Building Science Basis (Part I): Hydrological projections over the 3H region of China using climate change scenarios

Dan Li, Ji Jinjun, Xie Zhenghui , Chen Feng, Yuan Xing
Institute of Atmospheric Physics, Chinese Academy of Sciences

Wen Gang
China CDM Fund Management Center, Ministry of Finanace

Jeffrey E. RICHEY
University of Washington

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Part I: Brief introduction to design and implementation of the assessment

Part II: Hydrological assessment based on current resources and climate change scenarios

Part III: Relationship between the hydrological assessment and proposed adaptation measures

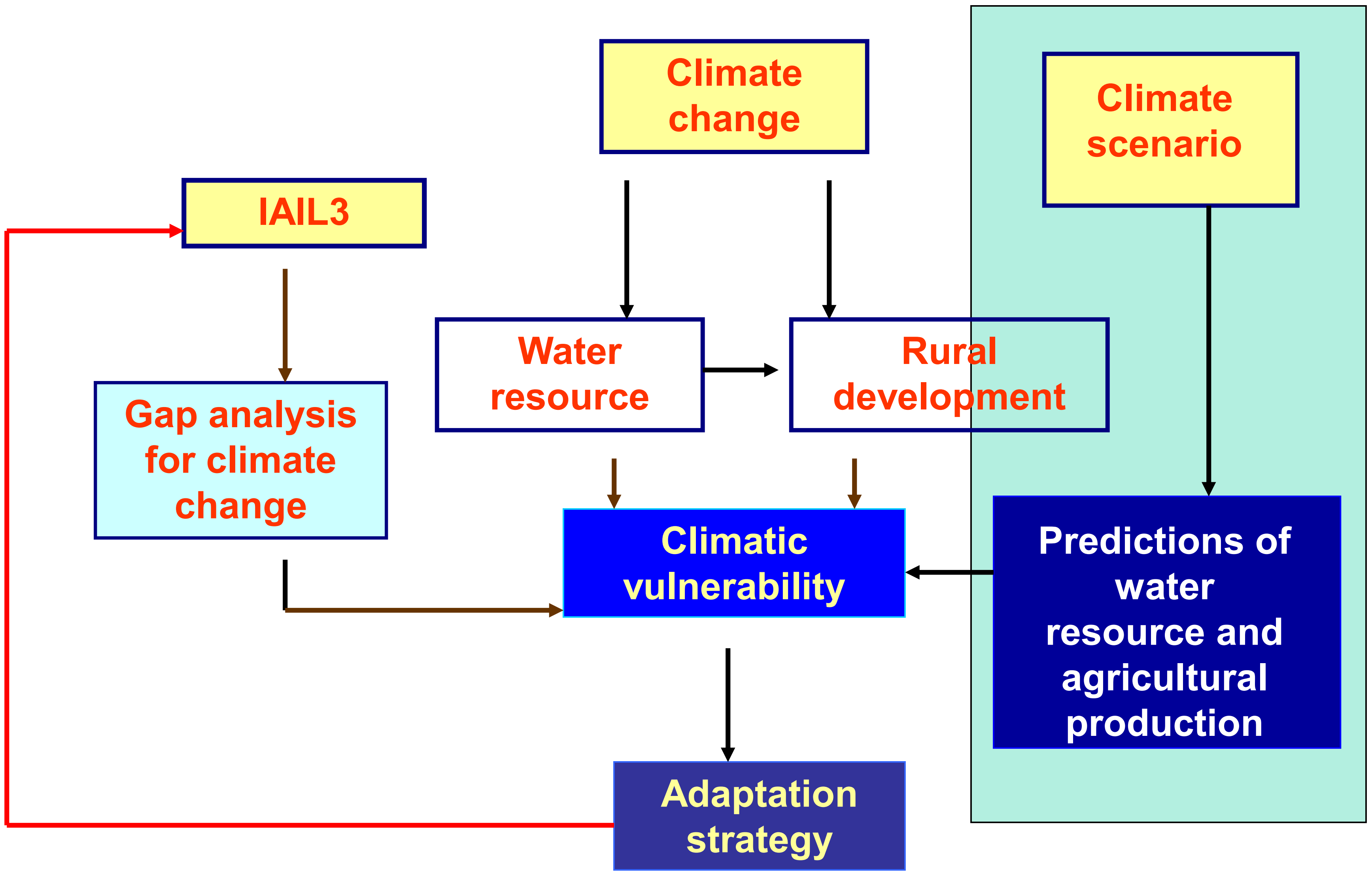
Part I: Brief introduction to design and implementation of the assessment

The objectives of the scientific assessment for MACC project preparation

•To provide basic scientific basis for the design and implementation of the MACC project, especially the reasonable and effective utilization of water resources in the 3H region.

•Based on the above activities, to provide scientific understanding support to supplement and strengthen measures and actions related to adaptation in IAIL3.

Schematic outline of the assessment



Agriculture, including Agriculture Adaptation,…

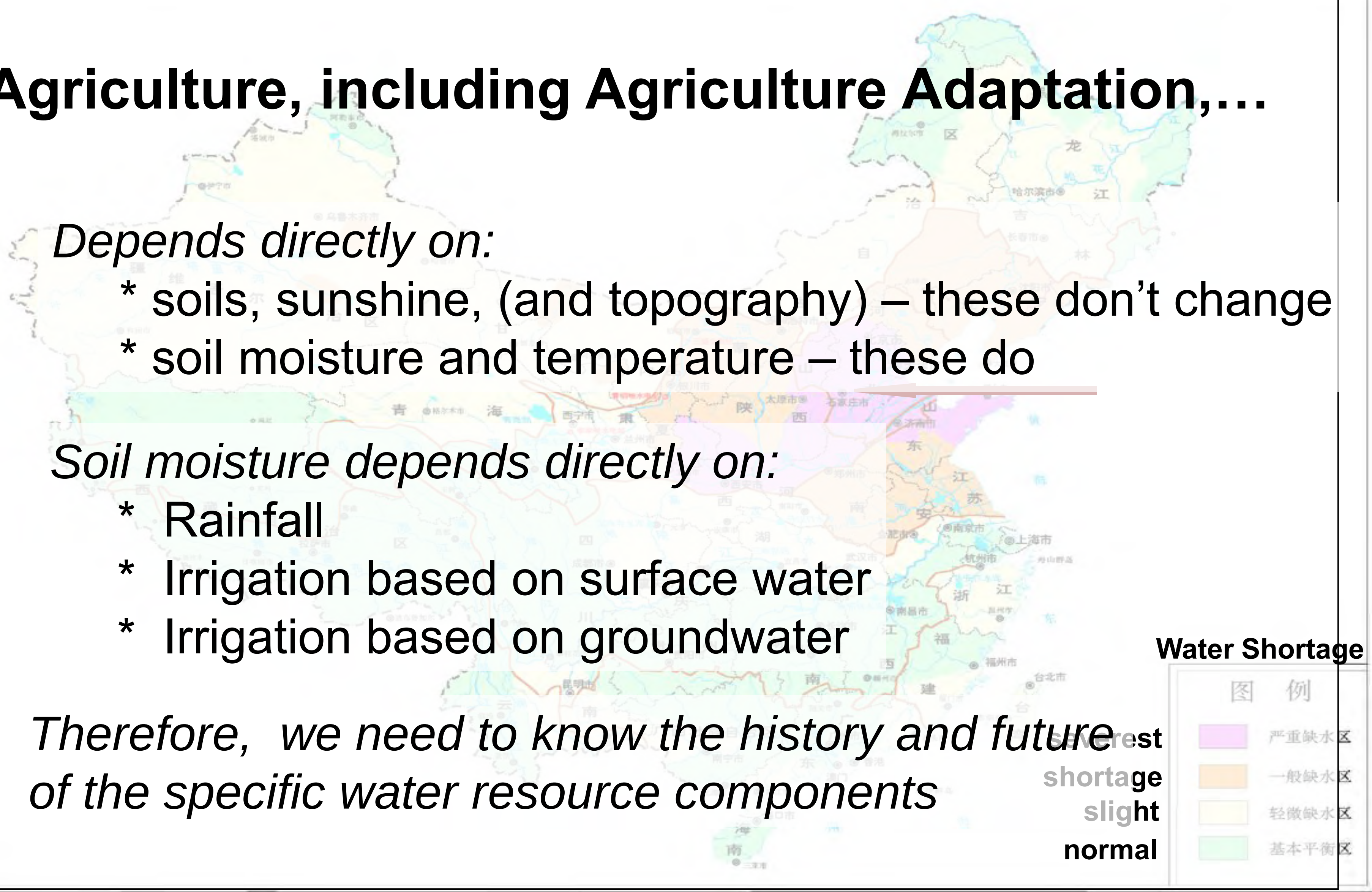
Depends directly on:

* soils, sunshine, (and topography) – these don't change
* soil moisture and temperature – these do

Soil moisture depends directly on:

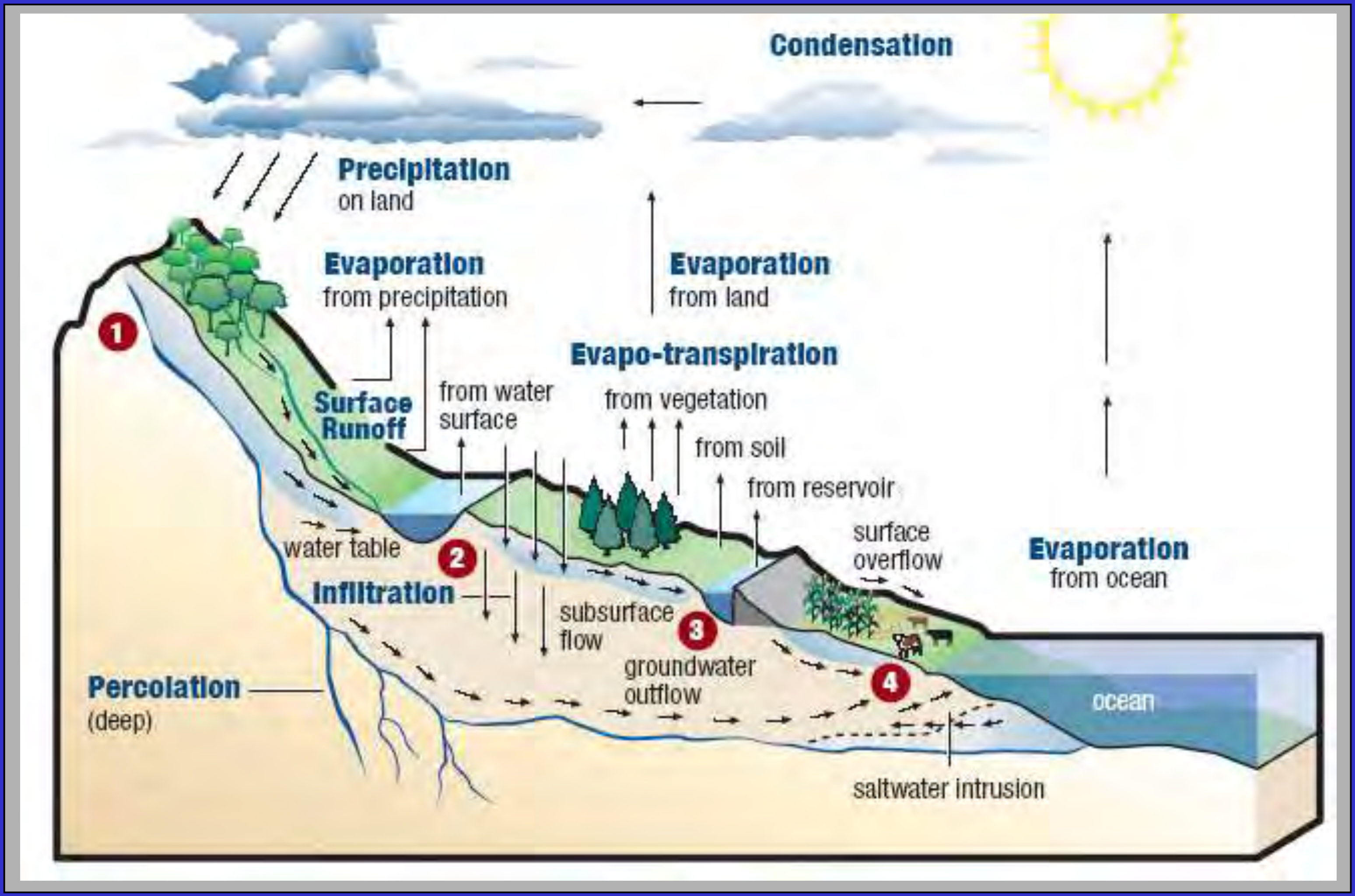
* Rainfall
* Irrigation based on surface water
* Irrigation based on groundwater

Therefore, we need to know the history and future of the specific water resource components

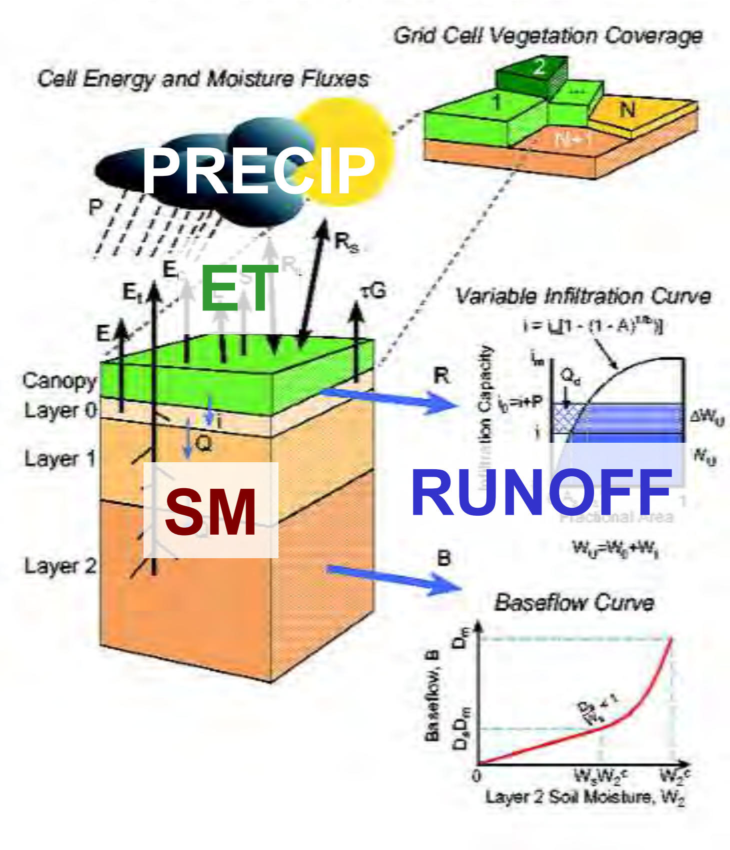


The Hydrologic Cycle

P (precipitation) = ET (evapotranspiration) - R (runoff) + ΔSM (soil moisture)

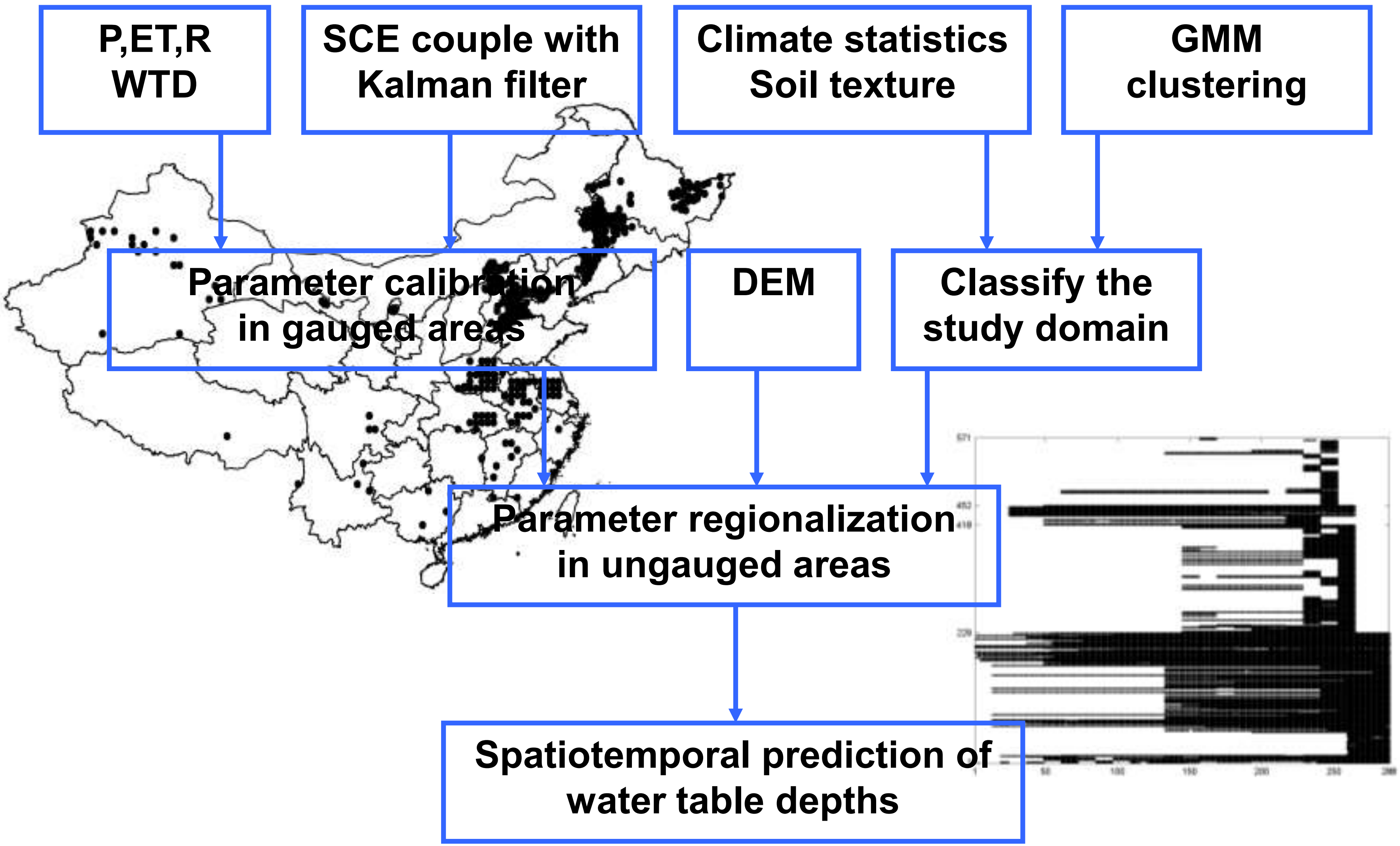


SURFACE WATER:
Variable Infiltration Capacity (VIC) Macroscale Hydrologic Model/ 10 km Resolution



- **Meteorological forcing data: 740- station observation of daily temperature and precipitation during 1980-2000,**
- **Vegetation data: Land cover classification of 1km (14 vegetation types) from University of Maryland's (UMD)/(LDAS)**
- **Soil data: Soil texture and derived parameters derived from the 5' FAO (1998) for 12 soil texture types.**
- **Hydrological data: 14 basins for calibration, 19 for verification (Xie et al.,2007).**

WATER TABLE DEPTH:
RTFN (Regionalized Transfer Function-Noise) Model

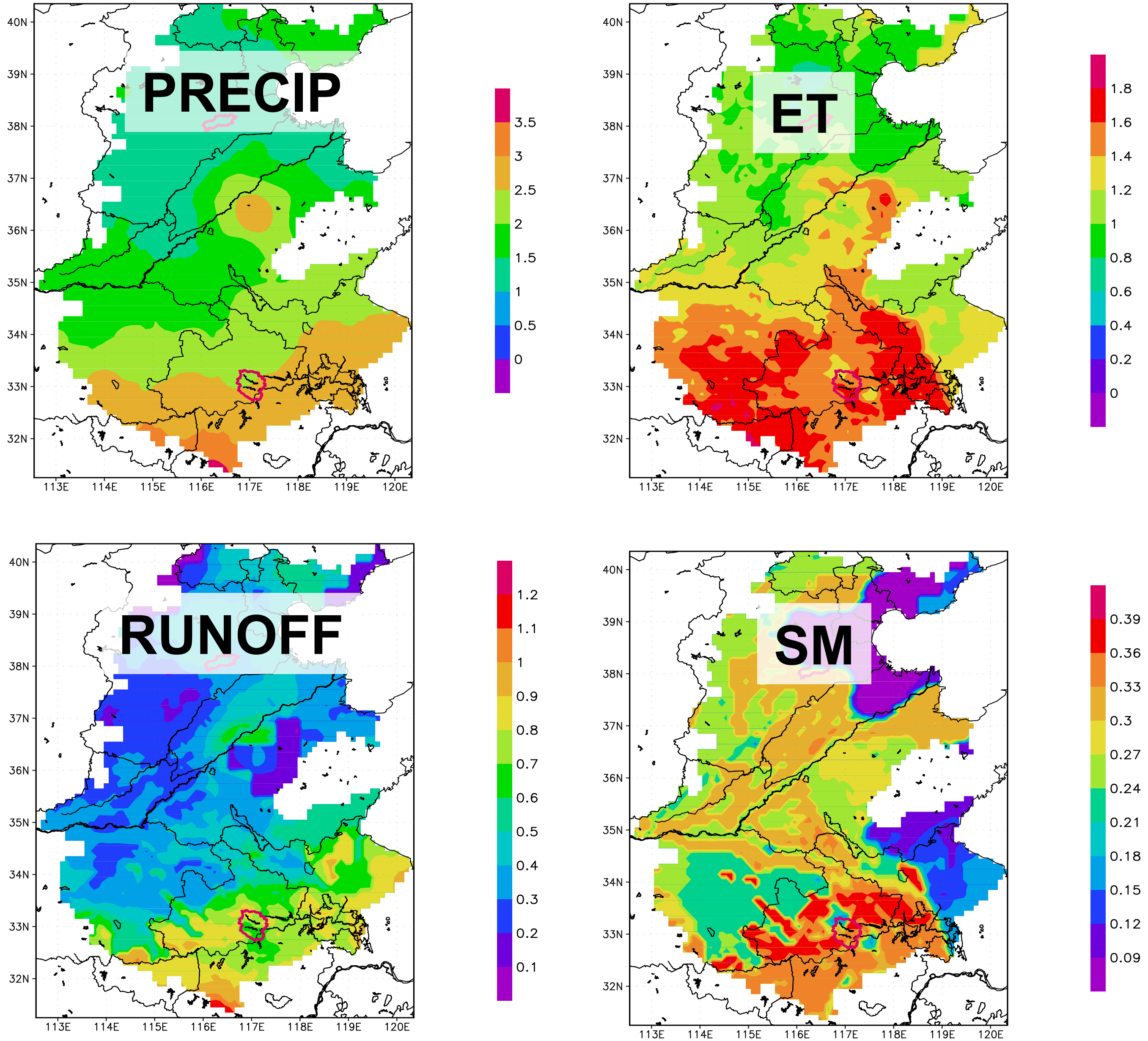


Part II: Hydrological assessment based on current resources and climate change scenarios

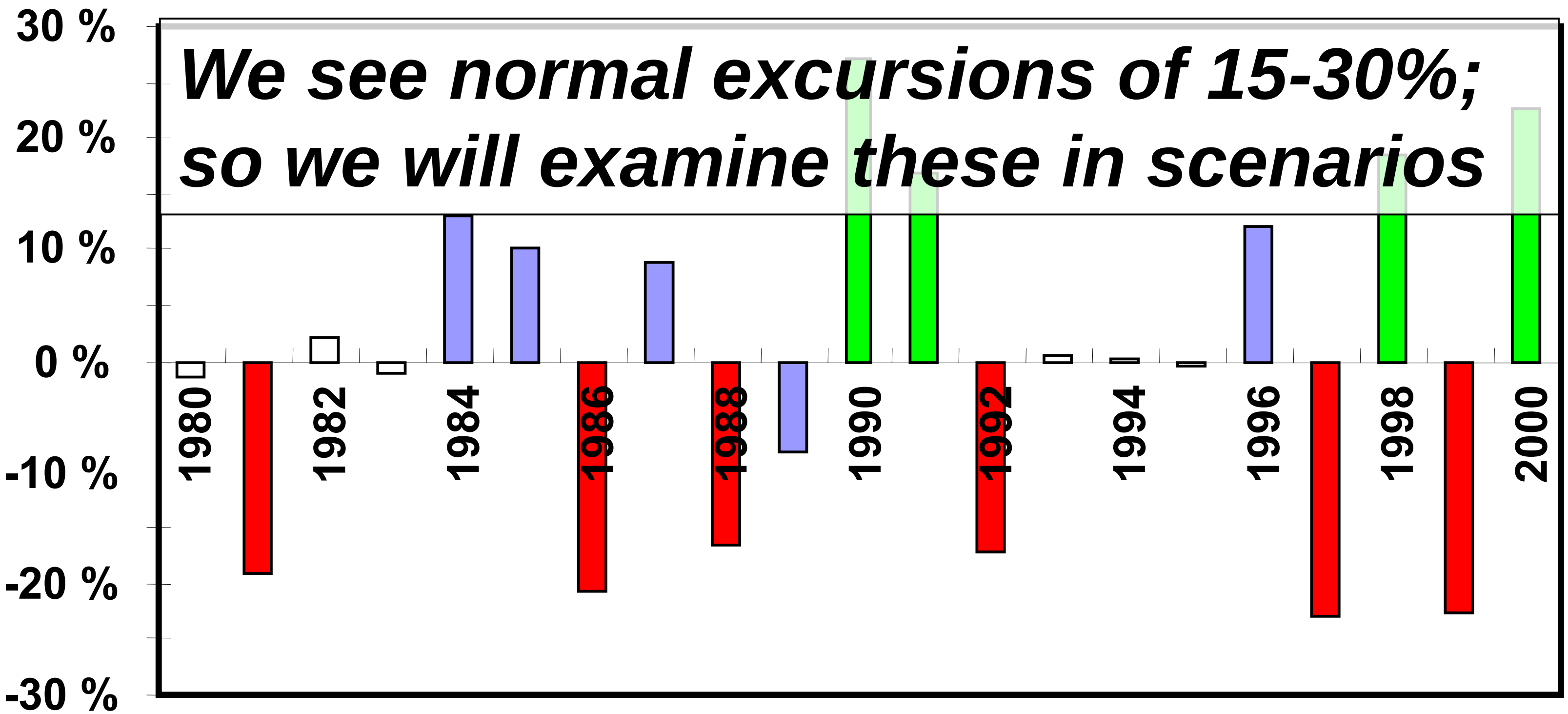
* Surface Water: P, ET, R, SM

* Water Table (~ ground water)

CURRENT CONDITIONS IN SURFACE WATER: 1980-2000



The observed precipitation anomaly percentage during the year of 1980-2000



The observed precipitation anomaly percentage relative to the value averaged in the year of 1980-2000: red bar means deficit water (≤−15%); green bar for overplus water(≥15%); and white bar for the normal year (within ±5%); blue bar for other conditions. Units: percentage. (All values are area-averaged precipitation over 3H of China.)

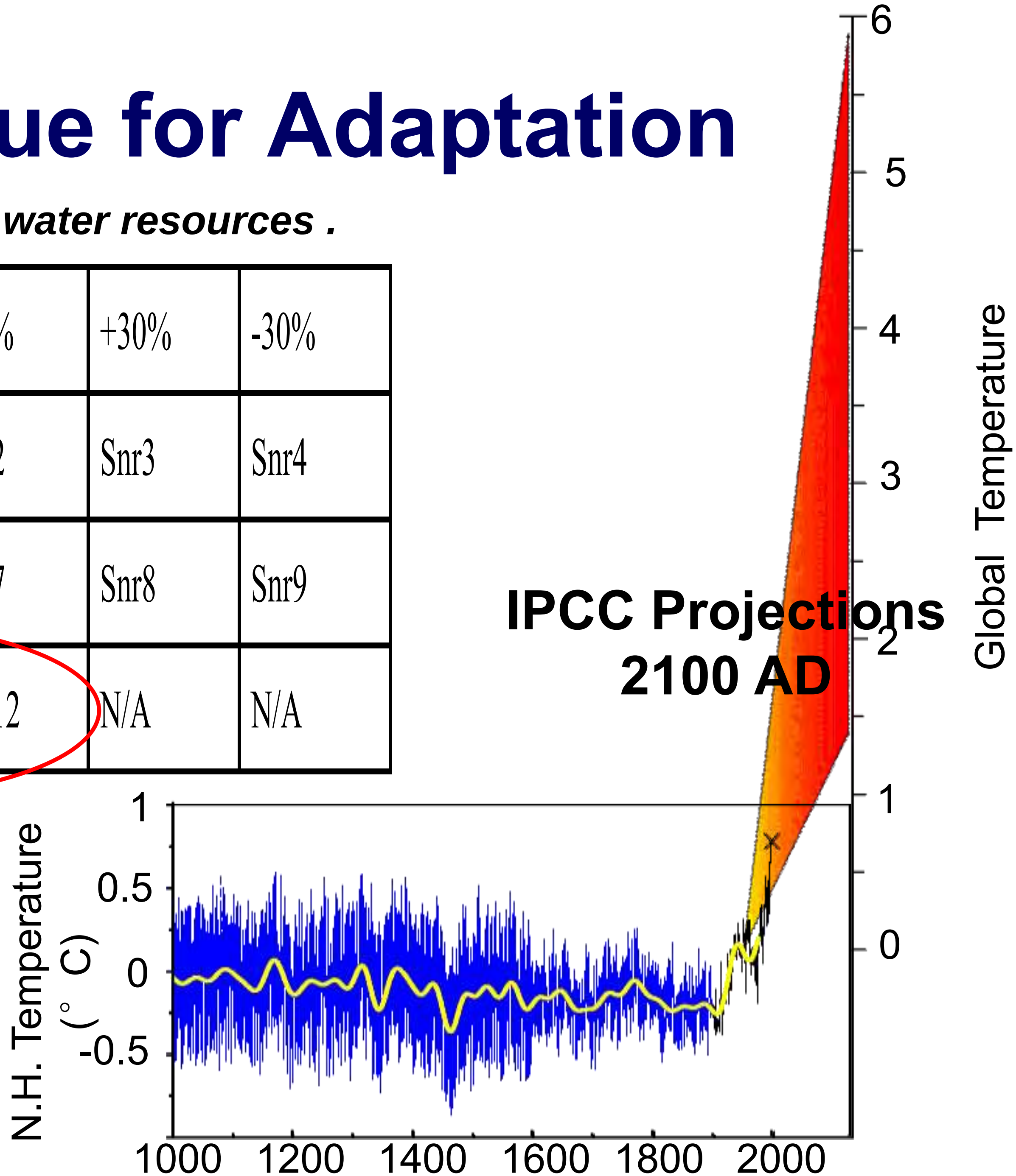
Hydrological Assessment Based on Climate Change Scenarios

What might the climate and water resources be in the future?

Key Issue for Adaptation

Scenarios (Snr) for surface water resources .

T \ p	Nomal	+15%	-15%	+30%	-30%
Nomral	Snr0	Snr1	Snr2	Snr3	Snr4
+5°C	Snr5	Snr6	Snr7	Snr8	Snr9
+2°C	Snr10	Snr11	Snr12	N/A	N/A



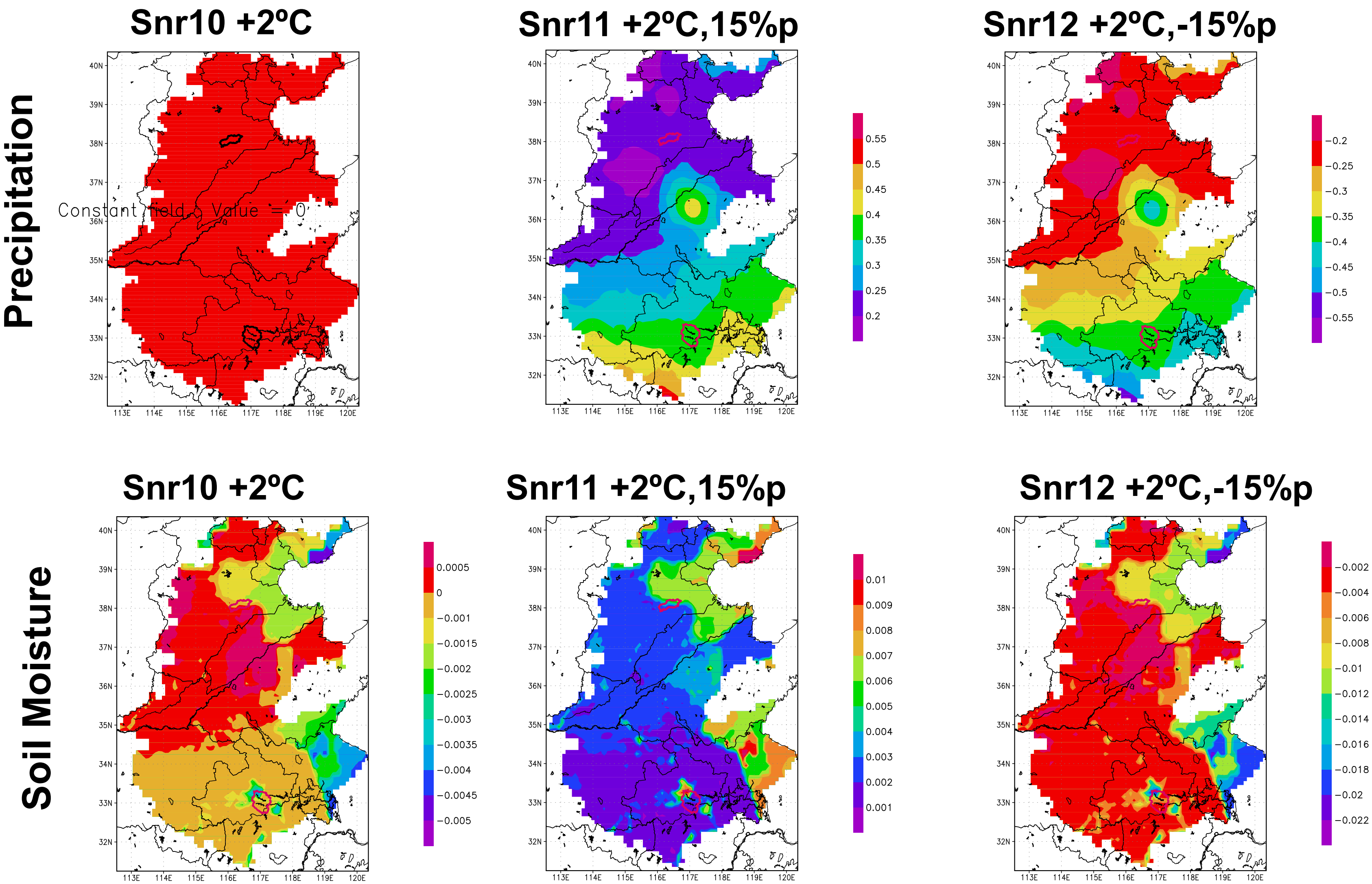
Temperature and rainfall variation in 3 H region as forecast by global models

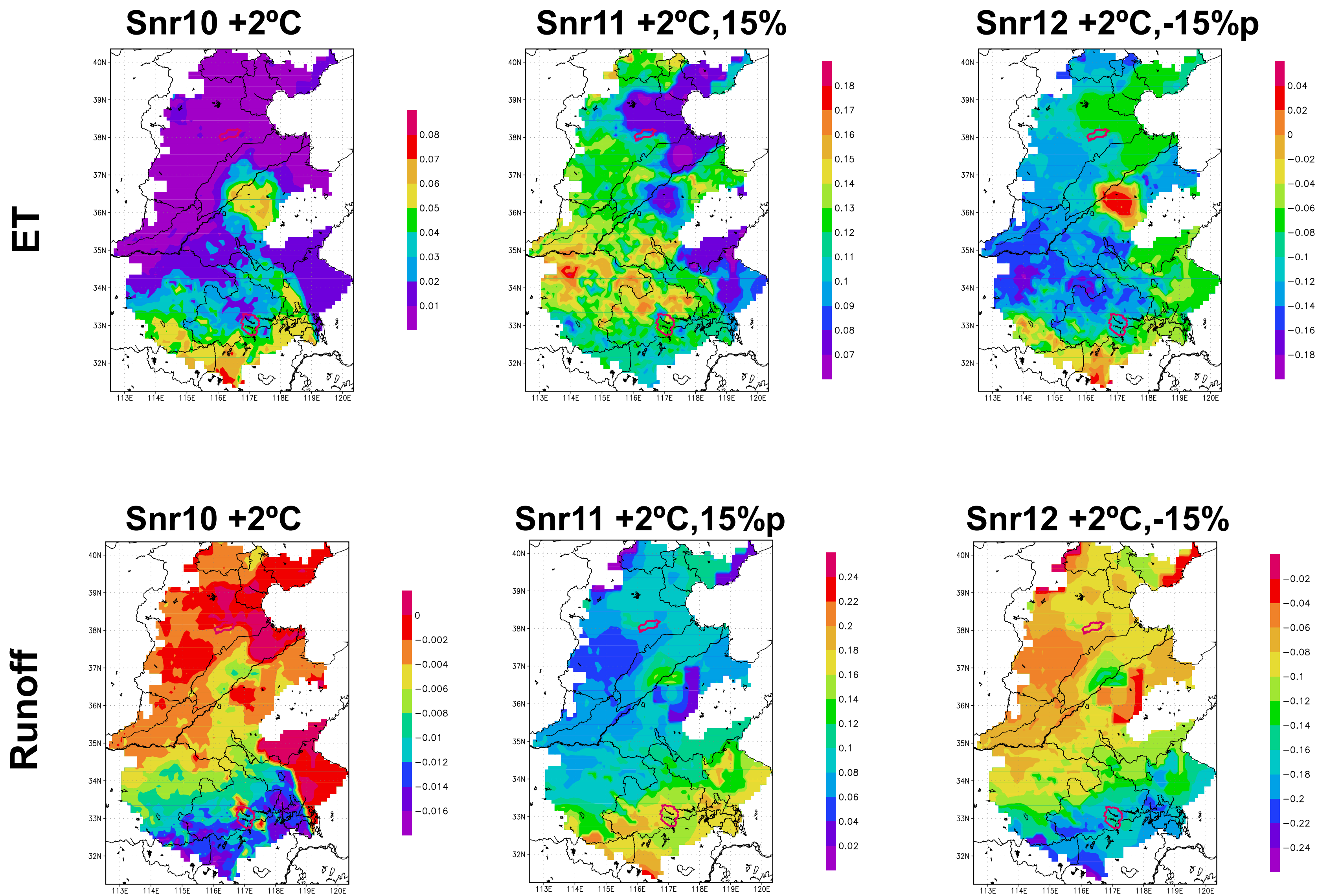
(based on IPCC A2 and B2 scenarios)

So how might the climate change:
Warming: ~ 2°C in 20 -30 years,, ~ 5°C in 100 years
Precip: ~ 0-5% in 20-30 years, ~10-20% in 100 years

Region	Temp. variations (°C)				Precipitation variations (%)			
	2020s	2050s	2080s	2100s	2020s	2050s	2080s	2100s
Yellow River								
A2	1.3	2.8	4.7	5.9	-1	4	9	12
B2	1.5	2.7	3.7	4.1	0	5	8	11
Hai River								
A2	1.4.	2.9	4.7	6.0	0	0	7	17
B2	1.5	2.7	3.8	4.1	2	4	7	17
Huai River								
A2	1.2	2.6	4.2	5.4	0	2	11	16
B2	1.3	2.4	3.5	3.8	1	2	5	11

Scenarios of Surface Water Resources




ET
Runoff
Snr10 +2ºC
Snr11 +2ºC,15%
Snr12 +2ºC,-15%p
Snr10 +2ºC
Snr11 +2ºC,15%p
Snr12 +2ºC,-15%
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.18
0.17
0.16
0.15
0.14
0.13
0.12
0.11
0.1
0.09
0.08
0.07
0.04
0.02
0
−0.02
−0.04
−0.06
−0.08
−0.1
−0.12
−0.14
−0.16
−0.18
0
−0.002
−0.004
−0.006
−0.008
−0.01
−0.012
−0.014
−0.016
0.24
0.22
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
−0.02
−0.04
−0.06
−0.08
−0.1
−0.12
−0.14
−0.16
−0.18
−0.2
−0.22
−0.24

Scenario Summaries; e.g.,

* Under the scenarios of +2ºC and ±15% P, ET has the largest variation in the region between 33-36ºN and west of 118ºE, sensitive to precipitation change. R has the largest variation in south end of 3H.

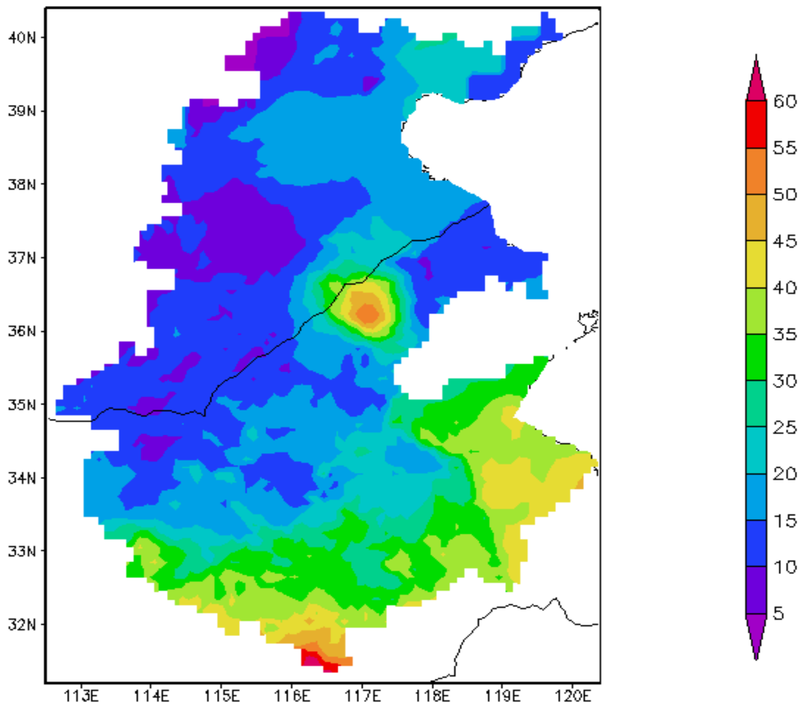
* Among the several scenarios, SM in Jiangsu changes the most. The impacts of P on ET and R is mainly in the south, whereas impacts on SM are mainly in the north of this region with +15% P.

* Cangxian and Gaomi have obvious changes of SM, whereas Liangyuan and Huaiyuan have larger variation of ET and R. This shows that ET and R are sensitive to precipitation change in south 3H (representative of Huaiyuan), and SM has the larger variation in the northern counties.

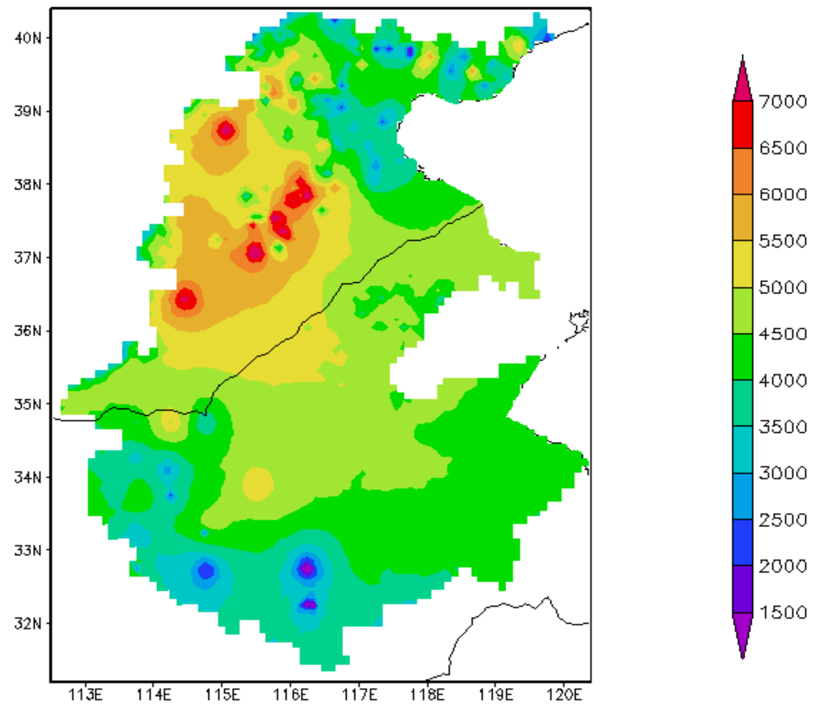
CURRENT CONDITIONS IN WATER TABLE: 1980-2000

Groundwater resources in Huang-Huai-Hai plain

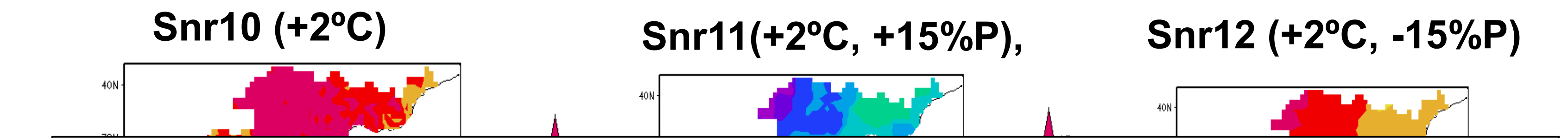
Precipitation Surplus



Water table depths



Scenario Results (21-year averages)

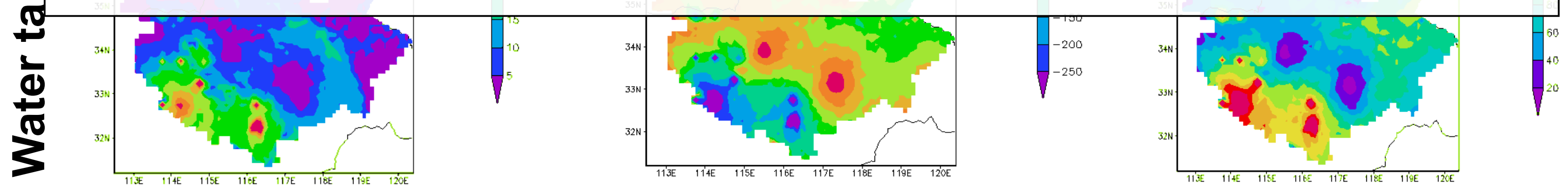


* The variation of water table depths are more sensitive to the variations of precipitation rather than the variation of temperature under the climate change scenario.

* ate ch

IMPORTANT POINT: THIS MODEL DOES NOT INCLUDE IRRIGATION WITHDRAWALS!!

* The most sensitive result occurs in summer when the precipitation increases; while the average water table depth in spring is the most sensitive result when the precipitation decreases. The average result in crop growing season is between the above two.



Part III

Relationship between the hydrological assessment

and proposed adaptation measures; e.g.,

- Better and effectively using rainfall by enhancing soil's water absorbing and holding capacity
- Better and effectively using rainfall by in crop growing season
- Storing runoff as ground water
- Storing runoff in more distributed sites (ponds, lakes, reservoirs and etc.)
- Seeking alternative water resources other than current surface water resources

SUMMARY STATEMENT:

This works provides the first step in a quantitative analysis of water availability for agriculture, and agriculture adaptation, under different scenarios of the future.

Thanks!