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ANALYSIS OF FUTURE PRECIPITATION CHANGES IN TAIWAN USING ENSEMBLE CLIMATE CHANGE SCENERIO DATABASE, D4PDF.

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ABSTRACT

Global warming, a world-discussed issue in recent years, increase temperature, being the main factor of climate change. The latest climate assessment report in 2021—IPCC AR6 has shown that, due to global temperature increases, the future climate must become more complicated and challenging. Extreme events, such as heavy rainfall, drought, and heatwave, will more frequently and severely occur than before; consequently, damage to human beings and organisms on the earth. Disasters induced by extreme events can directly damage a country on its human activities or foundation facilities, further, impact on the economy. Therefore, prevention and mitigation work have no doubt should be urgent. However, existing research may not enough for us to encounter the highly uncertain future climate. We still need more research to predict and understand future climate situations.

Fl Flooding, a classic type of disaster which usually accompanies an enormous impact on society and the economy. Most significant capitals and megacities are built along the river or in the delta areas; usually, exposed to higher flood risk. Climate change have had obviously changed the precipitation pattern, especially in Asia. A high intensity within short duration rainfall will occur frequently than before, further increasing the flooding risk. Taiwan, which is located in monsoon and typhoons attacked area. Integrate with geographic factors, Taiwan has suffered from flood attacks during the wet season for years. Under climate change, studies had shown that flood risk has increased; further, brings high potential flood risk to our society and economy. However, in Taiwan, future flooding research is still lacking since a shortage of robust future climate datasets. Therefore, developing and optimizing the climate dataset could progress on future flooding research.

Rainfall design is an essential part of flooding research. Traditionally, rainfall design usually gives rainfall based on different return periods. Generating high-intensity rainfall events usually relies on a long period of observation. However, acquiring numbers of observation data usually being difficult and challenging, making rainfall settings owing a huge uncertainty to utilize. For future flooding research, a robust and precise rainfall dataset would be necessary. In recent years, climate simulation data show a high potential to be utilized in various research to assess the climate change impact. Utilizing more precise and reliable data for future flooding research, we can assess future flooding more comprehensively. In Taiwan, simulation climate datasets are still lacking and immature; therefore, introducing a simulation climate dataset could provide a great opportunity to progress future flood research. Database

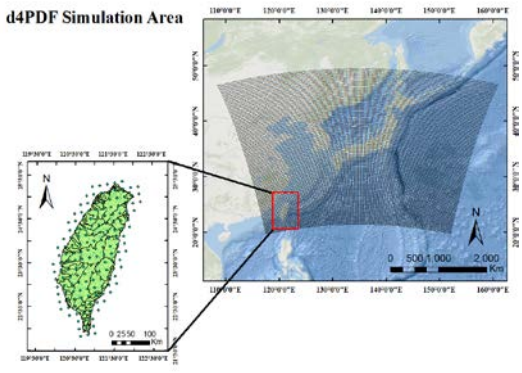

Fig. 1. d4PDF Simulation Area

for policy decision making for future climate change (d4PDF) Awhich produced by the Japan Meteorological Agency, which contains thousands of years of datasets of historic climate, 2K and 4K temperature raise conditions (Mizuta et al., 2017). For the use of +4K simulation, six CMIP5 models are selected to provide the sea surface temperature (SST) increase. Each scenario is conducted by setting different initial conditions and different SSTs change. Through ensemble simulation, d4PDF provides robust projection data for future climate studies using (Mizuta et al., 2014). Shown as **Fig. 1.**, Taiwan is located in the southwest part of the simulated scope of d4PDF; in other words, Taiwan owing a high potential could utilize the d4PDF dataset. In this study, the main target is to clarify the possibility of introducing d4PDF in the Taiwan region.

In this study, we extracted 20 km regional climate model simulation data of target catchments from d4PDF datasets and analyze the precipitation data by calculating the catchment average rainfall. Further, we extract 24, 48, and 72-hour annual maximum rainfall of each catchment to catch the extreme event for each year. Weibull Plotting Position Formulas was employed for statistical analysis; the statistical results were plotted on the Gumbel paper for presenting the relationship between non-exceedance probability, rainfall intensity, and return period. Comparing with the observation data and the historic data from d4PDF, and executing bias correction for specific catchments, we could indicate the agreement between both data of each catchment. Shown as **Fig. 2.** When observation data have a high agreement with d4PDF historic data, we could further confirm the reliability of d4PDF 4K temperature increase simulation data and import the simulation climate data into Taiwan flood research. In conclusion, this study presents the demonstration of d4PDF possesses the capability to employ in Taiwan or even countries out of Japan within the cover area, which have no doubt can provide benefit to those countries for progressing their climate change research; further, implementing the research results into society, such as disasters prevention, risk assessment, or even solving human security problem, to reduce the impact from climate change to human. Ultimately, by using simulation data and learning techniques for other countries, hope to stimulate the government to understand the importance of climate change research and develop a more suitable database for our countries policy decisions for future climate.

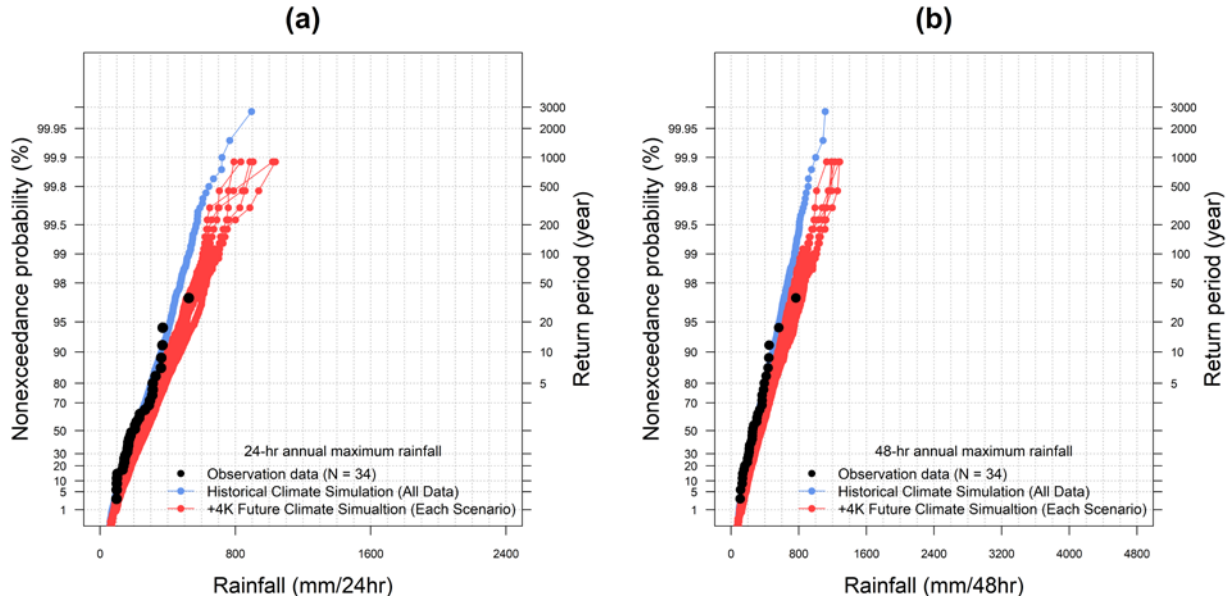

Fig. 2. T hour annual maximum rainfall for observation data, historical climate simulation, and +4K future climate simulation in Tamsui river basin (a) T = 24 (b) T = 48

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