

Politecnico di Torino
Masters Degree in
Environmental and Land Engineering (Climate Change)



Master's degree Thesis
(Appendix 1)

**Impact of climate change on groundwater levels in
the Iberian Peninsula**

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Models' evaluation

This appendix document contains the detailed results of each 92 models used in the analysis, including the model's performance in the test period for the last four years of datasets, as well as the model's performance under extreme conditions (quadrupole precipitation with a 5 degree increase in temperature in the historical period) results and SHAP summery plots, which are a commonly used technique for evaluating and selecting machine learning models. The SHAP values aid in explaining the significance of each input characteristic for the output of a particular model, offering significant insights into the model's behavior and performance. These results and assessments provide a thorough perspective of the models and their performance in many circumstances, laying the groundwork for additional research and decision-making.

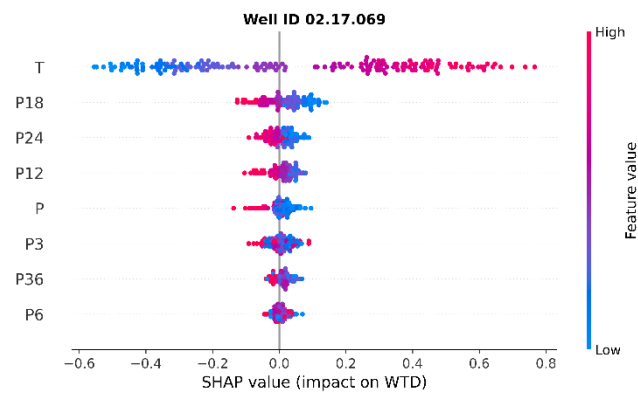
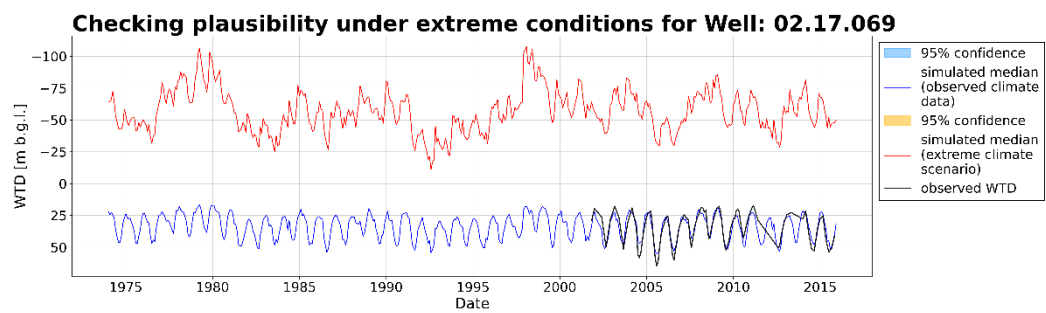
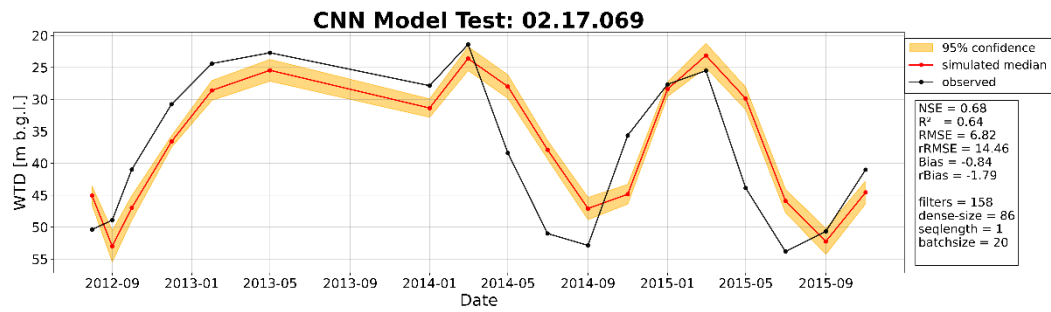


Figure S 1 Evaluation of 02.17.069 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

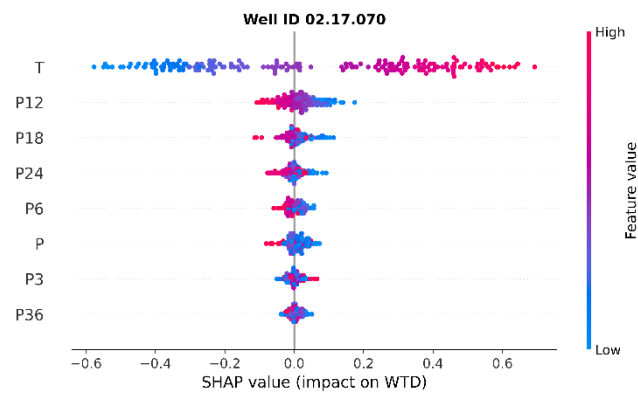
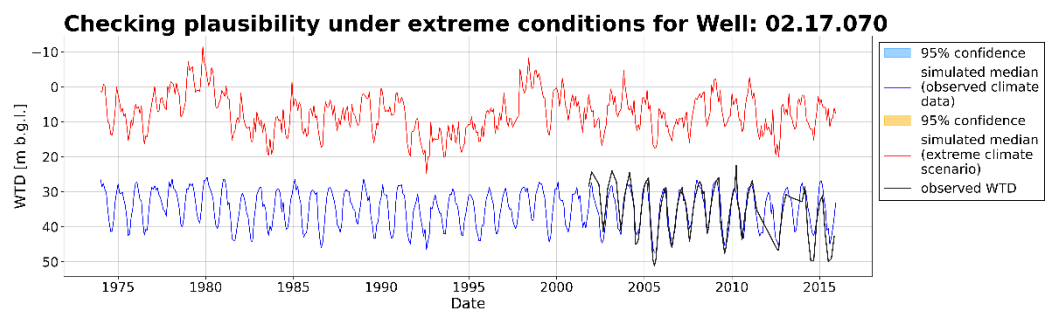
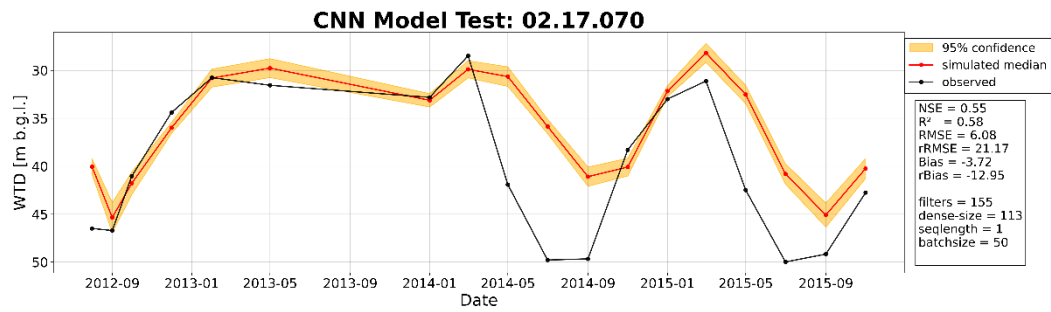


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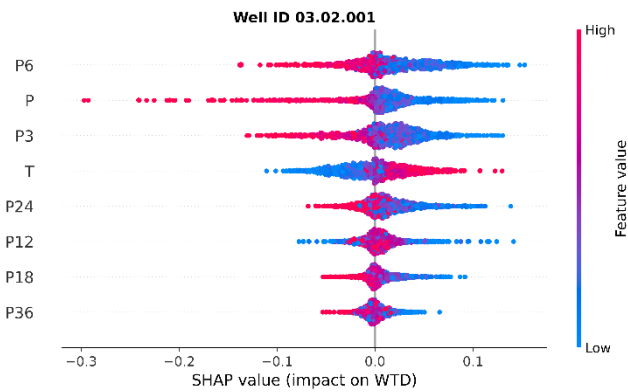
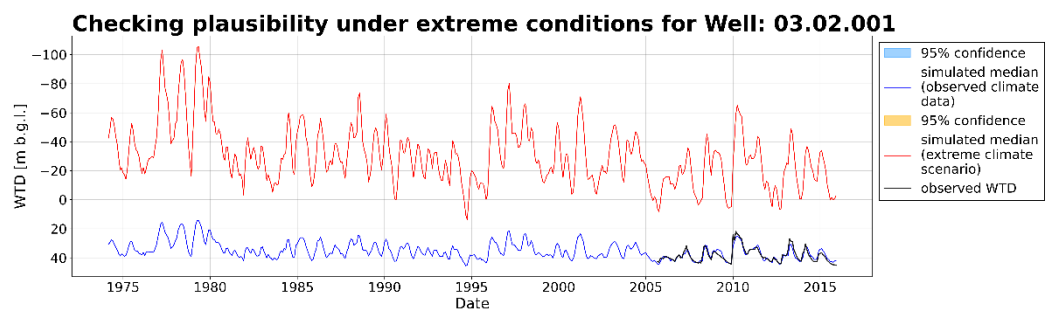
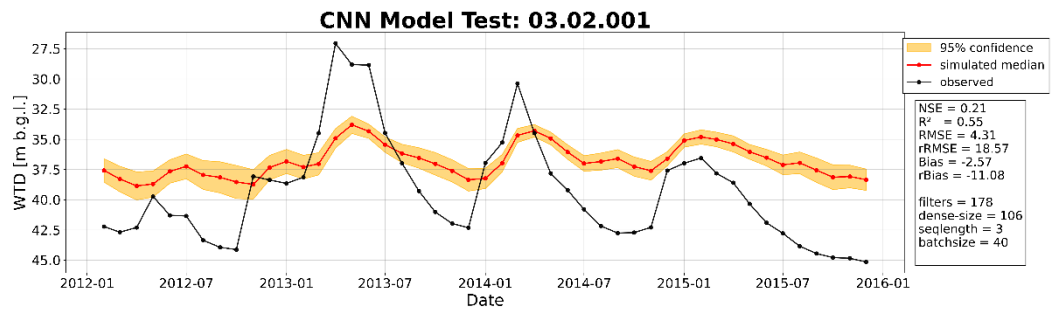


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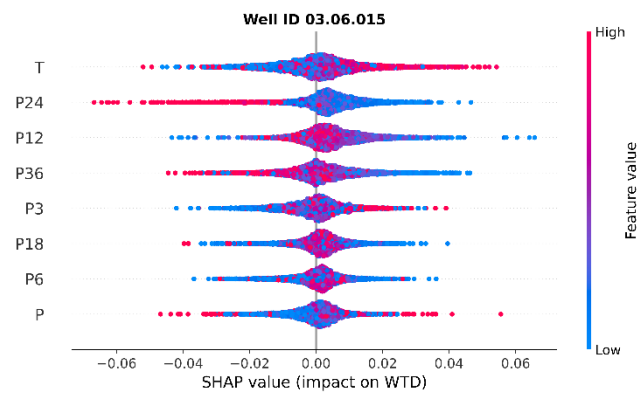
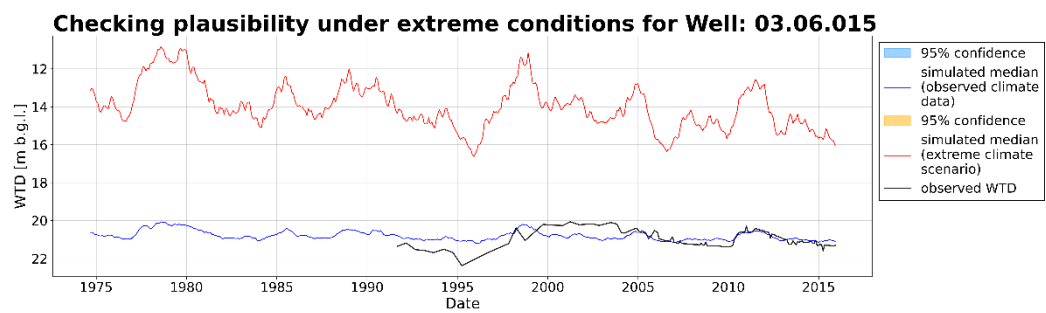
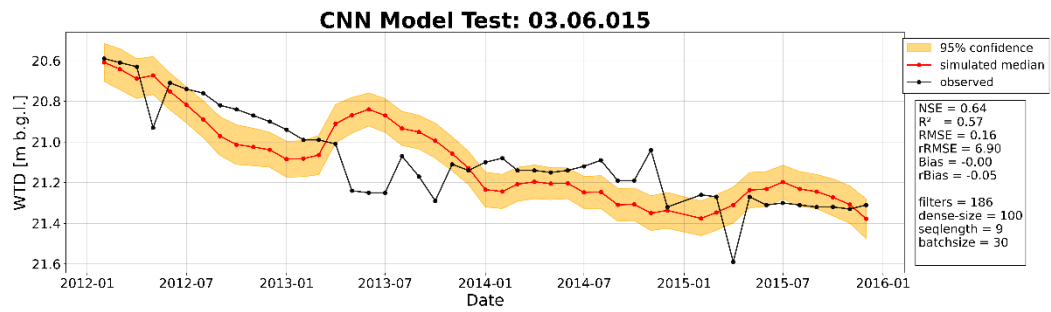


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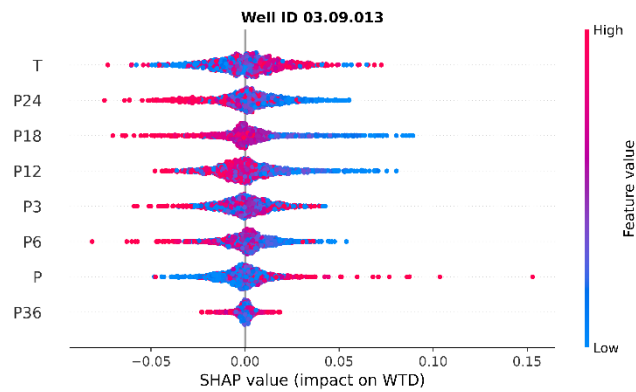
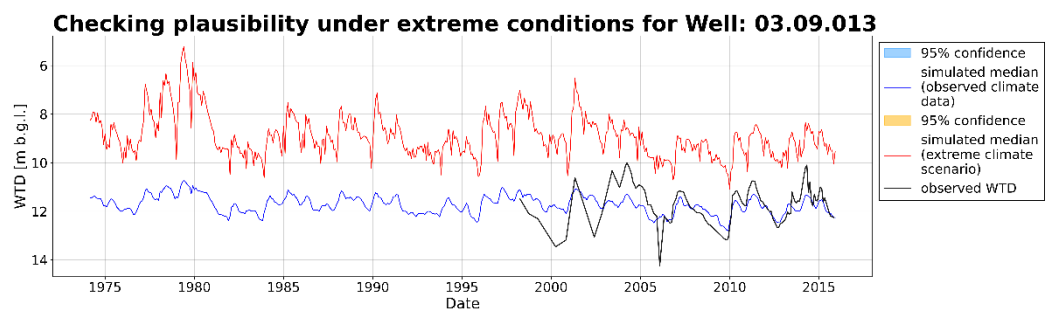
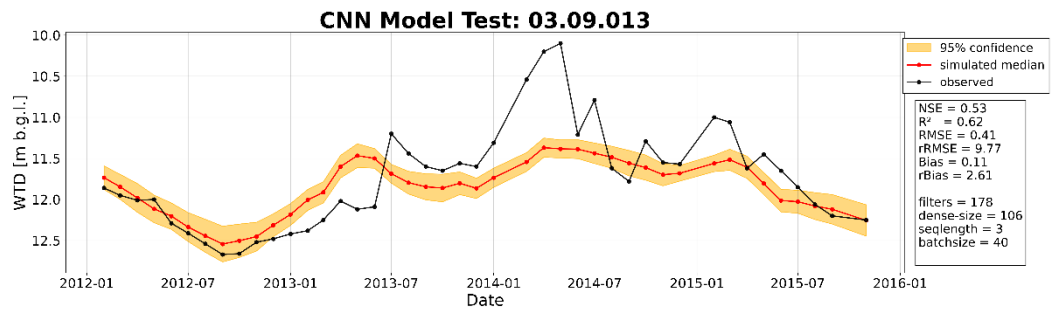


Figure S 5 Evaluation of 03.09.013 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

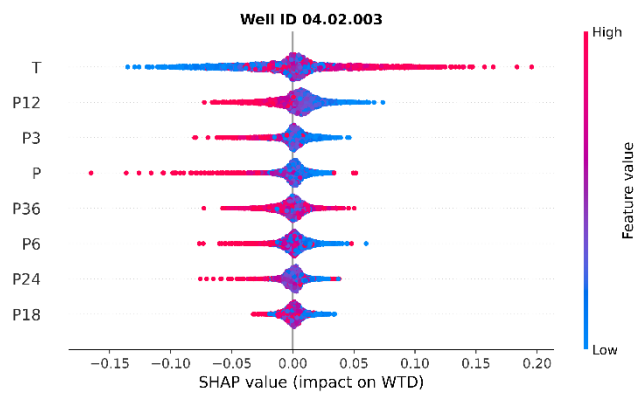
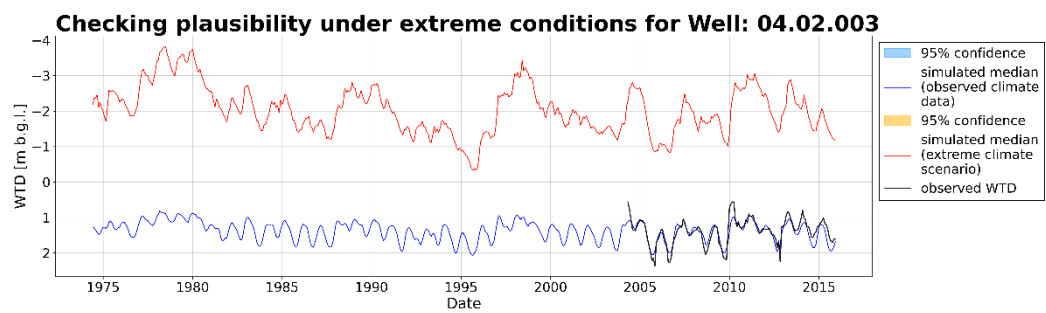
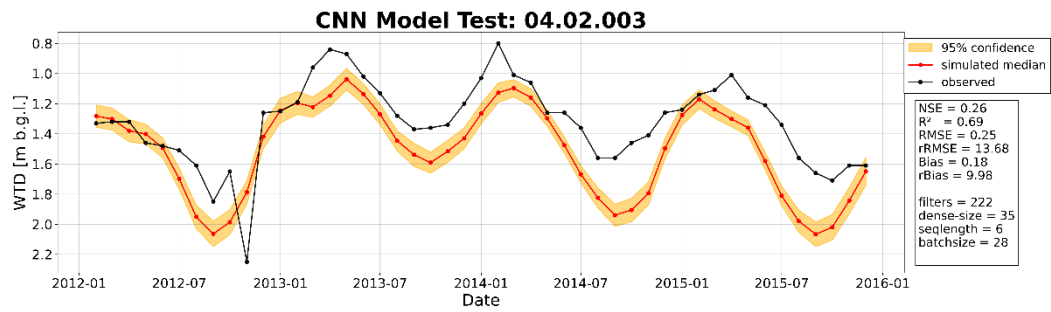


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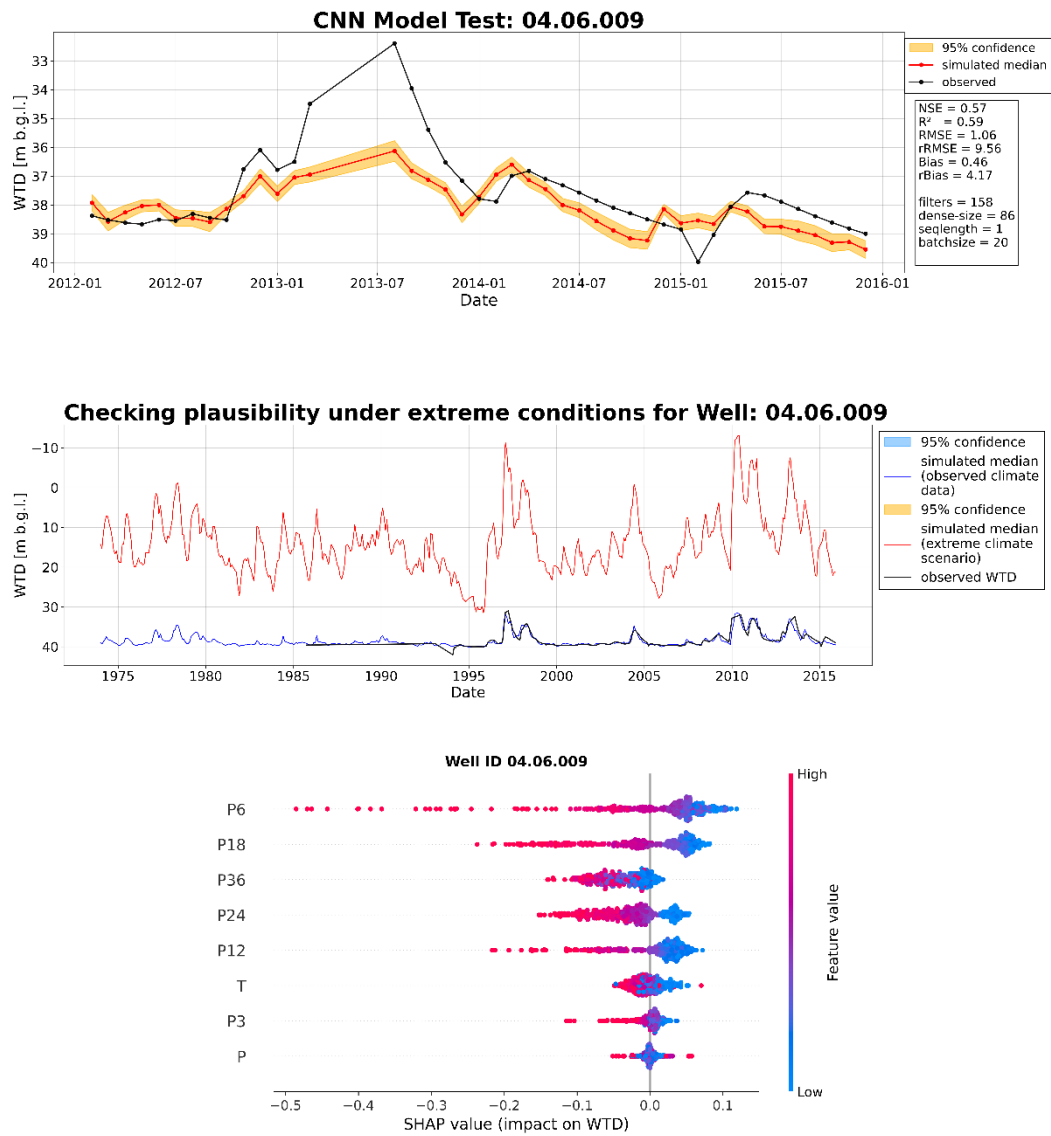


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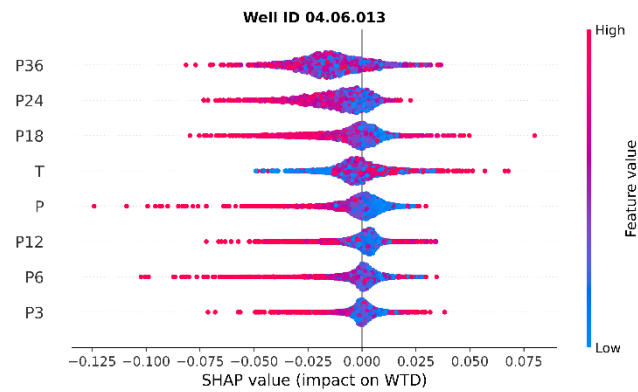
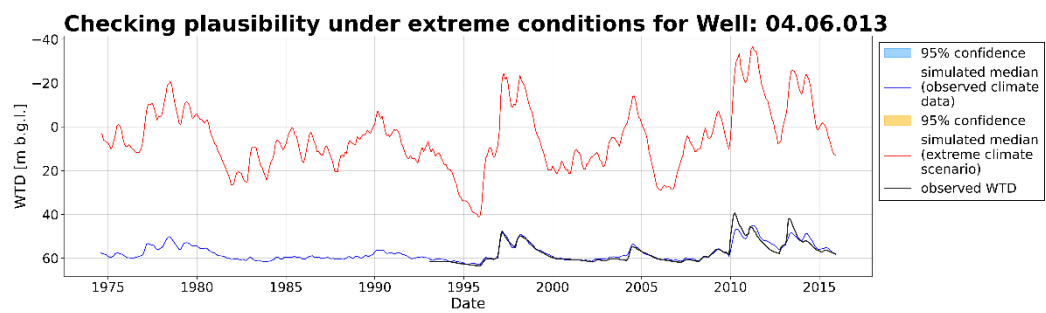
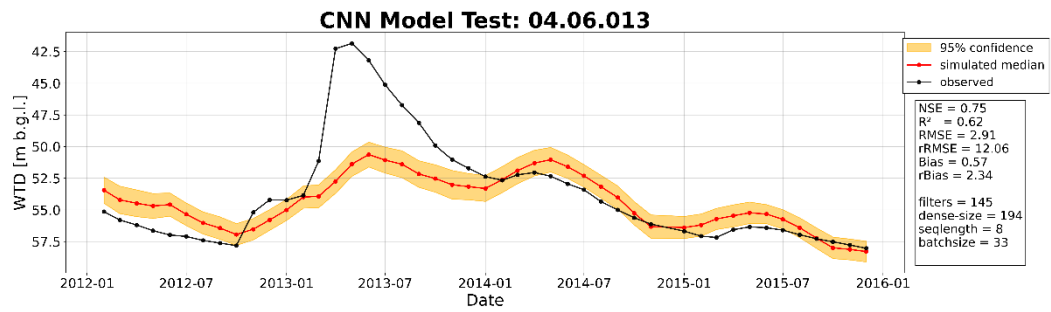


Figure S 8 Evaluation of 04.06.013 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

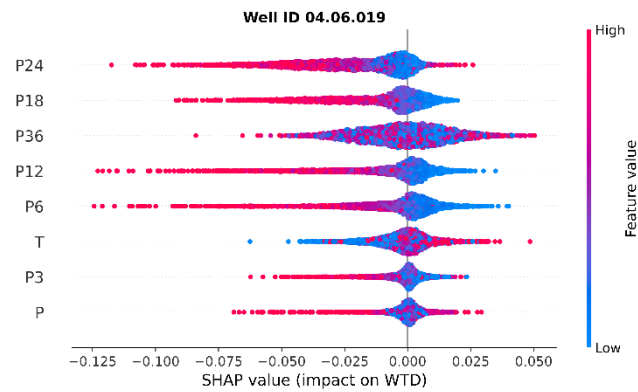
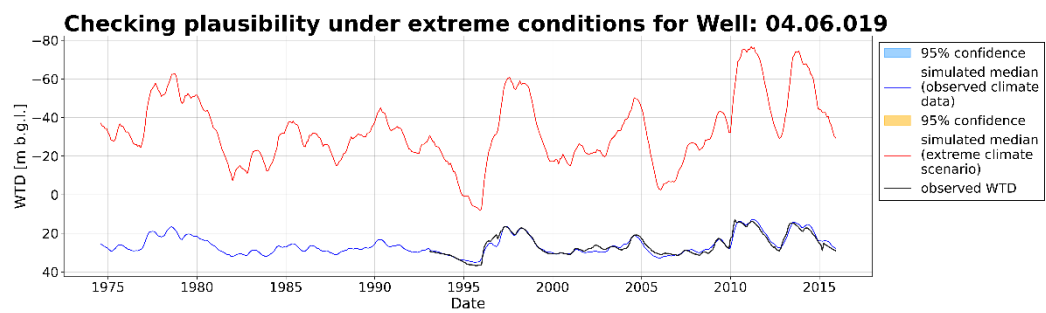
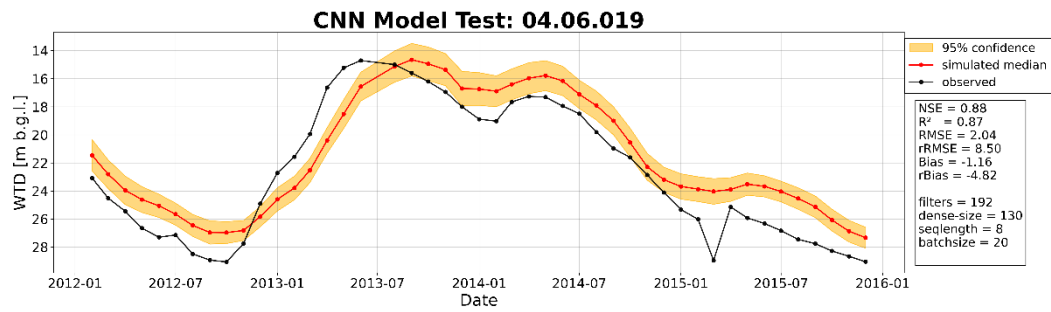


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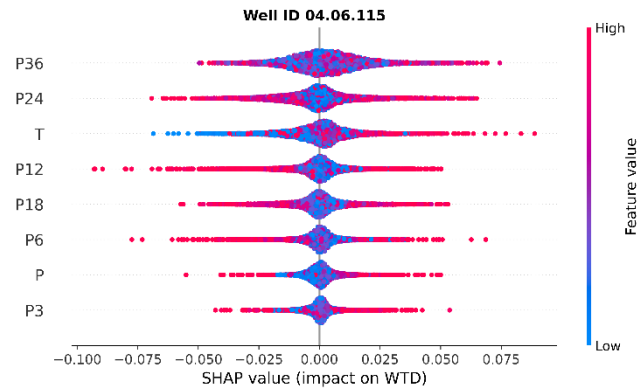
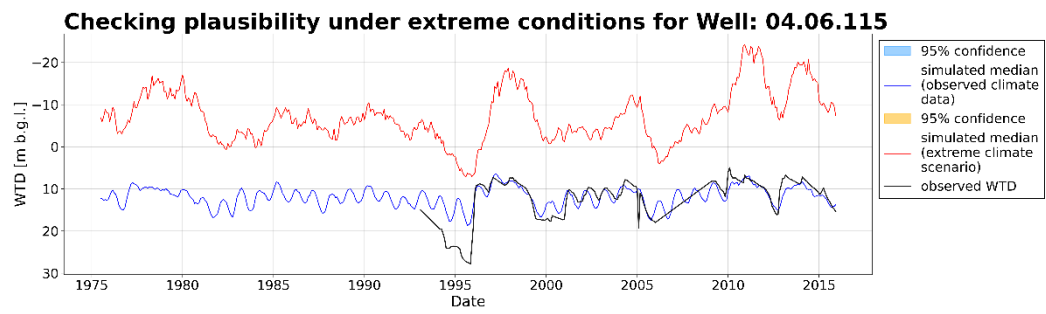
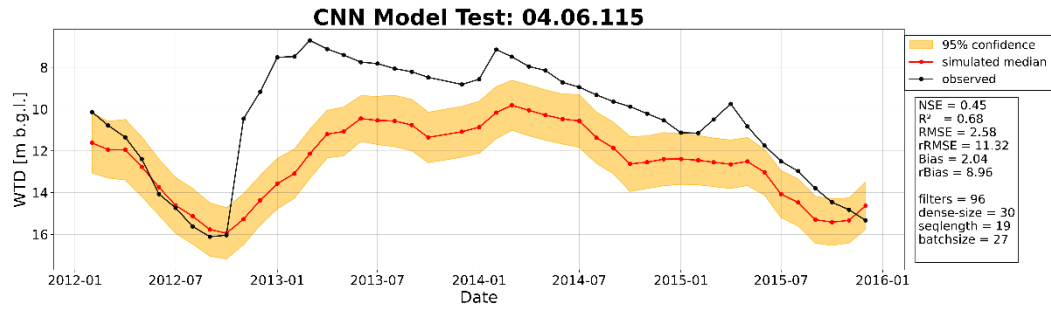


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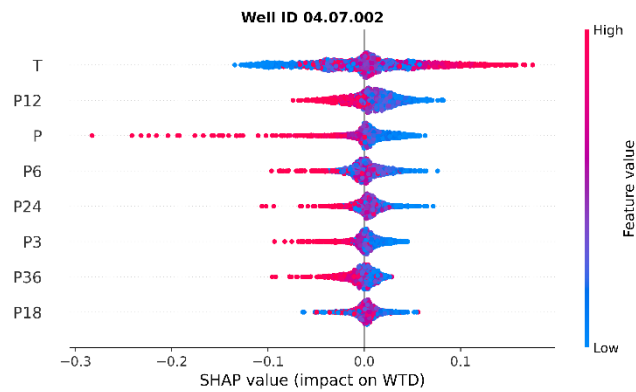
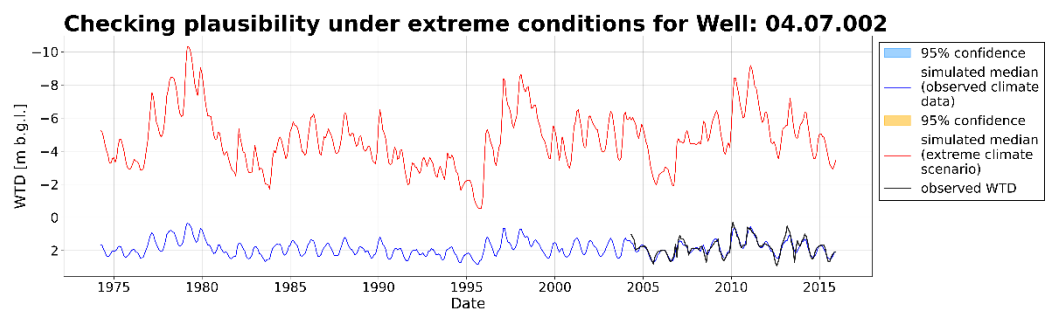
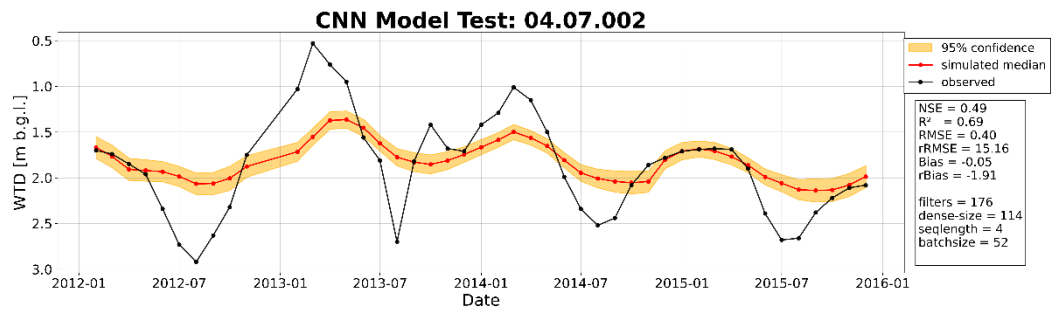


Figure S 11 Evaluation of 04.07.002 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

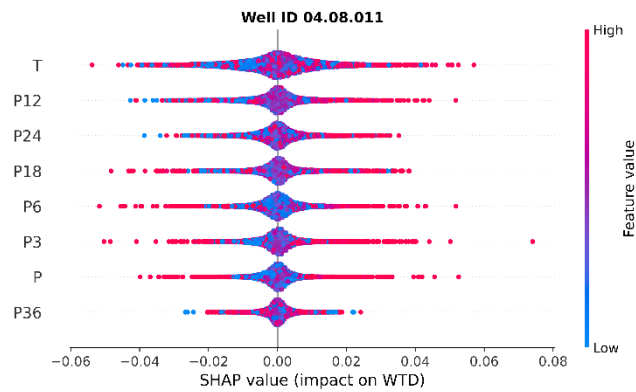
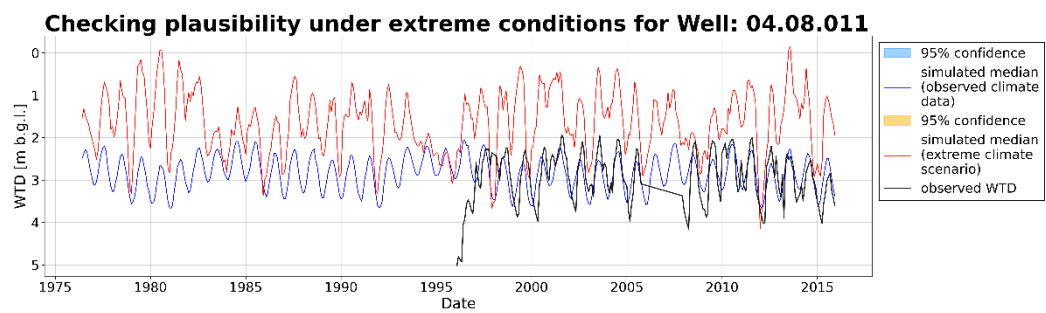
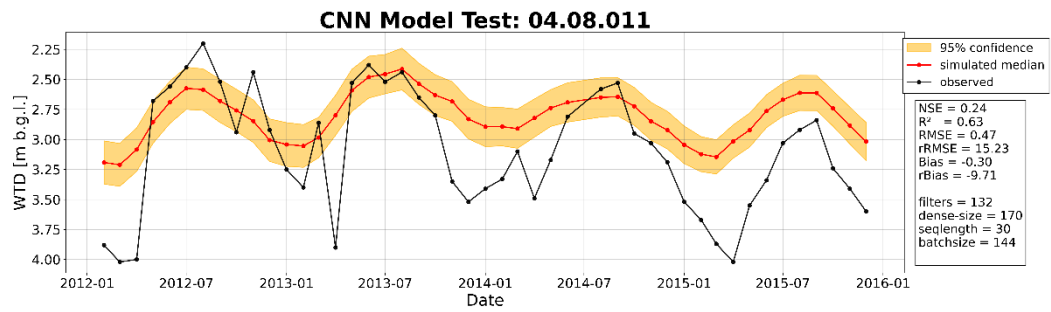


Figure S 12 Evaluation of 04.08.011 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

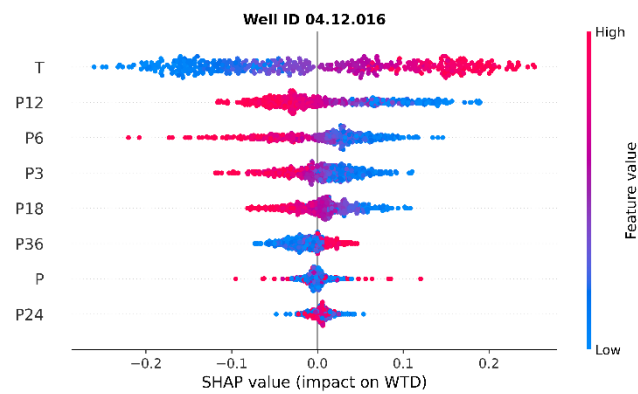
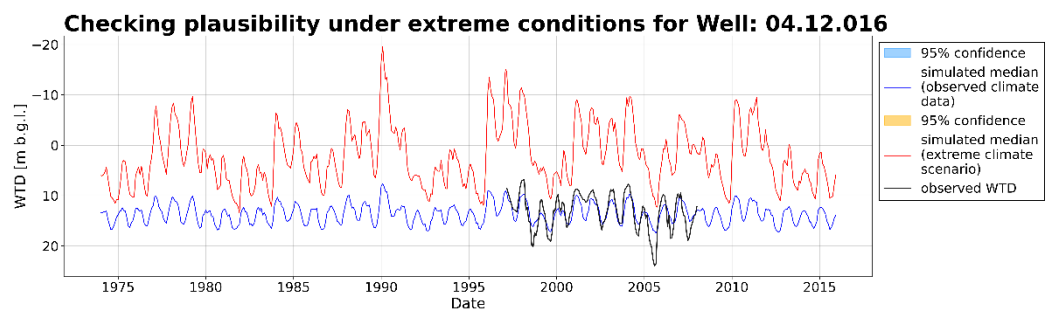
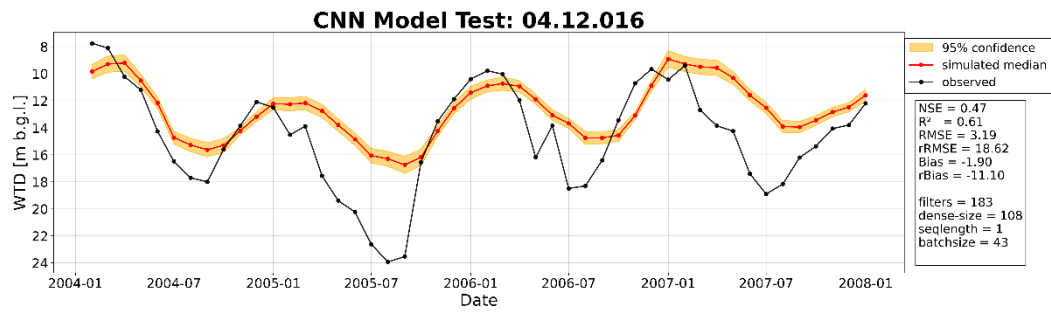


Figure S 13 Evaluation of 04.12.016 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

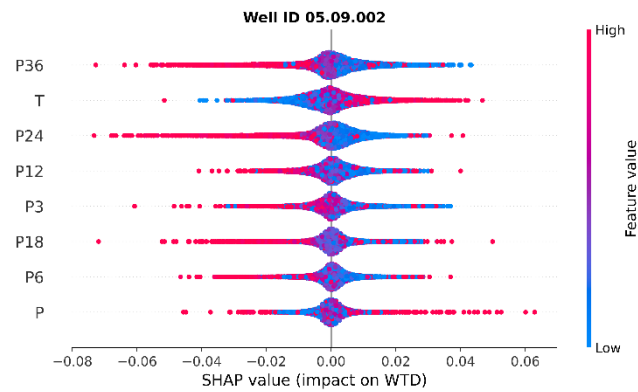
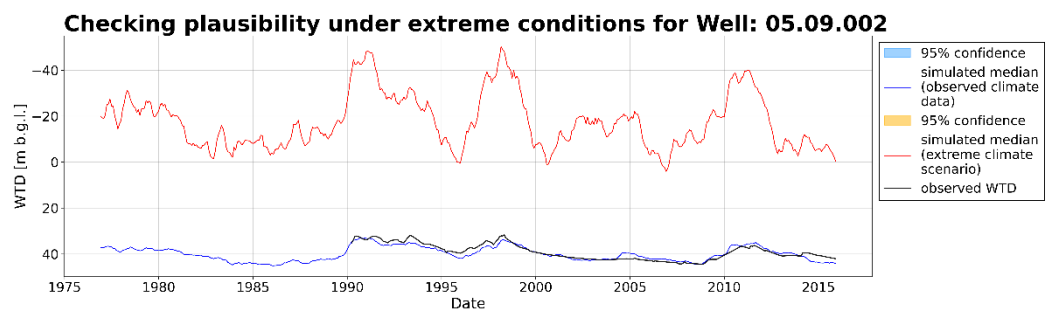
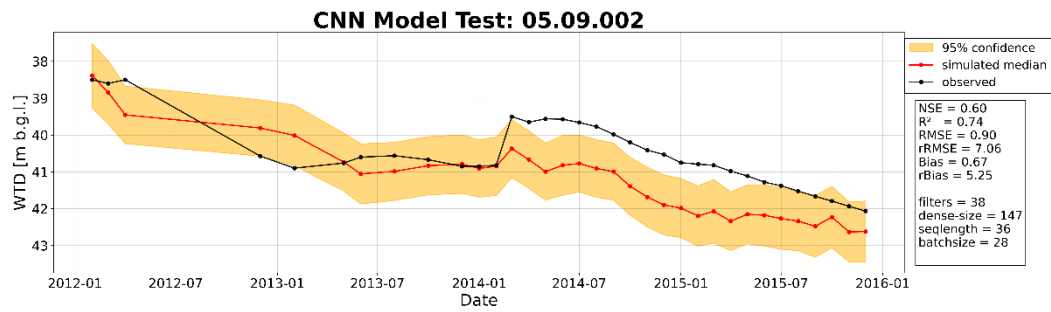


Figure S 14 Evaluation of 05.09.002 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

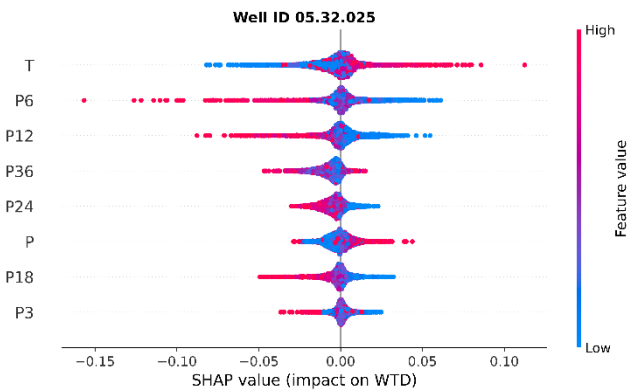
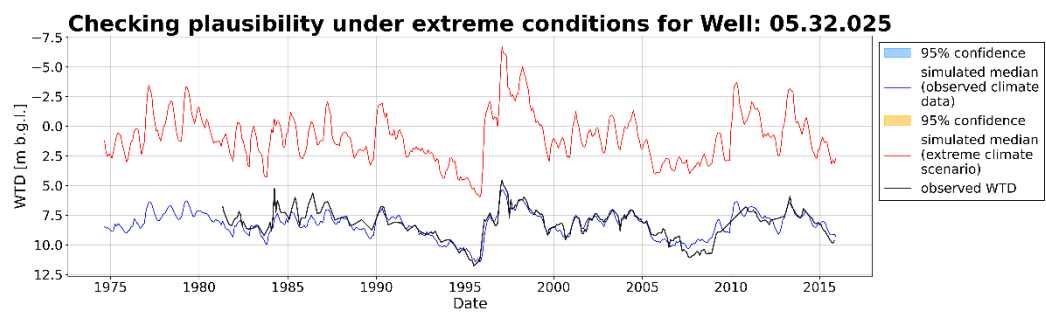
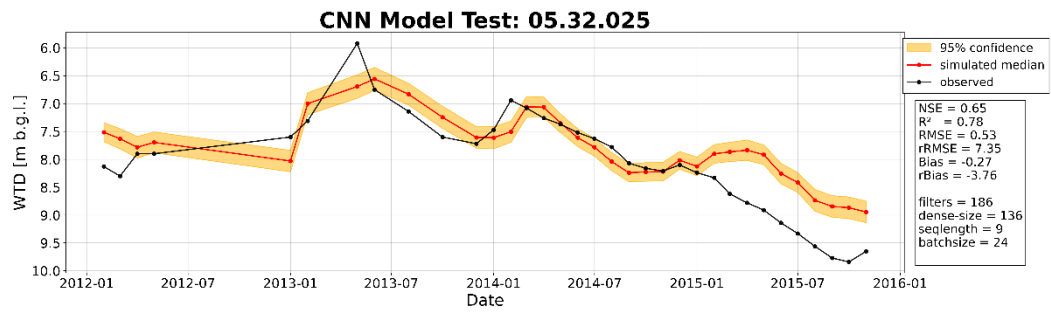


Figure S 15 Evaluation of 05.32.025 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

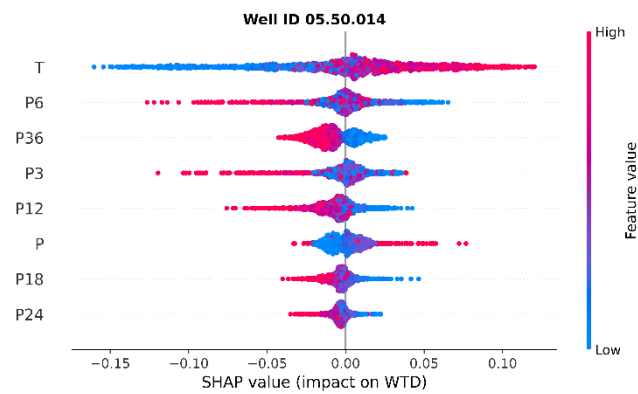
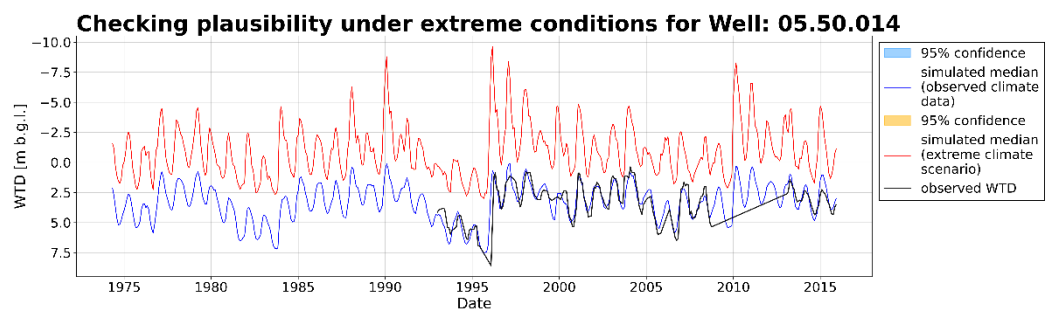
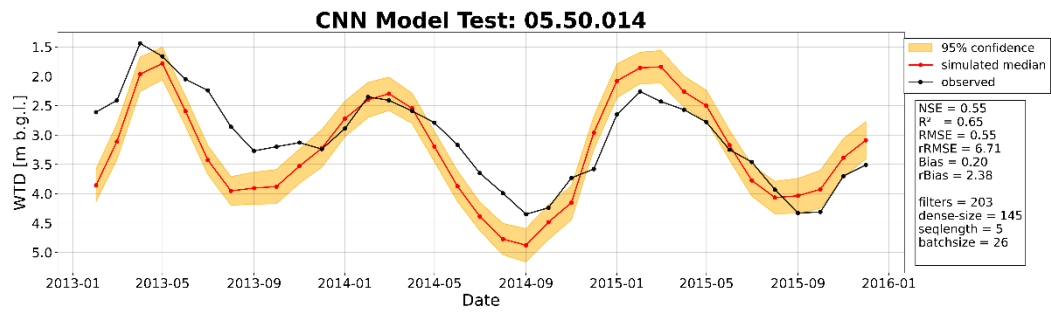


Figure S 16 Evaluation of 05.50.014 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

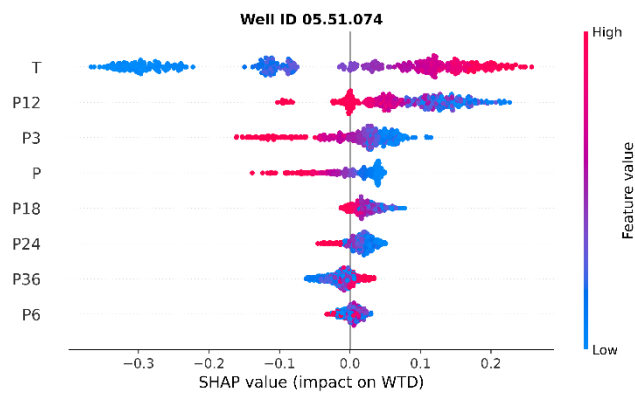
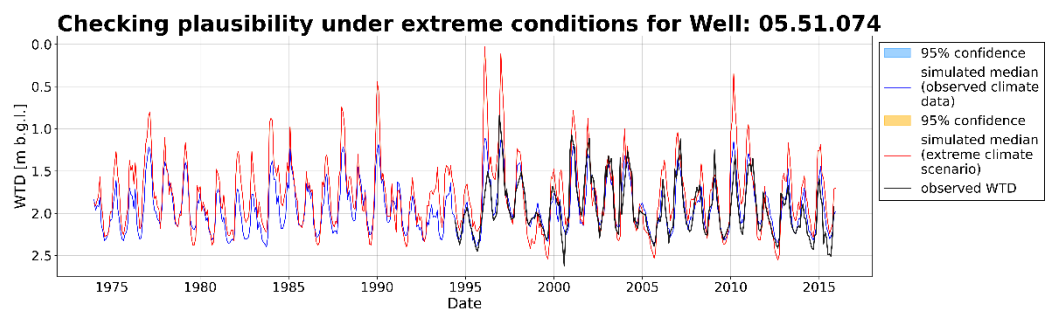
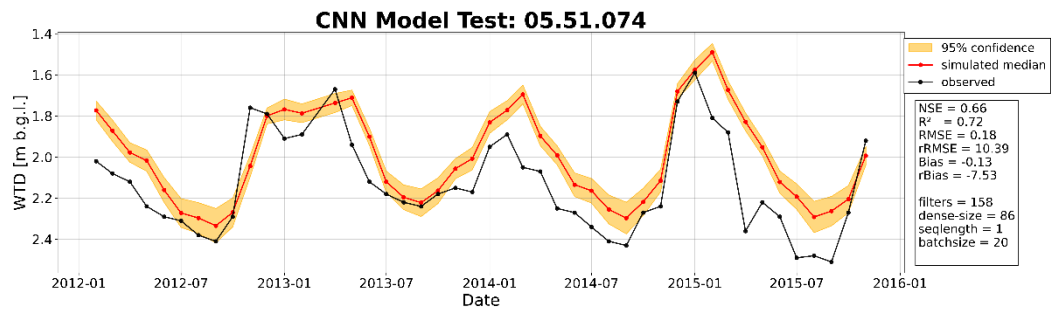


Figure S 17 Evaluation of 05.51.074 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

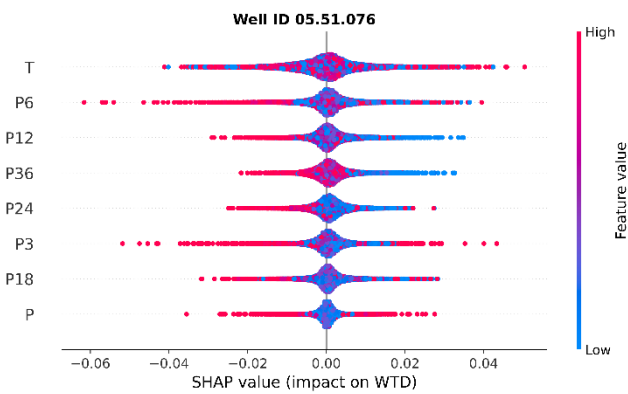
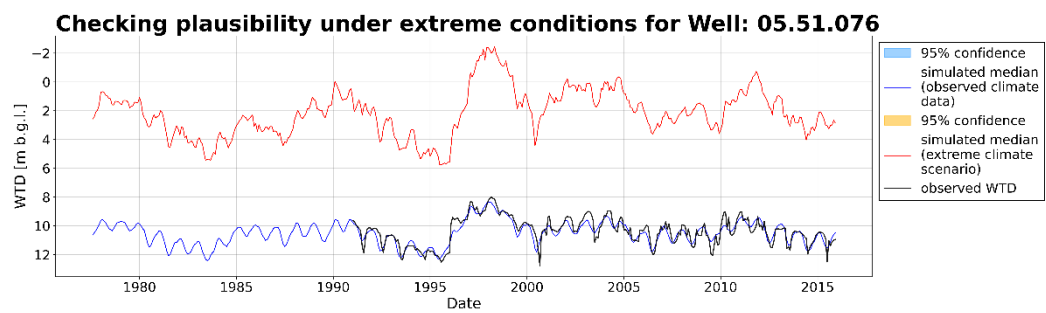
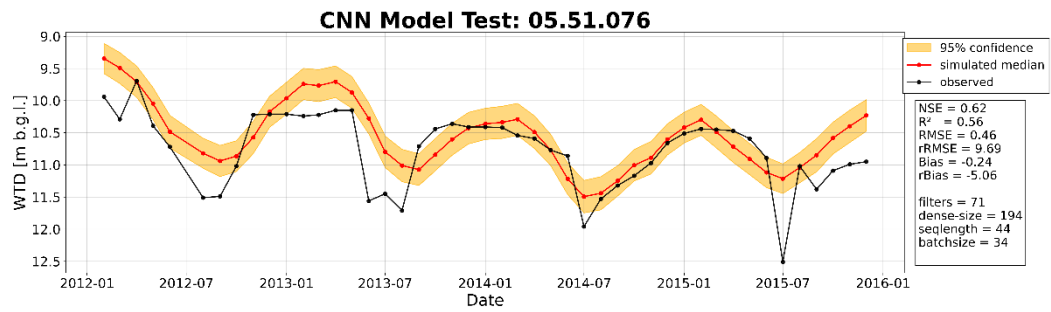


Figure S 18 Evaluation of 05.51.076 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

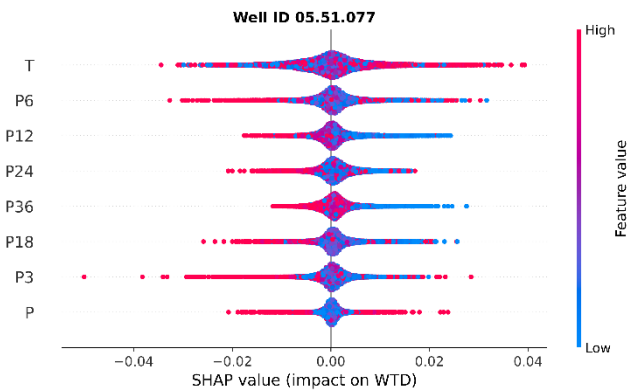
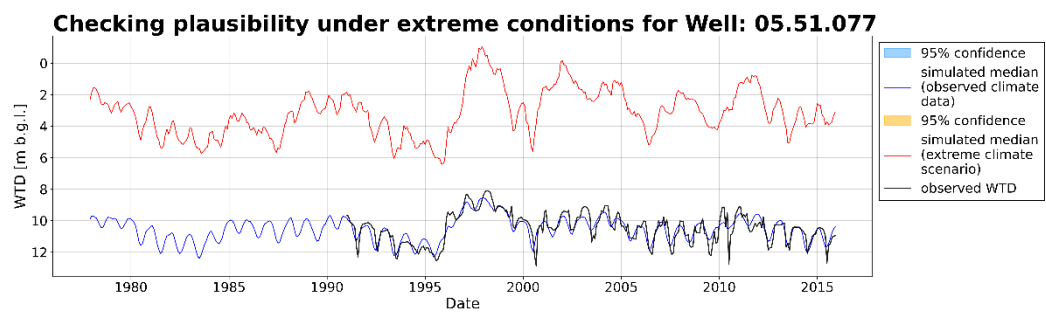
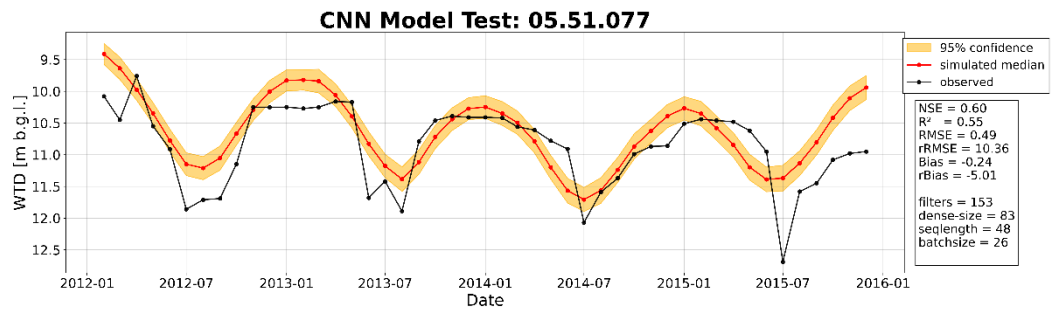


Figure S 19 Evaluation of 05.51.077 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

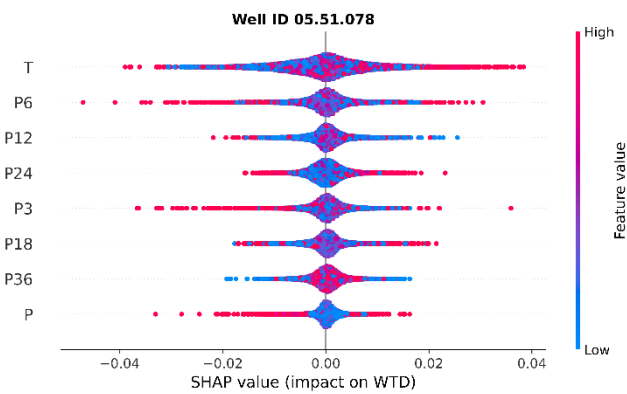
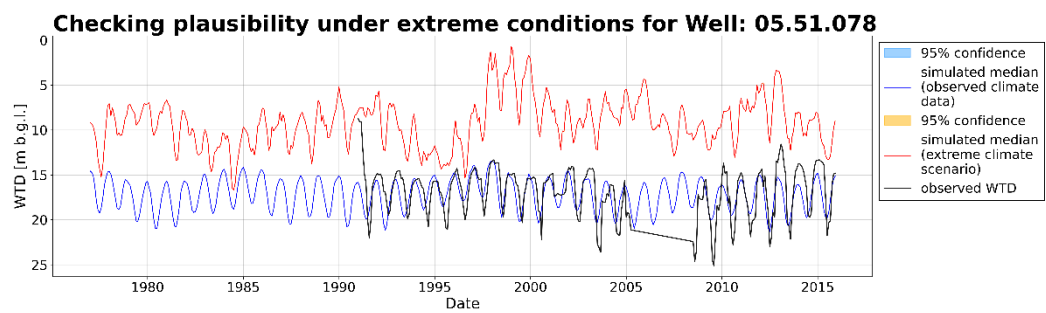
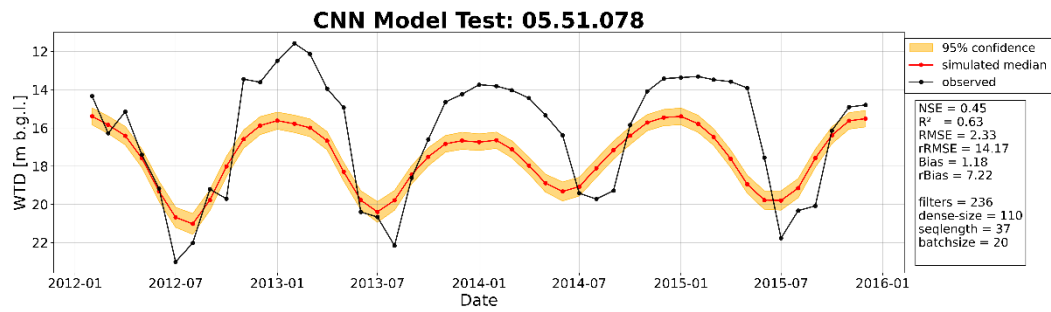


Figure S 20 Evaluation of 05.51.078 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

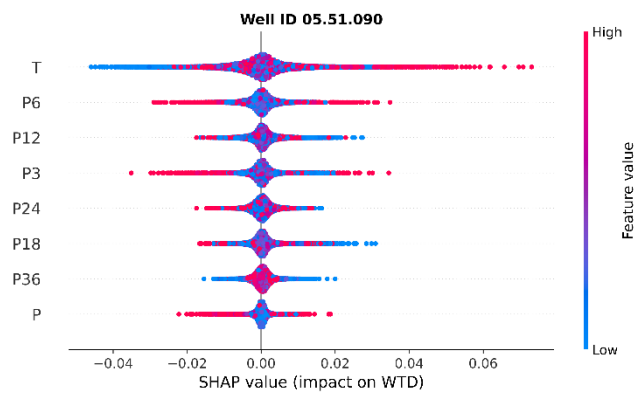
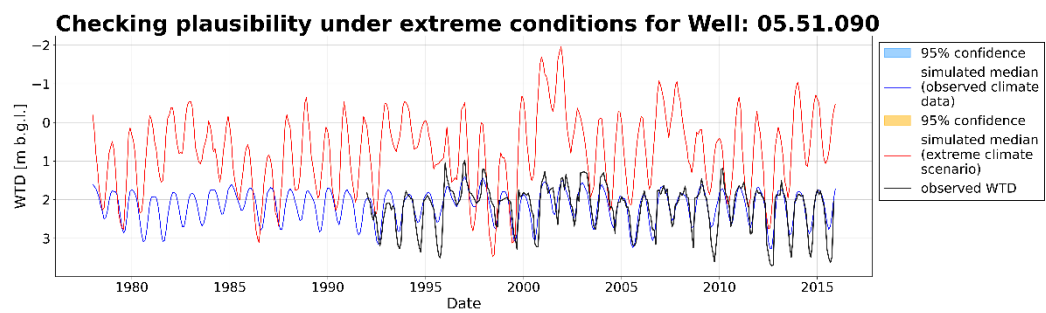
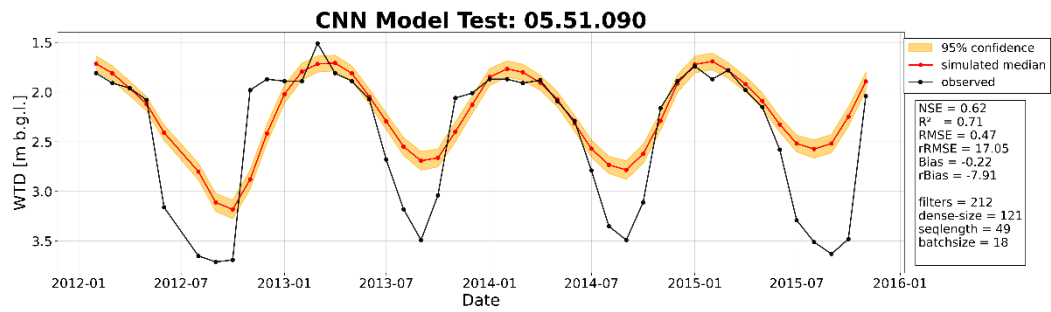


Figure S 21 Evaluation of 05.51.090 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

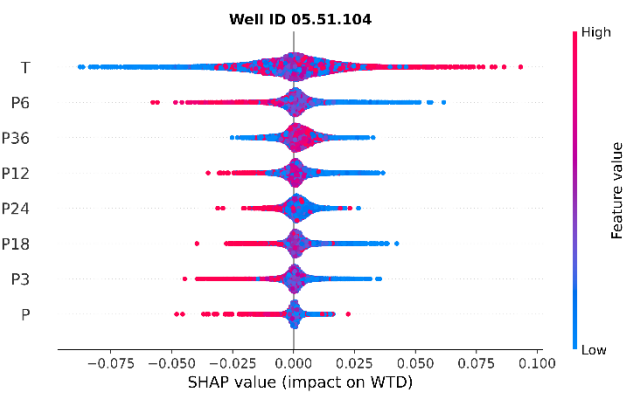
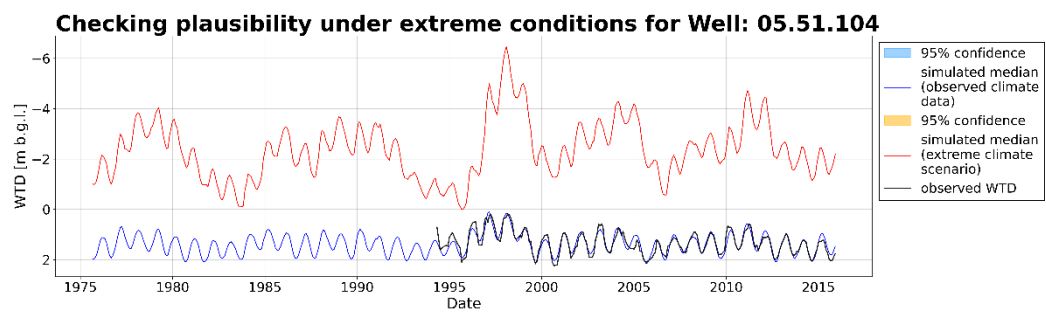
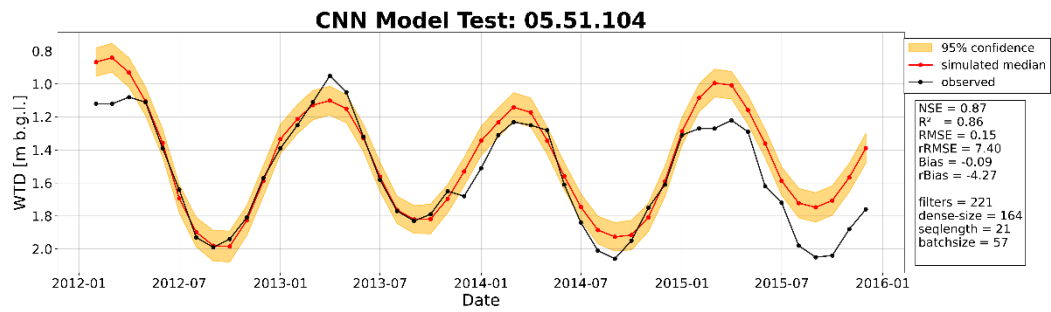


Figure S 22 Evaluation of 05.51.104 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

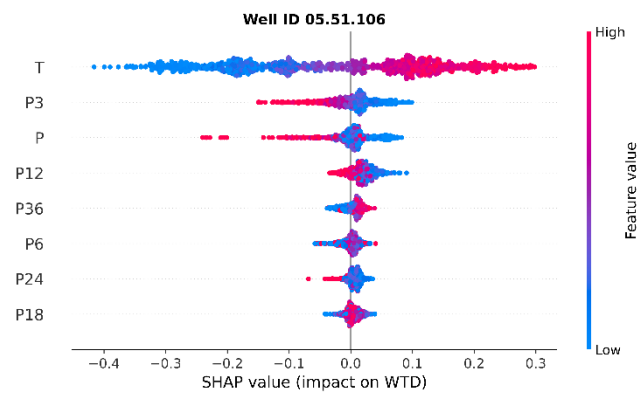
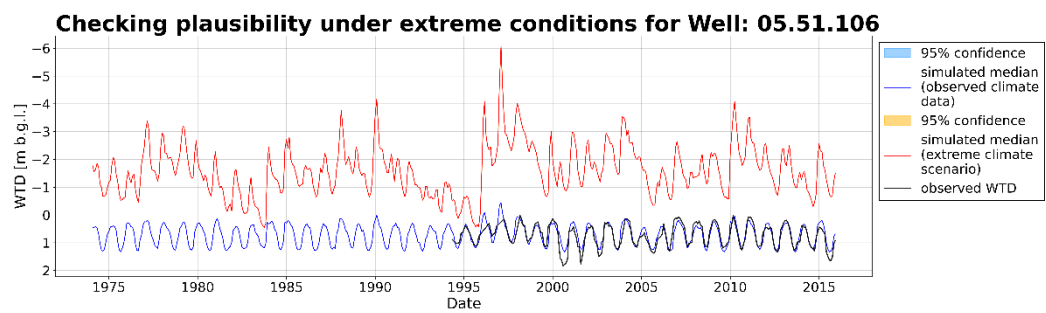
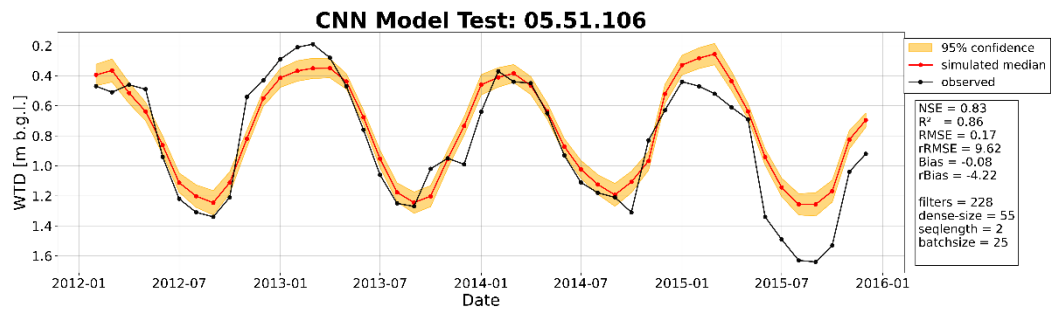


Figure S 23 Evaluation of 05.51.106 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

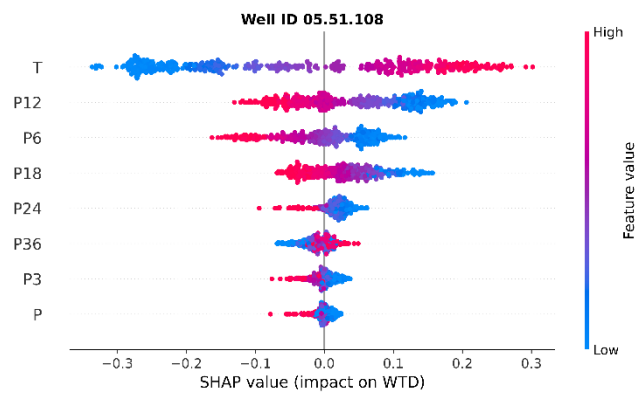
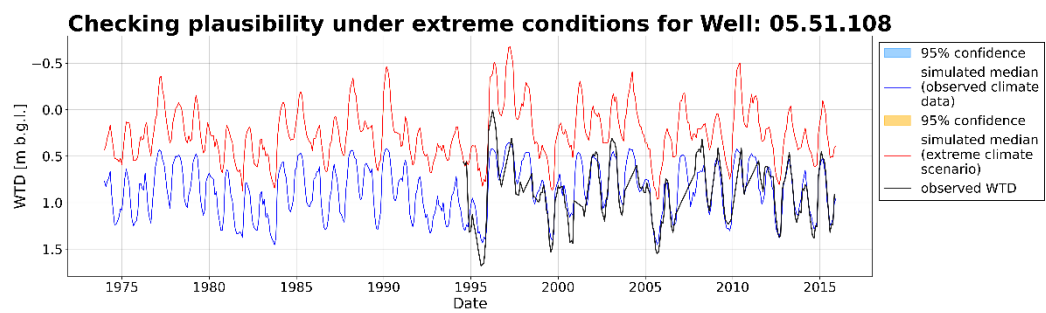
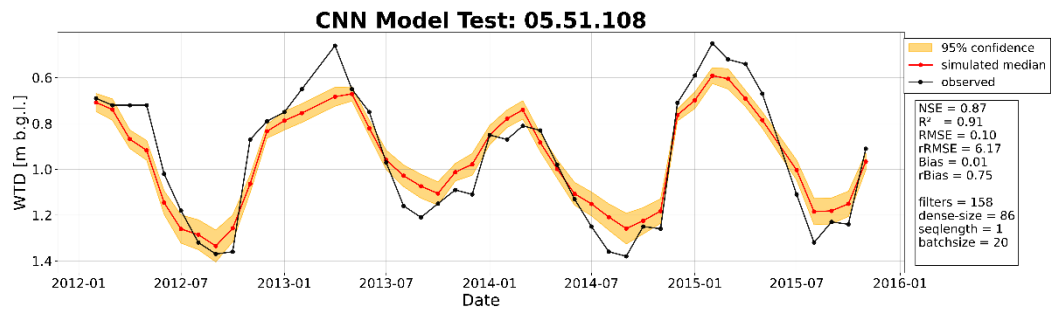


Figure S 24 Evaluation of 05.51.108 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

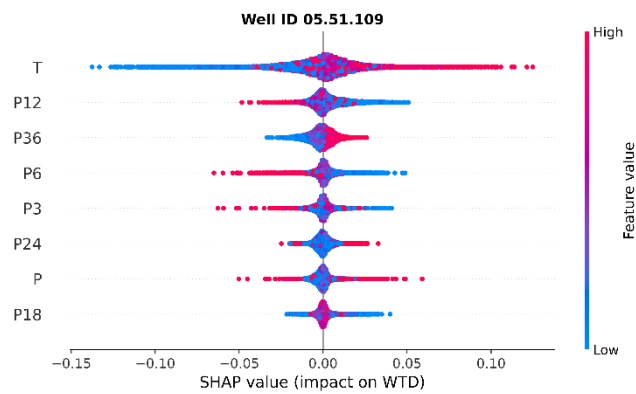
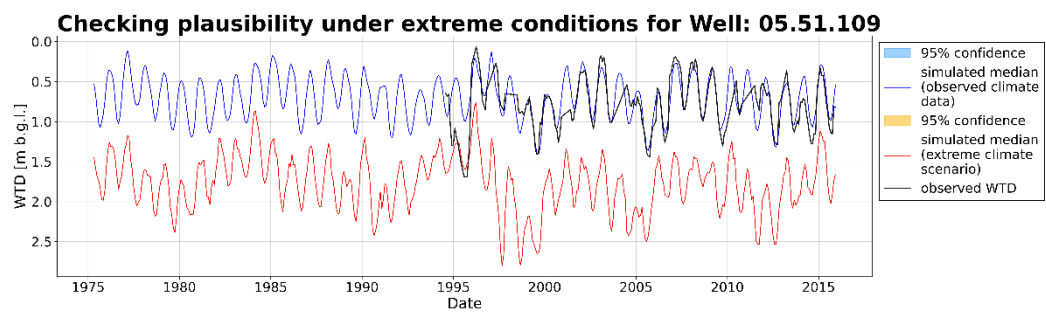
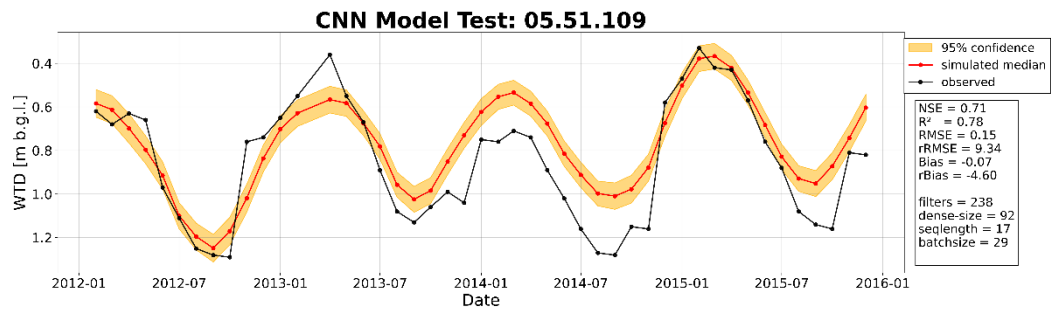


Figure S 25 Evaluation of 05.51.109 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

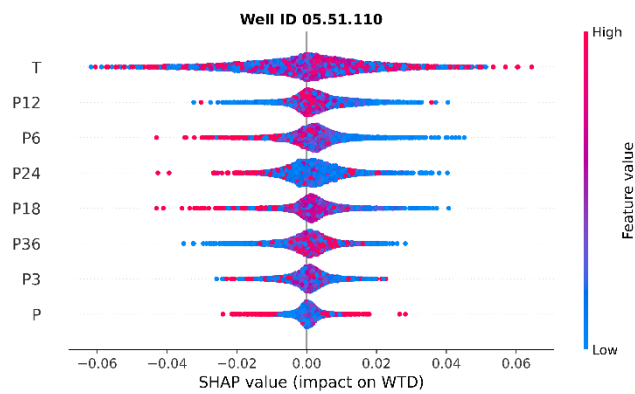
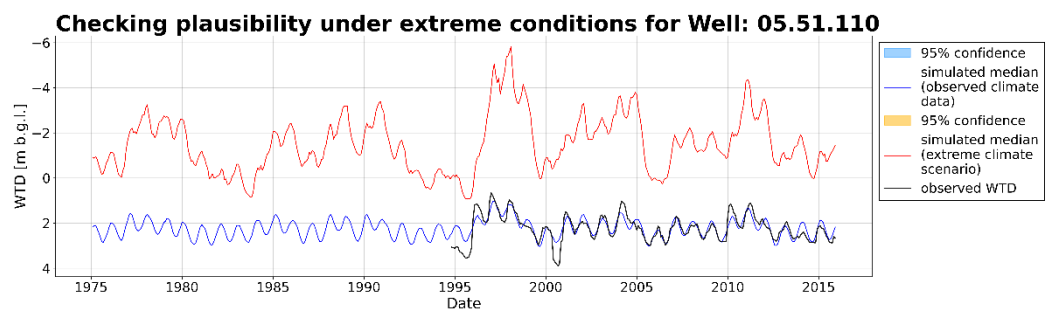
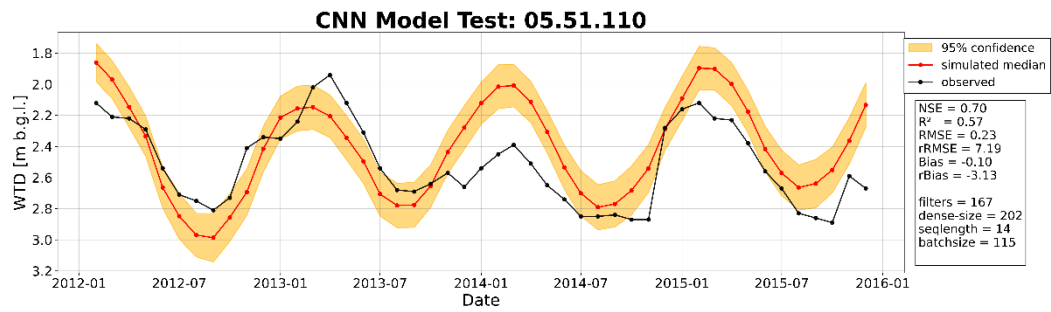


Figure S 26 Evaluation of 05.51.110 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

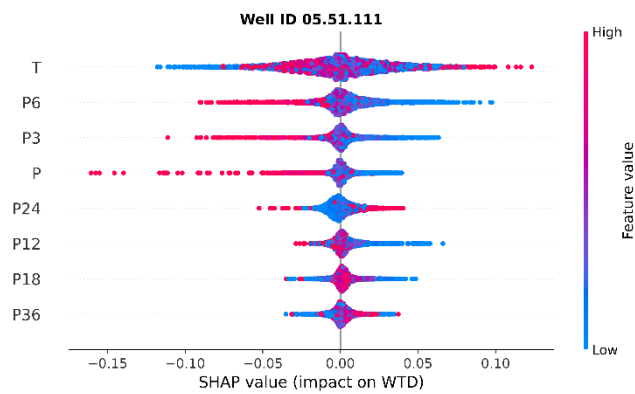
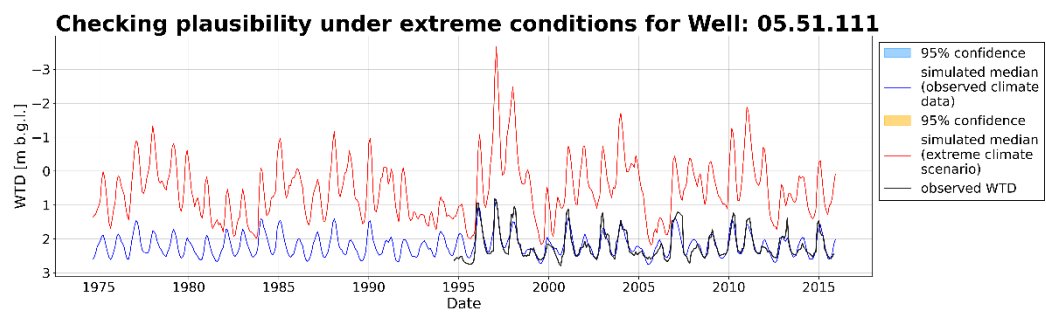
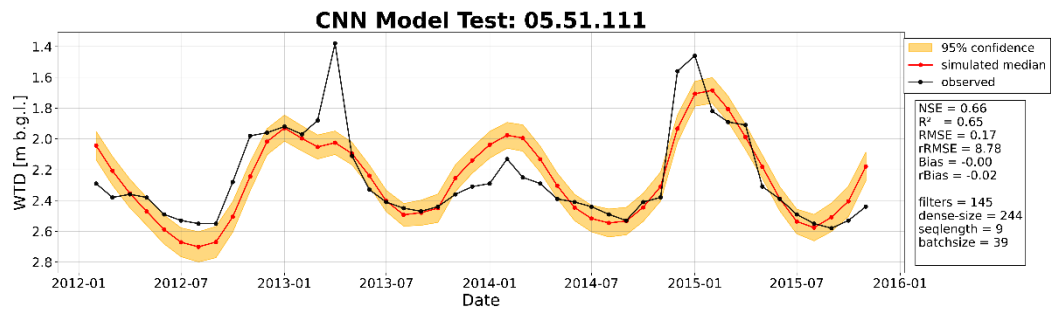


Figure S 27 Evaluation of 05.51.111 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

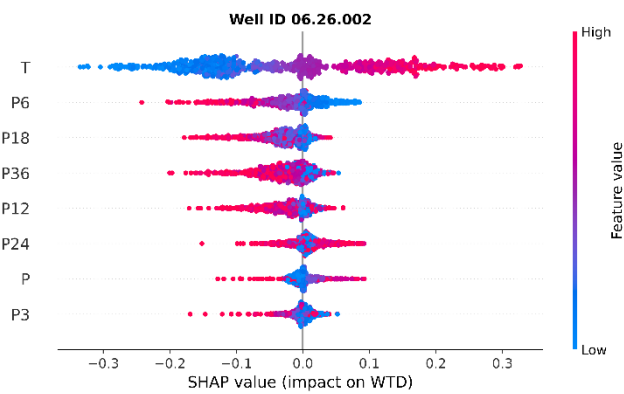
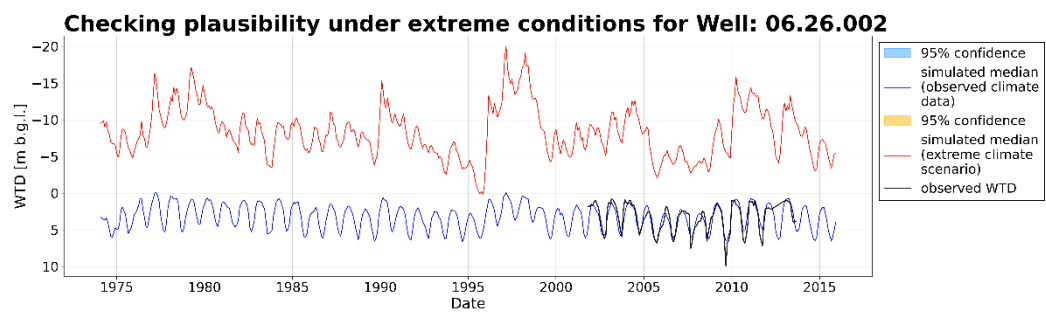
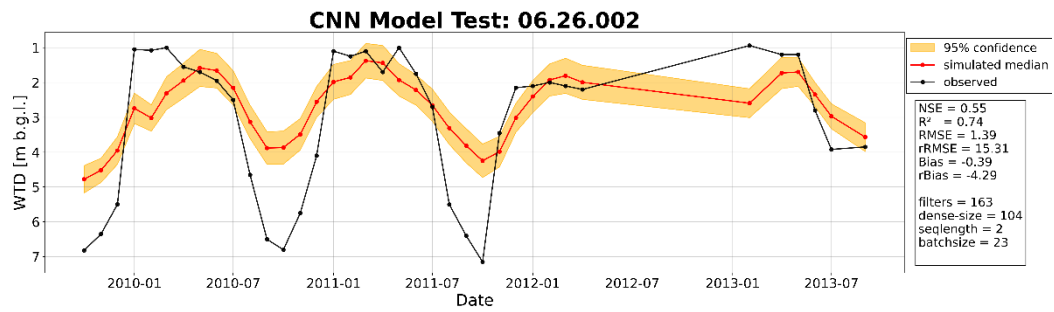


Figure S 28 Evaluation of 06.26.002 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

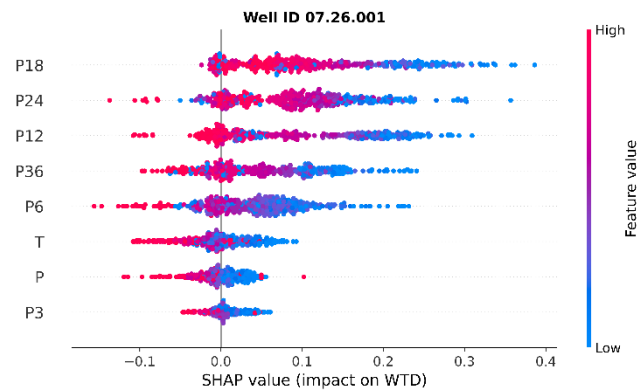
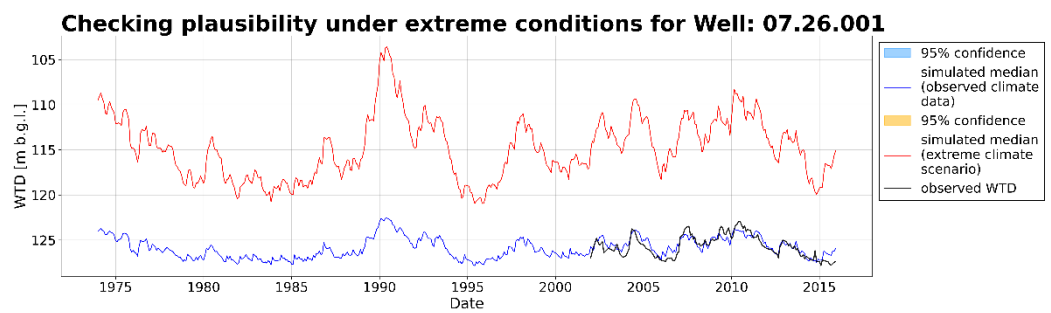
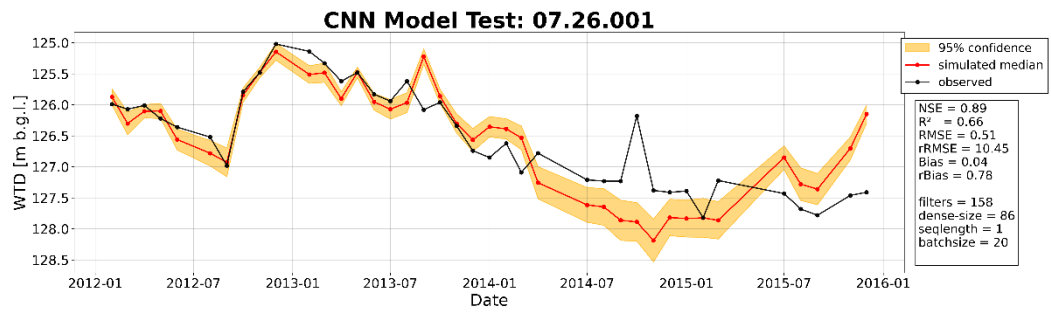


Figure S 29 Evaluation of 07.26.001 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

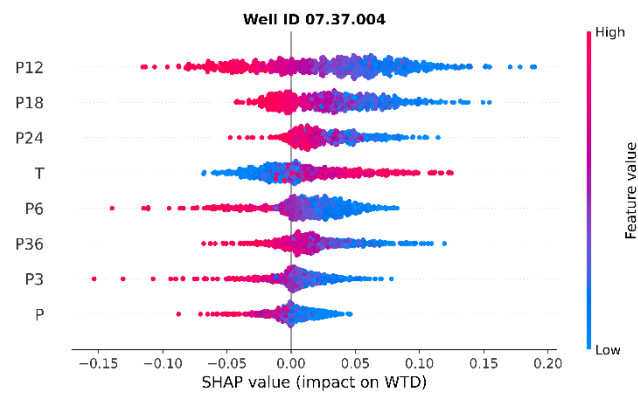
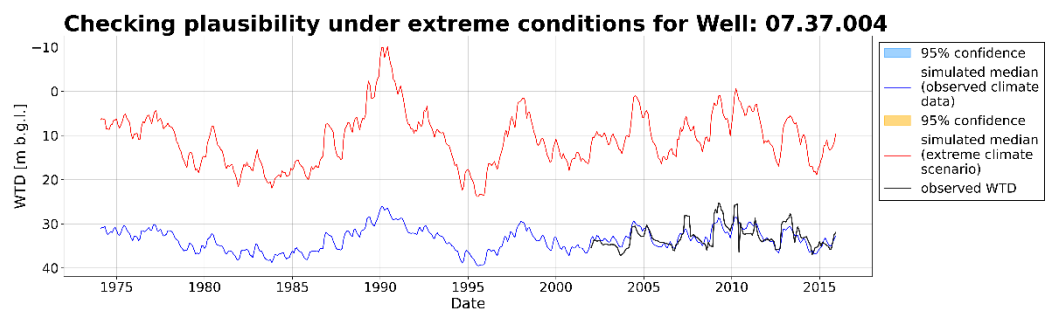
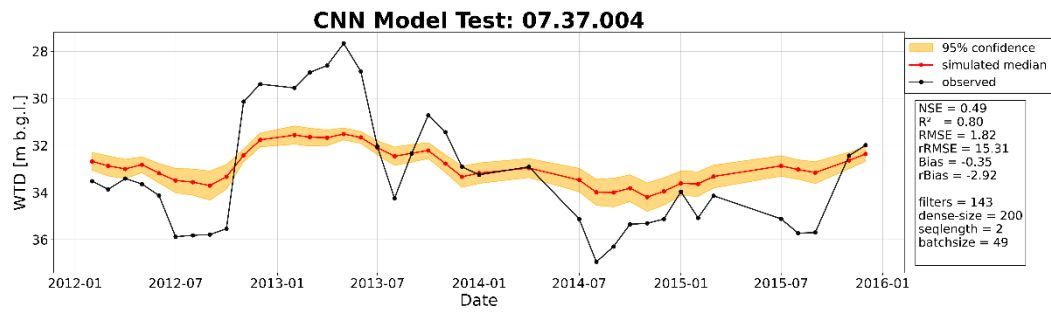


Figure S 30 Evaluation of 07.37.004 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

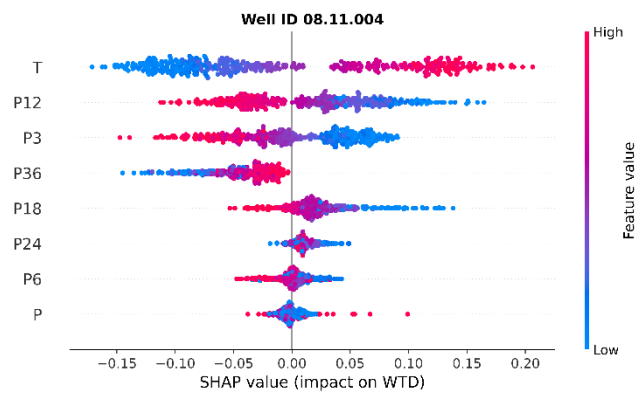
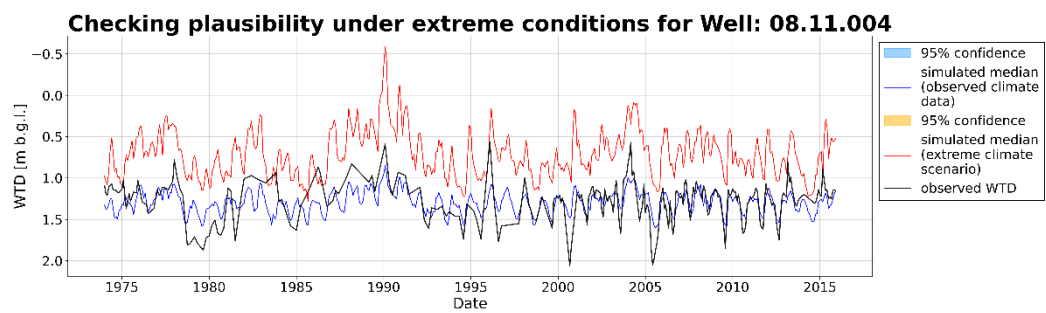
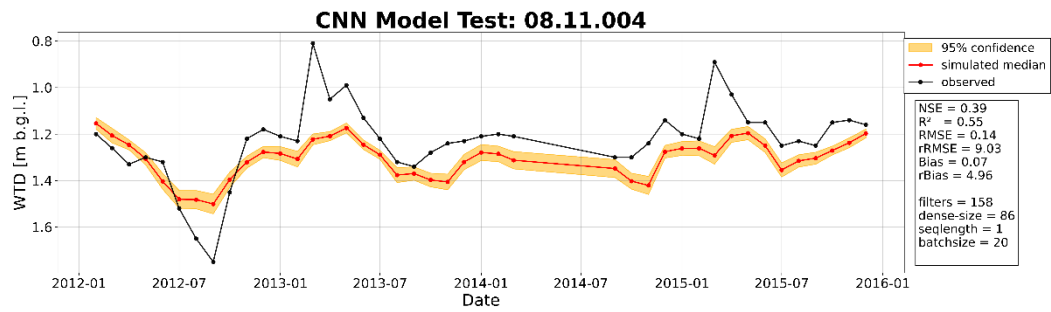


Figure S 31 Evaluation of 08.11.004 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

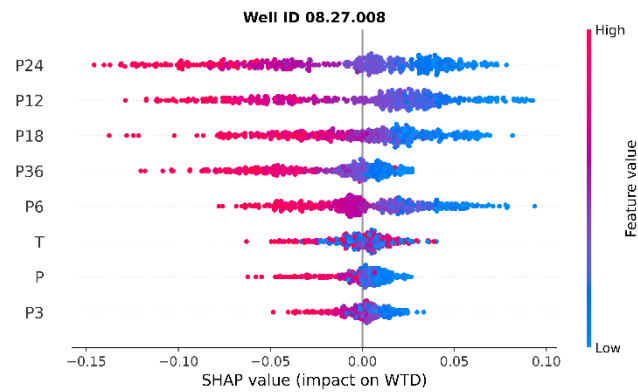
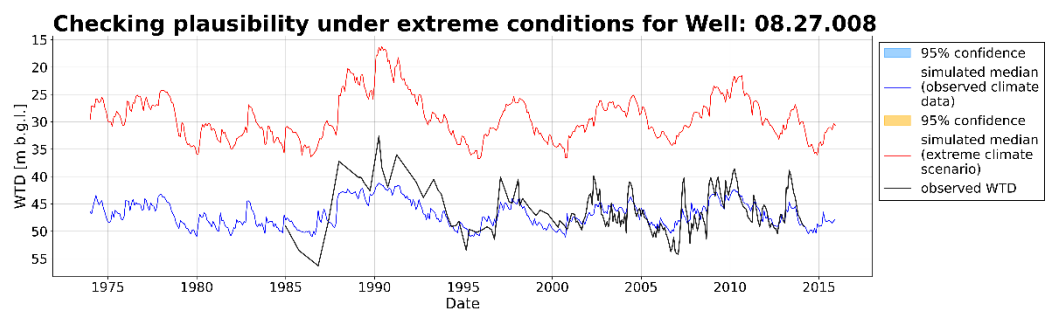
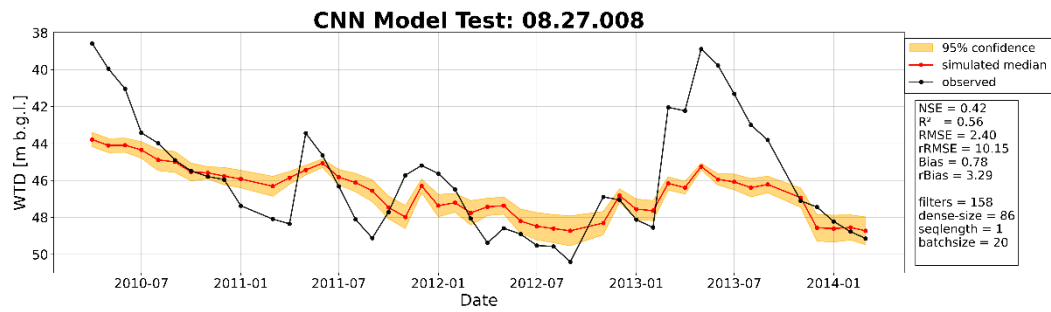


Figure S 32 Evaluation of 08.27.008 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

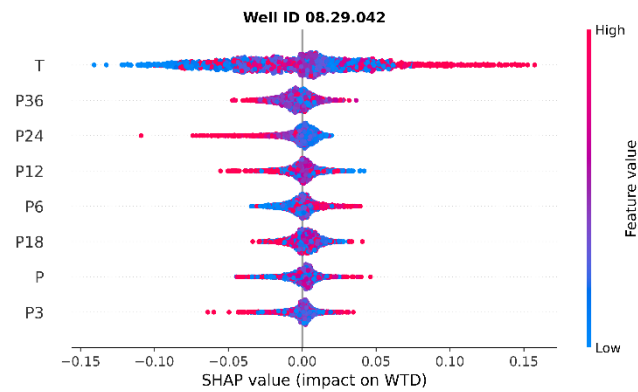
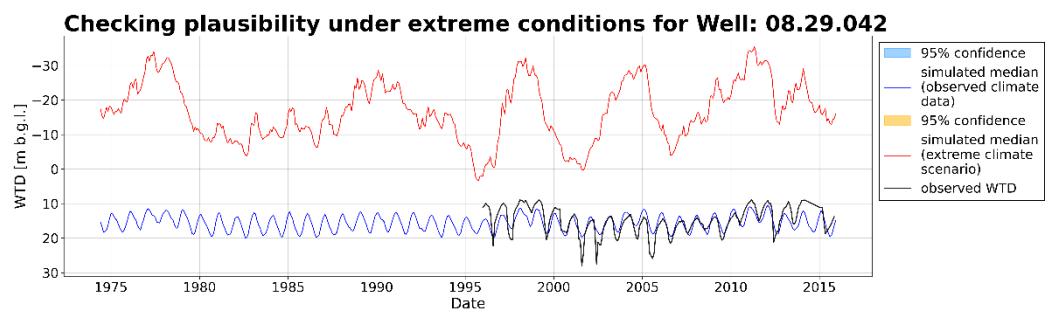
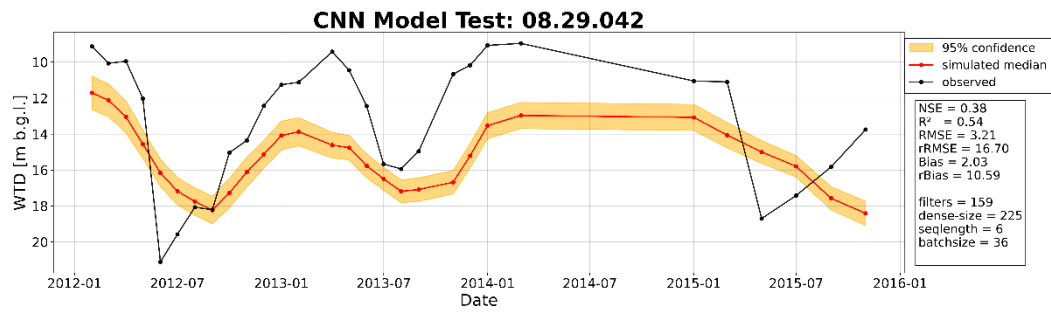


Figure S 33 Evaluation of 08.29.042 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

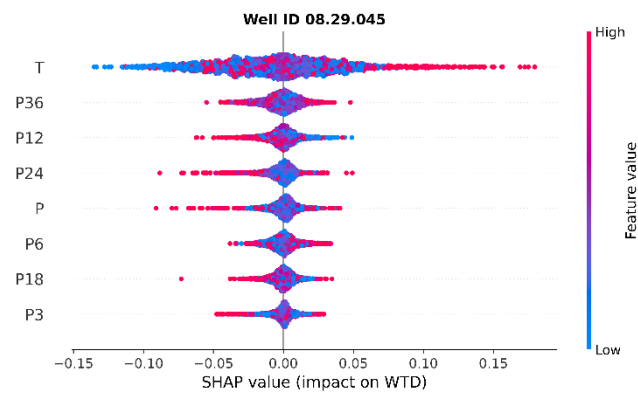
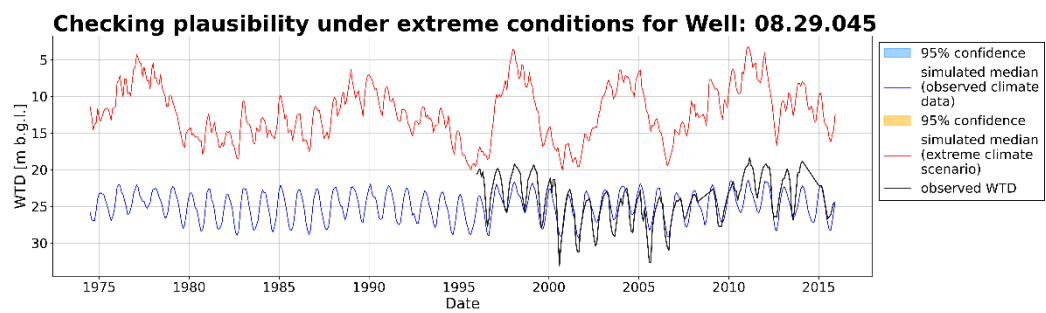
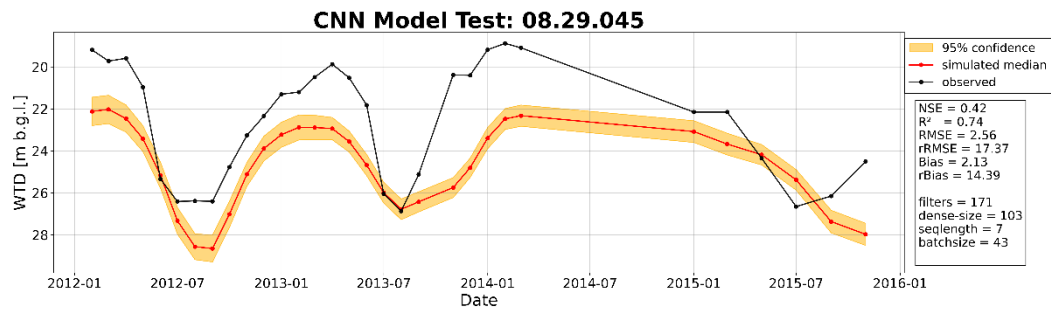


Figure S 34 Evaluation of 08.29.045 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

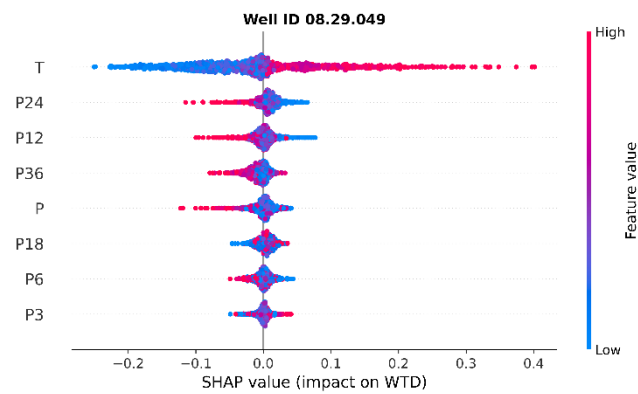
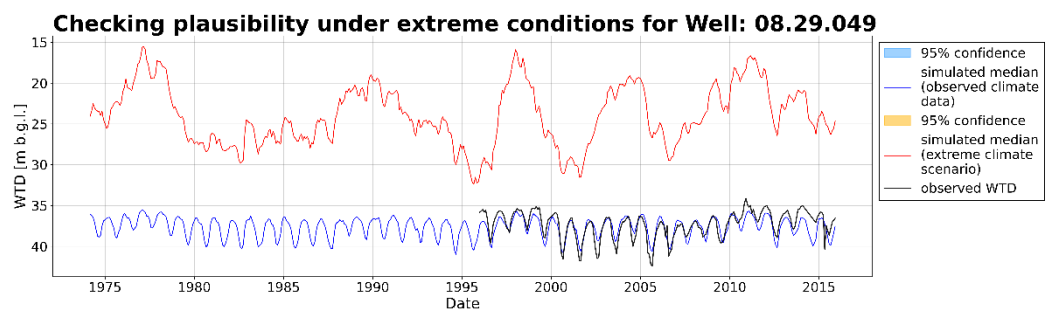
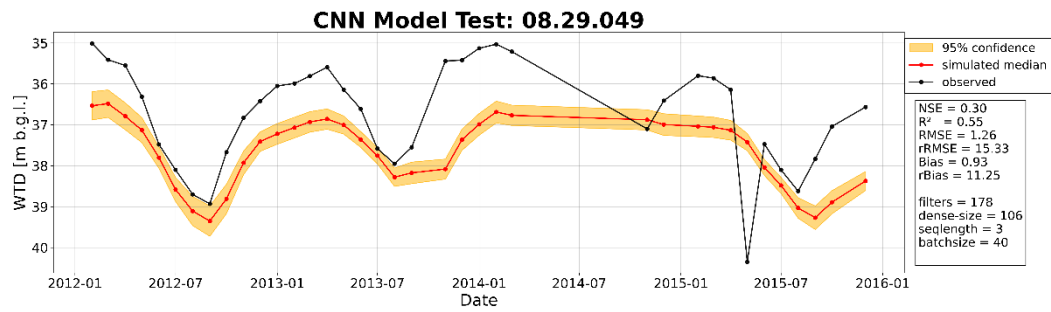


Figure S 35 Evaluation of 08.29.049 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

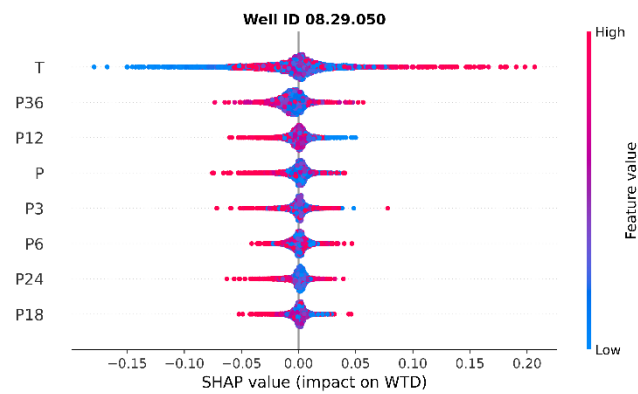
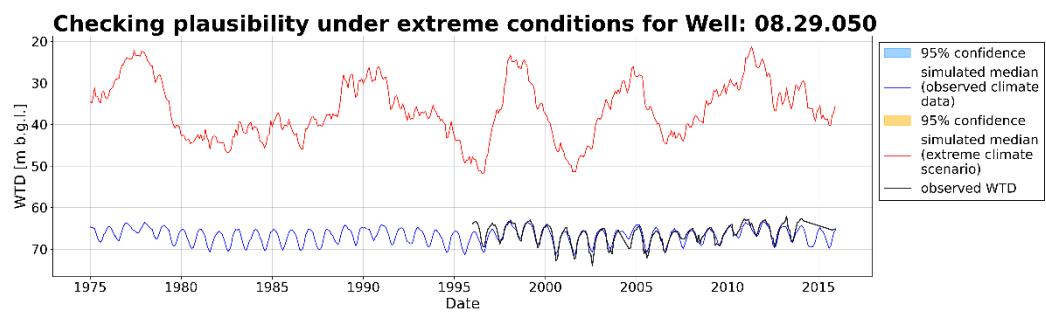
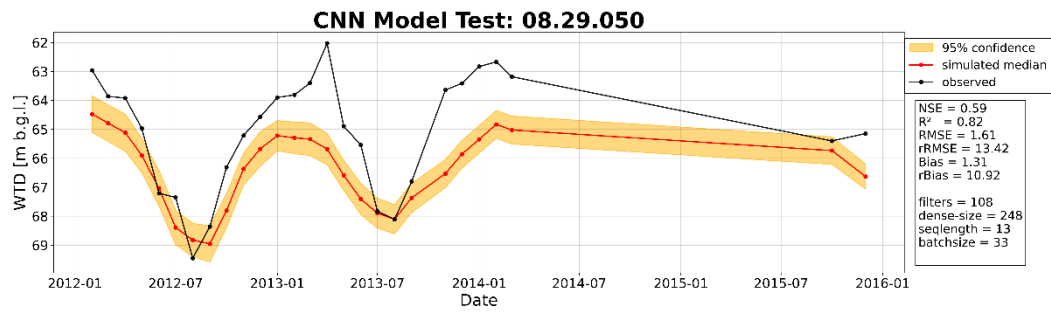


Figure S 36 Evaluation of 08.29.050 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

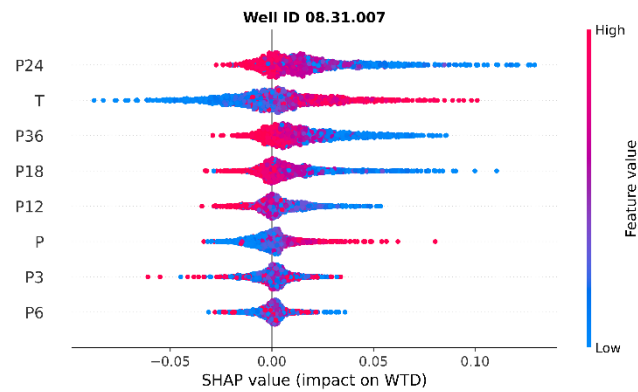
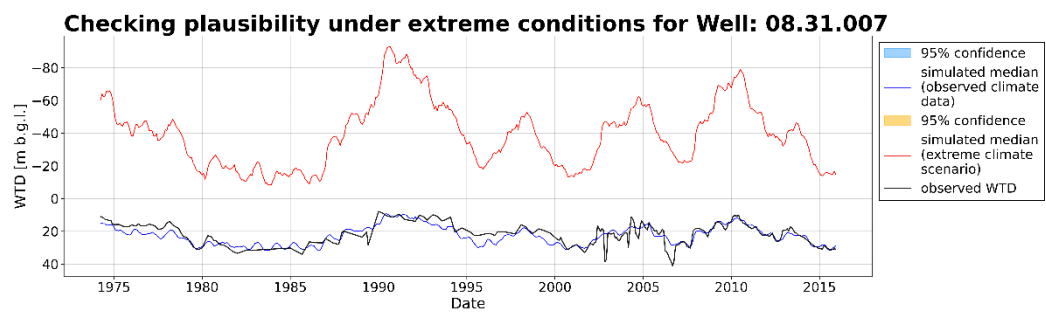
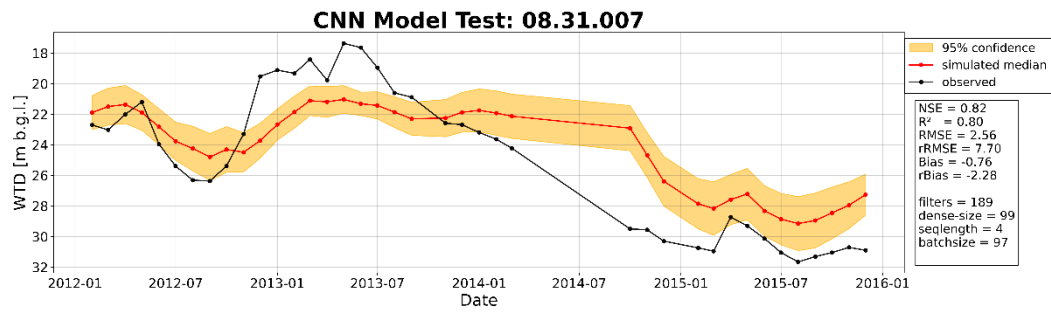


Figure S 37 Evaluation of 08.31.007 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

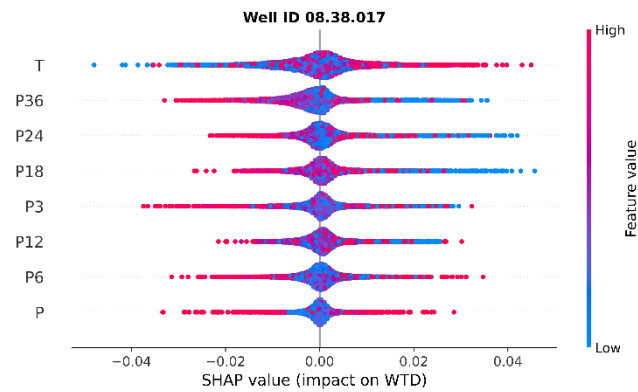
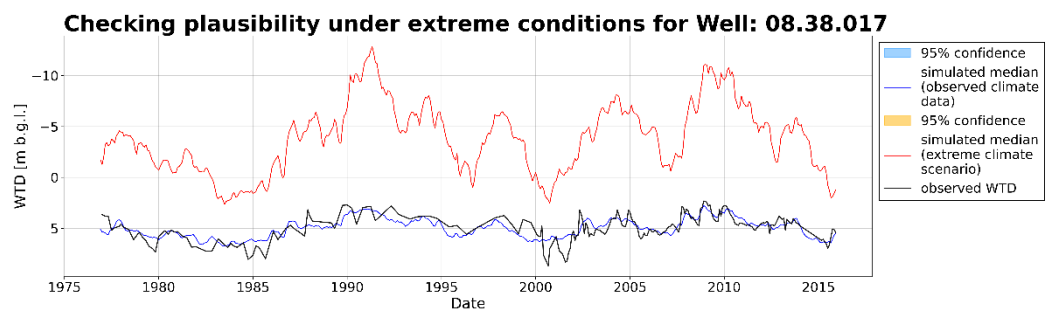
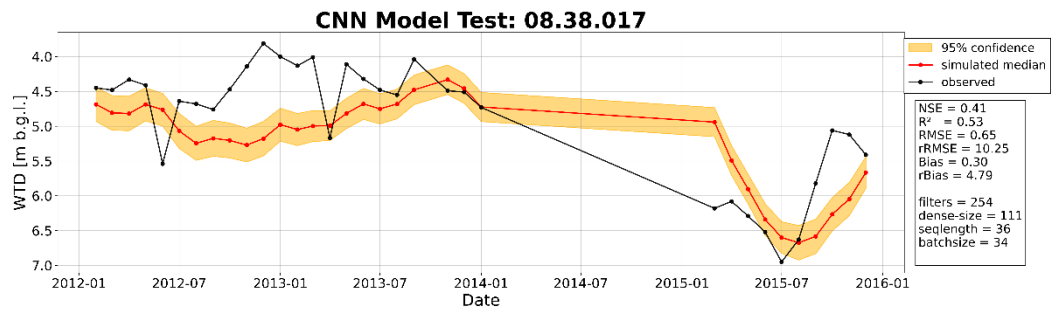


Figure S 38 Evaluation of 08.38.017 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

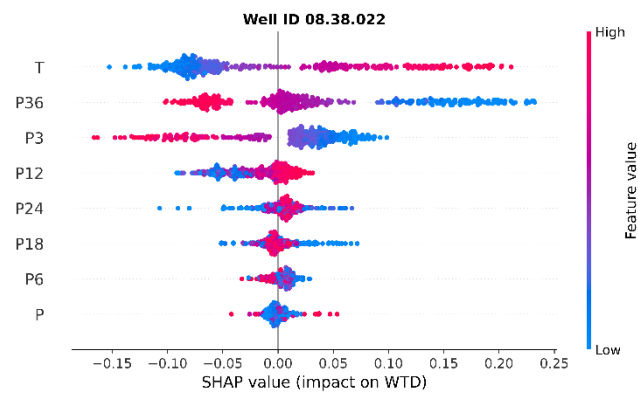
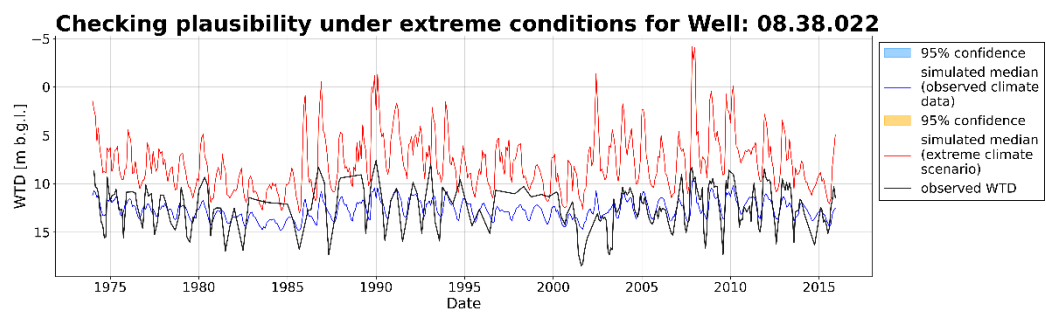
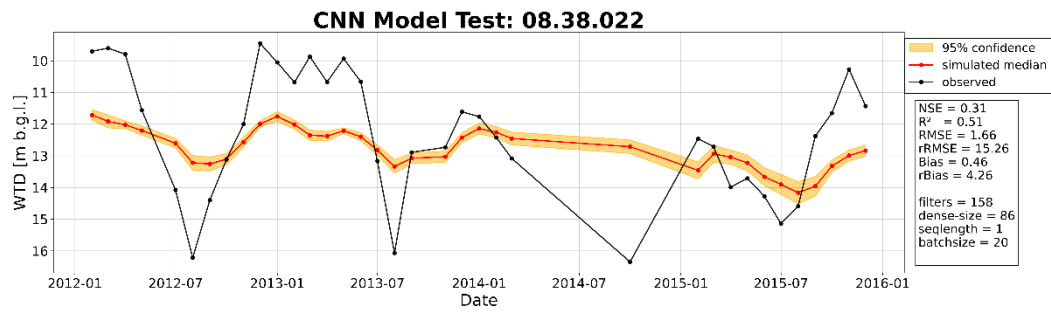


Figure S 39 Evaluation of 08.38.022 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

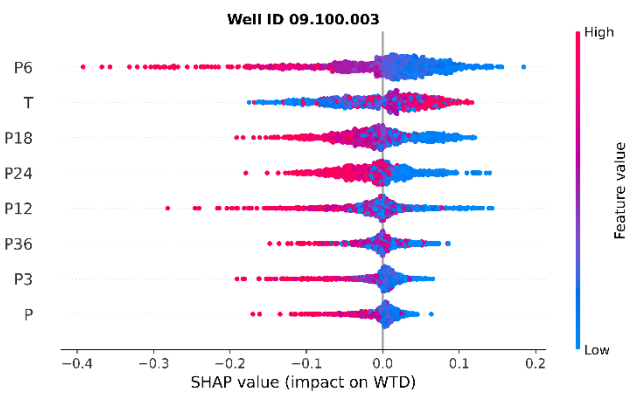
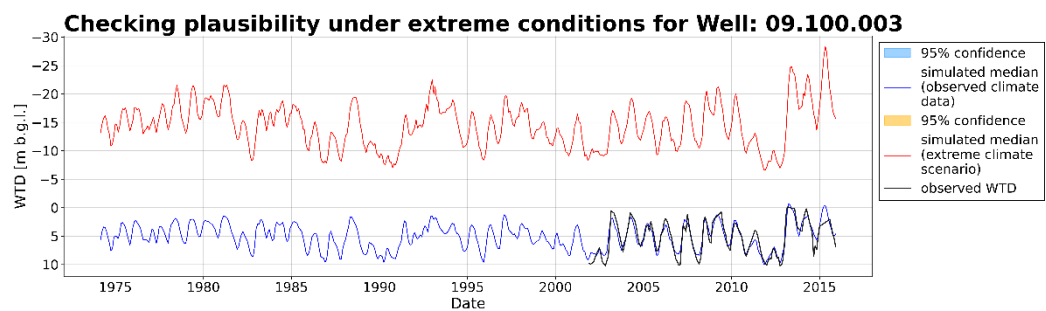
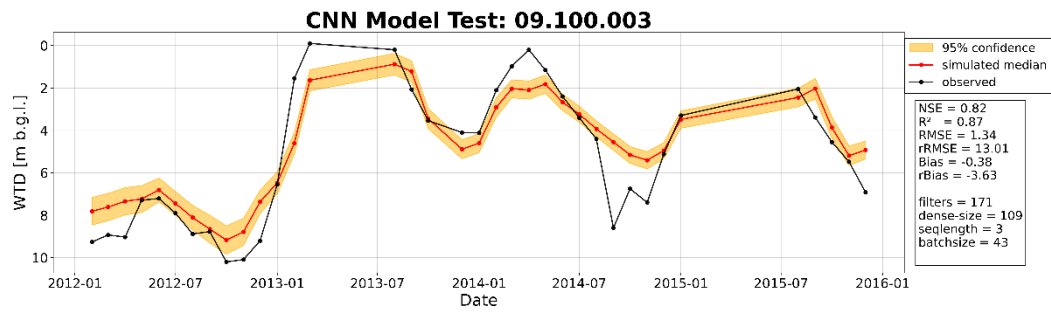


Figure S 40 Evaluation of 09.100.003 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

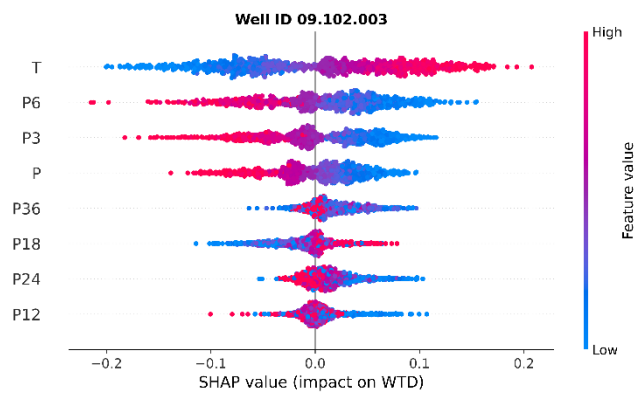
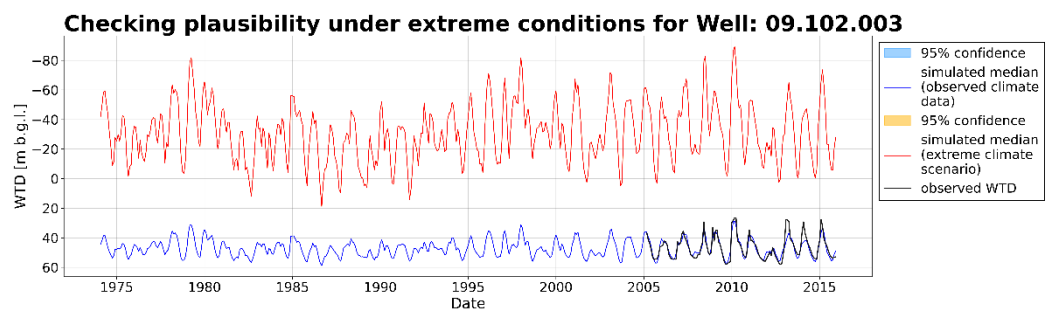
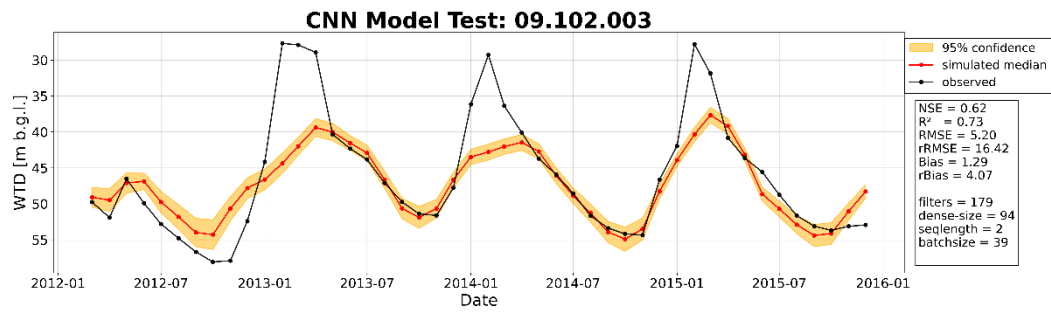


Figure S 41 Evaluation of 09.102.003 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

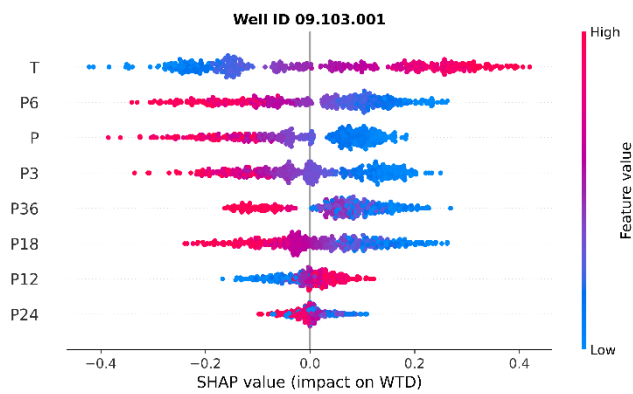
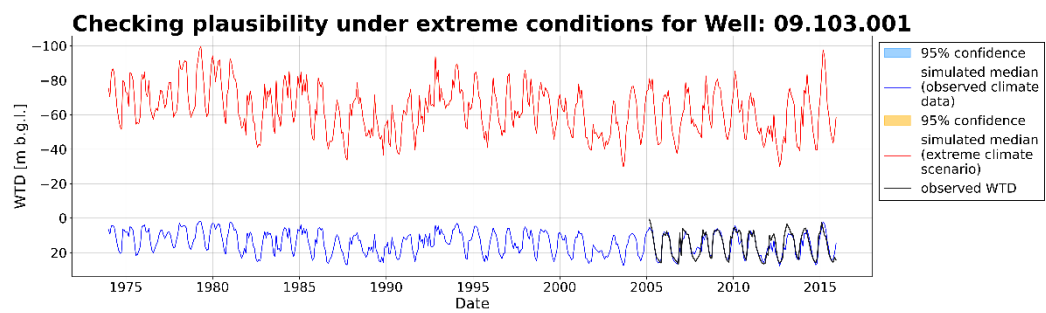
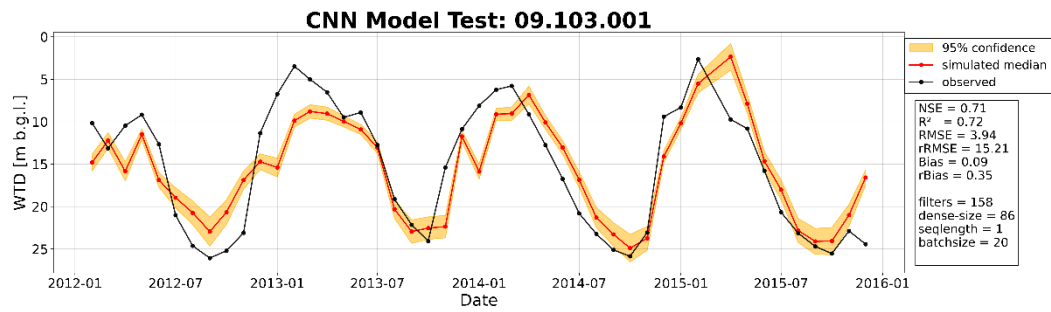


Figure S 42 Evaluation of 09.103.001 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

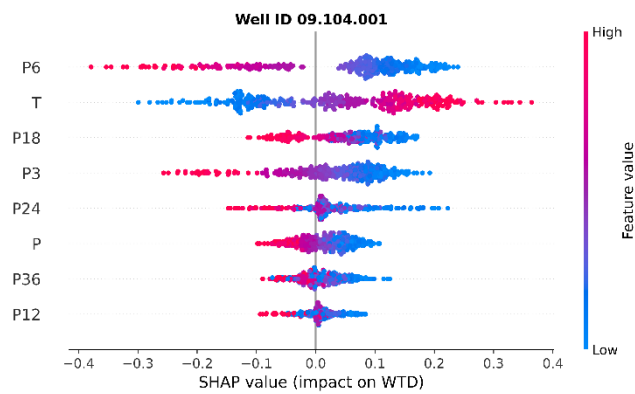
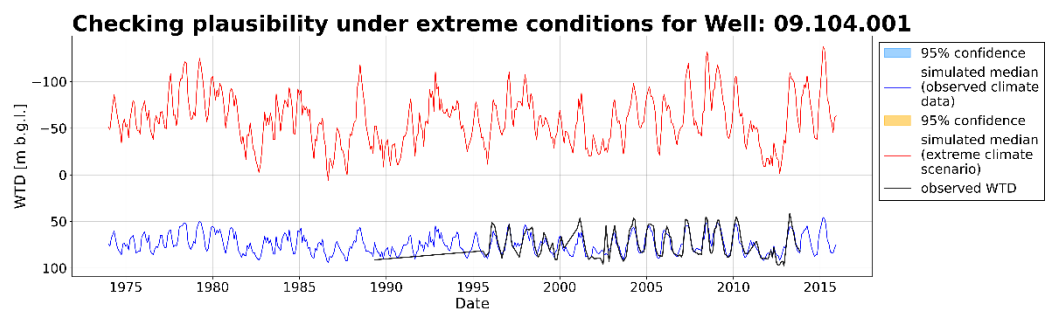
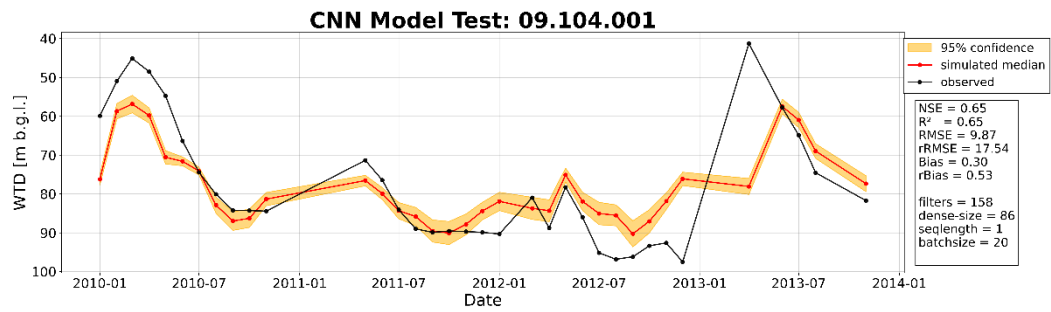


Figure S 43 Evaluation of 09.104.001 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

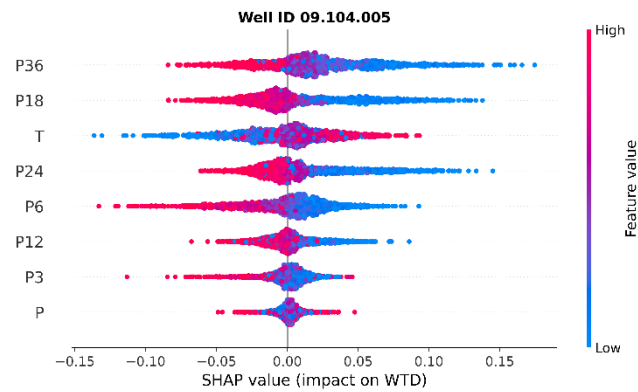
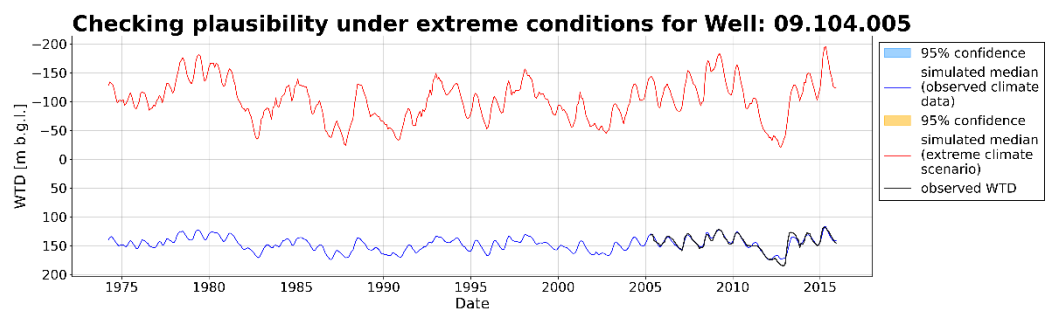
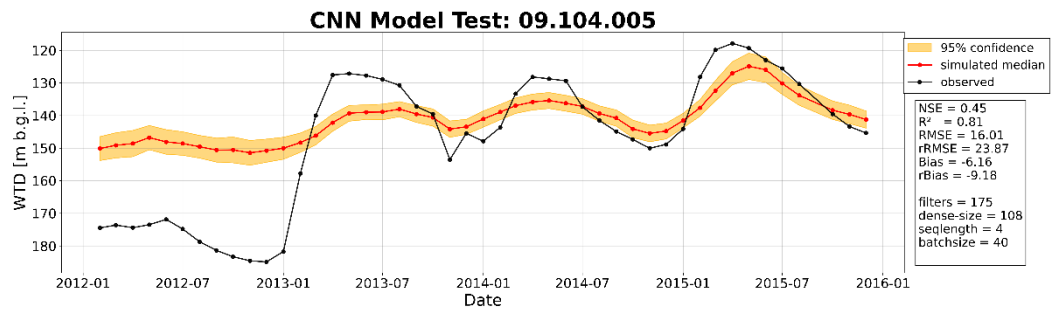


Figure S 44 Evaluation of 09.104.005 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

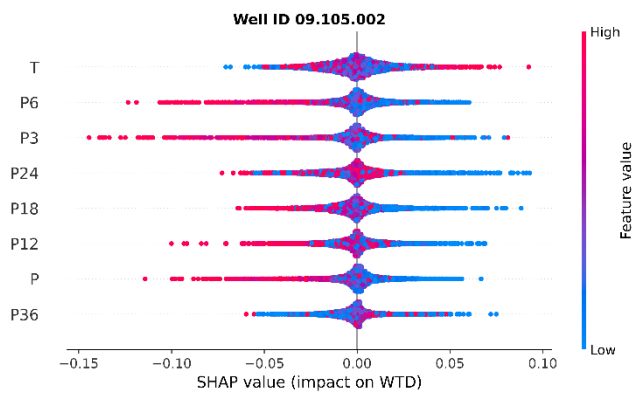
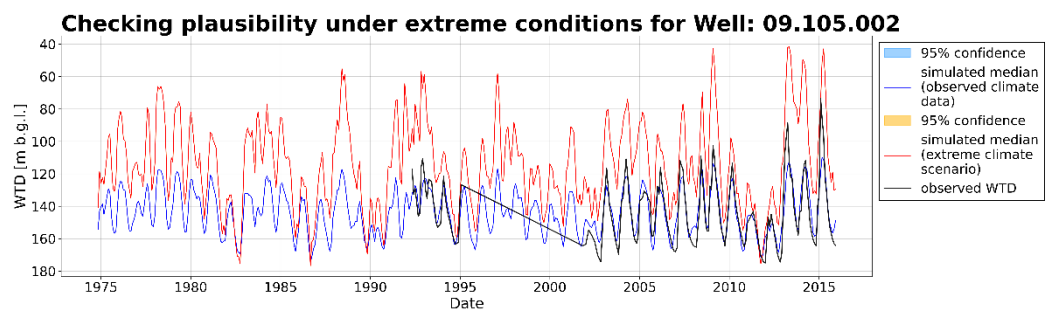
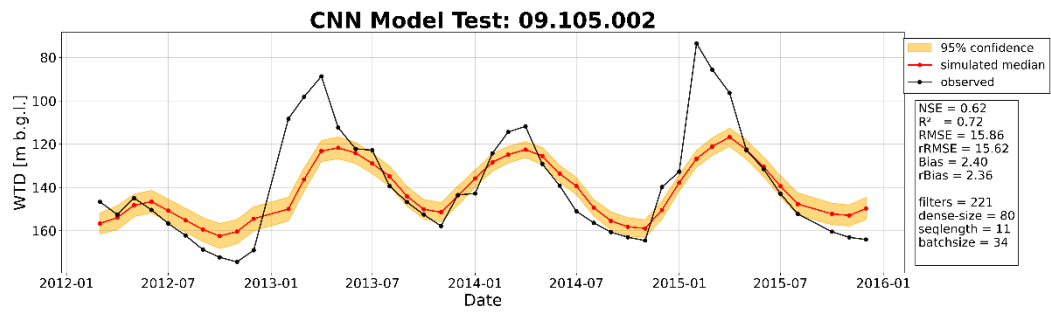


Figure S 45 Evaluation of 09.105.002 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

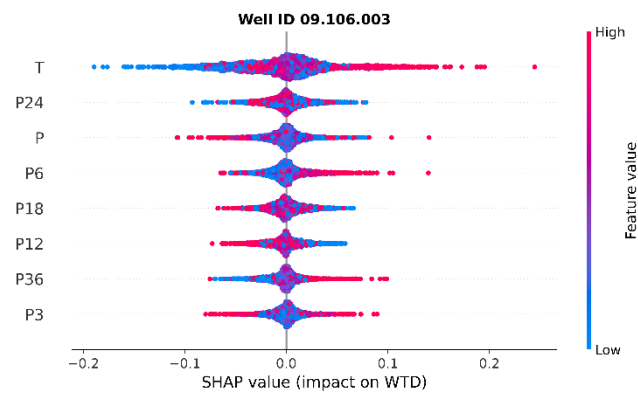
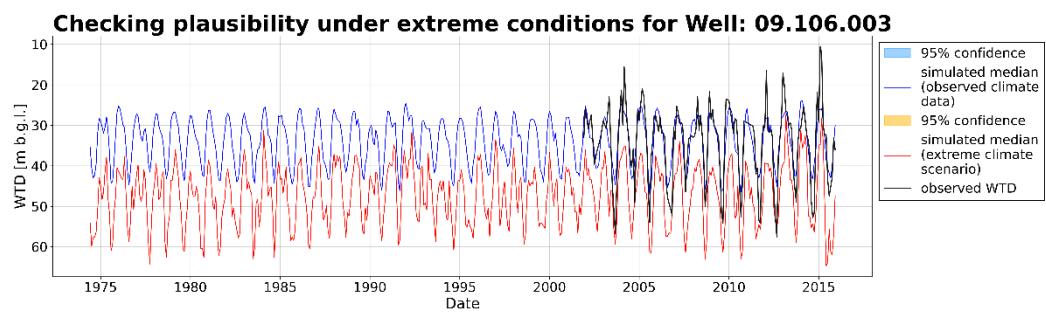
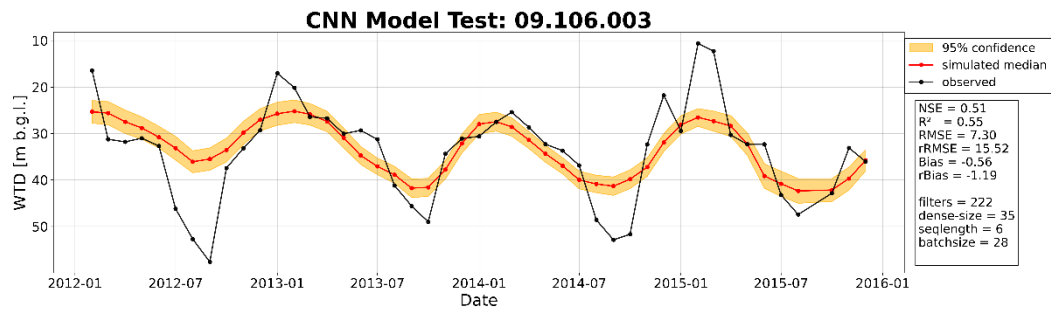


Figure S 46 Evaluation of 09.106.003 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

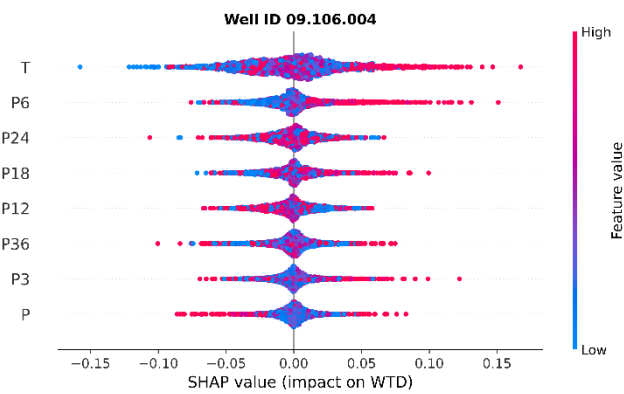
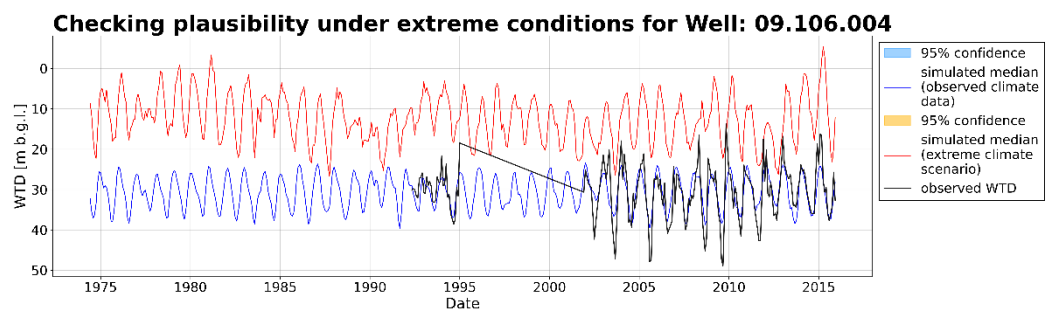
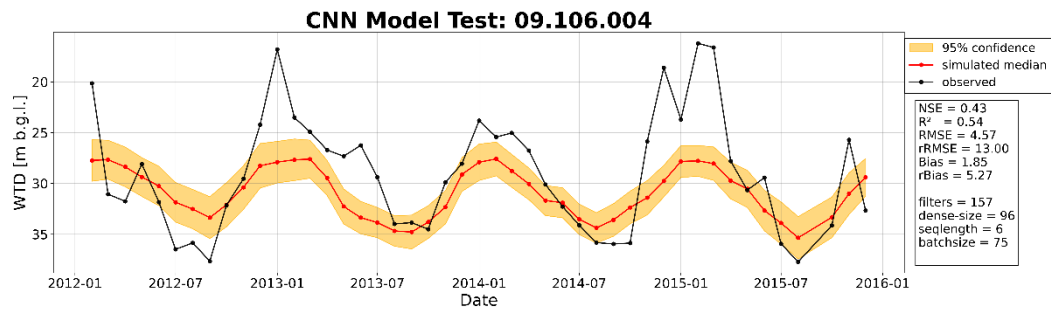


Figure S 47 Evaluation of 09.106.004 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

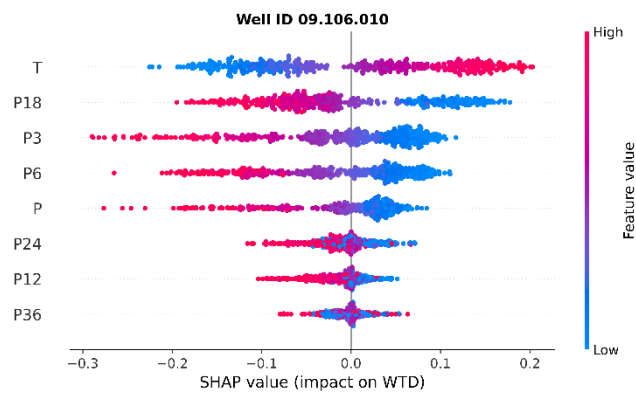
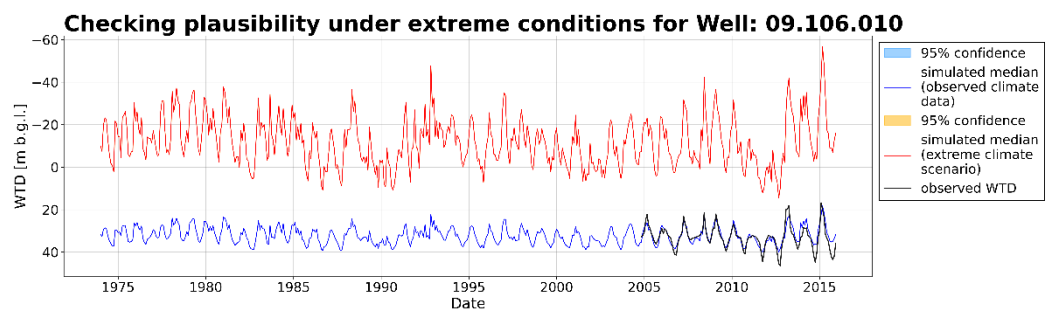
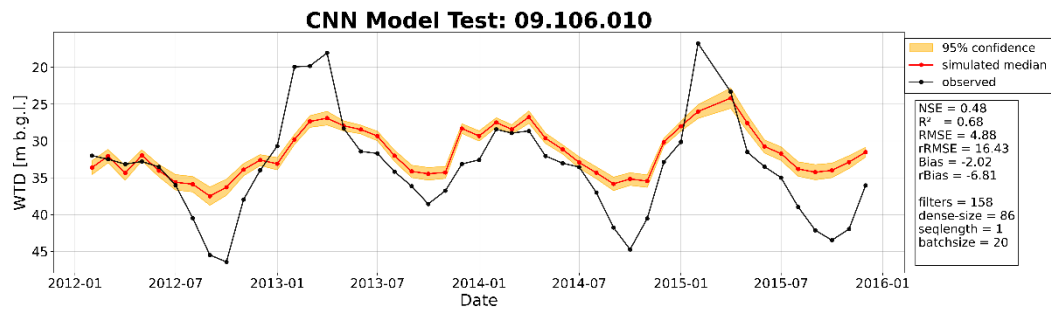


Figure S 48 Evaluation of 09.106.010 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

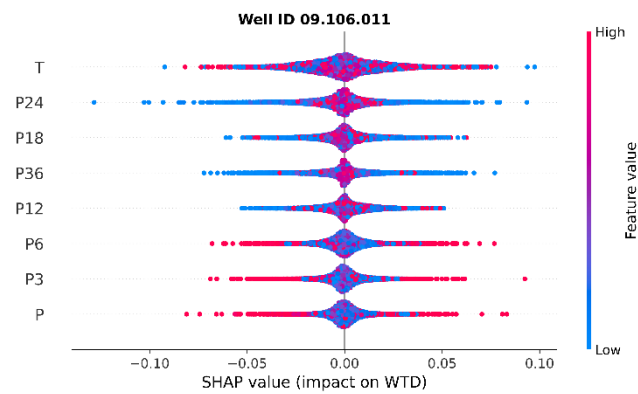
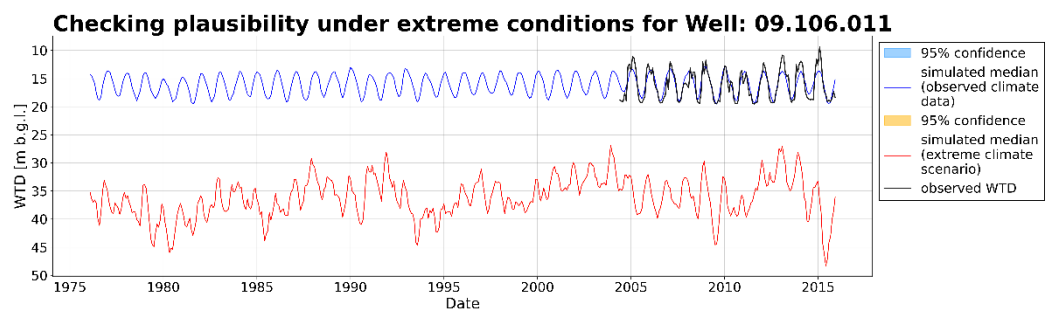
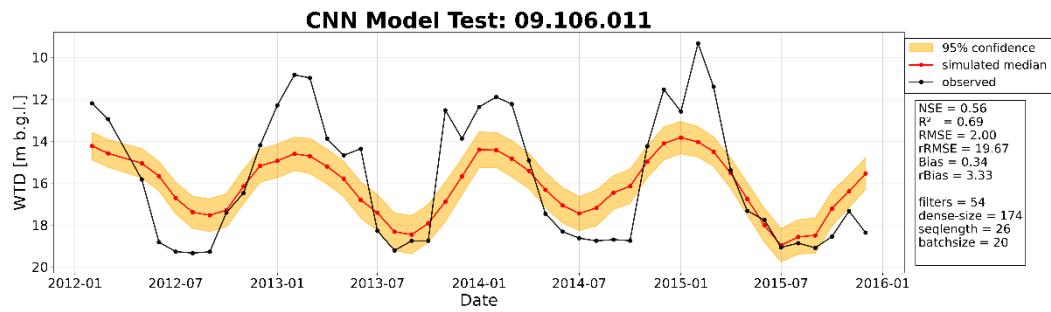


Figure S 49 Evaluation of 09.106.011 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

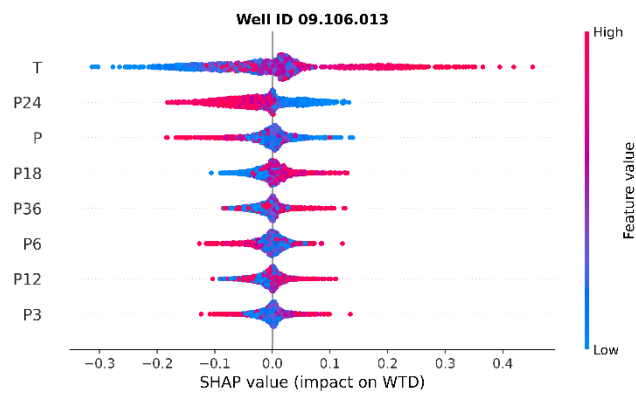
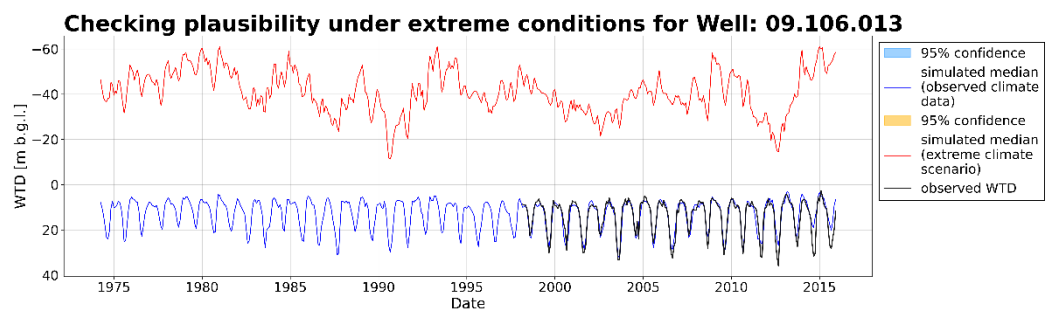
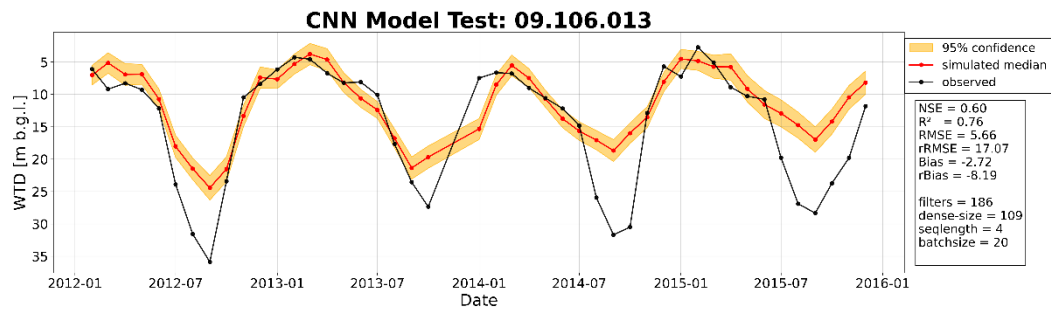


Figure S 50 Evaluation of 09.106.013 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

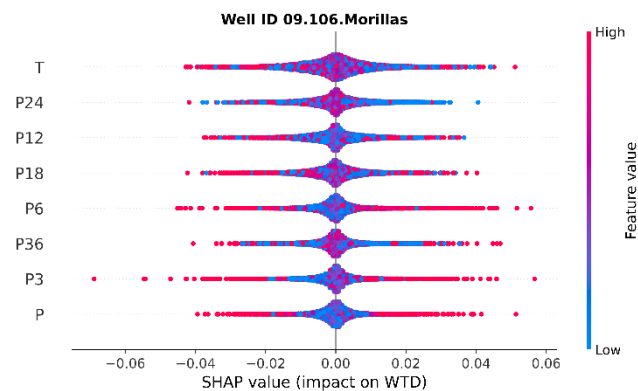
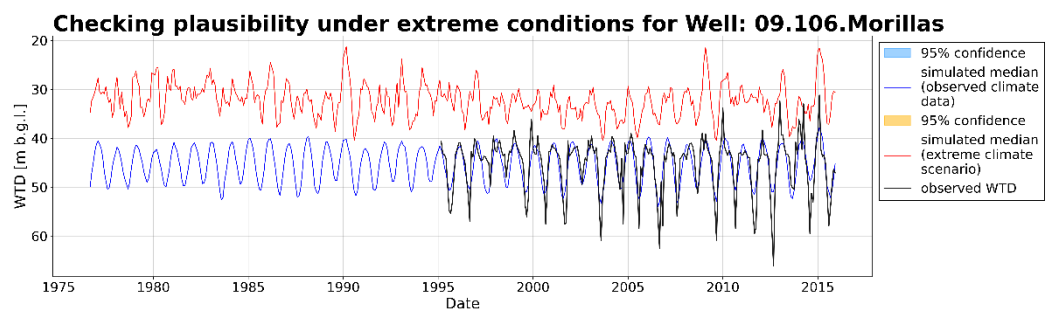
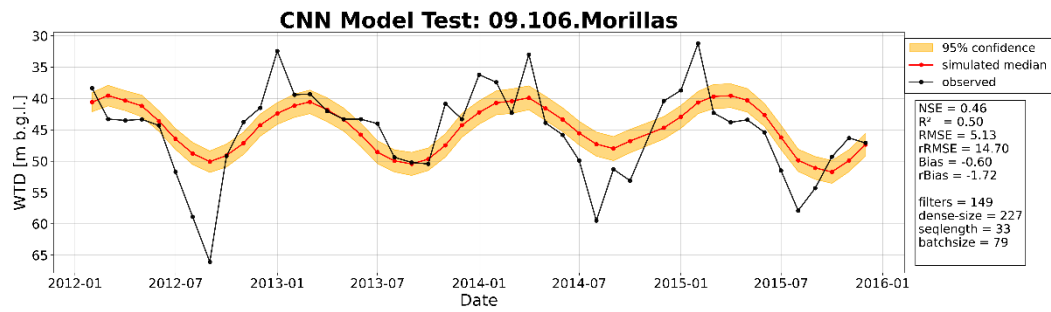


Figure S 51 Evaluation of 09.106.Morillas Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

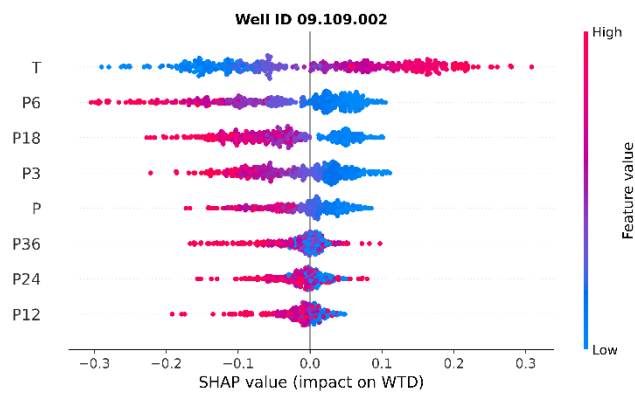
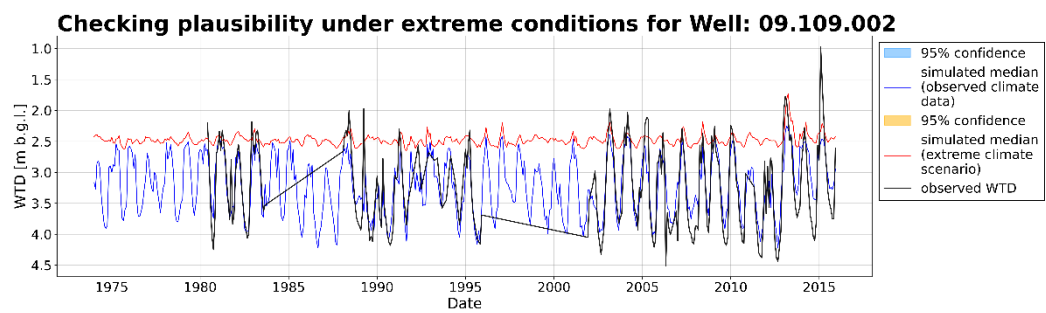
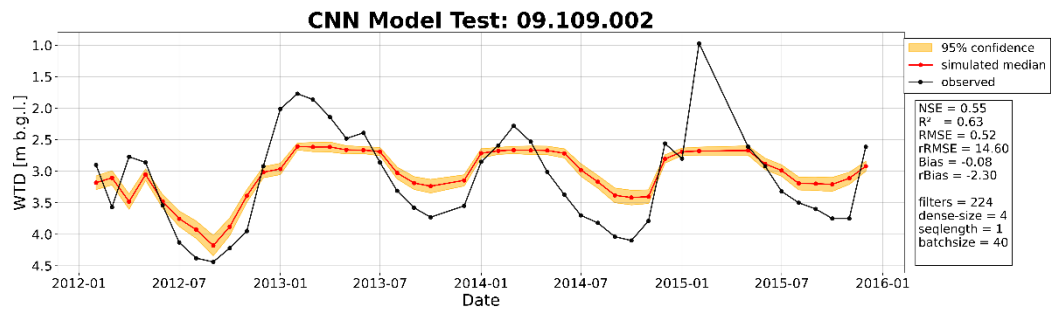


Figure S 52 Evaluation of 09.109.002 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

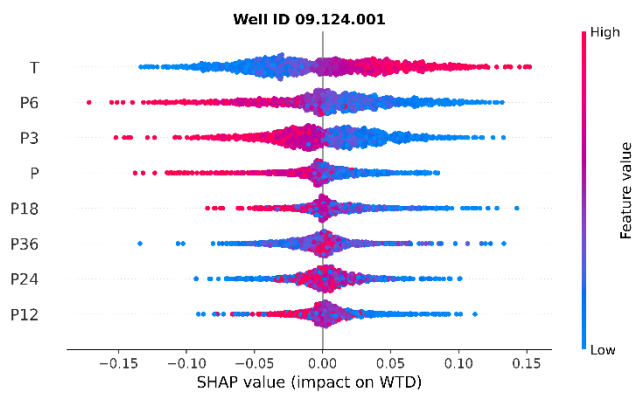
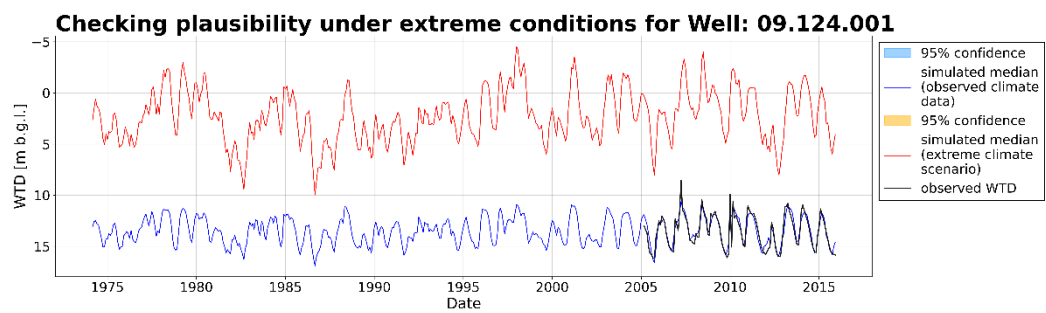
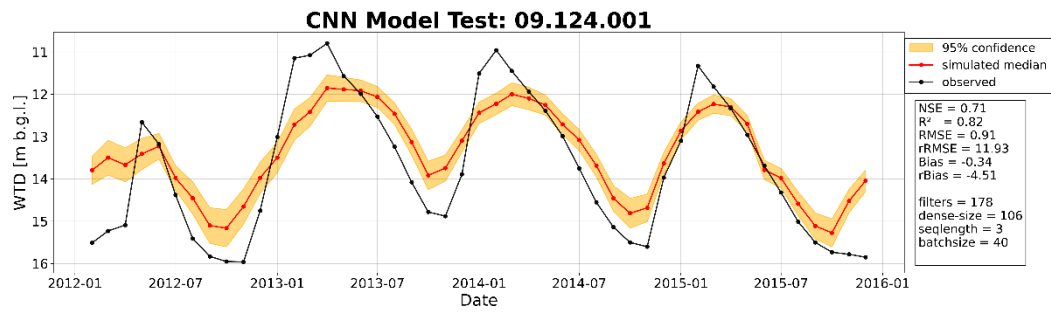


Figure S 53 Evaluation of 09.124.001 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

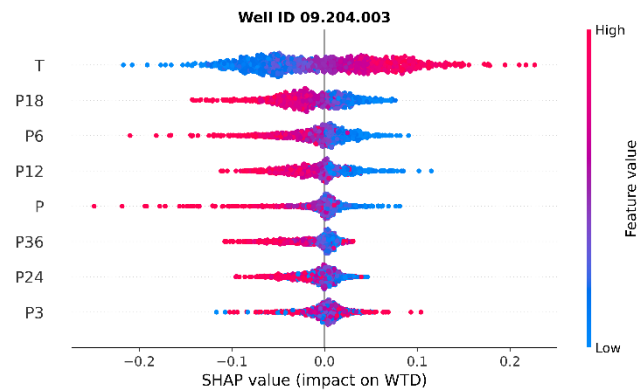
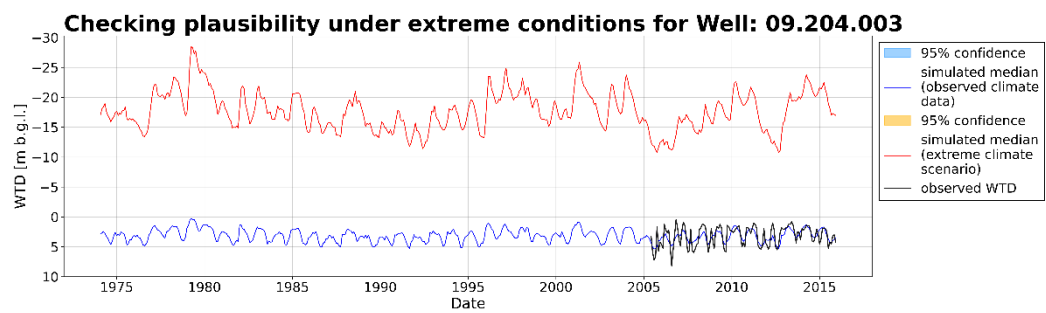
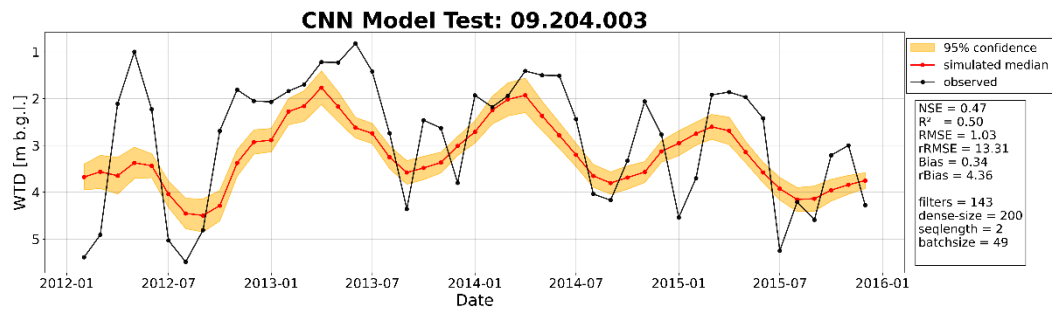


Figure S 54 Evaluation of 09.204.003 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

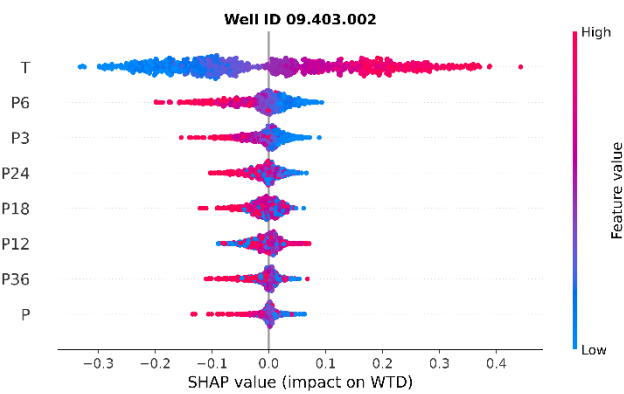
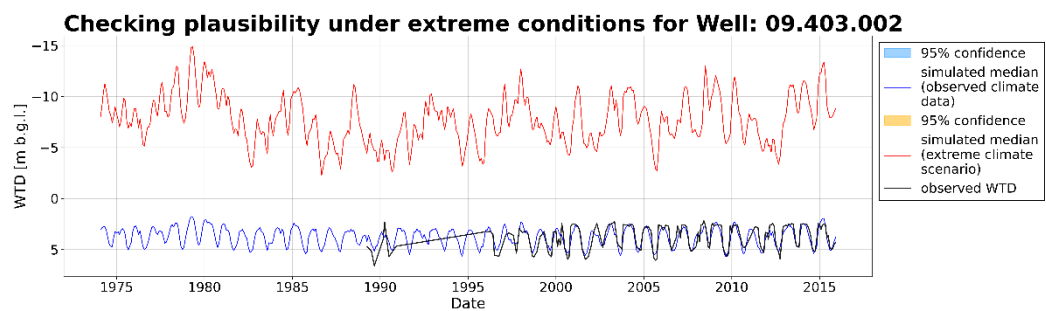
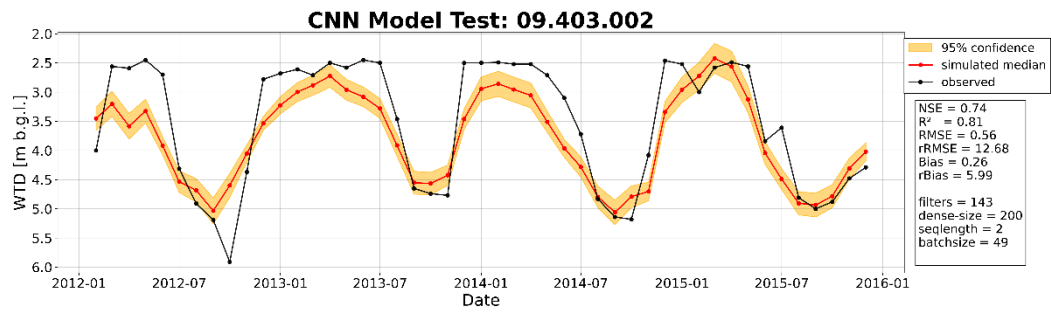


Figure S 55 Evaluation of 09.403.002 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

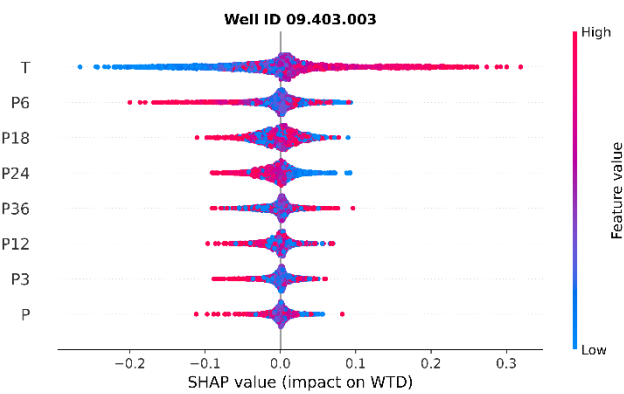
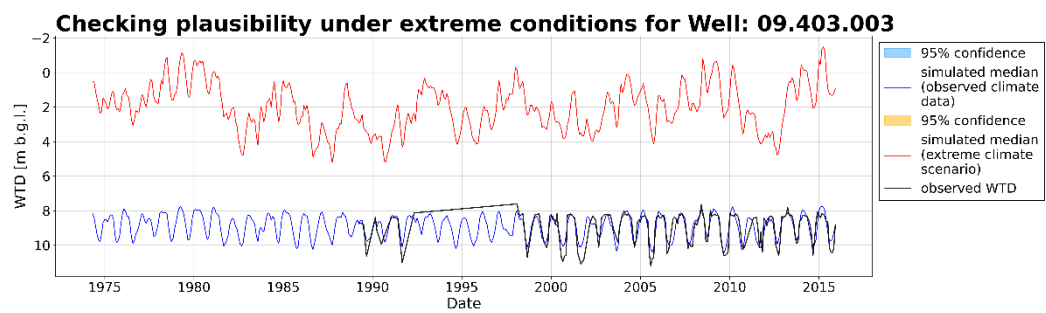
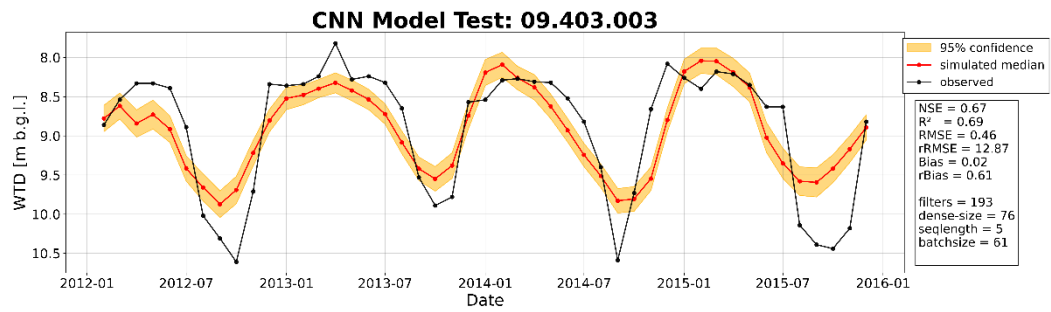


Figure S 56 Evaluation of 09.403.003 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

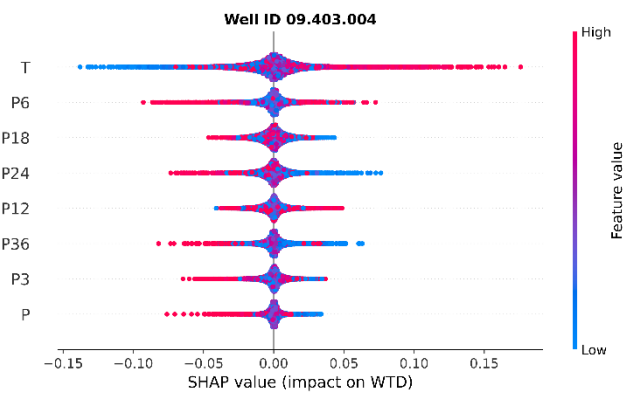
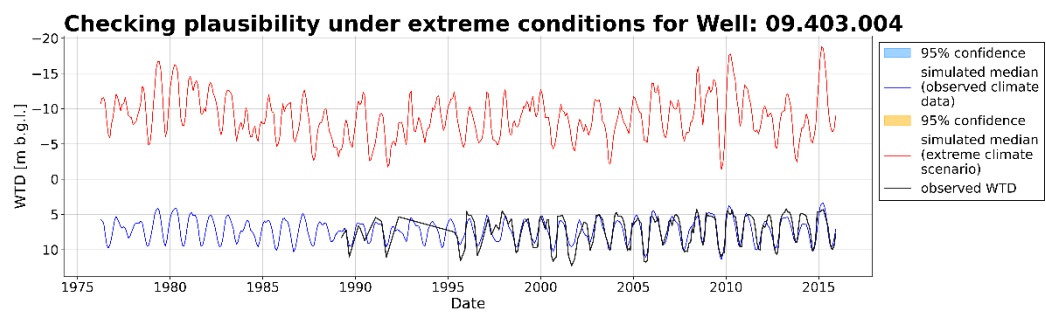
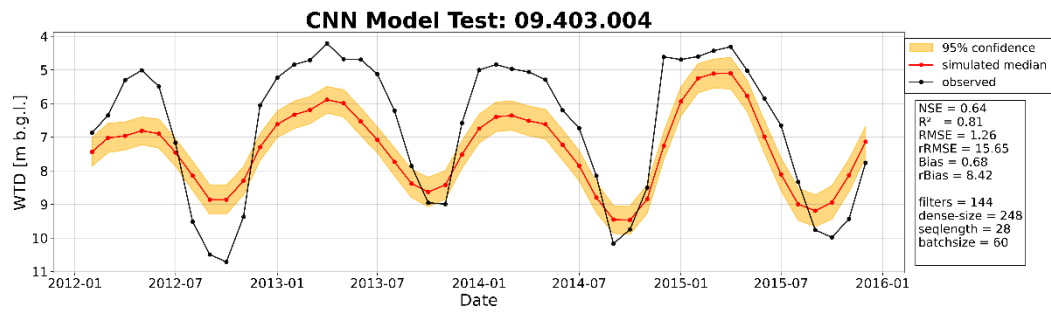


Figure S 57 Evaluation of 09.403.004 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

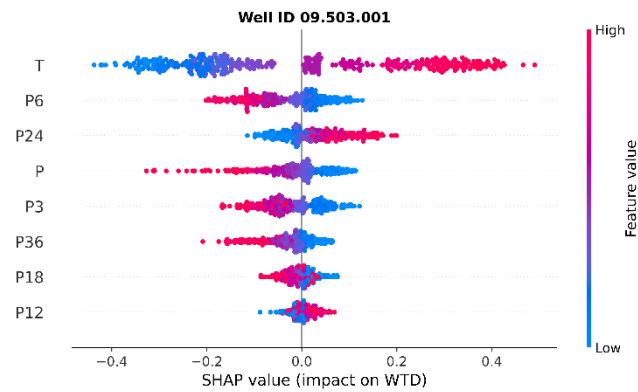
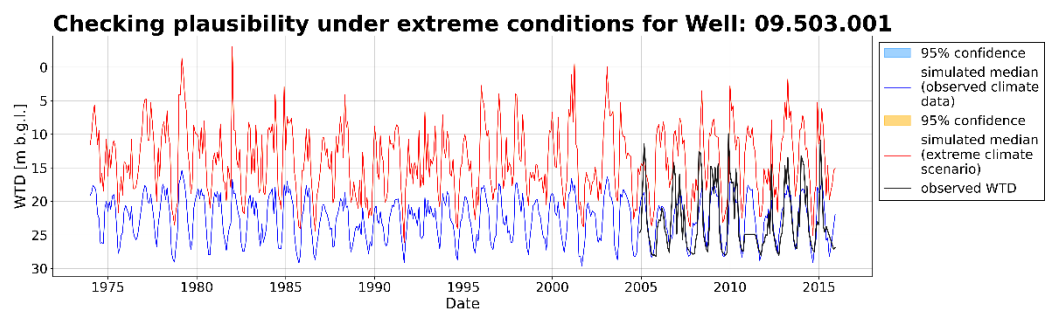
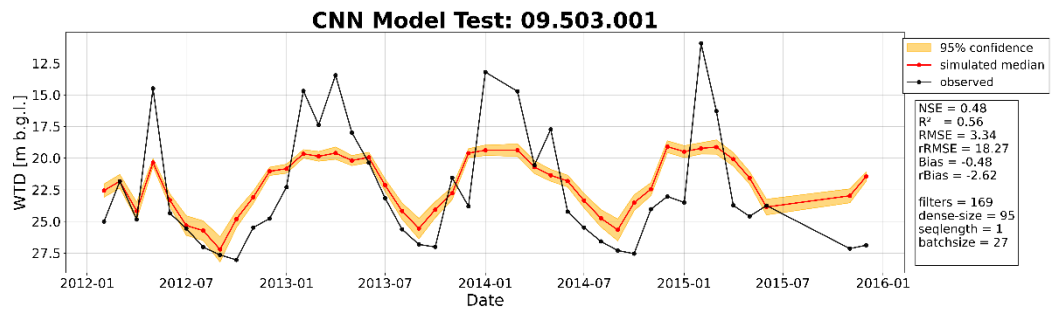


Figure S 58 Evaluation of 09.503.001 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

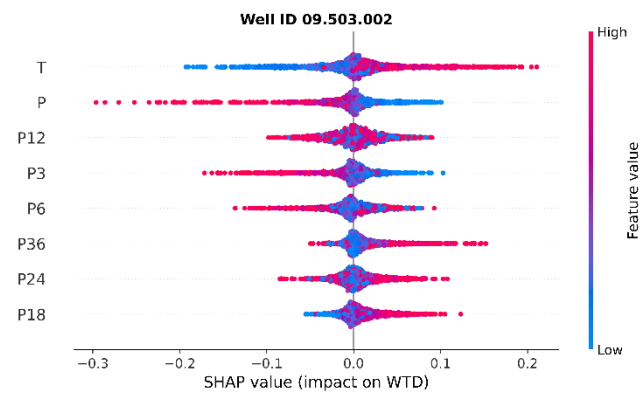
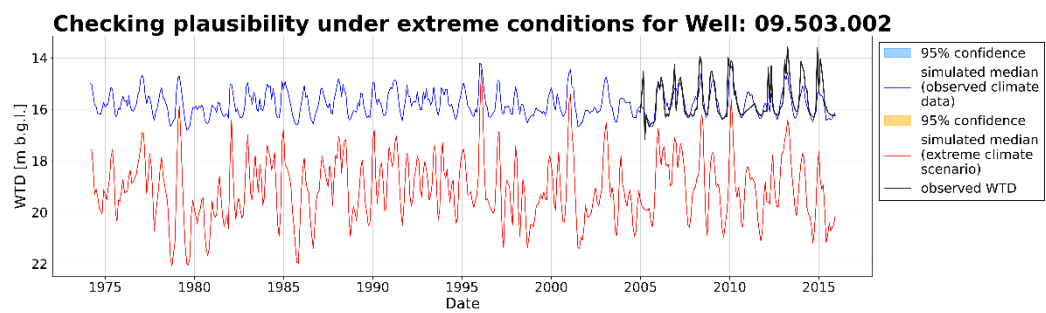
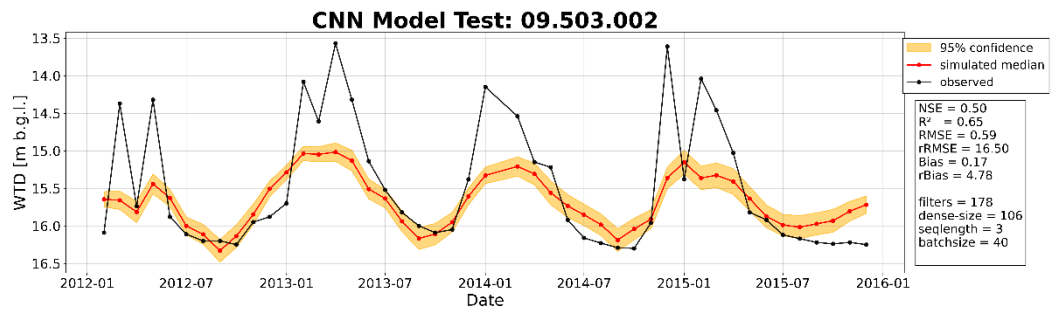


Figure S 59 Evaluation of 09.503.002 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

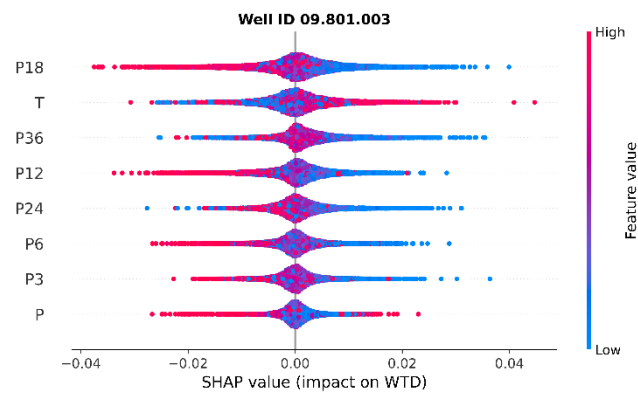
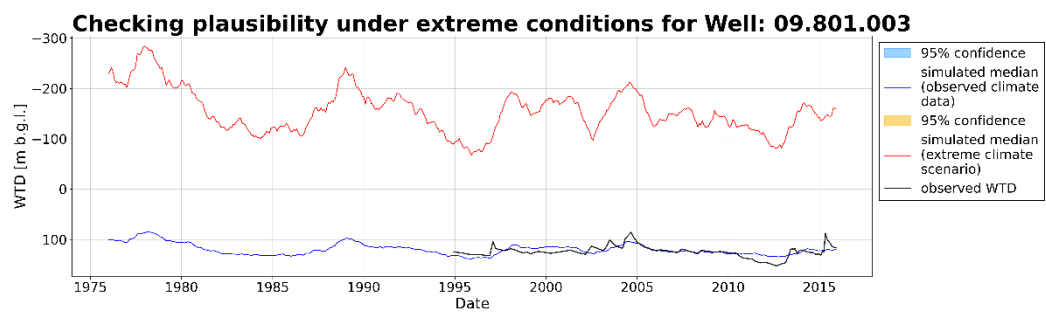
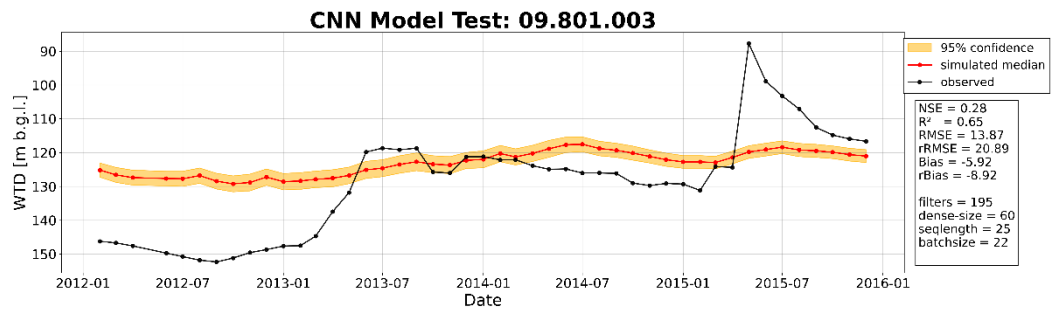


Figure S 60 Evaluation of 09.801.003 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

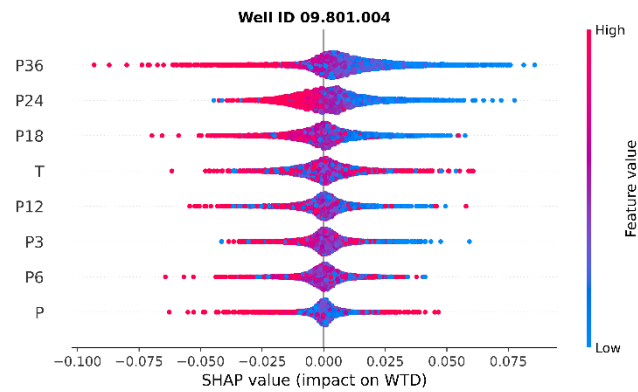
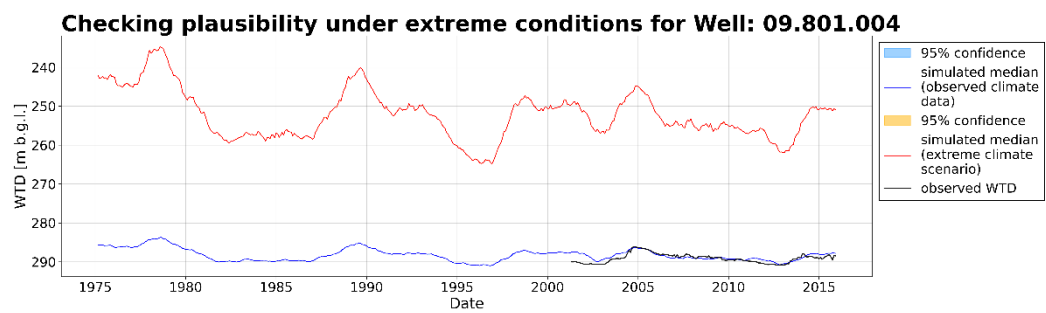
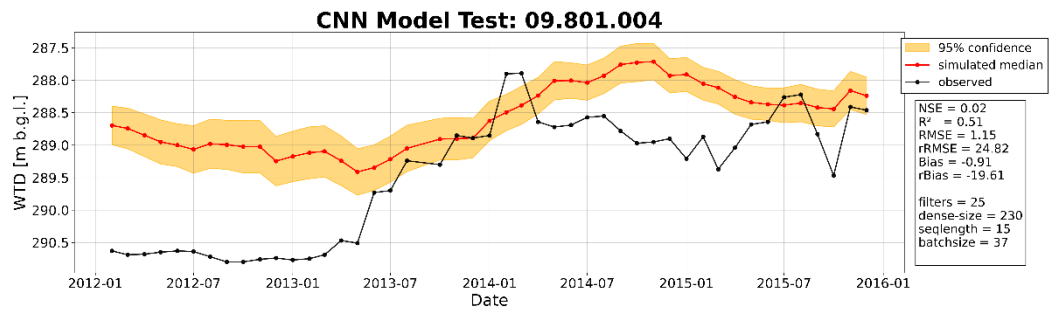


Figure S 61 Evaluation of 09.801.004 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

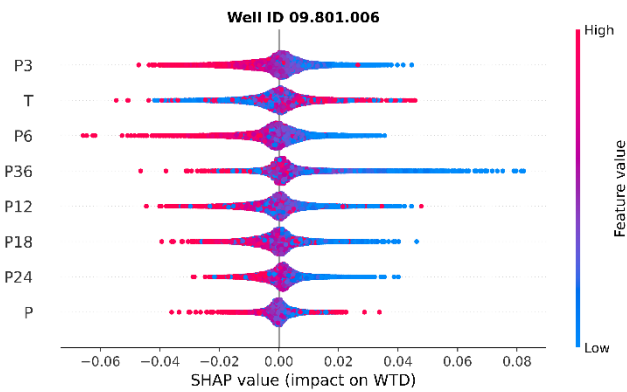
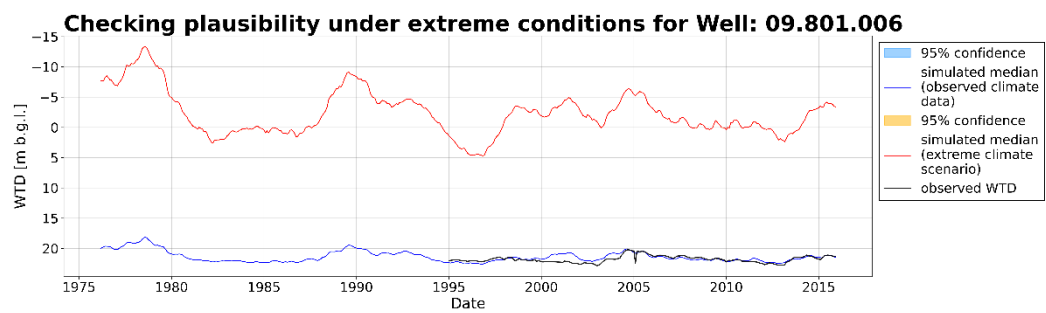
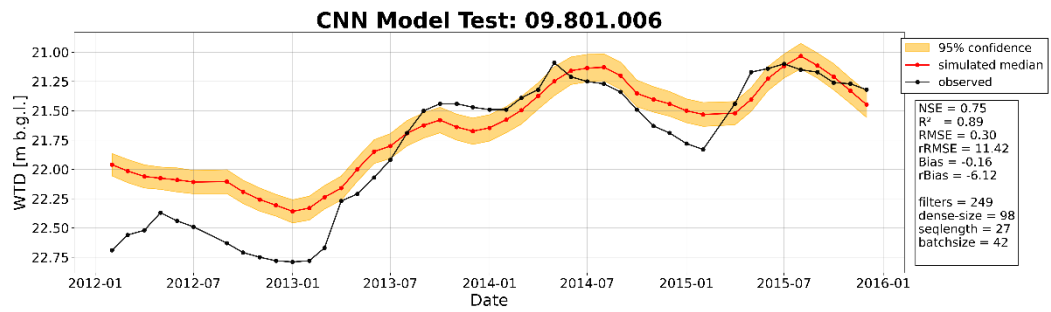


Figure S 62 Evaluation of 09.801.006 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

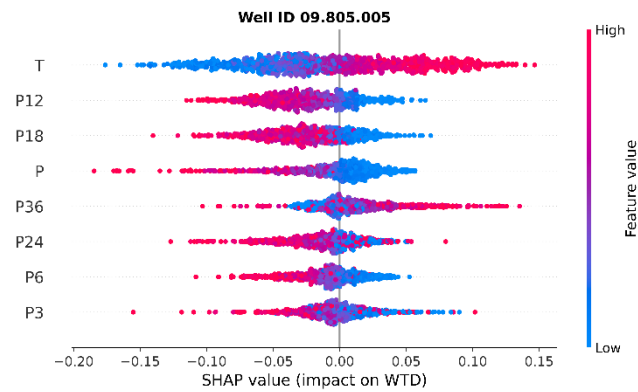
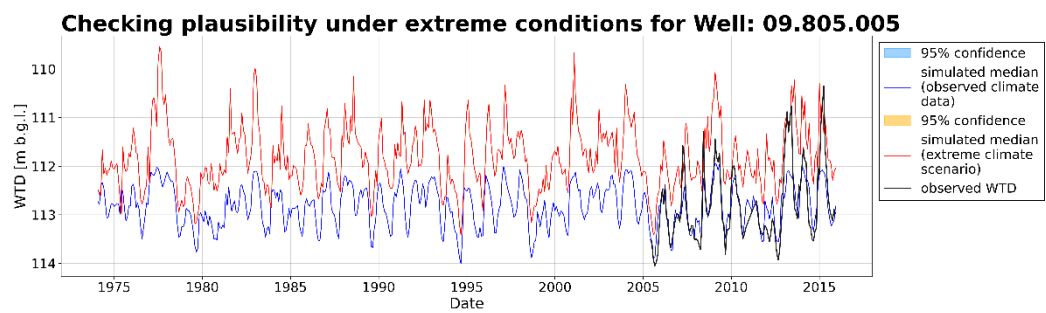
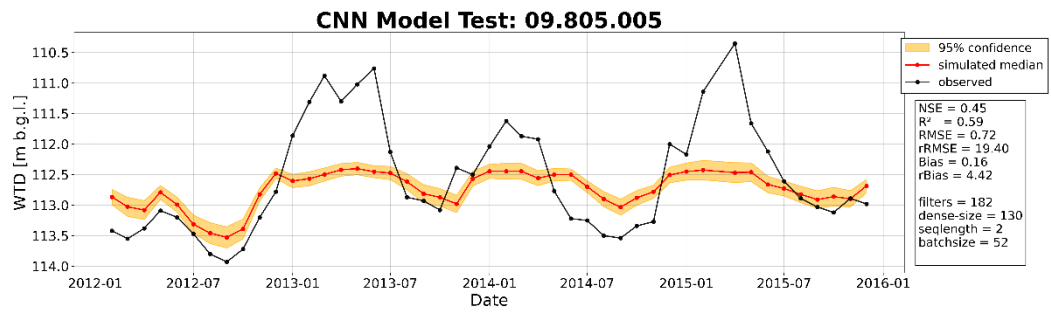


Figure S 63 Evaluation of 09.805.005 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

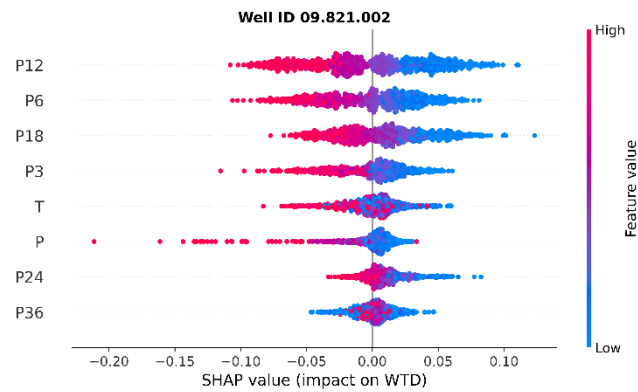
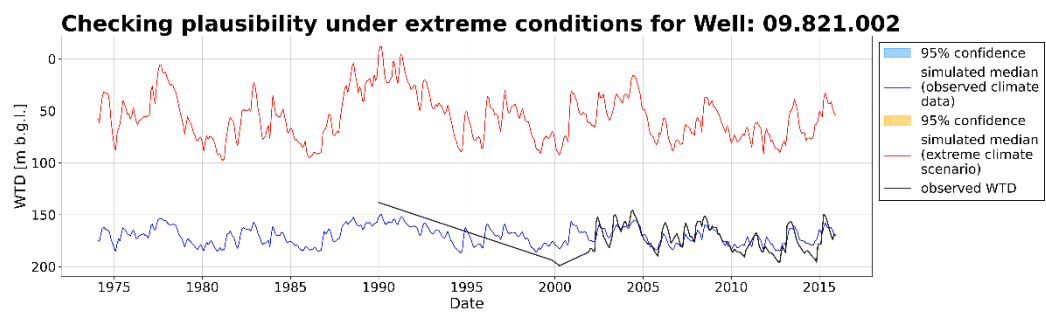
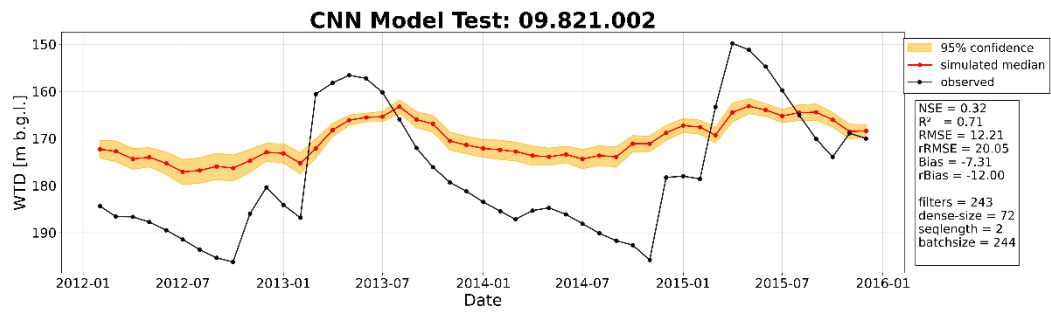


Figure S 64 Evaluation of 09.821.002 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

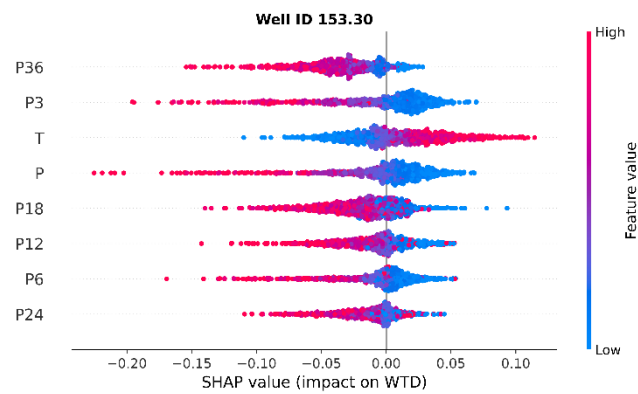
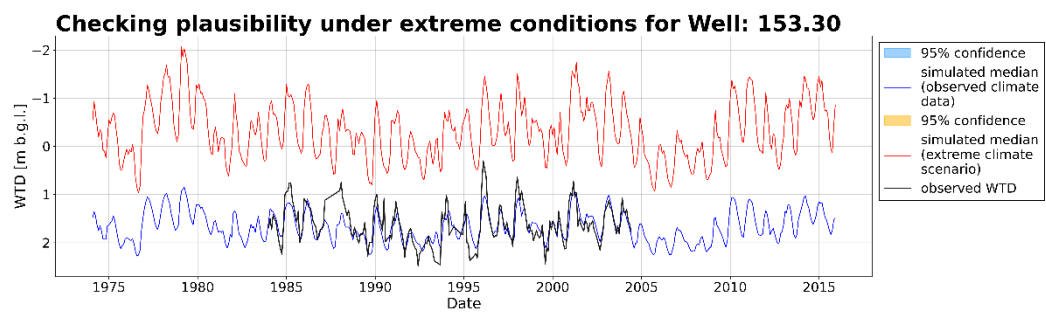
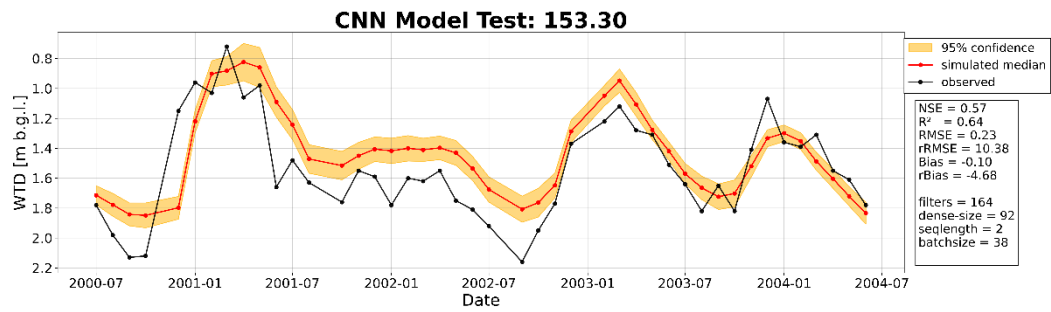


Figure S 65 Evaluation of 153.30 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

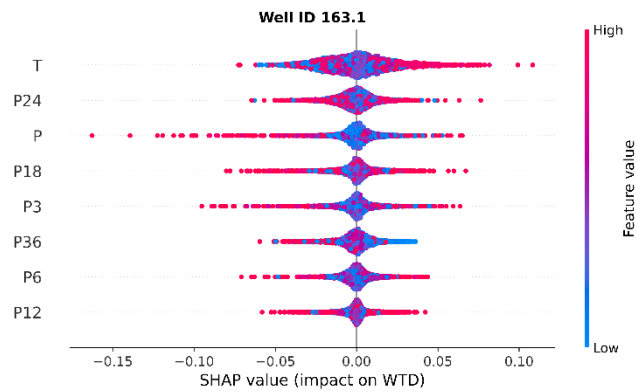
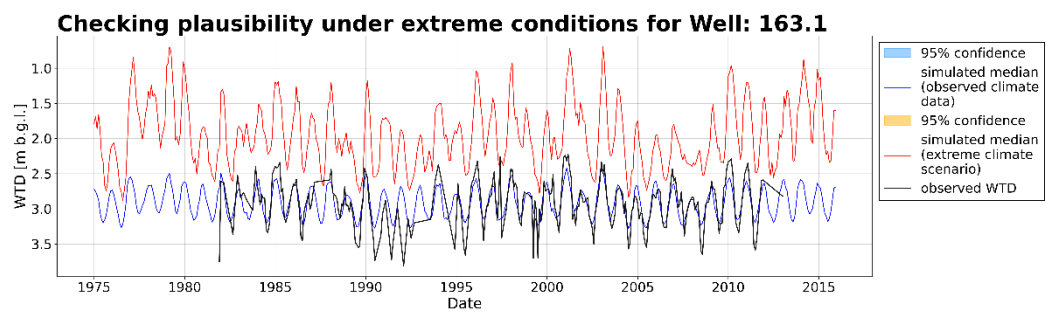
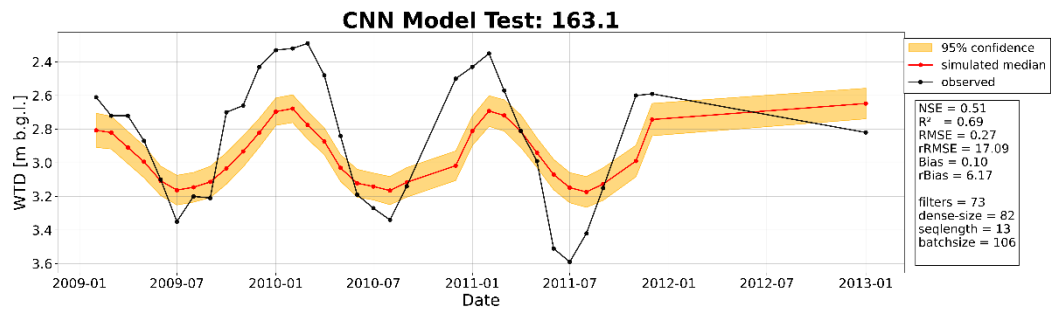


Figure S 66 Evaluation of 163.1 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

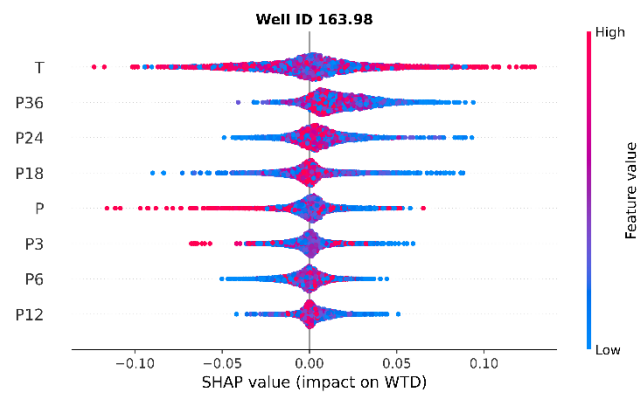
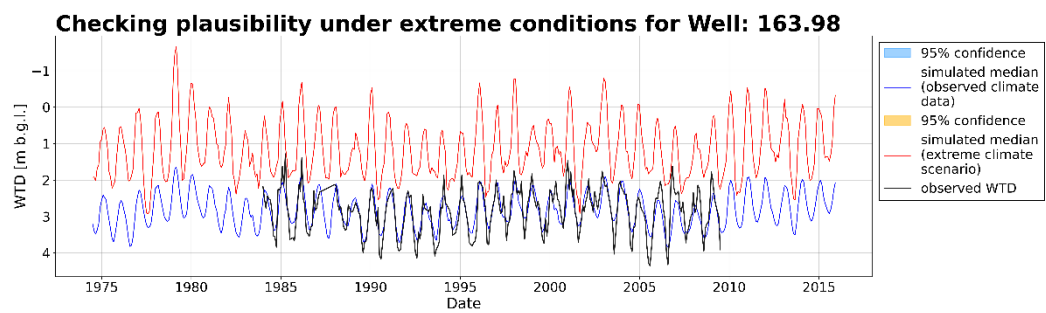
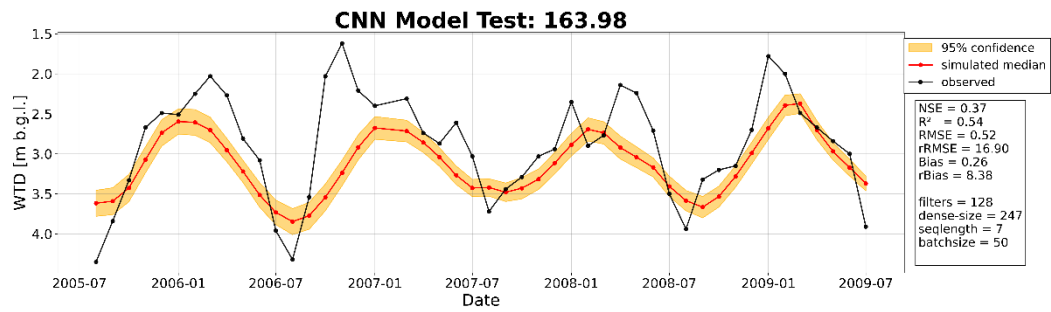


Figure S 67 Evaluation of 163.98 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

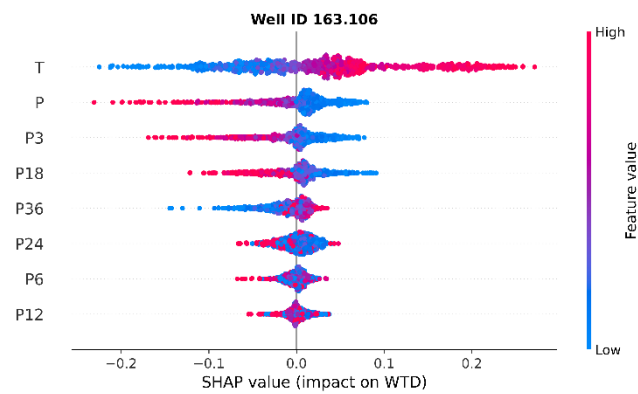
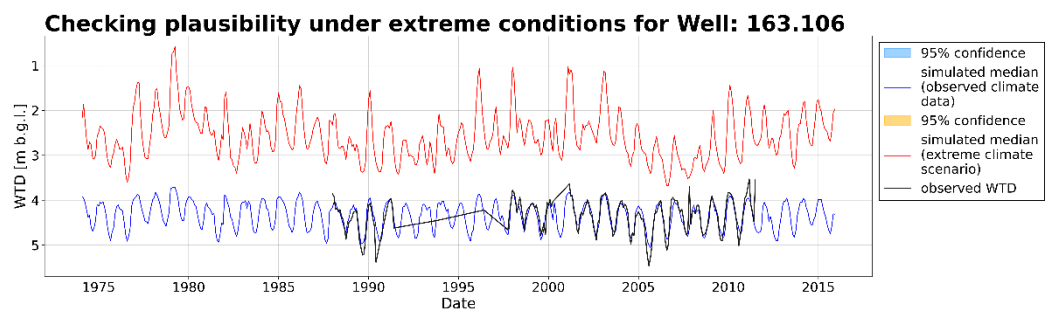
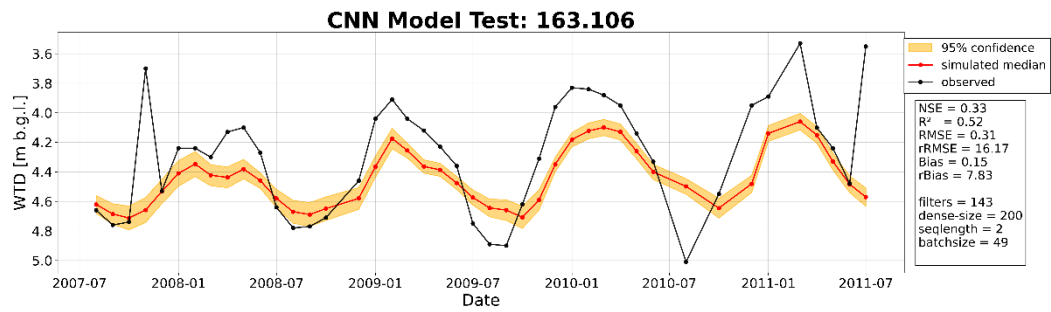


Figure S 68 Evaluation of 163.106 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

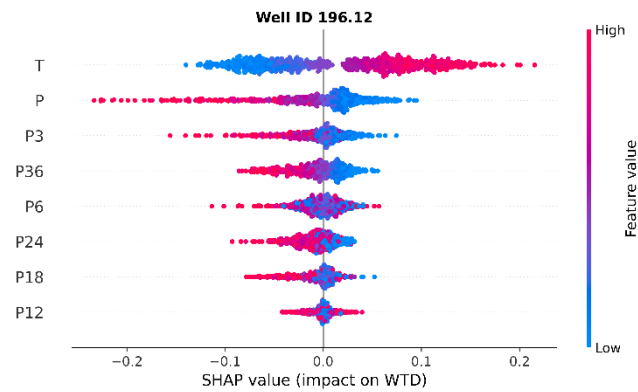
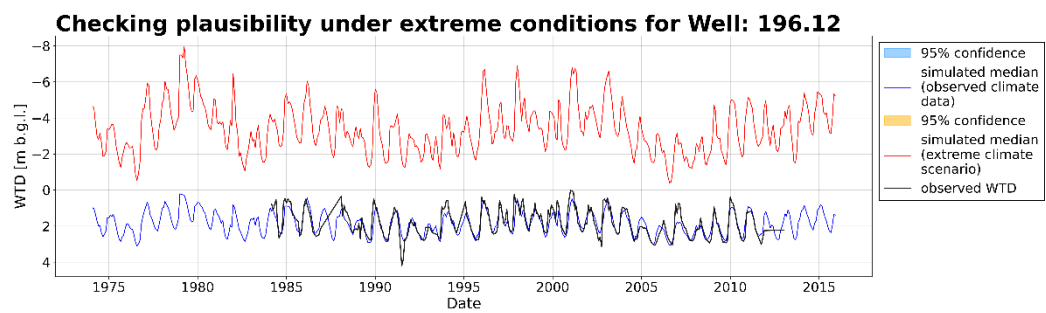
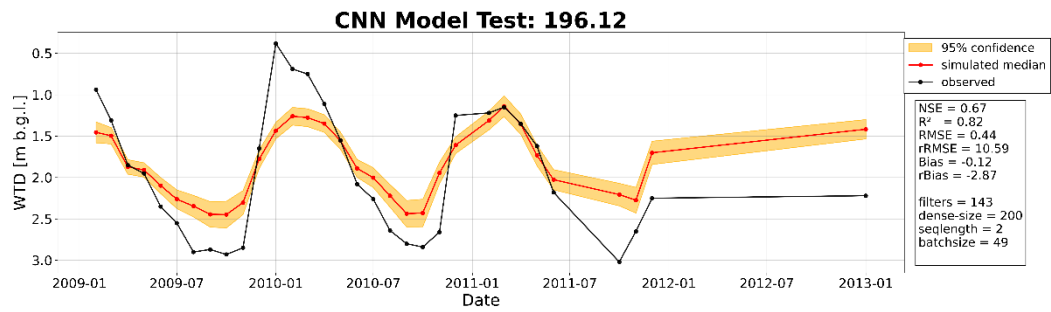


Figure S 69 Evaluation of 196.12 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

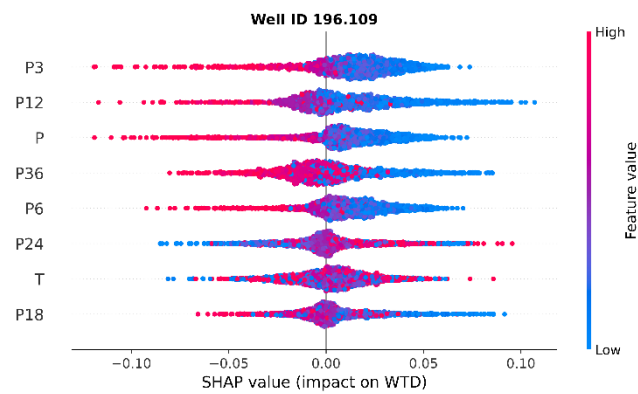
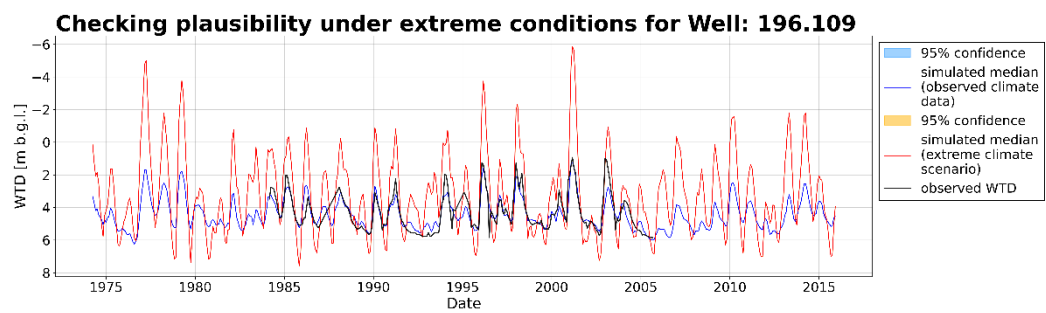
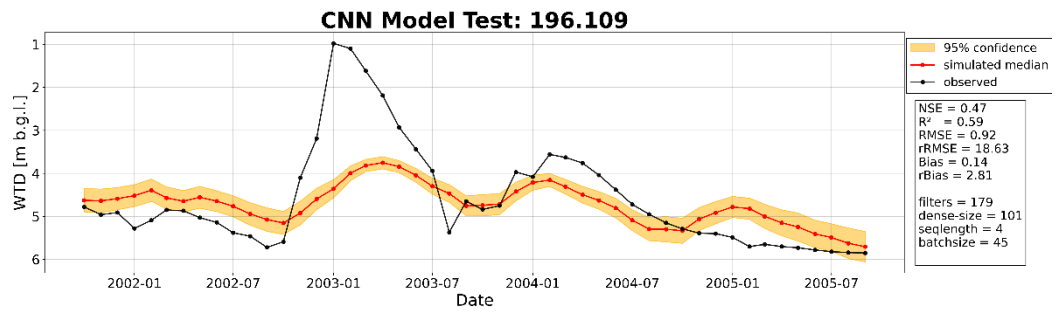


Figure S 70 Evaluation of 196.109 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

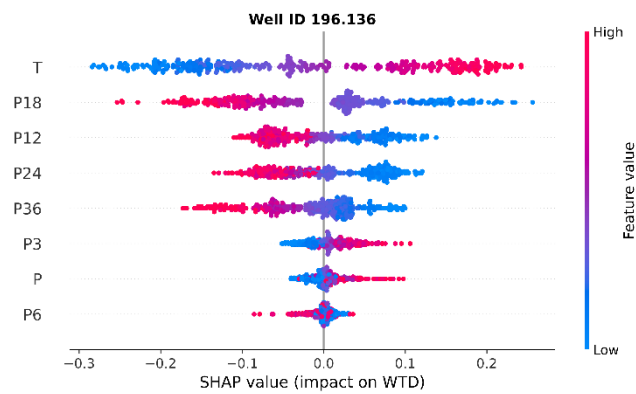
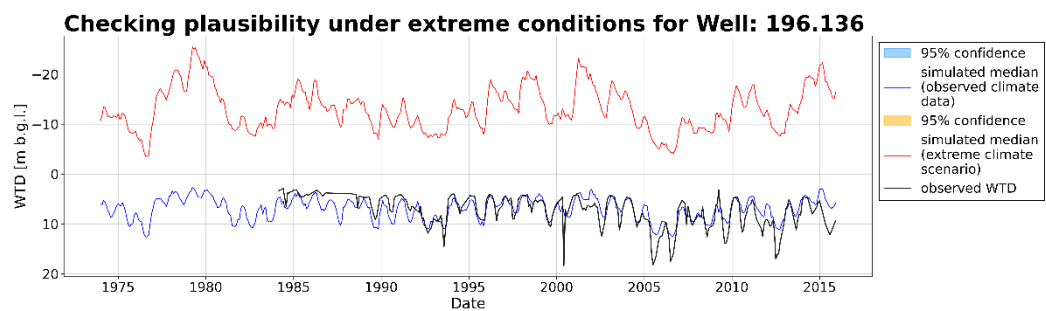
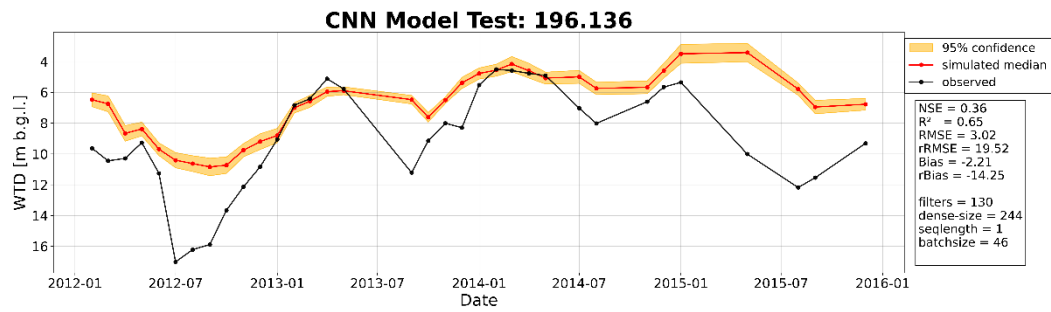


Figure S 71 Evaluation of 196.136 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

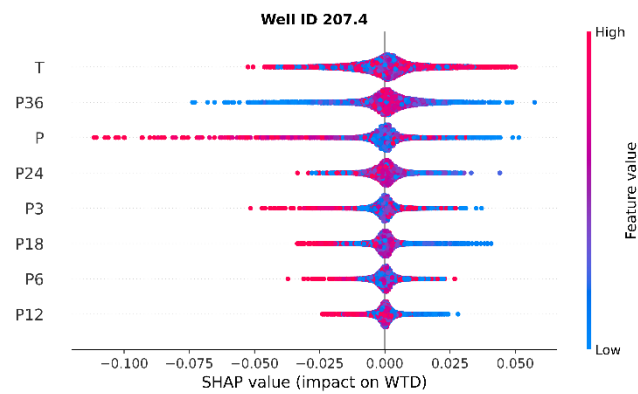
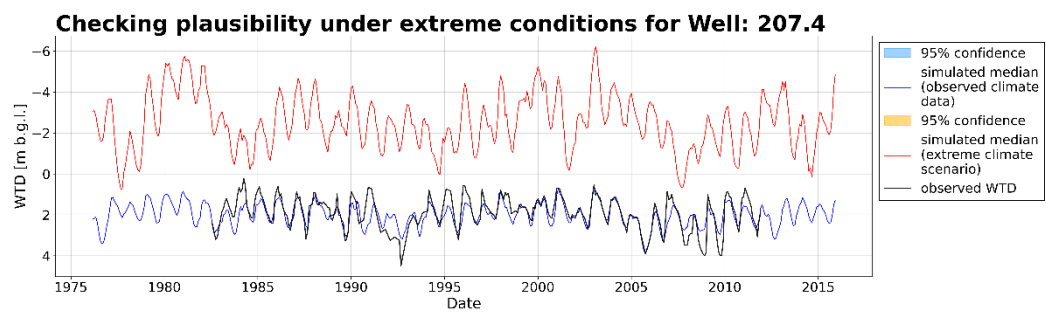
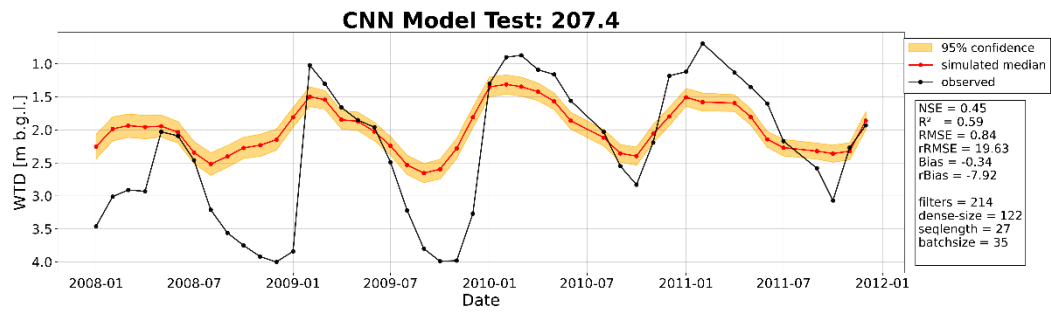


Figure S 72 Evaluation of 207.4 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

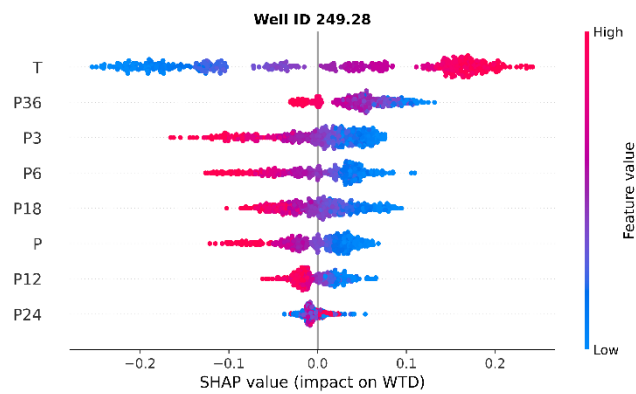
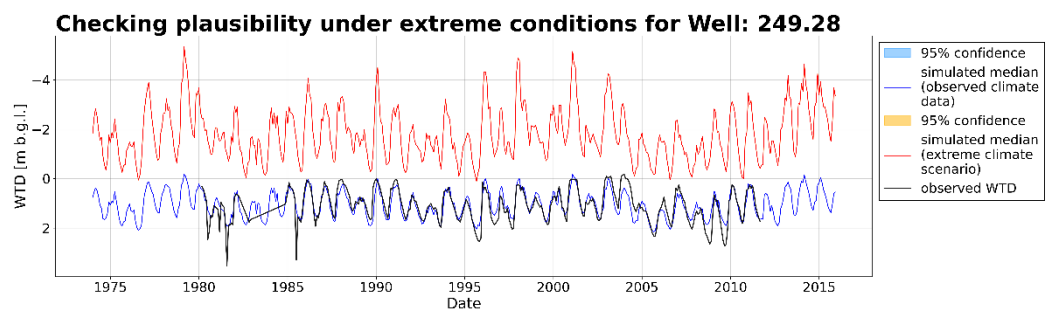
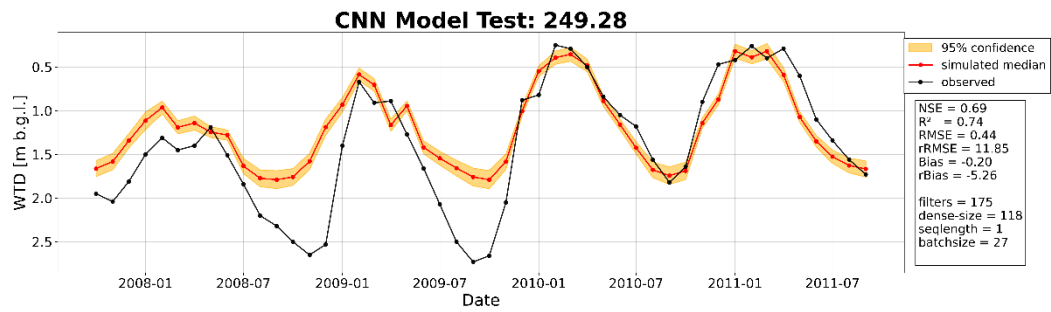


Figure S 73 Evaluation of 249.28 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

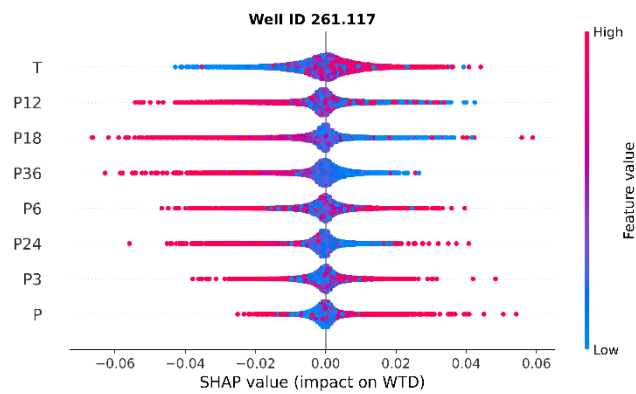
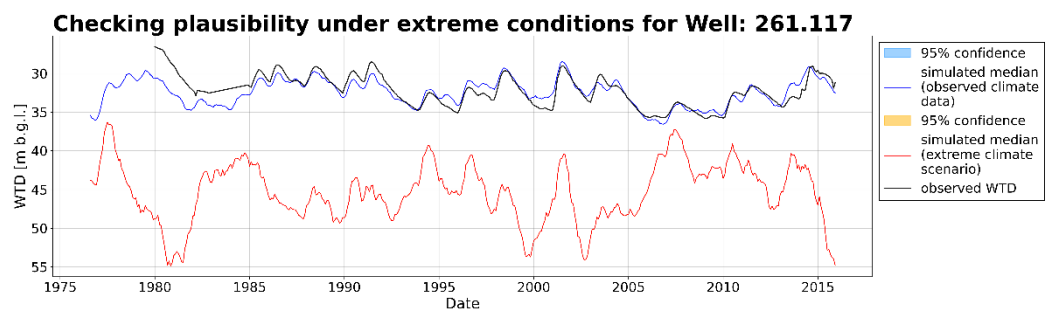
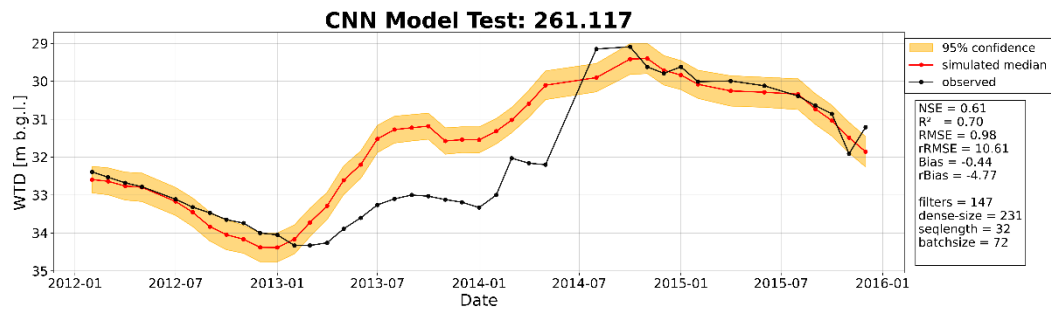


Figure S 74 Evaluation of 261.117 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

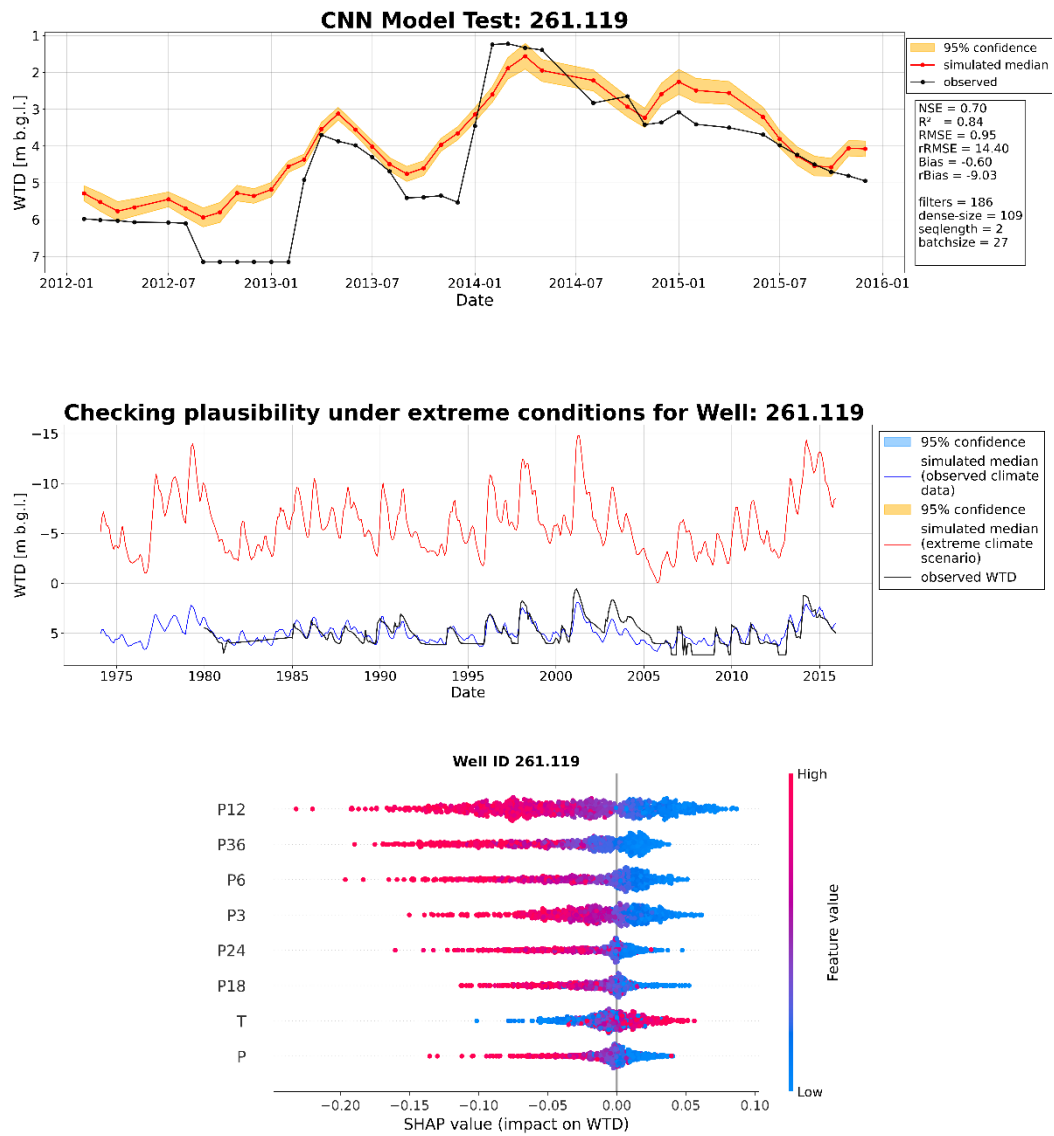


Figure S 75 Evaluation of 261.119 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

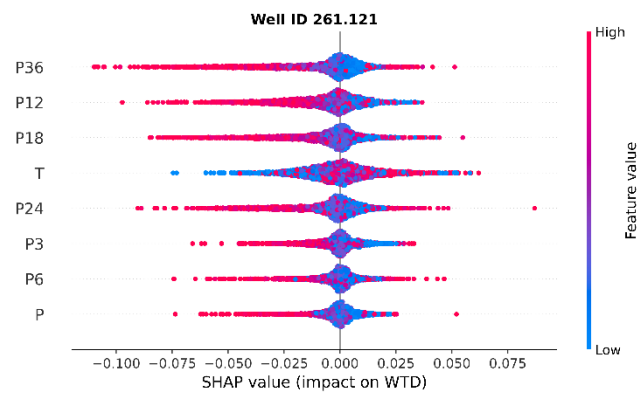
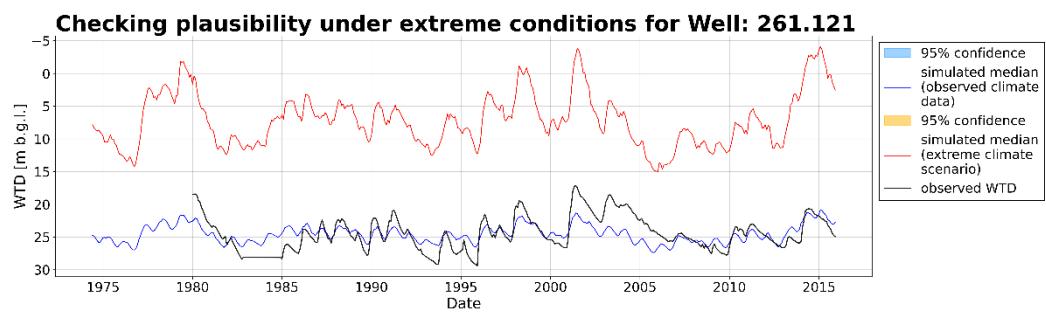
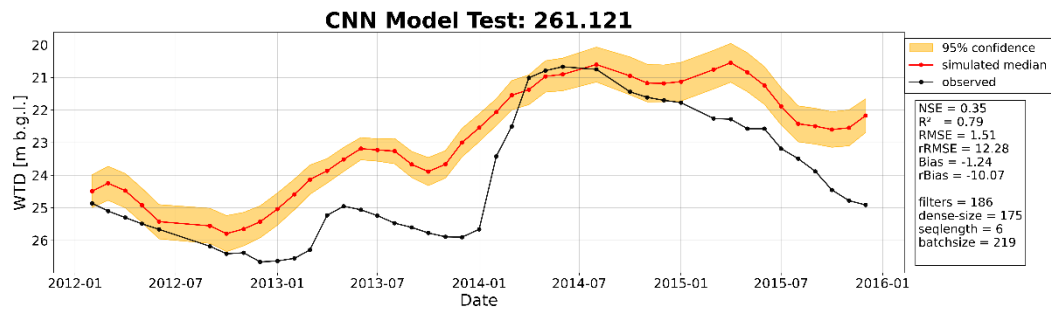


Figure S 76 Evaluation of 261.121 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

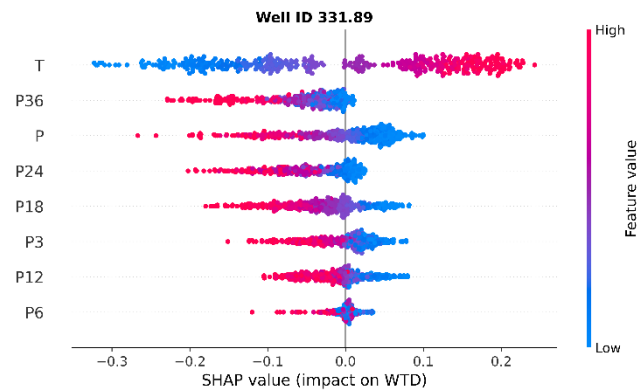
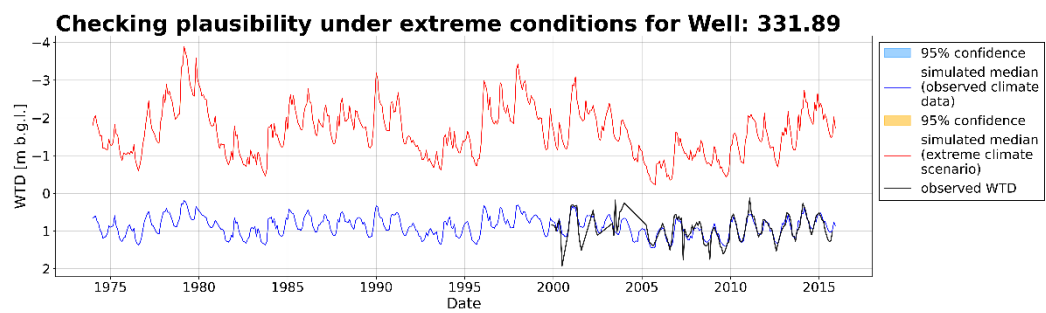
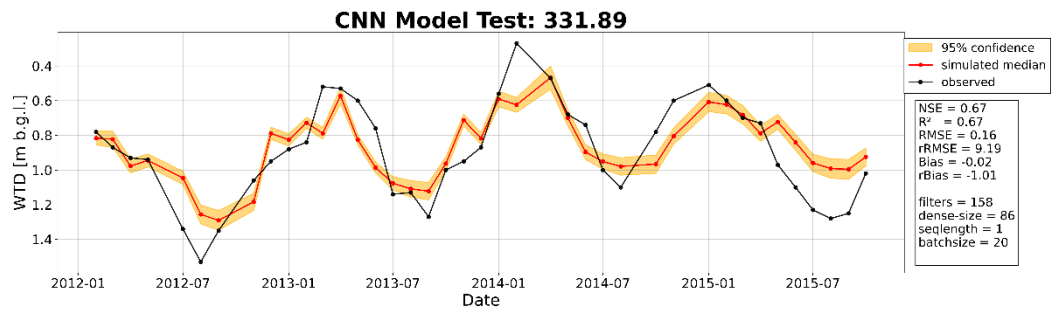


Figure S 77 Evaluation of 331.89 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

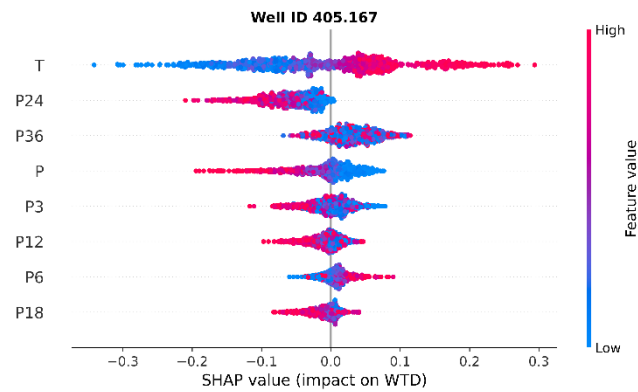
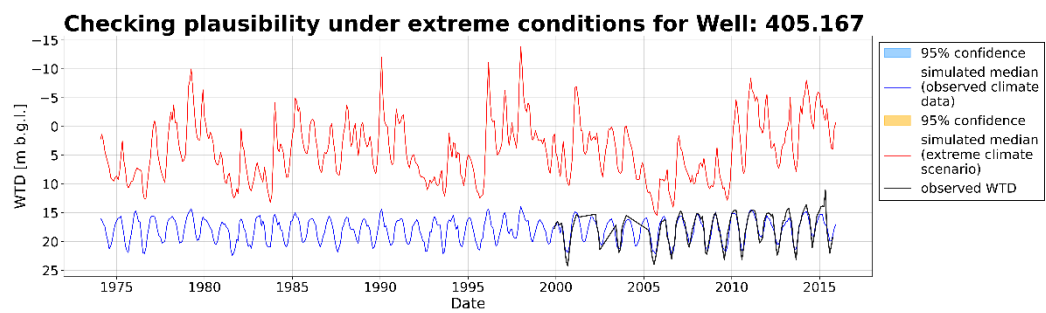
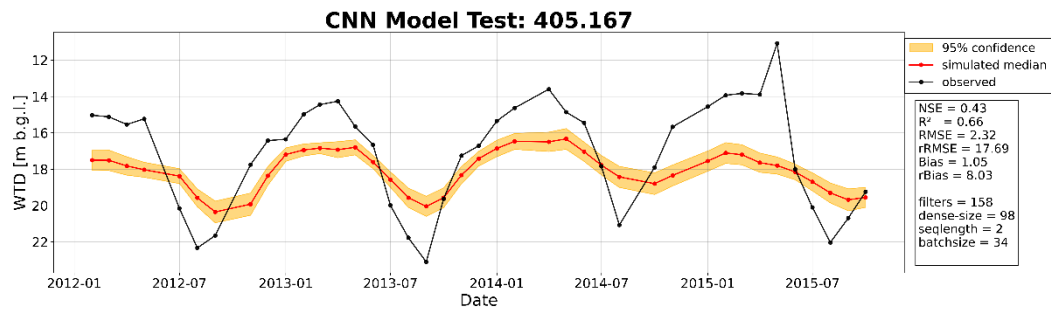


Figure S 78 Evaluation of 405.167 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

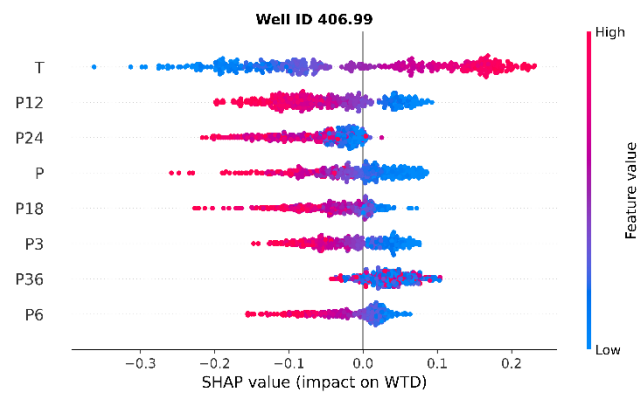
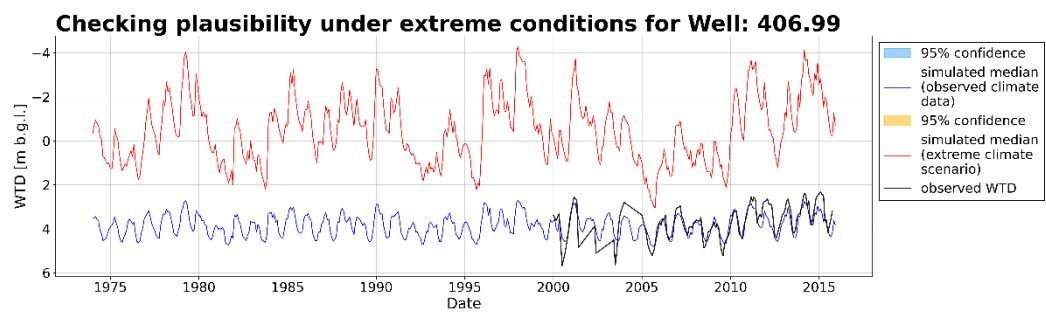
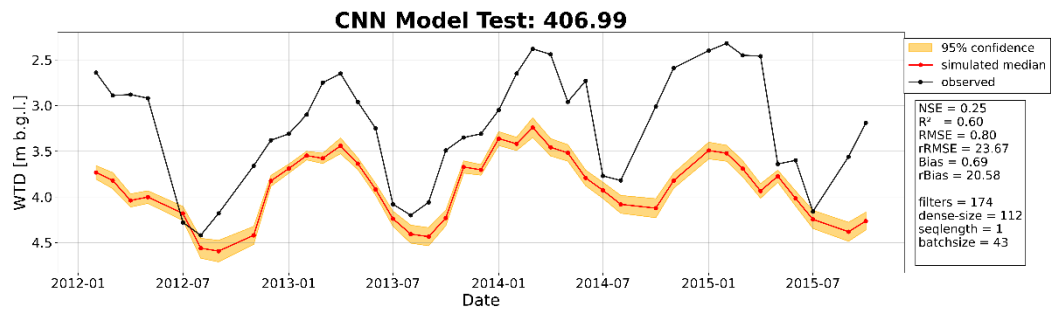


Figure S 79 Evaluation of 406.99 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

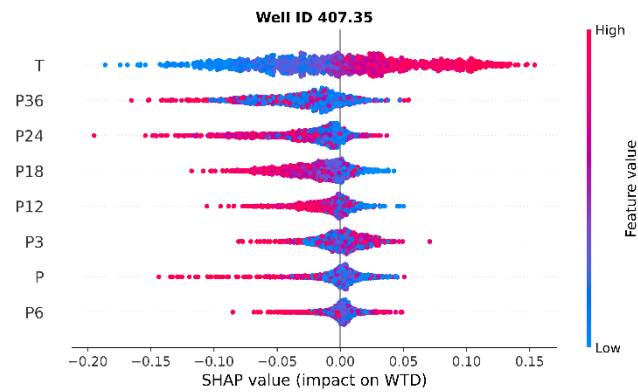
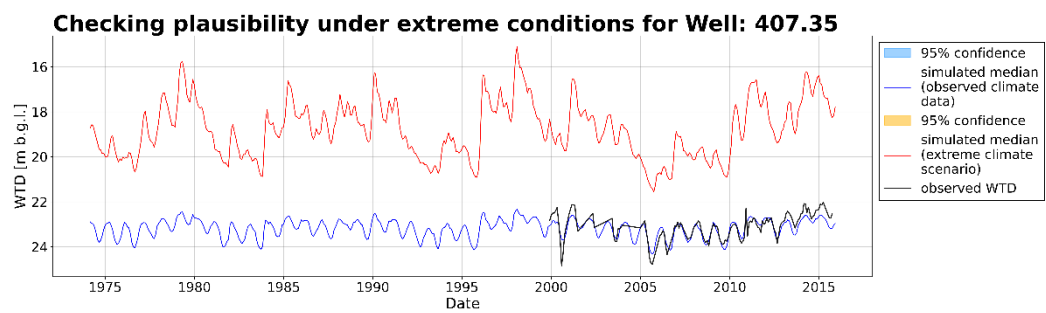
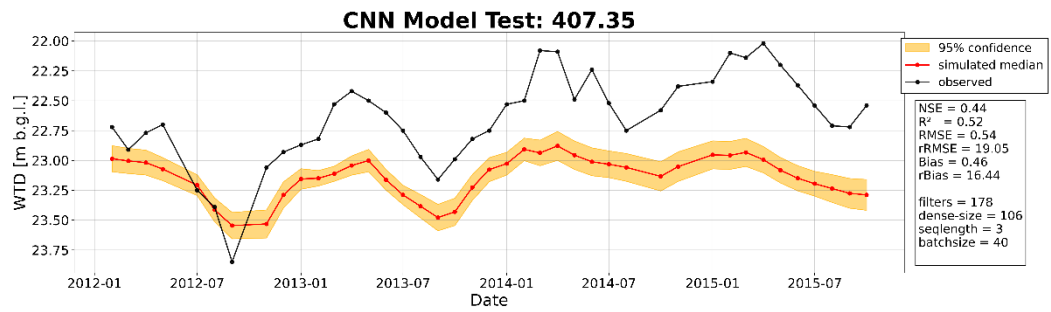


Figure S 80 Evaluation of 407.35 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

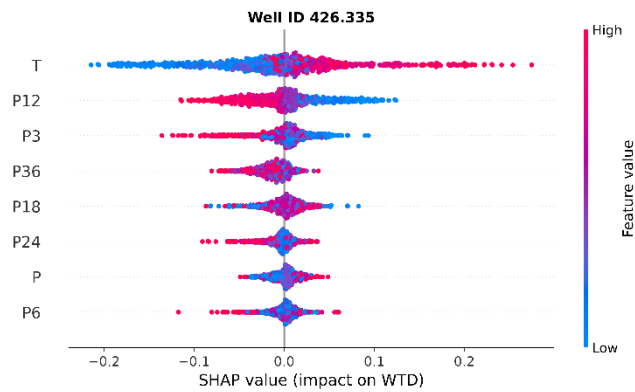
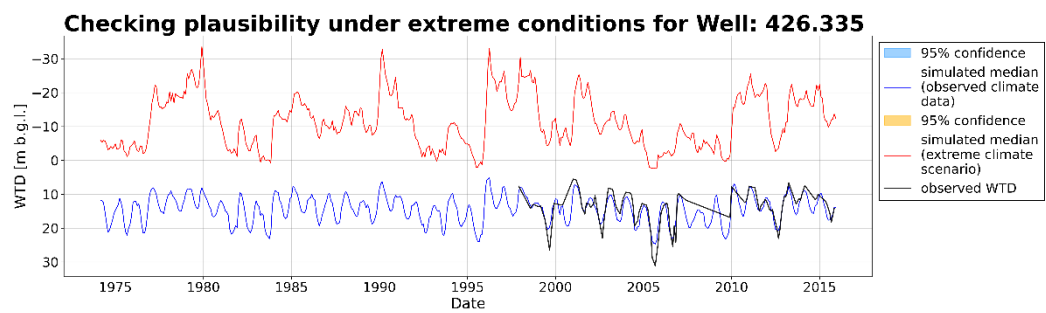
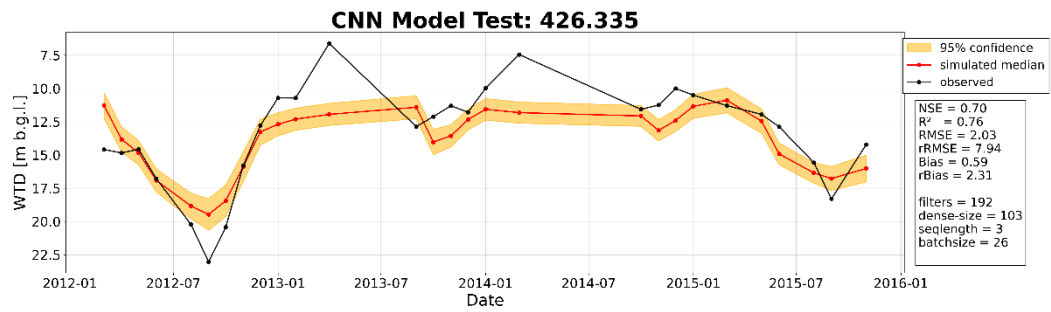


Figure S 81 Evaluation of 426.335 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

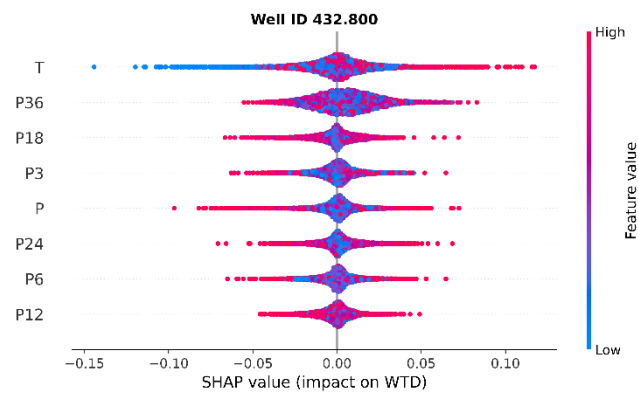
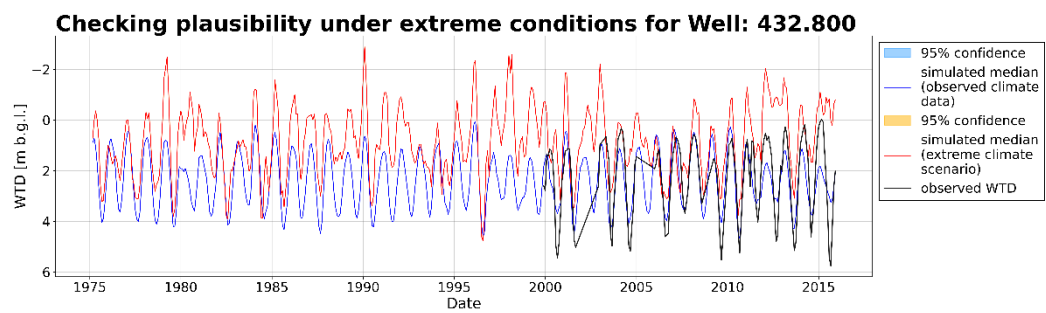
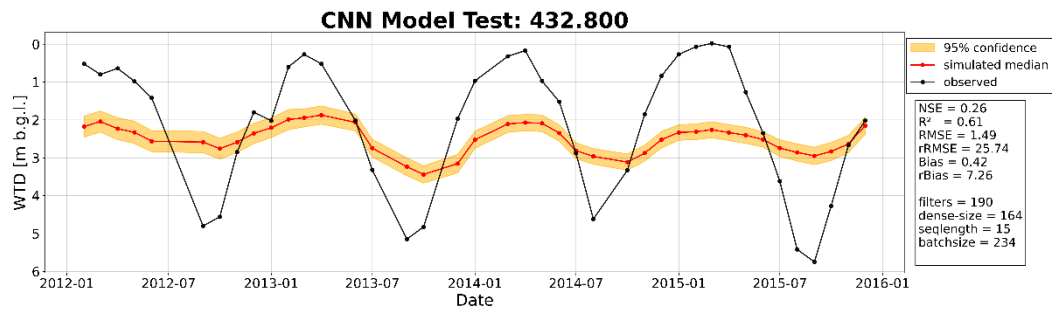


Figure S 82 Evaluation of 432.800 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

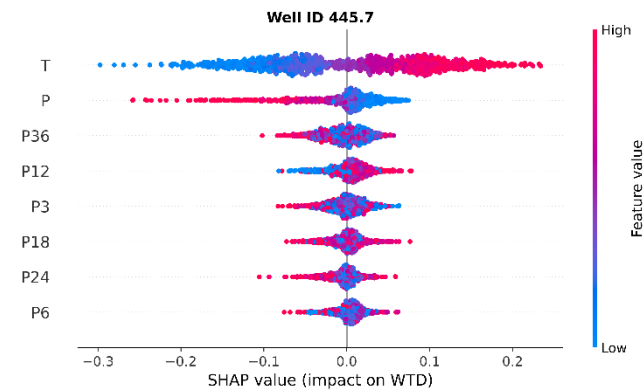
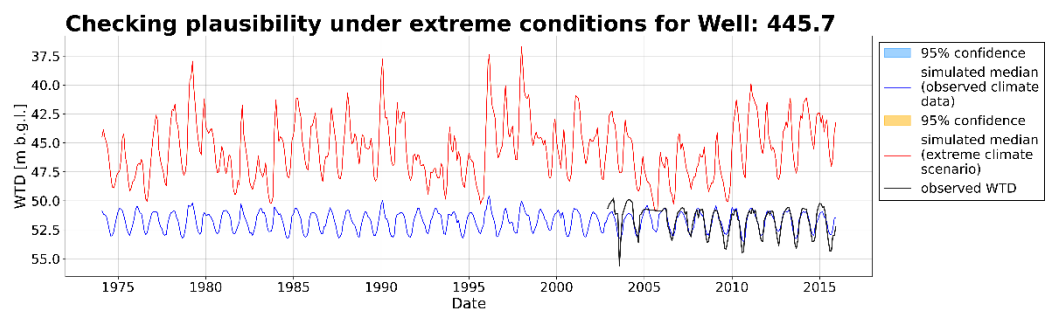
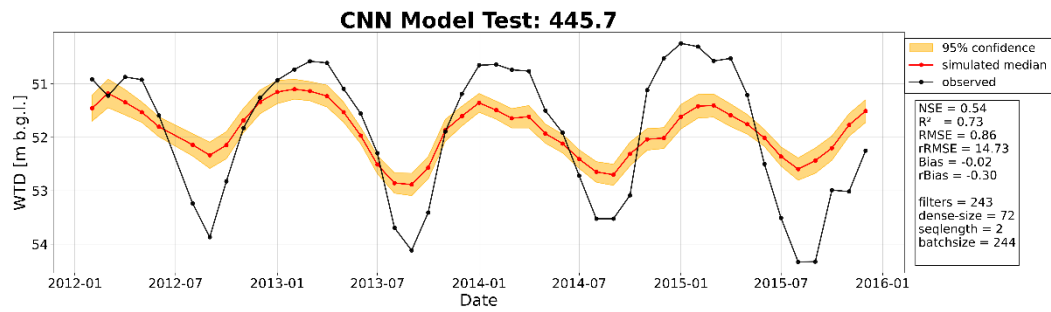


Figure S 83 Evaluation of 445.7 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

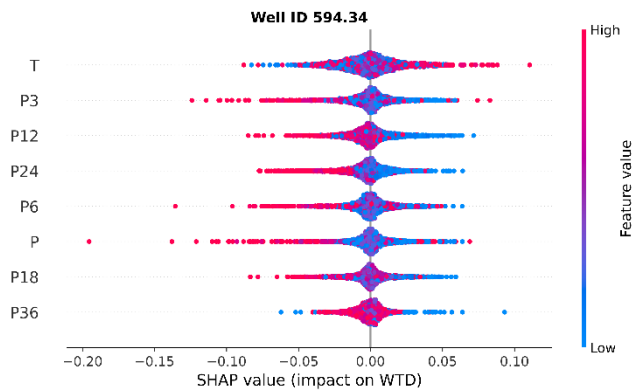
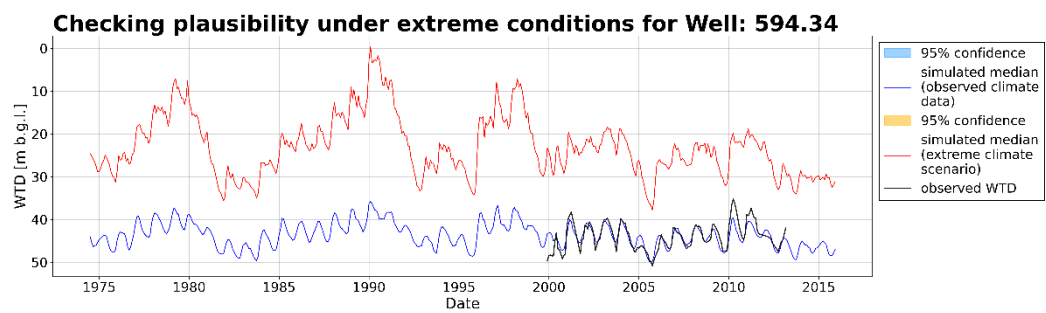
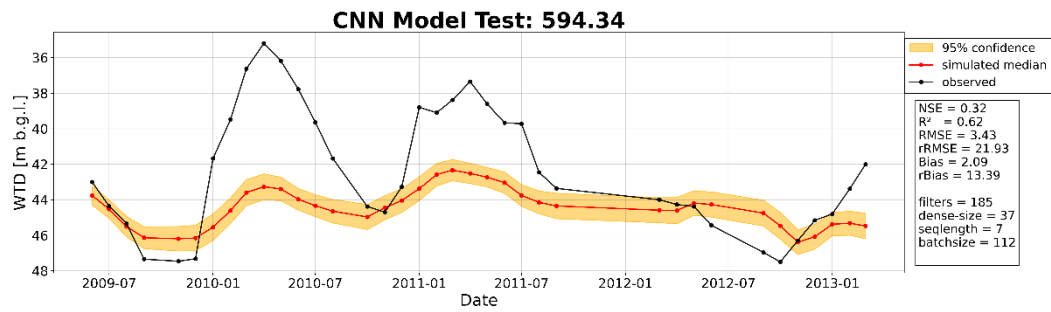


Figure S 84 Evaluation of 594.34 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

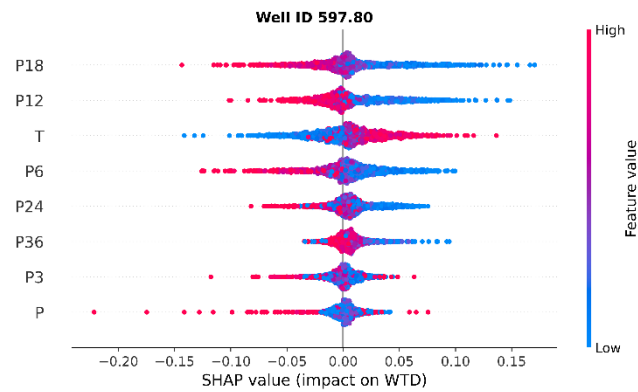
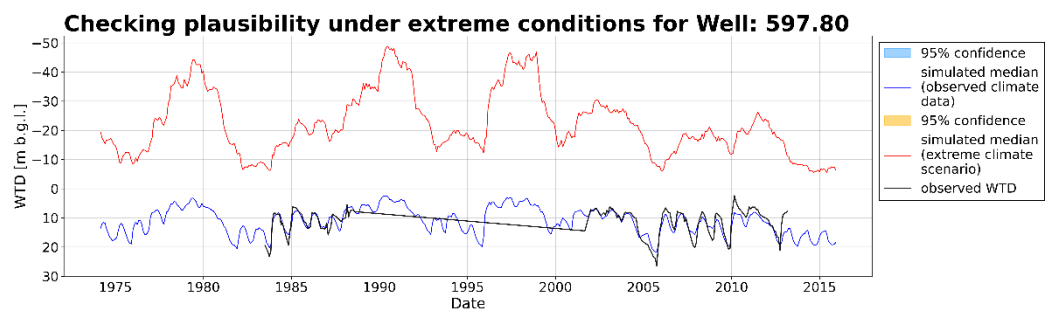
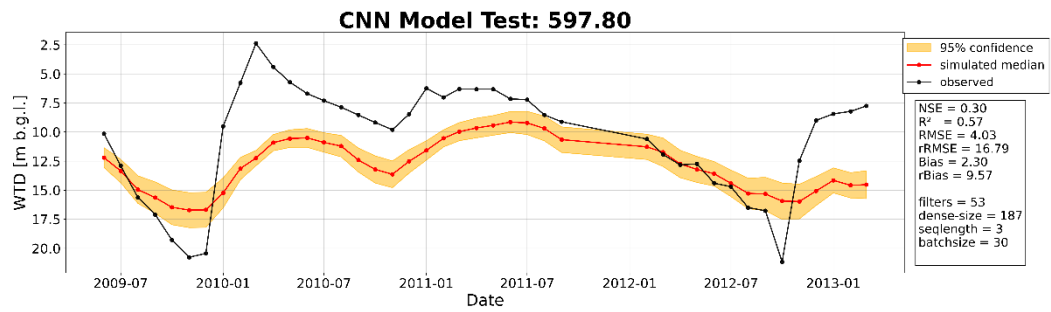


Figure S 85 Evaluation of 597.80 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

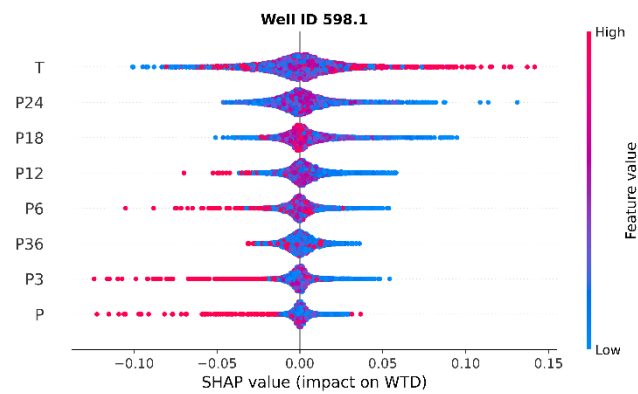
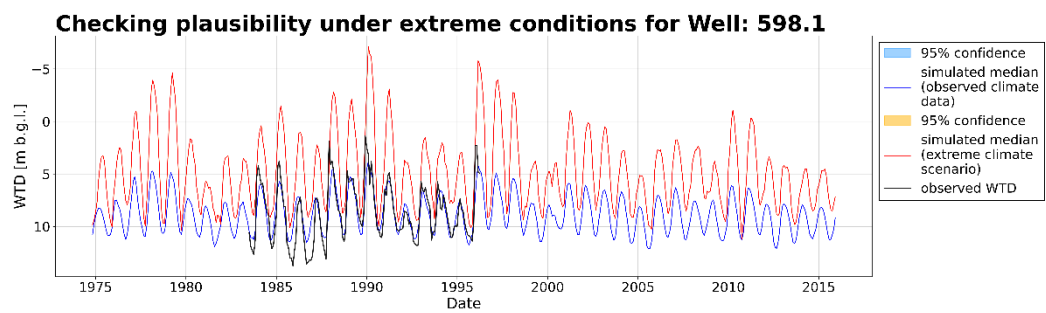
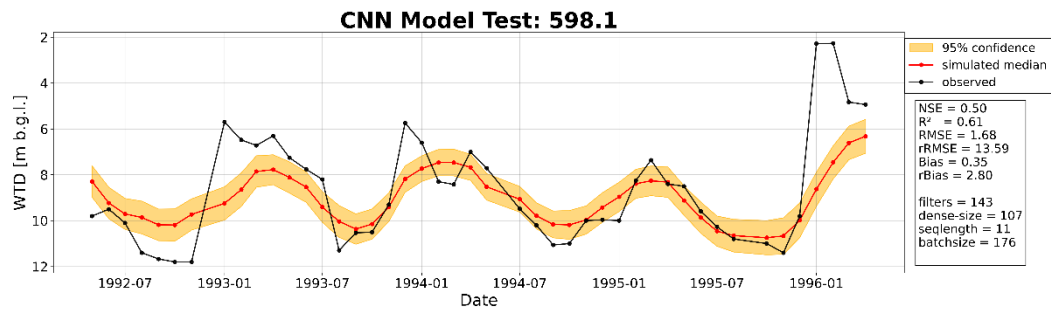


Figure S 86 Evaluation of 598.1 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

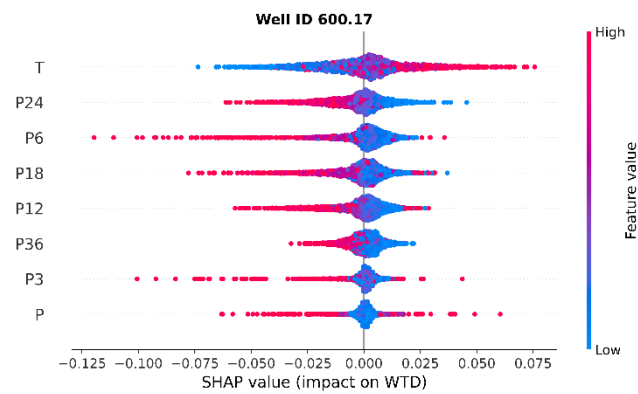
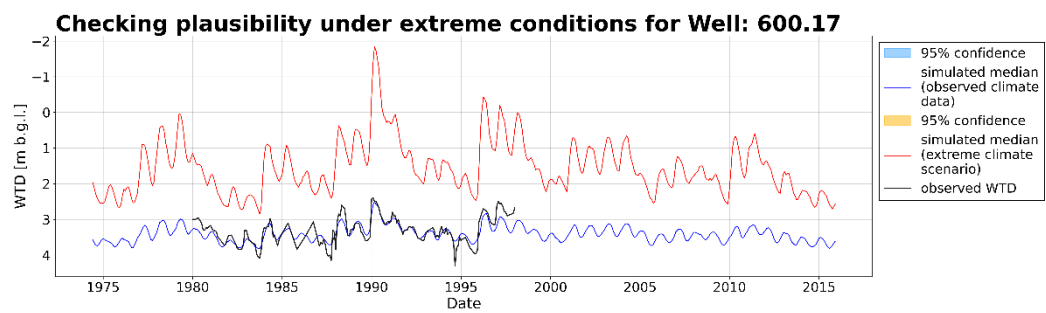
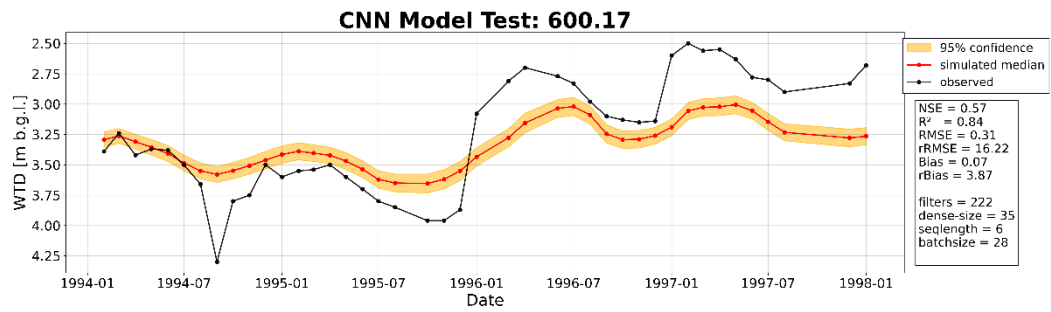


Figure S 87 Evaluation of 600.17 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

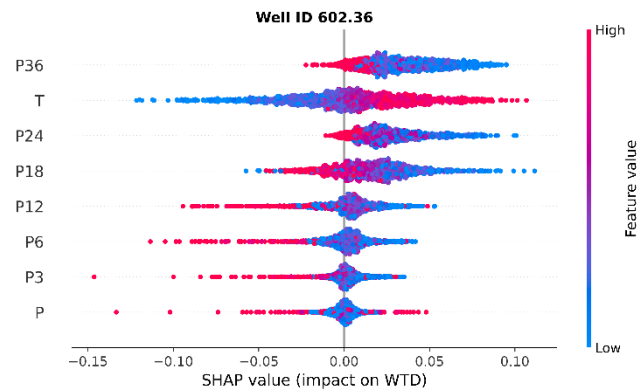
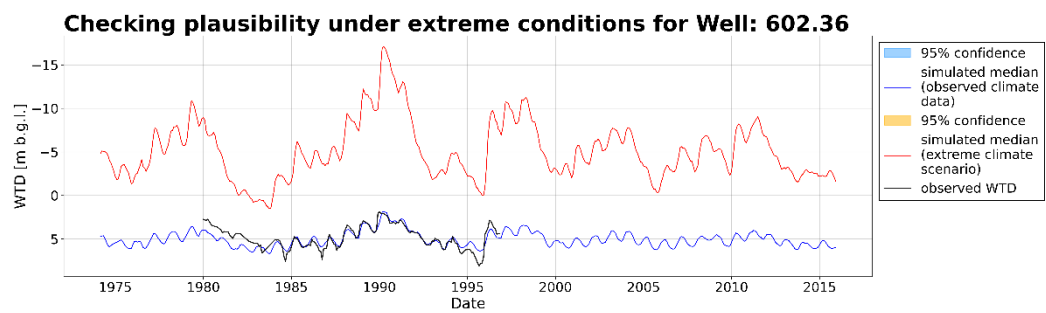
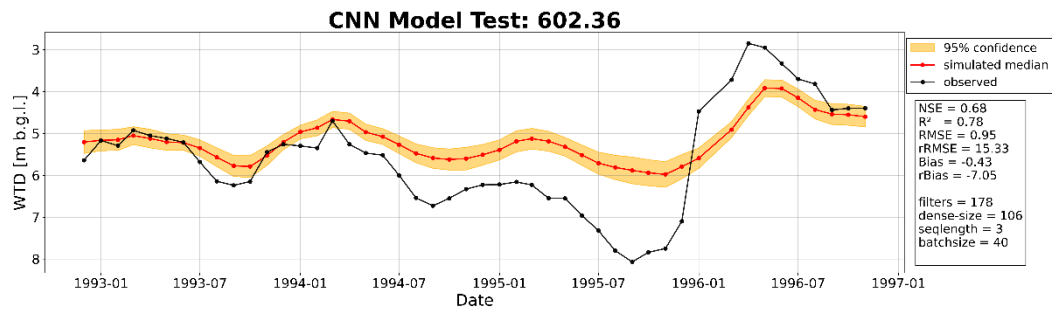


Figure S 88 Evaluation of 602.36 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

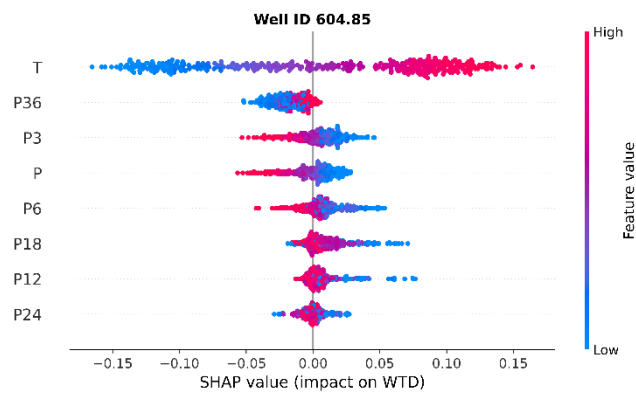
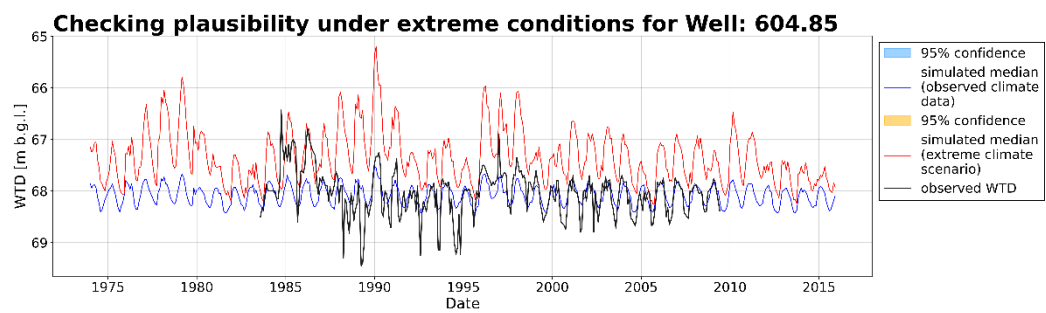
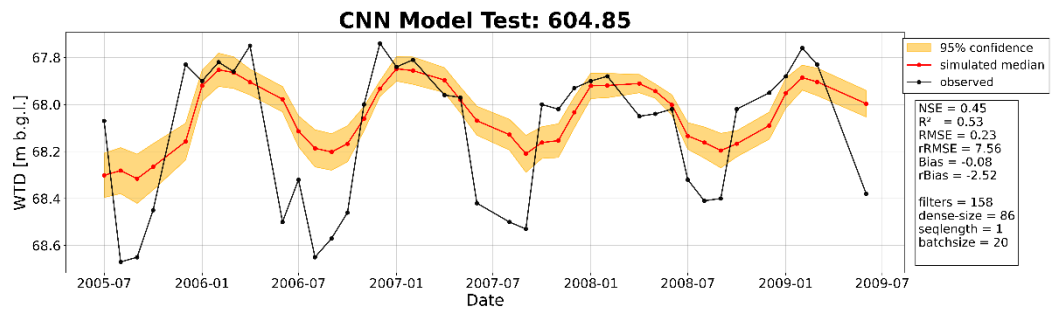


Figure S 89 Evaluation of 604.85 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

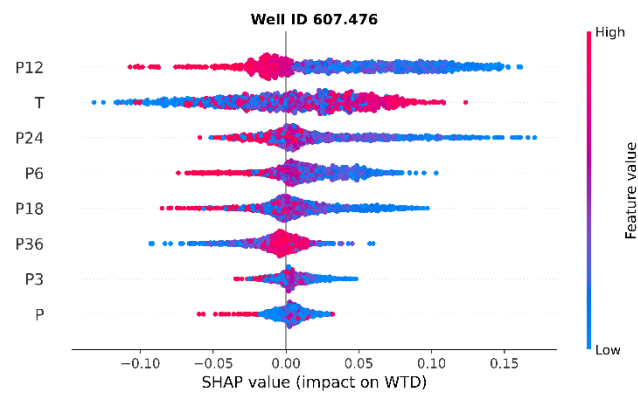
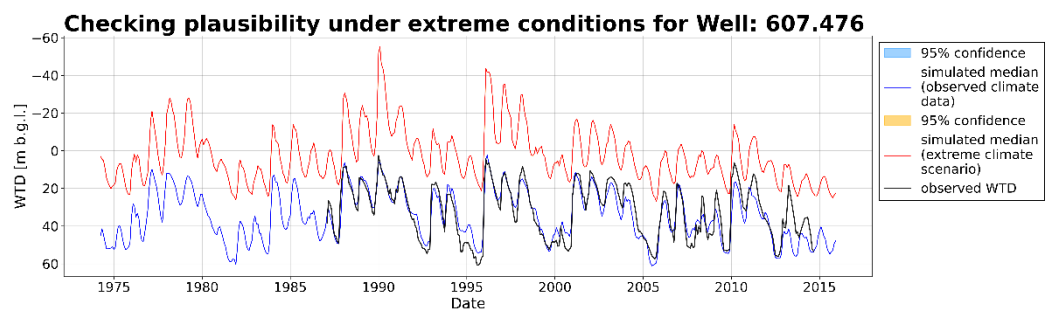
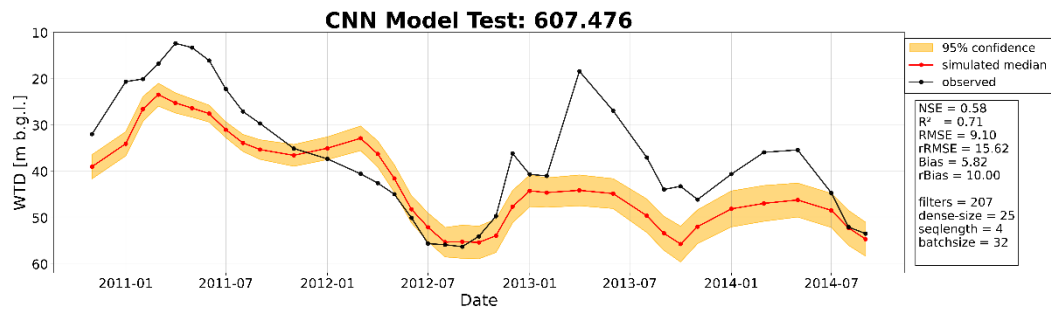


Figure S 90 Evaluation of 607.476 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

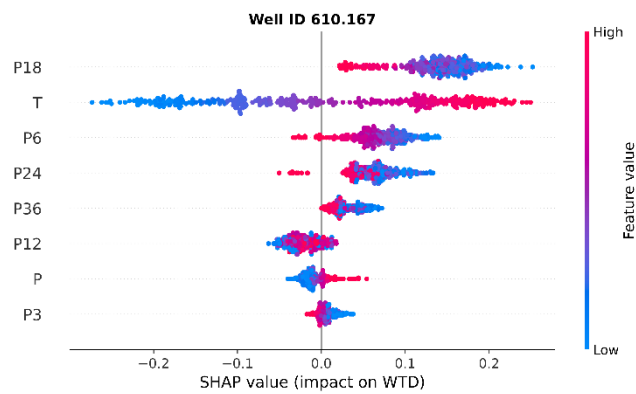
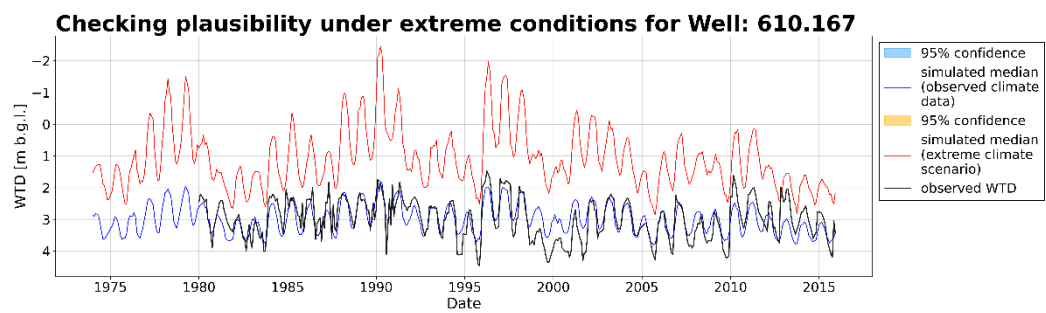
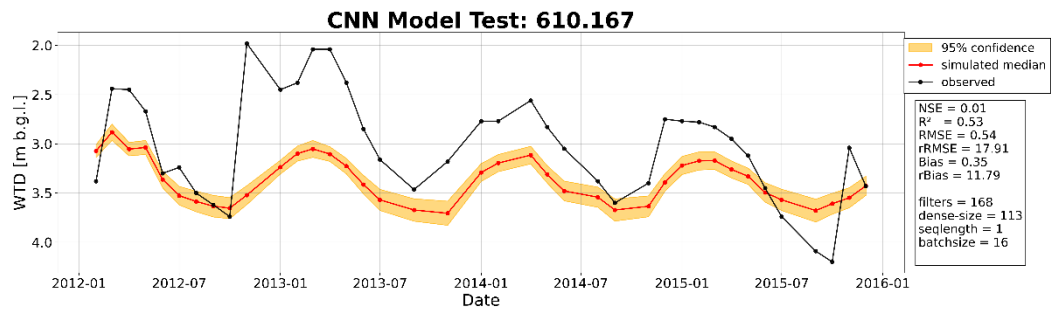


Figure S 91 Evaluation of 610.167 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)

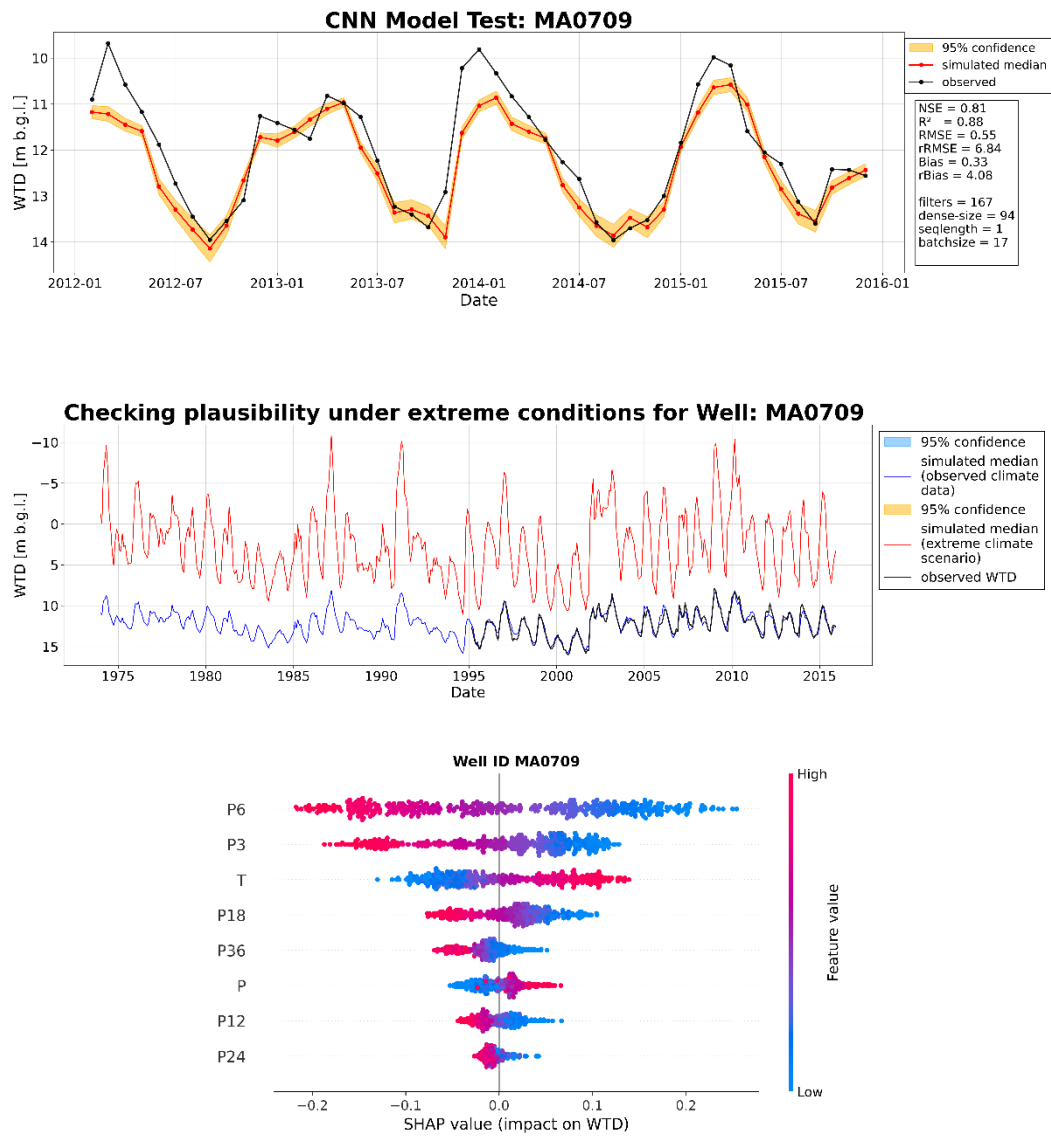


Figure S 92 Evaluation of MA0709 Model Performance in test period (upper), under extreme climate conditions (middle) and SHAP Summary plot (lower)