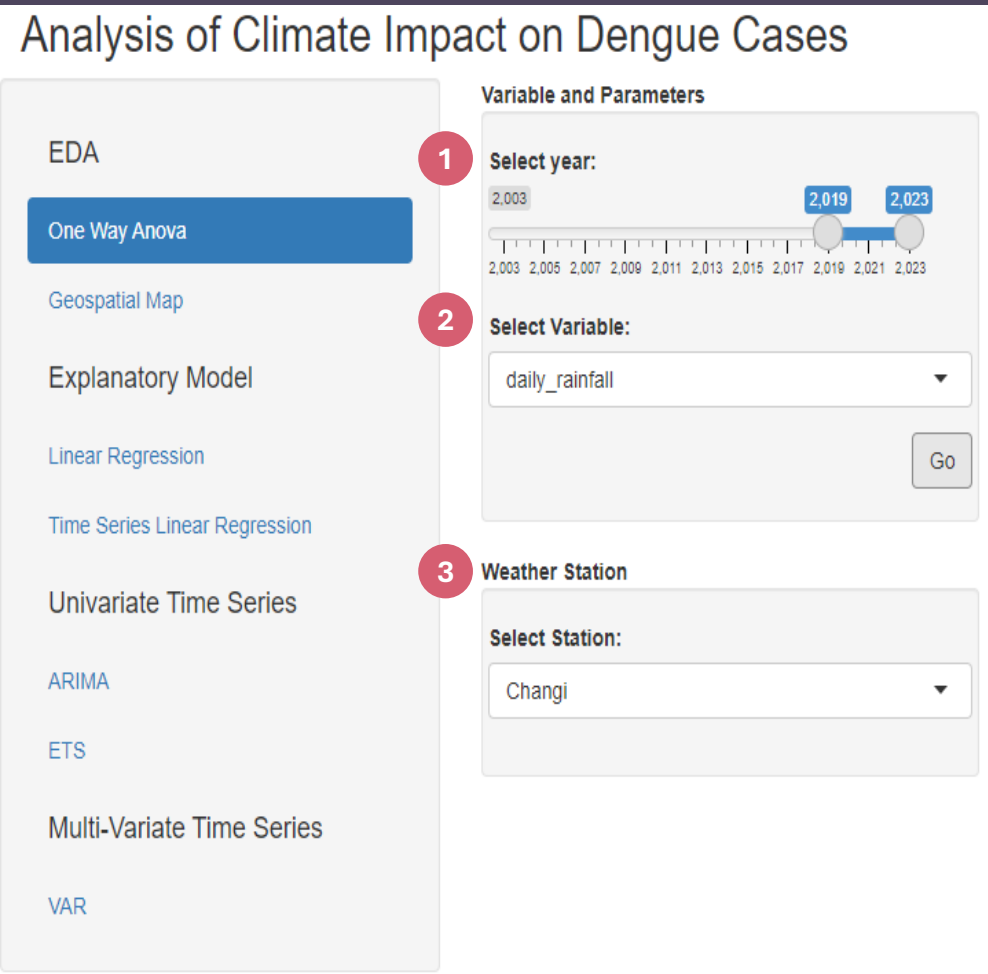
# Analysis of Climate Impact on Dengue Cases

ShinyApp User Manual

Group 3: CI Hui, Colin JIANG Kelin, SUN Yiping

# EDA – One Way Anova

This module allows users to analyze the difference in distribution of climate variables between two weather stations in Singapore.




1) Select period

2) Select variable

3) Select station

# EDA – One Way Anova

This module allows users to analyze the difference in distribution of climate variables between two weather stations in Singapore.

## Analysis of Climate Impact on Dengue Cases

- EDA
- One Way Anova
- Geospatial Map
- Explanatory Model
- Linear Regression
- Time Series Linear Regression
- Univariate Time Series
- ARIMA
- ETS
- Multi-Variate Time Series
- VAR

**Variable and Parameters**

**Select year:**

2,003 2,019 2,023

2,003 2,005 2,007 2,009 2,011 2,013 2,015 2,017 2,019 2,021 2,023

**Select Variable:**

daily_rainfall

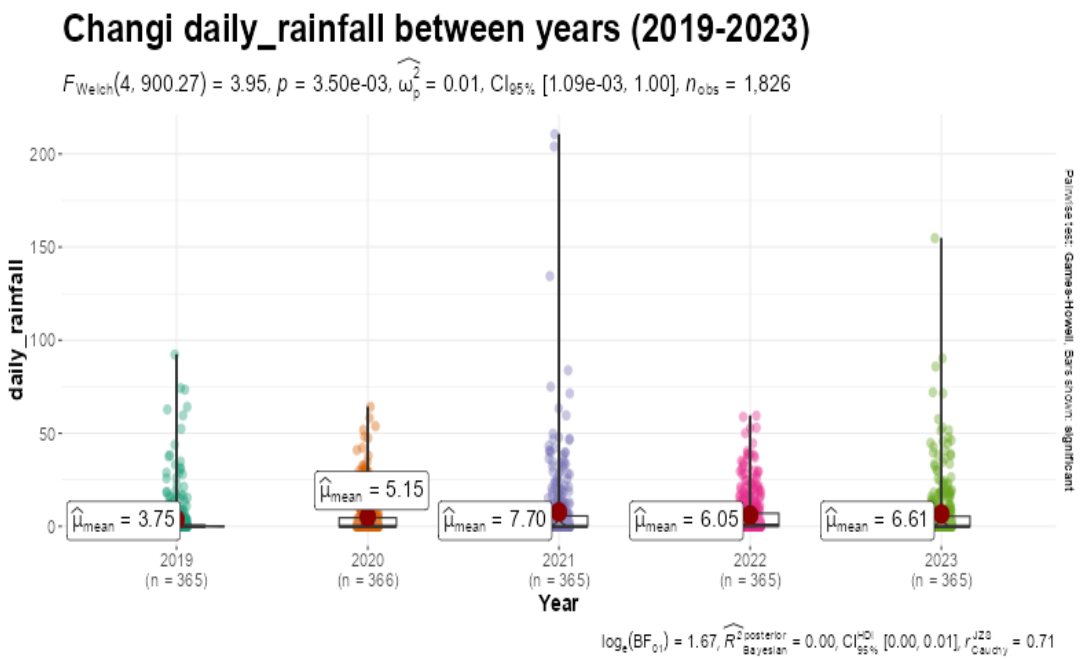
4 Go

**Weather Station**

**Select Station:**

Changi

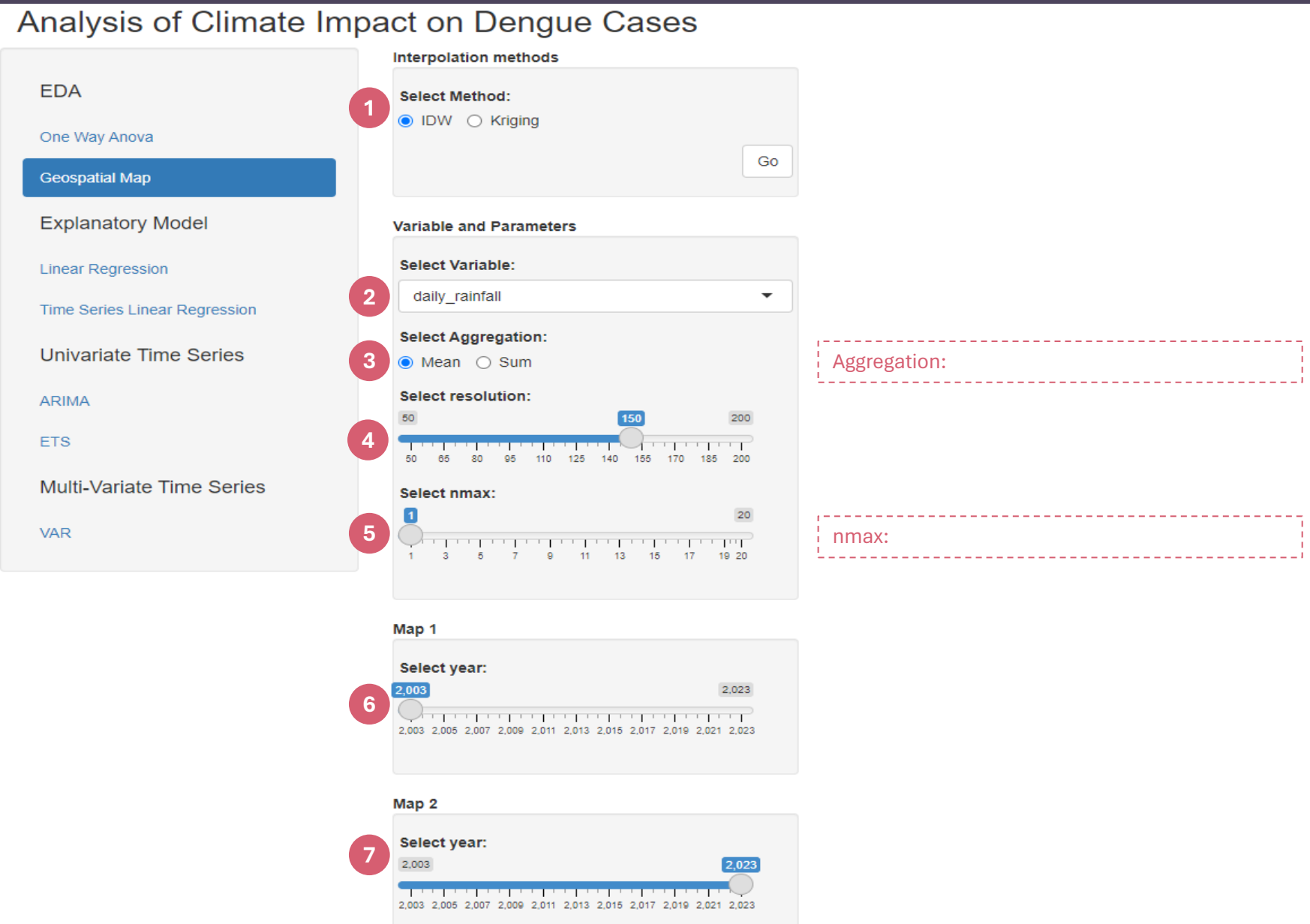
**Anova**




4) Click “Go” to plot

# EDA – Geospatial - IDW

This module allows users to analyze the difference in geospatial distribution of climate variables between two years across Singapore.




Aggregation:

nmax:

1) Select method of interpolation. This will change the interface and parameters accordingly

2) Select variable

3) Select aggregation

4) Select resolution

5) Select nmax

6) Select year map 1

7) Select year map 2

# EDA – Geospatial - IDW

This module allows users to analyze the difference in geospatial distribution of climate variables between two years across Singapore.

## Analysis of Climate Impact on Dengue Cases

- EDA
- One Way Anova
- Geospatial Map
- Explanatory Model
- Linear Regression
- Time Series Linear Regression
- Univariate Time Series
- ARIMA
- ETS
- Multi-Variate Time Series
- VAR

**Interpolation methods**

**Select Method:**

(•) IDW ( ) Kriging

7 Go

**Variable and Parameters**

**Select Variable:**

daily_rainfall

**Select Aggregation:**

(•) Mean ( ) Sum

**Select resolution:**

50 150 200

50 65 80 95 110 125 140 155 170 185 200

**Select nmax:**

1 20

1 3 5 7 9 11 13 15 17 19 20

**Map 1**

**Select year:**

2,003 2,023

2,003 2,005 2,007 2,009 2,011 2,013 2,015 2,017 2,019 2,021 2,023

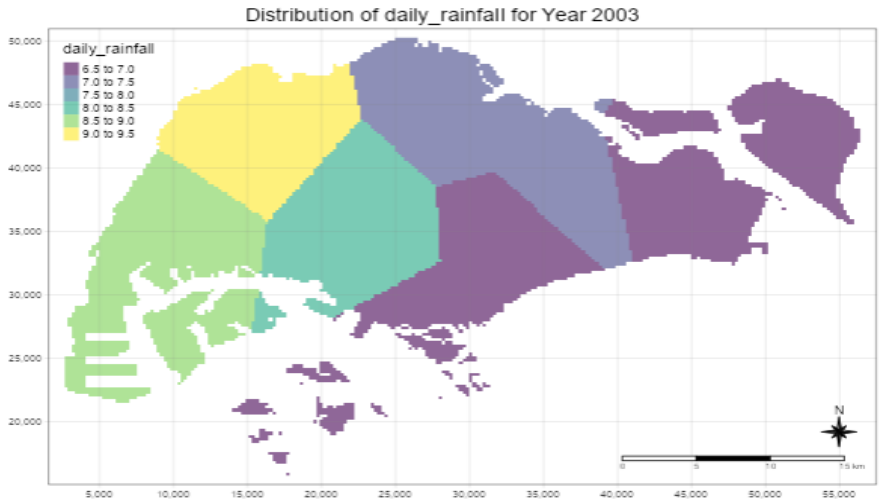
**Map 2**

**Select year:**

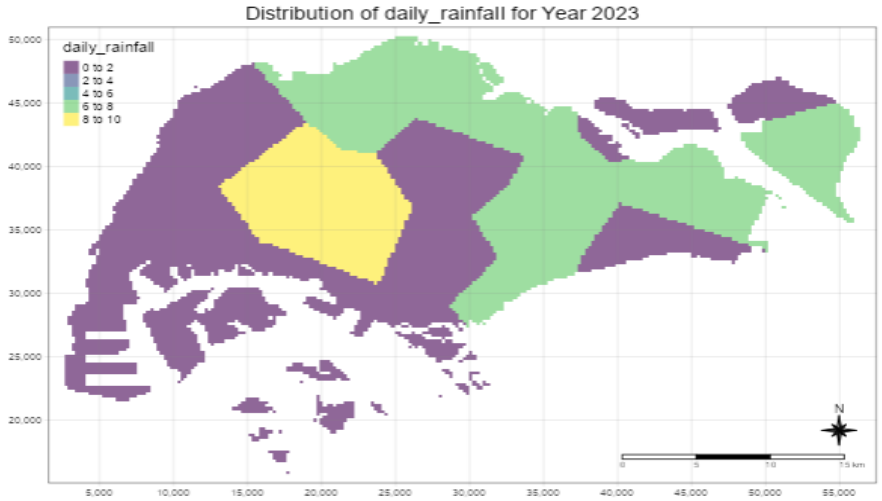
2,003 2,023

2,003 2,005 2,007 2,009 2,011 2,013 2,015 2,017 2,019 2,021 2,023

**Map 1**



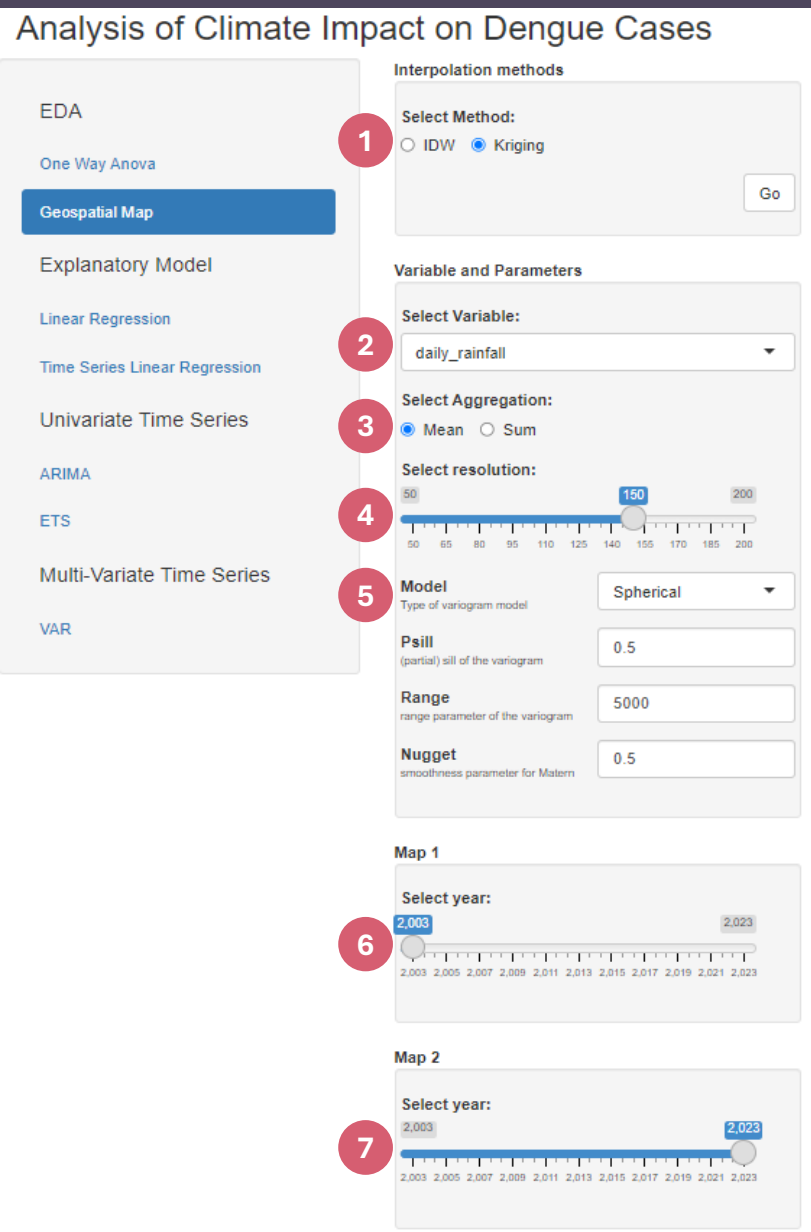

**Map 2**




7) Click “Go” to plot the 2 maps

# EDA – Geospatial - Kriging

This module allows users to analyze the difference in distribution of climate variables between two weather stations in Singapore.




1) Select method of interpolation. This will change the interface and parameters accordingly

2) Select variable

3) Select aggregation

4) Select resolution

5) Fill in other parameters

6) Select year map 1

7) Select year map 2

# EDA – Geospatial - Kriging

This module allows users to analyze the difference in distribution of climate variables between two weather stations in Singapore.

Analysis of Climate Impact on Dengue Cases

- EDA
- One Way Anova
- Geospatial Map
- Explanatory Model
- Linear Regression
- Time Series Linear Regression
- Univariate Time Series
- ARIMA
- ETS
- Multi-Variate Time Series
- VAR

**Interpolation methods**

Select Method: ○ IDW ◉ Kriging

8 Go

**Variable and Parameters**

Select Variable: daily_rainfall

Select Aggregation: ◉ Mean ○ Sum

Select resolution: 50 150 200

Model (Type of variogram model): Spherical

Psill ((partial) sill of the variogram): 0.5

Range (range parameter of the variogram): 5000

Nugget (smoothness parameter for Matern): 0.5

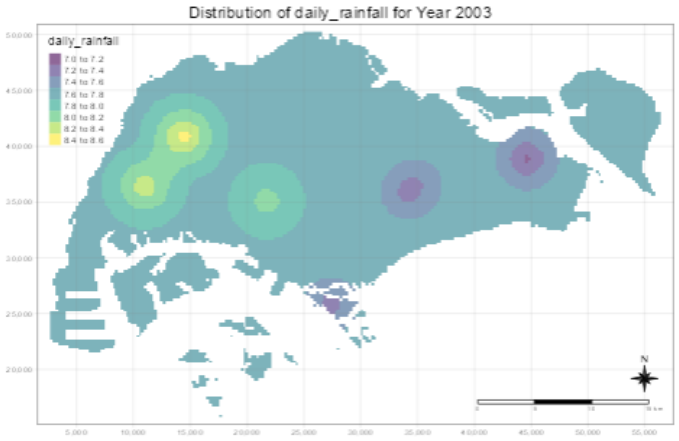
**Map 1**

Select year: 2,003 2,023

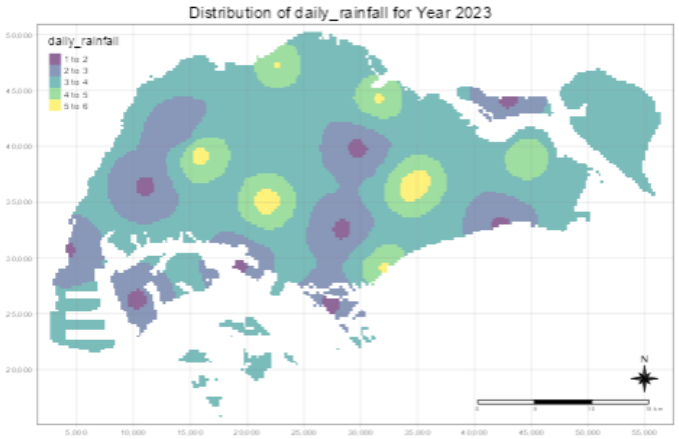
**Map 2**

Select year: 2,003 2,023

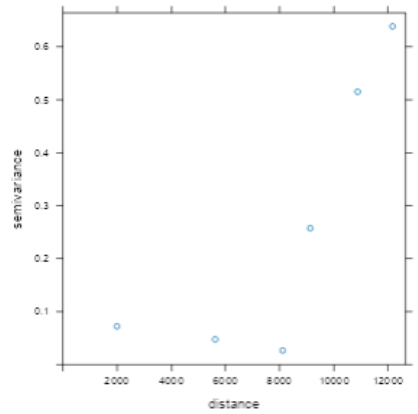
**Map 1**



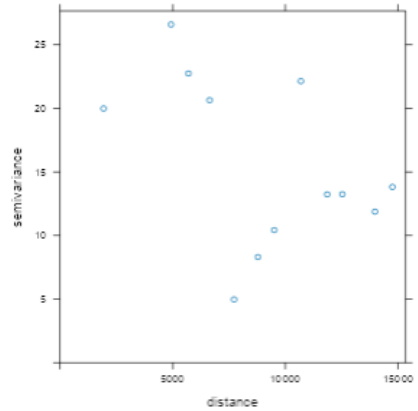

**Map 2**




**Variogram 1**



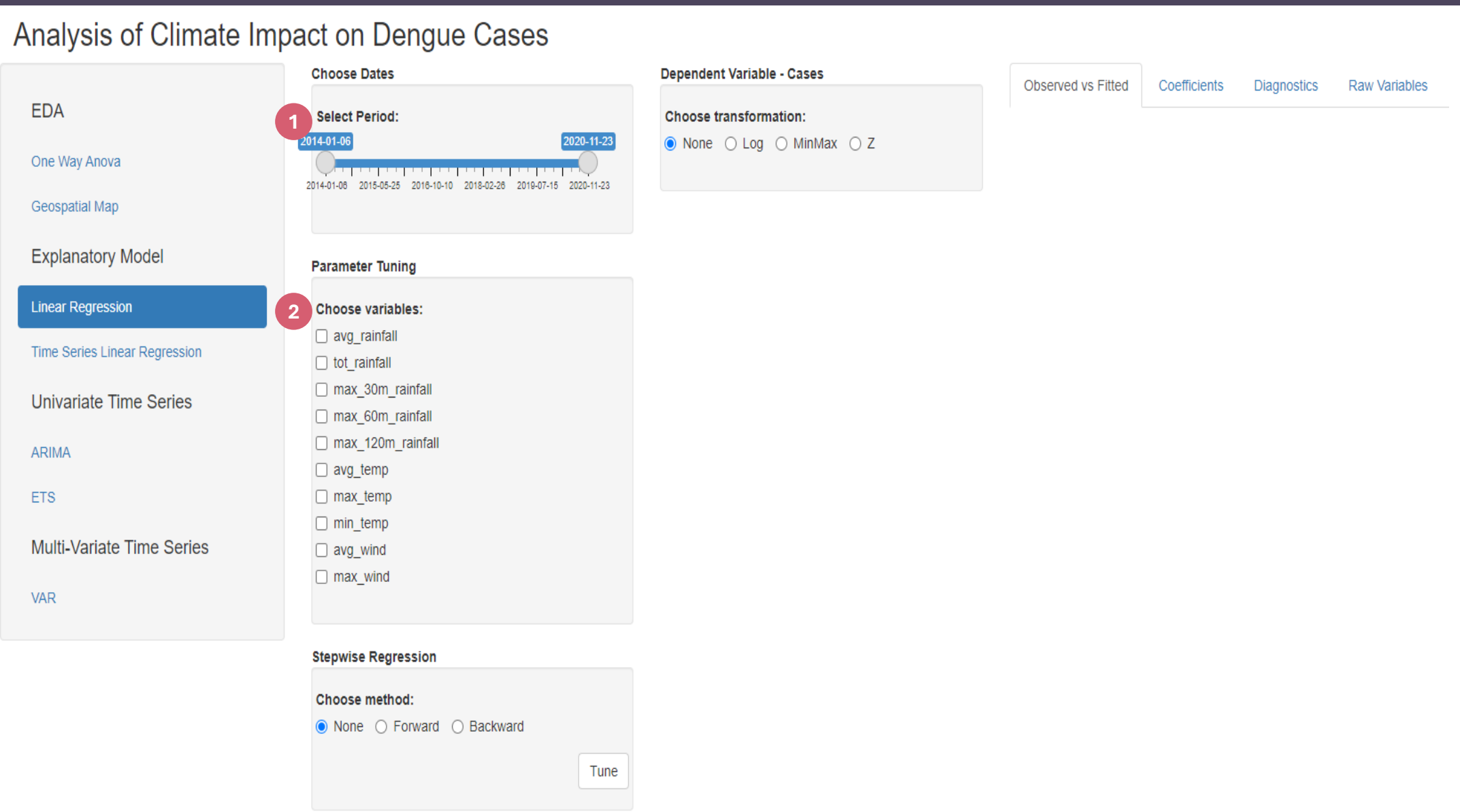

**Variogram 2**




8) Click “Go” to plot the 2 maps and variograms

# Explanatory Model – Linear Regression

This module allows users to fit a linear regression model on Dengue Cases and analyze the variable importance via coefficients

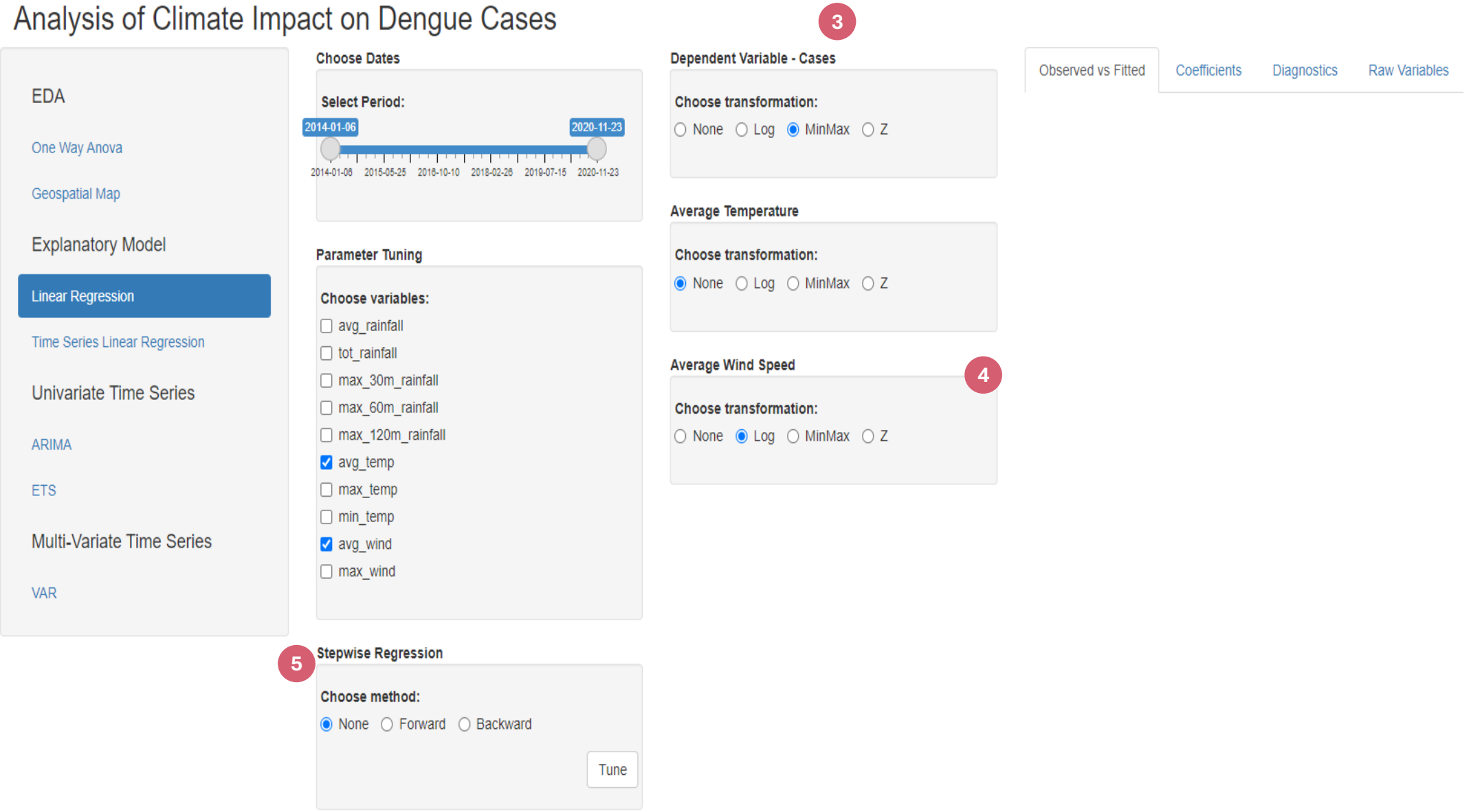



1) Select period of analysis

2) Choose variables to include in model

# Explanatory Model – Linear Regression

This module allows users to fit a linear regression model on Dengue Cases and analyze the variable importance via coefficients




3) Once a variable is added into the model, an additional panel will appear in the middle column

4) Select log transformation or standardization for each variable, if needed

5) Select forward or backward stepwise method for regression, if needed

# Explanatory Model – Linear Regression

This module allows users to fit a linear regression model on Dengue Cases and analyze the variable importance via coefficients

## Analysis of Climate Impact on Dengue Cases

EDA

One Way Anova

Geospatial Map

Explanatory Model

Linear Regression

Time Series Linear Regression

Univariate Time Series

ARIMA

ETS

Multi-Variate Time Series

VAR

**Choose Dates**

Select Period: 2014-01-06 – 2020-11-23

2014-01-06 2015-05-25 2016-10-10 2018-02-26 2019-07-15 2020-11-23

**Parameter Tuning**

**Choose variables:**

- [ ] avg_rainfall
- [ ] tot_rainfall
- [ ] max_30m_rainfall
- [ ] max_60m_rainfall
- [ ] max_120m_rainfall
- [x] avg_temp
- [ ] max_temp
- [x] min_temp
- [x] avg_wind
- [ ] max_wind

**Stepwise Regression**

**Choose method:**

( ) None ( ) Forward (•) Backward

6 Tune

**Dependent Variable - Cases**

**Choose transformation:**

(•) None ( ) Log ( ) MinMax ( ) Z

**Average Temperature**

**Choose transformation:**

(•) None ( ) Log ( ) MinMax ( ) Z

**Min Temperature**

**Choose transformation:**

(•) None ( ) Log ( ) MinMax ( ) Z

**Average Wind Speed**

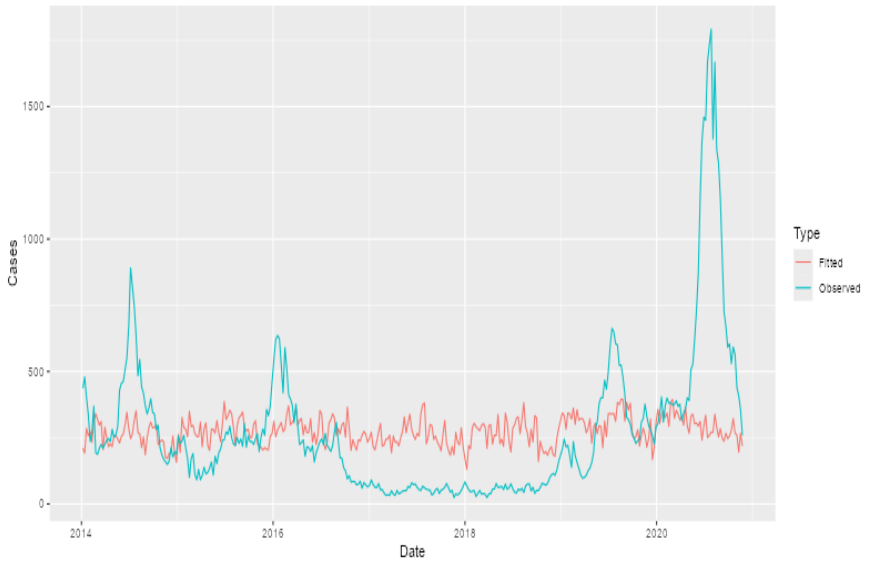
**Choose transformation:**

(•) None ( ) Log ( ) MinMax ( ) Z

7

Observed vs Fitted | Coefficients | Diagnostics | Raw Variables

Observed vs Fitted




Model Metrics

| Adjusted.R.2 | F.Statistics | MAPE |
|---|---|---|
| 0.03 | 5.84 | 1.52 |

Variables in Model (after stepwise)

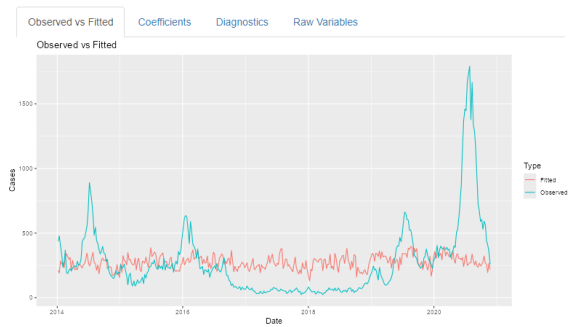
| term | estimate | std.error | statistic | p.value |
|---|---|---|---|---|
| (Intercept) | -1122.84 | 513.04 | -2.19 | 0.03 |
| avg_temp | 43.38 | 18.01 | 2.41 | 0.02 |
| avg_wind | 21.12 | 8.51 | 2.48 | 0.01 |

7) Toggle through tab panels to view various model diagnostics

6) Click “Tune” to generate results

# Explanatory Model – Linear Regression

This module allows users to fit a linear regression model on Dengue Cases and analyze the variable importance via coefficients




Model Metrics

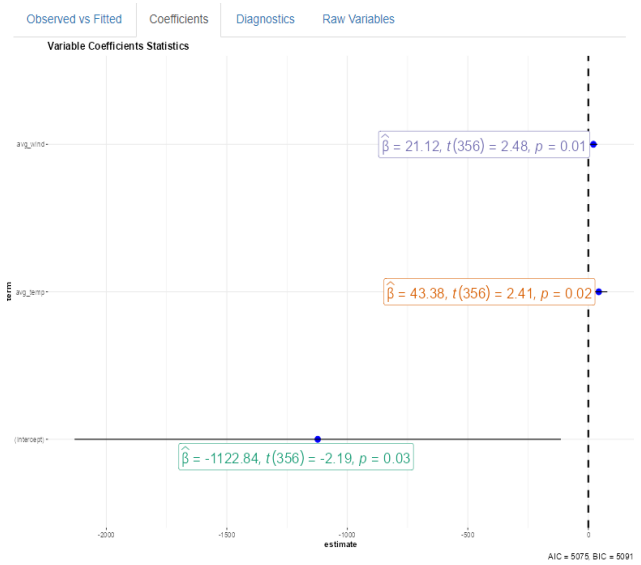
| Adjusted.R.2 | F.Statistics | MAPE |
|---|---|---|
| 0.03 | 5.84 | 1.52 |

Variables in Model (after stepwise)

| term | estimate | std.error | statistic | p.value |
|---|---|---|---|---|
| (Intercept) | -1122.84 | 513.04 | -2.19 | 0.03 |
| avg_temp | 43.38 | 18.01 | 2.41 | 0.02 |
| avg_wind | 21.12 | 8.51 | 2.48 | 0.01 |

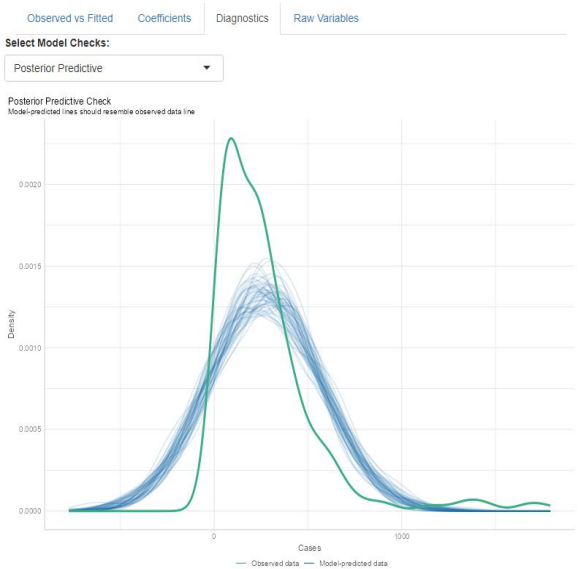
## Actual vs Fit

Check the fit of the LM model against the actual values



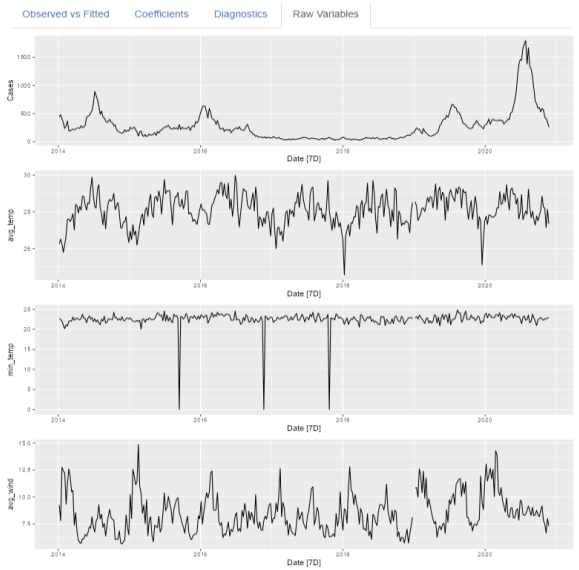

## Coefficients

View coefficients and error of variables in model




## Diagnostics

Check the various diagnostics of the model such as normality of residuals and multi-collinearity

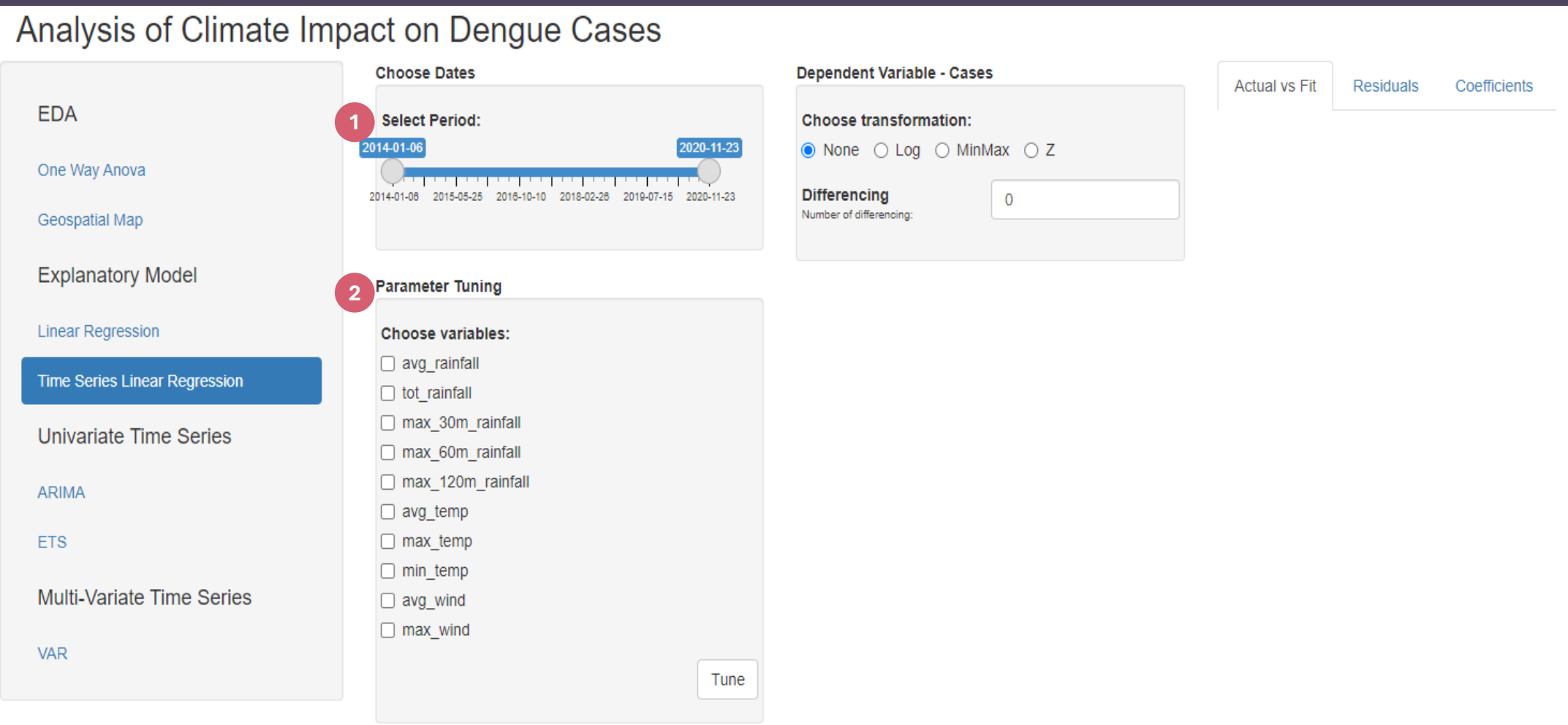



## Raw Variables

Check the plots of the individual variables in the model to determine transformations required

# Explanatory Model – Time Series Linear Model

This module allows users to fit a Time Series Linear model on Dengue Cases and analyze the variable importance via coefficients

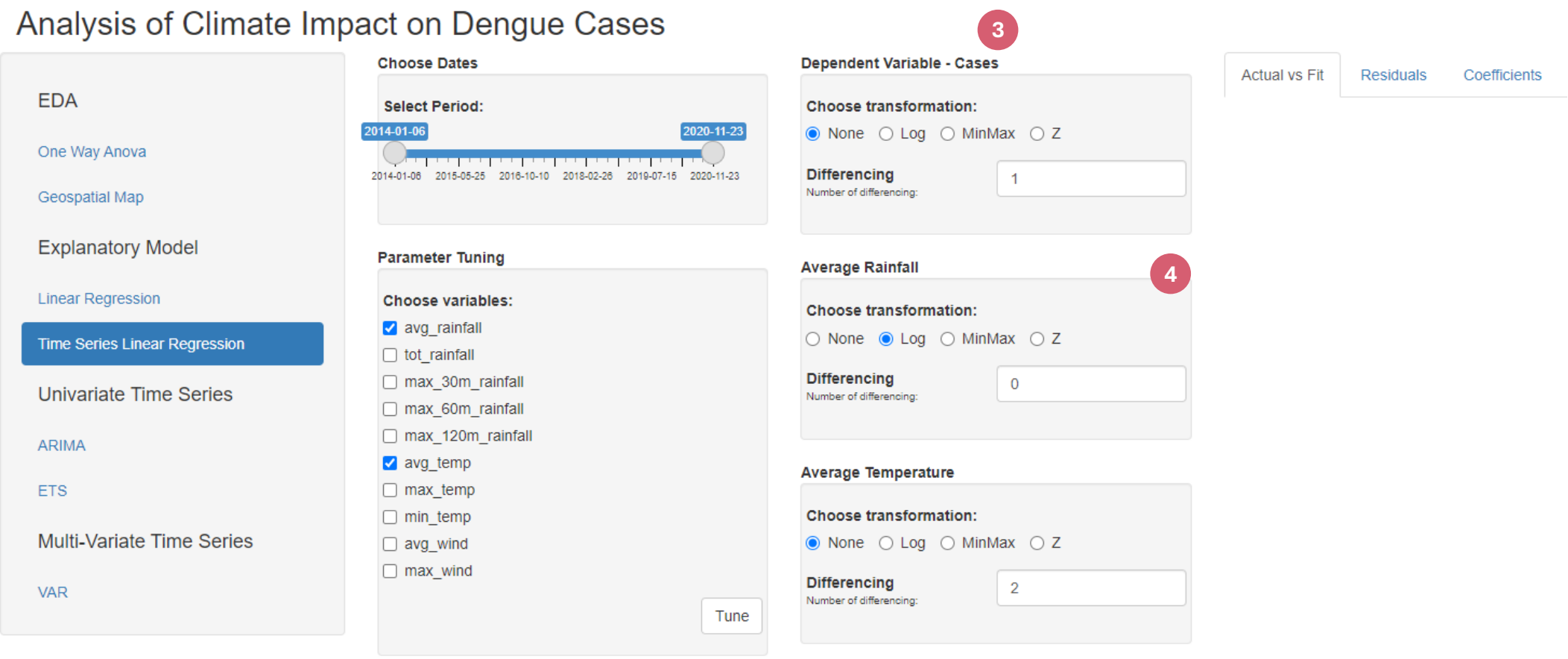



1) Select period of analysis

2) Choose variables to include in model

# Explanatory Model – Time Series Linear Model

This module allows users to fit a Time Series Linear model on Dengue Cases and analyze the variable importance via coefficients




3) Once a variable is added into the model, an additional panel will appear in the middle column

4) Select log transformation or standardization for each variable, if needed

Users can also determine the differencing required

# Explanatory Model – Time Series Linear Model

This module allows users to fit a Time Series Linear model on Dengue Cases and analyze the variable importance via coefficients

## Analysis of Climate Impact on Dengue Cases

- EDA
- One Way Anova
- Geospatial Map
- Explanatory Model
- Linear Regression
- Time Series Linear Regression
- Univariate Time Series
- ARIMA
- ETS
- Multi-Variate Time Series
- VAR

**Choose Dates**

Select Period: 2014-01-06 – 2020-11-23

2014-01-06 2015-05-25 2016-10-10 2018-02-26 2019-07-15 2020-11-23

**Parameter Tuning**

**Choose variables:**

- [x] avg_rainfall
- [ ] tot_rainfall
- [ ] max_30m_rainfall
- [ ] max_60m_rainfall
- [ ] max_120m_rainfall
- [x] avg_temp
- [ ] max_temp
- [ ] min_temp
- [x] avg_wind
- [ ] max_wind

5 Tune

**Dependent Variable - Cases**

Choose transformation: ○ None ◉ Log ○ MinMax ○ Z

Differencing — Number of differencing: 0

**Average Rainfall**

Choose transformation: ○ None ◉ Log ○ MinMax ○ Z

Differencing — Number of differencing: 1

**Average Temperature**

Choose transformation: ◉ None ○ Log ○ MinMax ○ Z

Differencing — Number of differencing: 0

**Average Wind Speed**

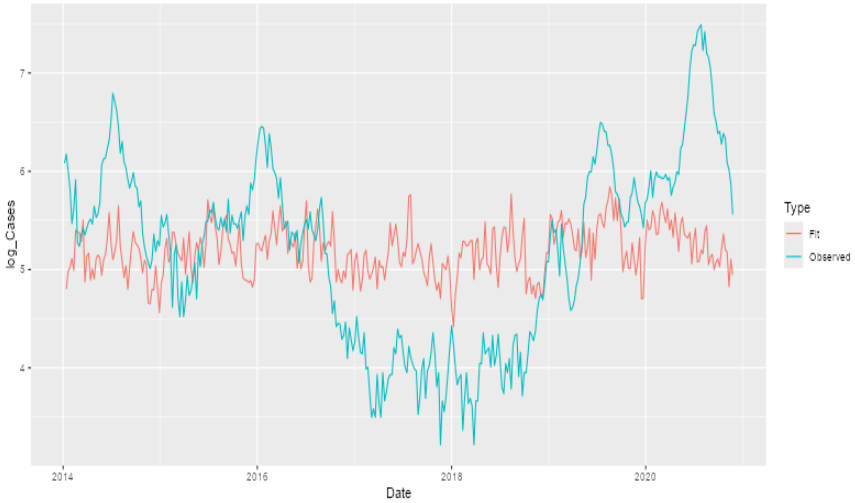
Choose transformation: ◉ None ○ Log ○ MinMax ○ Z

Differencing — Number of differencing: 0

6

Actual vs Fit | Residuals | Coefficients

Observed vs Fitted




Model Metrics

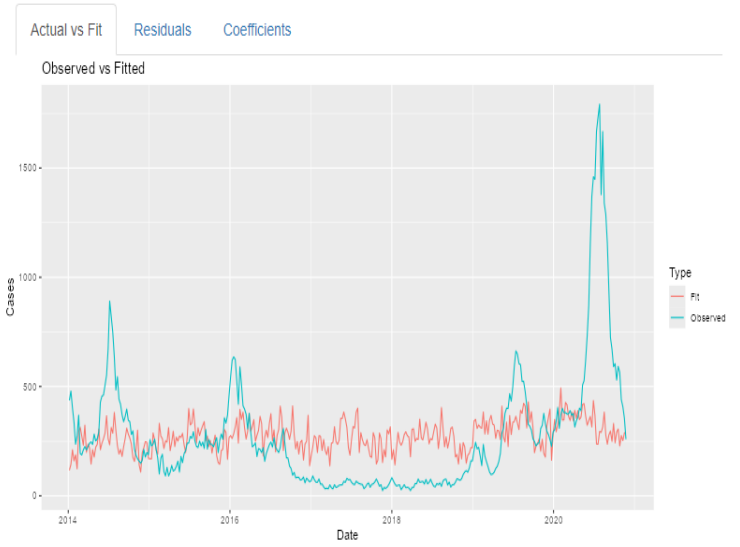
| RMSE | MAE | MAPE |
|---|---|---|
| 0.91 | 0.74 | 15.29 |

6) Toggle through tab panels to view various model diagnostics

5) Click “Tune” to generate results

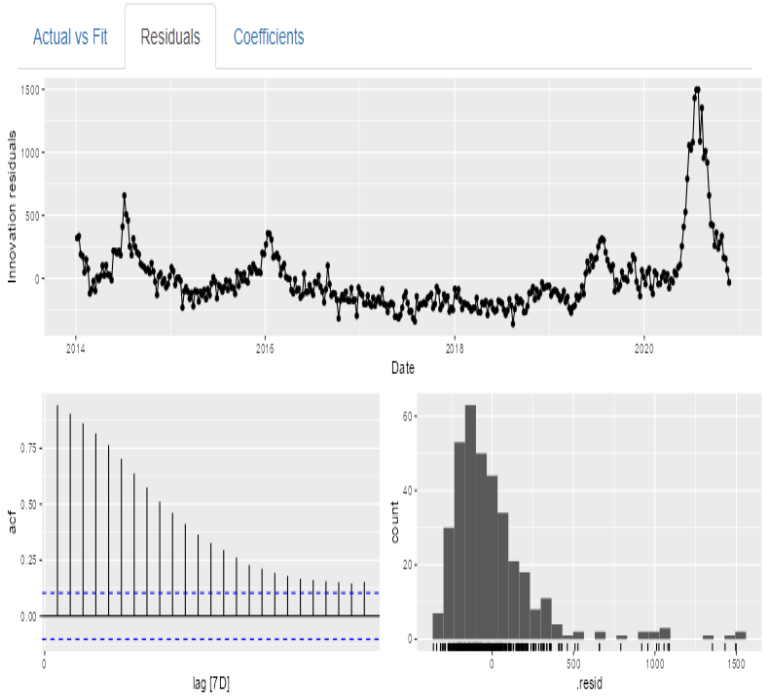
# Explanatory Model – Time Series Linear Model

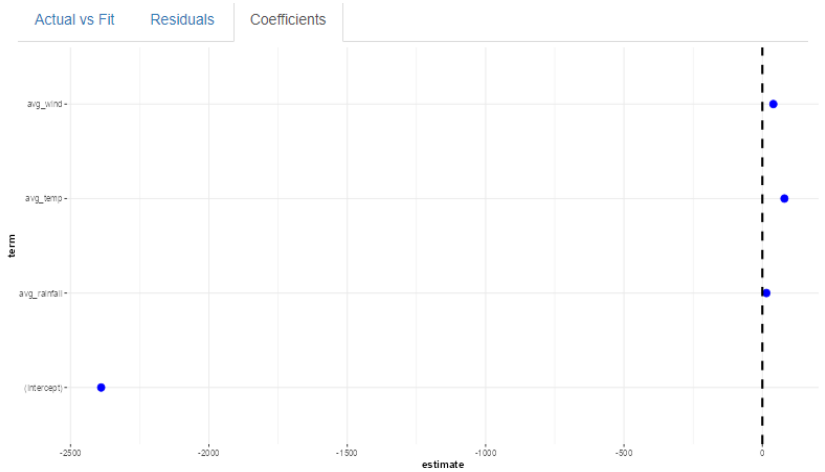
This module allows users to fit a Time Series Linear model on Dengue Cases and analyze the variable importance via coefficients




Model Metrics

| RMSE | MAE | MAPE |
|---|---|---|
| 276.89 | 180.25 | 149.44 |




Model Estimates

| term | estimate | std.error | statistic | p.value |
|---|---|---|---|---|
| (Intercept) | -2389.41 | 645.82 | -3.70 | 0.00 |
| avg_rainfall | 14.71 | 4.64 | 3.17 | 0.00 |
| avg_temp | 79.80 | 21.19 | 3.77 | 0.00 |
| avg_wind | 39.65 | 10.23 | 3.88 | 0.00 |

**Actual vs Fit**

Check the fit of the TSLM model against the actual values

**Residuals**

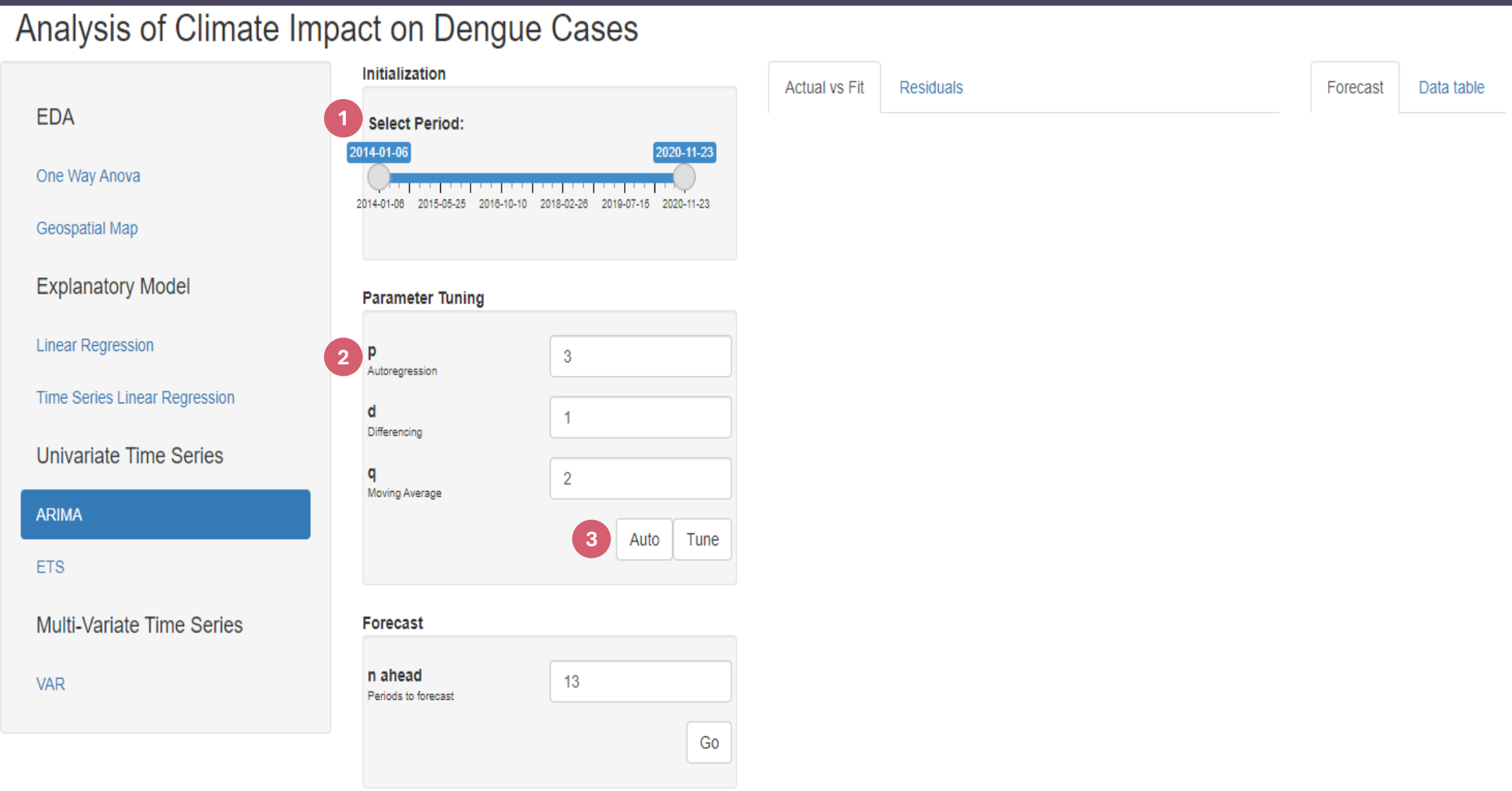
Check the normality of residuals to determine stationarity

**Coefficients**

Gain insights on variable estimates and statistics

# Univariate Time Series – ARIMA

This module allows users to fit a ARIMA model on Dengue Cases and generate forecast



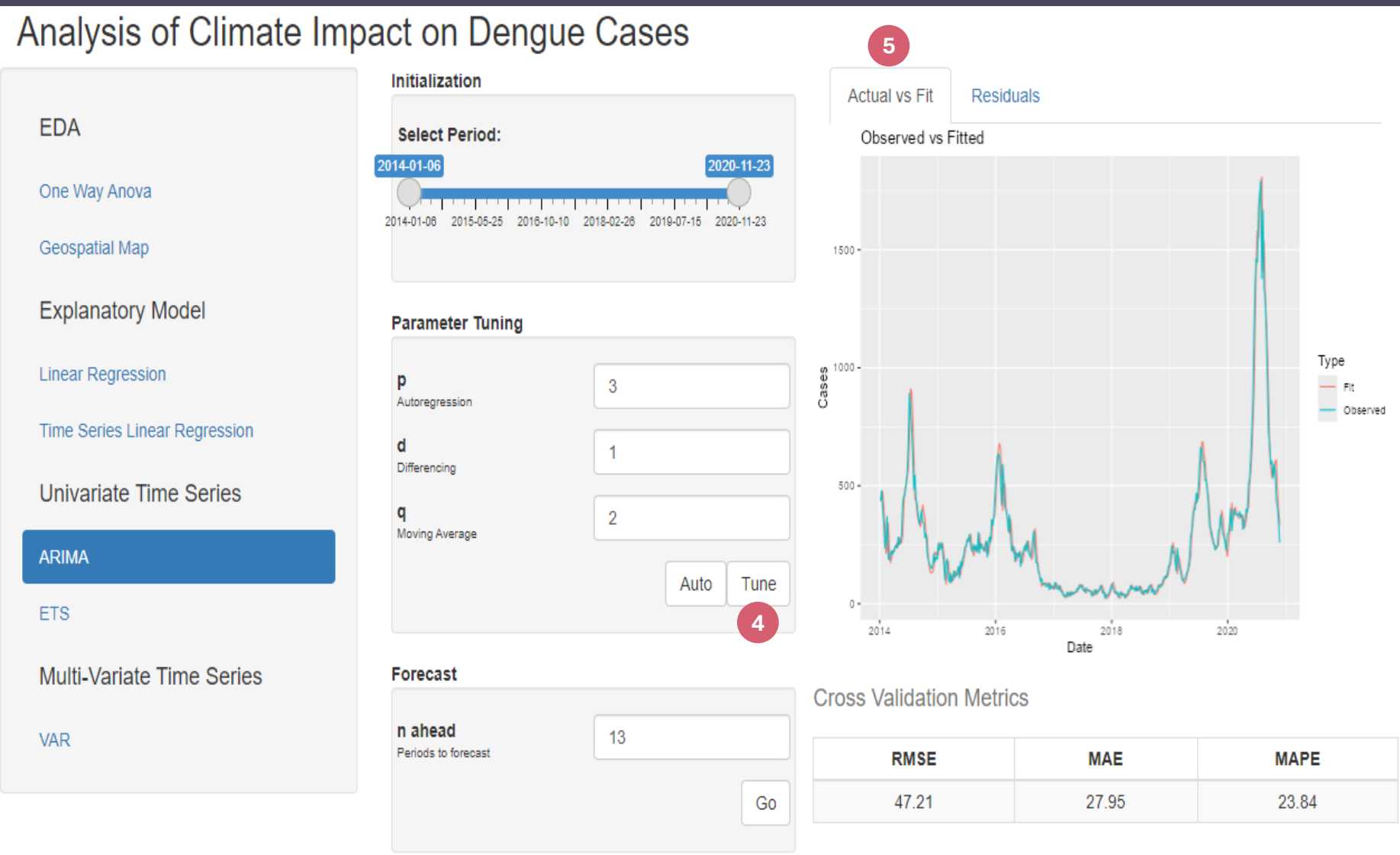

1) Select period of analysis

2) Select Input parameters to use for the model

3) Click “Auto” to fill parameter based on model’s aicc

# Univariate Time Series – ARIMA

This module allows users to fit a ARIMA model on Dengue Cases and generate forecast

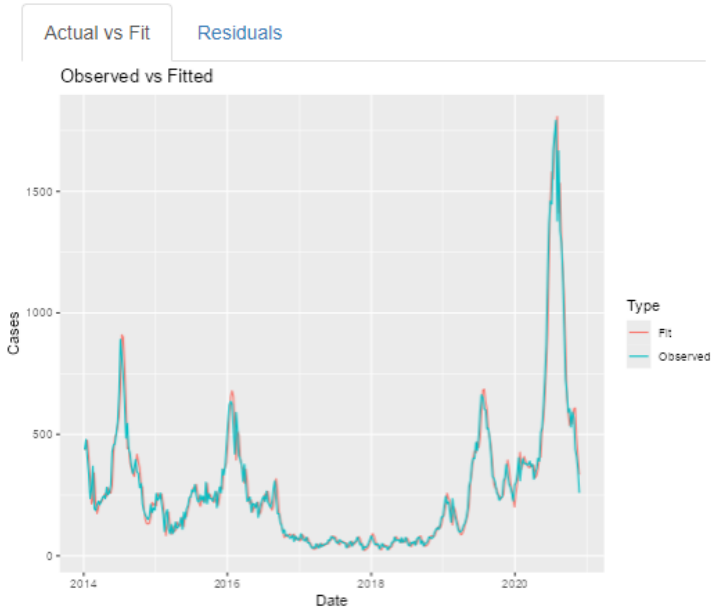



5) Toggle between tab panels for various diagnostics

4) Click “Tune” to generate model diagnostics

# Univariate Time Series – ARIMA

This module allows users to fit a ARIMA model on Dengue Cases and generate forecast




Cross Validation Metrics

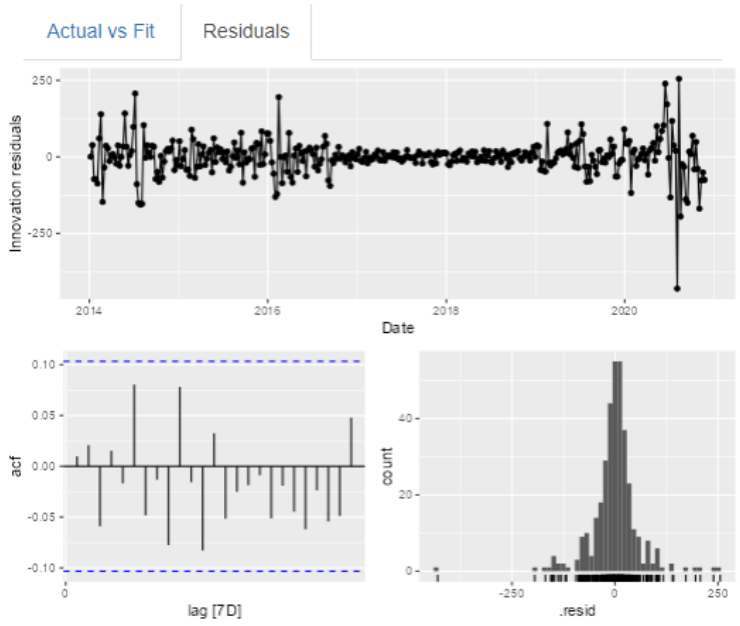
| RMSE | MAE | MAPE |
|---|---|---|
| 47.21 | 27.95 | 23.84 |

**Actual vs Fit**

Check the fit of the ARIMA model against the actual values

**Cross Validation Metrics**

Check and compare the performance of the model using Cross Validation metrics




Cross Validation Metrics

| RMSE | MAE | MAPE |
|---|---|---|
| 47.21 | 27.95 | 23.84 |

**Residuals**

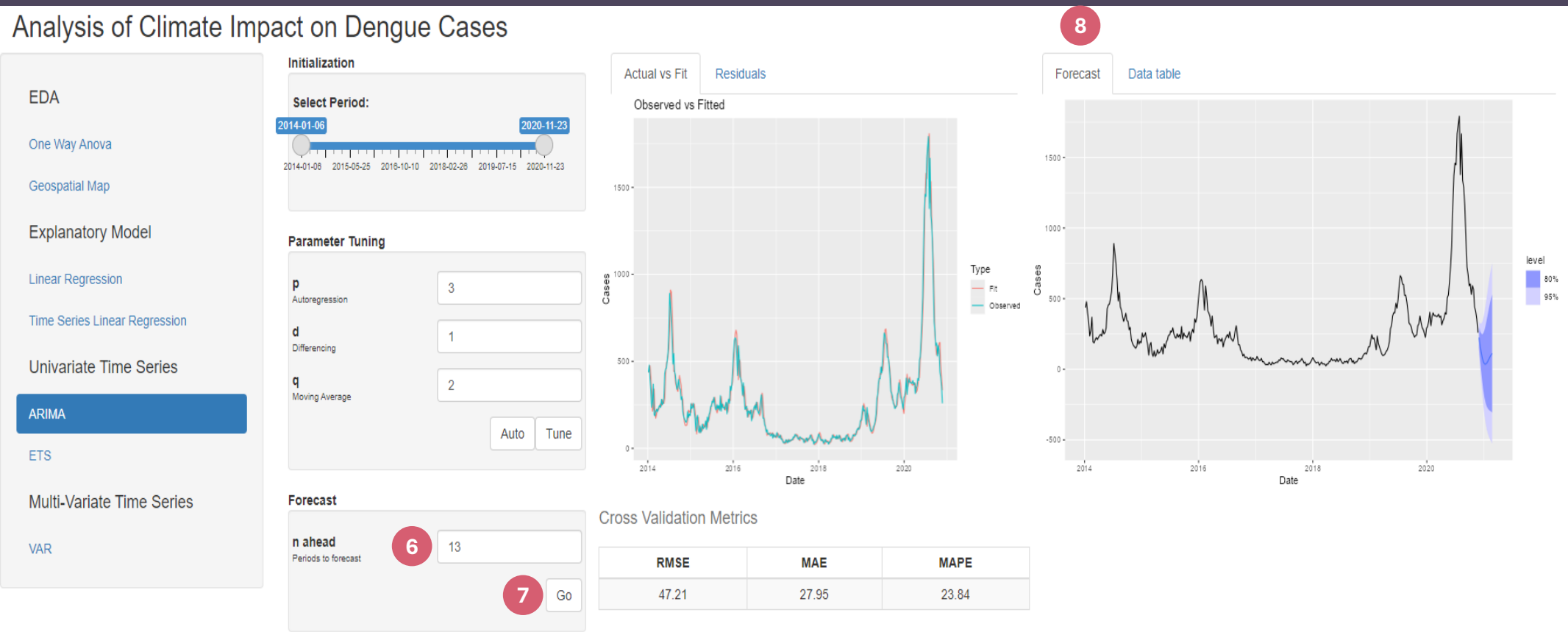
Check the normality of residuals to determine stationarity

Model Diagnostics

Users can use these diagnostics to determine if parameters are suitable, and re-tune models accordingly

# Univariate Time Series – ARIMA

This module allows users to fit a ARIMA model on Dengue Cases and generate forecast



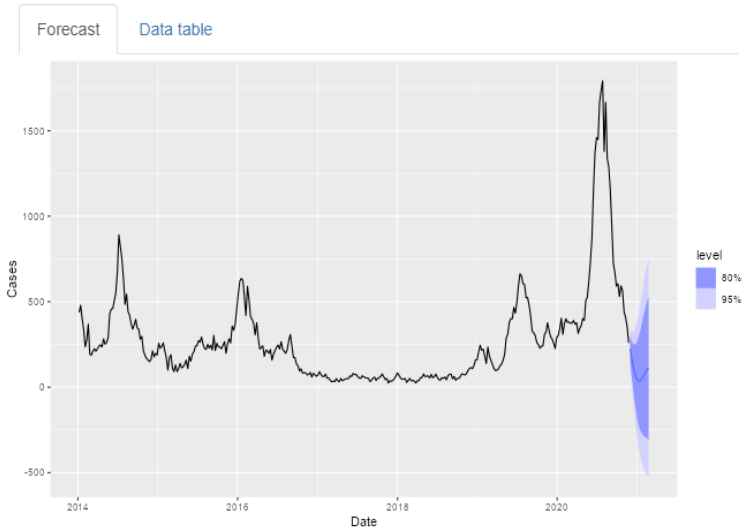

8) Toggle between tab panels for various forecast results

6) Key in number of forecast period

7) Click“Go” to generate forecast

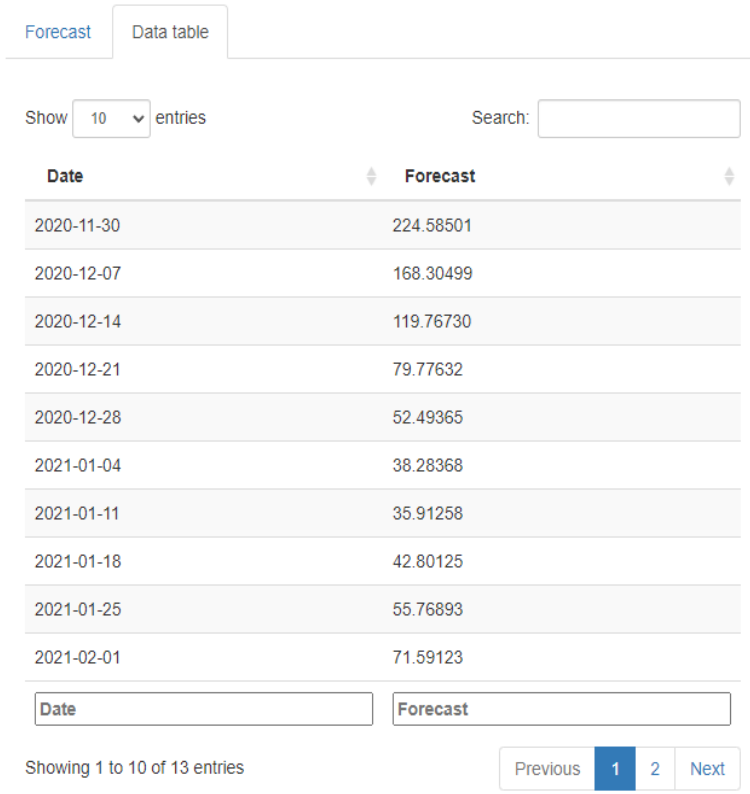
# Univariate Time Series – ARIMA

This module allows users to fit a ARIMA model on Dengue Cases and generate forecast




**Forecast**

View forecast results in plot, along with 80% and 95% confidence interval




**Data table**

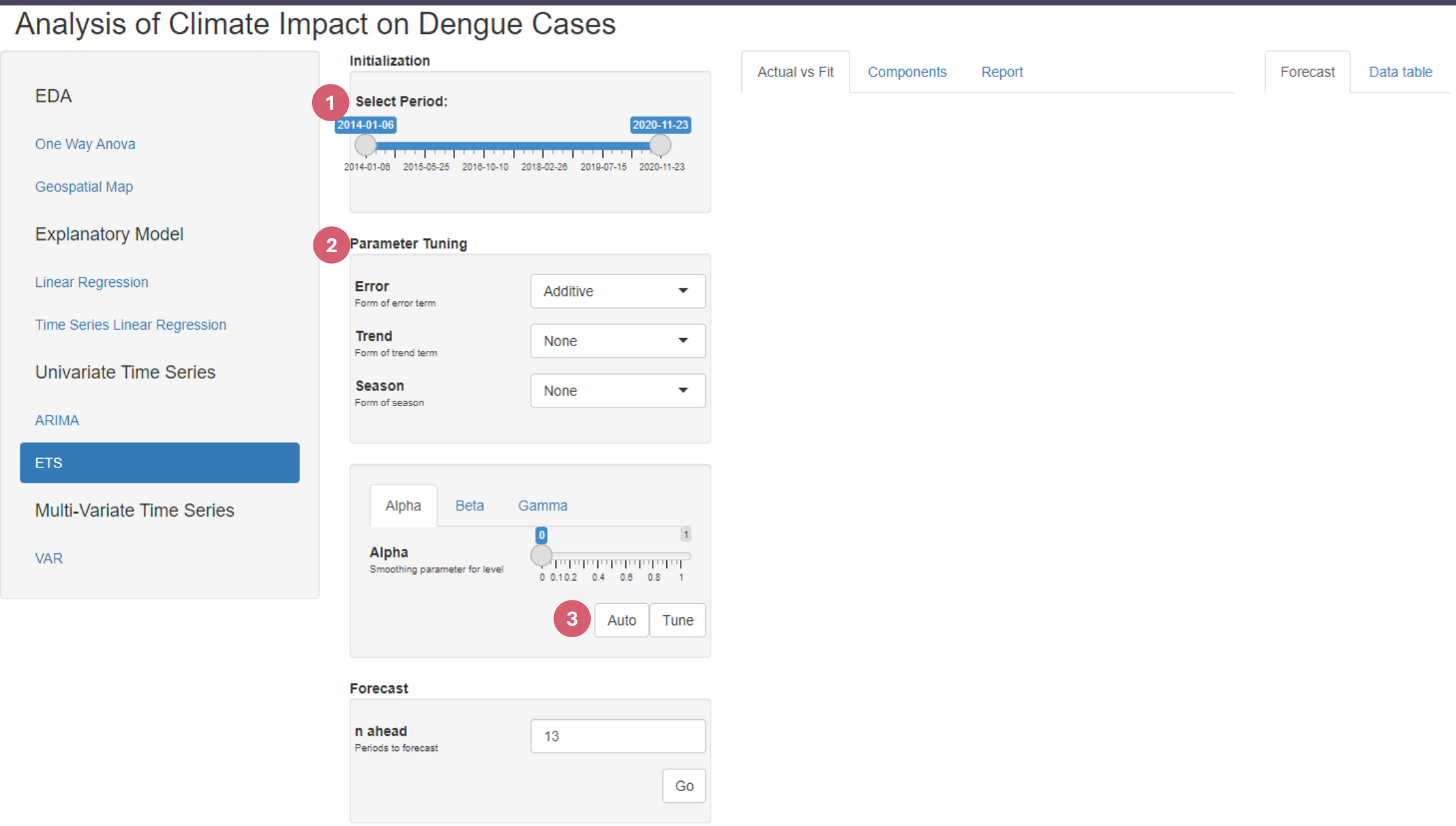
View forecast results in table format

Model Forecast

Users can use these forecast results to compare with that from other models

# Univariate Time Series – ETS

This module allows users to fit a Exponential Smoothing model on Dengue Cases and generate forecast




1) Select period of analysis

2) Select Input parameters to use for the model

3) Click “Auto” to fill parameter based on model’s aicc

# Univariate Time Series – ETS

This module allows users to fit a Exponential Smoothing model on Dengue Cases and generate forecast

## Analysis of Climate Impact on Dengue Cases

- EDA
- One Way Anova
- Geospatial Map
- Explanatory Model
- Linear Regression
- Time Series Linear Regression
- Univariate Time Series
- ARIMA
- ETS
- Multi-Variate Time Series
- VAR

**Initialization**

**Select Period:** 2014-01-06 – 2020-11-23

2014-01-06 2015-05-25 2016-10-10 2018-02-26 2019-07-15 2020-11-23

**Parameter Tuning**

**Error** — Form of error term: Multiplicative

**Trend** — Form of trend term: Additive

**Season** — Form of season: None

Alpha | Beta | Gamma

**Alpha** — Smoothing parameter for level: 0.83

0 0.1 0.2 0.4 0.6 0.8 1

Auto | Tune

4

**Forecast**

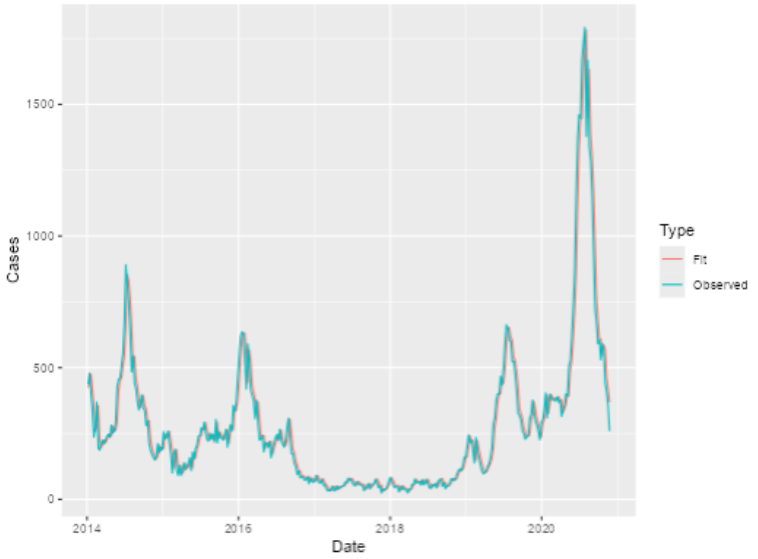
**n ahead** — Periods to forecast: 13

Go

5

Actual vs Fit | Components | Report | Forecast | Data table

Observed vs Fitted




Cross Validation Metrics

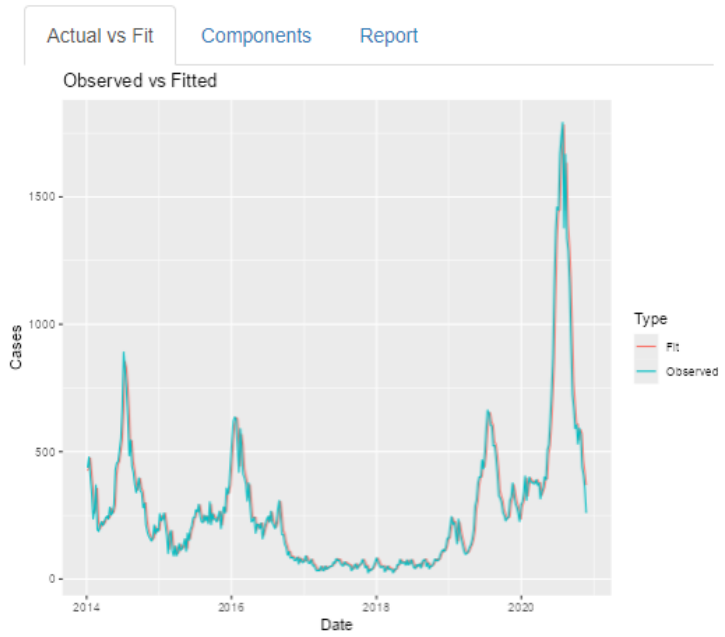
| RMSE | MAE | MAPE |
|---|---|---|
| 60.64 | 35.15 | 22.08 |

5) Toggle between tab panels for various diagnostics

4) Click “Tune” to generate model diagnostics

# Univariate Time Series – ETS

This module allows users to fit a Exponential Smoothing model on Dengue Cases and generate forecast




Cross Validation Metrics

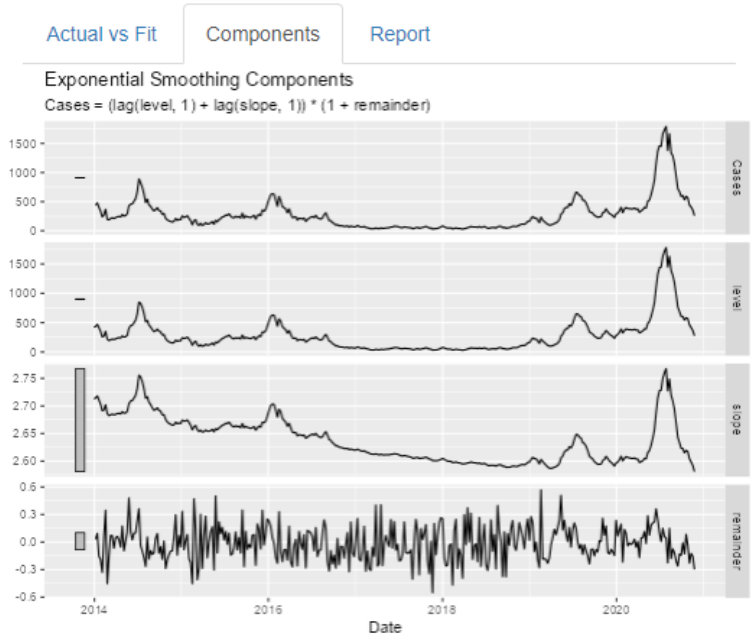
| RMSE | MAE | MAPE |
|---|---|---|
| 60.64 | 35.15 | 22.08 |

**Actual vs Fit**

Check the fit of the ETS model against the actual values

**Cross Validation Metrics**

Check and compare the performance of the model using Cross Validation metrics

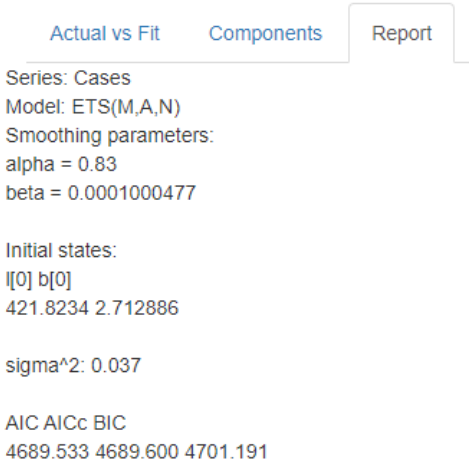



Cross Validation Metrics

| RMSE | MAE | MAPE |
|---|---|---|
| 60.64 | 35.15 | 22.08 |

**Components**

Check the decomposition of dependent variable to observe the levels of Trend, Error, and Seasonality, if any.




**Report**

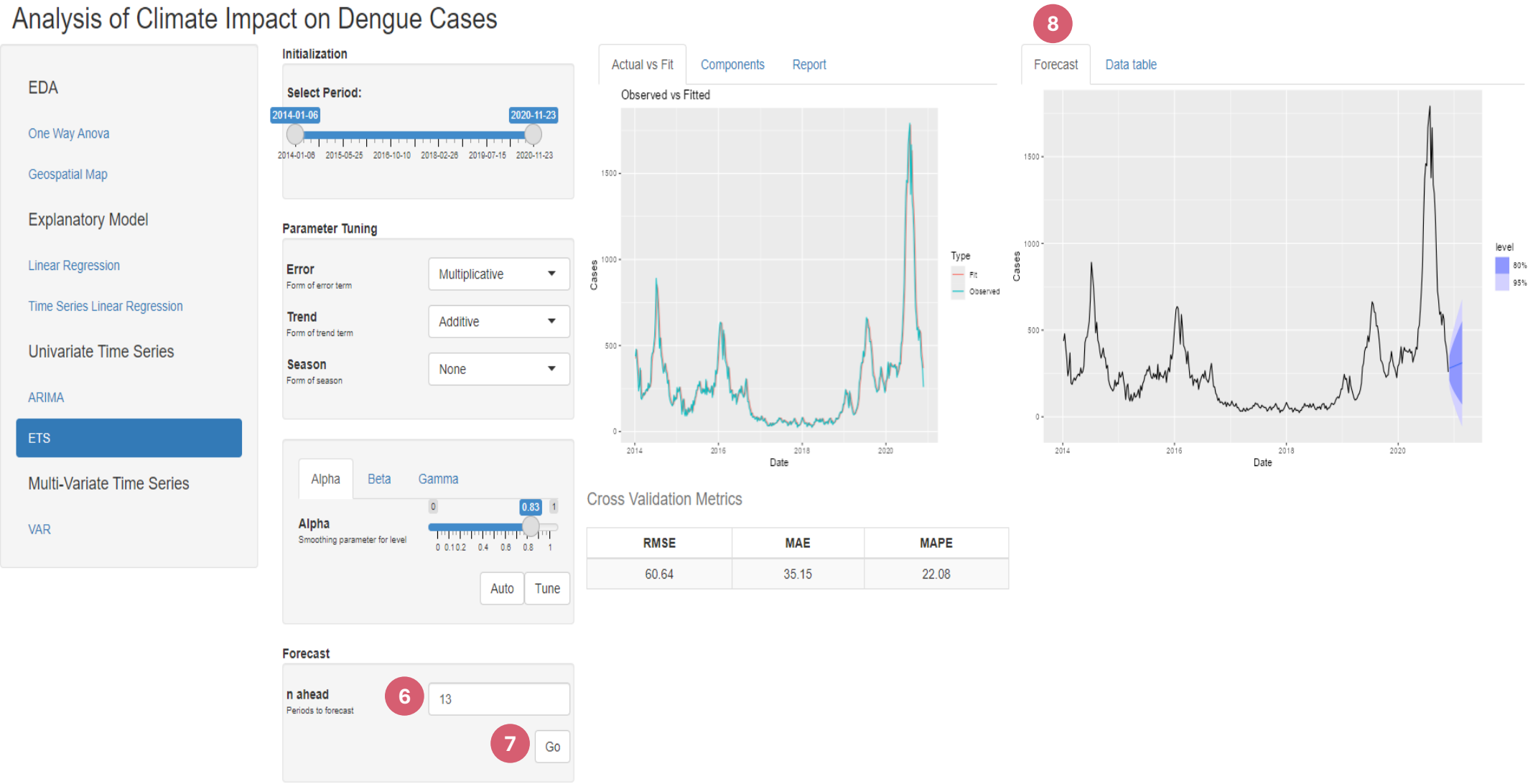
Check for other stats and parameter values in the model report

Model Diagnostics

Users can use these diagnostics to determine if parameters are suitable, and re-tune models accordingly

# Univariate Time Series – ETS

This module allows users to fit a Exponential Smoothing model on Dengue Cases and generate forecast



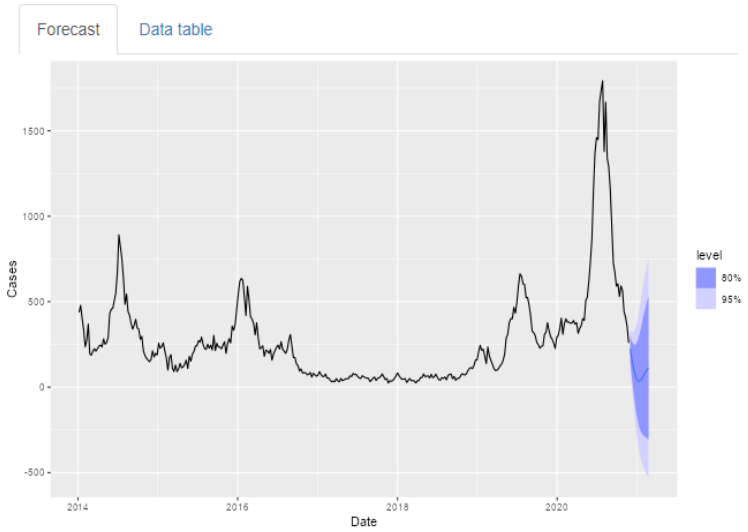

8) Toggle between tab panels for various forecast results

6) Key in number of forecast period

7) Click“Go” to generate forecast

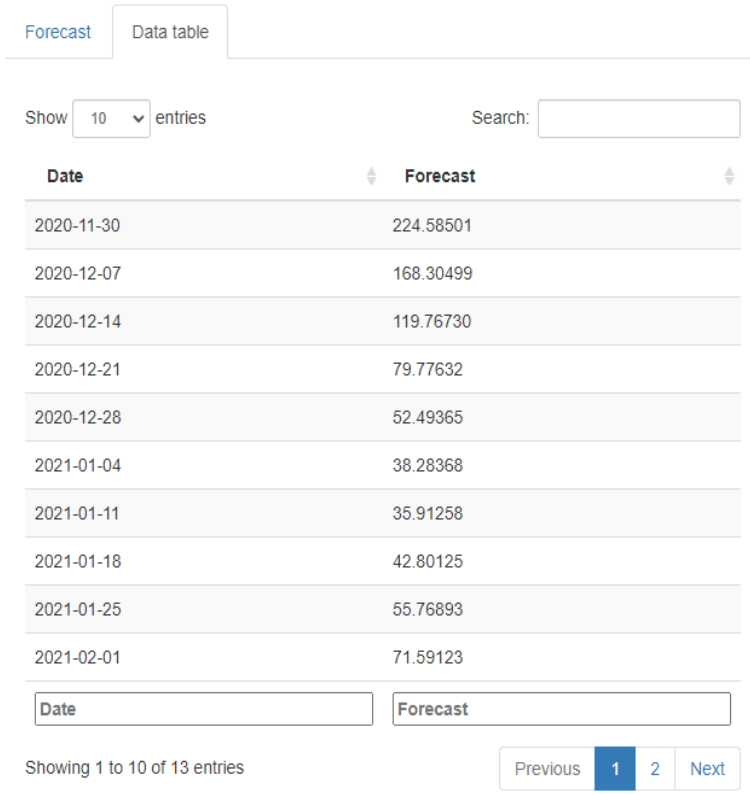
# Univariate Time Series – ETS

This module allows users to fit a Exponential Smoothing model on Dengue Cases and generate forecast




**Forecast**

View forecast results in plot, along with 80% and 95% confidence interval




**Data table**

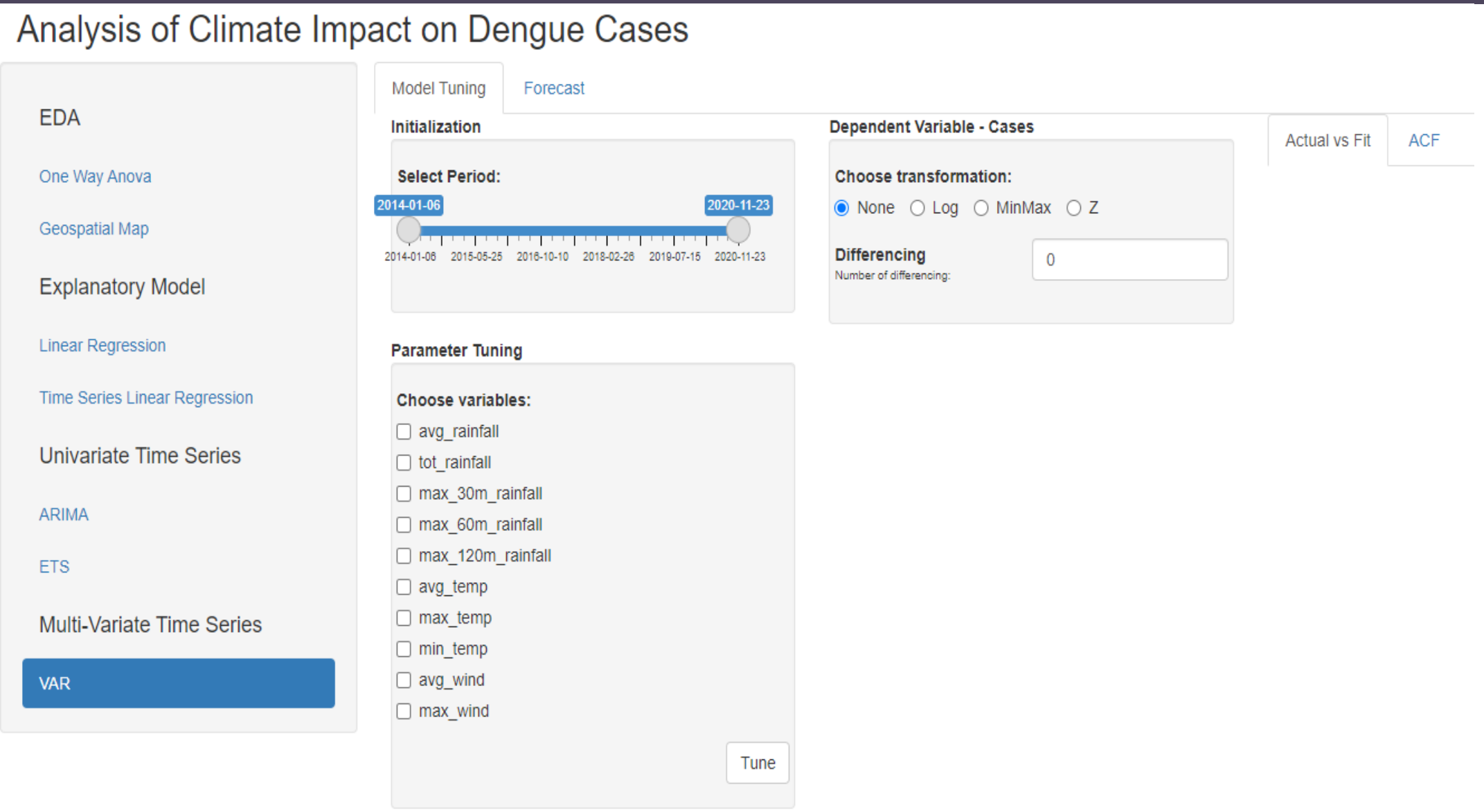
View forecast results in table format

Model Forecast

Users can use these forecast results to compare with that from other models

# Multivariate Time Series – VAR

This module allows users to fit a Vector AutoRegressions model on Dengue Cases and generate forecast



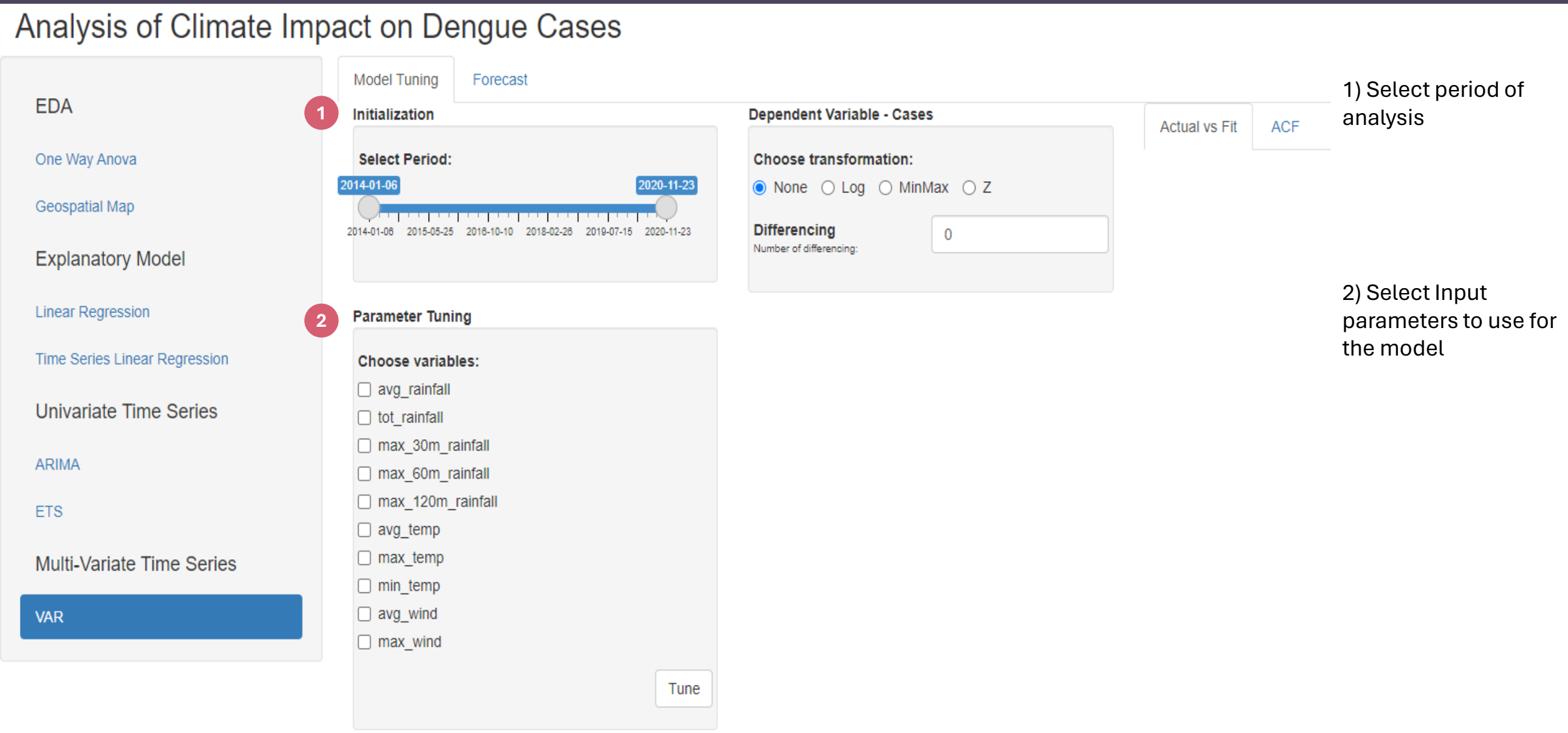

1) Select period of analysis

2) Select Input parameters to use for the model

3) Click “Auto” to fill parameter based on model’s aicc

# Multivariate Time Series – VAR

This module allows users to fit a Vector AutoRegressions model on Dengue Cases and generate forecast

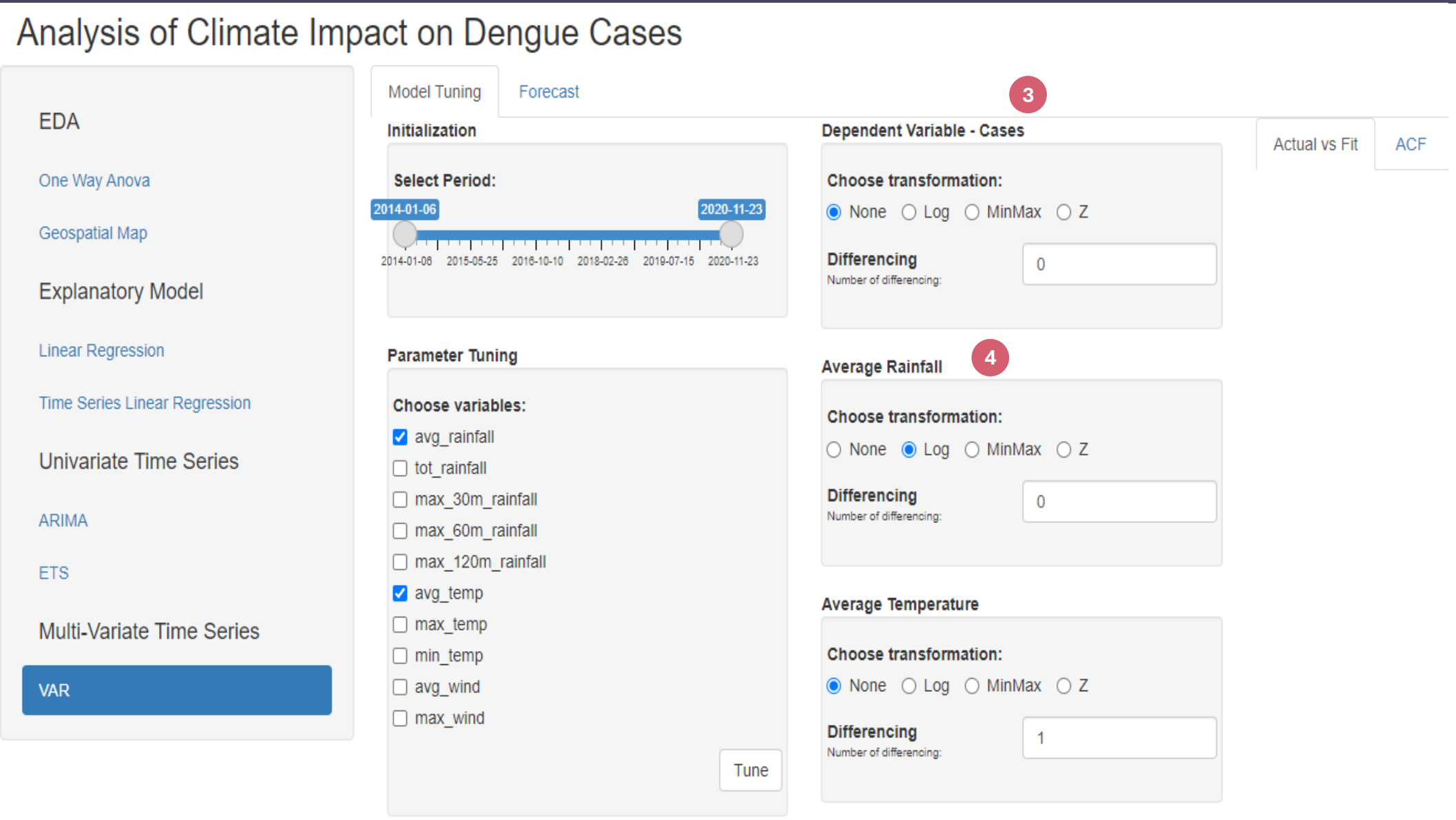



1) Select period of analysis

2) Select Input parameters to use for the model

# Multivariate Time Series – VAR

This module allows users to fit a Vector AutoRegressions model on Dengue Cases and generate forecast




3) Once a variable is added into the model, an additional panel will appear in the middle column

4) Select log transformation or standardization for each variable, if needed

Users can also determine the differencing required

# Multivariate Time Series – VAR

This module allows users to fit a Vector AutoRegressions model on Dengue Cases and generate forecast

## Analysis of Climate Impact on Dengue Cases

EDA
One Way Anova
Geospatial Map
Explanatory Model
Linear Regression
Time Series Linear Regression
Univariate Time Series
ARIMA
ETS
Multi-Variate Time Series
VAR

Model Tuning | Forecast

**Initialization**

**Select Period:** 2014-01-06 – 2020-11-23

2014-01-06 2015-05-25 2016-10-10 2018-02-26 2019-07-15 2020-11-23

**Parameter Tuning**

**Choose variables:**

- [x] avg_rainfall
- [ ] tot_rainfall
- [ ] max_30m_rainfall
- [ ] max_60m_rainfall
- [ ] max_120m_rainfall
- [x] avg_temp
- [ ] max_temp
- [ ] min_temp
- [ ] avg_wind
- [ ] max_wind

5 Tune

**Dependent Variable - Cases**

**Choose transformation:** (•) None ( ) Log ( ) MinMax ( ) Z

**Differencing** Number of differencing: 0

**Average Rainfall**

**Choose transformation:** ( ) None (•) Log ( ) MinMax ( ) Z

**Differencing** Number of differencing: 0

**Average Temperature**

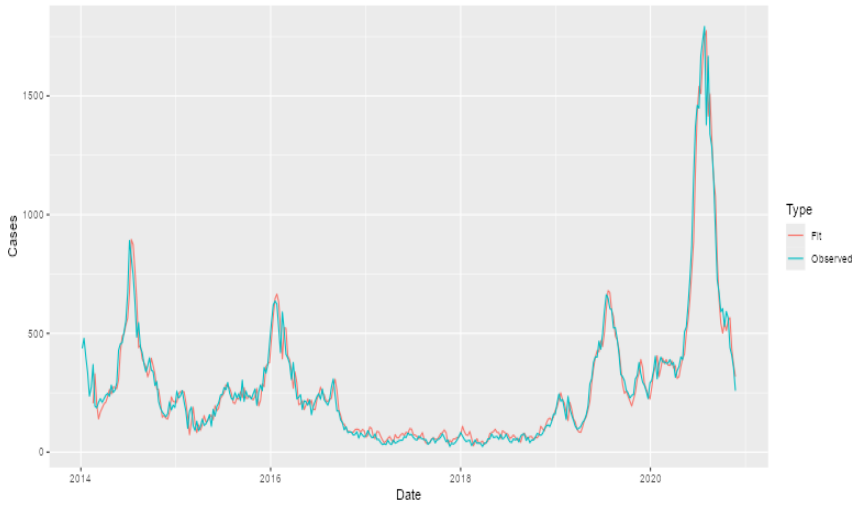
**Choose transformation:** (•) None ( ) Log ( ) MinMax ( ) Z

**Differencing** Number of differencing: 1

6

Actual vs Fit | ACF

Observed vs Fitted




Cross Validation Metrics

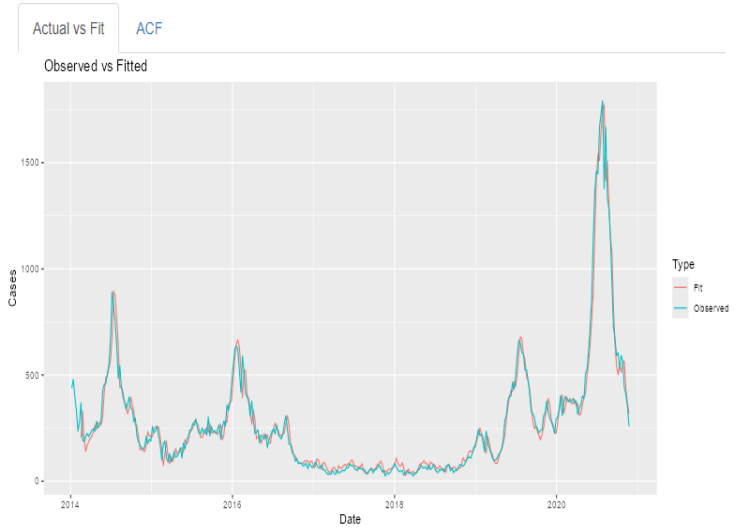
| .response | RMSE | MAE | MAPE |
|---|---|---|---|
| Cases | 61.29 | 37.26 | 36.52 |
| diff1_avg_temp | 0.80 | 0.74 | 111.69 |
| log_avg_rainfall | 0.60 | 0.49 | 41.27 |

6) Toggle through tab panels to view various model diagnostics

5) Click “Tune” to generate results

# Multivariate Time Series – VAR

This module allows users to fit a Vector AutoRegressions model on Dengue Cases and generate forecast

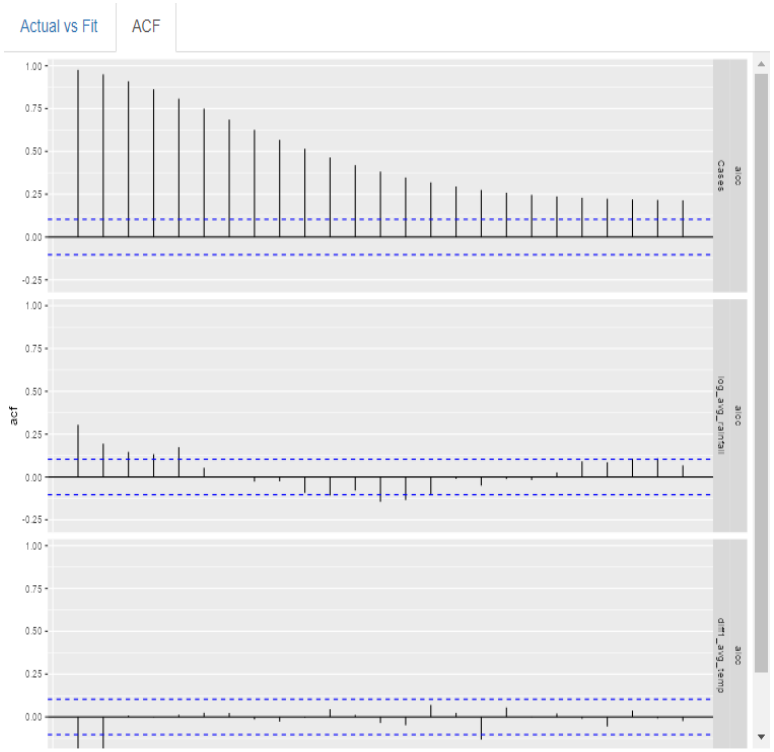



Cross Validation Metrics

| .response | RMSE | MAE | MAPE |
|---|---|---|---|
| Cases | 61.29 | 37.26 | 36.52 |
| diff1_avg_temp | 0.80 | 0.74 | 111.69 |
| log_avg_rainfall | 0.60 | 0.49 | 41.27 |

**Actual vs Fit**

Check model fit and metrics of individual responses

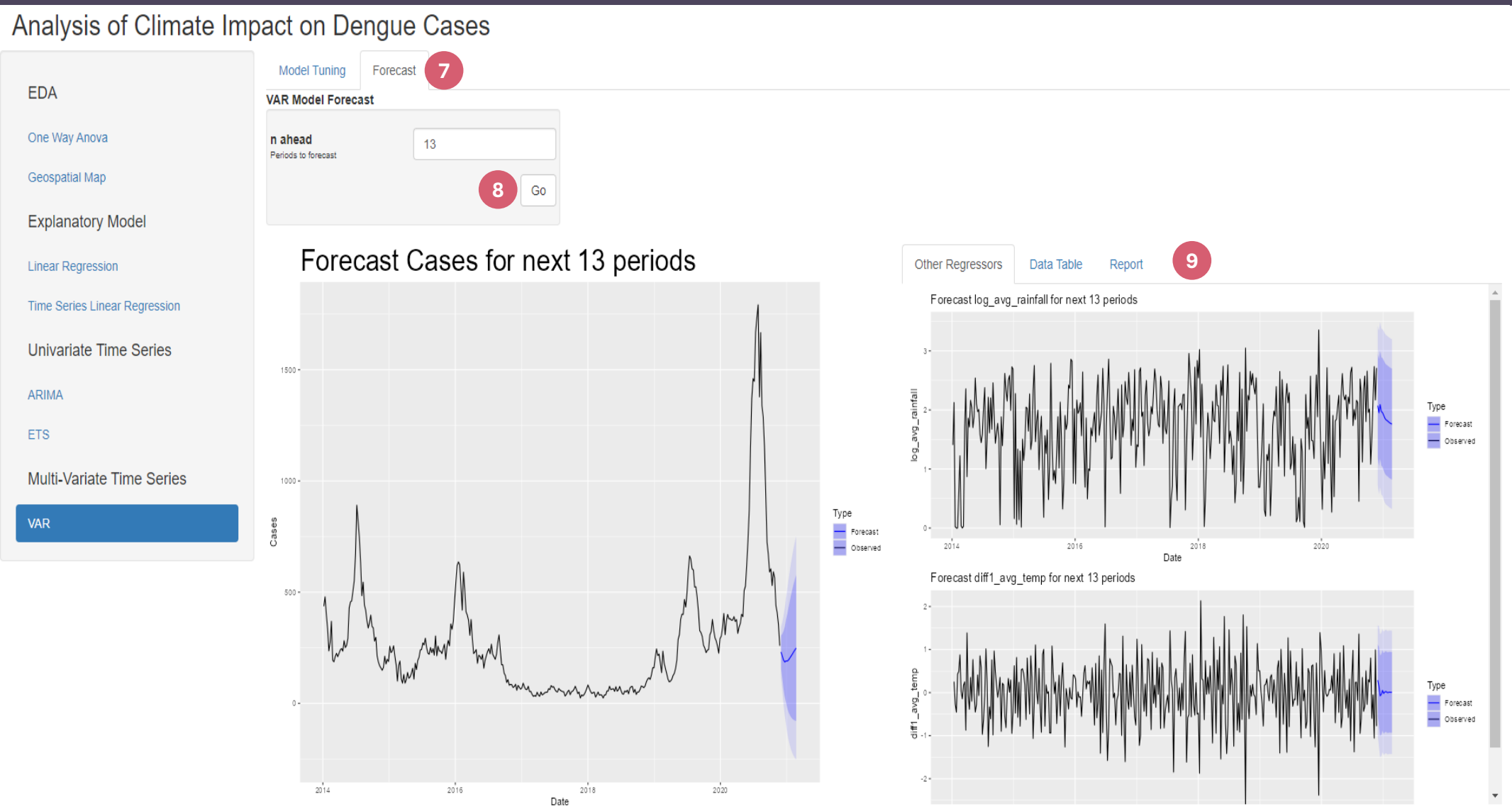



**ACF**

Check ACF plots for all variables to determine stationarity

# Multivariate Time Series – VAR

This module allows users to fit a Vector AutoRegressions model on Dengue Cases and generate forecast



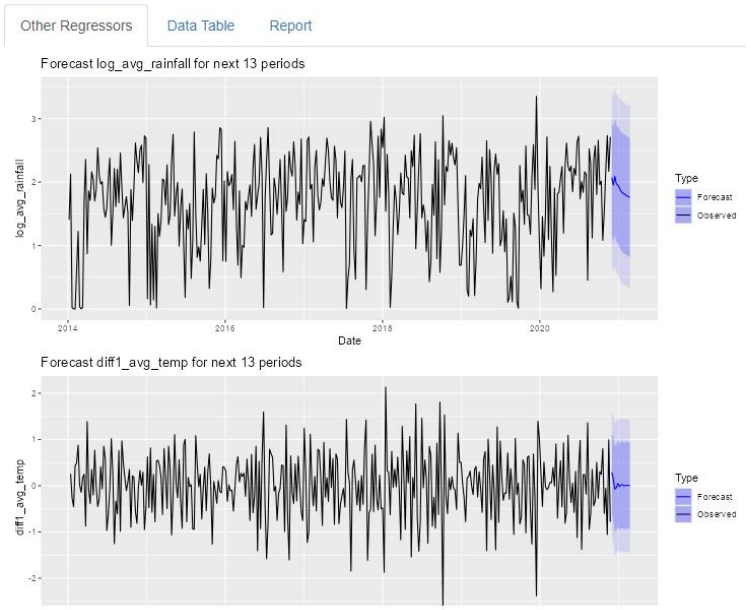

7) Toggle to "Forecast" tab panel for forecasting

8) Click"Go" to generate forecast

9) Toggle between tab panels for various forecast results

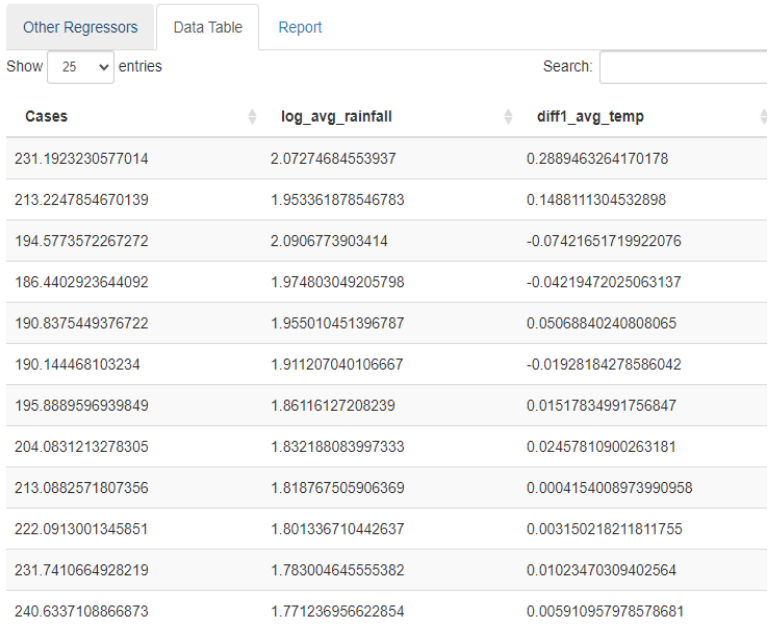
# Multivariate Time Series – VAR

This module allows users to fit a Vector AutoRegressions model on Dengue Cases and generate forecast




**Other Regressors**

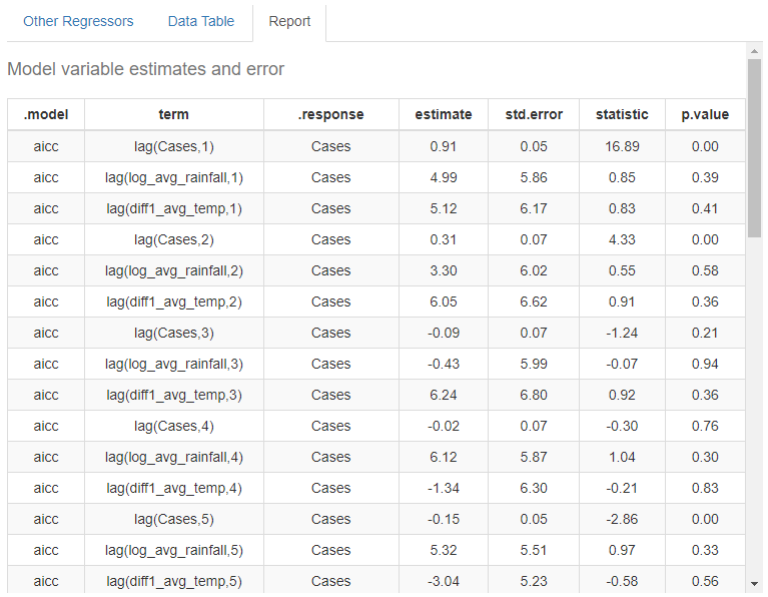
View the time series forecast of each individual regressors in the VAR model




| Cases | log_avg_rainfall | diff1_avg_temp |
|---|---|---|
| 231.1923230577014 | 2.07274684553937 | 0.2889463264170178 |
| 213.2247854670139 | 1.953361878546783 | 0.1488111304532898 |
| 194.5773572267272 | 2.0906773903414 | -0.07421651719922076 |
| 186.4402923644092 | 1.974803049205798 | -0.04219472025063137 |
| 190.8375449376722 | 1.955010451396787 | 0.05068840240808065 |
| 190.144468103234 | 1.911207040106667 | -0.01928184278586042 |
| 195.8889596939849 | 1.86116127208239 | 0.01517834991756847 |
| 204.0831213278305 | 1.832188083997333 | 0.02457810900263181 |
| 213.0882571807356 | 1.818767505906369 | 0.0004154008973990958 |
| 222.0913001345851 | 1.801336710442637 | 0.003150218211811755 |
| 231.7410664928219 | 1.783004645555382 | 0.01023470309402564 |
| 240.6337108866873 | 1.771236956622854 | 0.005910957978578681 |

**Data Table**

Obtain the forecast results in table format




| .model | term | .response | estimate | std.error | statistic | p.value |
|---|---|---|---|---|---|---|
| aicc | lag(Cases,1) | Cases | 0.91 | 0.05 | 16.89 | 0.00 |
| aicc | lag(log_avg_rainfall,1) | Cases | 4.99 | 5.86 | 0.85 | 0.39 |
| aicc | lag(diff1_avg_temp,1) | Cases | 5.12 | 6.17 | 0.83 | 0.41 |
| aicc | lag(Cases,2) | Cases | 0.31 | 0.07 | 4.33 | 0.00 |
| aicc | lag(log_avg_rainfall,2) | Cases | 3.30 | 6.02 | 0.55 | 0.58 |
| aicc | lag(diff1_avg_temp,2) | Cases | 6.05 | 6.62 | 0.91 | 0.36 |
| aicc | lag(Cases,3) | Cases | -0.09 | 0.07 | -1.24 | 0.21 |
| aicc | lag(log_avg_rainfall,3) | Cases | -0.43 | 5.99 | -0.07 | 0.94 |
| aicc | lag(diff1_avg_temp,3) | Cases | 6.24 | 6.80 | 0.92 | 0.36 |
| aicc | lag(Cases,4) | Cases | -0.02 | 0.07 | -0.30 | 0.76 |
| aicc | lag(log_avg_rainfall,4) | Cases | 6.12 | 5.87 | 1.04 | 0.30 |
| aicc | lag(diff1_avg_temp,4) | Cases | -1.34 | 6.30 | -0.21 | 0.83 |
| aicc | lag(Cases,5) | Cases | -0.15 | 0.05 | -2.86 | 0.00 |
| aicc | lag(log_avg_rainfall,5) | Cases | 5.32 | 5.51 | 0.97 | 0.33 |
| aicc | lag(diff1_avg_temp,5) | Cases | -3.04 | 5.23 | -0.58 | 0.56 |

**Report**

Gain insights on variable estimates and statistics