Global Challenge for Flood Disaster Risk Reduction
世界の洪水被害軽減に向けて

Roles of Science and Technology
科学技術が果たすべき役割

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Three Key Global Agendas in 2015

- The world knows that countries cannot act in isolation to address these risks.
- Concerted Action is Required

- March 2015: Sendai Framework on Disaster Risk Reduction
- September 2015: Sustainable Development Goals
- December 2015: Paris Agreement (COP 21)
Warming of the climate system is unequivocal.

IPCC/AR4(2007)

(a) Global average temperature
(b) Global average sea level
(c) Northern Hemisphere snow cover

IPCC/AR5(2013)

Observed globally averaged combined land and ocean surface temperature anomaly 1850–2012

(a) Northern Hemisphere spring snow cover
(b) Arctic summer sea ice extent
(c) Change in global average upper ocean heat content
(d) Global average sea level change
## Climate Change Impacts of Water Cycle Extremes


<table>
<thead>
<tr>
<th>Phenomenon and direction of trend</th>
<th>Likelihood of further changes</th>
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<tbody>
<tr>
<td>Heavy precipitation events. Increase in the frequency, intensity, and/or amount of heavy precipitation.</td>
<td><strong>Likely</strong> over many land areas <strong>Very likely</strong> over most of the mid-latitude land masses and over wet tropical regions</td>
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<tr>
<td>Increases in intensity and/or duration of drought</td>
<td><strong>Low confidence</strong> (g) <strong>Likely</strong> (medium confidence) on a regional to global scale (h)</td>
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<tr>
<td>Increases in intense tropical cyclone activity</td>
<td><strong>Low confidence</strong> <strong>More likely than not</strong> in the Western North Pacific and North Atlantic (j)</td>
</tr>
<tr>
<td>Increased incidence and/or magnitude of extreme high sea level</td>
<td><strong>Likely</strong> (l) <strong>Very likely</strong> (l)</td>
</tr>
</tbody>
</table>
Monsoon

IPCC/AR5 (2014)

Psd: standard deviation of inter-annual variability in seasonal average precipitation

→ Wet-Dry Contrast (water storage)

R5d: seasonal maximum 5-day precipitation total

→ Large Flood (wide coverage of rainfall observation)
End to End Approach on Climate Change Adaptation

- Climate models
- Process Study
- Integrated Observed Data Sets
- Quantifying uncertainty
- Multi-model Ensemble (MME)
- Down-scaling
- Basin-scale Prediction of quantity & quality

Water quantity & quality prediction:
- Flood
- Ordinary Water
- Ground Water
- Drought

Current facility, plan, management:
- Information
- Flood Control System
- Storage
- Treatment

Flood Disaster Potential
Drought Disaster Potential
Rainfall (June and July) Climatology (1981-2000)
Derived from Satellite Observations
Evaluation for relative distribution:
Correlation coefficient (CC)

Evaluation of absolute value:
RMSE

Scoring
CC and RMES are more than all GCM averaged value: 1
CC or RMES are more than all GCM averaged value: 0
CC and RMES are less than all GCM averaged value: -1
Bias-correction and Down-scaling in Yoshino River

(20 years average of monthly rainfall in September)
Top 20 Large Floods at the Ikeda, Yoshino River
past(1981-2000) — future(2046-2065) (m³/s)

Severer Floods Very Likely
Maximum Water Level

*Assumption here is 1981 and 2046 have the same initial condition (dam water level, discharge and volume of reservoir)

High Water Demand Season

Sameura Dam Water Level: Past

310

High Water Demand Season

Sameura Dam Water Level: Future

310

2046

2047

2048

2049

2050

2051

2052

2053

2054

2055

2056

2057

2058

2059

2060

2061

2062

2063

2064

2065

Average
MODEL SELECTION: Precipitation (May-November)
Frequency Analysis (1981-2000)

Frequency Analysis (2046-2065)

Bias corrected monthly distribution 1981-2000

Bias Corrected monthly distribution 2046-2065

10 year probability extreme rainfall

50 year probability extreme rainfall

100 year probability extreme rainfall
Insitu-station

Corrected GCMavg

Future Corr_GCMavg

Future - Past

Maximum Probable Extreme Rainfall Spatial Distribution by Insitu stations 10 Year Return Period (1981-2000)

Maximum Probable Extreme Rainfall Spatial Distribution by GCM average 10 Year Return Period (1981-2000)

Maximum Probable Extreme Rainfall Spatial Distribution by GCM average 10 Year Return Period (2046-2065)

Absolute Change in Maximum Probable Extreme Rainfall by GCM average 10 Year Return Period (2046-2065)

Probability: 10year

Probability: 100year
Changes of Flood in Angat Dam Basin
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Water Allocation & Cost
- Flood Disaster Potential
- Drought Disaster Potential

Impact Assessment
- Flood Disaster Potential
  - Environment
  - Human Behavior
  - Filed Survey
  - Economic Behavior
  - Industry
- Drought Disaster Potential

Adaptation Options
- Early Warning
- Innovative Technology
  - Flood
  - Quality Control
- Allocation Policy
- Land Use etc.

Decision Making

Implementation

Monitoring & Evaluation
Investment for Disaster Damage Reduction

Flood simulation

1. Develop flood models to reproduce actual flood damage.
2. Demonstrate countermeasure effects for reducing damage.
3. Translate flood model outputs into economic model inputs.

Economic simulation

4. Develop economic models to reproduce actual economic parameters.
5. Simulate effect of countermeasures on economy and society with several scenarios.

(Catchment-based Macro scale Floodplain model, Yamazaki, 2012)

(Disaster Risk Reduction investment Accounts for Development (DR²AD), Yokomatsu, 2013)
2. Establish the levee as disaster prevention and calculate the effect on damage reduction

Establishing **LEVEE** as **Disaster Prevention** in CaMa-flood and measure the effect of the levees on the **damage reduction**

![Sub-grid parameters diagram](image)

Building levee in **mainstream** of LOWER(LW) and **MIDDLE**(MD) basin

D. Yamazasi, 2012, Physically-based Modelling of Large-scale Flooding in Continental-scale Rivers of the World
Results are different between LW levee and MD levee

GDP comparison
Low levee/No levee
Middle levee/No levee

MD: more GDP growth
LW: less GDP growth

Gini coefficient reduction (%)
LW and MD levee against NO levee

MD: increase equality
LW: decrease equality
Dam Operation Optimization System by Using Rainfall Forecasting

Short-term

Weather forecast Output → Error Forecast

Spatially distributed data → Spatially distributed data

Optimization of dam network

Coupled DHM & Dam Operation

Minimization scheme

Integrated dam network release schedule

Potential Operational Rule & Weighting

Flood Peak Reduction Effect Water Use
Flood reduction with GPV 7~12

Water is stored until max capacity is reached

Flood peak reduction

Water level increase due to storage

Peak created due to water release from dams
End to End Approach on Climate Change Adaptation

End to END
Data Integration and Analysis System

To create knowledge enabling us to solve the Earth environment problems and to generate socio-economic benefits.

A legacy for Japan's contributions to GEOSS
Massive data on water, atmosphere, lands and oceans are collected, integrated and put into archive the Data Integration and Analysis System (DIAS).

It is also important for people to understand the meaning of disaster information they receive, and to take adequate measures such as prompt evacuations.