# Adaptation measures for extreme floods using huge ensemble of high-resolution climate model simulation in Japan

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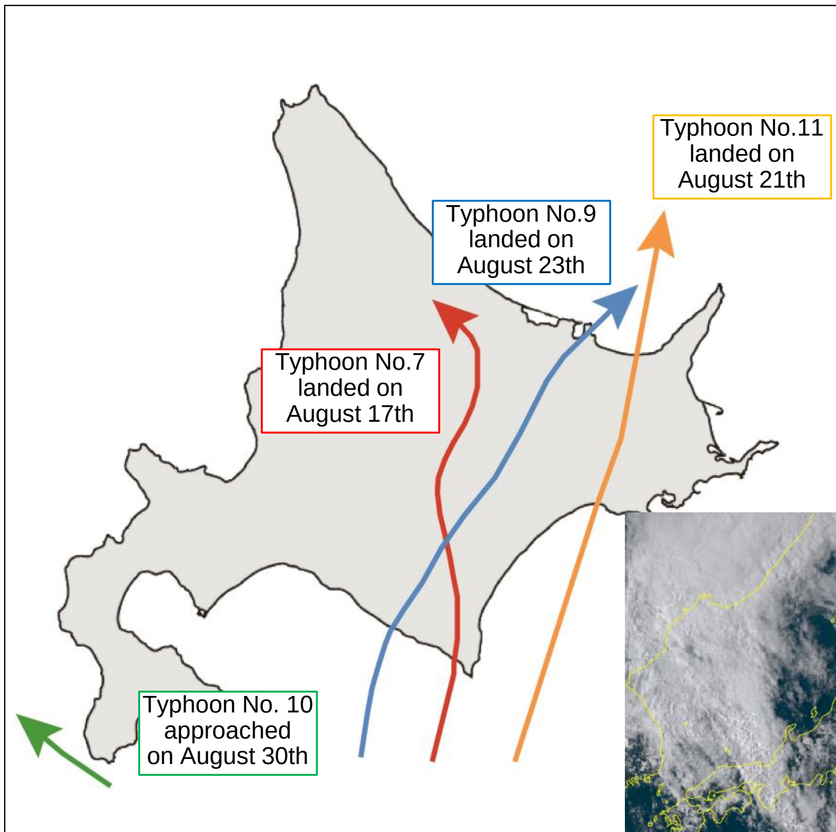
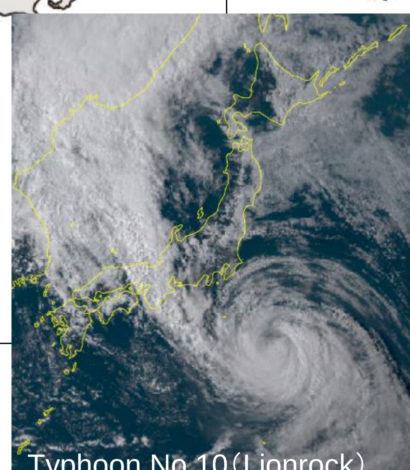
■ Three typhoons landed in Hokkaido for the first time in recorded history in a week of August 17th to 23th, 2016. After that, typhoon No. 10 approached to Hokkaido, and it brought recordable heavy rain in various places. Floods of rivers and sediment disasters occurred mainly in eastern of Hokkaido.

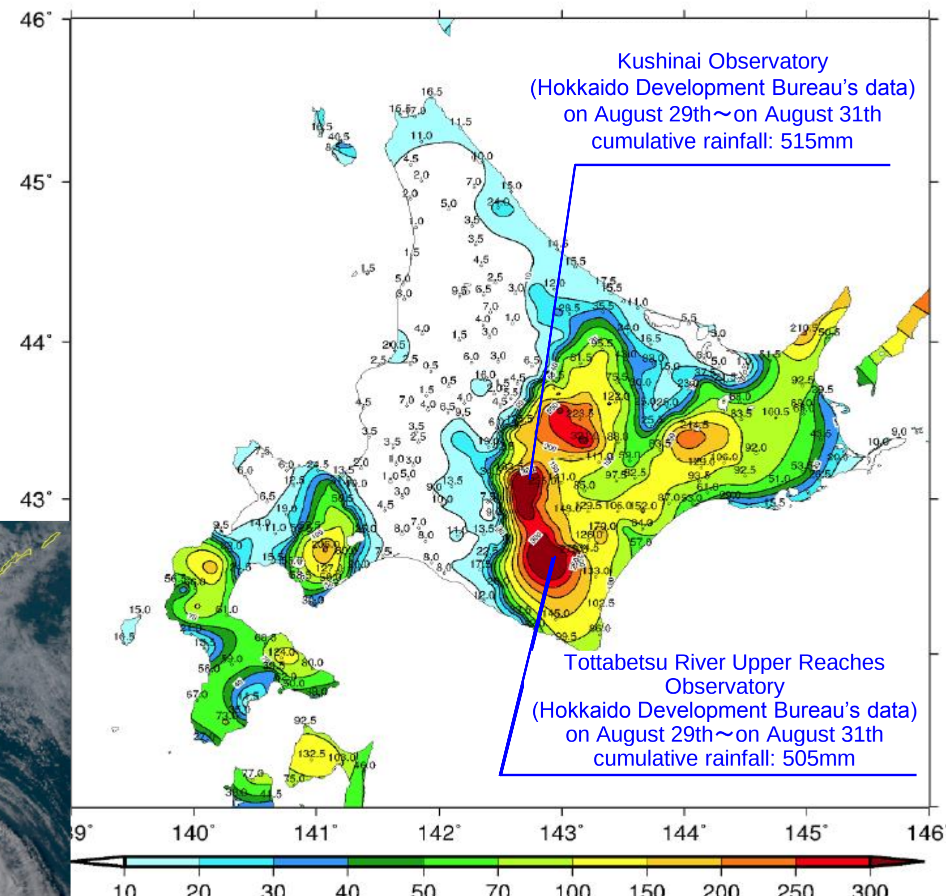
Typhoon routes in August, 2016





Typhoon No.10（Lionrock）

Precipitation distribution（AMEDAS）

at 1:00 on August 29th, 2016 ～ at 9:00 on August 31th, 2016



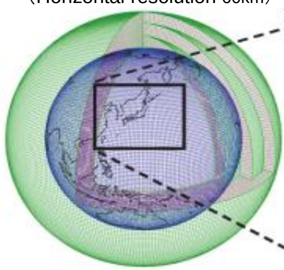
# Our Mission

〇We scientifically predict the influence of climate change(rainfall and discharge change) in Hokkaido based on the latest knowledge.

〇We calculate the change of risks (scale, form and frequency, etc) due to the influence of climate change and share them with society.

## Analysis Of Rainfall In The Future Climate

AGCM
(Horizontal resolution 60km)



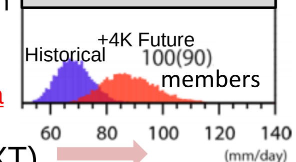
JMA/ NHRCM
(Horizontal resolution 20km)

We calculate dynamical downscaling Hokkaido region to several km by using "database for Policy Decision making for Future climate change(d4PDF)".(Start from 4 degrees rise model)

We analyze the occurrence intensity and frequency of heavy rain based on high resolution and large scale ensemble simulation.

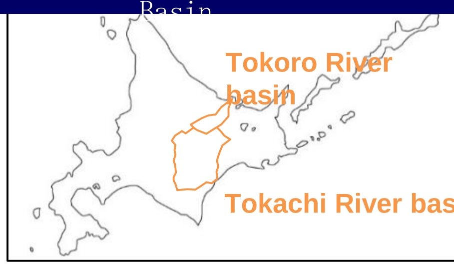
・Explanation of Extreme Phenomena

・Statistical Analysis




Supported by SOUSEI and SI-CAT (MEXT)

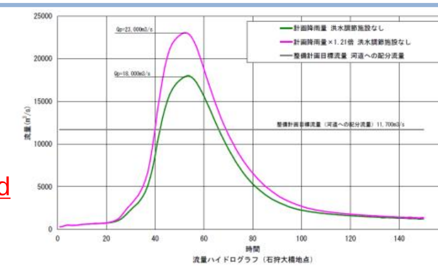
## Estimation Of Change Of Discharge On target Basin




Using Tokachi River and Tokoro River where extensive damage occurred, we predict changes of flood runoff in future climate.

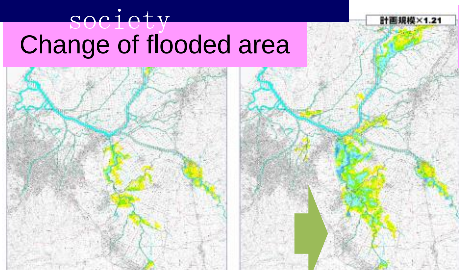
・Change of the peak discharge

・Reduction of safety level of flood control



## Share the flood risk with society

Change of flooded area




Estimation of personal suffering


Estimation of damaged area of agricultural land

Perform risk assessment due to the influence of climate change, and share with society.

・Increase of flooded area

・Increase of personal suffering

・Increase of social risk

・Comparison with other risks such as traffic accidents

Discuss adaptation policy for future flood control in nationwide committees (MLIT)

# Probability Evaluation Of Historical Climate Simulation Rainfall And +4K Future Climate Simulation Rainfall 【Tokachi River Obihiro Reference Point】

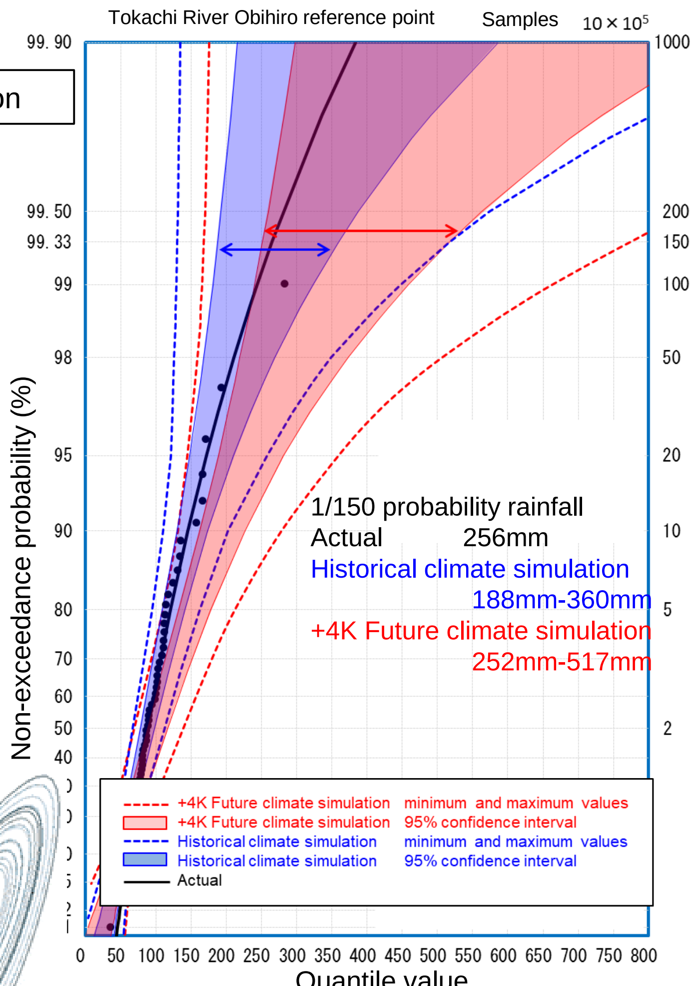
- 95% confidence interval of historical climate simulation based on 1/150 probability rainfall is between 188mm - 360mm in Highly compatible GEV distribution. 95% confidence interval of +4K future climate simulation is between 252mm - 517mm, which shows the trend of increasing rainfall.
- Multiple samples using weather simulation enable us to respond with maximum value of confidence interval by risk management.

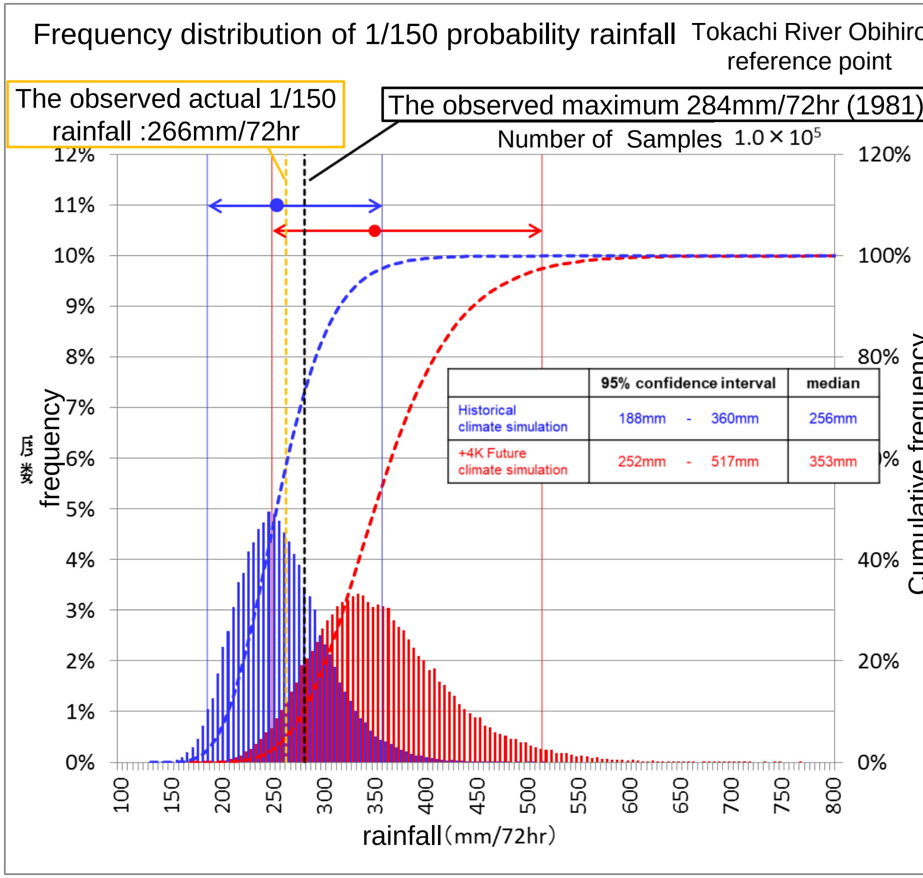
GEV distribution

SLSC Average of 1.0×105 Sample

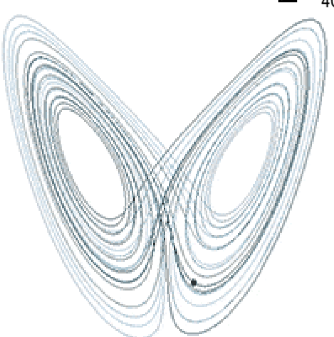
Historical climate simulation：0.014

+4K Future climate simulation： 0.015




| | 95% confidence interval | | | median |
|---|---|---|---|---|
| Historical climate simulation | 188mm | - | 360mm | 256mm |
| +4K Future climate simulation | 252mm | - | 517mm | 353mm |



Tis is a part of materials in a committee, MLIT (Hokkaido Regional Development Bureau).

# External Force Utilized For Risk Assessment 【 Future Experimant Of Tokachi River 】

- Selected 3 external forces for the risk assessment, within the range of 1/150 probability rainfall of +4K future climate simulation GEV distribution at Tokachi river Obihiro reference point: ①maximum peak discharge around median ② maximum peak discharge within 95% of confidence interval ③maximum basin average 72-hour-rainfall within 95% of confidence interval.
- Sampled maximum basin average 72-hour-rainfall out of 5400 cases of +4K future climate simulations to assume the worst possible scenario in the future Tokachi River basin.

## Risk Assessment based on probability rainfall scale

- Case①: Set up based on median of probability rainfall.
  →Select maximum peak discharge from the cases of medians 353±10mm of probability rainfalls .
  ⇒HA-m113-2051

| No | Case | Peak discharge($m^3/s$) | Basin average rainfall (mm/72h) |
|---|---|---|---|
| 1 | HFB_HA_m113_2051 | 8,807 | 350 |
| 2 | HFB_MI_m108_2065 | 7,985 | 350 |
| 3 | HFB_GF_m101_2099 | 7,767 | 354 |
| 4 | HFB_MI_m103_2056 | 7,764 | 353 |
| 5 | HFB_GF_m108_2052 | 6,256 | 362 |
| 6 | HFB_MI_m111_2108 | 5,961 | 355 |
| 7 | HFB_GF_m110_2082 | 5,853 | 344 |
| 8 | HFB_MI_m107_2060 | 5,198 | 351 |

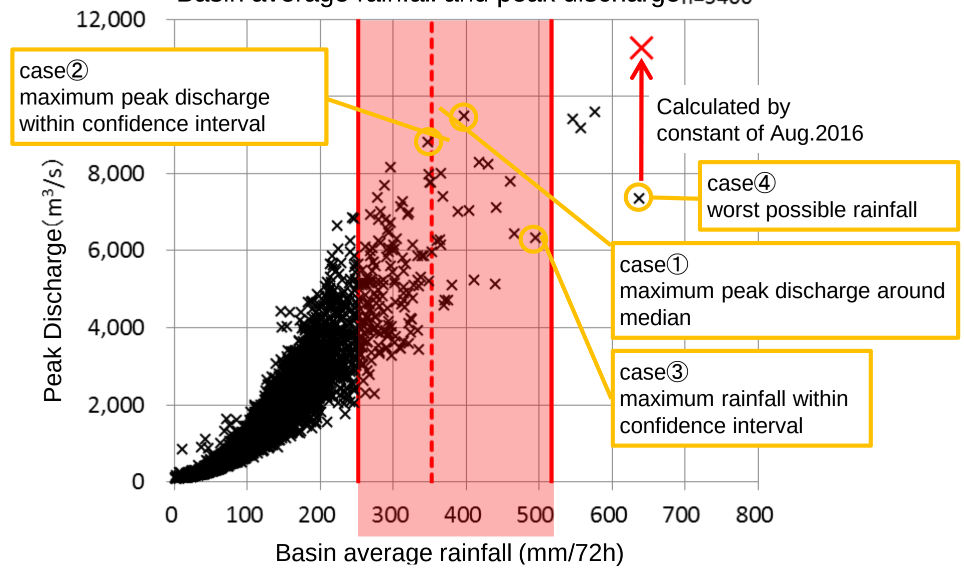
- Case②: Select maximum peak discharge from the cases within 95% of confidence interval of probability rainfall
  ⇒ GF-m110-2052
- Case③: Select maximum 72-hour-rainfall from the cases within 95% of confidence interval of probability rainfall
  ⇒MP-m112-2062

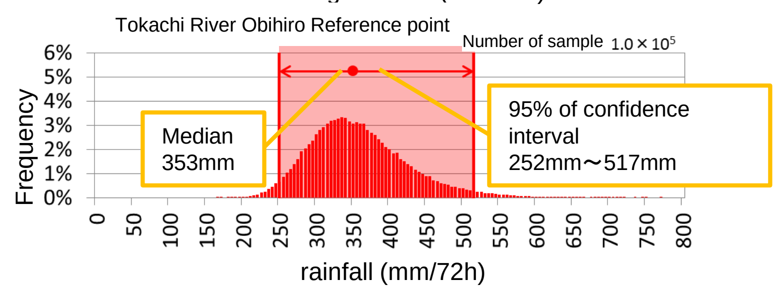
## Worst Possible Risk Assessment

- Case④: Select maximum rainfall from all the experiment cases ⇒MR-m108-2069

Tokachi River Obihiro Reference point
+4K future climate simulation

Basin average rainfall and peak discharge n=5400




GEV 1/150 probability rainfall distribution

## 【My Response to the Guiding Questions of Theme 2】

- What does the latest research tell us of the key challenges and approaches to achieve transformative adaptation and climate resilient development?
  - We have applied thousands of dynamical downscaling both for past and future climate conditions and estimated extreme conditions for precipitation. According to this approach, we found that extreme heavy precipitation in future climate could occur even in past climate even though probability is less. The result is supported by our theoretical approach. Therefore, it became possible to future flood control policy based on the probability.

- What do you consider to be the priority topics or questions on which we need to develop further research to succeed in transformative adaptation and climate resilient development?
  - According to our previous results, risks of disasters by heavy precipitation will be higher. However there are many types of risks in our life. We have to pursue universality of values/priorities of risks/benefit of all kinds of factors which affect human life.

- How can innovations in social sciences help achieve and manage the necessary social, economic and cultural changes?
  - Our study showed that extreme precipitation will be stronger in future climate condition in addition to more intense both in temporal and spatial scales. It means that damage due to heavy precipitation will be more severe. Flood control in future needs to be discussed not only in each river basin scale but also in regional scale (community scale). In addition, studies for risk/benefit assessment by incorporating various types of topics/targets to revitalize the community.