臺灣氣候變遷推估資訊與調適知識平台
Taiwan Climate Change projection and adaptation Information Platform

2019 TCCIP International Workshop on Climate Change

統計降尺度日資料於水文分析之應用

Hydrological Analysis Using Statistically Downscaled Daily Rainfall Data

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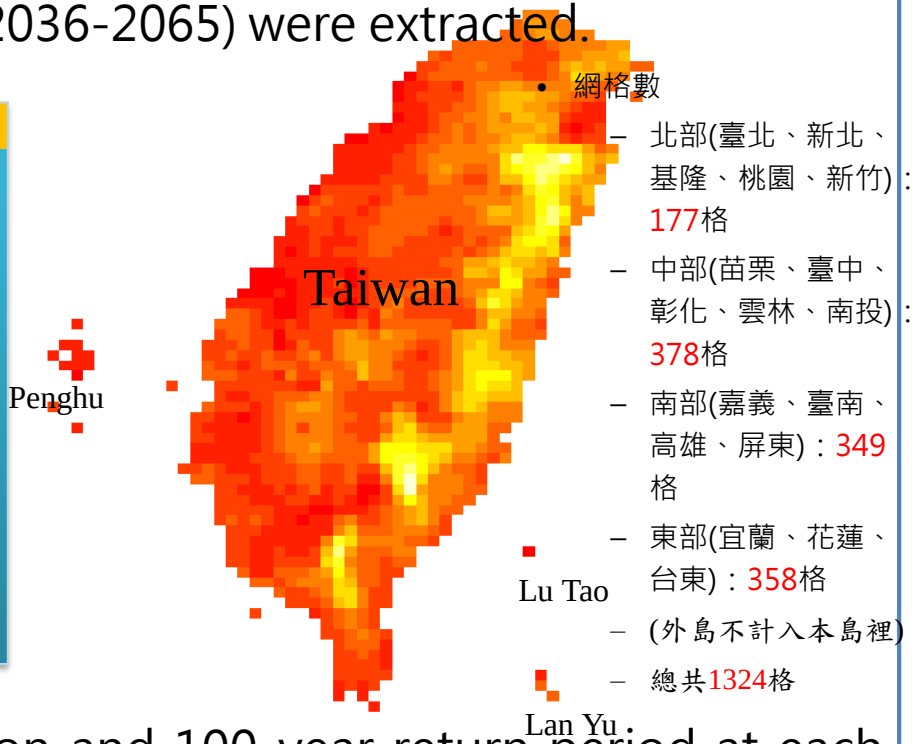
- From the observed rainfall data, gridded (5km x 5 km) daily rainfall data were generated by Team 1 of TCCIP. [Gridded observations]
- Annual maximum series of gridded daily observations were extracted.
- Design rainfall depth of 1-day duration and 100-year return period at each grid (5km x 5km) for the baseline period were calculated by using the Pearson type III distribution.

Simulated Rainfall Data of IPCC AR5 (Statistical Downscaling of 33 GCMs)

- Simulated daily rainfalls from 33 GCMs under the RCP 8.5 scenario, with 5km x 5km spatial resolution.
- Annual maximum series (AMS) of daily rainfalls of the baseline period (1981-2010) and the "mid-century" period (2036-2065) were extracted.

General Circulation Models		
ACCESS1-0	CNRM-CM5	IPSL-CM5A-LR
ACCESS1-3	CSIRO-Mk3-6-0	IPSL-CM5A-MR
rbcc-csm1-1-m	EC-EARTH	IPSL-CM5B-LR
bcc-csm1-1	FGOALS-g2	MIROC-ESM-CHEM
BNU-ESM	GFDL-CM3	MIROC-ESM
CanESM2	GFDL-ESM2G	MIROC5
CCSM4	GFDL-ESM2M	MPI-ESM-LR
CESM1-BGC	HadGEM2-AO	MPI-ESM-MR
CESM1-CAM5	HadGEM2-CC	MRI-CGCM3
CMCC-CESM	HadGEM2-ES	MRI-ESM1
CMCC-CM	inmcm4	NorESM1-M



- Design rainfall depth of 1-day duration and 100-year return period at each grid (5km x 5km) for the baseline and mid-century periods were calculated by using the Pearson type III distribution.

The Research Process of Hydrologic Frequency Analysis

Gridded daily rainfalls of the baseline period. (Gridded observations & GCMs)

Gridded daily rainfalls of the projection period. (outputs of 33GCMs)

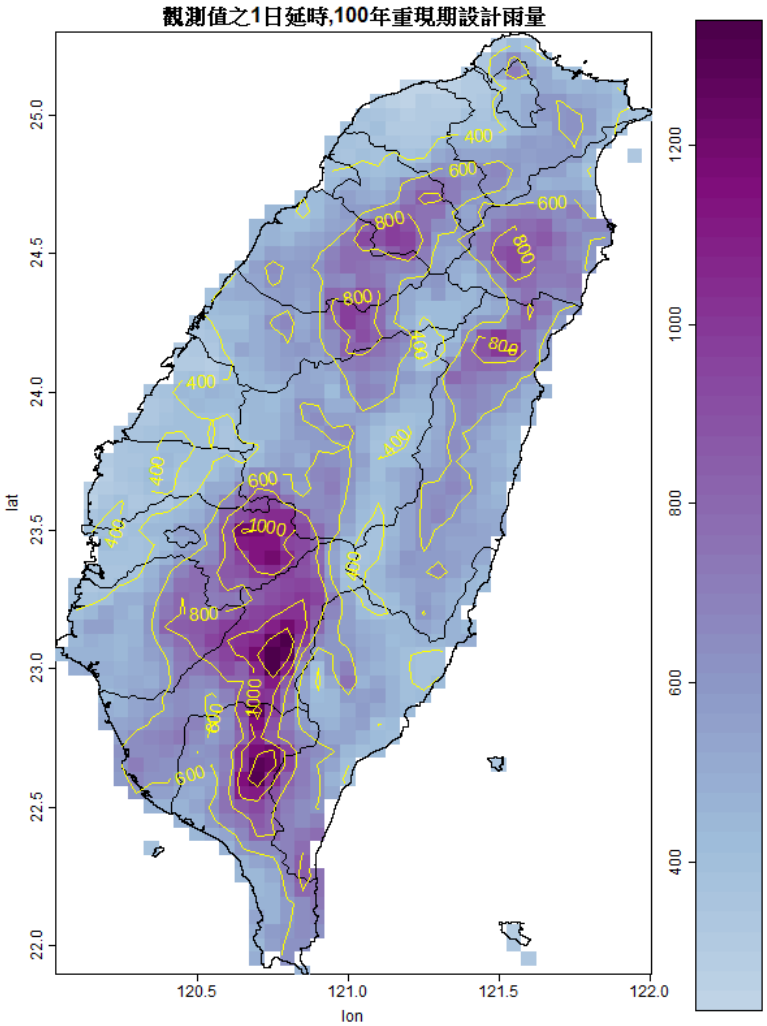
Extract the annual maximum series (AMS) of daily rainfalls of the baseline period (1981-2010) and "(21th) mid-century" period (2036-2065).

Calculate the design rainfall depth of 1-day duration and various return periods (from 1.1 to 200 years) at each grid for the baseline and the "(21th) mid-century" period.
(Annual maximum daily rainfalls were fitted to the Pearson type III distribution.)

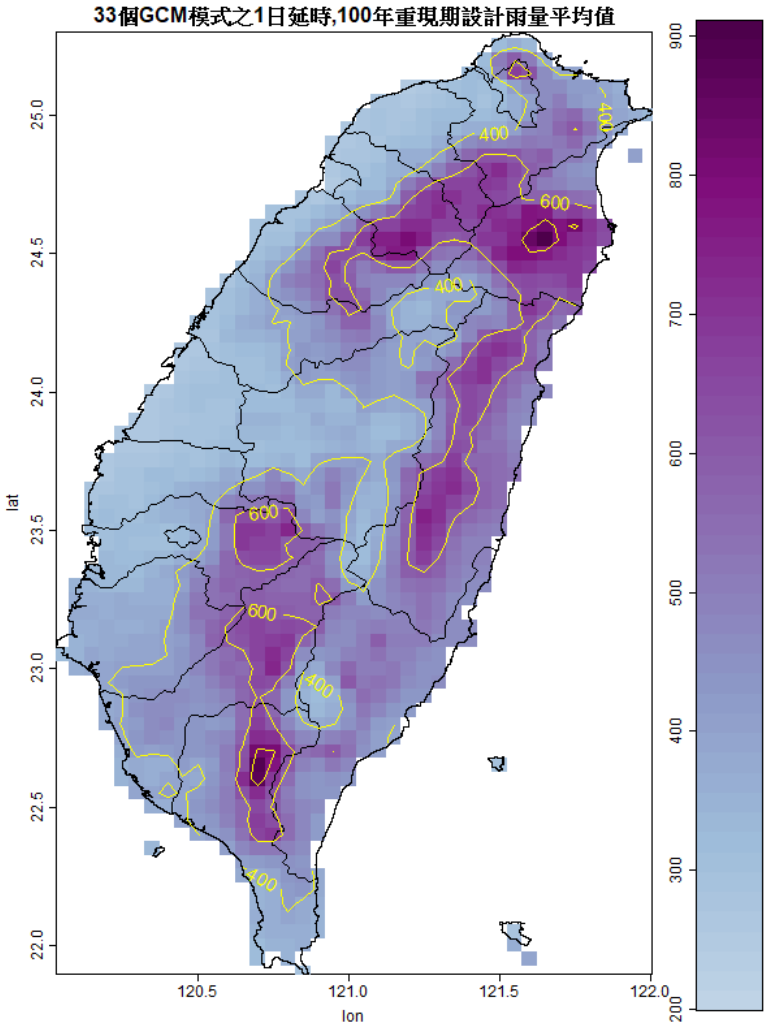
Calculate the design-rainfall ratio (r) of a specific return period of each GCM, and evaluate the differences of these design rainfall ratios among GCMs.
r = design rainfall of **"(21th) mid-century"**/ design rainfall of **historical baseline period**

Spatial variation of 1-day, 100-year design rainfalls of the baseline period. (Grided observation vs average of 33 GCMs)

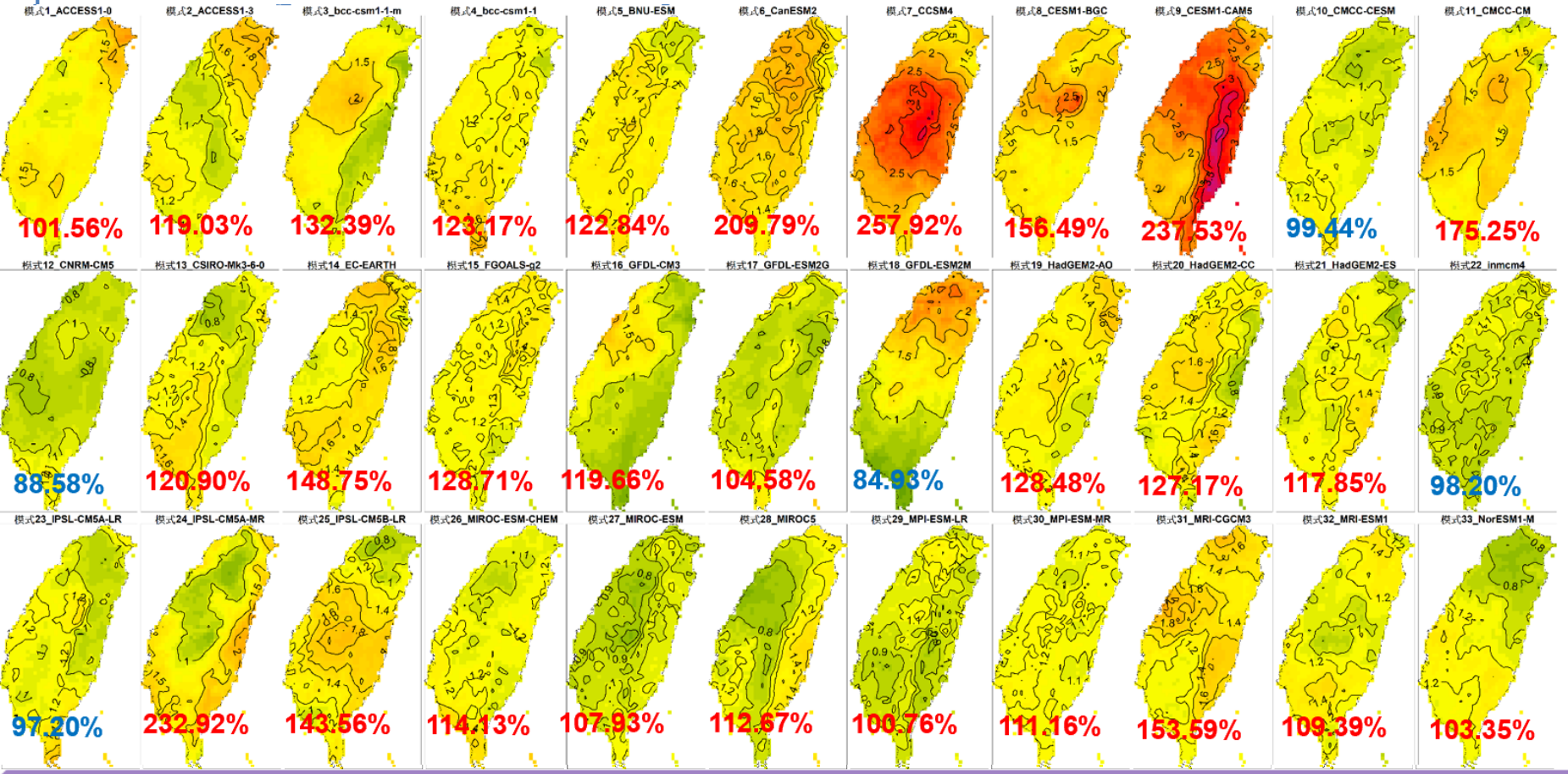
Gridded Observations



Average of 33 GCMs

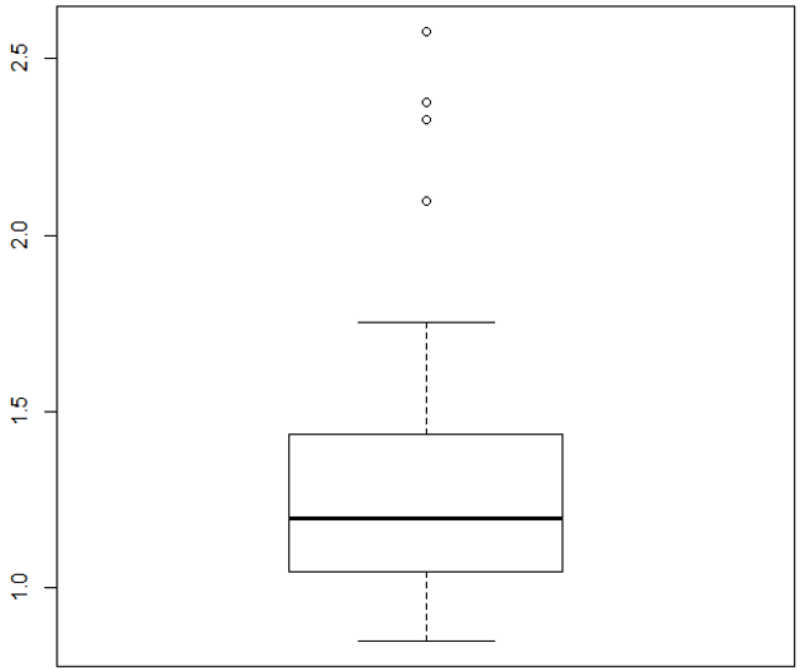


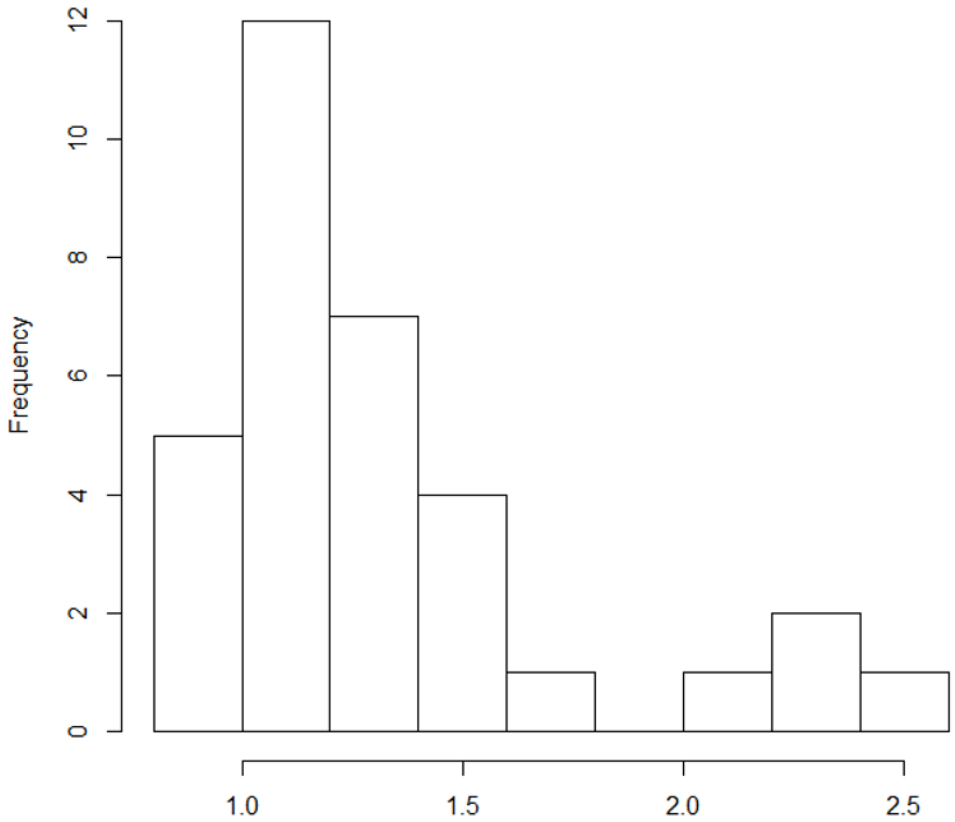
The design-rainfall ratios of the 1-day duration and 100-year return period of 33 GCMs



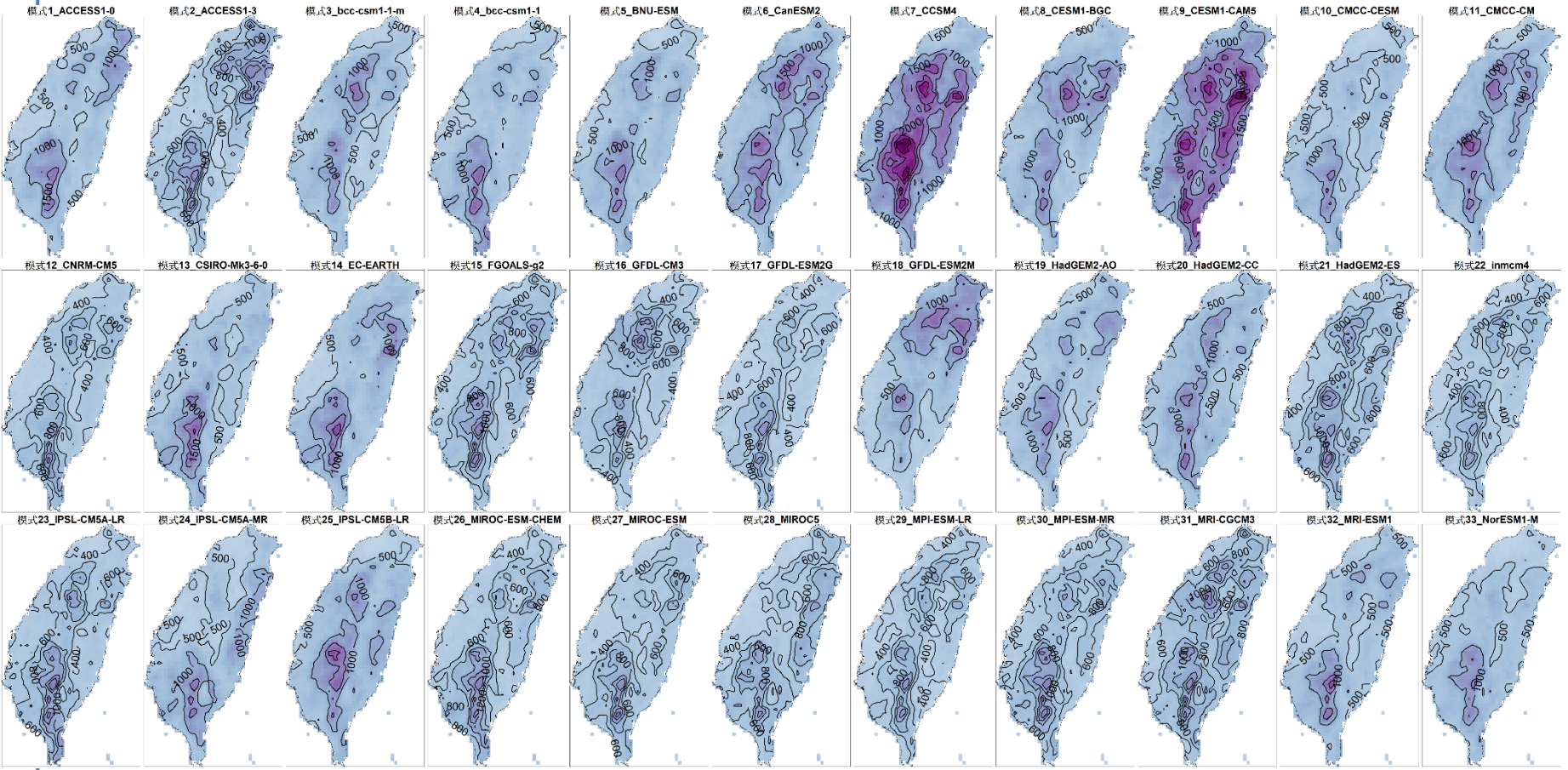
- Calculate the average of 1324 raster values of design rainfall ratio from 33 GCMs, there're only 5 GCMs that show the decreasing trend (from -0.1% to -7%) of design rainfalls in "(21th) mid-century" period.
- There are 28 GCMs that show the increasing trend (from 1.7% to 156%) of design rainfalls in this period.

Box plot and histogram of the design-rainfall ratio.





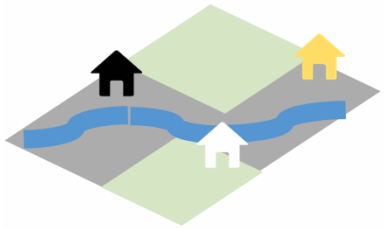
The design rainfall of the 1-day, 100-year event in the "(21th) mid-century" period under the RCP 8.5 scenario of 33 GCMs



Apply the design-rainfall ratio to the 1-day, 100-year design rainfalls of the gridded observations.

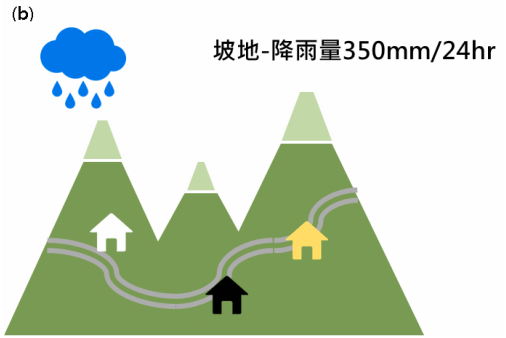
Other Potential Applications

For flood inundation risk mapping, the 24-hr 600mm annual max rainfall is considered.



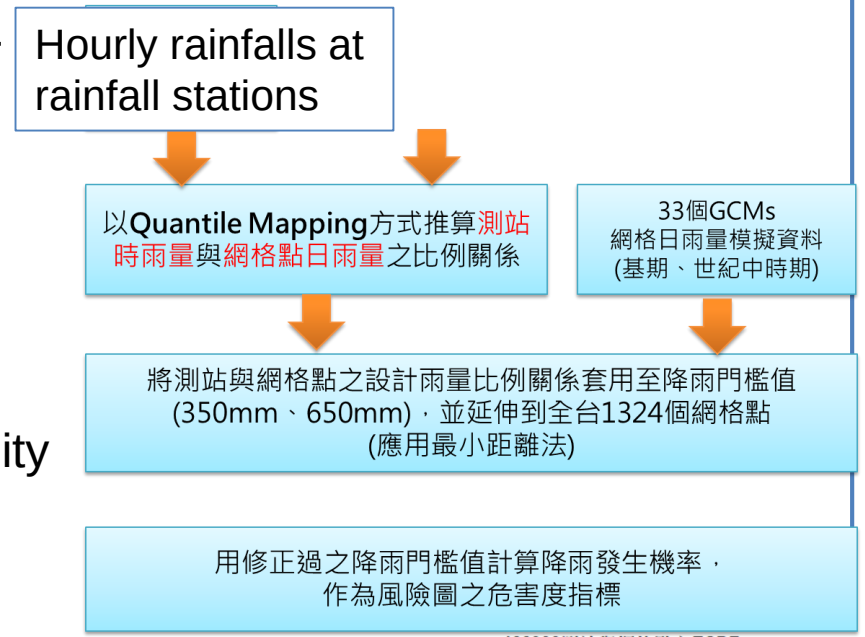
P(X>600 mm) = ?
An exceedance probability map is desired.

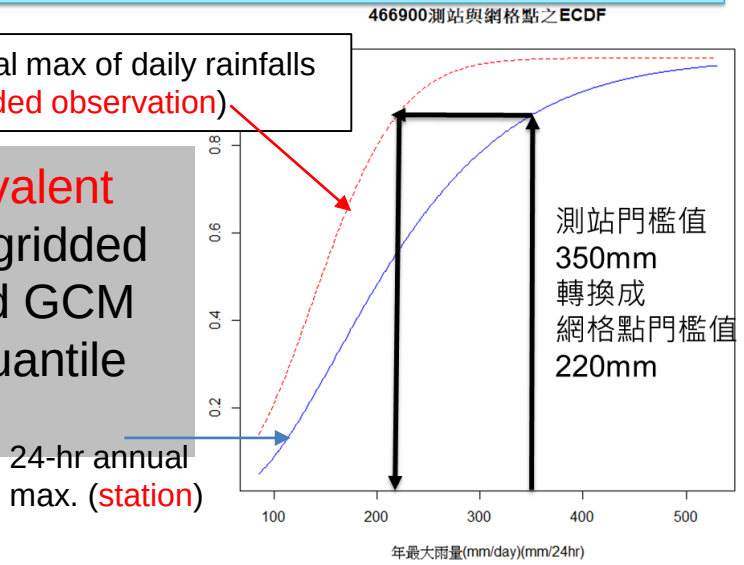
For hillslope disaster prevention, 24-hr, 350mm annual max rainfall is considered.



Finding the equivalent threshold of the gridded observations and GCM outputs by the quantile mapping.

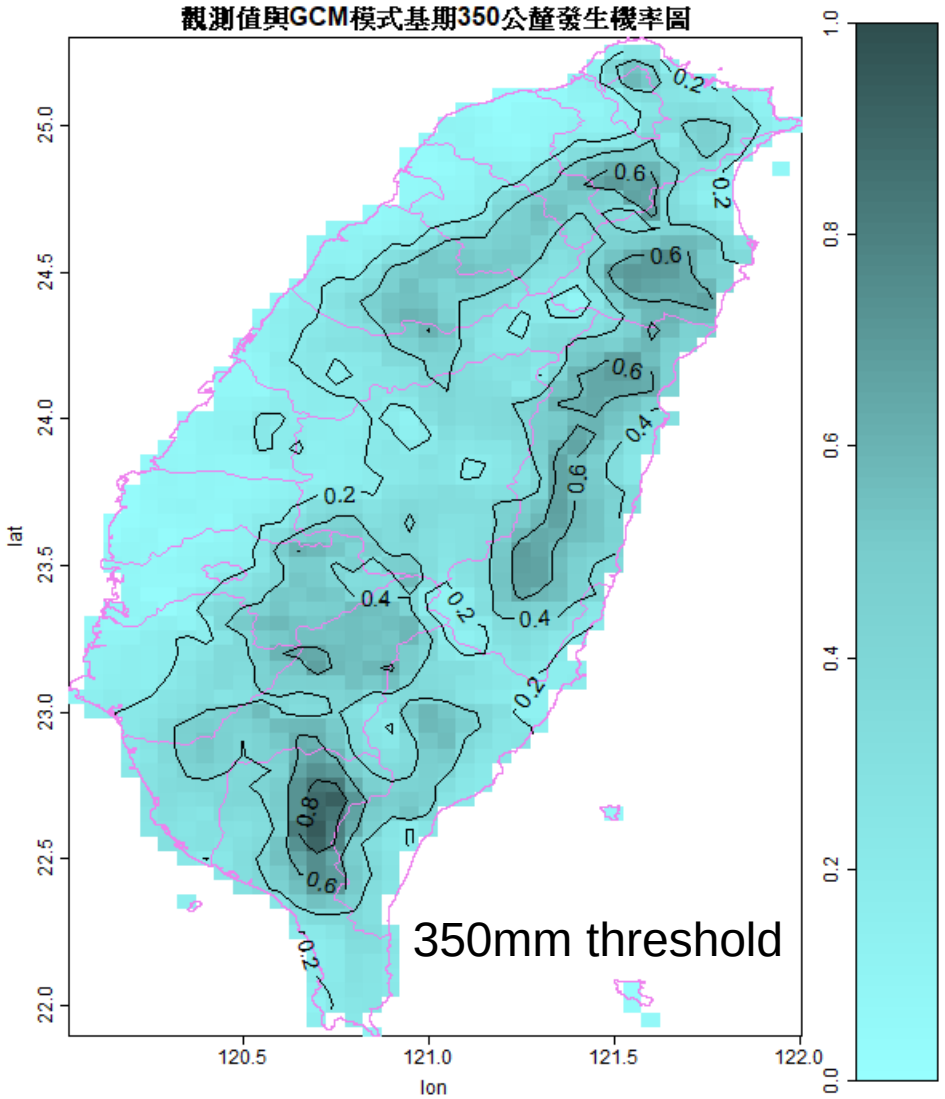
災害風險圖 研究流程

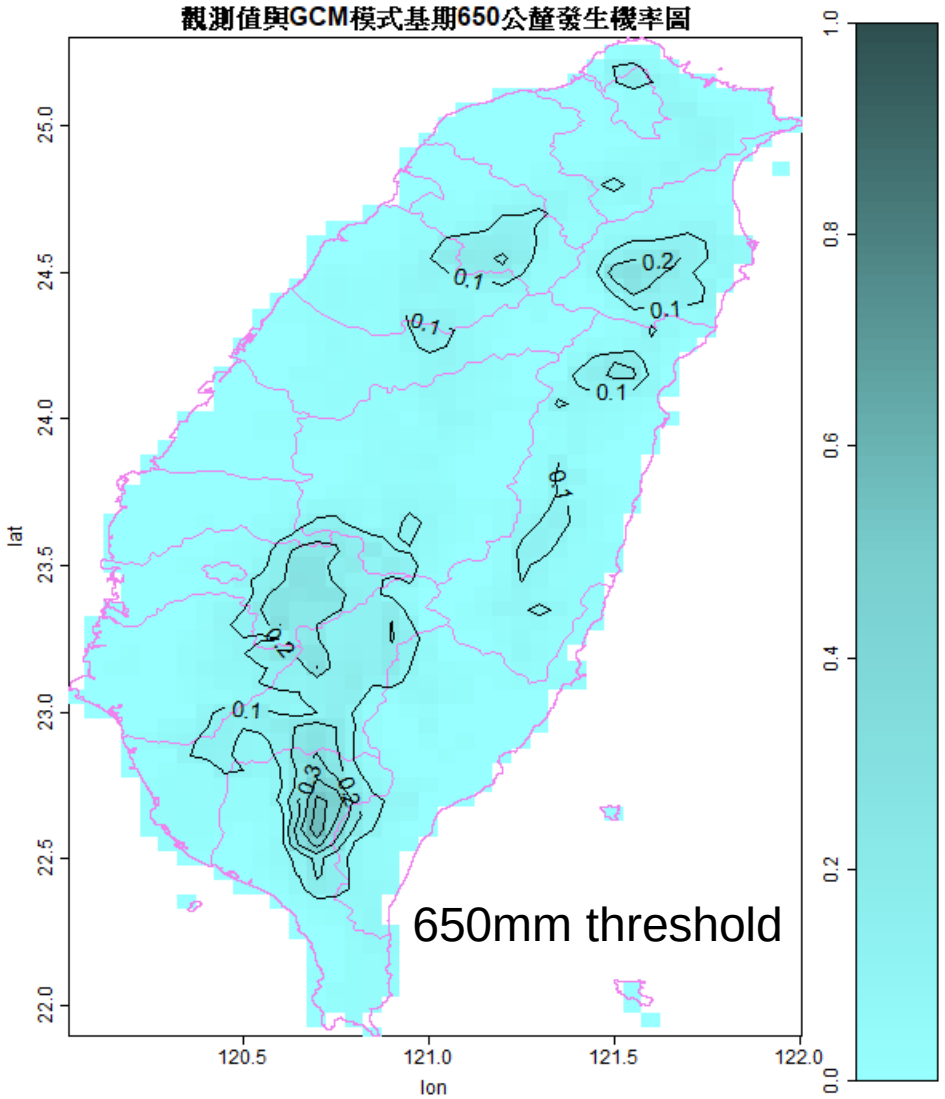




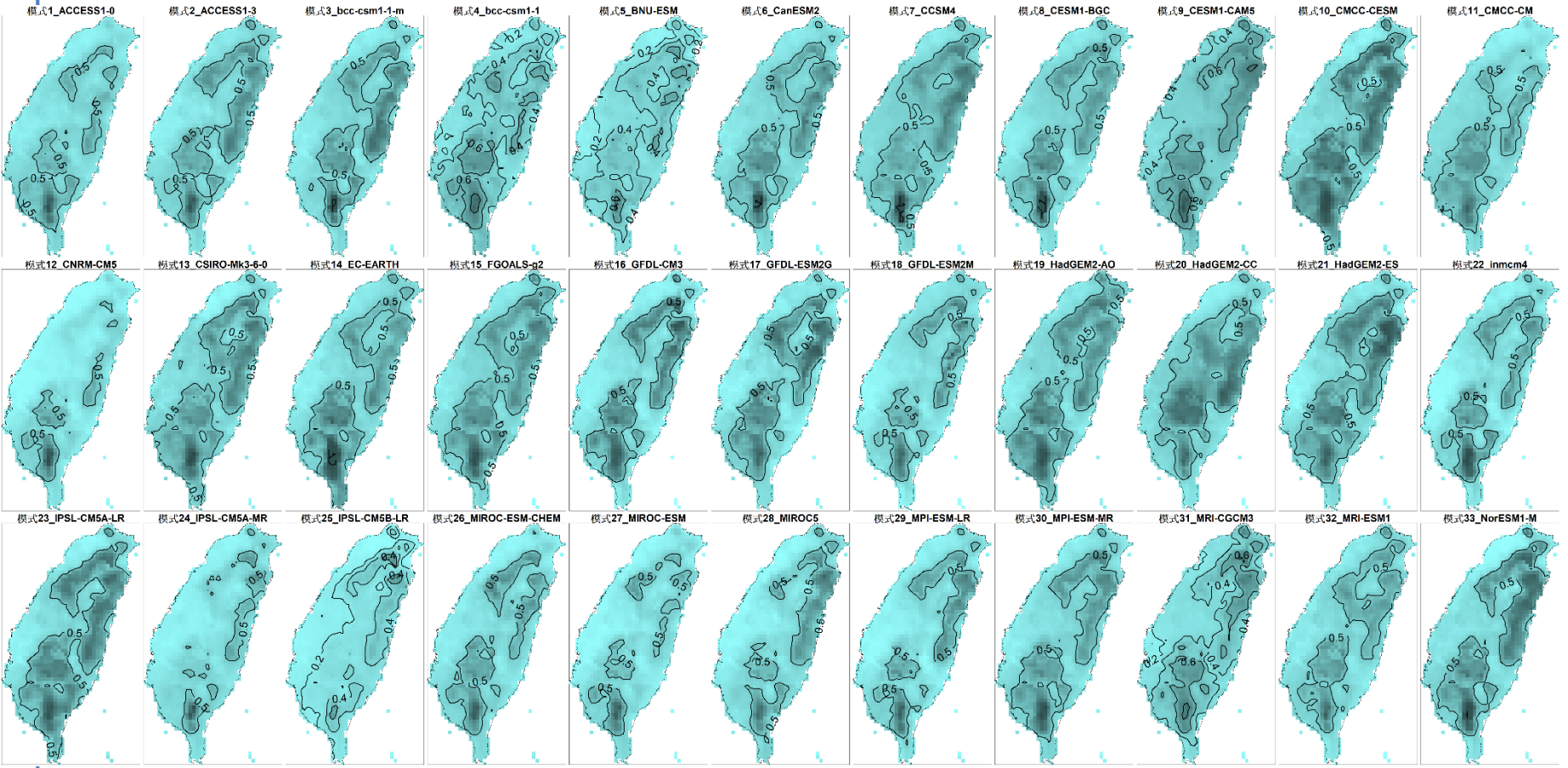
參考來源：科技部 災害管理資訊研發應用平台
http://dmip.tw/Lthree/2017/riskapp/report/2_2.aspx?counted=1

Exceedance probability map of a specific threshold of the 24-hr annual maximum rainfalls

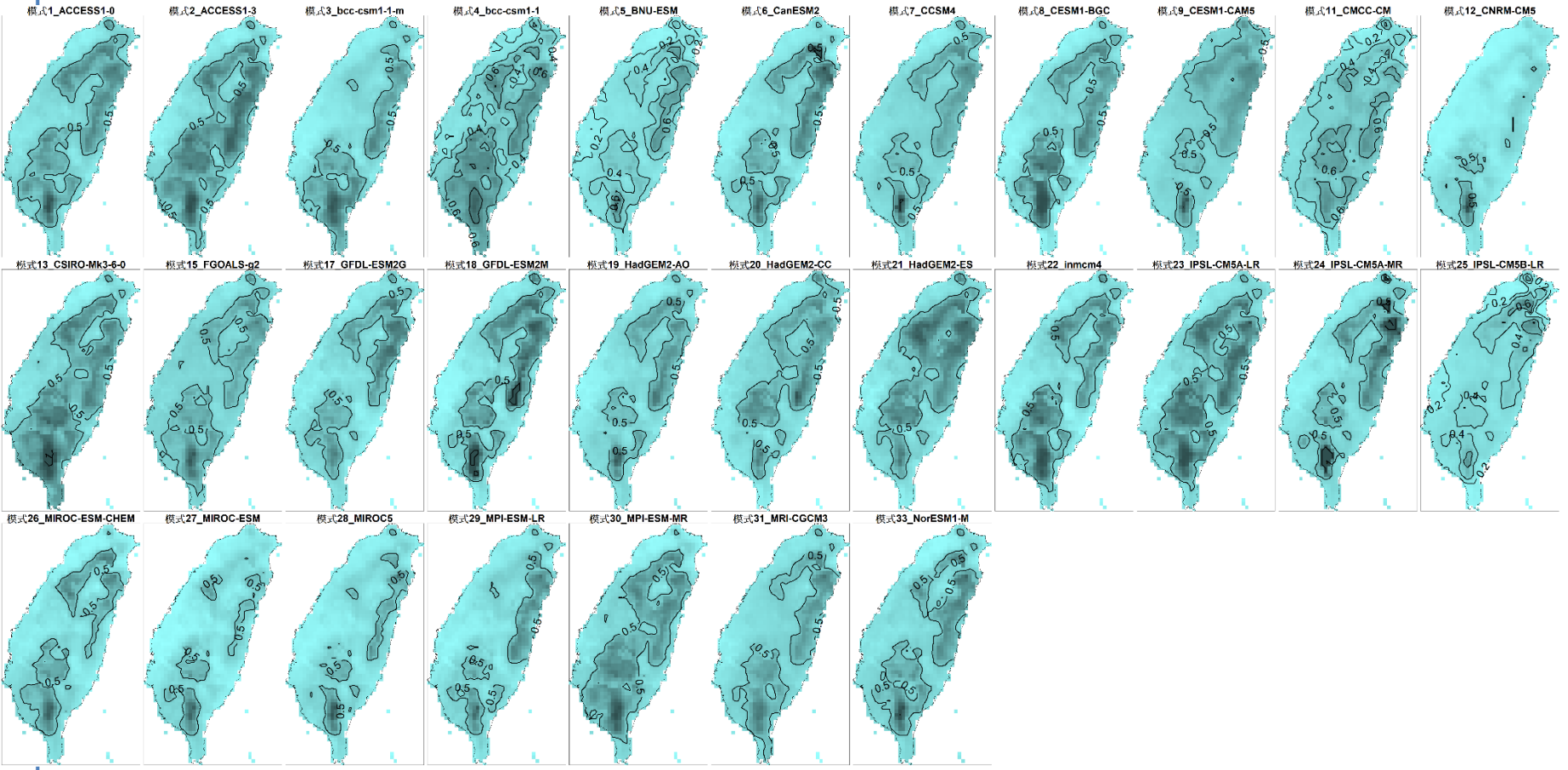




350mm發生機率圖 (RCP8.5情境、世紀中時期)

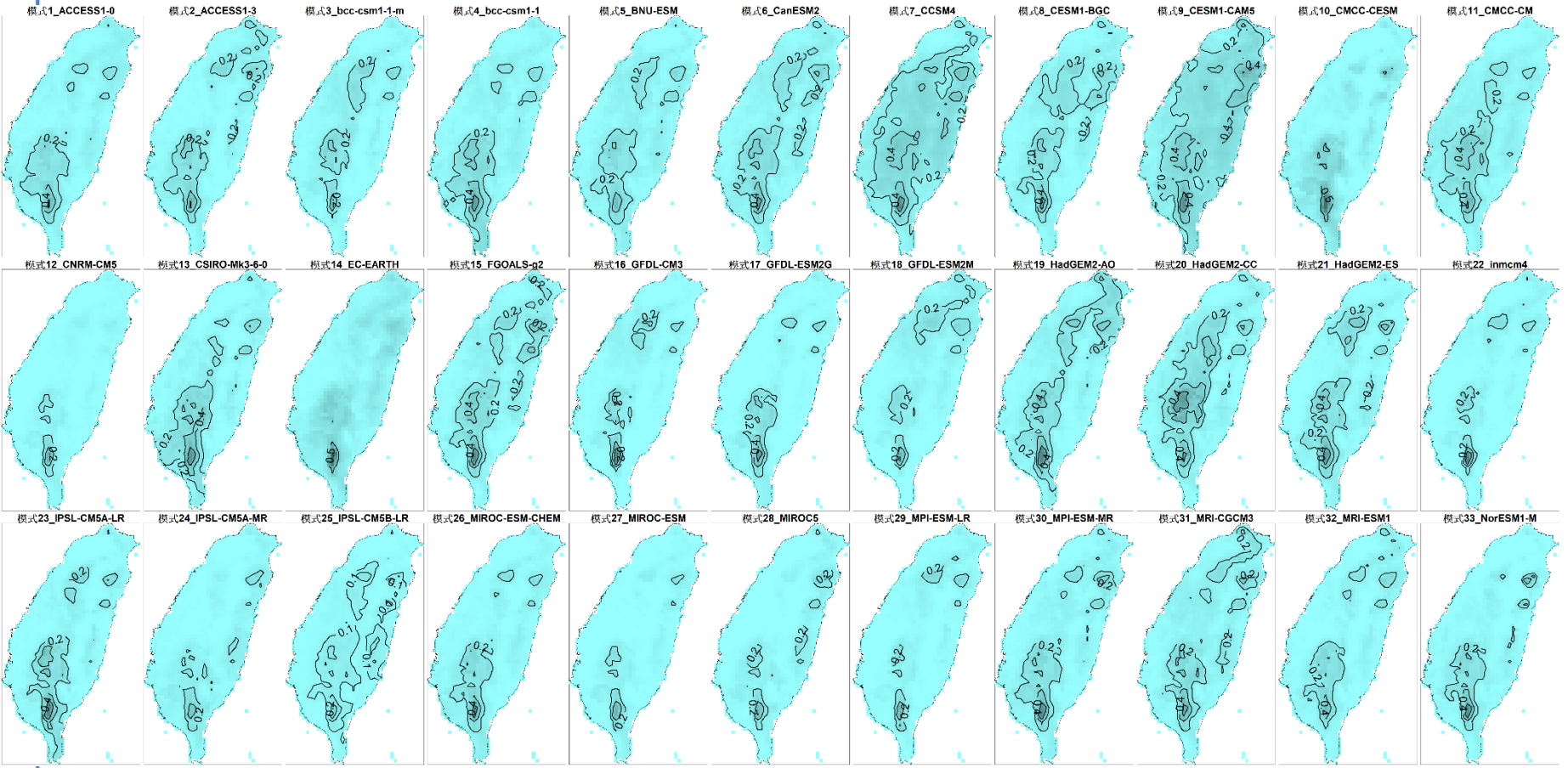


350mm發生機率圖 (RCP4.5情境、世紀中時期)

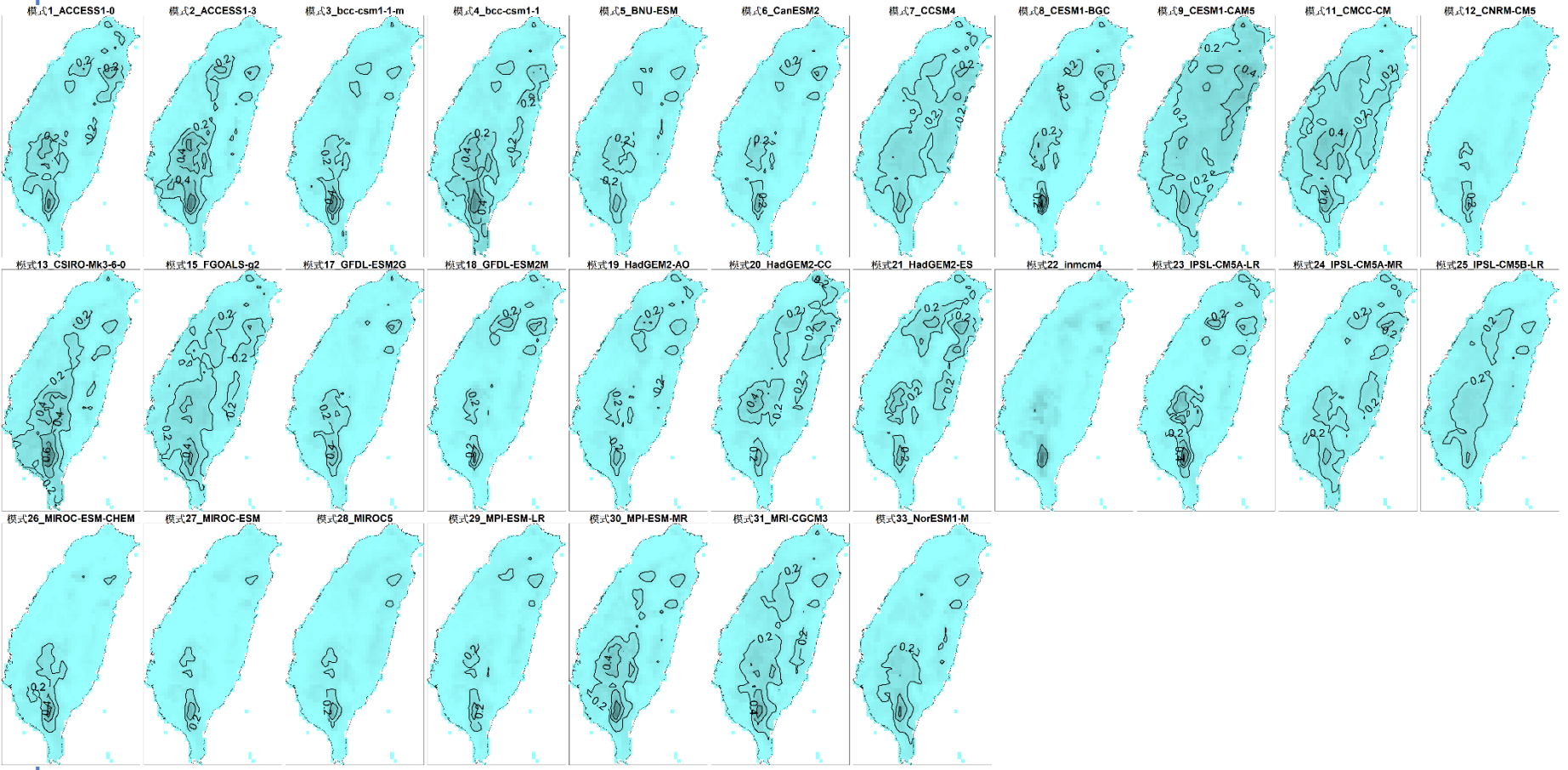


350mm門檻值下，各模式的RCP8.5情境之發生機率與RCP4.5情境之值互有高低

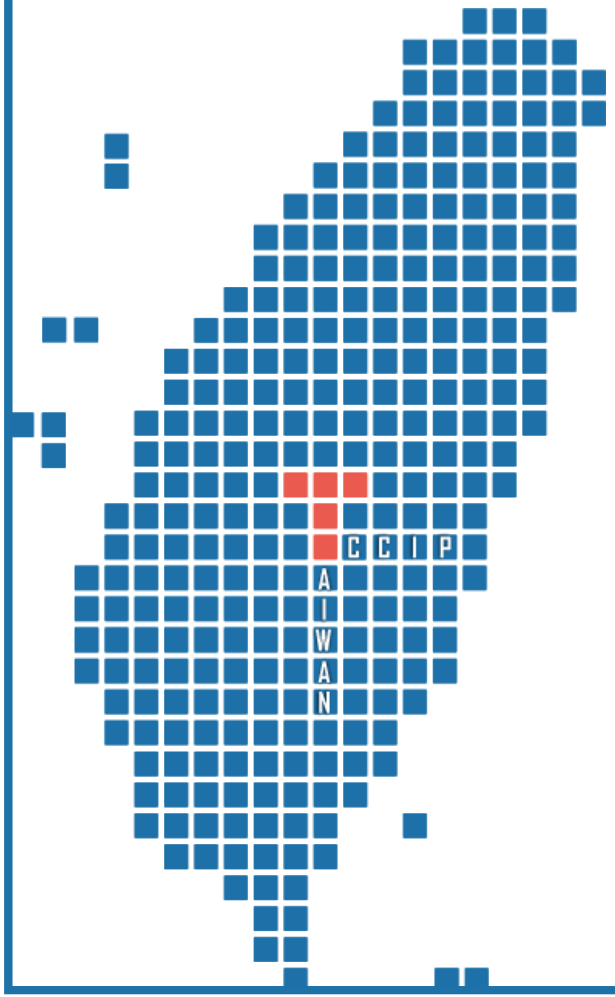
650mm發生機率圖 (RCP8.5情境、世紀中時期)



650mm發生機率圖 (RCP4.5情境、世紀中時期)



650mm門檻值下，各模式的RCP8.5情境之發生機率大都比RCP4.5情境之值高



Thank you for listening.