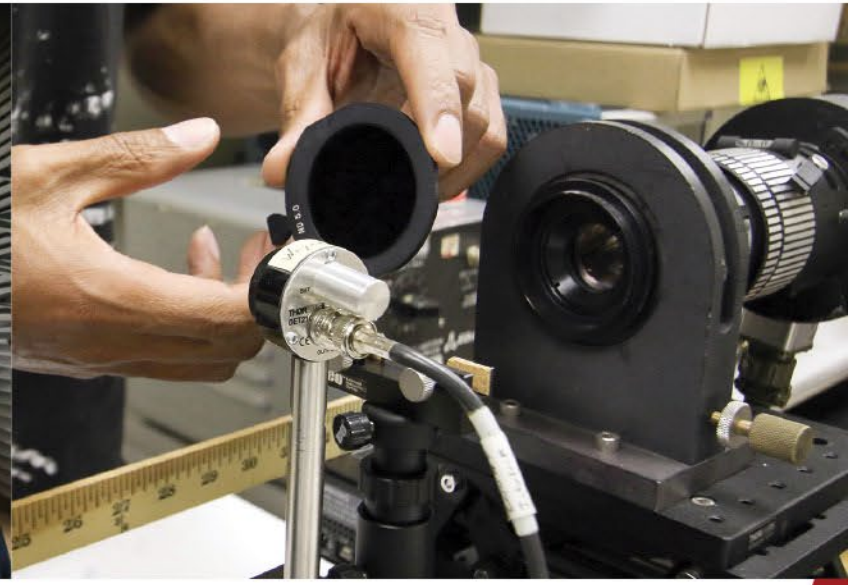
Workshop on the Implementation of the International Radiation Monitoring Information System (IRMIS)



IRMIS– a versatile EPR tool for all member states

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This work was done by Mission Support and Test Services, LLC, under Contract No. DE-NA0003624 with the U.S. Department of Energy, and the National Nuclear Security Administration.
DOE/NV/03624--1800

The Nevada National Security Site is managed and operated by MSTS under contract number DE-NA0003624.

IRMIS– a Versatile EPR Tool for all Member States

NEVADA NATIONAL NNSS SECURITY SITE

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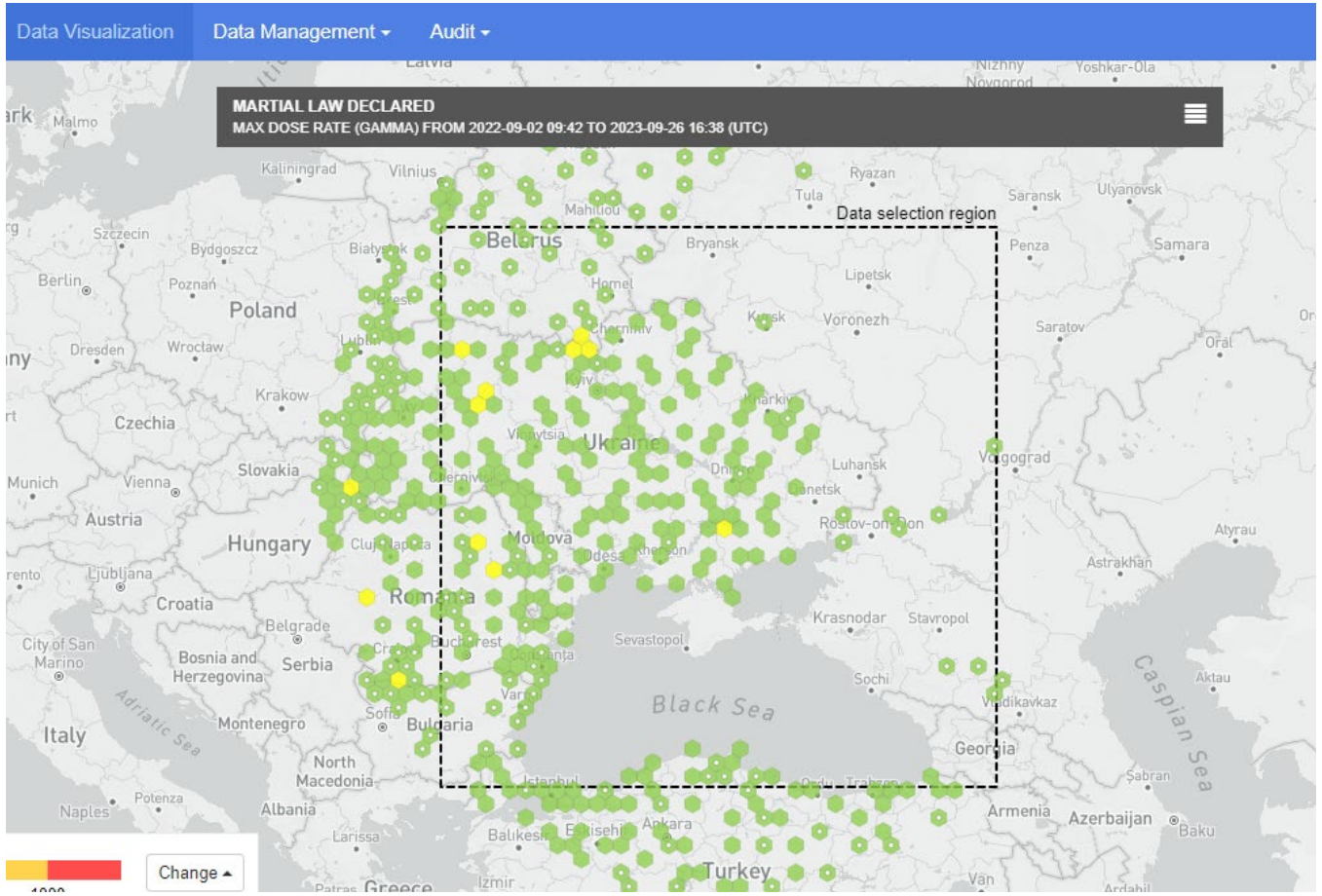


Now More than Ever IRMIS is Playing a Global Role in Networked Radiation Monitoring

A satellite image showed fires burning near the Russian occupied Zaporizhzhia nuclear power plant in Ukraine in August.
Credit...European Union, Copernicus Sentinel-2, via Reuters

Overview of IRMIS

IRMIS provides Competent Authorities, IEC, and other relevant International Organizations with a data sharing tool that helps to

- report and share information,
- evaluate radiation monitoring data to assess if the public is safe,
- identify protective actions,
- keep the public informed by Member State Competent Authority, and
- maintain transparency of data handling and processing.

IRMIS accessible to authorized users at https://iec.iaea.org/irmis

- IRMIS data types:
  - Routine data
  - Emergency data
- Both routine and emergency data can have ambient gamma dose rate, air concentration, and ground deposition data (for selected nuclides).

What's Under the Hood of IRMIS

- IRMIS uses two dedicated data collection server probes with IP addresses 161.5.6.0/24 and 161.5.0.0/24 to retrieve data from the Member State's storage server where IRMIS Data Reports are stored in an orderly file structure.
- For the migration of IRMIS data, the system uses Secure Shell (SSH) File Transfer Protocol (SFTP) to receive new data reports from the Member State's server.
- The SFTP uses encryption algorithms to securely move data to the server and keep files unreadable during the process, while authentication prevents unauthorized file access during the operation.
- The SFTP retrieval process runs in a Linux server. It is a script; this script is executed by CRON [a standard Unix utility that is used to schedule commands for automatic execution at specific intervals].
- It is a command line utility and connects to SFTP servers and synchronizes their content to a local folder, new files added to the local folder are submitted to the IRMIS uploader web site.

Caveats of IRMIS Data

1. Member States voluntarily provide radiation monitoring data – they have complete authority over the data.
2. IAEA data on IRMIS updated every hour on the Routine channel.
3. Member state can put their data at any intervals on their specific server – they can choose and pick data to be sent – it is voluntary.
4. For Emergency operations Member States may choose to send data at a higher frequency and IEC may decide to update that data at the same frequency – This will apply to a MARTIAL LAW DECLARED event created on IAEA-IEC's USIE site.
5. Realize IRMIS only cares about the HIGHEST dose rate at any particular interval – for example, a member state radiation monitoring station polls data every ten (10) minutes, so within a nominal one hour interval it will have six (6) dose rate data – for its hourly reporting the station will report only the highest dose rate encountered among the six data.

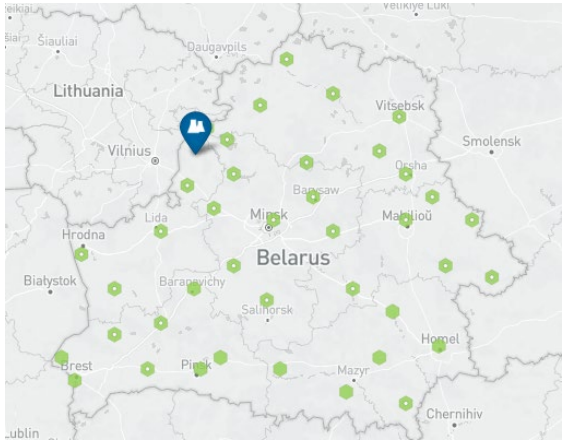
Types of IAEA/IRMIS Data Monitored for Situational Awareness

- Number of measurements from Belarus (40), Poland (57), Romania (35), Russian Federation (45) on a given day (totaling about 175 measurements)
- Number of measurements from the Chernobyl exclusion zone (a maximum of ~32 measurements usually on an hourly basis)

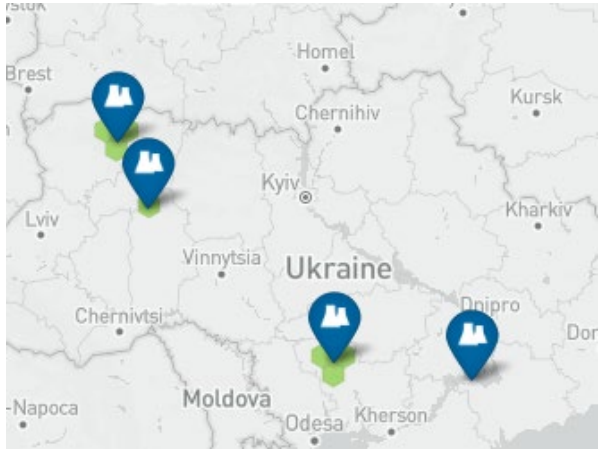
  Number of measurements from 11 exclusive sensors inside Chernobyl exclusion zone, but not counted in the 32 mentioned above)

- Number of measurements from around 4 NPPs in Ukraine (~52, some measurements are 0 μSv/h., which are discounted). Stopped receiving data from ZNPP quite some time – currently it is really ~40 sensors reporting from 4 NPP areas
- Country-wide Ukraine data from 145 sensors (not counted above)
- Overall deployed sensors accounted for ~228 within Ukraine, 175 surrounding Ukraine

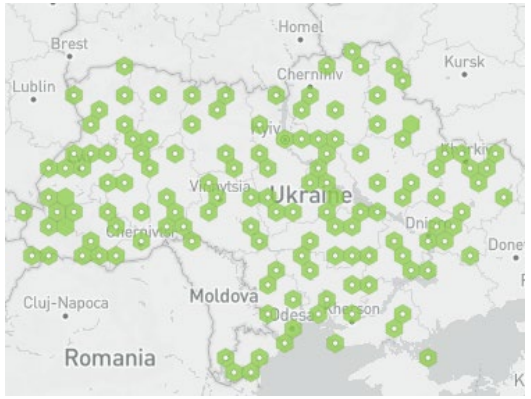
Data Visualization Monitored in/around Ukraine



Belarus



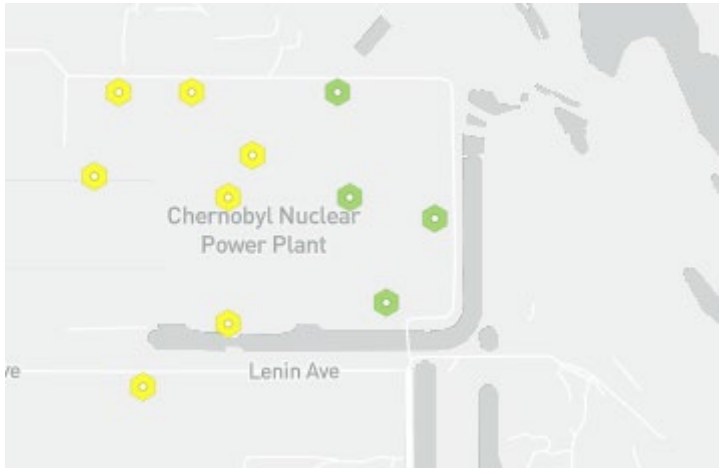
Ukraine NPP



Ukraine Country-wide

Romania

Poland



CherEZ (11) sensor data

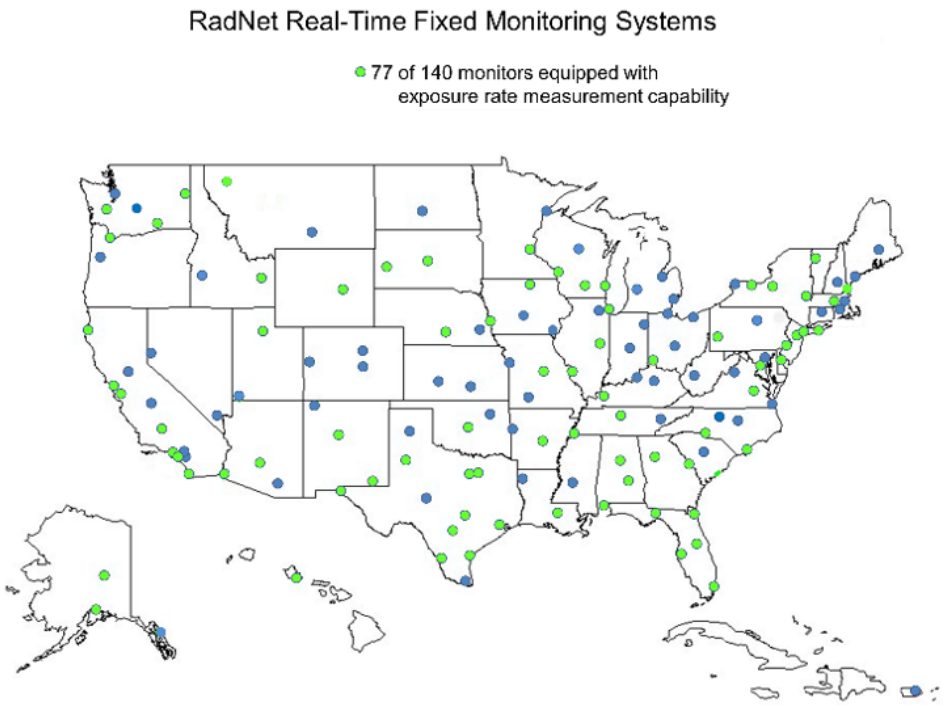
Russian Federation

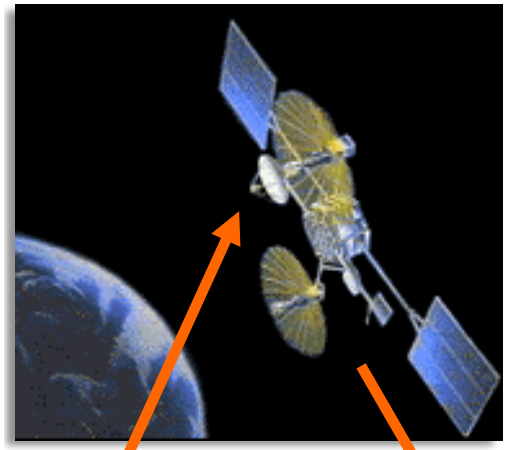
US National Perspective – EPA

RadNet Objectives

- Provide data for radiological emergency response assessments in support of homeland security and other responders to radiological incidents/accidents.
- Inform public officials and the general public of the impacts resulting from major radiological incidents/accidents and on ambient levels of radiation in the environment.
- Provide data on baseline levels of radiation in the environment.
- Measure large-scale atmospheric releases of radiation impacting large parts of the country and major population centers due to
  - nuclear weapon detonations,
  - radiological dispersal device incidents,
  - large nuclear facility incidents/accidents, and
  - large foreign radiological incidents/accidents.

RadNet Monitoring System Provides Data to IRMIS





Data Types

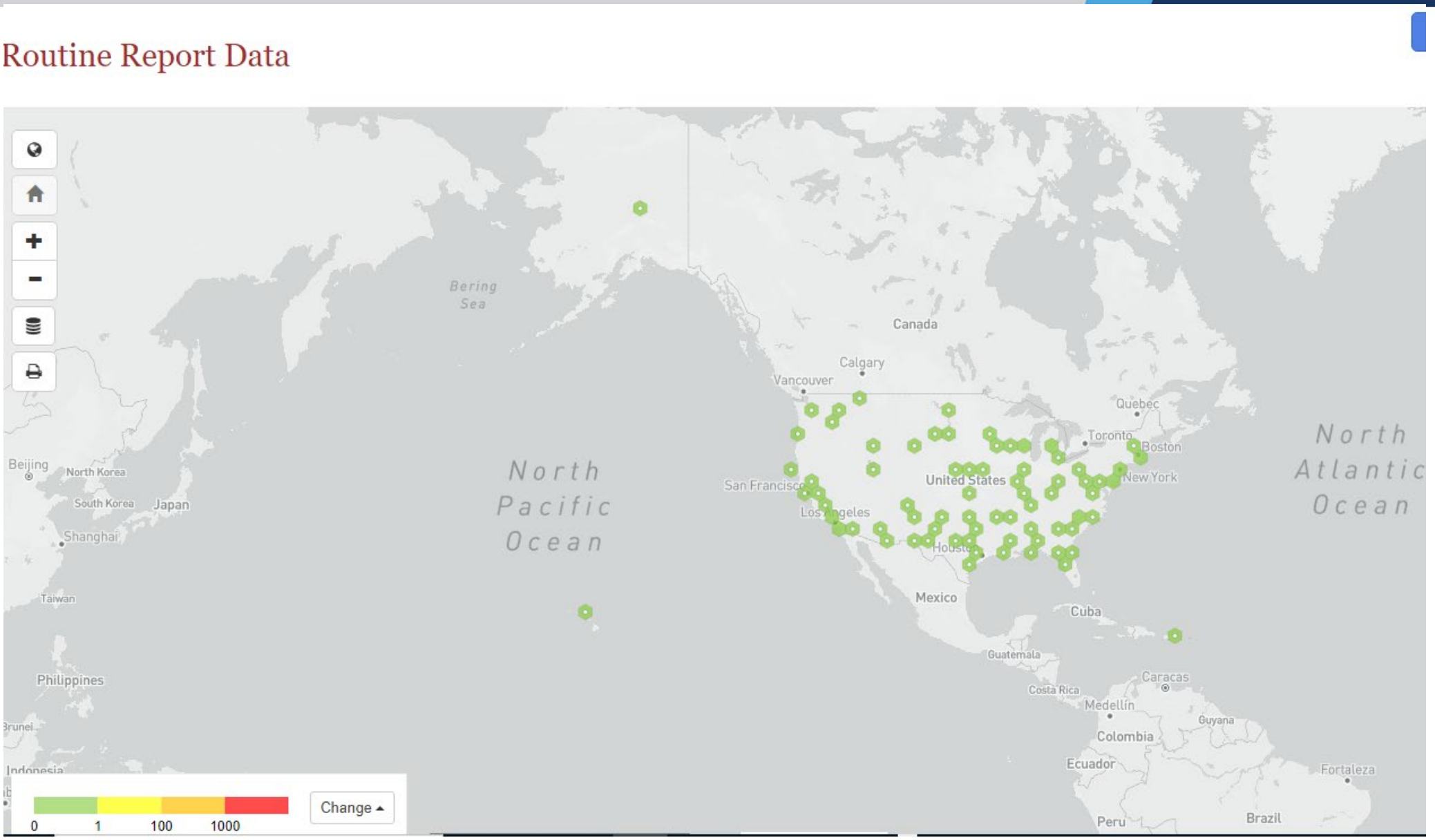
- Count rates (cpm)
- Nuclide-specific concentrations
- Dose rate (nSv/h)

Each fixed air monitor provides real-time capability and transmits data to EPA's National Analytical Radiation Environmental Laboratory (NAREL).

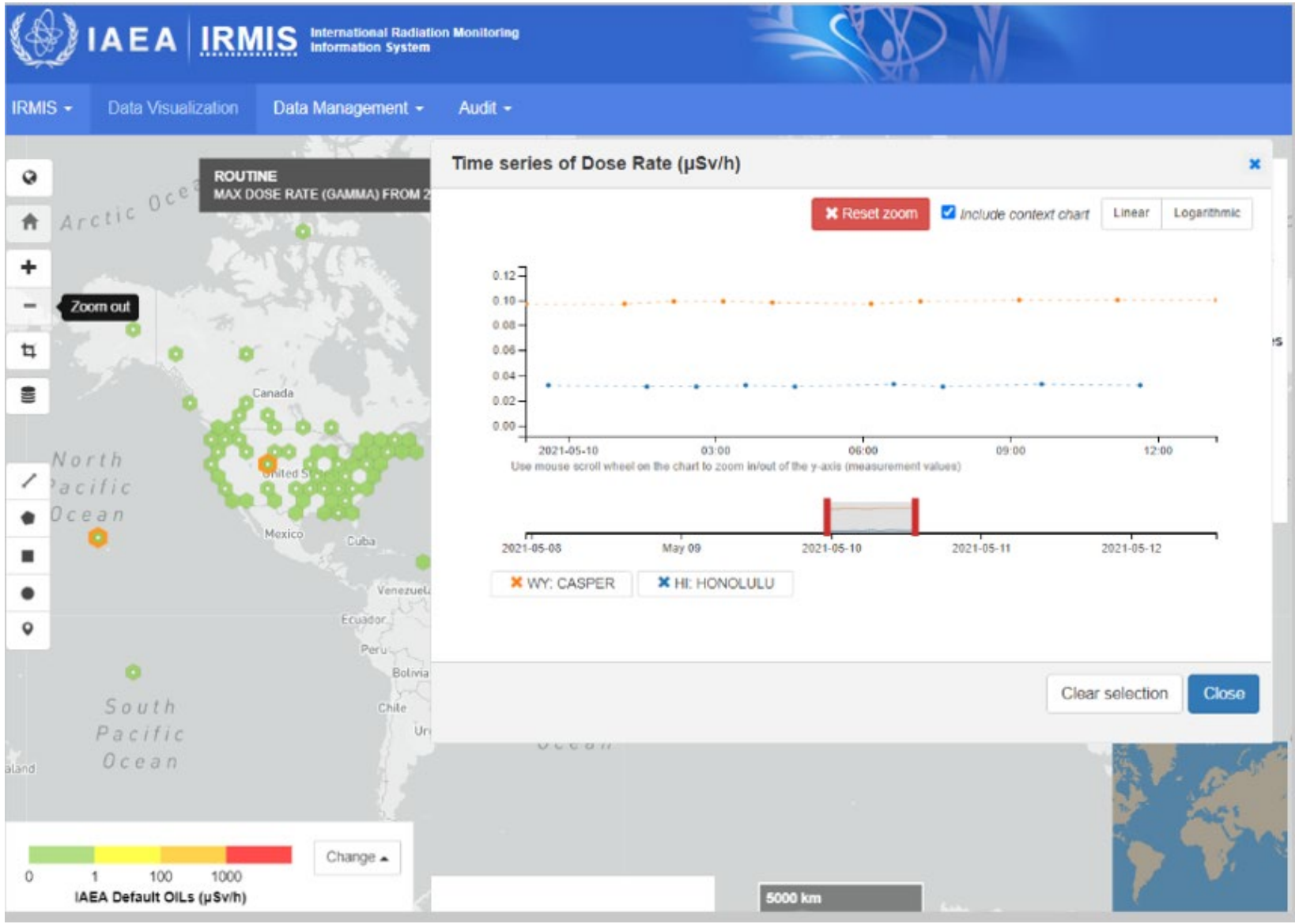
Data are transmitted by satellite telemetry and cell phone.

RadNet Sensor Data in IRMIS

Number of sensors reporting to IRMIS has gone up to 83 and steadily increasing



RadNet Dose Rate Data on IRMIS Visualization Page

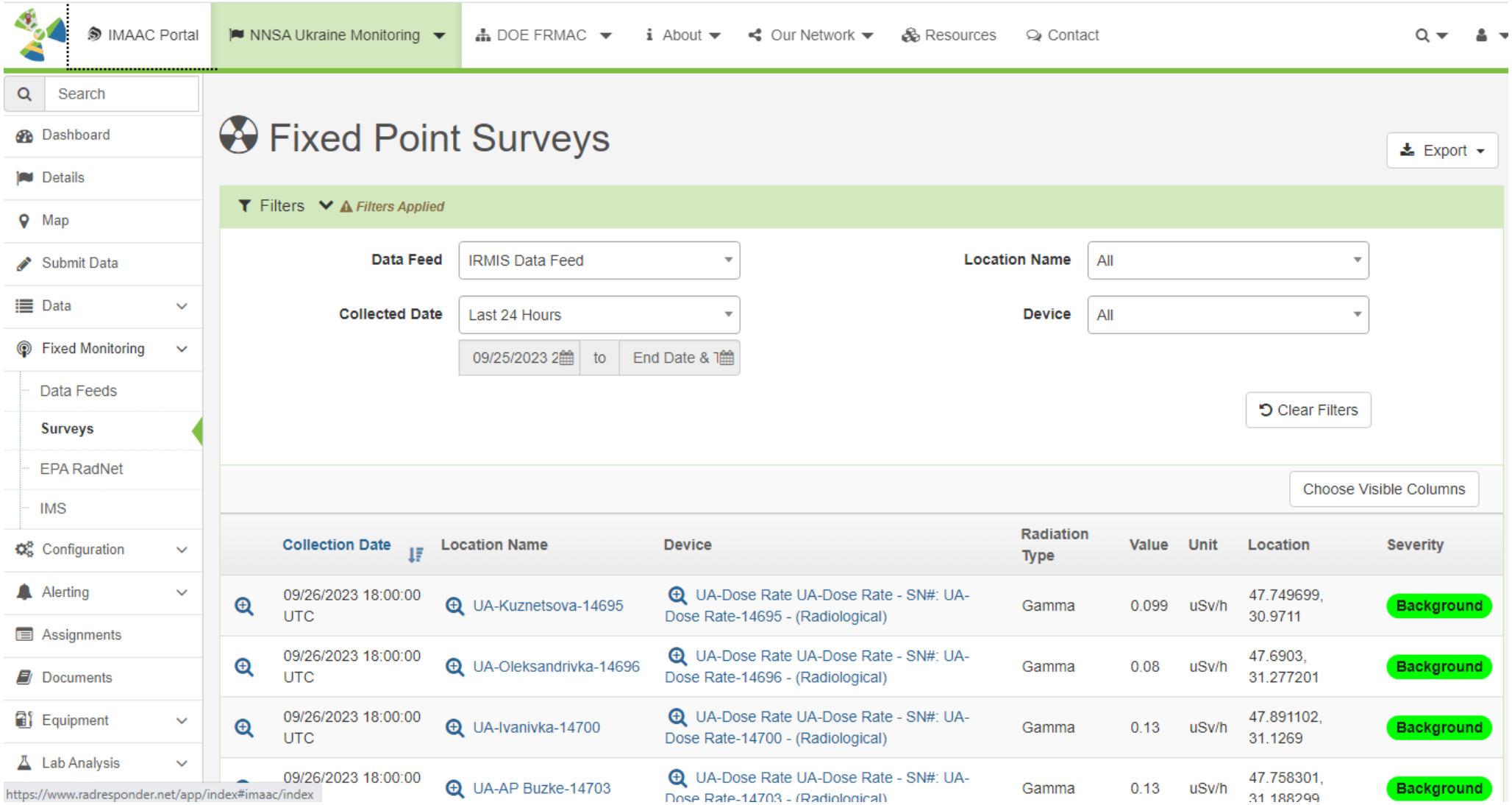


RadResponder Network - FEMA

The RadResponder Network, a collaborative tool

- Developed by FEMA, DOE/NNSA, and EPA,
- Enables federal, state, local, tribal, and territorial response organizations to rapidly and securely
  - Record,
  - Share, and
  - Aggregate large quantities of data while
  - Managing their equipment, personnel, interagency partnerships, and multijurisdictional event space
  - On a free, cloud-based radiation data collection system.

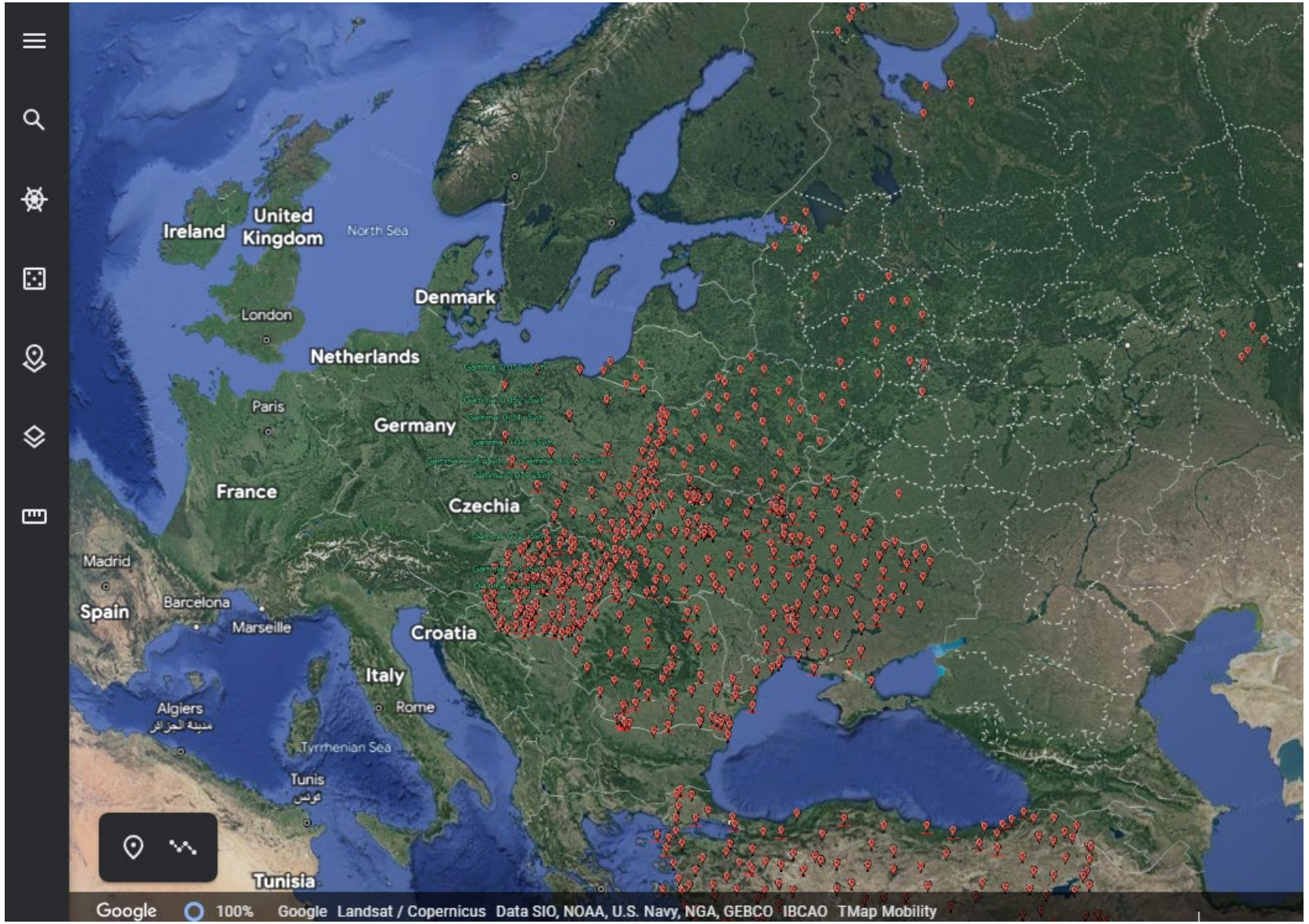
IRMIS Data on RadResponder



Exported KML File from RadResponder to Display IRMIS Feed

There are ~175 sensors in Turkey

RadResponder has efficient query capability, data manipulation is easy



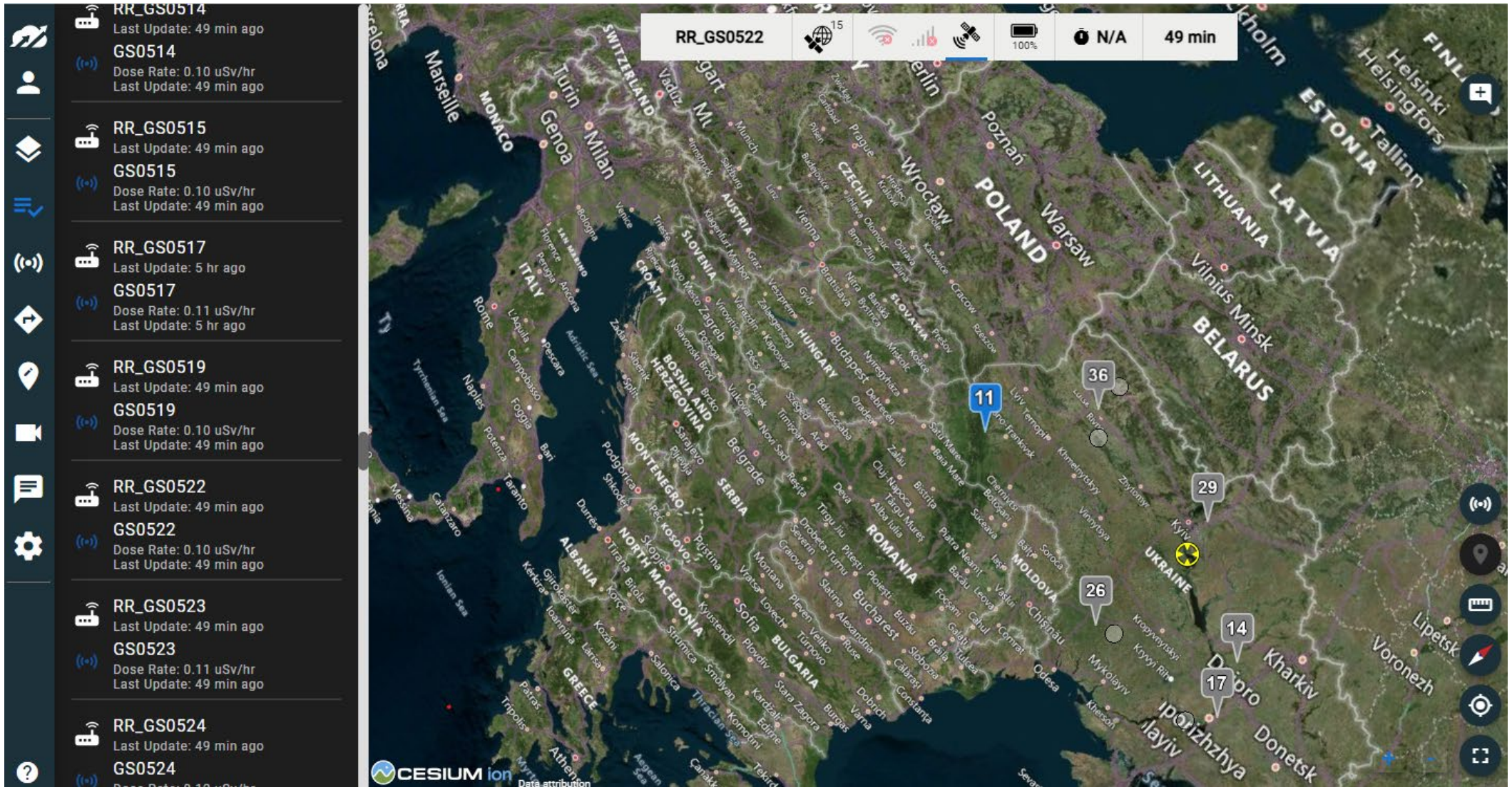
MAVNET Sensors – Types of Detector Systems

Thermo Fischer RadEYE

Bertin Technologies GammaTracers

Bertin Technologies SPIDER sensors – another variation of Gamma Tracers

MAVNET Sensors Data Visualization



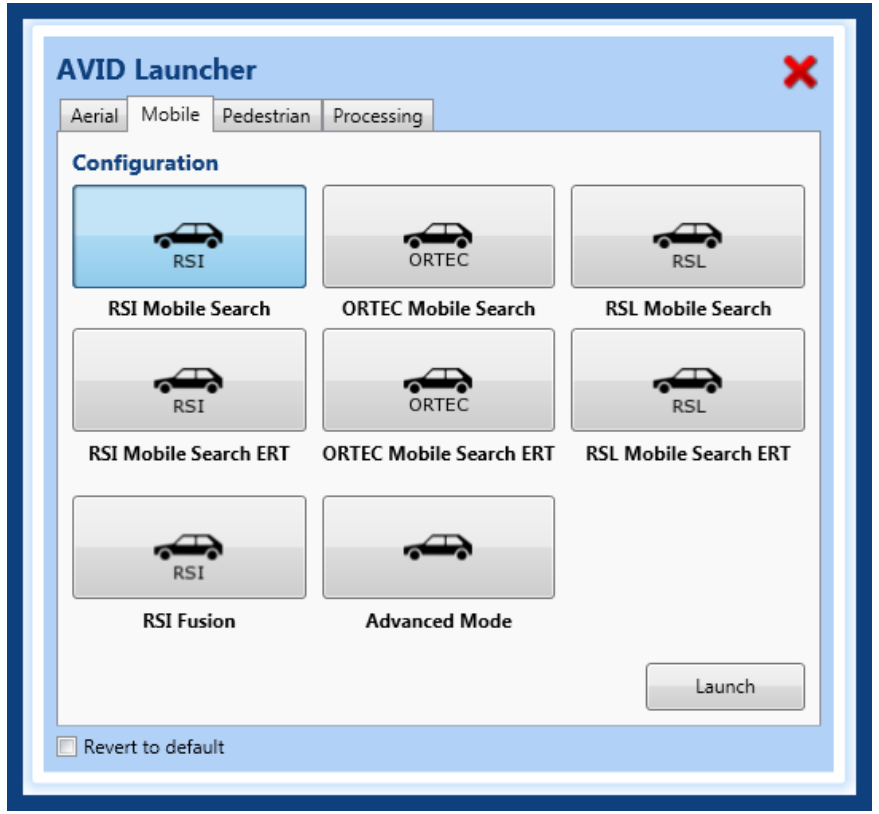
Advanced Visualization & Integration of Data (AVID)

AVID is an acquisition and analysis software of radiological (mostly) data committed to the following ideas:

- Modular, extensible framework for collaborative development
- Sensor agnostic (GOTS+COTS, ~ 10 systems integrated)
- Scalable configuration to meet mission need

AVID is currently deployed for operational use by US DOE/NNSA and offered to IEC as RANET capability.

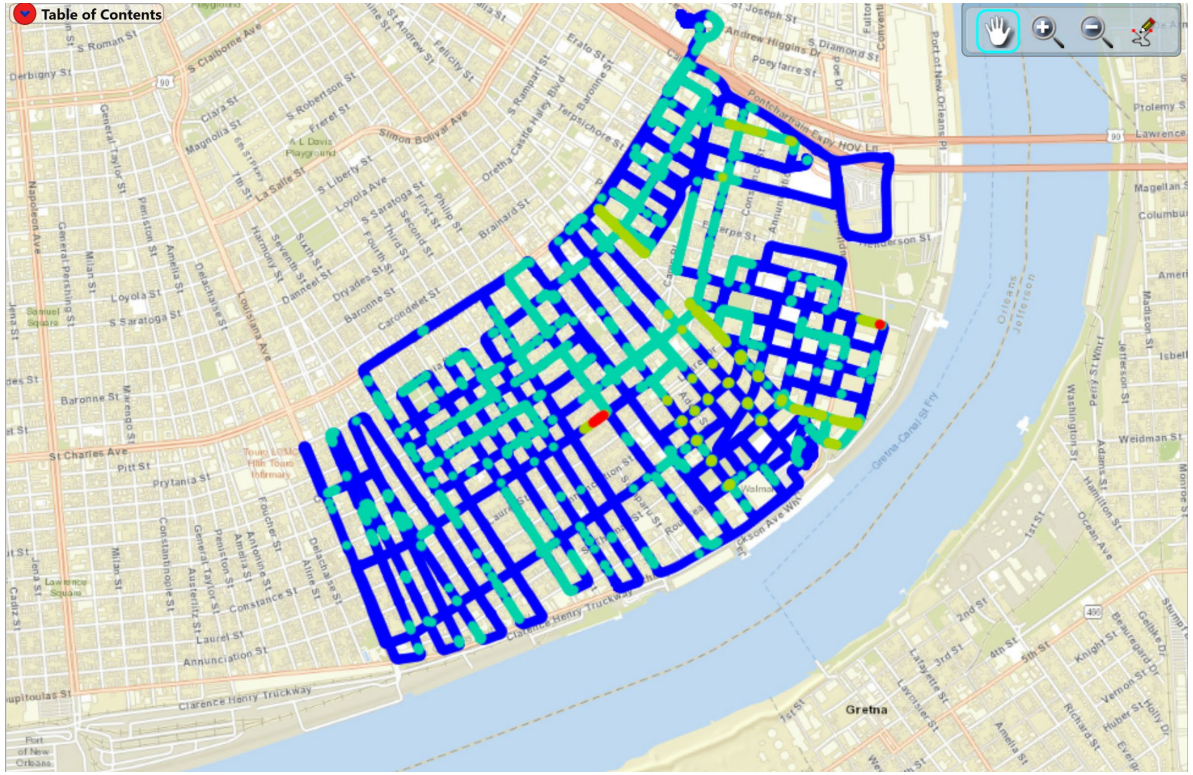
AVID Launcher



The AVID Launcher is the shell that starts AVID

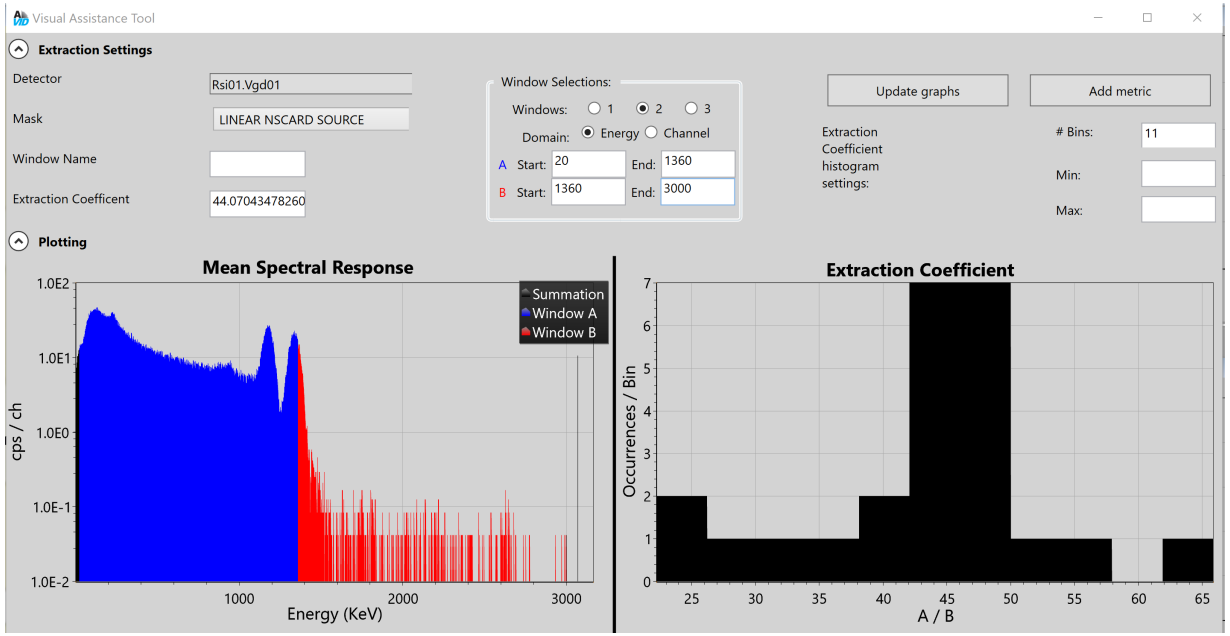
Selection of Data from Easy Graphical Interface

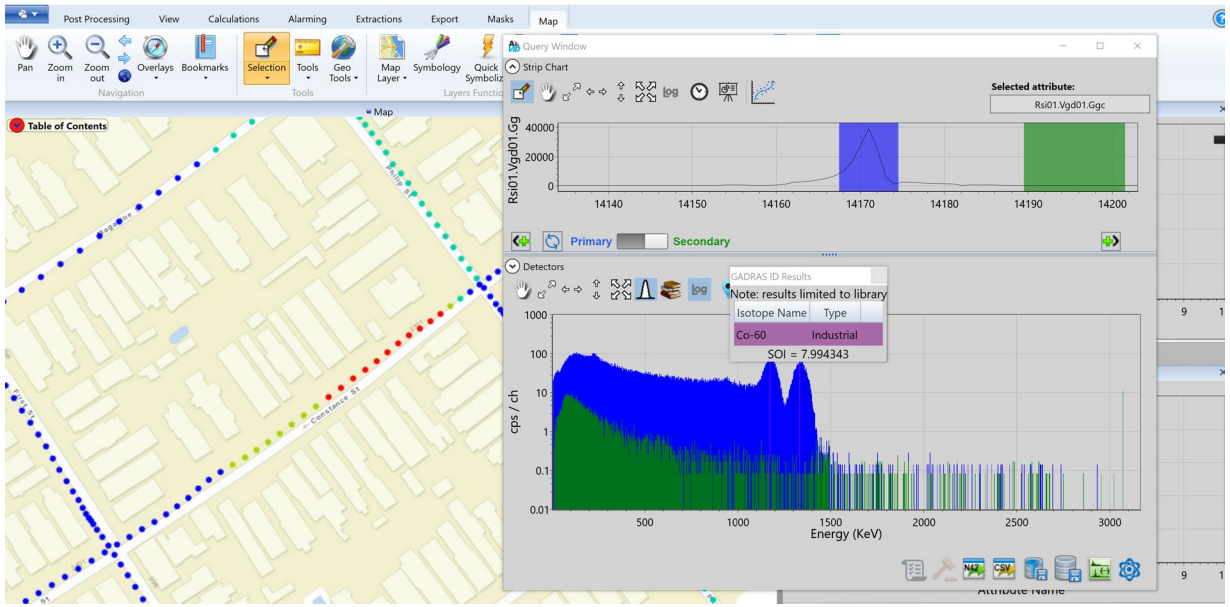
Freehand loops



Multiple Algorithm to Identify the Radioisotope

Spectral analysis tools





2-energy window extraction A/B ~44, Background ~27

Choice of background selection – event by event

Realize background can have strong spatial and time dependence

Application of Gamma Detector Response and Analysis Software (GADRAS)

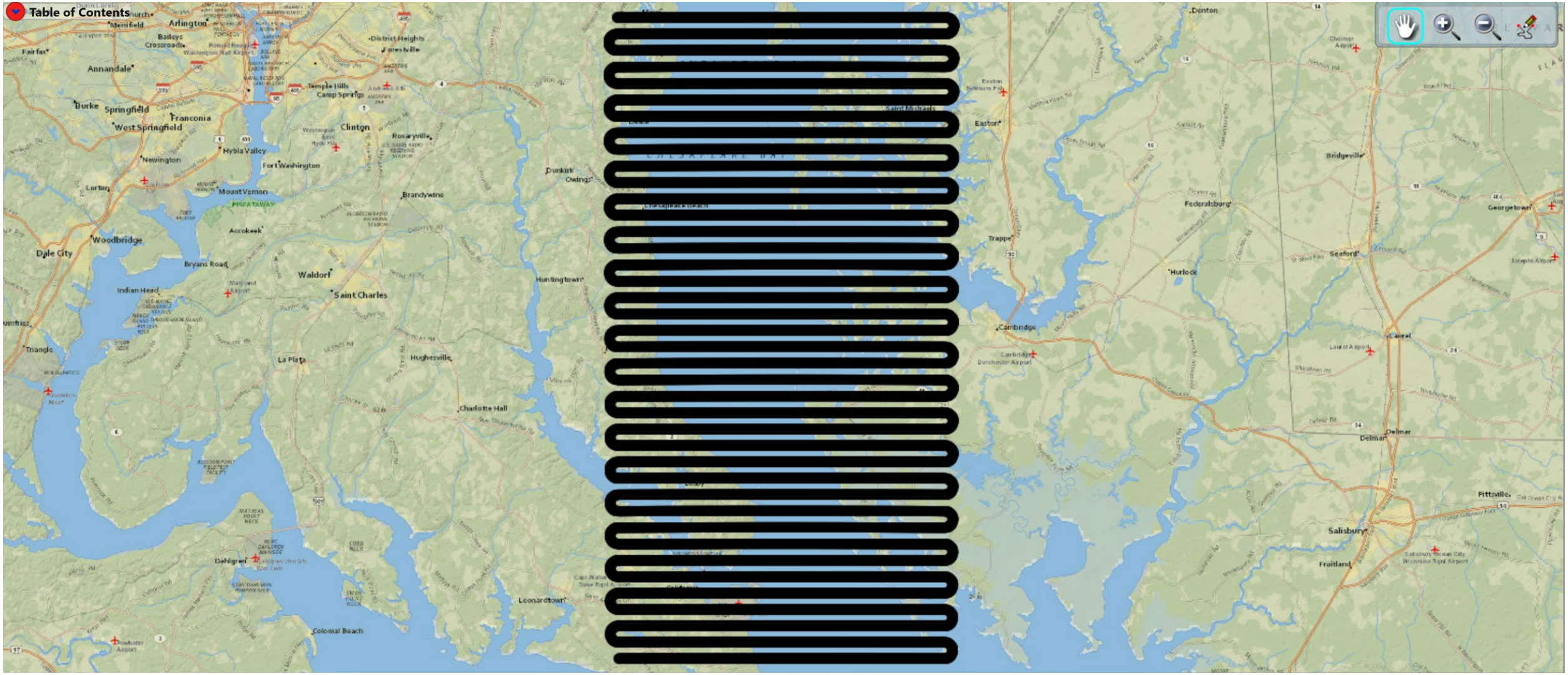
Strength of Index (SOI) ~8, anything about 3 is anomalous

^{60}Co present with high degree of confidence

How Can iAVID Support IRMIS?

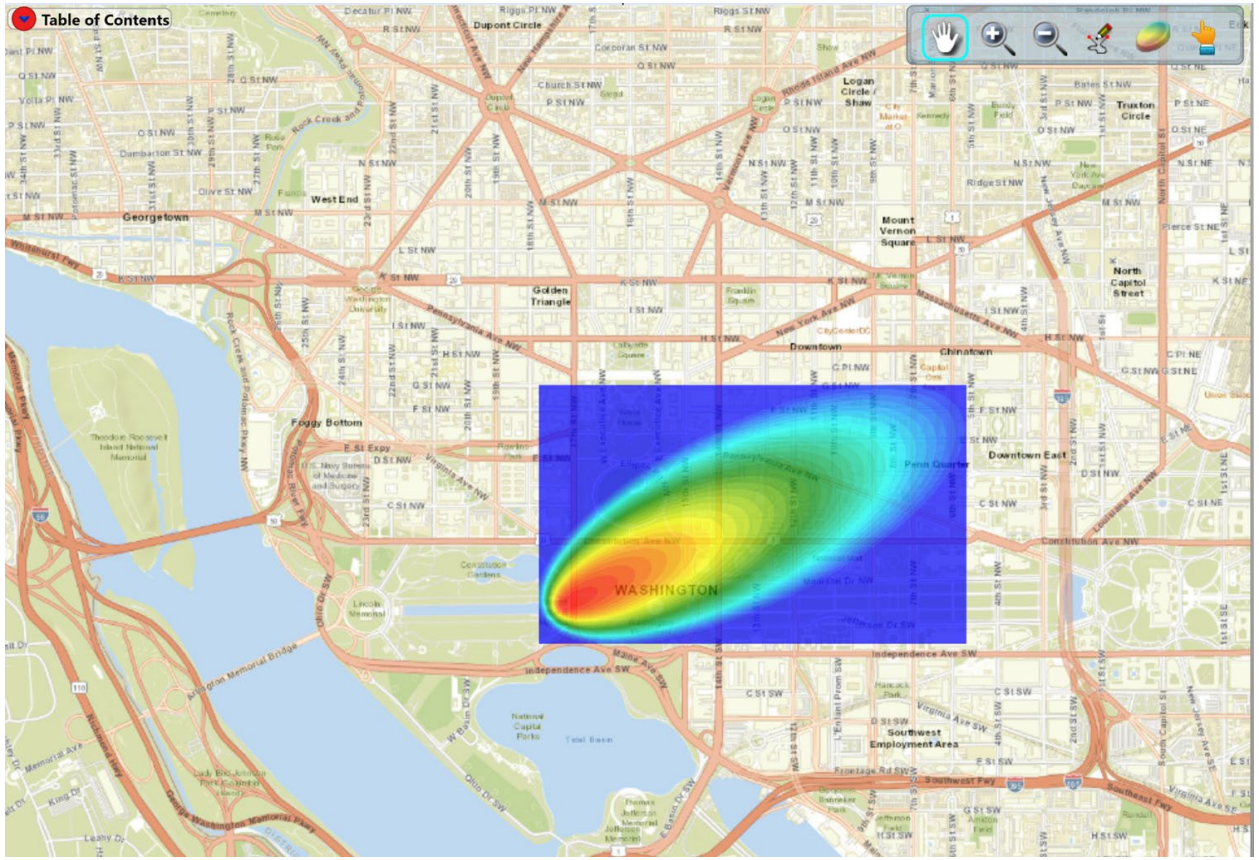
- Can support aerial mission plan by drawing path plot given the starting and end GPS coordinates and line spacing
- Plume simulation
- Can support IRMIS to obtain telemetered data from deployed system in the field in real time via Remote Control feature – very useful for emergency response
- Can directly incorporate radioisotope-mixture-specific ground deposition concentration data (Bq/m2) from accidental release – useful for real-world prerelease condition, training and exercise simulations from nuclear power plants or fuel cycle infrastructure like reprocessing units
- Can extract radioisotopes with high degree of confidence by applying GADRAS analysis when spectroscopic data are available in IRMIS

Built-in Aerial Mission Planning Simulation Tool

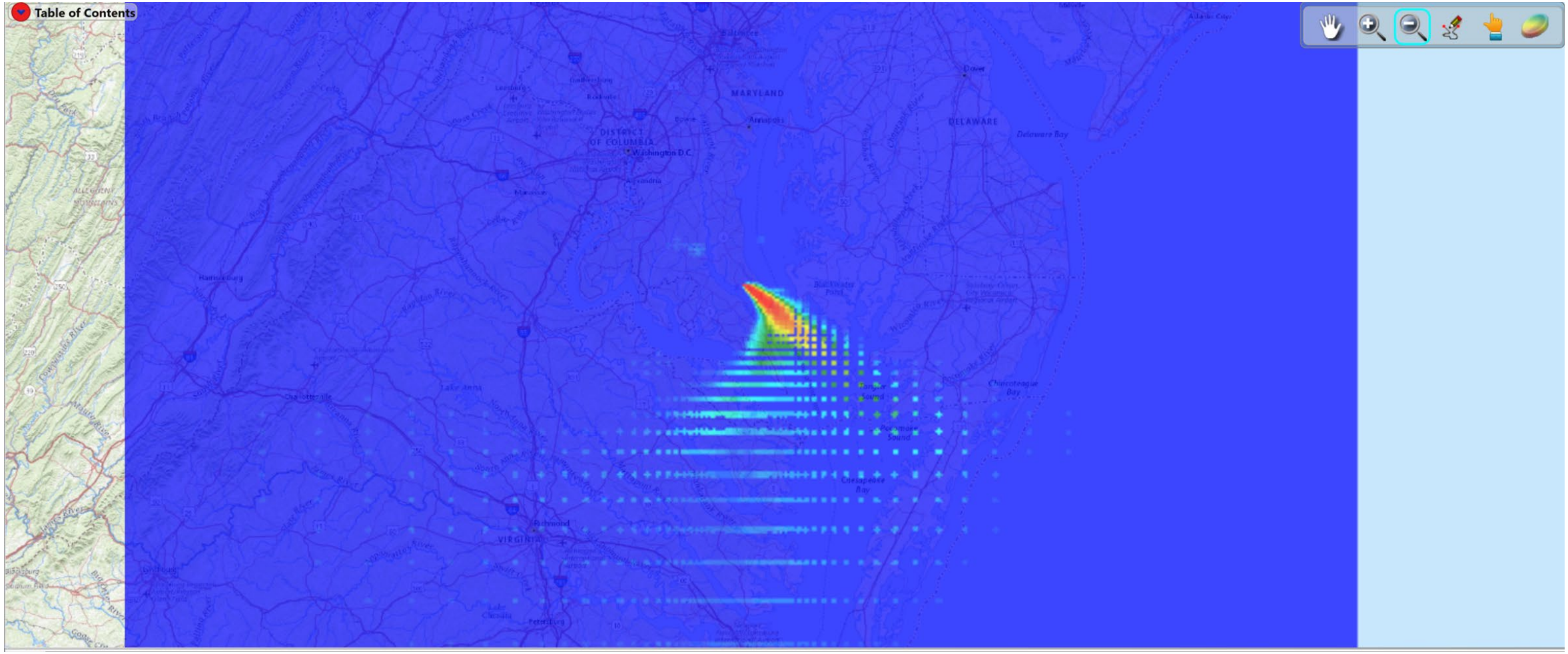


Built-in Plume Simulation Capability

- Can add a simulated detector response to real background data
- Add Plumes and ground deposition
  - Launch AVID in Mission Planning mode
  - Use Plume tool to specify foci of elliptical plume
  - Name plume, set total activity, and click OK
  - Plume will appear in Concentration File Manager
  - Optional: Highlight and click Add to Map
  - Will add raster image to survey



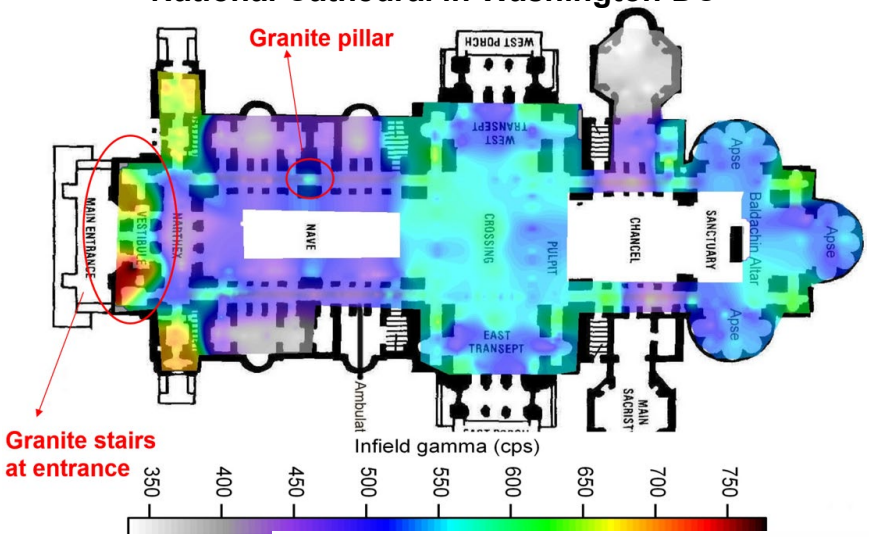
Ground Deposition Concentration Simulation Map from NARAC Atmospheric Model (via IXP)



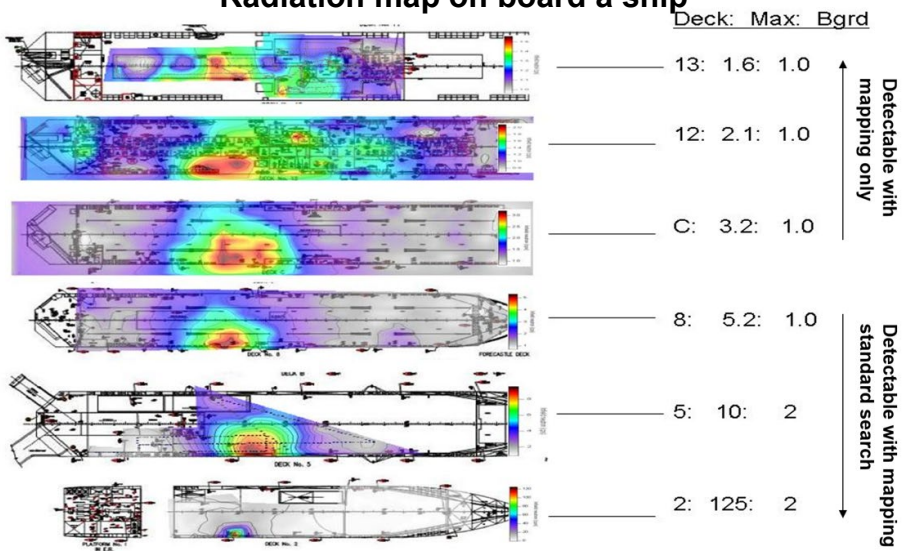
This would tremendously simplify IRMIS data simulation workflow

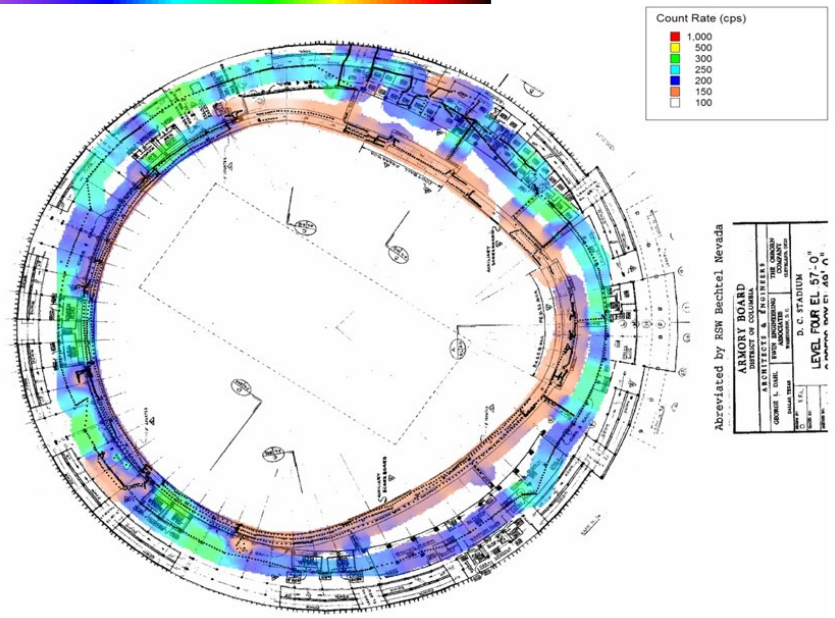
Mapping in GPS-denied Area with Inertial Measurement Unit

National Cathedral in Washington DC

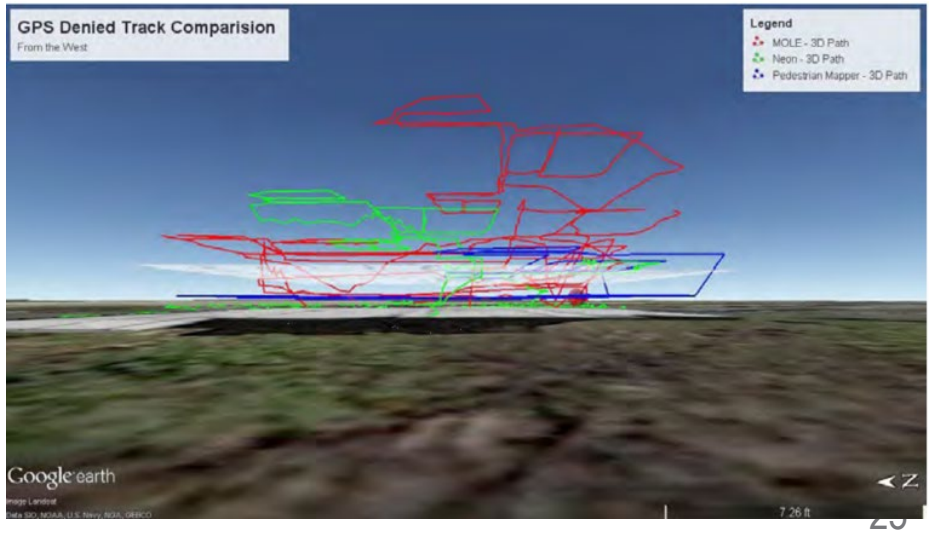


Radiation map on board a ship





Old RFK Stadium in Washington DC



Stitching together 2D maps to reconstruct 3D images

Concluding Remarks

US DOE/NNSA Nuclear Incident Policy and Cooperation has been providing support to IEC Emergency Preparedness and Response operations by providing equipment, infrastructure, and technical reach-back capabilities.

For example,

- IXP (International Exchange Program) – coordinated access to US National Atmospheric Release Advisory Center (NARAC)
- Spectral Advanced Radiological Computer System (SPARCS)
- TRIAGE radiological ALARM adjudication support
- REAC/TS – Radiation Emergency Assistance Center/Training Site
- CM Home Team – Consequence Management Support
- iAVID – International Advanced Visualization and Integration of Data