ISSS608 Visual Analytics And Applications

Shiny App User Guide

The Heat Is On!

Group 11

CHOCK Wan Kee

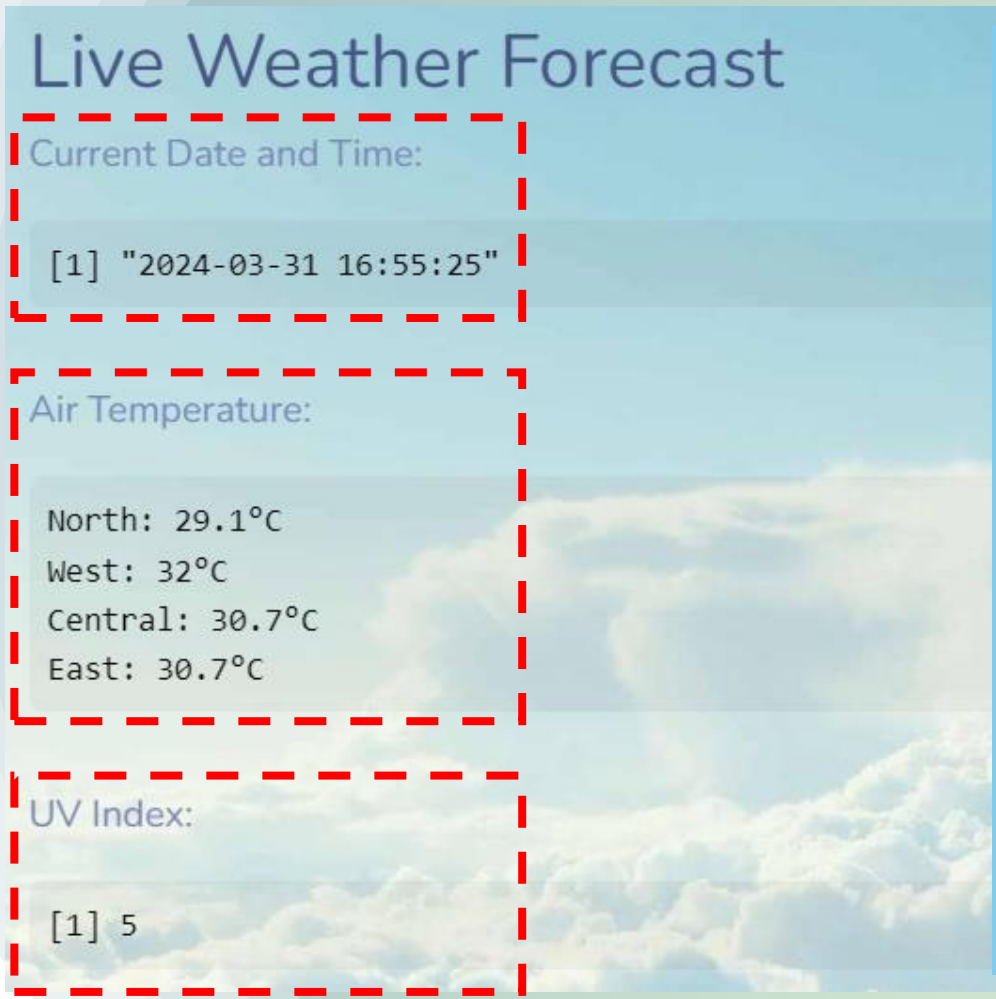
Mary Vanessa HENG Hui Khim

Noel NG Ser Ying

SMU
SINGAPORE MANAGEMENT UNIVERSITY

Toolkit 1: Live Weather Forecast

This page allows users to access real time weather readings through several publicly accessible API tools .



1. This functions calls upon system date and time.

2. This functions calls upon the weather reading API from data.gov.sg and returns a list containing the air temperature. Data is updated every half minute the API from NEA.

3. This functions calls upon the weather reading API from NEA. Data is averaged over the past hour and updated every hour between 7 AM and 7 PM everyday.

Legend	
0 - 2	Low
3 - 5	Moderate
6 - 7	High
8 - 10	Very High
Above 11	Extreme

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Current PSI Data:

	psi_measures	west	east	central	south	north
1	o3_sub_index	6	26	22	25	40
2	pm10_twenty_four_hourly	19	21	22	16	26
3	pm10_sub_index	19	21	22	16	26
4	co_sub_index	5	5	6	5	8
5	pm25_twenty_four_hourly	10	11	11	8	9
6	so2_sub_index	4	1	2	3	3
7	co_eight_hour_max	0	0	1	0	1
8	no2_one_hour_max	46	32	24	17	25
9	so2_twenty_four_hourly	6	2	3	4	5
10	pm25_sub_index	42	47	48	32	38
11	psi_twenty_four_hourly	42	47	48	32	40
12	o3_eight_hour_max	13	61	52	60	94

This functions calls upon the PSI API from data.gov.sg and returns a data frame of the different measures of the PSI across 5 different areas in Singapores and the overall measure for the given data-time. This data provided by the API is updated hourly.

The PSI is based on six pollutants particulate matter (PM10), fine particulate matter (PM2.5), sulphur dioxide (SO2), carbon monoxide (CO), ozone (O3) and nitrogen dioxide (NO2). For each pollutant, a sub-index is calculated from a segmented linear function that transforms ambient concentrations onto a scale extending from 0 through 500.

Index Category	PSI	24-hr $PM_{2.5}$ ($\mu g/m^3$)	24-hr PM_{10} ($\mu g/m^3$)	24-hr SO_2 ($\mu g/m^3$)	8-hr CO (mg/m^3)	8-hr O_3 ($\mu g/m^3$)	1-hr NO_2 ($\mu g/m^3$)^
Good	0 – 50	0 – 12	0 – 50	0 – 80	0 – 5.0	0 – 118	-
Moderate	51 – 100	13 – 55	51 – 150	81 – 365	5.1 – 10.0	119 – 157	-
Unhealthy	101 – 200	56 – 150	151 – 350	366 – 800	10.1 – 17.0	158 – 235	1130
Very Unhealthy	201 – 300	151 – 250	351 – 420	801 – 1600	17.1 – 34.0	236 – 785*	1131 – 2260
Hazardous	301 – 400	251 – 350	421 – 500	1601 – 2100	34.1 – 46.0	786 – 980*	2261 – 3000
	401 – 500	351– 500	501 – 600	2101 – 2620	46.1 – 57.5	981 – 1180*	3001– 3750

(Note: *When 8-hour ozone concentration exceeds 785$\mu g/m^3$, the PSI sub-index is calculated using the 1-hour concentration; ^Sub-index for nitrogen dioxide is reported only when the 1-hour concentration equals or exceeds 1130 $\mu g/m^3$.)

Toolkit 1: Live Weather Forecast

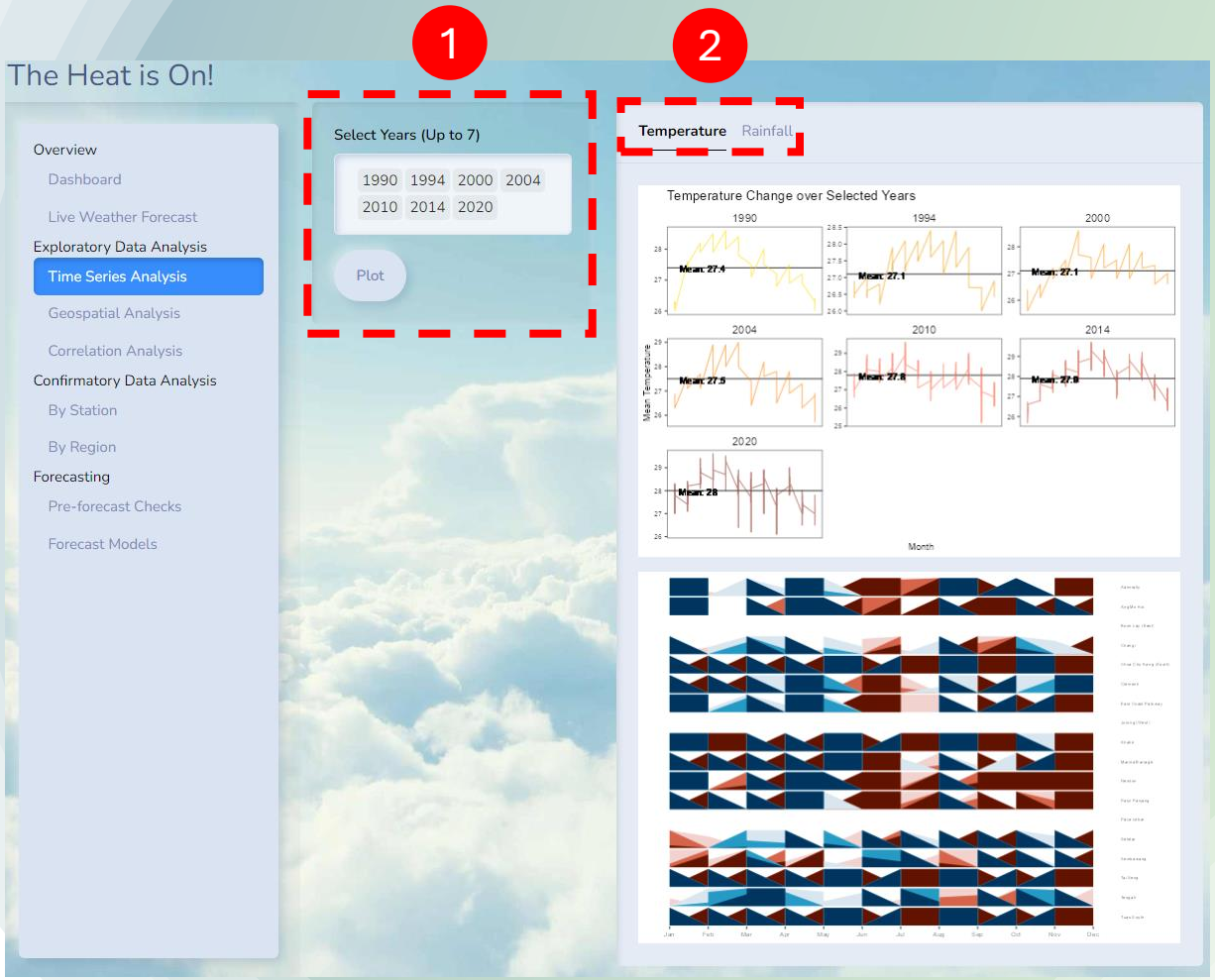
This page allows users to access real time weather readings through several publicly accessible API tools .

This functions calls upon the weather forecast API from data.gov.sg and returns a data frame containing different metrics of the forecast. It then returns a dataframe containing the forecast which is dependent on the date-time and parameter of forecast. This data provided by the API is updated half-hourly.

A 2-hour forecast returns the general forecast for each area in Singapore for the next 2-hours

Toolkit 2: Time Series Analysis

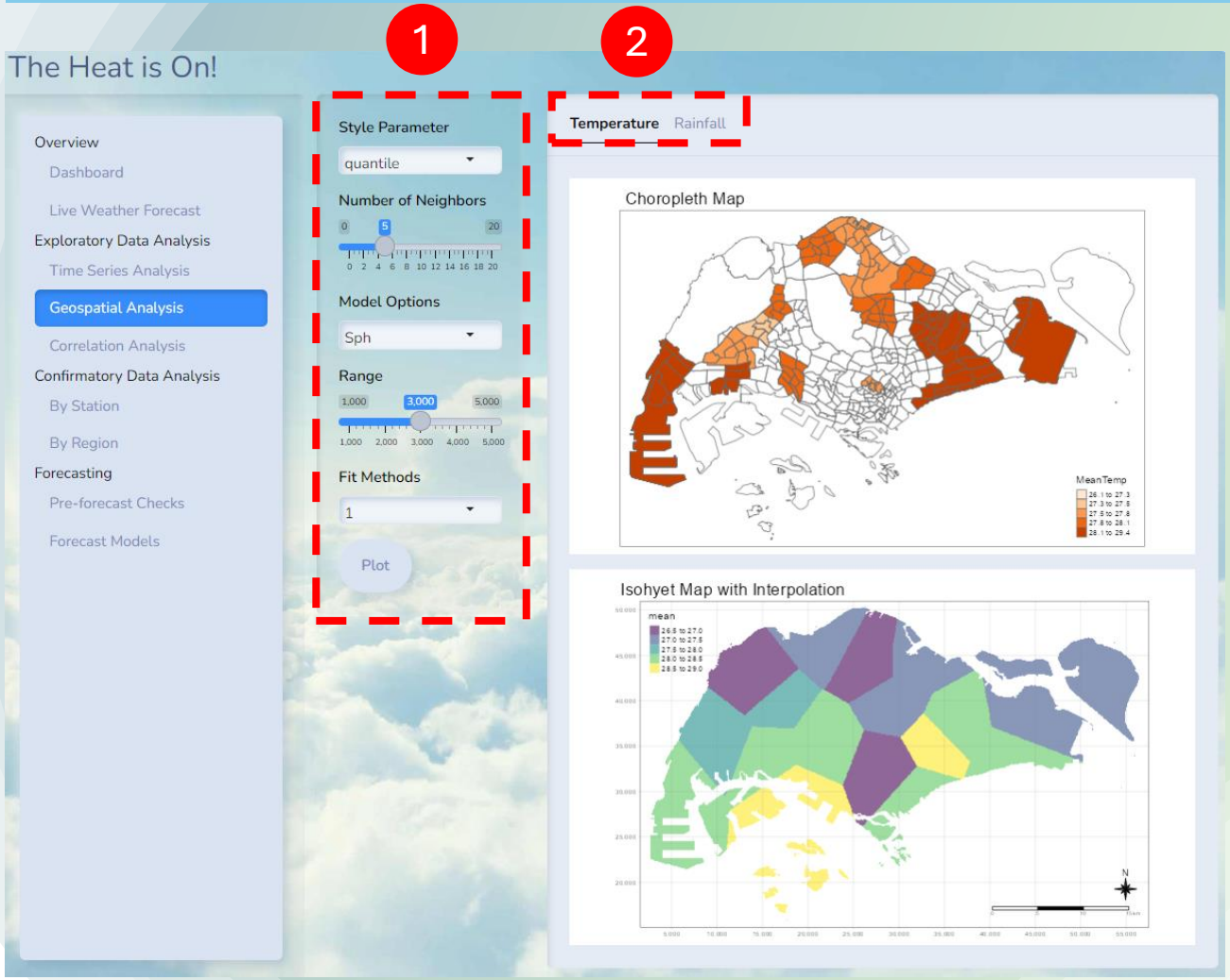
This page utilizes time-dependent line and ridgeline plots to discern the variations, trends and anomalies in the weather across the years by specific periods or regions.



1. Select **Years** from 1990 to 2022, the interval is set to 2 to reduce the options and a maximum of 7 years can be selected.
2. Select analysis for temperature or rainfall data.

Toolkit 3: Geospatial Analysis

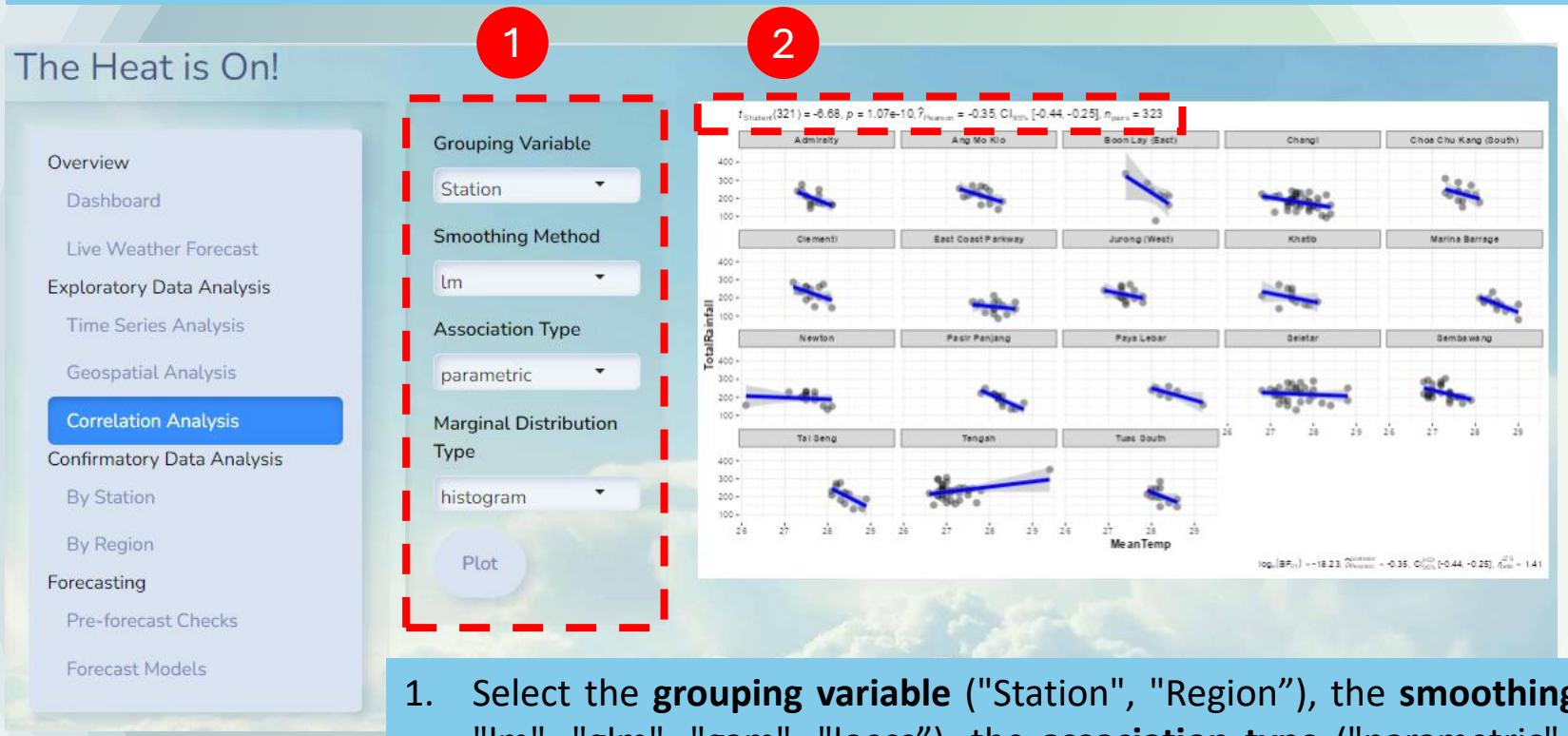
This page provides choropleth and isohyet maps with inverse distance weighted interpolation to show geographical climate patterns, such as urban heat issues.



1. Select the **style parameter** ("jenks", "pretty", "bclust", "equal", "fisher", "kmeans", "quantile"), the **number of neighbours** (0 to 20), the **model option** ("Sph", "Exp", "Gau", "Lin"), the **range** (1000 to 5000) and the fit methods (1, 2, 3, 4).
2. Select analysis for temperature or rainfall data.

Toolkit 4: Correlation Analysis

This page performs correlation analysis of temperature and rainfall by station and region and Spearman's rho (ρ) value and its associated p-value indicate the strength and significance.



1. Select the **grouping variable** ("Station", "Region"), the **smoothing method** ("auto", "lm", "glm", "gam", "loess"), the **association type** ("parametric", "nonparametric", "robust") and the **marginal type** ("histogram", "boxplot", "density", "violin", "densigram")
2. Select analysis for temperature or rainfall data.

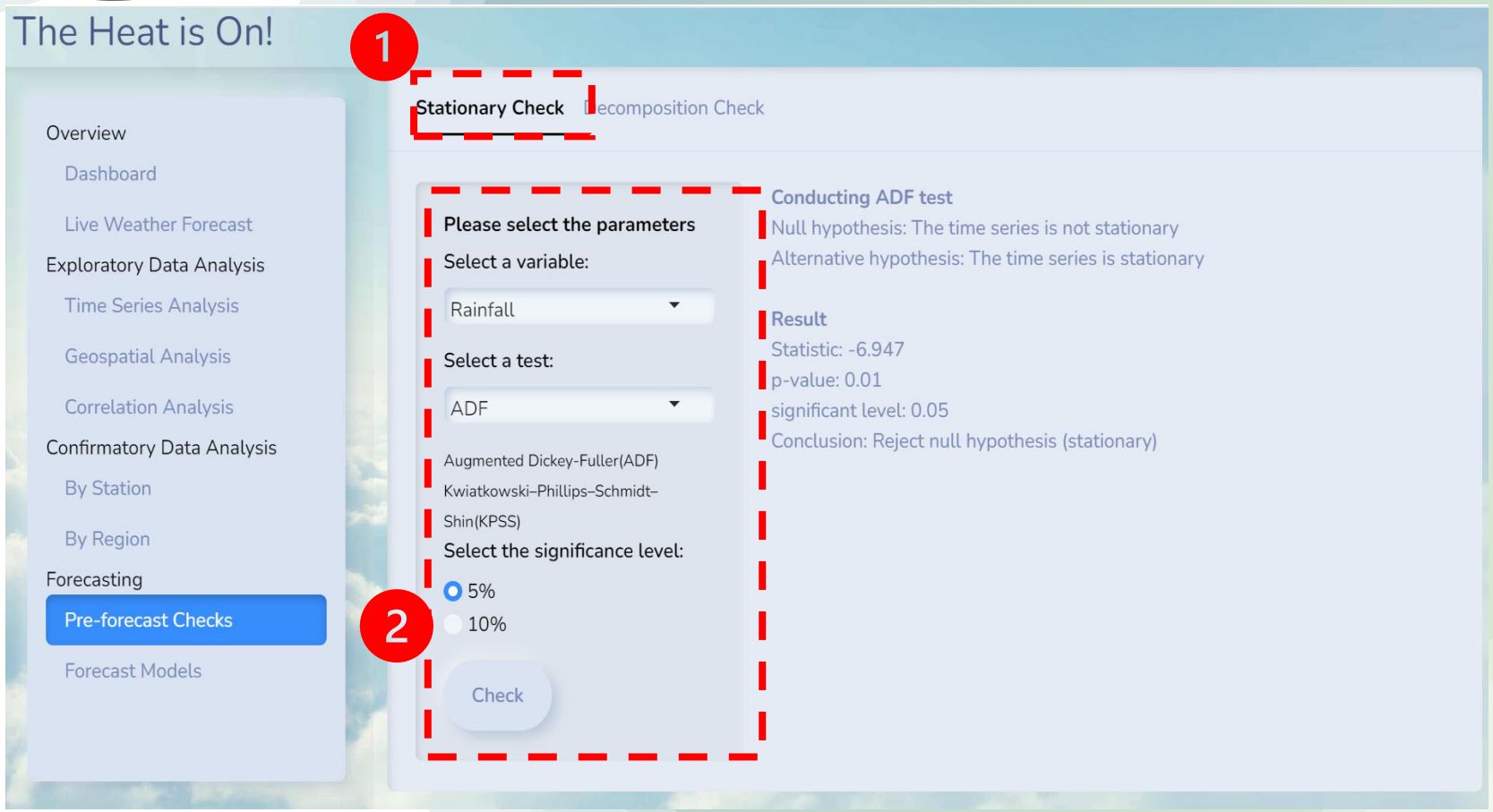
Toolkit 5: Confirmatory Analysis

This page allows users to perform confirmatory data analysis on the observed trends in temperature and rainfall at two levels of details – stations or regions.

1. Select analysis either by Station or by Region
2. Select analysis for temperature or rainfall data
3. Select the Stations (if “By Station is chosen at step 1) or Regions (if “By Region” is chosen at step 1) to be included in the analysis
   Select measurement for analysis (Monthly or Annual)
   Select metric for measurement
   (if Temperature is chosen at Step 2: Average of Mean Temp, Average of Max Temp, Average of Min Temp, Maximum Temperature, Minimum Temperature;
   if Rainfall is chosen at Step 2: Total Rainfall, Total Rainfall (30 min), Total Rainfall (60 min), Total Rainfall (120 min), Average of Total Rainfall, Average of Total Rainfall (30 min), Average of Total Rainfall (60 min), Average of Total Rainfall (120 min), Minimum of Total Rainfall, Maximum of Total Rainfall)
   Next, make customizations to the plot by choosing:
   Plot type (Box Violin, Box, Violin)
   Test type (Non-Parametric, Parametric, Robust, Bayes)
   Pair display (Significant, Non-Significant, Everything, All)
   Confidence level (90%, 95%, 99%).
   Click on “Plot” to generate the graph.

Toolkit 6: Pre-Model Check

This page allows users to perform pre-forecast modelling checks. Users can check if the selected time series data is stationary or not, as well as the decomposition of the time series data.



1. Select the “Stationary Check” Tab
2. Select the time series data (variable) to check. There are 4 options available (Rainfall, Mean Temp, Max Temp and Min Temp). Choose a suitable test. There are two tests available (Augmented Dickey-Fuller(ADF) and Kwiatkowski–Phillips–Schmidt–Shin(KPSS)).
   Select the significance level desired and click the “Check” button.

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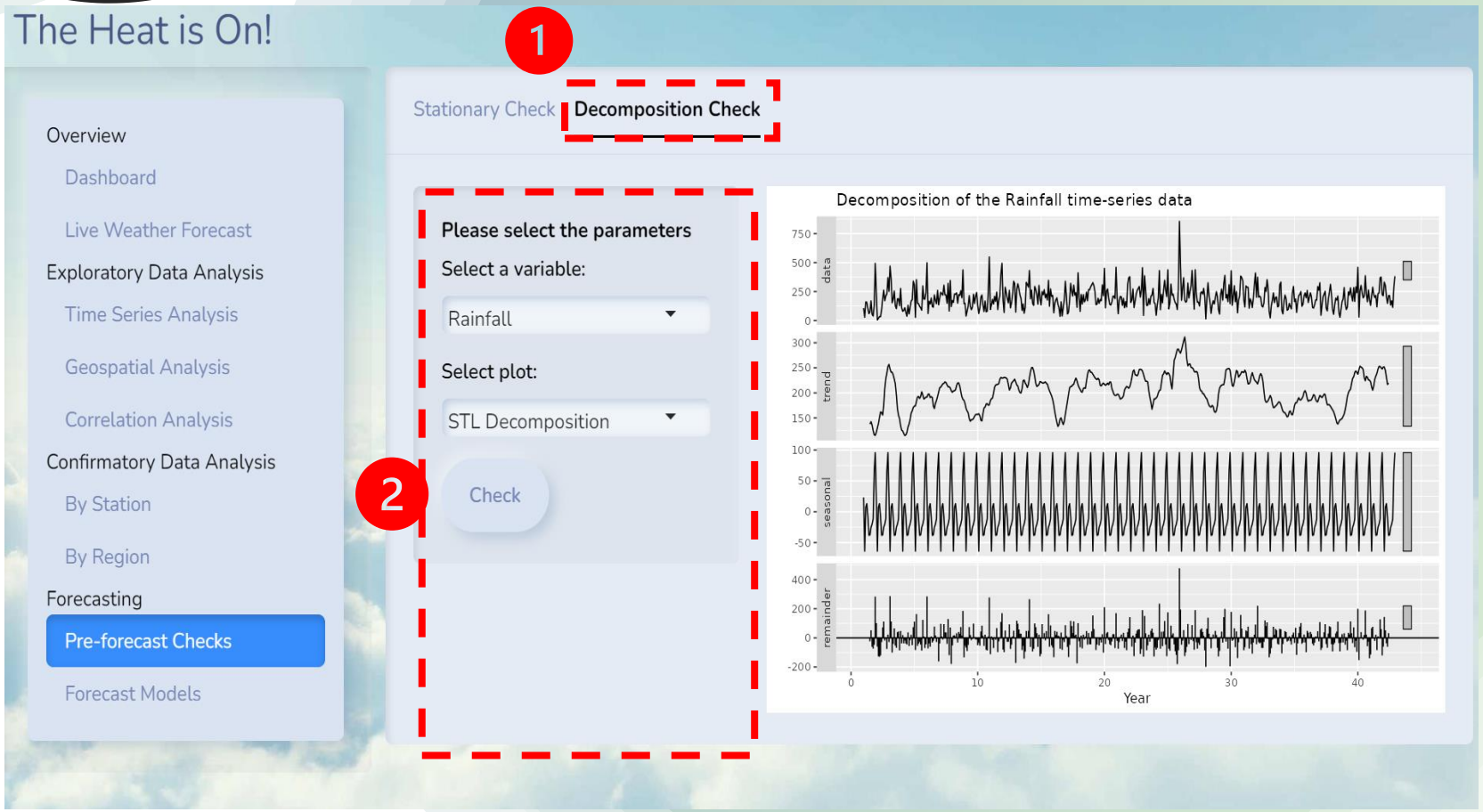
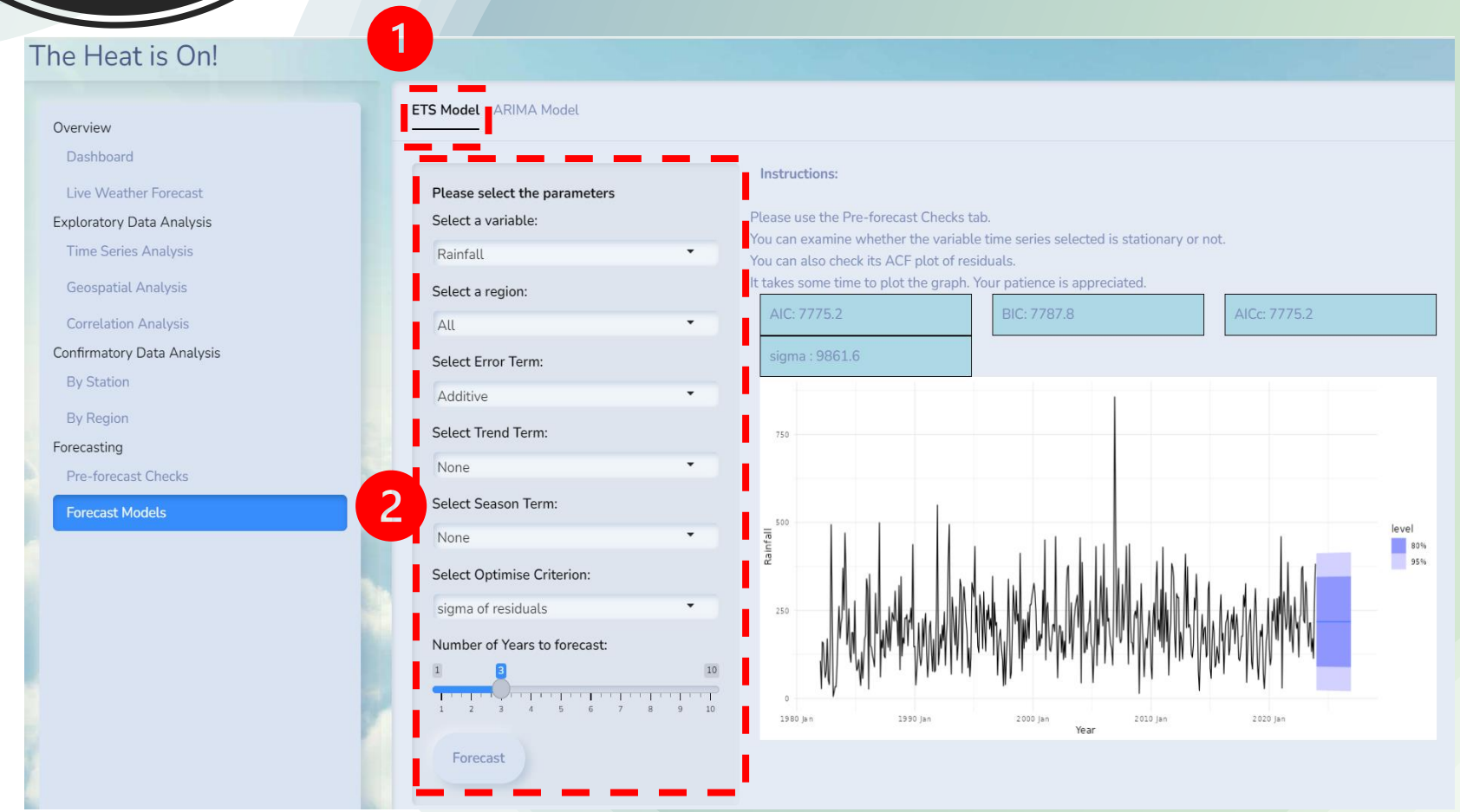


1. Select the “Decomposition Check” Tab
2. Select the time-series data (variable) to check. There are 4 options available (Rainfall, Mean Temp, Max Temp and Min Temp). Select the type of plot desired: STL decomposition - users can see the trend, seasonal and residuals of the time series data. PACF – users can view the partial autocorrelation plot of the selected time-series data to decide on the model parameters.

Toolkit 7: Forecast Models

This page allows users to perform forecasting using two popular models – ETS model (Exponential Smoothing State Space) and ARIMA model (AutoRegressive Integrated Moving Average)



1. Select the “ETS Model” Tab
2. Select the time-series data (variable) to check. There are 4 options available (Rainfall, Mean Temp, Max Temp and Min Temp).
   Select the appropriate method for each error, trend and seasonality component of the time-series data.
   Select the appropriate optimisation criterion for this model and the number of years to forecast.
   The plot will show the data and forecast values for each month with the 3 information criteria (AIC, BIC and AICc).

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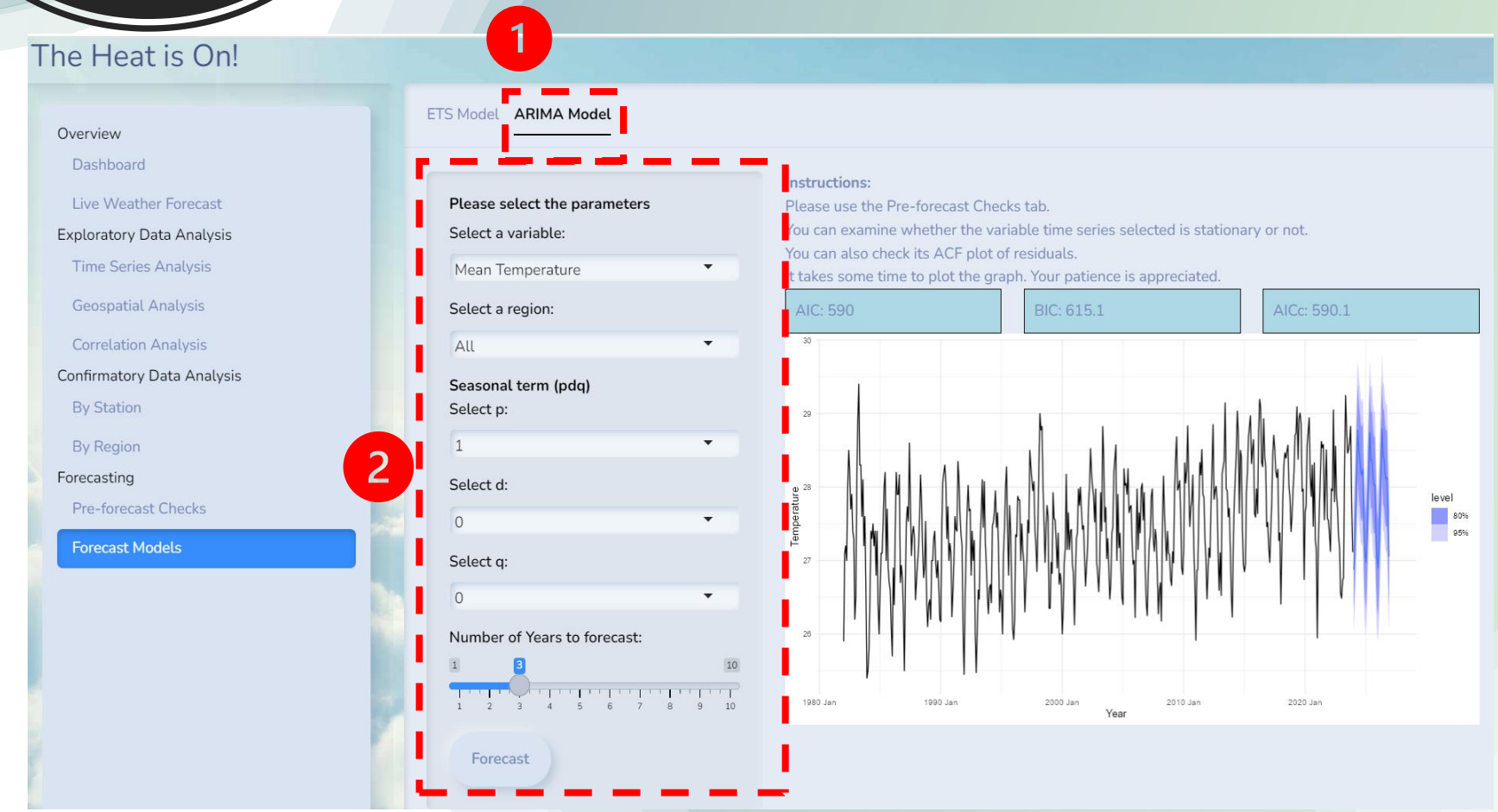

1. Select the “ARIMA Model” Tab
2. Select the time-series data (variable) to check. There are 4 options available (Rainfall, Mean Temp, Max Temp and Min Temp). Select the appropriate order of non-seasonal auto-regressive term (p), differencing term (d) and moving average term (q). Choose the number of years to forecast.
   The plot will show the data and forecast values for each month with the 3 information criteria (AIC, BIC and AICc).