Deep Argo vertical sampling

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Deep Argo float Models active & under testing

Deep SOLO

SIO float lab, MRV
0 – 6000 m
25 kg
13” glass sphere
SBE-61 CTD

Deep NINJA

TSK Co LTD, JAMSTEC
0 – 4000 m
50 kg
6’ high
Extended-depth SBE-41 CTD
Oxygen sensor optional

HM4000

QNLM, OUC, SOED, CSIO
0 – 4000 m
RBR or SBE-61 CTD

Deep APEX

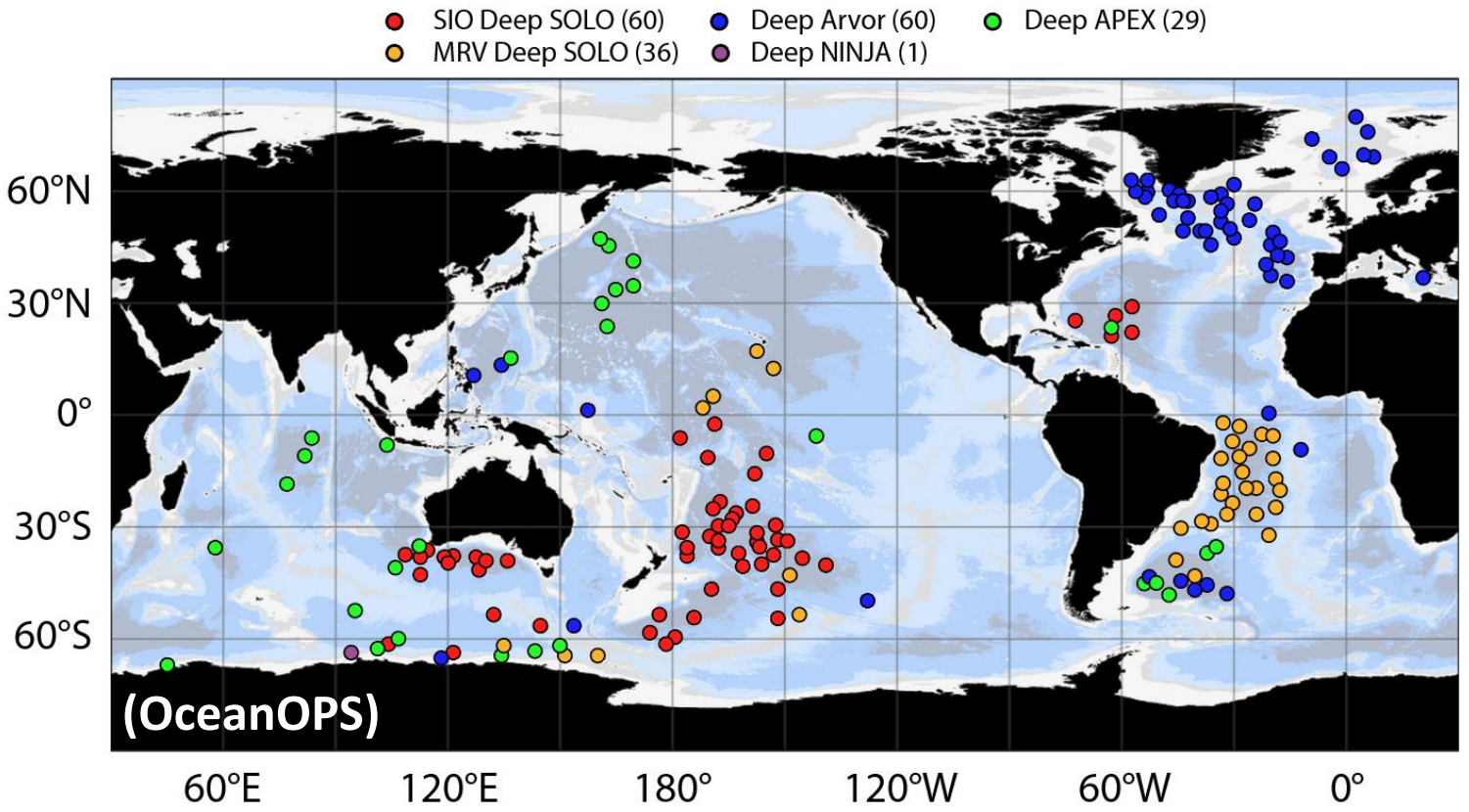
TWR, UW
0 – 6000 m
50 kg
17" glass sphere
RBR or SBE-61 CTD
Oxygen sensor optional

Deep Arvor

NKE, IFREMER
0 – 4000 m
26 kg
Extended-depth SBE-41 CTD
Oxygen sensor optional

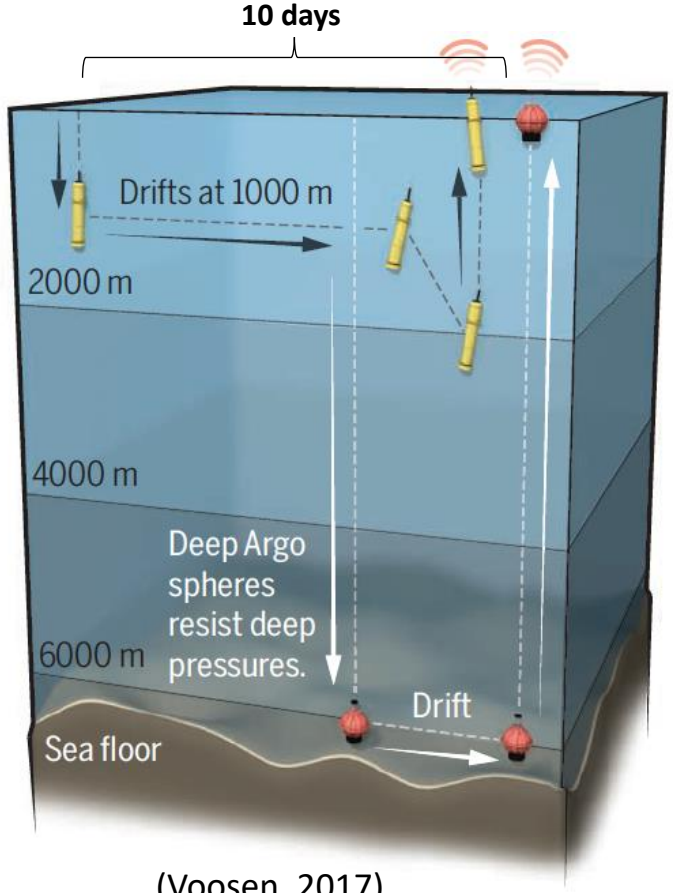
HM6000 (QNLM, OUC, SOED, CSIO, 2022), and **6000-m Deep Argo float** (IFREMER, 2025) are under development

Deep Argo float Models Currently Active



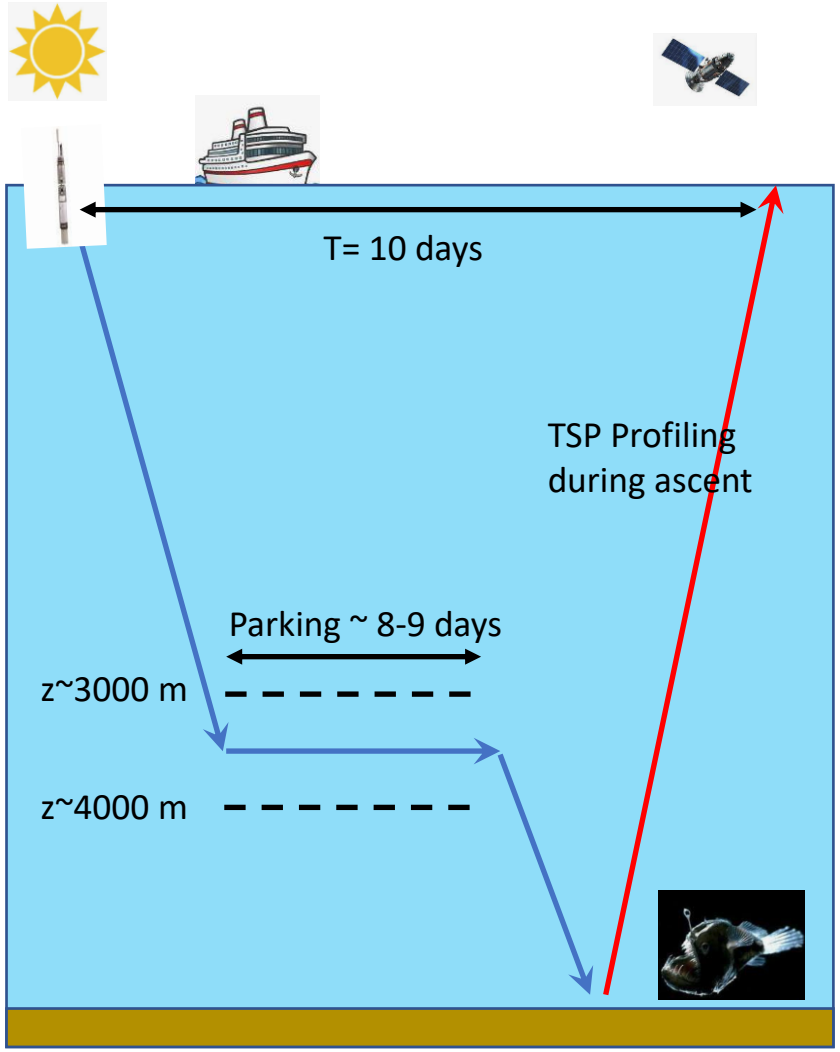
Regional pilot arrays implemented in ocean regions that are deep (> 2000-m), where deep-ocean warming has been observed, and technical support and reference data are available

Core, BGC, and Deep Argo float cycles



(Voosen, 2017)

Deep Arvor, Deep NINJA, Deep APEX sampling



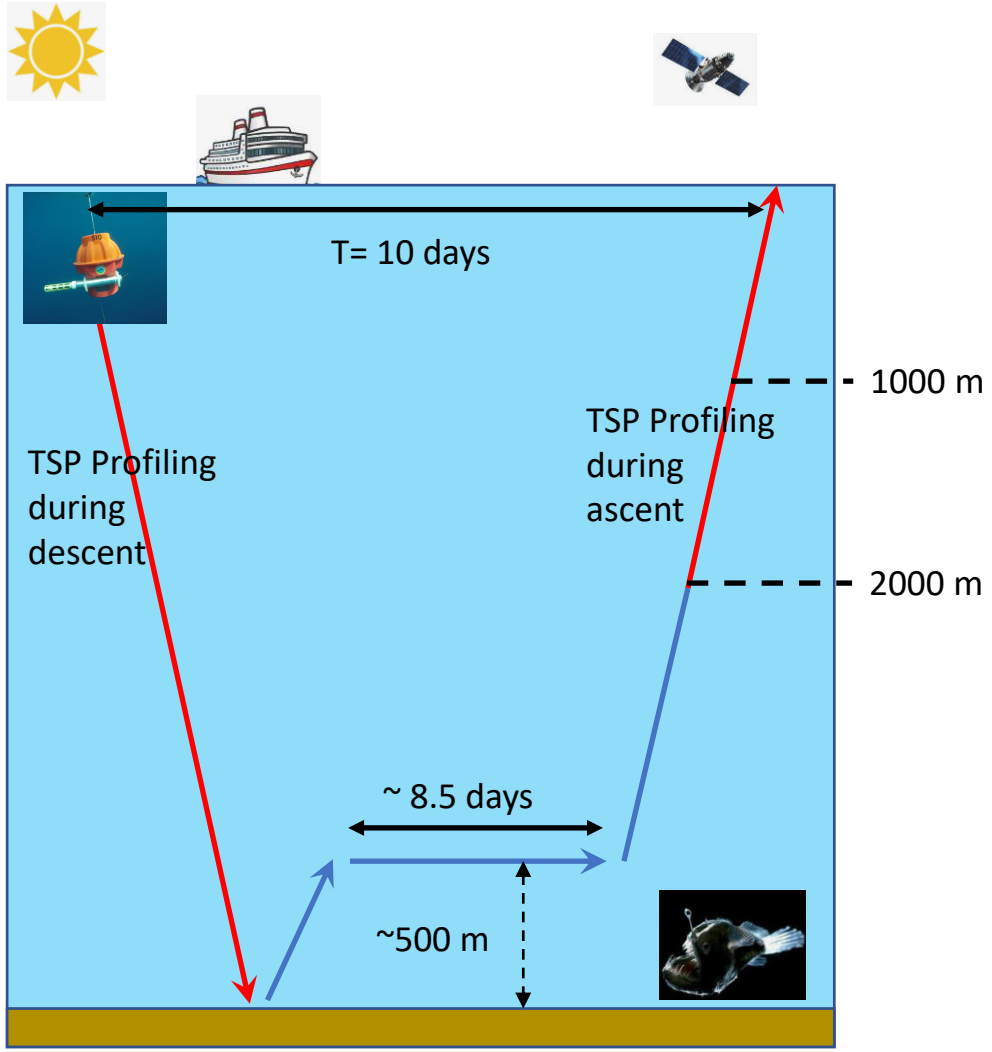
Deep Arvor, Deep NINJA, and Deep APEX float models profile temperature and salinity during ascent only

Vertical resolution can be modified prior to deployment

Current vertical sampling is

- Deep Arvor: 1-2 dbar between 0-4000-m
- Deep NINJA: 5 dbar between 0-4000-m
- Deep APEX : 4 dbar between 0-6000-m

Deep SOLO (SIO & MRV) sampling



Deep SOLO float models can profile temperature and salinity during descent and ascent

Vertical sampling near the surface and seafloor can be modified with impact on energy budget per cycle

Deep SOLO available energy (de-rated to 70%) is 6300 kJ

- **Scenario 1: Profile on 0-6000 dbar descent only**

0-500 (CP), 500-1000 @ 5 dbar, 1000-2000 @ 10 dbar, 2000-3000 @ 20 dbar, 3000-5800 @ 50 dbar, 5800-6000 @ 10 dbar
Lifetime: 234 cycles @26.9 kJ/cycle (6.4 years)

- **Scenario 2: Profile on 0-6000 dbar descent and 0-1000 dbar ascent**

Added 1.2 kj/cycle for 0-100 dbar continuous and 100-900 dbar discrete at 10 dbar. Added 0.3 kj/cycle for 3000-5800 @ 20 dbar

Lifetime: 221 cycles @ 28.4 kj/cycle (6 years)

Summary and Discussion

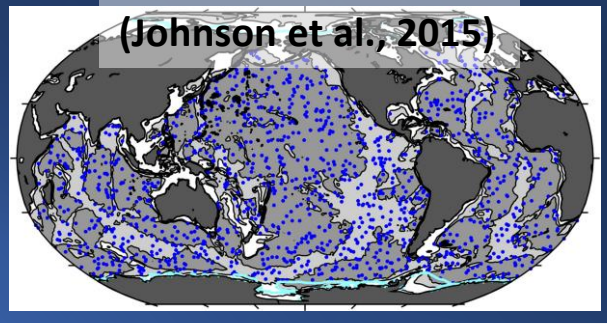
Providing near-real time data on ascent is feasible for all Deep Argo float models

Increasing vertical sampling has significant impact on Deep Argo float energy budget

Questions for the modeling community

- What maximum depth is required for near-real time Deep Argo profiling?
- What vertical resolution is needed (i) near the surface? (ii) above the seafloor?

Transition to Global Implementation
1250 Deep Argo floats


(Johnson et al., 2015)

Deep Argo mission parameters compatible with Core and BGC Argo

- 10-day cycle
- Parking at 1000-m depth
- Sea-ice avoidance software
- Float lifetime > 4 years
- Maximum profiling depth 4000-6000m or near seafloor

Deep Argo's priorities are to

- Improve the accuracy and stability of CTD measurements (±0.001°C, ±0.002 PSS-78, ±3 dbar/6000-m)
- Mature procedures for RT and DMQC
- Increase the number of Deep Argo float deployments/year

Potential float recovery

- Dedicated ship time is required
- Loss of ~5% battery life
- Valuable sensor recycling and calibration
- Limited float recycling value
- Environmental impact

Deep Argo CTD's specifications

	Temperature	Conductivity	Pressure
SBE-61 initial accuracy	±.001 °C	±.0002 S/m	±4.5 dbar/7000 m
SBE-61 stability	.0002 °C/year	.002 S/m over 10 yrs	0.8 dbar/year
4000 m SBE-41 initial accuracy	±.002 °C	±.0003 S/m	±4 dbar/4000 m
4000 m SBE-41 stability	.0002 °C/year	.003 S/m over 10 yrs	0.8 dbar/year
RBRargo CTDdeep6k accuracy	.002°C	±.0003 S/m	± .05% FS
RBRargo CTDdeep6k stability	.002°C/year	.001 S/m over 10 yrs	.05% FS