Projected Climate Change Impacts in Asia and Japan

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Research gaps and hot topics of impact research

• Costs of inaction / benefits of climate policy
• Projections of impacts considering future socio-economic development
• Evaluation of adaptation options
• Projections of impacts of extreme events
• Communication of uncertainties in impact projections
• Economics of adaptation
• Detection and attribution of observed impacts
Large-scale (>$3mil./year) research projects on adaptation or related matters in Japan

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S-4: Comprehensive assessment of climate change impacts on sensitive sectors in Japan (FY2005-2009; A predecessor of “S-8” project)
Sectoral risk maps reported in S-4 project

[S-4 project: Impacts on Forest: Distribution of suitable habitats for beech (Fagus crenata) forests]

- **Beech forests**
  - Nationwide decrease of suitable habitats
    - 2031-2050: 35-56%
    - 2081-2100: 69-93%
  - Vulnerable area: western Japan, the Pacific side of Honshu
S-4 project: Synthesis of sector analyses of climate change impacts (Radar charts)

Framework of S-8 Project (FY2010-2014)
Assessment of climate change impacts and adaptation strategy on whole Japan and local government

1. Research on highly reliable quantitative assessment of climate change impacts throughout Japan
   - Socio-Economic Scenarios
   - Climate Scenarios
   - Climate Scenario downscaler
   - Economic assessment
   - Integrated assessment model

2. Research on impact assessment and comprehensive adaptation policies at the local government level
   - Local government consortium

3. Research on indexes of vulnerability and adaptation effects in the Asia-Pacific Region
   - Feedback from local government
   - Feedback from developing country
   - Various impact and adaptation studies in the Asia-Pacific region

Transmission of research results to domestic and international policymaking
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- **RECCA**
  - Develop advanced data downscaling method
  - Develop data assimilation technology
  - Develop simulation technology for climate change adaptation

(cited from the URL above and translated)
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**Scheme of the S-5 project (2007-2011)**

Integrated research on climate change scenarios to increase public awareness and contribute to the policy process (S-5 project)

[S-5] Various uncertainties in impact projection

- Uncertainty in GHG / socio-economic scenario
- Climate projection
  - Natural variability
  - Climate model uncertainty
  - GHG emission uncertainty
- Impact projection
  - Uncertainty in methods for developing climate scenarios
    - Impact model uncertainty
    - Climate scenario uncertainty
    - Socio-economic scenario uncertainty
In order to contribute to IPCC-AR4, many research teams in the world conducted climate projections based on common GHGs emission assumptions. The results of the simulations were collected in PCMDI (US) and distributed publicly through the Internet.

Example of impact assessment considering uncertainty of climate projection:

**Impact on rice productivity**

Crop productivity assessments using plural GCM projections evaluated in IPCC-AR4


PDFs of estimated productivity change (Asia, with CO2 fertilization; 2080s-1990s)
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Innovative program of climate change projection for the 21st century

<table>
<thead>
<tr>
<th>Team Name</th>
<th>Principal Objective</th>
<th>Model Specification</th>
<th>Resolution</th>
<th>Characteristic Feature</th>
<th>Major Institute Involved</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Long-term</td>
<td>Projection up to 300 years for the basis of options of stabilization targets in Post-Kyoto issues</td>
<td>Integrated Earth system model (covering atmosphere, carbon cycle, land surface, chemistry and ocean)</td>
<td>280km</td>
<td>100km</td>
<td>JAMSTEC NES ADRI, the University of Tokyo</td>
</tr>
<tr>
<td></td>
<td>Proper simulation of tropical meteorology by directly resolving convective clouds (unique in the world)</td>
<td>Global cloud resolving model (atmosphere-land surface model with given SST)</td>
<td>14km [7km]</td>
<td>—</td>
<td>JAMSTEC ADRI, the University of Tokyo</td>
</tr>
<tr>
<td>2 Near-term</td>
<td>Near-term detail projection up to 2030 (irrelevant to scenario)</td>
<td>High resolution coupled atmosphere-ocean model (covering atmosphere, land surface and ocean)</td>
<td>50km</td>
<td>20km</td>
<td>JAMSTEC ADRI, the University of Tokyo</td>
</tr>
<tr>
<td>3 Extreme Events</td>
<td>Projection of extreme weather events (typhoons, heavy precipitation, etc. in the near-term future and at the end of the 21st century)</td>
<td>Super-high resolution atmospheric model (atmosphere and land surface model with given SST)</td>
<td>20km</td>
<td>—</td>
<td>MRI/JMA JAMSTEC</td>
</tr>
<tr>
<td></td>
<td>Dynamic downscaling from the above (limited area model)</td>
<td>Dynamic downscaling from the above (limited area model)</td>
<td>5km [2km&amp;1km]</td>
<td>—</td>
<td>MR/JMA JAMSTEC</td>
</tr>
<tr>
<td></td>
<td>(Reference) Atmosphere-ocean coupled models developed and/or used in Kyo-sei Project</td>
<td>(Reference) Atmosphere-ocean coupled models developed and/or used in Kyo-sei Project</td>
<td>110-280km</td>
<td>20-140km</td>
<td>(cited from a brochure of the program)</td>
</tr>
</tbody>
</table>

(cited from a brochure of the program)

Example of KAKUSHIN's output on climate change impacts
Change ratio of extreme flood discharge
(yearly maximum daily discharge, 50-year return period).

The area of river basins are equal to or larger than 3000000Km².
Bottom: Ration of the end of 21st century simulations (2075-2099) to the present-day simulations (1979-2004).

(cited from a brochure of the program)
Collaborations between research projects

Climate projection (funded by MEXT)

Kyosei (2002-2006)
- 100km AO-GCM by CCSR/NIES/FRCGC (-2100)
- 20km time-slice experiments by MRI/JMA

Kakushin
- [Long-term] 280km Earth System Model by FRCGC (-2300)
- [Near-term] 50km AO-GCM by CCSR/NIES/FRCGC (-2030)
- [Extreme event] 20km time-slice experiments by MRI/JMA

Sousei
- Probabilistic climate scenarios
- Long-term scenarios

Task Group on Climate Scenario Utilization
- Co-ordination of data exchange
- Share of know-how on climate scenario utilization

Impact assessment (funded by MOE)

S-5
- Analyses of sectoral impacts in Japan and Asia
- Spatial downscaling of climate scenarios (with RCM / SD)
- Downscaling of socio-economic scenarios (global)
- Sectoral impact assessment at global scale
- Risk communication with public citizen and business

S-10
- Risk management strategies
- Sectoral impacts and adaptation strategies in Japan
- Adaptation policy of Local Governments

S-8
- Risk communication of uncertainties in impact projections


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### Economics of Adaptation to Climate Change (WB, 2010)

#### Graph

- **East Asia and Pacific**
- **Europe and Central Asia**
- **Latin America and Caribbean**
- **Middle East and North Africa**
- **South Asia**
- **Sub-Saharan Africa**

#### Table

<table>
<thead>
<tr>
<th>Sector</th>
<th>UNFCCC (2007)</th>
<th>NCAR (降水が増える気候シナリオ)</th>
<th>CSIRO (降水が減る気候シナリオ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infrastructure</td>
<td>2-41</td>
<td>29.5</td>
<td>13.5</td>
</tr>
<tr>
<td>Coastal zones</td>
<td>5</td>
<td>30.1</td>
<td>29.6</td>
</tr>
<tr>
<td>Water supply and flood protection</td>
<td>9</td>
<td>13.7</td>
<td>19.2</td>
</tr>
<tr>
<td>Agriculture, forestry, fisheries</td>
<td>7</td>
<td>7.6</td>
<td>7.3</td>
</tr>
<tr>
<td>Human health</td>
<td>5</td>
<td>2</td>
<td>1.6</td>
</tr>
<tr>
<td>Extreme weather events</td>
<td>—</td>
<td>6.7</td>
<td>6.5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>28-67</strong></td>
<td><strong>89.6</strong></td>
<td><strong>77.7</strong></td>
</tr>
</tbody>
</table>

Source: UNFCCC (2007) and Economics of Adaptation to Climate Change study team.
Toward the improvement of impact analyses in Asia
-Enhancement of collaboration -

• Data
  – Climate scenarios, especially downscaled ones
  – Socio-economic scenarios both top-down (downscaled) scenarios and bottom-up scenarios
  – Public archive system for storing and sharing the data?

• Methods
  – Collaborative researches for developing and sharing tools and methods for impact analyses

• Adaptation experiences
  – Menu of adaptation options including indigenous ones
  – Accumulation of cases (good and bad practices)