KhavrSVR\_Micro\_modeltune\_Mn\_RS\_Landsat

Parameter tuning of ‘svm’:

- sampling method: 10-fold cross validation

- best parameters:

gamma cost

4 1

- best performance: 16.59373

KhavrSVR\_Micro\_Mn\_RS\_Landsat

Call:

svm(formula = Mn ~ b2\_reflectance + b3\_reflectance + b4\_reflectance + b5\_reflectance + b6\_reflectance + b7\_reflectance + ci\_mean\_kh +

gndvi\_mean\_kh + ndvi\_mean\_kh + satind\_mean\_kh + sgsi\_mean\_kh, data = SVR\_Micro\_Scenario\_models\_dataset[Training\_SVR\_Micro\_scenario,

], kernel = "radial", cost = 1, gamma = 4)

Parameters:

SVM-Type: eps-regression

SVM-Kernel: radial

cost: 1

gamma: 4

epsilon: 0.1

Number of Support Vectors: 44

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

R2 concordance MSE RMSE bias

1 0.6668448 0.7337937 5.745916 2.397064 -0.5874423

> # externalvalidation

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

R2 concordance MSE RMSE bias

1 0.04136831 0.08777493 13.33272 3.6514 -0.3973275

|  |
| --- |
| > #training  > nrmse(KhavrSVR\_Micro\_Mn\_RS\_Landsat\_Internal, SVR\_Micro\_Scenario\_models\_dataset$Mn[Training\_SVR\_Micro\_scenario])  [1] 57.1  > MAPE(KhavrSVR\_Micro\_Mn\_RS\_Landsat\_Internal, SVR\_Micro\_Scenario\_models\_dataset$Mn[Training\_SVR\_Micro\_scenario])  [1] 0.1077886  > ##testing  > nrmse(KhavrSVR\_Micro\_Mn\_RS\_Landsat\_External, SVR\_Micro\_Scenario\_models\_dataset$Mn[-Training\_SVR\_Micro\_scenario])  [1] 95.6  > MAPE(KhavrSVR\_Micro\_Mn\_RS\_Landsat\_External, SVR\_Micro\_Scenario\_models\_dataset$Mn[-Training\_SVR\_Micro\_scenario])  [1] 0.4247681 |
|  |
| |  | | --- | | > | |

KhavrSVR\_Micro\_modeltune\_Mn\_RS\_Sentinel

Parameter tuning of ‘svm’:

- sampling method: 10-fold cross validation

- best parameters:

gamma cost

4 1

- best performance: 16.81064

KhavrSVR\_Micro\_Mn\_RS\_Sentinel

Call:

svm(formula = Mn ~ Sen\_B02\_30m\_aoi + Sen\_B03\_Mean\_30m\_aoi + Sen\_B04\_Mean\_30m\_aoi + Sen\_B05\_Mean\_30m\_aoi + Sen\_B06\_Mean\_30m\_aoi +

Sen\_B07\_Mean\_30m\_aoi + Sen\_B08\_Mean\_30m\_aoi + Sen\_B08A\_Mean\_30m\_aoi + Sen\_B11\_Mean\_30m\_aoi + Sen\_B12\_Mean\_30m\_aoi + ClayInd\_Mean\_Sentinel\_khavr +

GNDVI\_Mean\_Sentinel\_khavr + MSAVI2\_Mean\_Sentinel\_khavr + NDVI\_Mean\_Sentinel\_khavr + Saturation\_Mean\_Sentinel\_khavr +

SGSI\_Mean\_Sentinel\_khavr, data = SVR\_Micro\_Scenario\_models\_dataset[Training\_SVR\_Micro\_scenario, ], kernel = "radial",

cost = 1, gamma = 4)

Parameters:

SVM-Type: eps-regression

SVM-Kernel: radial

cost: 1

gamma: 4

epsilon: 0.1

Number of Support Vectors: 45

goof(observed = SVR\_Micro\_Scenario\_models\_dataset$Mn[Training\_SVR\_Micro\_scenario], predicted = KhavrSVR\_Micro\_Mn\_RS\_Sentinel\_Internal , plot.it = TRUE)

R2 concordance MSE RMSE bias

1 0.6963508 0.7576961 5.237027 2.288455 -0.5552987

goof(observed = SVR\_Micro\_Scenario\_models\_dataset$Mn[-Training\_SVR\_Micro\_scenario], predicted = KhavrSVR\_Micro\_Mn\_RS\_Sentinel\_External, plot.it = TRUE)

R2 concordance MSE RMSE bias

1 -0.01846298 -0.001343475 14.16486 3.763623 -0.4760523

|  |
| --- |
| #training  > nrmse(KhavrSVR\_Micro\_Mn\_RS\_Sentinel\_Internal, SVR\_Micro\_Scenario\_models\_dataset$Mn[Training\_SVR\_Micro\_scenario])  [1] 54.5  > MAPE(KhavrSVR\_Micro\_Mn\_RS\_Sentinel\_Internal, SVR\_Micro\_Scenario\_models\_dataset$Mn[Training\_SVR\_Micro\_scenario])  [1] 0.1059064  > ##testing  > nrmse(KhavrSVR\_Micro\_Mn\_RS\_Sentinel\_External, SVR\_Micro\_Scenario\_models\_dataset$Mn[-Training\_SVR\_Micro\_scenario])  [1] 98.5  > MAPE(KhavrSVR\_Micro\_Mn\_RS\_Sentinel\_External, SVR\_Micro\_Scenario\_models\_dataset$Mn[-Training\_SVR\_Micro\_scenario])  [1] 0.4411574 |
|  |
| |  | | --- | | > | |

KhavrSVR\_Micro\_modeltune\_Mn\_RS\_Landsat\_Sentinel

Parameter tuning of ‘svm’:

- sampling method: 10-fold cross validation

- best parameters:

gamma cost

2 4

- best performance: 16.27865

KhavrSVR\_Micro\_Mn\_RS\_Landsat\_Sentinel

Call:

svm(formula = Mn ~ b2\_reflectance + b3\_reflectance + b4\_reflectance + b5\_reflectance + b6\_reflectance + b7\_reflectance +

ci\_mean\_kh + gndvi\_mean\_kh + ndvi\_mean\_kh + satind\_mean\_kh + sgsi\_mean\_kh + Sen\_B02\_30m\_aoi + Sen\_B03\_Mean\_30m\_aoi +

Sen\_B04\_Mean\_30m\_aoi + Sen\_B05\_Mean\_30m\_aoi + Sen\_B06\_Mean\_30m\_aoi + Sen\_B07\_Mean\_30m\_aoi + Sen\_B08\_Mean\_30m\_aoi + Sen\_B08A\_Mean\_30m\_aoi +

Sen\_B11\_Mean\_30m\_aoi + Sen\_B12\_Mean\_30m\_aoi + ClayInd\_Mean\_Sentinel\_khavr + GNDVI\_Mean\_Sentinel\_khavr + MSAVI2\_Mean\_Sentinel\_khavr +

NDVI\_Mean\_Sentinel\_khavr + Saturation\_Mean\_Sentinel\_khavr + SGSI\_Mean\_Sentinel\_khavr, data = SVR\_Micro\_Scenario\_models\_dataset[Training\_SVR\_Micro\_scenario,

], kernel = "radial", cost = 4, gamma = 2)

Parameters:

SVM-Type: eps-regression

SVM-Kernel: radial

cost: 4

gamma: 2

epsilon: 0.1

Number of Support Vectors: 43

goof(observed = SVR\_Micro\_Scenario\_models\_dataset$Mn[Training\_SVR\_Micro\_scenario], predicted = KhavrSVR\_Micro\_Mn\_RS\_Landsat\_Sentinel\_Internal , plot.it = TRUE)

R2 concordance MSE RMSE bias

1 0.9905722 0.9737624 0.1626014 0.4032386 0.09286635

> # externalvalidation

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

R2 concordance MSE RMSE bias

1 0.002965084 0.01410427 13.86683 3.72382 0.2553839

#training

> nrmse(KhavrSVR\_Micro\_Mn\_RS\_Landsat\_Sentinel\_Internal, SVR\_Micro\_Scenario\_models\_dataset$Mn[Training\_SVR\_Micro\_scenario])

[1] 9.6

> MAPE(KhavrSVR\_Micro\_Mn\_RS\_Landsat\_Sentinel\_Internal, SVR\_Micro\_Scenario\_models\_dataset$Mn[Training\_SVR\_Micro\_scenario])

[1] 0.07132884

> ##testing

> nrmse(KhavrSVR\_Micro\_Mn\_RS\_Landsat\_Sentinel\_External, SVR\_Micro\_Scenario\_models\_dataset$Mn[-Training\_SVR\_Micro\_scenario])

[1] 97.4

> MAPE(KhavrSVR\_Micro\_Mn\_RS\_Landsat\_Sentinel\_External, SVR\_Micro\_Scenario\_models\_dataset$Mn[-Training\_SVR\_Micro\_scenario])

[1] 0.5125314

KhavrSVR\_Micro\_modeltune\_Mn\_RS\_Topographic

Parameter tuning of ‘svm’:

- sampling method: 10-fold cross validation

- best parameters:

gamma cost

4 4

- best performance: 16.90645

KhavrSVR\_Micro\_Mn\_RS\_Topographic

Call:

svm(formula = Mn ~ b2\_reflectance + b3\_reflectance + b4\_reflectance + b5\_reflectance + b6\_reflectance + b7\_reflectance +

ci\_mean\_kh + gndvi\_mean\_kh + ndvi\_mean\_kh + satind\_mean\_kh + sgsi\_mean\_kh + Sen\_B02\_30m\_aoi + Sen\_B03\_Mean\_30m\_aoi +

Sen\_B04\_Mean\_30m\_aoi + Sen\_B05\_Mean\_30m\_aoi + Sen\_B06\_Mean\_30m\_aoi + Sen\_B07\_Mean\_30m\_aoi + Sen\_B08\_Mean\_30m\_aoi + Sen\_B08A\_Mean\_30m\_aoi +

Sen\_B11\_Mean\_30m\_aoi + Sen\_B12\_Mean\_30m\_aoi + ClayInd\_Mean\_Sentinel\_khavr + GNDVI\_Mean\_Sentinel\_khavr + MSAVI2\_Mean\_Sentinel\_khavr +

NDVI\_Mean\_Sentinel\_khavr + Saturation\_Mean\_Sentinel\_khavr + SGSI\_Mean\_Sentinel\_khavr + FlowAcc\_kh + PlanCur\_kh + ProflCur\_kh +

slope\_kh + spi\_kh + Twi\_kh + aoi\_dem\_clip\_khavr, data = SVR\_Micro\_Scenario\_models\_dataset[Training\_SVR\_Micro\_scenario,

], kernel = "radial", cost = 4, gamma = 4)

Parameters:

SVM-Type: eps-regression

SVM-Kernel: radial

cost: 4

gamma: 4

epsilon: 0.1

Number of Support Vectors: 43

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

R2 concordance MSE RMSE bias

1 0.9905282 0.9737388 0.1633595 0.4041776 0.08802006

goof(observed = SVR\_Micro\_Scenario\_models\_dataset$Mn[-Training\_SVR\_Micro\_scenario], predicted = KhavrSVR\_Micro\_Mn\_RS\_Topographic\_External, plot.it = TRUE)

R2 concordance MSE RMSE bias

1 -0.002245834 -4.367193e-08 13.93931 3.733538 0.1767331

|  |
| --- |
| #training  > nrmse(KhavrSVR\_Micro\_Mn\_RS\_Topographic\_Internal, SVR\_Micro\_Scenario\_models\_dataset$Mn[Training\_SVR\_Micro\_scenario])  [1] 9.6  > MAPE(KhavrSVR\_Micro\_Mn\_RS\_Topographic\_Internal, SVR\_Micro\_Scenario\_models\_dataset$Mn[Training\_SVR\_Micro\_scenario])  [1] 0.07153671  > ##testing  > nrmse(KhavrSVR\_Micro\_Mn\_RS\_Topographic\_External, SVR\_Micro\_Scenario\_models\_dataset$Mn[-Training\_SVR\_Micro\_scenario])  [1] 97.7  > MAPE(KhavrSVR\_Micro\_Mn\_RS\_Topographic\_External, SVR\_Micro\_Scenario\_models\_dataset$Mn[-Training\_SVR\_Micro\_scenario])  [1] 0.517641 |
|  |
| |  | | --- | | > | |

KhavrSVR\_Micro\_modeltune\_Mn\_RS\_Topographic\_Climate

Parameter tuning of ‘svm’:

- sampling method: 10-fold cross validation

- best parameters:

gamma cost

4 4

- best performance: 16.27503

KhavrSVR\_Micro\_Mn\_RS\_Topographic\_Climate

Call:

svm(formula = Mn ~ b2\_reflectance + b3\_reflectance + b4\_reflectance + b5\_reflectance + b6\_reflectance + b7\_reflectance +

ci\_mean\_kh + gndvi\_mean\_kh + ndvi\_mean\_kh + satind\_mean\_kh + sgsi\_mean\_kh + Sen\_B02\_30m\_aoi + Sen\_B03\_Mean\_30m\_aoi +

Sen\_B04\_Mean\_30m\_aoi + Sen\_B05\_Mean\_30m\_aoi + Sen\_B06\_Mean\_30m\_aoi + Sen\_B07\_Mean\_30m\_aoi + Sen\_B08\_Mean\_30m\_aoi + Sen\_B08A\_Mean\_30m\_aoi +

Sen\_B11\_Mean\_30m\_aoi + Sen\_B12\_Mean\_30m\_aoi + ClayInd\_Mean\_Sentinel\_khavr + GNDVI\_Mean\_Sentinel\_khavr + MSAVI2\_Mean\_Sentinel\_khavr +

NDVI\_Mean\_Sentinel\_khavr + Saturation\_Mean\_Sentinel\_khavr + SGSI\_Mean\_Sentinel\_khavr + FlowAcc\_kh + PlanCur\_kh + ProflCur\_kh +

slope\_kh + spi\_kh + Twi\_kh + aoi\_dem\_clip\_khavr + srad\_khavr + bio\_15\_khavr + bio\_12\_khavr + bio\_1\_khavr, data = SVR\_Micro\_Scenario\_models\_dataset[Training\_SVR\_Micro\_scenario,

], kernel = "radial", cost = 4, gamma = 4)

Parameters:

SVM-Type: eps-regression

SVM-Kernel: radial

cost: 4

gamma: 4

epsilon: 0.1

Number of Support Vectors: 43

goof(observed = SVR\_Micro\_Scenario\_models\_dataset$Mn[Training\_SVR\_Micro\_scenario], predicted = KhavrSVR\_Micro\_Mn\_RS\_Topographic\_Climate\_Internal , plot.it = TRUE)

R2 concordance MSE RMSE bias

1 0.9905246 0.9737368 0.1634214 0.4042541 0.08802007

goof(observed = SVR\_Micro\_Scenario\_models\_dataset$Mn[-Training\_SVR\_Micro\_scenario], predicted = KhavrSVR\_Micro\_Mn\_RS\_Topographic\_Climate\_External, plot.it = TRUE)

R2 concordance MSE RMSE bias

1 -0.002245794 -7.989455e-11 13.93931 3.733538 0.1767333

|  |
| --- |
| #training  > nrmse(KhavrSVR\_Micro\_Mn\_RS\_Topographic\_Climate\_Internal, SVR\_Micro\_Scenario\_models\_dataset$Mn[Training\_SVR\_Micro\_scenario])  [1] 9.6  > MAPE(KhavrSVR\_Micro\_Mn\_RS\_Topographic\_Climate\_Internal, SVR\_Micro\_Scenario\_models\_dataset$Mn[Training\_SVR\_Micro\_scenario])  [1] 0.07154767  > ##testing  > nrmse(KhavrSVR\_Micro\_Mn\_RS\_Topographic\_Climate\_External, SVR\_Micro\_Scenario\_models\_dataset$Mn[-Training\_SVR\_Micro\_scenario])  [1] 97.7  > MAPE(KhavrSVR\_Micro\_Mn\_RS\_Topographic\_Climate\_External, SVR\_Micro\_Scenario\_models\_dataset$Mn[-Training\_SVR\_Micro\_scenario])  [1] 0.517641 |
|  |
| |  | | --- | | > | |

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

Parameter tuning of ‘svm’:

- sampling method: 10-fold cross validation

- best parameters:

gamma cost

4 4

- best performance: 16.49747

KhavrSVR\_Micro\_Mn\_RS\_Topographic\_Climate\_Soil

Call:

svm(formula = Mn ~ b2\_reflectance + b3\_reflectance + b4\_reflectance + b5\_reflectance + b6\_reflectance + b7\_reflectance +

ci\_mean\_kh + gndvi\_mean\_kh + ndvi\_mean\_kh + satind\_mean\_kh + sgsi\_mean\_kh + Sen\_B02\_30m\_aoi + Sen\_B03\_Mean\_30m\_aoi +

Sen\_B04\_Mean\_30m\_aoi + Sen\_B05\_Mean\_30m\_aoi + Sen\_B06\_Mean\_30m\_aoi + Sen\_B07\_Mean\_30m\_aoi + Sen\_B08\_Mean\_30m\_aoi + Sen\_B08A\_Mean\_30m\_aoi +

Sen\_B11\_Mean\_30m\_aoi + Sen\_B12\_Mean\_30m\_aoi + ClayInd\_Mean\_Sentinel\_khavr + GNDVI\_Mean\_Sentinel\_khavr + MSAVI2\_Mean\_Sentinel\_khavr +

NDVI\_Mean\_Sentinel\_khavr + Saturation\_Mean\_Sentinel\_khavr + SGSI\_Mean\_Sentinel\_khavr + FlowAcc\_kh + PlanCur\_kh + ProflCur\_kh +

slope\_kh + spi\_kh + Twi\_kh + aoi\_dem\_clip\_khavr + srad\_khavr + bio\_15\_khavr + bio\_12\_khavr + bio\_1\_khavr + Clay\_khavr +

pH\_khavr + Sand\_khavr, data = SVR\_Micro\_Scenario\_models\_dataset[Training\_SVR\_Micro\_scenario, ], kernel = "radial", cost = 4,

gamma = 4)

Parameters:

SVM-Type: eps-regression

SVM-Kernel: radial

cost: 4

gamma: 4

epsilon: 0.1

Number of Support Vectors: 43

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

R2 concordance MSE RMSE bias

1 0.9905299 0.9737398 0.1633304 0.4041415 0.08802007

> # externalvalidation

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

R2 concordance MSE RMSE bias

1 -0.002245794 -3.517129e-11 13.93931 3.733538 0.1767333

> #training

> nrmse(KhavrSVR\_Micro\_Mn\_RS\_Topographic\_Climate\_Soil\_Internal, SVR\_Micro\_Scenario\_models\_dataset$Mn[Training\_SVR\_Micro\_scenario])

[1] 9.6

> MAPE(KhavrSVR\_Micro\_Mn\_RS\_Topographic\_Climate\_Soil\_Internal, SVR\_Micro\_Scenario\_models\_dataset$Mn[Training\_SVR\_Micro\_scenario])

[1] 0.071527

> ##testing

> nrmse(KhavrSVR\_Micro\_Mn\_RS\_Topographic\_Climate\_Soil\_External, SVR\_Micro\_Scenario\_models\_dataset$Mn[-Training\_SVR\_Micro\_scenario])

[1] 97.7

> MAPE(KhavrSVR\_Micro\_Mn\_RS\_Topographic\_Climate\_Soil\_External, SVR\_Micro\_Scenario\_models\_dataset$Mn[-Training\_SVR\_Micro\_scenario])

[1] 0.517641

KhavrSVR\_Micro\_modeltune\_Mn\_Topographic

Parameter tuning of ‘svm’:

- sampling method: 10-fold cross validation

- best parameters:

gamma cost

0.25 0.125

- best performance: 17.84561

KhavrSVR\_Micro\_Mn\_Topographic

Call:

svm(formula = Mn ~ FlowAcc\_kh + PlanCur\_kh + ProflCur\_kh + slope\_kh + spi\_kh + Twi\_kh + aoi\_dem\_clip\_khavr, data = SVR\_Micro\_Scenario\_models\_dataset[Training\_SVR\_Micro\_scenario,

], kernel = "radial", cost = 0.125, gamma = 0.25)

Parameters:

SVM-Type: eps-regression

SVM-Kernel: radial

cost: 0.125

gamma: 0.25

epsilon: 0.1

Number of Support Vectors: 42

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

R2 concordance MSE RMSE bias

1 0.0187069 0.1104939 16.92433 4.113919 -1.246825

> # externalvalidation

> goof(observed = SVR\_Micro\_Scenario\_models\_dataset$Mn[-Training\_SVR\_Micro\_scenario], predicted = KhavrSVR\_Micro\_Mn\_Topographic\_External, plot.it = TRUE)

R2 concordance MSE RMSE bias

1 -0.0798837 0.02637511 15.0191 3.875448 -1.186999

#training

> nrmse(KhavrSVR\_Micro\_Mn\_Topographic\_Internal, SVR\_Micro\_Scenario\_models\_dataset$Mn[Training\_SVR\_Micro\_scenario])

[1] 98

> MAPE(KhavrSVR\_Micro\_Mn\_Topographic\_Internal, SVR\_Micro\_Scenario\_models\_dataset$Mn[Training\_SVR\_Micro\_scenario])

[1] 0.3446299

> ##testing

> nrmse(KhavrSVR\_Micro\_Mn\_Topographic\_External, SVR\_Micro\_Scenario\_models\_dataset$Mn[-Training\_SVR\_Micro\_scenario])

[1] 101.4

> MAPE(KhavrSVR\_Micro\_Mn\_Topographic\_External, SVR\_Micro\_Scenario\_models\_dataset$Mn[-Training\_SVR\_Micro\_scenario])

[1] 0.3814905

KhavrSVR\_Micro\_modeltune\_Mn\_Climate

Parameter tuning of ‘svm’:

- sampling method: 10-fold cross validation

- best parameters:

gamma cost

0.25 0.5

- best performance: 17.01552

KhavrSVR\_Micro\_Mn\_Climate

Call:

svm(formula = Mn ~ srad\_khavr + bio\_15\_khavr + bio\_12\_khavr + bio\_1\_khavr, data = SVR\_Micro\_Scenario\_models\_dataset[Training\_SVR\_Micro\_scenario,

], kernel = "radial", cost = 0.5, gamma = 0.25)

Parameters:

SVM-Type: eps-regression

SVM-Kernel: radial

cost: 0.5

gamma: 0.25

epsilon: 0.1

Number of Support Vectors: 41

> # Internal validation

> goof(observed = SVR\_Micro\_Scenario\_models\_dataset$Mn[Training\_SVR\_Micro\_scenario], predicted = KhavrSVR\_Micro\_Mn\_Climate\_Internal , plot.it = TRUE)

R2 concordance MSE RMSE bias

1 0.2518557 0.3737148 12.90322 3.592105 -0.956185

> # externalvalidation

> goof(observed = SVR\_Micro\_Scenario\_models\_dataset$Mn[-Training\_SVR\_Micro\_scenario], predicted = KhavrSVR\_Micro\_Mn\_Climate\_External, plot.it = TRUE)

R2 concordance MSE RMSE bias

1 0.02966161 0.1854568 13.49554 3.673627 -0.8945419

#training

> nrmse(KhavrSVR\_Micro\_Mn\_Climate\_Internal, SVR\_Micro\_Scenario\_models\_dataset$Mn[Training\_SVR\_Micro\_scenario])

[1] 85.6

> MAPE(KhavrSVR\_Micro\_Mn\_Climate\_Internal, SVR\_Micro\_Scenario\_models\_dataset$Mn[Training\_SVR\_Micro\_scenario])

[1] 0.252749

> ##testing

> nrmse(KhavrSVR\_Micro\_Mn\_Climate\_External, SVR\_Micro\_Scenario\_models\_dataset$Mn[-Training\_SVR\_Micro\_scenario])

[1] 96.1

> MAPE(KhavrSVR\_Micro\_Mn\_Climate\_External, SVR\_Micro\_Scenario\_models\_dataset$Mn[-Training\_SVR\_Micro\_scenario])

[1] 0.4116081

KhavrSVR\_Micro\_modeltune\_Mn\_Soil

Parameter tuning of ‘svm’:

- sampling method: 10-fold cross validation

- best parameters:

gamma cost

0.25 4

- best performance: 14.23139

KhavrSVR\_Micro\_Mn\_Soil

Call:

svm(formula = Mn ~ b2\_reflectance + Clay\_khavr + pH\_khavr + Sand\_khavr, data = SVR\_Micro\_Scenario\_models\_dataset[Training\_SVR\_Micro\_scenario,

], kernel = "radial", cost = 4, gamma = 0.25)

Parameters:

SVM-Type: eps-regression

SVM-Kernel: radial

cost: 4

gamma: 0.25

epsilon: 0.1

Number of Support Vectors: 39

# Internal validation

> goof(observed = SVR\_Micro\_Scenario\_models\_dataset$Mn[Training\_SVR\_Micro\_scenario], predicted = KhavrSVR\_Micro\_Mn\_Soil\_Internal , plot.it = TRUE)

R2 concordance MSE RMSE bias

1 0.5628221 0.6735758 7.539992 2.745905 -0.5907874

> # externalvalidation

> goof(observed = SVR\_Micro\_Scenario\_models\_dataset$Mn[-Training\_SVR\_Micro\_scenario], predicted = KhavrSVR\_Micro\_Mn\_Soil\_External, plot.it = TRUE)

R2 concordance MSE RMSE bias

1 0.01239034 0.2093694 13.73575 3.706177 -0.6311608

#training

> nrmse(KhavrSVR\_Micro\_Mn\_Soil\_Internal, SVR\_Micro\_Scenario\_models\_dataset$Mn[Training\_SVR\_Micro\_scenario])

[1] 65.4

> MAPE(KhavrSVR\_Micro\_Mn\_Soil\_Internal, SVR\_Micro\_Scenario\_models\_dataset$Mn[Training\_SVR\_Micro\_scenario])

[1] 0.1916288

> ##testing

> nrmse(KhavrSVR\_Micro\_Mn\_Soil\_External, SVR\_Micro\_Scenario\_models\_dataset$Mn[-Training\_SVR\_Micro\_scenario])

[1] 97

> MAPE(KhavrSVR\_Micro\_Mn\_Soil\_External, SVR\_Micro\_Scenario\_models\_dataset$Mn[-Training\_SVR\_Micro\_scenario])

[1] 0.398915

KhavrSVR\_Micro\_modeltune\_Mn\_Rec\_Fea\_Elimination

Parameter tuning of ‘svm’:

- sampling method: 10-fold cross validation

- best parameters:

gamma cost

4 4

- best performance: 16.96949

KhavrSVR\_Micro\_Mn\_Rec\_Fea\_Elimination

Call:

svm(formula = Mn ~ b6\_reflectance + ci\_mean\_kh + ndvi\_mean\_kh + sgsi\_mean\_kh + Twi\_kh + Sen\_B02\_30m\_aoi + Sen\_B08\_Mean\_30m\_aoi +

Sen\_B12\_Mean\_30m\_aoi + GNDVI\_Mean\_Sentinel\_khavr + pH\_khavr, data = SVR\_Micro\_Scenario\_models\_dataset[Training\_SVR\_Micro\_scenario,

], kernel = "radial", cost = 4, gamma = 4)

Parameters:

SVM-Type: eps-regression

SVM-Kernel: radial

cost: 4

gamma: 4

epsilon: 0.1

Number of Support Vectors: 43

# Internal validation

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

R2 concordance MSE RMSE bias

1 0.9905259 0.9737374 0.1633999 0.4042275 0.08879741

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

R2 concordance MSE RMSE bias

1 -0.01665571 -0.006374412 14.13972 3.760282 0.2410724

#training

> nrmse(KhavrSVR\_Micro\_Mn\_Rec\_Fea\_Elimination\_Internal, SVR\_Micro\_Scenario\_models\_dataset$Mn[Training\_SVR\_Micro\_scenario])

[1] 9.6

> MAPE(KhavrSVR\_Micro\_Mn\_Rec\_Fea\_Elimination\_Internal, SVR\_Micro\_Scenario\_models\_dataset$Mn[Training\_SVR\_Micro\_scenario])

[1] 0.07154276

> ##testing

> nrmse(KhavrSVR\_Micro\_Mn\_Rec\_Fea\_Elimination\_External, SVR\_Micro\_Scenario\_models\_dataset$Mn[-Training\_SVR\_Micro\_scenario])

[1] 98.4

> MAPE(KhavrSVR\_Micro\_Mn\_Rec\_Fea\_Elimination\_External, SVR\_Micro\_Scenario\_models\_dataset$Mn[-Training\_SVR\_Micro\_scenario])

[1] 0.5216468