

TerraSAR-X and TanDEM-X Mission

NRT Ship Detection – MARISS

Stephan Brusch

Egbert Schwarz

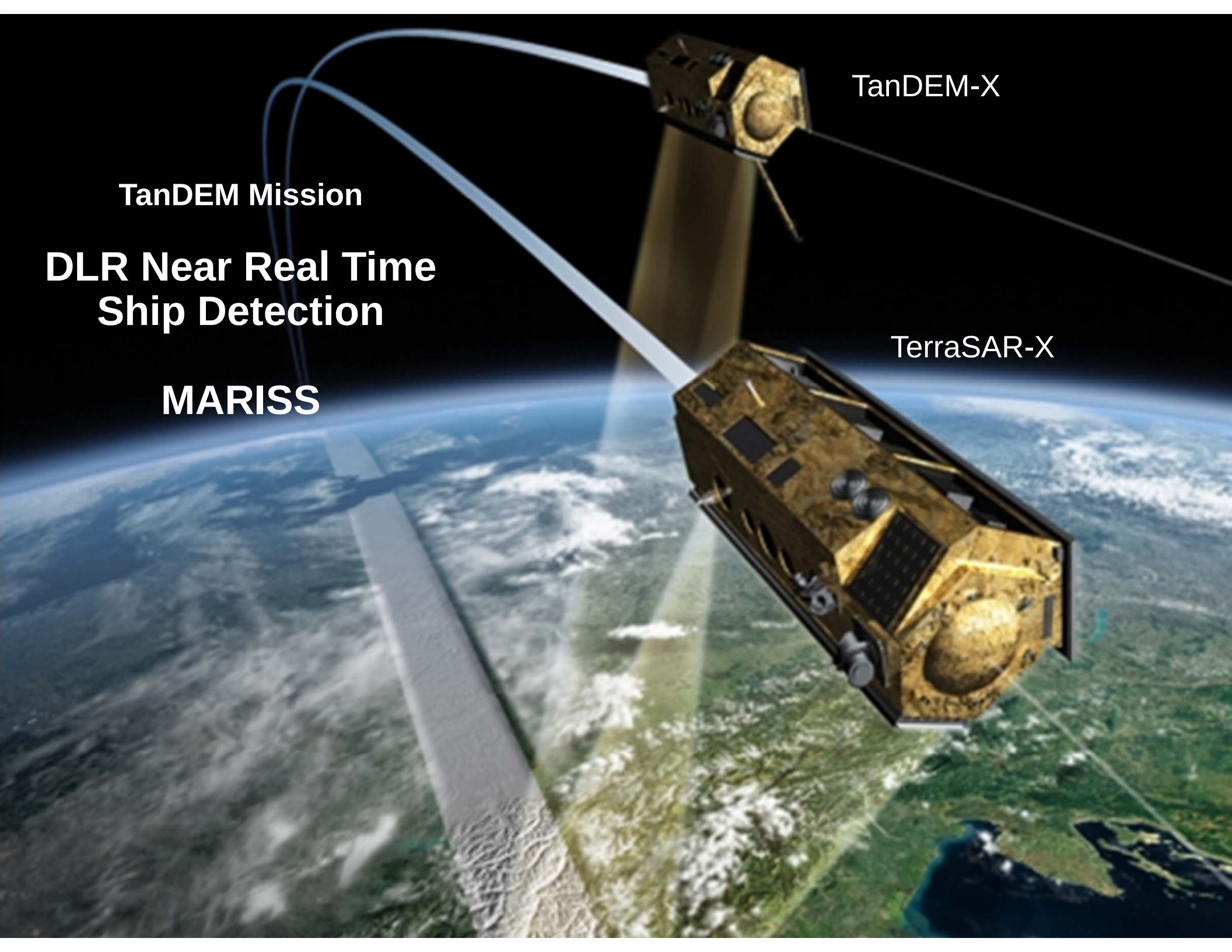
Susanne Lehner

Earth Observation Center - DLR



Knowledge for Tomorrow





TanDEM-X

TanDEM Mission

**DLR Near Real Time
Ship Detection**

MARISS

TerraSAR-X

TerraSAR-X



TanDEM-X



TerraSAR-X, TanDEM-X Overlay
Pursuit Monostatic Mode

TSX + TDX



TerraSAR-X, TanDEM-X Overlay
Pursuit Monostatic Mode

Fischland Darß



MARISS

(Start: 01.05.2010 Duration: 3 Years)

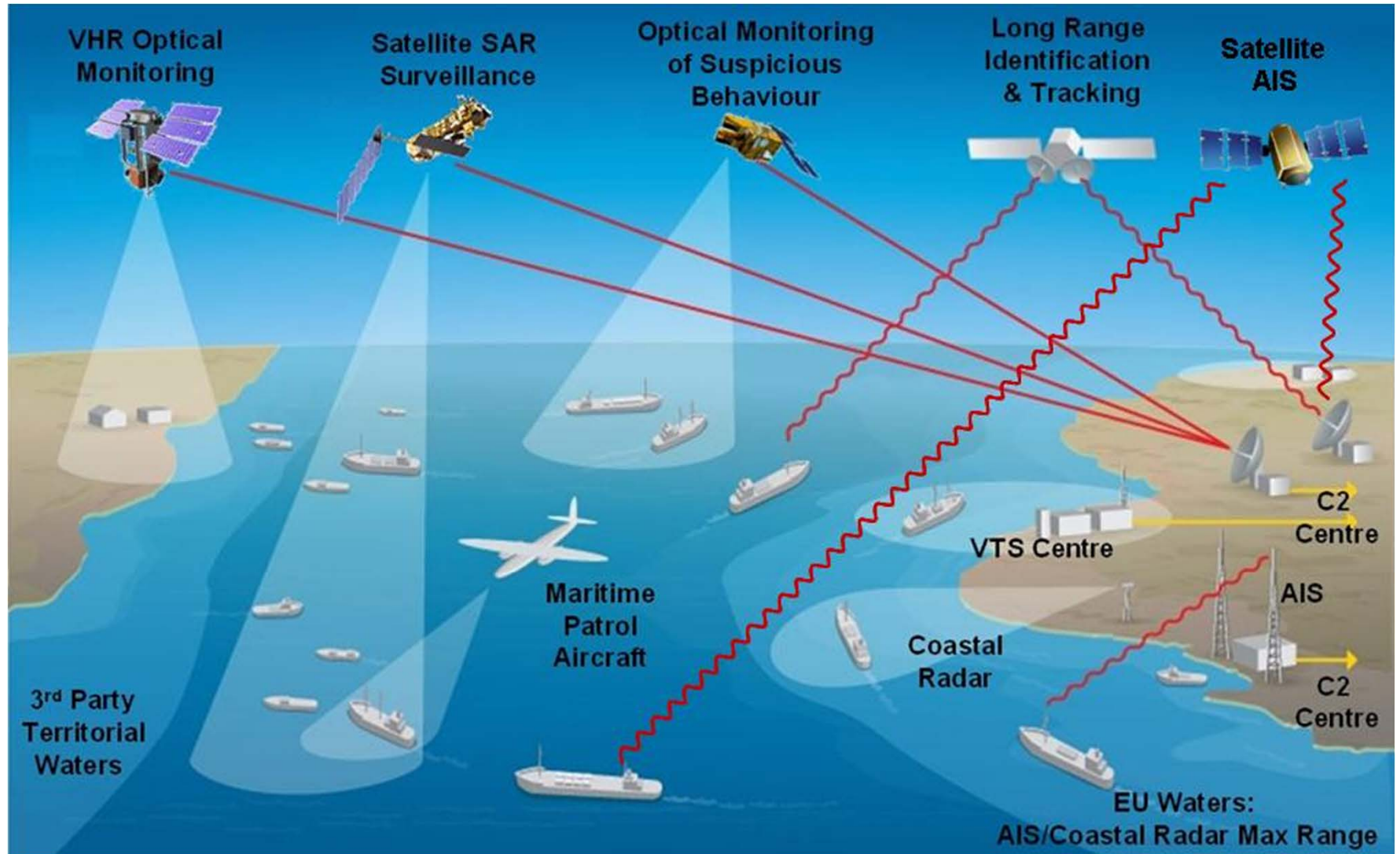


European Maritime Security Services – MARISS

„The Project main objective is to **create a Coordinated Service Network to provide all the Maritime European Users organizations with integrated ship detection Services**“



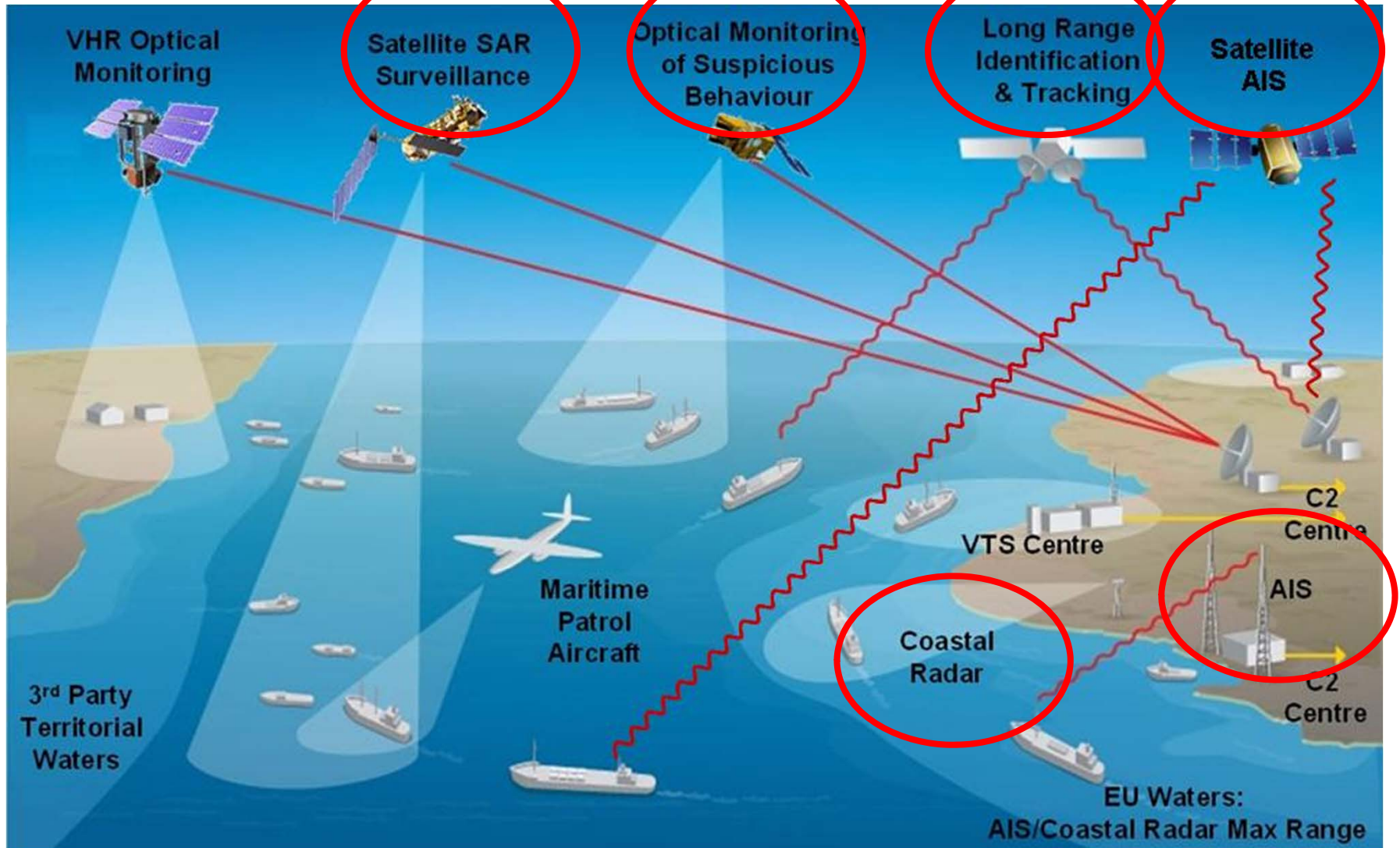
Ship Detection in Near Real Time (DLR)



source: ESA - MARISS



Ship Detection in Near Real Time (DLR)



source: ESA - MARISS



Ship Detection in Near Real Time (DLR)

Near Real Time:

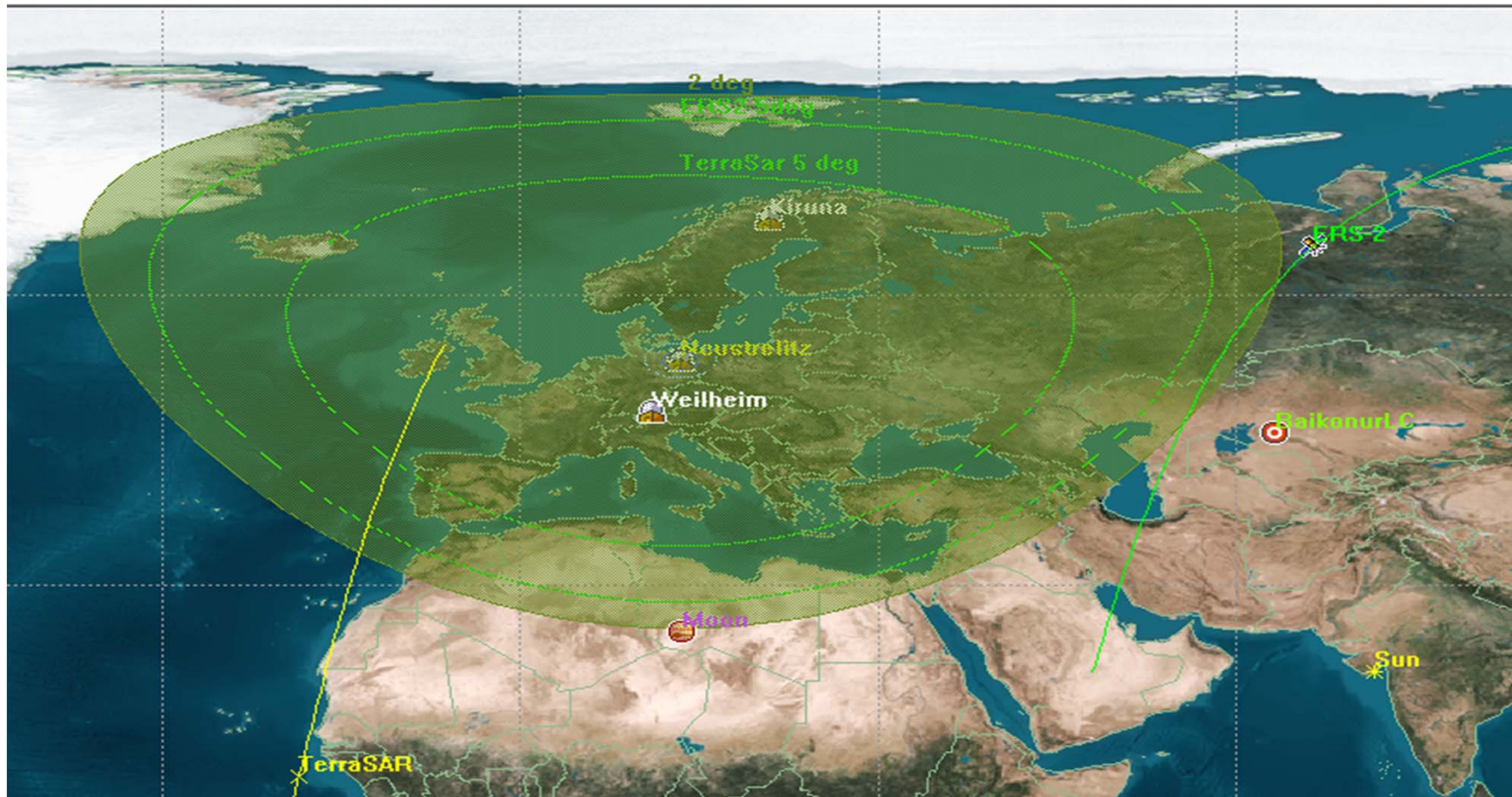
Products are available in less than 20 min

- 1. Downlink**
- 2. L1B Data Processing**
- 3. Preprocessing**
- 4. Landmasking**
- 5. Prescreening / Discrimination**

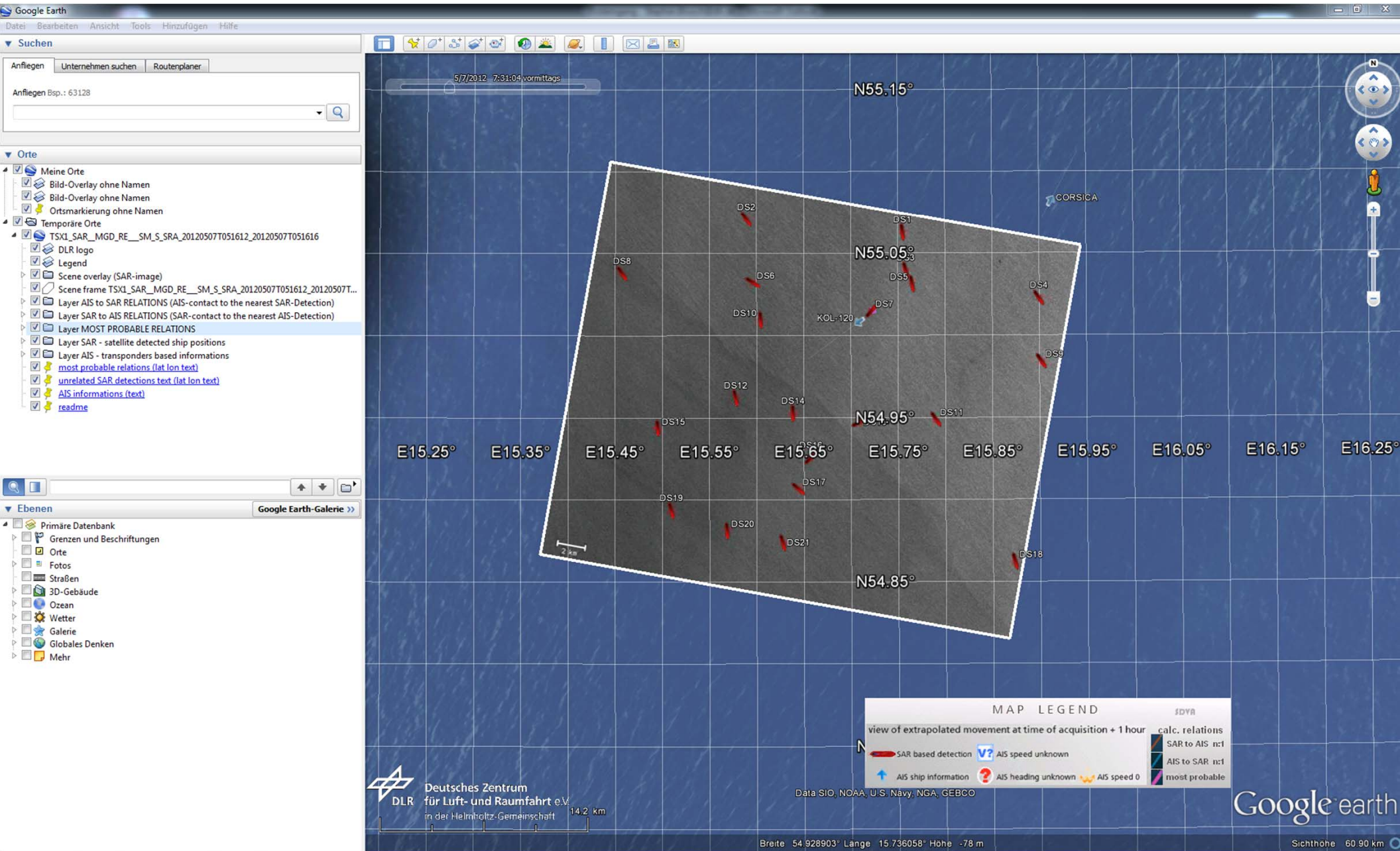


Ship Detection in Near Real Time (DLR)

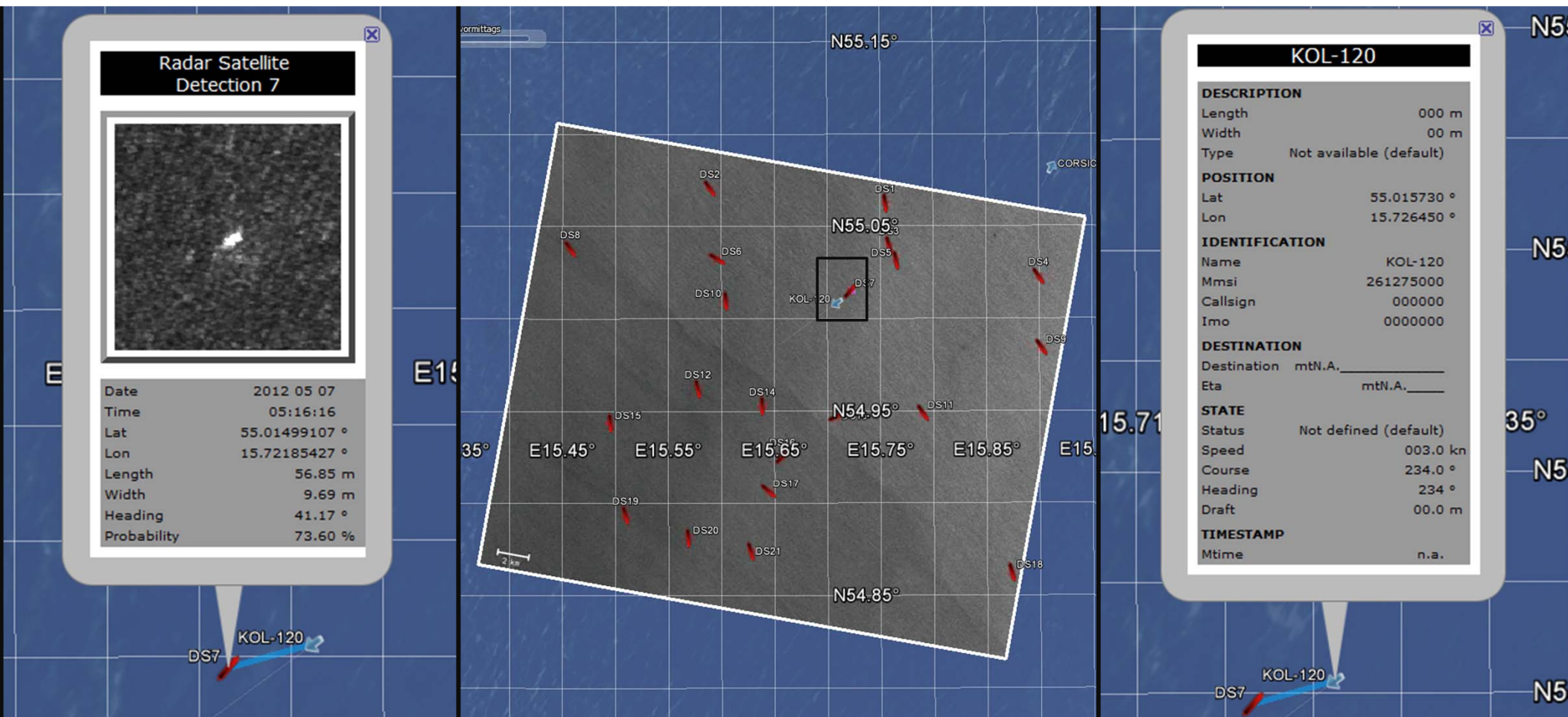
1. Downlink



DLR – Google Earth Solution



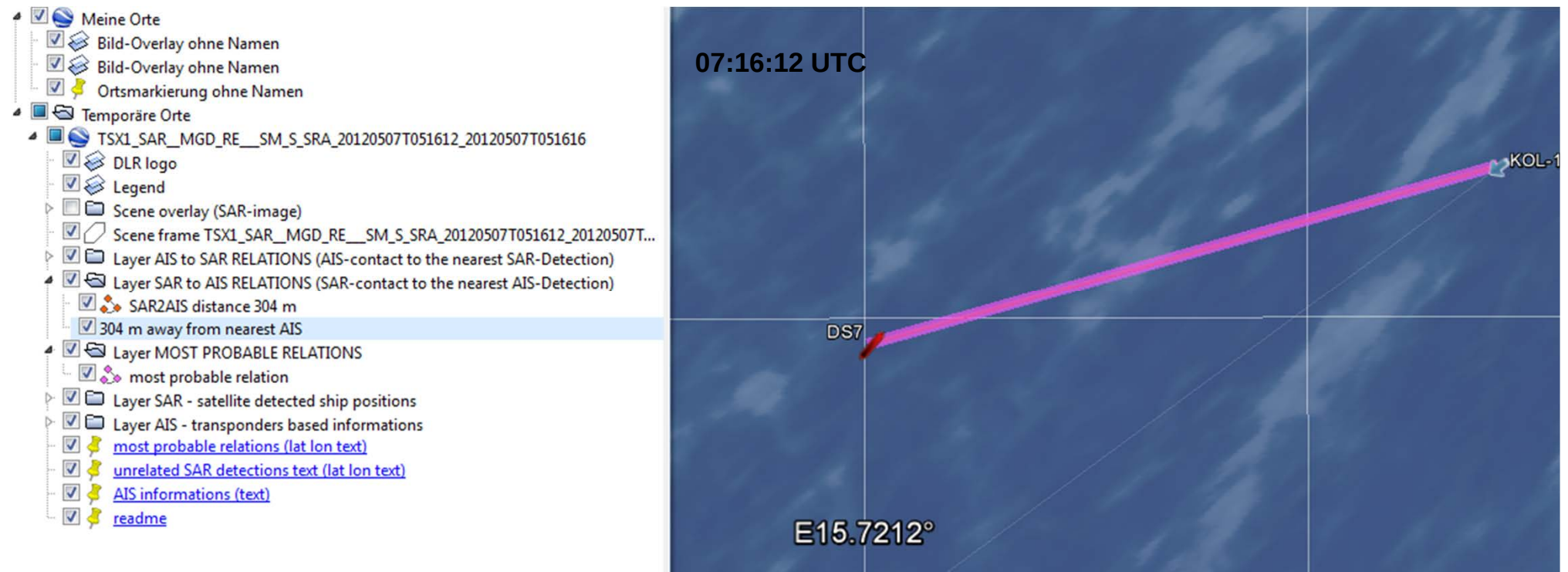
DLR – Google Earth Solution



DLR – Google Earth Solution

AIS and SAR:

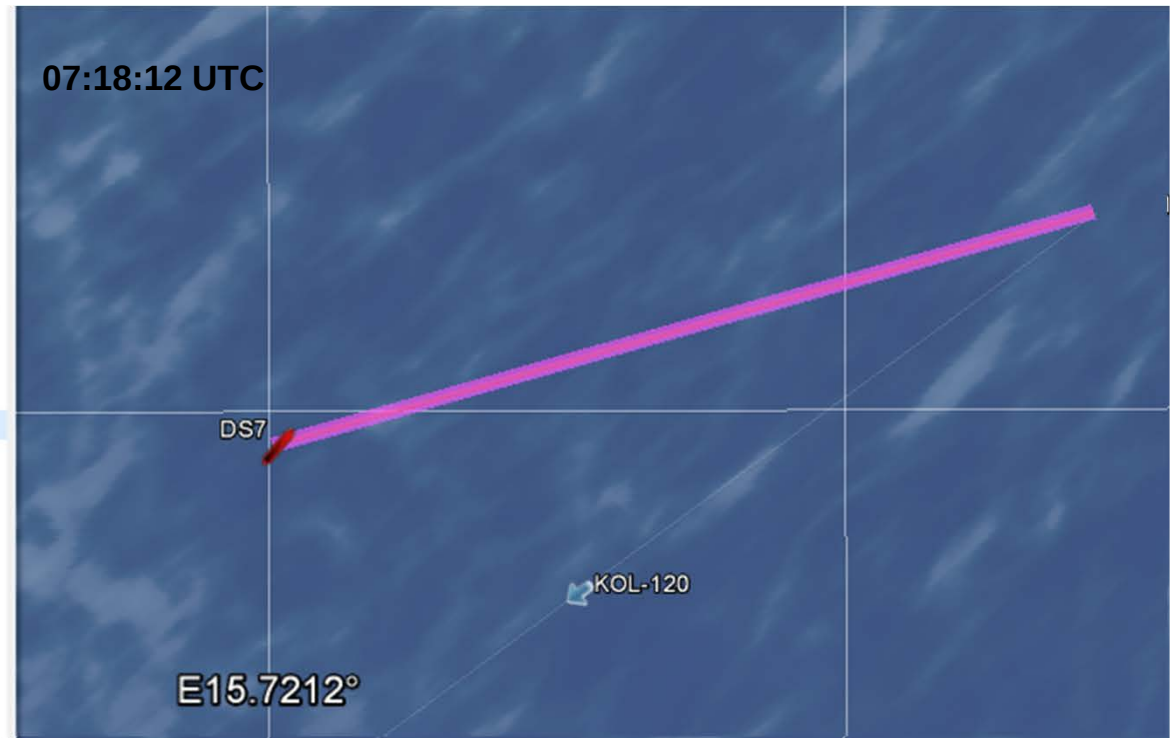
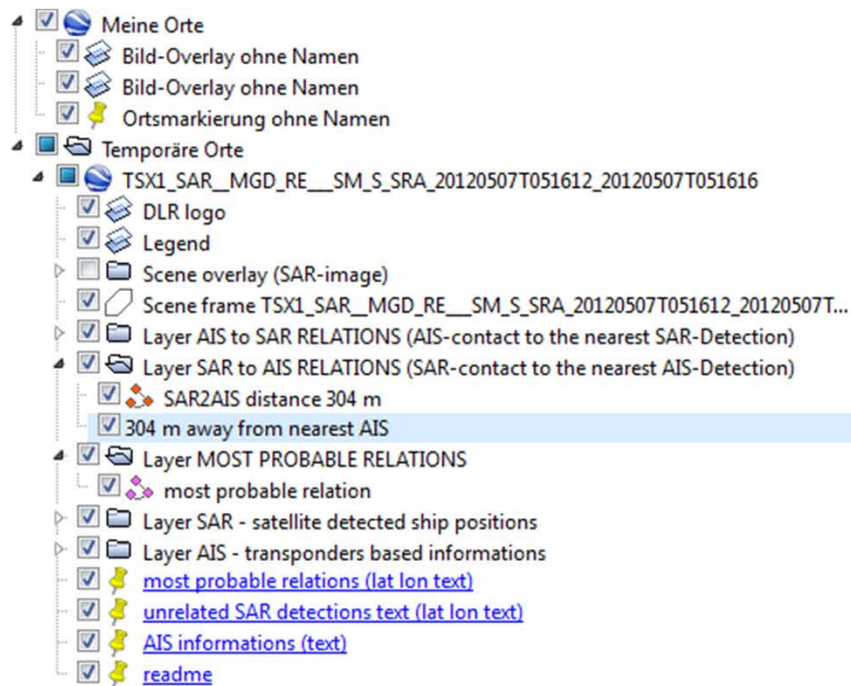
Correlation, Distances, Behaviour



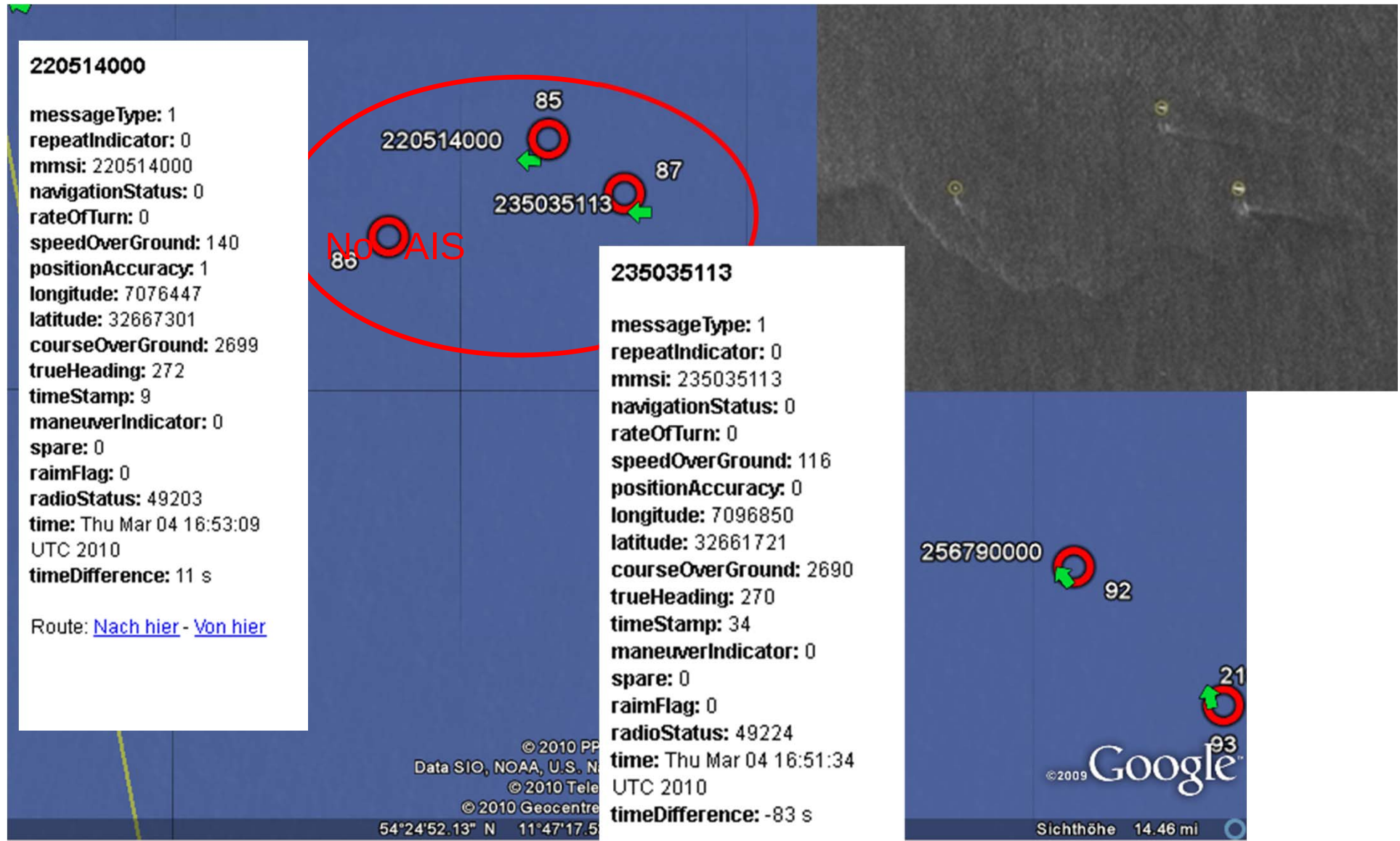
DLR – Google Earth Solution

AIS and SAR:

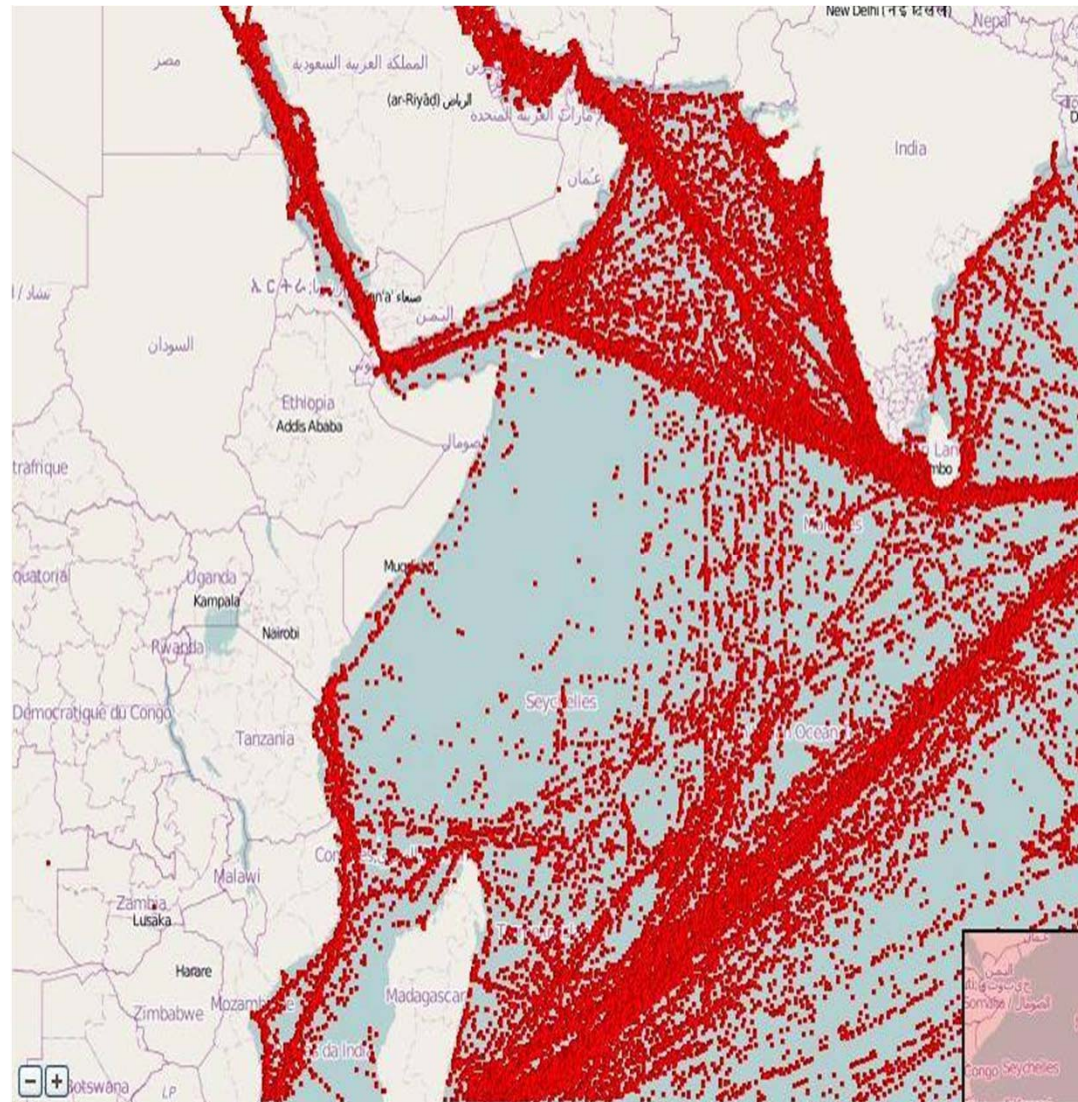
Correlation, Distances, Behaviour



Alerts (cooperative yes/no)



Ship Detection and Satellite AIS

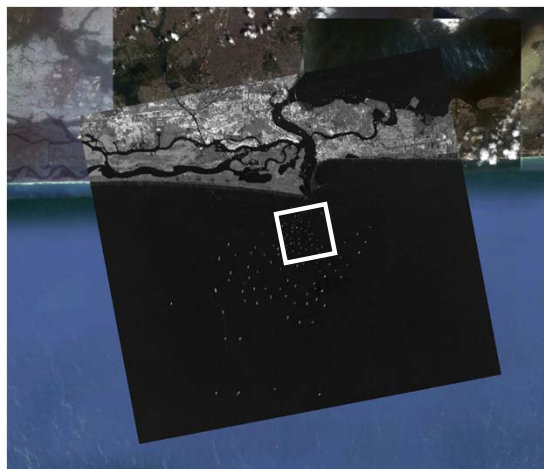


Satelliten AIS

© Luxspace



Integration of AIS Data



TSX1 SM

Date: 2010-07-15

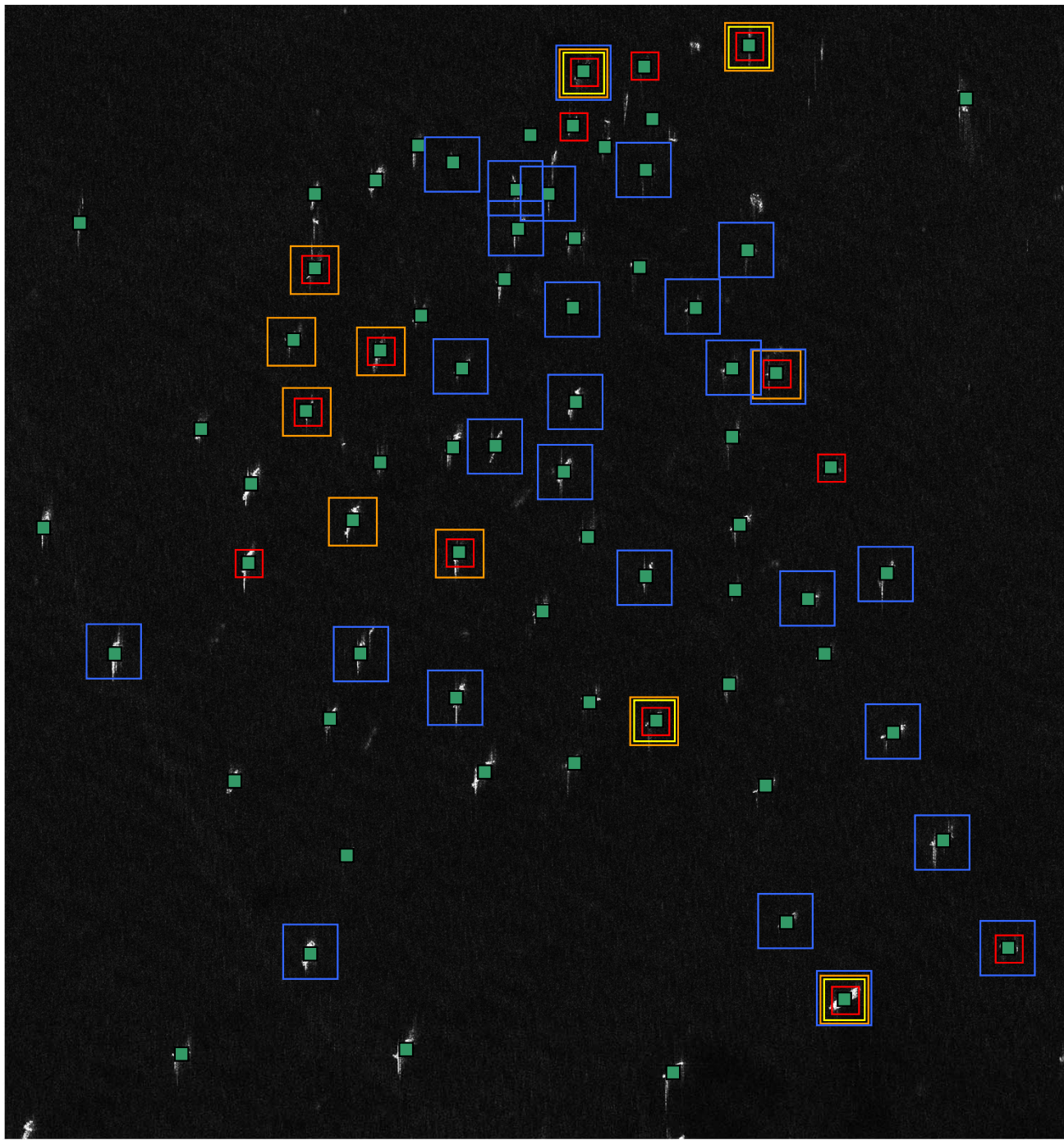
TS-X detections

FFI Satellite AIS

ORBCOMM Satellite AIS
at TSX overpass (OHB)

ORBCOMM Satellite AIS
whole day (OHB)

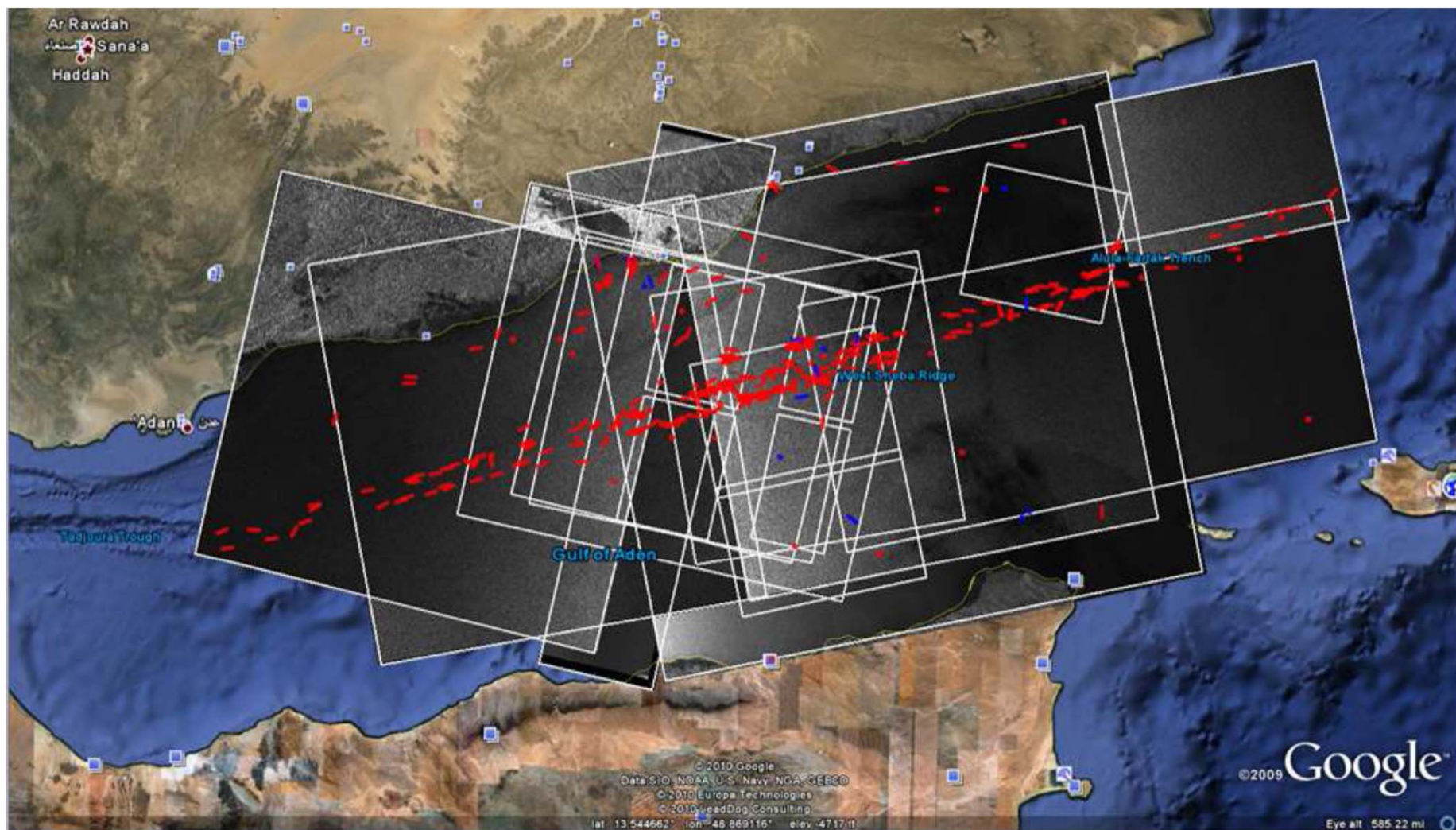
Terrestrial AIS (AIS Live)



Examples - Piracy



Piracy and Maritime Surveillance - PMAR



© EMSA



24-JAN-2011
09:08:20

S.P.D.F AIR WING



(Courtesy Bundespolizei)

AF
RATE

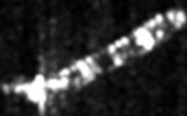
002.49.79.S
055.30.74.E

027

131

SCENE

Beluga Nomination
Length: 132 m



Piracy Somalia – Support of German Federal Police

N 4°51'

N 4°45'

N 4°39'

N 4°33'

N 4°27'

MV York

Length (SAR): ~95m

TSX1 SAR MGD RE Spotlight

2011-02-14 um 14:56 UTC

Beluga Nomination

Length (SAR): ~137m

E 48°03'

E 48°09'

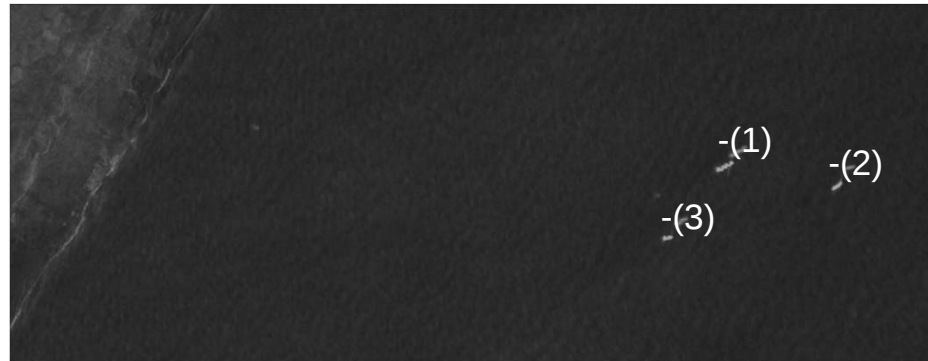
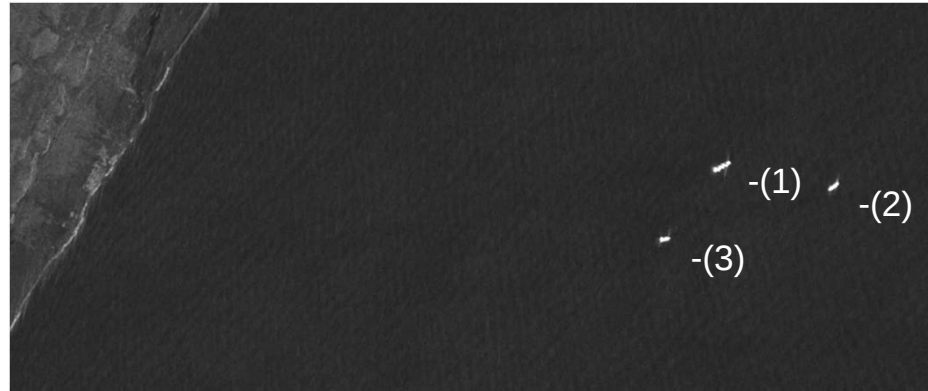
E 48°15'

E 48°21'

Situational Awareness 14.11.2010 – 18.11.2010

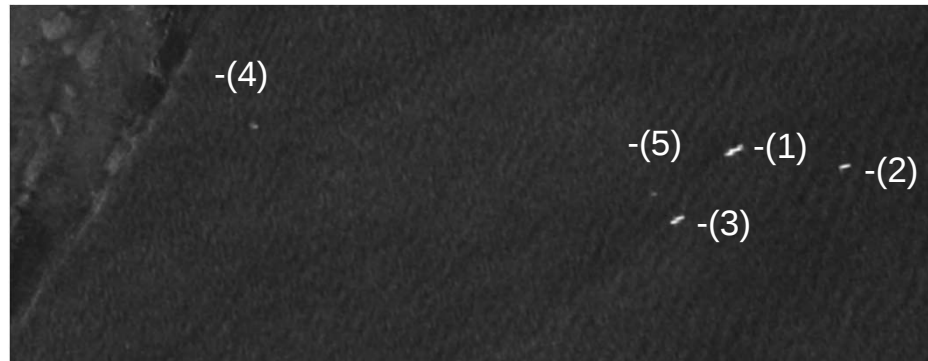
Spotlight 2010-11-14

- (1) Izumi: 147m
- (2) Golden Wave: 112m
- (3) MV York: 90m



Stripmap 2010-11-18

- (1) Izumi: 147m
- (2) Golden Wave: 112m
- (3) MV York: 90m



(4) 23m and (5) 9m

SAR detections



German Navy Support Fregatte Köln ATALANTA Mission



Fregatte KÖLN

Auftrag



Marine



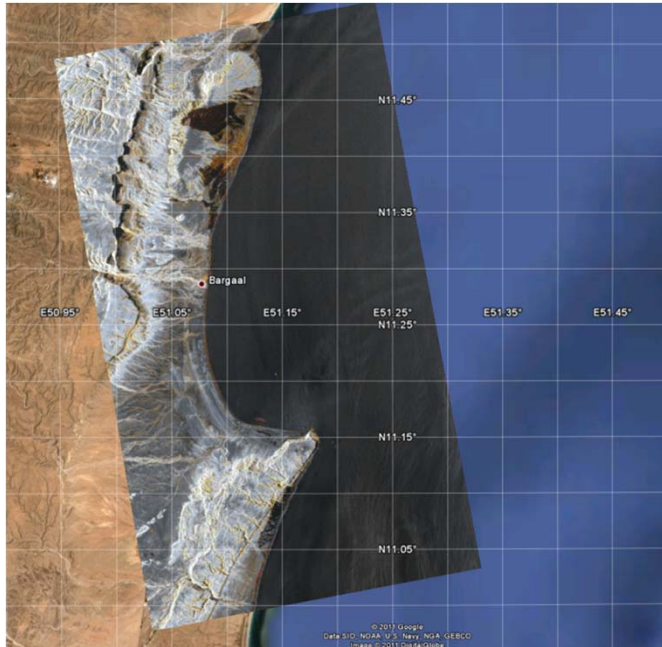
- Schutz der Schiffe des WFP/AMISOM
- Schutz anderer „verwundbarer“ Schiffe
- Verhindern von Akten der Piraterie
- Beitragen zur Überwachung der Fischerei vor der somalischen Küste



Deutsches Zentrum
für Luft- und Raumfahrt e.V.
in der Helmholtz-Gemeinschaft

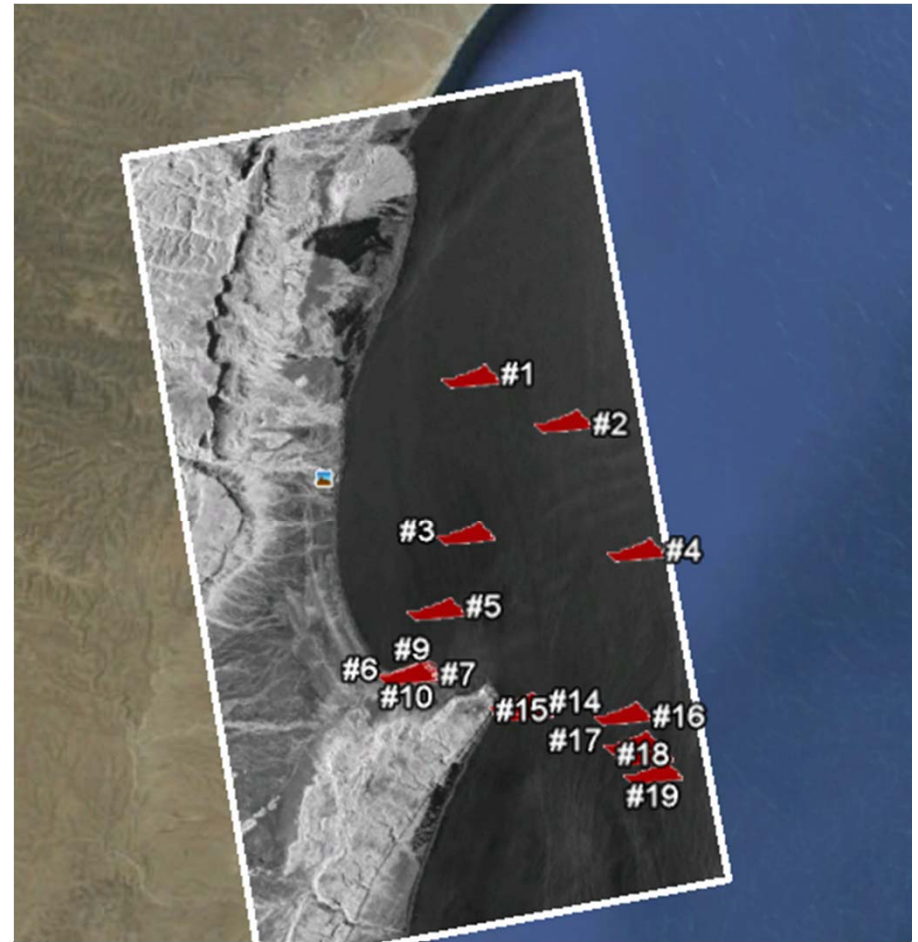


German Navy Support Fregatte Köln ATALANTA Mission



Sensor: TerraSAR-X

Onboard availability of
Ship detection reports within:
27 Minutes



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in der Helmholtz-Gemeinschaft

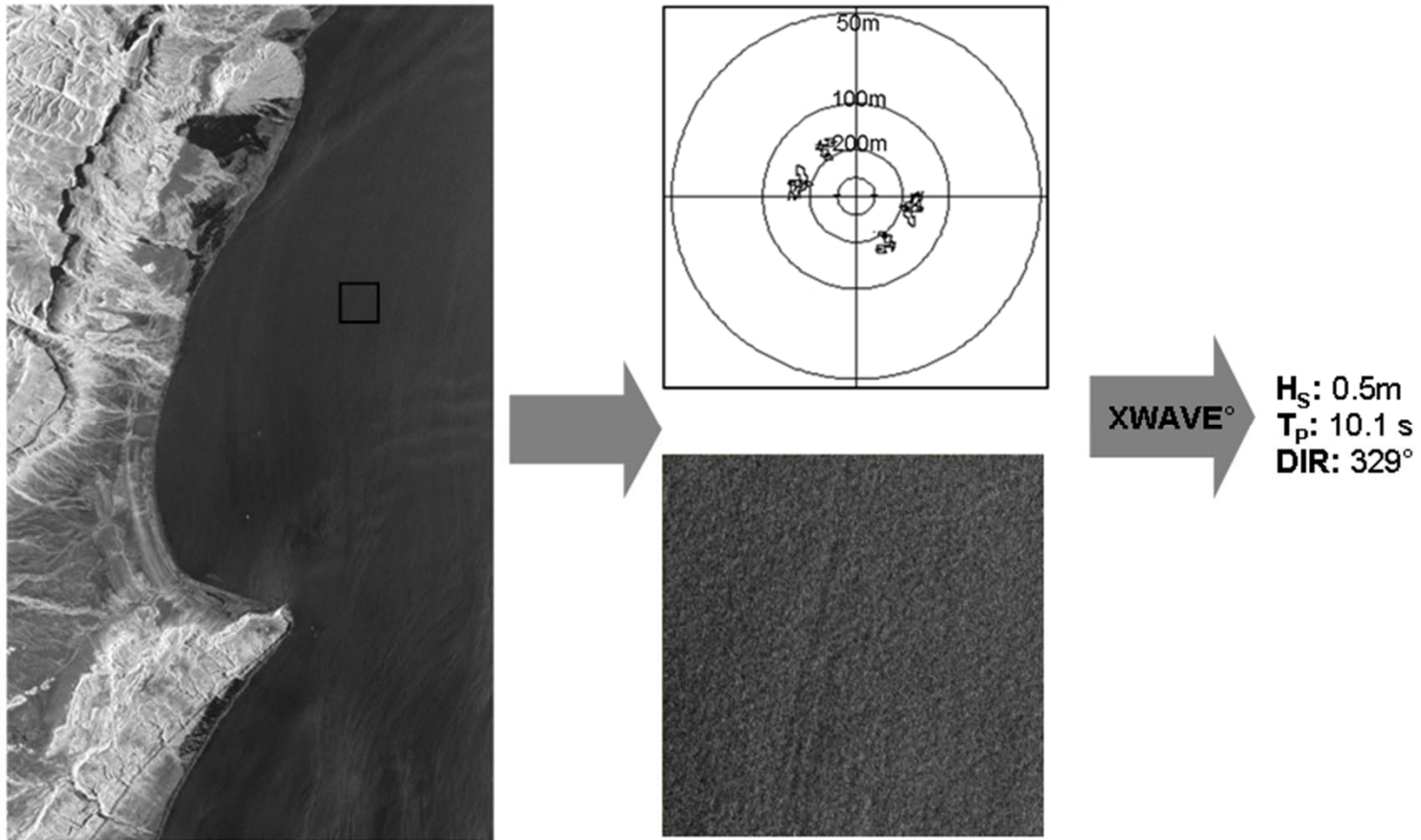


Marine



German Navy Support Fregatte Köln ATALANTA Mission

Sea State Estimation with XWAVE (DLR)



German Navy Support Fregatte Köln



Fregatte KÖLN



Marine

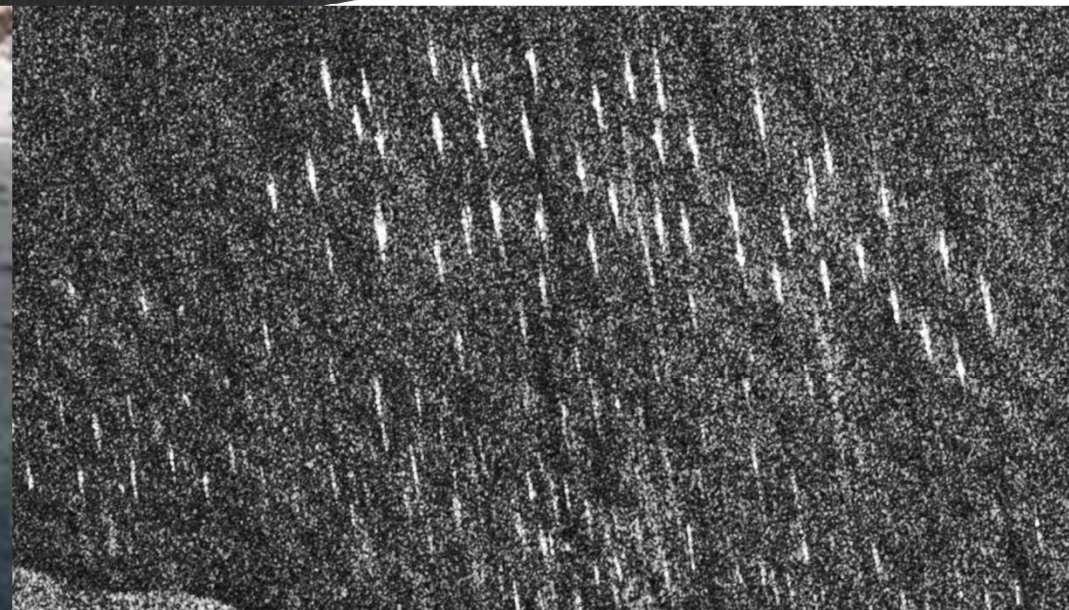
Beispiele Auswertung

Piratenamp „TicTac“, 23.09.2011



Ship positions:

latitude:	longitude:	length:	width:	heading:	
11.34836506	51.16625003	10.607	4.2478	214.32	63.8
11.3203723	51.22500051	10.607	4.2478	214.32	69.8
11.2498207	51.16268012	10.607	4.2478	214.32	61.5
11.23920152	51.27147658	35.576	7.1854	240.88	71.9
11.2024548	51.1440178	206.66	27.313	247.8	85.7
11.16311863	51.12623241	143.29	19.857	126.44	77.2
11.1634226	51.1276771	277.42	35.638	159.98	77.7
11.1631033	51.13021945	176.41	23.754	171.75	80.2
11.16268496	51.12890146	143.73	19.909	161.82	80.3
11.1622032	51.12539385	10.607	4.2478	214.32	74.6
11.16250598	51.13201112	208.72	27.556	187.1	78.3
11.16159809	51.1336175	189.33	25.274	161.35	77.2
11.16144625	51.13224858	135.93	18.992	193.76	79.3
11.14306847	51.19667552	87.545	13.299	89.184	73.5
11.13926863	51.19886951	73.866	11.69	103.28	67.4
11.13700572	51.26294284	10.607	4.2478	214.32	65.5
11.11884573	51.2693489	10.607	4.2478	214.32	64.5
11.11166592	51.27617291	10.607	4.2478	214.32	62.5

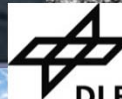


Source: Helicopter Köln

1108N05107E= 11.13N– 51.12E



DLR



DLR

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in der Helmholtz-Gemeinschaft



Marine



European Maritime Security Services

Source: Helicopter Köln



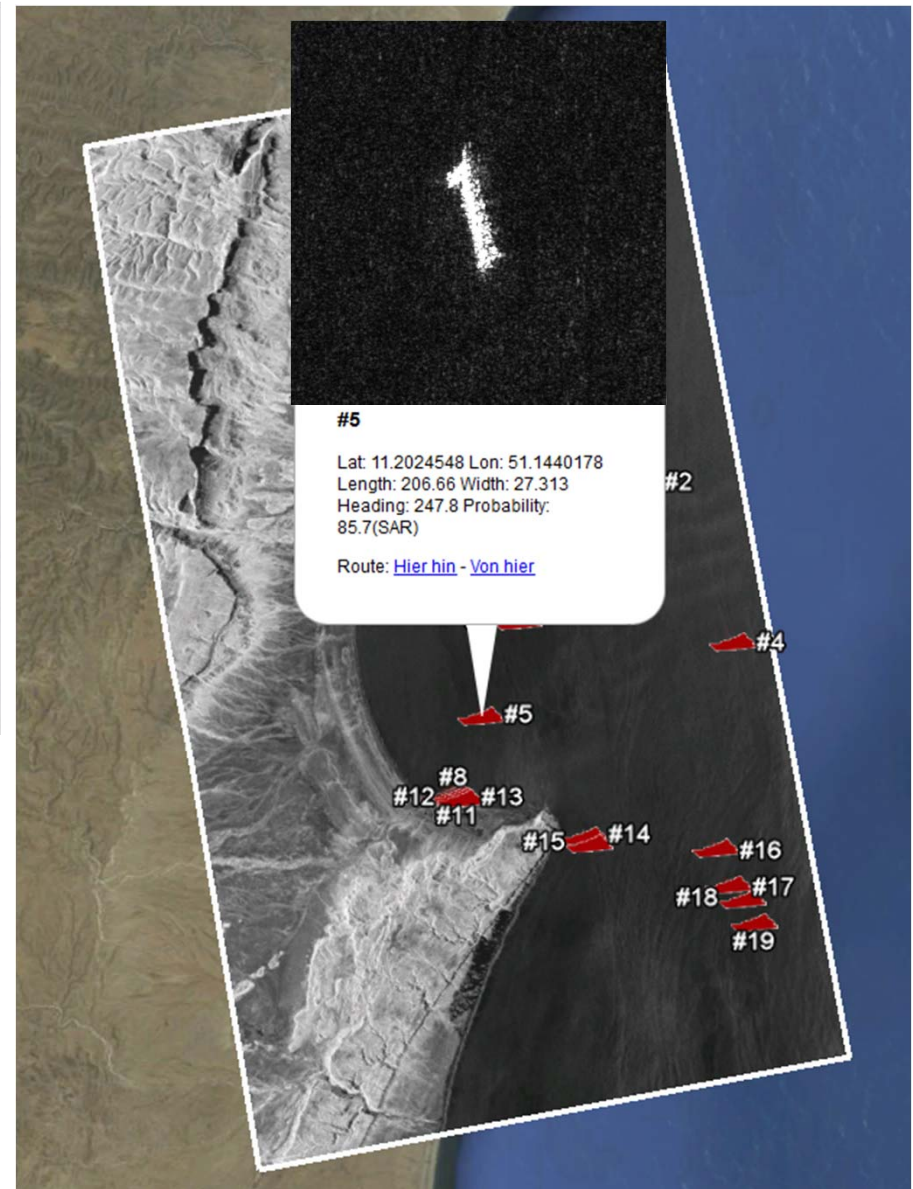
Hijacked ship MV DOVER

1112N 05108E = 11.20N – 51.14E

Länge: 208 m

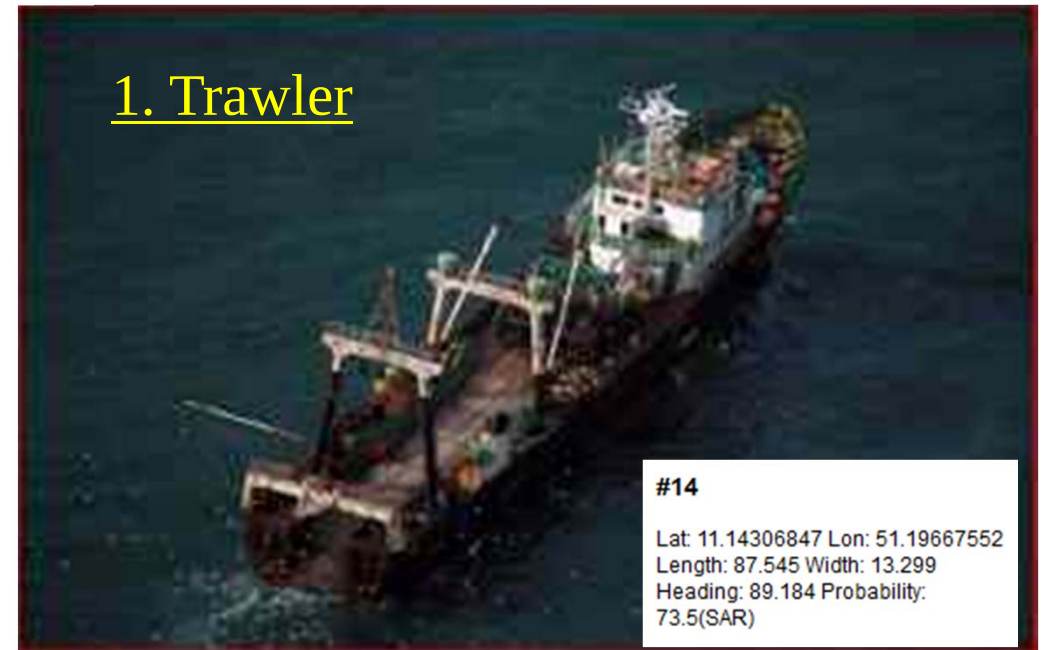
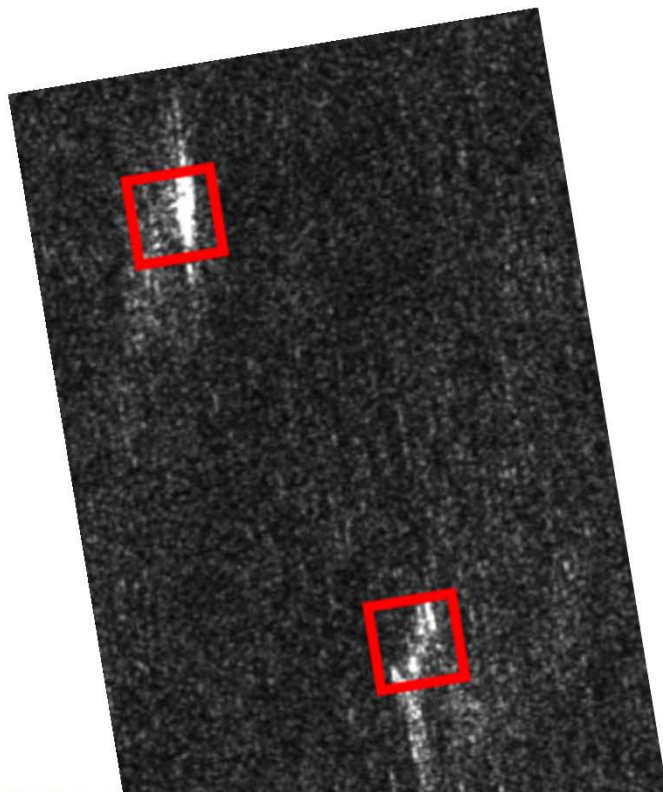
Ship positions:

latitude:	longitude:	length:	width:	heading:
11.34836506	51.16625003	10.607	4.2478	214.32
11.3203723	51.22500051	10.607	4.2478	214.32
11.2498207	51.16268012	10.607	4.2478	214.32
11.23920152	51.27147658	35.576	7.1854	240.88
11.2024548	51.1440178	206.66	27.313	247.8
11.16311863	51.12623241	143.29	19.857	126.44
11.1634226	51.1276771	277.42	35.638	159.98
11.1631033	51.13021945	176.41	23.754	171.75
11.16268496	51.12890146	143.73	19.909	161.82
11.1622032	51.12539385	10.607	4.2478	214.32
11.16250598	51.13201112	208.72	27.556	187.1
11.16159809	51.1336175	189.33	25.274	161.3
11.16144625	51.13224858	135.93	18.992	193.7



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Ship positions:

latitude:	longitude:	length:	width:	heading:
11.34836506	51.16625003	10.607	4.2478	214.32
11.3203723	51.22500051	10.607	4.2478	214.32
11.2498207	51.16268012	10.607	4.2478	214.32
11.23920152	51.27147658	35.576	7.1854	240.88
11.2024548	51.1440178	206.66	27.313	247.8
11.16311863	51.12623241	143.29	19.857	126.44
11.1634226	51.1276771	277.42	35.638	159.98
11.1631033	51.13021945	176.41	23.754	171.75
11.16268496	51.12890146	143.73	19.909	161.82
11.1622032	51.12539385	10.607	4.2478	214.32
11.16250598	51.13201112	208.72	27.556	187.1
11.16159809	51.1336175	189.33	25.274	161.35
11.16144625	51.13224858	135.93	18.992	193.76
11.14306847	51.19667552	87.545	13.299	89.184
11.13926863	51.19886951	73.866	11.69	103.28
11.13700572	51.26294284	10.607	4.2478	214.32
11.11884573	51.2693489	10.607	4.2478	214.32
11.11166592	51.27617291	10.607	4.2478	214.32



Fregatte KÖLN



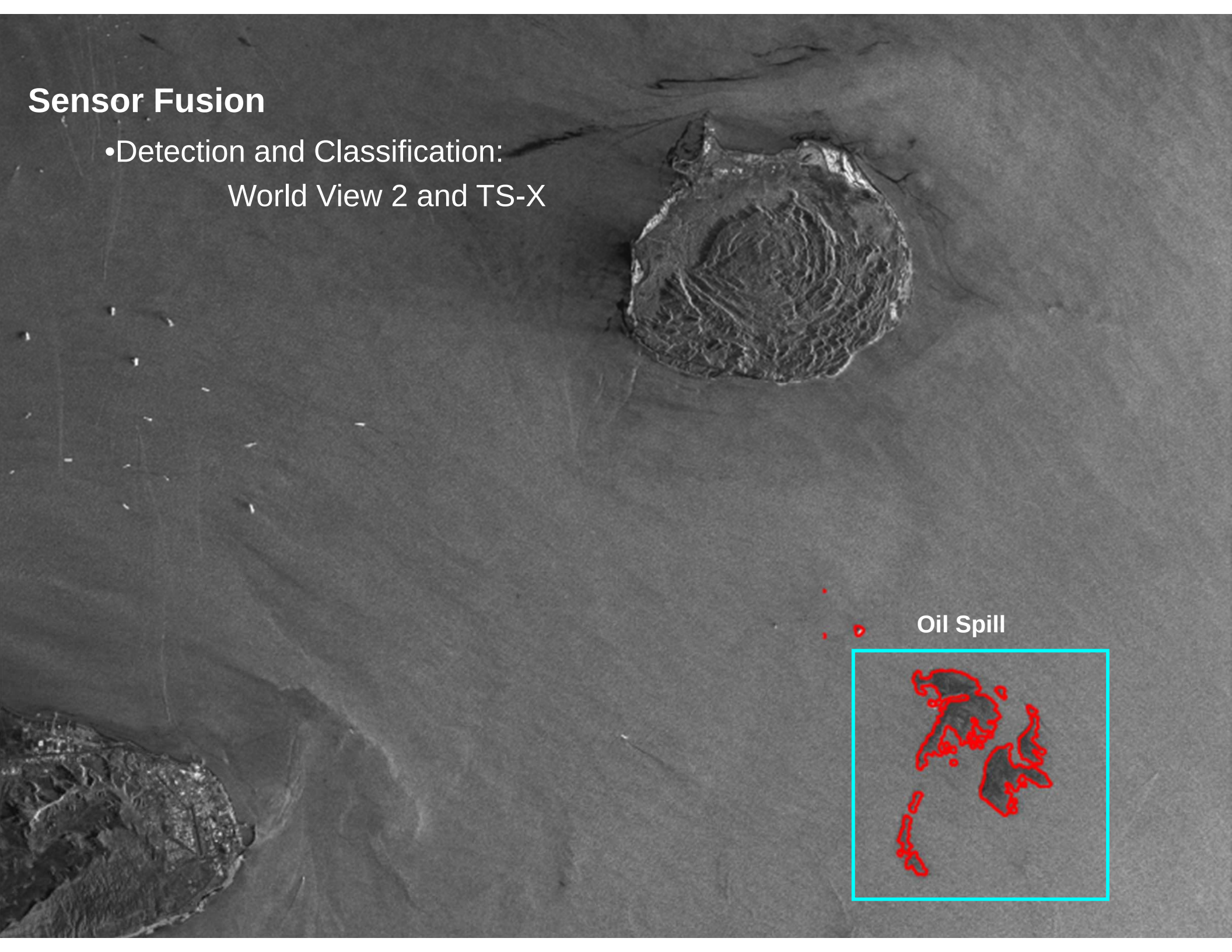
Beispiele Auswertung

Piratenkamp „TicTac“, Marine
23.09.2011



Sensor Fusion

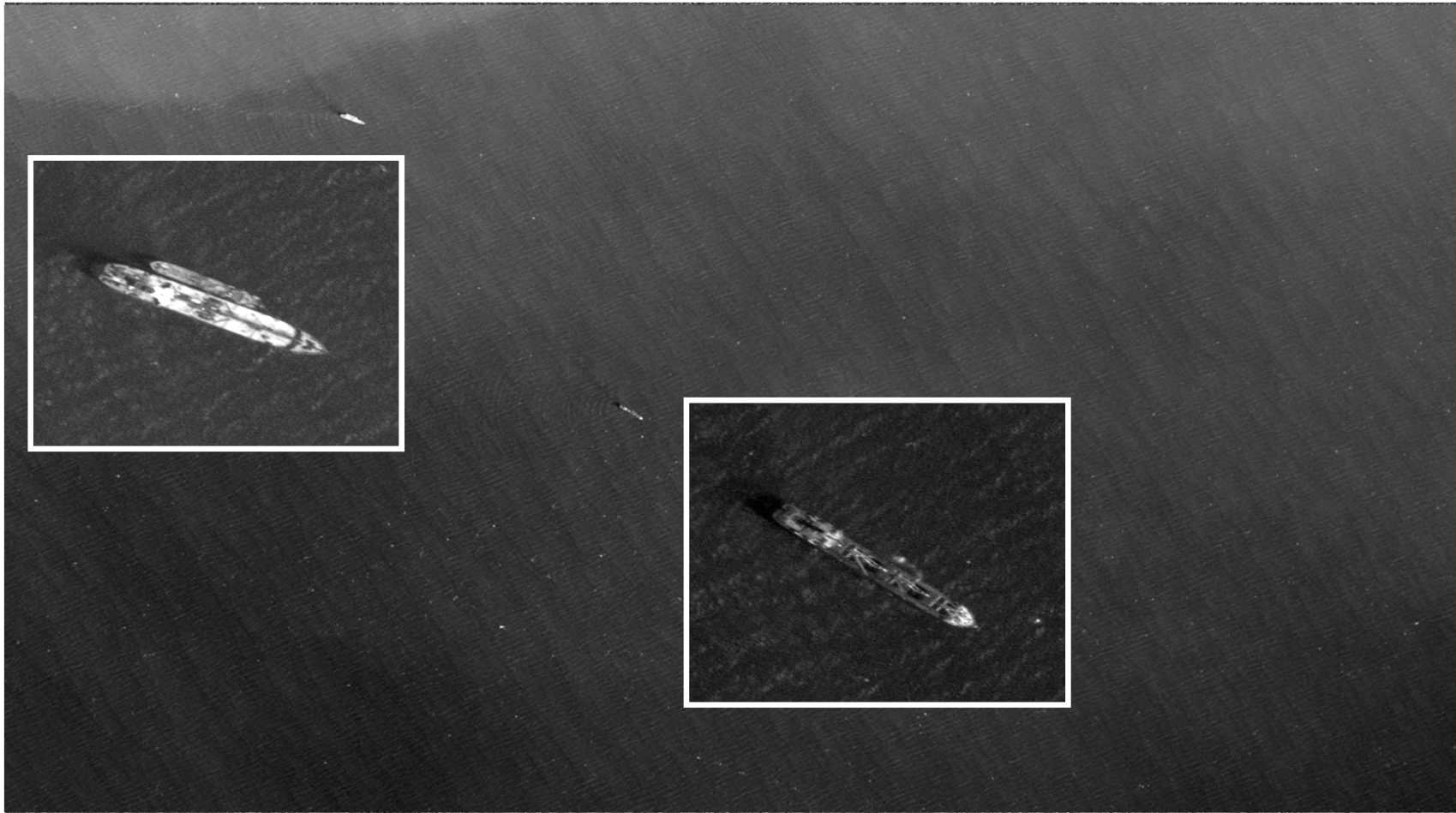
- Detection and Classification:
World View 2 and TS-X



Oil Spill

Sensor Fusion

- Detection and Classification:
World View 2 and TS-X



Thank You



Validation

Assumptions:

- open sea
- wind speed < 15 m/s
- sea state < 5

Results are based on 36 TSX acquisitions with
2256 detected objects and visual inspection

