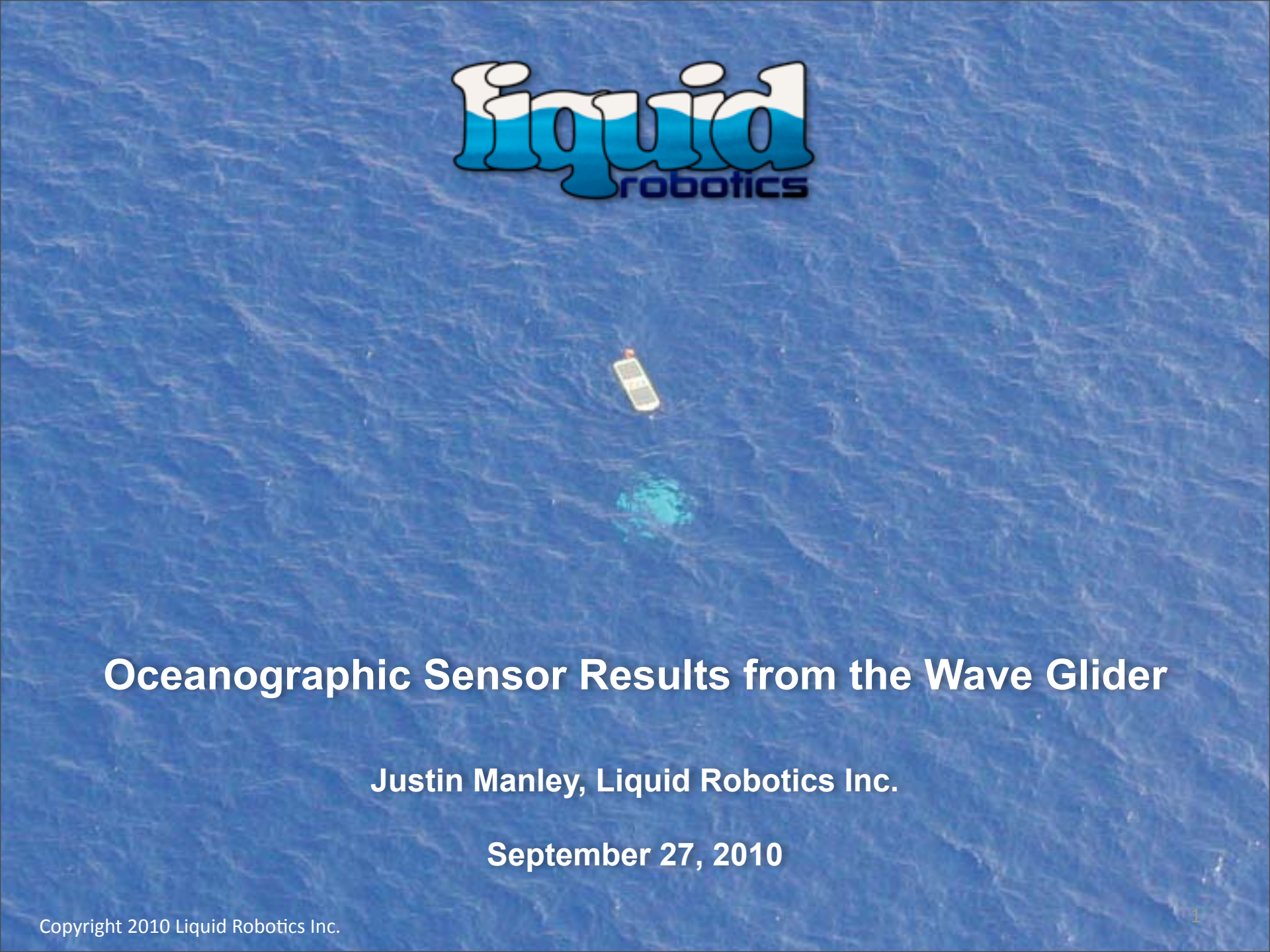

Oceanographic Sensor Results from the Wave Glider

Justin Manley, Liquid Robotics Inc.

September 27, 2010

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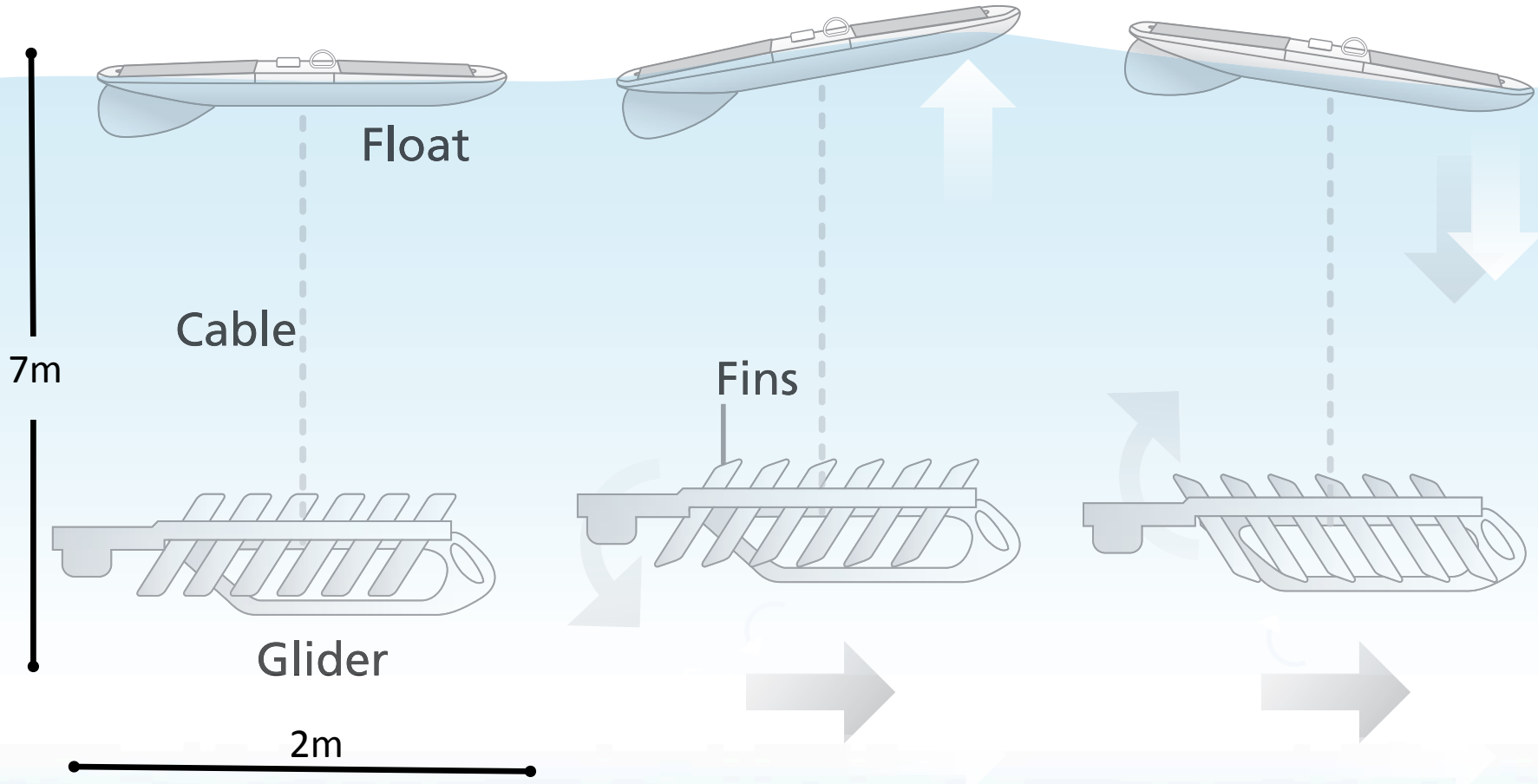
Wave Glider Concept
Submerged glider converts vertical motion into forward thrust



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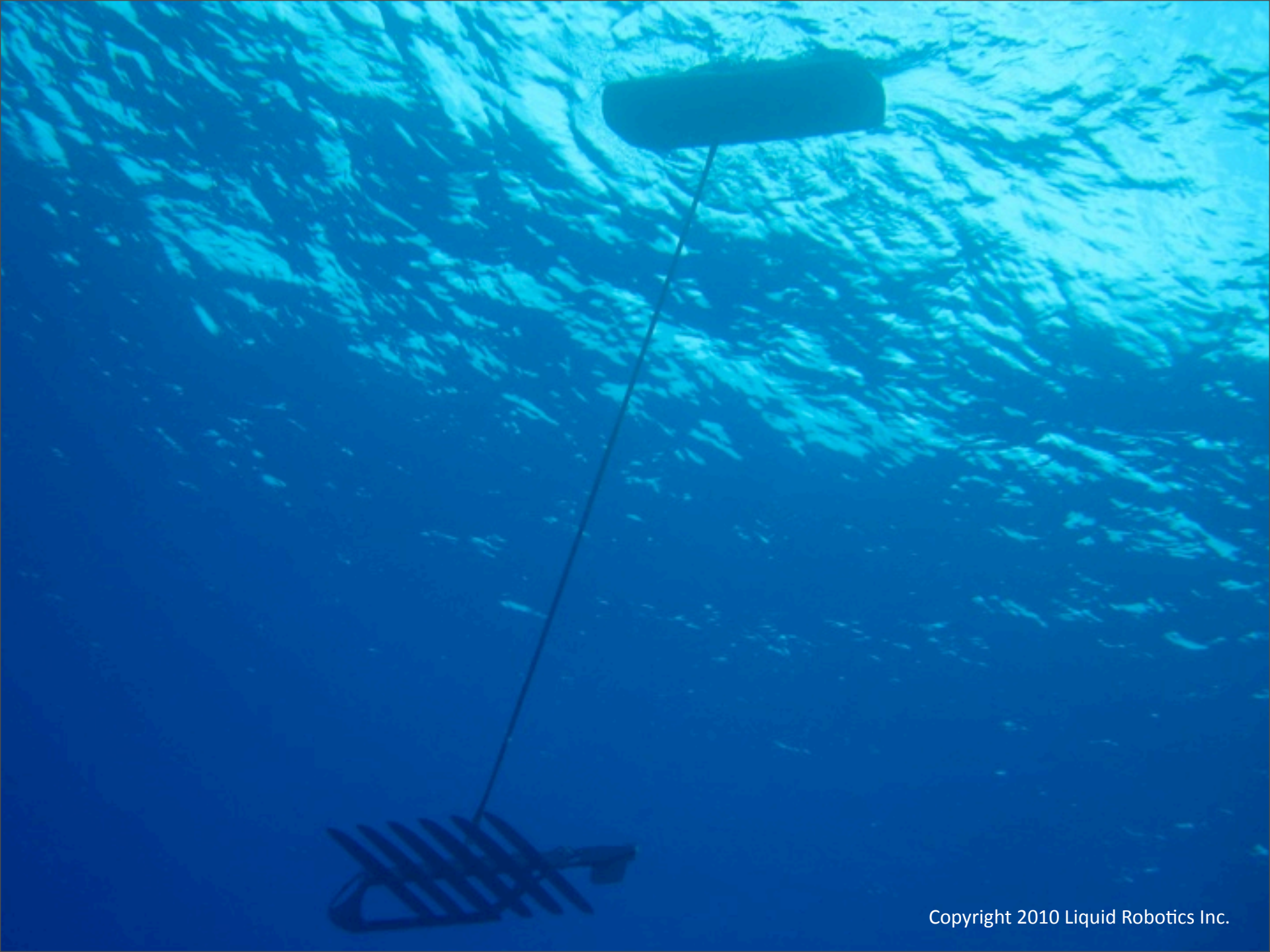

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Wave Glider Speed Performance

Propulsion Speed Performance	
Flat Calm	0 kts
Sea State 0	0.25 to 0.50 kts
Sea State 1	0.50 to 1.50 kts
Sea State 2	1.25 to 2.00 kts
Sea State 3+	1.50 to 2.25 kts
Average	1.50 kts

Under typical sea conditions, Wave Glider advances at 1.5 kts, independent of wave direction.

Wave Glider maintains 0.25 to 0.50 kt headway, even under very calm conditions.

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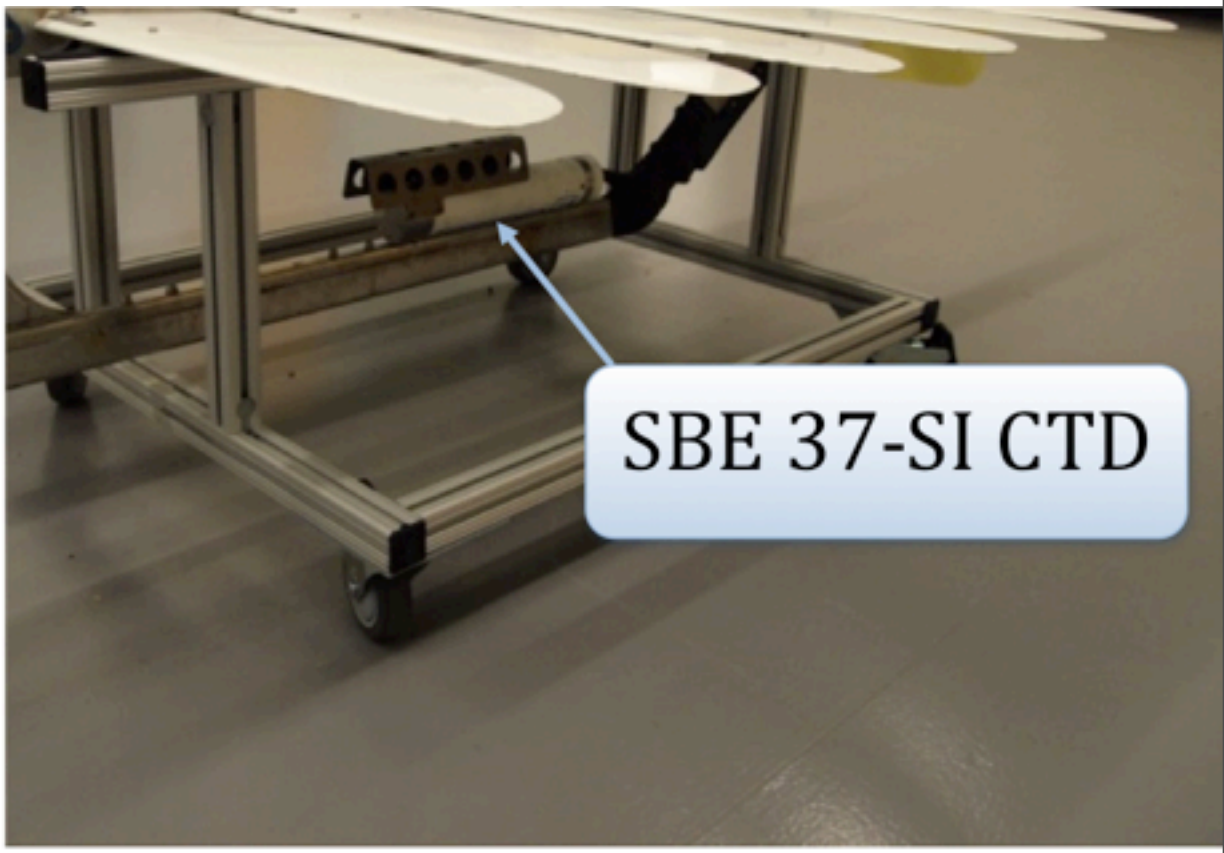
Red Flash CTD (April 2010)



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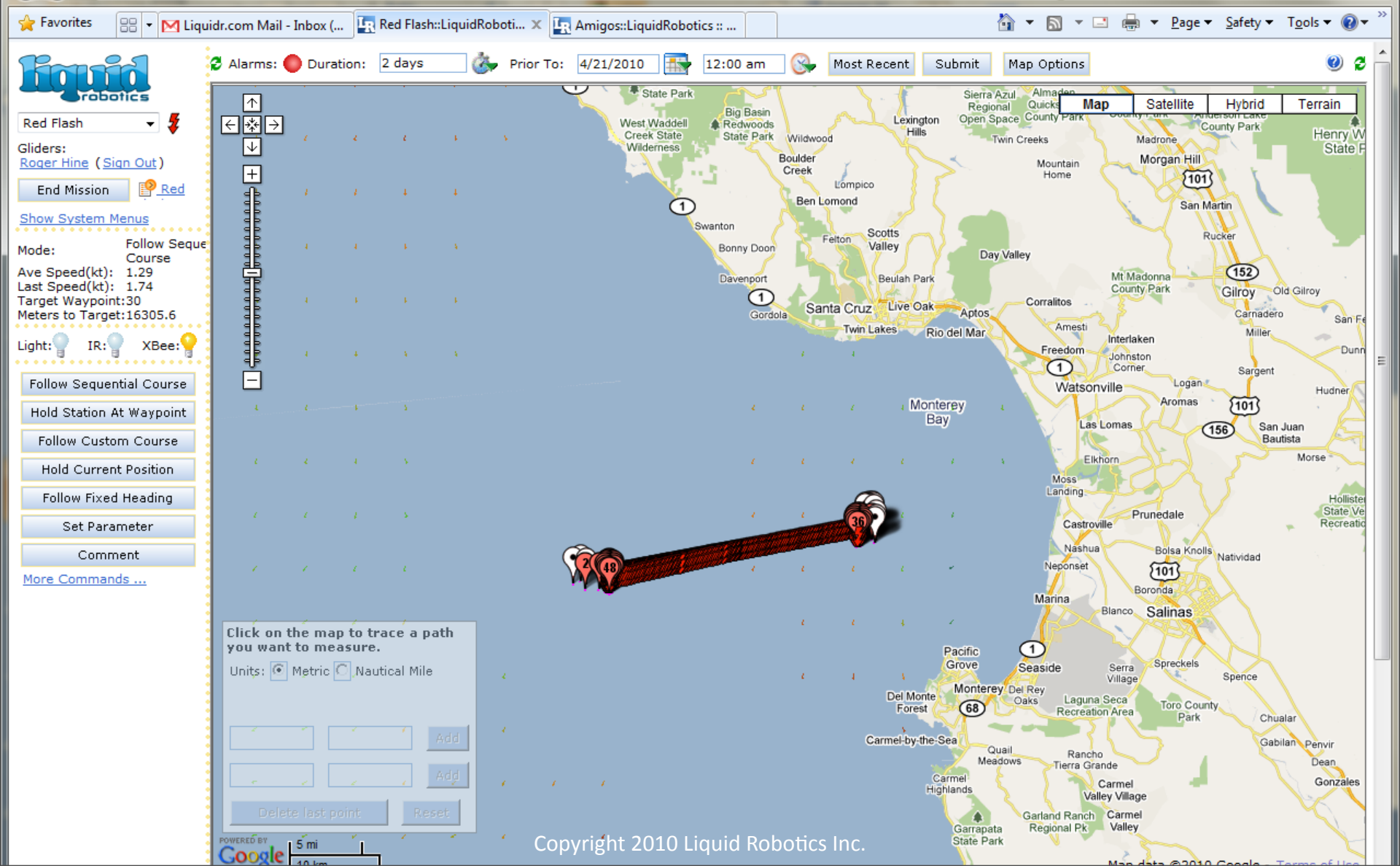
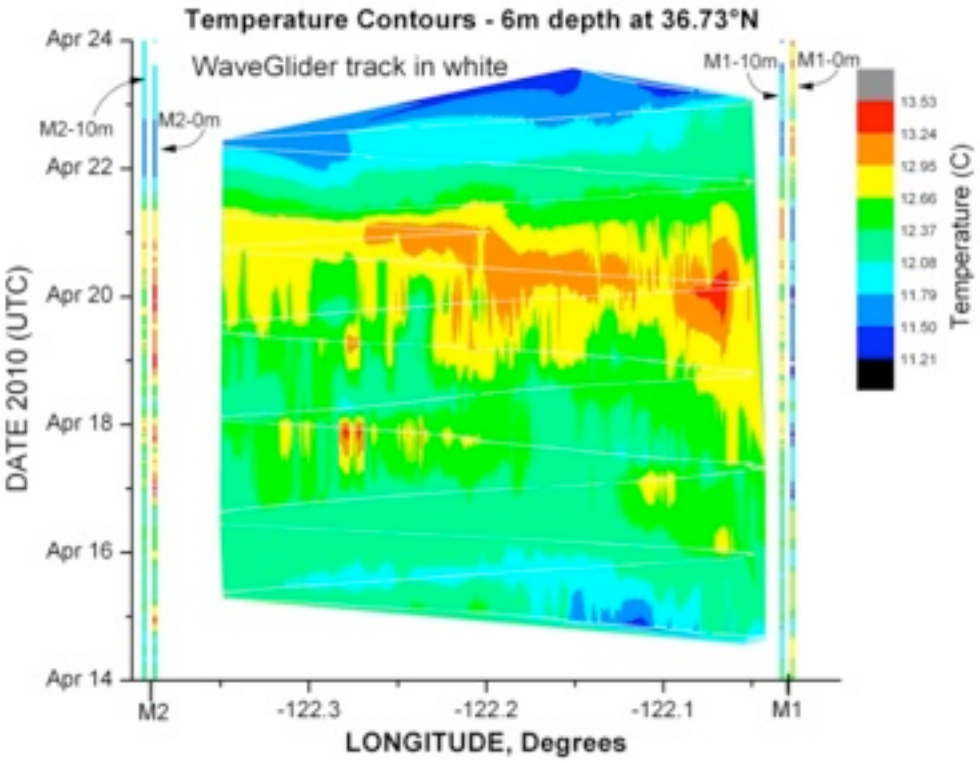
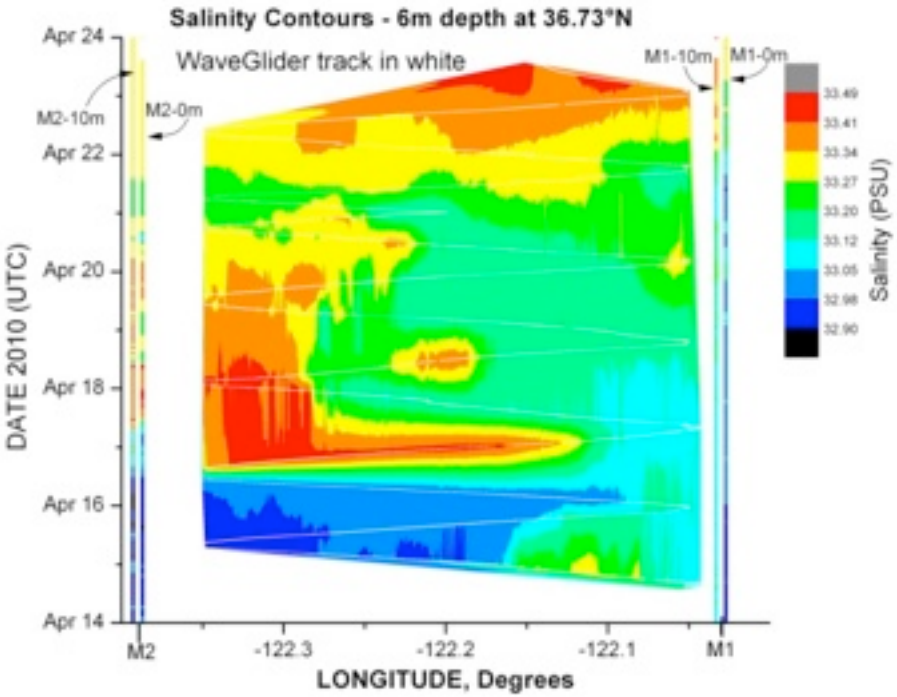
Red Flash Horizontal CT Profiles

April 2010



Red Flash Horizontal CT Profiles





Horizontal profiles proved interesting, paper submitted to the Journal of Ocean Dynamics, in review

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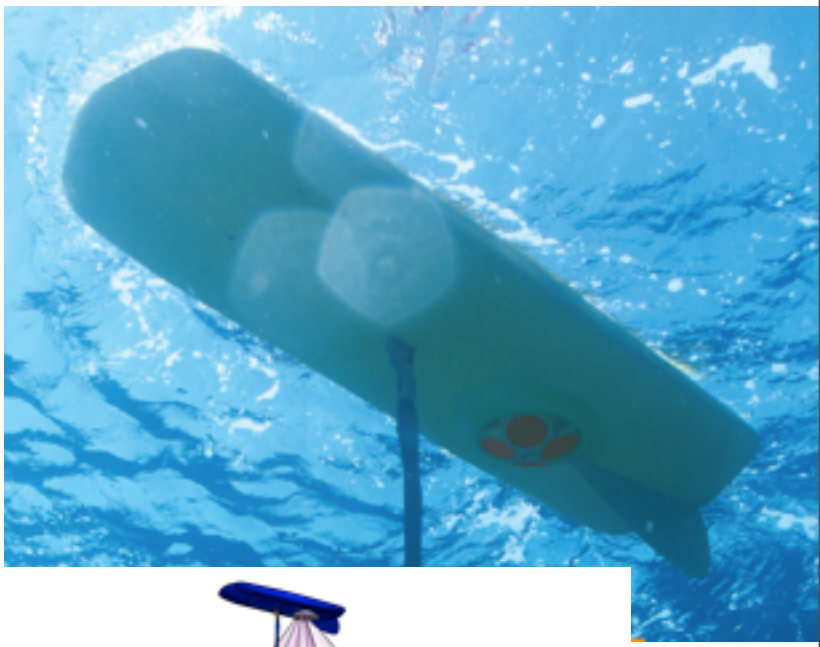
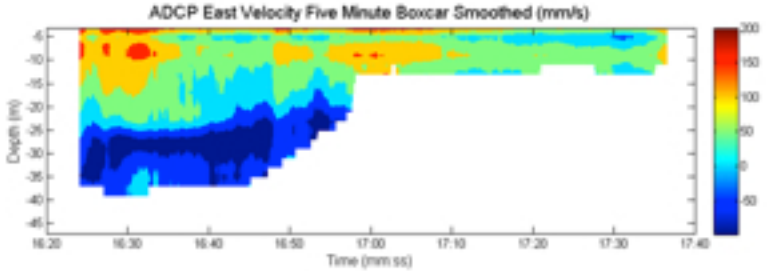
ADCP Standard Offering

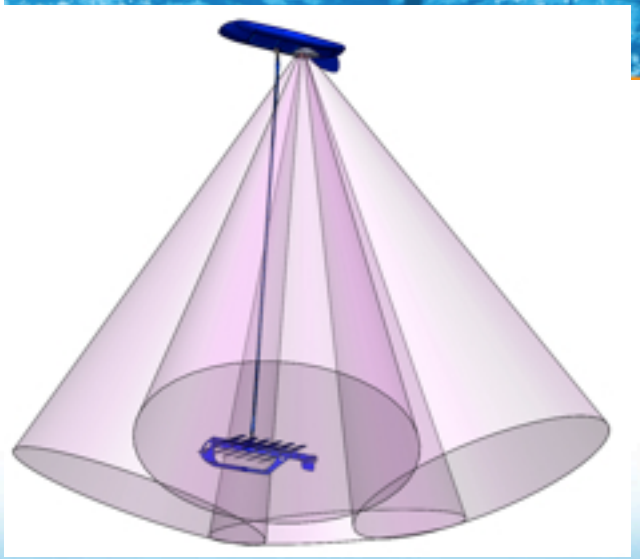
TELEDYNE RD INSTRUMENTS
A Teledyne Technologies Company

liquid robotics

- Successful system integration, Teledyne RDI 600 kHz Sentinel
- Series of tests to evaluate the ADCP performance and data quality
- Data below the glider validated
- Surface layers between the float and glider understood to be good quality
- Announced product last week at MTS/IEEE OCEANS in Seattle







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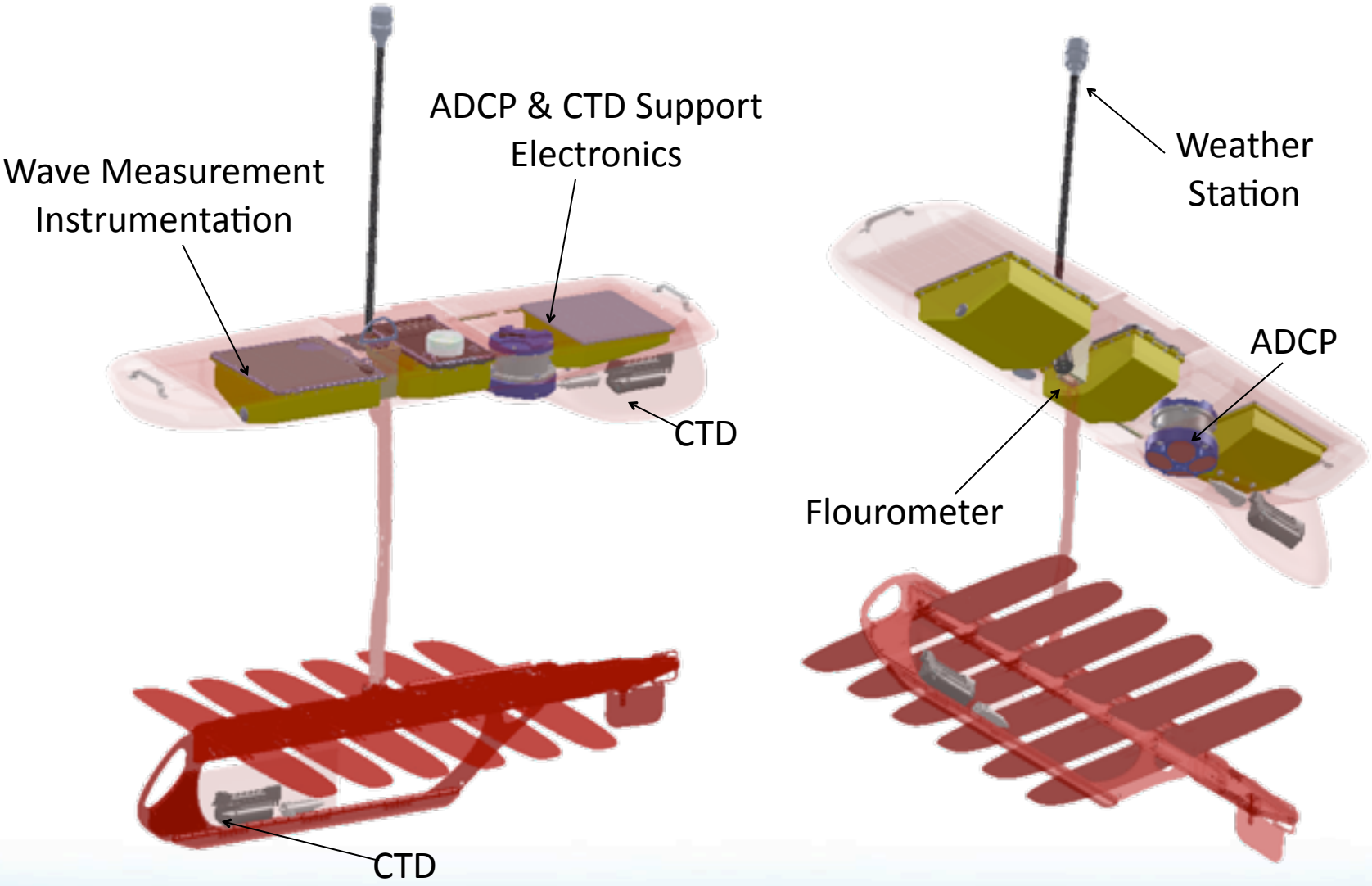
METOC Wave Glider
in development as a standard offering



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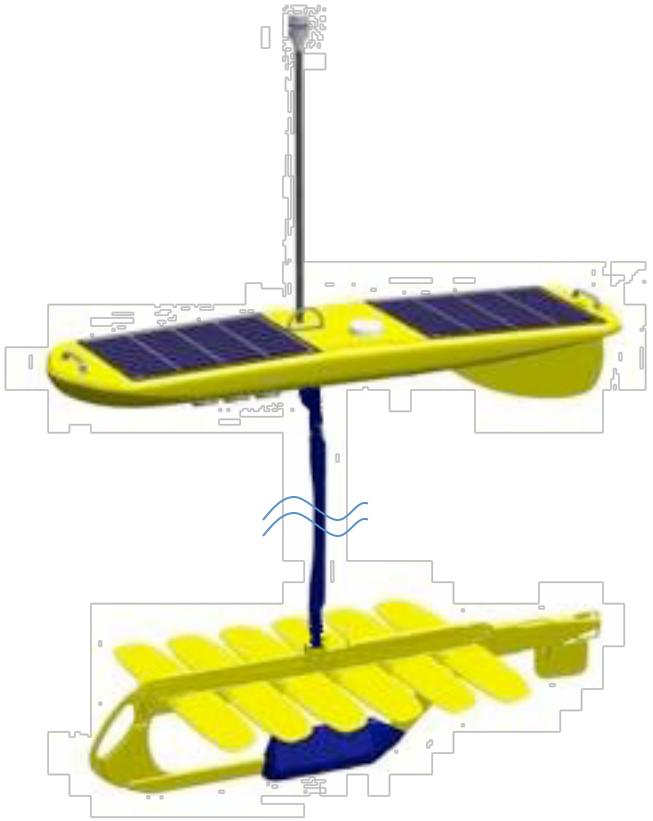
Water Quality Monitoring System Deployed in Gulf of Mexico for BP

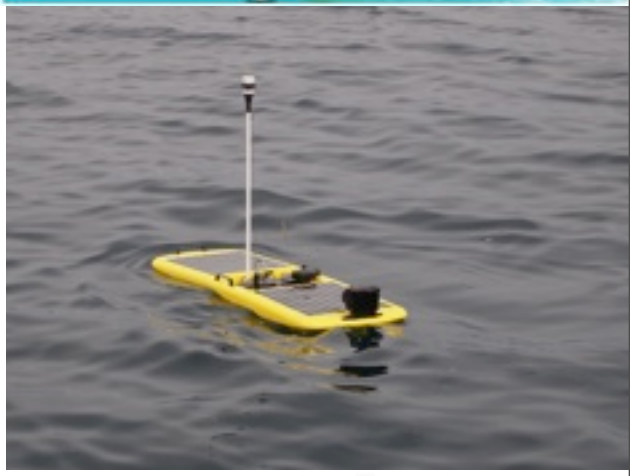
Fluorometer Array:
- Crude Oil
- CDOM
- Chlorophyll

Dissolved Oxygen

Sea Surface Temp (SST)

Meteorological Data:
- Wind Speed
- Wind Direction
- Air Temp
- Air Pressure





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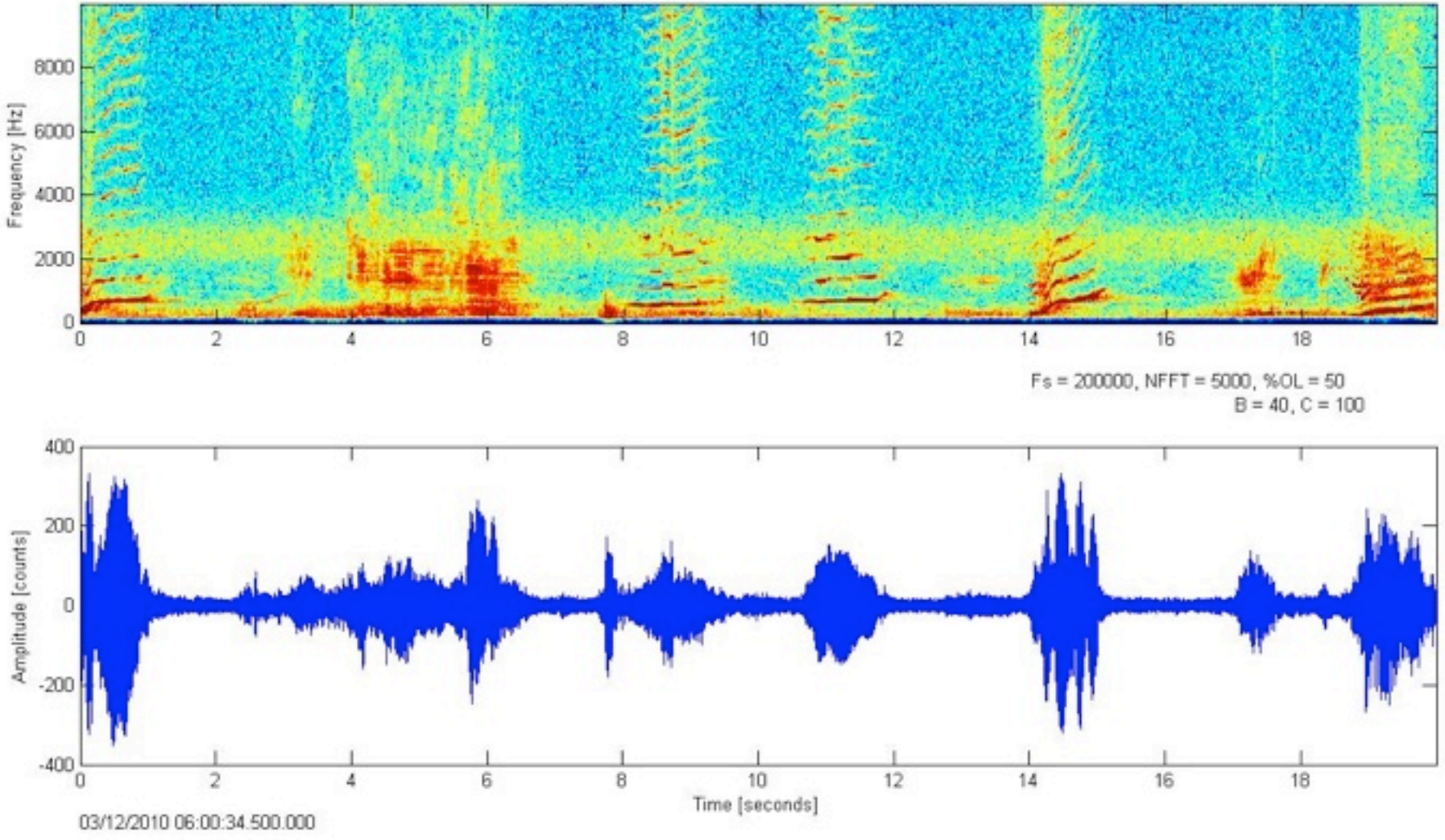
Humpback Recording

(Passive Acoustics)



Wiggins et. al. MTS/IEEE OCEANS 2010 – Seattle, WA

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2010 DART Demonstration

Float mounted payload

- Acoustic modem and iridium transmitter
- Target: minimize impact on hydrodynamic performance
- Uncertainty: Acoustic impact
- Tests demonstrated good results for both vehicle performance and data telemetry

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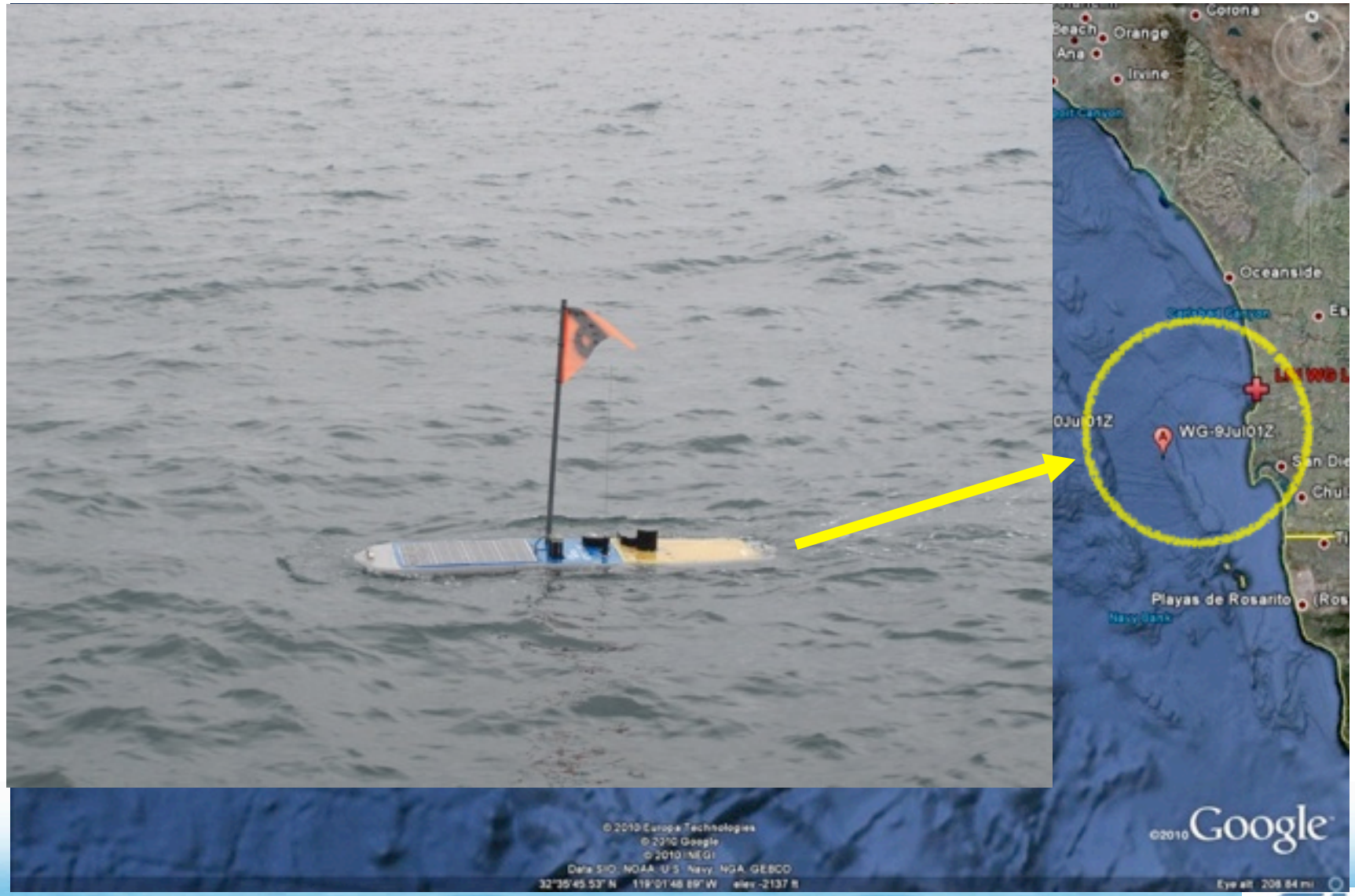
San Diego deployment, July 2010



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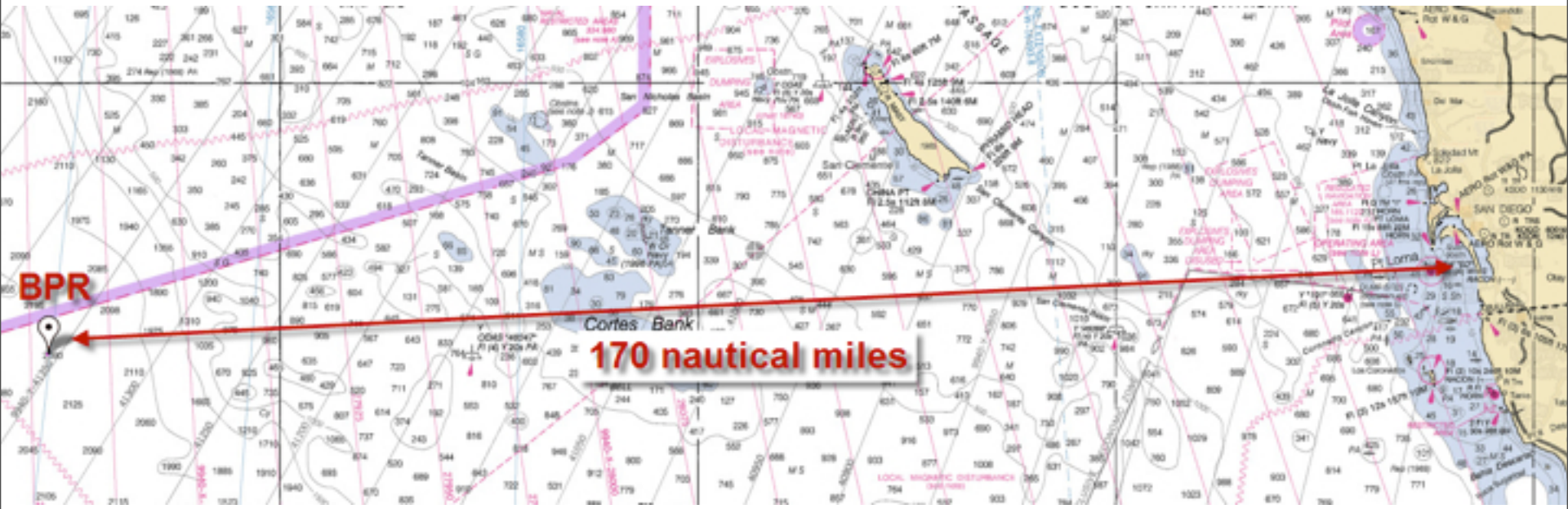
San Diego deployment, July 2010
Area of Operations



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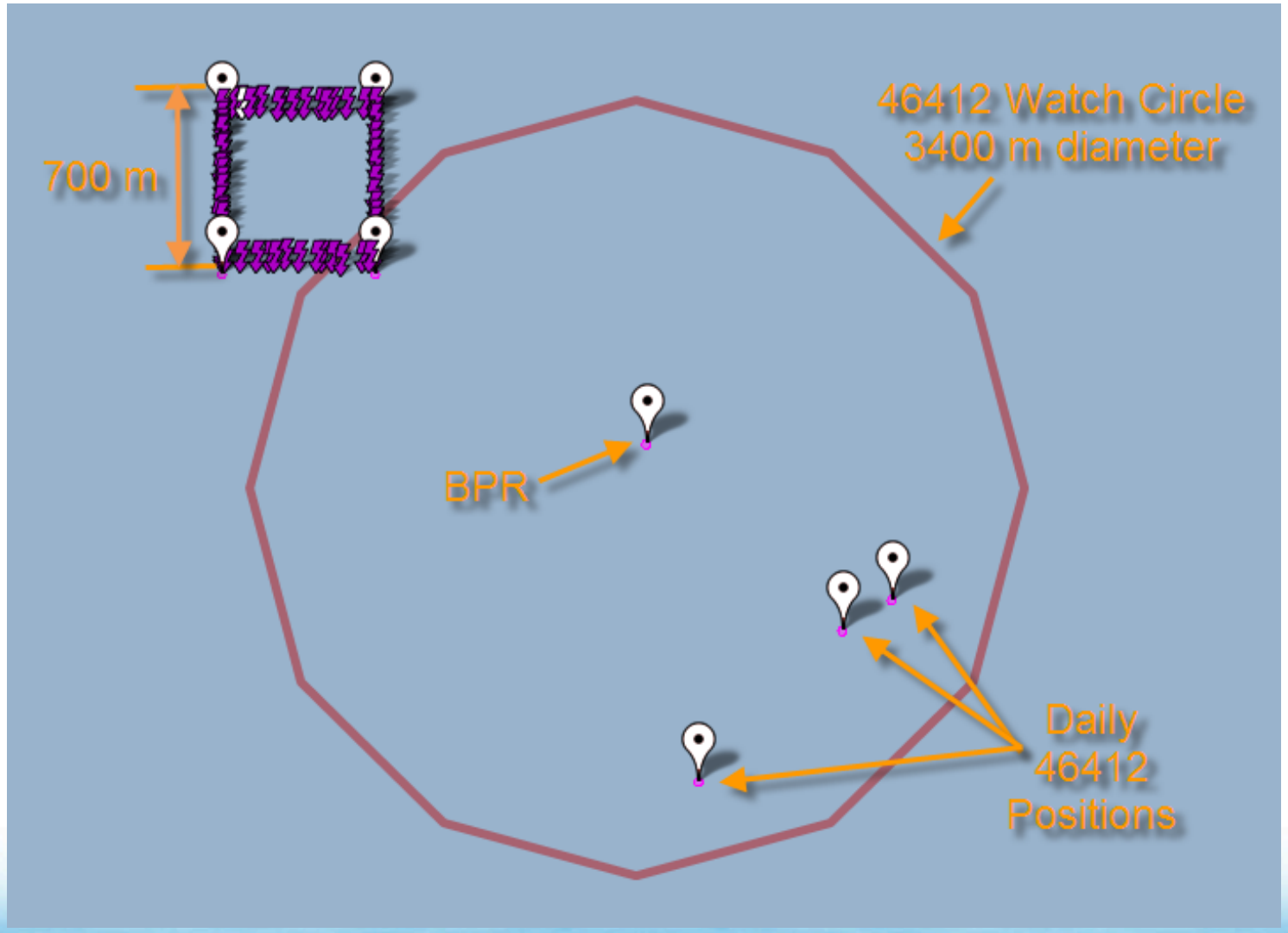
San Diego deployment, July 2010

Relative Positions, BPR, Buoy, Wave Glider



Copyright 2010 Liquid Robotics Inc.

San Diego deployment, July 2010

100% match buoy to Wave Glider over one week test period (sample data shown)

Wave Glider DART Payload

```
D$1I 07/24/2010 18:15:00 1444143 3717778 3717754 3717726 3717695  1* 32
D$1I 07/24/2010 19:15:00 1444143 3717665 3717628 3717597 3717565  1* 30
D$1I 07/24/2010 20:15:00 1444143 3717535 3717508 3717482 3717463  1* 3F
D$1I 07/24/2010 21:15:00 1444143 3717453 3717446 3717441 3717442  1* 38
D$1I 07/24/2010 22:15:00 1444143 3717453 3717469 3717494 3717524  1* 3F
D$1I 07/24/2010 23:15:00 1444143 3717559 3717601 3717650 3717700  1* 37

       D$0 07/25/2010 01:13:40 3227.7332 N 12034.5313 W 071* 40

D$1I 07/25/2010 00:15:00 1444143 3717754 3717812 3717875 3717943  1* 34
D$1I 07/25/2010 01:15:00 1444143 3718007 3718074 3718136 3718197  1* 33
D$1I 07/25/2010 02:15:00 1444143 3718256 3718308 3718356 3718398  1* 37
D$1I 07/25/2010 03:15:00 1444143 3718431 3718455 3718470 3718477  1* 3B
D$1I 07/25/2010 04:15:00 1444143 3718473 3718457 3718433 3718395  1* 34
D$1I 07/25/2010 05:15:00 1444143 3718352 3718299 3718237 3718164  1* 3B
                              D$MI
                  BATT 07/25/2010 01:19:00 24:00:00
                         11.37 0.00 0.01 0

D$1I 07/25/2010 06:15:00 1444143 3718085 3718002 3717910 3717818  1* 3D
D$1I 07/25/2010 07:15:00 1444143 3717722 3717624 3717523 3717425  1* 3A
D$1I 07/25/2010 08:15:00 1444143 3717327 3717233 3717140 3717054  1* 35
D$1I 07/25/2010 09:15:00 1444143 3716978 3716906 3716841 3716786  1* 39
D$1I 07/25/2010 10:15:00 1444143 3716738 3716706 3716676 3716661  1* 37
D$1I 07/25/2010 11:15:00 1444143 3716653 3716655 3716668 3716691  1* 3D

D$1I 07/25/2010 12:15:00 1444143 3716721 3716761 3716805 3716857  1* 3D
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D$1I 07/25/2010 15:15:00 1444143 3717489 3717549 3717610 3717666  1* 35
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```

DART Buoy 46412

```
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D$1I 07/24/2010 19:15:00 1444143 3717665 3717628 3717597 3717565  1* 30
D$1I 07/24/2010 20:15:00 1444143 3717535 3717508 3717482 3717463  1* 3F
D$1I 07/24/2010 21:15:00 1444143 3717453 3717446 3717441 3717442  1* 38
D$1I 07/24/2010 22:15:00 1444143 3717453 3717469 3717494 3717524  1* 3F
D$1I 07/24/2010 23:15:00 1444143 3717559 3717601 3717650 3717700  1* 37

       D$0 07/25/2010 01:13:11 3227.6065 N 12033.3008 W 041* 4F

D$1I 07/25/2010 00:15:00 1444143 3717754 3717812 3717875 3717943  1* 34
D$1I 07/25/2010 01:15:00 1444143 3718007 3718074 3718136 3718197  1* 33
D$1I 07/25/2010 02:15:00 1444143 3718256 3718308 3718356 3718398  1* 37
D$1I 07/25/2010 03:15:00 1444143 3718431 3718455 3718470 3718477  1* 3B
D$1I 07/25/2010 04:15:00 1444143 3718473 3718457 3718433 3718395  1* 34
D$1I 07/25/2010 05:15:00 1444143 3718352 3718299 3718237 3718164  1* 3B
                              D$MI
                  BATT 07/25/2010 01:19:00 24:00:00
                         15.69 10.29 44.98

D$1I 07/25/2010 06:15:00 1444143 3718085 3718002 3717910 3717818  1* 3D
D$1I 07/25/2010 07:15:00 1444143 3717722 3717624 3717523 3717425  1* 3A
D$1I 07/25/2010 08:15:00 1444143 3717327 3717233 3717140 3717054  1* 35
D$1I 07/25/2010 09:15:00 1444143 3716978 3716906 3716841 3716786  1* 39
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D$1I 07/25/2010 11:15:00 1444143 3716653 3716655 3716668 3716691  1* 3D

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D$1I 07/25/2010 15:15:00 1444143 3717489 3717549 3717610 3717666  1* 35
D$1I 07/25/2010 16:15:00 1444143 3717715 3717754 3717788 3717814  1* 35
D$1I 07/25/2010 17:15:00 1444143 3717832 3717843 3717848 3717845  1* 30
```

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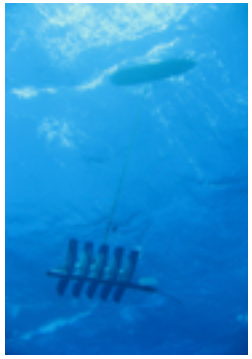
Wave Glider fits within a notional future of ocean data collection

~ 10 Floats = 1 WG

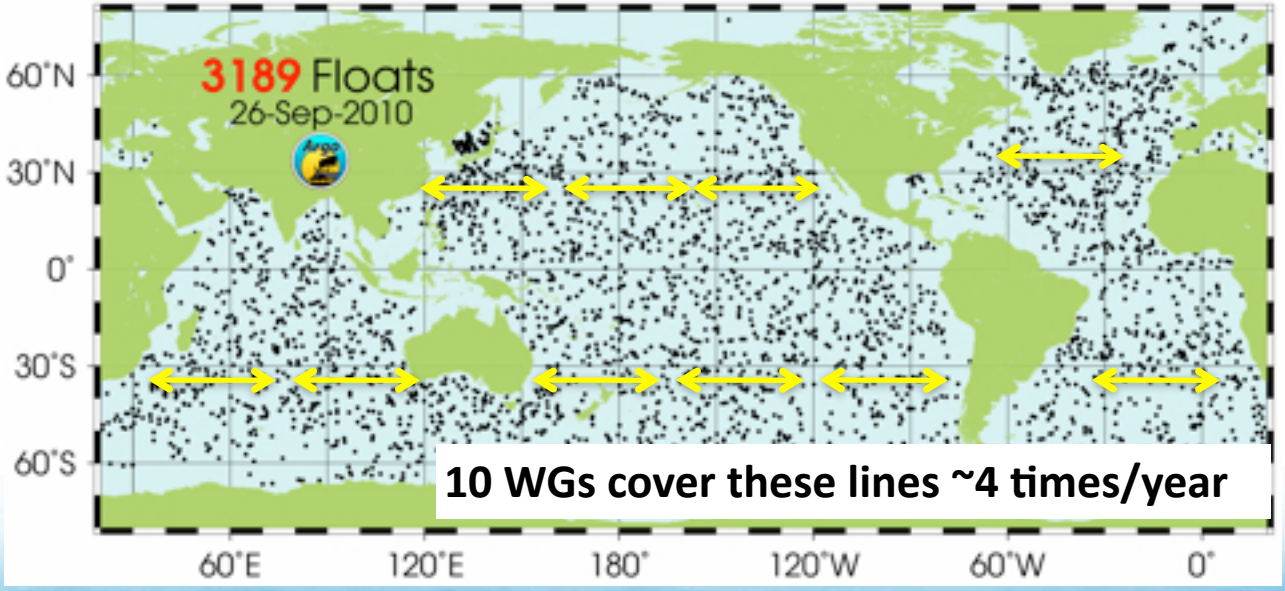


~ 10 WG = 1 Buoy deployment cruise

Future network could include drifters and WGs for controlled monitoring:

- Ocean basin transects
- Drifter "chasing" and deployment in remote waters
- Subsea data relay

And WGs come home when called



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Ride the next wave with us!

Looking forward to feedback, discussions and collaboration . . .

visits to Hawaii encouraged!

Contact: Justin Manley, Director Scientific and Commercial Business
+1-781-366-9680, justin.manley@liquidr.com

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