Spatial Velocity Measurements using X-Band Radar at a High Energy Tidal Test Site

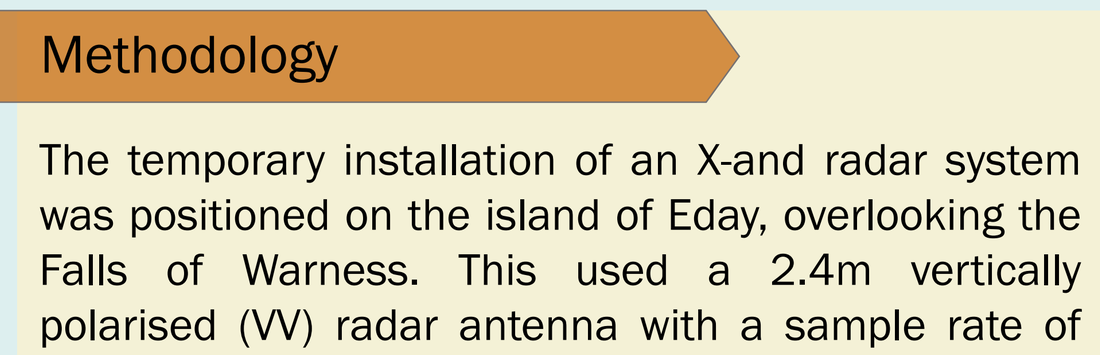
Charles Greenwood, Angus Murray, Arne Vogler, James Morrison
charles.greenwood@uhi.ac.uk University of Highlands and Islands

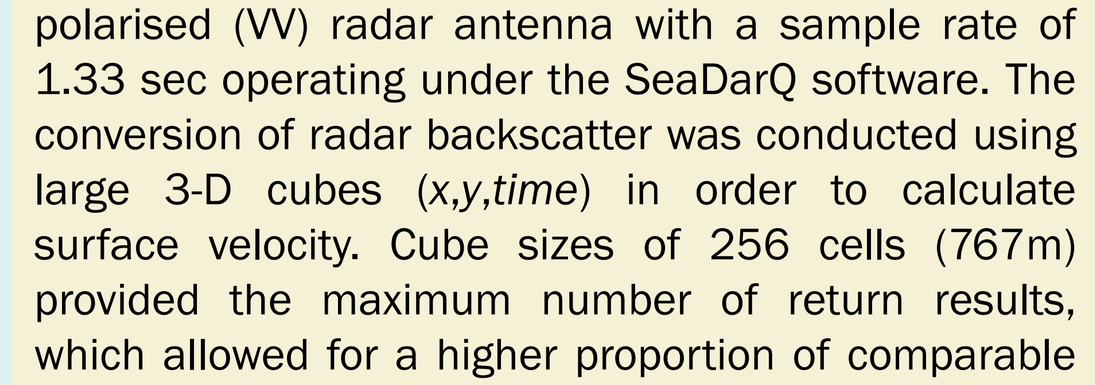
Outline

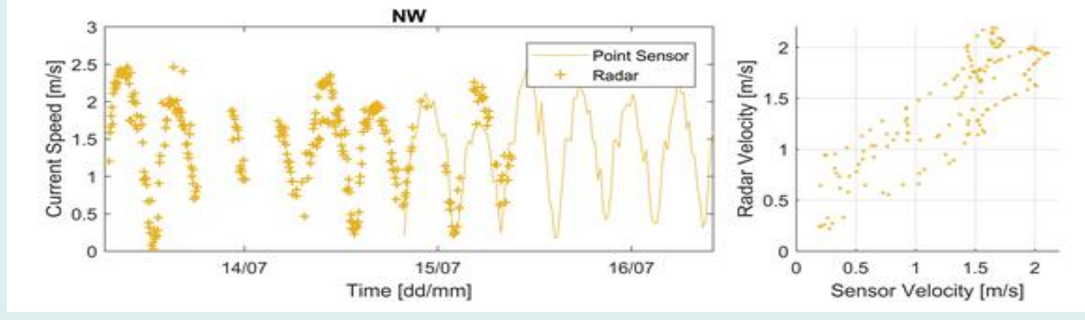
The work in this study assesses the use of an X-band radar for the remote measurement of surface current at the Falls of Warness, Orkney. A three dimensional FFT is used to convert radar backscatter into surface current using the dispersion relation. This provides a time averaged, spatial map of waves and currents within a 3km domain. Three additional in situ Acoustic Doppler Current Profilers (ADCPs) were deployed around the same time to provide validation for the results.

Methodology

The temporary installation of an X-and radar system was positioned on the island of Eday, overlooking the Falls of Warness. This used a 2.4m vertically polarised (VV) radar antenna with a sample rate of 1.33 sec operating under the SeaDarQ software. The conversion of radar backscatter was conducted using large 3-D cubes (*x*,*y*,*time*) in order to calculate surface velocity. Cube sizes of 256 cells (767m) provided the maximum number of return results, which allowed for a higher proportion of comparable data. Three additional sensors were deployed in the channel (NW, SP3 and SE). These were processed for 20 min time averaged flow characteristics.



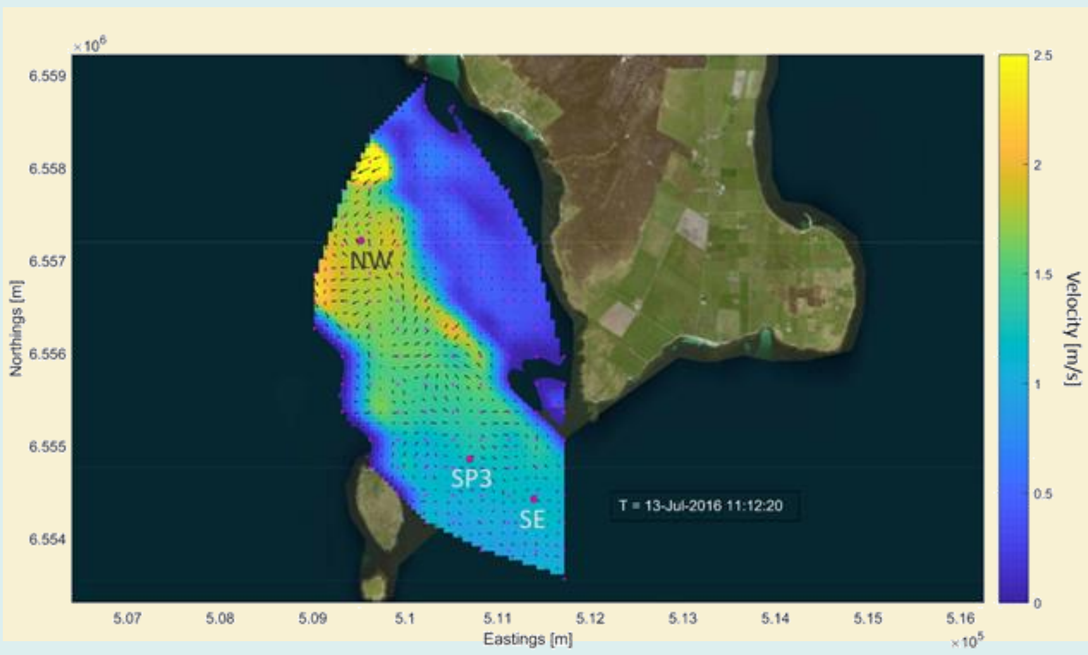




Location	Bias	SI	RMSE	NRMSE	*r*
SE	-0.32	0.53	0.46	0.24	0.85
SP3	0.08	0.25	0.34	0.17	0.86
NW	-0.13	0.25	0.33	0.16	0.84

Results

The comparison of basic flow parameters indicates a good phase and magnitude agreement for the current speed. The statistical analysis shows a strong phase agreement for all locations with the NW sensor showing the lowest deviation from the in situ sensor. The directional comparison (not shown here) achieves similar results where a good agreement is achieved for all sensor locations. The spatial distribution of velocity (shown below for a single time step) displays the flow velocity and direction for the radar domain including the point sensor locations.



Conclusions

This short term deployment has shown the use of X-band radar as a useful tool for measuring surface currents across the spatial domain. The comparison of multiple distributed point sensors indicates a good correlation with in situ measurements. This provides confidence in the spatial and temporal analysis of the data that enables the identification of variability of large flow features.

Acknowledgements

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