

# Radiological Emergency System in Korea

2019. 06. 12

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KINS KOREA INSTITUTE OF NUCLEAR SAFETY

# Public Protective Action Level

## Standards for Determining Sheltering, Evacuation, Iodine Prophylaxis Distribution, etc.

Urgent Public Protective Action	Determination Standards
Sheltering	10 mSv
Evacuation	50 mSv
Distribution of Iodine Prophylaxis	100 mGy
Temporary Relocation	30 mSv/first one month 10 mSv/next one month
Permanent Resettlement	1 Sv/lifetime

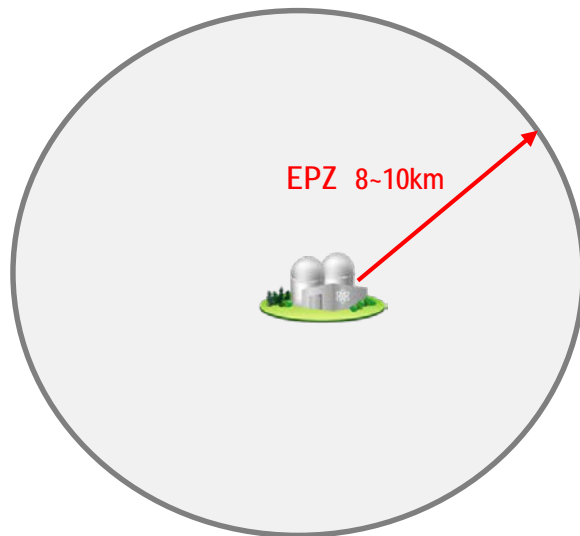
## Standards for Restriction on the Ingestion of Food

Classification			Meat/ Fish/ Crops (Bq/kg)	Vegetable /Fruit (Bq/kg)	Water/ Milk (Bq/L)	Infant Food (Bq/kg)
Radionuclide	Group 1	<sup>134</sup> Cs, <sup>137</sup> Cs, <sup>103</sup> Ru, <sup>103</sup> Ru, <sup>89</sup> Sr	2,000	1,000	200	100
	Group 2	<sup>131</sup> I, <sup>90</sup> Sr	1,000	500	100	10
	Group 3	<sup>235</sup> U, <sup>238</sup> U	100	100	20	10
	Group 4	<sup>241</sup> Am, <sup>238</sup> Pu, <sup>239</sup> Pu, <sup>240</sup> Pu, <sup>242</sup> Pu	10	10	10	1
	Group 5	<sup>3</sup> H	100 kBq/L			

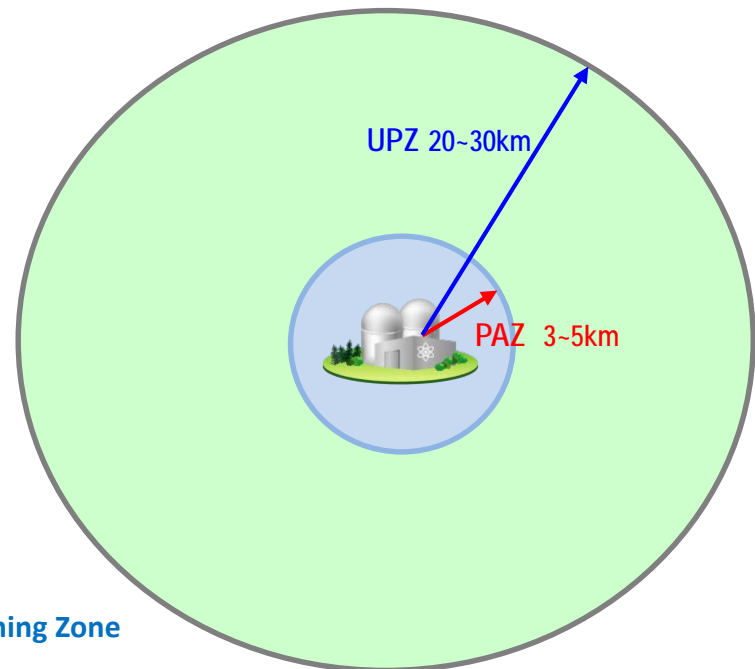
# New Strategy of Emergency Management in Korea

- New Strategy of Emergency Management in Korea
  - Set up the Goal of Emergency Management
    - To prevent occurrence of **deterministic effects**, to reduce occurrence of **stochastic effects** in emergency situation
  - Establish **Precautionary Action Zone (PAZ, 3~5km)**
  - Establish **Urgent Protective action planning Zone (UPZ, 20~30km)**

Emergency Planning Zone (Before)



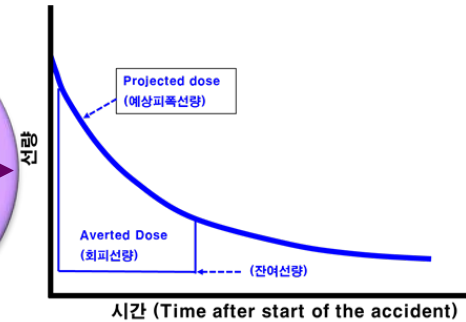
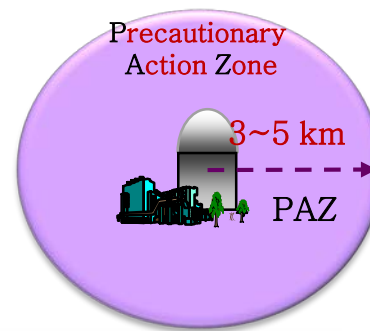
New Emergency Planning Zone (After)



- PAZ : Precautionary Action Zone
- UPZ : Urgent Protective Action Planning Zone

# New Strategy of Emergency Management in Korea

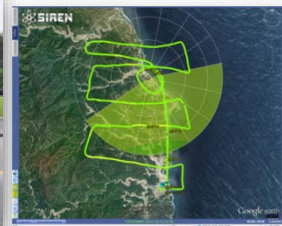
1. Establish **precautionary action zone (PAZ)** in advance and do precautionary urgent protective actions (**EAL, General Emergency**)
  - to prevent the deterministic effects



2. From (projected) dose assessment result, to perform protective actions in accordance with **GIL (Generic Intervention Level)**
  - to reduce stochastic effect
  - before radiological materials release



3. Based on environmental monitoring (sampling and analysis) results, to perform protective actions applying **OIL (Operational Intervention Level)**
  - to reduce stochastic effect
  - after radiological materials release

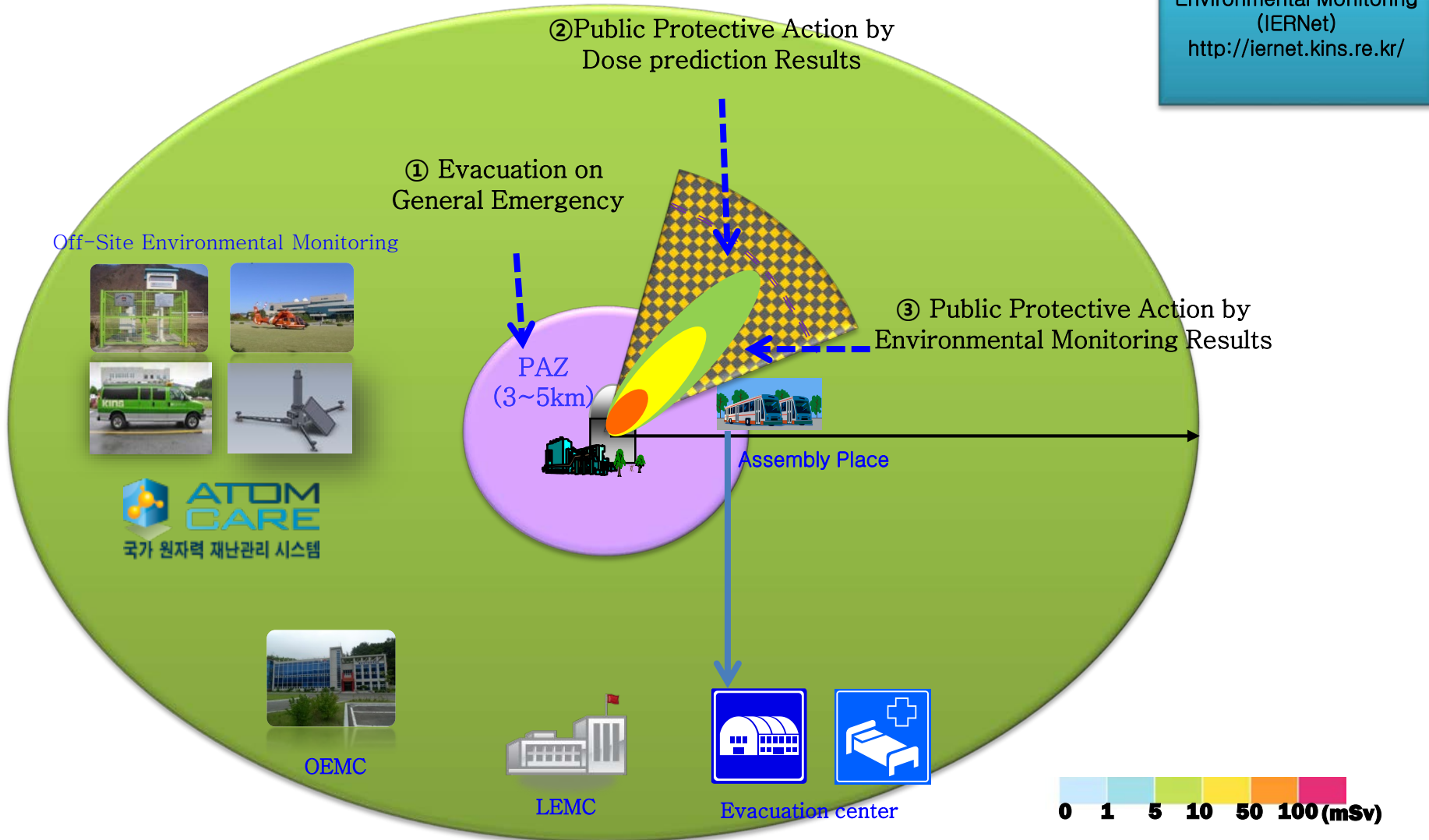




# 3 Stages of Emergency Response Strategy

## ● Response stage

National  
Environmental Monitoring  
(IERNet)  
<http://iernet.kins.re.kr/>

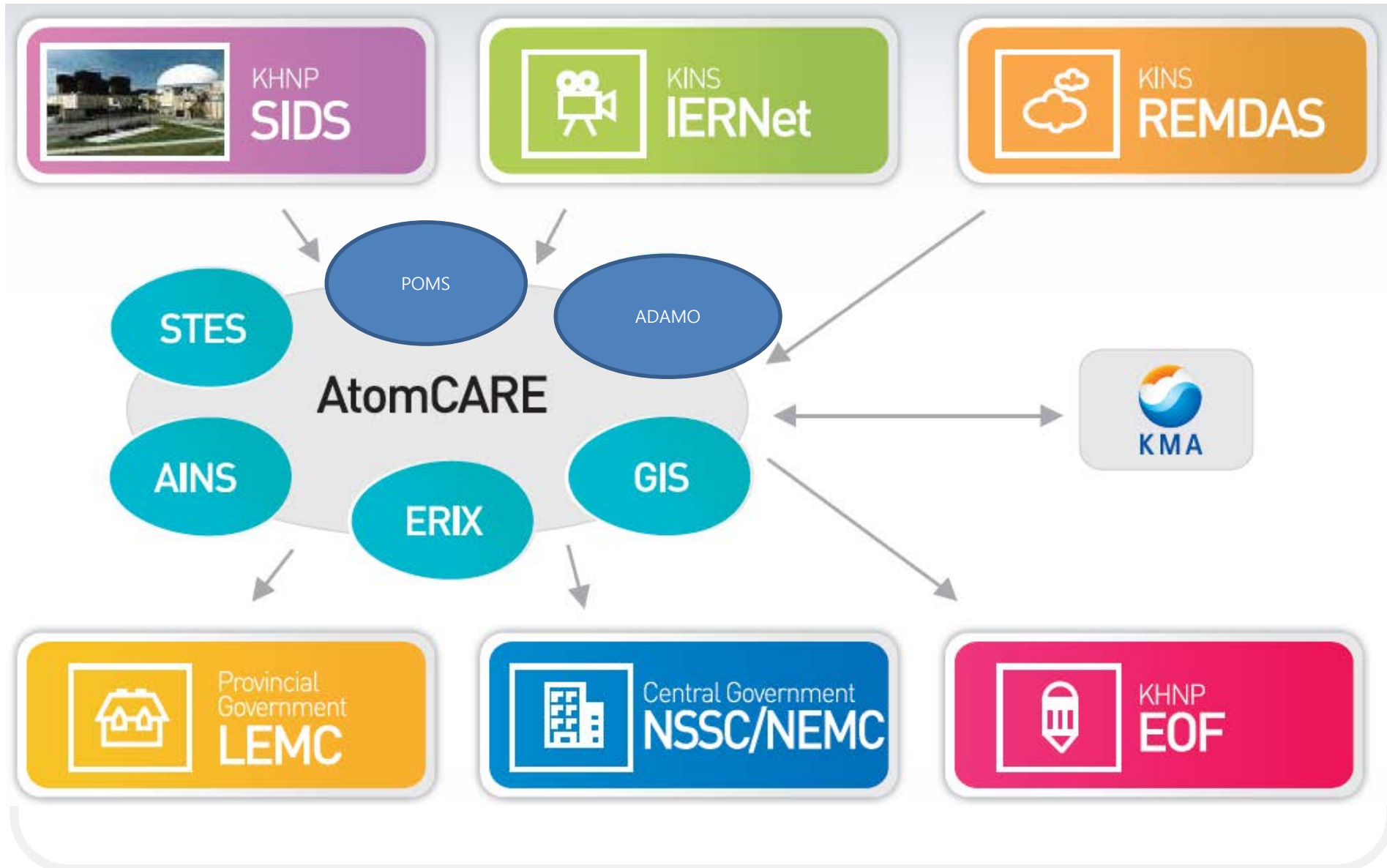


# Radiological Emergency Technical Advisory Center (KINS-RETAC)

- Technical Advice on Emergency Management
- Off-Site Radiological Monitoring and Evaluation Support
- Makes recommendation for emergency response measures
- Operates the Nuclear Emergency Management System (AtomCARE)

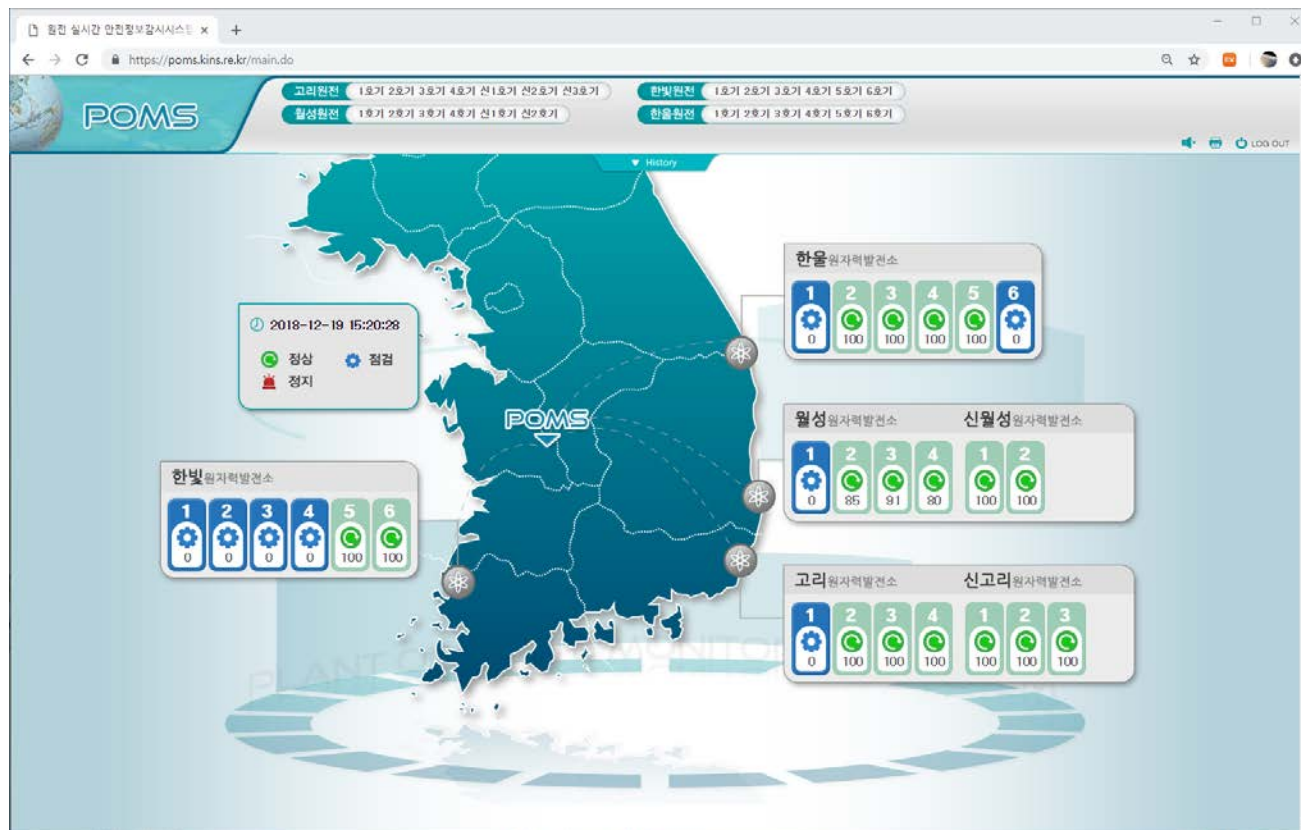


# Emergency Technical Supporting System (AtomCARE)



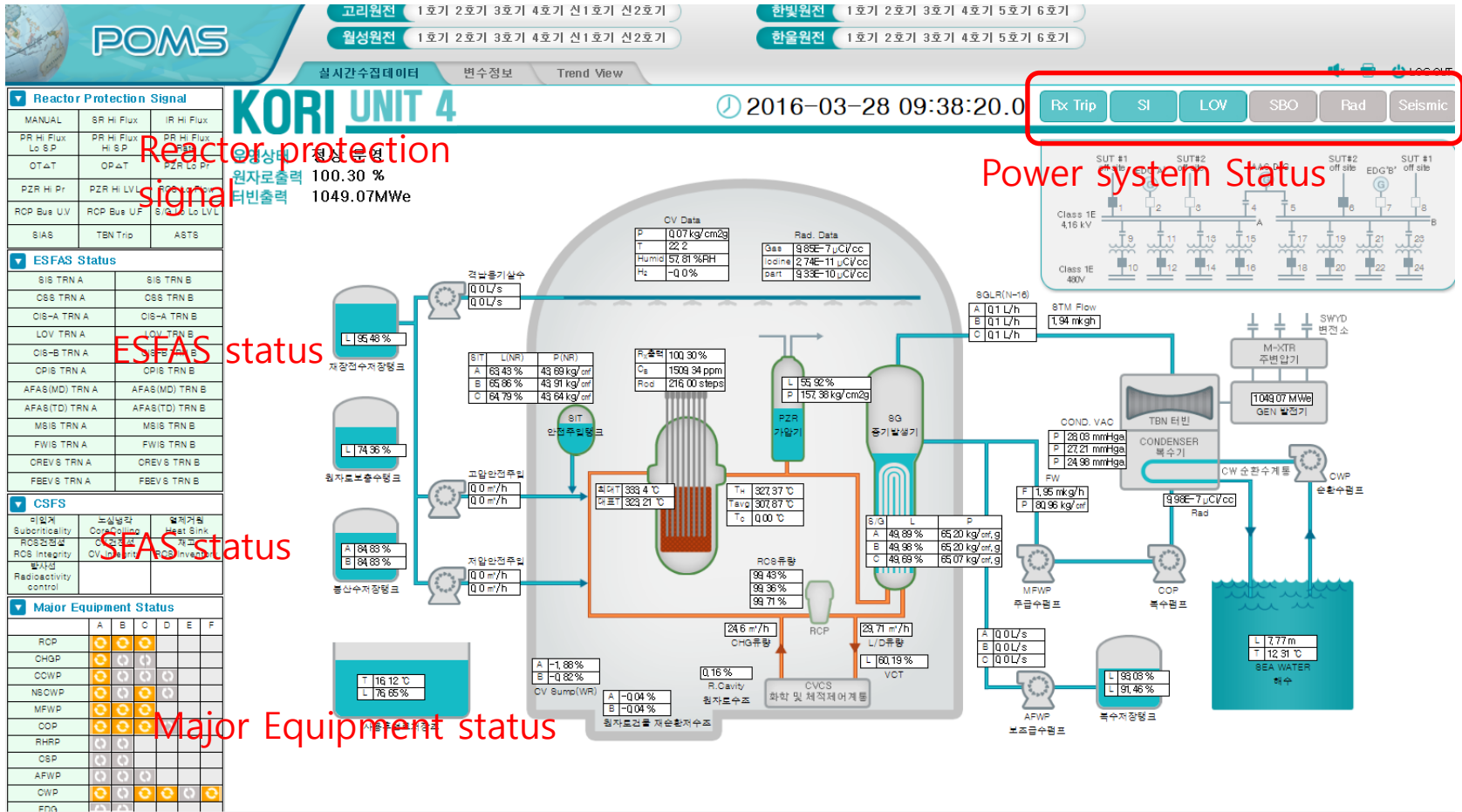
# Plant Operation Monitoring System (POMS)

- **Restructure of the NPP's safety parameter transmission system**
- **Collecting parameters :** primary system, SG, ECCS, SF pool, radiation monitoring, power system, significant alarm, Engineering Safety Feature Actuation signal, major equipment signal etc.





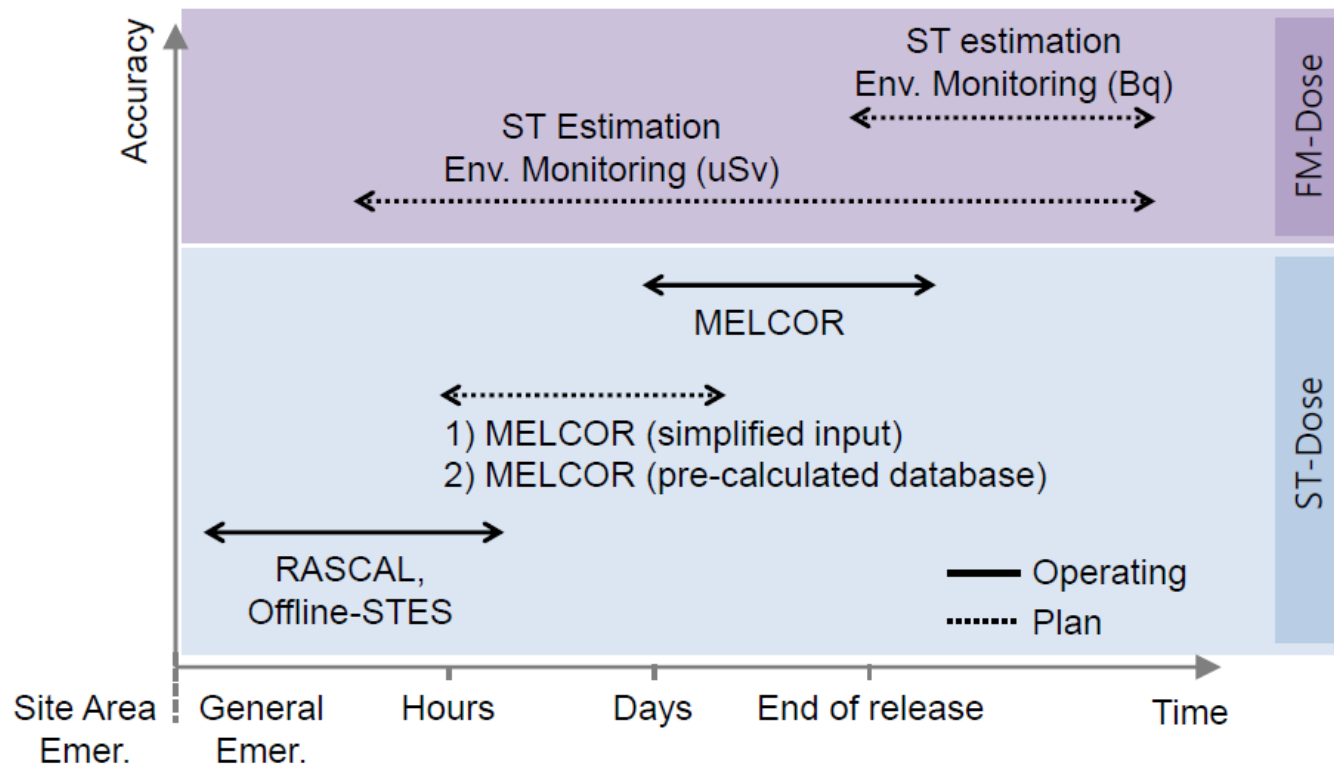
# Plant Operation Monitoring System (POMS)



# Source Term Estimation for Accident

- **Analyzes the causes and current status of an accident**

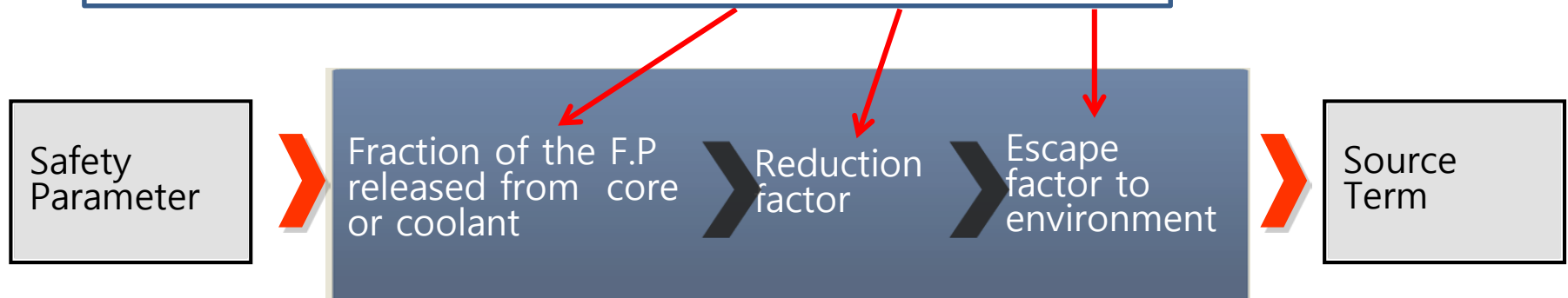
- Assesses the degree of reactor core damage
- Estimates the reduction factor & pathways of radioactive materials
- Evaluates the amount of released radioactive materials



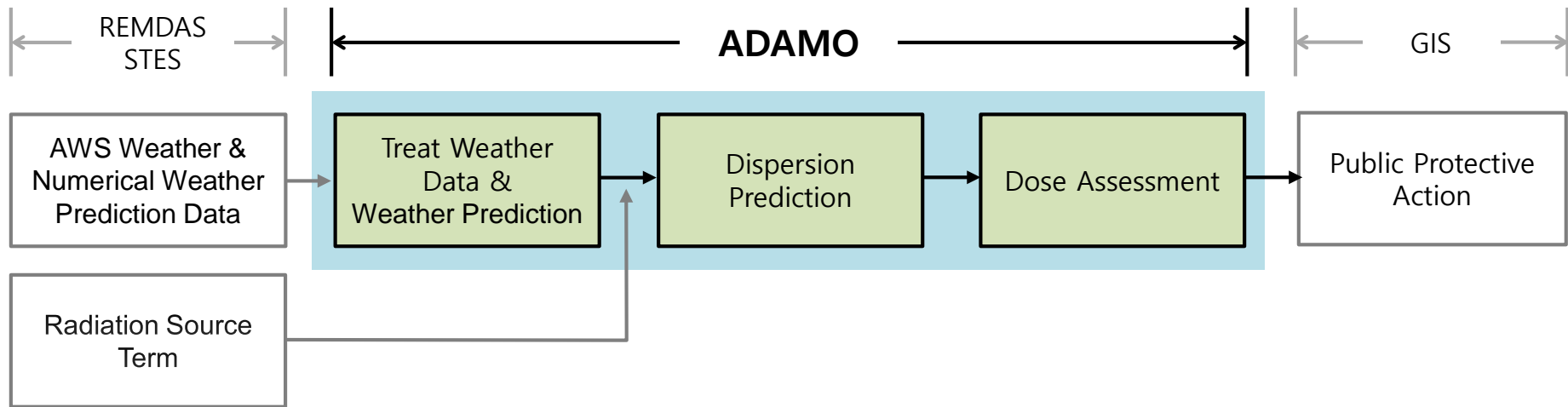
# STES (Source Term Estimation System)

- **Analyzes the causes and current status of an accident**
  - Assesses the degree of reactor core damage
  - Estimates the reduction factor & pathways of radioactive materials
  - Evaluates the amount of released radioactive materials
- **Estimates the Radiation Source Term (RTM & XSOR)**

$$SourceTerm = \sum (FPI_i \times CRF_i \times RDF_i \times EF_i)$$

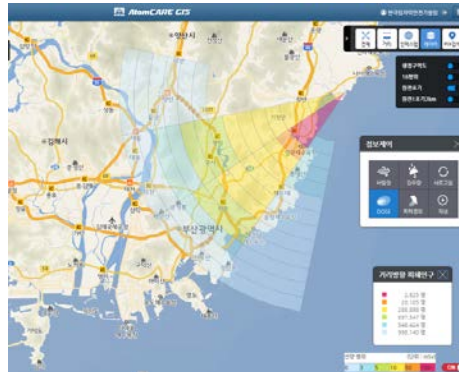
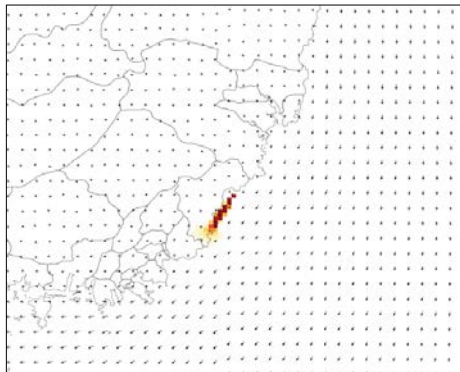
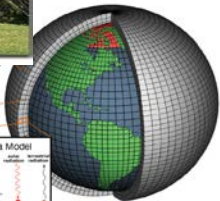
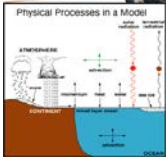


# Accident Dose Assessment MOdeling System (ADAMO)



Vertical Grid (Height or Pressure)

Physical Processes in a Model



Q 검색결과

시도/군구/자치단체: **경상북도** | 우역자점

예상피해분석

· 선택 : 시간병유효선량  
· 단위 : mSv · 구분 : **일반인**

수준	범위	인구수(명)
100초과	일광면	1,097
	광안면	8,695
	기장읍	5,485
10초과 50미만	반송읍	1,070
	변내읍	3,210
	석남면	2,140
	북미면	3,291
	최동면	3,237



# Accident Dose Assessment MObeling System (ADAMO)

## ● Input Data

- Meteorological data (NWP and AWS data)
  - : Wind, Precipitation, Temperature, etc.
- Topological data
- Radiation source term
- Multi-point release data

## ● Evaluates the Resultant Dose & Effects

- Predicts the size of an affected area
- Evaluates the radiation dose for the public
  - cloudshine (radiation from the plume of radioactive aerosols)
  - groundshine (radiation from ground contamination)
  - inhalation (radioactive aerosol particles entering the body)

# Automatic Weather System (REMDAS)

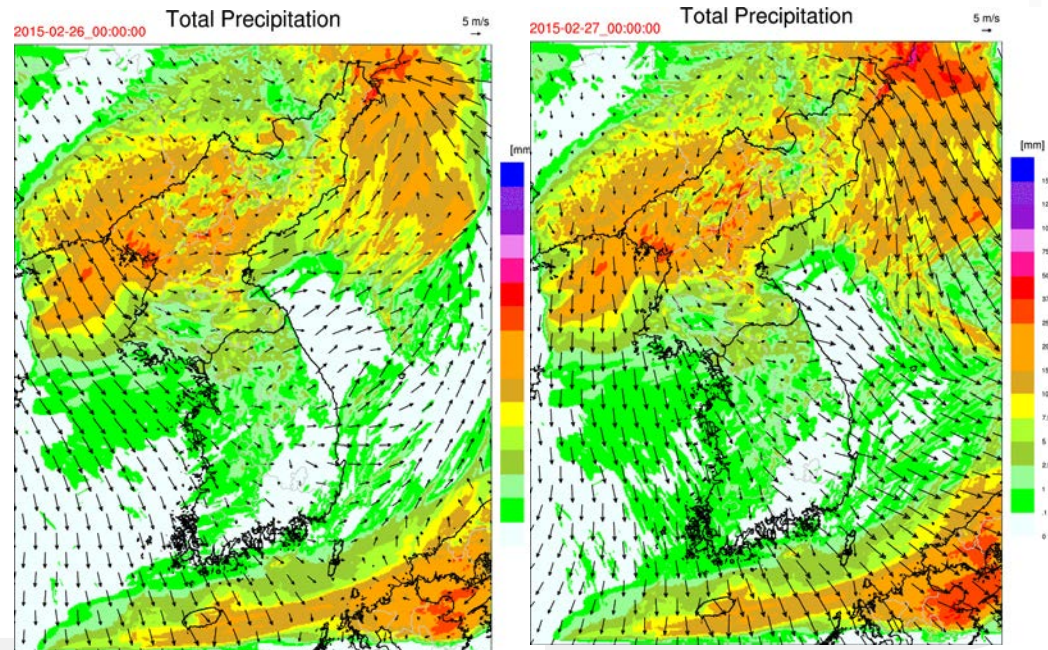
- **Collects Meteorological Information**

- Automatic weather stations in each NPP site
- AWS weather information every 10 minutes from KMA (about 600 site)
- Numerical Weather Prediction data every 6 hours from KMA (horizontal res. 25, 12, 1.5km)



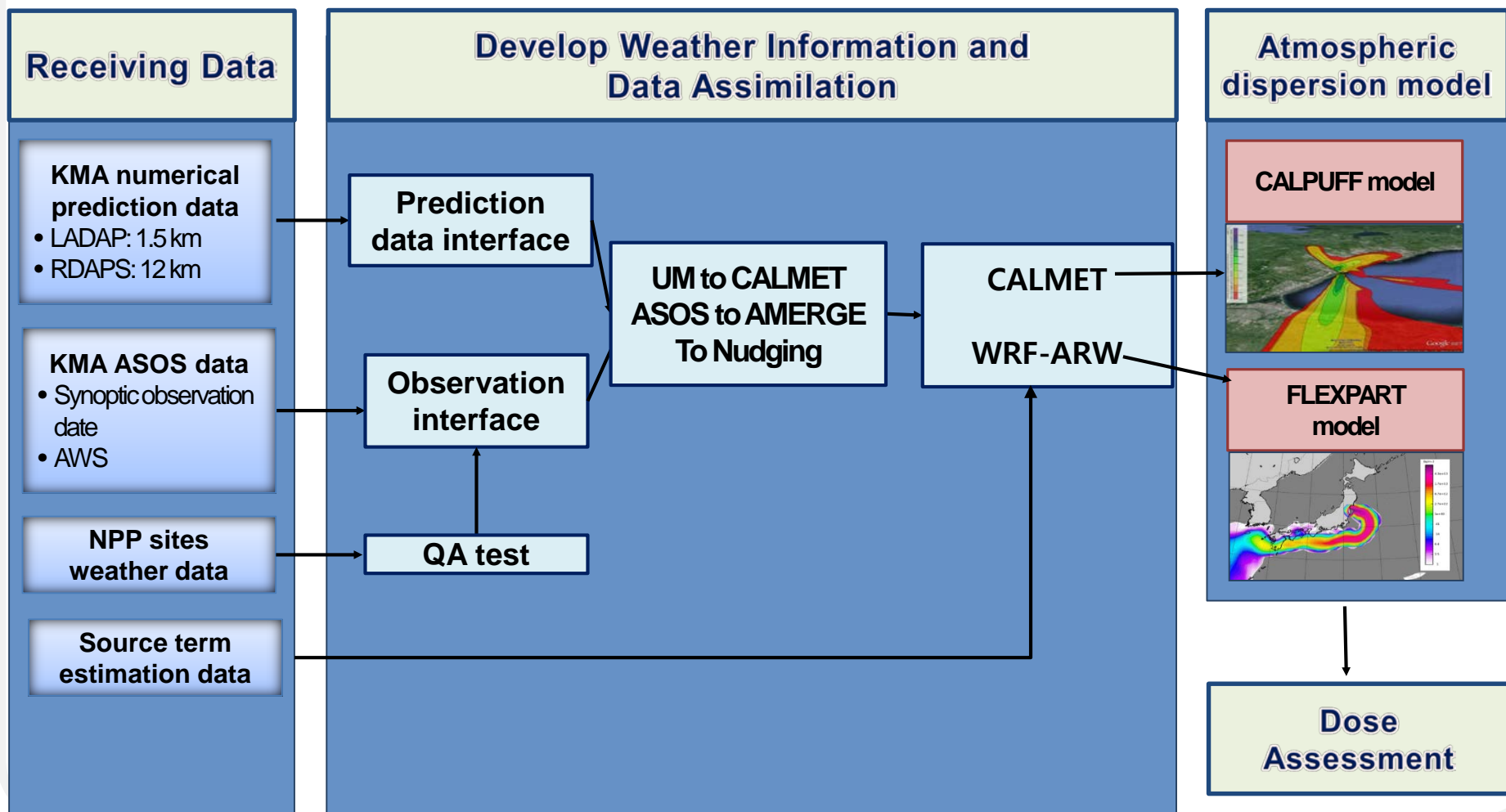
- **Generates 3-D Wind Fields**

- Altitudinal Range: 50 ~ 1500 m
- Numerical Weather Prediction Data from KMA



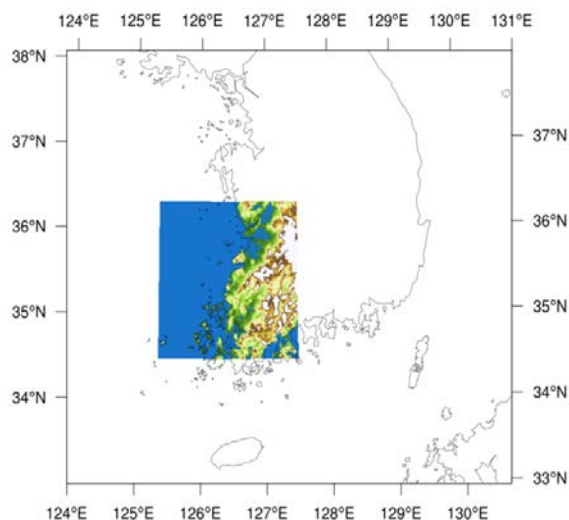
# Accident Dose Assessment MOdeling System (ADAMO)

## ● ADAMO Module

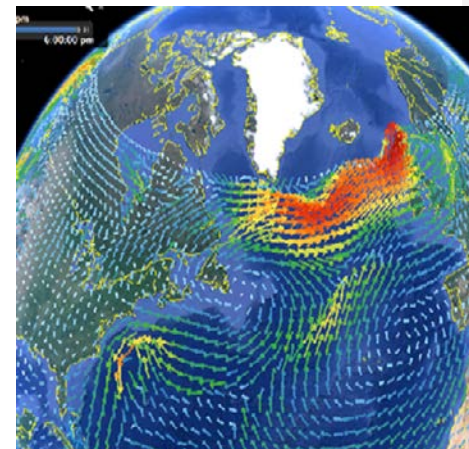


# Results of ADAMO

## CALPUFF – Preprocess



## FLEXPART – Preprocess



content

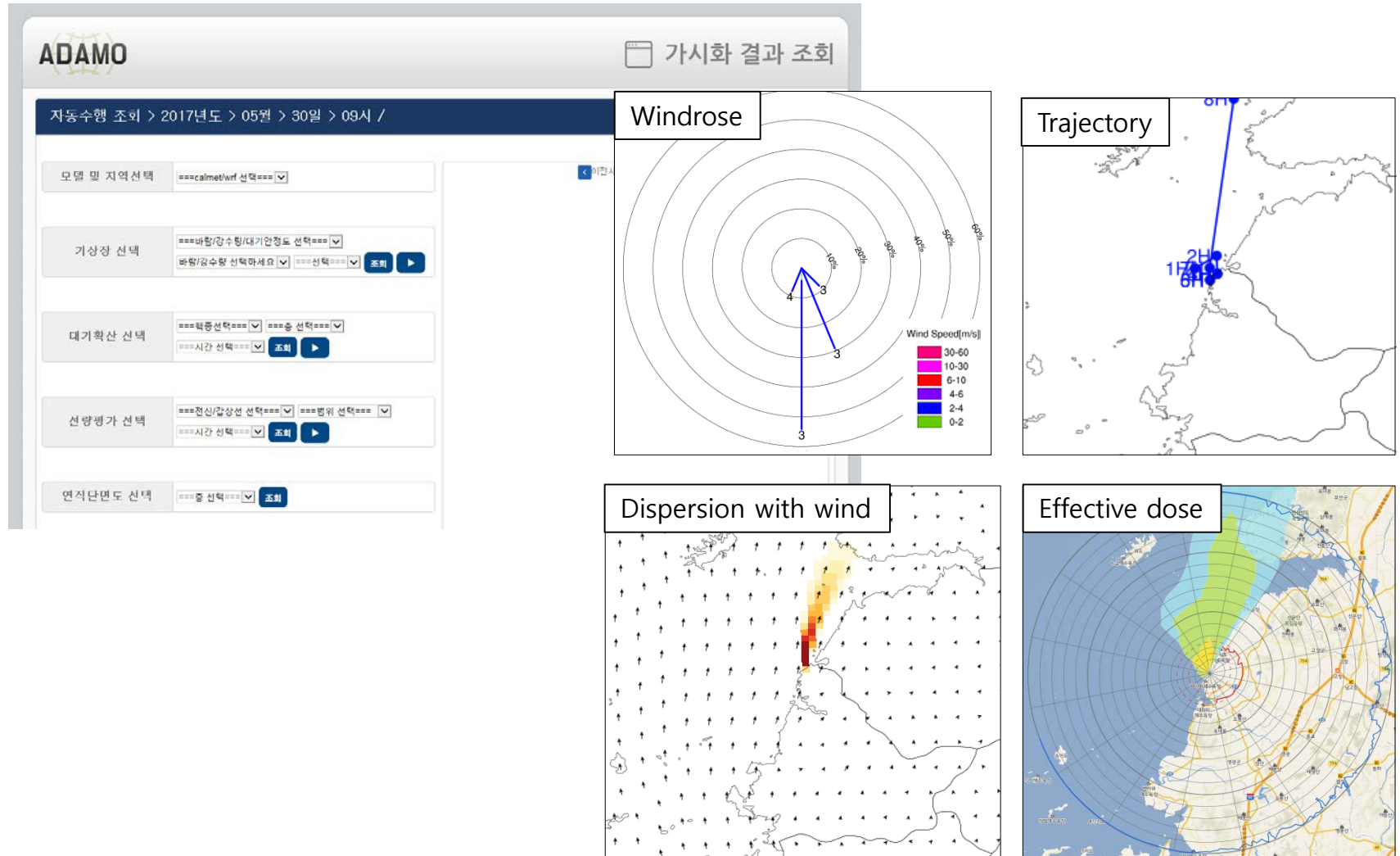
Map projection	UTM (Universal Transverse Mercator Grid)
location	50 km from NPP site
Horizon resolution	1km (101 × 101)
Vertical layer	0, 20, 40, 80, 160, 300, 600, 1000, 1500, 2200, 3000m

content

projection	Lambert Conformal Conic projection
location	127.6E, 38.0N (Korea, Global)
Horizon resolution	2 km (450 × 575)
Vertical layer	28 layers, model top = 100mb

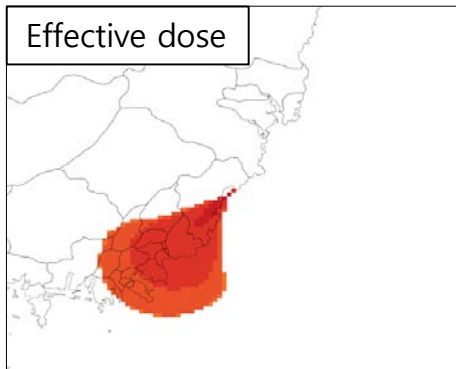
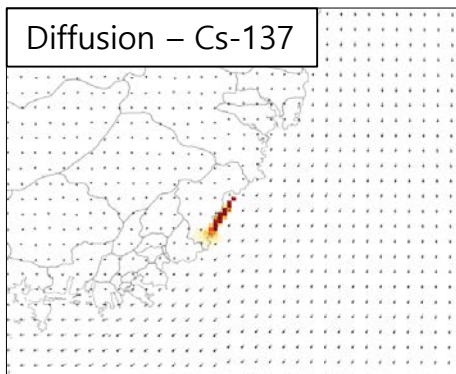


# Visualization (Web) of ADAMO

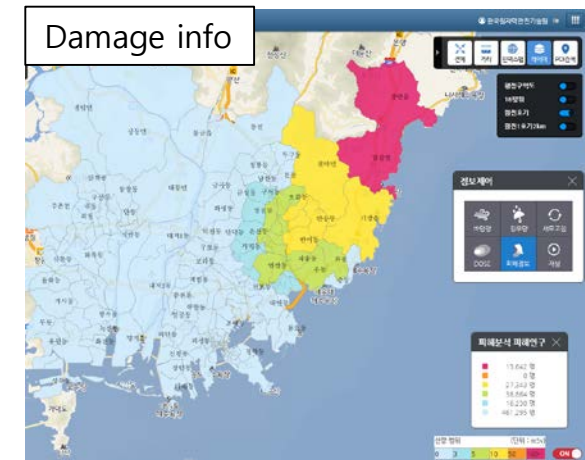
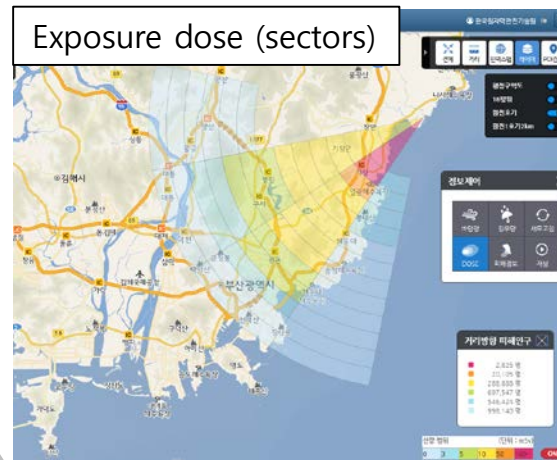


# ADAMO to GIS (Geographic Information System)

ADAMO output



GIS output



Exposure dose (locations)

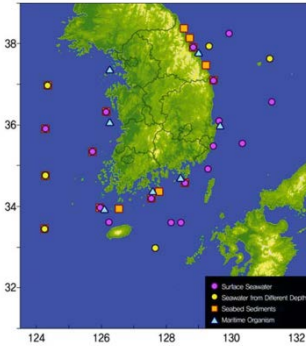
수준	읍면동	인구수(명)	전량	단위	대상	성인	지점명	피폭선량	위치
100초과	일광면	1,097	9,792	mSv	음연동		1	부산광역시강서구청	0.4085
	장안읍	8,695					2	부산광역시금정구청	3.358
	기장읍	5,485					3	부산광역시기장구청	13.381
	반송동	1,070					4	부산광역시남구청	1.465
10초과 50이하	반여동	3,210	18,433				5	부산광역시동구청	0.7843
	석대동	2,140					6	부산광역시동래구청	4.3903
	철마면	3,291					7	부산광역시부산전구청	1.846
	회동동	3,237					8	부산광역시북구청	0.5899



# Environmental Radiation Monitoring (IERNET)

- **Collects Environmental Radiation Levels (National Wide & Marine)**

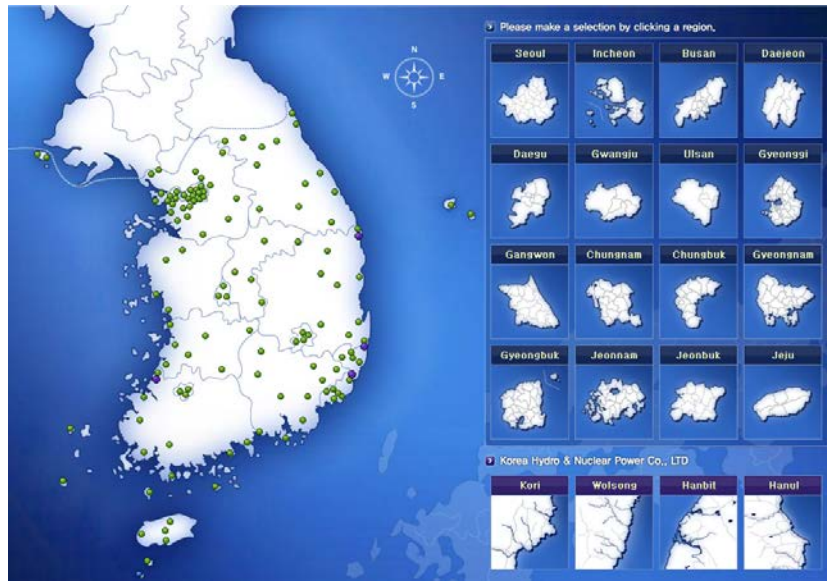
- Real time monitoring of nationwide environmental radiation levels
- 1 Central Monitoring Station / 14 Regional Monitoring Stations (CAMSNet)
- Total 172 Monitoring Posts (by Dec. 2018)
- 3 Xenon Monitoring Station  
(meteorological monitoring posts, remote islands, army bases)
- Monitoring Data of all NPPs are provided public by IERNET



- **Detects any Abnormal Variations in Environmental Radiation Levels**

- **Open to public using web & mobile phone application**

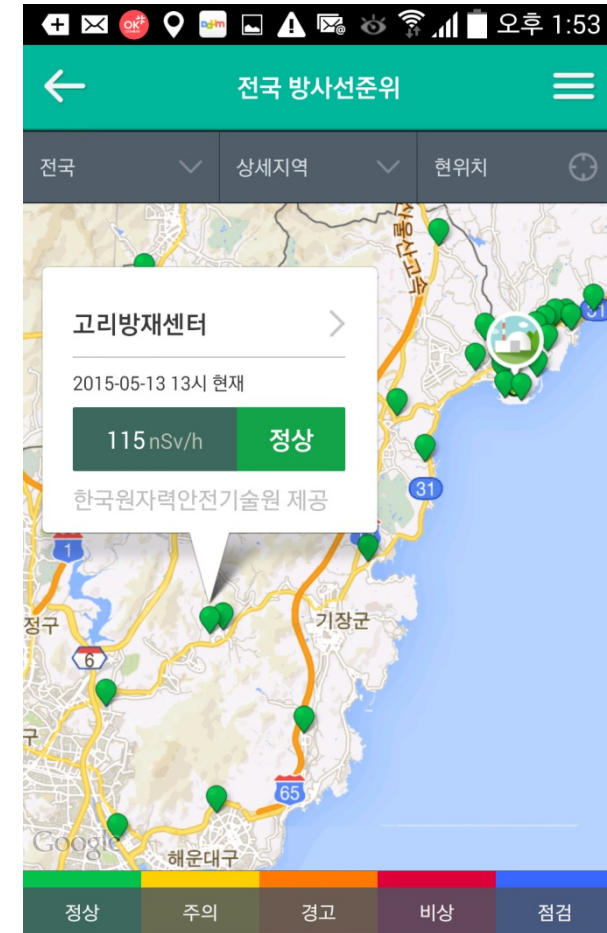
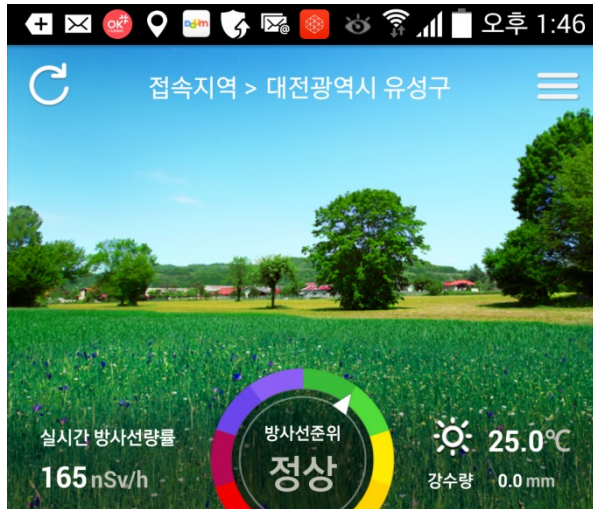
<http://IERNet.kins.re.kr/>





# Environmental Radiation Monitoring

- Environmental monitoring Information open to mobile phone application
- eRAD@NOW2



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# Joint Radiological Environmental Monitoring

Aerial Survey



Radioactive Airborne  
Dust Sampling



Marine Survey



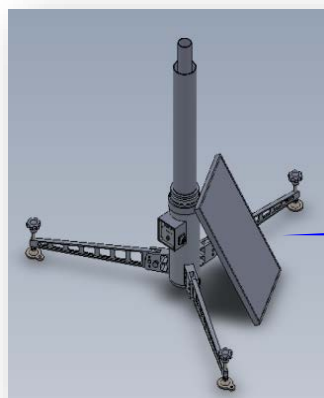
Car-borne Survey



Data/location  
transmission



Data/location  
transmission



**SIREN**

**System for Identifying Radiation in  
Environments Nationwide**



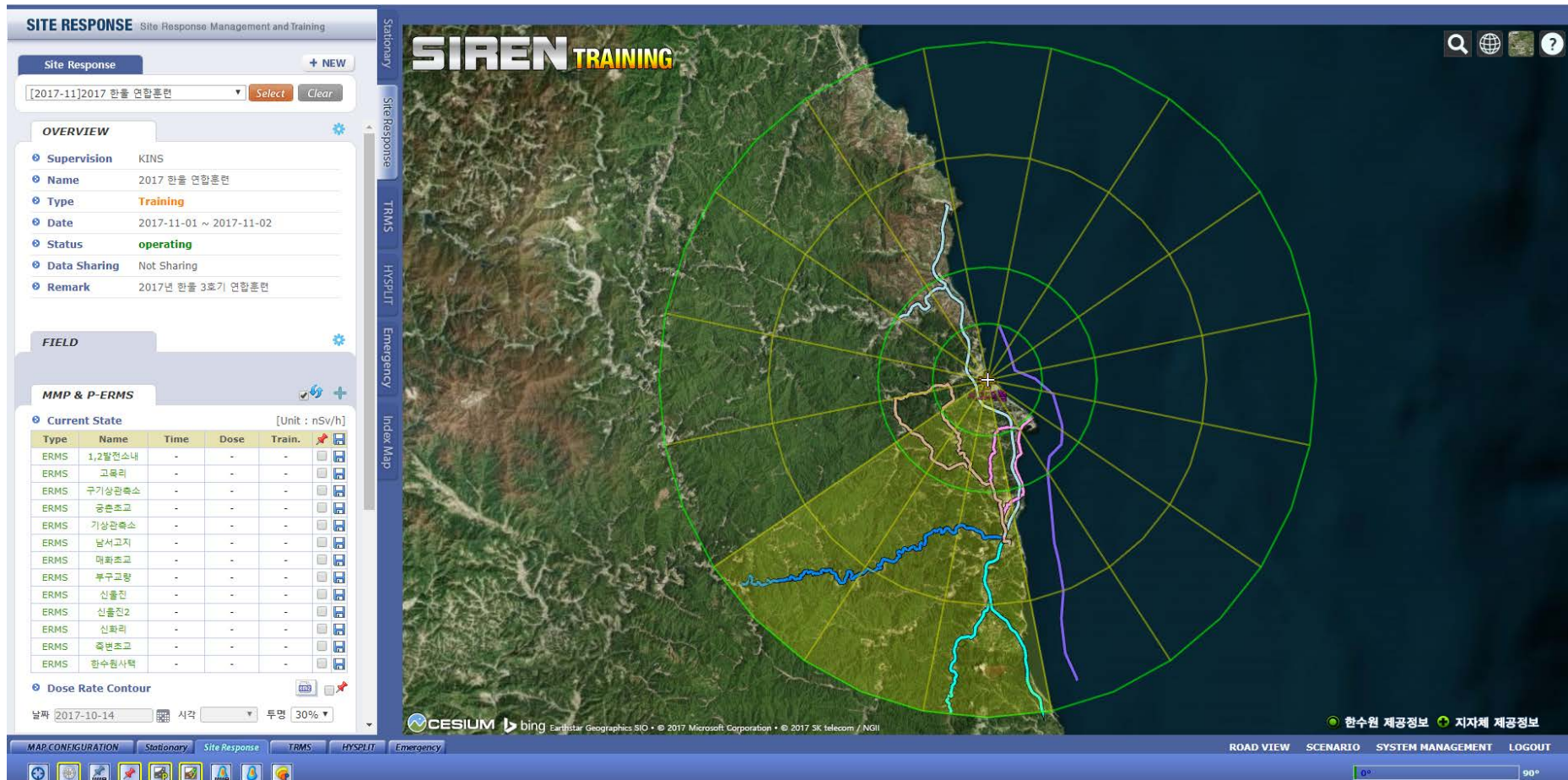
In Situ Gamma Spectroscopy

Mobile Monitoring Post

National Wide Systems (IRENet)

# Overview of Joint Radiological Emergency Monitoring Center Activities

- Monitoring area: within a radius of 25-30 km from NPP (UPZ)
- 3 Sectors of wind direction

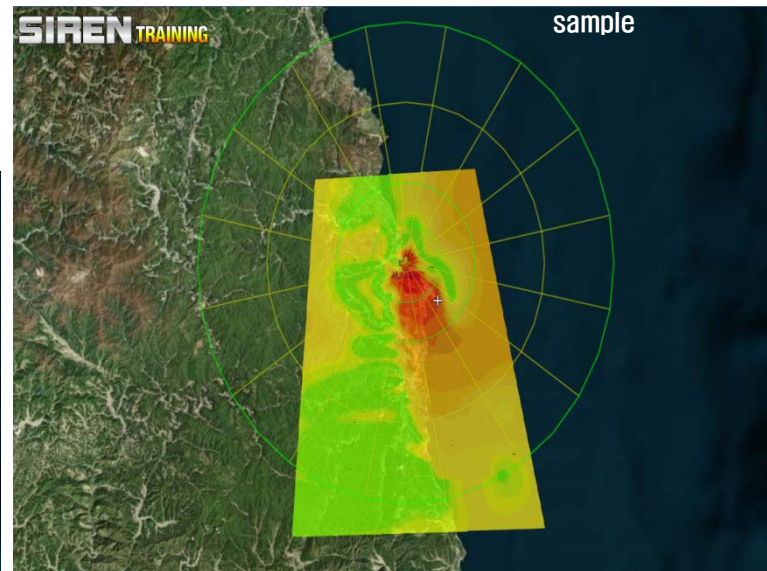
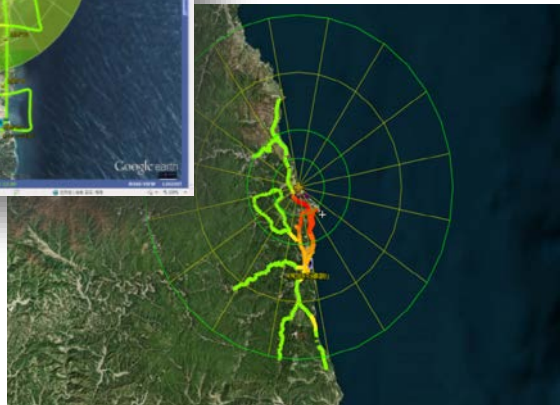
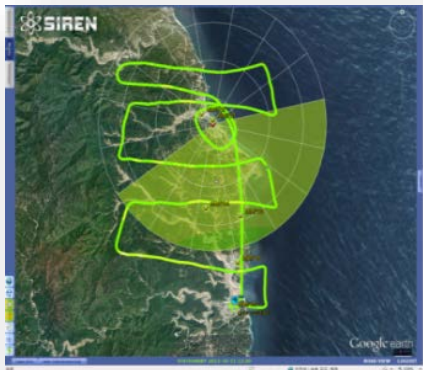




# SIREN for Radiation Monitoring Plan

## ● Monitoring route design : m-Siren

- Monitoring area: depended on the extent of leakage of radioactive materials
- Survey route design: by SIREN
- Data collection: real-time data collection and send to SIREN via CDMA
- Final result : **Radiation Contour map** → **Decision maker**





Thank you for your  
attention