SAFECAST

Joint ICTP-IAEA Workshop on Environmental Mapping:
Mobilising Trust in Measurements and Engaging Scientific Citizenry
ICTP, Trieste - Italy March 6-24, 2017

14:46:24 JST - March 11, 2011

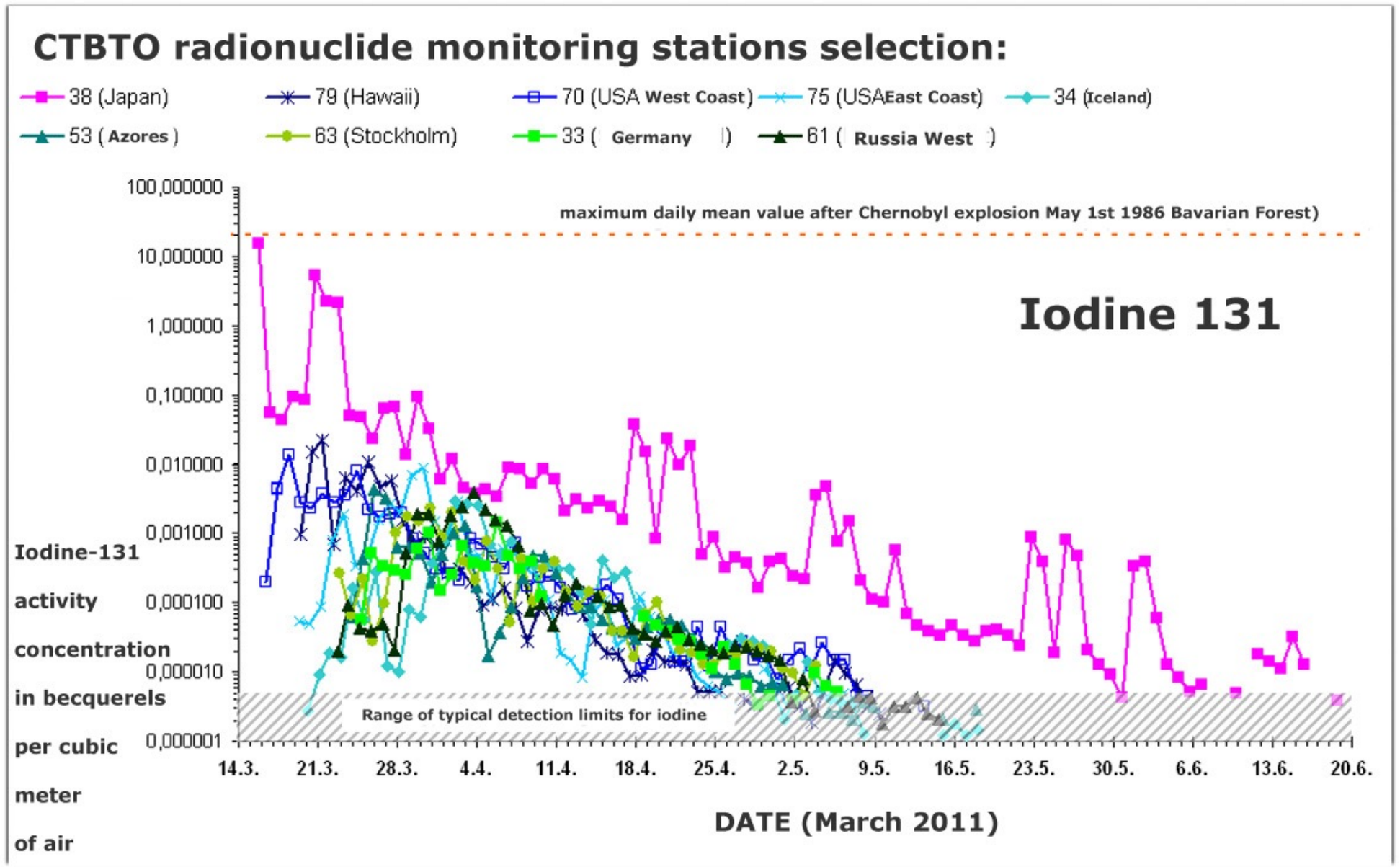
Greater Eastern Japan Earthquake and Tsunami

Fukushima Nuclear Powerplant Accident

From the point of view of average citizens:

- Fear, need to decide soon whether to flee
- Information vacuum
- Official sources deemed untrustworthy
- Social media paints more dire picture
- Even knowledgeable people can’t find enough reliable and useful data

Official MEXT Map -- Released March 17, 2011



Original file in german (Federal Office for Radiation Protection): http://www.bfs.de/de/ion/imis/ctbto_aktivitaetskonzentrationen_jod.gif

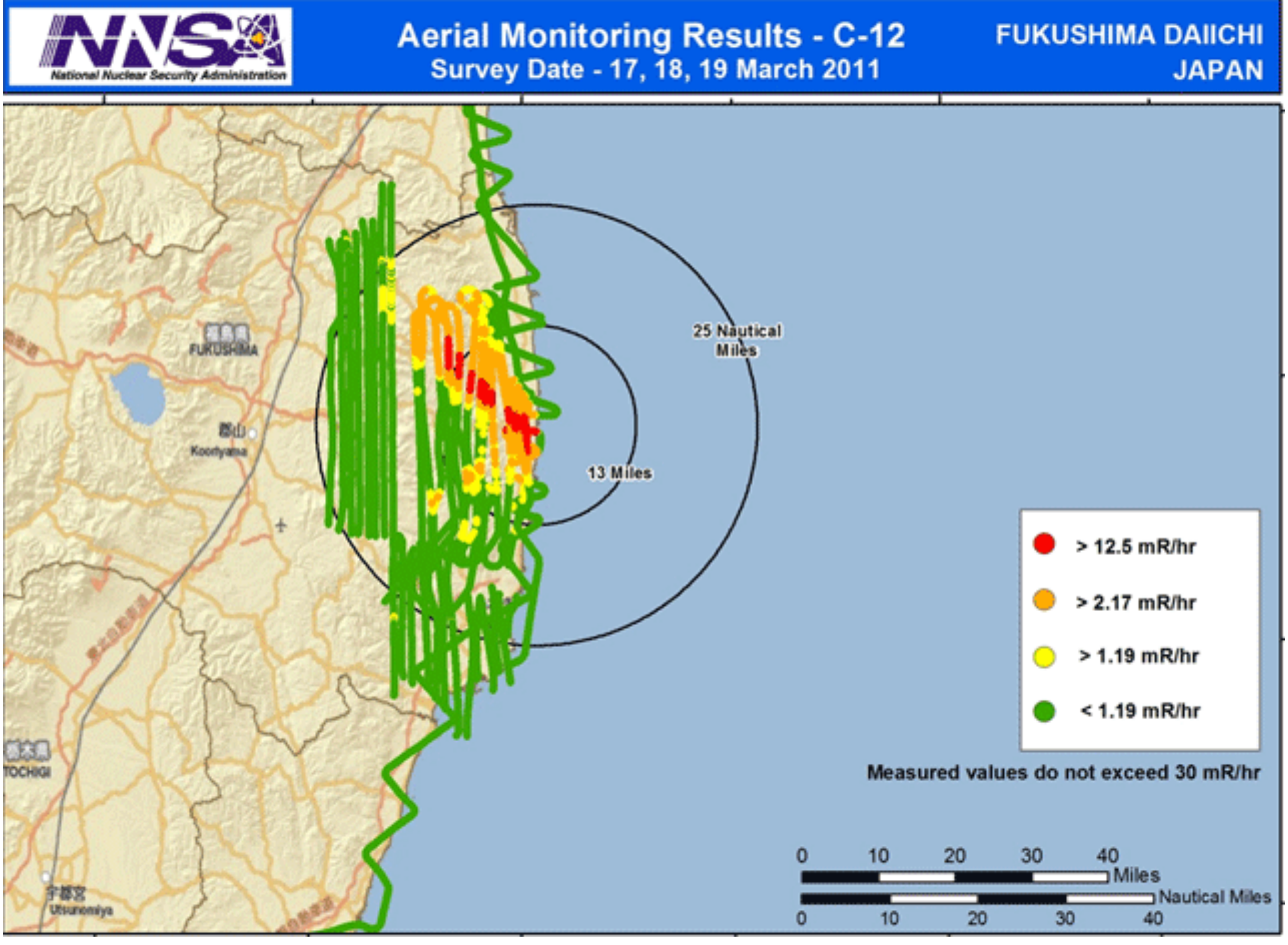
CTBTO DATA

MARCH 2011

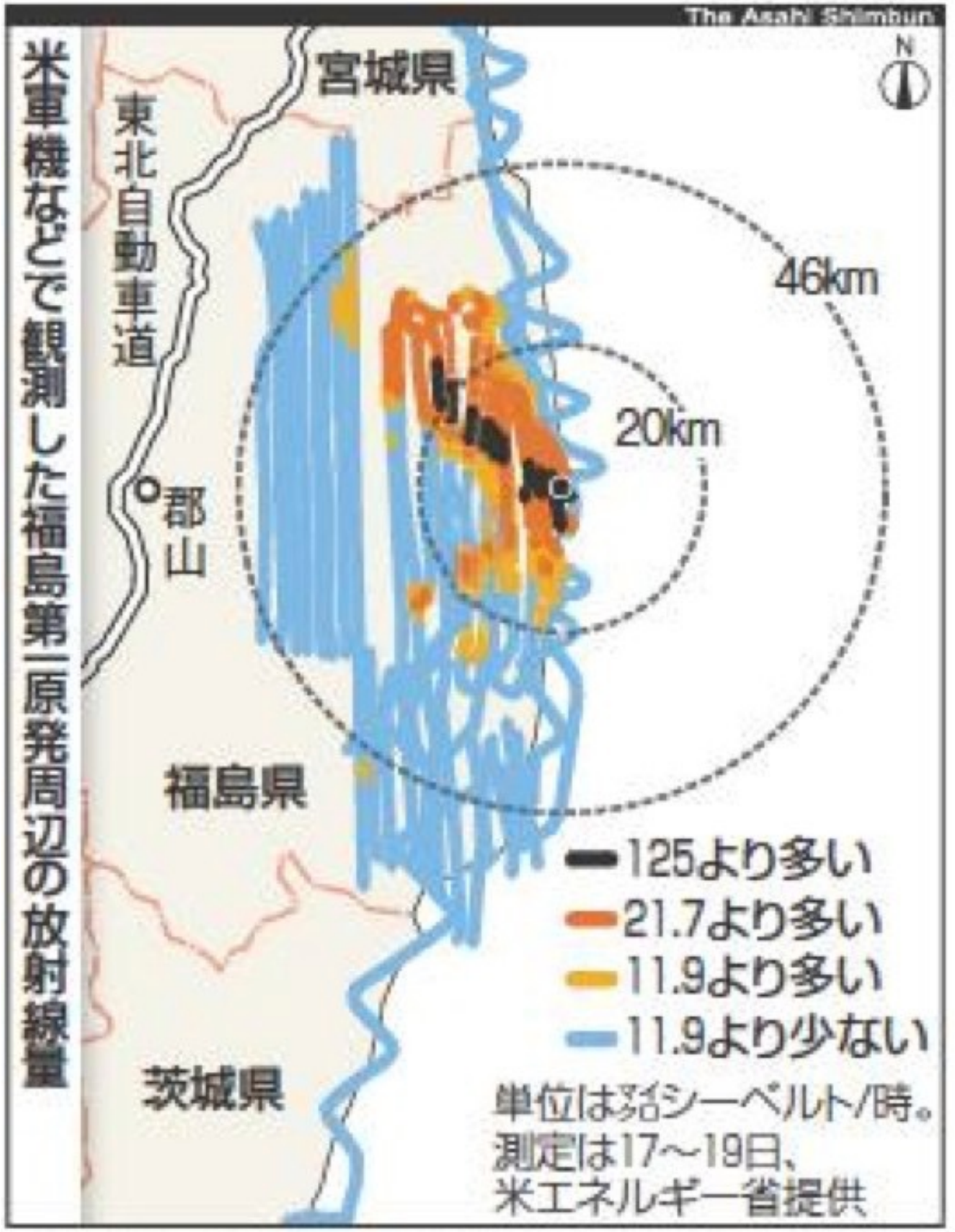
放射線量情報

（マイクロシーベルト／時）

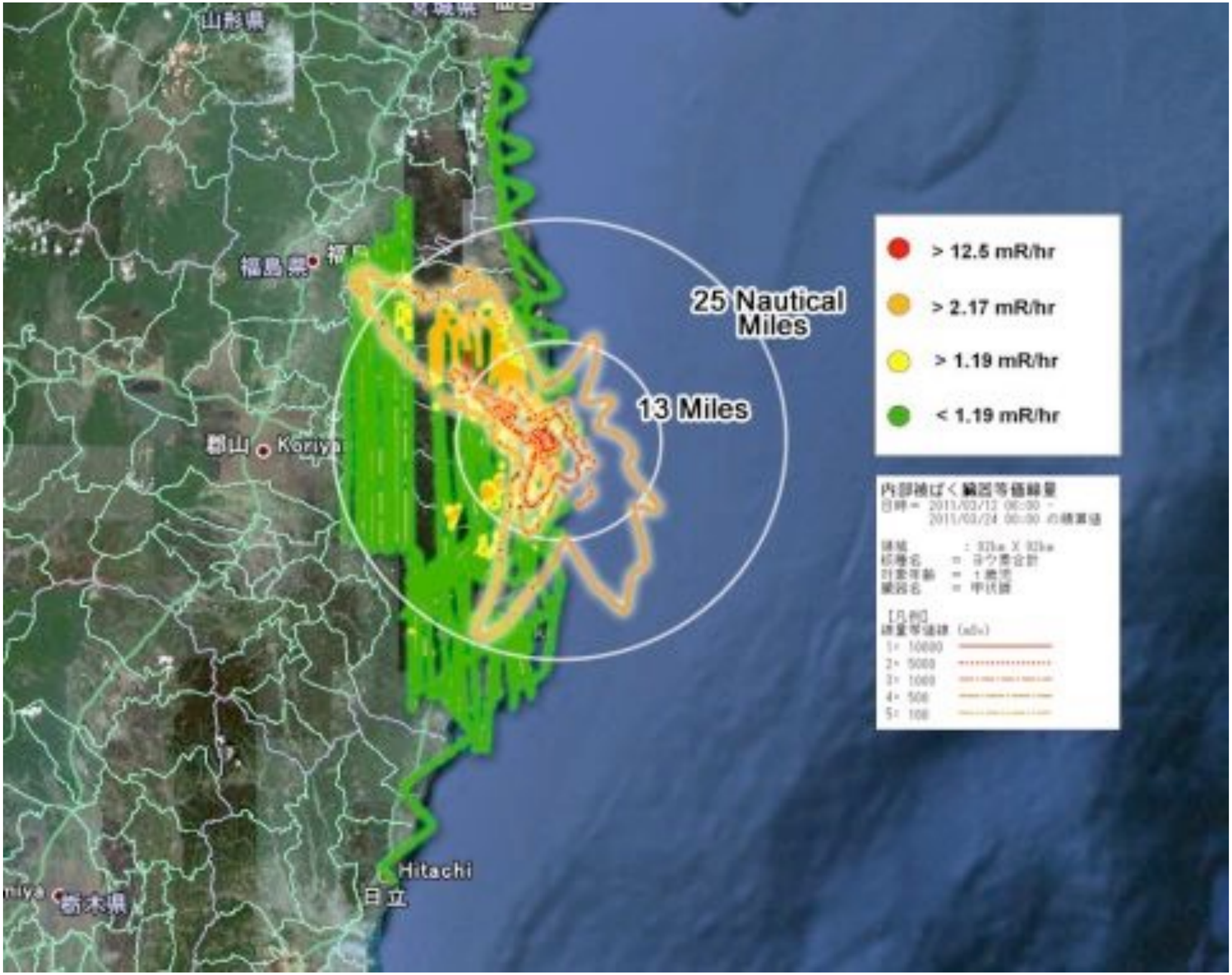
NHK News - April 22nd, 2011



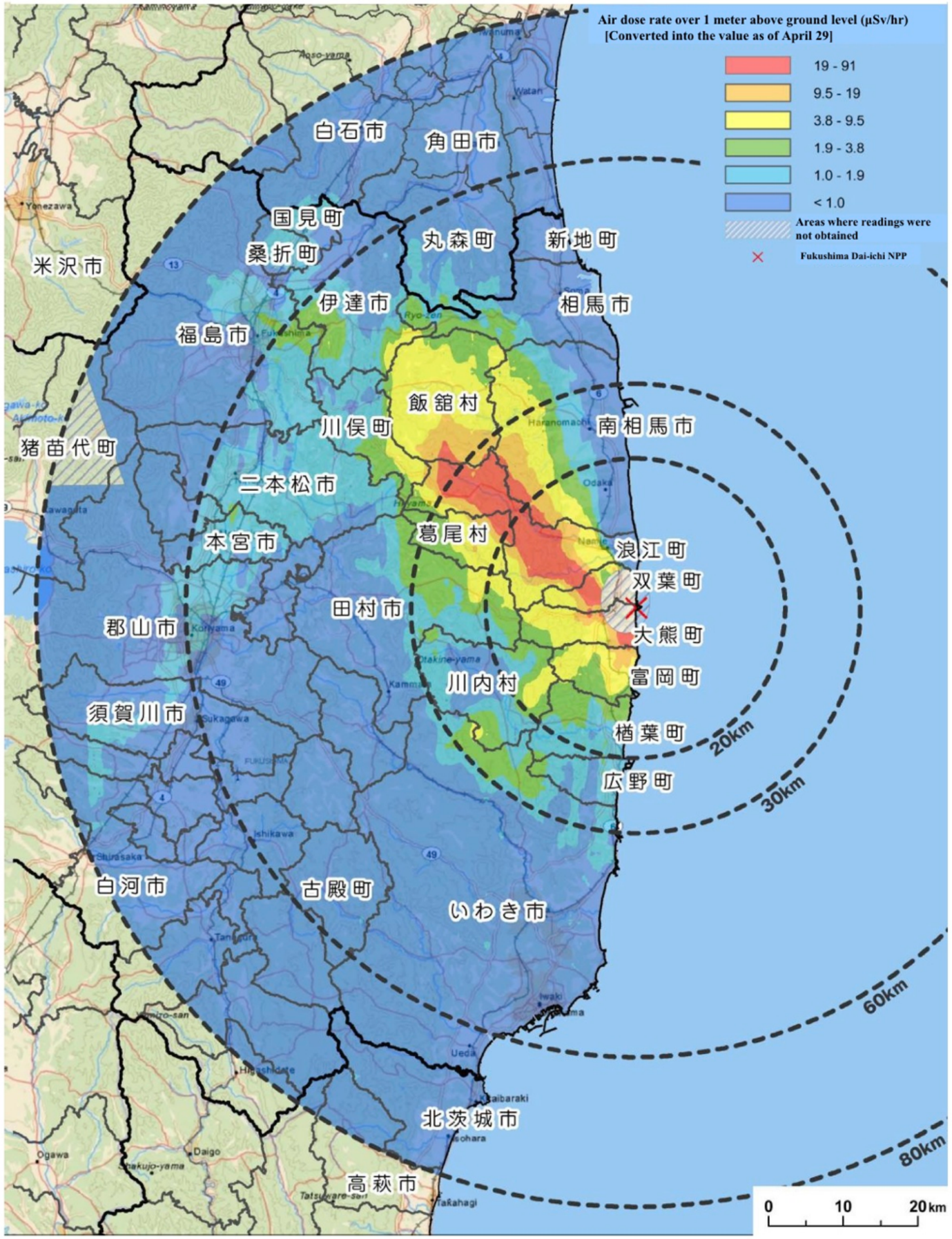
DOE/NNSA Map -- Released online March 22, 2011



DOE/NNSA Map -- in Japanese media March 24, 2011



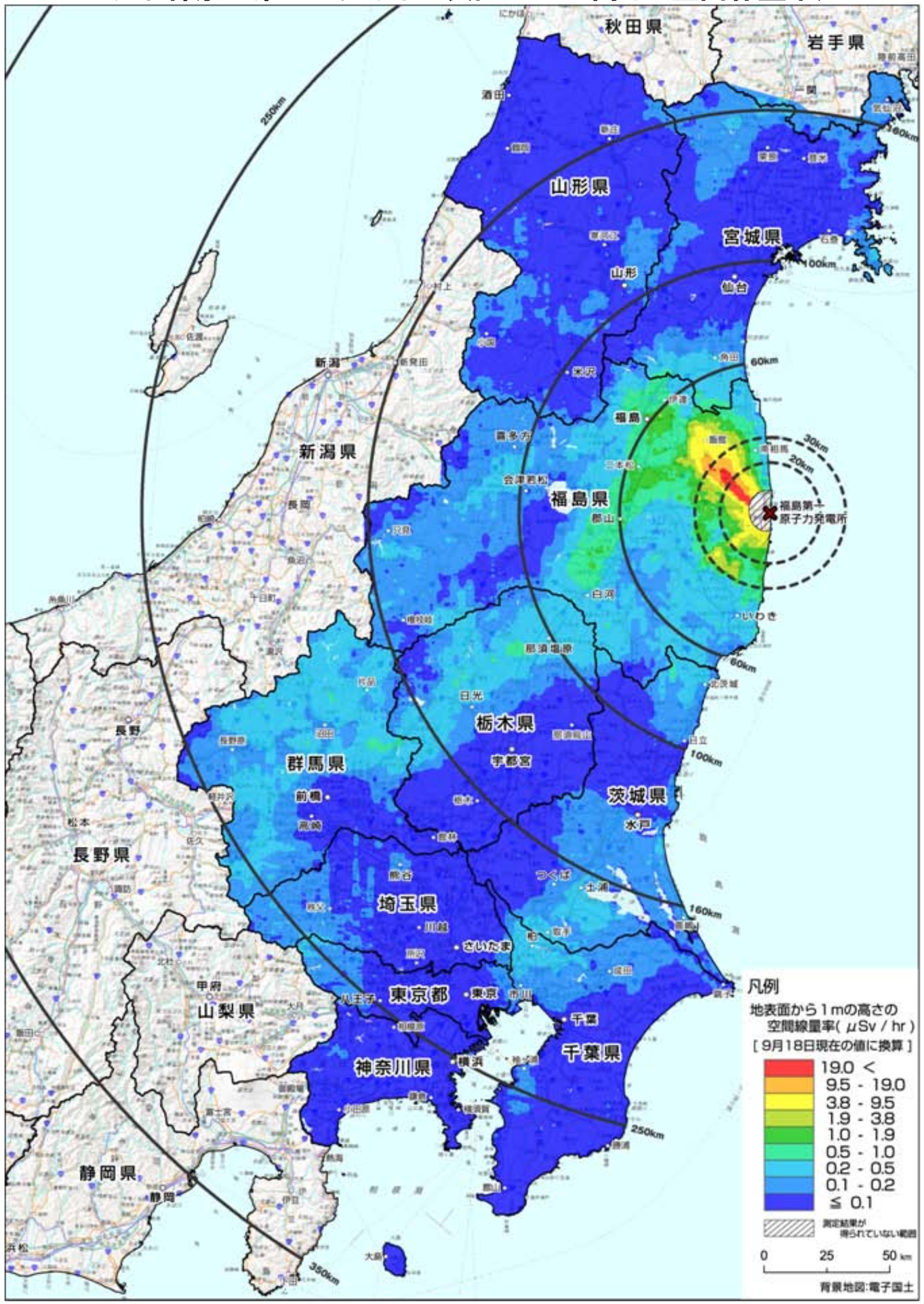
DOE/NNSA + SPEEDI -- Twitter, March 25, 2011



Useful official monitoring maps were slow to appear.

This official map was not released until May, 2011

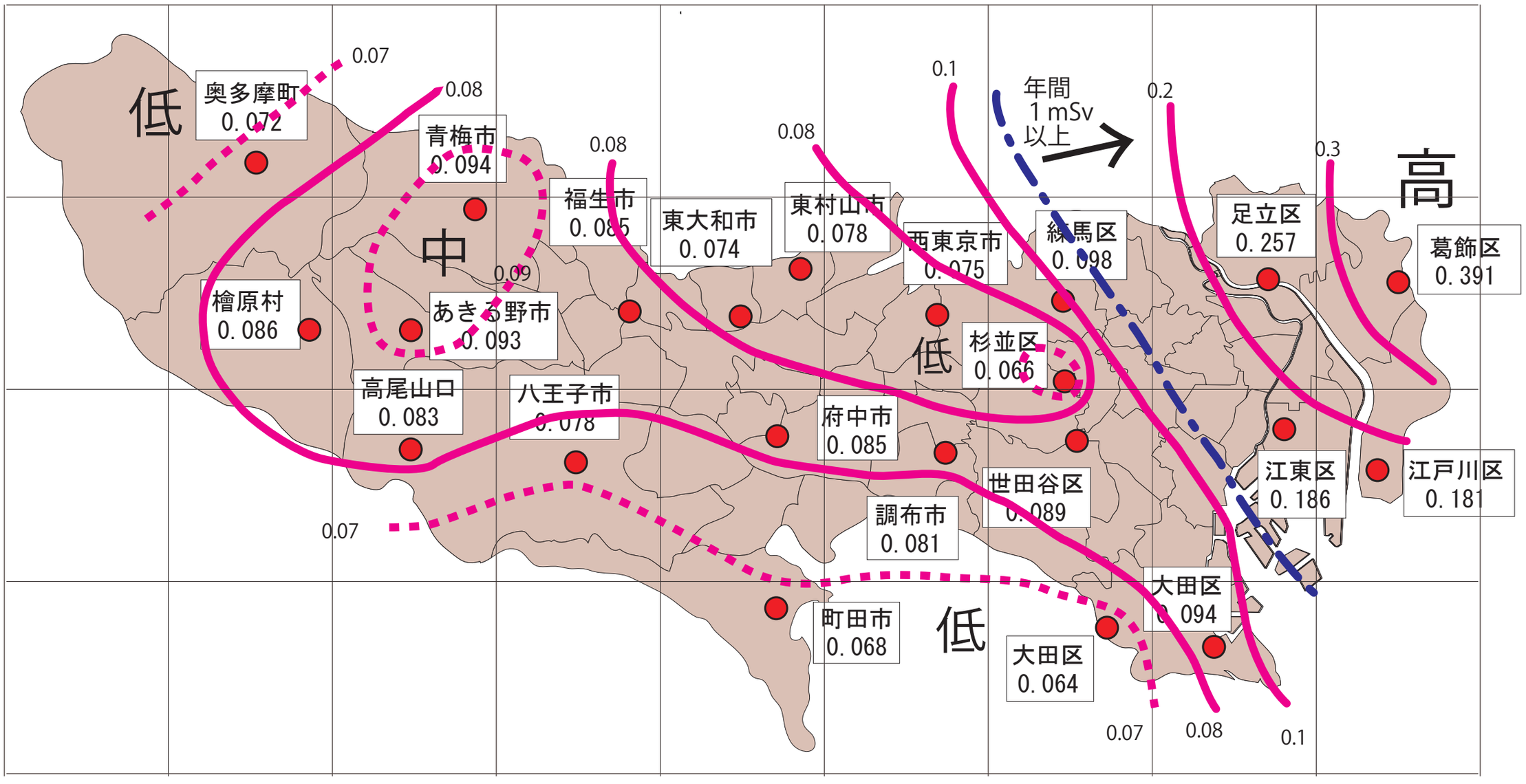
MEXT- DOE airborne monitoring map, May 2011



This official map was not released until Oct, 2011

資料③　都内各地の放射線量測定結果　（日本共産党都議団実施）

数値単位　μSv/h



測定日　2011年5月6日～20日　　複数地点、複数日で測定しているものについては高い方の通知を記載　　**測定者**　日本共産党都議団と専門家

測定地点　都内を10Kmメッシュで区切り

測定器　ALOKA　PDR-101型　ポケットサーベイメーター

測定方法　地上高約1mで表示数値を10秒間隔で10回読み取り（各値は平均値）

年間1mSvの積算の根拠　―　ICRP（国際放射線防護委員会）の「ALARAの原則」の考え方に基づき約0.12μSv/hの放射線量を24時間365日で受ける積算線量とした。
なお文科省や東京都が根拠とする「屋外に8時間、木造家屋内（低減効果0.4）に16時間」と仮定した場合には、約0.19μSv/hとなる。

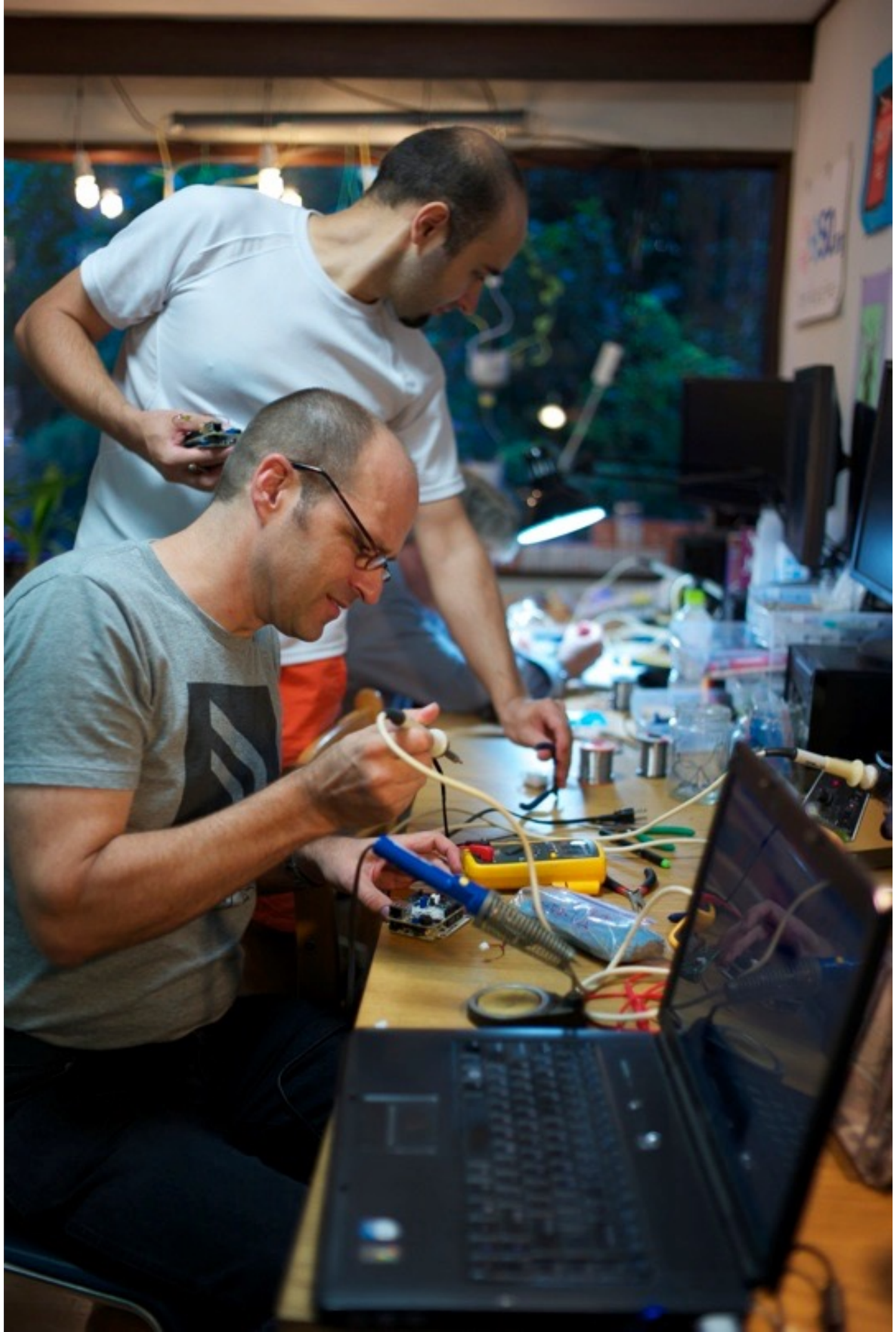
Tokyo radiation survey map by Japan Communist Party, June 2011

TEPCO

US OPERATION TOMODACHI

Our Response:

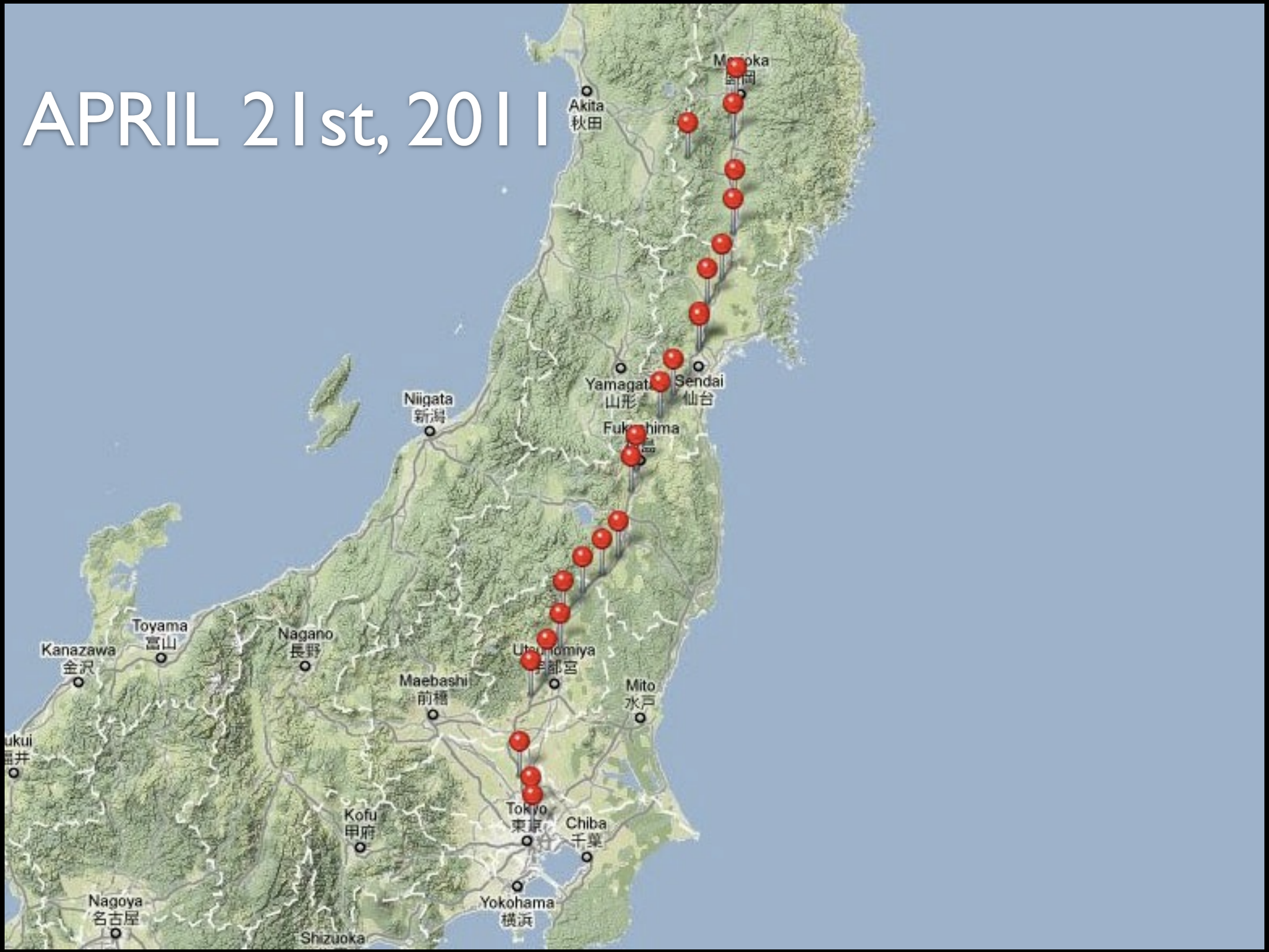
- Develop devices
- Make a mapping system
- Build a community of motivated citizen-scientists who want to measure radiation.



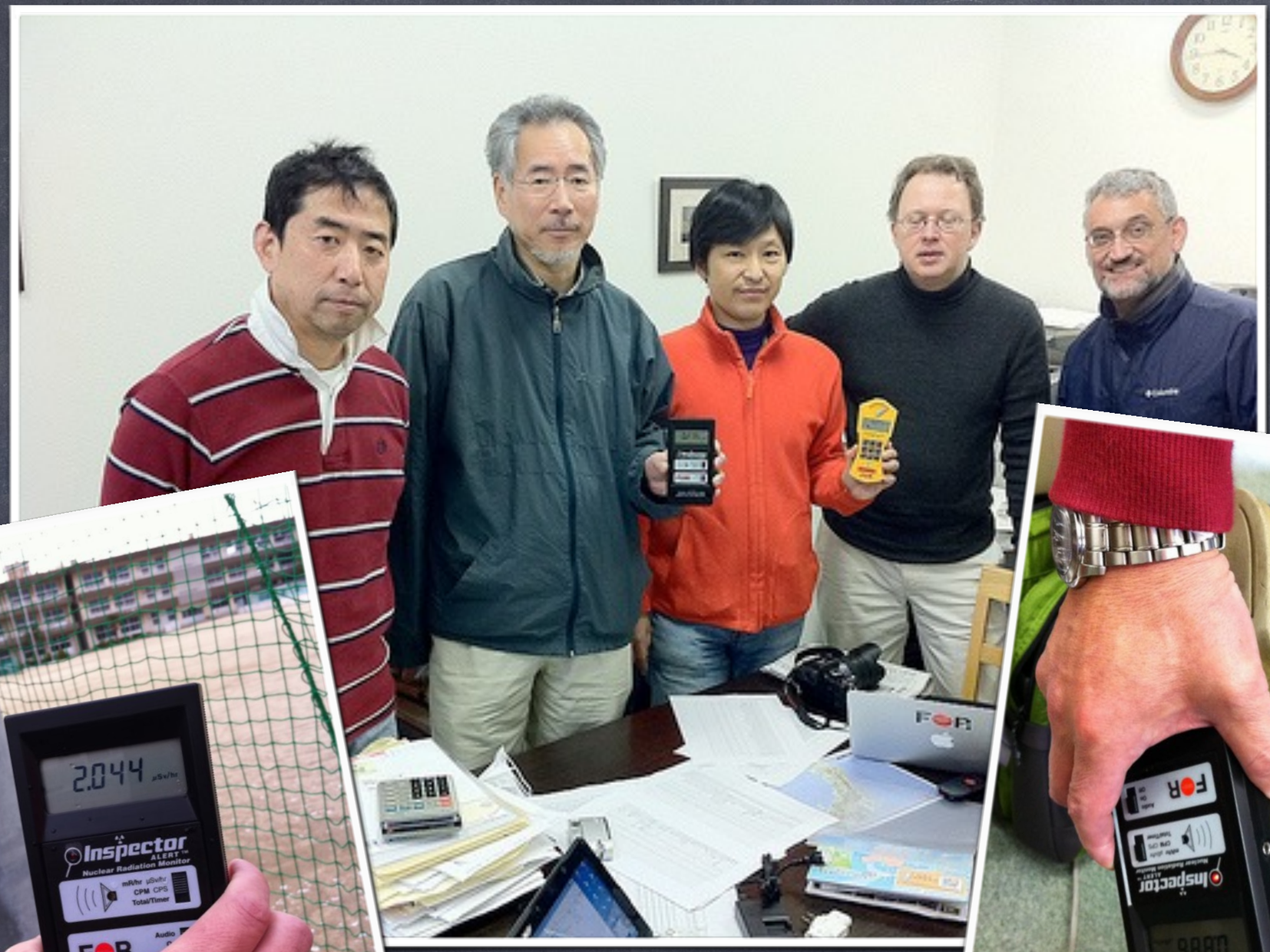
Scotch
Home and Shop Duct Tape
Scotch
Home and Shop Duct Tape

APRIL 20th, 2011

APRIL 21st, 2011



April 24th, 2011 - First Drive to Fukushima -



Our first systems were bulky, but worked.

Deployment:

Automobile

Bicycle

Hand-carry

Aerial drone

Current workhorse:

bGeigie Nano

- 7th-generation mobile detector
- Rugged
- Arduino-based
- GPS and data-logging
- LND 7317 2” pancake sensor
- OLED display
- Bluetooth and WiFi capable
- Open-source, open hardware, open data
- Designed to be sold as a kit, anyone can build it and upload data

Yes, We're OPEN

CC
0
ZERO

WE'RE PRO
DATA

POWER OF

PULL

DEPLOY OR DIE

AGILE + LEAN STARTUP

"to innovate quickly you need to reduce the cost of failure"

Technology!

- Cloud Computing
- Open Hardware / Open Software
- Arduino: community centric platform
- IoT
- Maker Movement / FabCafe
- Big Data
- Geo Mapping
- BLE / Low cost 3G / Mobile

INTERNET OF (NO)THINGS

DEVICE CENTRIC

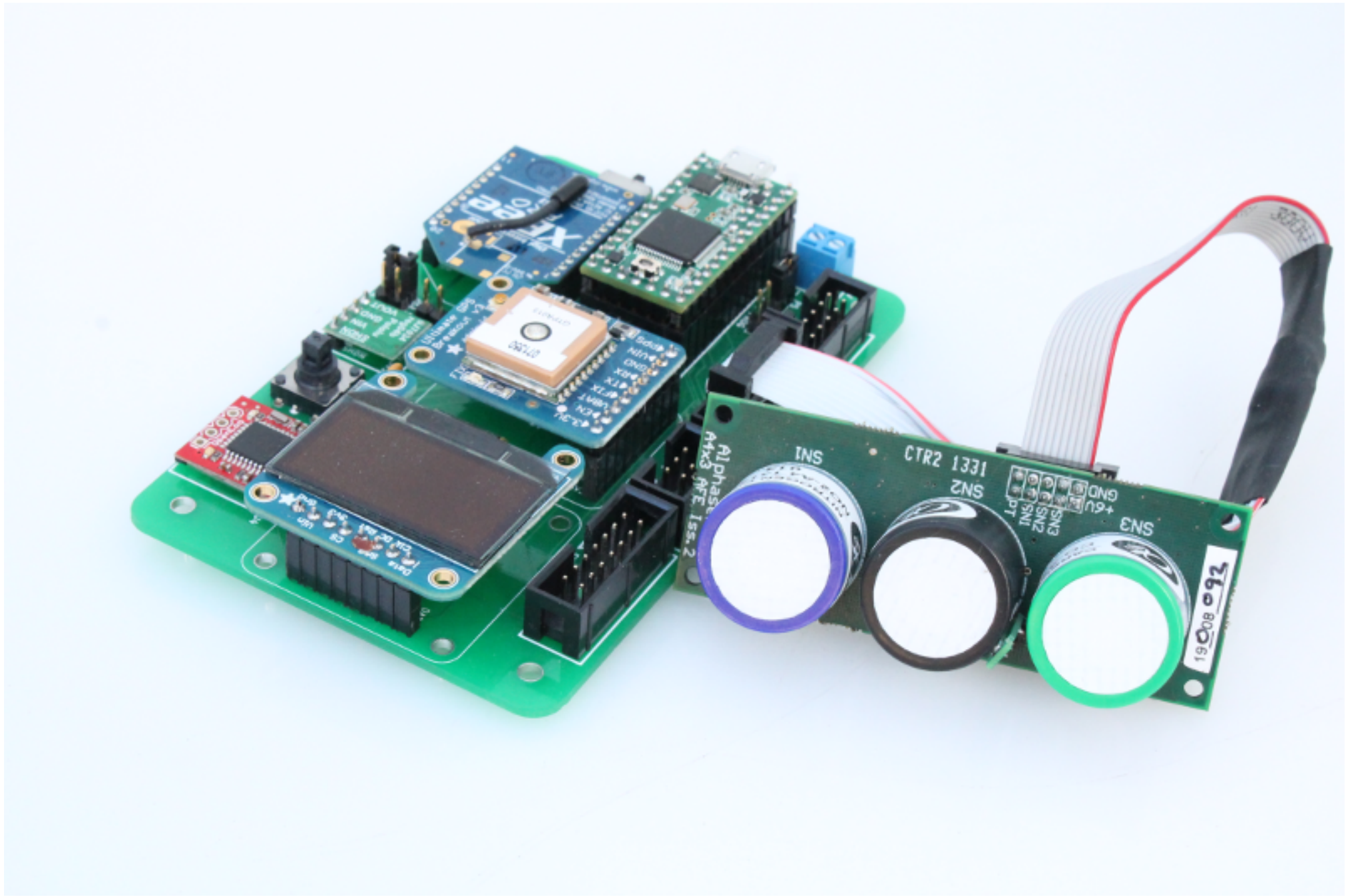
COMMUNITY CENTRIC

~1000 Devices worldwide

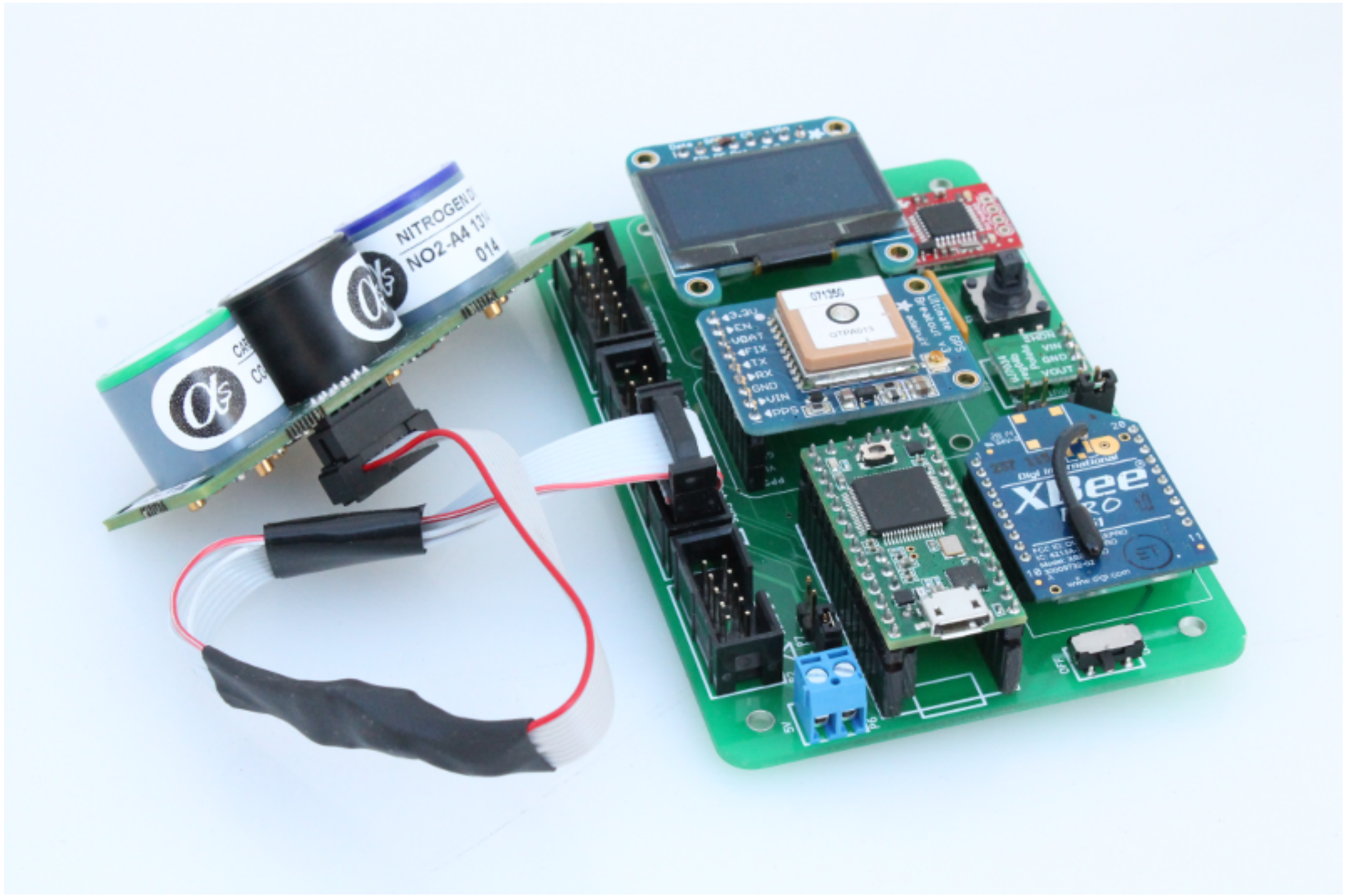
PROJECT:

AIR QUALITY

SAFECAST Air

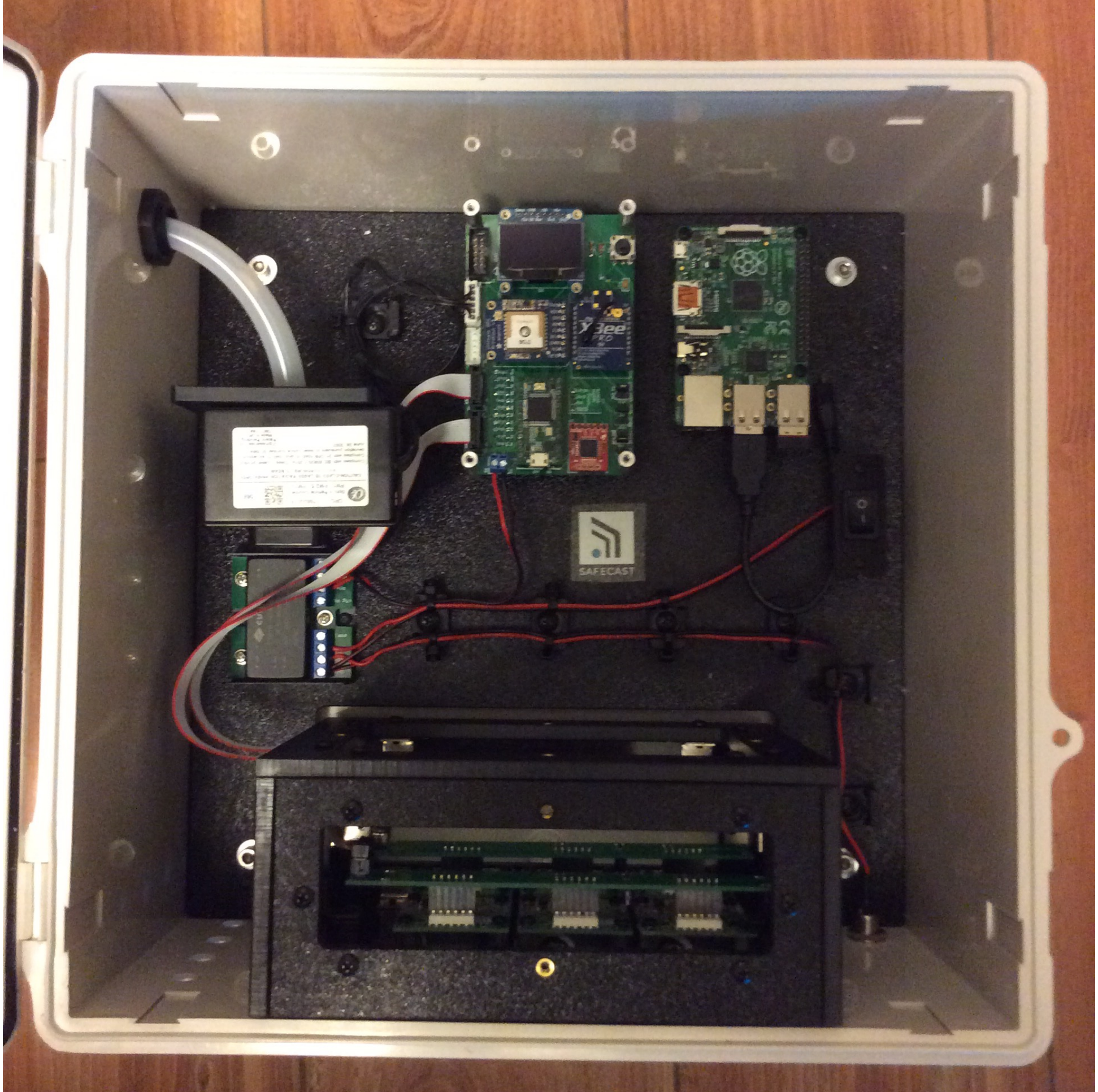


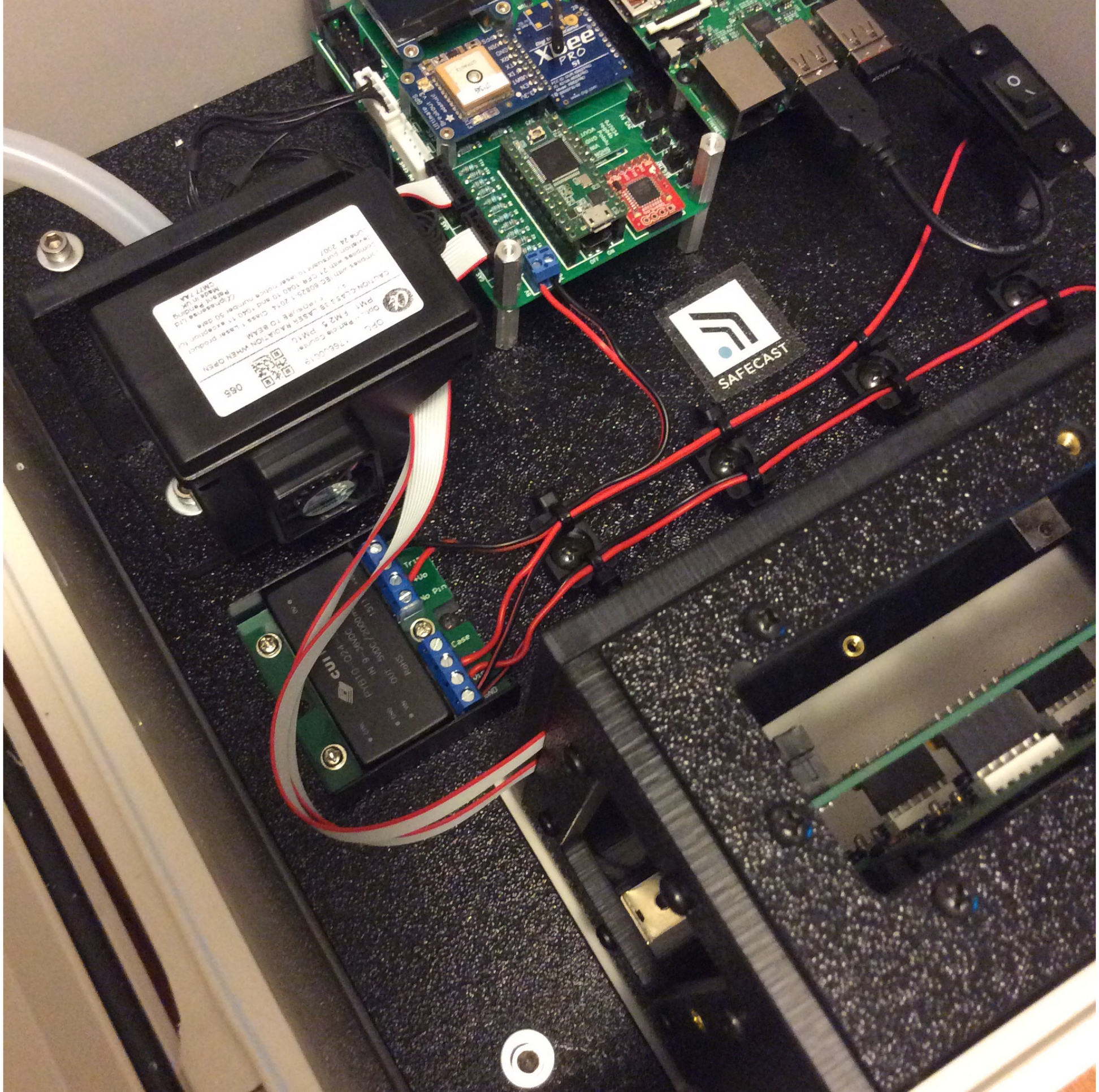
Prototype, 2015

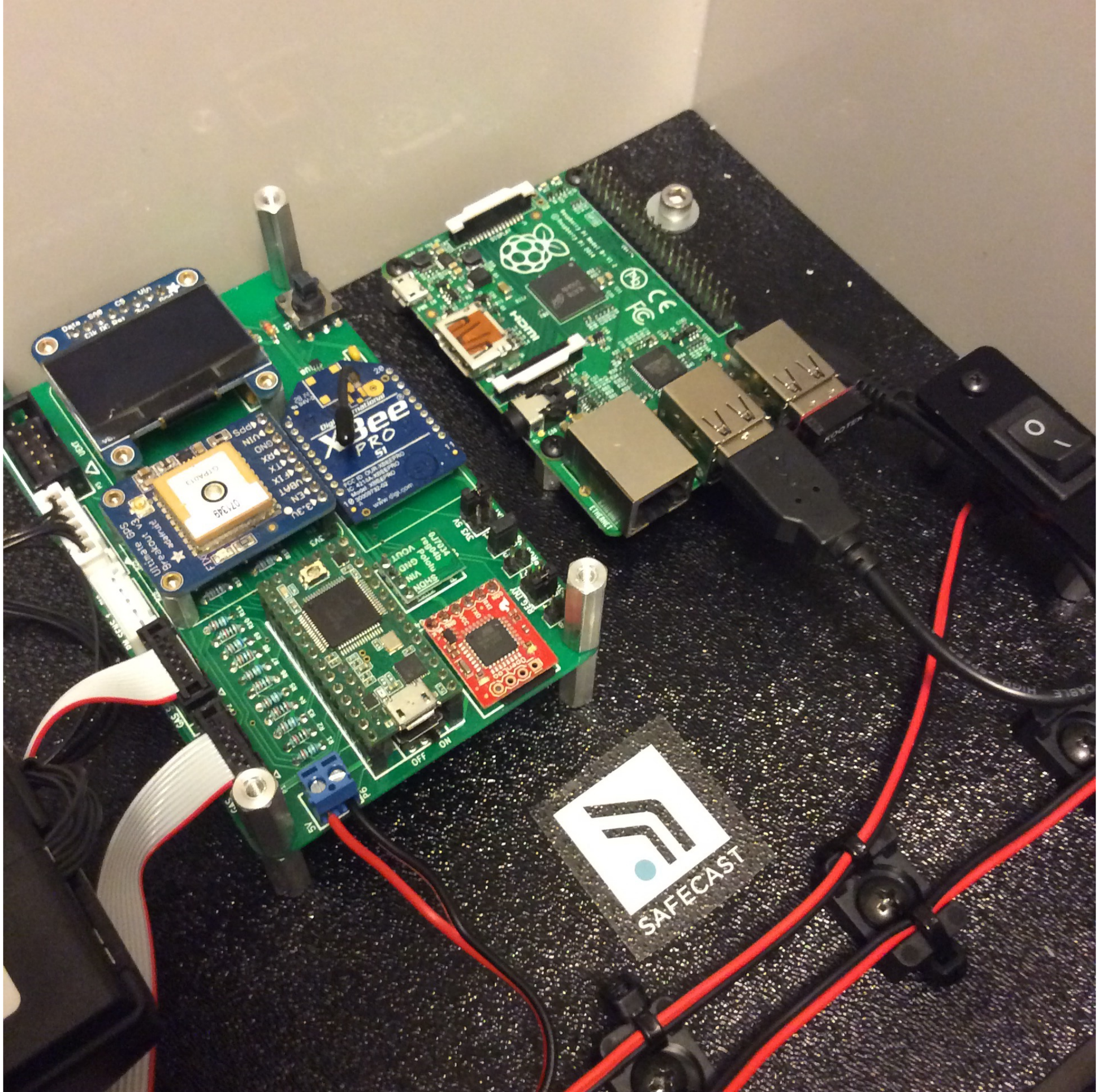


Prototype, 2015

Prototype 001, 2015

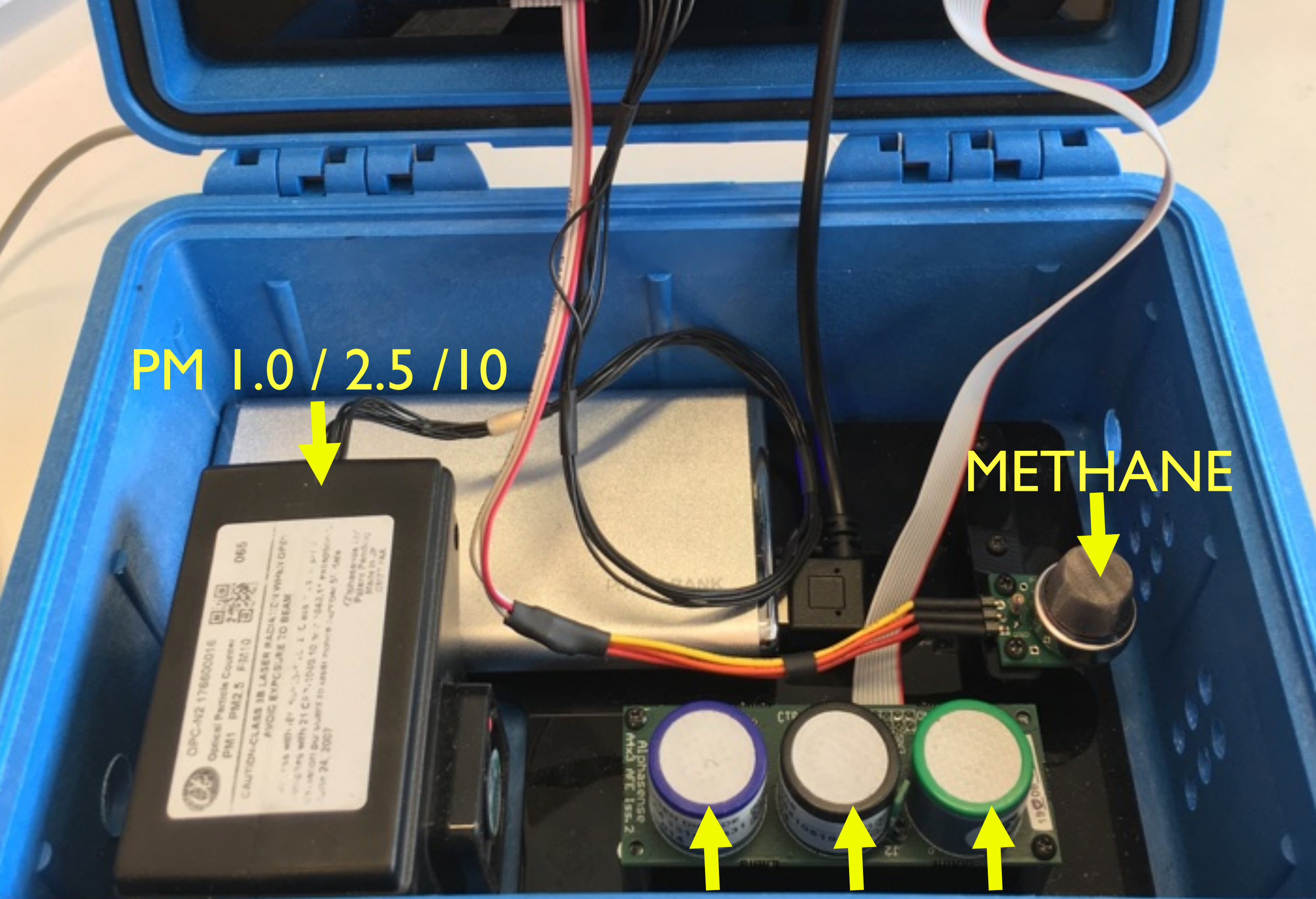

SAFECAST


SAFECAST

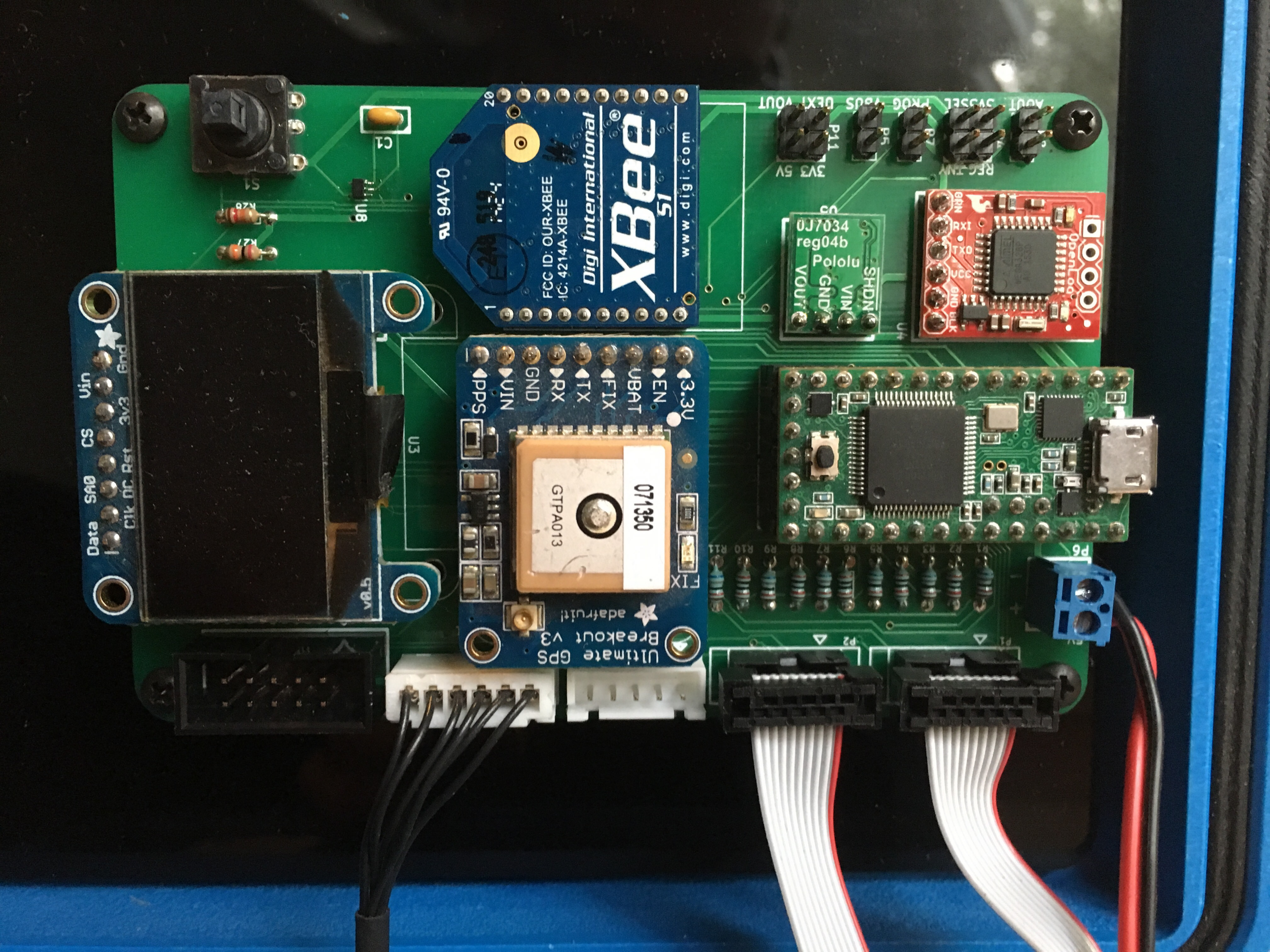

SAFECAST

SAFECAST Air

Prototype 002, 2016


PM 1.0 / 2.5 /10
METHANE
O3
CO
NO2

071350
Ultimate GPS
Breakout v3
SUNON

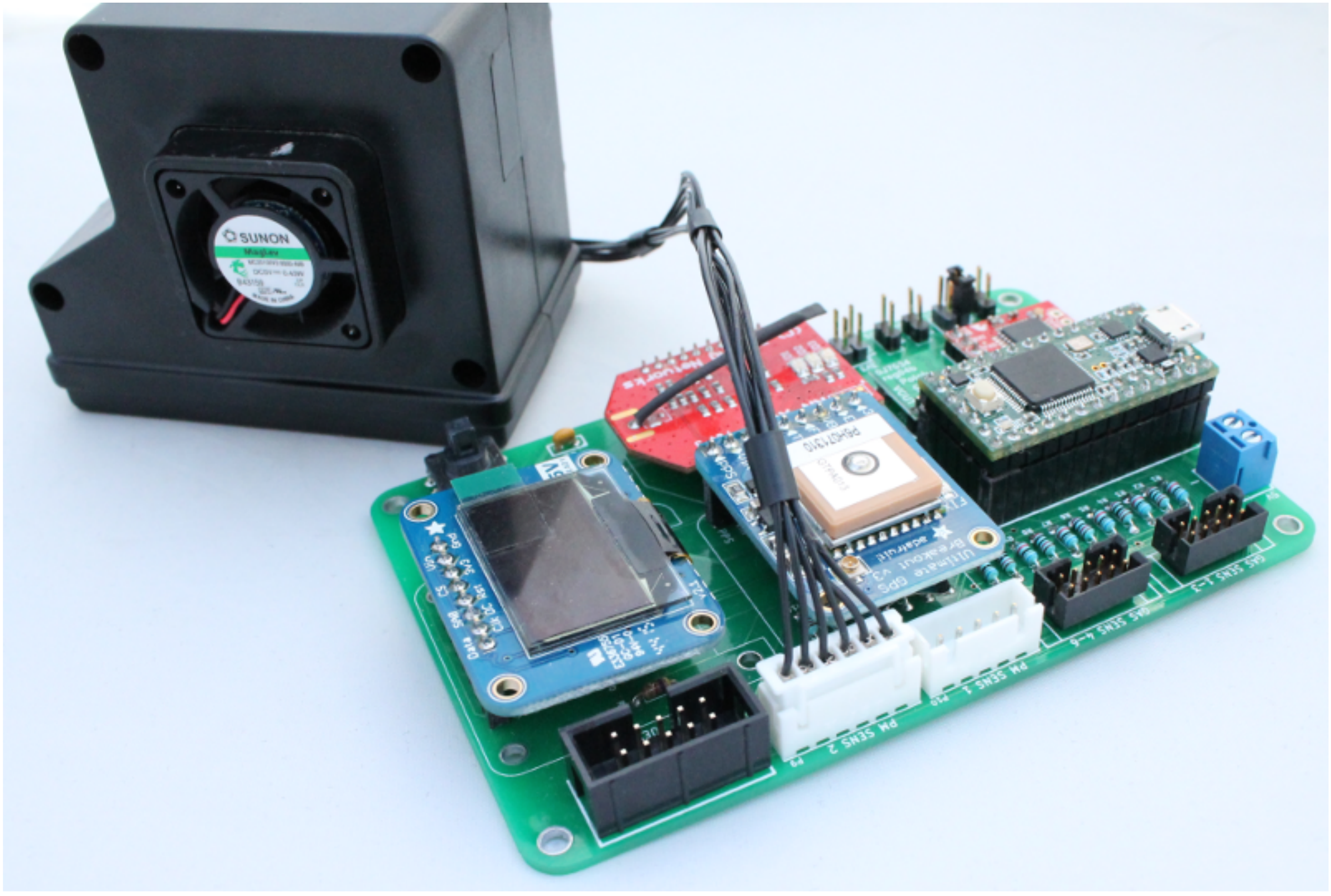


Digi International
XBee
S1
www.digi.com
FCC ID: OUR-XBEE
IC: 4214A-XBEE
94V-0
0J7034
reg04b
Pololu
VOUT
GND
VIN
SHDN
3V3 5V
REG-INV
AOUT
SVSSEL
PROG
VBUS
DEXI
VOUT
Data
Clk
SA0
CS
Rst
3v3
Vin
Gnd
U3
U8
C1
PPS
VIN
GND
RX
TX
FIX
VBAT
EN
3.3V
071350
GTPA013
FIX
adafruit!
Ultimate GPS
Breakout v3
P6

Prototype 003 (methane detector) 2016

Prototype 003 (methane detector) 2016

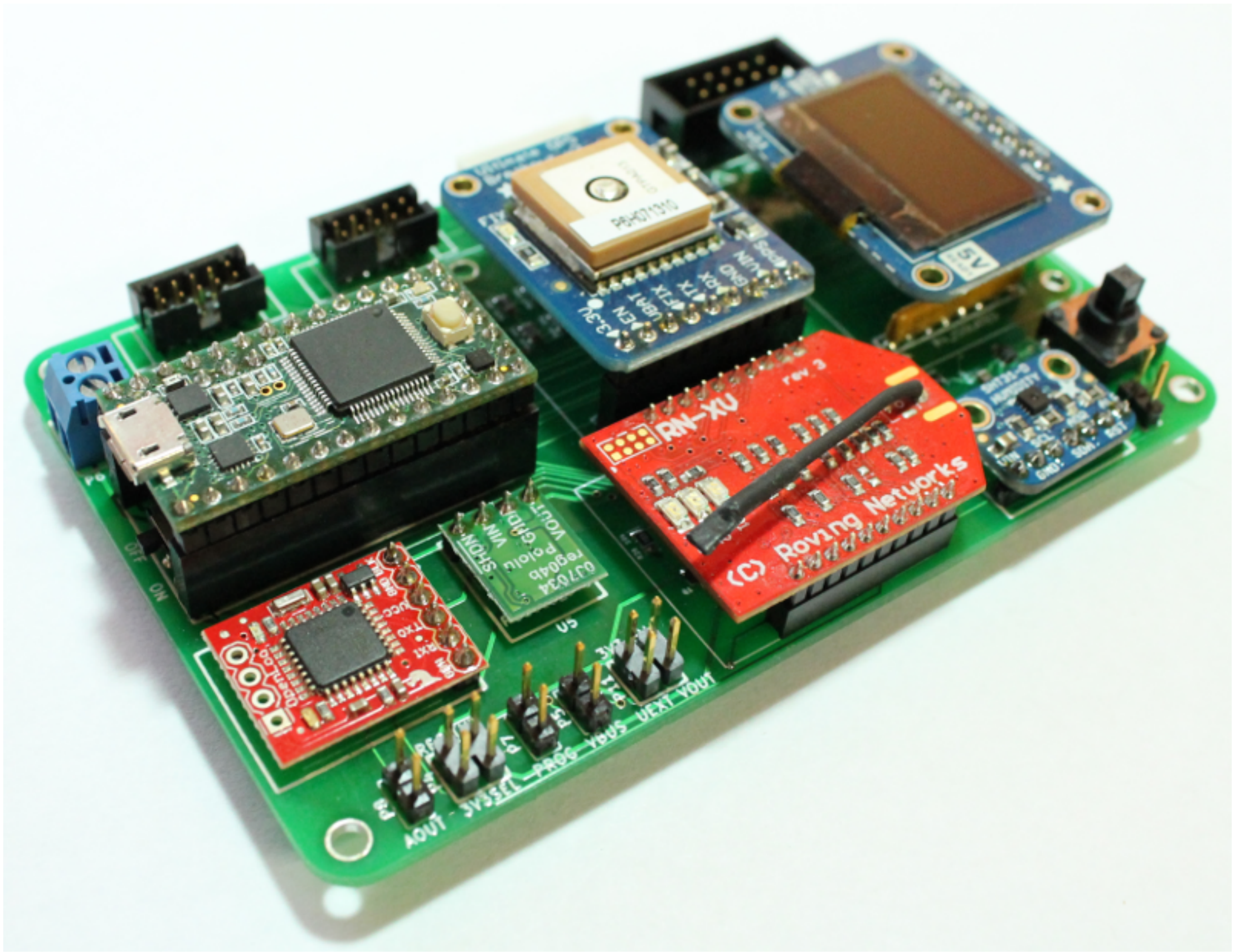
Safecast Air Beta Kit, 2016



Safecast Air Beta Kit, 2016

KEY USAGE PARAMETERS:

- Measure airborne particulate matter in PM10, PM2.5 and PM1.0 sizes.
- Log temperature and humidity for calibration purposes
- Static devices that to be installed in a single outside location for at least 3 months
- During beta period data will be published into public domain but considered beta, not scientific or research grade, and will not be included in the official Safecast dataset yet.



Safecast Air Beta Kit, 2016

Alphasense Particulate Monitor (OPC-N2)

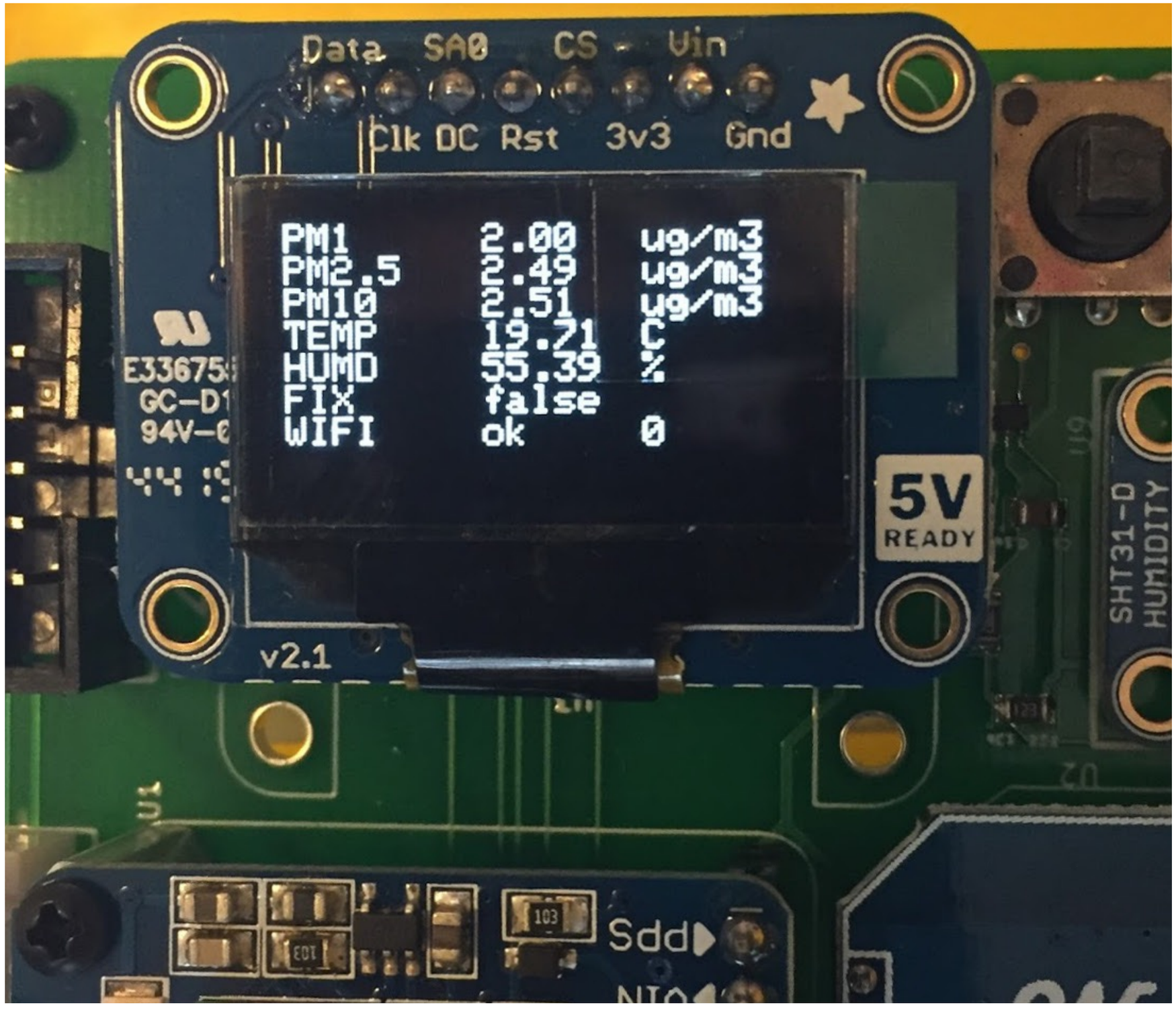
Plantower Particulate Monitor (pms7003)

FEATURES:

- Designated header for the Alphasense Particulate Monitor (OPC-N2)
- On-board temperature/humidity sensor
- On-board GPS for location data (similar to the Safecast radiation sensor)
- On-board WiFi for sending real-time data to Safecast server
- Based on Teensy 3.x development board
- SD card (OpenLog) for data storage
- LCD display

FEATURES:

- The Safecast Air board is an Open Source Hardware project. KiCad design files for the PCB can be found on Github
- https://github.com/Safecast/Safecast-Air.
- Configurable air quality measurement board. Can be expanded to include other gas measurements.
- Two designated headers for using up to six Alphasense 4-electrode gas sensors (both A4 and/or B4 types)
- UEXT expansion header for connecting other additional sensors or other hardware



Leftmost column: labels for the readings

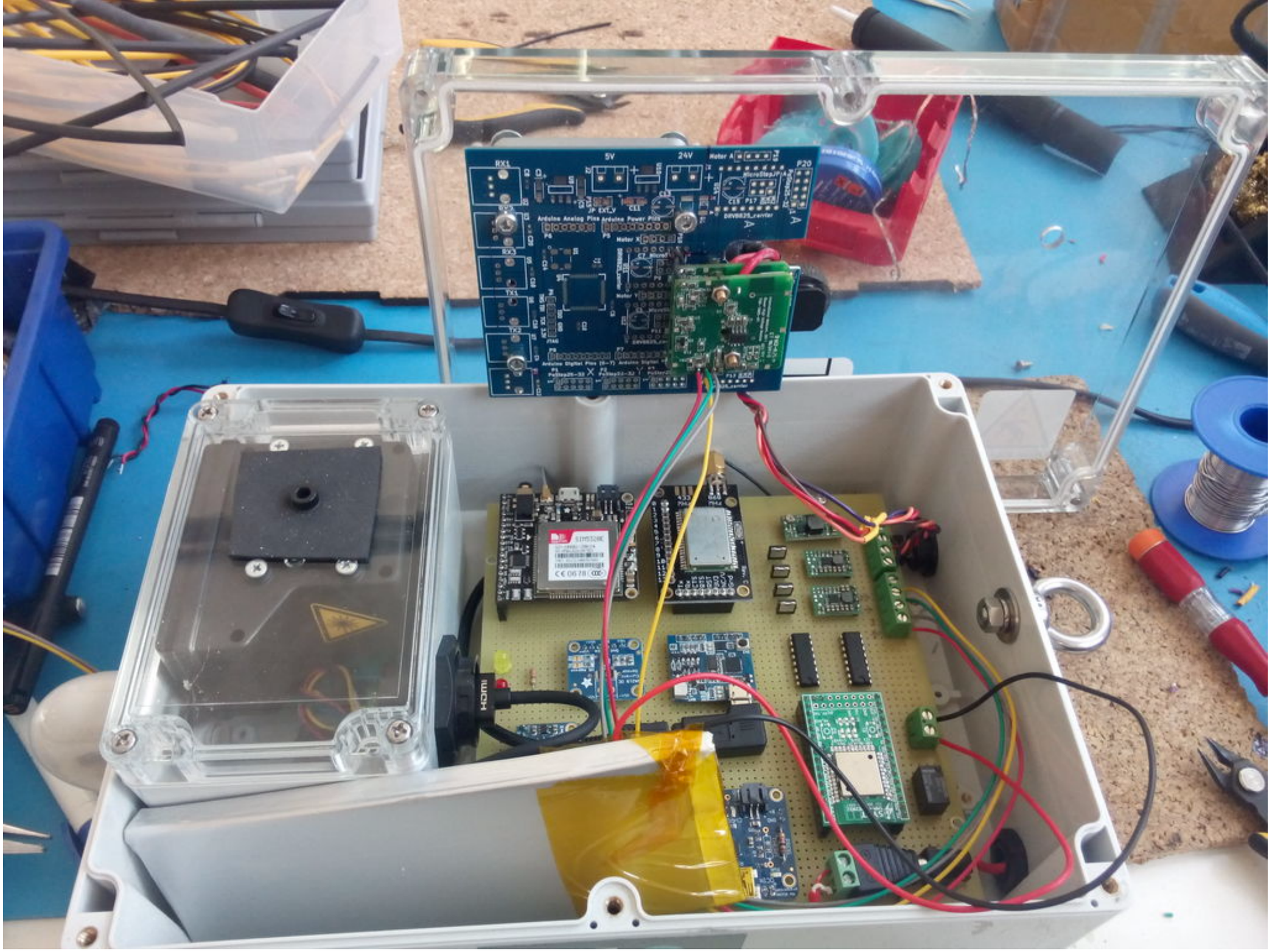
Middle column: the readings themselves

Last column: the unit of measurement.

Beta kit display info

Indicator	Description	Notes
PM1	particulate matter 1 micron or less in diameter	in micrograms per cubic meter of air
PM2.5	particulate matter 2.5 microns or less in diameter	in micrograms per cubic meter of air
PM10	particulate matter 10 microns or less in diameter	in micrograms per cubic meter of air
TEMP	temperature	in degrees Celsius
HUMD	relative humidity	as a percentage of water vapor in the air
FIX	status of GPS fix	Displays "true" when the GPS has a fix, and "false" when it does not. This may be a temporary issue due to the movement/visibility of GPS satellites. Note that it can take up to five minutes to get a GPS fix.
WIFI	the status of the wifi connection	should read “ok”

SOLARCAST - stand-alone radiation and air-quality sensor

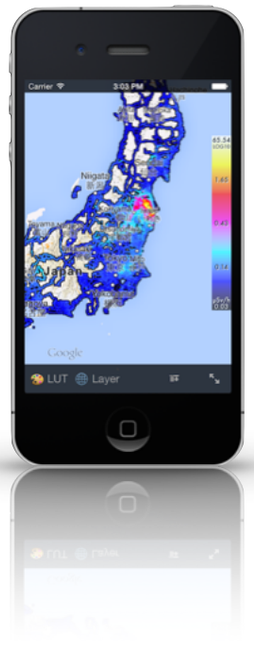


SOLARCAST - stand-alone radiation and air-quality sensor

FUTURE APPLICATION: Use with autonomous vehicles

DOCUMENTATION

iOS



OS X

Web

Map system:

- Database updated daily, now approx 10GB
- Both server-fed webmaps and smart-client iOS and OSX apps
- API with query/filtering by time, location, device, etc.
- Approx 400 volunteers have uploaded data.
  But 90% is contributed by the most active 10%.
- Data and system are open-source (Creative Commons CC0 license). Anyone can download the data, and we encourage independent efforts based on our dataset.

safecast.org

Map

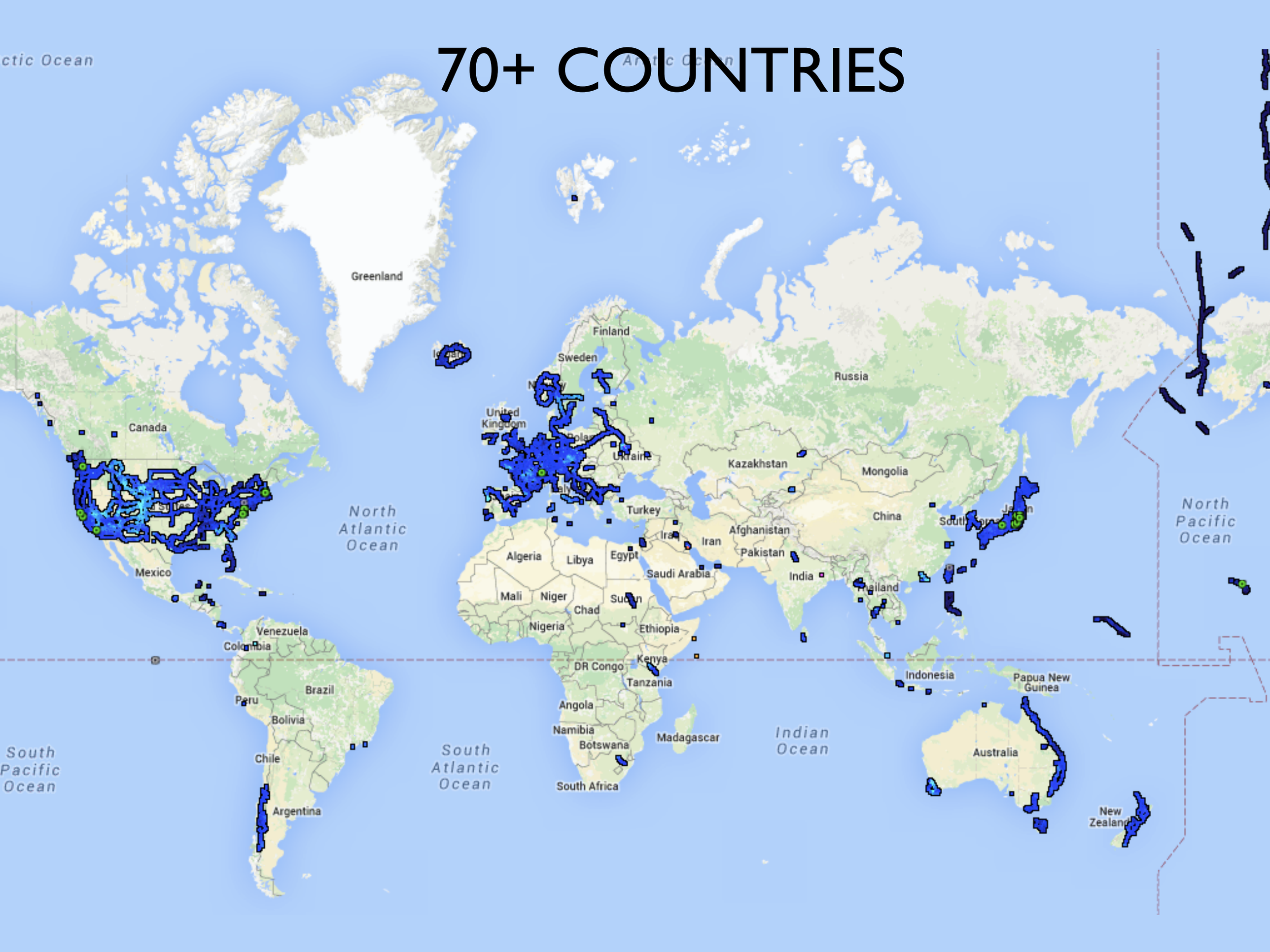
Vladivostok
Владивосток
Nakhodka
Находка
Sea of Japan
Niigata
新潟
Kanazawa
金沢
Fukuoka
福岡
Nagasaki
長崎
Miyazaki
宮崎
Mt. Dainichi
大日岳
Mount Nasu
那須岳

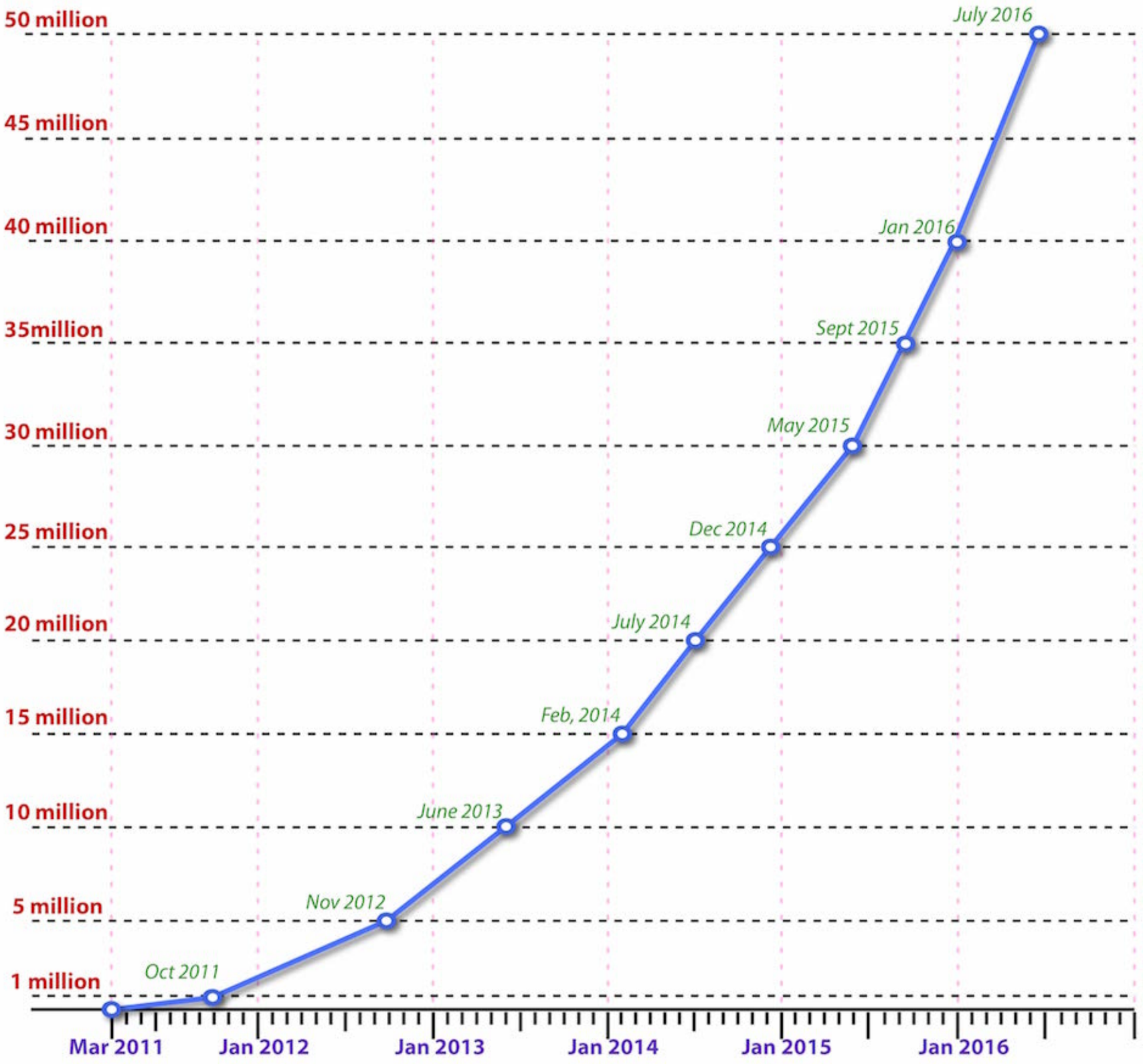
65.54
LOG10
10.09
3.99
2.13
1.31
0.87
0.60
0.43
0.31
0.23
0.16
0.12
0.08
0.05
μSv/h
0.03

Map data ©2016 Google, SK planet, ZENRIN
100 km
Terms of Use

safecast.org/tilemap/

70+ COUNTRIES





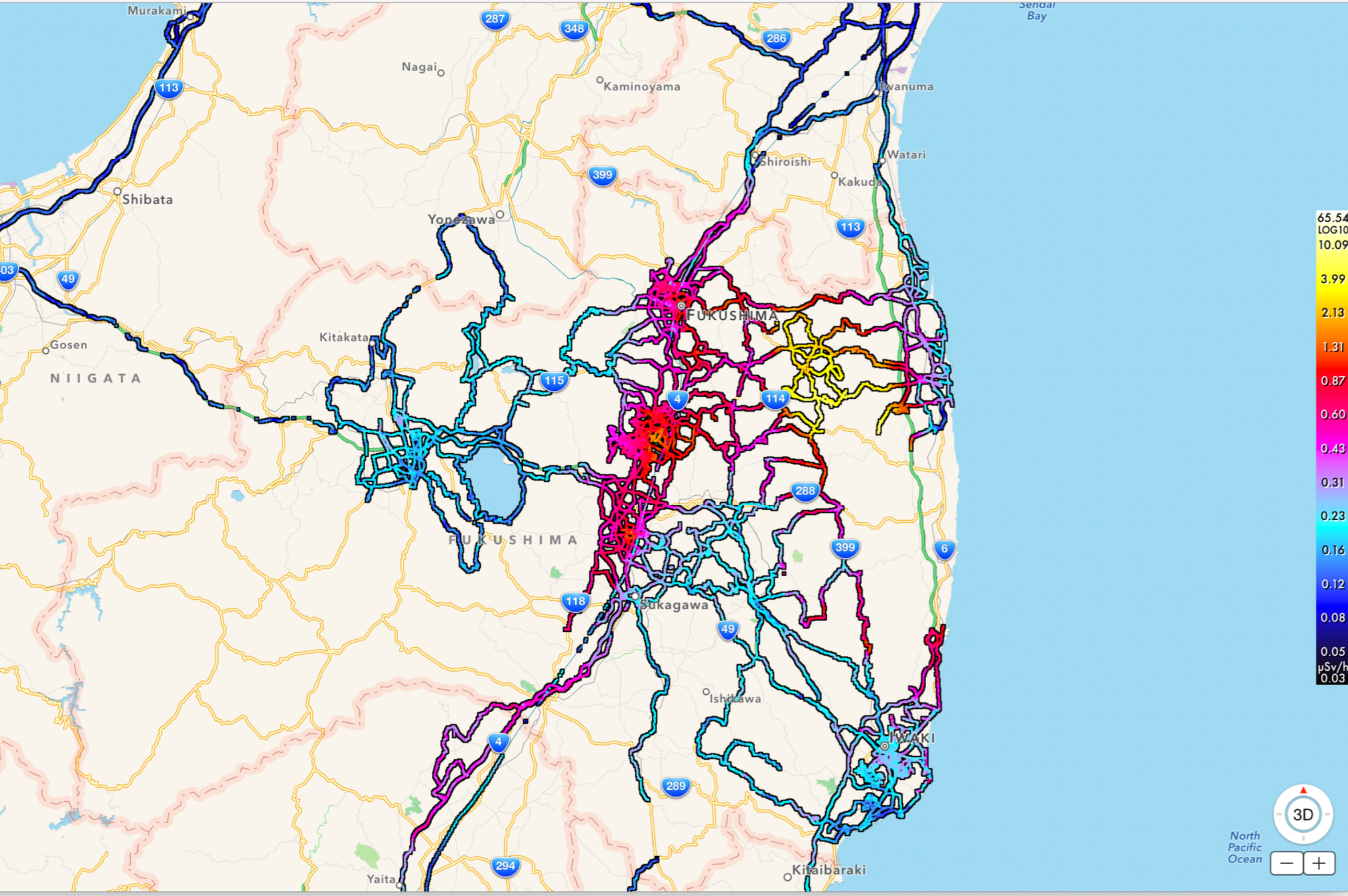
65,000,000 data points! (March 2017)

SAFECAST DATA

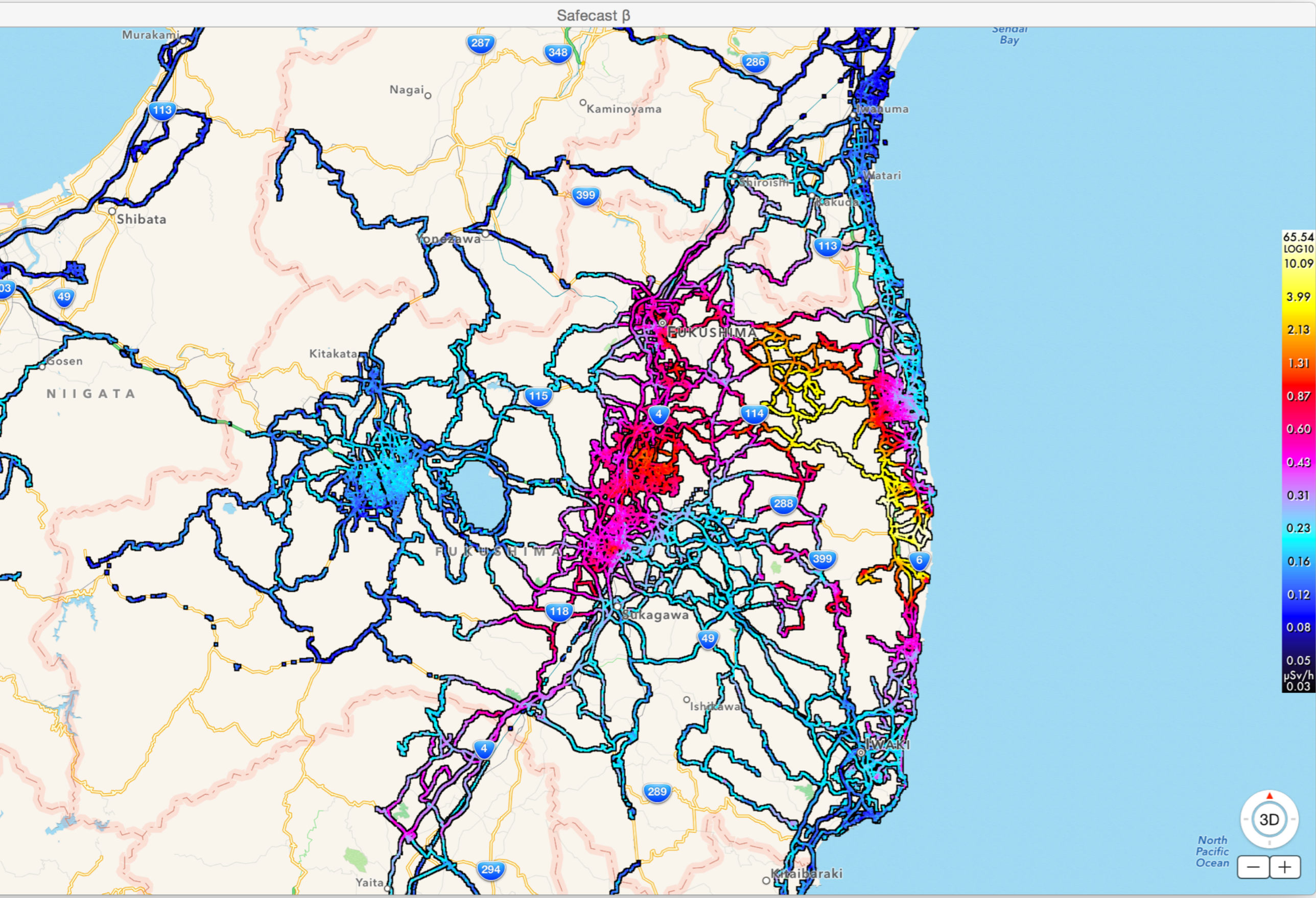
Change over time, March 2011- March 2016

Fukushima region

Safecast β

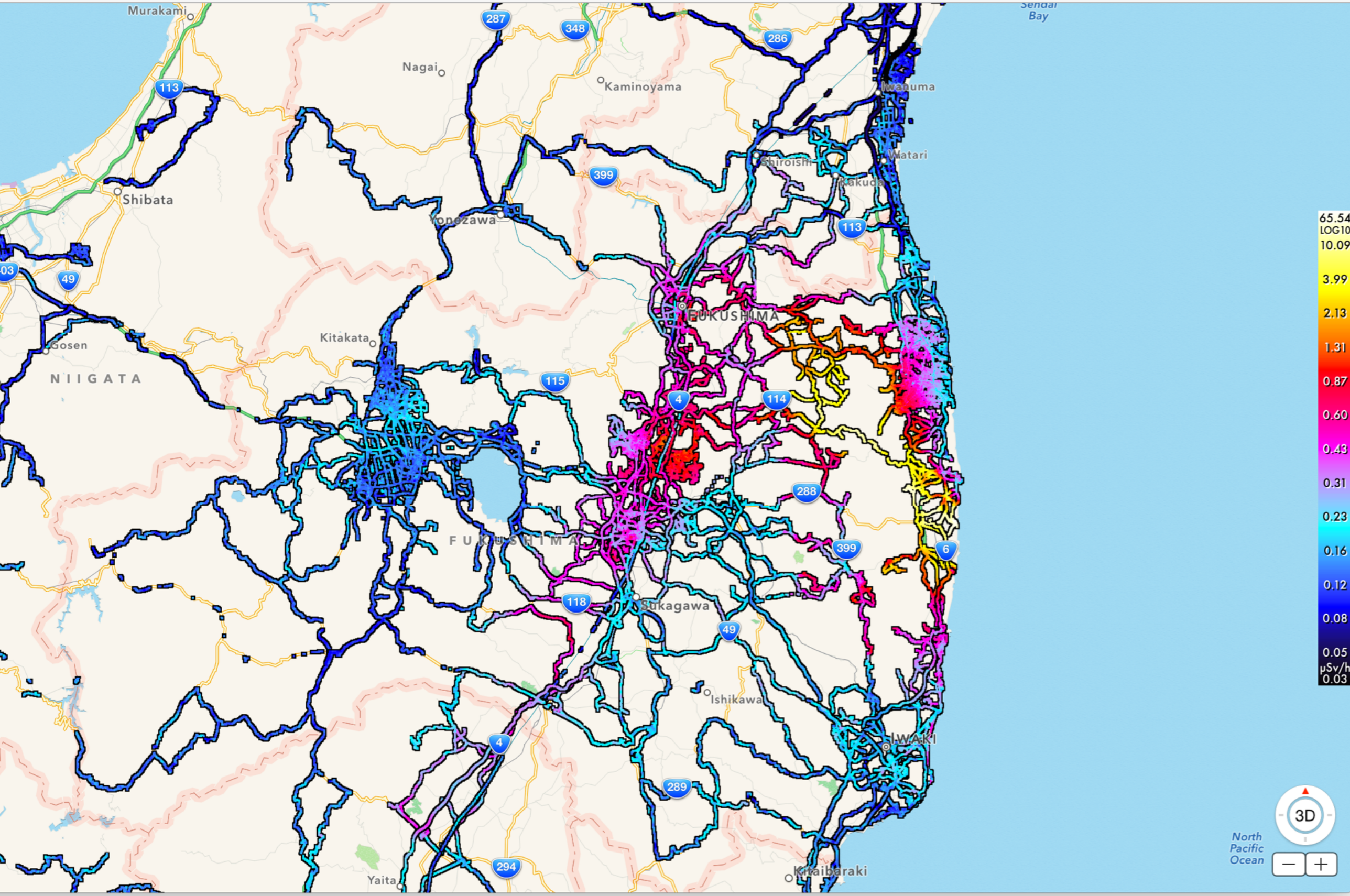


1) March 2011— Sept 2011

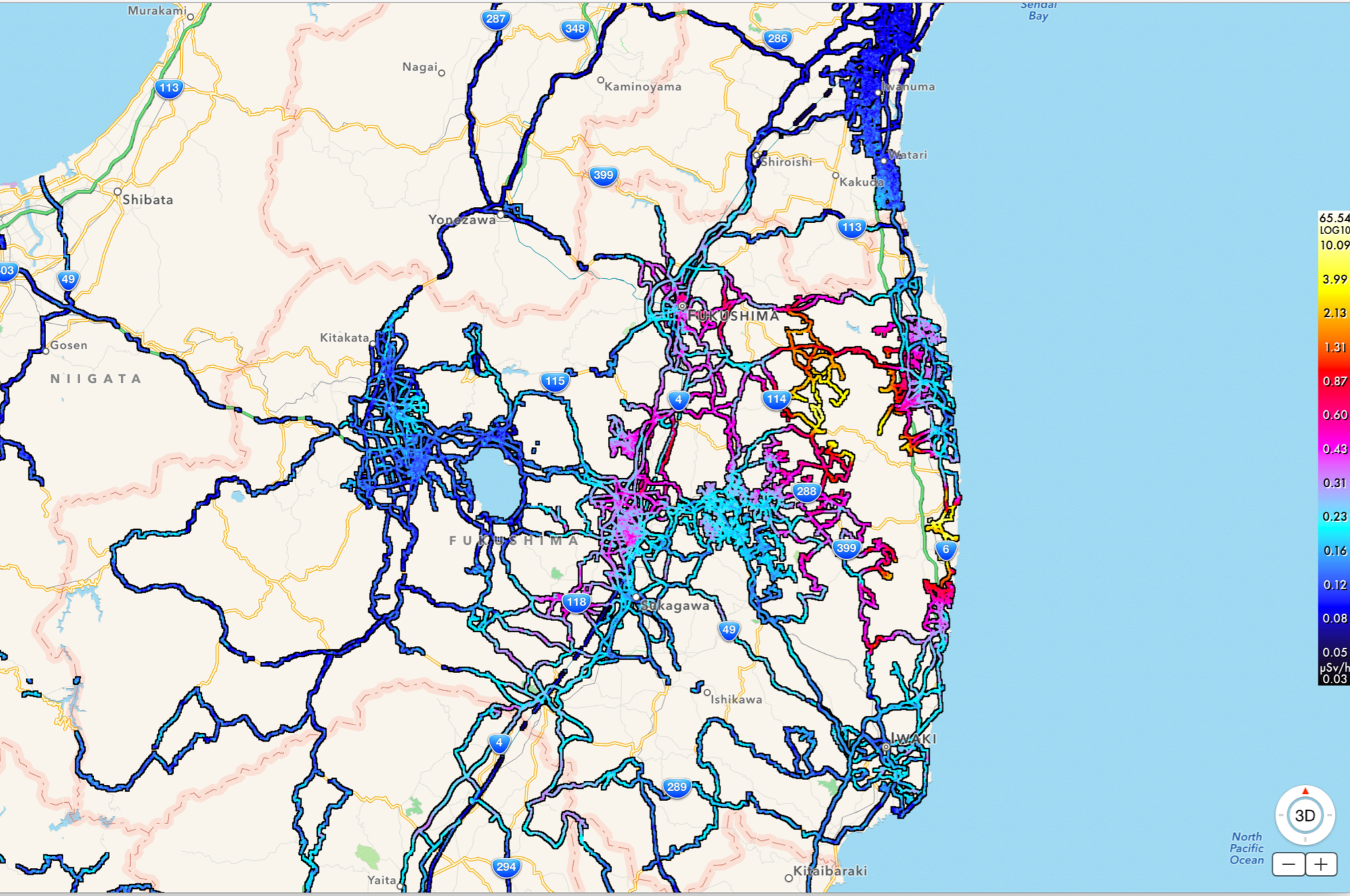


2) March 2011 — March 2012

Safecast β



3) Sept 2011— Sept 2012



4) March 2012 — March 2013

Safecast β

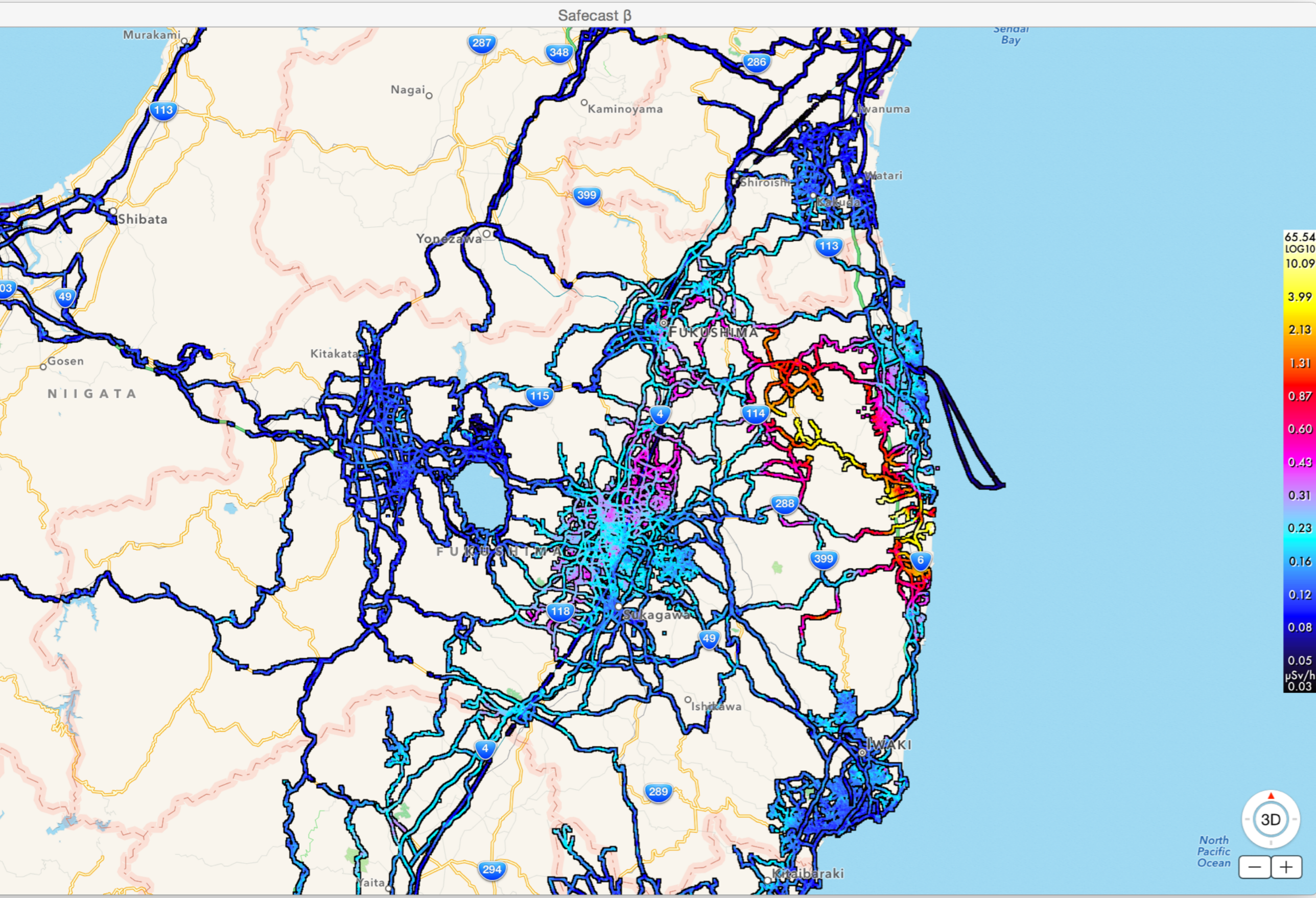
Murakami
Nagai
Kaminoyama
Iwanuma
Shiroishi
Watari
Kakuda
Shibata
Yonezawa
Gosen
NIIGATA
Kitakata
FUKUSHIMA
Sukagawa
Ishikawa
IWAKI
Kitaibaraki
Yaita
Sendai Bay
North Pacific Ocean

287 348 286 113 399 49 115 4 114 288 6 118 294 289

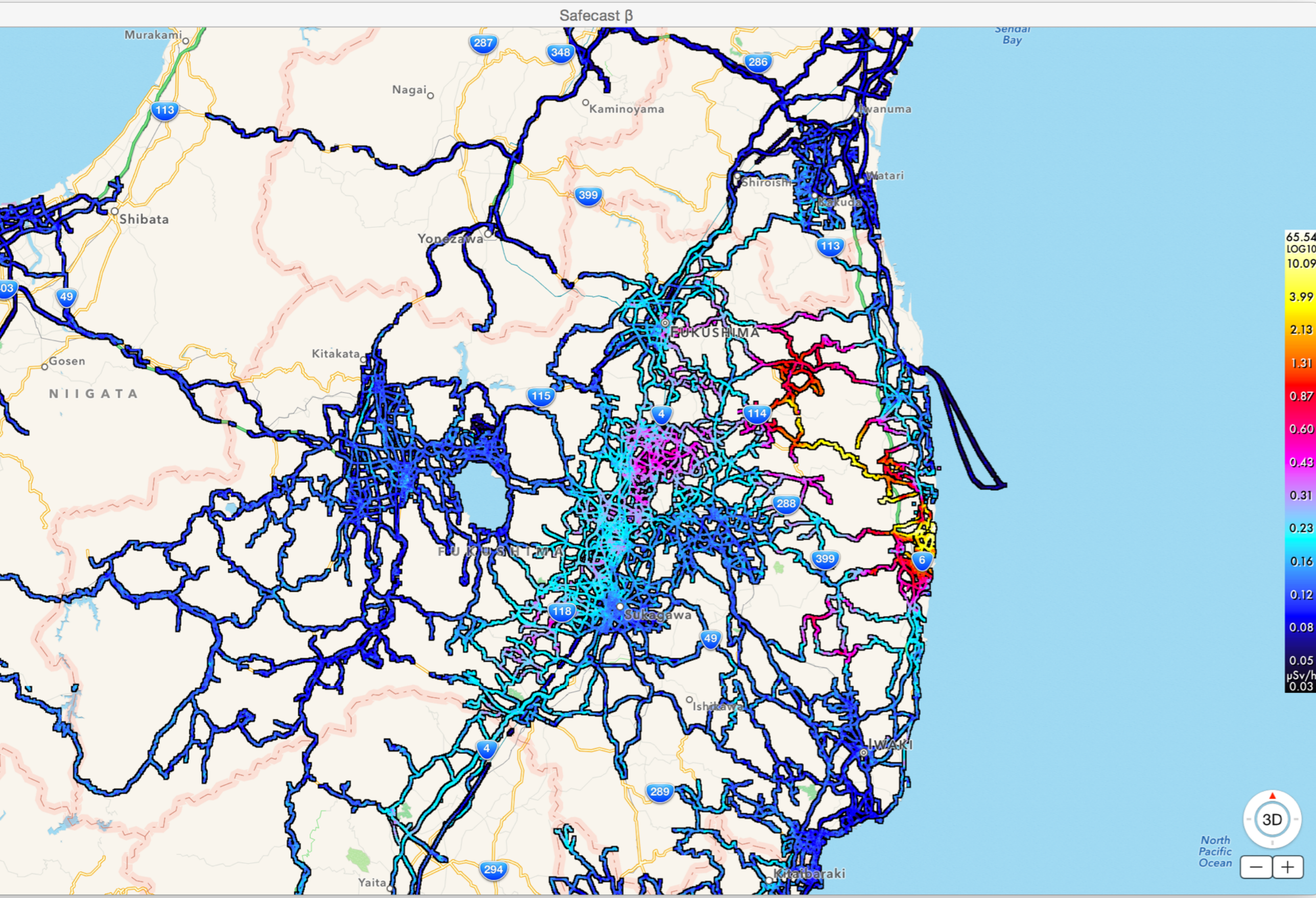
65.54
LOG10
10.09
3.99
2.13
1.31
0.87
0.60
0.43
0.31
0.23
0.16
0.12
0.08
0.05
μSv/h
0.03

3D

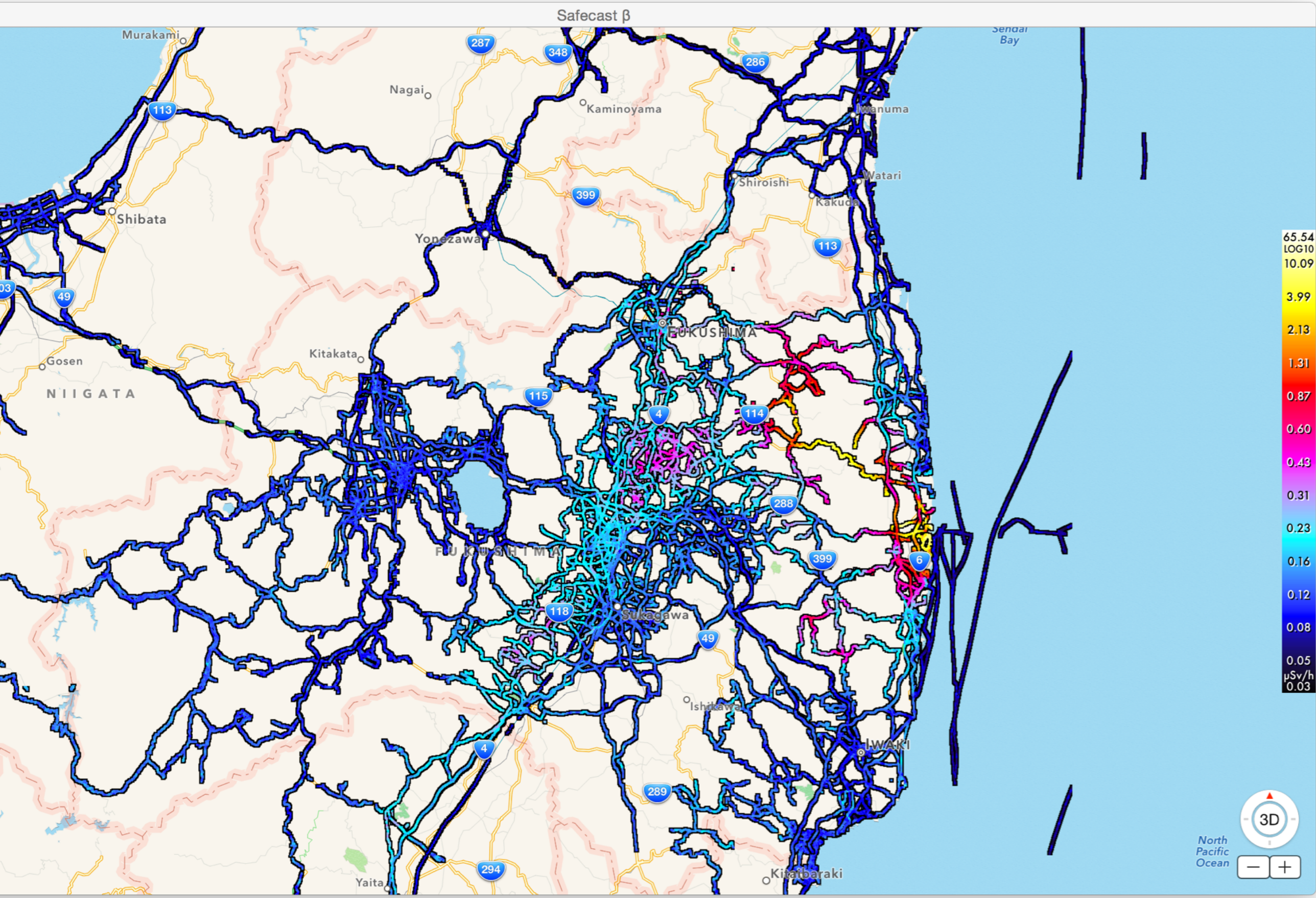
5) Sept 2012 — Sept 2013



6) March 2013 — March 2014



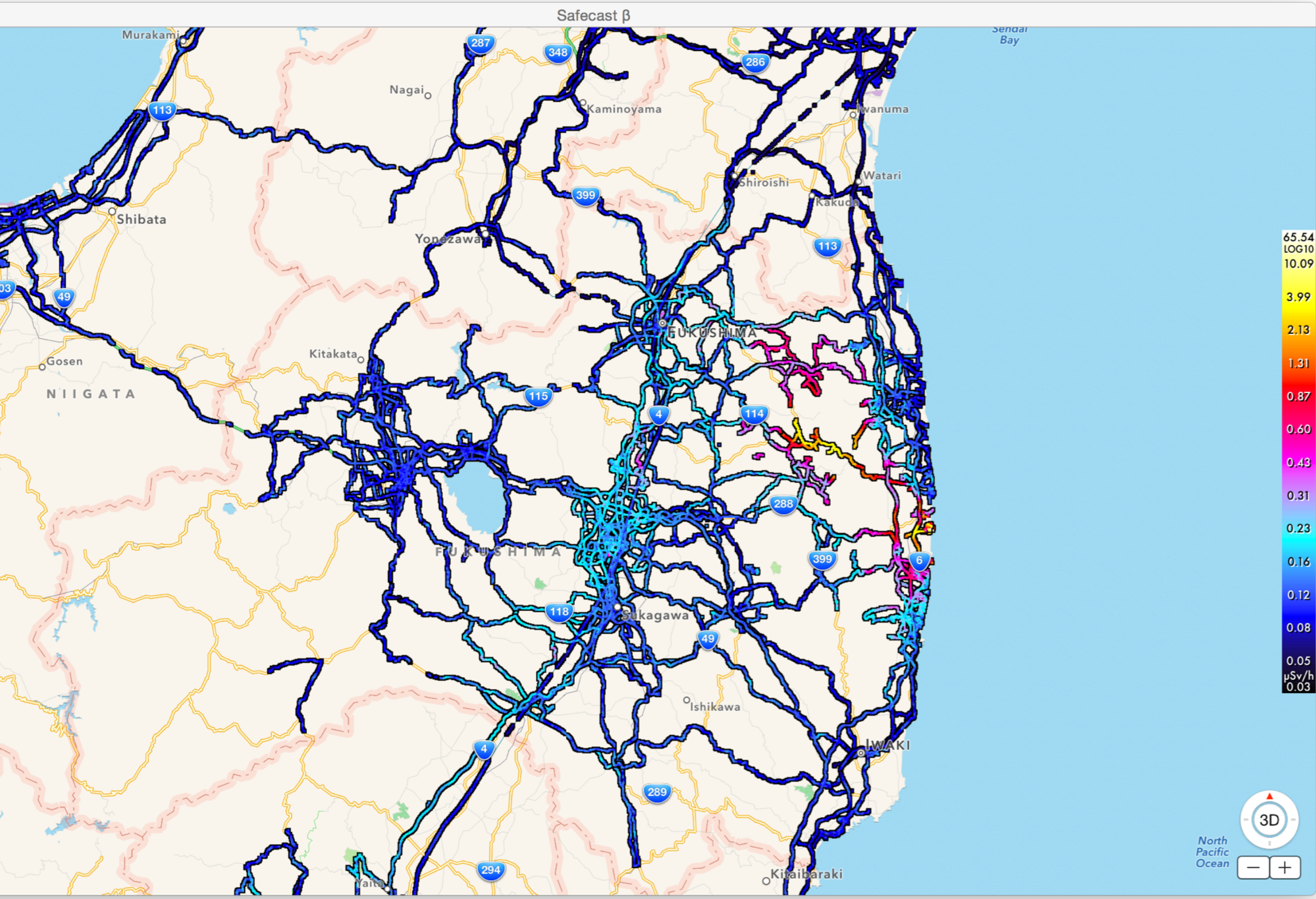
7) Sept 2013 — Sept 2014



8) March 2014 — March 2015

Safecast β

9) Sept 2014 — Sept 2015



10) March 2015 — March 2016

cast API

ttps://api.safecast.org/en-US/home

SAFECAST

ADMIN SUBMIT UPLOAD AZBY@ME.COM

- Dashboard
- Safecast Api
- Users
- Measurements
- bGeigie Imports
- Devices

The Safecast API

Query and add to the Safecast dataset with your own application.

API Endpoint

https://api.safecast.org/en-US

GET https://api.safecast.org/.json JSON HTML

Available Resources

Users	Add and view user accounts
Measurements	Add and view measurements
bGeigie Imports	Add and view bGeigie Imports
Devices	Add and view Devices

Users

Get a list of Safecast users	GET /users.json
Add a new user	POST /users.json
View a user	GET /users/334.json

Measurements

Get a list of Measurements	GET /measurements.json
Add a new measurement	POST /measurements.json
View a measurement	GET /measurements/22684490.json

api.safecast.org

SAFECAST

ADMIN SUBMIT UPLOAD AZBY@ME.COM

- Dashboard
- Safecast Api
- Users
- Measurements
- bGeigie Imports
- Devices

Bgeigie Import #019-1112.LOG Processed

Download Original File

If you don't see the map, please manually reload the page.

1. Uploaded | 2. Processed | 3. Metadata Added | 4. Submitted | 5. Approved | 6. Live

Metadata | Process Log | Edit Details

Uploaded By
KM.AIZU
Filename
019-1112.LOG
Number Of Lines
6079
Number Of Measurements
6079

Metadata

Title	Route6 2014/11/12
Description	Route 6 Return difficult district
Credits	Aizu radioactivity information center
Height	1.3m
Orientation	Facing Left
Cities	Koriyama,Hirata,Ono,Iwaki,Hirono, Naraha,Tomioka,Okuma,Futaba,Namie Minamisoma,Iitate,Kawamata,Fukushimaa, Nihonmatsu,Motomiya,Inawashiro,Aizuwakamatsu

API walks users through the upload process

Delete this Import

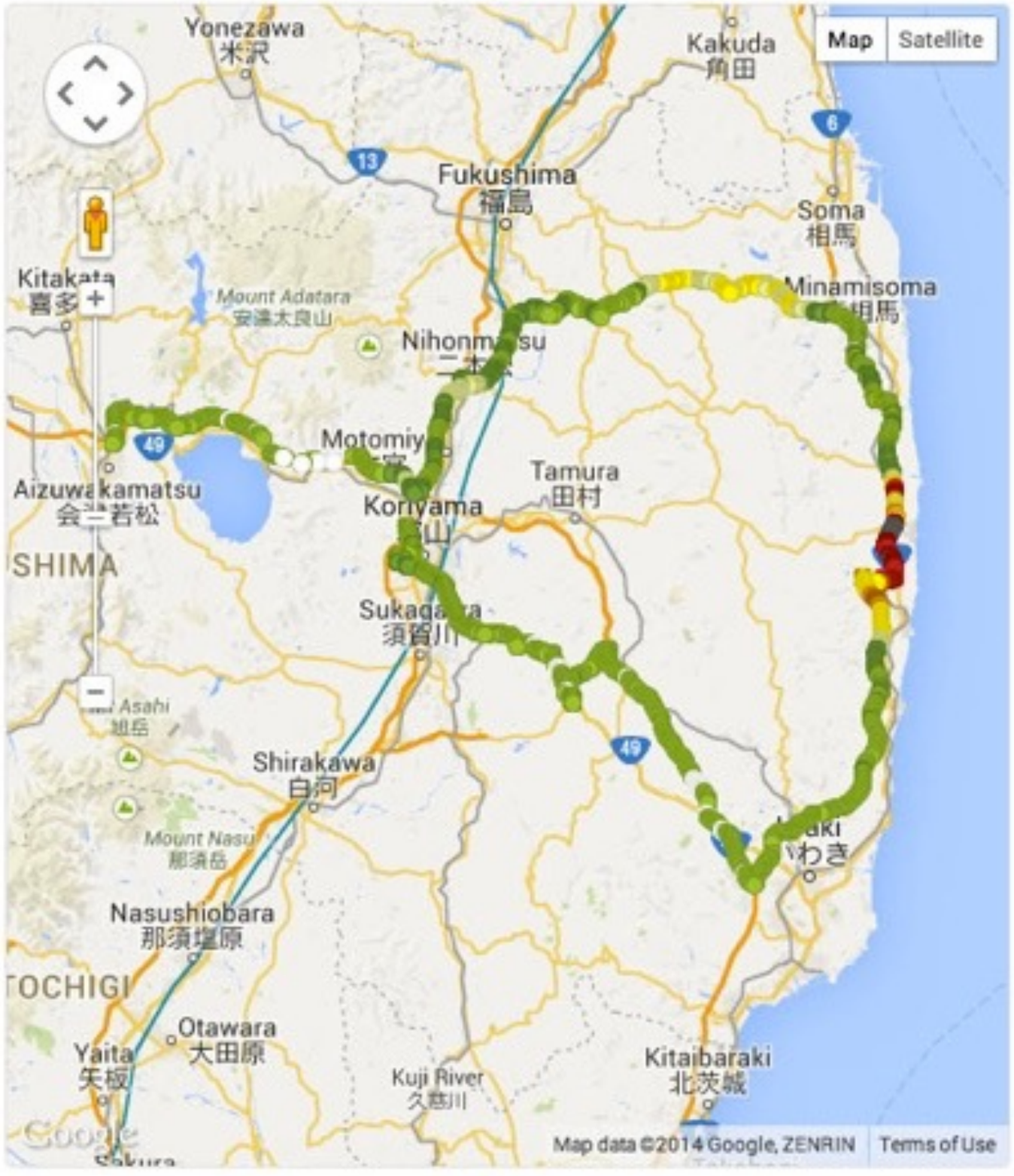
MEASUREMENT

Captured At	2014-11-12T10:27:28Z
Latitude	37.4701
Longitude	140.3621
CPM	72

Delete this Import

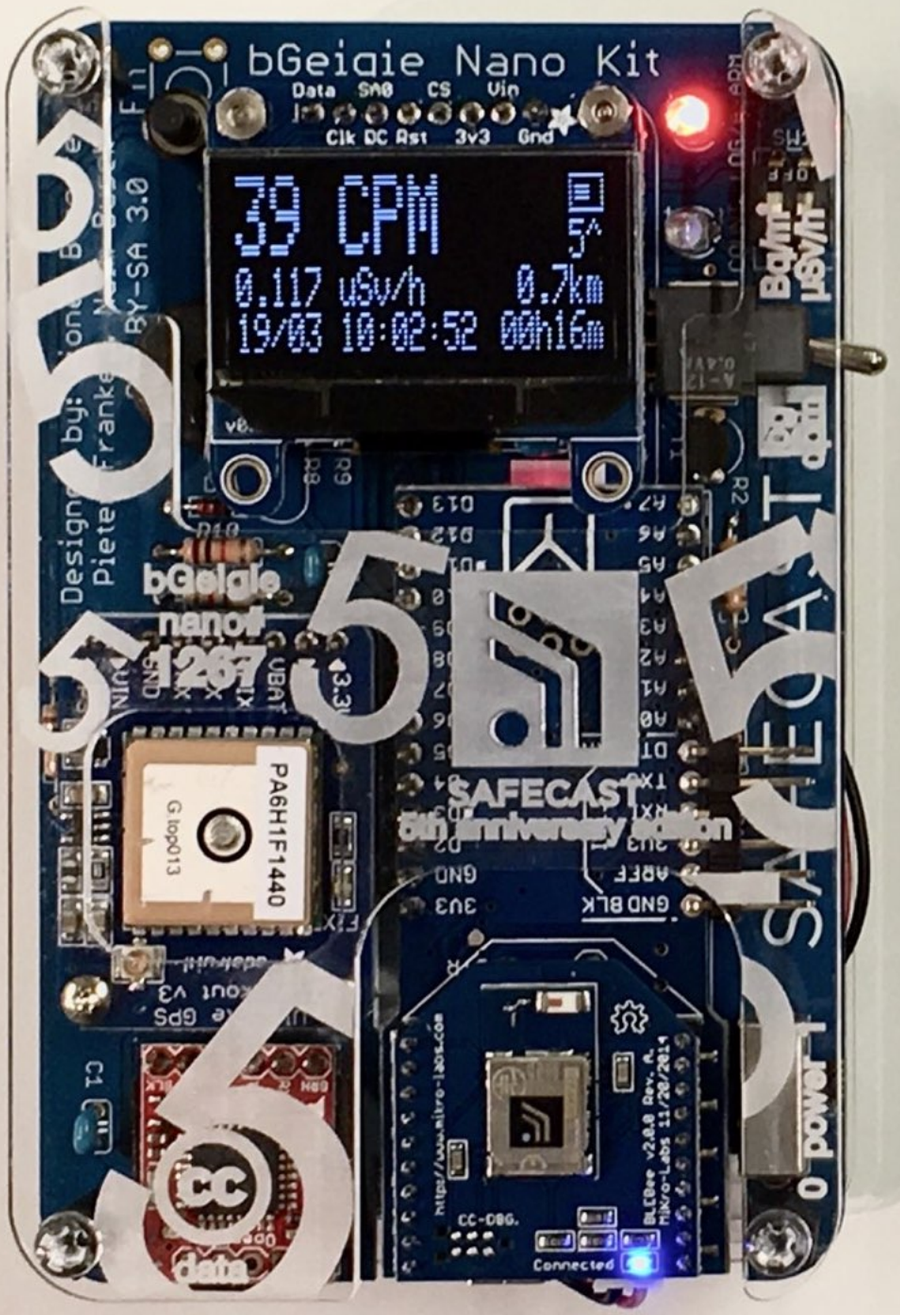
MEASUREMENT

Captured At	
2014-11-12T10:27:28Z	
Latitude	37.4701
Longitude	140.3621
CPM	72
µsv	0.22

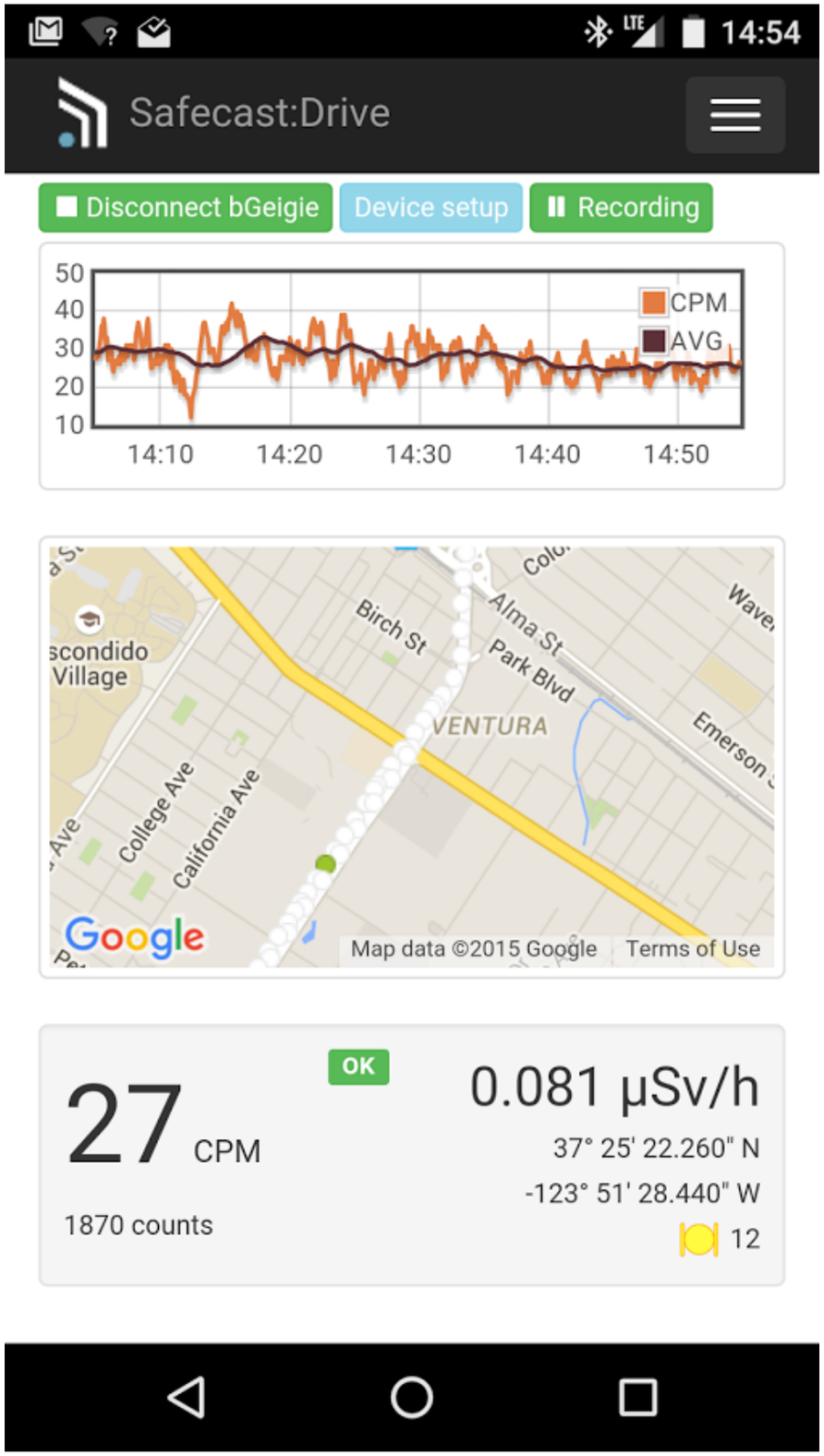


API allows each data point to be checked before approval

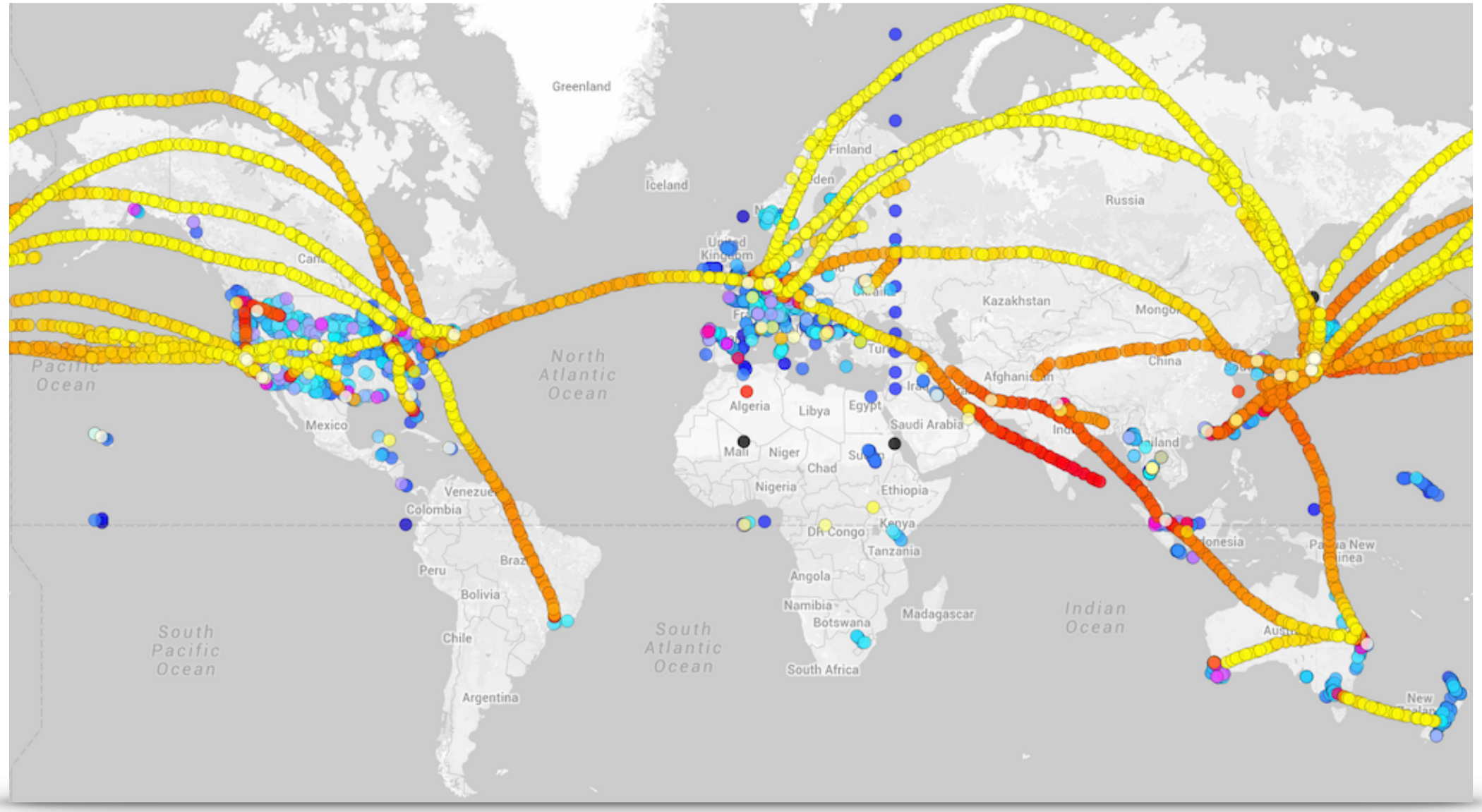
Because sometimes there's no substitute for human judgement, we think it's important to keep humans in the loop!



BLUETOOTH - ENABLED

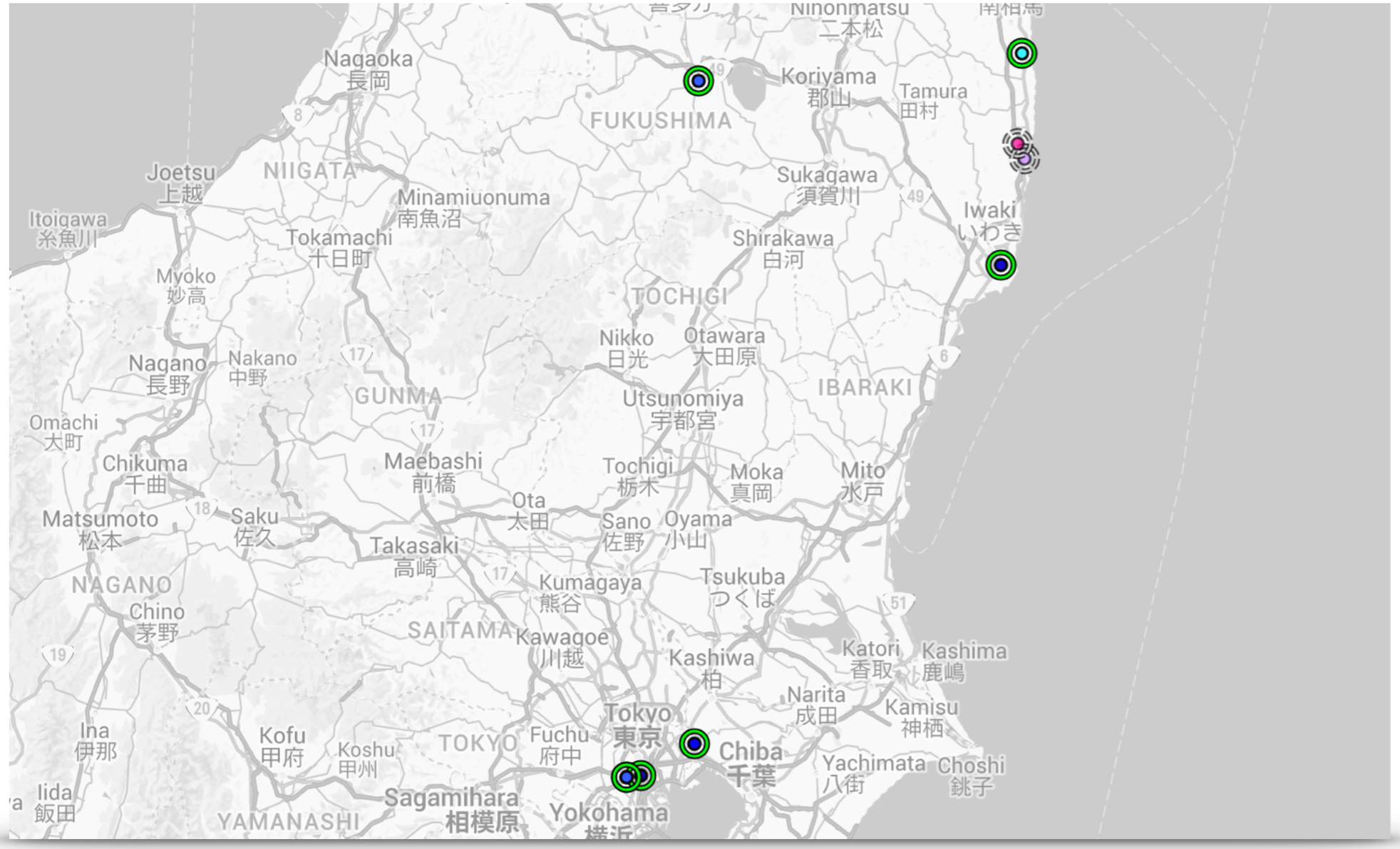


SAFECAST DRIVE APP - ANDROID



5000+ bGeigie Logs

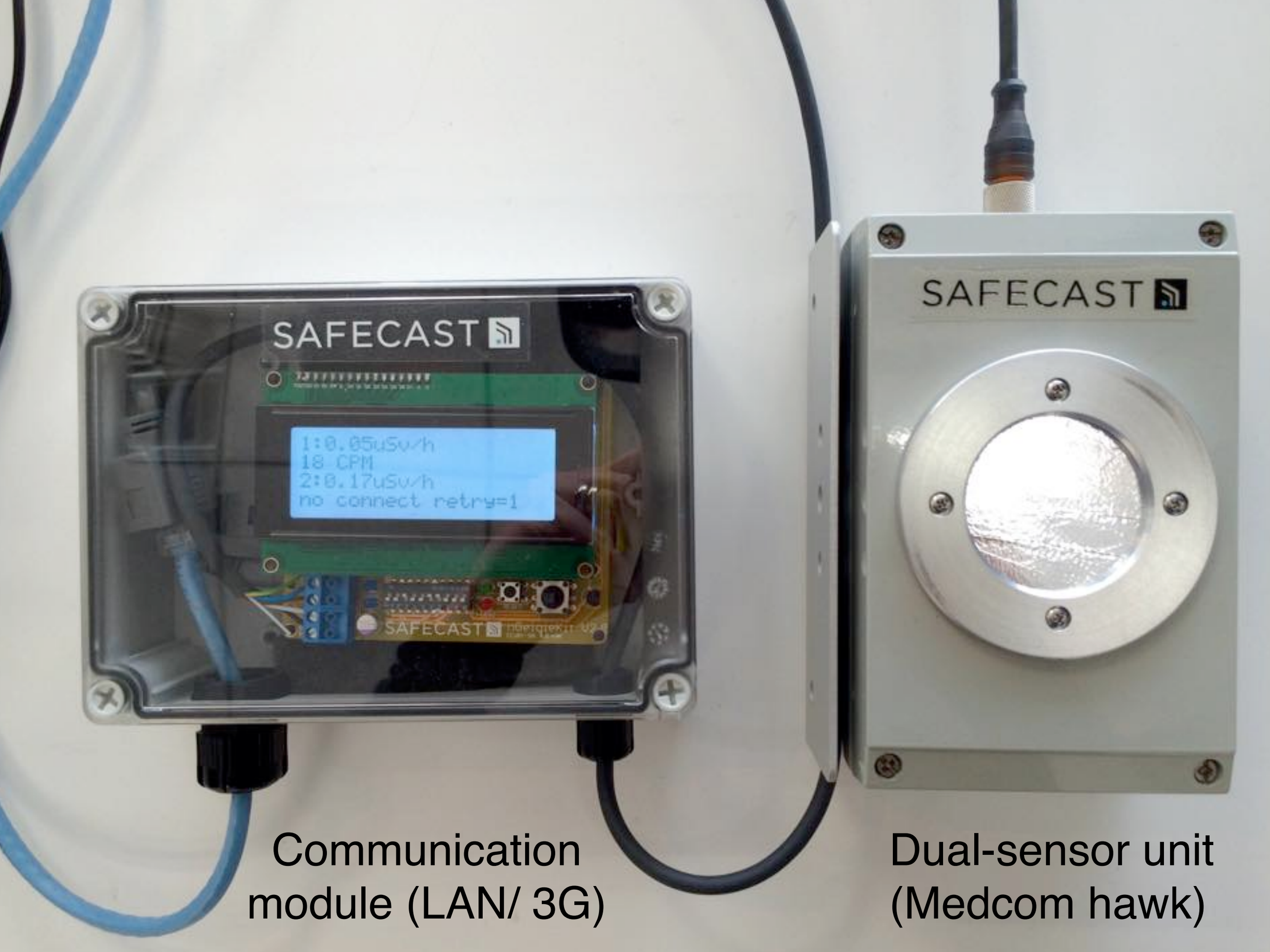
(In-flight radiation data can be displayed)



Realtime Sensors

pointcast.safecast.org

Wi-Fi
Odaka
Worker's
Base
小高ワーカーズベース



Communication module (LAN/ 3G)

Dual-sensor unit (Medcom hawk)

imi
International
Medcom, Inc

SAFECAST

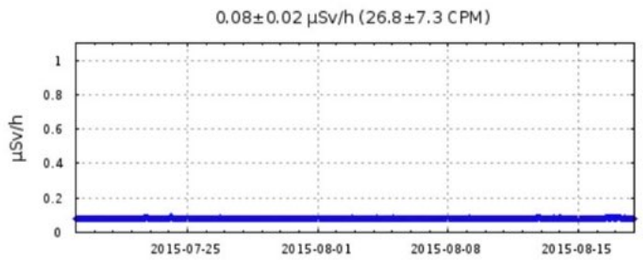
#10008
SAFECAST

SAFECAST
S1:46 CPM 0.14uSh
S2:18 CPM 0.15uSh
API:06:40GMT PASS
STS: 4.19V
SAFECAST
WHT= Vcc
BLK = Gnd
#10008
SAFECAST
#10008
SAFECAST
S1: http://realtime.safecast.org/sensors/100081/
S2: http://realtime.safecast.org/sensors/100082/

Japan, Tokyo, Minato-ku, Roppongi District (sensor 100022)

Online

4 mins ago	4 weeks ago
24 *cpm*	43 *cpm*
0.072 *µSv/h*	0.129 *µSv/h*



More sensor data

Tube:LND7317

Share

Comments

- Ross on USA, California, Bodega Head
- Kent Noonan on USA, California, Bodega Head
- robouden on Japan, Nara, Mitsue-Mura, Safecast Nara
- Marco Kaltofen on Japan, Fukushima , Matsukawa, Seirinji
- Safecast on Japan, Tokyo, Shibuya, Safecast Office
- Rob Oudendijk on Japan, Tokyo, Shibuya, Safecast Office
- Jam on Taiwan, Taipei, Fabcafe
- robouden on Taiwan, Taipei, Fabcafe
- robouden on Taiwan, Taipei, Fabcafe
- Tim Wong on Taiwan, Taipei, Fabcafe

Leave a Reply

Name (required)

Email (will not be published) (required)

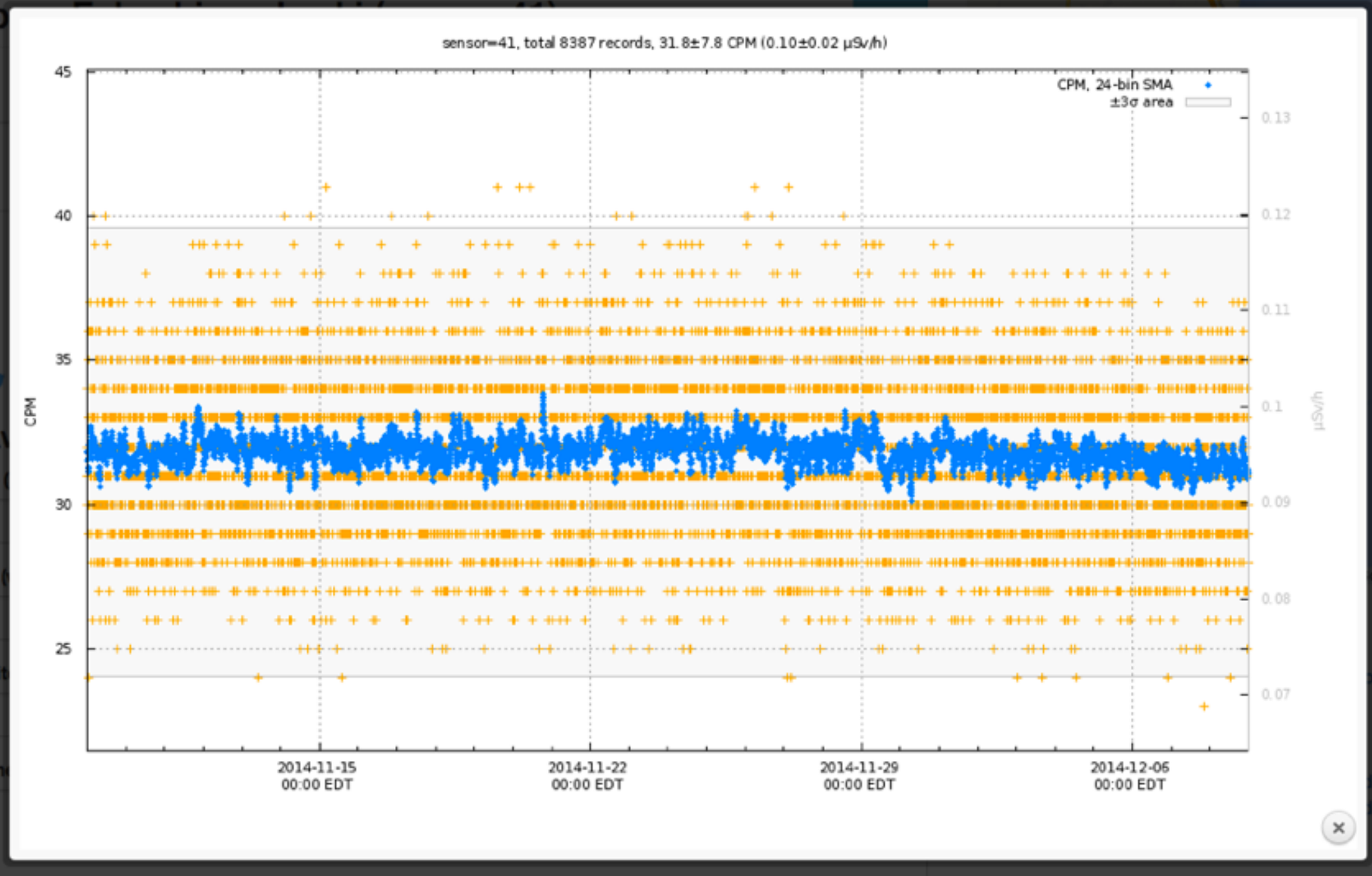
Website

Comment

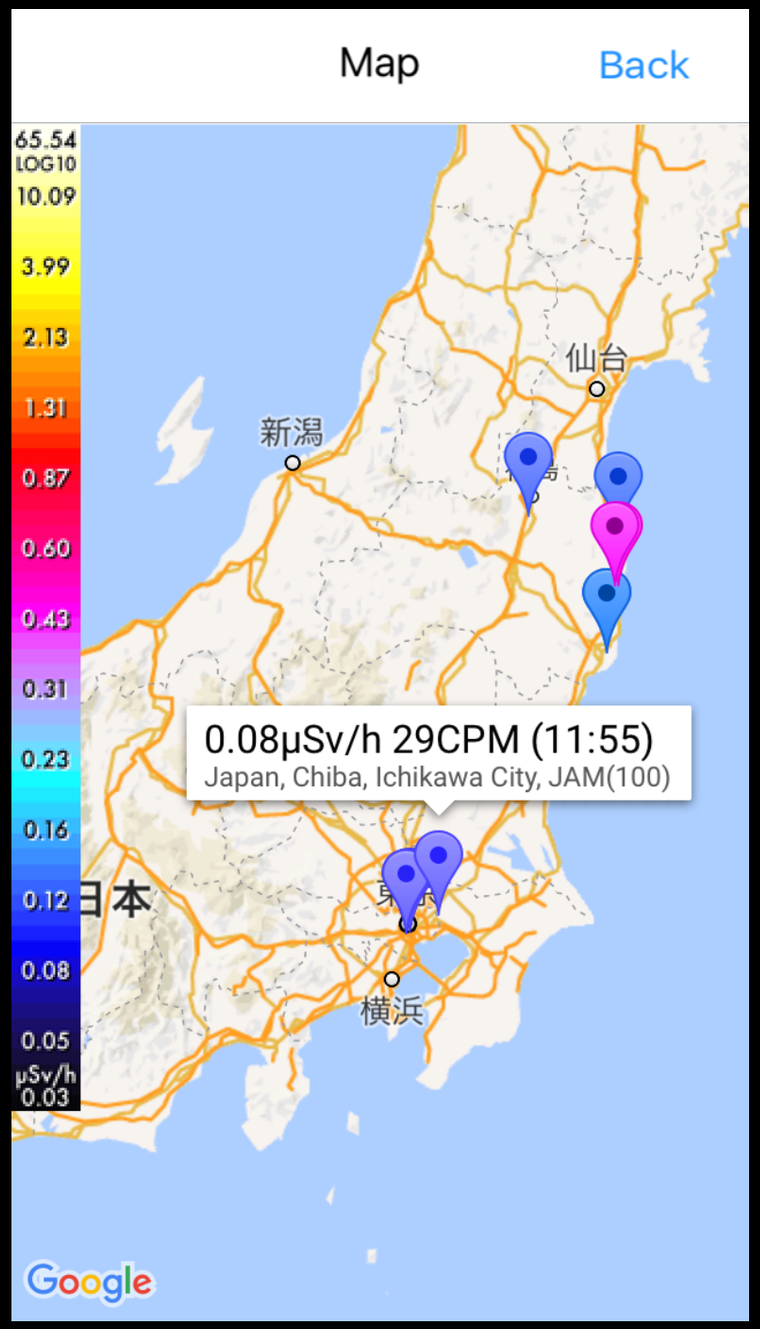
Pointcast unit webpage allows feedback and queries

Bgeigie Import #17323 \\ | Safecast Tile Map | Japan, Fukushima, IwakiSA

realtime.safecast.org/sensor/41



Detailed view of time series


Map
Back
65.54
LOG10
10.09
3.99
2.13
1.31
0.87
0.60
0.43
0.31
0.23
0.16
0.12
0.08
0.05
μSv/h
0.03
新潟
仙台
日本
横浜
0.08μSv/h 29CPM (11:55)
Japan, Chiba, Ichikawa City, JAM(100)
Google

Sensors
Back
Last Update : 2016/03/20 12:04
World
Favorite
Japan, Chiba, Ichikawa City, JAM
device_id : 100(LND7318/334)
2016-03-20 11:55:57
Average (yesterday, month, year)
30 cpm 123cpm 123cpm
Peak
37 cpm 123cpm 123cpm
29 CPM
0.086 μSv/h
Japan, Fukushima, Iwaki 1
device_id : 100101(LND7138/334)
2016-03-15 16:02:57
Average (yesterday, month, year)
0 cpm 123cpm 123cpm
Peak
0 cpm 123cpm 123cpm
49 CPM
0.146 μSv/h
Japan, Fukushima, Matsukawa, Seirinji
device_id : 100011(LND7317/334)
2016-03-20 11:57:50
Average (yesterday, month, year)
37 cpm 123cpm 123cpm
Peak
45 cpm 123cpm 123cpm
40 CPM
0.119 μSv/h
Japan, Fukushima, Minami-Soma ,
device_id : 100081(LND7317/334)
2016-03-20 11:58:19
Average (yesterday, month, year)
41 cpm 123cpm 123cpm
Peak
43 CPM
0.128 μSv/h

Sensors
Back
Last Update : 2016/03/20 12:04
World
Favorite
Japan, Chiba, Ichikawa City, JAM
device_id : 100(LND7318/334)
2016-03-20 11:55:57
Average (yesterday, month, year)
30 cpm 123cpm 123cpm
Peak
37 cpm 123cpm 123cpm
29 CPM
0.086 μSv/h
Japan, Fukushima, Tomioka 1
device_id : 100091(LND7138/334)
2016-03-01 16:35:00
Average (yesterday, month, year)
0 cpm 123cpm 123cpm
Peak
0 cpm 123cpm 123cpm
140 CPM
0.419 μSv/h
Japan, Tokyo, Minato-ku, Roppongi
device_id : 100021(LND712/120)
2016-03-20 11:58:31
Average (yesterday, month, year)
11 cpm 123cpm 123cpm
Peak
16 cpm 123cpm 123cpm
13 CPM
0.108 μSv/h

Community

Ad-hoc network

More

More

More

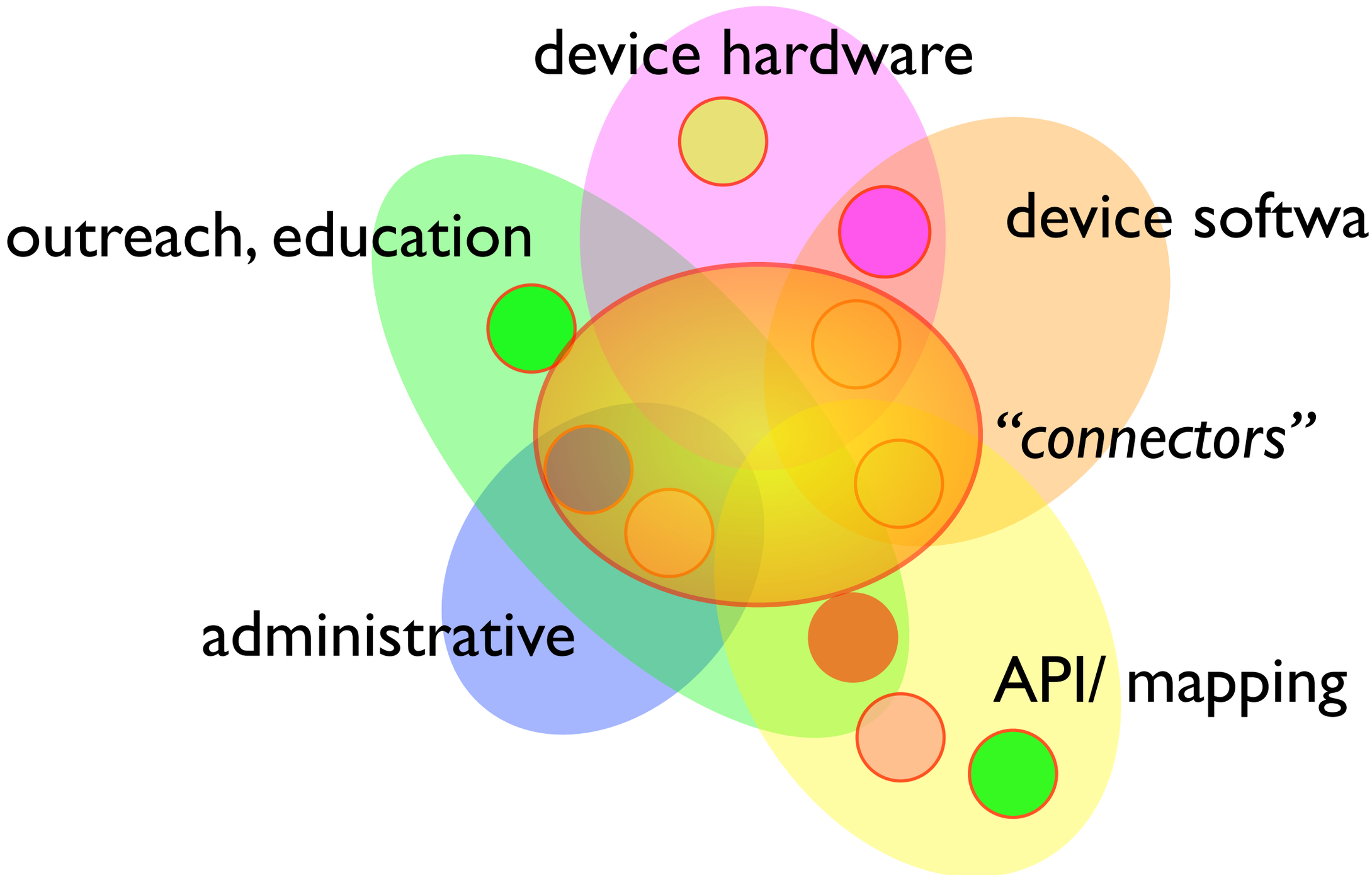
More

More

More

More

Our Teams



Lots of multitasking, multi-competence

ANTI DISCPLINARY

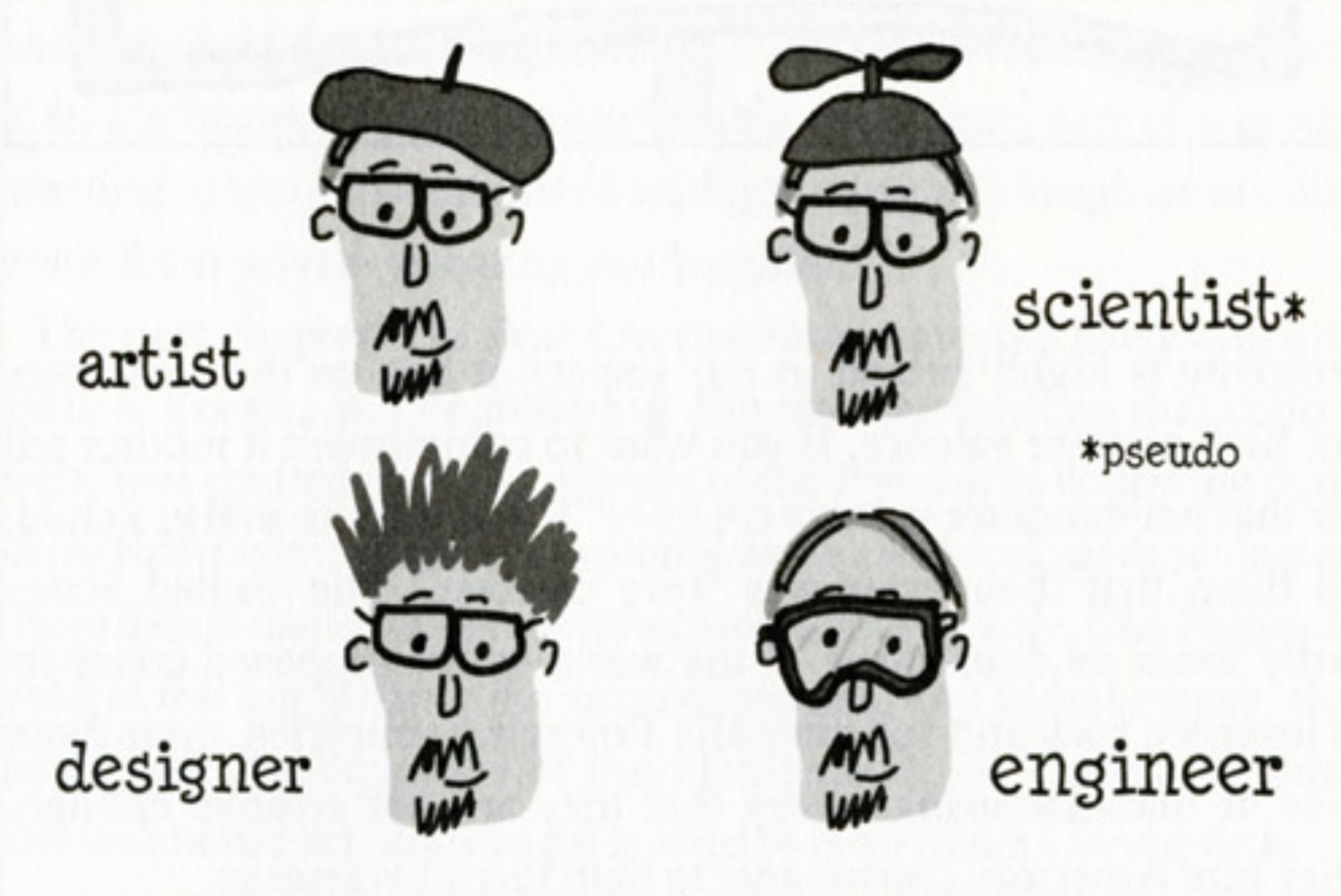


Image by Rich Gold

SAFECAST
SAFECAST

Funding:

- Individual donations
- Crowdfunding: Global Giving
- Kickstarter campaigns
- Support from private foundations
- In-kind support from manufacturers, etc.
- Most importantly, people donate their time

Building Community

We want to encourage people to get involved.
This requires skills in education and media.

- Strong social-media presence —
  blog, discussion, Facebook, Twitter, etc
- Device-building workshops
- Talks and presentations
- Media interviews

SAFECAST

ABOUT - | MAPS | DATA - | FAQ | DONATE | HOW TO HELP | MAILING LIST

English
日本語

‹ Development: Real-Time Interpolation | Safecast OS X | Updated Safecast Webmap! | Safecasting DC | Safecasting Iraq: Open ›

ABOUT SAFECAST

Safecast is a global project to empower people with data, primarily by mapping radiation levels and building a sensor network, enabling

Learn More

OUR PROJECTS

Safecast is a global sensor network for collecting and sharing radiation measurements to empower people with data about their environments.

Learn More

DONATE

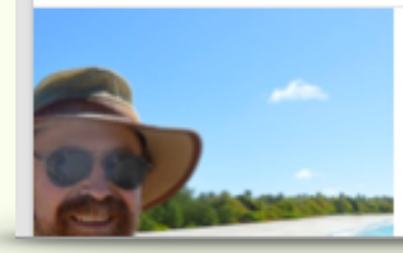
Safecast is made possible entirely thanks to tax deductible donations from people like you. We are a registered US 501(c) 3 non profit

Learn More

(日本語) BGEIGIE NANOの使用説明ーYOUTUBE動画

Sorry, this entry is only available in 日本語.

Posted on Saturday January 24th, 2015 07:16 PM Comment

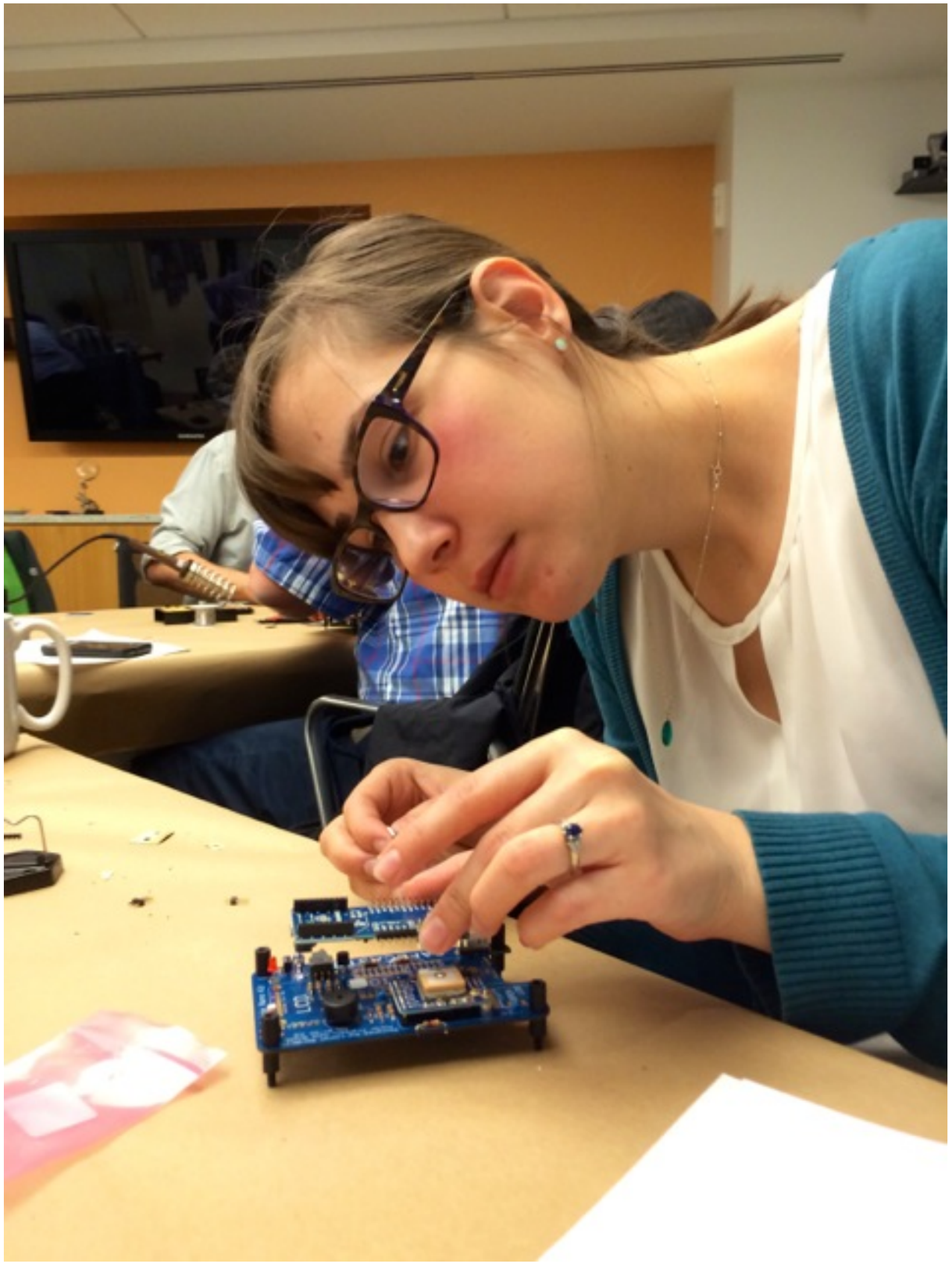


HELLO BIKINI !

Above: Dr. Buesseler on the beach at Bikini. We recently got some unique uploads from Bikini and Enewetak Atolls, courtesy of Dr. Ken Buesseler, of

Search Here Go

safecast.org



Recent workshops in:

Tokyo

Fukushima

Kobe

Washington, DC

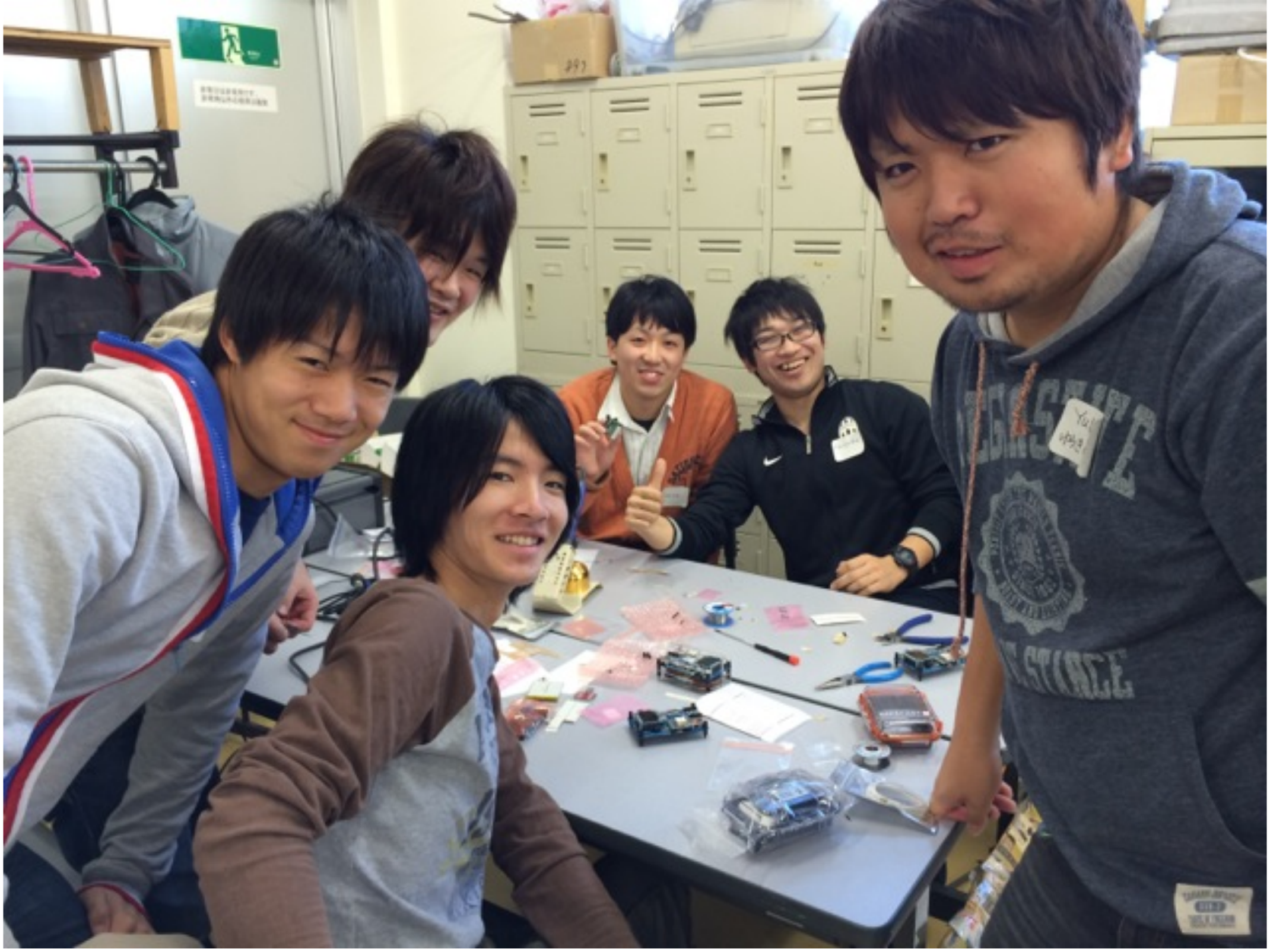
Strasbourg

Taipei

Hong Kong

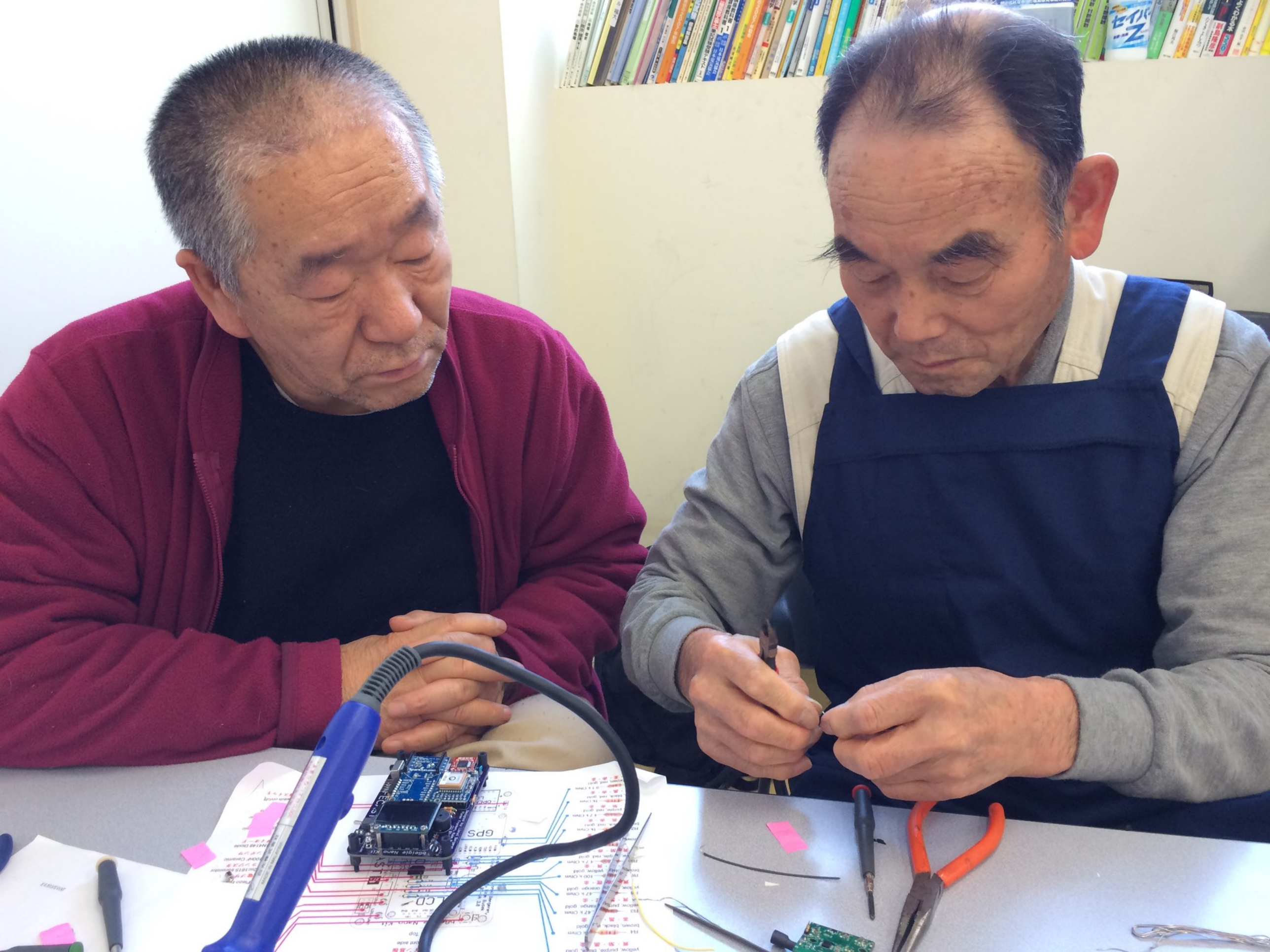
Seoul

TRIESTE!!



Geiger-counter building workshop with students in Koriyama
(They then become volunteers, contribute radiation readings, and teach others)

Testing 12 newly-built bGeigie Nanos in a nearby park.



The President in Conversation With MIT's Joi Ito and WIRED's Scott Dadich

WIRED

Safecast Street-by-Street

Safecast volunteers and Koriyama City officials

Ten bGeigies were delivered to Koriyama City

They were mounted on postal delivery vehicles, which cover every street in town over the course of normal daily activity.

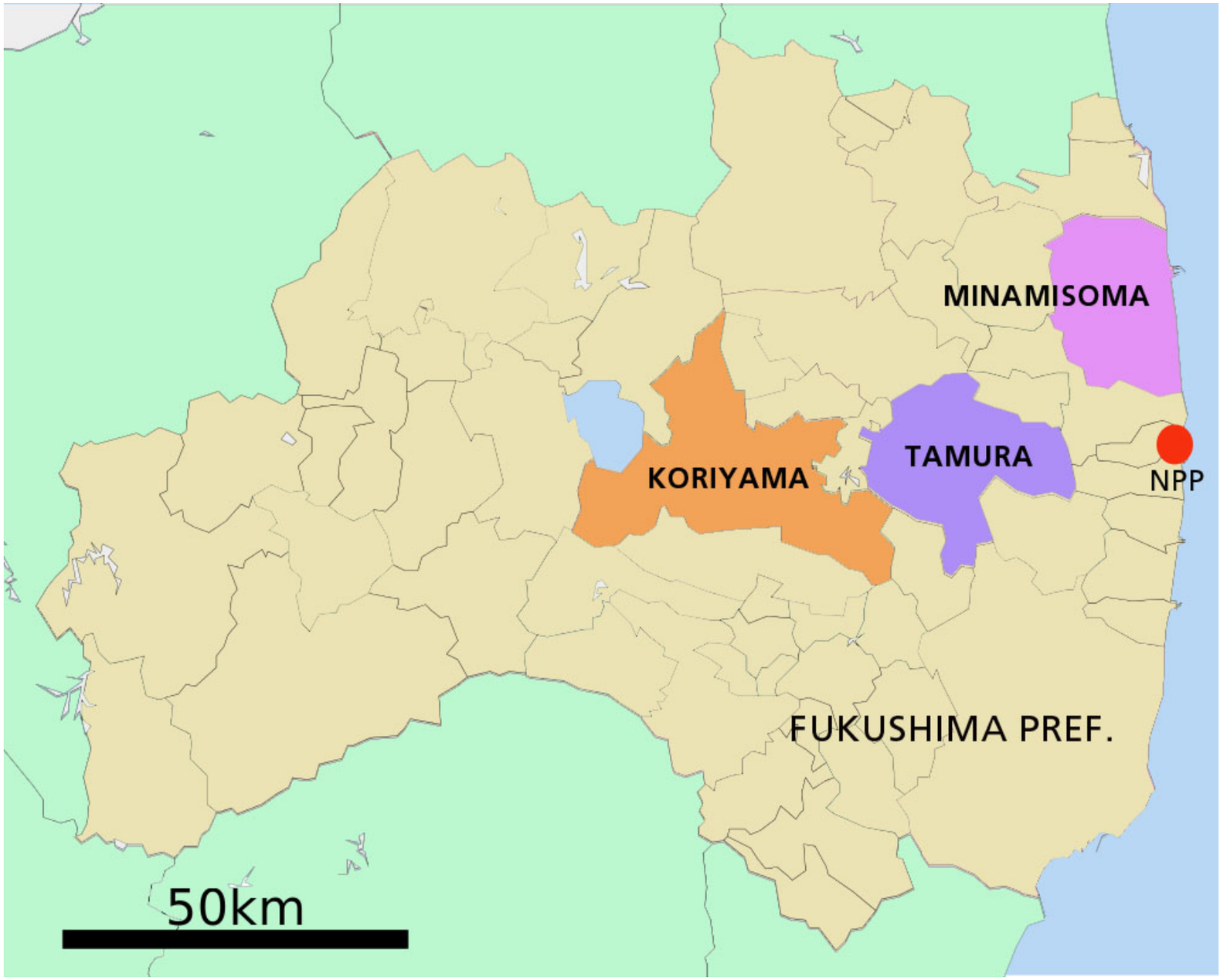
Safecast Street-by-Street

1.00
LIN
0.75
0.50
0.25
µSv/h
0.00

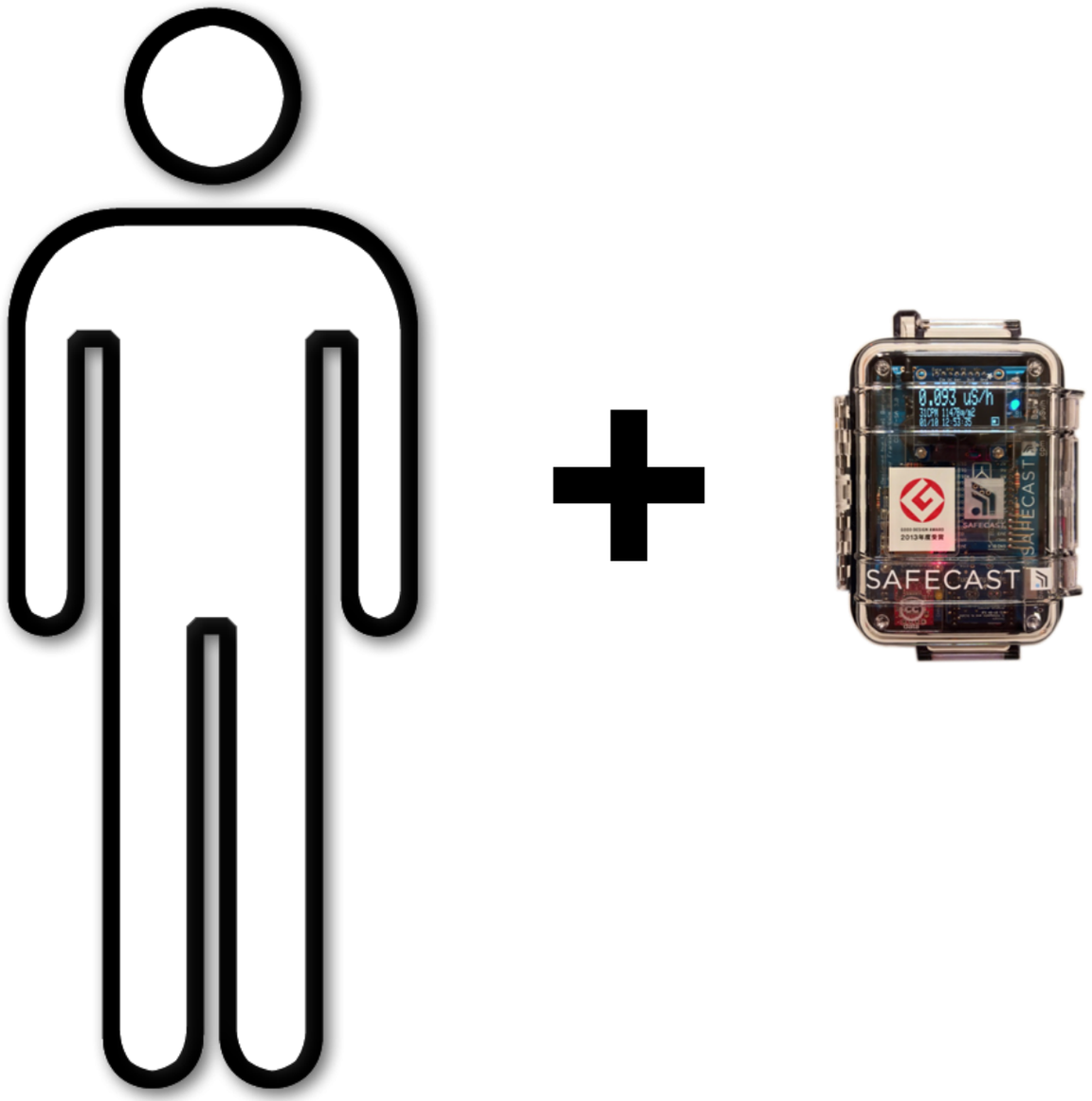
Shown: Koriyama detail -
100m grid

Info: Mem warning (66.7 MB)

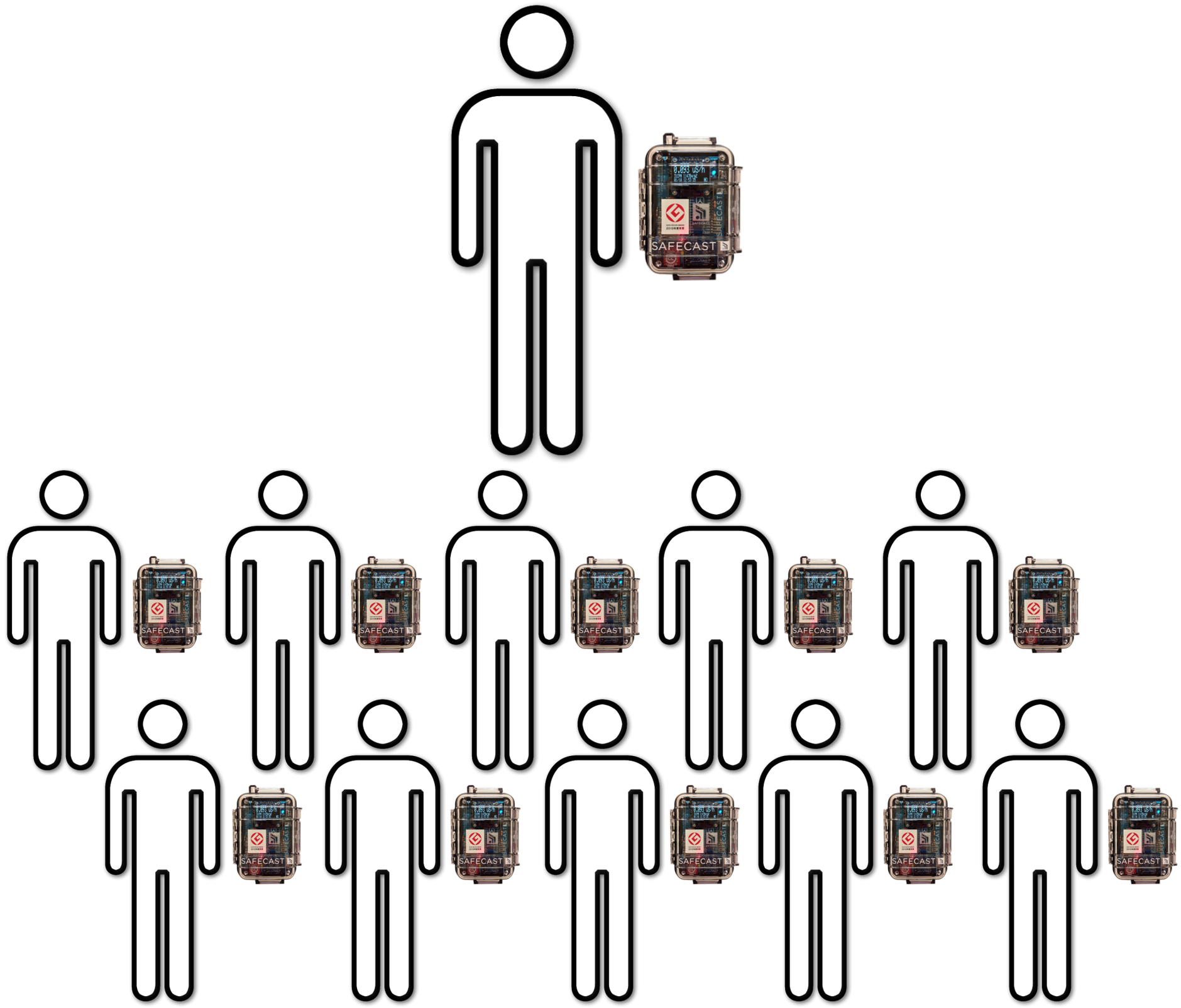
Layer



This solution has proven very scalable, and quite inexpensive. To date the towns of Minamisoma, Tamura, and Koriyama have been surveyed through this program (a combined affected population of over 400,000 people). Safecast is confident that every municipality in Fukushima Pref. could be quickly measured in this way.



Our experience after Fukushima suggests that in the event of another large radiation emergency additional manpower will be needed.



One person can quickly teach ten others.

We have prepared “airlift crates” of devices that can be quickly sent emergency areas anywhere in the world.

We've found it's necessary to educate media as well.

Link: http://blog.safecast.org/the-safecast-report/

SAFECAST REPORT

- First published 2015, second edition 2016
- Purpose: To collect, update information on issues of most concern, and provide guide to reliable sources.
- Also, to discuss controversies, summarize arguments
- Over 100 pages, produced by volunteer effort
- Japanese translation will be released soon.

Link: http://blog.safecast.org/the-safecast-report/

SAFECAST REPORT

Contents:

-Part 1: SAFECAST project update

-Part 2: Situation Update

2.1: Issues at Fukushima Daiichi NPP

2.1: Evacuees and Returnees

2.3: Environment and Decontamination

2.4: Food

2.5: Health

Link: http://blog.safecast.org/the-safecast-report/

SAFECAST REPORT

Sources used in Environment and Decontamination section (terrestrial impacts) include:

- 28 official reports (UNSCEAR, IAEA, JAEA, Japan Env. Ministry, etc)
- 31 peer-reviewed papers
- 21 journalistic articles
- 8 NGO reports (int'l and local organizations)

Link: http://blog.safecast.org/the-safecast-report/

SAFECAST REPORT

Issues discussed include:

- Environmental impacts as evaluated in scientific studies
- Remediation policy and implementation
- Forest remediation issues
- Longterm storage issues
- Social and economic consequences
- Communication and messaging
- Dissenting and critical voices

Link: http://blog.safecast.org/the-safecast-report/

CITIZEN SCIENCE:

- Where does the Safecast project lie within the spectrum of citizen science?
- ‘Crowd science’, ‘networked science’, ‘massively collaborative science’ ?
- Defined differently in different contexts
- Qualitative definitions and evaluative principles?
- Objective criteria for what constitutes ‘success’ ?

Journal of Radiological Protection

PAPER • OPEN ACCESS • FREE ARTICLE

Safecast: successful citizen-science for radiation measurement and communication after Fukushima

Azby Brown[1,3], Pieter Franken[2,3], Sean Bonner[2,3], Nick Dolezal[3] and Joe Moross[3]

Published 6 June 2016 • © 2016 IOP Publishing Ltd

Journal of Radiological Protection, Volume 36, Number 2

Article PDF

CITIZEN SCIENCE:

‘With appropriate protocols, training, and oversight, volunteers can collect data of quality equal to those collected by experts’

(Bonney, 2014)

CROWDSOURCING:

- Meaning of crowdsourcing has evolved
- Safecast's primary goal is to assemble database of observations
- Based on open-source hardware and software
- The achievement of specific social outcomes, such as promotion of openness, is a major motivation from the start
- Ad-hoc voluntary structure which embodies the emerging open collaborative culture

INFORMATION COMMONS:

- Decisions often reached through informal discussion
- Fluid decision making procedures
- Data-organization choices often impromptu, driven by affordances of open digital platforms
- Informal or semiformal hierarchies of authority, vs professional accreditation
- Norms that facilitate trust

OPENNESS and TRANSPARENCY:

- Have been key components of the Safecast project from the start.
- Use of open-source hardware and software is considered essential.
- All designs are publicly available for scrutiny.
- Any outside observer can independently evaluate the group's tools and methodology.
- Open-data publication principles go hand-in-hand with this approach.

Whatever authority Safecast possesses can be characterized as adaptive and fluid, and rooted in the shifting needs of the commons, as opposed to the ‘constituted’ authority of formal science and its institutions.

WHAT IS SUCCESS?

- Key Metrics: Database size, how many users, how many detectors, etc..
- Intangibles: Perceived shifts in attitudes in society, a growing sense of community
- Increased interest in the capabilities of citizen scientists worldwide

For Safecast as a project, the intangibles are arguably as important as the metrics.

‘...Safecast is as crisp an example as we have for how mutualism can serve as a successful workaround for failure (whether for lack of capacity or, more likely, for lack of political will) of a public body.’

(Benkler, 2013)

SUMMARY:

Though groups like Safecast can help fill crucial gaps, ultimately the timely provision of data that citizens need to make informed decisions about their livelihoods and well-being is the government's responsibility.

The fact that a group like Safecast proved necessary at all is in itself an indictment of the failures of government and the international system for informing the public of such risks.

The rise of citizen science should be seen as a very positive development, one of the few bright spots that have emerged following the Fukushima disaster.

SUMMARY:

Though groups like Safecast can help fill crucial gaps, ultimately the timely provision of data that citizens need to make informed decisions about their livelihoods and well-being is the government's responsibility.

The rise of citizen science should be seen as a very positive development, one of the few bright spots that have emerged following the Fukushima disaster.

SUMMARY:

The technical capabilities occasioned by the open-source and digital fabrication movements are poised to put increasingly sophisticated scientific and communication tools in the hands of average citizens worldwide.

This will continue to require social and regulatory accommodation and adjustment as governments and other established stakeholders grow to understand the implications of the changing information landscape and, hopefully, are motivated to reach mutually beneficial relationships with citizen scientists like those at Safecast.

“Emancipatory Catastrophism”

(Ulrich Beck)

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end