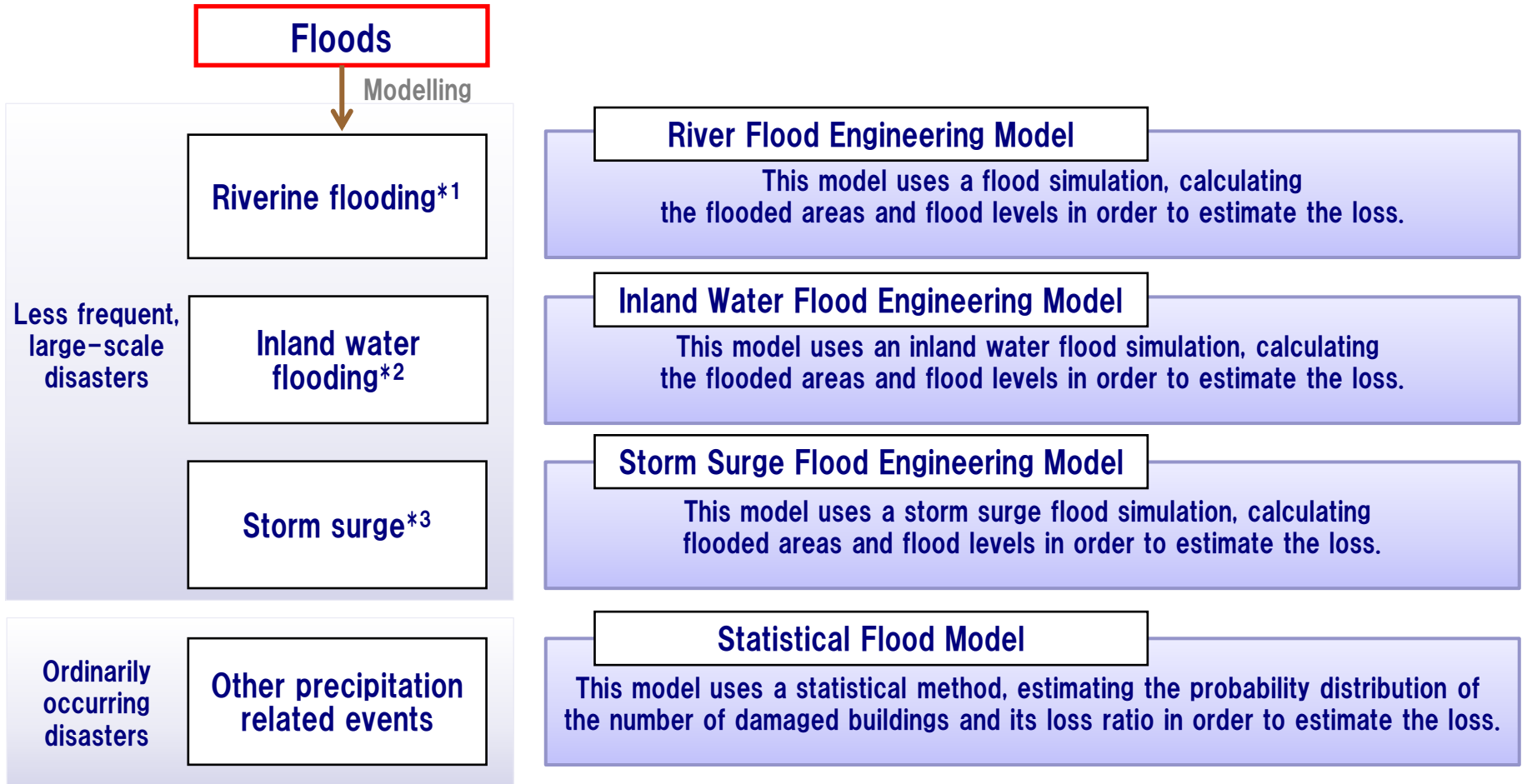


# GIROJ's Flood Loss Model

# The Overview of Our Flood Loss Model

- GIROJ's Flood Loss Model is consisted of four sub-models.



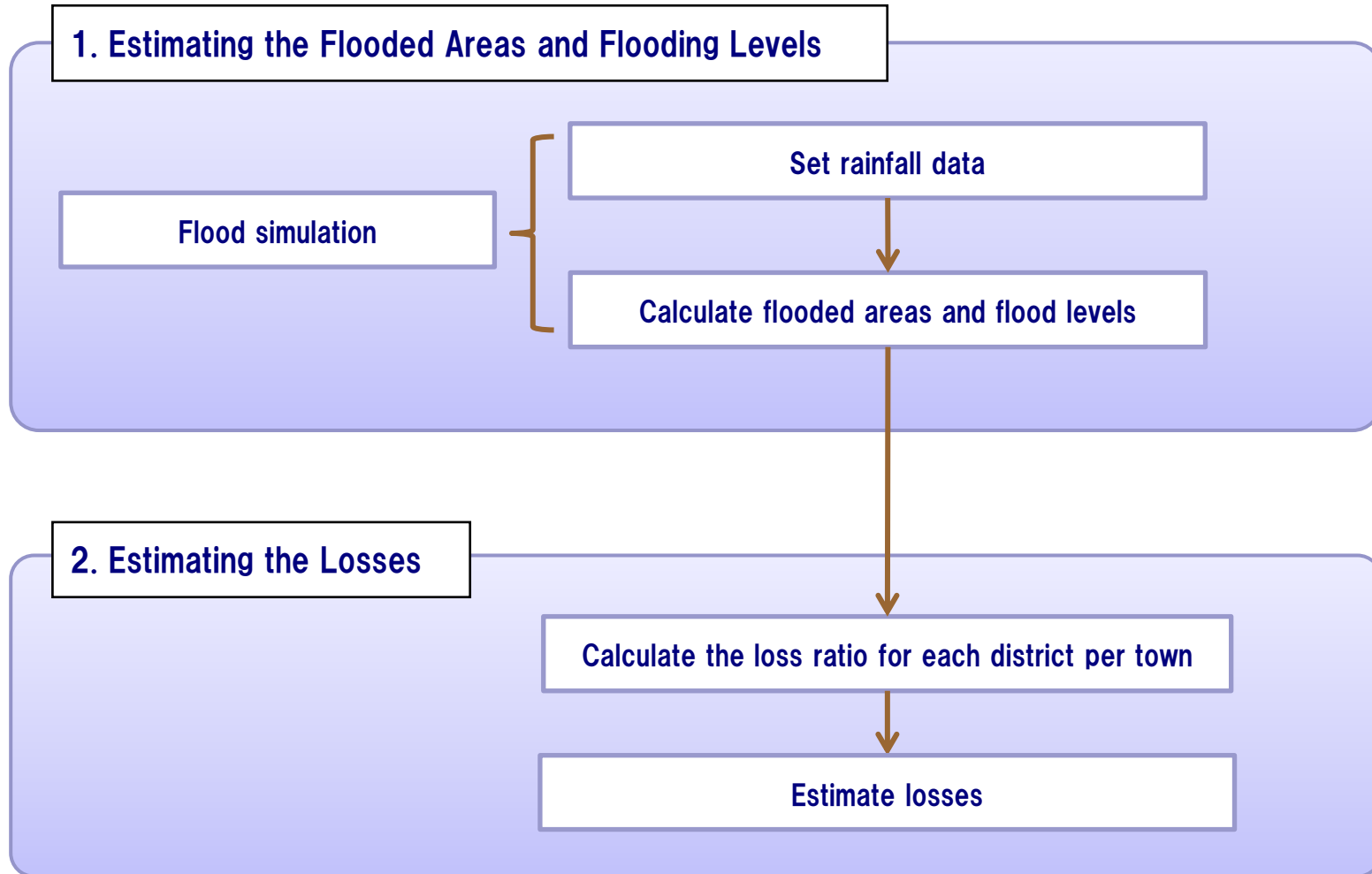
\*1 Floods that occur when water overflows its riverbank or when a riverbank breaches.

\*2 Floods that occur when the sewer system exceeds its capacity, causing the water to overflow.

\*3 Floods that occur when water overflows its bank or when a bank breaches, due to a typhoon or large low-pressure system approaching, resulting in a sea level rise in coastal regions.

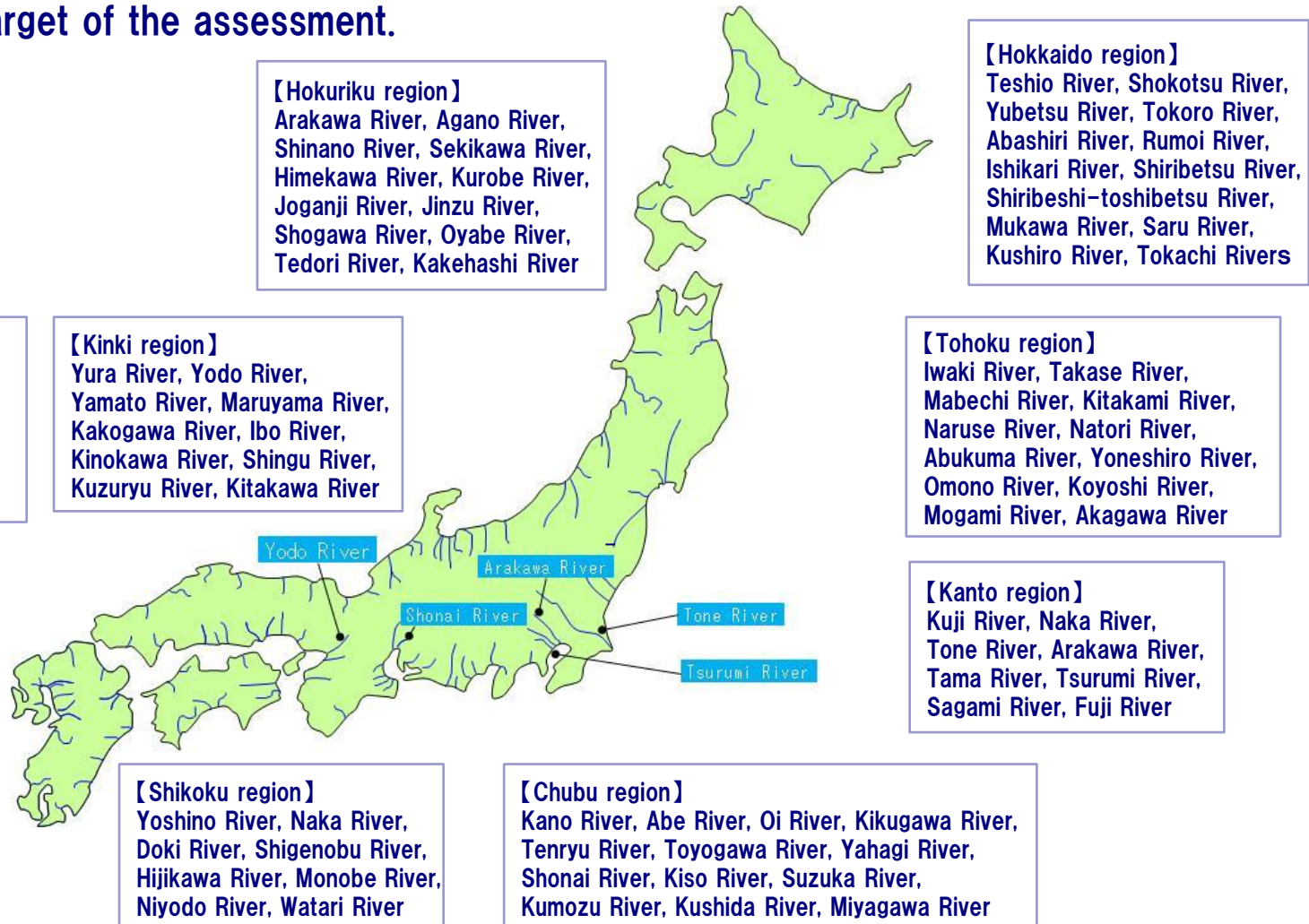
# The Overview of the River Flood Engineering Model

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# River Flood Engineering Model: Target of Assessment

- All Class A rivers (109 rivers shown below) and some Class B rivers (about 2000 rivers) are target of the assessment.



\* For Tone River, Arakawa River, Tsurumi River, Shonai River, and Yodo River, GIROJ's flood simulation results are used for risk assessment. For the other rivers, flood simulation results by the Ministry of Land, Infrastructure, Transport and Tourism are used for risk assessment.

# River Flood Engineering Model:

## 1. Assessing the Flooding Areas and Flooding Levels

- Calculating the flooding areas and flooding levels using the Flood Simulation.

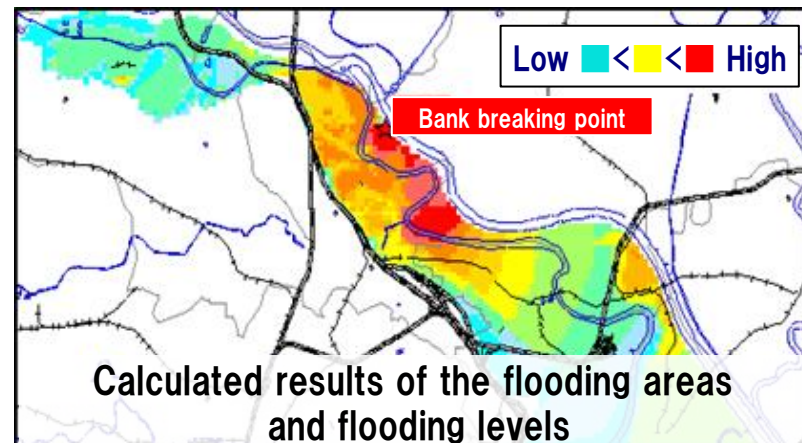
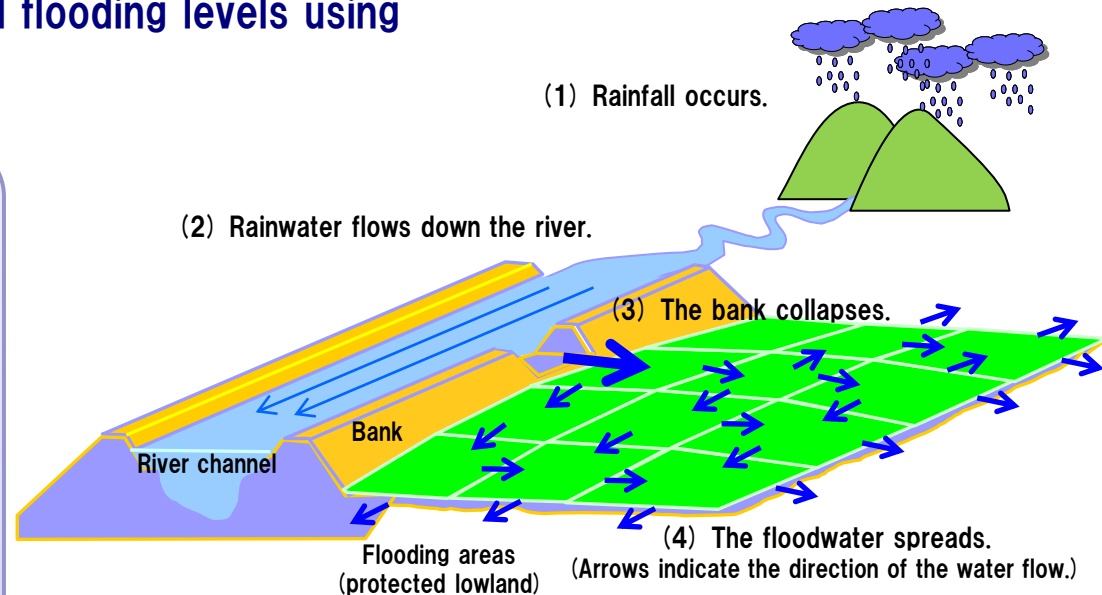
Set rainfall data

- (1) Rainfall occurs.  
(Rainfall pattern data)
- (2) Rainwater flows down the river.  
(River channel data)
- (3) The bank gives way.  
(Bank data)
- (4) The floodwater spreads.  
(Altitude data)

Calculate the flooding areas and flooding levels.

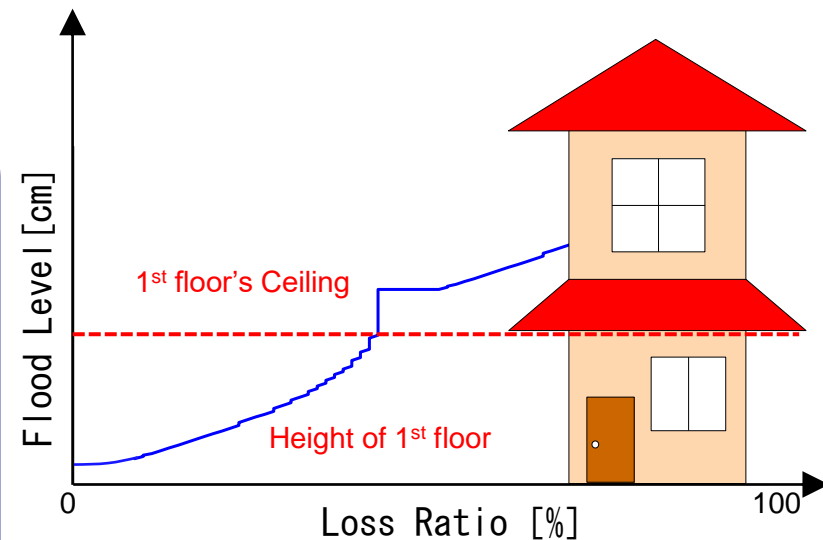
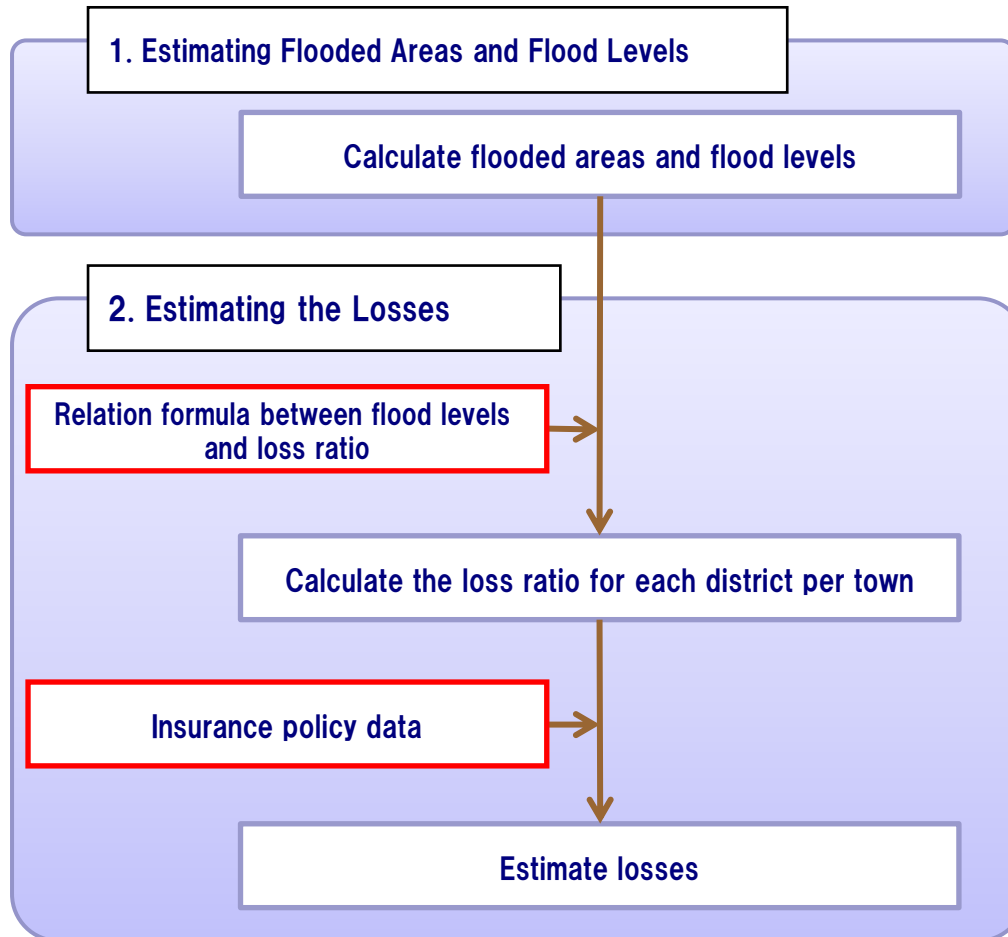
\* In step (1), heavy rainfall data, such as a 200-year return period is input.

\* The data mainly used is listed in ().

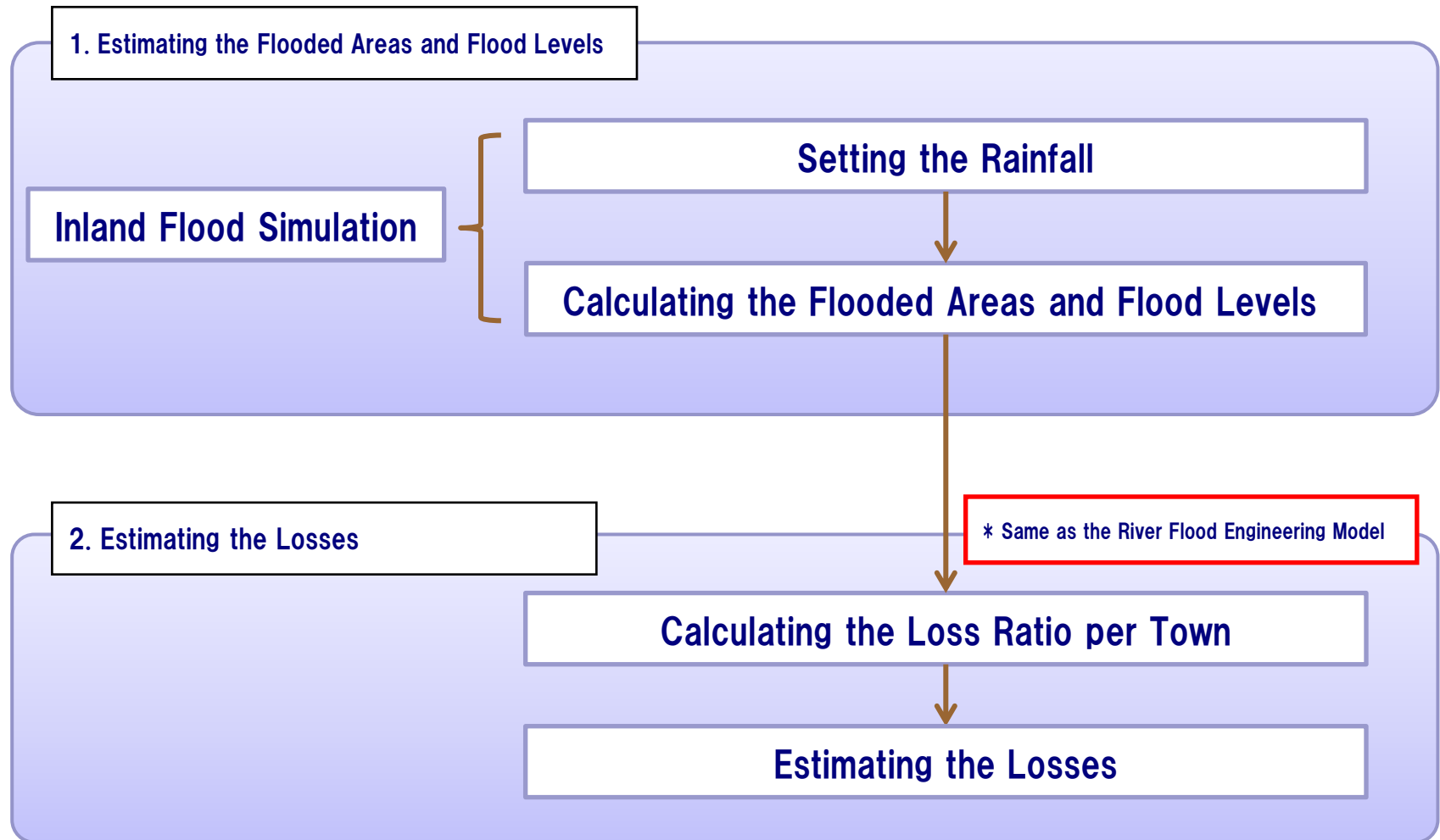


## River Flood Engineering Model: 2. Loss Assessment

- By combining the flooded areas and flood levels calculated by the flood simulation, and the “relation formula between the flood levels and the loss ratio”, the loss ratio per town is determined, and the loss is estimated from insurance policy data.



# Overview of Inland Flood Engineering Model



## Inland Flood Engineering Model: Target of Assessment

- The following cities included in the three major metropolitan areas of Japan are the target of the assessment.





# Inland Flood Engineering Model:

## 1. Assessing the Flooding Areas and Flooding Levels

- Calculating the flooding areas and flooding levels using the Inland Flood Simulation.

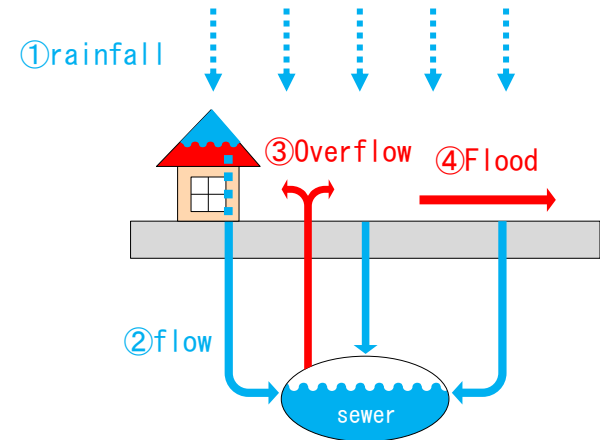
### Setting the Rainfall

- ① Rainfall occurs.  
(rainfall data)
- ② Flow: Rain flows down the sewer.  
(sewer system data)
- ③ Overflow: Water overflows the ground.  
( " )
- ④ Flood: The overflowed water spreads.  
(altitude data)

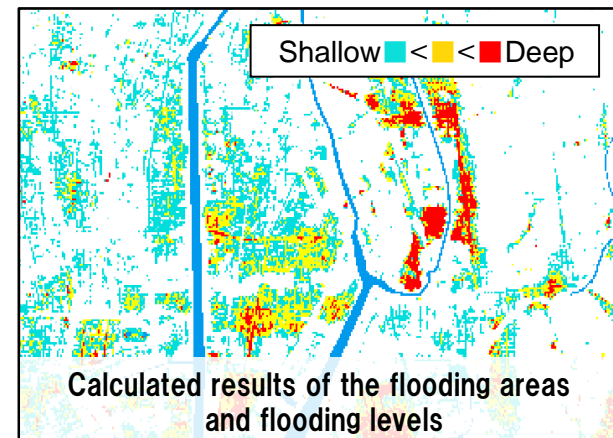
Calculating the flooding areas and flooding levels.

\* In step①, rainfall data such as a 200-year return period is input.

\* The data mainly used is listed in ().

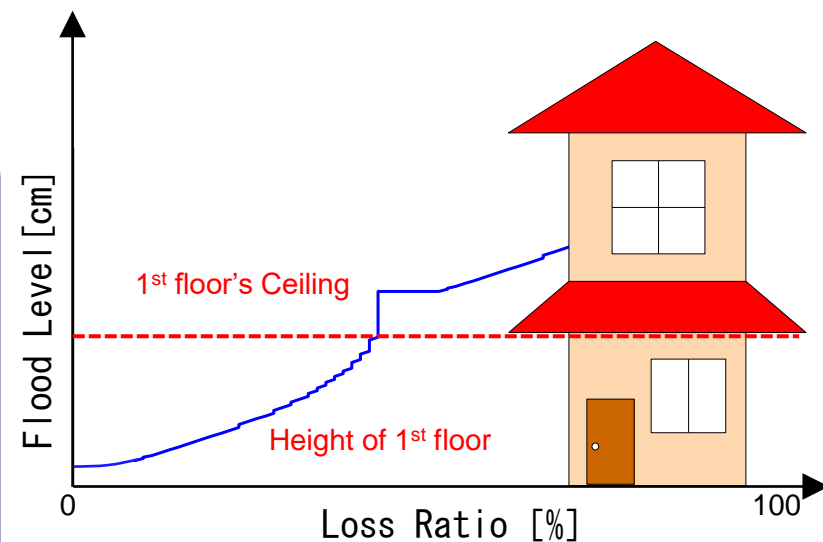
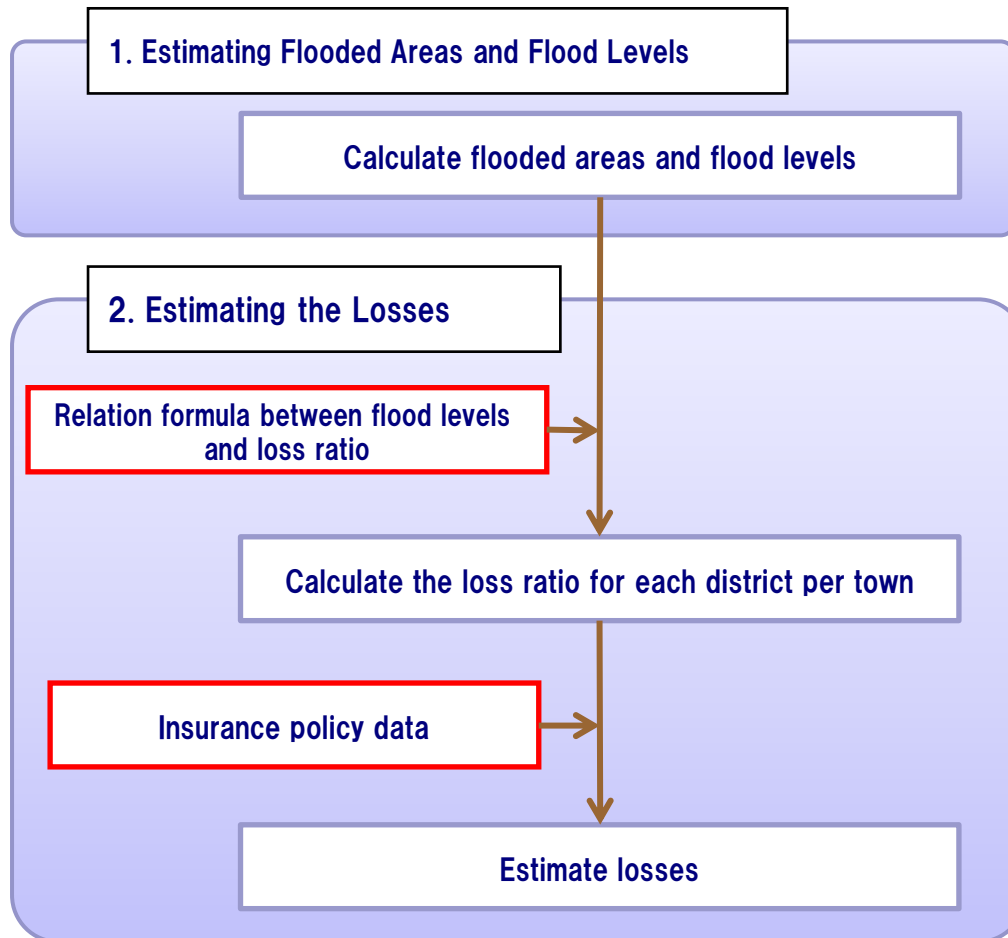


\*The overflow occurs when the flowing amount of rainwater exceeds the drainage capacity of the sewer.

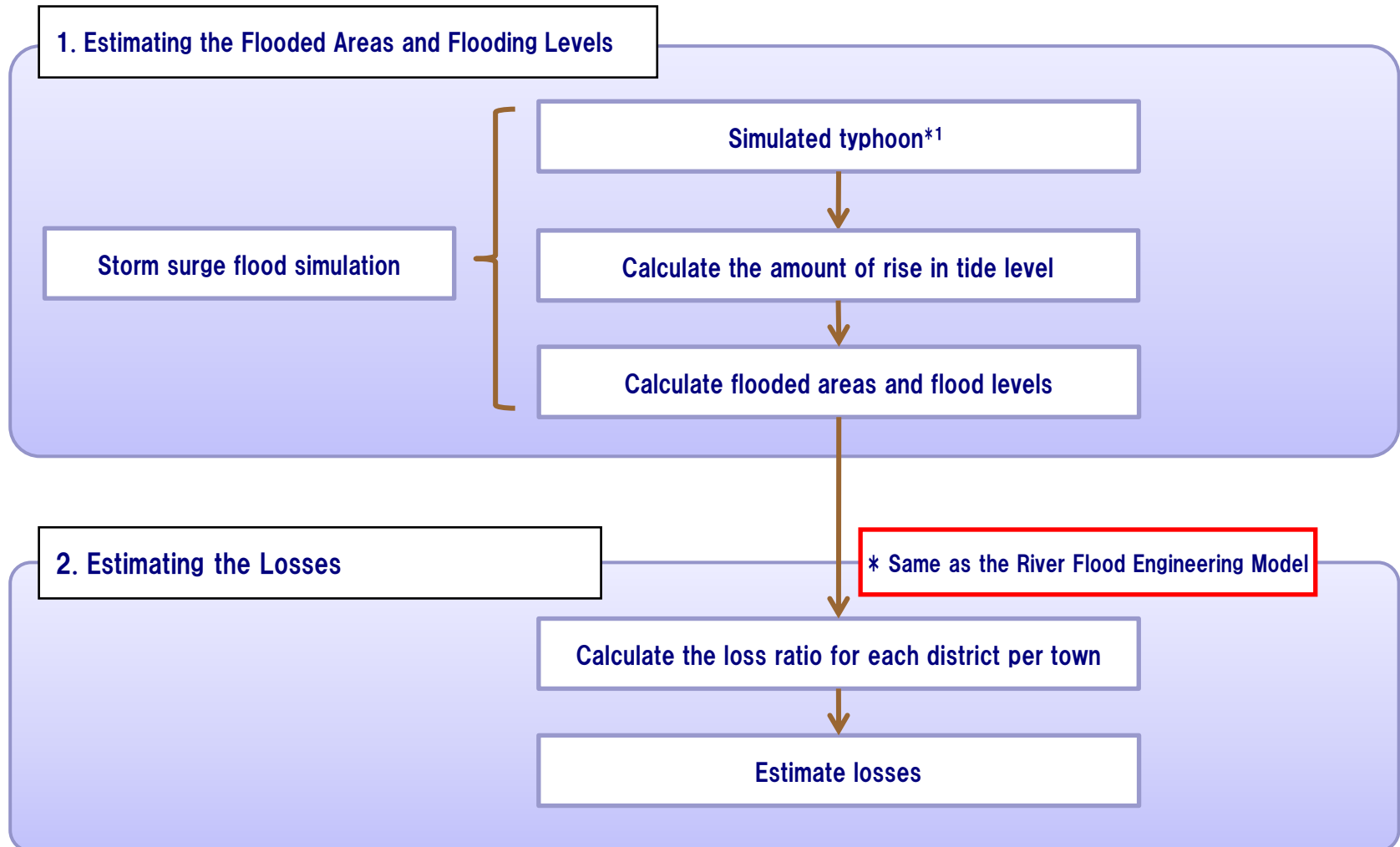


## Inland Flood Engineering Model: 2. Loss Assessment

- By combining the flooded areas and flood levels calculated by the Inland flood simulation, and the “relation formula between the flood levels and the loss ratio”, the loss ratio per town is determined, and the loss is estimated from insurance policy data.



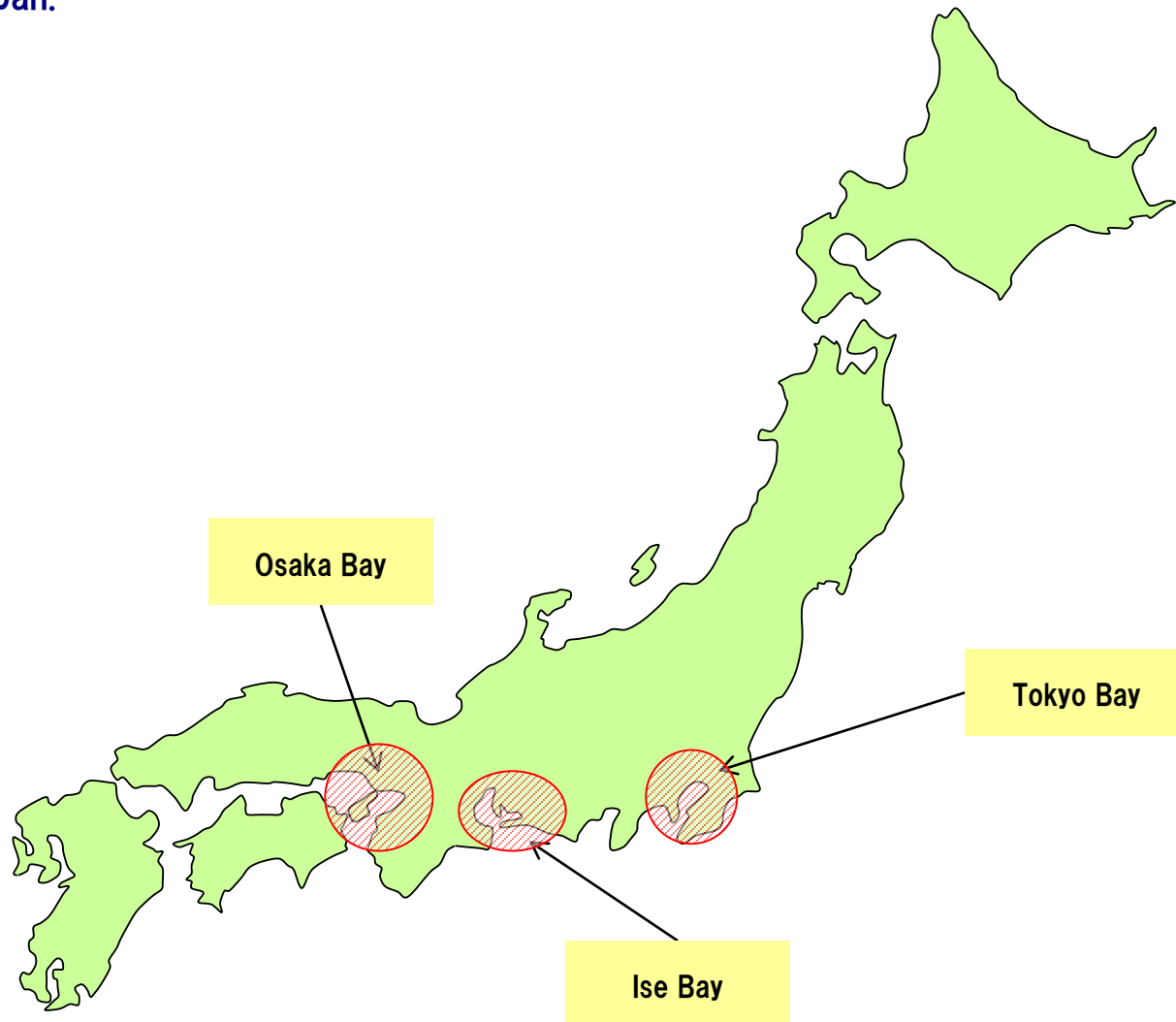
# The Overview of Storm Surge Flood Engineering Model



\*1 A typhoon generated by a simulation that is used in GIROJ's typhoon loss model

## Storm Surge Flood Engineering Model: Estimate targets

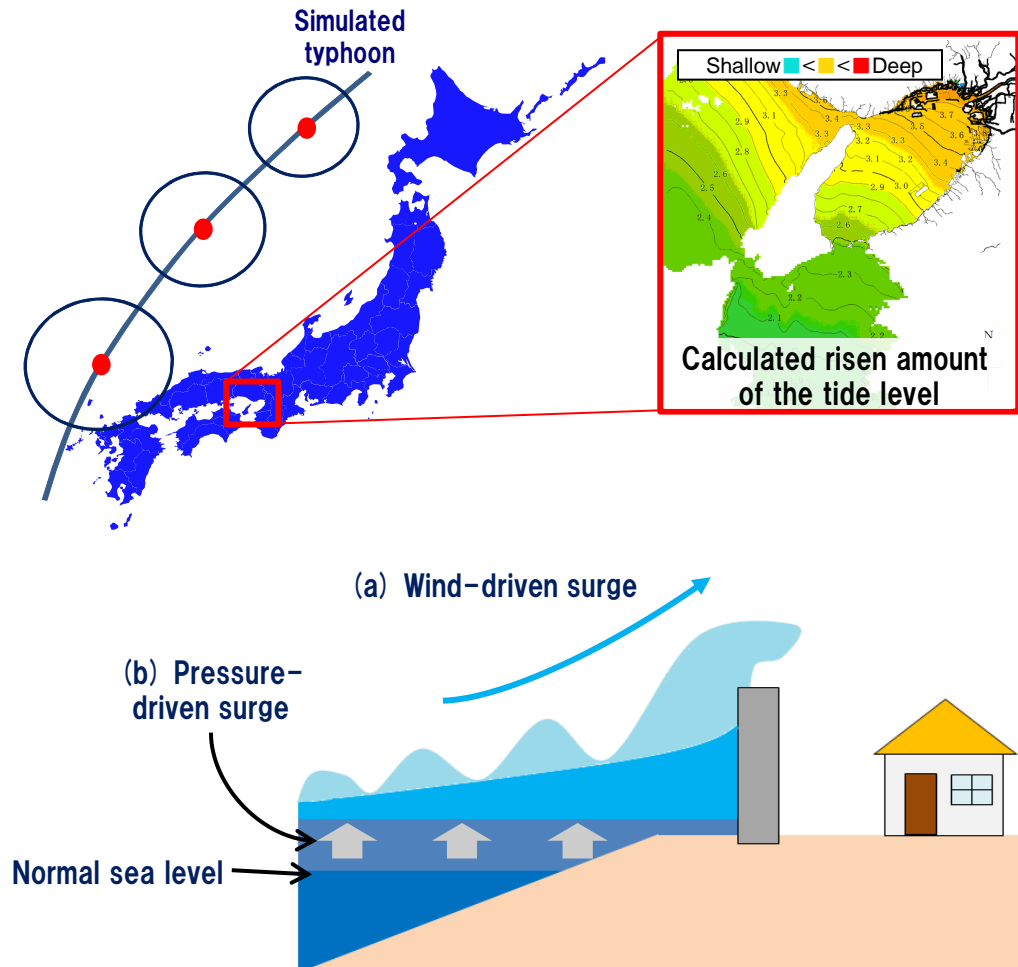
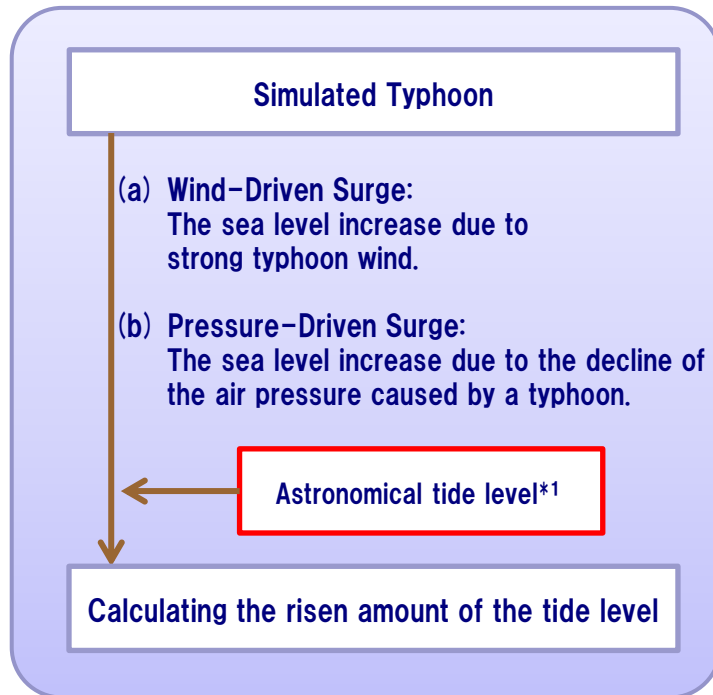
- Estimate targets are Tokyo Bay, Ise Bay, and Osaka Bay that adjoin the three major metropolitan areas in Japan.



# Storm Surge Flood Engineering Model:

## 1. Estimating Flooded Areas and Flood Levels

- The storm surge flood simulation, calculates the risen amount of the tide level (sea level) for each typhoon (Simulated Typhoon) generated by GIROJ's Typhoon Loss Model.



\*1 The periodically changing amount of sea level caused by the gravitation of the moon and sun.

# Storm Surge Flood Engineering Model:

## 1. Estimate Flooded Areas and Flood Levels

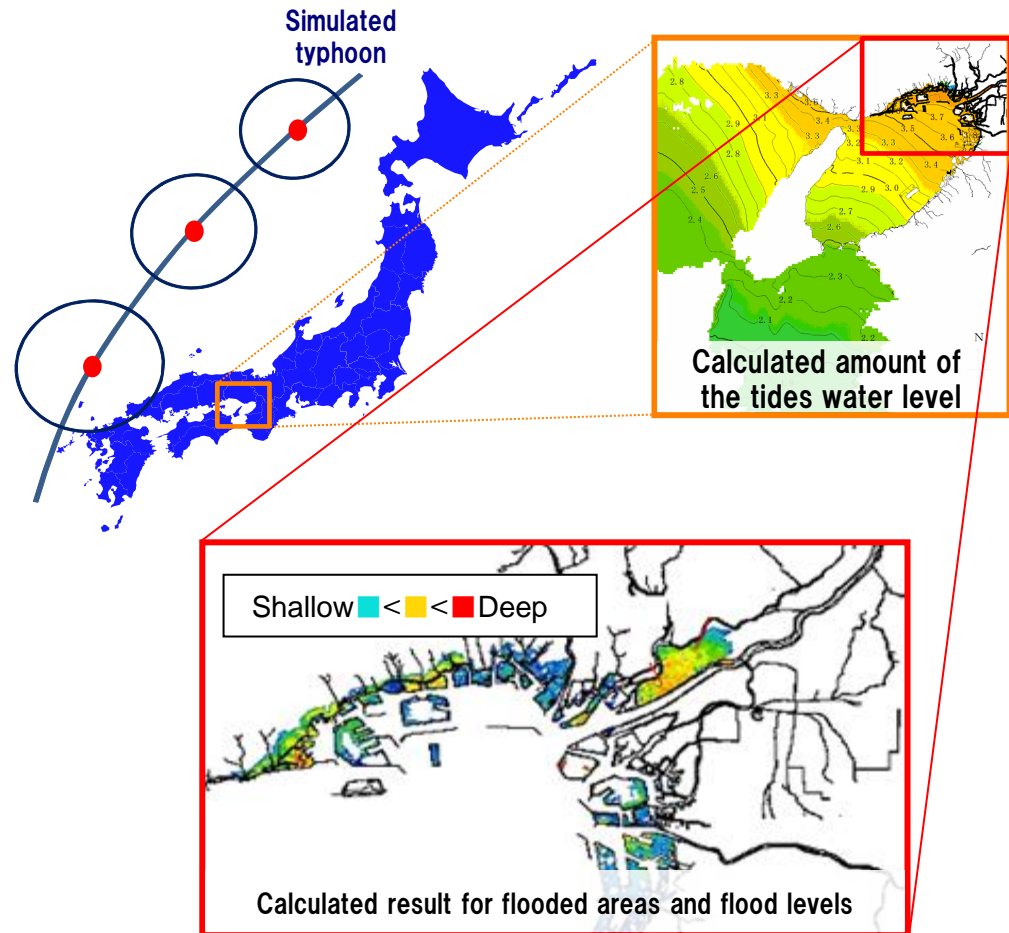
- Calculate the amount of seawater inundating land based on the rise in tide level and how the seawater spreads on land, thereby determining flooded areas and flood levels.

Calculate the amount of rise in tide level

- (1) Seawater inundates land.  
(Bank data)
- (2) The floodwater spreads.  
(Altitude data)

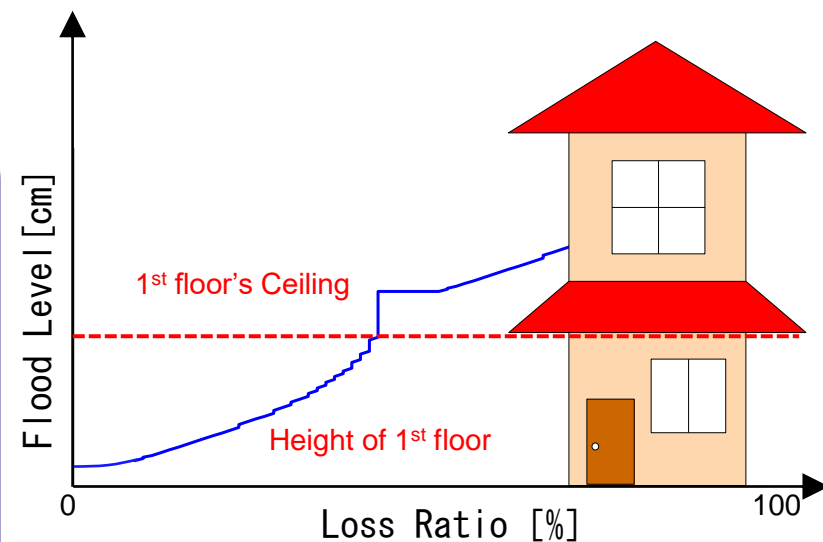
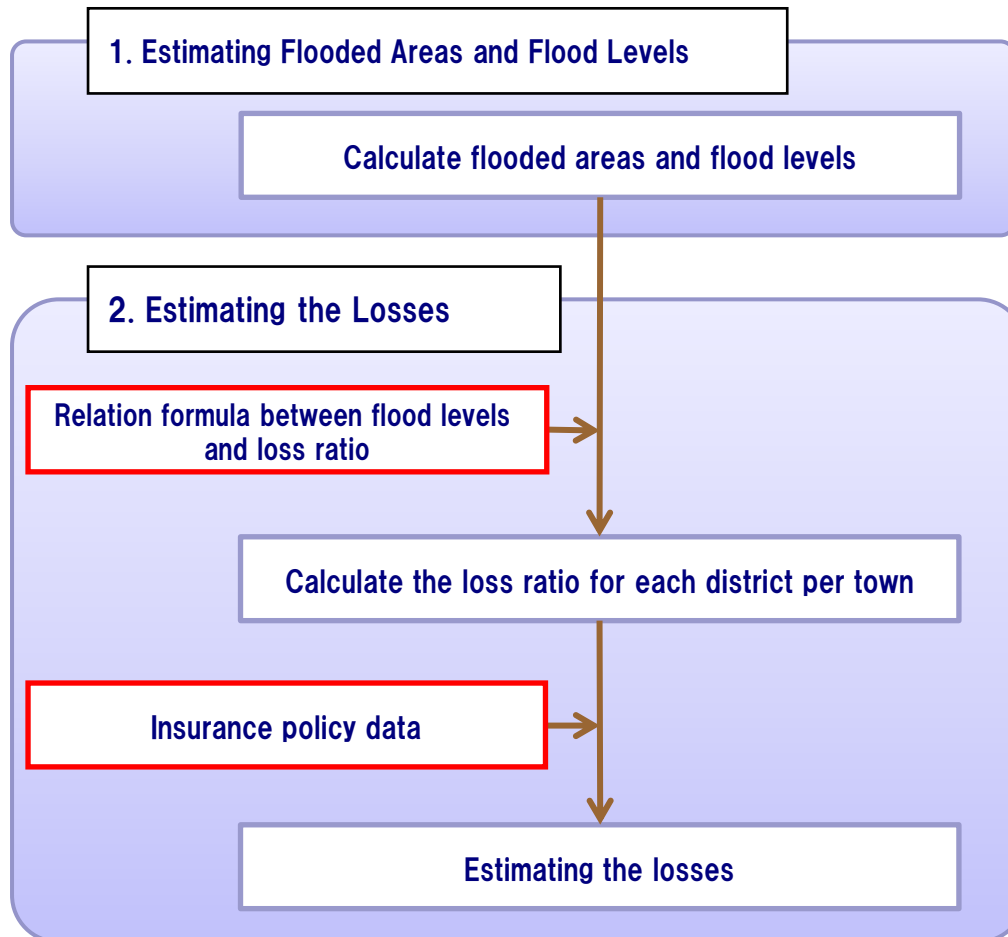
Calculate flooded areas and flood levels

\* Data inside the parentheses are mainly used.

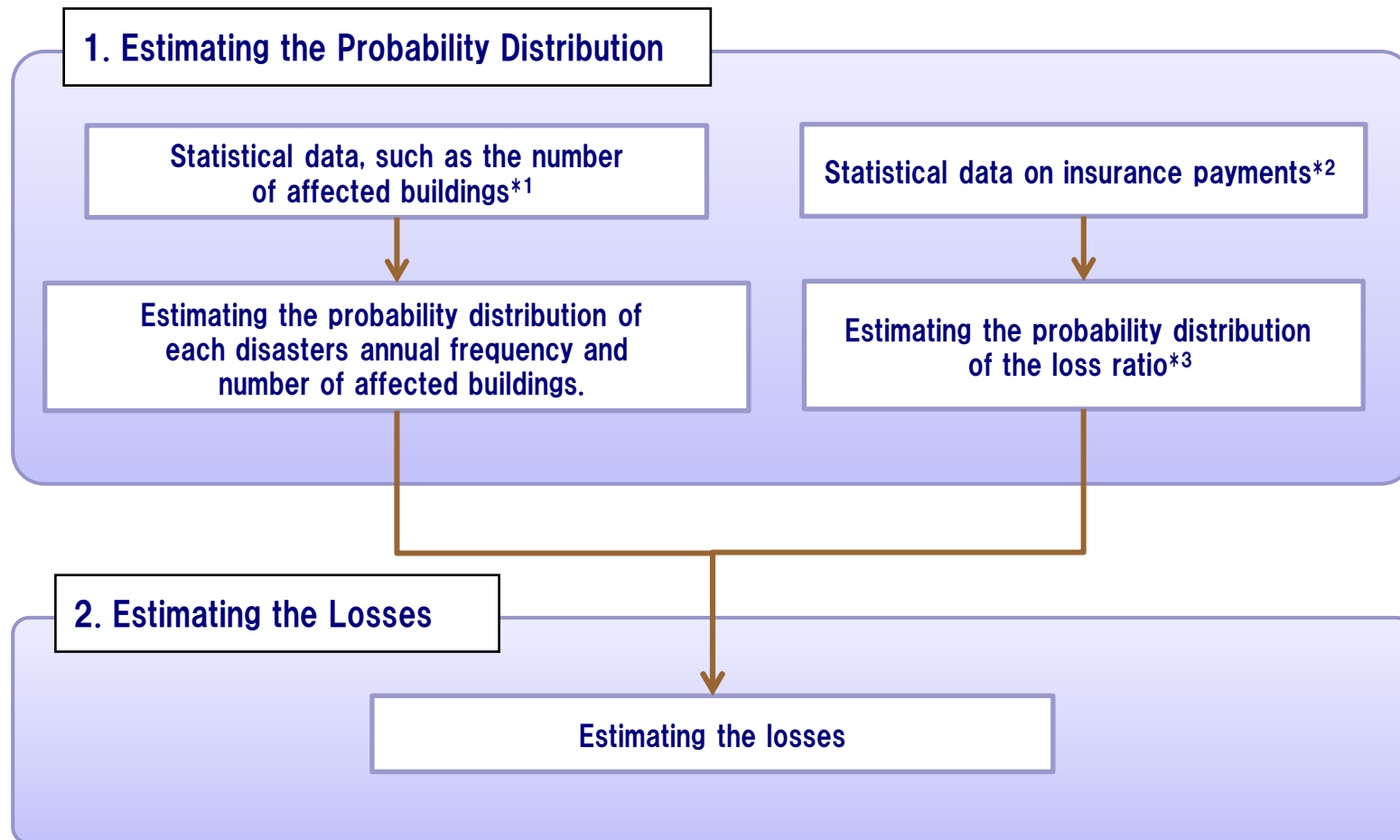


## Storm Surge Flood Engineering Model: 2. Loss Assessment

- By combining the flooded areas and flood levels calculated by the Storm Surge flood simulation, and the “relation formula between the flood levels and the loss ratio”, the loss ratio per town is determined, and the loss is estimated from insurance policy data.



# Overview of Statistical Flood Model



\*1 Flood Damage Statistics Survey (Ministry of Land, Infrastructure, Transport and Tourism) etc. is used.

\*2 Fire insurance statistics (General Insurance Rating Organization of Japan) is used.

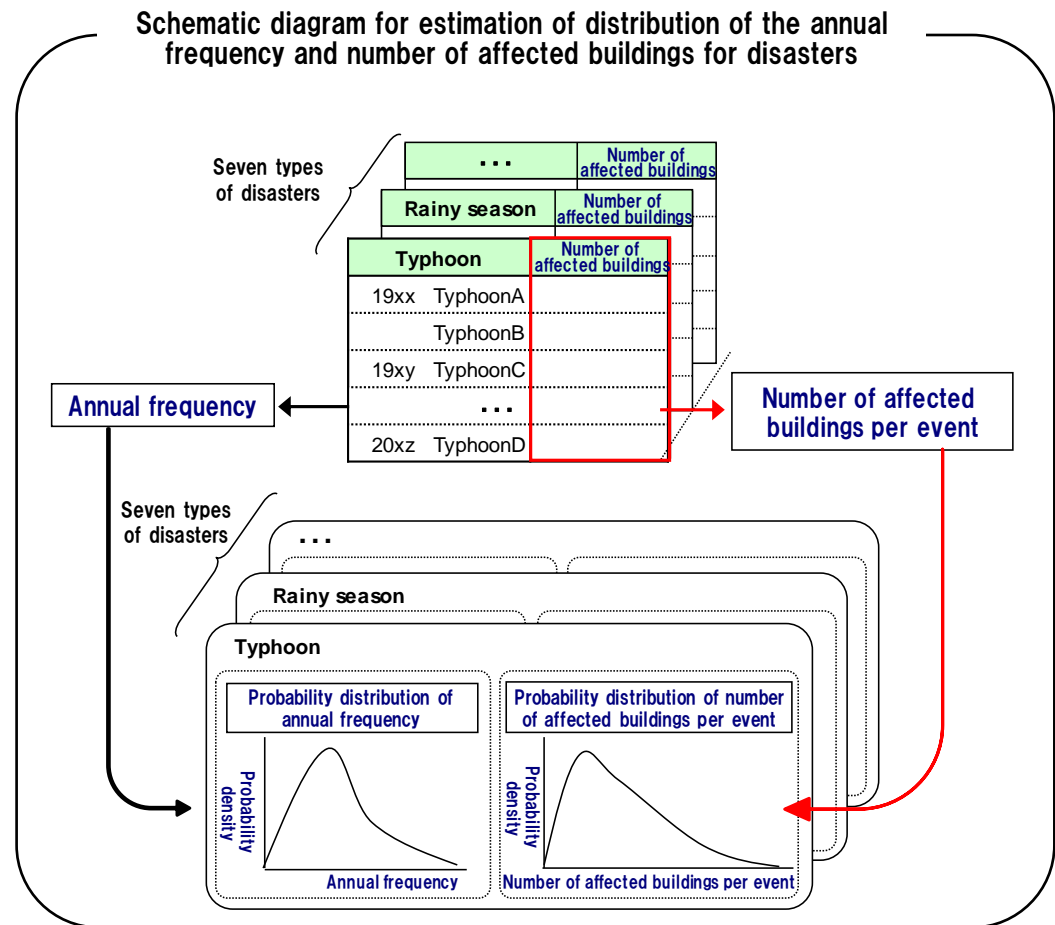
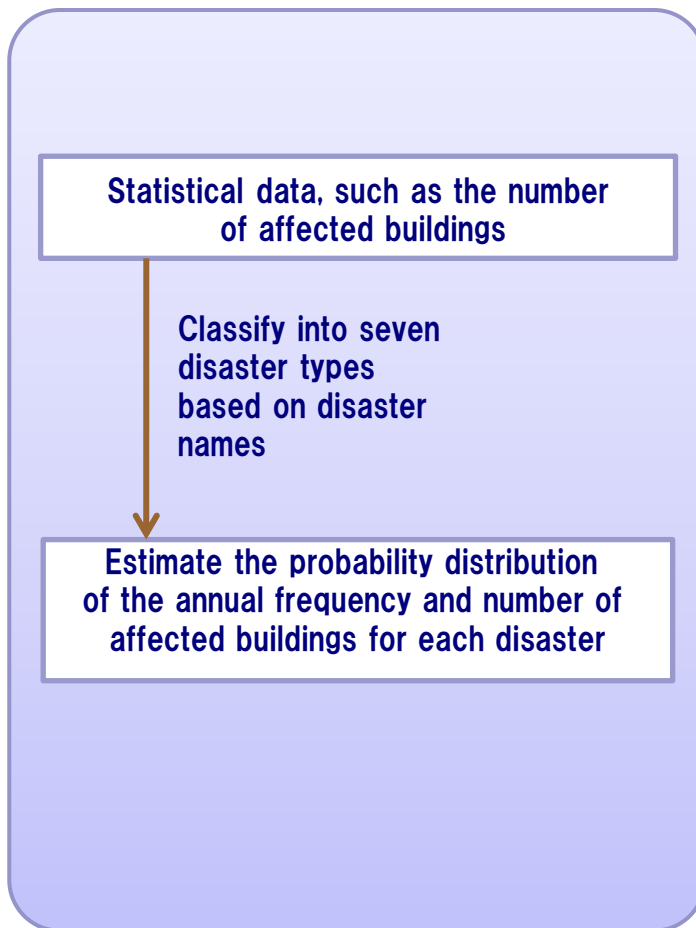
\*3 Loss ratio = amount of loss / insured value



# Statistical Flood Model: 1. Estimating the Probability Distribution

(about the distribution of the disasters annual frequency and number of affected buildings)

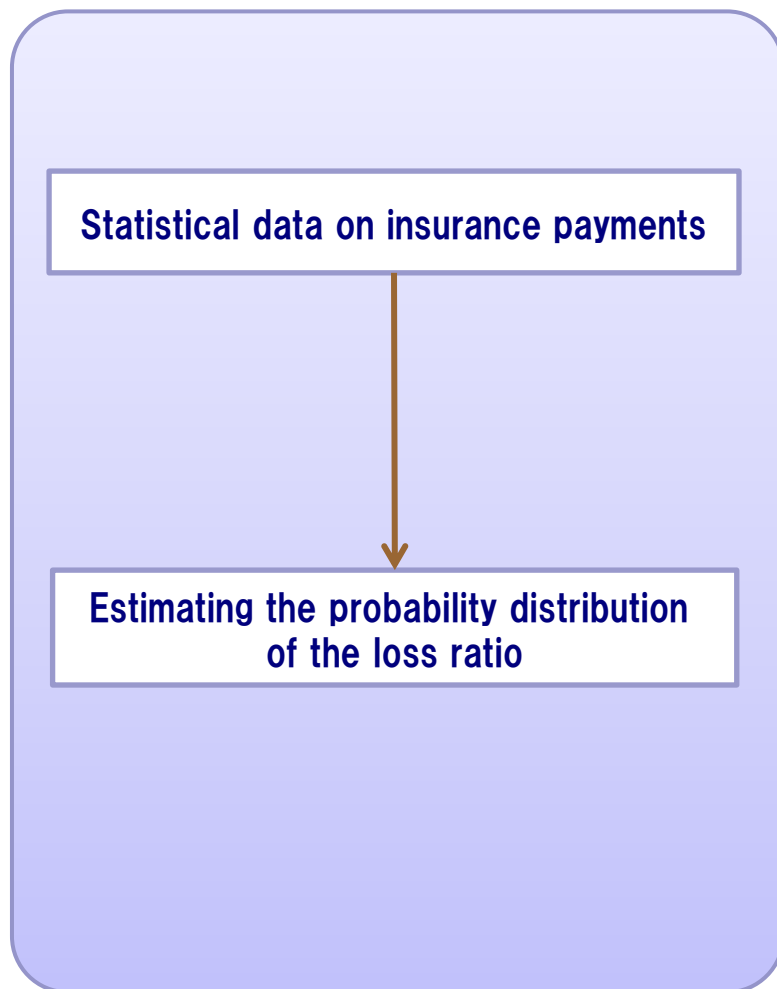
- Based on statistical data of the number of affected buildings etc, the probability distribution of the annual frequency and the number of affected buildings are estimated according to each seven types of disasters (1.typhoon, 2.rainy season, 3.heavy rain, 4.wind and waves, 5.snow melting, 6.landslides, and 7.other extraordinary disasters) .



# Statistical Flood Model: 1. Estimating the Probability Distribution

(about the distribution of the loss ratio)

- Estimating the probability distribution of the loss ratio common to all disaster types based on statistical data on insurance payments.



Schematic diagram for estimation of probability distribution of loss ratio

Statistical data on insurance payments

(1) Insured value	(2) Amount of loss
100	10
200	40
...	

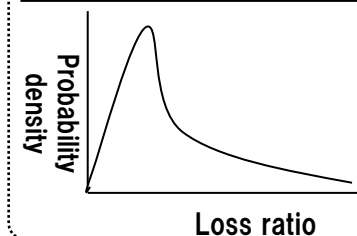


(3) Loss ratio = ((2) / (1))
0.1
0.2
...



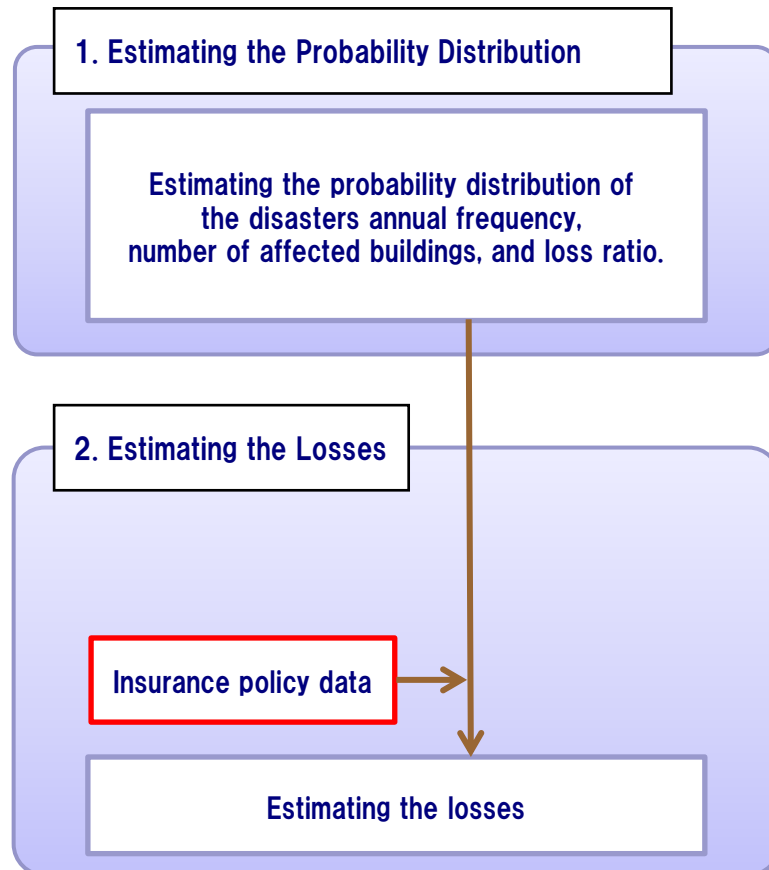
(Common to all disaster types)

Probability distribution of loss ratio

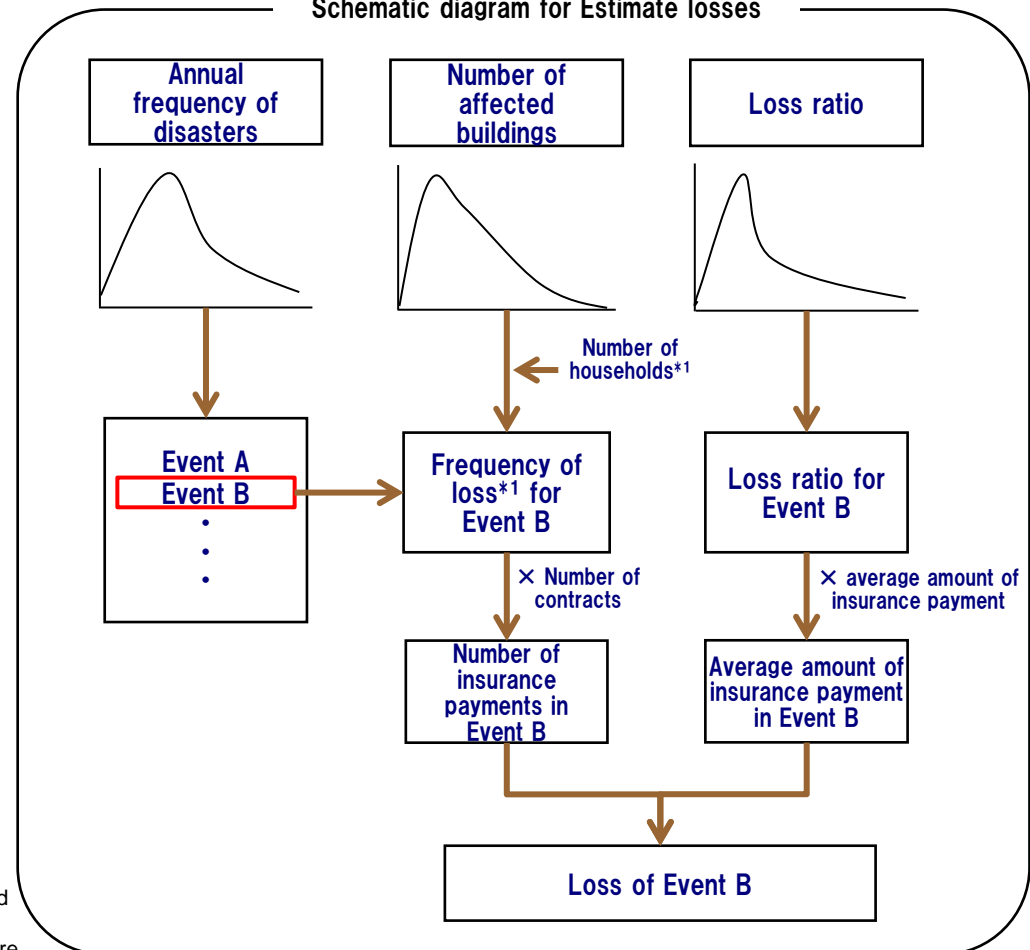


## Statistical Flood Model: 2. Estimate Losses

- Calculating the disasters annual frequency, number of affected buildings, and the loss ratio based on the estimated probability distribution. Then, after determining the number of insurance payments and the average amount of insurance payments using the insurance policy data, the loss is estimated per type of disaster, per prefecture.



Schematic diagram for Estimate losses



\*1 The calculated number of affected buildings is allocated across prefectures based on past disaster cases. Then, the allocated number is divided by the number of households for each prefecture to determine the frequency of loss for each prefecture.



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