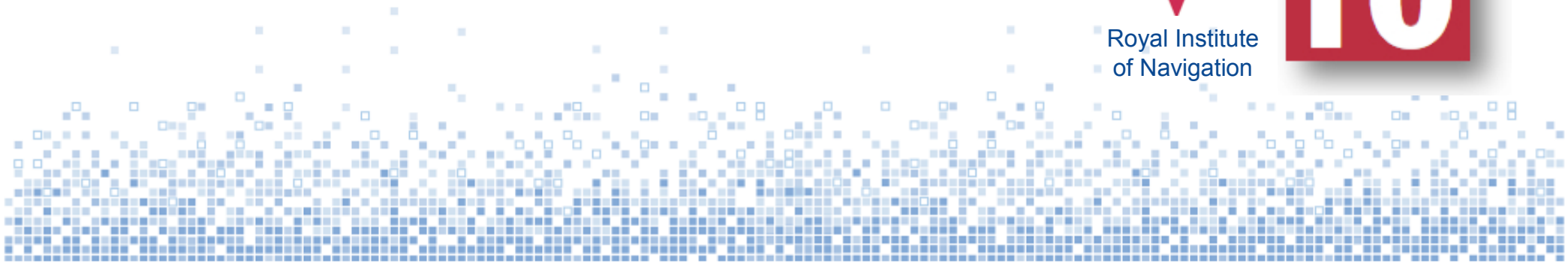


# The Potential effects of GPS Jamming on Marine Navigation

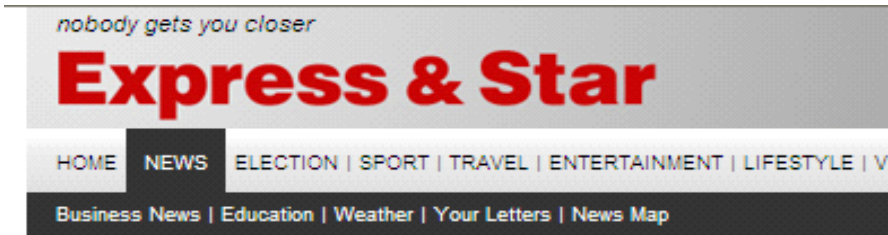
Alan Grant, Paul Williams & Nick Ward  
General Lighthouse Authorities of the United  
Kingdom and Ireland



Royal Institute  
of Navigation



# GPS Jamming is a threat to safe navigation



## £6m lorry hijackings gang face ten years

Thursday 6th May 2010, 11:30AM BST.



Two robbers who were part of a violent gang which hijacked 40 lorries around the Midlands with loads totalling £6 million were today facing up to 10 years in prison.

**“Satellite jamming equipment was used to stop lorries being tracked after they were stolen”**



Source: <http://www.expressandstar.com/news/2010/05/06/6m-lorry-hijackings-gang-face-ten-years/>

# GLA GPS Jamming trials

The GLAs have conducted two trials investigating the effects of GPS jamming.

April 2008 off Flamborough Head



*NLB Pole Star*

December 2009 off Newcastle Upon Tyne



*THV Galatea*



# Flamborough Head trial

## Effect of GPS jamming on safe navigation

### Aids to Navigation (AtoN)

- eLoran
- Differential GPS
- AIS as an AtoN

### On Ship

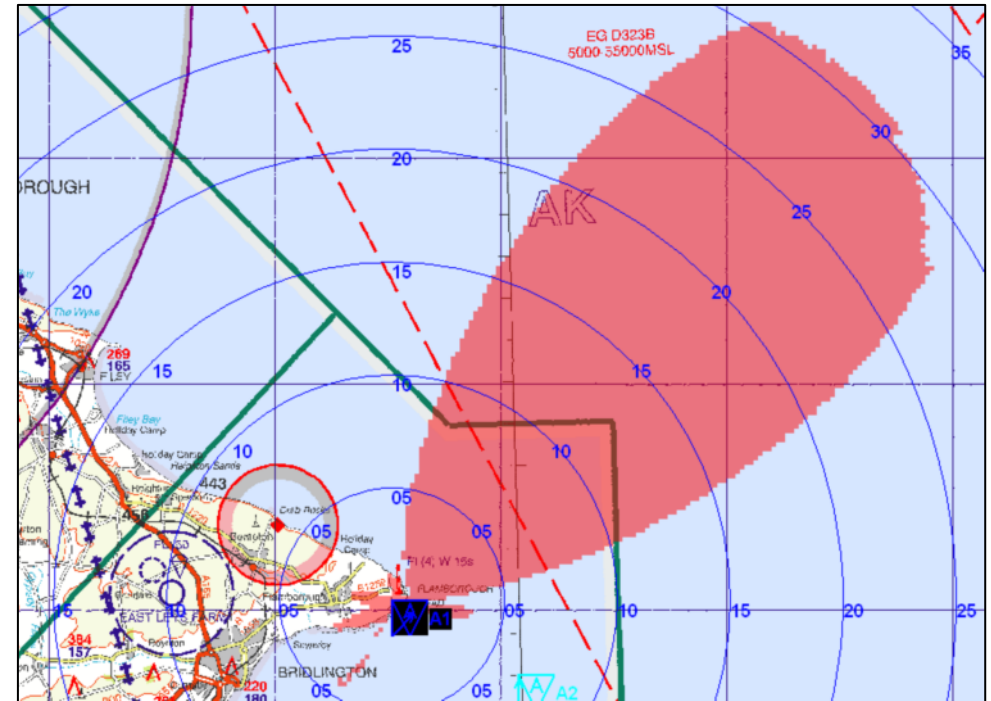
- Navigation systems
- Situational awareness

### On Shore

- Vessel Traffic Management

### On People

- Safe navigation

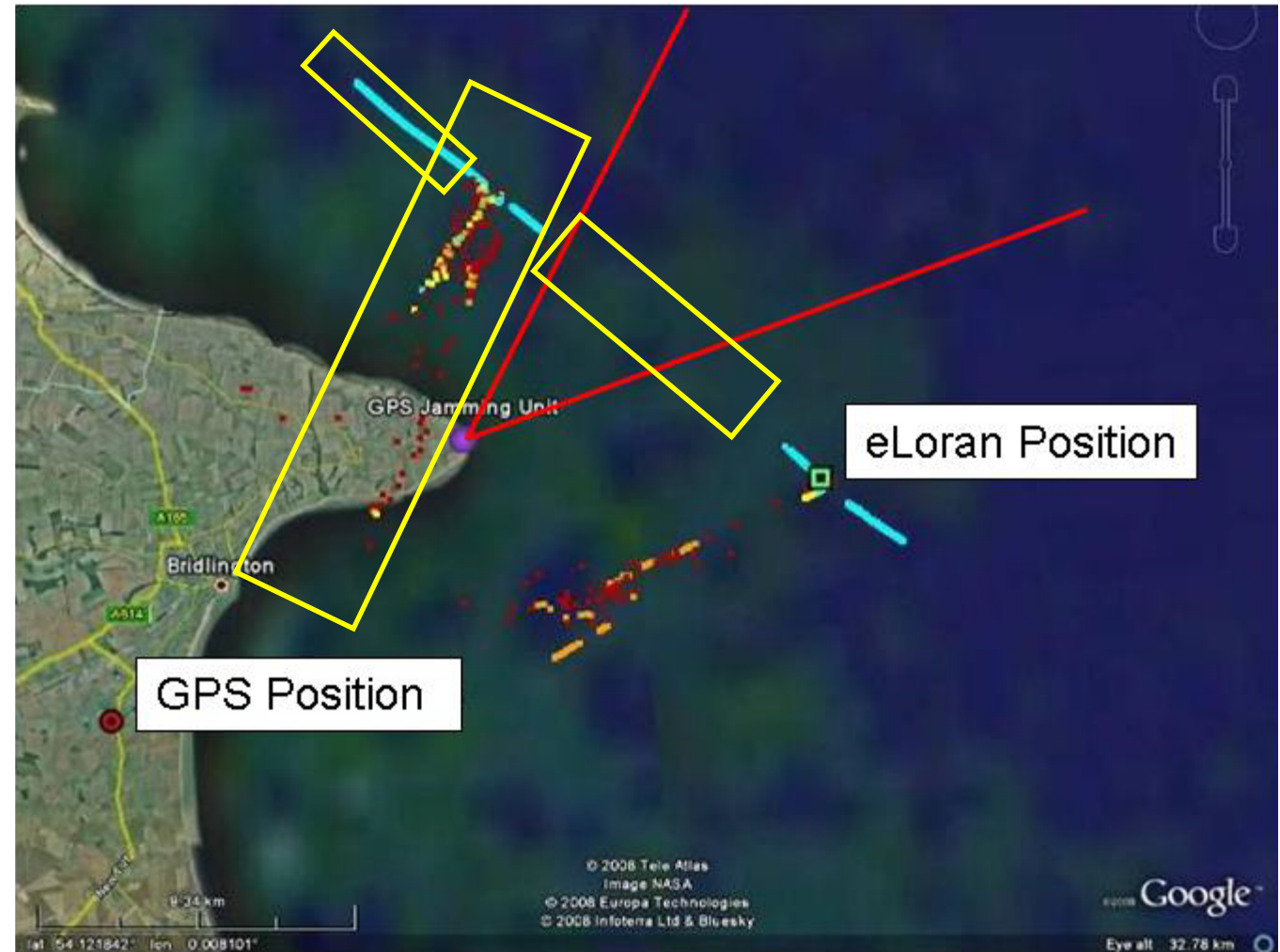


Coverage area of the GPS jamming unit at 25m above ground level on maximum power of 1.58W ERP.

(Image courtesy of DSTL)

# Ship systems

GPS reported position is inland and 22km away from true position (eLoran).

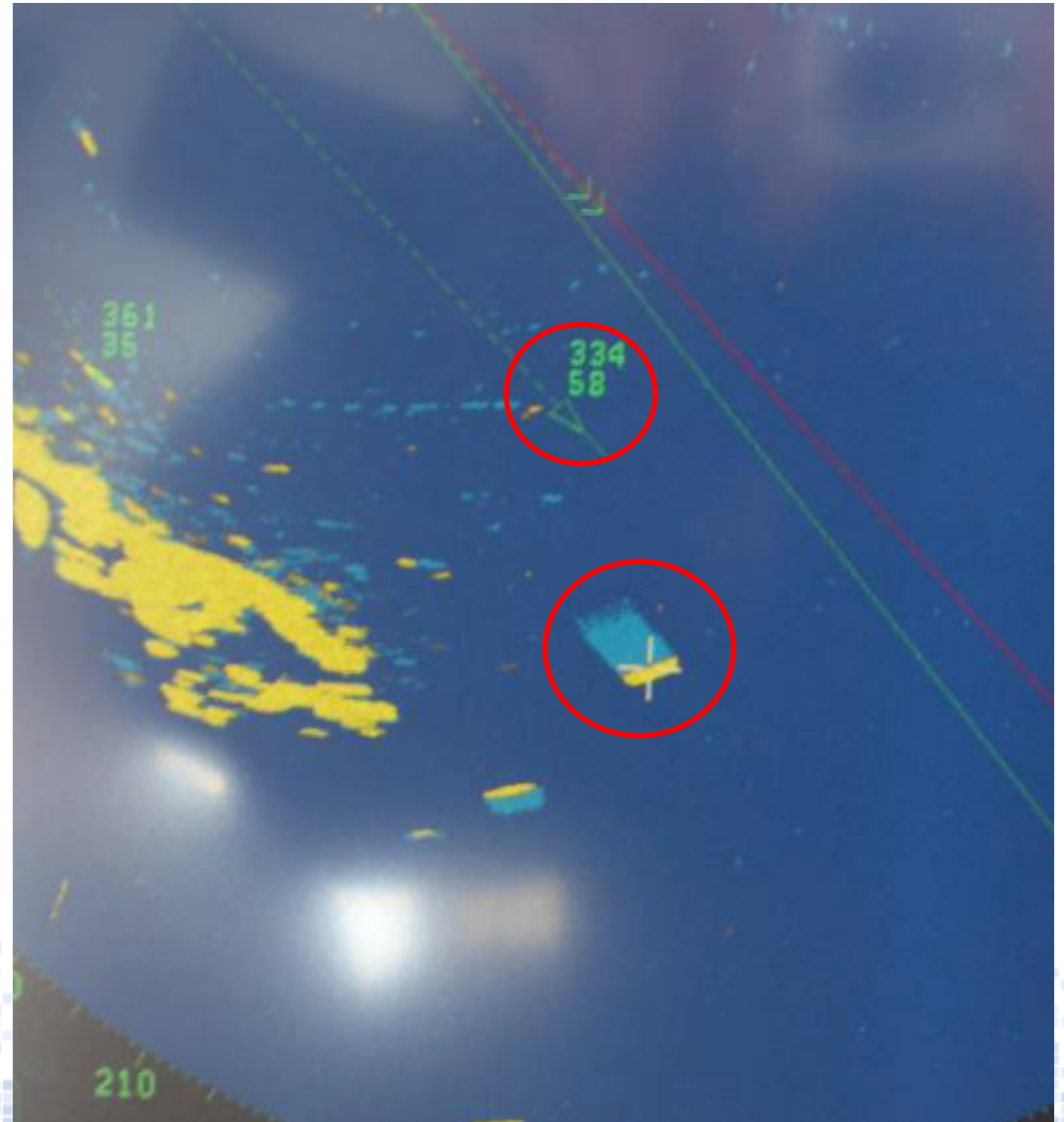


Colours indicate reported speed: blue <15knts, yellow < 50knts, orange <100knts and red >100knts

# Effect on Ship & Shore

The effect of GPS jamming on AIS was observed by:

- *NLV Pole Star's* AIS alarmed when GPS was lost.
- Without GPS it could not provide a range or bearing to surrounding vessels or AtoNs.
- Some AIS returns included erroneous positions.



# Effect on Ship & Shore

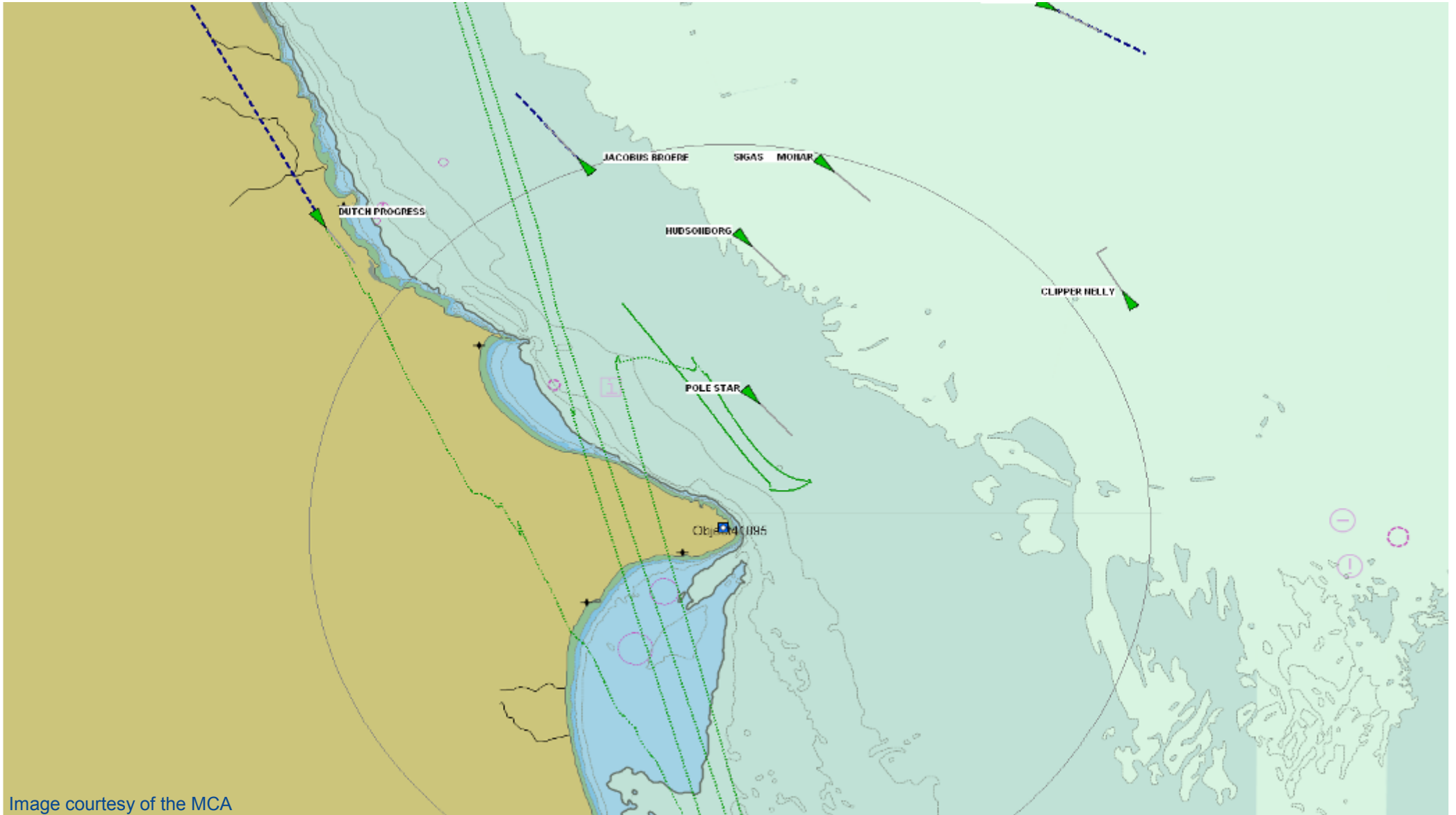


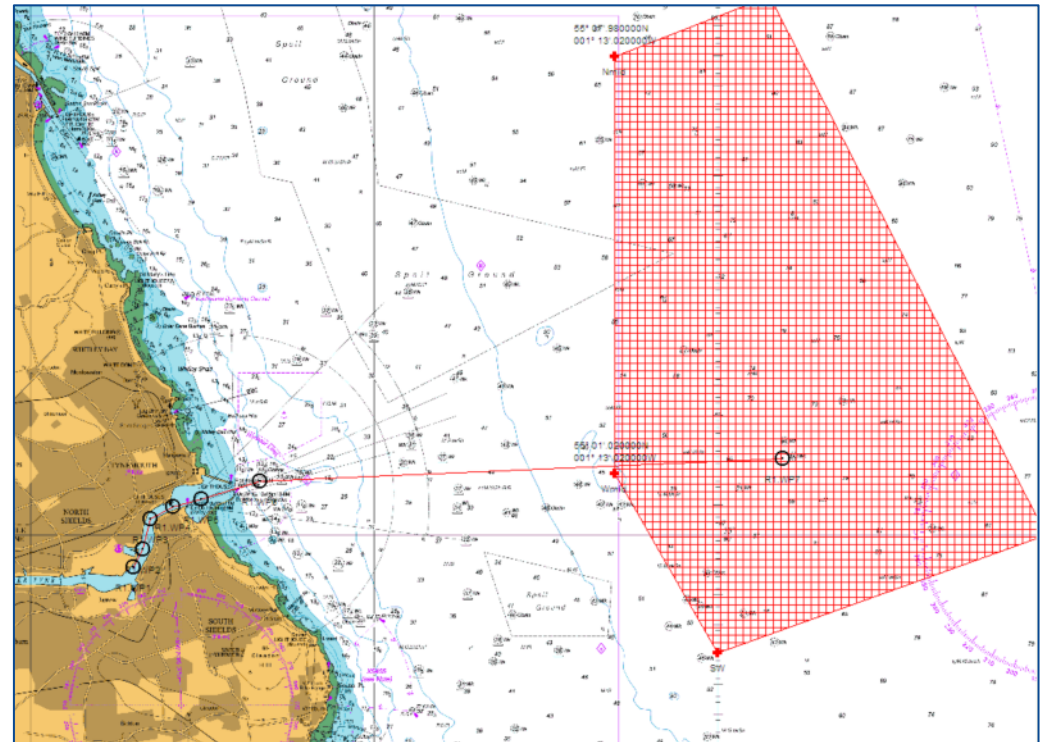
Image courtesy of the MCA

# Newcastle demonstrations

## Aims:

To raise awareness of the impact of jamming to the wider community

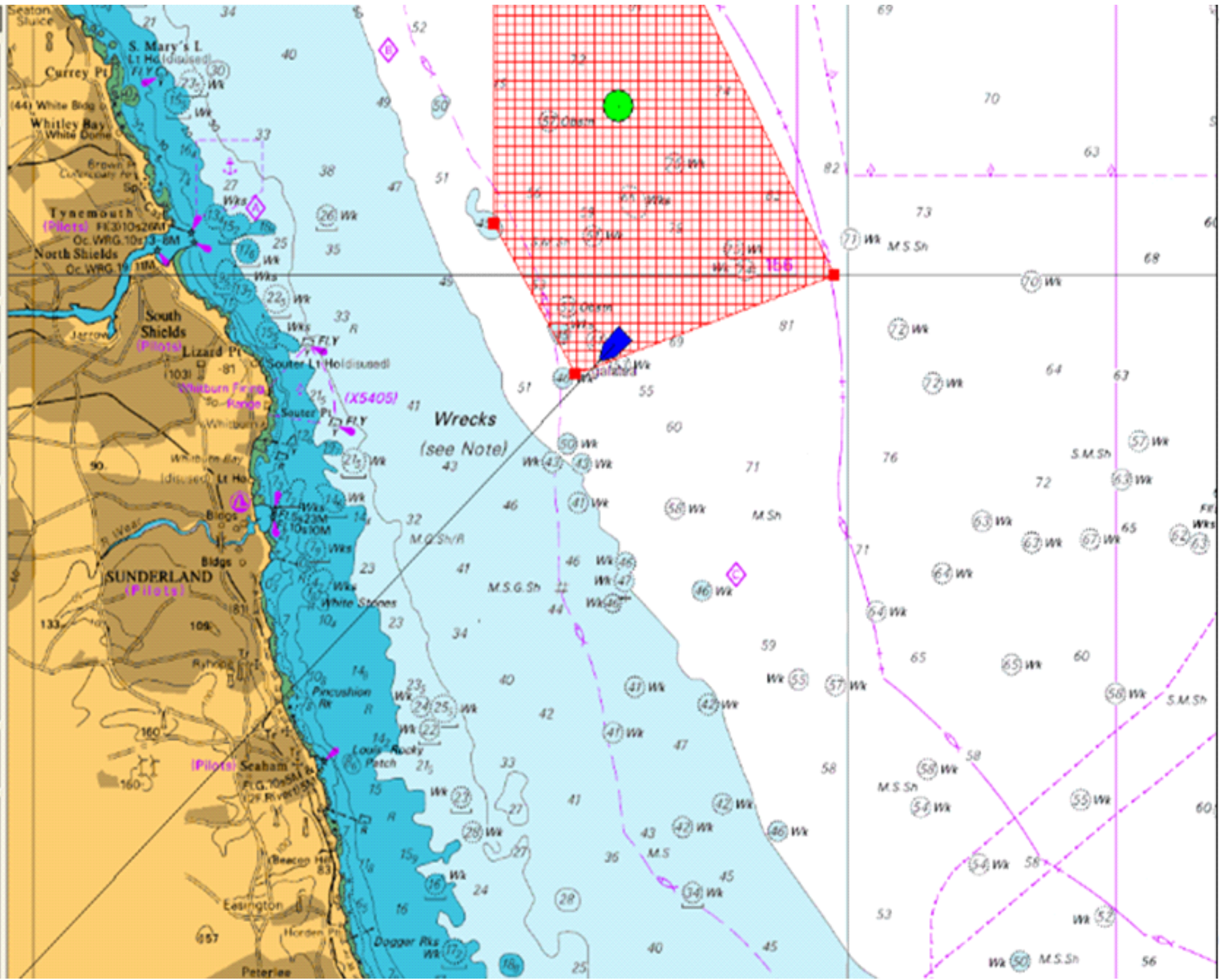
Investigate further the result of low power jamming



The jamming unit for these demonstrations were installed on THV Galatea



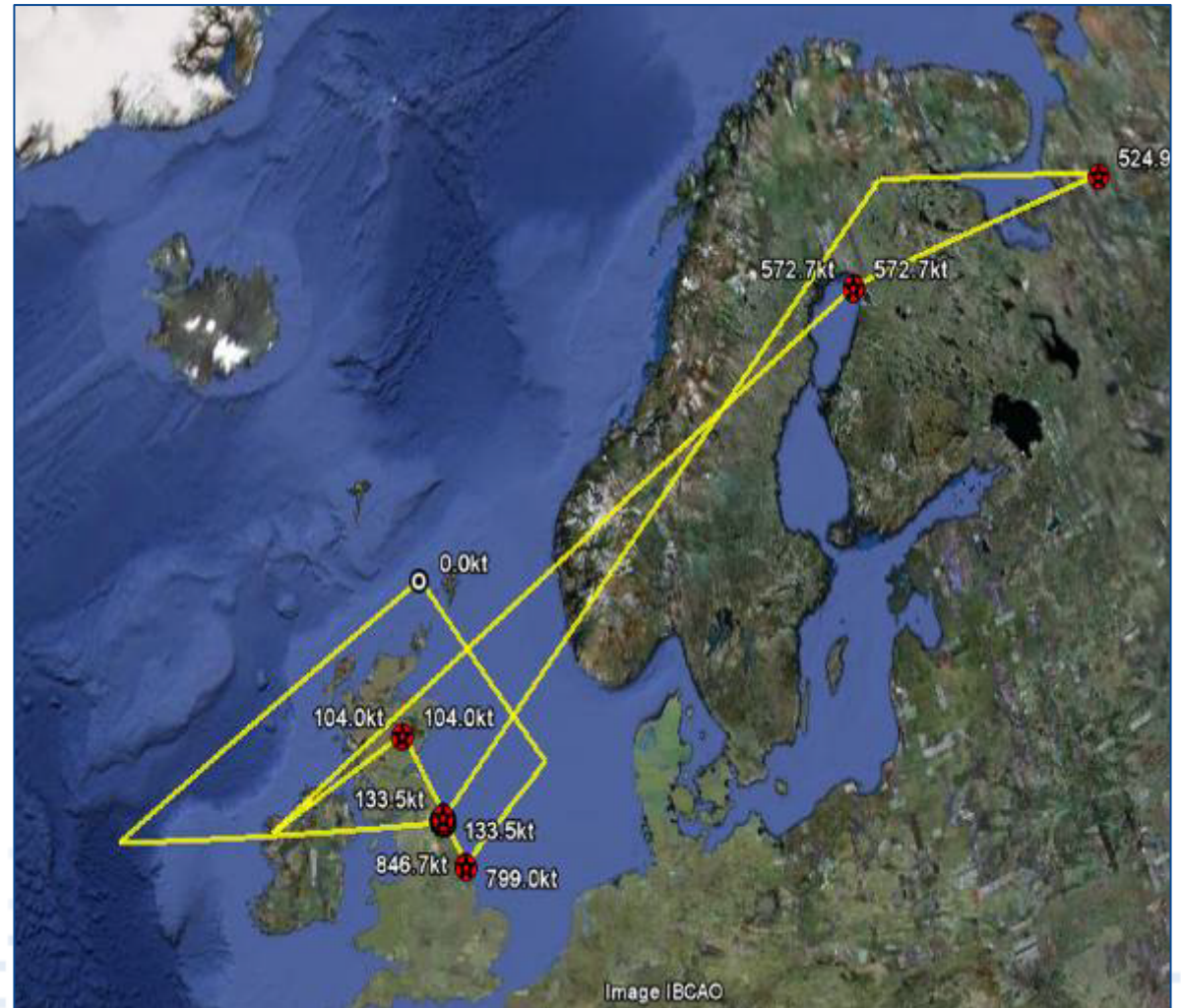
Page 1 >>	
Navigation Status	
<b>3D Position</b>	
Position Age: 1.6 secs.	
Vessel	
Lat:	54° 58' 613N
Lon:	001° 08' 632W
Course:	225° T
Speed:	707.1 Kts
COG:	225° T
SOG:	707.1 Kts
Hdg:	000° T
2nd GPS	
Lat:	55° 03' 386N
Lon:	001° 08' 446W
Vessel Cursor	
Lat:	54° 48' 542N
Lon:	000° 47' 305W
Range:	18.00 NM Rhumb Line
Brg:	137° T Rhumb Line
Active Waypoint	
Name:	n/a
Lat:	n/a
Lon:	n/a
Brg:	n/a
Range:	n/a
VMG:	n/a
TTG:	n/a
ETA:	n/a
XTE:	n/a
Stoor:	n/a
Tide	
Set:	000° T
Dir:	0.0 Kts
No - Active Target	
Name:	n/a
Lat:	n/a
Lon:	n/a
Brg:	n/a
Range:	n/a
COG:	n/a
SOG:	n/a
Hdg:	n/a



# Observed GPS position errors

Erroneous GPS positions were observed on both typical GPS receivers installed for the demonstration.

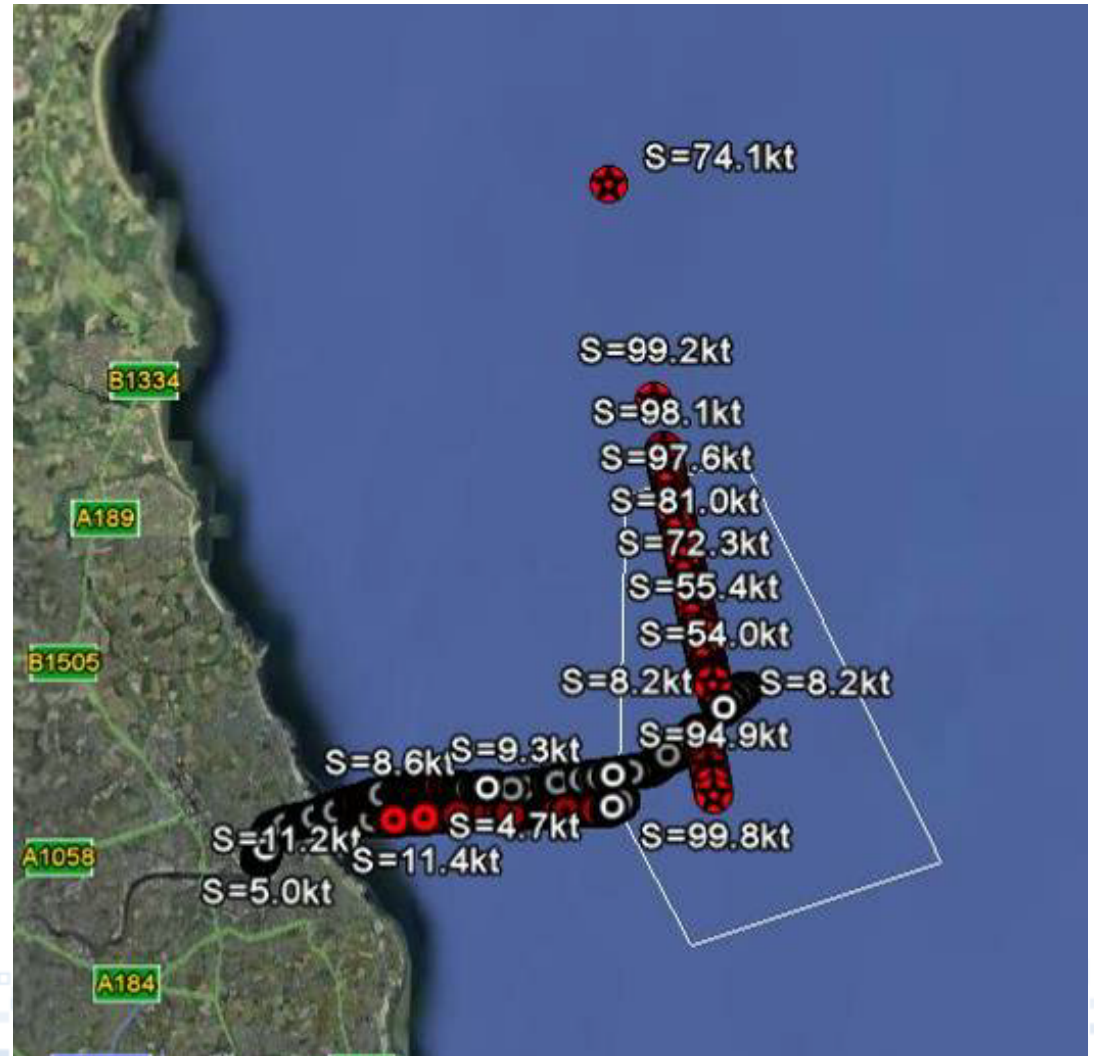
Observers with their own handheld GPS receivers observed erroneous positions, with Ireland and Eastern Europe favourite destinations.



# Potential for hazardous and misleading information

Subtle errors, giving hazardous and misleading information were also observed.

THV Galatea was steaming at approximately 10 knots.



# Observed effects on AIS MKD

Lat 54° 59.710' N 30 Nov 09:40

Long 1° 26.839' W

MMSI	NAME	RNG	BRG	
235031351		0.1	199	22
232003545	HEDWIN	0.4	211	
235064739	COLLINGWOOD	0.6	186	
244110000	NORTHSEA TRADER	0.7	212	1
636010538		0.8	223	
256555000	CITY OF NORDIC	0.9	233	↓
233234000	CITY OF BARCELONA	1.0	237	
563413000	DN26	1.3	246	

Extended Info Send SRM Sort By Bearing

AIS (normal conditions)

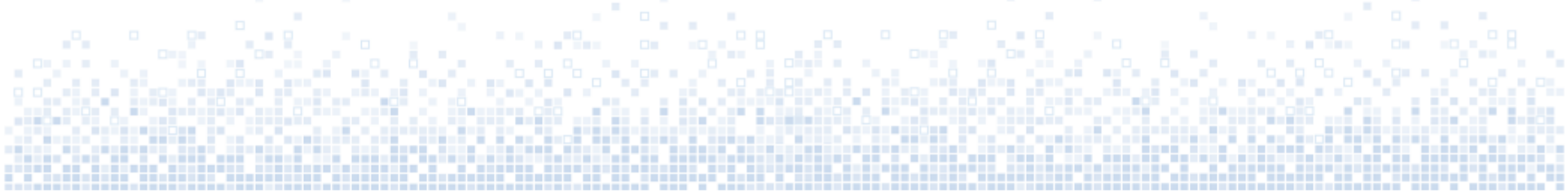
Lat --- 4 Dec 12:19

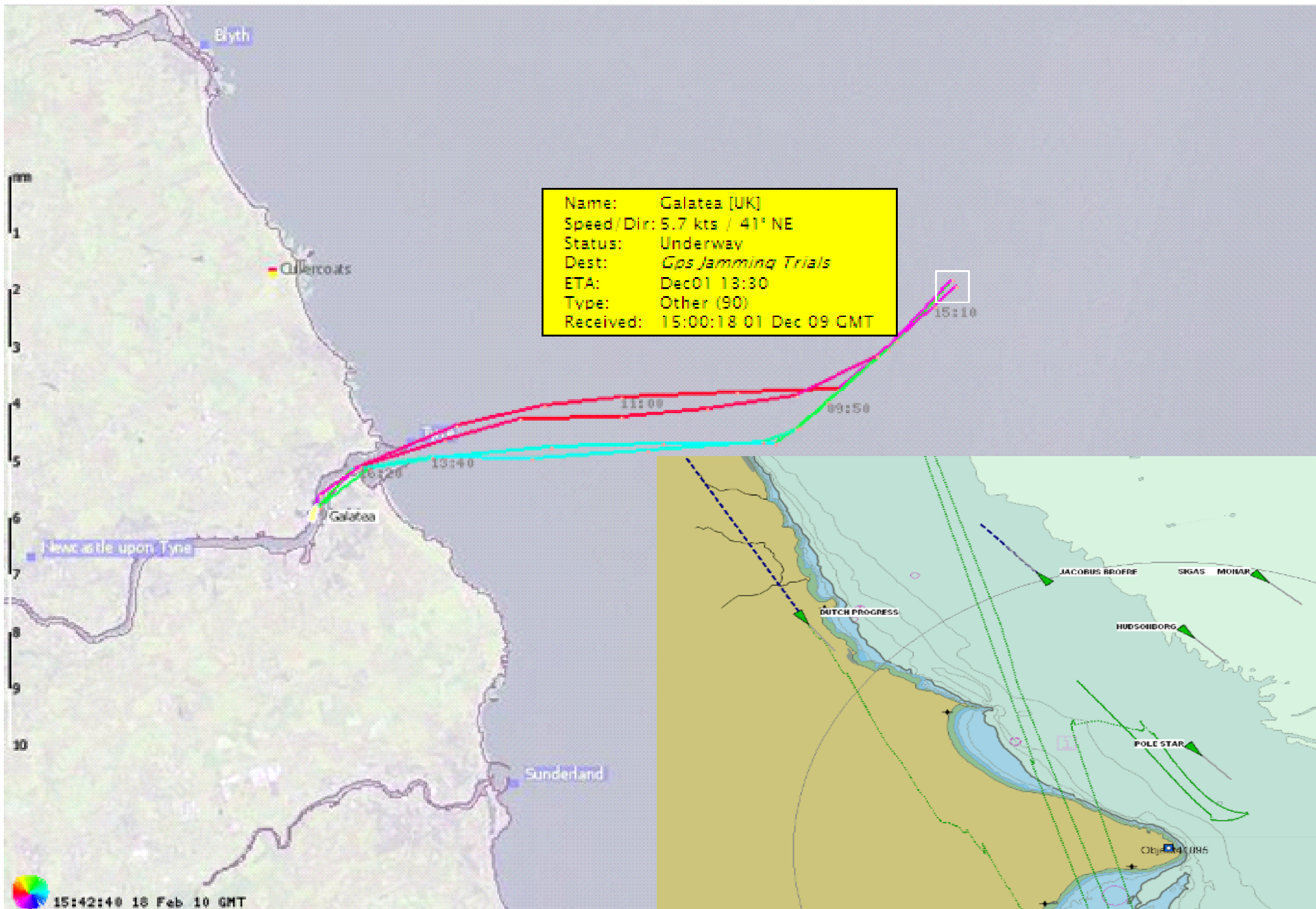
Long ---

MMSI	NAME	RNG	BRG	
244316000	AMADEUS	---	---	23
205429000	VESALIUS	---	---	
209729000	AMSTELDIJK	---	---	
220489000	PRINCESS OF NORWAY	---	---	1
232003545	HEDWIN	---	---	
232003613	ROWANGARTH	---	---	↓
232004936		---	---	
235008080	BORDER THISTLE	---	---	

Extended Info Send SRM Sort By Bearing

AIS (jamming conditions)





# Reverting to traditional means



## ***RADAR***

Alarms raised at the loss of GPS  
Can be misleading if AIS is overlaid

## ***Gyrocompass***

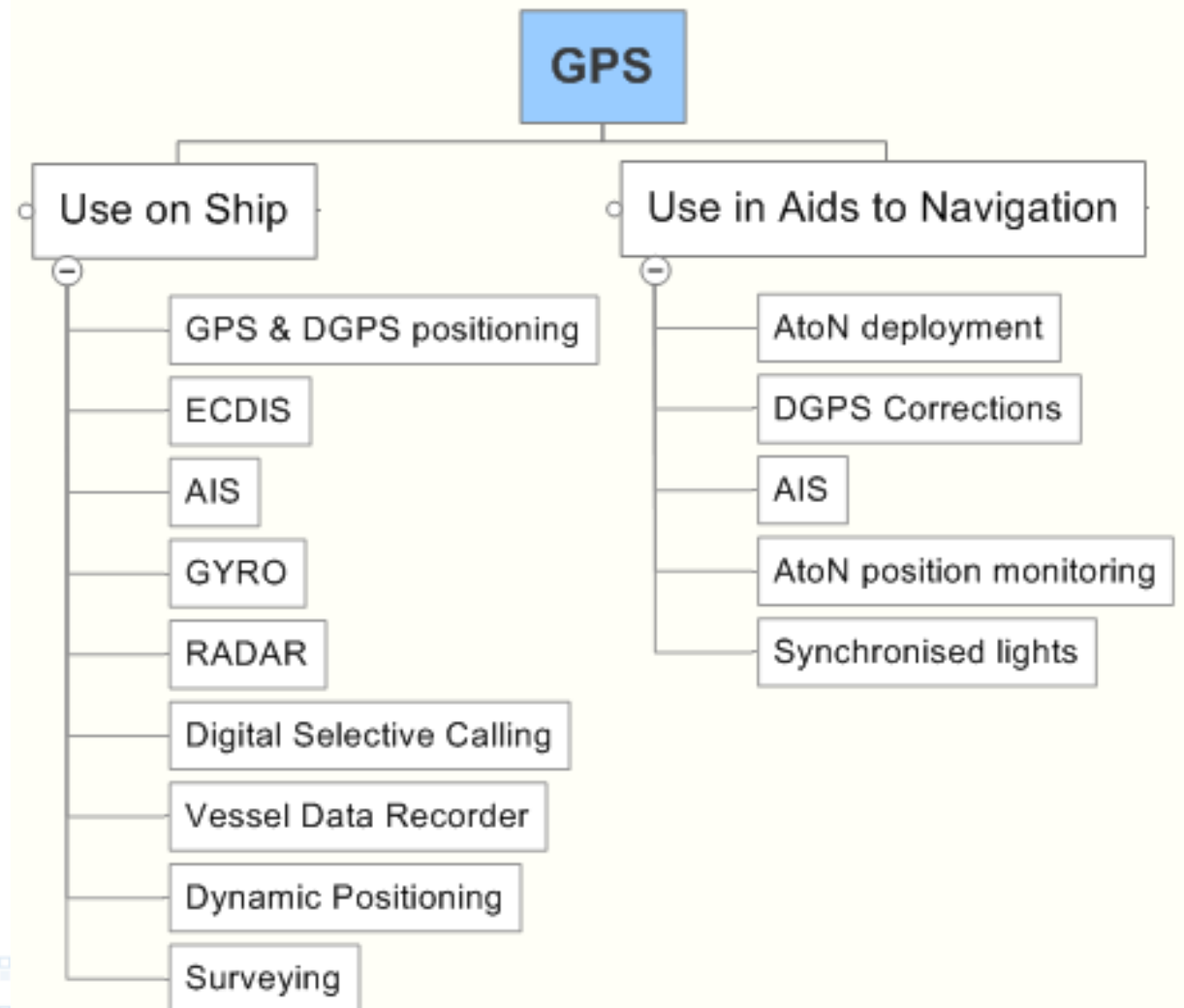
Alarms raised at the loss of GPS  
Drift errors can occur over time



# Equipment which can enter a failure mode with the loss of GPS

GPS has become the normal means for maritime positioning, navigation and timing.

The level of integration onboard is different for each vessel depending on equipment fitted.



# Conclusions

GPS jamming whether by intentional or unintentional means ***significantly affects*** maritime navigation.

GPS jamming can cause Hazardous and Misleading information

The level of disruption is dependent on:

- the make and model of the equipment installed on the vessel
- the configuration of the equipment (i.e. inputs to the ECDIS)
- the signal strength of the jamming signal

***The GLAs recommend the use of multiple means of navigation and support the development of resilient PNT.***





Thank you



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