Role of Science and Technology towards Future Safety

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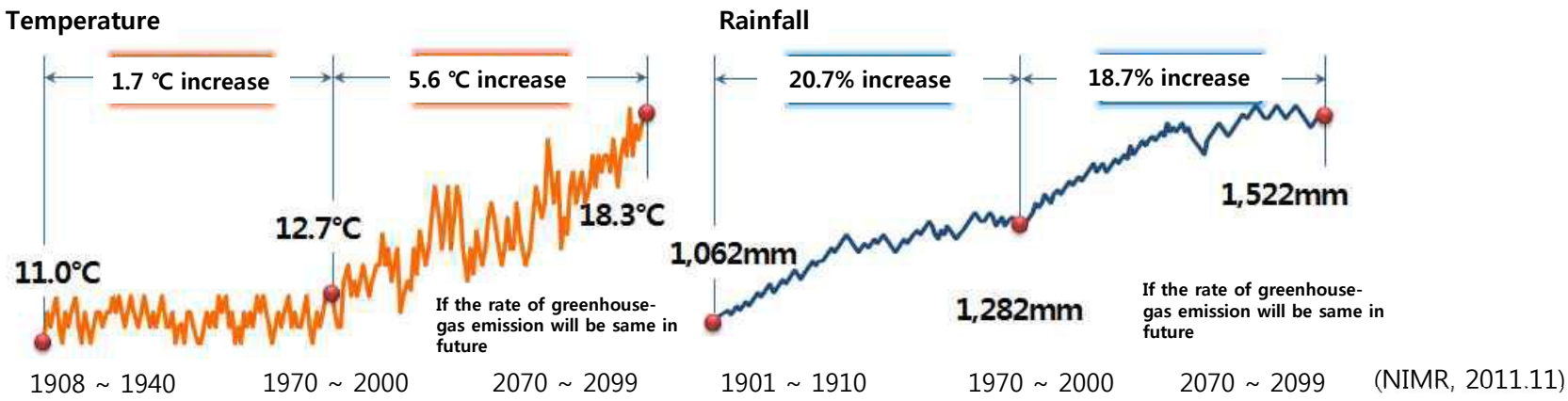
NATIONAL
DISASTER
MANAGEMENT
INSTITUTE

Changes in Disaster Safety Situation

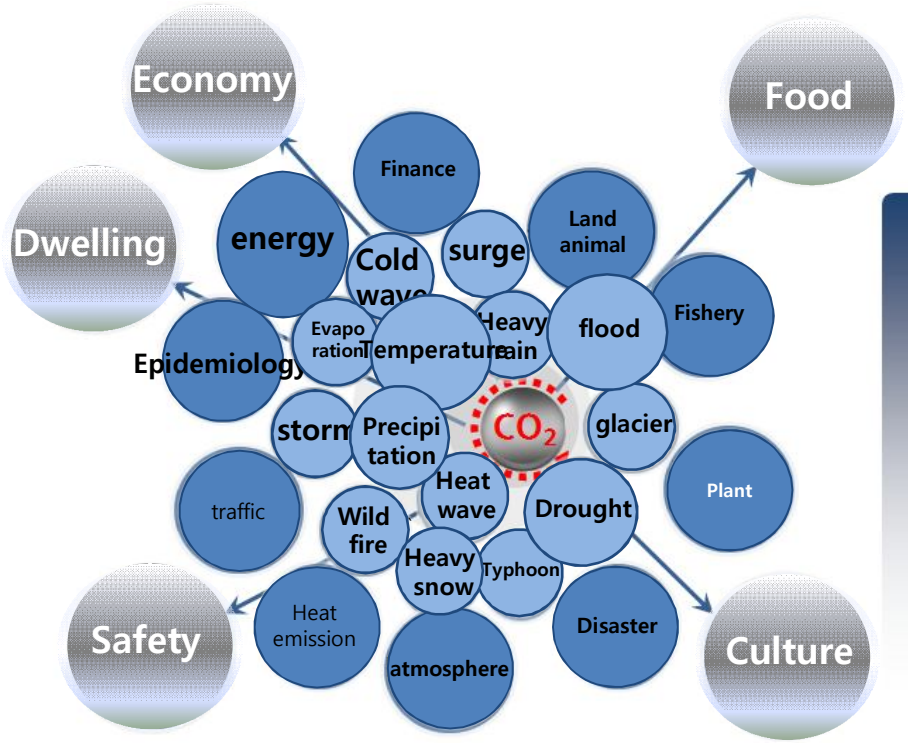
Global climate changes and Korean peninsula climate change

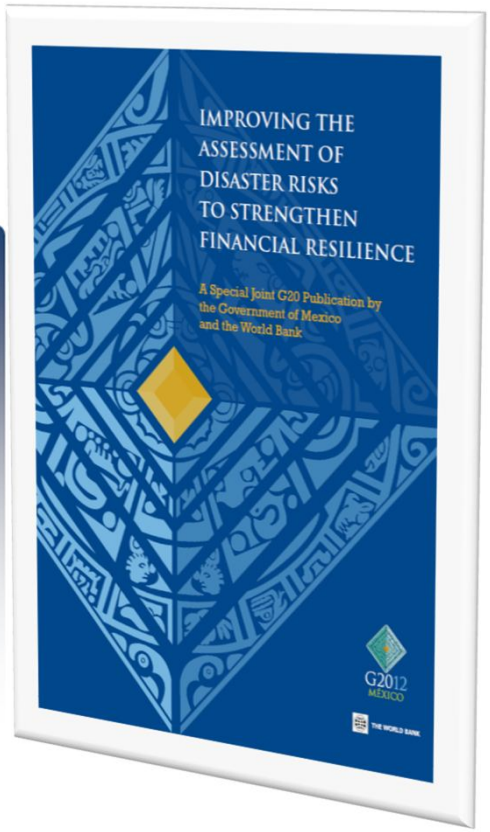


Globalization, Industrialization, Aging safety vulnerability growing

- Diffusion of large scale epidemic and animal infection
  * Novel swine('09.11), foot and mouse disease('10.11)
- New disaster due to industrialization and urbanization
  * Gumi hydro fluoric acid('12.9), Busan Haewoondae apart fire('10.10)
- New social problem on disaster handicapped person
  * Old person traffic casualties : ('08) 1,735 → ('12) 1,846

Radical trends, Wide regions of Disaster





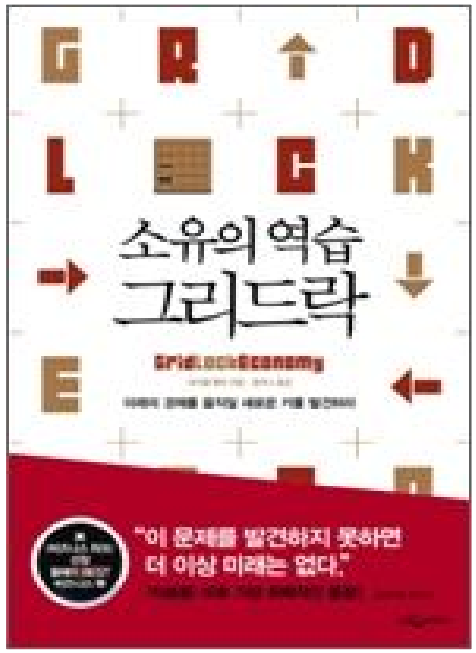
Code Green : Hot, Flat, and Crowded

1. Gradually more scarce in energy supply, more increase in natural resource demand
2. Vast riches to oil power nations and oil dictator
3. Destructive climate change by green-house gas
4. Owner Vs. Non-owner in electricity : Energy poverty
5. Extinction of various animals and plants : Decrease of biological diversity

1. Affluenza : Affluence + Influenza , Too many people in USA
2. Al-Qaeda, Strengthening Code Red, Anti-democratic moves in Middle Asia
3. Intensification of climate change and disasters, temporal and spatial imbalance in food and land
4. Africa and Southeast Asia : China and India
5. New Noah's ark : Sign of future risk

Grid Lock Economy

1. Difficulty with making new drugs
   : trouble with patent rights
2. Empty stores and exploding street stalls
   in Moscow
3. Mobile communications in Korea and USA
4. Original Thief : Noble of Rheine river
5. BIG INCH : 2100 millions quaker-oats in 1950
6. Patents of IBM



A New Market Dynamic

- 25 new runways would eliminate most air travel delays in America. Why can't we build them?
- 50 patent owners are blocking a major drug maker from cre ating a cancer cure. Why won't they get out of the way?
- 90% of our broadcast spectrum sits idle while American c ell phone service lags far behind Japan's and Korea's. W hy are we wasting our airwaves?

Perspectives on Disaster

Disaster = Dis(Bad) + Aster(Luck)

Acts of God, but Unnatural

Acts of Human, so Unpredictable

Disaster management administration vs. general administration

Efficiency based

- Small government with a focus on efficiency
- No systematic error

↕

Redundancy based

- Supplementary to an imperfect system
- For the unexpected and uncontrollable world

New Disaster Management Paradigm

Openness

Disaster Information Service

Value added disaster information
Consumer centered service
Disaster administration feedback

Communication

Two way communication

Citizen participated management
Field centered management
Quick management

Cooperative Public-private disaster management

Consumer centered service

Disaster safety nation

Sharing

Information sharing

Disaster and research
Integrated disaster management
Efficient disaster management

Cooperation

Mutual Cooperation

Disaster safety infra expansion
Private disaster safety capability
Disaster safety industry activation

Case study on large-scale disasters

Background : a presidential initiative

- **To rewrite a national disaster response plan including media response, organization of response team, on-site rescue, etc based on in-depth analysis of root causes of past disasters.**

✓Research target: 276 disaster events happened over last 50 years (1964-2013) with more than 10 casualties

✓Category: ① natural disasters ② maritime disasters ③ chemical disasters ④ aviation accident ⑤ large fire ⑥ building collapse ⑦ nuclear plant accidents ⑧ large traffic accidents

✓Methodology: Analysis on problems and respond plans according to the four stages; preparedness, prevention, response and recovery

Lessons Learned the Hard Way (1)

- Crisis starts with small omen
- Communication failure is a risk factor in every disaster
- Never short-change planning and preparedness
- Economic pressure can play a role in ineffective preparedness for natural disaster
- Not following procedure is a common catalyst for man-made accident
- Design and construction flaws are the bane of man-made accident

Operational Risk Management, Mark D. Abkowitz, 2008

Lessons Learned the Hard Way (2)

- Do not underestimate the significance of political agendas
- Arrogance among the experts is perhaps a far more significant risk factor
- Disaster policy not considering the characteristics of local community , that is disaster
- Regardless of how well risks are being addressed, "Luck"can change your fortunes one way or another
- It usually takes a disastrous event to convince people that something must be done
- Not prevent disaster, but reduce disaster

Operational Risk Management, Mark D. Abkowitz, 2008

The way ahead

Preparedness

- **Regulations in two-tracks**

- **Development of the Korean model of grassroots safety culture**
  - Education on disaster and safety issues for the whole life cycle

※ U.S. Grassroots Safety Leadership program

The way ahead

Response

- **Redefining Role of central and local disaster and safety counter measurement headquarters (establishment of a new ministry of national security)**
  - To improve capacity of local governments on disaster response and deploy experts in provinces
  - To form expert groups and spokespersons in the central emergency management agency

※ (Taiwan) Experts group at NCDR, (USA) special spokesperson system at CDC

- **Development of real-time based disaster response system with ICT**

※ Real-time images and locations can be sent through SBB(Smart Big Board)

The way ahead

Recovery

- **Application of TCS(Total Care System)**
  - From a onset of disasters to a return to normality, TCS supports the affected in various aspects including phycology, health, education, and economy

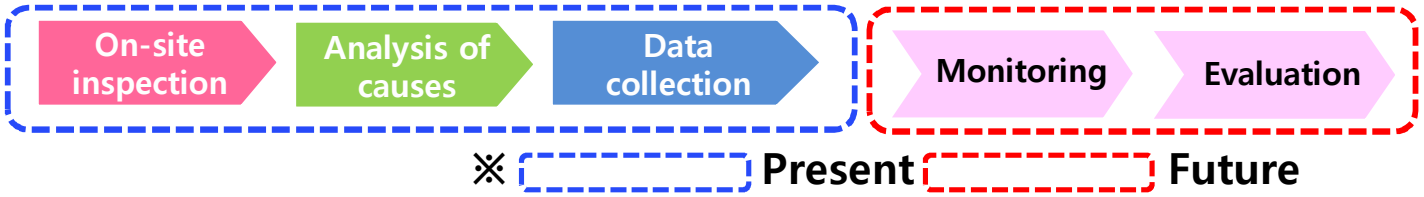
※ (Japan) Manual on healing mind, (USA) the 9·11 survivors health assistance program

- **Improvement of supportive measures for the victims and the bereaved families**
  - Private shelter will be provided to secure privacy of the families.

The way ahead

Evaluation and feedback

- **Continuous evaluation**
  - Through DSI, post-disaster monitoring system will be established.



  - Pan-government disaster and safety data collection and management system will be developed and operated

- **Enhanced efficiency of disaster and safety budget**
  - Disaster and safety will be added as a category in the national science and technology classification system.
  - Disaster and safety-related budget will be coordinated first at a new ministry

※ About 700 billion won is expected to be saved.

Concept of future disaster response

Operability in the field

: strengthening field response capability in the public and local government

- 自助 : **Survivability in disaster (education/training)**
- 互助 : **Capability to help the next person (education/training)**
- 公助 : **Customized rescue, Support, Golden time (field response capability)**

Concept of the operation of Disaster expert

Disaster management with overall administration + Professionalism in series of class of disaster prevention & safety

Poor professionalism Vs Expert without administration

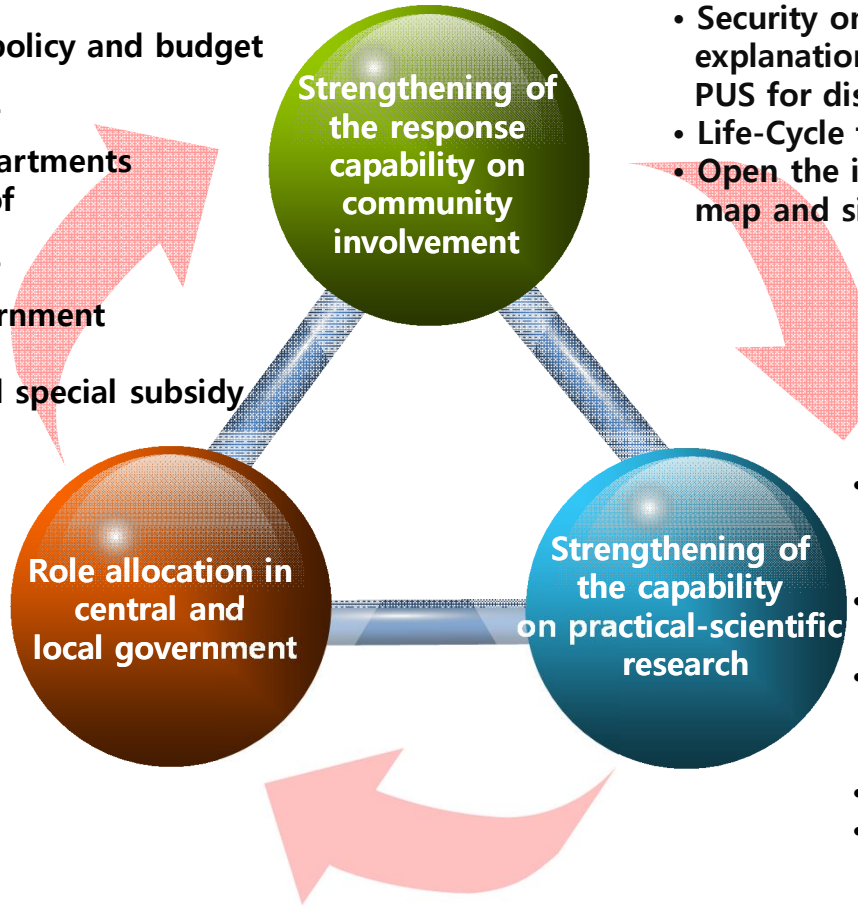
Administrative expert Vs Professional administrator
(Price, Kearney)

Limit on cycling position
: administrative expert, chance of promotion

Regular education-training and research service,
Appropriate operation of contract officer

Future Disaster Management Paradigm

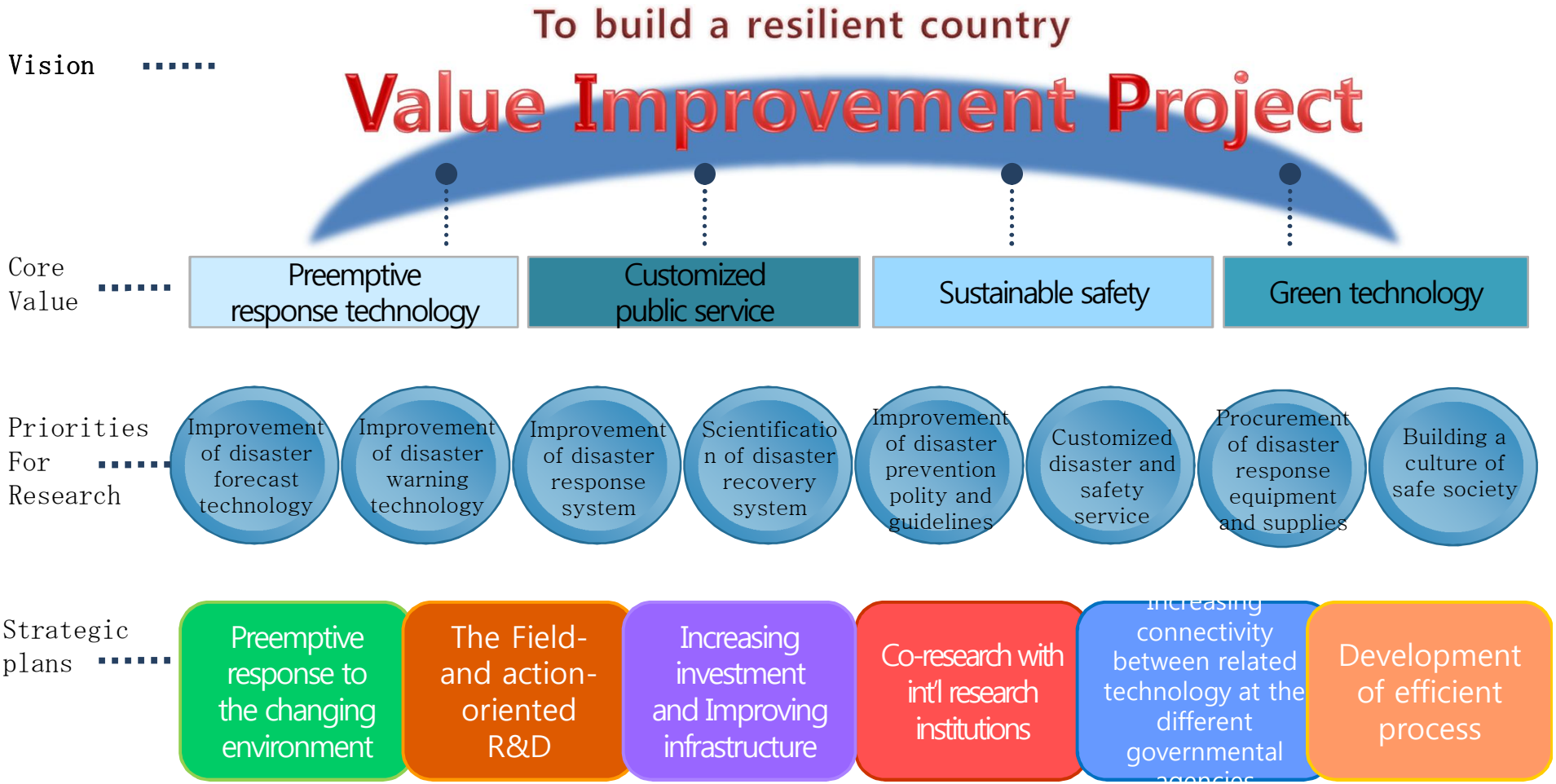
- Strengthening pre-preventive policy and budget in central government
- Strengthening the capability of overall control in different departments
- Early settlement of the series of class in disaster-safety
- Strengthening the capability of disaster response in local government
- Anticipative use of disaster management fund and special subsidy



- Institutionalization of community involvement in disaster management policy making
- Security on the power of the explanation in alternatives based on PUS for disaster management
- Life-Cycle training on various disasters
- Open the information of disaster risk map and situation in real time

- Establishment of pre-preventive response system for future complex disasters
- Removal of blind spot on disaster management facilities
- Development of real-time response technology based on IT & GIS
- Reflux system and D냐
- Development of the contents of education-training by the request of consumer

R&D on emergency management : Goals and Strategic plans



R&D on emergency management : Goals and Strategic plans

To reduce the national cost of disasters by 10%

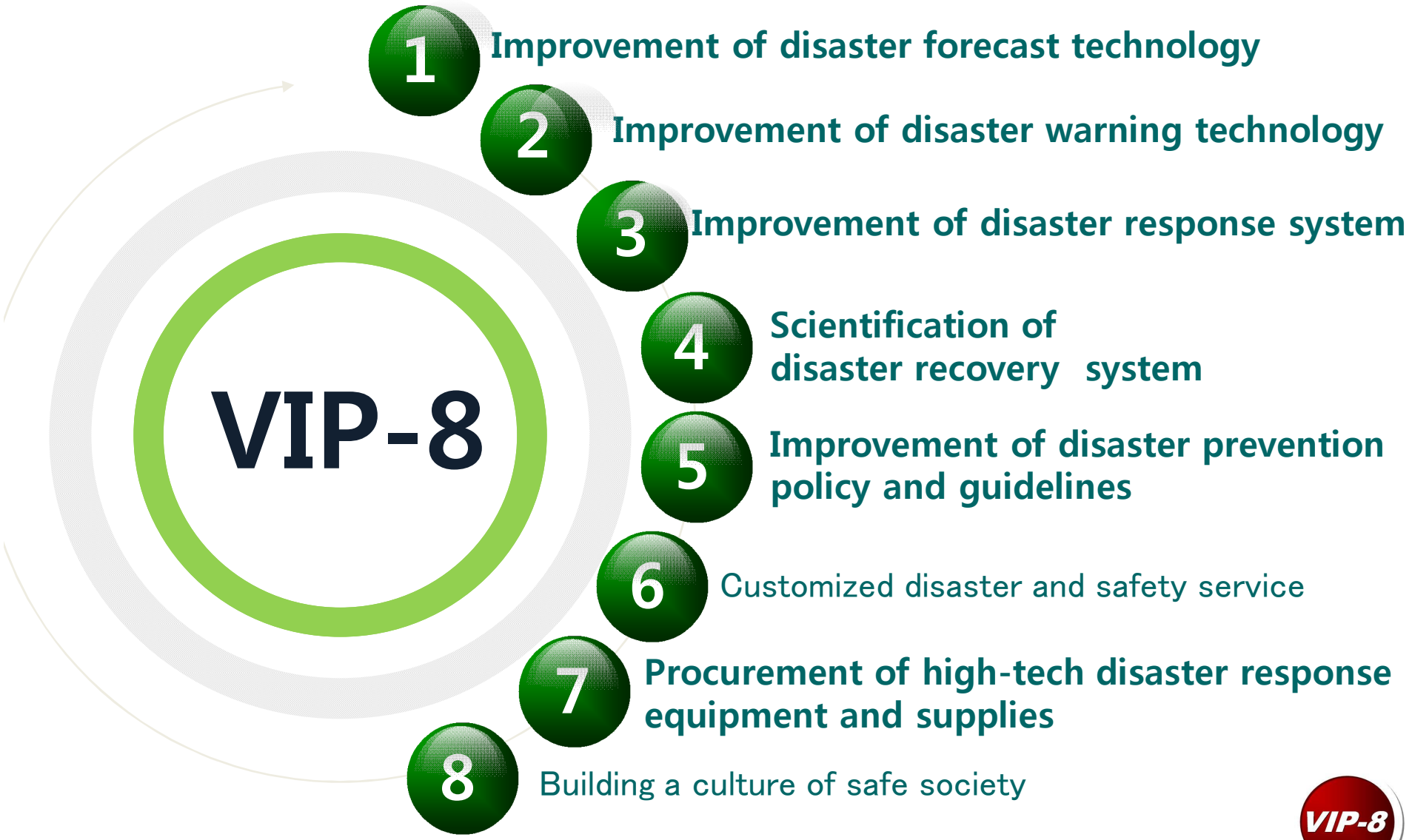
To keep up with disaster prevention technology of the advanced countries

To promote VIP-8

To enhance satisfaction of public on disaster and safety service

To increases investment in emergency management R&D by 500%

Value Improvement Project – 8



VIP-1 Advanced Disaster Prediction Technology

Contents	- Pre-sensing techniques and sensor development for disaster precursor - Disaster vulnerability assessment technologies for climate change scenarios
Brand	- Development of disaster precursor information system from past and present

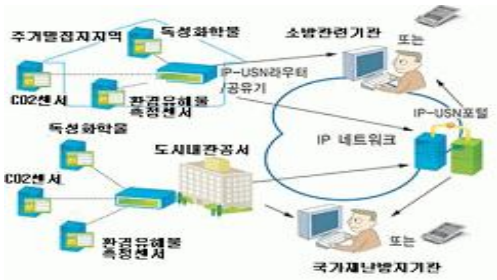
Disaster precursor information system

- Disaster precursor monitoring through internet
- Precursor Mining Technology and disaster type trend prediction system

Intelligent CCTV system

- Disaster type auto vision recognition and detection algorithms
- Intelligent disaster sensing system and guidelines development

Development disaster precursor monitoring sensor



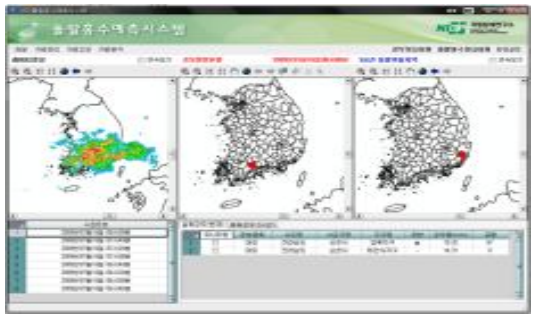
- Complex sensor sensing materials and sensor design
- Complex chip sensor and risk precursor information measurement system
- Disaster type cheap complex sensing sensor development

※ example

VIP-2 Advancement of Disaster Alert Techniques

Contents	- Flood warning system for evacuation - Link and Integrate system for disaster warning
Brand	- Step ahead of the next-generation disaster response alert technology

Flash flood warning system

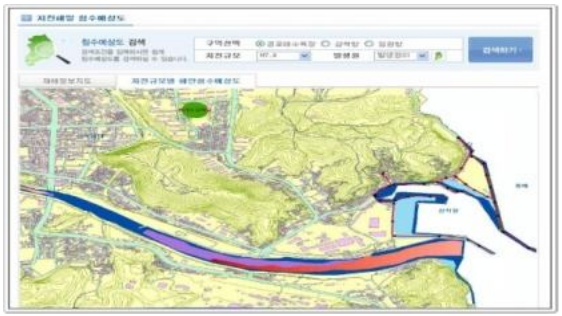


- Using KMA forecast data
- Extract flash flood area
- A system for predicting 2 hours before and responding for flood risk

Slope land alert system

- Slope land evacuation alarms and emergency response system
- Review the alert guideline by pilot test

Tsunami warning system



- Making flood risk map by scenario
- Settlement the resident's evacuation district in case of a tsunami

VIP-3 Efficient Disaster Response system

Contents

- Development of disaster response techniques for mitigation
- Development of fire detection and safety management techniques

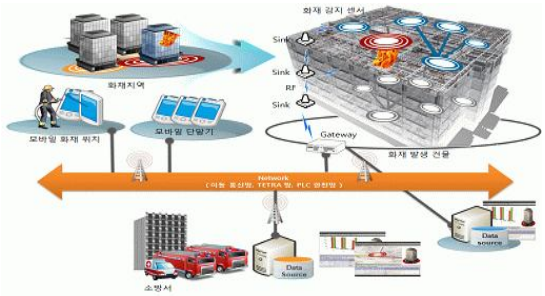
Brand

- Development of Multi-use-facility disaster response techniques based on UBIQUITOUS

Urban flood prevention system

- Urban flood inundation analysis system
- Development the flood risk map based on scenario and flood vulnerability index
- Development of child education program
- Urban flood action procedure of residents

USN fire detect system



- Development of smart fire detect mobile network by USN
- Technical standards and standardization for fire management system by IT

Wallpaper for earthquake and landslide deterrence

- preventing the collapse of the wall with a simple installation
- Development of strength, elasticity, excellent vibration absorption wallpaper

VIP-4 Scientific Disaster Response System

Contents

- Improvement of disaster recovery system and development of psychological support program for victims
- Deveoloping scientific disaster profiling technology

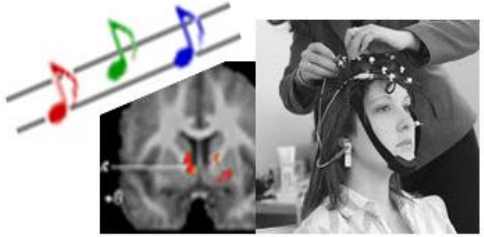
Brand

- Development of trusted Scientific Disaster Profiling Technology

Automatic disaster damage assessment technique

- Objective damage calculation using the optical camera and satellite disaster
- GIS-based portable damage survey system

Music therapy for psychological stabbility



- Brain Music Therapy technique utilizing the mechanism of neural feedback
- Treatment to reduce the severe fatigue of the activities of emergency and rescue

Disaster Profiling Technology

- Building professional disaster cause analysis system of criminal investigation
- Development of analysis and procedure standardization
- Disaster experienced retired public officer and expertise at the same time

VIP-5 Disaster prevention policy & standard advancemen

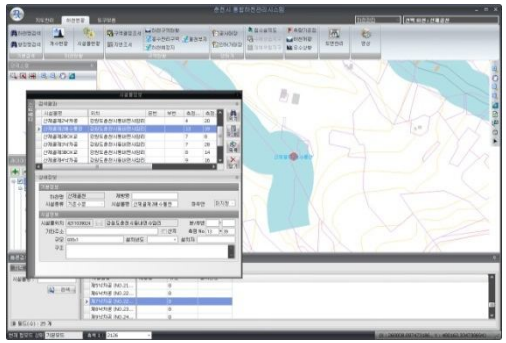
Contents

- Development of policy and standard to deliver disaster prevention service
- Development of safety management standards and standardization of disaster management

Brand

- Strengthening of disaster prevention standards corresponding to the disaster environment

a small river disaster prevention facility criteria



- Preparation of small river facility criteria
- Development small river information DB

Standardization and evaluation of international standard

- Settlement the international hazardous materials
- International test institute management standard
- International hazardous material classification manual

Disaster management Standard

- National disaster management Guidance
- Enterprise disaster mitigation plan
- Natural disaster standard manual

VIP-6 Customized Disaster Safety Service

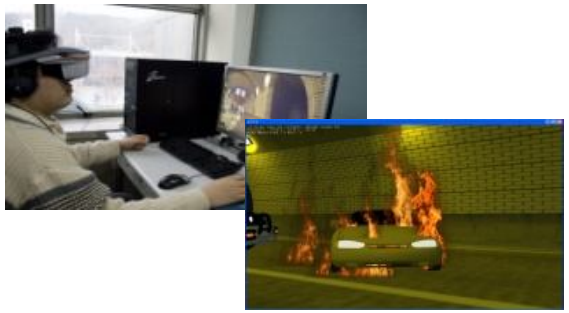
Contents

- Development the customized fire prevention education and training for public officer and citizen
- Various experience and situation through virtual reality based education and training

Brand

- Development of disaster education and training techniques based on virtual reality

Fire prevention training based on VR



- Disaster precursor phenomena through the Internet gathering and monitoring
- Building trend forecasting system by type

PUS bsase disaster prevention trial and game development

- Training game for VR disaster risk identifying and response countermeasure
- Need for VR experience by PUS

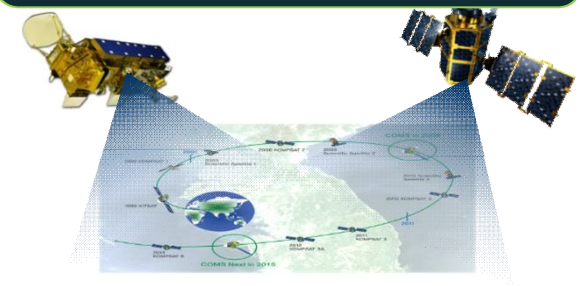
4D disaster experience by VR

- Development of hands-on type system
- Rain, snow, strong winds operation system
- System Using AR

VIP-7 High-tech disaster response equipment

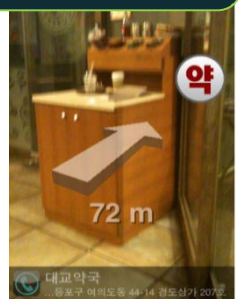
Content	- To strength national disaster response capacity through roboticization of the equipment - To develop mobile disaster response system based on high-tech ICT
Brand	- Development of disaster on-site response robot technoglogy

Satellite-based mobile response equipment



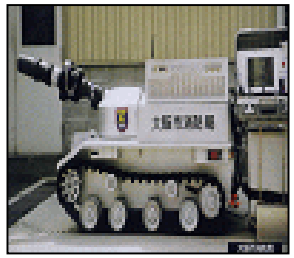
- Development of satellite images based response system in large-scale disaster
- Building a mobile satellite images acquisition and analysis system

Mobile disaster information content



- Development of automatic vision recognition and detect algorism for each type of disaster
- Development of intelligent disaster detection system and guideline

Development of fire fighting intelligent robotics technologies



- Development of robots for fire fighting and rescuing
- Development of robots for detection of harmful gas and search of closed spaces
- Development of radio-controlled helicopters for control of disaster

VIP-8 Future Safety society foundation

Contents	- Building Societal foundation "Safety First" as Critical value - Changing for Safety society based Cultural foundation
Brand	- Building societal culture based "Philotechnology" from risk society to safety society

Safety centered society

- Developing Safety culture based Philosophy and Ethics
- Development of life-long education program from childhood with 'safety first'
- Sustainable long term plan for safety society foundation
- Green Growth based Resilient Community foundation

National disaster prevention policy

- Paradigm shifting for disaster
- Developing Field Manual
- historical review and implication based mega disaster experiences

Disaster report & Media policy

- Development of disaster report guideline
- Enhancement of the safety awareness of the people by public relation

Next-generation Disaster Management

ALL HAZARD APPROACH & INFORMATION INTEGRATION

(Prediction) Korean Peninsula Disaster Response
- Urban flood, Typhoon, Drought, Wild fire

Korean type standard based on experiment

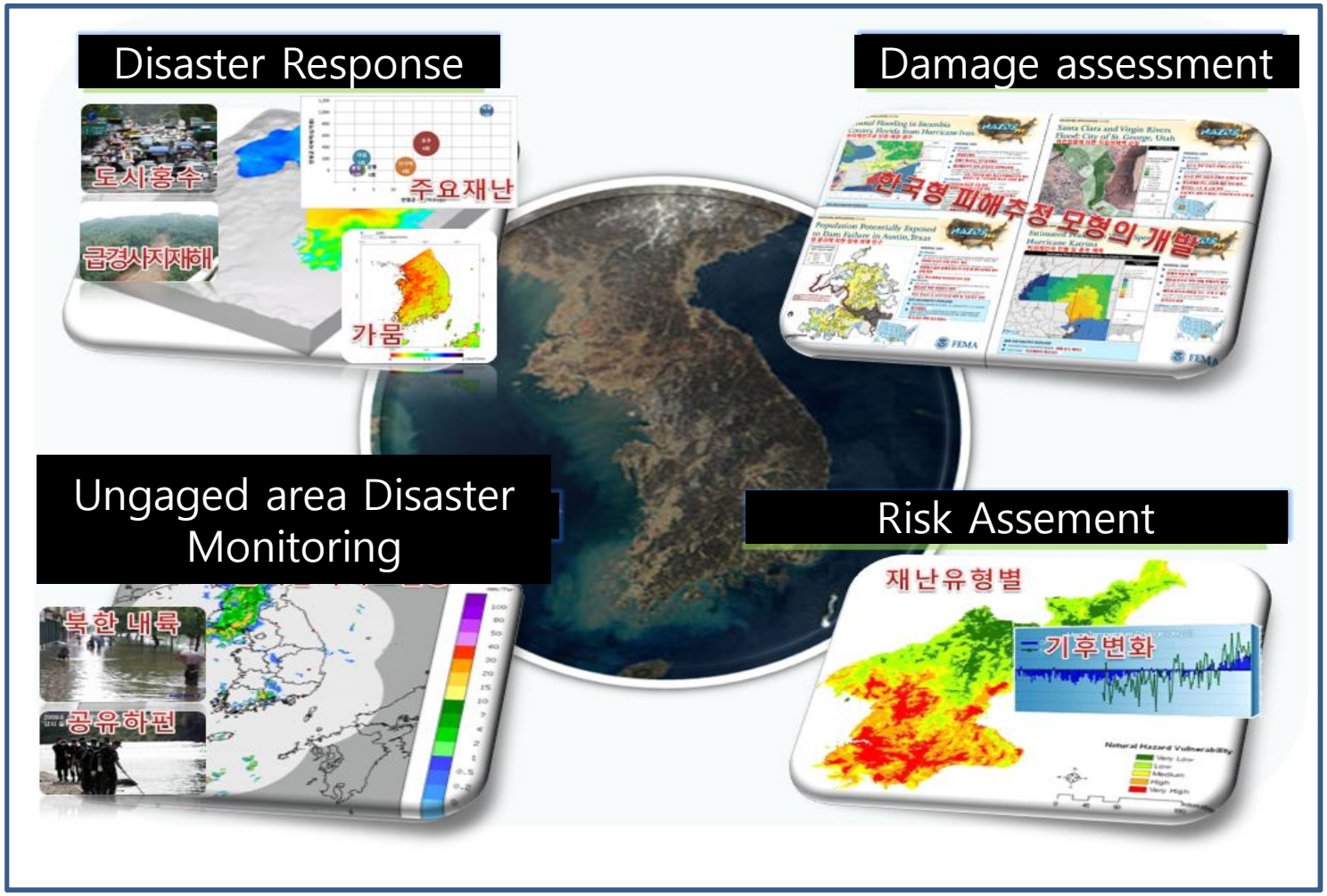
(Monitoring) Hi-tech disaster Information Integrated Using
- Satellite, UAV, CCTV

(Earthquake)
Vibration-based facility evaluation standard

(Pan department)
Integrated probe, Institution improvement
- Disaster Scientific Investigation

(local gov) smartphone damage investigation

Korean Peninsula Disaster Risk Assessment

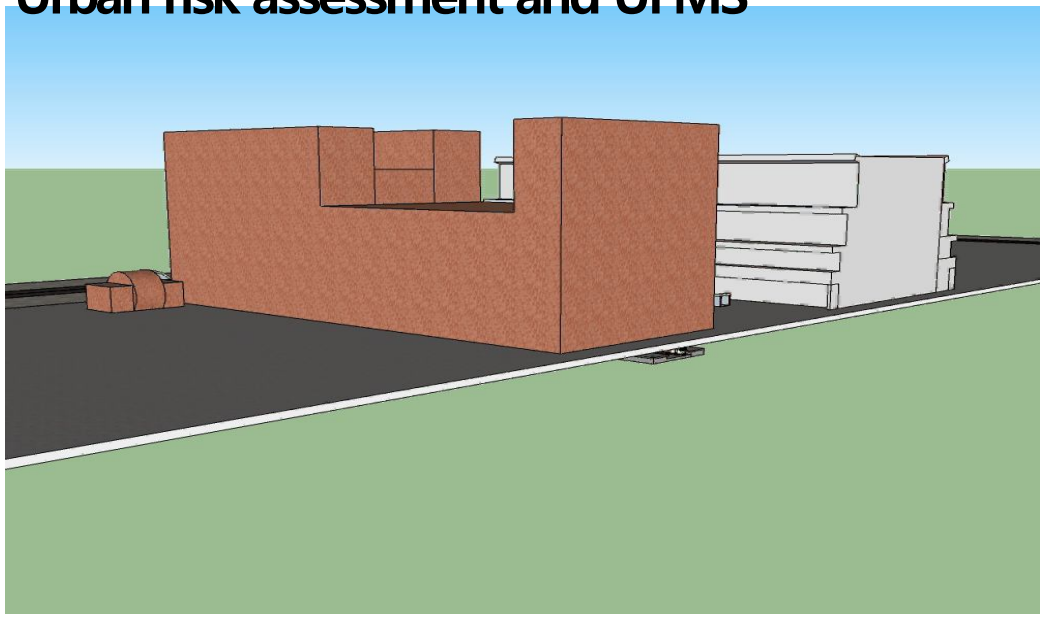


Korean Peninsula Disaster Risk Assessment

Urban flood prediction

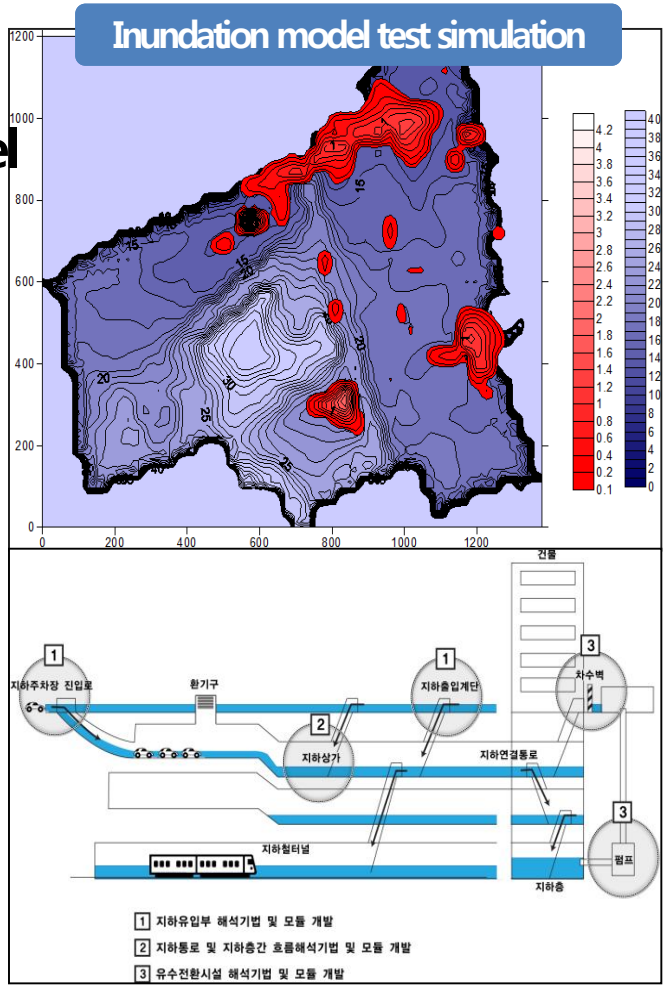
Development Korean type integrated urban ground-underground inundation prediction model

Urban risk assessment and UFMS



Establishing Gangnam bus terminal ground-underground model

Inundation model test simulation

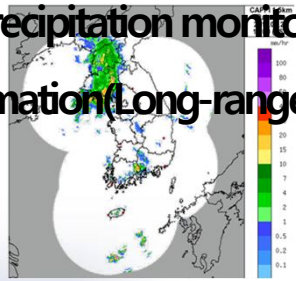


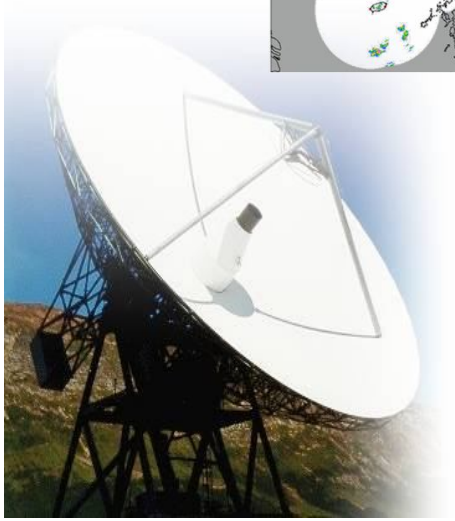
Korean Peninsula Disaster Risk Assessment

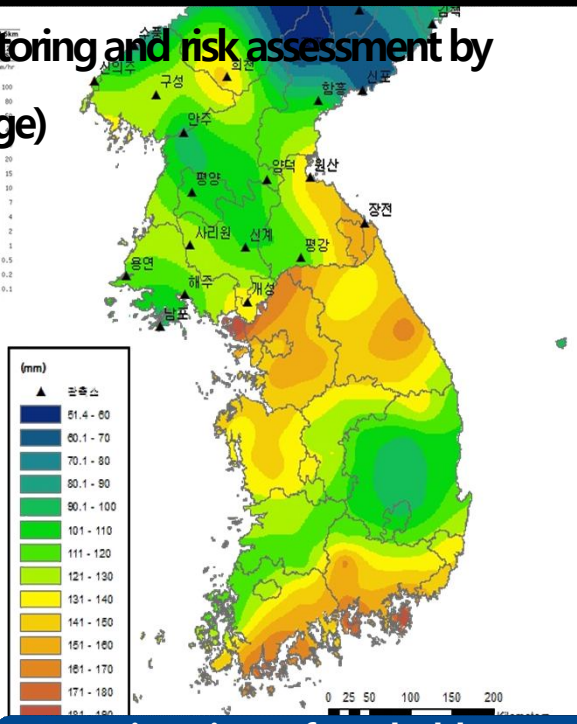
Ungaged Area flood prediction

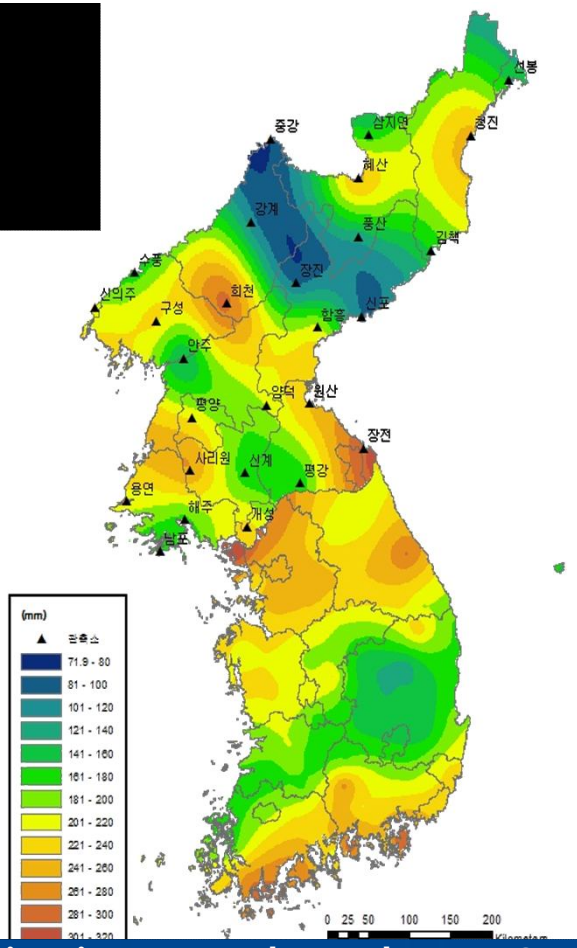
[redacted]

Real-time precipitation monitoring and risk assessment by radar information(Long-range)









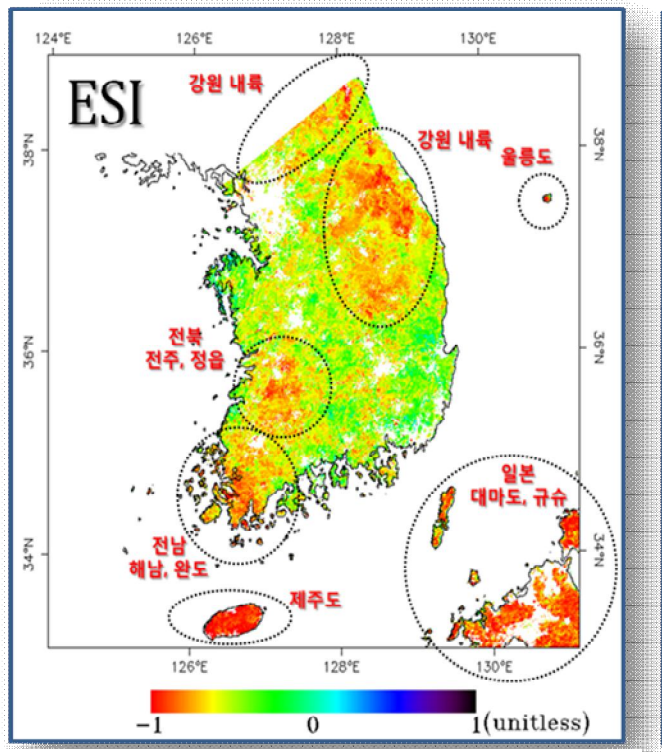
Estimation of probable precipitation in ungaged area by WMO rainfall data (2014, NDMI)

Korean Peninsula Disaster Risk Assessment

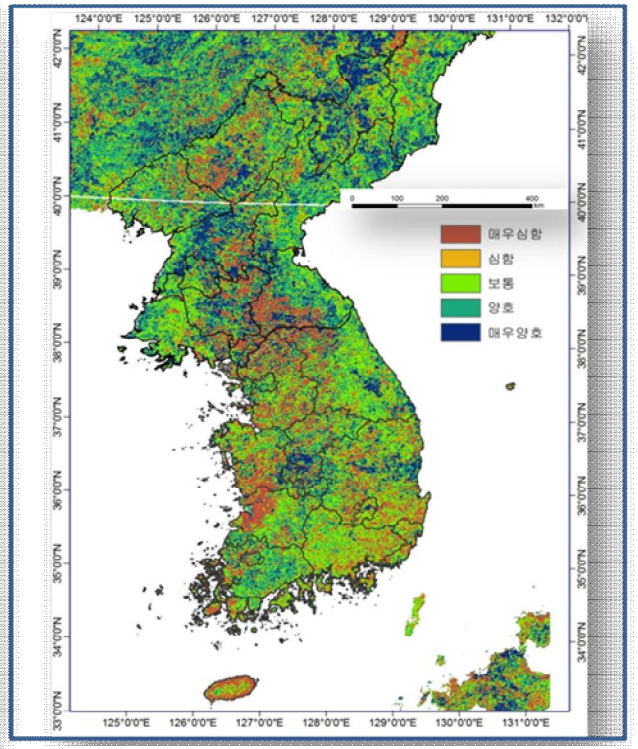
Drought Prediction

Development and operation by MODIS based drought monitoring system(evaporanspiration, NDVI)

Developing drought monitoring system by COMS(meteorological satellite)



Drought index by evapotranspiration, July



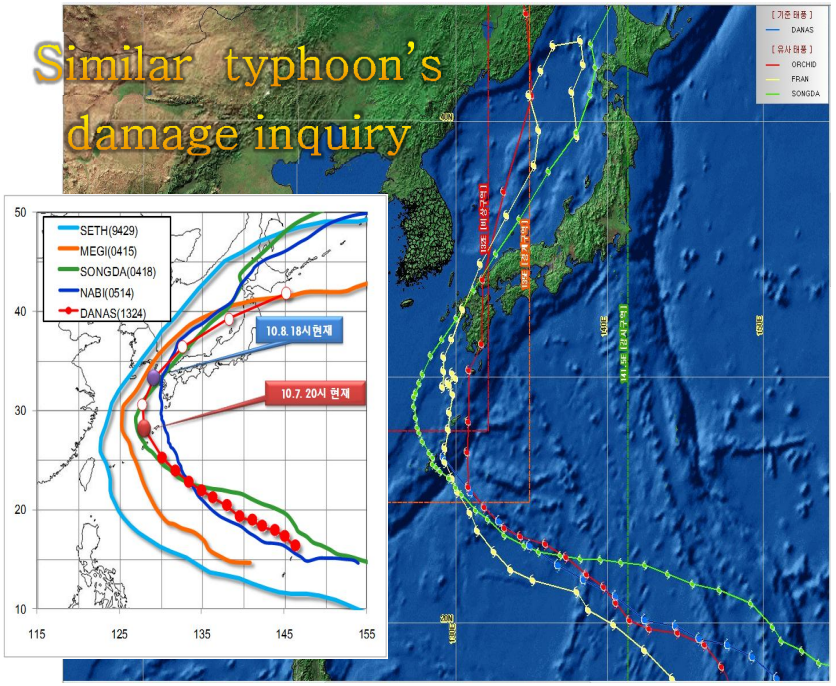
Drought index by vegetation condition, July

Korean Peninsula Disaster Risk Assessment

Typhoon prediction and response (TCDIS)

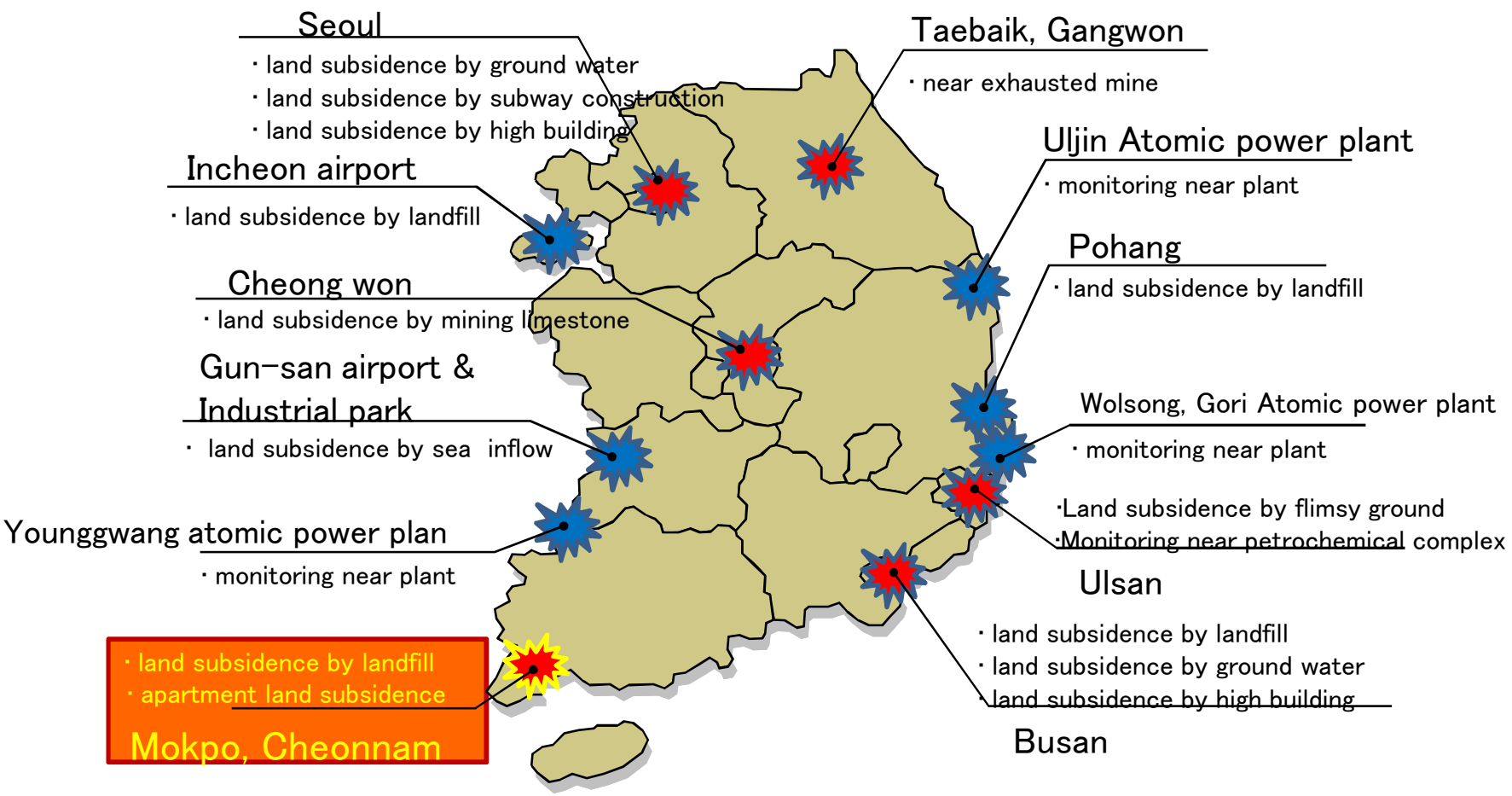
Typhoon information system based Web-GIS ; UN ESCAP/WMO

Typhoon track , damage and weather information DB OF Korea, Vietnam, Hong Kong



Land subsidence prediction by Satellite

Land subsidence risk map

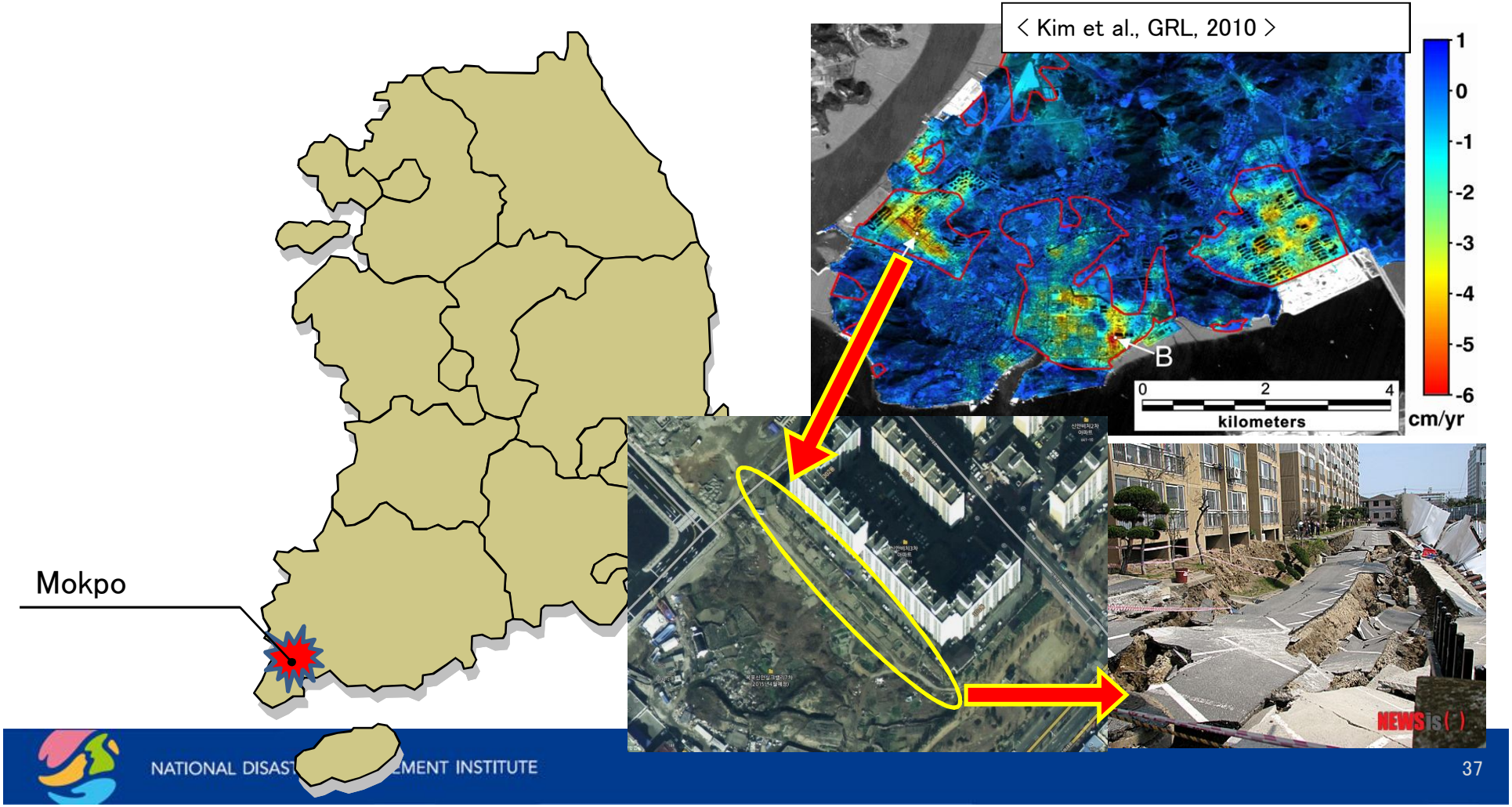


Forecasting ground subsidence using Satellite Image

Ground subsidence in Mokpo, Korea

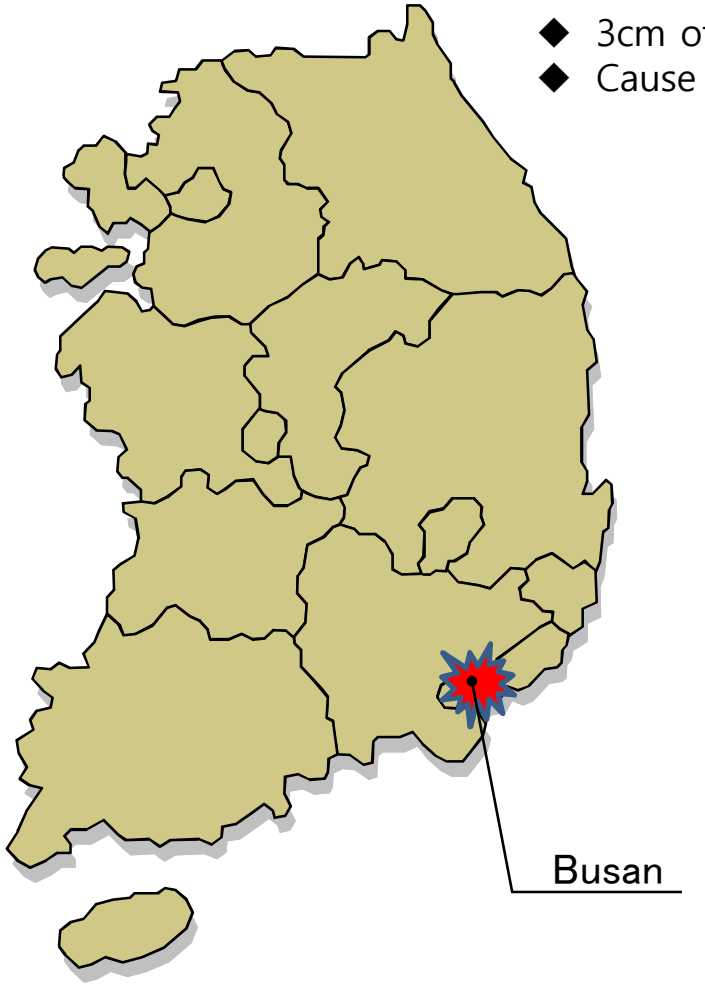
Ground subsidence in Mokpo, Korea (‘14, 4)

- 80m of Length and 7m of width

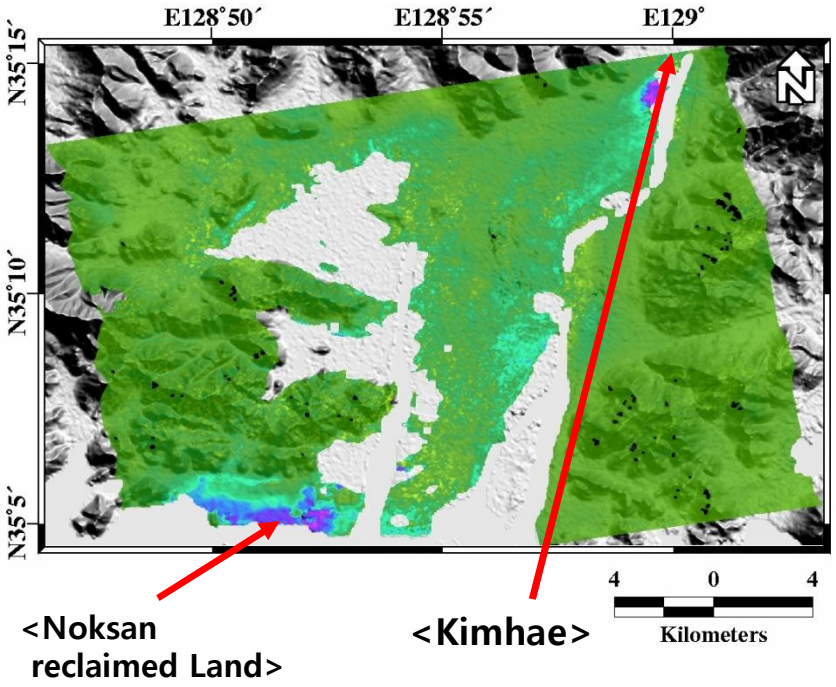


Forecasting ground subsidence using Satellite Image

Ground subsidence in Busan, Kore



- 3cm of ground subsidence yearly in Noksan reclaimed land, Busan
- Cause : use of groundwater in Kimhae area



Development of Korean Disaster-Safety Standard by Empirical Experiment

Application of empirical experiment results

Improve Korean design criteria for disaster prevention facility and revise the related law/regulation

Establish disaster-safety countermeasures at the level of the public's eye

Induce appropriate budget for recovery and analyze damage causes in disaster prevention facility

Destruction of the bridge by debris

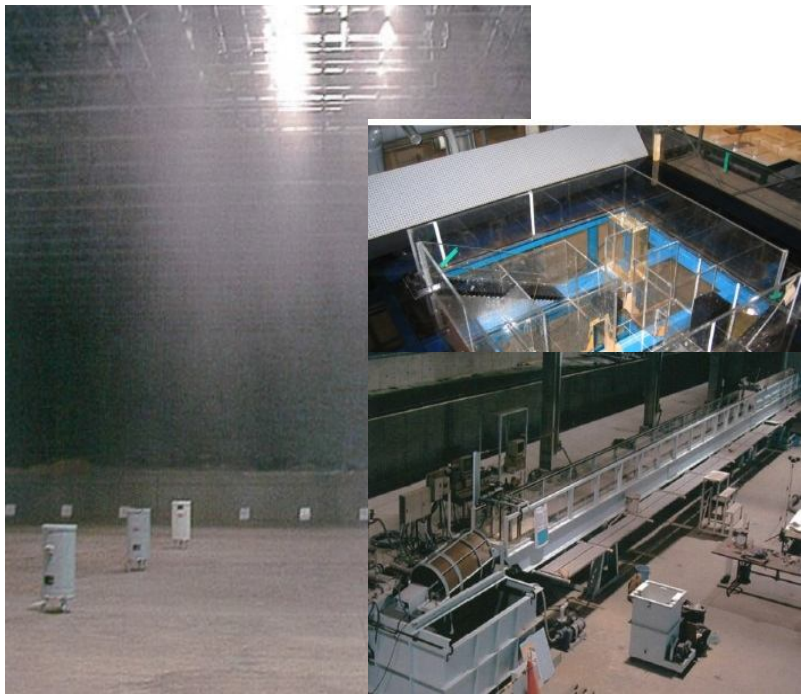
Flooded car

Development of Korean Disaster-Safety Standard by Empirical Experiment

Establishment of experimental laboratory

Construction of disaster experimental facilities (2015, Urban hydrological cycle & steep slope-land

Establishment of anticipative research basement for urban flood & steep slope collapse



Laboratory for urban flood & hydrological cycle

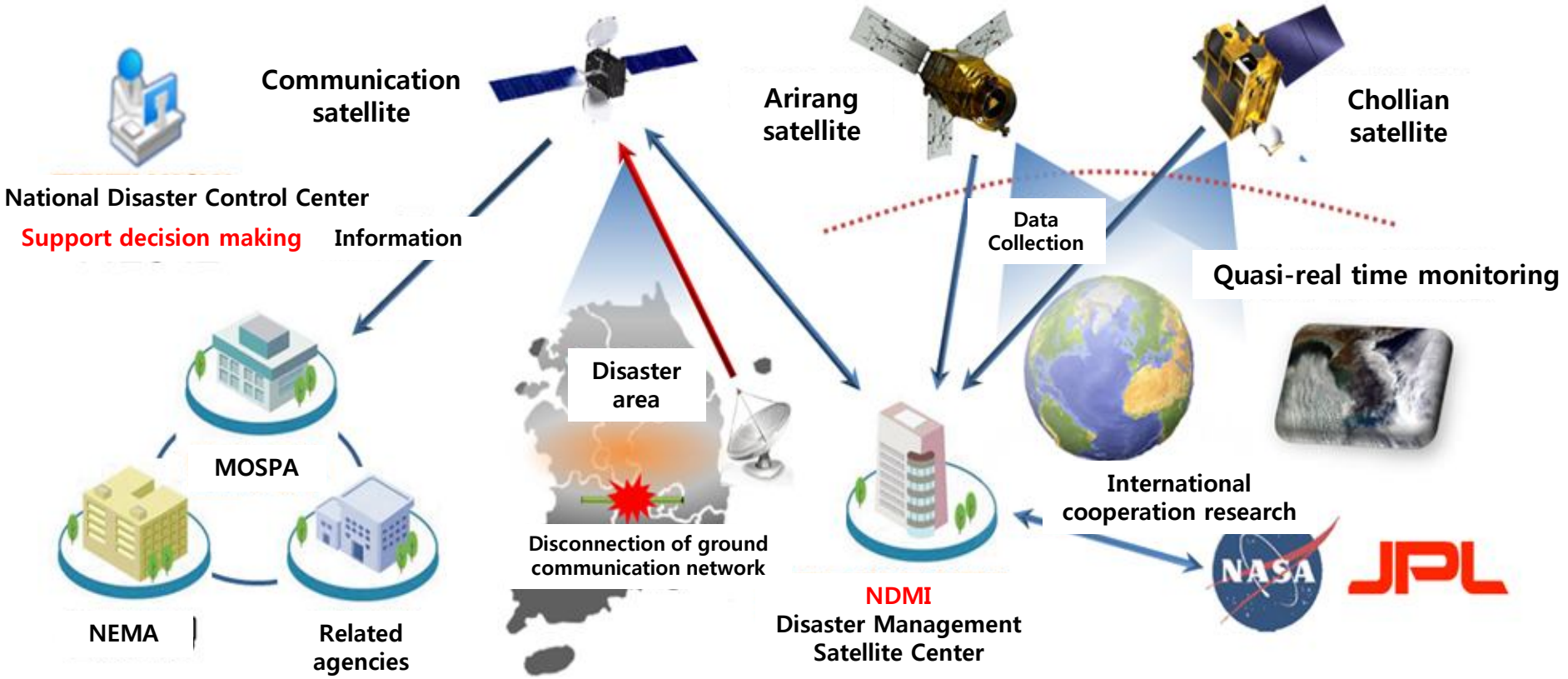
Laboratory for steep-slope land collapse

Disaster Response using Satellite

Establishment of wide disaster management system using Satellite

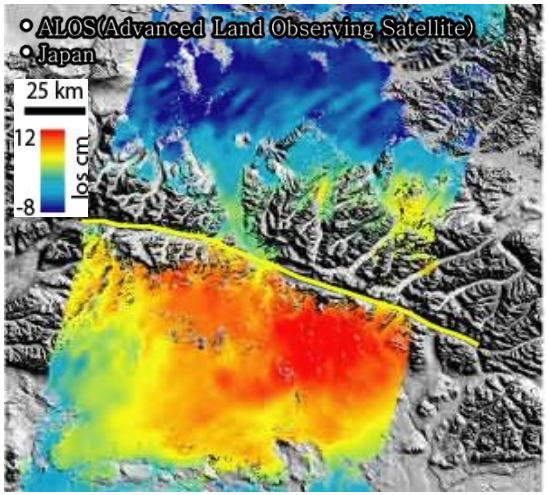
Establishment of complex disaster response system for wide & inaccessible area

- Disaster response system by periodic monitoring

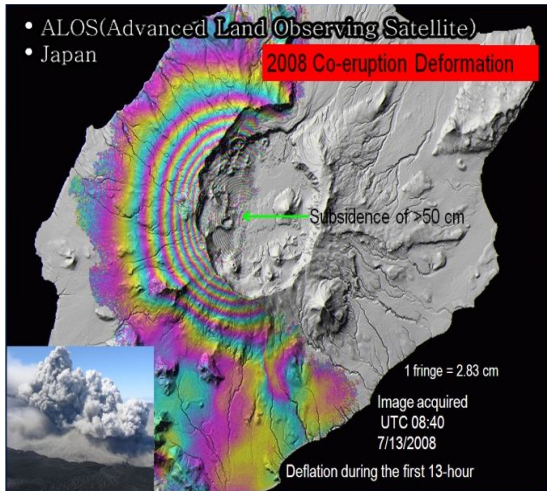


Examples of Disaster Response using Satellite

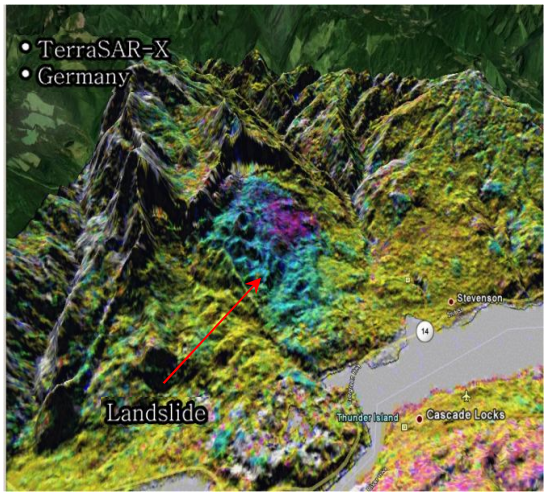
Wild file[Damaged area]



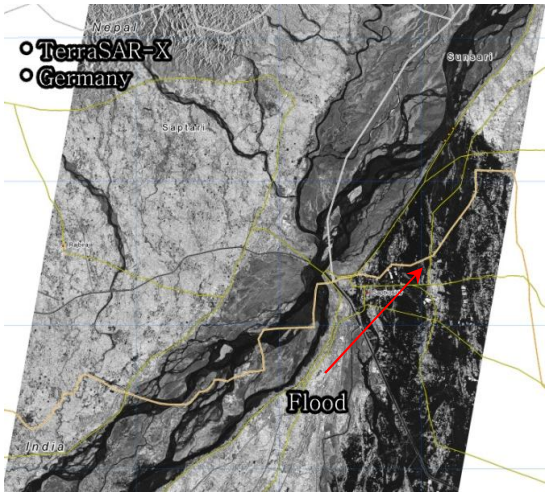
Earthquake[Type, Damage Area]



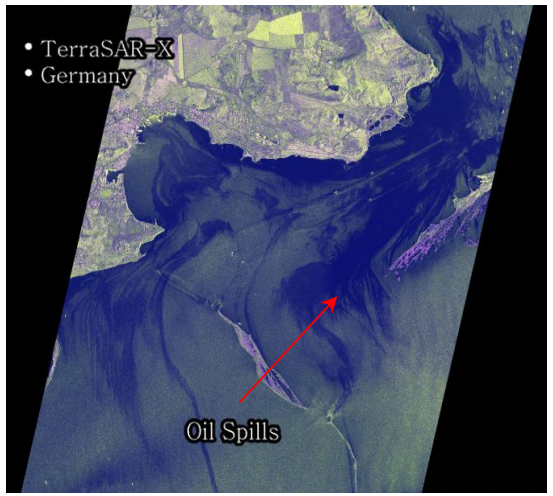
Volcano[Pre-sign,]



Landslide[Damaged area, Direction]



Flood[Flood mark]



Oil outflow[Spread range]

Real-time disaster response using UAV

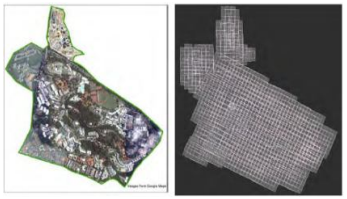
Prompt collection of disaster information

7 UAVs in NDMI (rotorcraft 5, fixed wing craft 2)

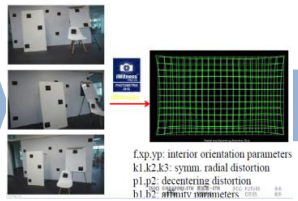
Fixed wing craft (2013)

Rotorcraft (2013)

Establishment of the system for collection & analysis



<Establishment of flight plan>



<Cal/Val of sensor>

<Aerial photograph & collection>>

<Image matching/ Geometric correction>

<3D Modeling>

Disaster response using intelligent CCTV

Effective disaster management using automatic system

Application of automatic system on disaster monitoring

- 24hr, continuous disaster monitoring system
- Solution for time gap in disaster monitoring

Realization of effective disaster information service

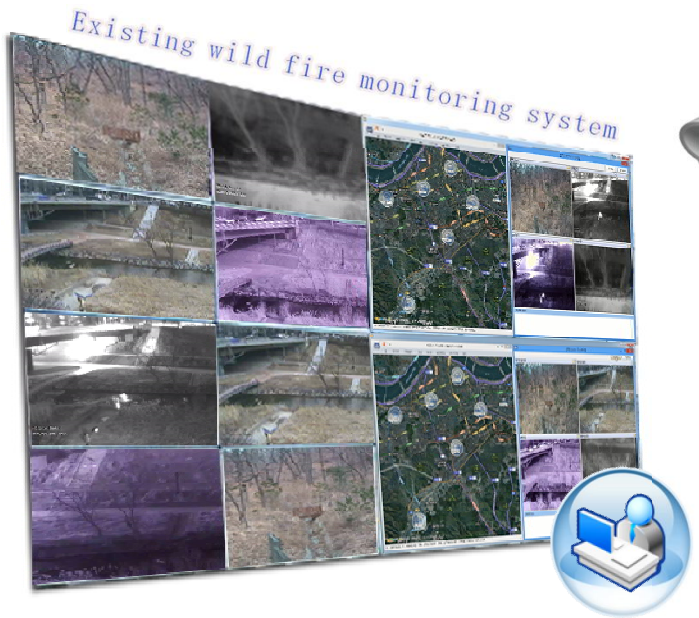
- Increase of understanding capability by image
- Maximize the effectiveness of decision making by sharing the disaster information

Intelligent CCTV for bushfire (Disaster monitoring Service)

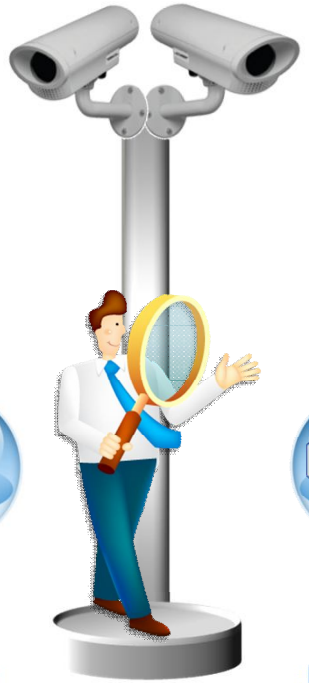
Intelligent CCTV for flooding (Disaster monitoring Service)

Automatic Detection of Wild Fire using Intelligent CCTV

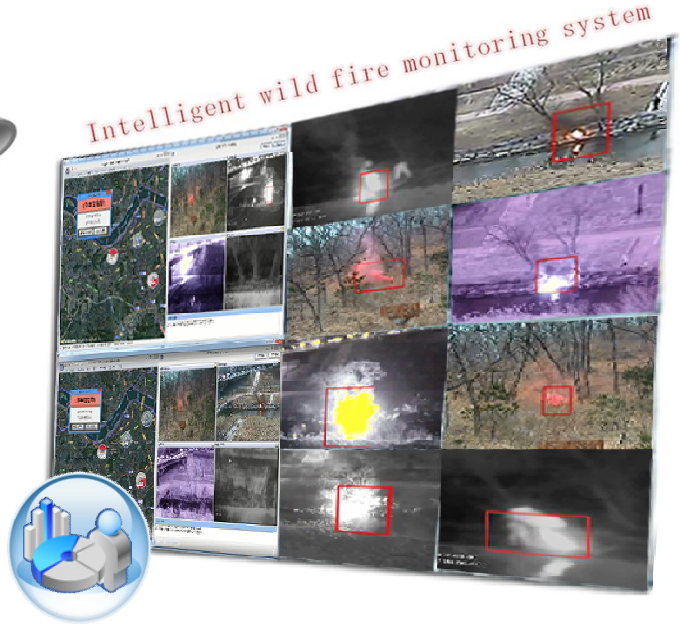
Until now.....



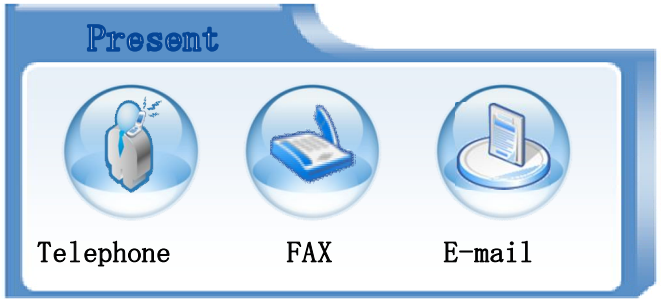
Monitoring by person

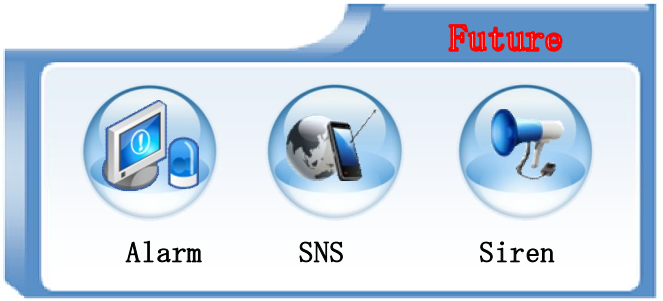


In future....



Over 85% of accuracy





Estimation and assessment of damage in facility using vibration characteristics

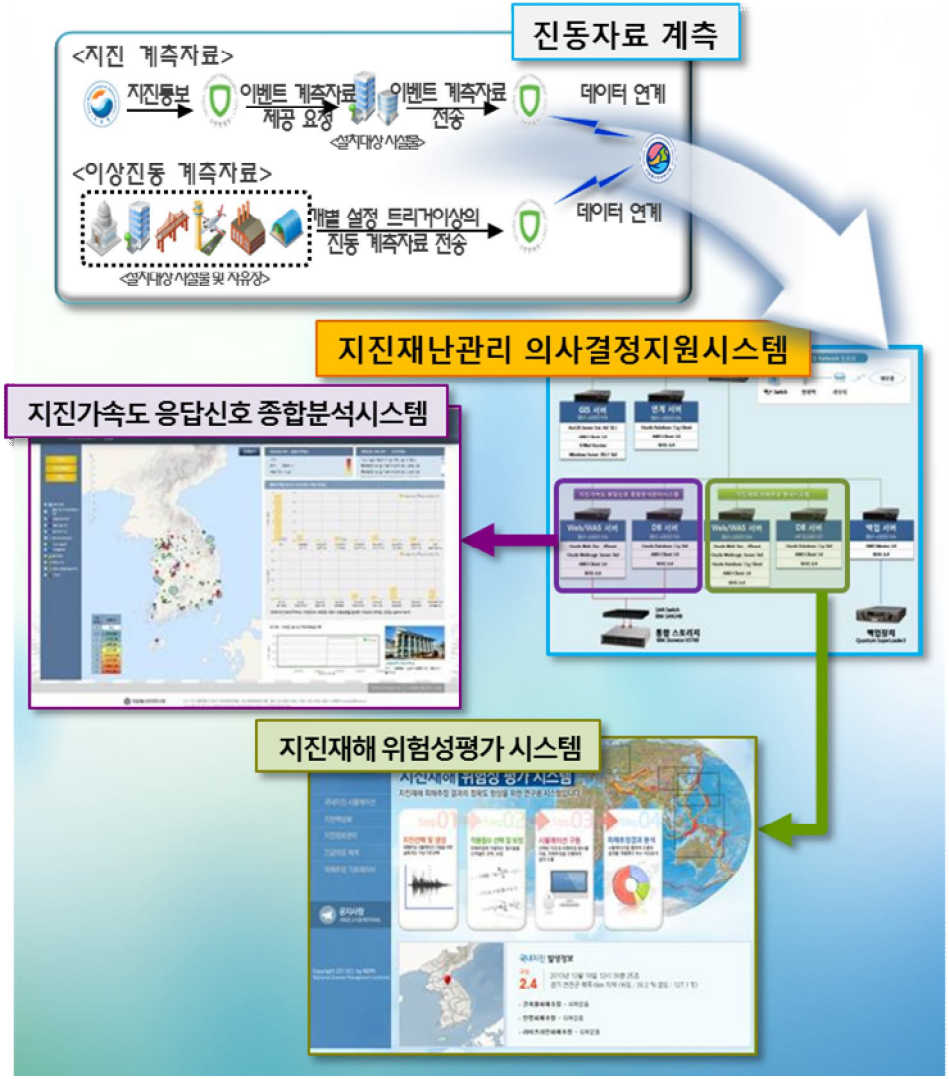
Systemic management of vibration data

Control Tower for facility disaster management

- Effective unified management of real measurement vibration data
- Unification of earthquake data supply

Providing the information of facility damage using GIS

- Display of detection results in abnormal vibration & sensor error
- Display of damage estimation of earthquake & abnormal vibration



DSI Disaster Scientific Investigation

DSI

Comprehensive countermeasures for public safety

Strategy 2. Induction of advanced policy for strengthening safety

☞ DSI : Establishment of exclusive center for investigating disaster & safety causes (2013. 8)

※ D:SI(Disaster Scientific Investigation)

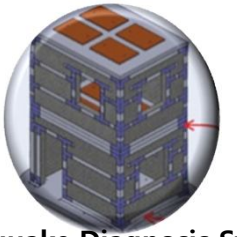
TECHNOLOGY

<Mobile Damage Investigation System>

< FARD>

Electric Field Report

Tsunami Response System



Earthquake Diagnosis System>

Existing DSI Technology

DEVELOPING

Quad copter

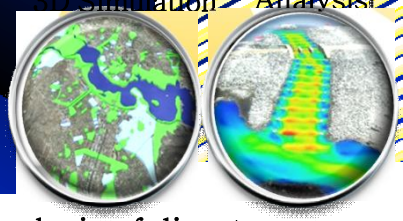
Tool Kit

Wearable Computer

Methodology for field investigation using cutting-edge tech.

3D Simulation

Analysis



Analysis of disaster causes by 3d simulation

UAV

Satellite

Estimation of damages

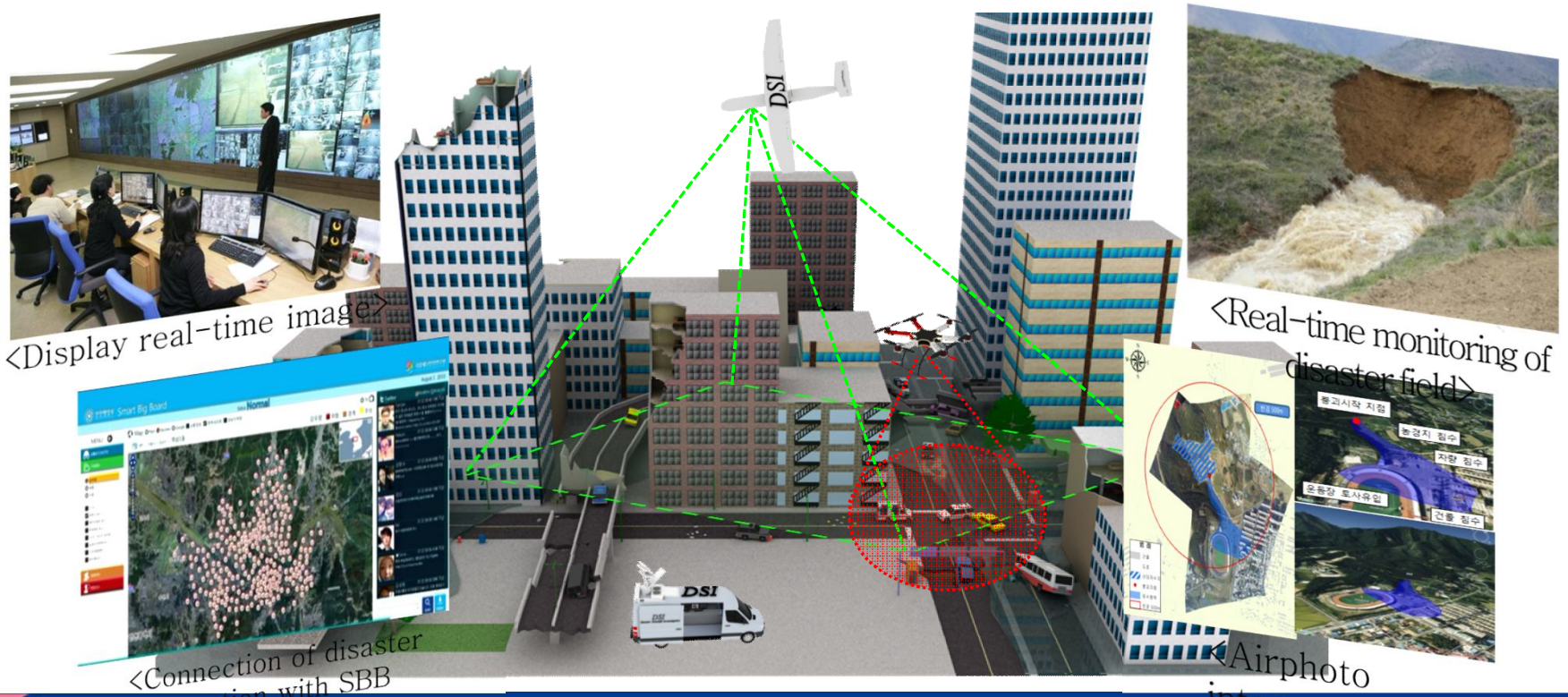
DSI UAV Application

Damage investigation by cutting-edge technology

- Mission in inaccessible area
- Early estimation of damage size by cutting-edge technology

Field investigation and analysis on examples

- Cause analysis on crisis with large scale and social issue
- Wildfire in Pohang, algal bloom in Nakdong river, etc.



DSI UAV Examples of Field investigation

Damage Investigation by UAV

F550

-Flying radius : 1.5km
-Flight altitude : 1m~700m
-Flying time : 20 min

Remo Eye006

-Flying radius : 15km
-Flight altitude : 20m~1km
-Flying time : 120 min

OCTO

-Flying radius : 500m
-Flight altitude : 1m~500m
-Flying time : 20 min

Smart Damage investigation

Disaster field investigation using cutting-edge technology

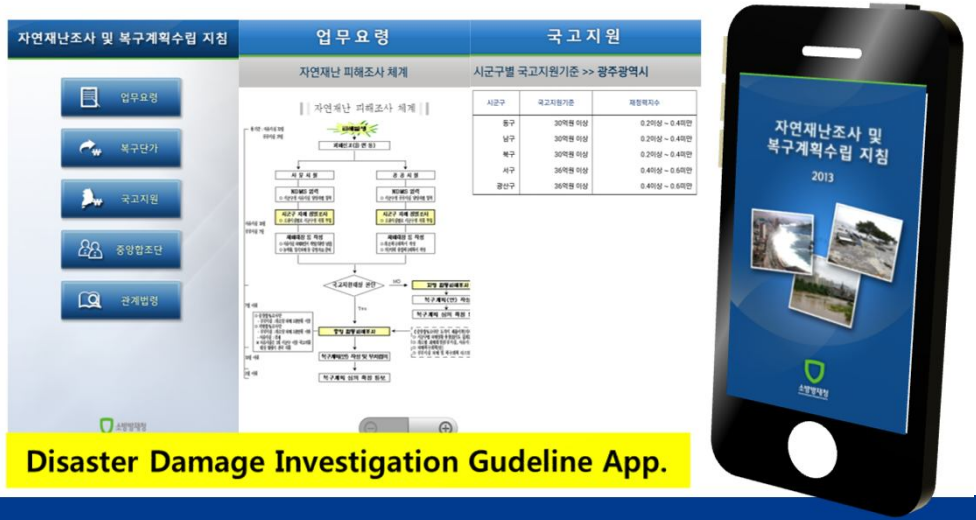
One-Stop Damage investigation

- Collection of location information by GPS
- Support of Tracking, Mapping function
- Making the report of field investigation with real time
- Saving time of 70%

Smart Disaster Damage Investigation App.

Guide Application in Smart Phone

- Investigation method, damage and recovery amount etc.
- Effective support for field investigation



Disaster Damage Investigation Gudeline App.

Conclusion

- Facing the Unexpected
- Disasters by Design
- Paying the Price
- Cooperating with Nature

National Academy Press Series

Knowing is not Enough, We must Apply

Willingness is not Enough, We must Do

Johann Wolfgang von Goethe

National Disaster Management Institute

Thank You!

NATIONAL
DISASTER
MANAGEMENT
INSTITUTE