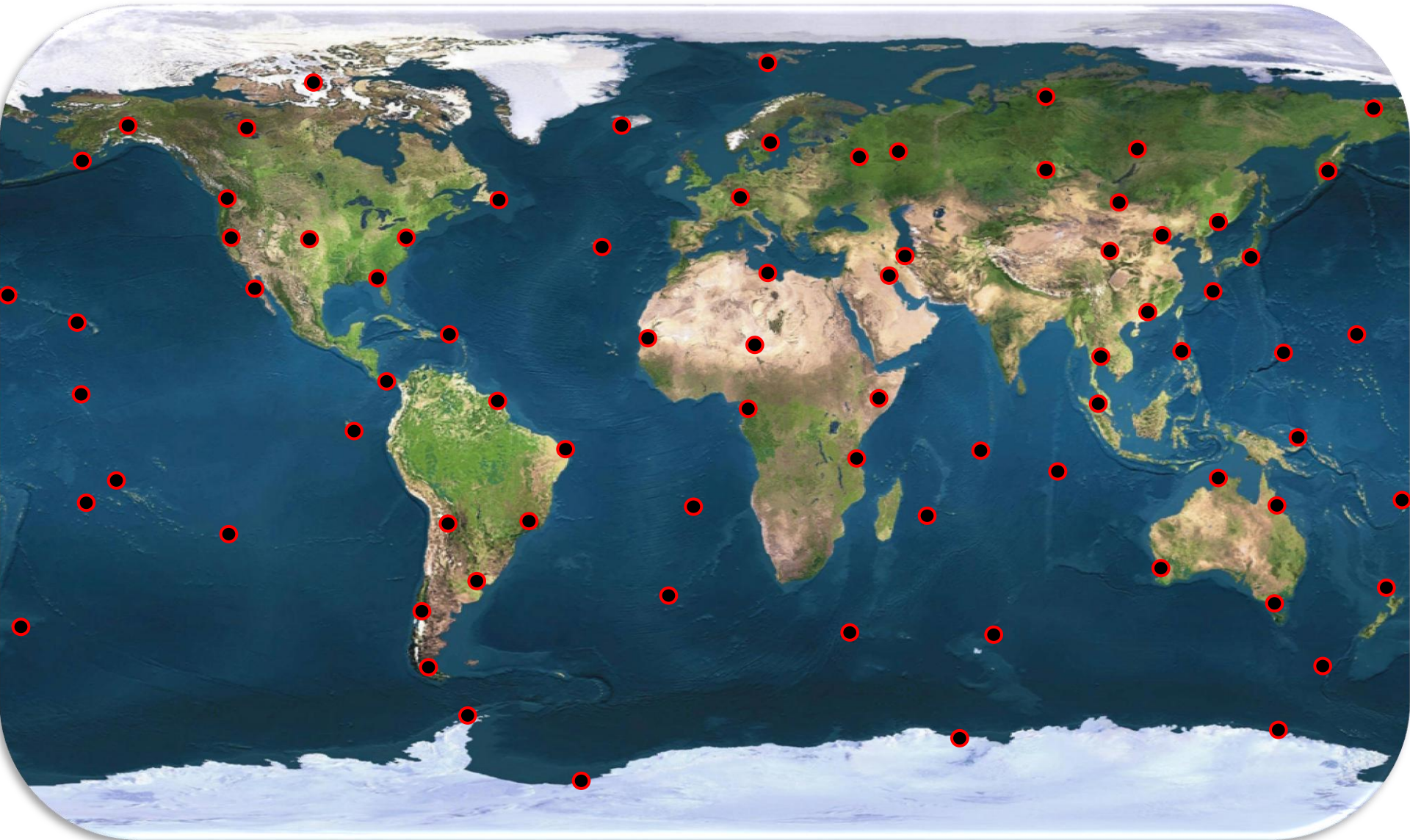


Detection of Elevated Xe-133 Following the Fukushima Nuclear Accident

TW Bowyer, Ph.D.
S&T 2011

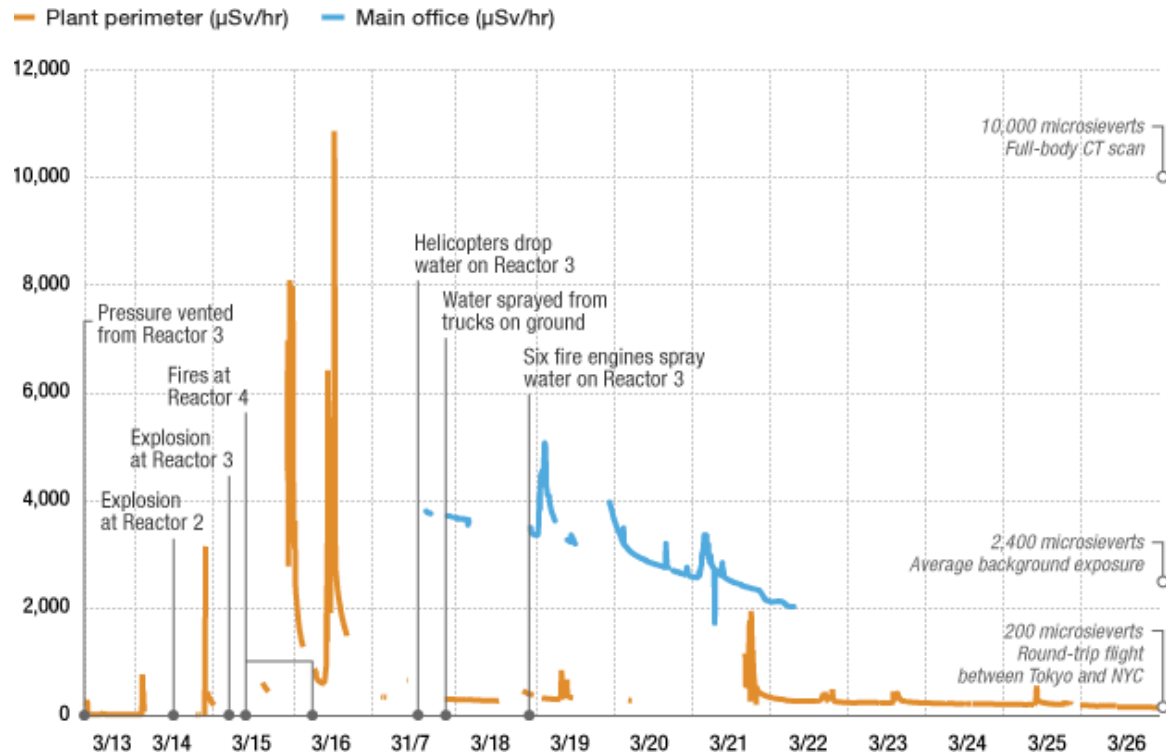
The views expressed here do not necessarily reflect those of the U.S. Government, the U.S. Department of Energy, or the Pacific Northwest National Laboratory

The International Monitoring System – Xe Monitoring Stations



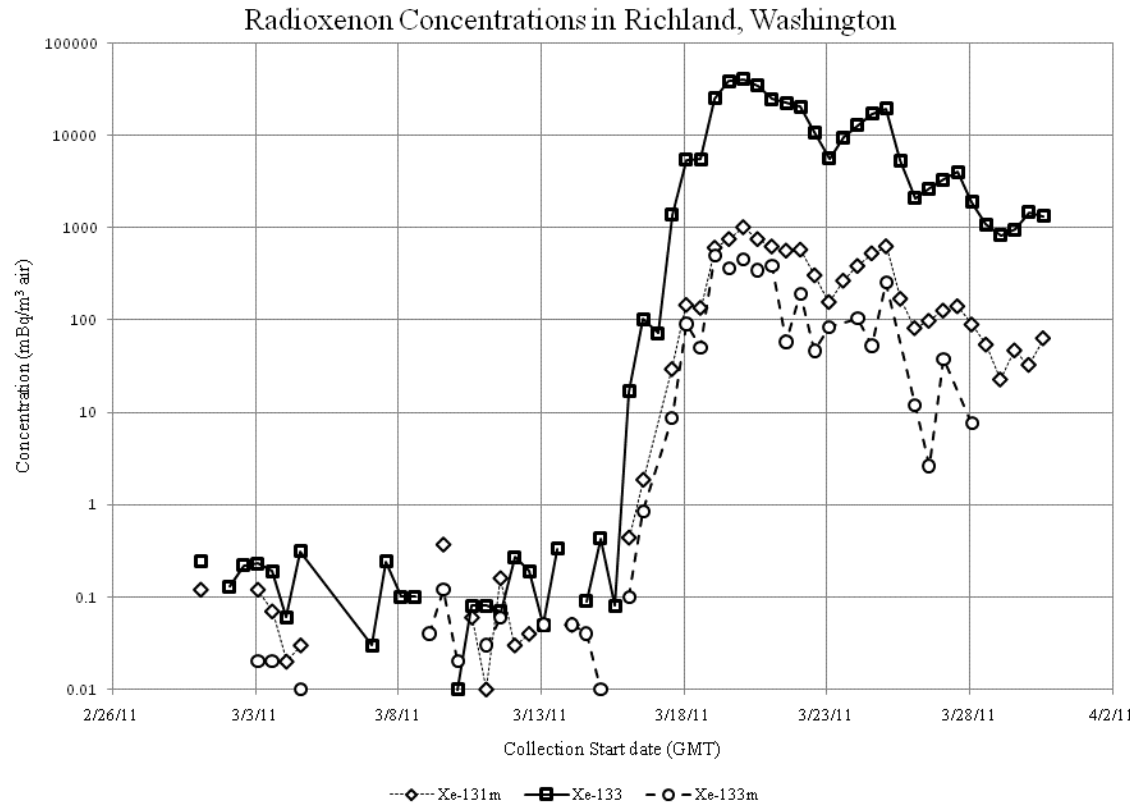
Following the Fukushima Detection

- ▶ Evidence of radionuclide released reached the Japanese IMS station within 2-3 days
- ▶ First evidence of the plume hitting the United States came to PNNL's experimental equipment about 1 day later (March 16)

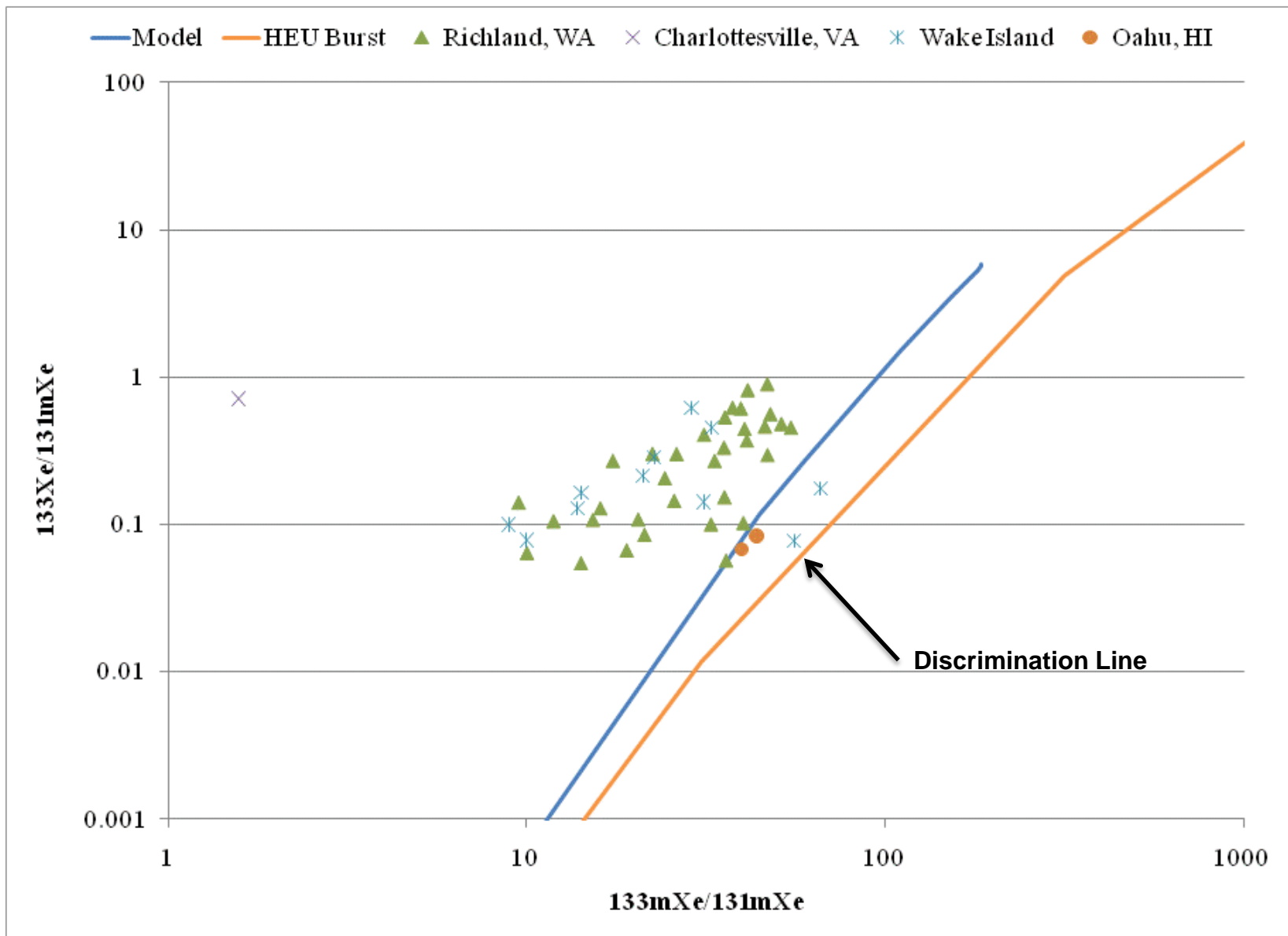


Our First Results

- ▶ Xenon-133 measurements were x450,000 our detection levels using a SAUNA-II xenon measurement system
- ▶ Noble gas does not “wash-out,” and is the first emitted from any possible fuel damage
- ▶ Levels persisted for weeks and isotopes were ultimately detected across the northern hemisphere
- ▶ We were able to calculate the amount of noble gases emitted from the cores of the three reactors



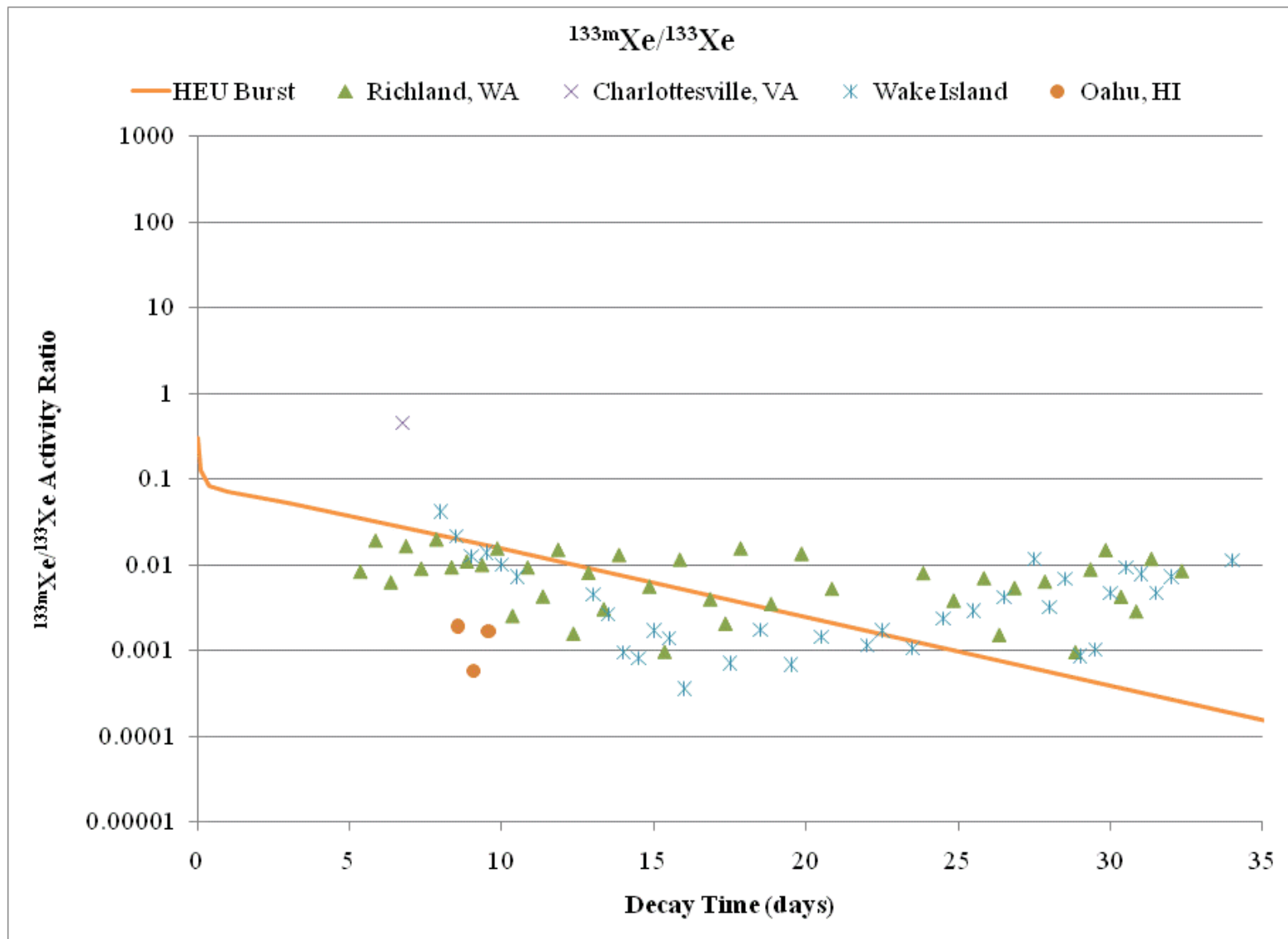
Event Discrimination vs. an Explosion



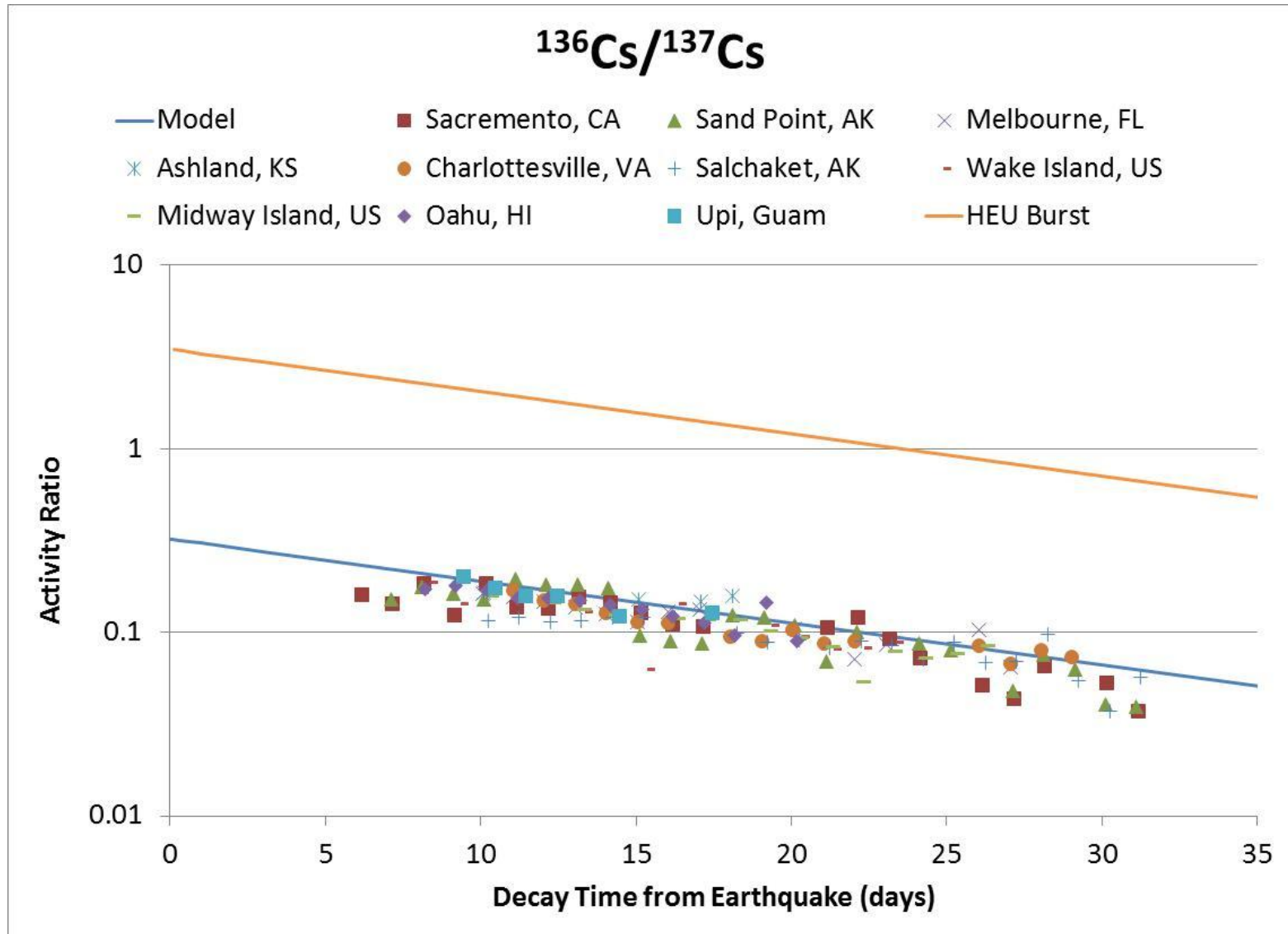
Major Observations

- ▶ The observed xenon isotopic ratios agree with model calculations with some uncertainty
- ▶ High count rates may have affected the measurement of ratios in some cases
 - This is being investigated
 - Effects from Iodine parents and other subtle effects have not been ruled out as causing ratios to deviate from the model
- ▶ The xenon measurements made by IMS-like equipment was the highest fidelity measurements made and far superior to what was available post-Chernobyl

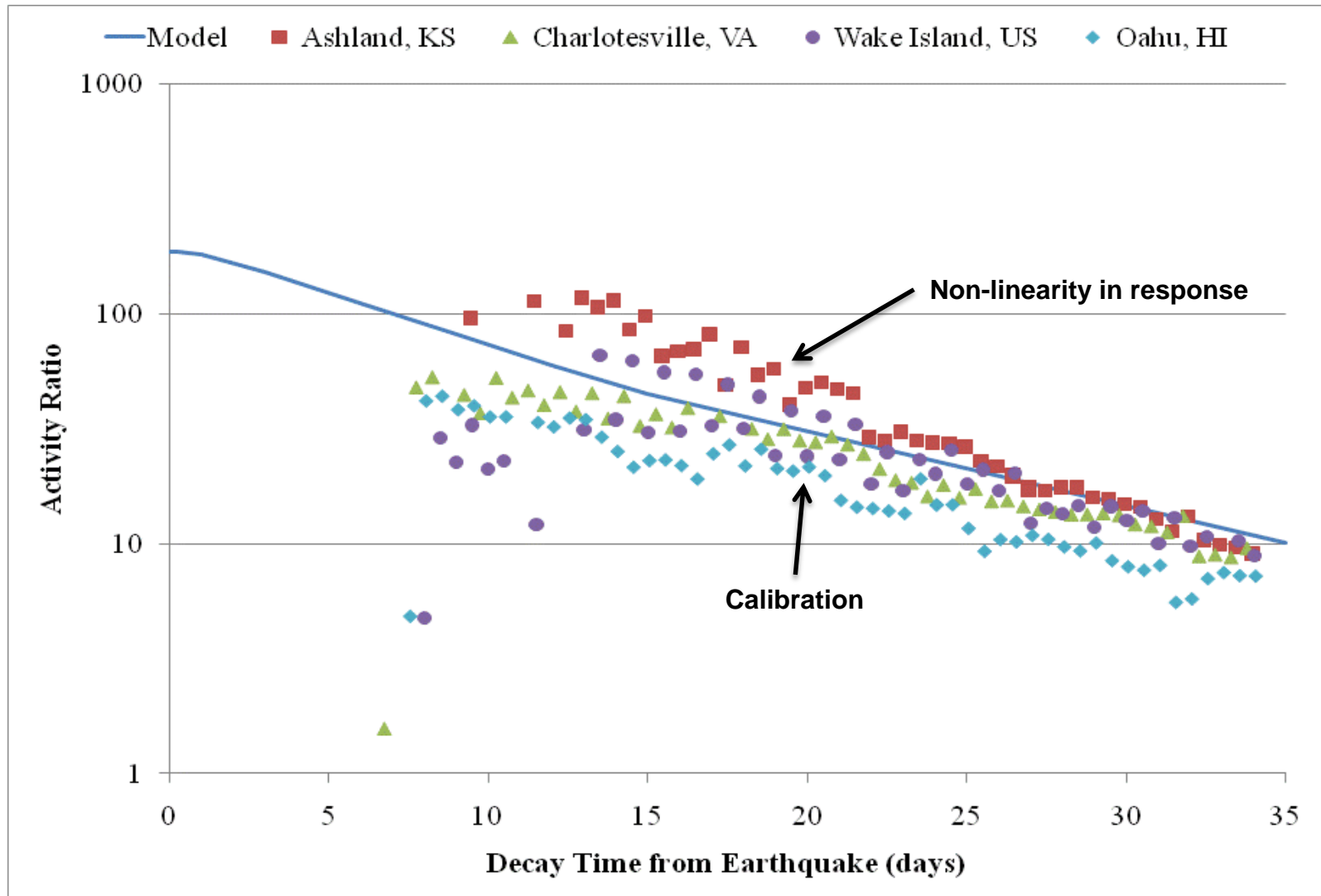
Use of the $^{133m}\text{Xe}/^{133}\text{Xe}$ Ratio



Check of the Model Using Cs Isotopes

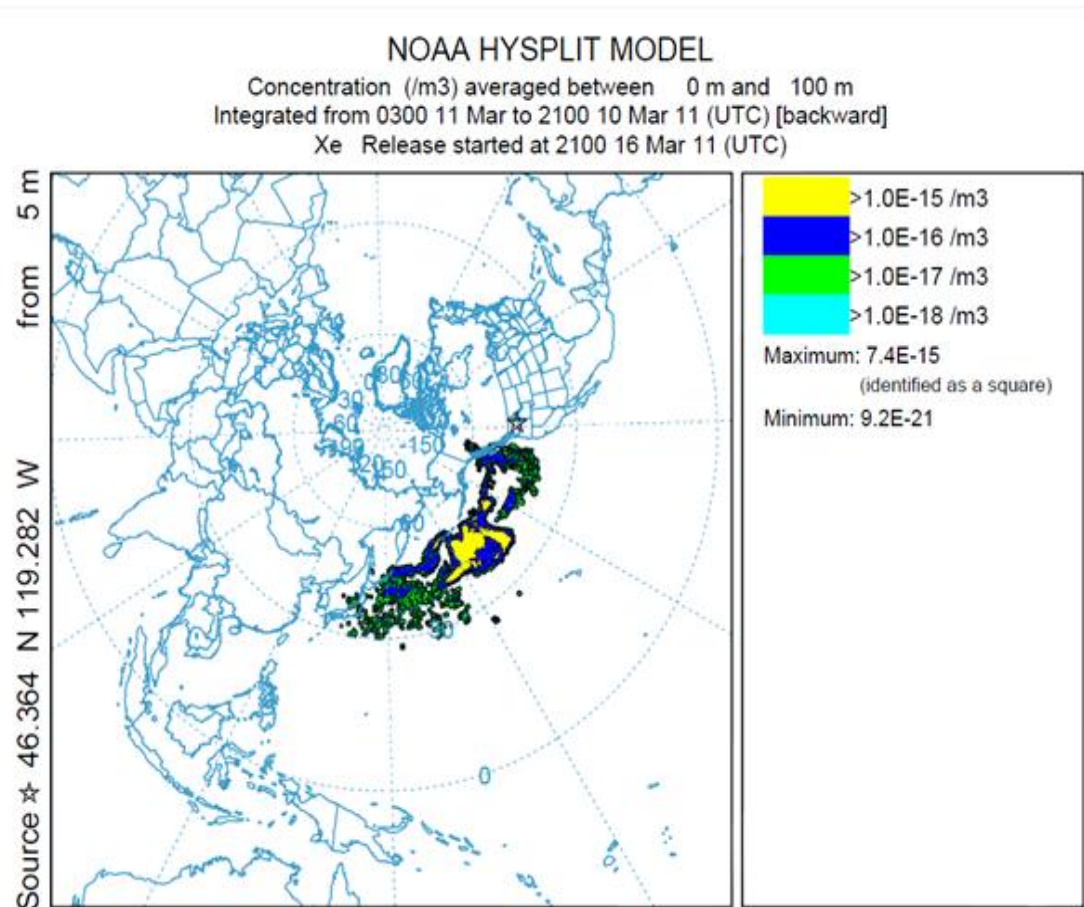


Details of the Ratios at U.S. IMS Stations



Determination of Source Term

- ▶ Using atmospheric transport modeling, a value of approximately 1.2×10^{19} Bq was emitted
- ▶ Details of the modeling are available upon request
- ▶ This is 95% of the total inventory of ^{133}Xe



Conclusions

- ▶ Xenon radioisotopes were easily detected from the Fukushima event at many locations
- ▶ Early evidence of fuel damage from Fukushima
- ▶ Some science impacts
 - Estimates total radionuclide release from accident
 - Assists in the determination of the evolving/complex scenario
 - Guide to possible radionuclide fallout
 - Improvement of global atmospheric transport modeling