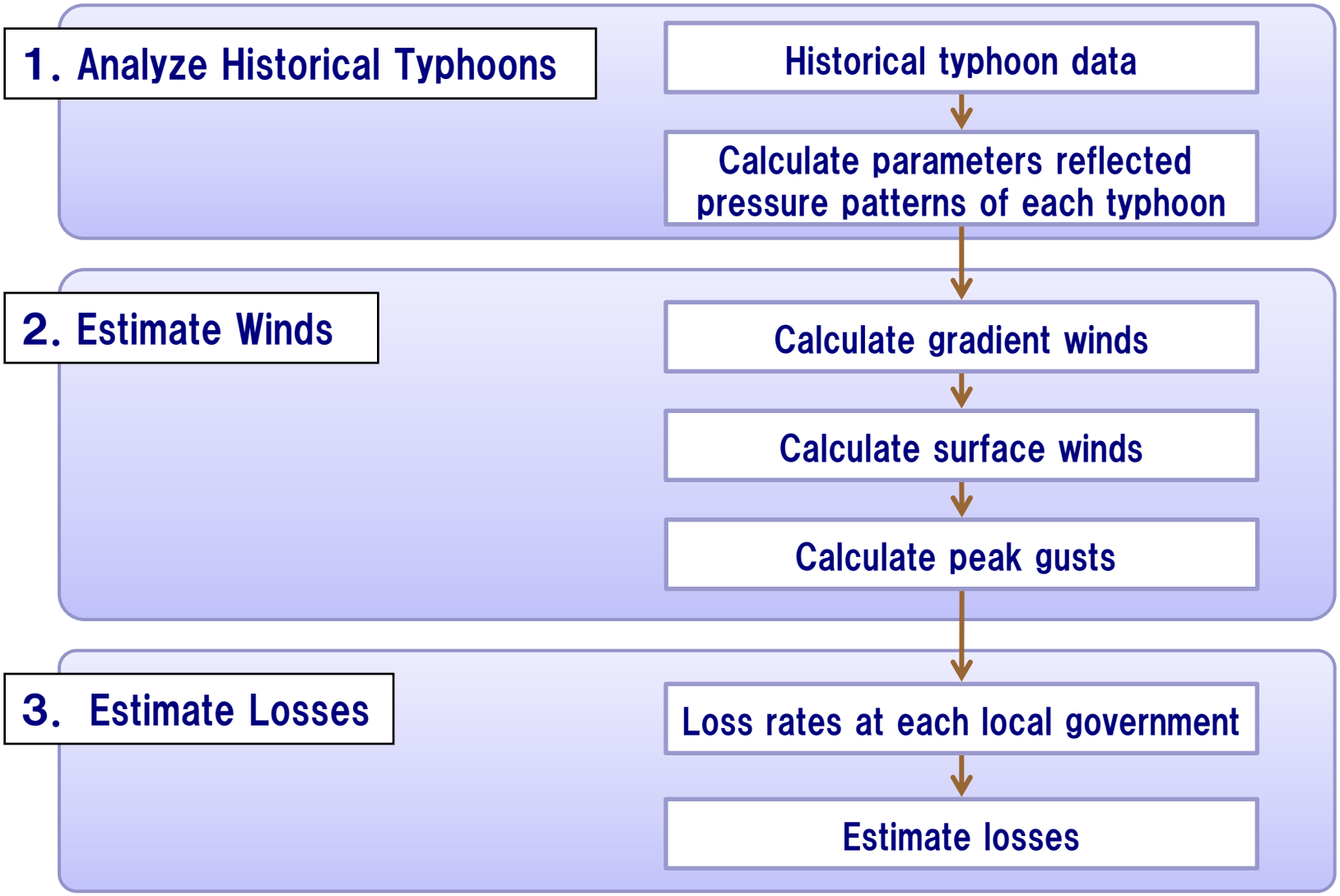
GIROJ
Typhoon Loss Model

General Insurance Rating Organization of Japan

Overview of Estimating Historical Typhoon Losses



※ "Historical typhoon losses" means the Loss generated by each Historical Typhoon using the current exposure data

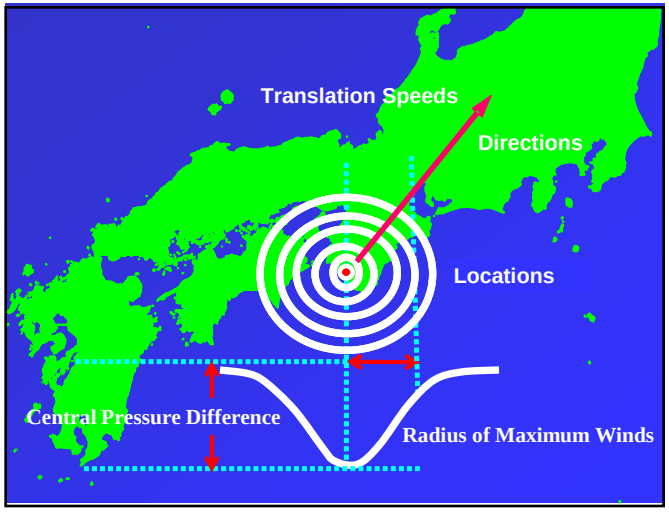
Estimating Historical Typhoon Losses 1. Analyze Historical Typhoons

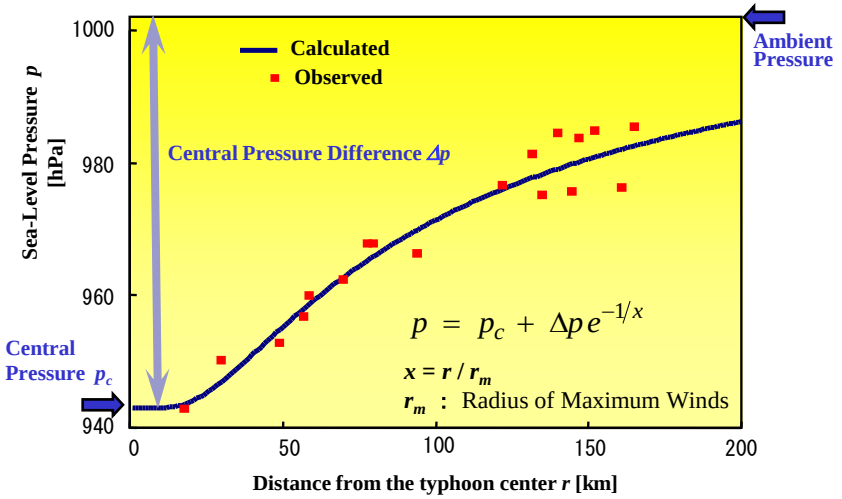
- Calculate parameters reflected pressure patterns of each historical typhoon from historical typhoon data and observed data.

Historical typhoon data
- Locations
- Central Pressure

Observed Data
- Locations
- Sea-Level Pressure

Calculate parameters reflected pressure patterns of each typhoon
- Locations
- Translation Speeds
- Central Pressure Difference
- Directions
- Radius of Maximum Winds





Estimating Historical Typhoon Losses 2. Estimate Winds

- Calculate peak gust at each location by the typhoon parameters analyzed.

1. Analyze Historical Typhoons

The typhoon parameters

Locations for calculation
(Each 1km grid)

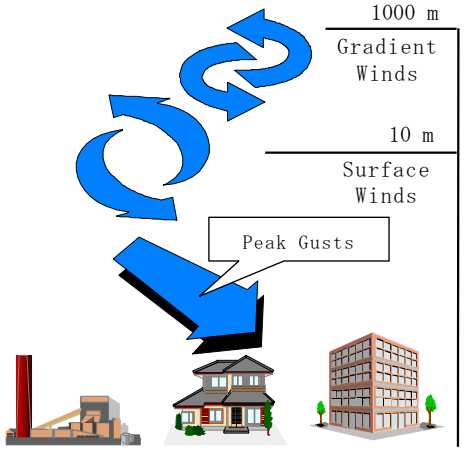
2. Estimate Winds

Calculate gradient winds

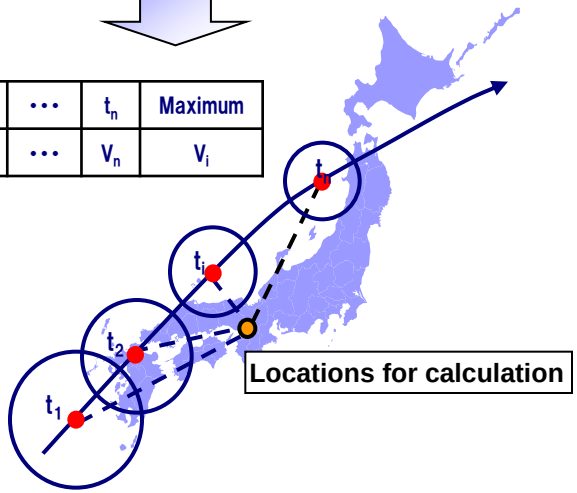
Calculate surface winds

Calculate peak gusts

Extract a maximum peak gust from peak gust at each time



Time	t_1	t_2	···	t_n	Maximum
Winds	V_1	V_2	···	V_n	V_i



Estimating Historical Typhoon Losses 3. Estimate Losses

- Estimate losses by peak gust at each location and relationships between peak gusts and fragility, damageability.

2. Estimate Winds

The peak gust at each location

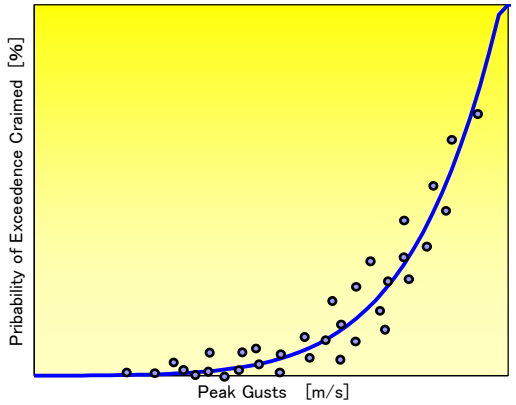
Relationships between peak gusts and fragility, damageability

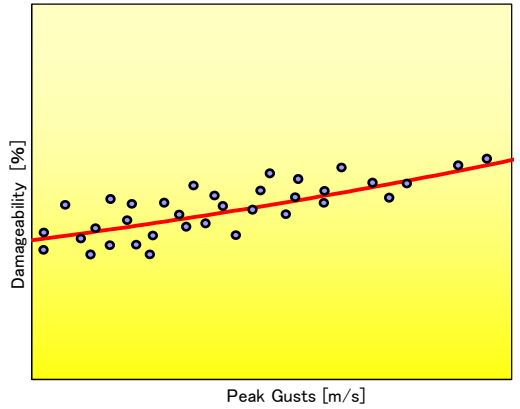
3. Estimate Losses

Loss rates at each local government

Insurance Data

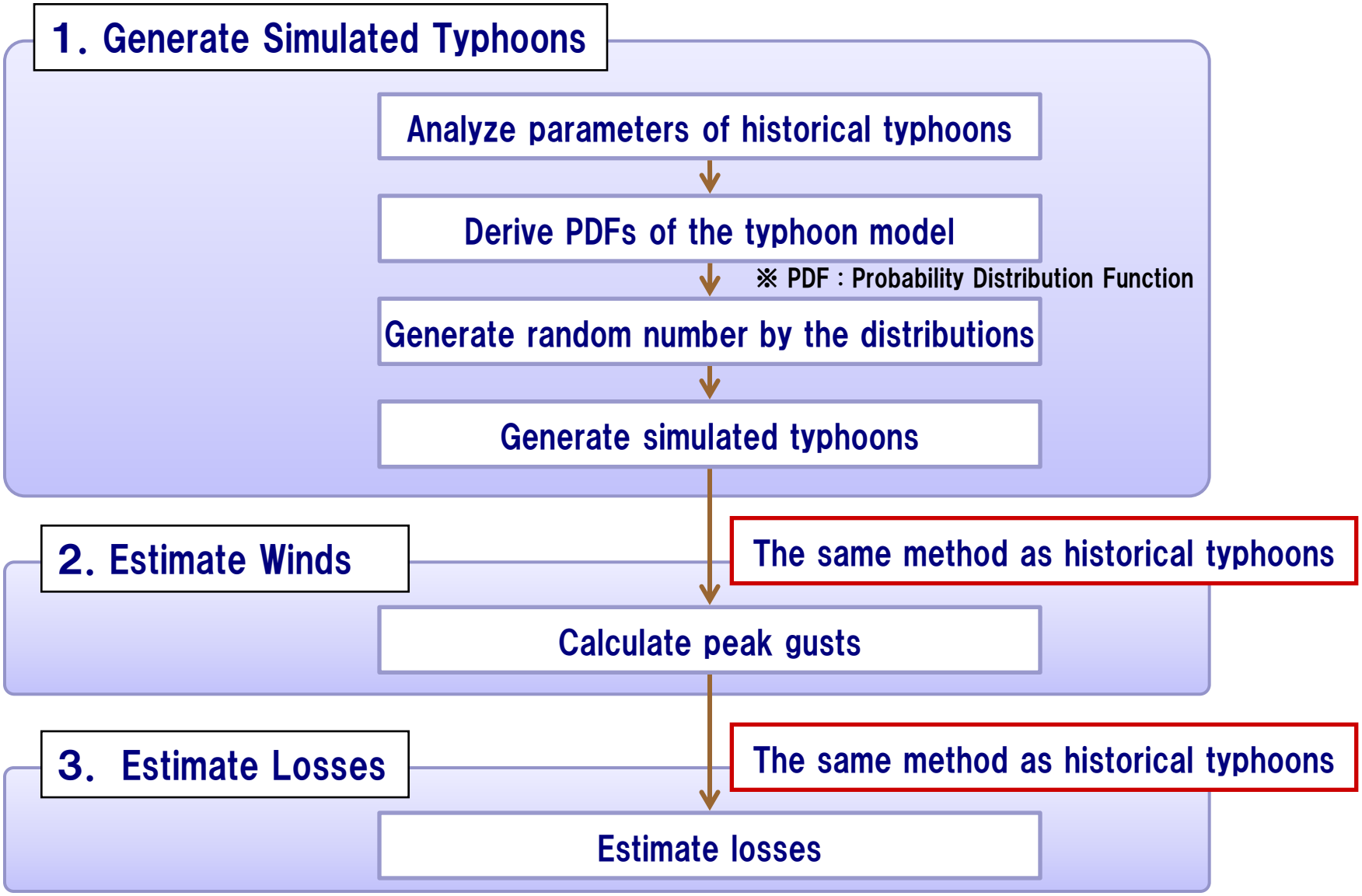
Estimate losses





※ The plots in two figs are not actual data.

Overview of Monte Carlo Simulation Model



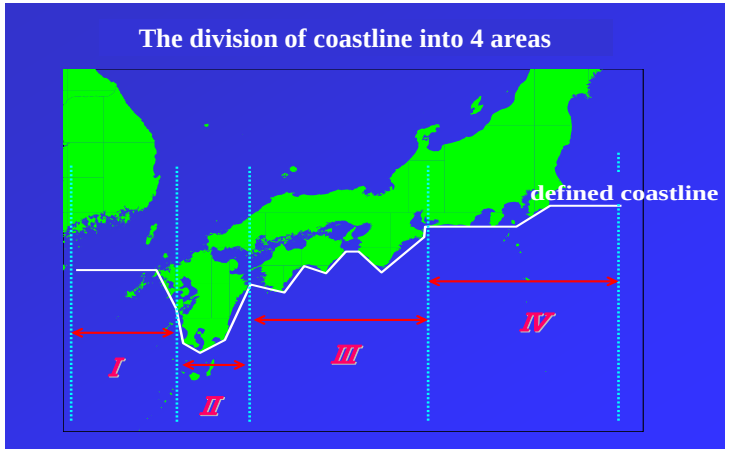
Monte Carlo Simulation Model ～Generate Simulated Typhoons～

■ Devide coastline 4 areas, and calculate typhoon parameters by each area.

Historical Typhoon Data
- Locations
- Central Pressure

Observed Data
- Locations
- Sea-Level Pressure

Calculate parameters of historical typhoons
- Landing Positions
- Translation Speeds
- Central Pressure Difference
- Radius of Maximum Winds
- Annual Landing number



Monte Carlo Simulation Model ～Generate Simulated Typhoons～

- Derive PDFs at each area.

The analyzed parameters of historical typhoons

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Derive PDFs

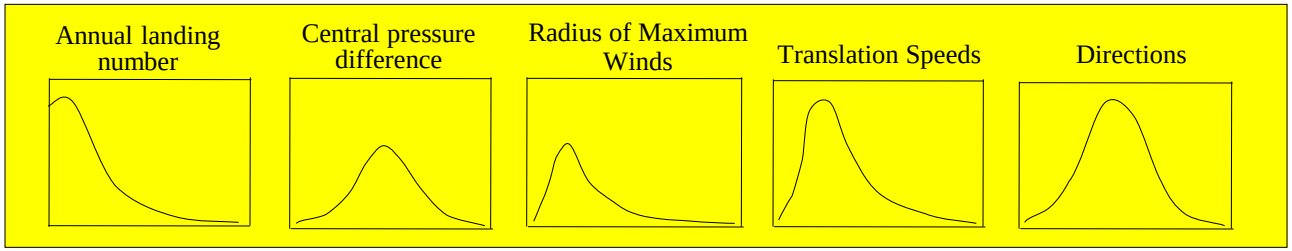
- Annual Landing number
- Translation Speeds
- Central Pressure Difference
- Radius of Maximum Winds
- Directions

Typhoon parameters at the time of landfall (Initial values)

Parameters			Probability Distribution	Remarks
Annual Landing number		(n)	Poisson	per Area (4 categories)
Central Pressure Difference	ΔP	(hPa)	Log-Normal	per Area (4 categories)
Radius of Maximum Wind	r_m	(km)	Log-Normal	per rank of ΔP (3 categories)
Translation Speeds	C	(km/h)	Log-Normal	per Area (4 categories)
Directions	γ	(deg)	Log-Normal	per Area (4 categories)

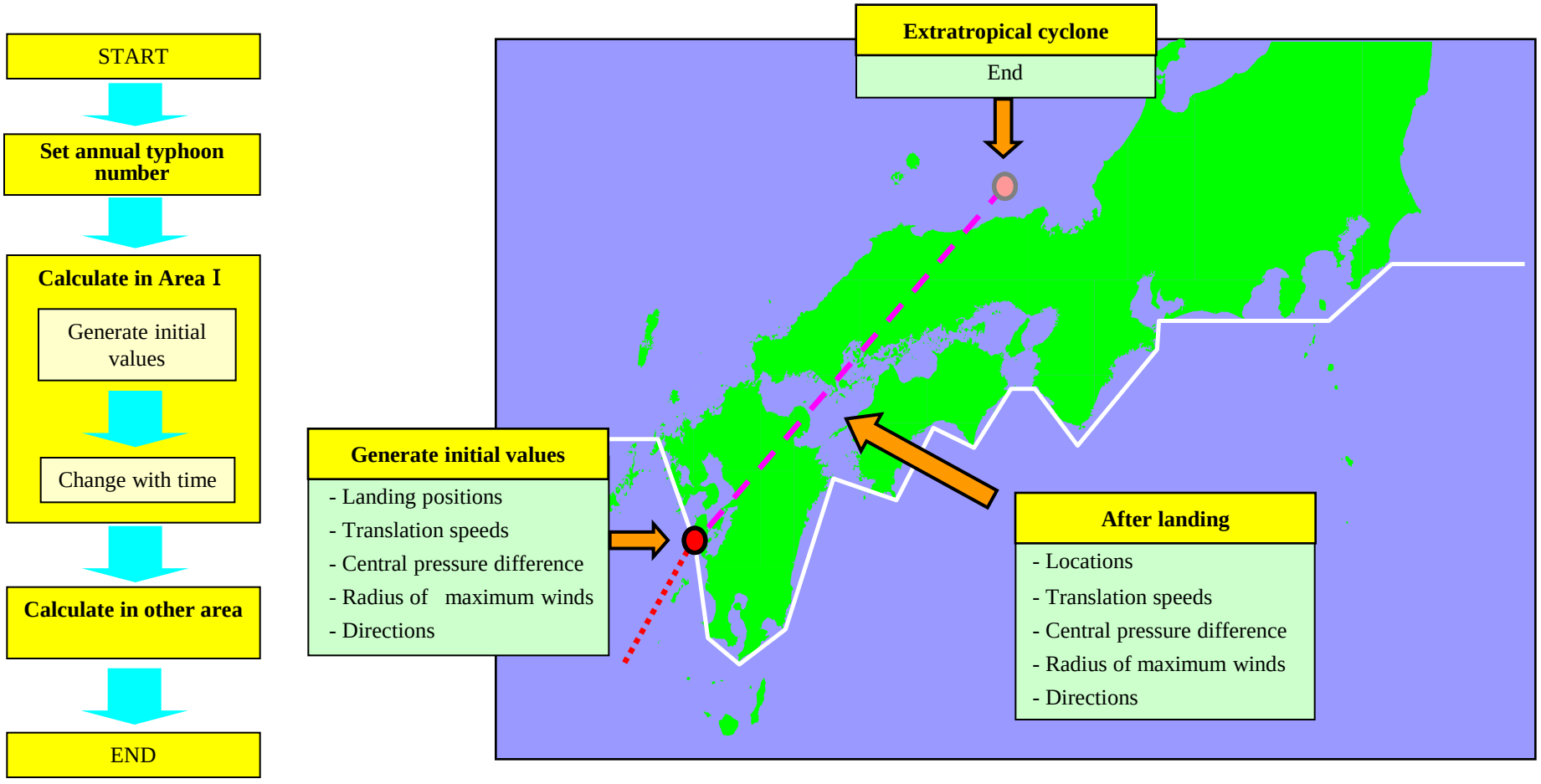
Changing parameters (after landfall)

Parameters			Function	Remarks
Central pressure difference	ΔP	(1/h)	exponential	per Area (4 categories)
Radius of Maximum Winds	r_m	(%/h)	linear	per Area (4 categories)
Translation Speeds	C	(%/h)	linear	per Area (4 categories)
Directions	γ	(deg.)	constant	per Area (4 categories)



Monte Carlo Simulation Model ～Generate Simulated Typhoons～

- **Generate simulated typhoons by generating random number using PDFs.**



Contact Information

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