USDA Natural Resources Conservation Service
U.S. DEPARTMENT OF AGRICULTURE

Soil Landscapes of the United States (SOLUS) Soil Property Maps: Overview, Feedback, and Future Directions

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SOIL SCIENCE AND RESOURCE ASSESSMENT

Soil Landscapes of the United States (SOLUS)

- Phase 1: 100 m
  - Maps, internal review, and paper in revision
- Phase 2: 30 m
  - Methods/covariates in development
- Harmonized depths
  - 0, 5, 15, 30, 60, 100, 150 cm
- Prediction uncertainty
  - 95 percent prediction intervals
  - Relative prediction interval (RPI)
- Standards – National Soil Survey Handbook Part 648

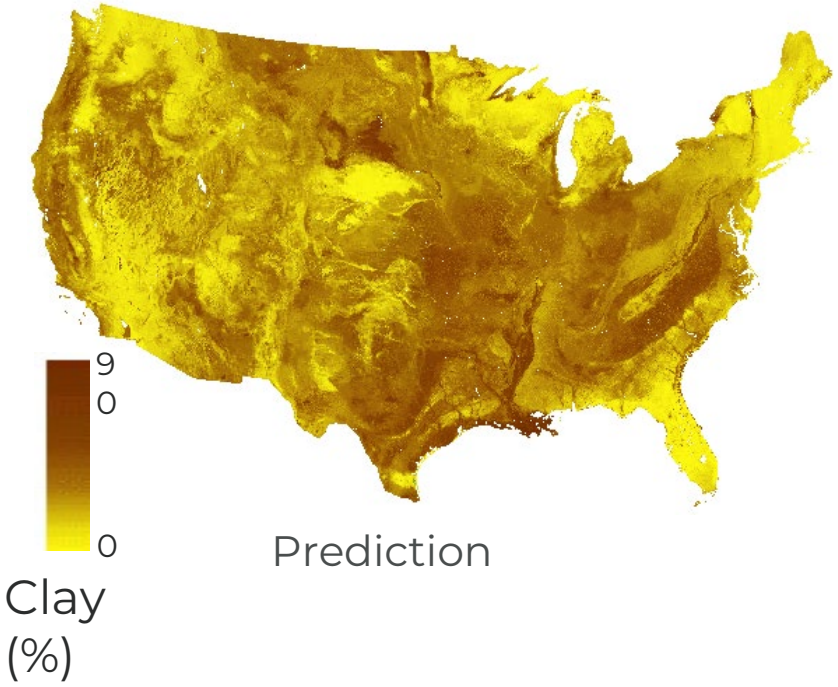
SOLUS100 properties

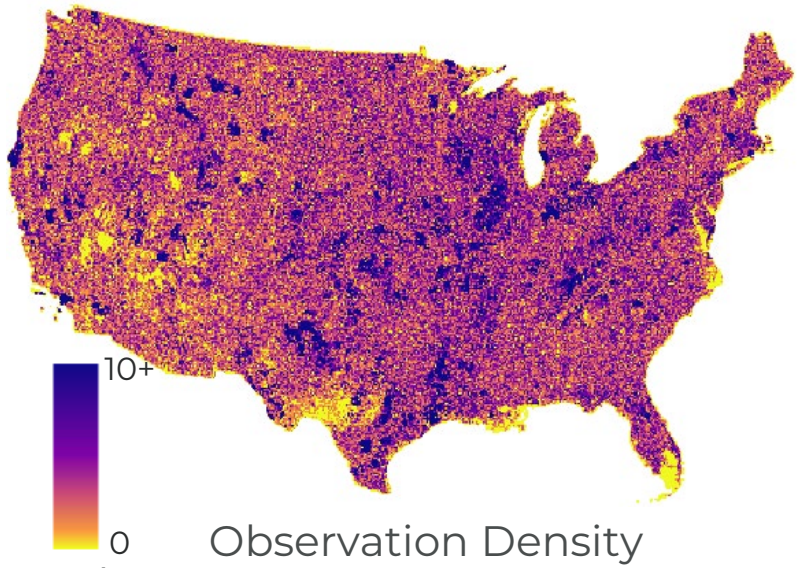
- Depth to bedrock (cm)
- Depth to restriction (cm)
- Sand, silt, clay (percent)
- Sand fractions (very fine, fine, medium, coarse, very coarse) (percent)
- Rock fragment volume (percent)
- Bulk density (g/cm3)
- SOC (percent)
- pH
- ECEC & CEC7 (meq/100g)
- Gypsum content (percent)
- CaCO3 (percent)
- SAR
- EC (mmhos/cm)

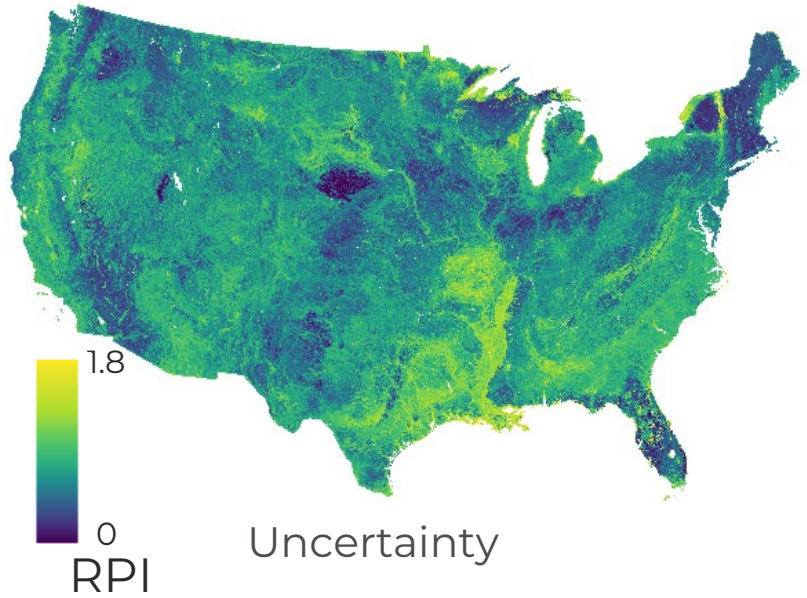
Accessing SOLUS

- **Google public bucket** with cloud optimized geotiffs
  - API: Can automate layer downloads with URL concatenation
  - Can be loaded into QGIS and other GIS without downloading
- **Ag Data Commons** repository
  - Google “Ag Data Commons SOLUS100”
  - Persistent DOI: https://doi.org/10.15482/USDA.ADC/25033856
  - Links to API services
  - Full git code repository and documentation available
- Future: **Google Earth Engine** catalogue

SOLUS100 Results – Example Maps and RPI







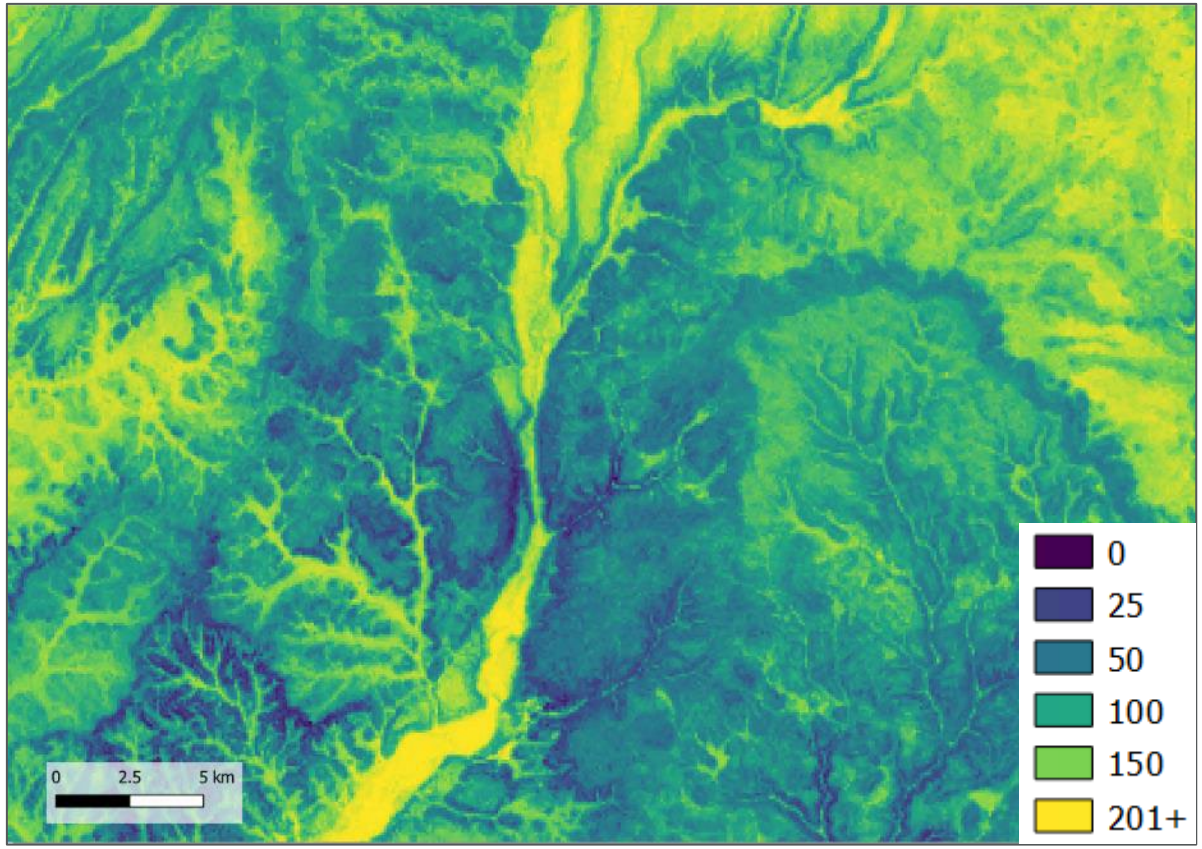
Example: Percent clay at 60 cm depth

Relative Prediction Interval (RPI)
RPI = PI width / training data inter-quantile width

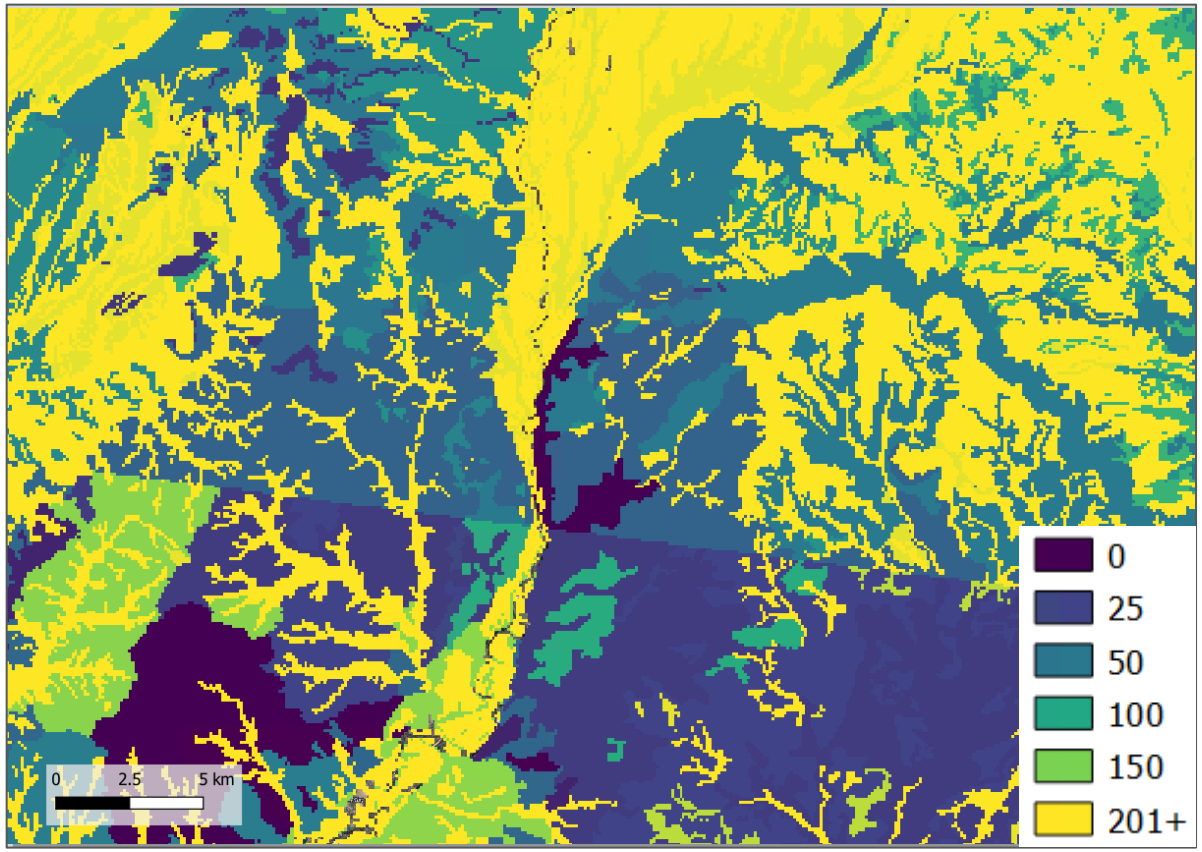
SOLUS100 Results – Cross Validation Coefficients of Determination

SOLUS100 vs gNATSGO: Improvements

Depth to bedrock contact (cm, right censored at 201 cm)
on Colorado – New Mexico border



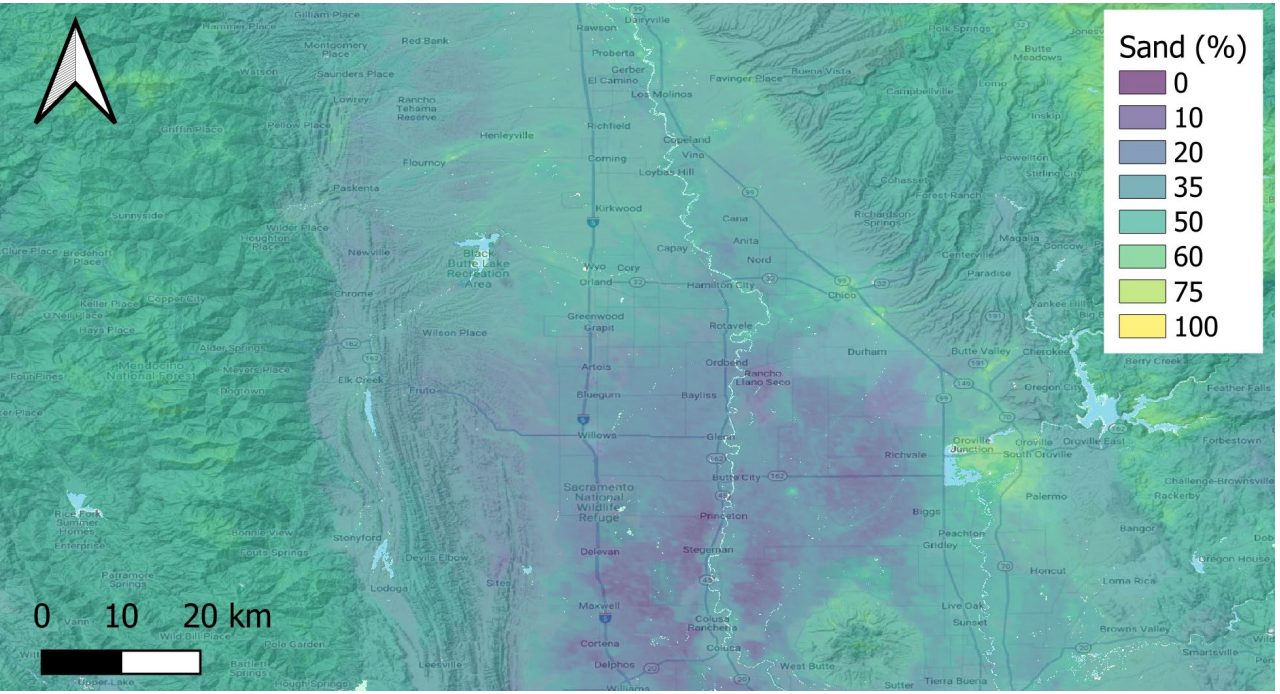
Soil Landscapes of the United States (SOLUS100)

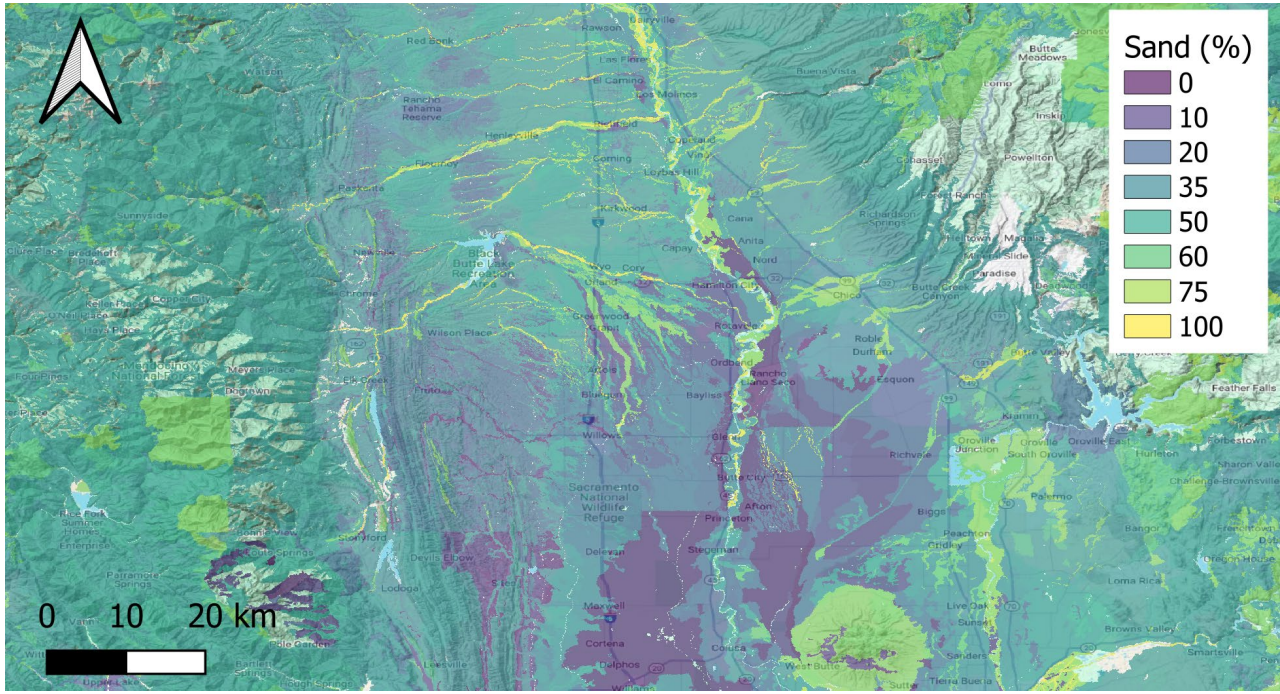


Gridded National Soil Survey Geographic Database (gNATSGO)

SOLUS100 vs gNATSGO: Issues

Surface sand content of Sacramento River Valley, CA





SOLUS 100

- Smooths over fine-scale alluvial patterns
- Eliminates survey edge artifacts

gNATSGO

- Fine-scale alluvial patterns captured by SSURGO
- Lots of artifacts and gaps

SOLUS100 Internal Review App

NCSS National Cooperative Soil Survey

Search places

Earth Engine Apps

Layers | Map | Satellite

Clay (%)
0
10
15
20
25
30
40
70+

Depth to Bedrock (cm)
0 100 201+

Relative Prediction Interval
0 0.75 1.5+

Google

Keyboard shortcuts | Map data ©2023 Google | 10 km | Terms of Use | Report a map error

Soil Landscapes of the US (SOLUS)

100m Maps of Clay (%)

These data are preliminary or provisional and are subject to revision. They are being provided to meet the need for timely best science. The data have not received final approval by the USDA NRCS and are provided on the condition that neither the NRCS nor the U.S. Government shall be held liable for any damages resulting from the authorized or unauthorized use of the data.

Provide feedback on form linked below. Include feedback on general spatial trends, if prediction values seem correct, or any artifacts observed.

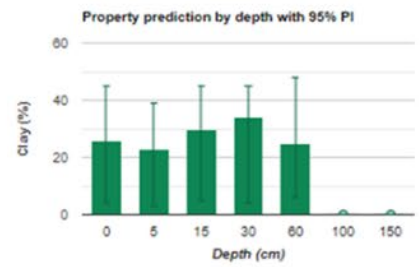
Feedback Form

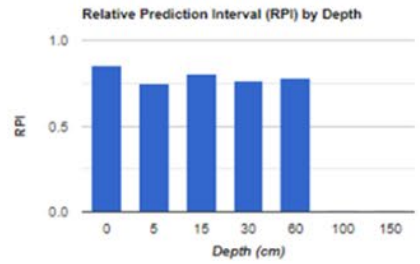
Click on the map for predictions (takes 5-10 sec)

Point latitude, longitude: 38.81390, -109.80662

Predicted Bedrock depth*: 89 cm , 95% PI: 0 to 201 cm

* Values are right censored at 201cm. Predictions close to 201 cm mean 201 cm or deeper.

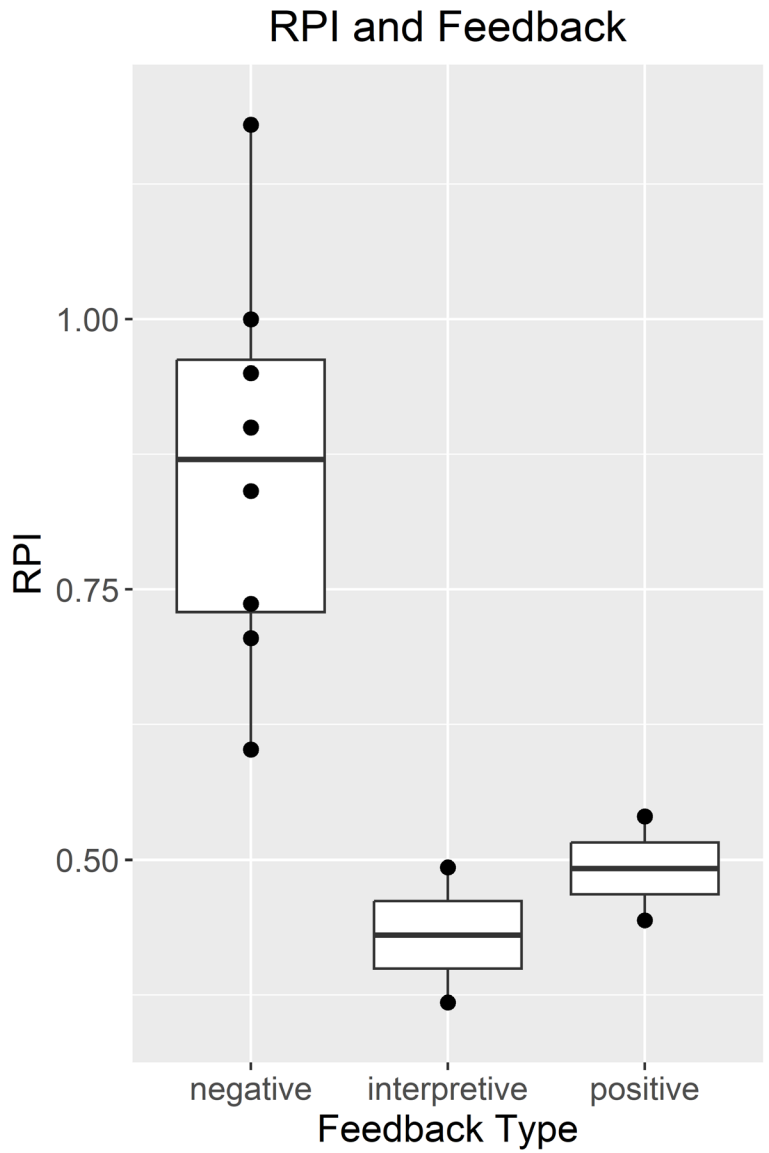




RPI is a relative measure of uncertainty with high values being more uncertain. It is computed as the ratio of the 95% PI width to the training set 95% quantile width (97.5% quantile value - 2.5% quantile value).

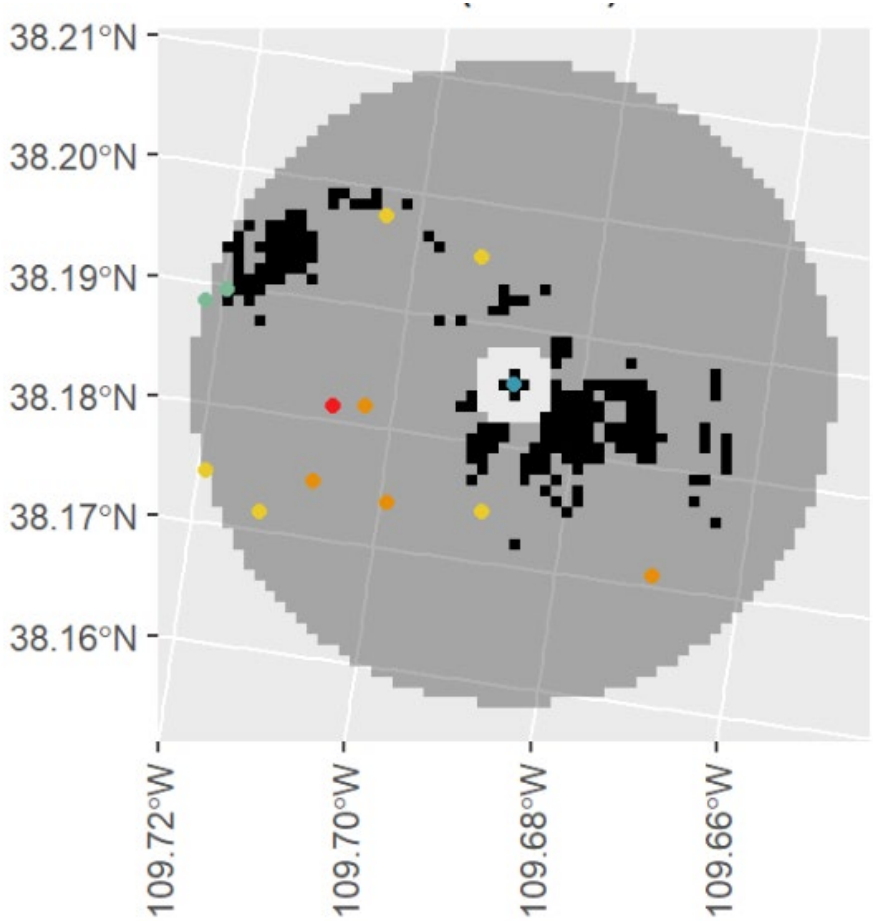
Internal Review Summary

- Responses include a mix of negative (40 percent), positive (23 percent), interpretive (13 percent), and not applicable (23 percent).
  - N = 30 responses
- Glacial areas and complex alluvial basins are difficult to model.
  - Old glacial lakes, deep glacial parent materials
- Soil depth to restriction maps require careful interpretation due to right censored training set.



Applications

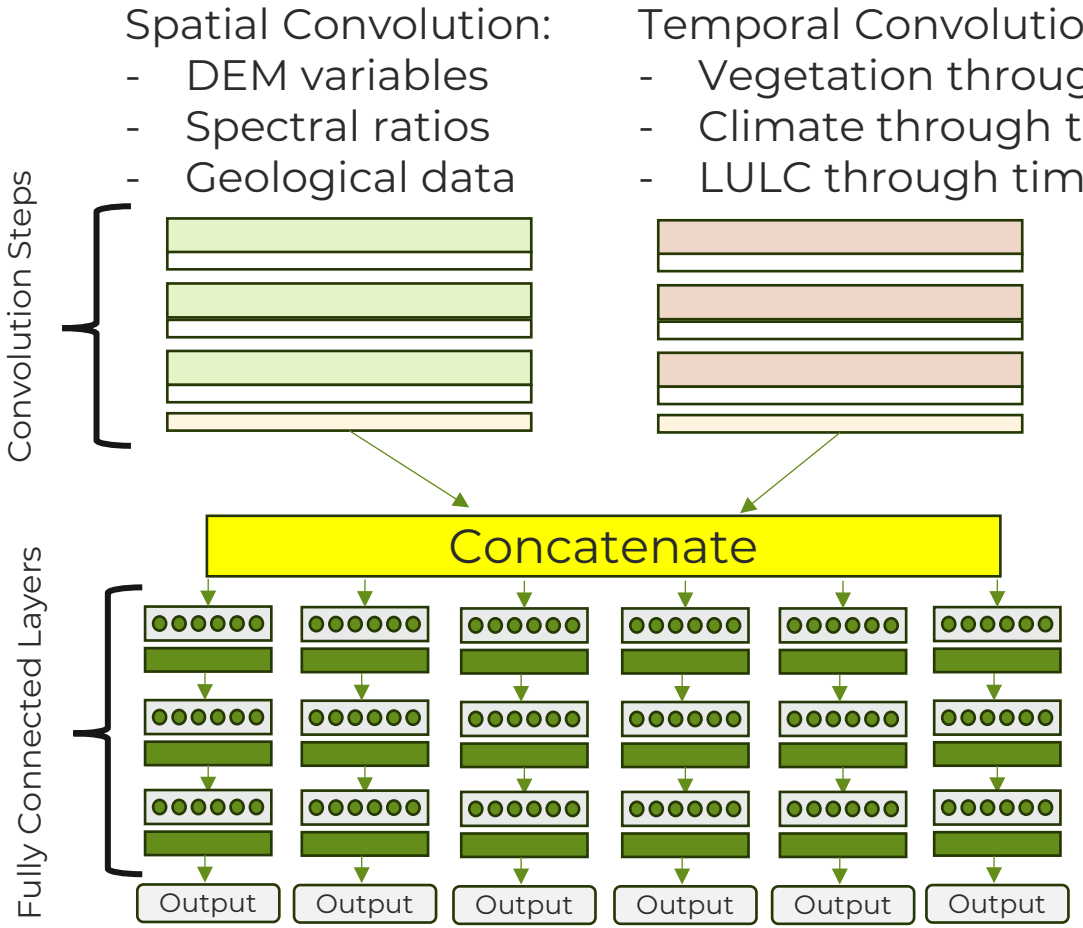
- Water quality models used for resource assessment concerns in conservation planning
- High speed internet installation
- Soil moisture models
  - University of Florida: soil moisture temporal predictions
  - University of Arizona: Rosetta soil hydraulic maps
- Disturbance Automated Reference Toolset (DART)
  - USGS spatial tool to assess discrete land treatments and disturbances



DART run in Utah identifying areas of similar ecological potential around a central plot

Next Steps

- 30-meter covariates
- Deep learning
  - Multi-task modeling
  - Models can be uptrained annually
- Spatiotemporal framework
  - Convolutions in space and time



Generalized scheme for possible spatiotemporal multi-task deep convolutional neural network


Loa
Lyman
Bicknell
Torrey
Junction
Kingston
Circleville
Antimony
24
89
153
62
22
12

Thank you!

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