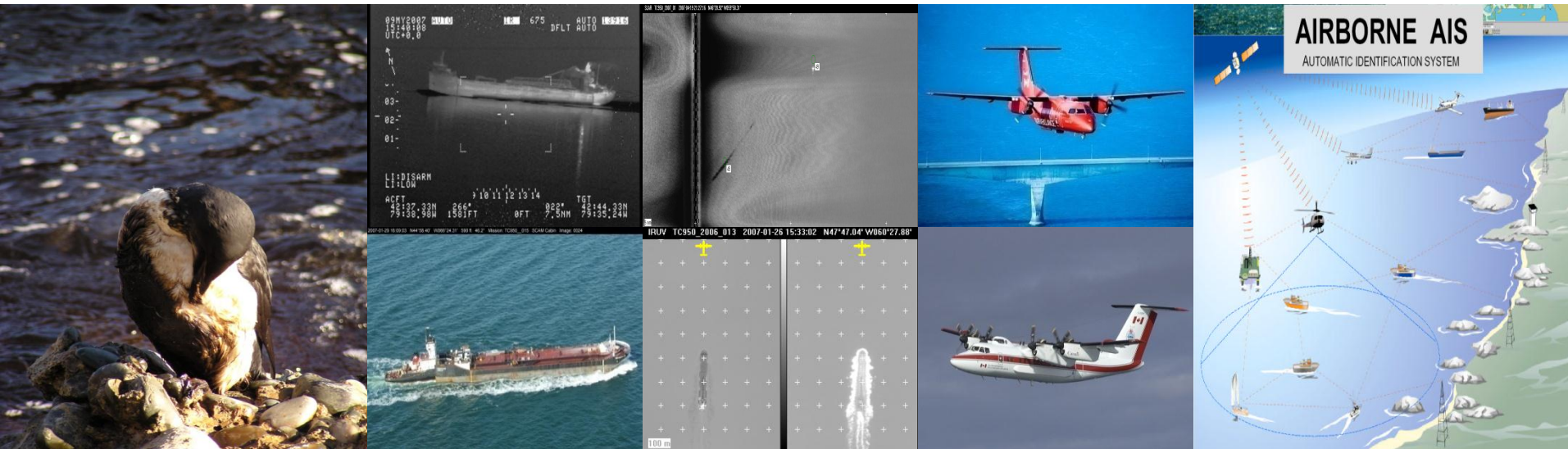


Surveillance and Reconnaissance

Optimizing the use of Transport Canada's Assets to Gain Public Confidence and Interdepartmental Recognition

Presented by:
Louis Armstrong
Chief - Intelligence, Surveillance and Reconnaissance
Feb 26, 2015

RDIMS# 10371230



Surveillance of Sea Surface Activities

- In Canada, Transport Canada works collaboratively with other departments to enforce the different mandates to protect the marine environment, enhance marine safety and security, and support economic development for the benefit of coastal communities and all Canadians



Environnement
Canada

Environment
Canada



Fisheries and Oceans
Canada

Pêches et Océans
Canada



National
Defence

Défense
nationale



Royal Canadian
Mounted Police

Gendarmerie royale
du Canada



Canadian Coast Guard
Garde côtière canadienne

Background / Milestones

- 1968 – Pollution Patrols commenced over the Great Lakes
- 1991 – NASP was created and expanded to the East and West
- 2003 – Program transferred to TC
- 2005 – Arctic Patrols began in Partnership with EC
- 2006 – First Dash 8 Commissioned with MSS6000
- 2008 – Second Dash 8 Commissioned with MSS6000
- 2009 – Dash 7 Modernization project was completed with MSS6000
- 2010 – 11 weeks in Houma responding to DWH Incident
- 2013 – World Class Tanker Safety System (WCTSS)
 - Secured sufficient permanent funding
- 2014 – NASP Crew found RCMP shooter using MX15

Program Enhancements – WCTSS

- Long Term Funding - \$47M over 5 years and \$10.7M ongoing
- Human Resources – FTEs and Salary
- Additional Hours – maximized utilization of the assets
- Satellite Communications System upgrades
- Equipment upgrades and additional spares



Why does TC Conduct Surveillance?

- Accidental or intentional discharges of oil
- Steady increase in commercial shipping
- The prevention of oiled wildlife
- Identification of vessels in marine protected areas
- Our department's role in maritime security
- Ensure public confidence in Canada's Transportation System



Program Resources

3 **DEDICATED** TC Aircraft

- 3 teams that cover Canada's 3 Oceans
- ~ 40 People across Canada

+ Access to 4 Contracted Private Industry aircraft

- Provincial Airlines (PAL)
- Surveillance in Newfoundland and Labrador

~ \$7M – budget for 2014/15



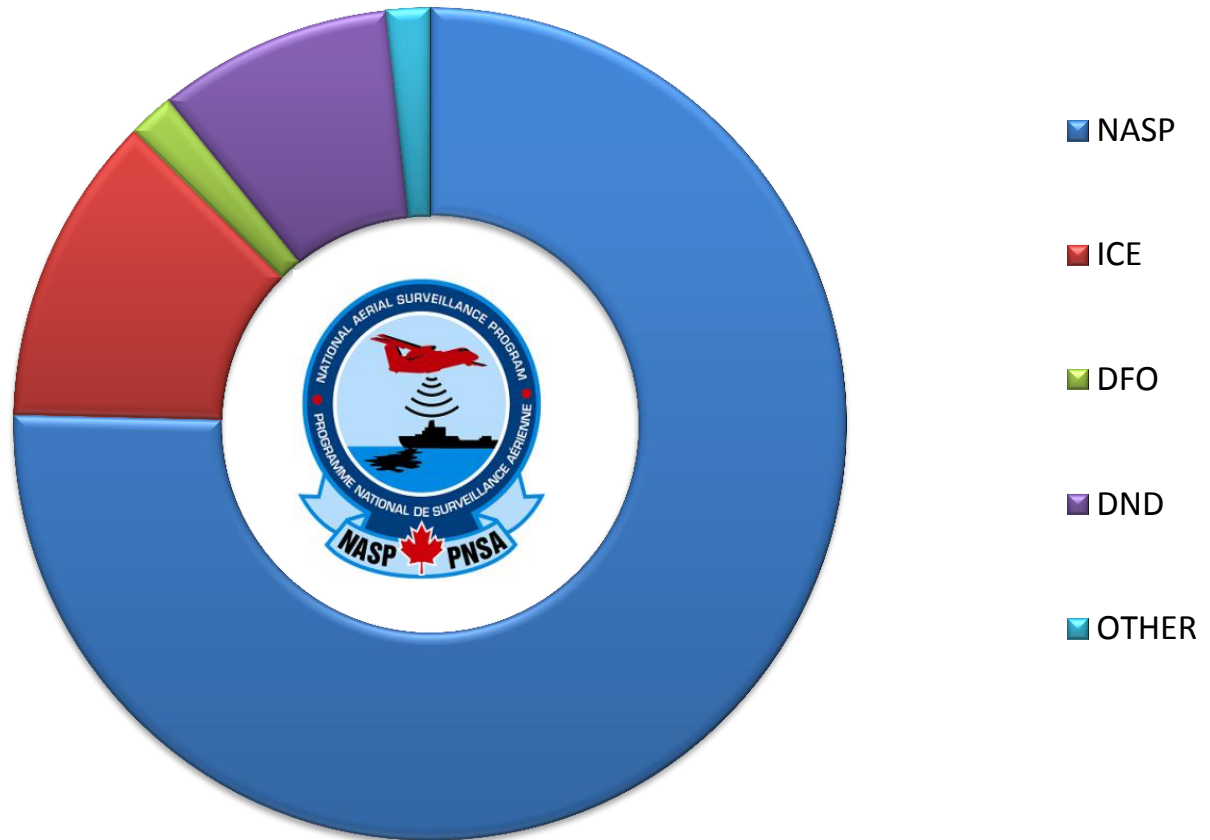


- Legend**
- ★ Vancouver (NASP Primary Base)
 - ★ Moncton (NASP Primary Base)
 - ★ Ottawa (NASP Primary Base)
 - ★ Iqaluit (NASP Secondary Base)
 - ★ St. John's (PAL Primary Base)
 - Canadian Exclusive Economic Zone

NASP Statistics

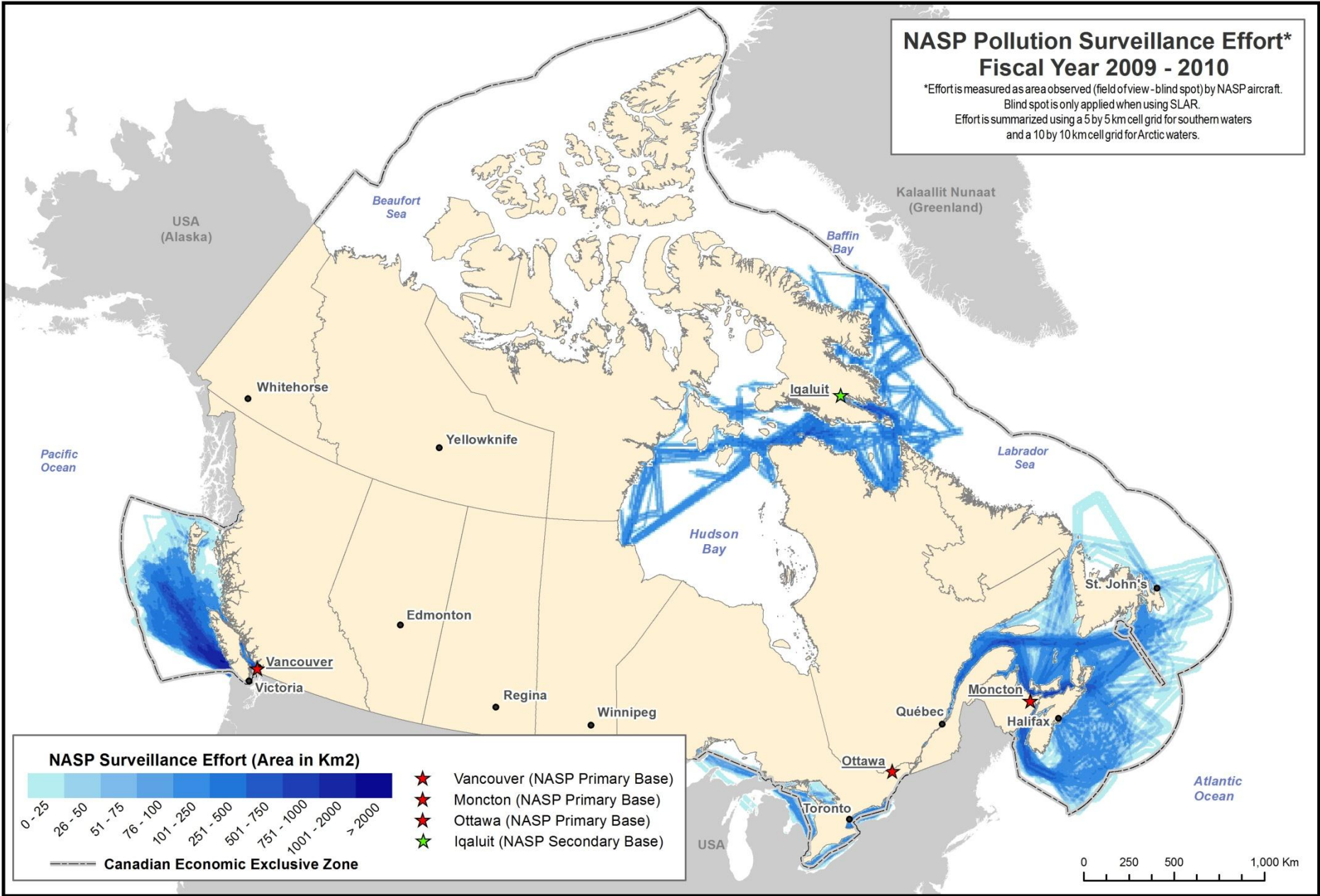
Fiscal Year	Patrol Hours	PAL Hours	TC Hours	Vessel Over-flights (VOF)	Pollution Sightings	Oil Volume (litres)
2007/2008	2,578	587	1,991	13,038	151	3,130
2008/2009	2,340	561	1,779	9,947	183	2,863
2009/2010	2,274	611	1,663	11,262	109	8,111
2010/2011	2,506	898	1,855	12,365	84	9,296
2011/2012	2,063	501	1,562	12,032	135	1,014
2012/2013	1,814	119	1,695	9,855	97	7,813
2013/2014	3,877	669	3,208	19,989	214*	4,453

NASP Mission Purpose Hours Fiscal Year 2013-2014



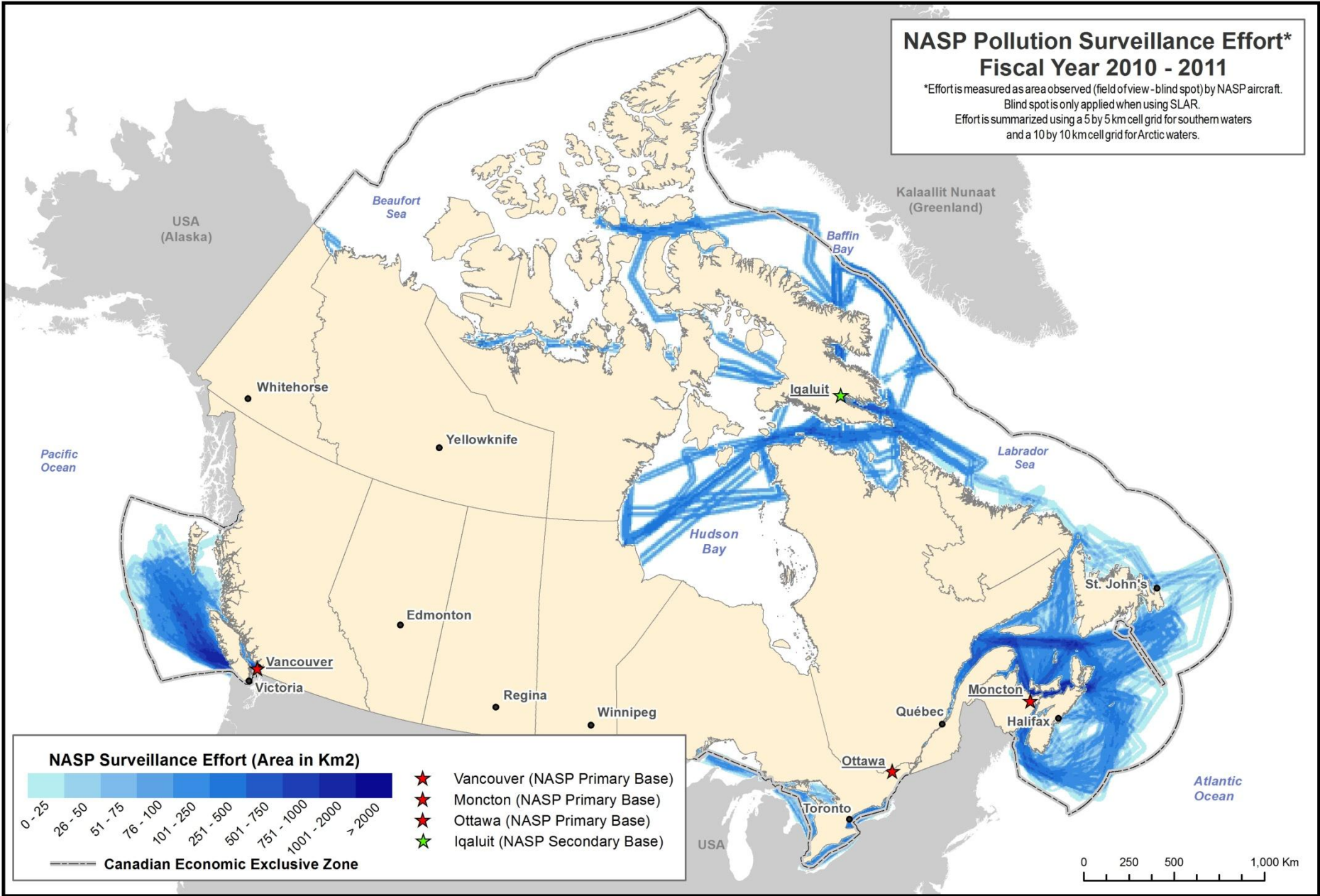
NASP Pollution Surveillance Effort* Fiscal Year 2009 - 2010

*Effort is measured as area observed (field of view - blind spot) by NASP aircraft.
Blind spot is only applied when using SLAR.
Effort is summarized using a 5 by 5 km cell grid for southern waters
and a 10 by 10 km cell grid for Arctic waters.



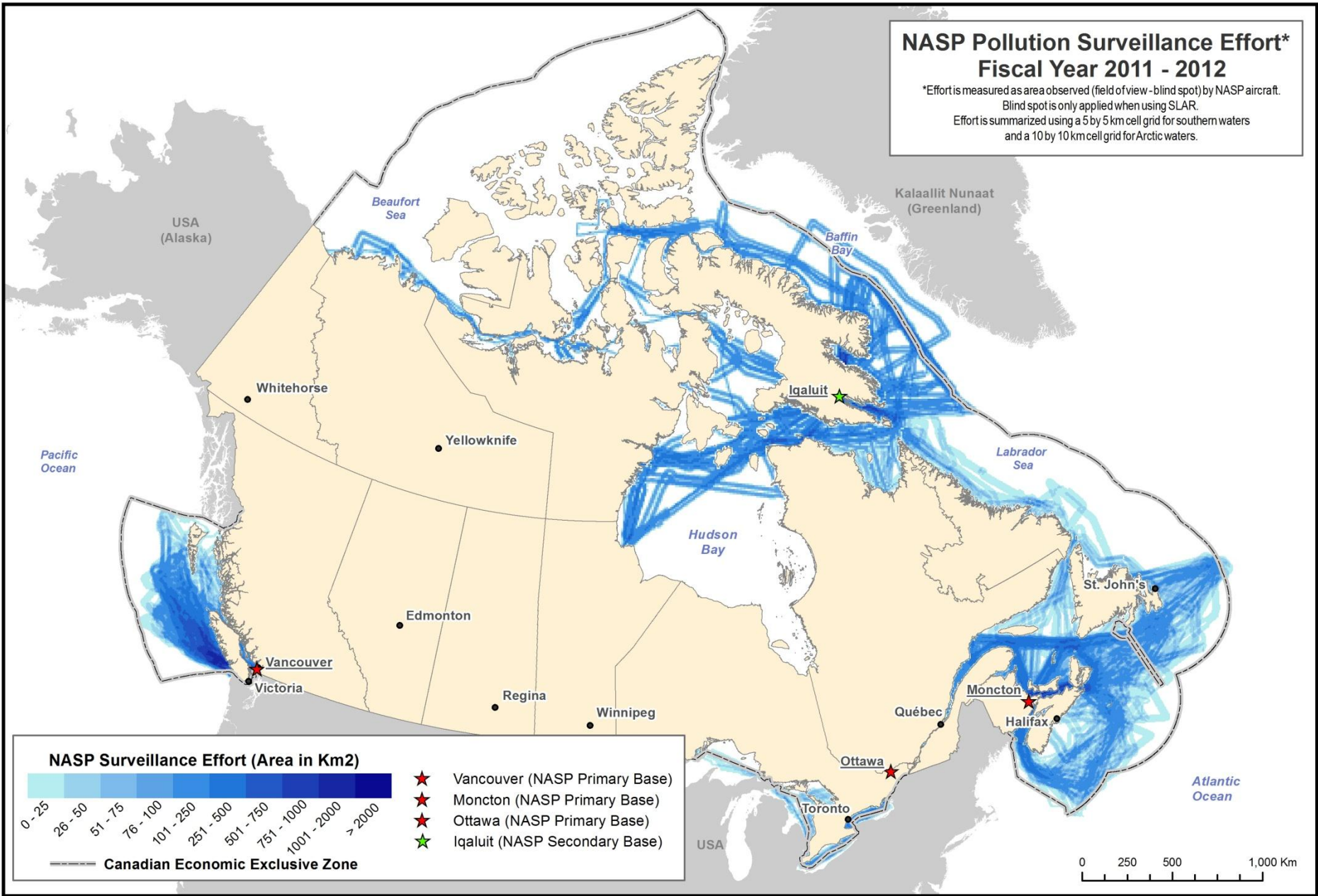
NASP Pollution Surveillance Effort* Fiscal Year 2010 - 2011

*Effort is measured as area observed (field of view - blind spot) by NASP aircraft.
Blind spot is only applied when using SLAR.
Effort is summarized using a 5 by 5 km cell grid for southern waters
and a 10 by 10 km cell grid for Arctic waters.



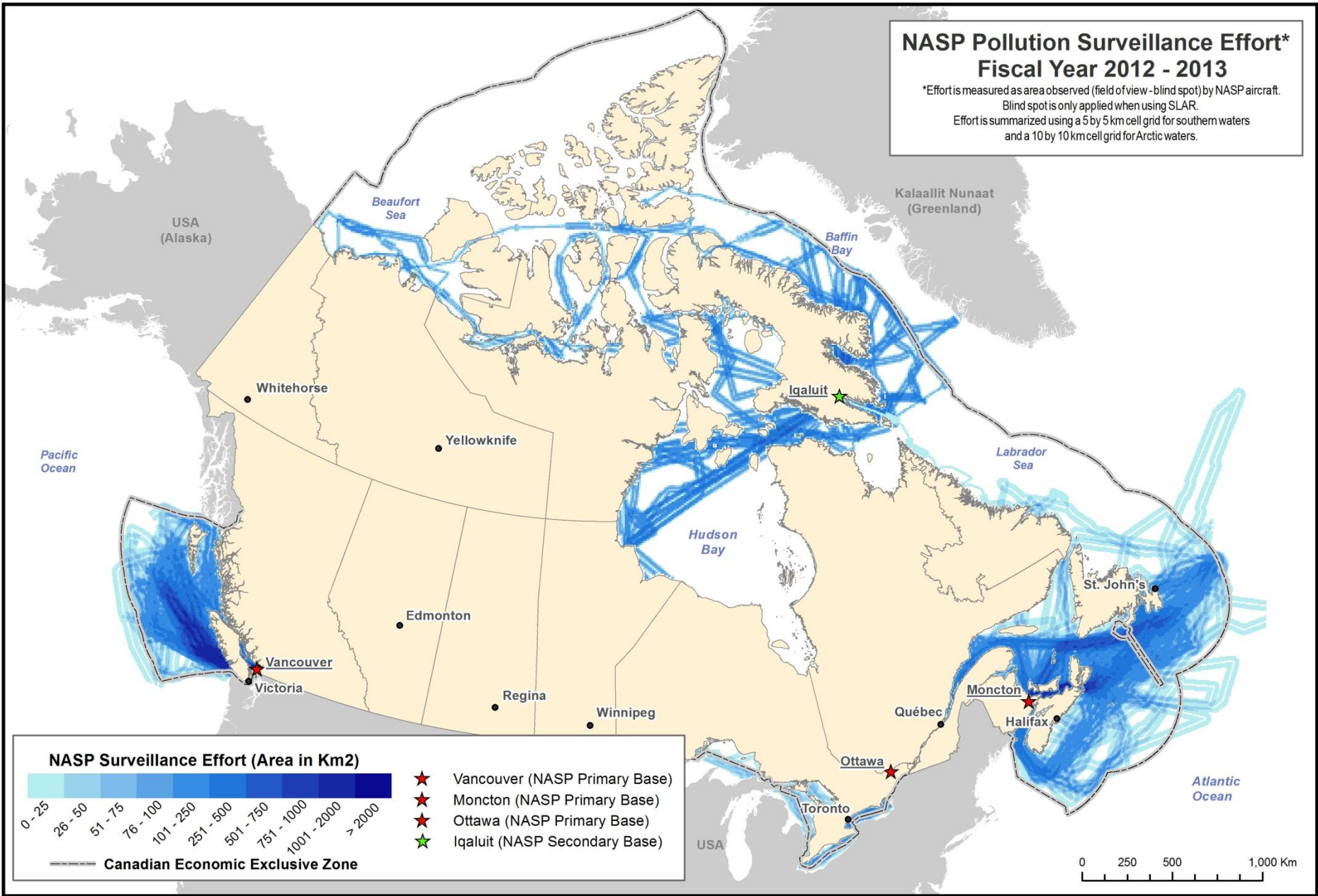
NASP Pollution Surveillance Effort* Fiscal Year 2011 - 2012

*Effort is measured as area observed (field of view - blind spot) by NASP aircraft.
Blind spot is only applied when using SLAR.
Effort is summarized using a 5 by 5 km cell grid for southern waters
and a 10 by 10 km cell grid for Arctic waters.



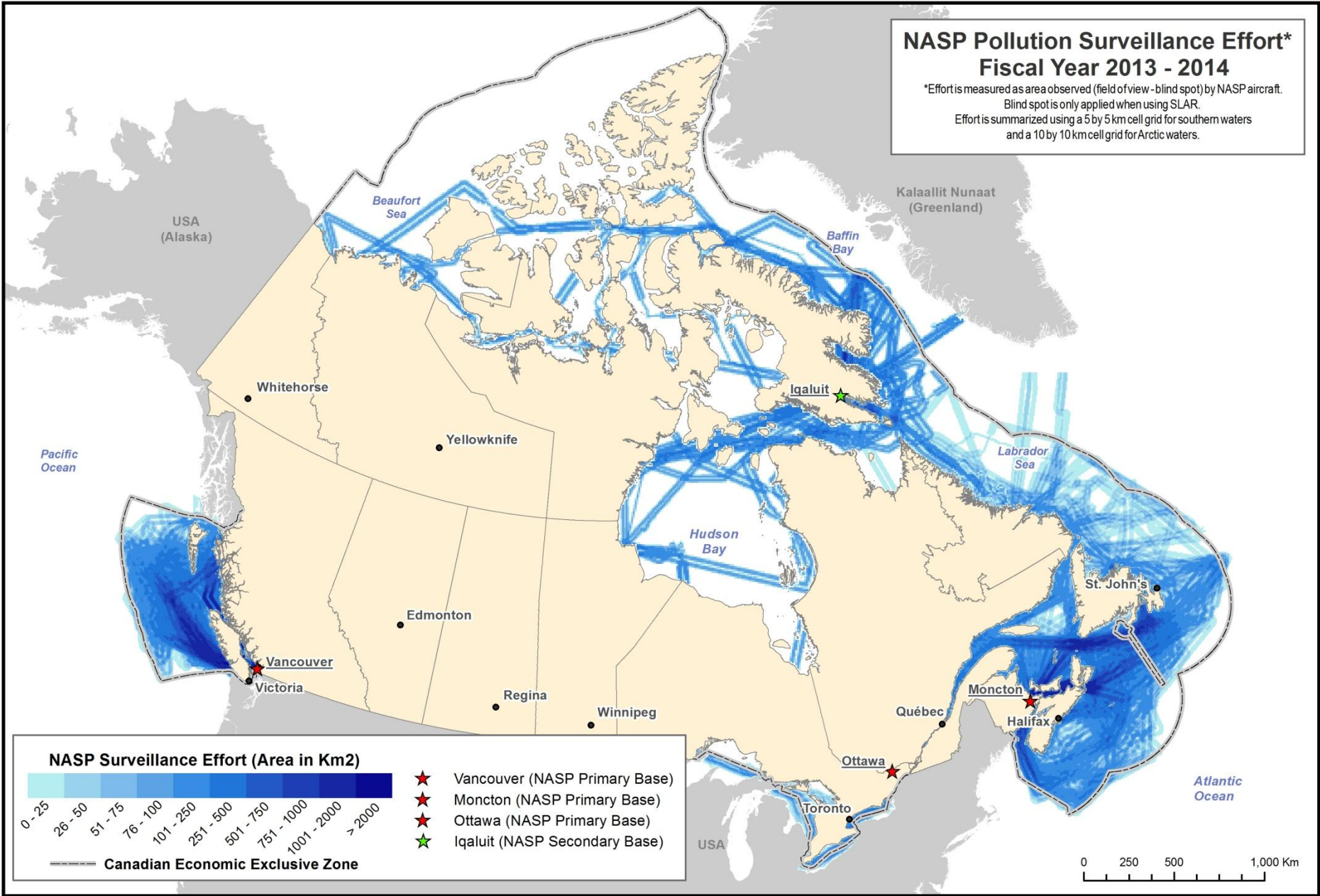
NASP Pollution Surveillance Effort* Fiscal Year 2012 - 2013

*Effort is measured as area observed (field of view - blind spot) by NASP aircraft.
Blind spot is only applied when using SLAR.
Effort is summarized using a 5 by 5 km cell grid for southern waters
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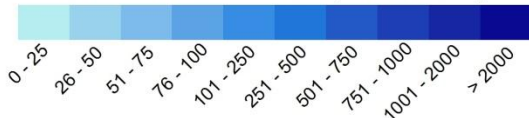


NASP Pollution Surveillance Effort* Fiscal Year 2013 - 2014

*Effort is measured as area observed (field of view - blind spot) by NASP aircraft.
Blind spot is only applied when using SLAR.
Effort is summarized using a 5 by 5 km cell grid for southern waters
and a 10 by 10 km cell grid for Arctic waters.

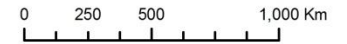


NASP Surveillance Effort (Area in Km²)



— Canadian Economic Exclusive Zone

- ★ Vancouver (NASP Primary Base)
- ★ Moncton (NASP Primary Base)
- ★ Ottawa (NASP Primary Base)
- ★ Iqaluit (NASP Secondary Base)



Flight Priorities

1. SAA
2. Emergency Response
3. Client Centered Immediate Action/
Response
4. Routine Patrol – Primary Mission
5. Routine Patrol – Secondary Mission
6. Special Requests by Clients
7. Special Requests by other agencies

Surveillance Tools Used Prior to 2006

Comprised of:

- Naked Eye
- Digital Still & Video Camera Systems
- Expert Witness Testimony

Maritime Surveillance System (MSS-6000)

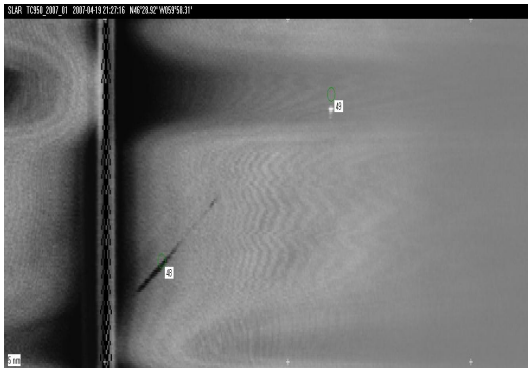
- Designed to meet Coast Guard requirements for airborne surveillance and reconnaissance
- Based on more than 35 years experience
- Designed by Swedish Space Corporation now called S&T Airborne Systems (Sjöland & Thyselius)
- Used in many other Countries: Estonia, Finland, Greece, India, Iceland, Malaysia, Portugal, Poland, Sweden, Vietnam, Uruguay
- MSS7000 coming soon!!!

Surveillance System Used Today

Maritime Surveillance System (MSS6000) is comprised of six components/sensors

- Side Looking Airborne Radar (SLAR) – **anomaly detection**
- Electro-optical Infrared Camera System (EO/IR) – **source identification**
- Infrared / Ultraviolet Line Scanner (IR/UV) – **oil analysis**
- Digital Still & Video Camera Systems – **evidence support**
- Automatic Identification System (AIS) – **evidence support**
- Satellite Communication System – **communication to the ground – Real time Streaming video since DWH**

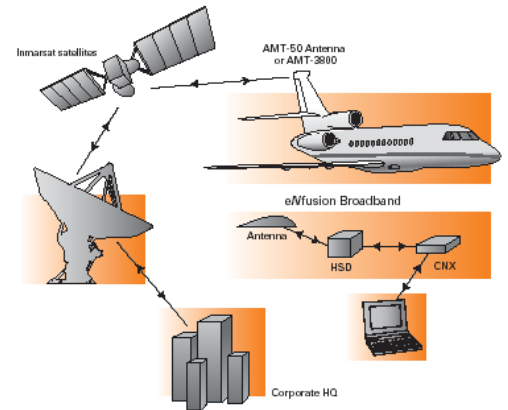
MSS6000 Sensors / Components



SLAR



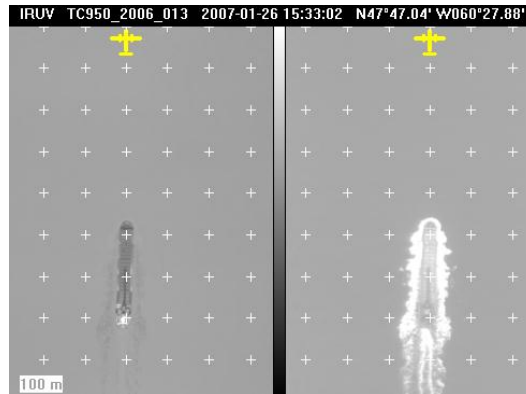
CONSOLE



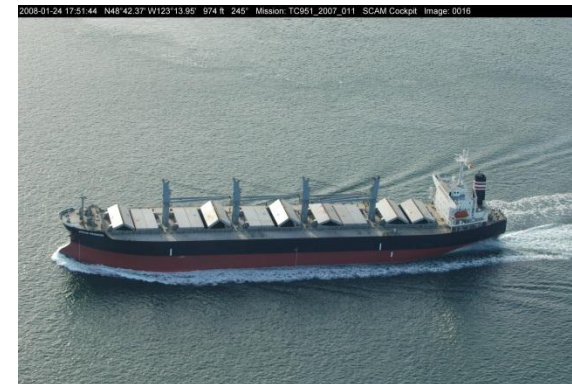
SATCOM



EO/IR



IR/UV



Cameras

NASP Maritime Surveillance System Sensors



INMARSAT ANTENNA

SLAR ANTENNA

AIS ANTENNA

IR/UV SCANNER

MX15 CAMERA

Primary Reason for Conducting Surveillance

Oil Spill Detection

- Position – Photo, EOIR, SLAR, IR/UV
- Area - SLAR, IR/UV , Moving Map (Polygon creation)
- Thickness - IR/UV (qualitative), visual observation
- Pollutant Type – visual observation
- Pollutant Characteristics - visual observation, photo , IR
- Polluter - Photo, EOIR, SLAR, AIS, Radio Communications

Side Looking Airborne Radar (SLAR)

Primary sensor in the suite

Swath width with visual surveillance (Naked Eye)

- 4 nm (2 nm each side)

Swath width using SLAR

- 30 nm (15 nm each side) – oil detection
- 80 nm (40 nm each side) – ice detection
- 90 nm (45 nm each side) – vessel detection

Can be used during conditions of reduced visibility and during hours of darkness - Insensitive weather and light conditions

X-Band Radar with a 60 m Resolution

The SLAR Antenna



The Blind Spot

- There is a swath beneath the aircraft that is blind to the radar
- This swath width is equal to 2 X the height of the aircraft.
 - So, for example, if the aircraft was flying at 20,000 feet the blind spot would be 40,000 feet or approximately 8 miles – 4 miles on either side of the aircraft.

Blind Spot



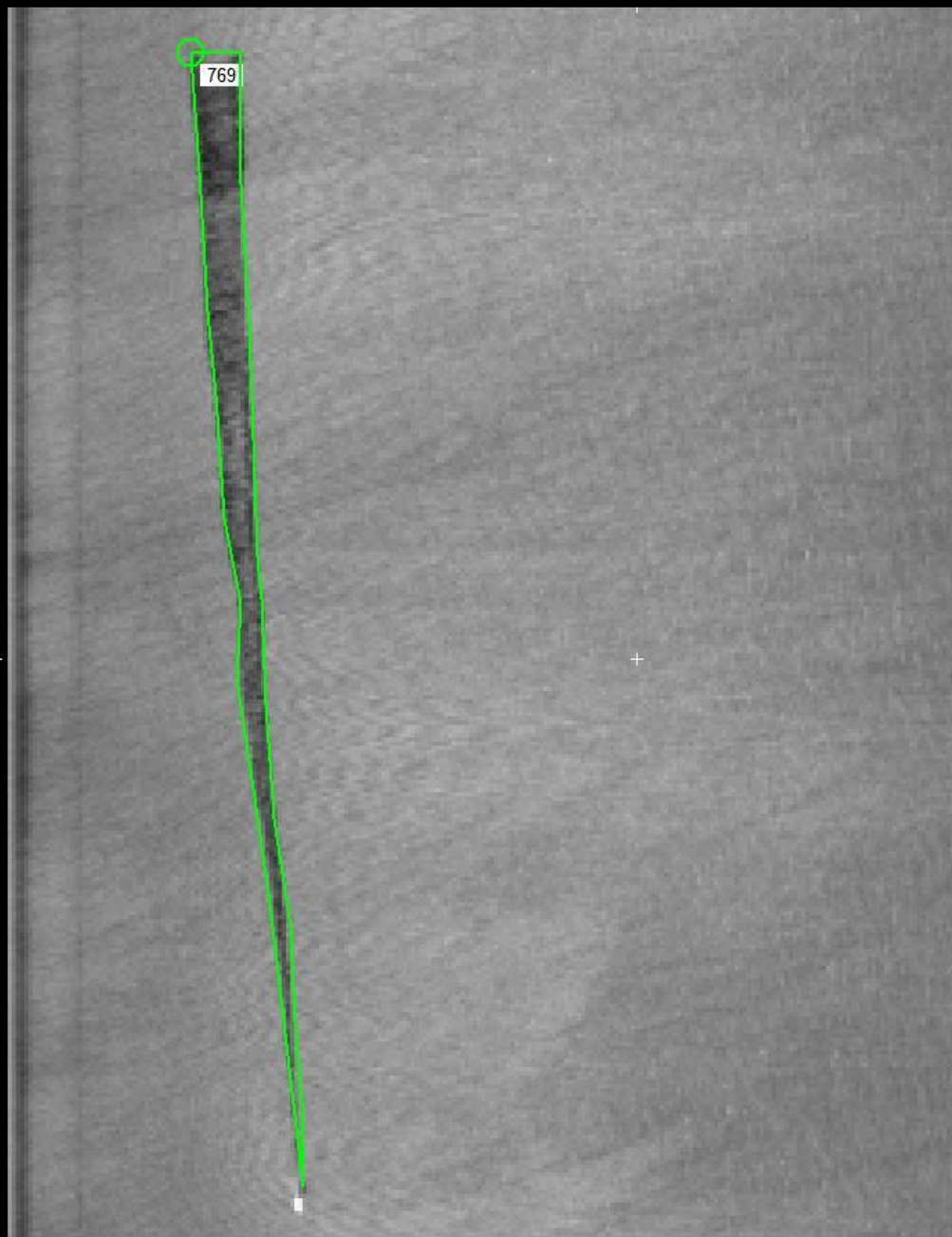
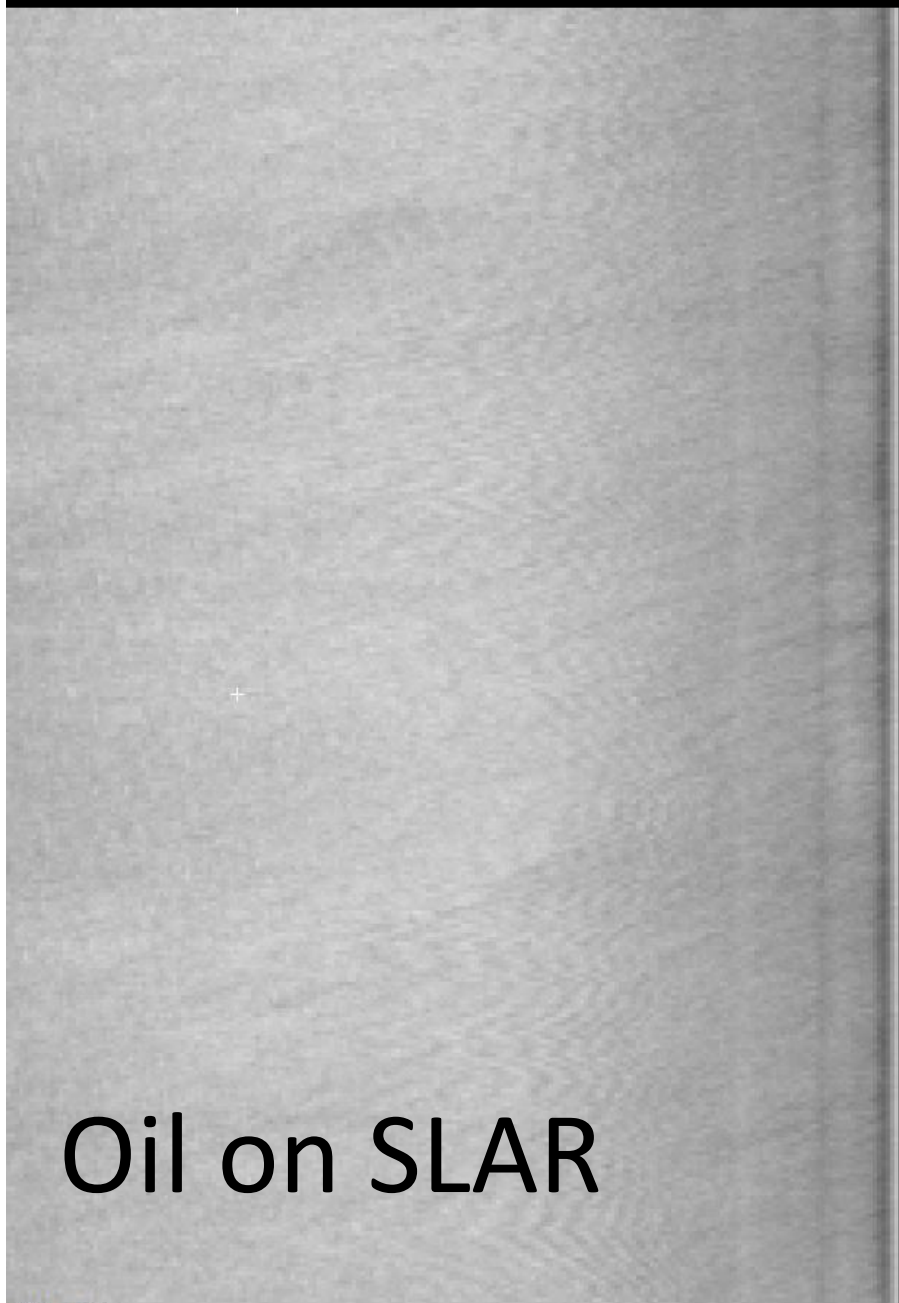
In this case, the altitude of the aircraft is 5500 feet or approximately one mile. The blind spot would then be two miles – one mile on either side.

SLAR Imagery

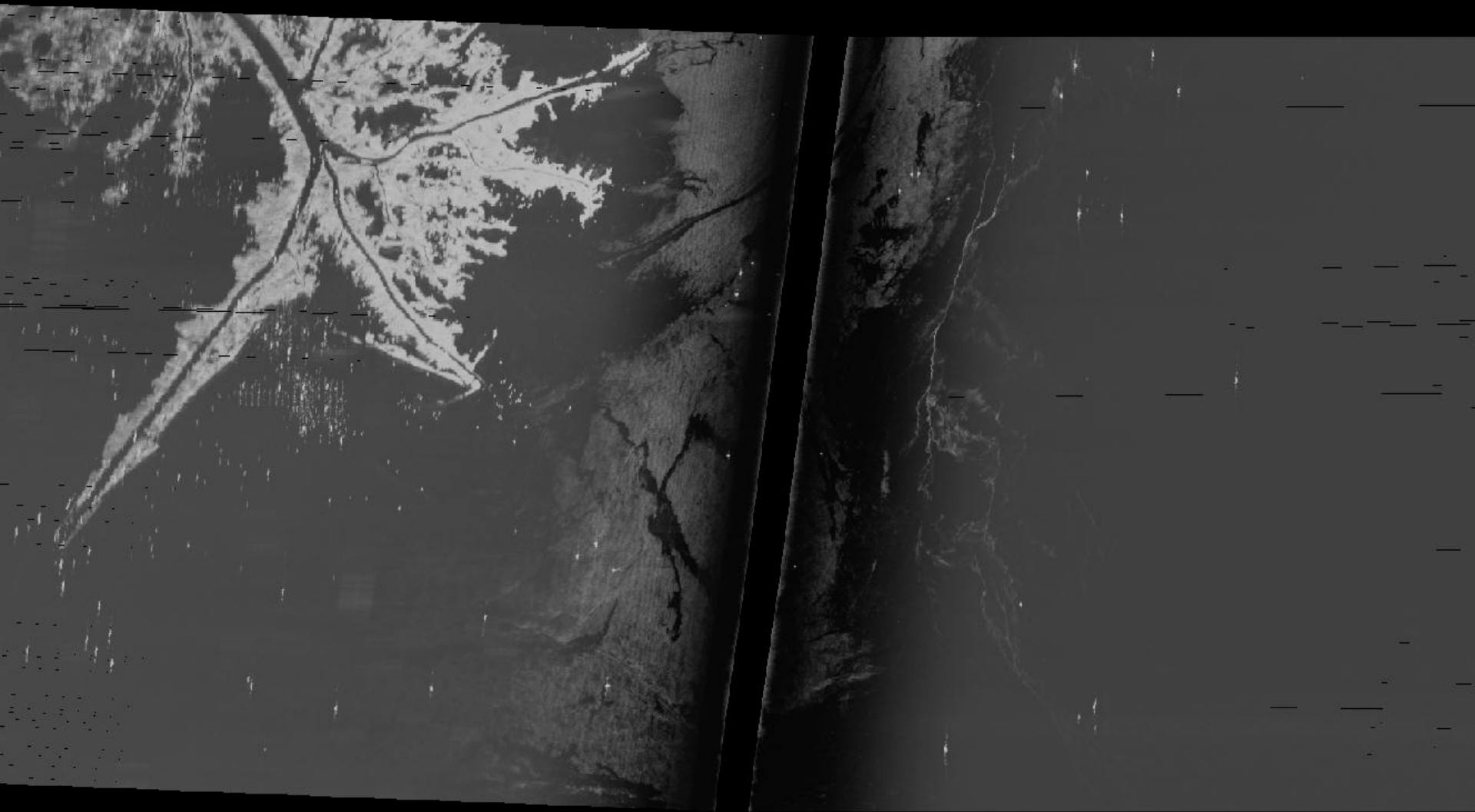
MSS 6000 Mission: TC951-2010-038 SLAR
Top center: 2010-07-29 18:45:37 N48°31.20' W129°50.06' 89° 1492 ft 217.5 kts
Left Gain: 85% Left STC: Medium Right Gain: 85% Right STC: Medium Antenna: Both
Aircraft: 2010-07-29 20:07:05 N48°38.17' W129°09.04' 75° 5488 ft 222.5 kts



MSS 6000 Mission: TC951-2010-038 SLAR
Top center: 2010-07-29 18:45:10 N48°31.38' W129°52.48' 90° 1496 ft 216.6 kts
Left Gain: 85% Left STC: Medium Right Gain: 85% Right STC: Medium Antenna: Both
Aircraft: 2010-07-29 20:11:15 N48°41.24' W128°45.95' 76° 5488 ft 226.1 kts



Oil on SLAR



SLAR Image

EO/IR (MX-15)

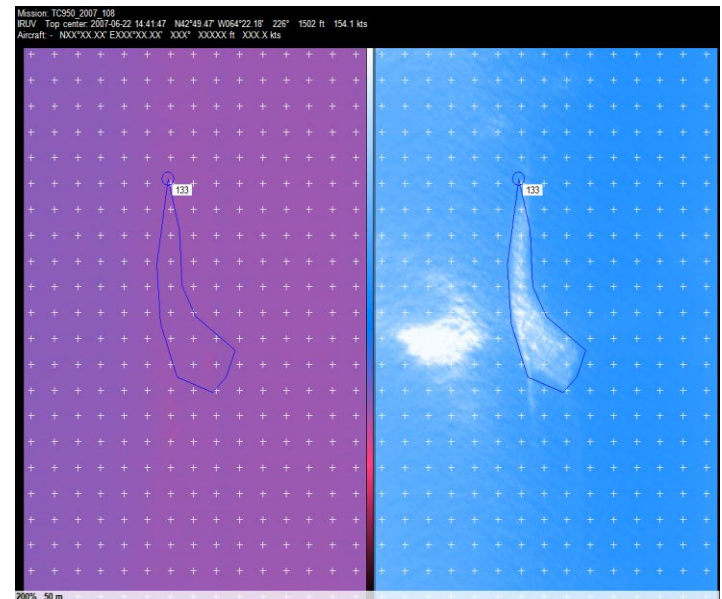
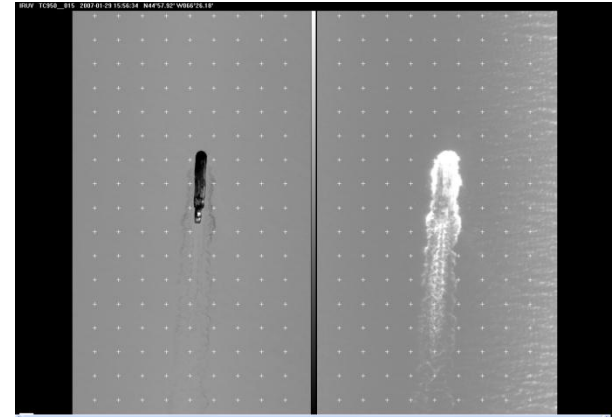


- Fully integrated into the MSS-6000
- Turret has 3 different cameras and a laser illuminator
- The video signal is shown in EO/IR monitor (best image quality) or in the Video window in the MSS-6000 (compressed image)
- Great for covert operations
- can read ship name and IMO at night without any auxiliary lighting



IR/UV Line Scanner

- Verifies oil pollution – reveals false alarms
- Detects total extent of oil spill (UV) and thicker parts (IR)
- Used to combat oil spills, assist in determining where are the heaviest concentrations of oil
- The UV Sensor needs sunlight to work and cannot be used at night
- Combining IR and UV will locate the combatable oil within the total area covered with oil



IR

UV

Satellite Communication System

Swift broadband (SBB) technology:

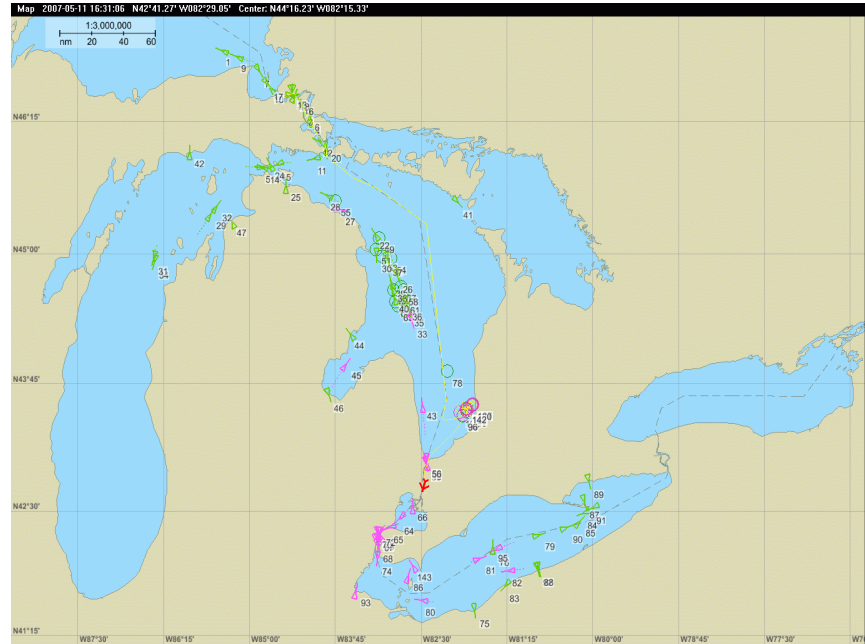
- Continuous connection throughout every mission allows:
 - Regular transmission of AIS information
 - Continuous flight following
 - Live streaming video capability
 - Transmission of target information
 - “Office Operable” while airborne
 - Recently upgraded to Xtreme Service
~ 480 kbs/sec
 - Improvements since DWH Response



Automatic Identification System (AIS) & Moving Map Display

AIS

- Maritime Domain Awareness
- Vessel Voyage and Identity Information
- Data sent to MSOCs
 - In flight – every 15 minutes
 - Post flight



MAP DISPLAY

- Drawing features (Polygons around slicks)
- Accurate Area Calculations = Better Estimation of Oil Quantity

Digital Still & Video Camera Systems



GPS Annotated Data:

- Date: 2007-01-29
- Time: 16:09:03
- Latitude: N44°58.40
- Longitude: W066°24.31
- Altitude: 590 ft
- Heading: 46.2°
- Mission #: TC950_015
- Image #: 0024

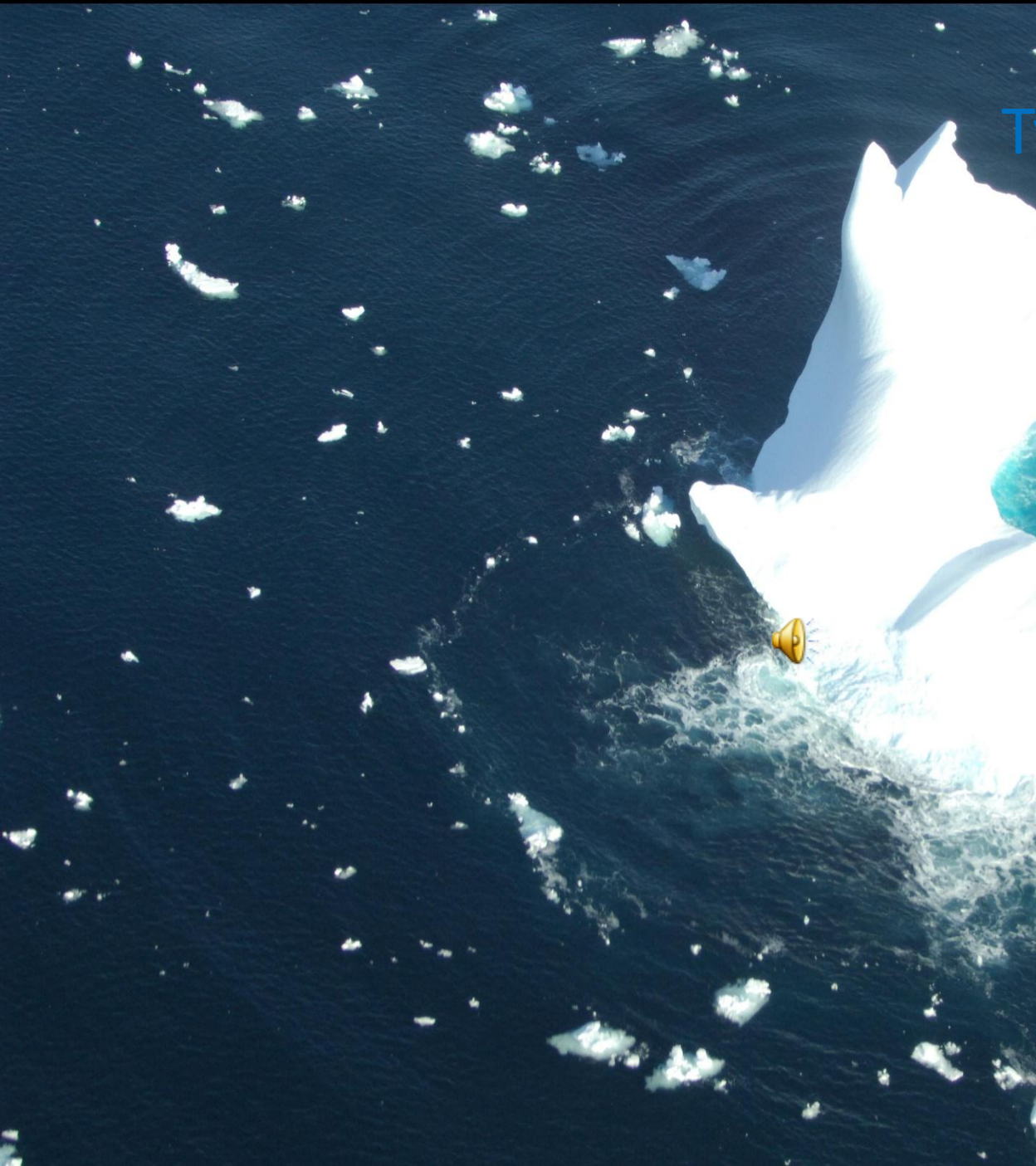












Filter>> Targets [623]

Id	C	Time	Lat	Long
597	AV	18:00	N47°44'	W128°03'
598	AV	18:38	N50°08'	W128°04'
599	AV	18:02	N48°30'	W128°48'
601	AV	17:46	N47°40'	W125°17'
605	AV	17:45	N47°23'	W124°48'
606	AV	20:08	N49°44'	W124°23'
607	AV	17:44	N47°43'	W122°25'
608	AV	20:00	N49°55'	W124°41'
609	AV	18:50	N50°48'	W127°08'
610	AV	18:54	N50°44'	W127°07'
611	AV	18:01	N49°53'	W126°50'
612	AV	19:59	N49°52'	W124°33'
613	AV	17:56	N47°57'	W129°06'
614	AV	18:48	N50°57'	W127°29'
615	AV	18:57	N50°35'	W127°00'
616	AV	18:03	N49°04'	W129°52'
617	AV	19:28	N49°52'	W124°34'

Property	Value
Category	AIS
Type	VESSEL
Date	2013-06-18
Time	18:03:17
Latitude	N49°03.56'
Longitude	W129°52.36'
Course	306°
Speed	11.7 kts
Vessel type	AIS Ship
Name	ALPHA EFFORT
Call sign	SVYL
IMO	9189081
Port of call	
Destination	CHINA SHANGHAI
ETA	-
Ship/cargo type	70 Cargo ship
Length/width	225 m/32 m
True heading	305.0°
ROT	0.0°/min
Max. draught	13.8 m
Nav. status	UNDER WAY

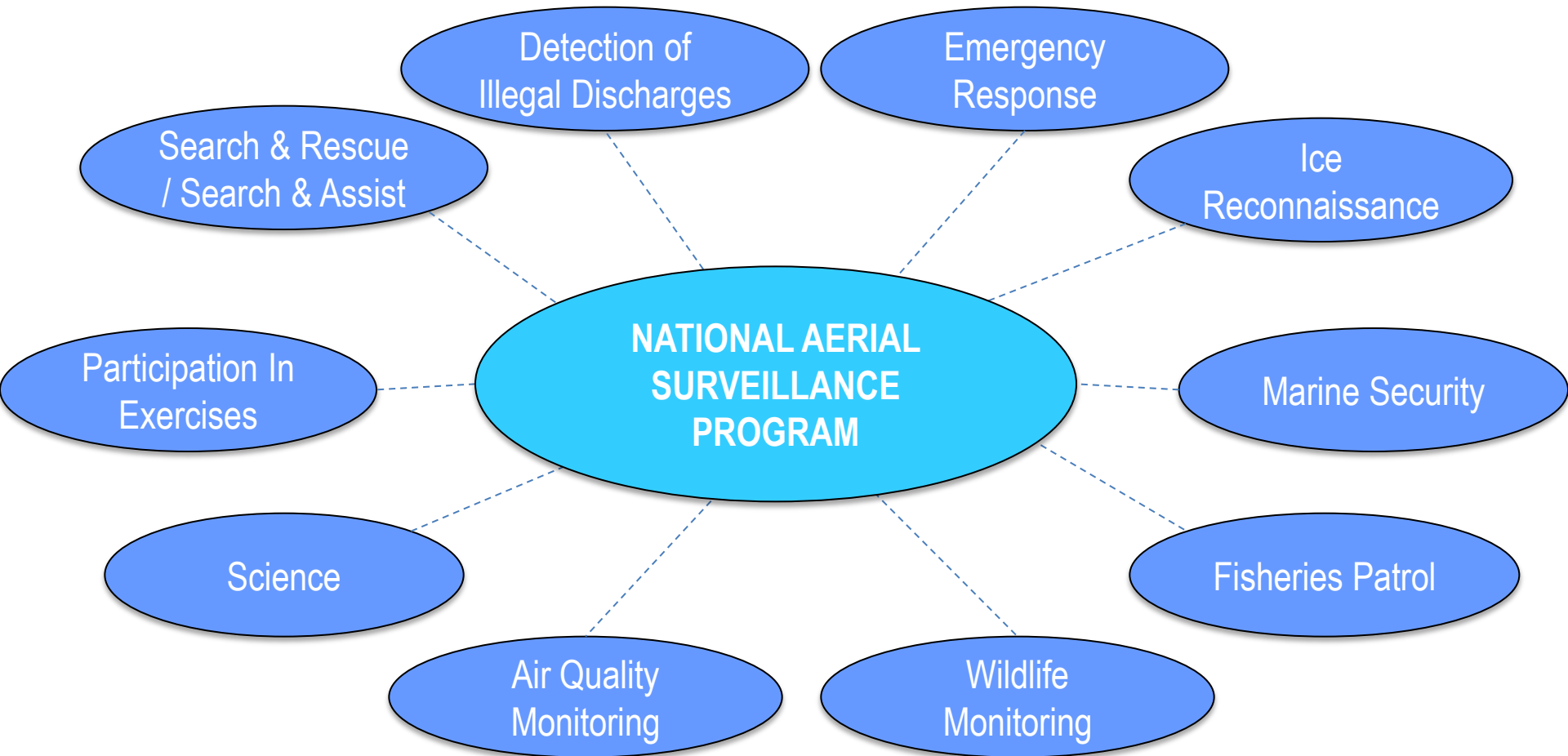
Comment

Cursor

Object 616

N49°03.56' W129°52.36'

NASP Activities



Deepwater Horizon Incident

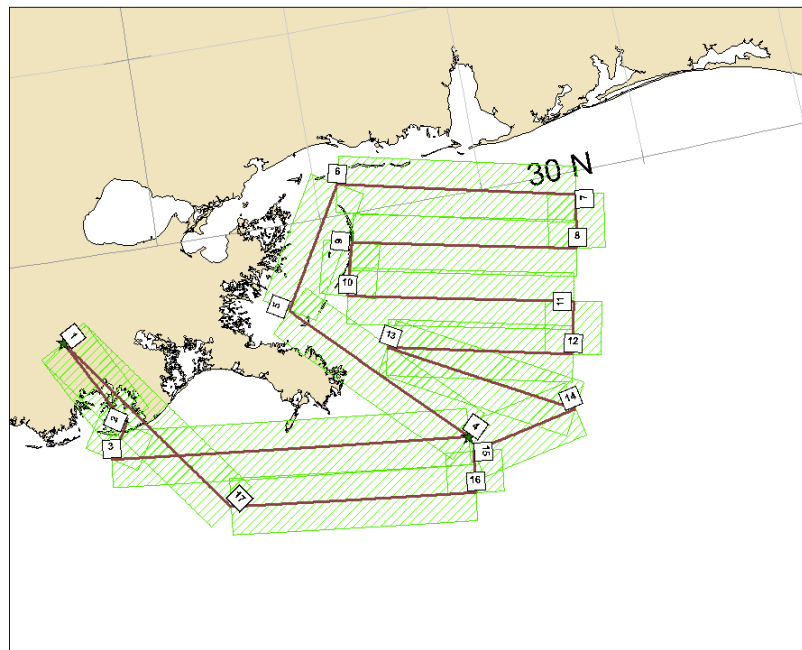
April 30, 2010 – The NASP was requested to assist USCG and BP

May 1, 2010 – The NASP deployed to Houma for 11 weeks and flew 297 hours in support of the response

July 15, 2010 – Arranged for Icelandic Coast Guard to replace Transport Canada Dash 8

First operation with heavy oil identification using the SLAR

Many lessons learned which will benefit future sorties

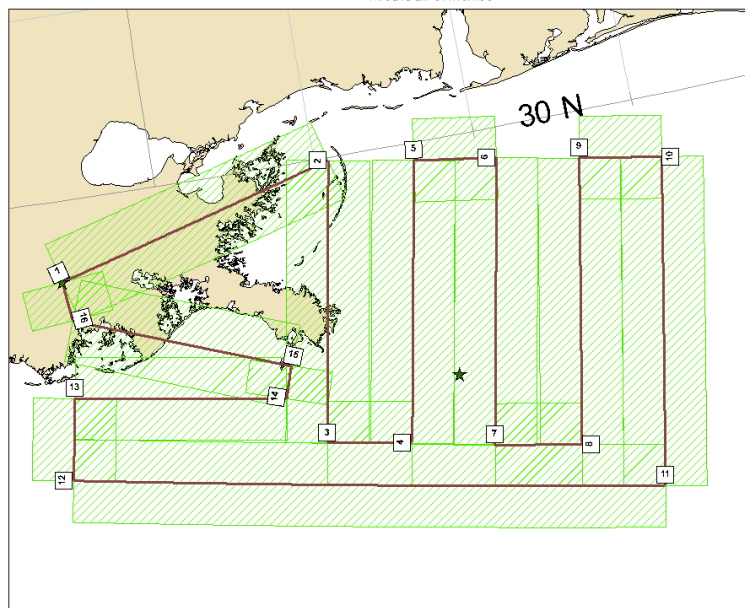


Leg	Start WPT Location	Start Time
001	29°34'N 090°39'W	0.00
002	29°08'N 090°21'W	0.31
003	29°53'N 090°28'W	0.38
004	29°44'N 088°21'W	0.49
005	29°33'N 089°17'W	1.01
006	30°10'N 088°52'W	1.32
007	29°53'N 087°27'W	1.49
008	29°36'N 087°30'W	2.15
009	29°51'N 088°50'W	3.14
010	29°34'N 088°55'W	3.40
011	29°20'N 087°35'W	3.49
012	29°03'N 087°39'W	4.02
013	29°16'N 089°44'W	4.52
014	28°48'N 087°42'W	4.58
015	28°39'N 088°20'W	5.23
016	28°26'N 088°22'W	5.23
017	28°35'N 089°49'W	5.36
	29°34'N 090°39'W	

Summary
 Number of Legs: 17
 Flight Length: 964
 Flight Duration: 4+4
 Avg. Speed: 200
 Visual Range: 10.1
 Radar Range: 31.1

★ POI
 — LEG
 VISU

Points of Interest
 1. 28°44'N 088°21'W, MC252 Incident site
 2. 29°34'N 090°39'W, Houma Airport

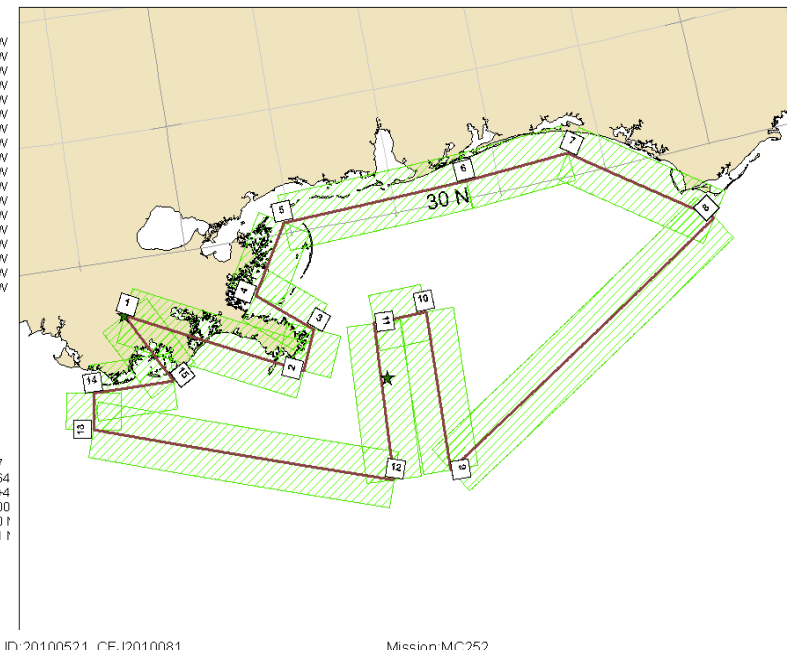


Leg	Start WPT Location	Start Time
001	29°34'N 090°39'W	0.00
002	29°59'N 089°55'W	0.32
003	28°30'N 089°13'W	1.03
004	28°25'N 089°43'W	1.12
005	29°54'N 089°24'W	1.43
006	29°50'N 087°53'W	1.52
007	28°20'N 089°13'W	1.56
008	28°15'N 087°43'W	2.05
009	29°45'N 087°23'W	2.36
010	29°40'N 086°53'W	2.45
011	27°57'N 087°16'W	3.16
012	28°31'N 090°45'W	3.52
013	28°56'N 090°41'W	4.01
014	28°46'N 089°23'W	4.34
015	28°56'N 089°21'W	4.28
016	29°21'N 090°37'W	5.32
	29°34'N 090°39'W	5.56

Summary
 Number of Legs: 16
 Flight Length: 1184 NM
 Flight Duration: 5+6
 Avg. Speed: 200 Kn
 Visual Range: 15 NM
 Radar Range: 31 NM

★ POI
 — LEG
 VISUAL

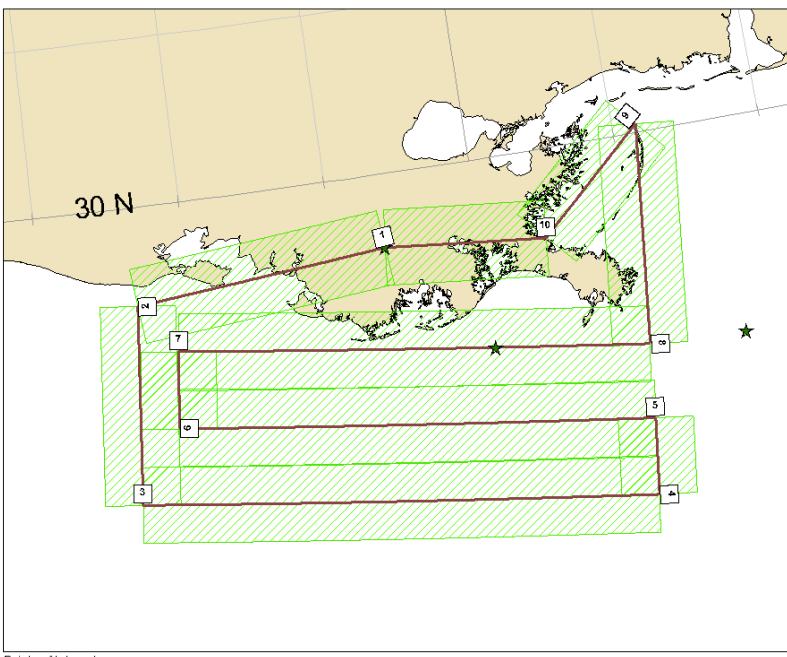
Points of Interest
 1. 28°44'N 088°21'W, MC252 Incident site
 2. 29°34'N 090°39'W, Houma Airport



Leg	Start WPT Location	Start Time
001	29°34'N 090°39'W	0.00
002	28°54'N 089°06'W	0.31
003	29°13'N 089°58'W	0.38
004	29°33'N 089°25'W	0.49
005	30°05'N 089°03'W	1.01
006	30°08'N 087°18'W	1.32
007	30°11'N 086°19'W	1.49
008	29°28'N 085°07'W	2.15
009	27°56'N 087°56'W	3.14
010	29°11'N 087°54'W	3.40
011	29°11'N 088°23'W	3.49
012	27°56'N 086°27'W	4.02
013	28°43'N 091°05'W	4.52
014	29°00'N 091°02'W	4.58
015	29°00'N 090°17'W	5.23
	29°34'N 090°39'W	5.36

Summary
 Number of Legs: 15
 Flight Length: 1119 NM
 Flight Duration: 5+6
 Avg. Speed: 200 Kn
 Visual Range: 15 NM
 Radar Range: 31 NM

★ POI
 — LEG



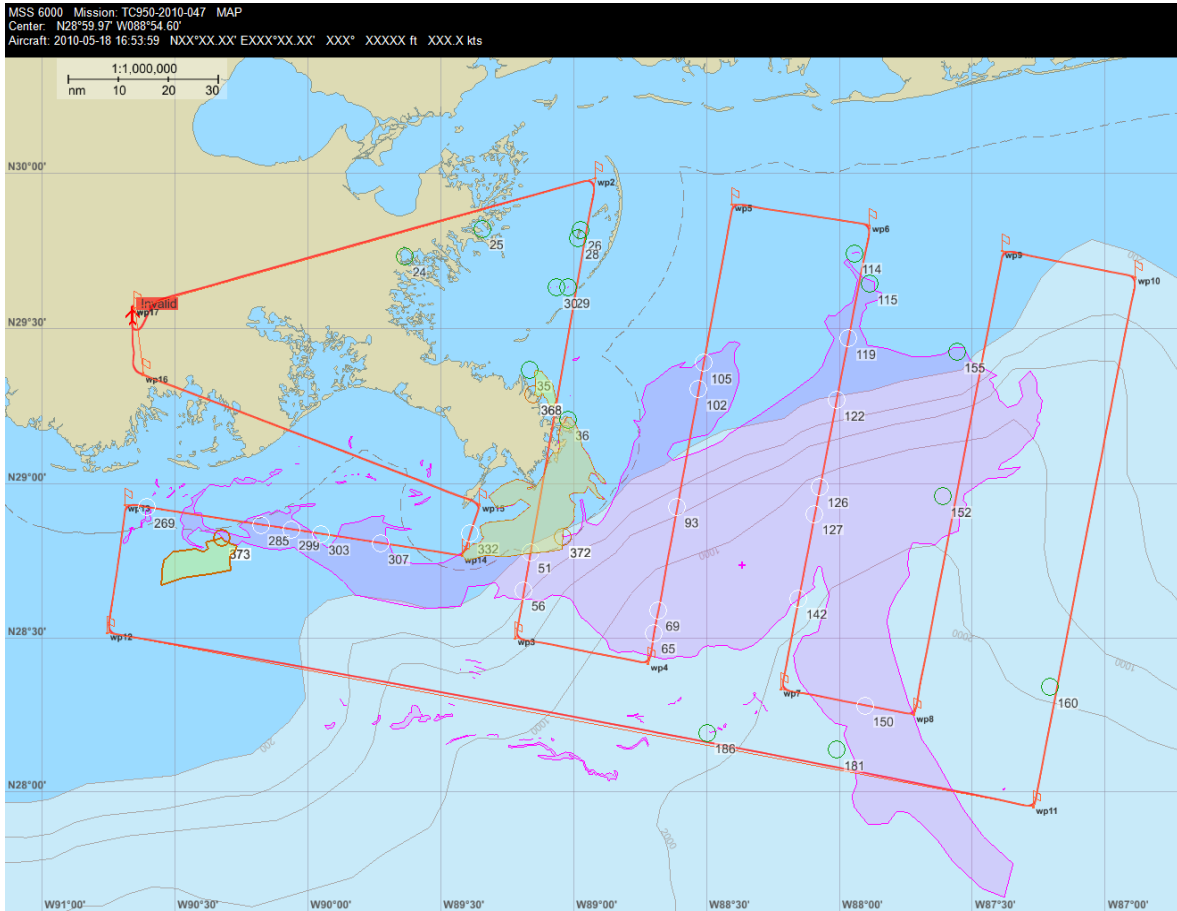
Leg	Start WPT Location	Start Time
001	29°34'N 090°39'W	0.00
002	29°25'N 092°22'W	0.30
003	28°15'N 092°29'W	0.54
004	27°53'N 089°06'W	1.56
005	28°20'N 089°03'W	2.05
006	28°40'N 092°11'W	3.02
007	29°07'N 092°07'W	3.11
008	28°46'N 089°00'W	4.07
009	30°03'N 088°50'W	4.33
010	29°29'N 089°34'W	4.50
	29°34'N 090°39'W	5.09

Summary
 Number of Legs: 10
 Flight Length: 1053 NM
 Flight Duration: 5+9
 Avg. Speed: 200 Kn
 Visual Range: 15 NM
 Radar Range: 31 NM

★ POI
 — LEG
 VISUAL

Points of Interest
 1. 28°53'N 090°01'W, New position Loop Platfo
 2. 28°44'N 088°21'W, MC252 Incident site
 3. 29°34'N 090°39'W, Houma Airport

Situational Awareness







Support During Emergency Response Situations



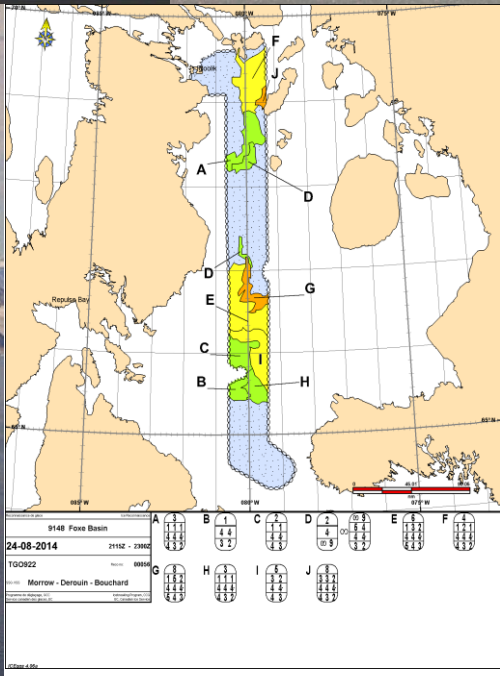
May include events such as:

- **Public Safety**
- **Ships stuck in ice**
- **Marine Casualties**
- **Floods**
- **Support to OGDs**
- **Response to Pollution Incidents**
- **etc**



The MX-15 camera and the live streaming video were vital with this operation

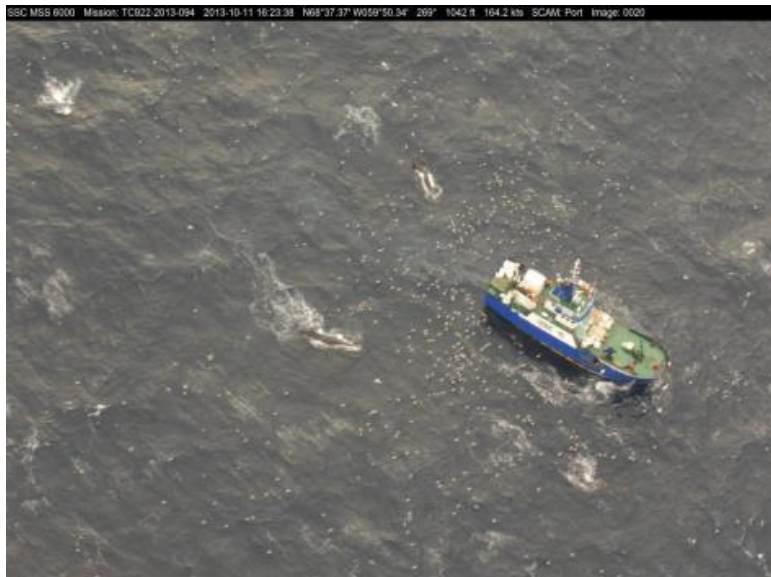
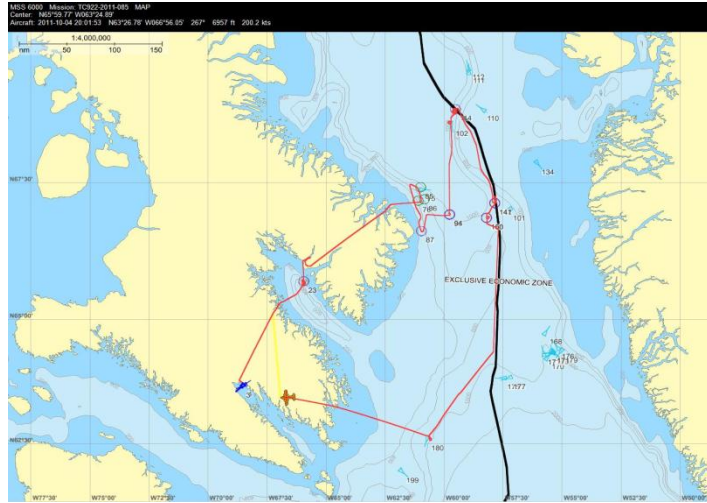
Ice Reconnaissance



Marine Security – Monitoring of Vessels of Interest – Maritime Domain Awareness



Fisheries Patrol



Air Quality Monitoring

SSC MSS 6000 Mission: TC950-2009-133 2010-03-19 14:34:29 N44°37.12' W054°47.06' 154° 1998 ft 224.0 kts SCAM: Port Image: 0028



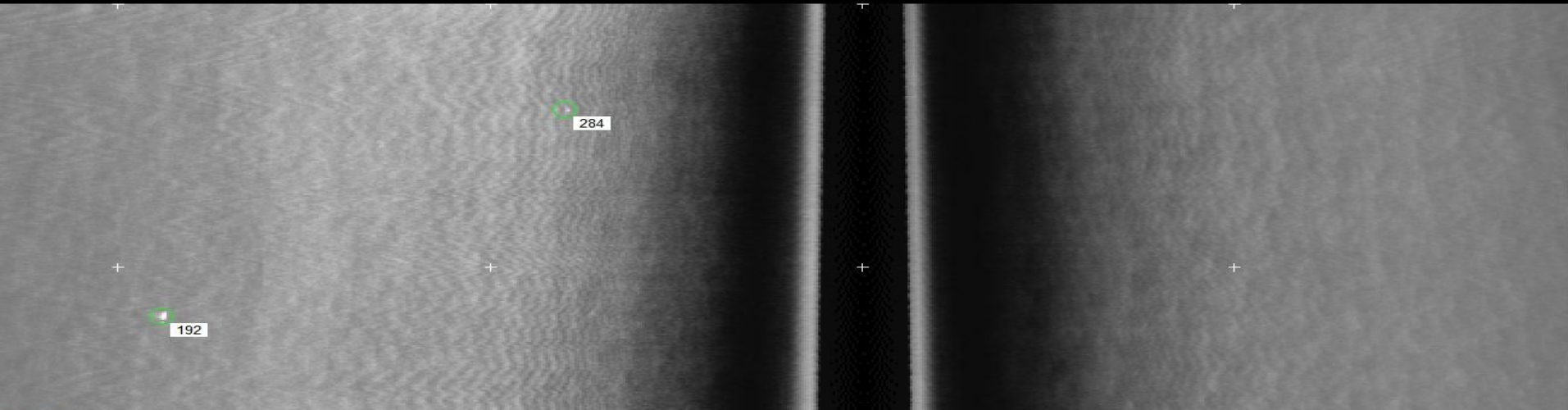
Science – Monitoring of Ice Flows in the Beaufort Sea

2007-04-02 20:34:26 N73°21.55' W145°15.75' 583 ft Mission: TC950_2007_055 SCAM Cabin Image: 0012



Training and Exercises

Mission: TC950_2007_111
SLAR Top center: 2007-06-25 19:04:04 N40°54.43' W063°59.73' 259° 9022 ft 208.9 kts
Aircraft: 2007-06-25 21:34:11 N43°12.85' W067°58.02' 295° 15991 ft 218.1 kts



Environmental Enforcement Support



Wildlife Monitoring



The Integrated Satellite Tracking of Pollution (ISTOP) Program



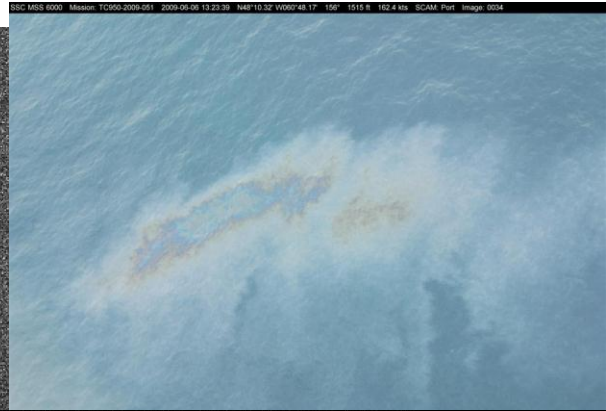
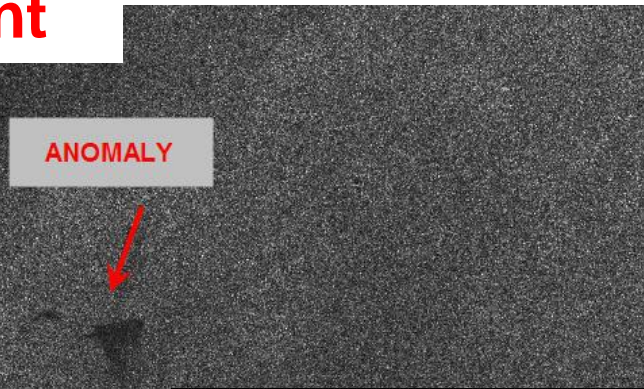
- Earth observation satellites to detect and monitor oil spills
- Created daily in near real time by the Canadian Ice Service

June 6, 2009 Incident

CATEGORY 1B

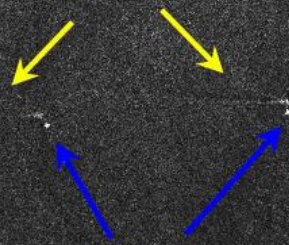
ISTOP detected a 5 km long anomaly in the Gulf of St. Lawrence

36 litre spill confirmed by the aircraft



SSC MSS 6000 Mission: TC950-2009-051 2009-06-06 15:57:47 N49°23.19' W065°44.15' 207° 1007 ft 168.5 kts SCAM: Port Image: 0070

WAKES



Visual photos of the June 6, 2009 oil spill taken from the DASH 8 aircraft. 56

Future Initiatives

- R & D Project
 - Currently working with France on the Polluprof Project for development of hyper-spectral sensor for HNS Products
- 2nd MSS6000 User consoles for all three aircraft
- International Survey on Program Resources, Training, and Exercising
- Seeking funding for the construction of an Arctic Hangar
- Replacement of aging fleet
- Manned verses Unmanned – Follow the evolution of the UAS

Conclusion

- TC - NASP will continue to observe, analyze, record and report marine pollution and sea based activities
- Public confidence and perception is a key driving factor
- Copious amounts of data is now available due to advancements in technology – TC should use this to our advantage
- Streaming video capability is a great tool for situational awareness for the entire department.

Thank You



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ISTOP Anomaly

Anomaly – An occurrence of an oil-like signature on an image.

1A – Anomaly detected with a target attached

Priority #1 – High - NASP should deploy

1B – Anomaly detected with a target within 50 km of the anomaly

Priority #2 – High - NASP should deploy

2 – Anomaly detected, but no target in the area

Priority #2 – Med - NASP should deploy if they are close to or in the area

3 – Anomaly detected, unsure what it is

Priority #3 – Low - NASP should deploy only if they are in the area

Prosecutions

- Since 2003/2004, evidence gathered by the NASP has led to over 35 charges as a result of 29 incidents, over \$1.3M in fines
- Largest penalty of \$170,000 was given to a Russian Fishing Vessel Olga
- CSA 2001 maximum punishment is a summary conviction to a person or a vessel of not more than \$1M or 18 months in prison or both

Tasking of NASP Assets

All Taskings should be initiated through the TC SitCen

1-888-857-4003 or 613-995-9737

The client is required to provide:

- Purpose of the tasking (e.g. oil spill, Search and Rescue, etc.)
- Is the tasking Urgent or Non-Urgent?
- Name
- Cell Phone Number
- Office Phone Number
- His/her department / organization
- Which aircraft is required
- Where the client is located (which Region)
- For which day & time the aircraft required

Tasking Authority

Tasking Authority

Clients must formulate a designated list of “class of persons” who are permitted to task the NASP aircraft.

Provide the list of the “class of persons” via email at NASP-PNSA@tc.gc.ca.

Should the requesting client not be on the “class of persons”, the affected Marine Aerial Reconnaissance Team (MART) Manager may refuse the request until proper authority is given from the client or TC official.

Streaming Video

- Not secure
- Available to select TC and OGD staff
- Stream only when required as it is expensive
- Requires small software package to be installed locally

