



DeSET; Approach of Innovation to Team-up Hyper-Interdisciplinary Project

GEBCO Symposium 2018 Session4 Ocean Mapping Science

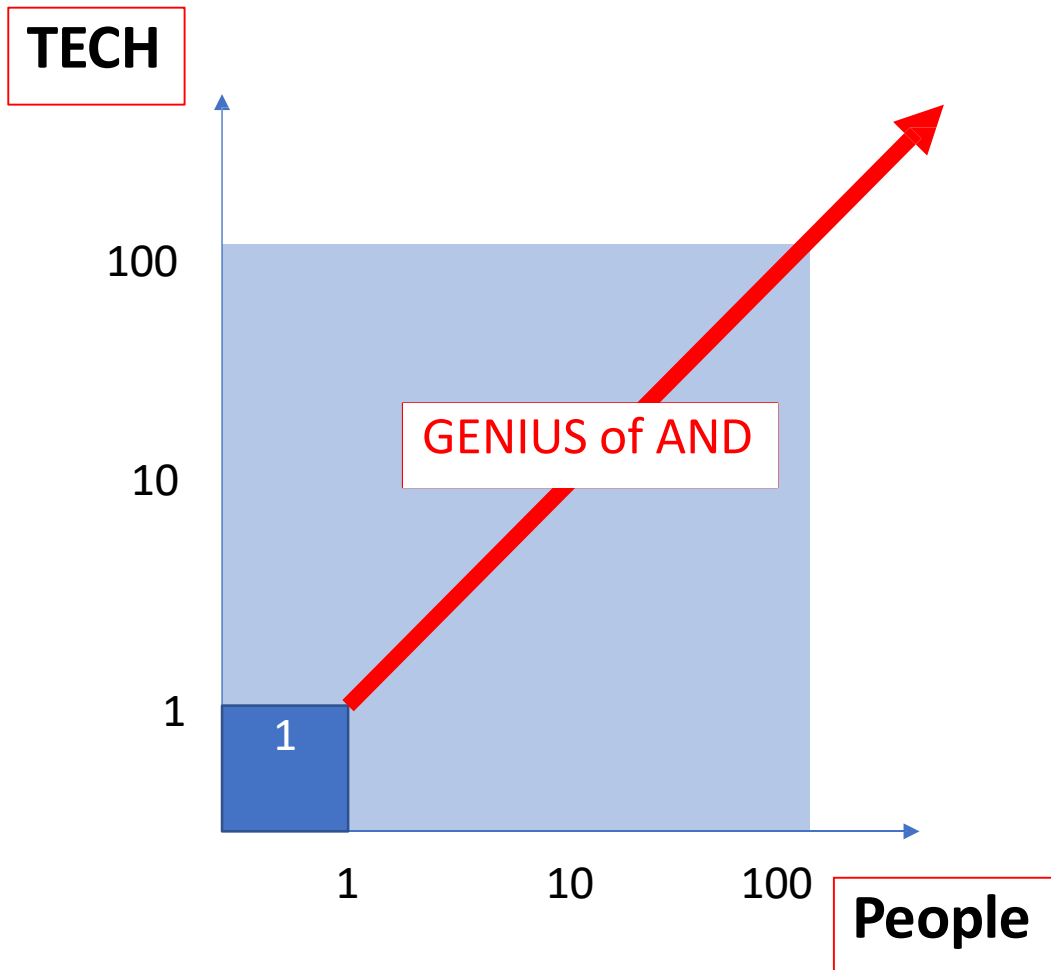
2018-11-14

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Ito (2), Toyoki Sasakura(3), Motoharu Sonogashira(4)

(1) Leave a Nest Co., Ltd. (2) Full depth Inc. (3) AquaFusion Inc. (4) Kyoto University

Contact deset@lnest.jp

The CHALLENGE

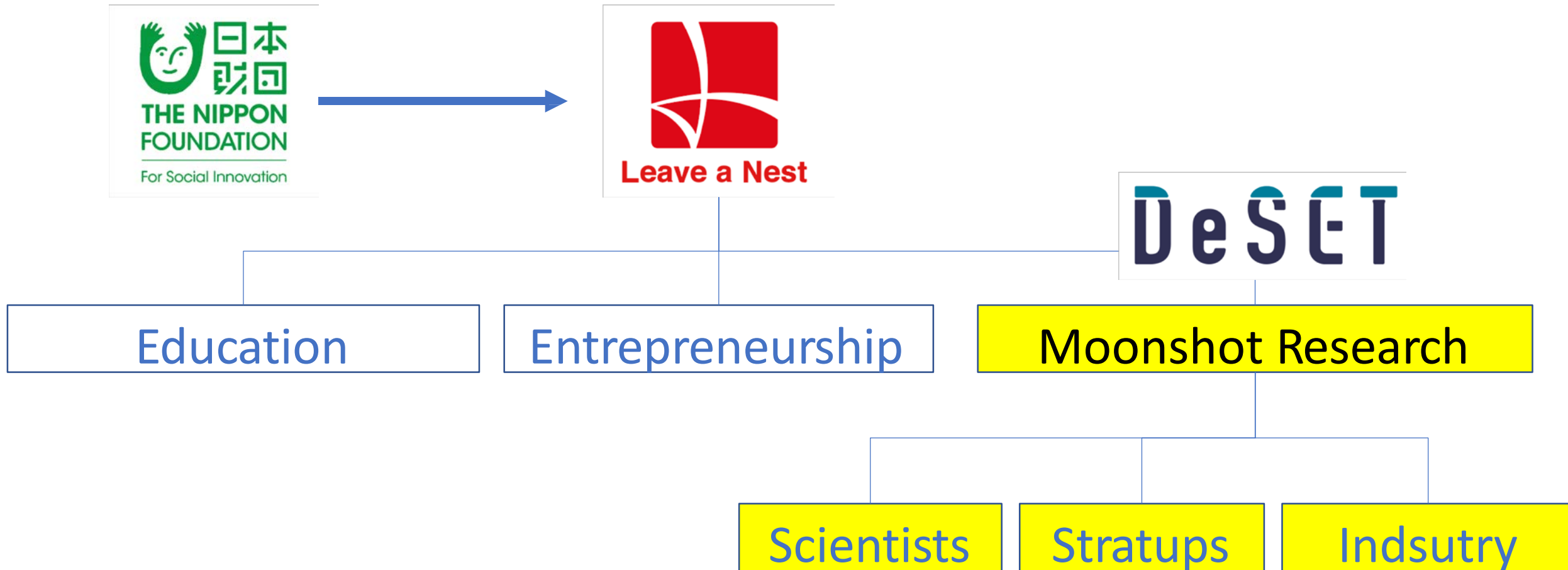


Backcasting from 2030, we need to work now to

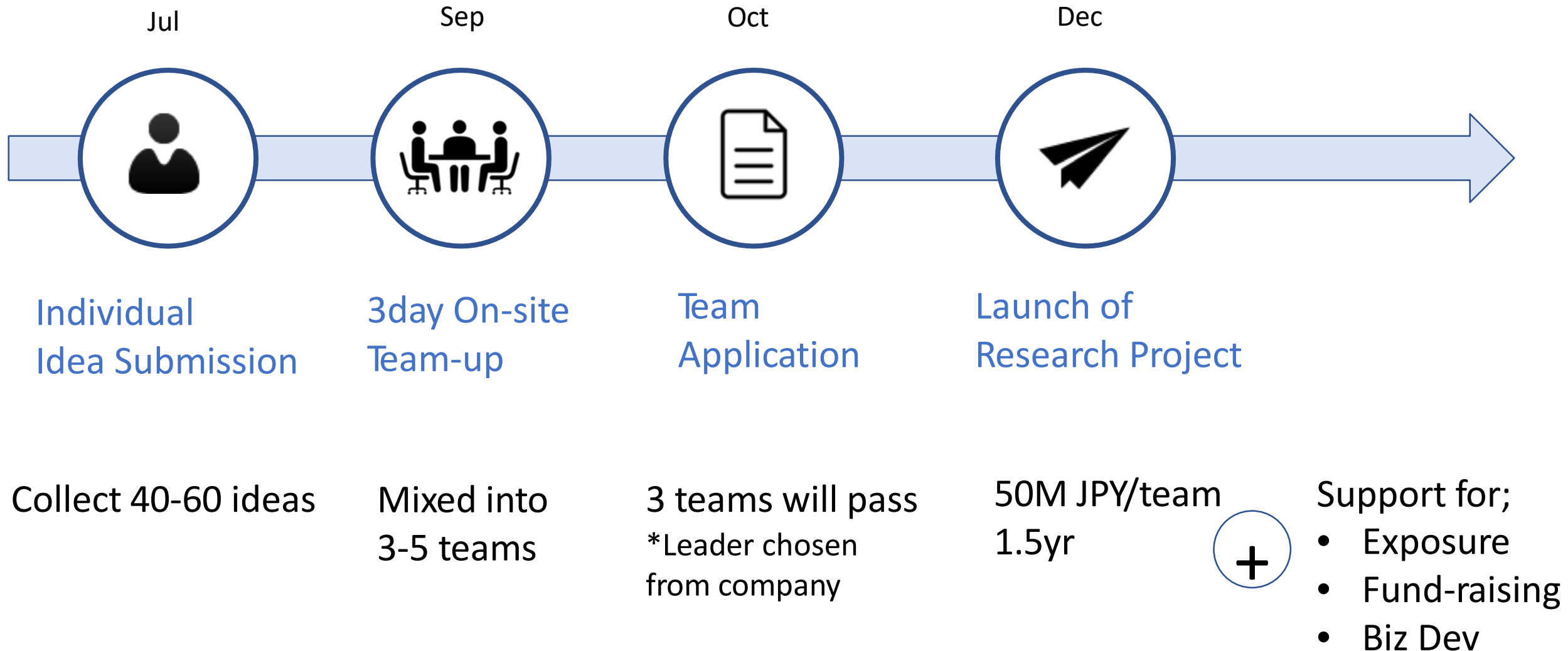
1. **>100X Efficient technology of mapping**
2. **>100X more people engaged, not leaving behind**

Not only technologies, we will create new business, jobs, ecosystem...

Project Structure



HOW IT WORKS



3 days On-site Team-up



Idea sketches

Discussion

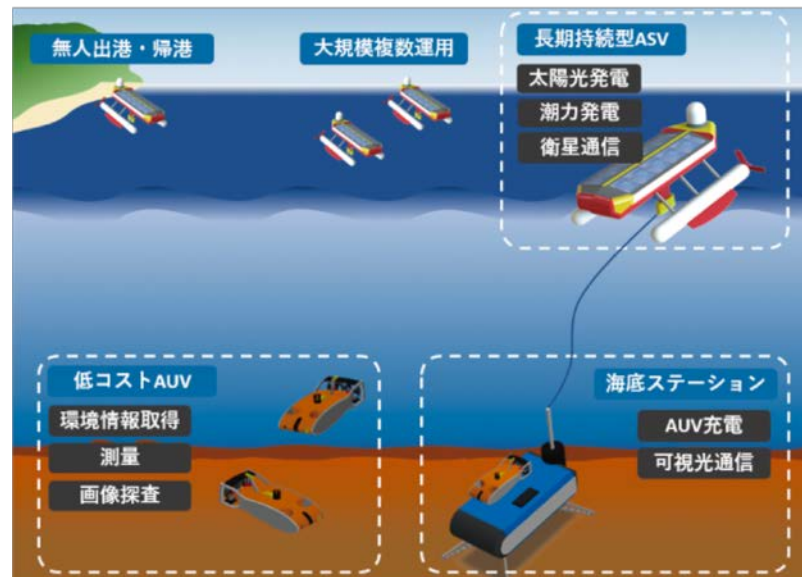


Team-up!!



1st BATCH 3 TEAMS

Subsea Autonomous Station



Speaker

Shohei ITO
CEO of FULLDEPTH

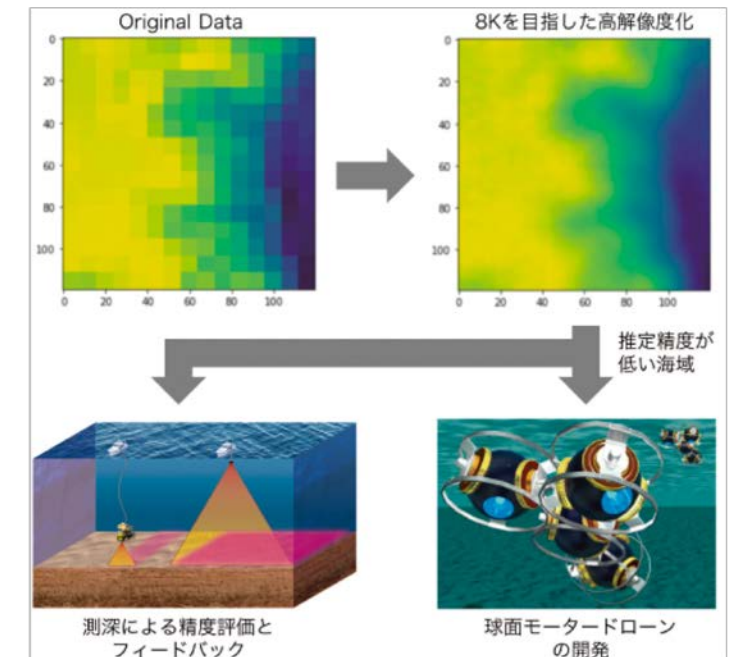
Remote Sensing



Speaker

Toyoki SASAKURA
CEO of AquaFusion

Super resolution AI



Speaker

Motoharu Sonogashira
Kyoto University

Coming Dec. 2nd BATCH will be announced



Subsea 3D Print
Construction



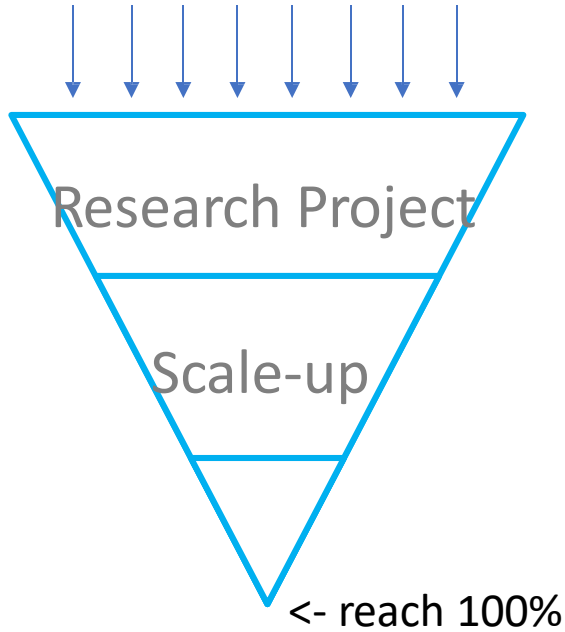
Biologic Agent



Open-Source
Swarm Drone

FUTURE PLAN

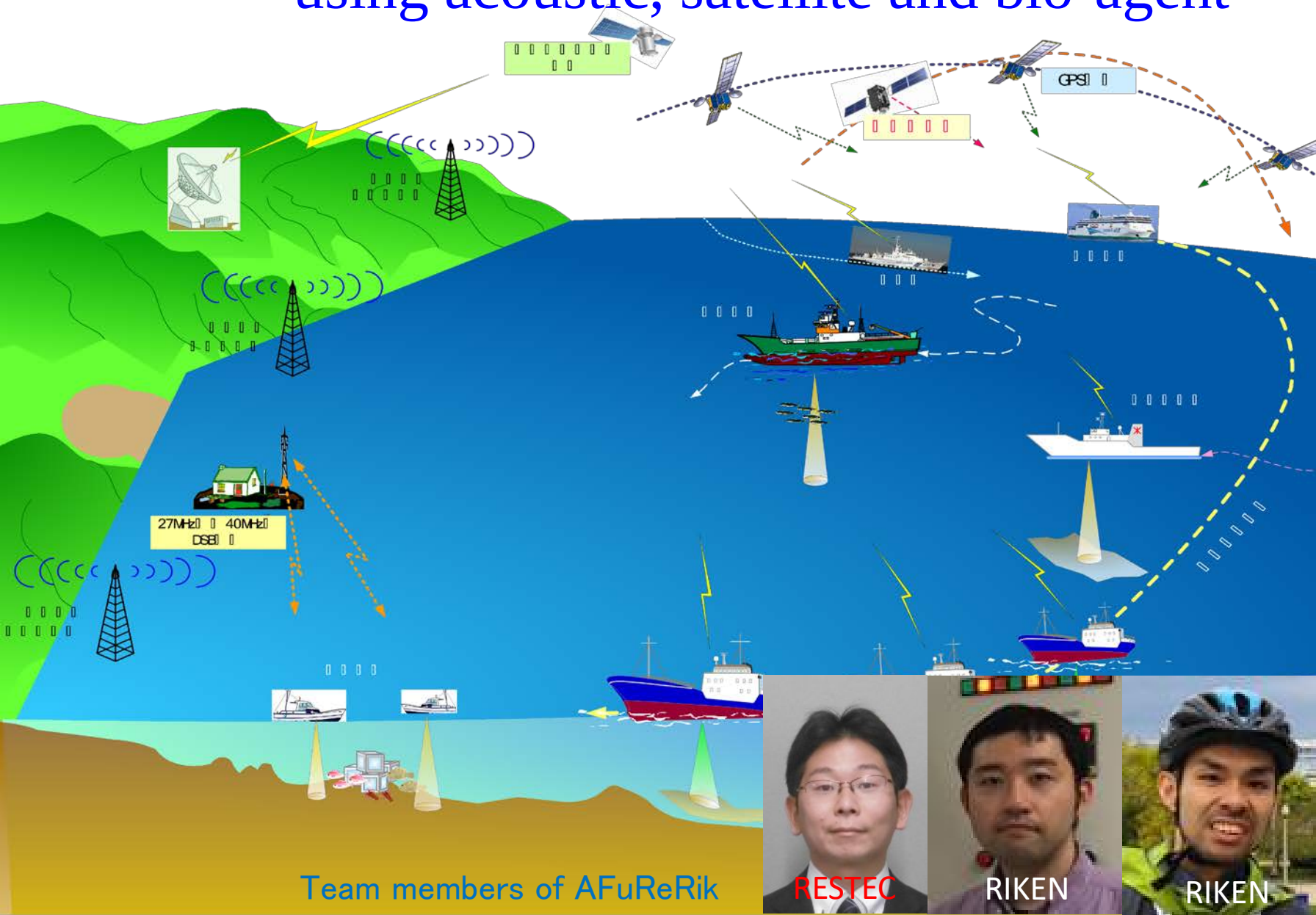
Idea / People engagement



After-mapping Era

- **Continue talent discovery from broader range**
- **Support transition to Scaleup-ready stage**
- **Evaluate Economics and Scalability of technology**
 - Does cost drop dramatically?
 - After-mapping economy is attractive enough for investment and scale-up?
- **Creating “Shared Vision”** for scaled mapping tech throughout industry/academic/gov

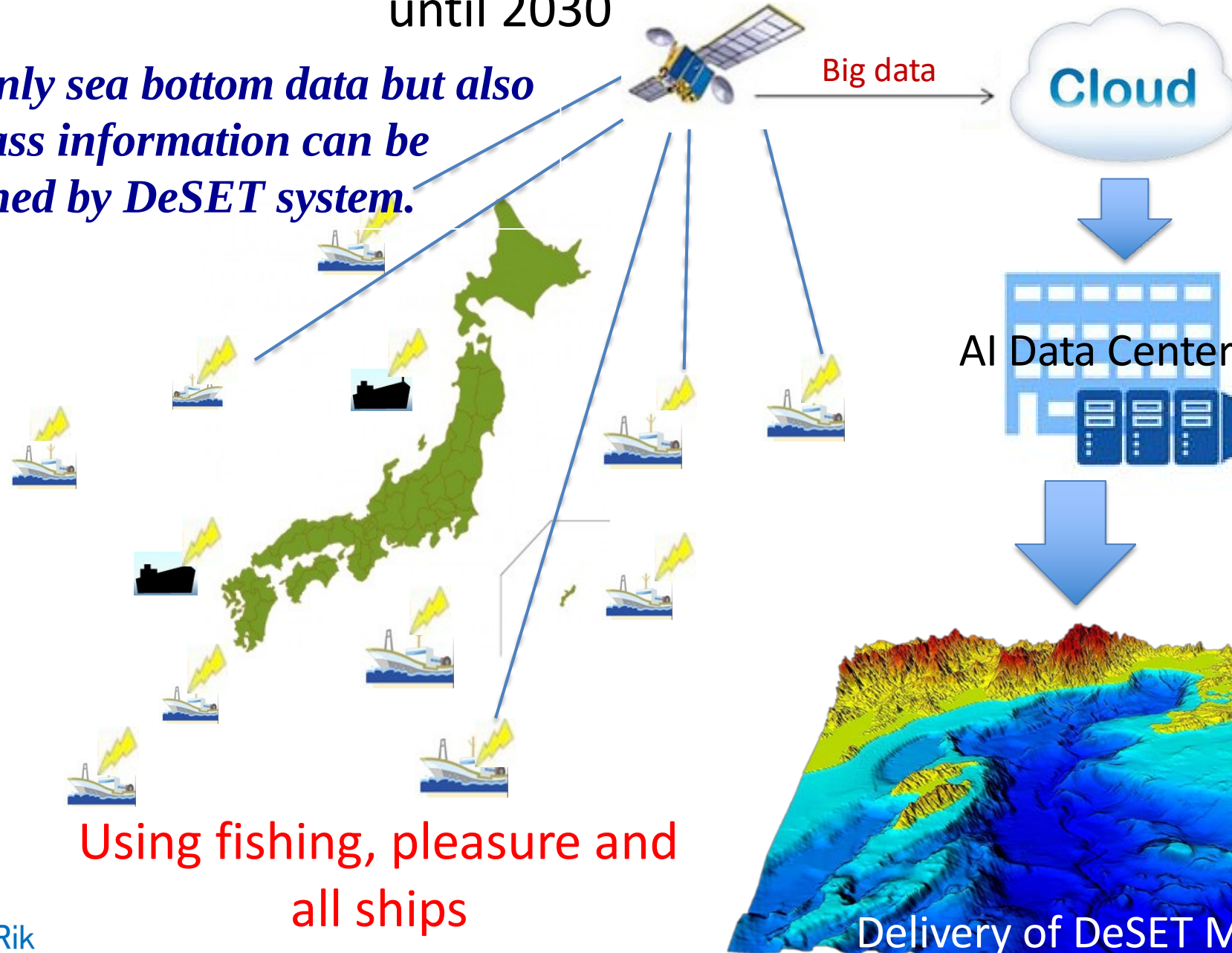
Seabed mapping by remote sensing using acoustic, satellite and bio-agent



Team members of AFuReRik

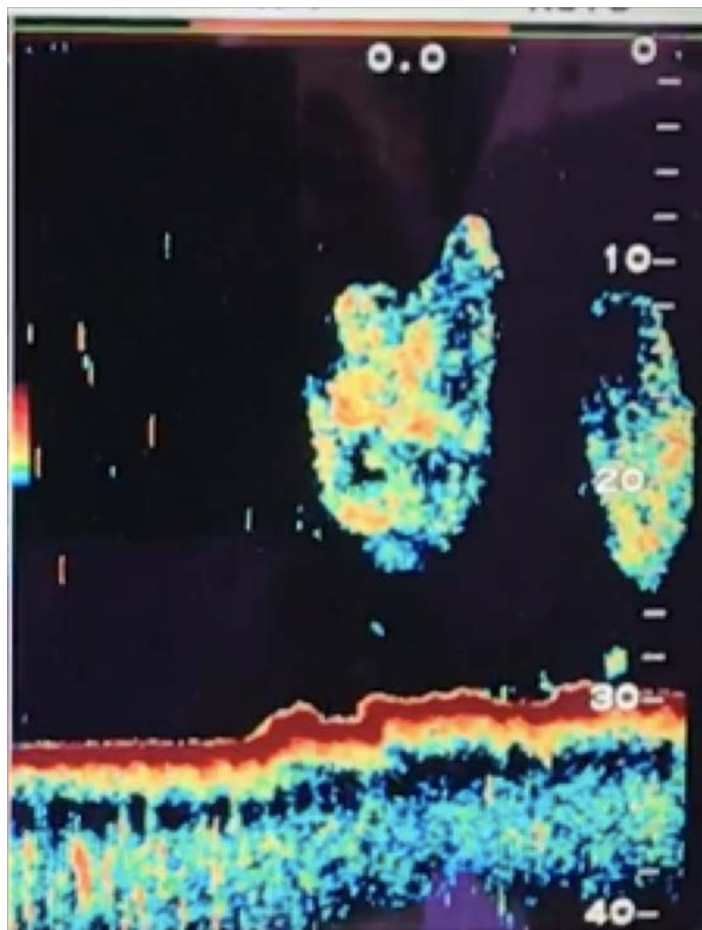
Every body can access to Marine DeSET Map
until 2030

*Not only sea bottom data but also
biomass information can be
obtained by DeSET system.*

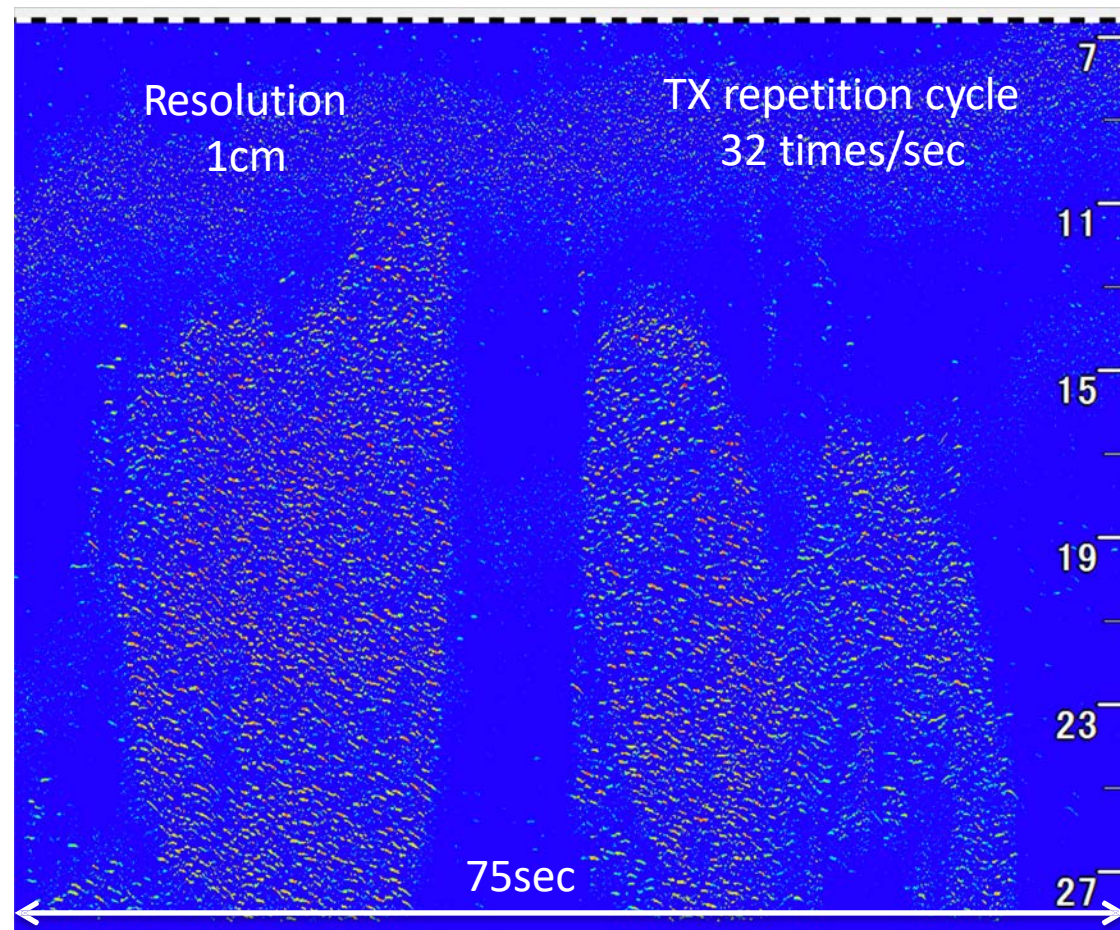


Using fishing, pleasure and
all ships

Super resolution Sonar by *FINE* technology (*FINE*=*F*irst *I*nterval *E*chosounding)



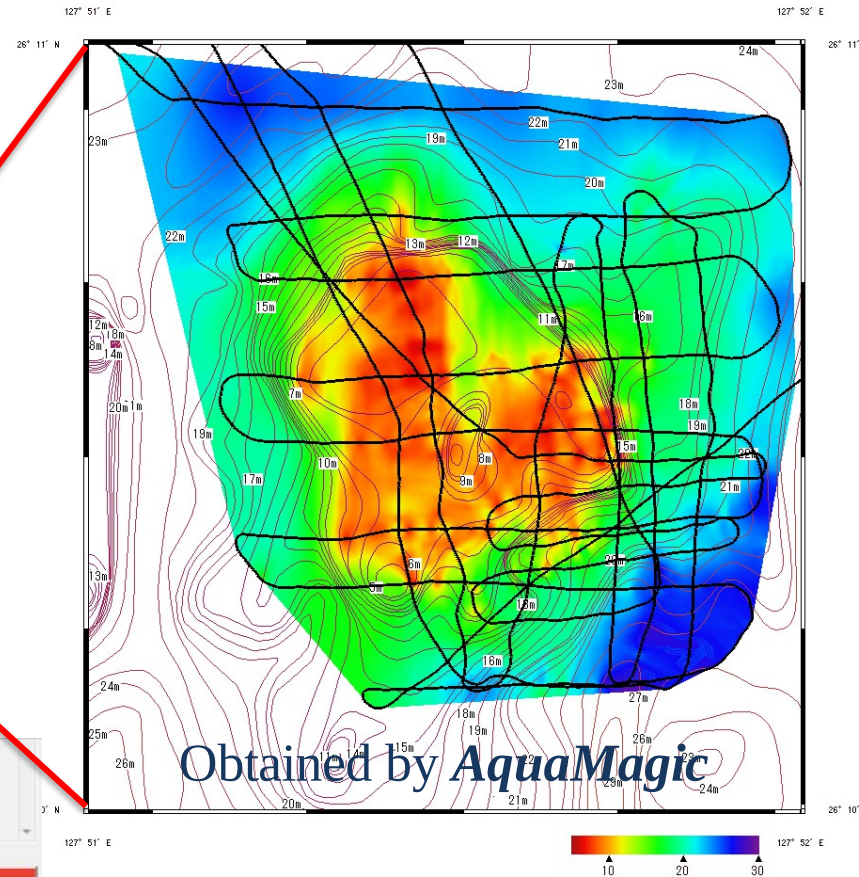
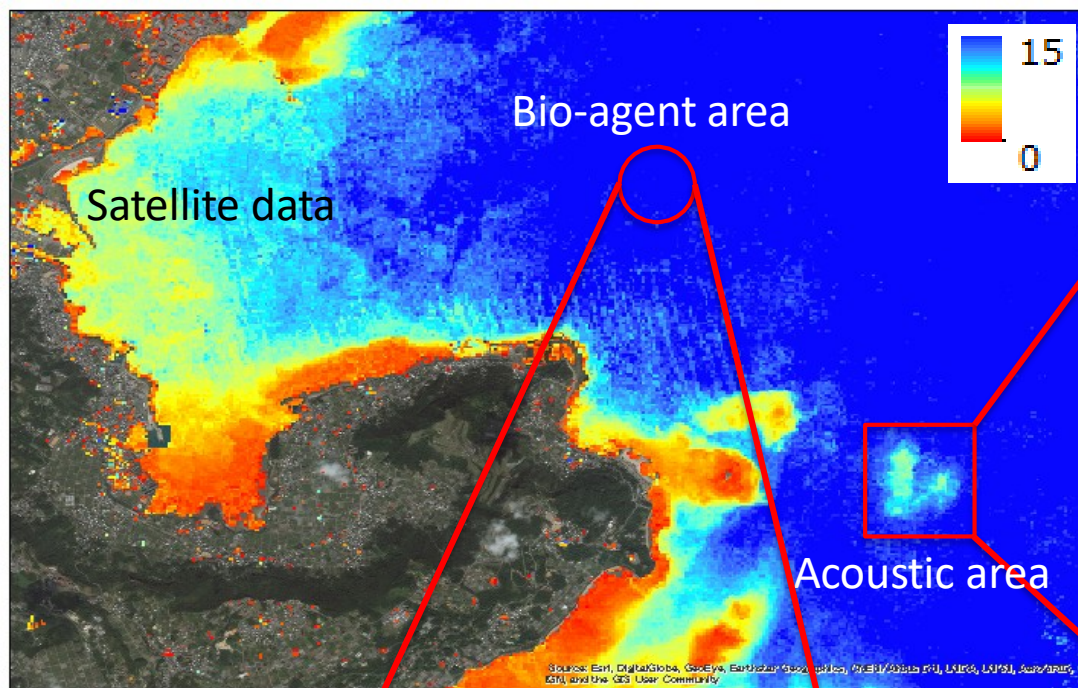
FURUNO FCV-295(200kHz)



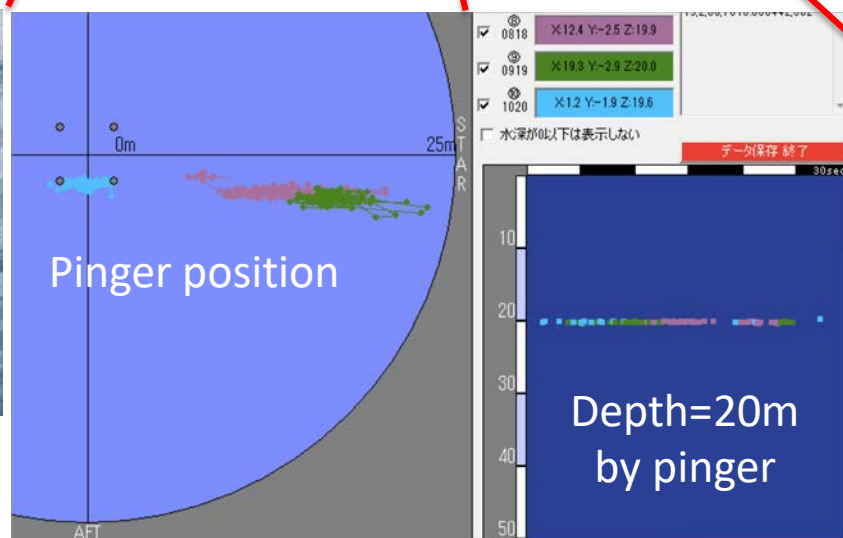
AquaMagic (240kHz)



Small anchovy TL≐5cm



Torpediniformes



The Marine DeSET Map will be merged satellite, acoustic and bio-agent data.

Next year's expansion

Many of fishing boat would be installed
'*AquaMagic*' and not only bottom data but
also fisheries information would be collected
to DeSET AI Center.



Super-Resolution (SR) AI Team



Environment Simulation Laboratory Co., Ltd.

constructs a bathymetric database.



Kyoto University

researches a SR-AI technology.



Ecomott Inc.

develops a SR-AI system.



Arc Geo Support Co., Ltd.

evaluates the system in the real-world.



Tokyo University of Agriculture and Technology

develops spherical-ultrasonic-motor drones.



QI Inc.

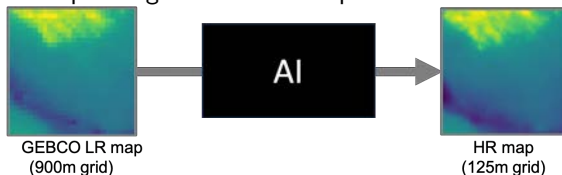
evaluates the drones.



Goal

Accelerate ocean floor mapping using AI.

- ▶ Automatically obtain high-resolution (HR) bathymetric maps from already-measured low-resolution (LR) data.
 - ▶ Use an AI to estimate a HR map of each ocean area from the corresponding LR GEBCO map.

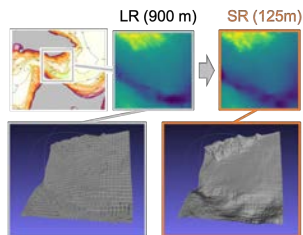
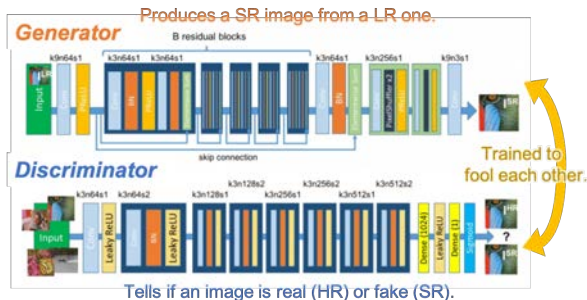


- ▶ Save a lot of measuring time and cost (e.g., labor and fuel) by not going to areas where the AI is accurate enough.
- ▶ Propose ocean areas where new measurement is required.
 - ▶ Let the AI yield both a HR-map estimate and its uncertainty.
 - ▶ Efficiently perform mapping by measuring only areas where AI may not be accurate.

Technology

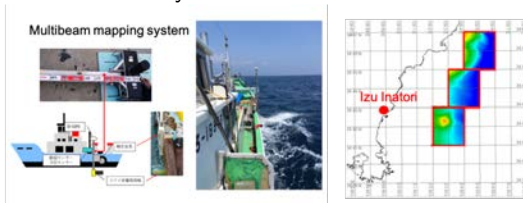
Apply *learning-based image super-resolution* to bathymetric data.

- ▶ Construct a dataset of LR and HR image pairs.
- ▶ Train an AI to learn a mapping between LR and HR images.
- ▶ Use *generative adversarial networks* (GAN).
 - ▶ Preserve structures, e.g., peaks and troughs.
 - ▶ Measure the uncertainty of each SR image.



Future Work

1. Improve the accuracy of our SR AI technology.
 - ▶ Network parameters should be tuned specifically to bathymetric data (different from general photo images).
 - ▶ Shortage of bathymetric (ocean) data may be compensated for by *transfer learning* from topographic (land) data.
2. Evaluate and fine-tune our SR AI system in the real world.
 - ▶ We have already measured some real data.



- ▶ Our novel spherical-ultrasonic-motor drones may be used to collect additional data.



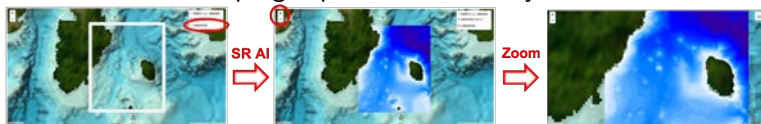
Possible Collaborations

Augmenting training dataset

- ▶ With more HR bathymetric images, the accuracy of our SR AI will be significantly improved.
- ▶ We do not own provided data nor require longitude/latitude information: just let us pass LR&HR image pairs through our system to update its internal parameters.

Real-world application

- ▶ We are now developing a practical SR-AI system.



- ▶ It will benefit everyone who needs HR bathymetric maps.

An unmanned -cean survey s-luti-n ca. a ble - f l-ng-term - .erati-n

Multiple sets are all over the world!!

ASV capable of sustainably
generating power at sea
with satellite communication

Autonomous visual survey
with multiple AUVs

Submarine station that
can charge AUVs

DeSET tea1 l 's 1 e1 bers

Visible Light o mmunication



t sushi Kura1 oto



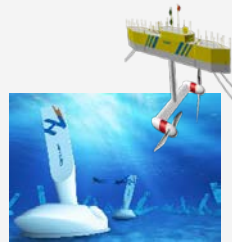
Under Water Drone



Shohei Ito



Tidal PoAer Generation



Shinji Hiej1 a



Under Water Robotics



Toshihiro Maki



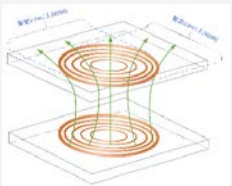
Machining



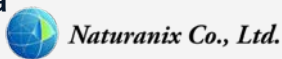
Hironori Taka1 itsu



Wireless PoAer Transfer

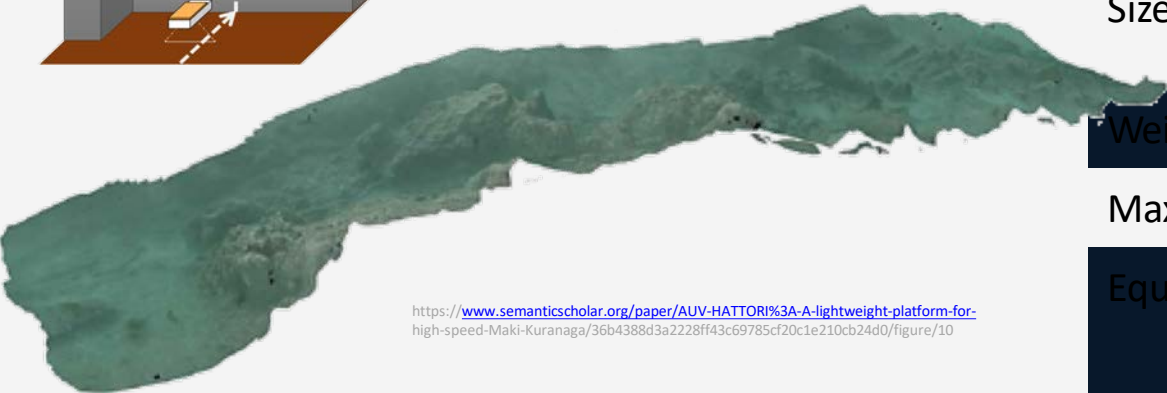
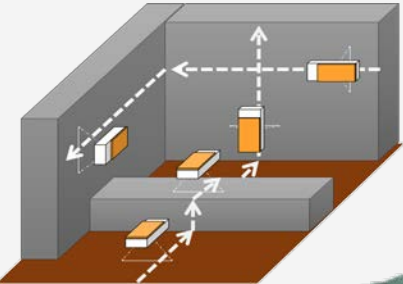


Yasuki Kanazawa



A lightweight A - . platform for high-speed and low-altitude SARv3D'

"HA, , ORI 2" automatically recognizes the bottom of the sea and can create an "Automatic" So we can continue to acquire the image of the seabed and create a fine 3D map"



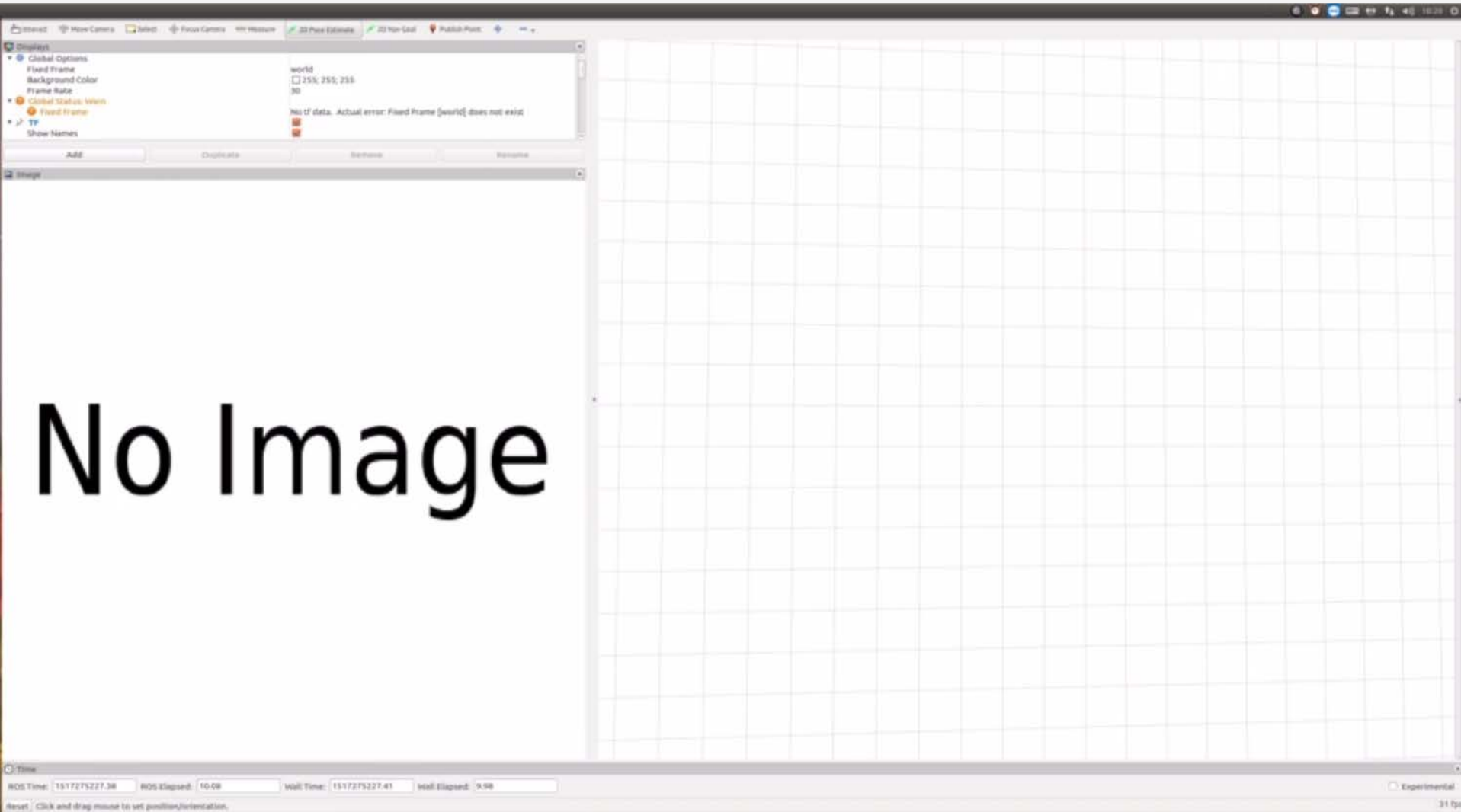
<https://www.semanticscholar.org/paper/AUV-HATTORI%3A-A-lightweight-platform-for-high-speed-Maki-Kuranaga/36b4388d3a2228ff43c69785cf20c1e210cb24d0/figure/10>



specifications: HATTORI2

Depth rating	300m
Size	360mm(W) x 1050mm(D) x 280mm(H)
Weight	30[kg]
Max. Speed	4[knot]
Equip.	2 x 4K camera (forward , bottom) 1 x HD camera (for measuring attitude)

Automatic navigation along the seafloor

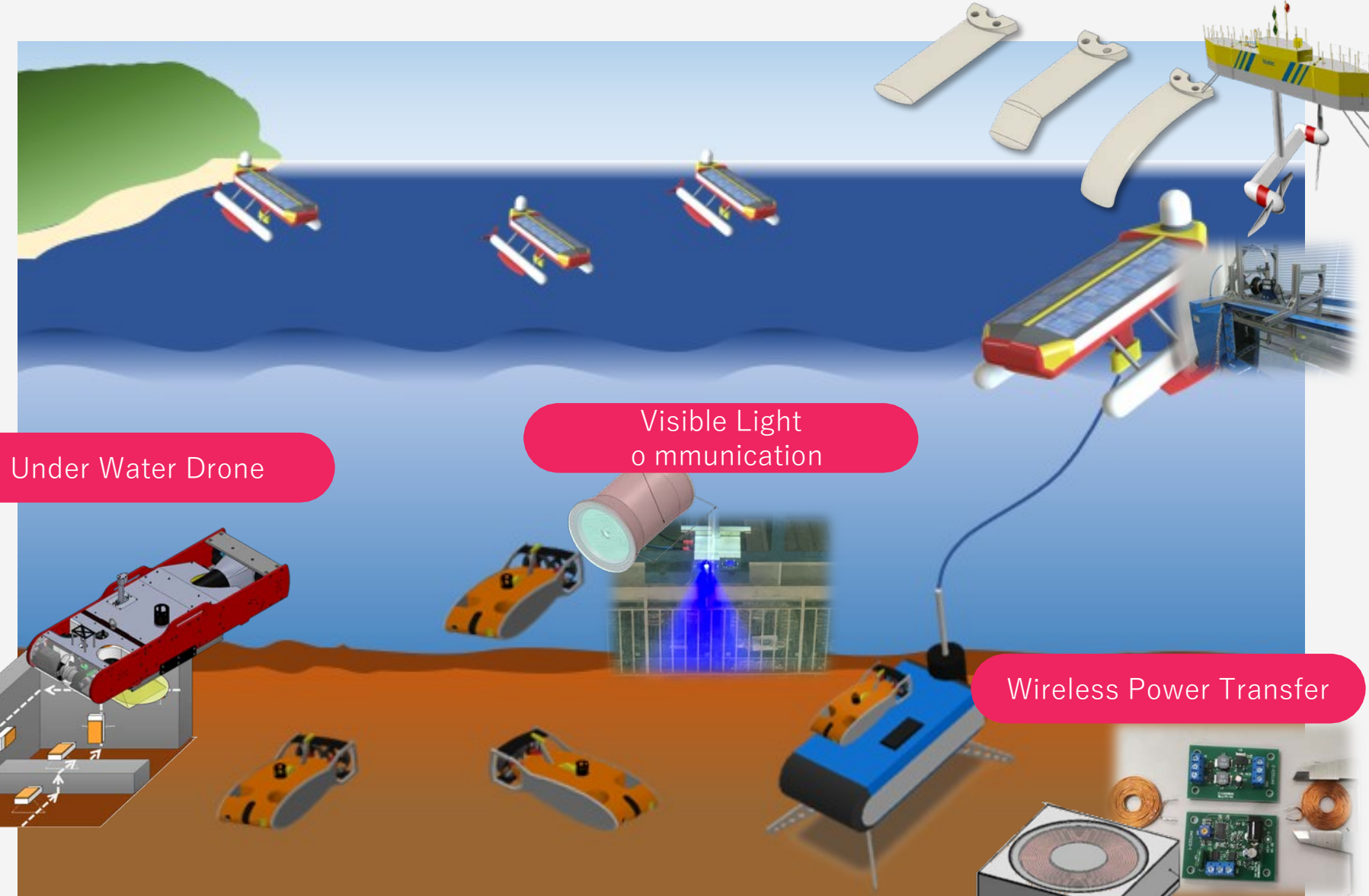


Automatic navigation along the wall



Prospects for the future

Tidal Power Generation



Under Water Drone

Visible Light
Communication

Wireless Power Transfer

CONFIDENTIAL