<><> Time Stamp <><>

Code started: 07/10/2022 - 11:48:55
Total Run Time: 13.804 s

<><> Bore Information <><>

Bore ID: GW036872.1.1
Region: Coastal
Bore Coordinates: (-30.923963, 153.044423)
Agency: WaterNSW
Drilled Date: 01/08/1990
Bore Depth: 30.5 m
Drilled Depth: 30.5 m
Reference Elevation: nan m
Time Series Reference Elevation: nan m
Land Surface Elevation: nan m
Silo Grid Point Coordinates: (-30.9, 153.05)

<><> Model Output <><>

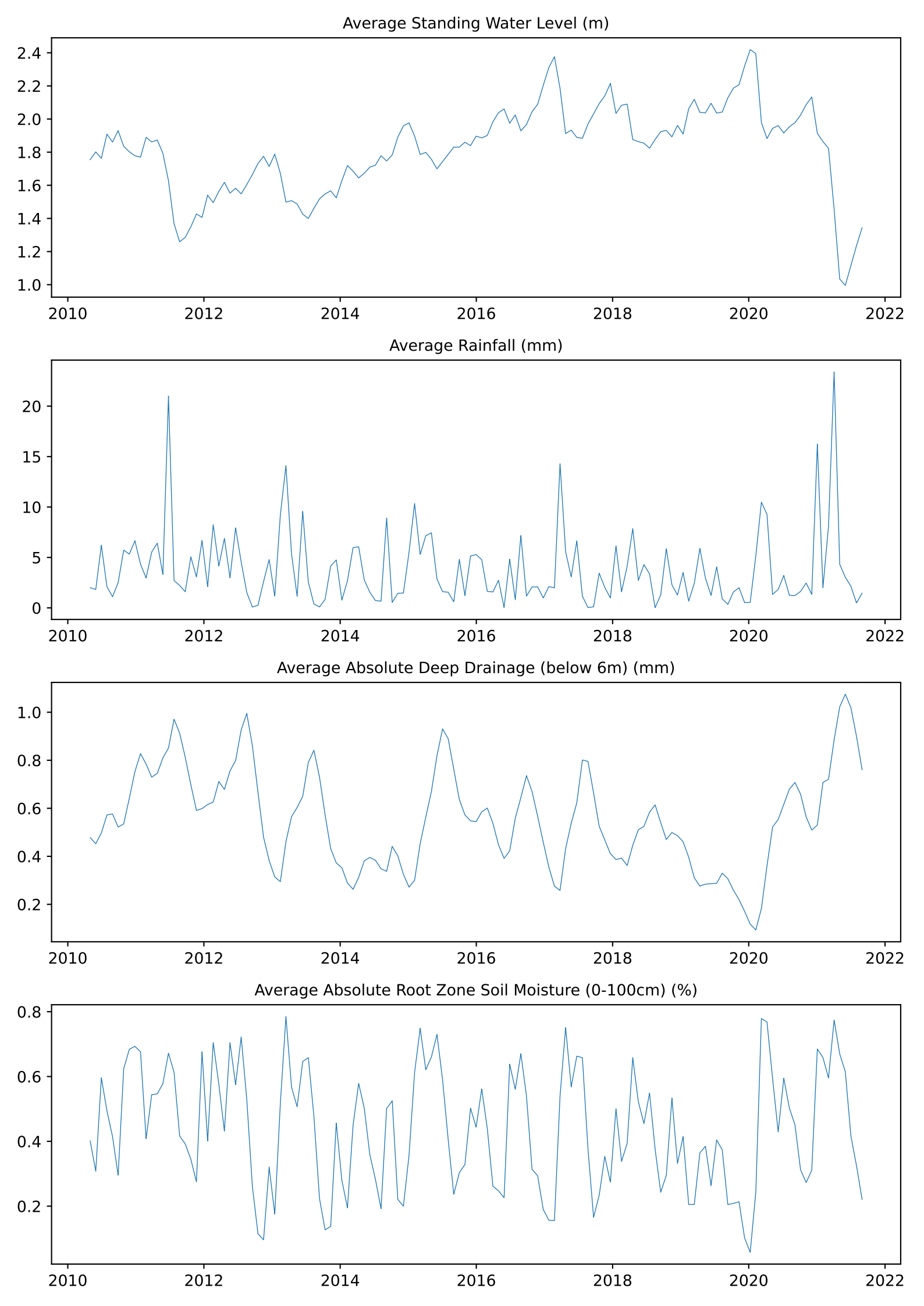
Averaged Period: 30 day(s)
Output: Average Standing Water Level (m) in 1 period(s) time

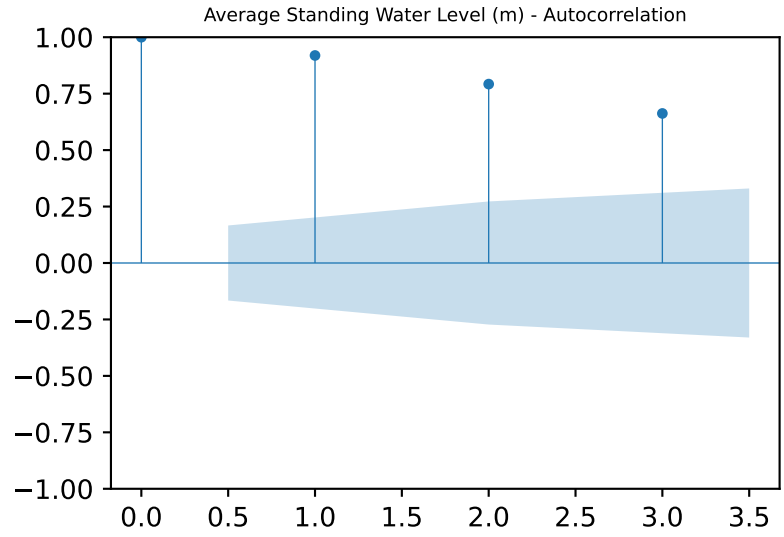
<><> Model Inputs <><>

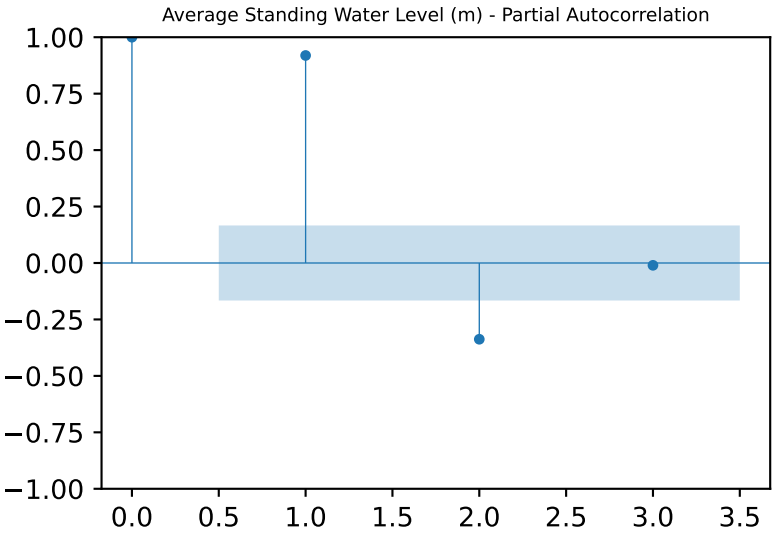
Data Range: 01/05/2010 - 31/08/2021
Train Set Size: 80.0%
Test Set Size: 20.0%
Input Timesteps: Current period + 2 preceeding period(s)
Input Variables:
    Average Standing Water Level (m)
    Average Rainfall (mm)
    Average Absolute Deep Drainage (below 6m) (mm)
    Average Absolute Root Zone Soil Moisture (0-100cm) (%)

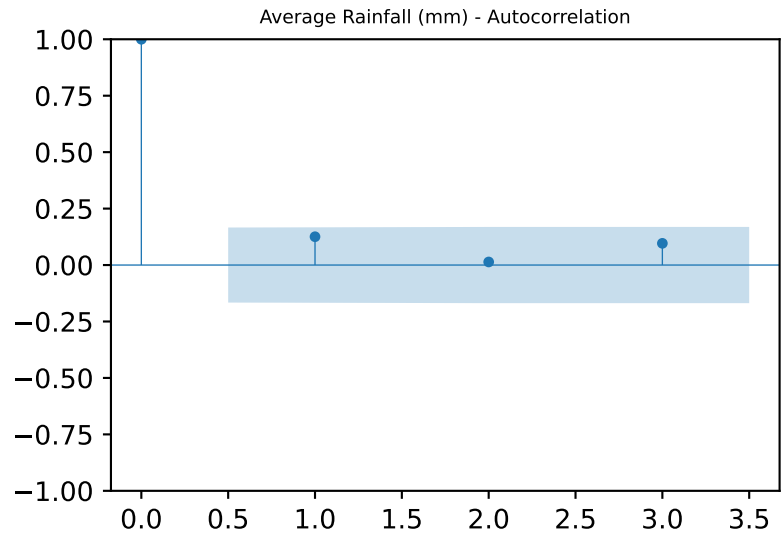
<><> Data Quality <><>

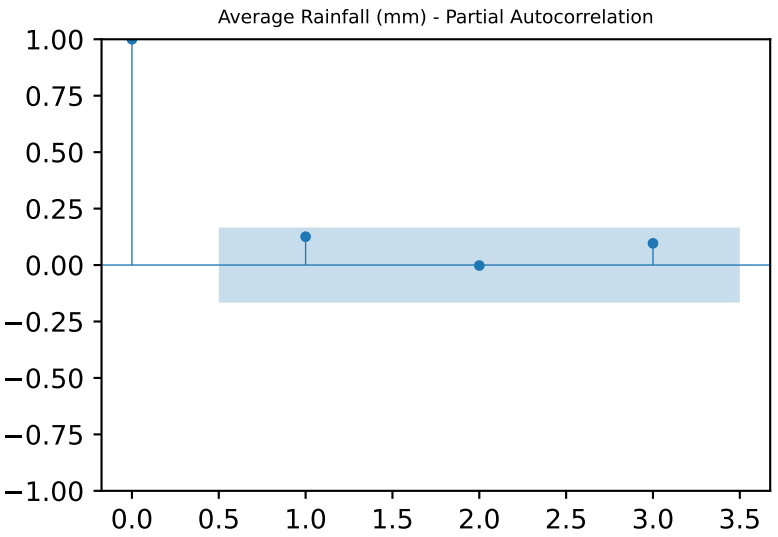
Interpolation Method: Spline
Quality Code: A,   Number: 3434,   Percentage: 82.33%
Quality Code: B,   Number: 645,   Percentage: 15.46%
Quality Code: C,   Number: 92,   Percentage: 2.21%

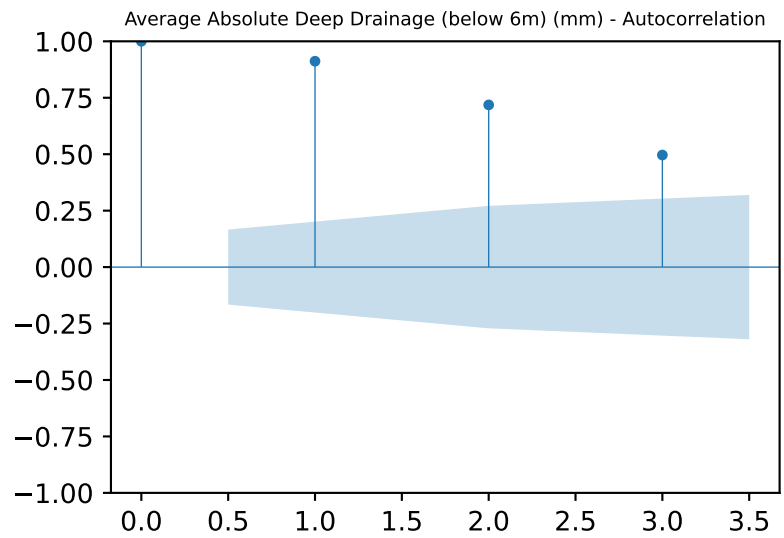

Average Standing Water Level (m)
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
2010
2012
2014
2016
2018
2020
2022
Average Rainfall (mm)
20
15
10
5
0
2010
2012
2014
2016
2018
2020
2022
Average Absolute Deep Drainage (below 6m) (mm)
1.0
0.8
0.6
0.4
0.2
2010
2012
2014
2016
2018
2020
2022
Average Absolute Root Zone Soil Moisture (0-100cm) (%)
0.8
0.6
0.4
0.2
2010
2012
2014
2016
2018
2020
2022

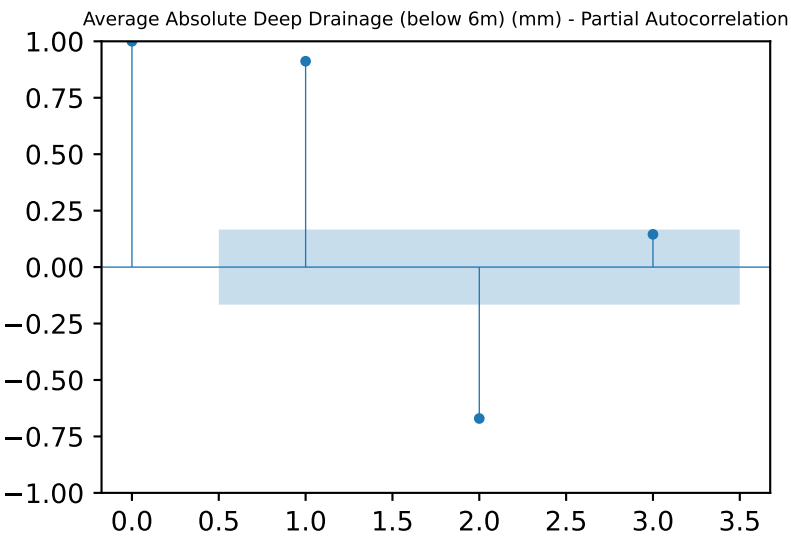

Average Standing Water Level (m) - Autocorrelation

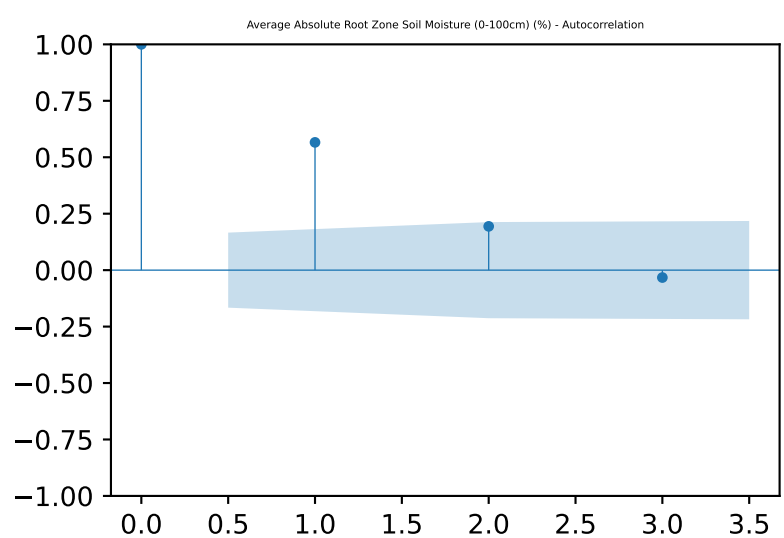

Average Standing Water Level (m) - Partial Autocorrelation

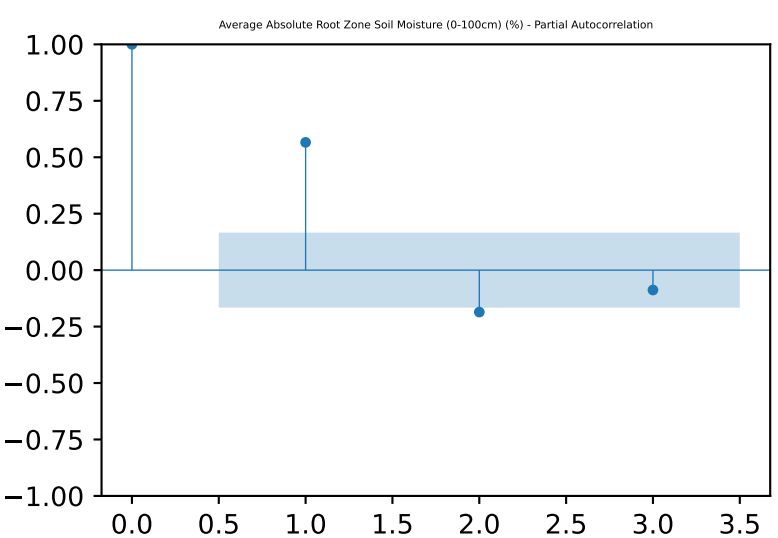

Average Rainfall (mm) - Autocorrelation

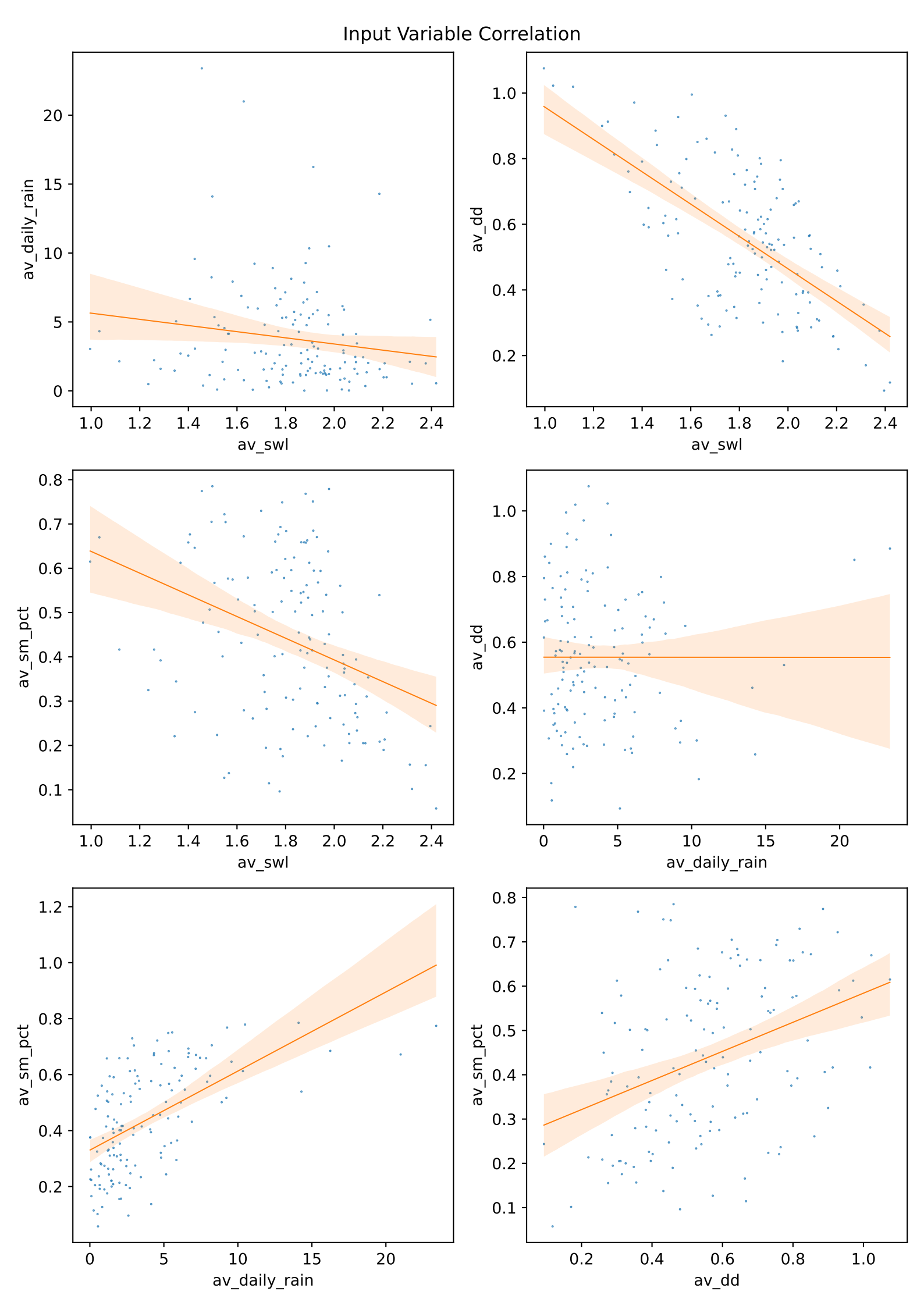

Average Rainfall (mm) - Partial Autocorrelation

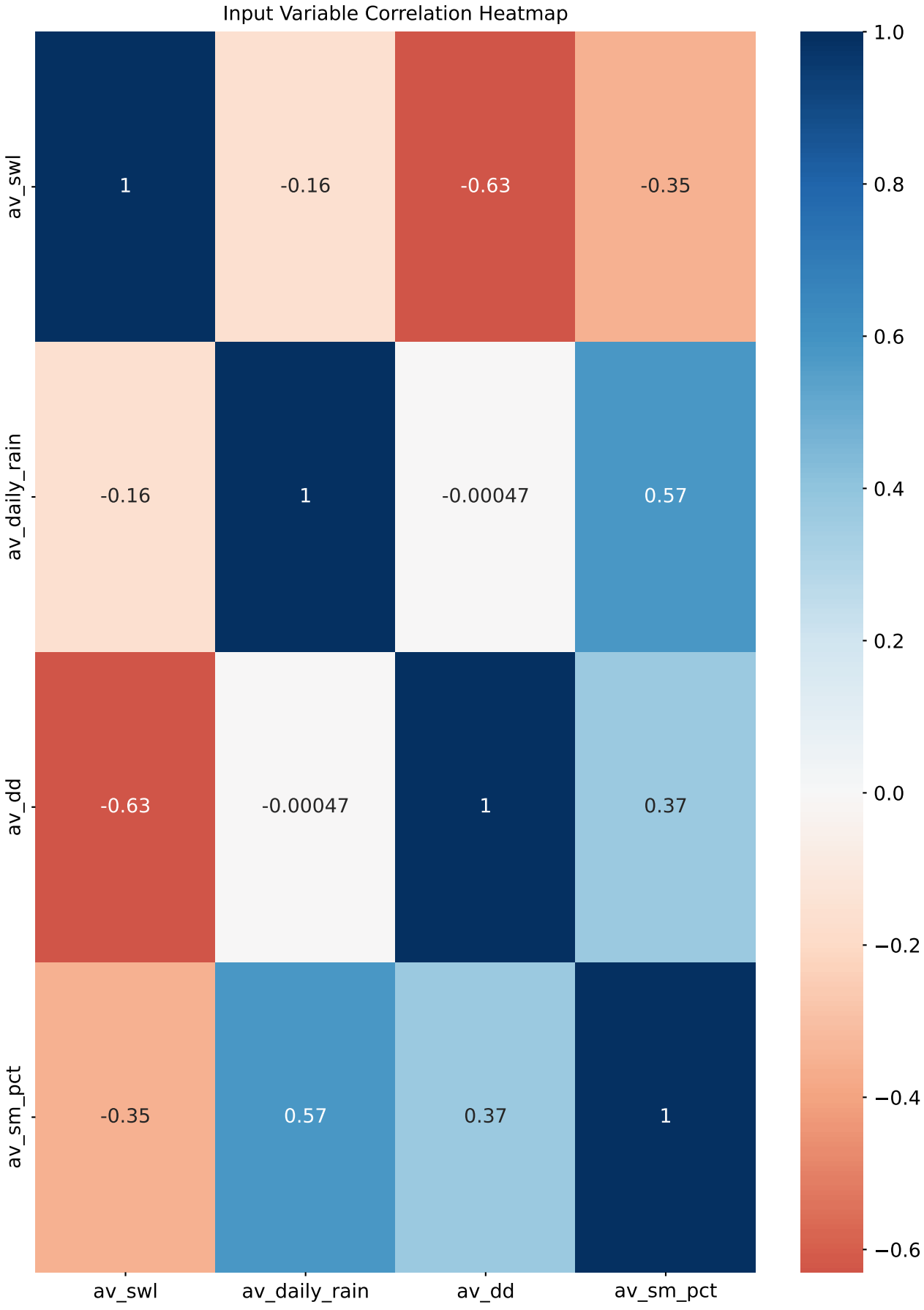

Average Absolute Deep Drainage (below 6m) (mm) - Autocorrelation


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


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


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


Input Variable Correlation
av_daily_rain
av_swl
av_dd
av_swl
av_sm_pct
av_swl
av_dd
av_daily_rain
av_sm_pct
av_daily_rain
av_sm_pct
av_dd


Input Variable Correlation Heatmap
av_swl
av_daily_rain
av_dd
av_sm_pct
1
-0.16
-0.63
-0.35
-0.16
1
-0.00047
0.57
-0.63
-0.00047
1
0.37
-0.35
0.57
0.37
1
av_swl
av_daily_rain
av_dd
av_sm_pct
1.0
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6

<><> 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): (108, 3, 4)
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_44"

| Layer (type) | Output Shape | Param # |
|---|---|---|
| lstm_44 (LSTM) | (None, 64) | 17664 |
| dense_132 (Dense) | (None, 32) | 2080 |
| dense_133 (Dense) | (None, 32) | 1056 |
| dense_134 (Dense) | (None, 1) | 33 |

Total params: 20,833
Trainable params: 20,833
Non-trainable params: 0

<><> Training Loss <><>

Epoch: 10,   Loss: 0.05627306178212166
Epoch: 20,   Loss: 0.023843633010983467
Epoch: 30,   Loss: 0.015527087263762951
Epoch: 40,   Loss: 0.013658182695508003
Epoch: 50,   Loss: 0.012607245706021786
Epoch: 60,   Loss: 0.017194772139191628
Epoch: 70,   Loss: 0.01196287851780653
Epoch: 80,   Loss: 0.012874209322035313
Epoch: 90,   Loss: 0.01653510518372059
Epoch: 100,   Loss: 0.012508458457887173

<><> Validation Loss <><>

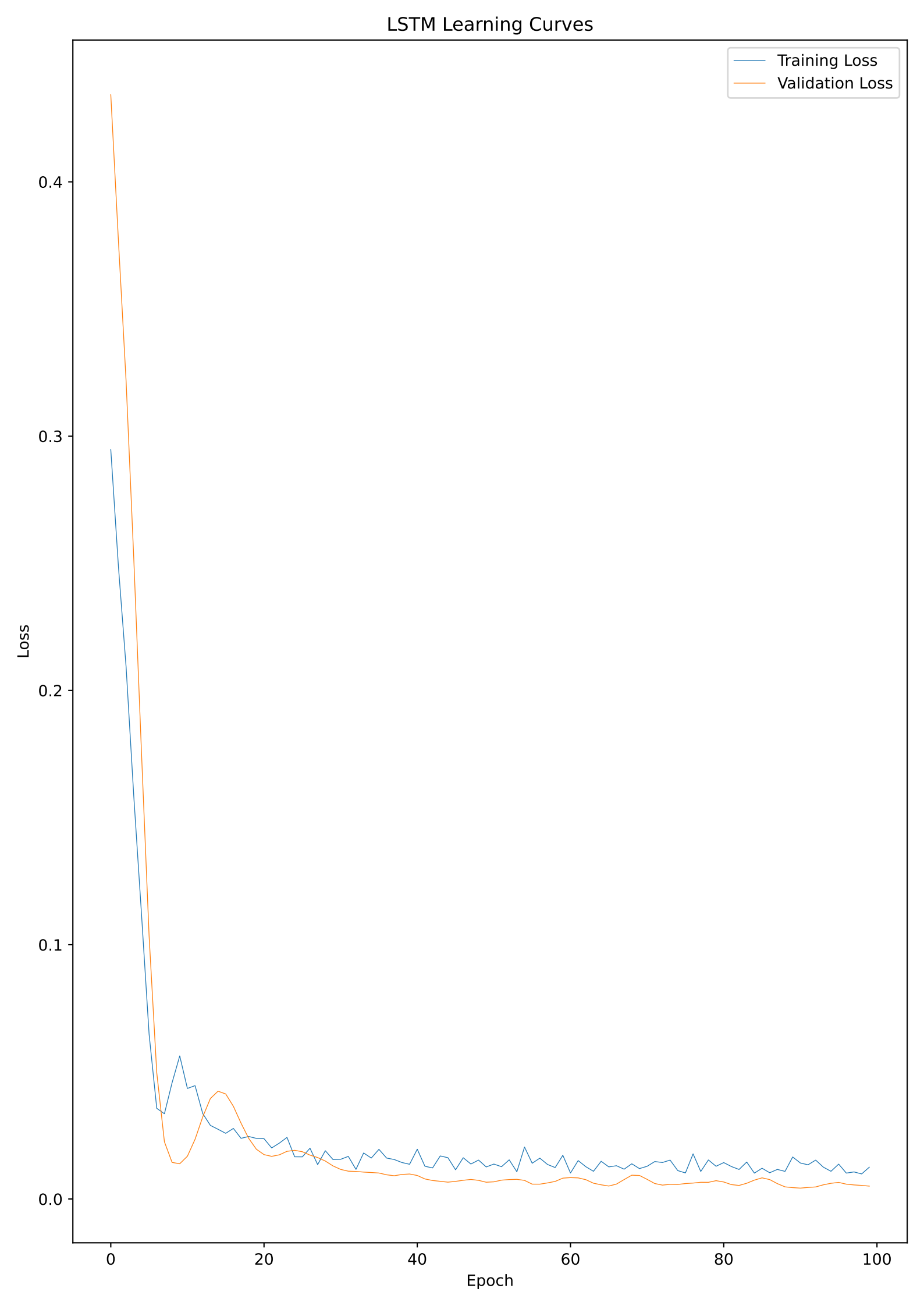
Epoch: 10,   Loss: 0.013861458748579025
Epoch: 20,   Loss: 0.019581647589802742
Epoch: 30,   Loss: 0.013018547557294369
Epoch: 40,   Loss: 0.009833306074142456
Epoch: 50,   Loss: 0.006599049083888531
Epoch: 60,   Loss: 0.008207541890442371
Epoch: 70,   Loss: 0.009261398576200008
Epoch: 80,   Loss: 0.007206635549664497
Epoch: 90,   Loss: 0.004479413852095604
Epoch: 100,   Loss: 0.005064154043793678

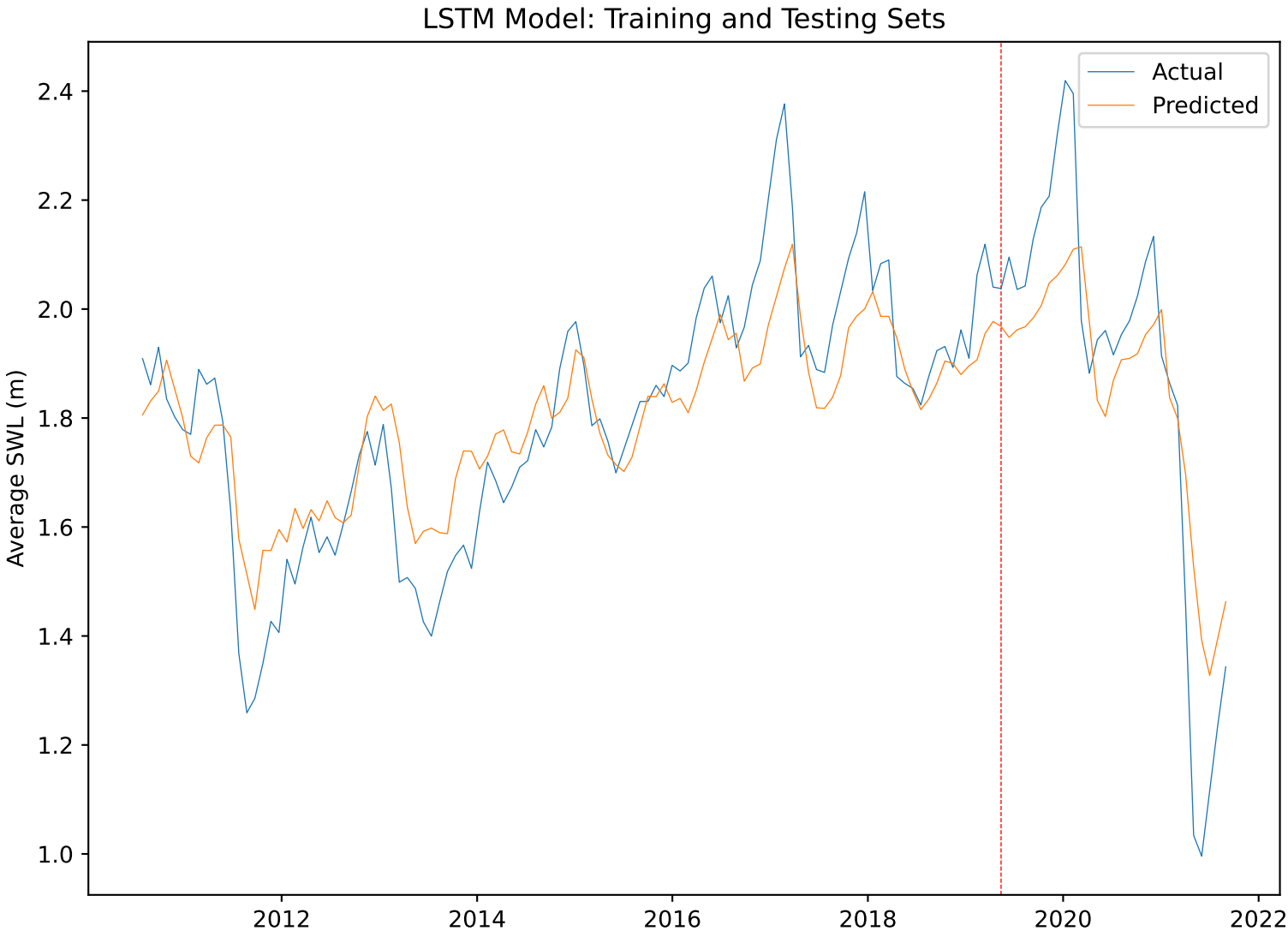
<><> Training Set Scores <><>

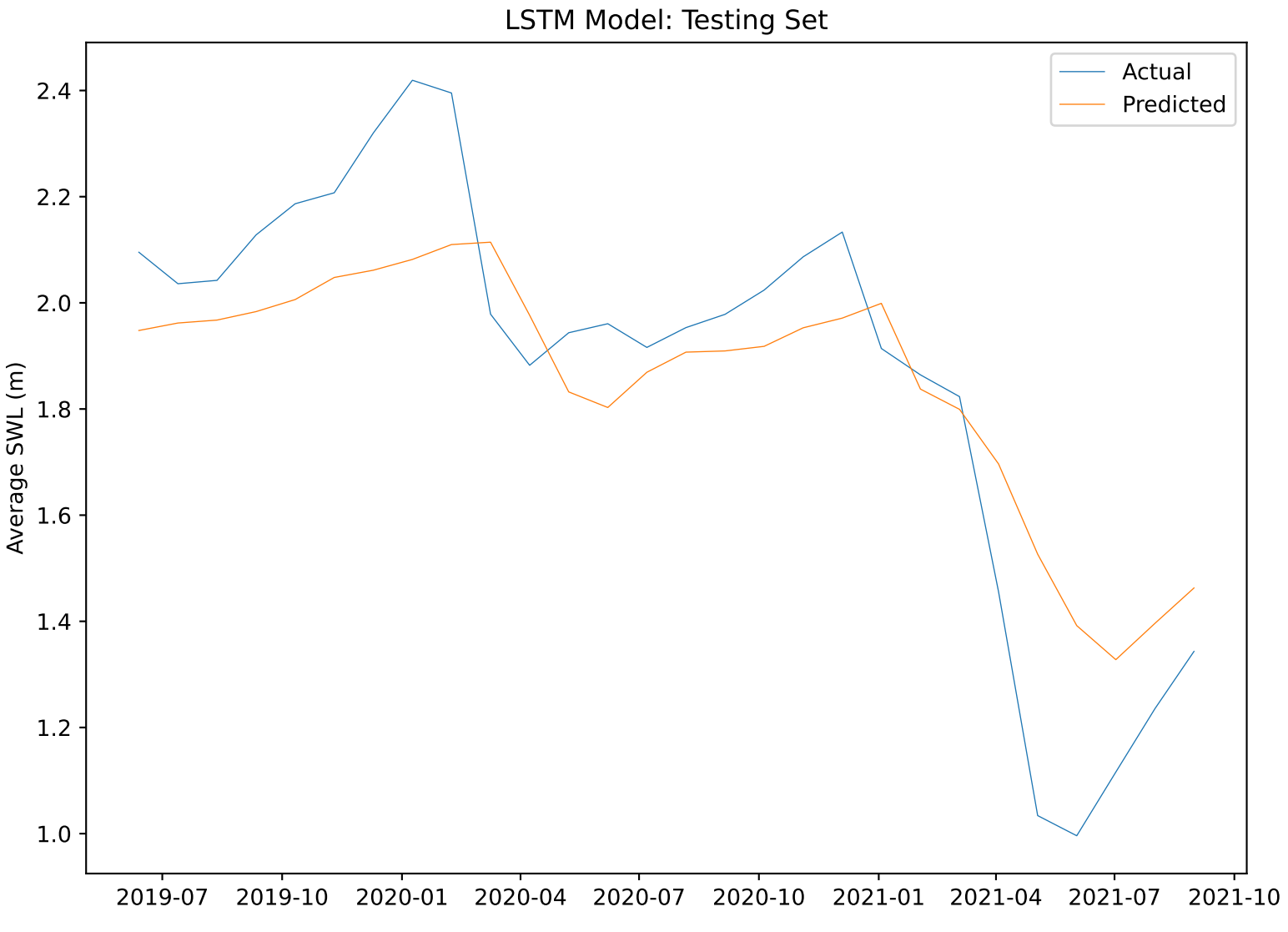
Train Root Mean Squared Error:   0.0795
Train Mean Squared Error:   0.00632
Train Normalised Root Mean Squared Error:   0.10127
Train Coefficient of Determination:   0.74667
Train Normalised Nash Sutcliffe Efficiency:   0.79787
Train Mean Absolute Error:   0.06321
Train Pearson's Correlation Coefficient:   0.92142
Train Index of Agreement:   0.89815
Train Kling-Gupta Efficiency:   0.59406
Train Mean Bias Error:   -0.002
Train Mean Absolute Percentage Error:   0.05144

<><> Test Set Scores <><>

Test Root Mean Squared Error:   0.13631
Test Mean Squared Error:   0.01858
Test Normalised Root Mean Squared Error:   0.13631
Test Coefficient of Determination:   0.75156
Test Normalised Nash Sutcliffe Efficiency:   0.801
Test Mean Absolute Error:   0.11248
Test Pearson's Correlation Coefficient:   0.94406
Test Index of Agreement:   0.89762
Test Kling-Gupta Efficiency:   0.57014
Test Mean Bias Error:   -0.01531
Test Mean Absolute Percentage Error:   0.09958


LSTM Learning Curves
Training Loss
Validation Loss
Loss
Epoch
0.0
0.1
0.2
0.3
0.4
0
20
40
60
80
100


LSTM Model: Training and Testing Sets
Actual
Predicted
Average SWL (m)
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
2012
2014
2016
2018
2020
2022


LSTM Model: Testing Set
Actual
Predicted
Average SWL (m)
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
2019-07
2019-10
2020-01
2020-04
2020-07
2020-10
2021-01
2021-04
2021-07
2021-10


LSTM Model: Training and Testing Sets
Actual
Predicted
Inverted Average SWL (m)
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2012
2014
2016
2018
2020
2022
Actual
Predicted
Inverted Average SWL (m)
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2019-07
2019-10
2020-01
2020-04
2020-07
2020-10
2021-01
2021-04
2021-07
2021-10

<><> 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: 20
Input/Support Vector Size: 12

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

Epoch: 8,   Loss: 0.0019374427545810011
Epoch: 16,   Loss: 0.00658206100054521
Epoch: 24,   Loss: 0.005878276236353975
Epoch: 32,   Loss: 0.0053705562940711115
Epoch: 40,   Loss: 0.005025177619068231
Epoch: 48,   Loss: 0.004763305960099366
Epoch: 56,   Loss: 0.004267592007814004
Epoch: 64,   Loss: 0.004320165174492026
Epoch: 72,   Loss: 0.0043240064164985995
Epoch: 80,   Loss: 0.004055122782769806

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

Epoch: 8,   Loss: 0.02183136536234781
Epoch: 16,   Loss: 0.03278169737716904
Epoch: 24,   Loss: 0.03314699926910146
Epoch: 32,   Loss: 0.028628936585510485
Epoch: 40,   Loss: 0.02644091323330467
Epoch: 48,   Loss: 0.02561856809187283
Epoch: 56,   Loss: 0.017910745025780616
Epoch: 64,   Loss: 0.018026115889585415
Epoch: 72,   Loss: 0.01151435651717271
Epoch: 80,   Loss: 0.008860935177434285

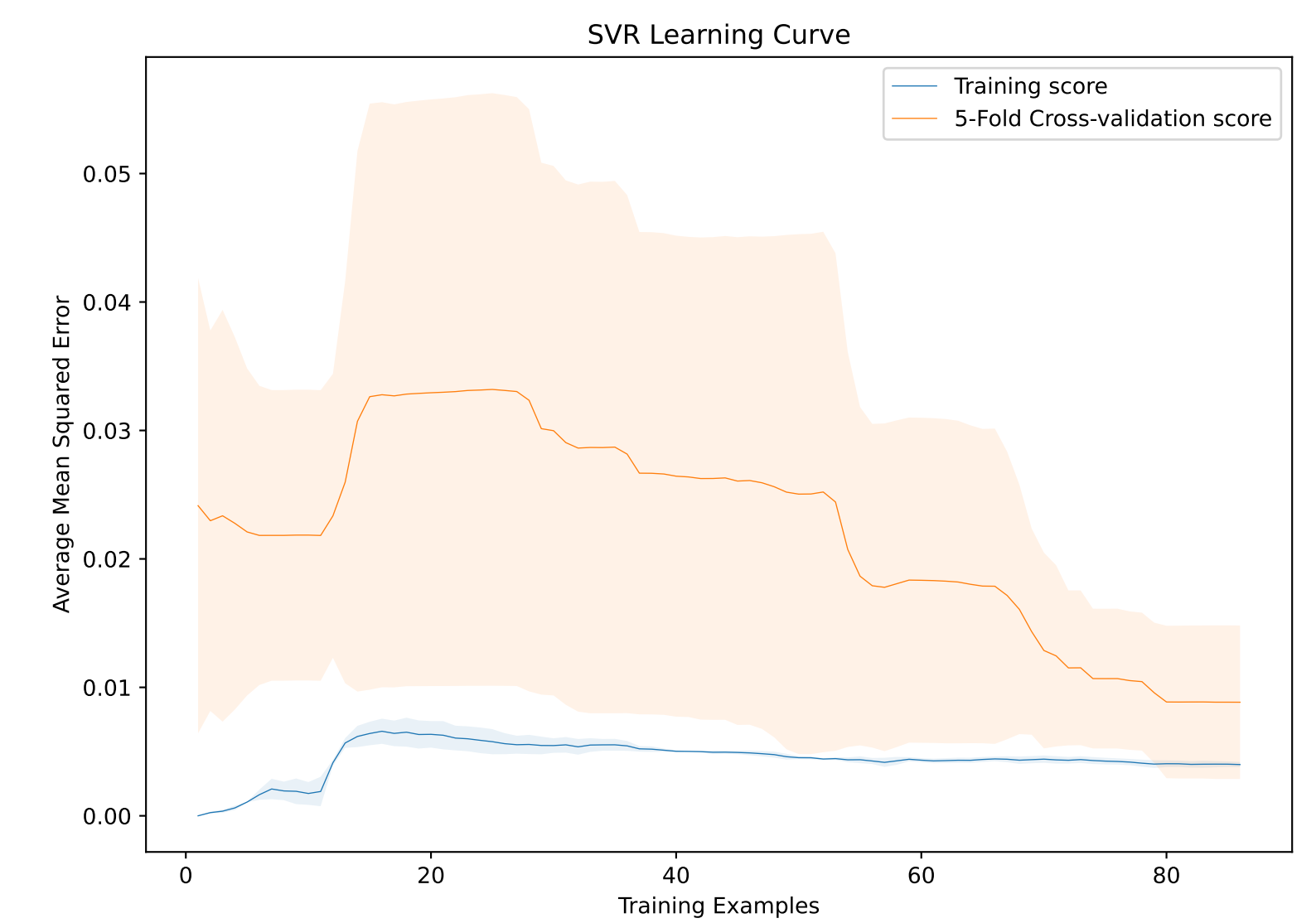
<><> Training Set Scores <><>

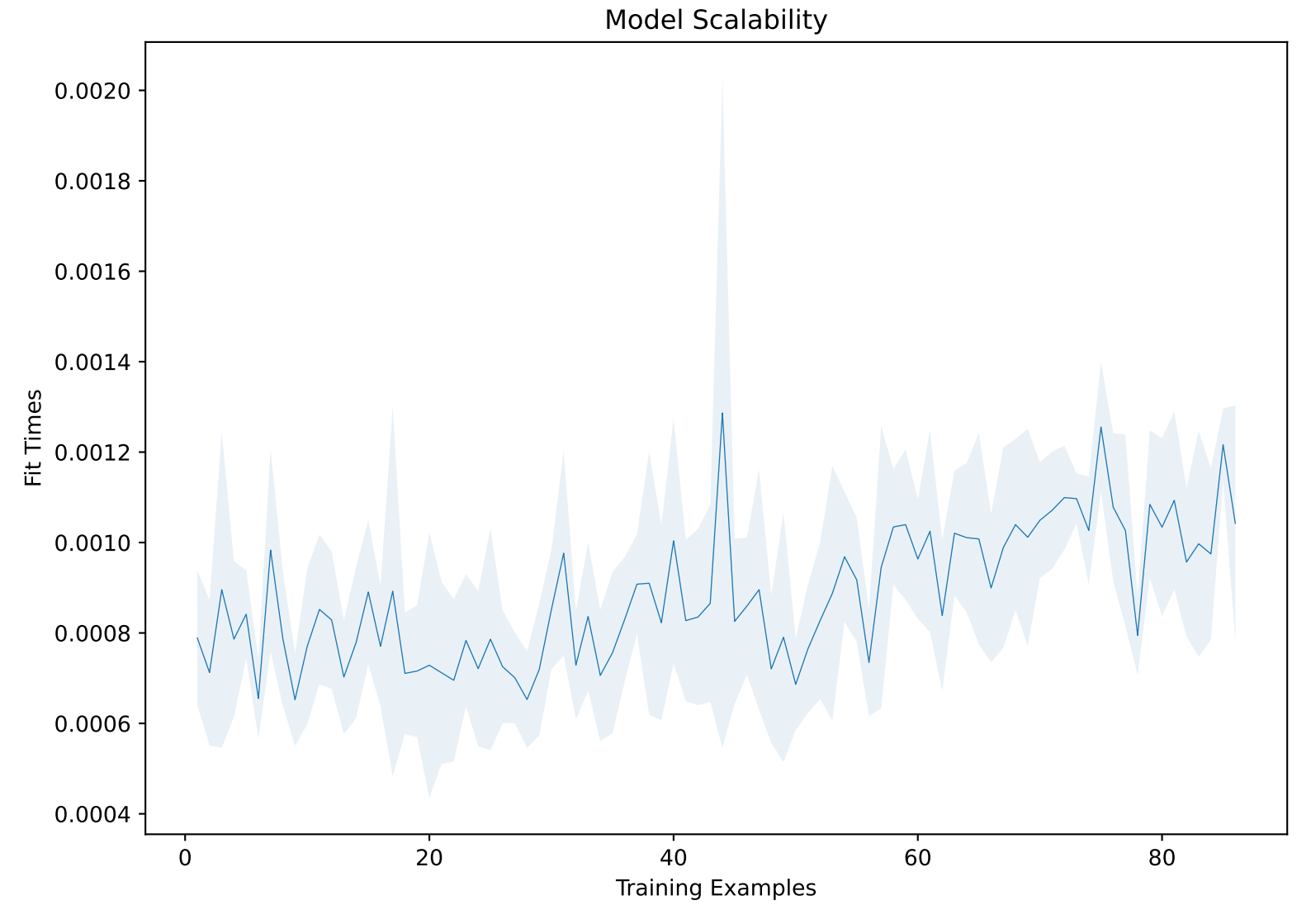
Train Root Mean Squared Error:   0.06136
Train Mean Squared Error:   0.00377
Train Normalised Root Mean Squared Error:   0.07817
Train Coefficient of Determination:   0.84906
Train Normalised Nash Sutcliffe Efficiency:   0.86886

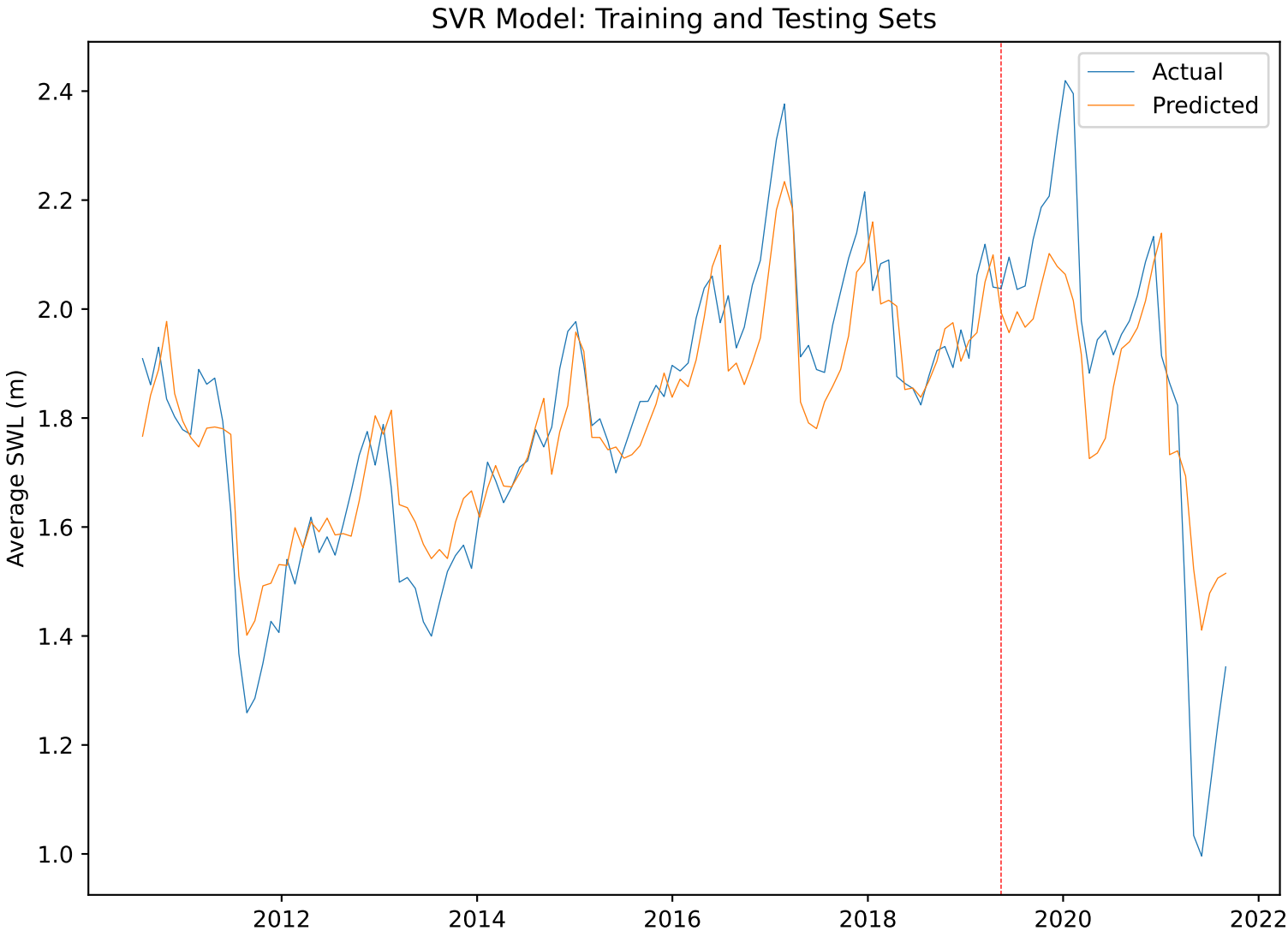
Train Mean Absolute Error:   0.05042
Train Pearson's Correlation Coefficient:   0.93395
Train Index of Agreement:   0.95126
Train Kling-Gupta Efficiency:   0.774
Train Mean Bias Error:   -0.0042
Train Mean Absolute Percentage Error:   0.04072

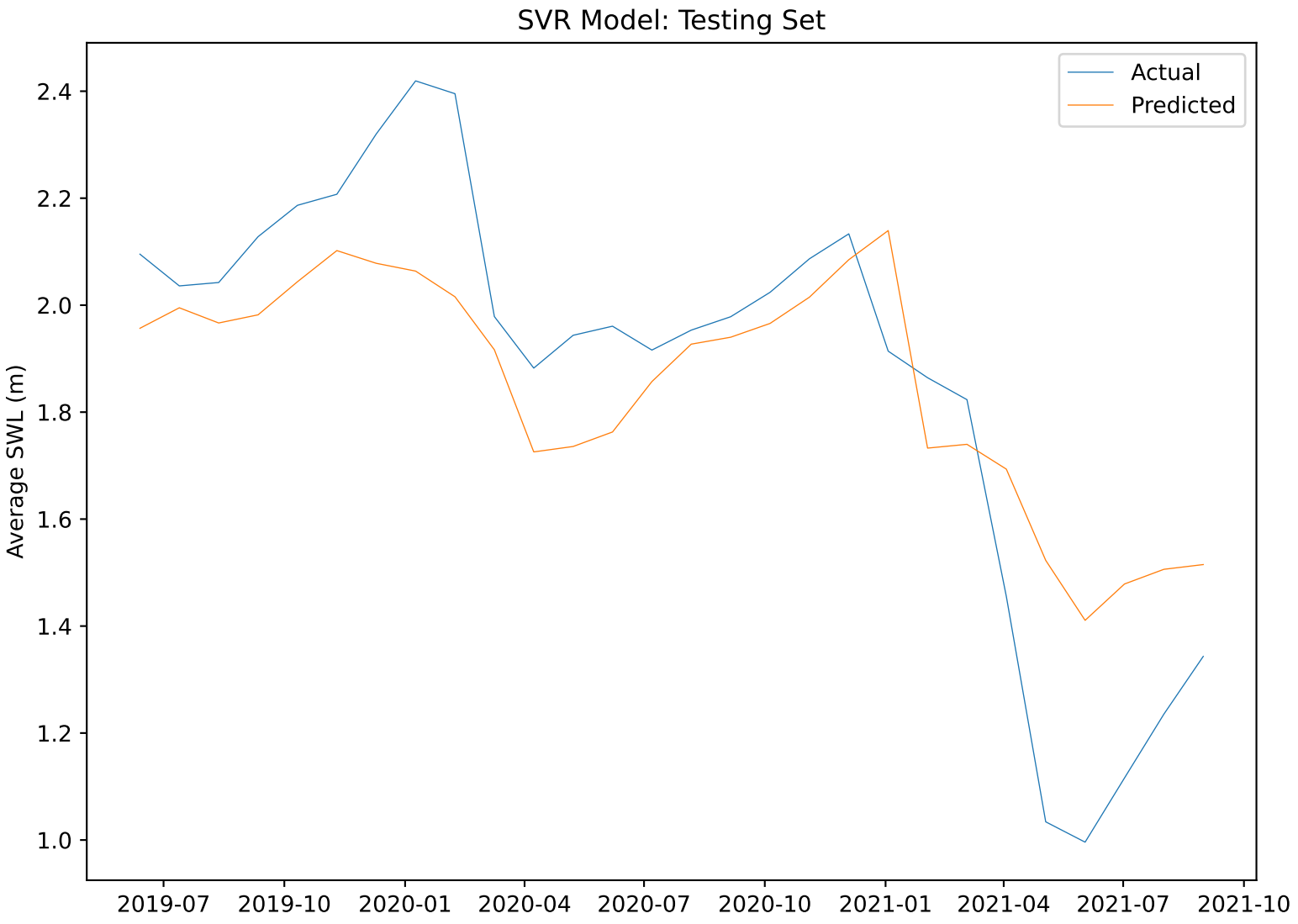
<><> Test Set Scores <><>

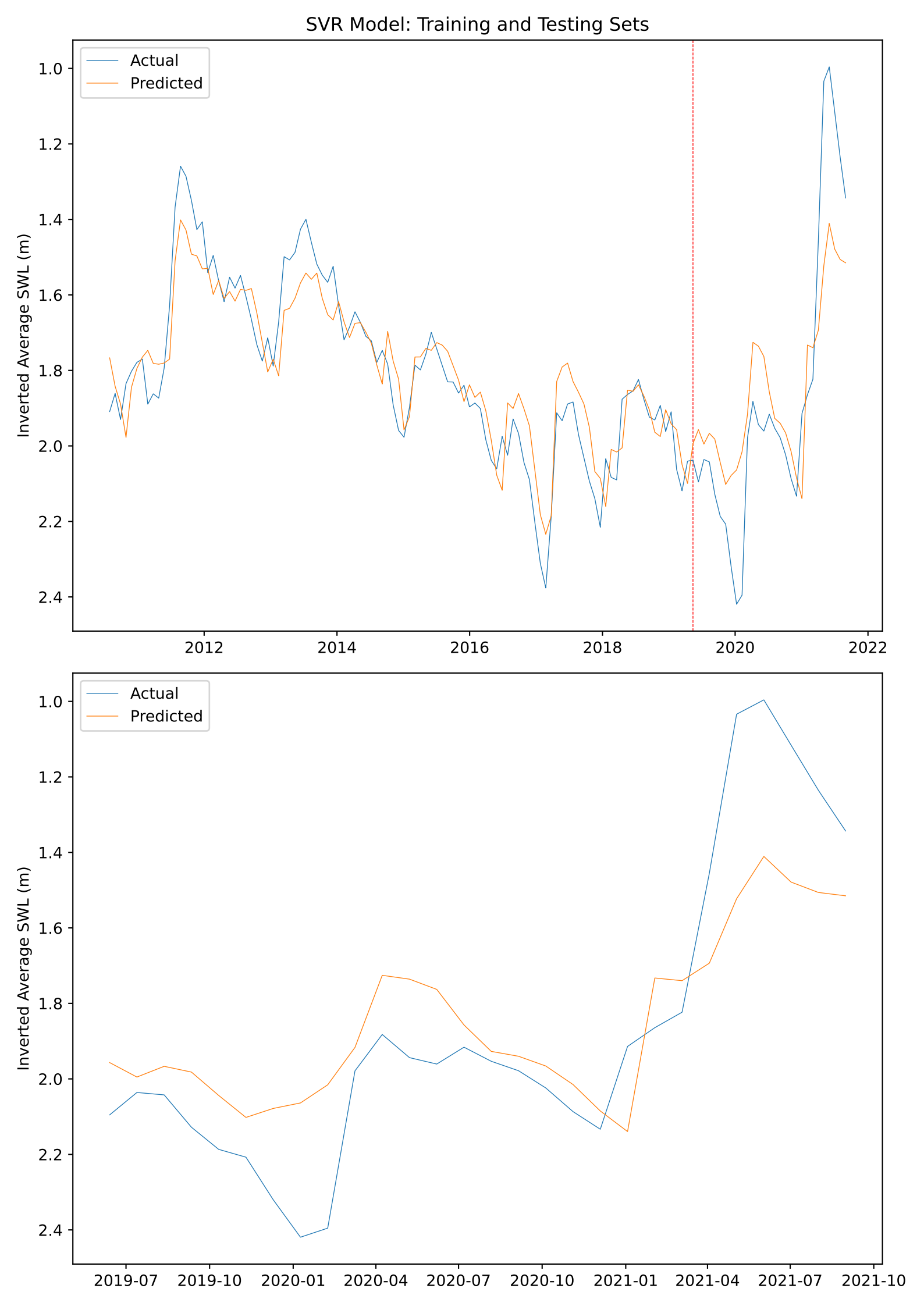
Test Root Mean Squared Error:   0.15213
Test Mean Squared Error:   0.02314
Test Normalised Root Mean Squared Error:   0.15213
Test Coefficient of Determination:   0.69054
Test Normalised Nash Sutcliffe Efficiency:   0.76368
Test Mean Absolute Error:   0.12396
Test Pearson's Correlation Coefficient:   0.91134
Test Index of Agreement:   0.86559
Test Kling-Gupta Efficiency:   0.53208
Test Mean Bias Error:   -0.01495
Test Mean Absolute Percentage Error:   0.11234


SVR Learning Curve
Training score
5-Fold Cross-validation score
Average Mean Squared Error
0.05
0.04
0.03
0.02
0.01
0.00
0
20
40
60
80
Training Examples


Model Scalability
Fit Times
0.0020
0.0018
0.0016
0.0014
0.0012
0.0010
0.0008
0.0006
0.0004
0
20
40
60
80
Training Examples


SVR Model: Training and Testing Sets
Actual
Predicted
Average SWL (m)
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
2012
2014
2016
2018
2020
2022


SVR Model: Testing Set
Actual
Predicted
Average SWL (m)
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
2019-07
2019-10
2020-01
2020-04
2020-07
2020-10
2021-01
2021-04
2021-07
2021-10


SVR Model: Training and Testing Sets
Actual
Predicted
Inverted Average SWL (m)
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2012
2014
2016
2018
2020
2022
Actual
Predicted
Inverted Average SWL (m)
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2019-07
2019-10
2020-01
2020-04
2020-07
2020-10
2021-01
2021-04
2021-07
2021-10