

Workshop on "Meta-Guidelines" for Climate Change Adaptation

How to bridge the gap of usable knowledge

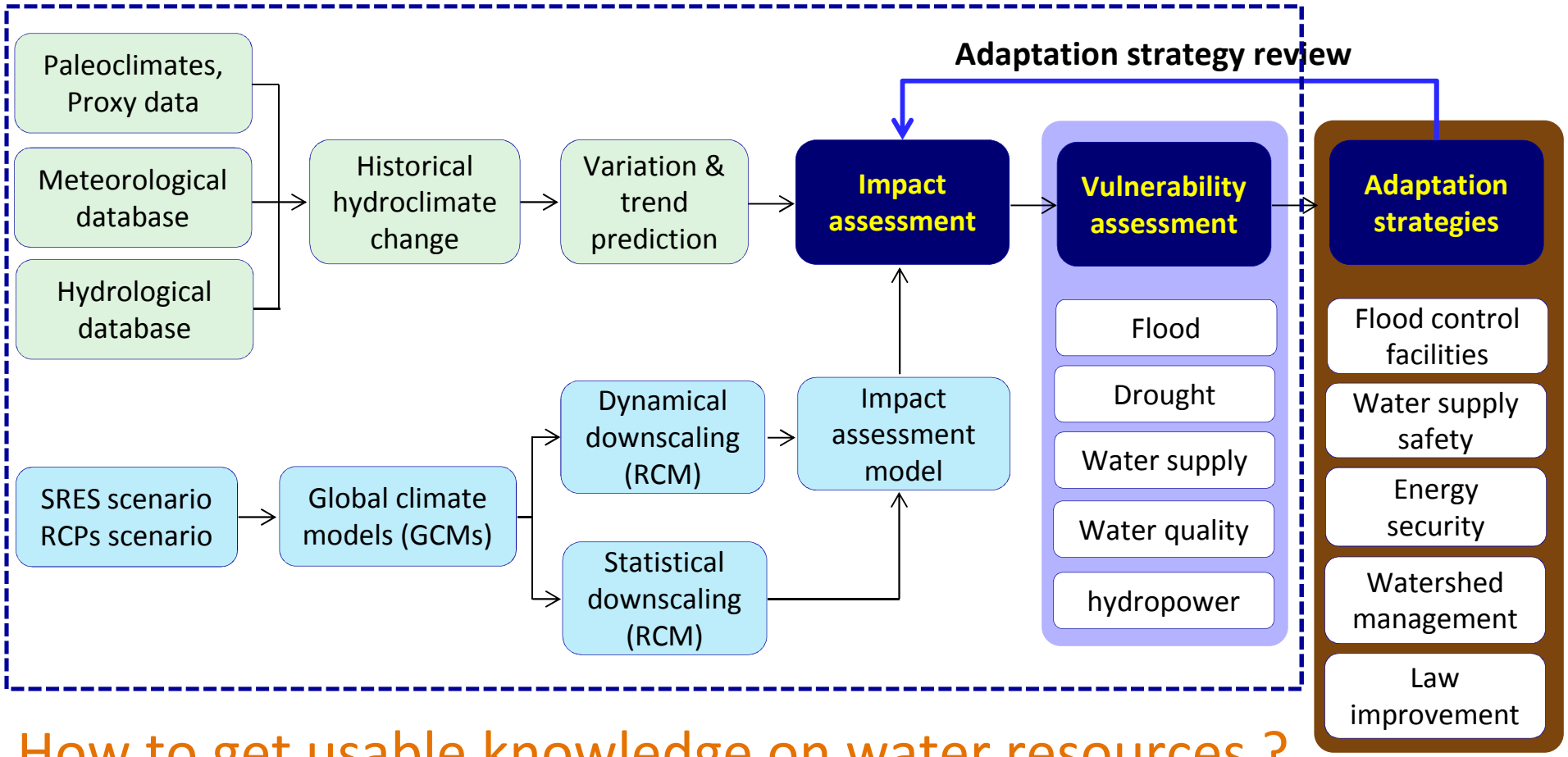
- Korean Experince

October 1, 2012

Deg-Hyo Bae, Professor

Dept. of Civil & Environmental Engineering, Sejong Univ., Seoul, Korea

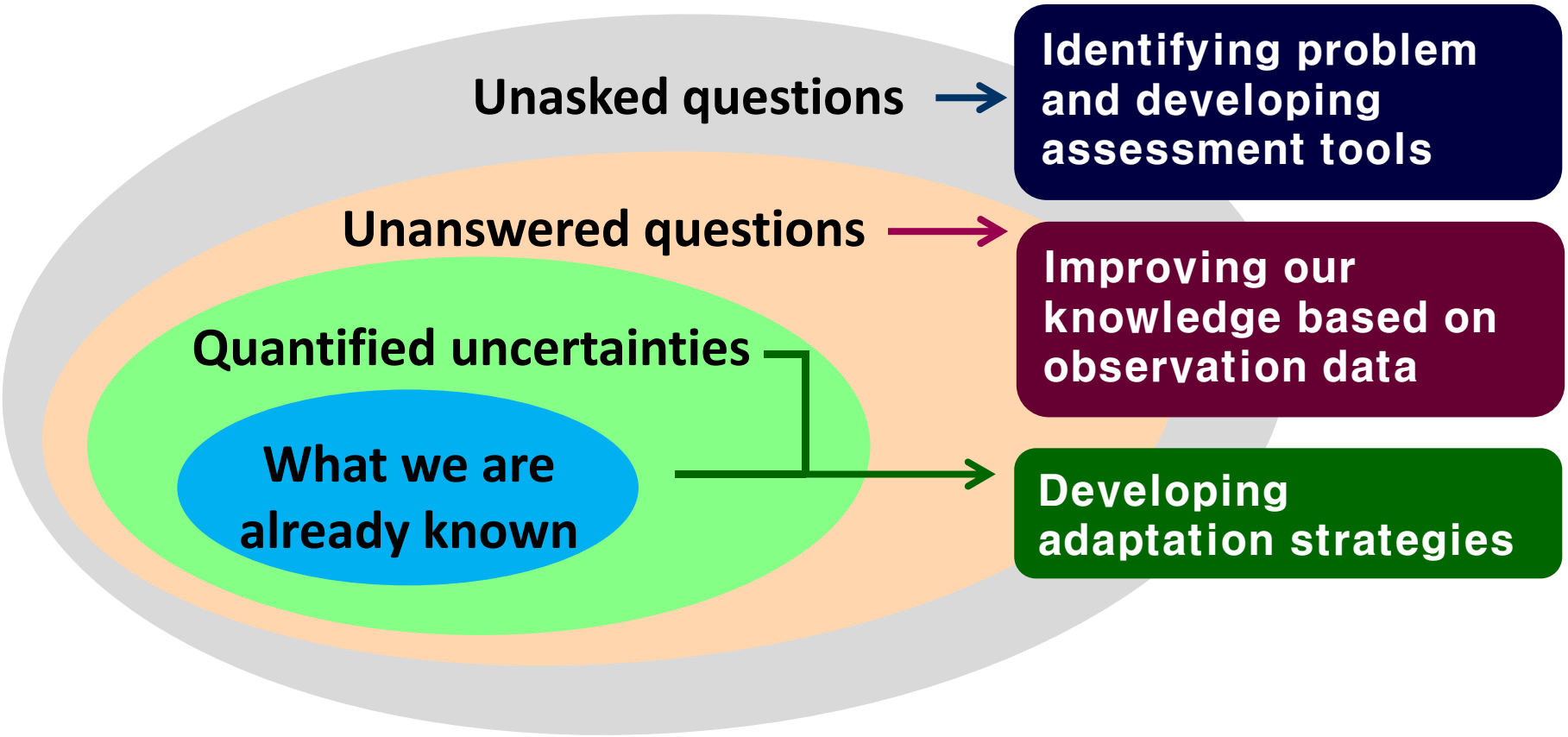
General process of climate change impact study on water resources



How to get usable knowledge on water resources ?

Source : based on Bae et al. (2008), Climate Research

Our possible futures on climate and water



1. What we are already known in Korea

Changes in annual precipitation & streamflow

SRES A2 emission scenario

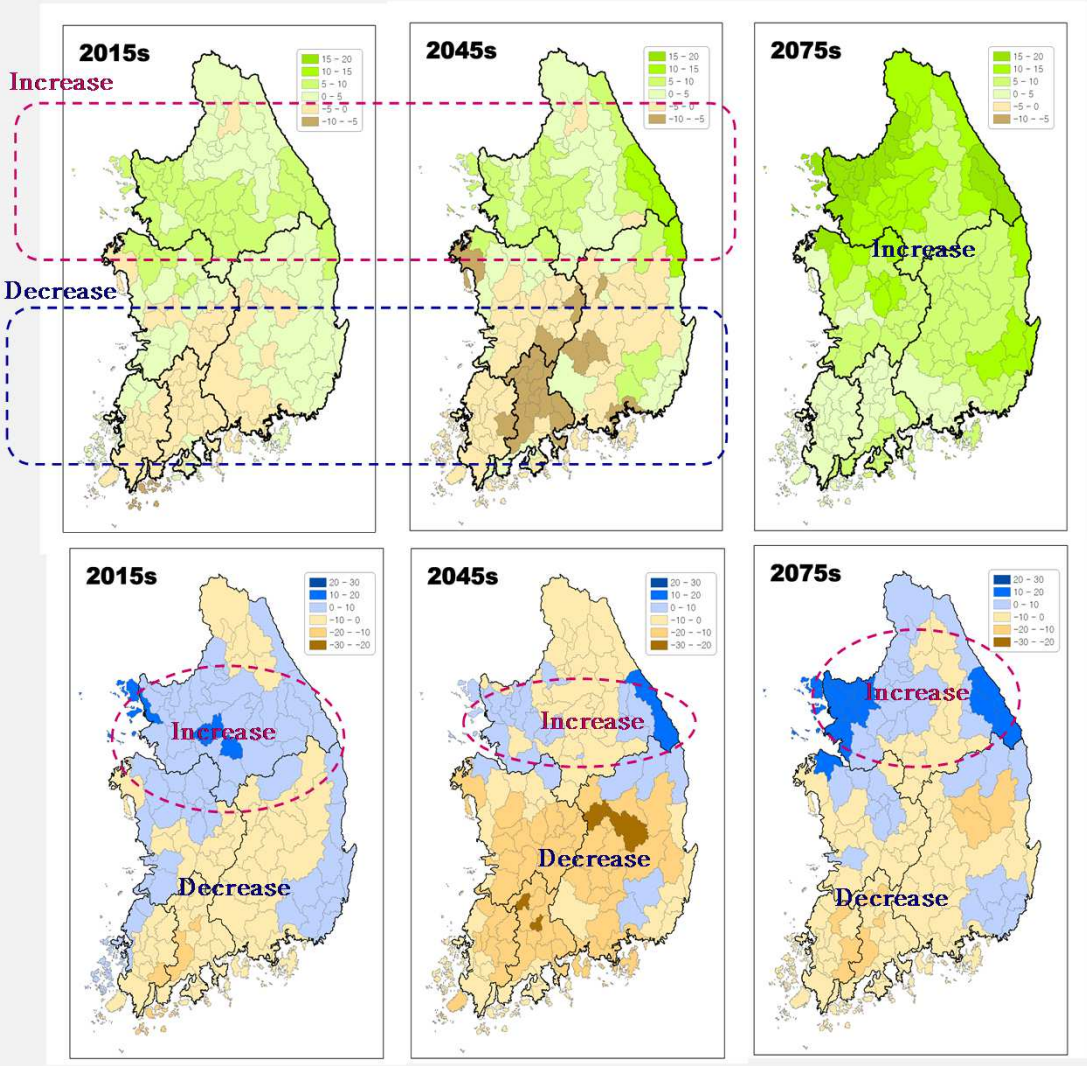
Climate projection (ECHO-G)

Dynamical downscaling (MM5)

Statistical downscaling (LARS-weather generator)

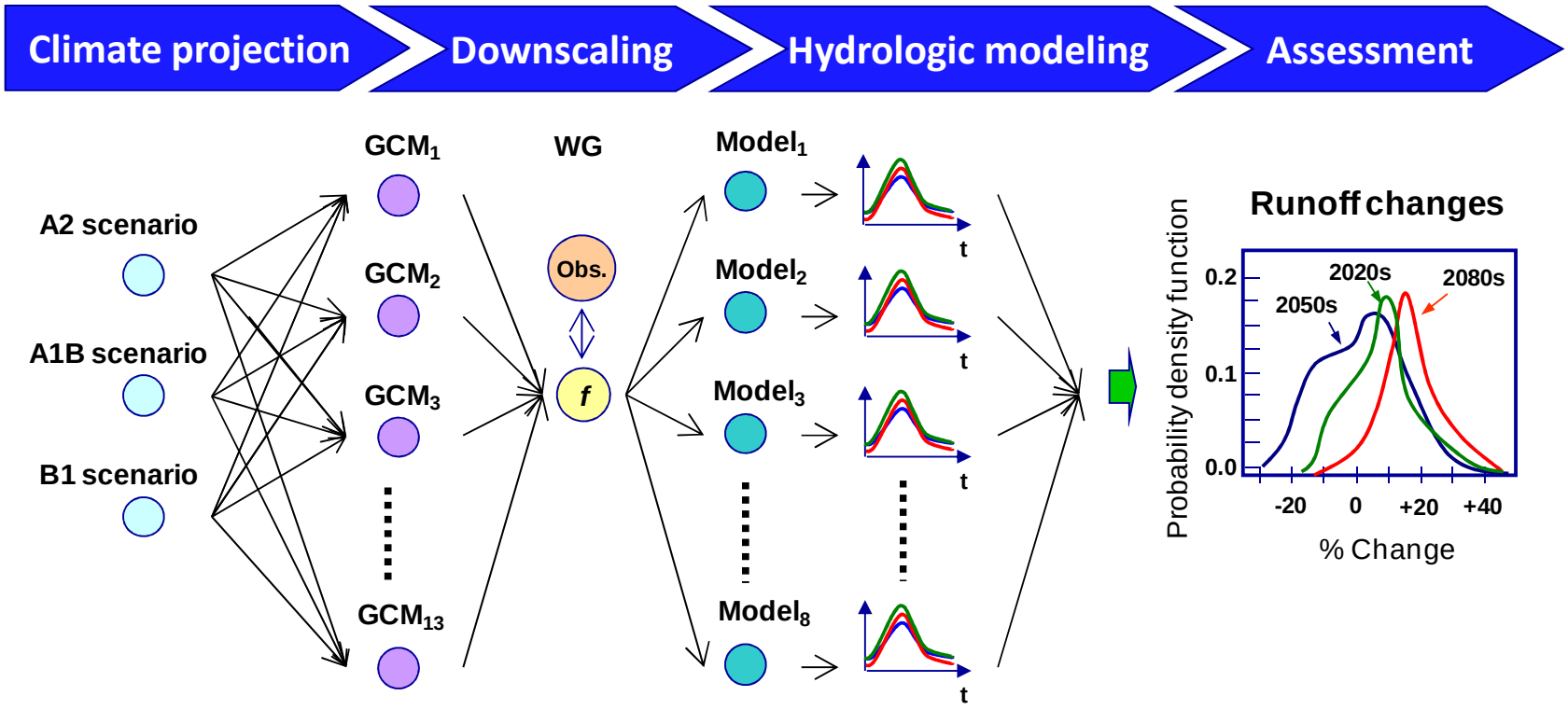
Generation of runoff scenarios (PRMS)

Impact assessment on water resources



Source : Bae et al. (2008), Climate Research

MME-based impact assessment

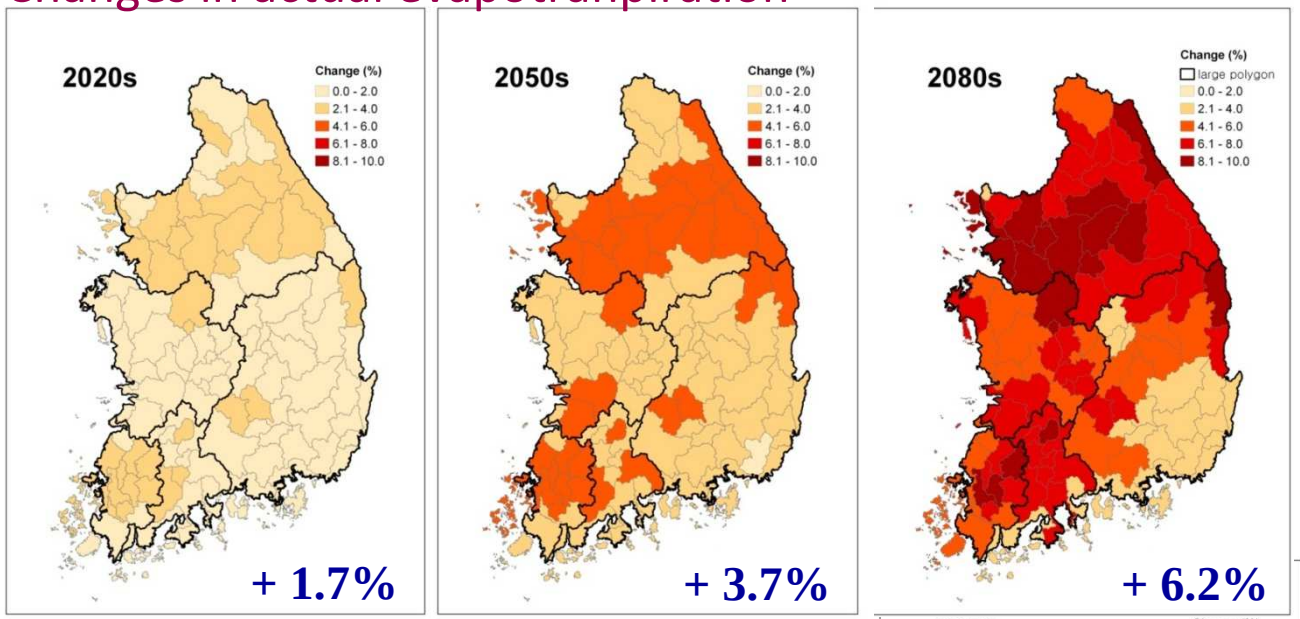


3 SRES emission scenarios × 13 GCM simulations × 7 hydrological models = 312 ensemble runoff scenario

Source : Bae et al. (2011), Journal of Hydrology

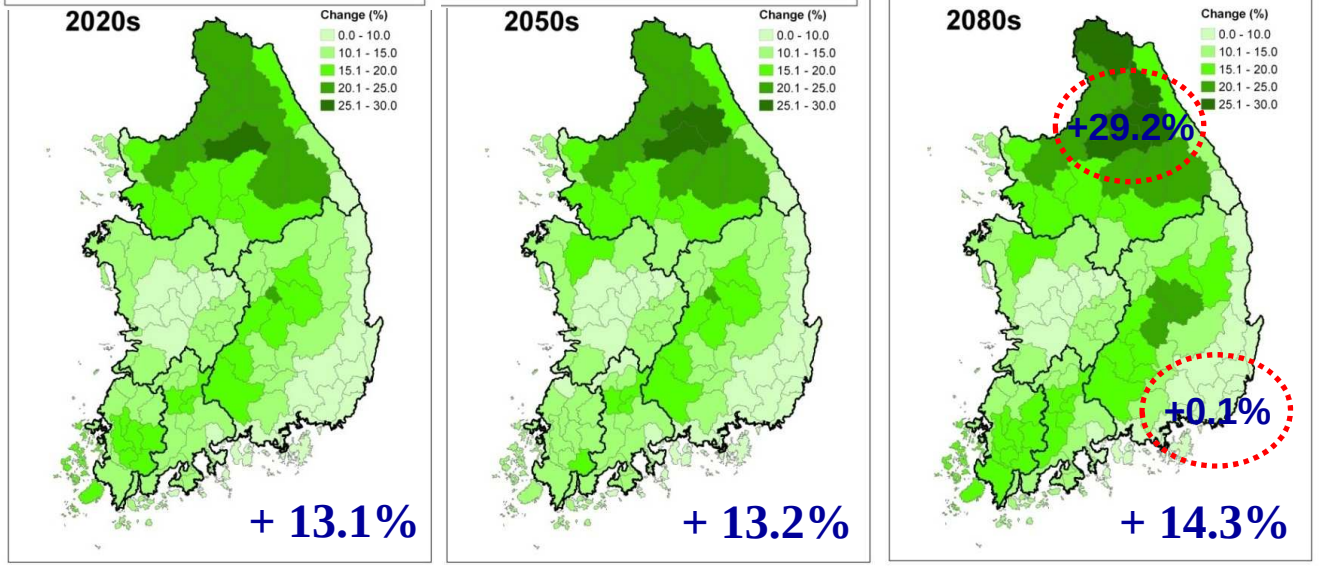
Change in annual water balances

Changes in actual evapotranpiration



Changes in streamflow

Ensemble mean of 312 scenarios



Source: Bae et al., (2011), Korean Water Resources Association

Representative Concentration Pathway (RCP) scenarios

RCP 4.5 & RCP 8.5

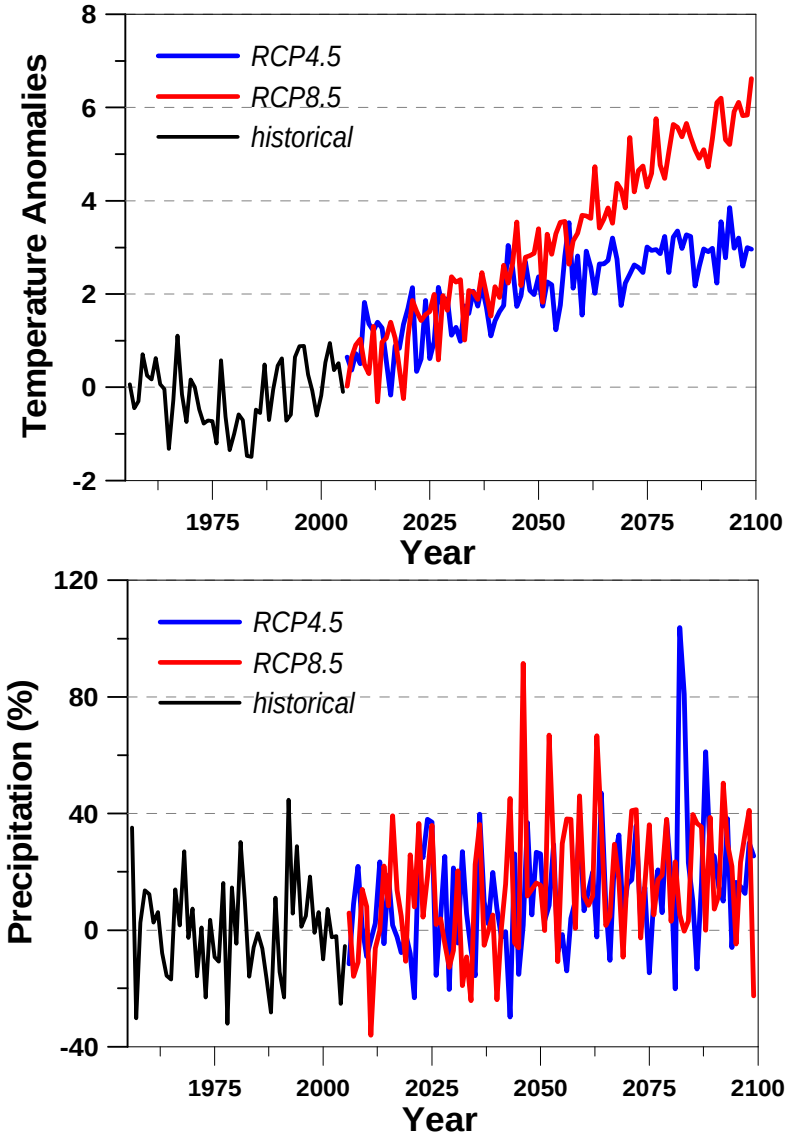
Climate projection (HadGEM2-AO)

Dynamical downscaling (HadGEM3-RA)

Statistical downscaling (Bias correction)

Hydrologic modeling (PRMS, SWAT, and SLURP)

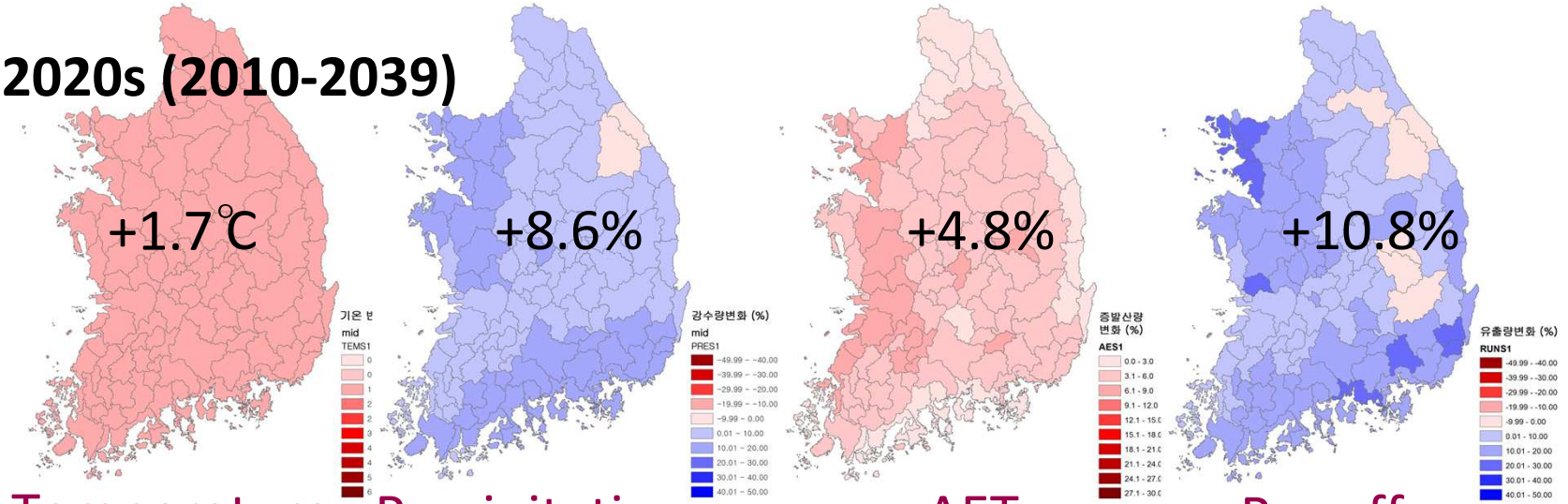
Impact assessment on water resources



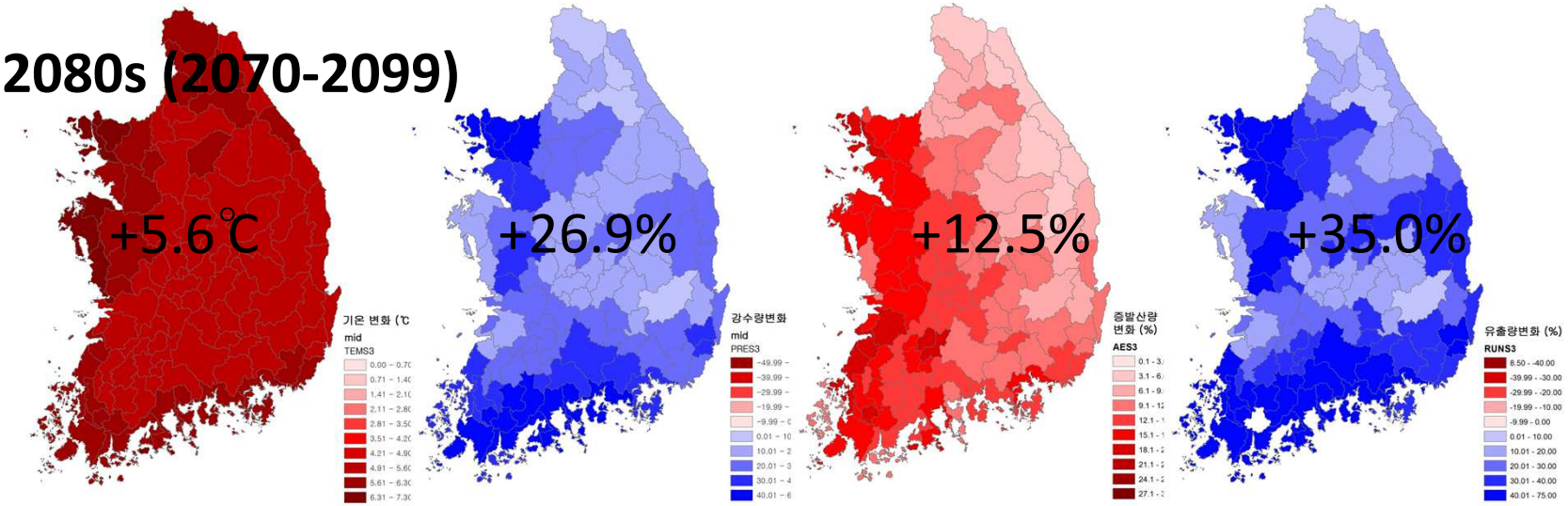
Source: NIMR (2011)

Annual change under RCP8.5

2020s (2010-2039)

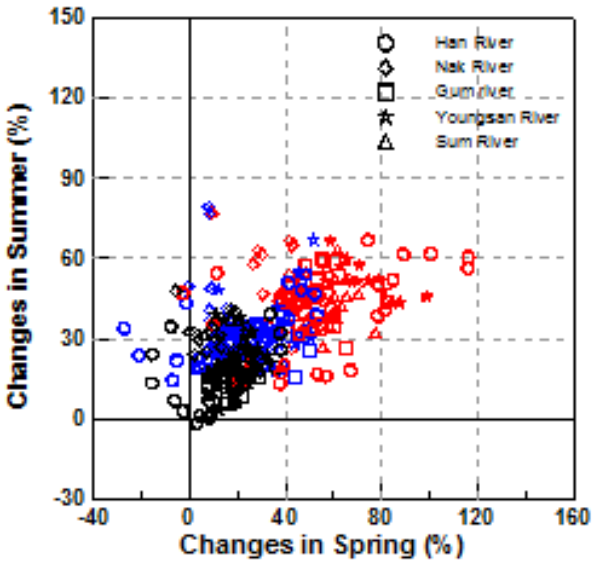


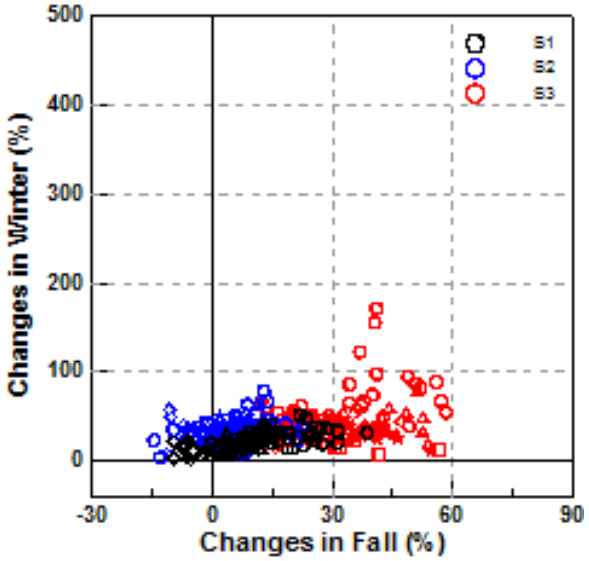
2080s (2070-2099)



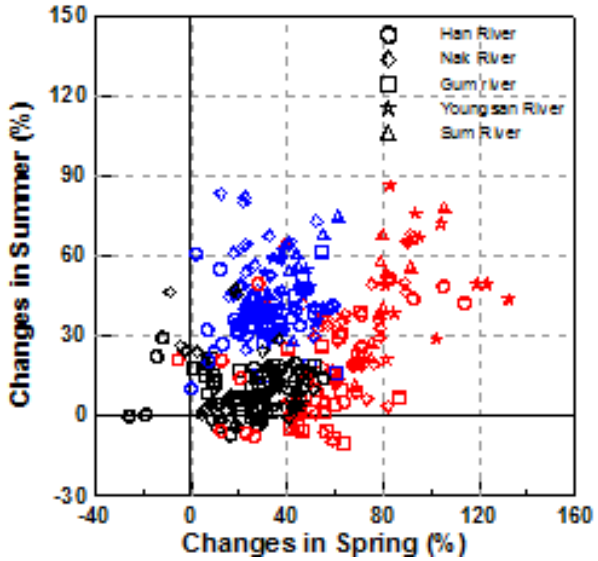
Seasonal runoff changes

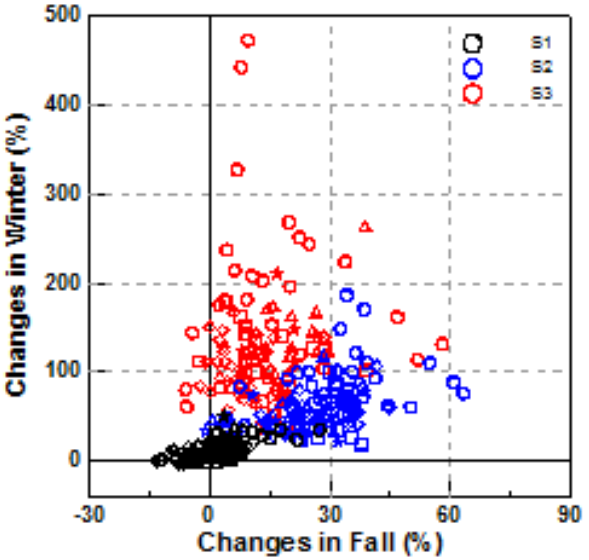
RCP 4.5





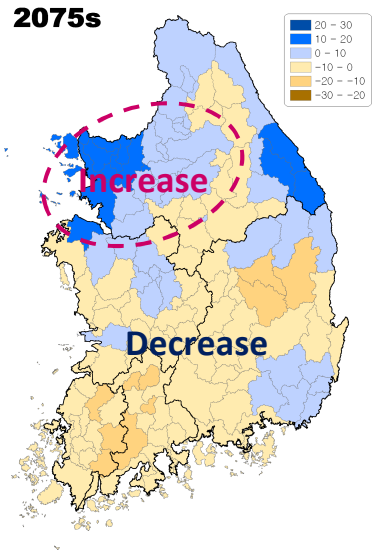
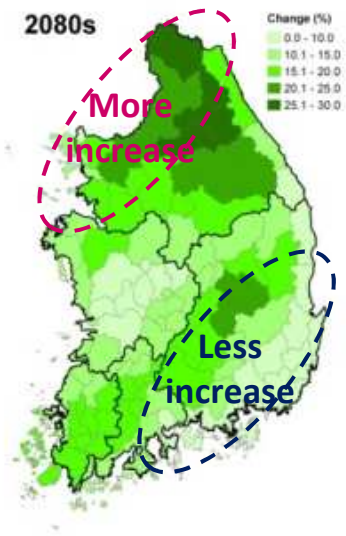
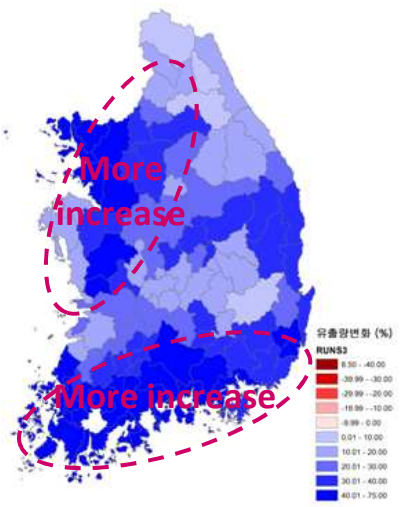
RCP 8.5



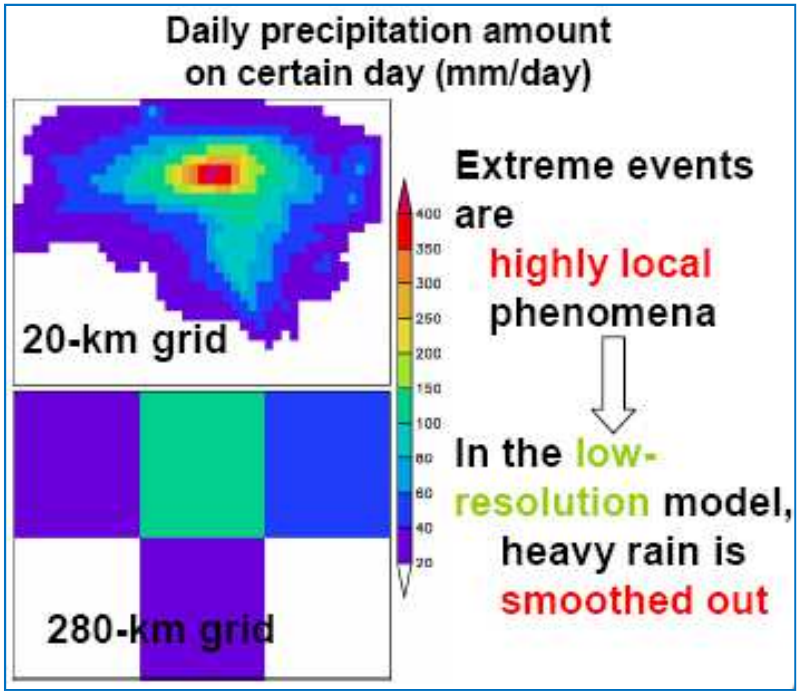


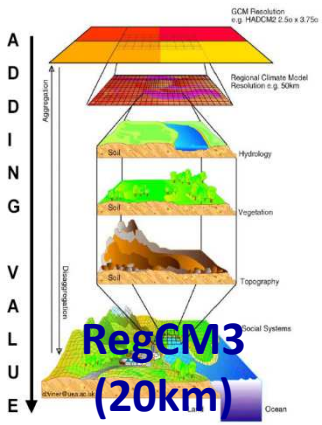
2. Unclear issues and unanswered questions

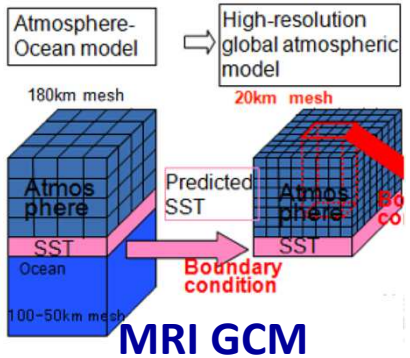
SRES vs. RCPs emission scenario

		AR4 (Single)	AR4 (Ensemble)	AR5 (RCP8.5)
Spatial difference				
Temporal difference	Spring	decrease ↓	decrease ↓	increase ↑
	Summer	increase ↑	increase ↑	increase ↑

Improvement of spatial resolution of climate projection



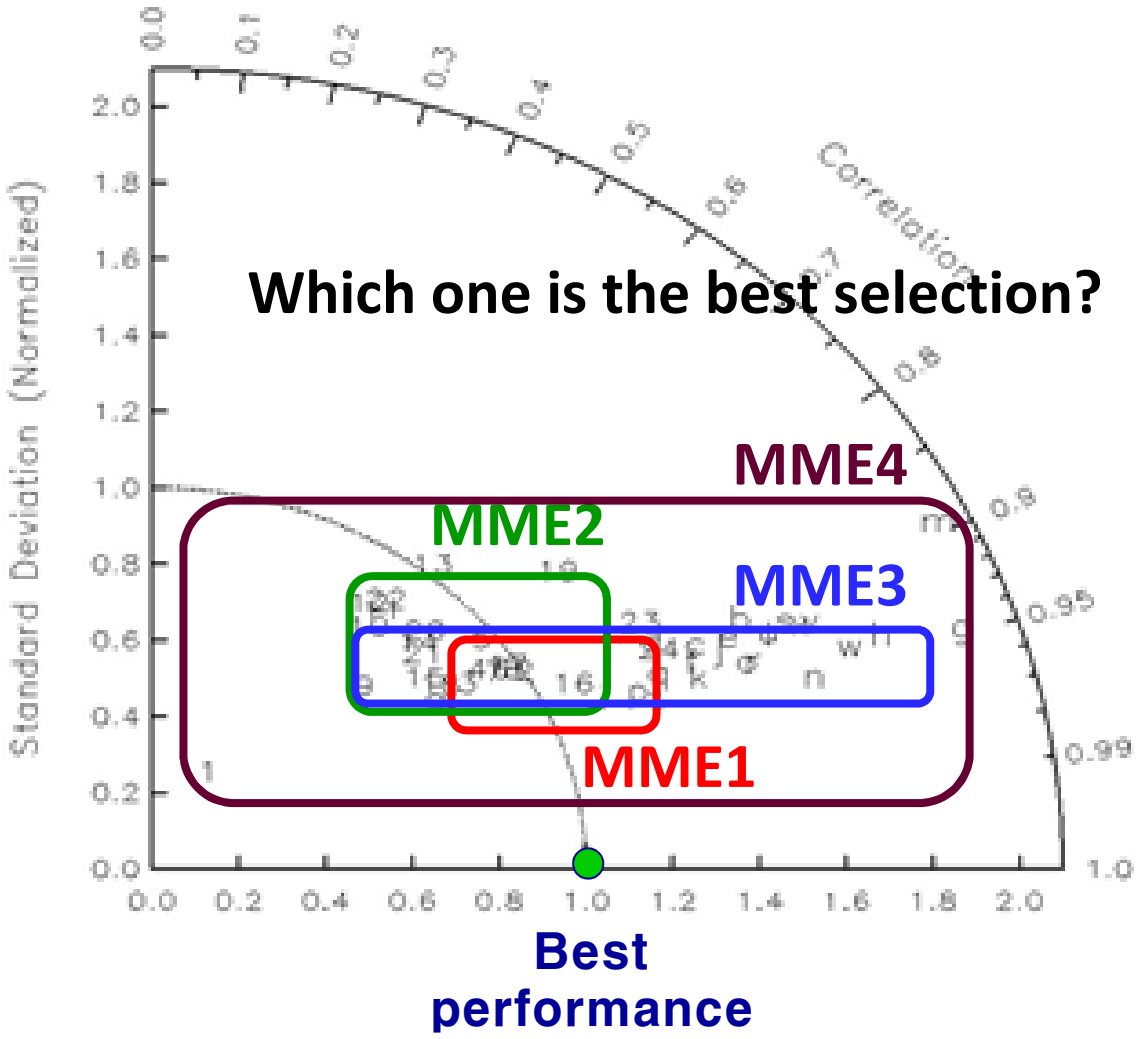




Index	RegCM3	GCM20	Obs.
PANU(mm)	763.5	1079	1388
PN80(days)	0.63	1.29	2.96
PN50(days)	2.04	3.71	6.83
PN10(days)	18.83	27.88	33.08
PN01(days)	91.71	90.21	79.04
PX1D(mm)	75.67	103.7	164.8
PX2D(mm)	101.4	137.6	207.9
PX3D(mm)	169.5	230.3	364.7

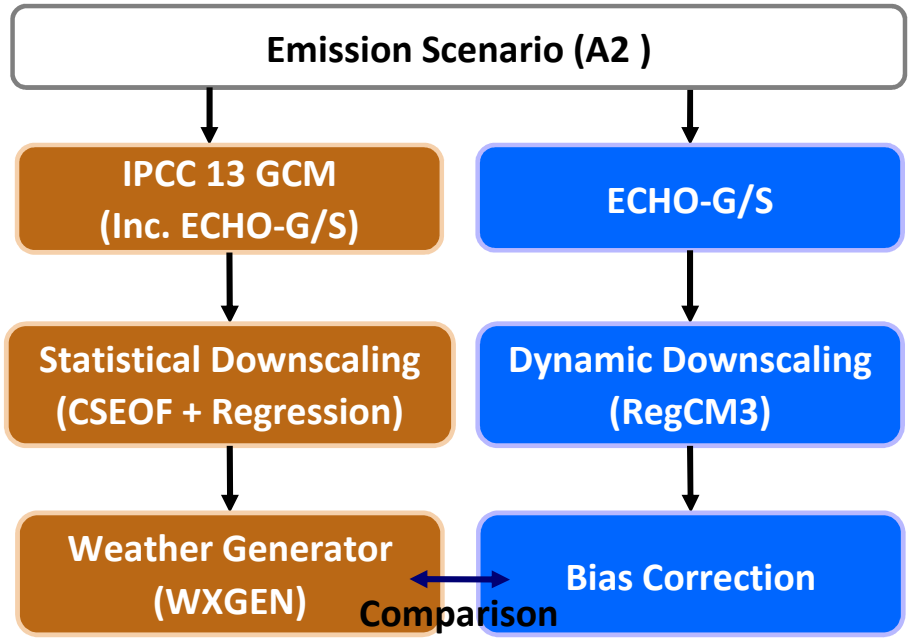
- PANU : Average of annual precipitation
- PN80 : The annual mean number of days in which 1-day precipitation is greater than 80 mm
- PX1D : Average of Annual maximum 1-day precipitation

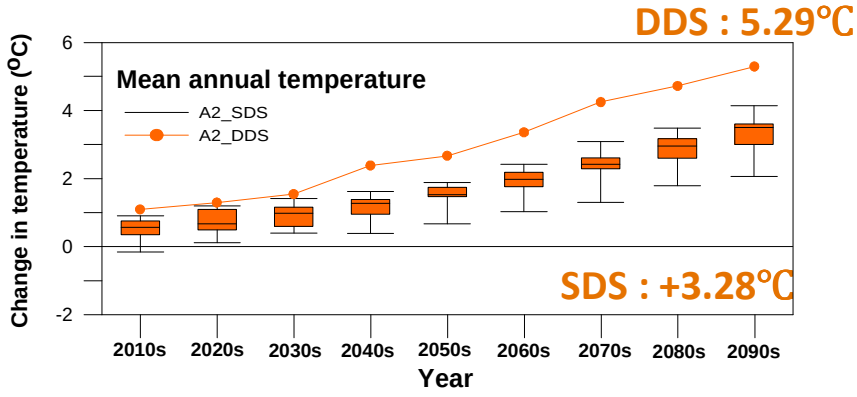
What is the optimal selection of GCM simulations for climate impact study?

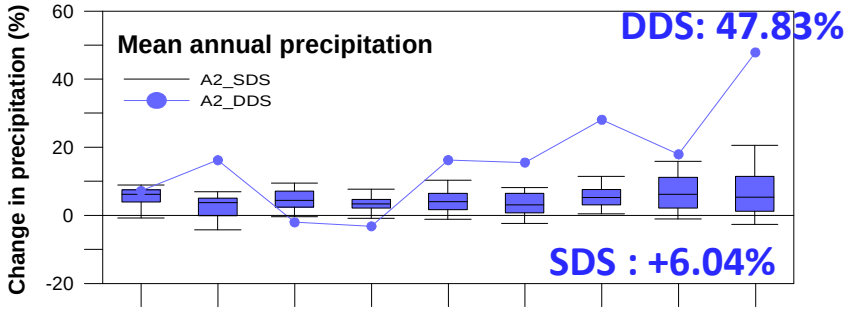


No.	ID	Abb.	No.	ID	Abb.
1	a	BCC	14	m	IPS
2	b	BCR	15	n	MET
3	c	CCM	16	p	MIH
4	d	CCH	17	q	MIM
5	e	CNR	18	r	MIU
6	f	CSR	19	s	MPI
7	g	GF0	20	t	MRI
8	h	GF1	21	u	NCC
9	i	GAO	22	v	NCP
10	j	GIH	23	w	UKC
11	k	GIR	24	x	UKG
12	l	IAP	25		MME24
13	m	INM	26		MME9

Uncertainty attributed from downscaling methods







Period	Index	PX1D	PN80	PN01	MDRY	DRYM	PANU
Dynamic	S1(2010-2039)	10.9 %	39.2 %	2.0 %	-1.8 %	2.9 %	8.2 %
	S2(2070-2099)	35.4 %	132.9 %	7.4 %	-4.5 %	0.8 %	34.1 %
Statistical	S1(2010-2039)	10.2 %	20.8 %	-1.0 %	0.0 %	0.4 %	5.7 %
	S2(2070-2099)	13.4 %	24.8 %	0.1 %	0.0 %	-0.2 %	11.0 %

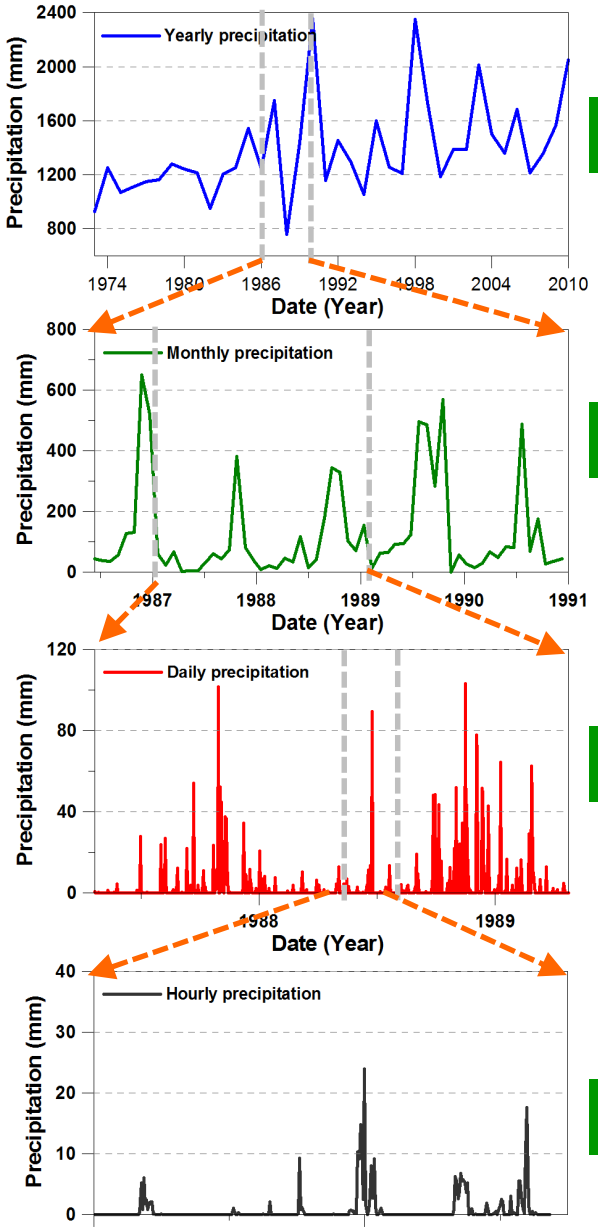
Temporal disaggregation of GCM simulations

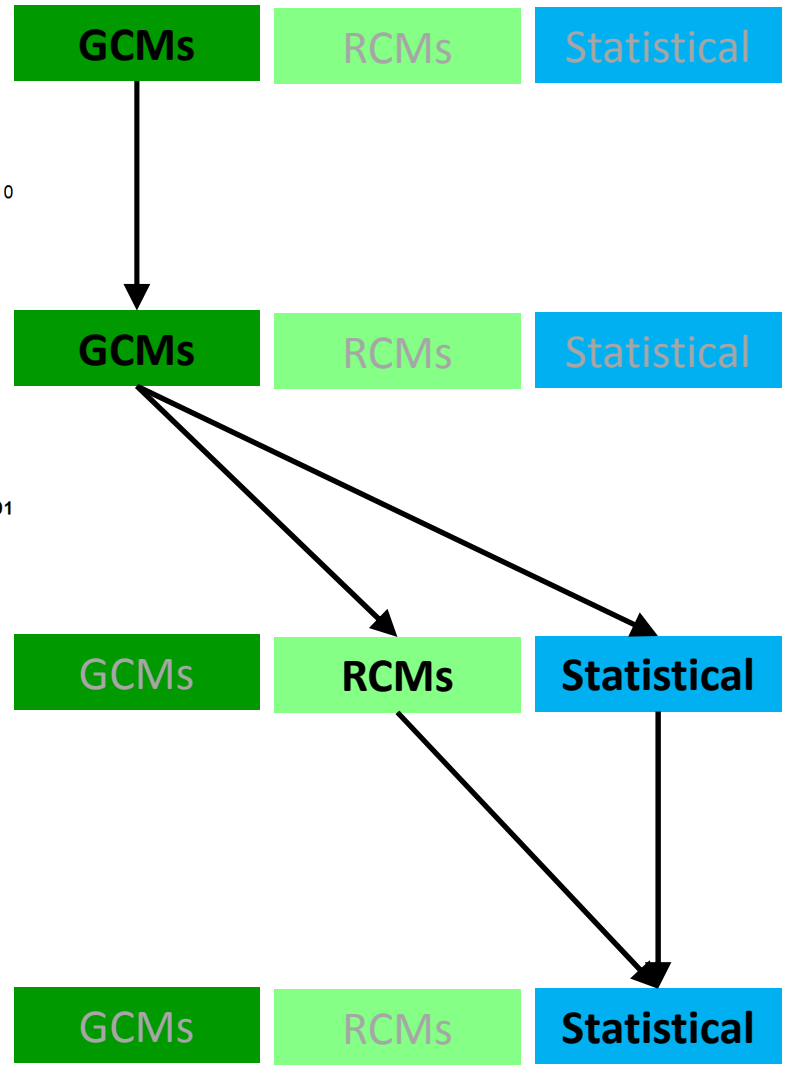
Annual scale

Monthly scale

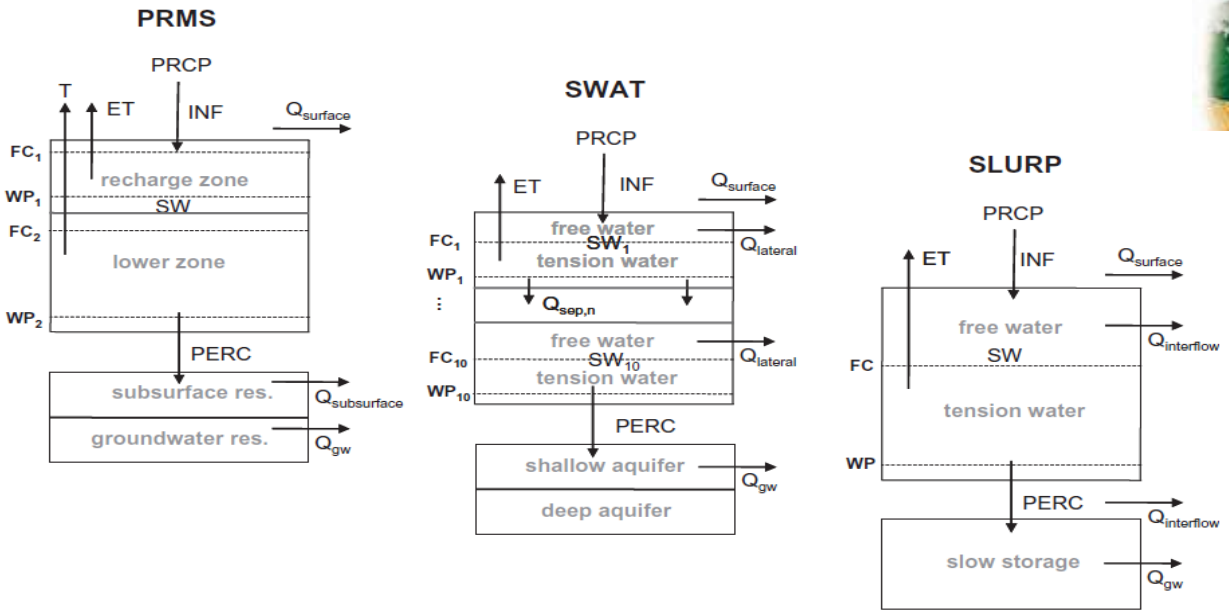
Daily scale

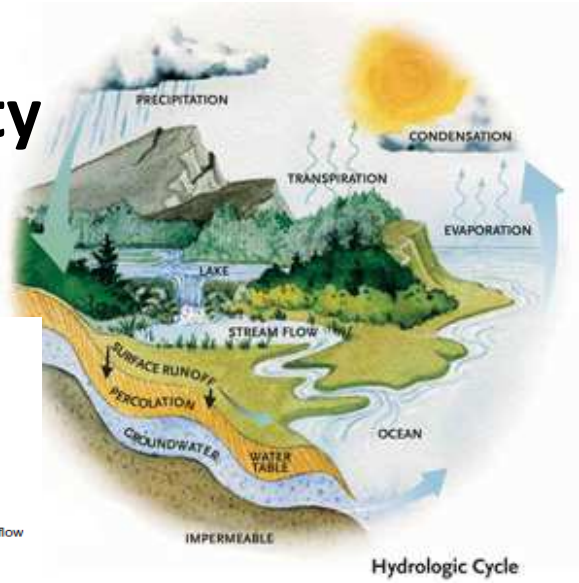
Hourly scale



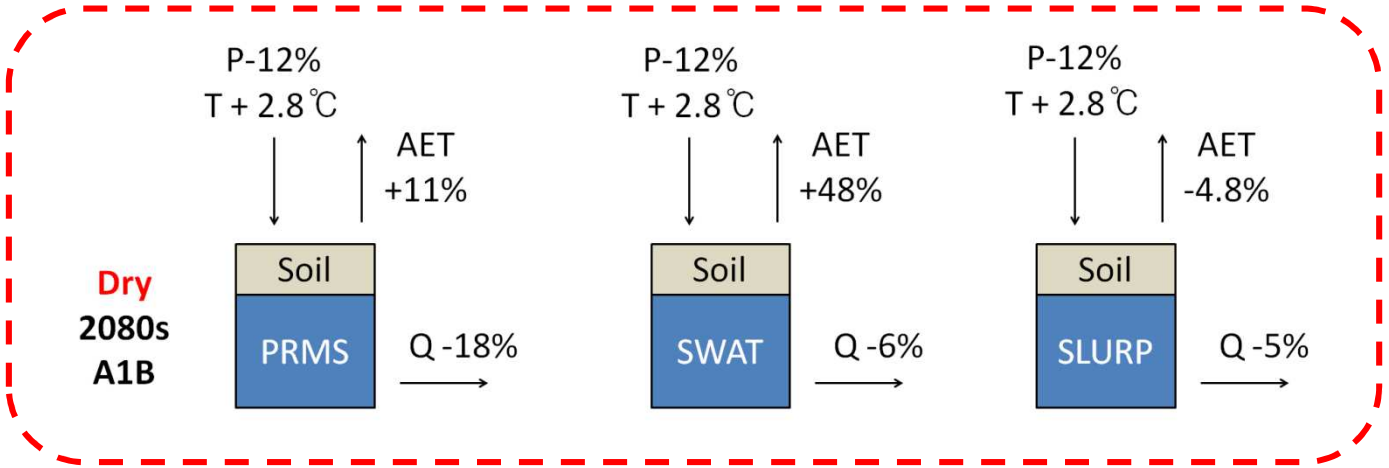


Hydrologic model selection uncertainty





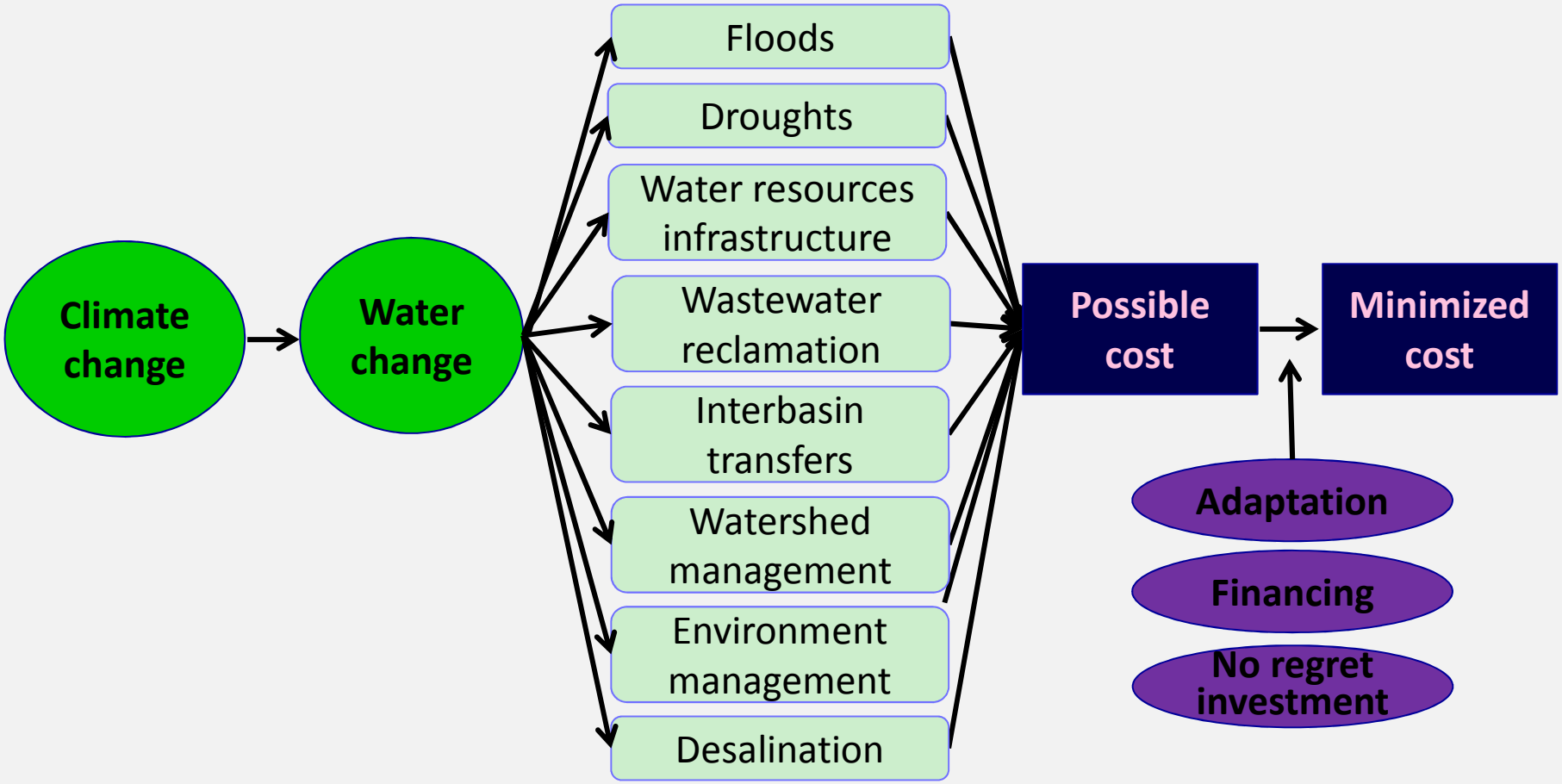
Hydrologic Cycle



Source : Bae et al. (2011), Journal of Hydrology

3. Are there any unasked issues ?

- **Socioeconomic impacts of climate change on Korean water resources**



Long-term natural climate variability

Chukwooki is the world's first rainfall gauge developed in 1442


Thank you for your attention!