

Blue Belt: satellite surveillance, evaluation and next steps



 Funded by
UK Government



Centre for Environment
Fisheries & Aquaculture
Science



Marine
Management
Organisation

Blue Belt: Satellite surveillance, evaluation and next steps

Introduction

Working in partnership with OceanMind and the Foreign Office (FCO), we have been employing Synthetic Aperture Radar (SAR) satellites to help detect illegal, unreported, unregulated (IUU) fishing vessels around the UK Overseas Territories (OTs).

SAR can provide day-and-night imagery of earth. In addition, clouds, fog and precipitation do not have any significant effect on microwaves, so images can also be acquired independent of weather conditions. The images can display enough detail to show vessels on the water. This is one of the few technologies available able to cover a larger area and identify vessel presence without relying on Automatic Identification Systems (AIS)/ Vessel Monitoring Systems (VMS) or similar.

Using a combination of European Space Agency and commercial satellites, a recent Blue Belt project was able to provide a broad picture of activity within OT waters and also high frequency images to support at-sea patrols.



Satellite surveillance

Limitations

The technology is not a perfect solution to address the IUU issue:

- The images provided by the satellite surveillance cannot always positively identify vessels. Results are given with confidence levels (low medium or high), depending on a range of factors. For example, weather activity, icebergs and other natural phenomena can give a false target.
- Small, wooden hulled boats are difficult to identify
- SAR/ optical imagery cannot positively identify vessels and confirm they are engaged in fishing activity to the extent that it would, in isolation, provide evidence of an offence. To identify a vessel correctly, we need to correlate the information with AIS or VMS patterns. Similarly, vessel detections that rely on AIS data for vessel identification are often treated as either intelligence or circumstantial evidence, depending on what other information is available.



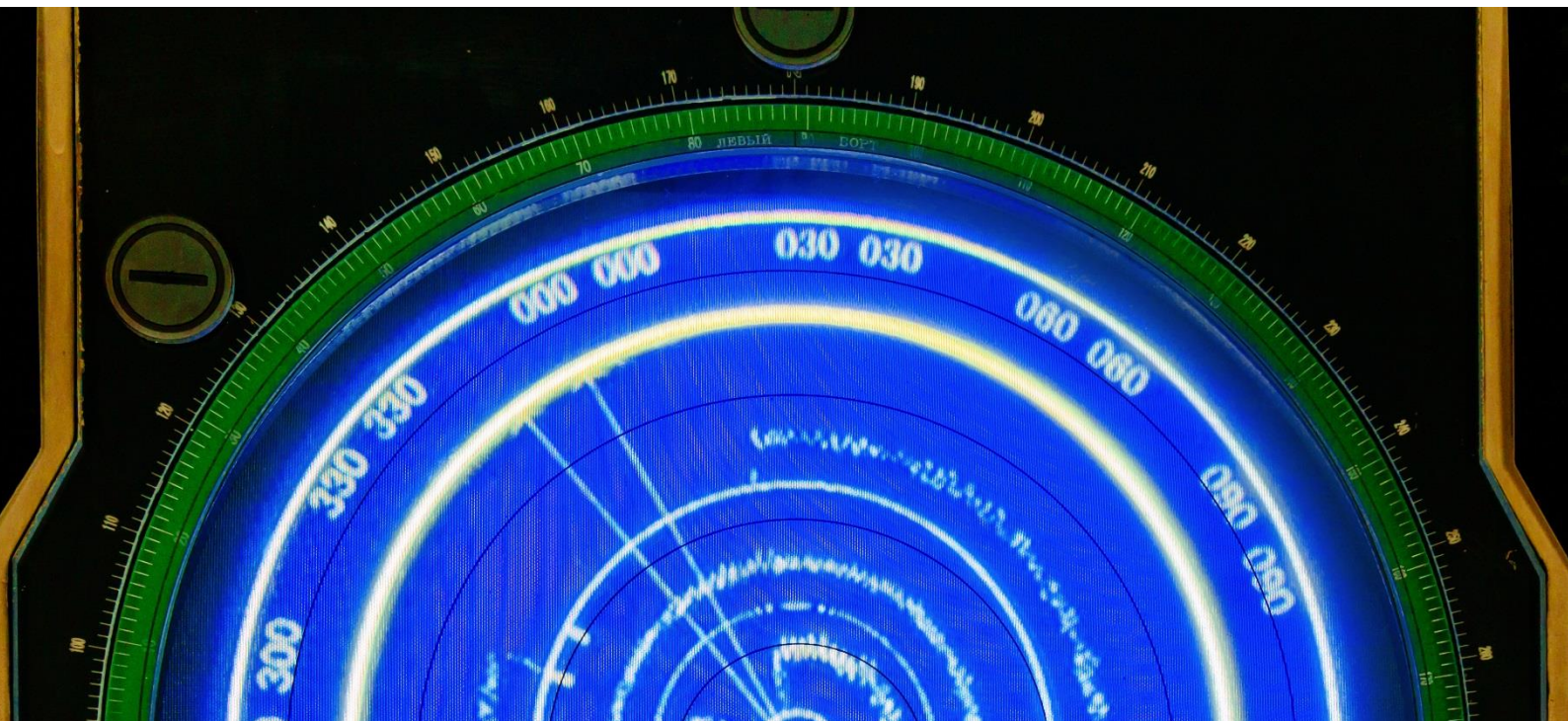
Satellite surveillance: benefits and lessons learnt

There is, however, considerable scope to provide intelligence ranging from overall activity levels through to vessel specific activity that can be used for near real-time tasking of enforcement assets. This benefit is magnified if it is used in conjunction with other technologies. The Blue Belt programme has also identified a number of lessons learned and areas where we can further hone and improve our performance identifiers, for surveillance and enforcement purposes: Using satellite surveillance to support real time tasking has considerable value.

The area of coverage has to be realistic to the response times of the vessel. For example, during a Blue Belt/ Tristan da Cunha patrol, the limited speeds of the patrol vessel meant that although targets were identified by the satellite imagery, the actual vessels remained too far away to allow for prompt engagement and, if appropriate, boarding.

Significant value could be added if analysis of the images could suggest a course and speed. This could give an indication of projected position making it more likely for the suspect vessel to be intercepted, currently only the last known position is received.

Surveillance should be considered as a long term option for use by the overseas territories as part of a suite of surveillance, compliance and enforcement tools. As the technology develops, we expect that both the quality and frequency of data will increase and the cost will decrease. While recognising the limitations at this stage it is important to continue to invest, apply and enhance what is currently available in order to maximise the long term benefits it offers.



Lessons learnt

- A new specification and tender is being drafted for further satellite surveillance work. This takes into account the lessons learned from the previous exercise
- The Blue Belt project is also working with Defra Earth Observations to determine whether Sentinel data could be used. Sentinels are SAR satellite operated by the European Space Agency. This data is available at a much lower cost when compared to commercial satellites and could be a long term solution. Work is underway to establish the frequency and the quality of the images and whether they could be used without the additional data provided by the commercial satellites in conjunction the process to bring the analysis in house is also being explored
- Satellite surveillance does provide valuable information however it is not a solution to the issue of IUU fishing in the OTs. If used it must be applied in conjunction with other technologies. In the short term using Blue Belt funding to support satellite surveillance is valid, longer term if a low cost option can be established it would be part of a complete surveillance, compliance and enforcement package available to the OTs.



Appendix 1: Territorial heat maps

Ascension Island

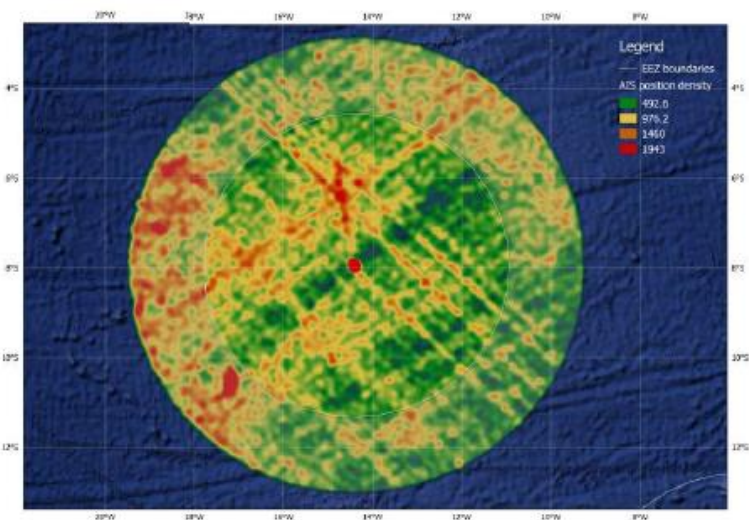
Total number of unique vessel AIS tracks analysed in the AOI

Category	2014	2015	2016	3 Year Total
Fishing vessel	57	60	95	135
Fish carrier	20	29	17	43
Fish bunker	1	2	3	3
Fishing buoy	0	6	131	137
Cargo	682	809	786	1914
Hazardous cargo	221	255	235	575
Passenger vessel	10	12	8	23
Pleasure craft	13	11	14	38
Unknown	181	125	185	461
Other	48	33	20	93
Total	1233	1342	1494	3422

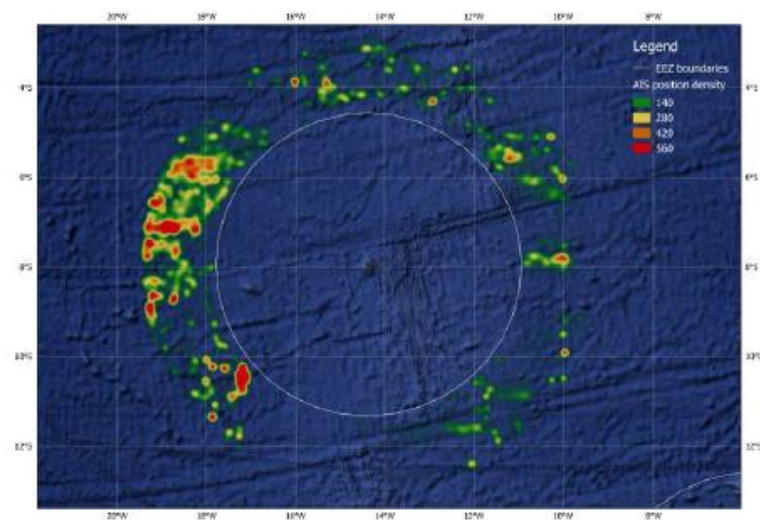
Average monthly AIS detections of fishing vessels in the area of interest across the 3 years



Heatmap of all AIS activity of vessels with all ship types



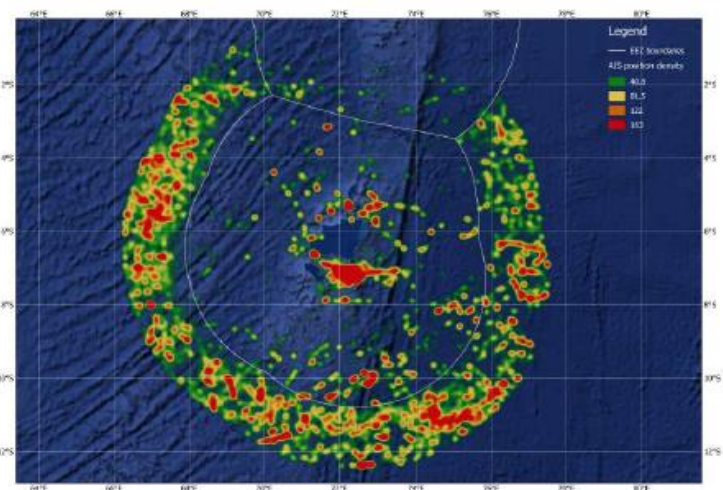
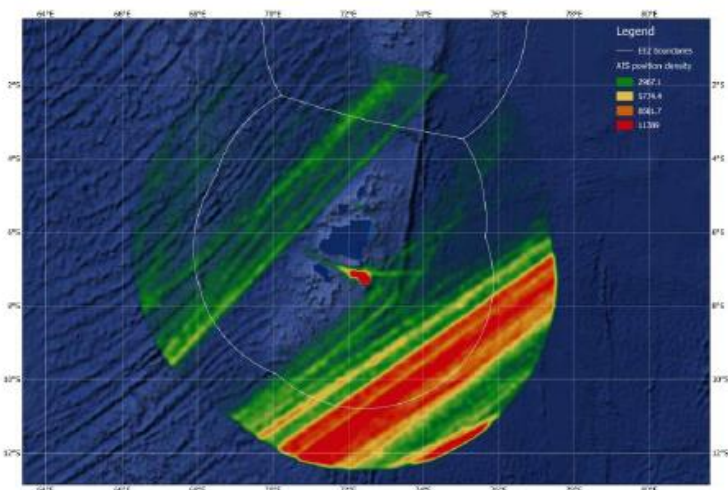
Heatmap of all AIS activity of fishing vessels operating between 0.25-5kts (speeds associated with fishing)



Appendix 1: Territorial heat maps

British Indian Ocean Territory

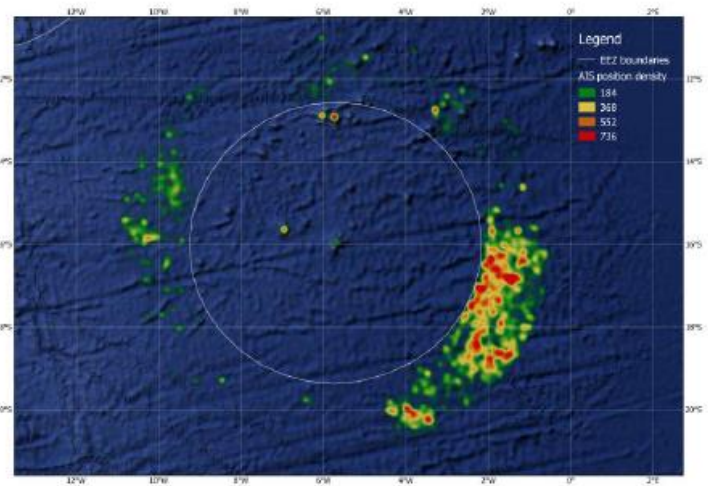
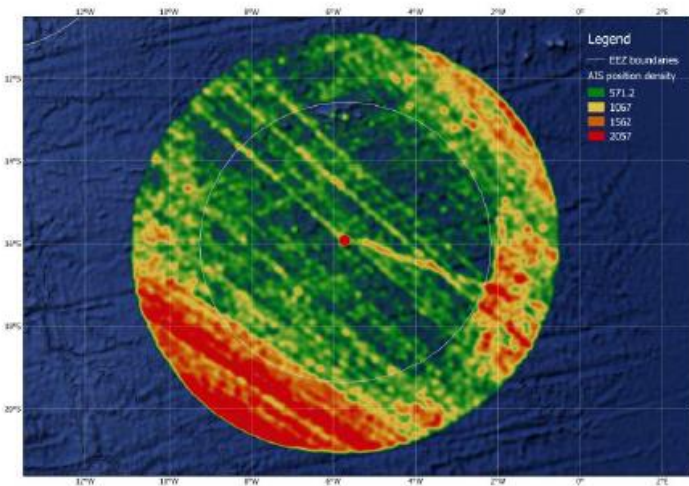
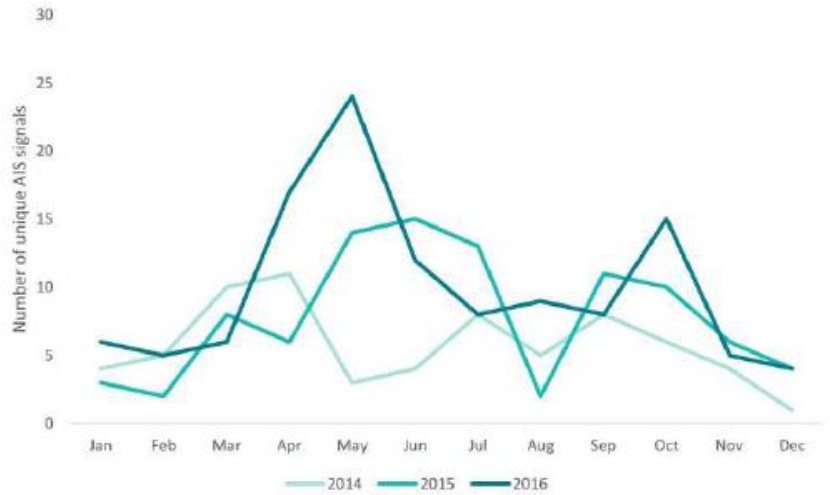
Category	2014	2015	2016	3 Year Total
Fishing vessel	267	345	381	647
Fish carrier	26	33	32	59
Fish bunker	4	4	5	6
Fishing buoy	19	31	95	134
Cargo	1486	2008	4344	5817
Hazardous cargo	432	559	894	1372
Passenger vessel	13	17	16	44
Pleasure craft	2	2	3	5
Unknown	352	305	853	1410
Other	104	121	100	276
Total	2705	3425	6723	9770



Appendix 1: Territorial heat maps

Saint Helena

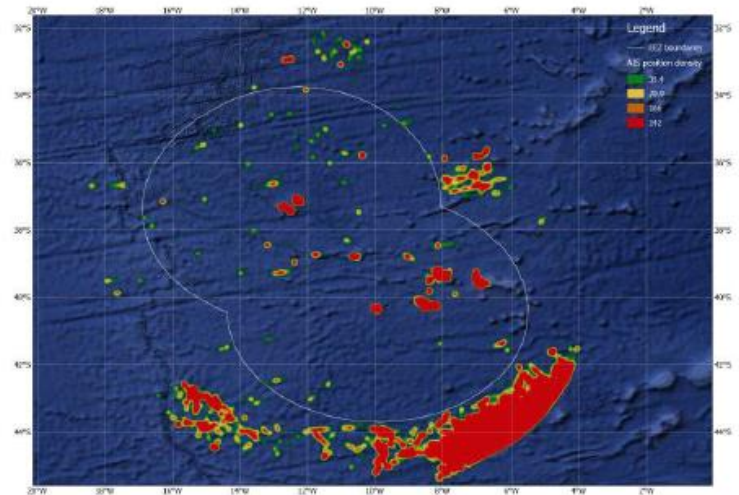
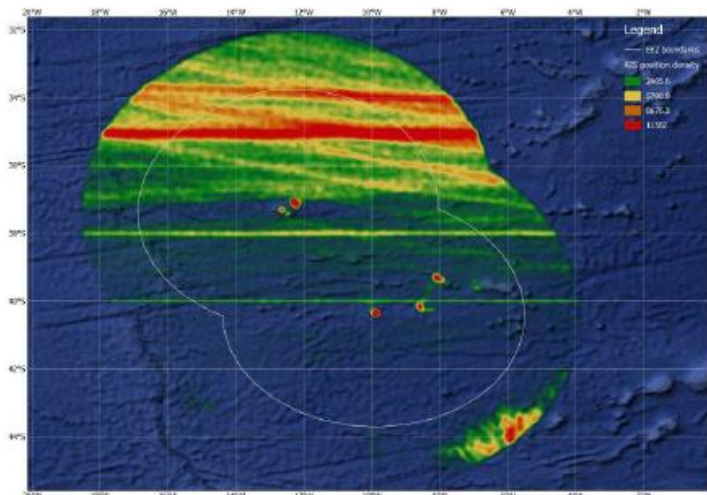
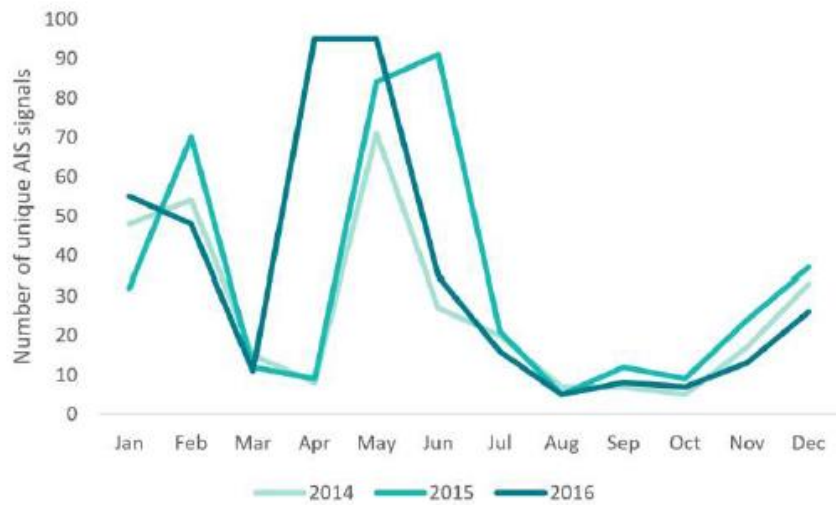
Category	2014	2015	2016	3 Year Total
Fishing vessel	35	52	66	109
Fish carrier	11	11	12	25
Fish bunker	1	2	1	2
Fishing buoy	0	6	16	22
Cargo	693	817	1043	2135
Hazardous cargo	297	355	363	734
Passenger vessel	10	14	12	28
Pleasure craft	12	11	14	37
Unknown	221	171	300	658
Other	44	53	26	114
Total	1324	1492	1853	3864



Appendix 1: Territorial heat maps

Tristan da Cunha

Category	2014	2015	2016	3 Year Total
Fishing vessel	209	241	246	432
Fish carrier	21	28	19	40
Fish bunker	0	0	0	0
Fishing buoy	7	6	5	13
Cargo	1841	2155	2125	4147
Hazardous cargo	199	276	284	616
Passenger vessel	9	10	8	24
Pleasure craft	0	0	0	0
Unknown	322	245	371	840
Other	48	40	35	107
Total	2656	3001	3092	6219



Notes

This project was funded by the UK Foreign & Commonwealth Office in conjunction with the UK Marine Management Organisation. OceanMind carried out fisheries compliance monitoring for the UK Overseas Territories to understand the potential risk of Illegal, Unreported and Unregulated (IUU) fishing and possible unauthorised activity taking place in their waters. This important piece of work was undertaken to support the fisheries' Monitoring, Control and Surveillance (MCS) activities of the UK Overseas Territories using Automated Identification System (AIS), Synthetic Aperture Radar (SAR) imagery and OceanMind's extensive database of vessel identity information. This identity information includes historic information and analyst reviews of likely identities based on track analysis for fishing vessels, fishing buoys, fish carriers, bunker vessels associated with at-sea replenishment of fishing fleets, and information from Regional Fisheries Management Organisations, IUU lists, and other databases.

The monitoring activity consisted of a historic review of transponder and vessel activity in each overseas territory for three years between 01 January 2014 to 01 January 2017. All Automated Identification System (AIS) activity was reviewed for the three-year period and the likely compliance of vessel activity was assessed against the relevant fisheries regulations. AIS data supplied by Exact Earth.

This information was used to create a fisheries compliance profile for each Overseas Territory, as identified above, that identified possible IUU fishing vessels for further investigation, and develop spatial and temporal patterns in fishing activity to assist in the planning of MCS assets and other aspects of fisheries management.

Maps were made using Quantum GIS Geographic Information System. Open Source Geospatial Foundation Project. Google Earth V7.1 US Dept of State Geographer and Google.

Geospatial boundaries from Flanders Marine Institute, Maritime Boundaries Geodatabase version 9 or developed by OceanMind are based on regulatory descriptions from fishery managers. CRS –WGS84.

**For more information, please contact the Blue Belt programme:
katie.mcpherson@marinemanagement.org.uk**