

# **Nanolanders: New Access to the Sea**

## **NOAA Town Hall**

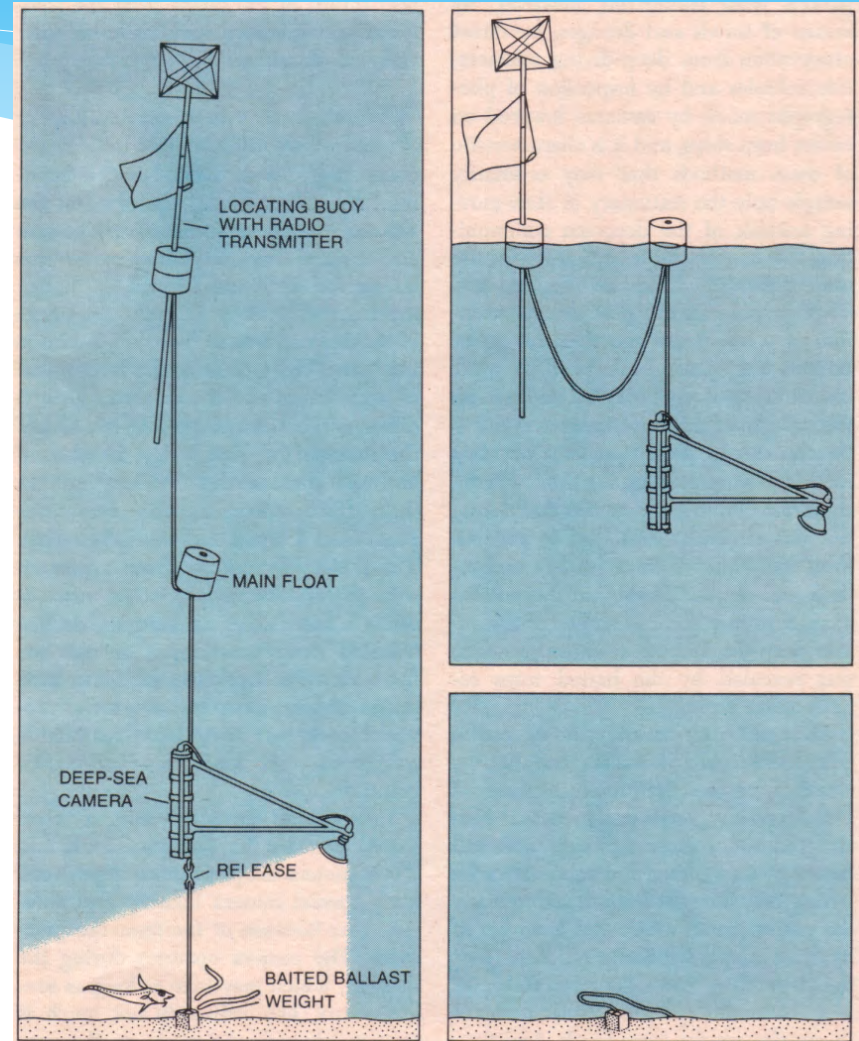
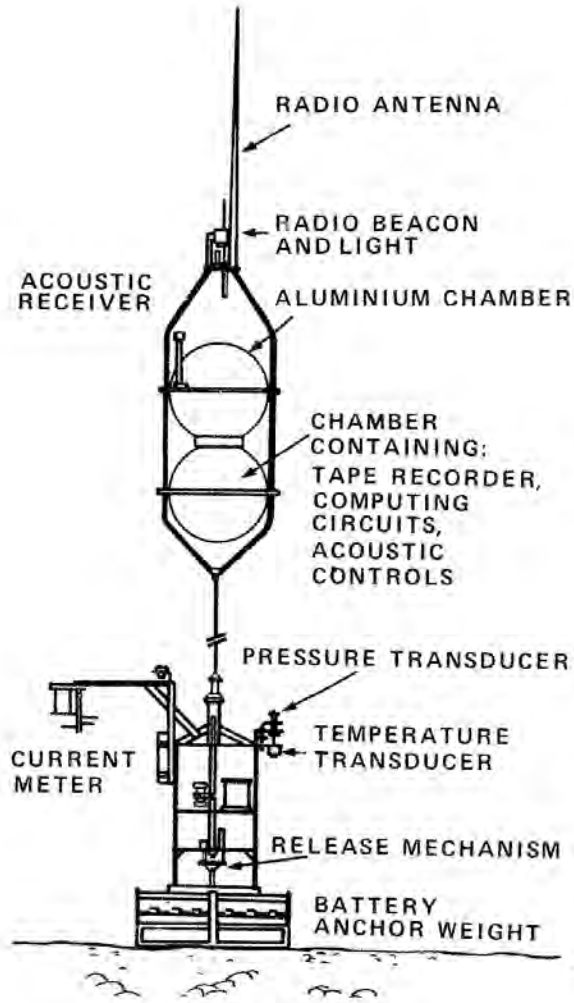
### **Ocean Innovation and Partnerships**

**Kevin Hardy,**  
SIO 1972-2011 (retired)  
Global Ocean Design, San Diego, CA



## Benthic Landers:

Untethered free vehicles that travel down and back to the seafloor. One of the earliest underwater vehicles, scientific applications go back to the 1930's.



# Nanolanders have Inherent stability when



Buoyancy  
is high

Weight is low





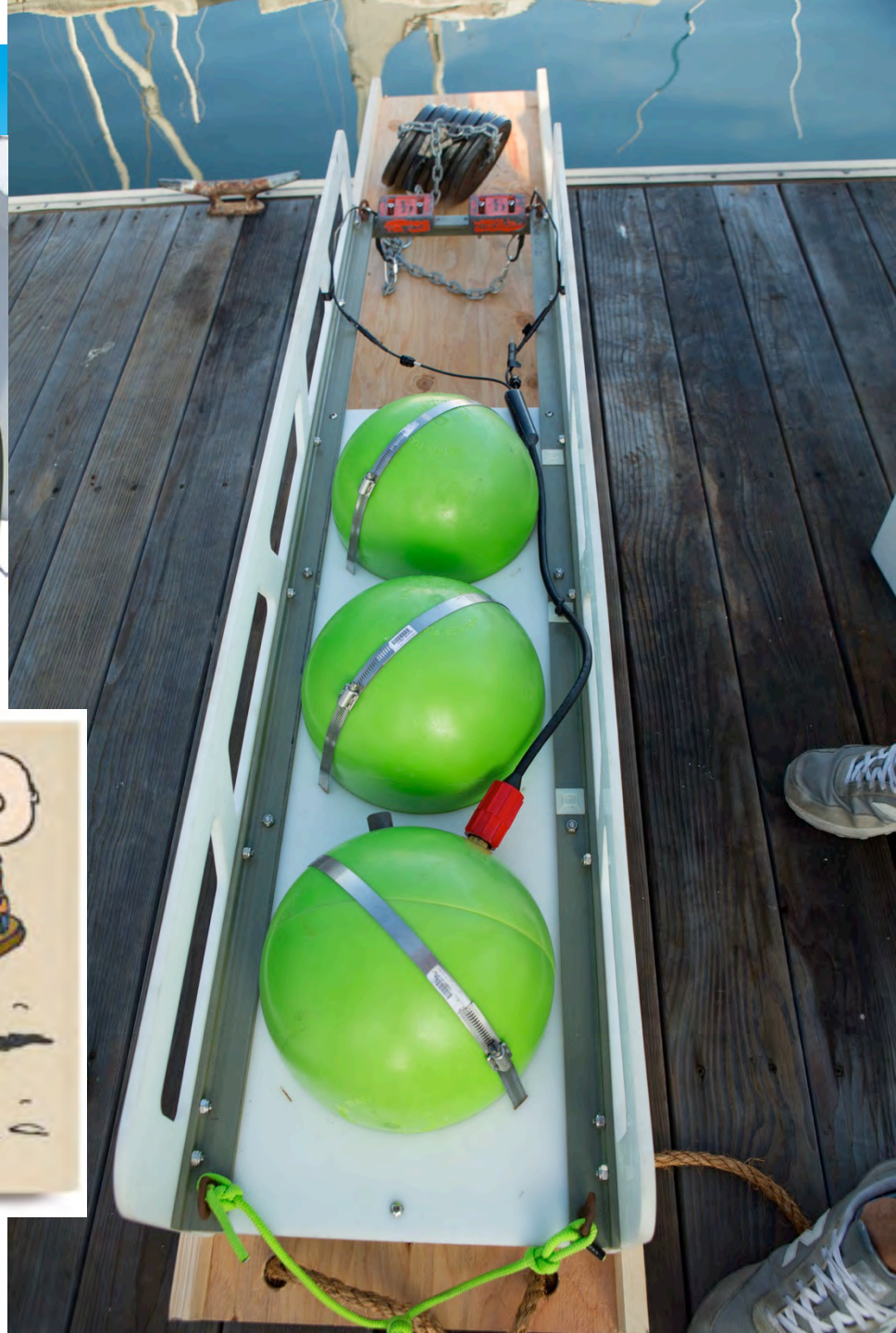
**Nanolanders are  
simple to launch.**



**Even from a small fishing boat.**



or use a wood chute



**Can sling one over the side.**



**In the early days, citizen scientists shared their ships.**



R/V Loma, 1905



R/V Alexander Agassiz, 1907-17



They still do.

come to experience Mangusta

YACHTS MIAMI BEACH (11/15 Feb 2016), Collins Avenue, RAMP 24



**Calling All Citizen Scientists:  
SeaKeepers, Scripps Need  
You**

Nanolanders make exciting and challenging expeditions possible.

Guacanayabo Trough

Cayman Ridge

Cayman Islands  
George Town

Cayman Trench

25,216ft

(7,700 m)



36' Intrepid Boat Charter In Cayman Island

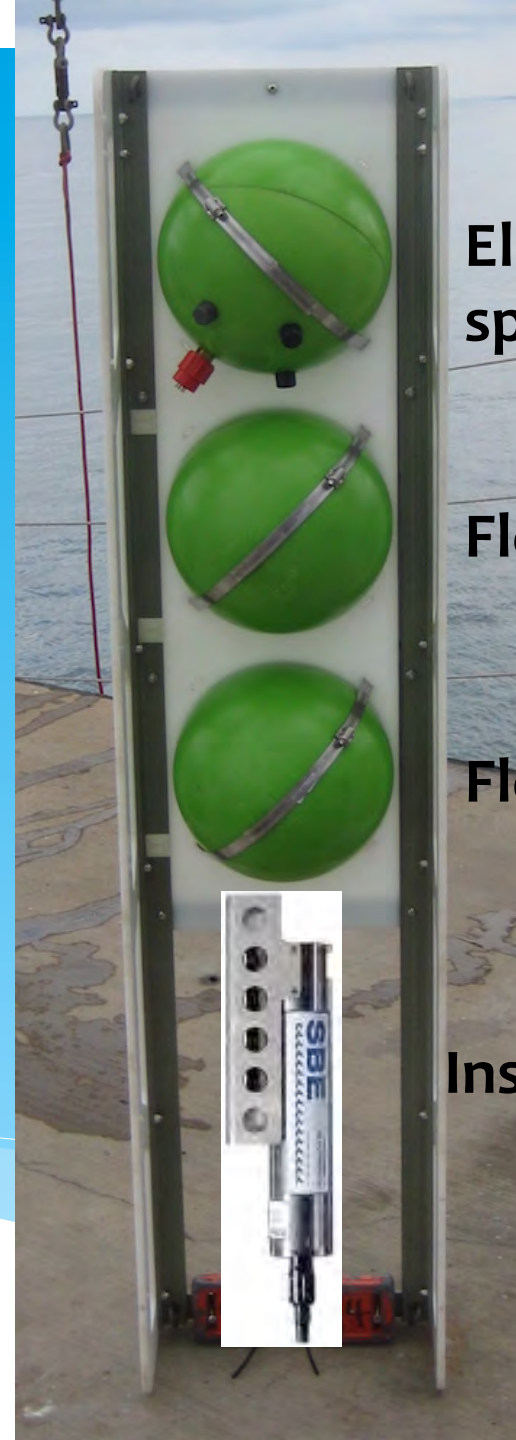
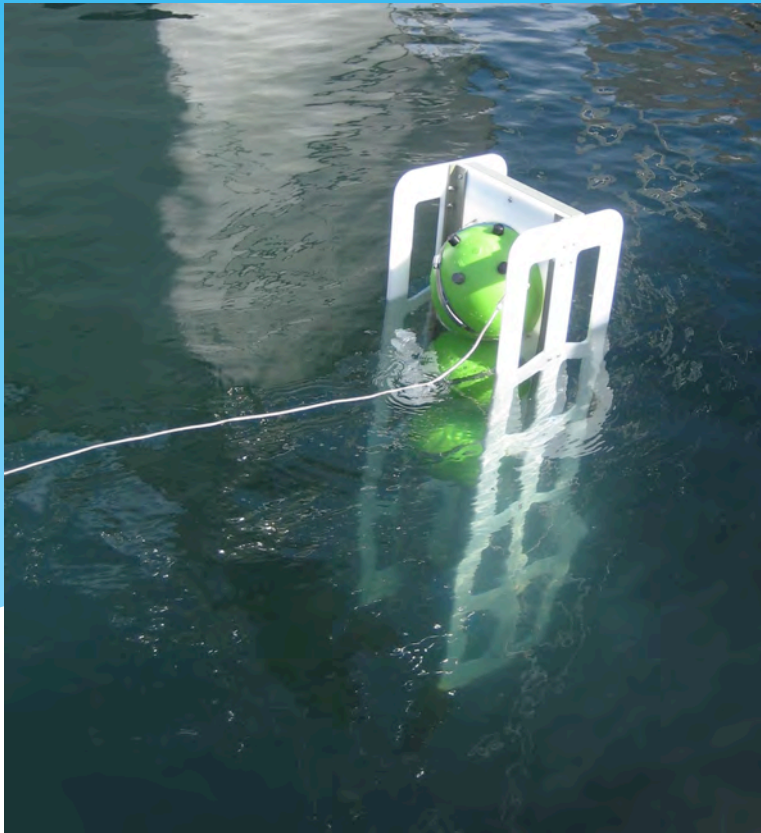
**Many institutions have small vessels ideally suited for local ops.**



**Scripps 26-ft aluminum hull**

# Payloads

SBE 37-SI MicroCAT C-T (P) Recorder



Electronics  
sphere

Flotation sphere

Flotation sphere

Instrumentation

# POLYSTYRENE SPHERE HOUSINGS



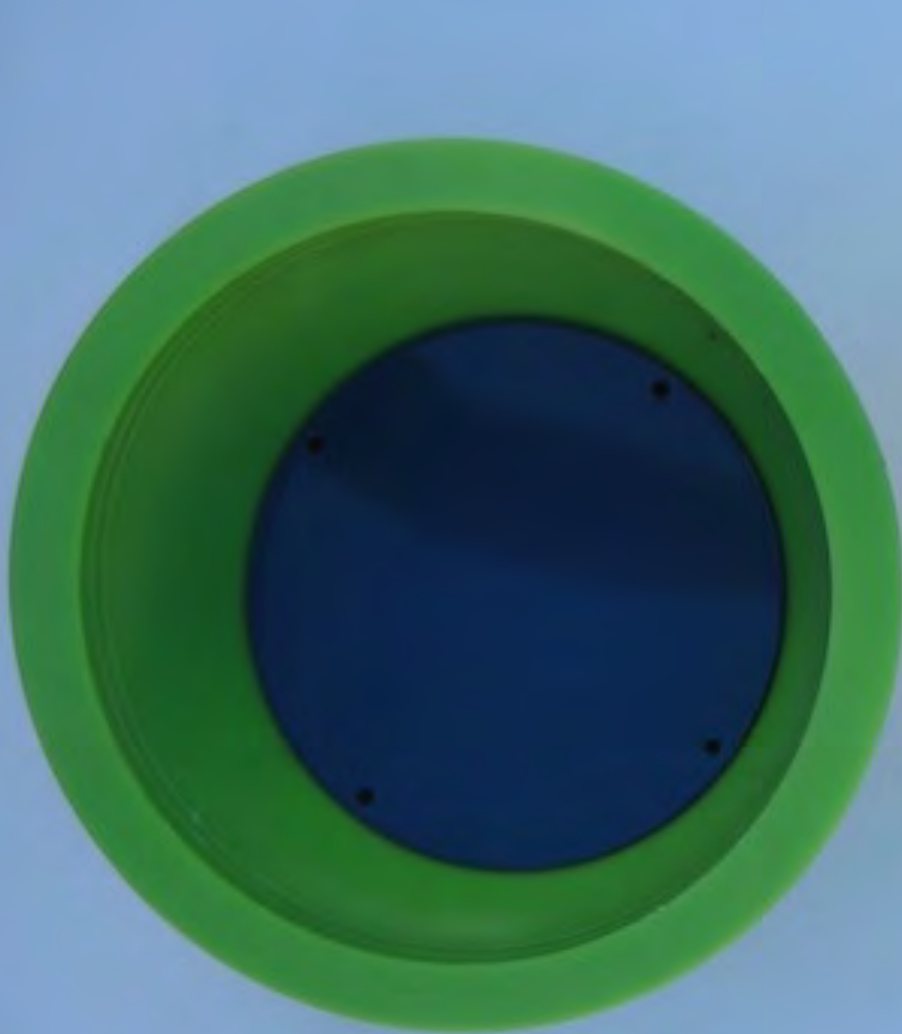
## Advantages of polystyrene

1. Buoyancy and Housing
2. Durable and shock-proof
3. Won't spall
4. Threaded holes possible
5. Machines easily
6. Maybe tapped, bonded, welded
7. Invisible to radio waves
8. Invisible to magnetic force
9. Corrosion proof
10. o-ring seal

## Disadvantages of polystyrene

1. Sensitive to certain hydrocarbons
2. Opaque
3. Implosion













DOV BEEBE



# GLASS SPHERE HOUSINGS



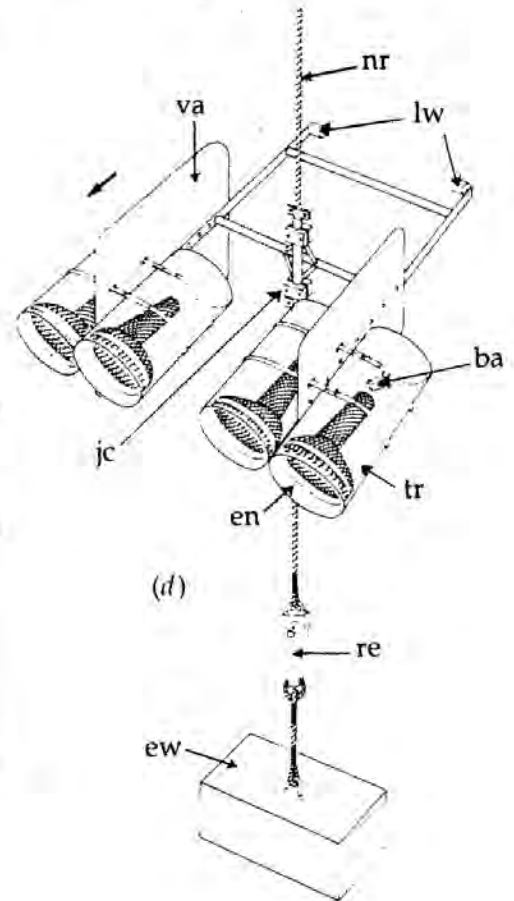
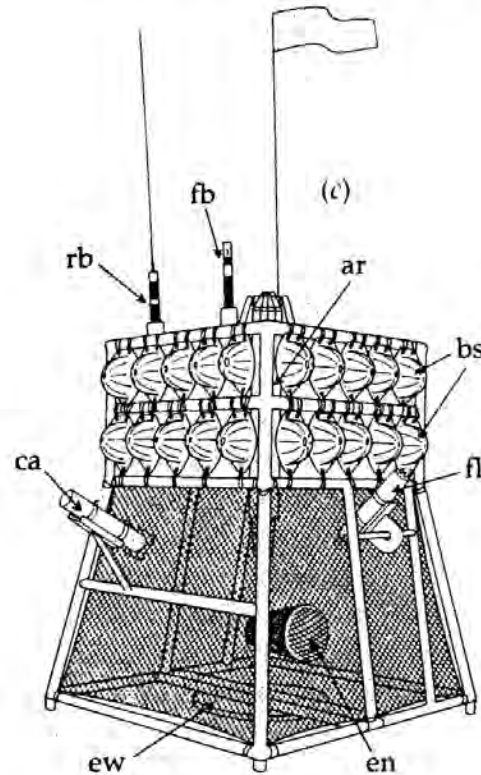
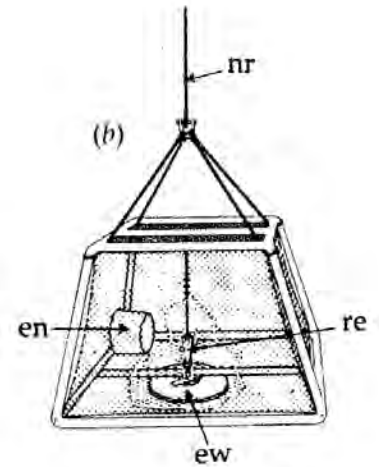
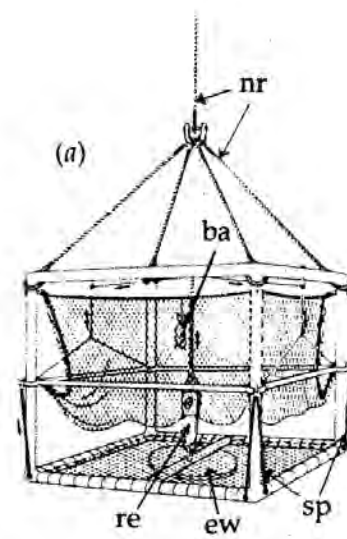
## Advantages of Glass

1. Buoyancy and Housing
2. Clear
3. Penetrations possible
4. Polish for camera housing
5. Invisible to radio waves
6. Invisible to magnetic force
7. Corrosion proof

## Disadvantages of Glass

1. Can chip easily
2. Spalling
3. Life cycle uncertain
4. Operator skill
5. Implosion force

# Traps and samplers can be rigged to operate remotely



# Sensors

CTDs -

conductivity

temperature

& depth

Cameras

current meters

DO

pH

Fluorometer

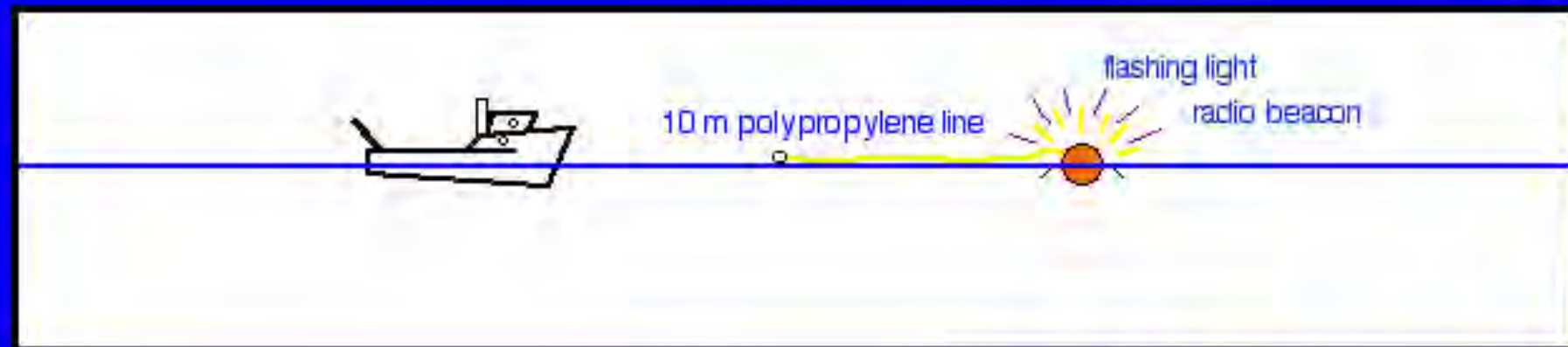
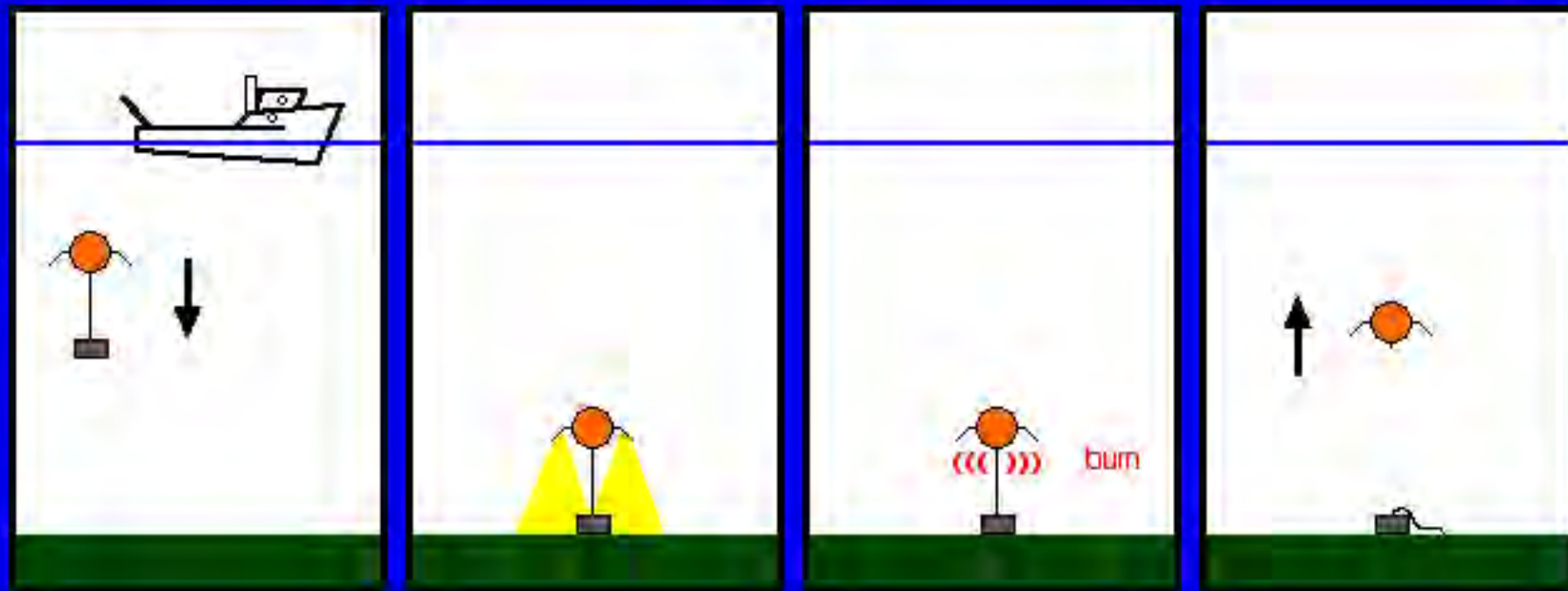
transmissometers

geomagnetic compasses

Seismographs

others

# Lander operations



**FREE VEHICLE**



**Dual release system**

# Nanolander Release Design



**Acoustic Link**

Edgetech

Teledyne Benthos

Desert Star

*...and others*



# Nanolander Release Design

## Countdown timer



# Galvanic Time Release



WATER TEMP	2C 30F	+2C 35F	4C 40F	7C 45F	1C 50F	13C 55F	16C 60F	18C 65F	21C 70F	24C 75F	27C 80F	Time Variation Between Hash Marks	
1 DAY		A1		A2		A3		A4		A5		A6	6 hrs
2 DAY		B1	B2		B3		B4		B5		B6		12 hrs
3 DAY		C1		C2		C3		C4		C5		C6	12 hrs
4 DAY		D1		D2		D2A		D3		D4		D5	12 hrs
5 DAY		E1		E1A		E2		E3		E4		E5	12 hrs
6 DAY		F1		F2		F3		F4		F5		F6	12 hrs
7 DAY		G1		G2		G3		G4		G5		G6	12 hrs
10 DAY		J1		J2		J3		J4		J5		J6	12 hrs
14 DAY		N1		N2		N3		N4		N5		N6	12 hrs
30 DAY		AK30											12 hrs

It's a little lander in a big ocean.









Ken



3.97<sup>m</sup>

GARMIN

IN

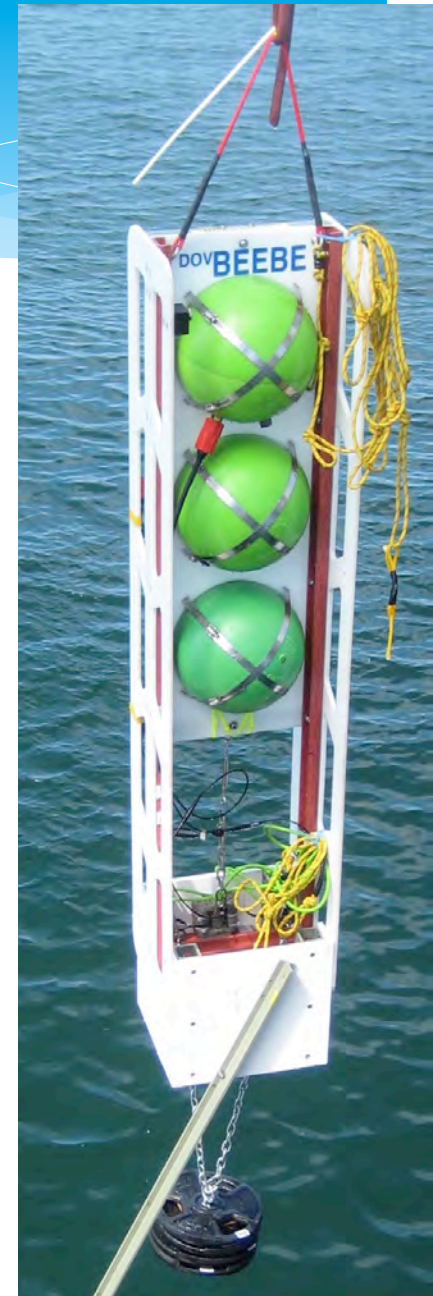
OUT

# Advantages of Nanolanders include:

1. Smaller instrument size

Smaller air shipment (Fed Ex)

2. no HazMat so a shipment of lander components can fly from point-of-origin to point-of-operation, and be assembled pier-side
3. Scrap iron anchors available in port
4. Multiple ballast release methods
5. Interchangeable payloads can fit within a standard payload bay, composed of multiple sensors and samplers,
6. Lander can remain on the seafloor bottom providing long, undisturbed records;
7. Independent of surface waves, currents, and weather
8. Landers can operate at any depth
9. Several landers may be deployed to survey a large area
10. Instruments or samplers can be placed at specified horizontal spacing or heights off the bottom at any depth;



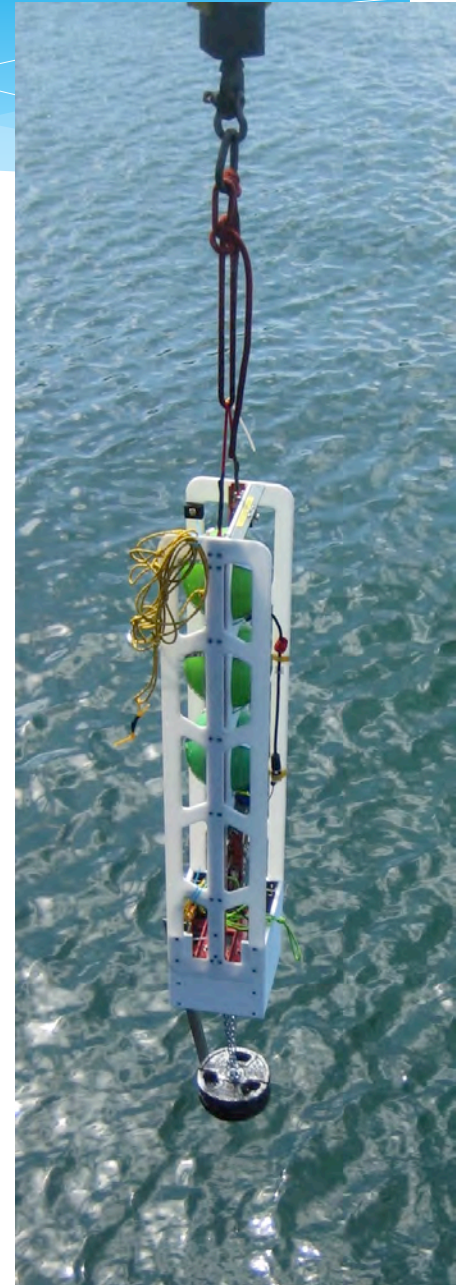
# Advantages of Nanolanders include:

11. Operators can follow descent or ascent by sound-ranging;
12. With a short coupled anchor, the ballast is on the bottom and left behind, minimizing the danger of being stuck in the mud or rocky clefts, and unaffected by bottom slope
13. Landers are simple and robust enough to be used by any size project or institution
14. Student projects are readily adapted to Landers, providing new ideas to principal investigators, and training and inspiration to a new generation of scientists and engineers
15. Standardization encourages adaptation and experimentation.



# Uses of Nanolanders include:

1. A primary data or sample **collection device**,
2. as a **test bed** to evaluate new components for other vehicles or future use.
3. It provides deck crew operational **training** on launch-and-recovery techniques for larger systems, and gives engineers and technicians field experience and the confidence that comes from a success deployment and recovery;
4. as a **baited lure**: The lander can be used to lure animals towards its position by the use of bait. Low-light cameras using red LEDs can image animal behavior without disturbance, or await the arrival of an ROV or manned submersible;
4. **Scout**: Landers can initially survey a specific area of interest



## Nanolandars require minimal deck gear:

A lander can be configured to whatever **ship-of-opportunity** presents itself, small or large.

A larger pool of smaller ships is available, in smaller harbors closer to points of interest, during a more advantageous time, at a more modest cost;

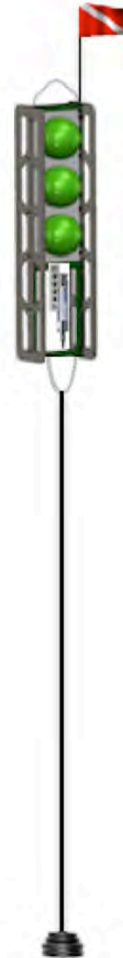
- no specialized deck gear required

- cheaper

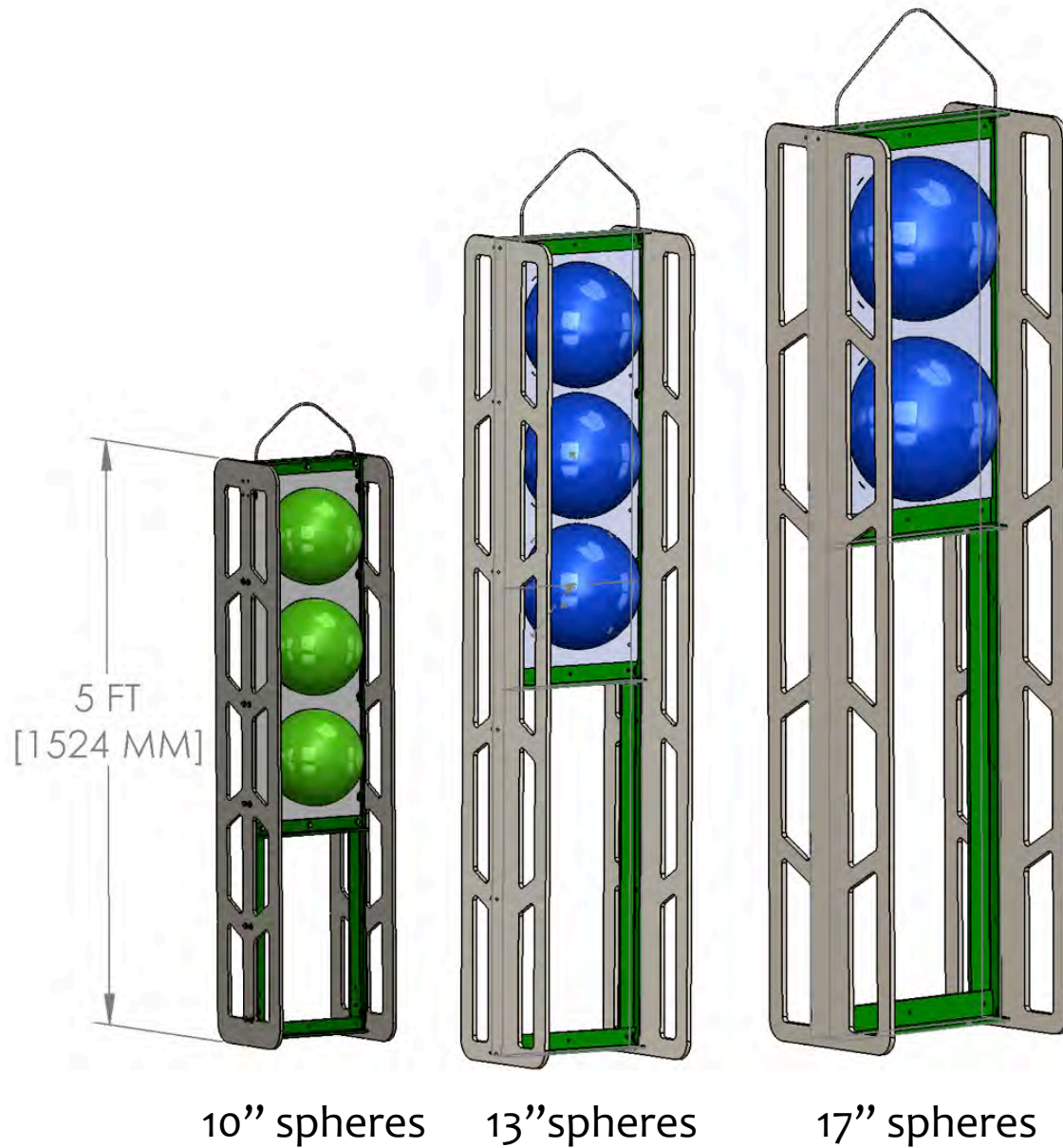
- smaller seaports, perhaps better located

- flexible schedule

# Potential Lander Configurations



## Nanolander come in sizes:



**DECK PURGE BOX**  
MODEL 100

POWER  
110V AC 60HZ  
FUSE

ON  
OFF

EXHAUST  
Max 5 PSI

VACUUM

REMOVE CAP FOR  
OPERATION

HOUSING INTERIOR  
PRESSURE

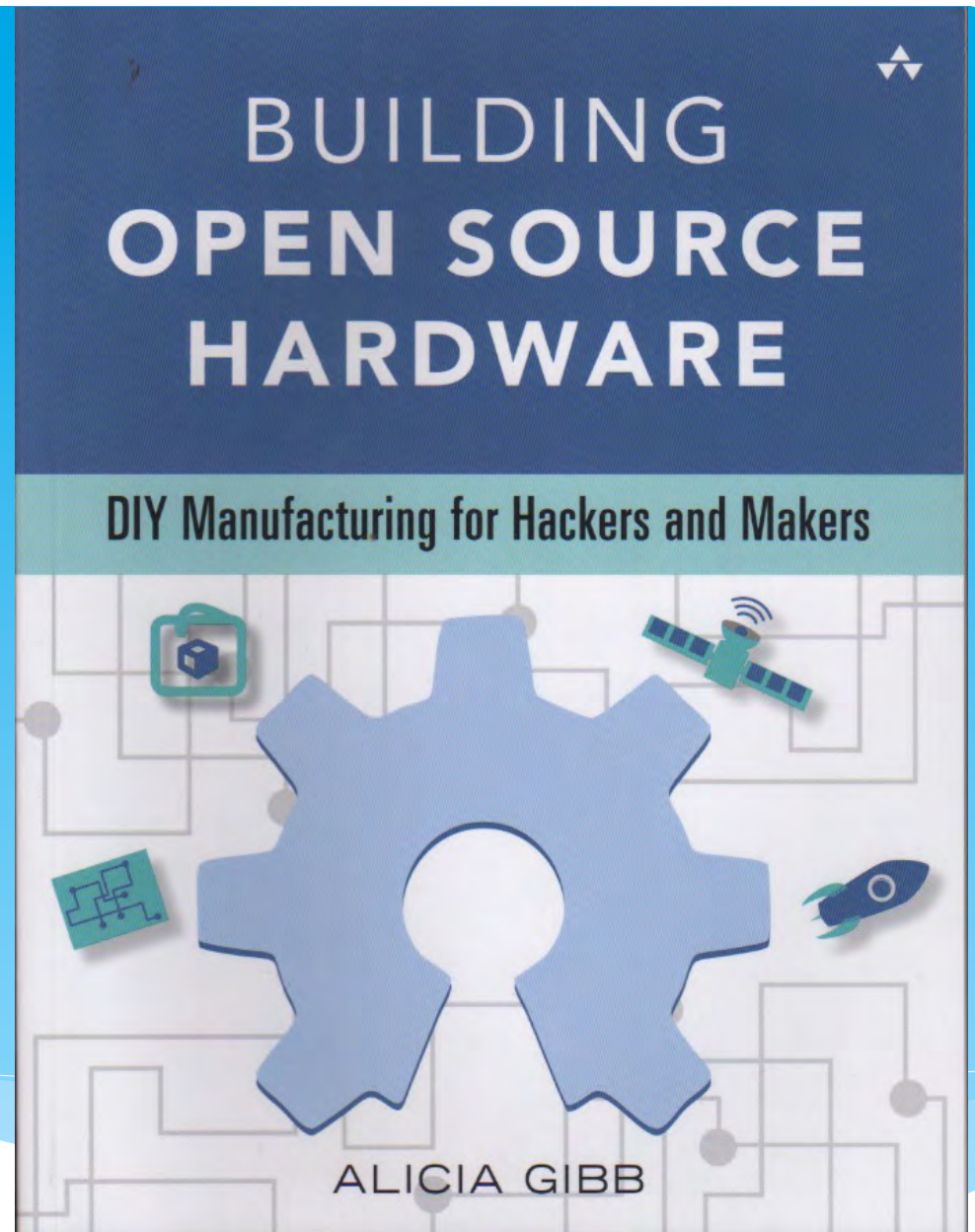
 **GLOBAL**  
OCEAN DESIGN  
PATENT PENDING



VACUUM

FLUOSICANT

Nanolanders are great for  
technology development,  
experimentation,  
or just following a hunch





## Oceanography for Everyone - The OpenCTD

Description

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### Latest Updates

**07/23/13:** Check out some of the coverage the OpenCTD has received over the last month!

- [Crowdfunding a tool to enable oceanography for the masses: OpenCTD](#)
- [Crowdsourcing may open up ocean science](#)
- [Crowdsourcing project targets open-source tool for ocean research](#)
- [OpenCTD project looks to bring oceanography instruments to the people](#)

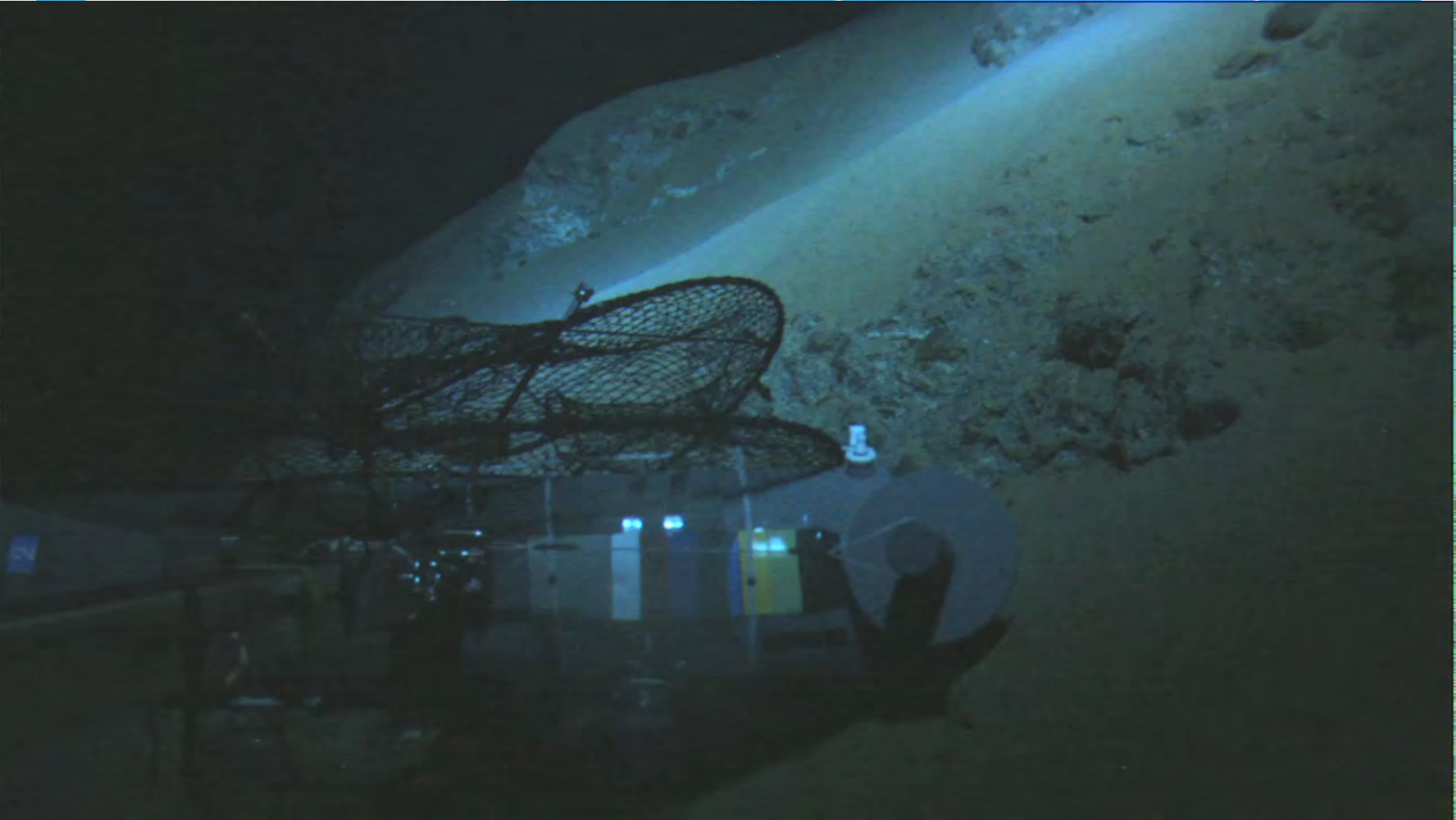
## SeeStar Imaging System



They're catching on.



Scripps Director's Cabinet meeting,  
June 17, 2016



**The End**