KhavrSVR\_Micro\_modeltune\_Fe\_RS\_Landsat

Parameter tuning of ‘svm’:

- sampling method: 10-fold cross validation

- best parameters:

gamma cost

0.25 2

- best performance: 0.4074986

KhavrSVR\_Micro\_Fe\_RS\_Landsat

Call:

svm(formula = Fe ~ 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 = 0.25)

Parameters:

SVM-Type: eps-regression

SVM-Kernel: radial

cost: 2

gamma: 0.25

epsilon: 0.1

Number of Support Vectors: 43

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

R2 concordance MSE RMSE bias

1 0.4604804 0.5778389 0.2268684 0.4763071 -0.06350114

> # externalvalidation

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

R2 concordance MSE RMSE bias

1 0.1073793 0.346217 0.4337594 0.6586041 -0.3057648

> #training

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

[1] 72.7

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

[1] 0.1370713

> ##testing

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

[1] 92.2

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

[1] 0.1702222

KhavrSVR\_Micro\_modeltune\_Fe\_RS\_Sentinel

Parameter tuning of ‘svm’:

- sampling method: 10-fold cross validation

- best parameters:

gamma cost

0.25 0.25

- best performance: 0.4320681

KhavrSVR\_Micro\_Fe\_RS\_Sentinel

Call:

svm(formula = Fe ~ 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 = 0.25, gamma = 0.25)

Parameters:

SVM-Type: eps-regression

SVM-Kernel: radial

cost: 0.25

gamma: 0.25

epsilon: 0.1

Number of Support Vectors: 45

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

R2 concordance MSE RMSE bias

1 0.2043979 0.2390644 0.3345514 0.5784042 -0.04575273

> # externalvalidation

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

R2 concordance MSE RMSE bias

1 0.02039921 0.1308987 0.4760265 0.6899467 -0.2320976

> #training

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

[1] 88.2

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

[1] 0.1997977

> ##testing

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

[1] 96.6

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

[1] 0.2076656

KhavrSVR\_Micro\_modeltune\_Fe\_RS\_Landsat\_Sentinel

Parameter tuning of ‘svm’:

- sampling method: 10-fold cross validation

- best parameters:

gamma cost

0.25 0.25

- best performance: 0.4327445

KhavrSVR\_Micro\_Fe\_RS\_Landsat\_Sentinel

Call:

svm(formula = Fe ~ 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 = 0.25, gamma = 0.25)

Parameters:

SVM-Type: eps-regression

SVM-Kernel: radial

cost: 0.25

gamma: 0.25

epsilon: 0.1

Number of Support Vectors: 45

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

R2 concordance MSE RMSE bias

1 0.2795275 0.3092181 0.3029593 0.5504174 -0.04794993

> # externalvalidation

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

R2 concordance MSE RMSE bias

1 -0.01488493 0.1182591 0.4931724 0.7022623 -0.2653181

> #training

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

[1] 84

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

[1] 0.1880712

> ##testing

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

[1] 98.3

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

[1] 0.2107498

KhavrSVR\_Micro\_modeltune\_Fe\_RS\_Topographic

Parameter tuning of ‘svm’:

- sampling method: 10-fold cross validation

- best parameters:

gamma cost

0.25 0.125

- best performance: 0.4583768

KhavrSVR\_Micro\_Fe\_RS\_Topographic

Call:

svm(formula = Fe ~ 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 = 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: 45

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

R2 concordance MSE RMSE bias

1 0.1761773 0.1845661 0.3464182 0.588573 -0.02839877

> # externalvalidation

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

R2 concordance MSE RMSE bias

1 -0.1178032 0.005831949 0.5431844 0.7370105 -0.2456976

> #training

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

[1] 89.8

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

[1] 0.2139957

> ##testing

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

[1] 103.2

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

[1] 0.2249907

KhavrSVR\_Micro\_modeltune\_Fe\_RS\_Topographic\_Climate

Parameter tuning of ‘svm’:

- sampling method: 10-fold cross validation

- best parameters:

gamma cost

0.25 4

- best performance: 0.4534617

KhavrSVR\_Micro\_Fe\_RS\_Topographic\_Climate

Call:

svm(formula = Fe ~ 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: 44

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

R2 concordance MSE RMSE bias

1 0.9902173 0.9735435 0.004113623 0.06413753 0.001789368

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

R2 concordance MSE RMSE bias

1 -0.04261071 0.05716126 0.5066454 0.7117903 -0.221437

> #training

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

[1] 9.8

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

[1] 0.03051524

> ##testing

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

[1] 99.6

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

[1] 0.2140204

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

Parameter tuning of ‘svm’:

- sampling method: 10-fold cross validation

- best parameters:

gamma cost

0.25 4

- best performance: 0.4469974

KhavrSVR\_Micro\_Fe\_RS\_Topographic\_Climate\_Soil

Call:

svm(formula = Fe ~ 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: 45

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

R2 concordance MSE RMSE bias

1 0.8273828 0.8634341 0.07258566 0.2694173 -0.04483233

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

R2 concordance MSE RMSE bias

1 -0.05092478 0.04707706 0.5106856 0.7146227 -0.2204225

#training

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

[1] 41.1

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

[1] 0.06236349

> ##testing

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

[1] 100

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

[1] 0.2170927

KhavrSVR\_Micro\_modeltune\_Fe\_Topographic

KhavrSVR\_Micro\_modeltune\_Fe\_Topographic

Parameter tuning of ‘svm’:

- sampling method: 10-fold cross validation

- best parameters:

gamma cost

0.25 0.25

- best performance: 0.4349869

KhavrSVR\_Micro\_Fe\_Topographic

Call:

svm(formula = Fe ~ 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 = 0.25, gamma = 0.25)

Parameters:

SVM-Type: eps-regression

SVM-Kernel: radial

cost: 0.25

gamma: 0.25

epsilon: 0.1

Number of Support Vectors: 43

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| |  | | --- | | goof(observed = SVR\_Micro\_Scenario\_models\_dataset$Fe[Training\_SVR\_Micro\_scenario], predicted = KhavrSVR\_Micro\_Fe\_Topographic\_Internal , plot.it = TRUE)  R2 concordance MSE RMSE bias  1 0.2610406 0.2974985 0.310733 0.5574343 -0.02359982  > # externalvalidation  > KhavrSVR\_Micro\_Fe\_Topographic\_External <- predict(KhavrSVR\_Micro\_Fe\_Topographic, newdata = SVR\_Micro\_Scenario\_models\_dataset[-Training\_SVR\_Micro\_scenario, ])  > goof(observed = SVR\_Micro\_Scenario\_models\_dataset$Fe[-Training\_SVR\_Micro\_scenario], predicted = KhavrSVR\_Micro\_Fe\_Topographic\_External, plot.it = TRUE)  R2 concordance MSE RMSE bias  1 -0.1010525 0.03414931 0.5350446 0.7314674 -0.240588  > #training  > nrmse(KhavrSVR\_Micro\_Fe\_Topographic\_Internal, SVR\_Micro\_Scenario\_models\_dataset$Fe[Training\_SVR\_Micro\_scenario])  [1] 85  > MAPE(KhavrSVR\_Micro\_Fe\_Topographic\_Internal, SVR\_Micro\_Scenario\_models\_dataset$Fe[Training\_SVR\_Micro\_scenario])  [1] 0.1990594  > ##testing  > nrmse(KhavrSVR\_Micro\_Fe\_Topographic\_External, SVR\_Micro\_Scenario\_models\_dataset$Fe[-Training\_SVR\_Micro\_scenario])  [1] 102.4  > MAPE(KhavrSVR\_Micro\_Fe\_Topographic\_External, SVR\_Micro\_Scenario\_models\_dataset$Fe[-Training\_SVR\_Micro\_scenario])  [1] 0.219943 | |  | | |  | | --- | |  | | |
| |  | | --- | | >  KhavrSVR\_Micro\_modeltune\_Fe\_Climate  Parameter tuning of ‘svm’:  - sampling method: 10-fold cross validation  - best parameters:  gamma cost  0.5 16  - best performance: 0.3285563  KhavrSVR\_Micro\_Fe\_Climate <- svm(Fe ~ srad\_khavr + bio\_15\_khavr + bio\_12\_khavr + bio\_1\_khavr, data = SVR\_Micro\_Scenario\_models\_dataset[Training\_SVR\_Micro\_scenario, ], kernel="radial", cost=2, gamma=1)  > KhavrSVR\_Micro\_Fe\_Climate  Call:  svm(formula = Fe ~ srad\_khavr + bio\_15\_khavr + bio\_12\_khavr + bio\_1\_khavr, data = SVR\_Micro\_Scenario\_models\_dataset[Training\_SVR\_Micro\_scenario,  ], kernel = "radial", cost = 16, gamma = 0.5)  Parameters:  SVM-Type: eps-regression  SVM-Kernel: radial  cost: 16  gamma: 0.5  epsilon: 0.1  Number of Support Vectors: 42 | |

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

R2 concordance MSE RMSE bias

1 0.9081121 0.9318299 0.03863894 0.1965679 -0.02088504

> # externalvalidation

> KhavrSVR\_Micro\_Fe\_Climate\_External <- predict(KhavrSVR\_Micro\_Fe\_Climate, newdata = SVR\_Micro\_Scenario\_models\_dataset[-Training\_SVR\_Micro\_scenario, ])

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

R2 concordance MSE RMSE bias

1 0.3677846 0.5706017 0.3072182 0.5542727 -0.202734

> #training

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

[1] 30

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

[1] 0.05595955

> ##testing

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

[1] 77.6

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

[1] 0.1759327

KhavrSVR\_Micro\_modeltune\_Fe\_Soil

Parameter tuning of ‘svm’:

- sampling method: 10-fold cross validation

- best parameters:

gamma cost

1 2

- best performance: 0.392114

KhavrSVR\_Micro\_Fe\_Soil

Call:

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

], kernel = "radial", cost = 2 , gamma = 1)

Parameters:

SVM-Type: eps-regression

SVM-Kernel: radial

cost: 2

gamma: 1

epsilon: 0.1

Number of Support Vectors: 46

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

R2 concordance MSE RMSE bias

1 0.6666715 0.7696272 0.1401649 0.374386 -0.004006505

> # externalvalidation

> KhavrSVR\_Micro\_Fe\_Soil\_External <- predict(KhavrSVR\_Micro\_Fe\_Soil, newdata = SVR\_Micro\_Scenario\_models\_dataset[-Training\_SVR\_Micro\_scenario, ])

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

R2 concordance MSE RMSE bias

1 0.1065795 0.2984425 0.4341481 0.6588991 -0.2446485

> #training

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

[1] 57.1

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

[1] 0.07942963

> ##testing

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

[1] 92.2

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

[1] 0.1769986

KhavrSVR\_Micro\_modeltune\_Fe\_Rec\_Fea\_Elimination

Parameter tuning of ‘svm’:

- sampling method: 10-fold cross validation

- best parameters:

gamma cost

0.25 1

- best performance: 0.4432197

KhavrSVR\_Micro\_Fe\_Rec\_Fea\_Elimination

Call:

svm(formula = Fe ~ 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\_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, data = SVR\_Micro\_Scenario\_models\_dataset[Training\_SVR\_Micro\_scenario,

], kernel = "radial", cost = 1, gamma = 0.25)

Parameters:

SVM-Type: eps-regression

SVM-Kernel: radial

cost: 1

gamma: 0.25

epsilon: 0.1

Number of Support Vectors: 45

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

R2 concordance MSE RMSE bias

1 0.8250662 0.8612134 0.07355979 0.2712191 -0.03995174

> # externalvalidation

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

R2 concordance MSE RMSE bias

1 -0.1004156 0.03703495 0.5347351 0.7312558 -0.2615498

> #training

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

[1] 41.4

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

[1] 0.06456583

> ##testing

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

[1] 102.4

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

[1] 0.2171303