Satellite-based applications for maritime safety and security

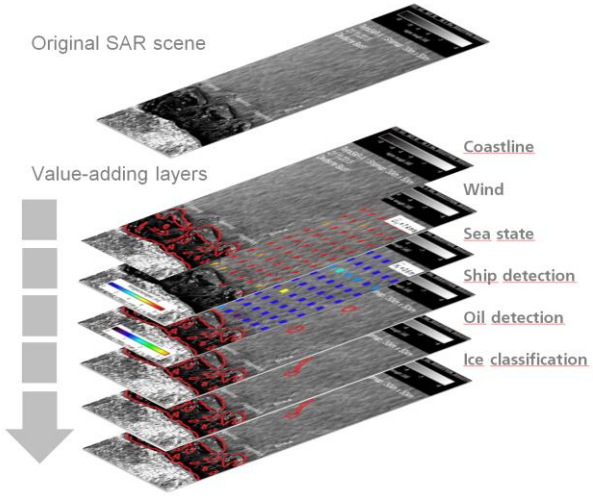
Synthetic Aperture Radar (SAR) satellites such as Germany's TerraSAR-X or ESA's Sentinel-1 are equipped with an active radar antenna and thus able to provide image data almost independent of weather conditions, cloud cover, or daylight.

Maritime information that can be extracted includes:

- Meteorological parameters like wind and sea state
- Positions and sizes of icebergs drifting in open water
- Type and movement of sea ice in polar regions
- Position, properties and heading of ships
- Position and extent of oil slicks
- Topography and morphology of the Wadden Sea
- Coastline
- Bathymetry

This information contributes to the Maritime Situation Awareness (MSA) and is used, for example, by ships in polar regions, for environmental protection, fishery control, and border surveillance.

Information derived from SAR images such as wind speed or wave height contributes to the Maritime Situation Awareness (MSA), guiding a ship's captain and navigator on the bridge.



With DLR's SAR processing toolbox, multiple value-adding products can be derived from the same original scene acquired by any supported SAR satellite.

Algorithms for operational processing of satellite data

The team of the Maritime Safety and Security Lab Bremen develops automatic algorithms for operational processing of maritime value-added products from SAR satellite imagery.

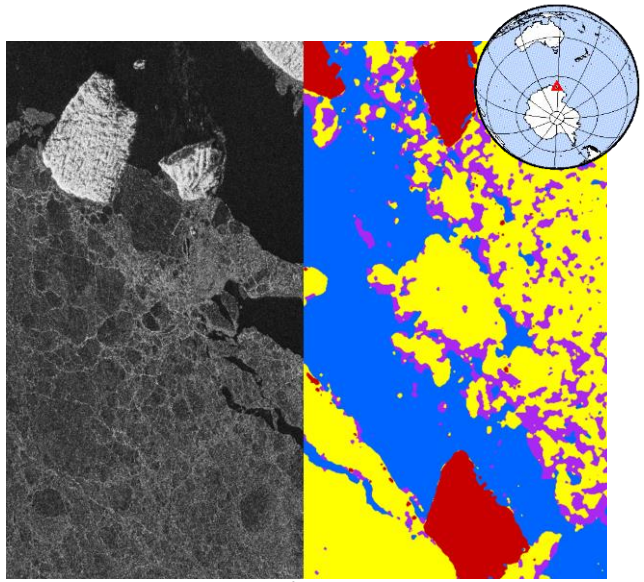
The products are derived using a selection of various processing techniques such as

- Machine Learning
- Spectral analysis
- Polarimetric properties.

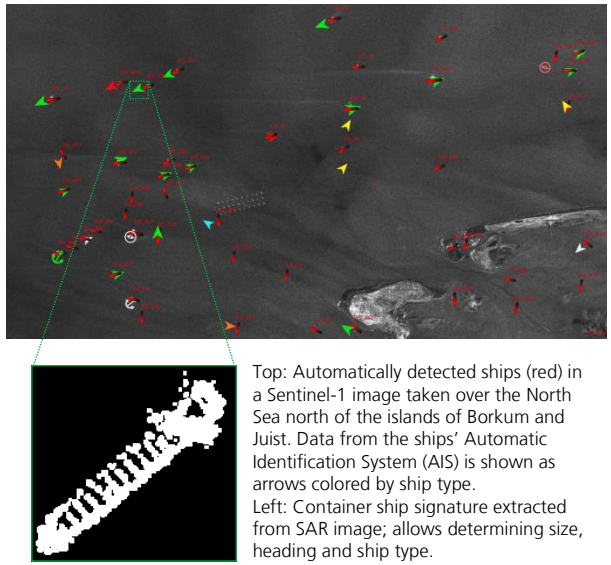
Multiple SAR satellites are supported, e.g.

- TerraSAR-X
- Sentinel-1
- RADARSAT-2

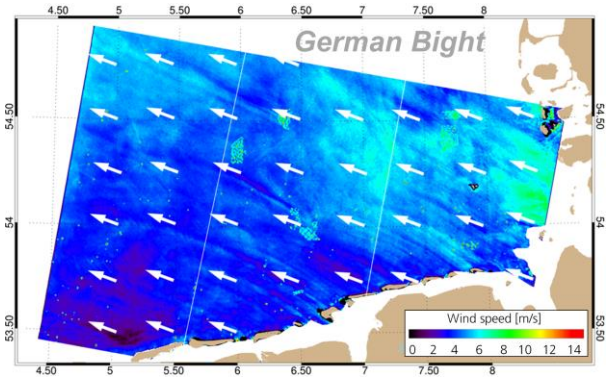
The processors are implemented in the near real-time (NRT) processing chain at DLR ground station Neustrelitz, from where the products are delivered to the users about 20 minutes after acquisition.



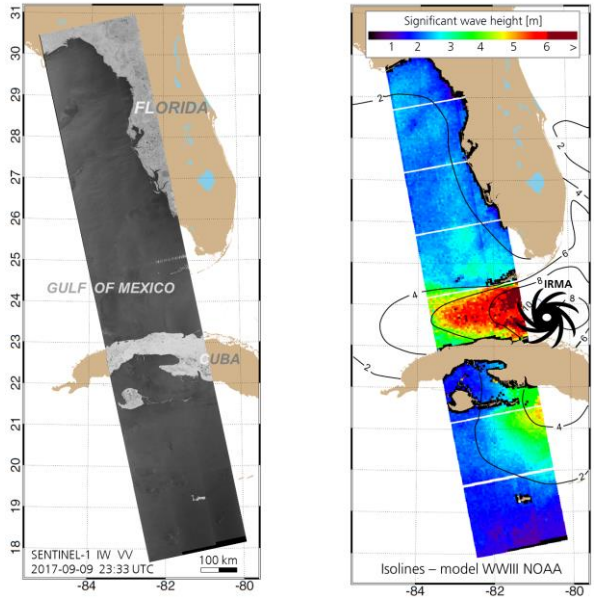
Sea ice mapping in polar waters. Left: RADARSAT-2 Fine Quad Pol scene, downlinked and processed at DLR ground station Neustrelitz. Right: Sea ice map: Blue: Open water/nilas, Purple: Young ice, Yellow: First year ice, Red: Rough first year ice/multi-year ice/iceberg



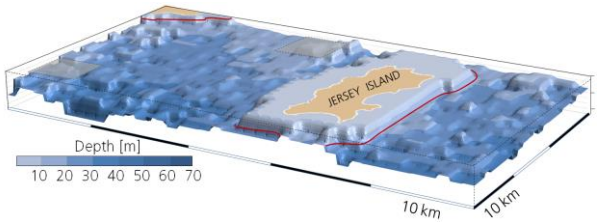
Top: Automatically detected ships (red) in a Sentinel-1 image taken over the North Sea north of the islands of Borkum and Juist. Data from the ships' Automatic Identification System (AIS) is shown as arrows colored by ship type.
Left: Container ship signature extracted from SAR image; allows determining size, heading and ship type.



Wind speed (colors) and direction (arrows) derived from a Sentinel-1 scene of the German Bight (North Sea).



Hurricane Irma in September 2017. Left: Sentinel-1 acquisitions. Right: derived wave height (colors) compared to models (lines).



Bathymetry around Jersey Island in the English Channel derived by wavelength analysis on a TerraSAR-X StripMap acquisition.

DLR at a glance

DLR is the Federal Republic of Germany's research centre for aeronautics and space. The organisation also completes research in the areas of energy, transport, security and digitalisation. Acting on behalf of the federal government, the DLR Space Administration designs and implements Germany's space programme, together with national and international partners. DLR is also the umbrella organisation for two project management agencies that promote research.

DLR has approximately 9000 employees at 27 locations in Germany. It also has international offices in Brussels, Paris, Tokyo and Washington D.C.

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