Research on Risk Management for Climate Change Impacts in China

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Outline

- Research progress on CC impacts
- Research progress on policy-making
- Future Work
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- Research progress on CC impacts
  - Climate scenarios employed
  - Scientific understanding: ---from impacts to risk assessment
- Research progress on policy-making
- Future Work
Climate Scenarios Employed

- **Before 8th 5-year**: incremental scenarios
- **8th 5-year (1991-1995)**: $2 \times \text{CO}_2$-$1 \times \text{CO}_2$, GCM+WG
- **9th 5-year (1996-2000)**: IS92, GCM+WG
- **10th 5-year (2001-2005)**: SRES, GCM+PRECIS
- **11th 5-year (2006-2010)**: SRES, PRECIS+RegCM, etc
- **12th 5-year (2011-)**: SRES+RCPs, PRECIS+RegCM, etc
An introduction to downscaling

GCMs

Horizontal resolution: ~250-600 km

Downscaling

Local details

Impacts Models
What is PRECIS?

- **PRECIS**—Providing **REgional** Climates for **Impacts Studies**
- A regional modelling system developed at the Hadley Centre
Purpose of PRECIS

- To develop high-resolution regional climate scenarios
- To provide climate data for impacts assessment model
A demo for RCM downscaling

HadAM3P

- 50 km resolution
- 19 vertical levels
- Limited area

PRECIS

Schematic diagram of the resolution of the Earth’s surface and the atmosphere in the Hadley Centre regional climate model.
Downscaling with RCM

GCM

Lateral Boundary

Initial Conditions

Other Forcings

RCM
The climate change scenarios in China are developed based on SRES socio-economic assumptions.

SRES: IPCC 2000, Special Report on Emission Scenarios
Terrain of PRECIS

Unified Model Output (Vn 4.6): OROGRAPHY (/STRAT LOWER BC) (m)

- x: x (degrees_east)
- y: y (degrees_north)
- z: surface 0.000000 (level)
- t: date / t 1960/02/01 00:00:00 / 30.000000 (days since 1960-01-01 00:00:00)
RCM: HadRM3 (from Hadley Centre)

Horizontal resolution:
50km*50km
and 25km*25km

Temporal resolution
daily and hourly
Domain:

Previous

Resolution: ~50km*50km
Grids: 145*112

Current

CORDEX_easia_new
Resolution: .44
nx: 219 ny: 183

Resolution: ~50km*50km
Grids: 219*183
• ECMWF re-analysis data: 1957-2001
• ECMWF re-analysis data: 1979-1993
• ECMWF re-analysis data: 1989-2008
• HadAM3
  – Baseline (1961-1990): No1 No2 No3
  – A2 (2071-2100): No1 No2 No3
  – B2 (2071-2100): No1
• HadCM3
  – A1B (1961-2099): No1
  – A1B (1961-2099): No1 No2 No3 No4
•ECHAM5
  – A1B (1961-2100): No1
• CMIP5
  – RCP2.6 (1951-2100): No1
  – RCP4.5 (1951-2100): No1
  – RCP8.5 (1951-2100): No1

**Red:** ready

**Blue:** to be run
Climate change responses under SRES A2 scenario in 2080s relative to baseline (1961-1990)
Temperature responses in China under SRES B2 scenario

- Maximum temperature / °C
- Minimum temperature / °C
Precipitation responses in China under SRES B2 scenario
Drought over Yangtze River
## Extreme Climate Events Criteria-1

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>SU</td>
<td>daily maximum temperature is over 25 °C</td>
</tr>
<tr>
<td>CFD</td>
<td>the largest number of consecutive days with daily minimum temperature below 0 °C</td>
</tr>
<tr>
<td>GSL</td>
<td>number of days between the first occurrence of at least 6 consecutive days with daily mean temperature above 5 °C and the first occurrence after 1st July of at least 6 consecutive days with daily mean temperature below 5 °C</td>
</tr>
<tr>
<td>R20mm</td>
<td>extreme precipitation events with daily precipitation amounts greater than or equal to 20 mm</td>
</tr>
</tbody>
</table>
# Extreme Climate Events Criteria

<table>
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</thead>
<tbody>
<tr>
<td>RX5day</td>
<td>maximum precipitation amount for the 5-day interval</td>
</tr>
<tr>
<td>SDII</td>
<td>ratio of the daily precipitation amount for wet days (daily precipitation amounts greater than or equal to 1 mm) to the number of wet day</td>
</tr>
<tr>
<td>CDD</td>
<td>Consecutive dry days is calculated based on the largest number of consecutive days with daily precipitation below 1 mm</td>
</tr>
<tr>
<td>TX95</td>
<td>put daily maximum temperature of one year in an increasing order, then TX95 is defined as the 95th percentage of the maximum temperature of this year</td>
</tr>
</tbody>
</table>
Changes of Extreme Climate Events
2071-2100 vs 1961-1990, SRES A2

a. SU
b. CFD
c. GSL
d. R20mm
e. RX5day
f. SDII

(Unit: %)
Changes of Extreme Climate Events

- a. SU
- b. CFD
- c. GSL
- d. R20mm
- e. RX5day
- f. SDII

(Unit: %)
Warm night

The mean value of minimum temperature for 3 consecutive days’ warmest nights over China under A2 Scenario (Unit: °C) a. Observed (CN05, 1961-1990); b. Simulated by PRECIS (1961-1990); c. Relative changes of 2080s to baseline

Changes in 500 hPa mean height field in summer over China under future climate scenario simulated by PRECIS (Unit: gpm)
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➢ Future Work
Impacts Assessments of Climate Change on Chinese Agriculture

- **HadCM2**
- **ECHAM4**
- **Monthly T, P**
- **Weather Generator**
  - **Daily Tmax/min, Pre, Srad**
  - **Crop Varities**
  - **Soil Data**
  - **Management Data**
- **Crop Models**
  - **Yield Changes; etc**
Impacts Assessments of Climate Change on Chinese Agriculture

Weather Generator $\Rightarrow$ RCM

Daily Tmax/min, Pre, Srad

Crop Varities

Soil Data

Management Data

Crop models

Yield Changes, etc
How to use future climate change scenarios data
No CO$_2$ fertilization
CO$_2$ fertilization
2080s

No CO₂ fertilization
2080s

CO₂ fertilization
Changes of runoff in China

The drought would be enhanced along the Yellow River

While the potential flooding risk along the Yangtze River would increase under SRES A2 scenario

Similar to A2 scenario, but amplitude is not so large as A2 scenario
From average change to extremes impacts
Extreme events have extreme impacts on natural ecosystems in China

The impacts of extreme events on natural ecosystems in China under A2 scenario

The impacts of extreme events on natural ecosystems in China under B2 scenario
Risk assessment of Climate Change Impacts

\[ \text{Risk} = \text{Hazard} \times \text{Vulnerability} \]

\[ V = f(\text{exposure}, \text{sensitivity}, \text{adaptive capacity}) \]

To combine the social factors and climate change
ACCC Risk assessment on Maize
ACCC Risk Assessment on Wheat
ACCC Risk Assessment on Rice
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General feature of adaptation policy-making:

From Autonomous Response to Risk Management
1st Stage: Response Based on Observation Facts

- Features of the 1st Stage:
  - Autonomous
  - Not Systematic
2nd Stage: Response Based on Impacts Assessment

- Features of the 2st Stage:
  - Positive
  - Systematic, but the adaptation measures is still isolated from impacts assessments
  - Lack of Risk Assessment
3nd Stage: Response Based on Risk Assessment

- Features of the 3rd Stage:
  - Risk assessment
  - Integration with poverty alleviation, disaster reduction, & mitigation, etc.
Adaptation Progress in China

China’s INC on CC (2004)

Studies on National Strategy of CC Adaptation (2011)


National Climate Program on CC 2013

National Adaptation Strategy on CC
Structure of the Adaptation Strategy Report

1、Introduction
2、Guideline, Demands and Aims
3、Sectors’ Challenges and Action Plans
4、Regional Challenges and Action Plans
5、National Synthesis Tasks and Action Plans
Sectors’ Challenges and Action Plan

- Agriculture
- Water Resources
- Forestry
- Coastal Zone
- Human Health
- Eco-systems and biodiversity
- Major projects
- Energy
- Other sectors
3.10 Other sectors

- Urban development
- The second & tertiary industries
- Environmental protection
- Infrastructure & social lives
Regional challenges and action plan

- 9 Regions:
  - Northeast China
  - North China Plain
  - East China
  - Central China
  - South China
  - Northwest China
  - Southwest China
  - Qinghai-Tibet Plateau
  - China Sea
Main tasks
Action plan
Capacity Building
Policy
Challenges of Chinese Agriculture to Climate Change

- Threatening food security;
- Enhancing the agro-meteorological disasters;
- Getting hard to control the agricultural diseases, pests and weeds;
- Degrading the grassland and instablizing the animal husbandry;
- Exacerbating the poverty in rural and ecologically vulnerable regions.
Impacts-based Adaptation Planning

- Challenges
- Main Tasks
- Action Plans
Challenges of Chinese Agriculture to Climate Change

- Threatening food security;
- Enhancing the agro-meteorological disasters;
- Getting hard to control the agricultural diseases, pests and weeds;
- Degrading the grassland and instablizing the animal husbandry;
- Exacerbating the poverty in rural and ecologically vulnerable regions.
Main tasks of Chinese agriculture to adapt to climate change

- Enhancing the construction of agricultural infrastructures;
- Accelerating agricultural industrialization and modernization;
- Strengthening water conservancy facility and developing water-saving agriculture;
- Adjusting cropping systems and crop varieties layout;
- Developing adaptation techniques for animal husbandry;
- Establishing the early-warning systems for agricultural disasters and improving agricultural disasters insurance;
- Completing the adaptation technology check-list.
Action plan of agricultural adaptation

Based on the challenges to climate change and major tasks to adapt to climate change, we proposed the action plan towards the year 2020, including:

1. basic farmland construction
2. water saving project
3. agricultural infrastructure construction
4. constructing the gene pool and seed bank
5. adjusting the cropping system
6. monitoring, predicting and controlling the agro-meteorological disasters
7. developing the adaptation technique checklist
8. building the demonstration zone for adaptation
9. preventing the grassland degradation
10. forage resourcing and planning
Shortcomings for Present Adaptation Strategy

GHGs emissions → Climate change → Impacts assessments

√ Vulnerability analysis → Risk analysis → Adaptation strategy

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Future Work----

To have more risk assessments
To enhance integration
To issue the technical guideline to support the implementation of NAS
谢谢！
Thank you!