




NCDR CWB RCEC NTU NTNU NCTU WRA

臺灣氣候變遷推估與資訊平台建置計畫

Introduction of Taiwan Climate Change Projection and Information Platform Project (TCCIP)

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Outline

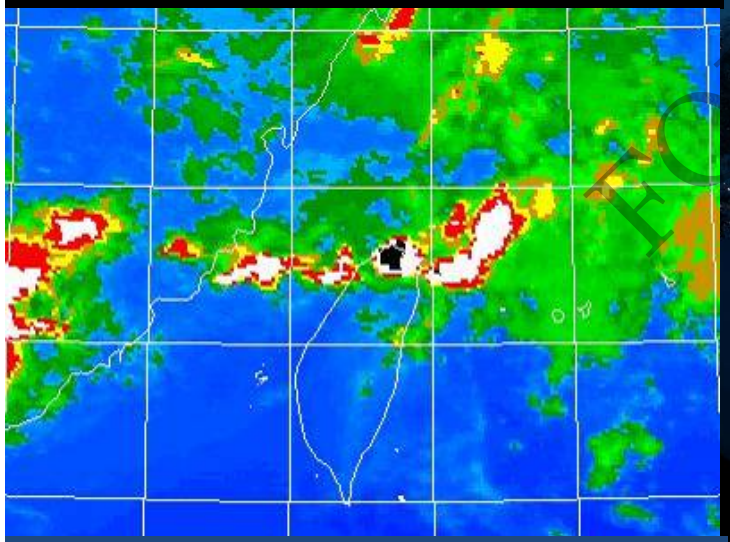
Taiwan Climate Change and Information Platform

(TCCIP)

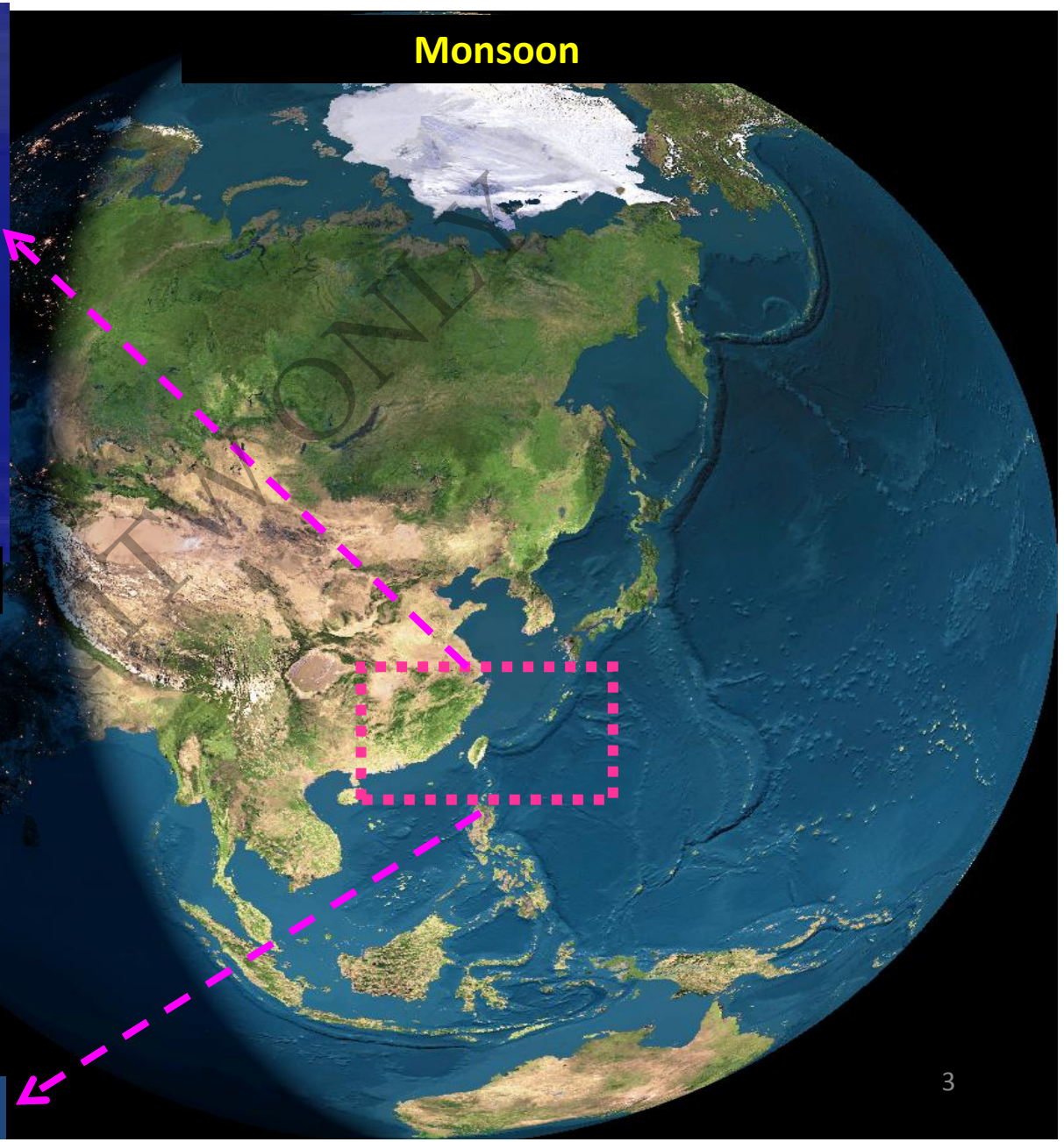
- Introduction
- The role of TCCIP
- Overview of TCCIP
- Summary

Introduction

Typhoon

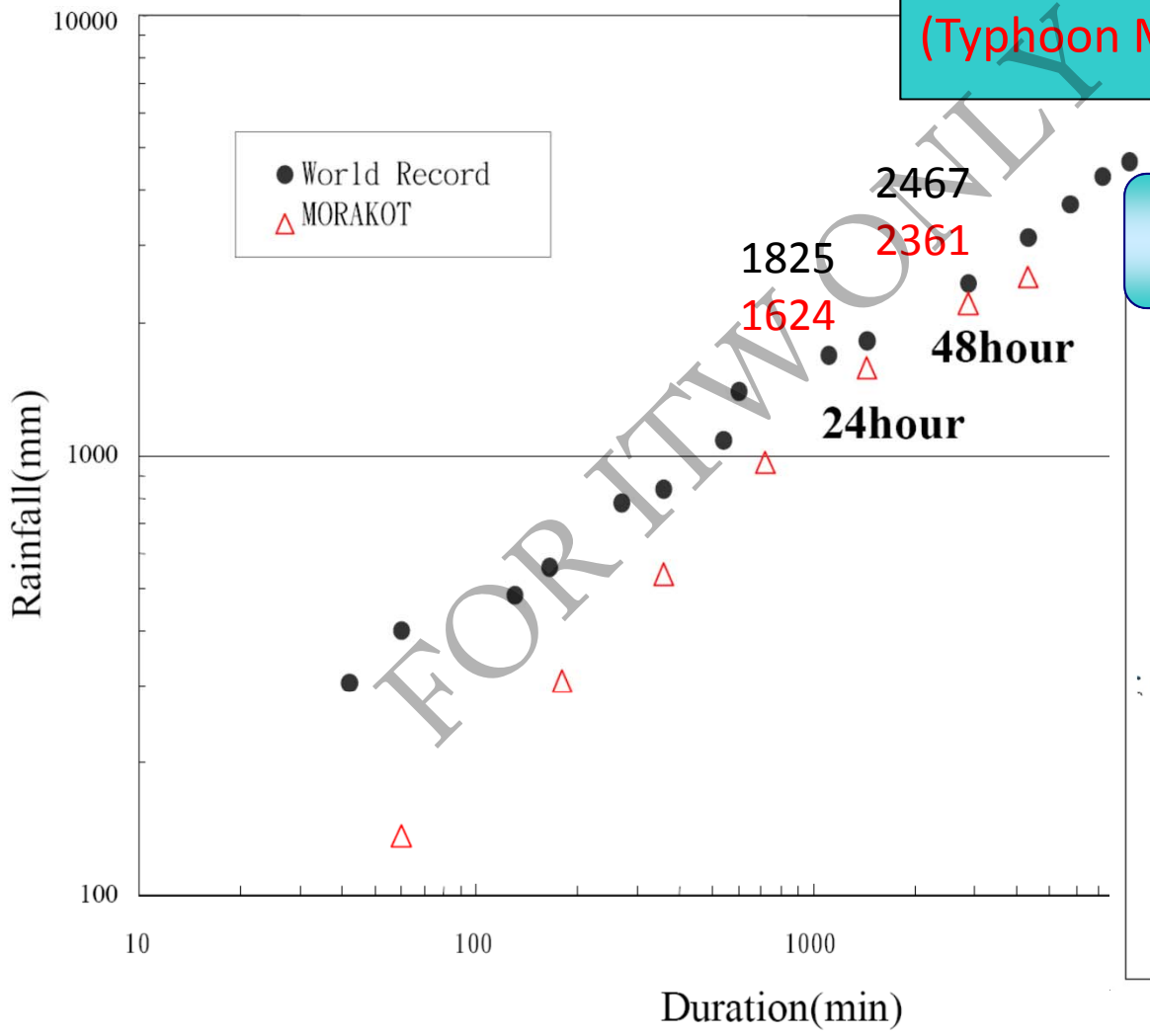


Mei-Yu

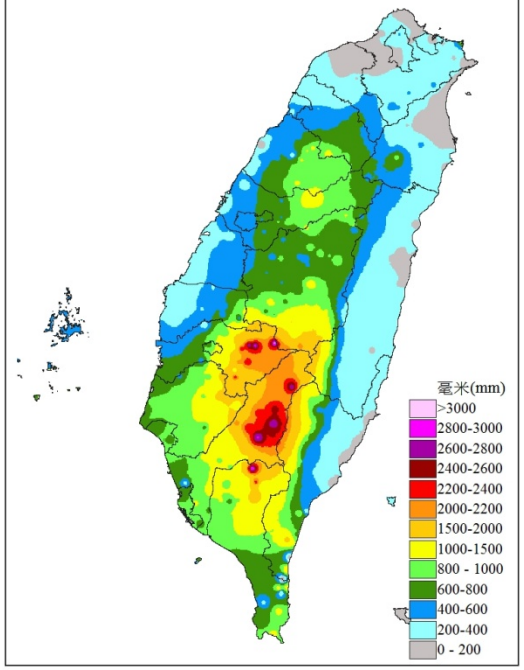


More and More Extreme Events in Taiwan ?

■ 24 to 48 hours accumulated rainfall: close to world records (Typhoon Morakot, 2009)



0805-0810 accumulated rainfall



Typhoon Morakot claimed almost 700 lives

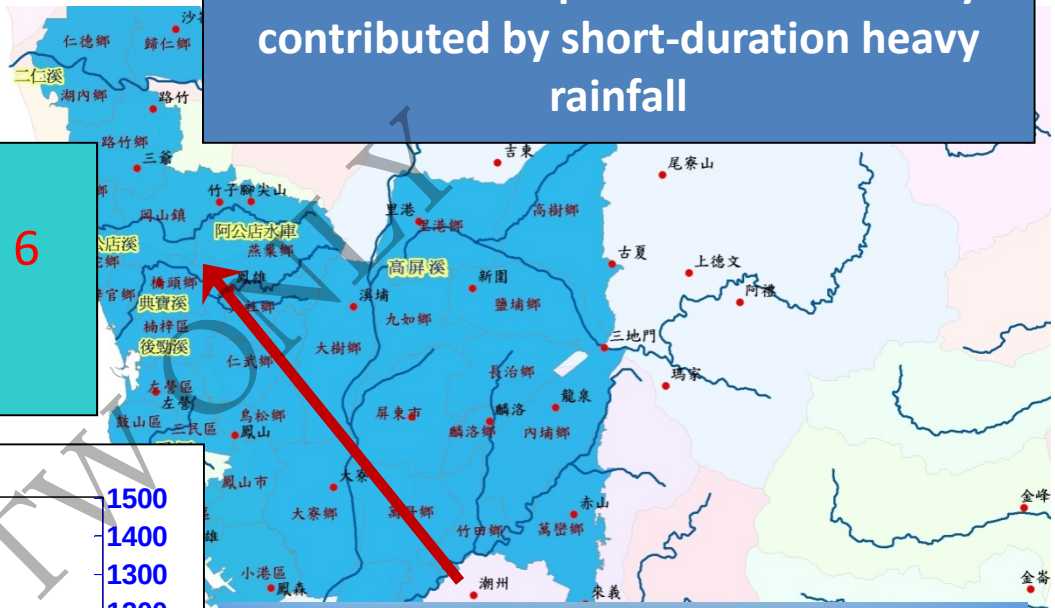
■ Massive deep landslide caused by Morakot

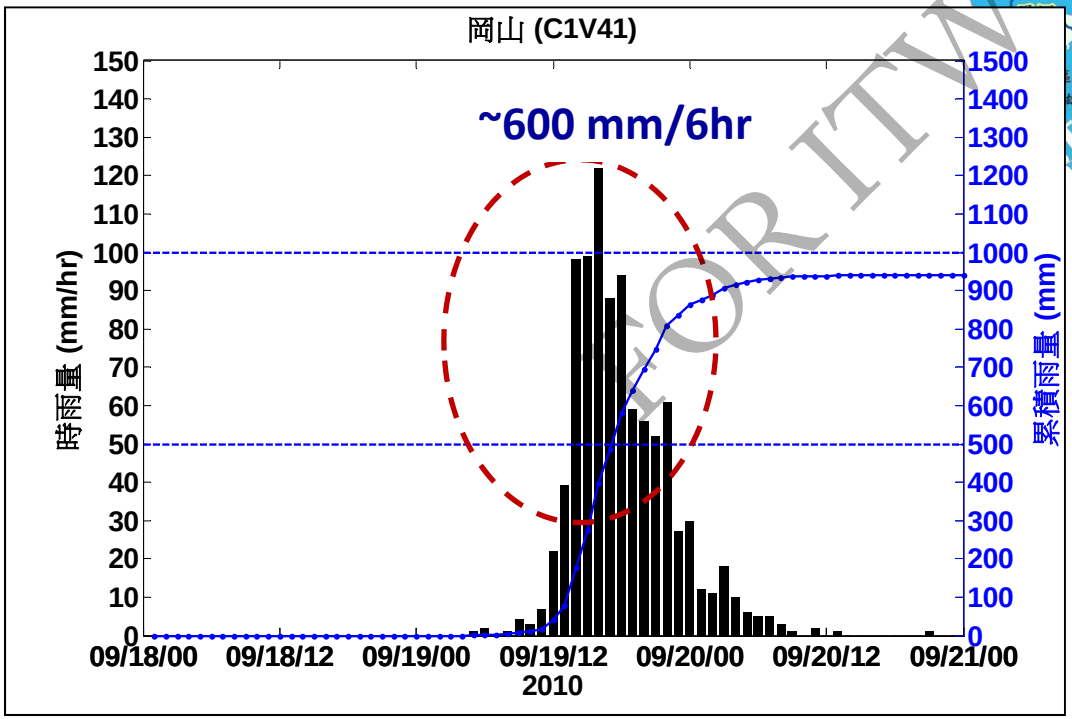
More and More Extreme Events in Taiwan ?

Typhoon Fanapi (2010)

Water in flood-prone areas is mainly contributed by short-duration heavy rainfall

■ 600mm accumulated rainfall during 6 hours at Gang-Shan station.

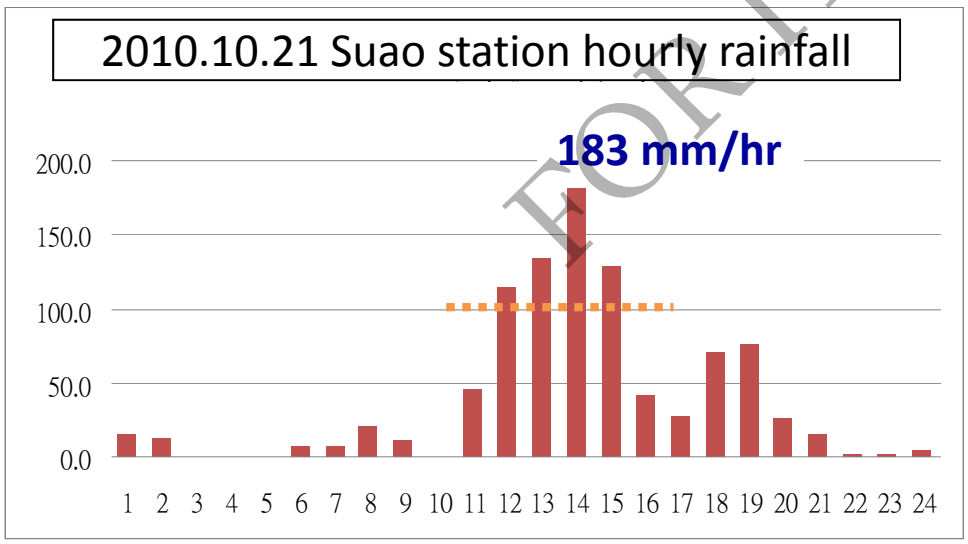




More and More Extreme Events in Taiwan ?

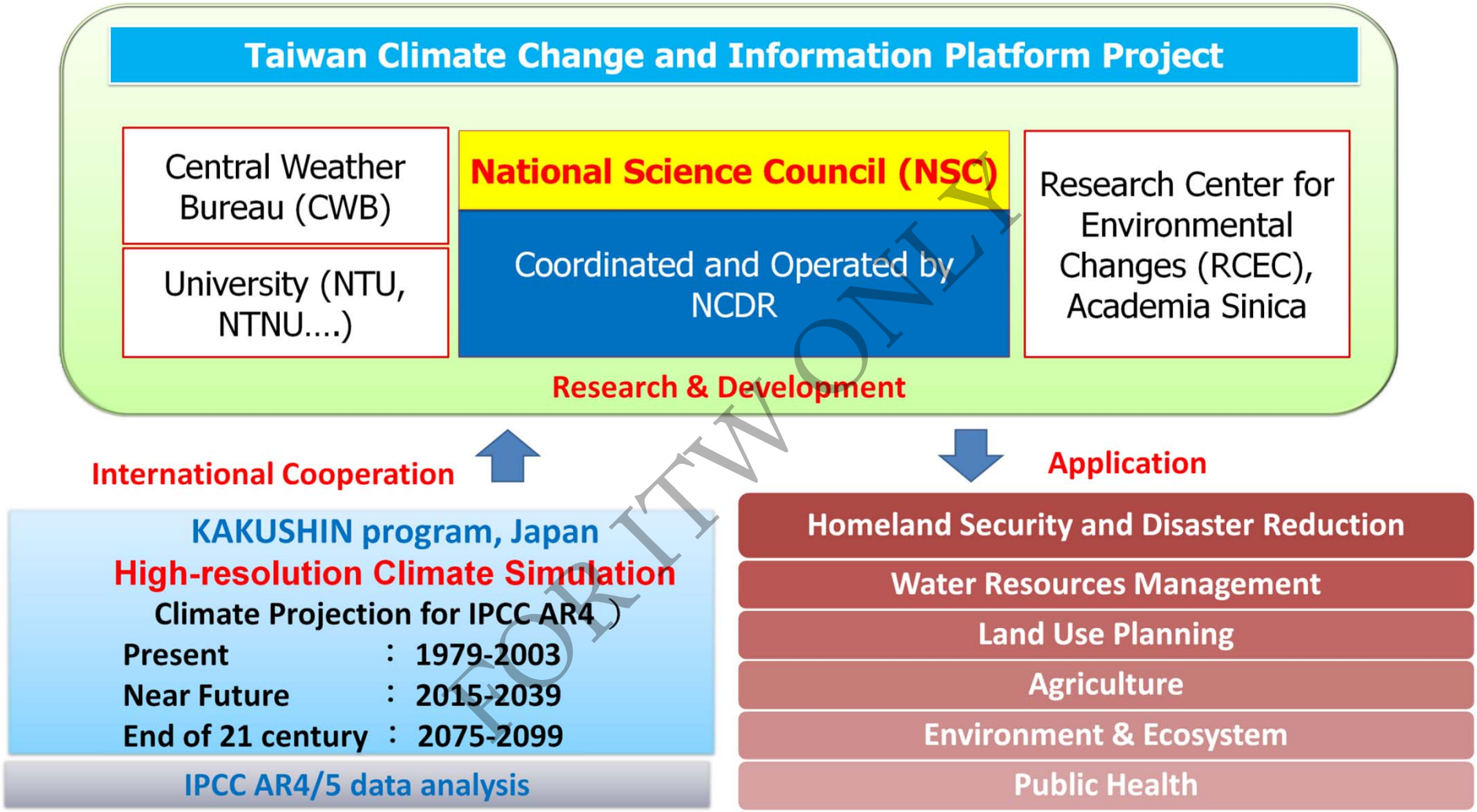
Typhoon Megi (2010)

- Rainfall rate exceeding 100 mm/hr lasted 4 hours.
- Peak value: 183 mm



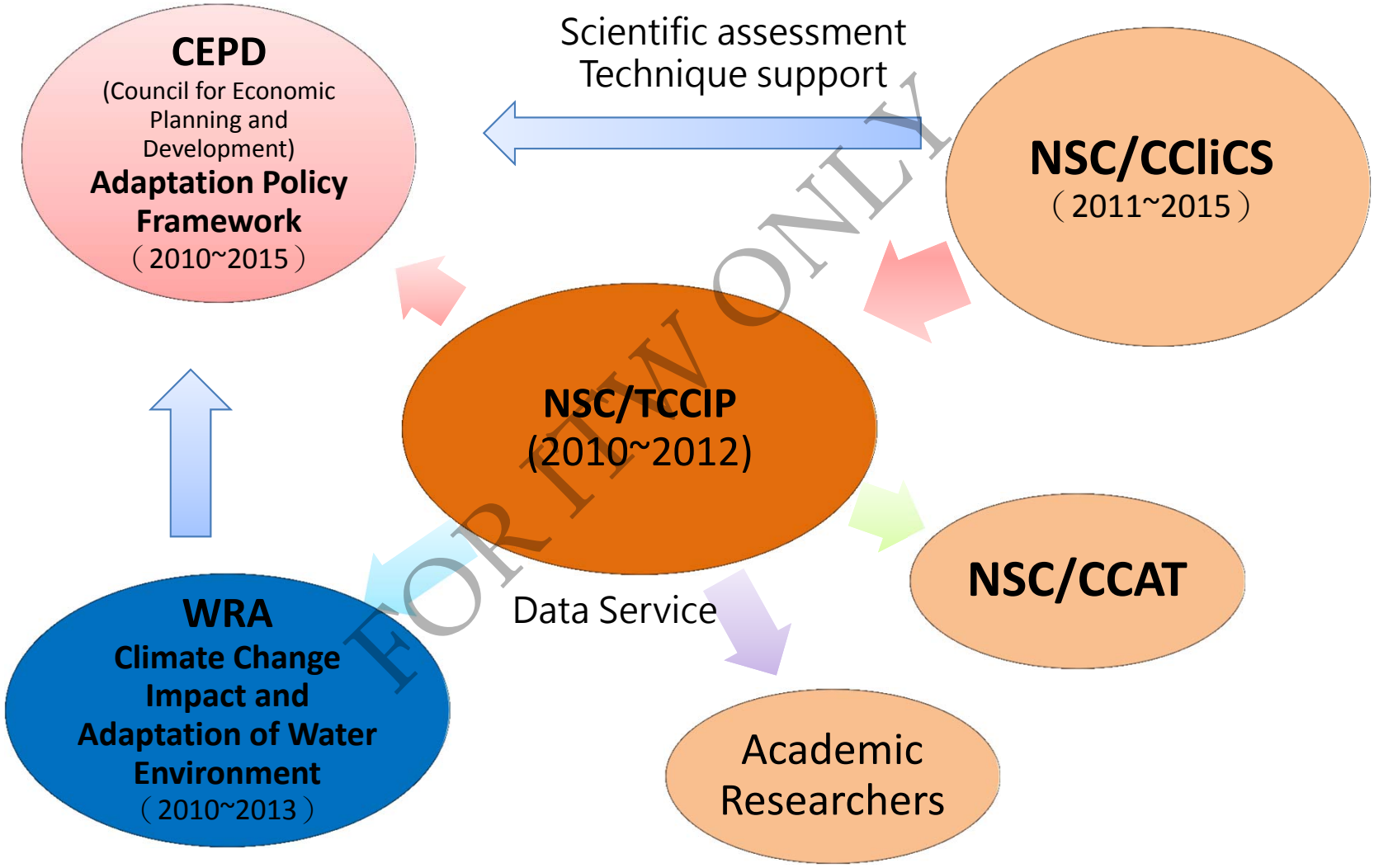
Landslide in Su-Hua Highway During Megi

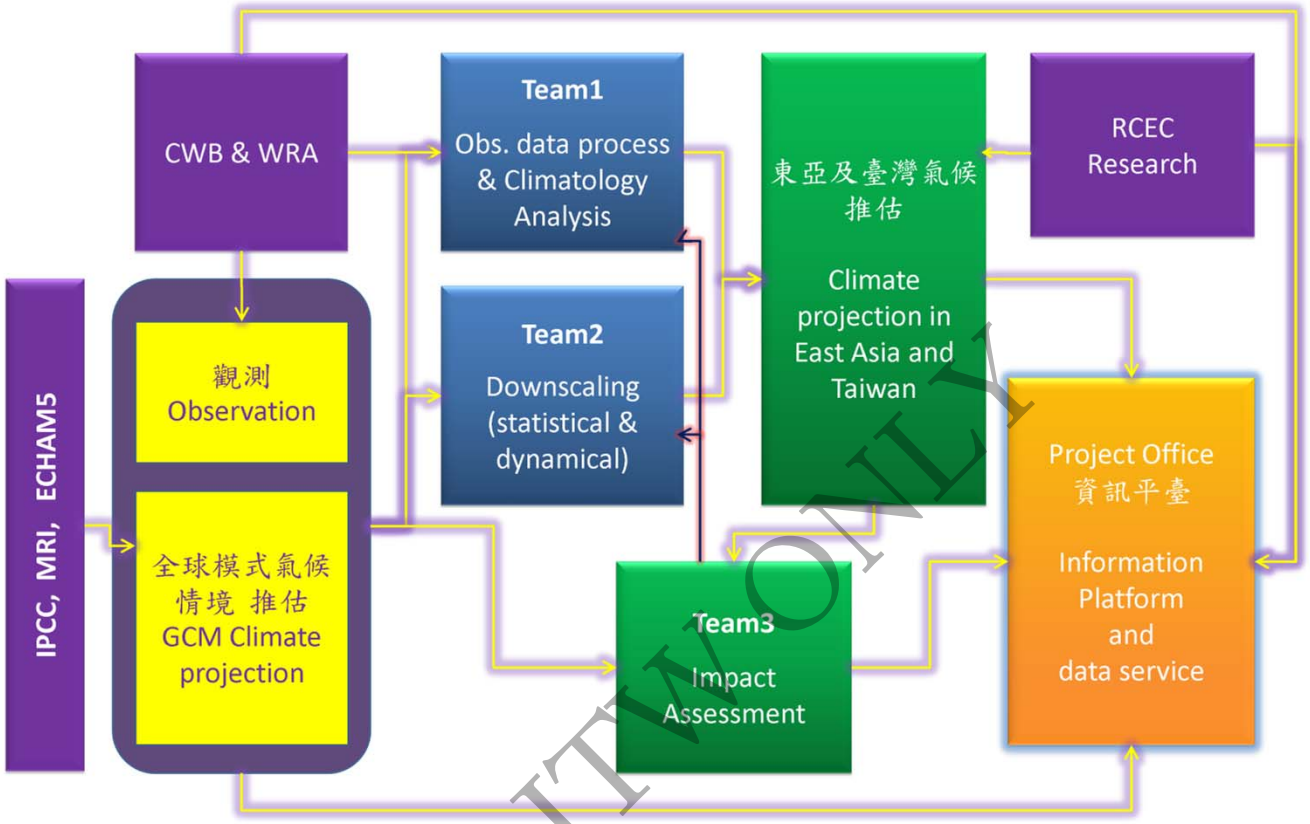
A Scientific Project: TCCIP



To fulfill the needs of government agencies and academia researchers, the TCCIP project, funded by NSC, aims to integrate and promote the resources of climate study, seek international collaboration and academic accomplishment, and generate data of climate projections for the policy making of climate mitigation and adaptation.

Role of TCCIP in Taiwan





Mission of TCCIP

Team 1 :

- Assess the climate change of Taiwan in the past century
- Project the future climate change in Taiwan based on climate projections of IPCC AR4/5
- Generate long-term and high-resolution observation data set

Team 2 :

- Develop and evaluate statistical and dynamical downscaling approaches for regional climate of Taiwan
- Provide high-resolution data for climate change projection of Taiwan
- Explain the limitation of downscaled data to data users. Helping users to use data in proper ways

Team 3 :

- Analyze extreme weather and climate events
- Analyze the variability of extreme precipitation event and assess its impact on disasters
- Analyze the variability of seasonal precipitation and assess its impact on water resources

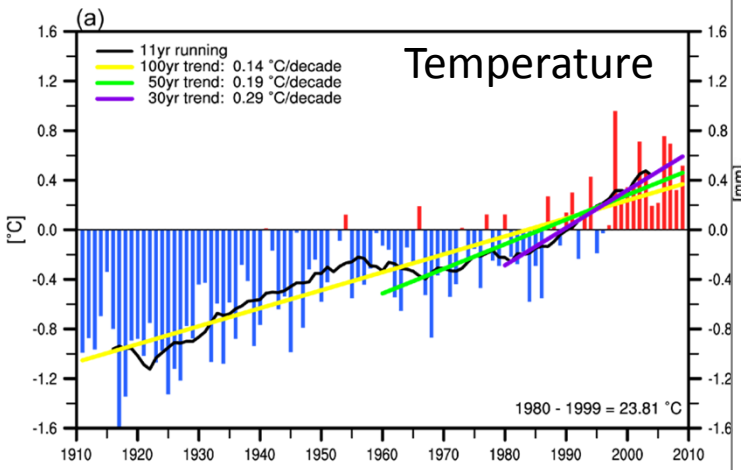
Project Office:

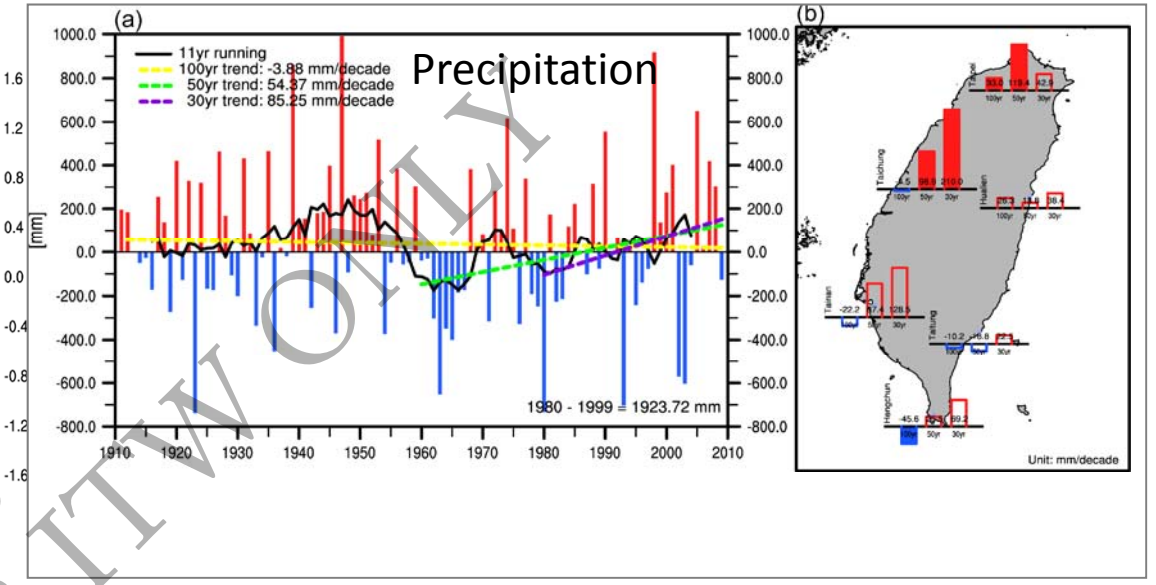
- Administration work
- Coordinate the operation of project
- Manage products of project
- Setup data and information sharing platform
- Communicate with data users
- Publish a Scientific Report of the climate change in Taiwan

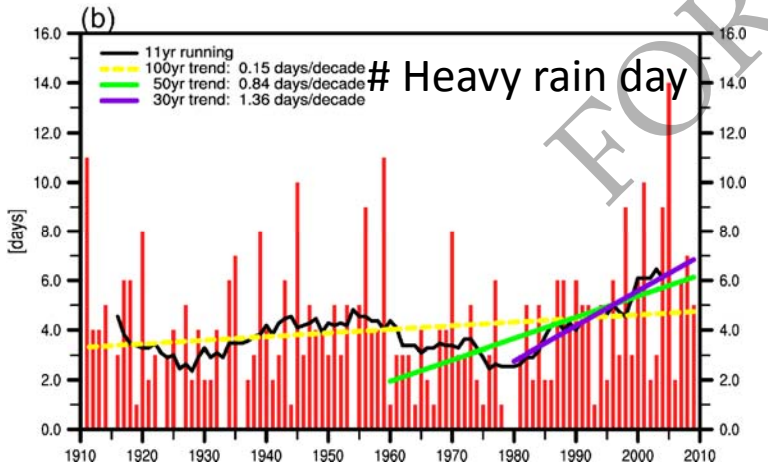
Team1

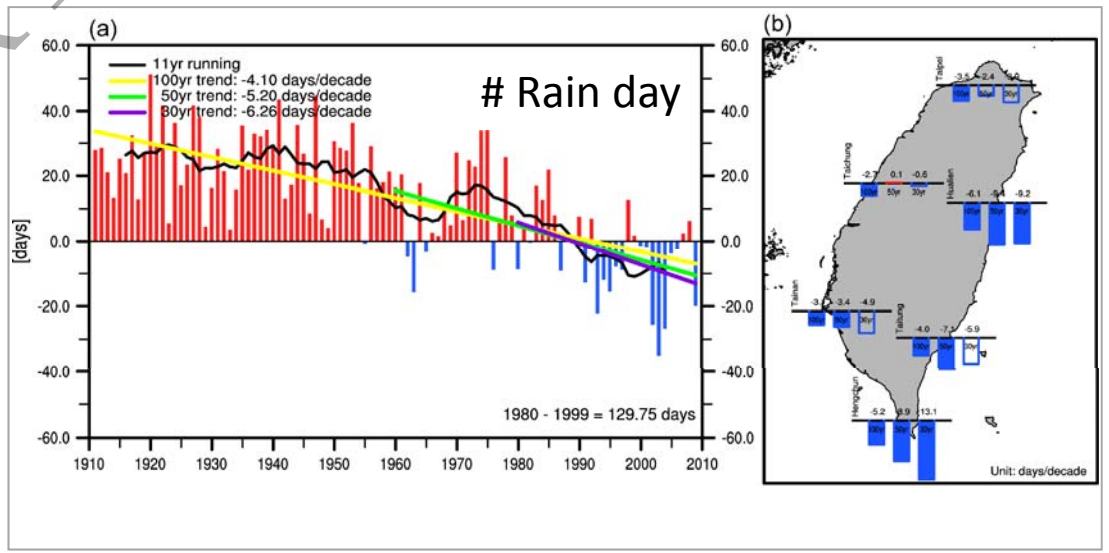
Observation Data Process and Climatology Analysis

Analysis of Taiwan Climatology

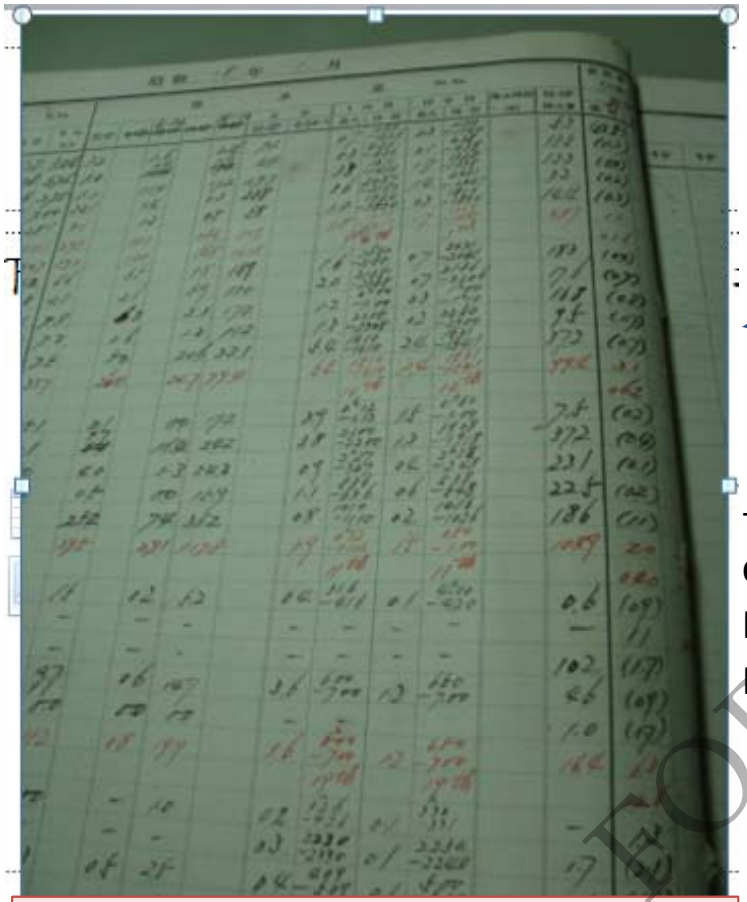








Digitization of the meteorological observation data



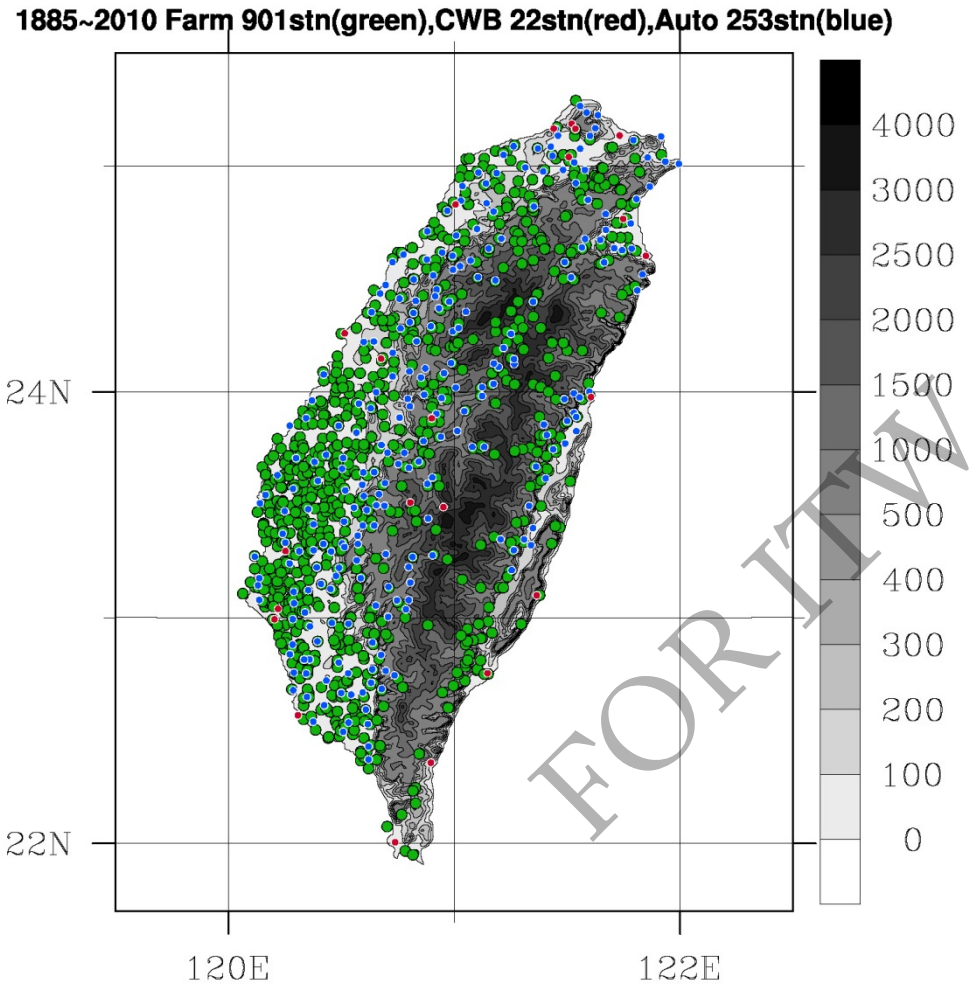
Central Weather Bureau
Precipitation data,
paper records.
about 7.2 million documents

Re-discovering Taiwan climate!

--- pressure、temperature、dew point temperature、Relative humidity、velocity Precipitation, et al. (23 items)

測站站名	設站年份	有報表年份
恆春	1896	1897-2000
臺中	1896	1897-2000
臺北	1896	1897-2000
臺南	1897	1897-2000
花蓮	1910	1910-2000
澎湖	1896	1897-2000
臺東	1901	1901-2000
彭佳嶼	1910	1909-1935, 1944-2000
、蘭嶼	1941	1942,1943, 1949-2000
高雄	1931	1931-2000
阿里山	1933	1933-2000
宜蘭	1935	1935-2000
大武	1940	1940-2000
新竹	1938	1938-2000
嘉義	1968	1968-2000
成功	1940	1940-2000
日月潭	1941	1942-2000
玉山	1943	1943-2000
淡水	1942	1942-2000
竹子湖	1937	1943-2000
鞍部	1937	1943, 1946-2000
東吉島	1962	1963-2000
永康	1947	1947-1974
鹿林山	1947	1947-1969
金六結	1940	1940-1972

Sources/Distributions of Rainfall observations

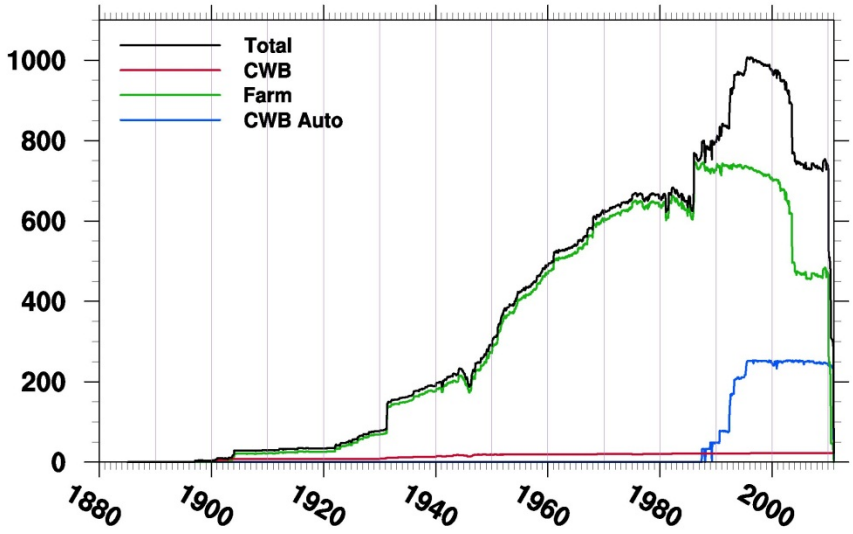


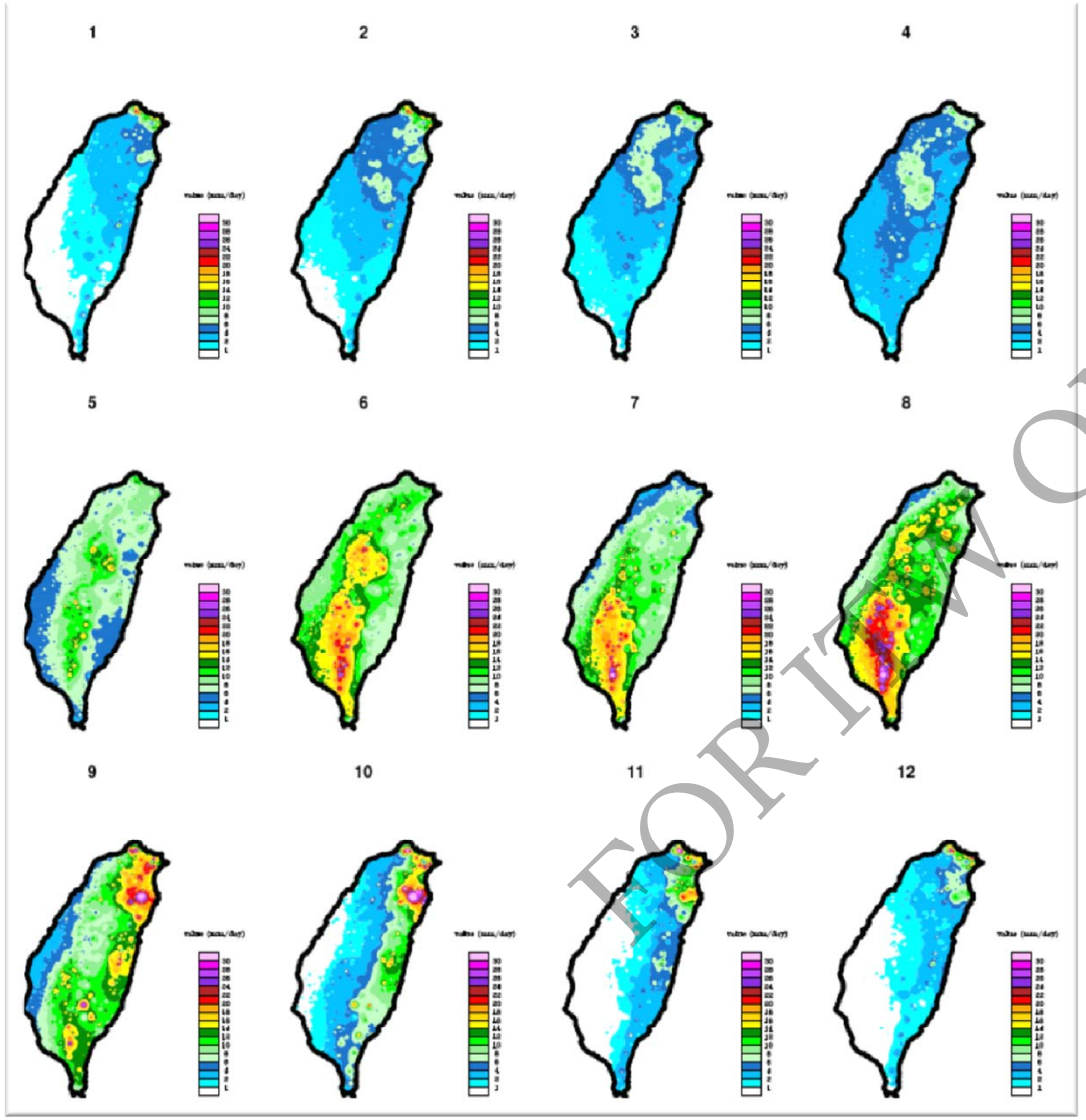
Red dots: CWB

Green dots:

Irrigation Associations + WRA

Blue dots: CWB Auto-gauge





Datasets now available

(Jan 1960 – Dec 2009)

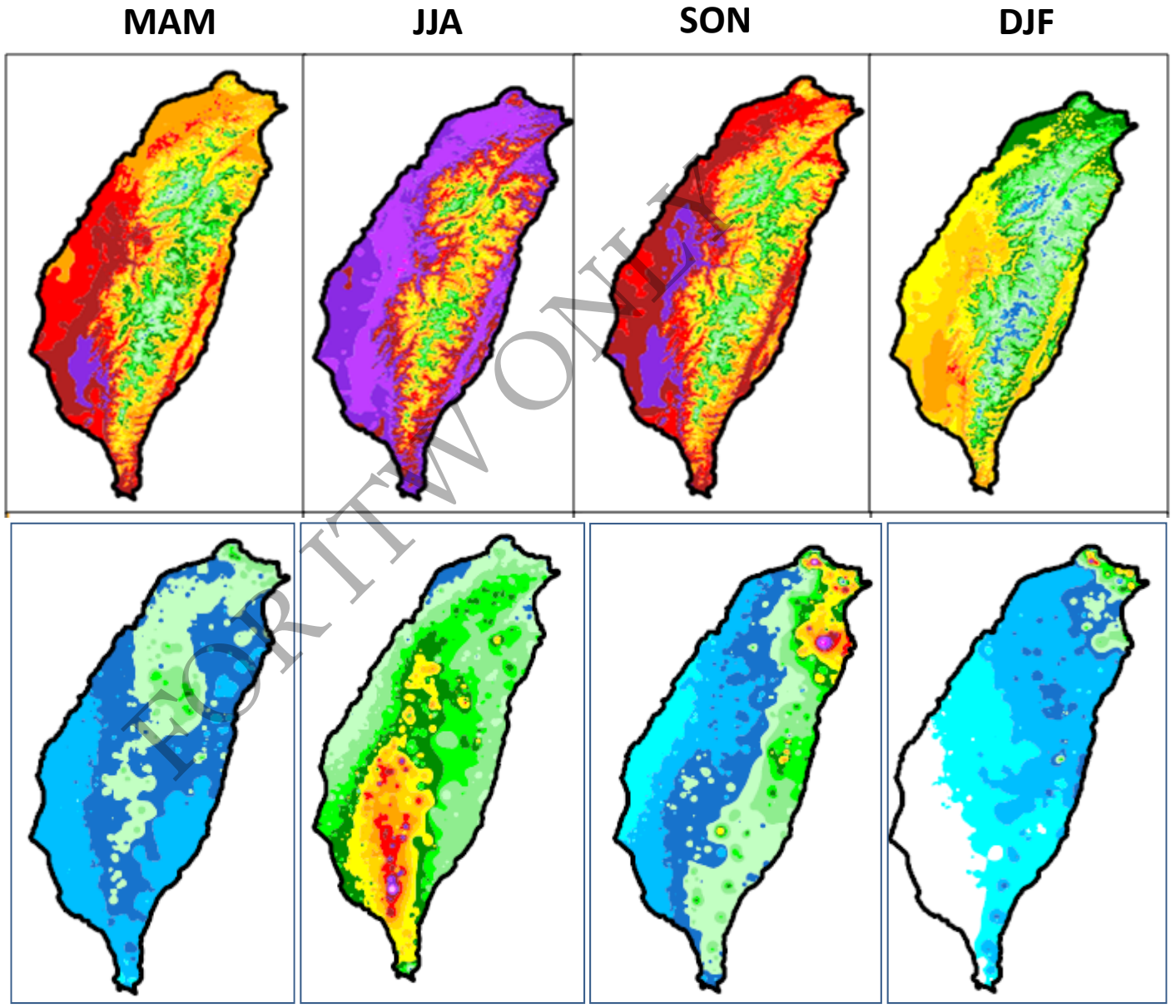
1km & 5km monthly mean Precip.
1km & 5km monthly mean Tavg
1km & 5km monthly mean Tmax
1km & 5km monthly mean Tmin

Datasets to be available

(Jan 1960 – Dec 2009)

1km & 5km Daily Precip.
1km & 5km Daily Tavg
1km & 5km Daily Tmax
1km & 5km Daily Tmin

CLIMATE (1960-2009)



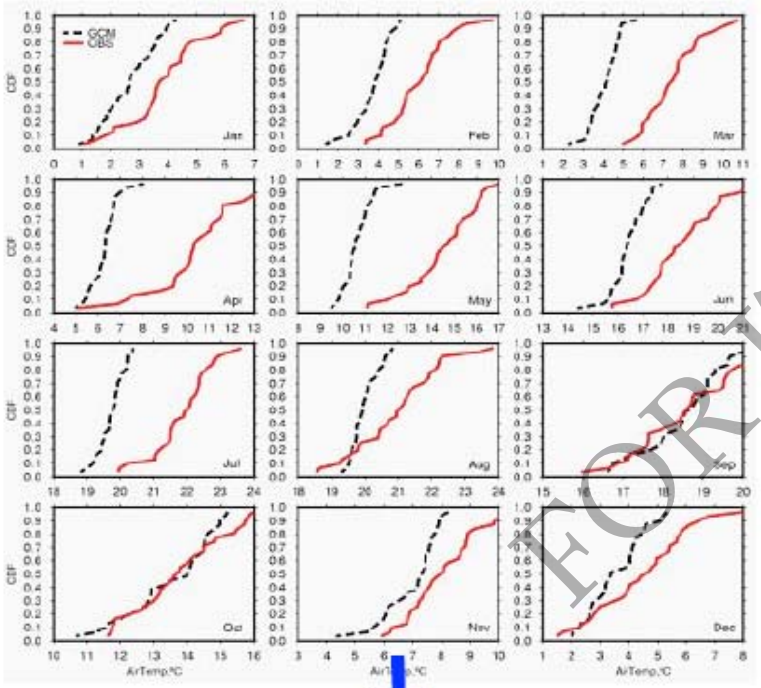
Team2

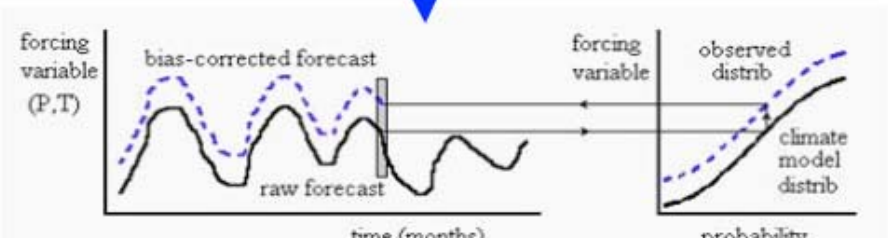
Statistical and Dynamical Downscaling

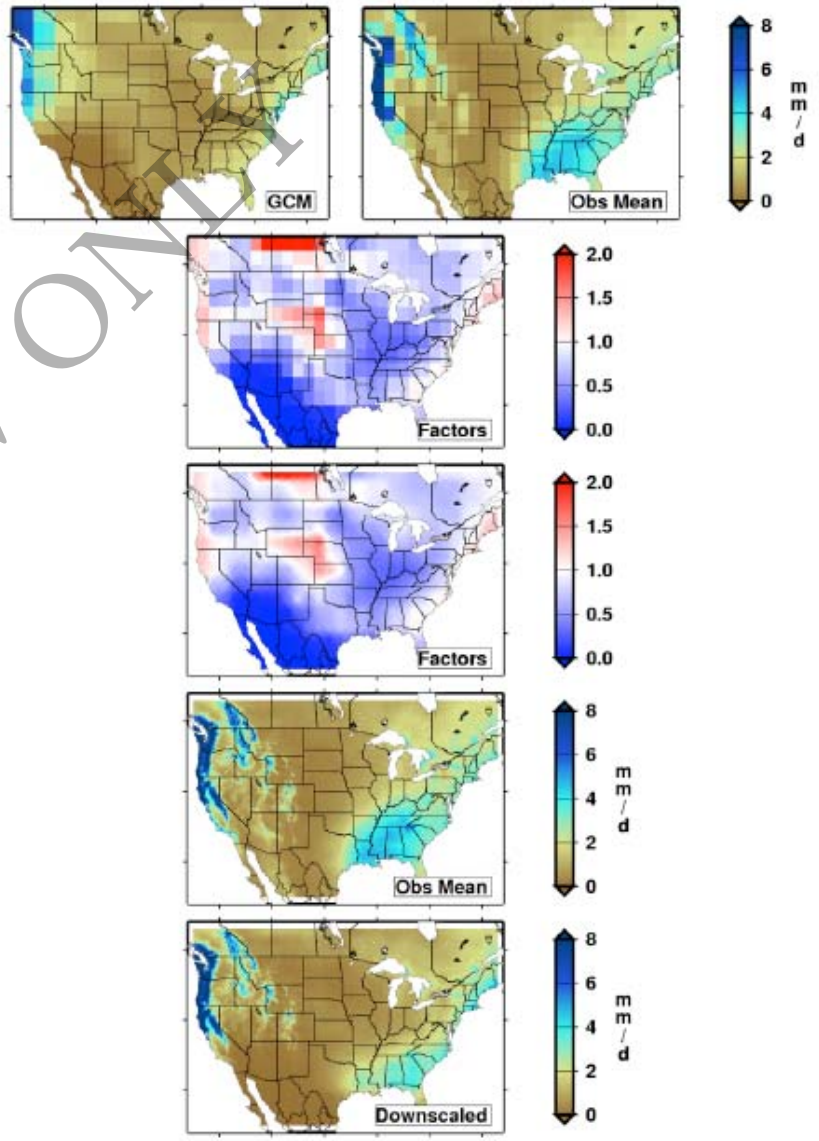
Statistical Downscaling

Wood et al. 2004, and Maurer 2007

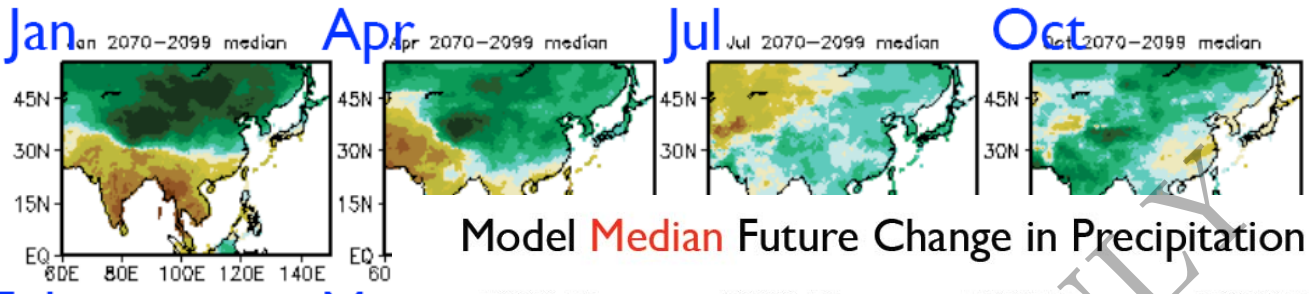
Statistical downscaling and bias correction by cumulative distribution function and interpolation



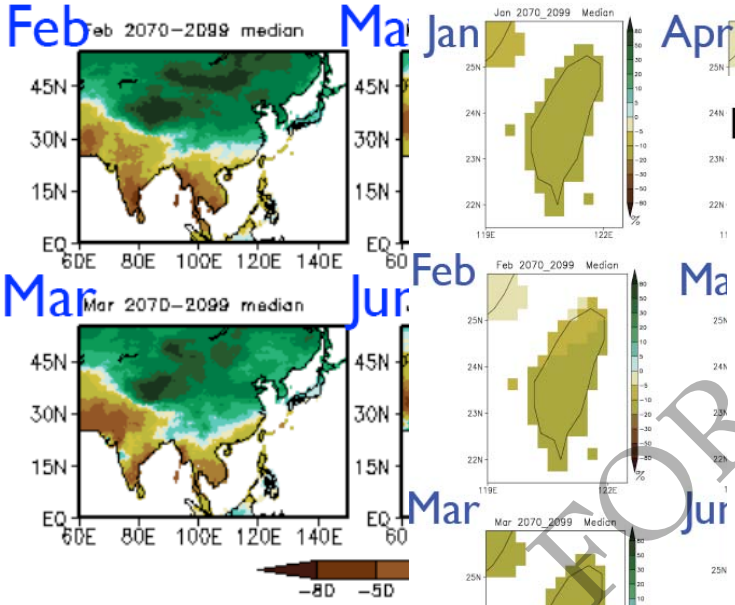




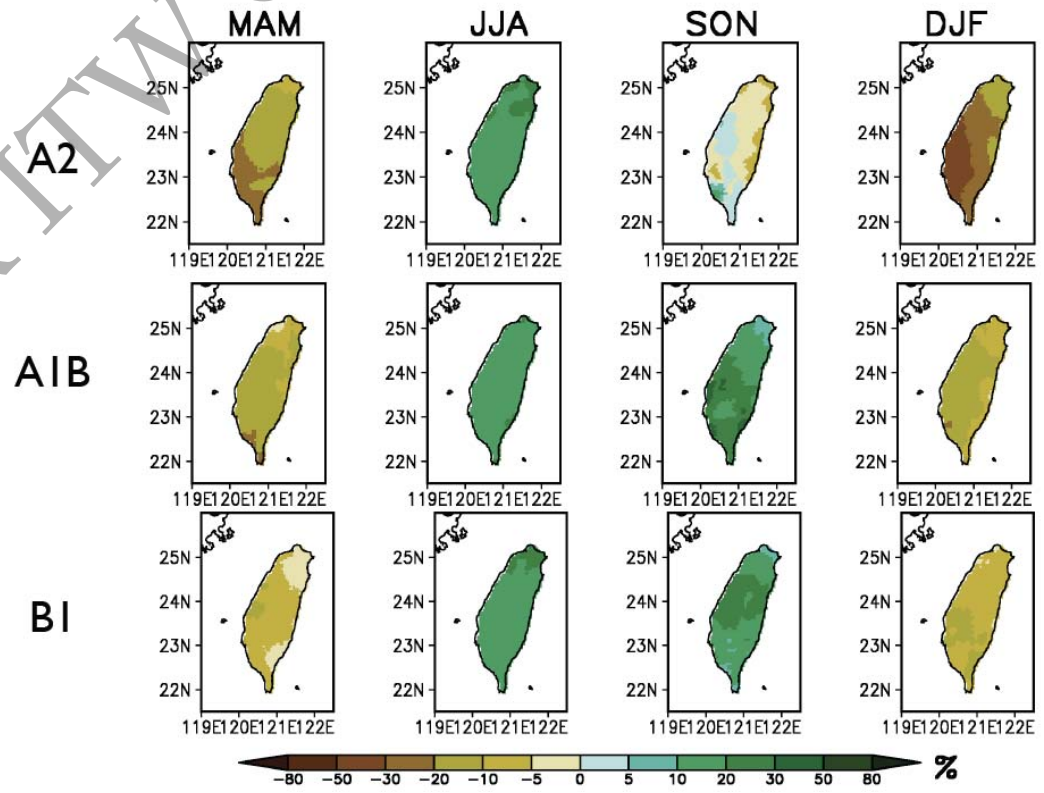
Model Median Future Change in Precipitation (%)



Model Median Future Change in Precipitation (%)

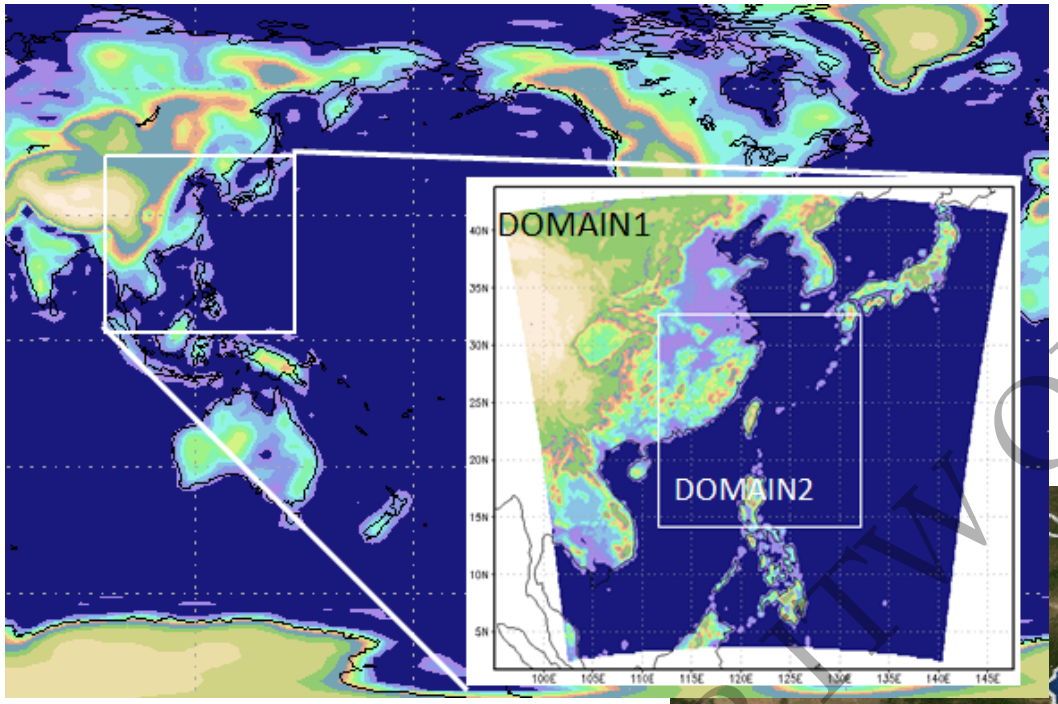


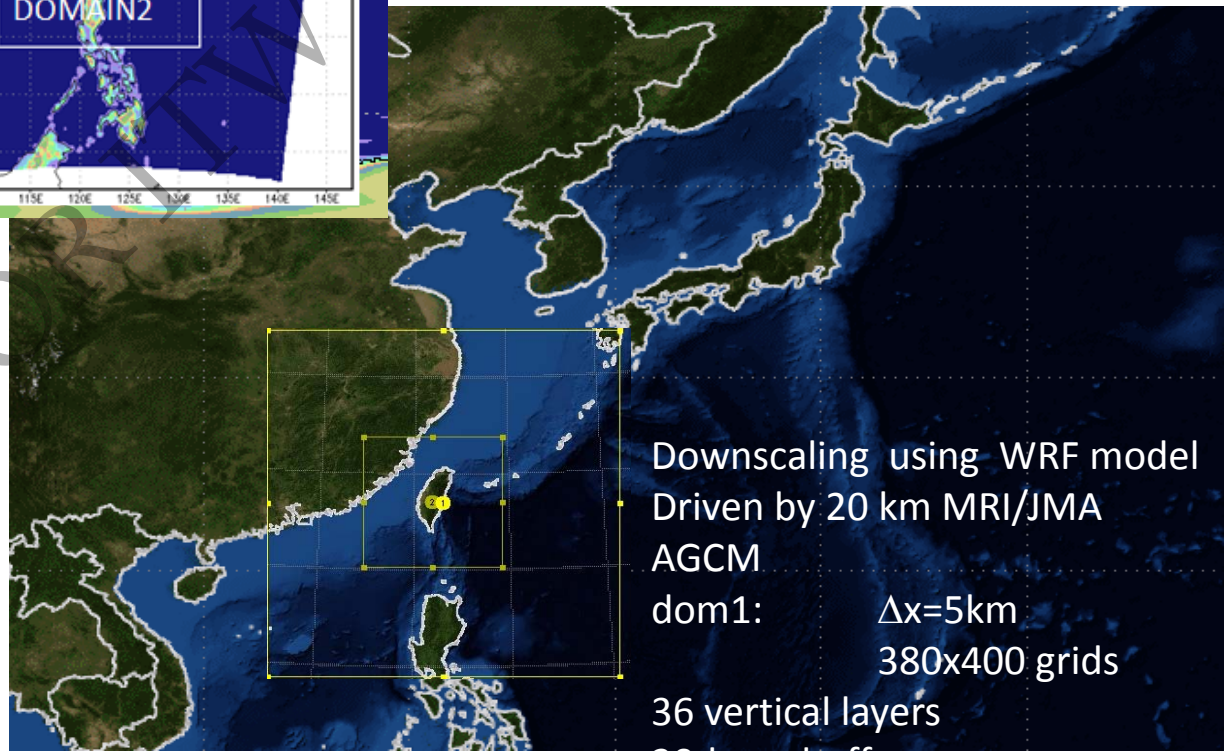
Model Median Future (2080-2099) Change in Precipitation (%)



Dynamical Downscaling

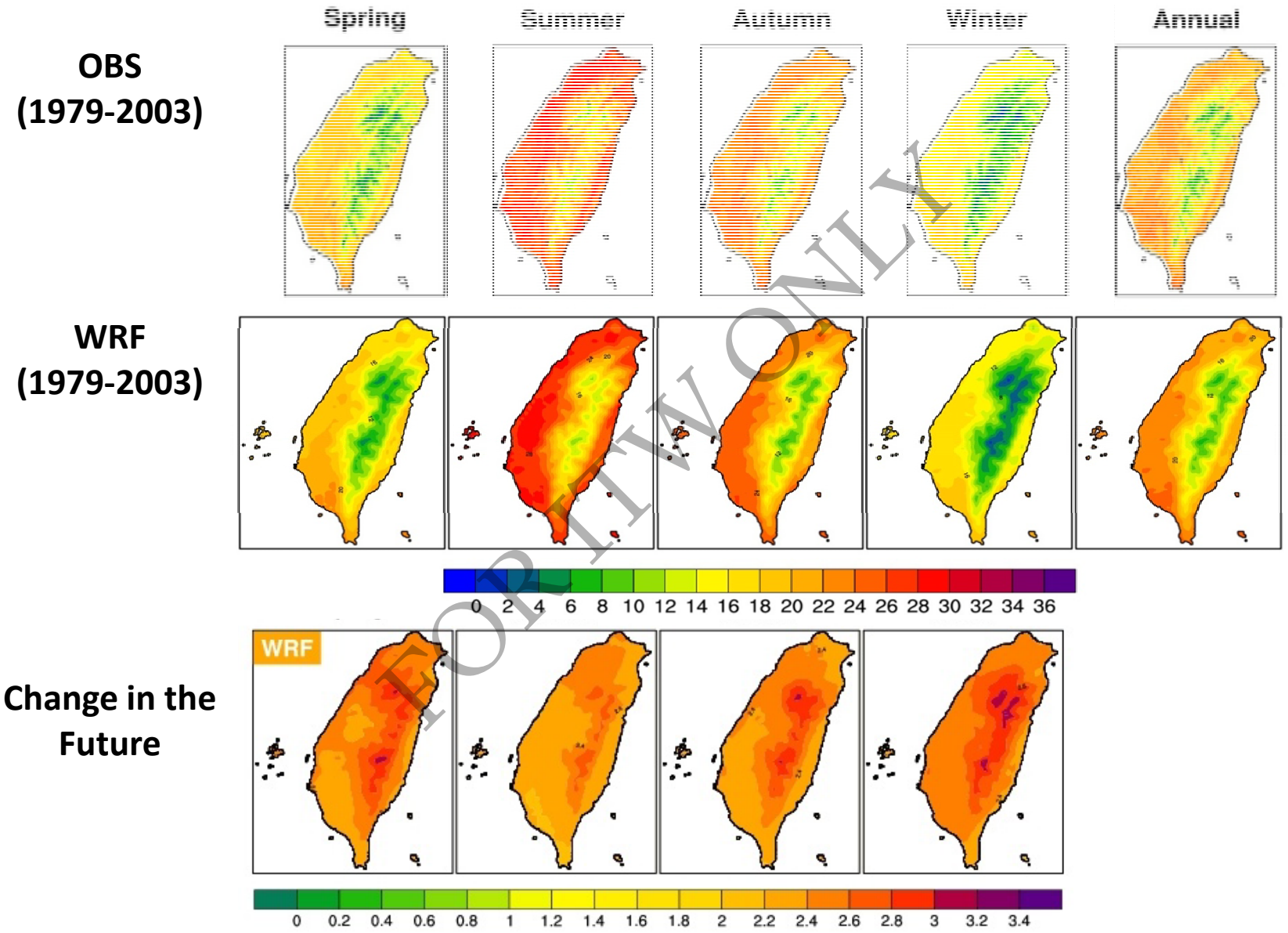
ECHAM5-WRF
& MRI-WRF



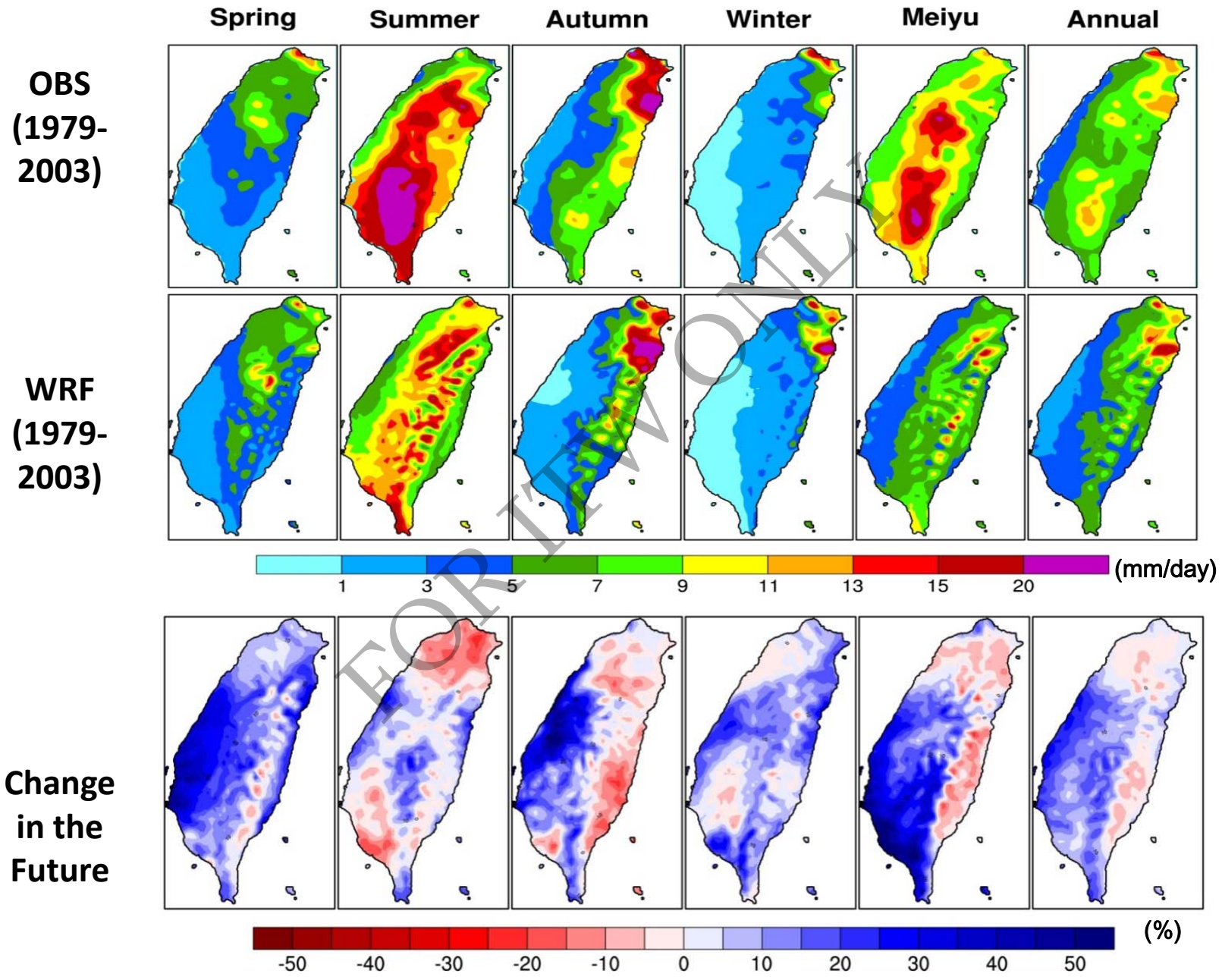


Downscaling using WRF model
Driven by 20 km MRI/JMA AGCM
dom1: Δx=5km
380x400 grids
36 vertical layers

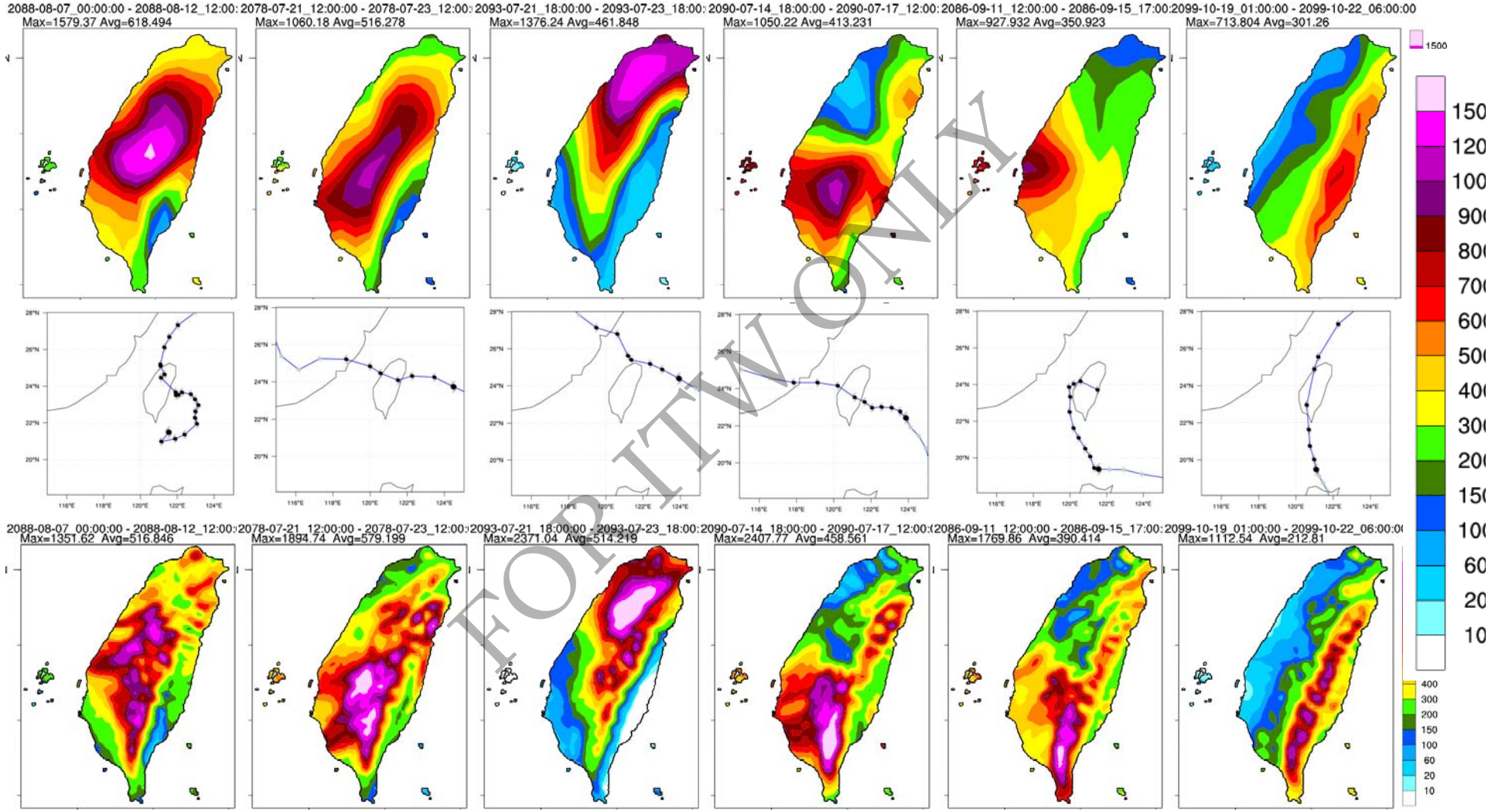
Temperature @ 2m



Seasonal Precipitation



Precipitation of top 6 typhoons in 2075-2099

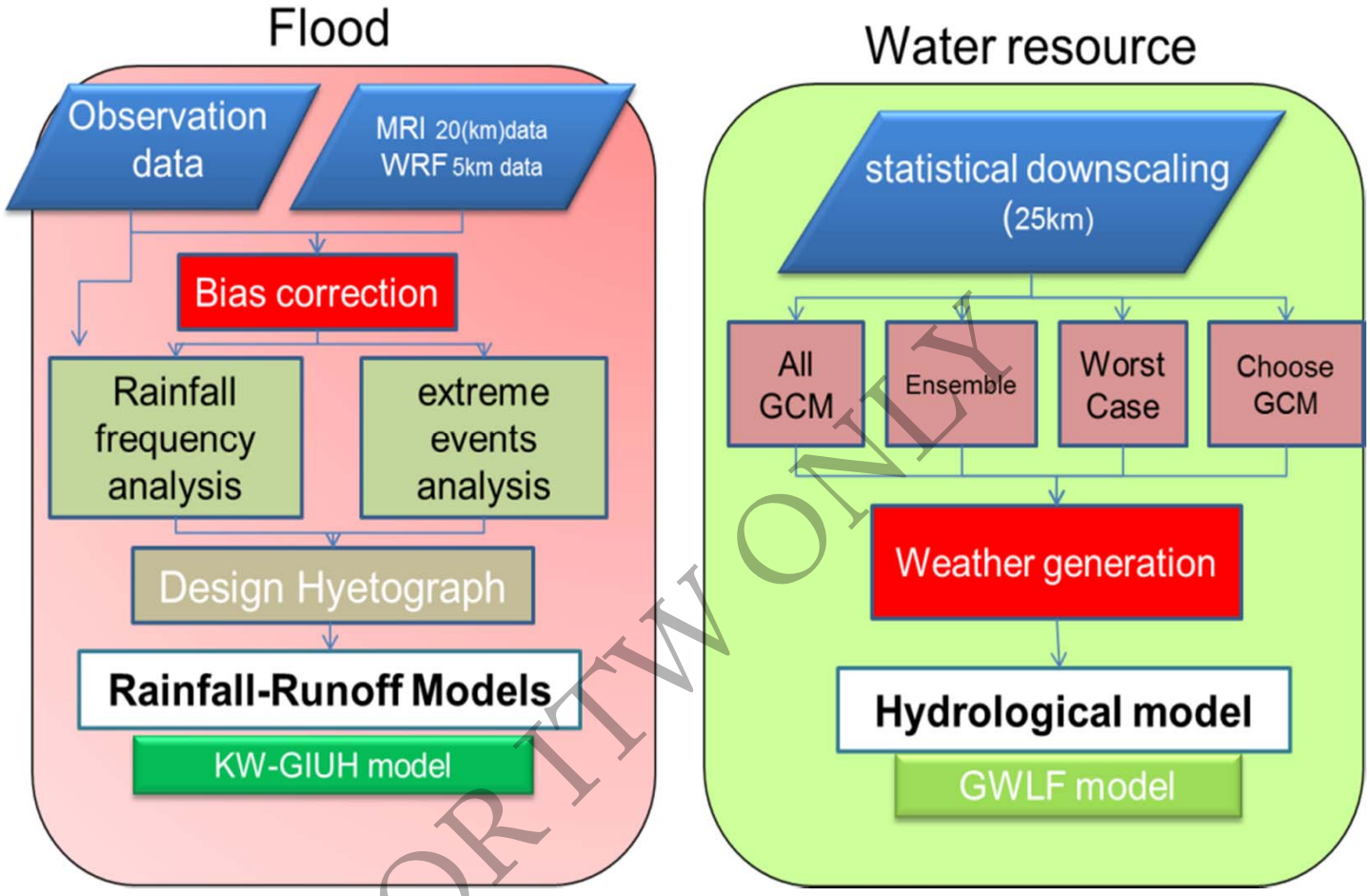


Team3

Impact Assessment

(water resources and extreme precipitation events)

R1



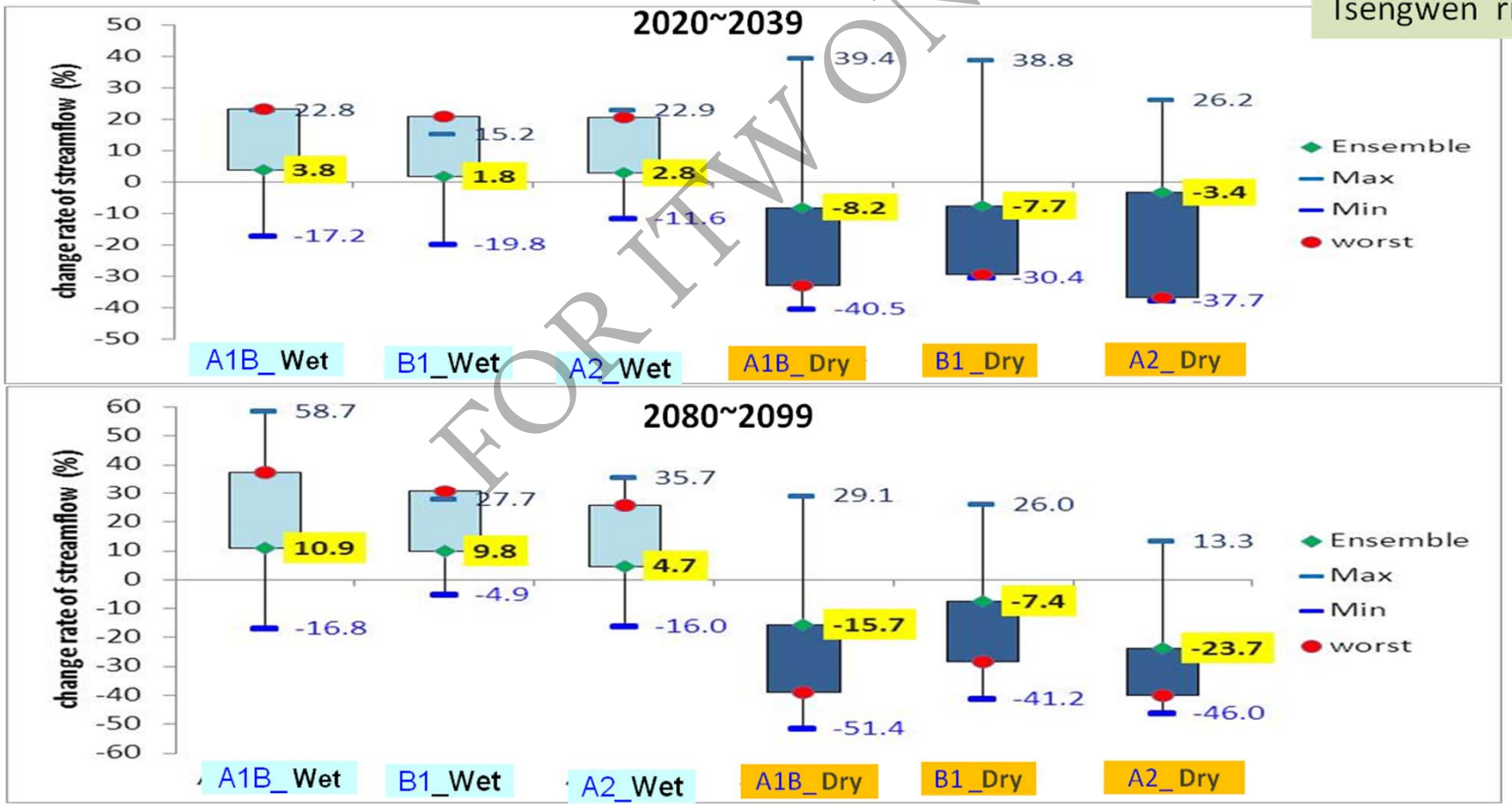
- To assess influence and uncertainty of hydrologic design due to climate change through analyzing the **100 year return period** maximum annual **24-hour rainfall** from observation, high-resolution MRI-AGCM data, and dynamical downscaled data.
- To estimate impacts and uncertainty of **water resources** due to climate change, **stream flows in wet and dry spells** are simulated using hydrological model, statistical downscaling (25km x 25km), weather generator, and data derived from IPCC 24 GCMs with different emission scenarios.

R1 what is 1/100 maximum?
RCEC, 2012/5/9

Change rate of stream flow in wet and dry spell

- Multi-model ensemble result is not significant. Change rate of stream flow only 2~4% in wet spell and -3~-8% in dry spell in near future.
- Greater variability of change rate of stream flow is in dry spell
- Variability of change rate: A1B>B1>A2

Tsengwen river



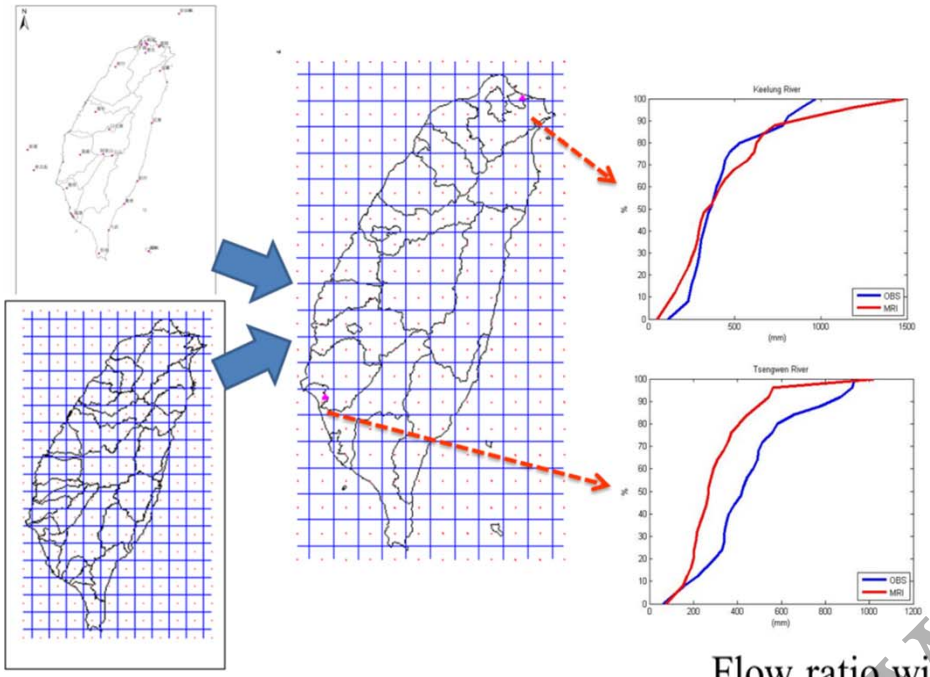


Fig3. Bias correction with MRI data

Flow ratio with original model output using KW-GIUH

KW-GIUH (original)	Tam-Sui river			Tseng-Wen stream		
	1979-2003	2015-2039	2075-2099	1979-2003	2015-2039	2075-2099
5km WRF	1	1.05	0.81	1	1.25	1.64
20km MRI	1	0.57	0.87	1	1.15	1.91

Flow ratio with bias-corrected data using KW-GIUH

KW-GIUH (BC1)	Tam-Sui river			Tseng-Wen stream		
	1979-2003	2015-2039	2075-2099	1979-2003	2015-2039	2075-2099
5km WRF	1	1.18	0.89	1	0.98	1.43
20km MRI	1	0.63	0.88	1	1.11	1.9

Project Office

Science Report

TCCIP Information Platform

http://satis.ncdr.nat.gov.tw/ccsr/

Chapter 6
Climate Projection

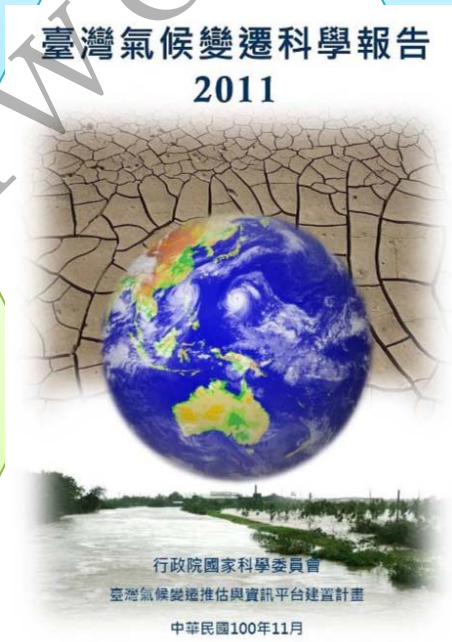
Chapter 5
Regional Climate Change in Taiwan

Chapter 3
EA/WNP Climate Change

Chapter 7
Climate Change and Disaster impact analysis

Chapter 2
Global Climate Change (Observation)

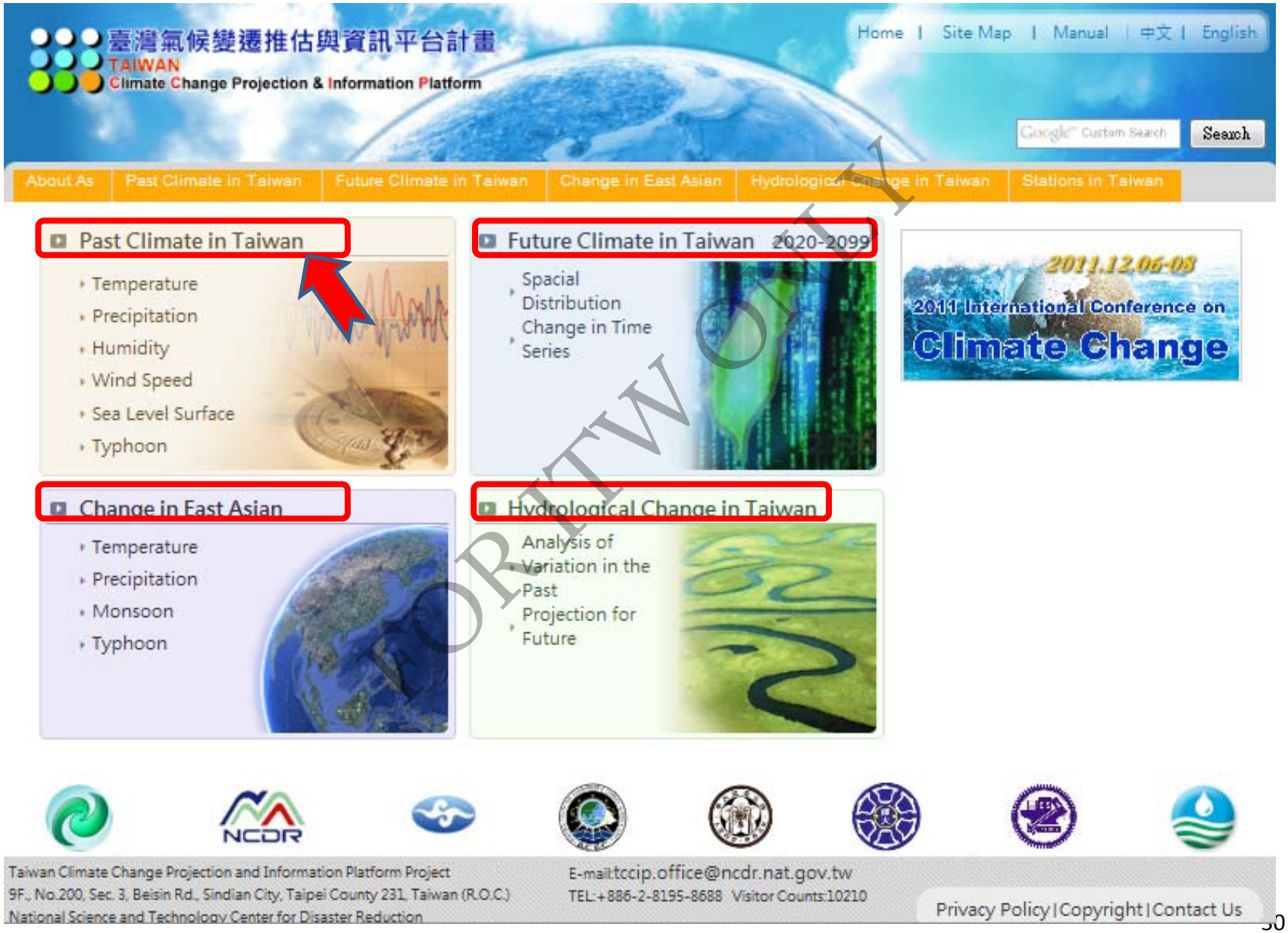
Chapter 4
Natural variability and Interdecadal change



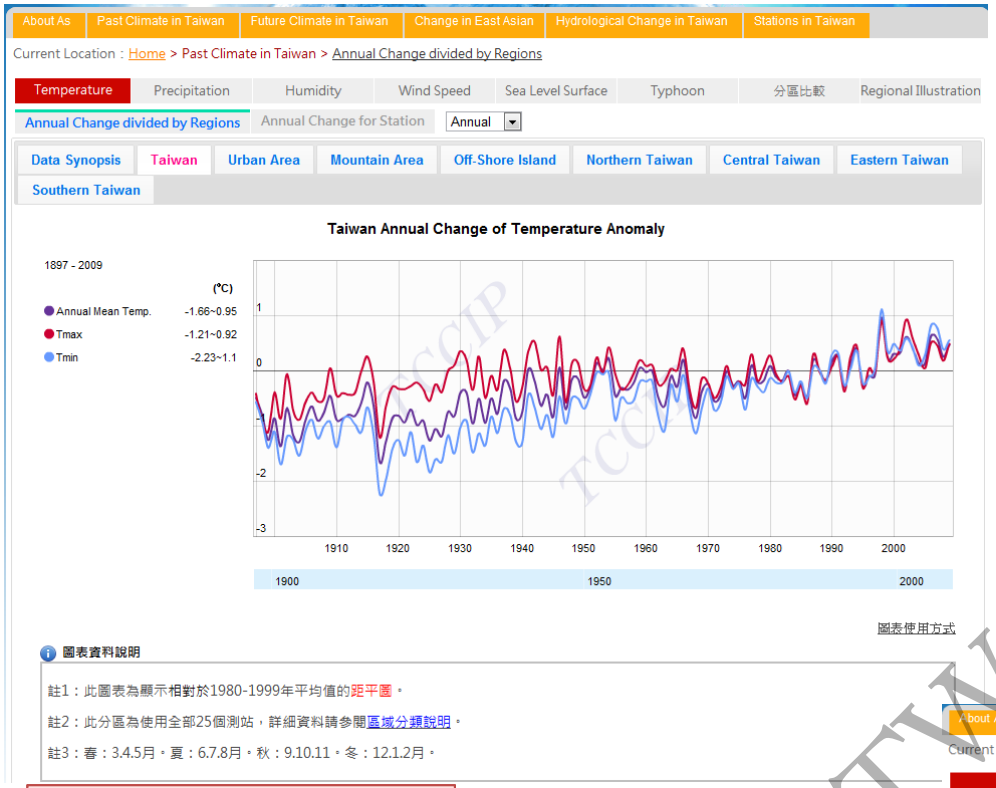
TAIWAN CLIMATE CHANGE SCIENCE REPORT 2011

TCCIP webpage

http://tccip.ncdr.nat.gov.tw/NCDR/main/index.aspx

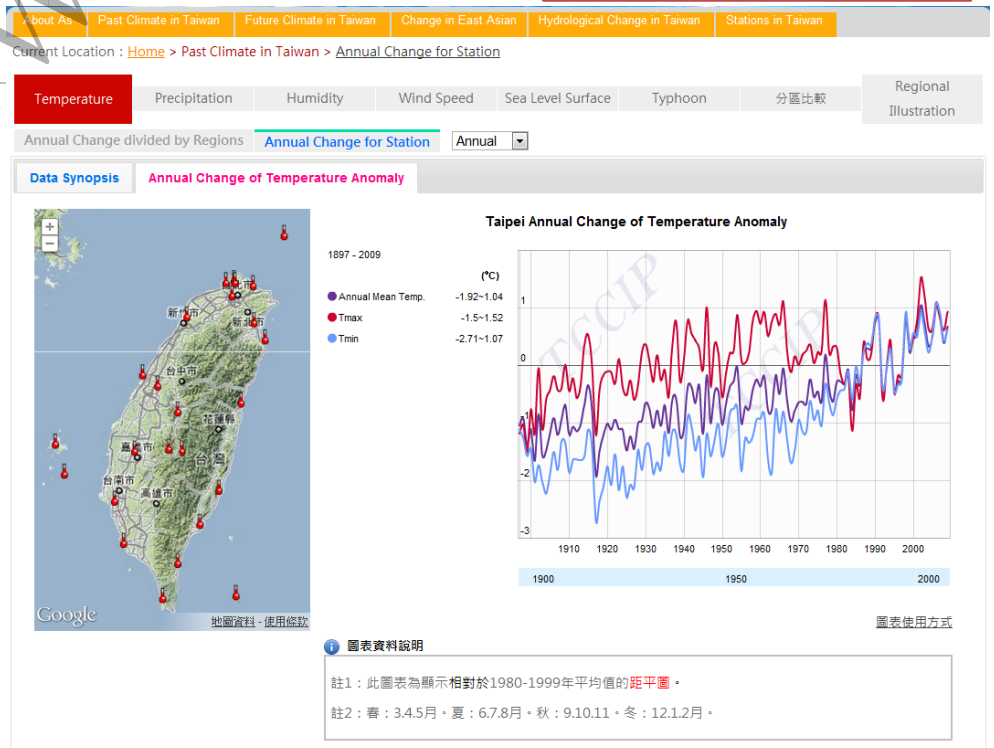


TCCIP webpage

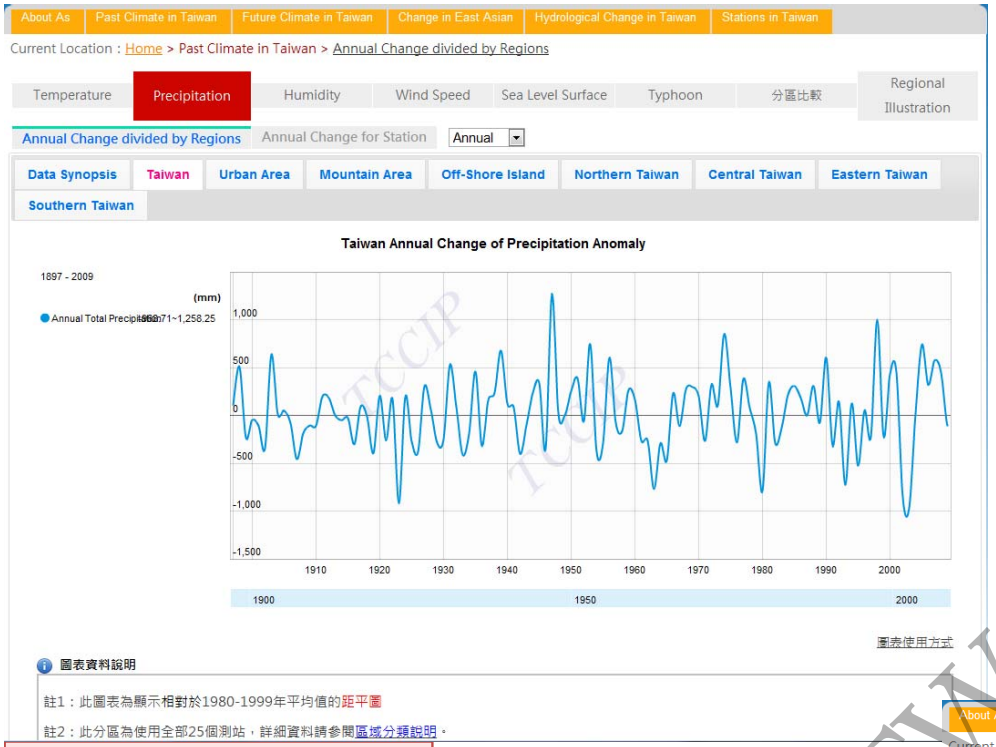


Past Climate in Taiwan (Temperature)

Past Climate in Taiwan (Temperature-station)

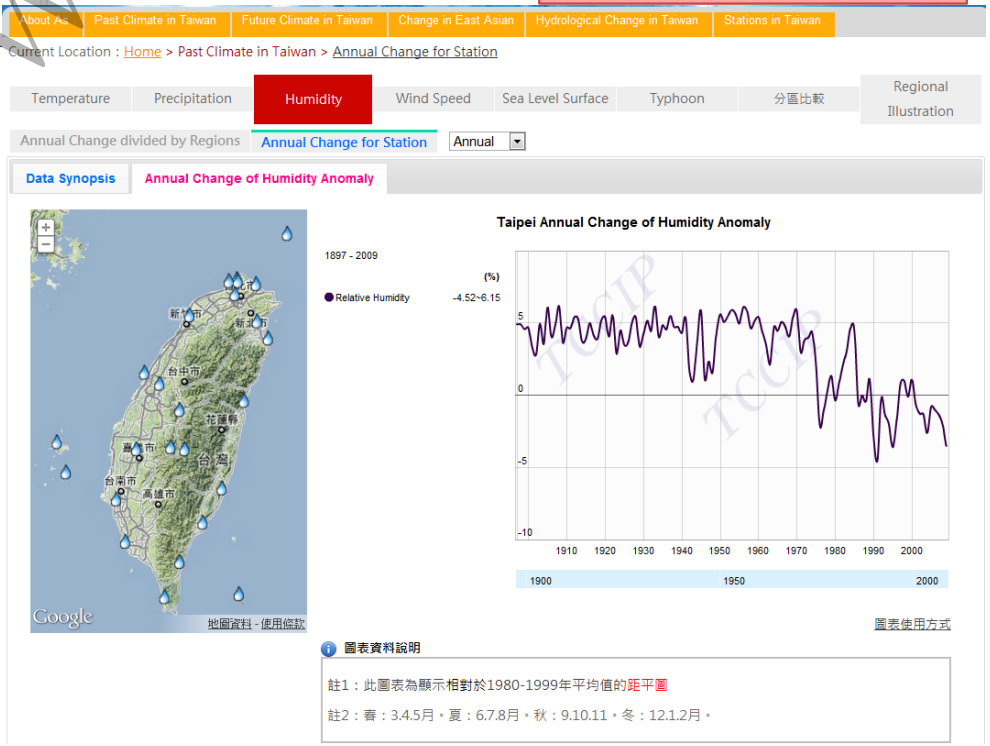


TCCIP webpage

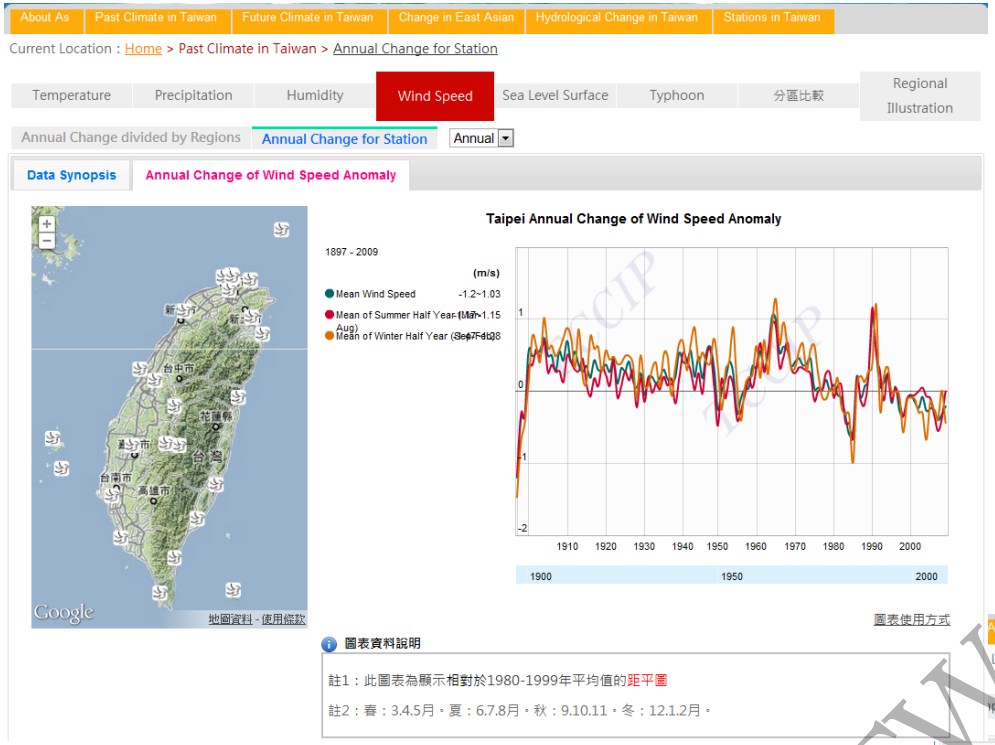


Past Climate in Taiwan (Precipitation)

Past Climate in Taiwan (Humidity)



TCCIP webpage

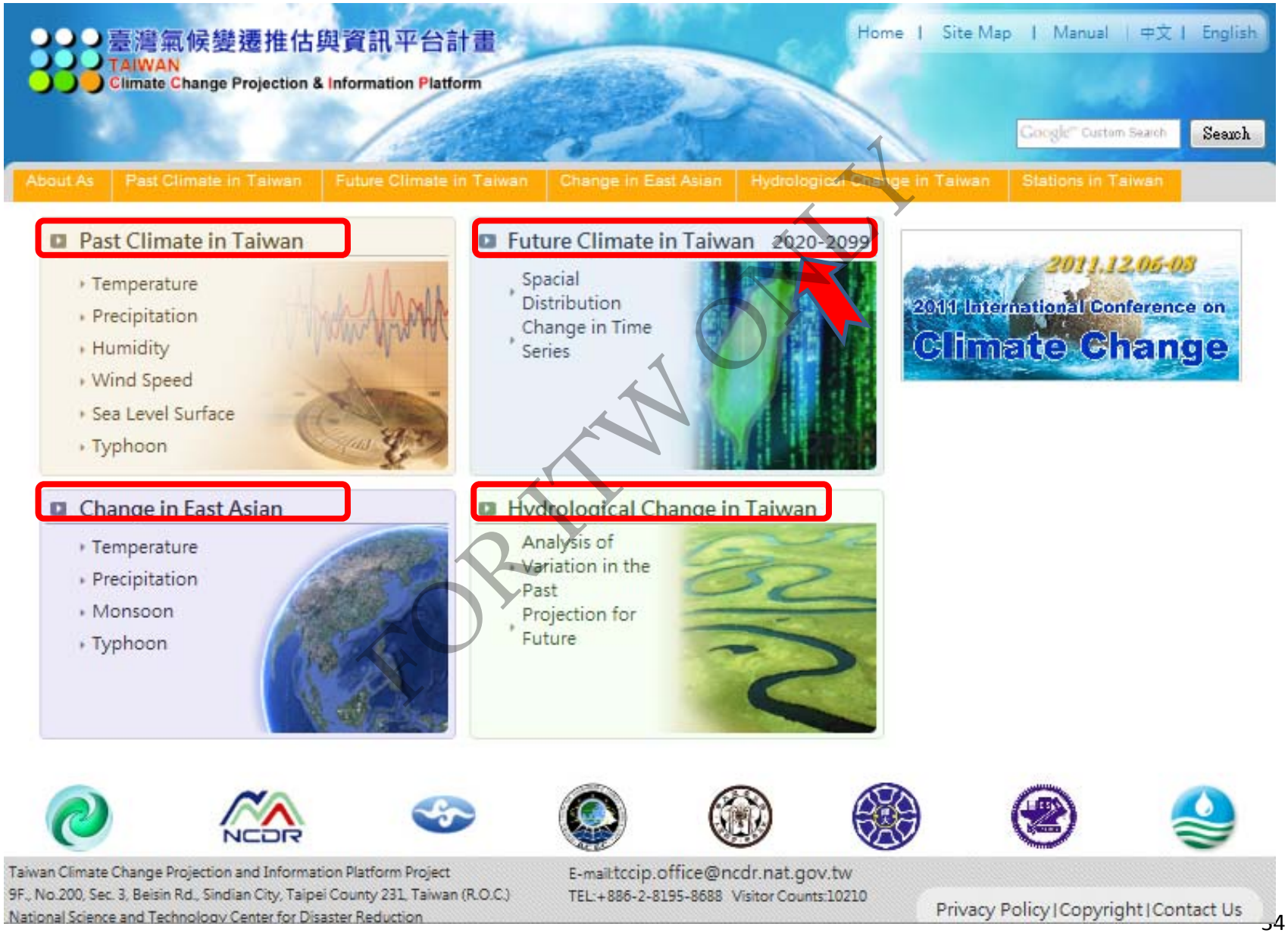


Past Climate in Taiwan (Wind speed)

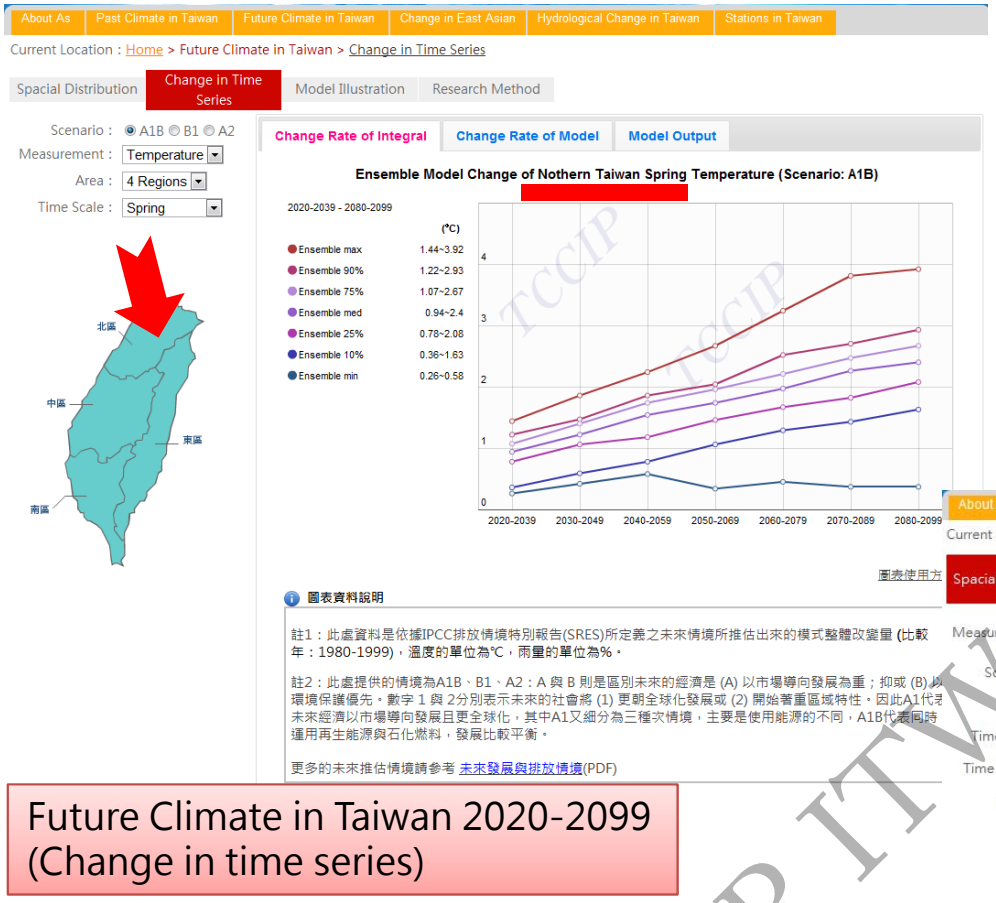
Past Climate in Taiwan (Typhoon)

TCCIP webpage

http://tccip.ncdr.nat.gov.tw/NCDR/main/index.aspx



TCCIP webpage

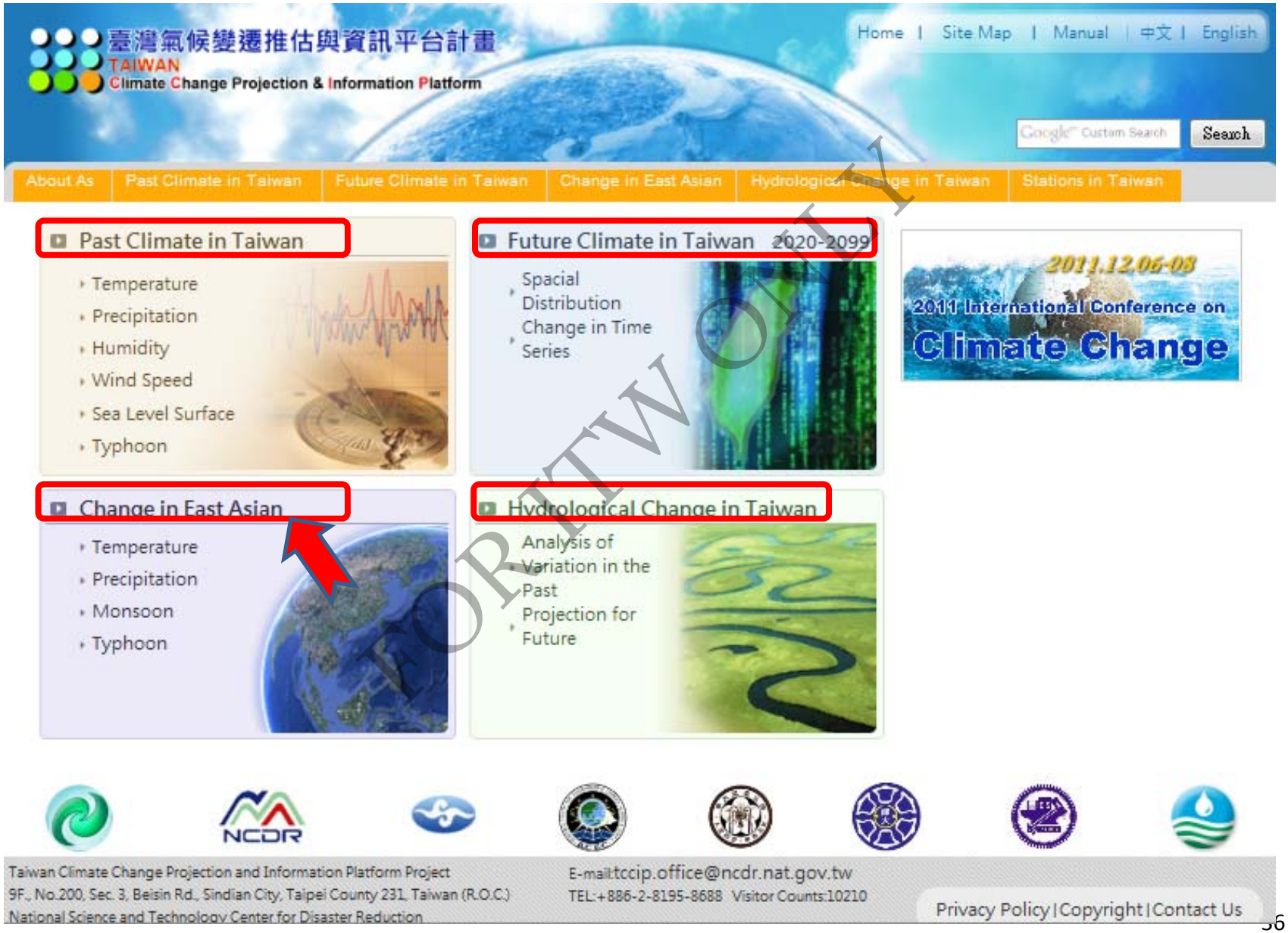


Future Climate in Taiwan 2020-2099
(Change in time series)

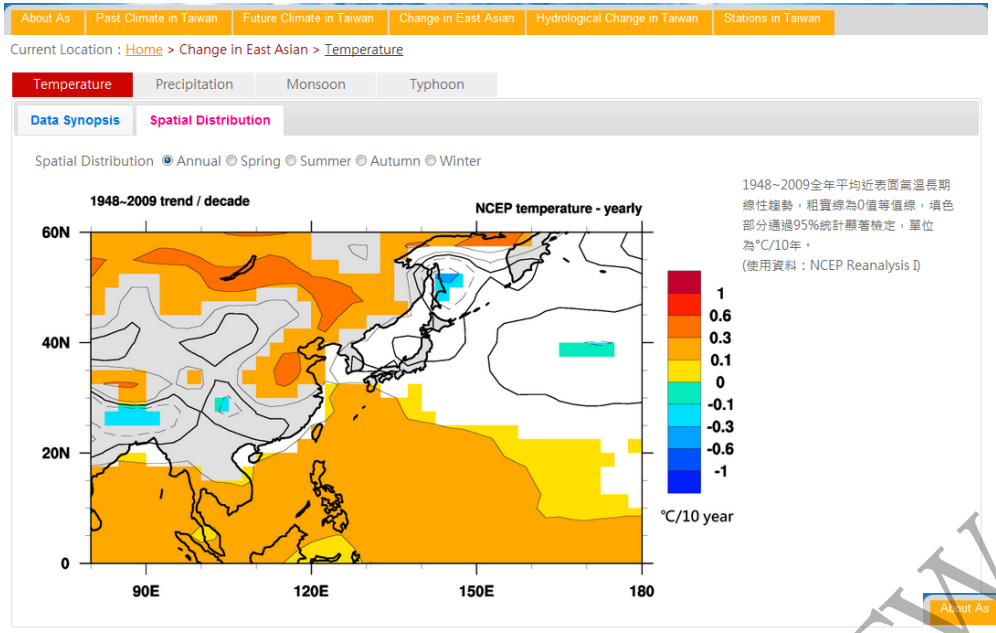
Future Climate in Taiwan 2020-2099
(Spatial distribution)

TCCIP webpage

http://tccip.ncdr.nat.gov.tw/NCDR/main/index.aspx

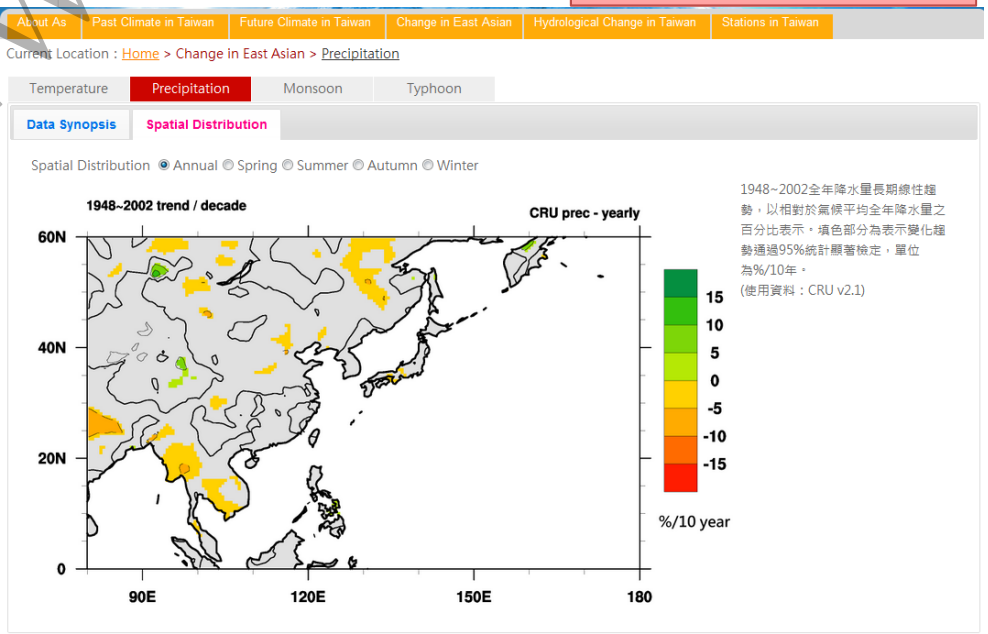


TCCIP webpage

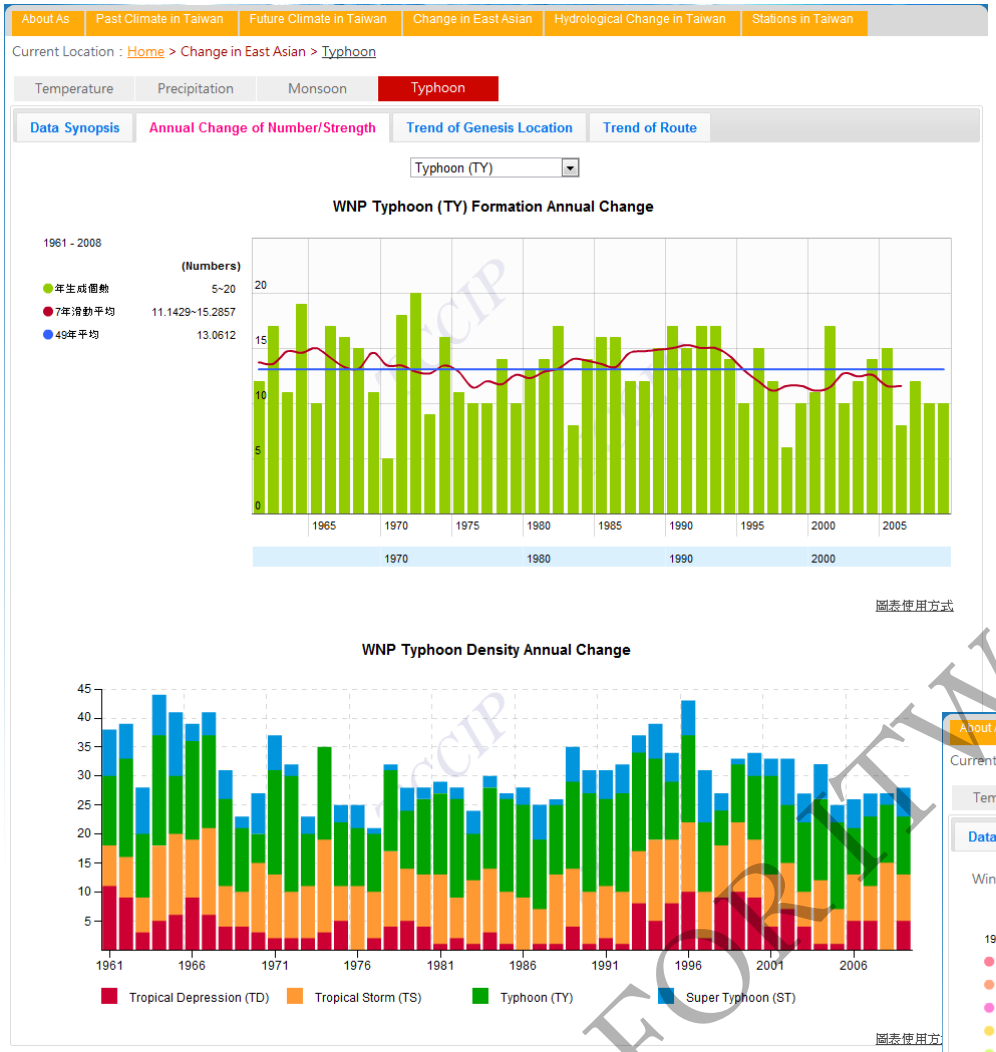


Change in East Asian (Temperature)

Change in East Asian (Precipitation)

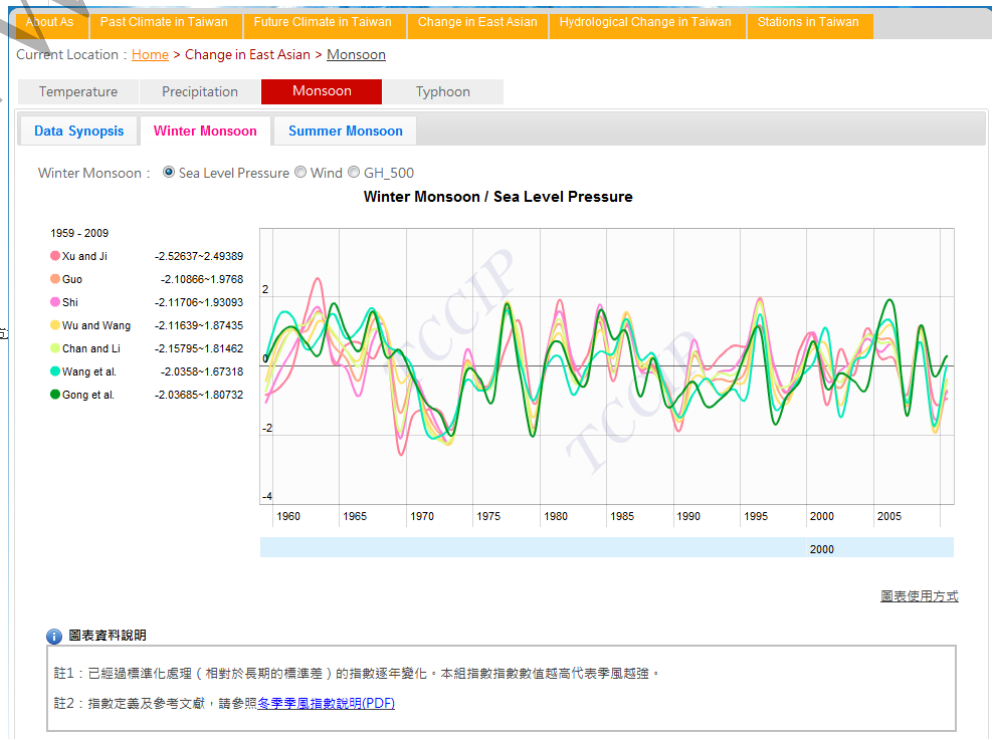


TCCIP webpage



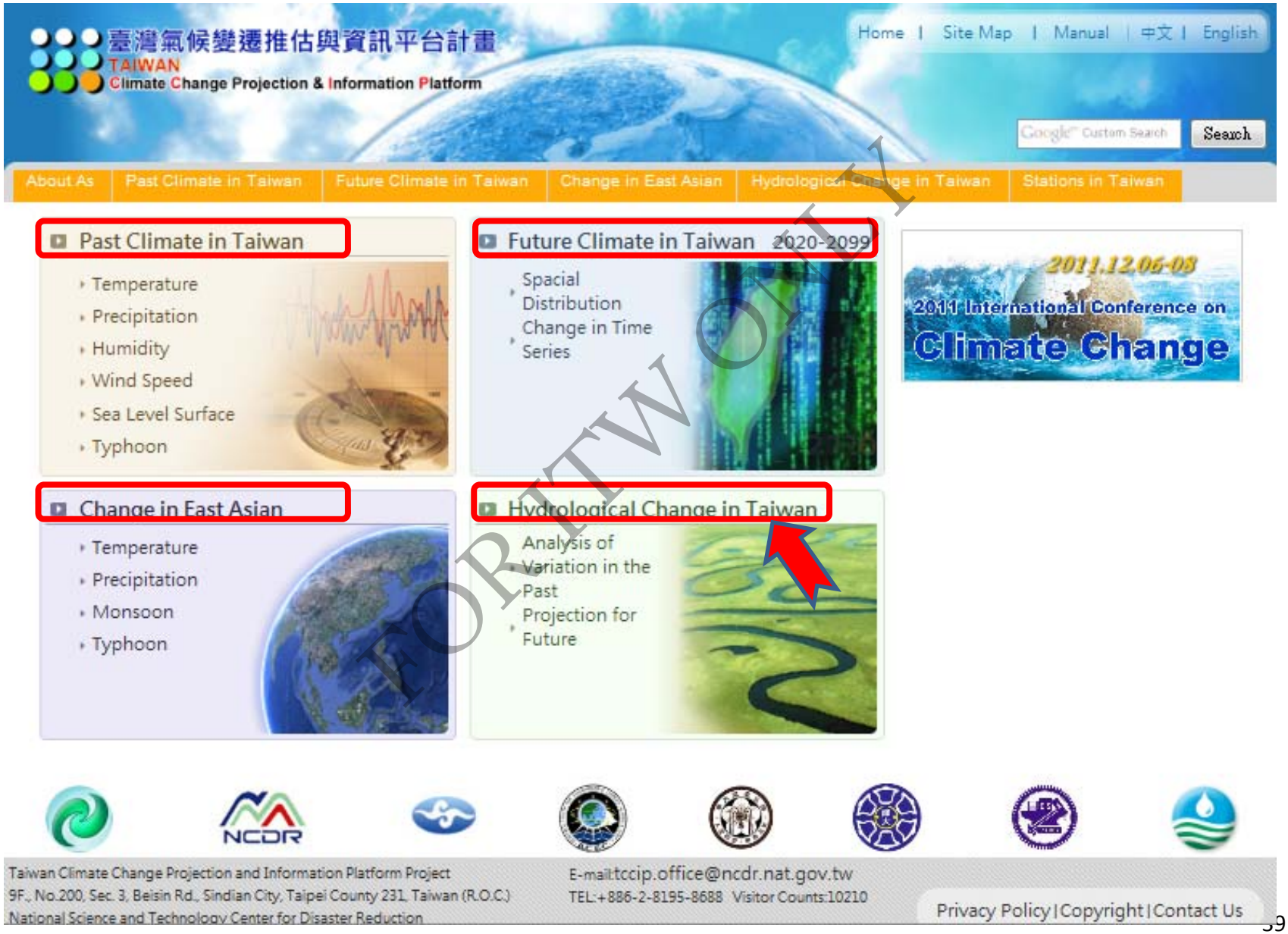
Change in East Asian- Typhoon
(Annual change of number/strength)

Change in East Asian- Monsoon

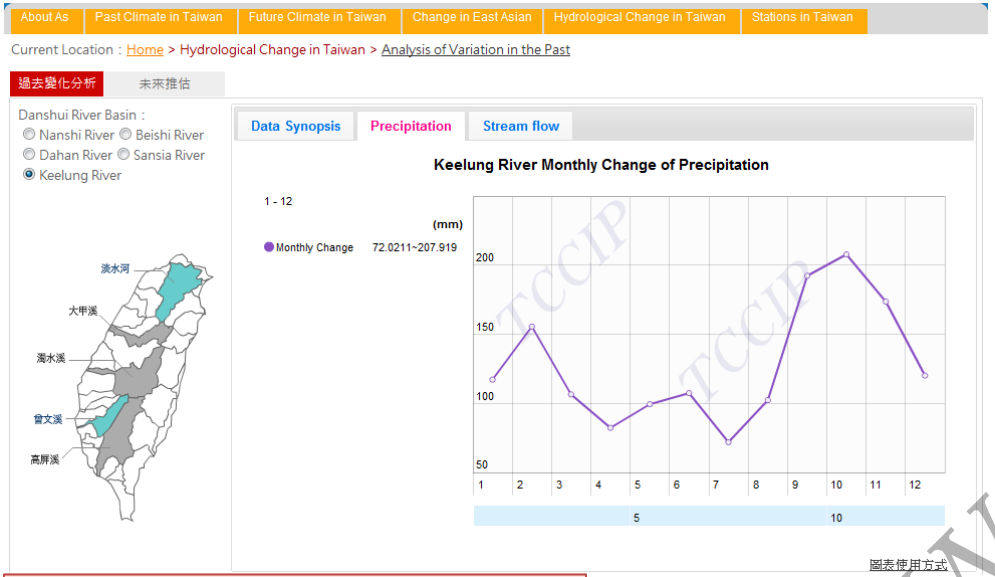


TCCIP webpage

http://tccip.ncdr.nat.gov.tw/NCDR/main/index.aspx

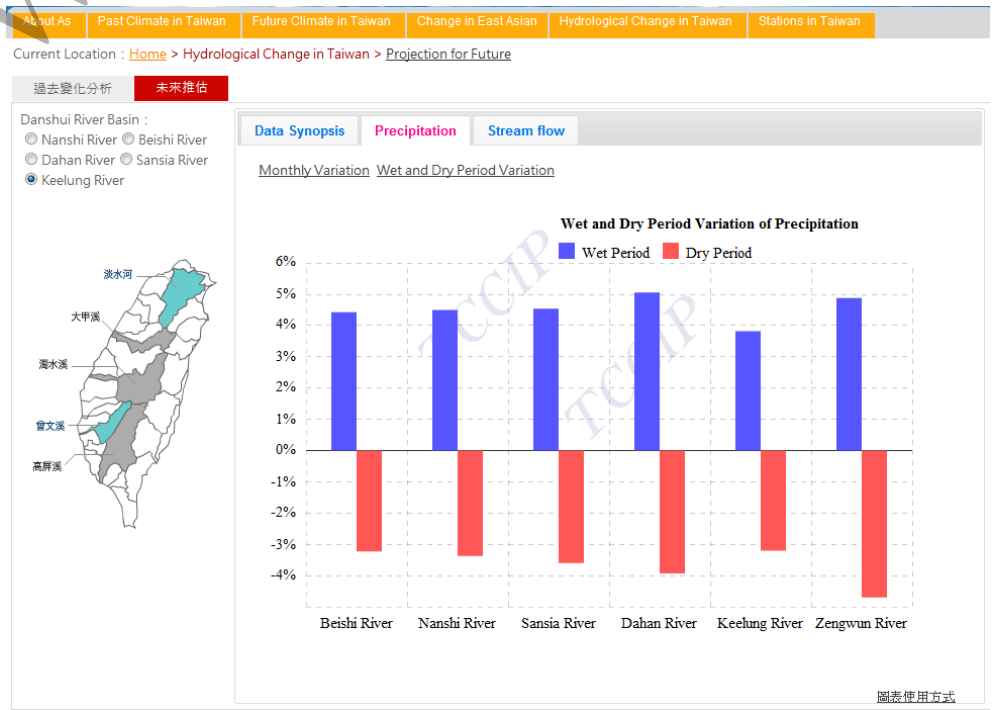


TCCIP webpage



Hydrological Change in Taiwan (Analysis of Variation in the Past)

Hydrological Change in Taiwan (Projection for Future)



Summary

- Producing projections of climate change in Taiwan through scientific methods
- Facilitating interdisciplinary cooperation and information integration in climate change research
- Enhancing international connection and collaboration on climate change research
- Providing TCCIP products to government agencies for policy making
- Publishing reports on climate change research and accomplishment in Taiwan

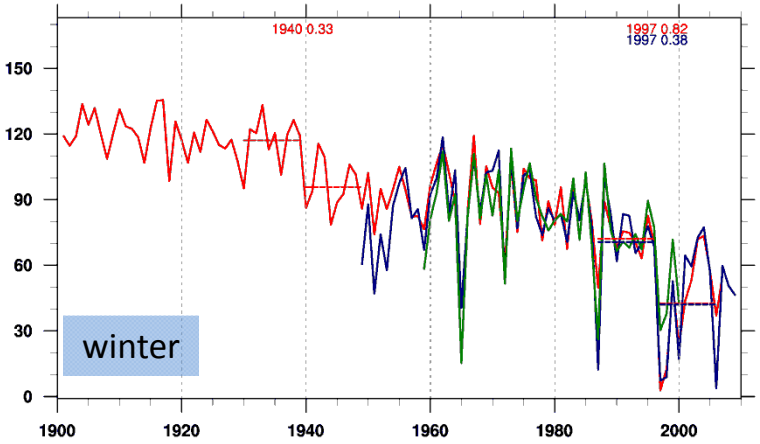
Thanks for your attention!

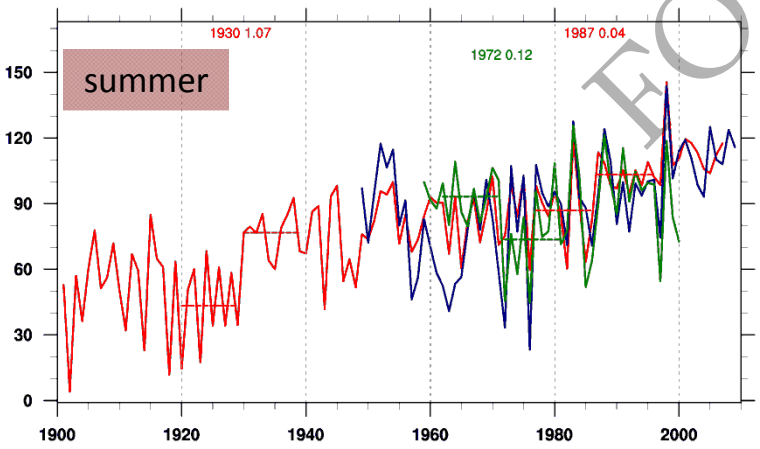
台灣鄰近區域

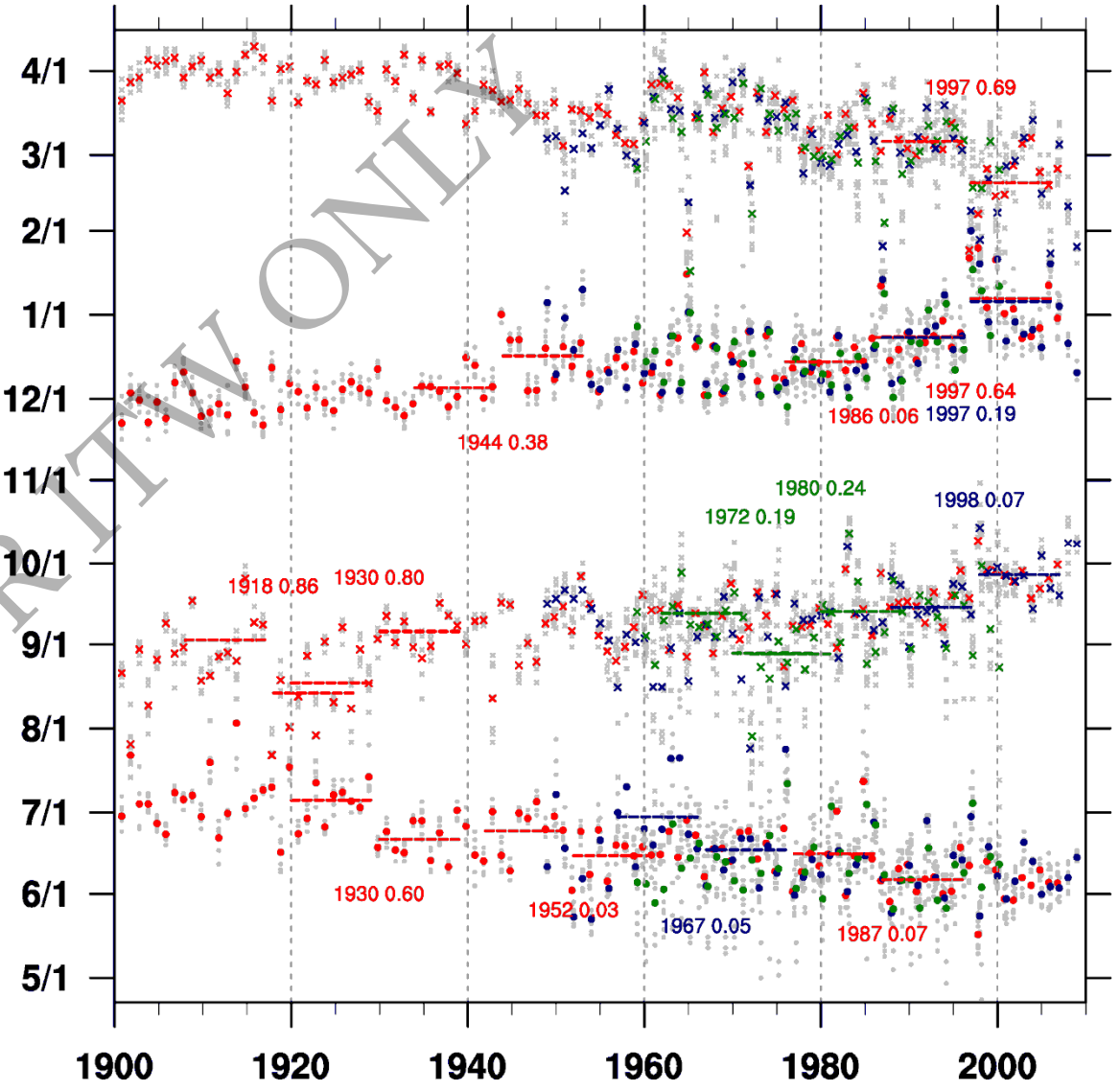
北緯20~25度、東經120~125度

20C Reanalysis
(1901~2007)
NCEP R1
(1949~2009)
ERA 40
(1959~2000)

長度



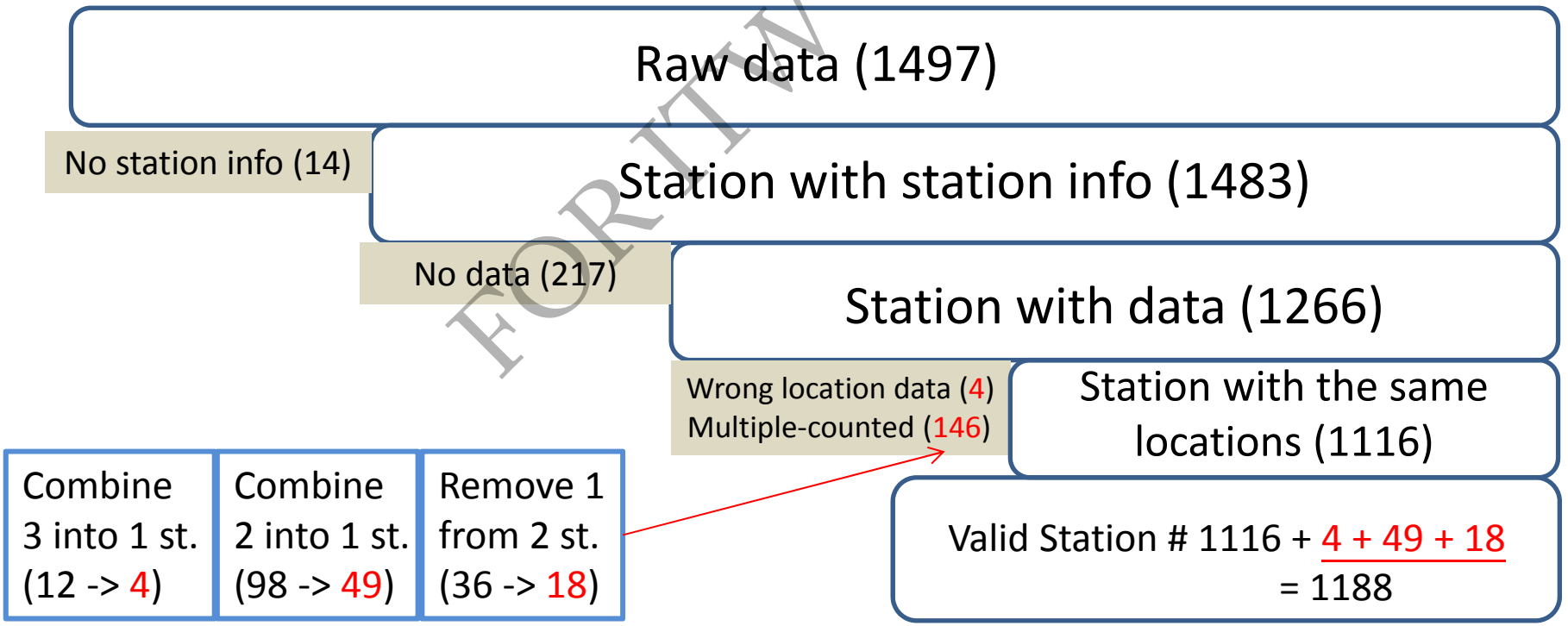




測站降水資料均一化、補遺、網格化

Data sifting process

- ✓Remove stations without station info
- ✓Remove stations without obs data
- ✓Remove stations with wrong location data
- ✓Combine/Remove multiple-counted stations



Flowchart for Assessing Impact on Water Resource

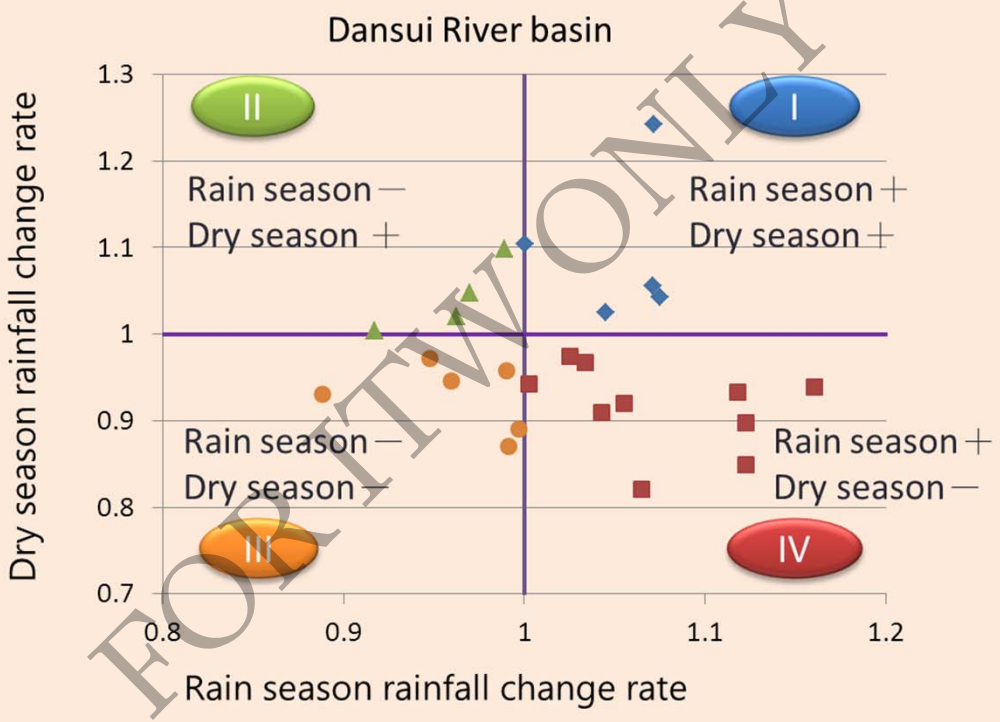
GCMs after Statistic Downscaling

Selection of GCM

- Performance of East Asian monsoon(9 GCMs)
- Characteristic of rainfall change rate in wet and dry spel (4 scenarios)

Projection of rain/dry season rainfall change rates

Dansui River basin

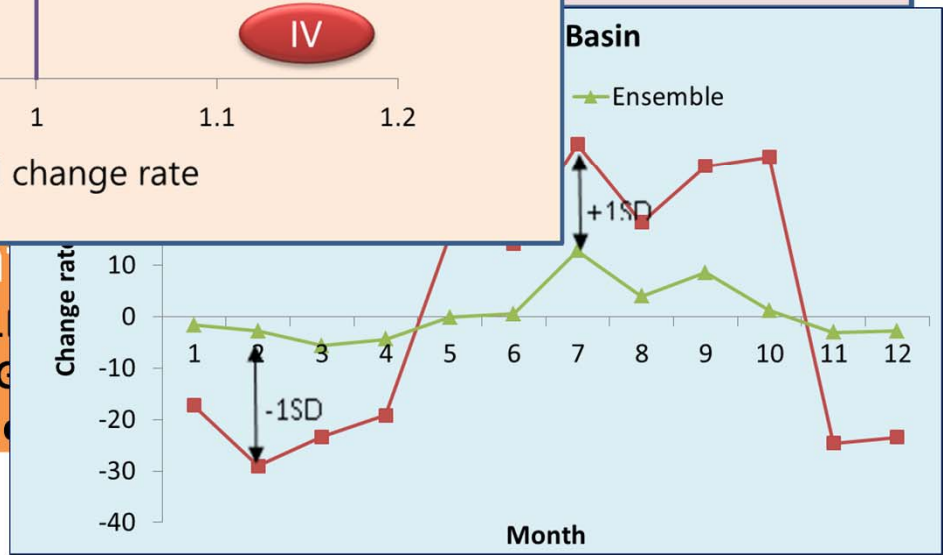


Uncertain

- Scenarios(A1
- Selection of G
- Weather gen

orst case

ulti-model nsemble



Critical Issues

1: How does the Taiwan's climate change comparing to the global climate change?

2: How will typhoons, torrential rains, droughts, heat waves, and cold surges be influenced by climate changes? Becoming more intense and/or frequent in the future?

3: How are climate changes related to climate variability such as the El Nino/Southern Oscillation?

4: The disasters in Taiwan seem to occur more frequently and more severely in recent years. Is that related to climate changes?

5: How reliable are the projections of future climate changes in Taiwan? How should the government and the general public interpret the related information?