

Future Change in Spring Drought and Its Impact on Water Resource in Taiwan

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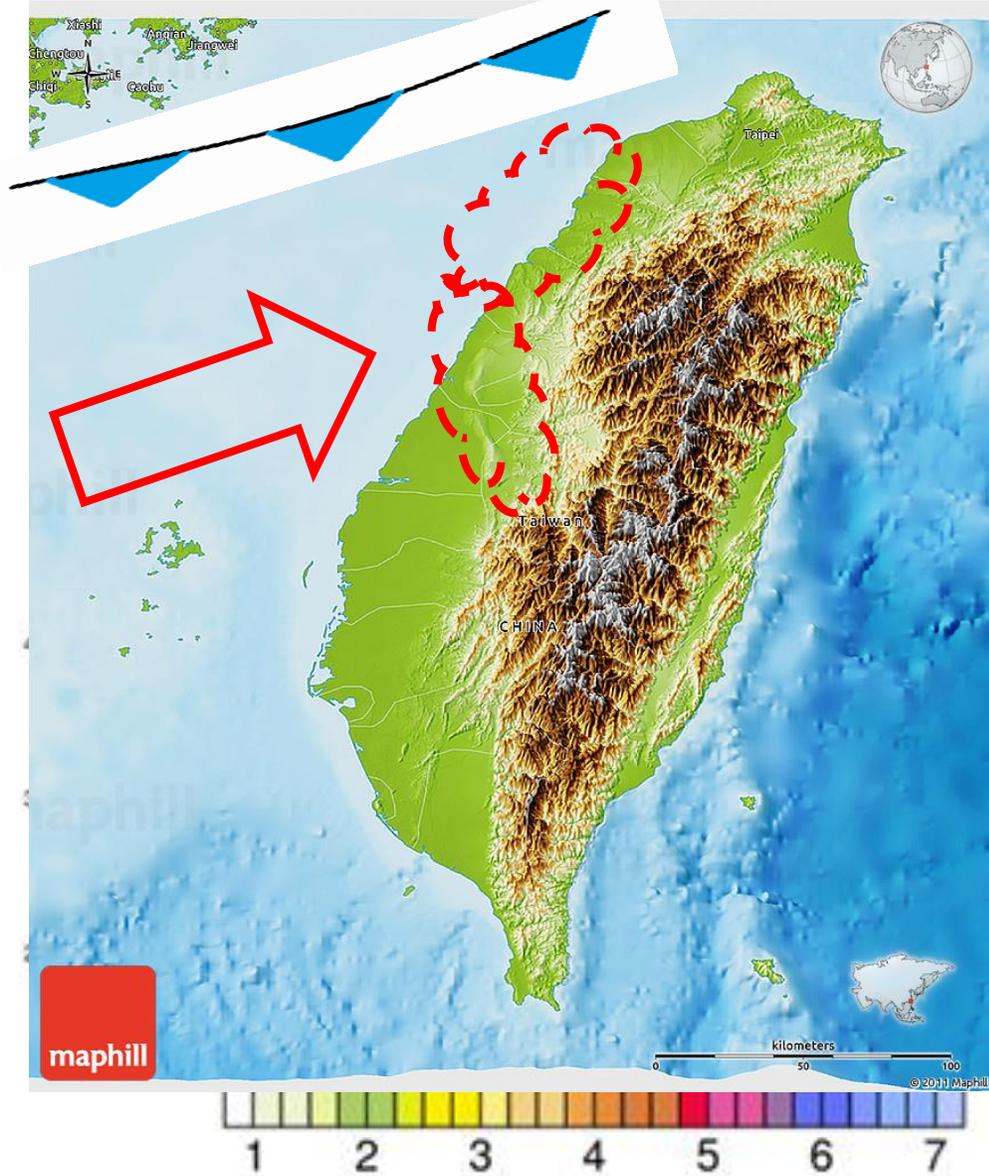
National Science and Technology Center for Disaster Reduction



2019 TCCIP International Workshop on Climate Change
Taipei, 22 October 2019



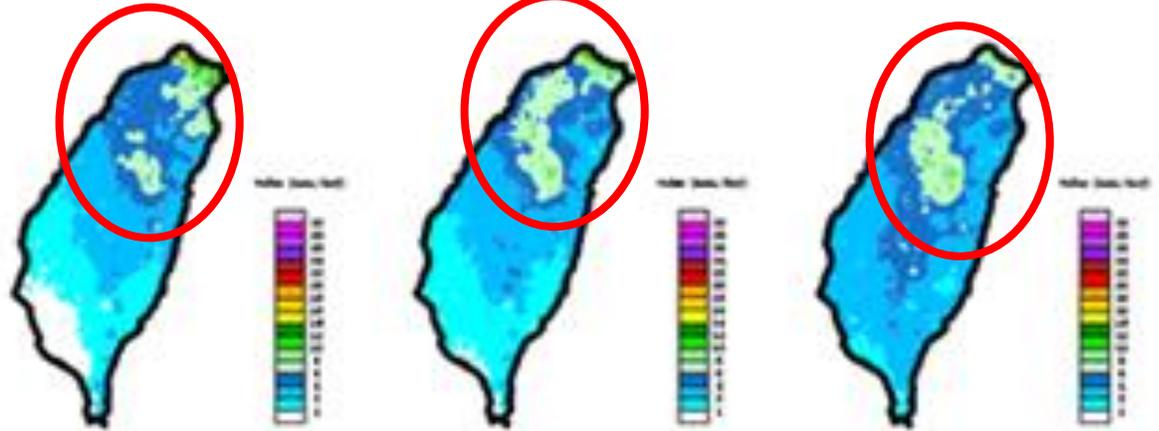
Topographically induced rainfall



February

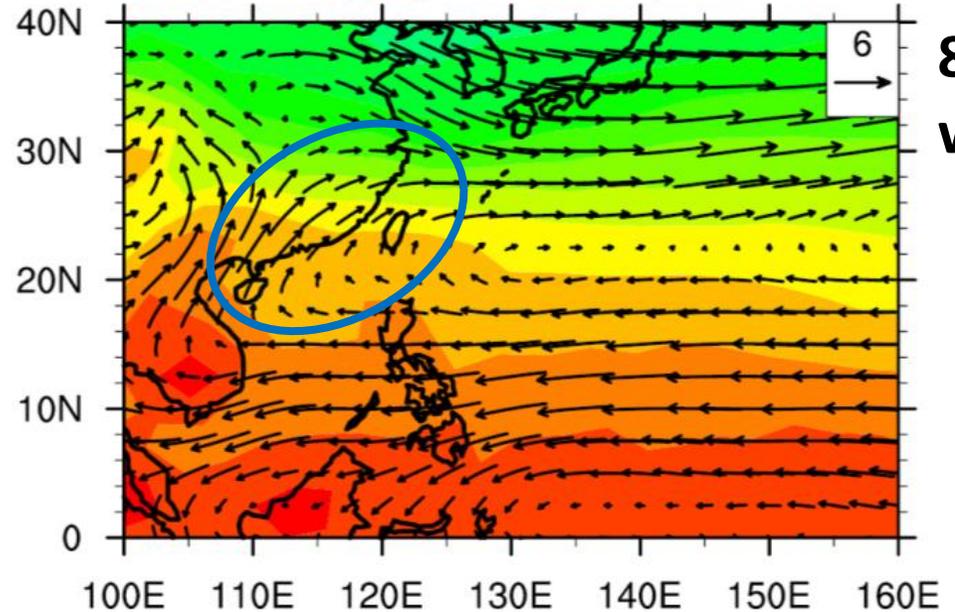
March

APRIL



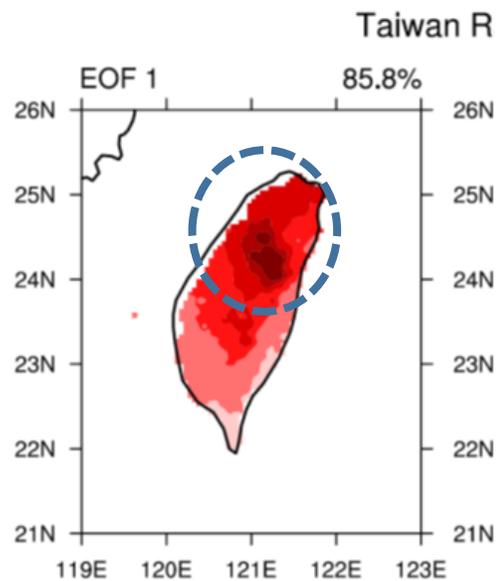
FMA

NCEP_R1-Shum_UV_850 Mean Feb-Apr 1960-2012

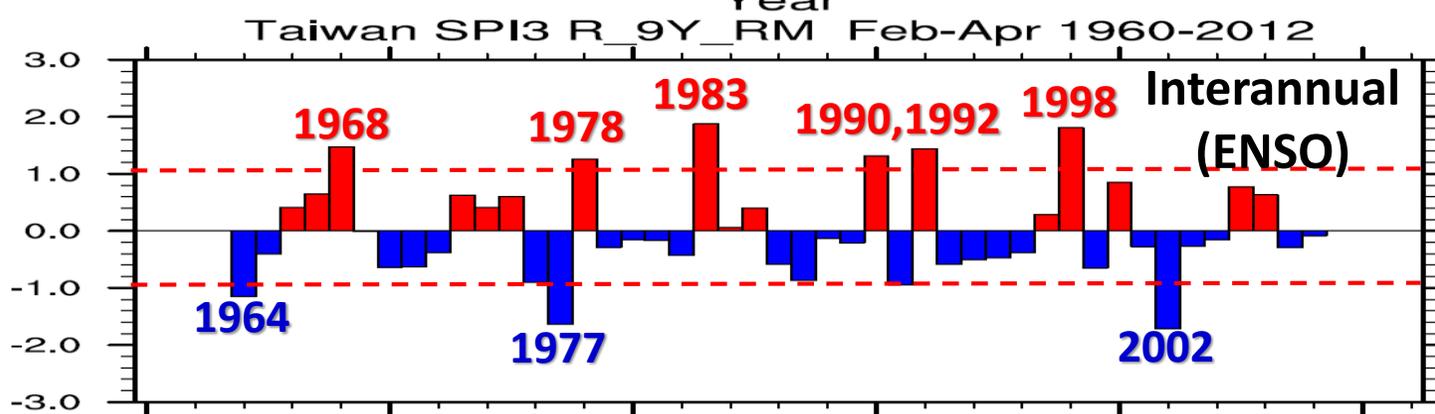
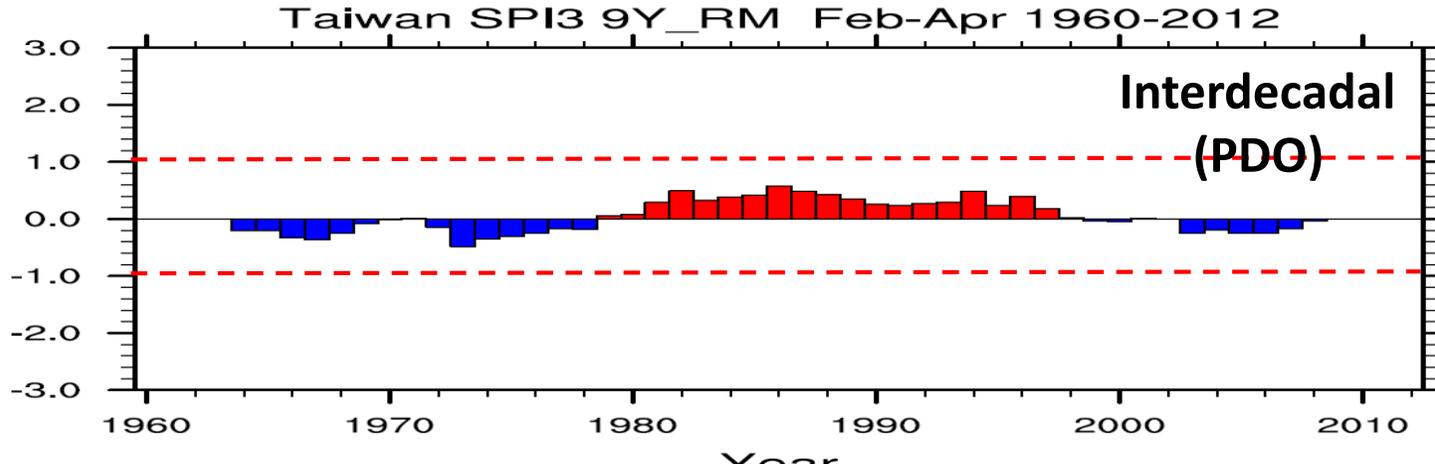
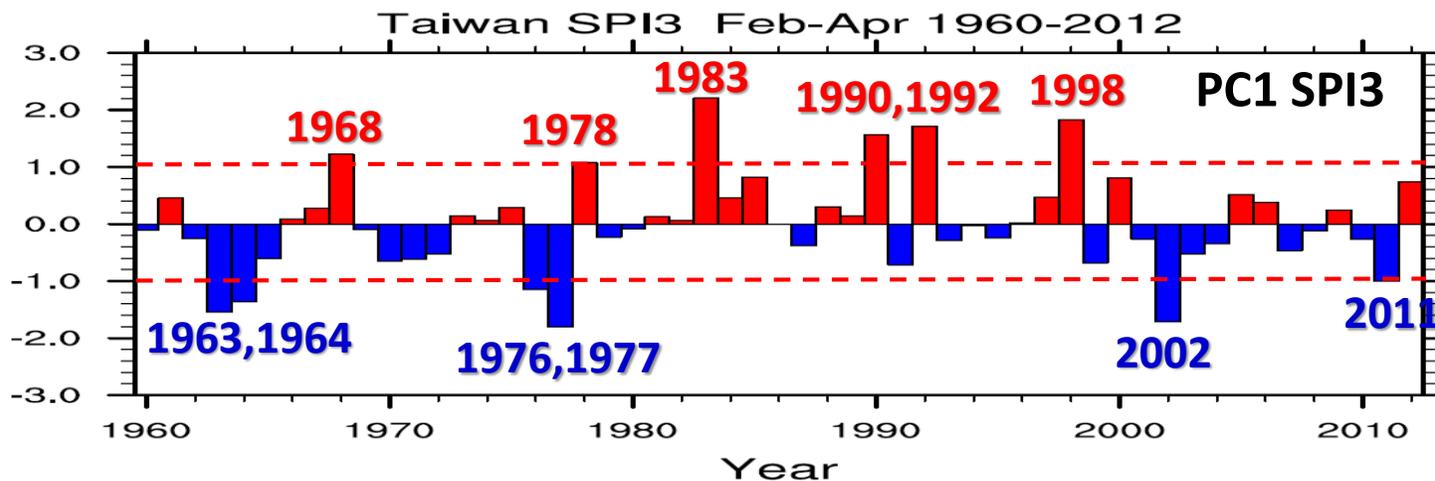
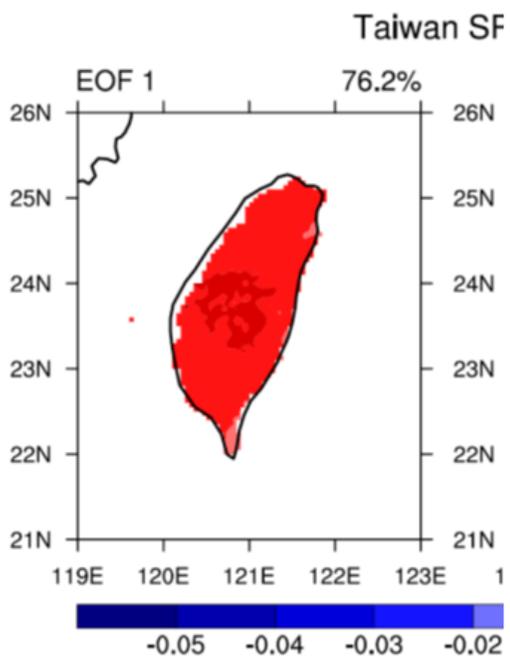


850 hPa
winds

Rainfall
EOF1
85.8%



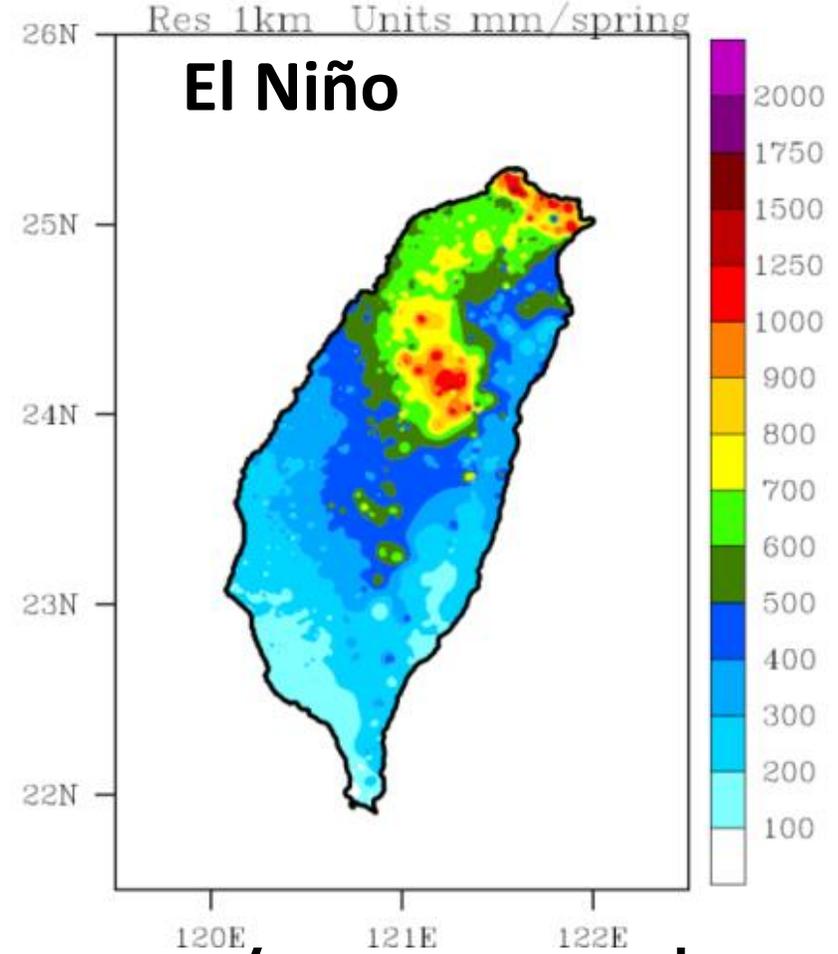
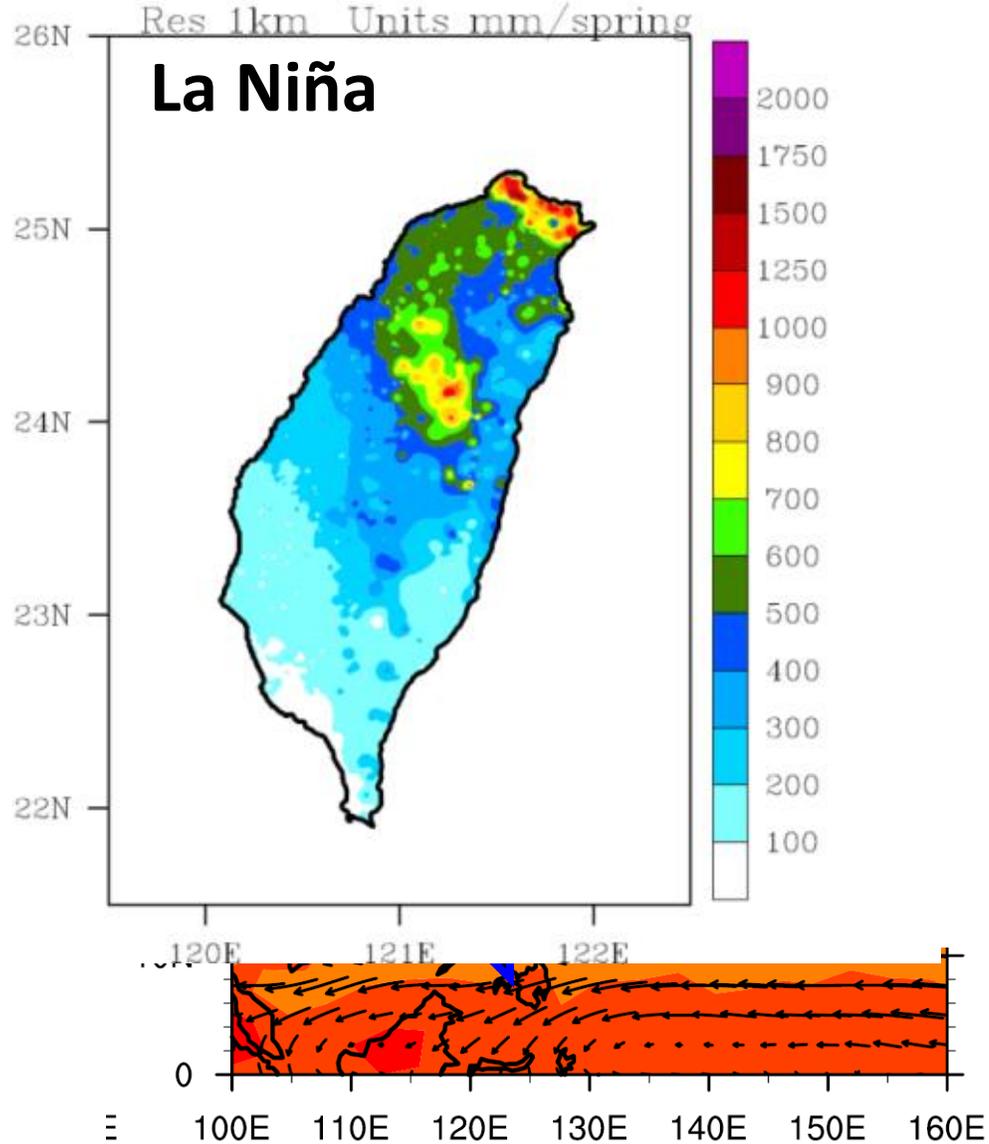
SPI3
EOF1
76.2%



Dry

Wet

Spring Rain in La Nina Years(84,85,89,96,99,00,01,08) Spring Rain in El Nino Years(83,87,88,92,95,98,03,07)



SST anomaly:

- **La Niña/PDO-like → Dry**
- **El Niño/PDO-like → Wet**

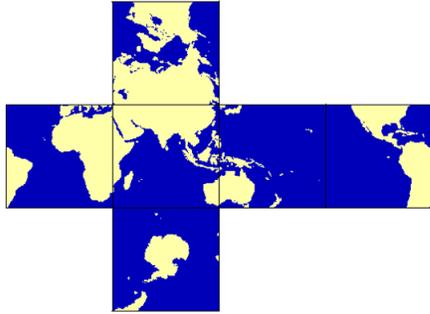
Future Projections

1. CMIP5: **CCSM4, GFDL_ESM2M, IPSL_CM5A_LR, MIROC5, MPI_ESM_LR**

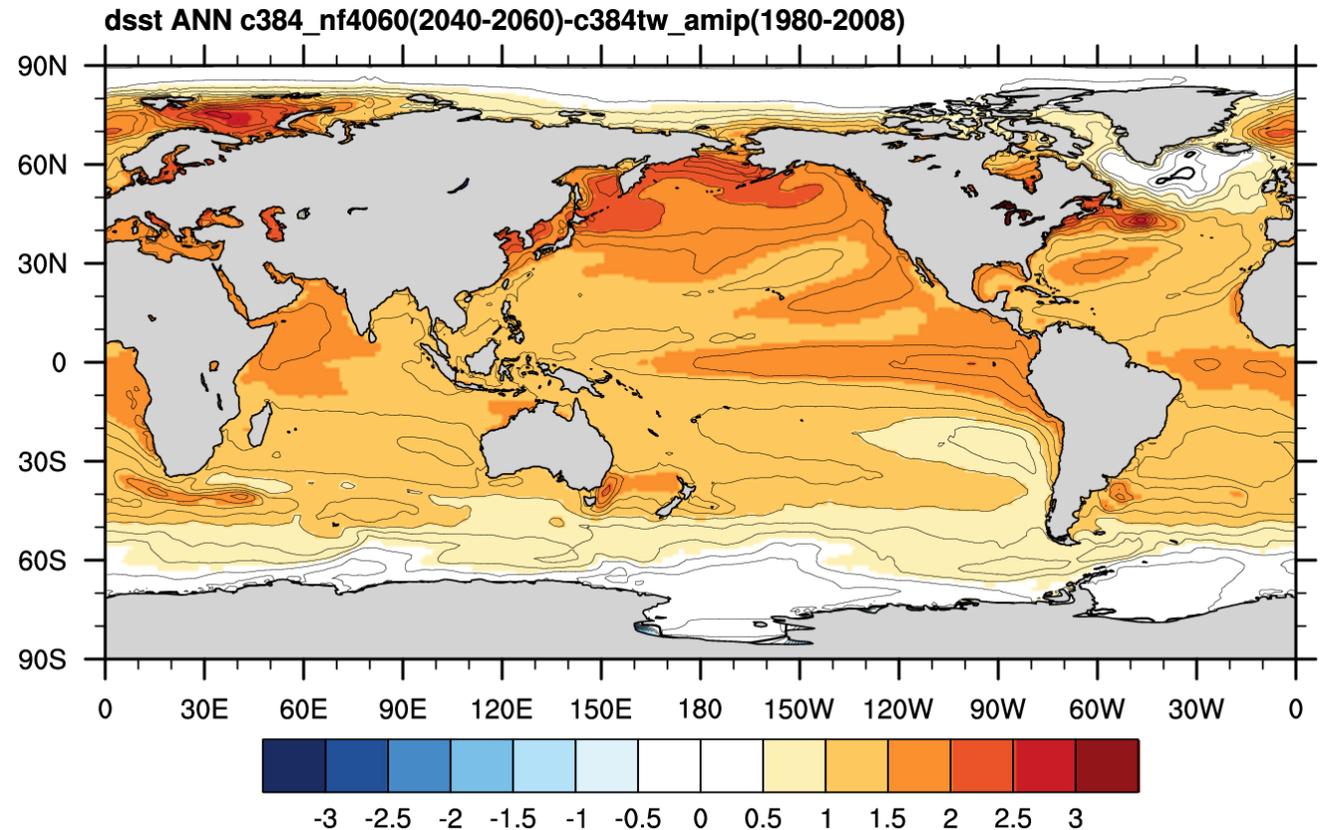
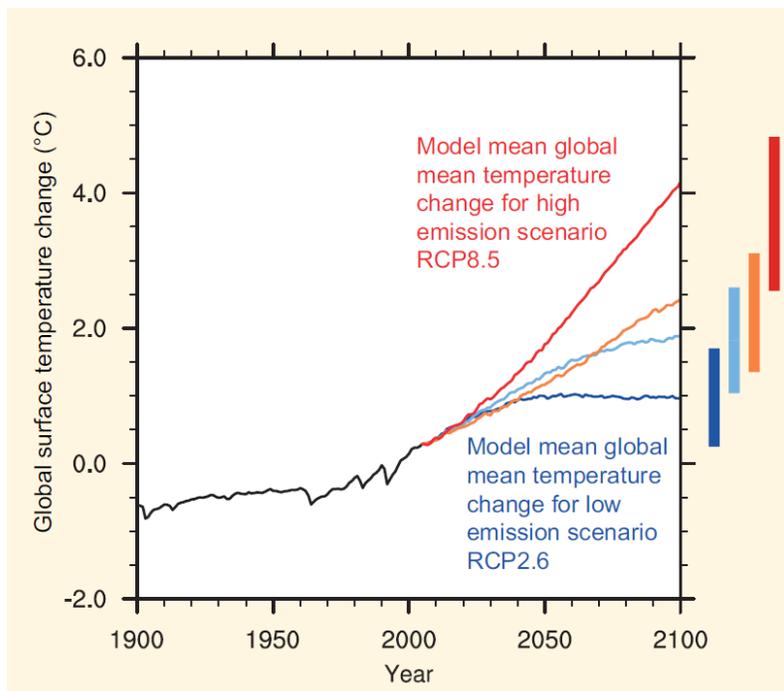
2. High-res. Climate Simulation and Projection

HiRAM/GFDL: 1979-2008, 2040-2060

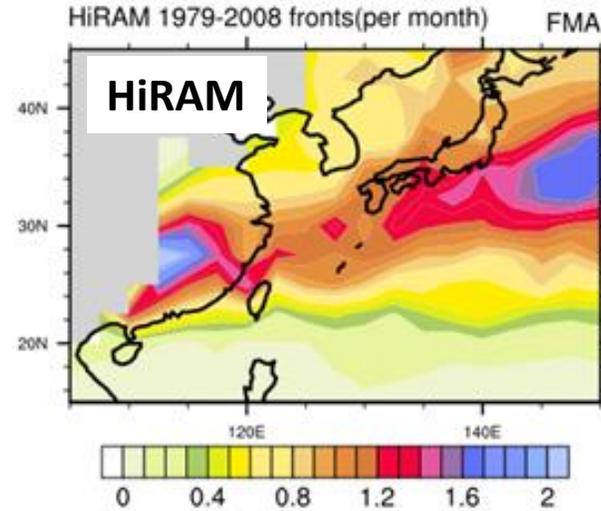
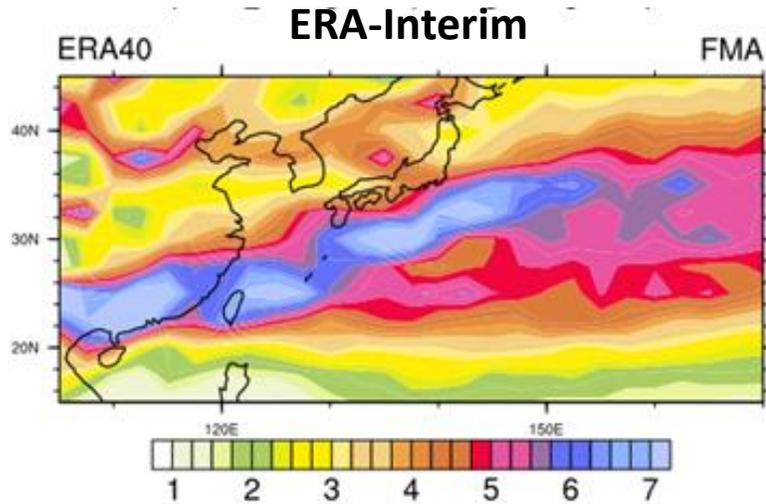
Deviation of Ensemble-mean SST (RCP8.5) from present
Used in time-slice experiment



C384, $\Delta x = \sim 25$ km

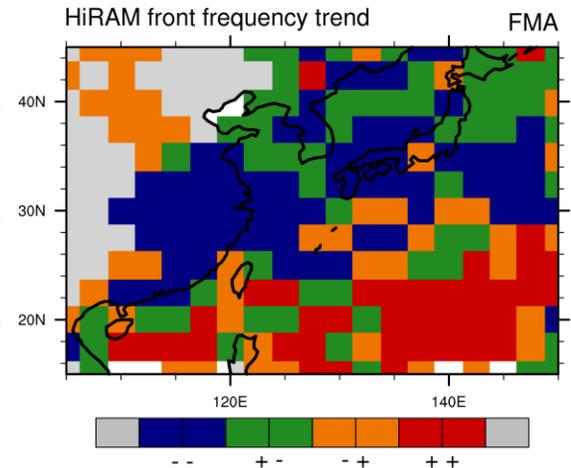
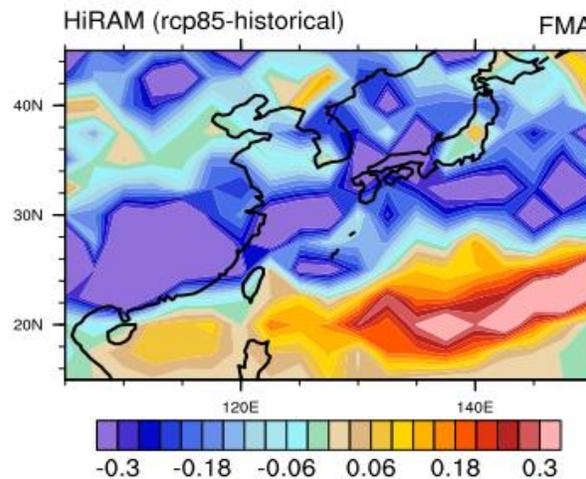
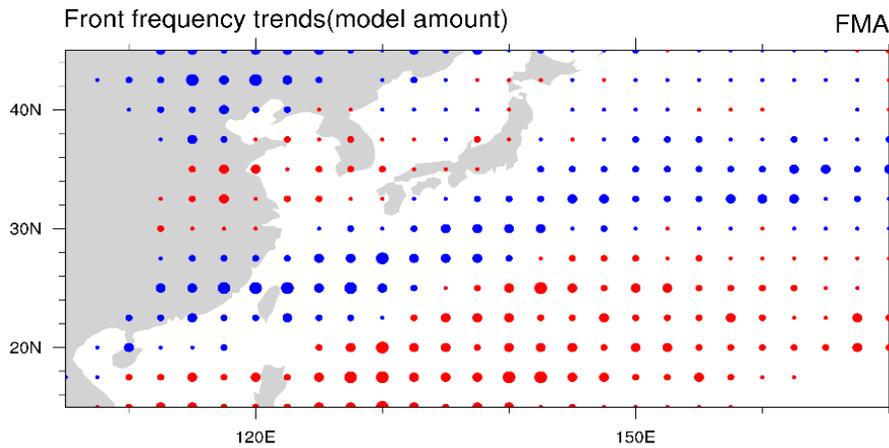


FMA Front frequency is **projected to reduce** under RCP8.5 Scenario

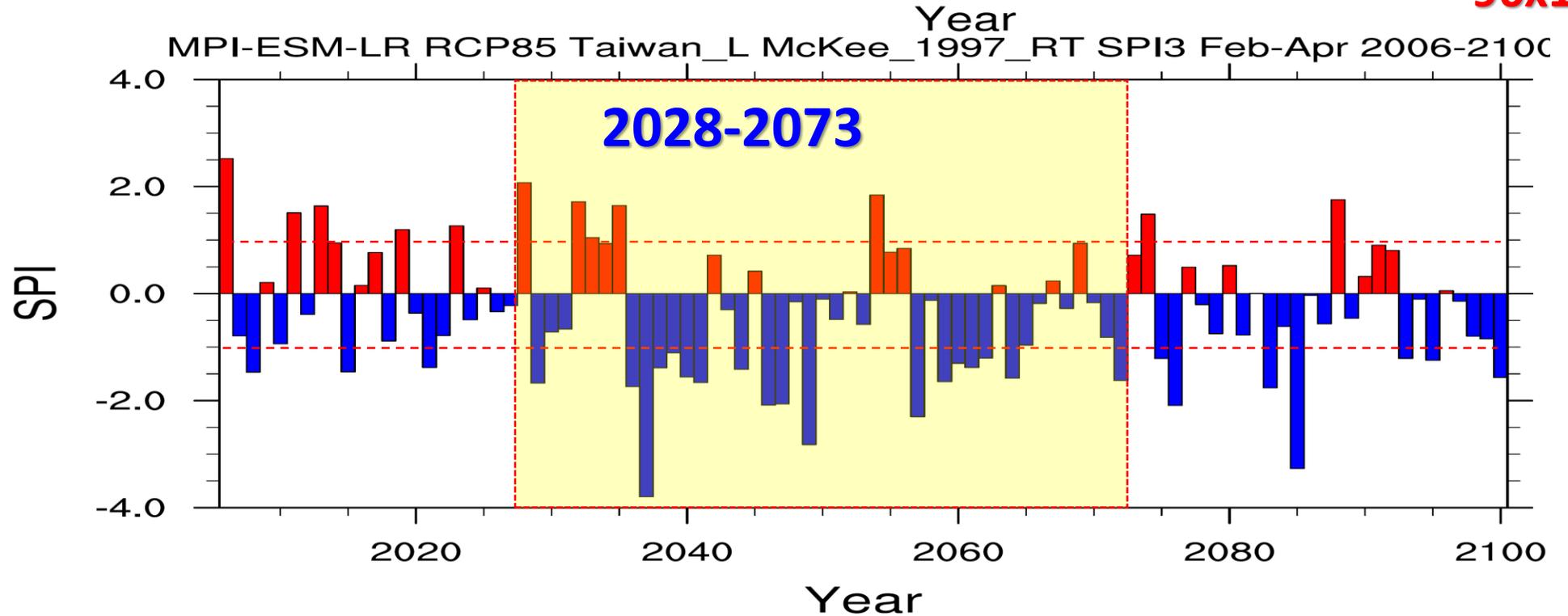
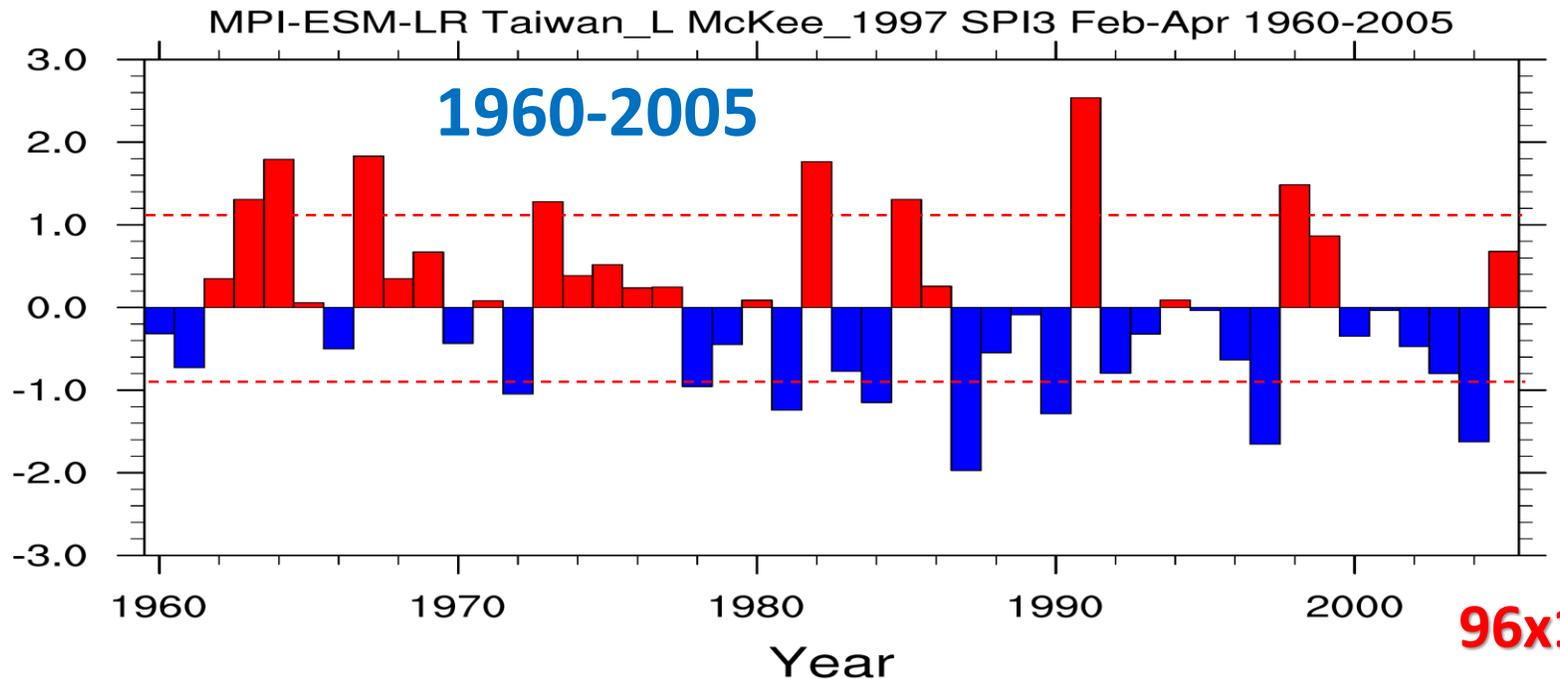


HiRAM(RCP8.5-historical) (NF-historical) (RCP8.5-NF)
2075-2100 **2040-2060**

CMIP5 (2075-2100)



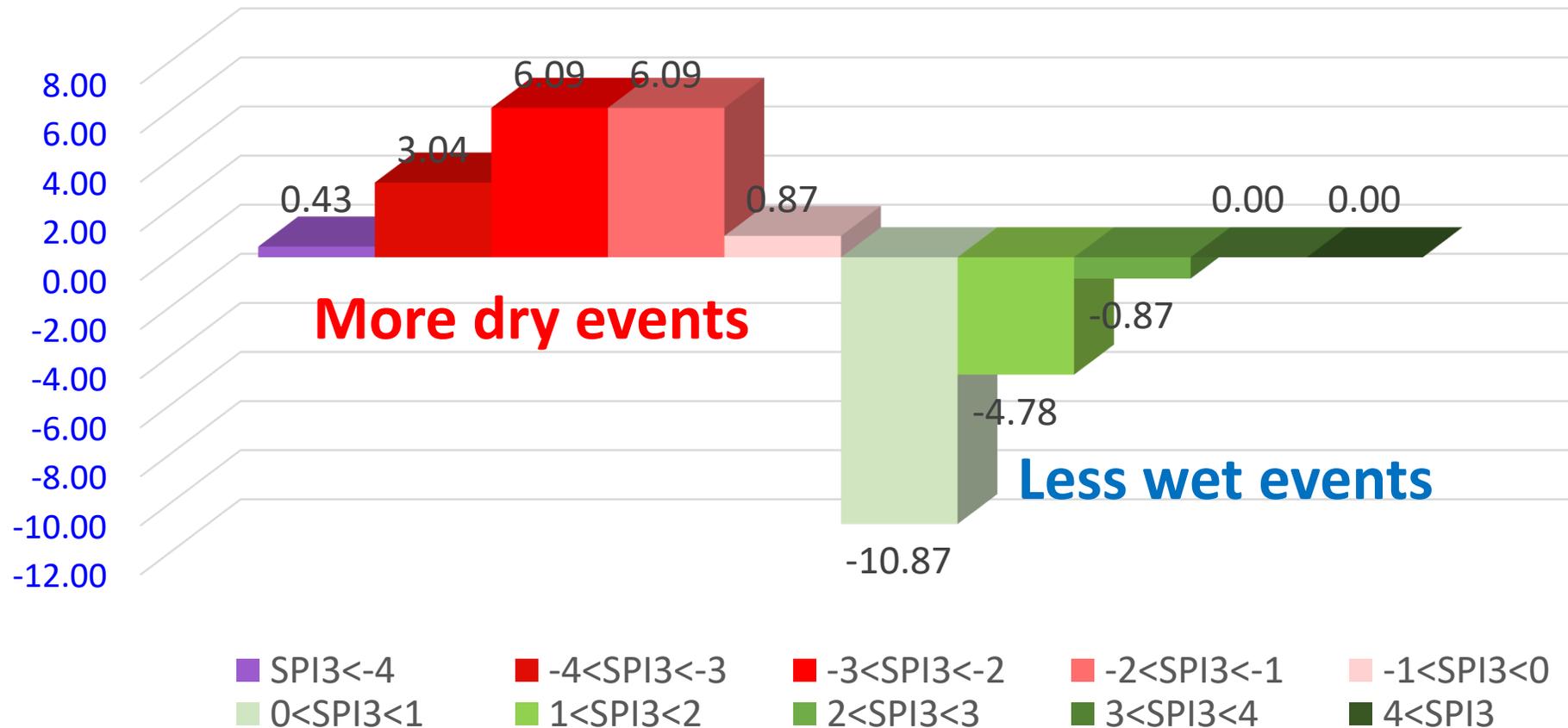
CMIP5 models: MPI
More dry springs
in the future.
Similar in other
models, except GFDL



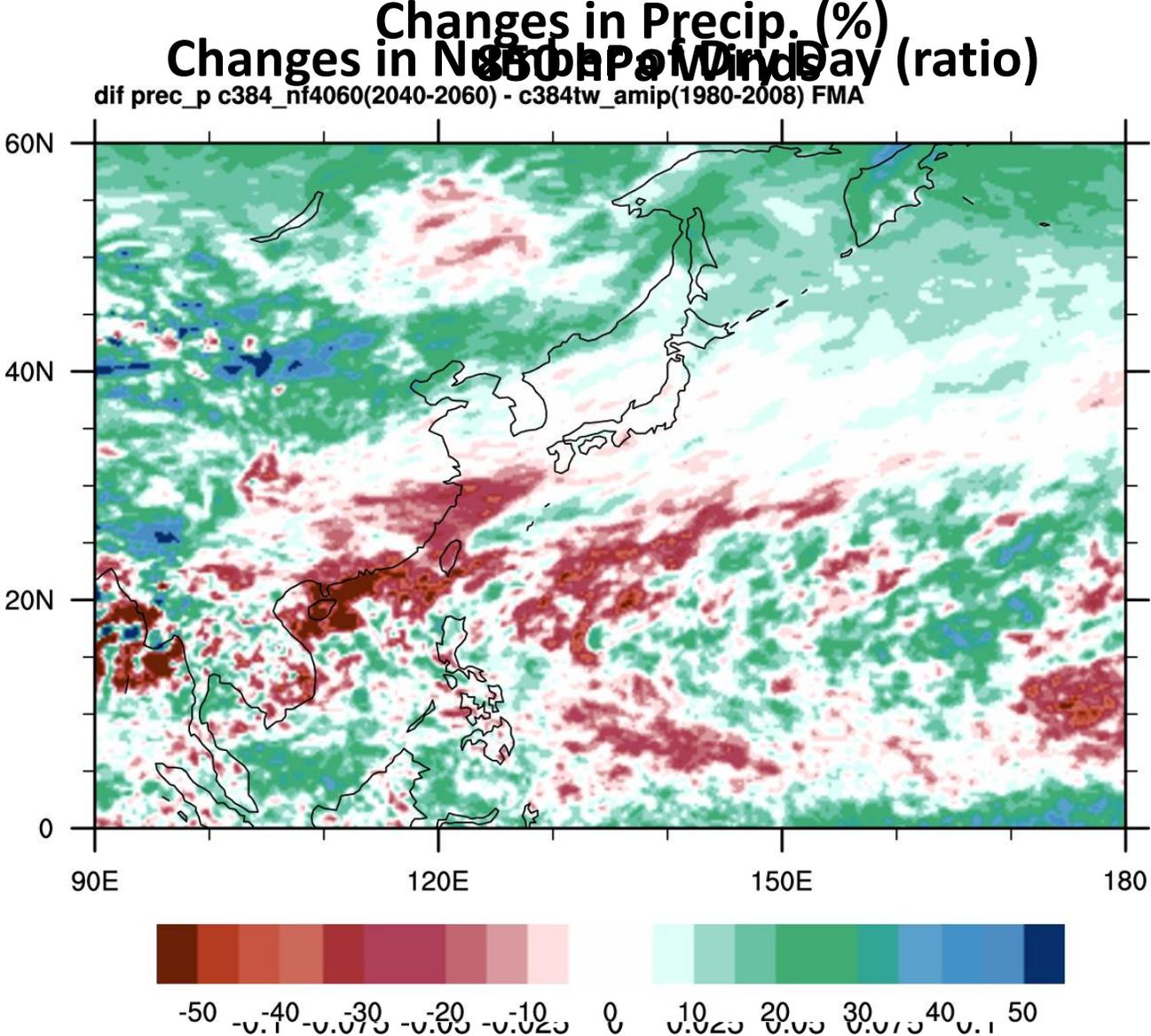
Spring in Southern China and Taiwan (21°N-28°N,110°E-123°E) projected to **become drier.**

Five CMIP5 models (best models for spring rainfall)

Changes in Probability of different **SPI3** categories in Spring Season
(RCP85-Historical, %)



HiRAM Projection of Spring Precip (2040–2060)

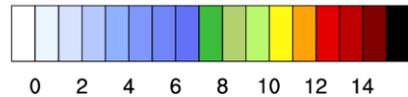
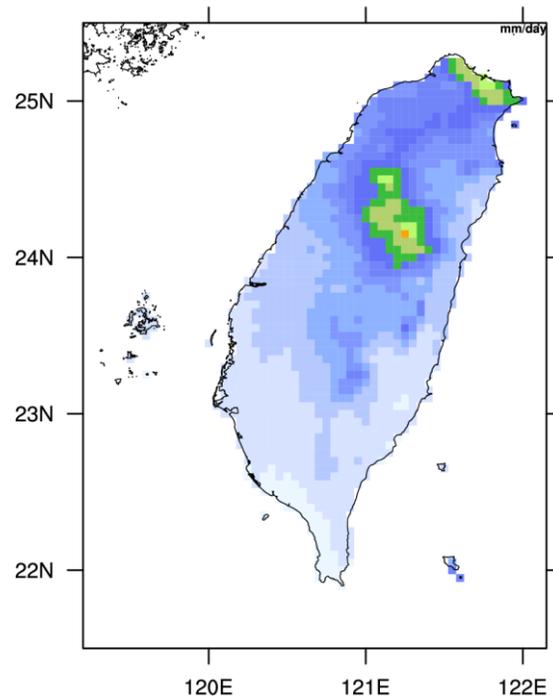


- Weaker southwesterly
- Less Precip.
- More dry days

Precipitation Changes in Taiwan: Drying in Northern Taiwan

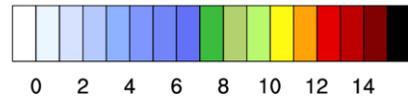
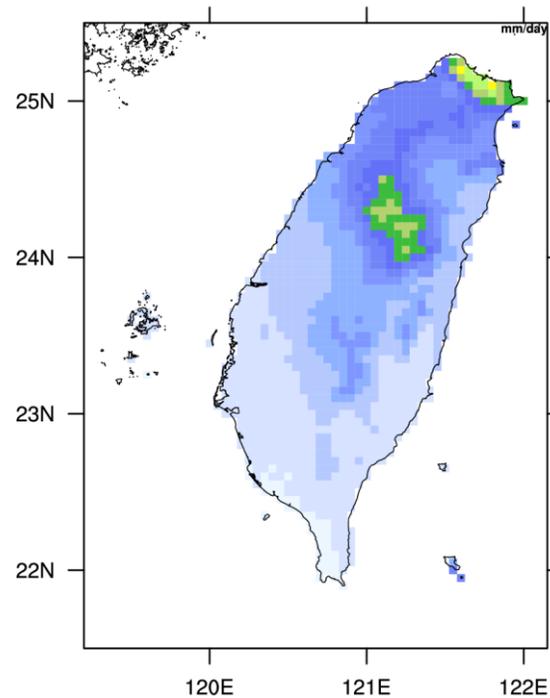
Observation

TCCIP obs. prec FMA 1986-2005



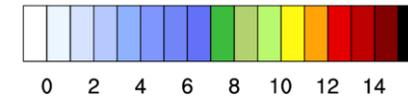
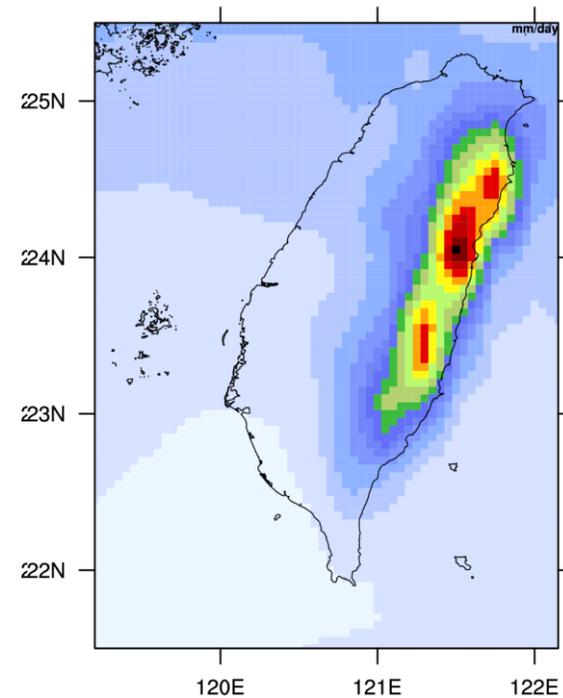
HiRAM (bias corrected)

HiRAM bc prec w31 thvar FMA

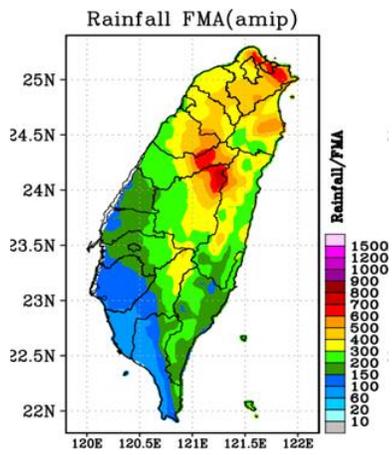


Projected Changes

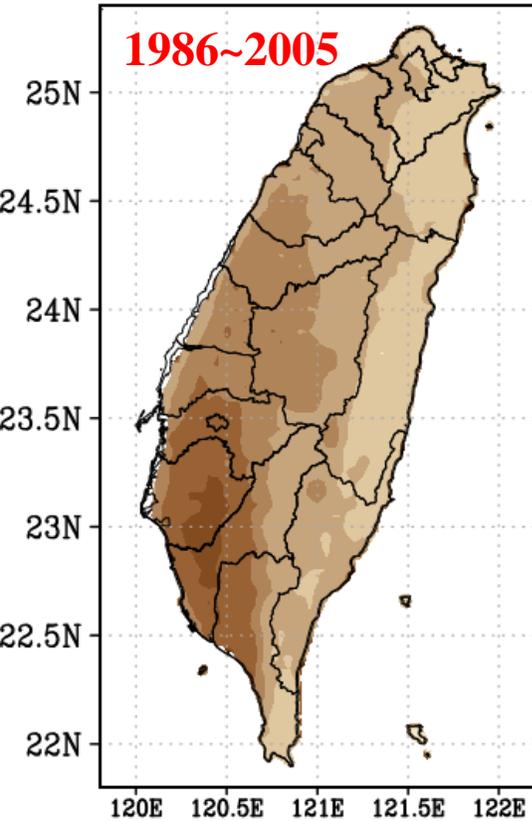
HiRAM c384tw_ amip prec FMA



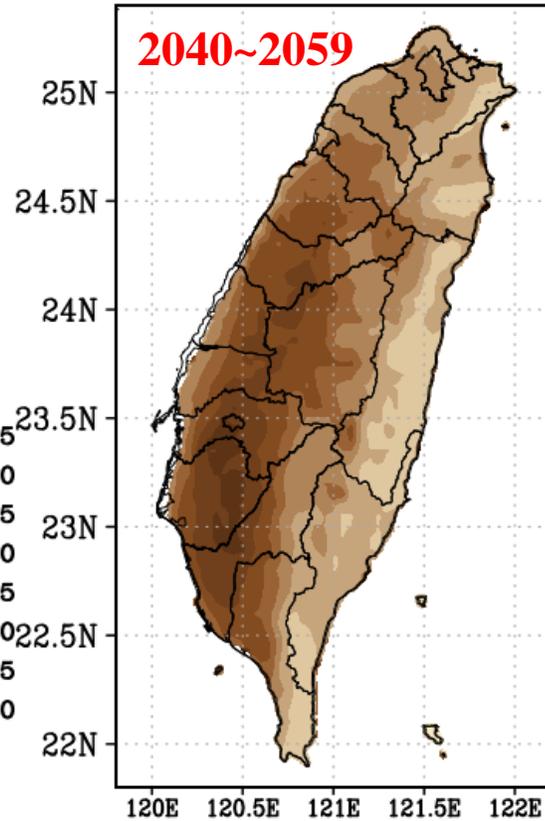
WRF downscaling: Maximum Continuous Dry Day (<0.1mm) (5-km, driven by HiRAM outputs)



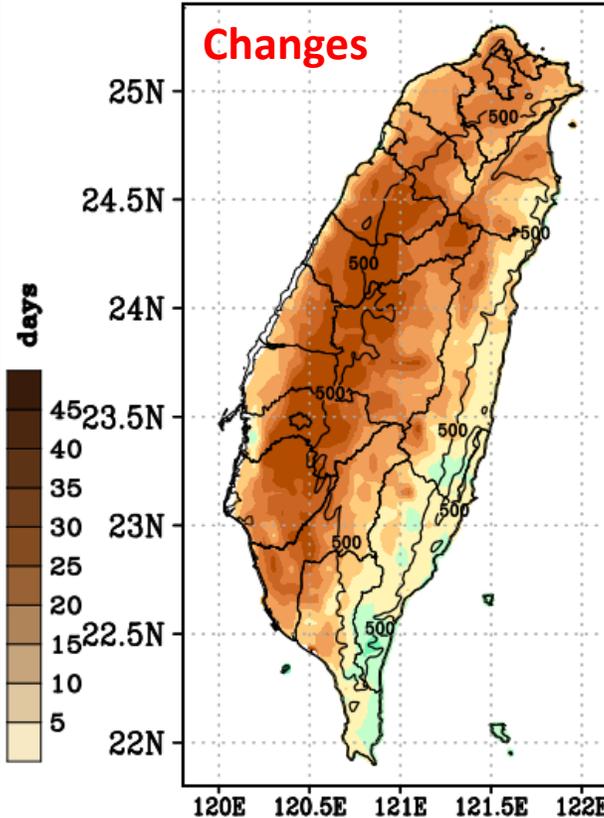
CDD FMA(amip)



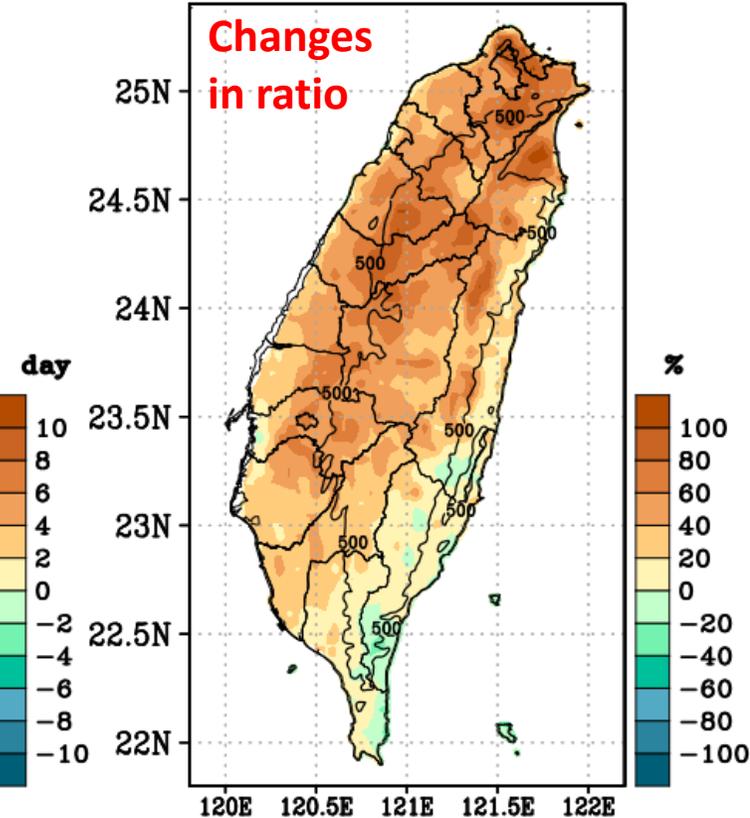
CDD FMA(nf)



Diff. in CDD per FMA
(nf-amip)

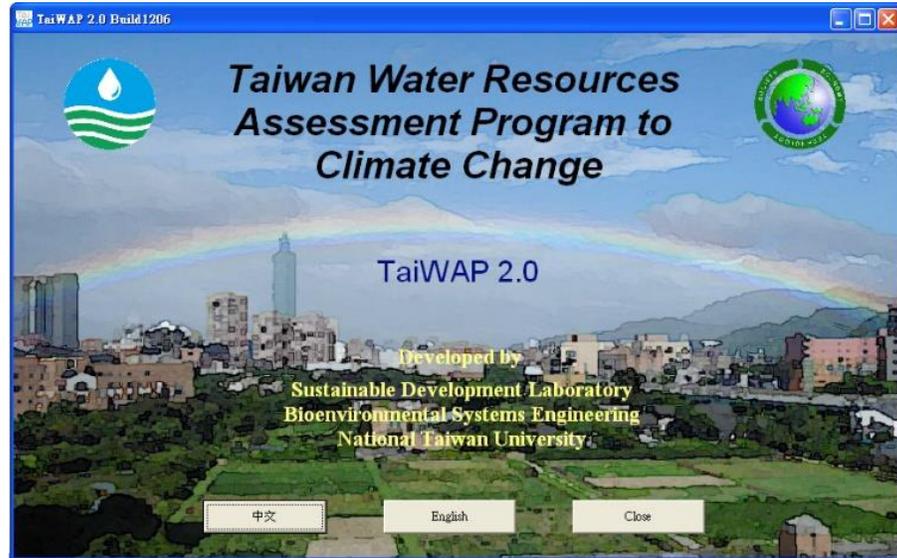


Change_Rate in CDD per FMA
(nf-amip)

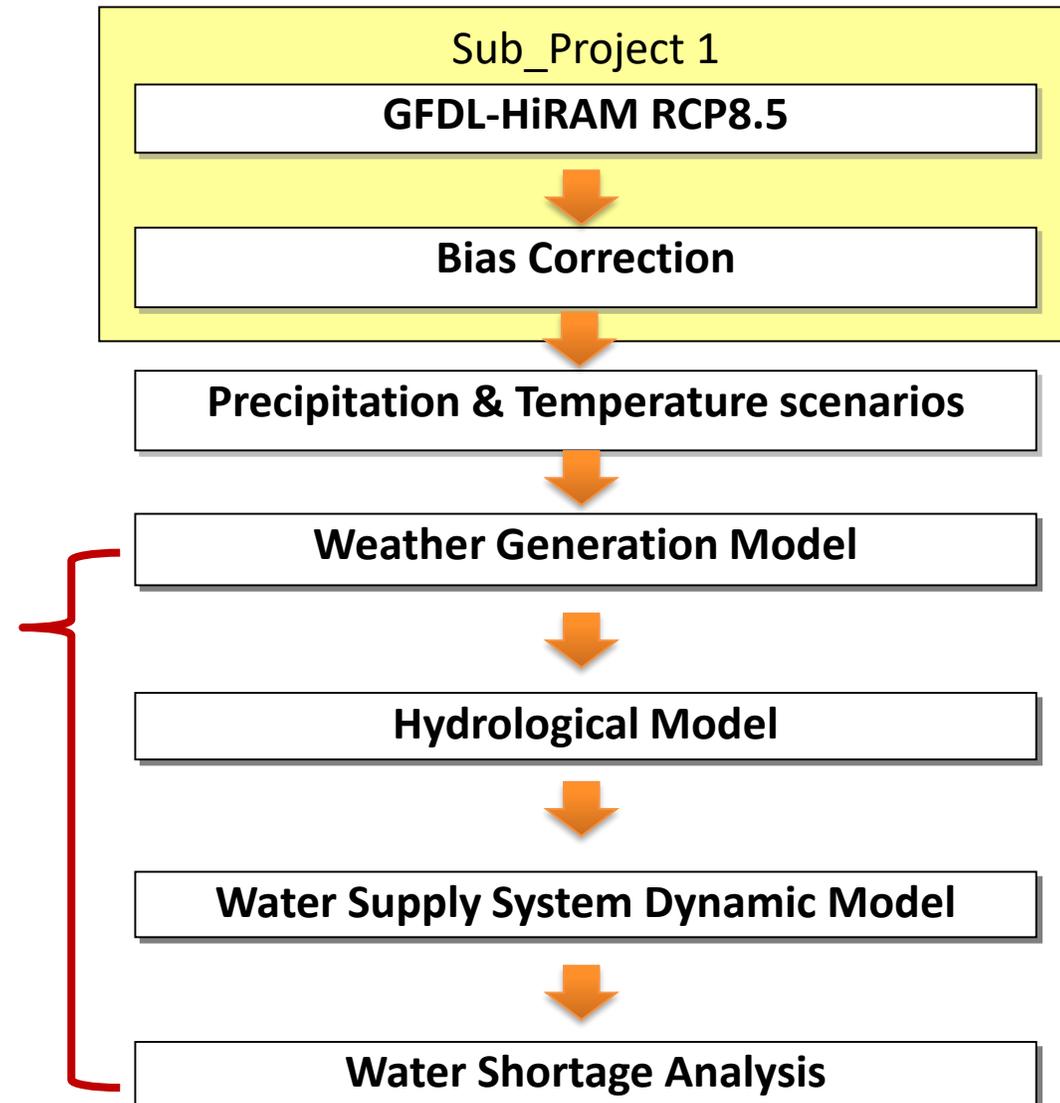


Assessing the Impacts on Water Resources in northern Taiwan - Framework and tool -

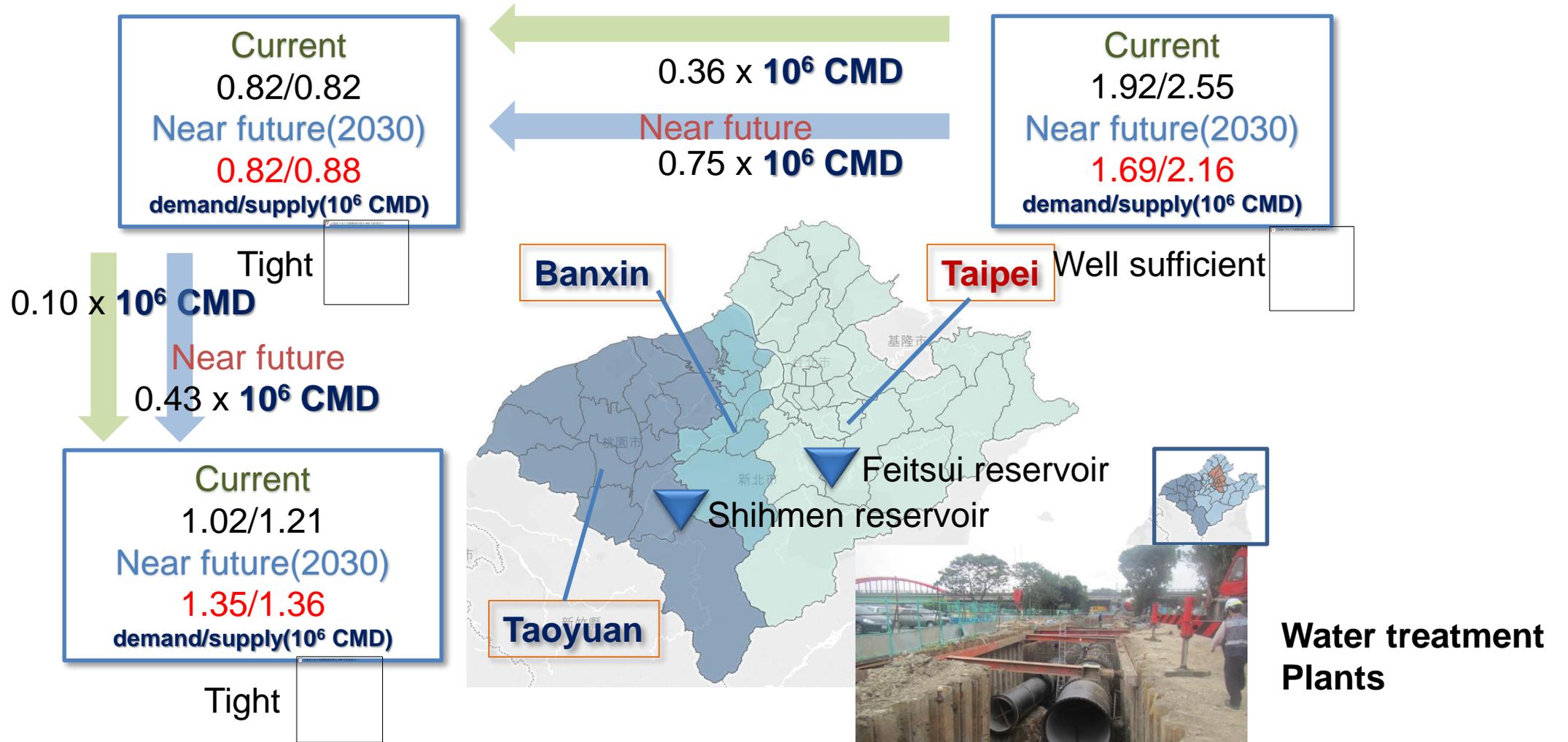
Integrated assessment tool TaiWAP



<http://sdl.ae.ntu.edu.tw/TaiWAP/>

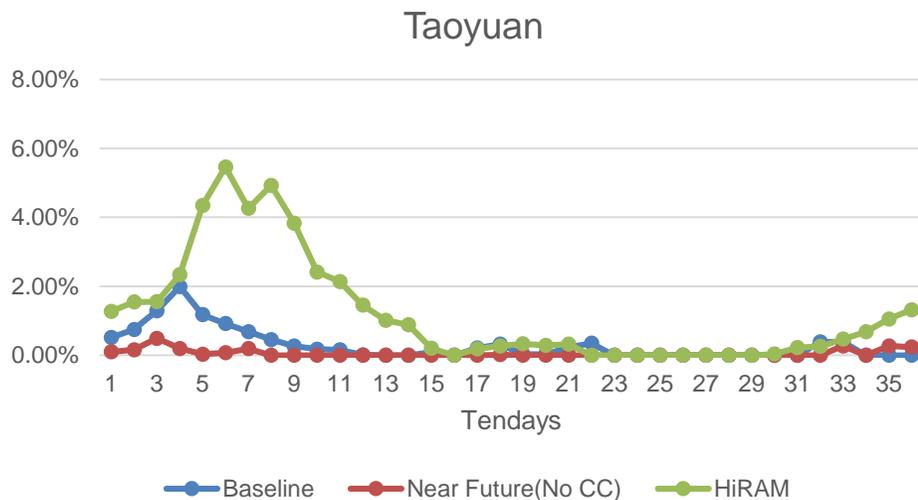
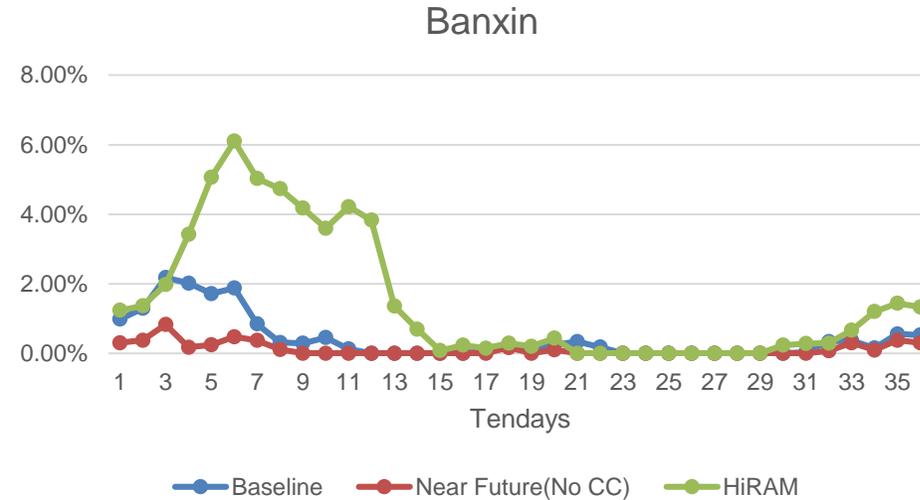
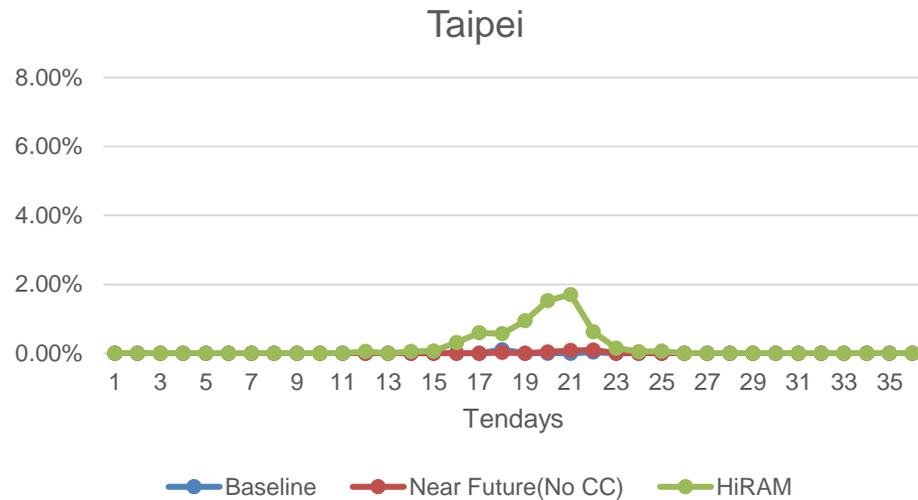


Current and Planned Water Supply - Northern Taiwan



More water supply from Taipei(Banxin 2nd phase project)

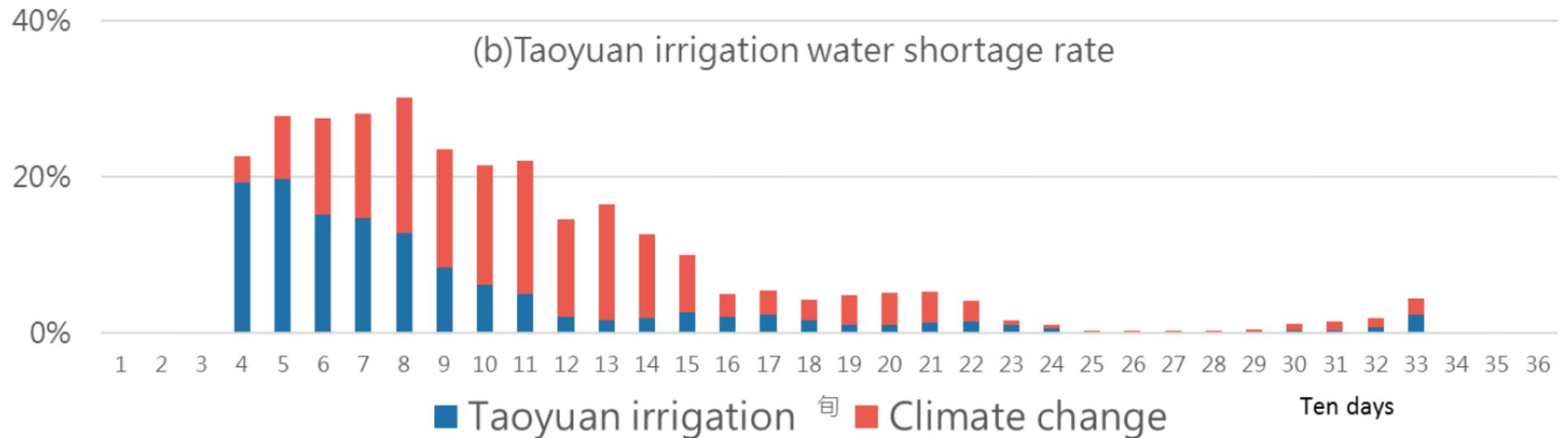
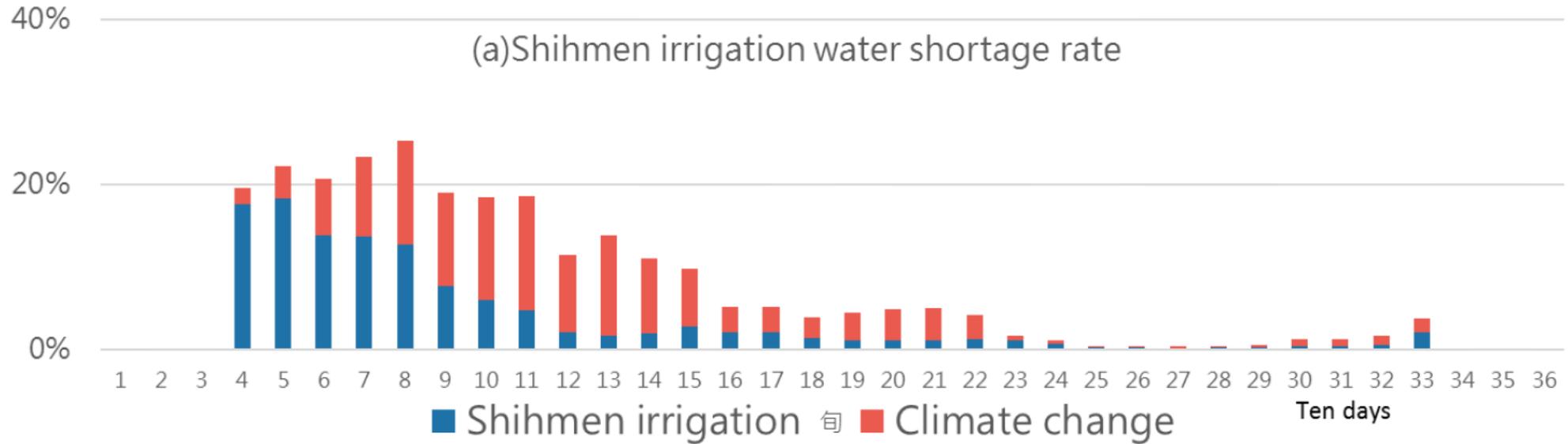
Average Water Shortage Rate



On average

- Three systems all have very low water shortage rate
- The Banxin 2nd phase project can reduce the water shortage in the near future
- Climate change effect likely increases the water shortage rate

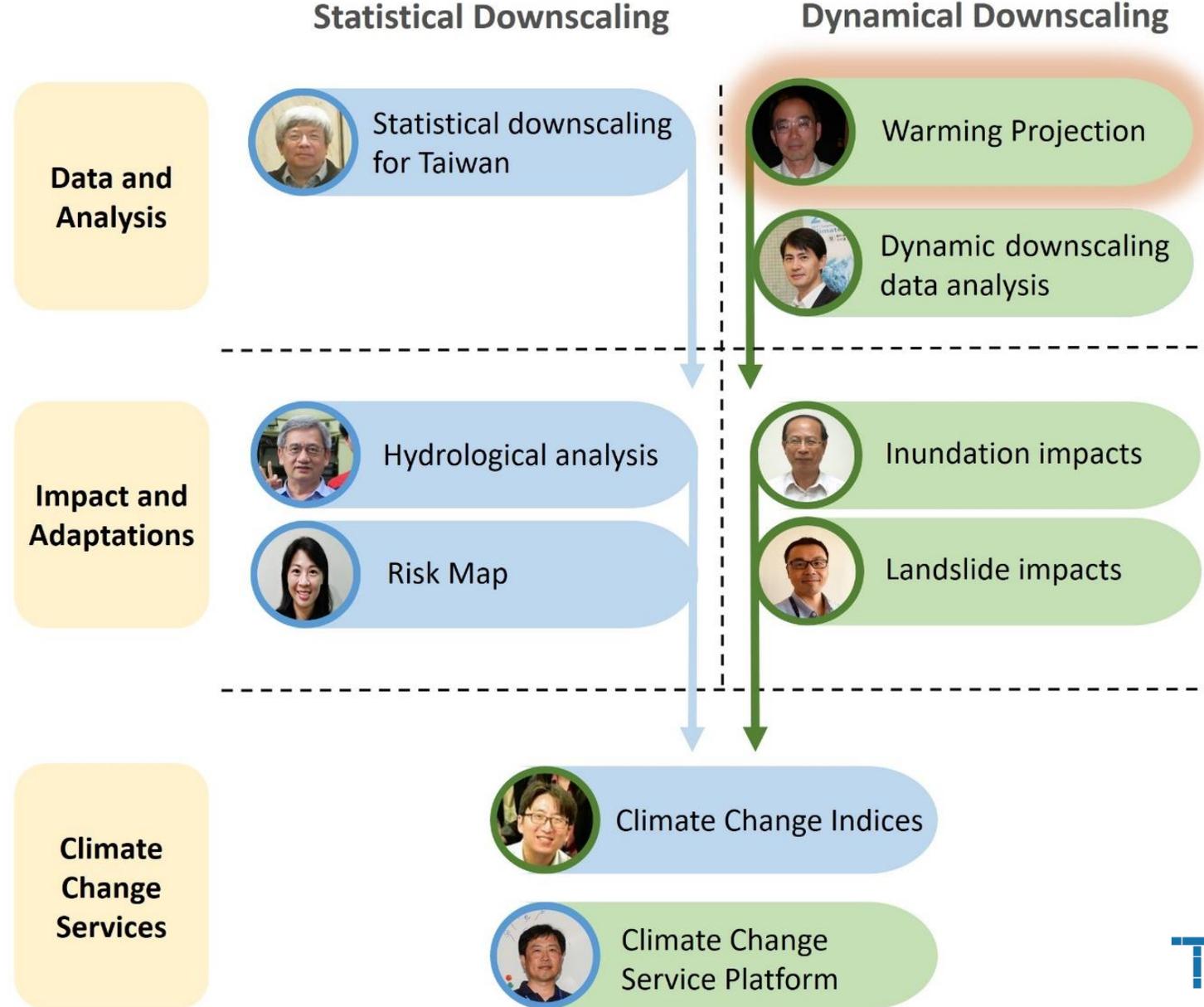
Larger Impact on Irrigation Water Shortage



Summary

- **Weaker moist southwesterly is projected in the warming future.**
- **Spring rainfall in Taiwan is likely to decrease.**
- **Spring drought likely to occur more frequently.**
- **Certain regions in northern Taiwan will likely suffer from water resource shortage without proper adaptation measures.**

TCCIP Oral Presentation outline



**Thank you for Your Attention
Questions and Comments?**

