

THE STUDY OF INSURANCE PREMIUM RATE GIS MAPPING CONSIDERING THE STORM AND FLOOD HAZARD RISKS

JunSeok Lee, InSu Lee

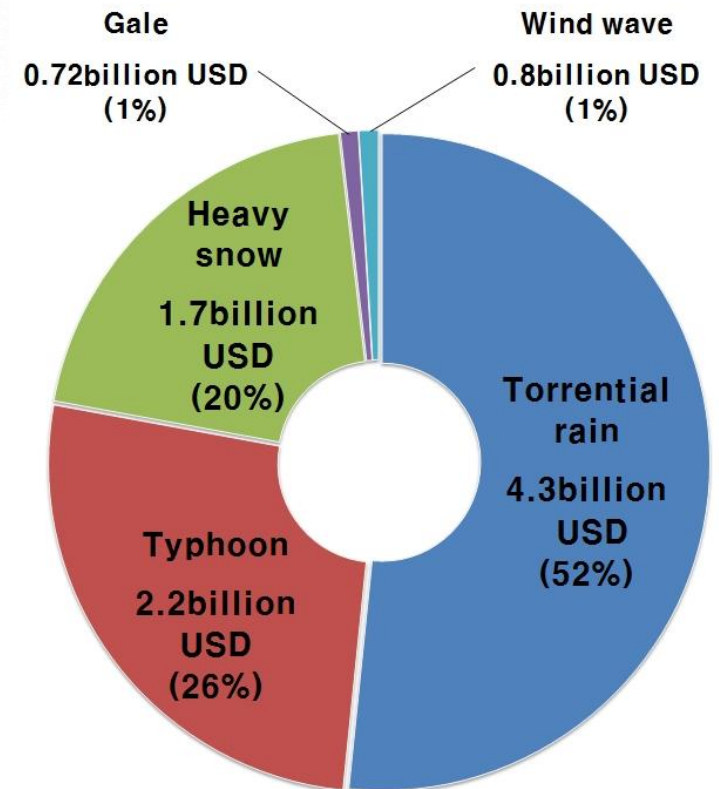
**Senior Resecher, Ph.D., LX Spatial Information
Research Institute**

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I . Introduction

Background

- The recent natural disaster occurrences are becoming massive, various and complex
- Their frequencies are rising and the scale of damage are becoming enormous
- For the last decade, torrential rain took a largest toll at 52% among all types of natural disasters followed by typhoon at 26% and heavy snow at 20% in Korea and this requires urgent countermeasures



Damage by natural disaster for the last decade
Source : Annual disaster report(Ministry of Public Safety and Security, 2013)

I . Introduction

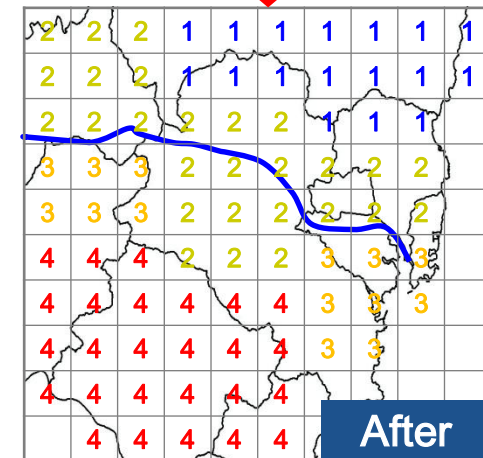
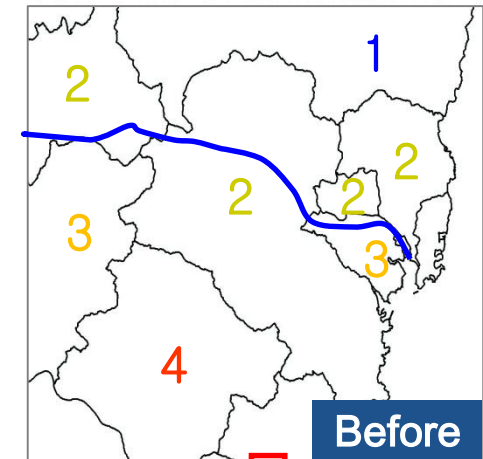
□ Background

- Korea has implemented a natural disaster insurance policy as a means of non-structural measure for green houses and building
- However, problem arises in the application of the insurance rate because it is uniformly distributed on all places in one administrative district
- It is required for the government and citizens to develop a reasonable insurance rate considering flood, wind and snow disaster

KOREA



- 1 Safe
- 2 Warning
- 3 Dangerous
- 4 Severely dangerous



I . Introduction

Purpose

To develop a flood, wind and snow disaster risk map

To make an Insurance rate map based from the risk map

To develop an integrated management system
for natural disaster insurance rate map

I . Introduction

□ Study Area

□ Study Area : Daegu, Gyeongbuk and Gangwon

□ Specification

Description	Daegu	Gyeong-Buk	Gang-won
Area (km ²)	884	19,037	16,644
Population	2.5 M	2.7 M	1.8 M
Average Precipitation (mm)	1,064	1,133	1,462
Average Temperature (°C)	14.1	12.2	11.0
Average Wind speed (m/s)	2.7	2.0	2.5
Average Snow depth (cm)	16.9	6.6	28.3



II. Development of Natural Disaster Risk Map

□ Development of flood risk map

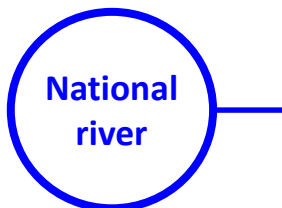
○ Procedure of analysis on flood risk

□ Selection of methodology

- Consideration

1. cost
2. simulation time
3. accuracy

Description	Numerical model		GIS tool method
	HEC-RAS (1Dimensionstional)	FLUMEN (2Dimensionstional)	
Cost	Middle	High	Low
Simulation time	Middle	Long	Short
Accuracy	Middle	High	Middle

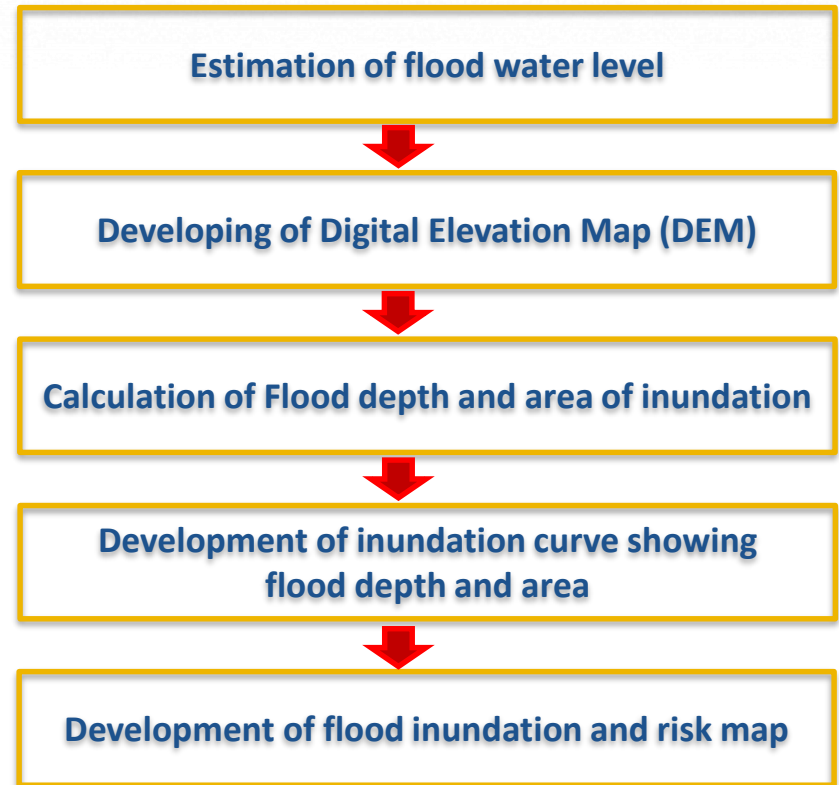


FIUMEN,
HEC-RAS



GIS tool
method

□ Procedure of GIS tool method







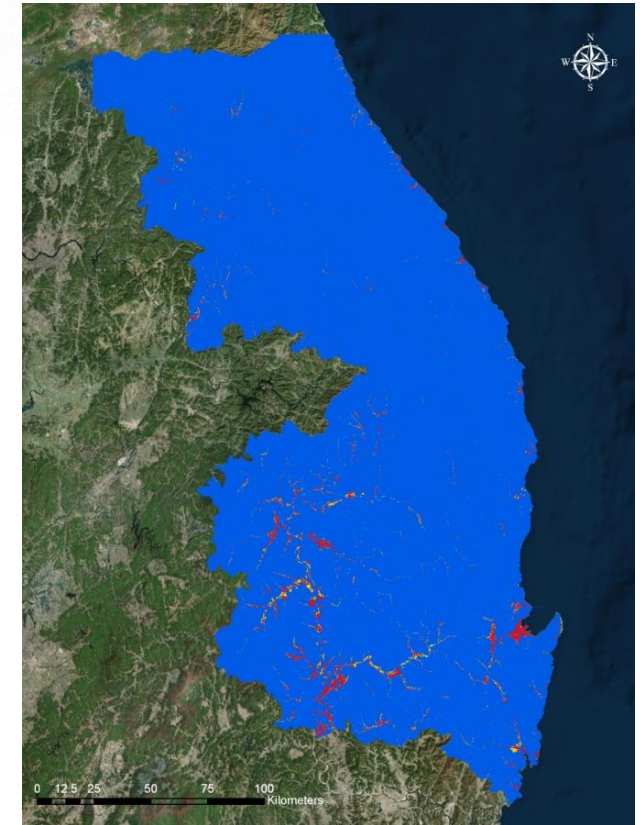
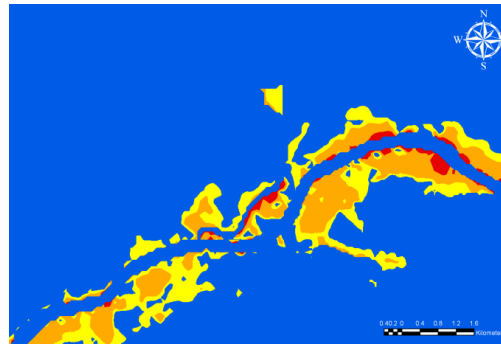
II. Development of Natural Disaster Risk Map

□ Development of flood risk map

○ Flood risk map

- Flood inundation map was developed first and risk are classified according to range of water depth
- 2% of the study area was inundated in the scenario of design flood frequency (100yr-frequency)
- Warning zone was 0.4%, Dangerous zone was 0.4% and severely dangerous zone was 1.2 %

Legend	Zone	Risk	Water Depth	Area (km ²)	Ratio
	I	Safe	$h = 0$	36,137	98.0
	II	Warning	$0.0 < h \leq 0.5$	122	0.4
	III	Dangerous	$0.5 < h \leq 1.0$	160	0.4
	IV	Severely Dangerous	$1.0 < h$	441	1.2
Total				36,860	100

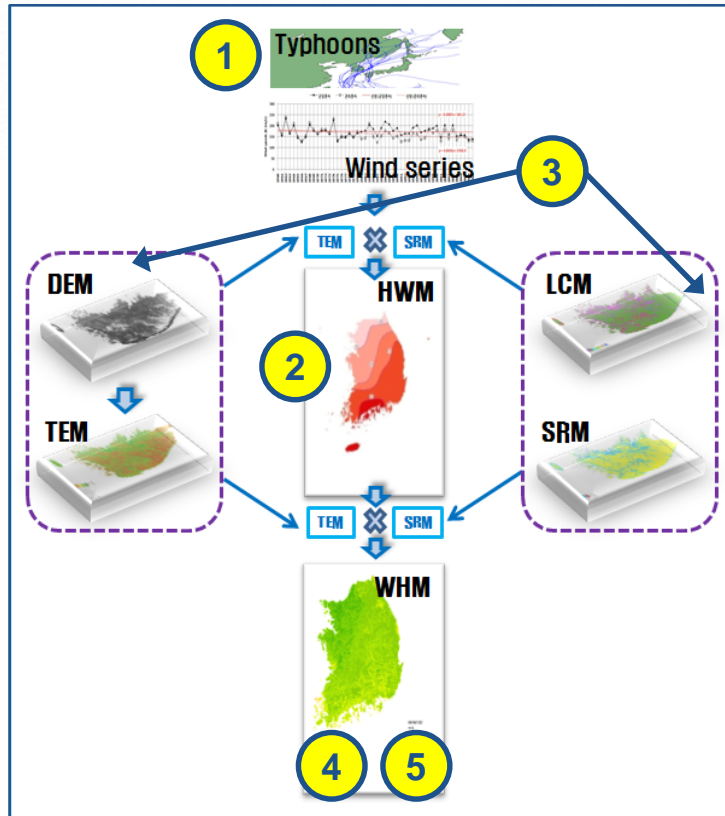


〈Flood risk map of Daegu, Gyeongbuk and Gangwon〉

II. Development of Natural Disaster Risk Map

□ Development of wind risk map

○ Procedure of analysis on wind risk



- 1 annual maximum wind velocity
- 2 homogeneous wind model by frequency analysis using Gumbel distribution
- 3 topographical effect model & surface roughness model
- 4 wind velocity map
- 5 wind disaster risk map comparing between design wind velocity and calculated velocity
 - Design wind velocity > calculated wind velocity : safe, warning
 - Design wind velocity < calculated wind velocity : dangerous, severely dangerous

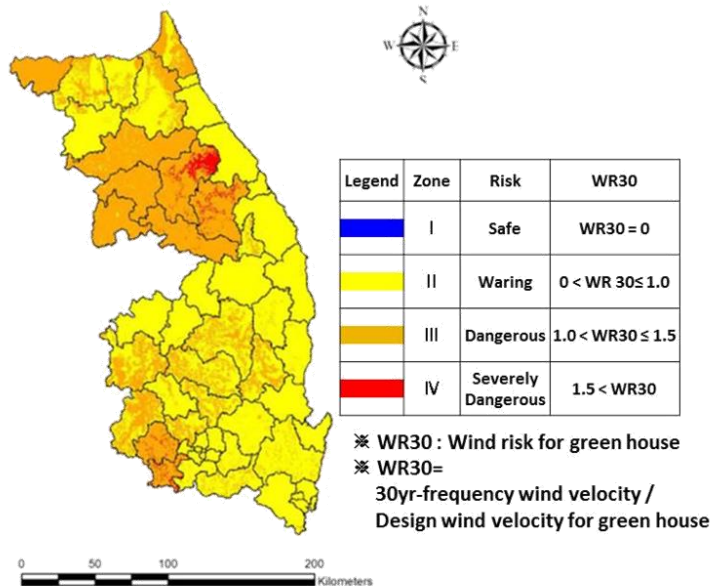
DEM : Digital Elevation Model, TEM : Topographical Effect Model, LCM : Land Cover Map
SRM : Surface Roughness Model, HWM : Homogeneous Wind Model, WHM : Wind Disaster Map

II. Development of Natural Disaster Risk Map

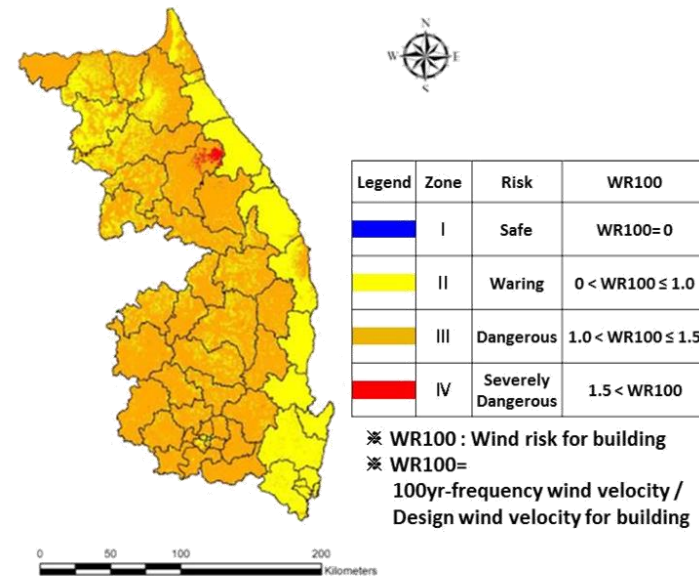
□ Development of wind risk map

○ Wind risk map

- Wind risk for green house is categorized by comparing between 30-year frequency wind velocity calculated in this study and design wind velocity determined by government
- Wind risk for green house equals 30-year frequency wind velocity / design wind velocity for green house
- The same goes on the wind risk for building



<Wind risk map for green house>

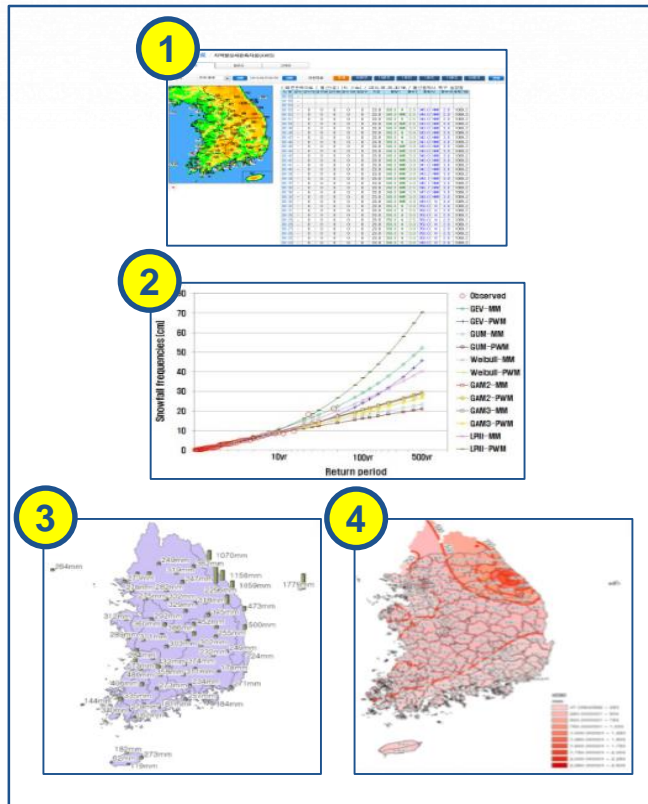


<Wind risk map for building>

II. Development of Natural Disaster Risk Map

□ Development of snow risk map

○ Procedure of analysis on snow risk



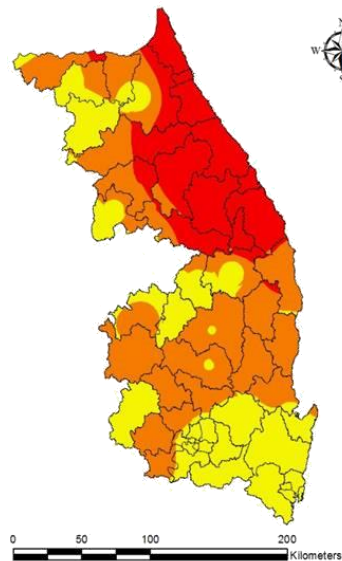
- 1** Annual maximum snow depth data
- 2** Selection of an appropriate probability distribution for Snow depth frequency analysis in Korea
- 3** Snow depth frequency analysis
- 4** Development of a snow depth map
- 5** Development of snow disaster risk map comparing between design snow depth and calculated snow depth
 - Design snow depth > calculated snow depth : safe, warning
 - Design snow depth < calculated snow depth : dangerous, severely dangerous

II. Development of Natural Disaster Risk Map

□ Development of snow risk map

○ Snow risk map

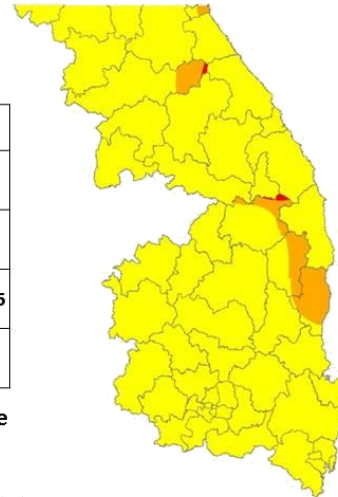
- Snow risk for building is categorized by comparing between 100-year frequency snow load calculated in this study and design snow load determined by government
- Snow risk for building equals 100-year frequency snow load / design snow load for building
- The same goes on the snow risk for green house



Legend	Zone	Risk	SR30
	I	Safe	SR30 = 0
	II	Waring	0 < SR 30 ≤ 1.0
	III	Dangerous	1.0 < SR30 ≤ 1.5
	IV	Severely Dangerous	1.5 < SR30

※ SR30 : Snow risk for green house
 ※ SR30=
 30yr-frequency snow depth /
 Design snow depth for green house

<Snow risk map for greenhouse>



Legend	Zone	Risk	SR100
	I	Safe	SR100 = 0
	II	Waring	0 < SR100 ≤ 1.0
	III	Dangerous	1.0 < SR100 ≤ 1.5
	IV	Severely Dangerous	1.5 < SR100

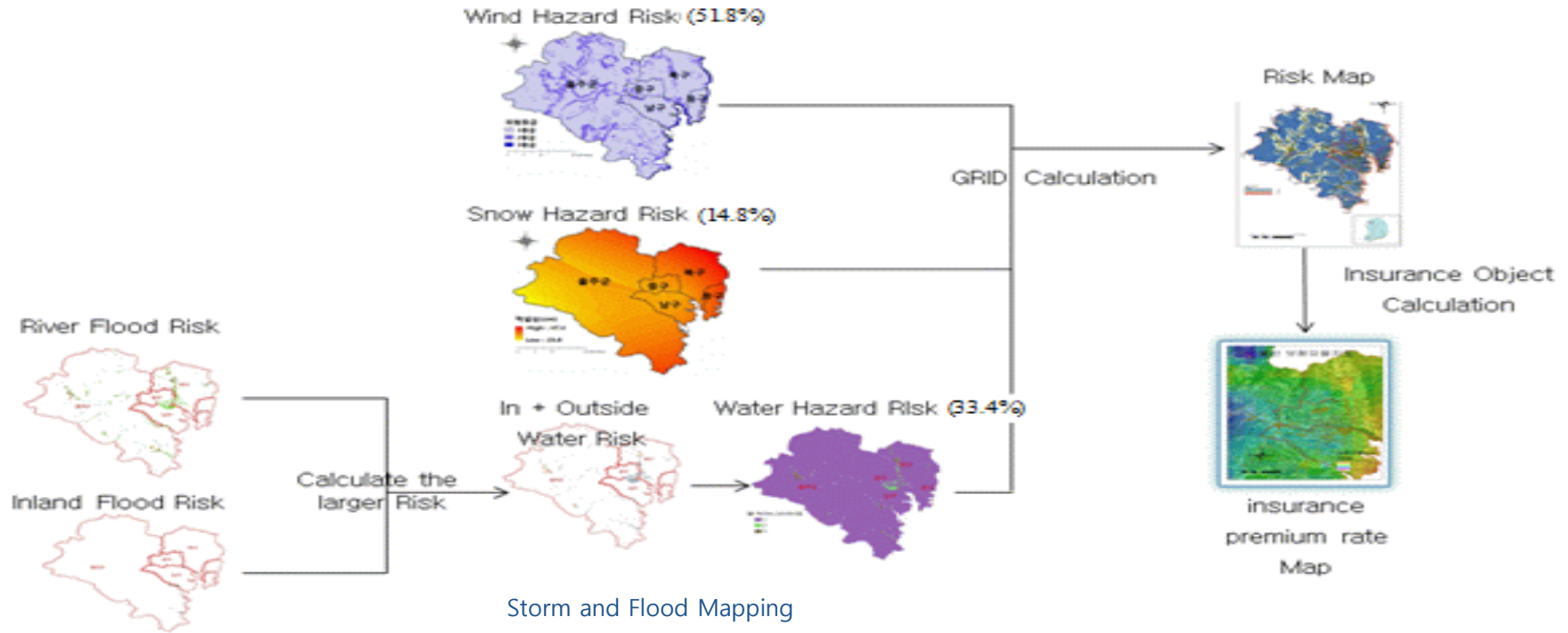
※ SR100 : Snow risk for building
 ※ SR100=
 100yr-frequency Snow depth /
 Design snow depth for building

<Snow risk map for building>

III. Insurance Rate Making and Mapping

□ Insurance Rate Map Making

○ Procedure



<Equation of insurance rate making>

$$\begin{aligned}
 PPR_i^* &= PPR_i \times w_i^*(flood) + PPR_i \times w_i^*(wind) \times (1 \pm \beta_i^*) \\
 &\quad + PPR_i \times w_i^*(snow) \times (1 \pm \gamma_i^*) \\
 &= PPR_i \times [w_i^*(flood) + w_i^*(wind) \times (1 \pm \beta_i^*) + w_i^*(snow) \times (1 \pm \gamma_i^*)]
 \end{aligned}$$

where, PPR_i : flood insurance rate of i class

PPR_i^* : Insurance rate applying wind and snow risk to flood insurance

$w_i^*(flood, wind, snow)$: weight value of flood, wind and snow

β_i^*, γ_i^* : discount and additional rate of wind and snow risk of i class

III. Insurance Rate Making and Mapping

□ Insurance Rate Making

○ Results of insurance rating

- Unit insurance rate that is being used in Korea has constant value on all classes
- While in applying the research on the 3 combined risk, insurance rate is divided into 4 classes
- Insurance premium of the 1st class area is lower than unit insurance rate because the area is safe
- However, insurance premium of the 2nd to 4th classes are higher than unit insurance rate because those areas are exposed to natural disasters

(Unit: %)



Administrative districts		Unit insurance rate	Results of insurance making			
			1 st class	2 nd class	3 rd class	4 th class
Daegu	Jung gu	0.2468	0.1411	0.6066	0.6963	1.0227
	Dong gu	0.3791	0.2204	1.0535	1.2114	1.7697
	Seo gu	0.1097	0.0553	3.9654	4.5526	6.8395
	Nam gu	0.6199	0.5004	0.6533	0.7499	1.0642
	Dalseo gu	0.1912	0.1204	0.2731	0.3136	0.4712

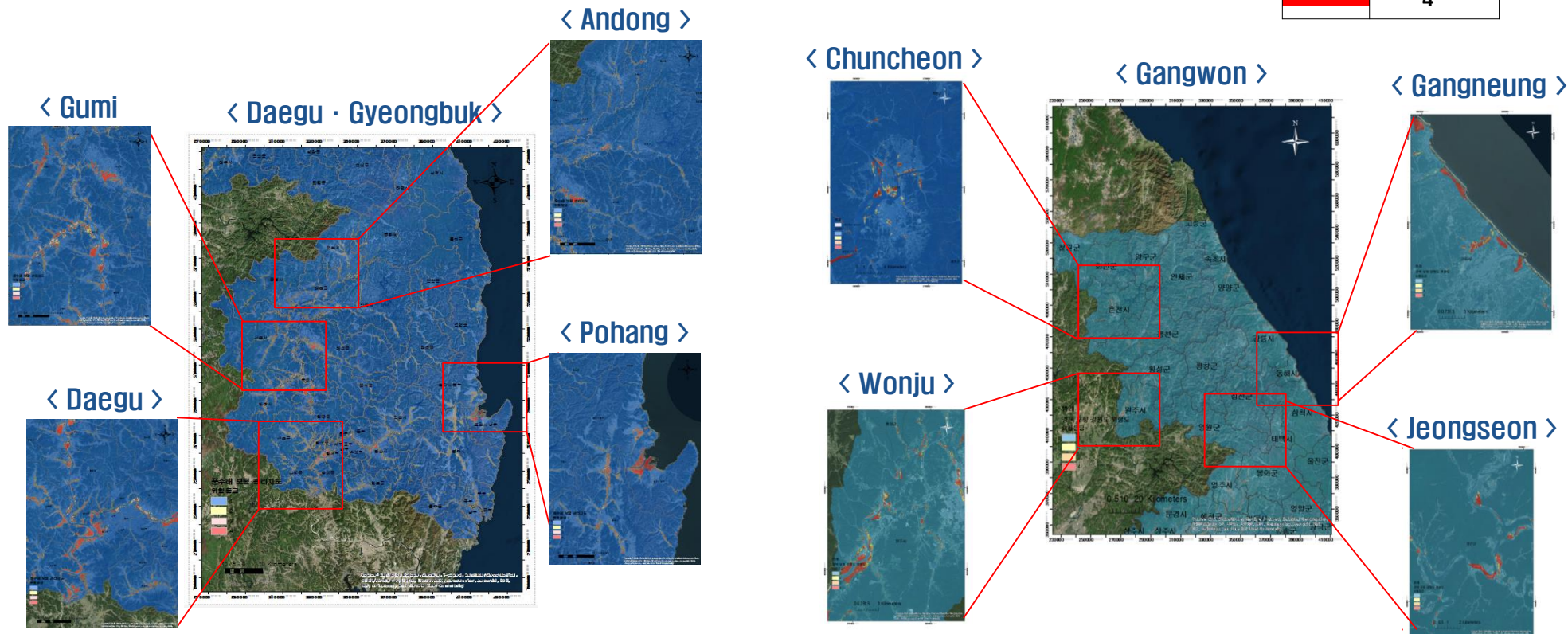
III. Insurance Rate Making and Mapping

Insurance Rate Mapping

Results of Insurance rate mapping

- Insurance rate maps of study area were developed
- The 10m grid based classification of insurance rate which is color coded is also seen for identification

Legend	Classification
	1 st
	2 nd
	3 rd
	4 th

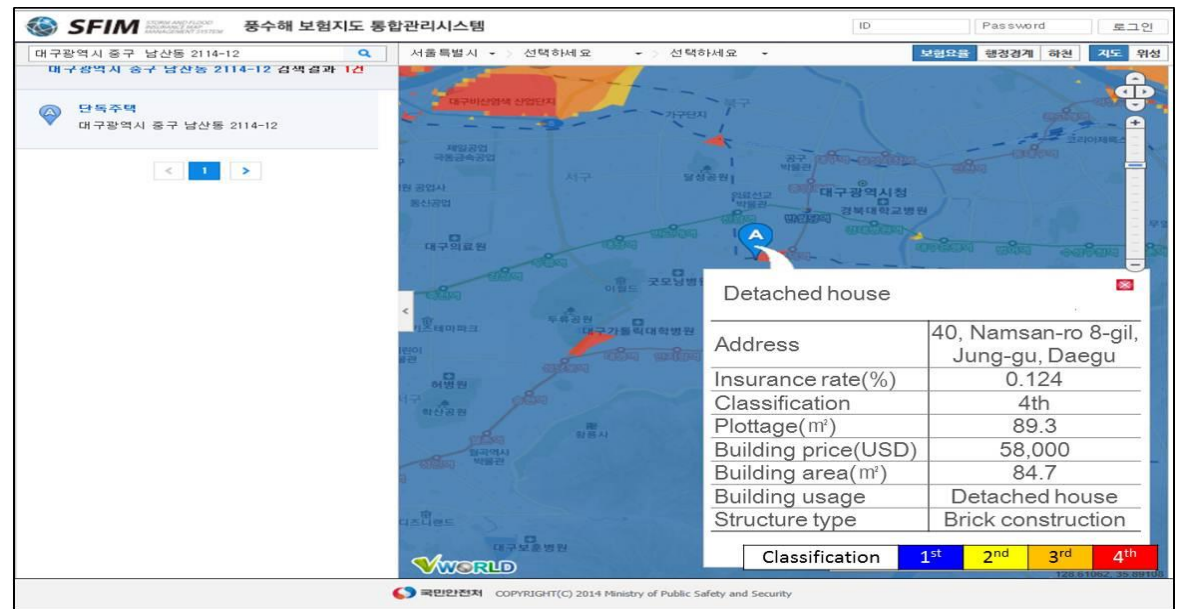
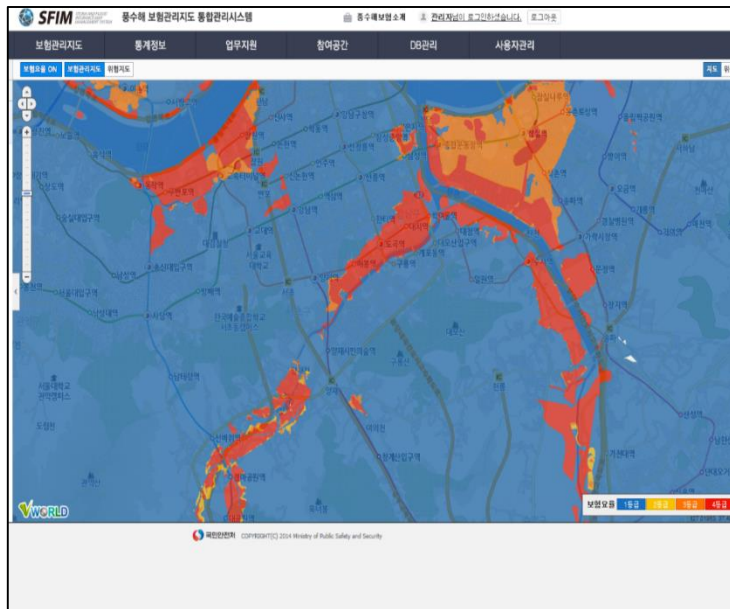


IV. Development of Integrated Management System

□ Development of integrated management system for insurance rate

○ Displayed function for insurance rate

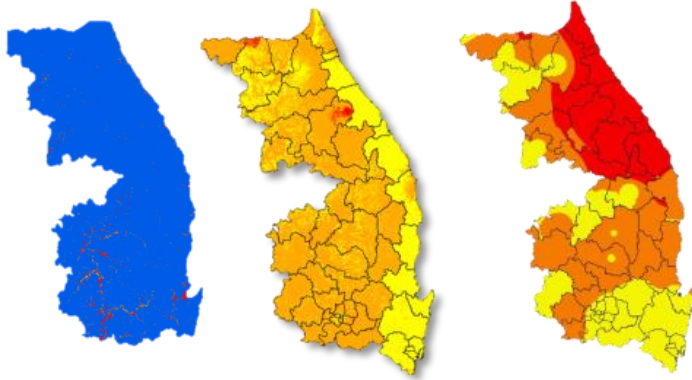
- The displayed function for insurance rate shows the following, simply by typing address
- Building type, insurance premium, land size and building area are provided
- Customers will be able to get a specific building information as seen from the figure
- Accessible and convenient for insured, assurer and insurance managing official



V. Conclusion

□ Outcome

Development of natural disaster risk map

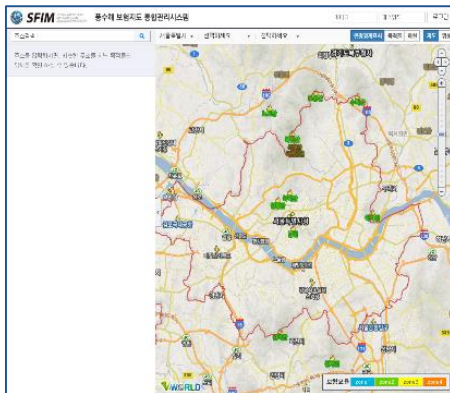


Insurance rate based on natural disaster risk

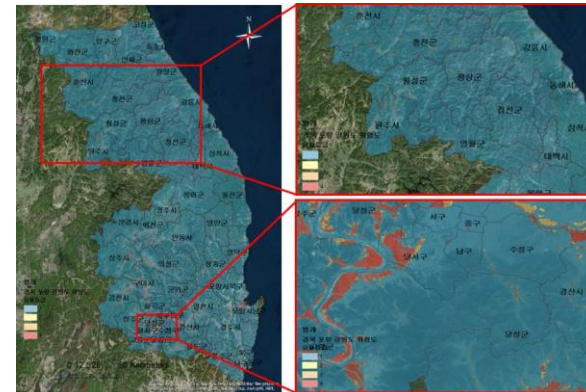
(단위 : %)

행정 단위 손보합요율(단독주택): 0.0644				
남구	1등급	2등급	3등급	4등급
	0.0644	0.0644	0.0644	0.0644
행정 단위 손보합요율(단독주택): 0.0670				
달서구	1등급	2등급	3등급	4등급
	0.0556	0.0741	0.0867	0.1157
행정 단위 손보합요율(단독주택): 0.0749				
달성군	1등급	2등급	3등급	4등급
	0.0556	0.0847	0.0972	0.1303
행정 단위 손보합요율(단독주택): 0.0677				
동구	1등급	2등급	3등급	4등급
	0.0640	0.0765	0.0878	0.1218
행정 단위 손보합요율(단독주택): 0.0709				
북구	1등급	2등급	3등급	4등급
	0.0572	0.0901	0.0919	0.1282
행정 단위 손보합요율(단독주택): 0.1507				
서구	1등급	2등급	3등급	4등급
	0.1338	0.1039	0.1350	0.2902
행정 단위 손보합요율(단독주택): 0.0670				
수성구	1등급	2등급	3등급	4등급
	0.0640	0.0757	0.0869	0.1186
행정 단위 손보합요율(단독주택): 0.0659				
중구	1등급	2등급	3등급	4등급
	0.0659	0.0659	0.0659	0.0659

Development of integrated management system for natural disaster insurance rate map



Insurance rate mapping based on natural disaster risk



VI. Expected effect

Establishment of a scientific prevention, preparation, response and restoration using 10m grid-base natural disaster risk map

Calculation of reasonable natural disaster insurance rate to take a break from existing unreasonable insurance system

Give Help to select habitual disaster area and policy enforcement

Improve public service by developing and operating integrated management system for natural disaster insurance map

Thank You!

ACKNOWLEDGEMENTS

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