KhavrSVR\_Micro\_modeltune\_Zn\_RS\_Landsat

Parameter tuning of ‘svm’:

- sampling method: 10-fold cross validation

- best parameters:

gamma cost

2 2

- best performance: 14.50995

KhavrSVR\_Micro\_Zn\_RS\_Landsat

Call:

svm(formula = Zn ~ 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 = 2, gamma = 2)

Parameters:

SVM-Type: eps-regression

SVM-Kernel: radial

cost: 2

gamma: 2

epsilon: 0.1

Number of Support Vectors: 42

|  |
| --- |
| oof(observed = SVR\_Micro\_Scenario\_models\_dataset$Zn[Training\_SVR\_Micro\_scenario], predicted = KhavrSVR\_Micro\_Zn\_RS\_Landsat\_Internal , plot.it = TRUE)  R2 concordance MSE RMSE bias  1 0.946967 0.9474451 0.6742392 0.8211207 0.0183607  > # externalvalidation  > goof(observed = SVR\_Micro\_Scenario\_models\_dataset$Zn[-Training\_SVR\_Micro\_scenario], predicted = KhavrSVR\_Micro\_Zn\_RS\_Landsat\_External , plot.it = TRUE)  R2 concordance MSE RMSE bias  1 -0.03840297 0.03377423 17.72342 4.209919 -0.6987909  > #training  > nrmse(KhavrSVR\_Micro\_Zn\_RS\_Landsat\_Internal, SVR\_Micro\_Scenario\_models\_dataset$Zn[Training\_SVR\_Micro\_scenario])  [1] 22.8  > MAPE(KhavrSVR\_Micro\_Zn\_RS\_Landsat\_Internal, SVR\_Micro\_Scenario\_models\_dataset$Zn[Training\_SVR\_Micro\_scenario])  [1] 0.4488702  > ##testing  > nrmse(KhavrSVR\_Micro\_Zn\_RS\_Landsat\_External, SVR\_Micro\_Scenario\_models\_dataset$Zn[-Training\_SVR\_Micro\_scenario])  [1] 99.4  > MAPE(KhavrSVR\_Micro\_Zn\_RS\_Landsat\_External, SVR\_Micro\_Scenario\_models\_dataset$Zn[-Training\_SVR\_Micro\_scenario])  [1] 2.182761 |
|  |
| |  | | --- | | > | |

KhavrSVR\_Micro\_modeltune\_Zn\_RS\_Sentinel

Parameter tuning of ‘svm’:

- sampling method: 10-fold cross validation

- best parameters:

gamma cost

4 4

- best performance: 14.59173

KhavrSVR\_Micro\_Zn\_RS\_Sentinel

Call:

svm(formula = Zn ~ 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 = 4)

Parameters:

SVM-Type: eps-regression

SVM-Kernel: radial

cost: 4

gamma: 4

epsilon: 0.1

Number of Support Vectors: 45

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

R2 concordance MSE RMSE bias

1 0.9899312 0.9734383 0.1280102 0.3577851 0.1882403

> # externalvalidation

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

R2 concordance MSE RMSE bias

1 -0.00607314 0.0006118842 17.17161 4.143865 -0.3293043

#training

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

[1] 9.9

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

[1] 0.4395897

> ##testing

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

[1] 97.9

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

[1] 2.599695

KhavrSVR\_Micro\_modeltune\_Zn\_RS\_Landsat\_Sentinel

Parameter tuning of ‘svm’:

- sampling method: 10-fold cross validation

- best parameters:

gamma cost

0.5 8

- best performance: 14.34724

KhavrSVR\_Micro\_Zn\_RS\_Landsat\_Sentinel

Call:

svm(formula = Zn ~ 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 = 8, gamma = 0.5)

Parameters:

SVM-Type: eps-regression

SVM-Kernel: radial

cost: 8

gamma: 0.5

epsilon: 0.1

Number of Support Vectors: 45

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

R2 concordance MSE RMSE bias

1 0.9899873 0.9734704 0.1272969 0.356787 0.1777043

> # externalvalidation

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

R2 concordance MSE RMSE bias

1 0.04312458 0.07900882 16.33191 4.041276 -0.4027641

> #training

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

[1] 9.9

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

[1] 0.4387069

> ##testing

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

[1] 95.5

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

[1] 2.321665

KhavrSVR\_Micro\_modeltune\_Zn\_RS\_Topographic

Parameter tuning of ‘svm’:

- sampling method: 10-fold cross validation

- best parameters:

gamma cost

0.25 4

- best performance: 13.57672

KhavrSVR\_Micro\_Zn\_RS\_Topographic

Call:

svm(formula = Zn ~ 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 = 0.25)

Parameters:

SVM-Type: eps-regression

SVM-Kernel: radial

cost: 4

gamma: 0.25

epsilon: 0.1

Number of Support Vectors: 46

|  |
| --- |
| goof(observed = SVR\_Micro\_Scenario\_models\_dataset$Zn[Training\_SVR\_Micro\_scenario], predicted = KhavrSVR\_Micro\_Zn\_RS\_Topographic\_Internal , plot.it = TRUE)  R2 concordance MSE RMSE bias  1 0.9899773 0.973462 0.1274248 0.3569662 0.1865665  > # externalvalidation  > goof(observed = SVR\_Micro\_Scenario\_models\_dataset$Zn[-Training\_SVR\_Micro\_scenario], predicted = KhavrSVR\_Micro\_Zn\_RS\_Topographic\_External, plot.it = TRUE)  R2 concordance MSE RMSE bias  1 0.04571692 0.06806624 16.28766 4.035798 -0.4982981 |
|  |
| > #training  > nrmse(KhavrSVR\_Micro\_Zn\_RS\_Topographic\_Internal, SVR\_Micro\_Scenario\_models\_dataset$Zn[Training\_SVR\_Micro\_scenario])  [1] 9.9  > MAPE(KhavrSVR\_Micro\_Zn\_RS\_Topographic\_Internal, SVR\_Micro\_Scenario\_models\_dataset$Zn[Training\_SVR\_Micro\_scenario])  [1] 0.4389675  > ##testing  > nrmse(KhavrSVR\_Micro\_Zn\_RS\_Topographic\_External, SVR\_Micro\_Scenario\_models\_dataset$Zn[-Training\_SVR\_Micro\_scenario])  [1] 95.3  > MAPE(KhavrSVR\_Micro\_Zn\_RS\_Topographic\_External, SVR\_Micro\_Scenario\_models\_dataset$Zn[-Training\_SVR\_Micro\_scenario])  [1] 2.18056 |

KhavrSVR\_Micro\_modeltune\_Zn\_RS\_Topographic\_Climate

Parameter tuning of ‘svm’:

- sampling method: 10-fold cross validation

- best parameters:

gamma cost

0.25 4

- best performance: 14.30255

KhavrSVR\_Micro\_Zn\_RS\_Topographic\_Climate

Call:

svm(formula = Zn ~ 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 = 0.25)

Parameters:

SVM-Type: eps-regression

SVM-Kernel: radial

cost: 4

gamma: 0.25

epsilon: 0.1

Number of Support Vectors: 46

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

R2 concordance MSE RMSE bias

1 0.989923 0.973435 0.1281143 0.3579306 0.1890811

> # externalvalidation

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

R2 concordance MSE RMSE bias

1 0.01998128 0.03015067 16.72692 4.089856 -0.3289946

#training

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

[1] 9.9

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

[1] 0.4397795

> ##testing

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

[1] 96.6

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

[1] 2.429856

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

Parameter tuning of ‘svm’:

- sampling method: 10-fold cross validation

- best parameters:

gamma cost

0.25 4

- best performance: 13.85519

KhavrSVR\_Micro\_Zn\_RS\_Topographic\_Climate\_Soil

Call:

svm(formula = Zn ~ 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 = 0.25)

Parameters:

SVM-Type: eps-regression

SVM-Kernel: radial

cost: 4

gamma: 0.25

epsilon: 0.1

Number of Support Vectors: 46

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

R2 concordance MSE RMSE bias

1 0.989919 0.9734322 0.1281649 0.3580012 0.1887117

> # externalvalidation

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

R2 concordance MSE RMSE bias

1 0.0303884 0.03814501 16.54929 4.068082 -0.3192144

#training

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

[1] 9.9

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

[1] 0.4398713

> ##testing

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

[1] 96.1

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

[1] 2.438404

KhavrSVR\_Micro\_modeltune\_Zn\_Topographic

Parameter tuning of ‘svm’:

- sampling method: 10-fold cross validation

- best parameters:

gamma cost

2 2

- best performance: 13.78853

KhavrSVR\_Micro\_Zn\_Topographic

Call:

svm(formula = Zn ~ 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 = 2, gamma = 2)

Parameters:

SVM-Type: eps-regression

SVM-Kernel: radial

cost: 2

gamma: 2

epsilon: 0.1

Number of Support Vectors: 45

|  |
| --- |
| goof(observed = SVR\_Micro\_Scenario\_models\_dataset$Zn[Training\_SVR\_Micro\_scenario], predicted = KhavrSVR\_Micro\_Zn\_Topographic\_Internal , plot.it = TRUE)  R2 concordance MSE RMSE bias  1 0.9604613 0.9559152 0.5026776 0.7089976 0.06838844  > # externalvalidation  > goof(observed = SVR\_Micro\_Scenario\_models\_dataset$Zn[-Training\_SVR\_Micro\_scenario], predicted = KhavrSVR\_Micro\_Zn\_Topographic\_External, plot.it = TRUE)  R2 concordance MSE RMSE bias  1 0.0696462 0.1137047 15.87924 3.984876 -0.6145591 |
|  |
| |  | | --- | | > | |

#training

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

[1] 19.7

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

[1] 0.4484286

> ##testing

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

[1] 94.1

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

[1] 2.183178

KhavrSVR\_Micro\_modeltune\_Zn\_Climate

Parameter tuning of ‘svm’:

- sampling method: 10-fold cross validation

- best parameters:

gamma cost

0.25 4

- best performance: 10.36481

KhavrSVR\_Micro\_Zn\_Climate <- svm(Zn ~ 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=0.25)

> KhavrSVR\_Micro\_Zn\_Climate

Call:

svm(formula = Zn ~ 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 = 0.25)

Parameters:

SVM-Type: eps-regression

SVM-Kernel: radial

cost: 4

gamma: 0.25

epsilon: 0.1

Number of Support Vectors: 40

|  |
| --- |
| # Internal validation  > goof(observed = SVR\_Micro\_Scenario\_models\_dataset$Zn[Training\_SVR\_Micro\_scenario], predicted = KhavrSVR\_Micro\_Zn\_Climate\_Internal , plot.it = TRUE)  R2 concordance MSE RMSE bias  1 0.7074757 0.7978903 3.719028 1.928478 -0.4758399  > # externalvalidation  > goof(observed = SVR\_Micro\_Scenario\_models\_dataset$Zn[-Training\_SVR\_Micro\_scenario], predicted = KhavrSVR\_Micro\_Zn\_Climate\_External, plot.it = TRUE)  R2 concordance MSE RMSE bias  1 0.1218117 0.2770433 14.98888 3.871548 -0.9950159 |
|  |
| |  | | --- | | > | |

#training

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

[1] 53.5

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

[1] 0.6805964

> ##testing

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

[1] 91.5

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

[1] 1.549557

KhavrSVR\_Micro\_modeltune\_Zn\_Soil

Parameter tuning of ‘svm’:

- sampling method: 10-fold cross validation

- best parameters:

gamma cost

2 4

- best performance: 9.731073

KhavrSVR\_Micro\_Zn\_Soil <- svm(Zn ~ b2\_reflectance + Clay\_khavr + pH\_khavr + Sand\_khavr, data = SVR\_Micro\_Scenario\_models\_dataset[Training\_SVR\_Micro\_scenario, ], kernel="radial", cost=4, gamma=2)

> KhavrSVR\_Micro\_Zn\_Soil

Call:

svm(formula = Zn ~ b2\_reflectance + Clay\_khavr + pH\_khavr + Sand\_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: 45

|  |
| --- |
| # Internal validation  > goof(observed = SVR\_Micro\_Scenario\_models\_dataset$Zn[Training\_SVR\_Micro\_scenario], predicted = KhavrSVR\_Micro\_Zn\_Soil\_Internal , plot.it = TRUE)  R2 concordance MSE RMSE bias  1 0.9901611 0.9735608 0.125087 0.3536764 0.1628444  > # externalvalidation  > goof(observed = SVR\_Micro\_Scenario\_models\_dataset$Zn[-Training\_SVR\_Micro\_scenario], predicted = KhavrSVR\_Micro\_Zn\_Soil\_External, plot.it = TRUE)  R2 concordance MSE RMSE bias  1 0.251945 0.3800009 12.76777 3.573202 -0.2479411 |
|  |
| |  | | --- | | > | |

#training

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

[1] 9.8

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

[1] 0.4312656

> ##testing

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

[1] 84.4

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

[1] 1.695885

KhavrSVR\_Micro\_modeltune\_Zn\_Rec\_Fea\_Elimination

Parameter tuning of ‘svm’:

- sampling method: 10-fold cross validation

- best parameters:

gamma cost

0.5 64

- best performance: 10.74208

KhavrSVR\_Micro\_Zn\_Rec\_Fea\_Elimination

Call:

svm(formula = Zn ~ Clay\_khavr + Sand\_khavr, data = SVR\_Micro\_Scenario\_models\_dataset[Training\_SVR\_Micro\_scenario, ], kernel = "radial",

cost = 64, gamma = 0.5)

Parameters:

SVM-Type: eps-regression

SVM-Kernel: radial

cost: 64

gamma: 0.5

epsilon: 0.1

Number of Support Vectors: 37

# Internal validation

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

R2 concordance MSE RMSE bias

1 0.7006235 0.8232028 3.806144 1.950934 -0.07454441

> # externalvalidation

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

R2 concordance MSE RMSE bias

1 -0.1915081 0.3683221 20.33661 4.509613 0.4738113

#training

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

[1] 54.1

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

[1] 0.7895835

> ##testing

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

[1] 106.5

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

[1] 2.630213