Long term comparison of drifters from four manufacturers deployed in 2006

ADB06

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NOAA/AOML, Miami, Florida

Data Buoy Cooperation Panel, October 15-19, 2007, Jeju, Korea

•In 2006, the Global Drifter Program deployed eight clusters of four SVP drifters, one each from **Clearwater**, **Technocean**, **Metocean**, and **Pacific Gyre**, in the Atlantic ocean, continuing a comparison study started in 2005.

•With data collected for 1 year from the last deployment, we have evaluated how well these particular drifters' transmitters are surviving to the design lifetime of 450 days, and how well we can detect drogue presence and how long are drogues lasting compared to the expected lifetime of 300 days.

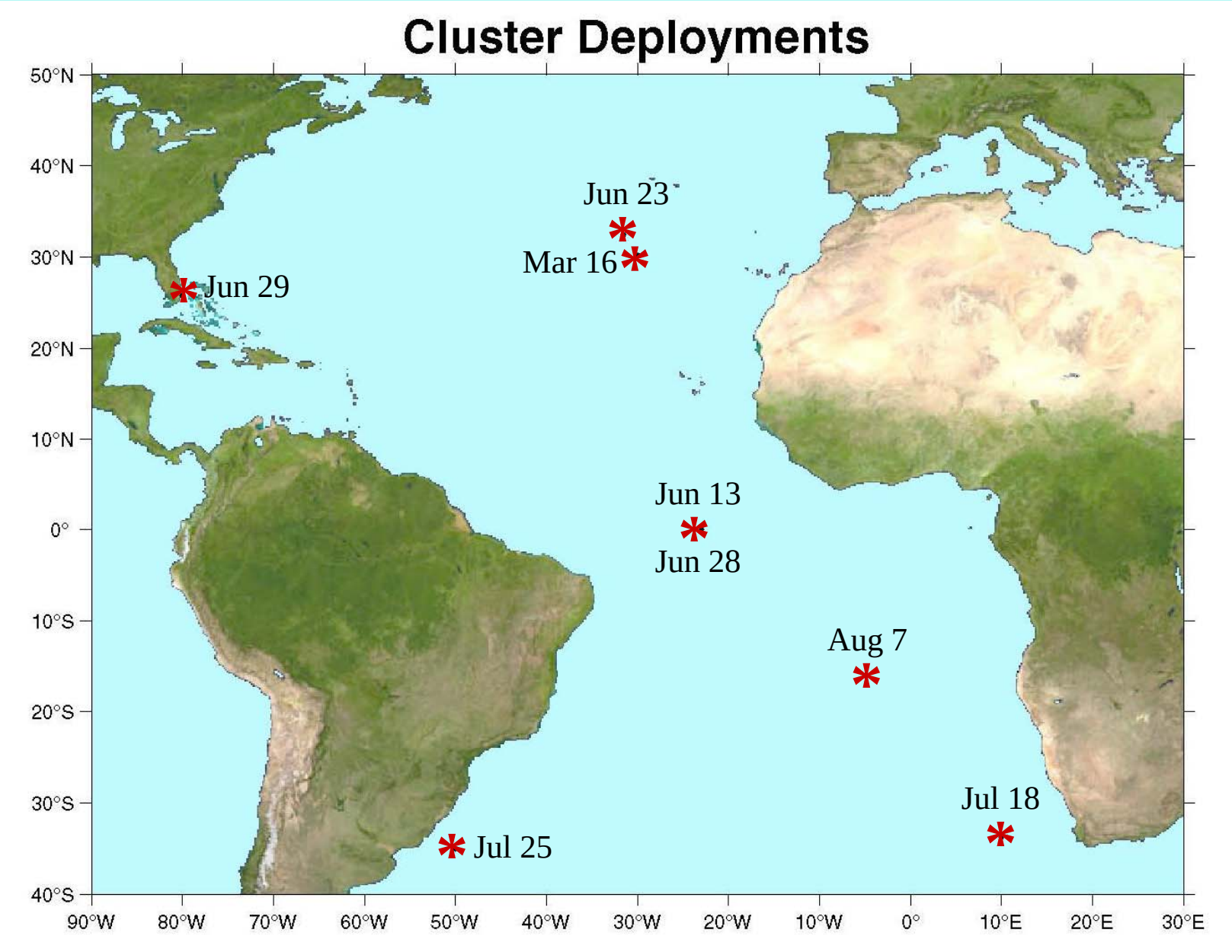
•Data updated through August 31, 2007

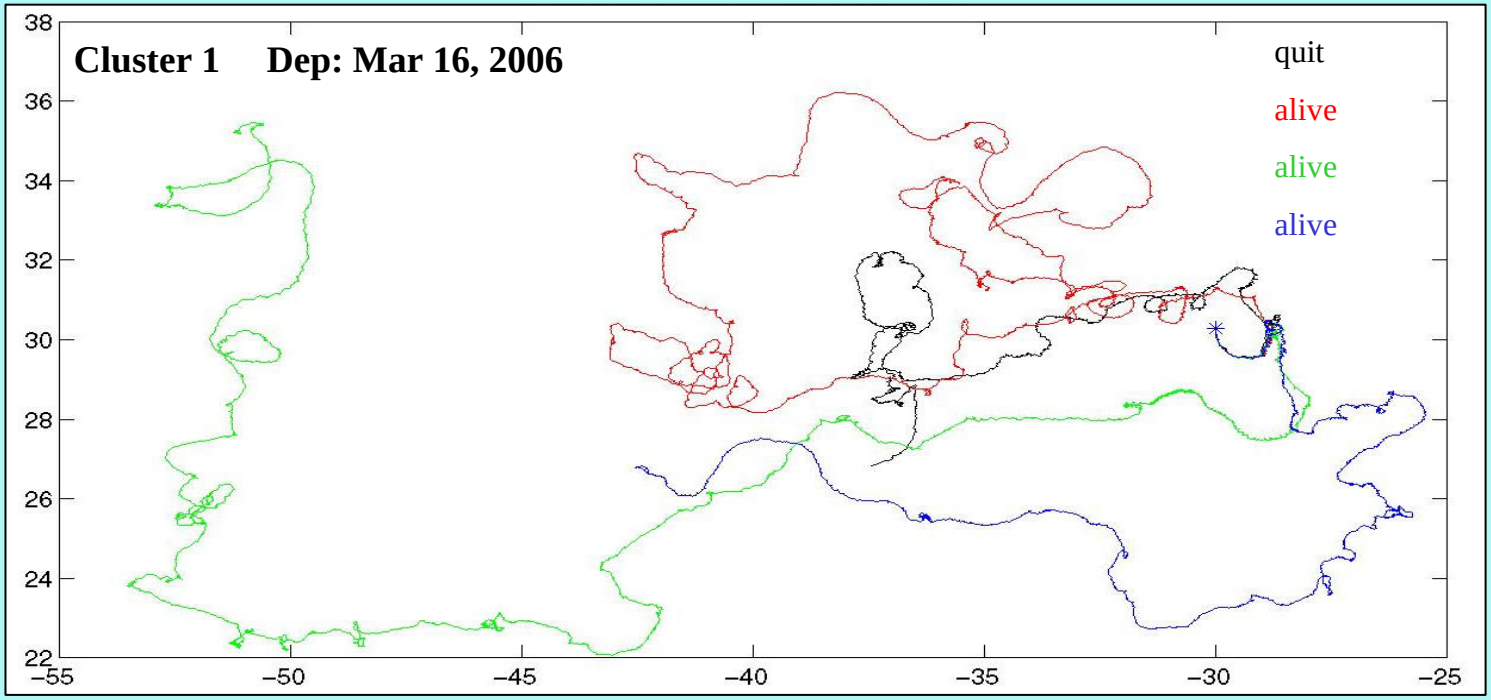
•In 2008, The Global Drifter Program plans to continue this comparison study with cluster deployments at locations worldwide.

Results presented in last year's DBCP technical workshop, indicated considerable improvements from 2005 study:

- All manufacturers used similar packaging.
- Technocean reverted to wired rope radial design, and fixed the wagon wheel original design problem to extend drogue life.
- Metocean attached deployment instructions directly to surface float.
- Pacific Gyre installed carrying handles.
- All deployments were successful, **no** drifters failed on deployment.
- All SSTs from neighboring drifters were consistent with each other.
- No transmission problems, only 1 10-day gap found in one drifter, which is not a concern.

2006


Cluster Deployments
50°N
40°N
30°N
20°N
10°N
0°
10°S
20°S
30°S
40°S
90°W
80°W
70°W
60°W
50°W
40°W
30°W
20°W
10°W
0°
10°E
20°E
30°E
Jun 23
Mar 16
Jun 29
Jun 13
Jun 28
Aug 7
Jul 18
Jul 25

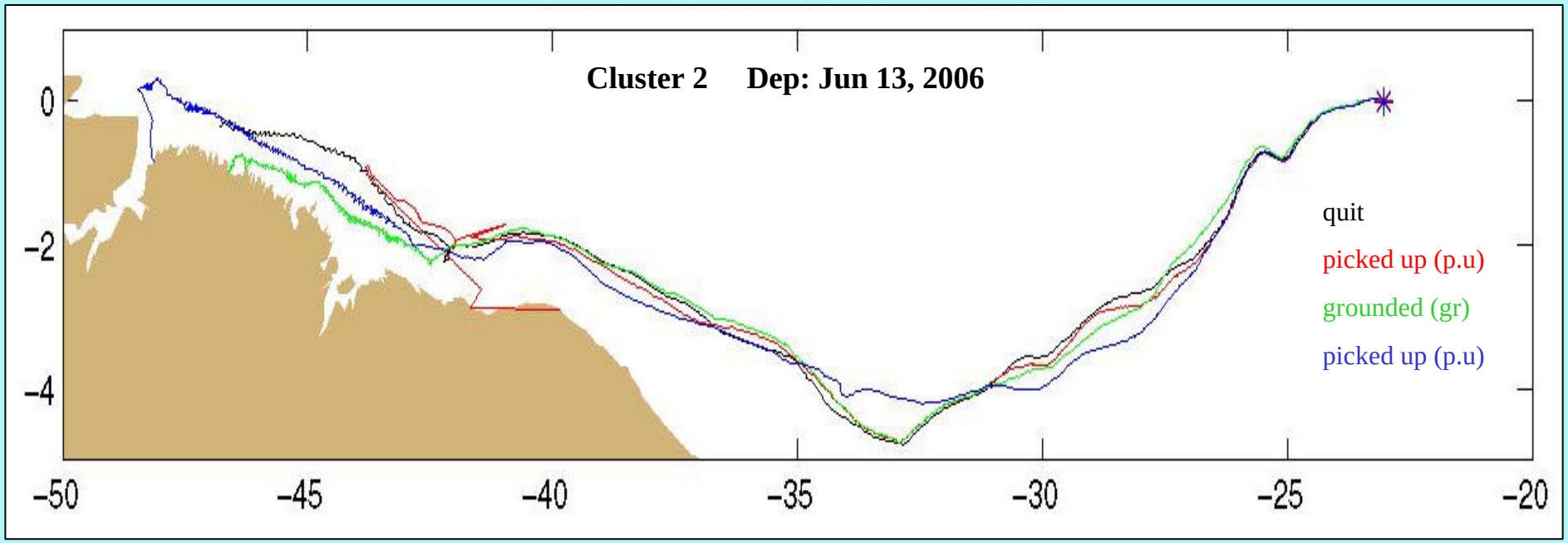


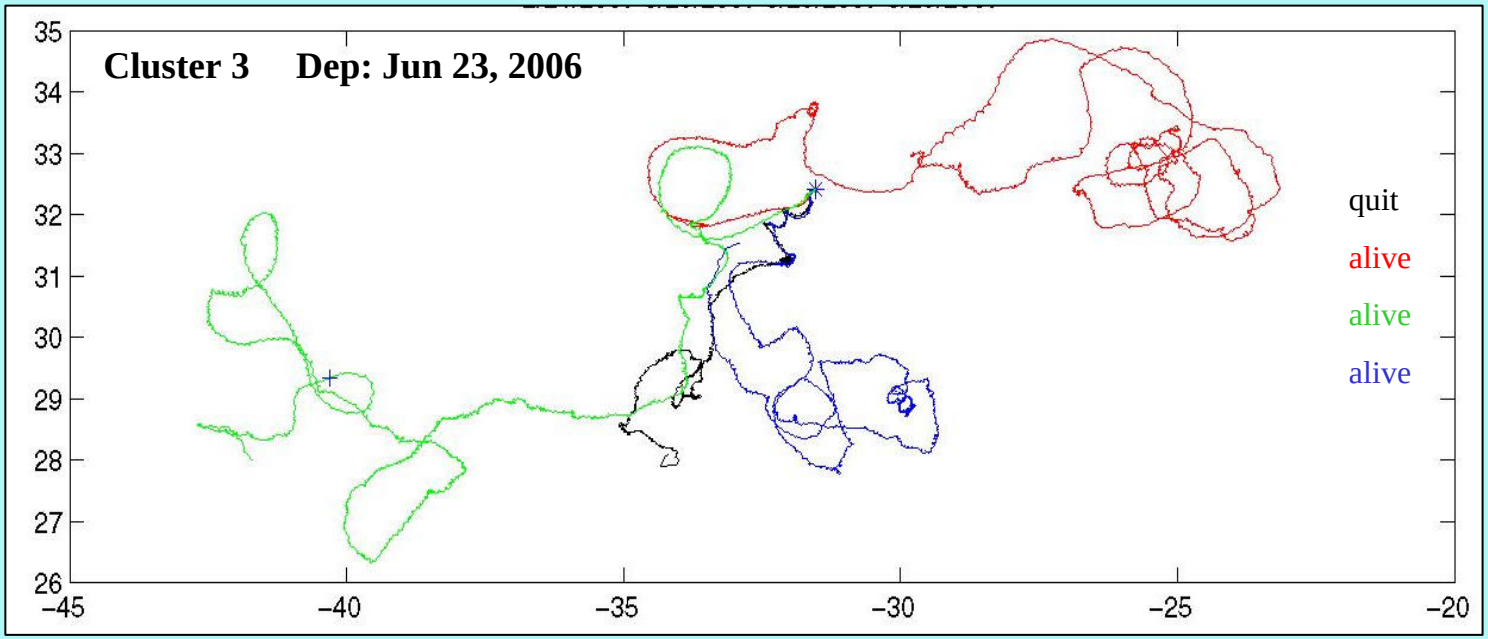
-- Clearwater

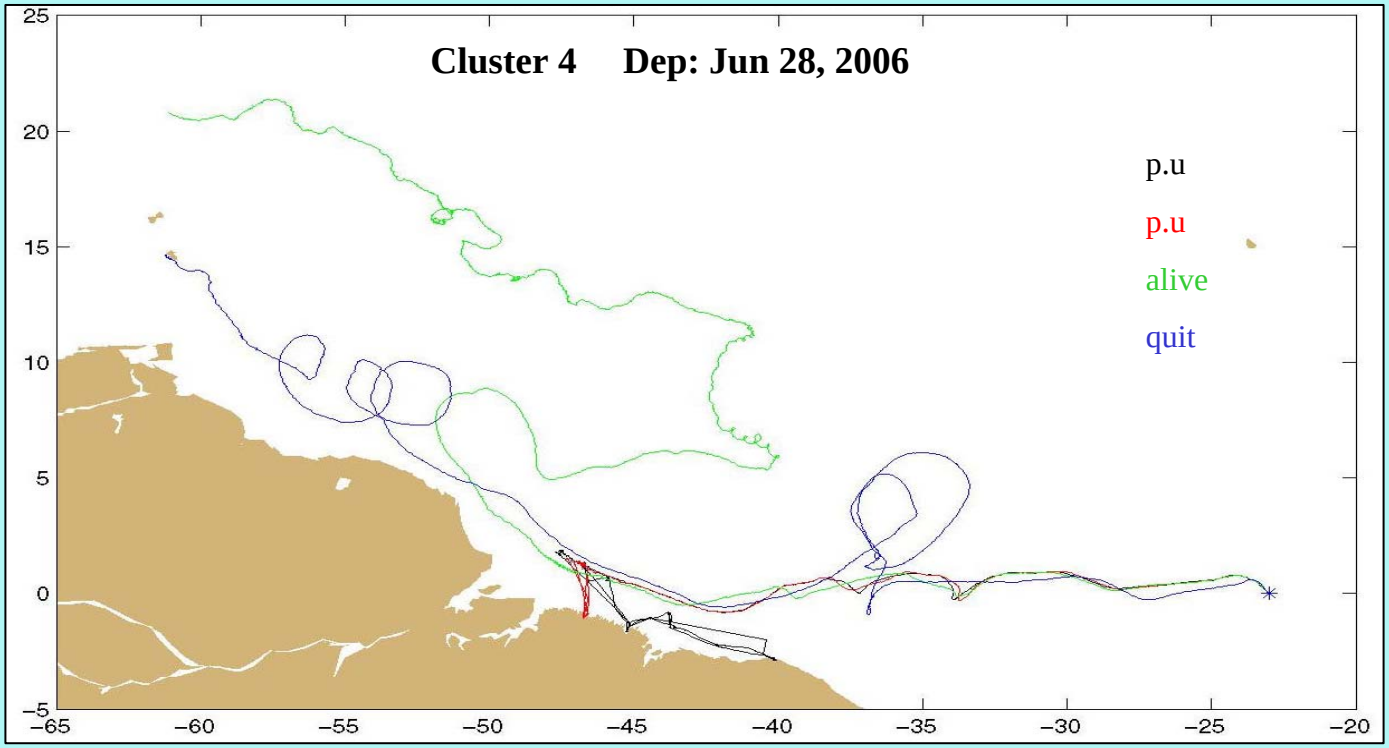
--Technocean

--Metocean

--Pacific Gyre







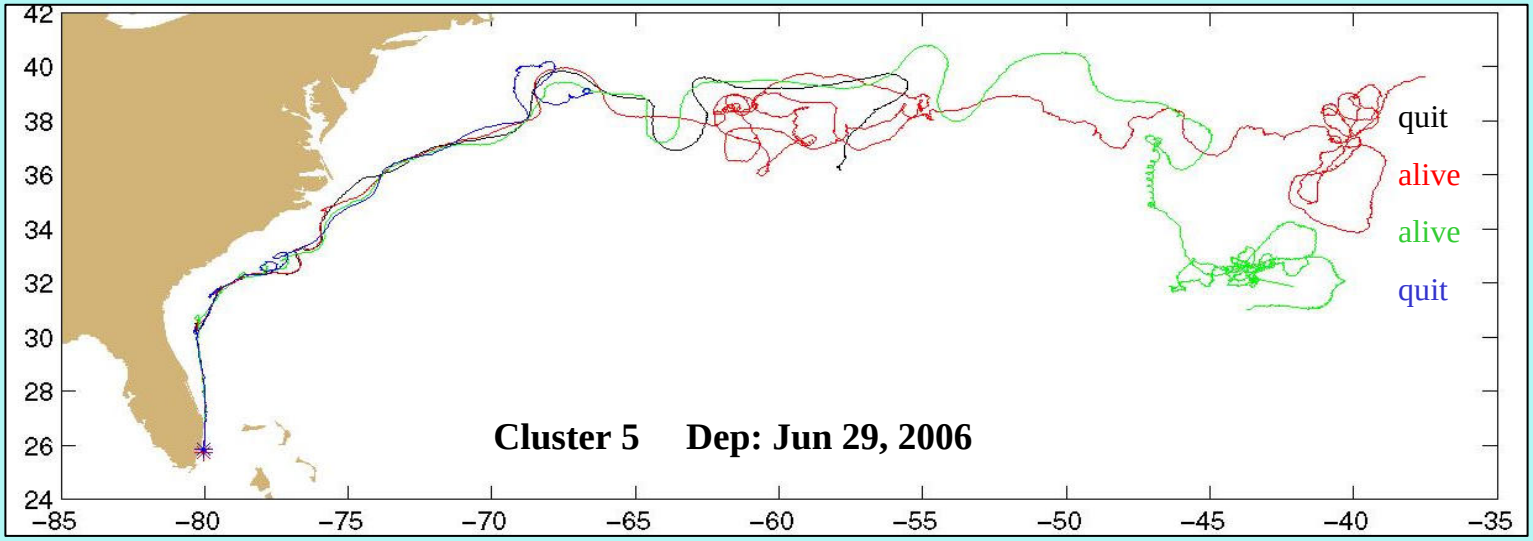
-- Clearwater

--Technocean

--Metocean

--Pacific Gyre

Deployment by Drifter group and Korean visitor from NFRDI

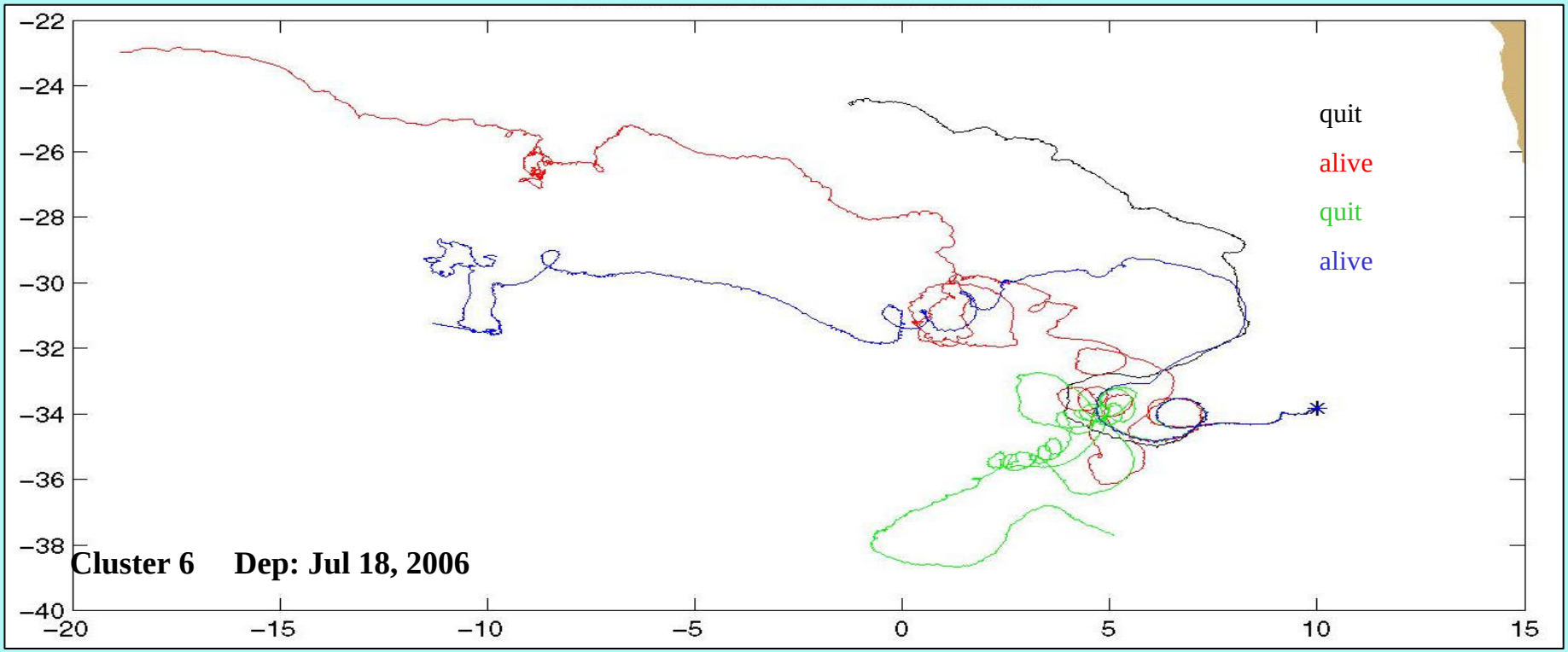


-- Clearwater

--Technocean

--Metocean

--Pacific Gyre

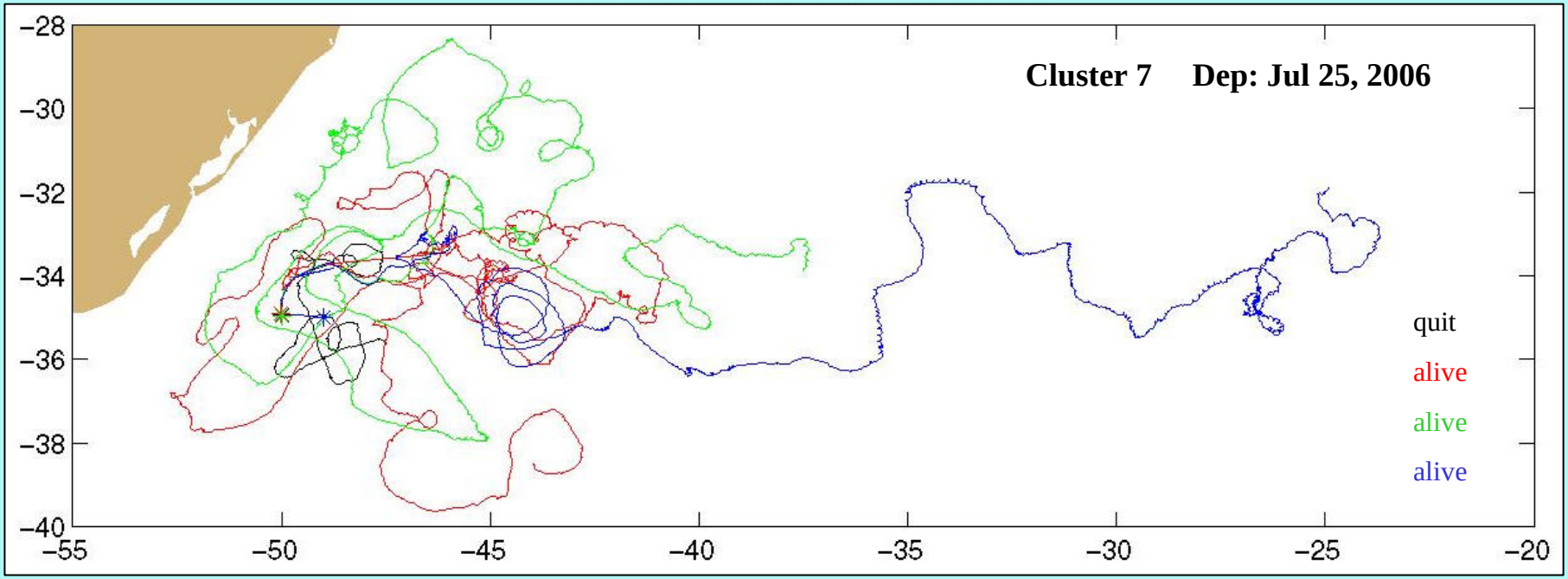


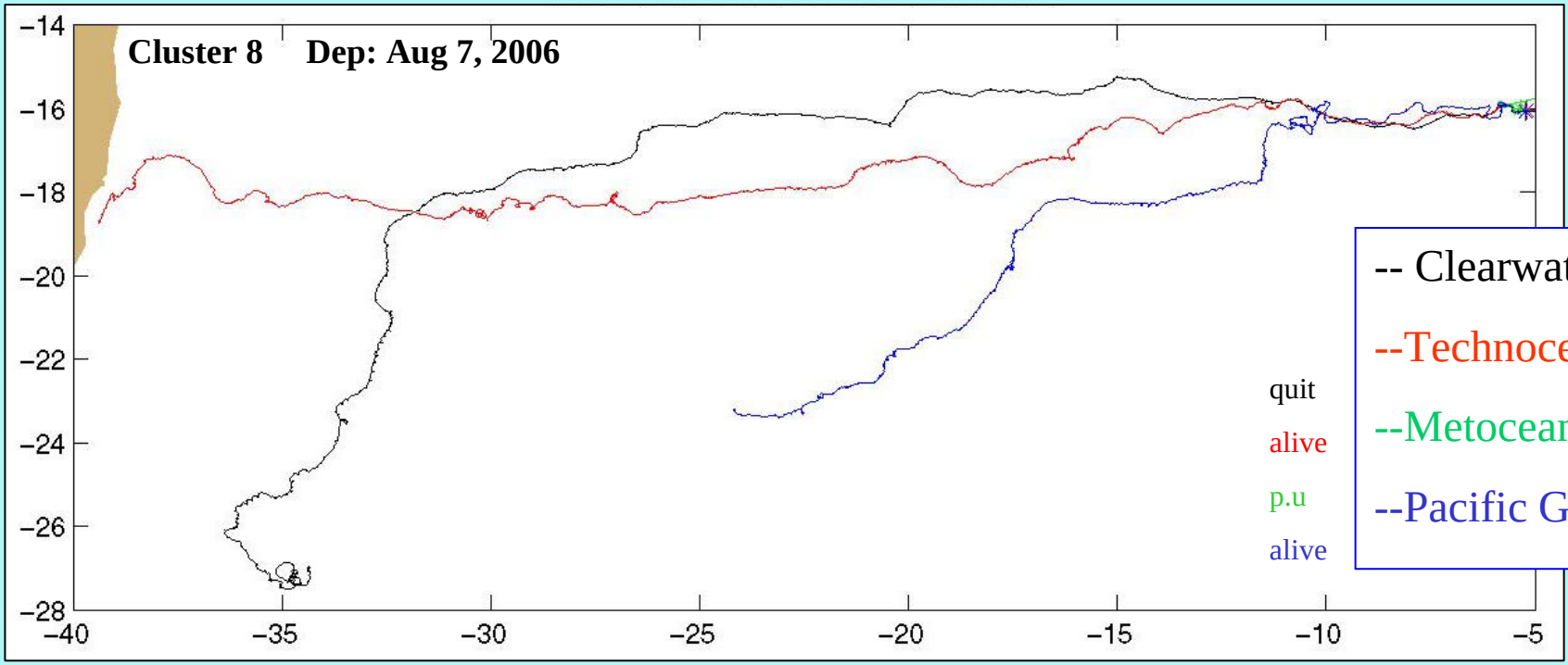
-- Clearwater

--Technocean

--Metocean

--Pacific Gyre





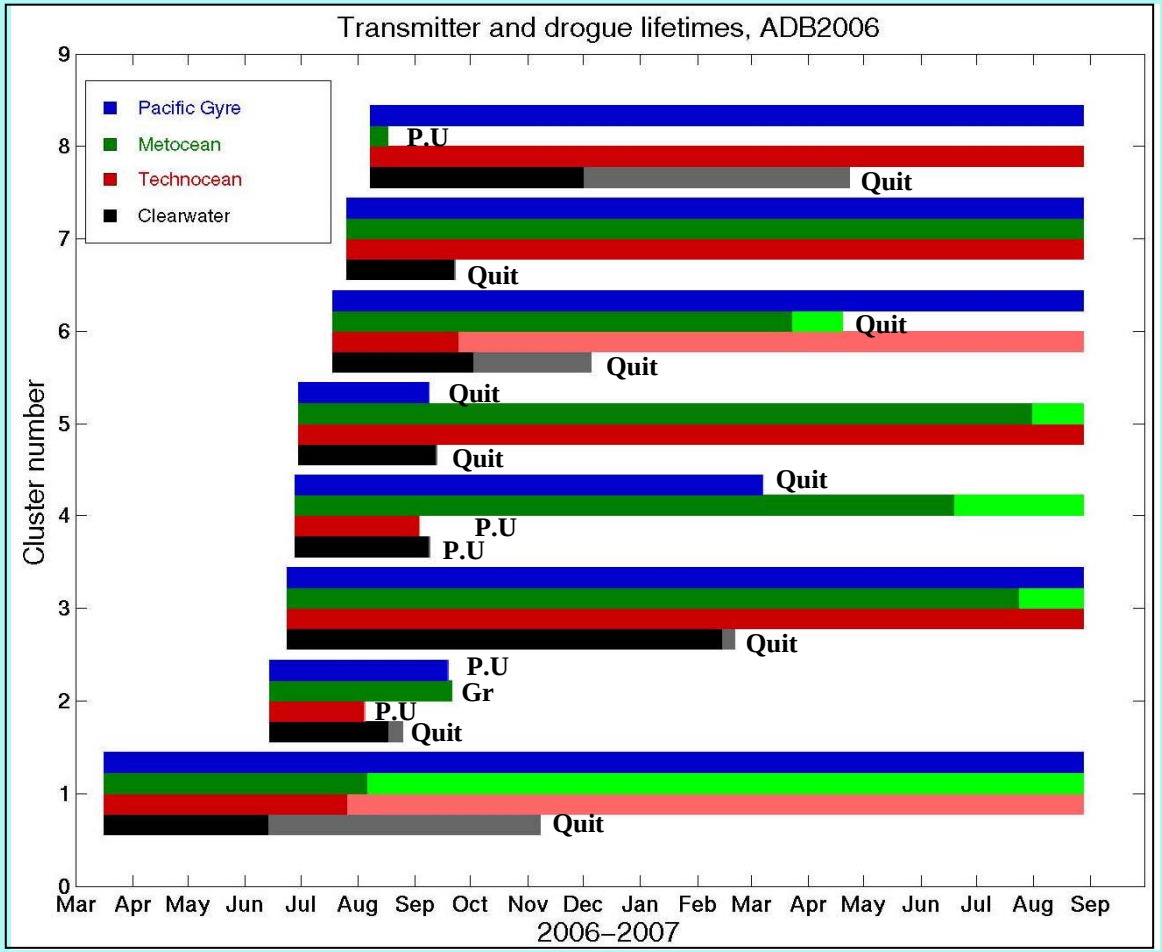
-- Clearwater

--Technocean

--Metocean

--Pacific Gyre

Facts about Transmitters' Life Times



Latest update: August 31, 2007

Lighter shades of colors indicate transmitters' life

Darker shades of colors indicate drogues' life

Technocean:

All buoys are still alive, except 2 that were picked up.

Metocean:

Only 1 transmitter quit after 276 days, 1 drifter was picked up and another one grounded.

Pacific Gyre:

Met expectations, with only 2 drifters that quit, and 1 that was picked up; the rest are still alive at more than 400 days.

Clearwater:

All transmitters quit at 59 to 260 days in water; 1 was picked up.

Summary Table of Transmitters' Life Times (days)

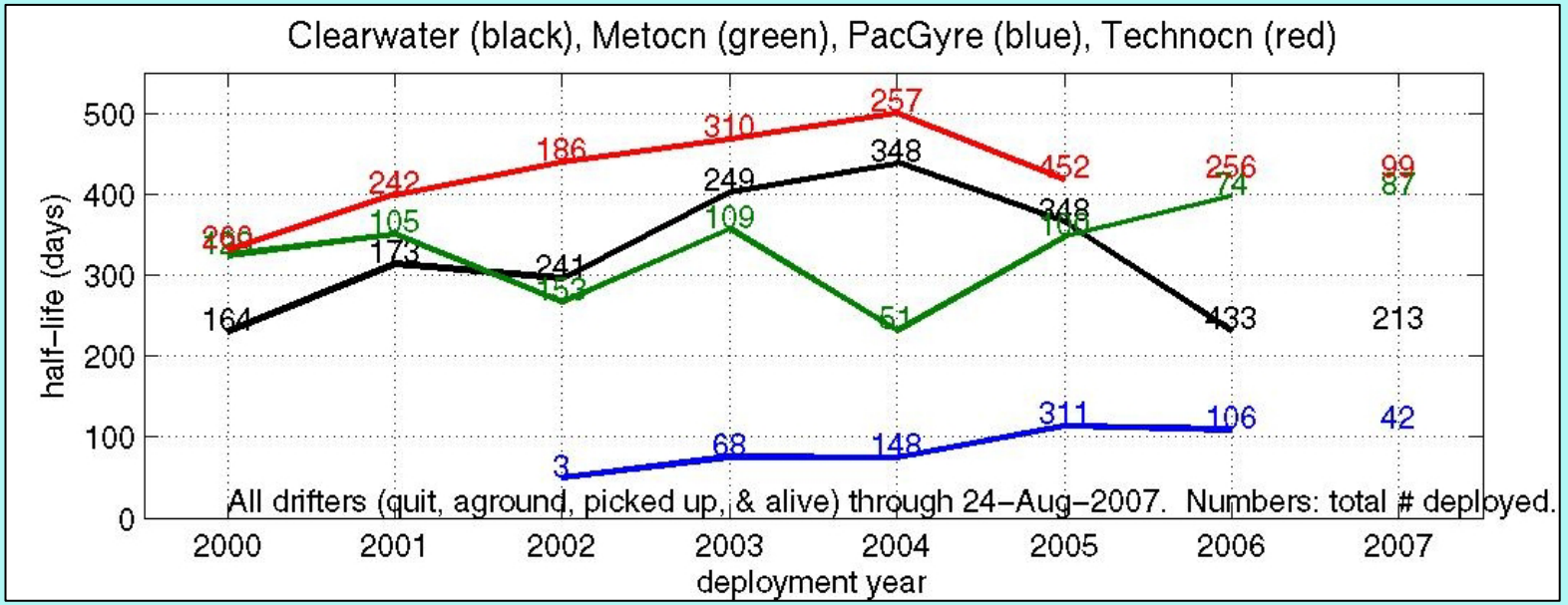
Clusters

Manufacturers	1	2	3	4	5	6	7	8
Clearwater	236 (Quit)	72 (Quit)	243 (Quit)	73 (P.U)	75 (Quit)	140 (Quit)	59 (Quit)	260 (Quit)
Technocean	*	51 (P.U)	*	68 (P.U)	*	*	*	*
Metocean	*	99 (Gr)	*	*	*	276 (Quit)	*	10 (P.U)
Pacific Gyre	*	96 (P.U)	*	253 (Quit)	70 (Quit)	*	*	*
Max possible	**531**	**442**	**432**	**427**	**426**	**407**	**400**	**387**

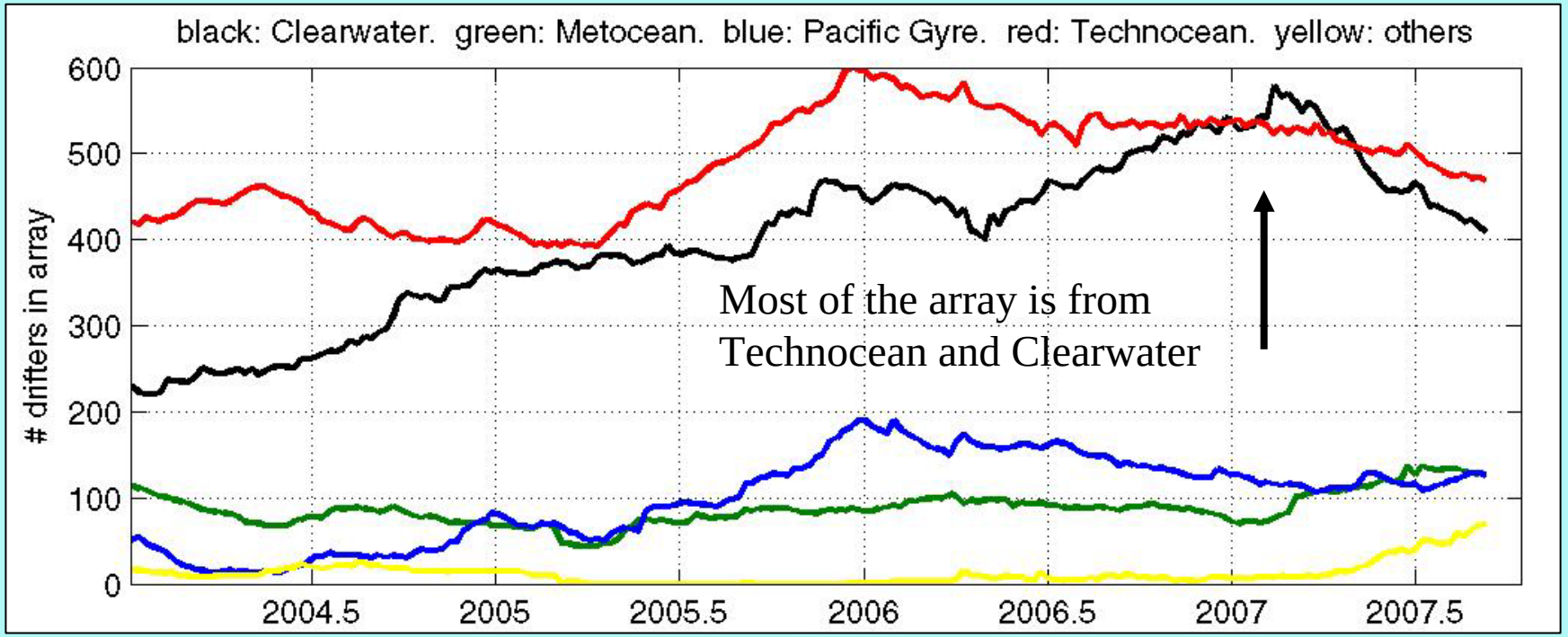
*** OK until last update, August 31, 2007**

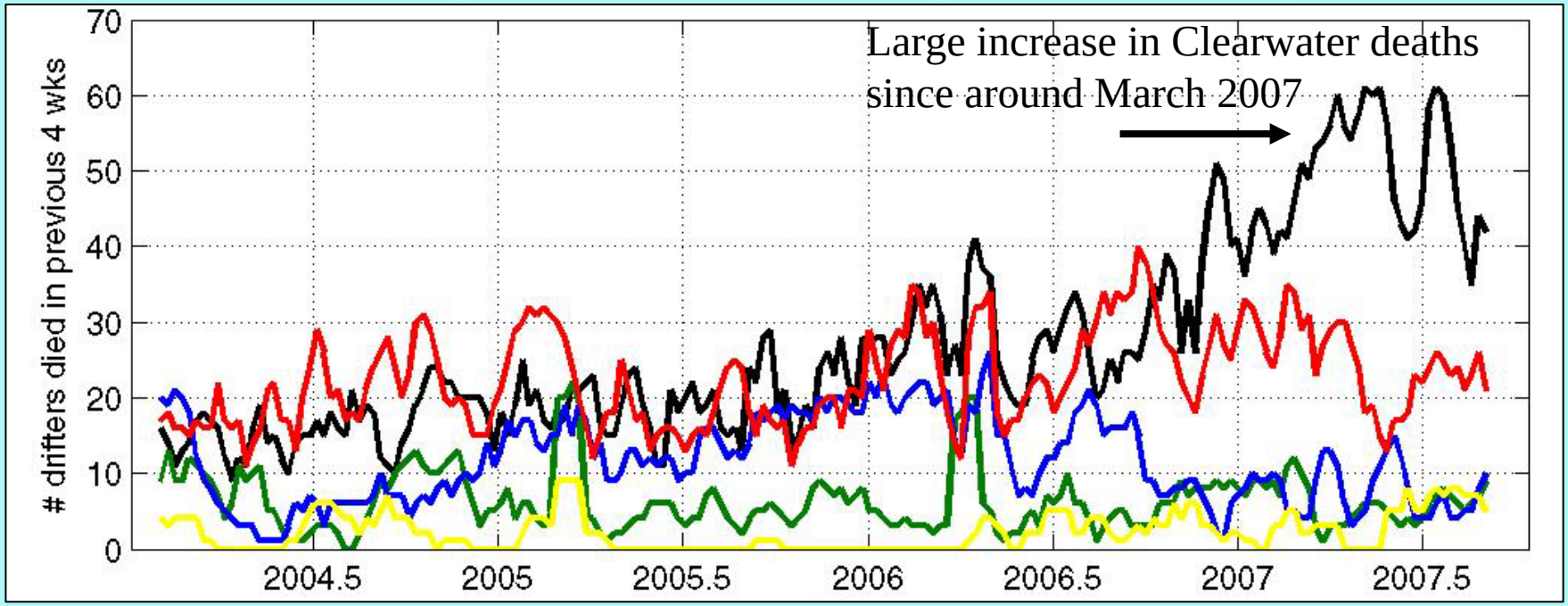
Looking at half-lives of all drifters deployed from 2000 to present

Half-life: Number of days after deployment until ½ of drifters are dead.
Median lifetime of a drifter should be **450 days**. Because some get picked up or run aground, a somewhat shorter half-life can be expected.
BUT: half-lives lower than 300 days are worrisome.



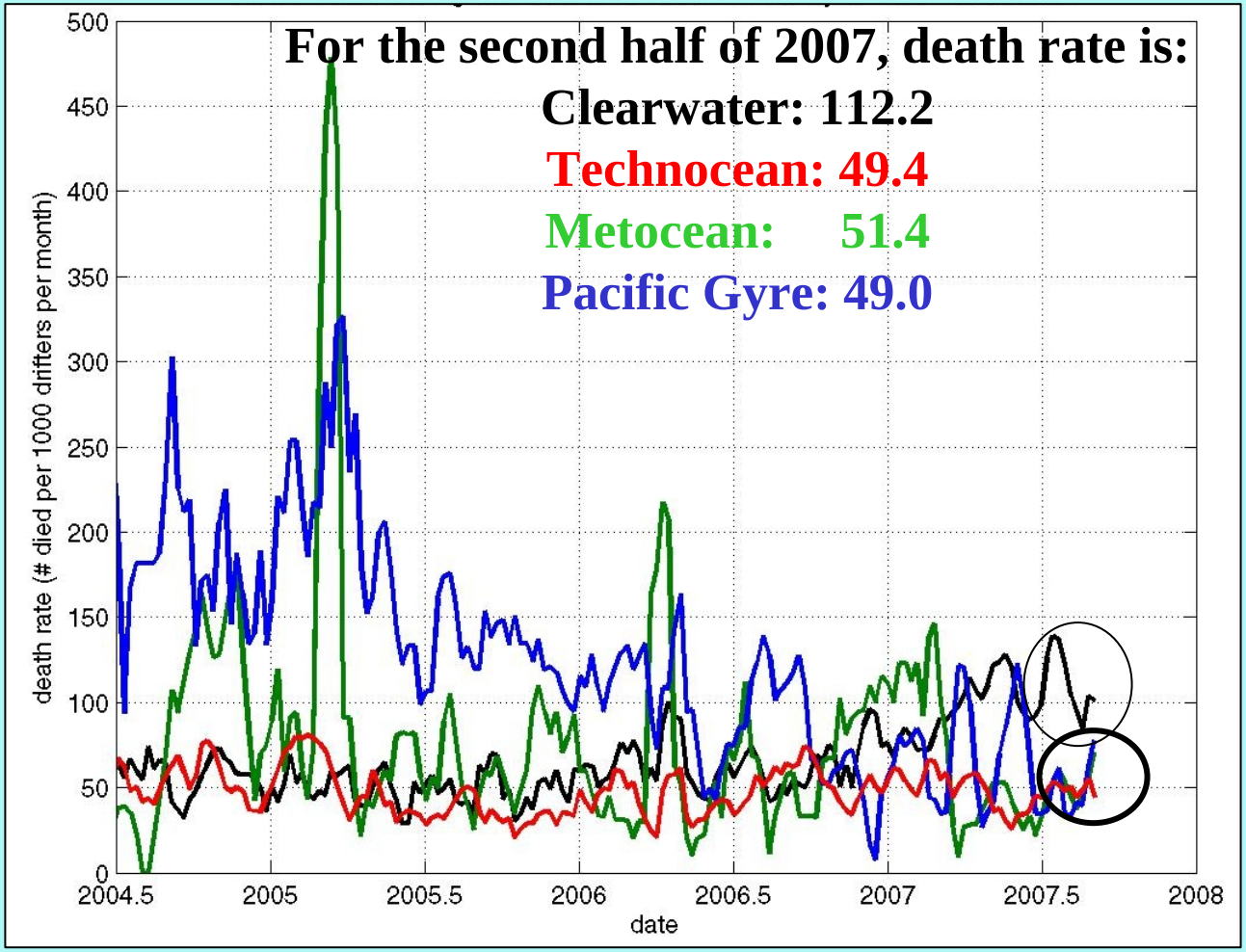
Clearwater: Half-life of Clearwater drifters decreased in 2006.
Technocean: There still isn't a calculable half-life in 2006, since more than half of them are still alive.
Metocean: Also looks good in 2006 with half-life of 400 days.
Pacific Gyre: Steadily increasing half-life.


black: Clearwater. green: Metocean. blue: Pacific Gyre. red: Technocean. yellow: others
drifters in array
600
500
400
300
200
100
0
2004.5
2005
2005.5
2006
2006.5
2007
2007.5
Most of the array is from
Technocean and Clearwater


drifters died in previous 4 wks
70
60
50
40
30
20
10
0
2004.5
2005
2005.5
2006
2006.5
2007
2007.5
Large increase in Clearwater deaths
since around March 2007

Another way of looking at drifter's death rate:

Number of drifters died
per 1000 drifters per month



Death rate for:
Technocean and
Metocean have stayed stable for a while now.

Pacific Gyre has been decreasing, from around 200 in 2004 to around 50 now.

Clearwater has grown from 50 in mid-2006 to over 100 now.

Keeping in mind that the Global Drifter Array must be maintained at 1250 drifters in the ocean

If the overall death rate is 50 drifters per 1000 drifters per month:

we would need to deploy 750 drifters per year to maintain the 1250 drifters

On the other hand, if the overall death rate is 100 drifters per 1000 drifters per month:

we would need to deploy 1500 drifters per year to keep 1250 drifters in the water.

BIG DIFFERENCE!!!!!

Drogue Performance

Facts:

Technocean, Metocean and Pacific Gyre use submergence sensors to indicate drogue presence.

Clearwater uses a strain gauge to indicate drogue on/off.

Tether Strain Gauge

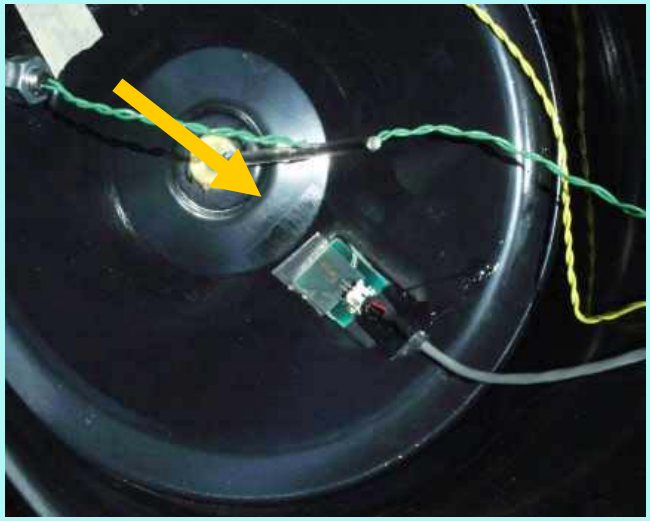
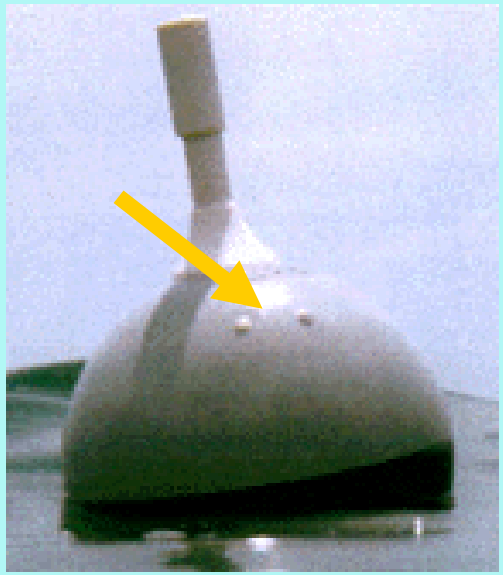


Figure courtesy *Clearwater Instrumentation*

The strain gauge is mounted near the tether attachment point at the bottom of the surface float.

The tugging of the drogue on the tether is transmitted to the surface float. This tugging is sufficient to produce very small fluctuations in the housing and strain gauge. Deformation of strain gauge are detected by sensitive circuitry of the controller.

Submergence Sensor

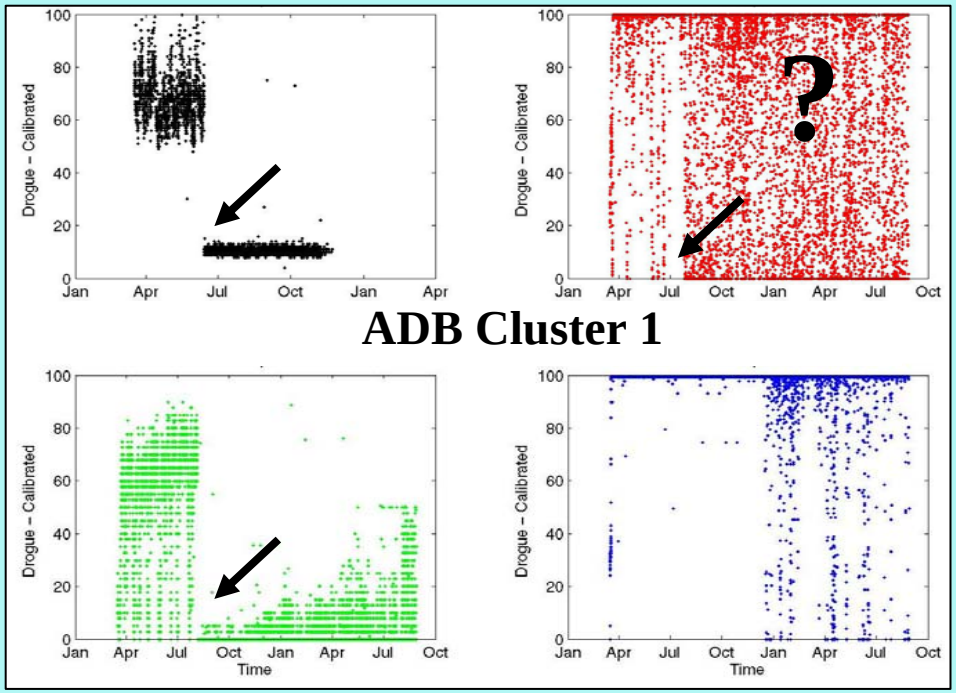


The submergence sensor is sampled 4 times every 90 seconds. The total number of times these sensors are underwater is summed over the 30-minute sampling period to determine the percentage of time the surface unit is submerged.

In 2006, Technocean:

- **Reverted to wired rope radial design and modified the original wagon wheel design to extend drogue life.**
- **Adjusted the submergence sensitivity to help determine drogue lost date with more accuracy.**

Determining drogue off date



ADB Cluster 1

Strain Gauge

Determining when drogue is lost in drifters that use strain gauge method is easier and more precise (Clearwater).

Submergence

In the case of submergence sensor, we must look for sudden drops to zero or much lower values to recognize drogue lost. In case there are values at the maximum and minimum , then we must pick the one with the most occurrences.

In the case of Technocean drifters, even with the reduced sensitivity, it is still a challenge to determine drogue lost.

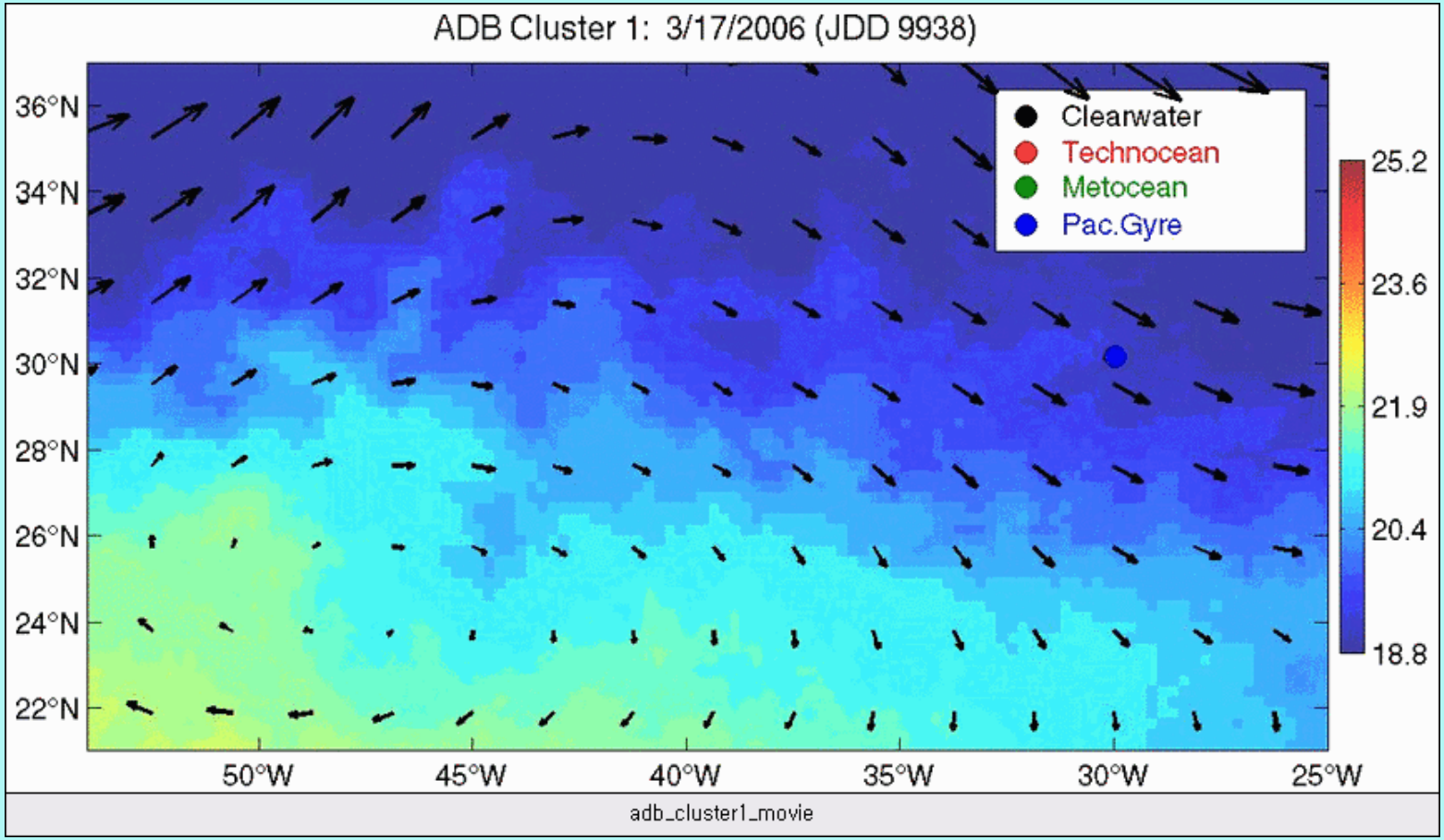
In this example, we compared the Technocean drifter with the others in the cluster and looked at wind speed and direction to determine drogue off date, but this method is not developed to be used in regular operations.

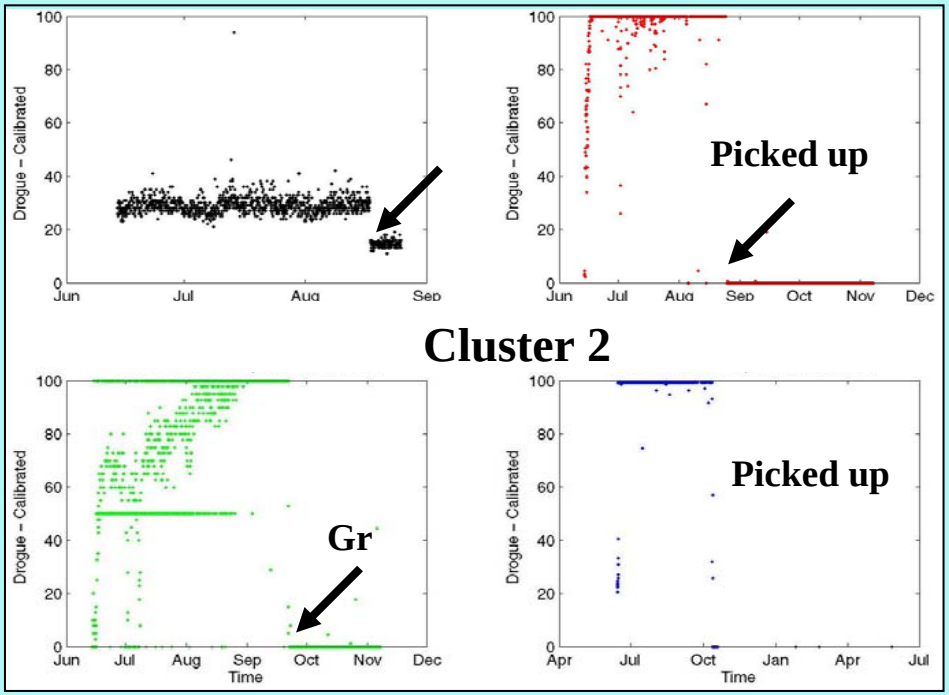
-- Clearwater

--Technocean

--Metocean

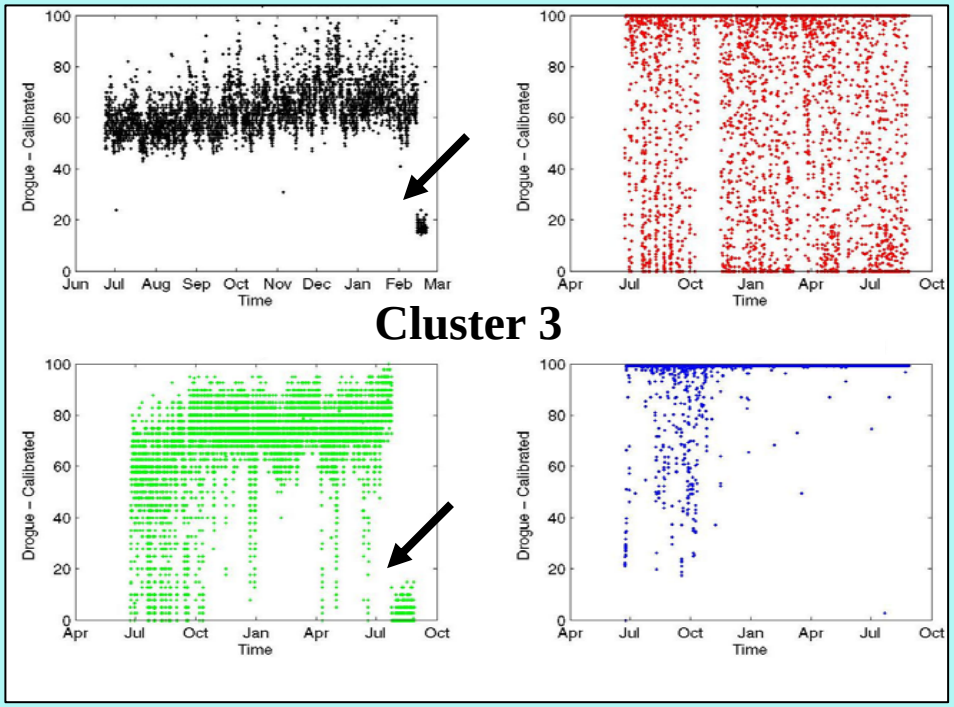
--Pacific Gyre

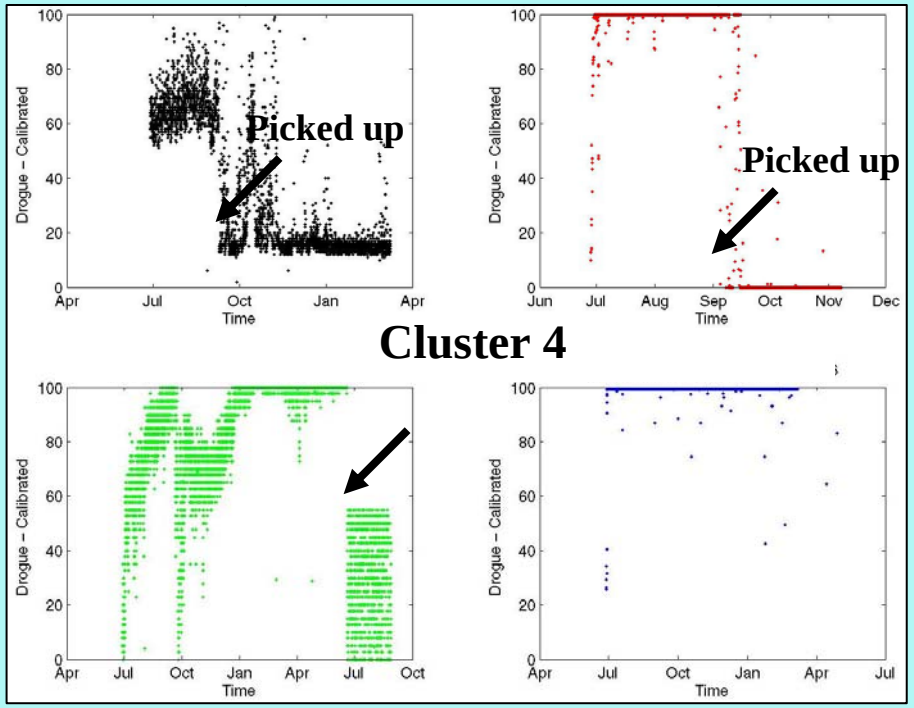

ADB Cluster 1: 3/17/2006 (JDD 9938)
36°N
34°N
32°N
30°N
28°N
26°N
24°N
22°N
50°W
45°W
40°W
35°W
30°W
25°W
Clearwater
Technocean
Metocean
Pac.Gyre
25.2
23.6
21.9
20.4
18.8
adb_cluster1_movie

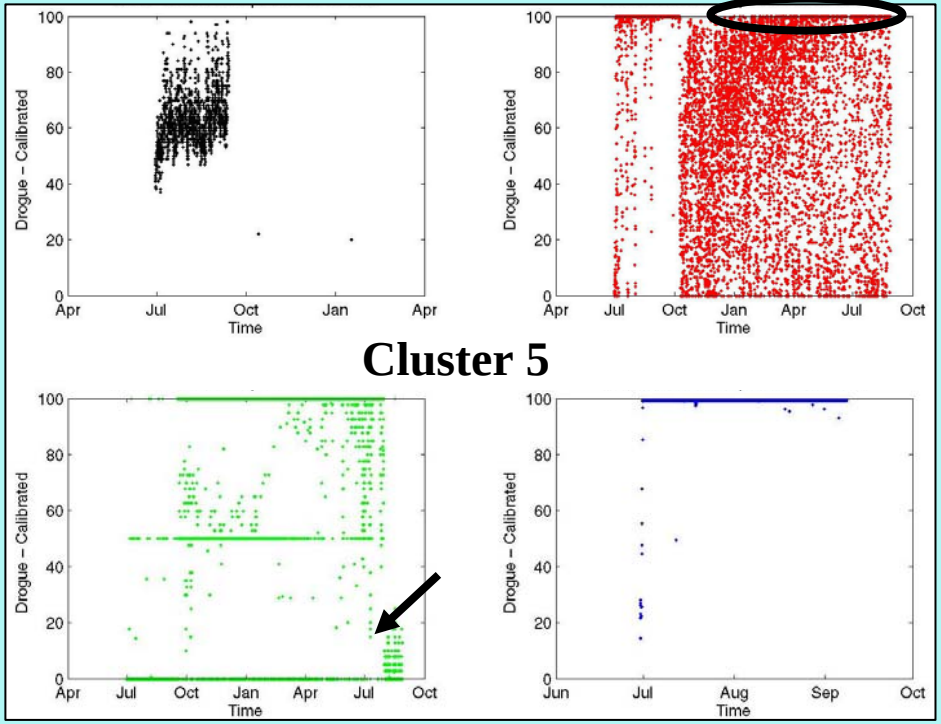


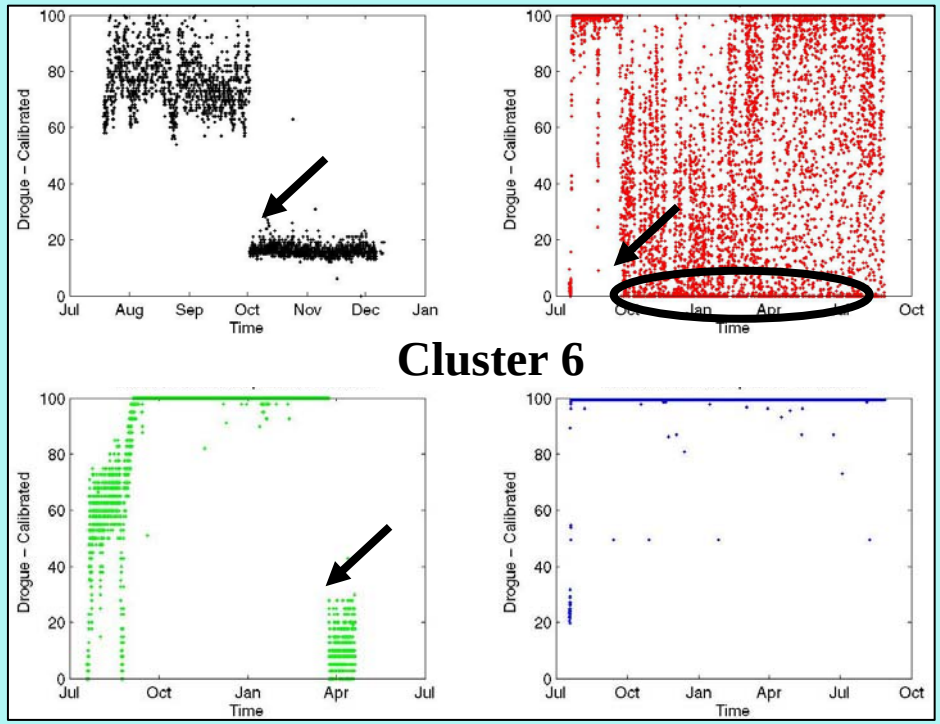
When drifters are picked up or grounded, the submergence drops to zero values.

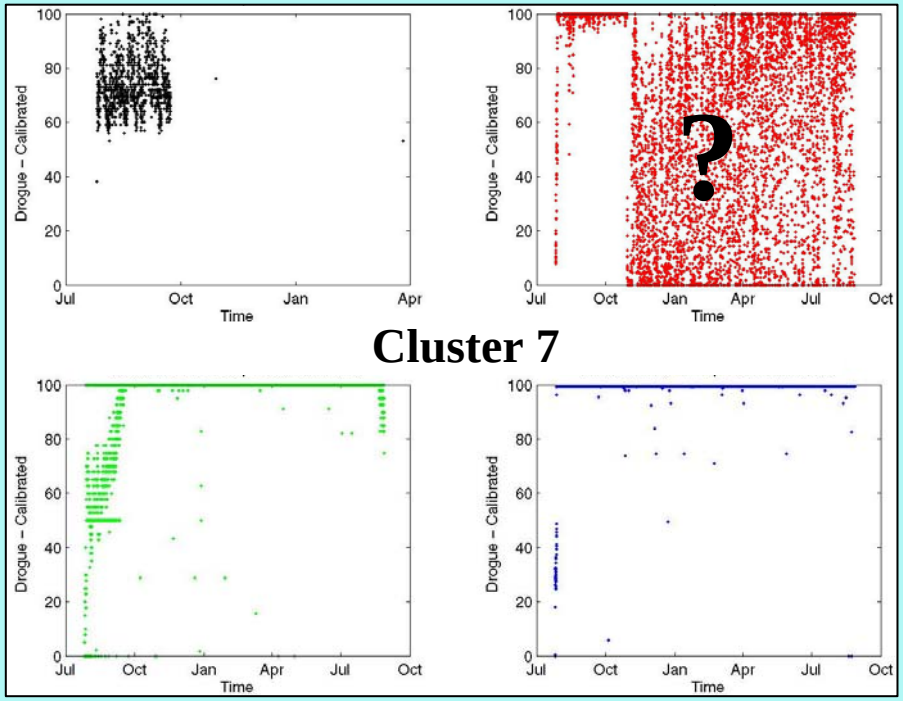
In the case of strain gauge, values drop and stay at a tight range.

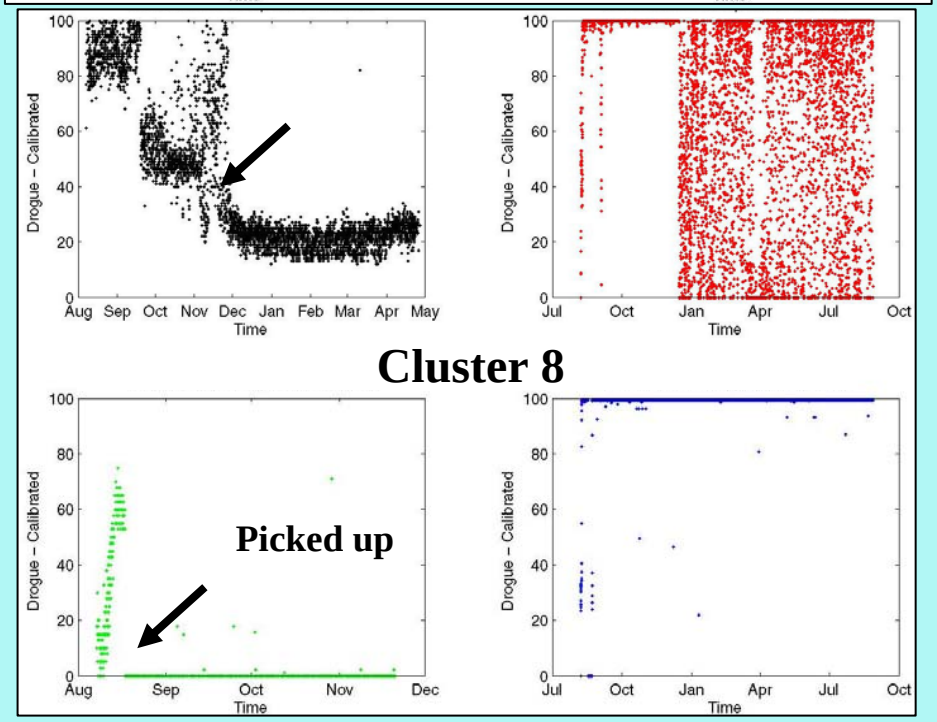


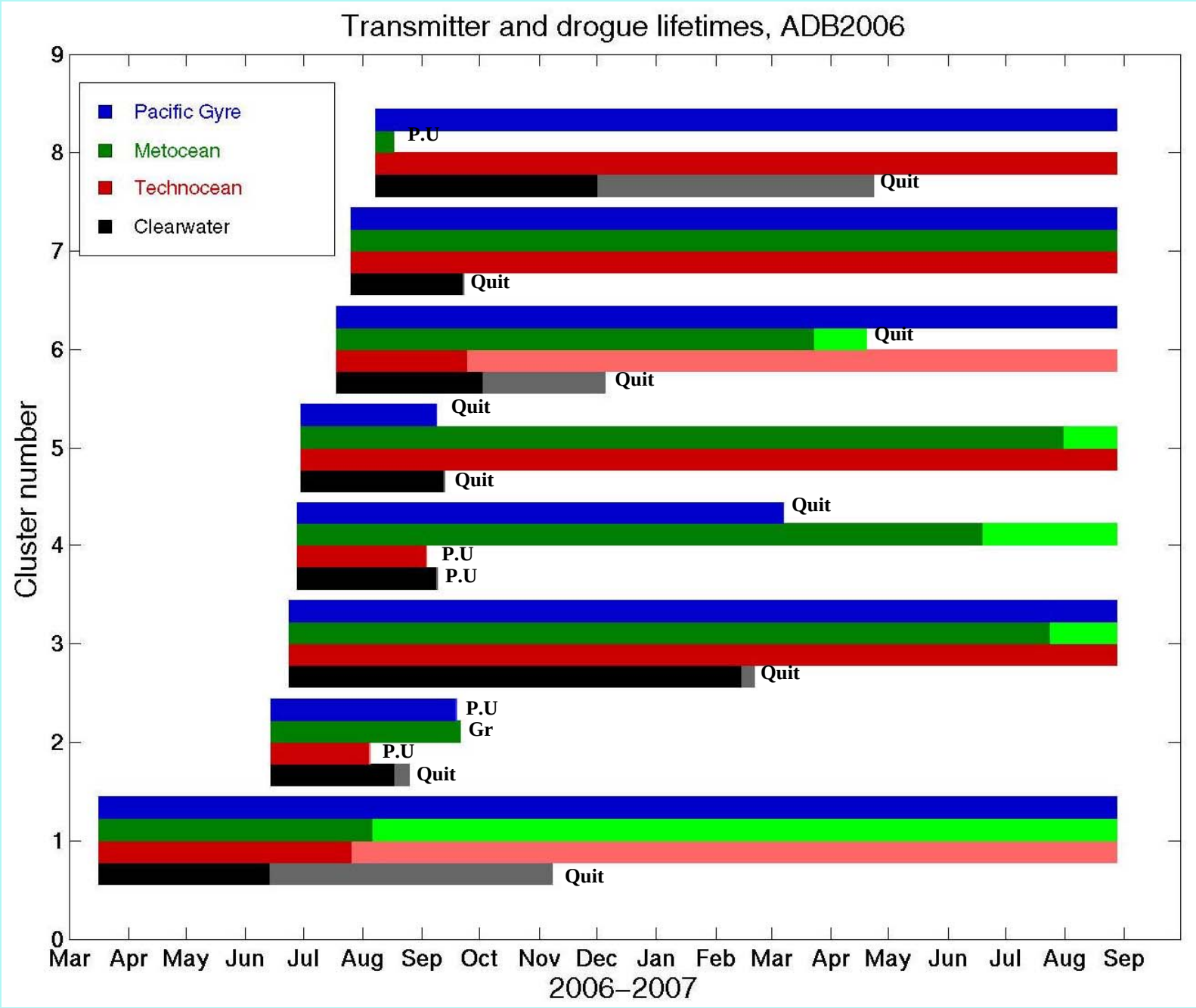



Drogue – Calibrated
Time
Cluster 5


Drogue – Calibrated
Time
Cluster 6


Drogue – Calibrated
Time
?
Cluster 7


Drogue – Calibrated
Time
Picked up
Cluster 8



Last update: August 31, 2007

Summary Table of Drogues' Life Times (days)

Clusters

Manufacturers	1	2	3	4	5	6	7	8
Clearwater	88	64	236	73* (P.U)	75* (Quit)	76	59* (Quit)	116
Technocean	133	51* (P.U)	*	68* (P.U)	*	68	*	*
Metocean	142	99* (Gr)	396	357	397	248	*	10* (P.U)
Pacific Gyre	*	96* (P.U)	*	253* (Quit)	70* (Quit)	*	*	*
Max Possible	**531**	**442**	**432**	**427**	**426**	**407**	**400**	**387**

*** OK until it died or last update, August 31, 2007**

Goal: 300 days lifetime for drogues

•Drogue life of Clearwater drifters in this study did not perform well. Five of the 8 drifters lost their drogues prior to transmitter failure. The resulting half life for the drogues is only 116 days.

•Metocean drifter drogues' half life is 357 days.

•No Pacific Gyre drifters lost their drogues in the ADB06 study. Excellent … or could there be a problem with the submergence sensor? We looked at submergence records of *all* Pacific Gyre drifters deployed in 2005 and 2006.

We found:

2005:

311 Pac Gyre drifters were deployed

71 lost their drogues before transmitter quit (24%)

2006:

105 Pacific Gyre drifters were deployed

8 lost their drogues before transmitter quit (8%)

•These numbers are very low compared to other manufacturers. We are concerned that submergence may not be indicating drogue loss (unless drogue life is exceptional for Pacific Gyre compared to other manufacturers).

Summary

•Clearwater drifters from this batch have shorter lifetimes than expected and shorter than previous years performances, half-life is only 140 days in ADB06. Clearwater has determined that the problem lies with the batteries, either due to a manufacturer (Eveready) problem, or due to extended pre-deployment storage, particularly in a hot, humid environment. While storage may be a factor for a particular batch of drifters, we do not believe that this can account for the overall recent reduced lifetimes of Clearwater drifters. Clearwater is looking actively to diagnose and solve this problem.

•It is imperative that manufacturers include strain gauge for accurate determination of drogue presence. This was recommended at last year's DBCP meeting and Reading workshop. This will help the DAC in writing software to detect drogue loss, independent of manufacturer.

•All SSTs are consistent with each other.

•There were no transmissions problems found.

Plans for 2008

2008 Buoy Comparison Study

- SVP drifters from the 4 manufacturers used in this study will be selected at random and tested according to GDP standards.
- Buoy deployments will be made in oceans throughout the world.
- Various participants will handle and deploy buoys from each manufacturer.

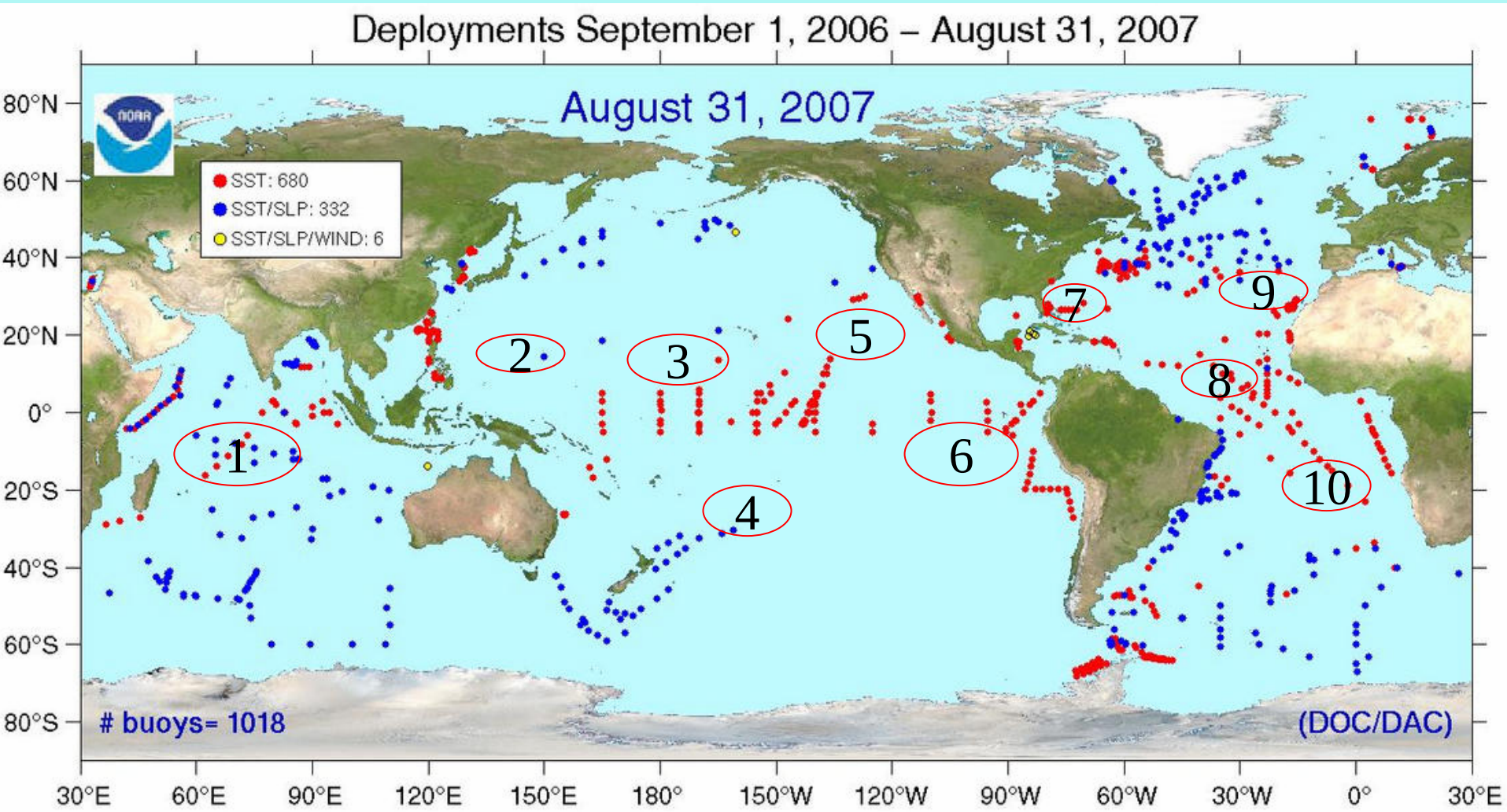
What Will Be Examined?

During the 2008 Buoy Comparison Study, the Drifter Operation Center and the Data Assembly Center will carefully analyze different aspects of the buoy life cycle. These aspects include (but are not limited to) packaging, shipping, drogue detection, signal strength, SST accuracy and buoy longevity.

Deployment Strategies

- Locations in accordance with Global Array and local needs
- Aboard ships capable of deploying 4 buoys at the same time
- Between 40˚N and 40˚S
- Variant temperatures and sea conditions
- Maximum drift time (i.e. limited shipping time and fast deployment ability)

2008 Buoy Comparison Study Deployment Locations

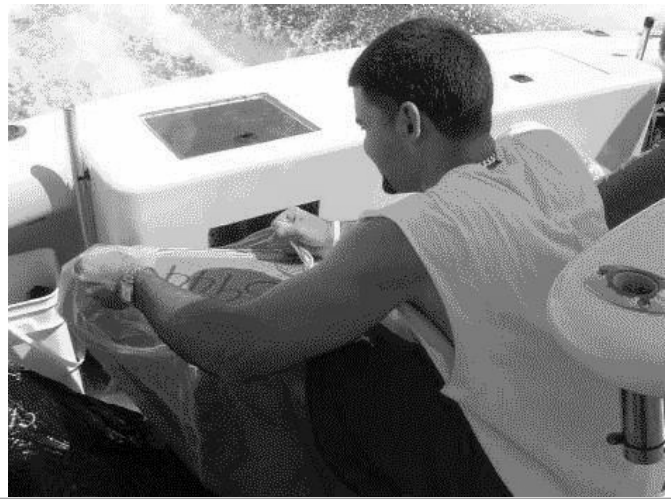


Current Concerns

1. Deployment Instructions need to be included with every buoy
2. Variation in packaging (with regard to colored safety tape and colored instructions)
3. Pull-Pin activation magnet used by one manufacturer

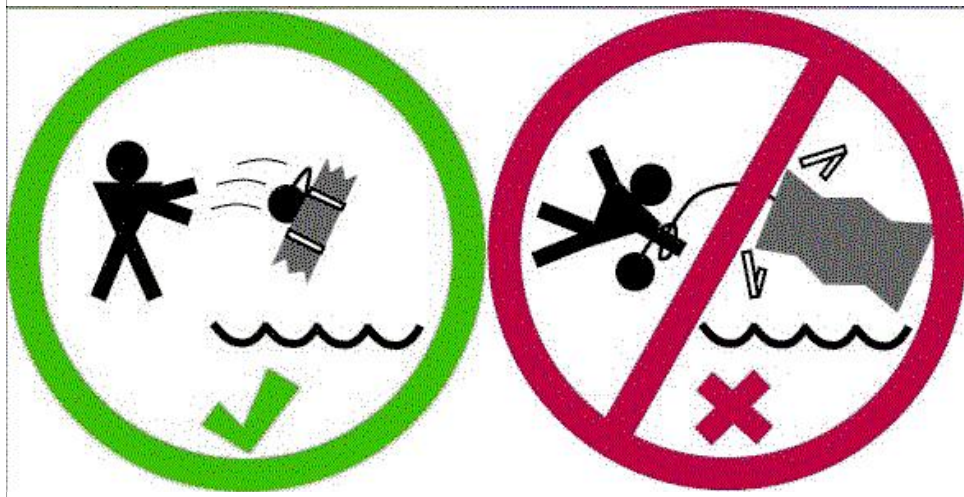
DEPLOYMENT INSTRUCTIONS

1. Remove plastic wrap



2 **<u>DO NOT REMOVE</u> paper tape or cardboard, <u>ONLY</u> remove plastic wrap.**

3. Throw buoy in water.



SVP AND SVP-BAROMETER DRIFTERS

1) Remove the buoys from the shipping container. **REMOVE ONLY** the plastic shrink-wrap.
2) **DO NOT REMOVE** paper tape securing the drogue and tether. **DO NOT REMOVE** cardboard surrounding the float.

***DANGER*: DO NOT REMOVE** the paper tape securing the tether and drogue. If you do, the drogue and/or tether can unfurl during deployment and cause injury!!!

3) Record the five digit ID number of the drifter. This number can be found on the shipping container, the plastic shrink-wrap or the protective cardboard box. It is also inscribed on the surface float.

4) If testing the buoy is desired prior to deployment, the magnet can be removed from the buoy by separating it from the float through a hole in the box surrounding the float. This action will start the ARGOS transmitter for testing. Re-attaching the magnet in the same position will turn off the transmitter and reset the program starting point. The transmitter will restart on its original program when the magnet is again removed.

5) Throw the buoy from the stern, lowest possible deck (preferably less than 10 meters including heave), into the sea. The ship may be traveling between 2 - 25 knots. The tether and drogue are secured with paper tape that will dissolve in the water.

6) Record the date, time (GMT) and location of deployment as well as the five digit ID, and send this information to the Global Drifter Program.

Thank you very much for your help!

CONTACT PERSON:

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E-mail: Shaun.Dolk@noaa.gov

Web site: http://www.aoml.noaa.gov/phod/dac/dep_form.html.

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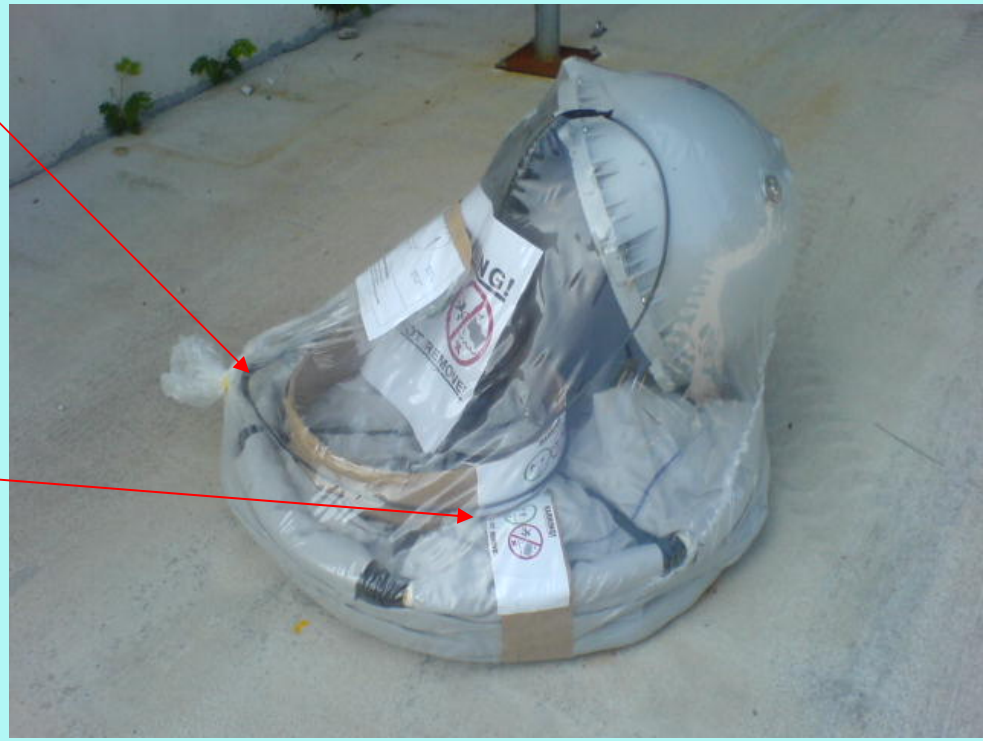
2. Packaging Consistency

- All buoys need to be wrapped with clear plastic.
- All buoys need colored, water-soluble tape to secure drogue and tether.



3. Pull-Pin Activation Magnet

- Metocean uses a pull-pin magnet to activate its buoys.
- Without removal of the magnet, the buoy remains “off”.
- Pull-pin magnet causes confusion among deployment personnel.

SVP Drift Buoy Specs.

	Clearwater	Metocean	Pacific Gyre	Technocean Inc.
Surface Float (diameter)	30.5 cm	38.0 cm	30.48 cm	38.0 cm
Drogue Segments	4	5	4	5
Drogue Segment Length	122 cm	130 cm	122 cm	122 cm
Drogue Design	Wire Rope Radials	Wire Rope Radials	Wire Rope Radials	Wagon Wheel
Drag Area Above Drogue	1,042	1,350.10	942	1,234
Drag Area of Drogue	42,672	54,776	41,664	52,139
Drag Area Ratio	40.95 : 1	40.57 : 1	44.23 : 1	42.25 : 1
Drogue Detection	Tether Strain	Submergence	Submergence	Submergence

THANK YOU!