An Adaptable Framework to Reduce the Flood Risk Under Climate Change Scenarios - A Case Study in Taipei Basin

Pei-Yu Wu[1*], Kun-Hsiang Lin[1]
[1]*National Cheng Kung University, Taiwan*
*Corresponding author: vivianwu0220@gmail.com

The Summary for Policymakers (IPCC, 2014) indicated that global sea-level rise is continuing in this century. In Taiwan, the flood risk in the capital, Taipei City, is expected to increase due to its low altitude and potential sea-level rise in the near future. In order to deal with the thorny problem, this study aims to develop an adaptable framework for flood risk reduction. The framework can be used as a tool to support local government authorities in decision or policy making processes. Firstly, data from the database for policy decision making for future climate change (d4PDF) were applied as input for flood simulation. The d4PDF offers baseline and future projections with a spatial resolution of 20km * 20km in which some key factors for the flood risk such as sea-level and rainfall can be found. Secondly, an ArcGIS-based tool will be used to calculate and visualize the submerged area in Taipei Basin. Finally, this study will utilize a multi-objective genetic algorithm (MOGA) with a number of objective functions such as pumping efficiency, financial cost of pumping stations, and economic loss of submerged area to find a compromised solution for flood risk reduction. Moreover, the optimal set of these pumps and the reduce of land loss will be reference to decide the policy in the future. The results of this study can be used to support the decision or policy making processes of the local government authorities.

An Acceptable Framework to Predict the Flood Stage Under Climate Change Scenarios – A Case Study in Taipei Basin

Pei-Yu WU*, Kun-Hsiang LIN

National Cheng Kung University, Taiwan **Responding Author: vivianwu0220@gmail.com*

Abstract ID : HS12-A007

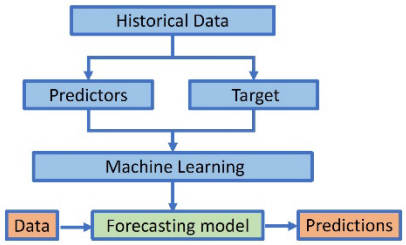
Asia Oceania Geosciences Society
www.asiaoceania.org

Abstract

The Summary for Policymakers (IPCC, 2014) indicated that climate change is continuing in this century. In Taiwan, the flood risk in the capital, Taipei City, is expected to increase due to its low altitude and extreme rainfall in the near future. In order to deal with the thorny problem, this study aims to apply support vector machines(SVMs) to develop a hourly typhoon flood stage forecasting model under 4 scenarios(RCP 2.6, 4.5, 6, 8.5) in the near future(2021-2040). Firstly, rainfall data were applied as input from the Central Weather Bureau and Water Resources Agency. The data of river stage from Taipei Bridge station were collected as target for river stage forecasting as well. Secondly, the Taiwan Climate Change Projection and Information Platform Project offers future projections with a spatial resolution of 5km * 5km in which some key factors for the flood risk such as temperature (℃) and increase of precipitation(%). Finally, 18 historical flood events and 2 typhoon events name AERE(2004) and HAITANG(2005) were used to calibrate and validate the forecasting model, respectively. Moreover, the 2 typhoon events were also applied to estimate the future stage under 4 scenario based on the increase of precipitation.

Key words: support vector machines, river stage forecasting, climate change

➢ Flow chart



➢ Study Area and Data Set

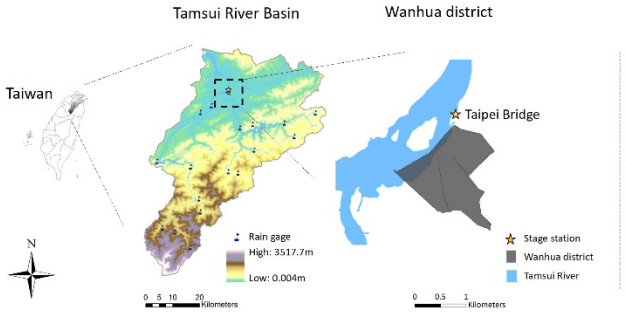


Figure 1. Study area and the locations of hydrological stations

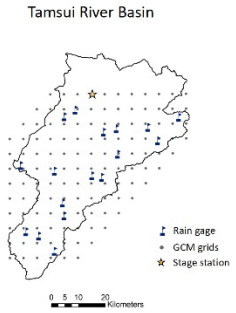
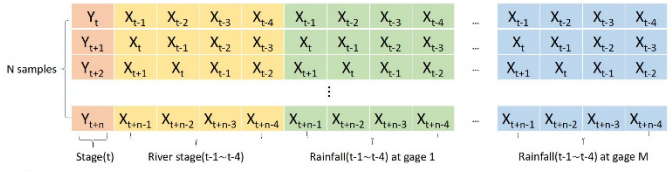


Figure 2. Distribution of rain gage and GCM grids

➢ Forecasting model

Training function



Test function

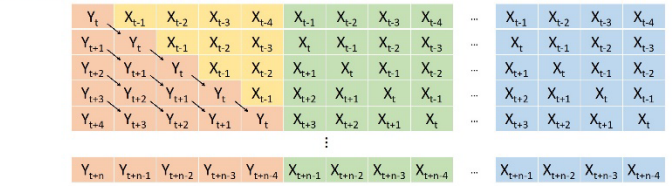


Table 1. Train and test events

No	Event	Date
1	DUJUAN	2015-09-27
2	SOUDELOR	2015-08-06
3	FUNG-WONG	2014-09-19
4	MATMO	2014-07-21
5	USAGI	2013-09-19
6	TRAMI	2013-08-20
7	SOULIK	2013-07-11
8	TEMBIN	2012-08-21
9	SAOLA	2012-07-30
10	NANMADOL	2011-08-27
11	MEGI	2010-10-21
12	FANAPI	2010-09-17
13	MORAKOT	2009-08-05
14	JANGMI	2008-09-26
15	SINLAKU	2008-09-11
16	FUNG-WONG	2008-07-26
17	KALMAEGI	2008-07-16
18	MINDULLE	2004-06-28
19	AERE	2004-08-23
20	HAITANG	2005-07-16

Training data Testing data

➢ Results

Testing event (SCC : 0.897)

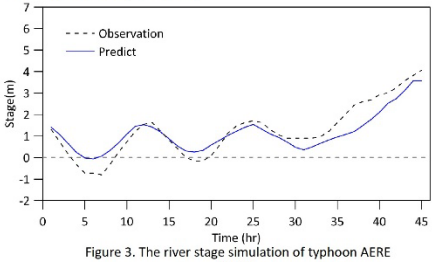


Figure 3. The river stage simulation of typhoon AERE (2004)

Testing event under 4 scenarios

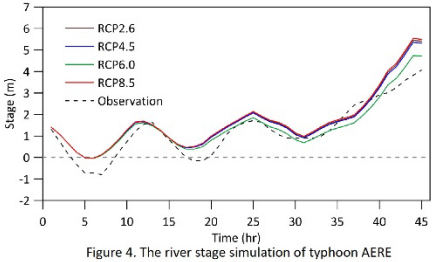


Figure 4. The river stage simulation of typhoon AERE (2021-2040)

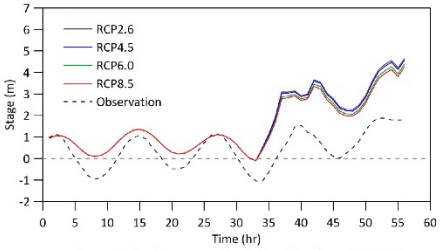


Figure 5. The river stage simulation of typhoon HAITANG (2021-2040)

➢ Conclusions

1. This study applies machine learning method-SVMs to construct an acceptable stage forecasting model in Taipei basin.
2. The prediction of river stage forecasting model on testing event - AERE(2004) shows appropriate performance which squared correlation coefficient is 0.897.
3. Finally, this study assumes that two new typhoons strong as testing events – AERE and HAITANG will make landfall in Taiwan again during 2021-2040. And the rainfall of these two future typhoon at each station under 4 scenarios are estimated by the increase of precipitation(%) at each GCM grid. The results show the river stage will increase 1-2 m in the pick of stage.