Near Real Time Applications for Maritime Situational Awareness

Egbert Schwarz
Maritime Security Lab Neustrelitz

German Remote Sensing Data Center (DFD)

WorldView Global Alliance User Conference
Munich November 2016

DLR

Outline

Background

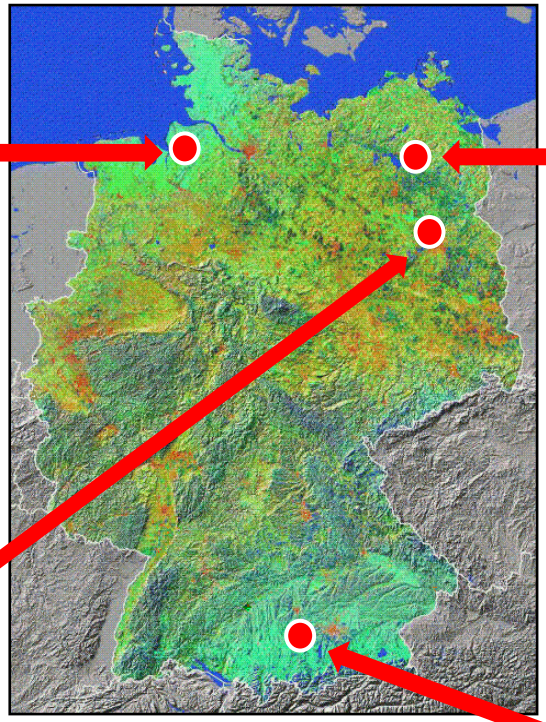
- Earth Observation Center
  - Maritime Security Lab
  - Mission and Sensors

Application Status and Future Development

- Ship Detection
- Oil Detection
- Activity and Change Detection
- Wind and Wave
- Icebergs, Ice Classification and Ice Drift

Earth Observation Center – EOC

Bremen
Maritime Security Lab



Neustrelitz
National Ground Segment
Maritime Security Lab

Berlin

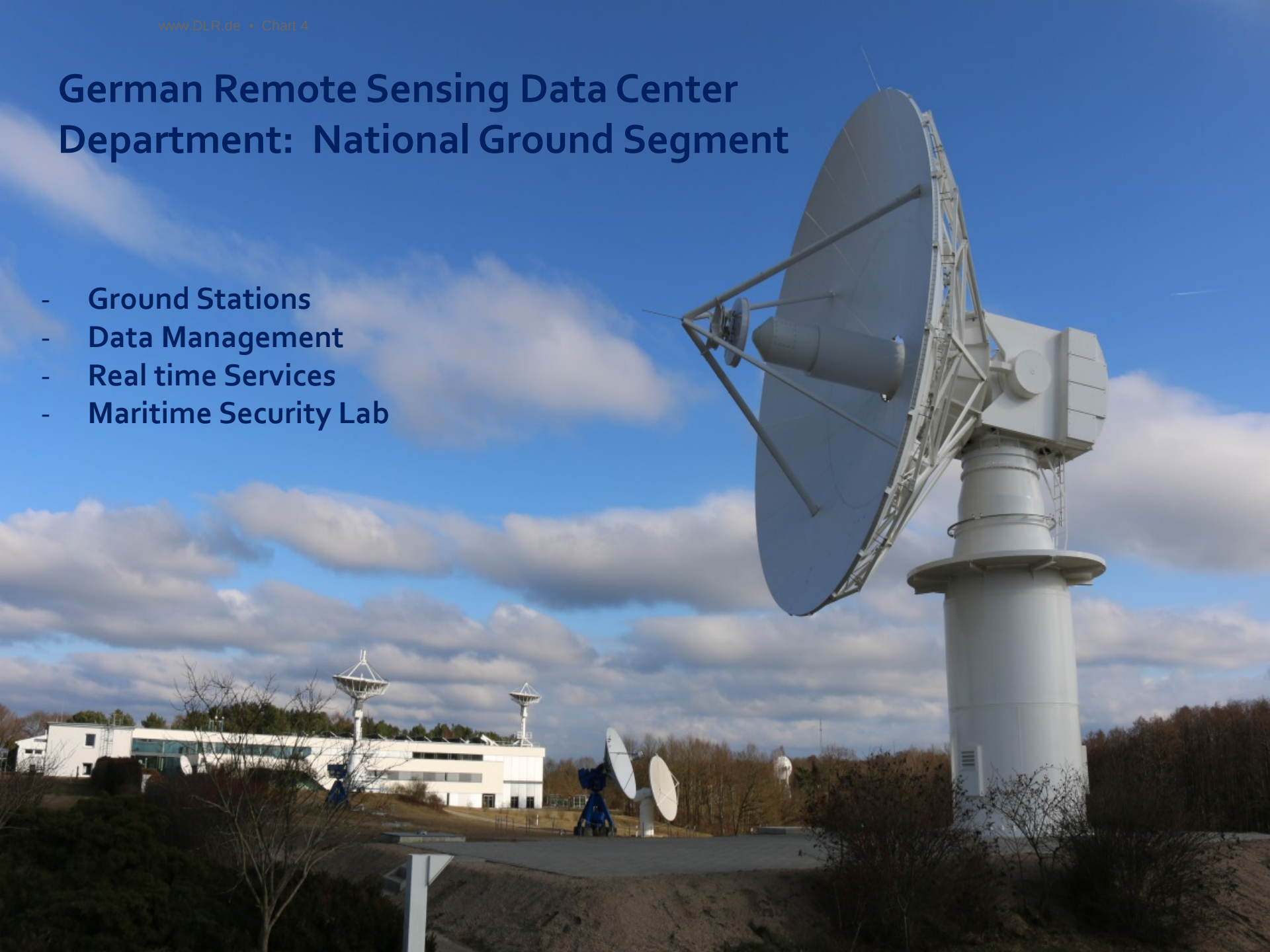
- Consists of the Remote Sensing Technology and the German Remote Sensing Data Center
- Appr. 350 employees at 4 sites
- Chairs at 2 university

Oberpfaffenhofen

DLR

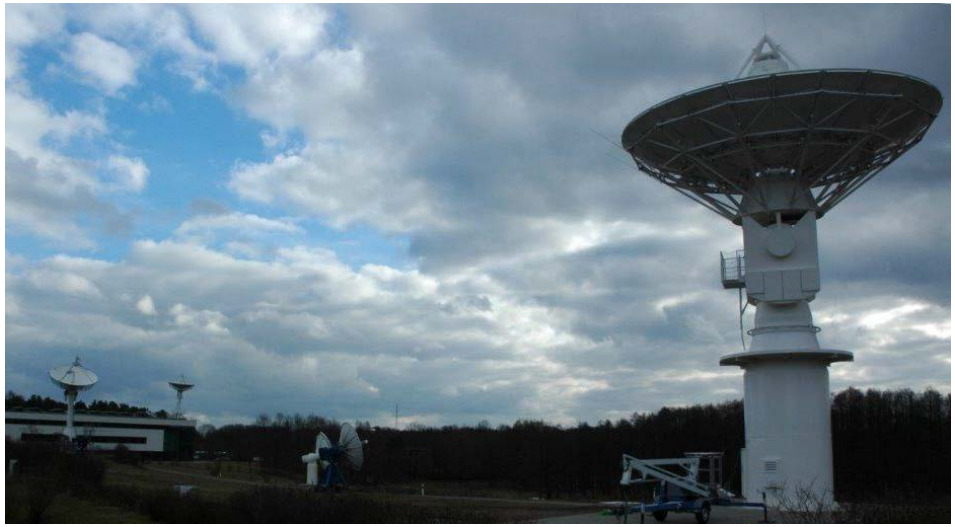
German Remote Sensing Data Center
Department: National Ground Segment

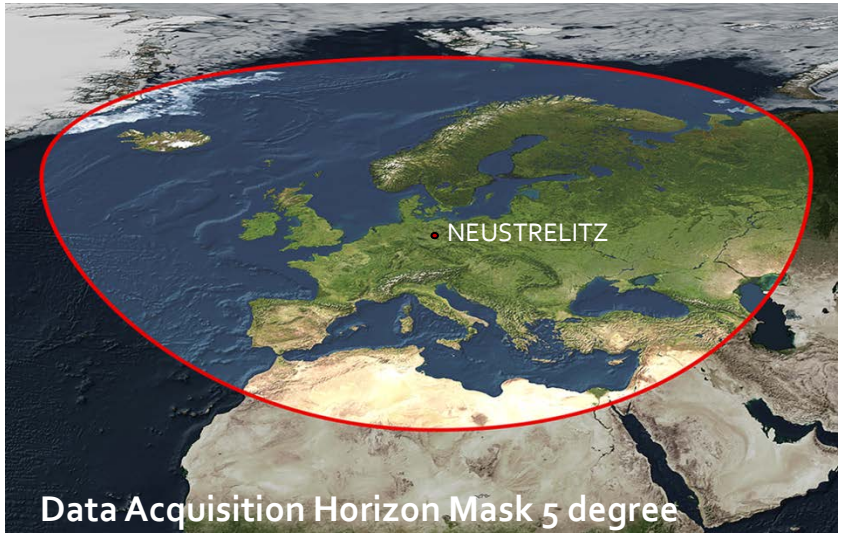
- Ground Stations
- Data Management
- Real time Services
- Maritime Security Lab



Ground Station and Processing Facility Neustrelitz

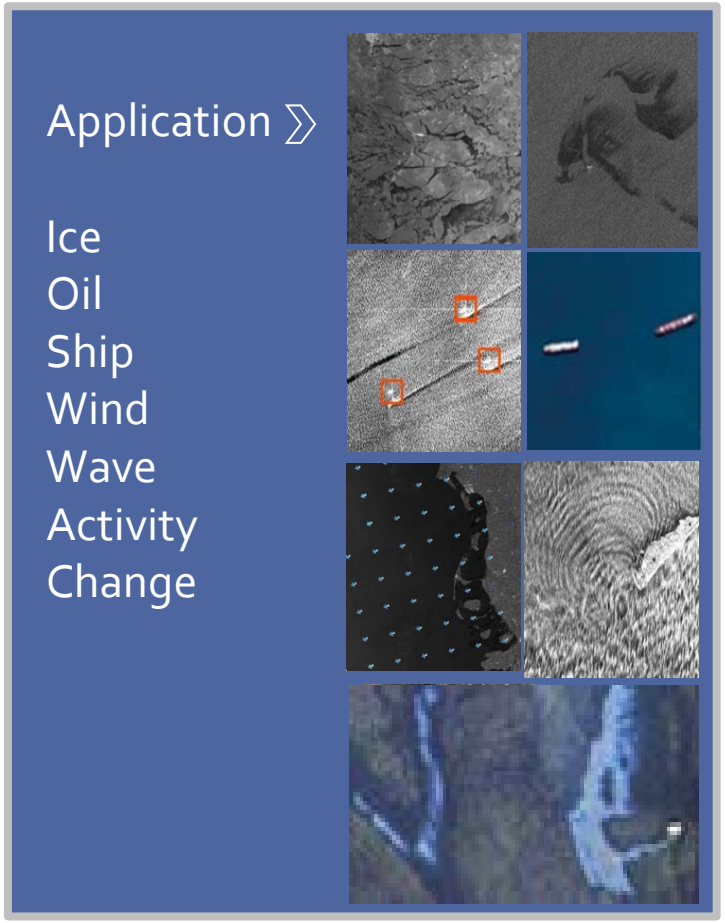
- Support of currently 12 different Satellite missions
- Main reception and processing facility for SAR Mission TerraSAR-X
- Collaborative Station for European Sentinel-1 mission
- Radarsat-2 Regional Ground System
- Landsat-8 Global Network Station
- CartoSAT, ResourceSat, Oceansat (GAFAG)

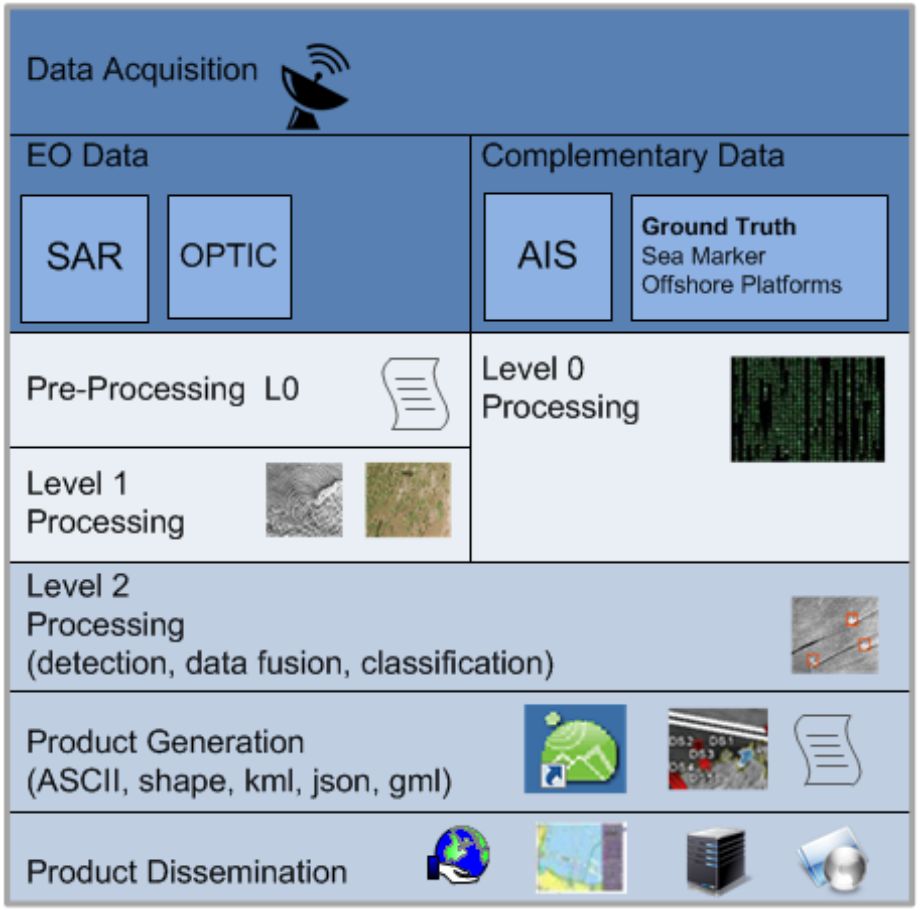




Objective

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

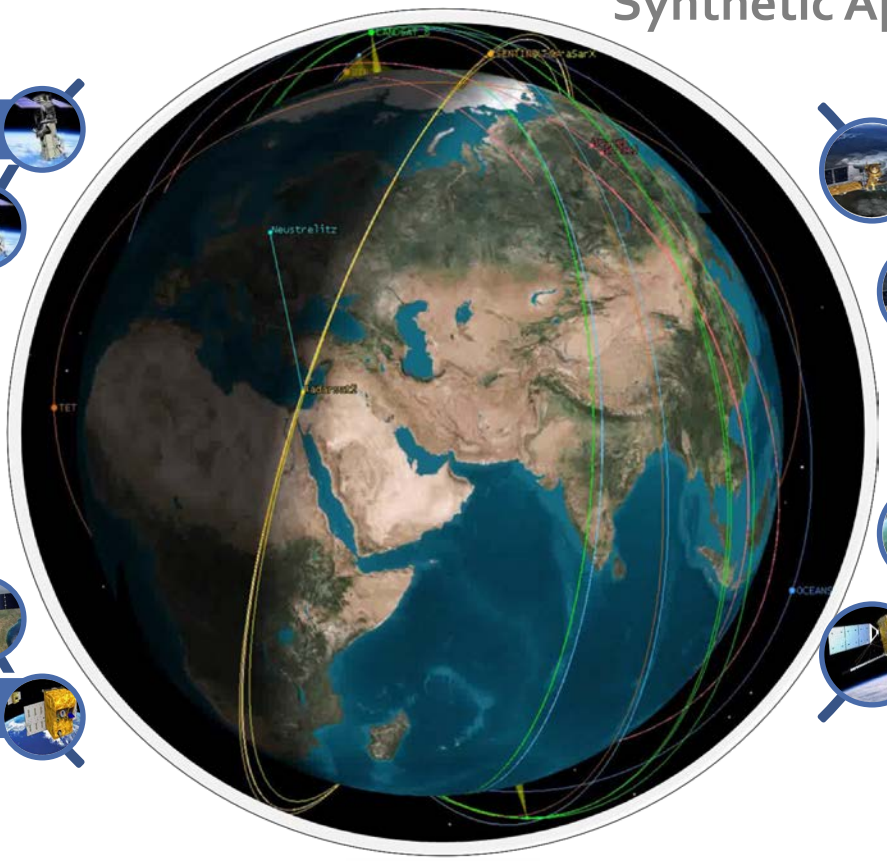




Sensors and Modes

Optical

- Worldview-1
- Worldview-2
- Worldview-3
- GeoEye-1
- Deimos
- Landsat-8
- Firebird



Synthetic Aperture Radar (SAR)

- Sentinel-1A
- Sentinel-1B
- TerraSAR-X
- TanDEM-X
- Radarsat-2

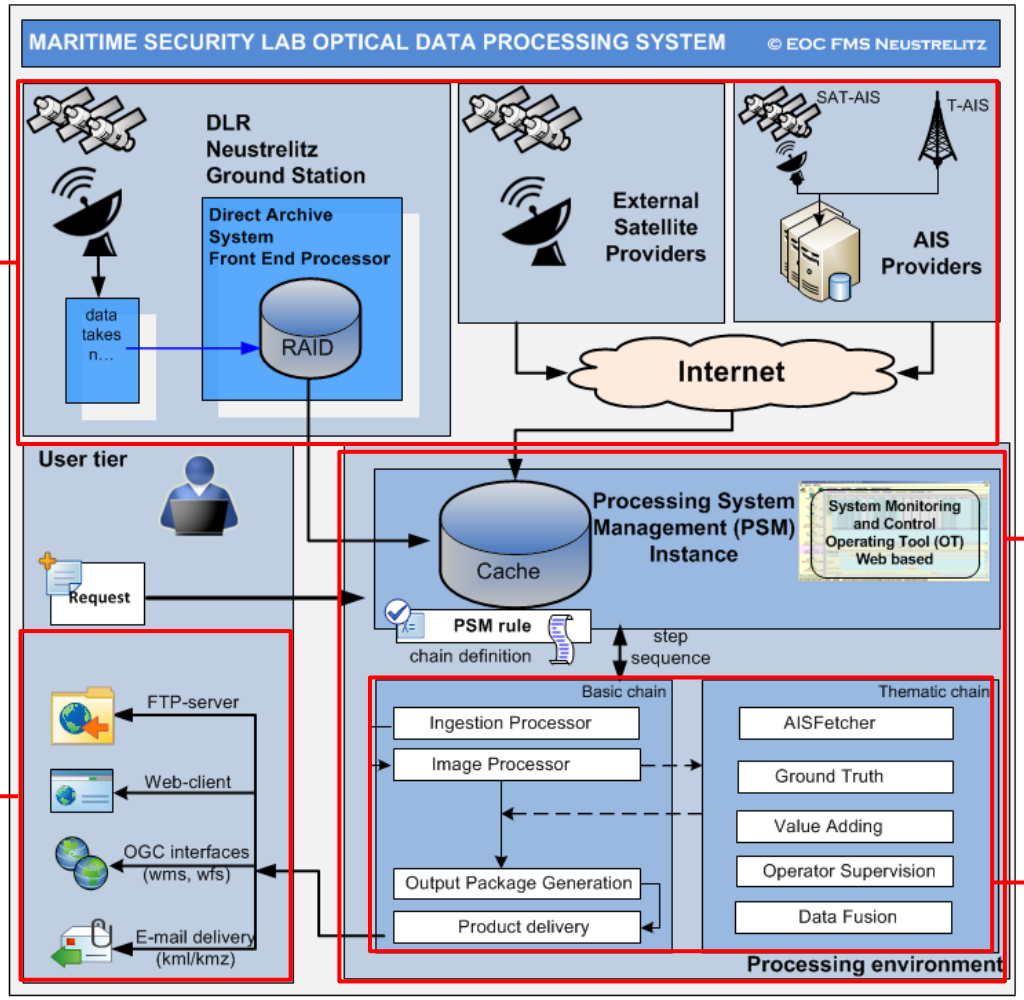
Automatic Identification System

- Terrestrial AIS
- Satellite AIS

Architecture of Processing Chain

DATA Collection

Product Dissemination



Processing environment

Processing Rules and Processors

Processing System Management - Workflows and Plug-Ins

DIMS EO

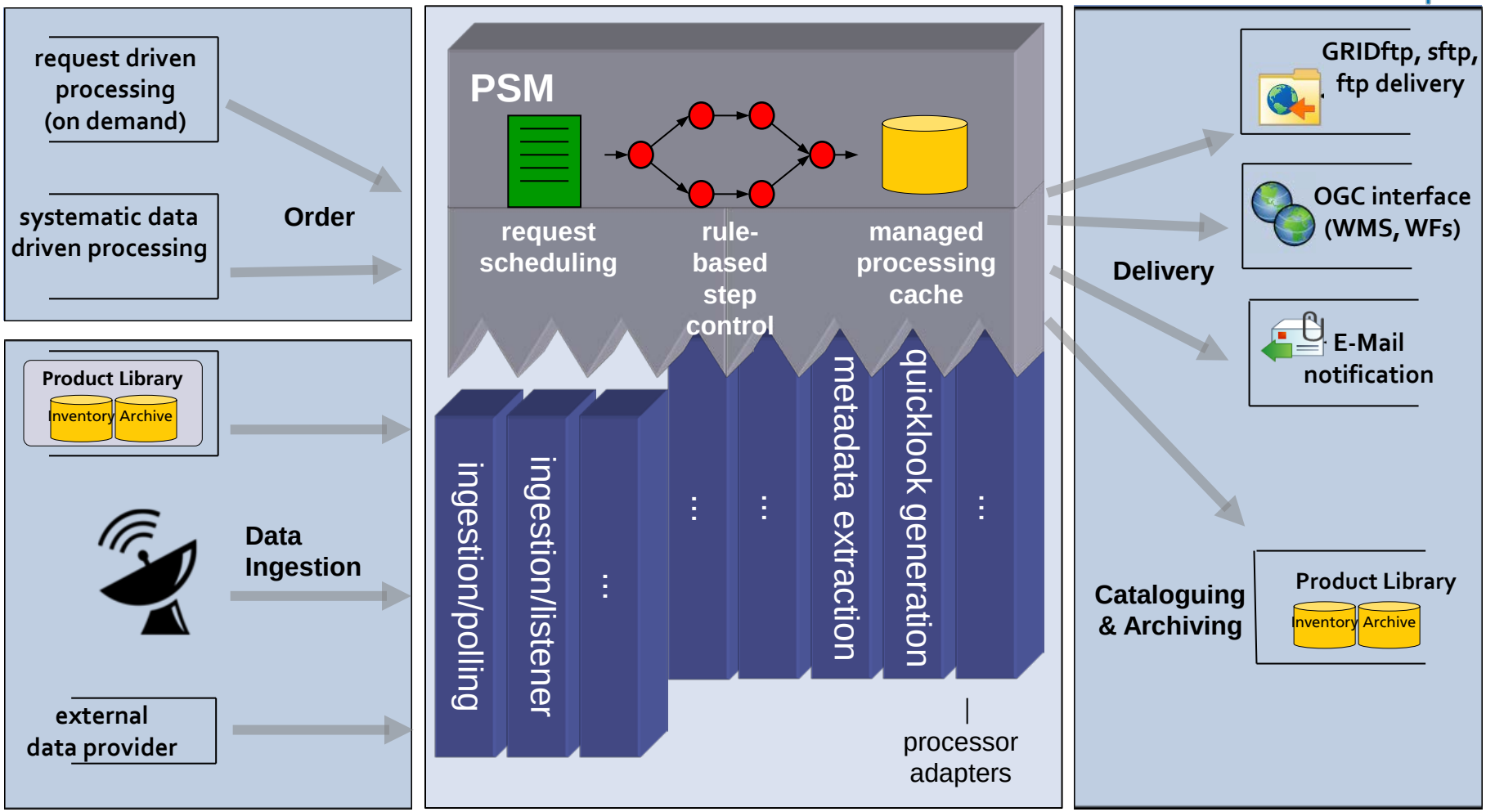
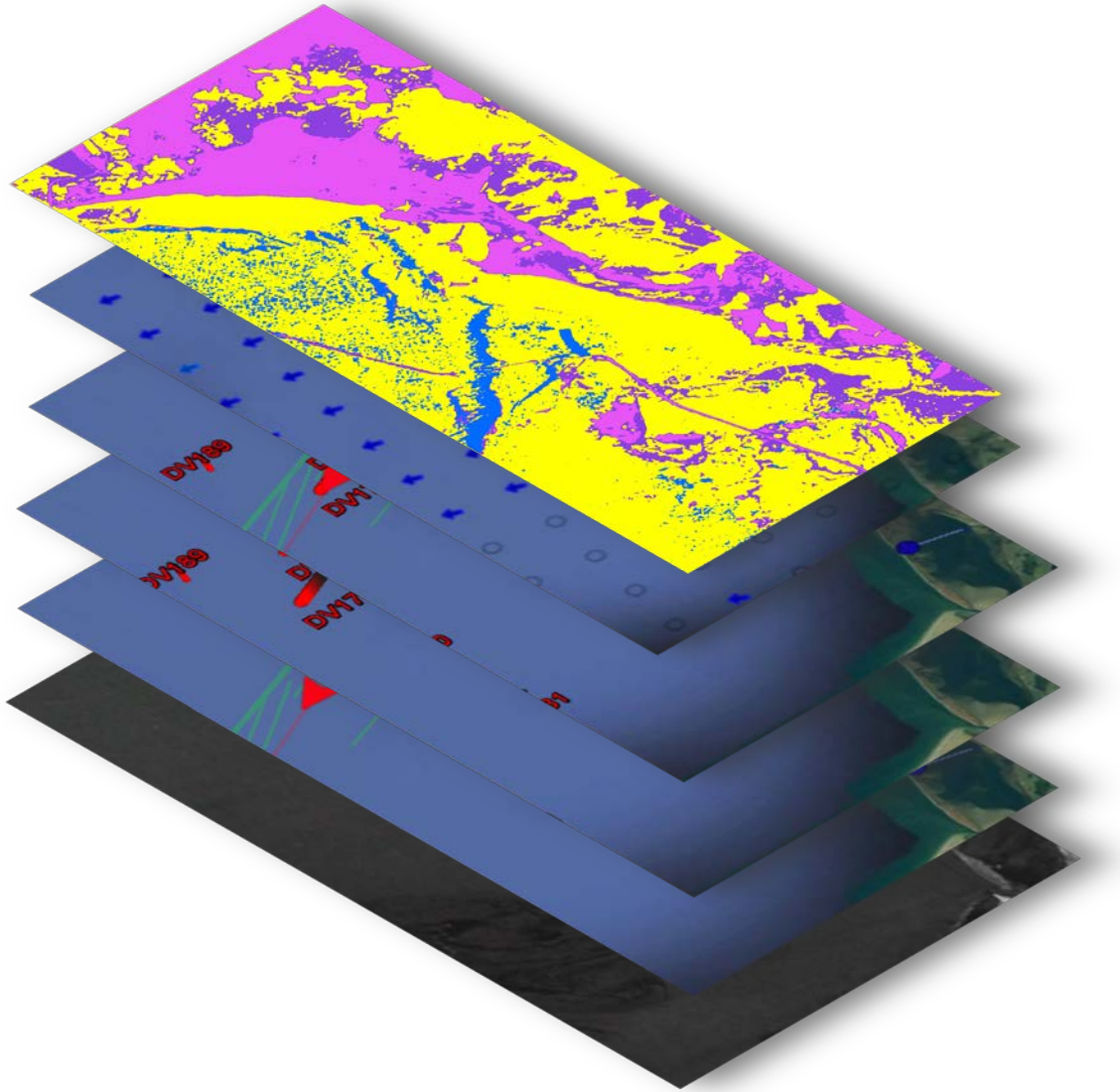


Image Processing

- Pre-processing
  - L0, L1b
- Scene Slicing
- image mosaicking
- Image projection
- Product Format
  - GeoTIFF
  - JPEG 2000

Thematic Processing Chain

- Automated processing
  - Target detection
  - Data fusion
  - Wind
  - Wave
- Semi automated algorithms
  - Target detection
  - Activity detection
  - Change detection
  - Data fusion
- Operator Interface
  - GUI with 3D viewer



Thematic Processing Chain

- Automated algorithm
  - Target detection
  - Data fusion
  - Wind
  - Wave
- Semi automated processing
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  - Data fusion
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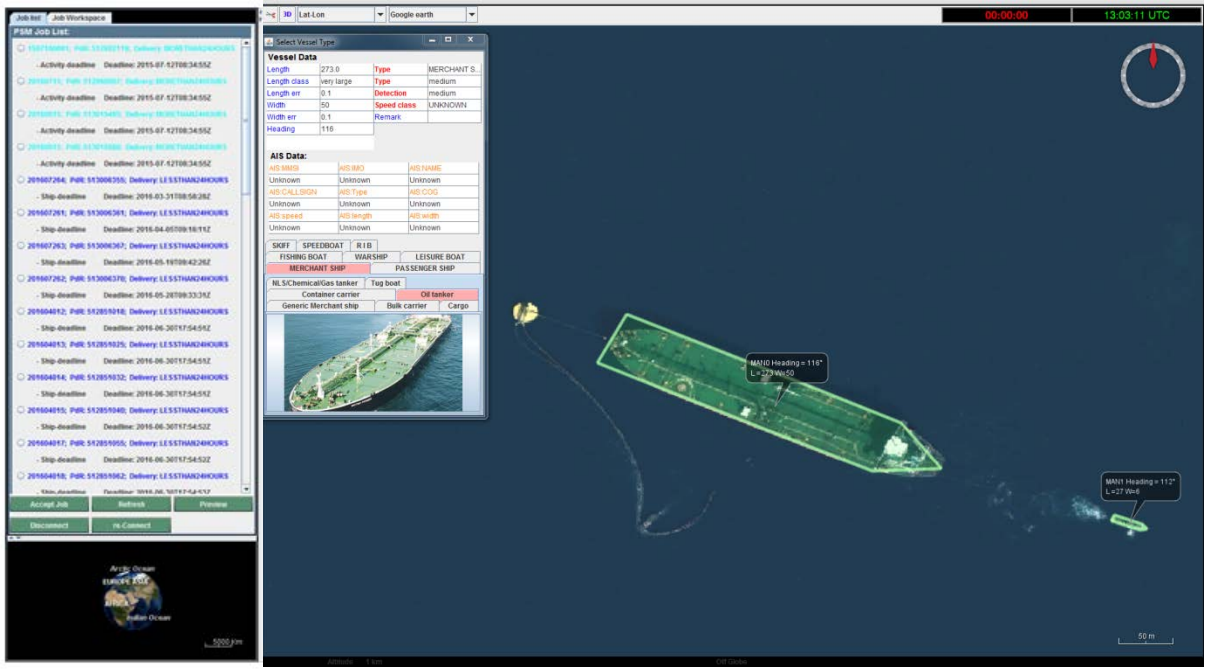
  - GUI with 3D viewer



Operator GUI of Analysis Framework (client side)

WorldView 3
© 2016 DigitalGlobe, Inc.
provided by European Space Imaging

Product Dissemination

Product Delivery Services

UKIS
http://dlr.de/

Leaflet
http://leafletjs.com/

ANGULARJS by Google
http://angularjs.org/

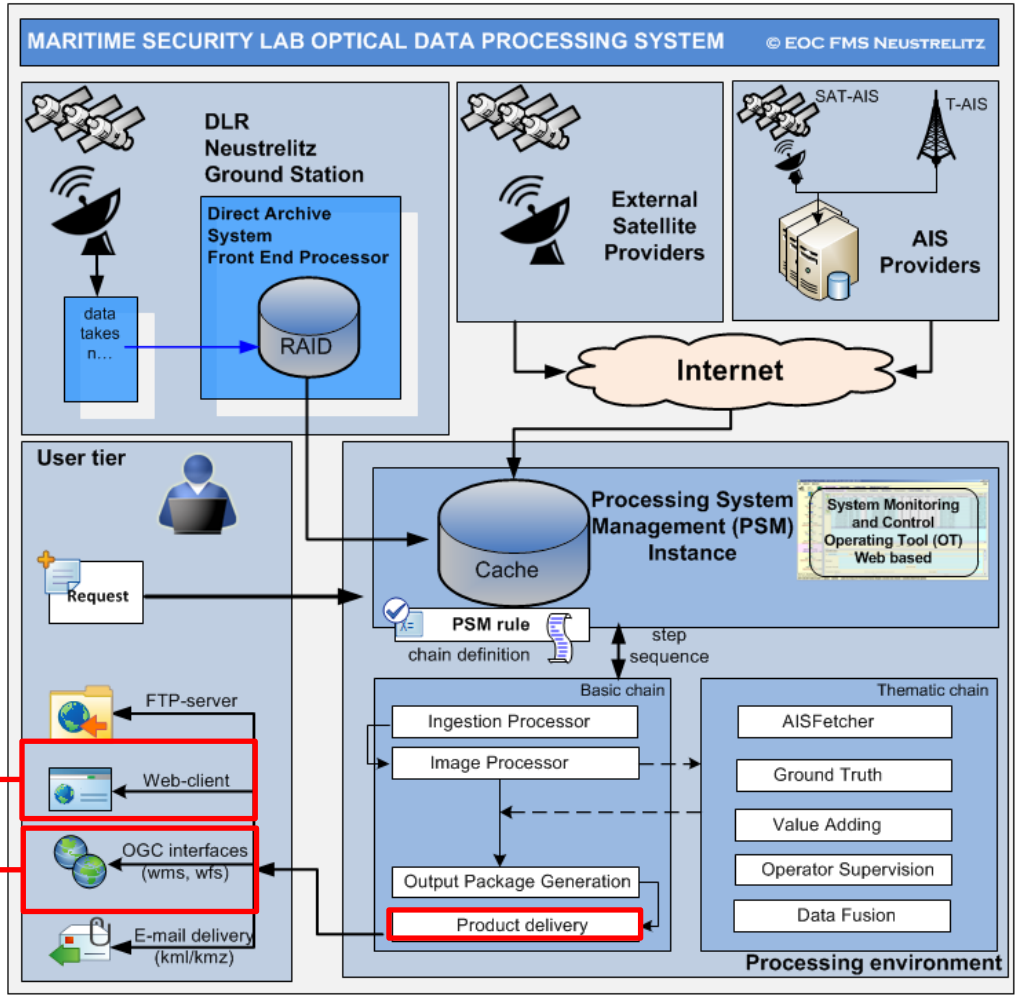
node JS
https://nodejs.org

Powered by:

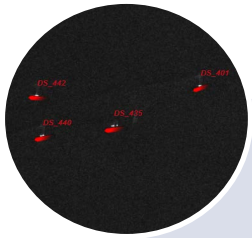
http://tomcat.apache.org/

GeoServer
http://geoserver.org/

PostgreSQL
https://www.postgresql.org/



Ship- Detection Application (SAR)



Near real time ship detection application based on SAR images

currently developed for:

TerraSAR-X,

TanDEM-X

Radarsat-2,

Sentinel-1A,

Sentinel-1B

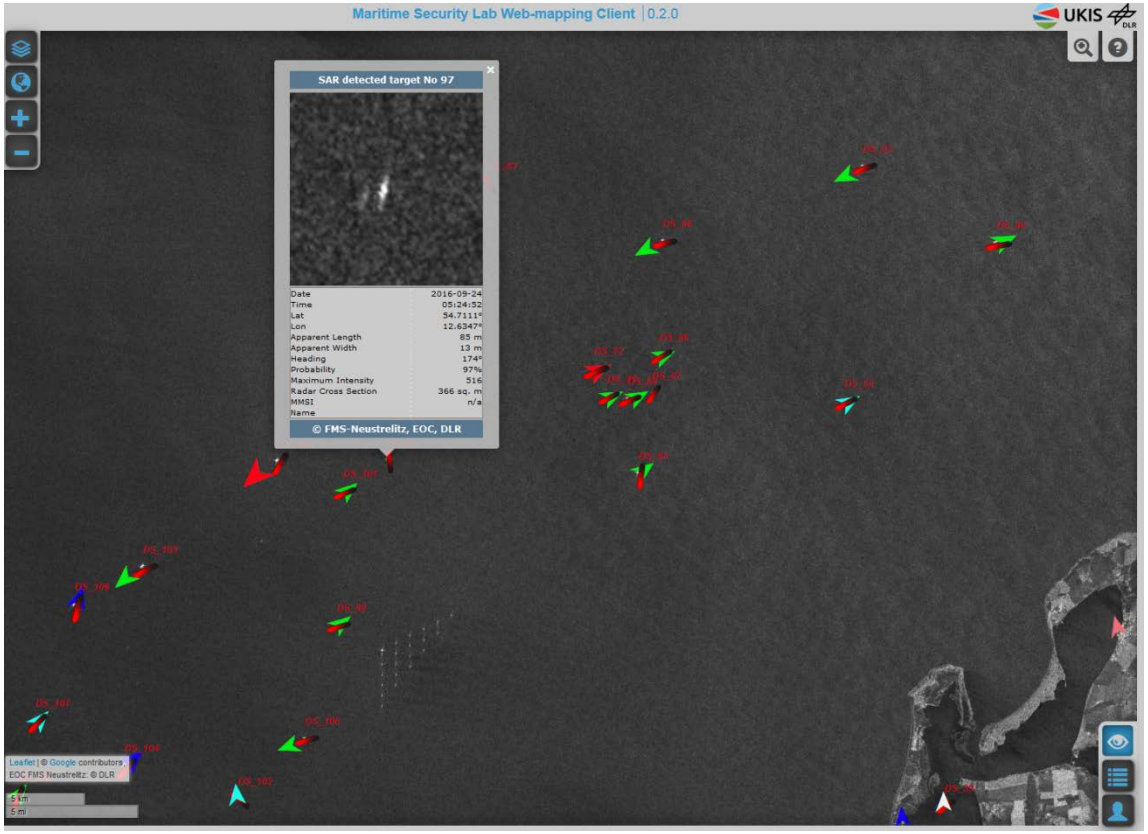


Image: S1A_IW_GRDH_1SDV_20160924T0524

Value added products

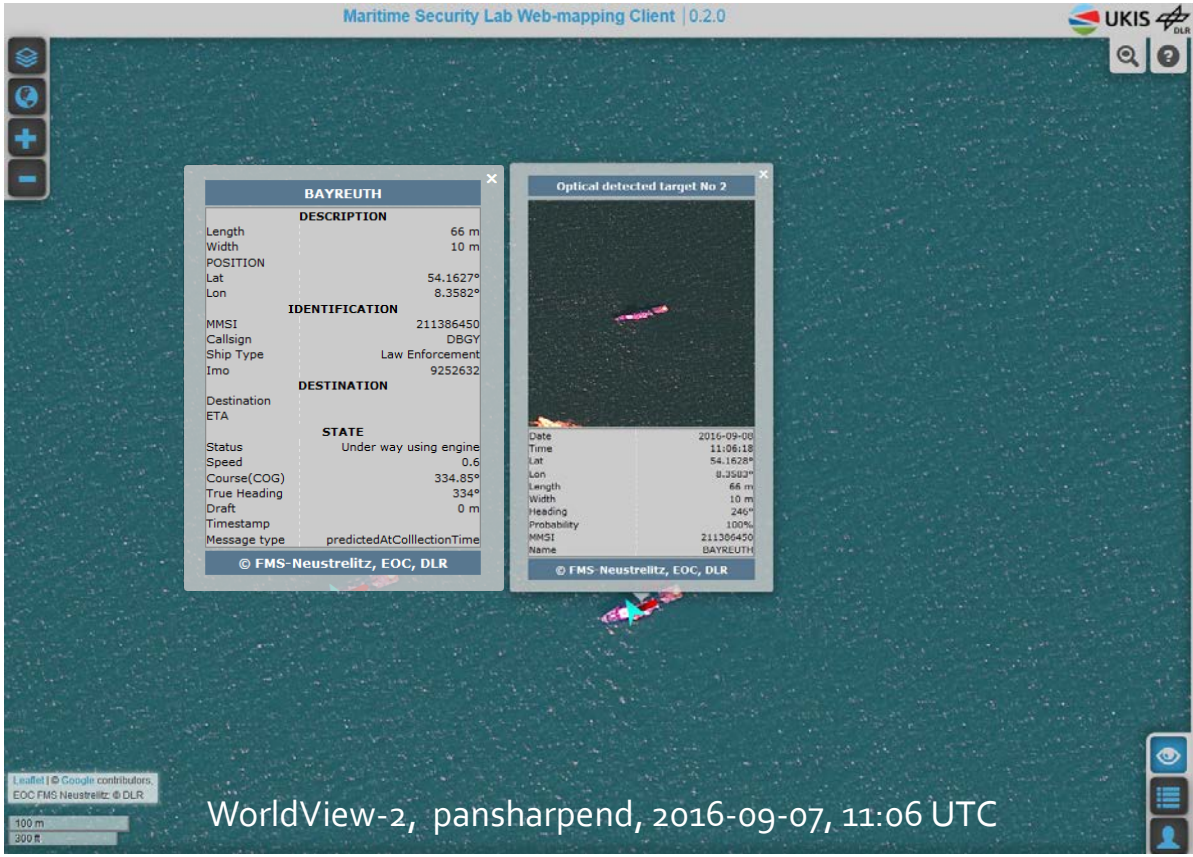
- **SAR/ AIS merged products** (in case of available AIS Data)
- ASCII ; KMZ, GML; DER (EMSA); ESRI shape; json;
- GeoTIFF (MRES_L1b; HRES_L1B)

Ship- Detection Application (Optic)

Near real time ship detection application based on optical data

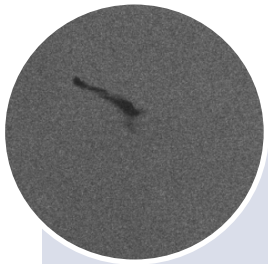
Core processor currently being developed by the Maritime Security_Lab Neustrelitz

value added products in near real time based on very high resolution images (Worldview 1-3, GeoEye,)



- Value added products
  - **OPT/ AIS merged products** (in case of available AIS Data)
  - ASCII ; KMZ, GML; VDS (EMSA); ESRI shape; json; GeoTIFF

Oil Spill Detection (SAR)



Near real time oil spill detection application based on SAR images

core function is the qualification algorithm developed by the Maritime Security Lab Bremen based on Neural Network

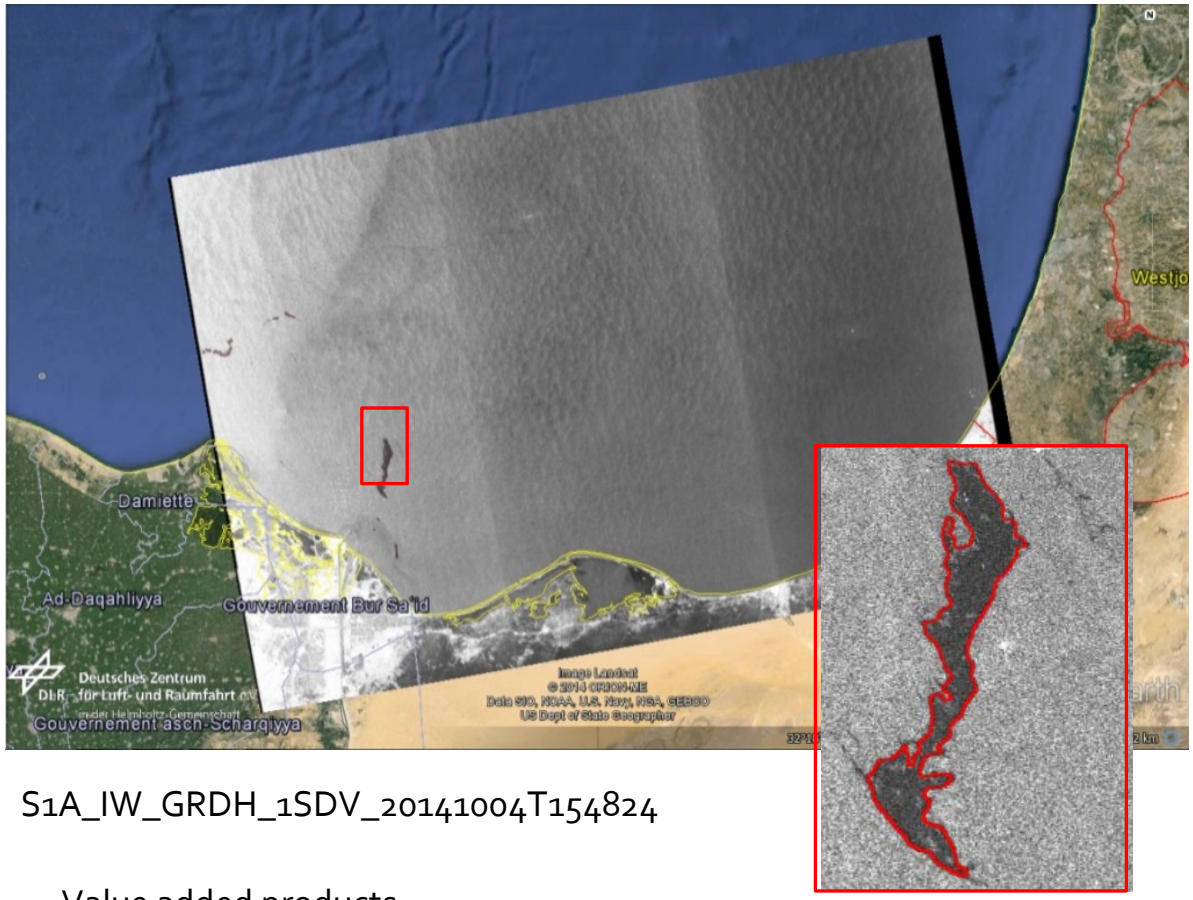
currently developed for:

TerraSAR-X, TanDEM-X

Radarsat-2, Sentinel-1A,

Sentinel-1B

Ackn: S. Singha; DLR- IMF



S1A_IW_GRDH_1SDV_20141004T154824

Value added products

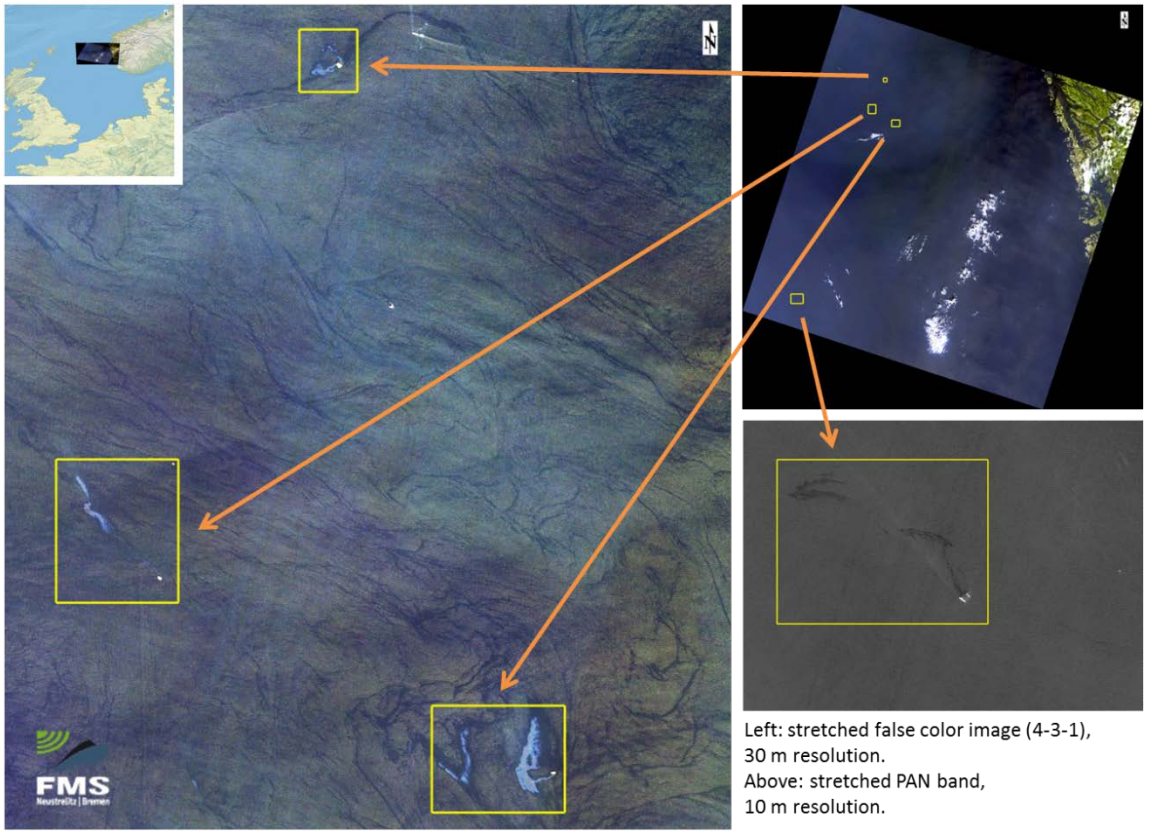
- ASCII ; KMZ, GML; OSN (EMSA); ESRI shape; pdf;
- GeoTIFF (MRES_L1b; HRES_L1B)

Oil Spill Detection (Optic)

Near real time oil spill detection application based on optical data

Core processor currently being developed by the Maritime Security_Lab Neustrelitz

planned value added products in near real time based on Landsat-8

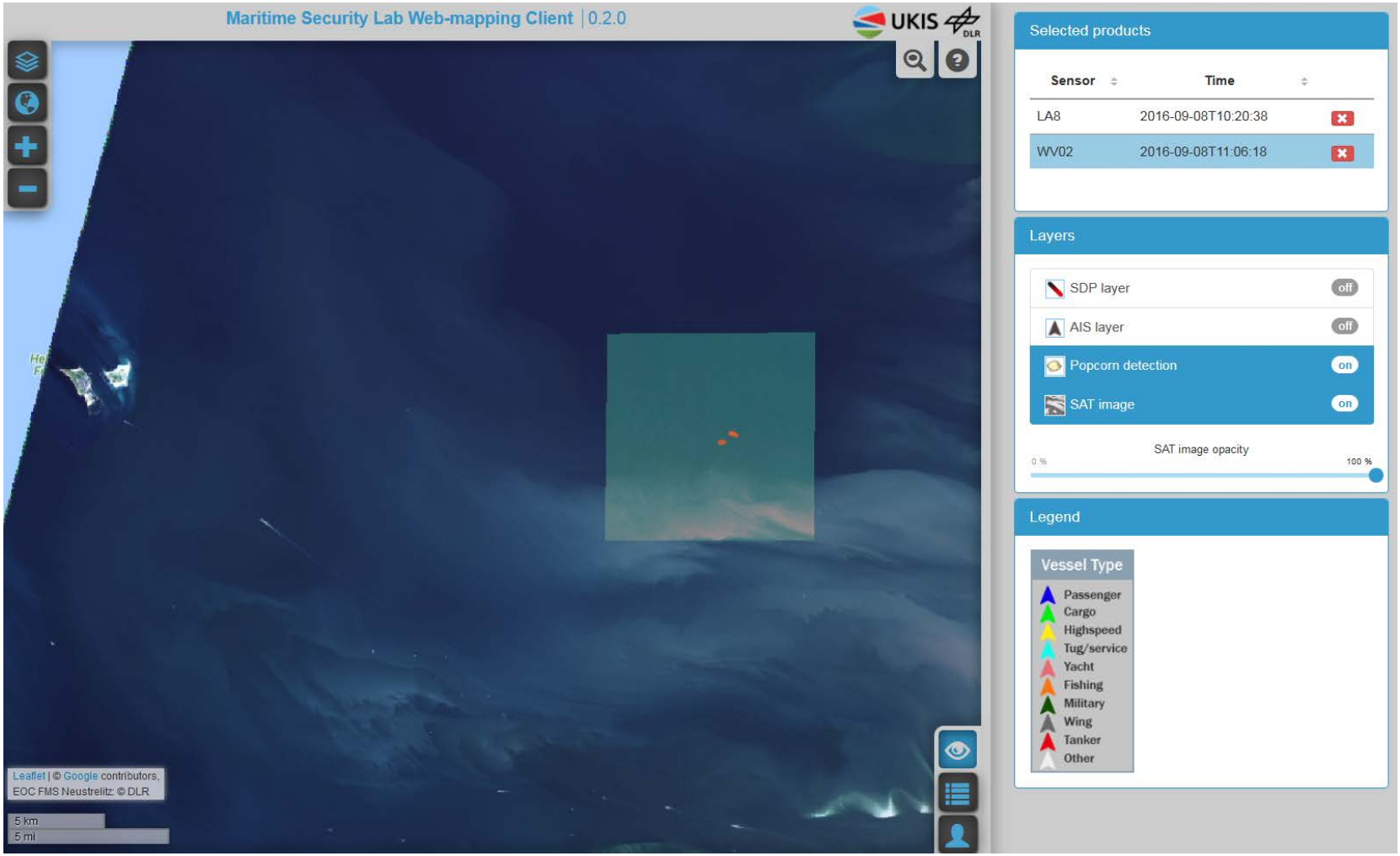


Left: stretched false color image (4-3-1), 30 m resolution.
Above: stretched PAN band, 10 m resolution.

Potential oil spills nearby platforms in the North Sea,

Landsat 8 OLI, 2014-07-11, 10:56 UTC

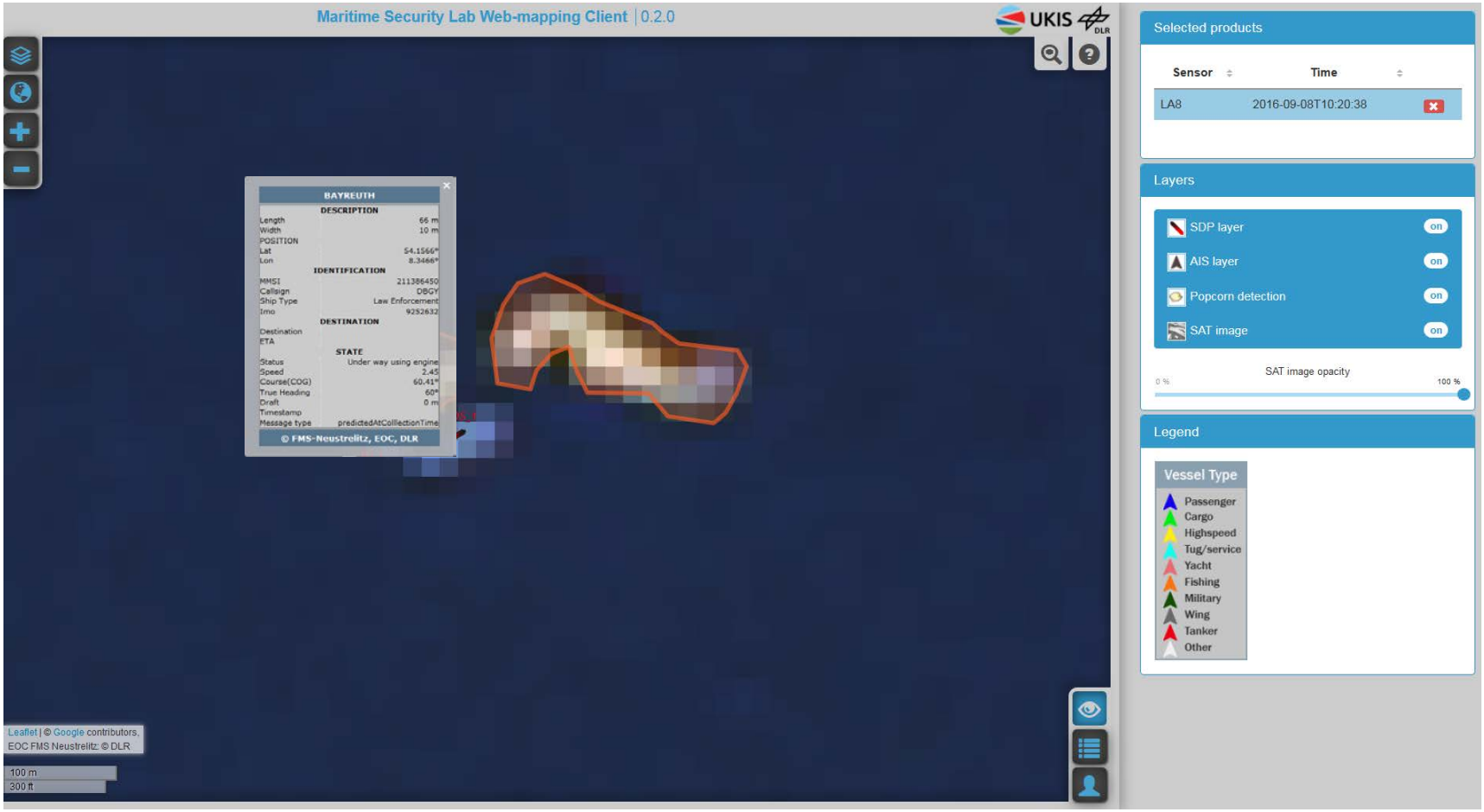
Example: Project EMSec, Sep. 2016 Optical Sensor based Hazard Detection



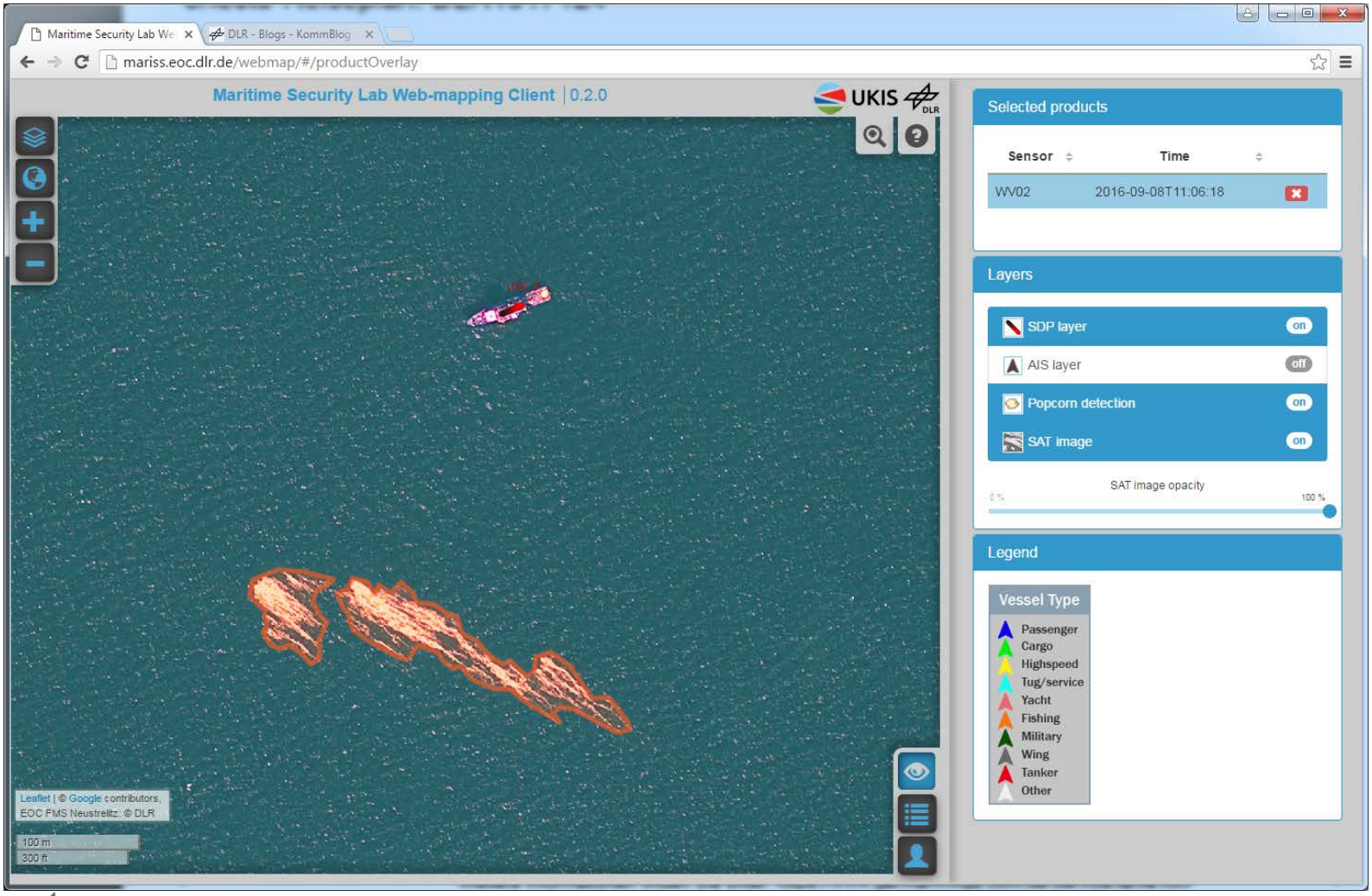
Example: Project EMSec, Sep. 2016 Optical Sensor based Hazard Detection

Project EMSec, Sep. 2016, Hazard (Popcorn) detection

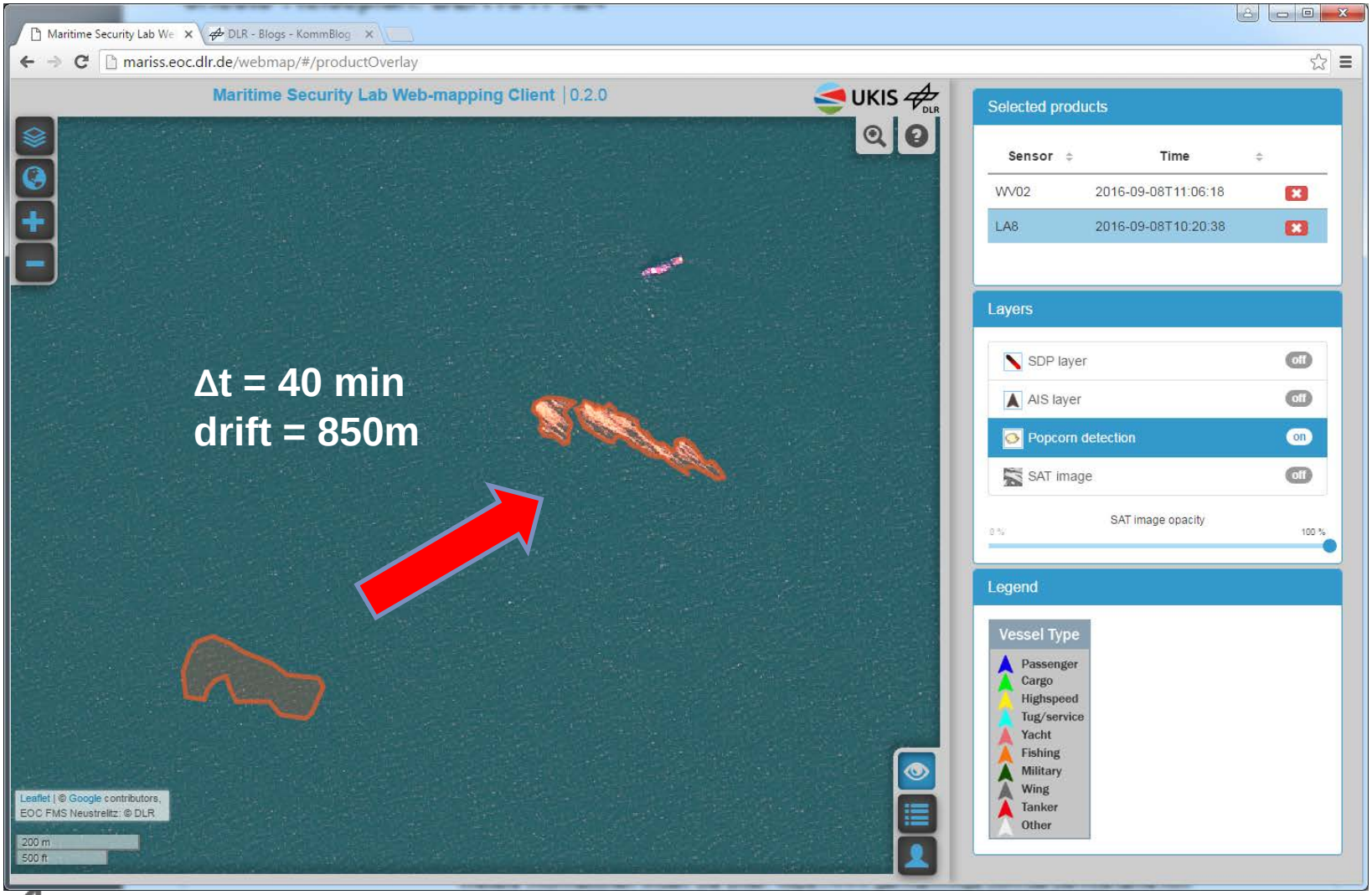
Example: Project EMSec, Sep. 2016 Optical Sensor based Hazard Detection – Landsat-8



Example: Project EMSec, Sep. 2016 Optical Sensor based Hazard Detection – WorldView-2



Example: Project EMSec, Sep. 2016 Optical Sensor based Hazard Detection – Landsat-8



Application for Wind field products

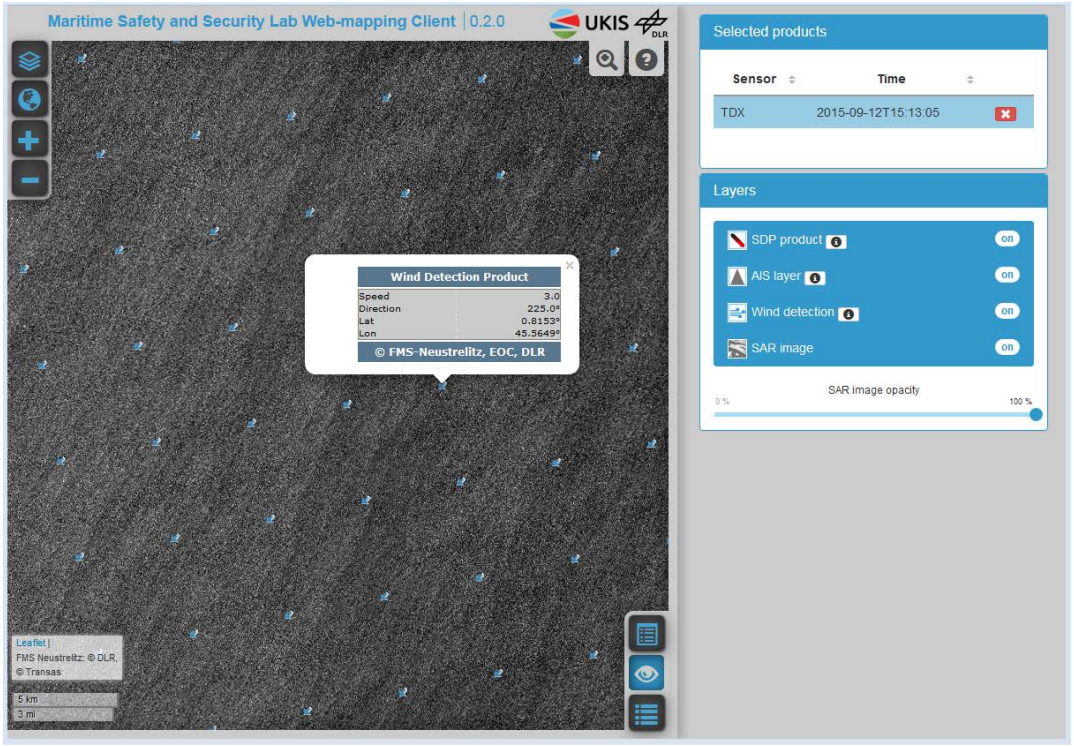


Image:
TDX1_SAR__MGD_RE___SC_S_SRA_20150912T151305_20150912T151310

The wind forecast and the Level 1 quicklook product in the background is overlaid by the DLR SAR WIND product (rectangle) derived from the Sentinel 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)

Example for Wind field products based on Sentinel-1

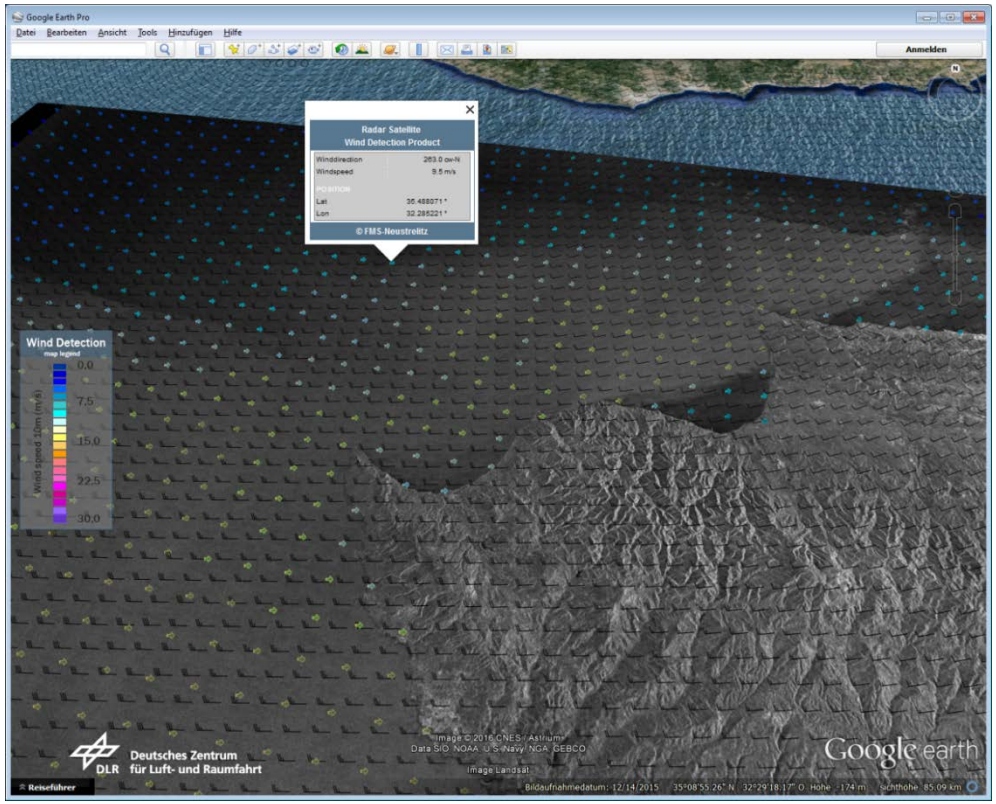
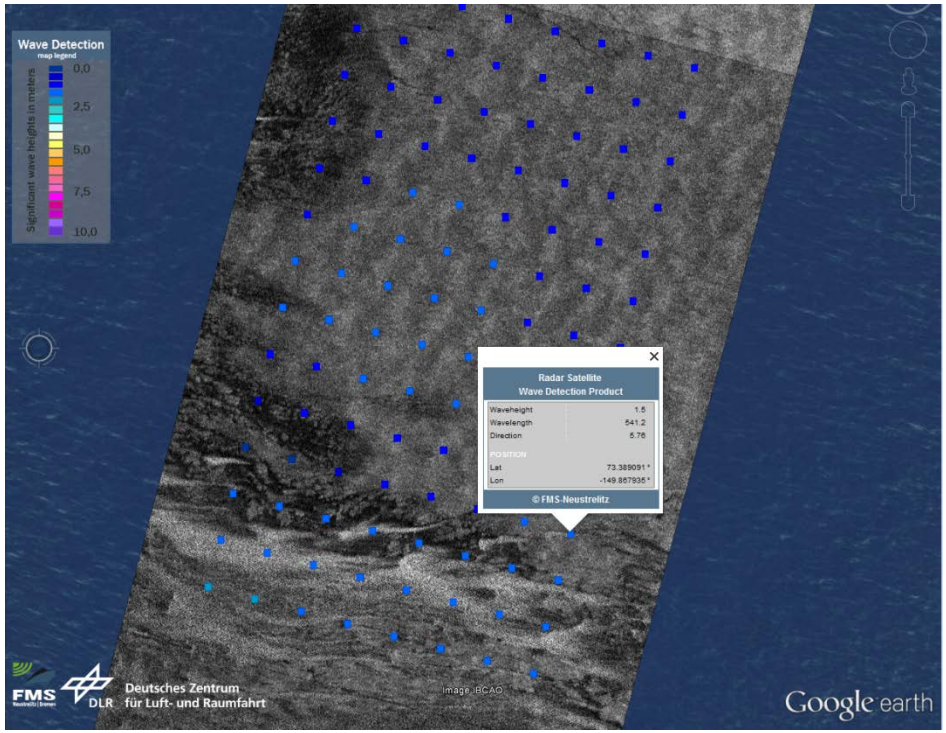


Image: S1A_IW_GRDH_1SDV_20160316T035101_20160316T035125

DLR SAR WIND product (rectangles) derived from the Sentinel image, wind forecast and Level 1 quicklook product as background.

- Core function is the CMOD-5 algorithm developed by the Maritime Security Lab Bremen to derive wind speed and direction, **validation ongoing,**
- 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

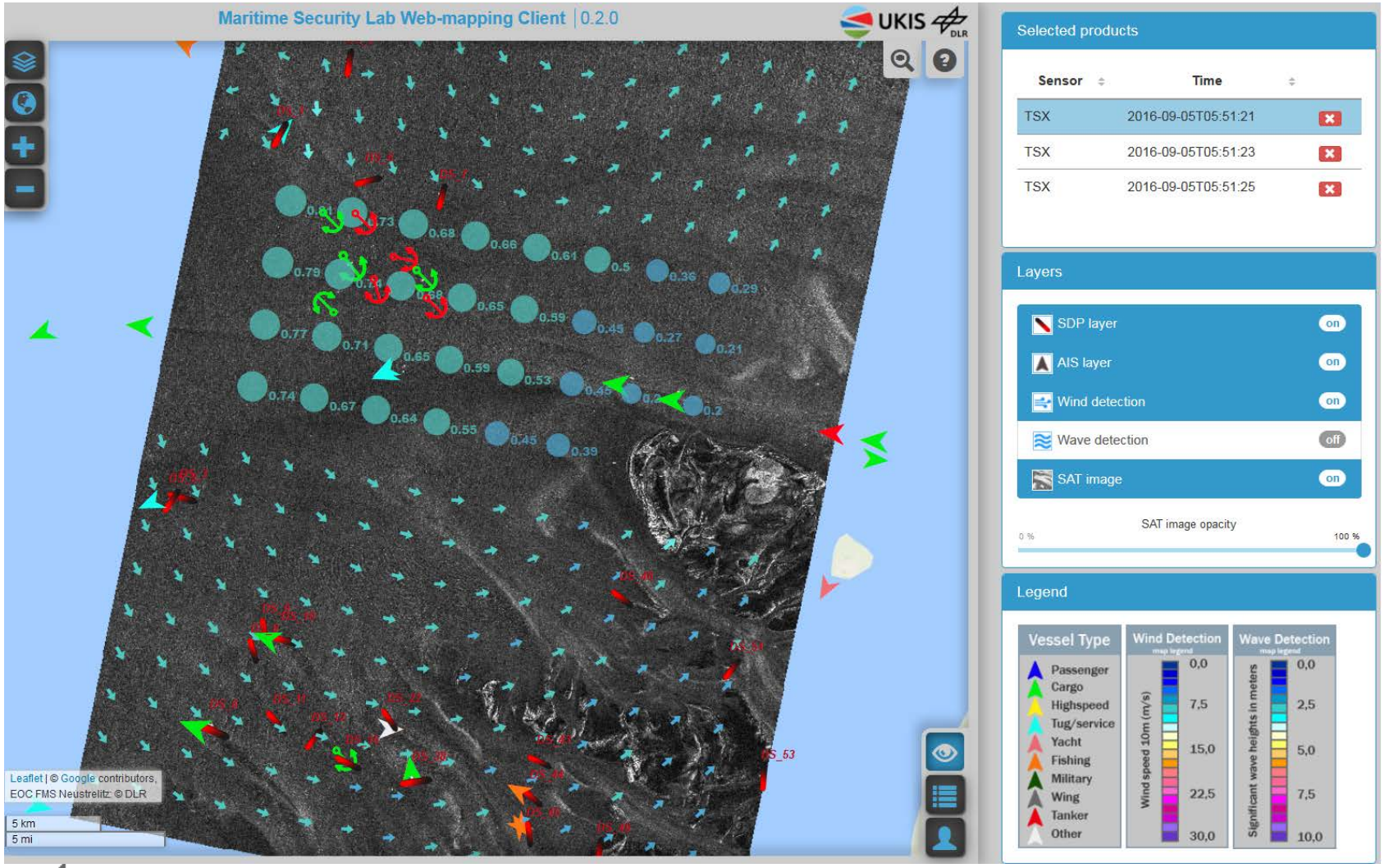


DLR SAR WAVE product (rectangles) derived from the TerraSAR-X StripMap image, L1 quicklook product as background.

- new XWAVE-2 algorithm developed by the Maritime Security Lab Bremen to derive wave height and wave length (Pleskachevsky et al., 2016)
- Level 2 Produktformate
  - ASCII
  - netCDF
  - Google (KMZ)
  - GIS, png, wld, png.aux.xml
  - ESRI Shape Layer Files (shape)

Pleskachevsky, A., Rosenthal, W., Lehner, S. (2016) Meteo-Marine Parameters for Highly Variable Environment in Coastal Regions from Satellite Radar Images. ISPRS Journal of Photogrammetry and Remote Sensing, Seiten 1-25. ELSEVIER. DOI: 10.1016/j.isprsjprs.2016.02.001. (in print)

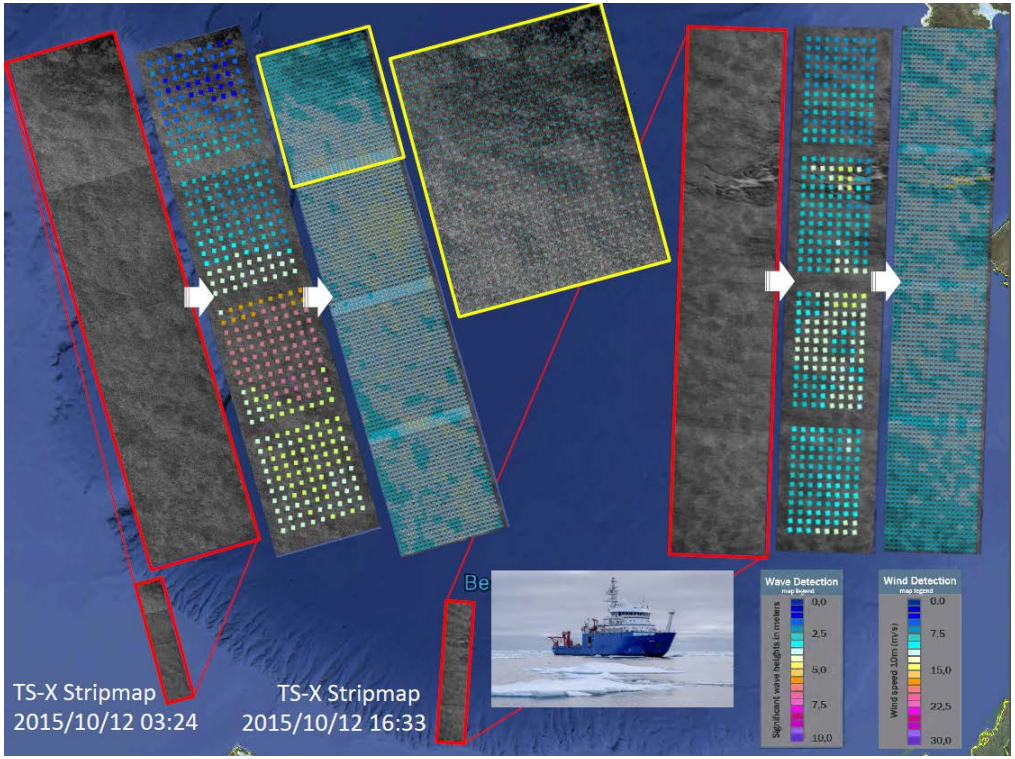
Example of Product delivery on GeoServer and connected via Web-mapping Client



Example of
NRT Support for Office of Naval Research (ONR)
Arctic Sea State Campaign 2015

Research Vessel Sikuliaq
Beaufort Sea

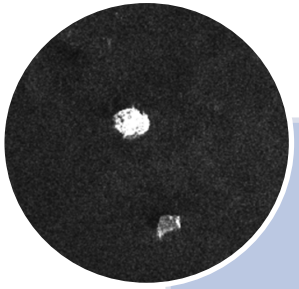
http://www.apl.washington.edu/project/project.php?id=arctic_sea_state



- 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

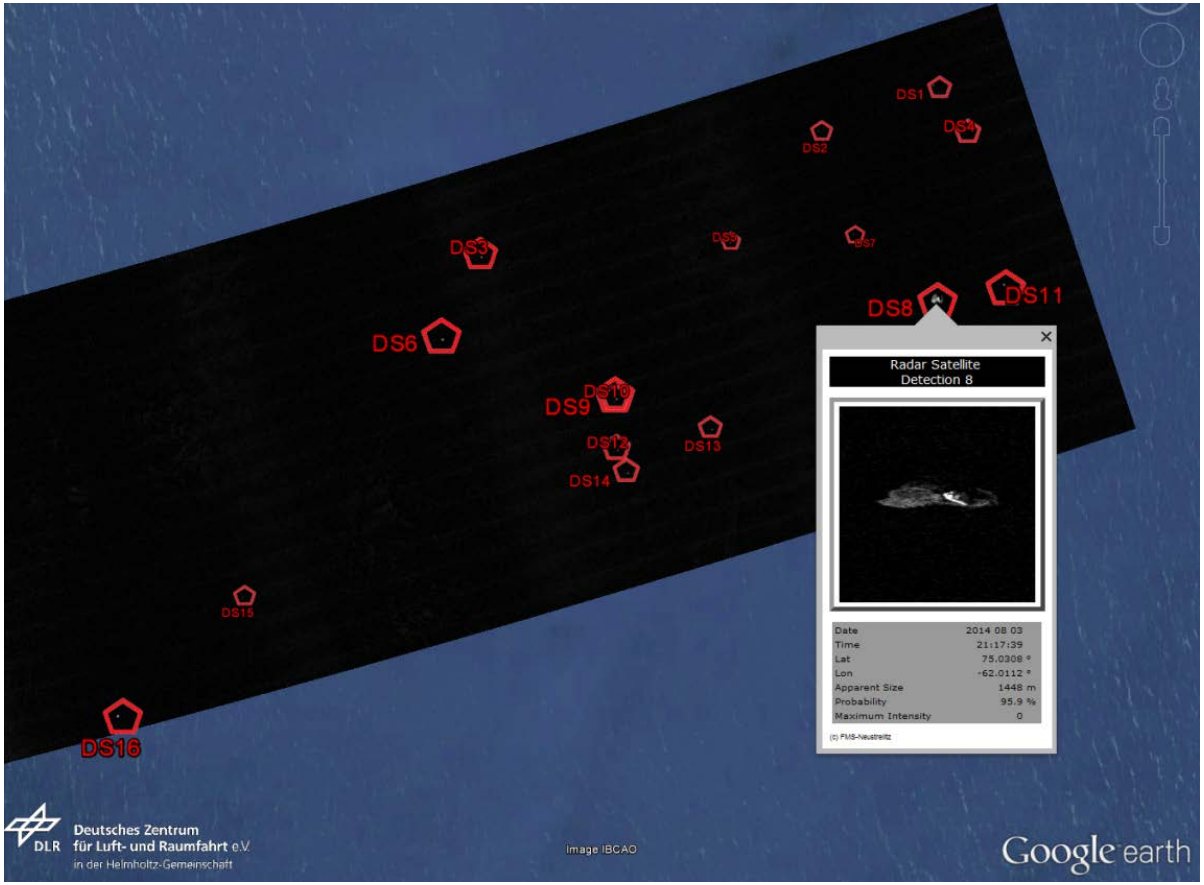
Outlook - Iceberg- detection



Near real time iceberg detection application to Support Maritime Situation Awareness

- Ice Service Center
- Support Exploration Management and Resource planning
- Route management

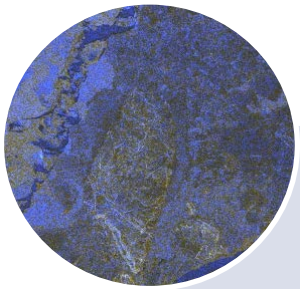
Ackn: A. Frost; DLR- IMF



TerraSAR-X ScanSAR Mode, Polarisation: HH, 150 km range,

Frost, Anja und Ressel, Rudolf und Lehner, Susanne (2015) Iceberg Detection over Northern Latitudes Using High Resolution TerraSAR-X Images. In: 36th Canadian Symposium of Remote Sensing - Abstracts. 36th Canadian Symposium of Remote Sensing, 8.-11. June 2015, ST. JOHN'S, NEWFOUNDLAND AND LABRADOR, CANADA.

Outlook - Ice Classification

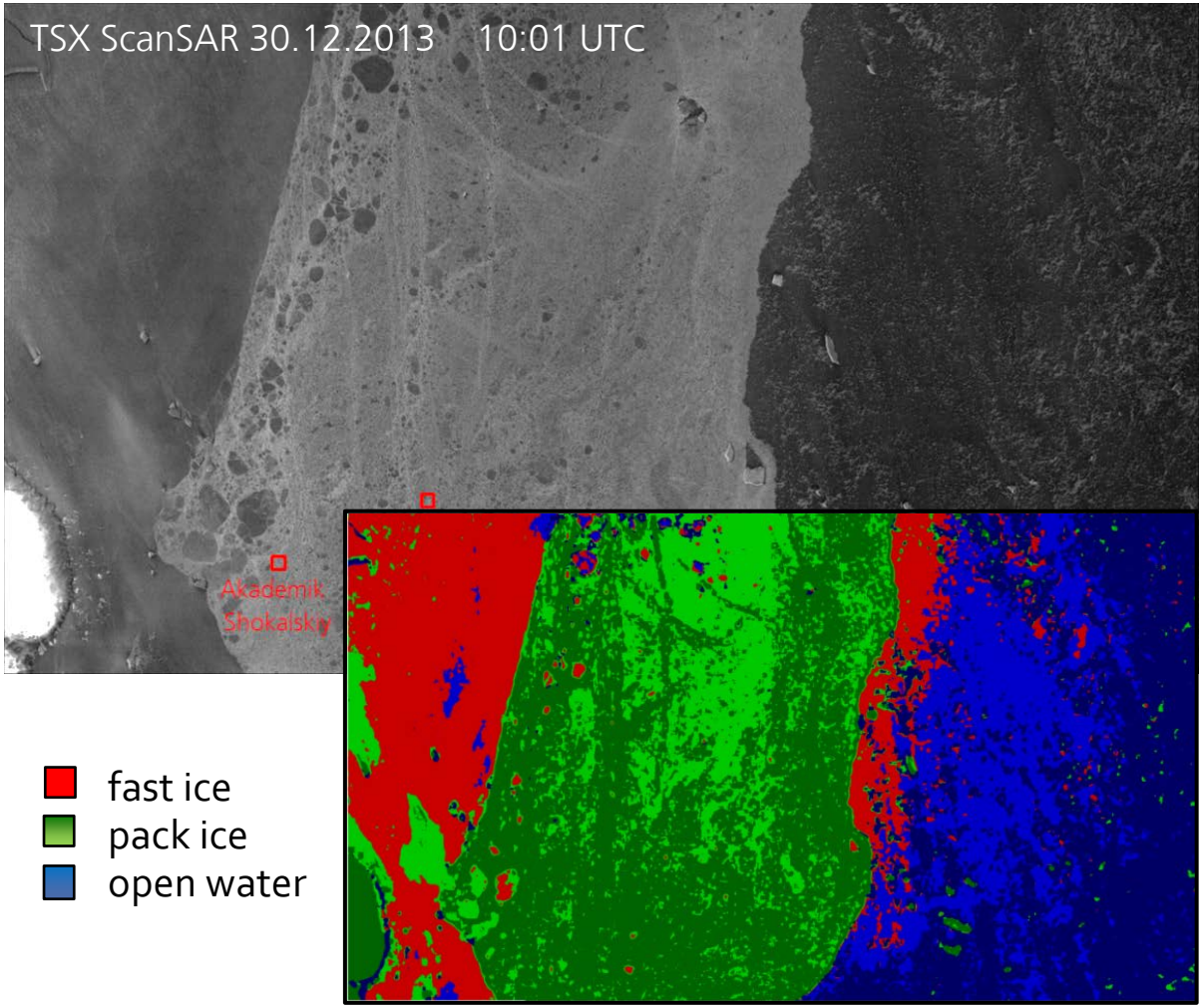


Near real time Ice drift application to Support Maritime Situation Awareness

Core processor currently being developed by the Maritime Security_Lab Bremen

Planned value added products based on TerraSAR-X (DualPol)

Ackn: S. Singha; DLR- IMF

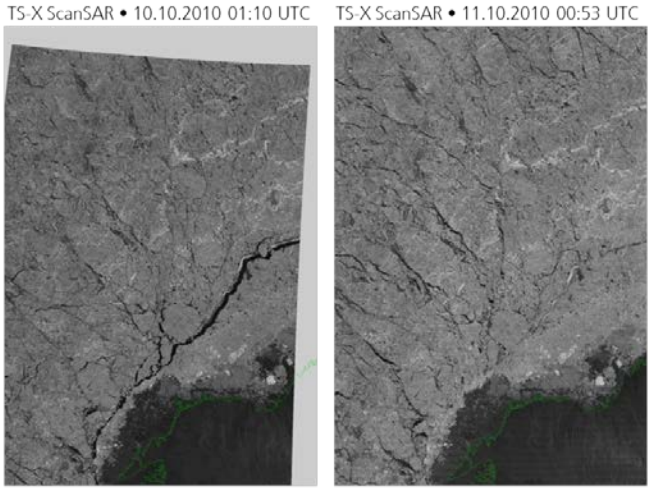


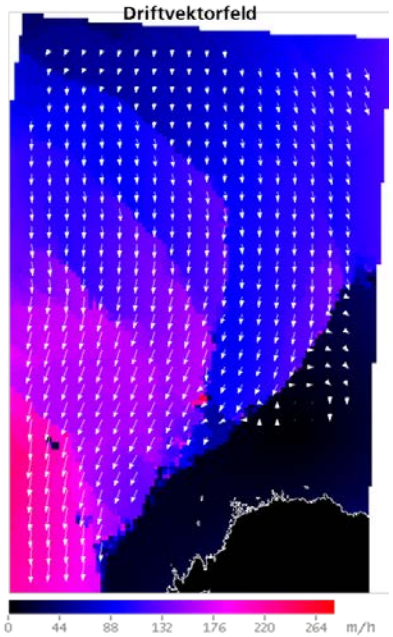
Outlook - Ice Drift

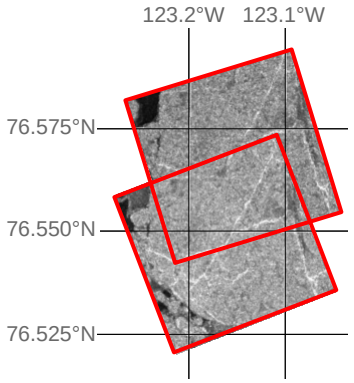
Near real time Ice drift application
to Support Maritime Situation Awareness

Core processor currently being developed by the Maritime Security_Lab Bremen

planned value added products in near real time based on TerraSAR-X, Sentinel-1 and Radarsat-2

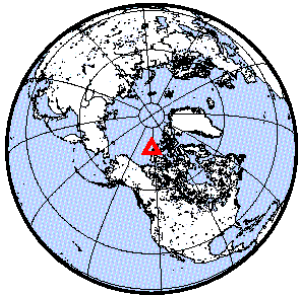






10.10.2010

11.10.2010



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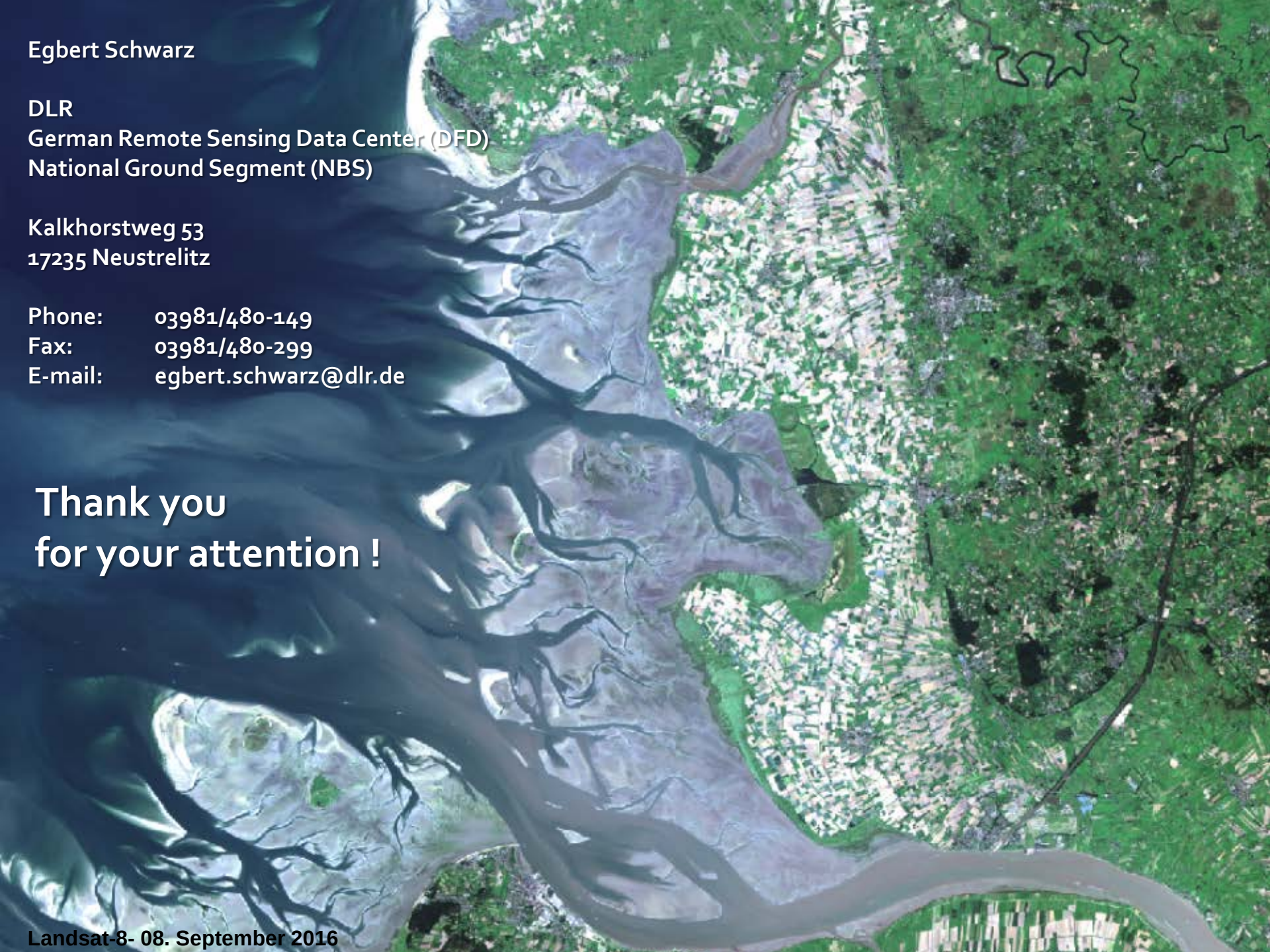
17235 Neustrelitz

Phone: 03981/480-149
Fax: 03981/480-299
E-mail: egbert.schwarz@dlr.de

Thank you for your attention !



Landsat-8- 08. September 2016