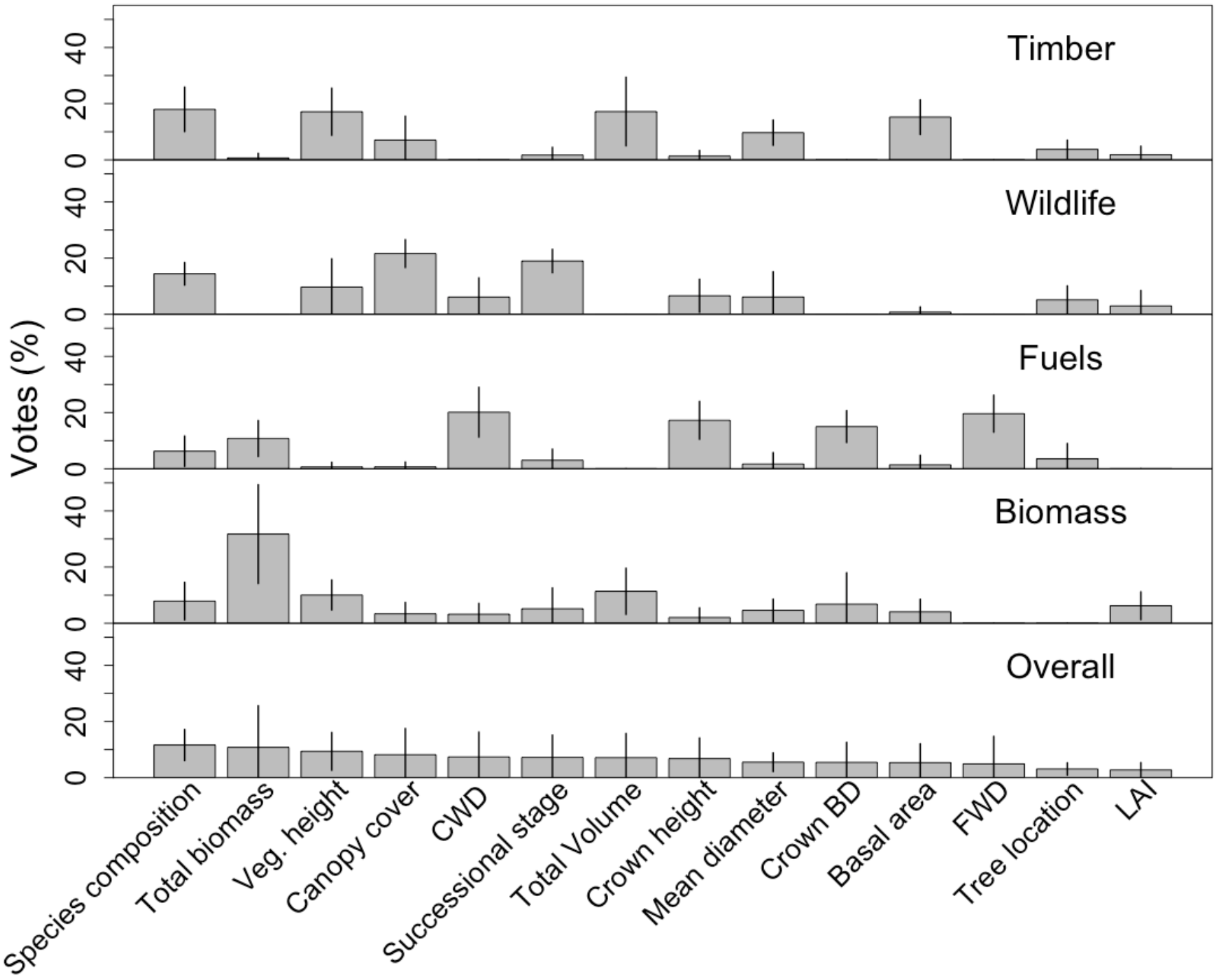
- **Preference for stand-level (0.5-5 acre) spatial resolution data**
- **Preference for larger extents**
- **Preference for precise (25%<RMSE<50%) and very precise (RMSE<25%) data**



Results - Workshop

Preferred metrics:

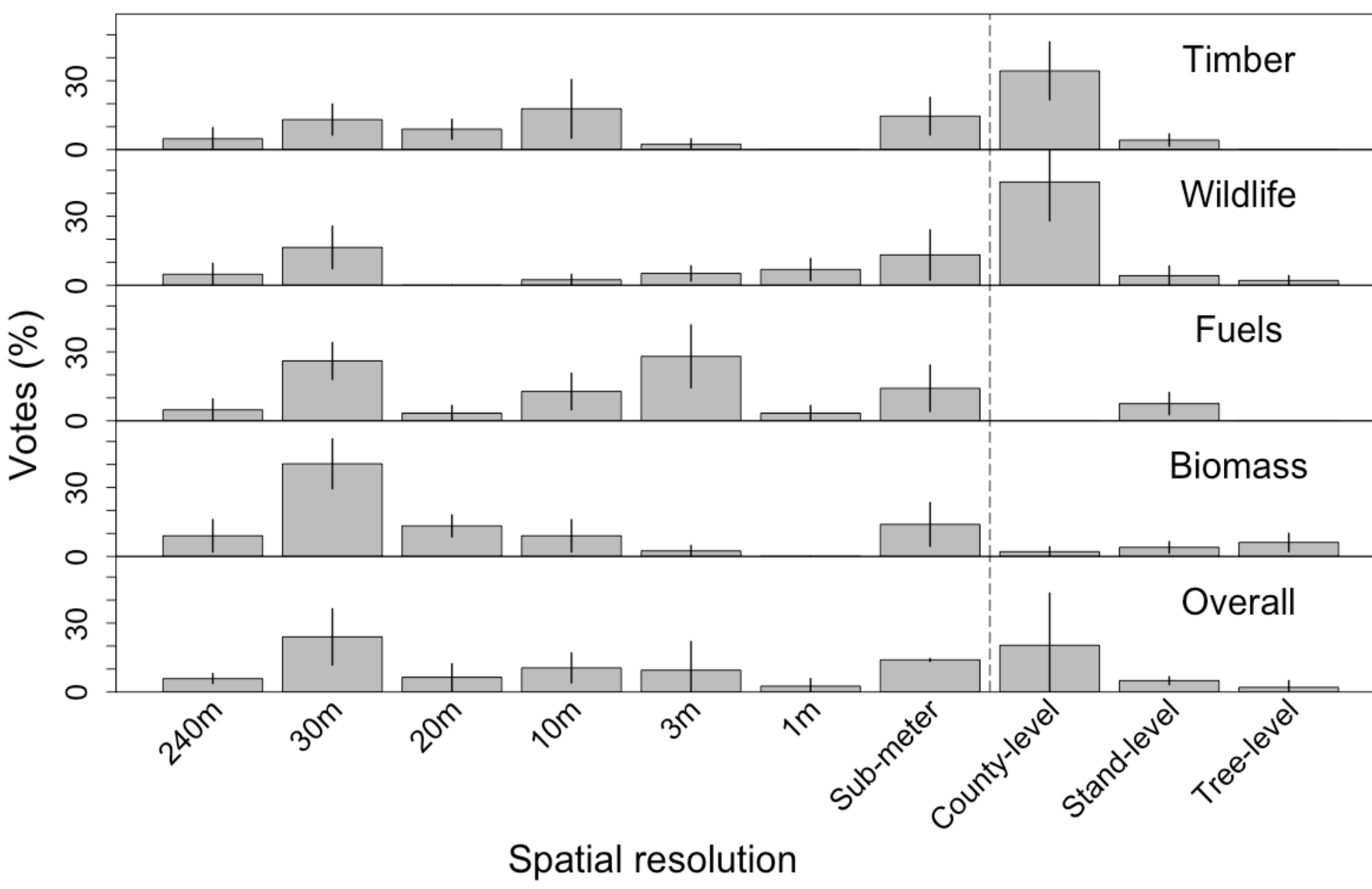
- **Different metrics are important for different management purposes**
- **Overall important: Spp. composition, total biomass, veg. height, can. cover**
- **Slight differences from online survey (e.g., basal area)**



Results - Workshop

Preferred spatial resolution:

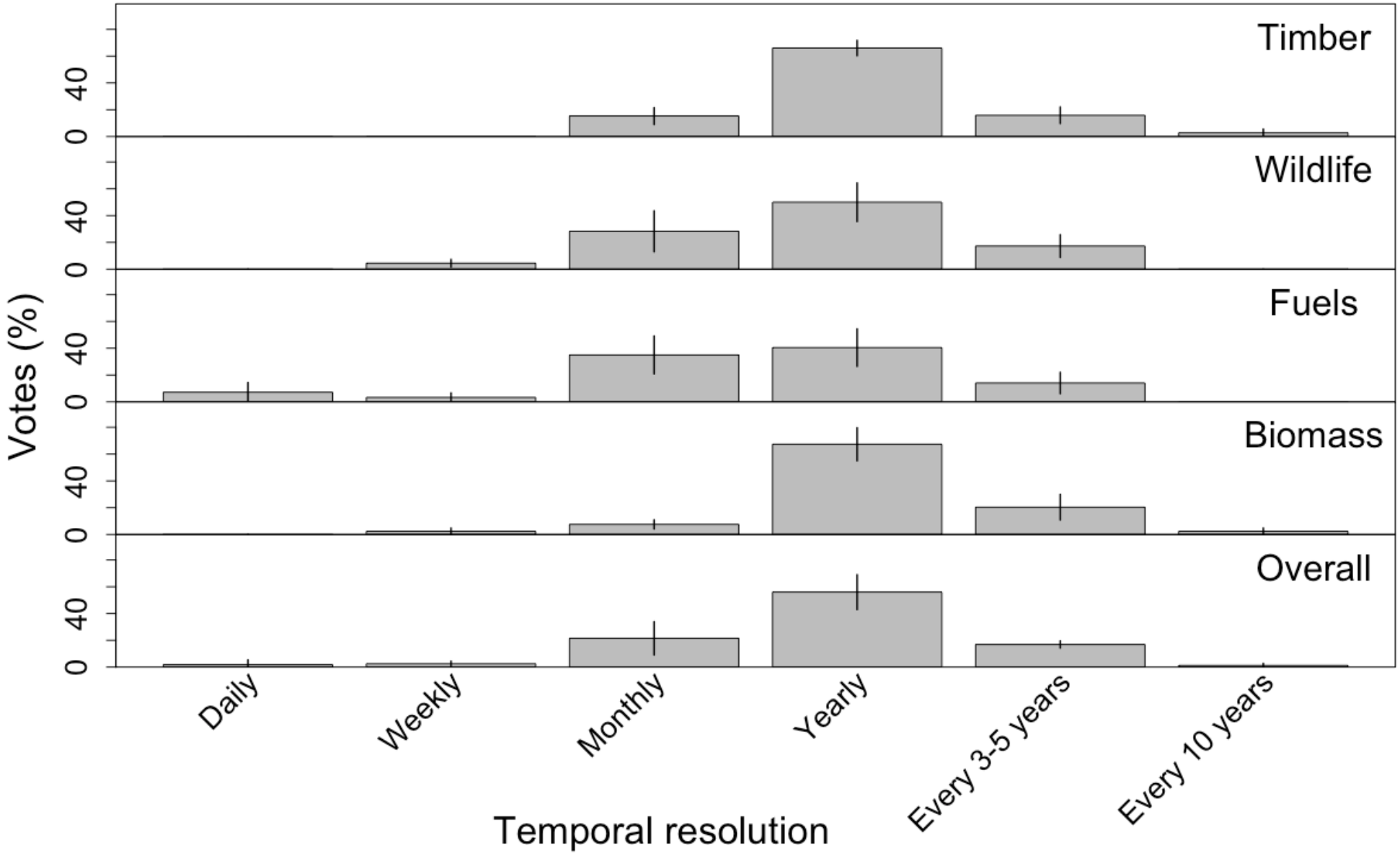
- **30-m (Landsat)**
- **Sub-meter**
- **County-level data**
- **Higher res. for <u>Timber</u> and <u>Fuels</u> as compared to <u>Wildlife</u> and <u>Biomass</u>**



Results - Workshop

Preferred temp. resolution:

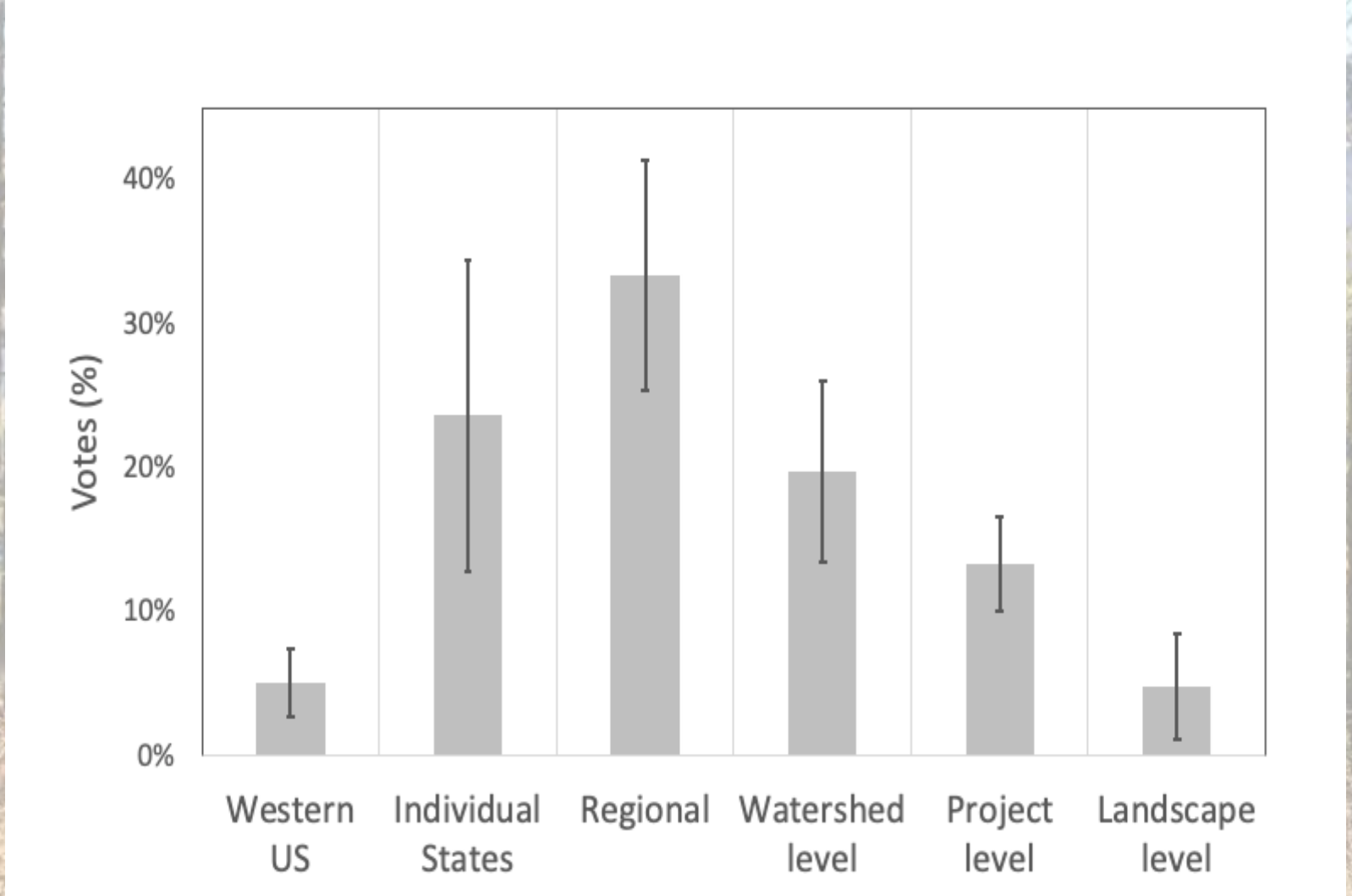
- **Yearly**
- **More frequent: Fuels**
- **Less frequent: Biomass**



Results - Workshop

Desired spatial extent for management purposes:

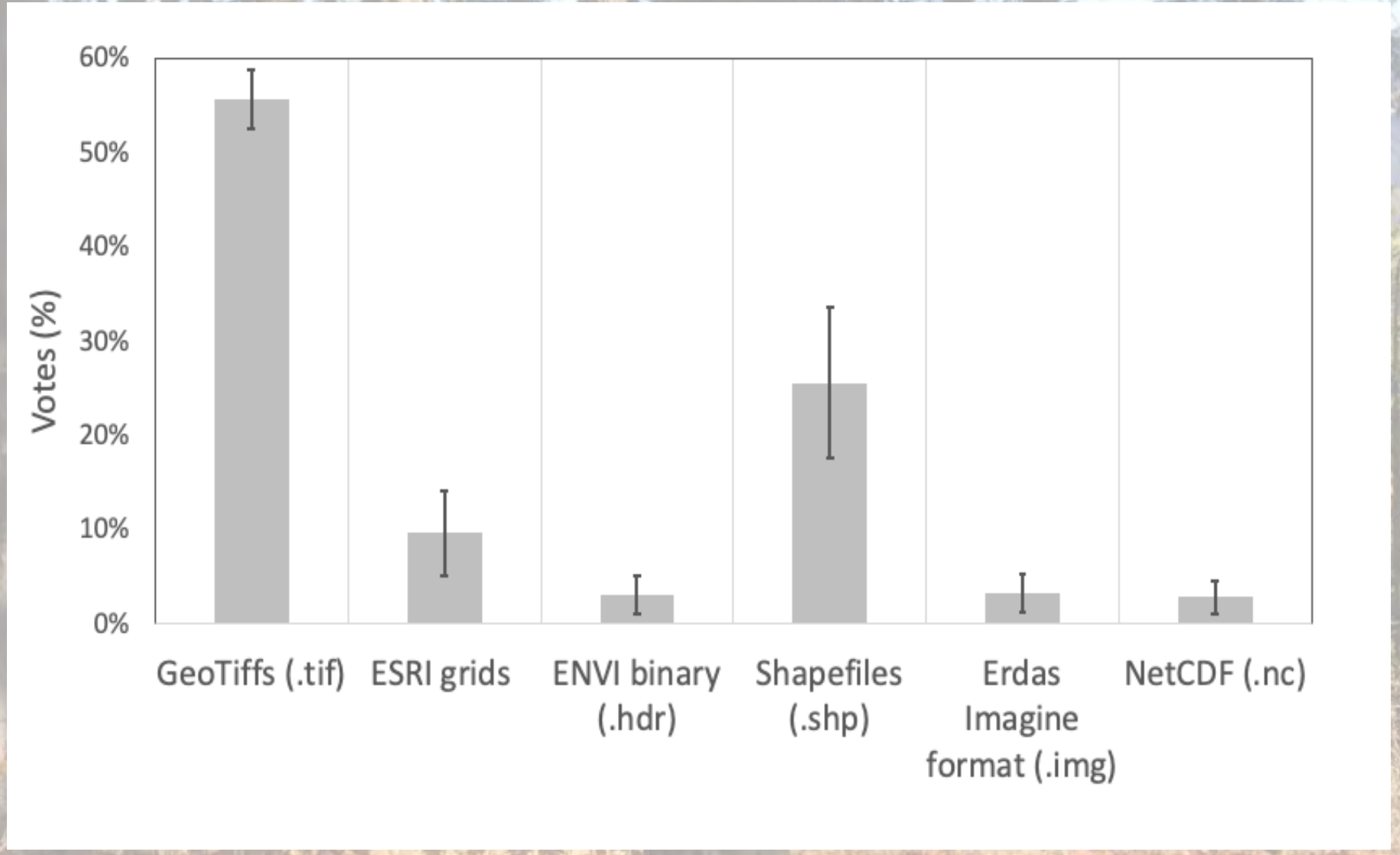
- **Regional**
- **Individual states**
- **Also related to data volume…**



Results - Workshop

Desired data types:

- **GeoTiffs**
- **Shapefiles**



Discussion

- **Overall – Similar data characteristics preferences:**
  - **Metrics: Veg. height, spp. composition, volume and biomass**
  - **Spatial resolution: 30m, sometimes higher**
  - **Temporal resolution: Yearly**
- **Different metrics are important for different management purposes**
- **Focused on OLI 2020 participants, not a random sample**
- **Exploratory – (not a formal statistical) analysis**

Discussion

- **Outcomes useful for:**
  - **Data developers (What do we develop?/Make available?)**
  - **Data users (What do we want?)**
  - **Funding agencies (What do we fund?)**

- **Participatory methods (Survey and Workshop) useful for assessing needs/preferences of stakeholders/clients**

- **Additional information from a survey followed by a in-person workshop session is useful**

Next steps

- **Environmental Research Letters:** https://doi.org/10.1088/1748-9326/ac5ee0
- **Discuss how to incorp**
- **Organize Workshop #2 City, 2023)**
- **Provide CMS data to s**
- **Further investigation i**

ENVIRONMENTAL RESEARCH
LETTERS

LETTER

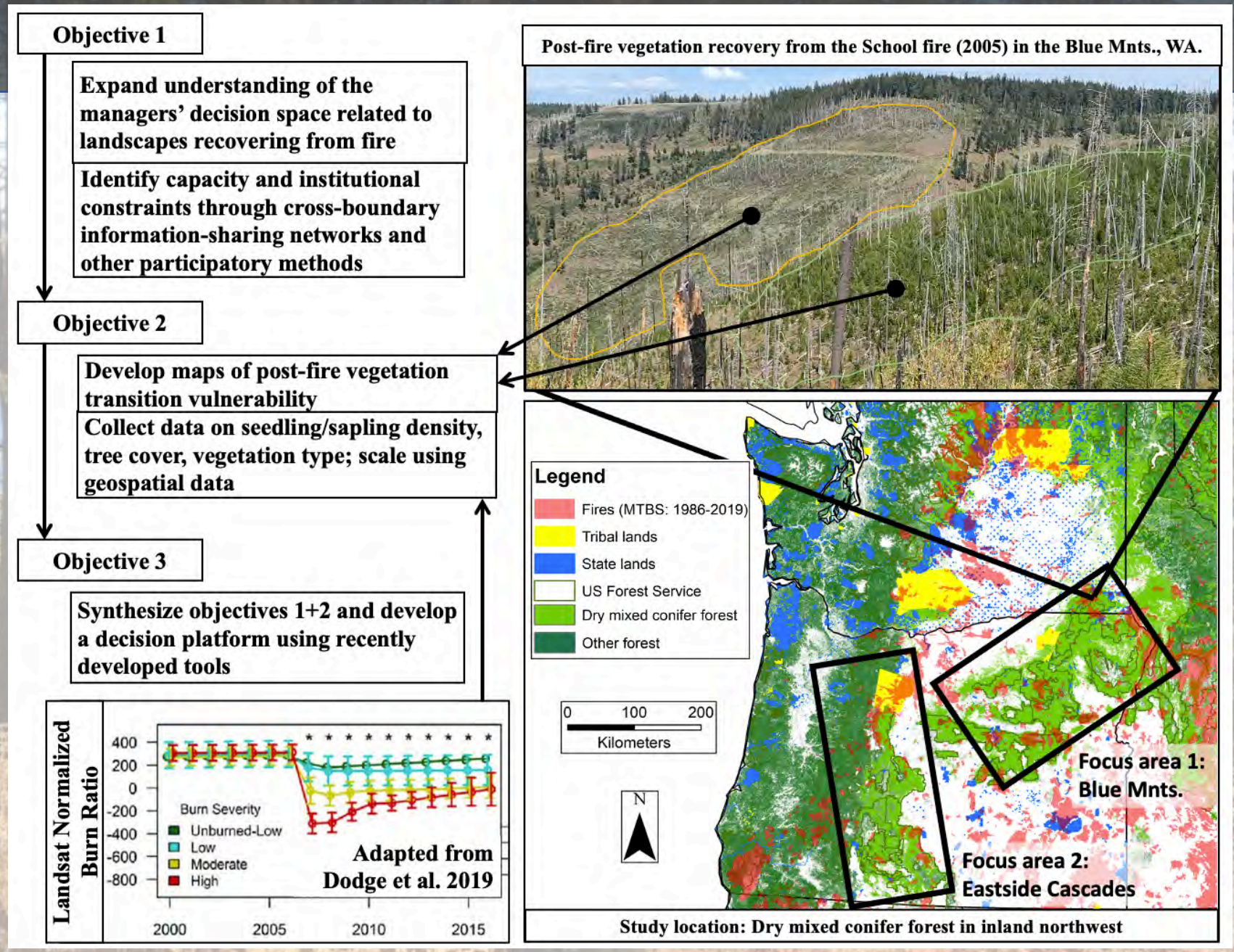
Specifying geospatial data product characteristics for forest and fuel management applications

Arjan J H Meddens[1,*], Michelle M Steen-Adams[2], Andrew T Hudak[3], Francisco Mauro[4], Paige M Byassee[1] and Jacob Strunk[5]

[1] School of the Environment, Washington State University, PO Box 642812, Pullman, WA 99164, United States of America
[2] School of the Environment, Washington State University, Vancouver, WA, United States of America
[3] Rocky Mountain Research Station, US Forest Service, Moscow, ID, United States of America
[4] Forest Biometrics and Measurements Laboratory, Department Forest Engineering, Resources and Management, Oregon State University, Corvallis, OR, United States of America
[5] Pacific Northwest Research Station, US Forest Service, Olympia, WA, United States of America
[*] Author to whom any correspondence should be addressed.

E-mail: arjan.meddens@wsu.edu

Keywords: natural resource professionals, remote sensing, online survey, workshop, geospatial data characteristics, landscape management, fuel loads

Next steps

- **NW Climate Science Center Project**
- **A multi-scale decision support platform for adaptive management of post-fire landscapes in the Inland Northwest**