Satellite based services and geospatial IT infrastructure for marine safety and security applications

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Maritime Safety and Security Lab Neustrelitz

German Remote Sensing Data Center (DFD)

Satellite Derived Bathymetry,
6-7 June, Herrsching, Germany

Knowledge for Tomorrow

DLR

Outline

Background

– DLR Earth Observation Center

  – Maritime Security Lab Neustrelitz

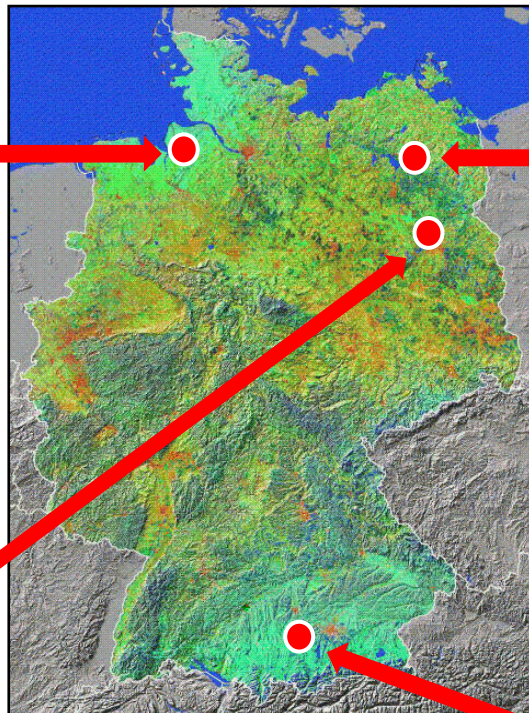 – Component of Service Chain

Analysis Framework

– Data Acquisition

– Processing Environment

– Processing Rules and Processors

– Product Dissemination

Earth Observation Center – EOC

Bremen
Maritime Security Lab

Neustrelitz
National Ground Segment
Maritime Security Lab

Berlin

Oberpfaffenhofen

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

Objective

– **Algorithm** development to derive value added information out of satellite remote sensing data (SAR, Optic) for the **Maritime Domain**

– **Application** development to generate value added information products by using **different data sources,** manly satellite remote sensing data and Automatic Identification System AIS data to provide maritime information products for **Maritime Situational Awareness**
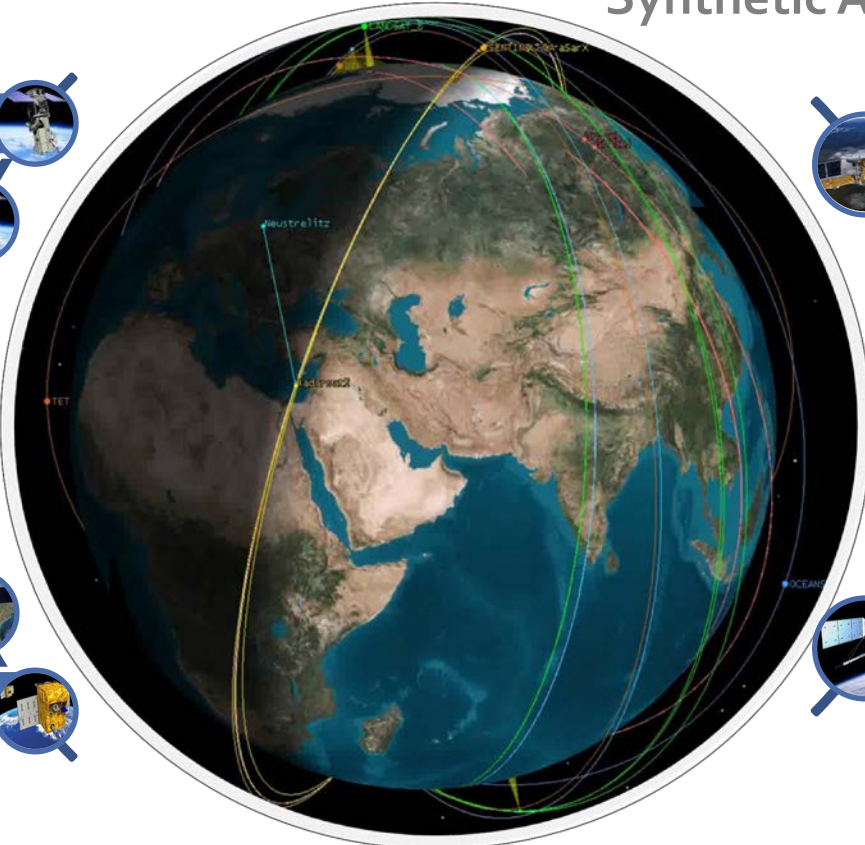
Sensors and Modes

Optical

Synthetic Aperture Radar (SAR)

Worldview-1

Worldview-2

Worldview-3

Worldview-4

GeoEye-1

Landsat-8
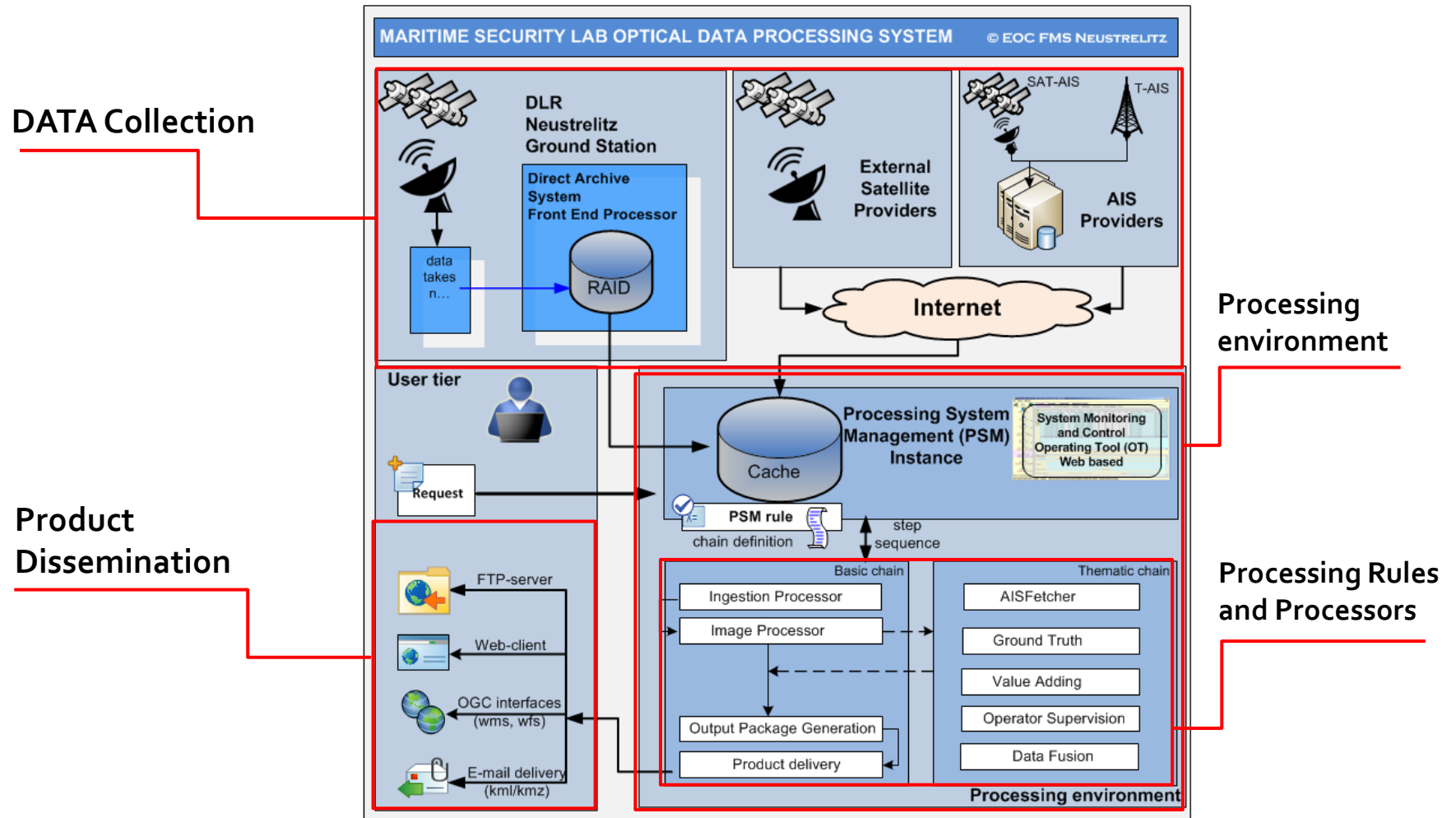
Firebird

Sentinel-1A

Sentinel-1B

TerraSAR-X

TanDEM-X

Radarsat-2

Automatic Identification System

Terrestrial AIS

T-AIS

Satellite AIS

Geospatial IT Infrastructure and Development

DATA Collection

Product Dissemination

Processing environment

Processing Rules and Processors

MARITIME SECURITY LAB OPTICAL DATA PROCESSING SYSTEM   © EOC FMS NEUSTRELITZ
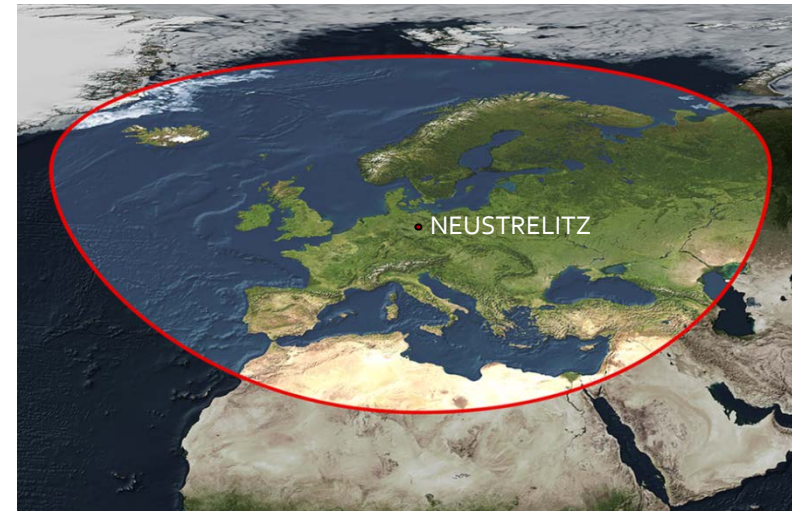
# DATA Acquisition (direct access)
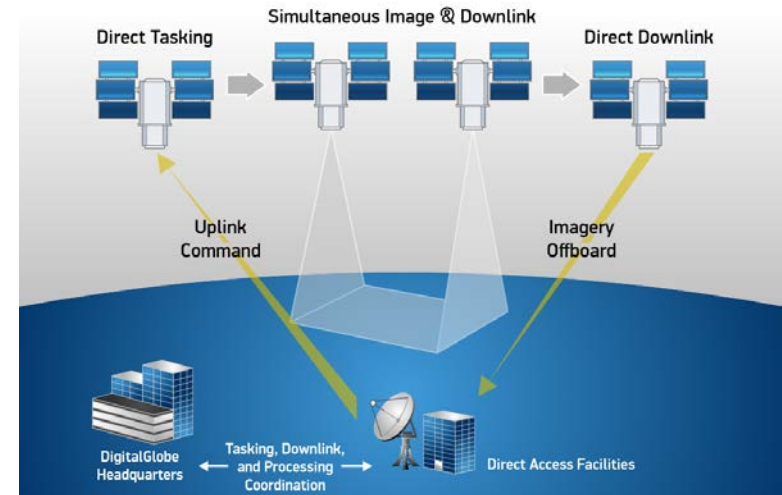
Neustrelitz Ground Station

- Ground Station and Processing Facility Neustrelitz support of currently 21 different Satellite missions

- **Main reception and processing facility for SAR Mission TerraSAR-X (TerraSAR-X/ TanDEM-X)**

- Collaborative Station for European Copernicus mission **Sentinel-1 (Sentinel-1A/ Sentinel-1B)**

- **Radarsat-2 Regional Ground System**

- **Landsat-8** Global Network Station, supporting United States Geological Survey (USGS)

- CartoSAT, ResourceSat, Oceansat supporting Gesellschaft für Angewandte Fernerkundung (GAFAG)

- **Kompsat 3, 3A, 5 supporting Korea Aerospace Research Institute (KARI)**

DATA Acquisition (via network)

**EUROPEAN SPACE IMAGING (EUSI)
Ground Station CDAF**

– Ground Station and Processing Facility CDAF

  – hosted at DLR - DFD facility in
    Oberpfaffenhofen near Munich,

  – Operated by DLR - DFD

  – currently ssupport of 5 different Satellite
    Missions (data reception and acquisition
    tasking)

    – GeoEye-1, WorldView-1, WorldView-2,
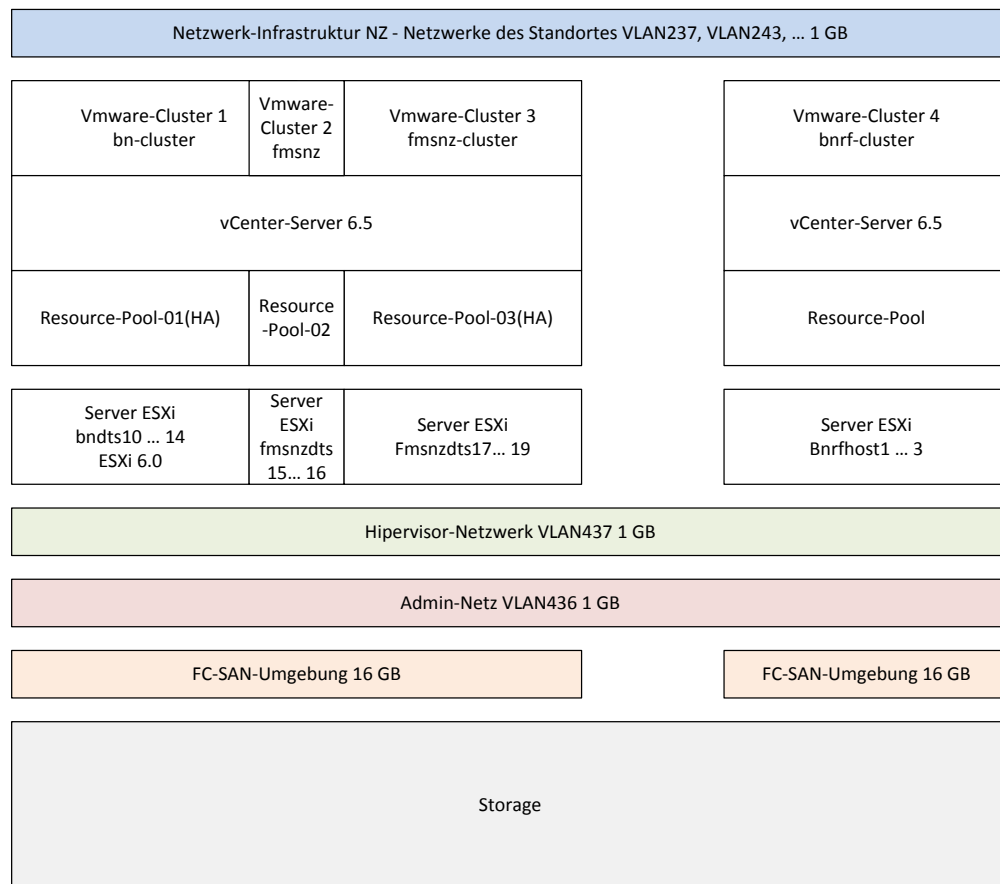   WorldView-3 and WorldView-4

www.euspaceimaging.com
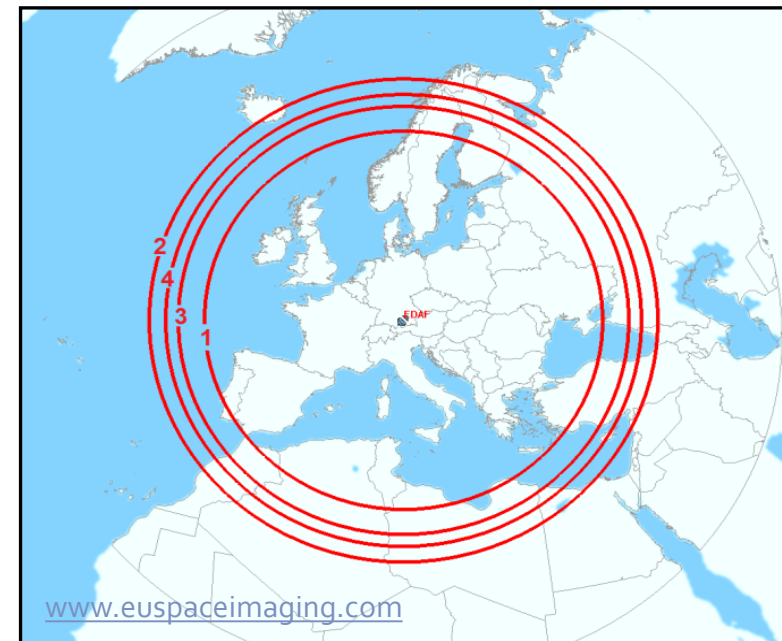
© 2017 European Space Imaging

IT infrastructure Neustrelitz

- 6 Antenna Systems

- VM Cluster
    - Ground Station Services (3))
        - Logical Cluster-Area
            - Production (2x)
            - Development (1x)
        - 3 Hosts,
          13 Virtual Machines
          4 Networks and 2 Data Stores

    - Processing and Archiving Facility
        - 3 Logical Cluster-Area
            - Development (1)
            - Production (2)
   - 10 Hosts,
          189 Virtual Machines,
          10 Networks and
          14 Data Stores

Netzwerk-Infrastruktur NZ - Netzwerke des Standortes VLAN237, VLAN243, ... 1 GB				

Vmware-Cluster 1 bn-cluster	Vmware-Cluster 2 fmsnz	Vmware-Cluster 3 fmsnz-cluster		Vmware-Cluster 4 bnrf-cluster
vCenter-Server 6.5				vCenter-Server 6.5
Resource-Pool-01(HA)	Resource-Pool-02	Resource-Pool-03(HA)		Resource-Pool
Server ESXi bndts10 ... 14 ESXi 6.0	Server ESXi fmsnzdts 15... 16	Server ESXi Fmsnzdts17... 19		Server ESXi Bnrfhost1 ... 3

Hipervisor-Netzwerk VLAN437 1 GB

Admin-Netz VLAN436 1 GB

FC-SAN-Umgebung 16 GB	FC-SAN-Umgebung 16 GB

Storage

IT infrastructure Neustrelitz

Processing Environment

- VM Cluster,
- Shared File System

- Processing System Management (PSM)

  - Product handling and cache management

  - Development of Control System to control the workflow
    - e.g., TerraSAR-X, Sentinel-1
    - Radarsat-2, Landsat-8,
    - DG Constellation

  - Integration of CORE Processor
    - e.g., TerraSAR-X Multimode SAR Processor TMSP, ESA Instrument Processing Facility IPF (Sentinel-1), USGS core processor Landsat-8
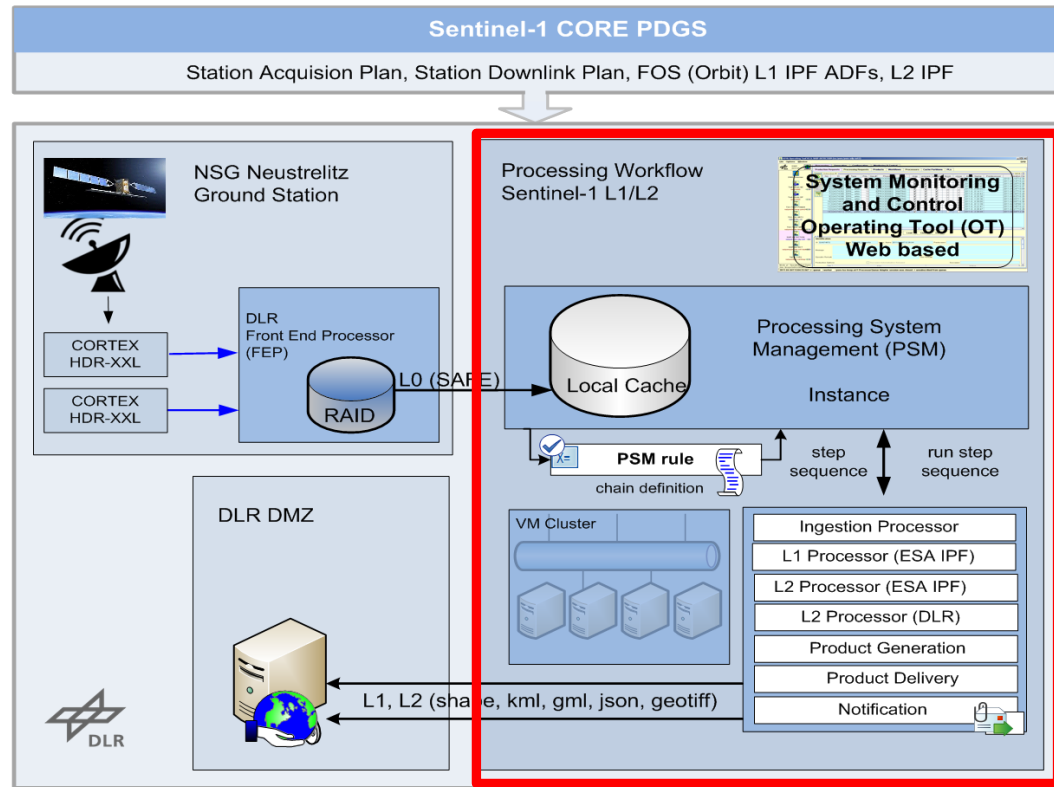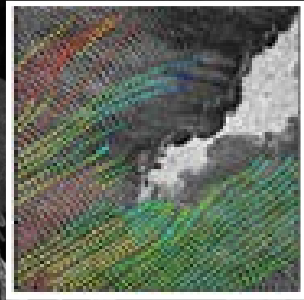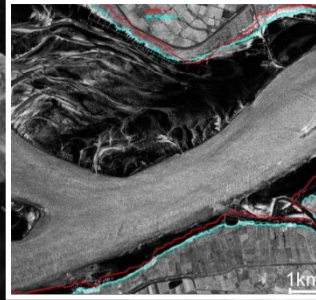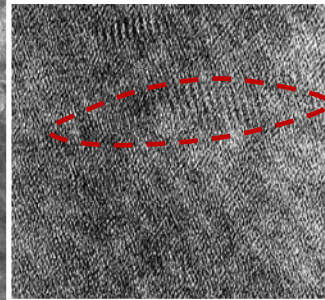

Example Sentinel-1 Solution

Research and Application Development for the Maritime Situational Awareness

Bathymetry

Land-Water Line

Wave groups & Forecast
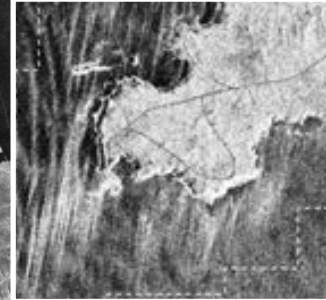
Wave breaking
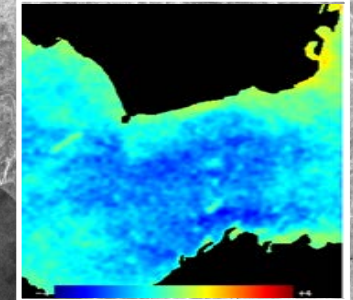
Surface Currents
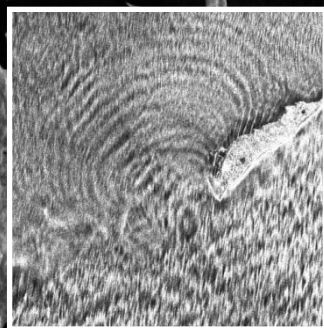
Sea State
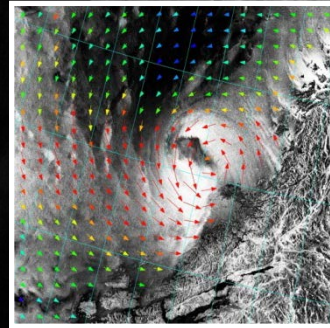
Wind

Ship- detection

Oil Spills
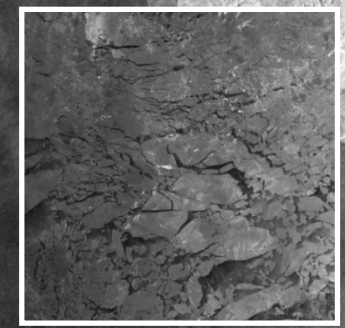
Iceberg-detection, Ice classification
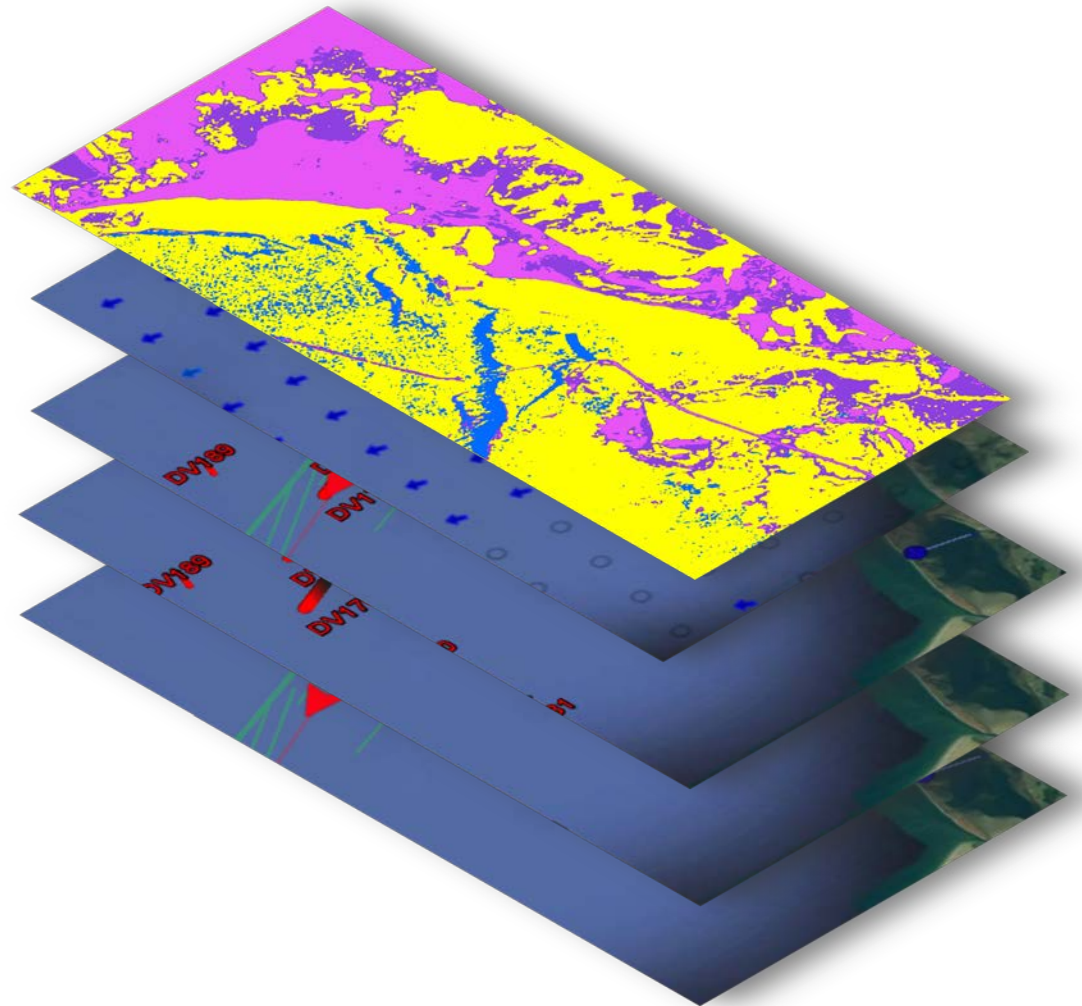
Processing Rules and Processors
Image Processing

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

WGS84 (EPSG:4326)

Processing Rules and Processors
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

Processing Rules and Processors
Thematic Processing Chain

– Automated algorithm

  – Target detection

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  – Wave

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  – GUI with 3D viewer
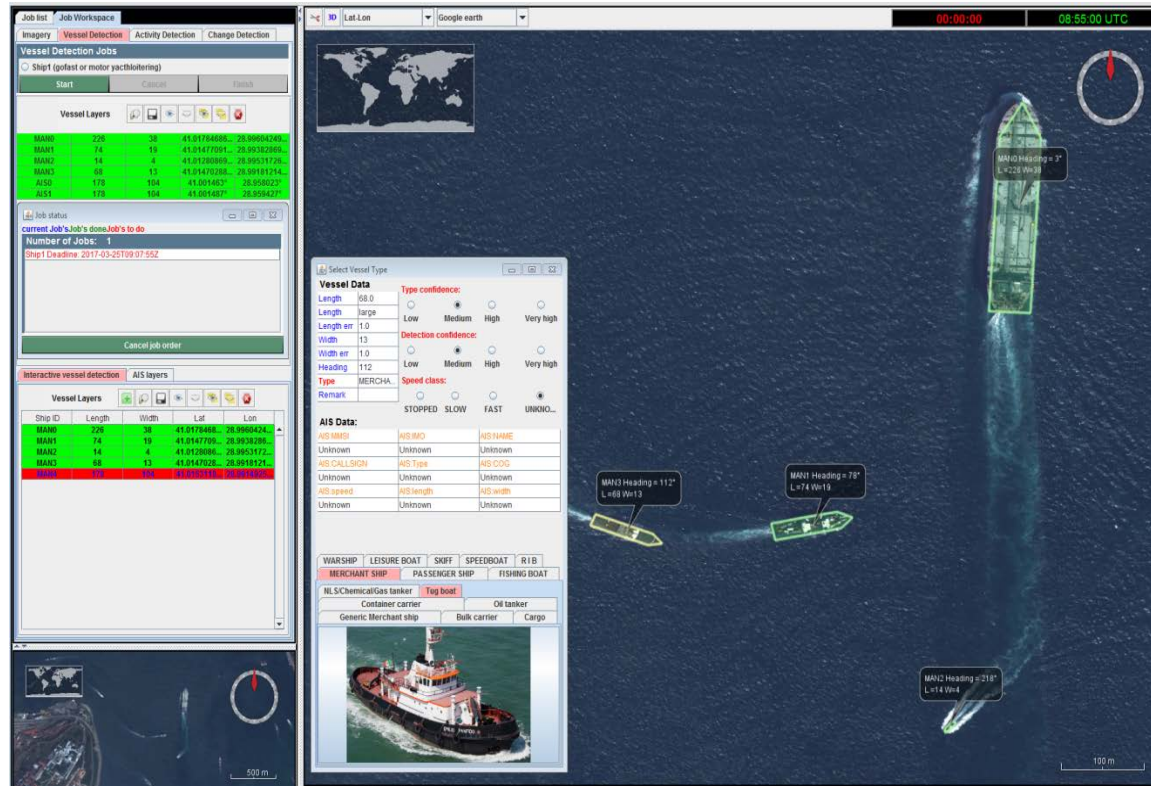
Operator GUI of Analysis Framework (client side)
WorldView 3 © 2016, 2017 DigitalGlobe, Inc. provided by European Space Imaging

Thematic Development
Vessel- Detection
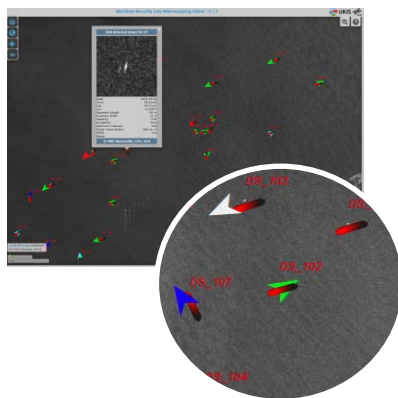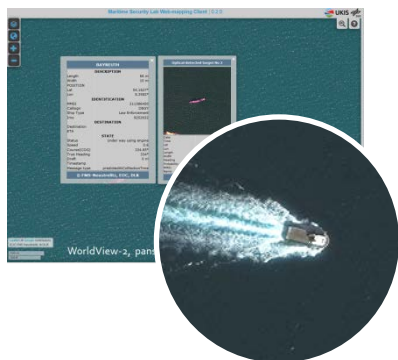
❶ Near real time vessel detection application based on **very high resolution optical satellite imagery** and Automatic Identification System AIS data

- value added products in near real time based on very high resolution images (Worldview 1-4, GeoEye-1 Deimos)

❷ Near real time vessel detection application based on **Synthetic Aperture Radar (SAR) imagery** and Automatic Identification System AIS data

- currently developed for TerraSAR-X, TanDEM-X, CosmoSkymed, Radarsat-2, Sentinel-1A, Sentinel-1B

Thematic Processing Chain
Oil Spill Detection Application
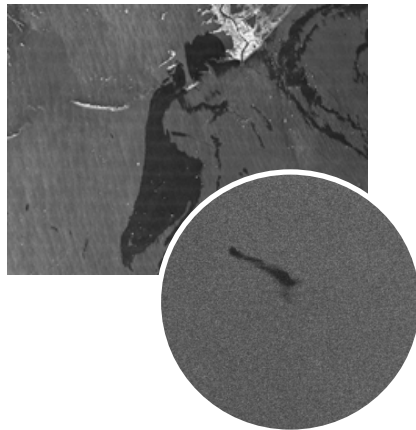
1 Near real time oil spill detection application based on **optical satellite imagery** currently being developed at the Maritime Security_Lab Neustrelitz

- value added products in near real time based on very high resolution images (Landsat-8, Sentinel-2)

2 Near real time oil spill detection application based on **SAR imagery,** core function is the qualification algorithm developed by the Maritime Security Lab Bremen based on Neural Network

- currently developed for TerraSAR-X, TanDEM-X Sentinel-1,and Radarsat-2

Sentinel-1 Ocean Products
Application for SAR WIND and WAVE
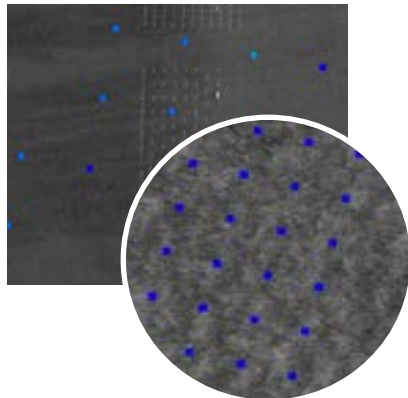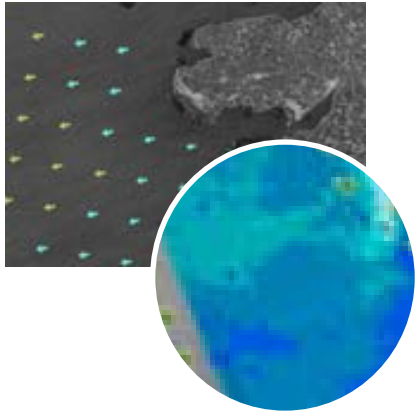
Wind detection application based on SAR imagery, core function is the **CMOD and CWAVE** processor developed by the Maritime Security Lab Bremen

- Operational processing framework available for:
  - product generation in near real time as part of the Sentinel-1 processing chain (ground station Neustrelitz)

  - cloud solution (docker) to support product generation from archive (CODE-DE, DIAS)

Partner:

Outlook SAR Ice Classification
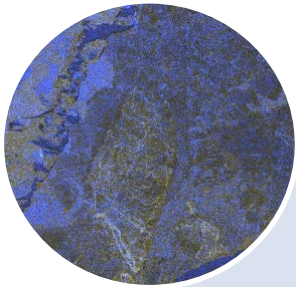
Near real time Ice drift application to Support Maritime Situation Awareness

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
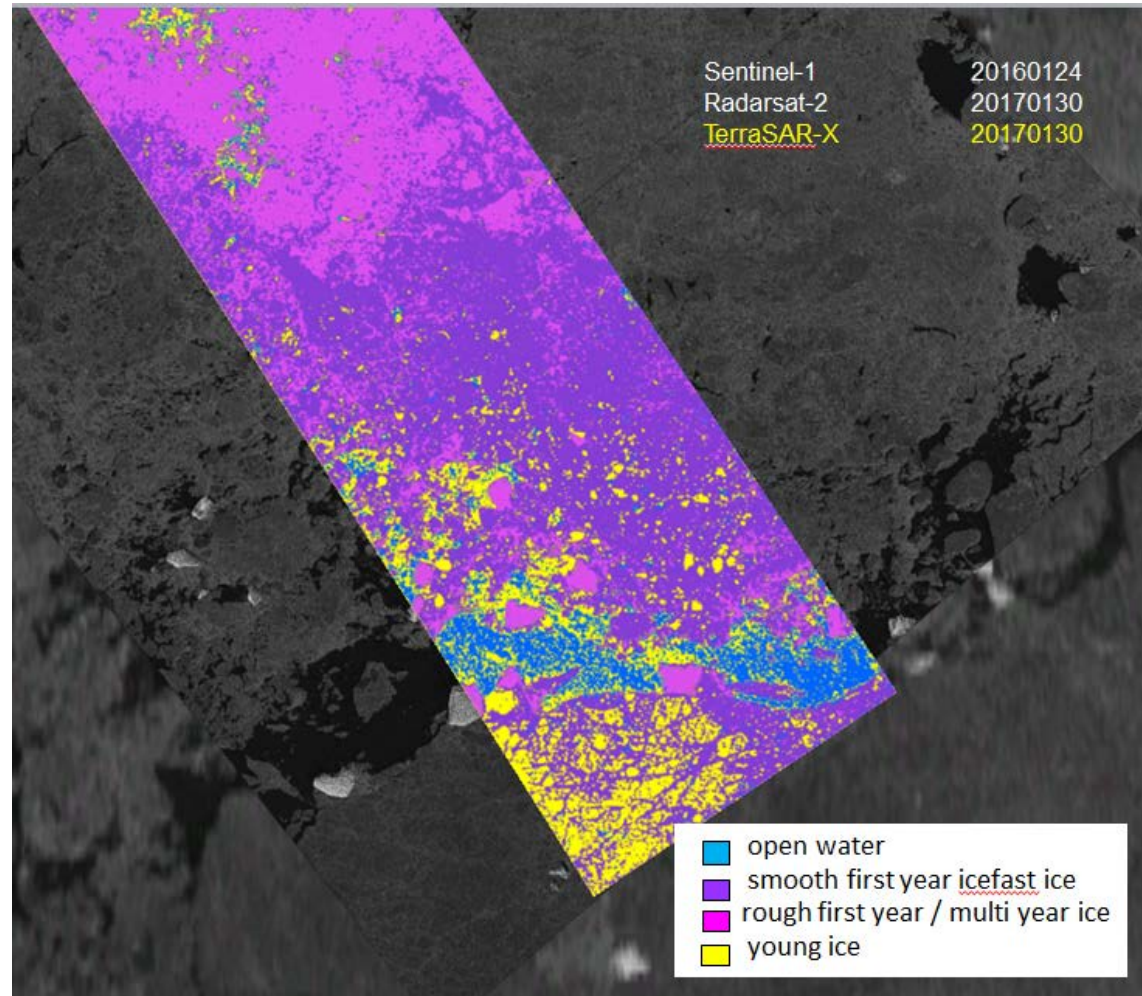
Example: Ice Classification

Swiss Polar Institute - ANTARCTIC CIRCUMNAVIGATION EXPEDITION

Sentinel-1	20160124
TerraSAR-X	20170127
Radarsat-2	20170130
TerraSAR-X	20170130

20170128T1754
20170128T1850

Mertz Gletscher

Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image U.S. Geological Survey
Data LDEO-Columbia, NSF, NOAA

Google earth

eoc Deutsches Zentrum DLR für Luft- und Raumfahrt

Example: Antarctic Circumnavigation Expedition (ACE)
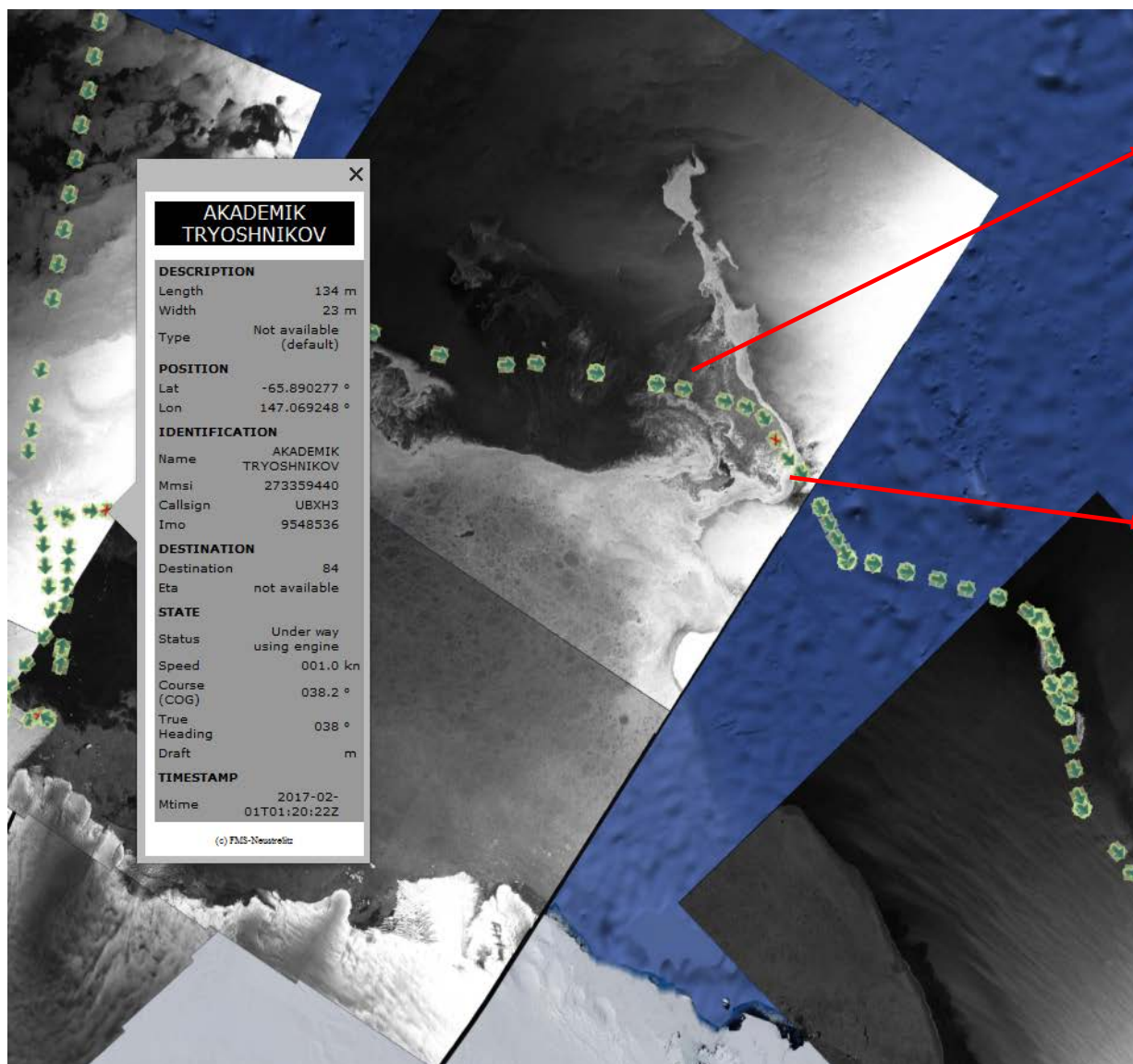
navigation support the Akademik Tryoshnikov for in ice-infested waters

Picture: Alessandro Toffoli, University of Melbourne

Example: NRT Support for German Research Vessel "POLARSTERN"
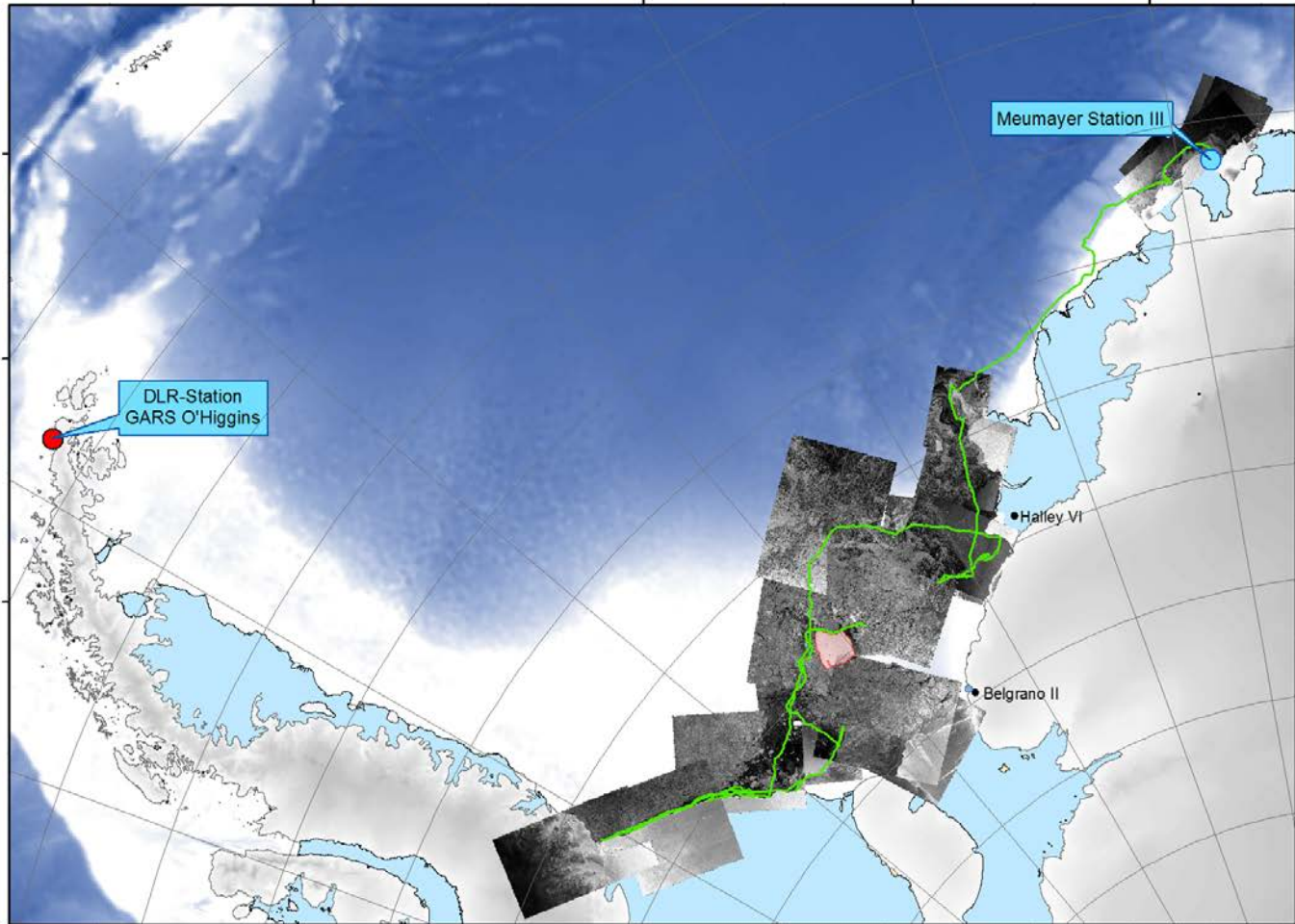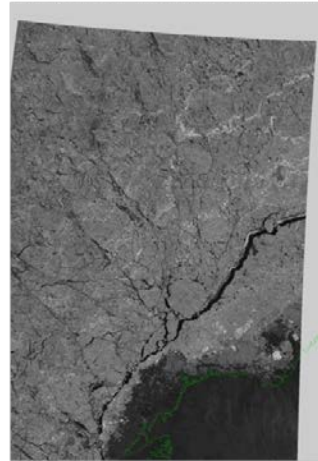

© Paul Wachter DFD-IBS

Outlook SAR Ice Drift
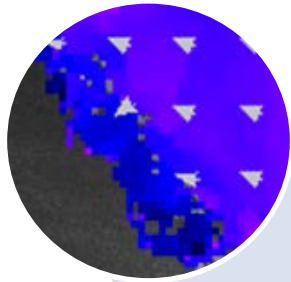
Near real time Ice drift application
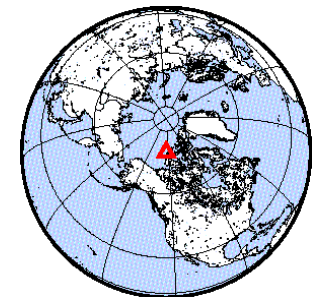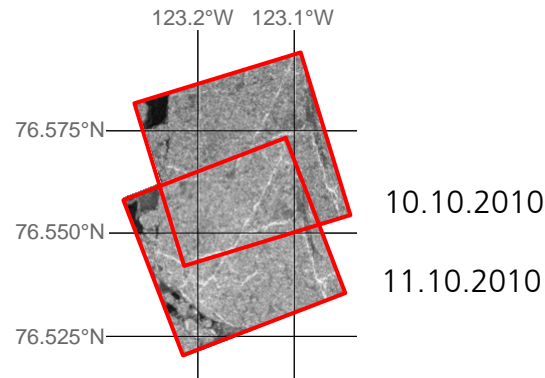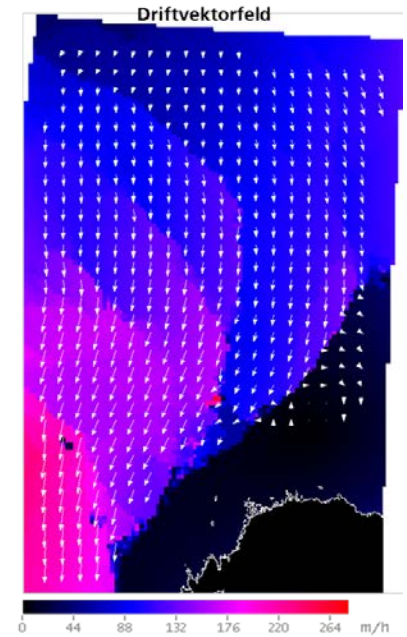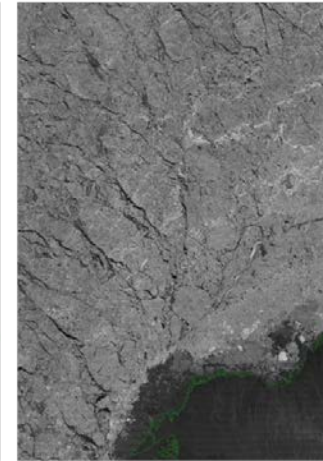to Support Maritime Situation Awareness

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

TS-X ScanSAR • 10.10.2010 01:10 UTC

TS-X ScanSAR • 11.10.2010 00:53 UTC

Driftvektorfeld

123.2°W   123.1°W

76.575°N

76.550°N   10.10.2010

76.525°N   11.10.2010

Questions?

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Landsat-8, 08.09.2016