Radionuclides in biota in island environments

MTV Kickoff Meeting

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Introduction and Motivation

1) explore a wider range of RNs to detect fissile material production and underground nuclear tests, 2) select organisms sequestering RNs that are geographically extent and 3) characterize the biochemical response induced by RNs in the selected organisms

- Extract patterns of event and region specific radionuclide fallout signatures recorded in biota (far-field island environments monitored by IMS)
- Analyze physiological changes, diversity changes, and other effects induced by ionizing radiation or the presence of RNs in selected organisms
- Education – graduate and undergraduate student advising as well as outreach (graduate and undergraduate research assistants, SOEST Open House (5000 attendees), NSF EPIK – bringing STEM to underrepresented minority high-school students)

Mission Relevance

- Develop events specific radionuclide signatures as recorded in biota: Evaluate IMS for inter-element and element isotopic ratios to determine production yields and trends of RNs with various half-lives during different events, develop detection methods of these RNs in biota
- Document RN uptake and elimination rates as well as physiological changes in organisms

- *NNSA Mission*
  - *Website:* https://www.energy.gov/nnsa/missions/nonproliferation

  Preventing nuclear weapons proliferation and reducing the threat of nuclear and radiological terrorism around the world are key U.S national security strategic objectives that require constant vigilance.

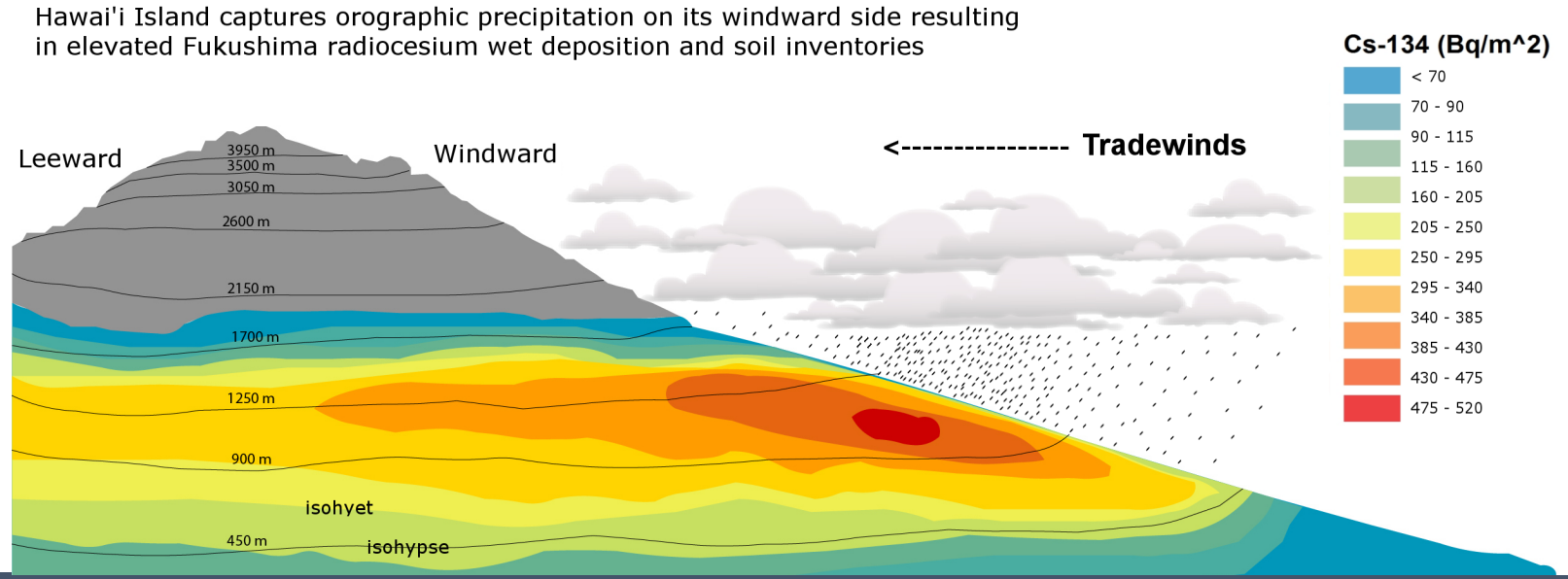
  NNSA's Office of Defense Nuclear Nonproliferation works globally to prevent state and non-state actors from developing nuclear weapons or acquiring weapons-usable nuclear or radiological materials, equipment, technology, and expertise.

Technical Work Plan

- Compilation of IMS data and evaluation of RN specific spatial response to nuclear incident and detonation events in the Pacific
- Identification of RNs relevant to post detonation and incident events
- Development of radiochemical methods to analyze RNs of interest and of physiological changes in biological samples (focusing on mosses and diatoms) – national lab colab
- Field sampling and analysis of RNs in mosses along concentration gradients resulting from fallout in the terrestrial environment and characterization of physiological changes – national lab colab
- Field sampling and analysis of RNs in diatoms along concentration gradients in estuarine settings in the marine environment and characterization of physiological changes
- Culture experiments of 3-5 diatom species on RN uptake and corresponding physiological response – national lab colab

Expected Impact

- Development of RN inventory and distribution in islands of the Pacific Ocean (e.g. Hawaii, Palau) in specific indigenous biota as well as documentation of physiological changes related to the presence and activity gradients of RNs.



^{134}Cs:^{135}Cs:^{137}Cs applicability to extract patterns of fallout from different RN sources

MTV Impact

- PIs and students to build collaborations with national labs and participate in internships
- Technology transitions
  - Interested in collaborating on physiological response identification/quantification and connecting near and far-field RN and bio signatures
  - Biosensor – remote sensing of fluorescence, diatom culture experiments – near to far-field applicability

Conclusion

- The applicability of organisms in the terrestrial (canopy interception; mosses) and marine environments (diatoms) for extended spatial monitoring of RNs selected based on IMS records of past nuclear events will be explored.

Acknowledgements

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