2022 DRAGON 5 MID-TERM RESULTS SYMPOSIUM

MONITORING HARSH COASTAL ENVIRONMENTS USING SAR MULTIFREQUENCY POLARIMETRIC SCATTERING

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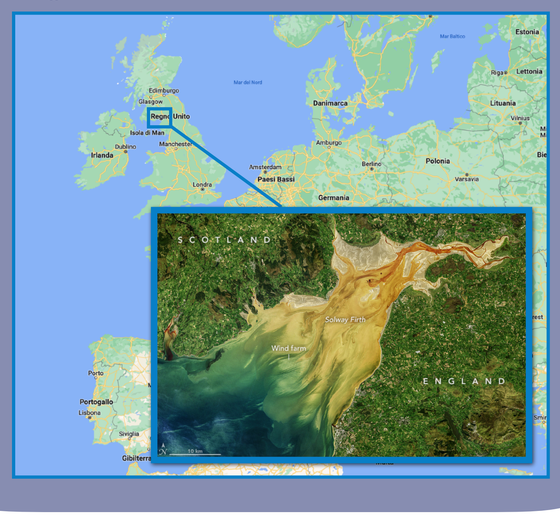
INTRODUCTION

Coastal regions represent areas where a large portion of the world's population lives. Human-induced phenomena, added to extreme natural events, lead to an ever-increasing pressure on such regions. As a result, harsh coastal environments can be formed where wetlands, mudflats, mangroves, marshes etc. are present altogether. Space-borne synthetic aperture radars (SARs) sensors gain great importance in monitoring such areas since they allow obtaining high-resolution imagery collected during almost all-weather conditions and captured during day and night. Moreover, the use of SAR multi-polarimetric imaging modes allows obtaining improved monitoring accuracy with respect to the optical and single-polarisation cases.
In this study, a multi-frequency and multi-polarimetric approach is proposed to study the properties of harsh coastal environments.

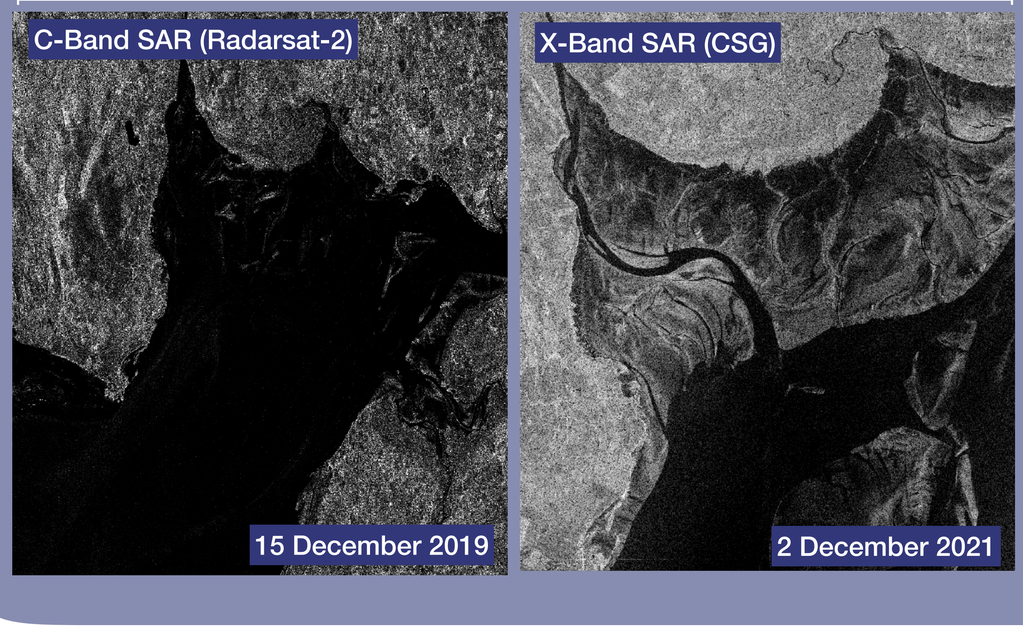
STUDY AREA

Solway Firth coastal region: represents a very harsh coastal environment composed of marshes, mudflats, agricultural crops, hill farming and shallow water rich in sediments.



DATA SET & ROIs

FULL-POLARIMETRIC SAR SCENES



SENTINEL-2 OPTICAL IMAGE

BACKSCATTERING ANALYSIS

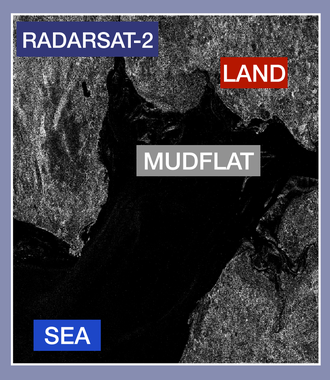
The average HH-, VV- and HV-polarized NRCSs are evaluated over the three ROIs and listed, in dB, in the following tables:

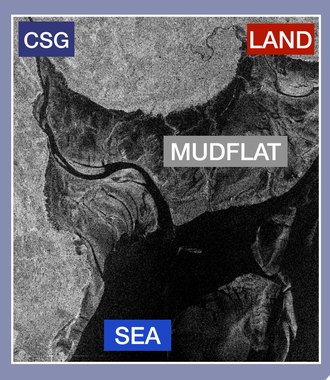
RADARSAT-2

ROI	Mean σ^0_{HH} (dB)	Mean σ^0_{VV} (dB)	Mean σ^0_{HV} (dB)
Land	-9.3	-9.9	-17.0
Sea	-20.0	-17.8	-27.9
Mudflat	-25.1	-20.9	-32.4

CSG

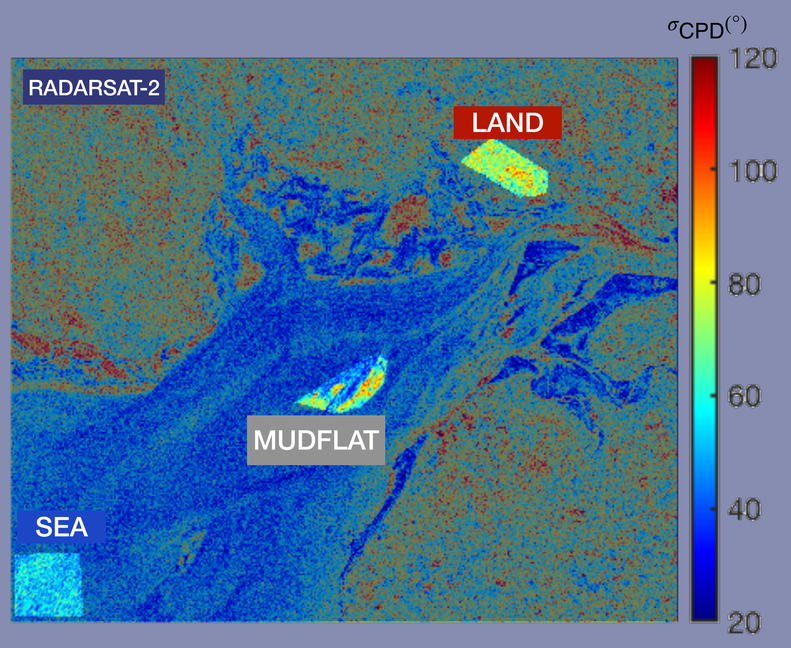
ROI	Mean σ^0_{HH} (dB)	Mean σ^0_{VV} (dB)	Mean σ^0_{HV} (dB)
Land	-16.5	-17.61	-24.05
Sea	-38.3	-36.1	-40.1
Mudflat	-28.43	-24.9	-36.8





POLARIMETRIC ANALYSIS

Solway Firth coastal region: represents a very harsh coastal environment composed of marshes, mudflats, agricultural crops, hill farming and shallow water rich in sediments.



RADARSAT-2_

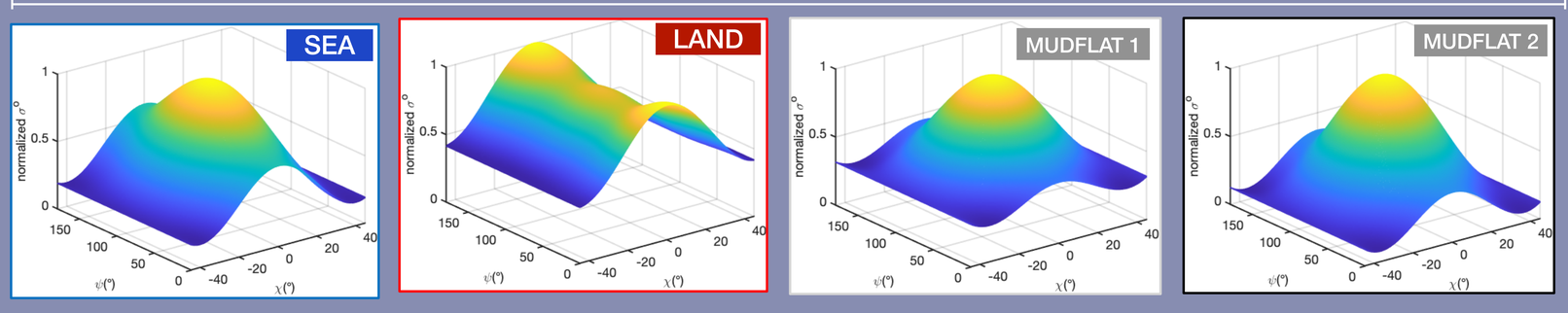
ROI	σ_{CPD} (°)	σ_{CPD} RELATIVE VARIABILITY (%)
Land	73.7	19
Sea	53.2	14
Mudflat	59.0	32

FOCUS ON MUDFLAT

MUDFLAT = HIGH σ_{CPD} + LOW σ_{CPD}

ROI	σ_{CPD} (°)
Mudflat	76
	44

CO-POLARISATION SIGNATURES



CONCLUSIONS

- A SAR multi-frequency and multi-polarimetric approach allows improving the understanding of the harsh coastal environment scattering processes
- SAR Full-Pol data may support the development of advanced and robust scattering-based algorithms for coastal management

KEY REFERENCES

1. M. Gade, S. Melchionna, K. Stelzer and J. Kohlus, "Multi-frequency SAR data help improving the monitor- ing of intertidal flats on the German North Sea coast," Es- tuarine, Coastal and Shelf Science, vol. 140, pp. 32-42, 2014.
2. E. Ferrentino, A. Buono, F. Nunziata, A. Marino and M. Migliaccio, "On the use of multipolarization satellite SAR data for coastline extraction in harsh coastal environments: the case of Solway Firth," IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, vol. 14, pp. 249-257, 2021.