LOVELY
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MACHINE AND DEEP LEARNING FOR ACCURATE STATE-WIDE WEATHER FORECASTING :

A CASE STUDY OF TELANGANA

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INTRODUCTION

OUR PROJECT AIMS TO FORECAST THE WEATHER IN TELANGANA STATE USING MACHINE LEARNING AND DEEP LEARNING ALGORITHMS SUCH AS SARIMA AND LSTM. WE HAVE IMPLEMENTED THE MODELS IN EACH DISTRICT OF TELANGANA TO OBTAIN ACCURATE WEATHER FORECASTING.

THE PROJECT INCLUDES FOUR SECTIONS:

- DATA COLLECTION AND PREPROCESSING
- IMPLEMENTATION OF MACHINE LEARNING AND DEEP LEARNING ALGORITHMS
- STORING AND RETRIEVING THE RESULTS PROVIDED BY THE MODEL
- AN INTERACTIVE WEB PLATFORM TO MAKE THE PROJECT USER-FRIENDLY.

METHODS AND TECHNIQUES

FOR DATA PREPROCESSING :

- PYTHON LIBRARIES NUMPY AND PANDAS ,JUPYTER NOTEBOOK

FOR ALGORITHMS AND MODEL CREATION :

- PYTHON , SCIKIT-LEARN, STATSMODELS AND TENSORFLOW

FOR DATABASE AND BACK-END :

- PHP, XAMP, APACHE ,MYSQLI AND MARIA_DB

FOR FRONT-END :

- HTML, CSS , JS , BOOTSTRAP

WHY DO WE NEED FORECASTING ?

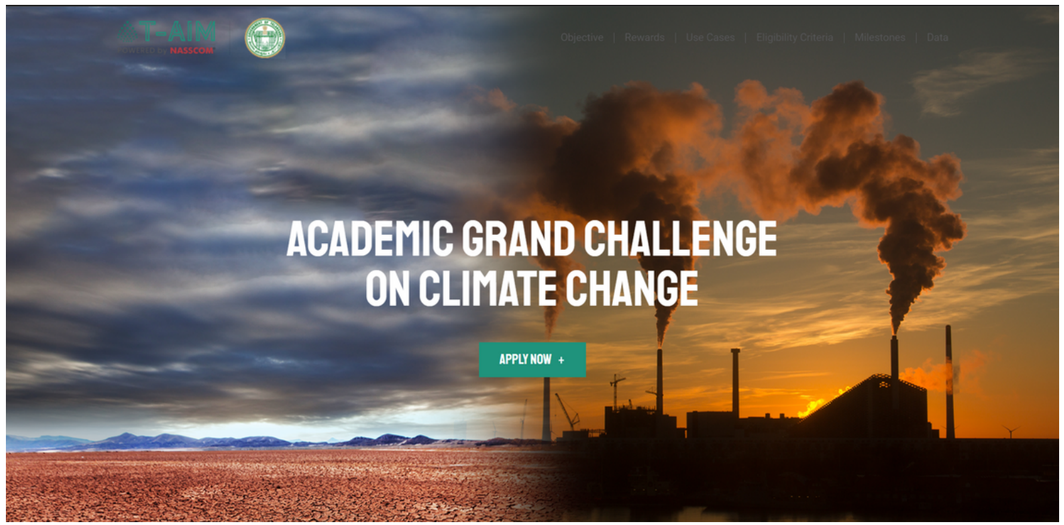
- THE STATE HAS EXPERIENCED A SIGNIFICANT DECREASE IN RAINFALL, WHICH HAS LED TO PERIODIC DROUGHTS.
- AGRICULTURE, THE STATE'S MAIN INDUSTRY, HAS BEEN NEGATIVELY IMPACTED DUE TO INCREASED CROP FAILURES AND POORER YIELDS.
- TELANGANA HAS ALSO BEEN IMPACTED BY SEVERE FLOODS, HEAT-RELATED ILLNESSES, AND DISEASES LIKE DENGUE AND MALARIA.
- TELANGANA STATE IS FACING ISSUES DUE TO MAJOR CLIMATE CHANGE, THAT CAUSES WATER SCARCITY, AGRICULTURE, HEALTH, AND BIODIVERSITY LOSS.

WEATHER FORECASTING CAN ASSIST THE STATE IN PREPARING FOR EXTREME WEATHER OCCURRENCES AND MINIMIZING THEIR EFFECTS BY PROVIDING PRECISE AND TIMELY INFORMATION ABOUT WEATHER PATTERNS AND EVENTS.

MACHINE LEARNING AND DEEP LEARNING ALGORITHMS CAN EFFECTIVELY ANTICIPATE WEATHER PATTERNS IN TELANGANA, WHICH CAN AID IN DECISION-MAKING AND PLANNING IN INDUSTRIES SUCH AS AGRICULTURE, TRANSPORTATION, AND DISASTER MANAGEMENT.

PROJECT IDEA

OUR PROJECT IS A CHALLENGE GIVEN BY T-AIM THAT IS TELANGANA AI MISSION BY THE GOVERNMENT OF TELANGANA AND ALSO THE RESOURCES AND DATASET WAS PROVIDED BY OPEN DATA TELENGANA



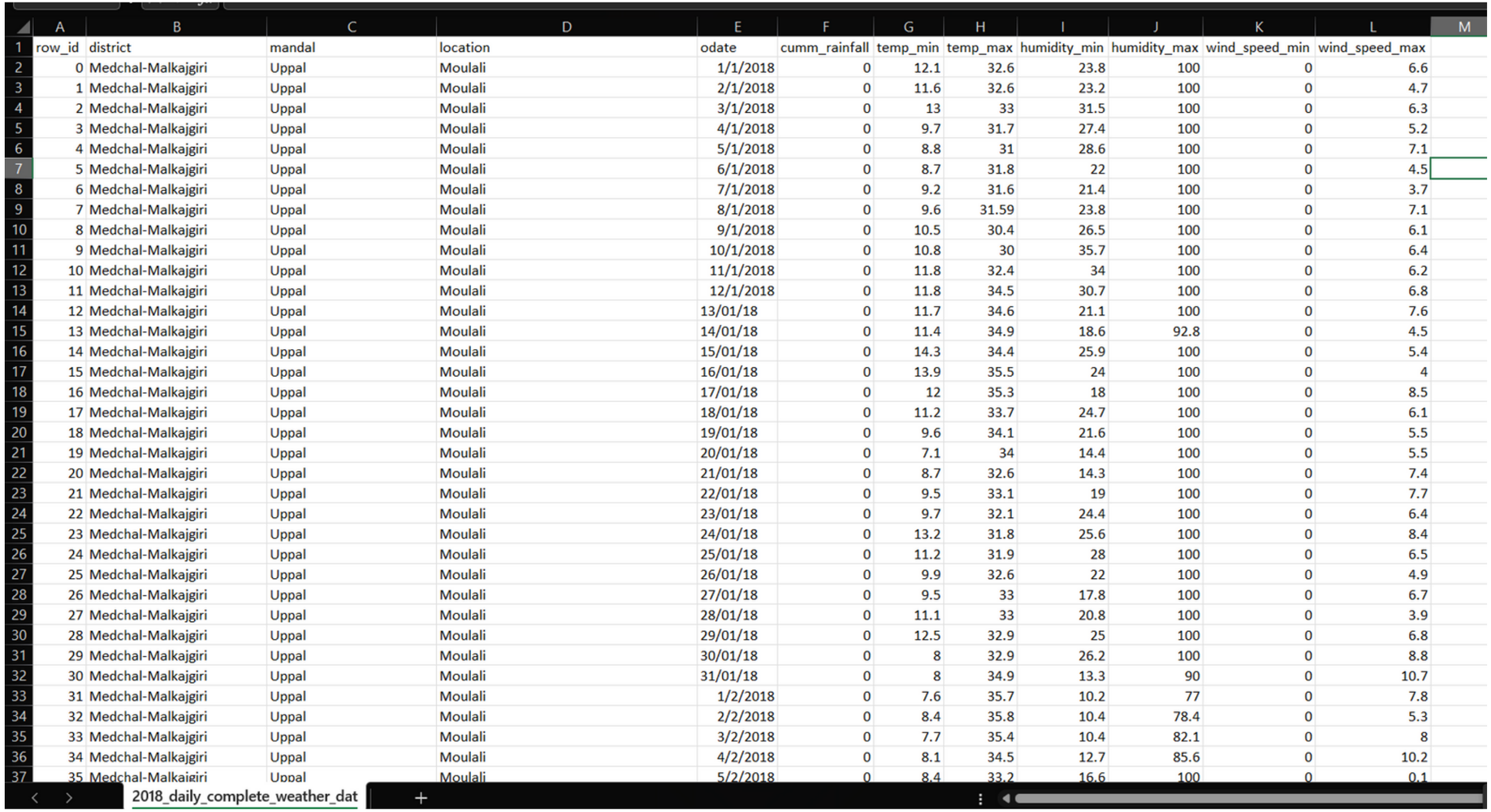
IMPLEMENTATION OF PROJECT

PREPROCESSING OF DATASET :

WHEN WE RECEIVED THE TELANGANA WEATHER DATA (2018-2022), THE DATASET CONSIST OF WEATHER-RELATED INFORMATION SUCH AS TEMPERATURE, HUMIDITY, RAINFALL, AND WIND SPEED.WE DISCOVERED VARIOUS UNWANTED COLUMNS, MISSING VALUES, AND INCORRECTLY FORMATTED DATES. TO MAKE THE DATA SUITABLE FOR OUR MODEL, WE MUST PREPROCESS IT ACCORDING TO OUR REQUIREMENTS.

IMPLEMENTATION OF PROJECT

BEFORE PREPROCESSING OF DATASET :



	A	B	C	D	E	F	G	H	I	J	K	L	M
1	row_id	district	mandal	location	odate	cumm_rainfall	temp_min	temp_max	humidity_min	humidity_max	wind_speed_min	wind_speed_max	
2	0	Medchal-Malkajgiri	Uppal	Moulali	1/1/2018	0	12.1	32.6	23.8	100	0	6.6	
3	1	Medchal-Malkajgiri	Uppal	Moulali	2/1/2018	0	11.6	32.6	23.2	100	0	4.7	
4	2	Medchal-Malkajgiri	Uppal	Moulali	3/1/2018	0	13	33	31.5	100	0	6.3	
5	3	Medchal-Malkajgiri	Uppal	Moulali	4/1/2018	0	9.7	31.7	27.4	100	0	5.2	
6	4	Medchal-Malkajgiri	Uppal	Moulali	5/1/2018	0	8.8	31	28.6	100	0	7.1	
7	5	Medchal-Malkajgiri	Uppal	Moulali	6/1/2018	0	8.7	31.8	22	100	0	4.5	
8	6	Medchal-Malkajgiri	Uppal	Moulali	7/1/2018	0	9.2	31.6	21.4	100	0	3.7	
9	7	Medchal-Malkajgiri	Uppal	Moulali	8/1/2018	0	9.6	31.59	23.8	100	0	7.1	
10	8	Medchal-Malkajgiri	Uppal	Moulali	9/1/2018	0	10.5	30.4	26.5	100	0	6.1	
11	9	Medchal-Malkajgiri	Uppal	Moulali	10/1/2018	0	10.8	30	35.7	100	0	6.4	
12	10	Medchal-Malkajgiri	Uppal	Moulali	11/1/2018	0	11.8	32.4	34	100	0	6.2	
13	11	Medchal-Malkajgiri	Uppal	Moulali	12/1/2018	0	11.8	34.5	30.7	100	0	6.8	
14	12	Medchal-Malkajgiri	Uppal	Moulali	13/01/18	0	11.7	34.6	21.1	100	0	7.6	
15	13	Medchal-Malkajgiri	Uppal	Moulali	14/01/18	0	11.4	34.9	18.6	92.8	0	4.5	
16	14	Medchal-Malkajgiri	Uppal	Moulali	15/01/18	0	14.3	34.4	25.9	100	0	5.4	
17	15	Medchal-Malkajgiri	Uppal	Moulali	16/01/18	0	13.9	35.5	24	100	0	4	
18	16	Medchal-Malkajgiri	Uppal	Moulali	17/01/18	0	12	35.3	18	100	0	8.5	
19	17	Medchal-Malkajgiri	Uppal	Moulali	18/01/18	0	11.2	33.7	24.7	100	0	6.1	
20	18	Medchal-Malkajgiri	Uppal	Moulali	19/01/18	0	9.6	34.1	21.6	100	0	5.5	
21	19	Medchal-Malkajgiri	Uppal	Moulali	20/01/18	0	7.1	34	14.4	100	0	5.5	
22	20	Medchal-Malkajgiri	Uppal	Moulali	21/01/18	0	8.7	32.6	14.3	100	0	7.4	
23	21	Medchal-Malkajgiri	Uppal	Moulali	22/01/18	0	9.5	33.1	19	100	0	7.7	
24	22	Medchal-Malkajgiri	Uppal	Moulali	23/01/18	0	9.7	32.1	24.4	100	0	6.4	
25	23	Medchal-Malkajgiri	Uppal	Moulali	24/01/18	0	13.2	31.8	25.6	100	0	8.4	
26	24	Medchal-Malkajgiri	Uppal	Moulali	25/01/18	0	11.2	31.9	28	100	0	6.5	
27	25	Medchal-Malkajgiri	Uppal	Moulali	26/01/18	0	9.9	32.6	22	100	0	4.9	
28	26	Medchal-Malkajgiri	Uppal	Moulali	27/01/18	0	9.5	33	17.8	100	0	6.7	
29	27	Medchal-Malkajgiri	Uppal	Moulali	28/01/18	0	11.1	33	20.8	100	0	3.9	
30	28	Medchal-Malkajgiri	Uppal	Moulali	29/01/18	0	12.5	32.9	25	100	0	6.8	
31	29	Medchal-Malkajgiri	Uppal	Moulali	30/01/18	0	8	32.9	26.2	100	0	8.8	
32	30	Medchal-Malkajgiri	Uppal	Moulali	31/01/18	0	8	34.9	13.3	90	0	10.7	
33	31	Medchal-Malkajgiri	Uppal	Moulali	1/2/2018	0	7.6	35.7	10.2	77	0	7.8	
34	32	Medchal-Malkajgiri	Uppal	Moulali	2/2/2018	0	8.4	35.8	10.4	78.4	0	5.3	
35	33	Medchal-Malkajgiri	Uppal	Moulali	3/2/2018	0	7.7	35.4	10.4	82.1	0	8	
36	34	Medchal-Malkajgiri	Uppal	Moulali	4/2/2018	0	8.1	34.5	12.7	85.6	0	10.2	
37	35	Medchal-Malkajgiri	Uppal	Moulali	5/2/2018	0	8.4	33.2	16.6	100	0	0.1	

2018_daily_complete_weather_dat

IMPLEMENTATION OF PROJECT

STEPS OF PREPROCESSING OF DATASET :

- MEARGE DATASETS YEAR WISE
- REMOVE UNWANTED COLUMNS
- TRANSFORMED DATE COLUMN INTO DATE-TIME FORMAT
- CREATE SEPRATE DATASETS FOR EACH DISTRICT
- HANDLED MISSING VALUES WITH MODE
- REMOVED DUPLICATE DATES AND MAKE DATE CONTINOUS

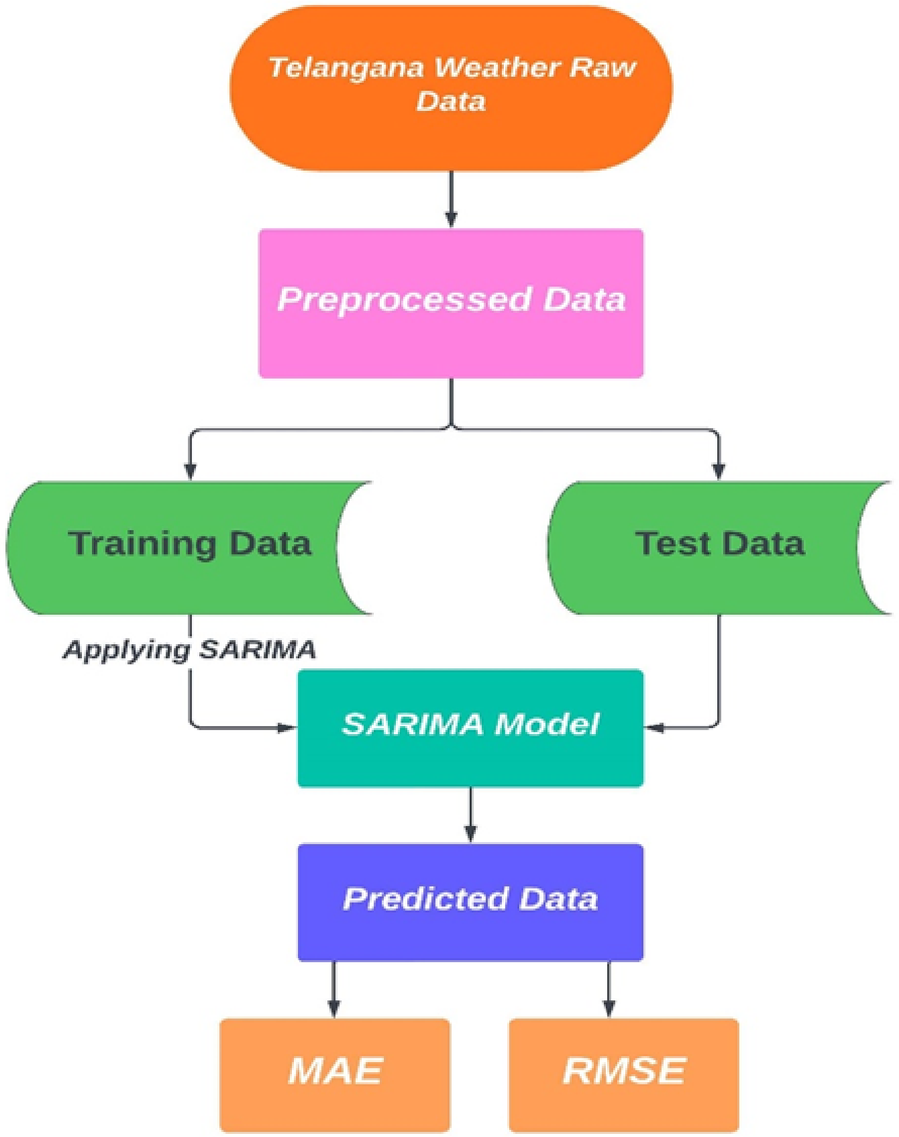
AFTER THAT DATASETS ARE ORGANISED AND CATEGORISED BY DATE FOR THE PURPOSE OF IMPLEMENTING ALGORITHMS.

IMPLEMENTATION OF PROJECT

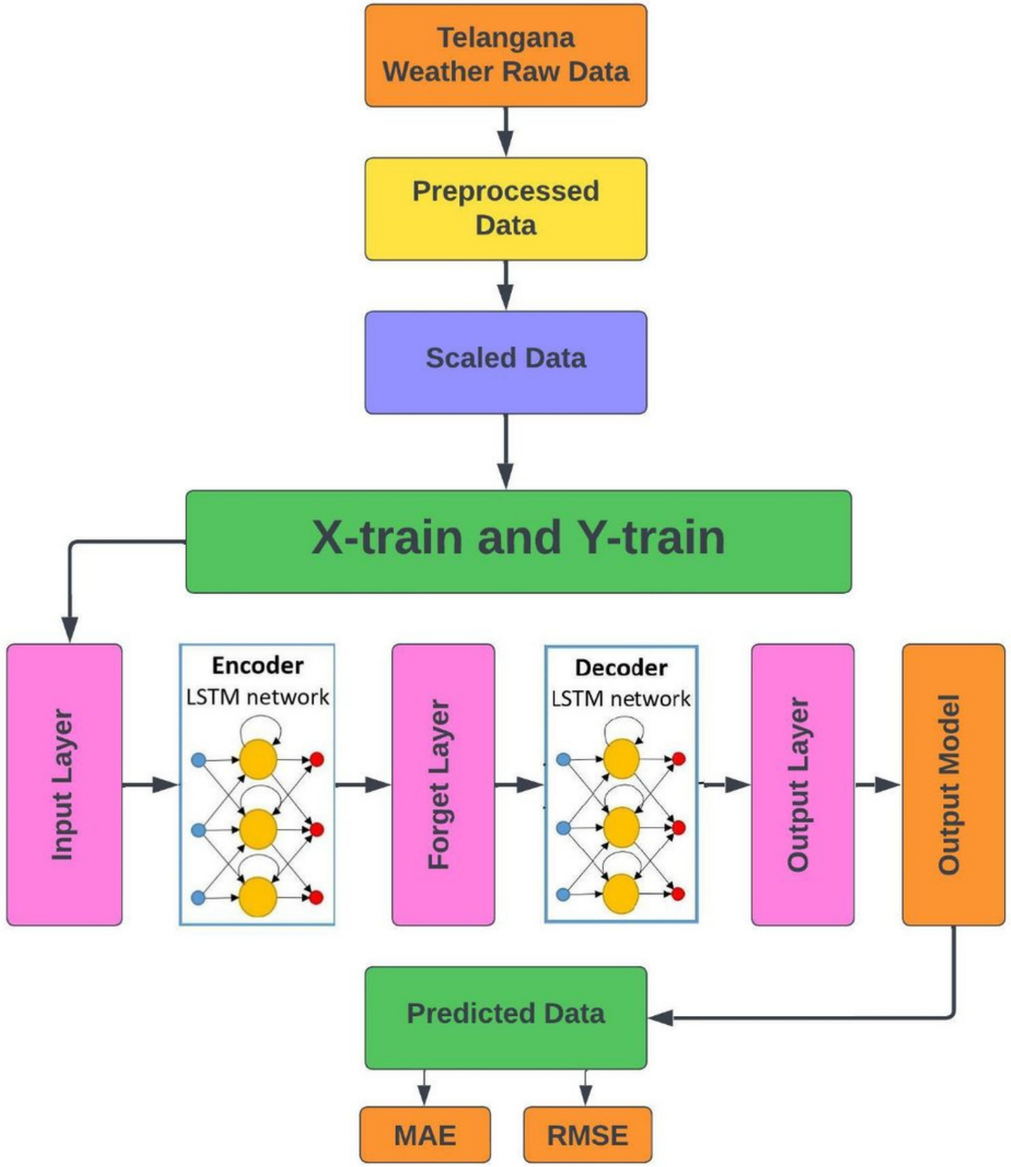
AFTER PREPROCESSING OF DATASET OF ADILABAD DISTRICT :

	A	B	C	D	E	F	G	H
1	date	rain	temp_min	temp_max	humidity_min	humidity_max	wind_speed_max	wind_speed_min
2	2018-01-01	0.00	10.40	29.70	41.80	83.80	0.00	5.70
3	2018-01-02	0.00	11.20	34.80	29.80	74.60	0.00	4.80
4	2018-01-03	0.00	17.30	38.00	31.80	71.50	0.00	3.40
5	2018-01-04	0.00	27.30	41.00	24.90	75.60	0.00	7.70
6	2018-01-05	0.00	28.70	43.20	27.70	48.90	0.00	13.50
7	2018-01-06	0.50	28.10	41.80	43.00	74.70	1.60	14.40
8	2018-01-07	0.00	26.20	34.90	61.30	78.50	0.00	4.10
9	2018-01-08	0.00	25.20	33.00	63.70	90.90	0.00	6.10
10	2018-01-09	35.20	22.70	26.40	79.80	97.30	0.00	8.60
11	2018-01-10	0.00	22.30	34.30	61.10	92.40	0.00	5.50
12	2018-01-11	0.00	17.30	31.90	54.40	90.30	0.00	11.50
13	2018-01-12	0.00	13.00	29.90	35.20	96.80	0.00	1.70
14	2018-01-13	0.00	13.30	33.30	39.20	81.30	0.00	5.30
15	2018-01-14	0.00	13.50	32.10	34.40	77.90	0.00	7.60
16	2018-01-15	0.00	16.60	33.00	39.40	79.30	0.00	4.50
17	2018-01-16	0.00	13.80	33.40	43.10	82.20	0.00	6.30
18	2018-01-17	0.00	12.70	31.90	39.90	81.00	0.00	8.60
19	2018-01-18	0.00	12.60	32.70	38.20	79.30	0.00	5.50
20	2018-01-19	0.00	10.40	31.60	36.90	78.60	0.00	7.70
21	2018-01-20	0.00	9.80	31.00	34.60	79.20	0.00	8.30
22	2018-01-21	0.00	10.30	32.00	36.20	79.50	0.00	5.20
23	2018-01-22	0.00	10.50	31.00	37.10	80.90	0.00	11.80
24	2018-01-23	0.00	12.80	31.50	38.30	82.80	0.00	7.10
25	2018-01-24	0.00	16.10	31.80	42.60	72.70	0.00	5.80
26	2018-01-25	0.00	11.00	31.30	40.90	79.00	0.00	6.20
27	2018-01-26	0.00	9.00	31.20	34.70	78.60	0.00	6.80
28	2018-01-27	0.00	8.60	30.90	33.20	79.10	0.00	7.70
29	2018-01-28	0.00	9.80	32.40	31.80	77.20	0.00	4.80
30	2018-01-29	0.00	10.80	33.00	33.90	78.10	0.00	5.50
31	2018-01-30	0.00	10.60	32.20	35.00	78.10	0.00	6.60
32	2018-01-31	0.00	10.60	33.60	33.70	77.10	0.00	5.50
33	2018-02-01	0.00	10.90	31.80	38.80	83.80	0.00	4.30
34	2018-02-02	0.00	10.90	34.30	29.40	74.00	0.00	9.40
35	2018-02-03	0.00	18.50	37.60	31.40	70.30	0.00	7.50
36	2018-02-04	0.00	23.80	39.80	35.70	67.30	0.00	7.50
37	2018-02-05	0.00	28.10	43.70	28.50	72.60	0.00	10.00

FLOW CHART OF WORKING MODULE



SARIMA MODEL



LSTM MODEL

ABOUT ALGORITHMS

- **SEASONAL AUTO REGRESSIVE INTEGRATED MOVING AVERAGE (SARIMA)**

SARIMA, OR SEASONAL AUTOREGRESSIVE INTEGRATED MOVING AVERAGE, IS A STATISTICAL MODEL USED FOR TIME-SERIES ANALYSIS. IT EXTENDS THE ARIMA MODEL BY INCORPORATING SEASONAL COMPONENTS, ALLOWING IT TO ACCOUNT FOR REPEATED PATTERNS IN THE DATA.

SARIMA USES THREE MAIN COMPONENTS: AUTOREGRESSION (AR), DIFFERENCING (I), AND MOVING AVERAGE (MA), WITH THE ADDITION OF A FOURTH COMPONENT, SEASONAL DIFFERENCING (S). THE AR COMPONENT ACCOUNTS FOR THE RELATIONSHIP BETWEEN PAST AND CURRENT VALUES, THE MA COMPONENT ACCOUNTS FOR THE RELATIONSHIP BETWEEN PAST ERRORS AND CURRENT VALUES, AND THE I COMPONENT ACCOUNTS FOR ANY NECESSARY DIFFERENCING TO MAKE THE SERIES STATIONARY. THE SEASONAL COMPONENT ACCOUNTS FOR ANY SEASONAL PATTERNS IN THE DATA.

ABOUT ALGORITHMS

- LONG SHORT TERM MEMORY (LSTM)

LONG SHORT-TERM MEMORY (LSTM) IS A TYPE OF RECURRENT NEURAL NETWORK (RNN) USED IN DEEP LEARNING FOR PROCESSING SEQUENTIAL DATA. IT IS DESIGNED TO OVERCOME THE VANISHING GRADIENT PROBLEM THAT CAN OCCUR IN TRADITIONAL RNNS BY ALLOWING THE NETWORK TO SELECTIVELY REMEMBER OR FORGET PREVIOUS INPUTS.

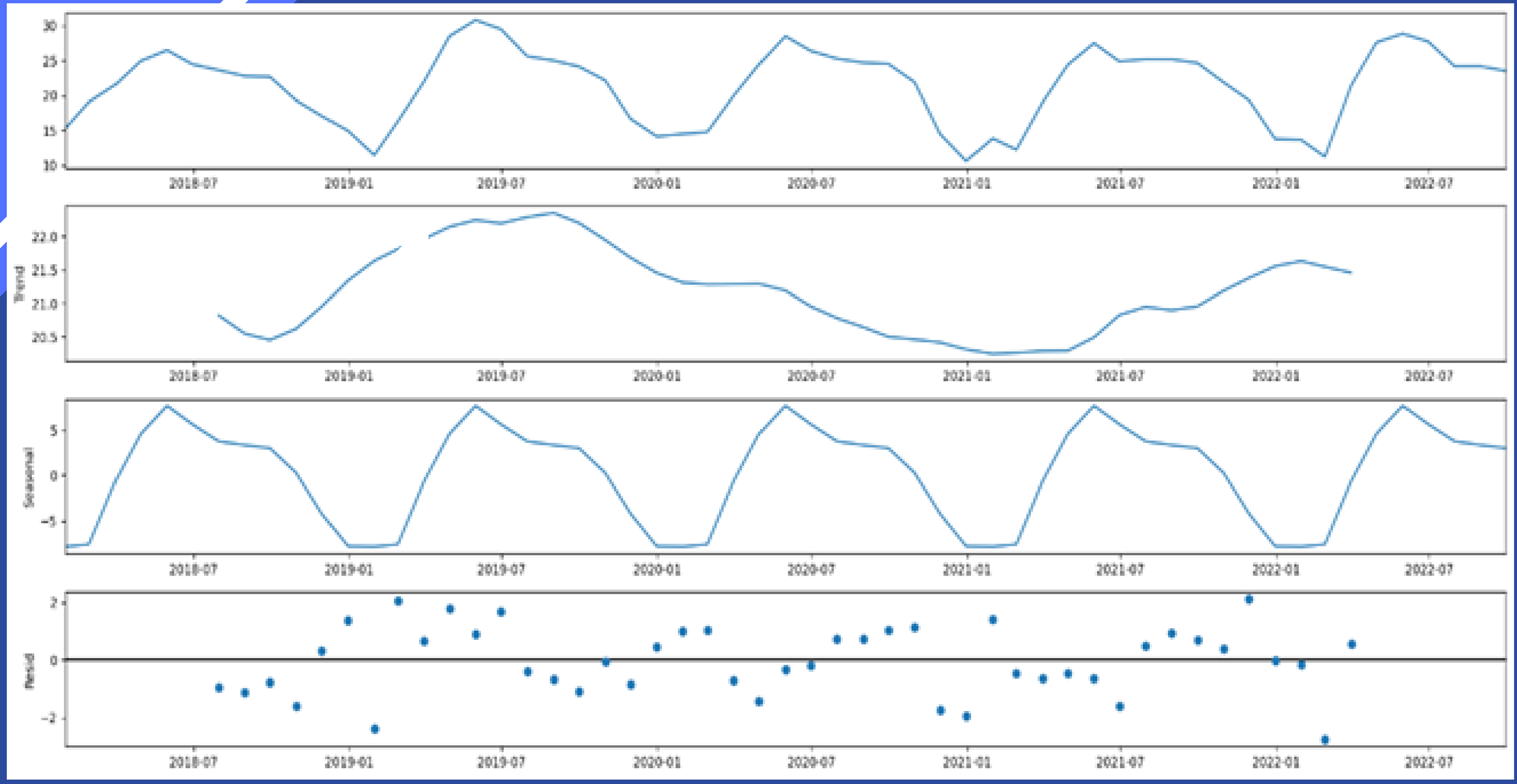
LSTM CELLS HAVE THREE MAIN COMPONENTS: AN INPUT GATE, A FORGET GATE, AND AN OUTPUT GATE. THE INPUT GATE CONTROLS WHETHER OR NOT NEW INFORMATION IS ADDED TO THE CELL STATE, THE FORGET GATE CONTROLS WHETHER OR NOT INFORMATION IS RETAINED IN THE CELL STATE, AND THE OUTPUT GATE CONTROLS HOW MUCH INFORMATION IS OUTPUT FROM THE CELL STATE.

RESULTS

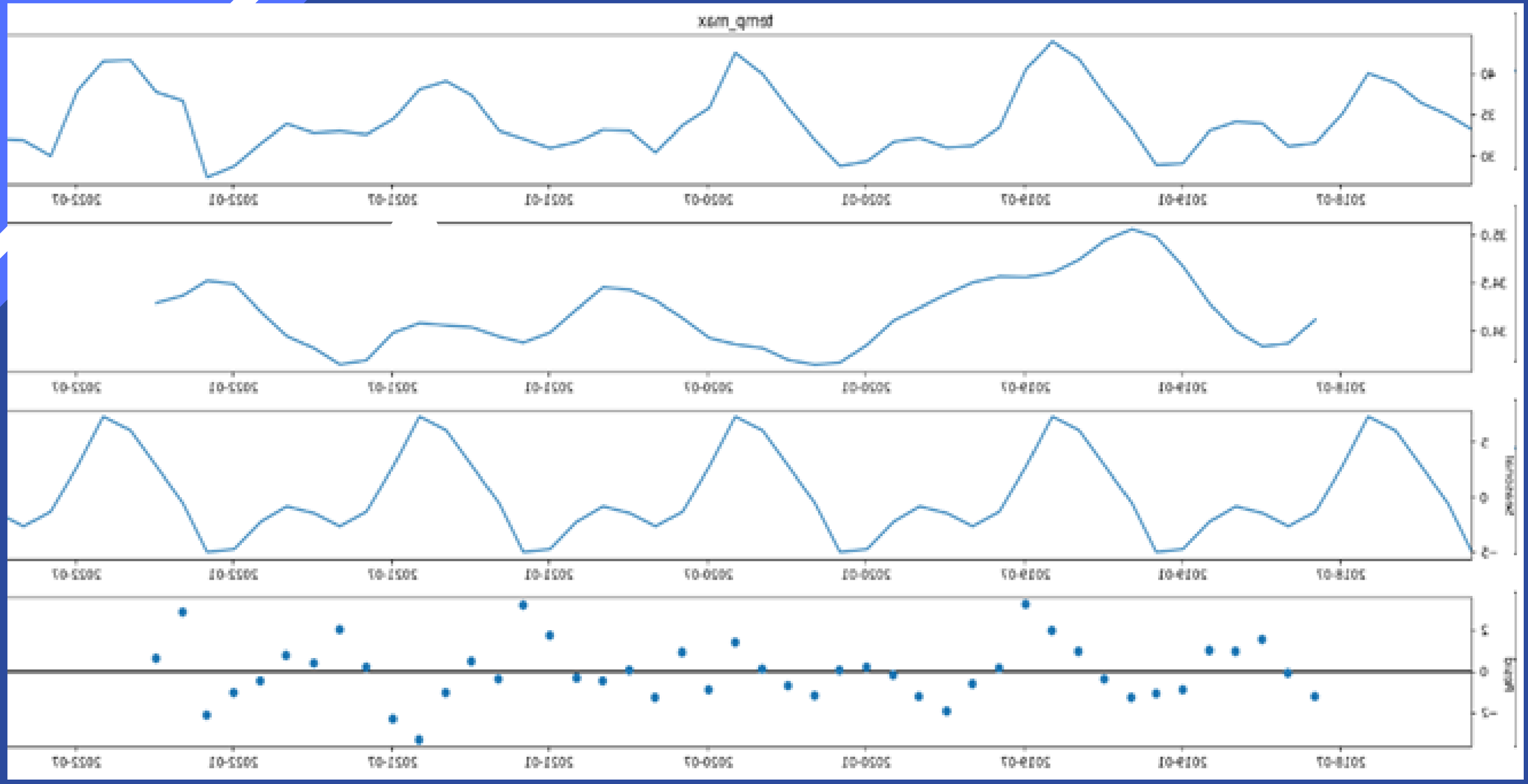
- **SEASONAL AUTO REGRESSIVE INTEGRATED MOVING AVERAGE (SARIMA)**

THE ADILABAD DISTRICT OF TELANGANA'S MIN AND MAX TEMPERATURES, MIN AND MAX HUMIDITY LEVELS, MIN AND MAX WIND SPEEDS, AND RAINFALL VOLUMES ARE ALL ANTICIPATED IN THIS RESEARCH USING THE MACHINE LEARNING METHOD SARIMA. DATA IS FIRST PREPROCESSED BEFORE BEING RESAMPLED FROM DAY TO MONTH.

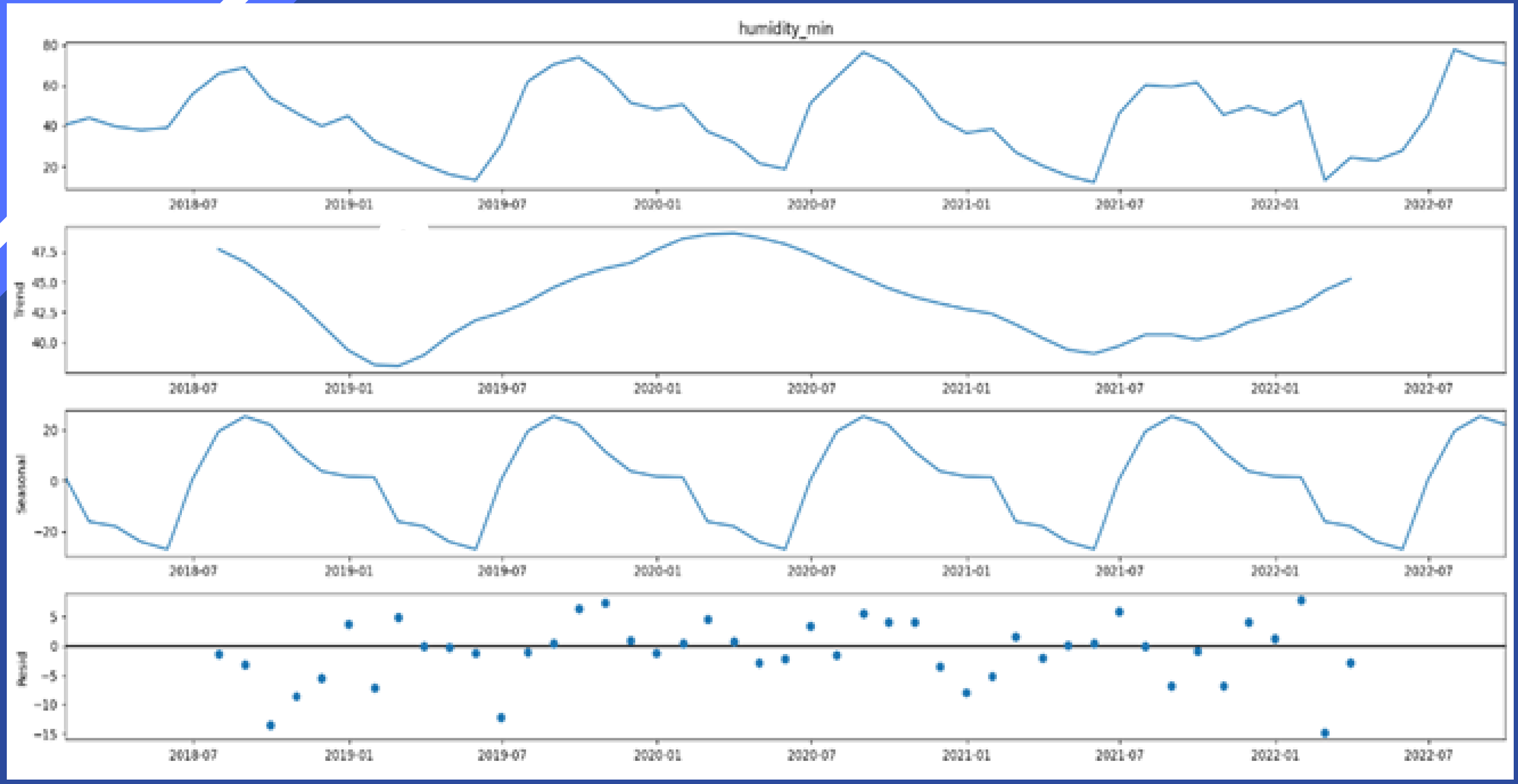
USING THE SEASONAL DECOMPOSE METHOD, WHICH DISPLAYS A SEASONALITY, TREND, AND RESIDUAL PATTERN THAT IS PRESENTED IN THE FOLLOWING IMAGES, WE MAY DETERMINE WHETHER THE DATA IS SEASONAL.



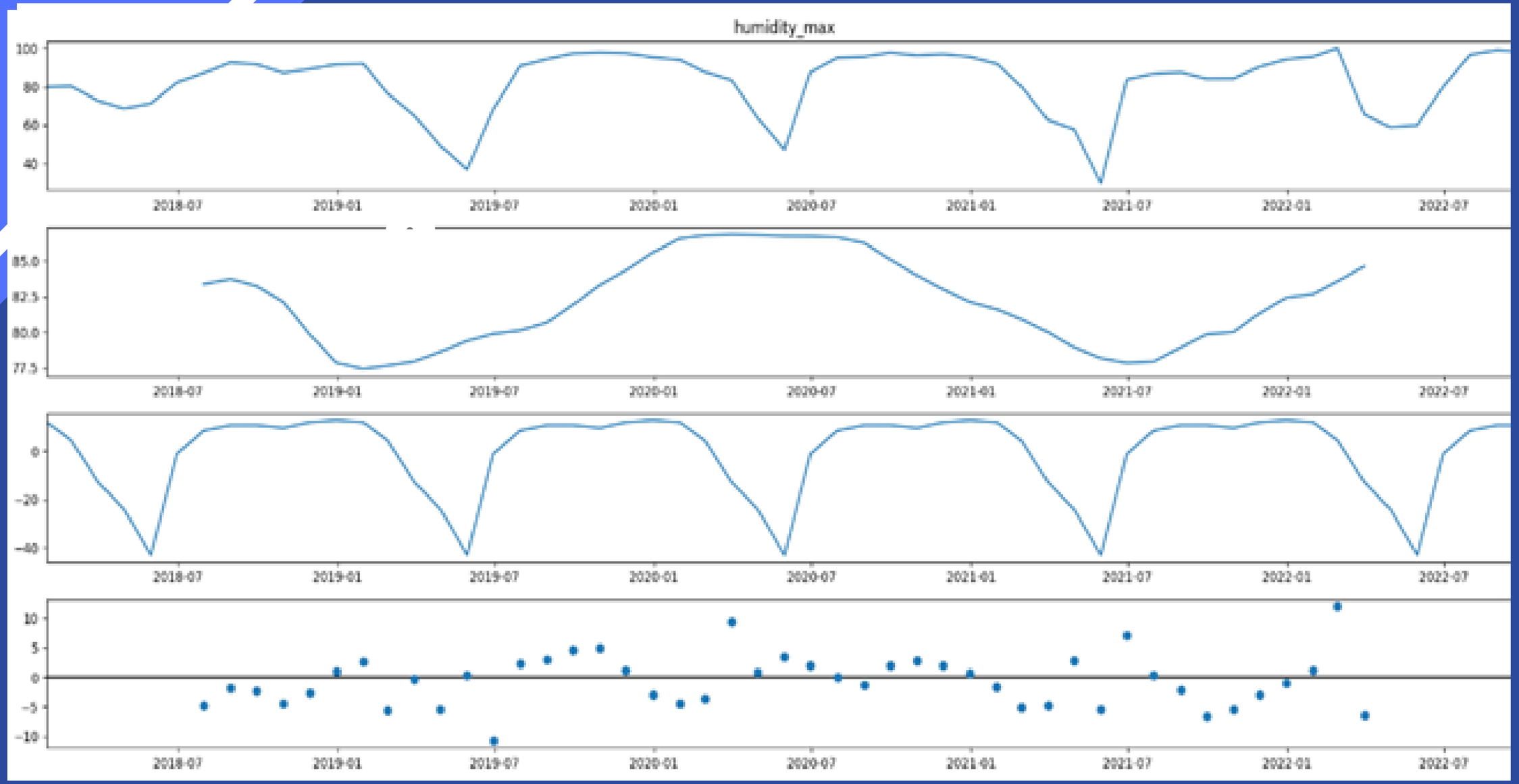
SEASONAL PATTERN OF MINIMUM TEMPERATURE OF ADILABAD DISTRICT FROM 2018 TO 2022



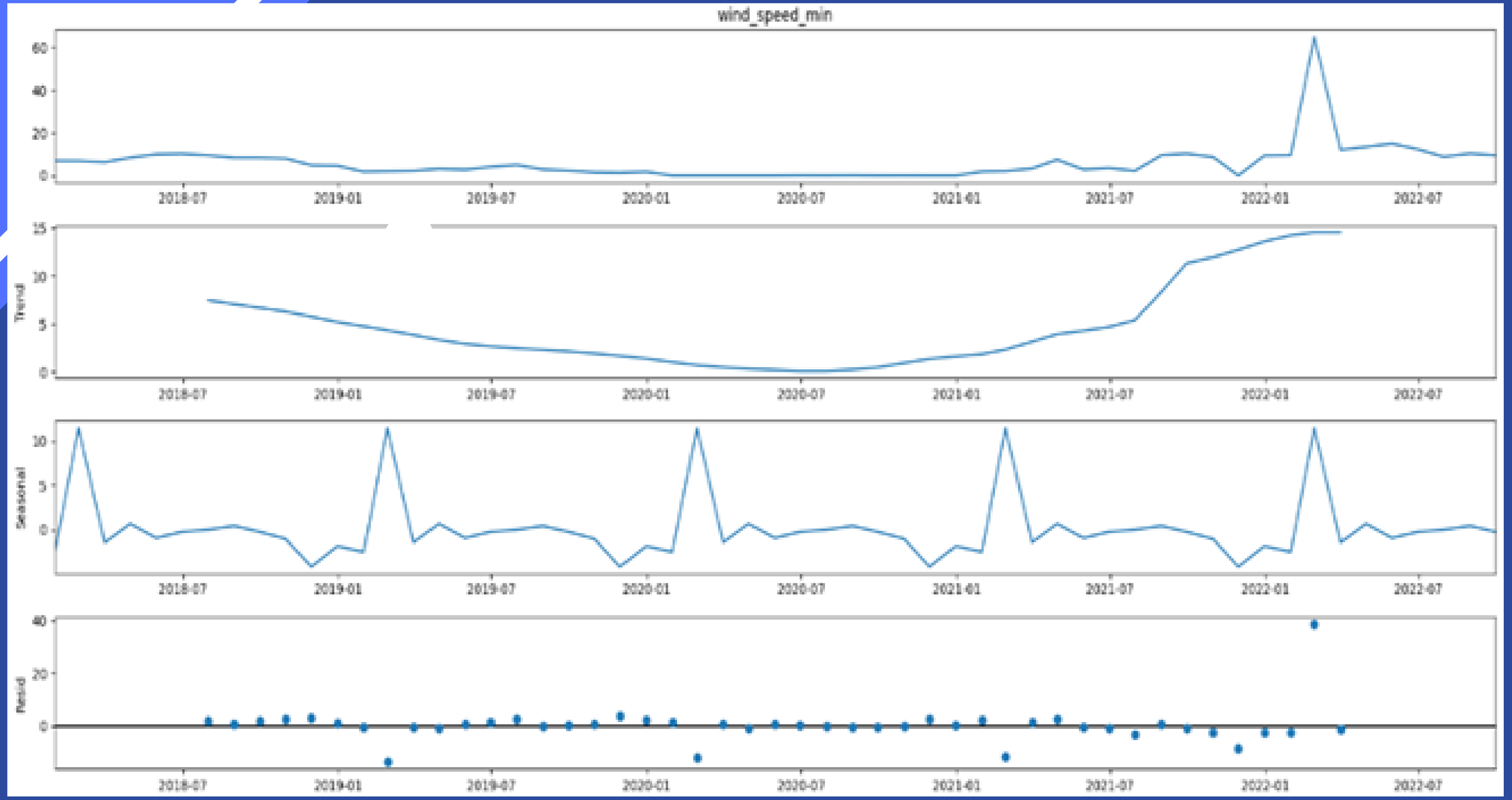
SEASONAL PATTERN OF MAXIMUM TEMPERATURE OF ADILABAD DISTRICT FROM 2018 TO 2022



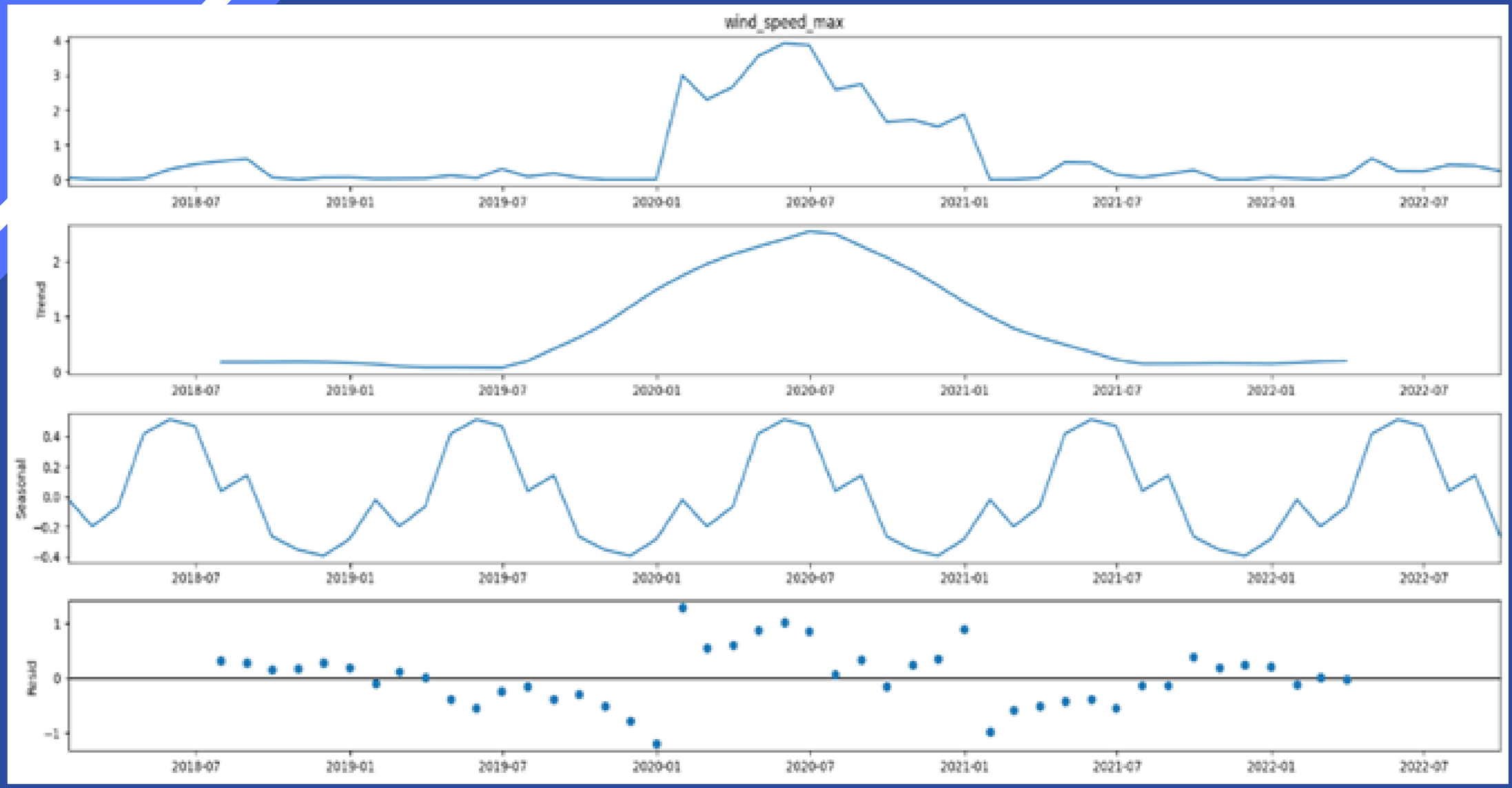
SEASONAL PATTERN OF MINIMUM HUMIDITY OF ADILABAD DISTRICT FROM 2018 TO 2022



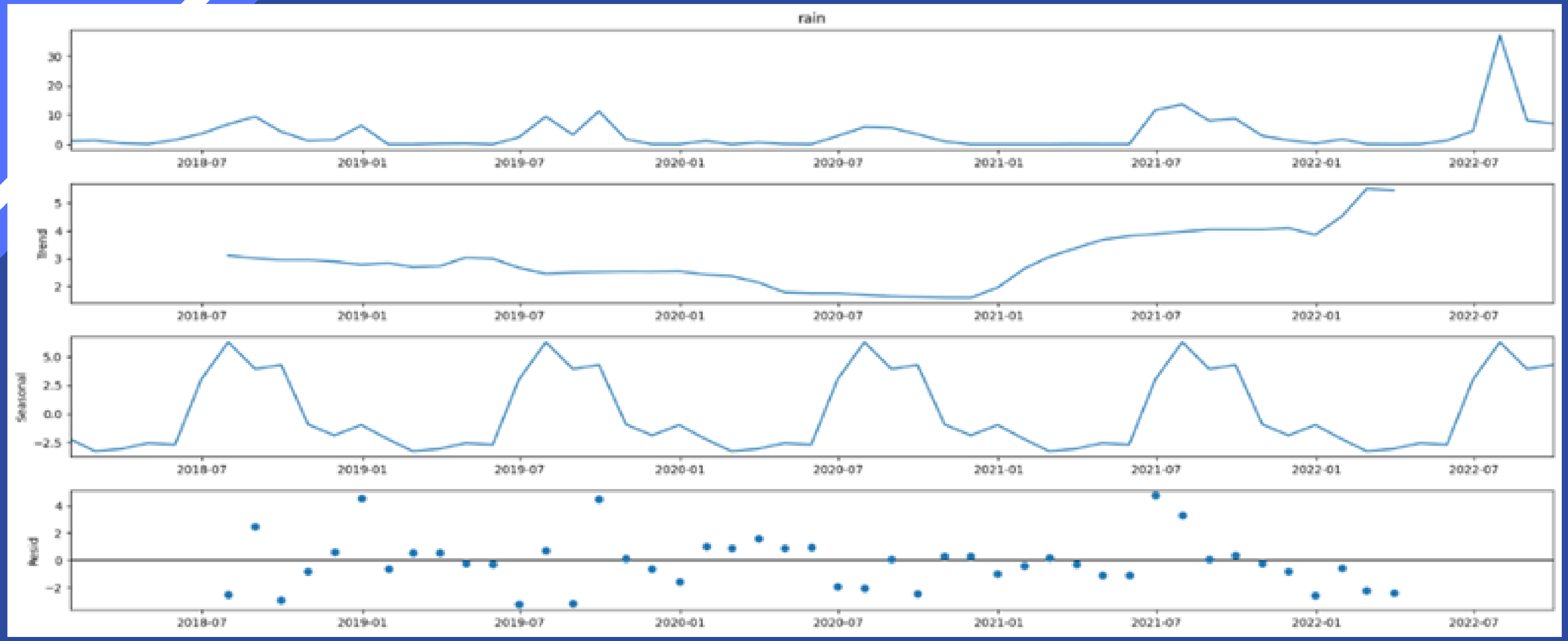
SEASONAL PATTERN OF MAXIMUM HUMIDITY OF ADILABAD DISTRICT FROM 2018 TO 2022



SEASONAL PATTERN OF MINIMUM WIND SPEED OF ADILABAD DISTRICT FROM 2018 TO 2022



SEASONAL PATTERN OF MAXIMUM WIND SPEED OF ADILABAD DISTRICT FROM 2018 TO 2022



SEASONAL PATTERN OF RAIN OF ADILABAD DISTRICT FROM 2018 TO 2022

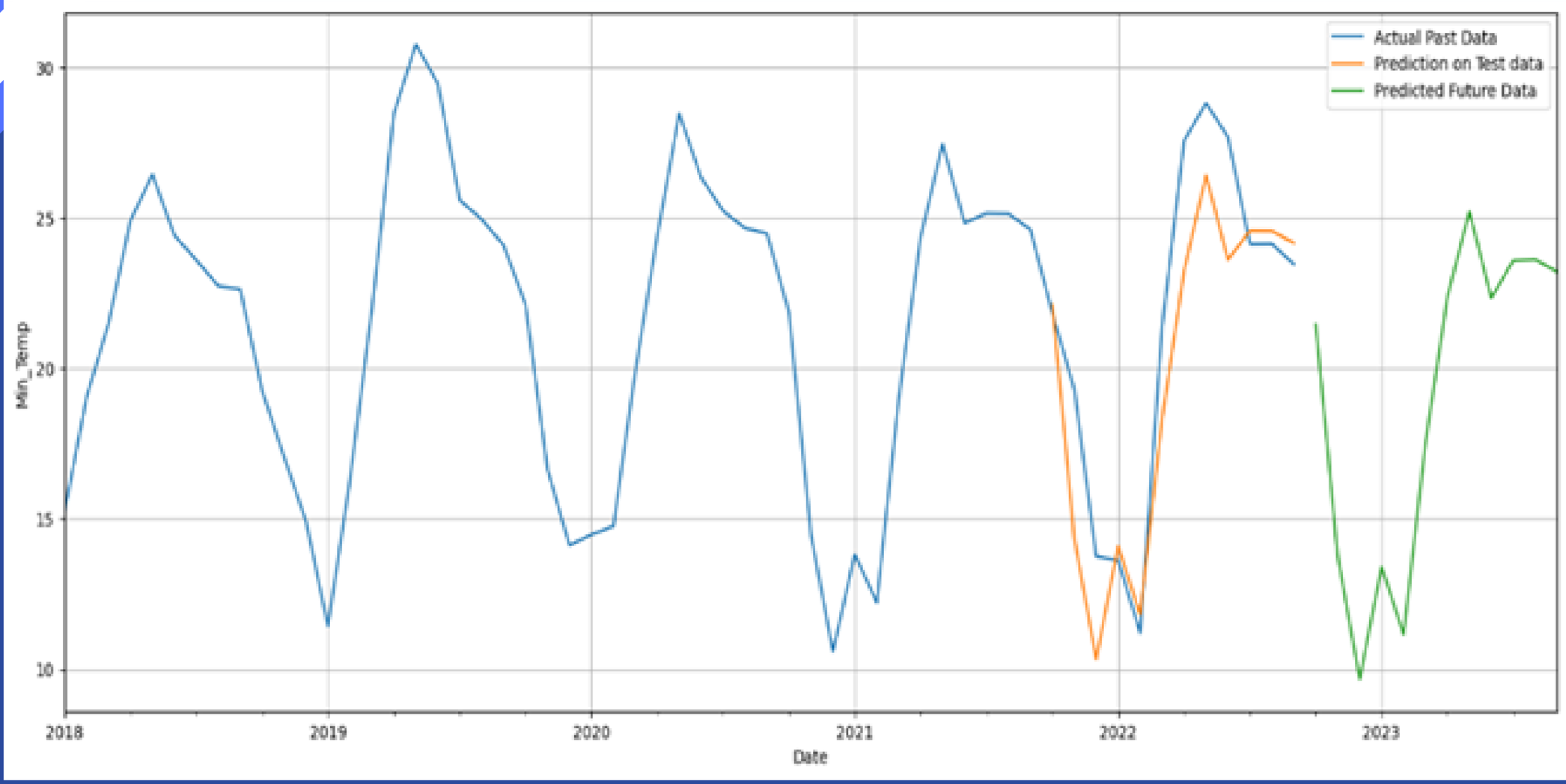
WE CAN INFER FROM THE AFOREMENTIONED THAT THE DATA IS SEASONAL. EVERY YEAR, THERE IS AN INCREASE IN MIN AND MAX TEMPERATURE, MIN AND MAX HUMIDITY, MIN AND MAX WIND SPEED, AND RAIN, WHICH CONTINUES FROM 2018 TO 2022. WHEN BUILDING A MODEL, IT IS NECESSARY TO TEST FOR SEASONALITY IN THE DATA. NOW, TO DETERMINE WHETHER THE DATA IS STATIONARY, THE "AUGMENTED DICKEY-FULLER TEST" IS APPLIED.

IN THE ADFULLER TEST, WE LOOKED AT THE P VALUE; IF IT IS LESS THAN 0.05, THE DATA IS STATIONARY; OTHERWISE, IT IS NOT. IF THE DATA IS STATIONARY, WE PLOT THE PACF AND ACF PLOTS TO FIND THE P (AR), Q (MA) VALUE FOR THE NON SEASONAL PART OF THE ALGORITHM, BUT IF THE DATA IS NOT STATIONARY, WE SHIFT THE DATA BY ONE AND STORE IT IN A NEW ATTRIBUTE, SUBTRACT IT FROM THE ORIGINAL DATA, AND

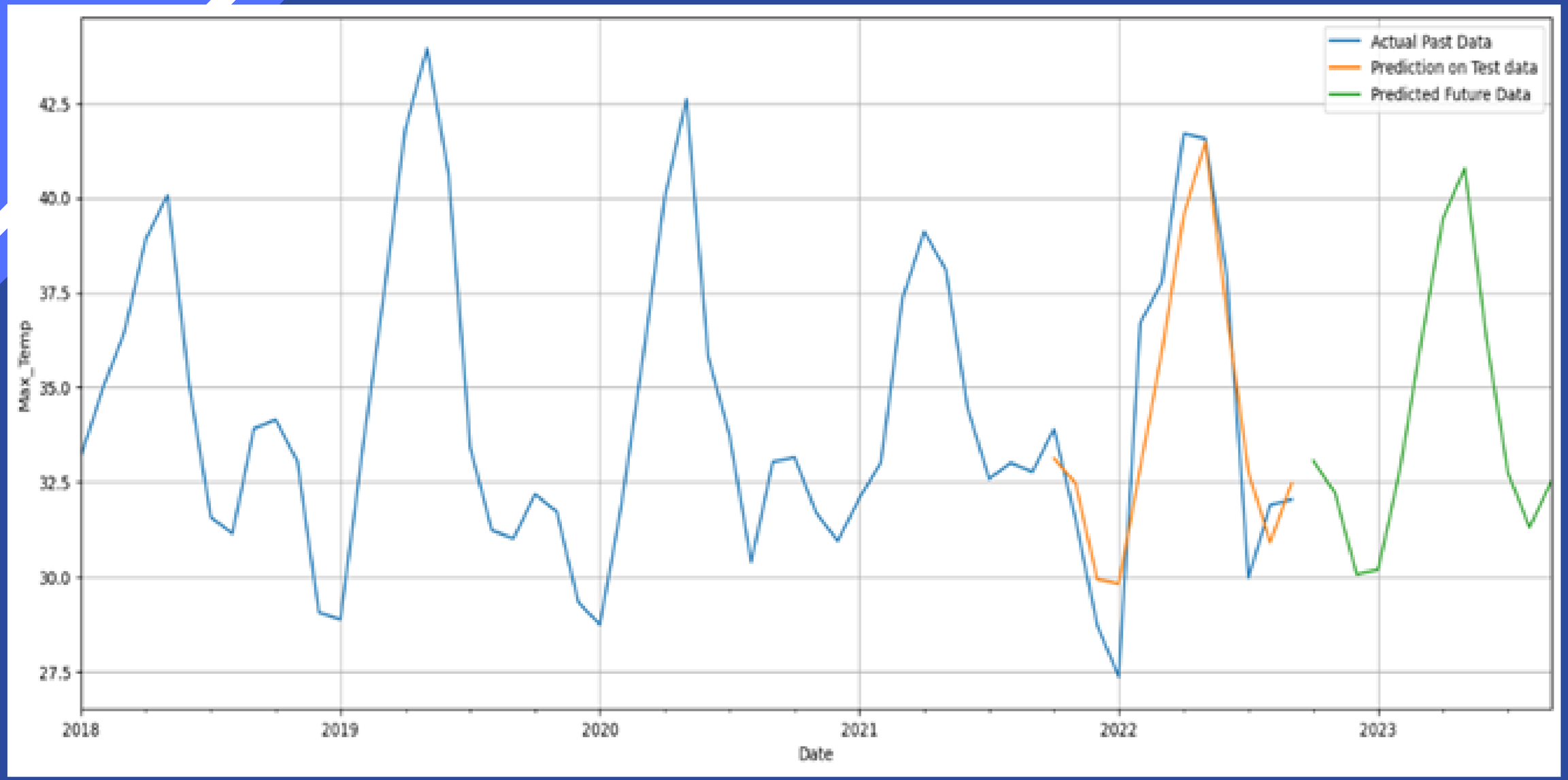
AND APPLY THE ADFULLER TEST TO SEE IF THE DATA IS STATIONARY OR NOT, AND THE NUMBER OF DIFFERENCES REQUIRED TO MAKE THE DATA STATIONARY IS THE VALUE OF D (I). TO CALCULATE THE SEASONAL P (AR), D (I), AND Q (MA) VALUES, WE SUBTRACT THE NEW 12 MONTHS SHIFTED DATA FROM THE ORIGINAL DATA AND PLOT PACF AND ACF PLOTS.

THE DATA SET IS SPLIT INTO TRAINING AND TESTING DATA IN THE FOLLOWING STAGE, WITH THE TRAINING DATA USED TO DEVELOP THE MODEL AND THE TEST DATA SET USED TO MAKE PREDICTIONS. FOLLOWING THE PROJECTION, A 12-MONTH RANGE OF FUTURE DATES IS PRODUCED FOR FORECASTING FUTURE WEATHER.

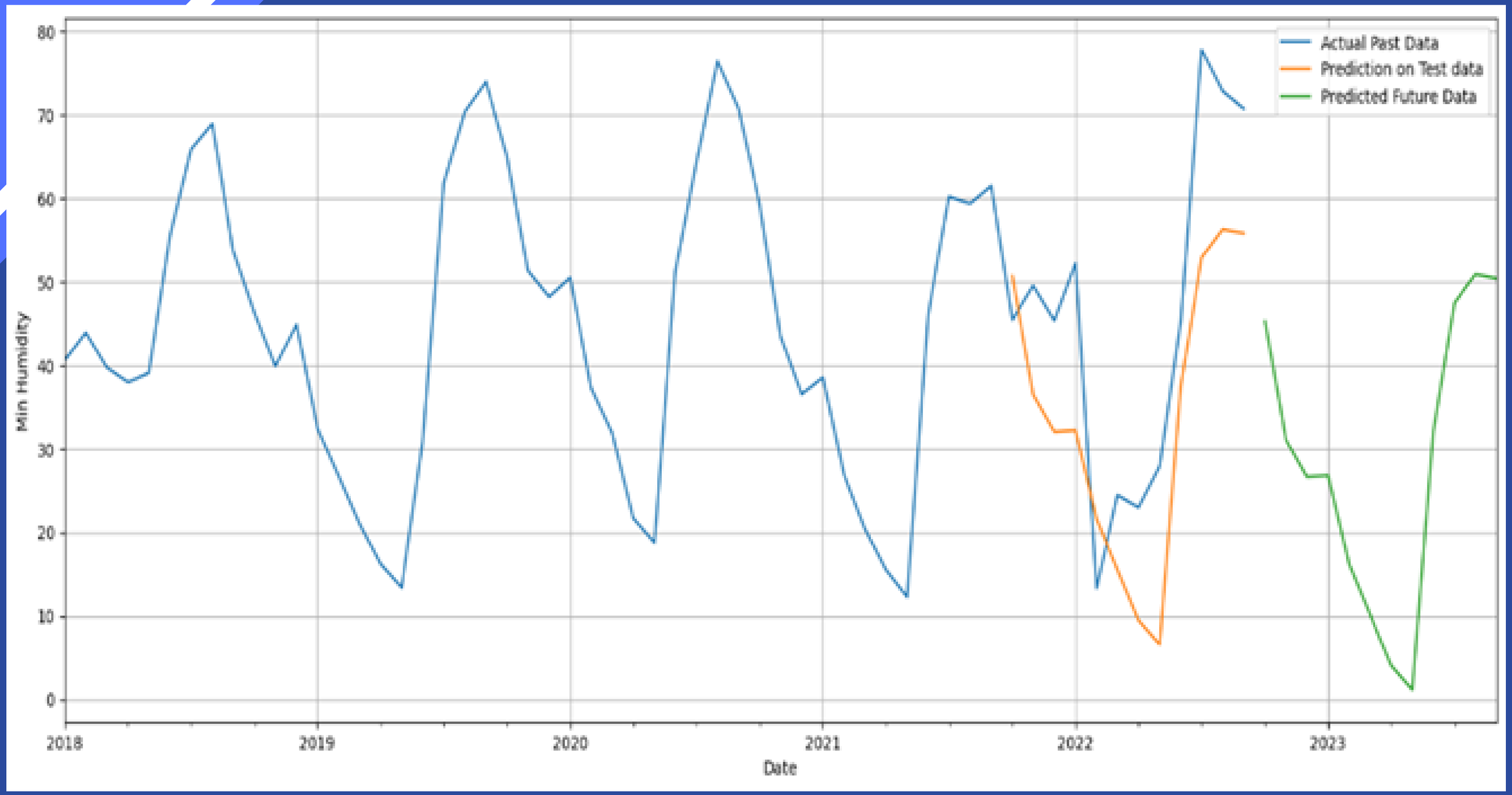
THE DATA FOR TRAINING, TESTING AND FUTURE FORECAST FOR ALL WEATHER VARIABLES IS PRESENTED :



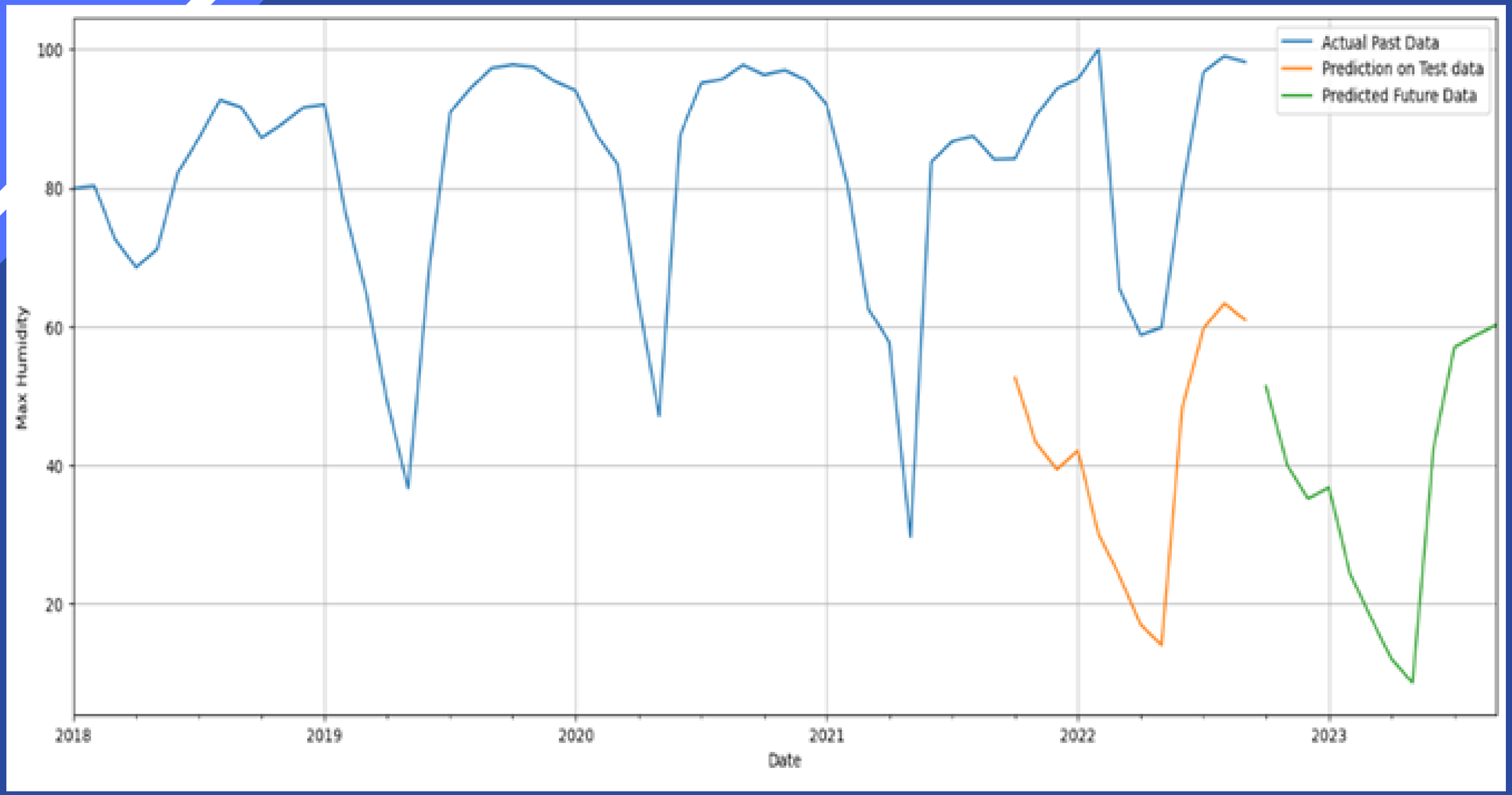
ACTUAL VS PREDICTED VS FUTURE FORECAST OF MINIMUM TEMPERATURE OF ADILABAD



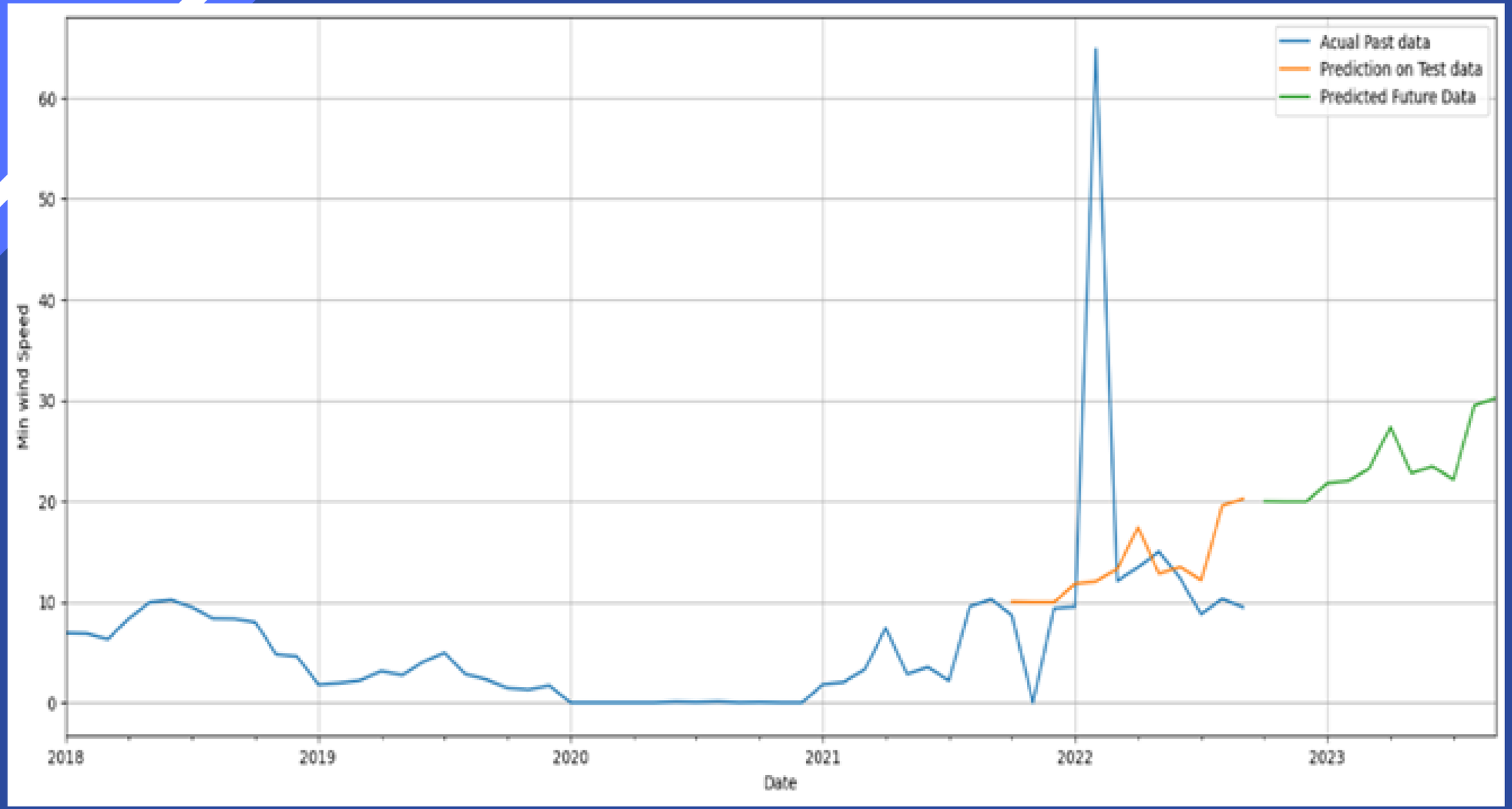
ACTUAL VS PREDICTED VS FUTURE FORECAST OF MAXIMUM TEMPERATURE OF ADILABAD



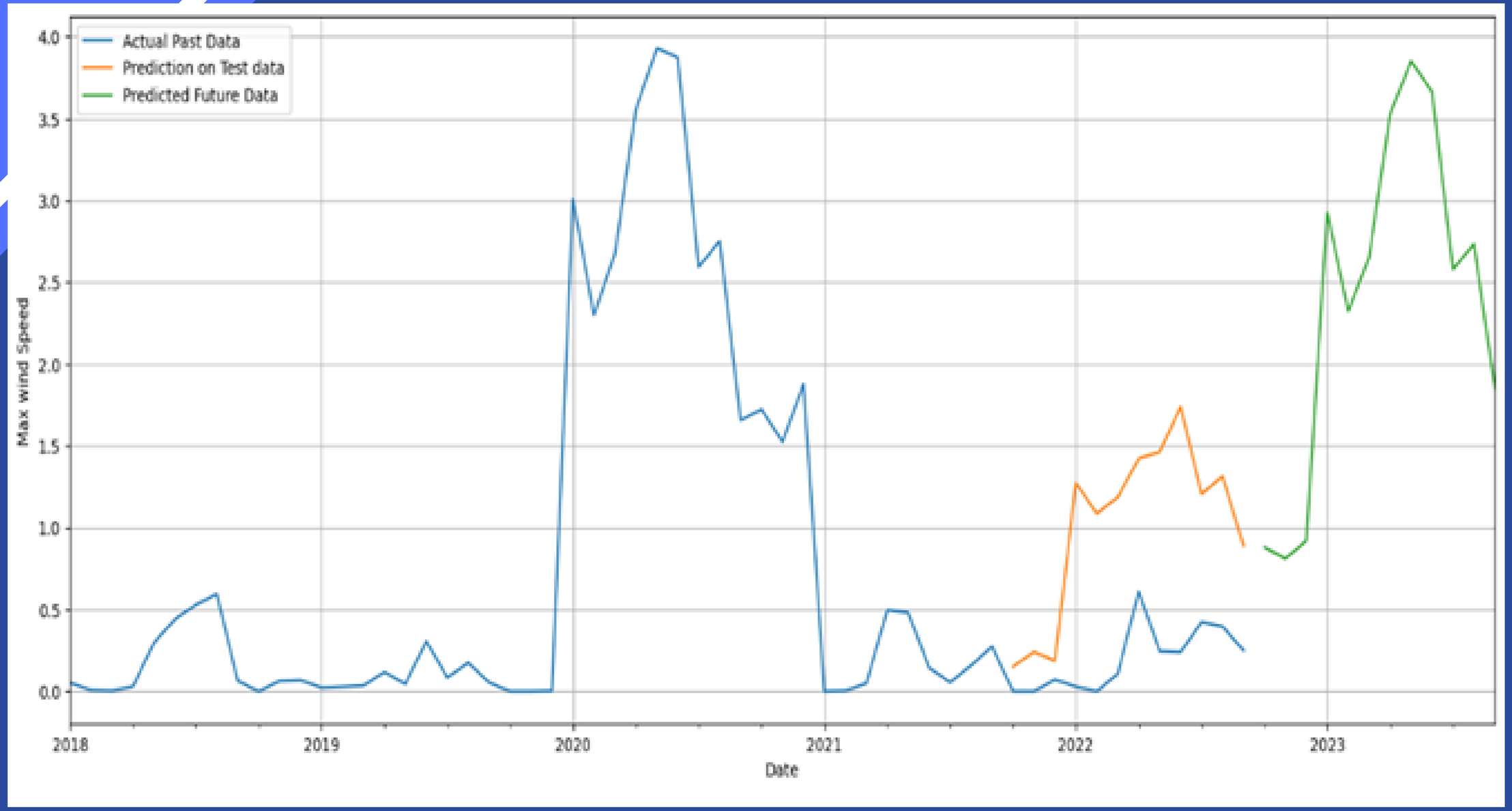
ACTUAL VS PREDICTED VS FUTURE FORECAST OF MINIMUM HUMIDITY OF ADILABAD



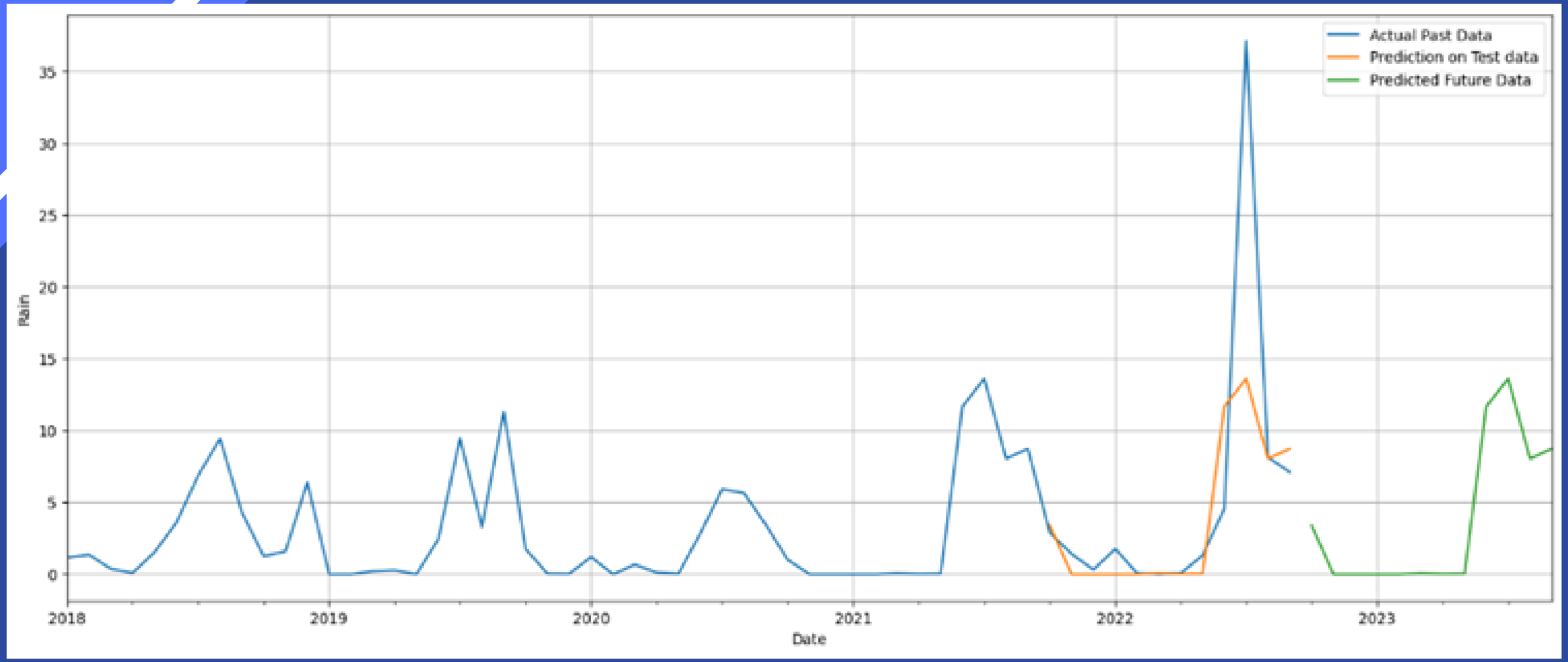
ACTUAL VS PREDICTED VS FUTURE FORECAST OF MAXIMUM HUMIDITY OF ADILABAD



ACTUAL VS PREDICTED VS FUTURE FORECAST OF MINIMUM WIND SPEED OF ADILABAD



ACTUAL VS PREDICTED VS FUTURE FORECAST OF MAXIMUM WIND SPEED OF ADILABAD



ACTUAL VS PREDICTED VS FUTURE FORECAST OF RAIN OF ADILABAD

Weather Factors	Root Mean Squared Error	Mean Absolute Error
Minimum Temperature	2.71	2.09
Maximum Temperature	1.85	1.54
Minimum Humidity	15.09	13.97
Maximum Humidity	45.25	43.96
Minimum Wind Speed	16.15	8.23
Maximum Wind Speed	0.92	0.81
Rain	7.14	3.14

PERFORMANCE OF THE USED MODEL (SARIMA)

RESULTS

- **LONG SHORT TERM MEMORY (LSTM)**

THE ADILABAD DISTRICT OF TELANGANA'S MIN AND MAX TEMPERATURES, MIN AND MAX HUMIDITY LEVELS, MIN AND MAX WIND SPEEDS, AND RAINFALL VOLUMES ARE ALL ANTICIPATED IN THIS RESEARCH USING THE DEEP LEARNING METHOD LSTM.

DATA IS PREPOSSESSED FIRST FOR THIS MODEL, THEN SCALED USING THE STANDARD SCALER FUNCTION.TWO EMPTY LISTS ARE FORMED, ONE FOR STORING THE SEQUENCE OF SCALED DATA AND THE OTHER FOR STORING THE OUTPUT SEQUENCE OF SCALED DATA. THESE TWO LISTS ARE LATER TURNED INTO NUMPY ARRAYS.

THIS MODEL EMPLOYS THREE LAYERS OF NEURONS: THE INPUT LAYER (64 NEURONS), THE HIDDEN LAYER (10 NEURONS), AND THE OUTPUT LAYER (1 NEURON). THE OUTPUT LAYER ACTIVATION FUNCTION 'LINEAR' IS UTILIZED, AS IS THE MODEL OPTIMIZER 'ADAM 'COMBINED WITH THE 'MEAN SQUARED ERROR' LOSS FUNCTION AND A LEARNING RATE OF 0.01%, IS USED.

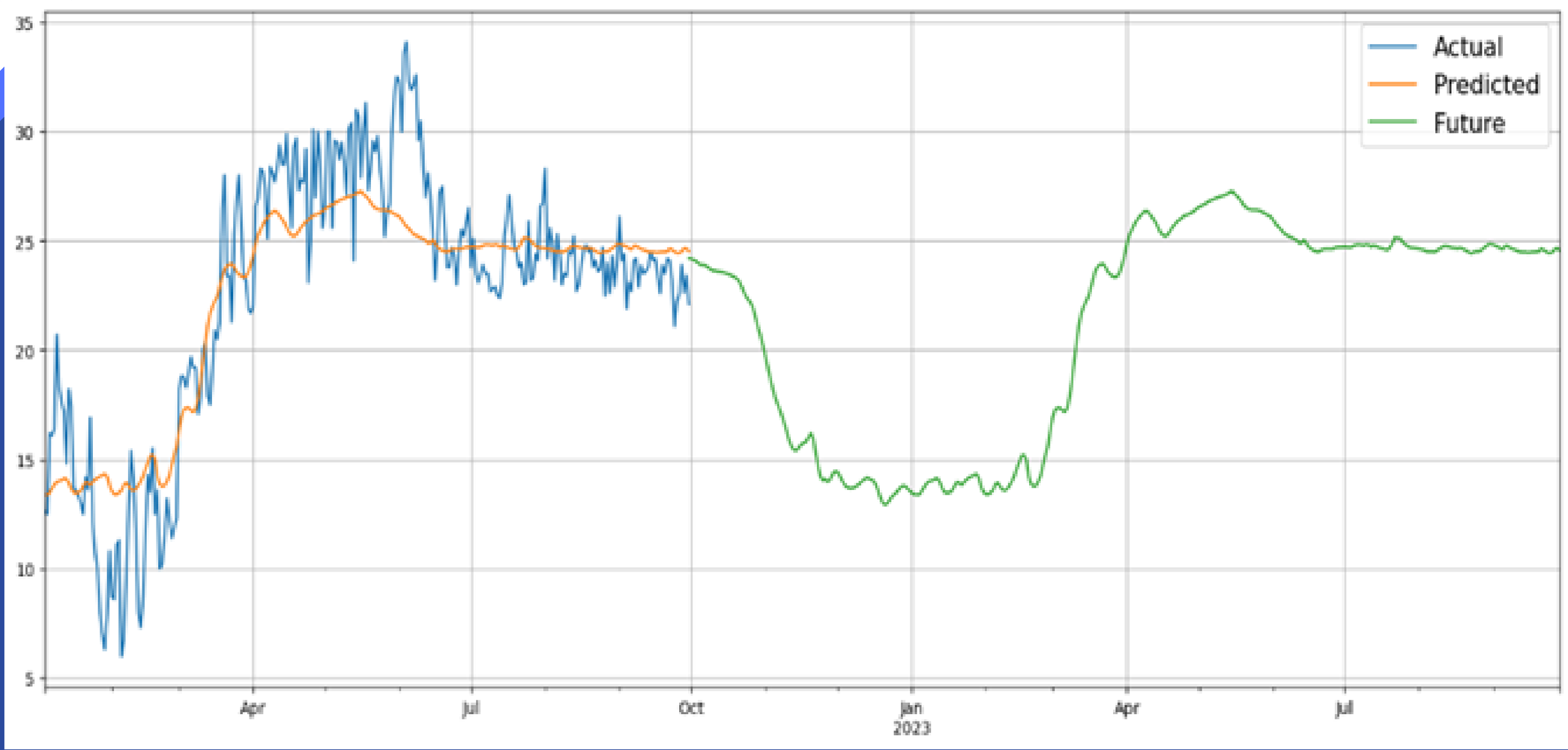
RESULTS

- **LONG SHORT TERM MEMORY (LSTM)**

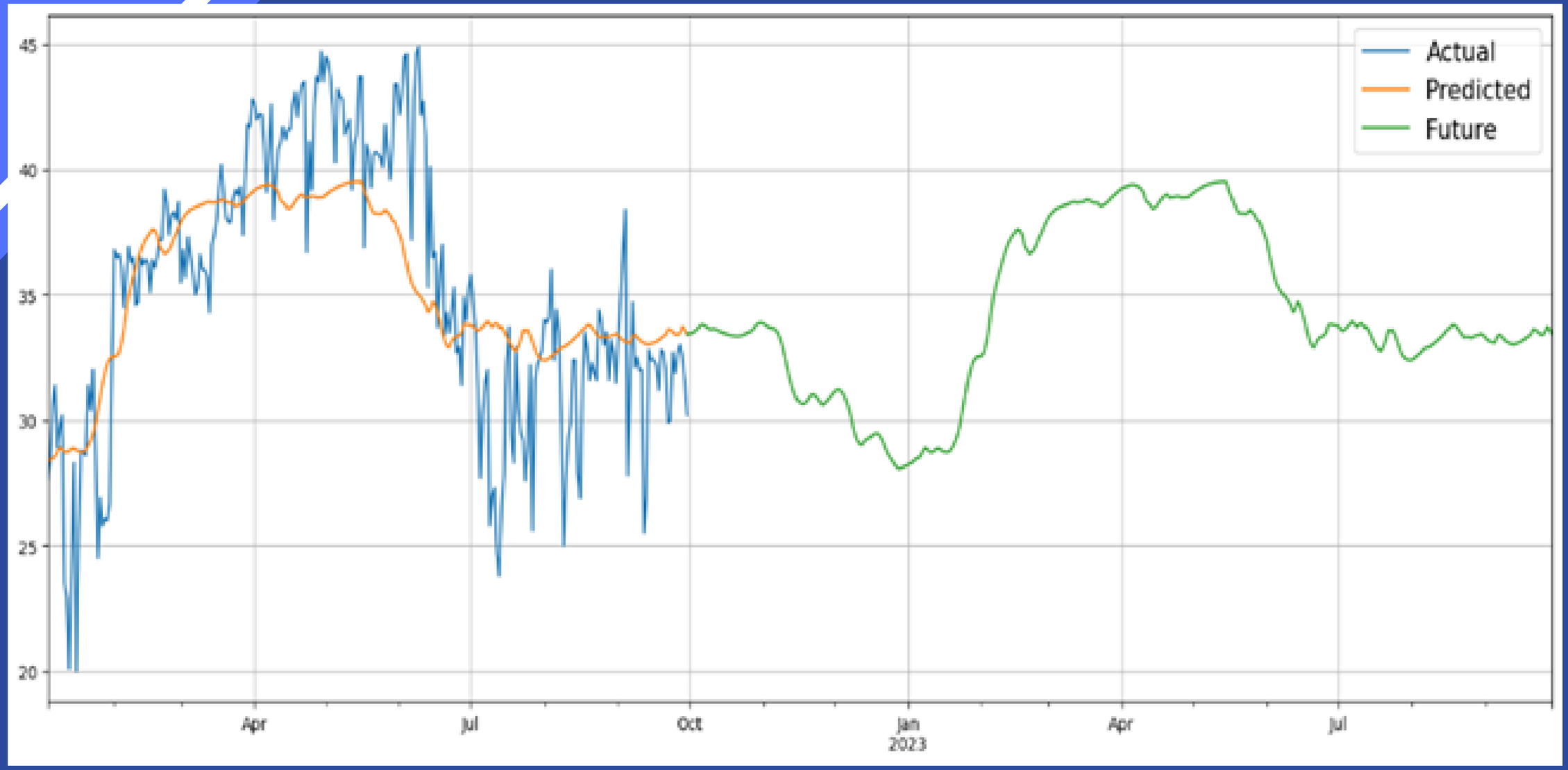
THE INPUT SEQUENCE AND OUTPUT SEQUENCE DATA ARE UTILIZED FOR MODEL FITTING ALONG WITH CALLBACKS FOR EARLYSTOPPING, REDUCELRONPLATEAU, AND MODELCHECKPOINT. VALIDATION SPLIT IS SET TO 0.2, VERBOSE TO 1, EPOCHS TO 30, AND BATCH SIZE TO 256.

THE MODEL IS THEN USED TO ANTICIPATE ONE YEAR AHEAD OF TIME.

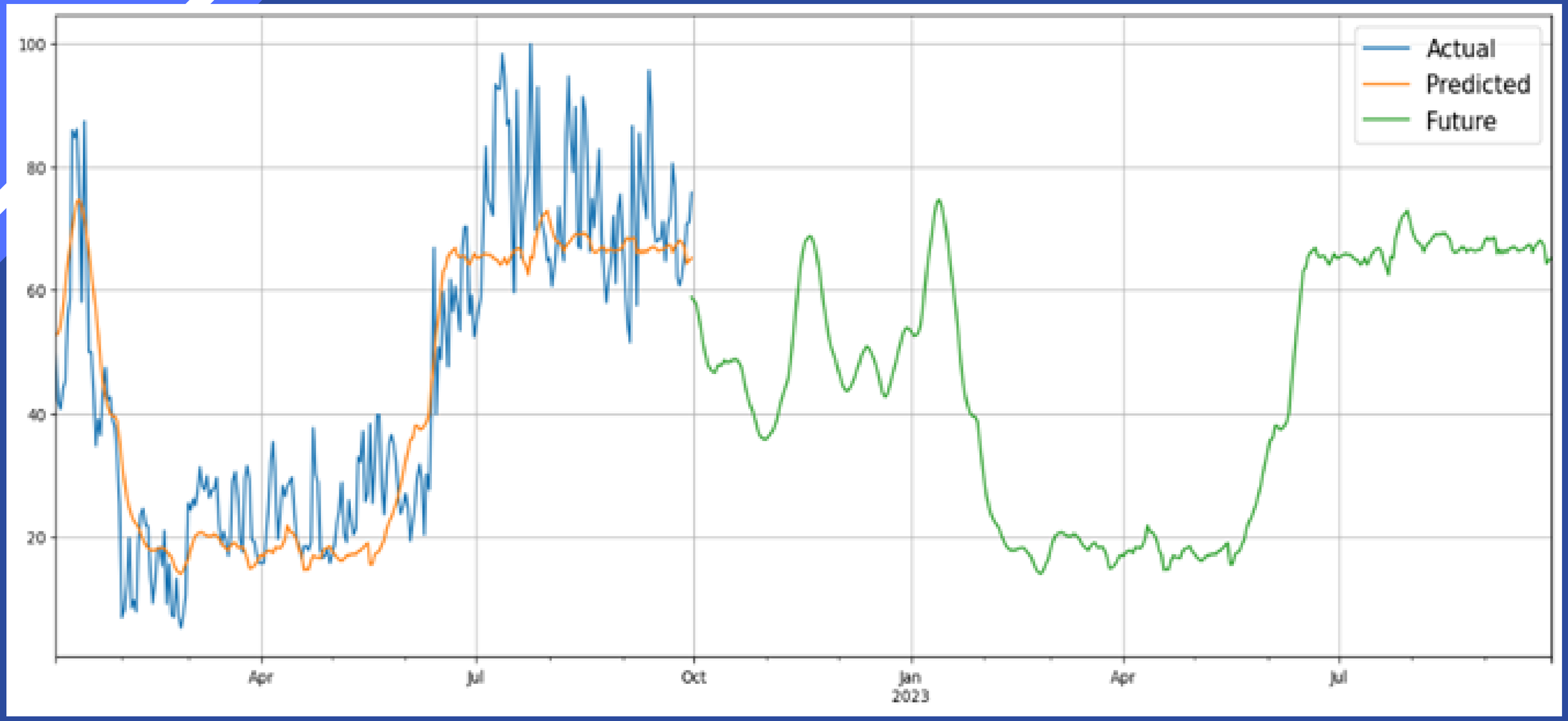
THE ACTUAL DATA, PREDICTED DATA AND FUTURE FORECAST FOR ALL WEATHER VARIABLES IS PRESENTED :



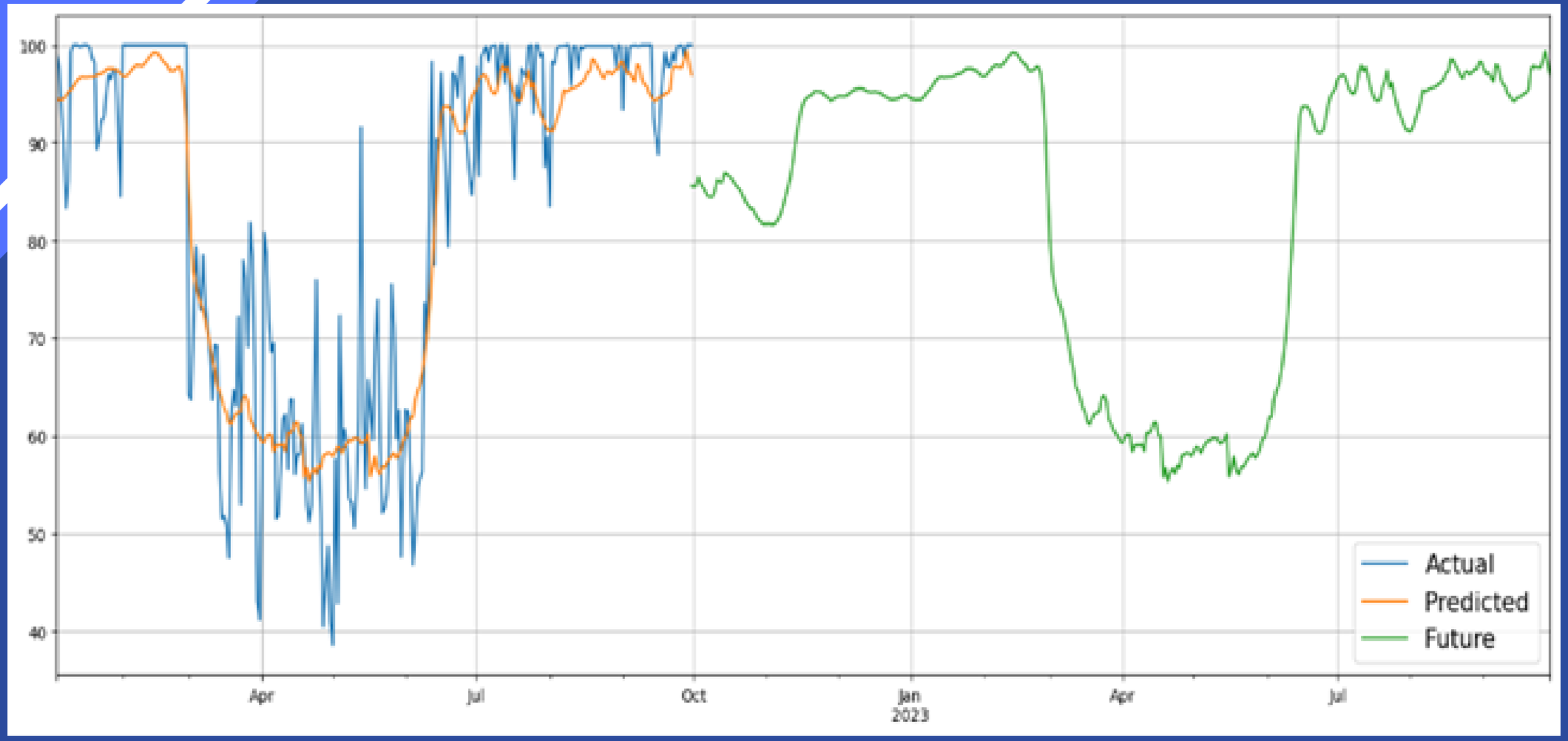
ACTUAL VS PREDICTED VS FUTURE FORECAST OF MINIMUM TEMPERATURE OF ADILABAD



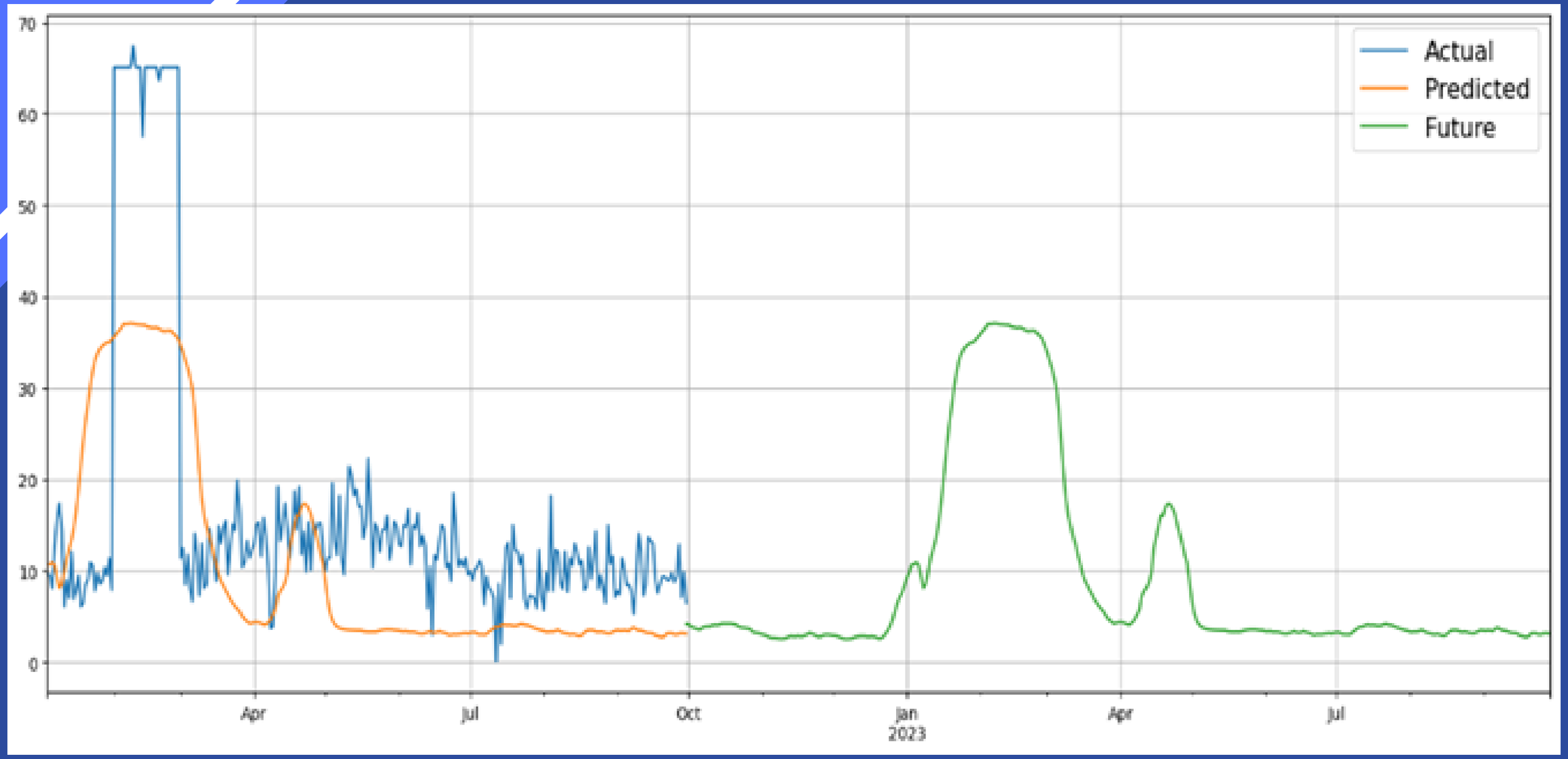
ACTUAL VS PREDICTED VS FUTURE FORECAST OF MAXIMUM TEMPERATURE OF ADILABAD



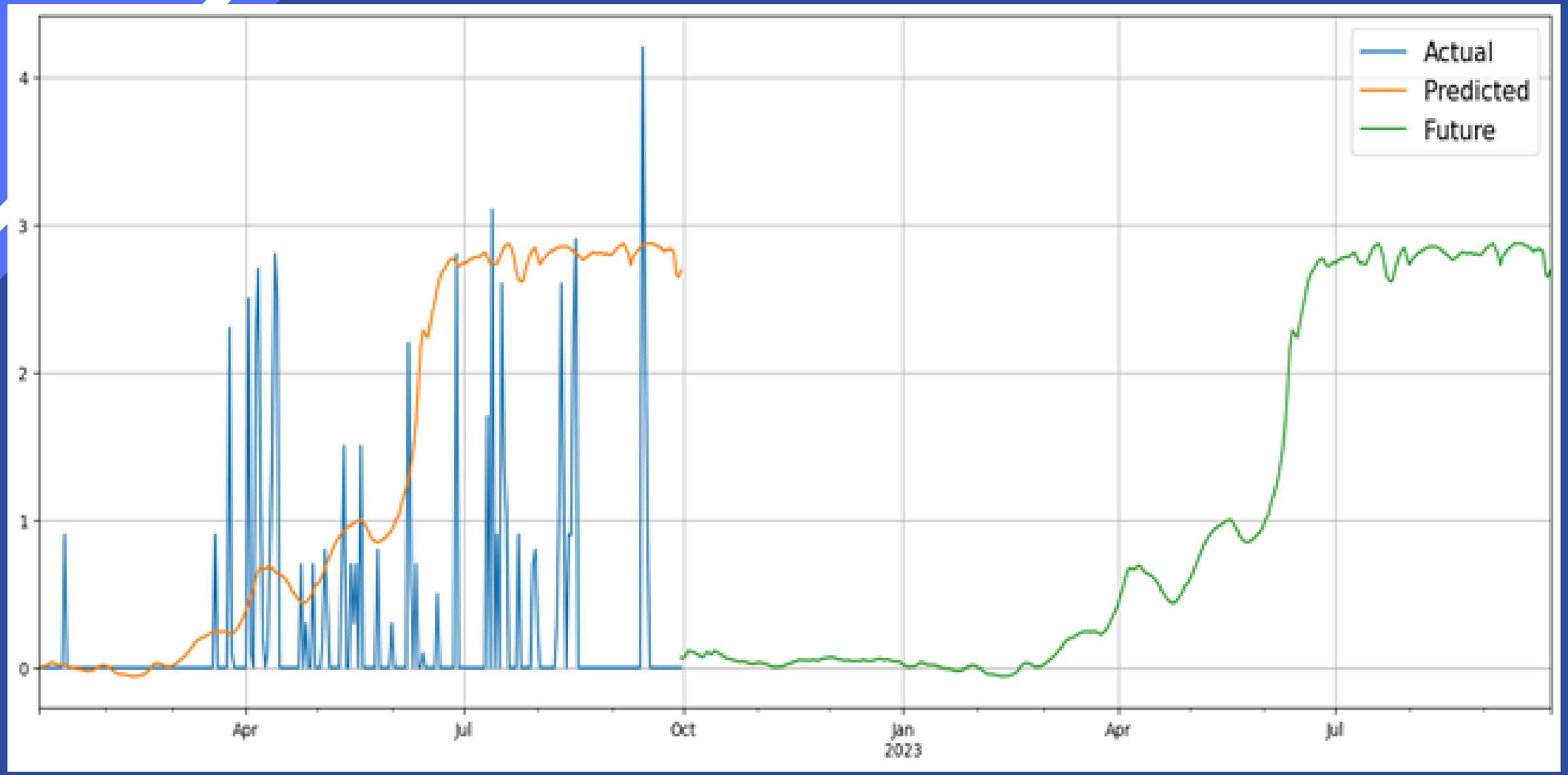
ACTUAL VS PREDICTED VS FUTURE FORECAST OF MINIMUM HUMIDITY OF ADILABAD



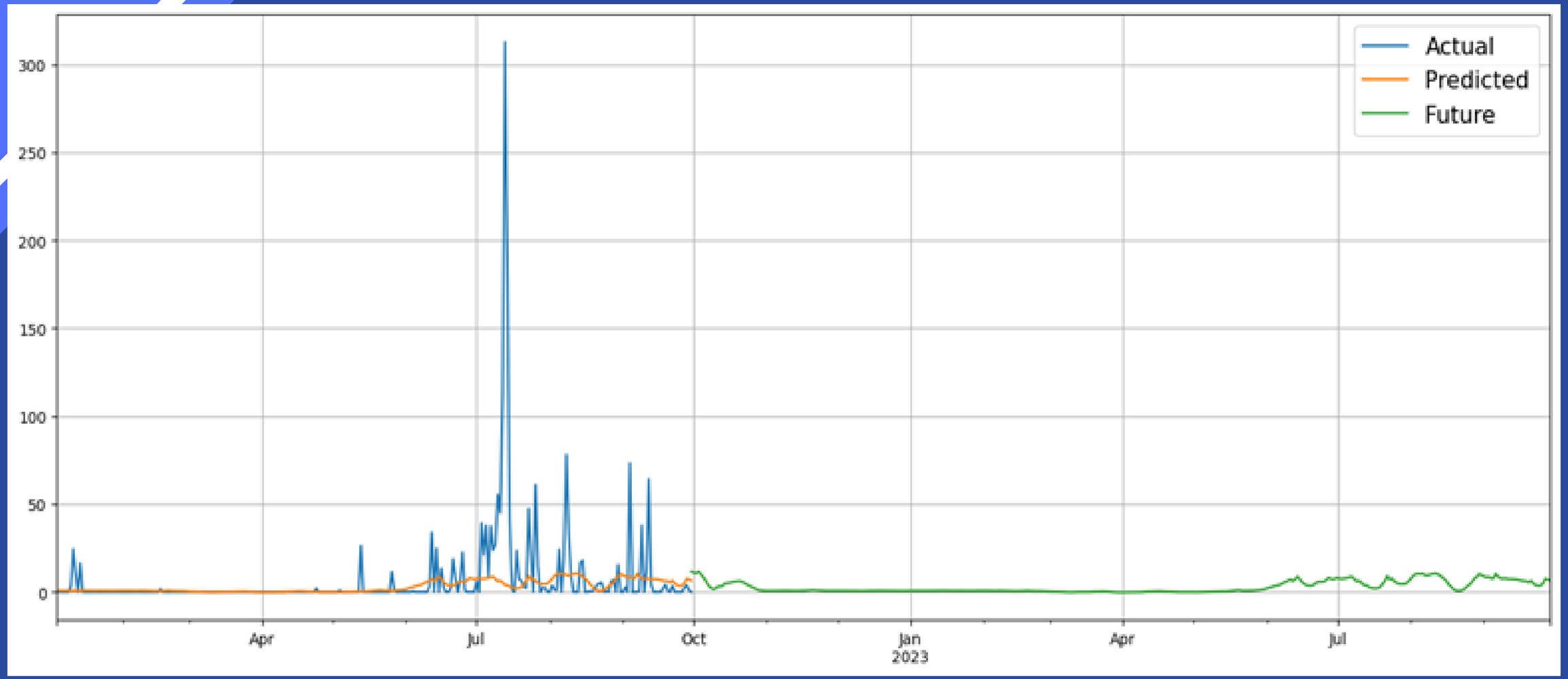
ACTUAL VS PREDICTED VS FUTURE FORECAST OF MAXIMUM HUMIDITY OF ADILABAD



ACTUAL VS PREDICTED VS FUTURE FORECAST OF MINIMUM WIND SPEED OF ADILABAD



ACTUAL VS PREDICTED VS FUTURE FORECAST OF MAXIMUM WIND SPEED OF ADILABAD



ACTUAL VS PREDICTED VS FUTURE FORECAST OF RAIN OF ADILABAD

Weather Factors	Root Mean Squared Error	Mean Absolute Error
Minimum Temperature	2.75	2.10
Maximum Temperature	3.43	2.63
Minimum Humidity	11.23	8.79
Maximum Humidity	7.16	5.16
Minimum Wind Speed	13.22	10.45
Maximum Wind Speed	1.70	1.24
Rain	25.19	7.38

PERFORMANCE OF THE USED MODEL (LSTM)

THE RMSE AND MAE FOR LSTM (DAY-WISE) ARE LESS THAN SARIMA (MONTH WISE) FOR ALMOST ALL WEATHER-RELATED PARAMETERS. BECAUSE OF ITS CAPACITY TO LEARN LONG-TERM DEPENDENCIES IN TIME-SERIES DATA, LSTM IS A GOOD MODEL FOR WEATHER FORECASTING, WHEREAS SARIMA IS A TRADITIONAL TIME-SERIES MODEL THAT HAS BEEN USED FOR DECADES.

THE SUPERIOR ACCURACY OF LSTM IN PREDICTING WEATHER HAS BEEN PROVED IN A VARIETY OF WEATHER-RELATED FACTORS INCLUDING TEMPERATURE, HUMIDITY, WIND SPEED, AND RAINFALL.

DATABASE

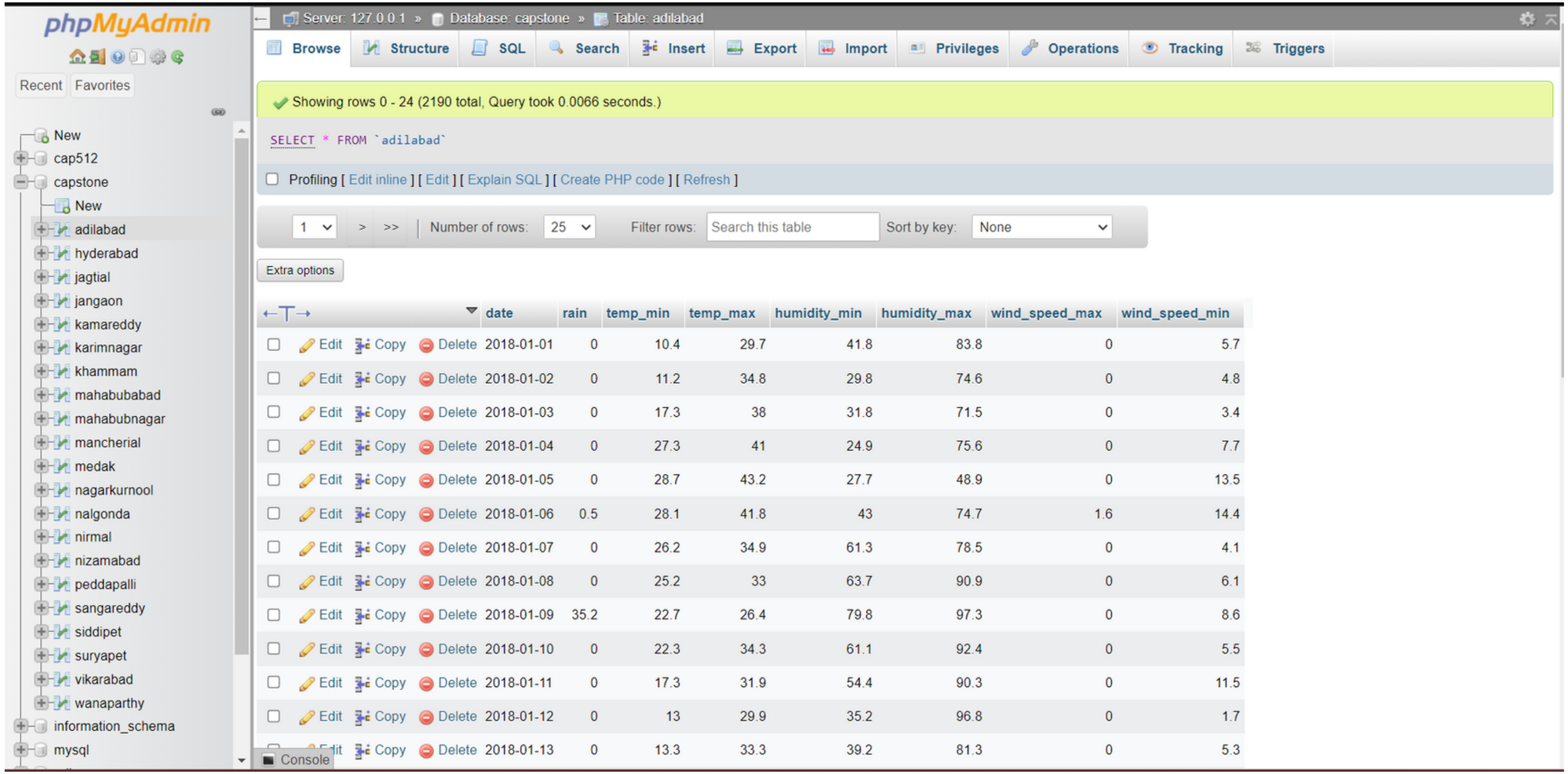
TO STORE THE MODEL'S OUTPUT, WE USED MARIADB, AN OPEN SOURCE RELATIONAL DATABASE OFFERED BY XAMP.

CREATED DATABASE NAMED CAPSTONE TO STORE OUR PREDICTED VALUES UP TO 2023. EACH TABLE NAMED AS DISTRICTS NAME OF TELANGANA AND STORED DATA OF 2190 COLUMN AND 8 ROWS. ROWS NAMES ARE RAIN, MIN_TEMP, MAX_TEMP, MIN_HUMIDITY, MAX_HUMIDITY, MIN_WIND_SPEED, MAX_WIND-SPEED AND DATE I.E. PRIMARY KEY WHICH CONTAIN DATE FROM 01-JAN-2018 TO 31-DEC2023.

WE FIRST BUILT A TABLE USING THE COLUMN NAMES FROM THE DATASETS, AND THEN WE USED THE IMPORT OPTION IN THE TOP BAR OF THE DATABASE PAGE TO IMPORT THE RESULTS DATASET INTO THE DATABASE.

DATABASE

OVERVIEW OF DATABASE :



	date	rain	temp_min	temp_max	humidity_min	humidity_max	wind_speed_max	wind_speed_min
Edit Copy Delete	2018-01-01	0	10.4	29.7	41.8	83.8	0	5.7
Edit Copy Delete	2018-01-02	0	11.2	34.8	29.8	74.6	0	4.8
Edit Copy Delete	2018-01-03	0	17.3	38	31.8	71.5	0	3.4
Edit Copy Delete	2018-01-04	0	27.3	41	24.9	75.6	0	7.7
Edit Copy Delete	2018-01-05	0	28.7	43.2	27.7	48.9	0	13.5
Edit Copy Delete	2018-01-06	0.5	28.1	41.8	43	74.7	1.6	14.4
Edit Copy Delete	2018-01-07	0	26.2	34.9	61.3	78.5	0	4.1
Edit Copy Delete	2018-01-08	0	25.2	33	63.7	90.9	0	6.1
Edit Copy Delete	2018-01-09	35.2	22.7	26.4	79.8	97.3	0	8.6
Edit Copy Delete	2018-01-10	0	22.3	34.3	61.1	92.4	0	5.5
Edit Copy Delete	2018-01-11	0	17.3	31.9	54.4	90.3	0	11.5
Edit Copy Delete	2018-01-12	0	13	29.9	35.2	96.8	0	1.7
Edit Copy Delete	2018-01-13	0	13.3	33.3	39.2	81.3	0	5.3

WEBSITE

WE INTRODUCE YOU TO WEATHERCAST, A WEBSITE THAT PROVIDES YOU WITH ACCURATE AND UP-TO-DATE WEATHER INFORMATION FOR TELANGANA. WE'LL SHOW YOU HOW EASY IT IS TO USE THE WEBSITE AND EXPLAIN THE VARIOUS FEATURES AVAILABLE

TO MAKE OUR MODEL INTERACTIVE, WE CONSTRUCTED WEATHERCAST WEB SITES. THERE ARE THREE PAGES IN TOTAL:

- THE HOME PAGE
- THE PREDICTOR PAGE
- THE RESULT PAGE

HOME PAGE:

IT HAS THE FOLLOWING SECTIONS : HOME, ABOUT, LIMITATION AND HOW TO USE. THE HOME AREA HAS A PREDICTOR BUTTON FOR THE PREDICTOR PAGE.

PREDICTOR PAGE :

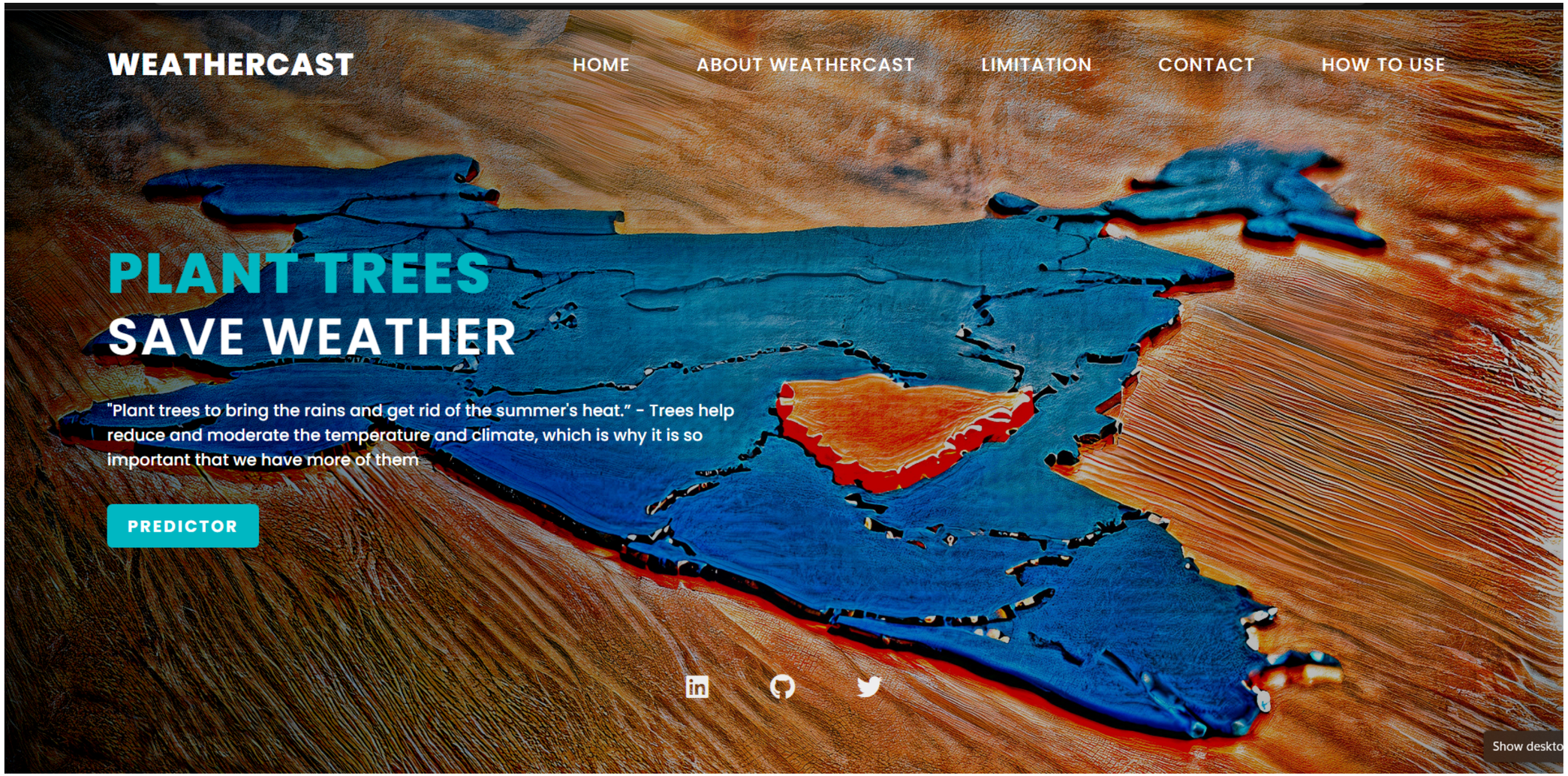
IT HAS TWO INPUT FIELDS FOR DISTRICT AND DATE TO FORECAST WEATHER CONDITIONS. THERE IS ALSO A SUBMIT BUTTON FOR FINDING PREDICTIONS AND A HOME BUTTON FOR RETURNING TO THE HOME PAGE.

RESULT PAGE :

IT LOOKS LIKE A TRANSLUCENT POPUP WITH ALL OF THE PROJECTED OUTCOMES INFORMATION SUCH AS DISTRICT NAME, DATE, TEMPERATURE, RAINFALL, HUMIDITY, AND WINDSPEED.

WEBSITE

HOME PAGE :

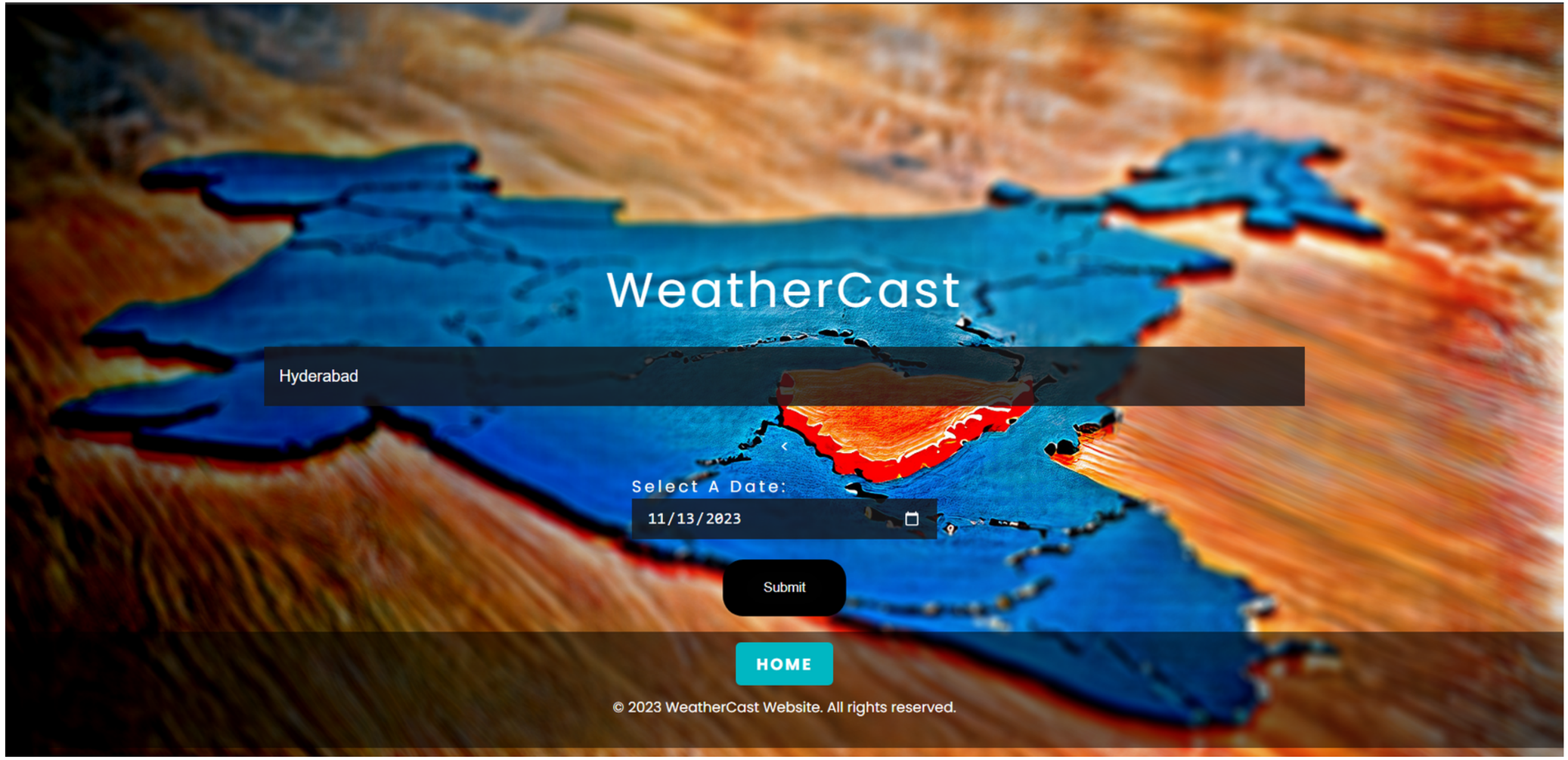


HOW TO USE

- CLICK ON PREDICTOR BUTTON AT 1ST VIEW OF HOME PAGE .
- ENTER LOCATION OF TELANGANA DISTRICTS.
- SELECT THE DATE (TILL DEC-2023) OF WEATHER INFORMATION YOU WANT TO SEE.
- VIEW THE WEATHER FORECAST FOR YOUR LOCATION OF PARTICULAR DATE.

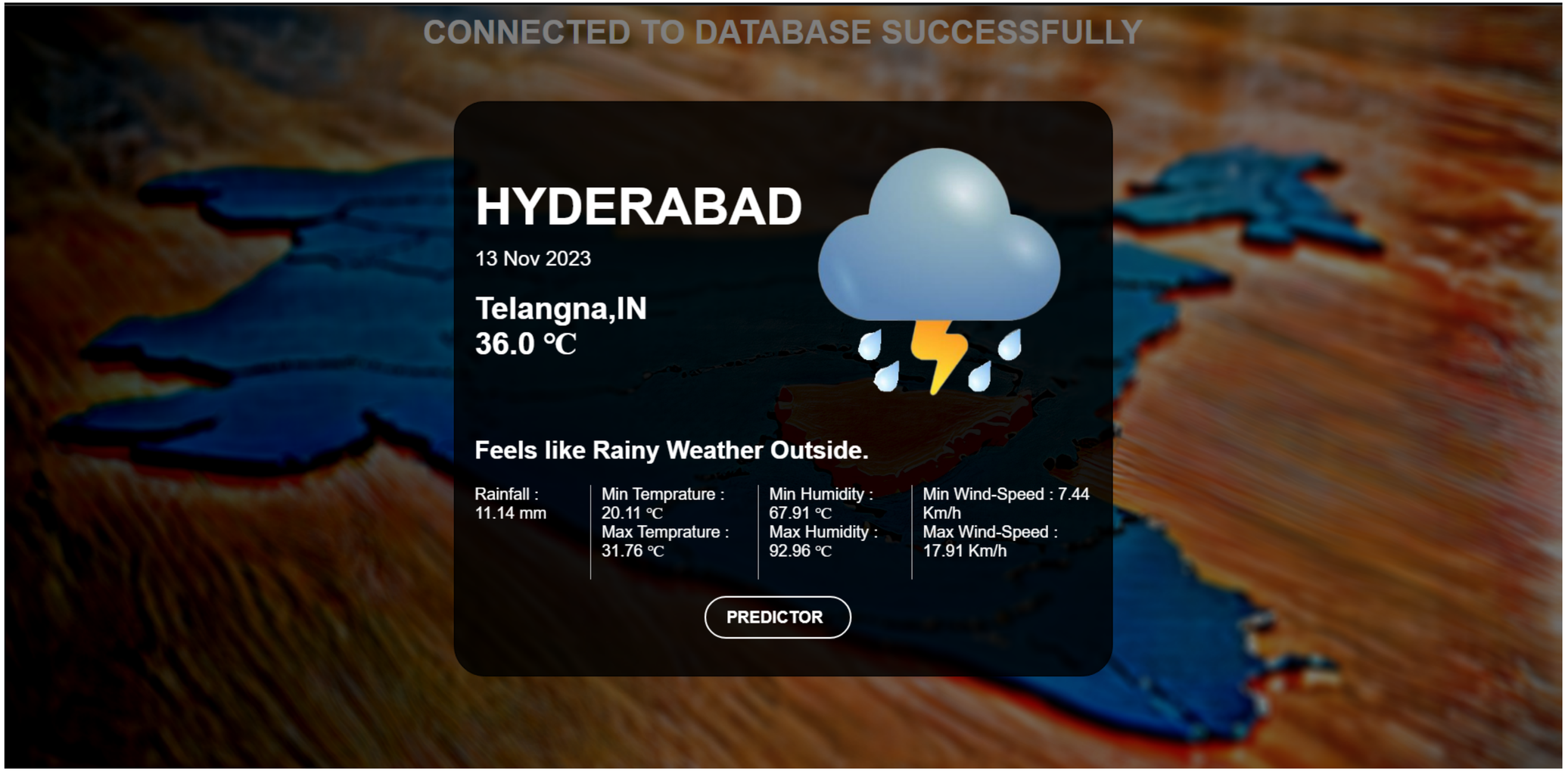
WEBSITE

PREDICTOR PAGE :



WEBSITE

RESULT PAGE :



LIMITATIONS

IN FACT, THERE ARE CERTAIN DRAWBACKS TO USING WEATHER FORECASTING APPLICATIONS, ONE OF WHICH IS THAT THE RESULTS ARE ONLY ACCURATE UP UNTIL 2023. THIS IS DUE TO THE PROBLEM OF DIFFICULTY IN WEATHER FORECASTING, WHICH ALSO DEPENDS ON SATELLITE DATA, HISTORICAL INFORMATION, AND WEATHER MODELS.

FURTHERMORE, IT'S POSSIBLE THAT SOME DATA WON'T BE ACCESSIBLE OR TRUSTWORTHY ENOUGH TO SUPPORT FORECASTS. THE ACCURACY OF THE FORECASTS MAY BE IMPACTED, FOR INSTANCE, IF A WEATHER STATION IS NOT WORKING OR IF THERE ARE GAPS IN THE HISTORICAL DATA.

HOWEVER, METEOROLOGISTS AND OTHER WEATHER SPECIALISTS ARE CONTINUALLY ATTEMPTING TO ENHANCE THE MODELS AND TECHNIQUES USED IN WEATHER FORECASTING, WHICH COULD RESULT IN FUTURE FORECASTS THAT ARE MORE ACCURATE.

THE WEATHERCAST IS LIMITED TO SOME DISTRICTS BECAUSE OF UNAVAILABLE PAST DATA OF *BHADRADRI-KOTHAGUDEM, JAYASHANKAR-BHUPALPALLY, JOGULAMBA-GADWAL, KOMARAM BHEEM-ASIFABAD, KUMURAM BHEEM - ASIFABAD, MEDCHAL-MALKAJGIRI, MULUG, NARAYANPET, RAJANNA-SIRICILLA, RANGAREDDY, WARANGAL (R),WARANGAL (U), YADADRI-BHONGIR.

CONCLUSION

BY ENHANCING ACCURACY, EFFICIENCY, AND THE CAPACITY TO RECOGNIZE AND UNDERSTAND COMPLEX PATTERNS IN METEOROLOGICAL DATA, MACHINE AND DEEP LEARNING HAVE THE ABILITY TO SIGNIFICANTLY IMPROVE WEATHER PREDICTION. THE ADOPTION OF THESE TECHNOLOGIES COULD IMPROVE SOCIETY'S PREPAREDNESS FOR AND RESPONSE TO EXTREME WEATHER DISASTERS. THE AIM OF OUR RESEARCH IS TO MAKE PREDICTIONS ABOUT THE WEATHER PATTERNS OF TELANGANA STATE. TO ACHIEVE THIS, WE HAVE EMPLOYED TWO DIFFERENT TECHNIQUES: SARIMA FOR PREDICTING MONTHLY WEATHER FACTORS AND LSTM FOR PREDICTING DAILY WEATHER FACTORS. THE FUTURE FOCUS OF THIS RESEARCH WOULD BE TO ENHANCE THE MODELS' ACCURACY BY MODIFYING THEIR PARAMETERS OR ADDING ADDITIONAL DATA SOURCES, AS WELL AS INTEGRATING REAL-TIME DATA SOURCES TO PROVIDE MORE PRECISE FORECASTS DEPENDING ON THE PRESENT WEATHER.

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TOPIC APPROVAL PERFORMA

School of Computer Application (SCA)

Program : P124-H::BCA (Hons.)

COURSE CODE : CAP463 **REGULAR/BACKLOG :** Regular **GROUP NUMBER :** CARGC0047

Supervisor Name : Ranjit Kaur **UID :** 28632 **Designation :** Assistant Professor

Qualification : _____ **Research Experience :** _____

SR.NO.	NAME OF STUDENT	Prov. Regd. No.	BATCH	SECTION	CONTACT NUMBER
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2	Sourav Sutradhar	12020293	2020	D2003	7002692443
3	Ashish Jamuda	12020257	2020	D2003	9337270319
4	Sumanta Saha	12010436	2020	D2014	9732040607

SPECIALIZATION AREA : Databases **Supervisor Signature:** _____

PROPOSED TOPIC : MACHINE AND DEEP LEARNING FOR ACCURATE STATE-WIDE WEATHER FORECASTING: A CASE STUDY OF TELANGANA

Qualitative Assessment of Proposed Topic by PAC		
Sr.No.	**Parameter**	**Rating (out of 10)**
1	Project Novelty: Potential of the project to create new knowledge	6.63
2	Project Feasibility: Project can be timely carried out in-house with low-cost and available resources in the University by the students.	6.09
3	Project Academic Inputs: Project topic is relevant and makes extensive use of academic inputs in UG program and serves as a culminating effort for core study area of the degree program.	6.00
4	Project Supervision: Project supervisor's is technically competent to guide students, resolve any issues, and impart necessary skills.	6.09
5	Social Applicability: Project work intends to solve a practical problem.	6.46
6	Future Scope: Project has potential to become basis of future research work, publication or patent.	6.54

PAC Committee Members		
PAC Member (HOD/Chairperson) Name: Sartaj Singh	UID: 11303	Recommended (Y/N): Yes
PAC Member (Allied) Name: Dr. Pawan Kumar	UID: 11522	Recommended (Y/N): Yes
PAC Member 3 Name: Dr. Geeta Sharma	UID: 26875	Recommended (Y/N): Yes

Final Topic Approved by PAC: **MACHINE AND DEEP LEARNING FOR ACCURATE STATE-WIDE WEATHER FORECASTING: A CASE STUDY OF TELANGANA**

Overall Remarks: Approved

PAC CHAIRPERSON Name: 27549::Dr. Ashok Kumar **Approval Date:** 15 May 2023

THANK YOU