Measuring the ‘First Five’ with HF radar

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HF radar wave measurements in South Australia

Data from IMOS/SA WERA radars

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HF radar wave measurement

Energy spectra, significant waveheight, peak direction, power, Fourier coefficients etc are obtained from the radar directional spectrum using standard methods.
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Buoy and model validations

Measurements from the IMOS South Australian Gulf WERA radars (green) compared with non-directional waverider buoy (black) and SWAN model (red).

Significant Waveheight

Peak Wave Direction

provided by Charles James, SARDI
Pisces buoy comparisons

**Significant Waveheight**

**Wave power**

**Hs (m)**

**Te (s)**

**Power data histogram**

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Buoy comparisons
Energy spectra time series

Pisces in Celtic Sea

WERA in Norwegian Sea

upper panel – radar
lower panel – buoy.
Buoy comparisons
Fourier coefficient timeseries

Pisces in Celtic Sea

WERA in Norwegian Sea

upper panel – radar, lower panel – buoy. upper pair $a_1(f)$, lower pair $b_1(f)$. 
Buoy mean comparisons

Pisces in Celtic Sea

Wera in Norway
Buoy mean comparisons

Pisces in Celtic Sea

Wera in Norway

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Simulation results

Using different radio frequencies, wind speed and directions.

$E(f)$

$\bar{\theta}(f)$
Simulation results

Mean Fourier Coefficients with std.

[Graphs showing mean Fourier coefficients with standard deviation for different sensors (radar m, buoy m, radar s, buoy s) over a range of wave frequencies.]
Simulation results

$E(f)$

- mean 5.96
- y mean 6.16
- bias 0.2
- std 0.65
- rms 0.68
- cc 0.997
- si 0.11
- N 10500

$a1(f)$

- mean 0.28
- y mean 0.27
- bias -0.01
- std 0.09
- rms 0.09
- cc 0.983
- si 0.32
- N 10500

$b1(f)$

- mean 0.05
- y mean 0.02
- bias -0.03
- std 0.12
- rms 0.12
- cc 0.946
- si 2.5
- N 10500
Summary

Simulations indicate that Fourier coefficients can be measured with reasonable accuracy within previously identified limitations of the inversion method:

- low radio frequencies at low waveheights
- high radio frequencies at high waveheights

Comparisons with buoys include additional sources of difference/error:

- noise levels, radio interference, ship signals
- uncertainties in buoy measurements
- spatial and temporal measurement differences
Thank you for your attention

HF radar and wavebuoy ocean wave spectra

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