# Tsunami Marine Debris

## Addressing Radioactivity Concerns

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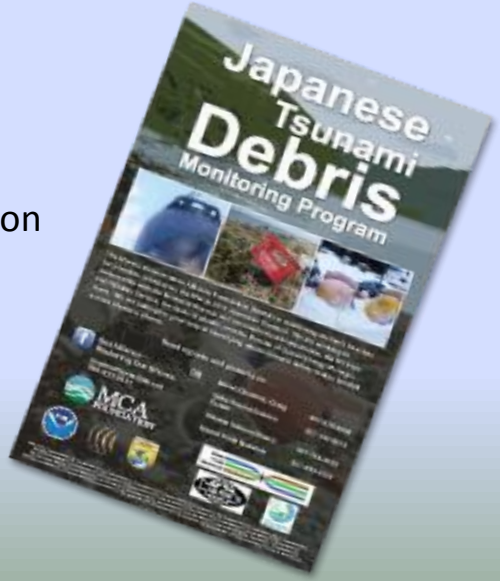


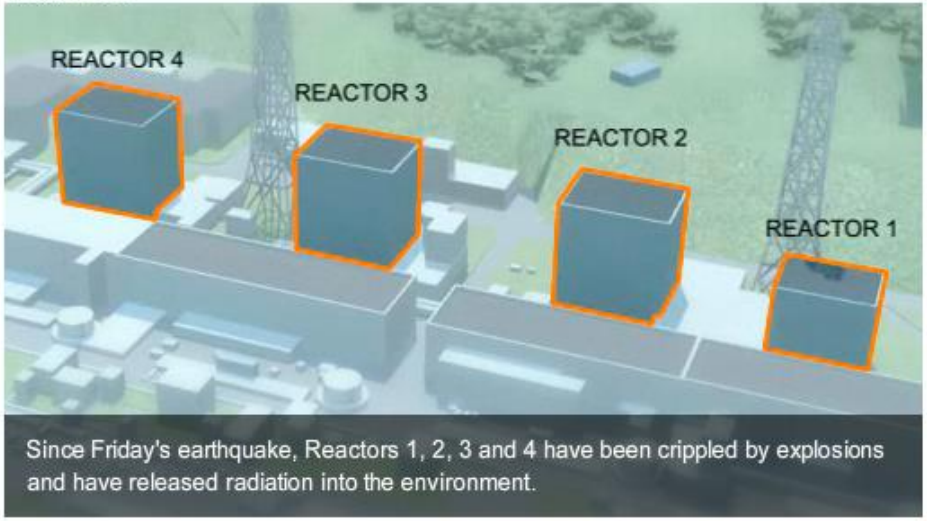
# Japanese Tsunami


# Fukushima Daiichi Nuclear Plant

Published: March 15, 2011

## Accident at Fukushima Daiichi Nuclear Plant

The worst nuclear accident since the Chernobyl explosion in 1986 is unfolding in nor at the Fukushima Daiichi power plant. Three reactors have been critically damaged a caught fire.



# Fukushima Daiichi Nuclear Plant

# The Big Question

*Is the tsunami debris radioactive?*

# First, a few definitions:

- What is “radiological”?

  Radiological refers to any event involving radiation, including radioactive materials and/or machine sources.

- What is an “event”?

  An event refers to any action that has caused significant effects on air, land, water, or the mindset of the affected community.

# LEGAL DEFINITIONS

- A radiation accident is defined by federal agencies as an “incident involving a whole body dose of more than 25 rem (0.25 Sv), or partial body doses of more than 600 rem (6.0 Sv).

- NOTE: A *whole body* dose of 600 rem (6 Sv) is lethal if left untreated.

# INTERNATIONAL NUCLEAR EVENT SCALE

- Level 7 **MAJOR ACCIDENT**
  - *-Chernobyl 1986*
  - *- Fukushima 2011*
- Level 6 **SERIOUS ACCIDENT**
  - *-Kysthym NFRP 1957*
- Level 5 **ACCIDENT WITH OFF-SITE RISK**
  - *-Sellafield NR 1957*
  - *-TMI 1979*
  - *-Tokaimura 1999*
- Level 4 **ACCIDENT W/O SIGNIFICANT OFF-SITE RISK**
  - *-Sellafield 1973*
  - *-Jaslovske B. 1977*
  - *-St. Laurent 1980*
- Level 3 **SERIOUS INCIDENT**
  - *-Vandellos 1989*
- Level 2 **INCIDENT**
- Level 1 **ANOMALY**
- Level 0 **NO SAFETY CONCERN**

# RADIATION or RADIOACTIVITY?

- In general, radiation refers to the energy or particles streaming from a device, which can be turned off. These are not radioactive materials.

- Radioactivity refers to disintegrating atoms which cannot be stopped from disintegrating, so they must be shielded. These are radioactive materials.

# Radiation Units

- Roentgen – Of interest only to physicists
- Rads & Grays – Absorbed dose, most useful for describing partial body exposures
- Rems & Sieverts – Equivalency unit, useful for describing whole body exposures
- Curies & Becquerels – Indicate number of atoms disintegrating, but reveal little about the exposure dose or internal exposure received from a radioactive material

# RADIATION & RADIOACTIVITY "DOSE"

The term "Dose" is used in many ways with respect to radiation, which causes some confusion.

Examples:

- **Exposure dose – measured in rads, rems,**
  - **(Actually, there are 10 different variations)**
- **Activity dose – measured in curies, Becquerels**
- **Volume dose – measured in ml or cc**
- **Chemical dose – quantity of a given chemical per volume of compound (measured in mg or µg)**

# COMPARATIVE EXPOSURES

| **Radiation Source Exposure (mSv)** | |
|---|---|
| • Japan - contamination in AK | 0.000000000002 |
| • Background - All sources – Alaska | 6.2 |
| • TSA - Airport Scanner - claimed | 0.00002/scan |
| • Transcontinental flight | 0.2/flight |
| • DEXA scan | 0.001/scan |
| • Chest x-ray (trained operator - AK) | **0.09** |
| • Mammogram | 0.04 |
| • Chest x-ray (un-trained operator) | **5.4** |
| • Barium enema | 7.0 |
| • CT abdomen | 10.0 |
| • Coronary angiogram | 8-60.0 |
| • Japan - 3 workers | 170-180 |
| • Radiation sickness | 1,000 |
| • Death | 6,000 |

# RADIATION IS WHERE YOU FIND IT…

- Hospital imaging
- Dental
- Radiation therapy
- Industrial radiography (oil Companies)
- School science labs
- Airport baggage
- Cruise ship baggage
- Federal offices
- Electron microscopes

- Consumer Products
  - Ceramic dishes
  - Welding rods
  - Watches & clocks
  - Glues
  - Shift quadrants
  - Fertilizers
  - Camp light mantles
  - Aircraft instruments
  - Building materials
  - Loss Prevention tags

# RADIATION IN OUR ENVIRONMENT

- Air, soil, water
- Medical
- In our body normally
- Consumer products
- Found naturally in foods
- Irradiated foods
- Cosmic, terrestrial, and primordial

# Consumer products

- Coleman lantern mantles
- Fiesta ware, Vaseline glass, other ceramic products
- Luminous wrist watches
- Welding rods
- Wood glue
- Marble counter tops
- Certain fruits and nuts - bananas, almonds
- Fertilizers (high phosphate)
- Instrument dials
- Jewelry
- Clay figures from South America
- Radon gas from the ground
- Television sets
- Airport scanners and baggage systems
- Tobacco products
- Eyeglasses
- False teeth
- Aircraft counterbalance weights
- Lead protective aprons

# Foods

- *Naturally radioactive**
  - *Bananas (3,520 pCi)/kg*
  - *Brazil nuts (6,000 pCi)/kg*
  - *Carrots (3,400 pCi)/kg*
  - *White potatoes (3,400 pCi)/kg*
  - *Beer (390 pCi)/kg*
  - *Red meat (3,000 pCi)/kg*
  - *Lima beans (4,640 pCi)/kg*
  - *Water (0.17 pCi/kg)*

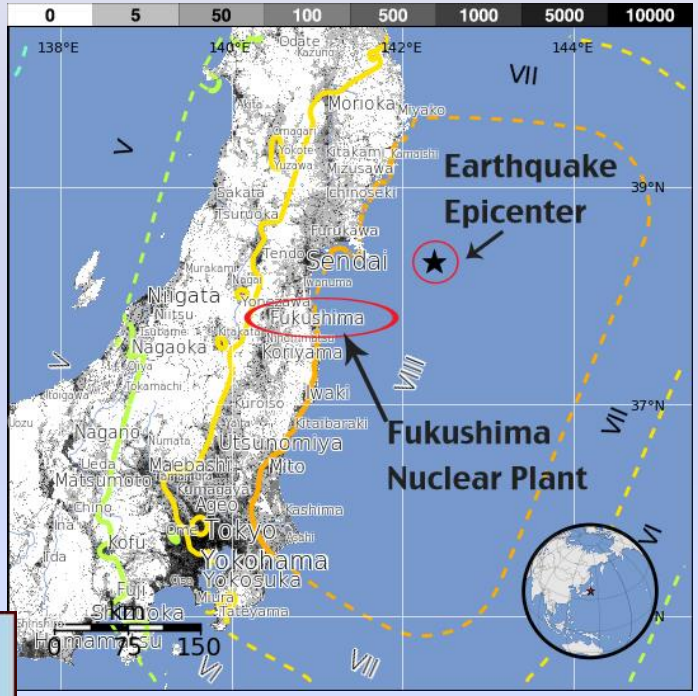
  *All the above, except the beer, also contain radium

- *Irradiated*
  - *Meat, poultry*
  - *Grains, cereals*
  - *Fruits*
  - *Onions, carrots, potatoes, ginger*
  - *Mangos, papaya, guava*
  - *Fish, seafood*
  - *Spices*
  - *Low sodium salt*

# Three fundamental principles

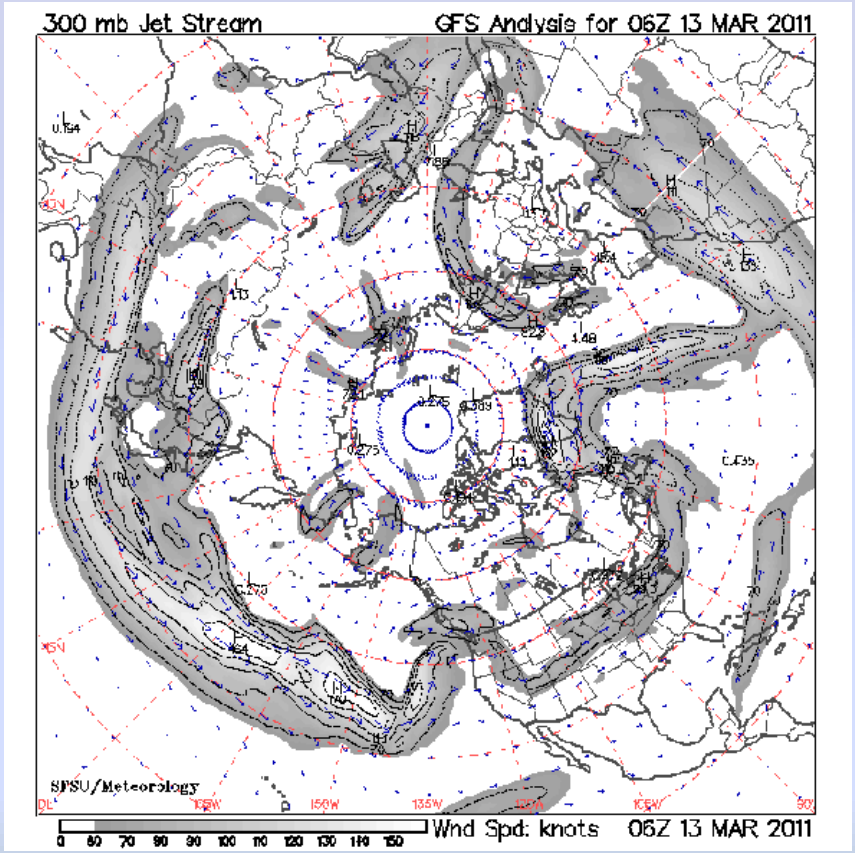
- **Time**
  - Procedural time, flush out
- **Distance**
  - Standing distance, tongs, shielding
- **Shielding**
  - Lead, Dirt, concrete, steel

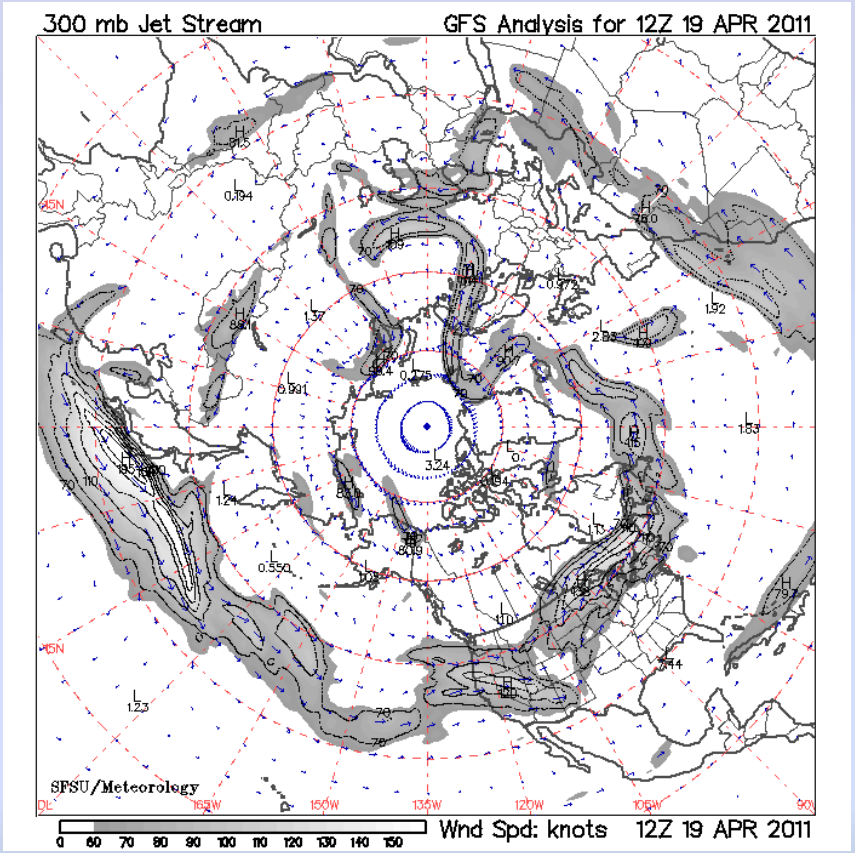
# U.S, Japan - Map


0
5
50
100
500
1000
5000
10000
138°E
140°E
142°E
144°E
39°N
37°N
Earthquake
Epicenter
Fukushima
Nuclear Plant
Sendai
Niigata
Fukushima
Nagaoka
Koriyama
Iwaki
Utsunomiya
Mito
Tokyo
Yokohama
Yokosuka
Hamamatsu
0
75
150
km

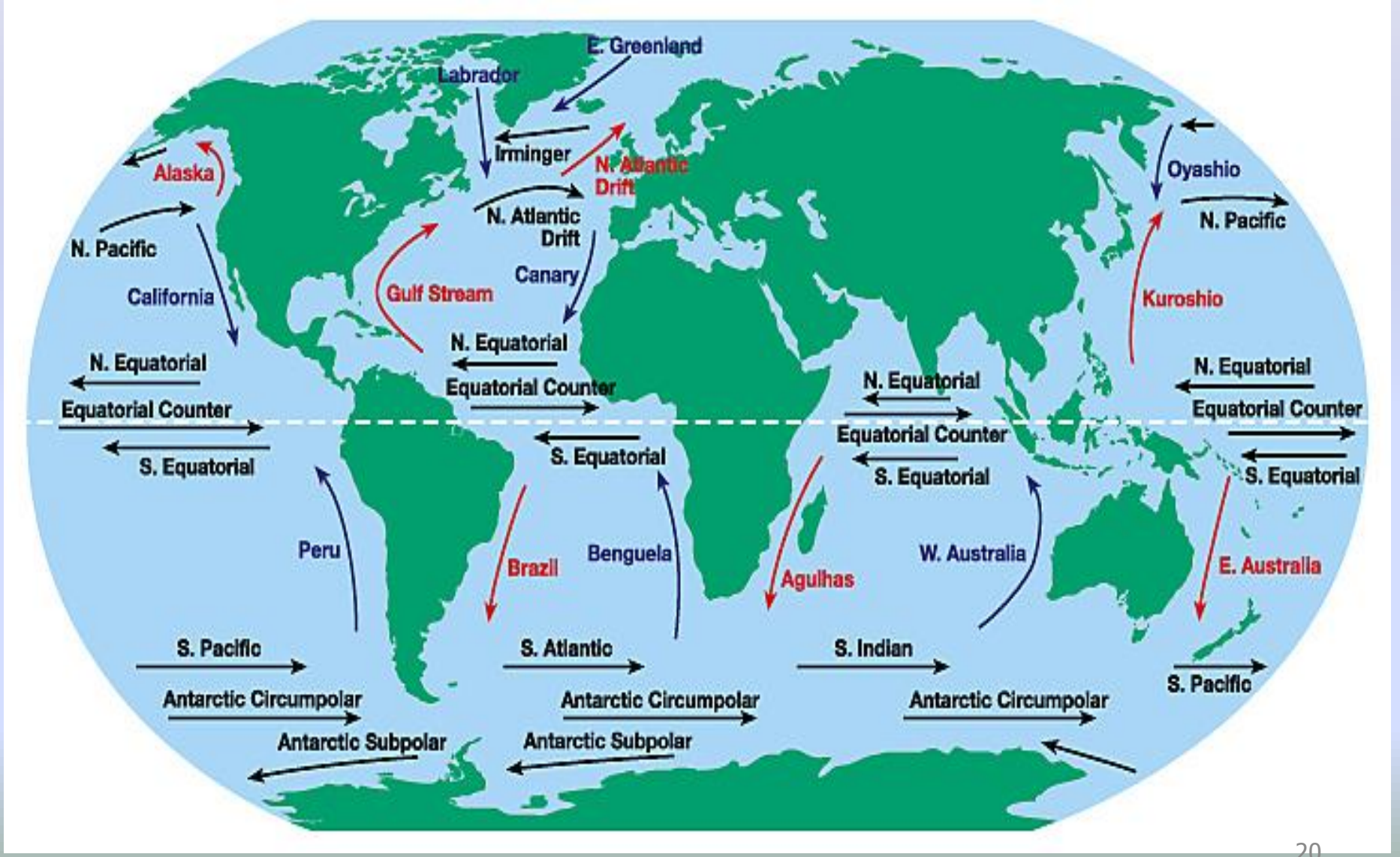

JAPAN
RUSSIA
KYŪSHŪ
HOKKAIDŌ
East China Sea
Tokara-shotō
Sapporo
Daisetsuzan National Park
Amami-shotō
Sea of Japan (East Sea)
Aomori
Okinawa-hontō
Okinawa City
Miyako-shotō
Yaeyama-shotō
Niigata
Sendai
Noto-Hanto Peninsula
HONSHŪ
JAPAN
PACIFIC OCEAN
SOUTH KOREA
Matsue
Mt Fuji
TOKYO
Yokohama
Hiroshima
Kyoto
Osaka
Nagoya
Nagasaki
KYŪSHŪ
SHIKOKU
Kirishima National Park
Seagaia
See Inset
0
400 km
0
240 miles

# CURRENTS – JET STREAM



# CURRENTS - OCEAN



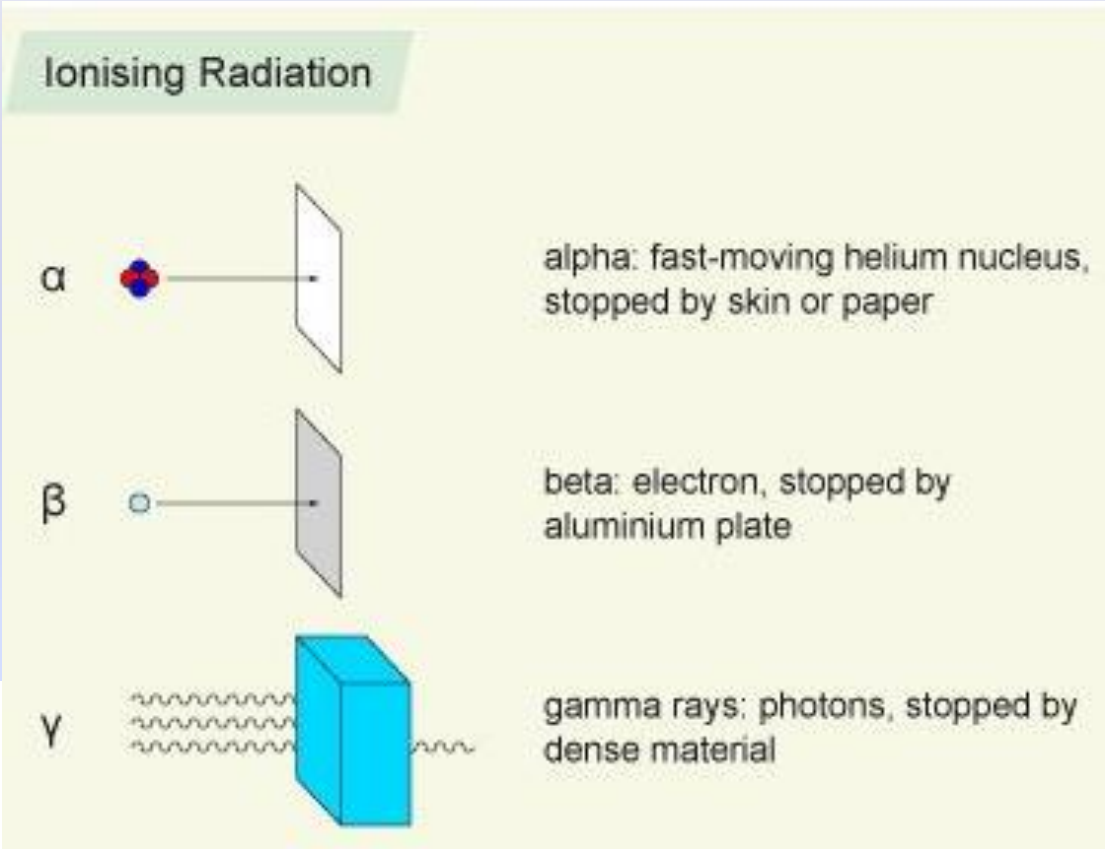
# COMPARATIVE DISTANCES

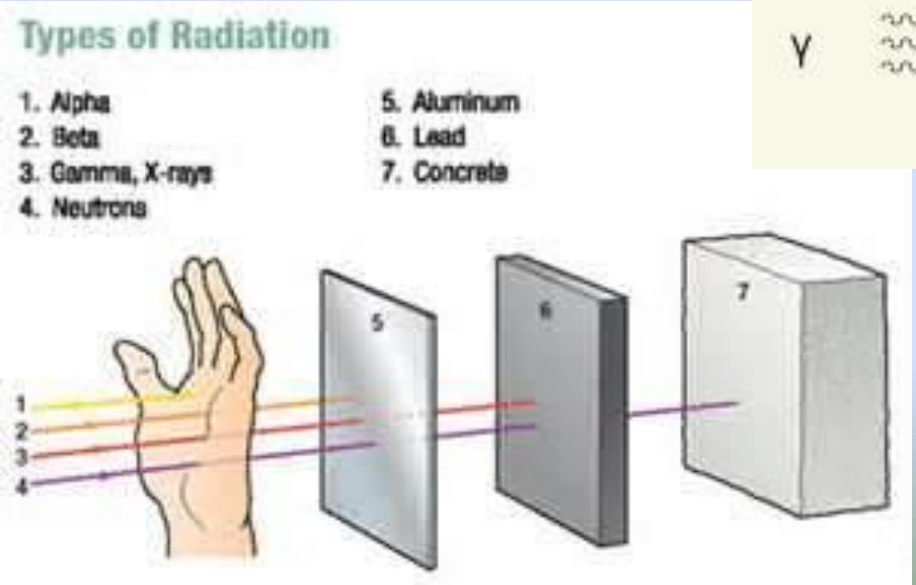
- Sendai to Los Angeles - 5,336 miles
- Sendai to San Francisco - 4,995 miles
- Sendai to Honolulu - 3,791 miles
- Sendai to Anchorage - 3,284 miles
- Sendai to Dutch Harbor - 2,666 miles
- Sendai to Adak - 2,241 miles
- Sendai to New York City - 6,735 miles

# Types of Radiation

| Type of Radiation | Alpha particle | Beta particle | Gamma ray |
|---|---|---|---|
| Symbol | $\alpha$ or $^{4}_{2}\alpha$ or $^{4}_{2}He$ | $\beta$ or $\beta^{-}$ | $\gamma$ (can look different, depends on the font) |
| **Mass** *(atomic mass units)* | 4 | 1/2000 | 0 |
| Charge | +2 | -1 | 0 |
| Speed | slow | fast | very fast (speed of light) |
| Ionising ability | high | medium | 0 |
| Penetrating power | low | medium | high |
| Stopped by: | paper | aluminium | lead |

# Shielding


Ionising Radiation
α
alpha: fast-moving helium nucleus, stopped by skin or paper
β
beta: electron, stopped by aluminium plate
γ
gamma rays: photons, stopped by dense material


Types of Radiation
1. Alpha
2. Beta
3. Gamma, X-rays
4. Neutrons
5. Aluminum
6. Lead
7. Concrete
1
2
3
4
5
6
7

# Fukushima Radioisotopes of Interest

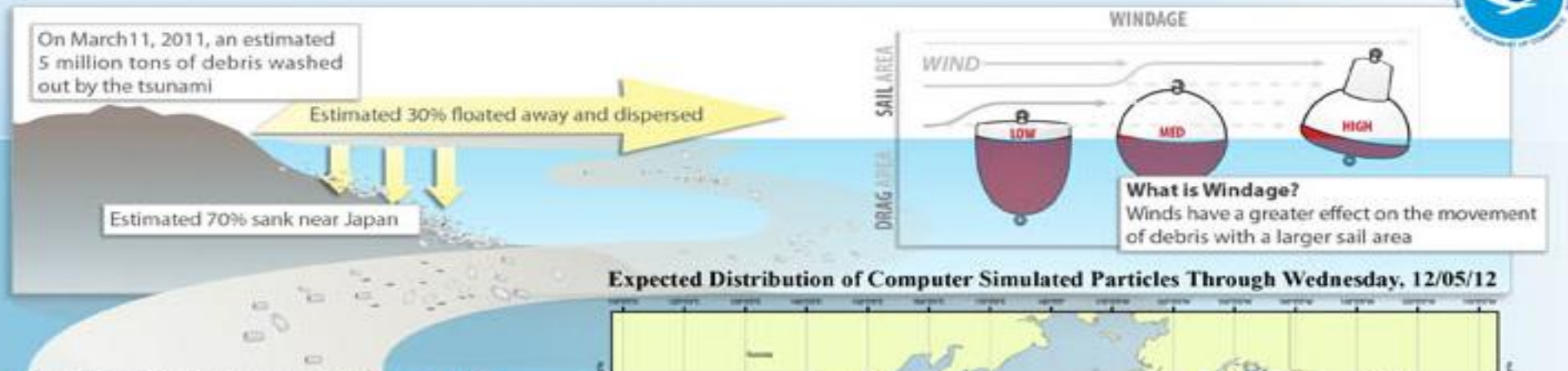
| Radioisotope | Half Life |
| --- | --- |
| Iodine-131 | 8 days |
| Cesium-134 | 2 years |
| Cesium-137 | 30 years |

# *So what do we know?*

- Lots of modeling data on where the tsunami debris is going & how fast it will get there
- Monitoring data
- Ongoing efforts

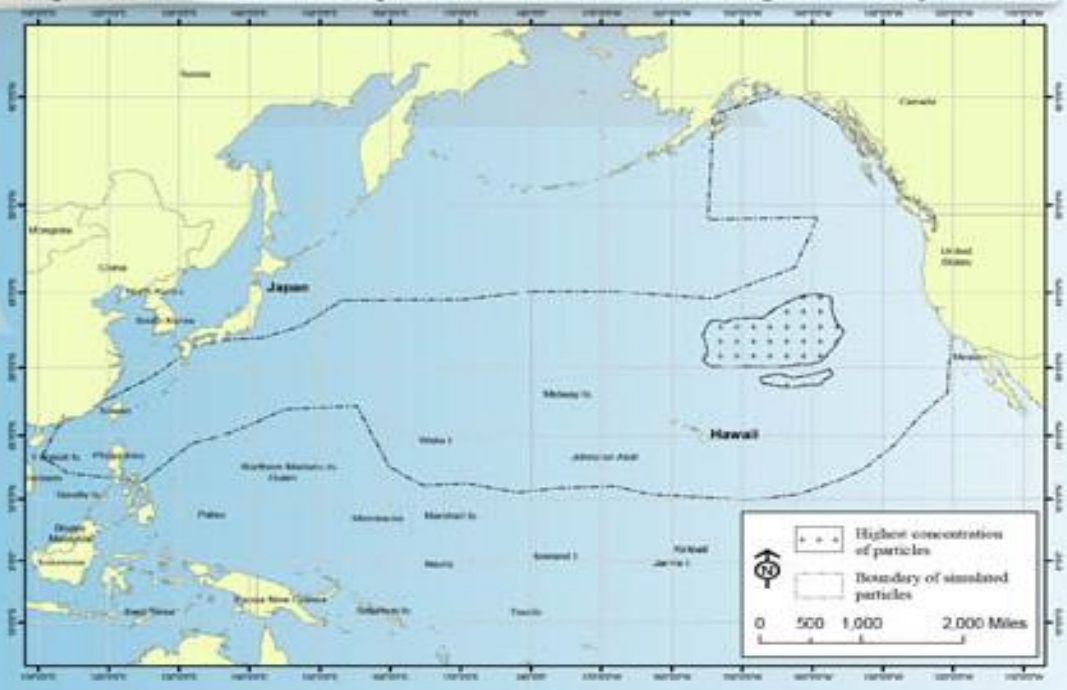
# Tsunami Debris Distribution

## Modeled Movement of the Marine Debris Generated by the March 2011 Japan Tsunami




- Japan Ministry of the Environment estimates that 5 million tons of debris washed into the ocean.
- They further estimated that 70% of that debris sank near the coast of Japan soon after the event.
- Model Results: High windage items may have reached the Pacific Northwest coast as early as winter 2011-2012.
- Majority of modeled particles are still dispersed north and east of the Hawaiian Archipelago.
- NOAA expects widely scattered debris may show up intermittently along shorelines for a long period of time, over the next year, or longer.

**Expected Distribution of Computer Simulated Particles Through Wednesday, 12/05/12**




NOAA used a computer model to simulate the movement of tsunami debris from March 11, 2011, to the present day. This GNOME model (General NOAA Operational Modeling Environment) simulation is based on ocean surface currents from the US Navy (the Hybrid Coordinate Ocean Model) and winds from NOAA (the NOAA blended wind product). The computer model simultaneously released 1,000 simulated particles from each of 8 locations on the Japan coastline where tsunami wave heights were 3.5 meters or greater. Particles were randomly assigned windage values from 1-5%, meaning that they were moved not only by ocean currents, but were also moved by 1-5% of wind speed in the down-wind direction. The dotted black line contains 95% of all simulated particles. The cross-hatched area indicates the region of the highest concentration of simulated debris with 1% windage at the end of the simulation. For more details on this model, please visit **marinedebris.noaa.gov**. Have you seen tsunami debris? Report it to: **DisasterDebris@noaa.gov**


- Monitored for Impact of Tsunami on Reactor & Material Licensees in Western States & Pacific Territories
- Began 24-Hour Monitoring & Analysis
- Sent NRC Team to Offer Expert Advice
- HQs Operations Center staffed 24/7 for two months in Monitoring mode
- Participation in Government & Industry Consortium to develop solutions & strategies to share w/ Japanese government
- Task force report on lessons learned containing 12 general recommendations

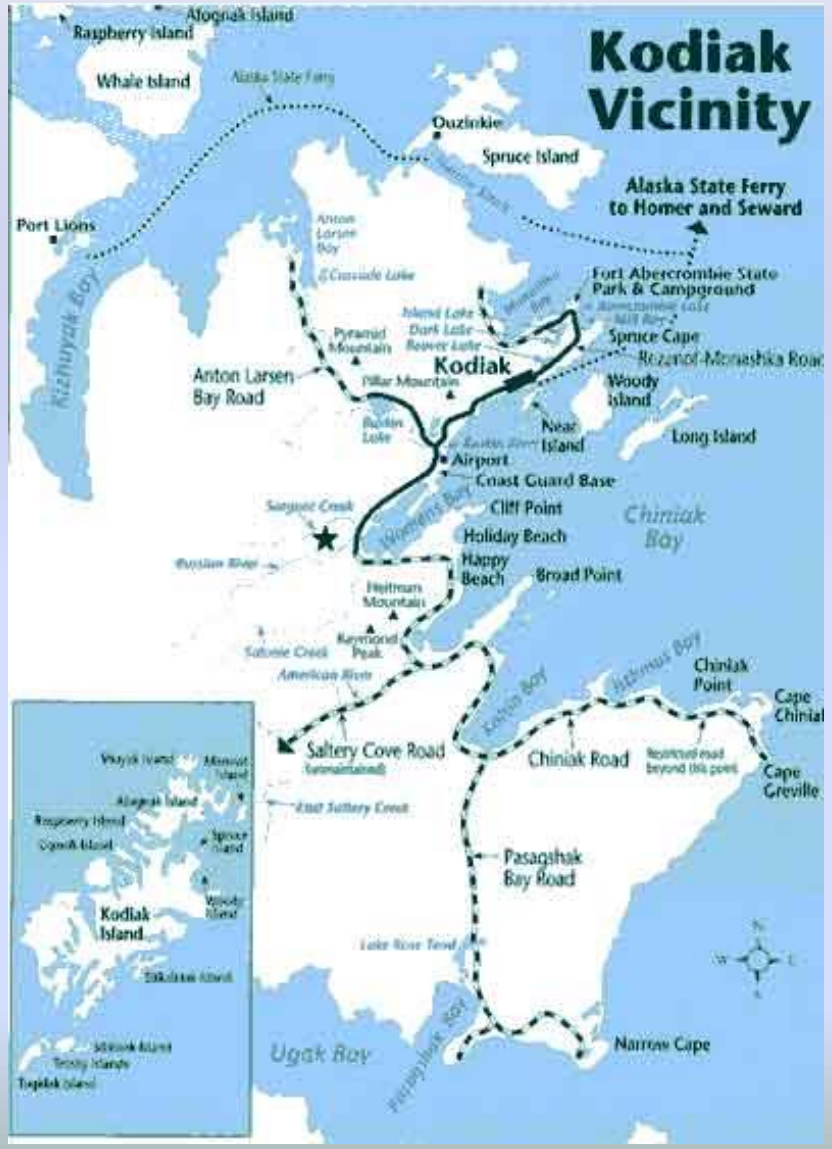
# DH&SS Testing

- Kodiak, Craig & Montague Island
- 3 kinds of testing performed
  - Sample collection
  - Wipe testing
  - Surface meter readings (large objects & kelp)
- No levels found above background at any location

# GM Survey Meters with Probes

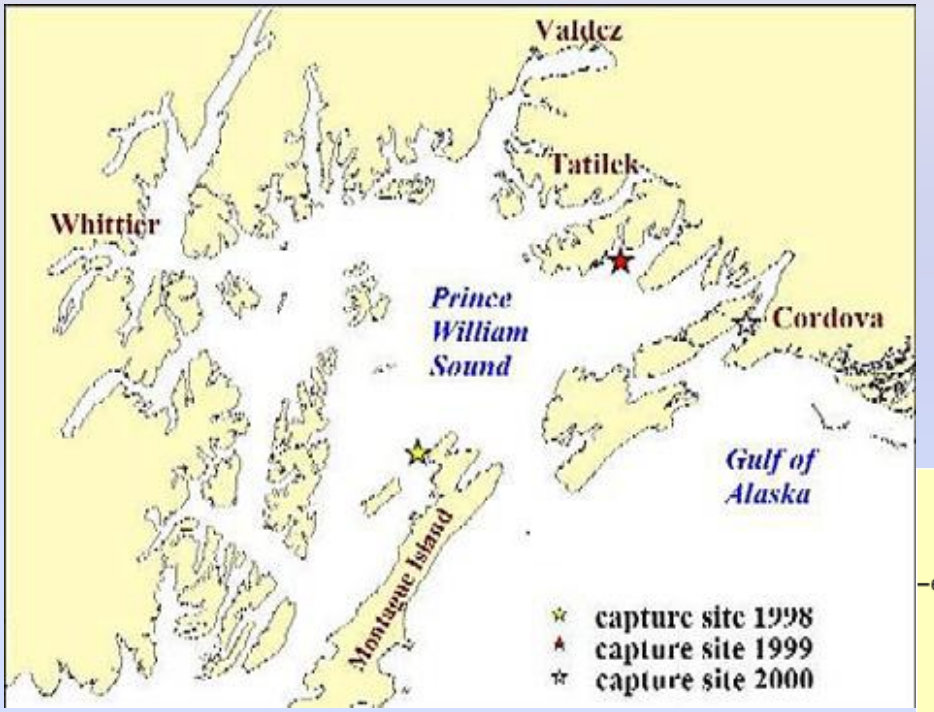
# SpecTech UCS-20 and well counter

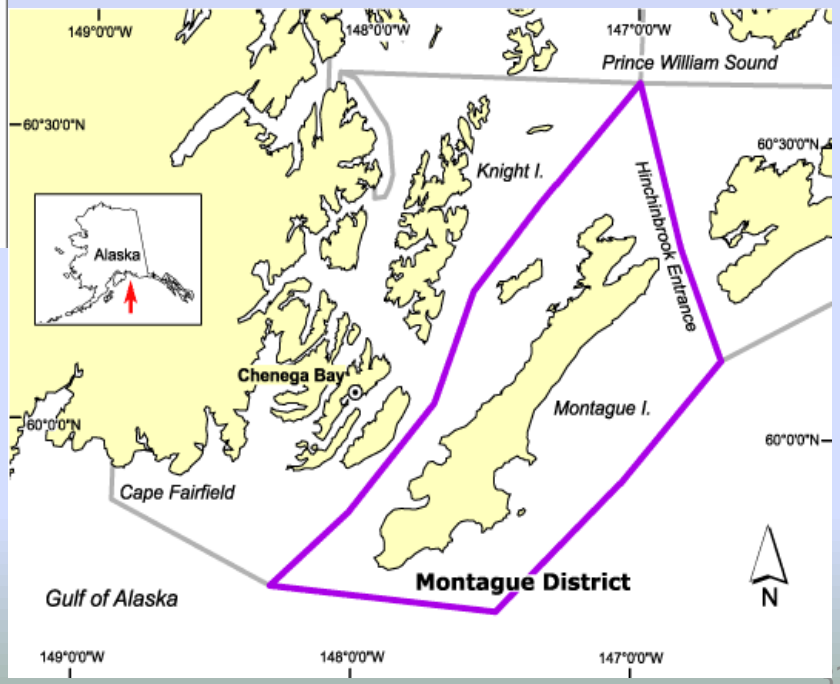

# KODIAK ISLAND




# CRAIG (Prince of Wales Island)

# Montague Island (PWS)



# Montague Island Debris

# Marine Conservation Alliance Foundation (MCAF)

- Screening of tsunami marine debris show no signs of radiation


- Japanese tsunami marine debris website
  - http://www.mcafoundation.org/tsunami_debris.html

# Marine Conservation Alliance Foundation (MCAF)

- 4 areas in Alaska on the North Pacific selected based on strategic location, accessibility & experienced personnel.
  - Systematic coverage began in late December & continuing.
  - Accessibility issues - weather has prevented access.

- Monitors supplied with Geiger counters instructed to survey beaches for items that may possibly be from the Japanese tsunami.

- 3 of 4 areas surveyed & only 2 areas surveyed often
  - Yakutat area has seen the most items that may be associated with the tsunami. Primarily floats used on Japanese oyster farms.

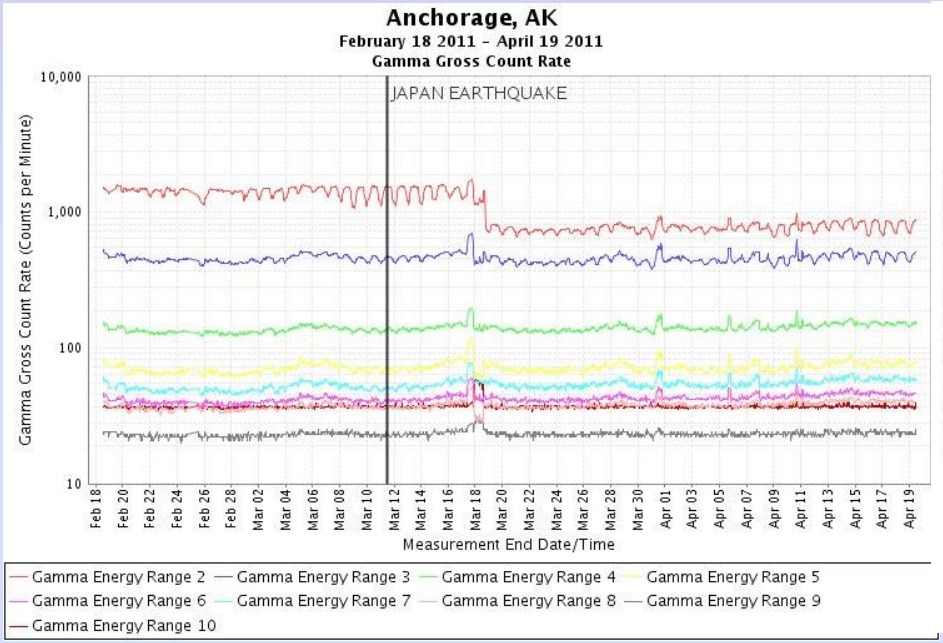
- All of the monitors have reported that no items have shown signs of radiation.

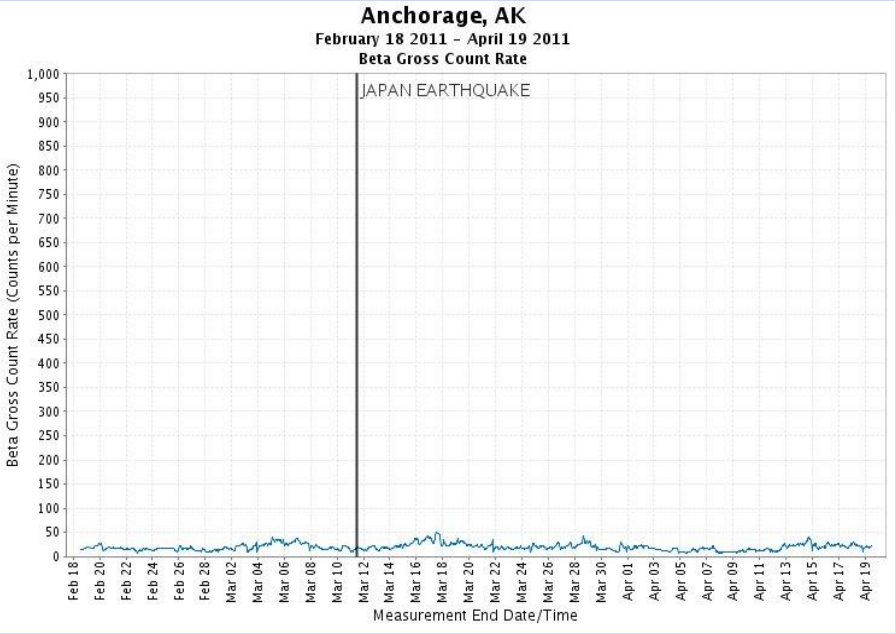
# Alaska Air Monitoring

- EPA's RadNet air monitoring
  - 3 permanent locations in AK (Anchorage, Fairbanks, Juneau)
  - 2 temporary mobile units (Unalaska & Nome)
    - Highest level of Iodine-131 detected in Dutch Harbor (2.8pCi/$m^3$)

# RadNet Air Monitoring

# RadNet Monitoring results – Anchorage

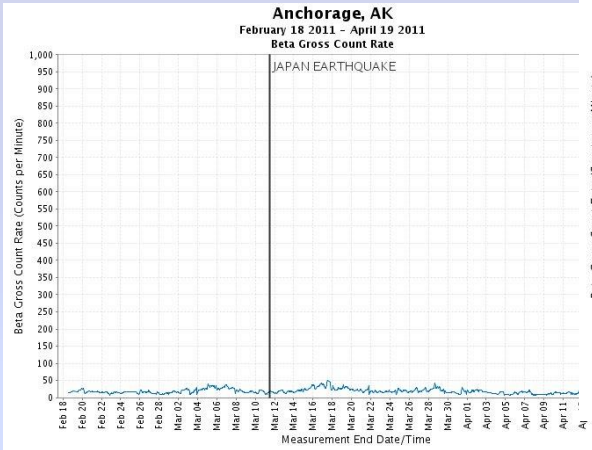


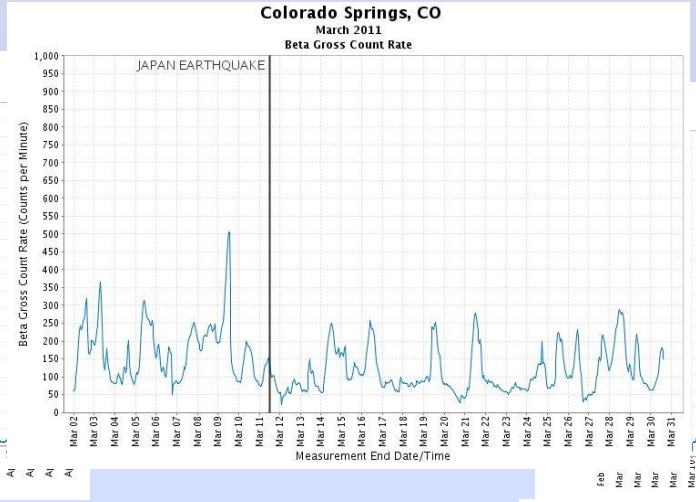



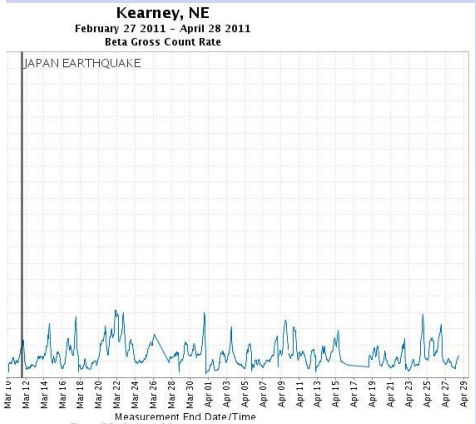

Gamma

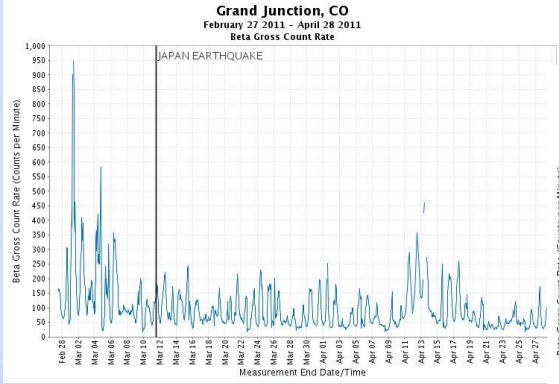
Beta

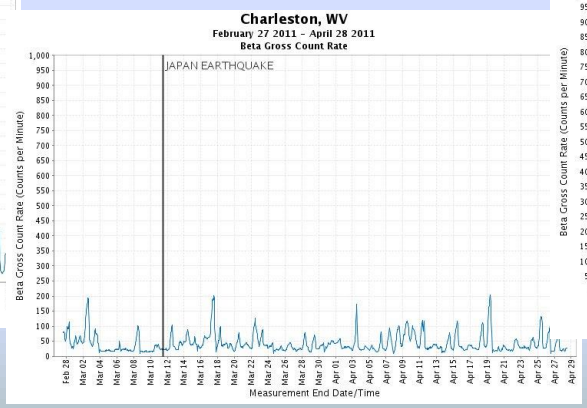
# SAMPLES OF BETA RESULTS IN OTHER STATES. . . .

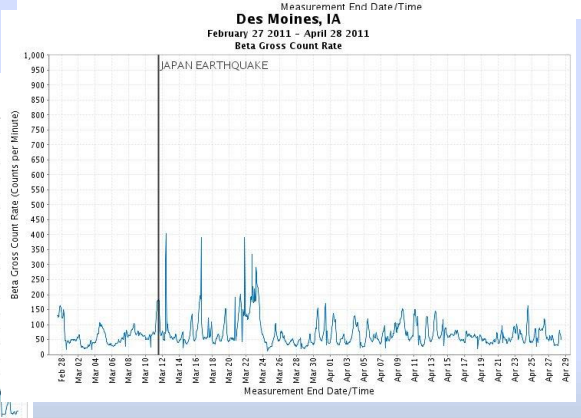


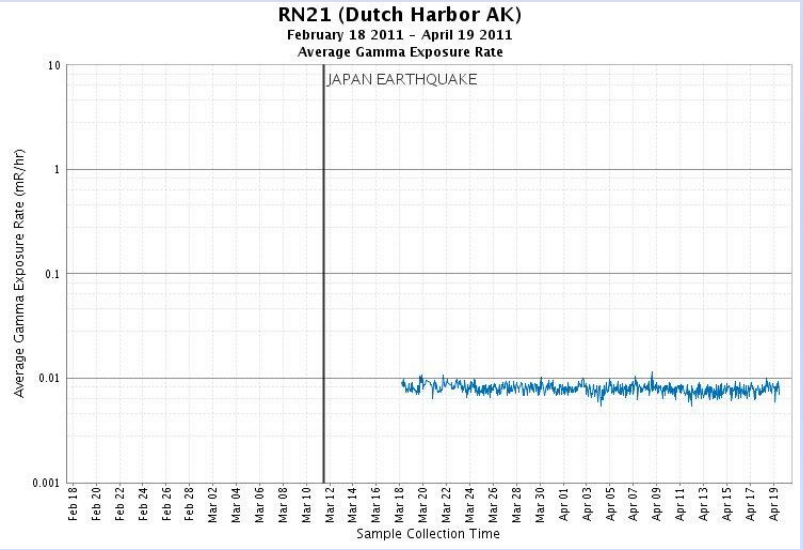



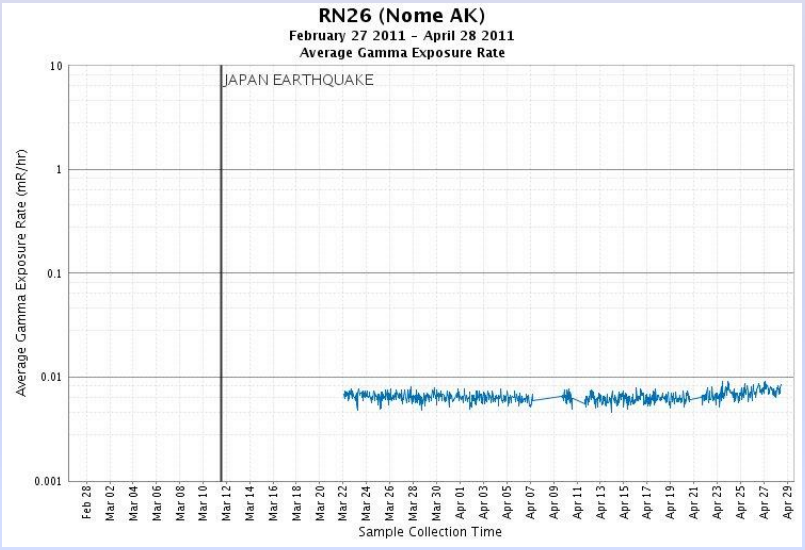



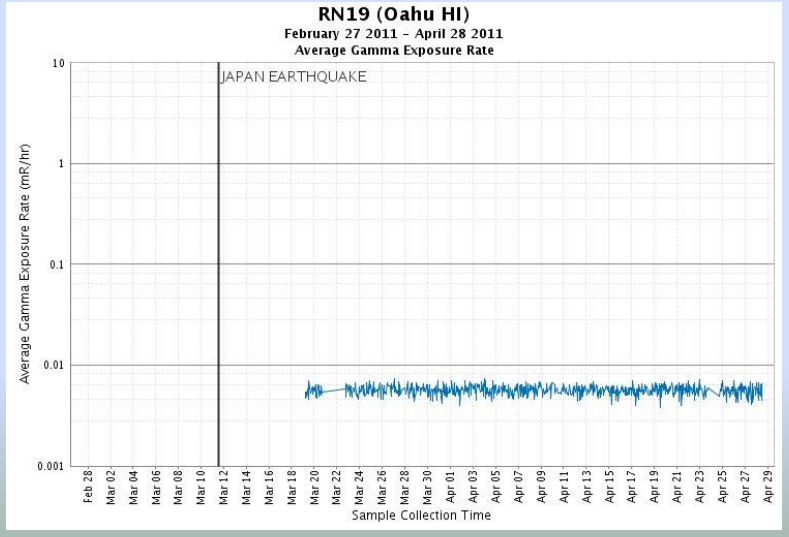



# RAD NET Results – Mobile



# Radiation & Seafood

- EPA, FDA, NOAA, & WHO maintain that seafood is safe
- FDA monitoring data available online
- ADEC Food Safety & Sanitation Program - *Fish & shellfish from Alaskan waters & beaches are not affected by the nuclear reactor damage in Japan & are safe to eat.*

# Additional Information

EPA's Japanese Nuclear Emergency: EPA's Radiation Monitoring
http://www.epa.gov/japan2011/

FDA's Radiation Safety
http://www.fda.gov/NewsEvents/Public HealthFocus/ucm247403.htm

NOAA's Japan Tsunami Marine Debris
http://marinedebris.noaa.gov/tsunamidebris/

Alaska Department of Health & Social Services Division of Epidemiology Radiation Information
http://www.epi.hss.state.ak.us/eh/radiation/default.htm

Alaska Department of Environmental Conservation Division of Air Quality Monitoring and Quality Assurance – Environmental Radiation
http://www.dec.state.ak.us/air/am/rad/radhome.htm

Alaska Department of Environmental Conservation Division of Food Safety & Sanitation Program
http://dec.alaska.gov/eh/fss/Food/radiation_news.htm

U.S. Nuclear Regulatory Commission Actions in Response to the Japan Nuclear Accident: Timeline
http://www.nrc.gov/reactors/operating/ops-experience/japan/japan-timeline.html

# Acknowledgements


- Alaska Department of Environmental Conservation (ADEC)
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- Environmental Protection Agency (EPA)
- Marine Conservation Alliance Foundation - Dave Gaudet
- National Oceanic and Atmospheric Administration (NOAA)
- Nuclear Regulatory Commission (NRC)
- University of Alaska, Fairbanks – Doug Dasher