Environmental Fate and Transport of Radionuclides

MTV Kickoff Meeting

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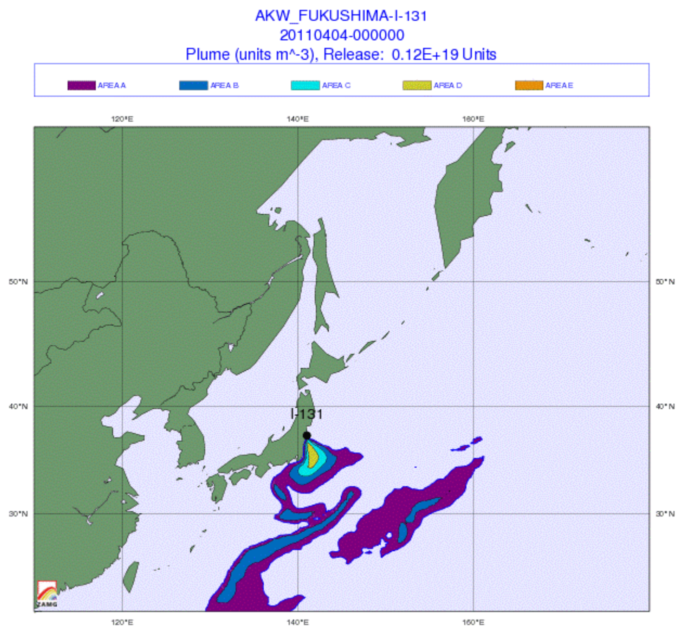
Introduction and Motivation

- The Comprehensive Nuclear-Test-Ban Treaty (CTBT) signed by 184 states bans nuclear explosions (United Nations, 1996). The monitoring of the treaty is implemented by the United Nations CTBT Organization (CTBTO)
- It operates an International Monitoring System (IMS) and collects seismic, infrasound, hydroacoustic data as well as radionuclide (particulate matter and noble gases) activity concentrations.
- What are the modes and options for inverse source determination and benign source discrimination?
  - Inverse modelling, local sampling, radionuclide transport etc



Source: CTBTO.org

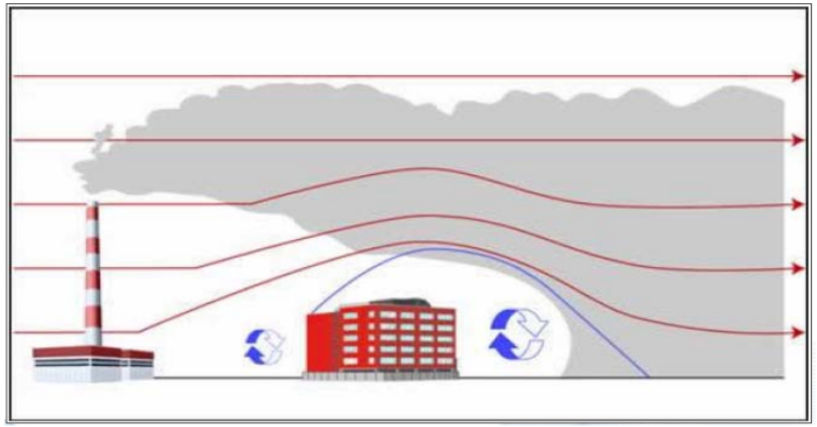
Mission Relevance

- *Environmental Fate and transport of Radionuclides* - Understand the transport, retention and fate of radionuclides over a large range of time and length-scales. Including benign sources that could interfere locally or on a global scale with detection and tracking efforts of suitable radionuclides.
  - Supports NNSA's mission to detect, characterize, and respond to explosion events and tests.
- This project will provide new methods to improve our understanding of radionuclide fate and transport in the environment. The work will improve the link between radioactivity measurements at IMS stations and source locations, providing valuable information on violation of the CTBT
  - Supports NNSA's work globally to prevent state and non-state actors from developing nuclear weapons through detection deterrence.

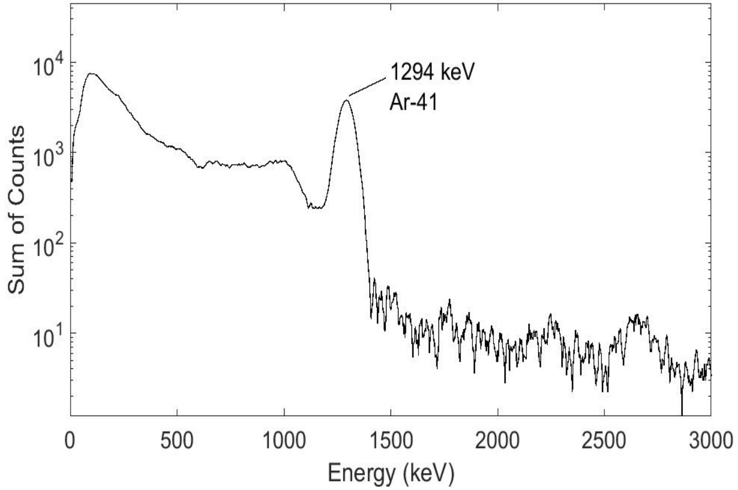
Source: NNSA

Technical Work Plan

- We propose to perform experiments at the University of Florida Training Reactor to study the transport of radionuclide argon/xenon in the environment.
- The Reactor has performed pilot measurements of atmospheric radionuclide transport in collaboration with multiple national labs. The effort leverages a UFTR generation of Ar-41, which has a gamma/beta cascade decay similar to many noble gas radioisotopes of interest from nuclear explosions and nuclear facilities.



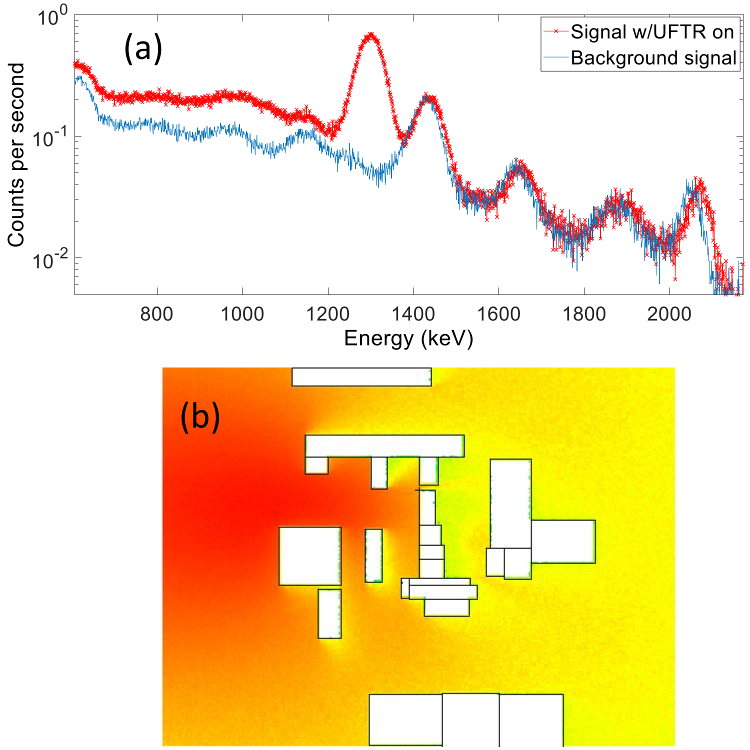
Source: S. Guerra, (2017)



Background subtracted Ar-41 spectrum (NaI) at UFTR

Expected Impact

- If successful this project will provide new methods to improve our understanding of radionuclide fate and transport in the environment.
- An additional benefit of this work is its direct impact on other research areas that use beta-gamma coincidence techniques, which also benefit from improved radionuclide transport and interaction understanding.
- Provide understanding of the non-localized radiation exposure and measurement (of special relevance to onsite or mobile measurements).



Signal vs background comparison (a) and Ar-41 plume at 40m height (b)

MTV Impact

- Student involvement in short courses
  - LANL Safeguards course
  - BNL nuclear nonproliferation, safeguards, and security summer school
- Internships
  - Current graduate internships at BNL
  - Future internships supporting MTV work at labs like LANL/SNL/PNNL
- Conferences / workshops:
  - INMM, ANS, WOSMIP, S&T (CTBT)
- Collaboration with MTV PIs: Steve Biegalski, Kyle Hartig, If needed in Other TA:s as expertise allows: Anil Prinja, Sara Pozzi
- Personnel transitions: Encourage graduate and undergraduate students supported by MTV to pursue careers at relevant entities supporting the nuclear security mission
- Technology transitions
  - Work with National labs and other entities of relevance such as PNNL, AFTAC for possible technology transitions

Conclusion

- Provide concluding statements that interpret what the results of the project will mean in context of the NNSA mission
- Graduate students will be involved in development of Radionuclide transport and detection work of relevance to nuclear activity monitoring with collaboration and internships with national laboratory partners.
  - It is our hope that these students will obtain employment at a national lab or in government following graduation.
- Expose undergraduate students to fundamental research, and learn about applied technologies of relevance to nonproliferation missions. Encourage interest monitoring technology and verification in nuclear security.
- This project will advance the state-of-the-art methods and improve our understanding of radionuclide fate and transport in the environment through experimental and theoretical work.

Acknowledgements

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