

How to Mitigate and Adapt to the Climate Change in Forest Ecosystems

- Perspectives from the case studies in Japan -

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東北大学
TOHOKU UNIVERSITY



TOUGOU | Integrated Research Program
for Advancing Climate Models



科研費
KAKENHI

International Forestry Students' Association (IFSA) Asia Pacific Regional Meeting 2021, 2021.June 1st



TOUGOU

Integrated Research Program
for Advancing Climate Models

20xx/08/09 06:00

Ocean wave [m]

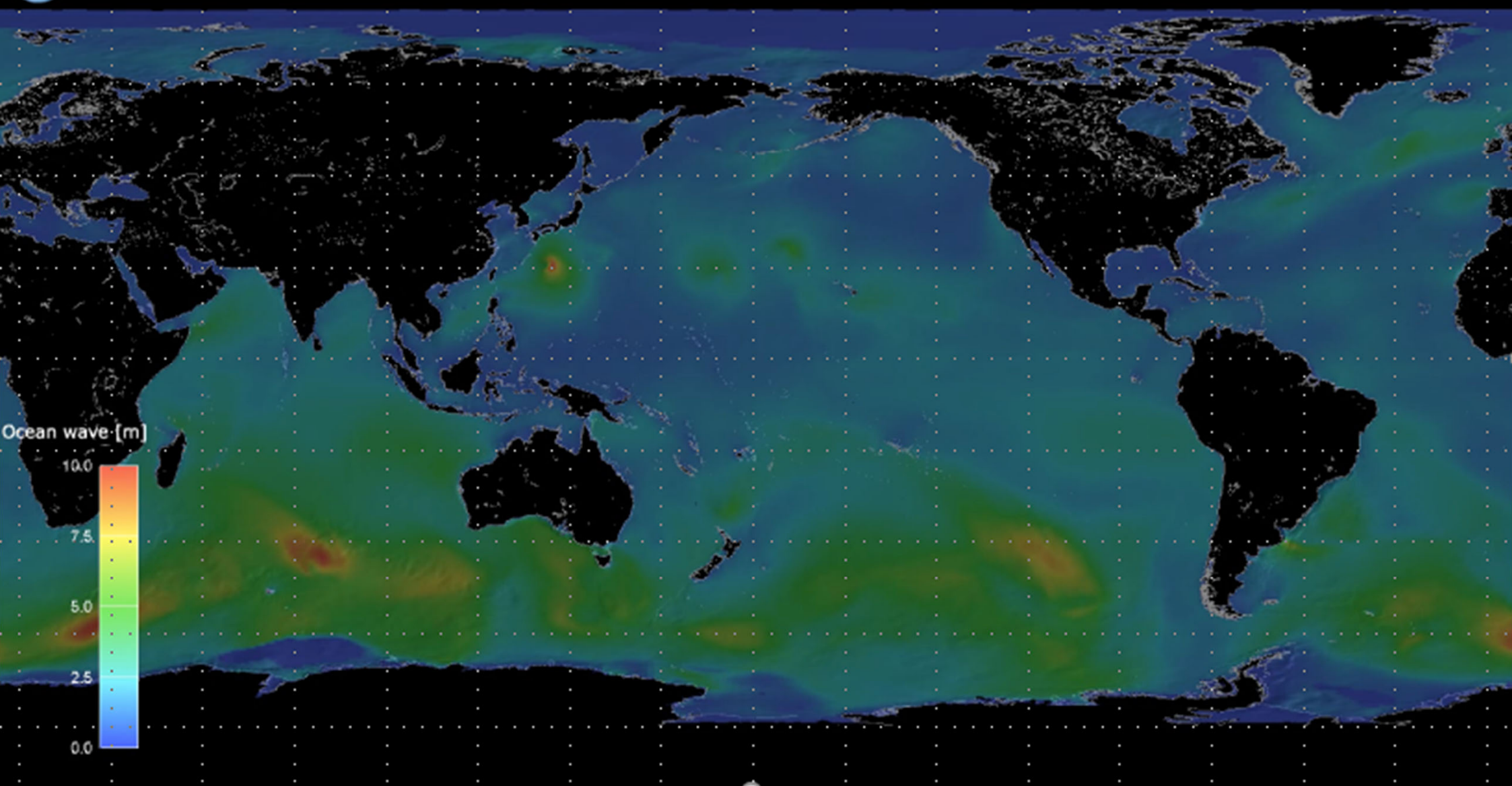
10.0

7.5

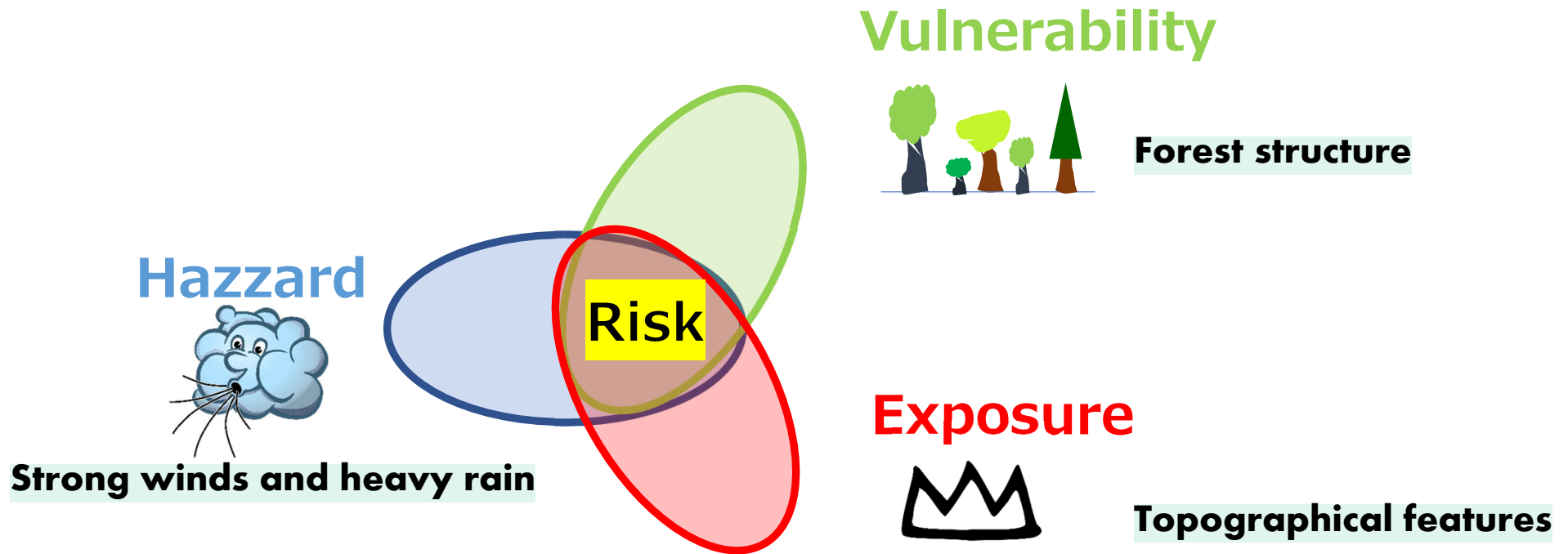
5.0

2.5

0.0



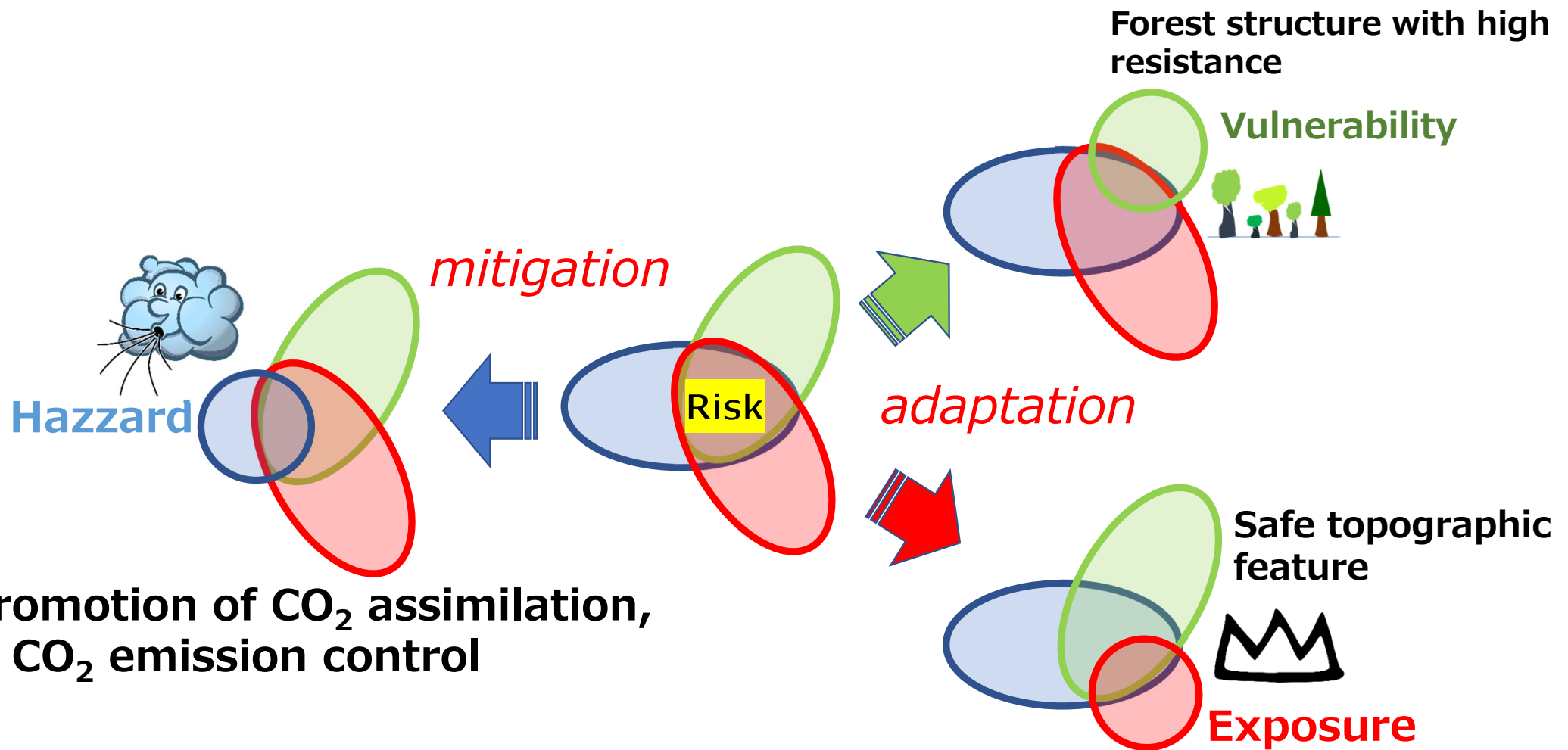
Climate change risk arises when hazard, exposure, and vulnerability factors overlap



Hazard: the probability of occurrence of a climate-related physical event that may cause the loss of resources.

Exposure: the presence of assets in places or settings that could be adversely affected.

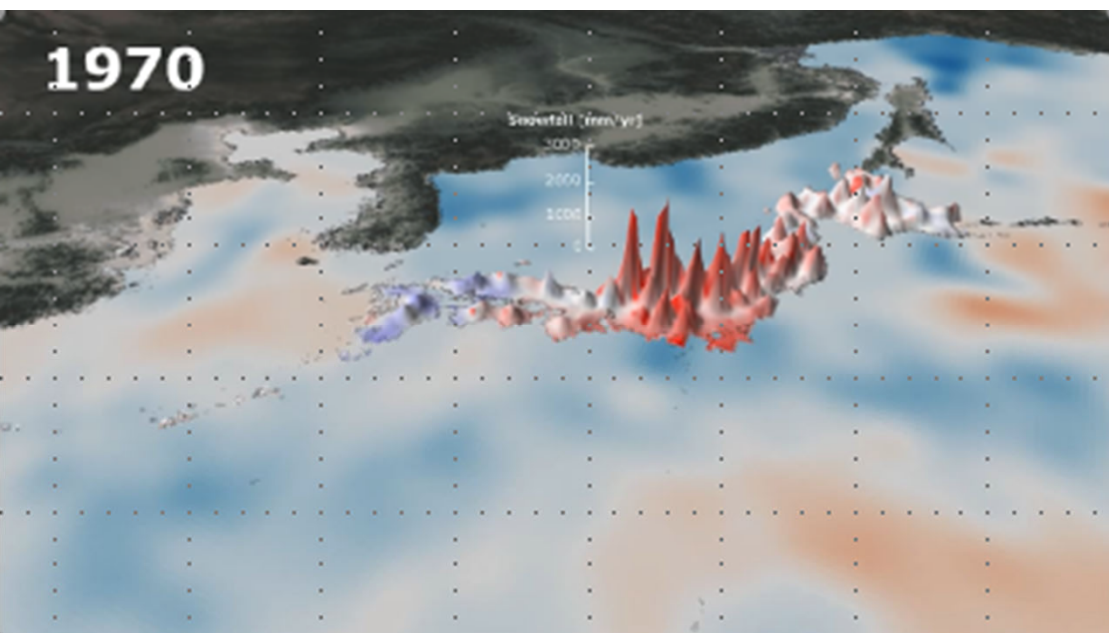
Vulnerability: the propensity to adverse effects. (IPCC 2014)



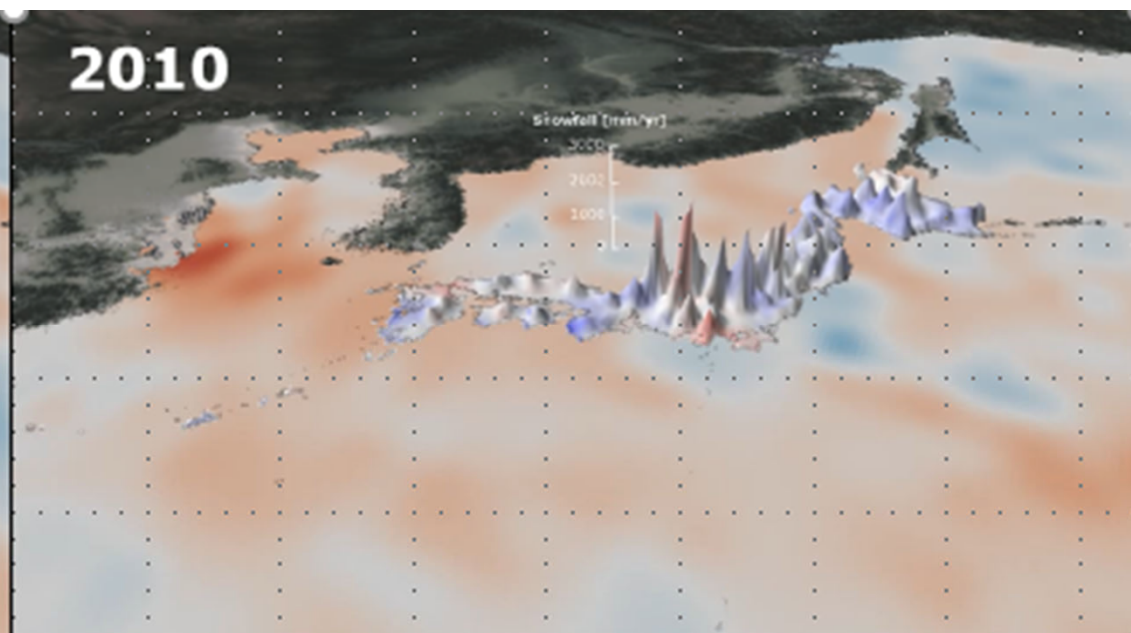
How to mitigate ?

How to adapt ?

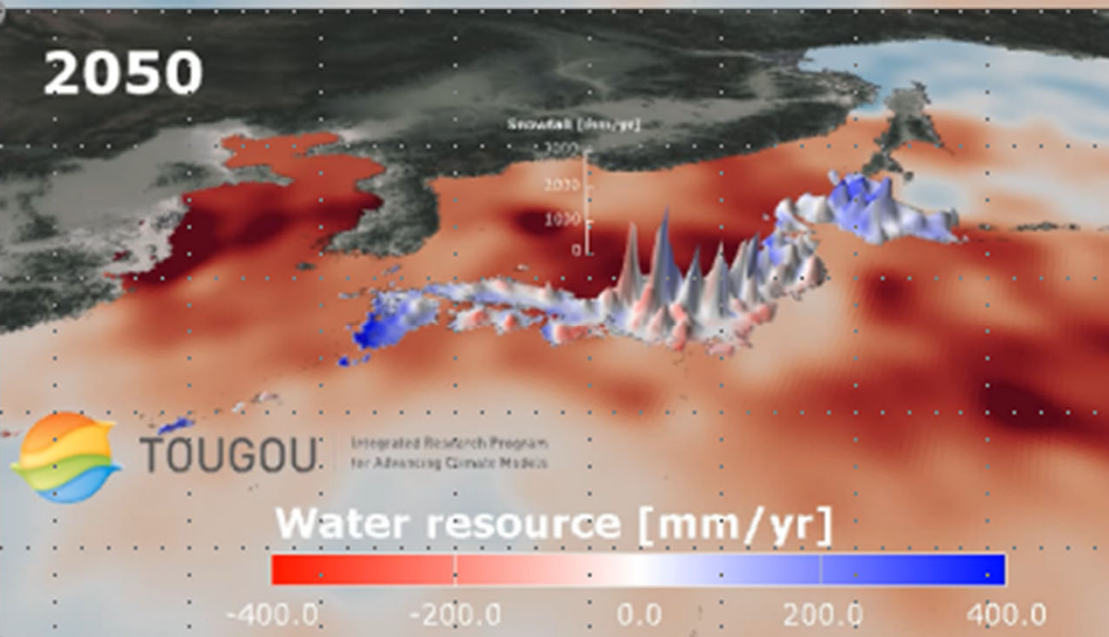
1970



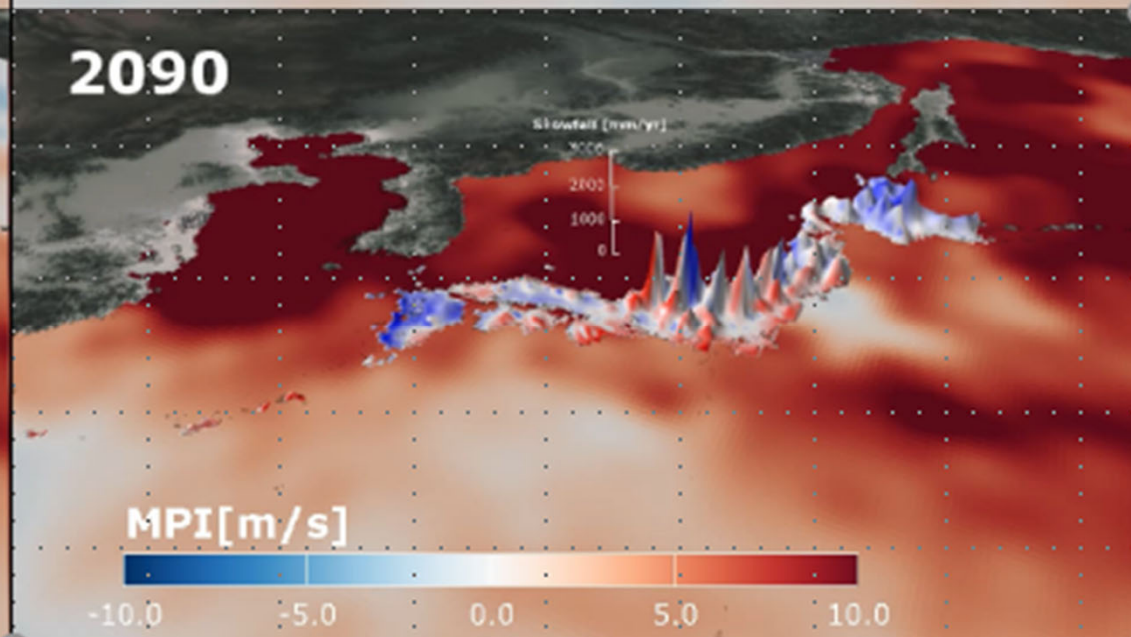
2010



2050



2090

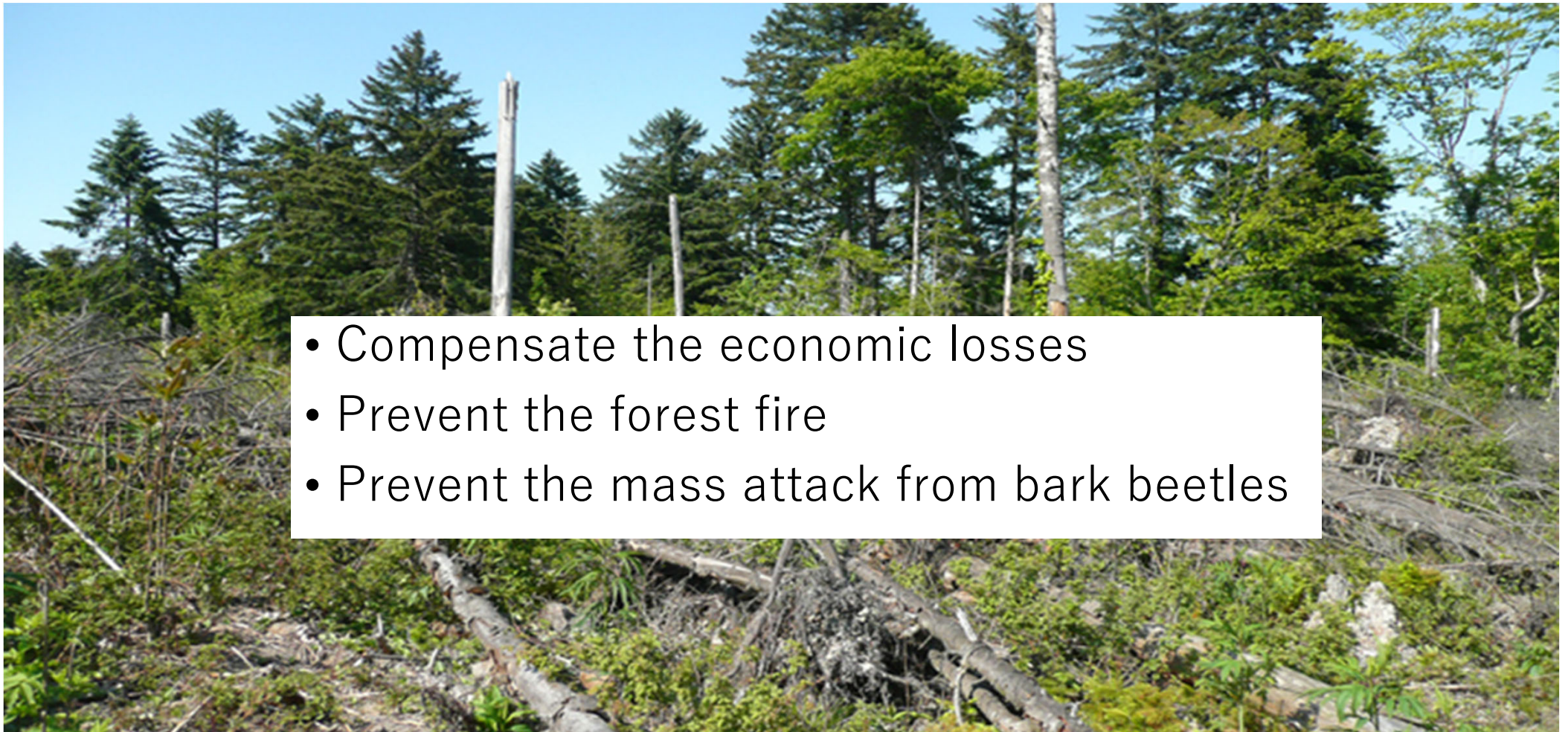


How to mitigate?



Japanese Policy after the severe windthrow

Salvage-logging and Planting



15 years after the Salvage logging & Planting



15 years after the windthrow





15 years after

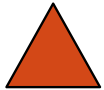


Other forest practices after the windthrow

Windthrow



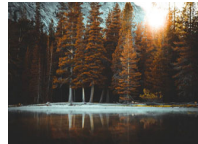
Salvaging



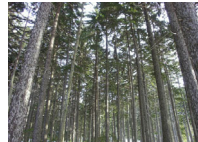
Scarification



Seeding

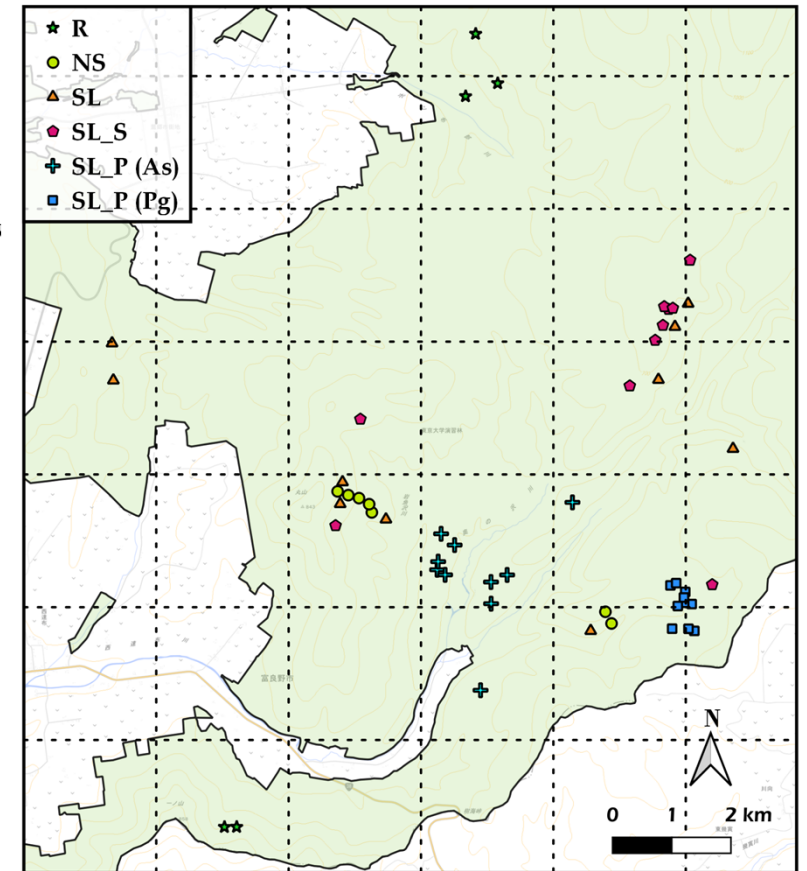
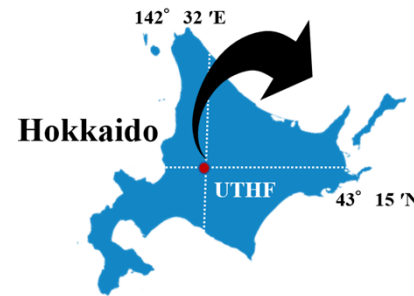


Planting Broadleaved seedlings



Planting Conifer seedlings

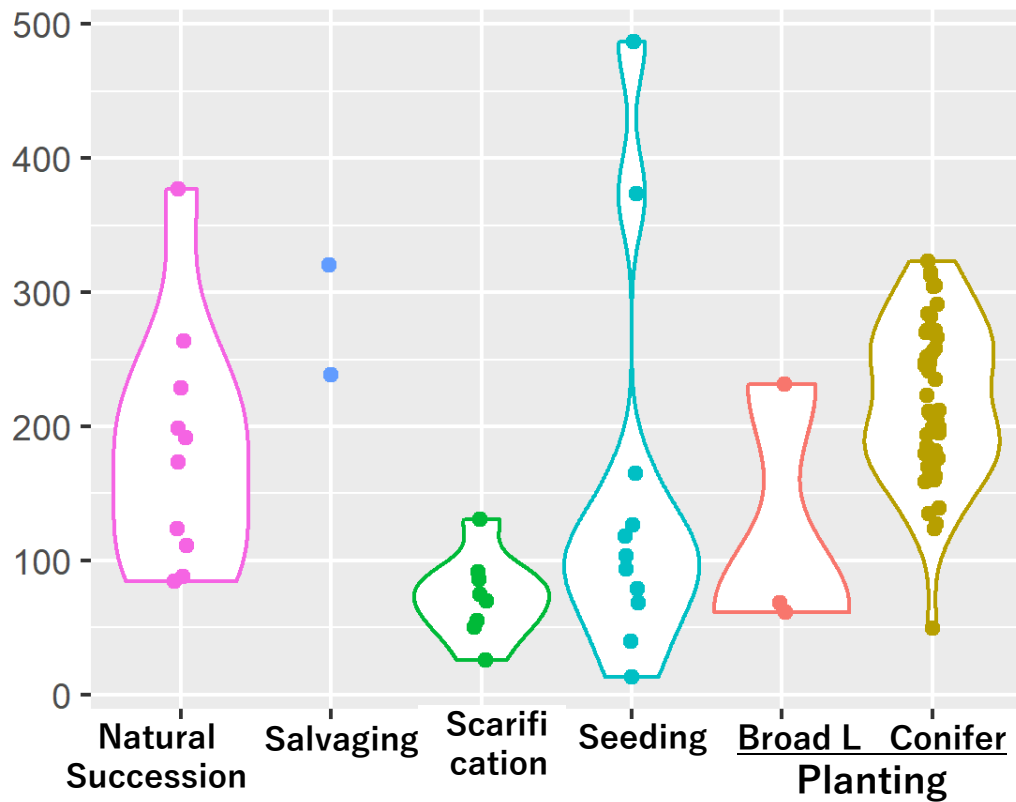
Li Jing(in preparation)



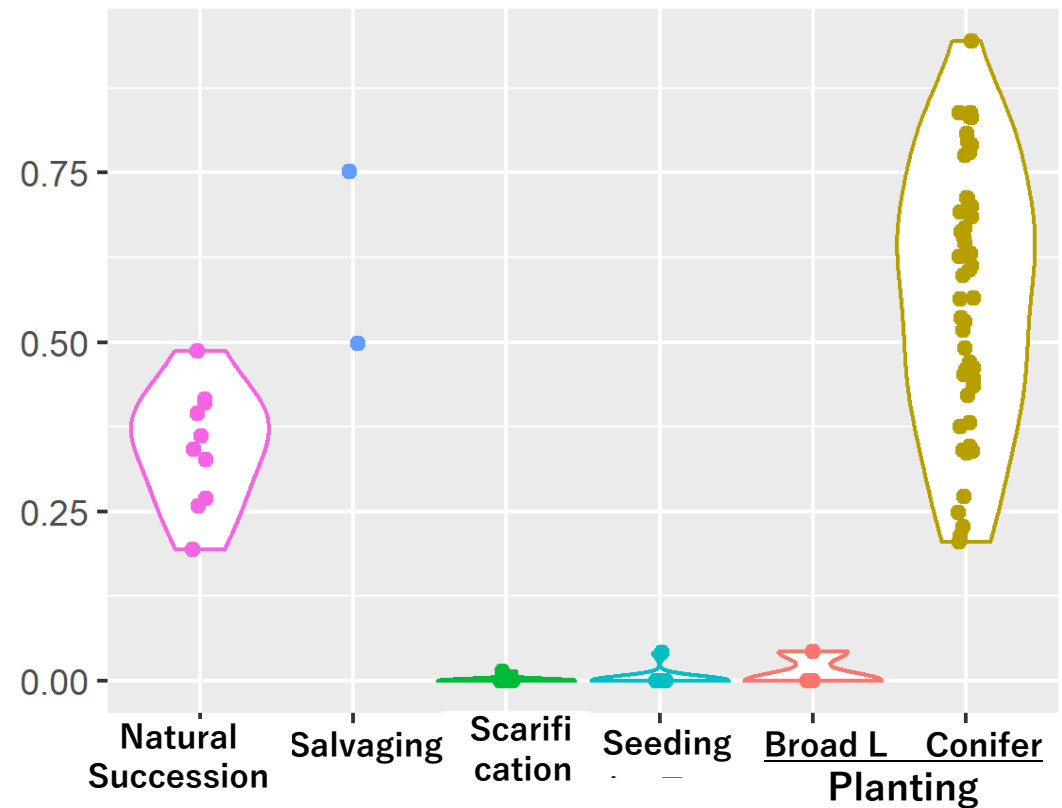
University of Tokyo Hokkaido Forests (UTHF)

36 years after the windthrow

Stand volume (m^3ha^{-1})



The ratio of conifer trees





Natural succession (2020)



Salvage-logging (2008)



Planting *Abies sachalinensis*



Planting *Picea glehnii*



Seeding *Betula ermanii*



東京大学北海道演習林撮影

Planting *Quercus crispula* -> *Betula* spp. dominant



東京大学北海道演習林撮影

Seeding *Quercus crispula* -> *Sasa* bush

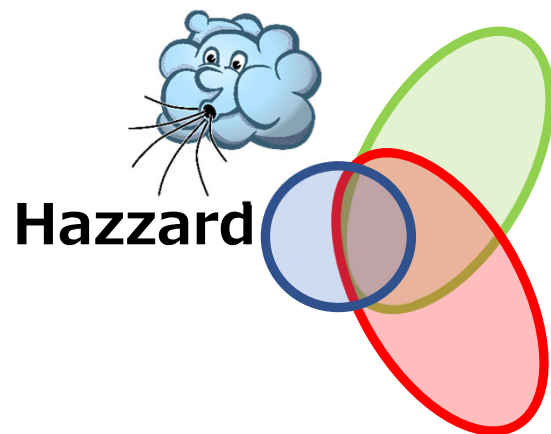


東京大学北海道演習林撮影

Seeding *Picea glehnii*, and *Betula* species,
-> *Betula* spp. dominant



Scarification -> *Betula* spp. dominant

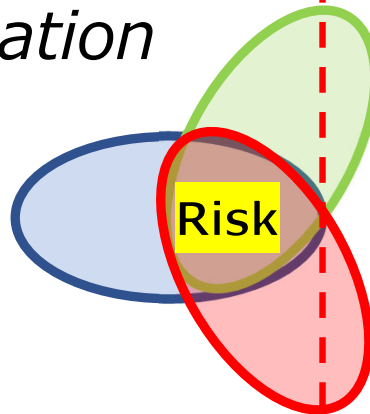


Hazzard

mitigation



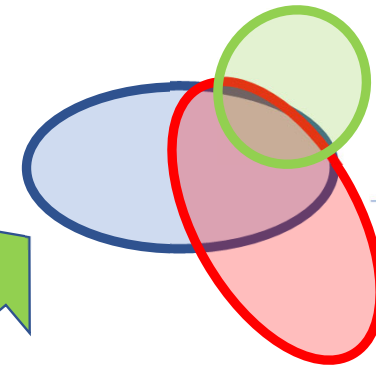
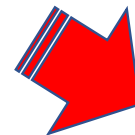
Promotion of CO₂ assimilation,
& CO₂ emission control



Risk

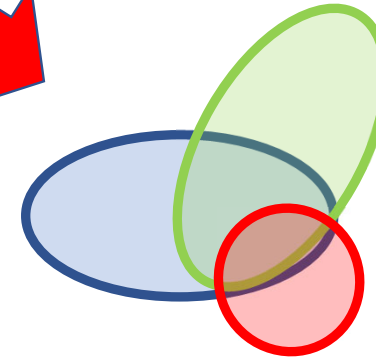


adaptation



Forest structure with high
resistance

Vulnerability



Safe topographic
feature

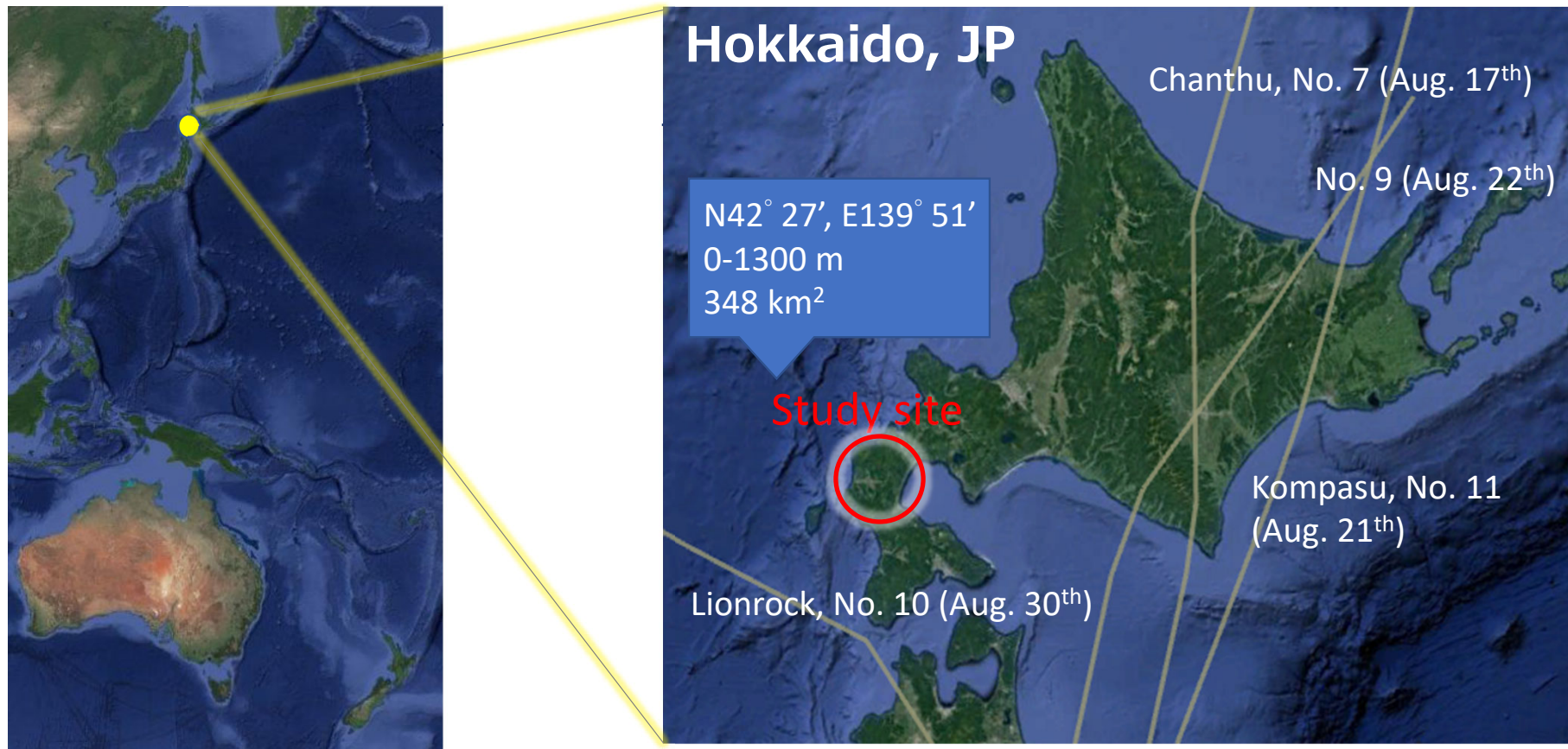


Exposure

How to mitigate ?

How to adapt ?

Four typhoons passed through Hokkaido during a 14-day period in late August of 2016



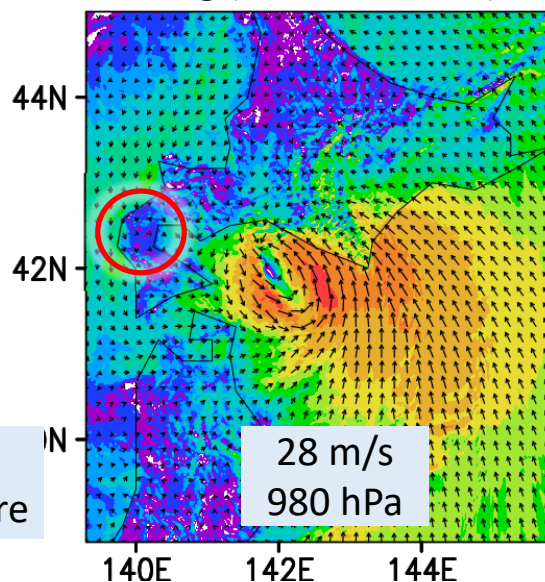
90 km² of forest area was damaged by windthrow and landslides

Maximum wind speed

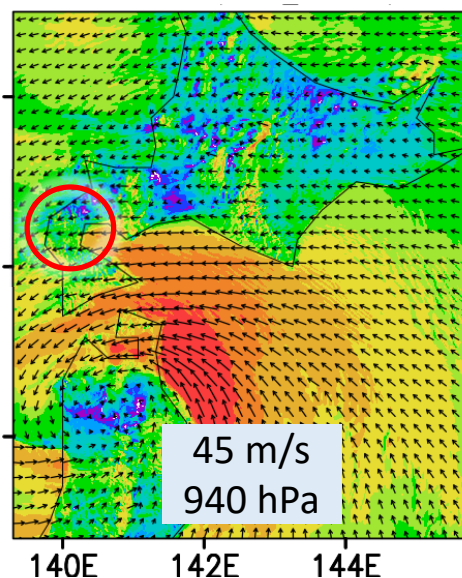
(at 10 m) during landfall

the lifetime MWS
the minimum pressure

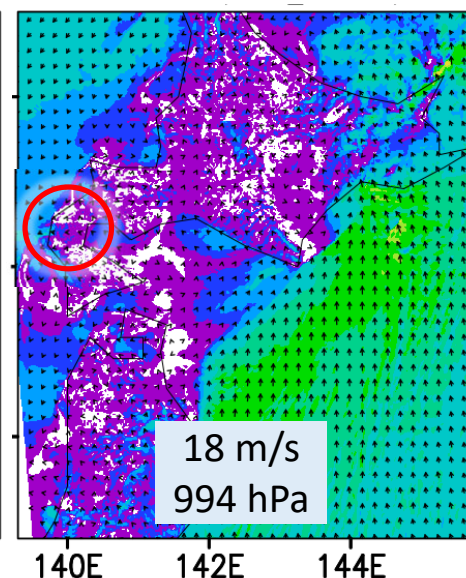
17 Aug (Chanthu, No.7)



30 Aug (Lionrock, No.10)



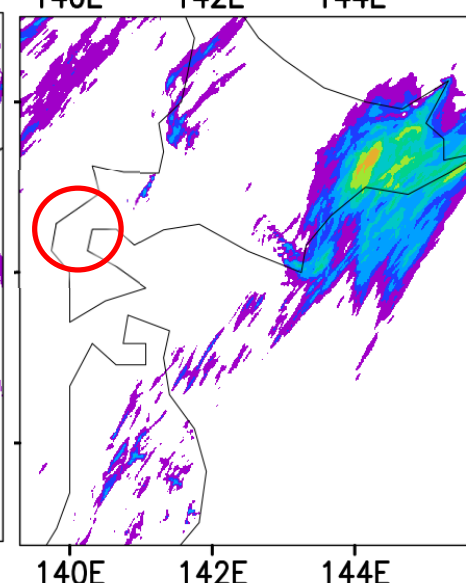
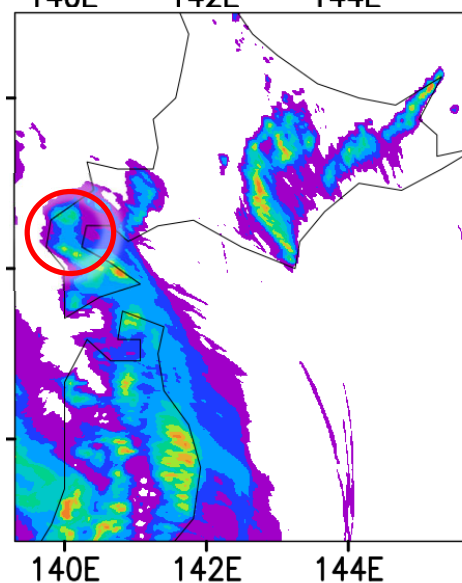
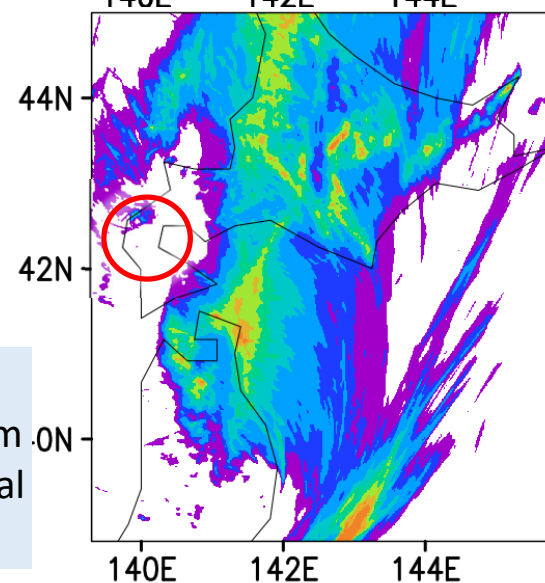
21 Aug (Kompasu, No.11)



12 hours accumulated rainfall

(± 6 hours of landfall)

The total amount of
precipitation > 500 mm
at many meteorological
observatories.



Extensive windthrow and landslides occurred following the typhoons.

Windthrow

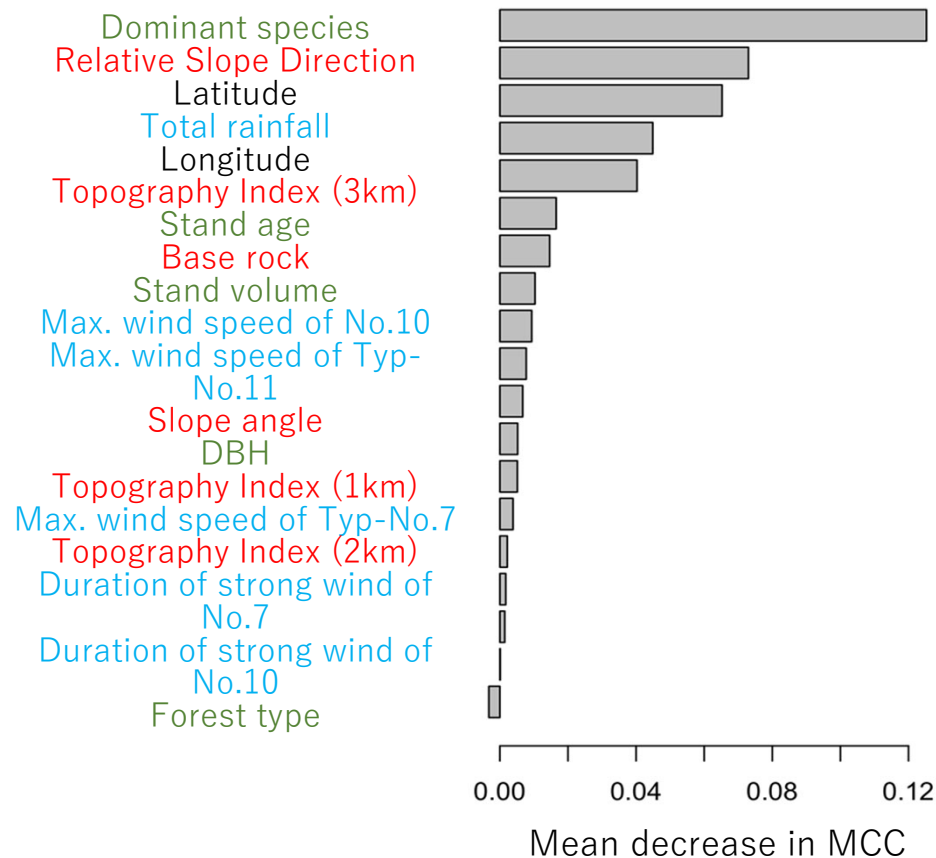


Landslide

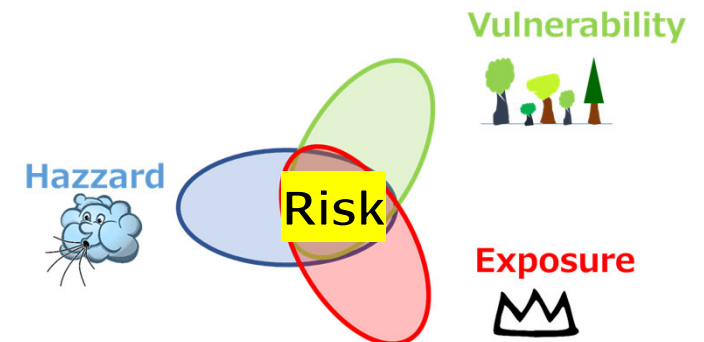
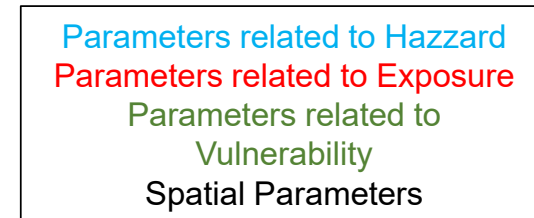


(2018.08.10.F Furukawa)

Important parameters that explain the windthrow

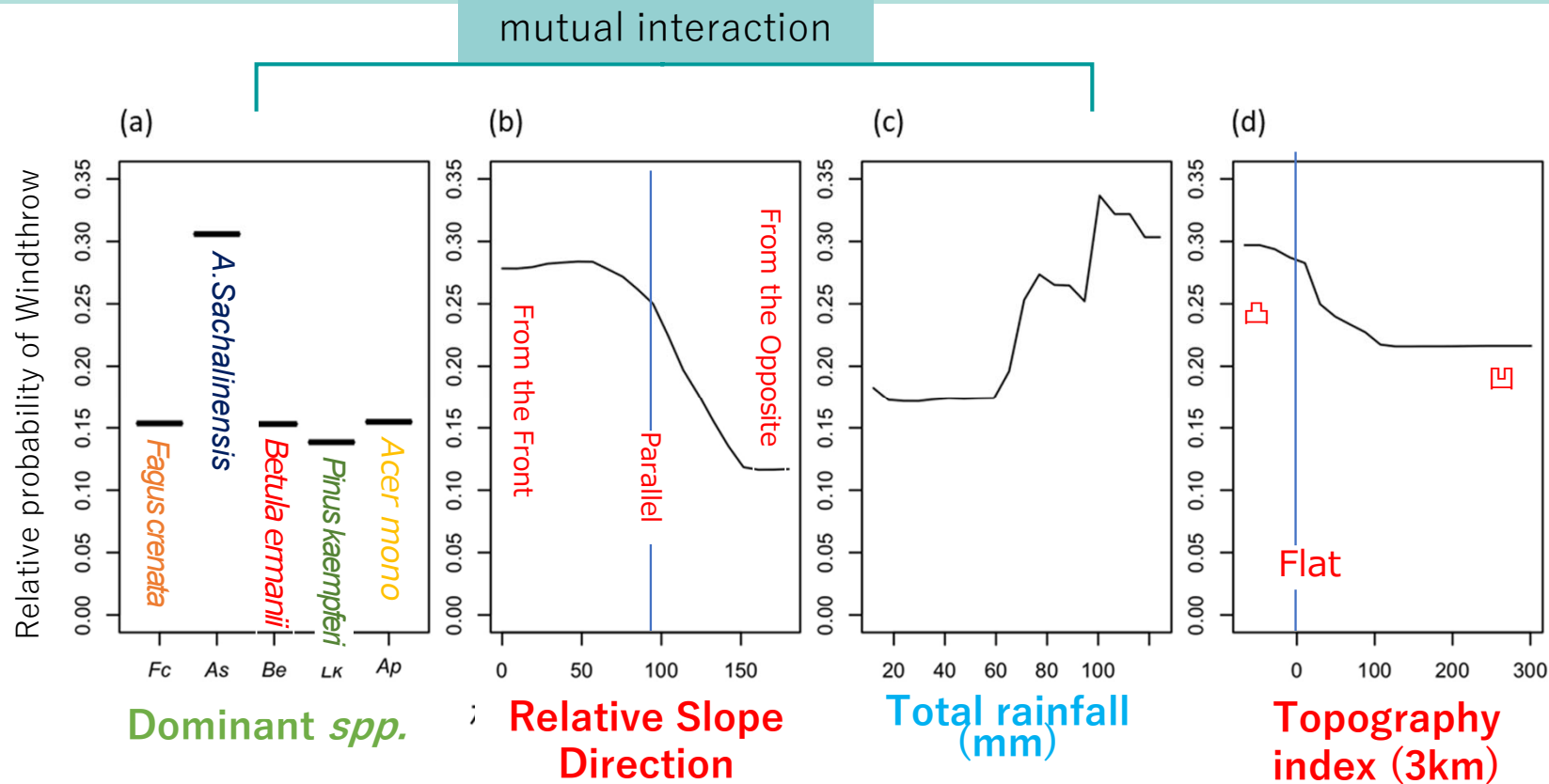


Model performance: Cross validation MCC=0.70



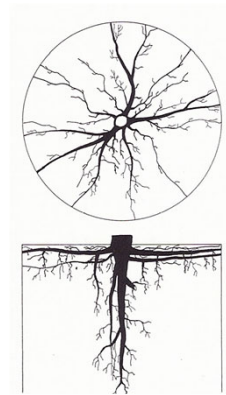
- Dominant species, Relative slope direction, Total rainfall, Roughness of Terrain

Relationship between Important Parameters and Windthrow Probability

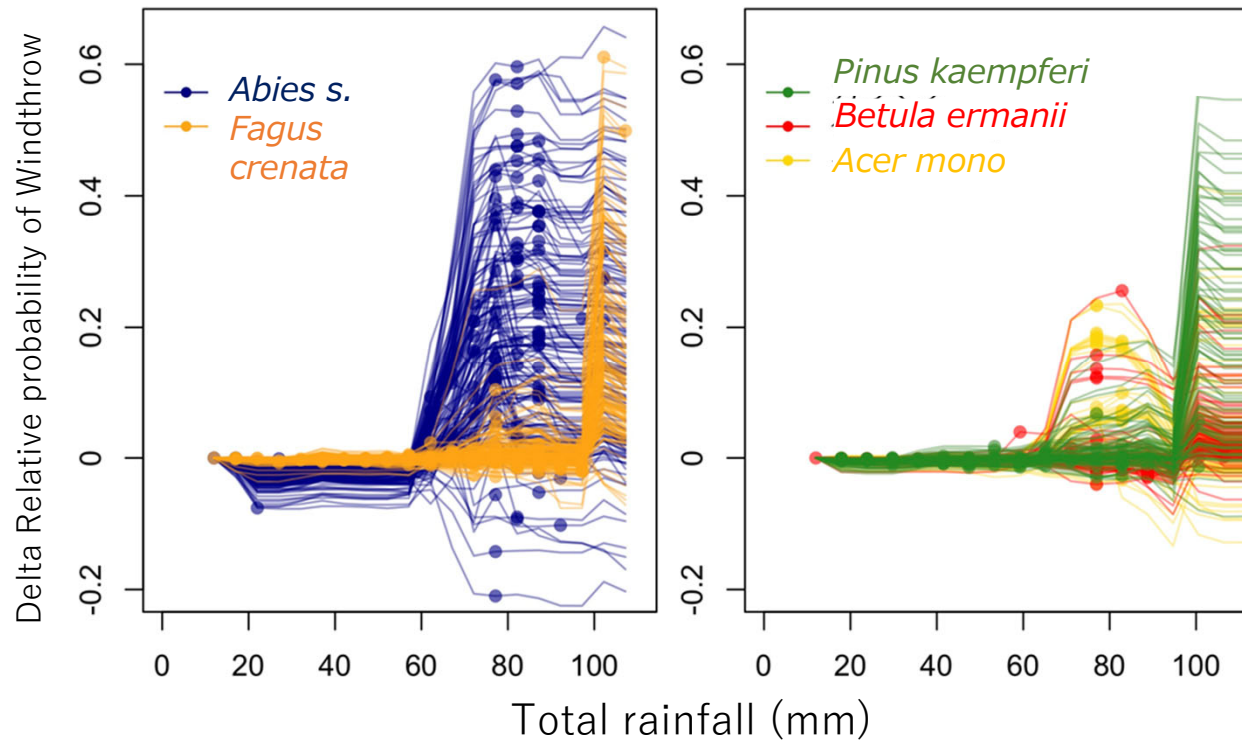


- *Abies S* is tremendously vulnerable.
- The risk of windthrow increase corresponding to **Total rainfall**.
- High risk at **windward** slope and **convex** terrain is expected.

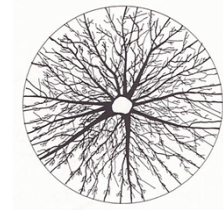
Interaction between Total rainfall and Tree species



Abies sachalinensis



Pinus kaempferi
Betula ermanii
Acer mono

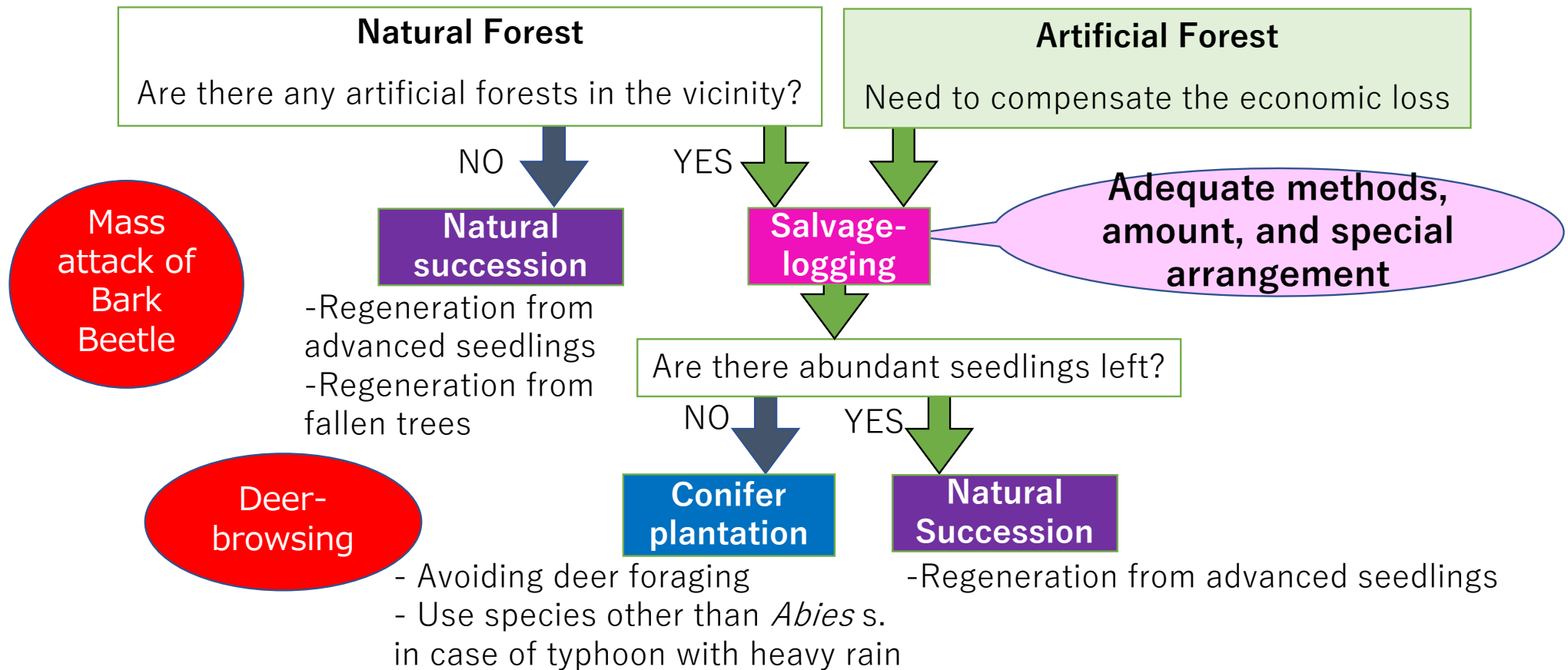


Fagus crenata

- Only for *Abies s.*, the windthrow probability increases significantly after a total rainfall of around 60 mm.

Recommended Forest Management after the windthrow for mitigation and adaptation to Climate Change

Catastrophic Wind Disturbance



Conservation of Forest Ecosystems

Thank you for your attention



For providing forest registry data:

Hokkaido Regional Forest Office of Forestry Agency
Hokkaido Government's Bureau of Forestry

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- The Environment Research and Technology Development Fund (JPMEERF16S11508) of the Environmental Restoration and Conservation Agency of Japan.
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