<><> Time Stamp <><>

Code started: 09/10/2022 - 19:28:59
Total Run Time: 13.557 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 <><>

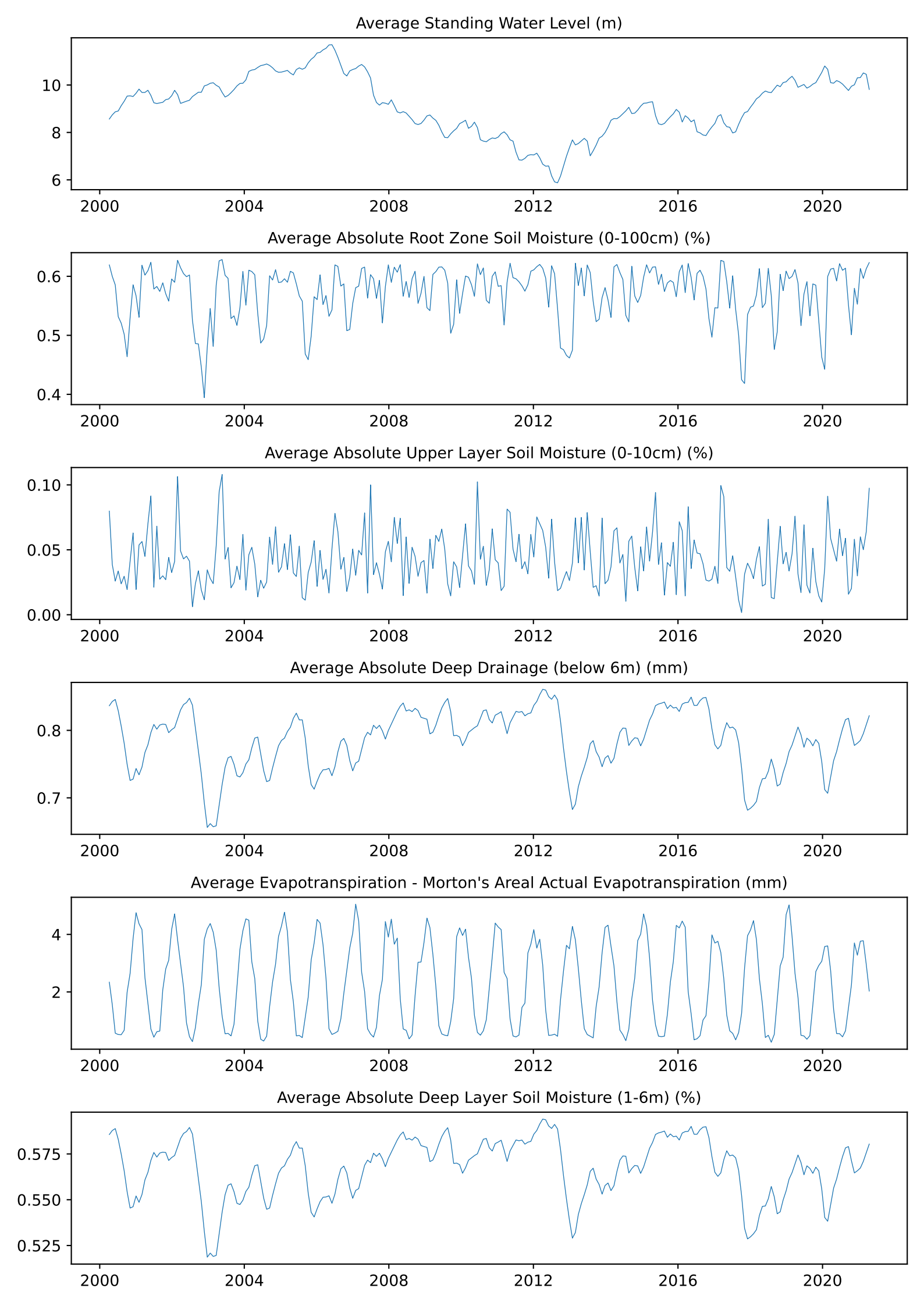
Averaged Period: 30 day(s)
Output: Average Standing Water Level (m) in 1 period(s) time

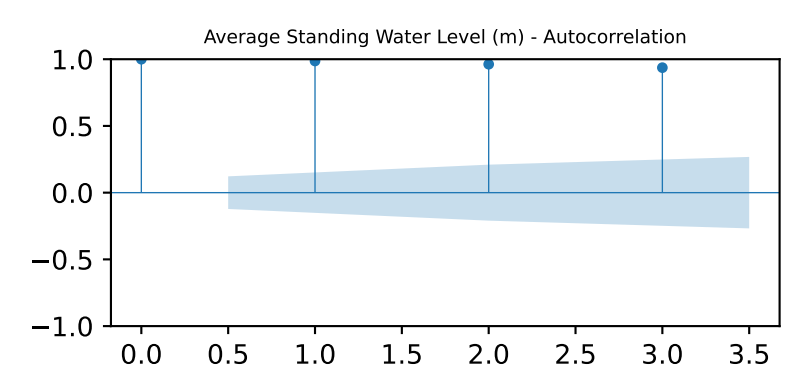
<><> Model Inputs <><>

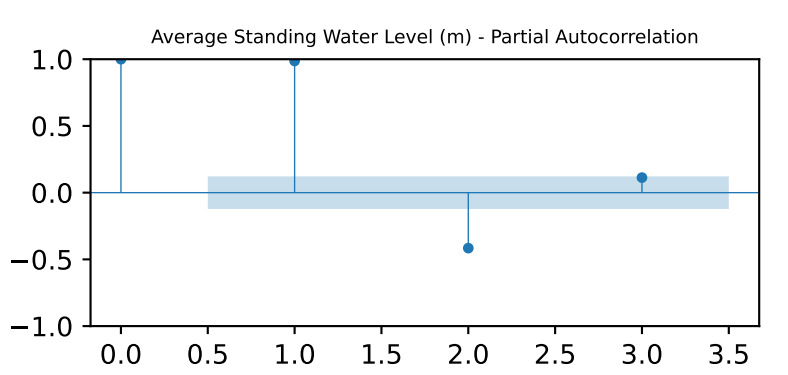
Data Range: 07/04/2000 - 17/04/2021
Train Set Size: 80.0%
Test Set Size: 20.0%
Input Timesteps: Current period + 2 preceeding period(s)
Input Variables:
    Average Standing Water Level (m)
    Average Absolute Root Zone Soil Moisture (0-100cm) (%)
    Average Absolute Upper Layer Soil Moisture (0-10cm) (%)
    Average Absolute Deep Drainage (below 6m) (mm)
    Average Evapotranspiration - Morton's Areal Actual Evapotranspiration (mm)
    Average Absolute Deep Layer Soil Moisture (1-6m) (%)

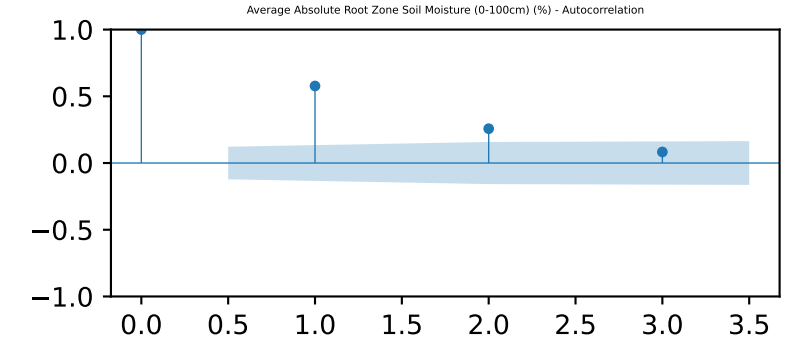
<><> Data Quality <><>

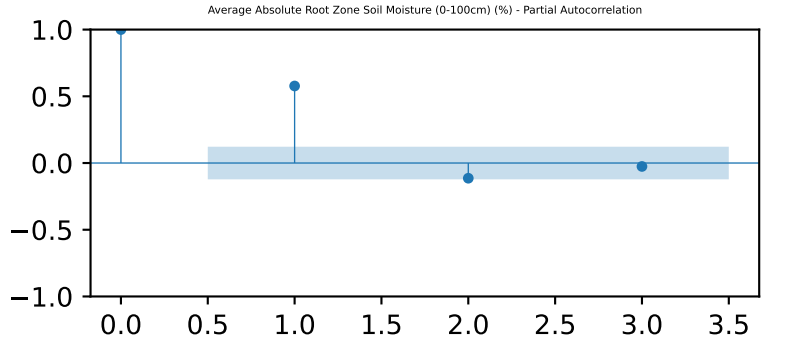
Interpolation Method: Spline
Quality Code: A,   Number: 4765,   Percentage: 61.67%
Quality Code: B,   Number: 1575,   Percentage: 20.39%
Quality Code: C,   Number: 628,   Percentage: 8.13%
Quality Code: E,   Number: 695,   Percentage: 9.0%
Quality Code: I,   Number: 63,   Percentage: 0.82%

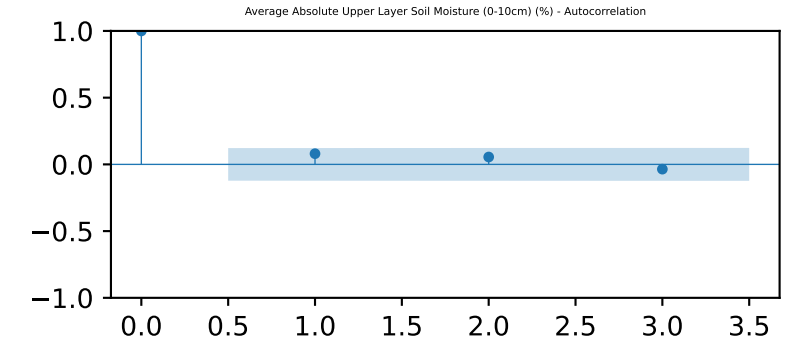

Average Standing Water Level (m)
10
8
6
2000
2004
2008
2012
2016
2020
Average Absolute Root Zone Soil Moisture (0-100cm) (%)
0.6
0.5
0.4
2000
2004
2008
2012
2016
2020
Average Absolute Upper Layer Soil Moisture (0-10cm) (%)
0.10
0.05
0.00
2000
2004
2008
2012
2016
2020
Average Absolute Deep Drainage (below 6m) (mm)
0.8
0.7
2000
2004
2008
2012
2016
2020
Average Evapotranspiration - Morton's Areal Actual Evapotranspiration (mm)
4
2
2000
2004
2008
2012
2016
2020
Average Absolute Deep Layer Soil Moisture (1-6m) (%)
0.575
0.550
0.525
2000
2004
2008
2012
2016
2020

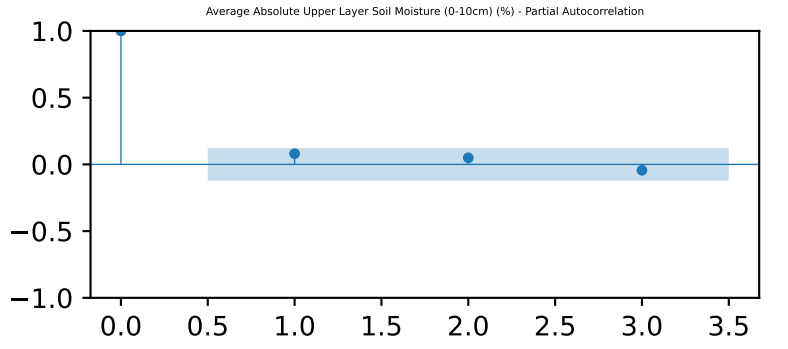

Average Standing Water Level (m) - Autocorrelation

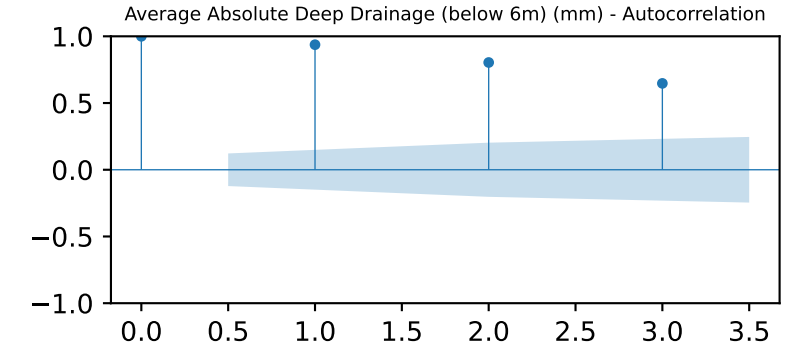

Average Standing Water Level (m) - Partial Autocorrelation

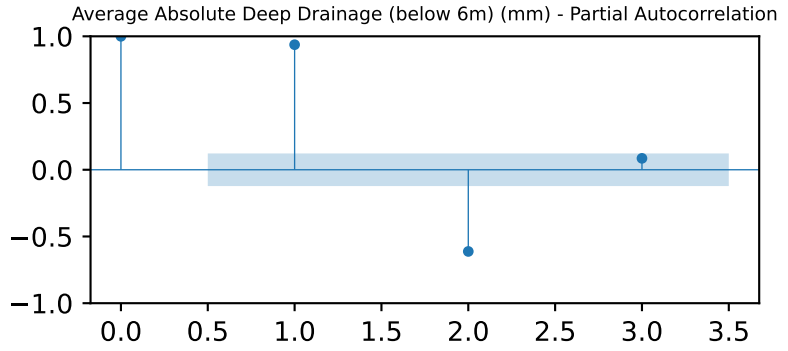

Average Absolute Root Zone Soil Moisture (0-100cm) (%) - Autocorrelation

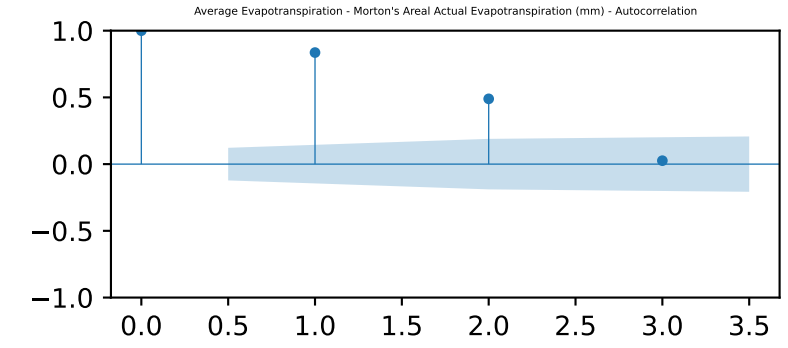

Average Absolute Root Zone Soil Moisture (0-100cm) (%) - Partial Autocorrelation

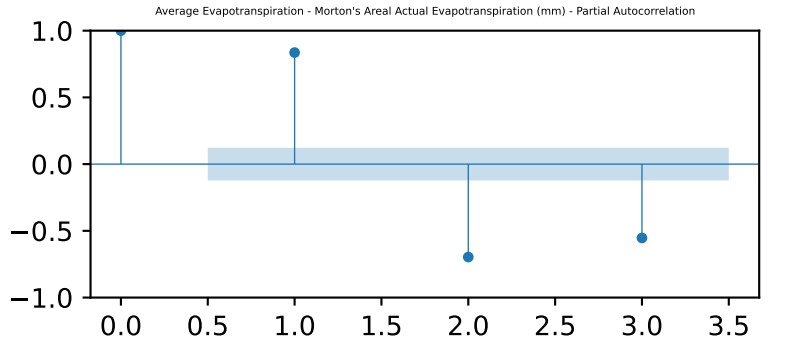

Average Absolute Upper Layer Soil Moisture (0-10cm) (%) - Autocorrelation

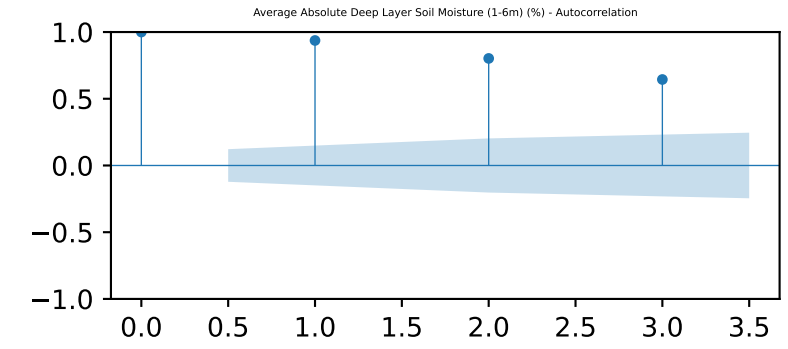

Average Absolute Upper Layer Soil Moisture (0-10cm) (%) - Partial Autocorrelation

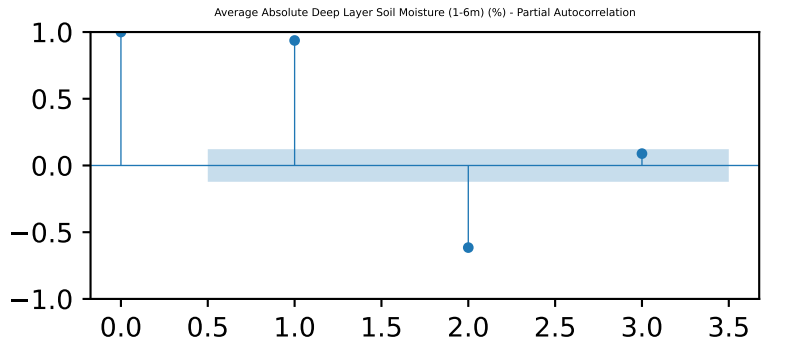

Average Absolute Deep Drainage (below 6m) (mm) - Autocorrelation

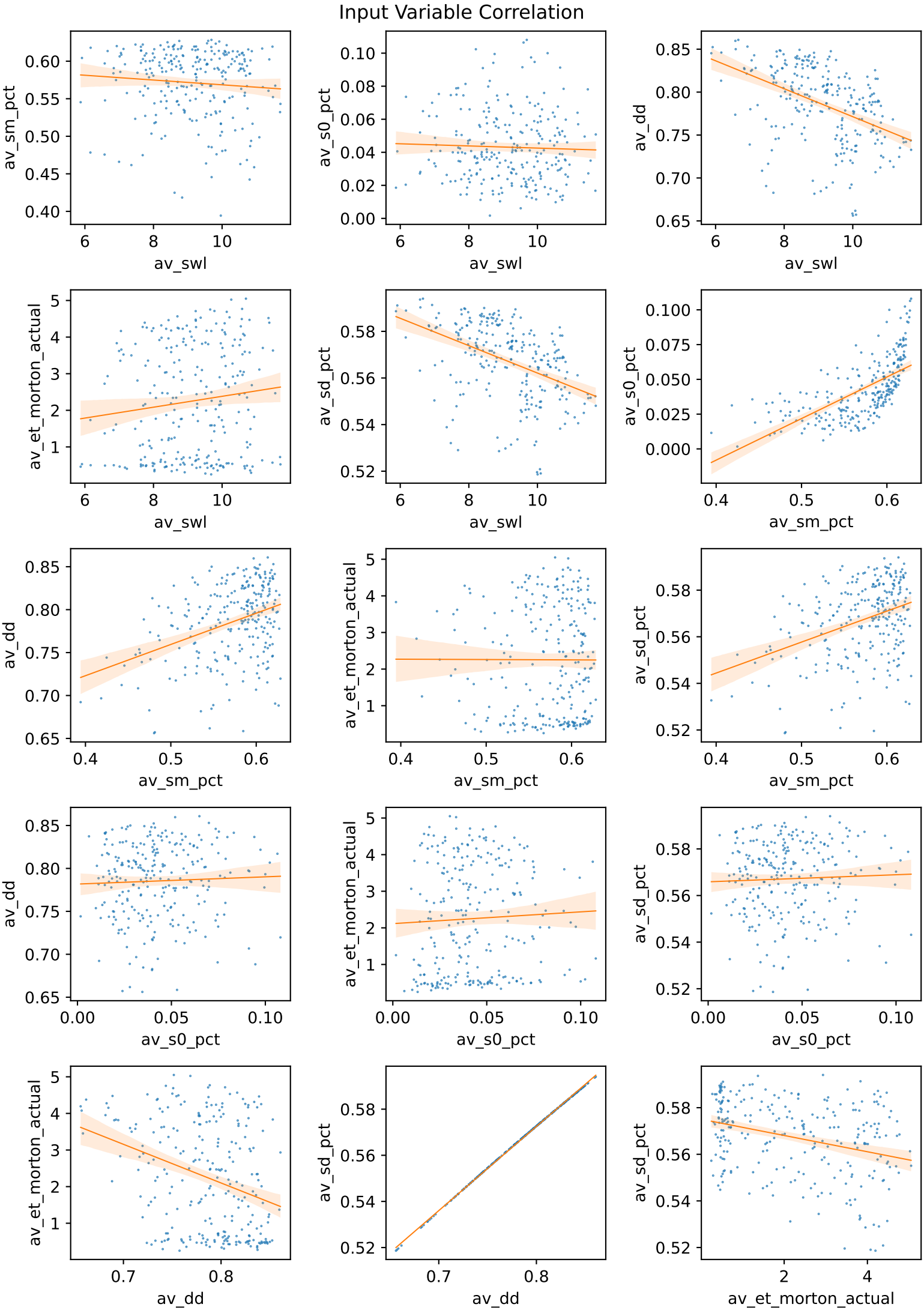

Average Absolute Deep Drainage (below 6m) (mm) - Partial Autocorrelation

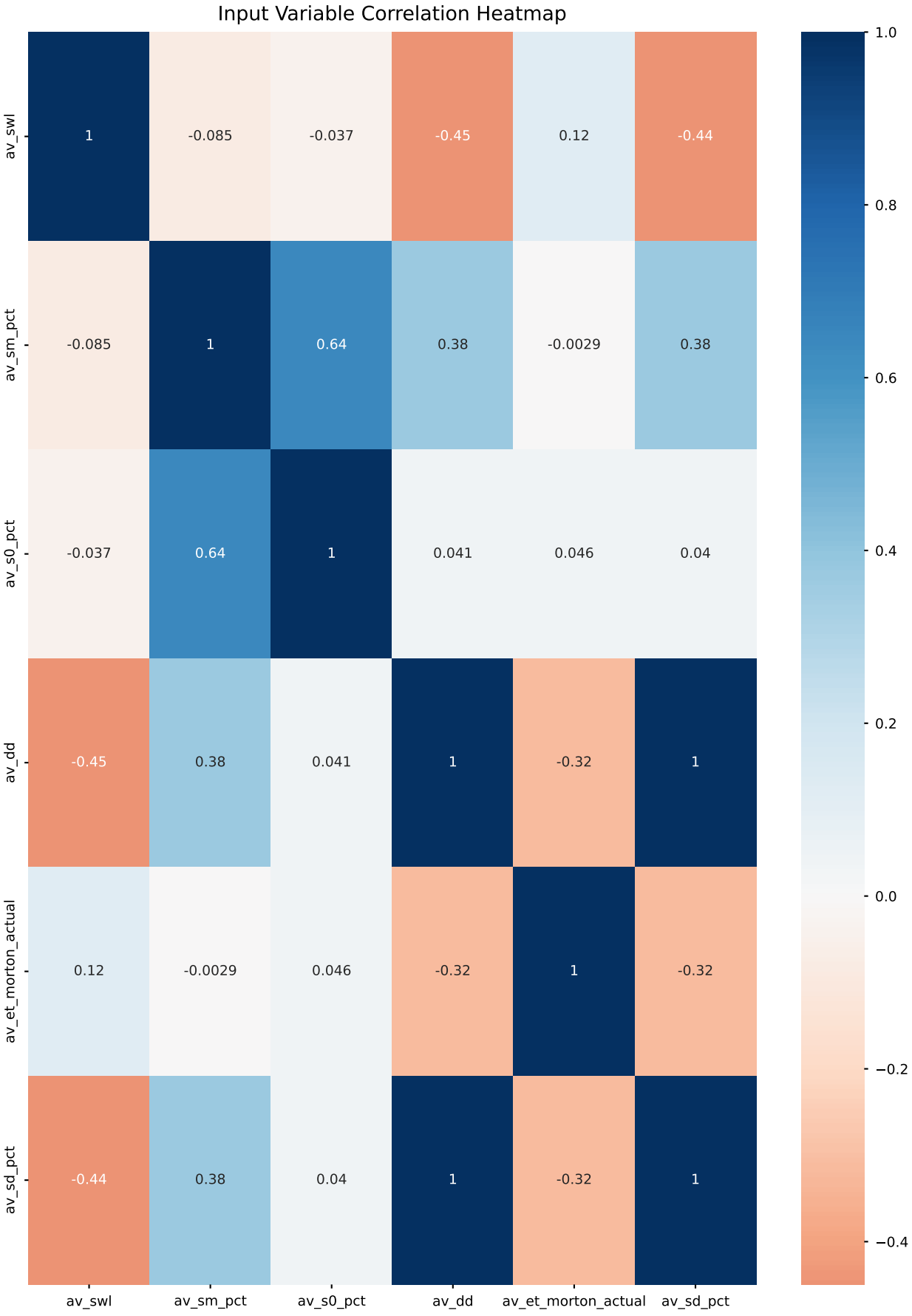

Average Evapotranspiration - Morton's Areal Actual Evapotranspiration (mm) - Autocorrelation


Average Evapotranspiration - Morton's Areal Actual Evapotranspiration (mm) - Partial Autocorrelation


Average Absolute Deep Layer Soil Moisture (1-6m) (%) - Autocorrelation


Average Absolute Deep Layer Soil Moisture (1-6m) (%) - Partial Autocorrelation


Input Variable Correlation
av_sm_pct
av_swl
av_s0_pct
av_dd
av_et_morton_actual
av_sd_pct


Input Variable Correlation Heatmap
av_swl
av_sm_pct
av_s0_pct
av_dd
av_et_morton_actual
av_sd_pct
1
-0.085
-0.037
-0.45
0.12
-0.44
-0.085
1
0.64
0.38
-0.0029
0.38
-0.037
0.64
1
0.041
0.046
0.04
-0.45
0.38
0.041
1
-0.32
1
0.12
-0.0029
0.046
-0.32
1
-0.32
-0.44
0.38
0.04
1
-0.32
1
av_swl
av_sm_pct
av_s0_pct
av_dd
av_et_morton_actual
av_sd_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, 6)
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_29"

Layer (type)	Output Shape	Param #
lstm_29 (LSTM)	(None, 64)	18176
dense_87 (Dense)	(None, 32)	2080
dense_88 (Dense)	(None, 32)	1056
dense_89 (Dense)	(None, 1)	33

Total params: 21,345
Trainable params: 21,345
Non-trainable params: 0

<><> Training Loss <><>

Epoch: 10, Loss: 0.03119635581970215
Epoch: 20, Loss: 0.024884965270757675
Epoch: 30, Loss: 0.016329988837242126
Epoch: 40, Loss: 0.01946192979812622
Epoch: 50, Loss: 0.016518646851181984
Epoch: 60, Loss: 0.01949523761868477
Epoch: 70, Loss: 0.013586128130555153
Epoch: 80, Loss: 0.01732061617076397
Epoch: 90, Loss: 0.012095574289560318
Epoch: 100, Loss: 0.018889999017119408

<><> Validation Loss <><>

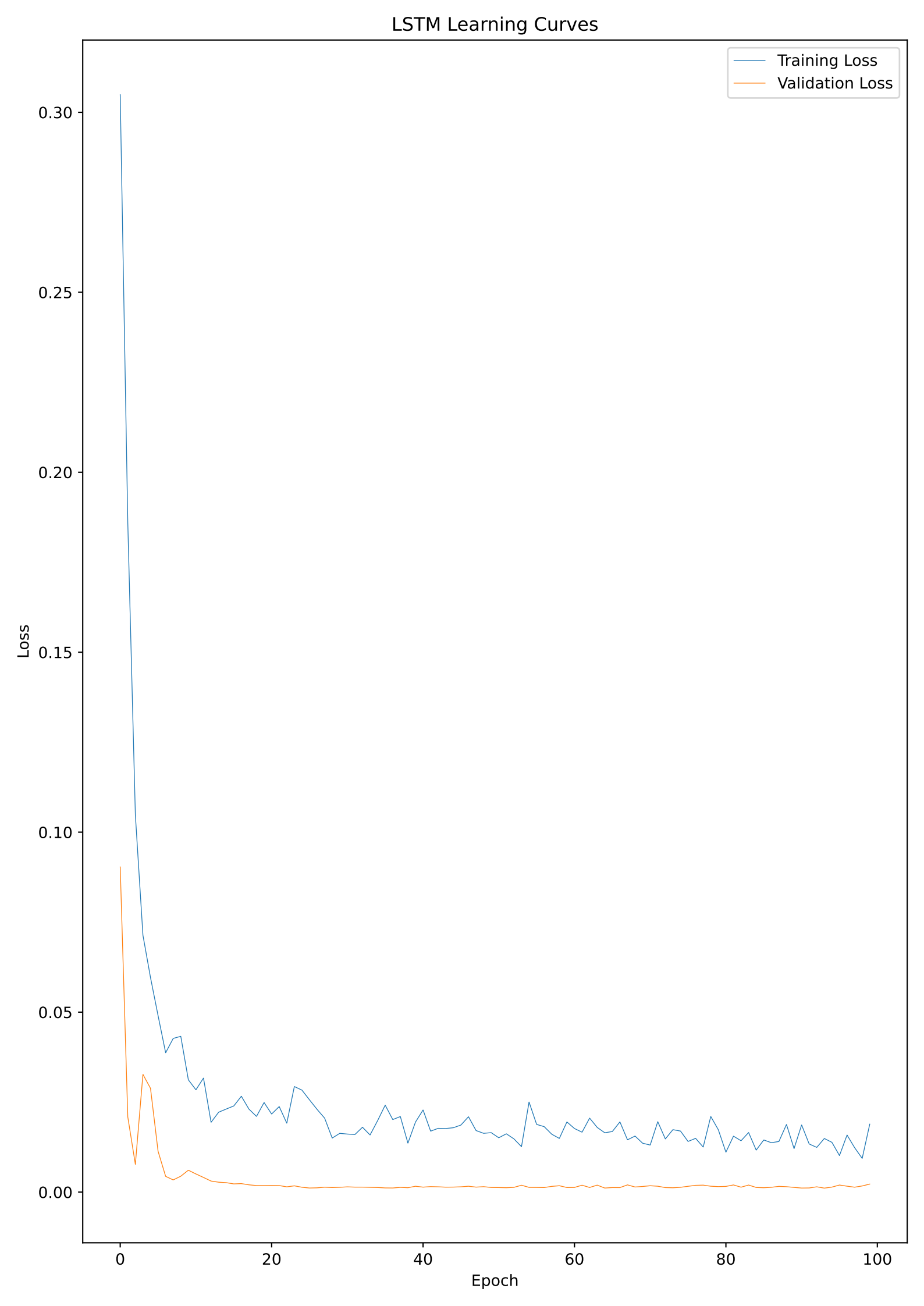
Epoch: 10,   Loss: 0.006086044479161501
Epoch: 20,   Loss: 0.0018222484504804015
Epoch: 30,   Loss: 0.0013423931086435914
Epoch: 40,   Loss: 0.0016299294074997306
Epoch: 50,   Loss: 0.0012974145356565714
Epoch: 60,   Loss: 0.0012795120710507035
Epoch: 70,   Loss: 0.001569148269481957
Epoch: 80,   Loss: 0.0015295208431780338
Epoch: 90,   Loss: 0.0013102965895086527
Epoch: 100,   Loss: 0.002236552070826292

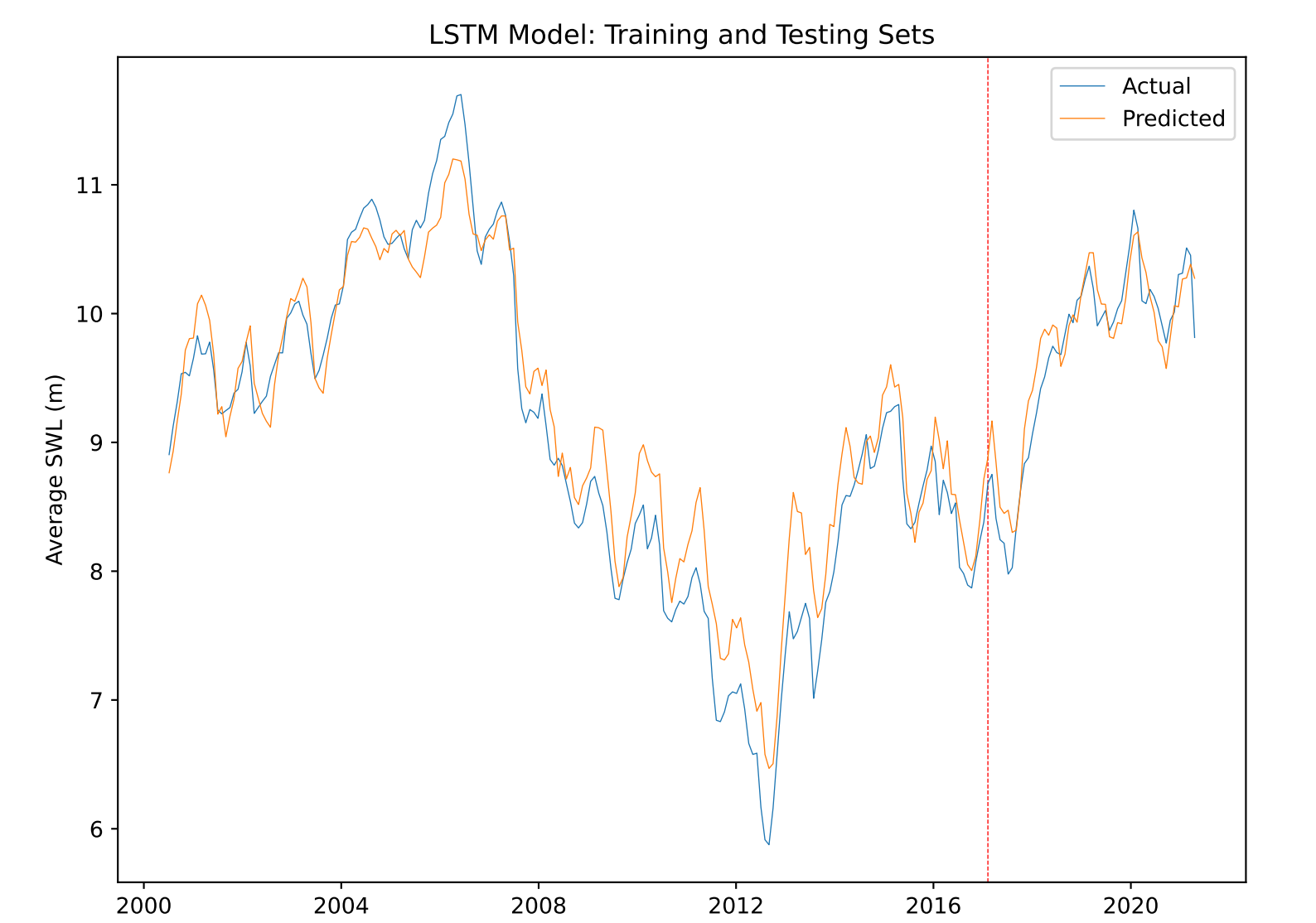
<><> Training Set Scores <><>

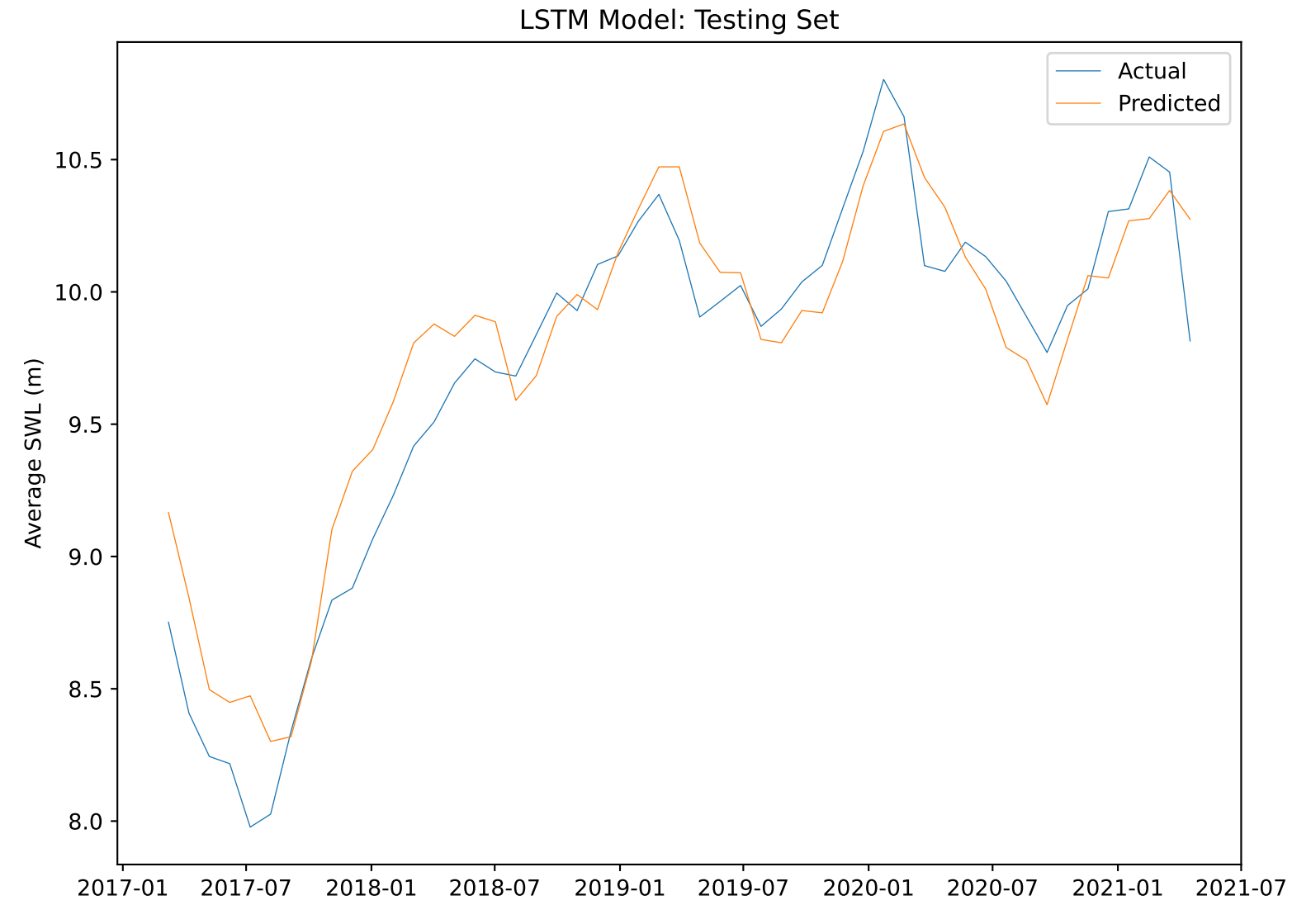
Train Root Mean Squared Error: 0.05949
Train Mean Squared Error: 0.00354
Train Normalised Root Mean Squared Error: 0.05949
Train Coefficient of Determination: 0.92768
Train Normalised Nash Sutcliffe Efficiency: 0.93256
Train Mean Absolute Error: 0.04839
Train Pearson's Correlation Coefficient: 0.98253
Train Index of Agreement: 0.97841
Train Kling-Gupta Efficiency: 0.82436
Train Mean Bias Error: 0.02734
Train Mean Absolute Percentage Error: 0.03368

<><> Test Set Scores <><>

Test Root Mean Squared Error: 0.04006
Test Mean Squared Error: 0.00161
Test Normalised Root Mean Squared Error: 0.08259
Test Coefficient of Determination: 0.89392
Test Normalised Nash Sutcliffe Efficiency: 0.90409
Test Mean Absolute Error: 0.03331
Test Pearson's Correlation Coefficient: 0.95691
Test Index of Agreement: 0.96858
Test Kling-Gupta Efficiency: 0.84364
Test Mean Bias Error: 0.01262
Test Mean Absolute Percentage Error: 0.0206


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: 26
Input/Support Vector Size: 18

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

Epoch: 10,   Loss: 0.002082817861608958
Epoch: 20,   Loss: 0.002532830696526749
Epoch: 30,   Loss: 0.003637429450888892
Epoch: 40,   Loss: 0.005064765630846782
Epoch: 50,   Loss: 0.005026847539975412
Epoch: 60,   Loss: 0.00463636753194459
Epoch: 70,   Loss: 0.004117808919399804
Epoch: 80,   Loss: 0.003836372128260012
Epoch: 90,   Loss: 0.0036554586221144193
Epoch: 100,   Loss: 0.003582342859121924

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

Epoch: 10,   Loss: 0.05766848657837981
Epoch: 20,   Loss: 0.06578325478345169
Epoch: 30,   Loss: 0.06251018858623666
Epoch: 40,   Loss: 0.06161097582223202
Epoch: 50,   Loss: 0.06232558392948971
Epoch: 60,   Loss: 0.0507787883129817
Epoch: 70,   Loss: 0.030149945607059147
Epoch: 80,   Loss: 0.023433401858271117
Epoch: 90,   Loss: 0.023476870812265564
Epoch: 100,   Loss: 0.022306445246000763

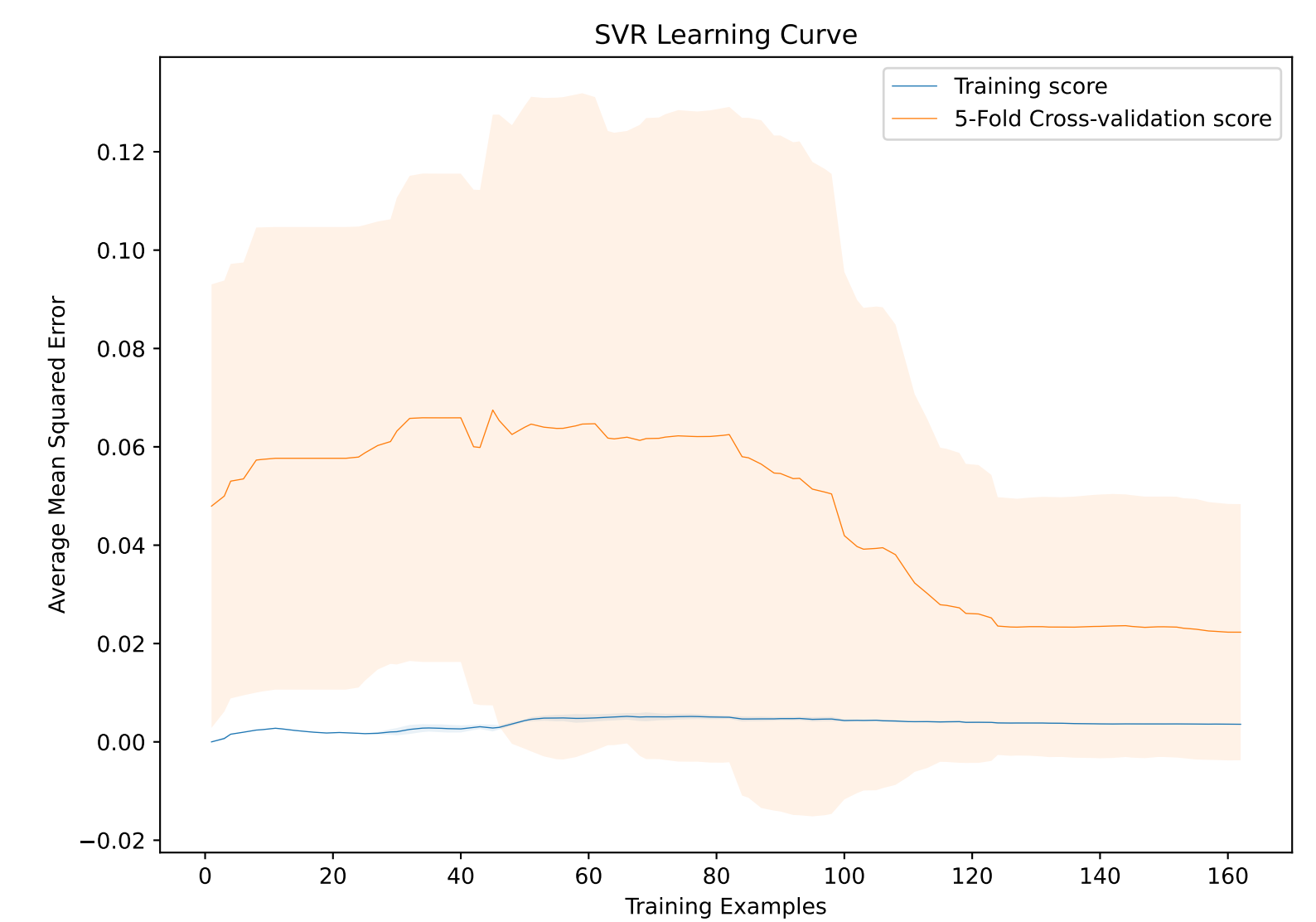
<><> Training Set Scores <><>

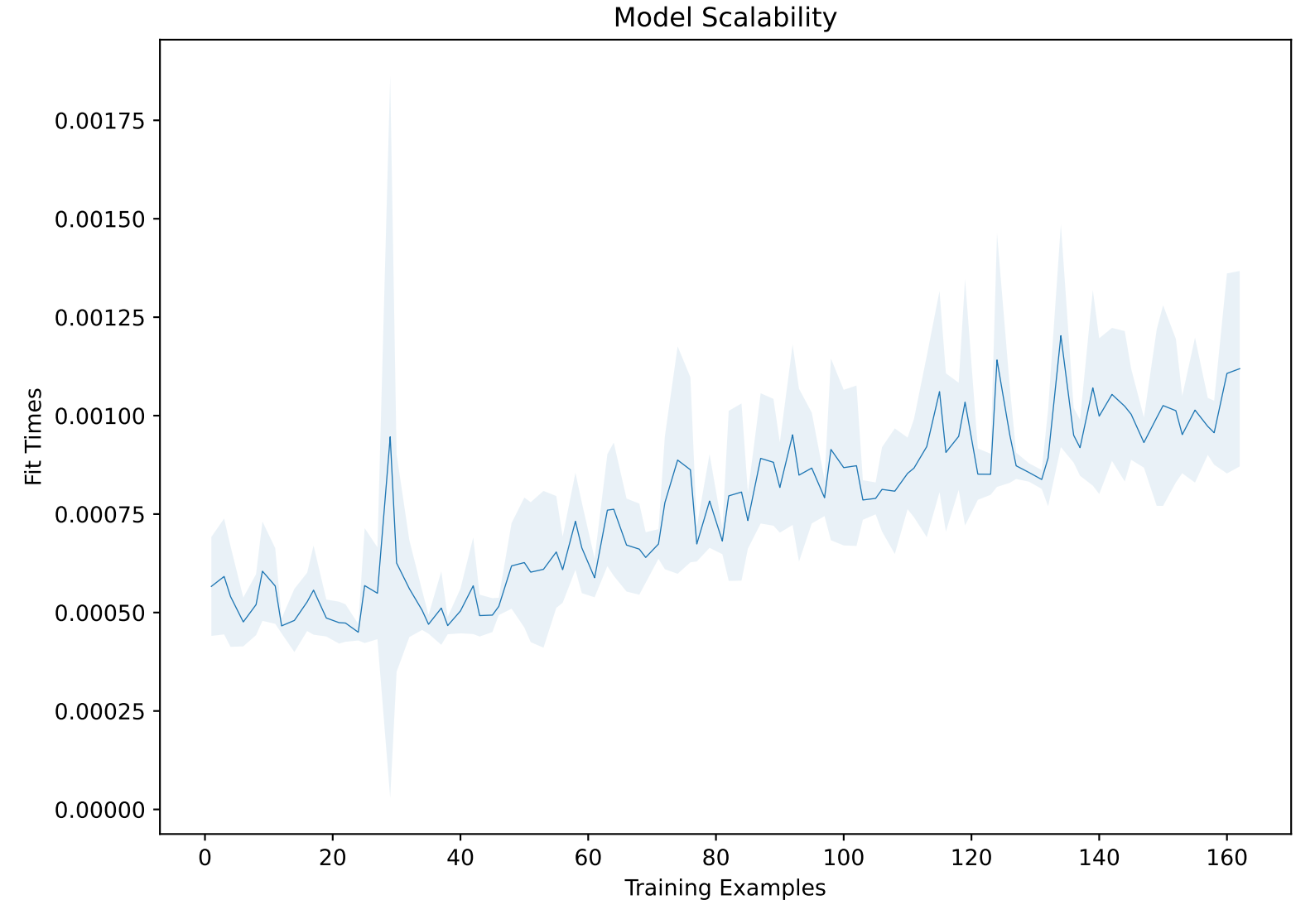
Train Root Mean Squared Error: 0.05669
Train Mean Squared Error: 0.00321
Train Normalised Root Mean Squared Error: 0.05669
Train Coefficient of Determination: 0.93432
Train Normalised Nash Sutcliffe Efficiency: 0.93837

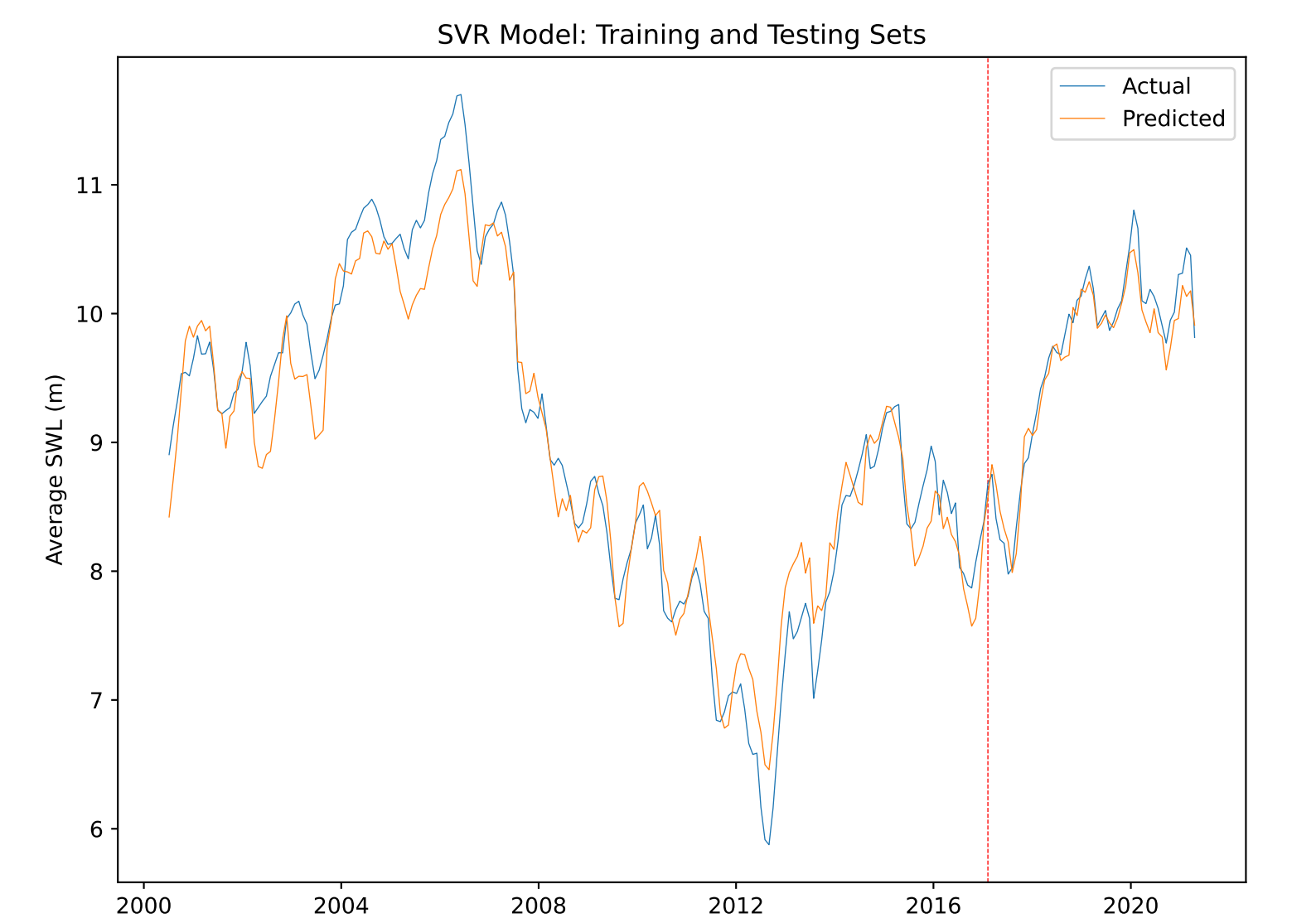
Train Mean Absolute Error: 0.04662
Train Pearson's Correlation Coefficient: 0.97472
Train Index of Agreement: 0.98077
Train Kling-Gupta Efficiency: 0.85483
Train Mean Bias Error: -0.01045
Train Mean Absolute Percentage Error: 0.03091

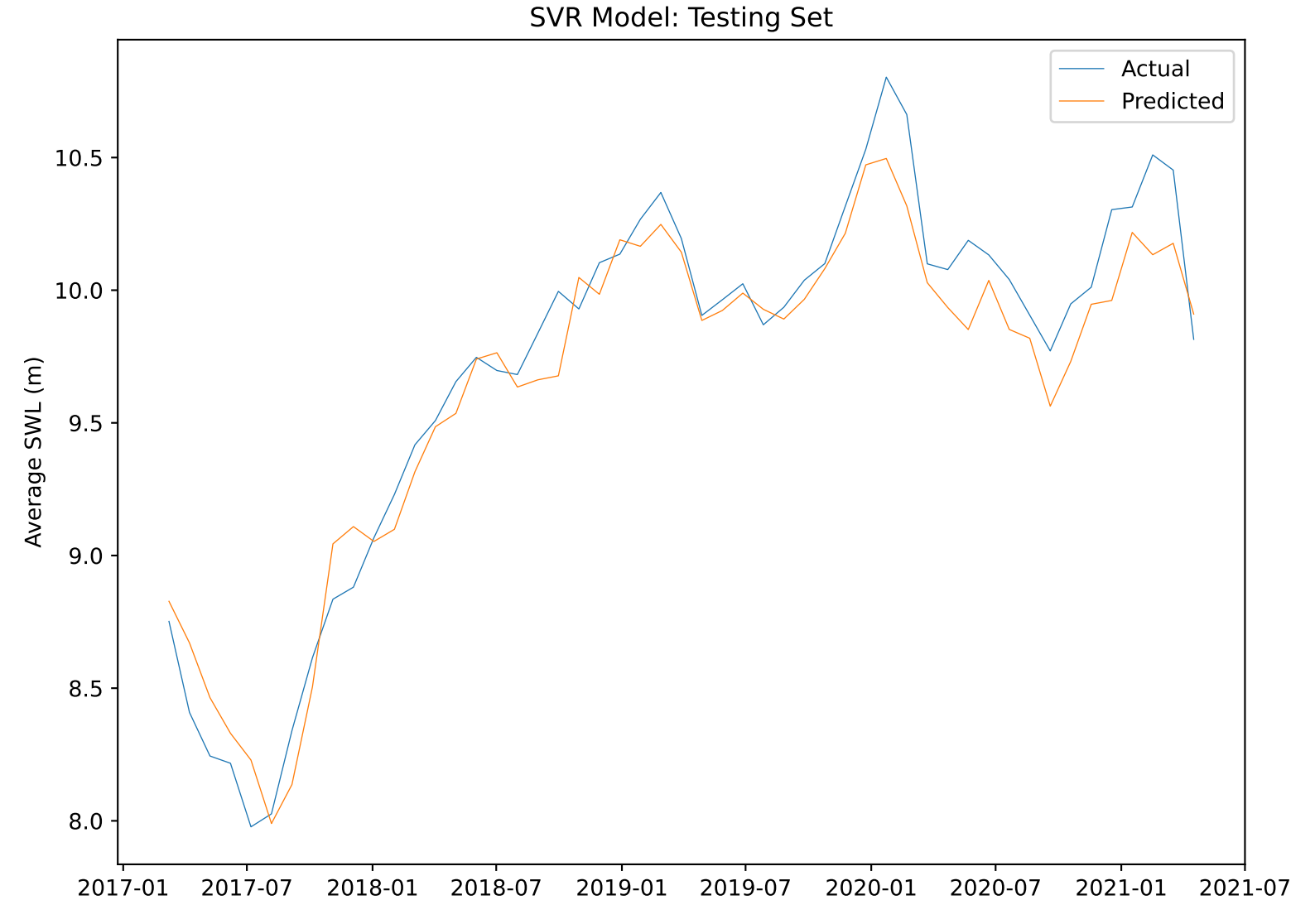
<><> Test Set Scores <><>

Test Root Mean Squared Error: 0.02913
Test Mean Squared Error: 0.00085
Test Normalised Root Mean Squared Error: 0.06006
Test Coefficient of Determination: 0.9439
Test Normalised Nash Sutcliffe Efficiency: 0.94688
Test Mean Absolute Error: 0.02348
Test Pearson's Correlation Coefficient: 0.98094
Test Index of Agreement: 0.98411
Test Kling-Gupta Efficiency: 0.88153
Test Mean Bias Error: -0.01168
Test Mean Absolute Percentage Error: 0.01416


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
0.00175
0.00150
0.00125
0.00100
0.00075
0.00050
0.00025
0.00000
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