|  |
| --- |
| KhavrRF\_Micro\_modeltune\_Fe\_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 0.7285119 0.04793141 0.5762633  6 0.7410977 0.03386117 0.5836672  11 0.7521459 0.02469768 0.5886620  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$Fe[Training\_RF\_Micro\_scenario], predicted = KhavrRF\_Micro\_Fe\_RS\_Landsat\_Internal , plot.it = TRUE)

R2 concordance MSE RMSE bias

1 0.7566066 0.8016158 0.1023471 0.3199174 0.01476911

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

R2 concordance MSE RMSE bias

1 0.1313149 0.3345446 0.4221281 0.6497139 -0.2732064

> #training

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

[1] 48.8

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

[1] 0.1177173

> ##testing

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

[1] 91

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

[1] 0.1883549

|  |
| --- |
| KhavrRF\_Micro\_modeltune\_Fe\_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 0.6931268 0.03842463 0.5506007  9 0.7055967 0.04685072 0.5527658  16 0.7167472 0.05030849 0.5614369  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$Fe[Training\_RF\_Micro\_scenario], predicted = KhavrRF\_Micro\_Fe\_RS\_Sentinel\_Internal , plot.it = TRUE)

R2 concordance MSE RMSE bias

1 0.7617807 0.8024839 0.1001714 0.3164987 0.005857901

> # externalvalidation

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

R2 concordance MSE RMSE bias

1 0.1239825 0.2407714 0.4256913 0.6524502 -0.1794282

> #training

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

[1] 48.3

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

[1] 0.1220244

##testing

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

[1] 91.3

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

[1] 0.1940415

KhavrRF\_Micro\_modeltune\_Fe\_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 0.6958265 0.02101085 0.5564743

14 0.7204180 0.02951051 0.5738209

27 0.7326162 0.03272336 0.5836834

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$Fe[Training\_RF\_Micro\_scenario], predicted = KhavrRF\_Micro\_Fe\_RS\_Landsat\_Sentinel\_Internal , plot.it = TRUE)

R2 concordance MSE RMSE bias

1 0.7683419 0.8075344 0.09741244 0.3121097 0.004422213

> # externalvalidation

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

R2 concordance MSE RMSE bias

1 0.1696034 0.300564 0.4035223 0.635234 -0.2199298

#training

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

[1] 47.6

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

[1] 0.1165318

> ##testing

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

[1] 88.9

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

[1] 0.1804915

KhavrRF\_Micro\_modeltune\_Fe\_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 0.6410554 0.04415764 0.5123893

18 0.6820457 0.04896128 0.5563741

34 0.7108660 0.04245438 0.5815999

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$Fe[Training\_RF\_Micro\_scenario], predicted = KhavrRF\_Micro\_Fe\_RS\_Topographic\_Internal , plot.it = TRUE)  R2 concordance MSE RMSE bias  1 0.7613938 0.8007485 0.1003341 0.3167556 0.007136014  > # externalvalidation  > goof(observed = RF\_Micro\_Scenario\_models\_dataset$Fe[-Training\_RF\_Micro\_scenario], predicted = KhavrRF\_Micro\_Fe\_RS\_Topographic\_\_External, plot.it = TRUE)  R2 concordance MSE RMSE bias  1 0.1648761 0.2703927 0.4058195 0.6370396 -0.2043616 |
|  |
| |  |  |  |  |  | | --- | --- | --- | --- | --- | | > #training  > nrmse(KhavrRF\_Micro\_Fe\_RS\_Topographic\_Internal, RF\_Micro\_Scenario\_models\_dataset$Fe[Training\_RF\_Micro\_scenario])  [1] 48.3  > MAPE(KhavrRF\_Micro\_Fe\_RS\_Topographic\_Internal, RF\_Micro\_Scenario\_models\_dataset$Fe[Training\_RF\_Micro\_scenario])  [1] 0.1183919  > ##testing  > nrmse(KhavrRF\_Micro\_Fe\_RS\_Topographic\_\_External, RF\_Micro\_Scenario\_models\_dataset$Fe[-Training\_RF\_Micro\_scenario])  [1] 89.2  > MAPE(KhavrRF\_Micro\_Fe\_RS\_Topographic\_\_External, RF\_Micro\_Scenario\_models\_dataset$Fe[-Training\_RF\_Micro\_scenario])  [1] 0.1888224   |  | | --- | | KhavrRF\_Micro\_modeltune\_Fe\_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 0.6444293 0.05079944 0.5303637  20 0.6749598 0.04416977 0.5639133  38 0.6952439 0.04123465 0.5816228  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$Fe[Training\_RF\_Micro\_scenario], predicted = KhavrRF\_Micro\_Fe\_RS\_Topographic\_Climate\_Internal , plot.it = TRUE)  R2 concordance MSE RMSE bias  1 0.7659166 0.8048646 0.09843228 0.3137392 0.0102594  > goof(observed = RF\_Micro\_Scenario\_models\_dataset$Fe[-Training\_RF\_Micro\_scenario], predicted = KhavrRF\_Micro\_Fe\_RS\_Topographic\_Climate\_\_External, plot.it = TRUE)  R2 concordance MSE RMSE bias  1 0.1924325 0.2846398 0.3924287 0.6264413 -0.1949709 | |   > #training  > nrmse(KhavrRF\_Micro\_Fe\_RS\_Topographic\_Climate\_Internal, RF\_Micro\_Scenario\_models\_dataset$Fe[Training\_RF\_Micro\_scenario])  [1] 47.9  > MAPE(KhavrRF\_Micro\_Fe\_RS\_Topographic\_Climate\_Internal, RF\_Micro\_Scenario\_models\_dataset$Fe[Training\_RF\_Micro\_scenario])  [1] 0.1201851  > ##testing  > nrmse(KhavrRF\_Micro\_Fe\_RS\_Topographic\_Climate\_\_External, RF\_Micro\_Scenario\_models\_dataset$Fe[-Training\_RF\_Micro\_scenario])  [1] 87.7  > MAPE(KhavrRF\_Micro\_Fe\_RS\_Topographic\_Climate\_\_External, RF\_Micro\_Scenario\_models\_dataset$Fe[-Training\_RF\_Micro\_scenario])  [1] 0.1827511  KhavrRF\_Micro\_modeltune\_Fe\_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 0.6635125 0.04395813 0.5295392  21 0.6941765 0.03074545 0.5662621  41 0.7052193 0.03629284 0.5774977  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$Fe[Training\_RF\_Micro\_scenario], predicted = KhavrRF\_Micro\_Fe\_RS\_Topographic\_Climate\_Soil\_Internal , plot.it = TRUE)  R2 concordance MSE RMSE bias  1 0.7724995 0.8093591 0.09566414 0.3092962 0.01037987  > # externalvalidation  R2 concordance MSE RMSE bias  1 0.1863161 0.2704298 0.3954009 0.6288091 -0.1824331 |
|  |
| |  | | --- | | > | |

#training

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

[1] 47.2

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

[1] 0.1192327

> ##testing

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

[1] 88

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

[1] 0.1893345

KhavrRF\_Micro\_modeltune\_Fe\_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 0.6628990 0.07826823 0.5276718

4 0.6838791 0.07109694 0.5512073

7 0.7081428 0.06854800 0.5762264

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$Fe[Training\_RF\_Micro\_scenario], predicted = KhavrRF\_Micro\_Fe\_Topographic\_Internal , plot.it = TRUE)

R2 concordance MSE RMSE bias

1 0.7535162 0.7971847 0.1036466 0.321942 0.005848428

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

R2 concordance MSE RMSE bias

1 -0.1740845 0.004994141 0.5705337 0.7553368 -0.1691865

nrmse(KhavrRF\_Micro\_Fe\_Topographic\_Internal, RF\_Micro\_Scenario\_models\_dataset$Fe[Training\_RF\_Micro\_scenario])

[1] 49.1

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

[1] 0.1185174

> ##testing

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

[1] 105.7

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

[1] 0.2361978

KhavrRF\_Micro\_modeltune\_Fe\_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 0.6615847 0.1468394 0.5342894

3 0.6673061 0.1495761 0.5415361

4 0.6736123 0.1485831 0.5470384

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$Fe[Training\_RF\_Micro\_scenario], predicted = KhavrRF\_Micro\_Fe\_Climate\_Internal , plot.it = TRUE)

R2 concordance MSE RMSE bias

1 0.7768138 0.8224759 0.09384998 0.3063494 -0.01104323

> # externalvalidation

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

R2 concordance MSE RMSE bias

1 0.1411916 0.3316344 0.4173287 0.6460098 -0.2551421

#training

> nrmse(KhavrRF\_Micro\_Fe\_Climate\_Internal, RF\_Micro\_Scenario\_models\_dataset$Fe[Training\_RF\_Micro\_scenario])

[1] 46.7

> MAPE(KhavrRF\_Micro\_Fe\_Climate\_Internal, RF\_Micro\_Scenario\_models\_dataset$Fe[Training\_RF\_Micro\_scenario])

[1] 0.1213802

> ##testing

> nrmse(KhavrRF\_Micro\_Fe\_Climate\_\_External, RF\_Micro\_Scenario\_models\_dataset$Fe[-Training\_RF\_Micro\_scenario])

[1] 90.4

> MAPE(KhavrRF\_Micro\_Fe\_Climate\_\_External, RF\_Micro\_Scenario\_models\_dataset$Fe[-Training\_RF\_Micro\_scenario])

[1] 0.1746691

KhavrRF\_Micro\_modeltune\_Fe\_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 0.7035331 0.05439329 0.5608090

3 0.7100183 0.05554795 0.5645761

4 0.7170810 0.05113747 0.5716035

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$Fe[Training\_RF\_Micro\_scenario], predicted = KhavrRF\_Micro\_Fe\_Soil\_Internal , plot.it = TRUE)

R2 concordance MSE RMSE bias

1 0.7744658 0.8169804 0.09483734 0.3079567 0.001496738

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

R2 concordance MSE RMSE bias

1 -0.002027539 0.1601645 0.4869245 0.6977997 -0.09811324

nrmse(KhavrRF\_Micro\_Fe\_Soil\_Internal, RF\_Micro\_Scenario\_models\_dataset$Fe[Training\_RF\_Micro\_scenario])

[1] 47

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

[1] 0.1133496

> ##testing

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

[1] 97.7

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

[1] 0.2391638

KhavrRF\_Micro\_modeltune\_Fe\_Rec\_Fea\_Elimination

Random Forest

47 samples

39 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 0.6615629 0.05995176 0.5283897

20 0.6949430 0.04729588 0.5656414

39 0.7116615 0.05117950 0.5766644

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$Fe[Training\_RF\_Micro\_scenario], predicted = KhavrRF\_Micro\_Fe\_Rec\_Fea\_Elimination\_Internal , plot.it = TRUE)

R2 concordance MSE RMSE bias

1 0.7763208 0.8133798 0.09405728 0.3066876 0.01477287

> # externalvalidation

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

R2 concordance MSE RMSE bias

1 0.2191929 0.3087521 0.3794248 0.6159747 -0.187175

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

[1] 46.8

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

[1] 0.1198965

> ##testing

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

[1] 86.2

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

[1] 0.1787152