



Understanding oceans  
Sustaining future



## Progress on XUANWU

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# History of XUANWU

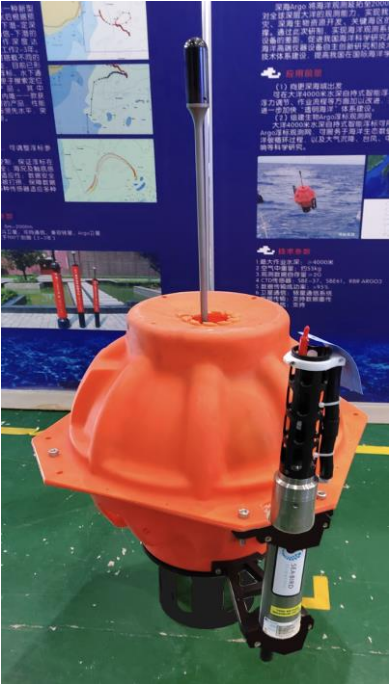
2021  
HM4000 →

2022  
HM6000 →

XUANWU



RBR CTD



SBE61 CTD



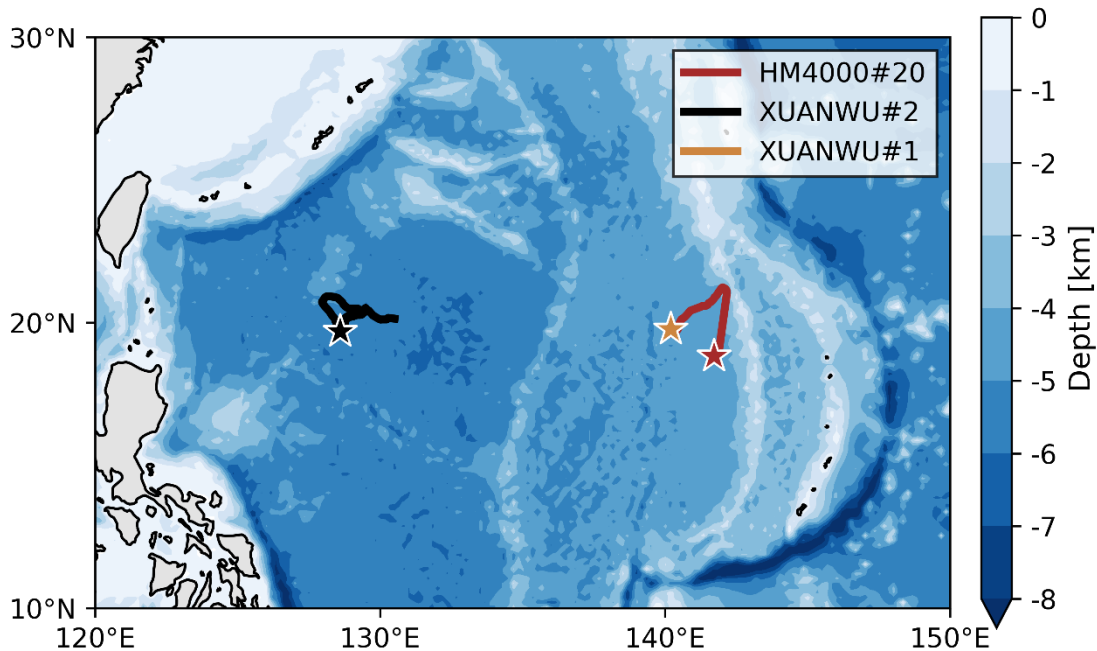
Pronunciation is more like :  
**shine-woo**

# HM4000 vs XUANWU

	HM4000	XUANWU
Shell	Nautilus shell	A newly-designed shell, including a buoyancy compensation module
Buoyancy drive	operating pressure $\geq 42$ Mpa	operating pressure $\geq 63$ Mpa
CTD mounting type	Vertically mounted CTD	Horizontally mounted CTD
Communication module	Rigid antenna	Dismountable antenna
Power	$\geq 75$ (180) *24 Wh	$\geq 216$ *24 Wh

# Deployment in 2022 and current status

- 3 floats (1 HM4000, 2 XUANWU) deployed in the Philippine basin, northwestern Pacific.
- CTD cast and on-board salinity measurement were conducted after deployment.



Float	CTD model	Cycle Count	Current Status	Cycle period (day)	Parking depth (m)
XUANWU1	SBE61	0	inactive	----	----
XUANWU2	SBE61	117	active	2	2000 m
HM4000	RBR	109	inactive	1	----

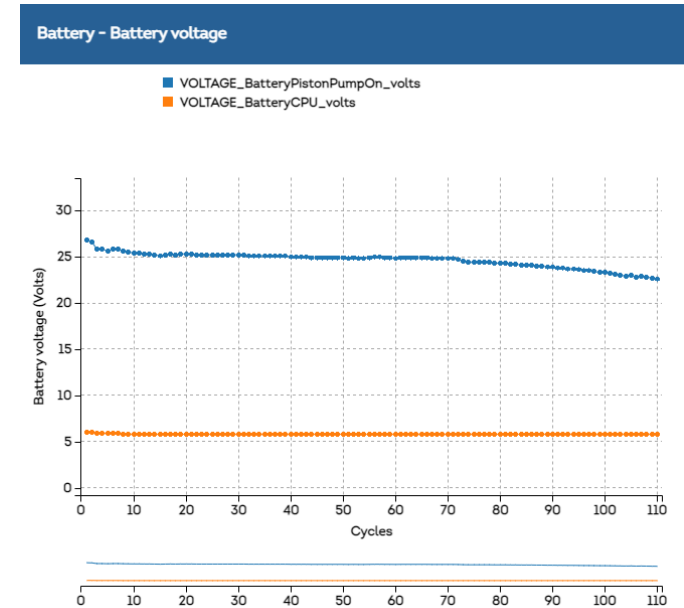
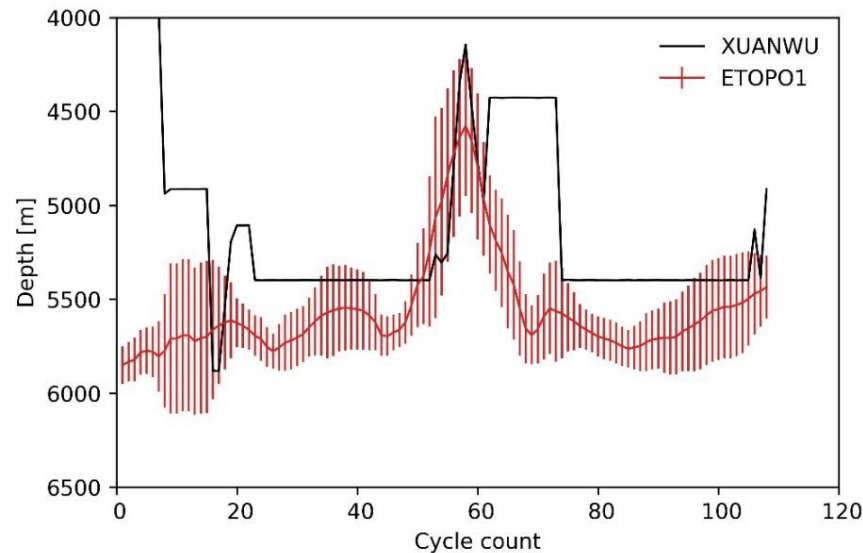
As of 2023.3.17

# Deployment in 2022 and current status

## XUANWU #1



## XUANWU #2

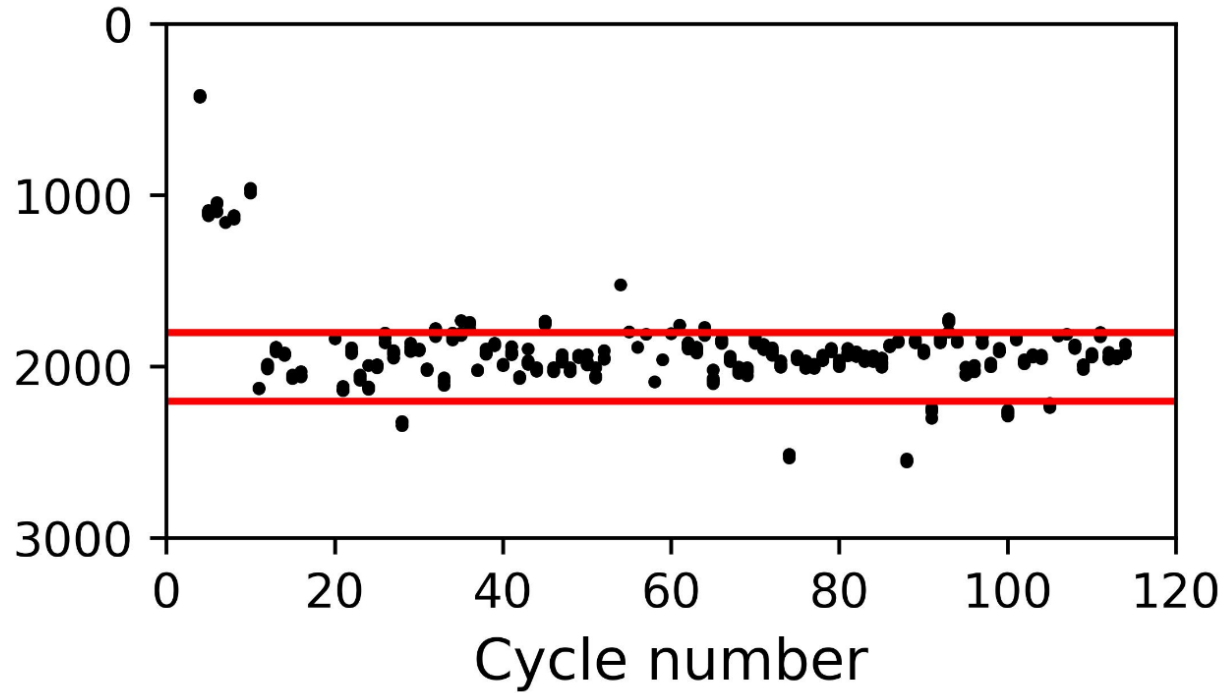


- The communication between CTD and float failed after the first descent, which may be due to the interface faults.
- The float drifted to the seashore after a few months.

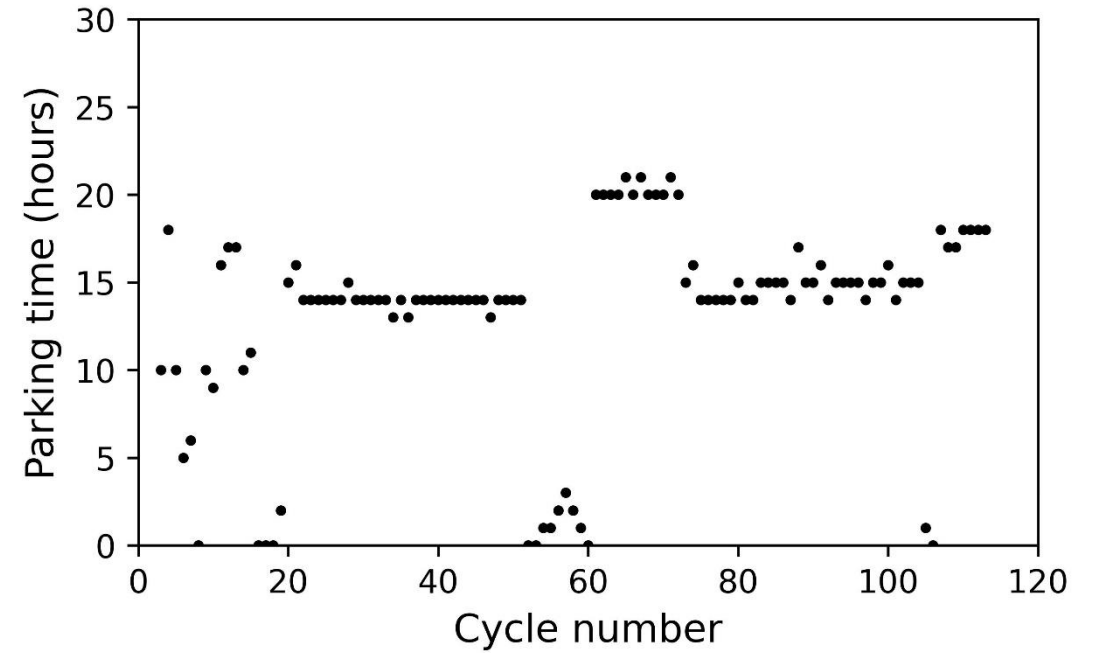
- 2 profiles reached ~6000 m and most of the profiles reached 5500 m.
- Battery voltage drops fast after 80 cycles.

# Parking depth and time

XuanWu 2#

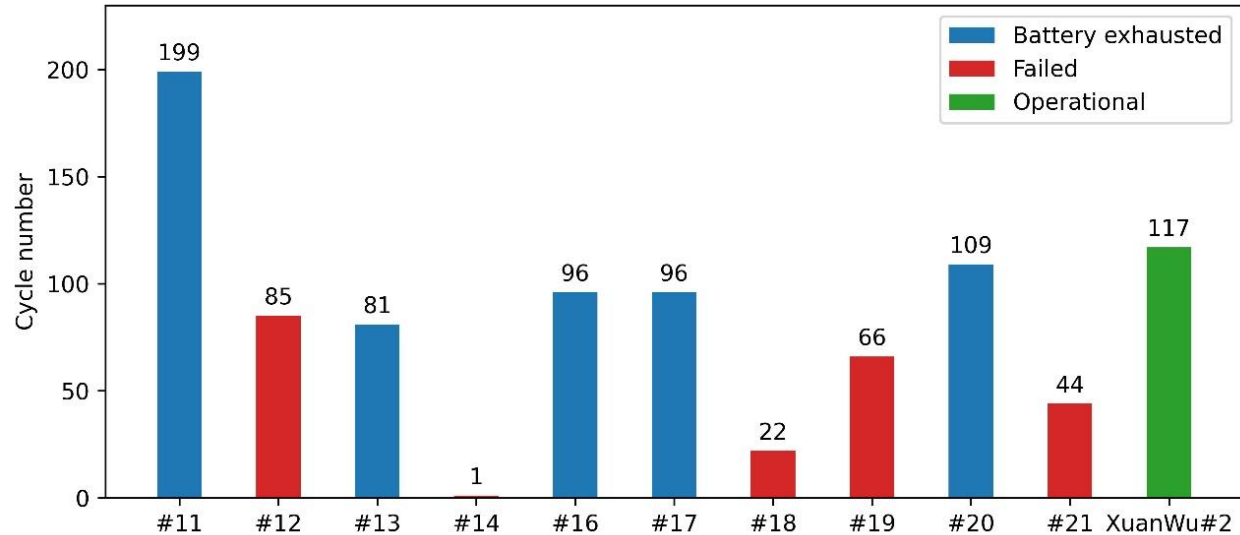
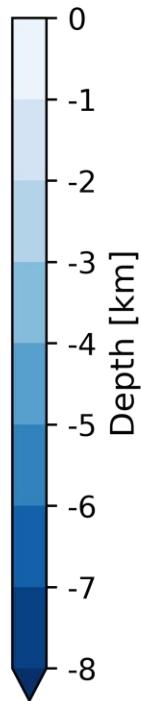
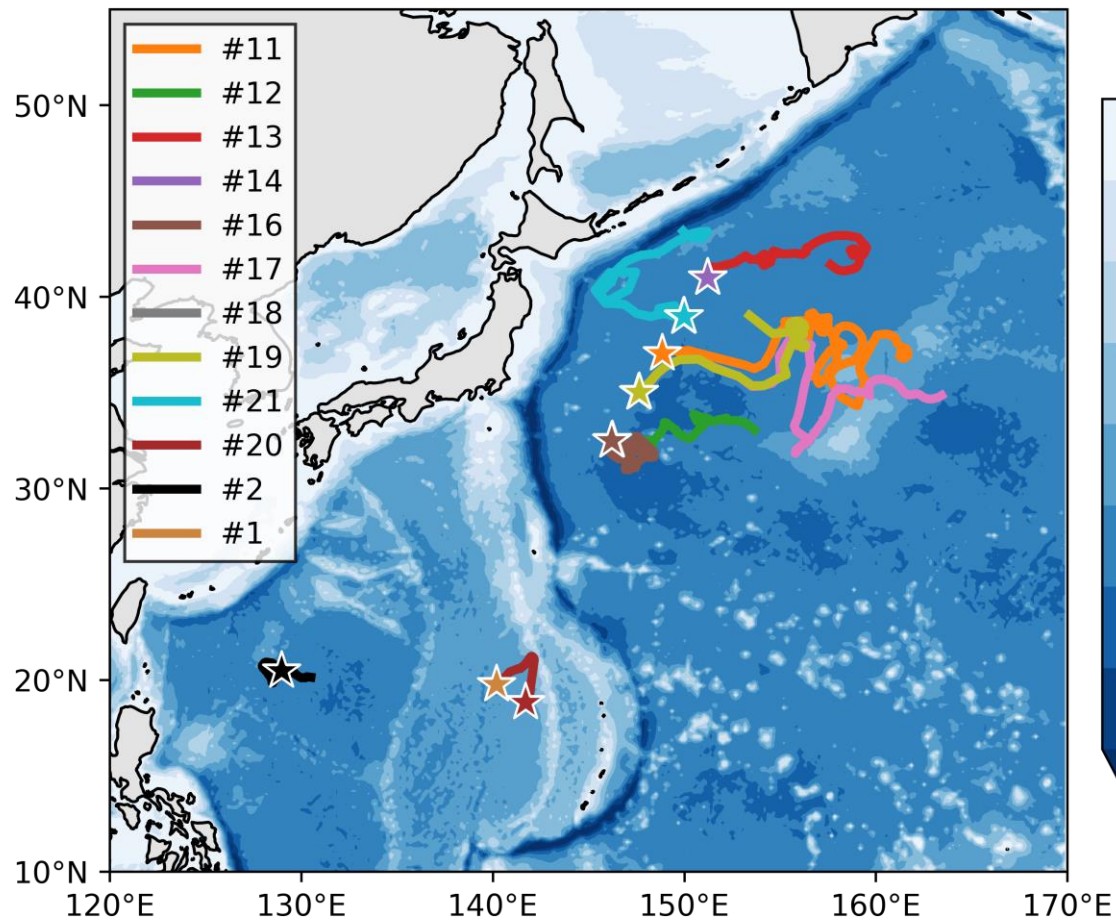


Parking depth changes greatly (~200m)



Parking time unstable

# Status of 9 HM4000 floats deployed in 2021

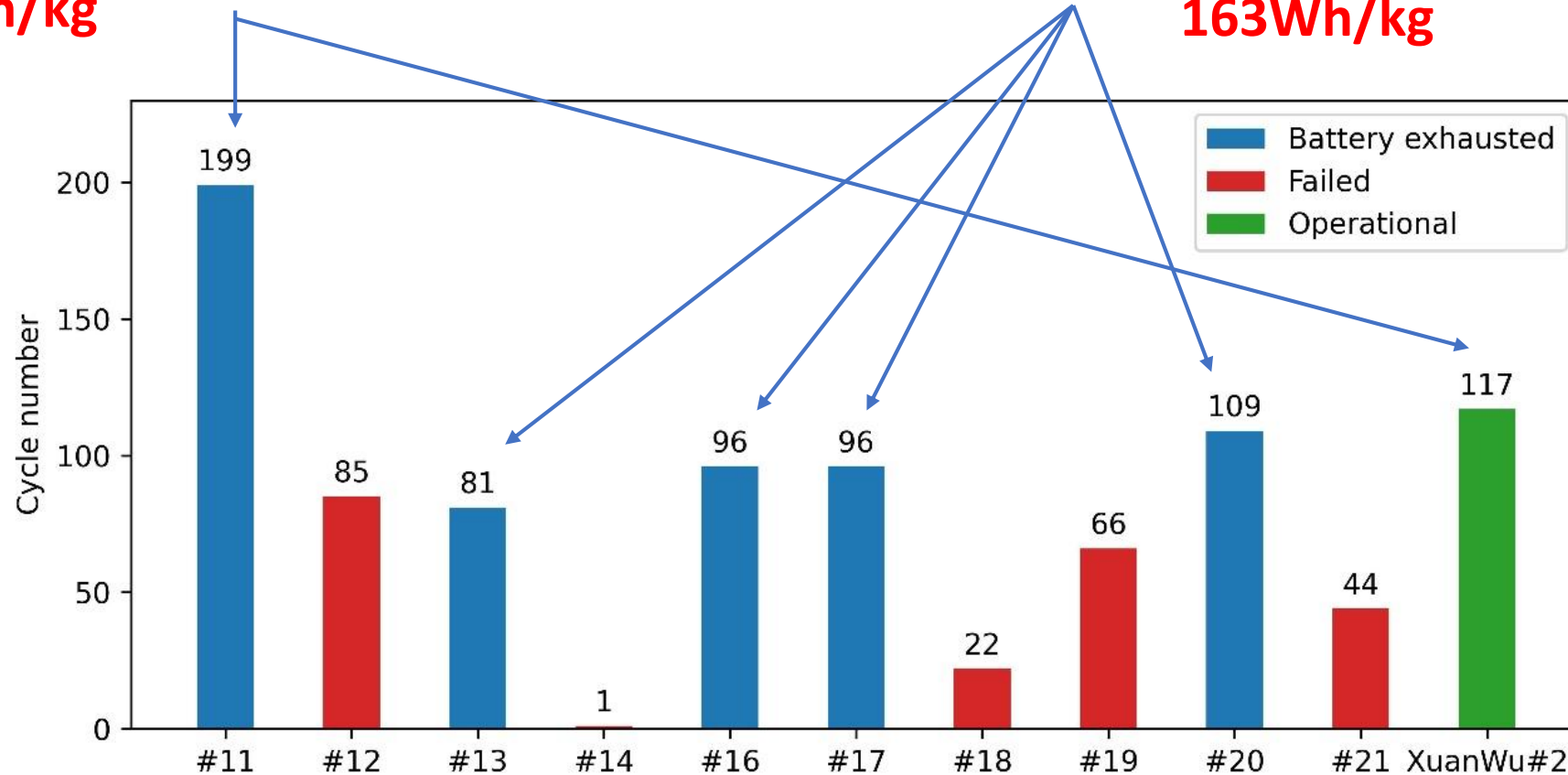


Battery-dependent maximum cycles

# Battery scheme for two types of float

Lithium manganese dioxide ( $\text{Li-MnO}_2$ )  
primary lithium battery  
Comprehensive energy density:  
**282Wh/kg**

Lithium sulfur dioxide ( $\text{Li-SO}_2$ )  
primary lithium battery  
Comprehensive energy density:  
**163Wh/kg**





# 2023: Updated version of XUANWU (ongoing)

## Structure:

- Redesign the shell
- Flexible antenna

## Power supply system:

- Increased the battery capacity by 30%.

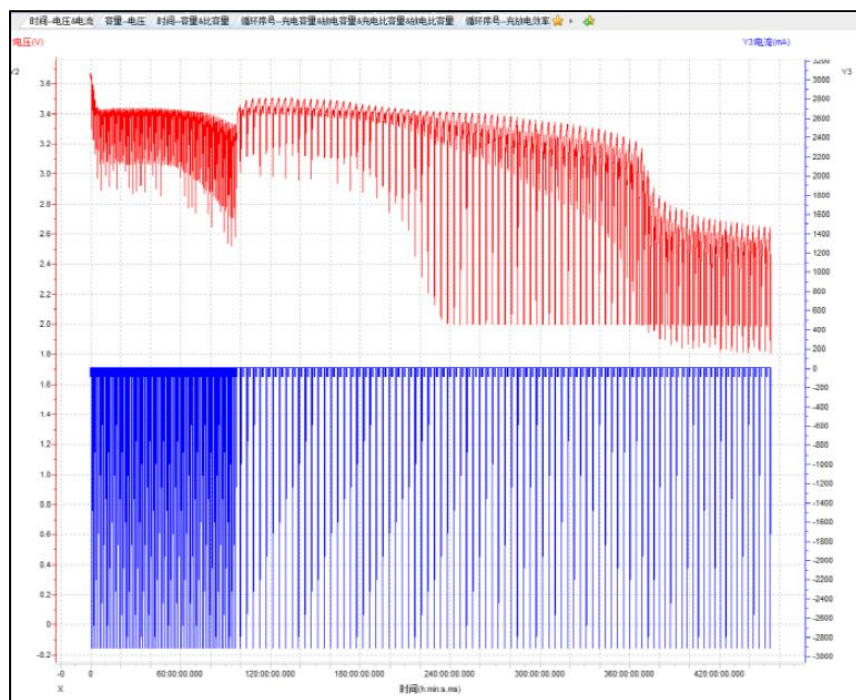
## Buoyancy drive system:

- Reduced bladder volume
- Buoyancy compensation module



## Power

thionyl chloride ( $\text{Li-SOCl}_2$ ) cells:  
high energy density + super capacitor scheme



Measured energy density of single cell combination

**413Wh/kg**

## Buoyancy compensation module



Save ~19% consumption for each cycle

# Conclusion

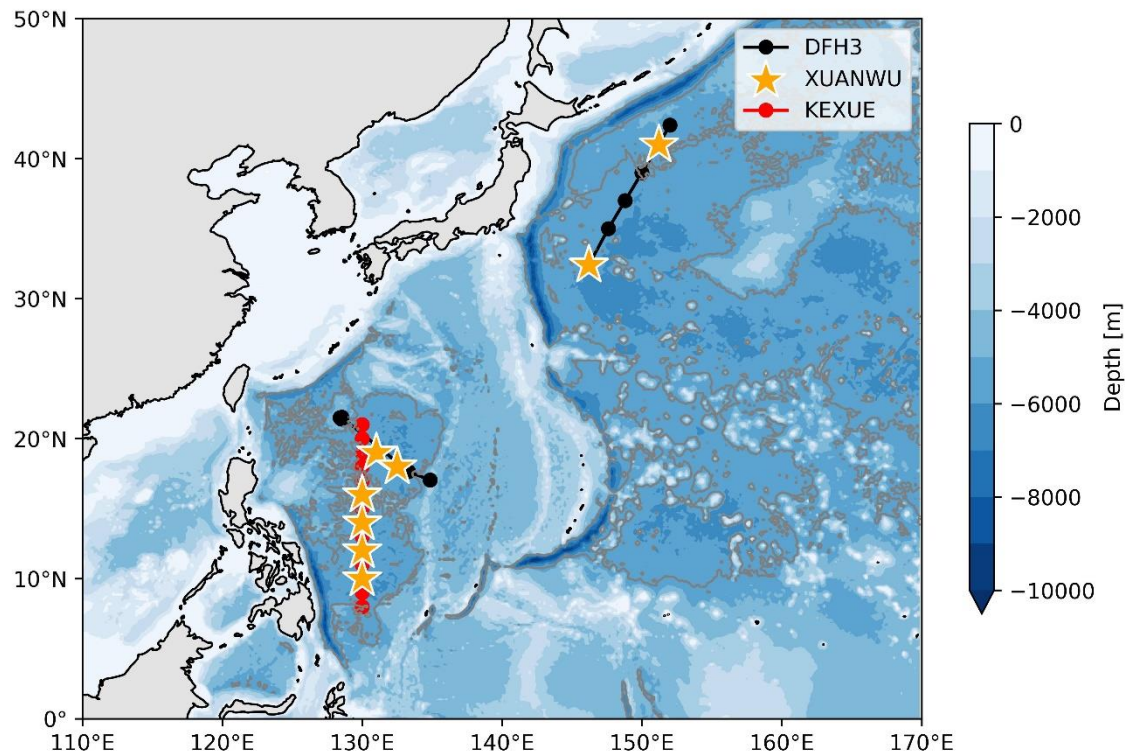
- Communication failure between CTD and float for XUANWU 1# float after deployment.
- The bottom detection system will be included.
- Parking depth changes greatly. The parking depth adjustment control strategy will be developed.
- The stability and lifetime of the float will be improved further.
- The redesigned float structure and the buoyancy compensation module will be tested this year.

# Deployment plan in 2023

China plans to deploy **8 XUANWU** floats this year.

Cruise in **May**: 2 in the Kuroshio Extension region and 2 in the Philippine basin

Cruise in **November**: 4 in the Philippine basin, western Pacific



DFH3



KEXUE

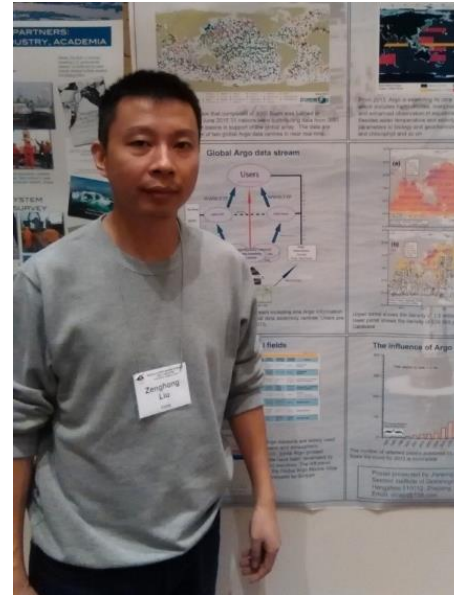
# Thank you for your attention!



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