KhavrRF\_Micro\_modeltune\_Mn\_RS\_Landsat

Random Forest

47 samples

11 predictors

No pre-processing

Resampling: Bootstrapped (25 reps)

Summary of sample sizes: 47, 47, 47, 47, 47, 47, ...

Resampling results across tuning parameters:

mtry RMSE Rsquared MAE

2 4.864003 0.05614325 3.613889

6 5.043042 0.06922151 3.780928

11 5.184470 0.07114126 3.913102

RMSE was used to select the optimal model using the smallest value.

The final value used for the model was mtry = 2.

goof(observed = RF\_Micro\_Scenario\_models\_dataset$Mn[Training\_RF\_Micro\_scenario], predicted = KhavrRF\_Micro\_Mn\_RS\_Landsat\_Internal , plot.it = TRUE)

R2 concordance MSE RMSE bias

1 0.7006369 0.7451854 5.163106 2.272247 0.1145265

> # externalvalidation

> goof(observed = RF\_Micro\_Scenario\_models\_dataset$Mn[-Training\_RF\_Micro\_scenario], predicted = KhavrRF\_Micro\_Mn\_RS\_Landsat\_\_External , plot.it = TRUE)

R2 concordance MSE RMSE bias

1 -0.2169222 -0.05186831 16.92504 4.114006 0.1832669

#training

> nrmse(KhavrRF\_Micro\_Mn\_RS\_Landsat\_Internal, RF\_Micro\_Scenario\_models\_dataset$Mn[Training\_RF\_Micro\_scenario])

[1] 54.1

> MAPE(KhavrRF\_Micro\_Mn\_RS\_Landsat\_Internal, RF\_Micro\_Scenario\_models\_dataset$Mn[Training\_RF\_Micro\_scenario])

[1] 0.2795664

> ##testing

> nrmse(KhavrRF\_Micro\_Mn\_RS\_Landsat\_\_External, RF\_Micro\_Scenario\_models\_dataset$Mn[-Training\_RF\_Micro\_scenario])

[1] 107.7

> MAPE(KhavrRF\_Micro\_Mn\_RS\_Landsat\_\_External, RF\_Micro\_Scenario\_models\_dataset$Mn[-Training\_RF\_Micro\_scenario])

[1] 0.5351033

KhavrRF\_Micro\_modeltune\_Mn\_RS\_Sentinel

Random Forest

47 samples

16 predictors

No pre-processing

Resampling: Bootstrapped (25 reps)

Summary of sample sizes: 47, 47, 47, 47, 47, 47, ...

Resampling results across tuning parameters:

mtry RMSE Rsquared MAE

2 4.483621 0.04244965 3.396645

9 4.631561 0.04986813 3.530062

16 4.627542 0.05117537 3.544000

RMSE was used to select the optimal model using the smallest value.

The final value used for the model was mtry = 2.

> goof(observed = RF\_Micro\_Scenario\_models\_dataset$Mn[Training\_RF\_Micro\_scenario], predicted = KhavrRF\_Micro\_Mn\_RS\_Sentinel\_Internal , plot.it = TRUE)

R2 concordance MSE RMSE bias

1 0.7079523 0.7552216 5.036938 2.244312 0.0657355

> # externalvalidation

> goof(observed = RF\_Micro\_Scenario\_models\_dataset$Mn[-Training\_RF\_Micro\_scenario], predicted = KhavrRF\_Micro\_Mn\_RS\_Sentinel\_\_External, plot.it = TRUE)

R2 concordance MSE RMSE bias

1 -0.3743038 -0.1565592 19.11392 4.371947 0.2059027

> #training

> nrmse(KhavrRF\_Micro\_Mn\_RS\_Sentinel\_Internal, RF\_Micro\_Scenario\_models\_dataset$Mn[Training\_RF\_Micro\_scenario])

[1] 53.5

> MAPE(KhavrRF\_Micro\_Mn\_RS\_Sentinel\_Internal, RF\_Micro\_Scenario\_models\_dataset$Mn[Training\_RF\_Micro\_scenario])

[1] 0.2501511

> ##testing

> nrmse(KhavrRF\_Micro\_Mn\_RS\_Sentinel\_\_External, RF\_Micro\_Scenario\_models\_dataset$Mn[-Training\_RF\_Micro\_scenario])

[1] 114.4

> MAPE(KhavrRF\_Micro\_Mn\_RS\_Sentinel\_\_External, RF\_Micro\_Scenario\_models\_dataset$Mn[-Training\_RF\_Micro\_scenario])

[1] 0.5791464

KhavrRF\_Micro\_modeltune\_Mn\_RS\_Landsat\_Sentinel

Random Forest

47 samples

27 predictors

No pre-processing

Resampling: Bootstrapped (25 reps)

Summary of sample sizes: 47, 47, 47, 47, 47, 47, ...

Resampling results across tuning parameters:

mtry RMSE Rsquared MAE

2 4.340249 0.06646753 3.281702

14 4.450236 0.05273517 3.401355

27 4.481199 0.04833728 3.441205

RMSE was used to select the optimal model using the smallest value.

The final value used for the model was mtry = 2.

> goof(observed = RF\_Micro\_Scenario\_models\_dataset$Mn[Training\_RF\_Micro\_scenario], predicted = KhavrRF\_Micro\_Mn\_RS\_Landsat\_Sentinel\_Internal , plot.it = TRUE)

R2 concordance MSE RMSE bias

1 0.6959087 0.7407223 5.244653 2.290121 0.07204719

> goof(observed = RF\_Micro\_Scenario\_models\_dataset$Mn[-Training\_RF\_Micro\_scenario], predicted = KhavrRF\_Micro\_Mn\_RS\_Landsat\_Sentinel\_\_External, plot.it = TRUE)

R2 concordance MSE RMSE bias

1 -0.2735009 -0.1099131 17.71194 4.208556 0.1723118

> #training

> nrmse(KhavrRF\_Micro\_Mn\_RS\_Landsat\_Sentinel\_Internal, RF\_Micro\_Scenario\_models\_dataset$Mn[Training\_RF\_Micro\_scenario])

[1] 54.6

> MAPE(KhavrRF\_Micro\_Mn\_RS\_Landsat\_Sentinel\_Internal, RF\_Micro\_Scenario\_models\_dataset$Mn[Training\_RF\_Micro\_scenario])

[1] 0.2627467

> ##testing

> nrmse(KhavrRF\_Micro\_Mn\_RS\_Landsat\_Sentinel\_\_External, RF\_Micro\_Scenario\_models\_dataset$Mn[-Training\_RF\_Micro\_scenario])

[1] 110.1

> MAPE(KhavrRF\_Micro\_Mn\_RS\_Landsat\_Sentinel\_\_External, RF\_Micro\_Scenario\_models\_dataset$Mn[-Training\_RF\_Micro\_scenario])

[1] 0.5497459

|  |
| --- |
| KhavrRF\_Micro\_modeltune\_Mn\_RS\_Topographic  Random Forest  47 samples  34 predictors  No pre-processing  Resampling: Bootstrapped (25 reps)  Summary of sample sizes: 47, 47, 47, 47, 47, 47, ...  Resampling results across tuning parameters:  mtry RMSE Rsquared MAE  2 4.722786 0.05062098 3.580923  18 5.005340 0.04975698 3.844386  34 5.130754 0.06117285 3.958379  RMSE was used to select the optimal model using the smallest value.  The final value used for the model was mtry = 2. |
|  |
| |  | | --- | | > | |

goof(observed = RF\_Micro\_Scenario\_models\_dataset$Mn[Training\_RF\_Micro\_scenario], predicted = KhavrRF\_Micro\_Mn\_RS\_Topographic\_Internal , plot.it = TRUE)

R2 concordance MSE RMSE bias

1 0.7098356 0.7527254 5.004455 2.237064 0.106212

> # externalvalidation

> goof(observed = RF\_Micro\_Scenario\_models\_dataset$Mn[-Training\_RF\_Micro\_scenario], predicted = KhavrRF\_Micro\_Mn\_RS\_Topographic\_\_External, plot.it = TRUE)

R2 concordance MSE RMSE bias

1 -0.2353052 -0.09652083 17.18071 4.144963 0.2281323

#training

> nrmse(KhavrRF\_Micro\_Mn\_RS\_Topographic\_Internal, RF\_Micro\_Scenario\_models\_dataset$Mn[Training\_RF\_Micro\_scenario])

[1] 53.3

> MAPE(KhavrRF\_Micro\_Mn\_RS\_Topographic\_Internal, RF\_Micro\_Scenario\_models\_dataset$Mn[Training\_RF\_Micro\_scenario])

[1] 0.2595243

> ##testing

> nrmse(KhavrRF\_Micro\_Mn\_RS\_Topographic\_\_External, RF\_Micro\_Scenario\_models\_dataset$Mn[-Training\_RF\_Micro\_scenario])

[1] 108.5

> MAPE(KhavrRF\_Micro\_Mn\_RS\_Topographic\_\_External, RF\_Micro\_Scenario\_models\_dataset$Mn[-Training\_RF\_Micro\_scenario])

[1] 0.5513762

KhavrRF\_Micro\_modeltune\_Mn\_RS\_Topographic\_Climate

Random Forest

47 samples

38 predictors

No pre-processing

Resampling: Bootstrapped (25 reps)

Summary of sample sizes: 47, 47, 47, 47, 47, 47, ...

Resampling results across tuning parameters:

mtry RMSE Rsquared MAE

2 4.516786 0.02250125 3.332326

20 4.647706 0.05151425 3.393200

38 4.733629 0.04897640 3.468053

RMSE was used to select the optimal model using the smallest value.

The final value used for the model was mtry = 2.

> goof(observed = RF\_Micro\_Scenario\_models\_dataset$Mn[Training\_RF\_Micro\_scenario], predicted = KhavrRF\_Micro\_Mn\_RS\_Topographic\_Climate\_Internal , plot.it = TRUE)

R2 concordance MSE RMSE bias

1 0.738916 0.7805479 4.502907 2.122005 0.1047086

> # externalvalidation

> goof(observed = RF\_Micro\_Scenario\_models\_dataset$Mn[-Training\_RF\_Micro\_scenario], predicted = KhavrRF\_Micro\_Mn\_RS\_Topographic\_Climate\_\_External, plot.it = TRUE)

R2 concordance MSE RMSE bias

1 -0.0921897 -0.02067063 15.19025 3.897468 0.1167036

> nrmse(KhavrRF\_Micro\_Mn\_RS\_Topographic\_Climate\_Internal, RF\_Micro\_Scenario\_models\_dataset$Mn[Training\_RF\_Micro\_scenario])

[1] 50.5

> MAPE(KhavrRF\_Micro\_Mn\_RS\_Topographic\_Climate\_Internal, RF\_Micro\_Scenario\_models\_dataset$Mn[Training\_RF\_Micro\_scenario])

[1] 0.2443198

> ##testing

> nrmse(KhavrRF\_Micro\_Mn\_RS\_Topographic\_Climate\_\_External, RF\_Micro\_Scenario\_models\_dataset$Mn[-Training\_RF\_Micro\_scenario])

[1] 102

> MAPE(KhavrRF\_Micro\_Mn\_RS\_Topographic\_Climate\_\_External, RF\_Micro\_Scenario\_models\_dataset$Mn[-Training\_RF\_Micro\_scenario])

[1] 0.5275647

KhavrRF\_Micro\_modeltune\_Mn\_RS\_Topographic\_Climate\_Soil

Random Forest

47 samples

41 predictors

No pre-processing

Resampling: Bootstrapped (25 reps)

Summary of sample sizes: 47, 47, 47, 47, 47, 47, ...

Resampling results across tuning parameters:

mtry RMSE Rsquared MAE

2 4.521293 0.04370415 3.341781

21 4.622233 0.07841284 3.269838

41 4.815564 0.07915723 3.337800

RMSE was used to select the optimal model using the smallest value.

The final value used for the model was mtry = 2.

> # Internal validation

> goof(observed = RF\_Micro\_Scenario\_models\_dataset$Mn[Training\_RF\_Micro\_scenario], predicted = KhavrRF\_Micro\_Mn\_RS\_Topographic\_Climate\_Soil\_Internal , plot.it = TRUE)

R2 concordance MSE RMSE bias

1 0.7438379 0.7845476 4.41802 2.101909 0.0667676

> # externalvalidation

> goof(observed = RF\_Micro\_Scenario\_models\_dataset$Mn[-Training\_RF\_Micro\_scenario], predicted = KhavrRF\_Micro\_Mn\_RS\_Topographic\_Climate\_Soil\_\_External, plot.it = TRUE)

R2 concordance MSE RMSE bias

1 -0.04845936 0.008956014 14.58205 3.818645 0.1073983

> nrmse(KhavrRF\_Micro\_Mn\_RS\_Topographic\_Climate\_Soil\_Internal, RF\_Micro\_Scenario\_models\_dataset$Mn[Training\_RF\_Micro\_scenario])

[1] 50.1

> MAPE(KhavrRF\_Micro\_Mn\_RS\_Topographic\_Climate\_Soil\_Internal, RF\_Micro\_Scenario\_models\_dataset$Mn[Training\_RF\_Micro\_scenario])

[1] 0.2342512

> ##testing

> nrmse(KhavrRF\_Micro\_Mn\_RS\_Topographic\_Climate\_Soil\_\_External, RF\_Micro\_Scenario\_models\_dataset$Mn[-Training\_RF\_Micro\_scenario])

[1] 99.9

> MAPE(KhavrRF\_Micro\_Mn\_RS\_Topographic\_Climate\_Soil\_\_External, RF\_Micro\_Scenario\_models\_dataset$Mn[-Training\_RF\_Micro\_scenario])

[1] 0.5127552

KhavrRF\_Micro\_modeltune\_Mn\_Topographic

Random Forest

47 samples

7 predictor

No pre-processing

Resampling: Bootstrapped (25 reps)

Summary of sample sizes: 47, 47, 47, 47, 47, 47, ...

Resampling results across tuning parameters:

mtry RMSE Rsquared MAE

2 4.605364 0.04037626 3.640496

4 4.810116 0.04277724 3.792795

7 4.999196 0.04307982 3.907442

RMSE was used to select the optimal model using the smallest value.

The final value used for the model was mtry = 2.

goof(observed = RF\_Micro\_Scenario\_models\_dataset$Mn[Training\_RF\_Micro\_scenario], predicted = KhavrRF\_Micro\_Mn\_Topographic\_Internal , plot.it = TRUE)

R2 concordance MSE RMSE bias

1 0.702602 0.7459579 5.129213 2.264777 0.1121816

> goof(observed = RF\_Micro\_Scenario\_models\_dataset$Mn[-Training\_RF\_Micro\_scenario], predicted = KhavrRF\_Micro\_Mn\_Topographic\_\_External, plot.it = TRUE)

R2 concordance MSE RMSE bias

1 -0.1173199 -0.005931364 15.53977 3.942051 0.3030875

#training

> nrmse(KhavrRF\_Micro\_Mn\_Topographic\_Internal, RF\_Micro\_Scenario\_models\_dataset$Mn[Training\_RF\_Micro\_scenario])

[1] 54

> MAPE(KhavrRF\_Micro\_Mn\_Topographic\_Internal, RF\_Micro\_Scenario\_models\_dataset$Mn[Training\_RF\_Micro\_scenario])

[1] 0.2817511

> ##testing

> nrmse(KhavrRF\_Micro\_Mn\_Topographic\_\_External, RF\_Micro\_Scenario\_models\_dataset$Mn[-Training\_RF\_Micro\_scenario])

[1] 103.2

> MAPE(KhavrRF\_Micro\_Mn\_Topographic\_\_External, RF\_Micro\_Scenario\_models\_dataset$Mn[-Training\_RF\_Micro\_scenario])

[1] 0.5315657

KhavrRF\_Micro\_modeltune\_Mn\_Climate

Random Forest

47 samples

4 predictor

No pre-processing

Resampling: Bootstrapped (25 reps)

Summary of sample sizes: 47, 47, 47, 47, 47, 47, ...

Resampling results across tuning parameters:

mtry RMSE Rsquared MAE

2 4.309808 0.10704171 3.019858

3 4.461972 0.09101396 3.095229

4 4.557936 0.09031629 3.155536

RMSE was used to select the optimal model using the smallest value.

The final value used for the model was mtry = 2.

|  |
| --- |
| goof(observed = RF\_Micro\_Scenario\_models\_dataset$Mn[Training\_RF\_Micro\_scenario], predicted = KhavrRF\_Micro\_Mn\_Climate\_Internal , plot.it = TRUE)  R2 concordance MSE RMSE bias  1 0.7371447 0.7974139 4.533456 2.129191 0.07440066  > # externalvalidation  > goof(observed = RF\_Micro\_Scenario\_models\_dataset$Mn[-Training\_RF\_Micro\_scenario], predicted = KhavrRF\_Micro\_Mn\_Climate\_External, plot.it = TRUE)  R2 concordance MSE RMSE bias  1 0.07133425 0.267076 12.91595 3.593877 0.109065  > #training  > nrmse(KhavrRF\_Micro\_Mn\_Climate\_Internal, RF\_Micro\_Scenario\_models\_dataset$Mn[Training\_RF\_Micro\_scenario])  [1] 50.7  > MAPE(KhavrRF\_Micro\_Mn\_Climate\_Internal, RF\_Micro\_Scenario\_models\_dataset$Mn[Training\_RF\_Micro\_scenario])  [1] 0.2126379  > ##testing  > nrmse(KhavrRF\_Micro\_Mn\_Climate\_External, RF\_Micro\_Scenario\_models\_dataset$Mn[-Training\_RF\_Micro\_scenario])  [1] 94  > MAPE(KhavrRF\_Micro\_Mn\_Climate\_External, RF\_Micro\_Scenario\_models\_dataset$Mn[-Training\_RF\_Micro\_scenario])  [1] 0.4785707 |
|  |
| KhavrRF\_Micro\_modeltune\_Mn\_Soil  Random Forest  47 samples  4 predictor  No pre-processing  Resampling: Bootstrapped (25 reps)  Summary of sample sizes: 47, 47, 47, 47, 47, 47, ...  Resampling results across tuning parameters:  mtry RMSE Rsquared MAE  2 4.589422 0.10400632 3.315339  3 4.731857 0.10290863 3.410111  4 4.818461 0.09881534 3.454069  RMSE was used to select the optimal model using the smallest value.  The final value used for the model was mtry = 2.   |  | | --- | |  | |

goof(observed = RF\_Micro\_Scenario\_models\_dataset$Mn[Training\_RF\_Micro\_scenario], predicted = KhavrRF\_Micro\_Mn\_Soil\_Internal , plot.it = TRUE)

R2 concordance MSE RMSE bias

1 0.7325141 0.789373 4.613321 2.147864 0.06798289

> # externalvalidation

> goof(observed = RF\_Micro\_Scenario\_models\_dataset$Mn[-Training\_RF\_Micro\_scenario], predicted = KhavrRF\_Micro\_Mn\_Soil\_\_External, plot.it = TRUE)

R2 concordance MSE RMSE bias

1 0.3044147 0.3786006 9.674251 3.110346 0.3155289

#training

> nrmse(KhavrRF\_Micro\_Mn\_Soil\_Internal, RF\_Micro\_Scenario\_models\_dataset$Mn[Training\_RF\_Micro\_scenario])

[1] 51.2

> MAPE(KhavrRF\_Micro\_Mn\_Soil\_Internal, RF\_Micro\_Scenario\_models\_dataset$Mn[Training\_RF\_Micro\_scenario])

[1] 0.2318084

> ##testing

> nrmse(KhavrRF\_Micro\_Mn\_Soil\_\_External, RF\_Micro\_Scenario\_models\_dataset$Mn[-Training\_RF\_Micro\_scenario])

[1] 81.4

> MAPE(KhavrRF\_Micro\_Mn\_Soil\_\_External, RF\_Micro\_Scenario\_models\_dataset$Mn[-Training\_RF\_Micro\_scenario])

[1] 0.4289302

KhavrRF\_Micro\_modeltune\_Mn\_Rec\_Fea\_Elimination

Random Forest

47 samples

10 predictors

No pre-processing

Resampling: Bootstrapped (25 reps)

Summary of sample sizes: 47, 47, 47, 47, 47, 47, ...

Resampling results across tuning parameters:

mtry RMSE Rsquared MAE

2 4.387828 0.07030345 3.057550

6 4.399227 0.09580233 3.012684

10 4.502322 0.10064704 3.072695

RMSE was used to select the optimal model using the smallest value.

The final value used for the model was mtry = 2.

# Internal validation

> KhavrRF\_Micro\_Mn\_Rec\_Fea\_Elimination\_Internal <- predict(KhavrRF\_Micro\_Mn\_Rec\_Fea\_Elimination, newdata = RF\_Micro\_Scenario\_models\_dataset[Training\_RF\_Micro\_scenario, ])

> goof(observed = RF\_Micro\_Scenario\_models\_dataset$Mn[Training\_RF\_Micro\_scenario], predicted = KhavrRF\_Micro\_Mn\_Rec\_Fea\_Elimination\_Internal , plot.it = TRUE)

R2 concordance MSE RMSE bias

1 0.7531434 0.7932033 4.257528 2.063378 0.110063

> # externalvalidation

> goof(observed = RF\_Micro\_Scenario\_models\_dataset$Mn[-Training\_RF\_Micro\_scenario], predicted = KhavrRF\_Micro\_Mn\_Rec\_Fea\_Elimination\_External, plot.it = TRUE)

R2 concordance MSE RMSE bias

1 -0.1335625 0.07030369 15.76567 3.970601 0.4534177

> #training

> nrmse(KhavrRF\_Micro\_Mn\_Rec\_Fea\_Elimination\_Internal, RF\_Micro\_Scenario\_models\_dataset$Mn[Training\_RF\_Micro\_scenario])

[1] 49.2

> MAPE(KhavrRF\_Micro\_Mn\_Rec\_Fea\_Elimination\_Internal, RF\_Micro\_Scenario\_models\_dataset$Mn[Training\_RF\_Micro\_scenario])

[1] 0.2306273

> ##testing

> nrmse(KhavrRF\_Micro\_Mn\_Rec\_Fea\_Elimination\_External, RF\_Micro\_Scenario\_models\_dataset$Mn[-Training\_RF\_Micro\_scenario])

[1] 103.9

> MAPE(KhavrRF\_Micro\_Mn\_Rec\_Fea\_Elimination\_External, RF\_Micro\_Scenario\_models\_dataset$Mn[-Training\_RF\_Micro\_scenario])

[1] 0.5687115