







the ship to sea contrast. The image segment is from February 12th 2016, and Norne FPSO is imaged at 41.8°.

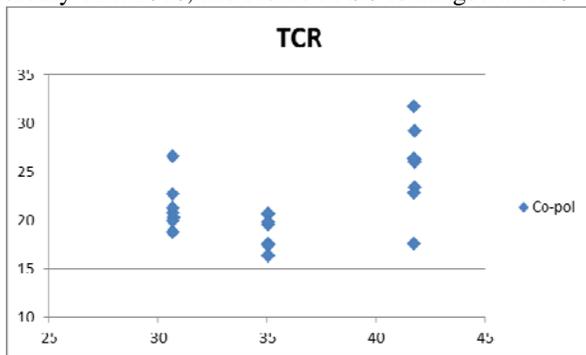


Figure 7. TCR for Norne FPSO for co-polarization.

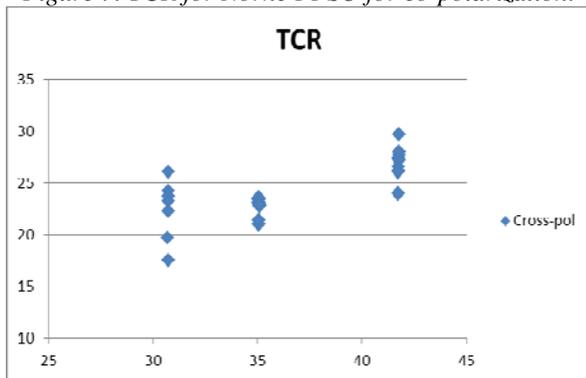


Figure 8. TCR for Norne FPSO for cross-polarization.

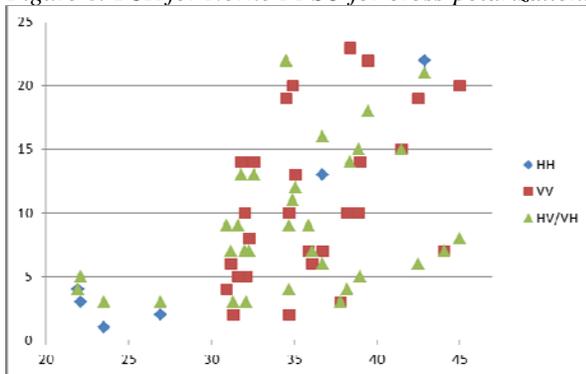


Figure 9. Ship to sea contrast for vessels of length 10-89 m in Sentinel-1A EW and IW images.

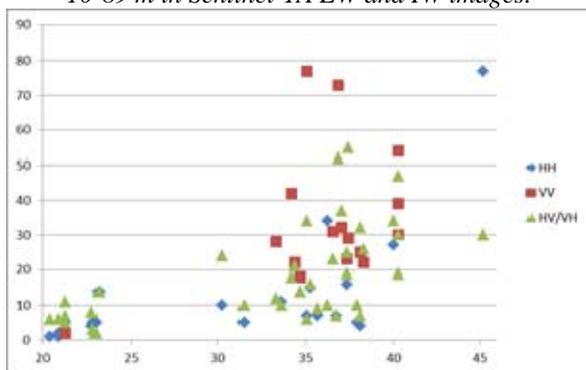


Figure 10. Ship to sea contrast for vessels of length 90-175 m in Sentinel-1A EW and IW images.

The contrast is 16 for VV, 30 for VH (not shown in the figure), and 375 for the combined case. The small vessel, Ocean King (75 m) is not clearly visible in the VV-polarization, but is easier to detect in the combined 3D image segment.

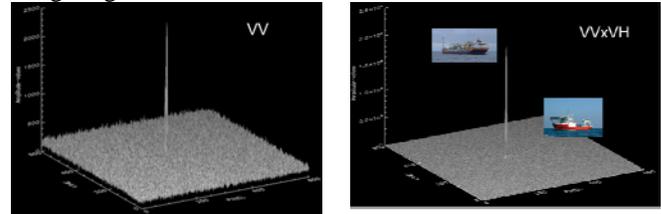


Figure 11. 3D image segments showing contrast enhancement by combining the available polarizations.

### 3. RECOMMENDATIONS AND CONCLUSIONS

The Sentinel-1 satellites are a great step forward toward an operational ship detection capacity using European SAR satellites. The overall impression is that Sentinel-1A and Sentinel-1B deliver high quality SAR data, compliant with the mission and performance requirements. The satellites have fewer modes than ENVISAT to avoid user conflicts. Sentinel-1 TOPS mode gives better radiometric performance in the along-track direction compared to ENVISAT, RADARSAT-1, and RADARSAT-2, but a marked banding effect and variations in the noise floor can still be seen due to insufficient beam calibration in the SAR processor.

After the launch of Sentinel-1A, timeliness was a key issue when using the ESA scientific data hub. Product availability did not meet timeliness or latency requirements of the Norwegian operational users in the maritime sector. After establishment of a Norwegian collaborative ground segment in October 2015, the data latency for Norwegian users became acceptable.

Geographic distribution of EW and IW acquisitions is as expected. A recommendation from a Norwegian view is to use more HH/HV for ship traffic areas in the Arctic areas, especially for the IW mode. Studies have shown that HH/HV give better ship to sea performance and also better sea ice and iceberg observations.

### 4. REFERENCES

- [1] SENTINEL-1 SAR User Guide Introduction (2016). <https://sentinel.esa.int/web/sentinel/user-guides/sentinel-1-sar>
- [2] Hannevik, T.N.A & K. Eldhuset. Improving Ship Detection by Using Polarimetric Decompositions. FFI-rapport 2015/01554.
- [3] Arnesen, T.N., R.B. Olsen, and D.J. Weydahl. "Ship Detection Signatures in AP Mode Data," International Astronautical Congress, Fukuoka, Japan, 2005..