<><> Time Stamp <><>

Code started: 09/10/2022 - 16:37:27
Total Run Time: 14.045 s

<><> Bore Information <><>

Bore ID: GW075025.1.1
Region: Coastal
Bore Coordinates: (-33.932117, 151.228967)
Agency: WaterNSW
Drilled Date: 20/07/1998
Bore Depth: 24.2 m
Drilled Depth: 25.5 m
Reference Elevation: 8.5 m
Time Series Reference Elevation: 24.17 m
Land Surface Elevation: 8.5 m
Silo Grid Point Coordinates: (-33.95, 151.25)

<><> Model Output <><>

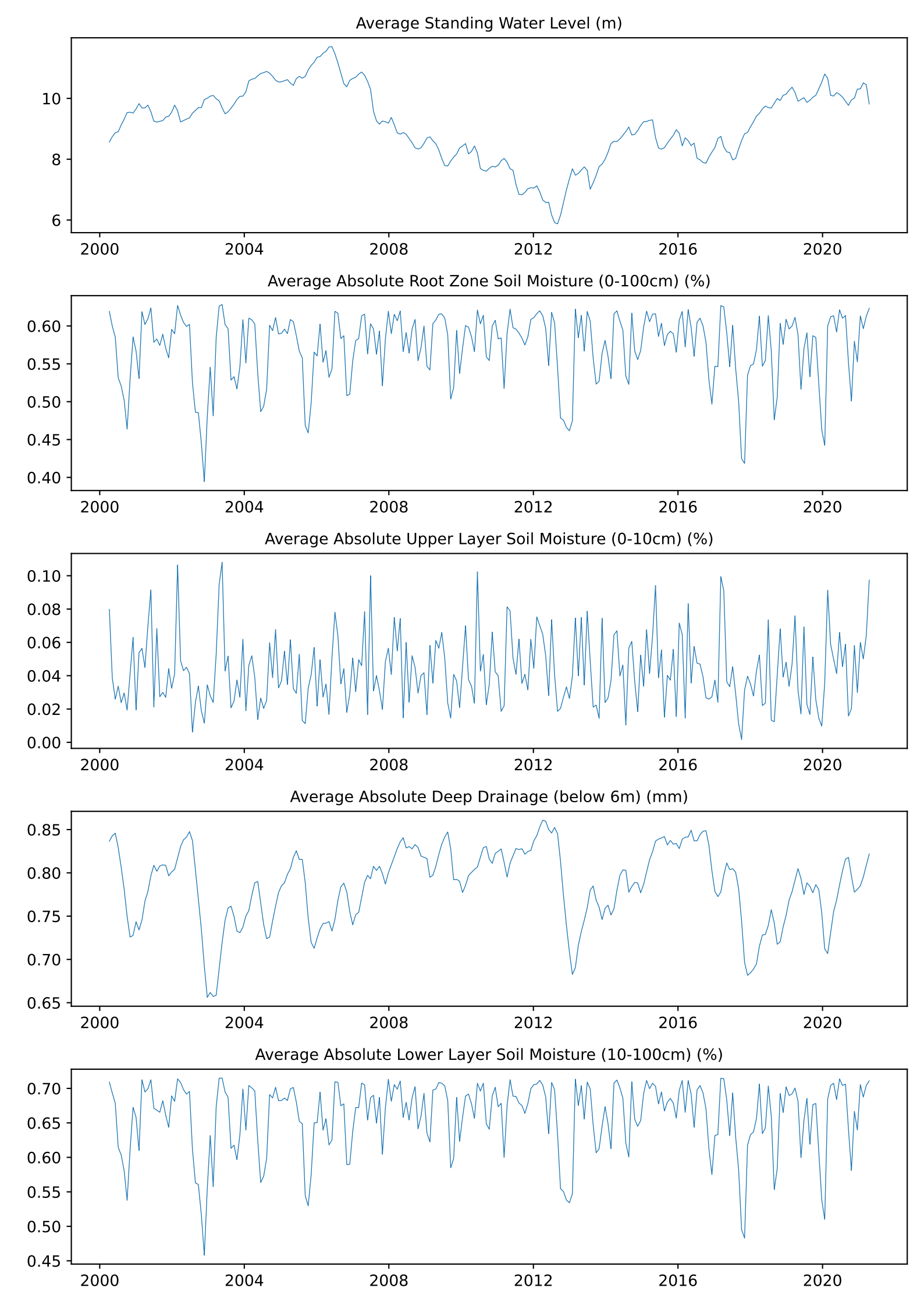
Averaged Period: 30 day(s)
Output: Average Standing Water Level (m) in 1 period(s) time

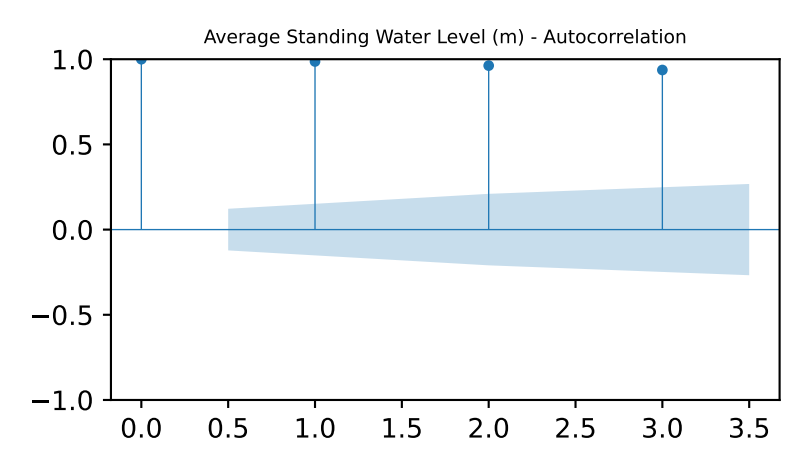
<><> Model Inputs <><>

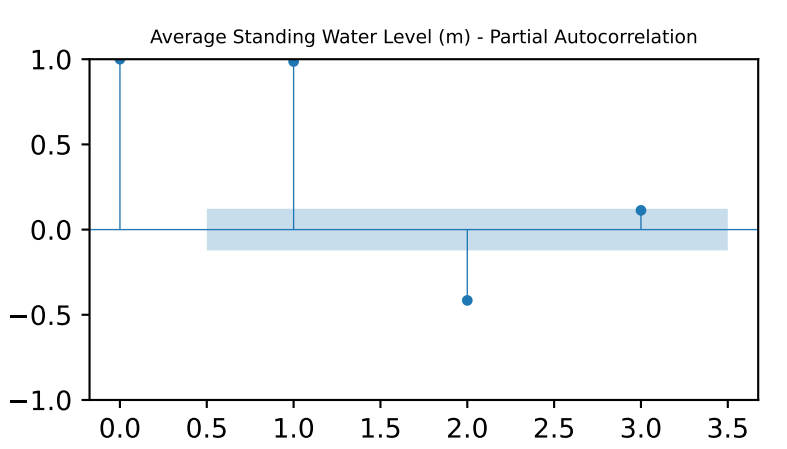
Data Range: 07/04/2000 - 17/04/2021
Train Set Size: 80.0%
Test Set Size: 20.0%
Input Timesteps: Current period + 2 preceeding period(s)
Input Variables:
    Average Standing Water Level (m)
    Average Absolute Root Zone Soil Moisture (0-100cm) (%)
    Average Absolute Upper Layer Soil Moisture (0-10cm) (%)
    Average Absolute Deep Drainage (below 6m) (mm)
    Average Absolute Lower Layer Soil Moisture (10-100cm) (%)

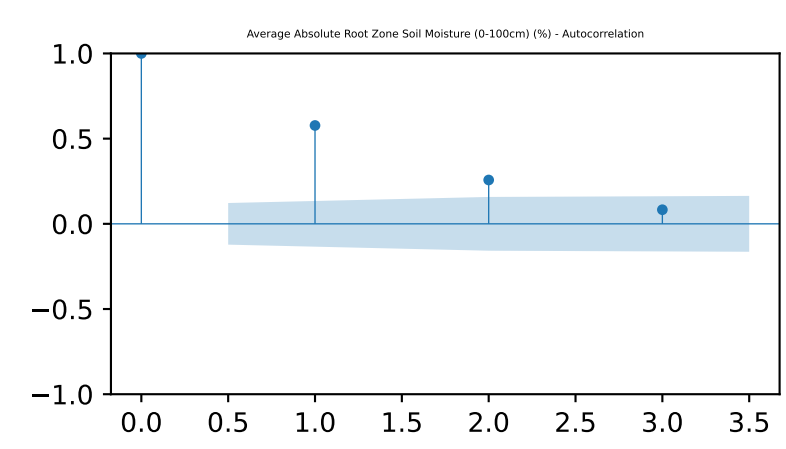
<><> Data Quality <><>

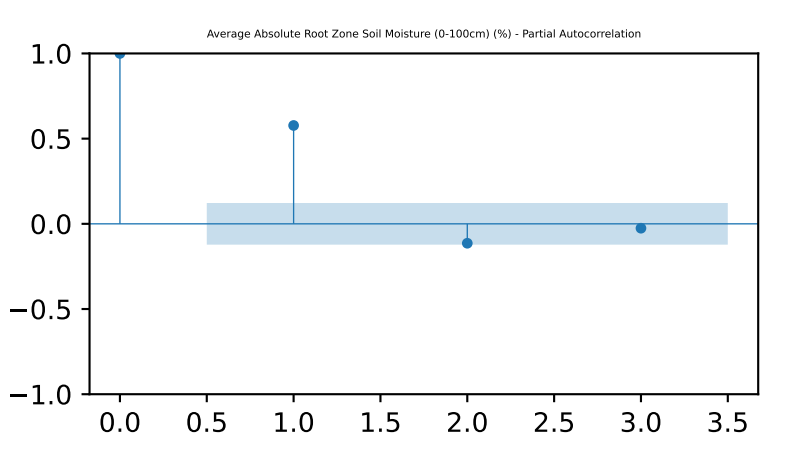
Interpolation Method: Spline
Quality Code: A,   Number: 4765,   Percentage: 61.67%
Quality Code: B,   Number: 1575,   Percentage: 20.39%
Quality Code: C,   Number: 628,   Percentage: 8.13%
Quality Code: E,   Number: 695,   Percentage: 9.0%
Quality Code: I,   Number: 63,   Percentage: 0.82%

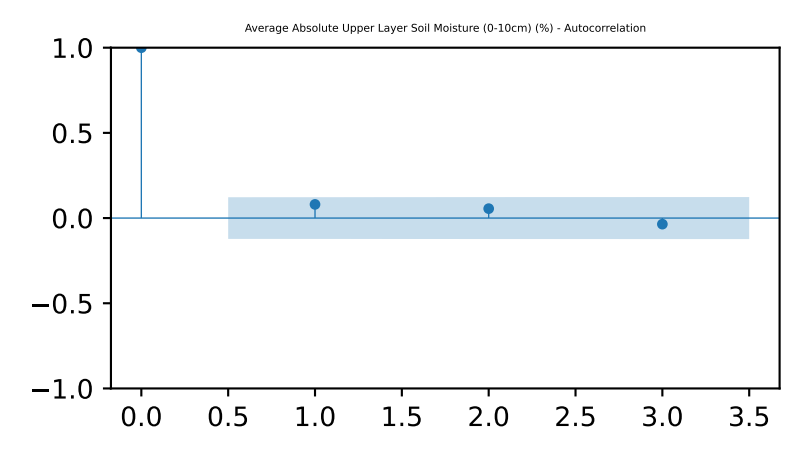

Average Standing Water Level (m)
10
8
6
2000
2004
2008
2012
2016
2020
Average Absolute Root Zone Soil Moisture (0-100cm) (%)
0.60
0.55
0.50
0.45
0.40
2000
2004
2008
2012
2016
2020
Average Absolute Upper Layer Soil Moisture (0-10cm) (%)
0.10
0.08
0.06
0.04
0.02
0.00
2000
2004
2008
2012
2016
2020
Average Absolute Deep Drainage (below 6m) (mm)
0.85
0.80
0.75
0.70
0.65
2000
2004
2008
2012
2016
2020
Average Absolute Lower Layer Soil Moisture (10-100cm) (%)
0.70
0.65
0.60
0.55
0.50
0.45
2000
2004
2008
2012
2016
2020

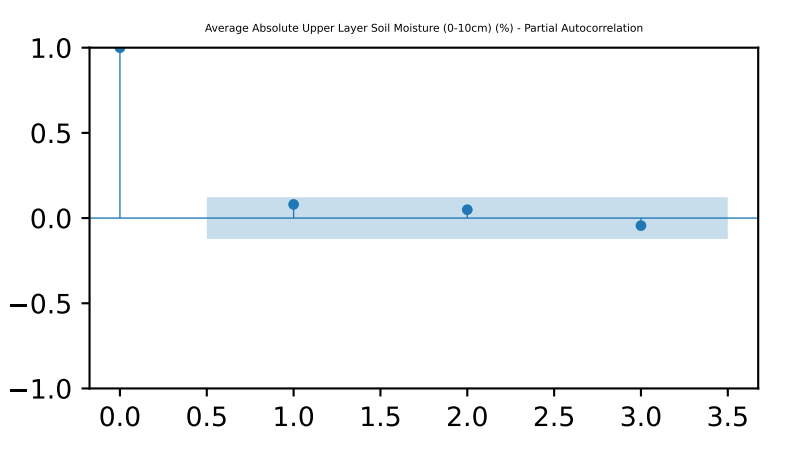

Average Standing Water Level (m) - Autocorrelation

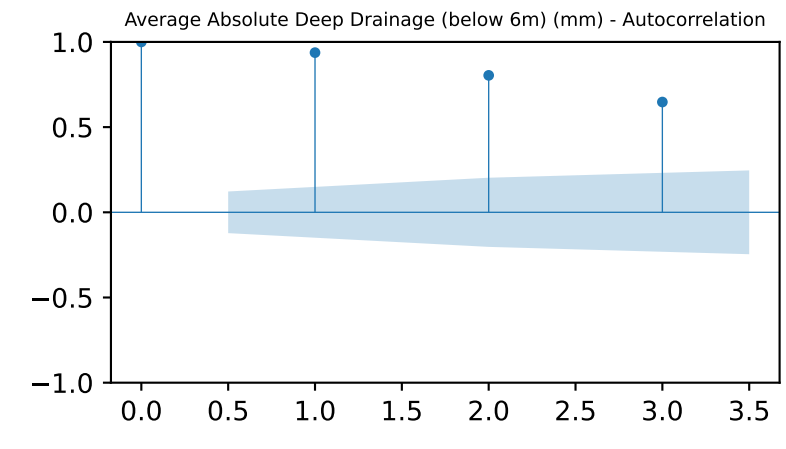

Average Standing Water Level (m) - Partial Autocorrelation

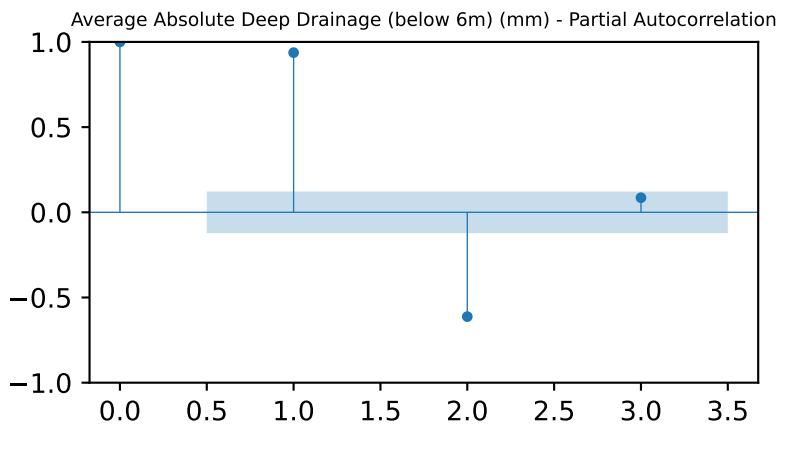

Average Absolute Root Zone Soil Moisture (0-100cm) (%) - Autocorrelation

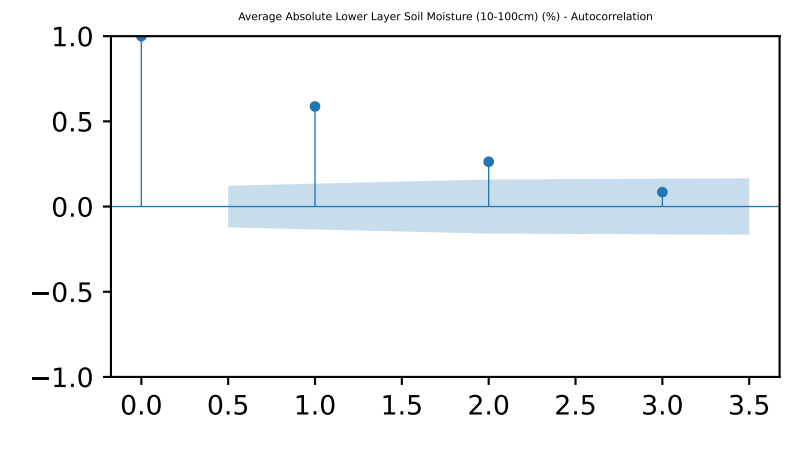

Average Absolute Root Zone Soil Moisture (0-100cm) (%) - Partial Autocorrelation

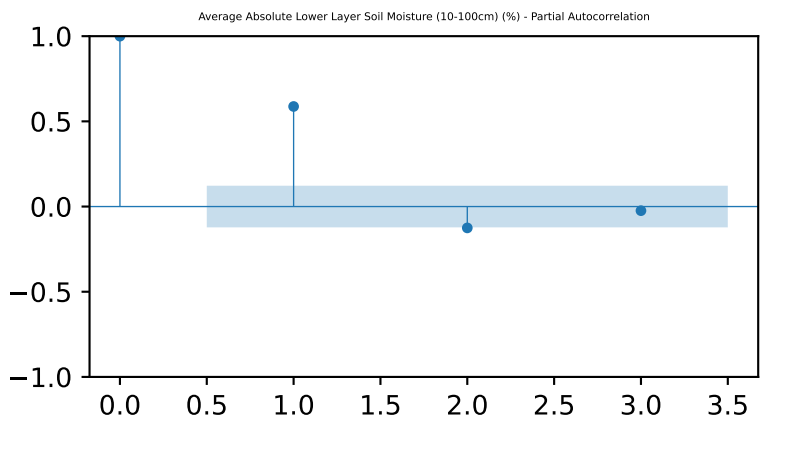

Average Absolute Upper Layer Soil Moisture (0-10cm) (%) - Autocorrelation

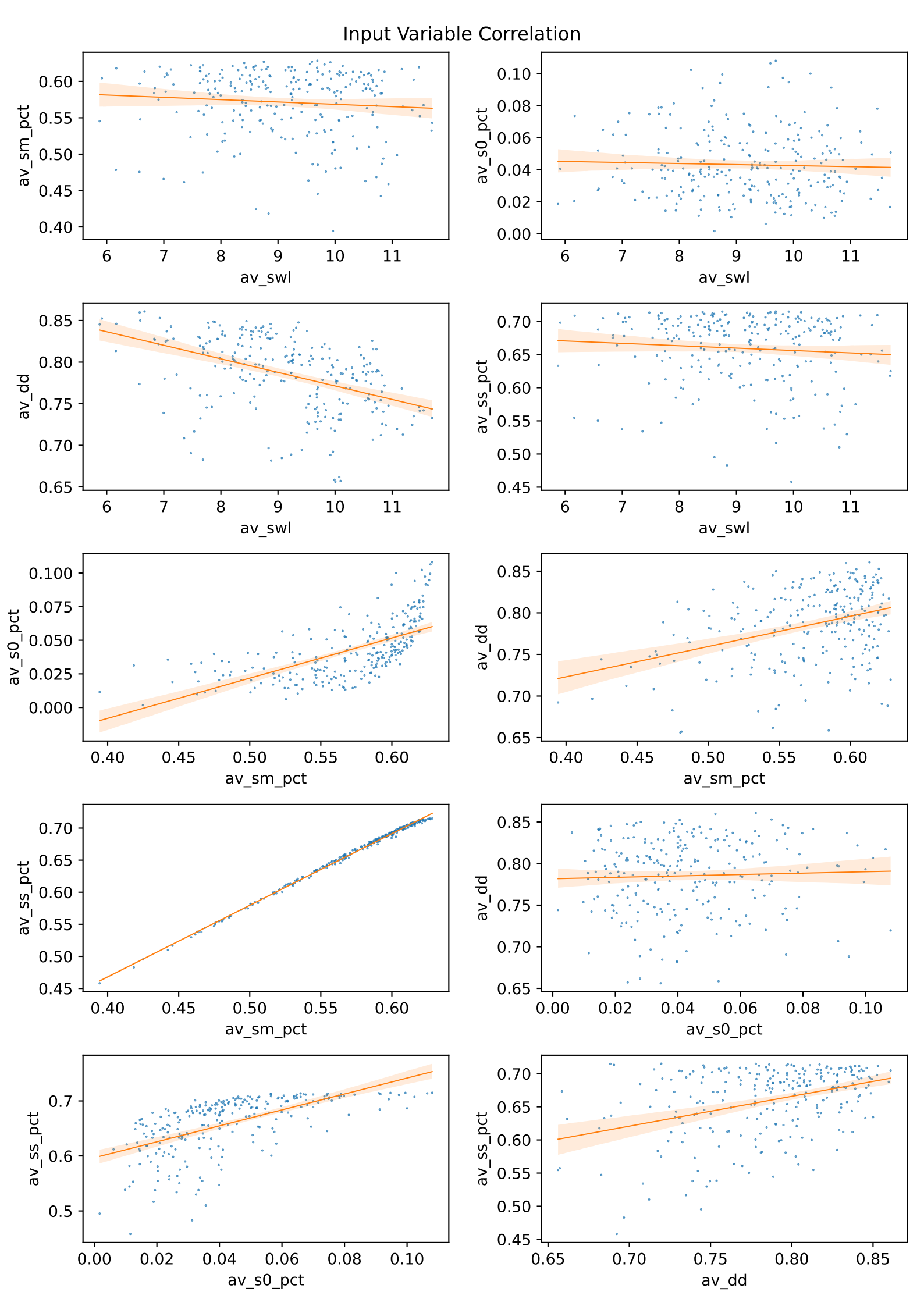

Average Absolute Upper Layer Soil Moisture (0-10cm) (%) - Partial Autocorrelation

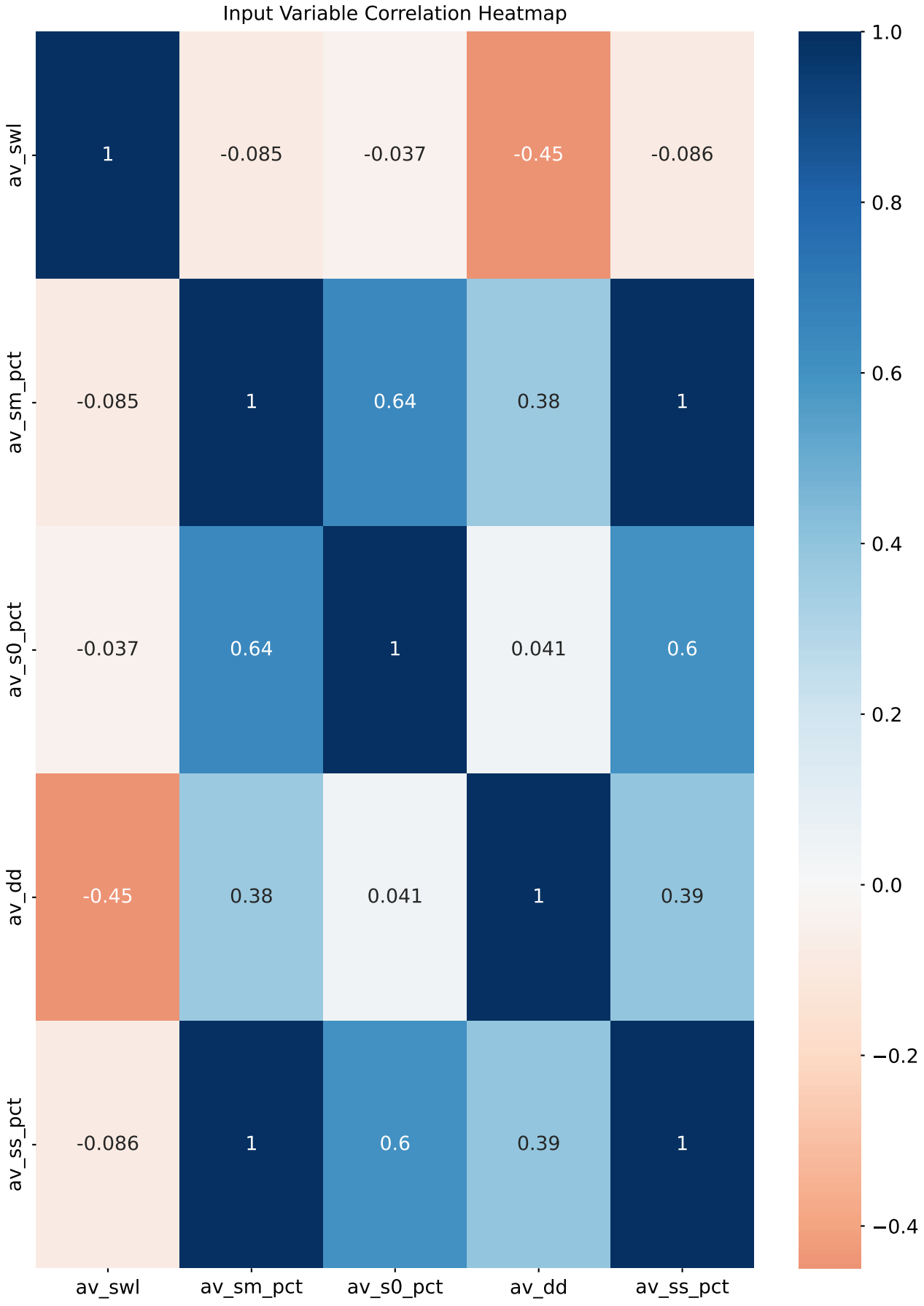

Average Absolute Deep Drainage (below 6m) (mm) - Autocorrelation


Average Absolute Deep Drainage (below 6m) (mm) - Partial Autocorrelation


Average Absolute Lower Layer Soil Moisture (10-100cm) (%) - Autocorrelation


Average Absolute Lower Layer Soil Moisture (10-100cm) (%) - Partial Autocorrelation


Input Variable Correlation
av_sm_pct
av_swl
av_s0_pct
av_swl
av_dd
av_swl
av_ss_pct
av_swl
av_s0_pct
av_sm_pct
av_dd
av_sm_pct
av_ss_pct
av_sm_pct
av_dd
av_s0_pct
av_ss_pct
av_s0_pct
av_ss_pct
av_dd


Input Variable Correlation Heatmap
av_swl
av_sm_pct
av_s0_pct
av_dd
av_ss_pct
1
-0.085
-0.037
-0.45
-0.086
-0.085
1
0.64
0.38
1
-0.037
0.64
1
0.041
0.6
-0.45
0.38
0.041
1
0.39
-0.086
1
0.6
0.39
1
av_swl
av_sm_pct
av_s0_pct
av_dd
av_ss_pct
1.0
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4

<><> TensorFlow Keras LSTM Model <><>

Optimiser: adam
Loss: mse
Number of Epochs: 100
Percentage of Training Data for Validation: 20.0%
Time Series Order: Chronological
Verbose: Off

<><> Model Architecture <><>

Input Shape (Samples, Timesteps, Features): (203, 3, 5)
LSTM Layers: 1
LSTM Cells per Layer: 64
Fully Connected Hidden Layers: 2
Fully Connected Hidden Neurons per Layer: 32
Fully Connected Output Neurons: 1
LSTM Dropout Rate: 20.0%
LSTM Recurrent Dropout Rate: 20.0%

Model: "sequential_30"

Layer (type)	Output Shape	Param #
lstm_30 (LSTM)	(None, 64)	17920
dense_90 (Dense)	(None, 32)	2080
dense_91 (Dense)	(None, 32)	1056
dense_92 (Dense)	(None, 1)	33

Total params: 21,089
Trainable params: 21,089
Non-trainable params: 0

<><> Training Loss <><>

Epoch: 10,   Loss: 0.040520112961530685
Epoch: 20,   Loss: 0.020273728296160698
Epoch: 30,   Loss: 0.019091878086328506
Epoch: 40,   Loss: 0.01548762060701847
Epoch: 50,   Loss: 0.018988216295838356
Epoch: 60,   Loss: 0.014266405254602432
Epoch: 70,   Loss: 0.01473001204431057
Epoch: 80,   Loss: 0.014987465925514698
Epoch: 90,   Loss: 0.01218485925346613
Epoch: 100,   Loss: 0.015495063737034798

<><> Validation Loss <><>

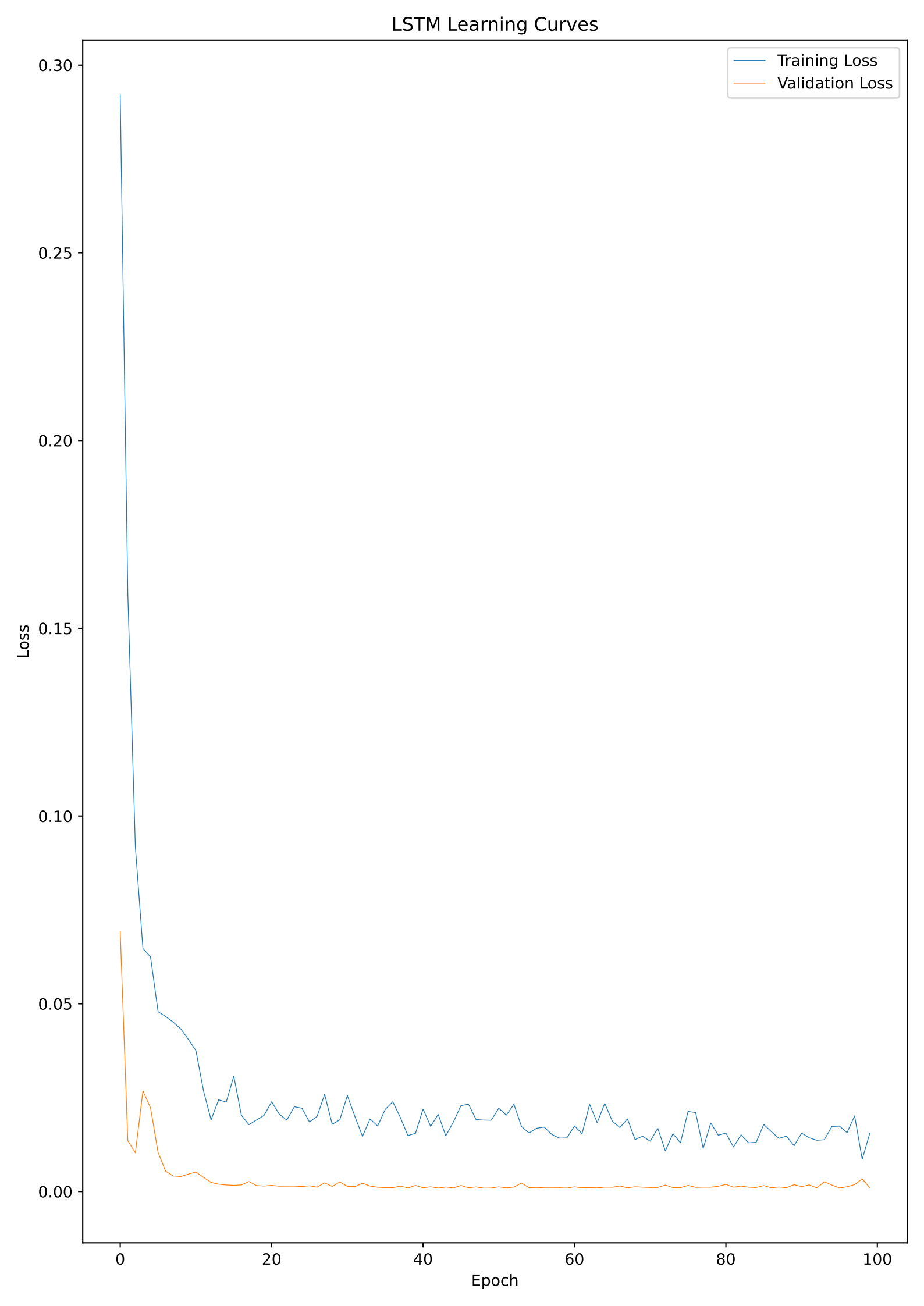
Epoch: 10,   Loss: 0.0046349638141691685
Epoch: 20,   Loss: 0.0014663604088127613
Epoch: 30,   Loss: 0.0025492676068097353
Epoch: 40,   Loss: 0.0016218565870076418
Epoch: 50,   Loss: 0.0009368427563458681
Epoch: 60,   Loss: 0.0009335964568890631
Epoch: 70,   Loss: 0.0011598190758377314
Epoch: 80,   Loss: 0.001409607008099556
Epoch: 90,   Loss: 0.0018220155034214258
Epoch: 100,   Loss: 0.0010306871263310313

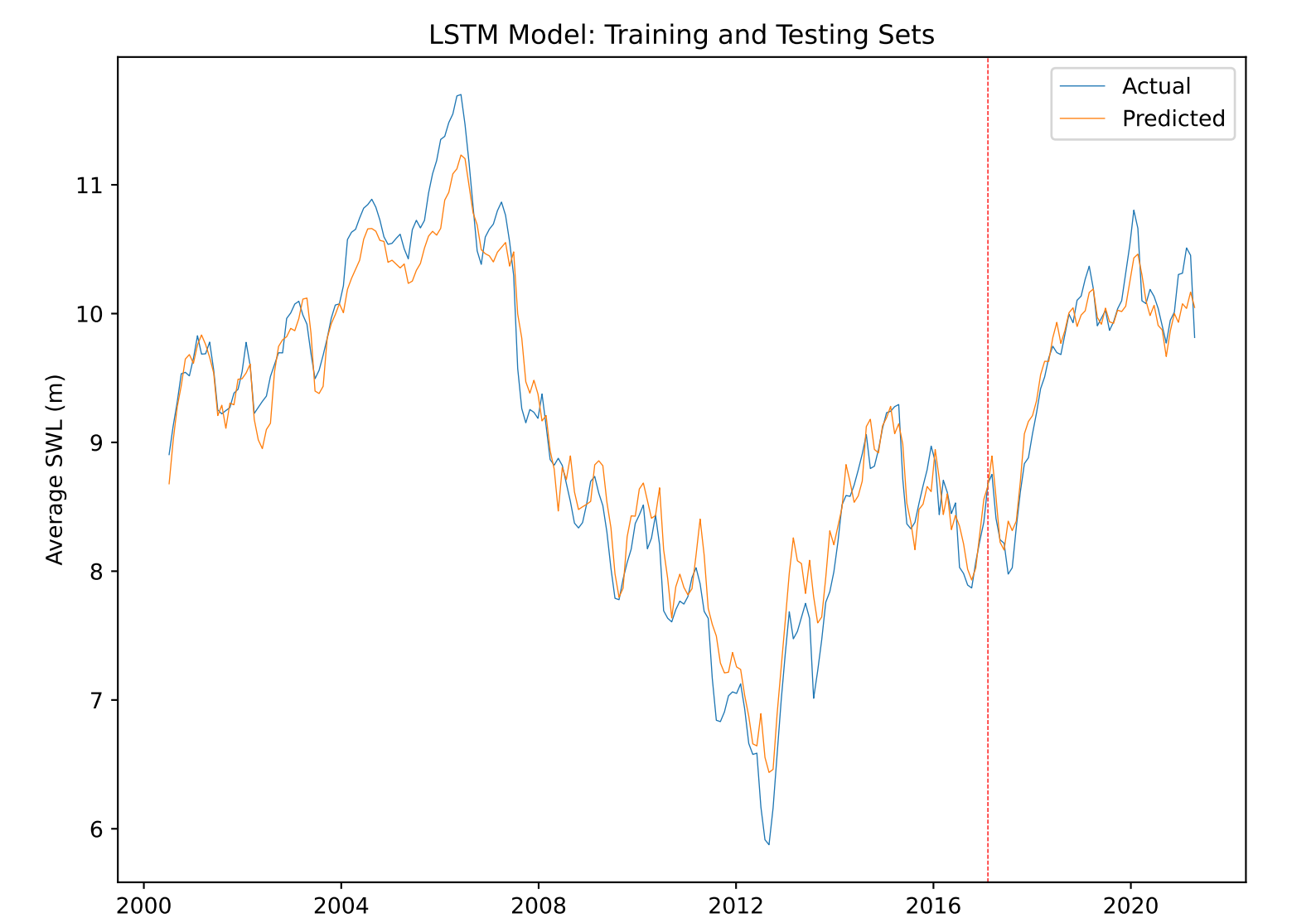
<><> Training Set Scores <><>

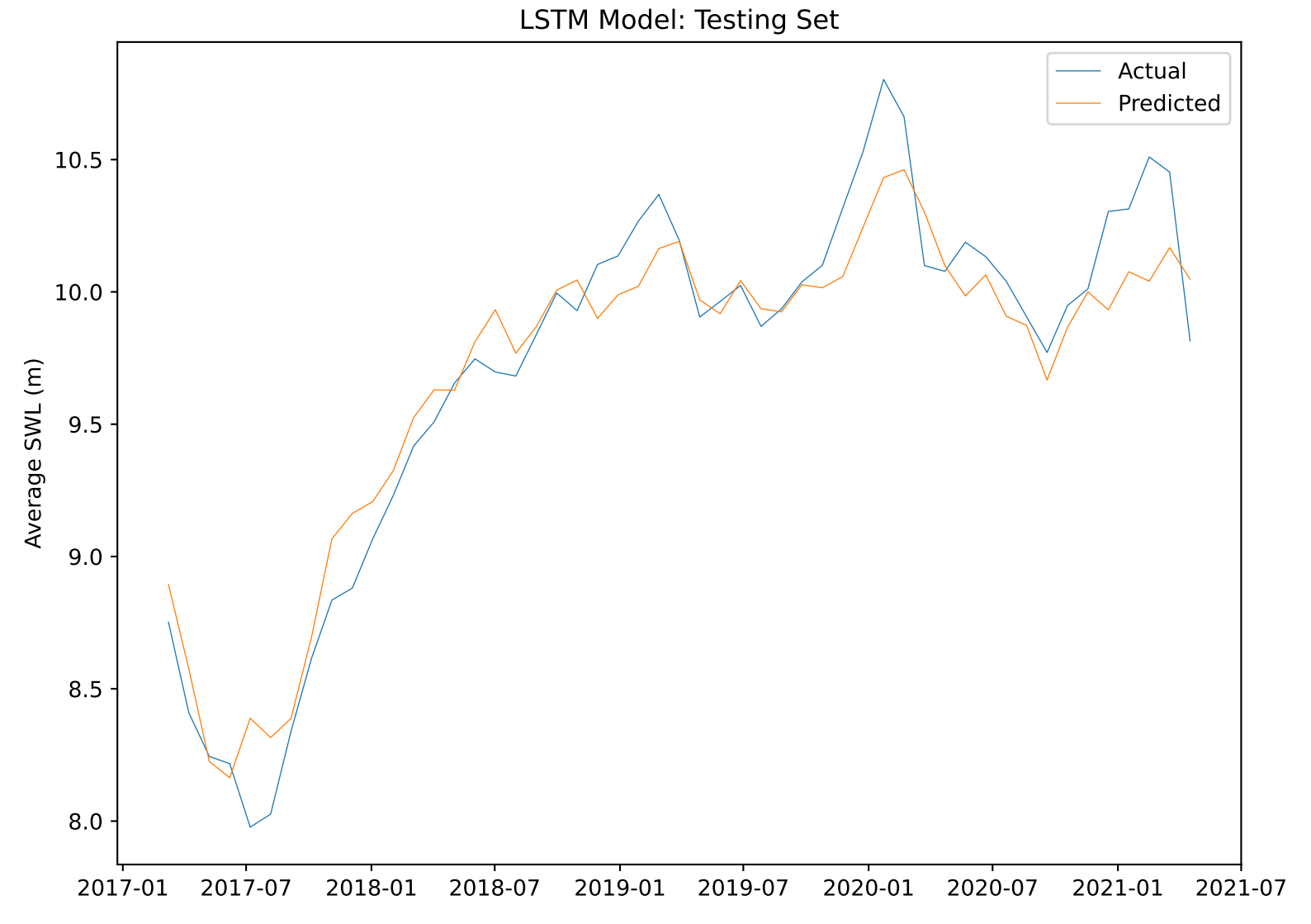
Train Root Mean Squared Error: 0.04615
Train Mean Squared Error: 0.00213
Train Normalised Root Mean Squared Error: 0.04615
Train Coefficient of Determination: 0.95647
Train Normalised Nash Sutcliffe Efficiency: 0.95829
Train Mean Absolute Error: 0.03662
Train Pearson's Correlation Coefficient: 0.98677
Train Index of Agreement: 0.9873
Train Kling-Gupta Efficiency: 0.85617
Train Mean Bias Error: 0.00447
Train Mean Absolute Percentage Error: 0.02465

<><> Test Set Scores <><>

Test Root Mean Squared Error: 0.03196
Test Mean Squared Error: 0.00102
Test Normalised Root Mean Squared Error: 0.06589
Test Coefficient of Determination: 0.93249
Test Normalised Nash Sutcliffe Efficiency: 0.93676
Test Mean Absolute Error: 0.02503
Test Pearson's Correlation Coefficient: 0.97502
Test Index of Agreement: 0.97987
Test Kling-Gupta Efficiency: 0.84048
Test Mean Bias Error: -0.00305
Test Mean Absolute Percentage Error: 0.01507


LSTM Learning Curves
Training Loss
Validation Loss
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Loss
0
20
40
60
80
100
Epoch


LSTM Model: Training and Testing Sets
Actual
Predicted
Average SWL (m)
11
10
9
8
7
6
2000
2004
2008
2012
2016
2020


LSTM Model: Testing Set
Actual
Predicted
Average SWL (m)
10.5
10.0
9.5
9.0
8.5
8.0
2017-01
2017-07
2018-01
2018-07
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07


LSTM Model: Training and Testing Sets
Actual
Predicted
Inverted Average SWL (m)
6
7
8
9
10
11
2000
2004
2008
2012
2016
2020
Actual
Predicted
Inverted Average SWL (m)
8.0
8.5
9.0
9.5
10.0
10.5
2017-01
2017-07
2018-01
2018-07
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07

<><> Scikit Learn SVR Model <><>

Kernel Function: rbf
Kernel Coefficient: scale
Epsilon: 0.1
Stopping Criterion Tolerance: 1e-05
Regularisation Parameter: 1.0
Shrinking: True
Time Series Order: Chronological
Verbose: Off

<><> Model Architecture <><>

Number of Support Vectors: 23
Input/Support Vector Size: 15

<><> 5-Fold Cross Validation Mean Training Loss <><>

Epoch: 10,   Loss: 0.002082817861608958
Epoch: 20,   Loss: 0.0025816637679063276
Epoch: 30,   Loss: 0.003752805776197263
Epoch: 40,   Loss: 0.004606345575939026
Epoch: 50,   Loss: 0.004487746792444732
Epoch: 60,   Loss: 0.004007719253425821
Epoch: 70,   Loss: 0.003635547081787603
Epoch: 80,   Loss: 0.003448795545357574
Epoch: 90,   Loss: 0.0033432311227071542
Epoch: 100,   Loss: 0.0032583448706020707

<><> 5-Fold Cross Validation Mean Validation Loss <><>

Epoch: 10,   Loss: 0.05766848657837981
Epoch: 20,   Loss: 0.06548390013629501
Epoch: 30,   Loss: 0.05742734238335985
Epoch: 40,   Loss: 0.05878082971434597
Epoch: 50,   Loss: 0.06138535680101713
Epoch: 60,   Loss: 0.05067357506651662
Epoch: 70,   Loss: 0.0294323649560101
Epoch: 80,   Loss: 0.021072964048716173
Epoch: 90,   Loss: 0.021289440171868425
Epoch: 100,   Loss: 0.021019889660233777

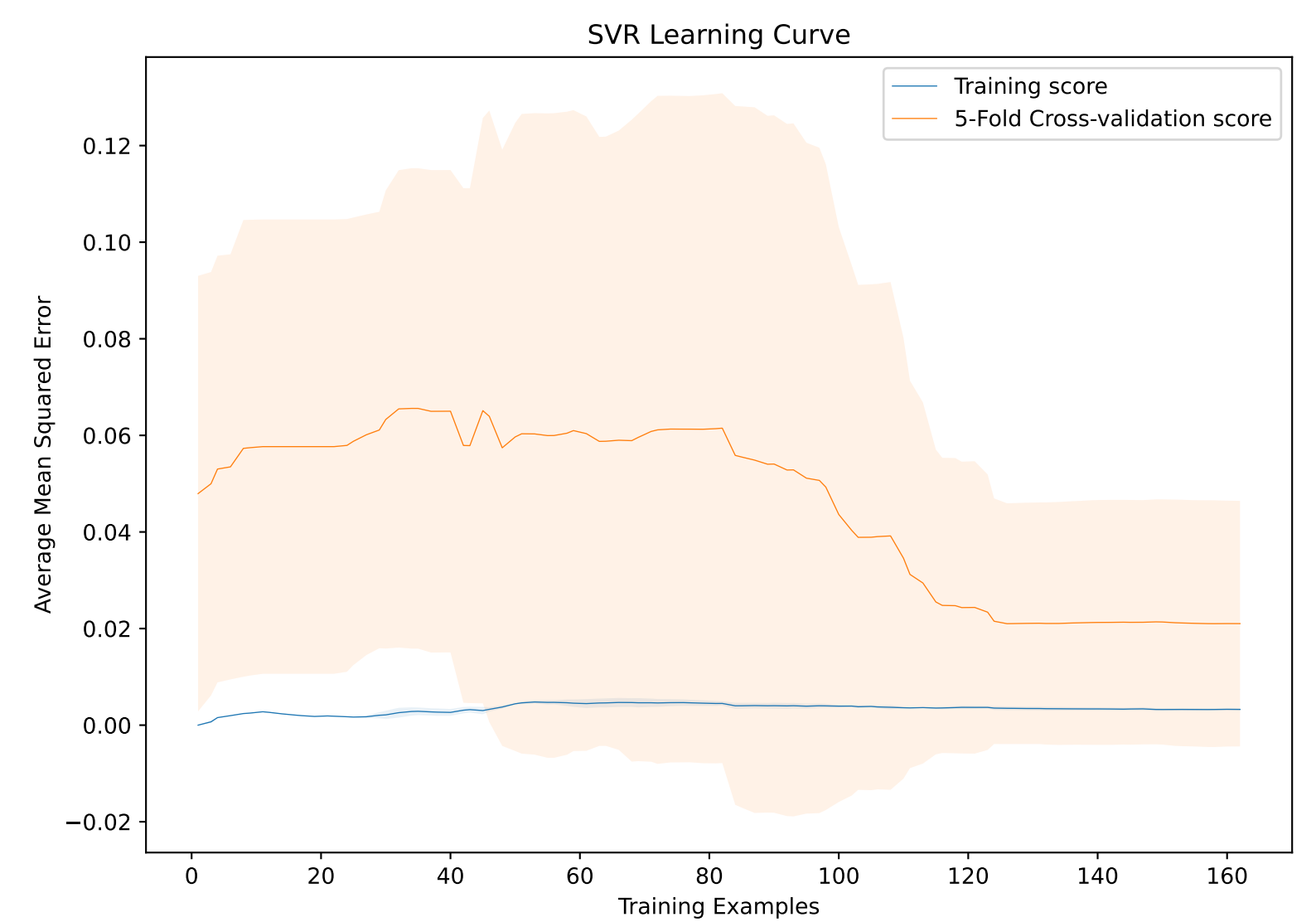
<><> Training Set Scores <><>

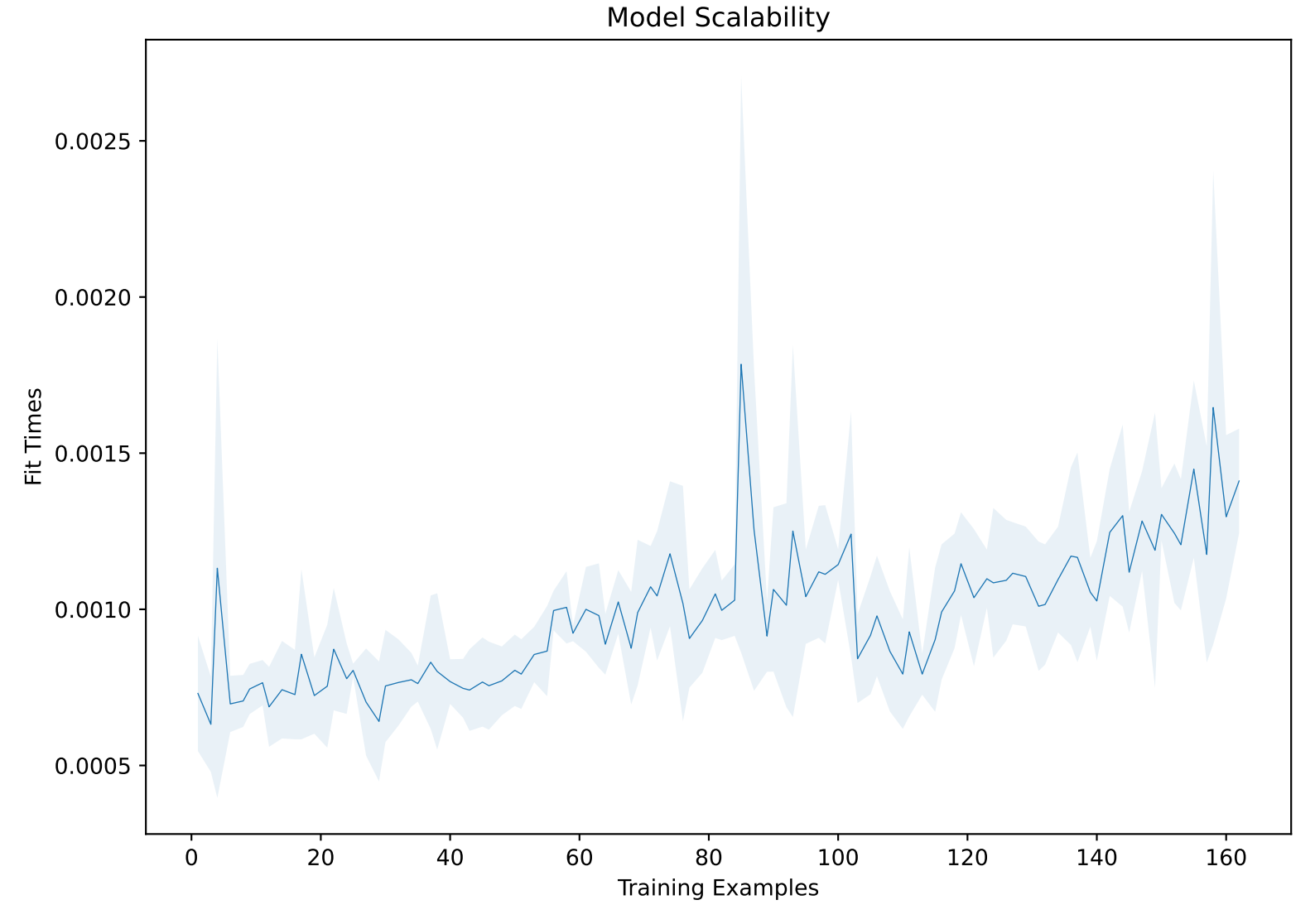
Train Root Mean Squared Error: 0.05512
Train Mean Squared Error: 0.00304
Train Normalised Root Mean Squared Error: 0.05512
Train Coefficient of Determination: 0.93791
Train Normalised Nash Sutcliffe Efficiency: 0.94154

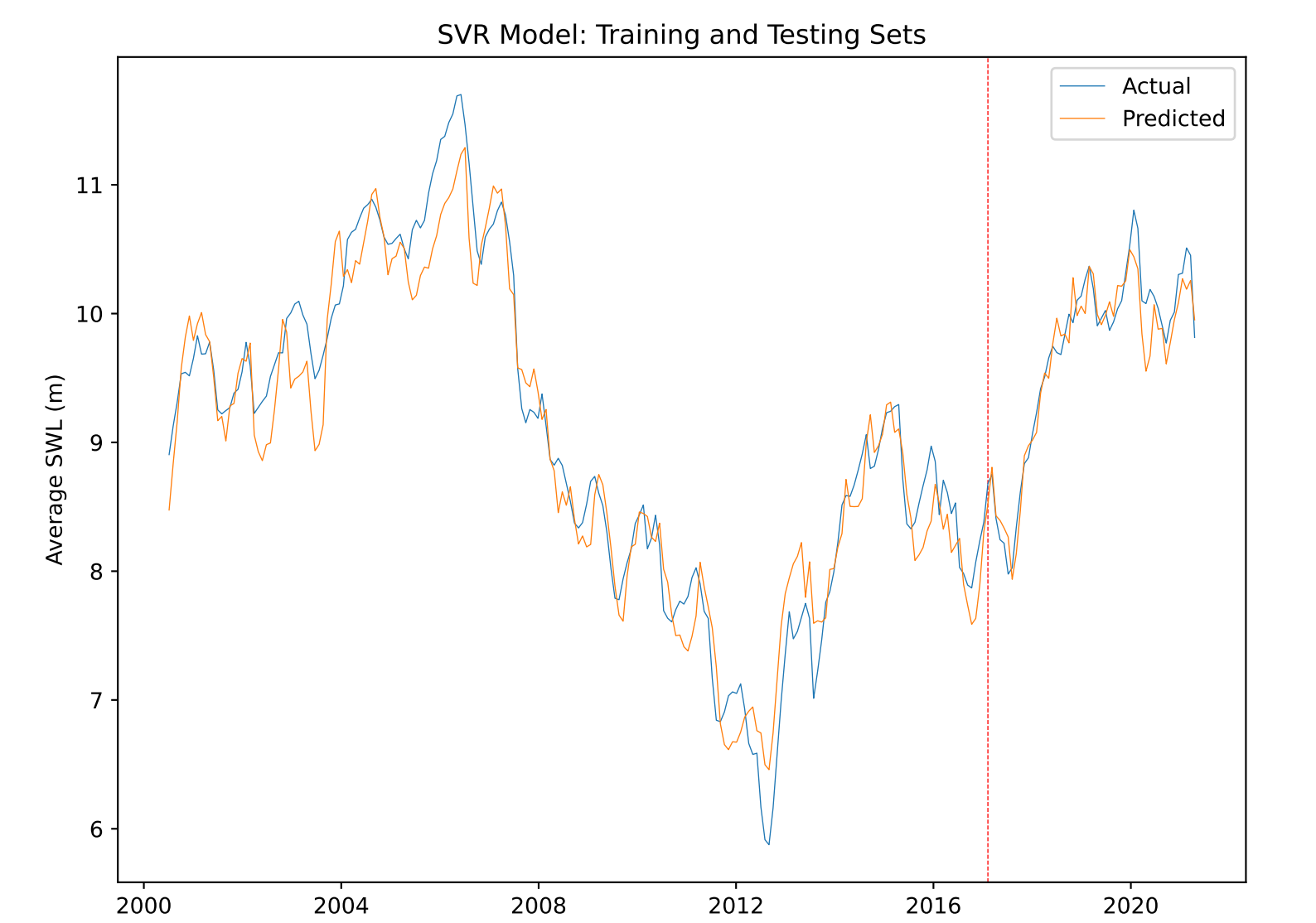
Train Mean Absolute Error: 0.04549
Train Pearson's Correlation Coefficient: 0.97129
Train Index of Agreement: 0.98296
Train Kling-Gupta Efficiency: 0.91327
Train Mean Bias Error: -0.01212
Train Mean Absolute Percentage Error: 0.03029

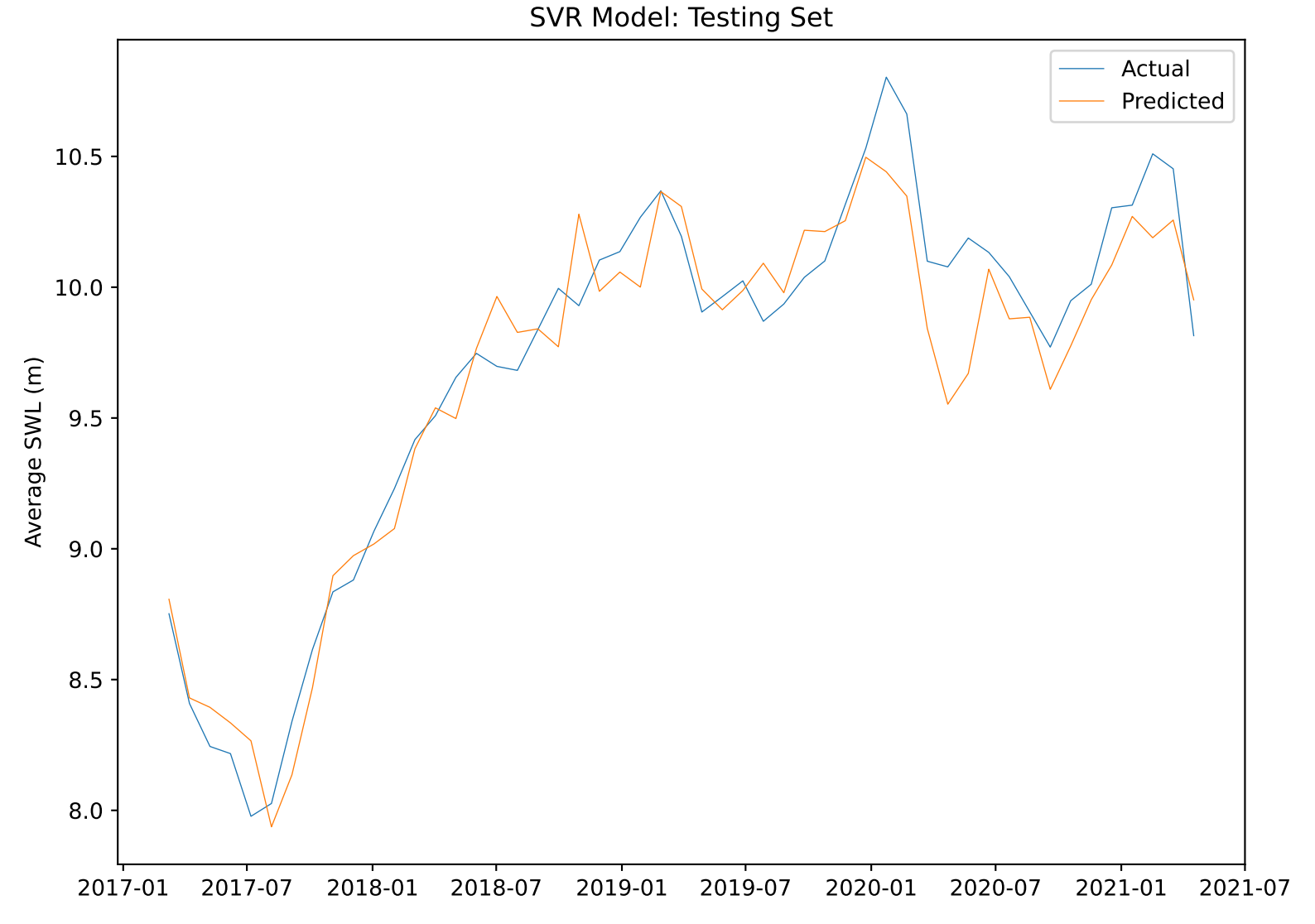
<><> Test Set Scores <><>

Test Root Mean Squared Error: 0.03297
Test Mean Squared Error: 0.00109
Test Normalised Root Mean Squared Error: 0.06796
Test Coefficient of Determination: 0.92817
Test Normalised Nash Sutcliffe Efficiency: 0.93299
Test Mean Absolute Error: 0.02558
Test Pearson's Correlation Coefficient: 0.96647
Test Index of Agreement: 0.98065
Test Kling-Gupta Efficiency: 0.92838
Test Mean Bias Error: -0.00877
Test Mean Absolute Percentage Error: 0.01527


SVR Learning Curve
Training score
5-Fold Cross-validation score
Average Mean Squared Error
0.12
0.10
0.08
0.06
0.04
0.02
0.00
−0.02
0
20
40
60
80
100
120
140
160
Training Examples


Model Scalability
Fit Times
0.0025
0.0020
0.0015
0.0010
0.0005
0
20
40
60
80
100
120
140
160
Training Examples


SVR Model: Training and Testing Sets
Actual
Predicted
Average SWL (m)
11
10
9
8
7
6
2000
2004
2008
2012
2016
2020


SVR Model: Testing Set
Actual
Predicted
Average SWL (m)
10.5
10.0
9.5
9.0
8.5
8.0
2017-01
2017-07
2018-01
2018-07
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07


SVR Model: Training and Testing Sets
Actual
Predicted
Inverted Average SWL (m)
6
7
8
9
10
11
2000
2004
2008
2012
2016
2020
Actual
Predicted
Inverted Average SWL (m)
8.0
8.5
9.0
9.5
10.0
10.5
2017-01
2017-07
2018-01
2018-07
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07