Presentations in Session VI

- Overview of recent impact studies by NIES AIM/Impact team and introduction to ICA-RUS project, Dr. Kiyoshi Takahashi (NIES)
- Recent research on climate change impacts assessment and adaptation policies in Japan, Dr. Yasuaki Hijioka (NIES)
- Economic modeling of climate change impacts and adaptation: a review of global Integrated Assessment Models, Dr. Su Xuanming (NIES)
- The state of local government adaptation in Korea, Dr. Huicheul Jung and Dr. Seongwoo Jeon (KEI, Korea)
- Climate Change Impact Studies in APCC, Dr. Yonghee Shin (APCC, Korea)

The 19th AIM workshop
13-14 Dec 2013: Tsukuba

Overview of recent impact studies by NIES AIM/Impact team and introduction to ICA-RUS project

Kiyoshi Takahashi, Hideo Harasawa, Yasuaki Hijioka, Naota Hanasaki, Yoshimitsu Masaki, Yuko Onishi, Xuanming Su, Akemi Tanaka

News and Noteworthy Activities

- New team members and other internal transfer
- Enhanced participation in international academic activities
- Increase in the number of peer-reviewed papers
- Revisit to the Impact Function approach
- Analyses of climate change impacts at global scale utilizing the new scenarios (CMIP5 based on RCPs and/or SSPs).
- Adaptation analyses at global scale
- Contribution to the development process of Japanese National Adaptation Plan

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NIES Climate change impact modeling team in 2013


Dr. Hideo Harasawa, Vice president of NIES, Integrated assessment


Dr. Yasuaki Hijioka, National-scale integrated impact assessment


Dr. Yuko Onishi, National-scale impact assessment (Vegetation)


Dr. Naota Hanasaki, Global-scale impact assessment (Water)


Dr. Yoshimitsu Masaki, Global-scale impact assessment (Water)


Dr. Kiyoshi Takahashi, Global-scale integrated impact assessment


Dr. Xuanming Su, Integrated assessment model for adaptation analyses


Ms. Akemi Tanaka, Global-scale impact assessment (Agriculture)

- Collaborators:
  - Ex-members: Dr. Yuji Masutomi, Dr. Huicheul Jung, Dr. Yonghee Shin, Dr. Takahiro Yamamoto
  - In NIES: Dr. Tomoko Hasegawa, Dr. Shinichiro Fujimori and other emission team members

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Ongoing Research Projects on Impacts and Adaptation

NIES Climate Change Research Program

- Project 2: Climate change and global risk assessment [Takahashi, Hijioka, Hanasaki, Masaki, Su, Tanaka; 2011.4-2016.3]

The Environment Research & Technology Development Fund (ERTDF) funded by the MoE, Japan

- S-10: Integrated research on the development of global climate risk management Strategies [Takahashi, Hanasaki, Hijioka, Su, Tanaka; 2012.4-2017.3]
- S-8: Comprehensive research on climate change impact assessment and adaptation policies [Harasawa, Hijioka, Hanasaki, Takahashi; 2009.4-2014.3]
  - Assessment of climate change impacts in Japan considering feasibility of realizing a safe and secure climate change adaptive society

Ongoing Research Projects on Water Resource

Grants-in-Aid for Scientific Research funded by Japan Society for Promotion of Science

•Detecting drought and flood risks by real time simulation using a global water resources model [Hanasaki]

•Initiative of global water sustainability risk assessment using integrated hydrological and water resources model [Hanasaki]

Science and Technology Research Partnership for Sustainable Development (SATREPS) funded by the Japan Science and Technology Agency (JST) and the Japan International Cooperation Agency (JICA)

•Integrated study on hydro-Meteorological Prediction and Adaptation to Climate change in Thailand [Hanasaki]

Core Research for Evolutional Science and Technology (CREST)

•Development of long term vision for sustainable water use of the world process [Hanasaki]

Contribution to International Academic Activities

- **Agricultural Model Inter-comparison and Improvement Project (AgMIP)** [Fujimori, Hasegawa, Masui, Takahashi]
- **Inter-Sectoral Impact Model Intercomparison Project (ISI-MIP)** [Hanasaki, Masaki]
- **Impacts and Risks from High-End Scenarios: Strategies for Innovative Solutions (IMPRESSIONS)** [Takahashi, Hanasaki, Masui]
- **IPCC**
  - AR5 (WGII)
    - LA of Ch. 19 (Emergent risks and key vulnerabilities) [Takahashi]
    - CLA and CS of Ch. 24 (Asia) [Hijioka and Onishi]

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Publications (Refereed; Published in 2013)

- Davie, J. C. S., P. D. Falloon, R. Kahana, R. Dankers, R. Betts, F. T. Portmann, D. Wisser, D. B. Clark, A. Ito, **Y. Masaki**, K. Nishina, B. Fekete, Z. Tessler, Y. Wada, X. Liu, Q. Tang, S. Hagemann, T. Stacke, R. Pavlick, S. Schaphoff, S. N. Gosling, W. Franssen and N. Arnell, 2013, Comparing projections of future changes in runoff from hydrological and biome models in ISI-MIP, Earth System Dynamics, 4, 359--374, doi:10.5194/esd-4-359-2013
- Davie, J. C. S., P. D. Falloon, R. Kahana, R. Dankers, R. Betts, F. T. Portmann, D. B. Clark, A. Itoh, Y. **Masaki, K**. Nishina, B. Fekete, Z. Tessler, X. Liu, Q. Tang, S. Hagemann, T. Stacke, R. Pavlick, S. Schaphoff, S. N. Gosling, W. Franssen, N. Arnell, 2013, Comparing projections of future changes in runoff from hydrological and ecosystem models in ISI-MIP for the "aggressive mitigation" scenario RCP2.6, compared with the high-end scenario RCP8.5, Impacts World 2013 Conference Proceedings, Potsdam Institute for Climate Impact Research, pp: 350--361, DOI: 10.2312/pik.2013.001
- Flörke, M., S. Eisner, N. **Hanasaki, Y. Masaki, Y**. Wada and M. Bierkens, 2013, A multi-model ensemble for identifying future water stress hotspots, Impacts World 2013 Conference Proceedings, Potsdam Institute for Climate Impact Research, pp: 254--260, DOI: 10.2312/pik.2013.001
- Hagemann, S., Chen, C., Clark, D. B., Folwell, S., Gosling, S. N., Haddeland, I., **Hanasaki, N.**, Heinke, J., Ludwig, F., Voss, F., and Wiltshire, A. J.: Climate change impact on available water resources obtained using multiple global climate and hydrology models, Earth Syst. Dynam., 4, 129-144, 10.5194/esd-4-129-2013, 2013.
- **Hanasaki, N.**, S. Fujimori, T. Yamamoto, S. Yoshikawa, **Y. Masaki**, **Y. Hijioka**, M. Kainuma, Y. Kanamori, T. Masui, **K. Takahashi** and S. Kanae, 2013, A global water scarcity assessment under Shared Socio-economic Pathways – Part 1: Water use, Hydrology and Earth System Sciences, 17, 2375–2391, DOI: 10.5194/hess-17-2375-2013
- **Hanasaki, N.**, S. Fujimori, T. Yamamoto, S. Yoshikawa, **Y. Masaki**, **Y. Hijioka**, M. Kainuma, Y. Kanamori, T. Masui, **K. Takahashi** and S. Kanae, 2013, A global water scarcity assessment under Shared Socio-economic Pathways – Part 2: Water availability and scarcity, Hydrology and Earth System Sciences, 17, 2393–2413, DOI: 10.5194/hess-17-2393-2013
- **Hanasaki, N.**, **Y. Masaki** and **T. Yamamoto**, 2013, Adaptation measures for the impact of climate change on global water resources— Option 2: Adding storage capacity, Impacts World 2013 Conference Proceedings, Potsdam Institute for Climate Impact Research, pp: 433--437, DOI: 10.2312/pik.2013.001
- Honda Y, Kondo M, McGregor G, Kim H, Guo YL, **Hijioka Y**, Yoshikawa M, Oka K, Takano S, Hales S, Kovats RS. (2013) Heat-related mortality risk model for climate change impact projection. Environ Health Prev Med. 2013
- Konar, M., Hussein, Z., **Hanasaki, N.**, Mauzerall, D. L., and Rodriguez-Iturbe, I.: Virtual water trade flows and savings under climate change, Hydrol. Earth Syst. Sci., 17, 3219-3234, 10.5194/hess-17-3219-2013, 2013.
- Kurane, I., Shibasaki, K., Kotaki, A., **Hijioka, Y.** and Takasaki, T. (2013) The Effect of Precipitation on the Transmission of Japanese Encephalitis (JE) Virus in Nature: A Complex Effect on Antibody-Positive Rate to JE Virus in Sentinel Pigs. Int. J. Environ. Res. Public Health 2013, 10, 1831-1844; doi:10.3390/ijerph10051831
- **Masaki, Y.** and **N. Hanasaki**, 2013, Adaptation measures for the impact of climate change on global water resources— Option 1: Reducing water use, Impacts World 2013 Conference Proceedings, Potsdam Institute for Climate Impact Research, pp: 516--521, DOI: 10.2312/pik.2013.001
- Mateo, C. M. R., **Hanasaki, N.**, Komori, D., Yoshimura, K., Kiguchi, M., Champathong, A., Yamazaki, D., Sukhapunnaphan, T., and Oki, T.: A simulation study on modifying reservoir operation rules: tradeoffs between flood mitigation and water supply, IAHS Publication, 362, 33-40, 2013.
- **Ogawa-Onishi, Y.**, Berry, P.M., 2013. Ecological impacts of climate change in Japan: The importance of integrating local and international publications. Biological Conservation, Vol.157, p.361-371.
- van Huijgevoort, M. H. J., Hazenberg, P., van Lanen, H. A. J., Teuling, A. J., Clark, D. B., Folwell, S., Gosling, S. N., **Hanasaki, N.**, Heinke, J., Koirala, S., Stacke, T., Voss, F., Sheffield, J., and Uijlenhoet, R.: Global Multimodel Analysis of Drought in Runoff for the Second Half of the Twentieth Century, J. Hydromet., 14, 1535-1552, 10.1175/jhm-d-12-0186.1, 2013.
- Wada, Y., Wisser, D., Eisner, S., Flörke, M., Gerten, D., Haddeland, I., **Hanasaki, N.**, **Masaki, Y**., Portmann, F. T., Stacke, T., Tessler, Z., and Schewe, J.: Multi-model projections and uncertainties of irrigation water demand under climate change, Geophys. Res. Lett., 40, 4626-4632, 10.1002/grl.50686, 2013.

- Other 10 or more publications in Japanese

Publications (Refereed; Accepted/in press)

- Dankers, R., N. W. Arnell, D. B. Clark, P. D. Falloon, B. M. Fekete, S. N. Gosling, J. Heinke, H. Kim, **Y. Masaki**, Y. Satoh, T. Stacke, Y. Wada and D. Wisser, XXXX, A first look at changes in flood hazard in the ISI-MIP ensemble, Proceedings of the National Academy of Sciences of the United States of America, (accepted)
- Elliott J., D. Deryng, C. Müller, K. Frieler, M. Konzmann, D. Gerten, M. Glotter, M. Flörke, Y. Wada, N. Best, S. Eisner, B. M. Fekete, C. Folberth, I. Foster, S. N. Gosling, I. Haddeland, N. Khabarov, F. Ludwig, **Y. Masaki**, S. Olin, C. Rosenzweig, A. C. Ruane, Y. Satoh, E. Schmid, T. Stacke, Q. Tang and D. Wisser, XXXX, Constraints and potentials of future irrigation water availability on agricultural production under climate change, Proceedings of the National Academy of Sciences of the United States of America, (accepted)
- Haddeland, I., J. Heinke, H. Biemans, S. Eisner, M. Flörke, **N. Hanasaki**, M. Konzmann, F. Ludwig, **Y. Masaki**, J. Schewe, T. Stacke, Z. D. Tessler, Y. Wada and D. Wisser, XXXX, Global water resources affected by human interventions and climate change, Proceedings of the National Academy of Sciences of the United States of America, (accepted)
- Hasegawa, T., Fujimori, S., **Shin, Y.**, **Takahashi, K.**, Masui, T., **Tanaka, A.** (XXXX) Climate Change Impact and Adaptation Assessment on Food Consumption Utilizing a New Scenario Framework. Environmental Science and Technology, in press.
- Ishizaki Y., Yokohata T., Emori S., Shiogama H., **Takahashi K**, Nakaegawa T., **Hanasaki N.**, Nozawa T., Ogura T., Yoshimori M. (2013) Verification of a pattern scaling approach for determining the maximum available renewable freshwater resource, Journal of Hydrometeorology, in press
- Ishizaki Y., Shiogama H., Emori S., Yokohata T., Nozawa T., **Takahashi K.**, Ogura T., Yoshimori M. Nagashima T. (2013) Dependence of precipitation scaling patterns on emission scenarios for representative concentration pathways. Journal of Climate, in press
- Kundzewicz Z.W., Kanae S., Seneviratne S.I., Handmer J., Nicholls N., Peduzzi P., Mechler R., Bouwer L.M., Arnell N., Mach K., Muir-Wood R., Brakenridge G.R., Kron W., Benito G., Honda Y., **Takahashi K.**, Sherstyukov B. (2013) Flood risk and climate change – global and regional perspectives. Hydrological Sciences Journal, in press
- Nelson G.C., van der Mensbrugghe D., Blanc E., Calvin K., Hasegawa T., Havlik P., Kyle P., Lotze-Campen H., von Lampe M., Mason d'Croz D., van Meijl H., Muller C., Reilly J., Robertson R., Sands R.D., Schmitz C., Tabeau A., **Takahashi K.**, Valin H. (2013) Agriculture and Climate Change in Global Scenarios: Why Don't the Models Agree. Agricultual economics, in press
- Piontek, F., C. Müller, T. A. M. Pugh, D. B. Clark, D. Deryng, J. Elliott, F. J. Colón-González, M. Flörke, C. Folberth, W. Franssen, K. Frieler, A. D. Friend, S. N. Gosling, D. Hemming, N. Khabarov, H. Kim, M. R. Lomas, **Y. Masaki**, M. Mengel, A. Morse, K. Neumann, K. Nishina, S. Ostberg, R. Pavlick, A. C. Ruane, J. Schewe, E. Schmid, T. Stacke, Q. Tang, Z. Tessler, A. M. Tompkins, L. Warszawski, D. Wisser and H. J. Schellnhuber, XXXX, Leaving the world as we know it: Hotspots of global climate change impacts, Proceedings of the National Academy of Sciences of the United States of America, (accepted)
- Prudhomme, C., I. Giuntoli, E. L. Robinson, D. B. Clark, N. W. Arnell, R. Dankers, B. Fekete, W. Franssen, D. Gerten, S. N. Gosling, S. Hagemann, D. M. Hannah, H. Kim, **Y. Masaki**, Y. Satoh, T. Stacke, Y. Wada and D. Wisser, XXXX, Hydrological droughts in the 21st century: hotspots and uncertainties from a global multi-model ensemble experiment, Proceedings of the National Academy of Sciences of the United States of America, (accepted)
- Schewe, J., J. Heinke, D. Gerten, I. Haddeland, N. W. Arnell, D. B. Clark, R. Dankers, S. Eisner, B. Fekete, F. J. Colón-González, S. N. Gosling, H. Kim, X. Liu, **Y. Masaki**, F. T. Portmann, Y. Satoh, T. Stacke, Q. Tang, Y. Wada, D. Wisser, T. Albrecht, K. Frieler, F. Piontek, L. Warszawski and P. Kabat, XXXX, Multi-model assessment of water scarcity under climate change, Proceedings of the National Academy of Sciences of the United States of America, (accepted)
- Shen, Y., Oki, T., Kanae, S., **Hanasaki, N.**, Utsumi, N., and Kiguchi, M.: Projection of future world water resources under SRES scenarios: An integrated assessment, Hydrolog. Sci. J., 10.1080/02626667.2013.862338, 2013, accepted.

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- Enhanced participation in international academic activities
- Increase in the number of peer-reviewed papers
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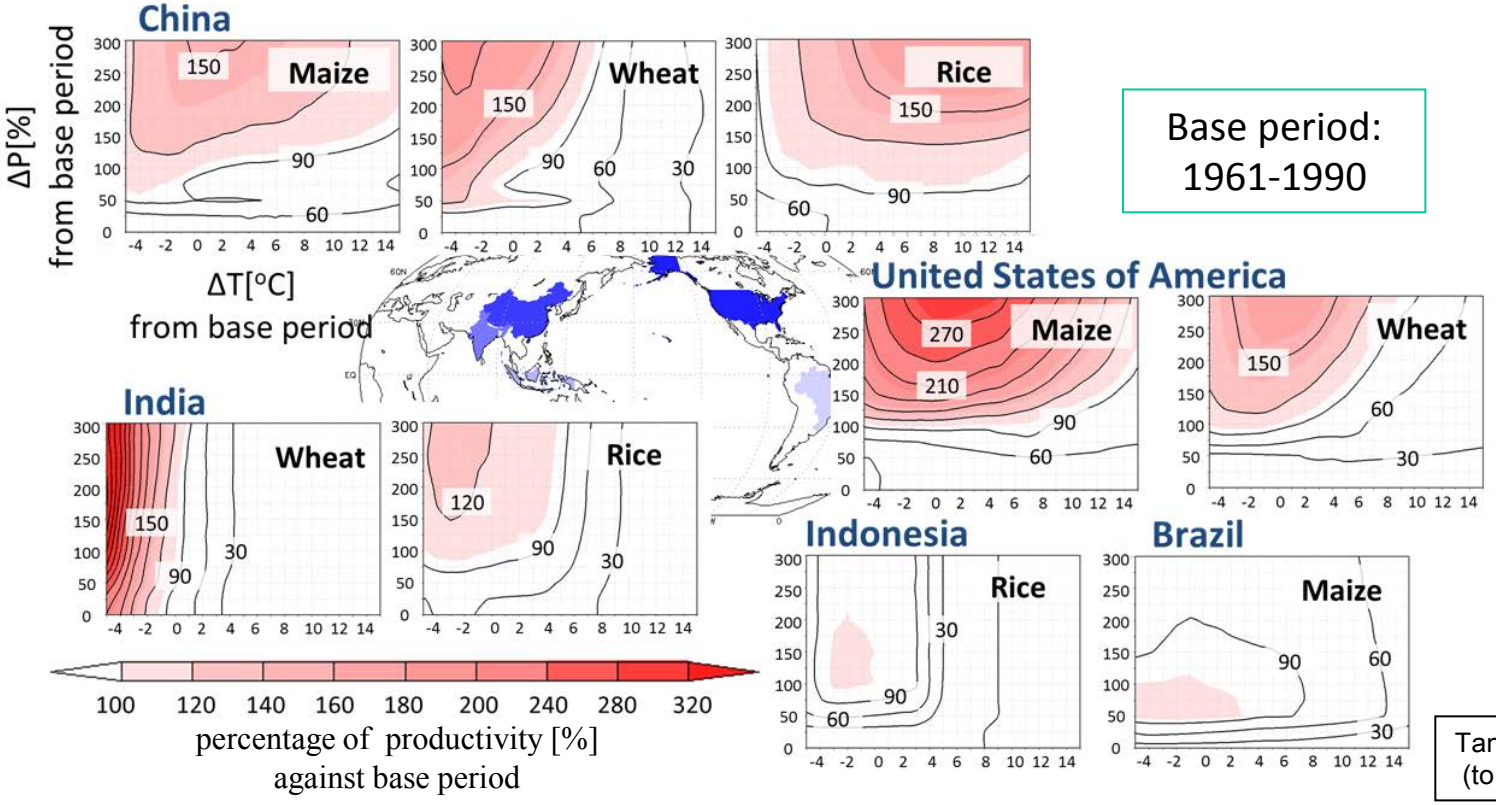
Impact Function development in AIM/Impact [Policy] (An example of Impact Function for crop productivity)

- The impact function is a look-up-table of country-averaged results of sensitivity analyses using a process-based detailed model.
- We developed an impact function for maize, wheat, and paddy-rice productivity with two explanatory variables, change in annual mean temperature (ΔT) and change in annual mean precipitation (ΔP), using the M-GAEZ model.



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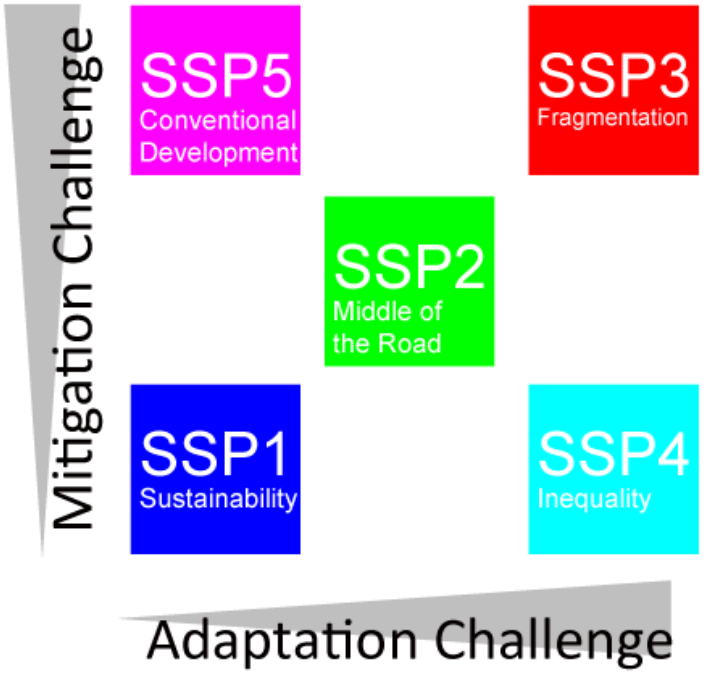
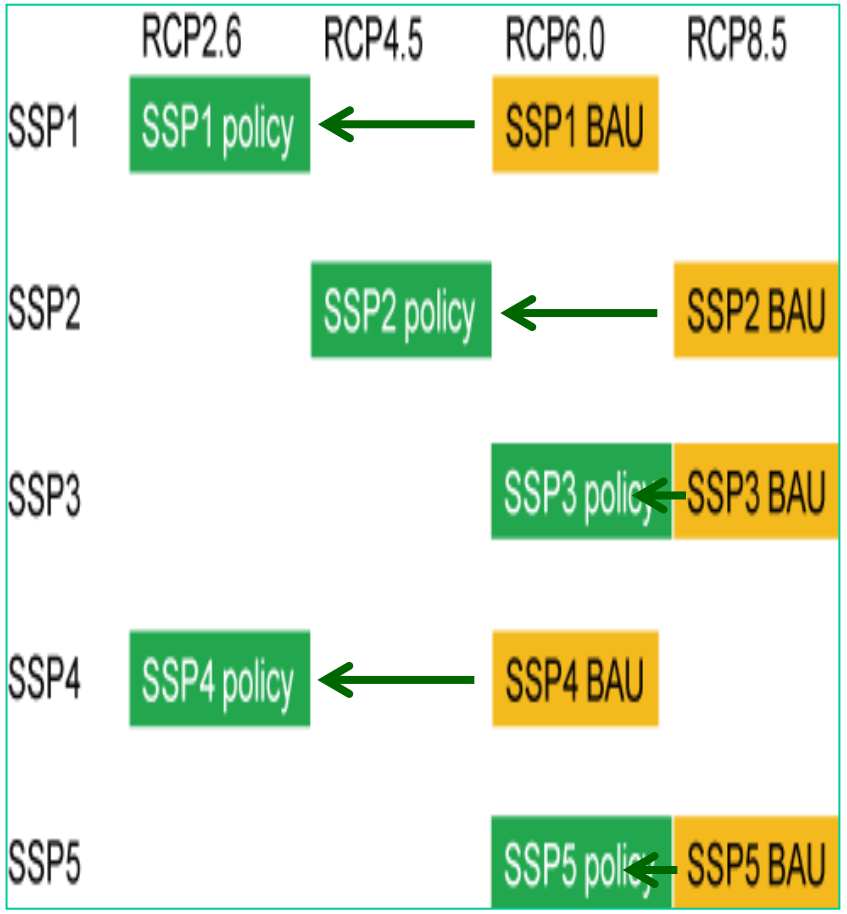
Global water scarcity assessment

SSP

- SSP is a global socio-economic scenario, the successor of SRES. Five different views of the world are depicted.
- SSP doesn't include scenarios on water. We developed a compatible water use scenario.



We also developed a scenario matrix of SSP and RCP. We analyzed the results with/without climate policy.

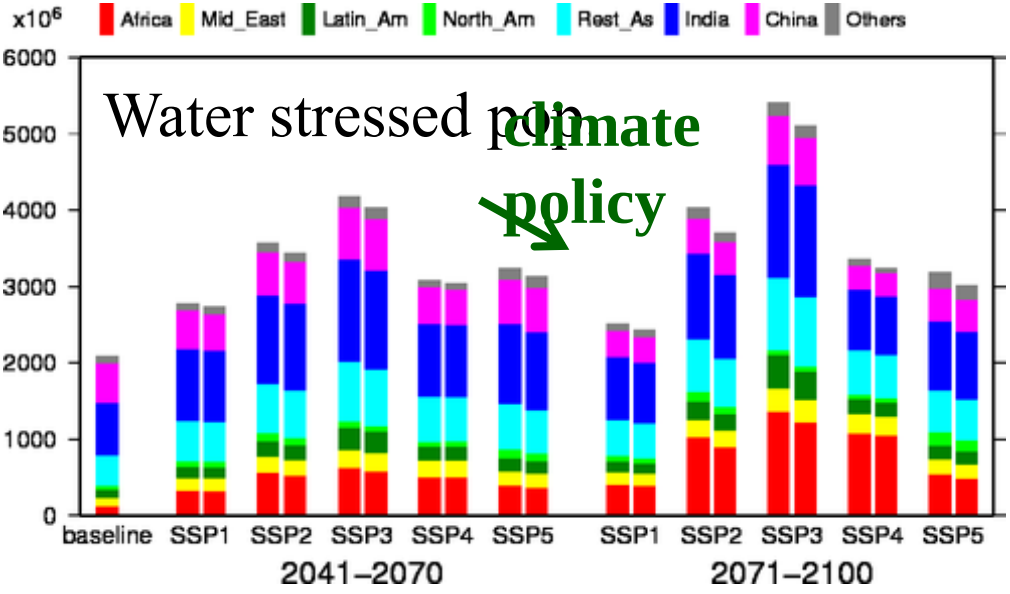


Hanasaki et al. 2013a,b, Hydrology and Earth System Sciences

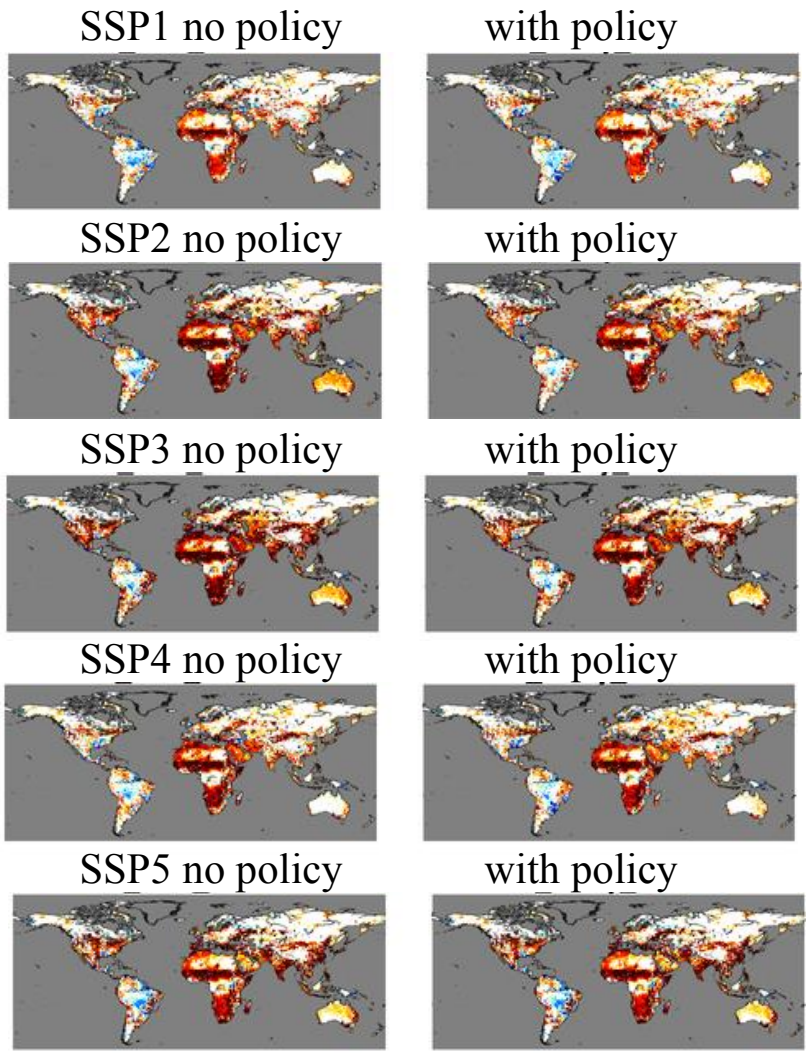
Global water scarcity assessment

Water resources assessment

- Water availability and use was simulated at daily interval, at spatial resolution of 0.5 deg x 0.5 deg.
- A new index was used to evaluate whether water is available when it is needed.



2041-2070, difference from present



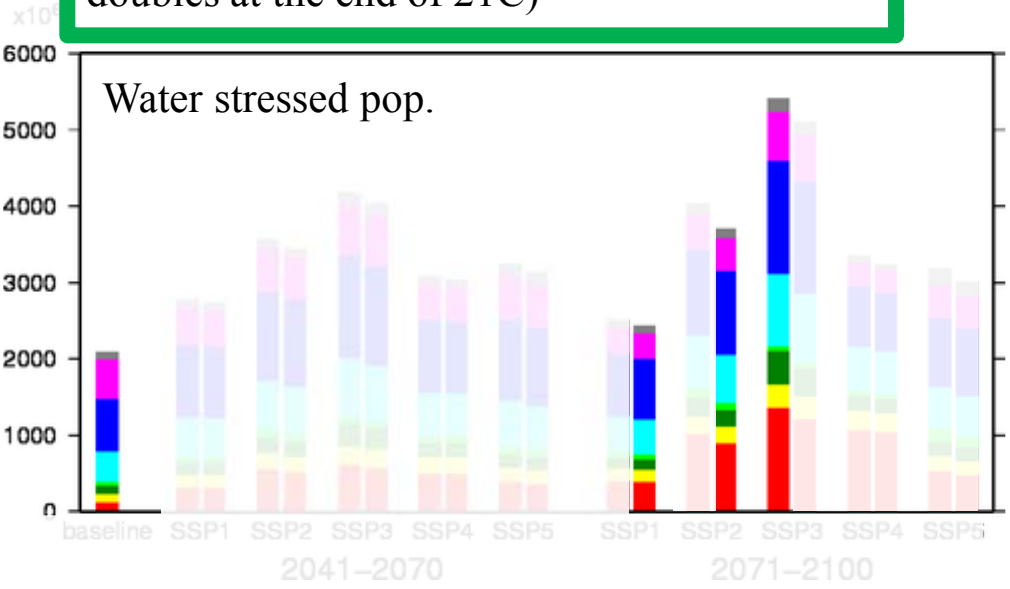
- Ten sets of comprehensive global water scenarios have been developed.

Hanasaki et al. 2013a,b, Hydrology and Earth System Sciences

Global water scarcity assessment

Best scenario (Blue)
-Sustainable society
-Efficient climate policy
-Water stress stabilizes except Africa

BAU scenario (Green)
-Middle of the road
-Moderate climate policy
-Water stress increases (stressed population doubles at the end of 21C)



2041-2070, difference from present

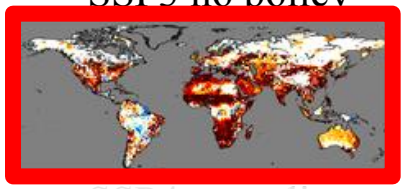
SSP1 no policy

with policy

SSP2 no policy

with policy

SSP3 no policy



Worst scenario (Red)
-Low technological change and low environmental consciousness
- High birth rate and low income
-Water stress heavily increases (stressed population triples at the end of 21C)

- Ten sets of comprehensive global water scenarios have been developed.

Hanasaki et al. 2013a,b, Hydrology and Earth System Sciences

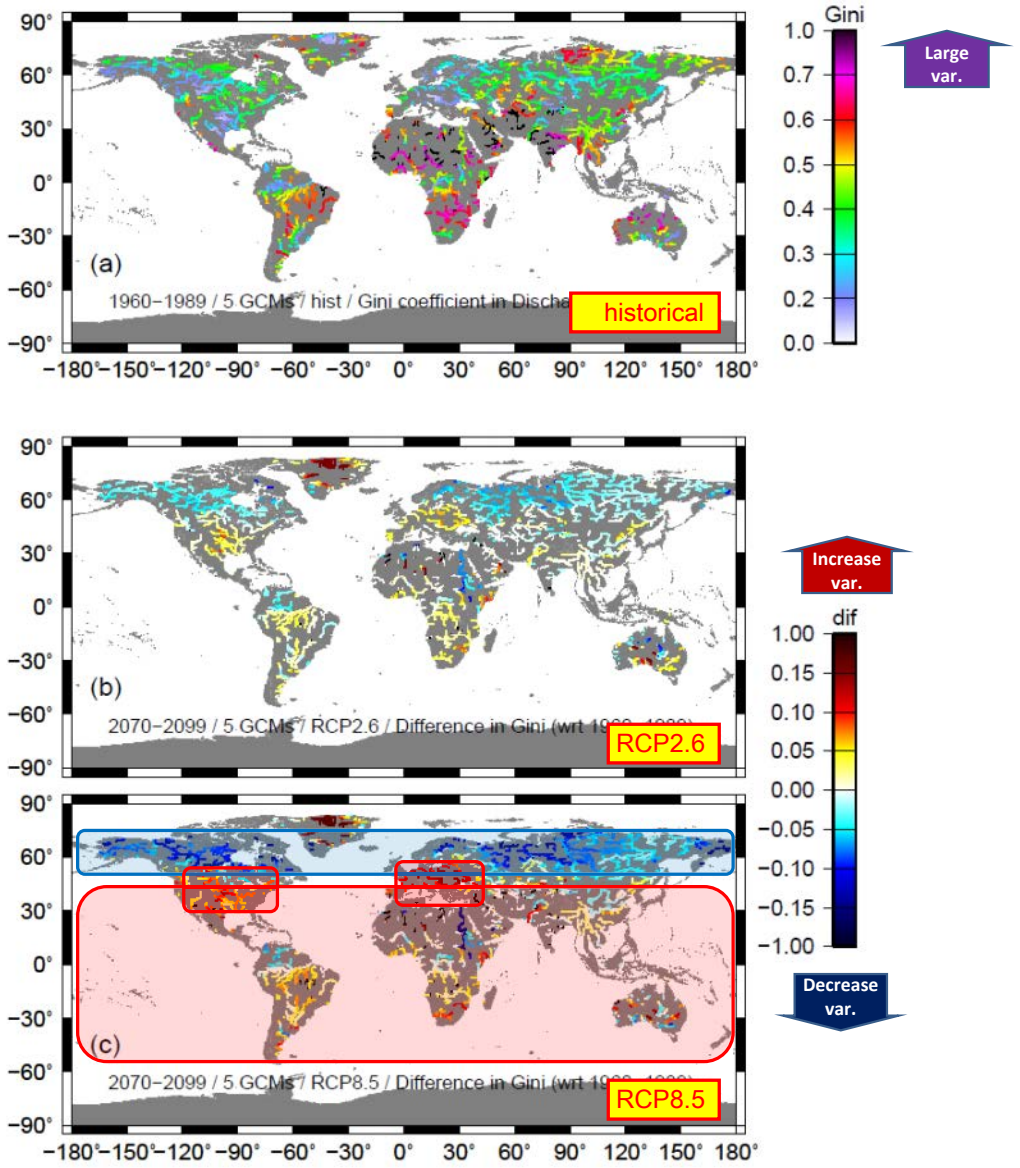
Change in index of river flow regimes

Masaki et al. Global-scale analysis on future changes in flow regimes using Gini and Lorenz asymmetry coefficients (under review)

- Annual-mean discharge will change, but…
  - Seasonal pattern will also change
  - Inhomogeneous changes are seen within the same river basin
- Problems: how to perceive future impacts on flow regimes at a global scale?
  - Hydrographs and flow-duration curves are suitable for ONE site
  - A scalar quantity is favorable

Introducing an index expressing seasonal distribution of river discharge

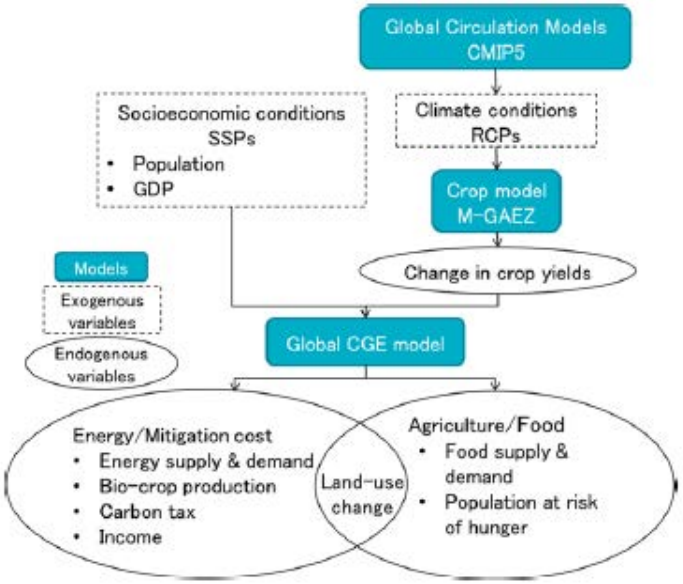
- Gini coefficient (variability) ***G***
  - Originally used in evaluating inequalities among household incomes in economics
- Lorenz asymmetry coefficient (inequality) ***S***



Global distributions of (a) **Gini coefficient** of historical (1960-1989) data and future changes in Gini coefficient under (b) RCP 2.6 and (c) RCP 8.5 climate scenarios for 2070-2099 with respect to the historical values.

Population at risk of hunger

Hasegawa et al: Climate Change Impact and Adaptation Assessment on Food Consumption Utilizing a New Scenario Framework. Environmental Science and Technology, in press.



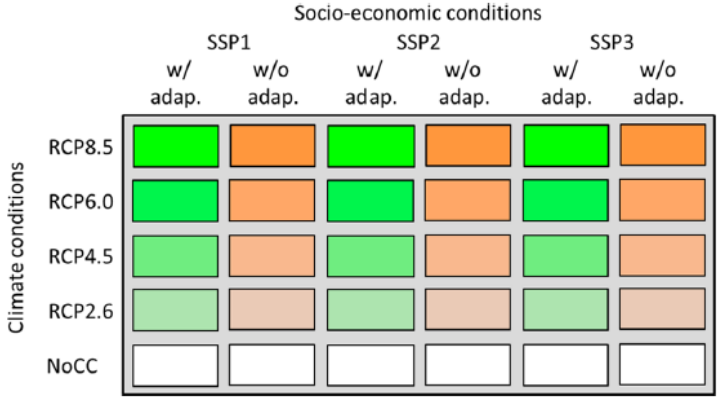
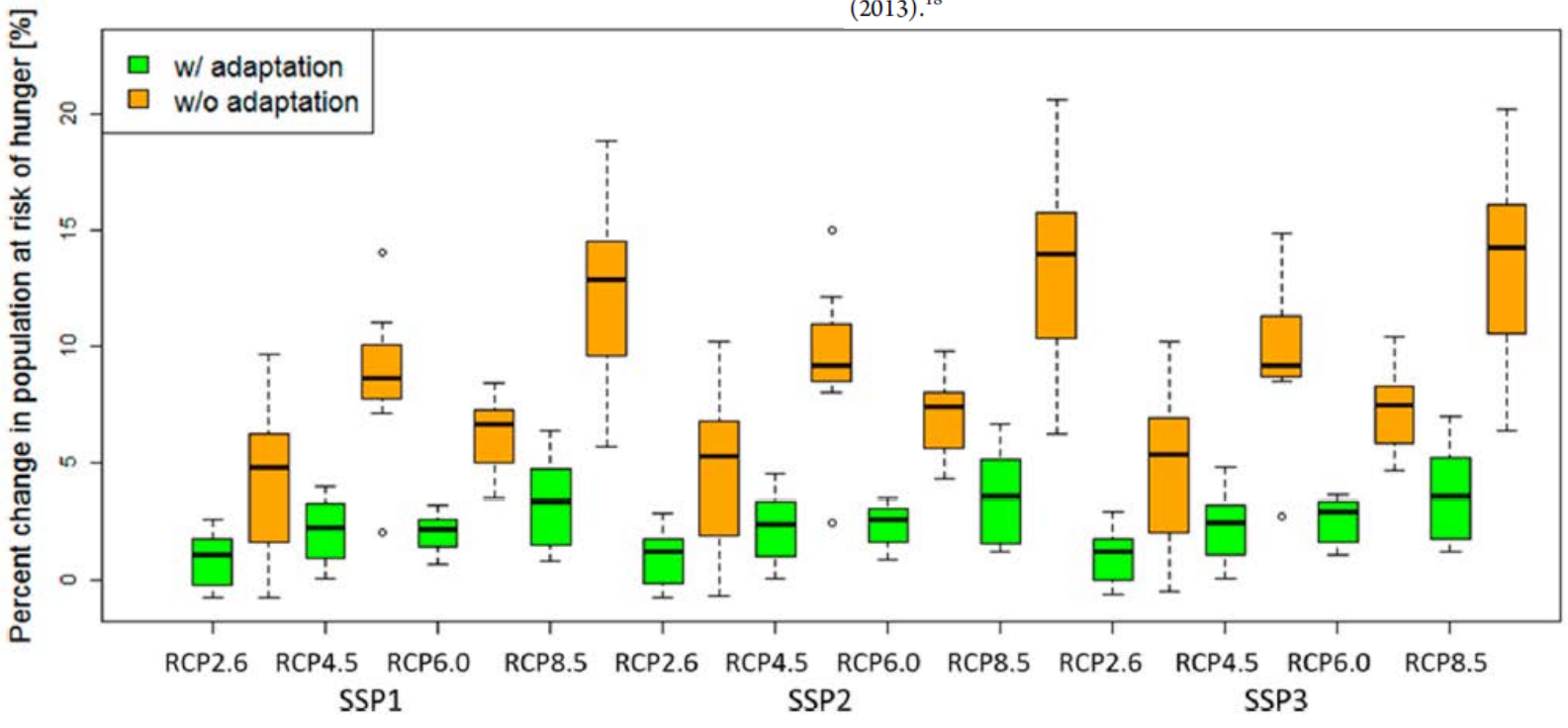


Figure 2. Scenario settings. Option with/without adaptation (adap.) is only for transition and developing countries. Adaptation is considered in industrial countries for all scenarios. "NoCC": No climate change. Present climate condition without adaptation is assumed under the NoCC condition. This figure is based on Figure 1 in van Vuuren et al. (2013).[18]



Spatial variability in phenological responses to climate change in the 21st century

Aim:

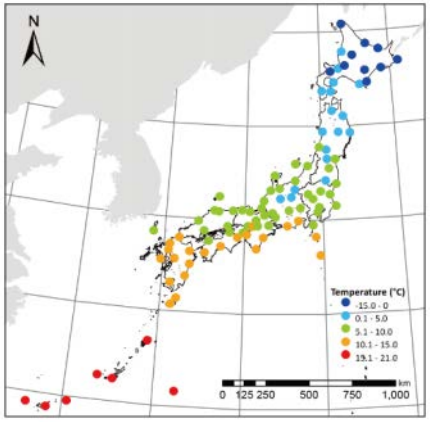
◆To investigate spatial variability of phenological responses within species

◆To project phenological changes in the 21st century under climate change scenarios

Data:

◆Phenology observation (1961-2008)

- Flowering
- Budding



◆Climate model outputs

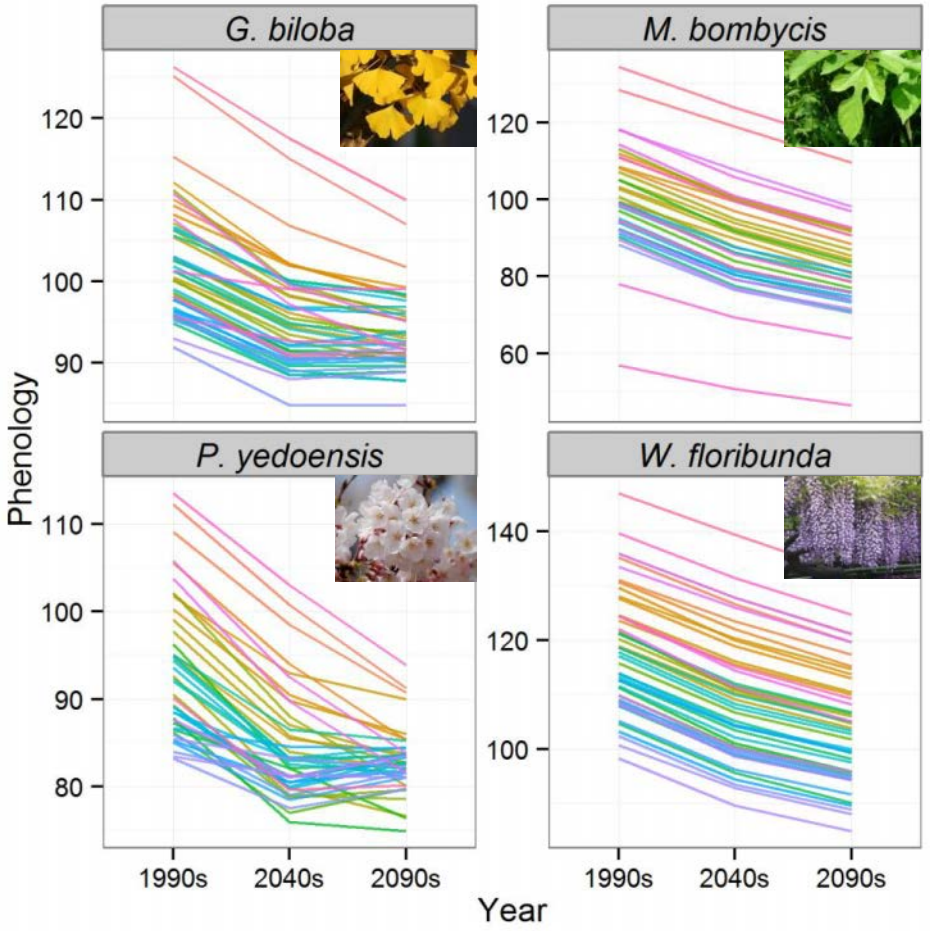
Method:

◆Generalised Additive Mixed Models (GAMM)

Phenology=s(SprT)+s(WinT)+RanEf

SprT: Spring temperature
WinT: Winter temperature
RanEf: Random Effects

Results (e.g. 4 species by MIROC):



Onishi et al. (to be submitted soon)

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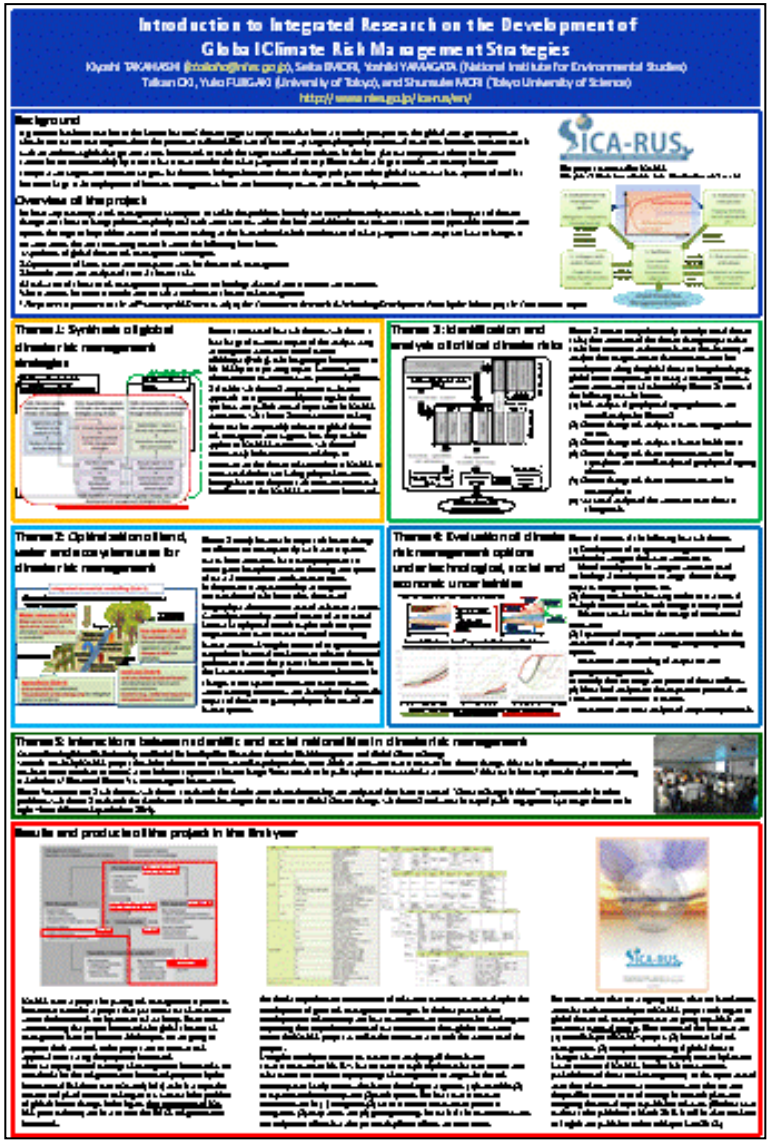
- S-8: Comprehensive research on climate change impact assessment and adaptation policies [Harasawa, Hijioka, Hanasaki, Takahashi; 2009.4-2014.3]
  - Assessment of climate change impacts in Japan considering feasibility of realizing a safe and secure climate change adaptive society

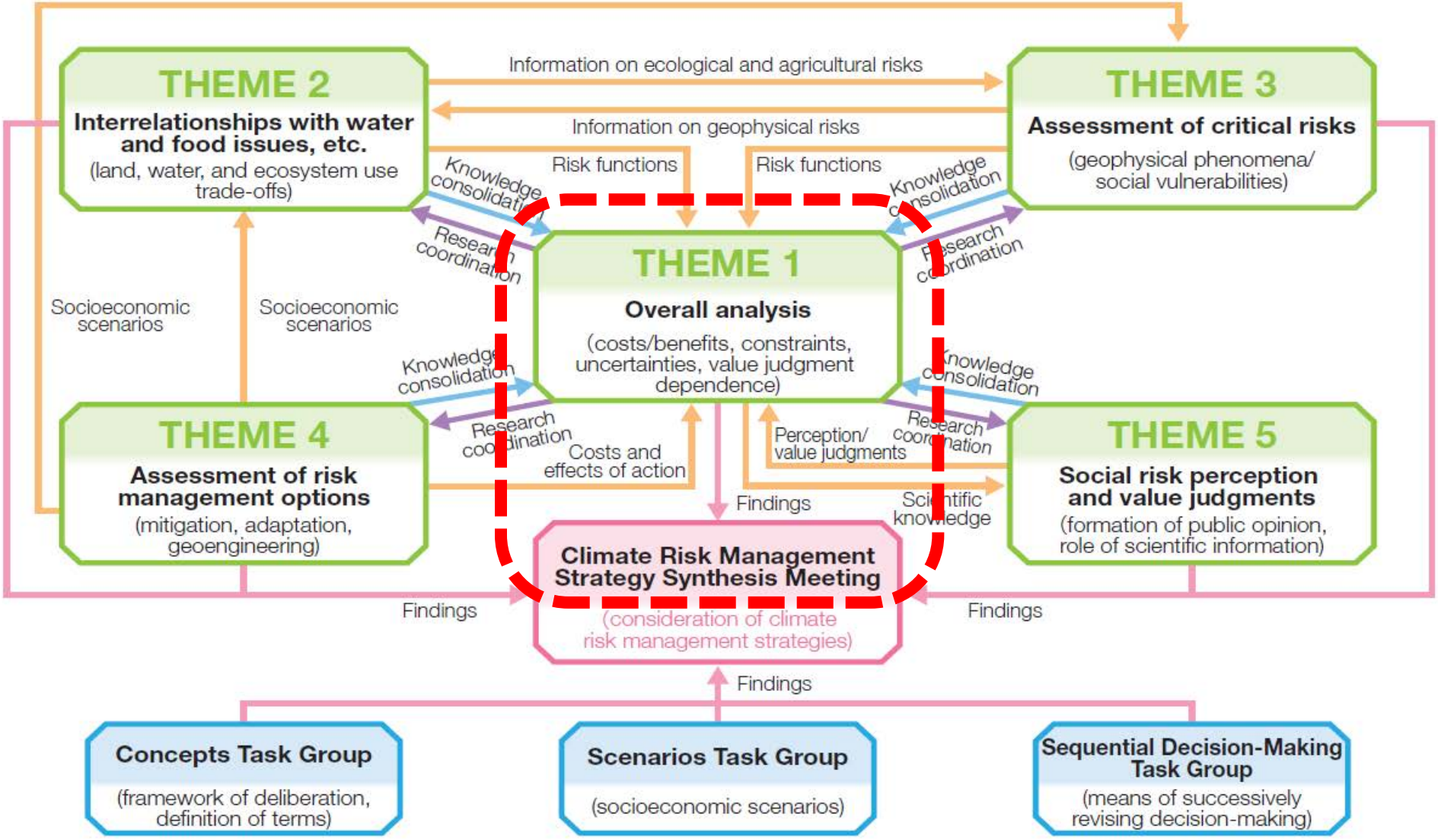
ICA-RUS (FY2012-16)

Integrated Climate Assessment – Risks, Uncertainties and Society

- Objective
  - To propose strategies of global climate risk management
- ‘Integration’ in ICA-RUS
  - Coherent consideration of mitigation and adaptation for managing global climate risks
- Risk management in ICA-RUS
  - Comprehensive assessment of climate change risks
  - Explicit consideration of uncertainties
  - Consideration of every possible options

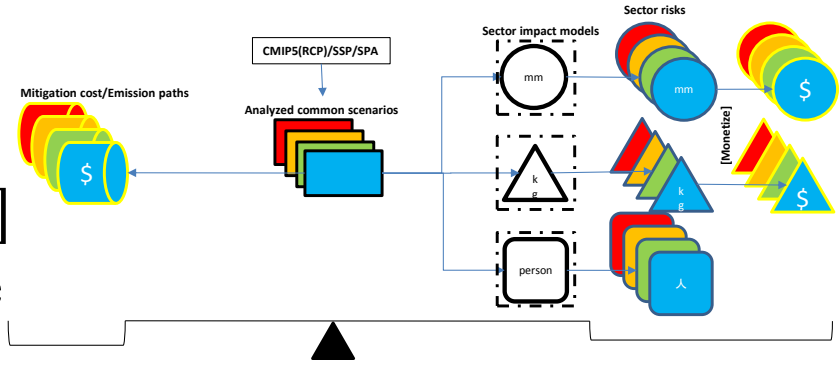


Research system of ICA-RUS project

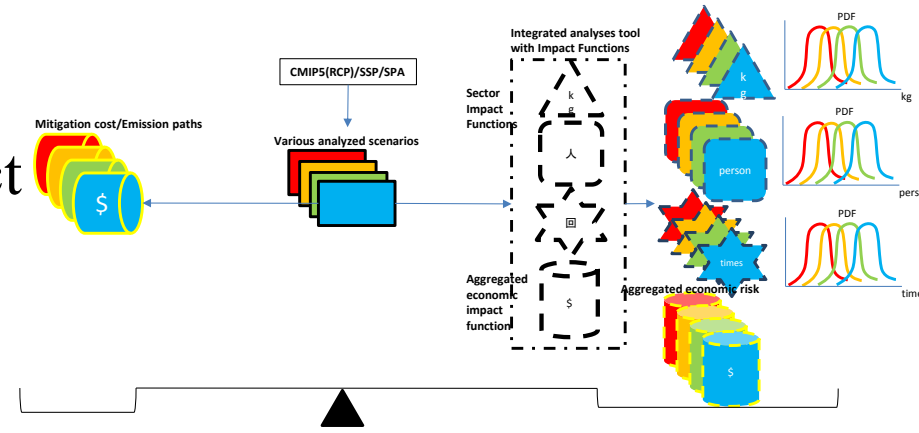


2 way approach for quantitative analysis of risk management strategies in ICA-RUS project

- End-to-end scenario analyses
  - Sector risk analyses using full-scale impact model based on limited number of mitigation scenarios [Theme 2 and Theme 3]
  - Exploration of policies to achieve the assumed mitigation scenarios in the sector risk analyses. [Theme 4]

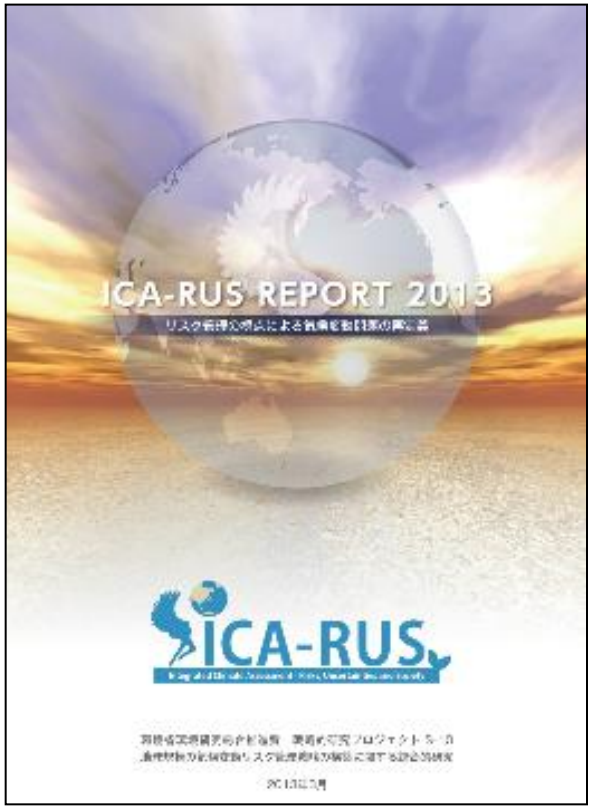


- Integrated analyses tool
  - Development of 'Impact Functions' for each sector impact [Theme 2 and 3]
  - Probabilistic analyses of multi-sector climate risks [Theme 1]
  - Mitigation policy analyses [Theme 4]



ICA-RUS Report 2013 / ICA-RUS/CCRP-PJ2 international workshop

- Annual report (English version) was published at the end of October.



http://www.nies.go.jp/ica-rus/en/index.html

- Title
  - ICA-RUS/CCRP-PJ2 international workshop
- Date and Place
  - 4-6 December 2013
  - Time 24 Building (Tokyo)
- Presentation files will be publicly available by the end of this month.
  - http://www.nies.go.jp/ica-rus/workshop/program.html

News and Noteworthy Activities

- New team members and other internal transfer
- Enhanced participation in international academic activities
- Increase in the number of peer-reviewed papers
- Revisit to the Impact Function approach
- Analyses of climate change impacts at global scale utilizing the new scenarios (CMIP5 based on RCPs and/or SSPs).
- Adaptation analyses at global scale
- Contribution to the development process of Japanese National Adaptation Plan