Semi-automation for mapping Cowardin classes and wetland vegetation in Alaska

Timm Nawrocki, University of Alaska Anchorage

Acknowledgements

AKVEG Map Development
Matt Macander, JJ Frost (ABR); Aaron Wells (AECOM); Elizabeth Powers, Hunter Gravely, Tina Boucher (DOI); Lindsey Flagstad, Anjanette Steer, Amanda Droghini (ACCS)

Chenega NWI Mapping
Lindsey Flagstad, Anjanette Steer

Funding
ADF&G, BLM, NPS, and EPA

Field Data
Numerous ecologists and technicians for over 30 years!

Outline

1. Why change a good thing?
2. Automated polygon delineation (image segmentation + aggregation)
3. Mapping wetlands directly
4. Mapping wetland components
5. Conclusion and questions

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Manual delineation is a “tried and true” method to produce reliable results given a knowledgeable analyst.

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Goal: demonstrate ideas to integrate *manual delineation* and *automated methods* while retaining strengths

Definitions and clarifications

Wetlands: defined according to Cowardin classification

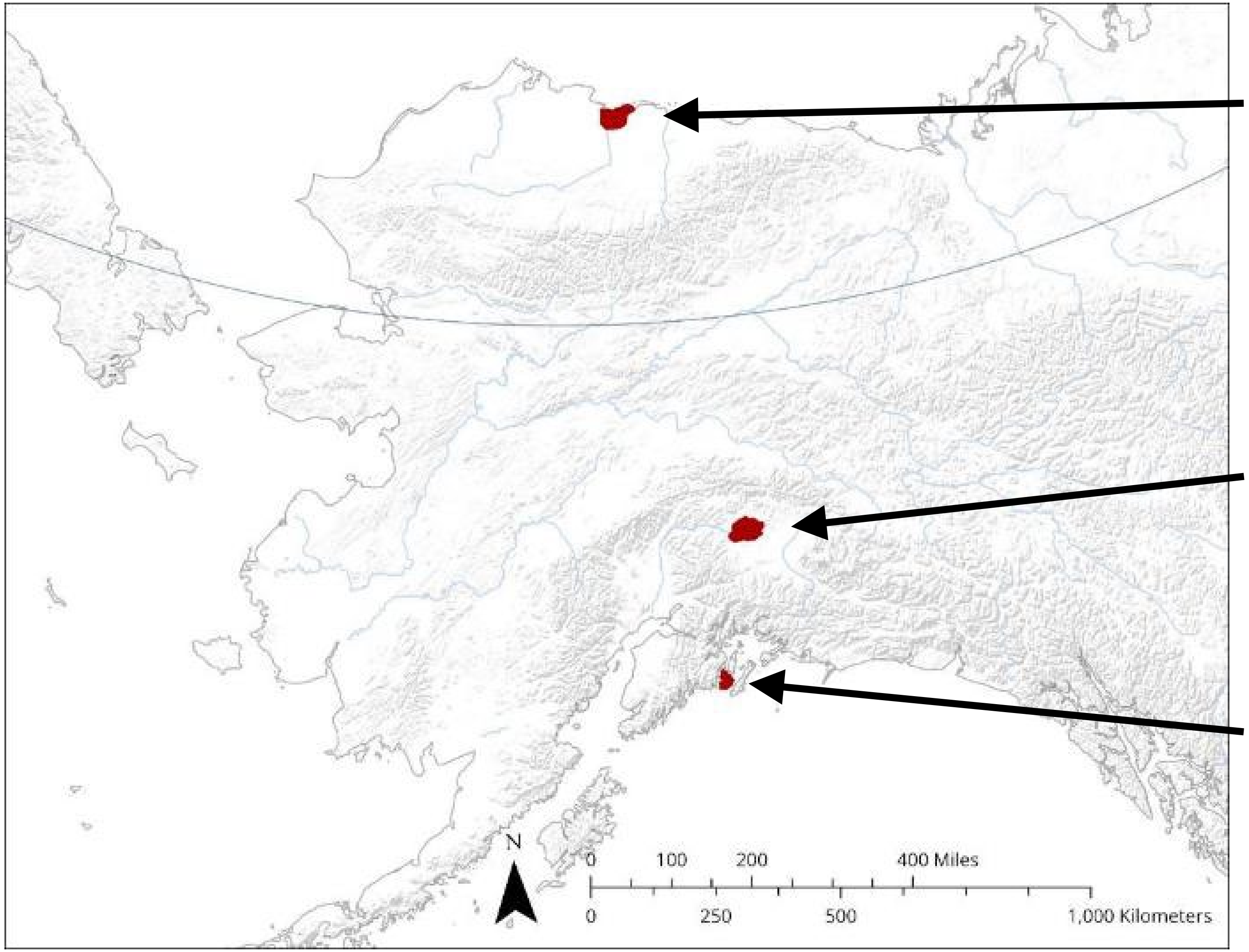
1-parameter wetlands: defined based solely on dominance of hydrophytic vegetation

3-parameter wetlands: defined based on

a. dominance of hydrophytic vegetation
b. substrate is predominantly undrained hydric soil
c. saturated/covered with water part of growing season

Wetland plant communities: defined according to U.S. National Vegetation Classification

Definitions and clarifications

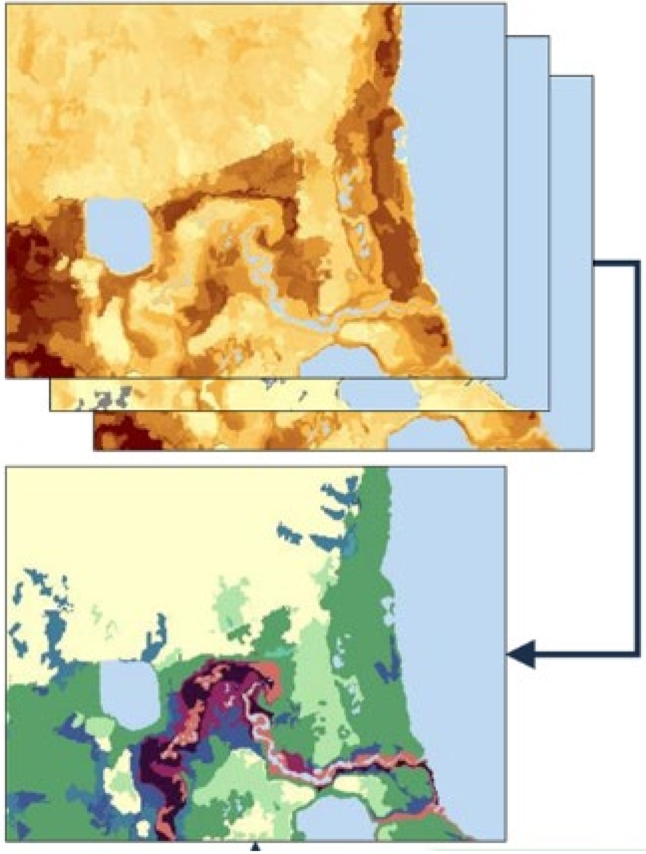


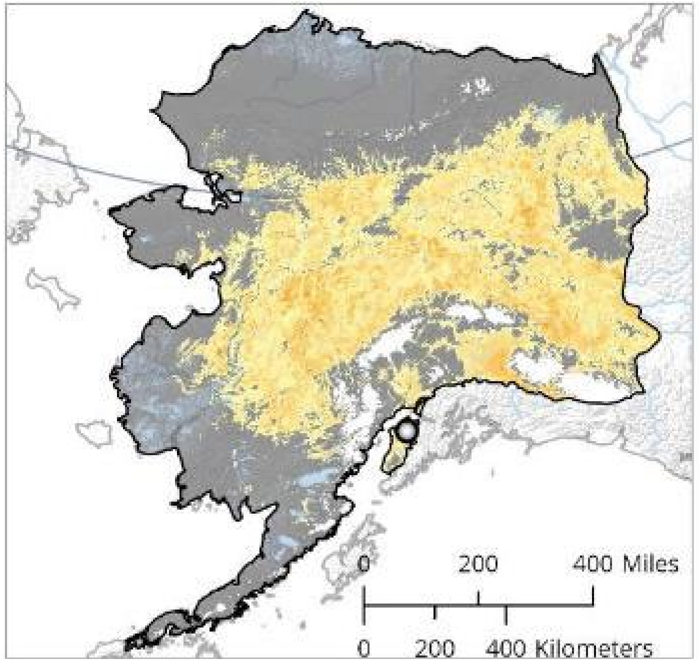
GMT-2 (Arctic)
AKVEG pilot project

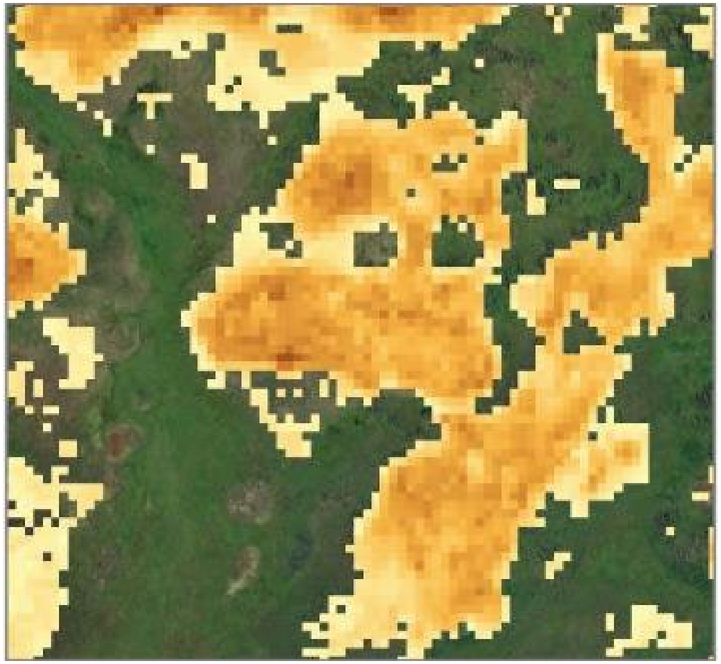
Alphabet Hills (boreal)
AKVEG pilot project

Chenega (temperate)
NWI preliminary results; not QC'ed

AKVEG Map: high ecological and spatial resolution

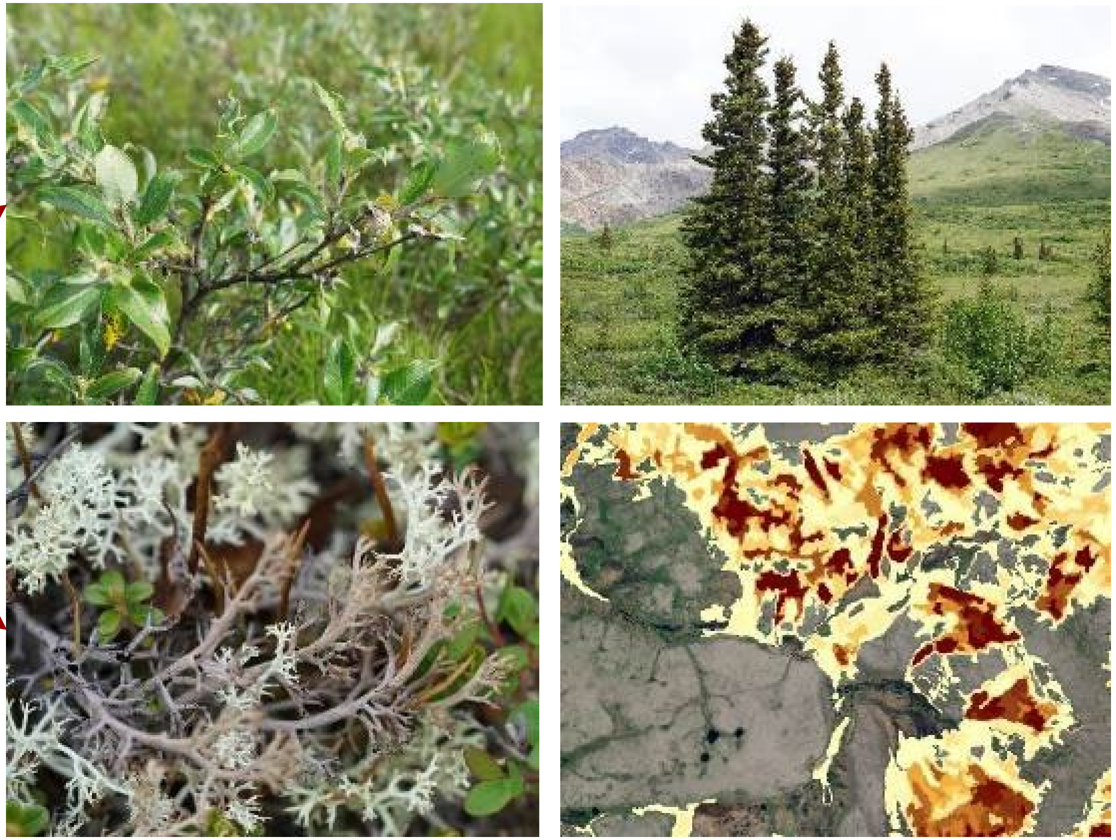






- Collaborative effort mapping vegetation composition & structure for Alaska
- Currently available: foliar cover of plant species, aggregates, and functional types (version 1.0)
- Nawrocki et al. 2021 & Macander et al. 2022

AKVEG Map represents wetland plant communities (USNVC)



Break ecological complexity to manageable units.

Two types of maps:

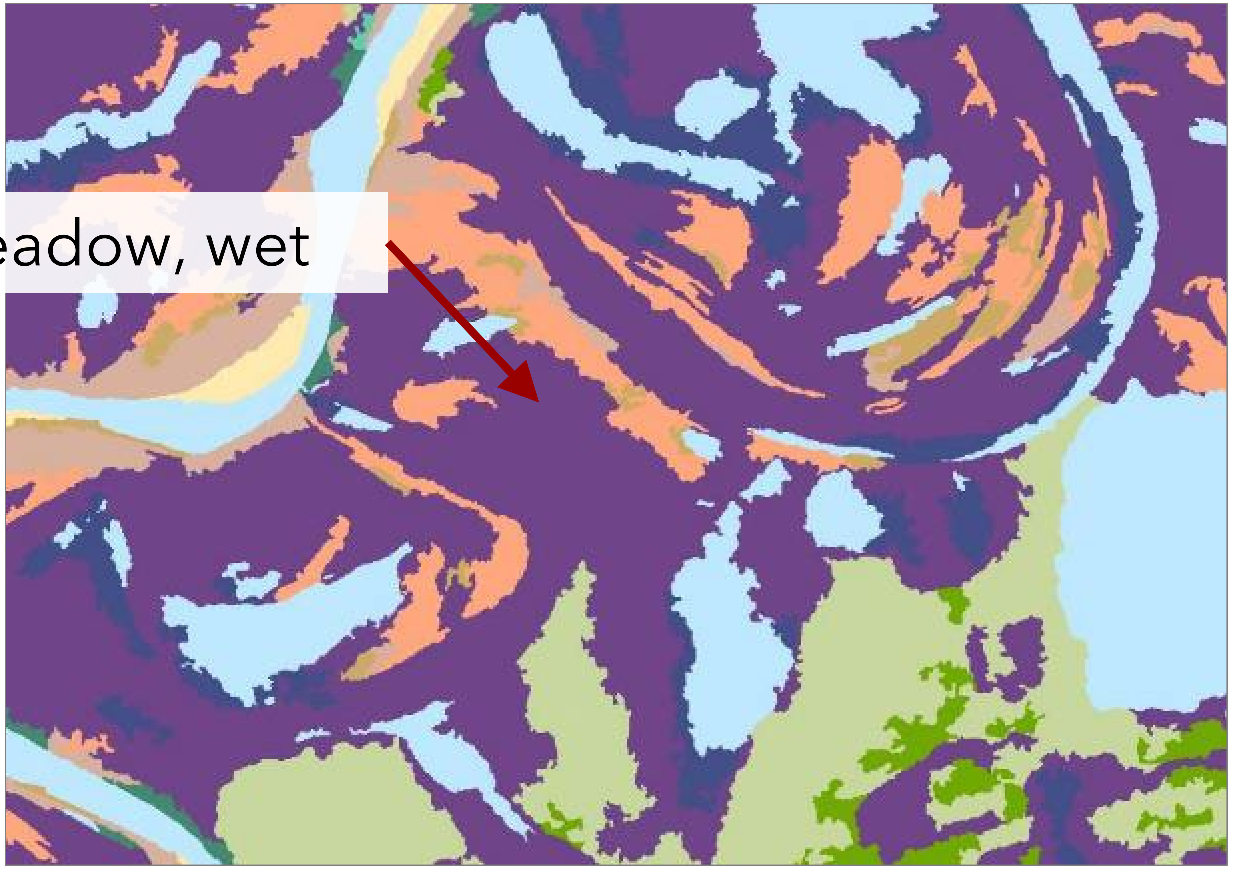
Continuous maps show "what is present" using numbers

Two types of maps:

Categorical maps describe what the feature "looks like"

Arctic sedge meadow, wet

Imagery © Maxar 2021



Existing Vegetation Types (USNVC Alliances)

Semi-automated workflow

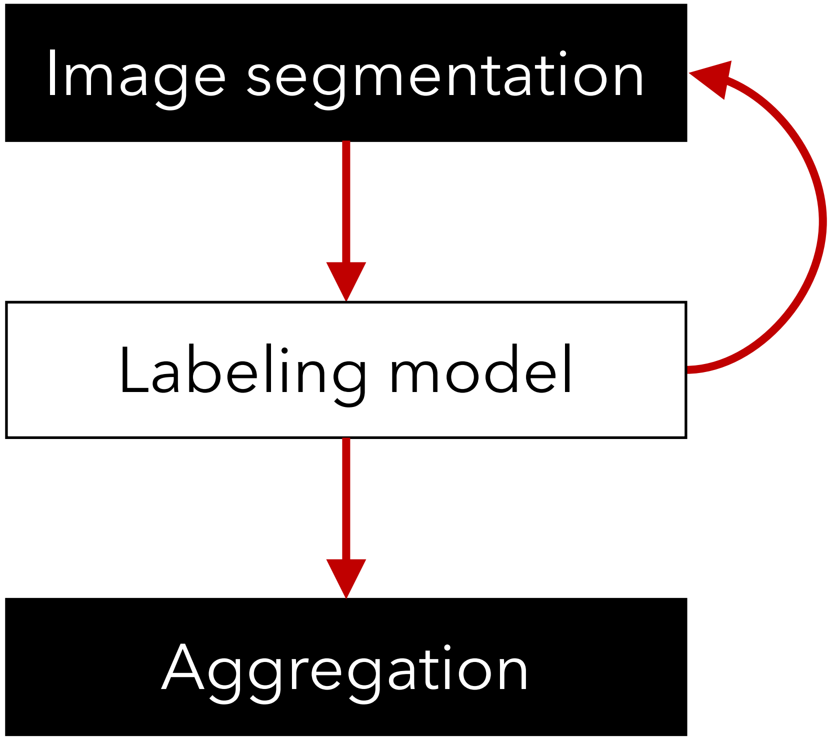
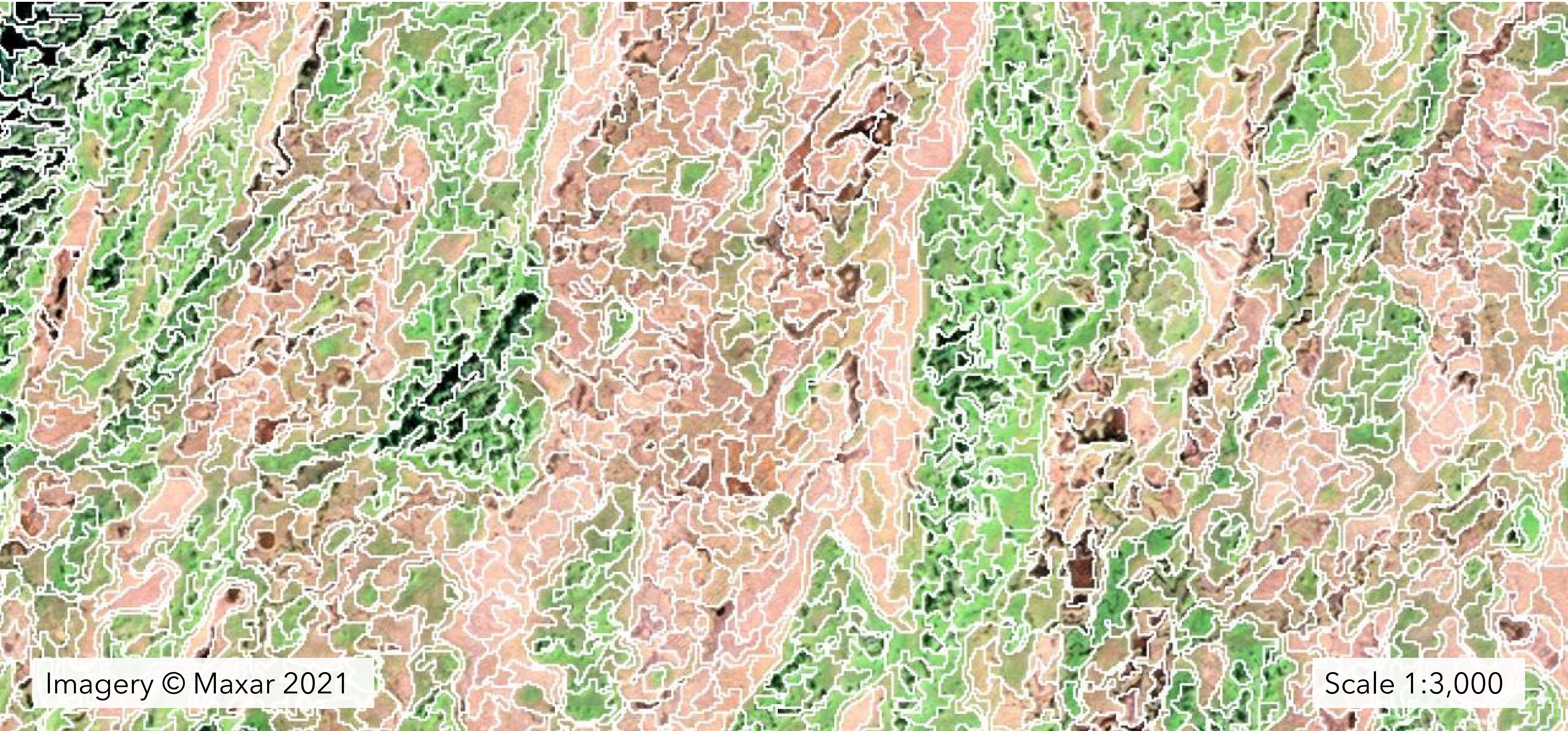


Image segments provide "building blocks" for mapping.

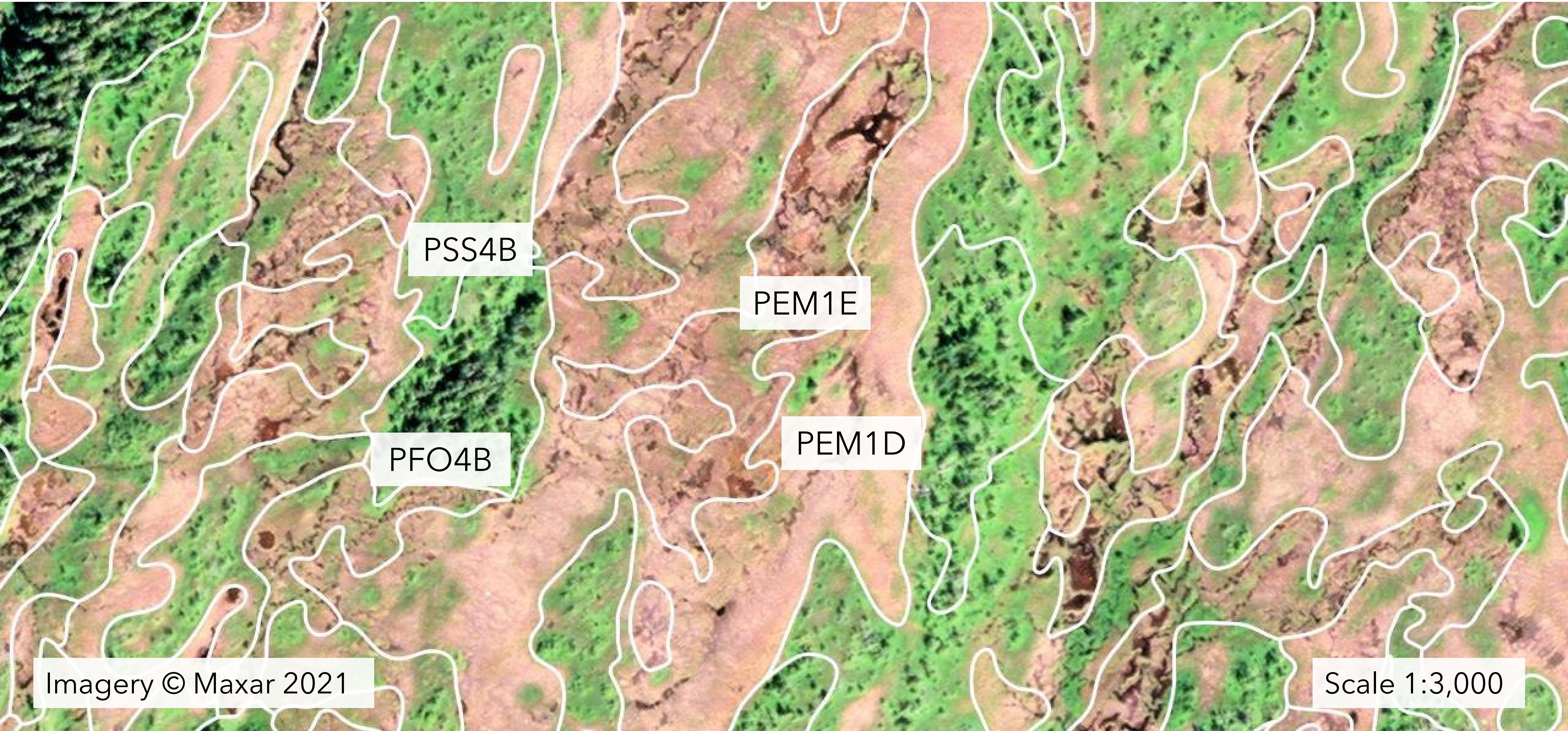
Labeling model assigns initial classes to segments.

Like classes aggregated to features.

Image segments developed from high-res imagery

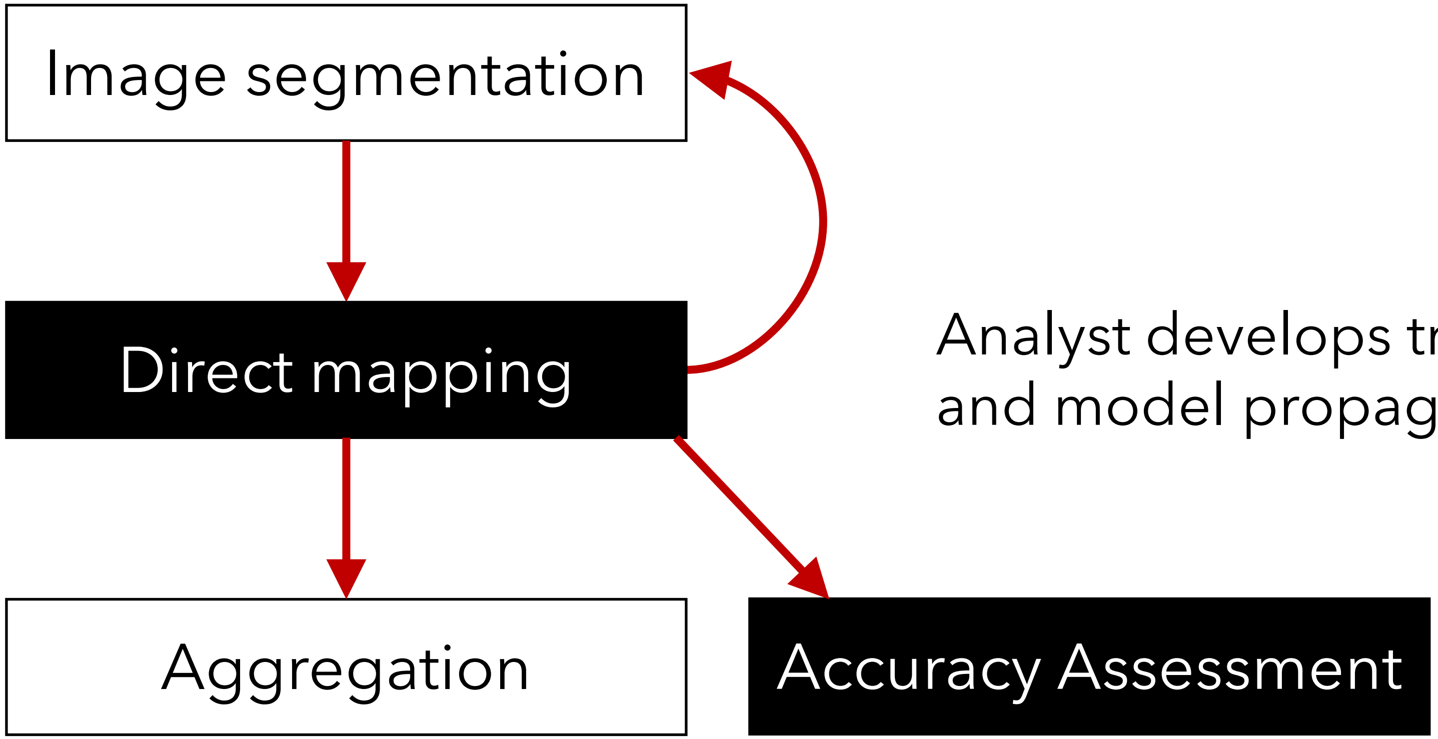


Form polygons based on aggregated model predictions



Aggregate to MMU (0.5 acre)

Semi-automated workflow

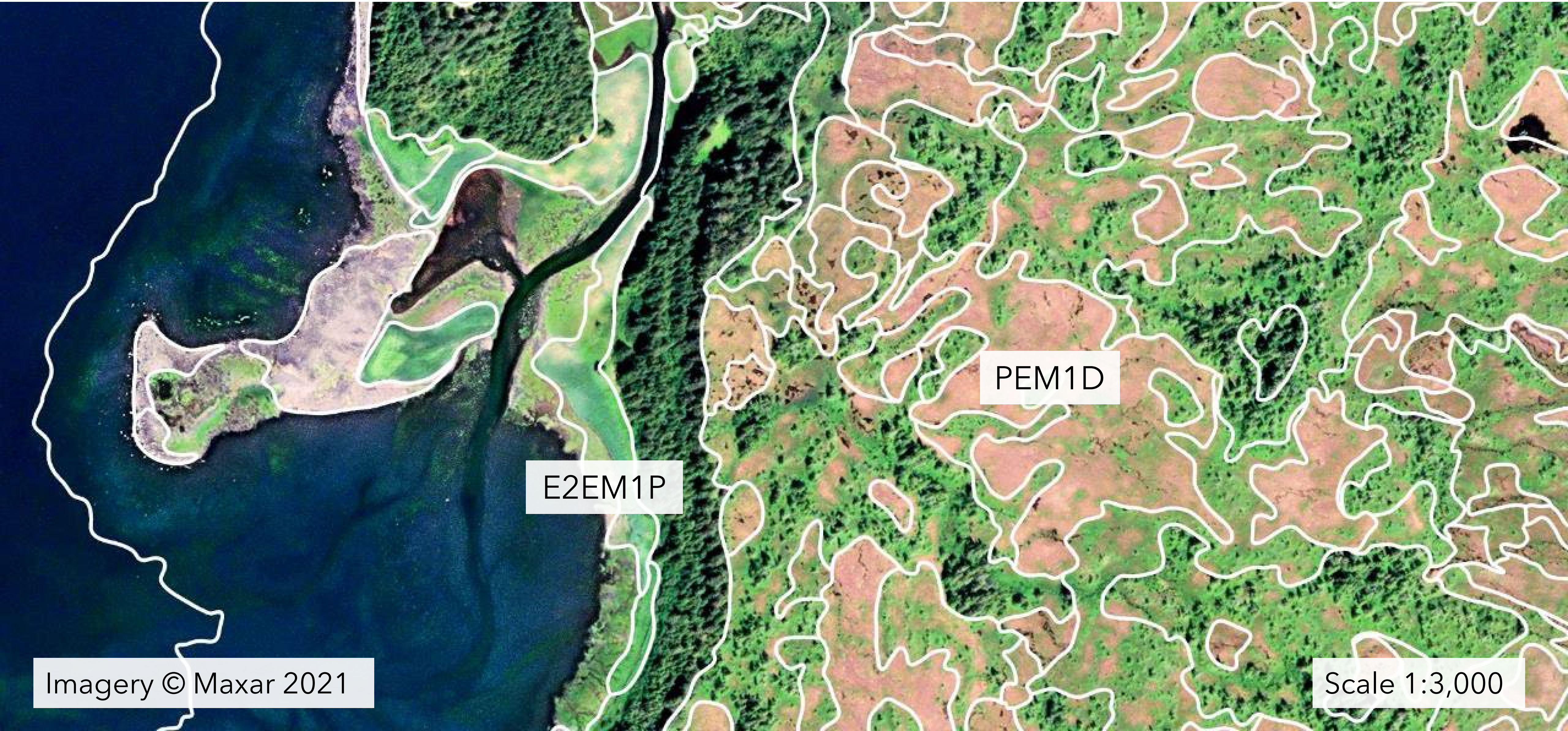


Analyst develops training labels and model propagates them.

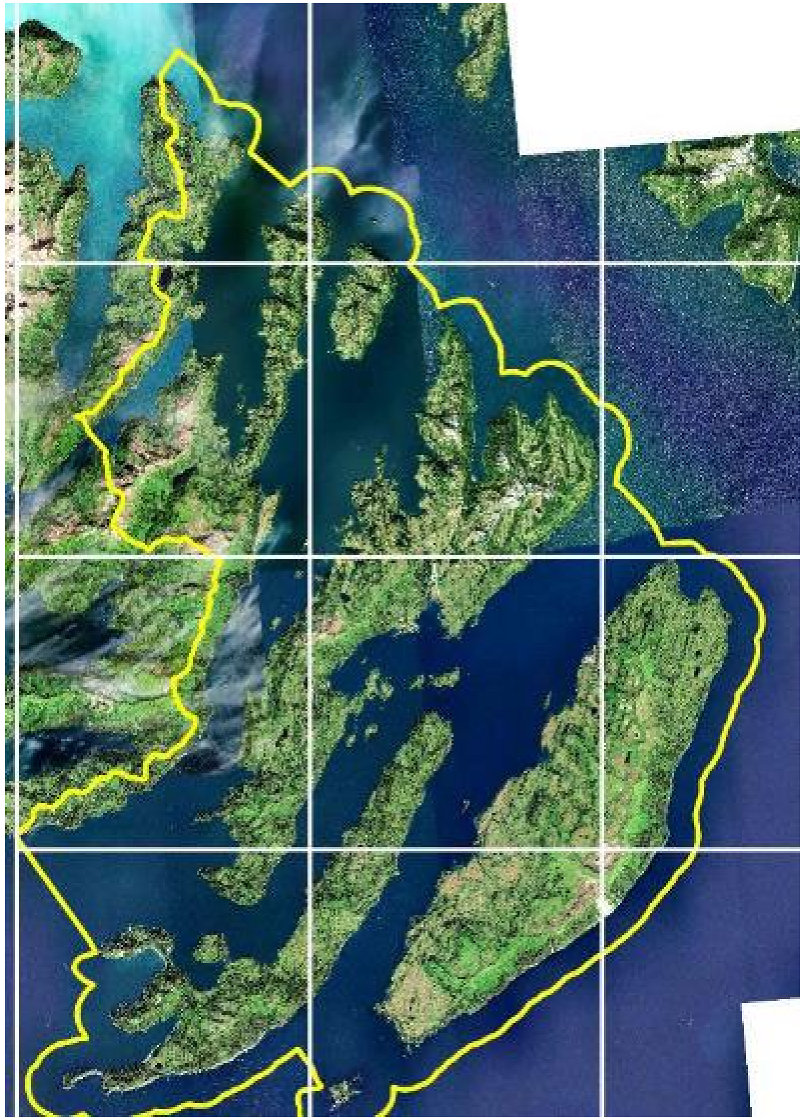
Accuracy assessment identifies where analyst effort needed.

Direct mapping starts with manual training polygons

Propagate labels to segments using trained model



Statistically robust accuracy assessment



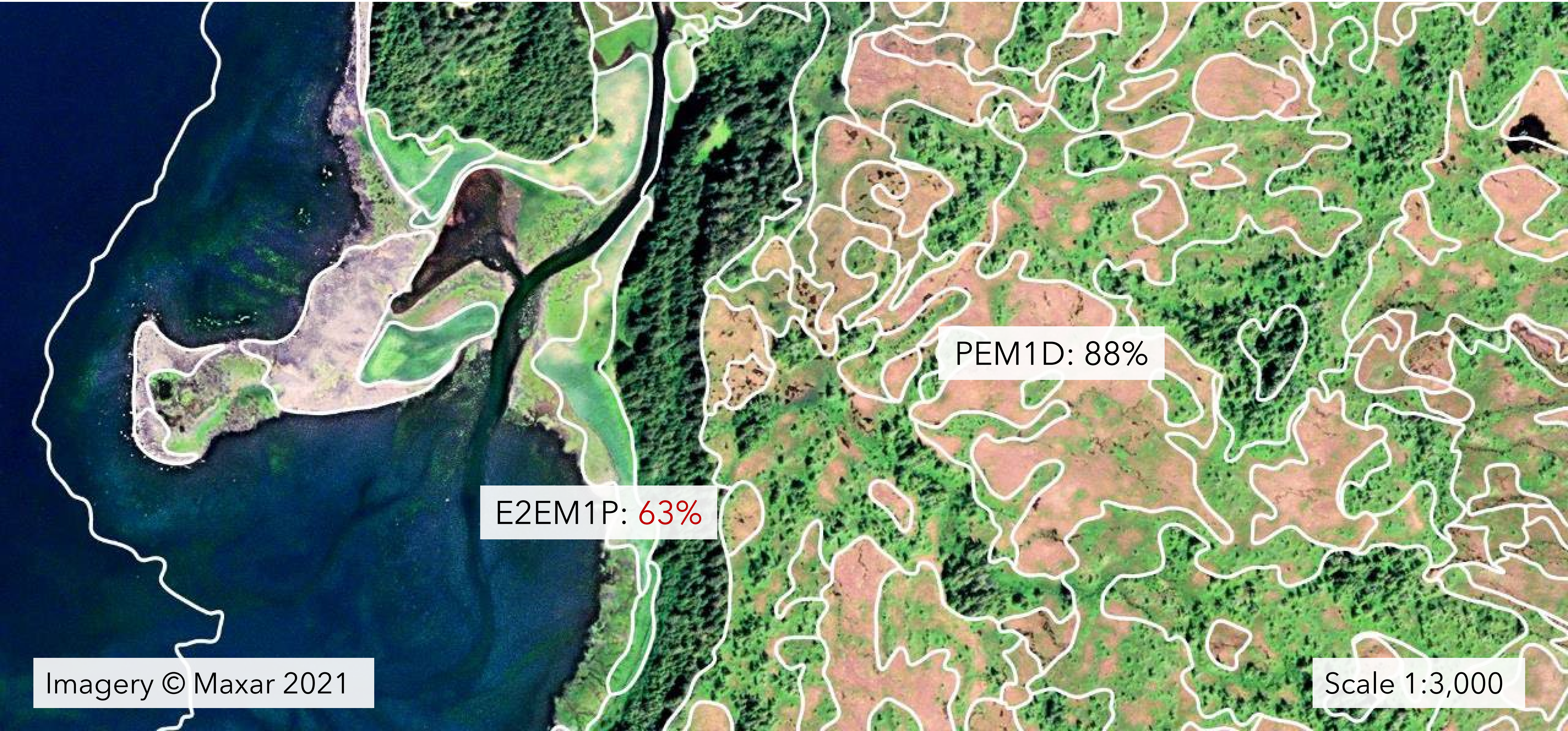
Study area (yellow) divided into cross validation blocks (white)

Training data in each block retained once as independent test partition of cross validation

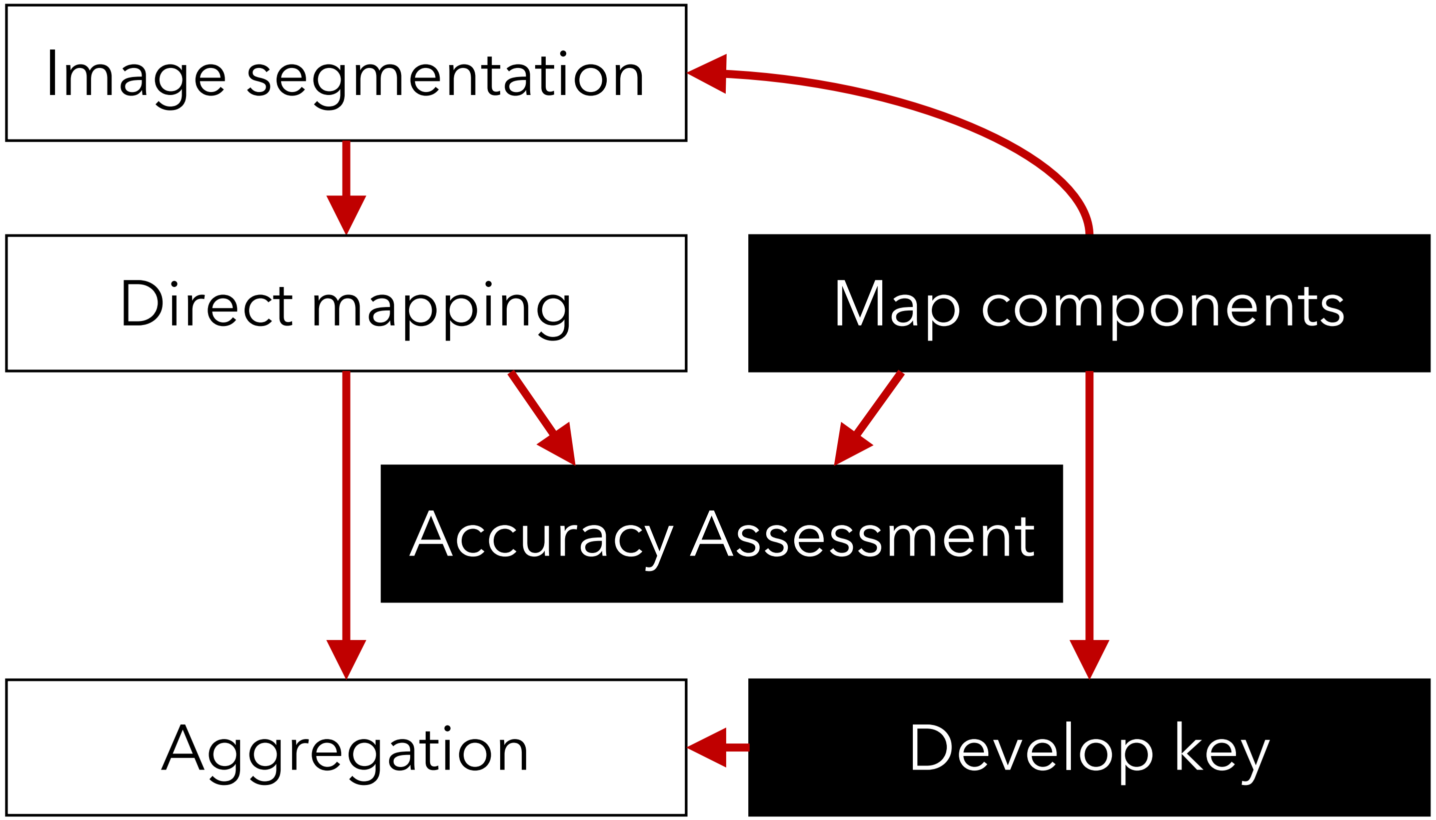
Identifies problems related to:

1. Misclassification/omission
2. Ecological ambiguity
3. Analyst errors/inconsistency
4. Additional data needs
5. Model error (analyst's effort needed)

Identify where analyst’s effort is best spent



Semi-automated workflow



Use quantitative and labeled data to map characteristics.

Accuracy assessed for individual components.

Use a map key to assign propagate class labels.

Mapping wetland components

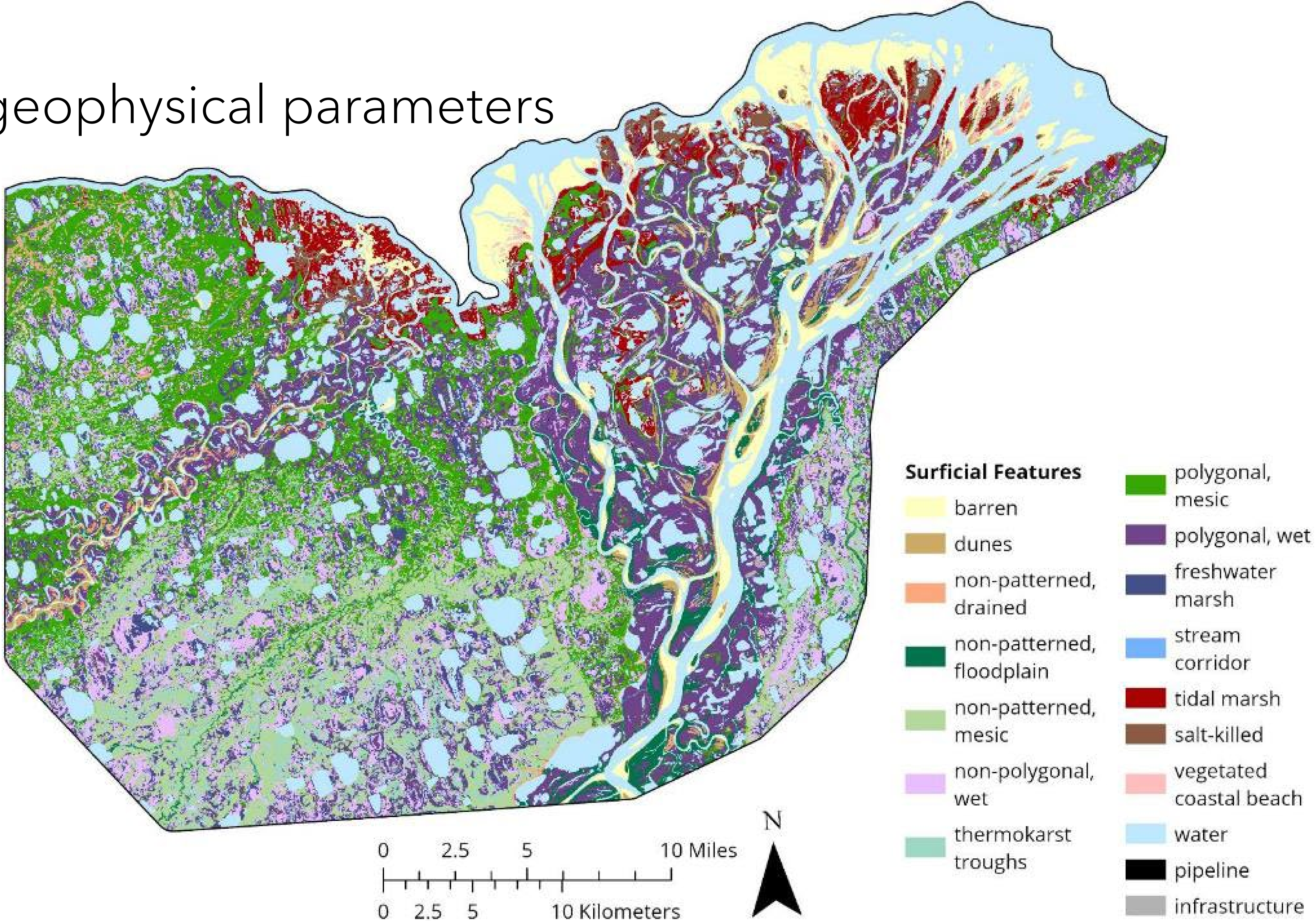
- *Eriophorum vaginatum* (tussock cottongrass) is FACW

- FACW definition: predominately occur in hydric soils, geomorphic settings where water saturates or floods the soil at least seasonally.

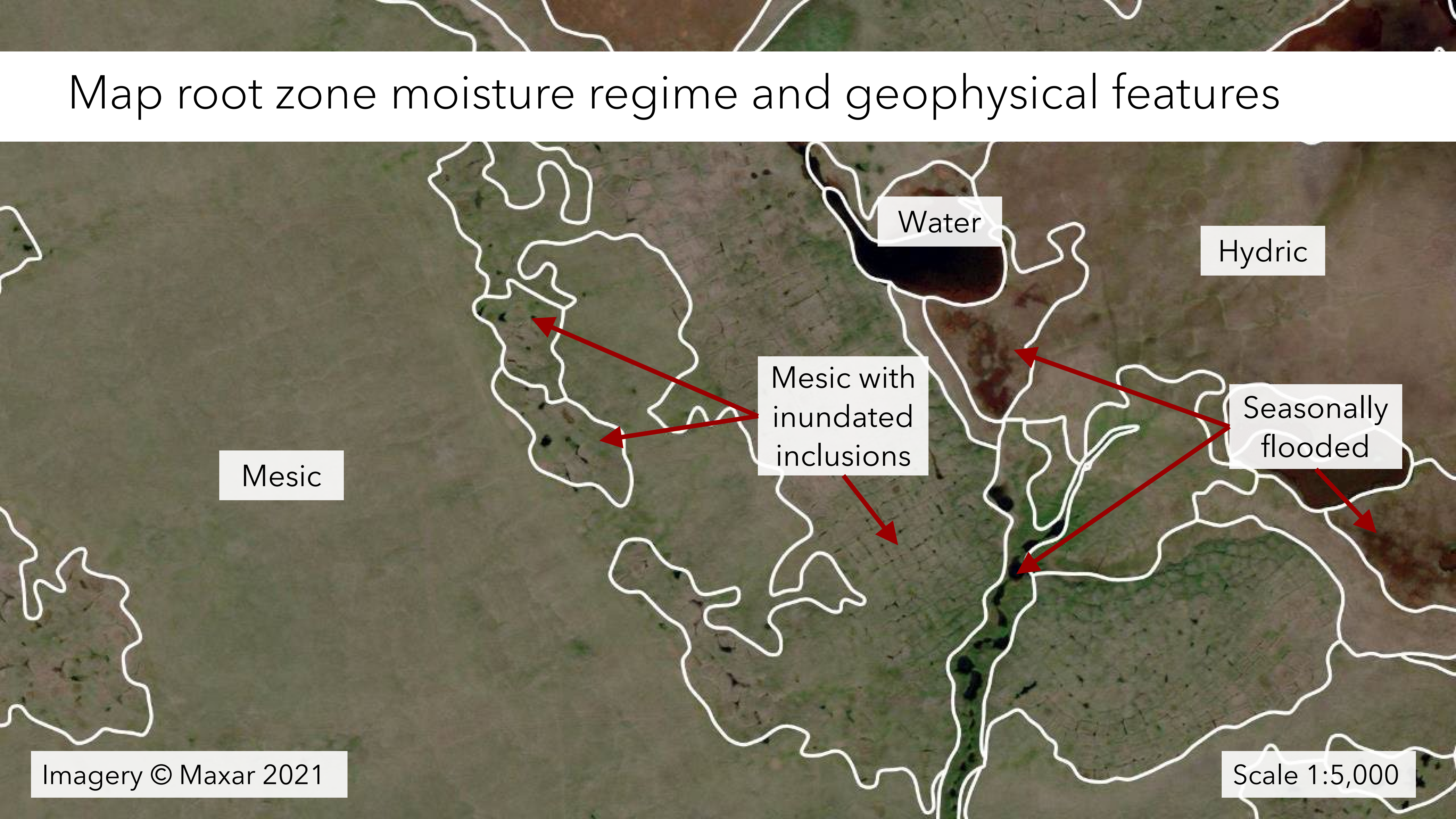
- Summary of 187 sites across Alaska of paired vegetation plots and soil pits:
  - 52% of occurrences in mesic soils
  - 48% of occurrences in hydric soils

Net effect: FACW designation drives thousands of acres of 1-parameter mapped wetlands

Soil and geophysical parameters



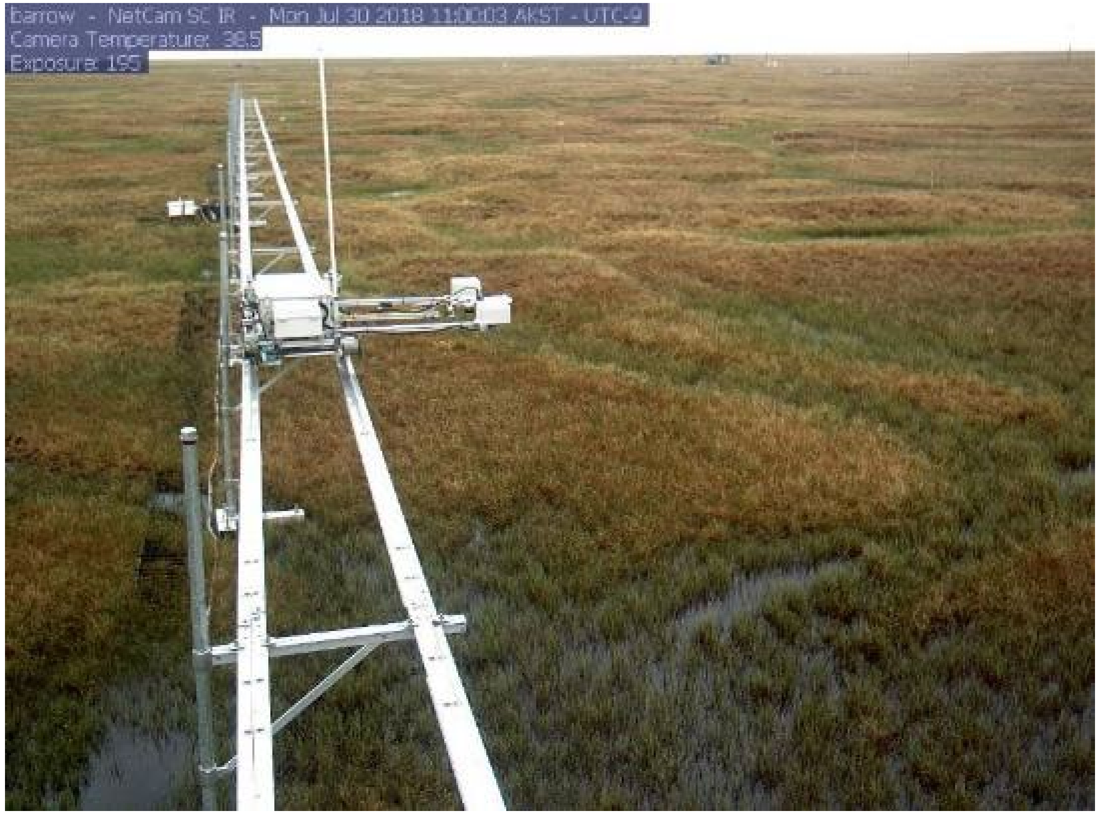
Map root zone moisture regime and geophysical features



Growing season % surface water

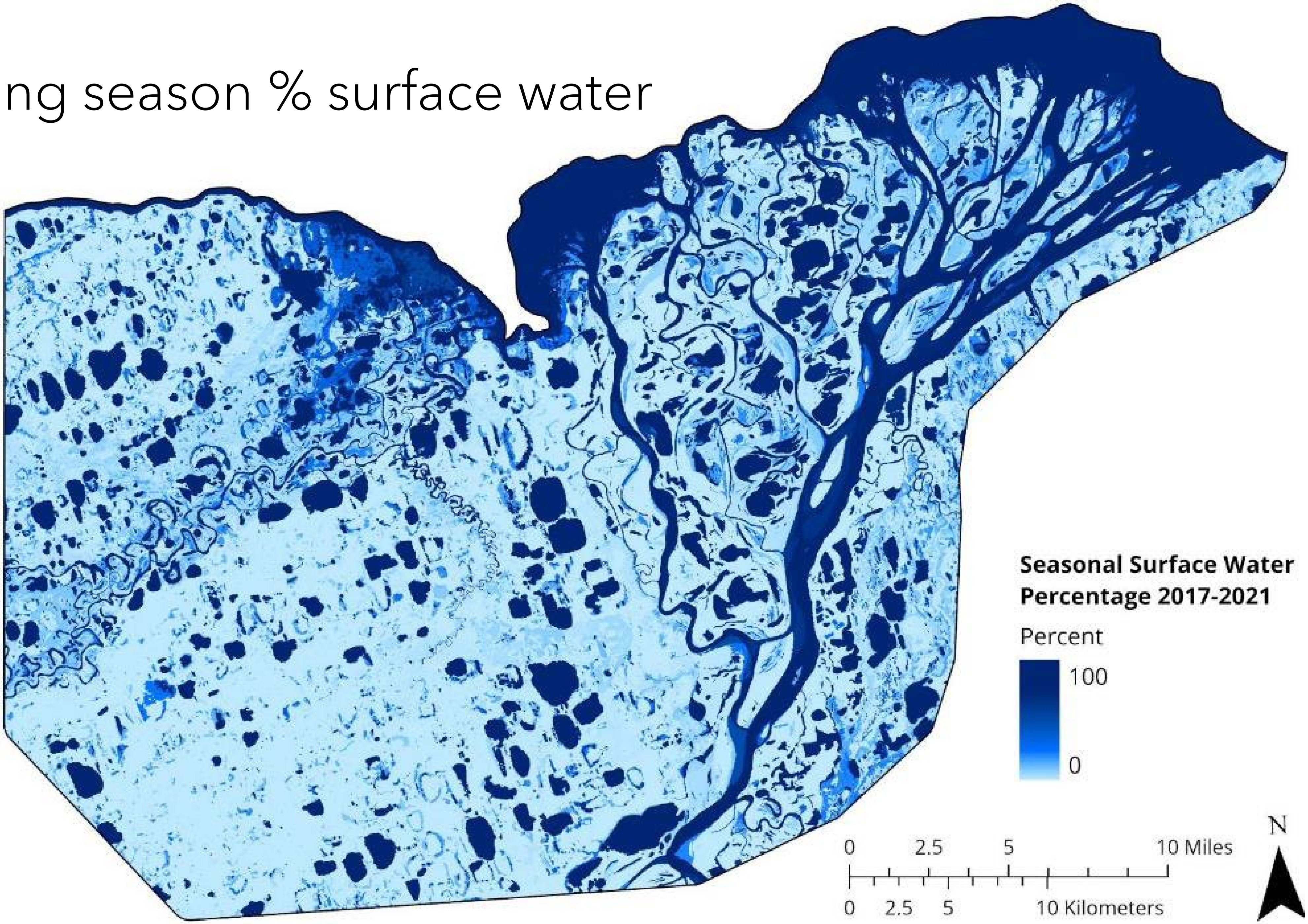
Percent of season when surface water is present

Surface water on June 27, 2018

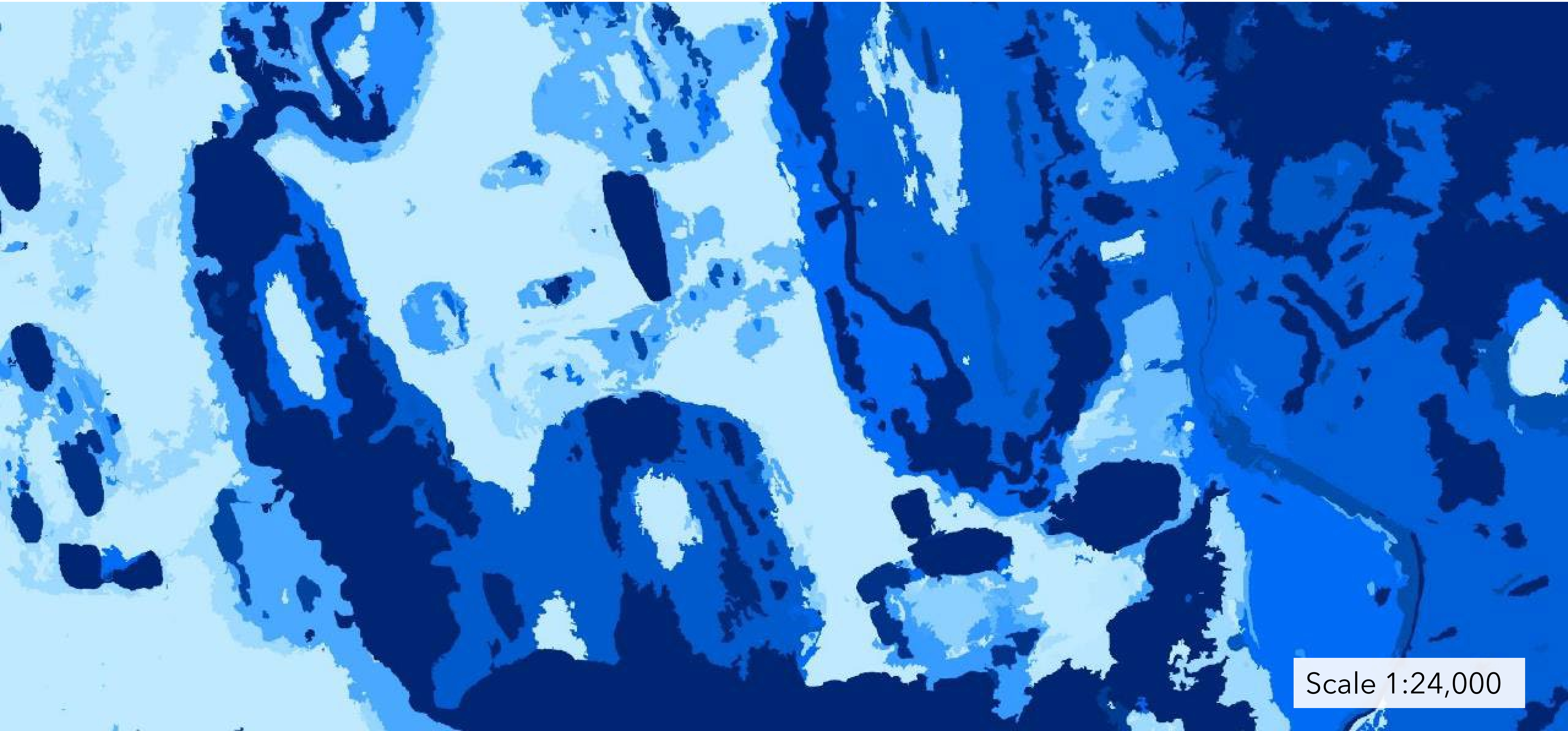


Not surface water (overtopped) by July 30, 2018

Growing season % surface water



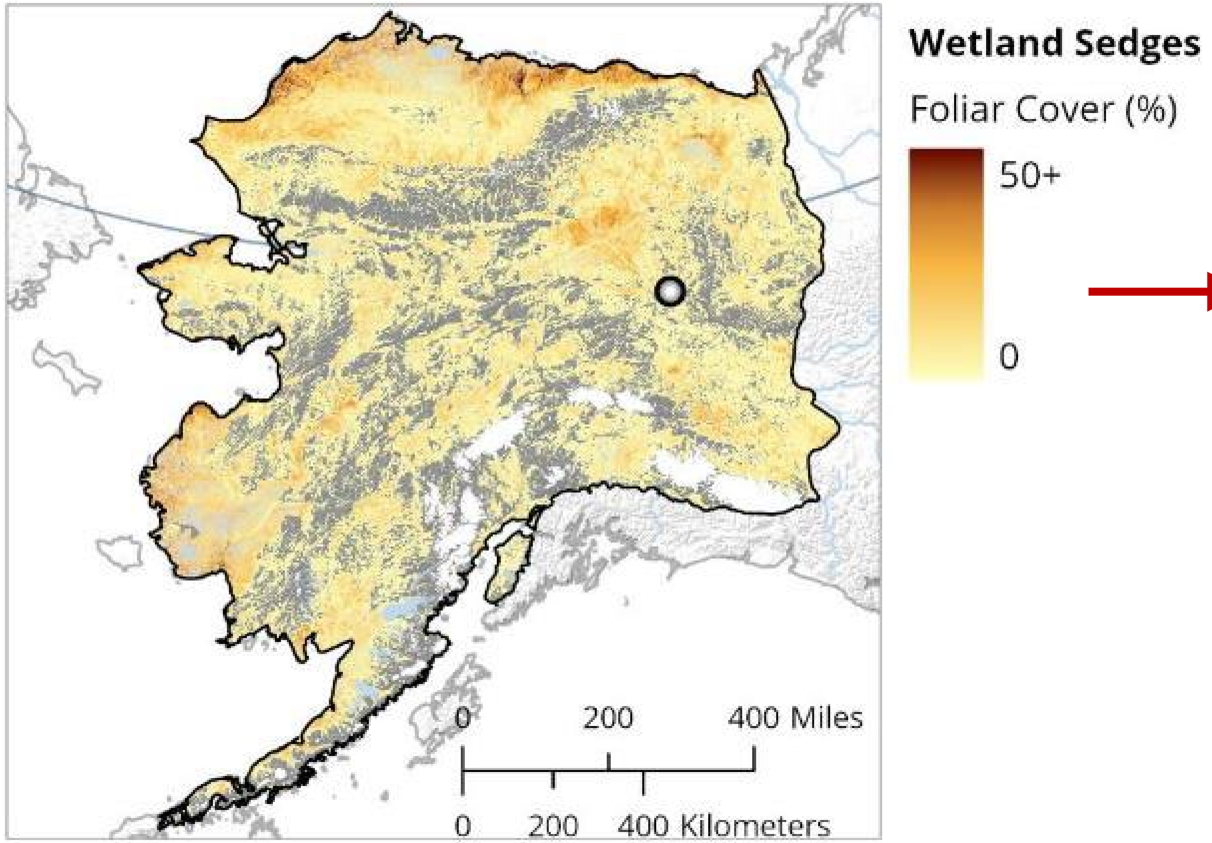
Tidal and flooding patterns represented as %

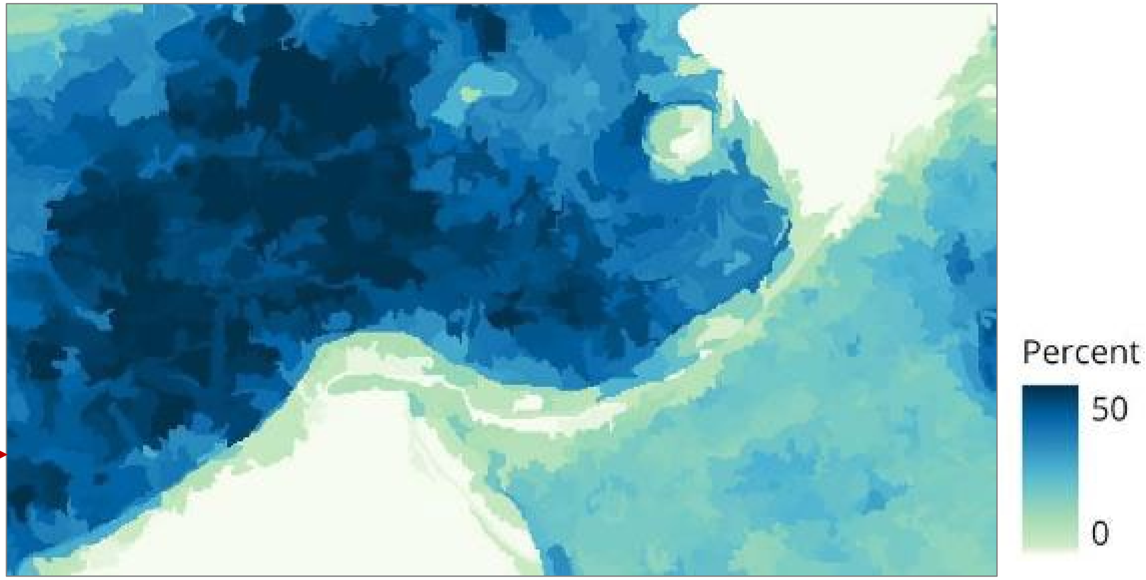


Scale 1:24,000

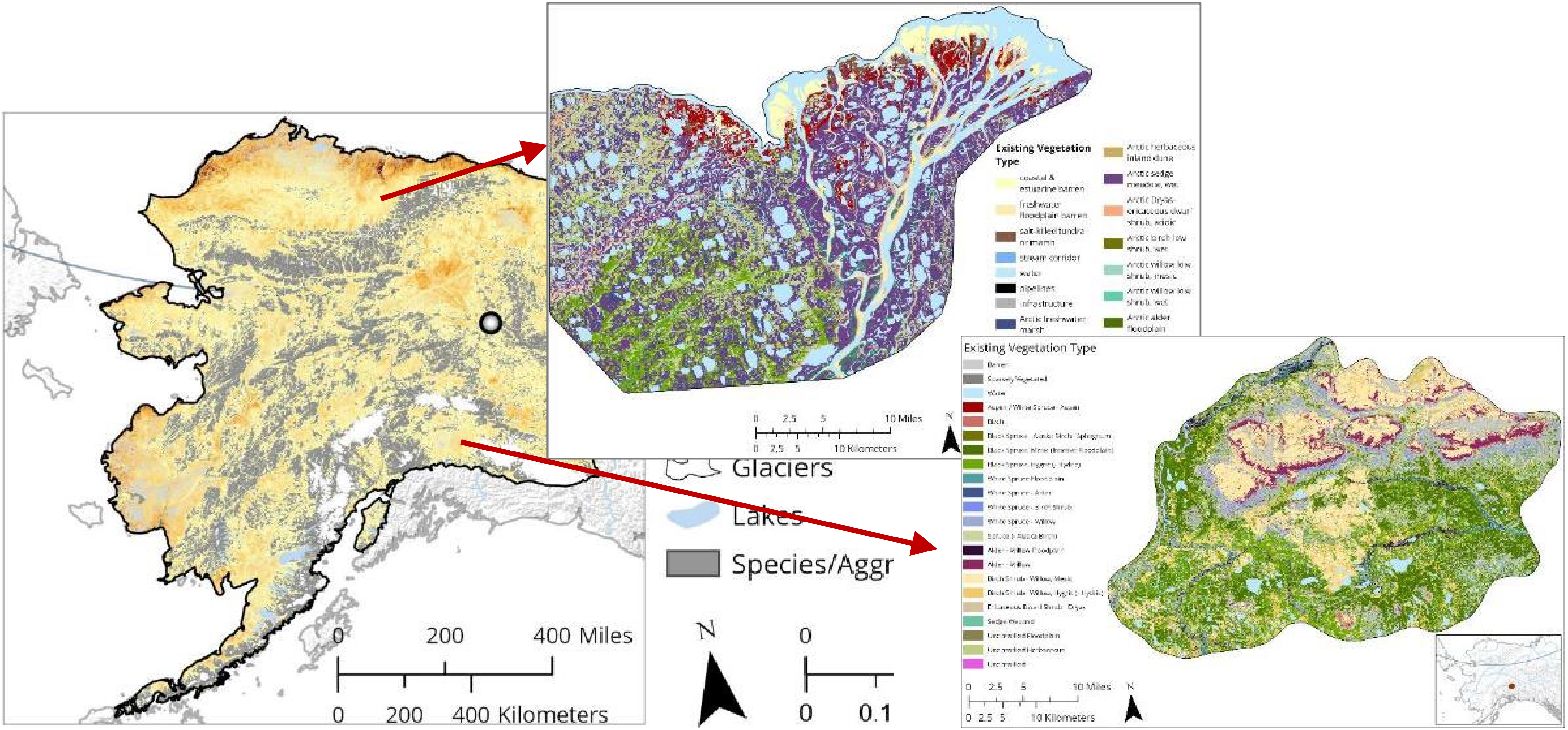
Tidal and flooding patterns represented as %

Mapping wetland vegetation cover: obligate wetland sedges

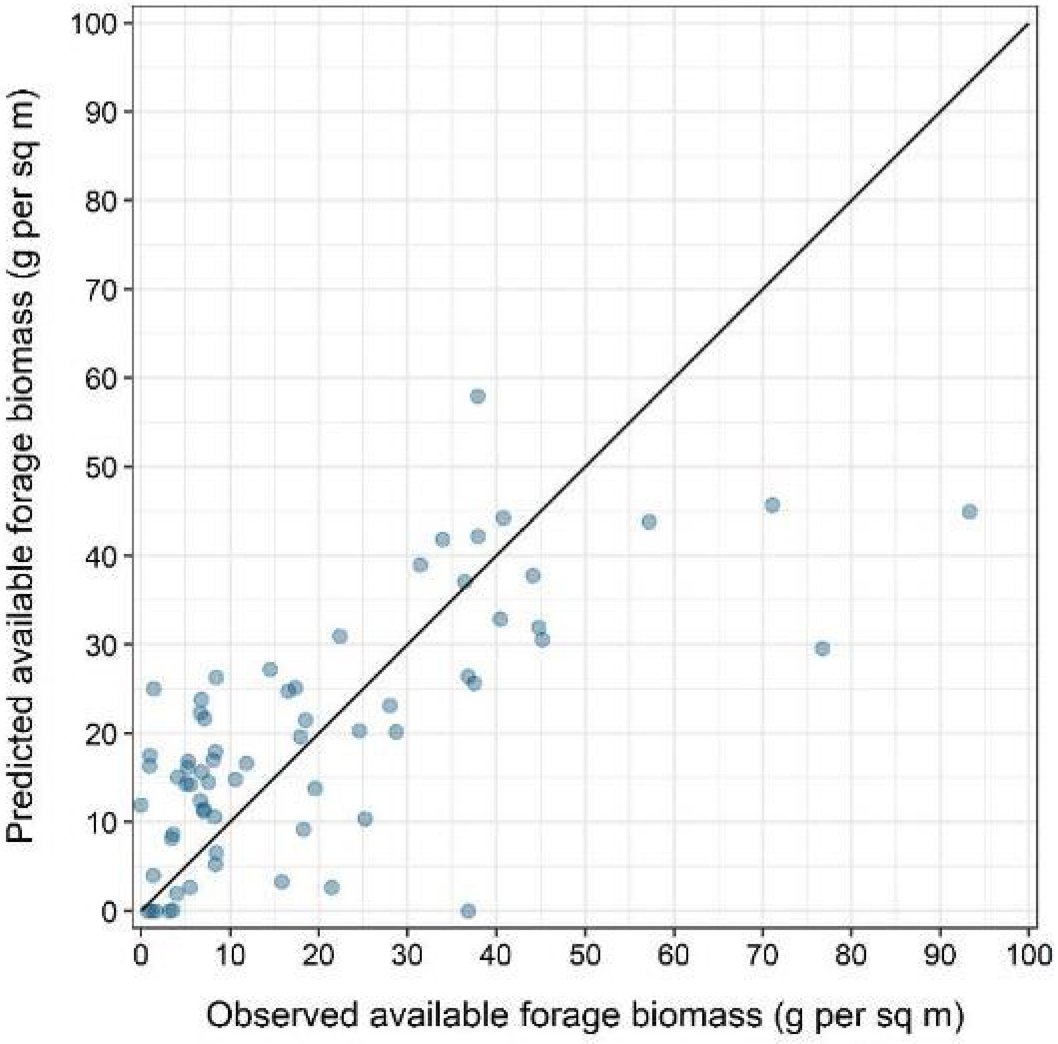




Consistent and cost efficient for large regions



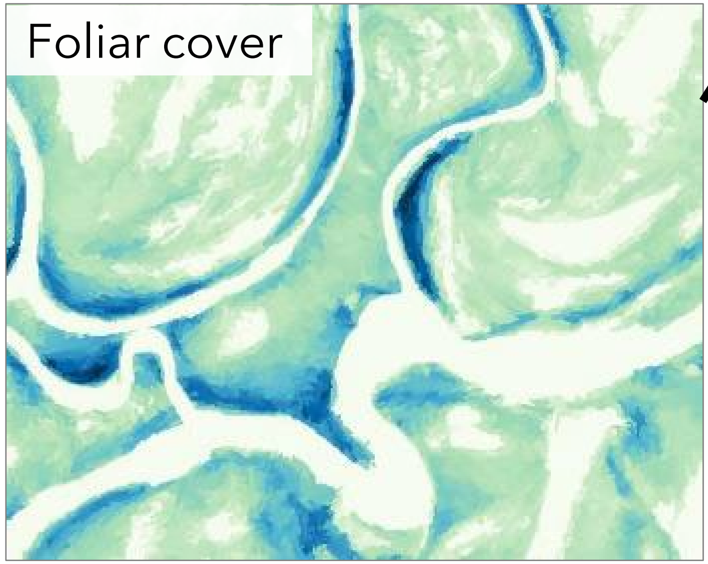
Interpreting predictive R^2 and RMSE



- Predictive R^2 is the R^2 of the model predictions, not of the model
- Calculated from a simple OLS model for observed values as a function of predicted values where the intercept is 0 and the slope coefficient is 1.
- The amount of "generalization".

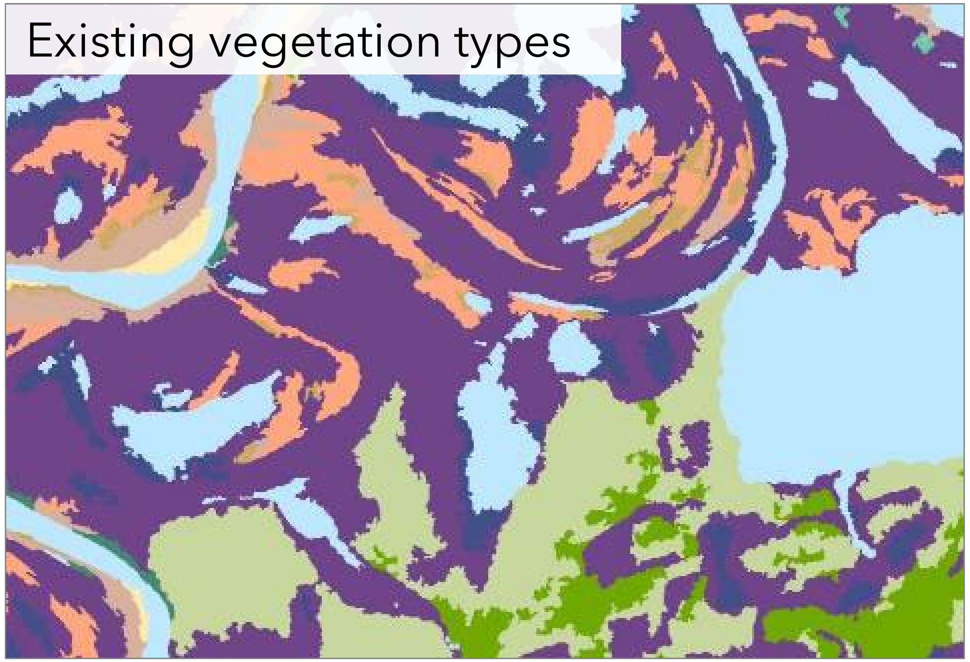
- RMSE is in the same units as the dependent variable.
- The "discriminatory" power of the model.

Map wetland vegetation types using programmatic key



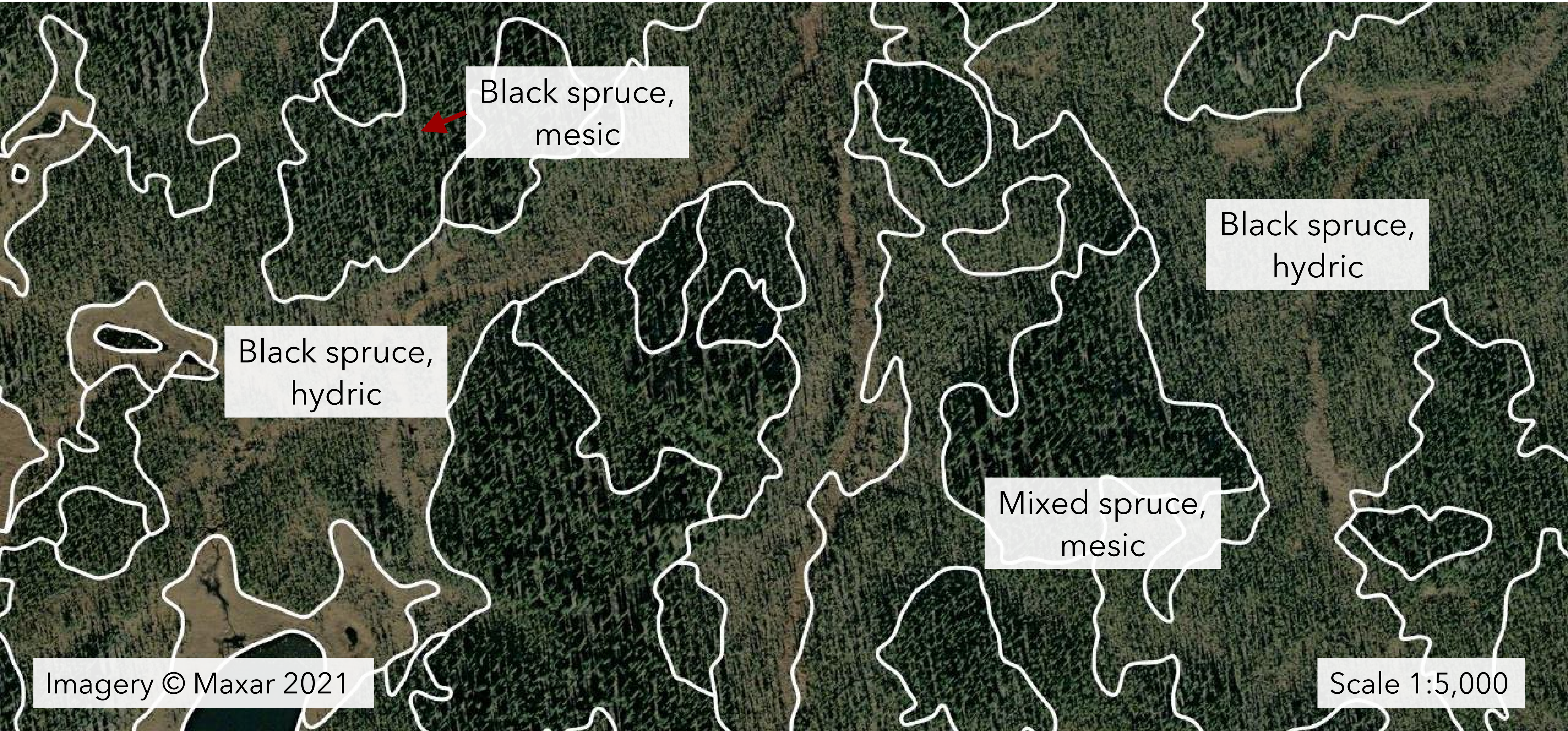
United States National Vegetation Classification
USNVC

Automated map key



Map wetland vegetation types using programmatic key

Separate similar types using component indicators



Should it be mapped as wetland? It depends…

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1-parameter: **Yes…** but is *Eriophorum vaginatum* reliable in this context?

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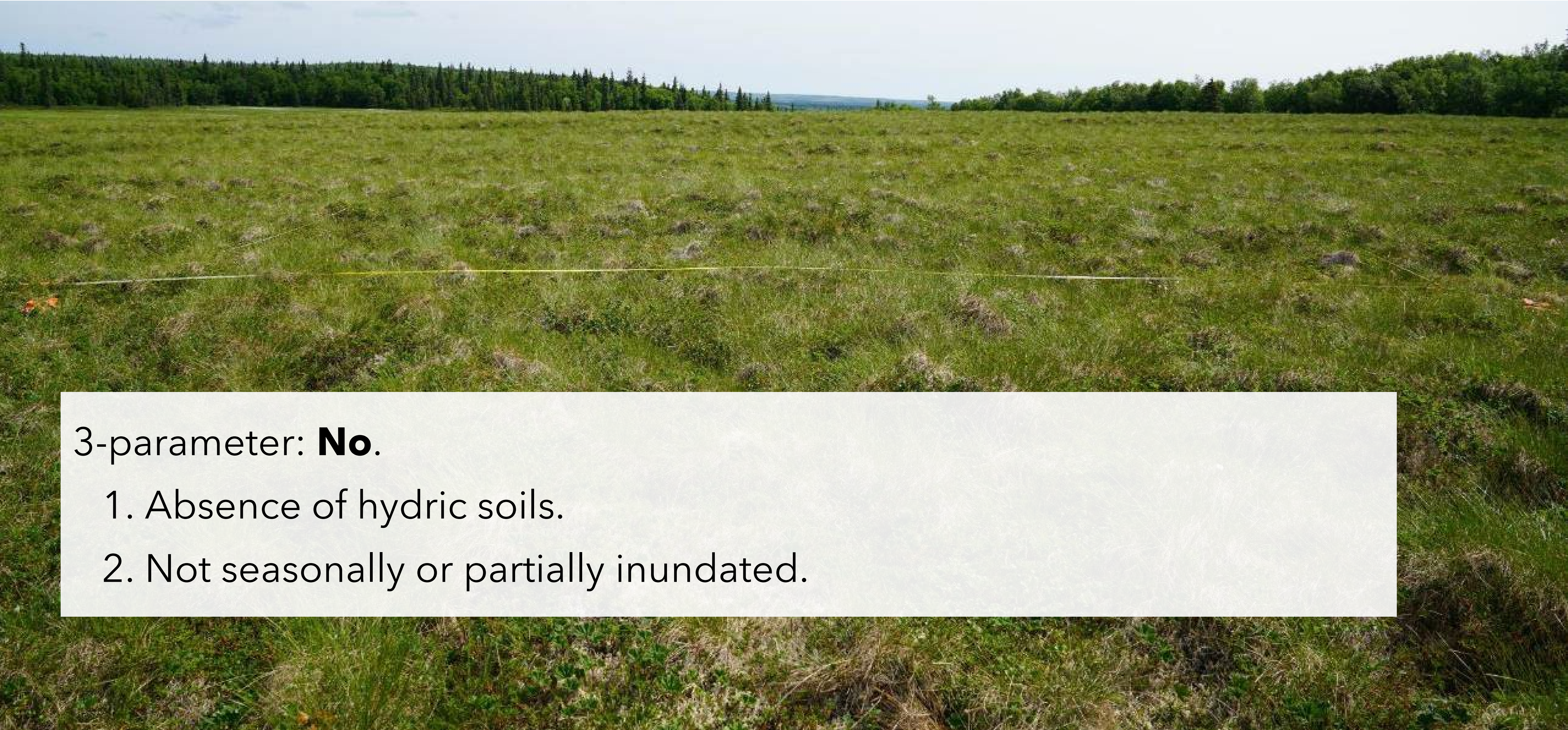
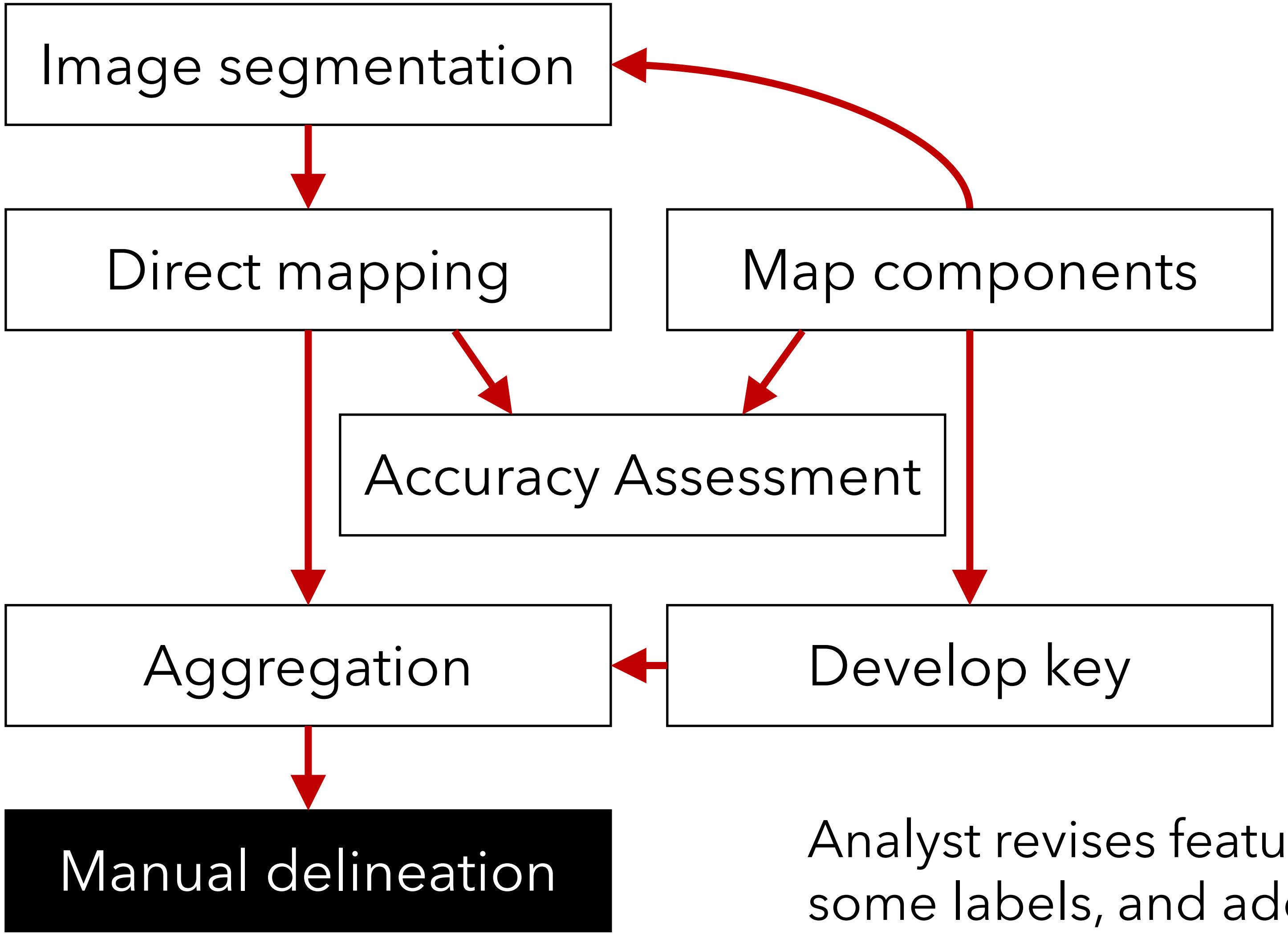


3-parameter: **No**.

1. Absence of hydric soils.
2. Not seasonally or partially inundated.

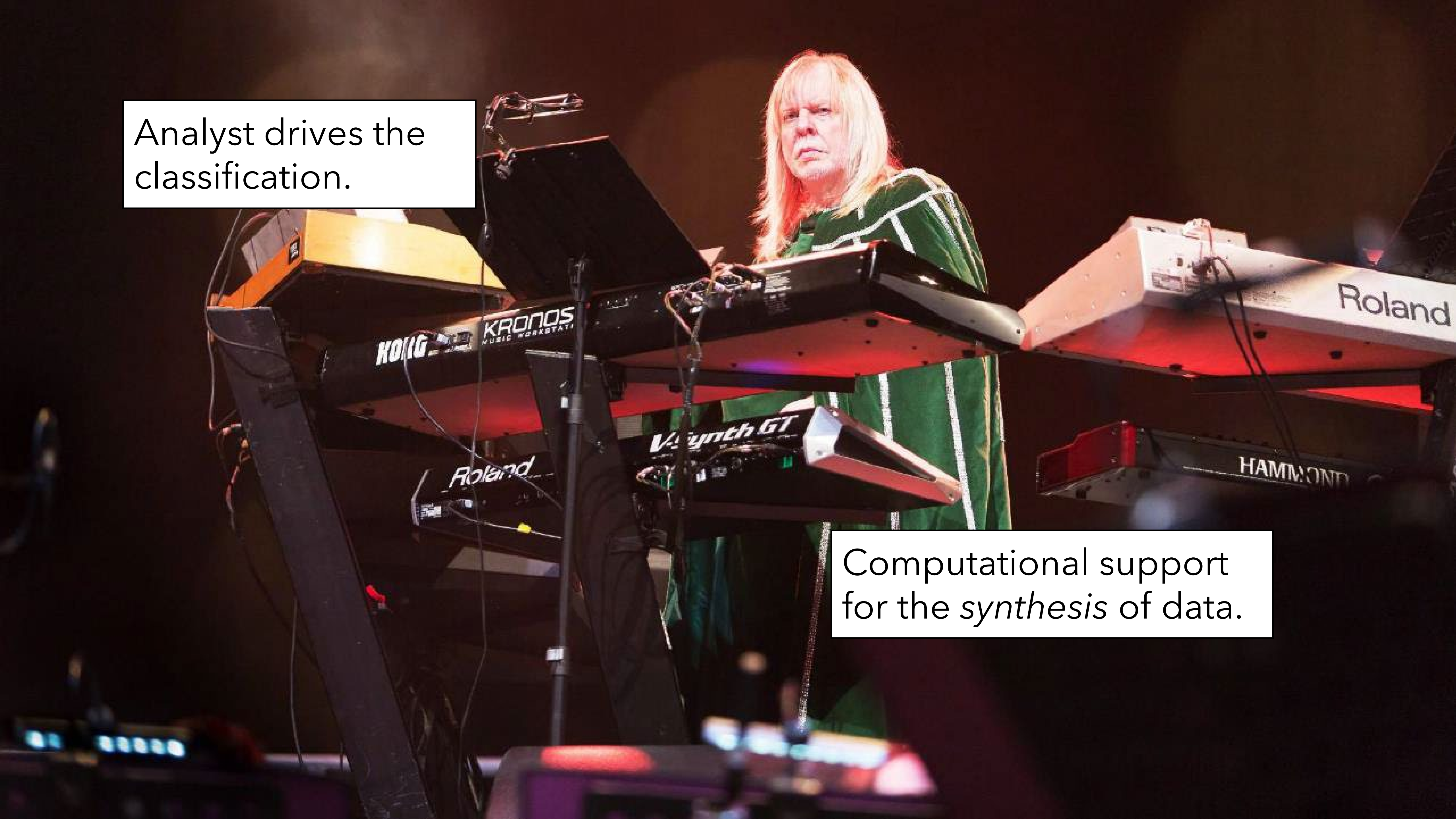
Semi-automated workflow



Workflow is scripted for repeatability.

Analyst revises feature polygons, corrects some labels, and adds non-modeled features.

Analyst drives the classification.



Computational support for the *synthesis* of data.

Conclusion

Automated methods offer:

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Combined with a knowledgeable analyst, workflow can combine benefits of *automated* and *manual* methods.

Presented as an idea rather than a true proof of concept.

Data and code availability

Geospatial data: https://accscatalog.uaa.alaska.edu

Code repository: https://github.com/accs-uaa

The AKVEG Map

Continuous foliar cover of species & aggregates: https://accscatalog.uaa.alaska.edu
Time-series of plant functional types: https://daac.ornl.gov (Macander et al. 2022)

AKVEG Database: https://akveg.uaa.alaska.edu

Vegetation Mapping Standards
Alaska Vegetation Technical Working Group: https://agc.dnr.alaska.gov

Results: tealeaf willow (*Salix pulchra*)

obs.: 60 (out of 66)