

STUDY OF TREND OF SEA SURFACE TEMPERATURE, FOR SEA ADJACENT TO KOLKATA ALONG WITH INSIGHTS OF THE SAME FOR NEAR FUTURE BY NEURAL NETWORK

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OBJECTIVE OF STUDY

Analyze sea surface temperature adjacent to Kolkata using ERA5 and NOAA data. Compare historical deviations and 2027–2030 forecasts across ERA5 (1991–2020 and 1940–2020) and NOAA (1991–2020, 1940–2020 and 1854–2026) baseline means.

ERA5 DATA | RNN Training and Validation Loss

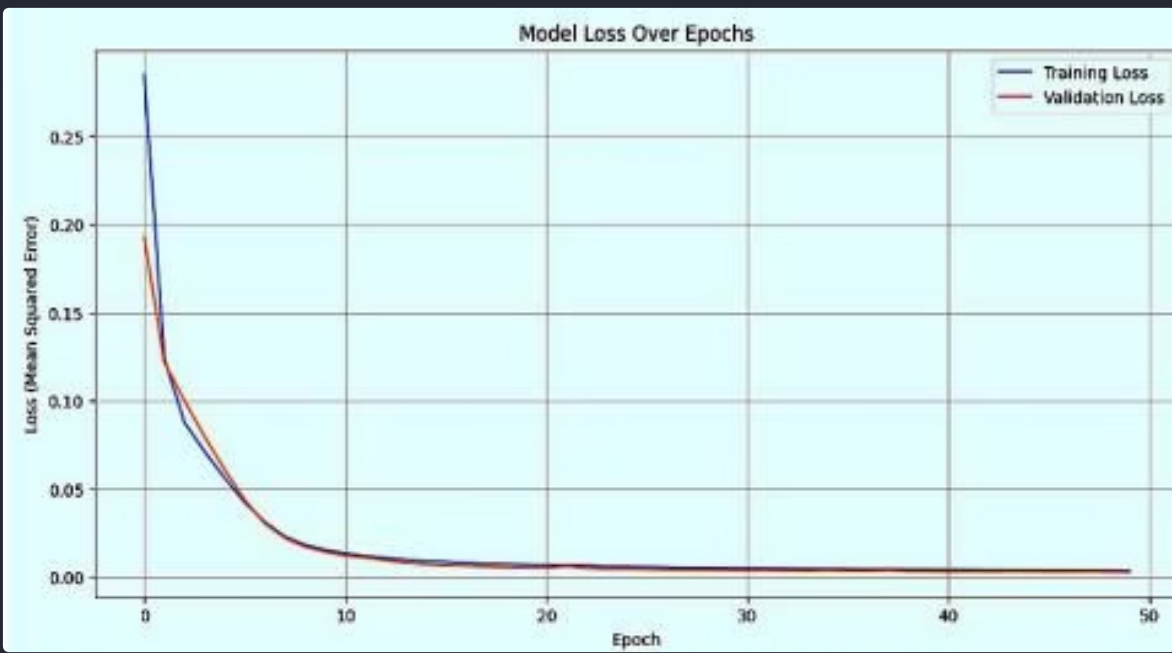


Figure 1: Model Loss Over Epochs. Training Loss (blue) and Validation Loss (red) over 50 epochs. Both losses start high (~0.25) and stabilize near 0.00 after ~10 epochs.

ERA5 DATA | Observed and Predicted SST, 2018–2026

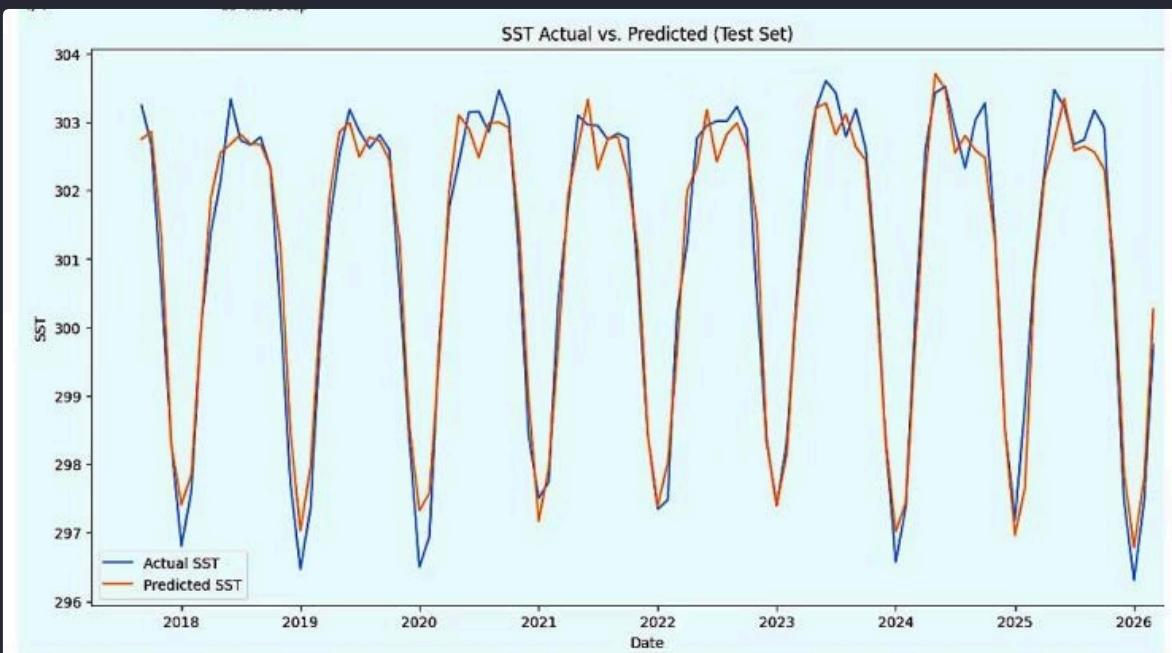


Figure 2: SST Actual vs. Predicted (Test Set). Actual SST (blue) and Predicted SST (orange) from 2018 to 2026. Predicted values closely follow actual values, showing a clear seasonal cycle between ~296 and 304 K.

ERA5 DATA | Historical SST and Lagged LSTM RNN Forecast Through 2030

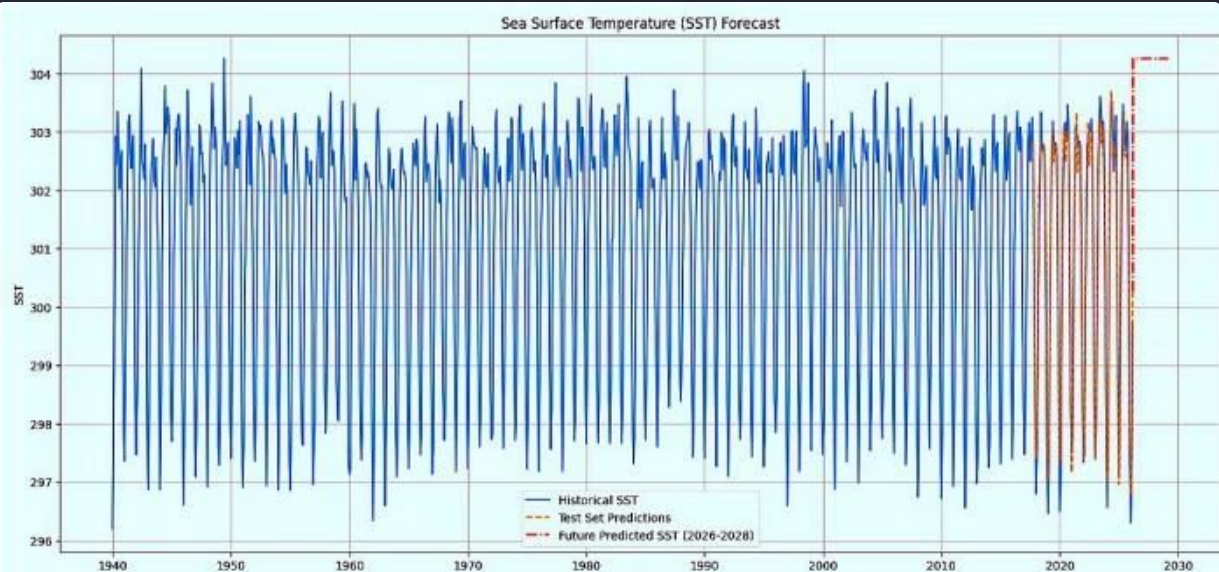


Figure 3: SST Forecast. Historical SST (blue), Test Set Predictions (orange), and Future Predicted SST 2026–2030 (red dashed) from 1940 to 2030. Future prediction shows a steady upward trend.

ERA5 DATA | 1991–2020 Climatology: Annual SST Forecast

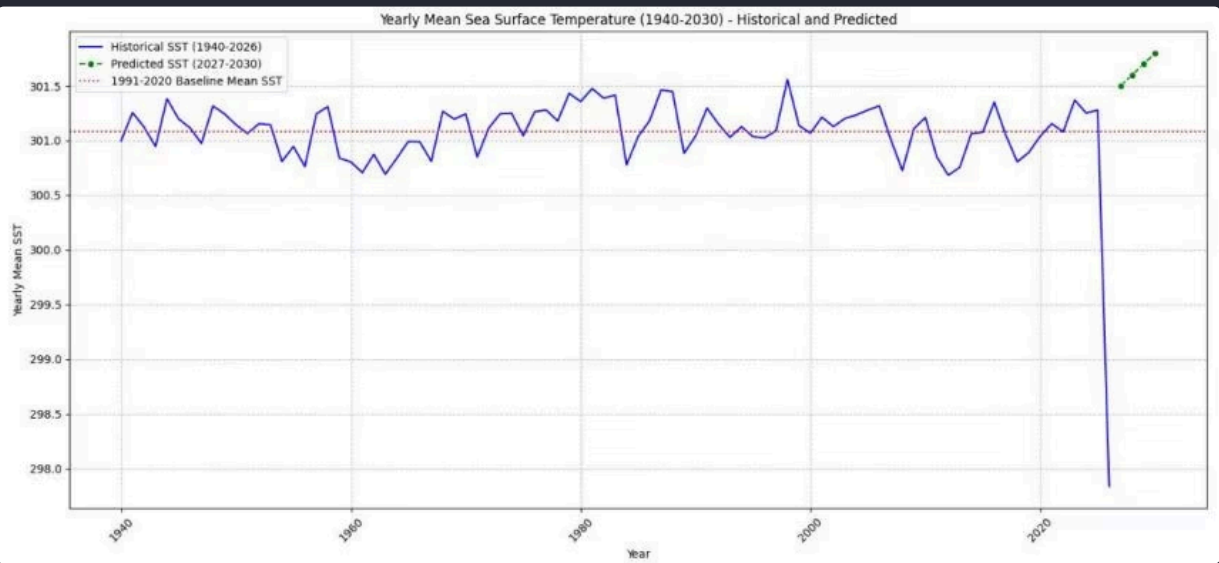


Figure 4: Yearly Mean SST (1940–2030). Historical SST (blue), Predicted SST 2027–2030 (green dashed), and 1991–2020 Baseline Mean SST (red dashed). Historical mean ~301.0 K.

ERA5 DATA | 1940–2020 Long-Term Mean: Annual SST Forecast

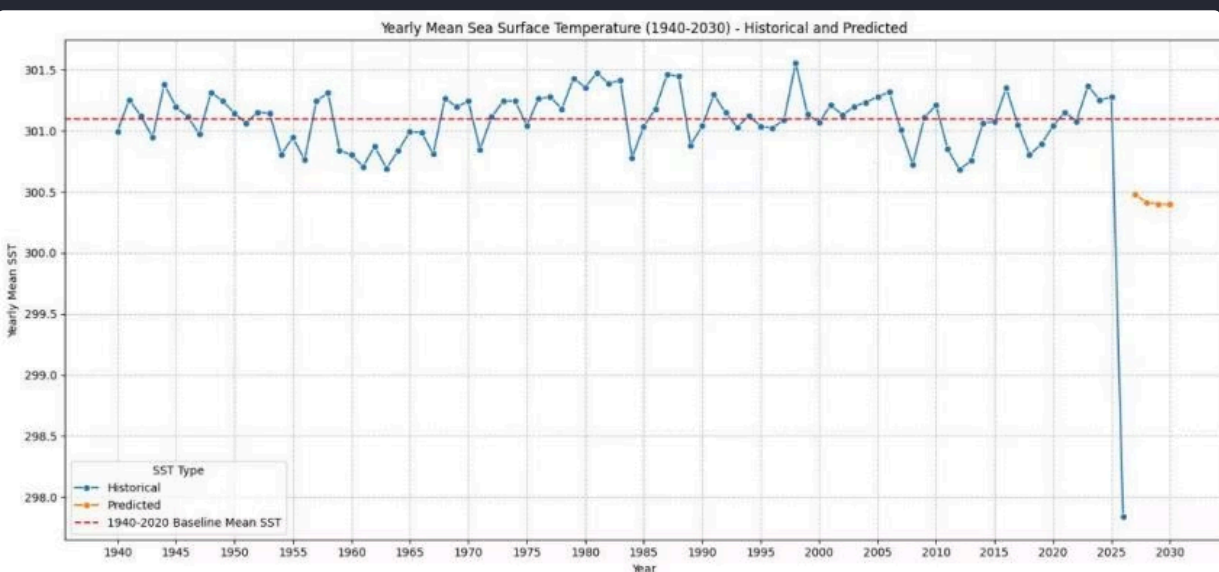


Figure 5: Yearly Mean SST (1940–2030). Historical SST (blue), Predicted SST (orange), and 1940–2020 Baseline Mean SST (red dashed). Historical mean ~301.0 K.

NOAA DATA | Yearly Mean SST, 1854–2026

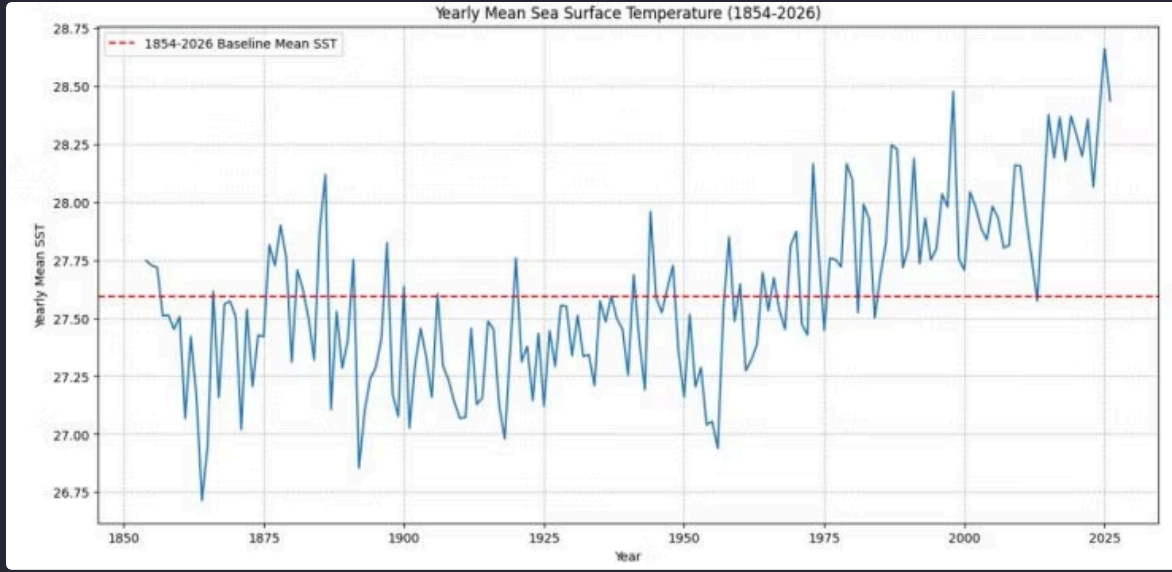


Figure 6: Yearly Mean SST (1854–2026). Yearly Mean SST (blue) and 1854–2026 Baseline Mean SST (red dashed). Historical mean ~27.5°C.

NOAA DATA | Historical and Predicted SST Differences from Three Baselines

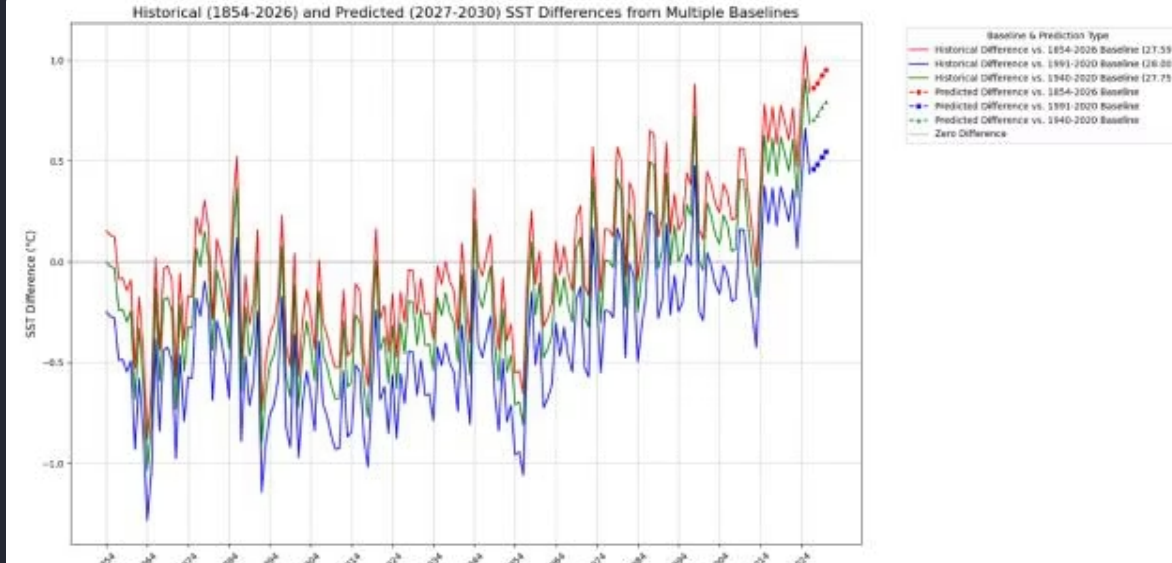


Figure 7: Historical (1854–2026) and Predicted (2027–2030) SST Differences from Multiple Baselines. Baselines: 1854–2026 (27.53°C), 1940–2020 (28.00°C), 1991–2020 (27.79°C). Predicted 2027–2030 shown as green dashed line.

PREDICTED MEAN SST WITH YEARLY NOAA DATA, 1854-2026

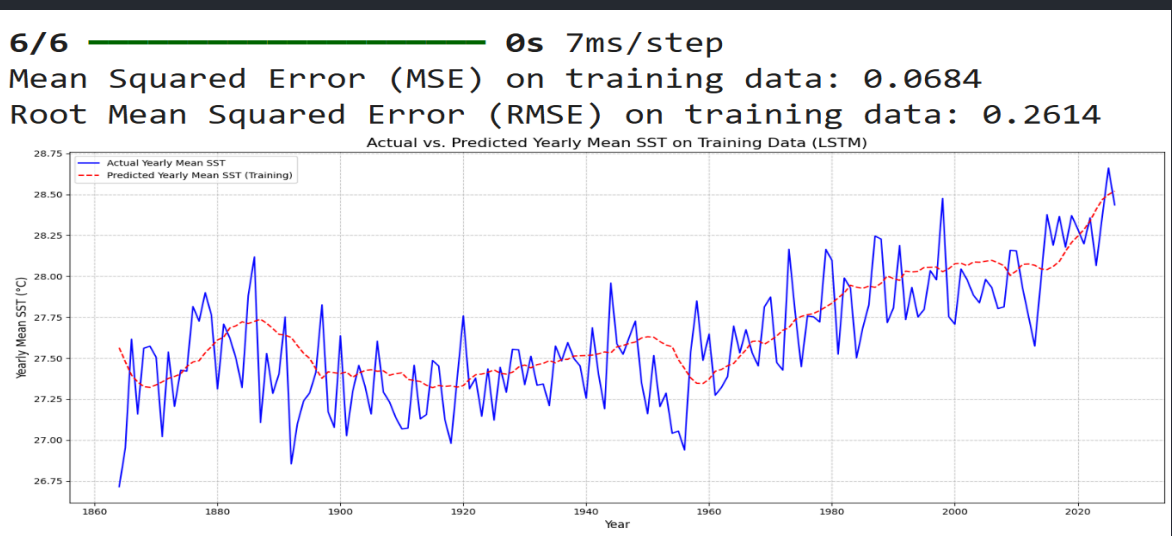


Figure 8: Actual and predicted yearly mean SST (training data), NOAA 1854-2026.

FIGURE 9: PREDICTED VALUE SST 2027-2030, HOURLY ERA5 DATA

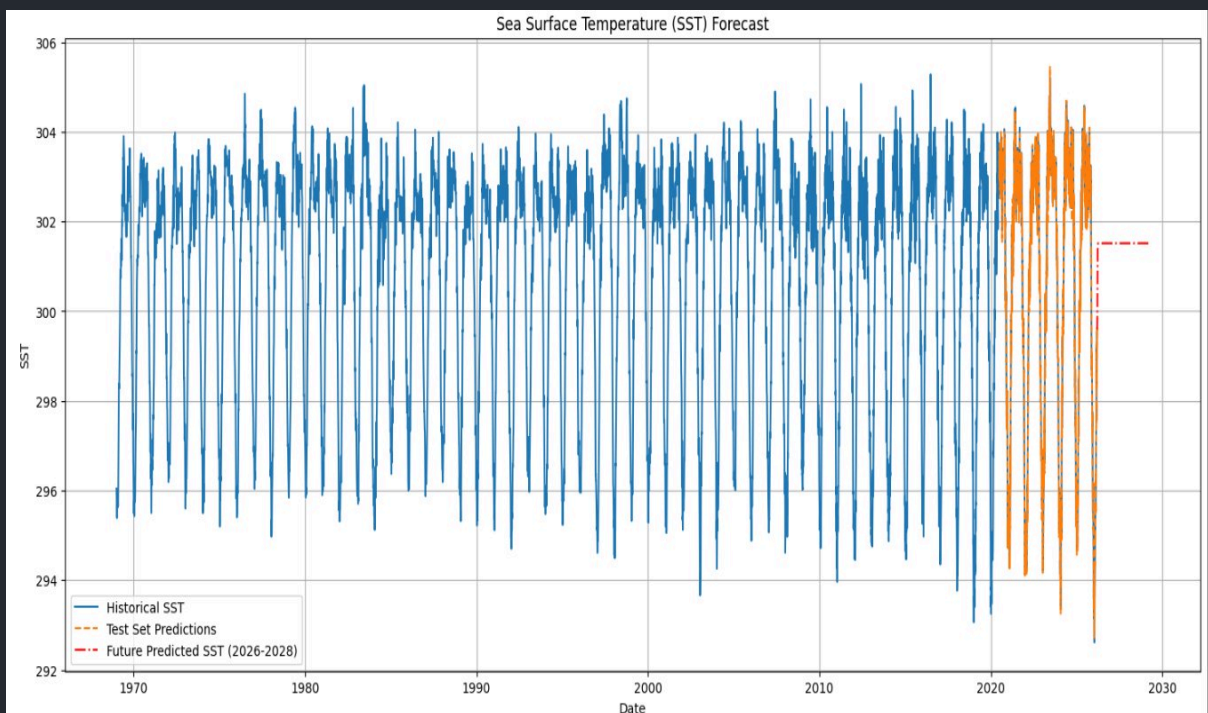


FIGURE 10: LOSS OF ANALYSIS WITH ERA5 HOURLY DATA

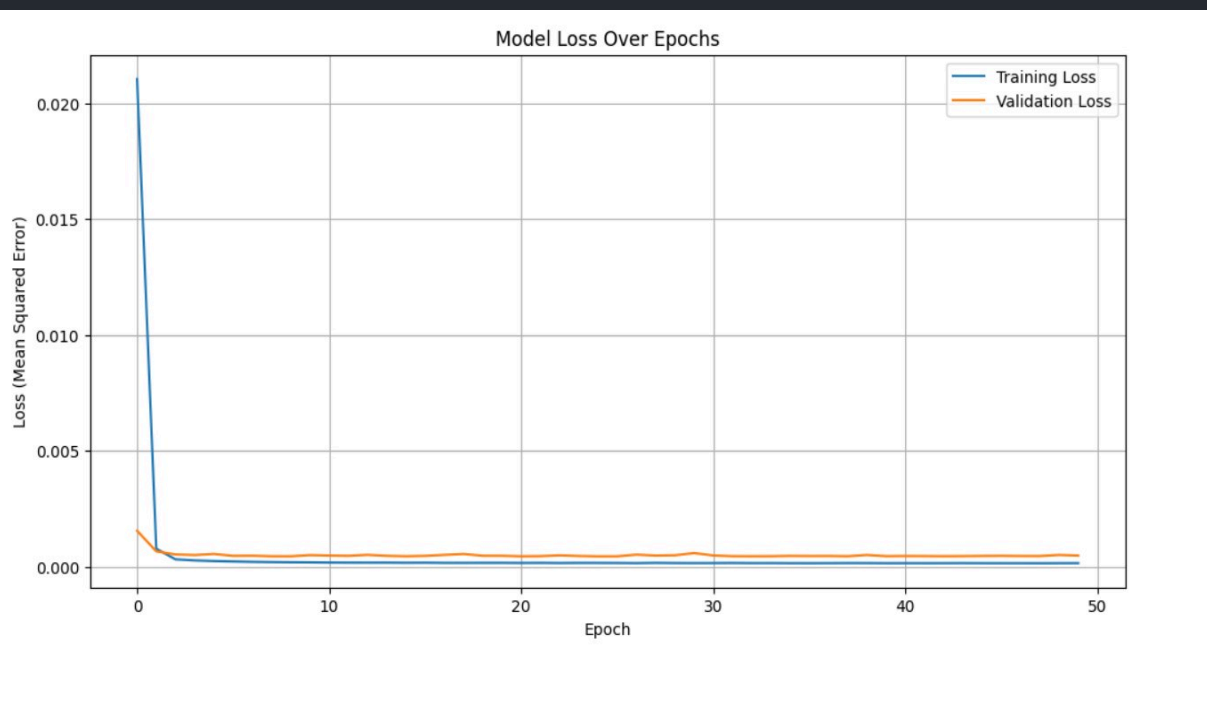
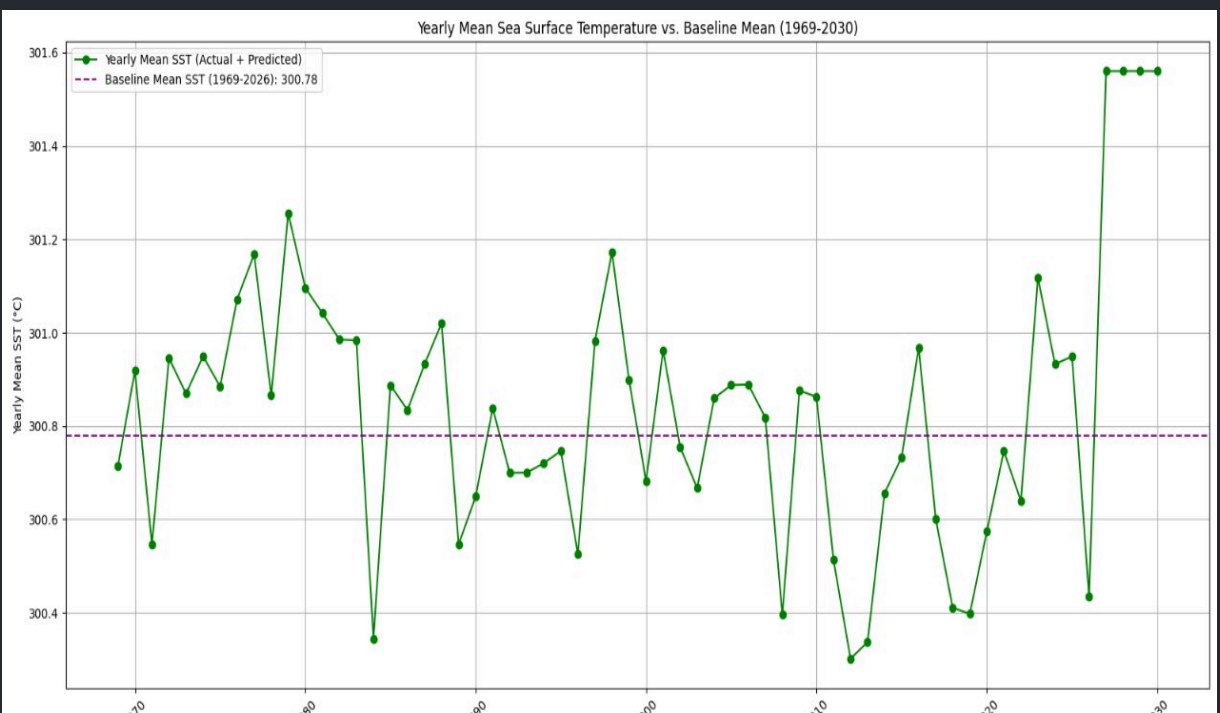


FIGURE 11: SST DIFFERENCE FROM BASELINE 1969-2026, WITH ERA5 HOURLY DATA



COMMENT

Note: Figures 1-7 are based on analysis with Copernicus ERA5 data and NOAA data, data with year wise mean monthly sea surface temperature of sea adjacent to Kolkata, area 21.5° N, 88.5° E. Figure 8 shows predicted mean SST with yearly NOAA data, 1854-2026. Figures 9, 10 and 11 use ERA5 hourly data, 1969-2026.

INFERENCE: 2027–2030 FORECAST VALUES

ERA5 DATA | Predicted Annual SST and Difference from Baseline Mean (K)

Year	1991–2020 Predicted (K)	Above 301.08 K	1940–2020 Predicted (K)	Below 301.10 K
2027	301.50	+0.420	300.478	−0.622
2028	301.60	+0.520	300.415	−0.685
2029	301.70	+0.620	300.399	−0.701
2030	301.80	+0.720	300.398	−0.702

❑ **ERA5 Key Finding:** All 2027–2030 predictions using the 1991–2020 baseline are **above** its mean (301.08 K). All 2027–2030 predictions using the 1940–2020 baseline are **below** its mean (301.10 K).

NOAA DATA | Predicted Annual SST and Difference from Baseline Mean (°C)

Year	Predicted SST (°C)	vs 1854–2026	vs 1940–2020	vs 1991–2020
2027	28.458	+0.863	+0.708	+0.460
2028	28.481	+0.887	+0.731	+0.483
2029	28.519	+0.925	+0.769	+0.521
2030	28.546	+0.951	+0.795	+0.547

❑ **NOAA Key Finding:** All 2027–2030 predictions are **above** the 1854–2026 mean (27.5946°C), the 1940–2020 mean (27.7501°C), and the 1991–2020 mean (27.9981°C).

ERA5 HOURLY DATA | 2027-2030 FORECAST VS. 1969-2026 BASELINE

Year	Predicted yearly mean SST (K)	Increase above baseline (K)	1969-2026 baseline mean (K)
2027	301.561	+0.782	300.778
2028	301.561	+0.782	300.778
2029	301.561	+0.782	300.778
2030	301.561	+0.782	300.778

HOURLY ERA5 INSIGHT: SST FOR 2027-2030 IS 0.782 K ABOVE THE 1969-2026 BASELINE MEAN.