From Marine Pollution to Inland Wildfire Mapping

The Mobilization of the National Aerial Surveillance Program (NASP) in support of the Fort McMurray Wildfires

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Overview

- What is the NASP?
- Capabilities of the NASP
- Support of Fort McMurray Wildfires
- R&D and Potential application



National Aerial Surveillance Program



- Coast Guard pollution patrols commenced over the Great Lakes in 1968
- Coast Guard expanded aerial surveillance operations in 1991 to cover Atlantic and Pacific coasts, thus creating the NASP.
- In 2003, the NASP moved to Transport Canada.
- In 2005, acquired remote sensor suite
- The NASP is Transport Canada's primary method for detecting illegal discharges at sea.
- Current partnership between TC Marine Safety and Security, TC ASD and Environment Canada (EC) Marine Aerial Reconnaissance Team (MART) allows for multitasking and shared costs.

Marine Aerial Reconnaissance Team (MART)

- Group of Environment and Climate Change Canada – Canadian Ice Service employees who conduct the mission planning and execution on board TC NASP aircraft
- Created 2006 when the MSS-6000 was installed on the first Dash8
- MART role: observe, analyze, record and report primarily maritime, but also land-based phenomena, from an aerial platform.



Why does TC Conduct Surveillance?

- Accidental or intentional discharges of oil
- Increase in AIS traffic
- 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 TC Aircraft

- 3 teams that cover Canada's 3 Oceans
- ~ 40 People across Canada
- + Private Industry contract aircraft
 - Provincial Airlines (PAL)
 - Surveillance in Newfoundland and Labrador





NASP Activities



Marine and land-based SAR support as secondary resource



Search for downed Russian helicopter in Davis Strait 2015. provided ice data to response vessels

Search for downed aircraft in northern Quebec 2015



Ice Reconnaissance



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
- Wildfires

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

Marine Security







Verifying that vessels inbound to Canada appear on an approved list



The Integrated Satellite Tracking of Pollution (ISTOP) Program





June 17, 2012 Incident

Canadă

Category 1A

ISTOP detected an anomaly originating from the Hibernia platform

306 litre spill confirmed by the aircraft the next day.



Arctic Fisheries and Wildlife Monitoring







Marine Mammal Surveys

Whale Researches on board conducting transects to determine populations and

Red = fin whale Orange = large unidentified whale or like fin whale or unidentified baleen whale Yellow = humpback **Blue stars = blue whale** Smaller yellow star = baird's beaked whale Purple = sperm whale Grey = Risso's dolphin, pacific white sided dolphin, northern right whale dolphin and all other dolphin/porpoise Black - killer whale Lime green = grey whale White = Cuvier's beaked whale

MSS-6000 and MX-15

Capabilities of the NASP with the Surveillance System



NASP Surveillance System Components



SLAR



AIS









Cameras



IR/UV



Digital Still & Video Camera Systems



GPS Annotated Data:

- Mission #: TC951_2010_086
- Date: 2011-03-23
- Time: 16:41:25
- Latitude: N44°15.05
- Longitude: W123°29.49
- Altitude: 1489 ft
- Speed: 202.0 kts
- Image #: 0026

Images for Wildfire support









Wildfire Support – Damage Assessment



Electro Optical Infrared (EO/IR)



WESCAM MX 15 EO/IR – 4 sensors

- Infrared Camera w/ high magnification 4 step zoom
- Colour Daylight Camera with continuous Zoom Lens (EOW)
- Dual Channel Spotter Lens Fixed focal length (Daylight Camera & Low Light Camera) (EON)
- Laser illuminated Night Spotter (Illuminates the target in total darkness)

Electro Optical Infrared (EO/IR)

- Primary use: Identification and analysis of targets from far away.
- Secondary use: To document (stored frames or video clips) targets for the records, both day and night, & during conditions of reduced visibility.
- Covert Operation: Positive subject identification (ship names) in total darkness

Images from this system can be live streamed, recorded and still images taken



SSC MSS 6000 Mission: TC951-2010-029 VIDEO Video: 2010-07-08 21:41:53 N48°44.32' W125°50.28' 329° 1476 ft 200.6 kts EO/IR EO/IR: N48°44.81' W125°51.55' Aircraft: 2010-07-08 23:21:42 N48°49.17' W125°26.59' 82° 9501 ft 234.1 kts







SSC MSS 6000 Mission: TC951-2010-038 VIDEO Video: 2010-07-29 19:21:30 N48'29.42' W130°17.54' 302° 669 ft 134.8 kts EO/IR EO/IR: N48'30.24' W130°17.77' Aircraft: 2010-07-29 20:03:57 N48'35.83' W129°26.18' 74° 5488 ft 222.1 kts





SSC MSS 6000 Mission: TC951-2010-038 VIDEO Video: 2010-07-29 19:21:26 N48°29.35' W130°17.34' 302° 666 ft 134.6 kts EO/IR EO/IR: N48'30.22' W130°17.74' <u>Aircraft: 2010-07-29 20</u>:03:53 N48'35.78' W129°26.54' 74° 5488 ft 222.0 kts



Tasking to Support Wood Buffalo Wildfire





IR/UV Line Scanner

- Detects oil on surface.
 (IR) thicker sections
 (UV) extent of oil spill
- Data are georeferenced
- Used to map spatial extent of oil spills and get area of coverage
- Draw polygon around the oil
- Assists in determining where are the heaviest concentrations of oil



NASP IR imagery – Night time fire mapping

Side Looking Aerial Radar (SLAR)

Microwave energy is reflected by microscopic waves on the ocean surface when enough wind is present. The lack of wind and these "capillary waves" prevents backscatter from returning to the SLAR antennas, thus creating a darker appearance on the display.

Swath width with visual surveillance (Naked Eye) - 4 nm (2 nm each side)

Swath width using SLAR

- 90 nm (45 nm each side) vessels
- 30 nm (15 nm each side) oil detection
- 80 nm (40 nm each side) strip map ice

Increases effectiveness by expanding window of opportunity for Surveillance. Can be used during conditions of reduced visibility.
 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:

 Aircraft:
 2010-07-29
 20:11:15
 N48°41.24' W128°45.95'
 76°
 5488 ft
 226.1 kts

SLAR anomaly/oil_slick

769

SLAR target - Outbound tanker

Wood Buffalo Fire Support – Day 1

- Vancouver to Edmonton picked up Dr. Josh Johnston (Forest Fire Research Scientist, Natural Resources Canada)
- Conducted early evening overflight (daylight) – gathered video, still images and some IR legs converted to GEOTIFFs







Wood Buffalo Fire Support – Day 2

- Conducted early evening overflight of Fort McMurray for IR scanning (daylight)
- Gathered video, still images and IR data converted to GEOTIFFs.
- Procedures needed to be refined to enhance data and also image resolution needed to be addressed.







Wood Buffalo Fire Support – Day 3 Tasking Received



Project: Z:WWF009vnap_projects/Additional Maps/Media/mwf009_Media_11X17_100516.mxd; Exported: May-10-16 9:27:53 AM; Last Updated: May-10-16 7:07:21 AM

110 400 W



Hotspot map made inflight

MSS 6000 Missi Center: N56°42.3 Aircraft: 2016-05-	on: TC951018 MAP 31' W111°19.85' 11.05-59-55 N53°41 (9 84' W113°31 23' - 20	7° 8520 ft	247 1 kts					
	1:90,000		0520 11	241.4 N3					
nm N56°48'	1 2	3							
N56°45'		0 110/62	0	0_112_					
N56*42'			66 158	RT MCMAURRAY					
		1		Date time (UTC)	Lat	Long	Image Name	Screen Shot	EO/IR target
				11/05/2016 3:35	N56°21.40'	W110°55.62'	MSS VIDEO Image 053.BM	VIP 53	52
		/		11/05/2016 3:38	N56°22.75'	W110°49.16'	MSS VIDEO Image 055.BM	VIP 55	54
				11/05/2016 3:39	N56°23.44'	W110°50.38'	MSS VIDEO Image 057.BN	VIP 57	56
NECTOR I				11/05/2016 3:41	N56°27.60'	W111°04.56'	MSS VIDEO Image 059.B	/IP 59	58
N96'39'				11/05/2016 3:41	N56°27.97'	W111°05.92'	MSS VIDEO Image 061.B	MP 61	60
				11/05/2016 3:42	N56°38.74'	W111°13.89'	MSS VIDEO Image 063.BN	VIP 63	62
				11/05/2016 3:43	N56°39.69'	W111°15.06'	MSS VIDEO Image 065.BN	VIP 65	64
				11/05/2016 3:43	N56°41.84'	W111°11.87'	MSS VIDEO Image 067.BN	MP 67	66
				11/05/2016 3:51	N56°41.21'	W111°16.30'	MSS VIDEO Image 069.BN	AP 69	68
N56°36'				11/05/2016 3:52	N56°39.45'	W111°13.93'	MSS VIDEO Image 071.BN	MP 71	70
	W111°33	W111°30	W111°27'						

11MY2016 AUTO VIC SPA UP 95:10:46 CENT SPA UP 675 DFLT ÅU

LI:DISARM LI:LOW ACFT 56:43.03N 159 111:25.79W 6416FT

(TESA)

1

-84

0.52" 56 1.8NM 111:23. 1200FT

Wood Buffalo Fire Support – Day 4-5 Tasking



Area of Scanning for Transport Canada Area of Interest for 20160511 Boundary_of_AOI_20160510



Created May 11, 2016



Raw, unprocessed IR imagery



How does NASP get here?



Pollock Pines, CA, Grayscale Phoenix Imagery King Fire Run #5 18 September 2014 @ 0118 MDT. Phoenix imagery is acquired as Black = Hot. Pixels tagged as red indicate those areas that exceed the fire detection algorithm threshold. http://nirops.fs.fed.us/pages/imagery



Processed imagery



Fire Progression Mapping





Fire Progression Mapping





Integrate Emerging Science





What we have – what we need

Have:

- Deployable aircraft with crew
- IR/UV linescanner
- EO/IR camera

Can get raw remote sensed data

Need to:

- Gauge stakeholders (clients) interest
- What can we do above and beyond private industry
- R&D to process files and streamline for operational use
- Need to develop SOPs and training for operators in data acquisition and processing

Future Initiatives

If this resource is of interest for wildfire support:

- Seek funding for R&D
- Possibly upgrade equipment (MX-15 and/or linescanner)



Thank You



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Natural Resources Ressources naturelles Canada Canada



National Aerial Surveillance Program

Protecting Our Waters



Programme national de surveillance aérienne

Protéger nos eaux

Mission Planning for Wildfire -IR/UV Scanner

Altitude	Swath	Pixel Resolution
1500ft	~ 750 m	3 x 3 m
8000ft	~ 4 km	14 x 14 m
20000ft	~10 km	~ 35 x 35 m