Operative Arctic Maritime Surveillance with Sentinel-1 Data using a Norwegian Collaborative Ground Segment

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Norway uses SAR (Synthetic Aperture Radar) satellites operationally to get a situational picture of the maritime picture. Every day numerous RADARSAT-2, Sentinel-1A and -1B images are downloaded over the Norwegian areas of interest of over 2 million km². The SAR images are processed at KSAT (Kongsberg Satellite Services AS), and downloaded via FTP to FFI (Norwegian Defence Research Establishment), and run through the FFI developed automatic ship detector Aegir. The ship detection results are fused with other sources, such as AIS (Automatic Identification System) (AISSat-1, AISSat-2 and coastal AIS), VMS (Vessel Monitoring System) and LRIT (Long Range Identification and Tracking) data in the Multi Hypothesis Tracker (MHT), also developed at FFI. (Si litt mer om MHT)

In the beginning of the lifetime of Sentinel-1A, the timeliness requirements of the Norwegian operational users in the maritime sector in Norway were not met. The average time latency from the image was recorded until it was available on ESA Sentinels Scientific Data Hub for our test period was 6h23min, while the fastest was 3h4min and the slowest was 1d7h27min. Thus, Norway established a national collaborative ground segment at KSAT in Tromsø for downloading and processing of Sentinel-1 data. The ground station in Tromsø is inside the Norwegian AOI (Area of Interest), enabling rapid exploitation of the SAR data, meeting the 1 hour requirement for open ocean surveillance, including all steps from acquisition to analysis. Maritime Situational Awareness is important for Norway because 50 % - 80 % of all vessel traffic above the Arctic Circle is in the “Norwegian sector”.

The paper will present the timeliness and results of using the national collaborative ground segment, results from trials and early operations with Sentinel-1A and -1B for maritime surveillance in the Norwegian Arctic. System performance from an end user perspective and a Norwegian collaborative ground segment are discussed and analyzed to determine if the SAR data, the downloading services, how fast the data is received and associated monitoring services are suitable to meet the national operational requirements. Use of the Sentinel-1 satellites for ship detection is also addressed, and ship to sea contrast and target to clutter ratio (radar cross section) are analyzed as well as ways to enhance the ship to sea contrast to improve the probability to detect vessels. The ship detections from SAR are compared with AIS to validate which vessels are imaged.