Evaluation of Rice Production Potential in Taiwan Using SDSM Future Climate Data

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Outline

- **Introduction**
- Method: future climate data
- Method:
  evaluation system of crop production
- Result
- Conclusion

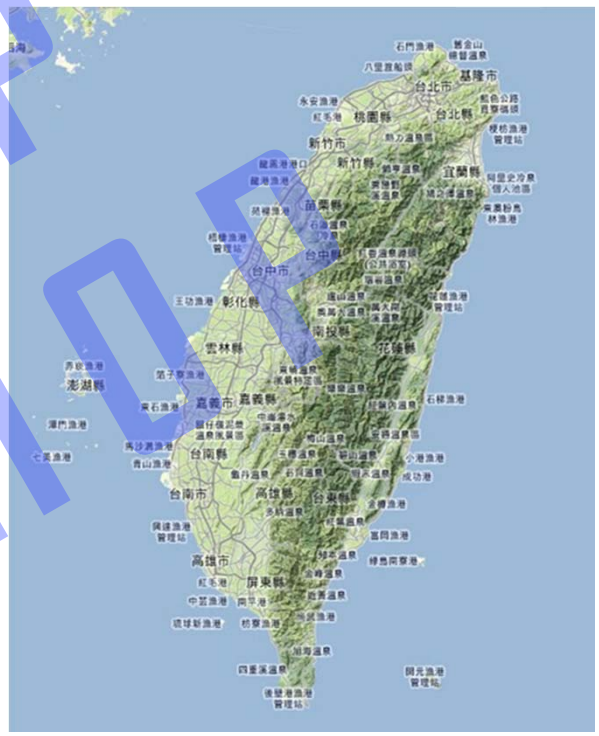
Climate / Agricultural land

Temperature: average 22°C.

lowest in February (16°C) &
highest in July/August (28°C).

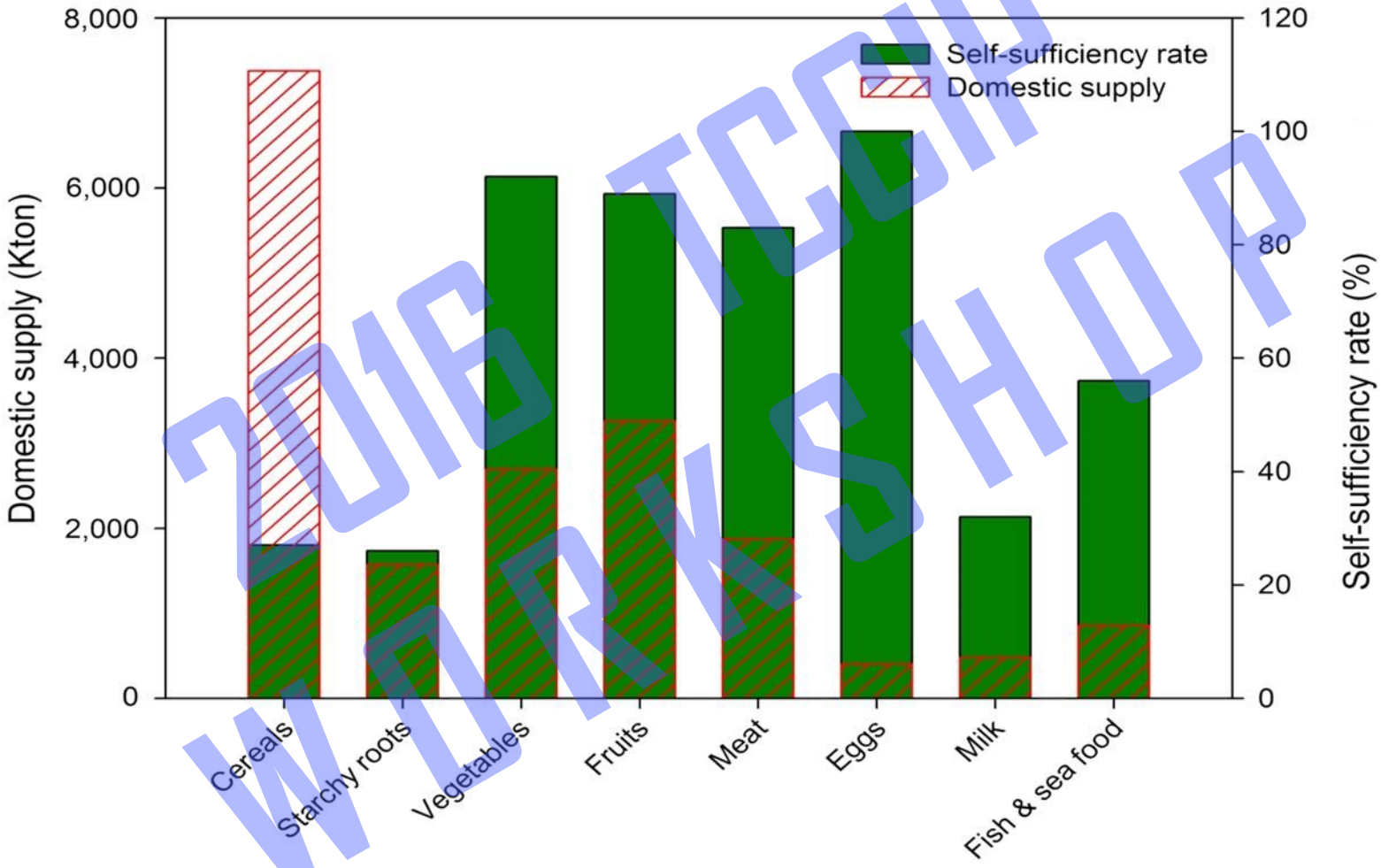
Rainfall: 2,515 mm / year.

The wet season -May to September.
The dry season -November to March.

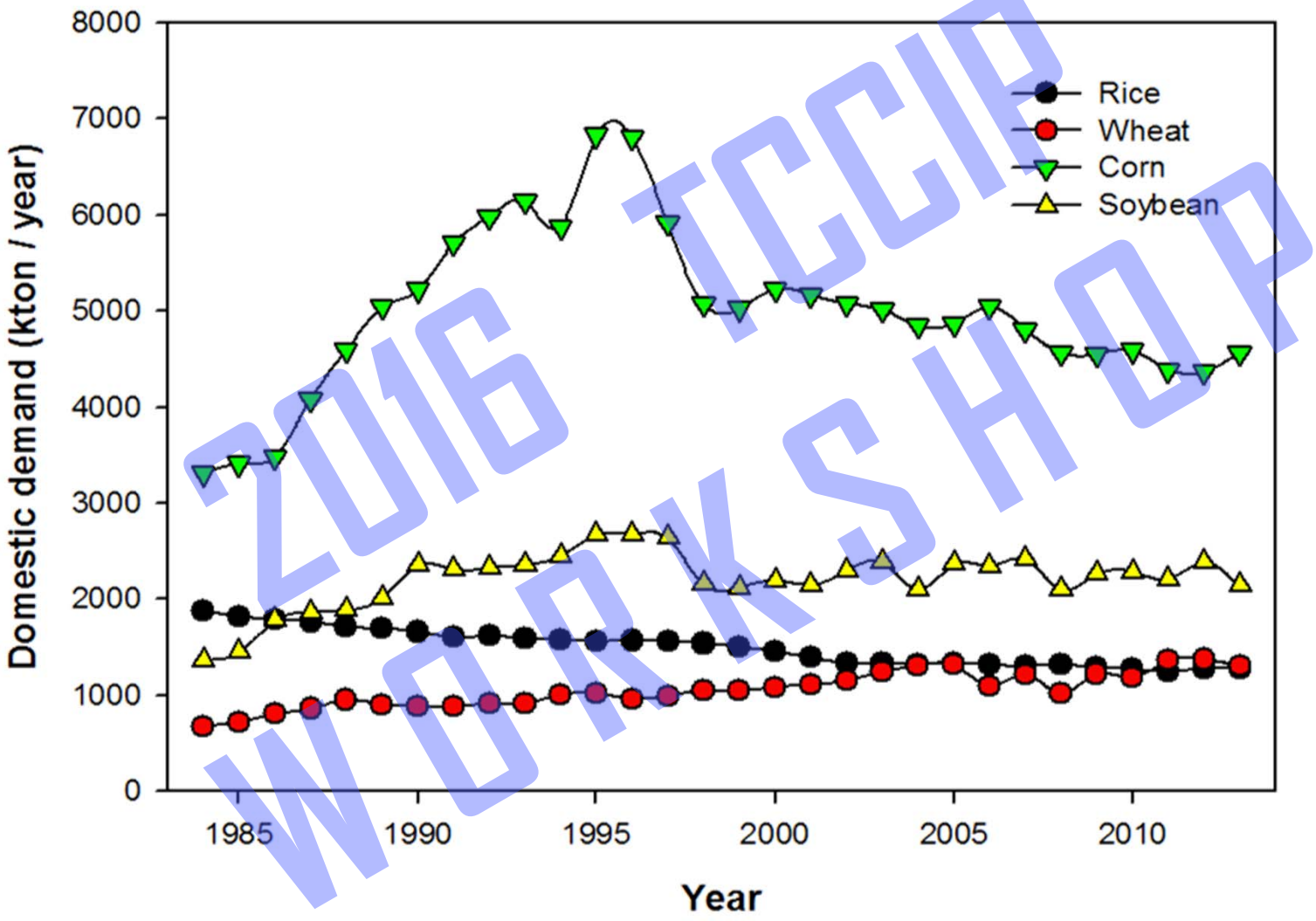


Agricultural Land : 799,611 hectares .
Cultivated rice: 271,001 hectares(34%).

Supply / self-sufficiency



Domestic crop demand



Vulnerability (domestic production)

Domestic production is insufficient to provide demand

production

271,007 ha

1,300 k ton

vs

demand

1300 k ton

19,901 ha ； 87 k ton

vs

8000 k ton

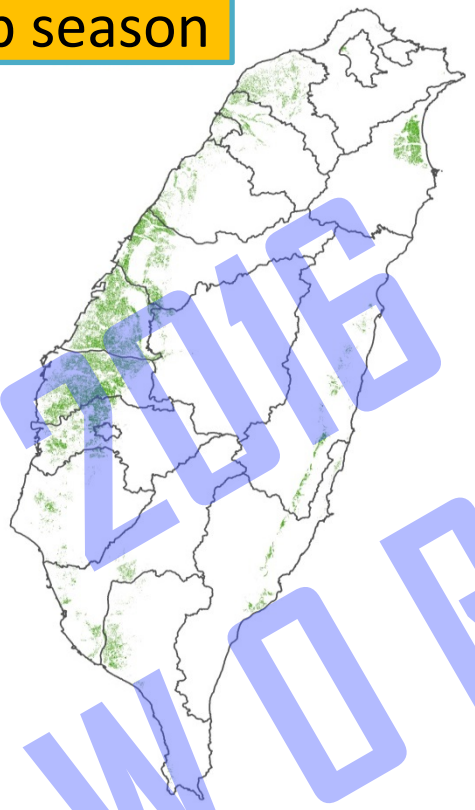
Growth stages and disasters happen in the first and second seasons of rice

Month	1	2	3	4	5	6
Stage	seedling		Maxi. tilling		flowering	Grain filling / Mature
disasters	Chilling drought		Pest flooding Chilling	Pest Flooding	Pest Flooding Heat	Pest Typhoon Strong wind

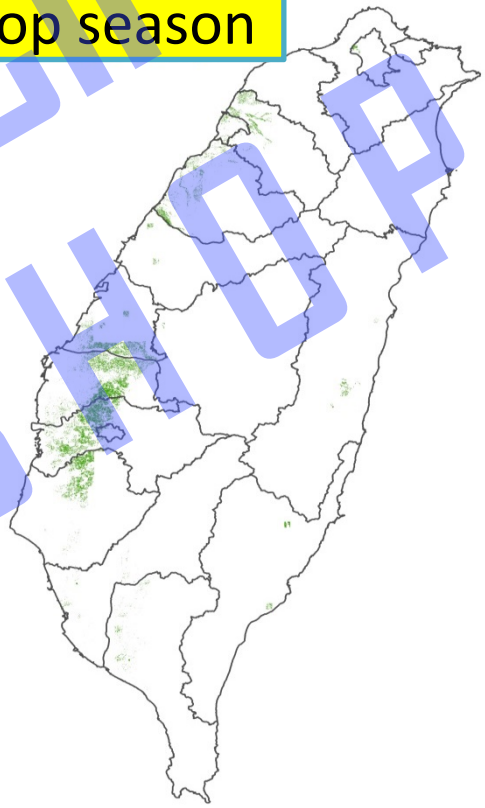
7	8	9	10	11	12
seedling	Maxi. tilling		flowering	Grain filling	Mature
Typhoon	Typhoon Pest		Typhoon Foehn Pest	Pest Low light	

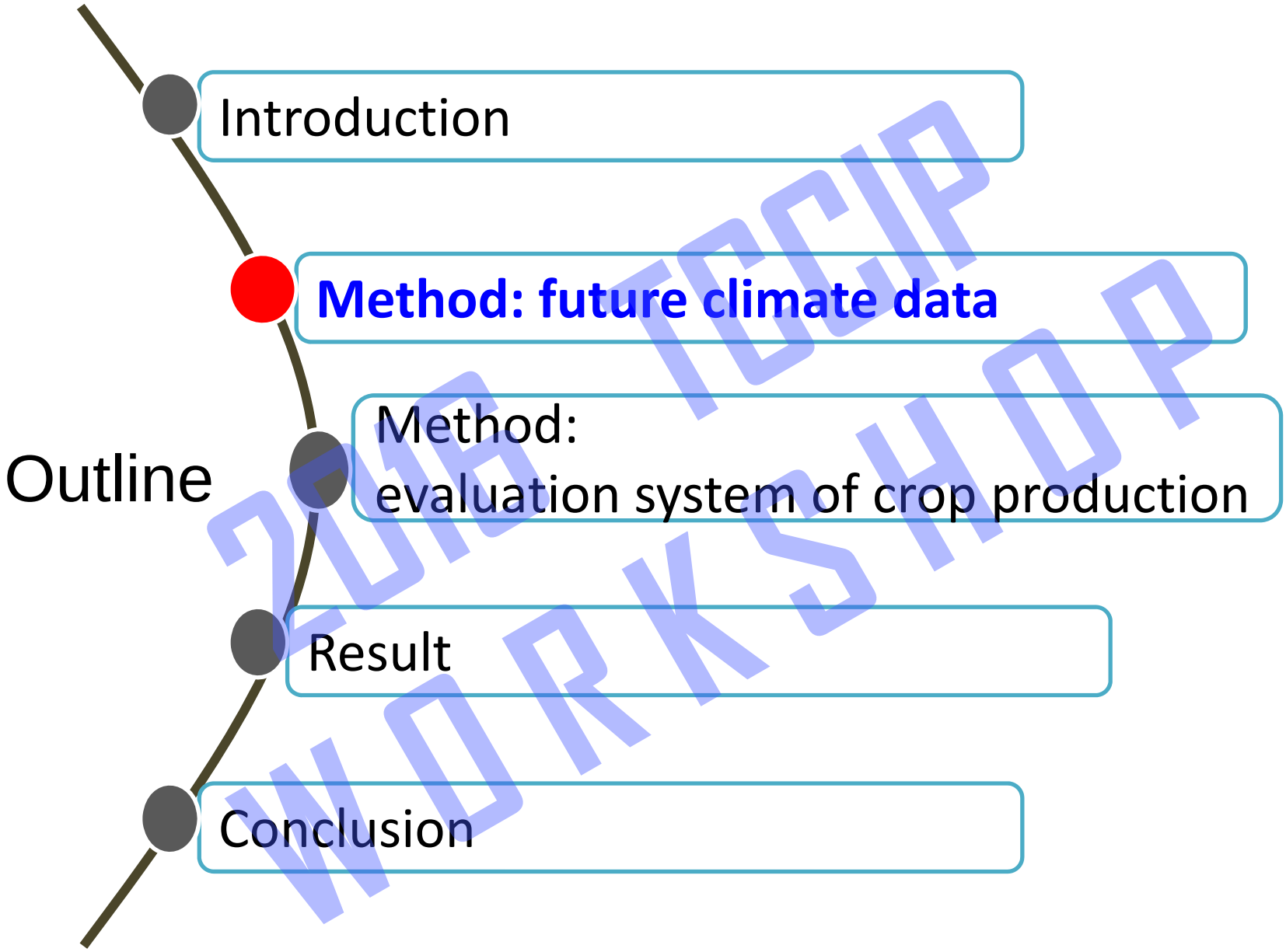
Rice: the most important agricultural product both in total harvest (**1,300 kton)** and value **(41,479 million NTD**).

Distribution of first crop season



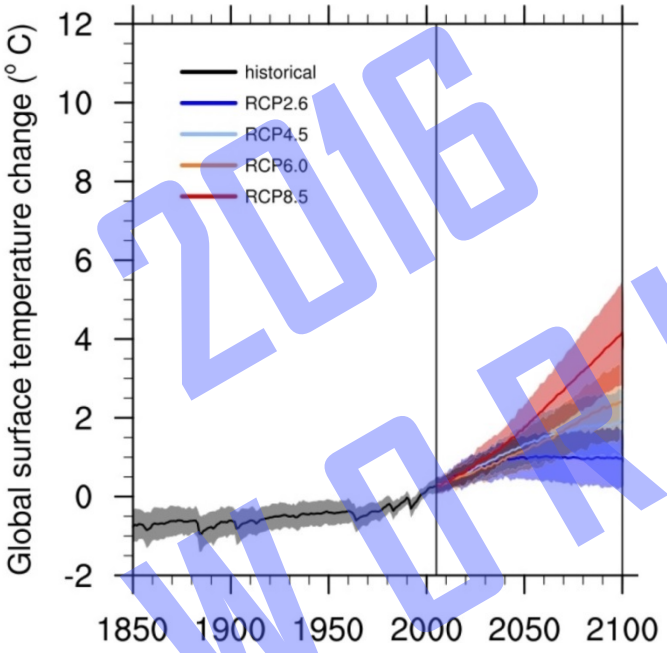
Distribution of second crop season





Scenarios in the Fifth Assessment Report of IPCC

Representative Concentration Pathways, RCPs identified by their approximate total radiative forcing in year 2100 relative to 1750



2.6 W m-2 for RCP2.6

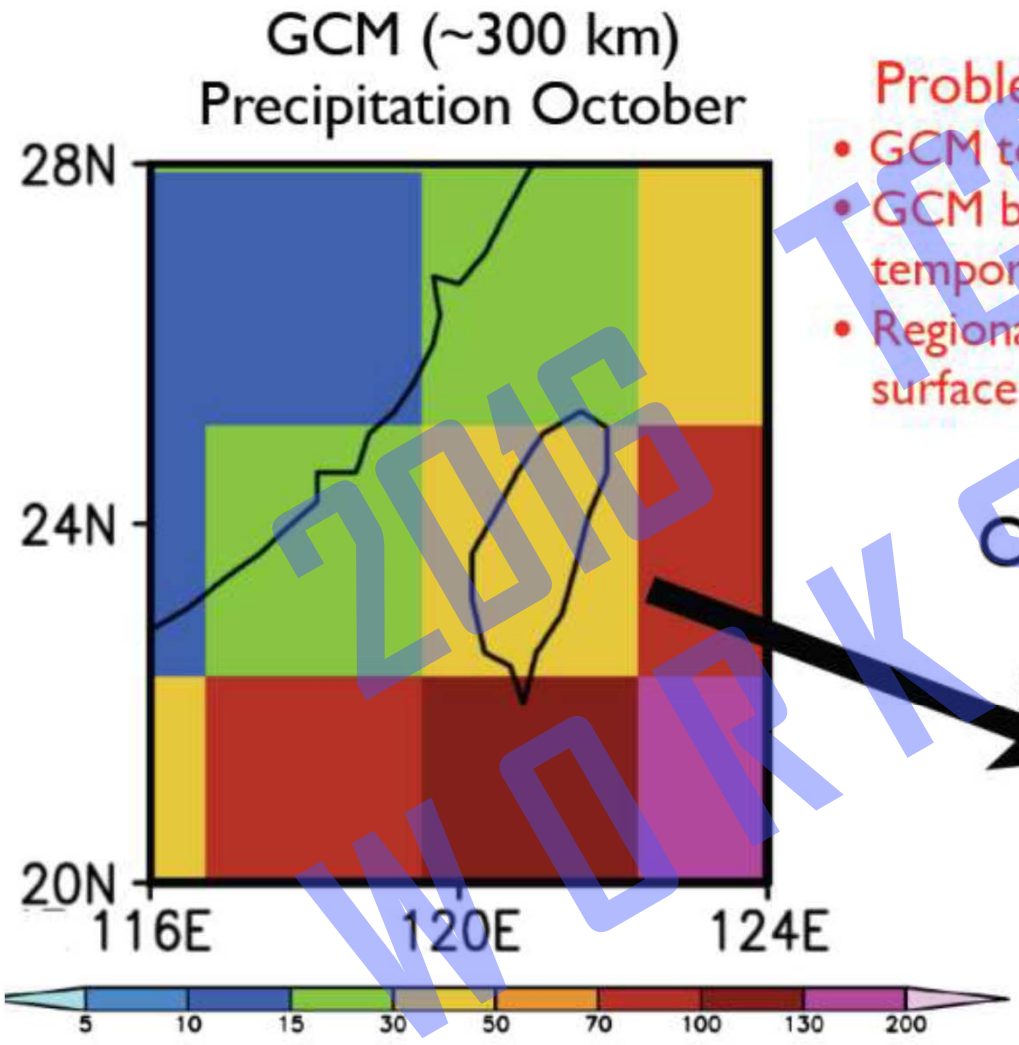
4.5 W m-2 for RCP4.5

6.0 W m-2 for RCP6.0

8.5 W m-2 for RCP8.5

Resource : IPCC AR5

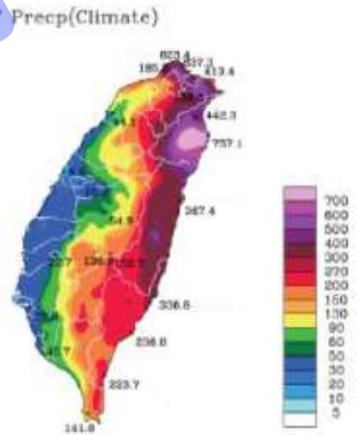
Downscaling data



Problems:

- GCM too coarse for local assessment
- GCM biases in climatology (spatially and temporally)
- Regional climate variability (topography, surface landscapes, coastlines)

Observation (~5km)



Process of future meteorological data

IPCC AR5

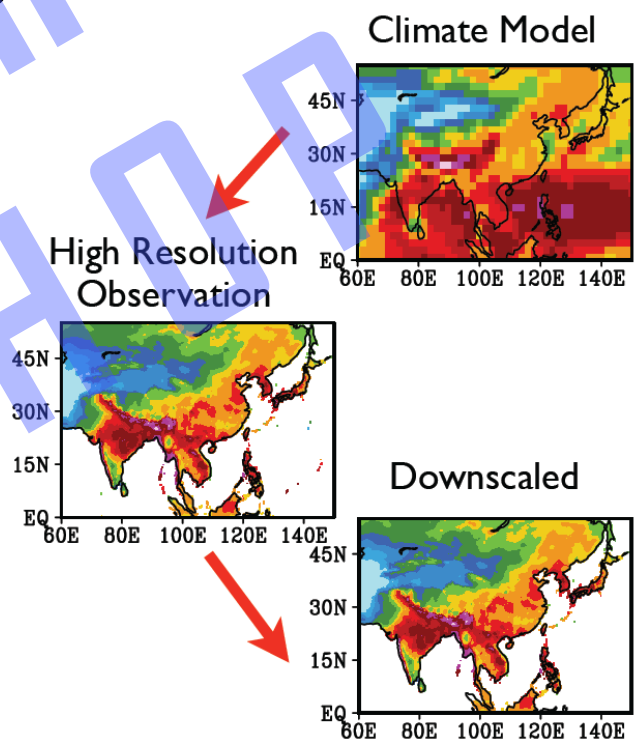
Spatial resolution: > 100km
Temporal resolution: monthly

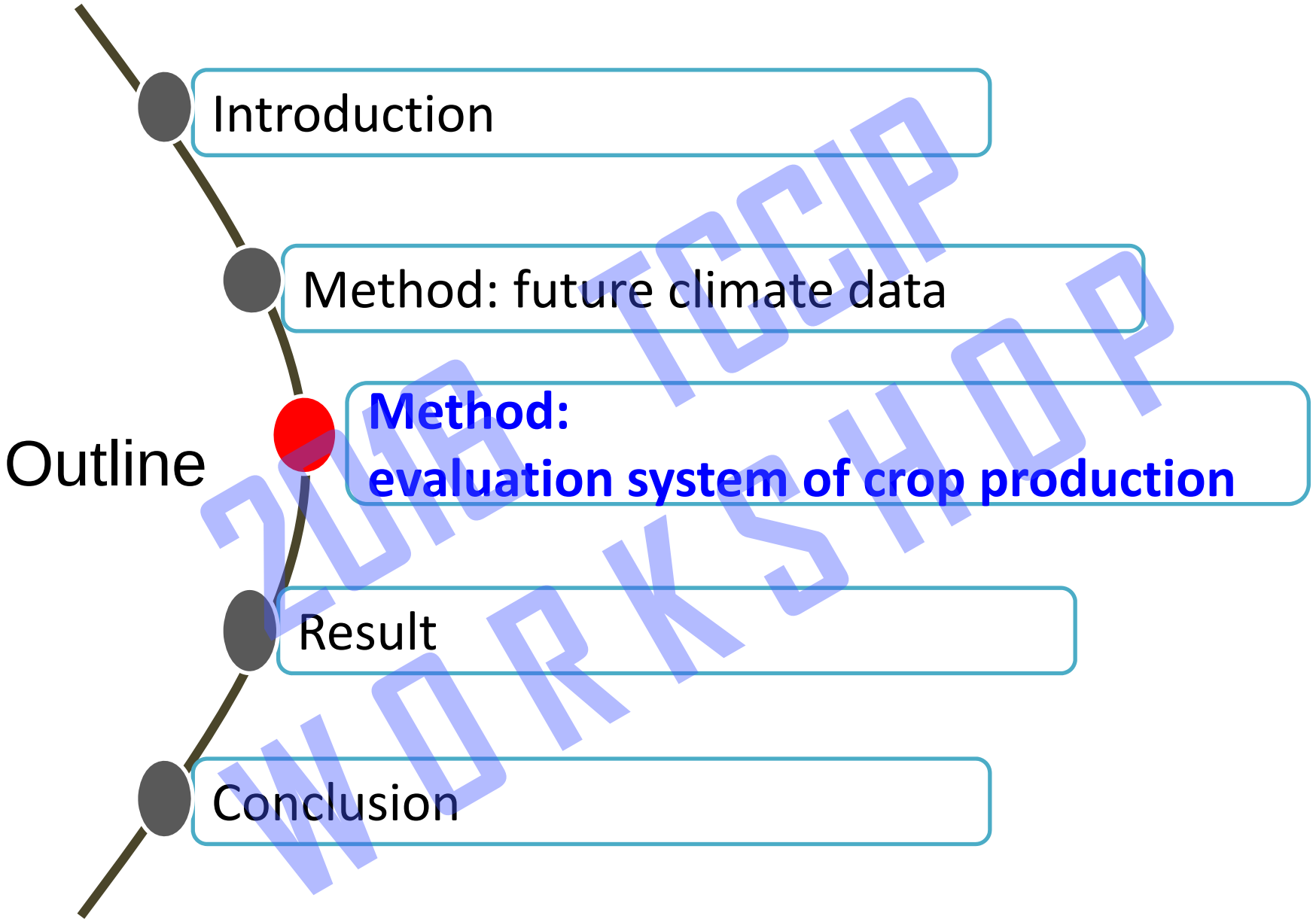
Statistical downscaling

Spatial resolution: **5km**
Temporal resolution: monthly

weather generators

Spatial resolution: 5km
Temporal resolution: **daily**



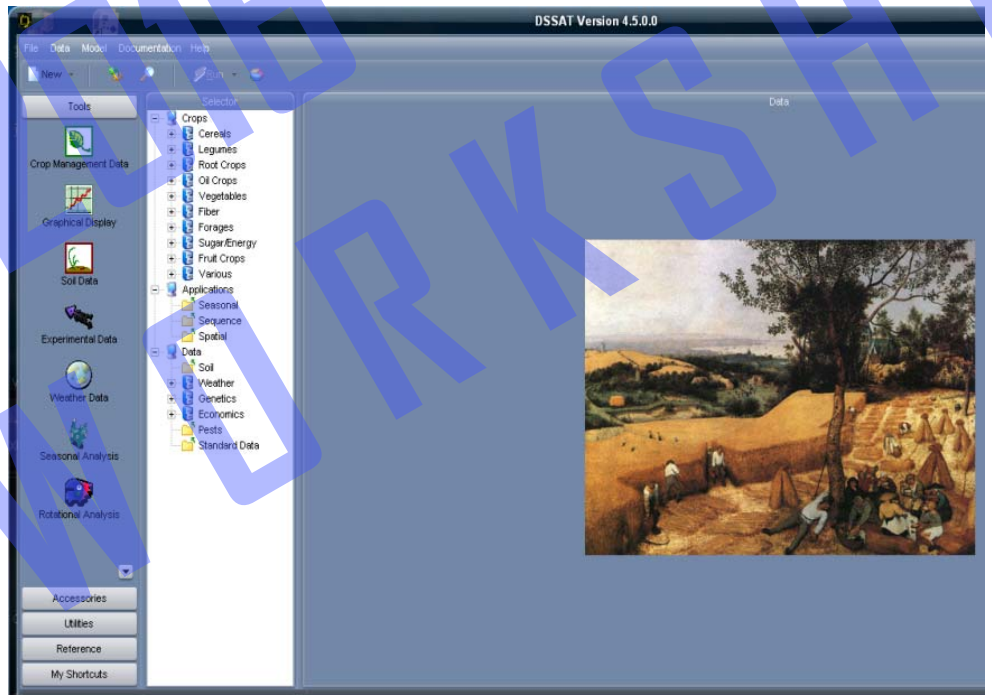


Establishment of evaluation system for crop production

A assessment tool of crop production

—DSSAT crop model V. 4.5
(Decision Support System for Agrotechnology Transfer)

This model have been used for many applications ranging from on-farm and precision management to regional assessments of the impact of climate variability and climate change.

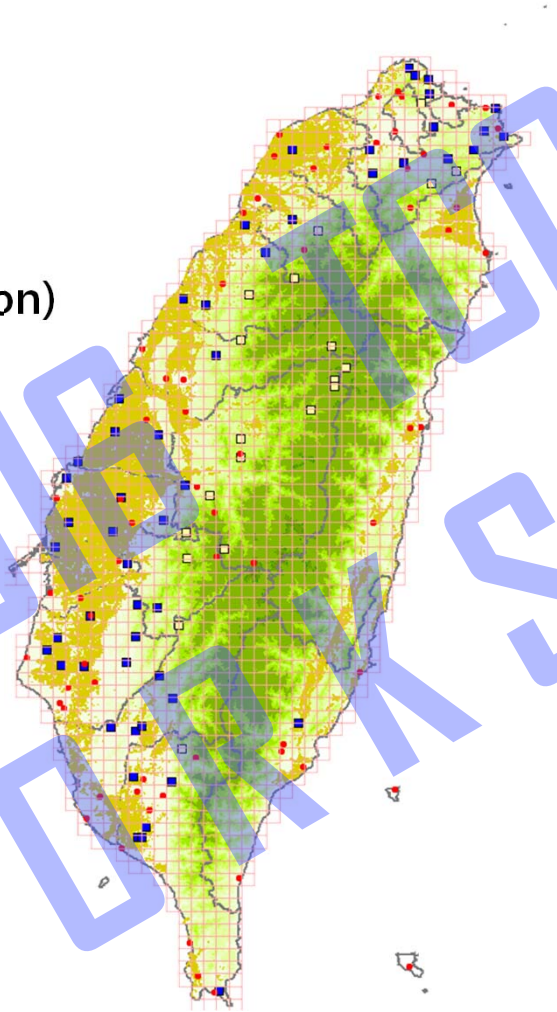


Spatial characteristics and database of evaluation system

- Spatial resolution was divided into 5×5 km.

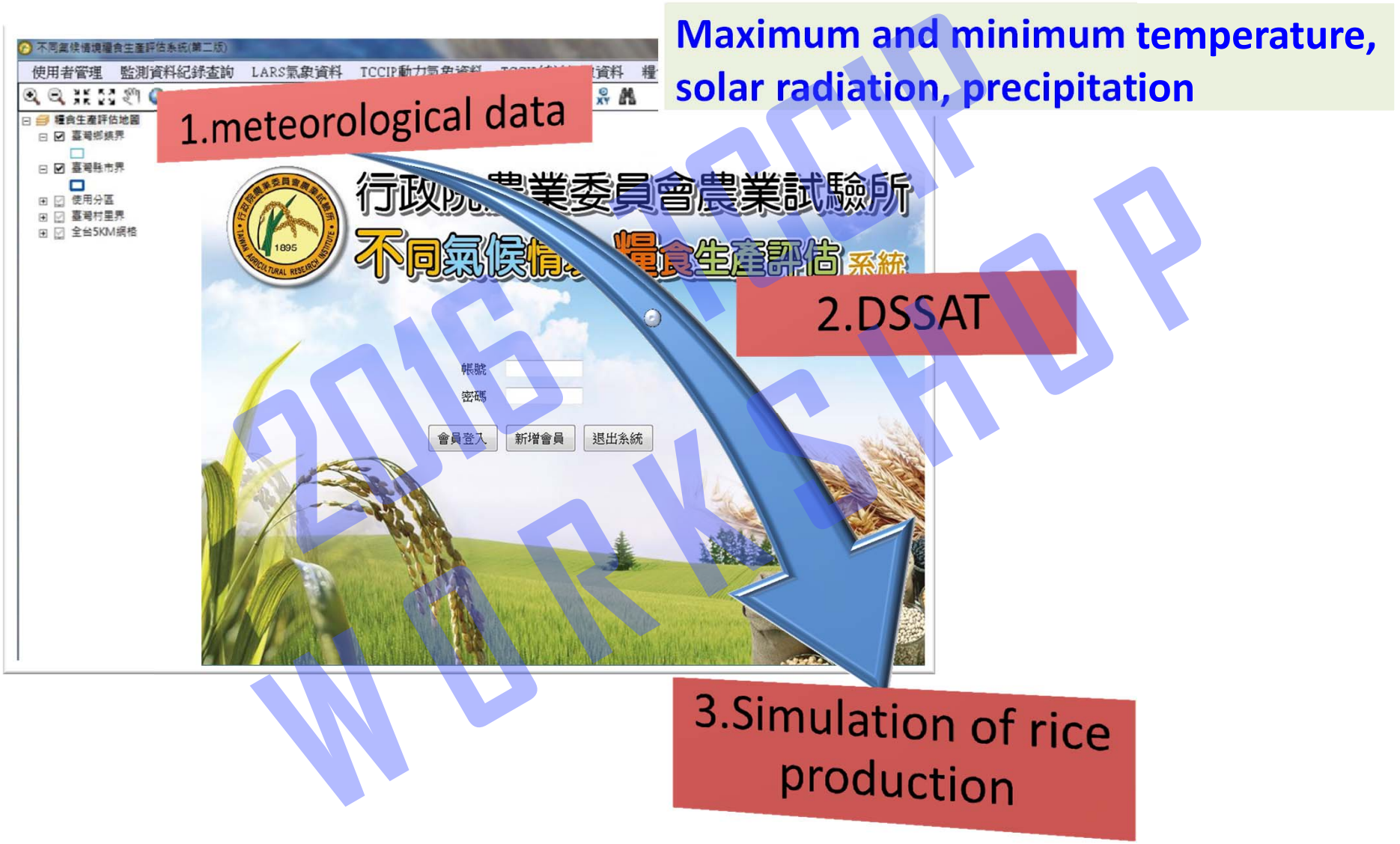
(Climate scenario resolution)

- a smaller scale within townships.
- (The basic unit of crop survey)
- 2006-2010 year 5 year
- (The year of complete information)

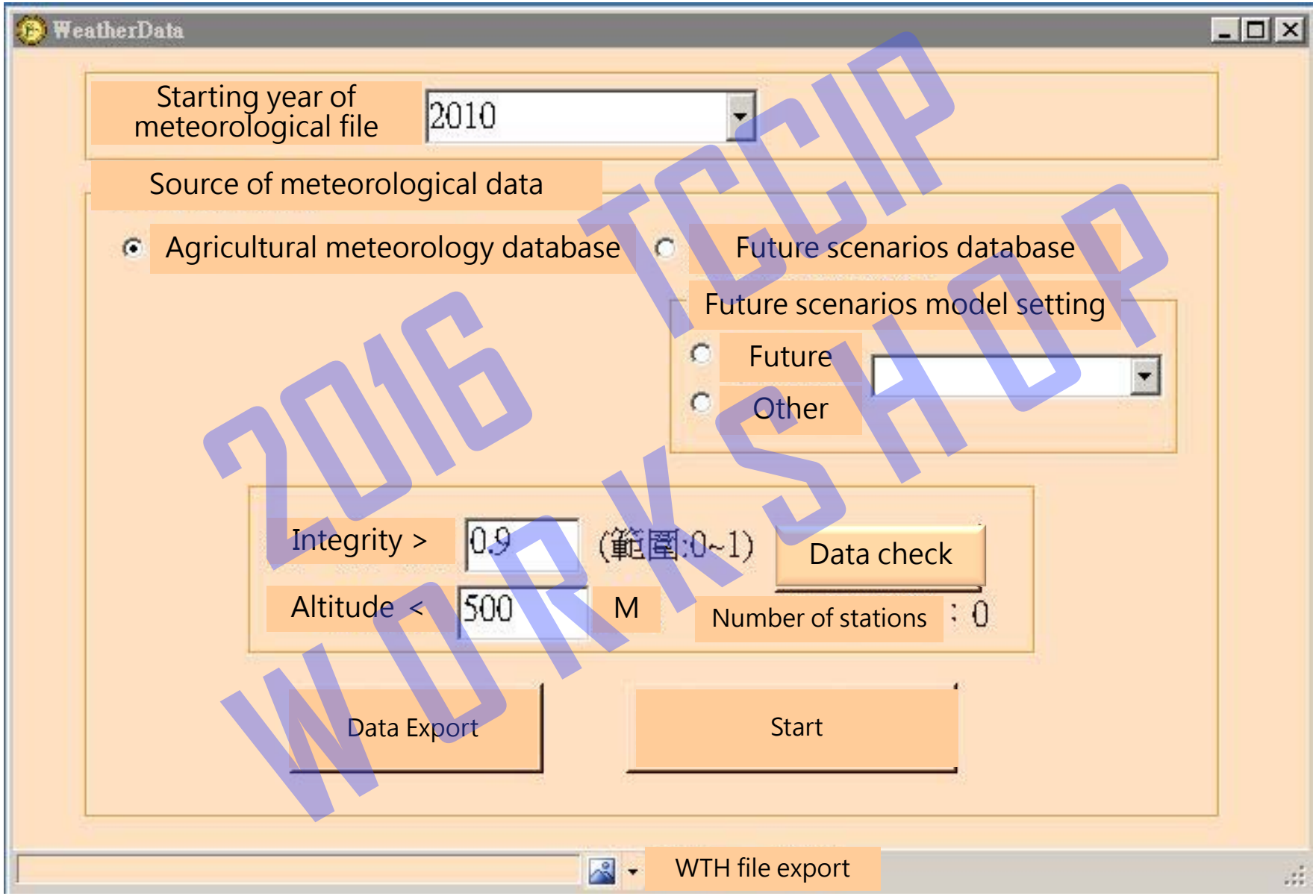


- Harvested area(township) and production statistics database.
- Crop growth models and yield estimation database.
- Land use classification database.
- Historical weather observation database.
- Future climate database.
- Climate disaster probability
- agricultural disaster area and yield loss statistics

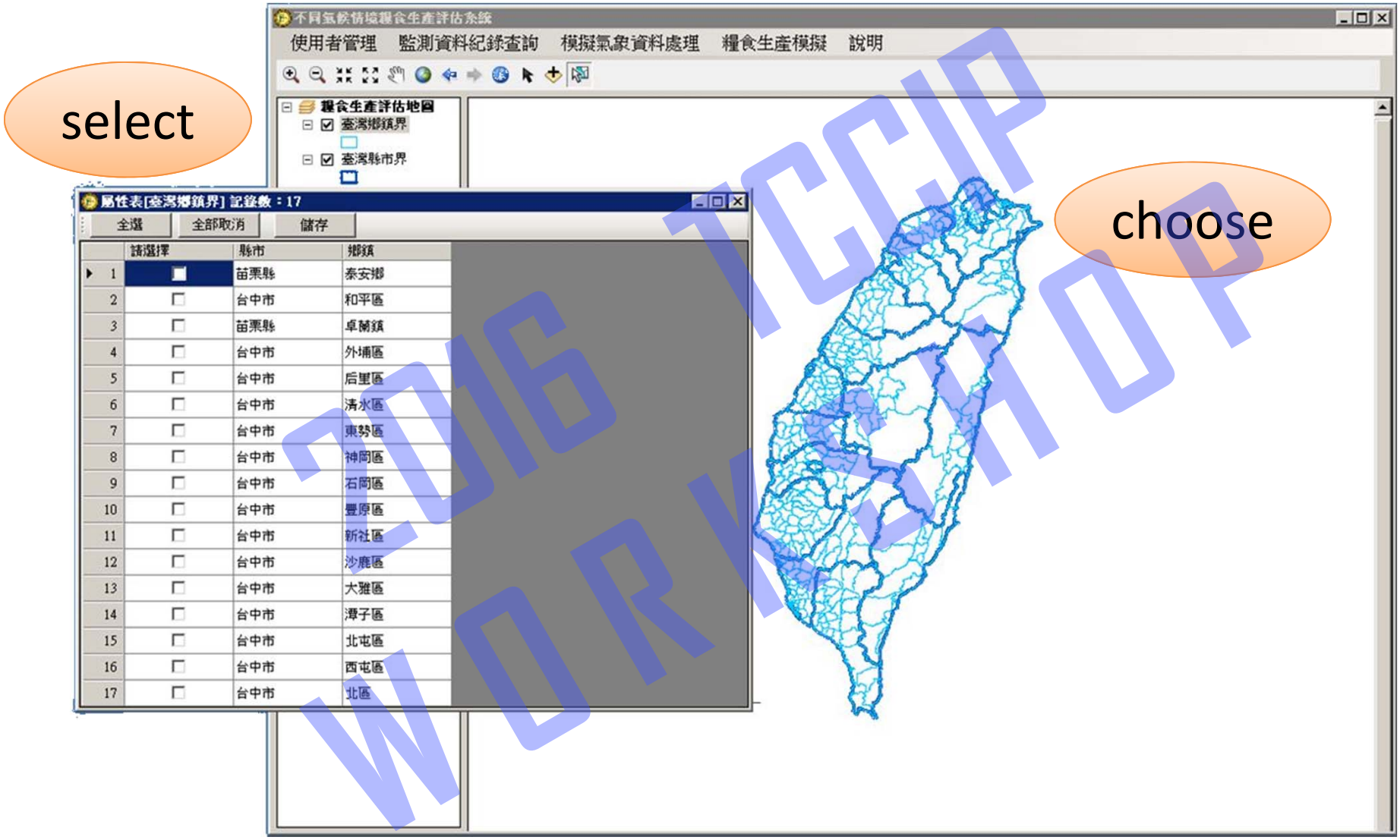
Simulation procedure of evaluation system



1. Meteorological data input and check system

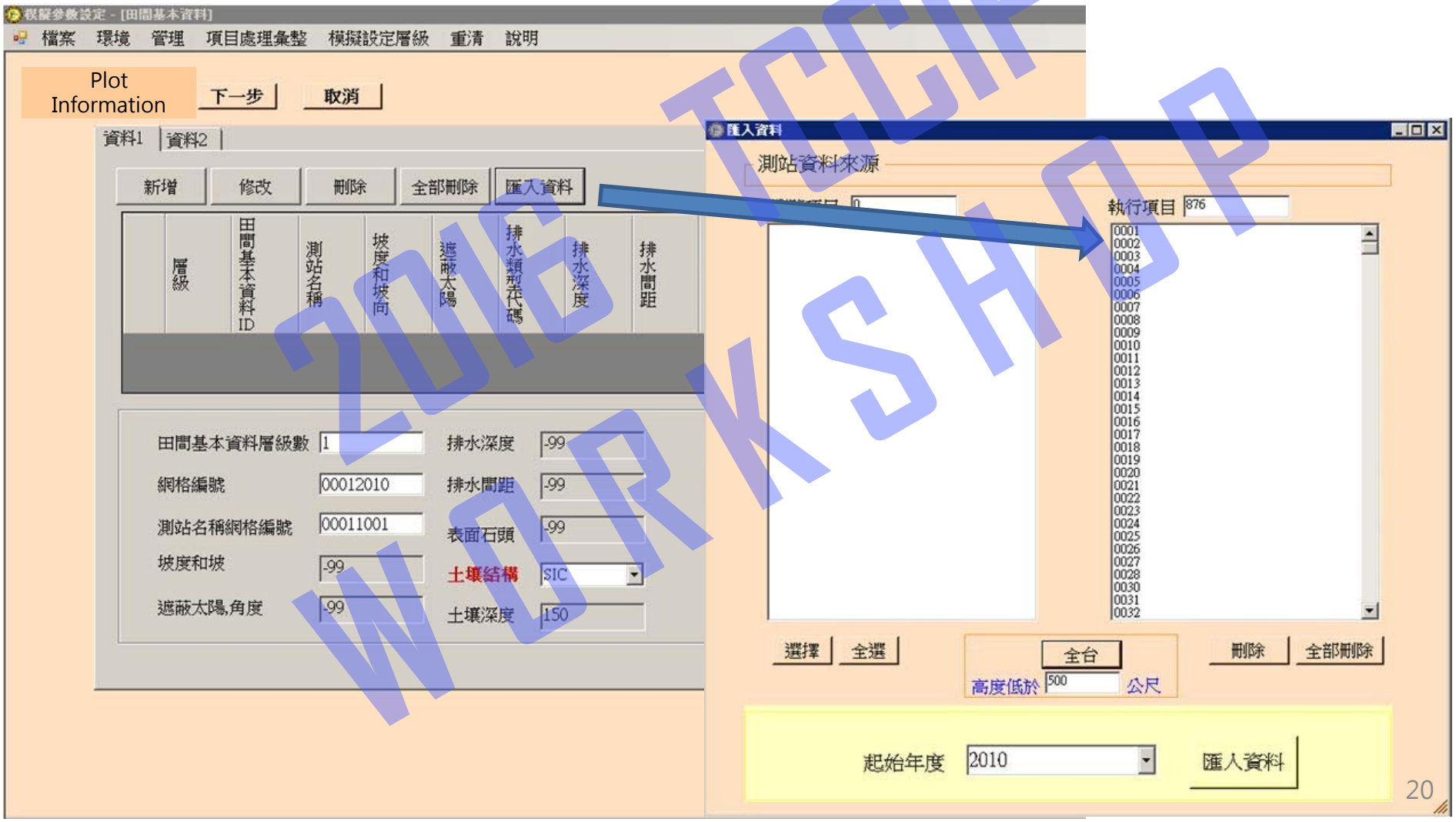


2. The setting function of modelling region



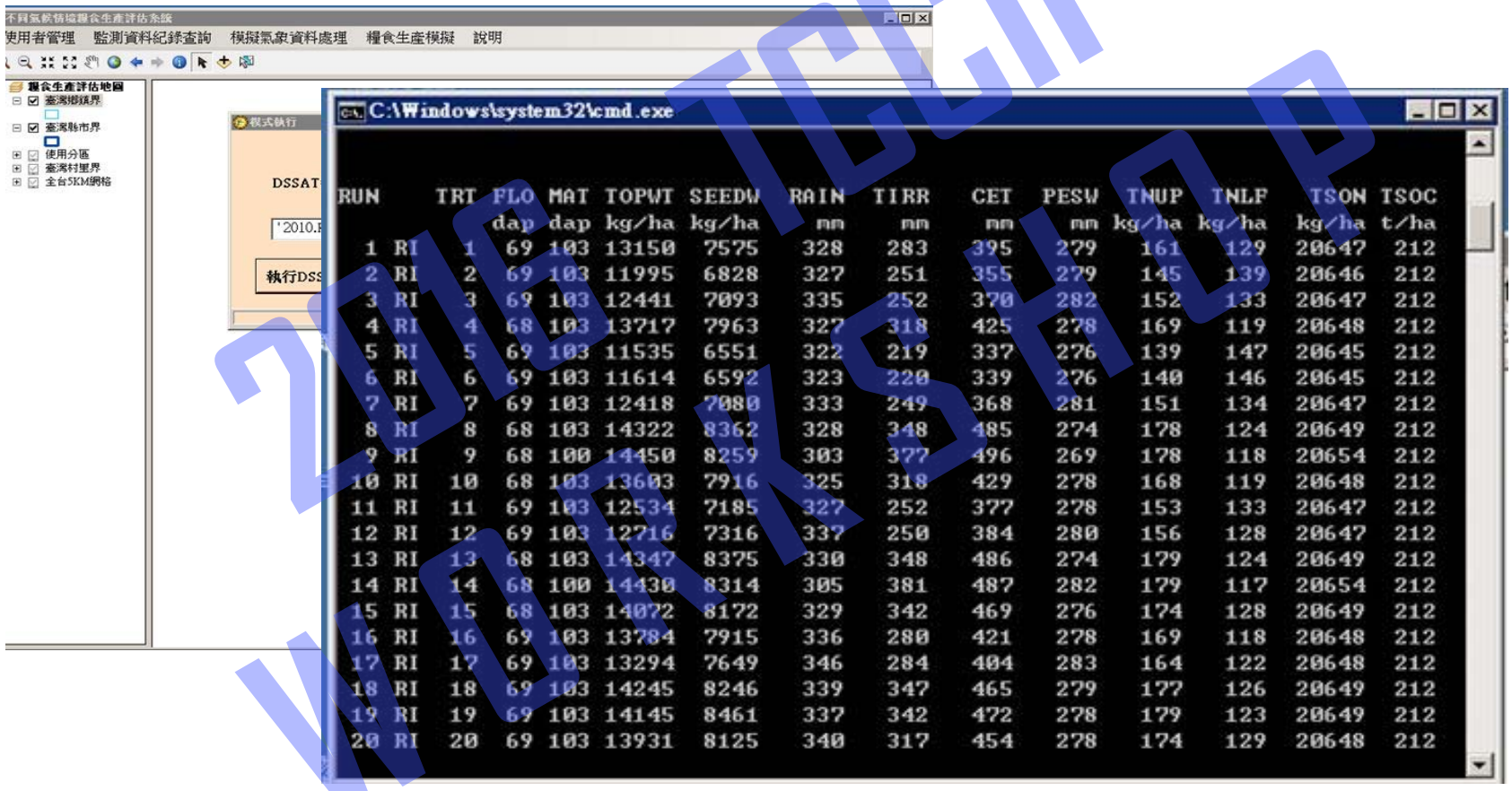
3.DSSAT model parameter setting

The field basic information of selected area.



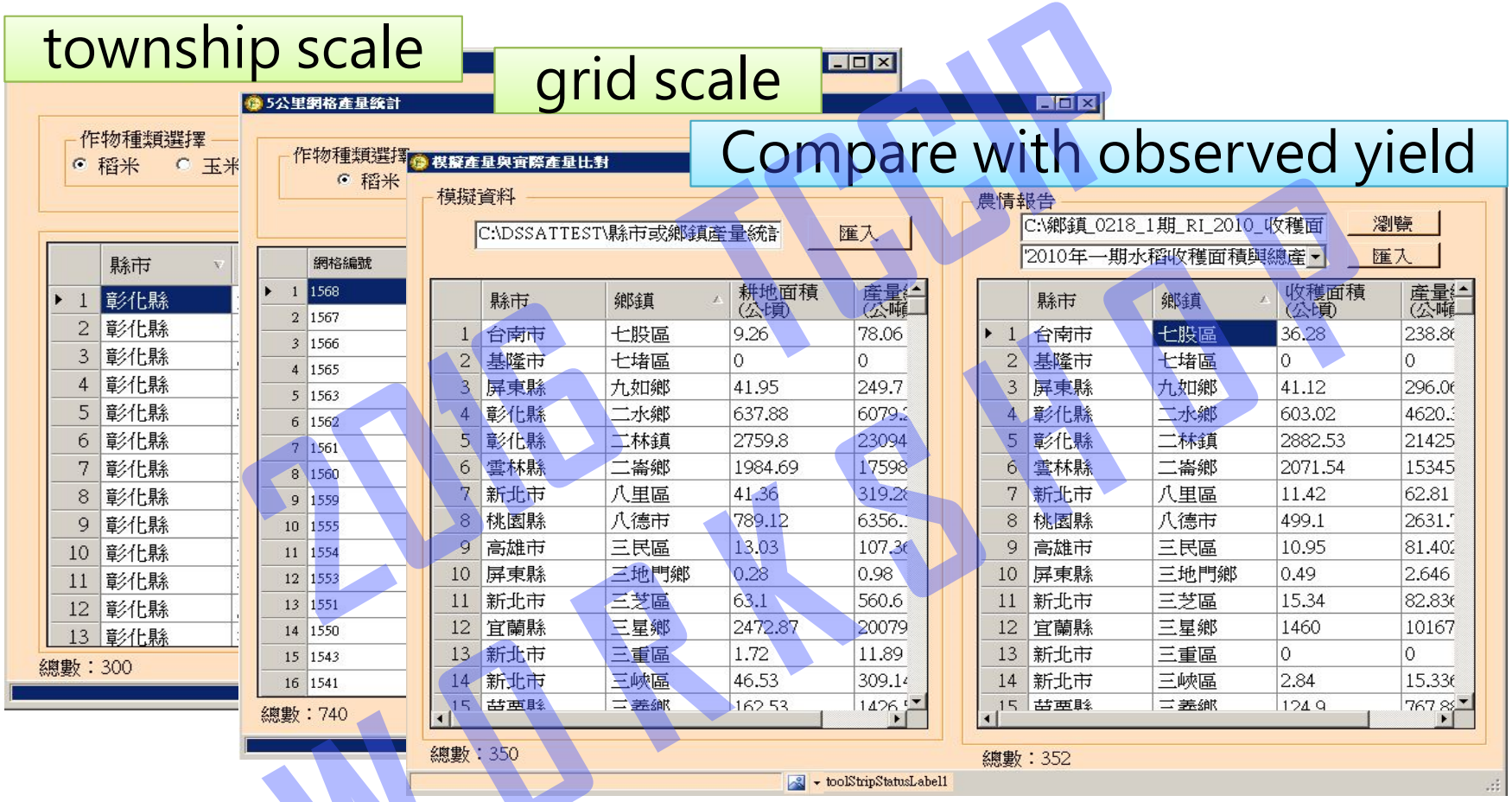
4. DSSAT model executive function

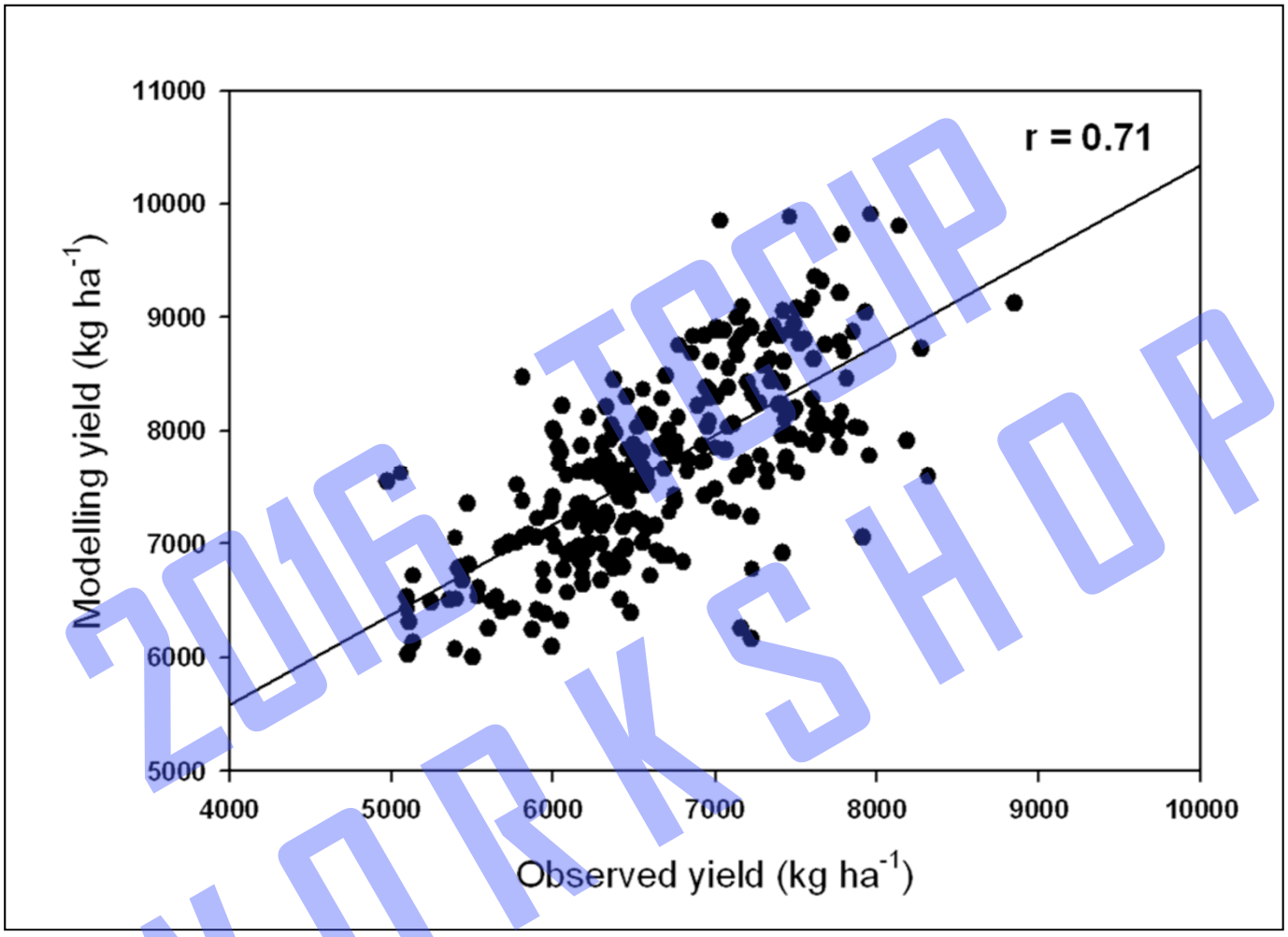
Select the crop parameter setting file / execute DSSAT



RUN		TRT	FLO	MAT	TOPWT	SEEDW	RAIN	TIRR	CET	PESW	TNUP	TNLF	TSON	TSOC
			dap	dap	kg/ha	kg/ha	mm	mm	mm	mm	kg/ha	kg/ha	kg/ha	t/ha
1	RI	1	69	103	13150	7575	328	283	395	279	161	129	20647	212
2	RI	2	69	103	11995	6828	327	251	355	279	145	139	20646	212
3	RI	3	69	103	12441	7093	335	252	370	282	152	133	20647	212
4	RI	4	68	103	13717	7963	327	318	425	278	169	119	20648	212
5	RI	5	69	103	11535	6551	322	219	337	276	139	147	20645	212
6	RI	6	69	103	11614	6592	323	220	339	276	140	146	20645	212
7	RI	7	69	103	12418	7080	333	249	368	281	151	134	20647	212
8	RI	8	68	103	14322	8362	328	348	485	274	178	124	20649	212
9	RI	9	68	100	14450	8259	303	377	496	269	178	118	20654	212
10	RI	10	68	103	13603	7916	325	318	429	278	168	119	20648	212
11	RI	11	69	103	12534	7185	327	252	377	278	153	133	20647	212
12	RI	12	69	103	12716	7316	337	250	384	280	156	128	20647	212
13	RI	13	68	103	14347	8375	330	348	486	274	179	124	20649	212
14	RI	14	68	100	14430	8314	305	381	487	282	179	117	20654	212
15	RI	15	68	103	14072	8172	329	342	469	276	174	128	20649	212
16	RI	16	69	103	13784	7915	336	280	421	278	169	118	20648	212
17	RI	17	69	103	13294	7649	346	284	404	283	164	122	20648	212
18	RI	18	69	103	14245	8246	339	347	465	279	177	126	20649	212
19	RI	19	69	103	14145	8461	337	342	472	278	179	123	20649	212
20	RI	20	69	103	13931	8125	340	317	454	278	174	129	20648	212

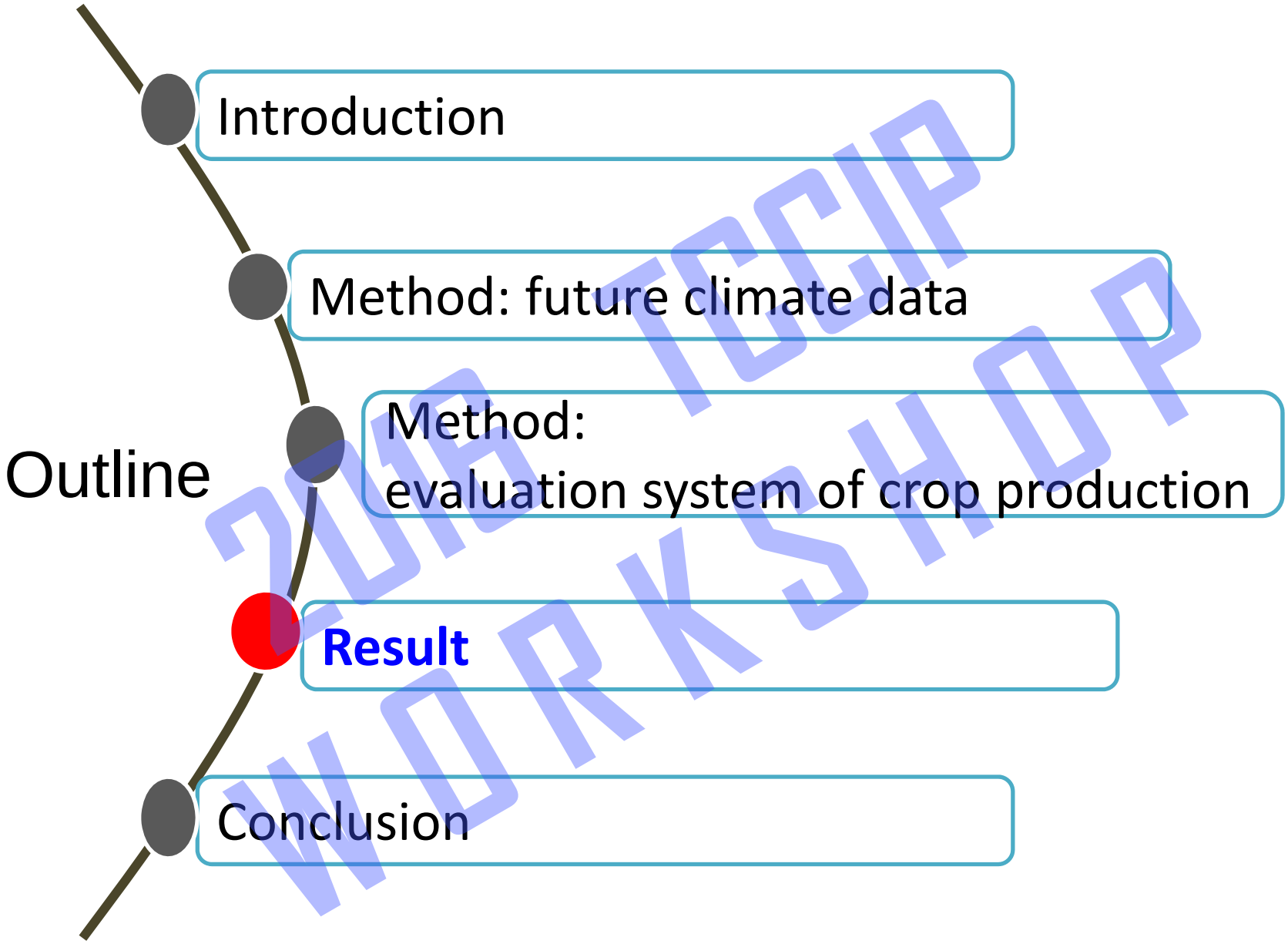
5. The compare function of modelling yield and observed yield





The relationship between observed rice yield and simulated by the DSSAT model.

Each point was represented the village of paddy rice cultivation area ≧ 1000 ha.



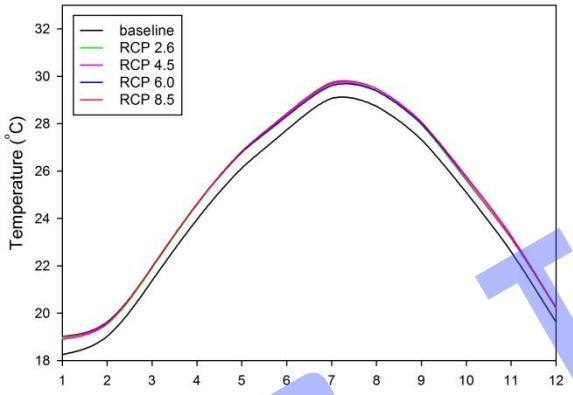
Trend of temperature under climate change

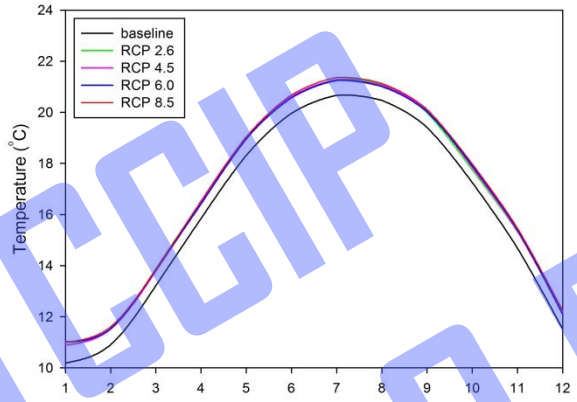
maximum

minimum

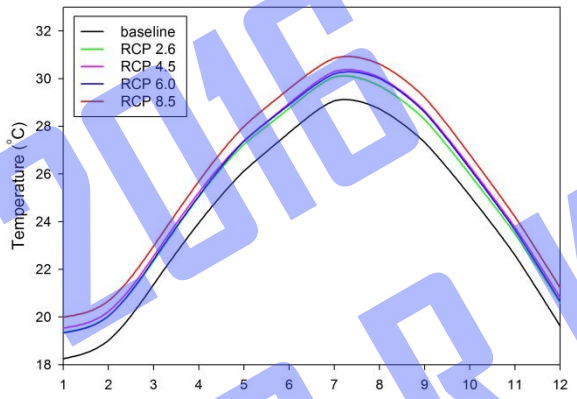
baseline
RCP2.6
RCP4.5
RCP6.0
RCP8.5

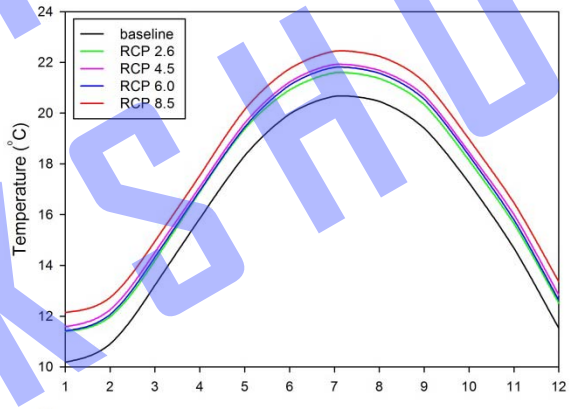
near-term
2016-2035



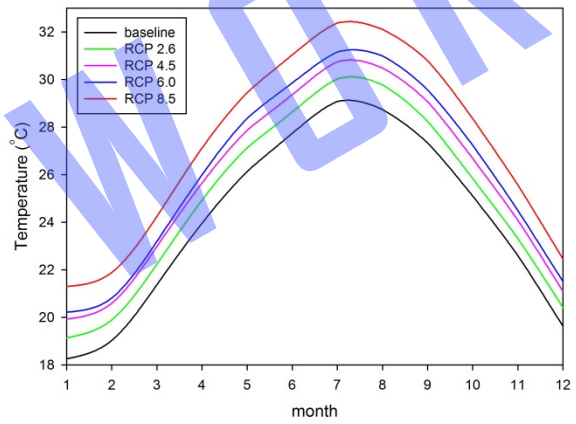


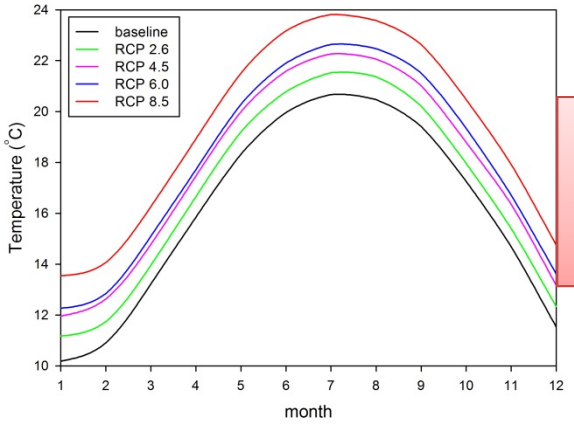
mid-term
2046-2065



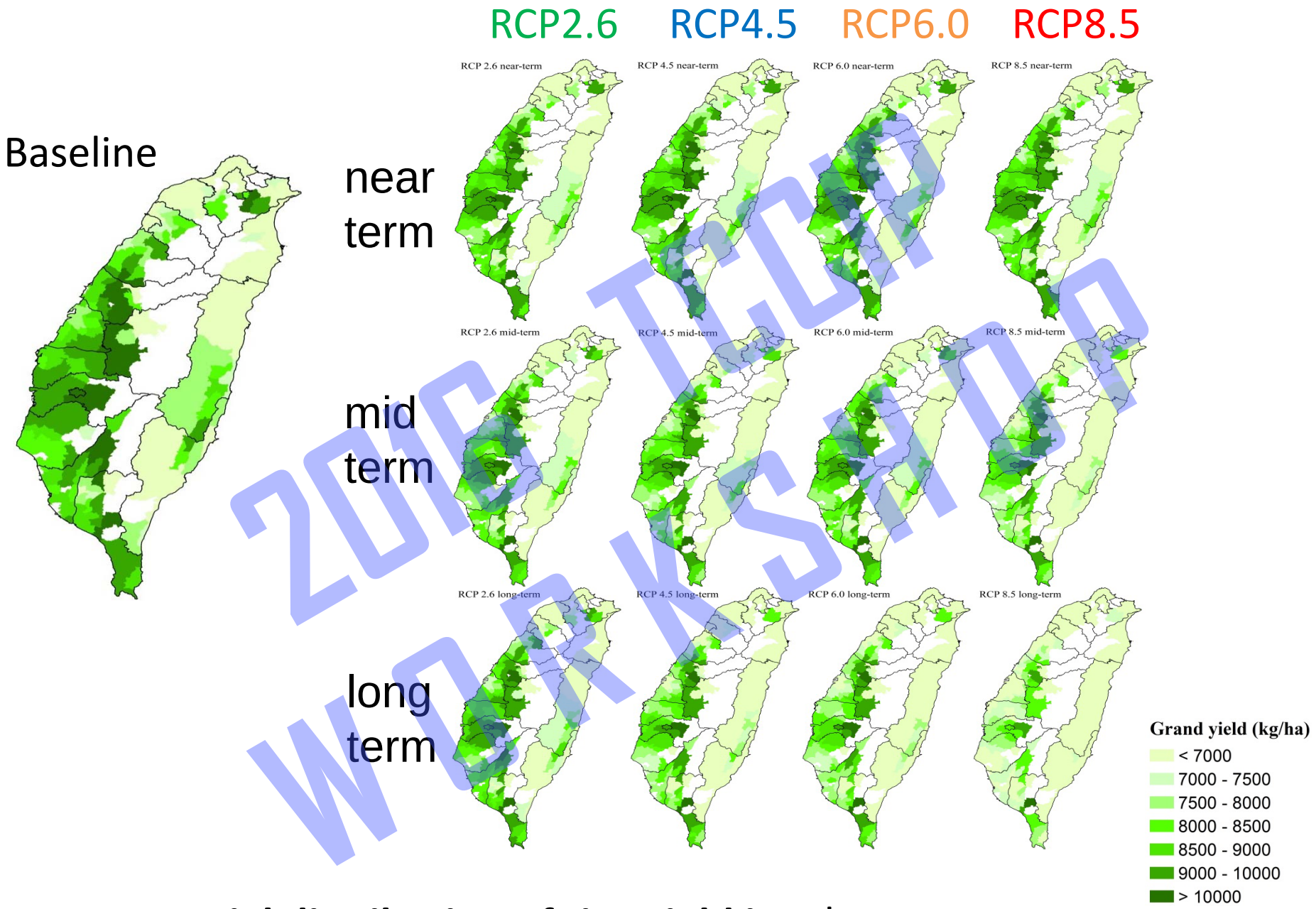


long-term
2081-2100

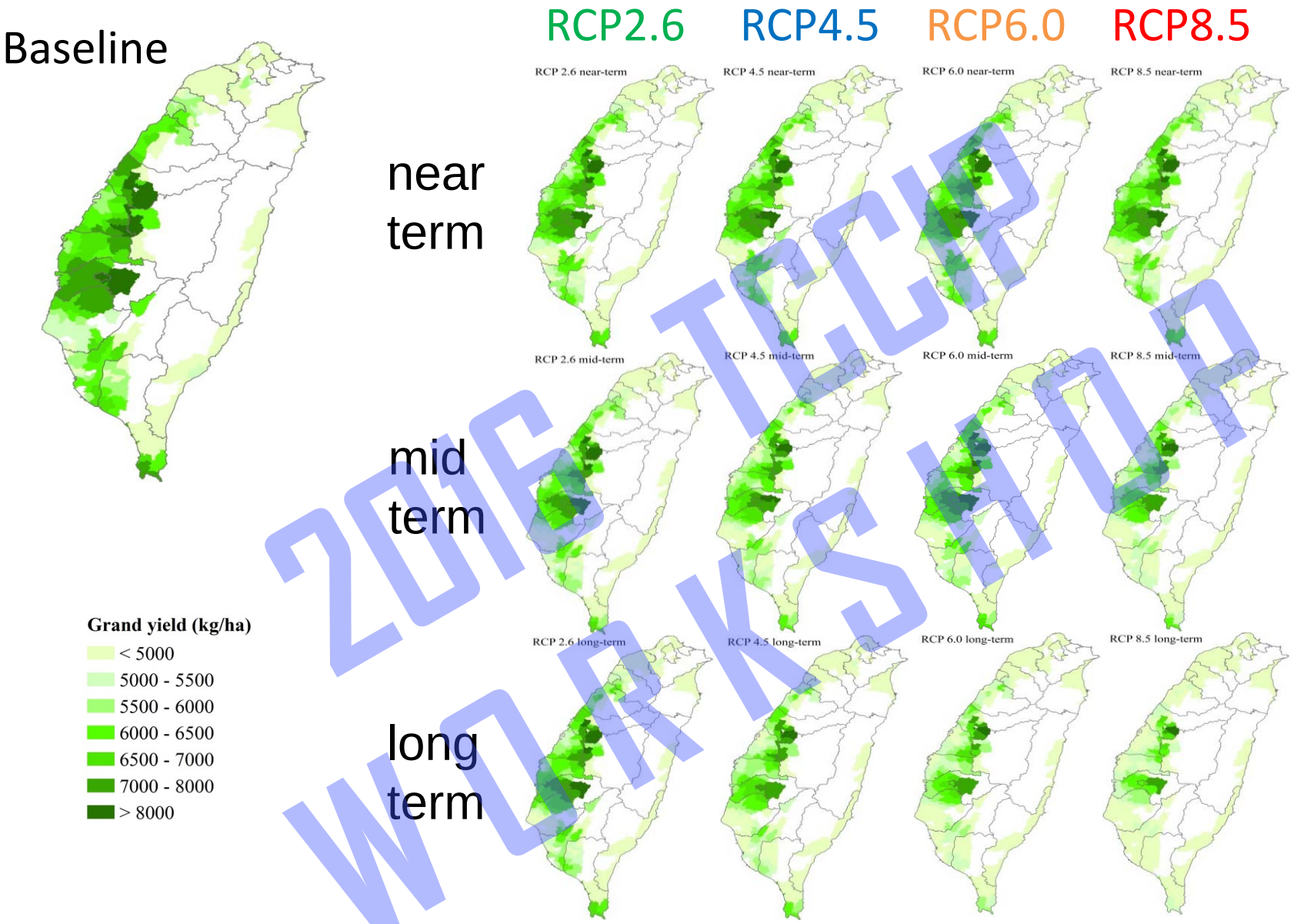




Warming with RCPs, raise 4℃ in RCP8.5



Spatial distribution of rice yield in 1st crop season



Spatial distribution of rice yield in 2nd crop season

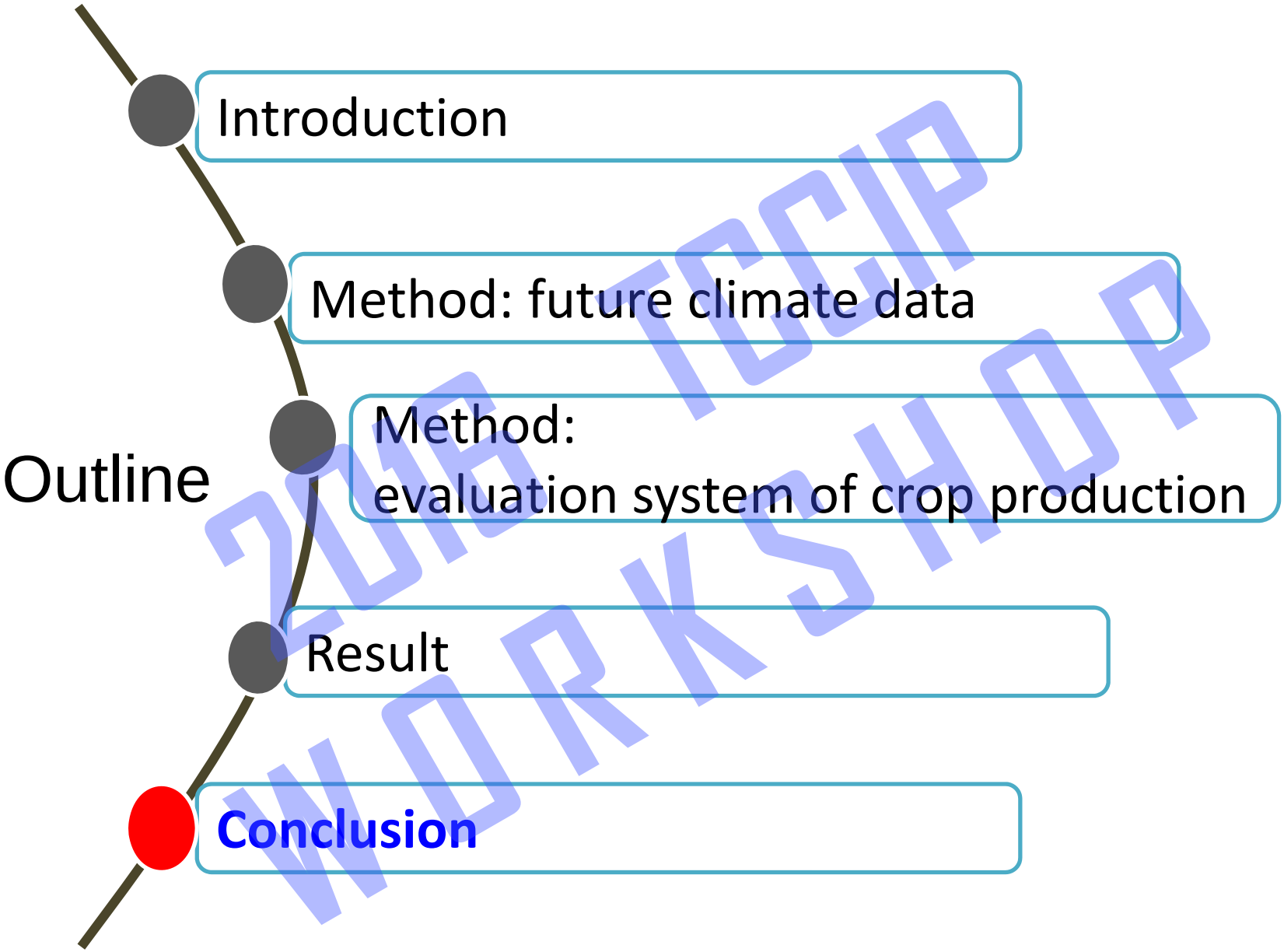
RCP2.6 RCP4.5 RCP6.0 RCP8.5

first season

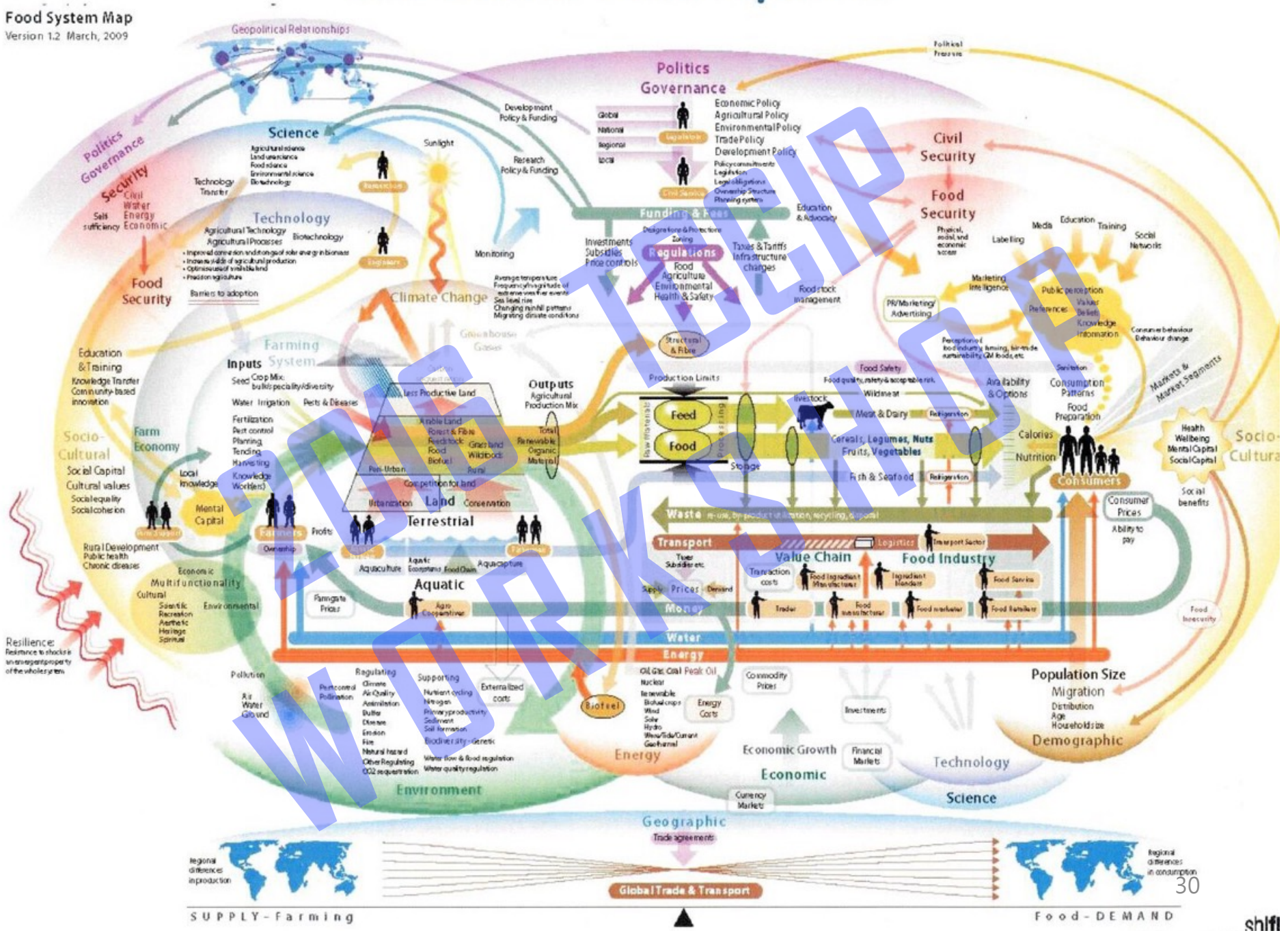
second season

Spatial distribution of growing degree days change rate in long-term

Growing degree days (GDD) is a weather-based indicator for assessing crop development. It is a calculation used by crop producers that is a measure of heat accumulation used to predict plant development rates such as the date that a crop reaches maturity.



The Global Food System



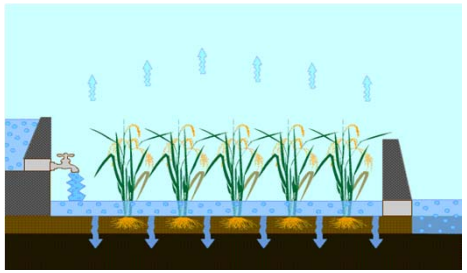
COPING STRATEGIES OF ADAPTATION AND MITIGATION OF CLIMATE CHANGE

Adaptation of rice production

- To breeding the new variety of rice for anti-stress and feed-use
- To adjust the growing season for fitting newly environment
- To evaluate the water resources and irrigation vulnerability under climate change analysis
- To setup the food security early warning system and strategy map
- To promote the rice insurance for extreme weather
- To construct the regional emergency food reserve mechanism in cooperation with the international food aid







Thank you for your attention！