Software platforms for Collecting, Managing and Providing Monitoring Data for Food and Agricultural Products

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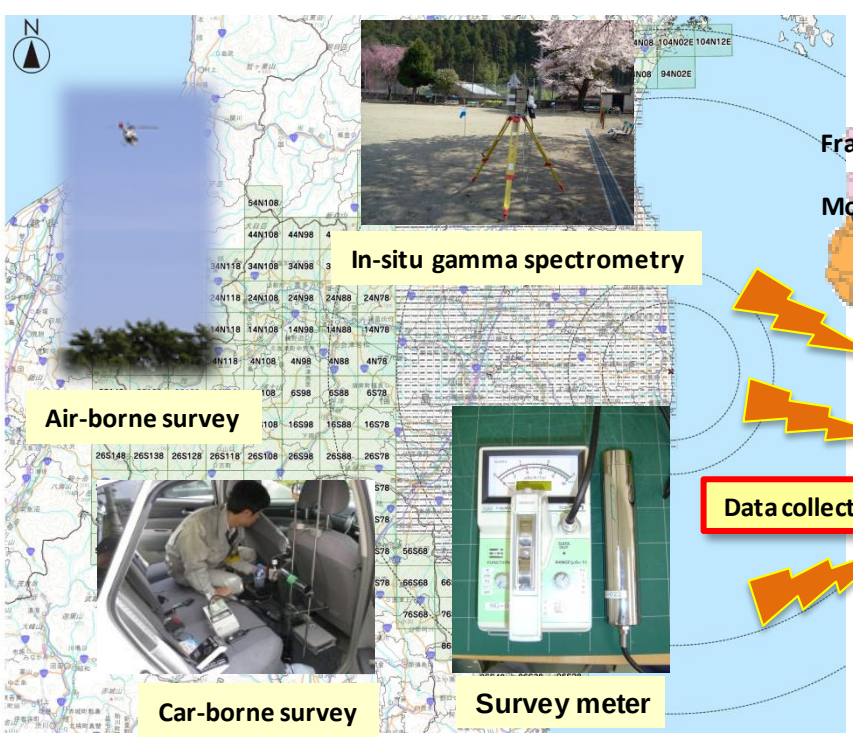
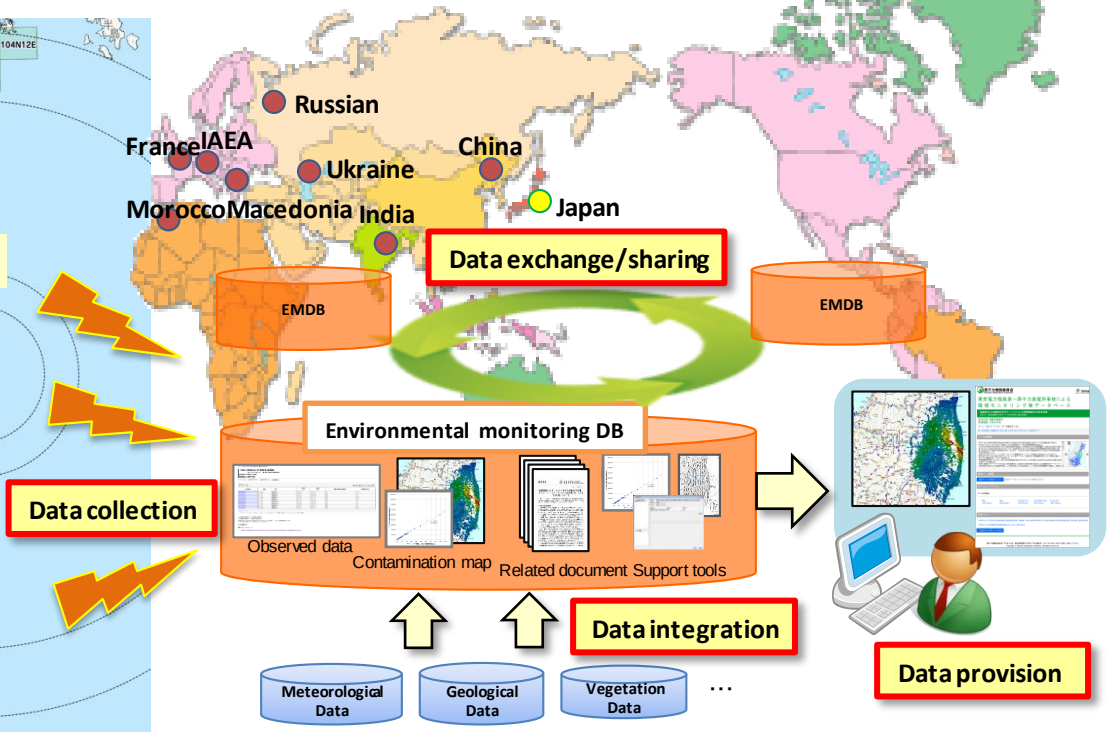
introduction

- JAEA has been developing 3 kinds of software systems for collecting, managing and providing environmental monitoring data
  - Started just after the Fukushima accident (2011～)
  - Part of the project were supported by;
    - National government: MEXT, NSR
    - Local government: Fukushima prefecture
    - International organization: IAEA (CRP "Response to Nuclear Emergencies Affecting Food and Agriculture")
  - Goal
    - Enabling to provide timely and reliable information on the distribution of radioactive materials to government, residents and researchers
- Considering "what are important for constructing software systems for collecting, managing, and providing monitoring data" from the viewpoint of information science.



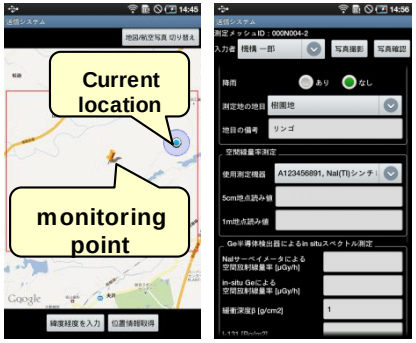


Data collection system for field survey

- Tablet-based data collection system
  - Collecting field survey data rapidly and efficiently
  - Avoiding human errors to keep data reliability
- Features
  - Navigating workers to a measuring point using GPS
  - Immediate data sending to a base camp through mobile network
  - Checking data on the spot by comparing the result with data measured on the near-by points or past records on the same point
- Operation experience
  - Used in field surveys within 80 km around FDNPP
    - Dozen of teams distributed over 9 prefecture
    - Measuring dose rate and concentration at ～1,000 points

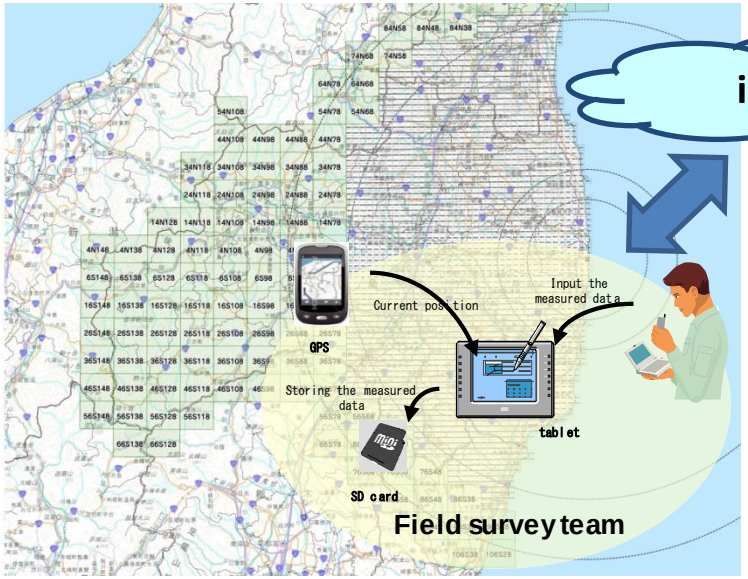
Printed map

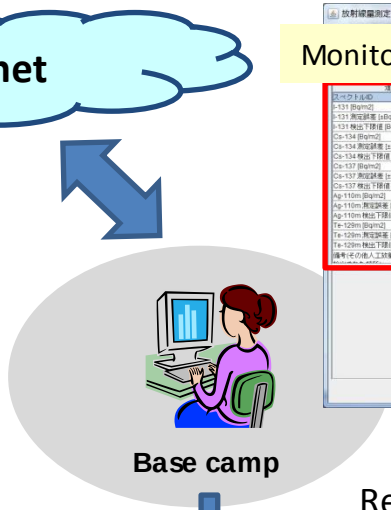
Data sheet

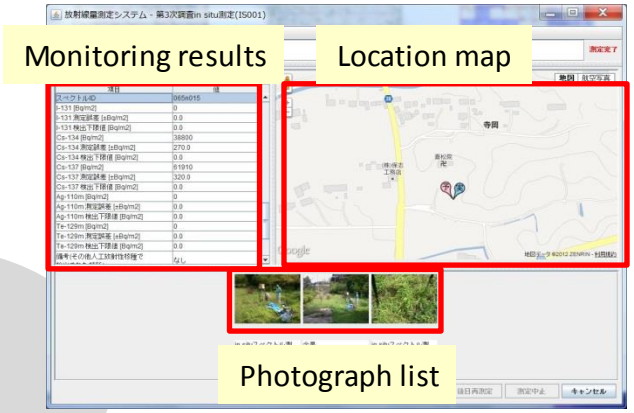


Navigation window

Data input window







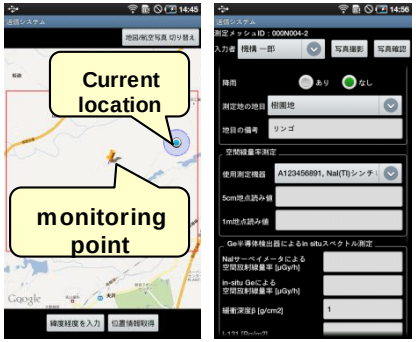
data validation tool

Registering monitoring data to a data management system

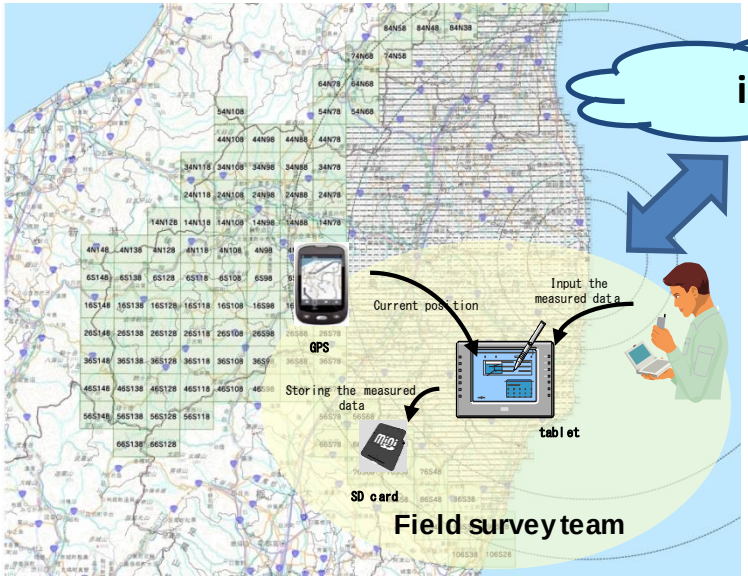
Lessons learned from the experience

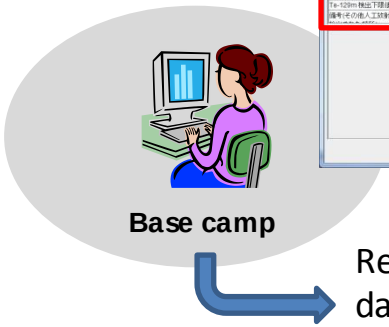
- Collection efficiency is drastically improved
  - 3 man-months work after the survey was needed to digitalize and validate the data
  - Data collection is finished with the field survey
- Data reliability is also improved
  - Automatic recording of survey data reduces human errors
    - Location, sampling time, photographs…
  - Data validation by both sides (field workers and base camp) on the spot is also effective to find errors as well as to reduce the cost of re-measuring

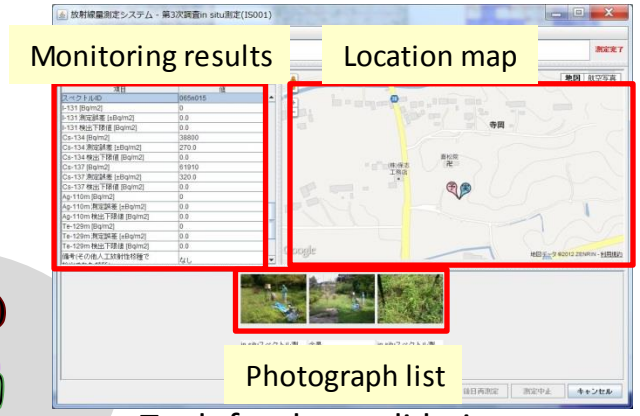
Printed map　　Data sheet



Navigation window　　Data input window





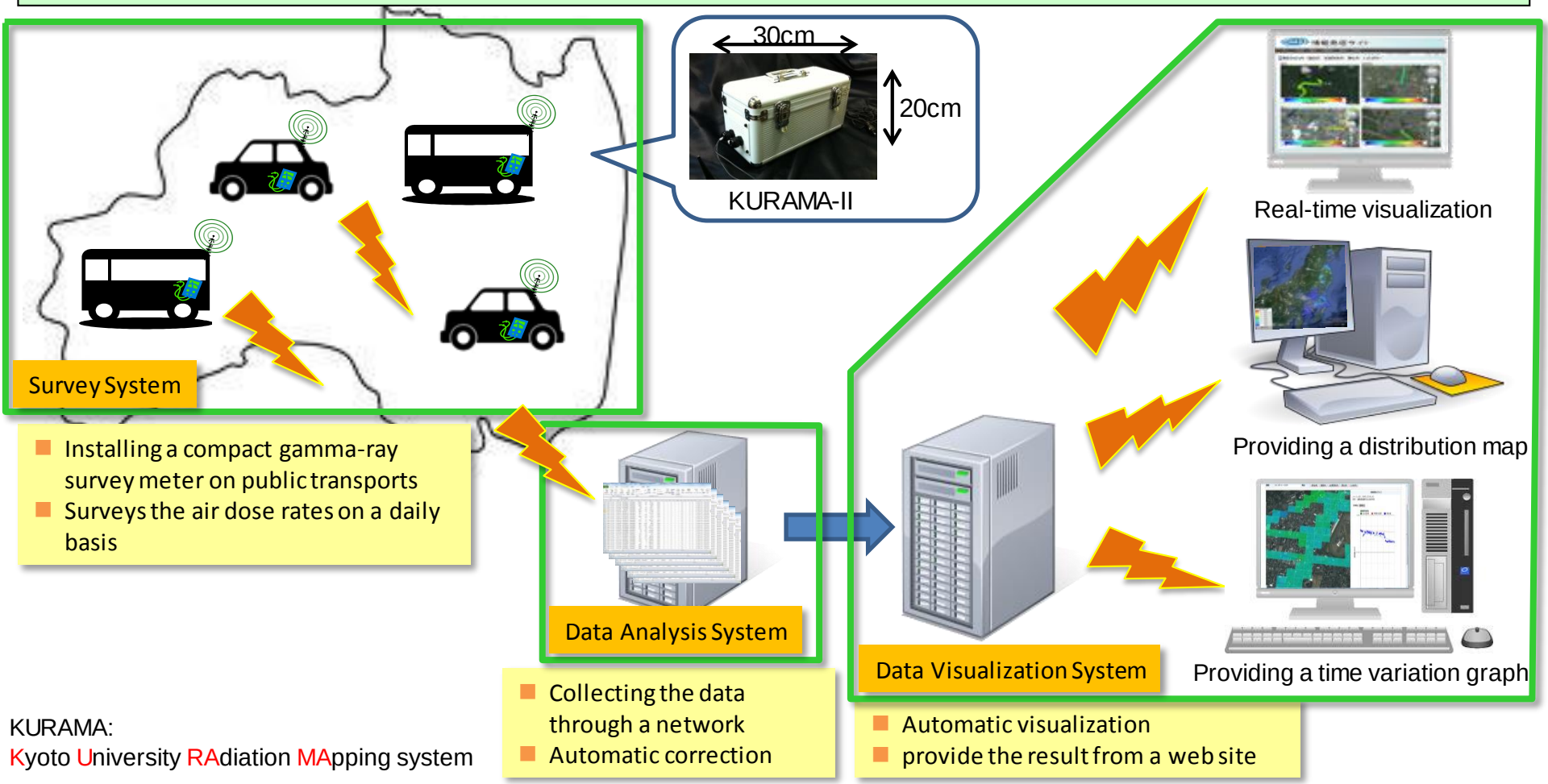


Tools for data validation

Registering monitoring data to a data management system

Real-time visualization system for car-borne survey

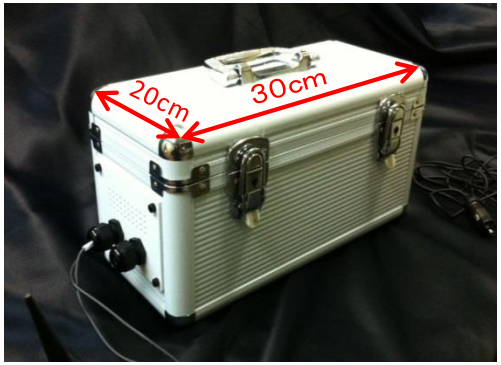
- Goals
  - Providing visualized information on the distribution of air dose rates in Fukushima in a real-time fashion.
- Features
  - Installing a compact gamma-ray survey system on totally ~60 cars and buses
  - Survey data are collected, analyzed, and visualized automatically



KURAMA:
Kyoto University RAdiation MApping system

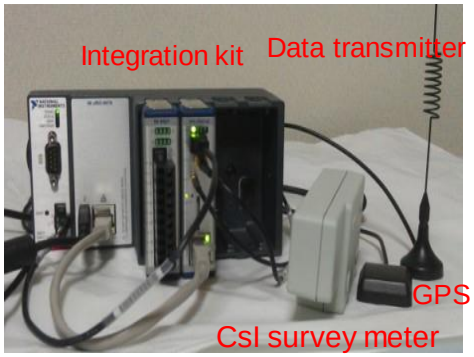
KURAMA-II (Kyoto University Radiation MApping system)

- Portable gamma-ray survey system
  - Developed by Kyoto University
  - Adopting a CsI survey meter
- Features
  - Compact, light-weight, and robust
    - Survey meter, GPS system, and network adaptor are integrated and stored in one box
    - Robust against network trouble as well as physical impact
  - Easy operation
    - Designed to be operated by Non-specialists (e.g. bus drivers)
    - On/off the power switch -> automatically start/terminate to measure the air dose rate
  - Automatic data collection
    - Monitoring data is automatically sent to a server through a cellular phone network



KURAMA-II (outside)


KURAMA-II (inside)

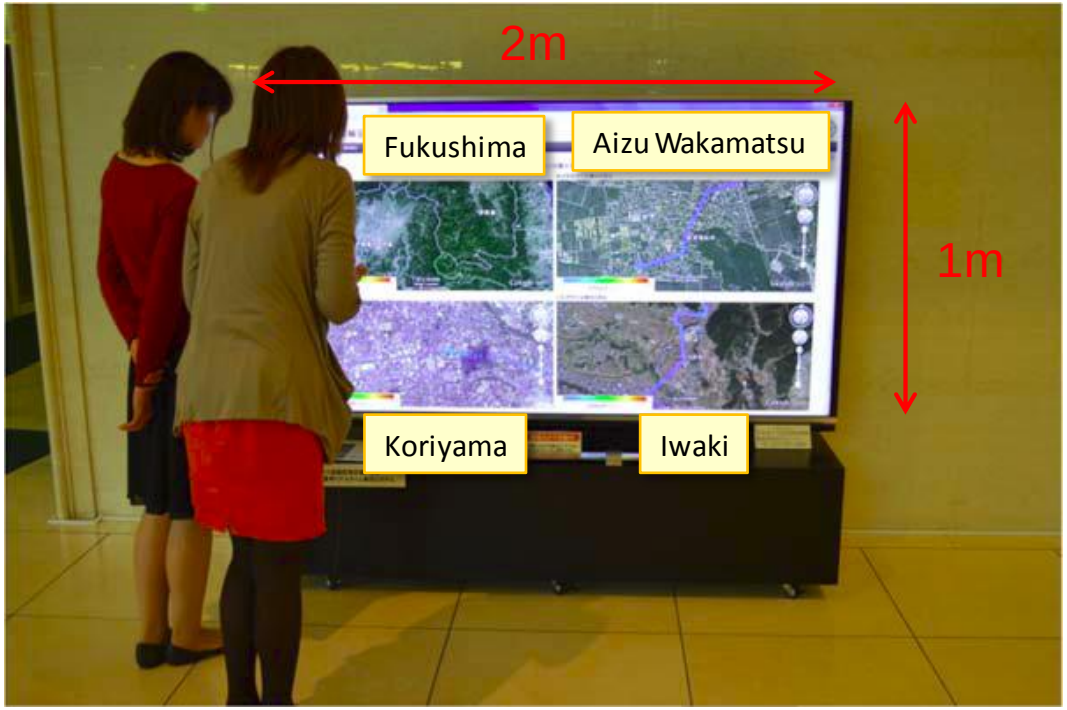


KURAMA-II system

Compact CsI survey meter

Real time visualization system

- Monitoring results are analyzed, visualized and displayed on a wide screen in Fukushima office of JAEA in a real-time fashion

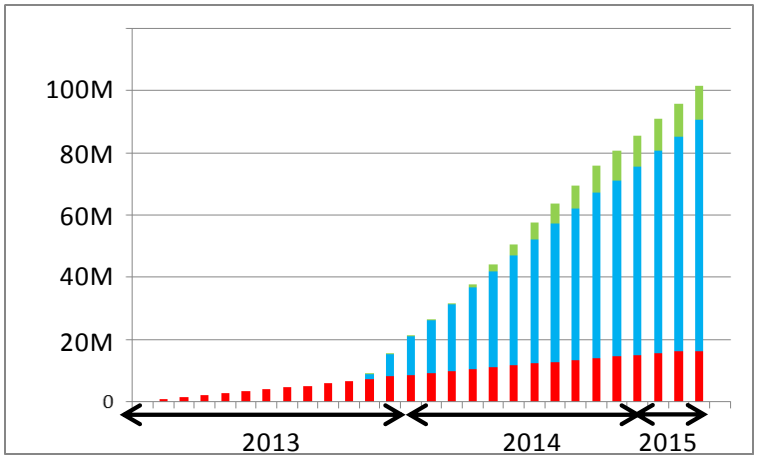


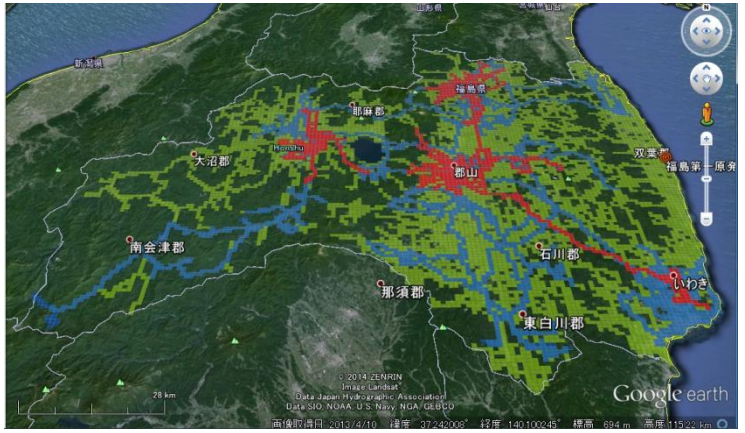
Real-time visualization system

JAEA Fukushima Office
(in front of Fukushima station)

Operation History

- Operation Test from Jan. 2013
  - Installing a KURAMA on 4 route buses in Fukushima, Koriyama, Aizu Wakamatsu, and Iwaki cities respectively
  - The number of data amounts to 16M points
- Operation start from Nov. 2013
  - The number of route buses has increased up to 32.
  - Target areas were extended to southern and north-east areas of Fukushima pref.
  - The number of data amounts to 74M points
- Full scale operation from Apr. 2014
  - KURAMA was installed also on official vehicles of Fukushima local government
  - Target areas were extended to all of cities, towns, and villages in Fukushima Pref.
  - The number of data amounts to 11M points



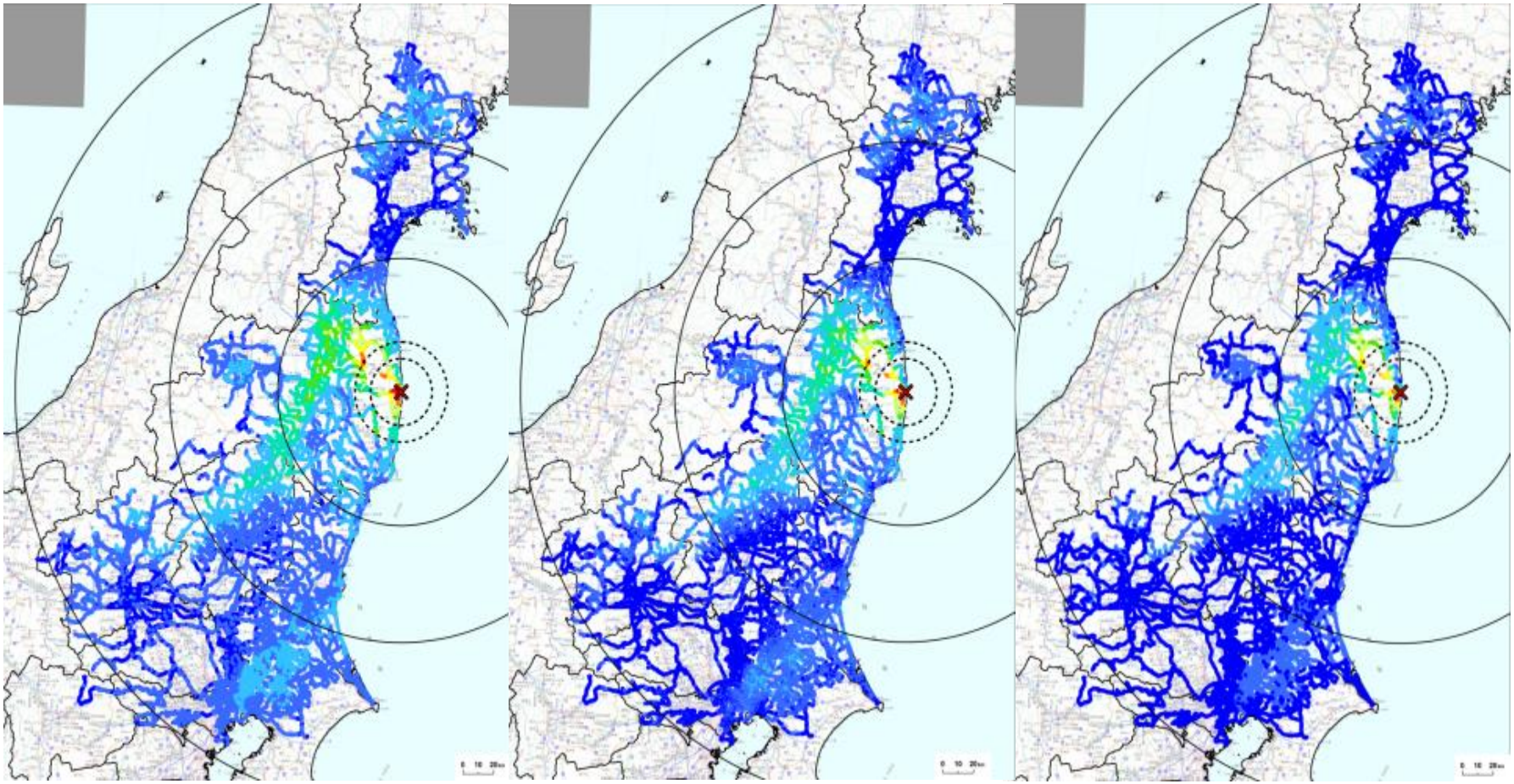


- Our system could process monitoring data from as much as ~60 vehicles and provide visualized result in real-time fashion
- Special care should be required in visualizing a lot of data using a GIS system

Visualizing a lot of data on a display

- Visualizing the data more than the resolution limit of the display is harmful
  - Long processing time prevents users from interactive analysis
  - Results change machine by machine depending on graphics hardware

LOD (Level Of Detail) control is important



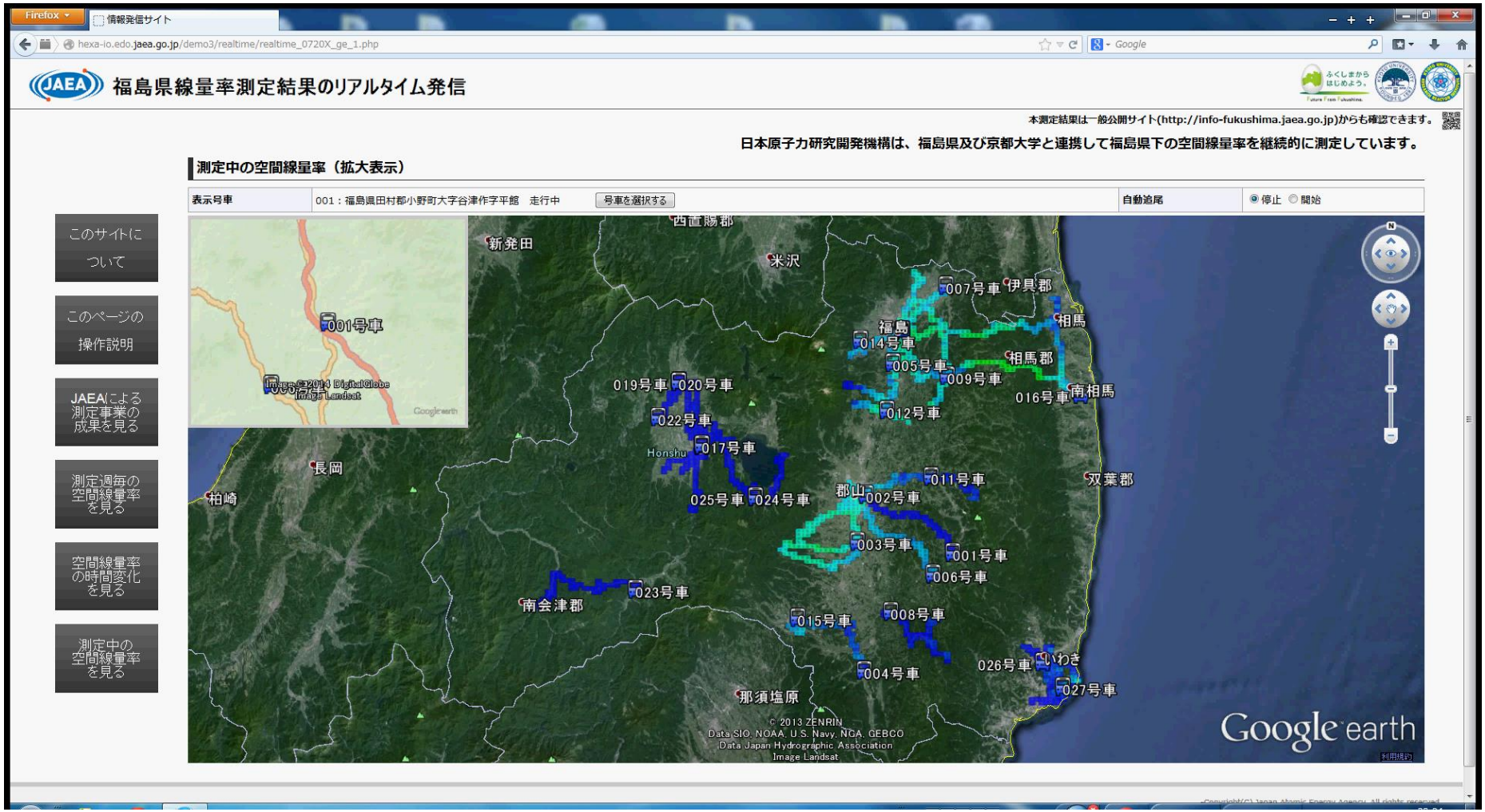
High priority for high value

No control

High priority for low value

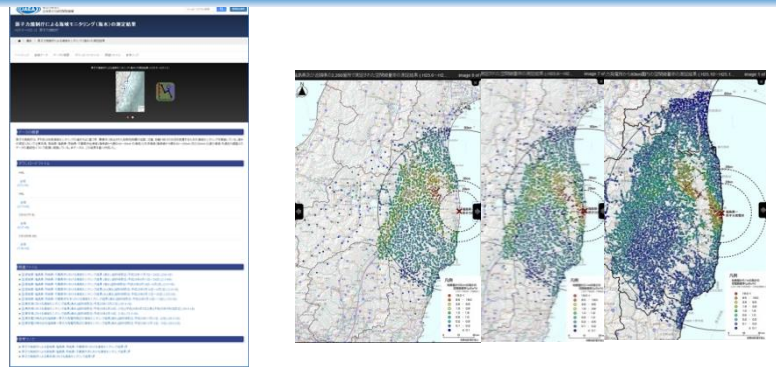
An example of LOD control

- Controlling a resolution of information according to the display area
  - 1km^2 Mesh (entire region) -> 500 m^2 Mesh (city level) -> 100 m^2 Mesh (town level) -> point data

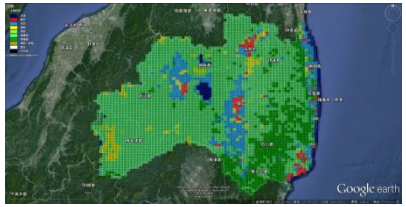


Environmental monitoring DB

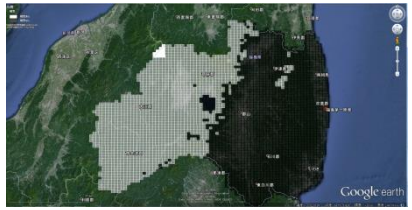
- Web-based environmental monitoring DB
  - Integrating monitoring results individually measured by governments, local governments, research organizations, TEPCO and so on.
  - Providing monitoring information in a common XML based data format, “EMML”
- Features
  - Providing maps and graphs to help intuitive understanding of a spatial and temporal distribution
  - Providing meteorological and geological data on Fukushima
  - Providing Data analysis tools conformant to EMML to assist analysis of our monitoring data
- Operation experience
  - Operation has been started since Feb. 2015 (http://emdb.jaea.go.jp)
  - Data on the DB
    - Air Dose Rate: 416M records
    - Land water: 33K records
    - Soil: 14M records
    - Food: 153K records
    - Dust: 20K records
    - Marine: 20K records



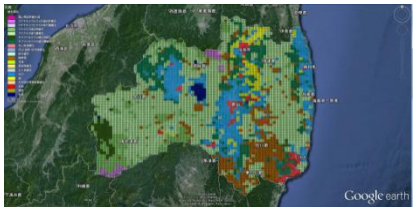
GUIs of environmental monitoring DB



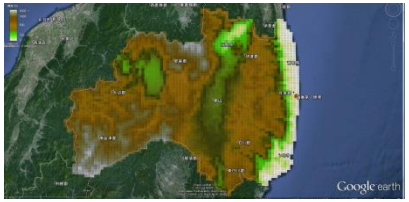
Land use map



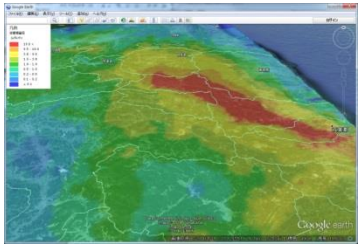
Weather map (fallen snow)



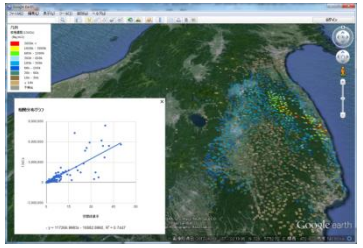
Vegetation map



Elevation map



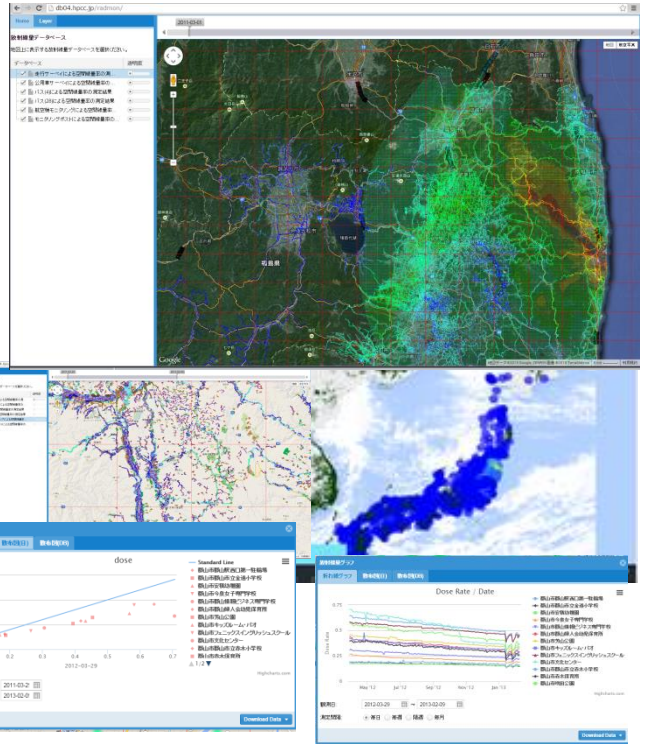
Interpolation tool

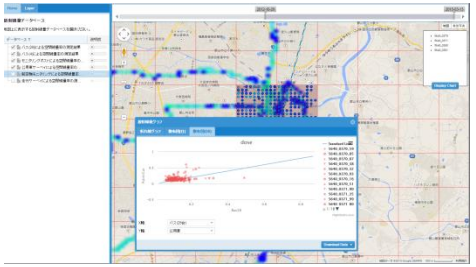


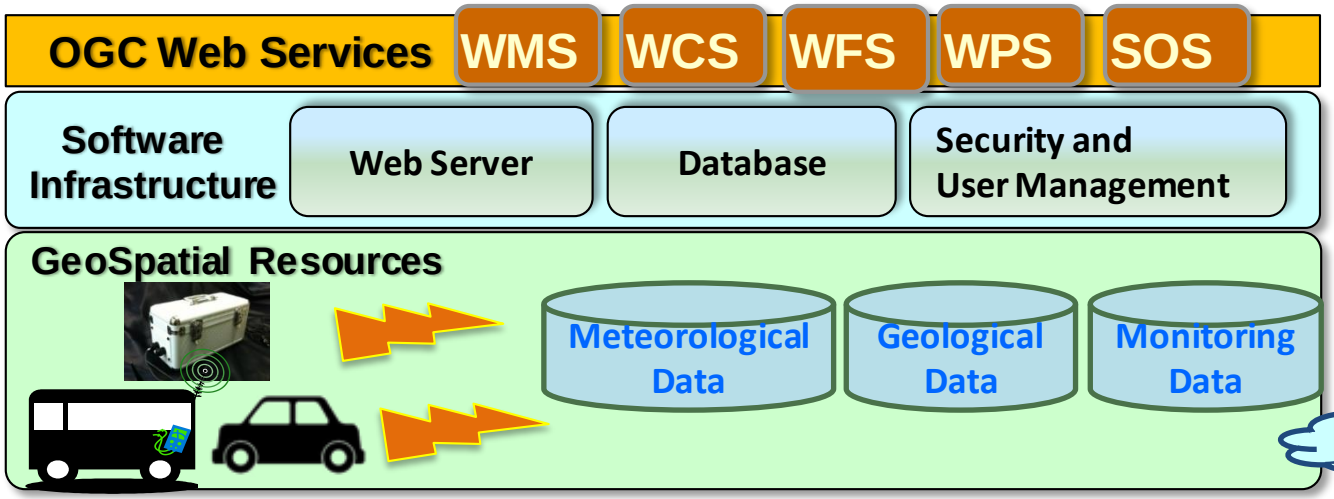
Correlation analysis tool

Standard-based approach (1)

- Using OGC Web Services for providing dynamic and flexible monitoring information
  - OGC: Open Geospatial Consortium
- Proto-typing a Web Service based monitoring DB
  - Goal
    - Evaluating applicability and usability of OGC web services
- Lessons learned
  - Rapid proto-typing was possible, by interconnecting standard(OGC)-based web services, tools and data resources.
  - Performance is the bottle-neck for manipulating "Big" monitoring data interactively.



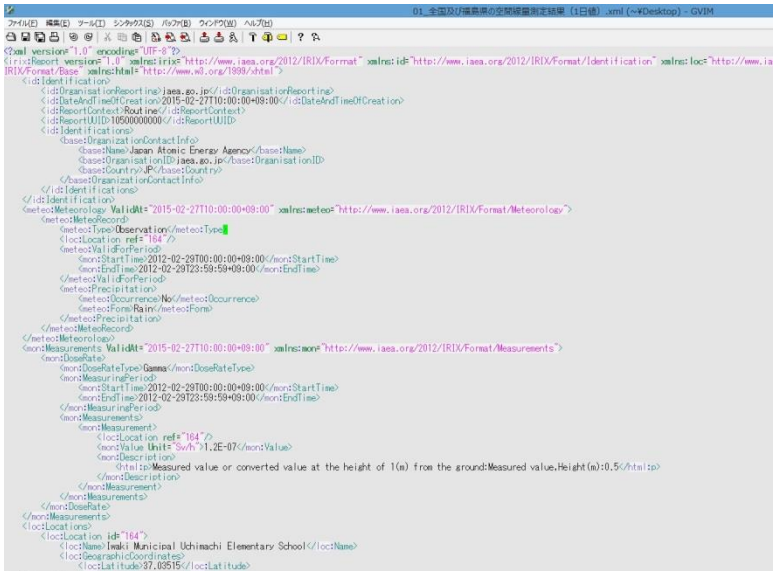




Standard-based approach (2)

- Using IRIX for monitoring data
  - IRIX: International Radiological Information Exchange Standard
    XML-based data format

- Applied the format for monitoring data of Fukushima accident
  - Goal
    - Studying flexibility and applicability of IRIX to our monitoring data
    - Enabling international data exchange and sharing
  - Target data
    - Air dose rate (6 survey results)
    - Food (1 survey result)
    - Soil (2 survey results)
    - Marine soil(1 survey results)
    - Seawater (1 survey result)



- Lessons learned
  - Most of data could be easily expressed successfully, but some data could not…
  - Ex. Car-borne survey data
    - Large numbers of monitoring data: ~ 1,000,000 data/day
      - Impractical to express each data by the XML format
      - No way to express area-averaged dose rate value
  - Meta-data should be needed to know what data is available on what database