Erdbeobachtung für die Maritime Sicherheit

Nationales Forum für Fernerkundung und Copernicus 2015
"Copernicus erfolgreich nutzen"

Egbert Schwarz
German Remote Sensing Data Center
Maritime Security Lab Neustrelitz

DLR

Presentation Outline

Background

- Maritime Security Lab Neustrelitz
- Component of Service Chain

Application Status and Future Development

- Ship Detection
- Oil Detection
- Wind and Wave
- Iceberg Detection and Classification

Earth Observation Center (EOC)

German Remote Sensing Data Center (DFD)

Remote Sensing Technology Institute (IMF)

Locations: Oberpfaffenhofen, Neustrelitz, Bremen, Berlin

Earth Observation Ground Segment

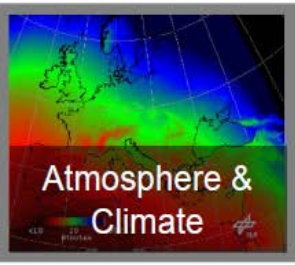
Neustrelitz

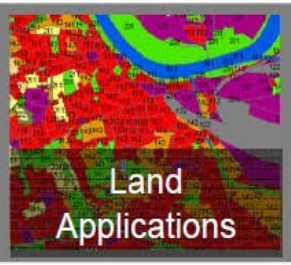
O'Higgins (Antarctic)

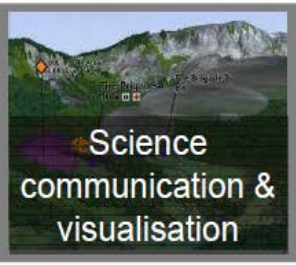
Inuvik (Canada)

Oberpfaffenhofen

Applications and Services







The World Data Center for Remote Sensing of the Atmosphere

Center for Satellite Based Crisis Information
– Emergency Mapping & Disaster Monitoring –
a service of DFD

Bundesministerium des Innern

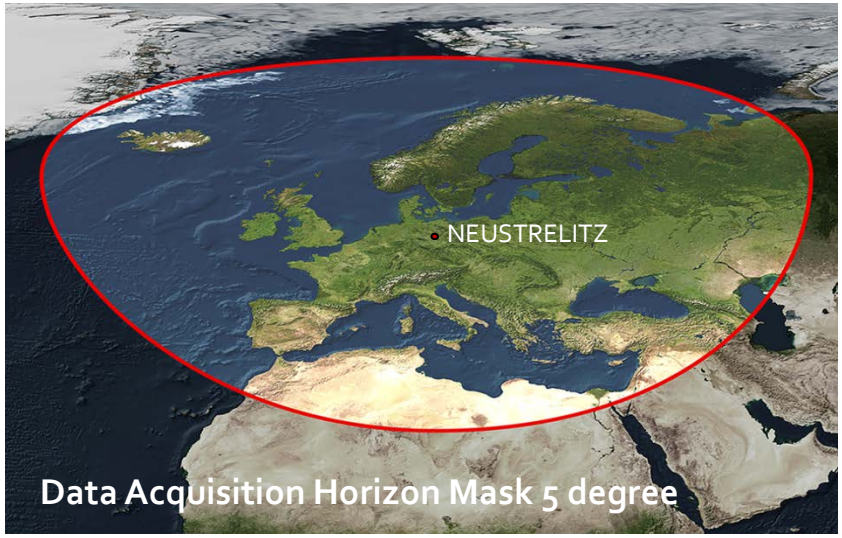
DSDA
Deutsches Satellitendatenarchiv

DLR

Ground Station and Processing Facility Neustrelitz

- Support of currently 12 different Satellite missions
- Main reception and processing facility for SAR Mission TerraSAR-X
- Collaborative Station for European Sentinel missions
  - Sentinel-1 currently being developed
- Radarsat-2 Regional Ground System

  for science purpose implemented and operation since August 2015



DLR Forschungsverbund Maritime Sicherheit

Verteilung der Forschungsthemen im Projekt „F&E für die Maritime Sicherheit und entsprechende Echtzeitdienste“ (EMS & EMSec)

- **Braunschweig**
- **Bremen**
- **Neustrelitz**
- **Oberpfaffenhofen**

Bemannte und unbemannte Verbunddienste luftgestützter Plattformen zur Erstellung komplexer maritimer Lagebilder in Echtzeit

Erhöhung der Effektivität zeitkritischer maritimer Hubschraubereinsätze im Bedrohungs- und Gefahrenfall, speziell an Offshore-Windkraftanlagen

Neue Methoden und Algorithmen zur Erfassung von relevanten Objekten und Flächen und zur Ableitung meteo-mariner Parameter aus SAR -Daten

Entwicklung einer luftgestützten AIS-Erfassung im weiträumigen Seemonitoring / Entwicklung von AIS-Nutzlasten und AIS-Missionen

Echtzeitsysteme für maritime Informationsprodukte aus Satellitendaten im Multimissionsbetrieb

Entwicklung eines neuen, integrierten PNT Systems / Verbesserung der Integrität der Verkehrslage und Weiterentwicklung von AIS (AIS-Evolution)

Entwicklung eines neuartigen luftgestützten Multikamerasystems für die maritime Lagebilderfassung in Echtzeit

Entwicklung eines neuen maritimen Kommunikationssystems / Verfahren zum Schutz maritimer KOM /NAV Systeme vor Störungen und Missbrauch

DFD	FL	FT
KN	MF	RMC	RY

GEFÖRDERT VOM

Bundesministerium für Bildung und Forschung

Bundesministerium für Wirtschaft und Technologie

DLR

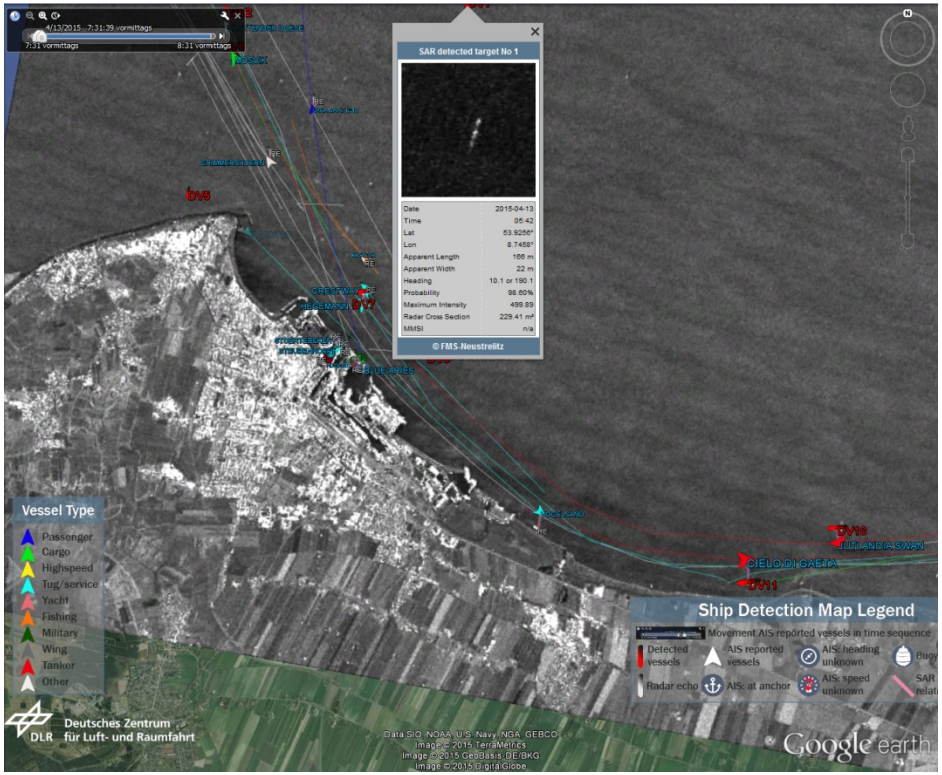
Objective

Research and development of integrated applications enabling specific value added
Maritime Information Products for the Maritime Situational Awareness

System engineering and development

- efficient use of the processing environment (parallel processing)
- operational use of research findings
- processing of different sensors and modes
- operational data fusion of different data sources like EO data and terrestrial AIS or AIS from space
- product development
- dissemination systems development

Ship- Detection Application



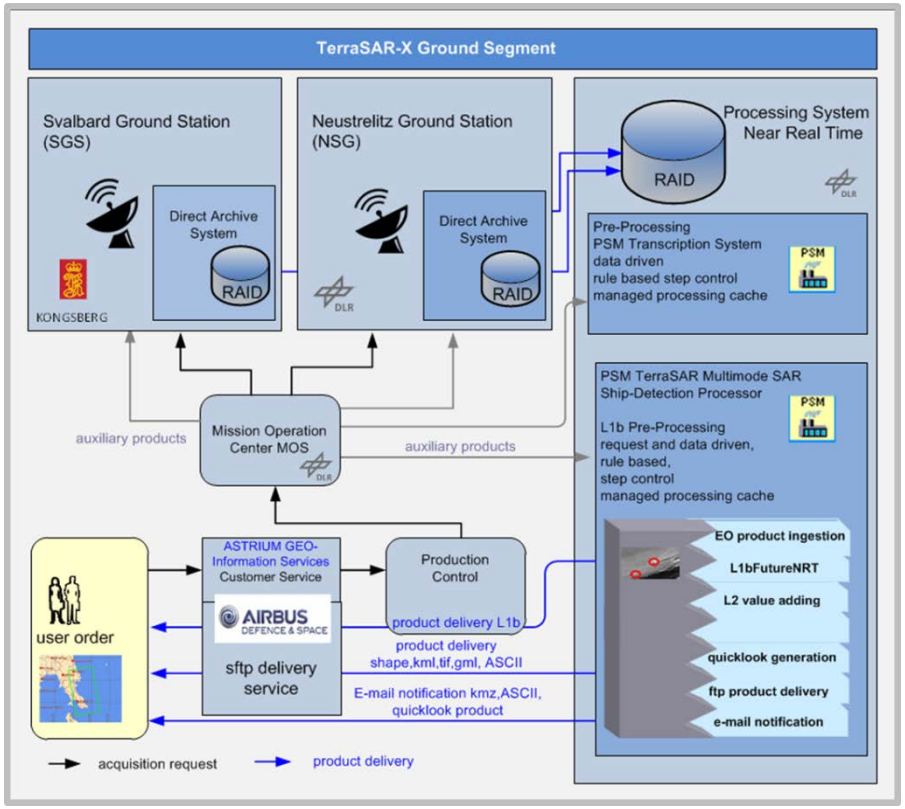
Available for:

- TerraSAR-X, TanDEM-X
- CosmoSkyMed
- Radarsat-2
- Sentinel-1

Value added products

- **SAR/ AIS merged products** (in case of available AIS Data)
- ASCII ; KMZ, GML; DER (EMSA);
- ESRI shape; json;
- GeoTIFF (MRES_L1b; HRES_L1B)

Ship- Detection Application – TerraSAR-X



Available for:

- StripMap and ScanSAR Mode provided by AIRBUS DS

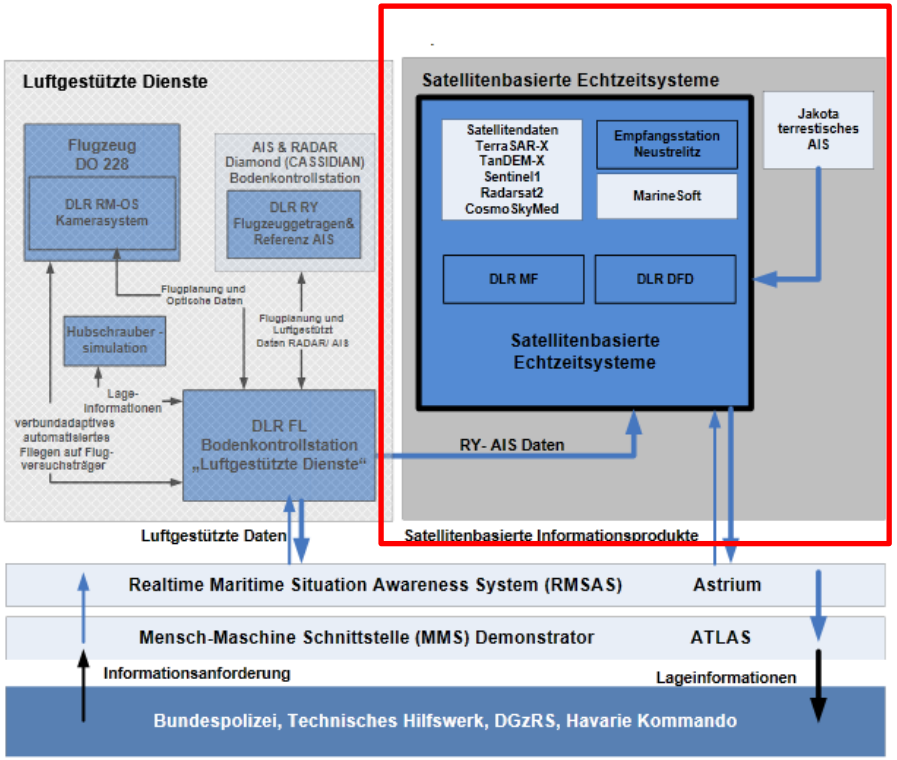
Value added products

- **SAR/ AIS merged products** (in case of available AIS Data)
- ASCII ; KMZ, GML; DER (EMSA);
- ESRI shape; json; png,wld,
- GeoTIFF (MRES_L1b; HRES_L1B)

EMSec
Echtzeitdienste für die Maritime Sicherheit – Security

- Development of Experimental Systems for Validation of new Algorithm, developed for Ship detection, Wind and Wave at the Security-Lab Bremen (DLR IMF)

- Development of Experimental Systems adress the following tasks
  - Automated processing, product generation and dissimination within 10 to 15 minutes
  - Processing System Management
  - Integration of Satellite date and Automated Identification System (AIS) Data
  - Data fusion
  - Product development
  - Interface development for data dissimination Realtime Maritime Situation Awareness System (RMSAS)



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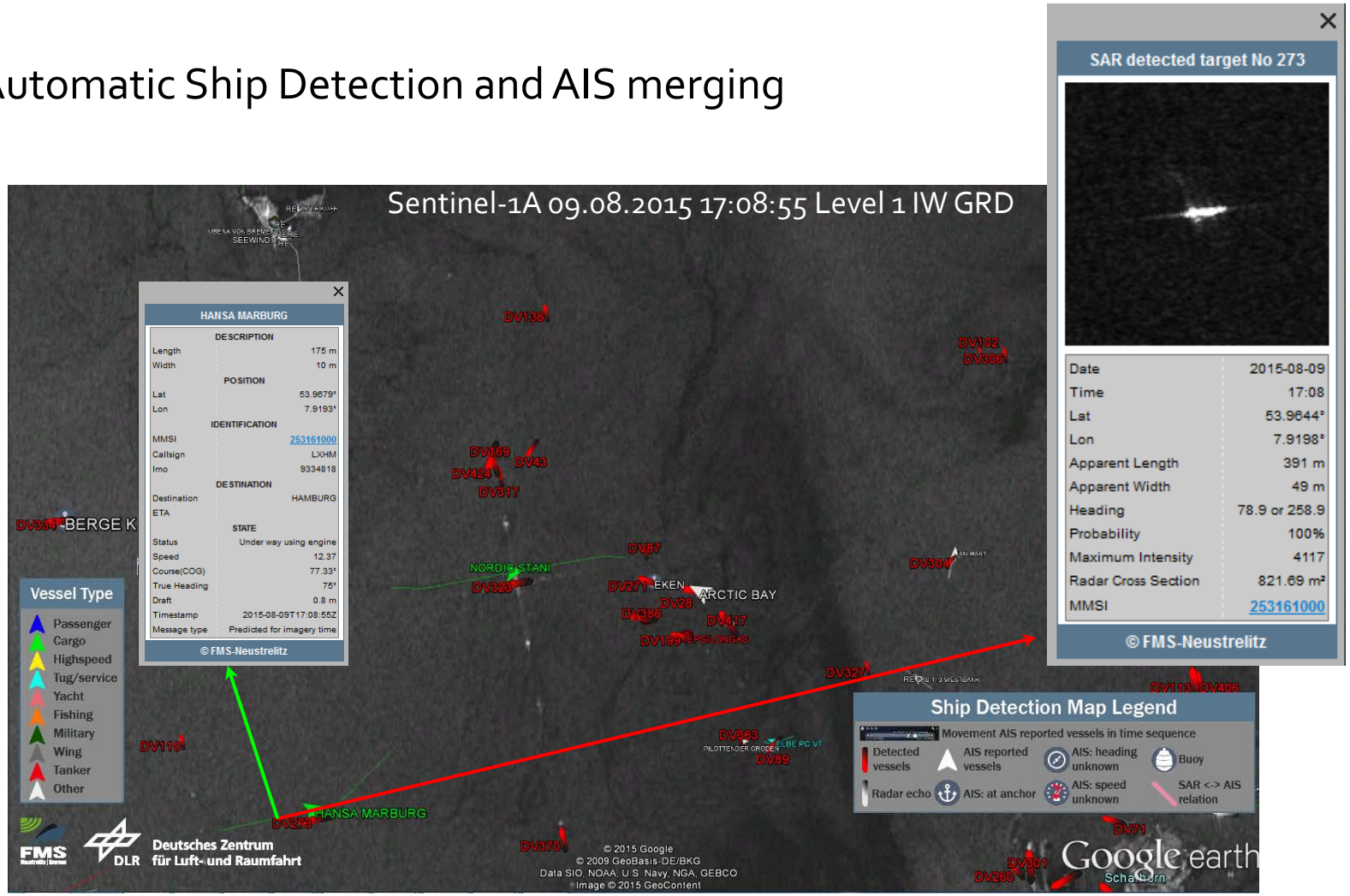
Bundesministerium für Bildung und Forschung
VDI
ATLAS ELEKTRONIK
A joint company of ThyssenKrupp and EADS
JAKOTA Cruise Systems GmbH
AIRBUS DEFENCE & SPACE
Universität Rostock
MARINE SOFT
DLR

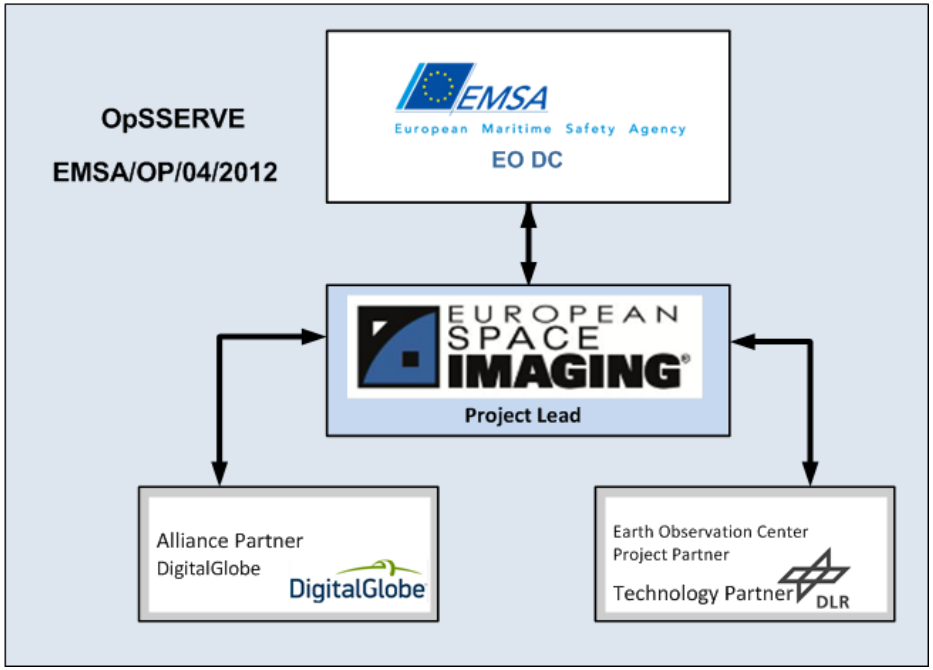
Ship Detection Application - Sentinel-1

Automatic Ship Detection and AIS merging



Optical Satellite Services for EMSA OpSSERVE

- **Service contract**:
  European Maritime Safety Agency EMSA
- project partner: **EUSI** (contractor) and **DLR** (subcontractor)
- project duration: **36 months** with the option to extend by 12 months, currently extended up to April 2016
- project start: **October 2012**
- project summary: **rapid access to satellite data and derived information** for use in maritime situational awareness



- OpSSERVE 2 Kick-off October 2015

Optical Satellite Services for the European Maritime Safety Agency EMSA (OpSSERVE)

partner: EUSI (contractor) and DLR (subcontractor)

- **optical satellite imagery (< 1m)**
  - Worldview-1;Wordview-2 (0.50m)

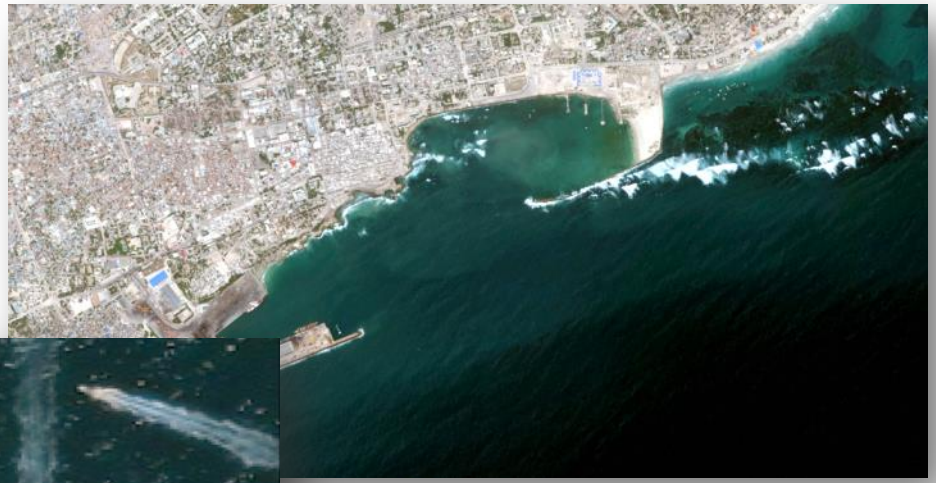
    NRT Delivery ≤1 hour*

    NRT Delivery ≤3 hours*
  - GeoEye-1;EROS-B; Ikonos;Quickbird
  - ; Worldview1; Worldview-2, 3

    Non NRT Delivery ≤24 hours*

    Archive Delivery ≥24 hours*

- **Provision of Vessel- and**
- **Activity- detection service**

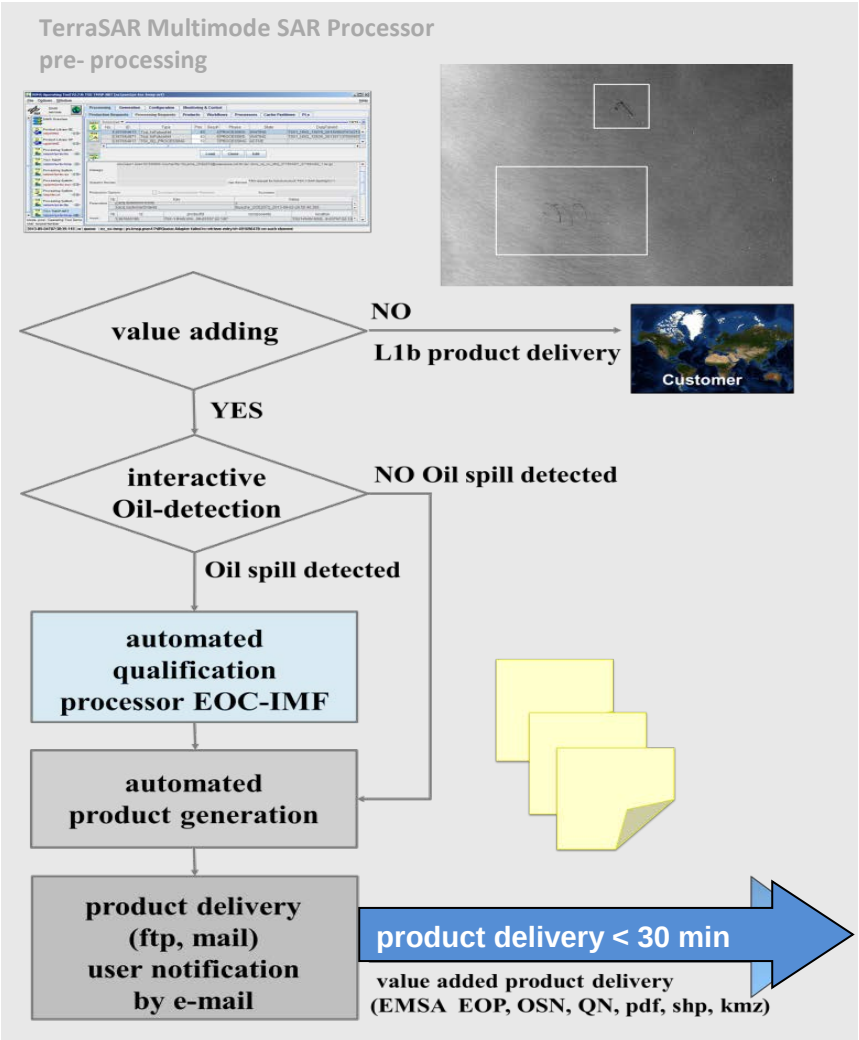


WorldView-2, Mogadishu, Somalia, 28.08.2012

skiffs

skiffs on the beach

Oil Spill Detection Application



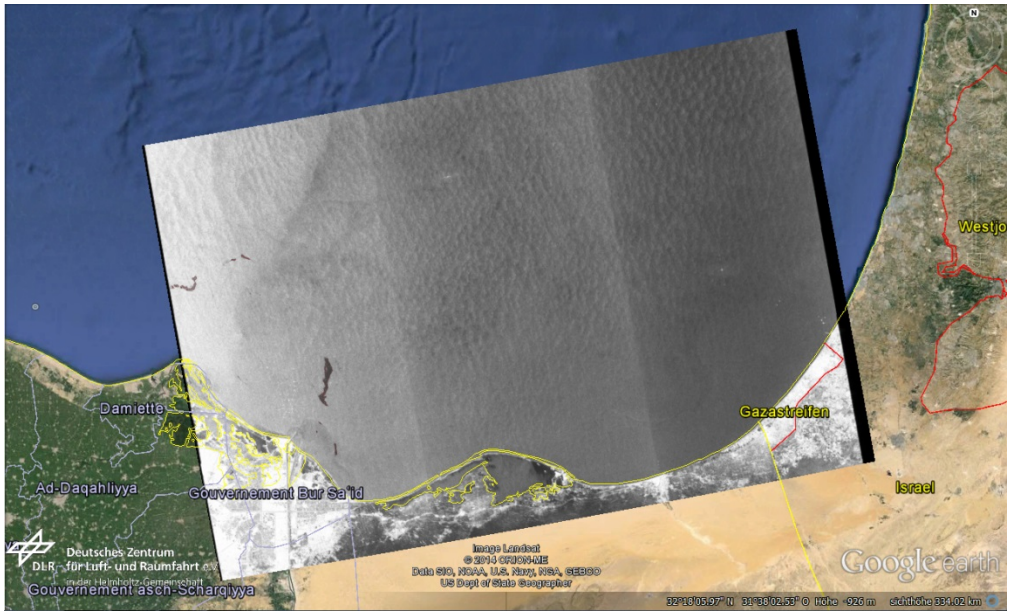
Control system implemented using the DLR Processing System Management (PSM) part of the Data Information Management System (DIMS)

- Interactive processing
- Operator interface via Virtual Network Computing (VNC)
- Automated qualification processor integrated based on Neural Network
- Automated product delivery within 30 minutes

Oil Spill value adding Products

Level 2 Produktformate

- EMSA (EOP,OSN, QNO)
- Portable Document Format (pdf)
- Google (kml)
- Shape Layer Files (shp)



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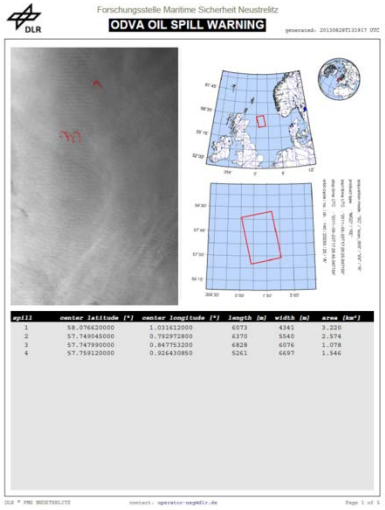
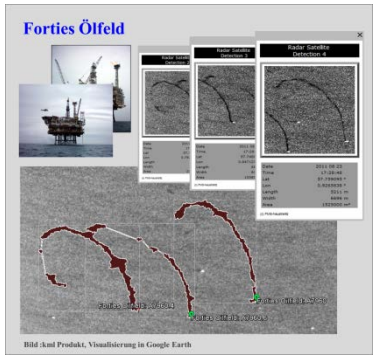
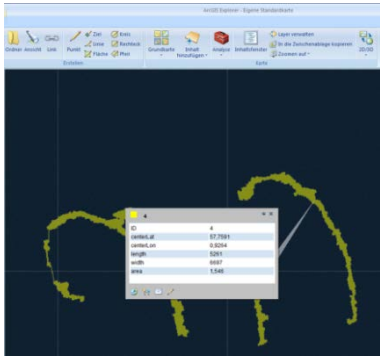
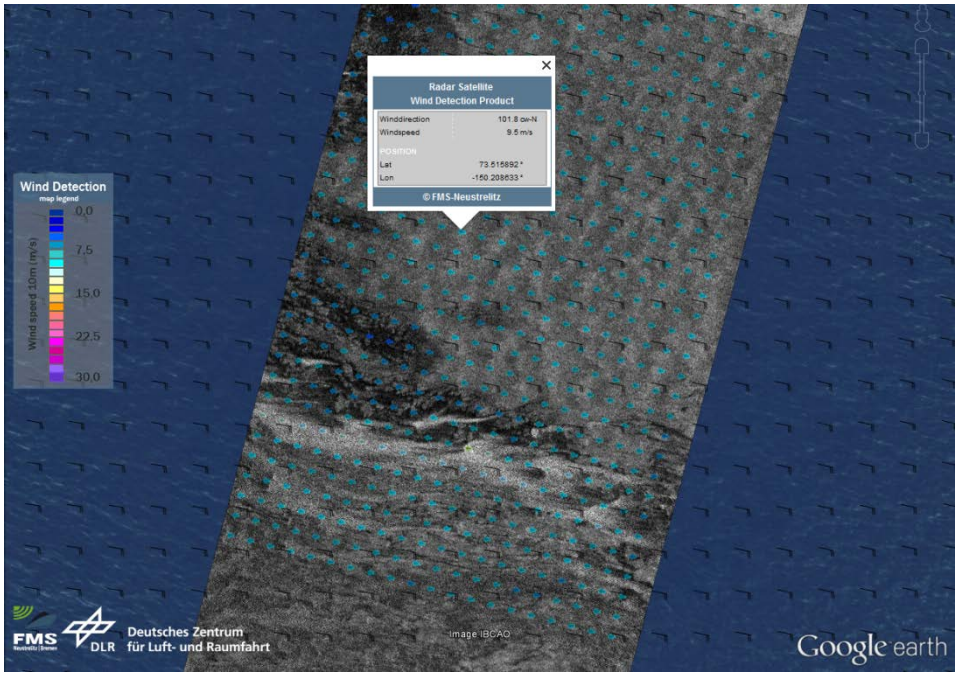






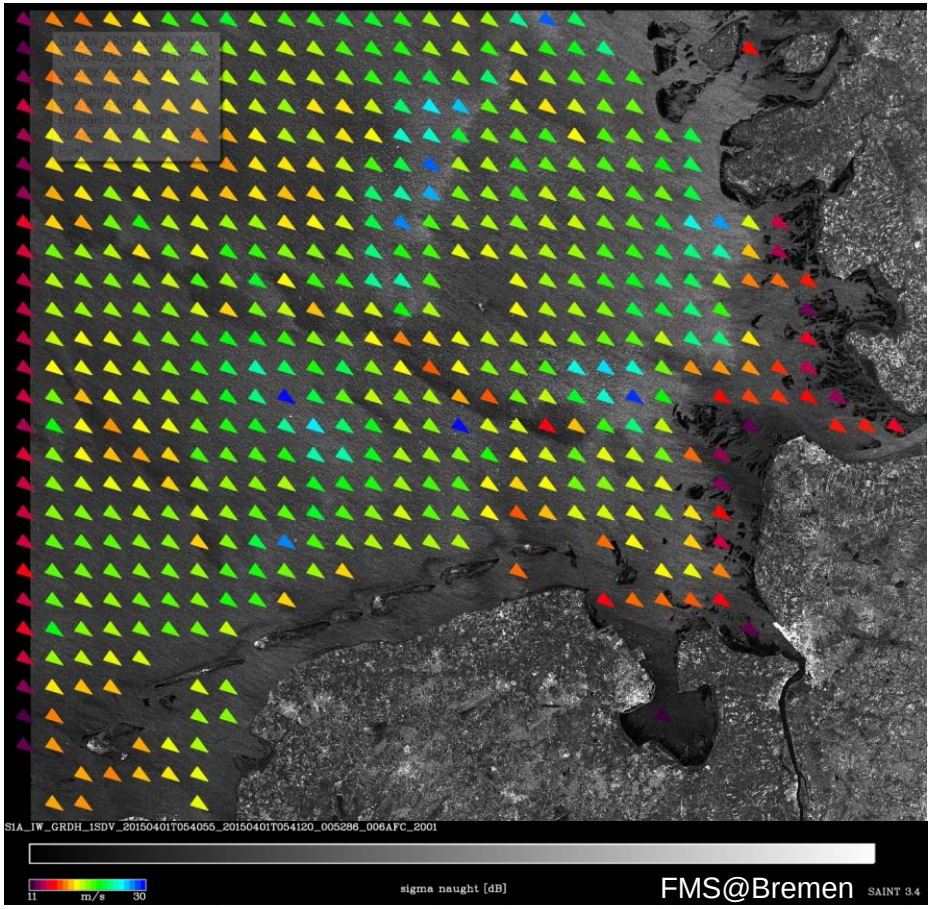
Application for Wind field products based on TerraSAR-X



The wind forecast and the Level 1 quicklook product in the background is overplayed by the DLR SAR WIND product (rectangle) derived from the TerraSAR-X StripMap image

- Core function is the XMOD-2 algorithm developed by the Maritime Security Lab Bremen to derive wind speed and direction (Jacobsen et al., 2013)
- Forecast model is implemented to provide wind direction , the netCDF output is generated, containing the wind direction and intensity (WD10)
- Level 2 Produktformate
  - ASCII
  - netCDF
  - Google (KMZ)
  - png, wld, png.aux.xml
  - ESRI Shape Layer Files (shape)

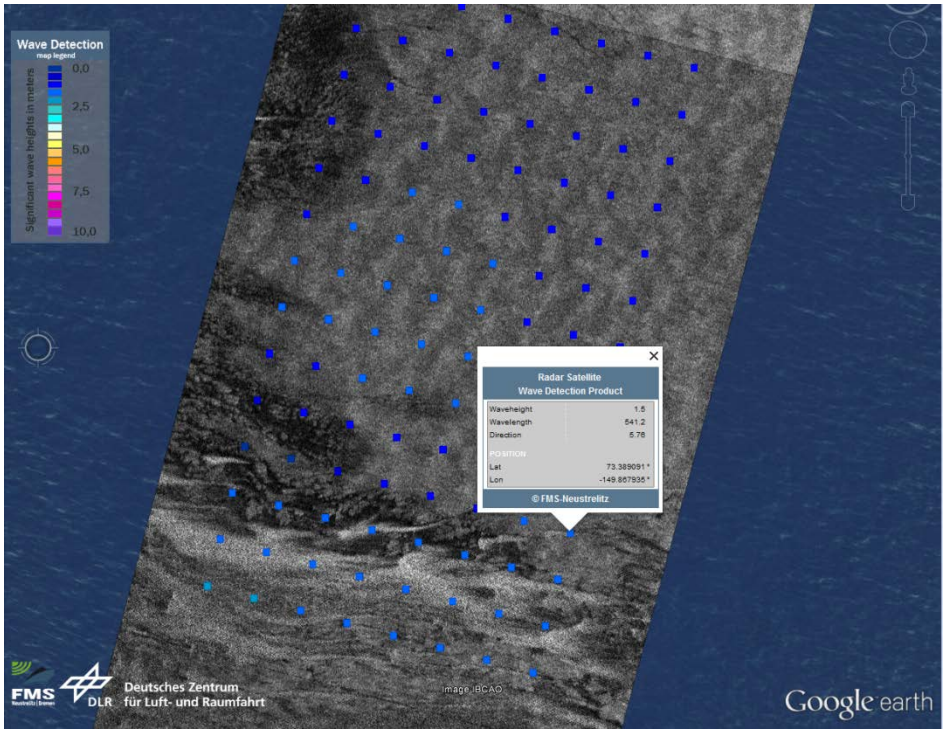
Application for Wind field products based on Sentinel-1



S1A_IMGRDH_1SDV_20150401T054055

- Core function is the CMOD-2 algorithm developed by the Maritime Security Lab Bremen to derive wind speed and direction (Jacobsen et al., 2013)
- Forecast model is implemented to provide wind direction , the netCDF output is generated, containing the wind direction and intensity (WD10)
- Level 2 Produktformate
  - ASCII
  - netCDF
  - Google (KMZ)
  - png, wld, png.aux.xml
  - ESRI Shape Layer Files (shape)

Application for Wave products based on Mission TerraSAR-X

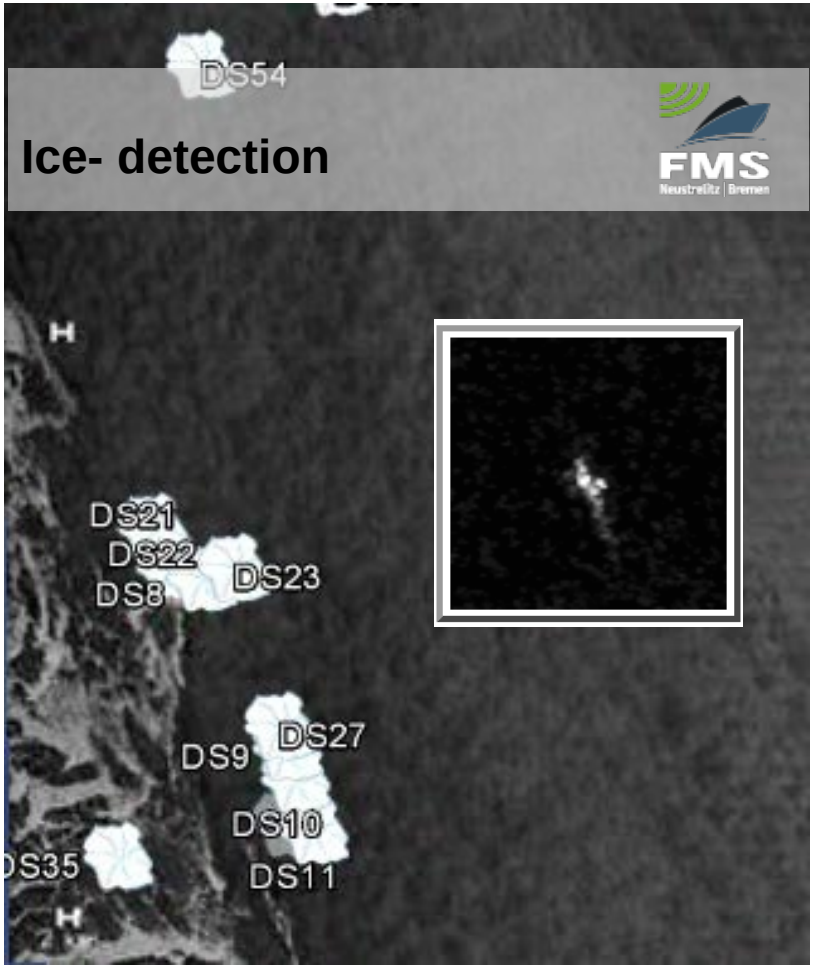


The L1 quicklook product in the background is overplayed by the DLR SAR WAVE product (rectangle) derived from the TerraSAR-X StripMap image

- new XWAVE-2algorithm developed by the Maritime Security Lab Bremen to derive wave height and wave length (Pleskachevsky et al., 2015)
- Level 2 Produktformate
  - ASCII
  - netCDF
  - Google (KMZ)
  - GIS, png, wld, png.aux.xml
  - ESRI Shape Layer Files (shape)

Iceberg Detection

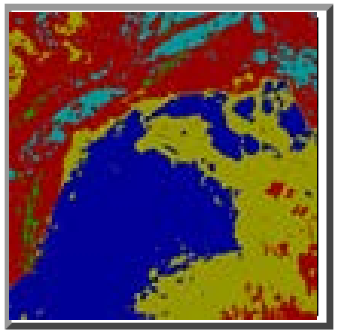
- Near real time iceberg detection application to
  - Support Maritime Situation Awareness e.g. Ice Service Center
  - Support Exploration management and resource planning
  - Route management

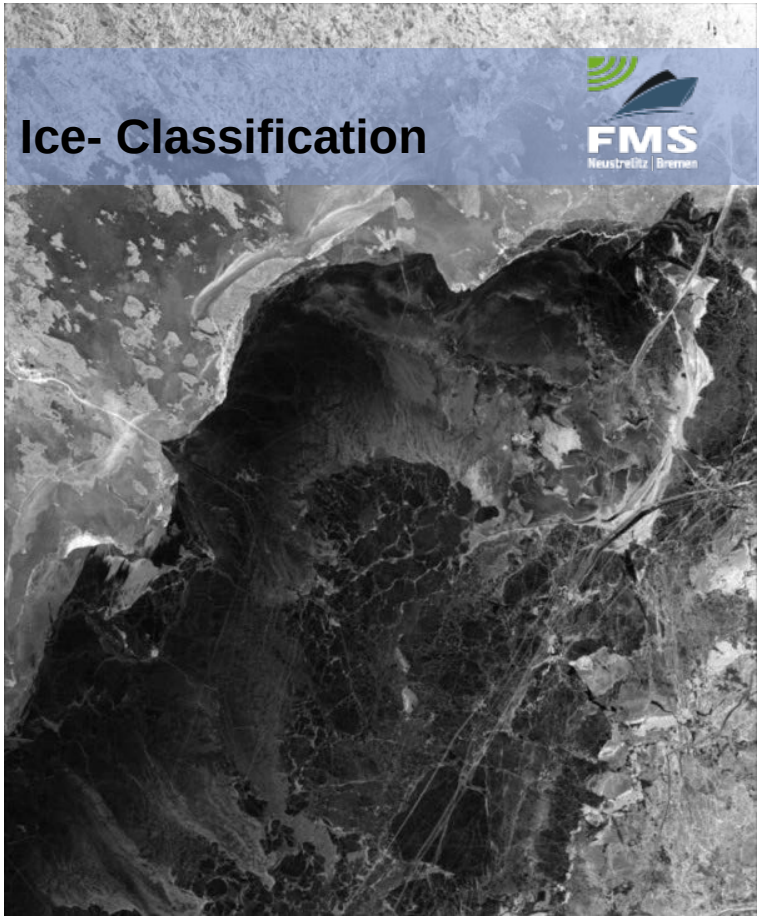


Ice Classification

- Currently being developed by the Maritime Security_Lab Bremen (Ressel et al., IEEE, TGARS)

- Planned value added products based on TeaarSAR-X (DualPol)
  - ASCII ; png, KMZ,
  - ESRI shape;
  - ECDIS (S411) Ice Chart

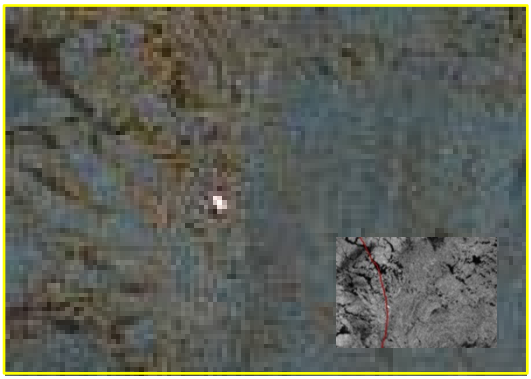


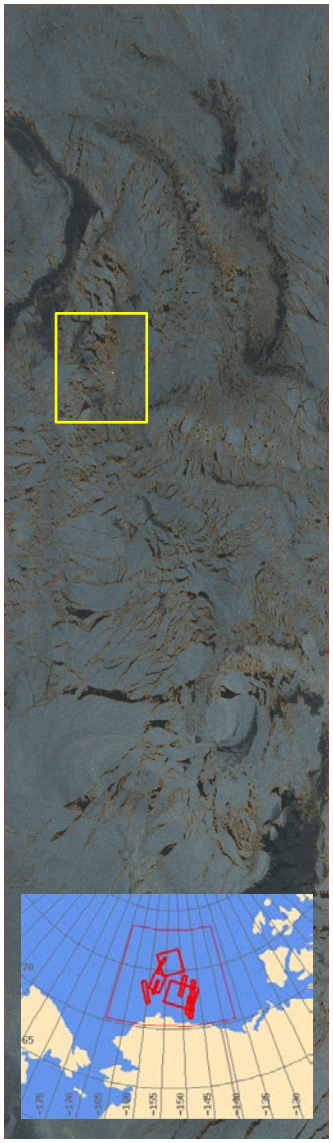


TerraSAR-X NRT Support in October 2015 for ONR Arctic Sea State Campaign 2015

Research Vessel Sikuliaq
Beaufort Sea

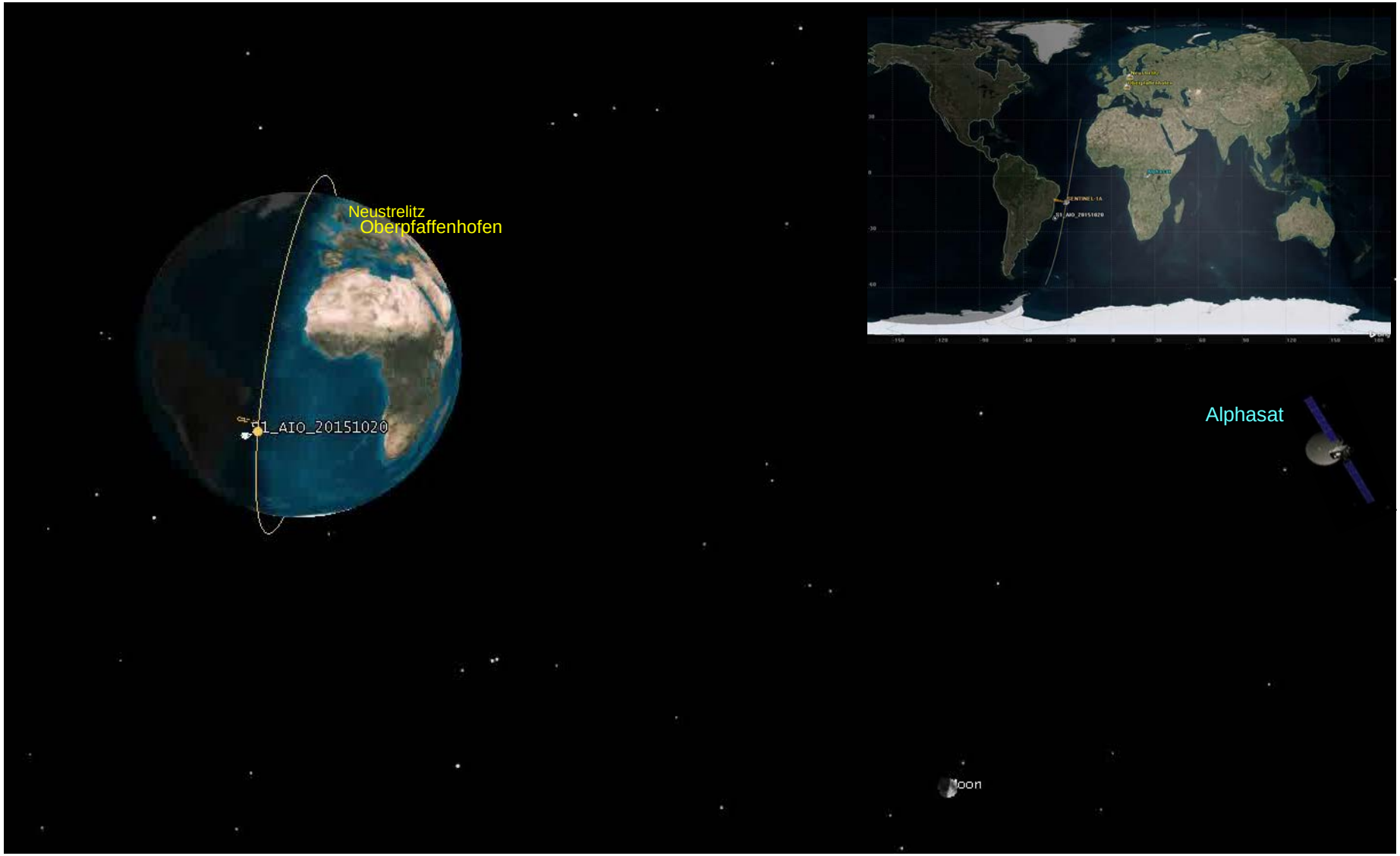
- http://www.apl.washington.edu/project/project.php?id=arctic_sea_state
  - TerraSAR-X support comprises
  - additional SGS contacts used for D/L
  - NRT L1b product delivery
  - products deliveries for usage at ship
  - Quicklook products in addition with wind and wave charts





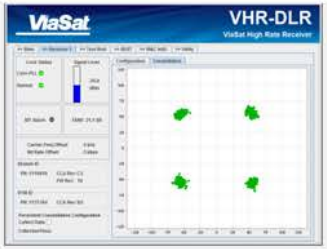
so far 10 acquisitions (SM, SC, SC wide) between Oct 07 and Oct 19

Alphasat Near Real Time Demo



DLR DFD K_a-Ground Station Oberpfaffenhofen

7.3m antenna: G/T=40 dB/K



VHR Demodulator

RF

ECL

Reverse LIAU

ECL

MDA

Direct Archiving System
S1 FEP / L0 processing

ftp

Data Delivery Server

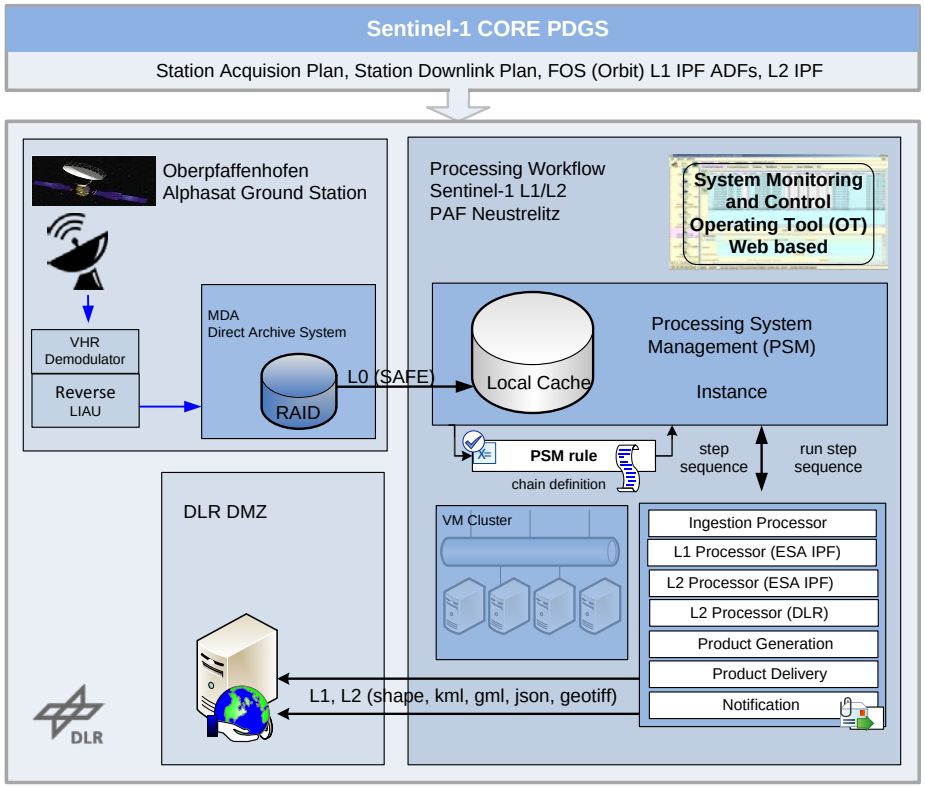
Internet

ftp: L0: SAFE-file

S1 PDGS ESRIN

DLR Neustrelitz

Alphasat NRT Demo: Processing and Dissemination



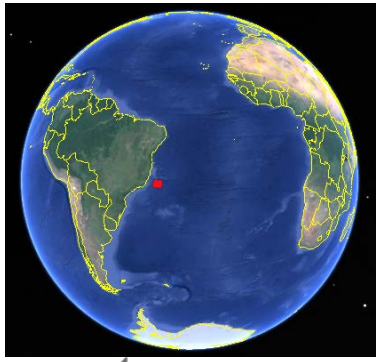
Processing and Data Dissemination

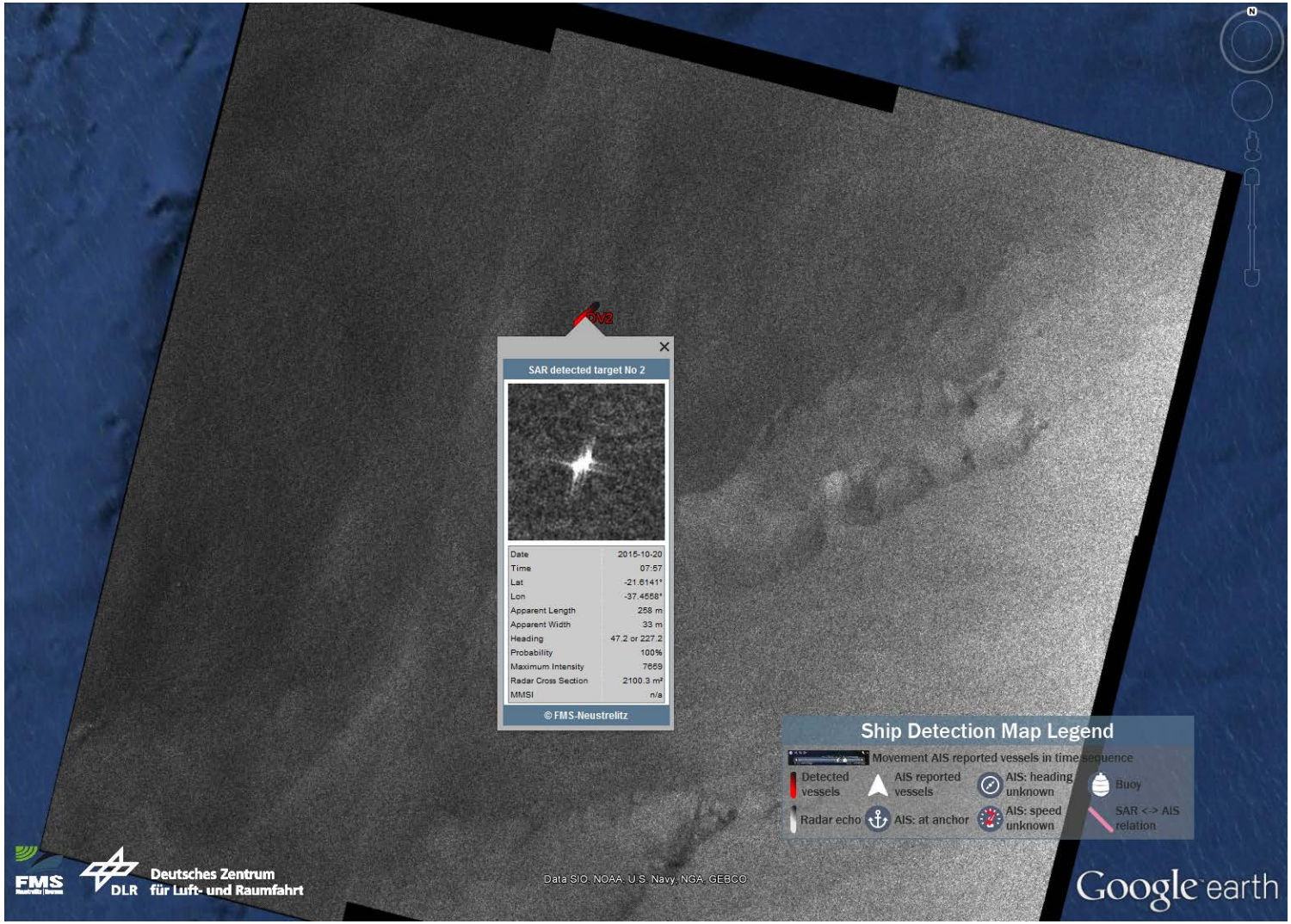
- Ka-Band Link, L0 processing (L0 SAFE format, 800 Mbyte) **~2 Minutes**
- ftp transfer,
- available at Neustrelitz after **~3 Minutes**
- L1 processing duration and ftp delivery (S1A_IW_GRDH_1SSV_20151020T0757) after **~ 8 Minutes**
- L2 ship detection product available
- delivery by Mail **~ 5 Minutes**
- available at GeoServer after **~10 Minutes**

E2E time from Alphasat downlink to availability of value added product

- ≈ 18 min (email)
- ≈ 28 min (incl. server upload)

Alphasat NRT Demo:
L2 ship detection product at Google Earth





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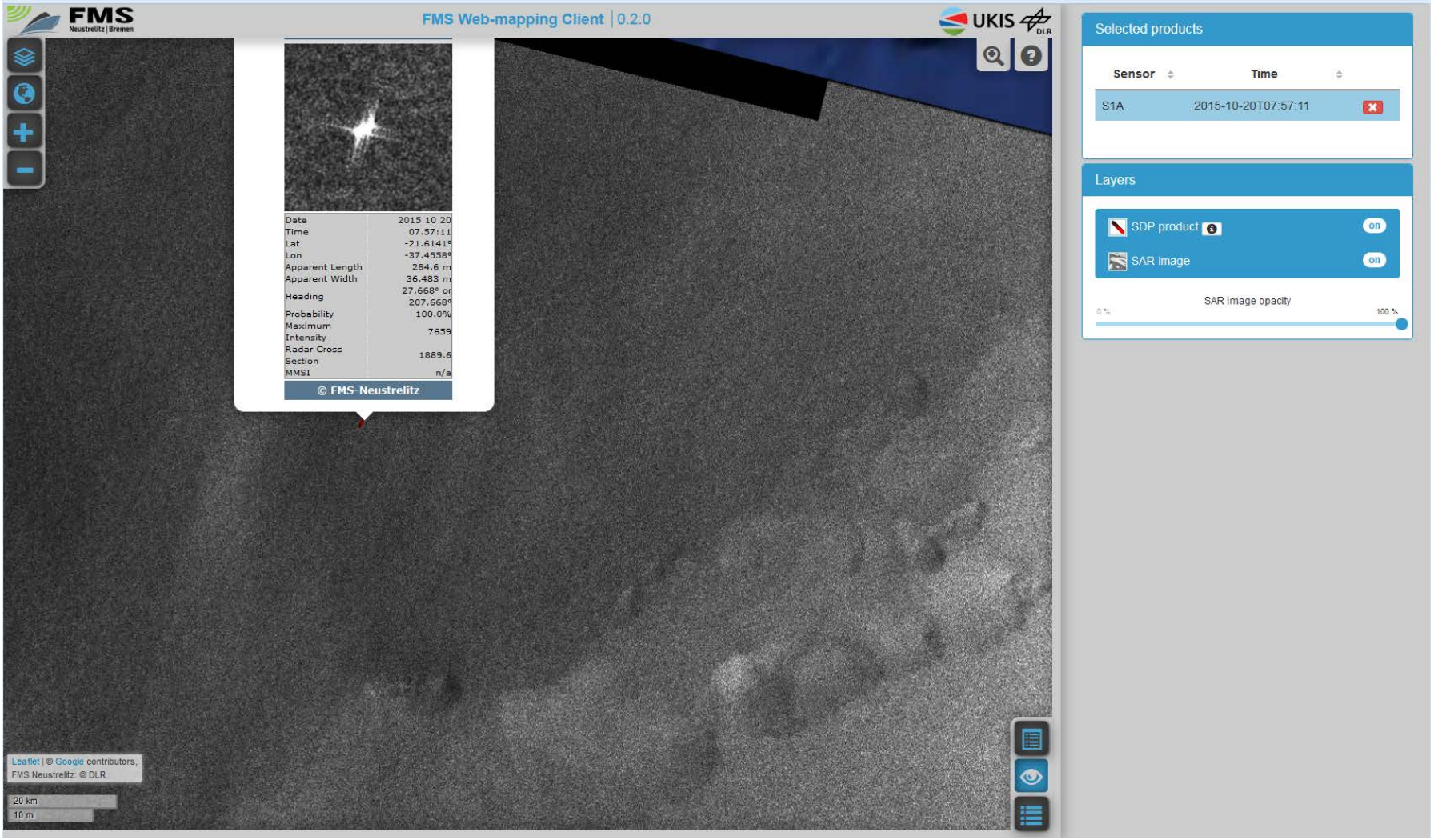
Product Dissemination on Web Mapping Client



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Conclusion

- EO data are more and more in use to support maritime surveillance.

- Near real time capabilities are amongst others the main requirements for such services.
- SAR processing enable automated fast processing of large volumes of data and information delivery within ~15 to 30 minutes of image acquisition, requirement for very high resolution optical images 45 minutes.

- Main tasks for multi-mission applications are
  - high availability of fully automated processing chain an big data handling
  - the virtualisation of processing systems to improve the resource management,
  - big data handling (new applications on top of standard protocols)

- Cooperative use of different satellites and sensors helps to improve the revisit time

- The integration of further data streams, not only from radar but also optical sensors, as well as satellite based AIS will increase the reliability of the service.

- Further development needed to apply the multi mission approach

Thank you for attention!

Egbert Schwarz
DLR
German Remote Sensing Data Center (DFD)
National Ground Segment (NBS)
Kalkhorstweg 53
17235 Neustrelitz
Phone: + 49 03981/480-149
Fax: + 49 03981/480-299
E-mail: Egbert.Schwarz@dlr.de

FMS
Neustrelitz | Bremen

Rostock: TerraSAR-X, Spotligth 19.10.2012