# Surface Incoming Solar Radiation Over Egypt , Climatological Study

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# Objectives

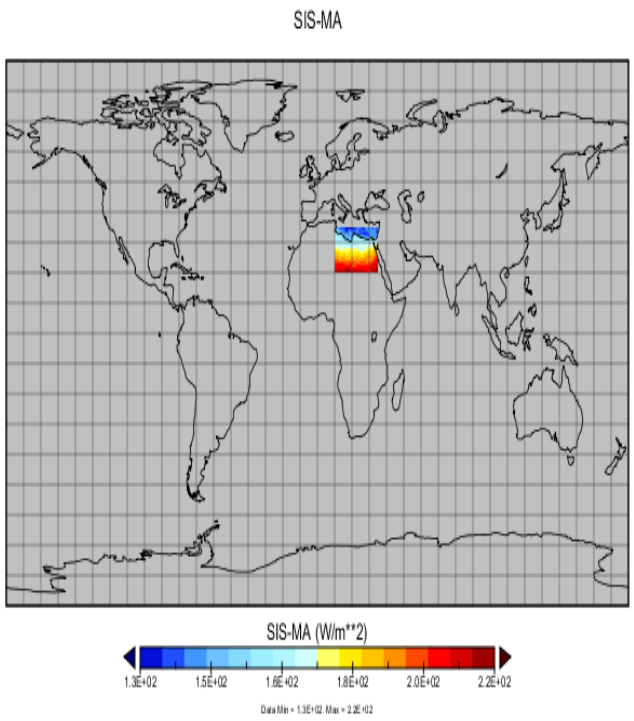
- *CM SAF PRODUCTS AND DATASETS..
- *WHY WE CHOOSE SIS
- *TWO YEARS MONTHLY MEAN DATA TO SHOW THE SIS TIME SERIES
- *WORK ON DAILY MEAN DATA FOR CHAOTIC TIME SERIES PREDICTION

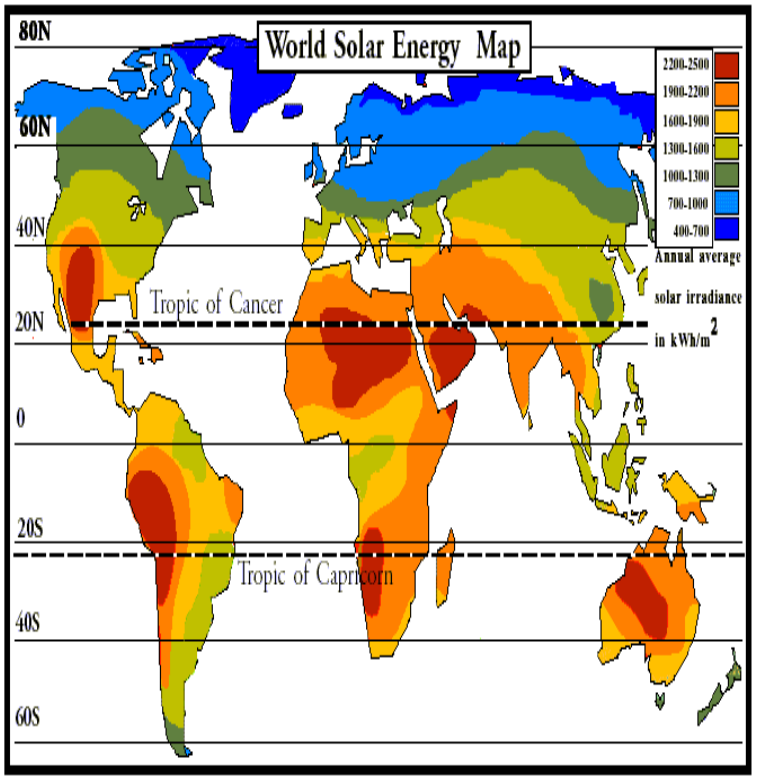
By Studying the solar radiation calculations and examining radiation measurements, we can:

*gain a better understanding of many physical cycles and concepts associated with the Earth system.

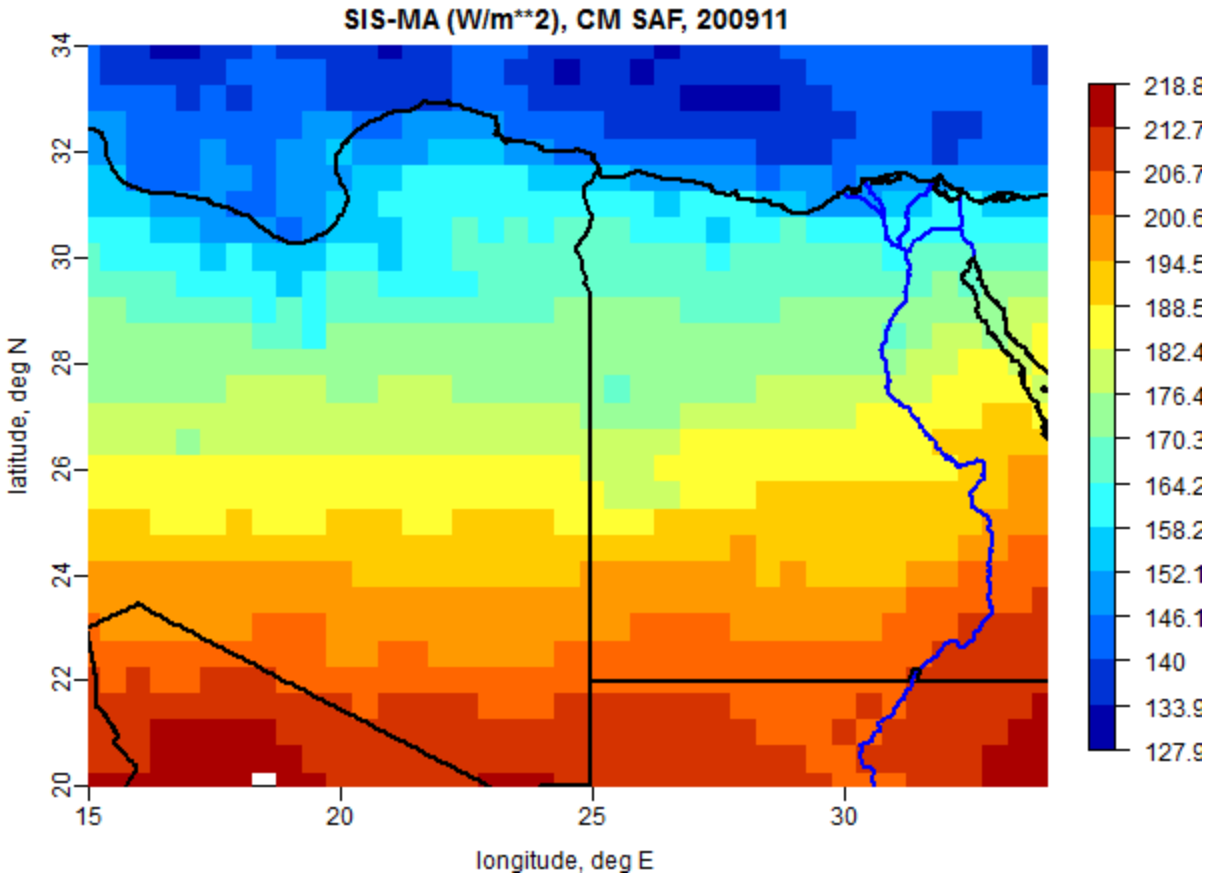
*Climate variation and seasonal change of radiation can give a global idea in the development if renewable energy field was considered

# Select SIS product to study over Egypt

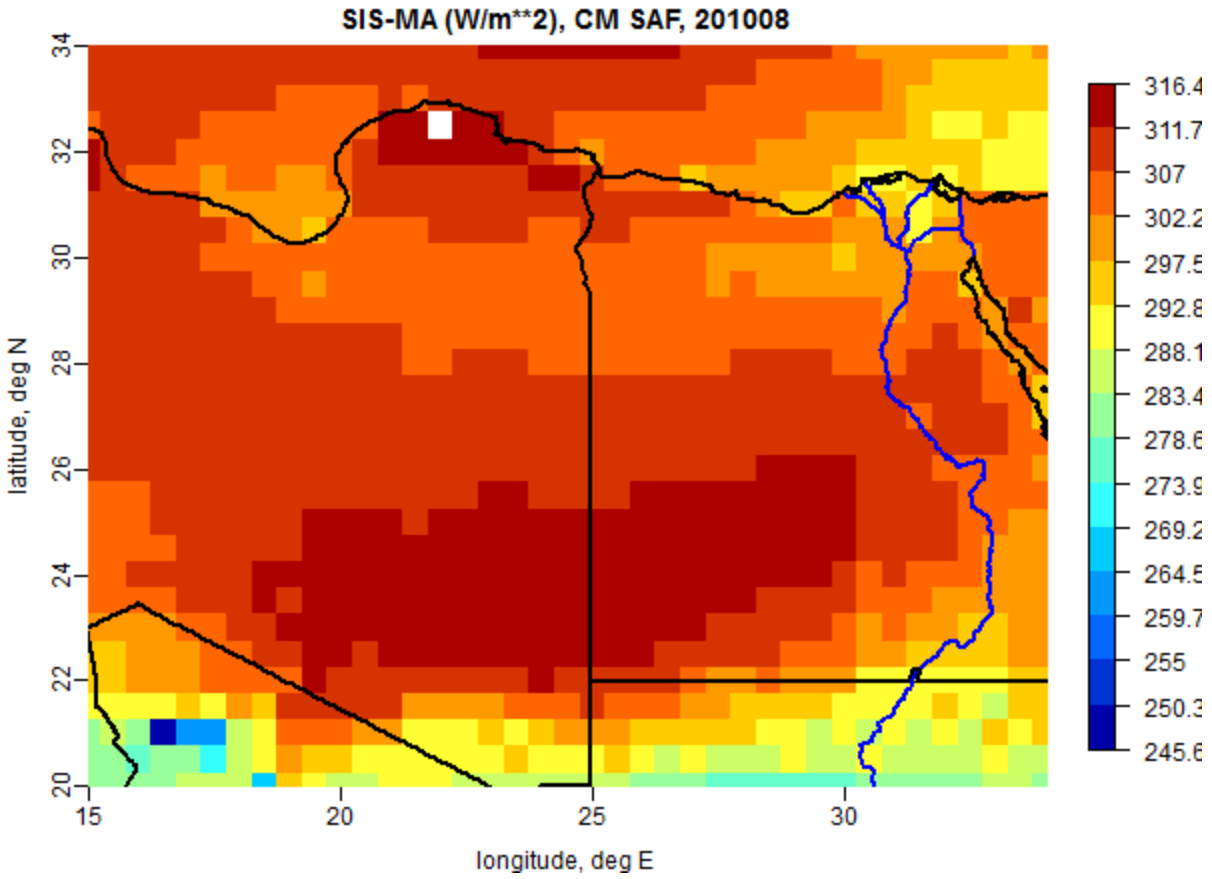


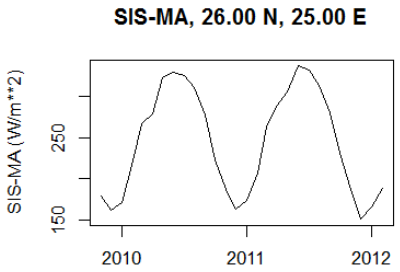
# SIS Over The Selected Area

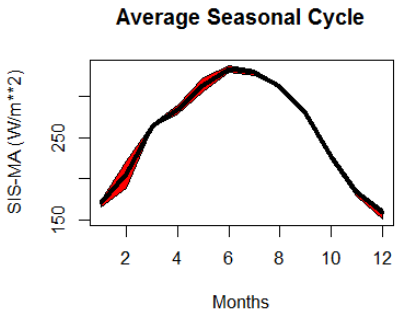


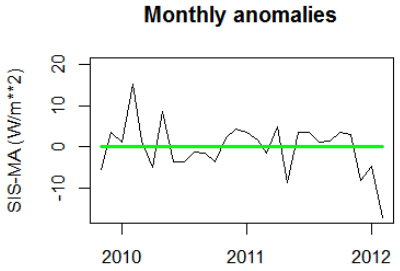
# Anomalies

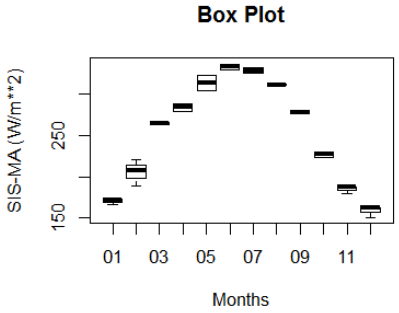

SIS-MA (W/m**2), CM SAF, 201008
latitude, deg N
longitude, deg E
20
22
24
26
28
30
32
34
15
20
25
30
316.4
311.7
307
302.2
297.5
292.8
288.1
283.4
278.6
273.9
269.2
264.5
259.7
255
250.3
245.6

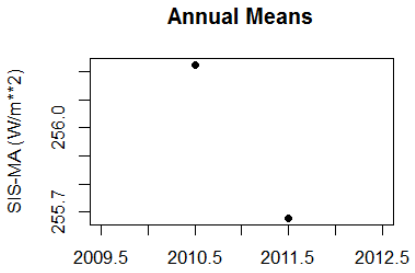
# Study The Time Series

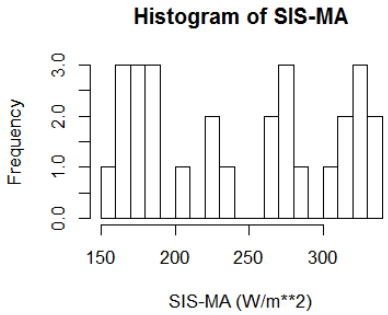


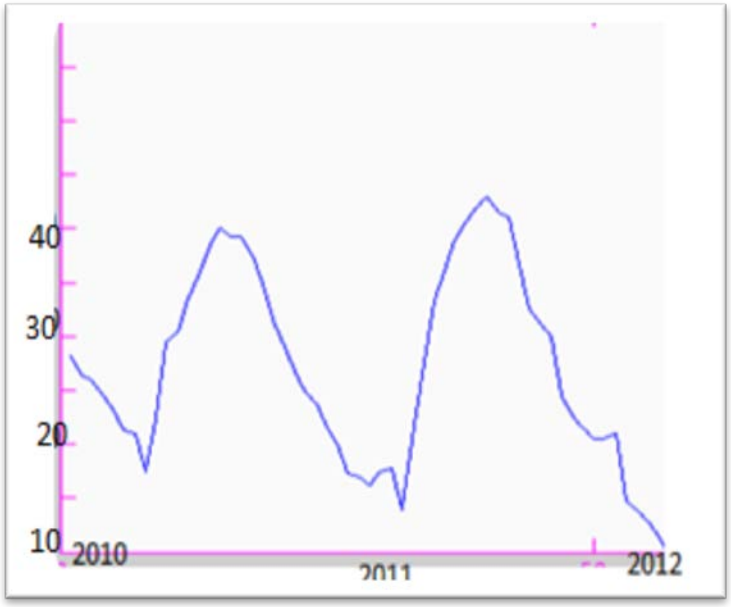



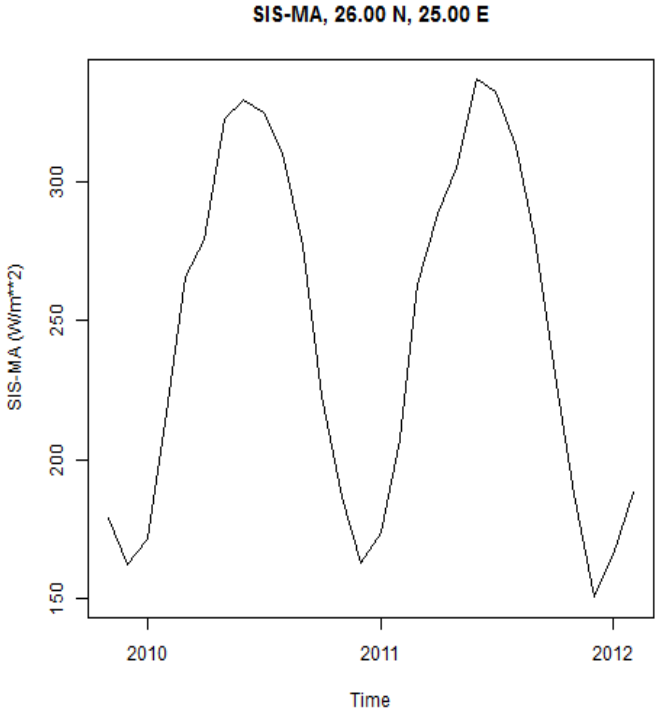



# Cairo temperature

- Temerature




- SIS



## ANFIS in Chaotic Time Series Prediction

Time series can be applied in wide variety of applications. The prediction of future values based on past and/or present information. Many established methods in time series prediction has been published.

In time series analysis, there are two main goals: First, determining the nature of the phenomenon represented by continues observations, second prediction future values (Hamilton, James D 1994).

The non-linear system in which the output has high degree of sensitivity to the initial conditions is considered having chaotic behavior (Casdagli, 1992).
The delay differential equations (DDEs) can describe mathematically this chaotic behavior
From the most commonly used DDE is the Mackey-Glass model (Glass and Mackey, 1988) which was introduced as a model for the production of white blood cells then used in many time series problems (R.N. Yadav , P.K. Kalra, J. John, 2007). The model is given by the following equation:

$$\frac{dx}{dt} = Ax_\tau \frac{\theta^n}{\theta^n + {x_\tau}^n} - Bx$$

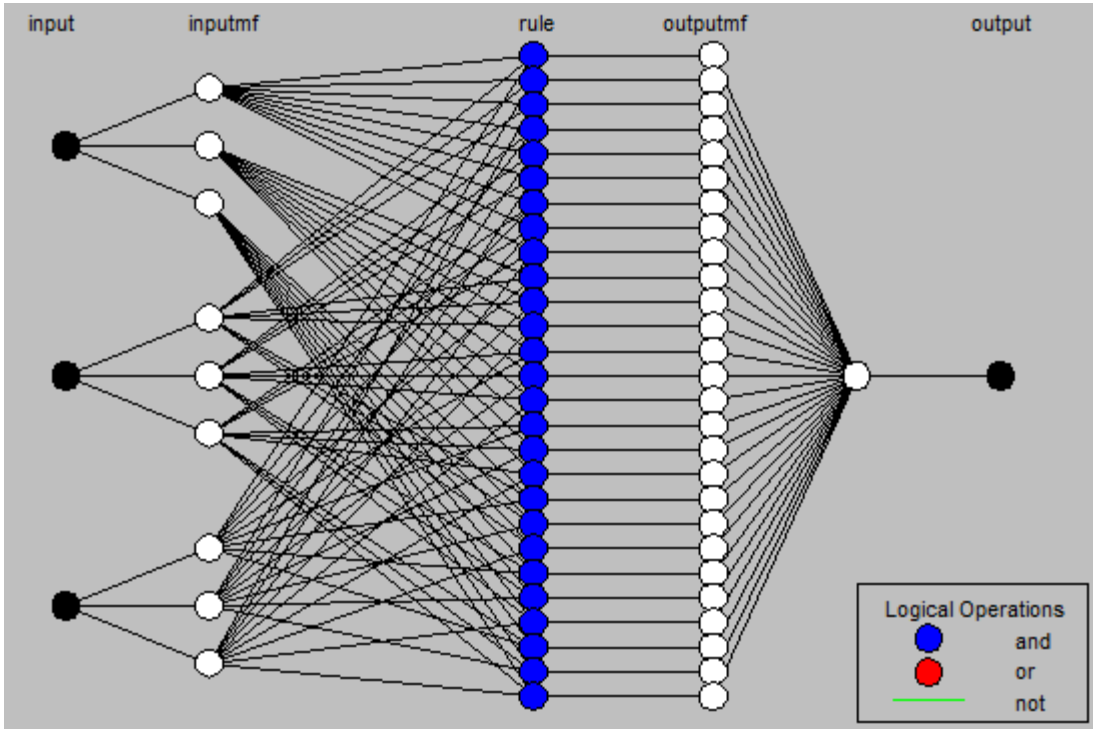
Where A, $\theta$and n are parameters. For $\tau$>17, this equation is known to exhibit chaos

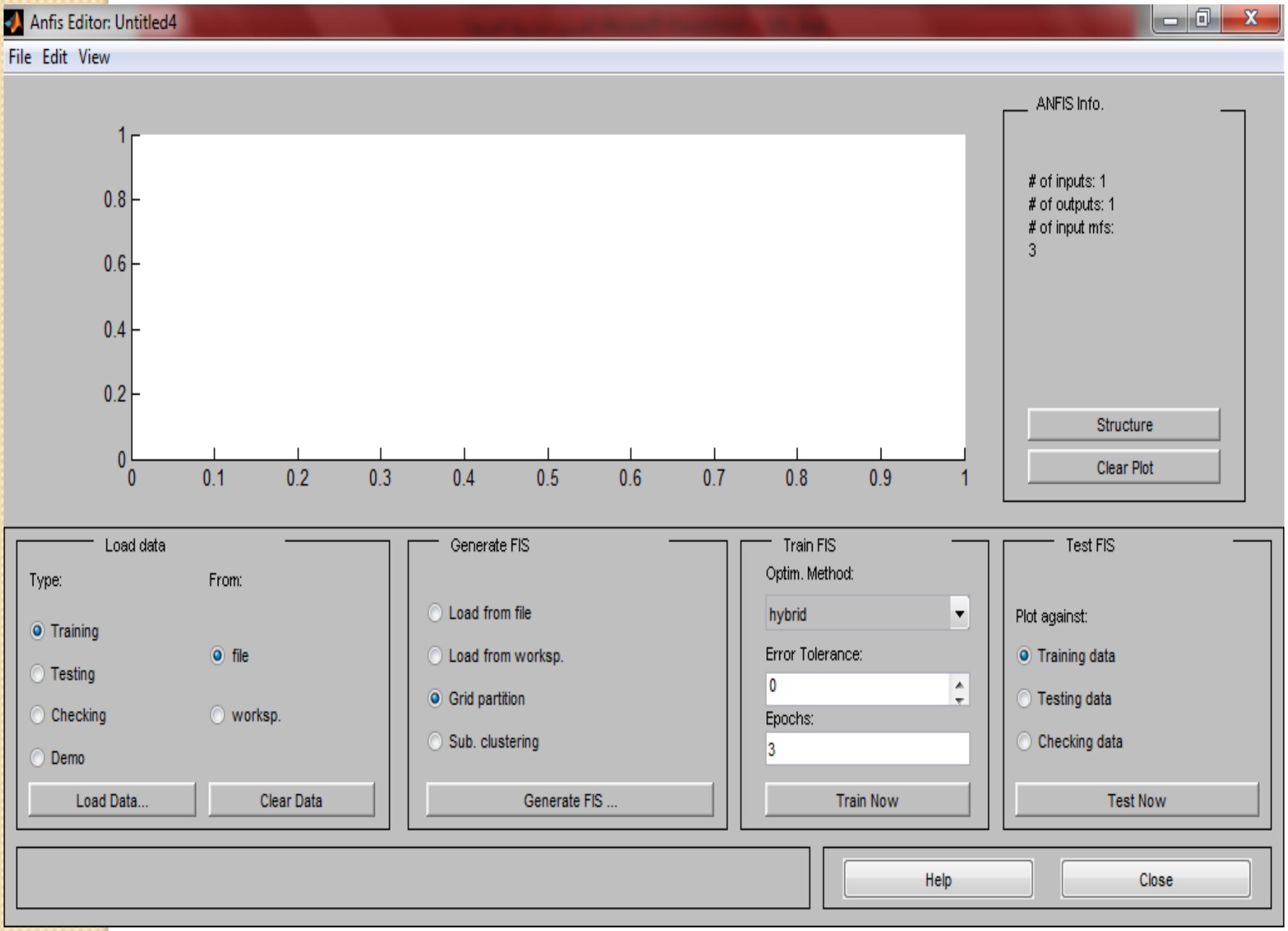
## Adaptive Neuro Fuzzy Inference system (ANFIS)

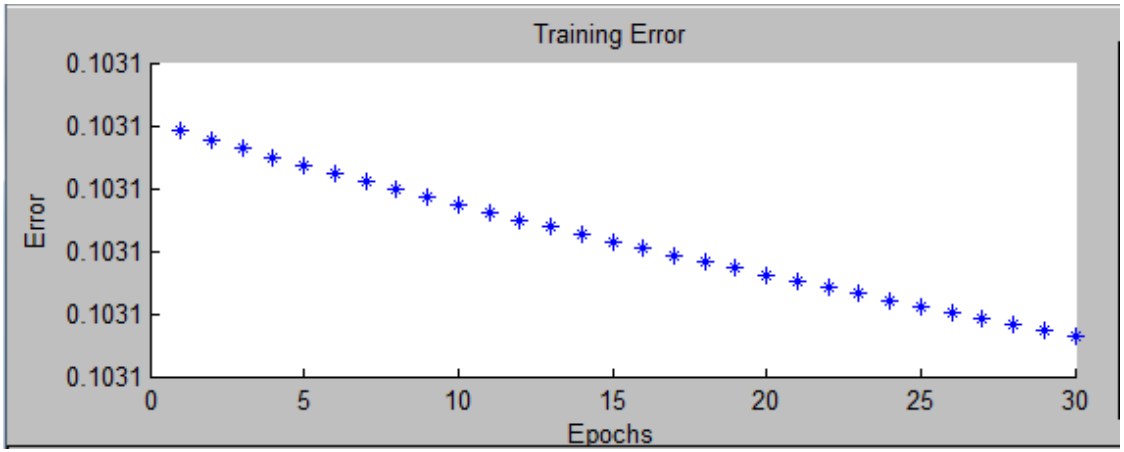
*ANFIS introduced by Jang (1993) can use for constructing a set of fuzzy IF-THEN rules with appropriate membership functions

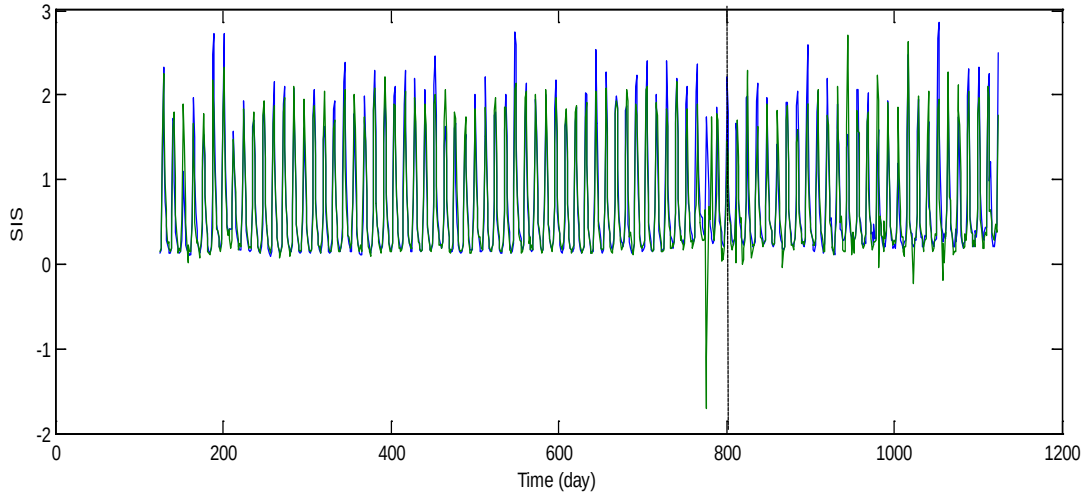
- generate the input-output pairs.
- Since, the membership functions are changed through the training process to get good results (Ciji Pearl Kurian et al., 2006).
- The membership function pattern used for the input series in this work is gebell shape

# Basic ANFIS Architecture




Anfis Editor: Untitled4
File Edit View
1
0.8
0.6
0.4
0.2
0
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1
ANFIS Info.
# of inputs: 1
# of outputs: 1
# of input mfs:
3
Structure
Clear Plot
Load data
Type:
From:
Training
Testing
Checking
Demo
file
worksp.
Load Data...
Clear Data
Generate FIS
Load from file
Load from worksp.
Grid partition
Sub. clustering
Generate FIS ...
Train FIS
Optim. Method:
hybrid
Error Tolerance:
0
Epochs:
3
Train Now
Test FIS
Plot against:
Training data
Testing data
Checking data
Test Now
Help
Close


Training Error
Error
0.1031
0.1031
0.1031
0.1031
0.1031
0.1031
0
5
10
15
20
25
30
Epochs


SIS
3
2
1
0
-1
-2
0
200
400
600
800
1000
1200
Time (day)