Signature Detection and Identification

Thrust Area 4 Summary

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Challenges and Gaps

Global Monitoring Networks
Treaty on the Non-Proliferation of Nuclear Weapons (NPT)

GAPS & CHALLENGES

- Detect and identify small-yield nuclear explosions
- Uncertainty management in source identification
- Data collection under Additional Protocol
- Improved tools for site inspections

**CVT
Thrust Area**

Undeclared Activities and Facilities

NNSA
National Nuclear Security Administration

Thrust Area Four
Signature Detection and Identification

Seismology

PI: Paul Richards, Columbia University: richards at ldeo.columbia.edu

Fellows: Michael Howe (Ph.D.), David Schaff (Ph.D.)

Associated Investigators: Won-Young Kim, Göran Ekström, Columbia
Howard Patton, LANL, Bill Walter, LLNL, Chris Young, SNL

Infrasound

PI: Milton Garces, FY2016 T4 Lead
University of Hawaii: milton at isla.hawaii.edu

Fellows: Anthony Christe (Ph.D.), Julie Schnurr (Ph.D.),
Karina Asmar (Ph.D.)

Associated Investigators: Steven Magana-Zook and Jessie Gaylord, LLNL,
Arthur Rodgers and Keehoon Kim, LLNL, David Mascarenas, LANL
Il-Young Che, KIGAM

NNSA
National Nuclear Security Administration

Thrust Area Four
Signature Detection and Identification

Radionuclide Atmospheric Transport

PI: John Lee, University of Michigan: jcl at umich.edu

Fellows: Matthew Krupcale (Ph.D.), Marc Monahan (Undergrad)

Associated Investigator: Paul Eslinger, PNNL

Radioxenon

PI: Abi Farsoni, Oregon State University: abi.farsoni at oregonstate.edu

Fellows: Steven Czyz (MS), Harish Gadey (MS), Eric Becker (PostDoc)

Associated Investigator: Justin McIntyre, Mitchell Myjak, PNNL

Simulations of Fuel Cycle Monitoring

Paul Wilson and Meghan McGarry, Baptiste Mouginot, University of Wisconsin
          paul.wilson at wisc.edu, mbmcgarry at wisc.edu

Fellows: Chris Hoffman (MS), Drew Buys (MS), Owen Selles (MS),
   Arrielle Opotowsky (Ph.D.)

Associated Investigator: Tom Atwood, SNL

NNSA National Nuclear Security Administration

Seismic Signatures of Nuclear Testing

Paul Richards, M. Howe, D.P. Schaff, W-Y Kim, G. Ekström
H. Patton, LANL, W. Walter, LLNL, C. Young, SNL

- Rapid seismic analysis of North Korea nuclear tests
- Underground 2016 explosions were localized near previous tests in 2009 and 2013
- Forensic analysis of May 2010 seismic event: appears to be a small earthquake
- Ongoing data rescue of archived analog recordings from nuclear explosions in the atmosphere and underground
- Improved seismic source parameters with surface wave analyses
- Participation in international programs
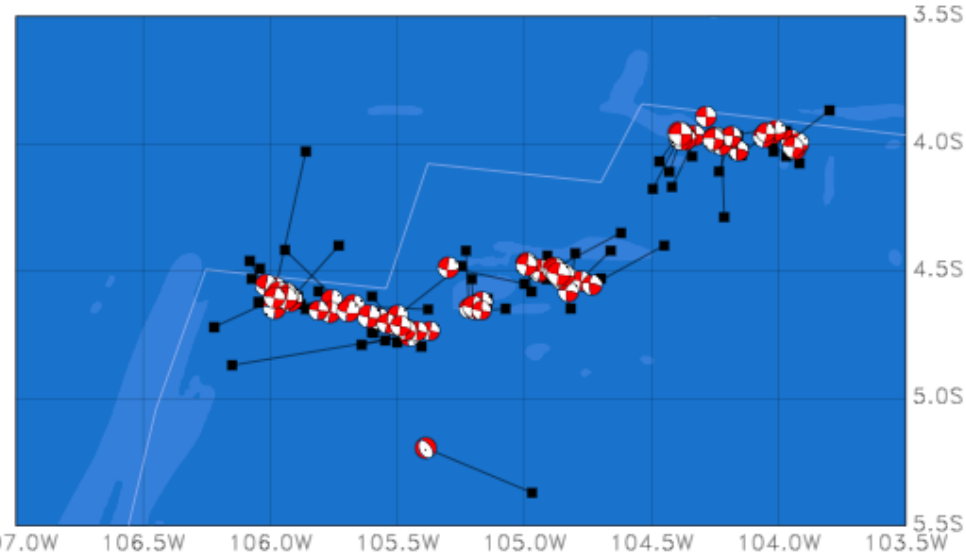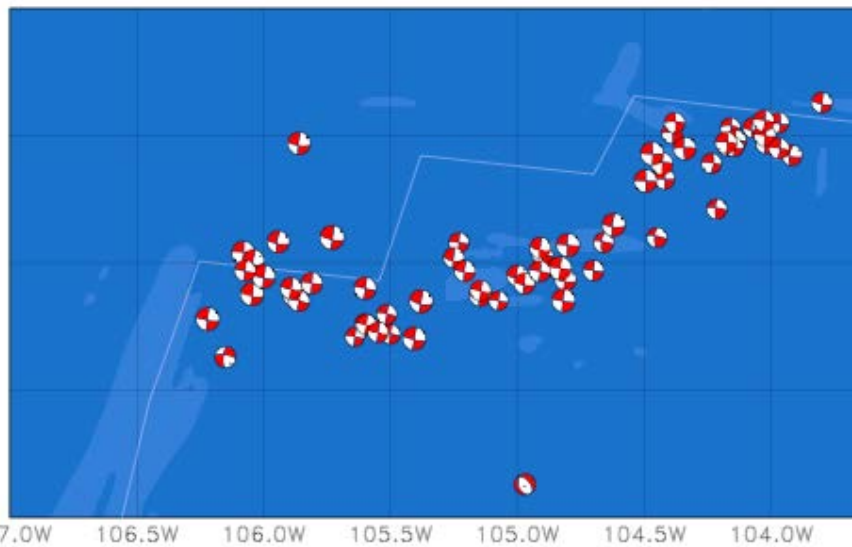
# Infrasonic Signatures, Jets and Blasts

M. Garces, A. Christe, J. Schnurr, K. Asmar, University of Hawaii
S. Magana-Zook, J. Gaylord, A. Rodgers and K. Kim, LLNL, D. Mascarenas, LANL,
I-Y Che, KIGAM

- 2016 DPRK Tests were primarily seismic events, Positive IMS seismic, Negative IMS infrasound, Positive ROK infrasound
- Rocket launch and proximal trajectory of 7 February picked up by traditional and next-gen mobile infrasound systems at ranges >500 km
- LLNL Collaborations: Design next-gen sensor systems and cloud architectures. Characterize blast signatures
- LANL Pilot Study: Organize AI algorithms within artificial personality framework. Explore human-machine interfaces


DPRK Rocket, 2/716, 00:30 UTC
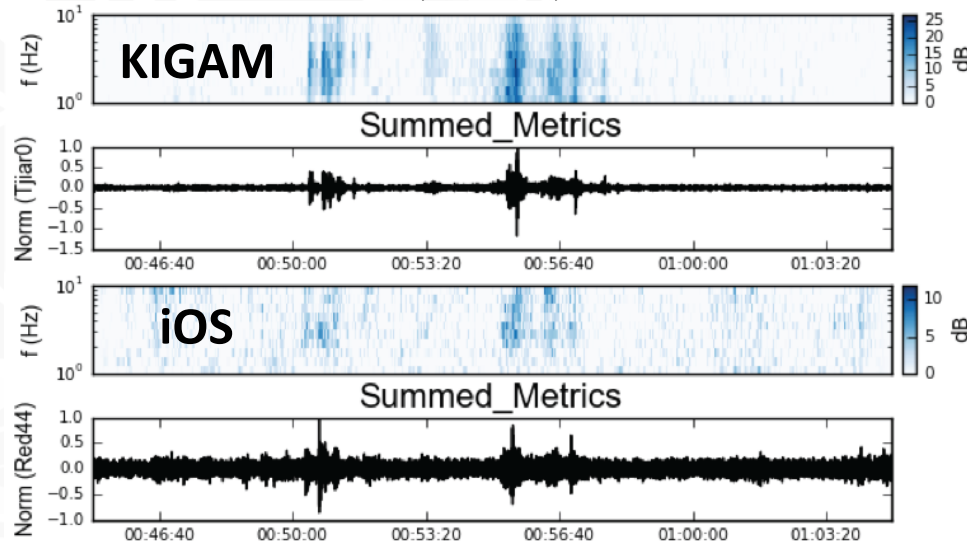
TJIAR data courtesy of KIGAM

Radionuclide Atmospheric Transport

John Lee, Matthew Krupcale, Marc Monahan, University of Michigan
Paul Eslinger, PNNL

- Performed FLEXPART atmospheric transport simulation of Fukushima radionuclide releases using ORIGEN2 radionuclide inventories

- Mixed agreement between FLEXPART results and IMS station data

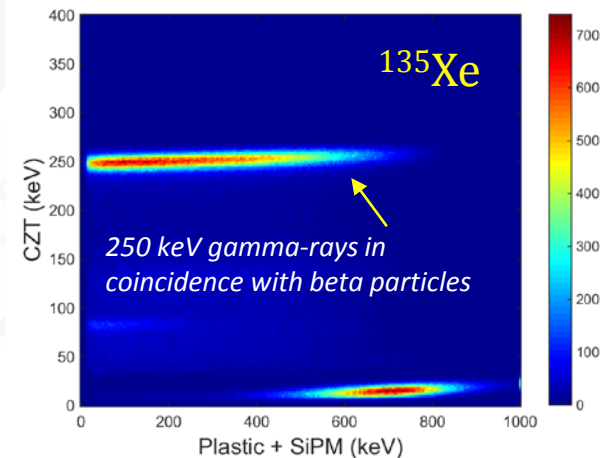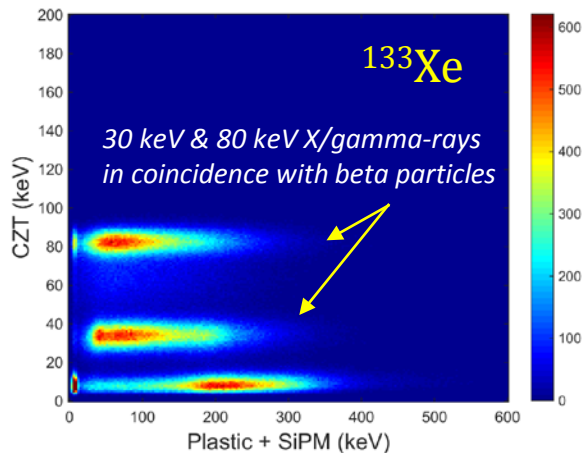- Continuing ATM code benchmarking with volcanic ash data simulation
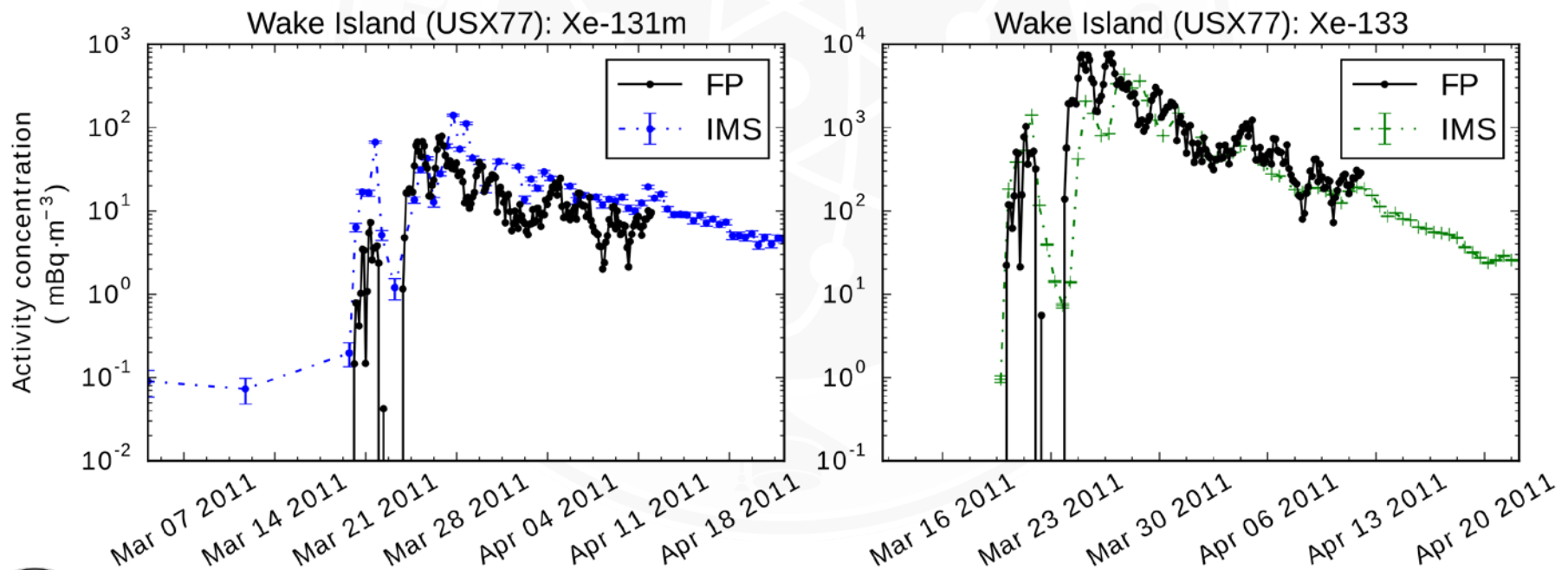
Radioxenon Beta-Gamma Coincidence

A. Farsoni, S. Czyz, E. Becker, and H. Gadey, Oregon State University
J. McIntyre, M. Myjak, PNNL

- New prototype detector utilizing CdZnTe, an Array of SiPMs, and a Plastic scintillator (CASP) has been constructed and characterized
    - Well-type plastic used to mitigate effects from conversion electron backscatters seen in TECZT (the first prototype) detector

- Irradiation of xenon gas samples in OSU TRIGA reactor and conducted coincidence measurement of ^{135}Xe and ^{133}Xe

- Further measurements of ^{135}Xe, ^{133}Xe, ^{133m}Xe, and ^{131m}Xe samples underway for evaluation of Minimum Detectable Concentration (MDC)

^{133}Xe

30 keV & 80 keV X/gamma-rays in coincidence with beta particles

CASP Detector

^{135}Xe

250 keV gamma-rays in coincidence with beta particles

# Fuel Cycle Simulation as Virtual Testbed

P. Wilson, M. McGarry, Baptiste Mouginot, A. Opotowsky, C. Hoffman, D. Buys, O. Selles, U. of Wisconsin.   Tom Atwood, SNL

- Diverse synthetic fuel cycle signatures have been developed, expanding to signals available through satellite imaging
- A model of the factors that motivate states to pursue nuclear weapons has been developed
  - Compare proliferation risk under different regional scenarios
- Developed UW Madison Chapter of the Nuclear Policy Working Group: Student-led discussion of nuclear issues
  - Focusing on modernization and deterrence
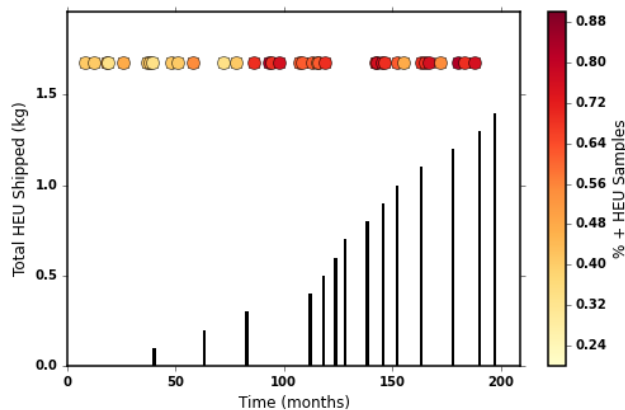
Shipping + Inspections
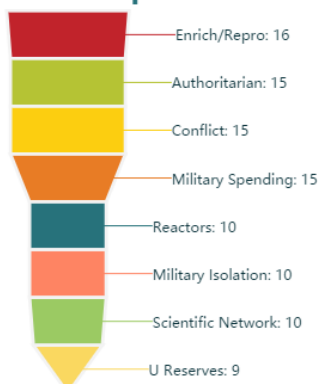
Why States Pursue Weapons

Nuclear Policy Working Group: Modernization and Deterrence

Thrust Area 4 Objectives, FY17

- Pursue DNN R&D Objectives: "Detect, identify, locate, and characterize foreign nuclear weapons program activities, illicit diversion of special nuclear materials, and global nuclear detonations"

- Address technological gaps and challenges in treaty monitoring and verification

- Establish trusted data and information pathways to and from responsible agencies

- Develop cyberinfrastructure to expedite event identification

- Building next-gen human capital and technology to addresses real-world national and international security challenges