Citizen Science During Nuclear Emergency

Analysis of the Fukushima-Dahichi Nuclear Accident

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CyberScience

PENNSTATE 1855

- Last 3 centuries: observation, theory development, experimentation
- Last 3 decades: computation and data-enabled research
- 10 years ago: CyberScience and Geoinformatics
- Far reaching repercussions in the sciences, engineering, and the humanities
- Transformative and will continue to change the way research is undertaken

From Data to Knowledge

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- Problem
  - Raw data is useless
    - Data: recorded information; collection of symbols
    - Information: Interpreted data
    - Knowledge: Patterns in data to solve a problem

- Solution
  - Geoinformatics algorithms
  - Methods from AI, Machine Learning, GIS, Research on databases, Mathematics, Statistics

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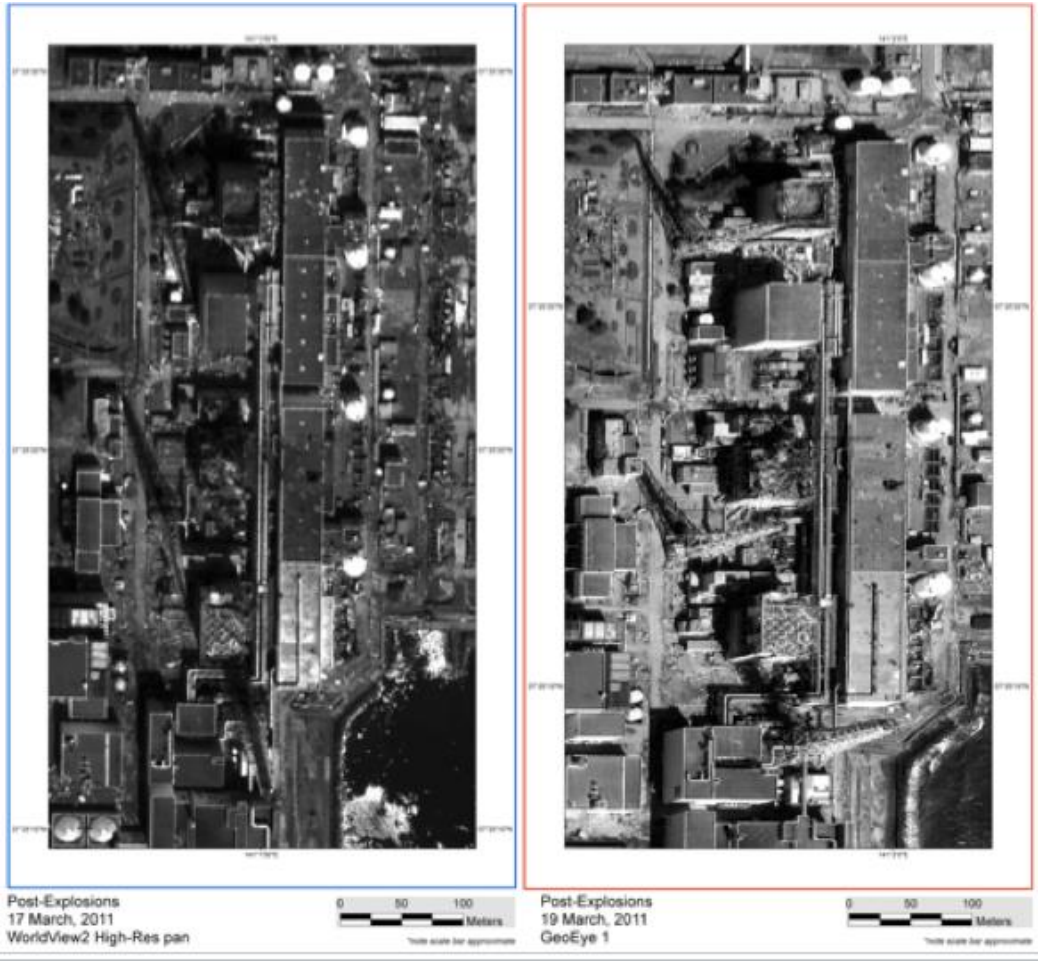
G. Cervone, J. Lin, N. Waters Data Mining for Geoinformatics, Springer, 223 pages, 2014

Data Types

- Largest Datasets
  - Commercial Transactions
  - Videos and Audio
  - Remote Sensing
  - Numerical Modeling
  - Volunteered Geographical Information
    - Social Media
    - Citizen Science

Satellite Images



United States Department of the Interior

U.S. GEOLOGICAL SURVEY
Reston, Virginia 22092

Mr. Guido Cervone
Center for Earth Observing and Space Research
George Mason University
4400 University Drive
MS 5C3
Fairfax, Virginia 22044

MAR 2 9 2011

Dear Mr. Cervone:

The March 10, 2011 earthquake and tsunami was a great tragedy for the nation of Japan. I would like to commend you and your colleagues for your impressive effort and commitment made in response to the demands of the disaster and the request of the Government of Japan. Your hard work and personal sacrifices benefited the Japanese and U.S. agencies assisting in the response effort during a very busy and difficult time.

The efforts you have put forth in collecting and analyzing imagery and creating maps depicting the areas impacted by the disasters, have been recognized and appreciated by many agencies responding to the disaster. As Hiroshi Murakami of the Geospatial and Information Authority of Japan (GSI) indicated in a message:

> "the image maps posted by Brenda Jones (all created by U.S. Volunteers) seem to cover most of the important coastal areas of Iwate Prefecture, and will be very helpful for understanding the impact. The weather in the region did not allow us to take air photos today, and these image maps are very helpful. I was impressed that so much information on the damaged areas becomes available on the web immediately after the earthquake by many experts in the world."

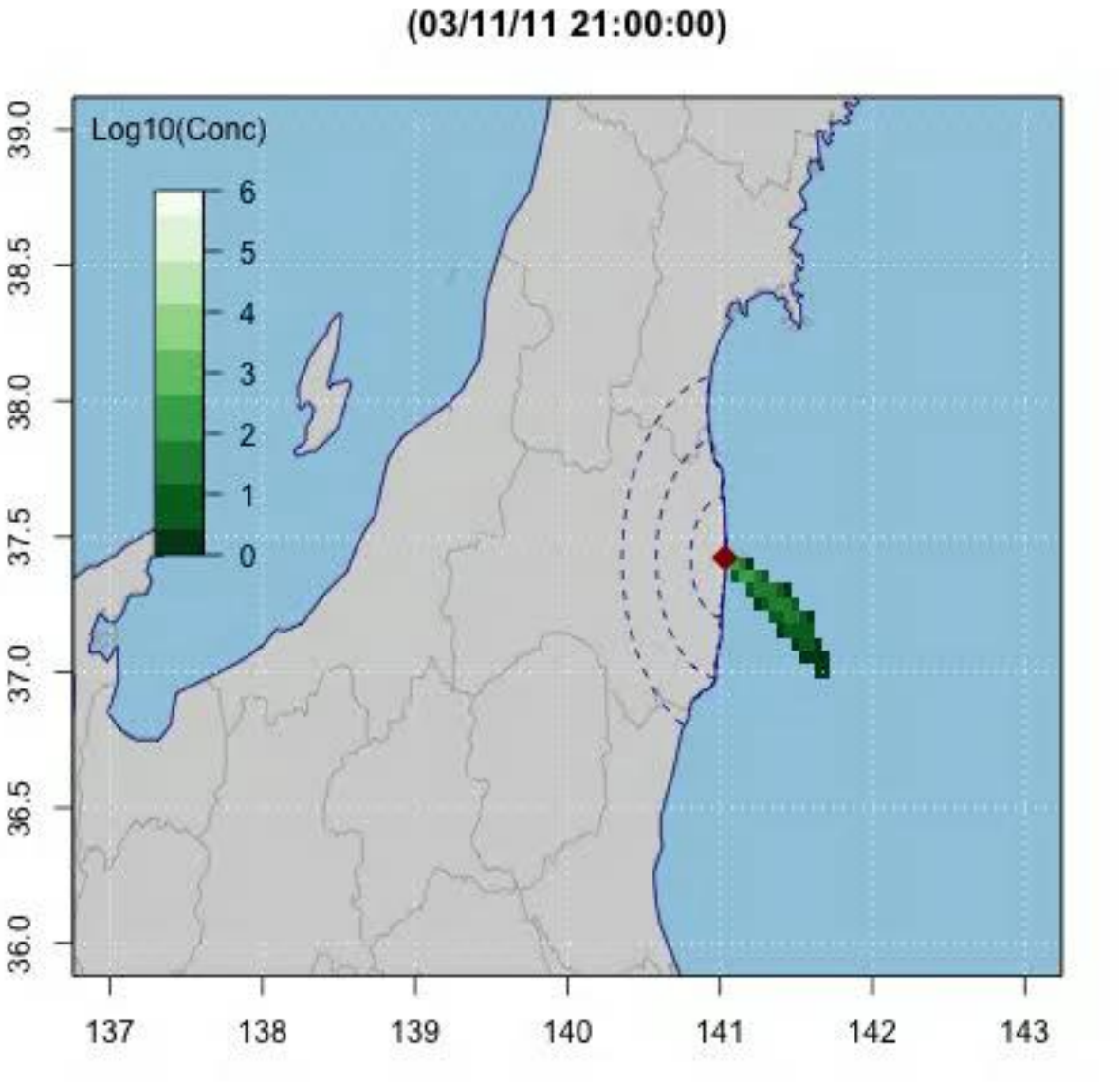
On behalf of our Japanese and U.S. agency colleagues, the USGS would like to recognize your contributions to the 2011 Japan Earthquake/Tsunami Response Effort and extend our sincere thanks and appreciation for your immediate action and quick response to the request for assistance. This positive response to the Japanese request for assistance would not have been possible without your help.

Sincerely,

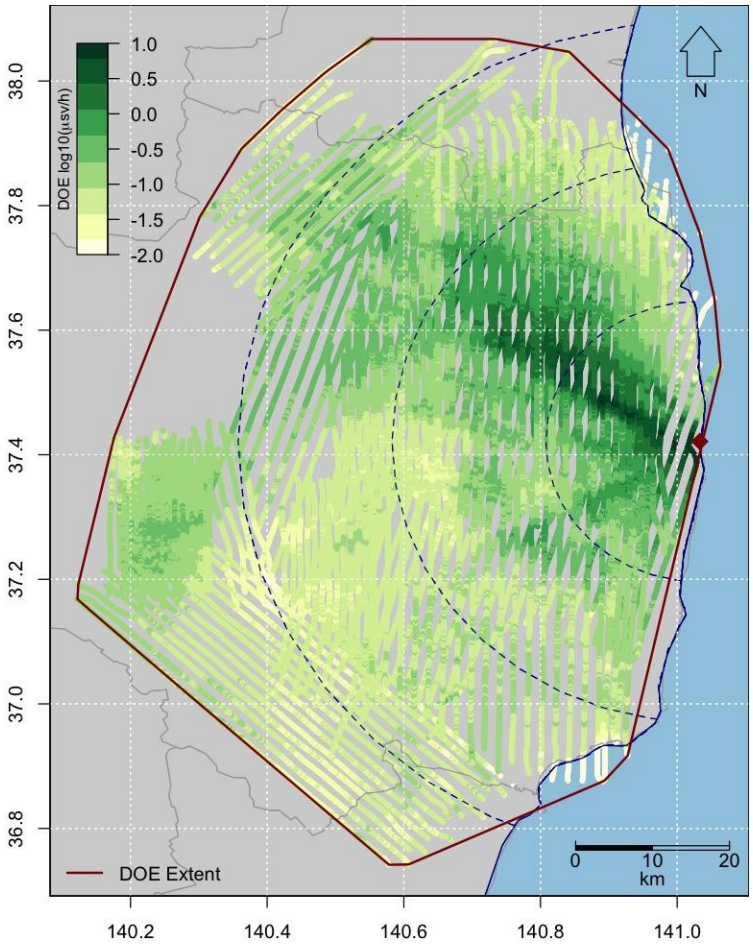
William S. Leith
Acting Associate Director for
Natural Hazards

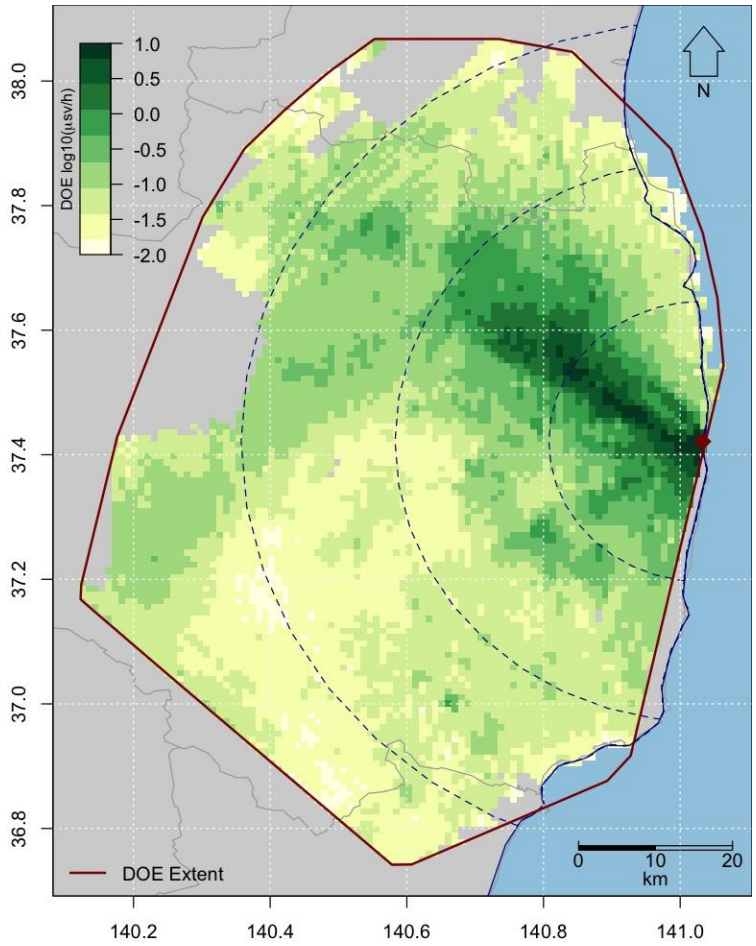
Cervone G., Manca G., Damage Assessment of the 2011 Japanese Tsunami Using High Resolution Satellite Data, Carthographica, 2011.

Hysplit Animation



DOE RS Measurement

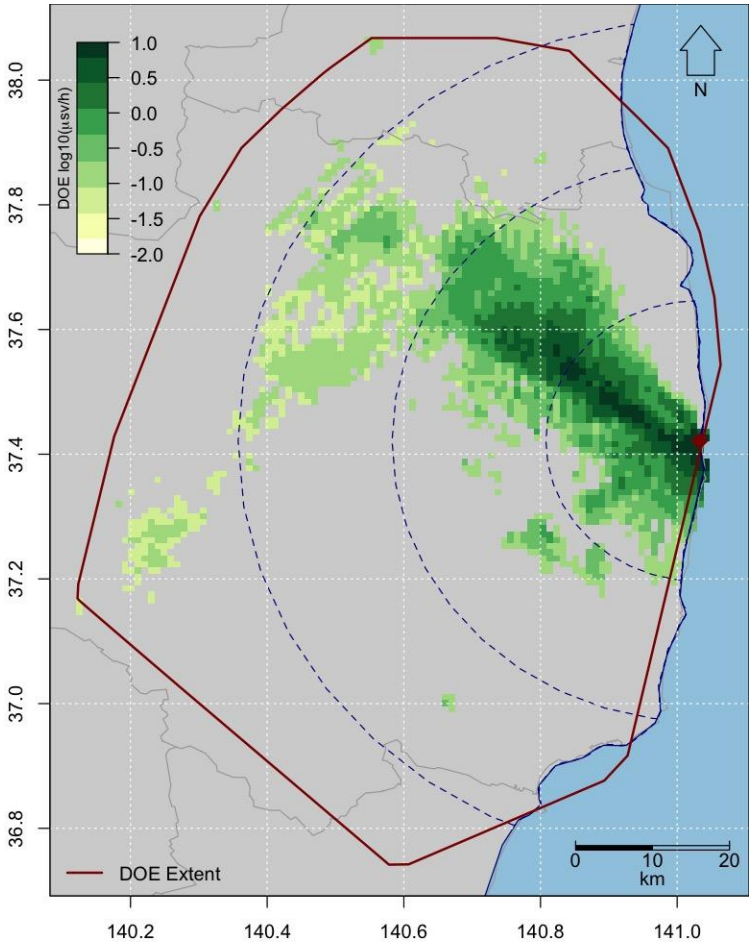


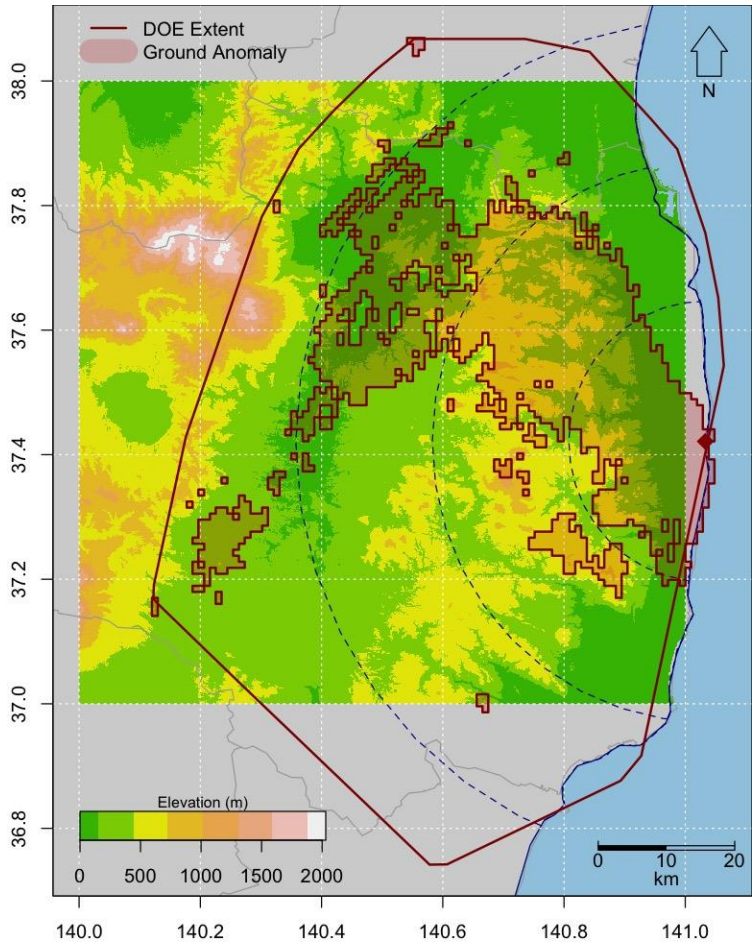


Data collected over 2 months: March to April 2011

Decayed to June 1, 2011

DOE Anomaly



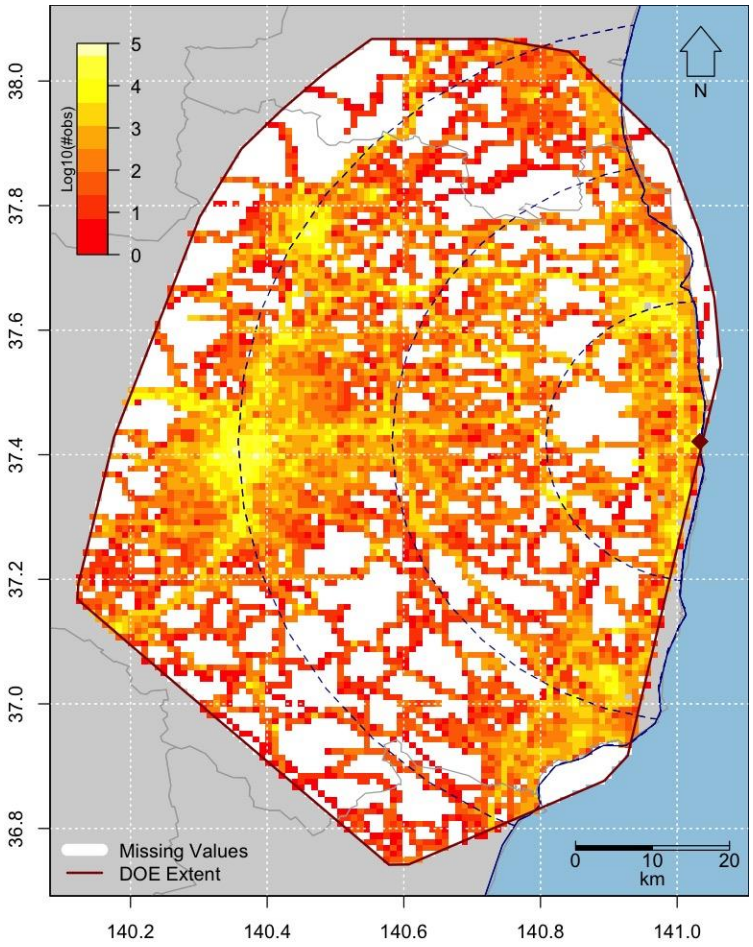


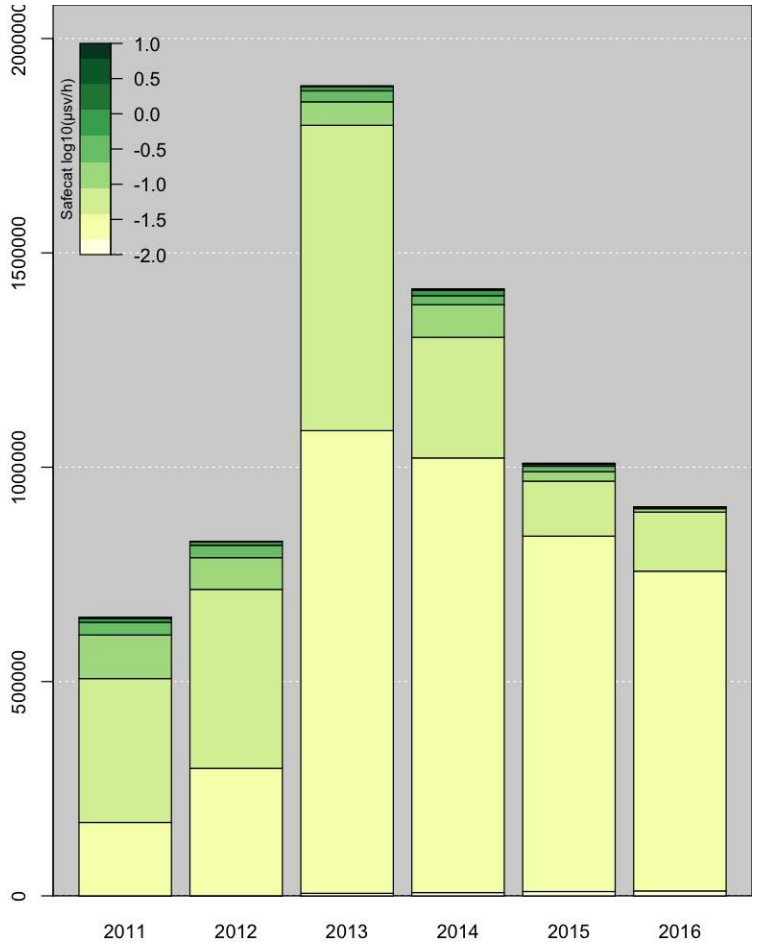
DEM: NASA/JAXA Aster

SAFECAST Measurements

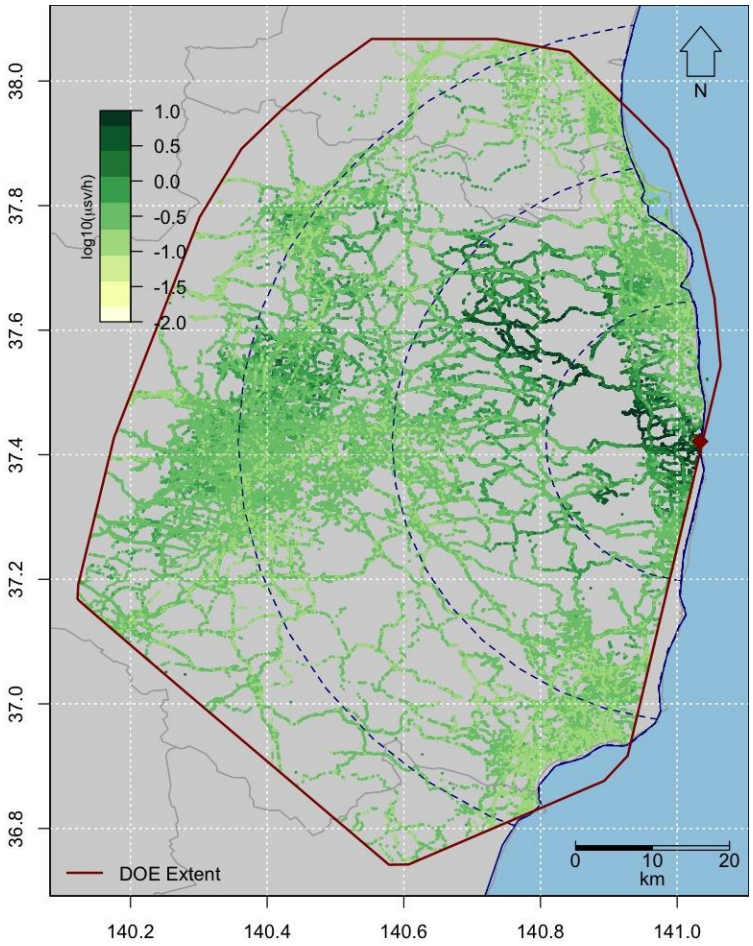
- Safecast (SC) is crowdsourced radiation sensor data.
- Available since a week after the catastrophic March 2011 Japanese earthquake
- Open Source bGeigie Nano device.
- Uses the LND7317 radiation sensor, which can detect alpha, beta, and gamma radiation
- 70 million such observations uploaded to the Safecast server

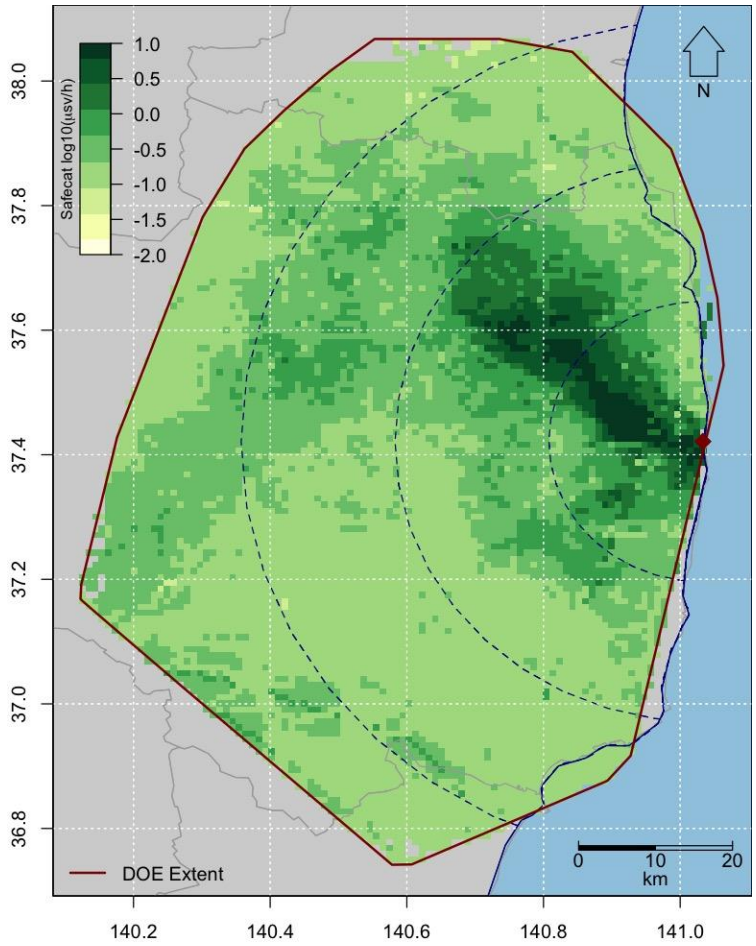
SC Variability in Space and Time





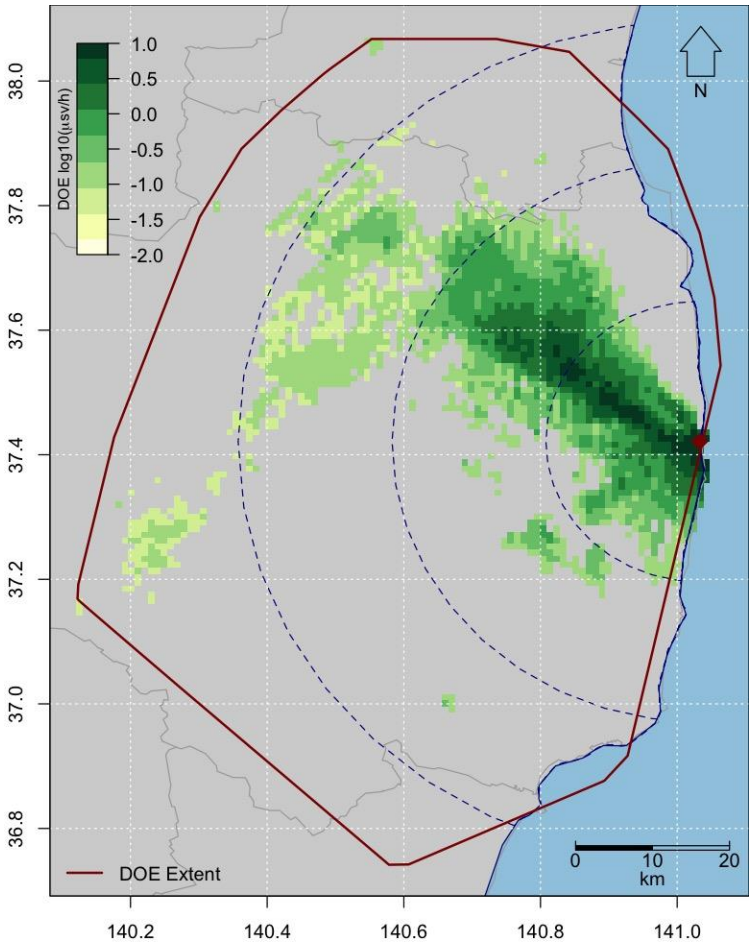
SC Data at Fukushima



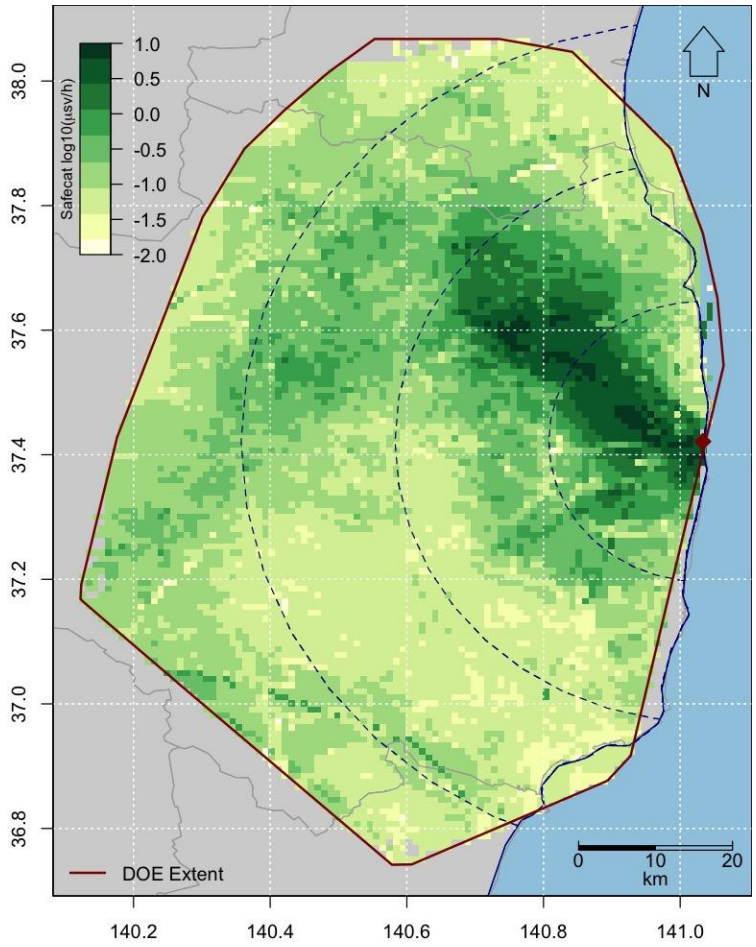


6M Observations between April 2011 and December 2016

Anomaly (Mis) Comparison

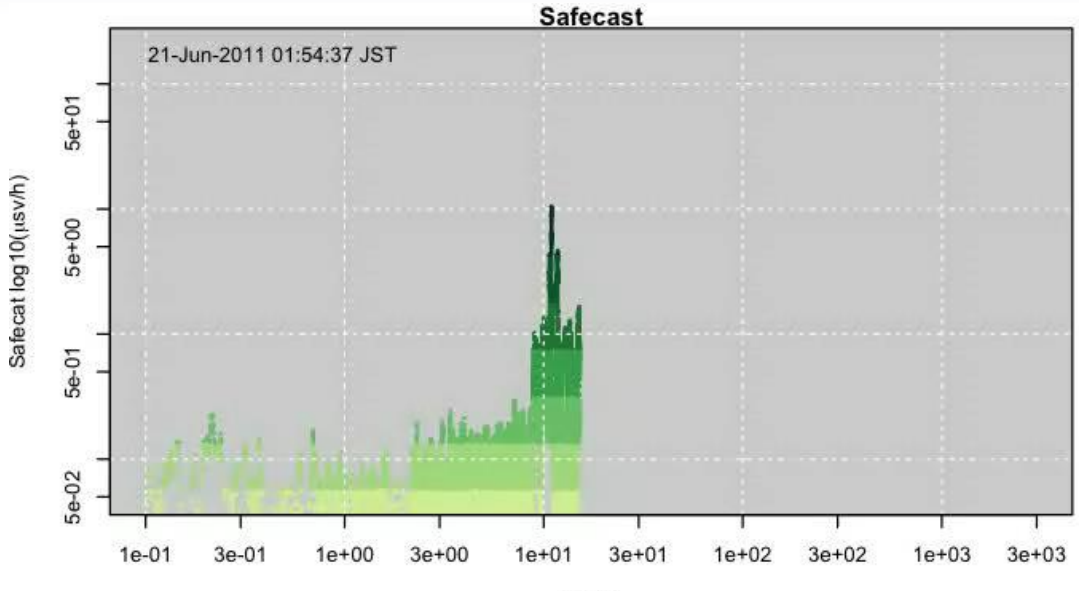


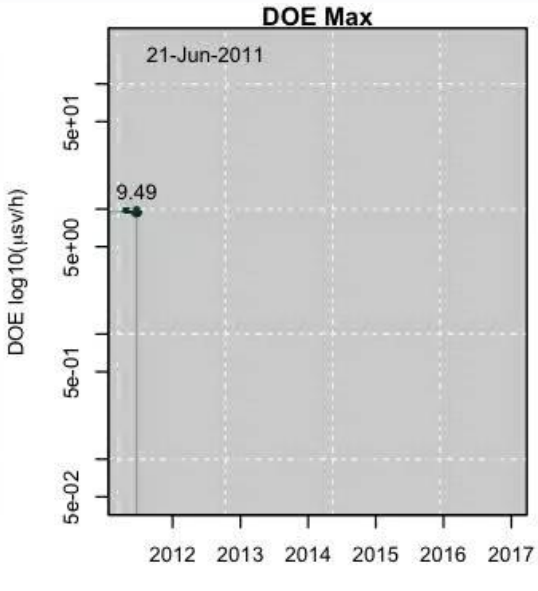
DOE

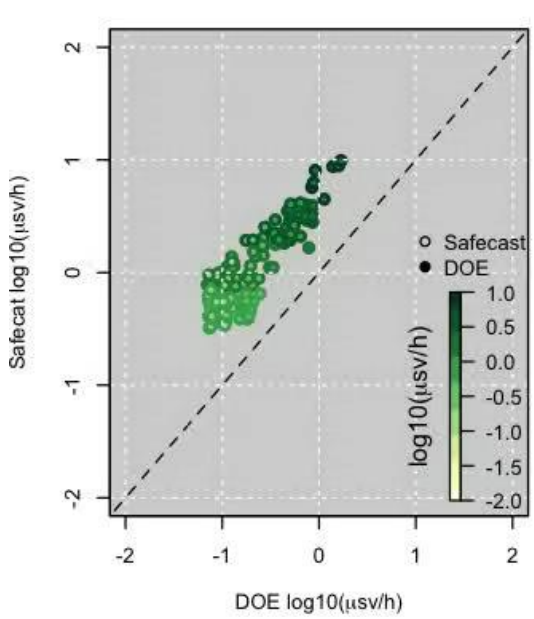


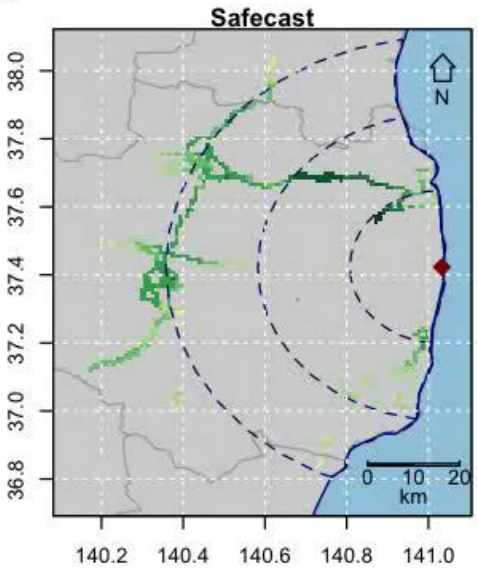
SAFECAST

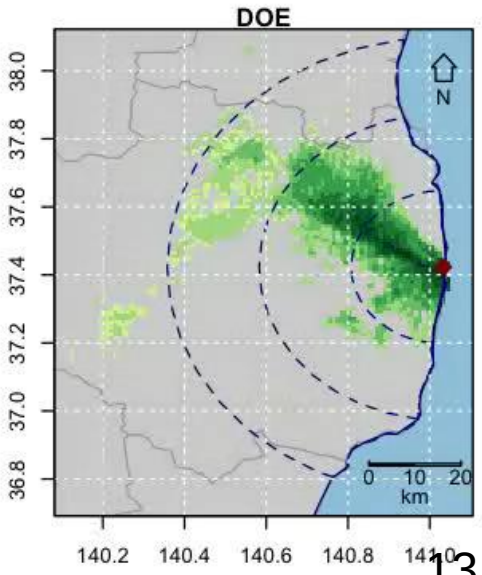
Before Calibration



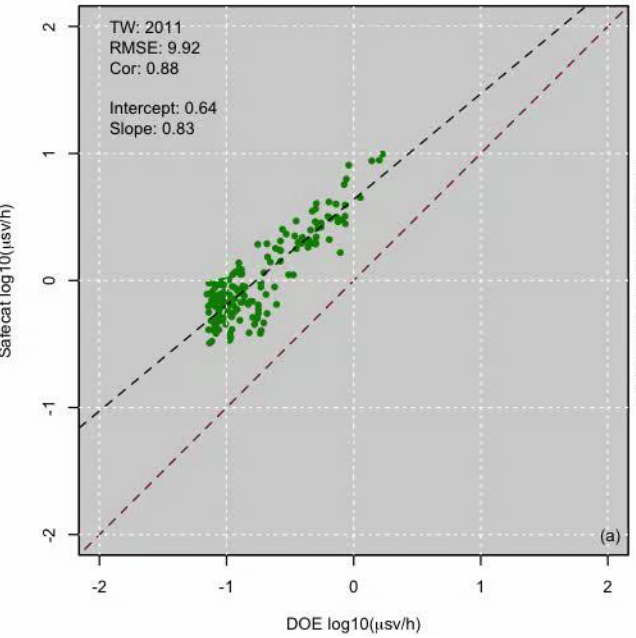


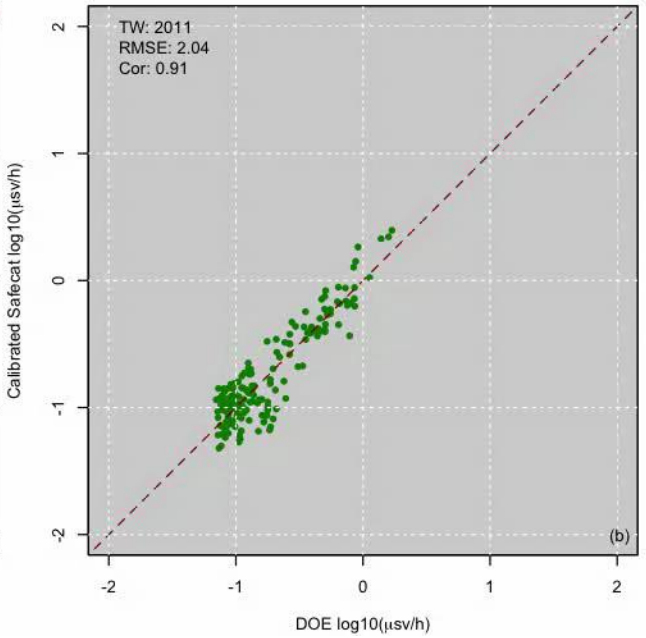


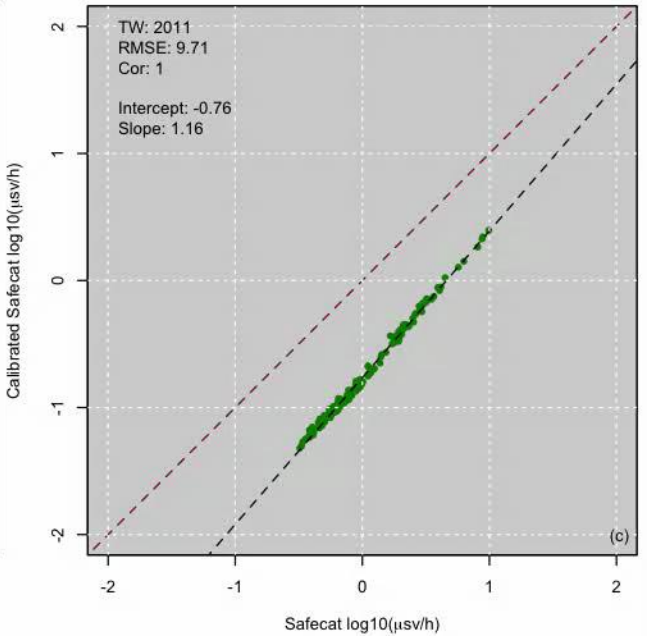




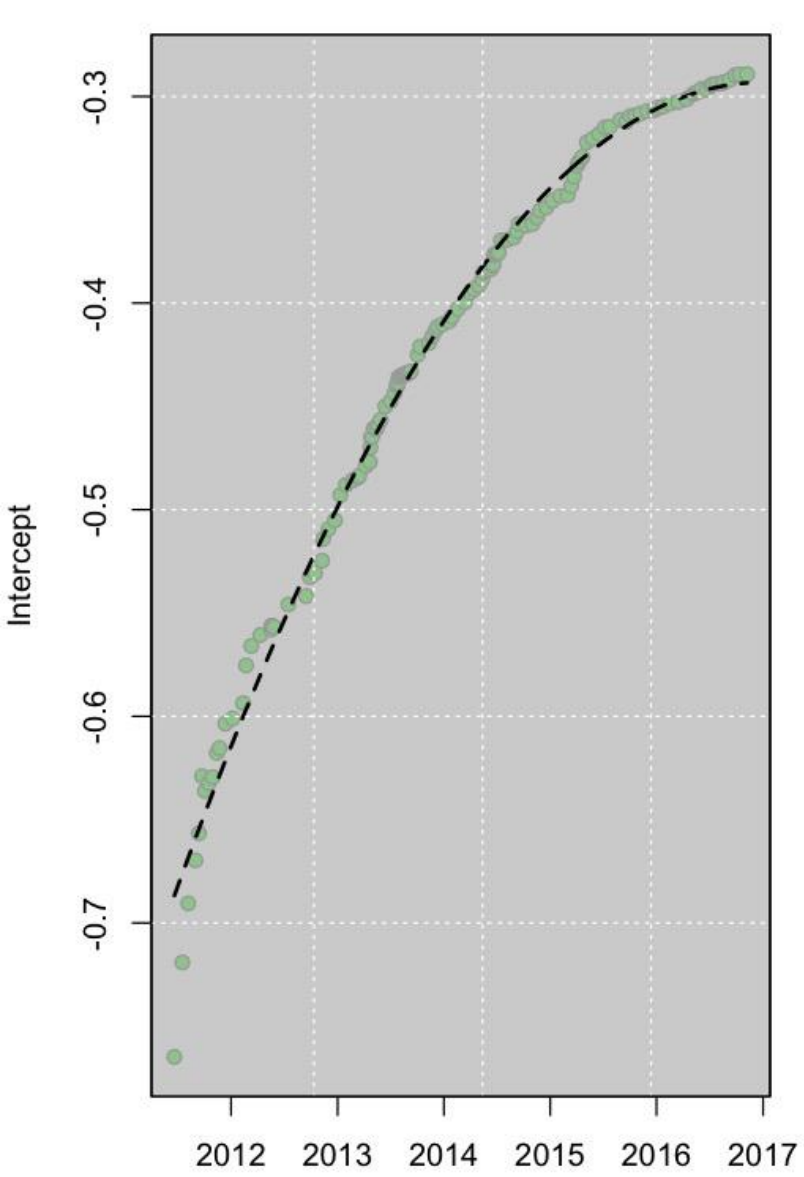
Calibration

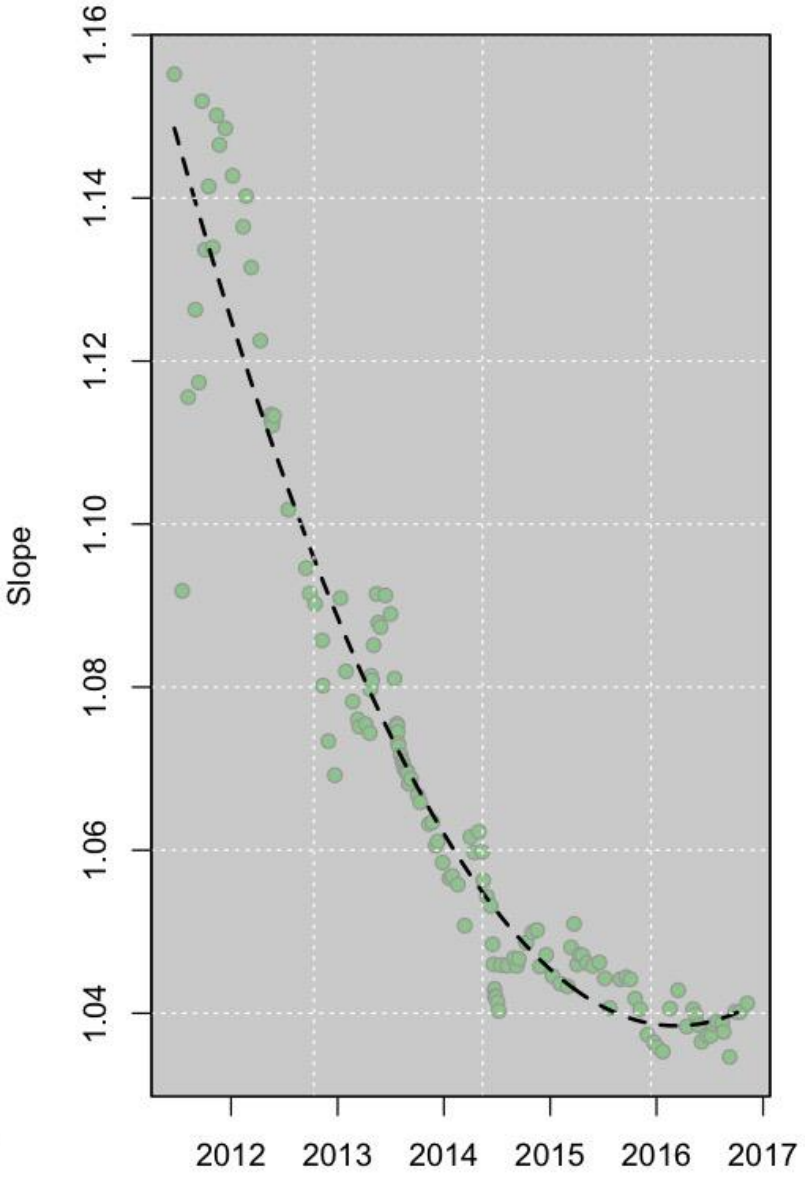




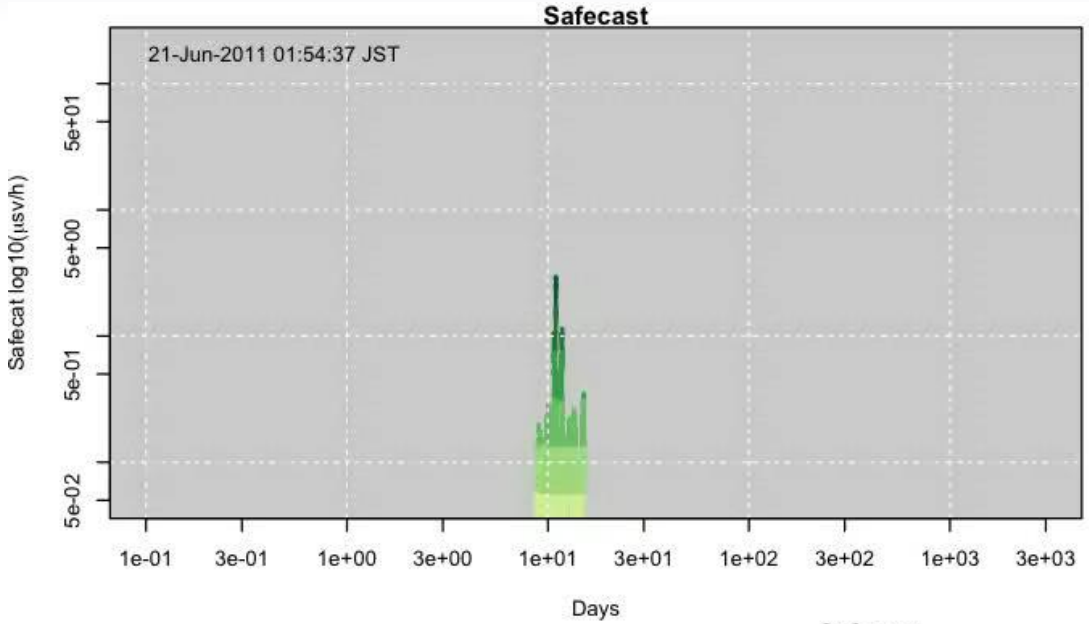


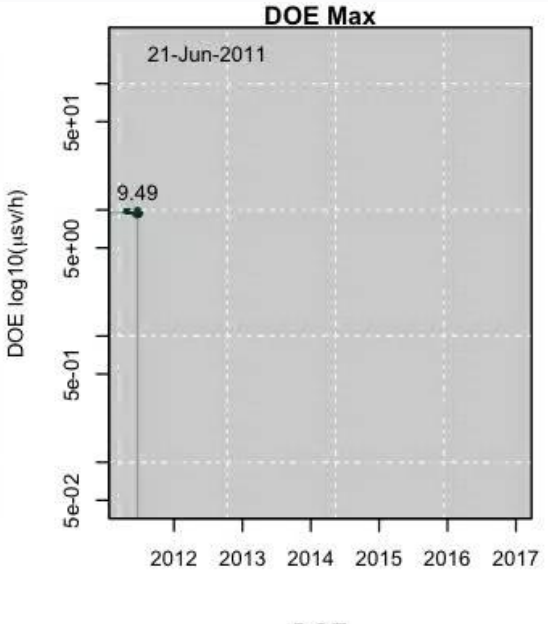
Calibration Coefficients

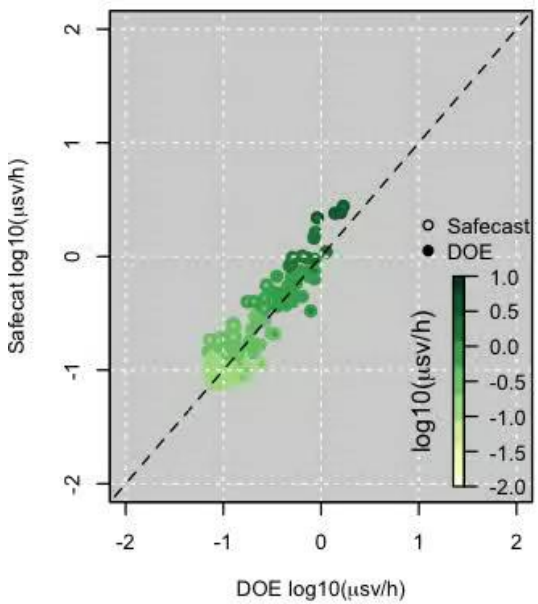


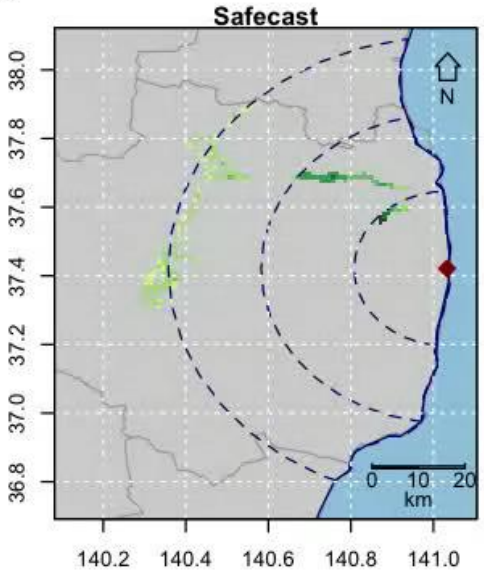


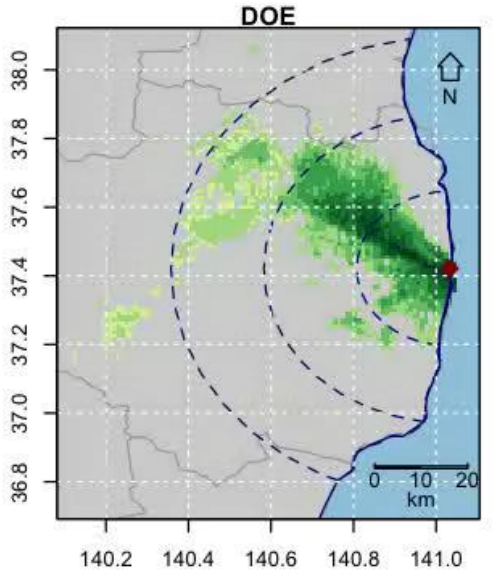
After Calibration











Overall Error