Flood Prediction Using Artificial Neural Networks: A case study of Lower Tallapoosa, Alabama

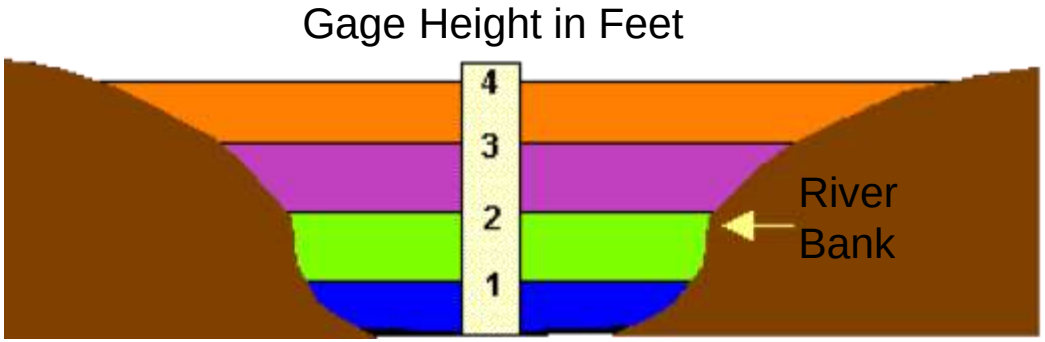
- Rajesh Sawant
PhD Student,
School of Forestry and Wildlife Sciences
Auburn University, Auburn

Introduction

- Background
- Hypothesis and Objective
- ANN Model introduction
- Model concept
- Site
- Methodology
- Model Output
- Decision Making

Background

- How does the height of water in a stream relate to the amount of water flowing?



- Upstream and Downstream relationship.
- Use of ANN in streamflow prediction.

Hypothesis and Objective

Hypothesis:

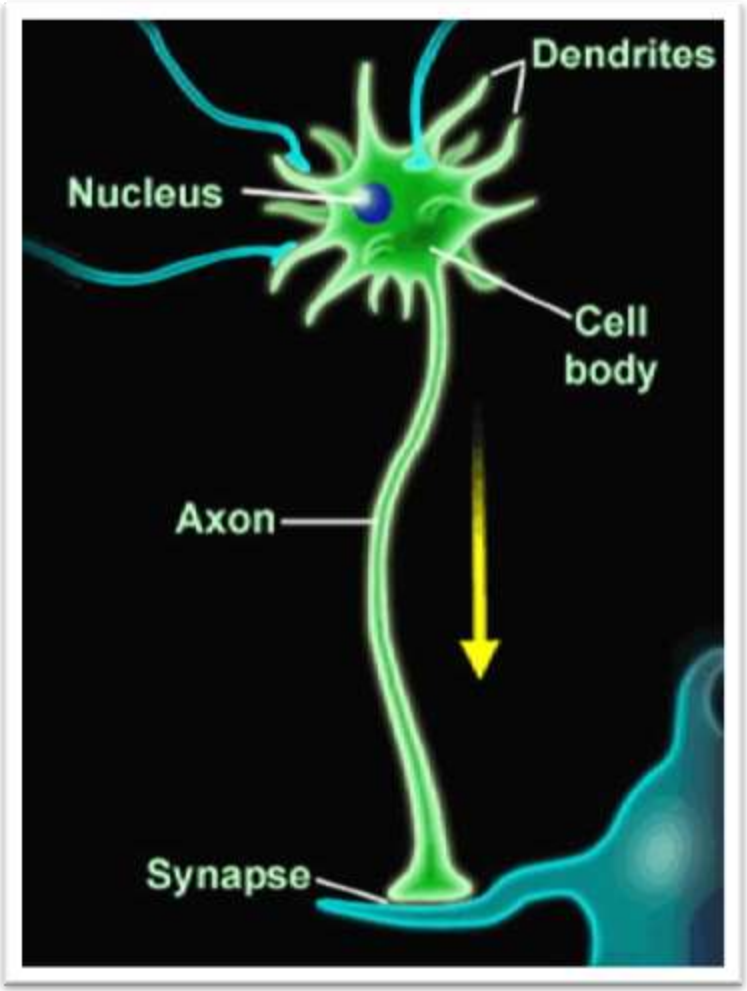
- Using hydro-climatic data from upstream in an ANN model for predicting streamflow at downstream gages.

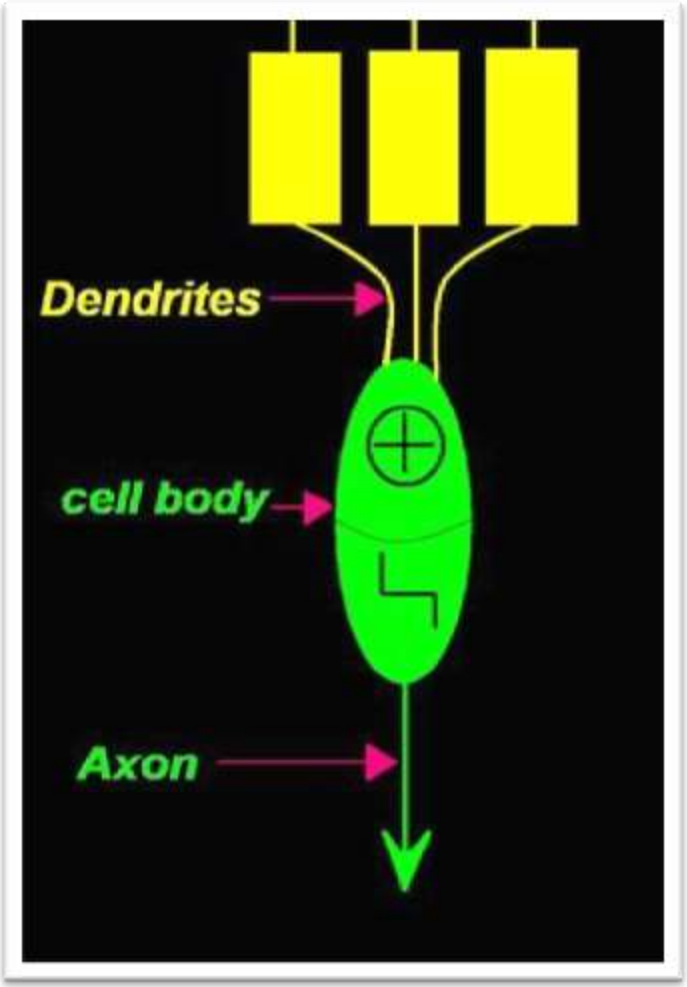
Objective:

- Develop an ANN Model for downstream streamflow prediction using upstream streamflow, stream level and weather parameters such as precipitation and temperature.

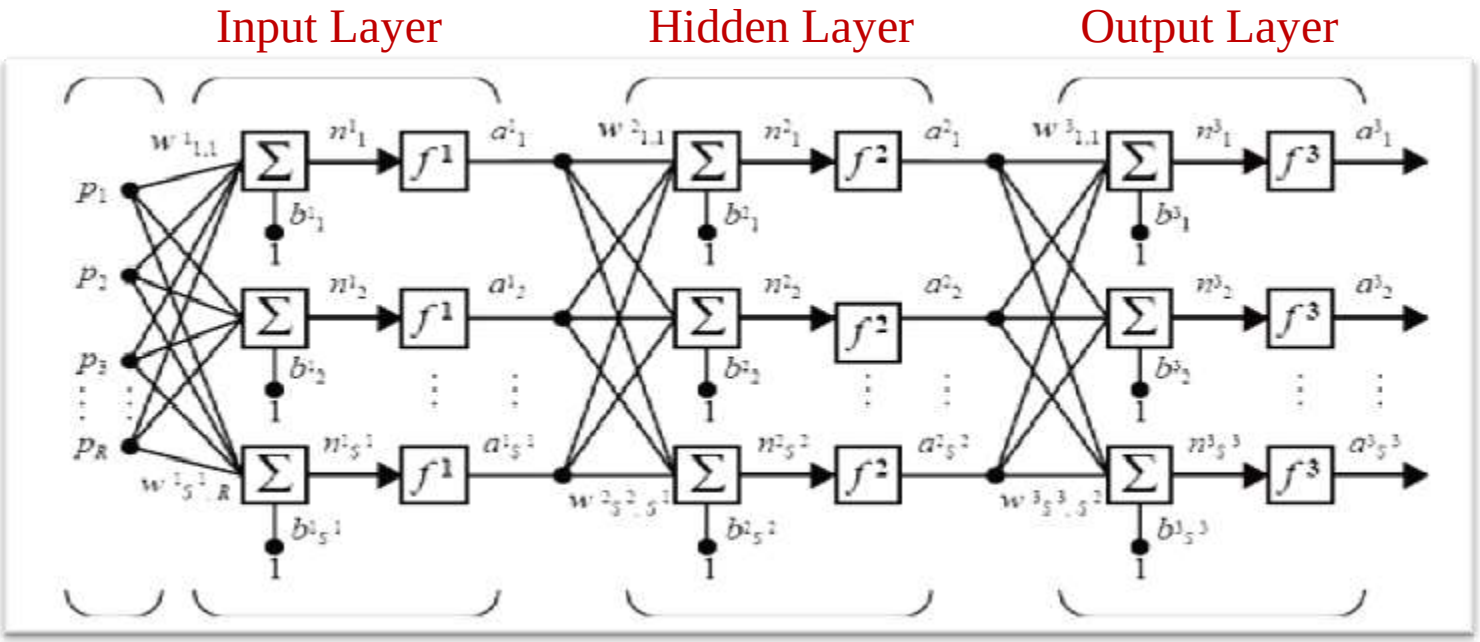
Artificial Neural Network (ANN)

- Neurons

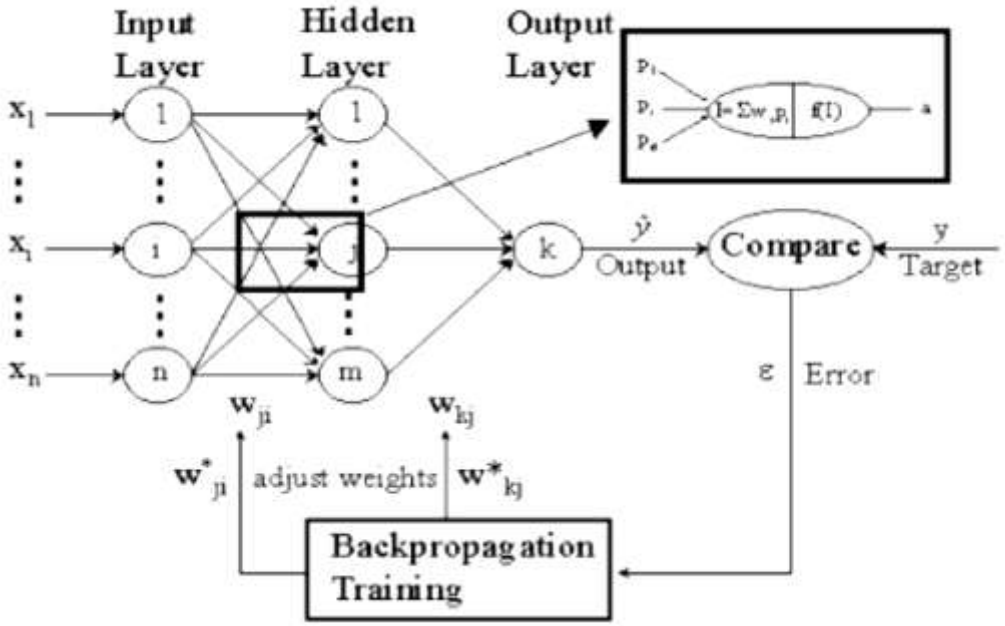


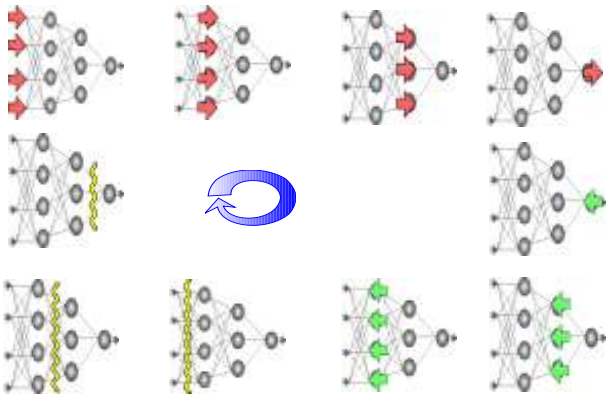


General Structure of Multi Layer Perceptron (MPL) for Stream Gage Modeling

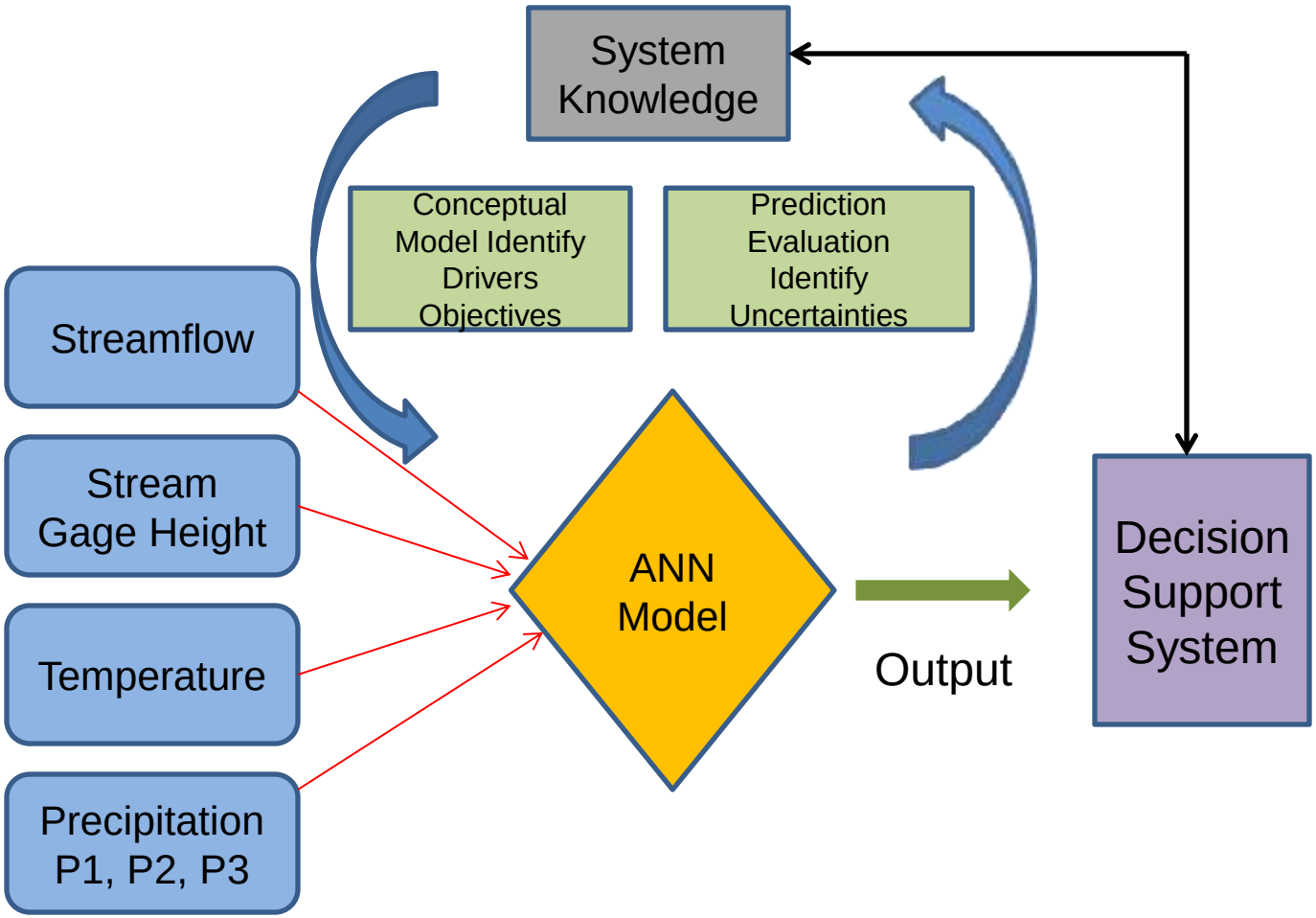


Weight and Bias Optimization

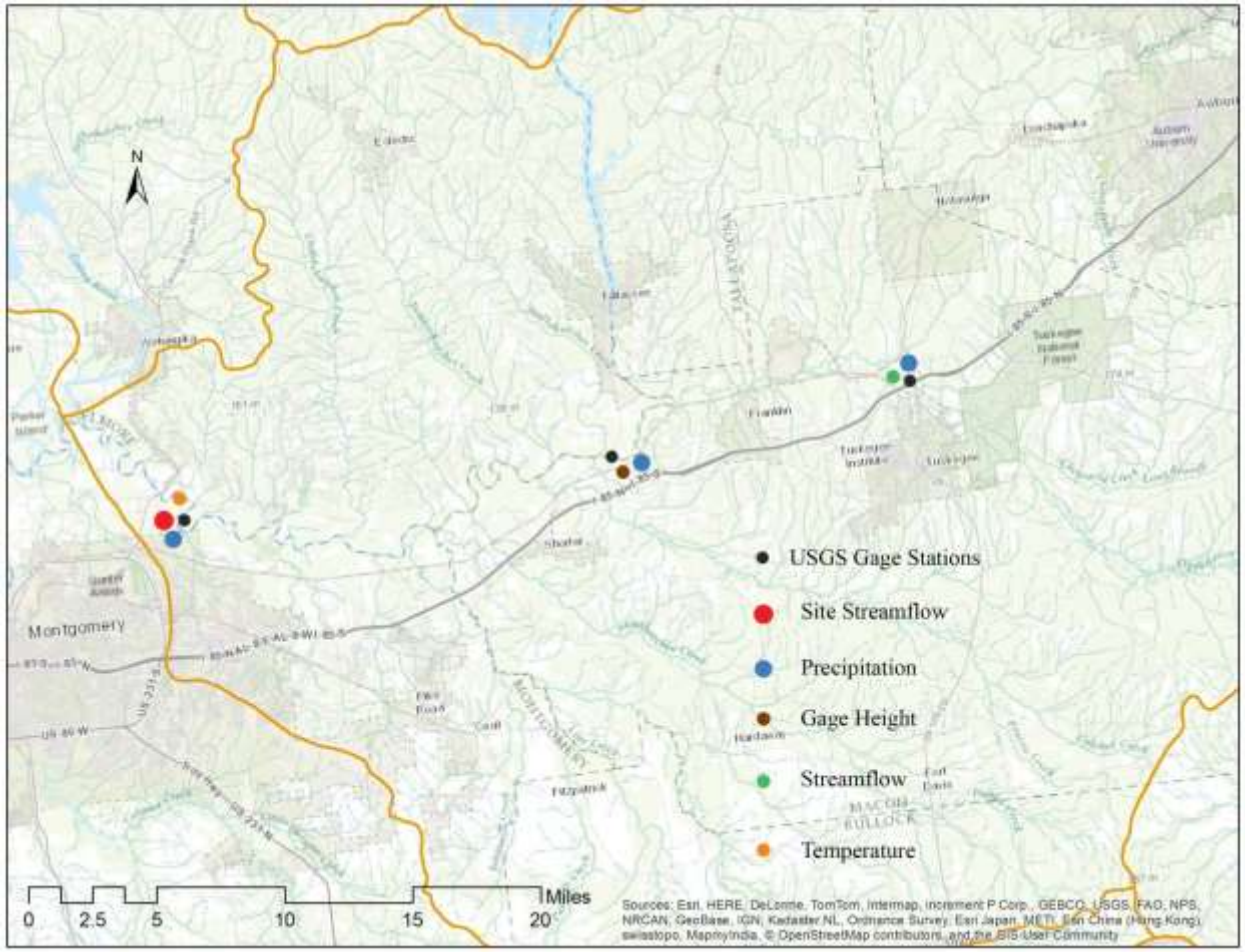




Conceptual Model



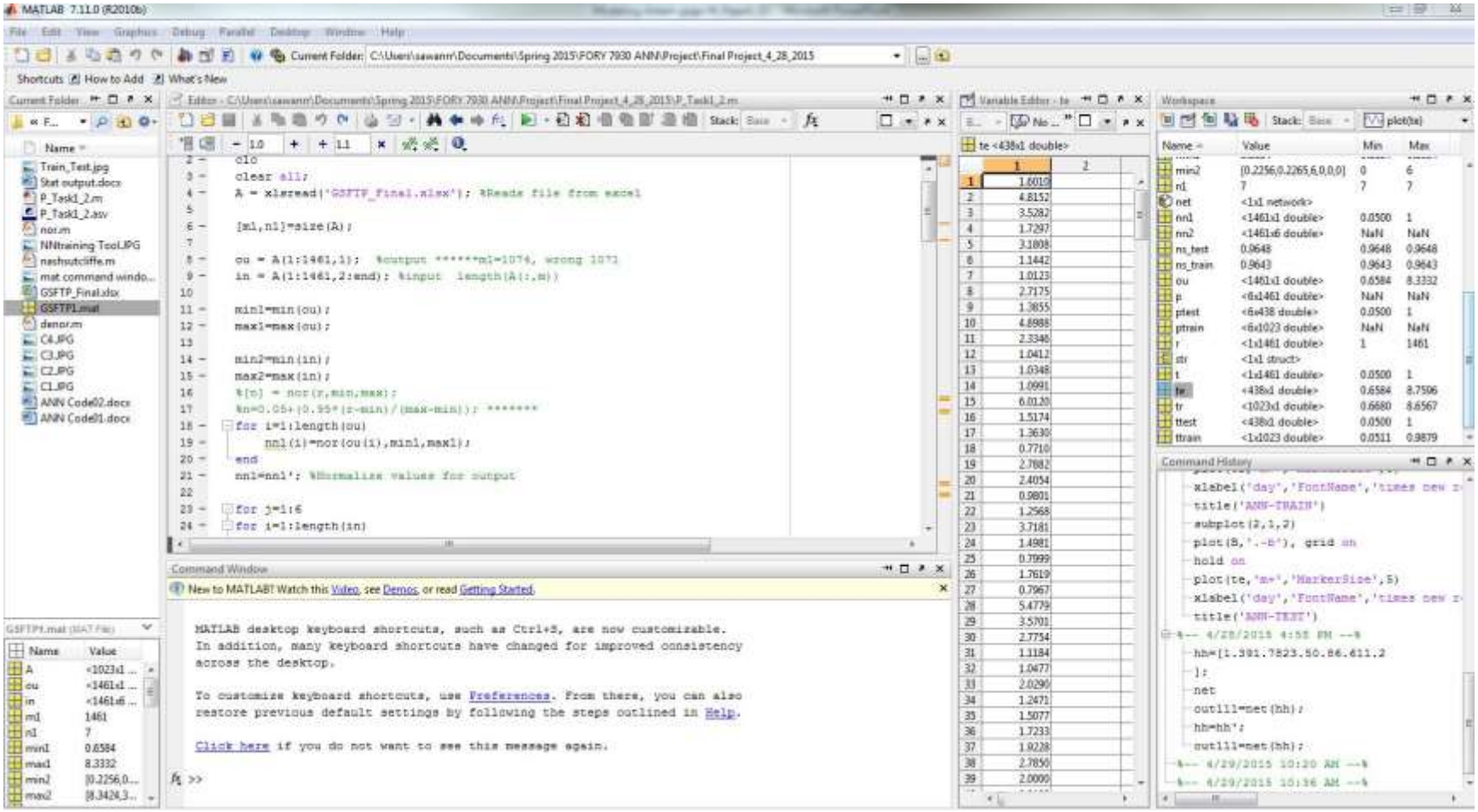
Site: Tallapoosa River at Montgomery Water Works



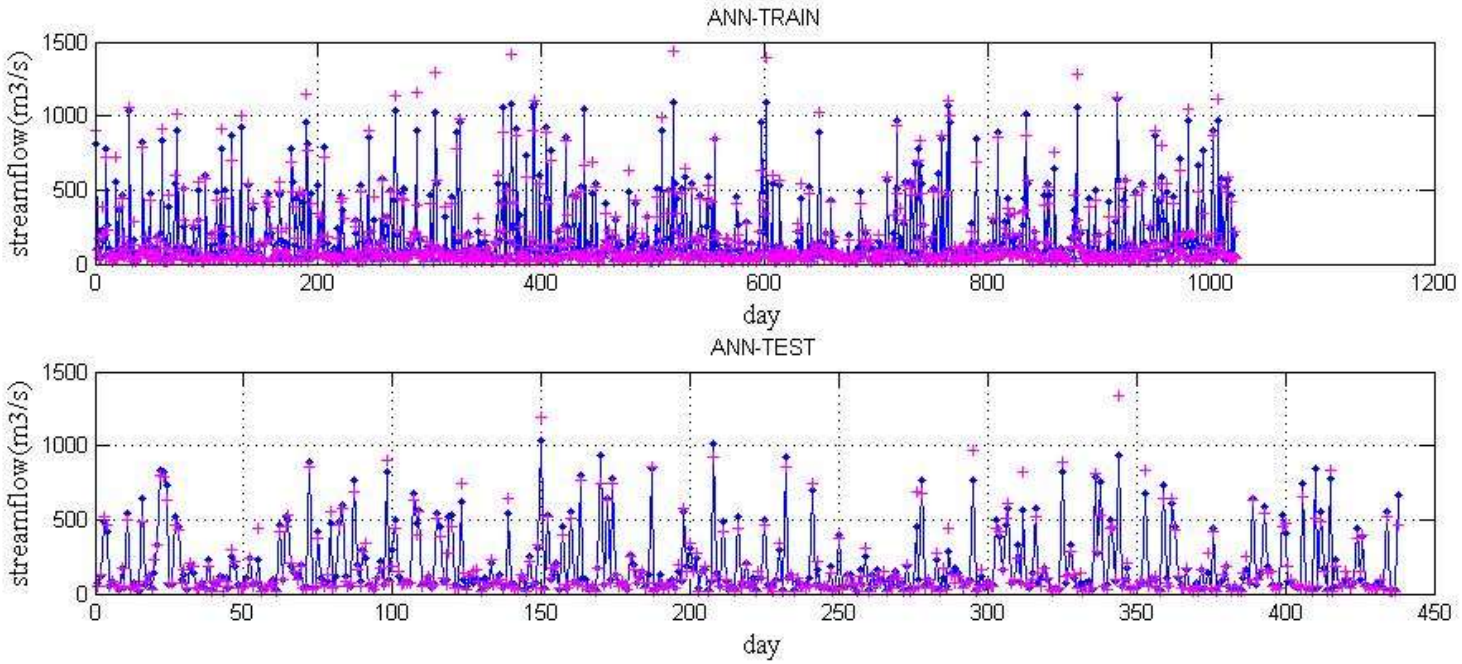
ANN Model Workflow

- Clean the dataset
- Read dataset
- Normalize dataset
- Randomize dataset
- Splitting the dataset
- Train network and Test network
- Denormalize dataset
- Read output

ANN Model Code

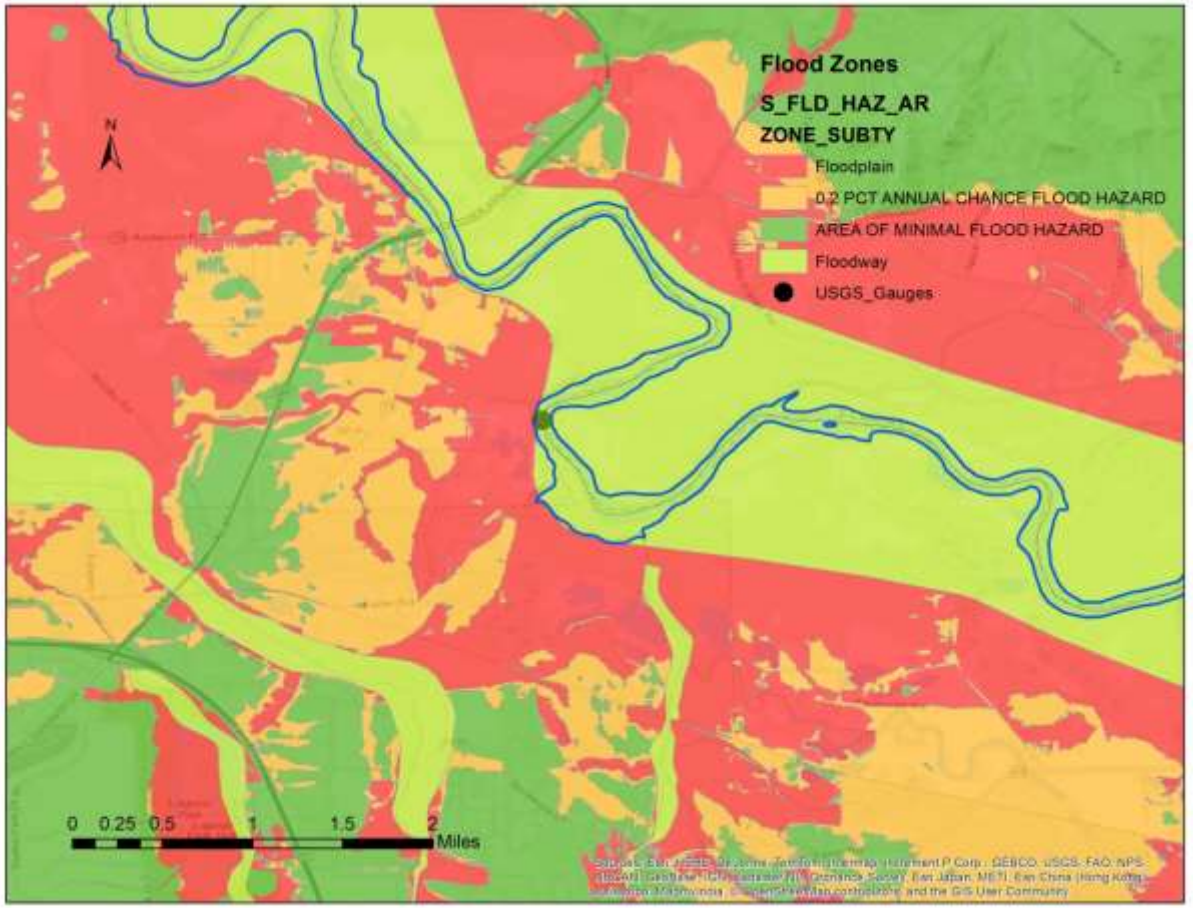


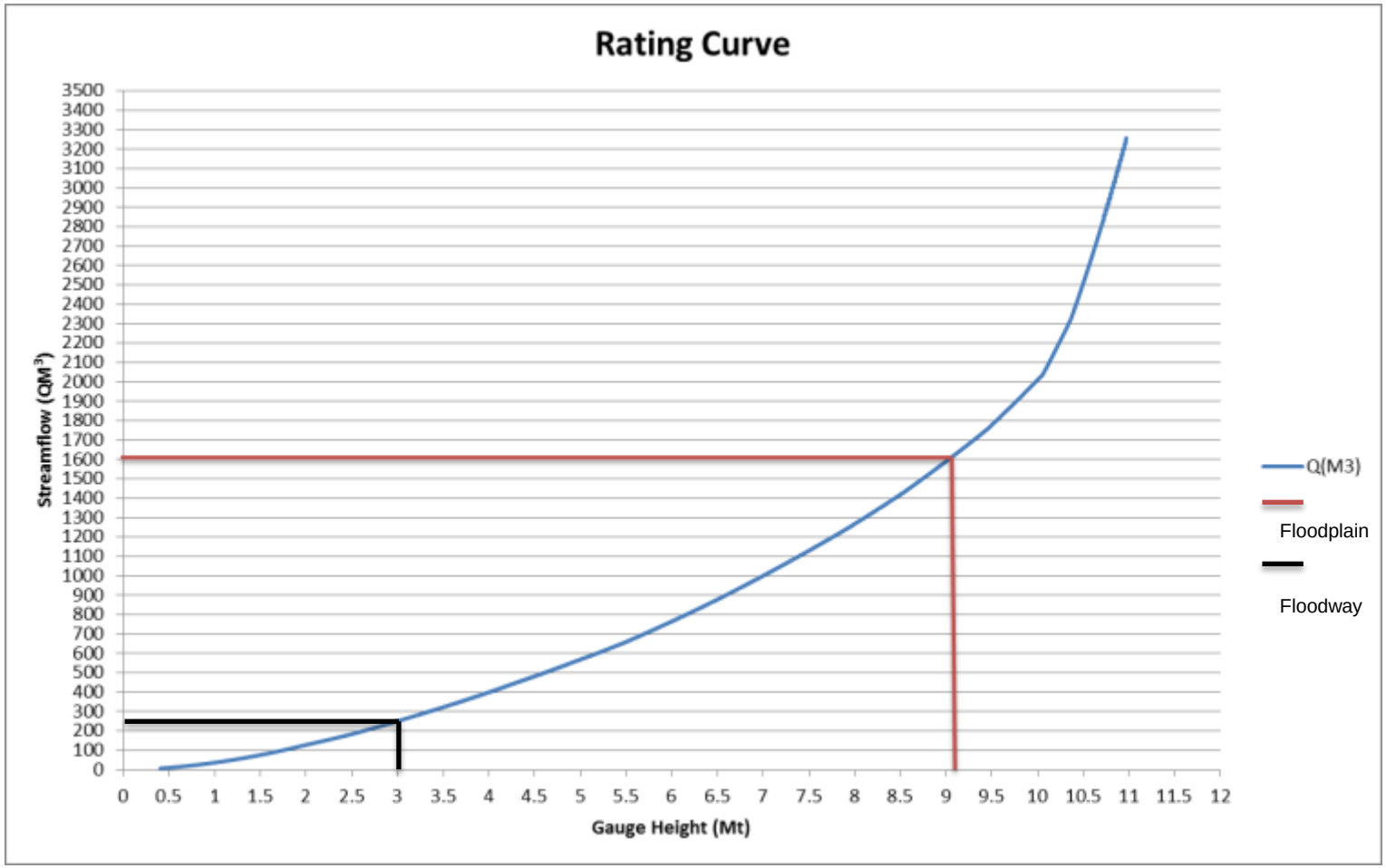
ANN Model Graph Output



Combination (Train)	Nash	R2	RMSE M3/s
ANNCP4	0.9506	0.9506	49.1912
Combination (Test)	Nash	R2	RMSE M3/s
ANNCP4	0.9418	0.9425	52.6667

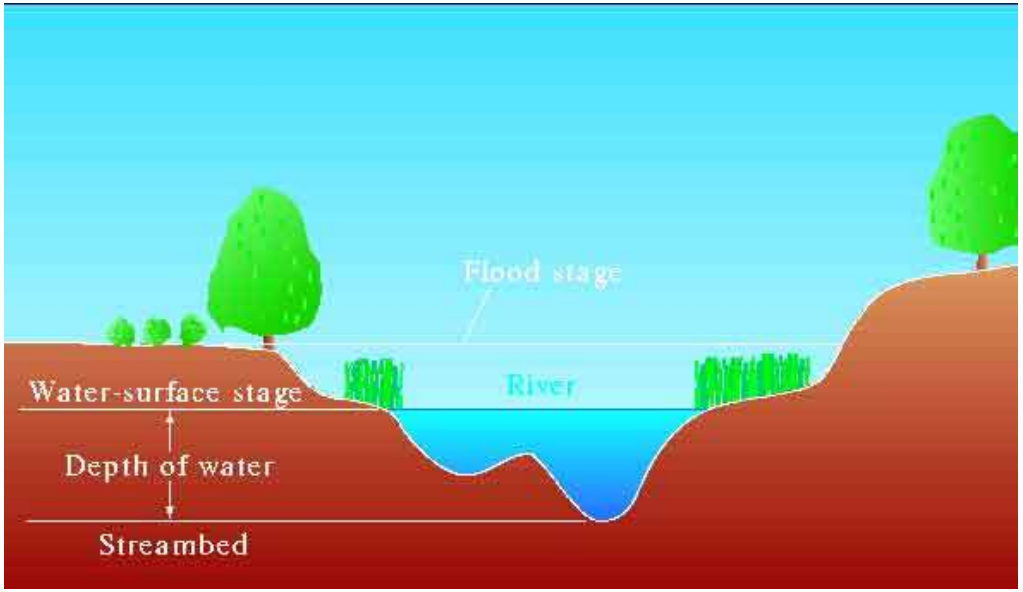
Flood Map


Flood Zones
S_FLD_HAZ_AR
ZONE_SUBTY
Floodplain
0.2 PCT ANNUAL CHANCE FLOOD HAZARD
AREA OF MINIMAL FLOOD HAZARD
Floodway
USGS_Gauges
N
0 0.25 0.5 1 1.5 2
Miles


Rating Curve
Streamflow (QM3)
3500
3400
3300
3200
3100
3000
2900
2800
2700
2600
2500
2400
2300
2200
2100
2000
1900
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
0 0.5 1 1.5 2 2.5 3 3.5 4 4.5 5 5.5 6 6.5 7 7.5 8 8.5 9 9.5 10 10.5 11 11.5 12
Gauge Height (Mt)
Q(M3)
Floodplain
Floodway

Decision making

- This model can be used for future prediction
- If the stream water level exceeds the threshold level, a flood warning can be determined.



Future Study

- Since this study was a point analysis of streamflow prediction, it can be further improved by :
  - Flood frequency analysis to estimate design flood based on various return periods (SMADA, HEC-SSP)
  - A HEC-RAS analysis to map the flood zone


Thank you for your attention!