

Satellite-based oil spill detection

Success Story on the use of EO to monitor oil spills

Summary

Kongsberg Satellite Services (KSAT) in Tromsø, Norway, has since 1998 been a world leading provider of an operational near real-time service using satellite radar data to detect oil discharges and locate potential polluters. Extensive experience, close integration with satellite owners and end-users, and continuous innovation has made the KSAT oil spill detection service a World Class service.

Project Background

The development has undergone several phases R&D, through demonstrations and pilot projects with involvement from the end-users, onto today's operational utilisation. National and European (ESA) programs were important during the initial phases. The service is today used by national authorities, offshore oil and gas industry and by the European Maritime Safety Agency (EMSA) on behalf of the European coastal states.

Issues & Needs

Discharges of oil from ships, oil platforms and other sources can cause significant damage to coastlines and the marine environment in general. It is not always the largest spills that cause the worst damage, as the timing and location of a spill can sometimes be more critical impact determinants than the volume of oil introduced. Satellite radar (SAR) data can provide wide area monitoring day and night and operate independently of weather conditions and is an excellent tool for detecting oil films on the sea surface, either independently or in combination with other data.

Oil companies have a high degree of environmental awareness, social responsibility and reputation is also an important issue. Some have been accused of illegal discharges that are actually caused by dumping from bypassing ship traffic, and the service information can provide valuable documentation in case of such false accusations. The satellite based service is used for self monitoring and early warning of accidental leakages from offshore installations, or just for documentation of clean seas in areas.

The KSAT satellite oil spill monitoring service has been developed in cooperation with users, including the Norwegian offshore industry, the Norwegian Coastal Administration, the Swedish Coast Guard, the Finnish Environmental Institute, the Admiral Danish Fleet and the Maritime and Coastguard Agency (MCA) of the UK. Since 2007 EMSA has contracted a satellite monitoring service, CSN, to the European service industry and KSAT has been a lead partner since the beginning.

Solution

The customer is responsible to define the areas to be monitored and the monitoring frequency. It is then up to KSAT to assure the availability of the satellite data for reception at a KSAT ground station for further processing, and analysis. Time is crucial for and the KSAT oil spill analysis results and satellite images are delivered to the customer within 30 to 120 minutes after satellite acquisition, depending on satellite and user requirements.

KSAT utilises satellite data in combination with additional data to identify and discriminate oil slicks from other phenomenon in the image, pin-point the location, estimate the size and assign a confidence parameter and identify a potential source. Vessel traffic information such as terrestrial and satellite AIS (Automatic Identification System) is used for identifying possible pollution source(s). Information on offshore installations and metocean conditions (wind, waves) is also useful as support for discriminating man made slick and identifying possible polluters.

The KSAT service is provided twenty-four hours per day, seven days per week. By using our global ground network in combination with the agreements with the satellite operators we can provide very fast access to global satellite radar data, both under normal circumstances and in case of emergencies. If an oil spill is detected an alert message is delivered to the customer, either as a phone message, email report or SMS message depending on customer preference. Each customer also has access to a dedicated web portal with information on all data and products delivered.

Results & Perspectives

The result of the analysis distributed to the customer includes:

- Time of observation
- Position in Latitude/Longitude.
- Confidence assignment of the identified spill.
- If a potential source could be identified, this information is included in the message.
- Predicted wind information from numerical models
- SAR based wind information

The KSAT web portal provides access to the oil spill service, and offers data search and retrieval functionality, map based dynamic and interactive viewing, overlaying of datasets, interactive user reporting facilities and some data manipulation functions, as illustrated herein.

KSAT supports most commercial satellites today, e.g. including Radarsat, Cosmo-Skymed and TerraSAR, but also optical missions. The actual selection might be a function of the coverage frequency at a specific location, the delivery times, local and national regulatory requirements, and budgetary constraints. KSAT has a broad expertise to carefully match what is technically possible in a given location to the needs and capabilities of the end user.

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In case of a large incident, KSAT can include additional satellites to increase the monitoring frequency, introducing optical satellite coverage, or modifying the defined area of interest. This was demonstrated during the large accident in the Gulf of Mexico.

Figure 1: SAR image from the west coast of Norway. An oil spill is visible in the middle of the image, and several vessels are also detected. The AIS positions with tracks (indicated as icons with green boats and green lines) are overlaid the image, and the potential source is identified. Copyright raw data ESA, 2009

Satellite radars are in general capable to detect oil spills at wind speeds ranging from app 5m/s up to 18 m/s. The detected features include mostly mineral oil, but also plant oil, fish oil, chemical spills and algae blooms. Three different confidence categories are assigned to a spill, Low, Medium or High, depending upon a set of observation feature and sea state description criteria. User verifications show that more than 2/3 of the reported High confidence spills are real spills. These customers use the service information to coordinate and perform more efficient operations of the surveillance aircrafts.

Identification of the potential source has become very important for the users. KSAT uses AIS data in combination with the satellite radar to identify and report about who might be the most likely polluting source. It is then up the user to take the next step for final identification and eventual prosecution. The figures show examples of the detected and reported features, as well as examples of combined use of satellite and AIS data.

The KSAT multimission service utilises in principle any satellite radar mission, as opposite to those relying only on a single mission. This showed very useful when Envisat was lost, where KSAT could continue to support the customers by using Radarsat and TerraSAR. Recently KSAT has included global data reception and processing capabilities for Cosmo-Skymed.

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KSAT has been a pioneer in developing the service since its start. The service reliability is accepted among the customers, and new missions like Sentinel-1 and Radarsat Constellation will ensure service continuity. KSAT were the lead provider in establishing the European use and since then we have focused on the global market. Today KSAT is serving customers in Europe as well as in America, Asia and Australia. For the coming years we expect a strong global growth, and KSAT will be present to serve these markets. *Figure 2: Pipeline rupture outside India. January 2011. Radarsat satellite radar image (upper) and aerial photo documentation (lower). Copyright raw data MacDonaldDettweiler, 2011*

Related Info

Kongsberg Satellite Services (KSAT) in Tromsø, Norway, is a world leading provider of Earth Observation services and satellite Ground Station services. The company has been involved in satellite operations from Tromsø for over 40 years and has through several projects and service contracts demonstrated that radar satellites is an efficient tool to provide early warning to offshore operators and to assist national authorities in detecting oil discharges and locating potential polluters.

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