WORKSHOP 5

Enhancing Global Resilience to Disasters and Climate Change

Organiser: Ministry of the Interior and Safety (MOIS)

SESSION 3

Science & Technology Innovation for Responding to Landslides and Urban Floods

Organiser: Ministry of the Interior and Safety (MOIS)

Innovations in Science and Technology for Landslide Response

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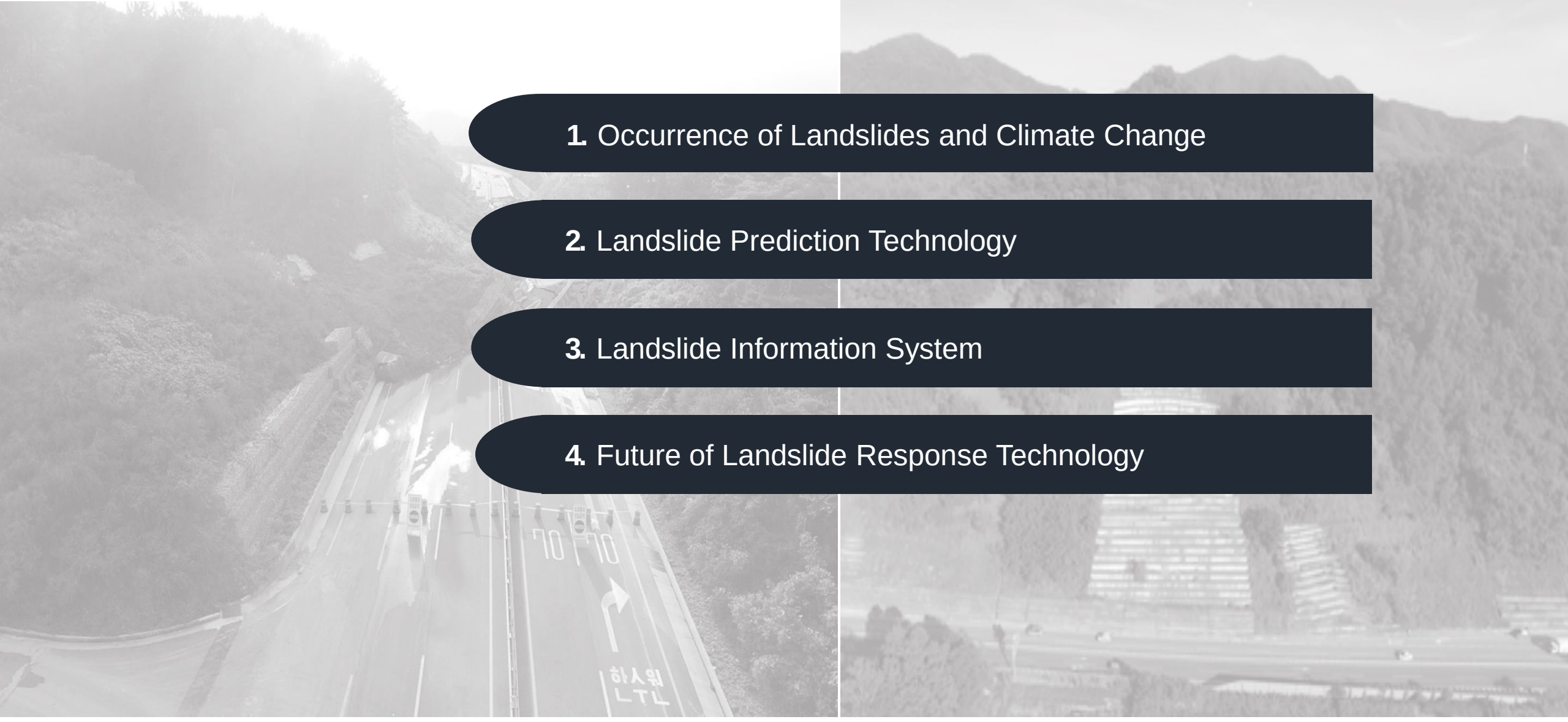
Innovations in Science and Technology for Landslide Response



1. Occurrence of Landslides and Climate Change
2. Landslide Prediction Technology
3. Landslide Information System
4. Future of Landslide Response Technology

1. Occurrence of Landslides and Climate Change

Trend of Increasing Scale of Landslide Damage due to Climate Change

Recent Landslide Damage

- Landslide damage area increased 8 times over the past 5 years
- Mainly occurs in July (21.1%) and August (60.2%)
- Gradual increase in landslide damage due to climate change

Average Number of Rainfall Events Exceeding 50mm per Hour

- (2000s) 14 → (2010s) 16 → (2023) 25 events
- 2023: Cumulative rainfall during the rainy season increased by over 85% compared to normal years
- 2022: Record heavy rainfall in central regions from August 8 to 11
- 2020: Record damage due to localized heavy rainfall and typhoons

< 최근 10년간 산사태 피해 추이 >

(단위: ha, %)

구 분	합 계	비 율	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
계	2,586	100	70	0	54	94	56	156	1,343	27	327	459
5월	1	0.1										1
6월	33	1.2	-	-	-	-	2	-	4	-	4	23
7월	**545**	21.1	-	-	-	94	-	1	33	13	2	402
8월	**1,557**	60.2	-	-	1	-	31	-	1,194	12	286	33
9월	222	8.6	70	-	-	-	2	1	112	2	35	-
10월	228	8.8	-	-	53	-	21	154	-	-	-	-

[Source: Korea Forest Service, Landslide Prevention Department]

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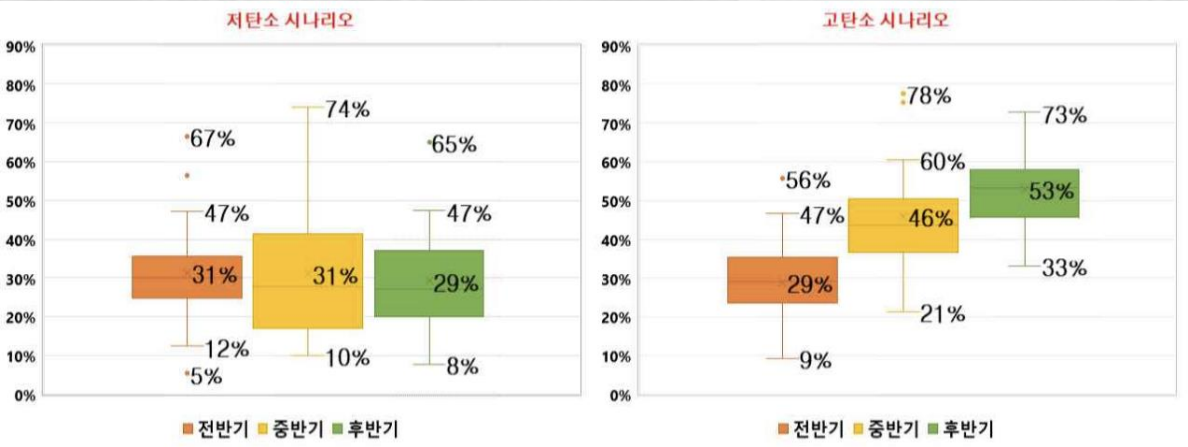
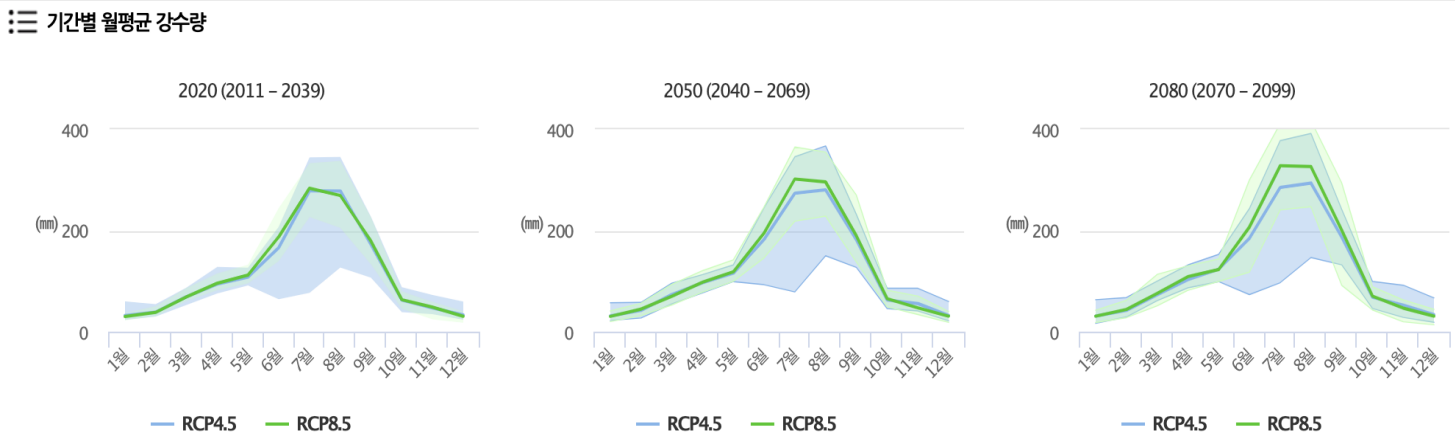
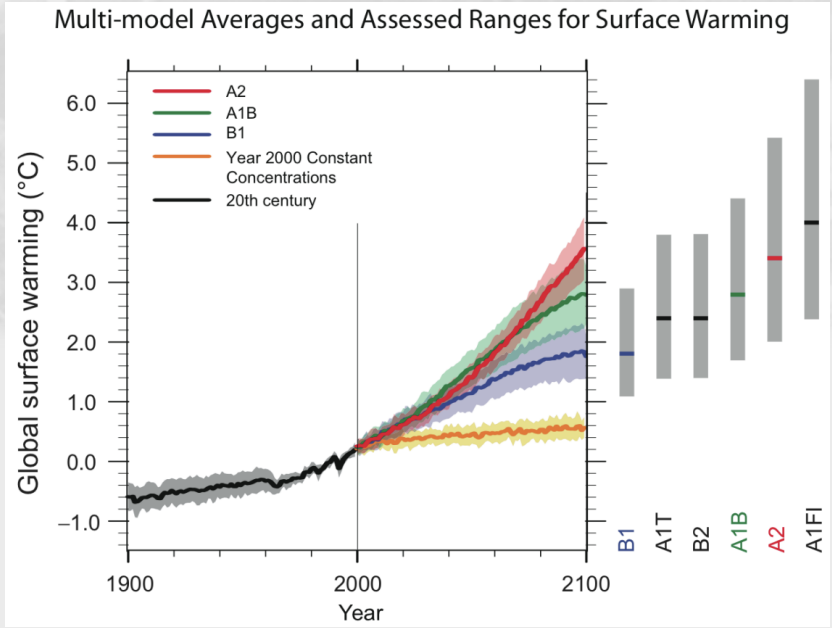
1. Occurrence of Landslides and Climate Change

Climate Exchange

Change in Extreme Rainfall Rates According to Carbon Emission Scenarios (Present~2100)







[Source: IPCC Report]

[National Water Resources Management Comprehensive Information System]

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2. Landslide Prediction Technology

Changes in Landslide Prediction Technology

Physical-Based Model

- Collecting of information (terrain, forest, geotechnical, weather data, etc.)
- Evaluation through analysis of information using physical models

Statistical Model

- Collection and analysis of landslide occurrence data (terrain, geology, etc.)
- Evaluation through statistical analysis of correlations between data

Examples from the USA, Japan, Taiwan, Italy, etc.

- Statistical analysis of landslide history and rainfall data
- Empirical or probabilistic evaluation → Early warning of landslides
- I-D(Intensity-Duration) curves based on empirical relationships

Advances in computer and internet technologies

Changes in Physical-Based Models

- Development of field information collection technology
- Significant reduction in computation time
- Emergence of various numerical analysis modeling techniques
- Evolution of data sharing methods
- Increased practicality

Development of Landslide Early Warning Systems

- Comprehensive analysis of results from statistical and physical-based models with rainfall forecast data
- Use of web-based early warning systems

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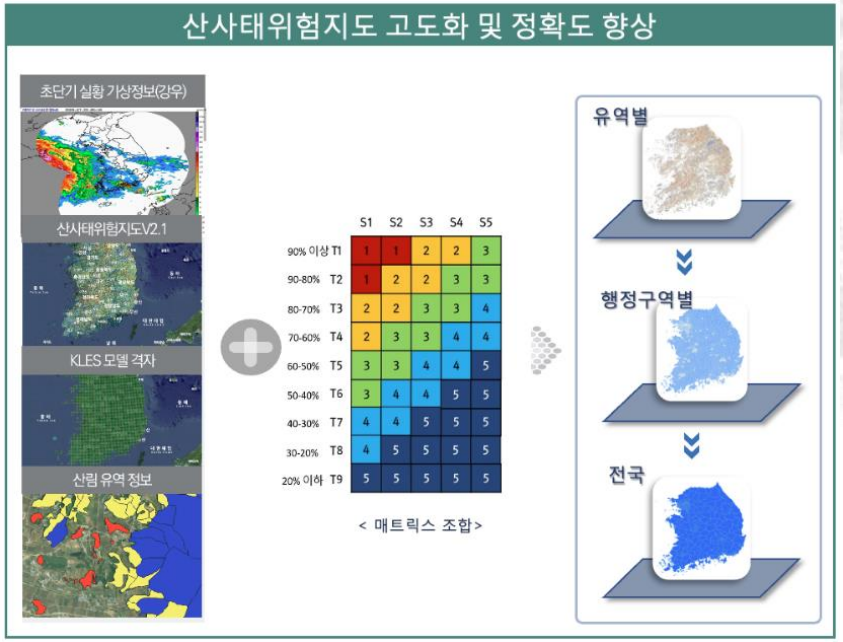
3. Landslide Information System

Landslide Information System of the Korea Forest Service

- Classification of the entire country based on rainfall distribution and geological characteri stics
- Providing predictive information by analyzing rainfall data from the Meteorological Admini stration
- Reflecting real-time rainfall conditions on static landslide risk maps to provide real-time la ndslide risk by administrative district

Limitations

- Realistic constraints in reflecting detailed soil characteristics (permeability, groundwater l evel, etc.) by region make landslide prediction challenging



[Source: Korea Forest Service, Landslide Information System]

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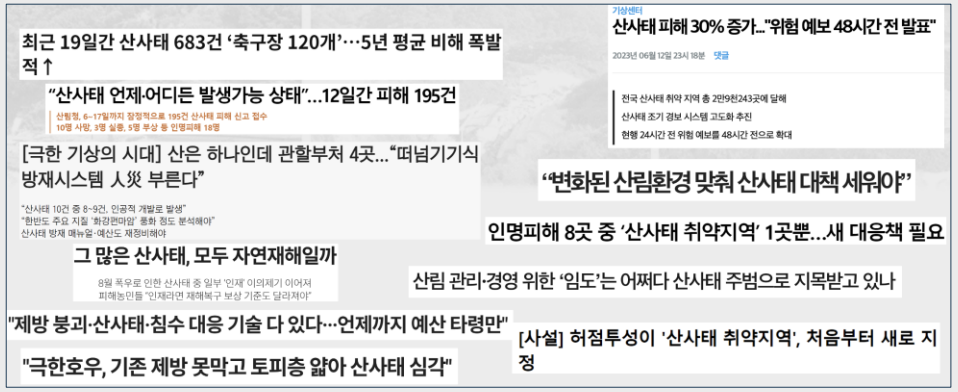
3. Landslide Information System

Landslide prediction information

올해 붕괴한 급경사지 4곳 중 1곳, 정부 평가에선 '안전'

(One out of four steep slopes collapsed this year, ‘Safe’ in government evaluation)

- 2020. 10. 6 Yonhap News article
- A total of 208 steep slopes collapsed due to record-breaking heavy rain in 2020.
- Of these, 53, or 25.4%, are graded A and B with no disaster risk.
- Due to the increasing frequency and amount of heavy rainfall caused by climate change, there is a need to supplement and improve the ‘disaster risk assessment standards’ of the Ministry of Public Administration and Security.



[Source: Google, “2023, Landslide’]

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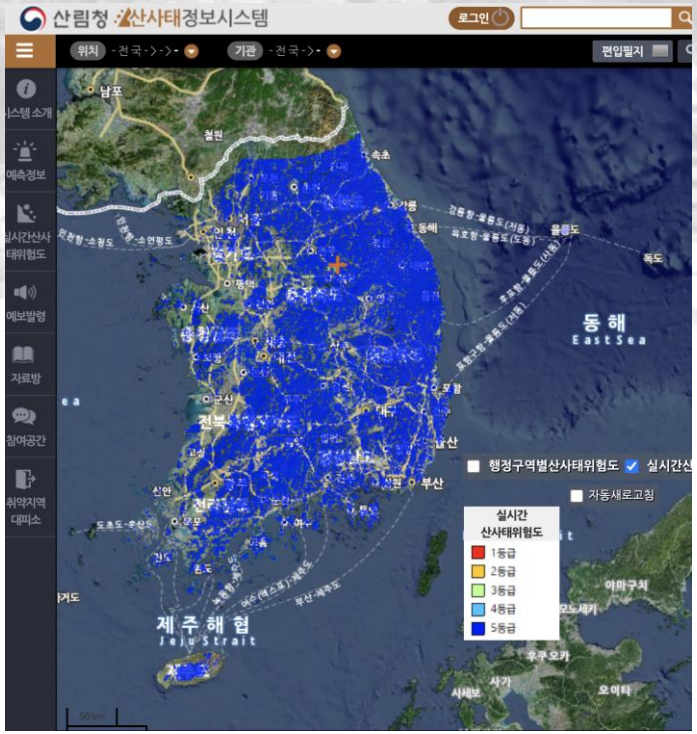
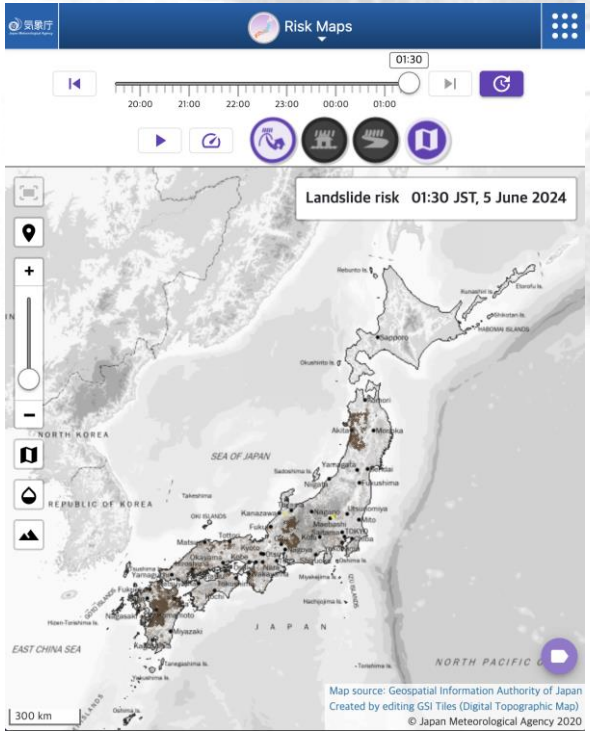
3. Landslide Information System

Landslide Information System(Landslide prediction information)



Landslide information system of the Korea Forest Service



Real-time landslide risk map of Japan.

Landslide early warning system of Italy

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4. Future of Landslide Response Technology

Development direction of landslide response technology

Advancement in collected information

- Diversification of basic information
- Securing high-quality basic data for analysis

Real-time reflection of variables

- Inclusion of risk variables like rainfall forecast information
- Real-time Monitoring and Rapid Response

Improvement of accuracy in information analysis

- Enhancement of prediction algorithms
- Integration of advantages from physical and statistical models

Utilization of AI Technology

Machine Learning

- Predictive modeling using past landslide data
- Identification of collapse patterns and risk factors

Remote Sensing and Data Analysis

- Use of images (satellite, drones, etc.) for data collection
- Analysis of terrain changes, vegetation cover, etc.

Internet of Things (IoT)

- Development and use of sensors for real-time monitoring
- Development of comprehensive analysis techniques
- Integration and analysis of data from various sources

Operation of integrated system including generation of high-resolution risk maps, real-time analysis, forecast and warning system, and damage recovery analysis

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Thank you for your attention

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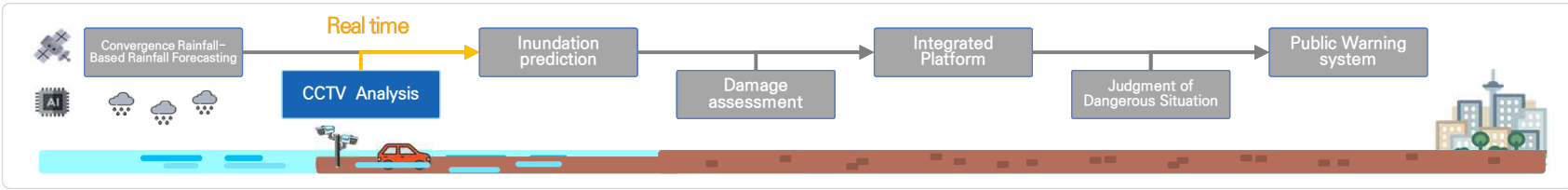
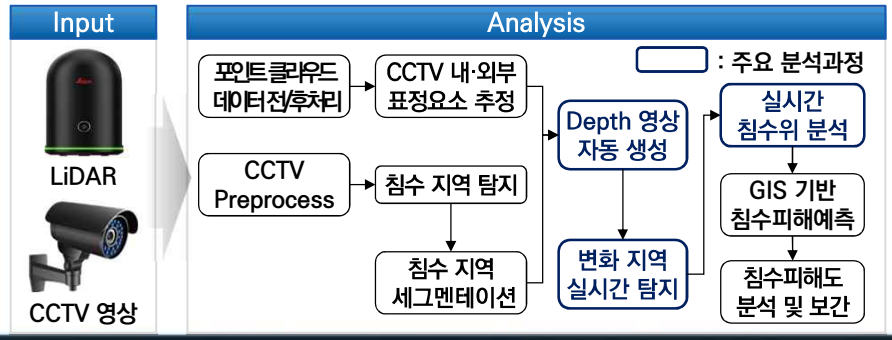
03 On going Researches in Korea : Example

Development of Artificial Intelligence-Based Urban Inundation Prediction Model

Development of CCTV utilization technology

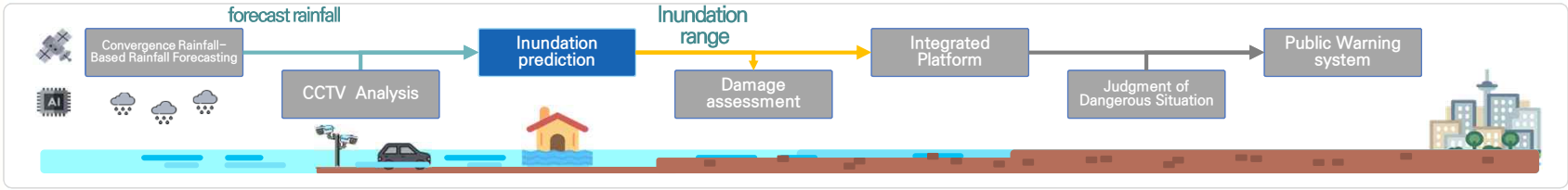


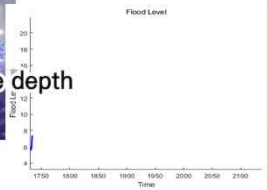


03 On going Researches in Korea : Example

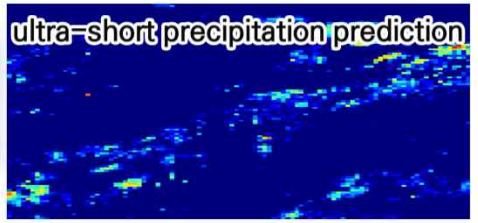
▶ Development of Artificial Intelligence-Based Urban Inundation Prediction Model

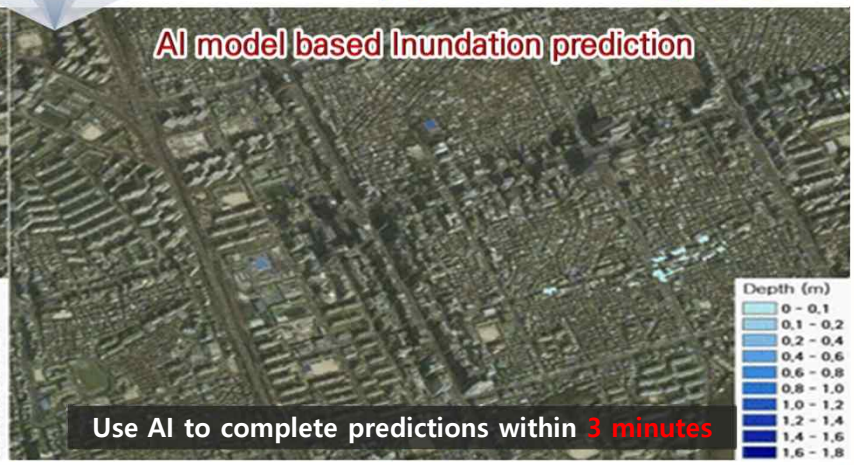
›AI Inundation simulation model





AI model prediction

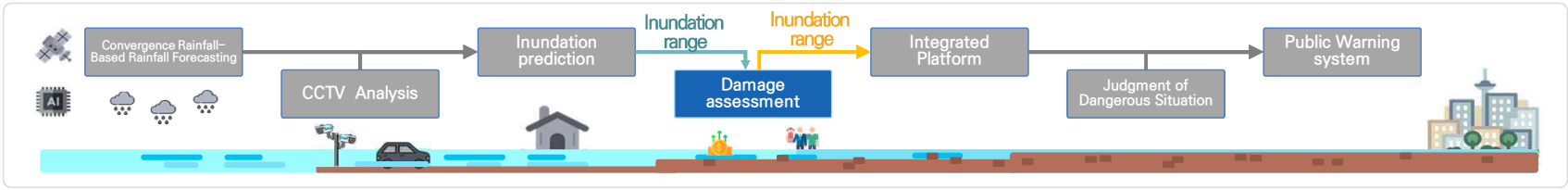




03 On going Researches in Korea : Example

Development of Artificial Intelligence-Based Urban Inundation Prediction Model

Damage Assessment system



Development of quantitative and qualitative damage assessment technology

피해자산 유형분류 및 인벤토리 구조 설계

- 피해자산 유형 및 분류체계 확립
- 국내 가용자료(일반 통계자료, 공간 DB 등) 검토
- 자산유형 별 인벤토리 DB 구조 설계 및 구축방안 검토
- TEST-BED 대상 인벤토리 DB 구축

→ AI기반 도시하천범람 및 도시침수 예측결과와 연계

건물
공공시설
인명(동적)
지하공간
지하출입구

※ 지하철 출구별 elevation

정량적·정성적 피해 평가 모델 개발 및 실증

- 기존 정량적 평가 방법론과의 비교, 검토
- 중요시설물을 고려한 정성적 피해 평가 모형 개발
- TEST-BED 적용 및 실증
- TEST-BED 확대

AI 기반 도시하천 범람 및 도시침수 피해 평가 가이드라인 작성

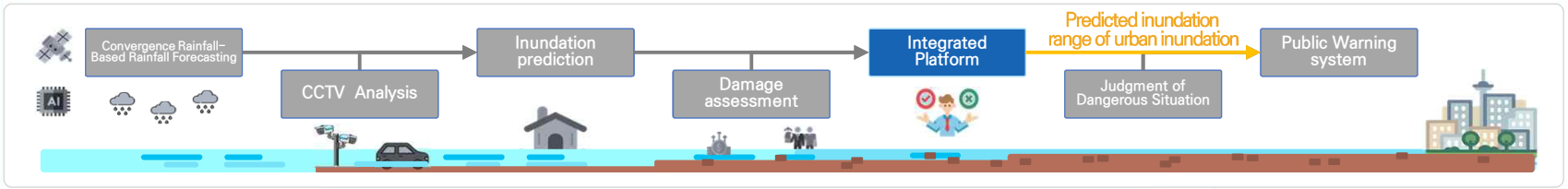
- 건물, 공공시설, 인명 등 정량적 피해 평가 및 정성적 피해평가 가이드라인 작성
- 실무적용 예제 작성

Quantitative and qualitative damage assessment model

03 On going Researches in Korea : Example

Development of Artificial Intelligence-Based Urban Inundation Prediction Model

Development Integrated Platform



통합 플랫폼 기능 모듈

도시침수 피해 위험지역 예 · 경보 기술 현장운영 모니터링

① 테스트베드 운영계획 수립

- 지자체 및 관리기관, 제안사 품질관리 실무 담당자
- 플랫폼 운영 방안 및 일정 등 세부협의를 통한 계획 수행

② 리빙랩 운영

- 관련 공무원 및 전문가 리빙랩 운영

③ 테스트베드 운영

- 지자체 현장 플랫폼 환경 구축 및 시범운영

CCTV 모니터링

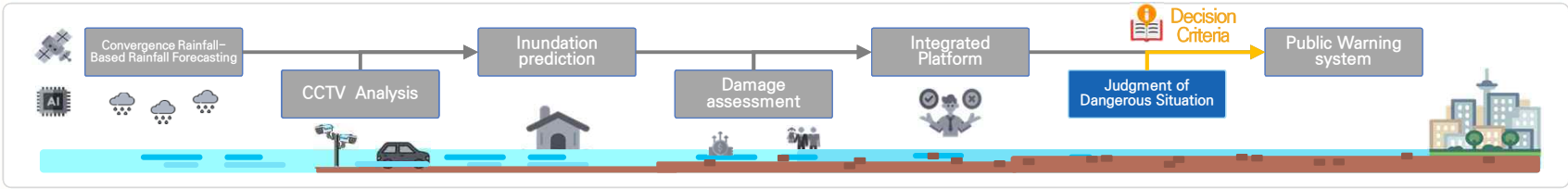
강우설정을 통한 시뮬레이션

장치별 예·경보 범위 확인

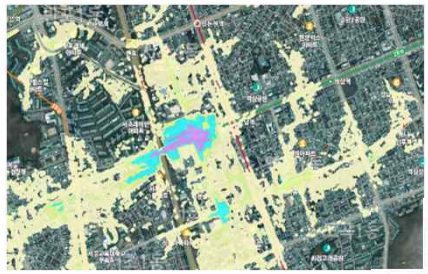
03 On going Researches in Korea : Example

Development of Artificial Intelligence–Based Urban Inundation Prediction Model

Judgment of Dangerous Situation : Warning Call



Inundation forecasting



Historical records

Field Survey for Establishment of Criteria : Degerming of urban flooding condition

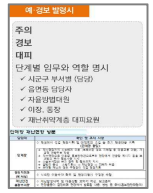
Alert issuance criteria

주의보 | 경보 | 대피

- 도시침수예측 결과(침수심, 범위)와 위험상황 판단 고려요소 등을 종합하여 예·경보 단계별 정량적 판단기준 수립

Manual

- 예·경보 단계별 및 대응주체별로 매뉴얼을 구성, 실무적으로 이해하기 쉽도록 구체적인 대응요령 제시



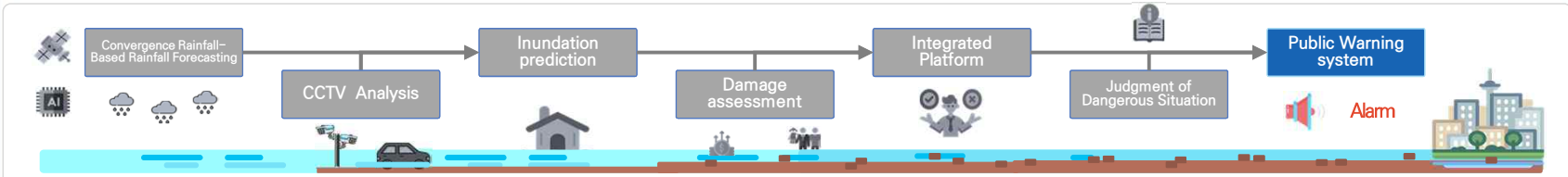
Tips for People's Action

- 예·경보 단계에 따른 발령 대상별 국민 행동요령(차수판 설치 등)

03 On going Researches in Korea : Example

Development of Artificial Intelligence-Based Urban Inundation Prediction Model

Development of Public Warning System



Damage Estimation

- Rain forecasting
- AI prediction
- Damage
- Decision

Urban Inundation Damage Risk Warning System

Data

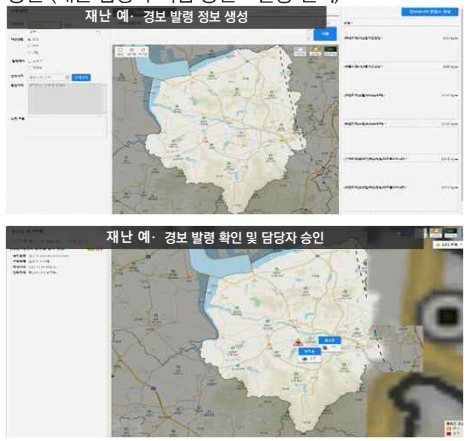
- 예상 및 발생 시간
- 예상 및 발생 위치 (행정구역, 폴리곤)
- 위험 수준

Create Contents

- 대상 매체별 적용 가능 콘텐츠(이미지 기반)
- CAP 기반 표준 준용

Approved integrated control and alert issuance

- 예 · 경보 정보 수신 및 상황 확인
- 지역및매체선정에따른재난정보콘텐츠생성요청
- 발령 지역 및 생성 정보 확인에 따른 재난 담당자 발령 승인 (재난 담당자 직접 승인· 발령 원칙)



Facility control

Public Warning

Information within the government

지하공간 침수 (ex : 지하철 출구별 elevation) 분석

03 On going Researches in Korea : Example

Development of Artificial Intelligence-Based Urban Inundation Prediction Model

Example of Integrated Management System

Integrated Urban Inundation Management System

Rainfall forecasting

Digital Twin (3D)

Indundation modeling

Gauge data

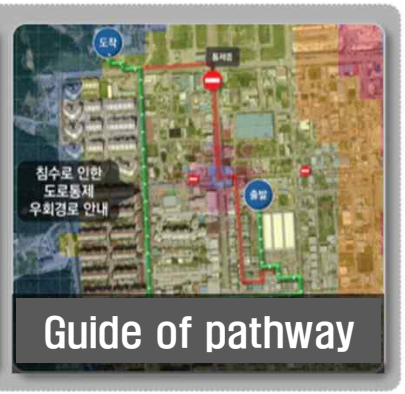
Management system

Optimal Operation

03 On going Researches in Korea : Example

Development of Artificial Intelligence-Based Urban Inundation Prediction Model

Decision-making tools based on urban flooding prediction and damage assessment

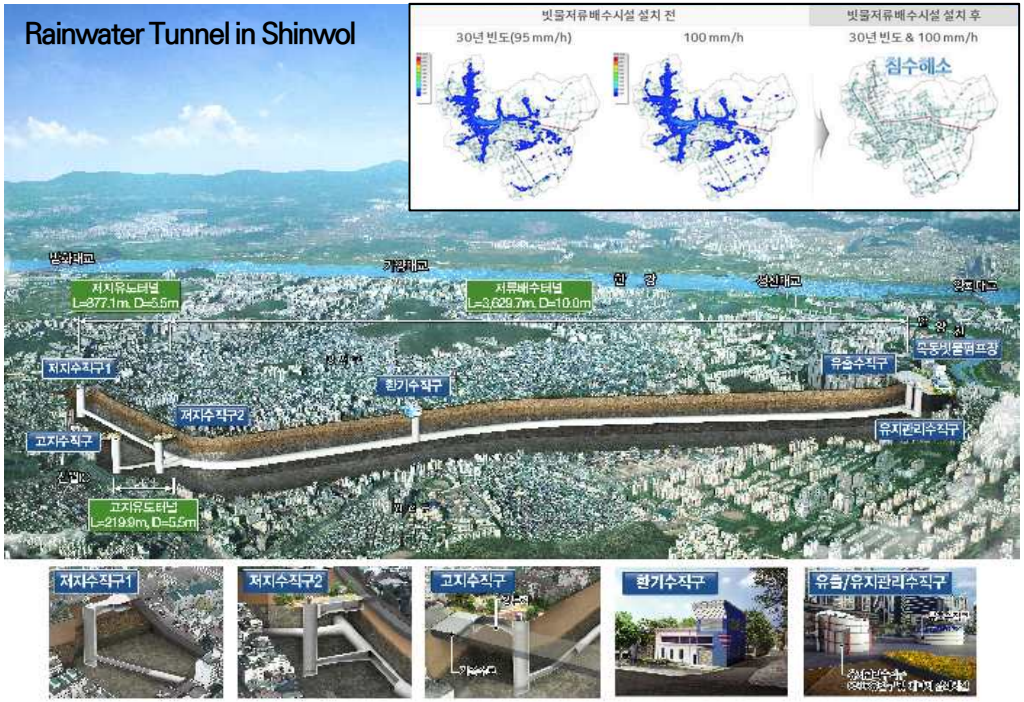


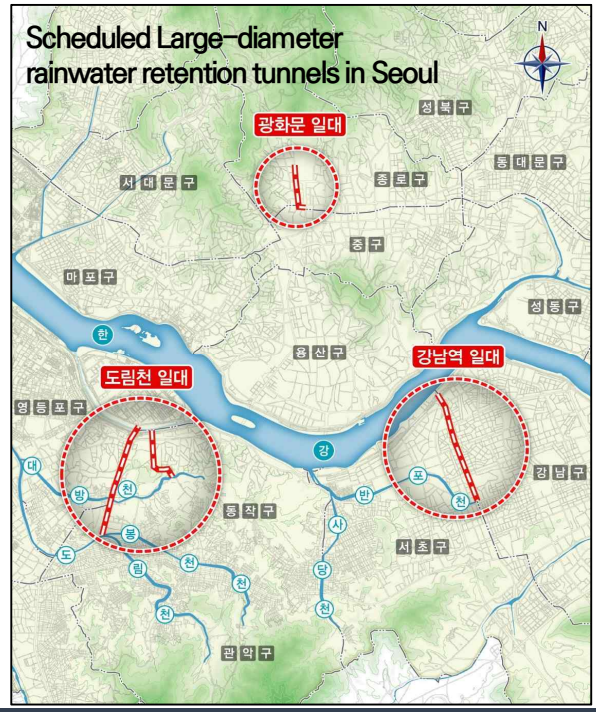
03 On going Countermeasures in Korea

Construction of a Large-Diameter Rainwater Retention Tunnel

Establishment of the system through the application of new technologies

- Tunnel excavation 70-80 meters underground (Diameter10-20m) : Storage & forced drainage of rainfall
- Shinwal Tunnel was constructed at '19
- This year 3 more tunnel will be constructing (Kangnam, Kwanghwamun, Dorimcheon)





단일 목적(치수)보다는 다목적 시설(지하 고속도로 등) 병행 필요

03 On going Countermeasures in Korea

Construction of a Large-Diameter Rainwater Retention Tunnel

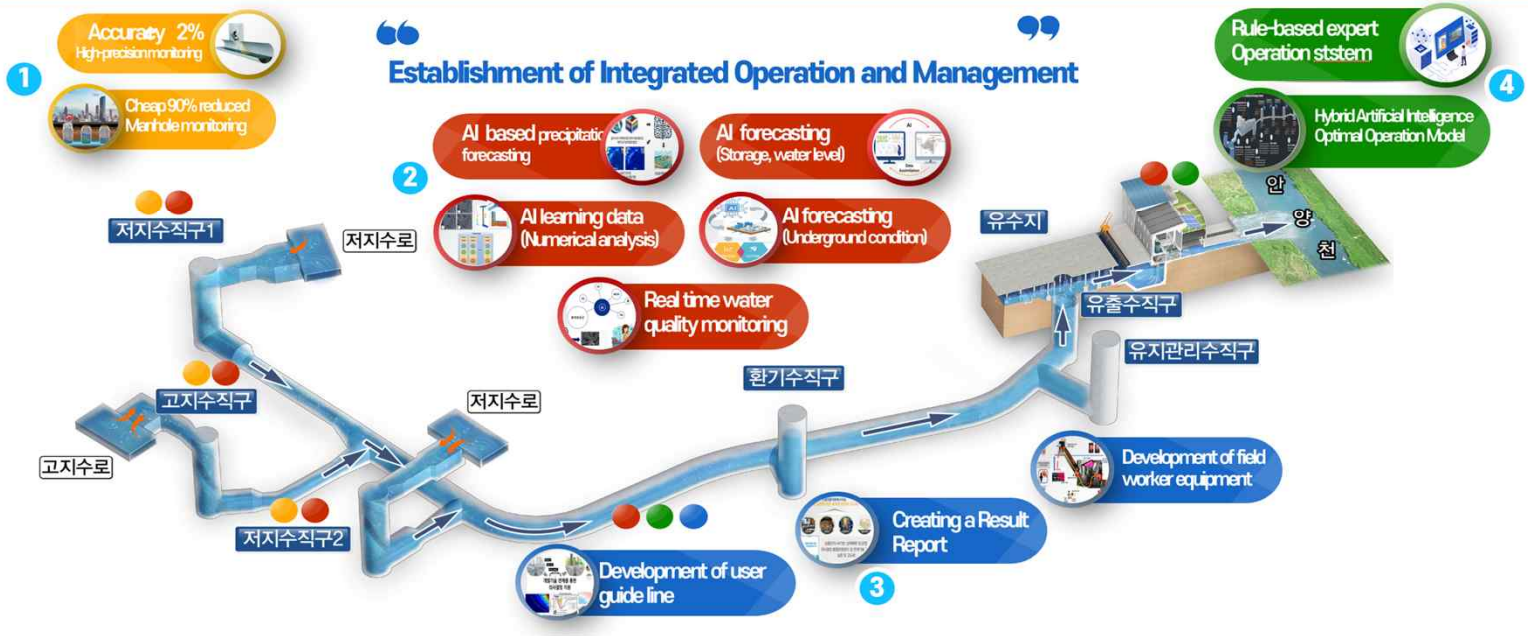
Establishment of the system through the application of new technologies

Real-time monitoring
① **Monitoring using advanced observation technology**

AI based Forecasting
② **Precisely predicting and observing sulfur throughout the basin**

AI optimum operation
③ **Optimal operation of infrastructure** against urban flooding

Operation management
④ **Technology to reduce the risk of flooding** even in the worst-case scenario



Contents

IV

IV. Closing Remark

04 Closing Remark

Suggestion 1

Unstructured Measures Using New Technologies

- AI based Urban Flood Response System
- Expansion of monitoring system using new technology

Suggestion 2

Construction of large-scale facilities as a structural measure

- Construction of a Large-Diameter Rainwater Retention Tunnel
- Development of optimal operating rules for facilities

Suggestion 3

Improvement of disaster prevention capabilities by raising facility standards

- Increasing the Central Government Management Rivers
- Increase design frequency of water facilities
- River Maintenance Rate Upward Management

Suggestion 4

Cooperation of the political community

- Revision of laws and regulations related to climate change response
- Expansion of additional facility investment
- Establishment of a control tower agency to respond to the climate crisis

United Nations | Department of Economic and Social Affairs

Ministry of the Interior and Safety

THANK YOU

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