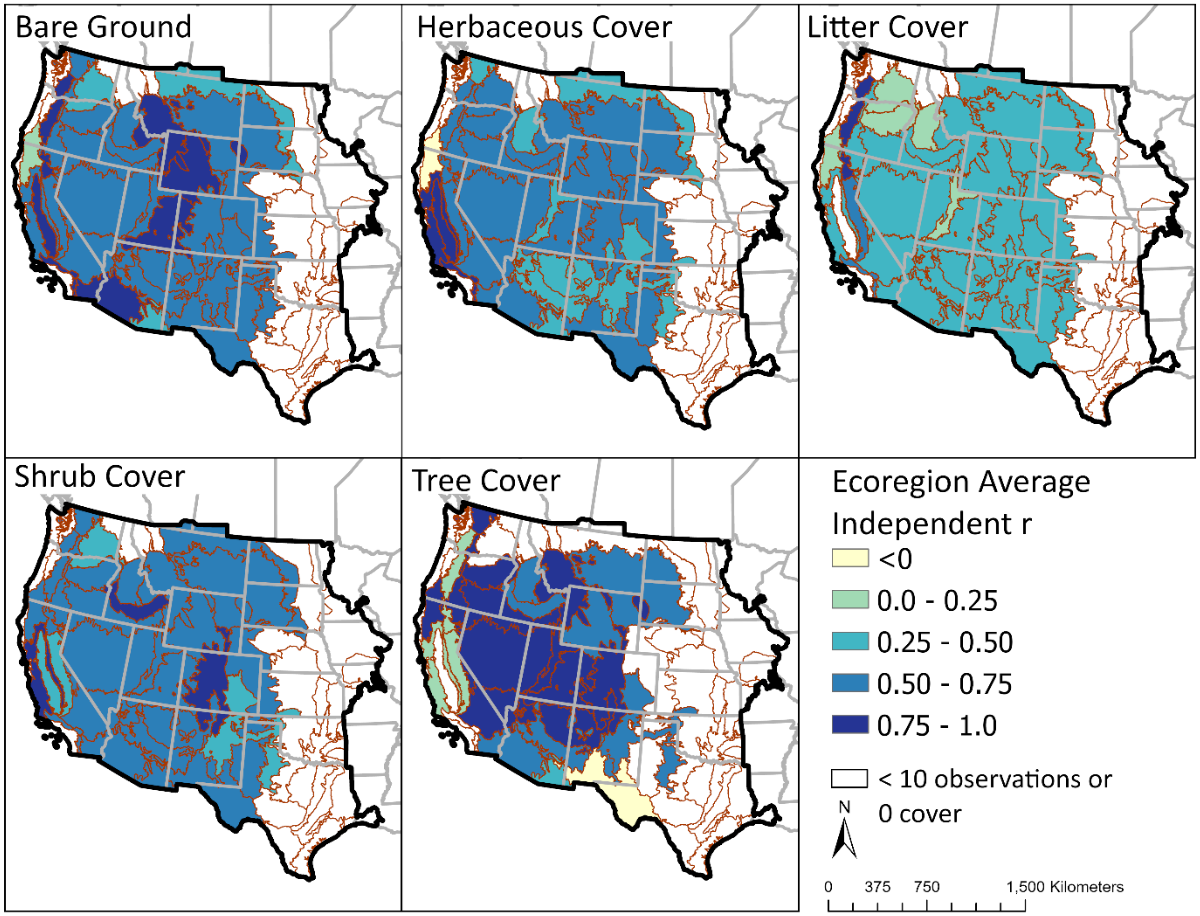
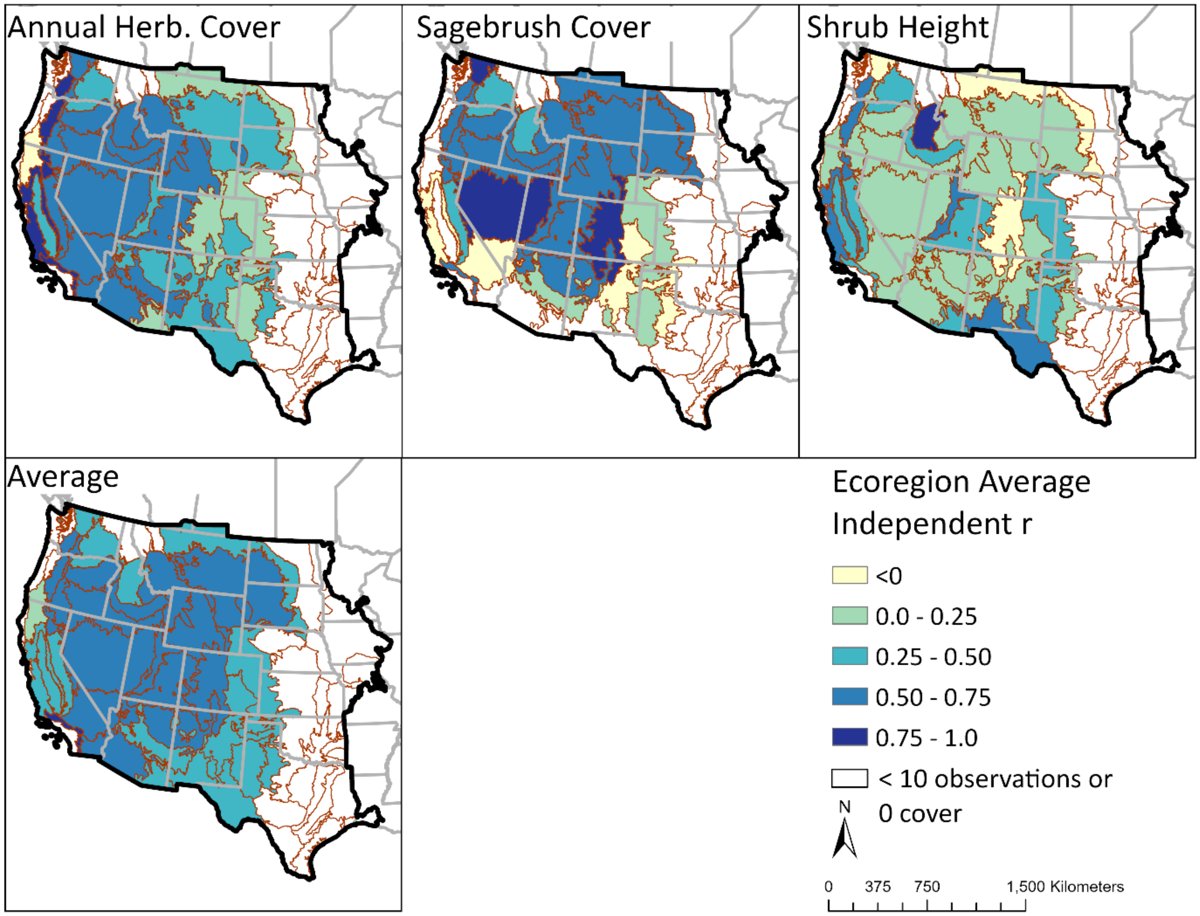
RCMAP 020282025 Release of 1985-2024 Time-Series Products; Additional Accuracy Metrics

RCMAP time-series data are rigorously validated using field data not included as training (i.e., independent). Our independent data consisted of 2,014 observations collected by RCMAP between 2013 and 2023 and a 10% withholding of BLM AIM and LMF data not used for training (n = 5,926) collected between 2011 and 2023. As reported in the metadata files for each time-series layer, at the withheld BLM AIM and LMF sites (n = 5,926), correlations between RCMAP and AIM/LMF data were: Bare Ground - R2 0.64, RMSE 14.1, Herbaceous - R2 0.57, RMSE 16.2, Litter - R2 0.14, RMSE 11.6, Shrub - R2 0.53, RMSE 8.7, Sagebrush - R2 0.60, RMSE 6.6, Annual Herbaceous - R2 0.45, RMSE 12.1, Tree - R2 0.73, RMSE 6.5, Shrub Height - R2 0.11, RMSE 33.9.

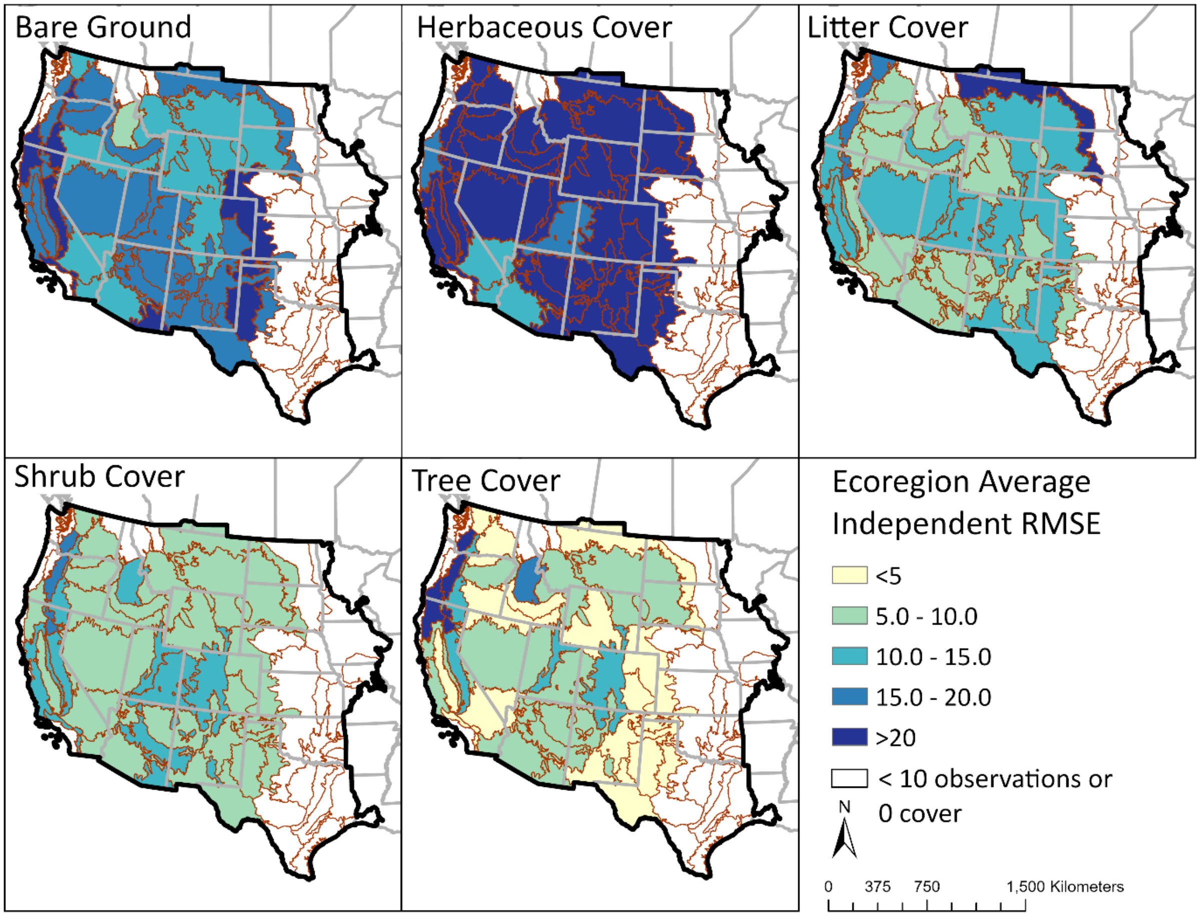
We add nuance to the overall statistics above by 1) evaluating variation in accuracy by ecoregion, 2) by component cover value, and 3) by level of spatial aggregation.

1. **Variation in Accuracy by Ecoregion**
   The statistics reported above represent a mean across the entire study area, but regional variation in accuracy does exist. We conducted further accuracy assessment by pooling the RCMAP independent data and withheld AIM (n = 7,940) and breaking down accuracy by level III ecoregion. Ecoregion average correlation (r), RMSE, and bias (RCMAP prediction minus field observation) were calculated, with ecoregions having less than 10 field observations or no observations of a component excluded.

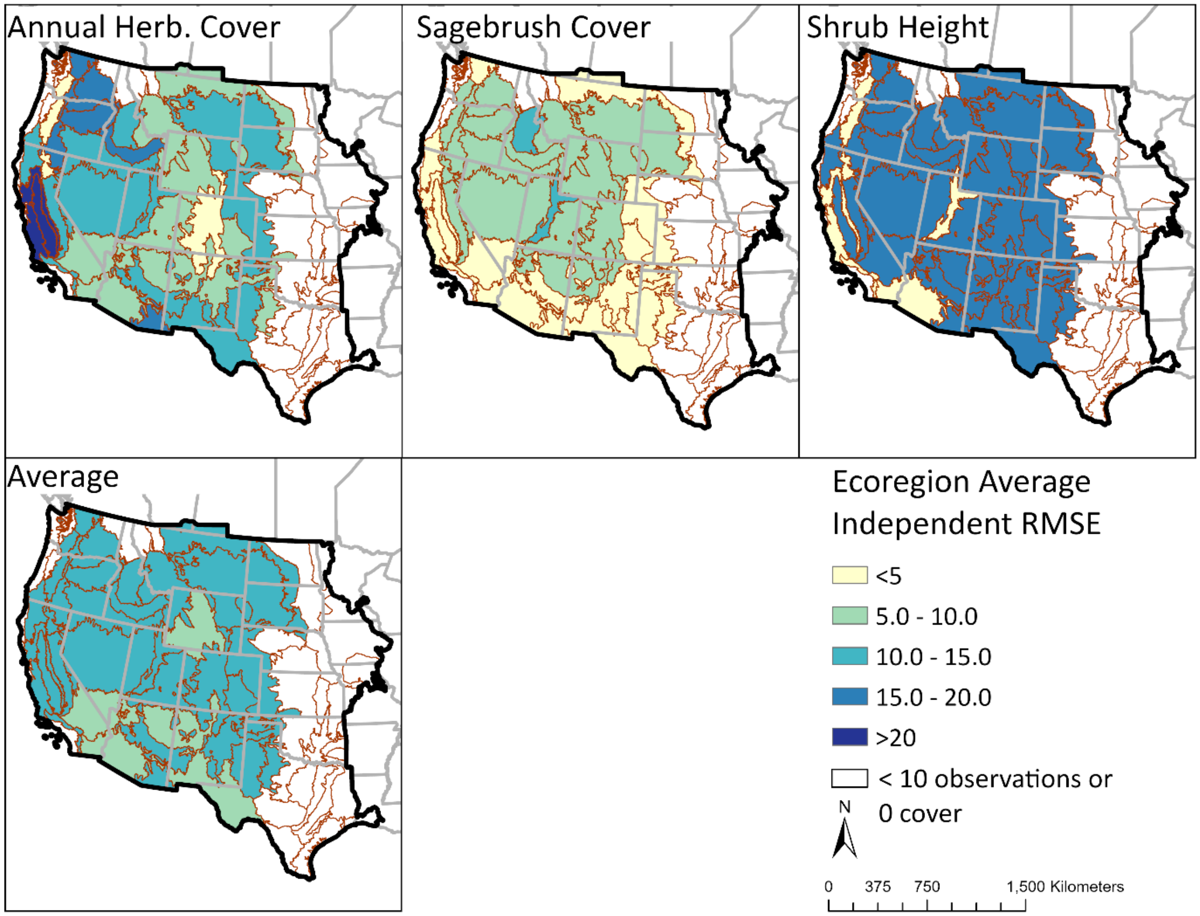

Bare Ground
Herbaceous Cover
Litter Cover
Shrub Cover
Tree Cover
Ecoregion Average
Independent r
<0
0.0 - 0.25
0.25 - 0.50
0.50 - 0.75
0.75 - 1.0
< 10 observations or
0 cover
N
0
375
750
1,500 Kilometers

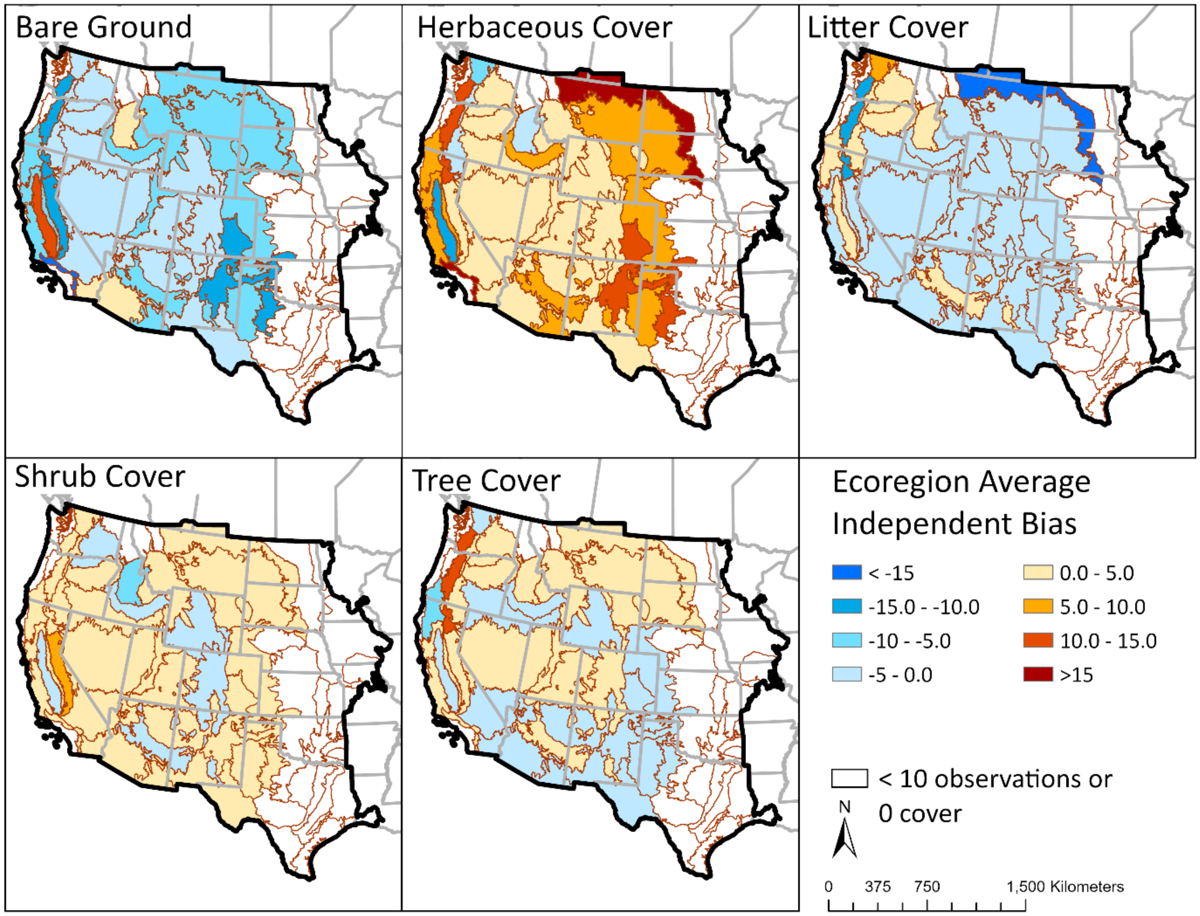


Annual Herb. Cover
Sagebrush Cover
Shrub Height
Average
Ecoregion Average Independent r
<0
0.0 - 0.25
0.25 - 0.50
0.50 - 0.75
0.75 - 1.0
< 10 observations or 0 cover
N
0
375
750
1,500 Kilometers

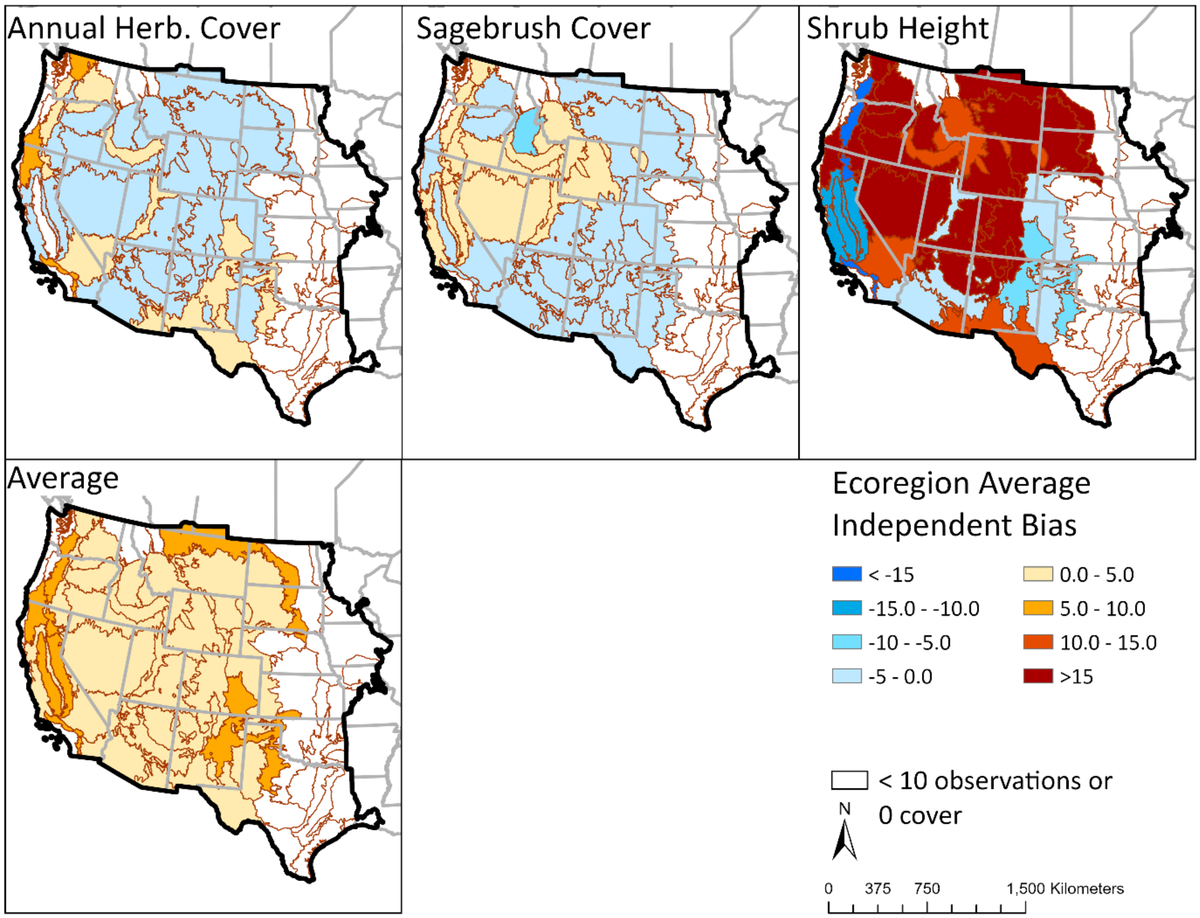


Bare Ground
Herbaceous Cover
Litter Cover
Shrub Cover
Tree Cover
Ecoregion Average
Independent RMSE
<5
5.0 - 10.0
10.0 - 15.0
15.0 - 20.0
>20
< 10 observations or
0 cover
N
0
375
750
1,500 Kilometers


Annual Herb. Cover
Sagebrush Cover
Shrub Height
Average
Ecoregion Average
Independent RMSE
<5
5.0 - 10.0
10.0 - 15.0
15.0 - 20.0
>20
< 10 observations or
0 cover
N
0
375
750
1,500 Kilometers



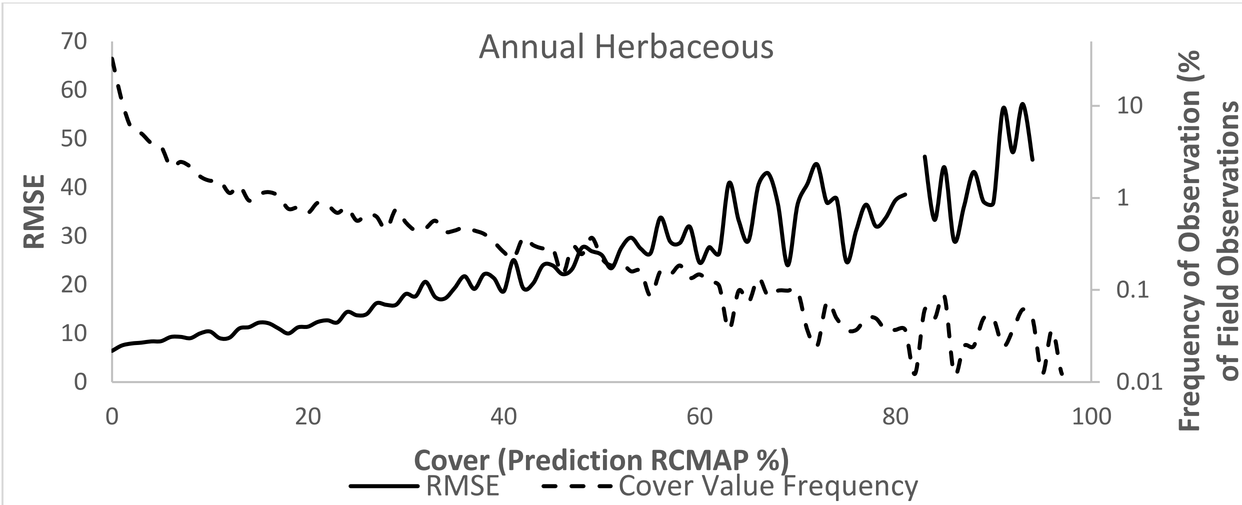
Bias is calculated as RCMAP prediction minus field observation, so positive values indicate overprediction of RCMAP while negative values indicate underprediction.

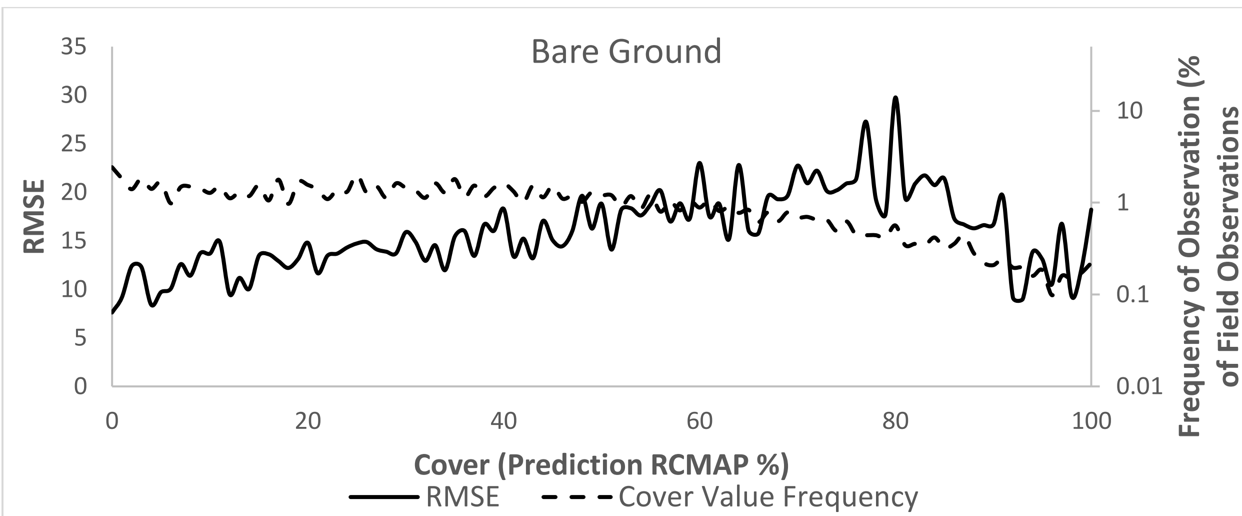


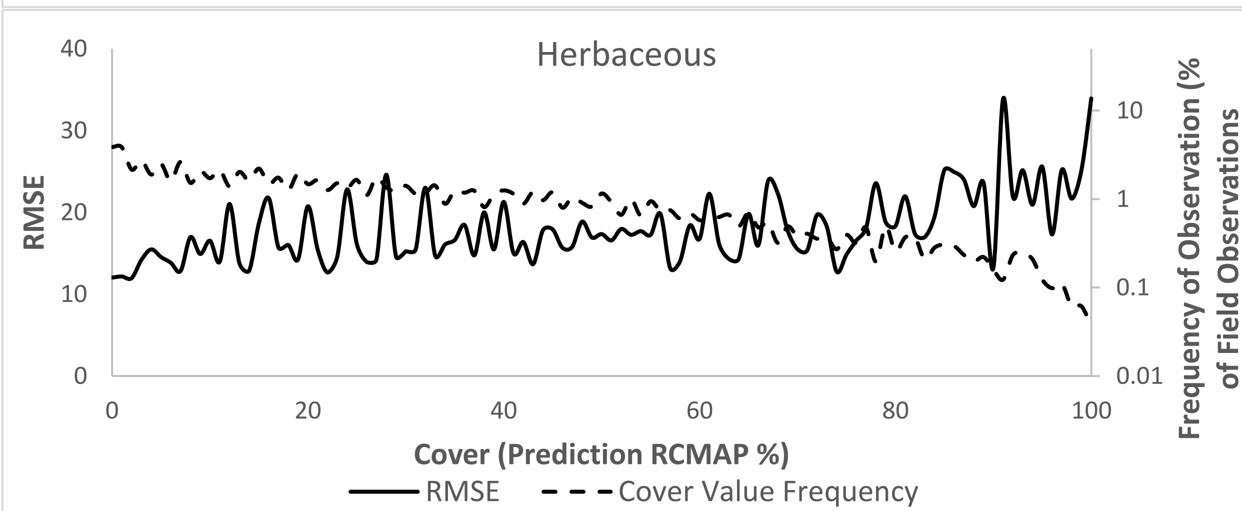
Bias is calculated as RCMAP prediction minus field observation, so positive values indicate overprediction of RCMAP while negative values indicate underprediction.

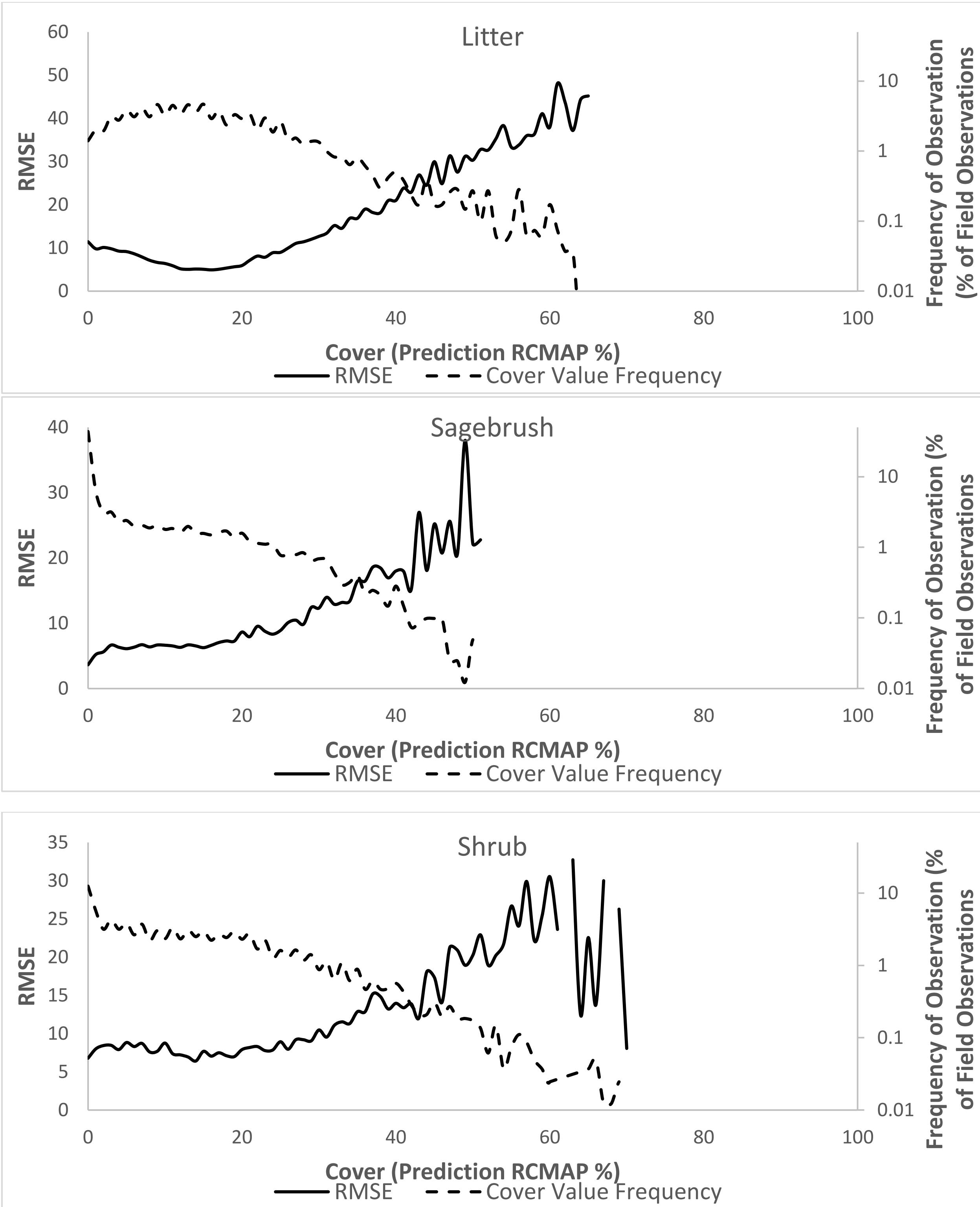
2. **Variation in Accuracy by Component Cover Value**

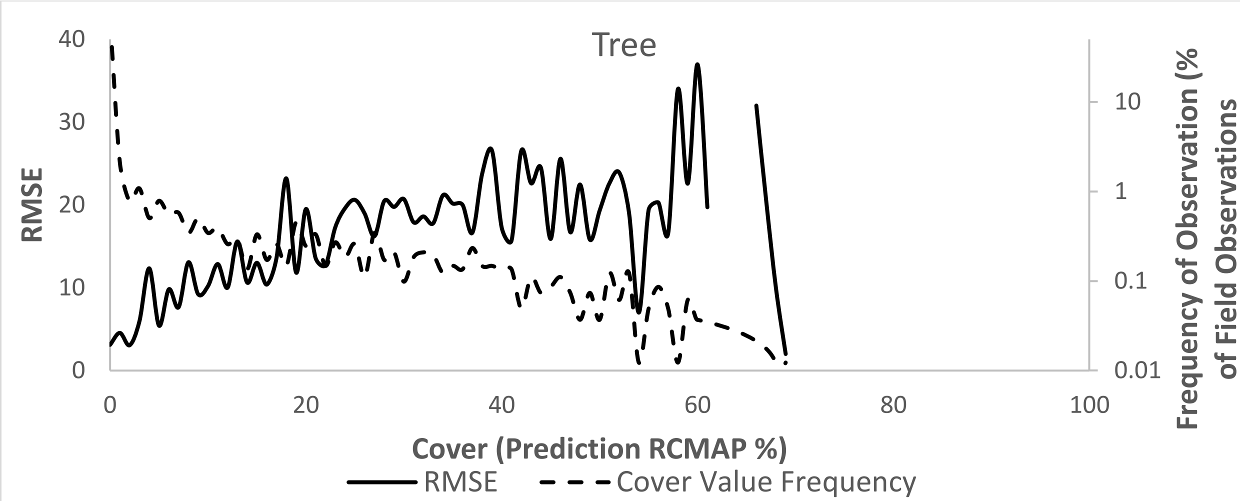
   Using the same set of RCMAP independent data and withheld AIM (n = 7,940), we investigated the variation in RMSE across the range of predicted values by component. Results show accuracy (RMSE) decreases with decreasing frequency of cover values in the field data. In other words, accuracy is higher for more common cover values.

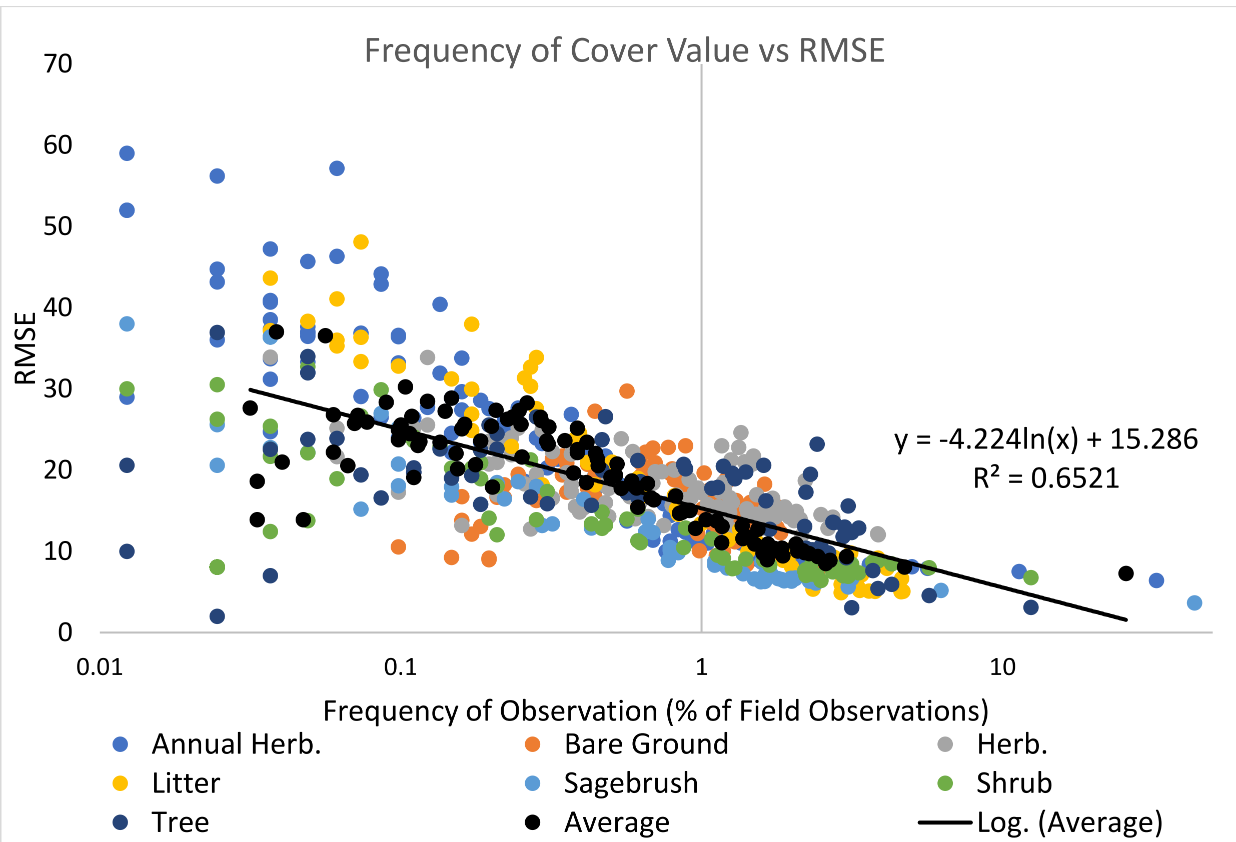

Annual Herbaceous
RMSE
Frequency of Observation (% of Field Observations
Cover (Prediction RCMAP %)
RMSE
Cover Value Frequency
0
10
20
30
40
50
60
70
0.01
0.1
1
10
0
20
40
60
80
100


Bare Ground
RMSE
Frequency of Observation (% of Field Observations
Cover (Prediction RCMAP %)
RMSE
Cover Value Frequency
0
5
10
15
20
25
30
35
0.01
0.1
1
10
0
20
40
60
80
100


Herbaceous
RMSE
Frequency of Observation (% of Field Observations
Cover (Prediction RCMAP %)
RMSE
Cover Value Frequency
0
10
20
30
40
0.01
0.1
1
10
0
20
40
60
80
100

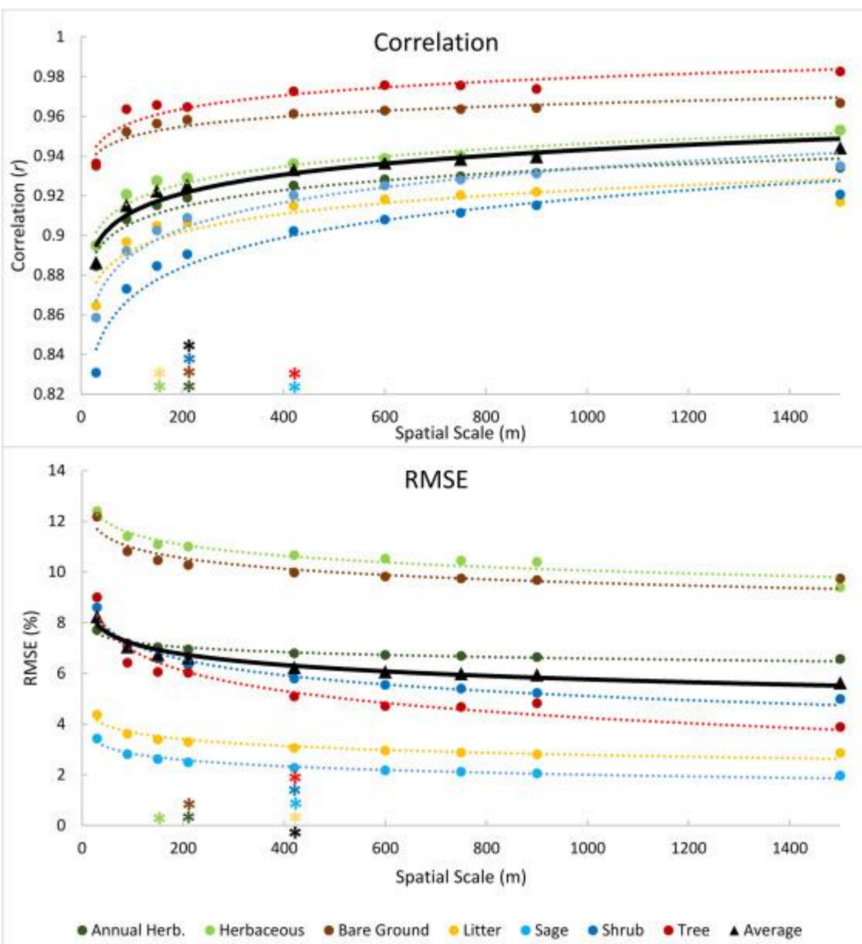

Litter
RMSE
Frequency of Observation (% of Field Observations
Cover (Prediction RCMAP %)
RMSE
Cover Value Frequency
Sagebrush
RMSE
Frequency of Observation (% of Field Observations
Cover (Prediction RCMAP %)
RMSE
Cover Value Frequency
Shrub
RMSE
Frequency of Observation (% of Field Observations
Cover (Prediction RCMAP %)
RMSE
Cover Value Frequency


Tree
RMSE
40
30
20
10
0
0
20
40
60
80
100
Cover (Prediction RCMAP %)
10
1
0.1
0.01
Frequency of Observation (% of Field Observations
RMSE
Cover Value Frequency


Frequency of Cover Value vs RMSE
RMSE
70
60
50
40
30
20
10
0
0.01
0.1
1
10
y = -4.224ln(x) + 15.286
R² = 0.6521
Frequency of Observation (% of Field Observations)
Annual Herb.
Bare Ground
Herb.
Litter
Sagebrush
Shrub
Tree
Average
Log. (Average)

3. Impact of Spatial Scale on Error

A recent paper by Rigge et al. (2025) evaluated the impact of spatial aggregation on the accuracy of RCMAP predictions. Data from high-resolution predictions at 342, ~10 by 10 km, image sites and the overlapping RCMAP predictions were scaled to various focal window sizes ranging from 30 to 1,500 m using focal averaging. Results demonstrated increased accuracy at broader windows, across all components, and most increases in accuracy level off at ∼200–600 m scales. At the scale with highest accuracy, cross-component average correlation (r) increased by 6.5%, and root mean square error (RMSE) was reduced 46.4% relative to 30-m scale data. Scaling-related improvements to accuracy were greatest in components such as shrub and tree with more spatially heterogeneous cover and in ecoregions with more spatially heterogenous cover. The general principle remains that remotely sensed products are intended to address landscape-scale questions (e.g. Allred et al. 2022), our analysis indicates that applying data at finer than landscape spatial scales and grouping even a handful of pixels resulted in lowered error compared to pixel-level comparisons. Note that this analysis was conducted using the prior generation (01172024) of RCMAP predictions, but the general principles remain valid in the current (020282025) generation.



Allred, B.W., Creutzburg, M.K., Carlson, J.C., Cole, C.J., Dovichin, C.M., Duniway, M.C., Jones, M.O., Maestas, J.D., Naugle, D.E., Nauman, T.W. and Okin, G.S., 2022. Guiding principles for using satellite-derived maps in rangeland management. *Rangelands*, *44*(1), pp.78-86. https://doi.org/10.1016/j.rala.2021.09.004

Rigge, M., Bunde, B., McCord, S.E., Harrison, G., Assal, T.J. and Smith, J.L., 2025. Spatial Scale Dependence of Error in Fractional Component Cover Maps. *Rangeland Ecology & Management*, *99*, pp.77-87. https://doi.org/10.1016/j.rama.2025.01.004