上海交通大学
SHANGHAI JIAO TONG UNIVERSITY

Rural Climate Risk Assessment and Adaptative Planning

Research Center for Sustainability Ecology
Shanghai Jiao Tong University

28th August, 2024

饮 水 思 源 • 爱 国 荣 校

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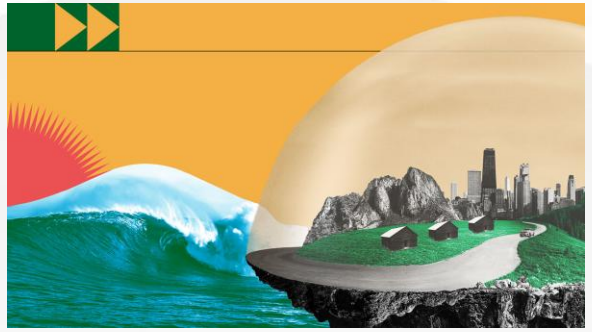
Contents

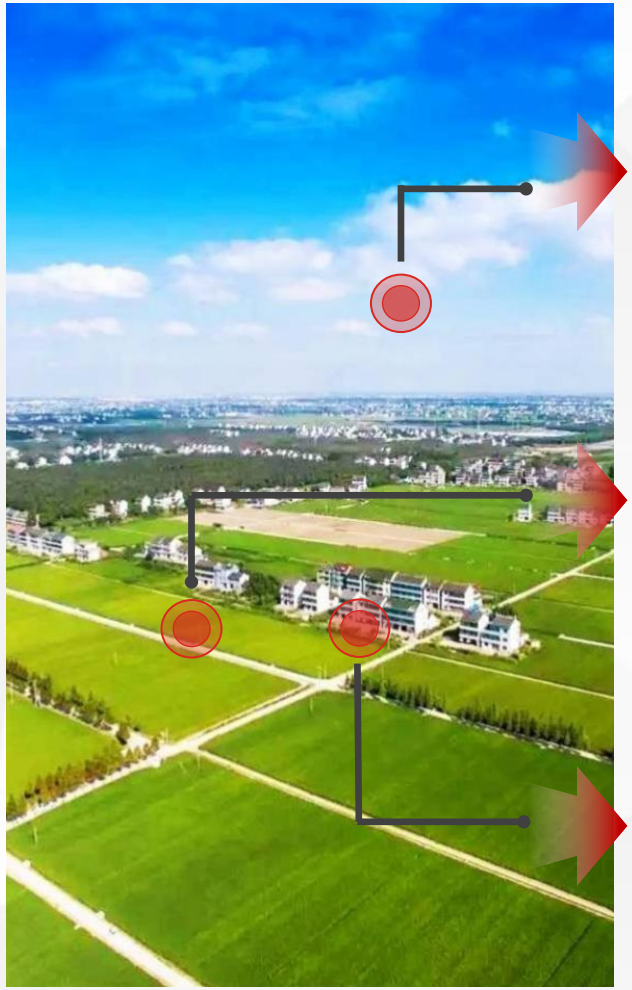
Overview

Climate Change	Refers to changes in global or regional climate patterns attributed largely to human-caused increased levels of atmospheric greenhouse gases.
Climate Adaption	Means taking action to prepare for and adjust to both the current and projected impacts of climate change.
Rural Climate Adaption	Climate change adaptation countermeasures and programs in rural area are still insufficient, especially the research on climate change prediction, risk diagnosis, vulnerability assessment and planning of governance measures



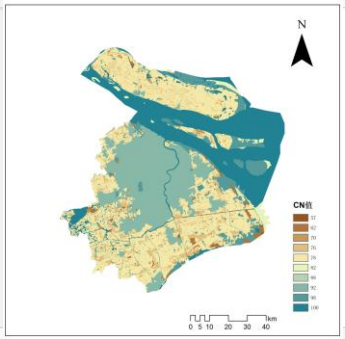
(Source: UN, 2023)

Steps for Rural Climate Adaptive Governance and Management Measures



1

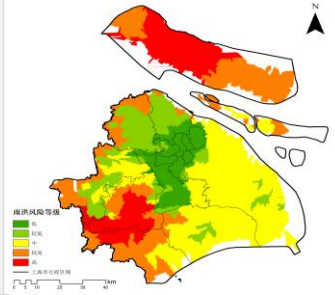
Evaluation



Carbon monitoring and assessment, ecosystem climate change simulation, and climate risk assessment in the context of climate change.

2

Risk Identification



Identifying and assessing rural climate risks.

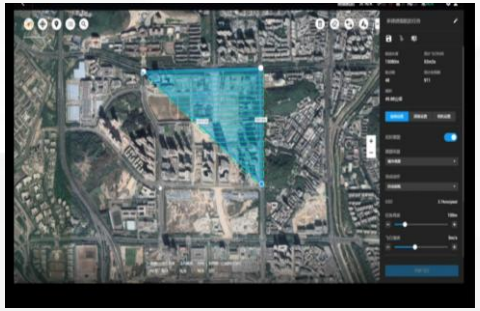
3

Governance & Measures

Form a set of strategies for climate adaptive development regarding policy, technology, and governance.

Field Research Plan

Field Investigation Contents



1 Mapping for rural area

Layout and land cover of the research site (by UAV surveying and mapping).

2 Researching on climate adaptation actions

Interview local officials and residents, get to know measures used to deal with hazards due to natural disasters or weather, and the awareness of climate change.

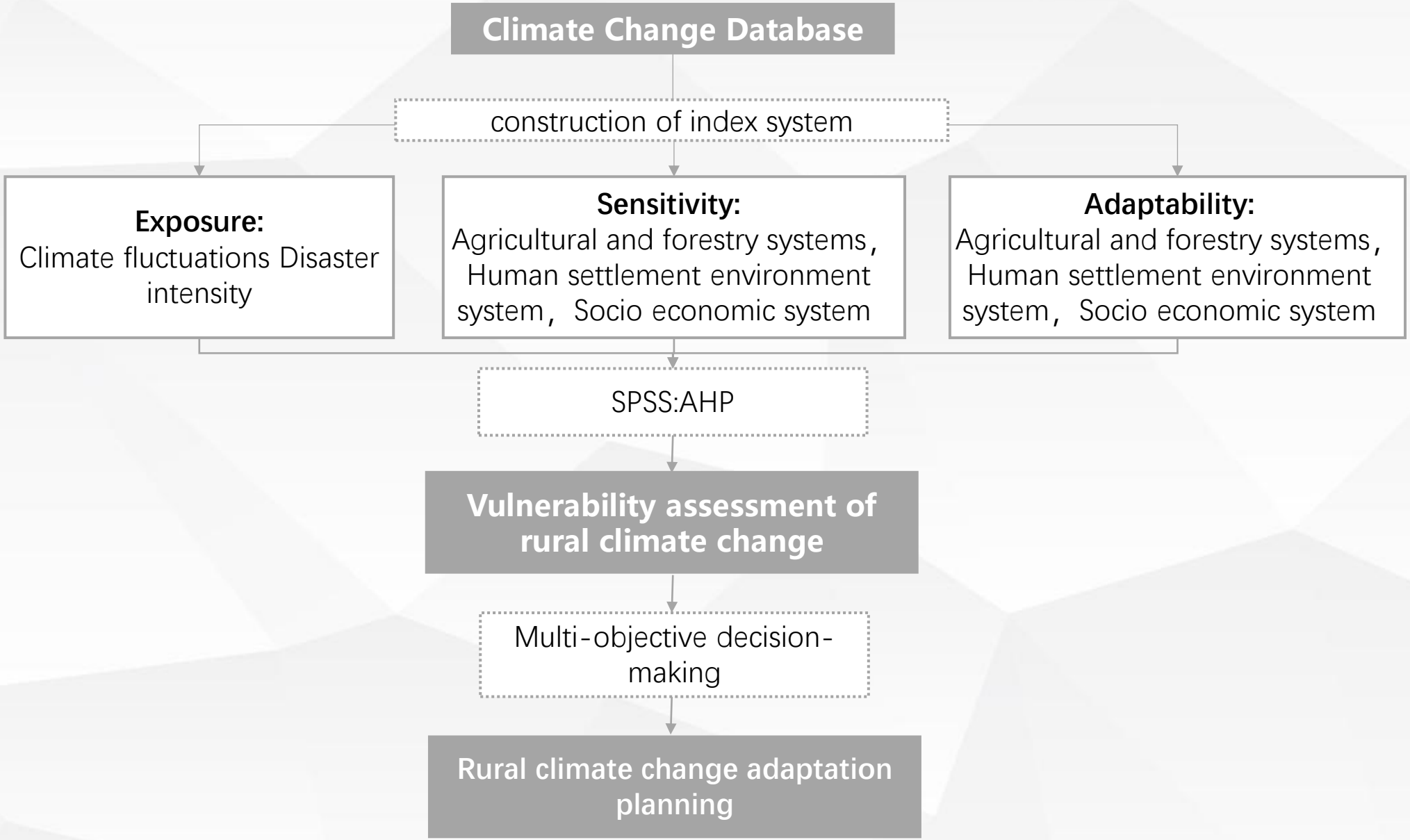
3 Researching on socio-economic situation

Interview local officials to get local socioeconomic data.

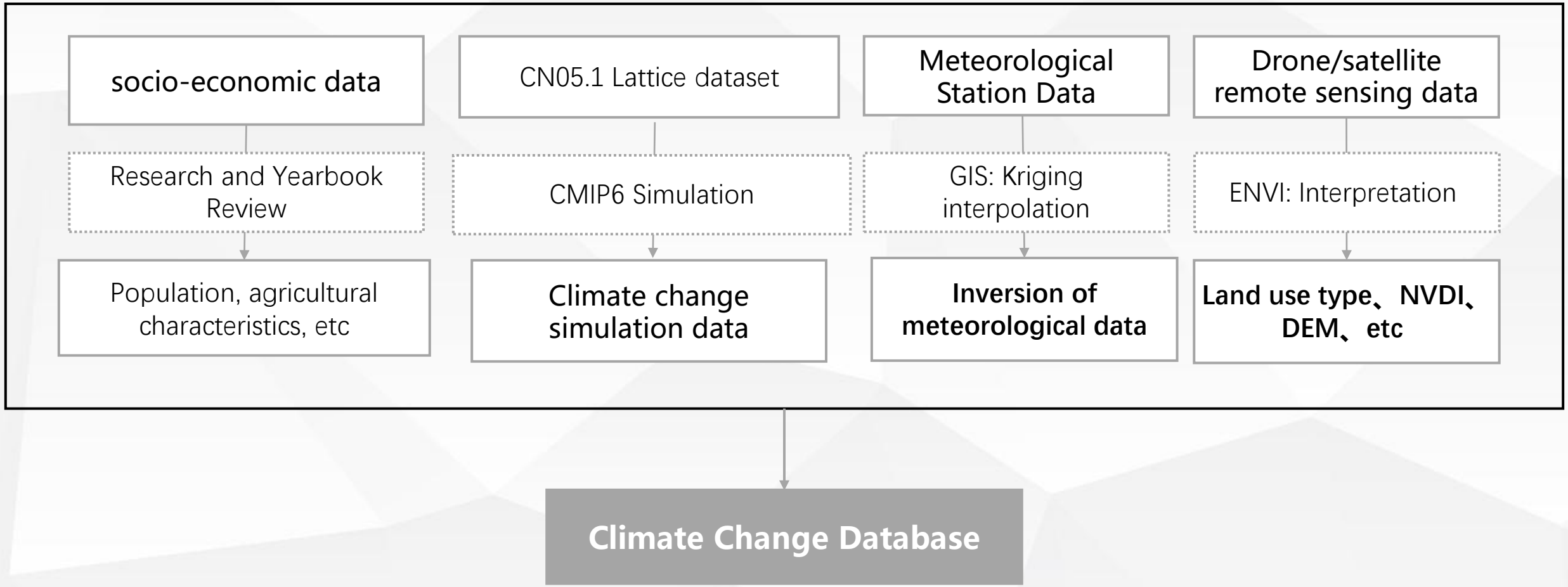
Research Framework

Climate Database	Database of climate adaptation research includes historical meteorological observations and disaster data, future climate projections from climate models, and necessary ecological, environmental, social and economic data
Climate Modeling	CMIP6 climate model group was used to simulate and predict the climate change trend and the occurrence type of climate disasters in different time periods under different greenhouse gas emission scenarios.
Vulnerability Assessment	Vulnerability Assessment will be conducted according to the type of rural climate risk and the basic characteristics of human environment ecosystem, agroforestry system and economic system.
Adaptive Planning	Adaptation planning measures for rural ecosystems will be proposed based on near, medium and long-term climate risk prediction, impact assessment and ecosystem vulnerability evaluation.

Research Framework



Step 1: Construct Climate Database

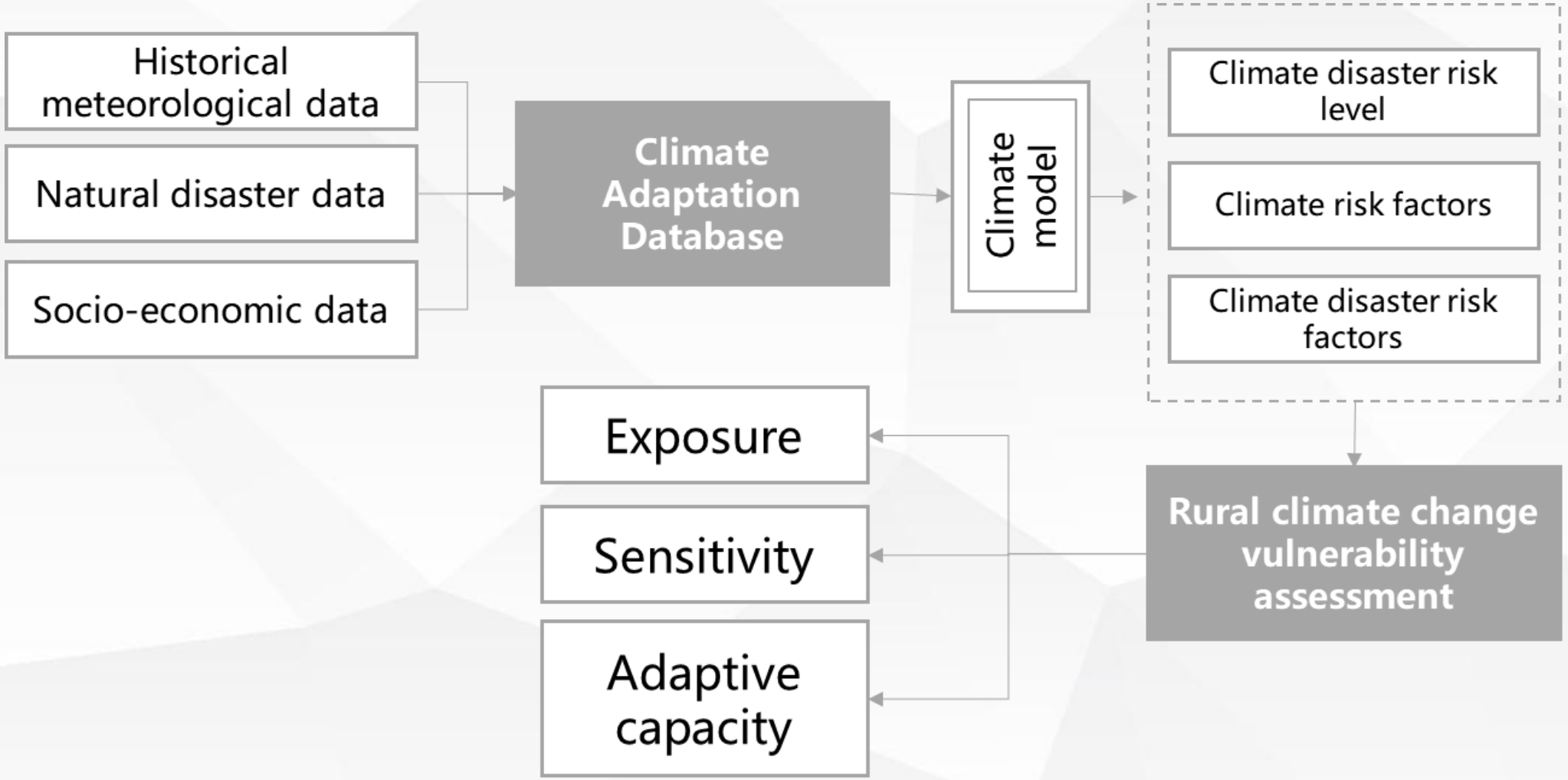


Step 1: Construct Climate Database

Data sources

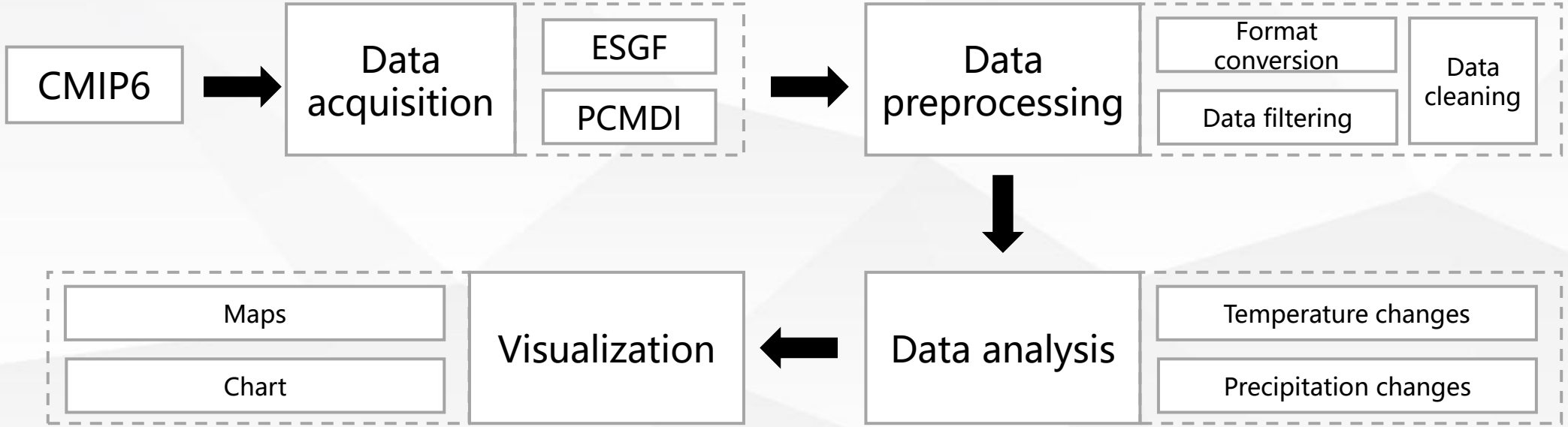
- Meteorological data is available from the following sources:
  (1) National meteorological agencies;
  (2) WeatherSpark: https://weatherspark.com
- Land Use Data: Globeland30: http://globeland30.org
- Comprehensive remote sensing data are available from the following sources:
  (1) USGS: https://www.glovis.usgs.gov/
  (2) CAS Data Cloud: www.csdb.cn/
  (3) Beijing Normal University: www.glass-product.bnu.edu.cn
  (4) Remote sensing cloud: www.rscloudmart.com/
  (5) National Earth System Science: www.geodata.cn/
- Socio-economic data can be found from national statistical office
  (1) China National Bureau of Statistics: http://www.stats.gov.cn/
  (2) Bulgarian National Statistical Office: https://www.nsi.bg/en
  (3) Eurostat: https://ec.europa.eu/eurostat/

Step 2: Climate prediction

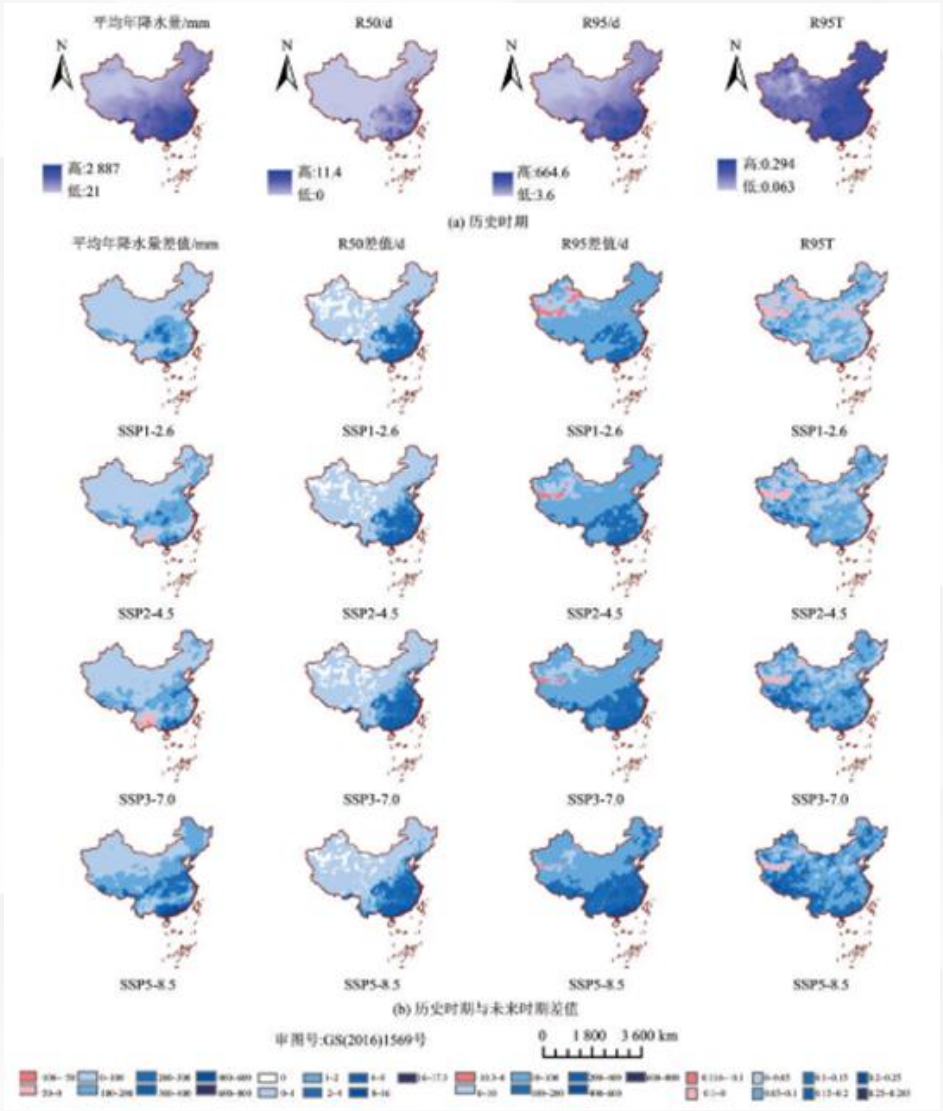


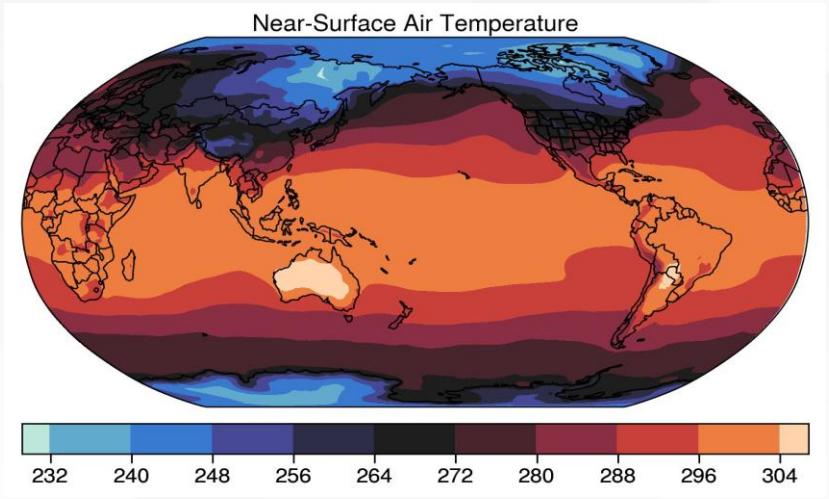
Step 2: Climate prediction

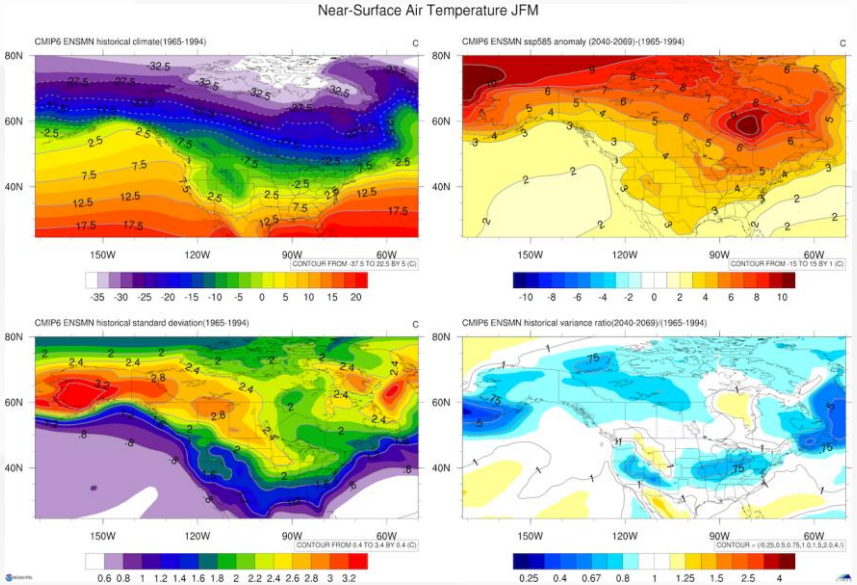
- CMIP is a project of the World Climate Research Program (WCRP)'s Working Group of Coupled Modelling (WGCM).
- CMIP has led to a better understanding of past, present and future climate change and variability in a multi-model framework.
- CMIP has developed in phases, with the simulations of the fifth phase, CMIP5 now completed, and the planning of the sixth phase, i.e. CMIP6, well underway



Step 2: Climate prediction—CMIP

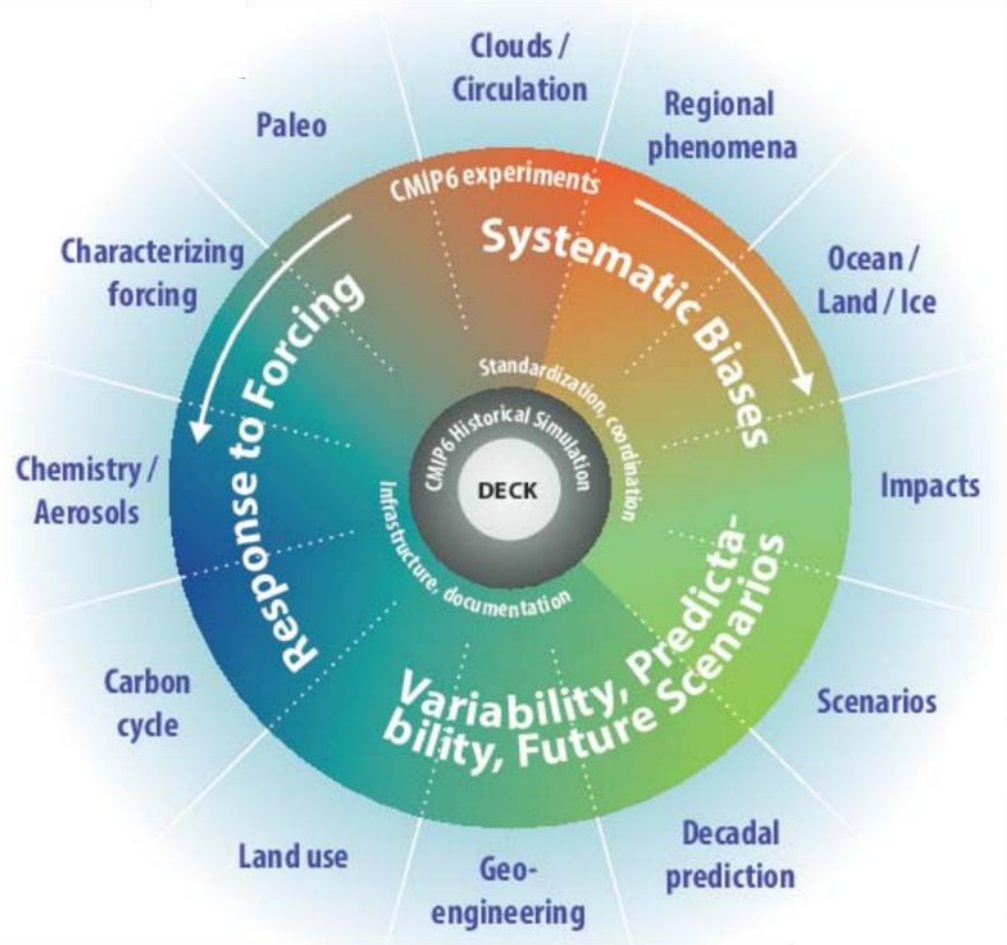




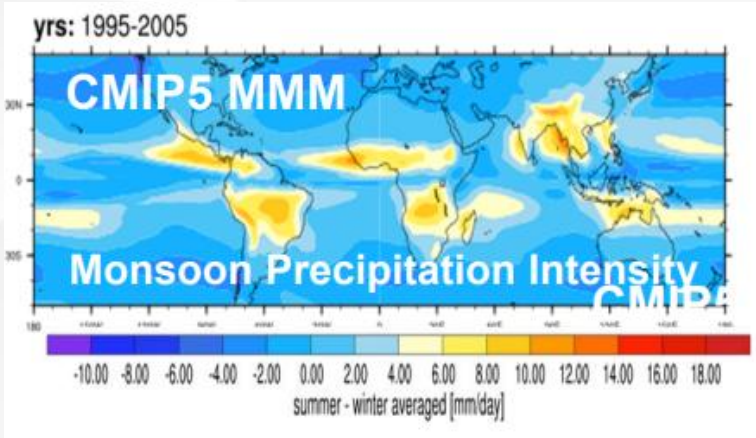


CMIP6 outputs examples (Xiang，2021; PSL 2023)

Step 2: Climate prediction—CMIP



CMIP/CMIP6 experiment design(Eyring et al., 2016)

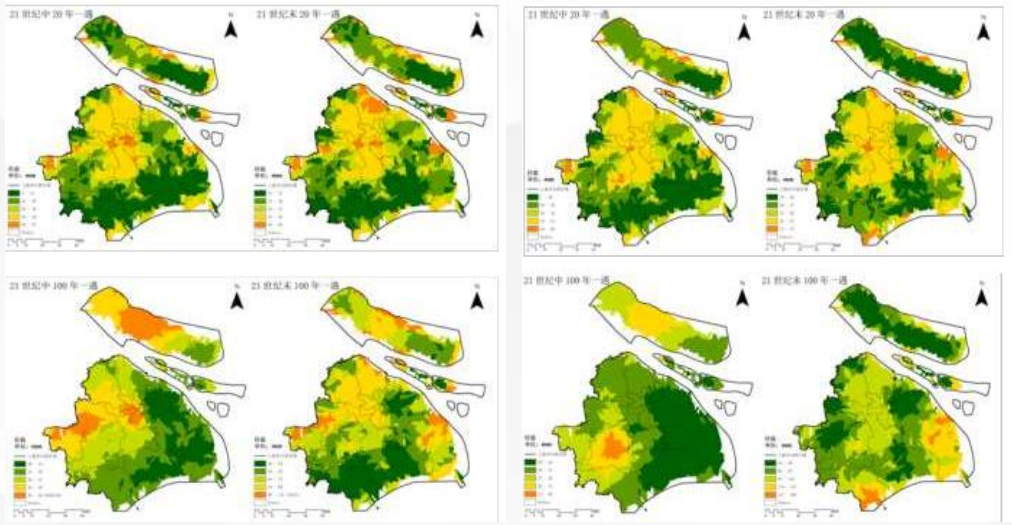


(IPCC, 2021)

Downscaling

$$delta_{ymoni\_p} = obs_{ymoni\_p} / gcm_{ymoni\_p}$$

$$gcm_{dailyi\_p} = gcm_{dailyi\_p} \times delta_{ymoni\_p}$$

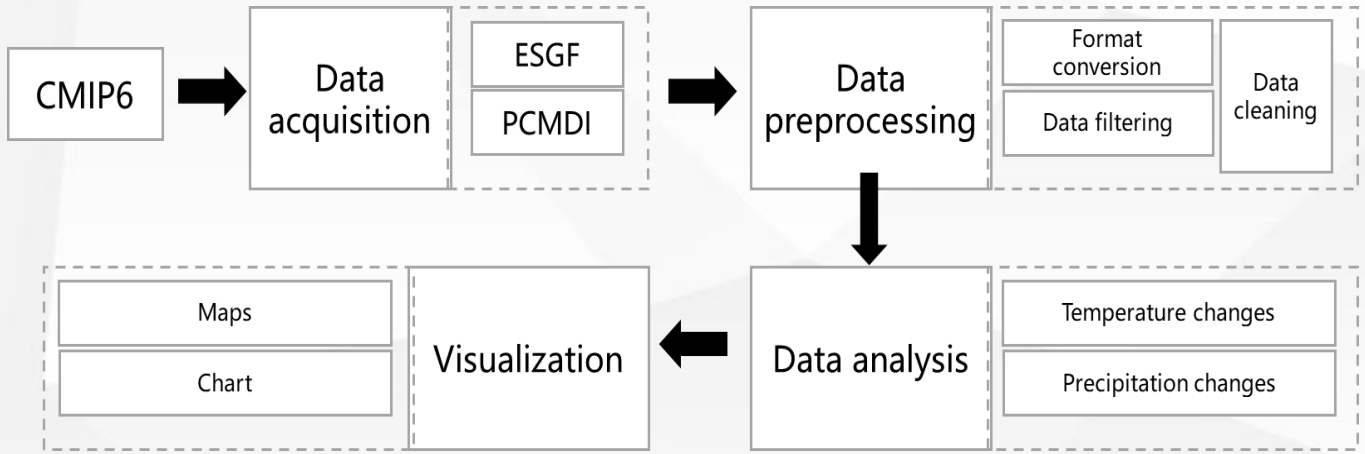


Distribution of precipitation intensity in Shanghai under SSP585 Scenario

Step 2: Climate prediction—CMIP

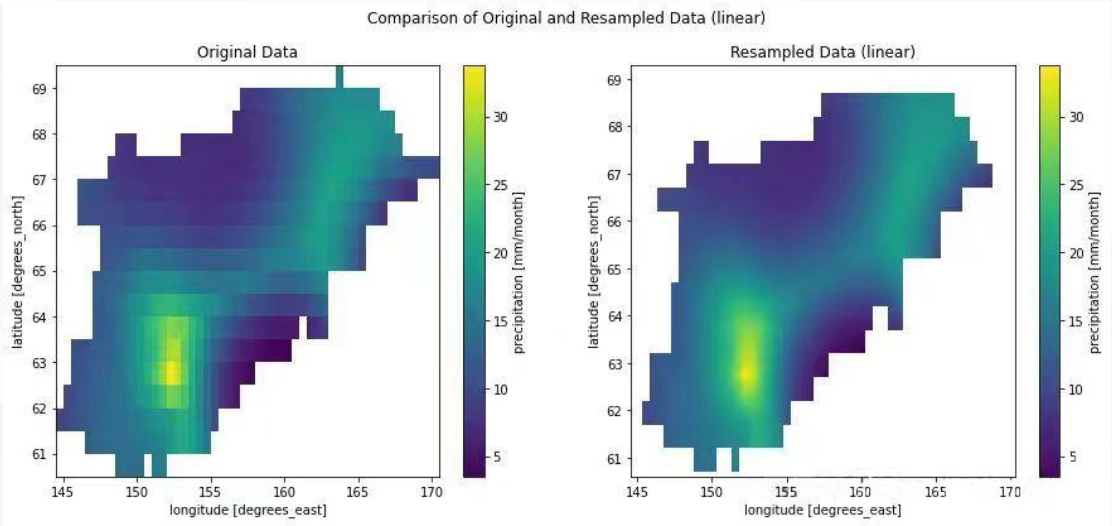
➢ Downscaling multi-scenario climate simulation method based on CMIP6

The downscaling method for multi-scenario urban-scale future climate simulation based on CMIP6, which couples data from different GCMs with meteorological station data. This method could **improve the resolution of the climate prediction from 45km to 10km**, which could be used for climate prediction for city scale.



Downscaling multi-scenario climate simulation method framework

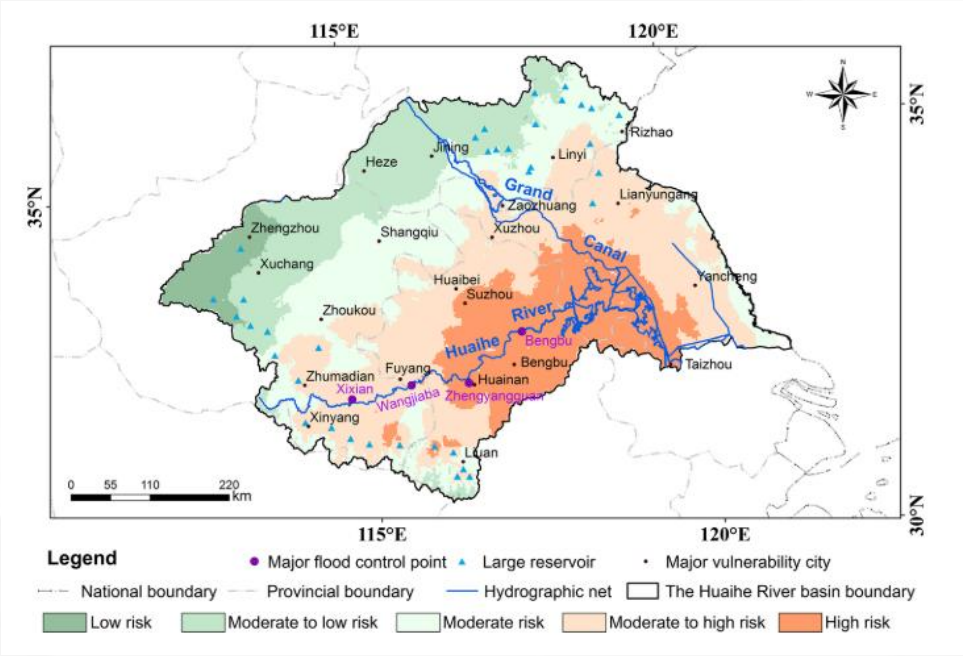
Resolution: 45km **Improve to** **Resolution: 10km**



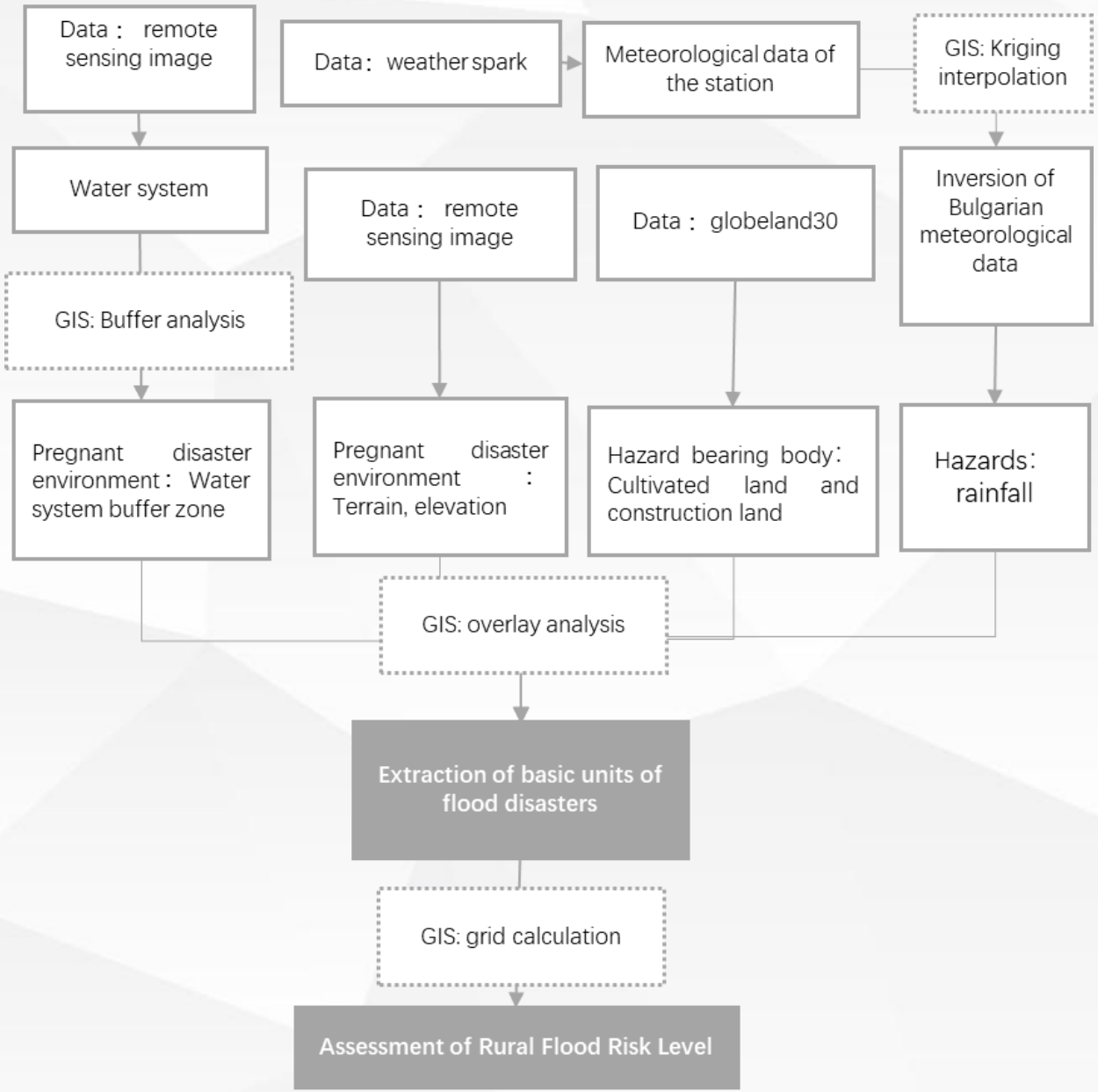
Step 3: Vulnerability Assessment

(1) Risk Assessment

- Assess the level of risk
- Identify areas with high risk level
- Identify risk factors



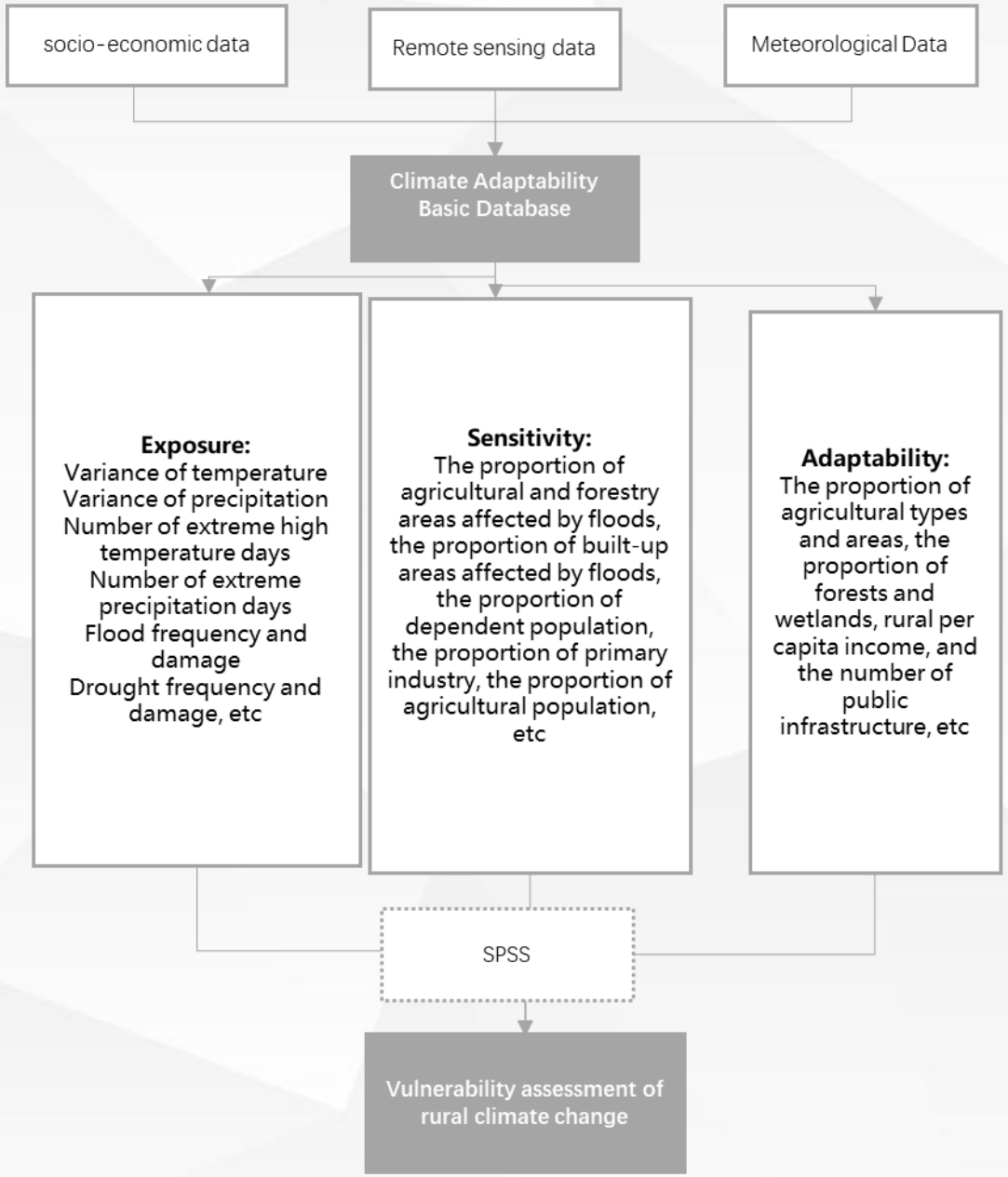
Flood risk assessment examples (Wu et al., 2015)



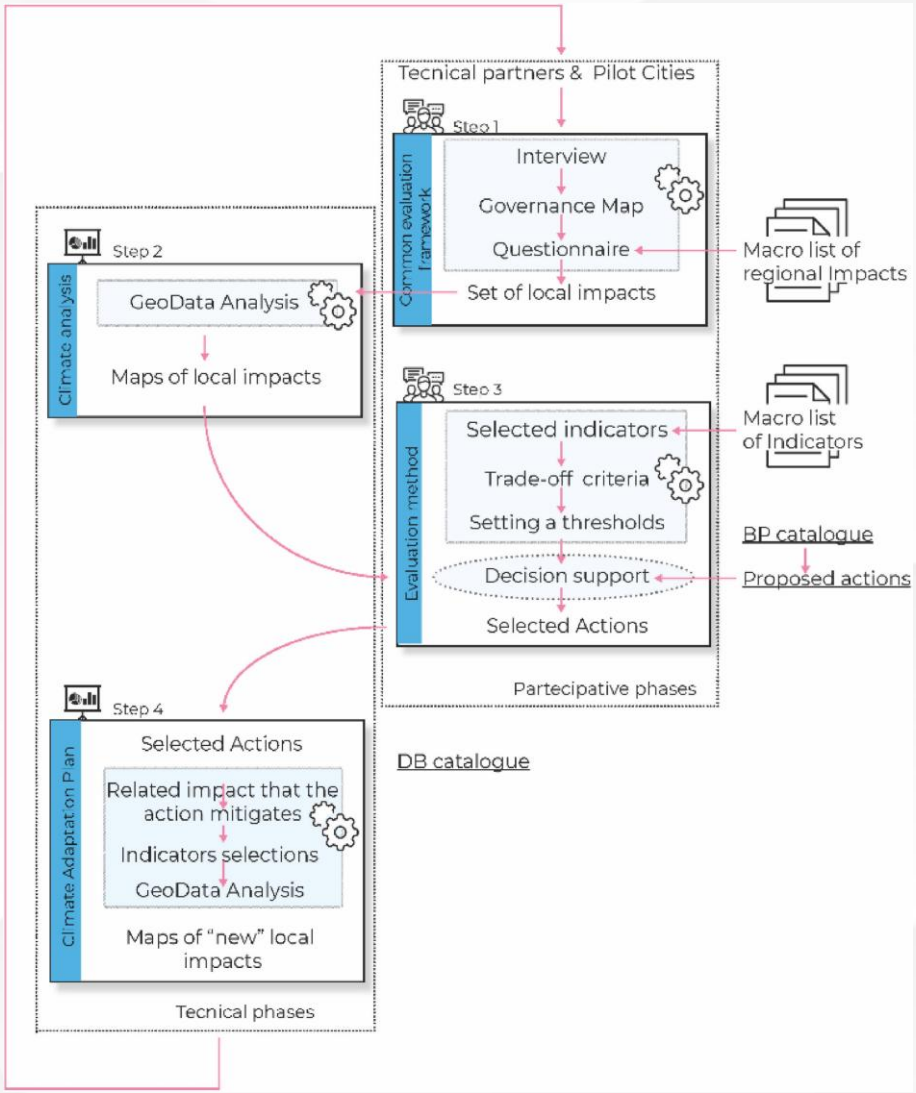
Step 3: Vulnerability Assessment

(2) vulnerability assessment

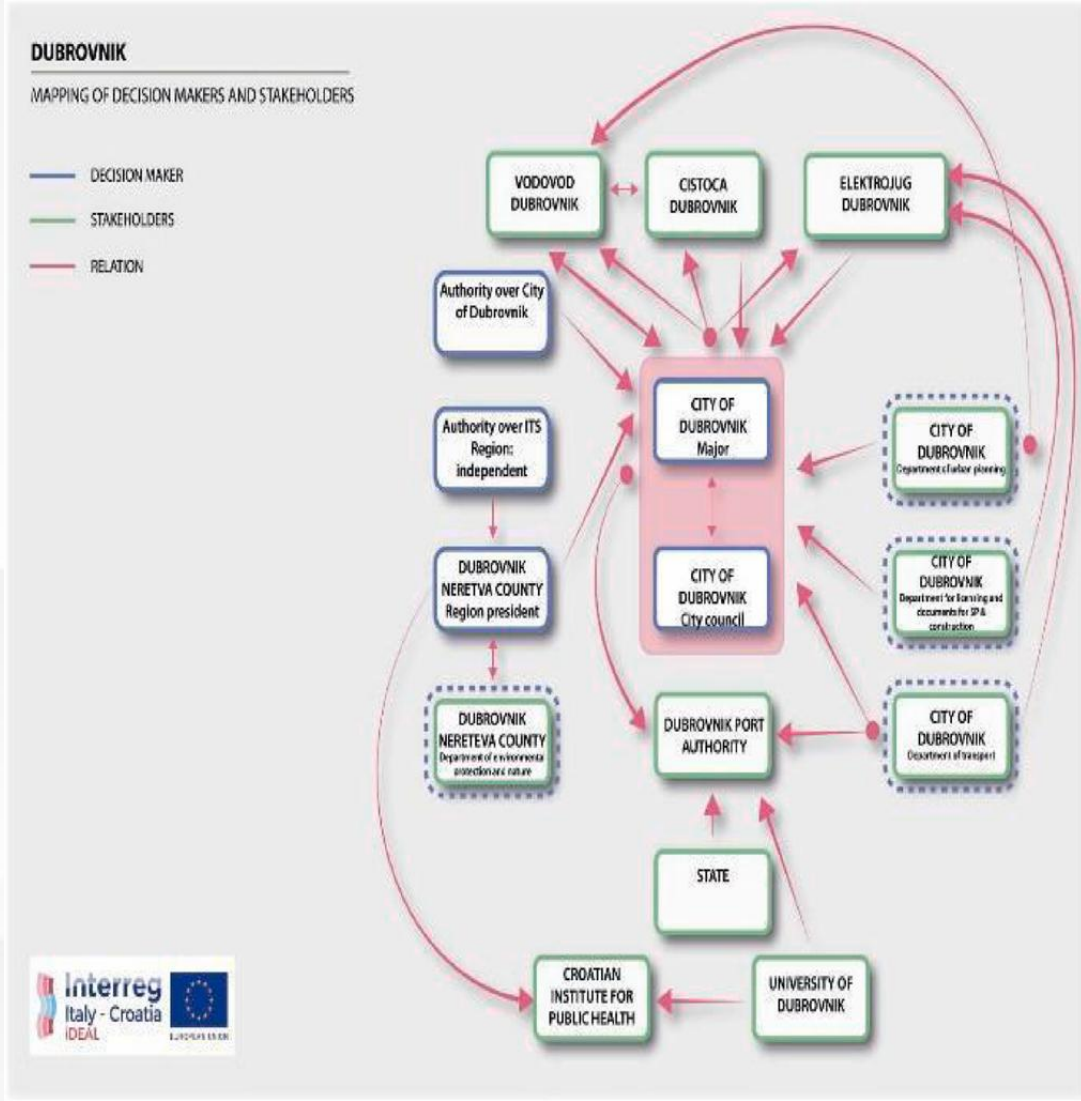
- Use the standardized methods of SPSS software to process various indicators. Identify areas with high risk level
- Vulnerability is composed of three primary indicators: exposure (EI), sensitivity (SI), and adaptability (AI).
- The evaluation values of exposure, sensitivity, and adaptability are calculated separately through weighted summation



Step 4: Adaptive Planning



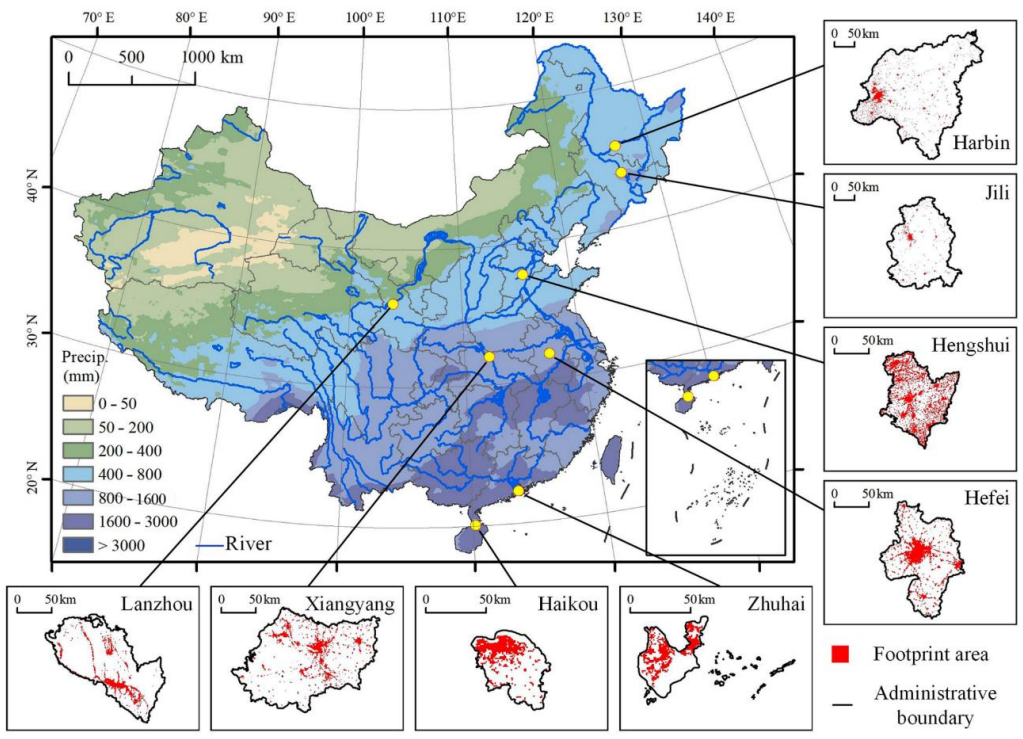
The process to support the decision-making of adaptation measures through a climate adaptation plan



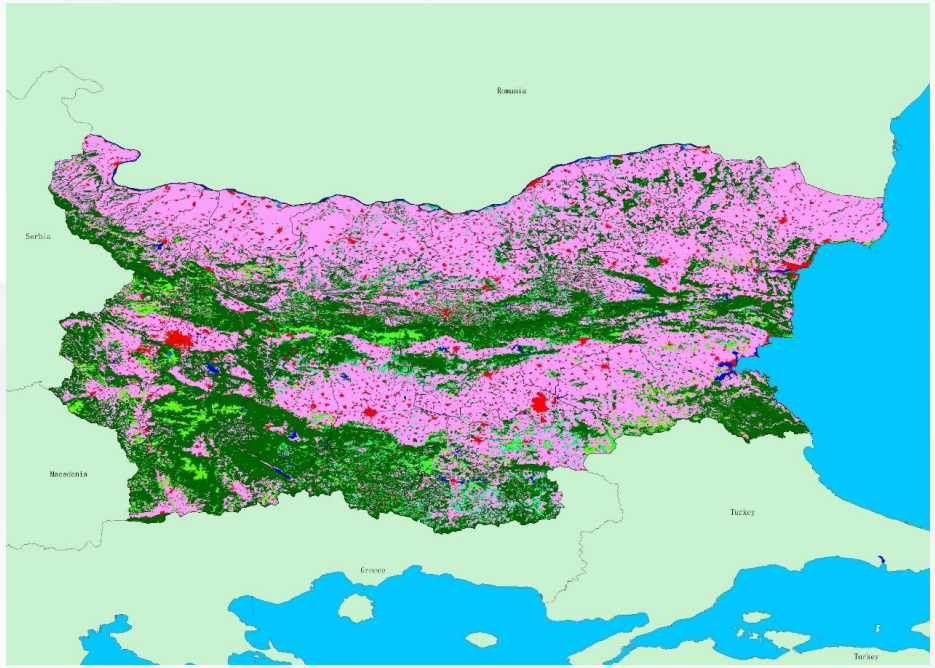
Example of governance map

Database

At present, about 12TB of data related to China and Bulgaria have been collected and collated



Main hydrological and rainfall data across China



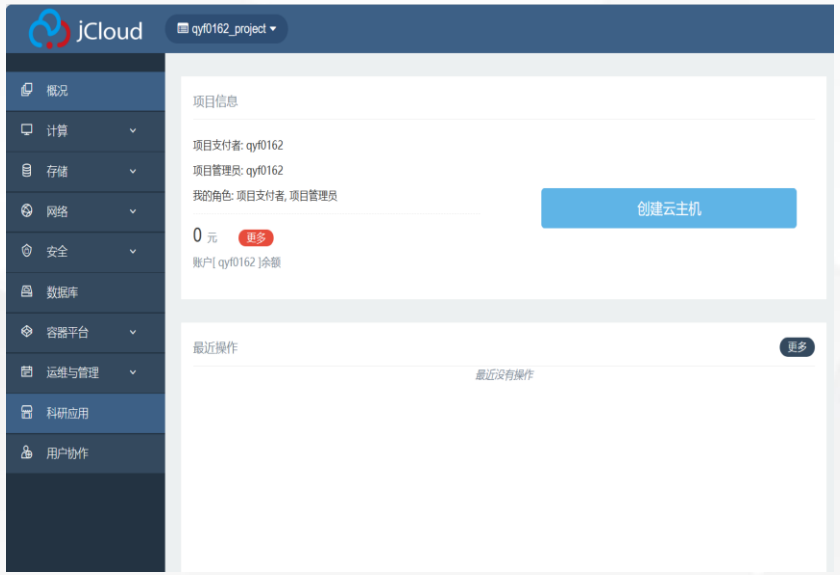
Land use data for Bulgaria

Supercomputing platform and cloud server

The "Siyuan No. 1" cluster of Shanghai Jiao Tong University **ranks 1st supercomputing cluster in Chinese universities.** With the help of Shanghai Jiao Tong University high-performance computing cluster, large-scale climate change simulation and risk assessment can be carried out.

JCloud is a campus cloud platform **is biggest cloud platform in Chinese universities**. The Infrastructure as a Service (IaaS) cloud computing service platform developed based on OpenStack integrates IaaS core technologies such as elastic and scalable computing, distributed block storage, and software defined network (SDN). JCloud allows user to easily conduct climate simulation by WRF. Normally, the installation process of WRF is complex, and the operation process is also extremely time-consuming.

SJTU Center for High Performance Computing



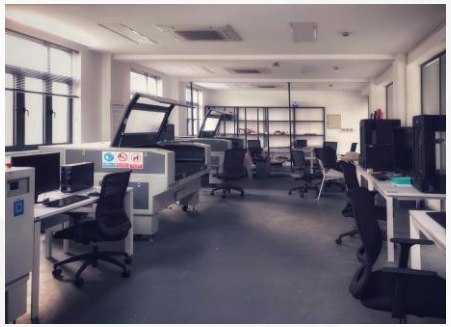
JCloud Console

JCloud Server

Technical Resources of the Joint Lab

Sino-Bulgarian Joint Lab on Climate Change Adaptive Governance for Rural Ecosystem

The Joint Lab located in SJTU's Minhang Campus, with the area of 1500 m^2, divided into four functional area: Living Environment Research, GIS & RS Research, Data Analysis and Computation, and Planning and Design.



Planning and Design

The Joint Lab

Big data computing center

GIS & RS Research

Surveying And Mapping, Environmental and Meteorological Monitoring Equipment

Surveying and mapping UAVs

Portable Gas Analyzer

Portable Weather Station

Portable 3D Scanner

Field observation station

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Thank You

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