



# ***Naval Oceanographic Office***



## ***Airborne Coastal Surveys Program Brief for 15<sup>th</sup> Annual JALBTCX Technical Workshop Mobile, AL***

*10 June 2014*

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# Summary



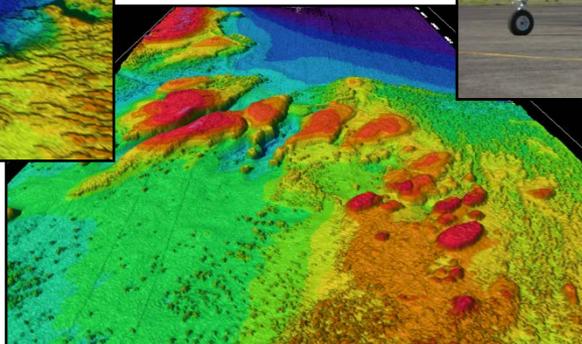
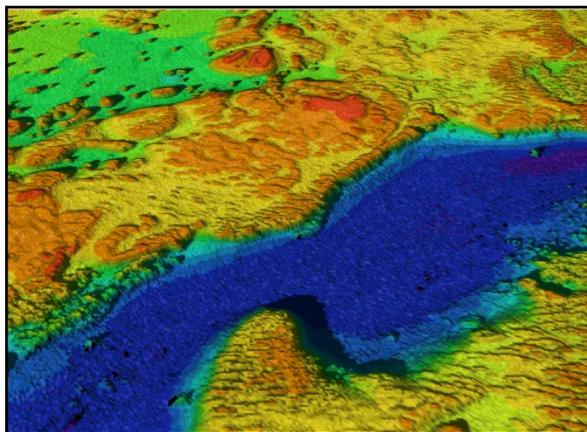
- ***Airborne Coastal Survey Program Mission***
- ***Activities Since 2013 Workshop***
  - ***Bahamas***
  - ***Honduras Survey***
  - ***Philippines Survey***
- ***Future Activities***



# Airborne Coastal Surveys Mission



*“The mission of the ACS program is to utilize aerial platforms, sensors, and advanced techniques in the mapping and charting of coastal environments in order to provide relevant products to the Department of Defense in a timely and efficient manner.”*





# NAVAL OCEANOGRAPHIC OFFICE

## Airborne Coastal Surveys (ACS) Program



**Basler BT-67 ACS Survey Aircraft**



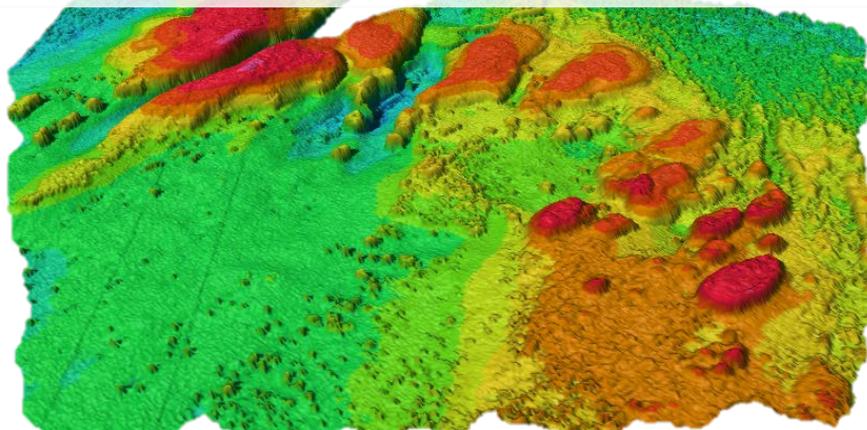
*Enhanced capability  
Long range  
Long endurance*

**Coastal Zone Mapping & Imaging  
Lidar (CZMIL) System**

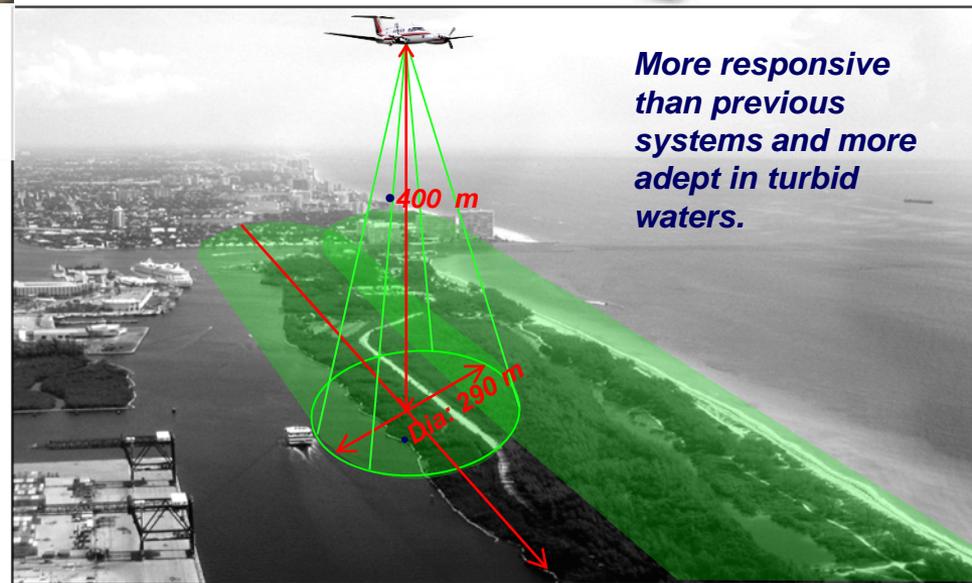


- Hydro/Topo Lidar
- Hyperspectral
- RGB Imagery

*The right tool for fast, efficient, safe data collection  
of shallow-water hydrography and near-shore  
topography*



Naval Oceanography



*More responsive  
than previous  
systems and more  
adept in turbid  
waters.*

Approved for Public Release



# New ACS Aircraft - CFBKB





# ***New Aircraft Lessons Learned***



- ***New aircraft are great!***
- ***New aircraft are expensive!***
- ***BT-67 has longer endurance than the people onboard***
- ***There is no such thing as too much aircraft air conditioning for the locations the ACS program typically works***
- ***The BT-67 needs an auto-pilot (we knew that one already)***
- ***The BT-67 has allowed us to expand the traditional ACS surveys to include launching of physical oceanography/acoustics buoys and probes. More data during deployments.***



# ***ACS Activities Since 2013 Workshop***



# ACS Activities Since 2013 Workshop





# ACS Activities Summary



***Jul – Aug 2013***

***Bahamas (flown from Florida)***

***Great Bahamas Bank***

***Product: Shoreline Mapping & Nautical Charting***

***Dec 2013***

***Integration of CZMIL #2 into BT-67 aircraft***

***Testing and calibration***

***Jan – Mar 2014***

***Honduras***

***Nicaraguan Rise***

***Product: Shoreline Mapping & Nautical Charting***

***Apr – May 2014***

***Republic of the Philippines***

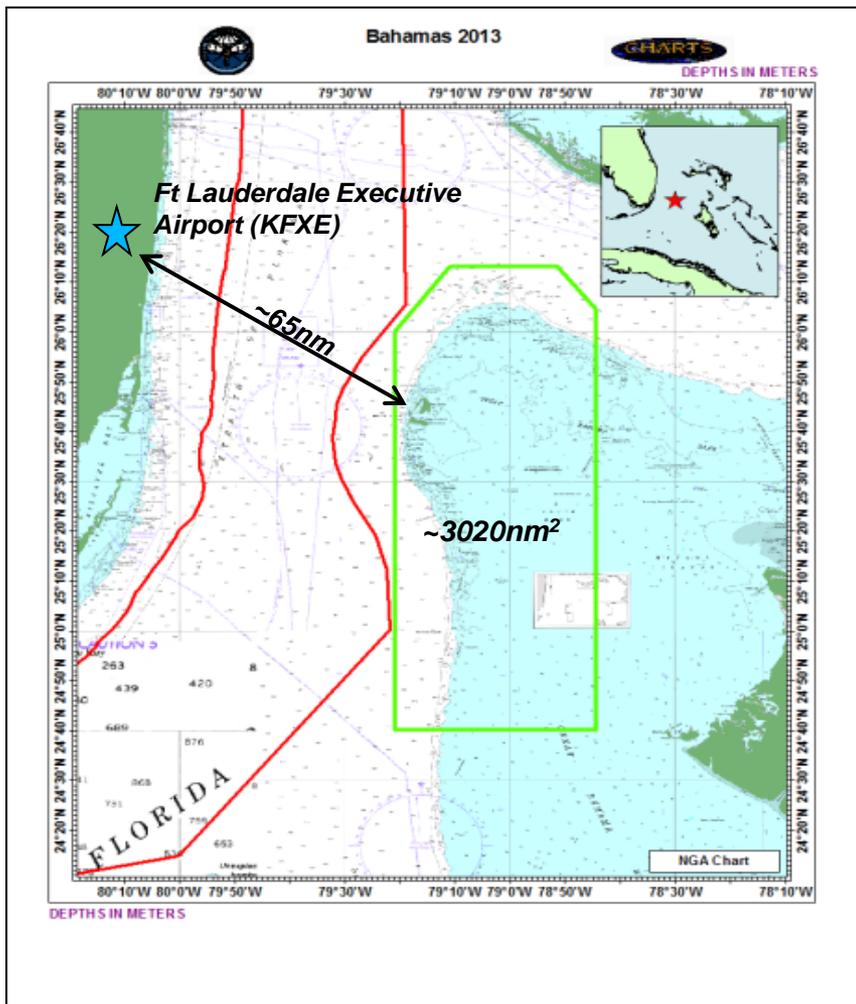
***Ulugan Bay Approach, Pearl Bank***

***Product: Shoreline Mapping & Nautical Charting***

***Jun 2014***

***Indonesia – Airborne Coastal Surveys Subject Matter***

***Expert Exchange***



## Survey Assets:



**C-FBCN with CZMIL #2**



**C-FBKB with CZMIL #4**

Personnel & AC arrive Florida:	01 Jul
Aircraft & Personnel Departed:	20 Aug
Total Survey Days:	31 days
Total Area Coverage:	~620nm <sup>2</sup>
Furlough Days:	July 12, 19, & 26 & Aug 9

1<sup>st</sup> Operational Deployment of CZMIL #2 (Navy CZMIL)

1<sup>st</sup> Operational Deployment of CFBKB (CONUS)

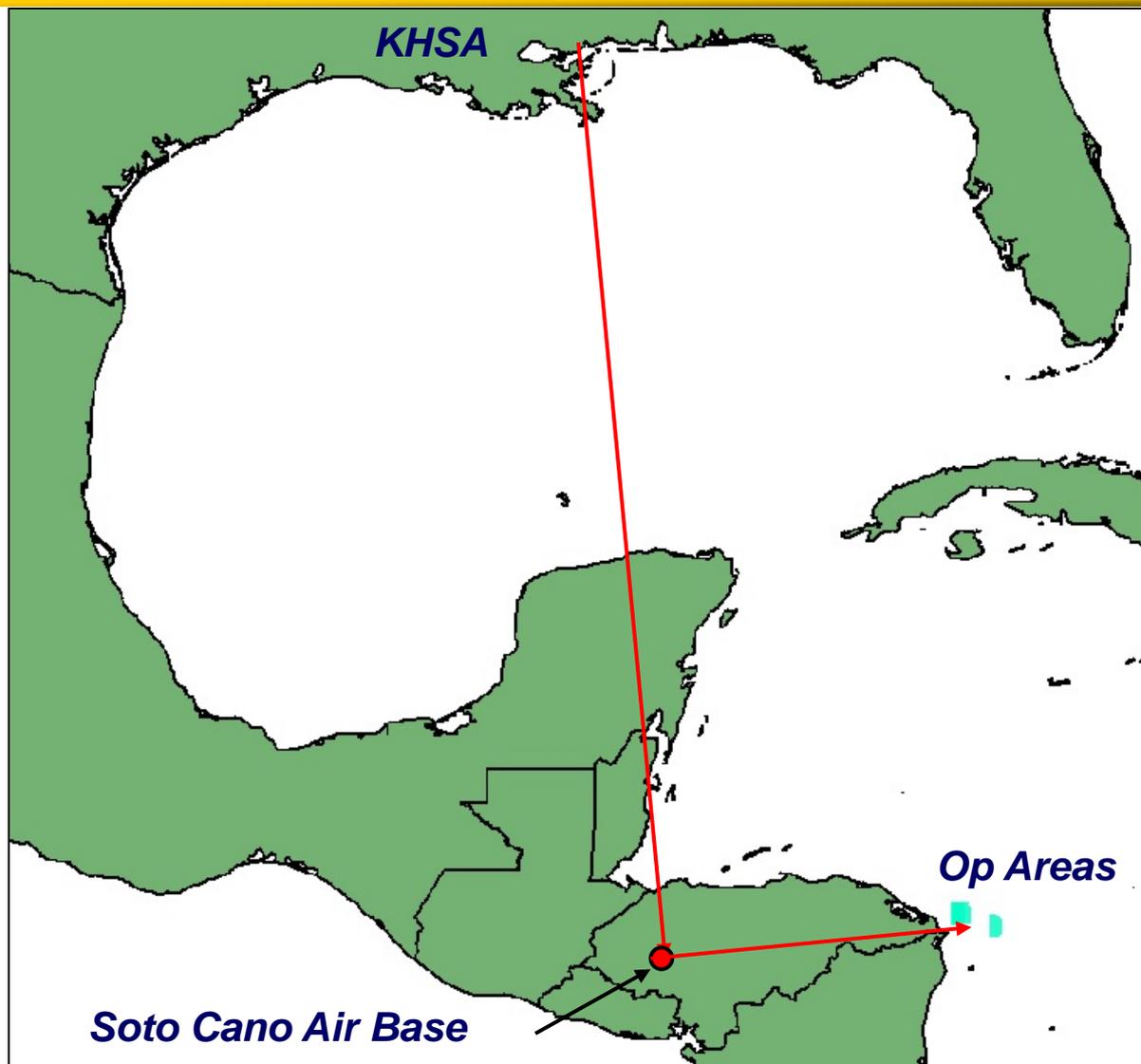
# Honduras



*Aircraft C-FBKB at Soto Cano Air Base, Honduras: 19 Jan 2014*

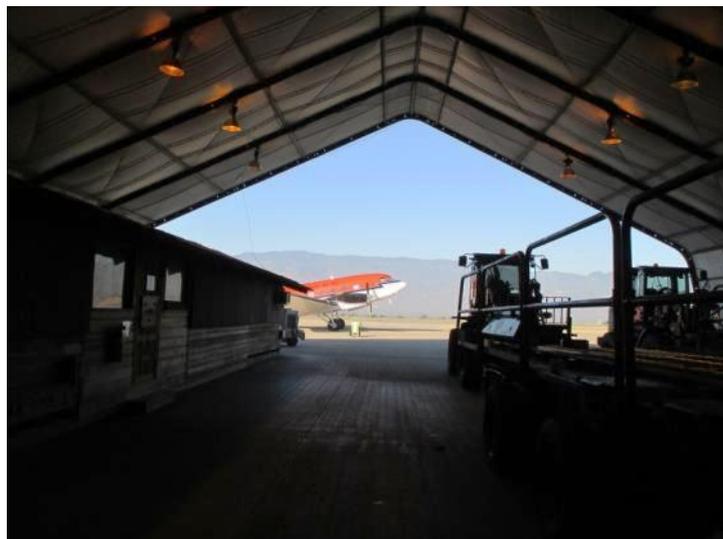
# 2014 Mission Timelines

- 10-13 Jan: surveyors arrived
- 13 Jan: US-HND C-FBKB transit (field office and sensor suite)
- 15 Jan: First survey day
- 27 Jan – 05 Feb: C4 CASREP and transit to/from CONUS for repairs
- 13 Mar: Last scheduled survey day
- 17 Mar HND-US C-FBKB transit
- 17-18 Mar: surveyors departed





# Field Office



# BT-67 Interior





# Flight Statistics and Totals



NAVAL OCEANOGRAPHIC OFFICE AIRBORNE COASTAL SURVEY 14ACS01, HONDURAN TERRITORIAL WATER SURVEY CONDUCTED FROM SOTO CANO AIR BASE, HONDURAS: STATISTICS AND TOTALS FROM 15 JAN TO 13 MAR 2014

FLIGHT OP	DATE				HOURS OF ENGINE TIME							GALLONS JET A	GIGABYTES OF DATA LOGGED			PERSONNEL ONBOARD						COMMENTS	
	JD	Month	Date	Day	TOTAL	PR1	PR2	PR3	PR4	CAL	TRANSIT		GROUND	lidar raw	spectral camera raw	RGB camera raw	PILOT1	PILOT2	CREW1	CREW2	CREW3		CREW4
1	15	JAN	15	WED	8.8	4.4					3.7	0.6	1176	406	142	68	Cameron	Espersen	Powell	Kerling			
2	16	JAN	16	THU	7.5	3.2					3.9	0.4	1001	386	104		Cameron	Espersen	Ellard				camera failed to log
3	17	JAN	17	FRI																			unanticipated airfield closure
4	21	JAN	21	TUE	8.5	3.3				0.3	4.3	0.6	1134	335	111	117	Cameron	Espersen	Powell	Borja			
5	22	JAN	22	WED	8.7	2.2	1.6				4.4	0.6	1191	427	121	135	Cameron	Espersen	Powell				
6	23	JAN	23	THU	7.6	3.5					3.6	0.6	1020	391	123	98	Cameron	Espersen	Ellard	Tinkler			
7	24	JAN	24	FRI	4.8	0.4				0.3	3.7	0.4	686				Cameron	Espersen	Ellard				little data due to weather
8	27	JAN	27	MON	1.3							1.3					Cameron	Espersen	Powell	McGuire			CZML PDU failure no flight
9	28	JAN	28	TUE																			CASREP
10	29	JAN	29	WED																			CASREP
11	30	JAN	30	THU																			CASREP/TRANSIT
12	31	JAN	31	FRI																			CASREP
13	34	FEB	3	MON																			CASREP
14	35	FEB	4	TUE																			CASREP
15	36	FEB	5	WED																			CASREP/TRANSIT
16	37	FEB	6	THU	6.9	2.6					3.6	0.7	912	302	86	71	Emberley	Bayes	Powell				shorter flight due to weather
17	38	FEB	7	FRI	0.7							0.7	469				Emberley	Bayes	Imm	Borja			brake failure no flight
18	41	FEB	10	MON	8.2	2.7	1.0				3.9	0.6	1062	407	116	94	Emberley	Bayes	Imm	Haynes	Rogers		
19	42	FEB	11	TUE	7.9	3.5					3.7	0.8	1051	417	125	96	Emberley	Bayes	Ellard	Gagan			
20	43	FEB	12	WED	8.0	3.8					3.6	0.6	1043	347	105	81	Emberley	Bayes	Ellard	Tinkler			
21	44	FEB	13	THU	7.6		3.3				3.8	0.6	1024	553	112	89	Emberley	Bayes	Ellard	Sieck	Winstanley		
22	45	FEB	14	FRI																			unanticipated airfield closure
23	49	FEB	18	TUE	8.0		4.1				3.3	0.7	1094	450	136	106	Emberley	Bayes	Ellard	Sieck	Winstanley	Mahr	
24	50	FEB	19	WED	7.8	2.1	1.3				3.8	0.6	1026	270	82	151	Emberley	Bayes	Ellard	Sieck	Winstanley	Mahr	
25	51	FEB	20	THU	8.2		4.3				3.3	0.6	1095	450	124	104	Emberley	Bayes	Sieck	Mahr			
26	52	FEB	21	FRI	8.1		4.2				3.3	0.6	1066	534	149	121	Emberley	Bayes	Winstanley	Mahr			
27	55	FEB	24	MON	8.2		4.4				3.3	0.6	1085	392	108	70	Emberley	Espersen	Sieck	Bowen	Owens		camera failure midflight
28	56	FEB	25	TUE	8.6		3.4	1.1			3.5	0.6	1123	567	164		Cameron	Espersen	Sieck	Mahr	Bear		
29	57	FEB	26	WED	6.9			2.8			3.3	0.8	945	287	97		Cameron	Espersen	Mahr	Kothuri			shorter flight due to weather
30	58	FEB	27	THU	8.2			4.4			3.2	0.5	1024	487	158		Cameron	Espersen	Sieck				
31	59	FEB	28	FRI	8.4			4.5			3.2	0.7	1189	536	165		Cameron	Espersen	Mahr	Andersen			
32	62	MAR	3	MON	8.2		1.7	2.6			3.3	0.5	1092	457	139		Cameron	Espersen	Sieck	Walkup			
33	63	MAR	4	TUE	7.9			3.8			3.4	0.6	1030	372	111		Cameron	Espersen	Mahr	Borja			
34	64	MAR	5	WED	8.5			4.7			3.2	0.6	1122	499	171		Cameron	Espersen	Mahr	Winstanley			
35	65	MAR	6	THU	8.5			4.8			3.2	0.5	1130	547	125		Cameron	Espersen	Powell	McGuire			
36	66	MAR	7	FRI	7.7		0.5		2.9		3.8	0.6	1017	365	109	91	Cameron	Espersen	Powell				
37	69	MAR	10	MON	4.9			0.9			3.2	0.8	605				Cameron	Espersen	Winstanley				no data due to weather
38	70	MAR	11	TUE	8.3			3.2		1.1	3.4	0.6	1133	460	128	108	Cameron	Espersen	Winstanley	Powell			
39	71	MAR	12	WED	8.1			1.6	2.1		3.9	0.5	1108	413	116	94	Cameron	Espersen	Winstanley				
41	72	MAR	13	THU													Cameron	Espersen	Powell				right engine malfunction

SURVEY TOTALS *not including transits between CONUS and SOUTHCOM	HOURS OF ENGINE TIME							GALLONS JET A	TERABYTES OF DATA LOGGED			
	TOTAL	PR1	PR2	PR3	PR4	CAL	TRANSIT		GROUND	lidar raw	spectral camera raw	RGB camera raw
	221.0	31.7	29.7	34.5	5.0	1.7	99.7	18.8	29653	10.80	3.15	1.65

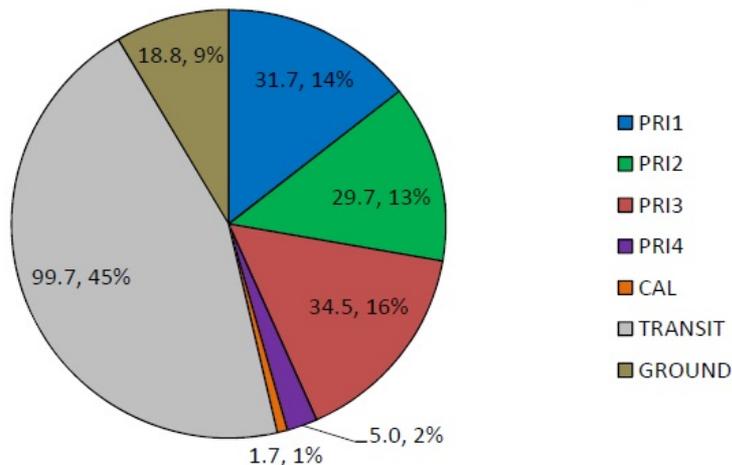
PERSONNEL AFFILIATION				
KBA CTR	NGC CTR	Navy CIV	Air Force	Army



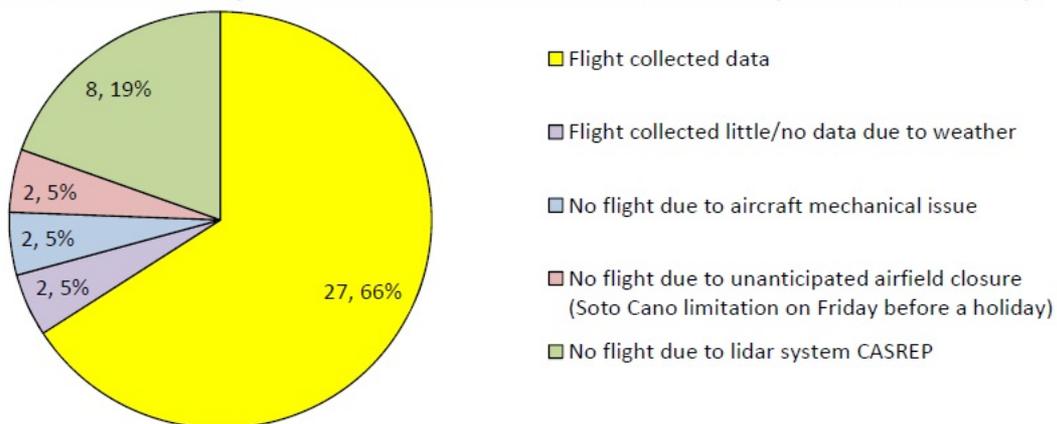
# Flight Statistics and Totals



ENGINE HOURS (TOTAL = 221): INCLUDES WEATHER/SYSTEM IMPACTS BUT NOT CONUS/SOUTHCAM TRANSITS



PLANNED (POSSIBLE SORTIES = 41) SURVEY FLIGHT OPPORTUNITIES FOR JD 15-72 (ACTUAL SORTIES = 29)



THIS EXCLUDES AN ADDITIONAL 18 DAYS OF 'NO OPS' ON WEEKENDS / FEDERAL HOLIDAYS AT SOTO CANO

## ***Sensor Issues***

- ***Pre-mission scanner assembly CASREP delayed survop by 1 week***
- ***CASREP Jan 27 failure of Power Distribution Unit leading to transit between SOUTHCOM and CONUS for repairs***
- ***CZMIL calibration was a continued work in progress throughout the survey; operation proceeded at risk***
- ***Non-mission critical RGB camera issues***

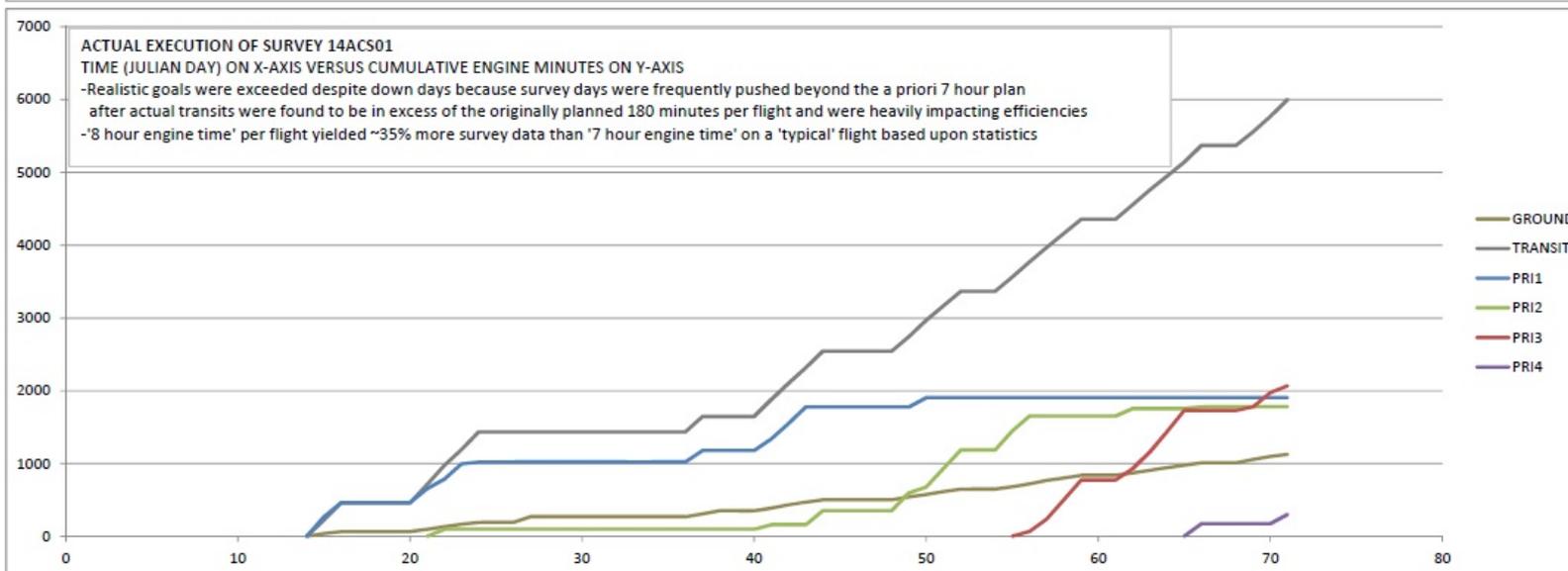
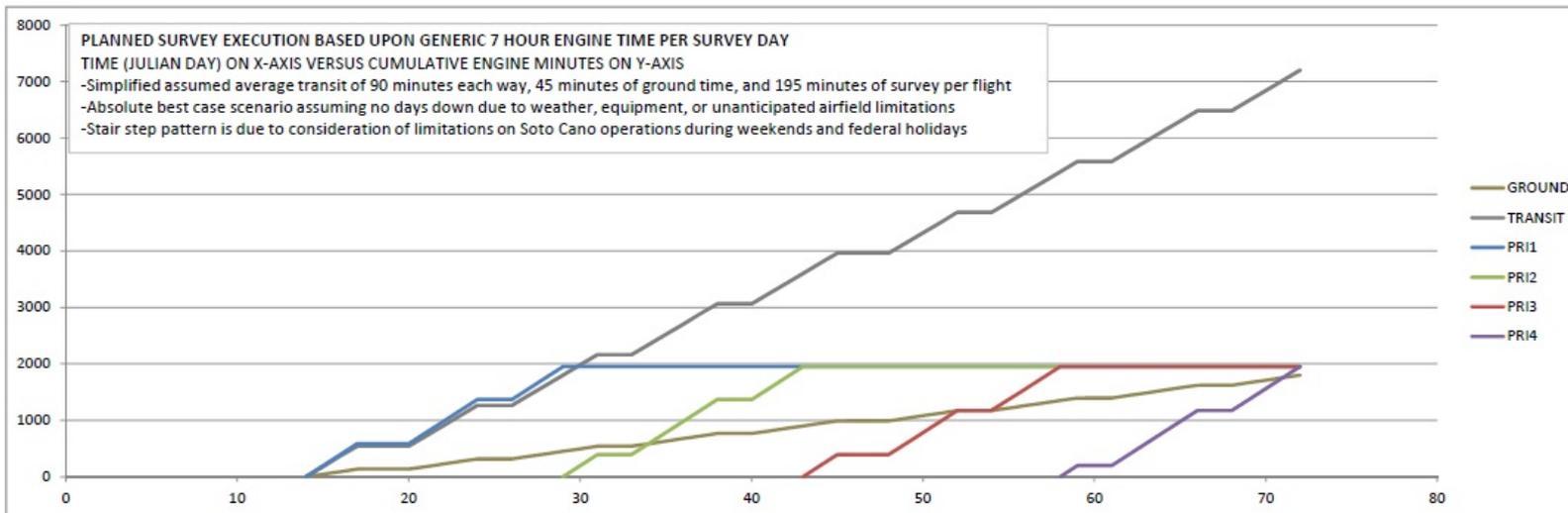
## ***Aircraft Issues***

- ***Engine fuel flow stoppage***
- ***Aircraft brake failure (now changed from tube expander to disc brakes)***
- ***Need improved A/C in aircraft for tropical maritime operations at low altitude***



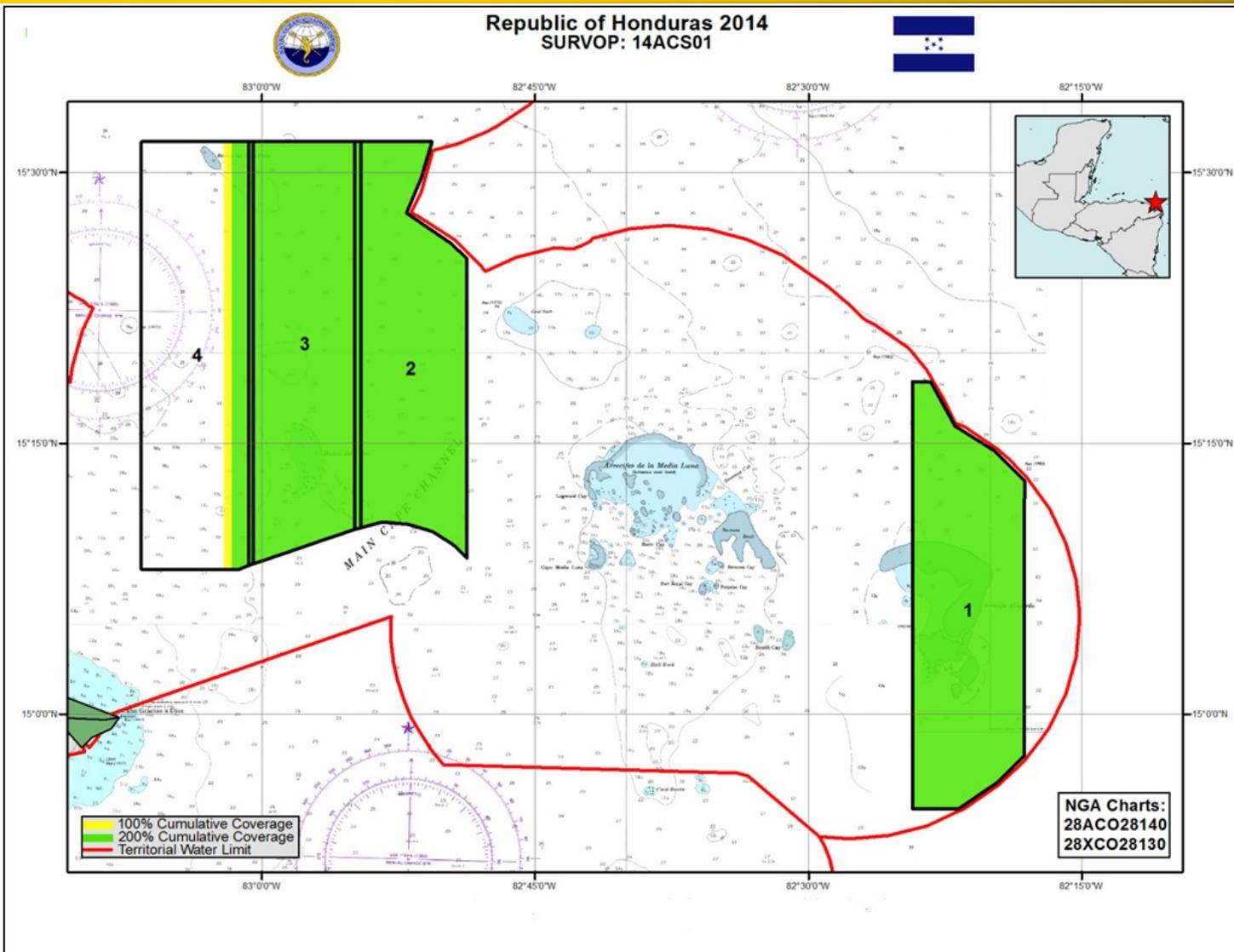


# Cumulative Execution: Plan vs Actual





# Data Collected: ~360 Nm<sup>2</sup>





# Public Affairs



- ***'612<sup>th</sup> Air Base Squadron manages arrival of historic aircraft' by TSgt Stacy Rogers, [jtfb.southcom.mil](http://jtfb.southcom.mil), 15 Jan 2014***
- ***'NAVOCEANO teams up with Air Force in Honduras,' NAVO Ocean Frontier, Feb 2014***
- ***'Old, new technologies combine to make seas safer in Honduras' by Capt Zach Anderson, [jtfb.southcom.mil](http://jtfb.southcom.mil), 10 March 2014***



# Summary



- ***360 square nautical miles were mapped to >200% lidar coverage***
- ***> 95% of survey areas yielded lidar returns***
- ***Most seafloor was too deep for quality camera/spectral yield***
- ***Calibration process changes impacted survey; data were field-processed to assure issues were identified and coverages were known. Data need to be re-processed with final parameters and revised code***
- ***Calibration data spanning large depth range in clear water were collected coincident with 2011 SHOALS data to improve CZMIL02 characterization***
- ***Soto Cano airfield procedures and long transit times dominated impacts on survey efficiencies: BT-67 was the right platform for this operation!***
- ***3 new Northrup Grumman surveyors were trained; Kenn Borek Air pilots became more familiarized with Navy ops***



# *Philippines*



## *Requirements:*

*Philippines Hydrography*  
*South China Sea Acoustics*  
*Sulu Sea Acoustics*  
*Sulu Sea Phys-O*

*Dates: 03 Apr – 27 May 2014*

*SNR: Bill Elenbaas*

*Vessel: Basler BT-67/ C-FBKB*



# Mission Summary



- **25 Mar: Elenbaas, Kerling attend HSWG, HQ PN, Manila**
- **30 Mar: Survey personnel arrive**
- **01 Apr: Field equipment delivered by NALO**
- **01 Apr: C-FBKB arrived**
- **03 Apr – 27 May: 40 total survey flights**
- **29 May: C-FBKB departed**
- **31 May: Survey equipment shipped, survey personnel departed**



# BLUF

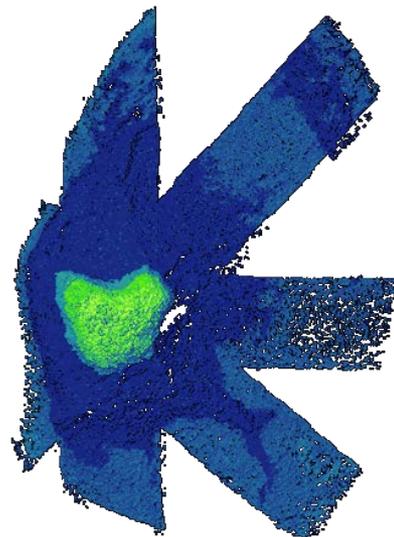


**SURVOP dates: 03 April – 27 May**  
**DIPCLEAR days: 56**  
**Planned survey days : 39**  
**Scheduled down-days: 17**  
**Un-scheduled down-days: 1**  
**Actual survey flights: 42**

**Total flight hours: 273**

**Area surveyed (100% coverage):**

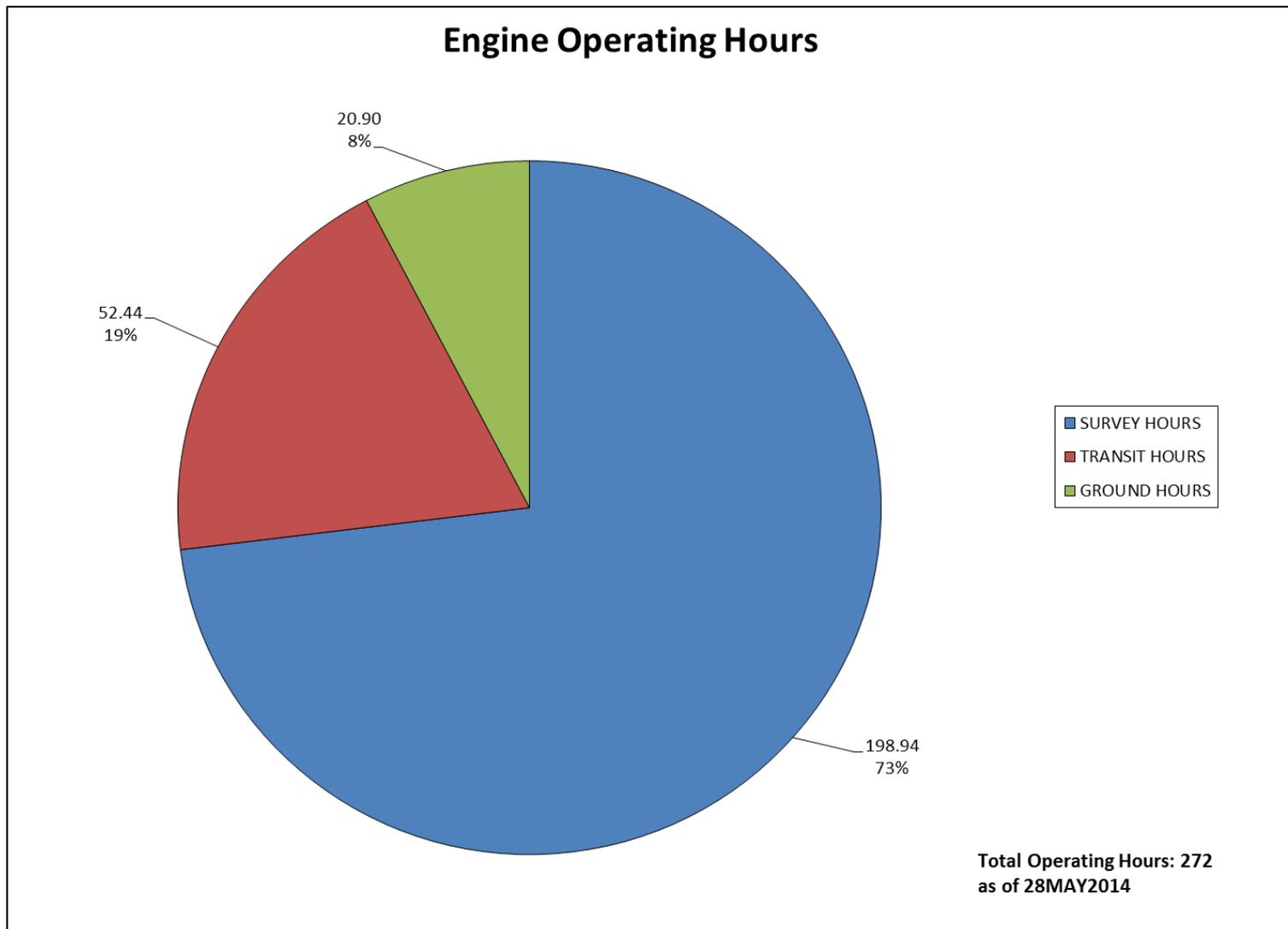
<b>Approaches to Ulugan Bay:</b>	<b>287 km<sup>2</sup> / 84 nm<sup>2</sup></b>
<b>Pearl Bank:</b>	<b>287 km<sup>2</sup> / 84 nm<sup>2</sup></b>
<b>Balabac 5B:</b>	<b>287 km<sup>2</sup> / 84 nm<sup>2</sup></b>
<b>Total area surveyed :</b>	<b>12,720 km<sup>2</sup> / 353 nm<sup>2</sup></b>



**(Not including cross check, re-flown, or calibration lines)**

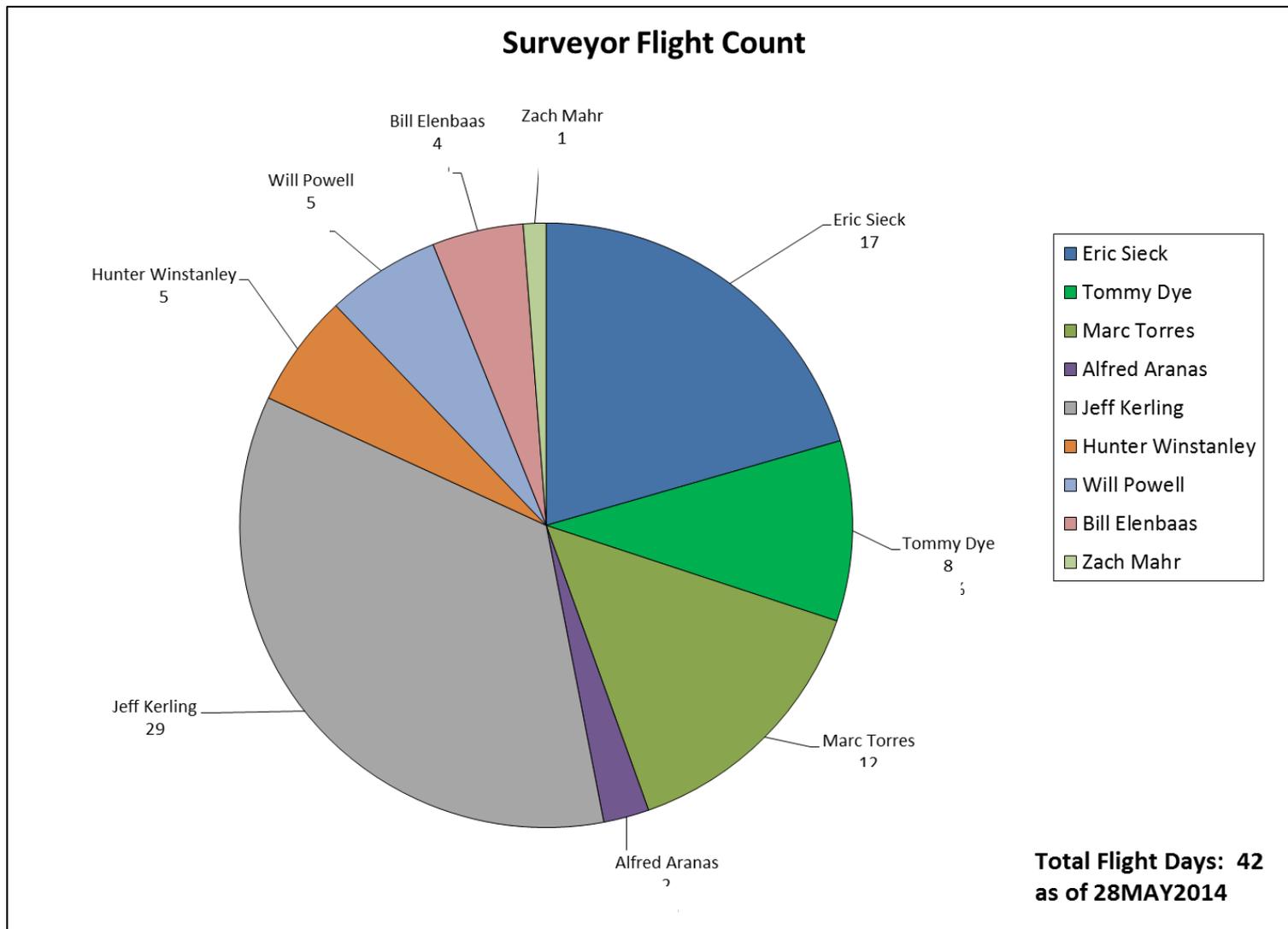


# Survey Efficiency



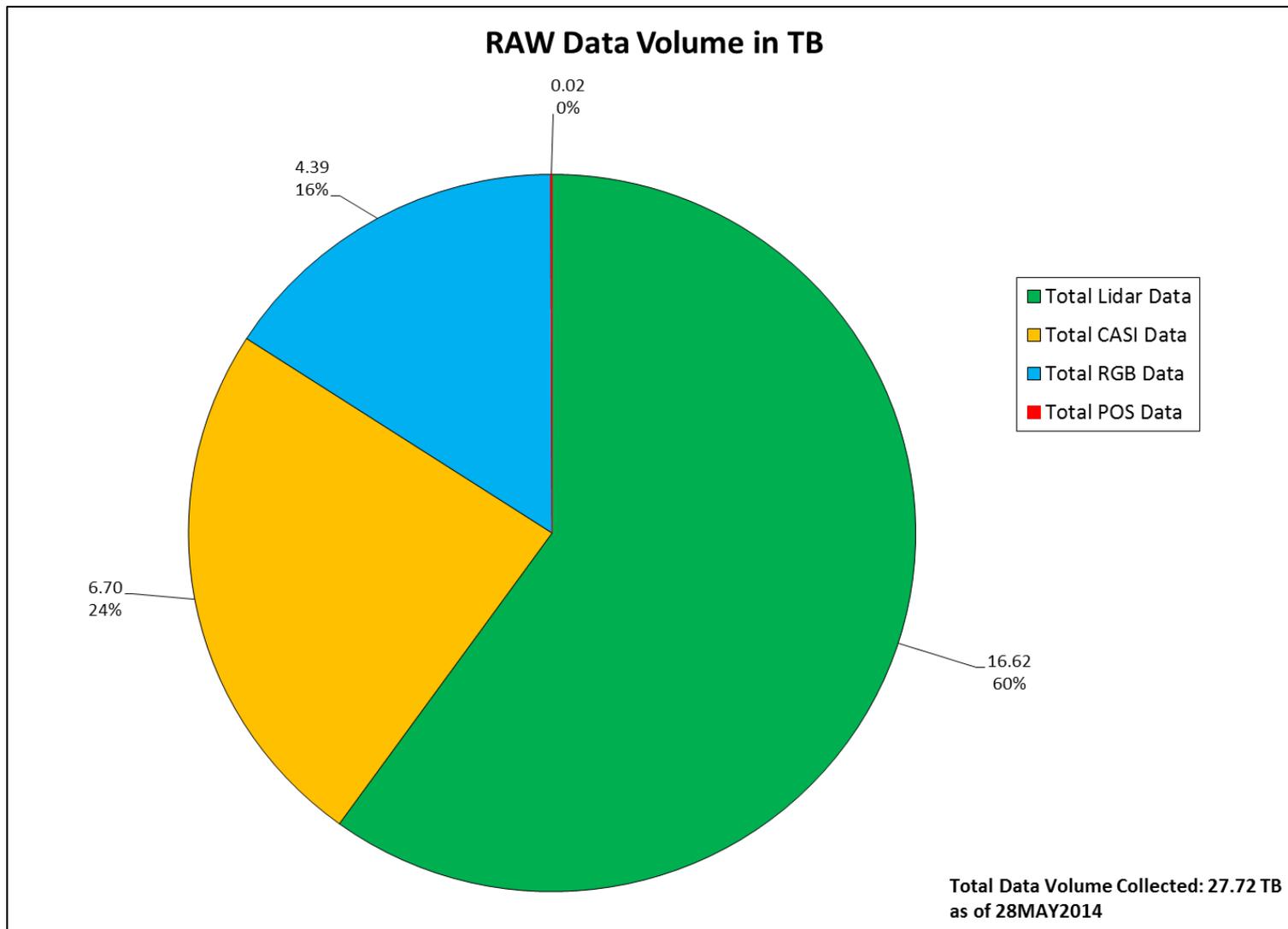


# Sensor Operators

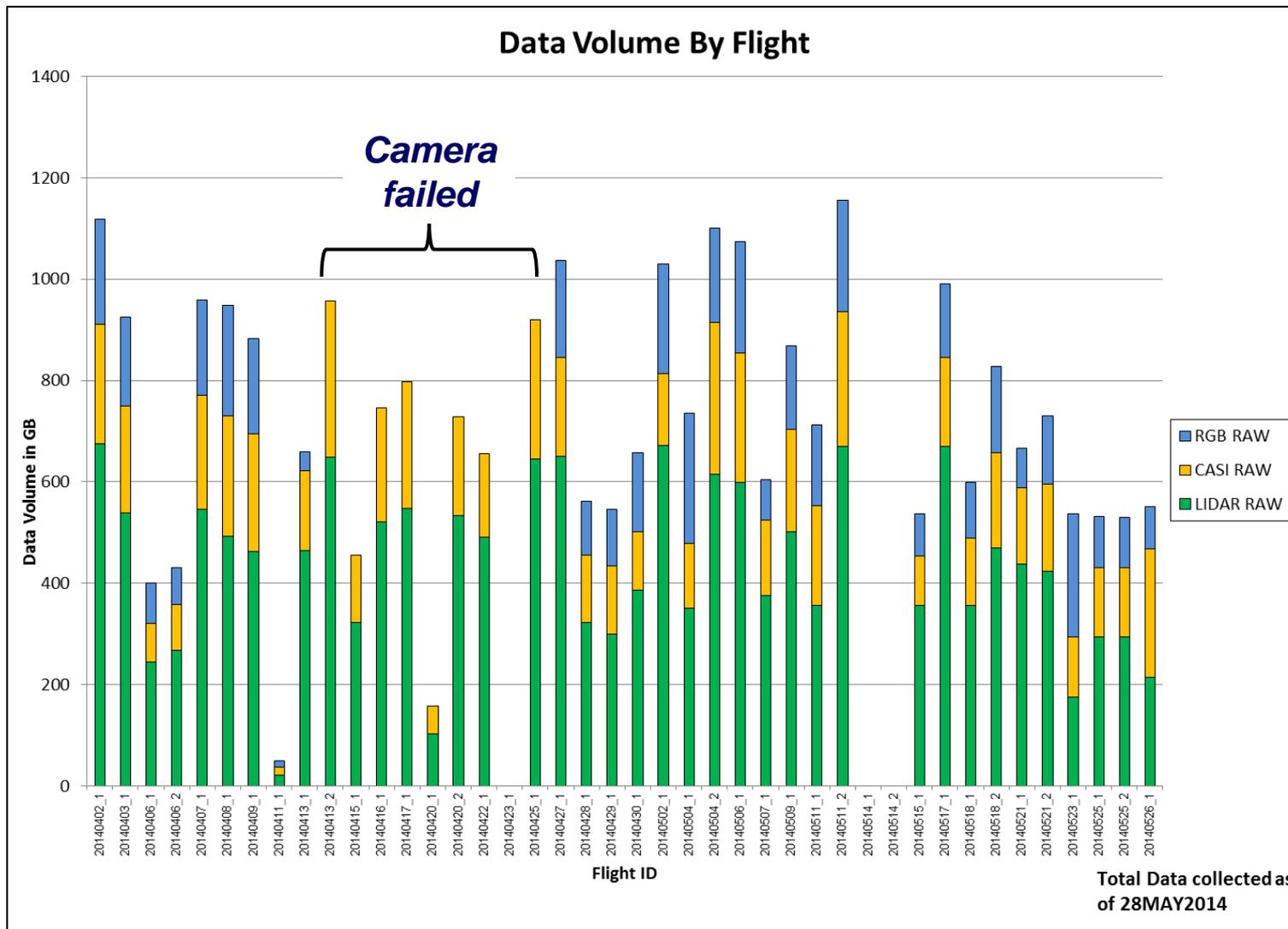




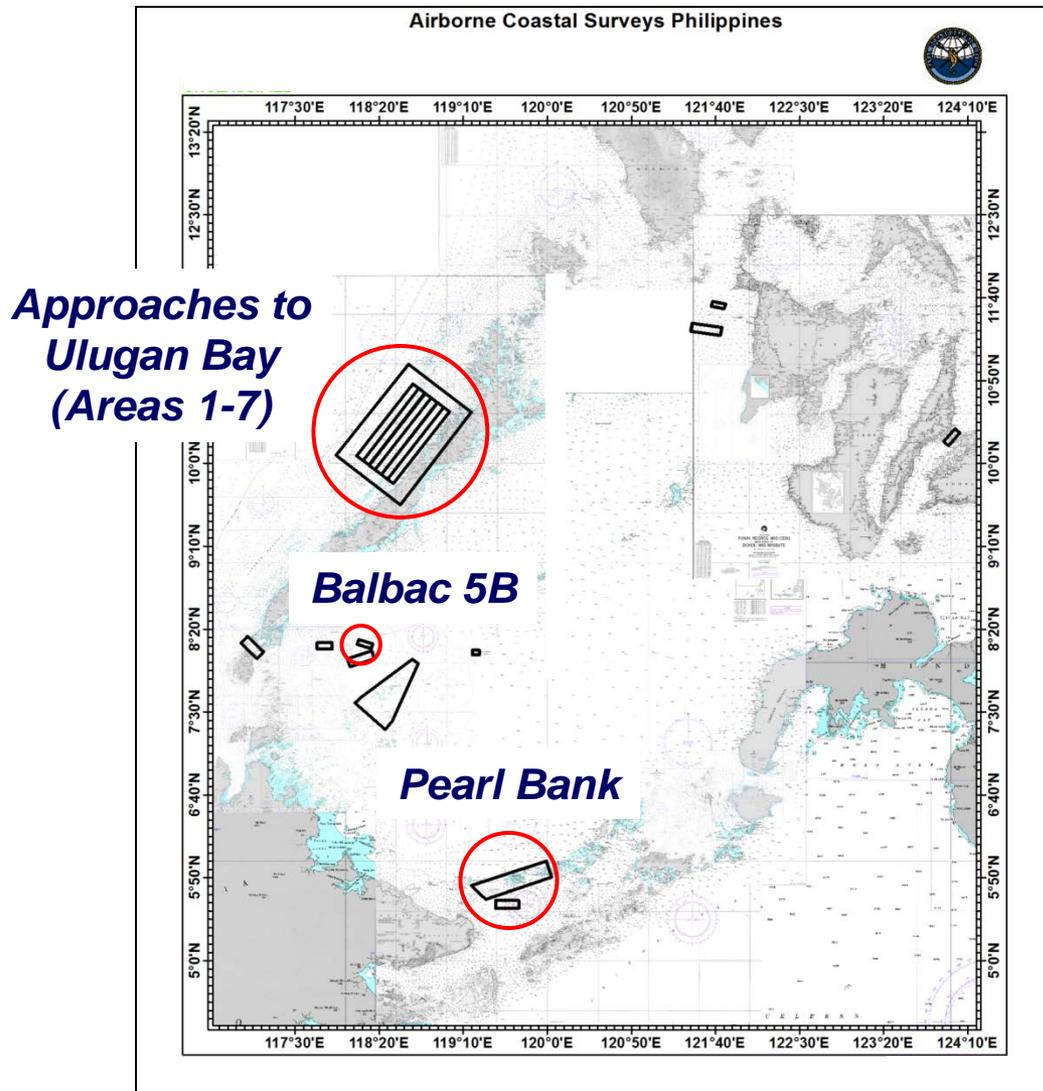
# Data Volume



# Data Volume

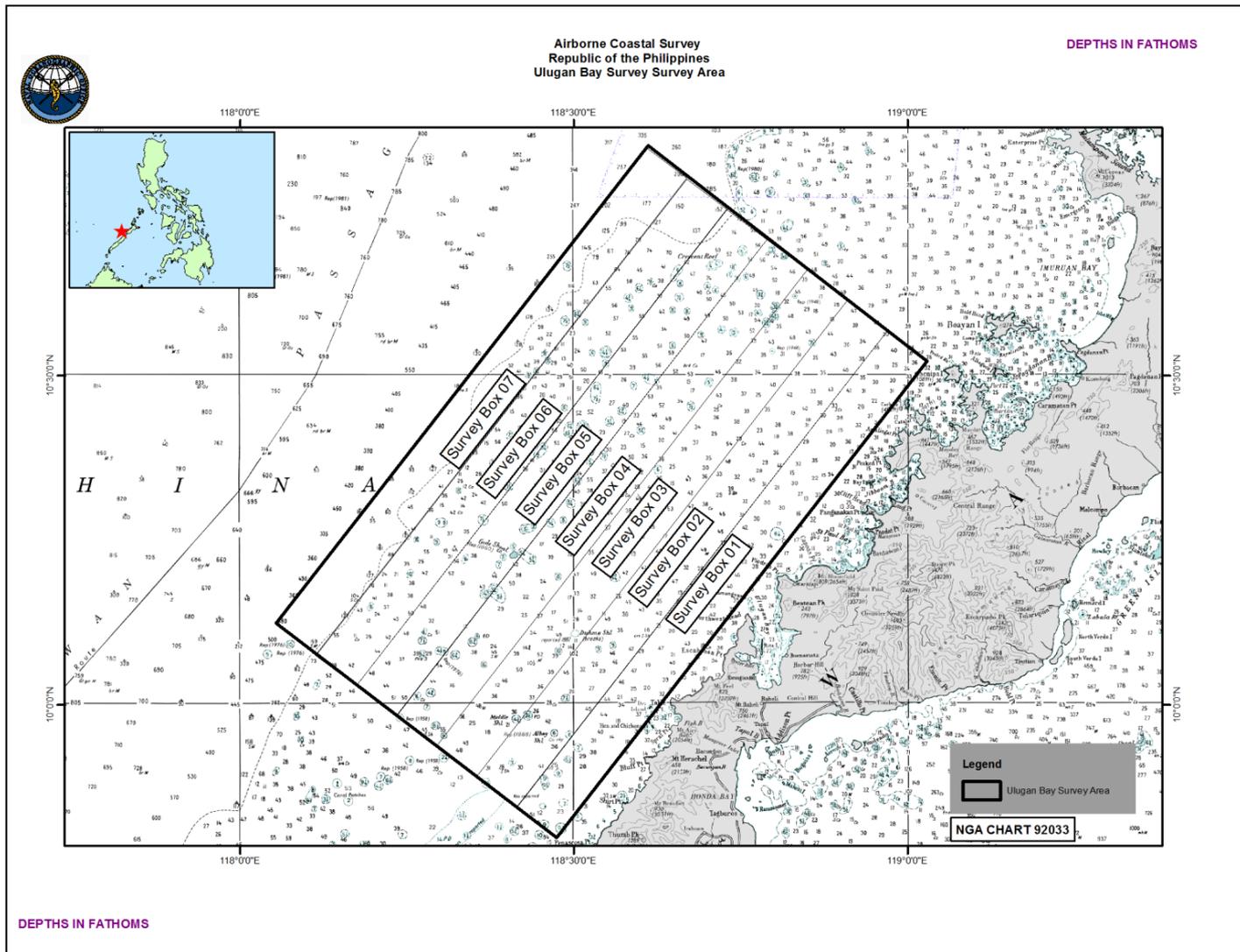


# Survey Areas

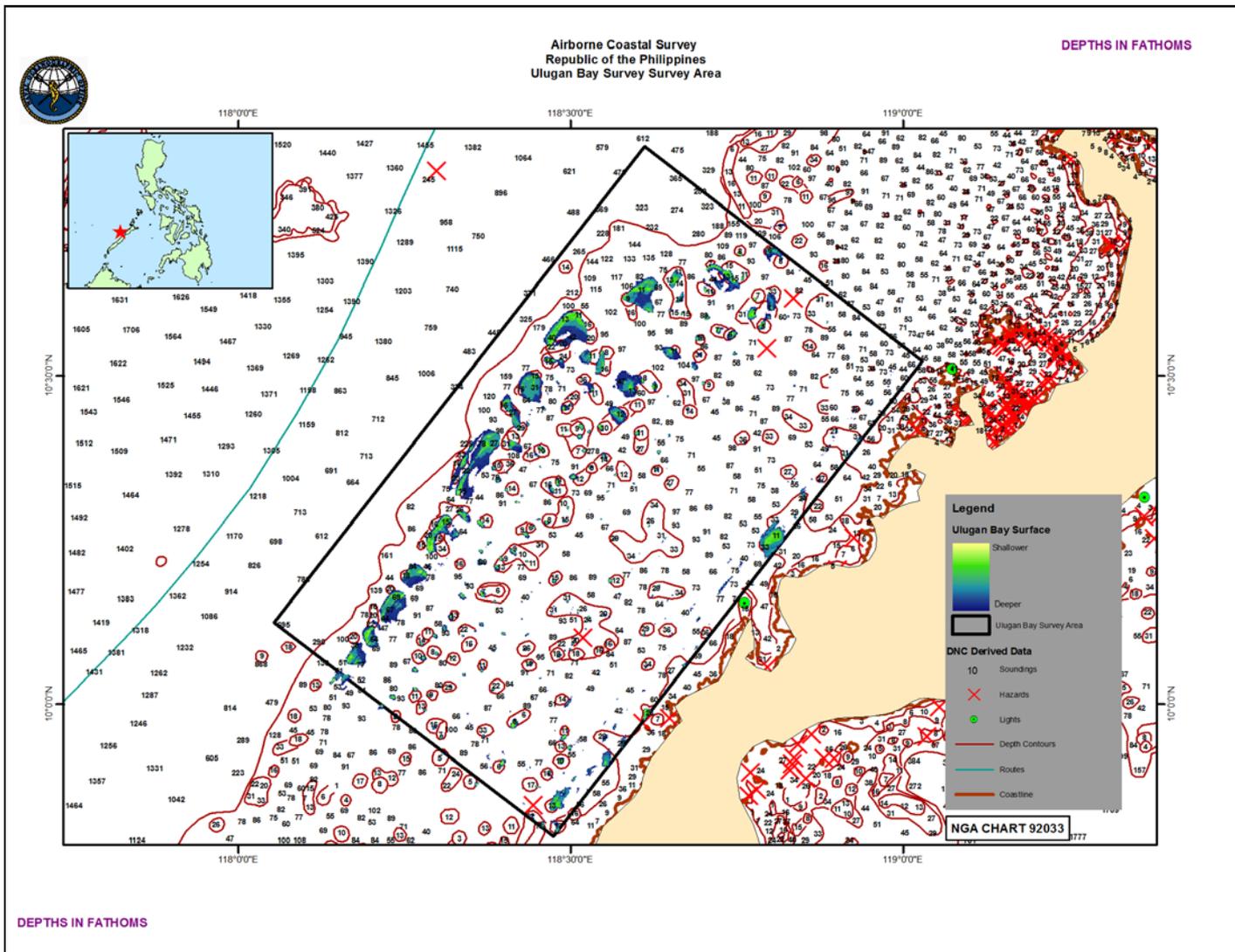




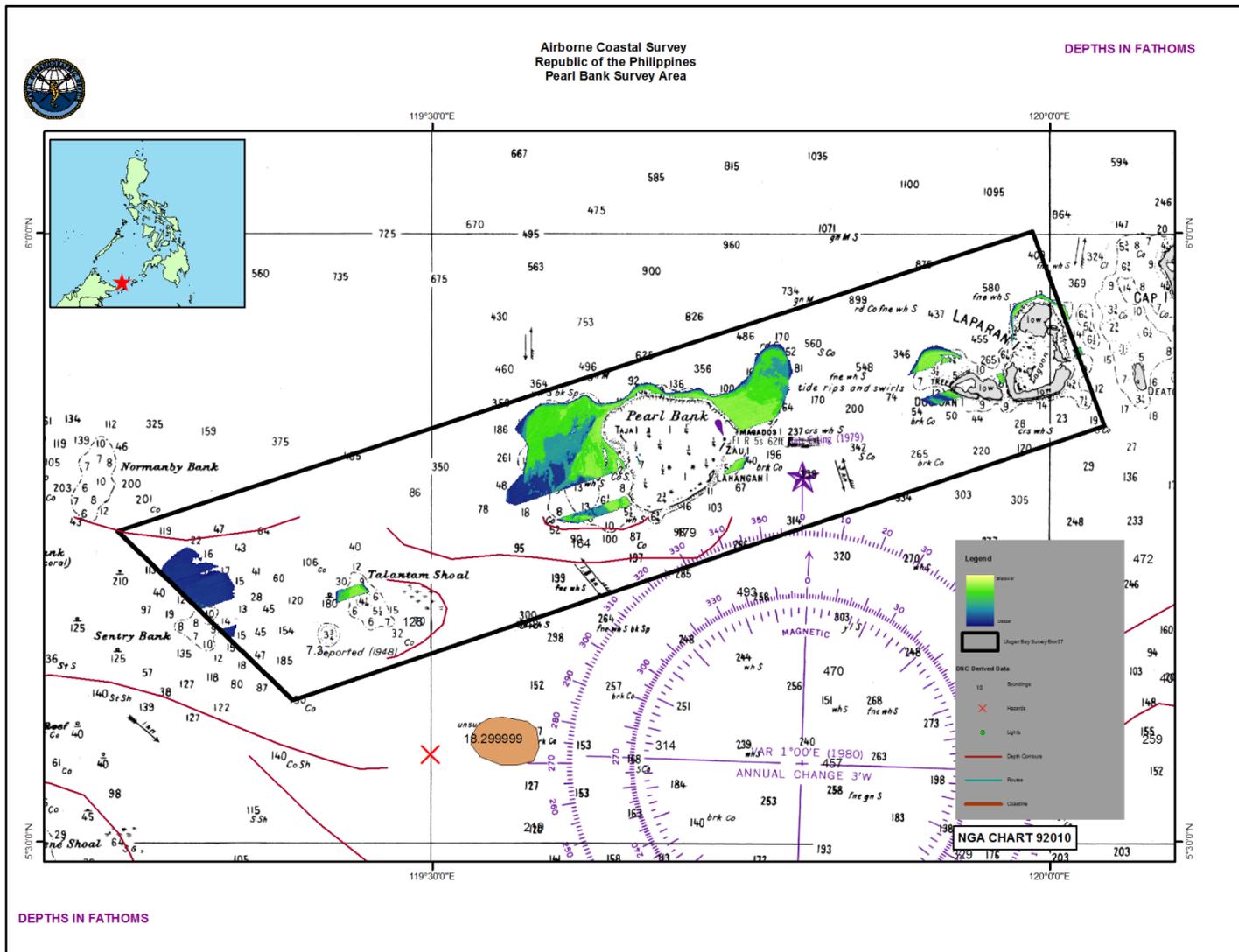
# Approaches to Ulugan Bay



# Approaches to Ulugan Bay

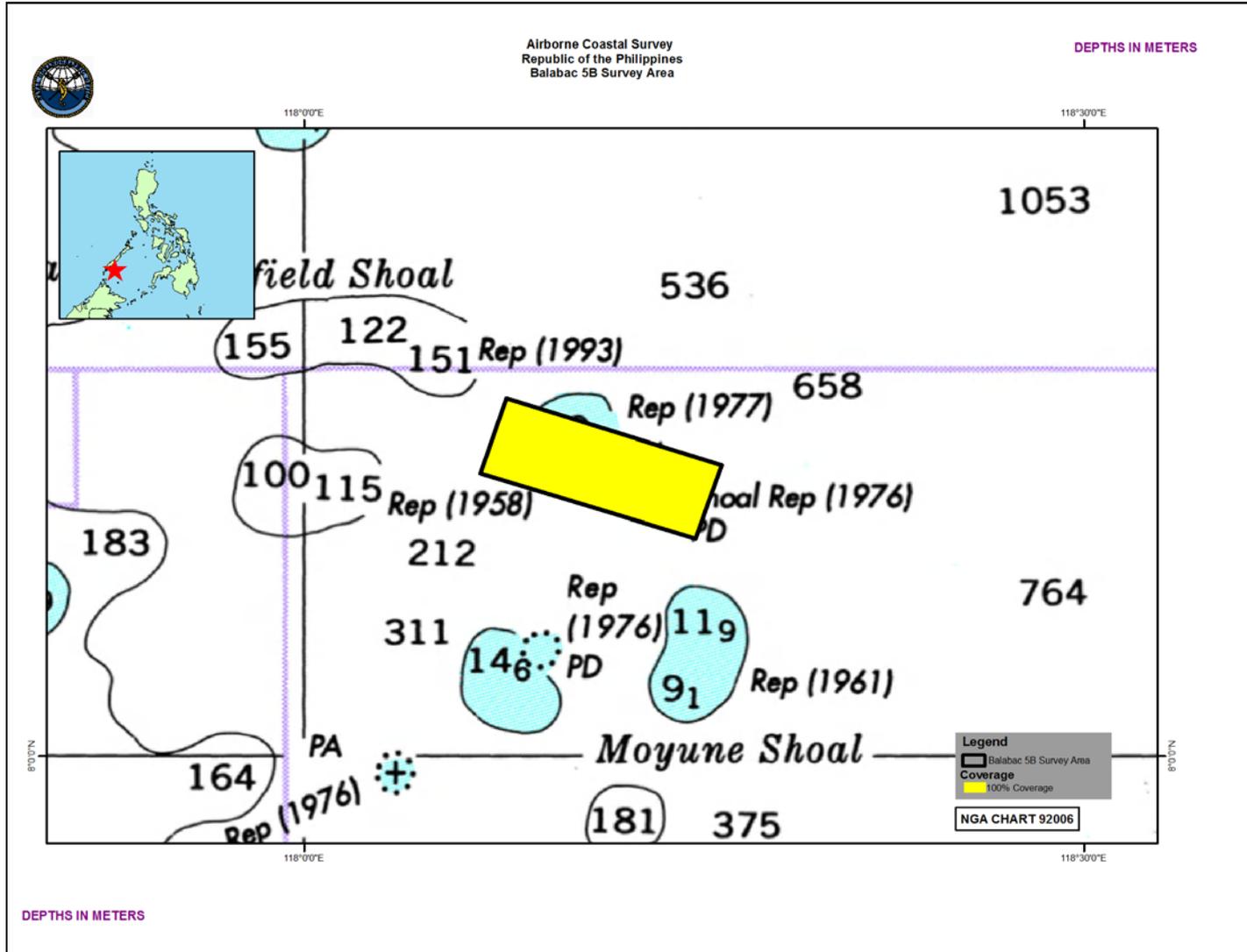


# Pearl Bank

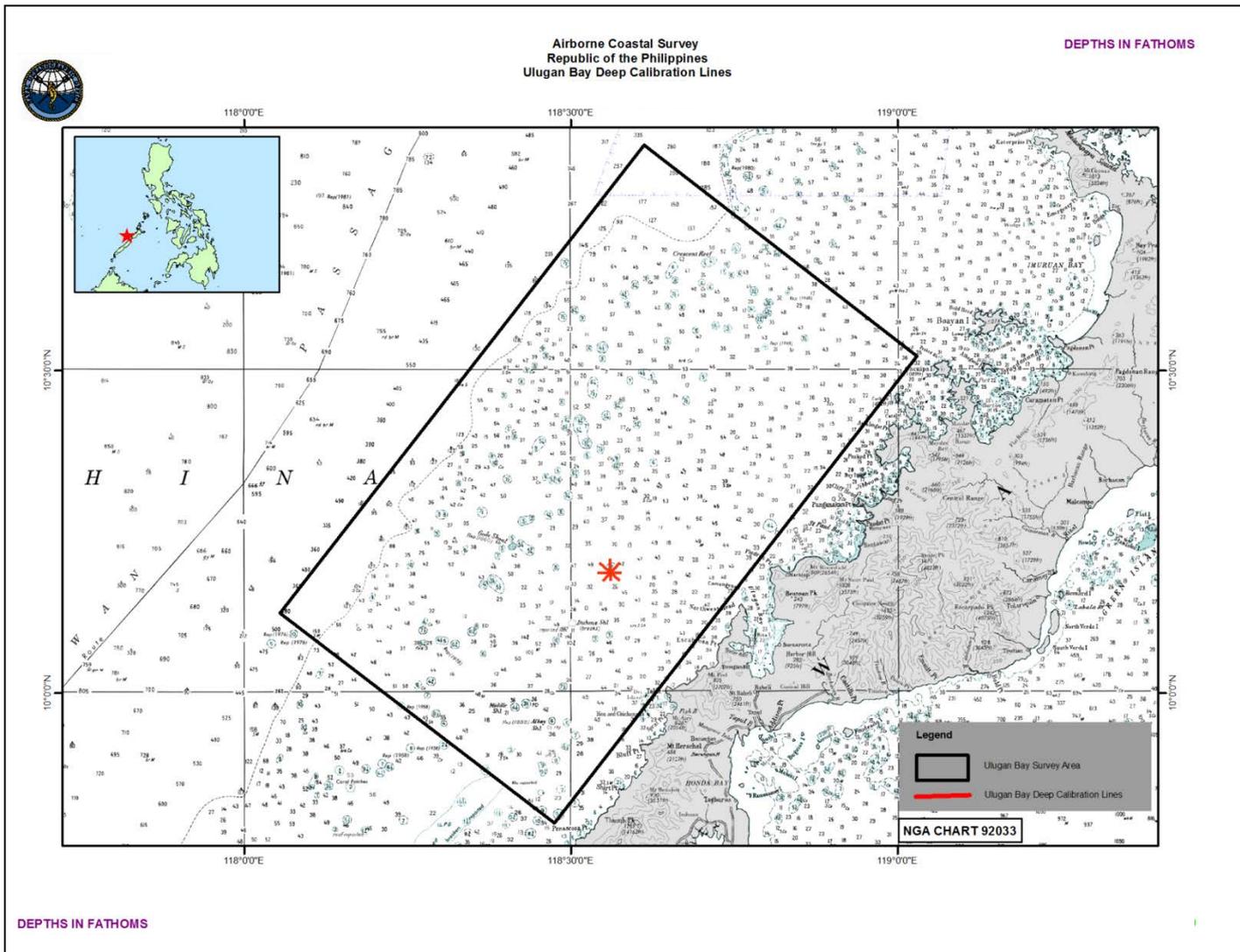




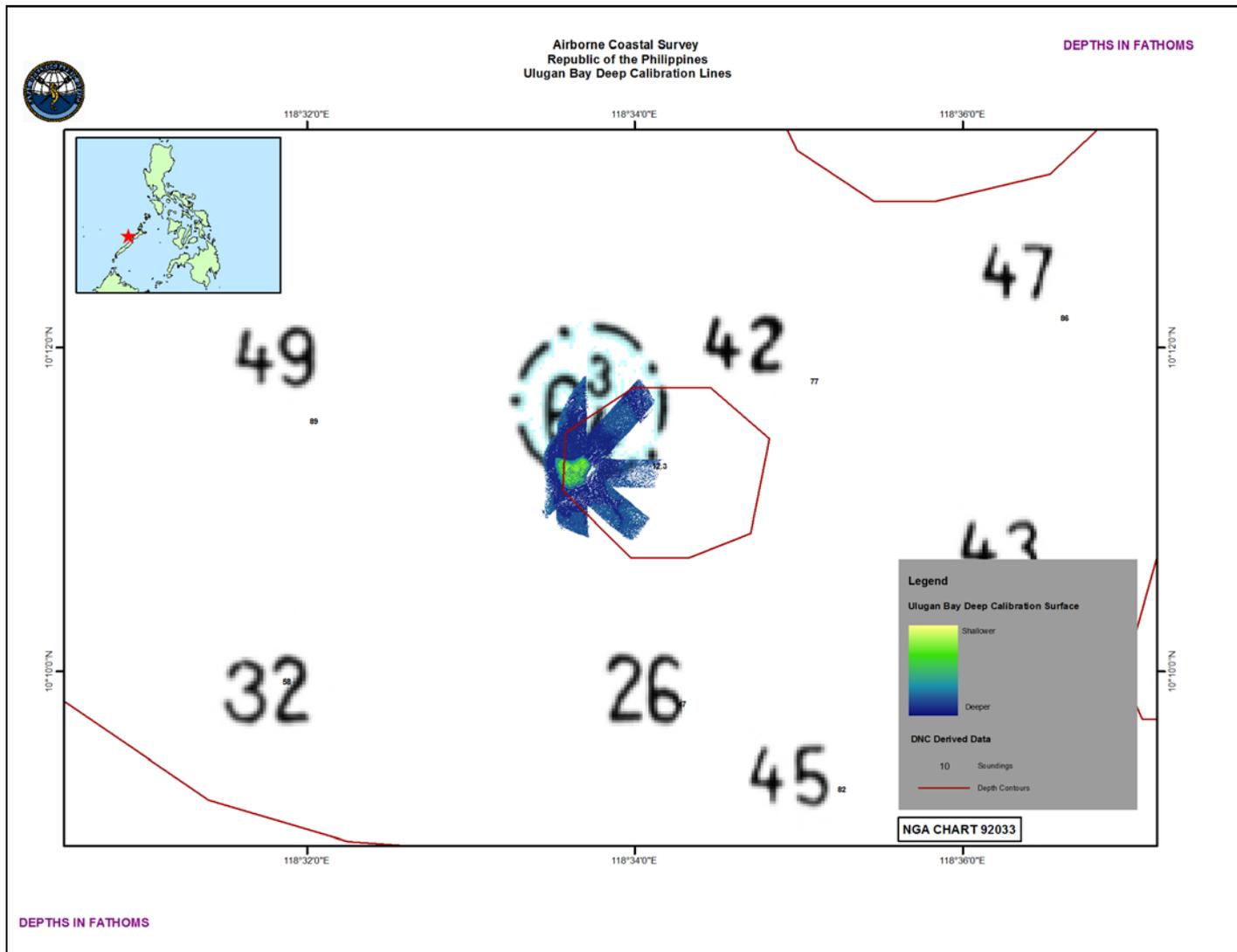
# Balabac 5B



# “Calibration Shoal”



# “Calibration Shoal”



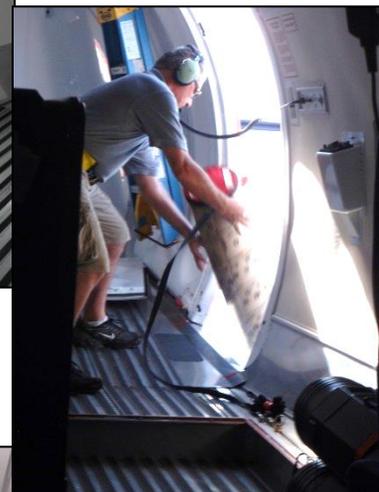


# Weather--“severe calm”

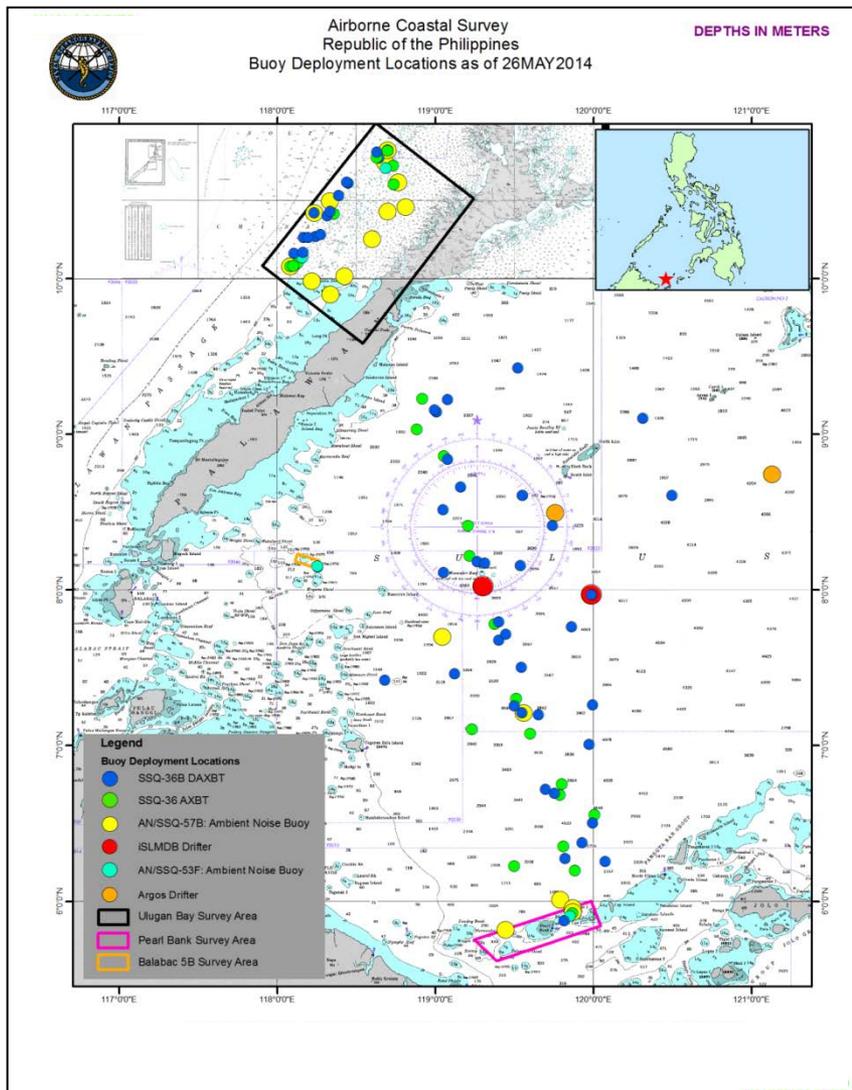




# Air-Dropped Expendables



# Air-Dropped Expendables



**107 operational air-dropped buoys deployed:**

<b>AN/SSQ-57B:</b>	<b>18</b>
<b>AN/SSQ-53F:</b>	<b>5</b>
<b>SSQ-36/36B:</b>	<b>80</b>
<b>iSLDMB:</b>	<b>2</b>
<b>Argos drifter:</b>	<b>2</b>

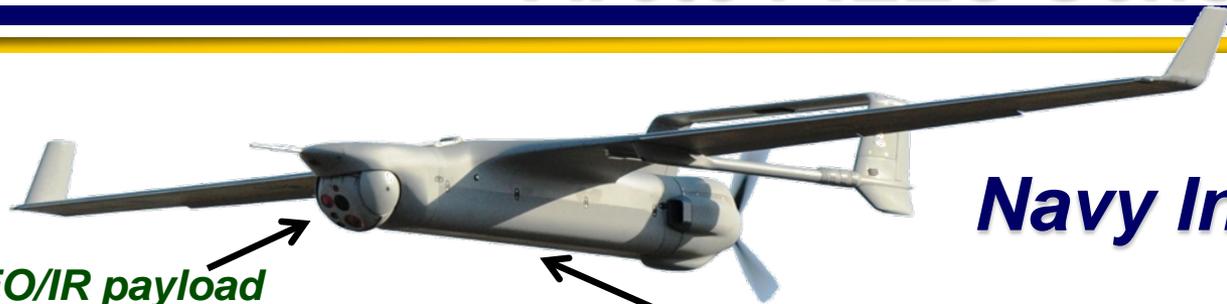


# Lessons Learned

- *100 km / 55 nm mile lines were efficient, maximum recommended length no discernable POS A/V drift, but difficult to fly*
- *April-May is in the middle of the Philippine “summer” – infrequent rain but occasional glassy calm surface hampered data collection in all areas.*
- *Palawan has slow, intermittent internet service*
- *Total collected data volume (27.2 TB raw) was underestimated*
- *JBOD good backup solution*
- *Recommend more workstations with JBOD cards*
- *Recommend faster workstations, more data storage*
  
- *C-FBKB*
- *Excellent survey platform (endurance, number of seats, fuel burn, multi-mission capability, low maintenance, )*
- *Will need 3 pilots / 2 mechanics IOT fly 6 days/ week*
- *Air-expendable capability was proven, could be improved with updated equipment and newer buoys*



# Future Technology Arête PILLS Sensor



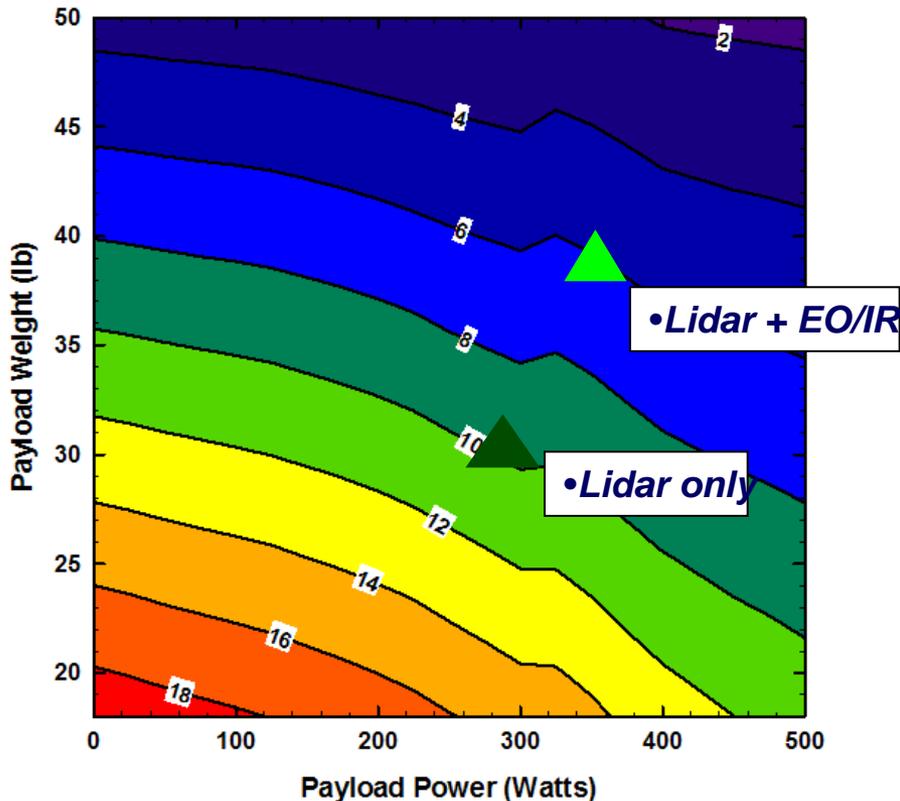
EO/IR payload

Lidar payload

135#, 26X12 Prop,

## Navy Integrator (STUAS)

NAVOCEANO is currently evaluating data collected during a Florida system demo



### Endurance:

Six hour (lidar + EO/IR)

Ten hour endurance (lidar only)

### Mission example:

100km transit 1 hour

100km<sup>2</sup> survey 3 hrs @ 33km<sup>2</sup>/hr

100km return 1 hour

Reserve 1 hour

Total mission 6 hours

Courtesy Arête Associates



# Questions?

