What level of wave data is needed for ship motion analysis?
A ship hydrodynamics point of view

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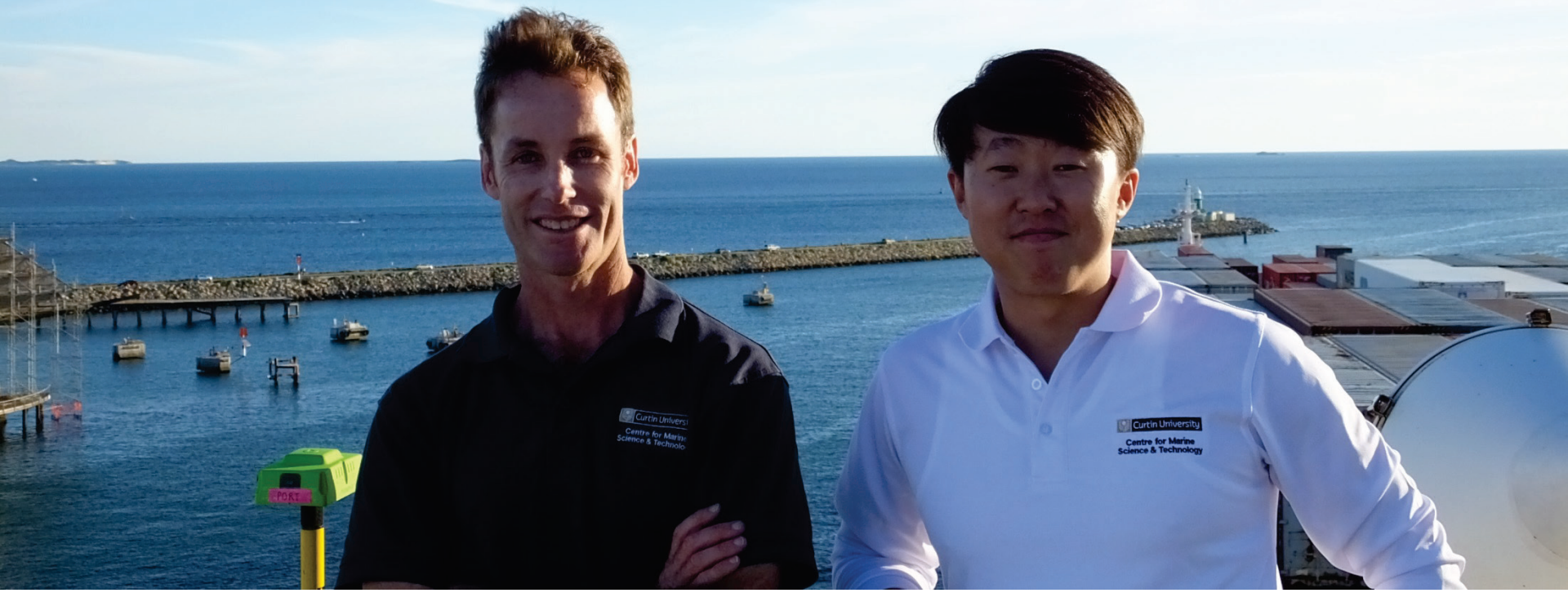

3rd Australian Wind Waves Symposium 2017

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Small vessels

- **Simple wave criteria are appropriate**
- **E.g. tugs: safe operation up to H_S = 2.0 m**

Medium-size vessels

- **Recognition that wave period is important**
- **Standard spectra used for analysis**
- **Operability criteria normally based on H_S**

Service Class	Operational				
	Sig. Wave Height (m)	Average Zero Up Crossing Period Range (sec)	Sea State	Wind Speed	
				Design (knots)	Nom (B'fort)
Ocean Unlimited	6.0	5.2-11.6	6	70	9
Ocean Limited	6.0	5.2-11.6	6	60	8
Offshore	4.0	4.2-9.5	5	50	7
Restricted Offshore	2.5	3.3-7.5	4	40	6
Protected Waters	1.25	2.4-5.3	3	30	5
Smooth Waters	0.5	1.5-3.3	2	30	5

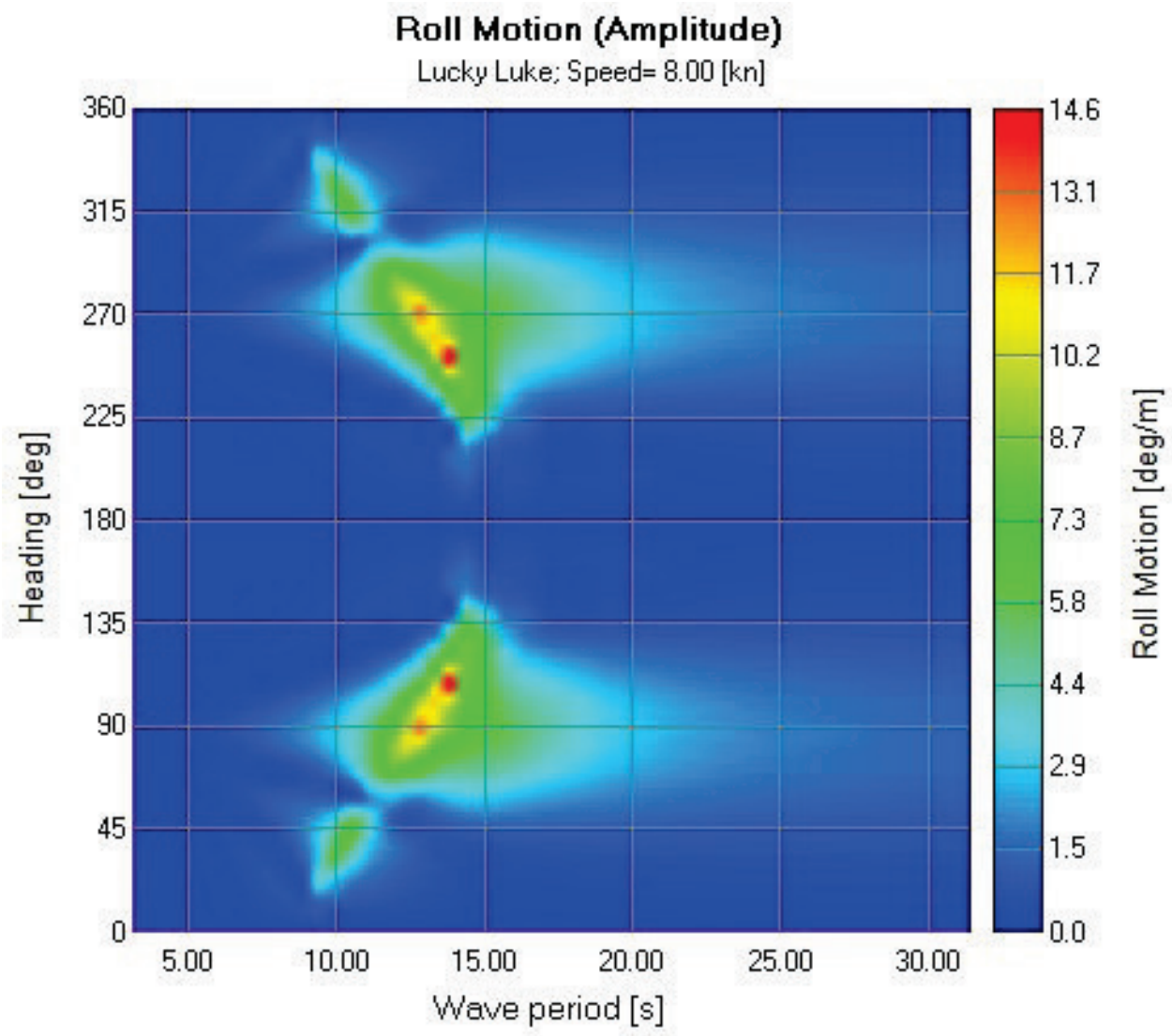
Table 4.2 – Operational Environment

RAN seakeeping standards

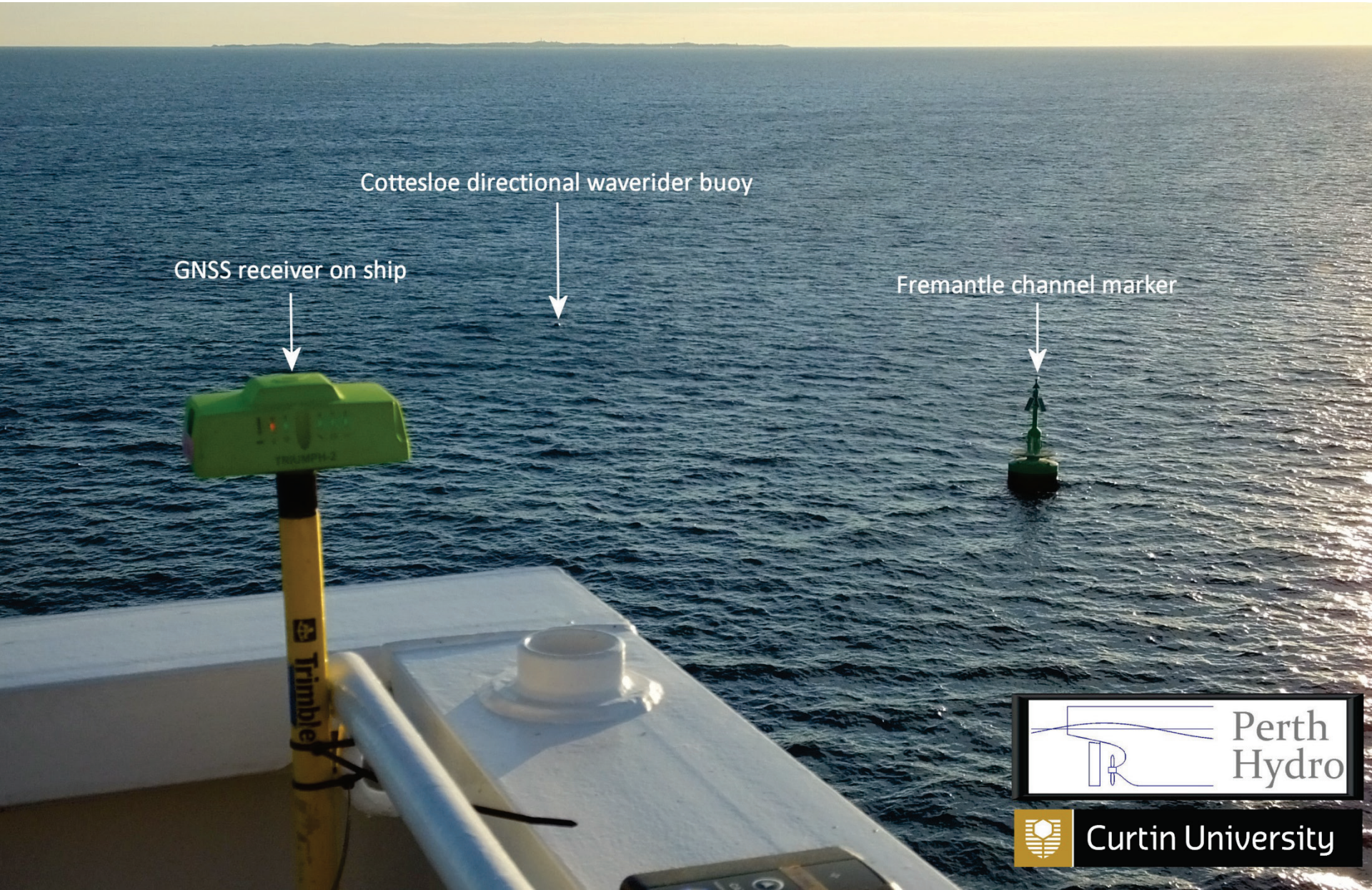
Cargo ships in short-period seas
Negligible wave-induced motions

MV Sea Diamond, Geraldton
$H_{S(swell)} = 1.5m$, $H_{S(sea)} = 0.5m$

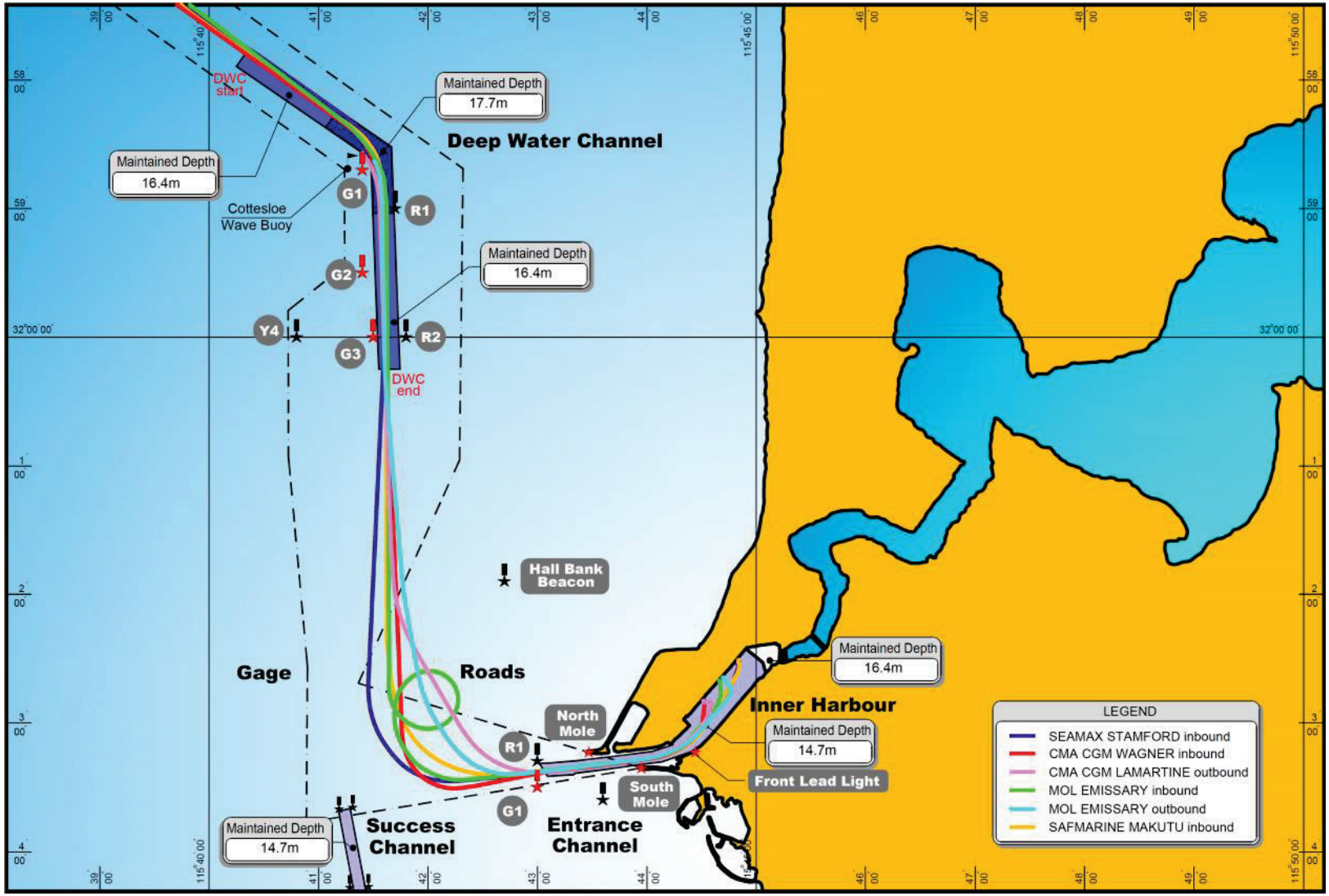
Linear ship motions: RAOs



Combining RAOs with wave spectra



Fremantle port approach



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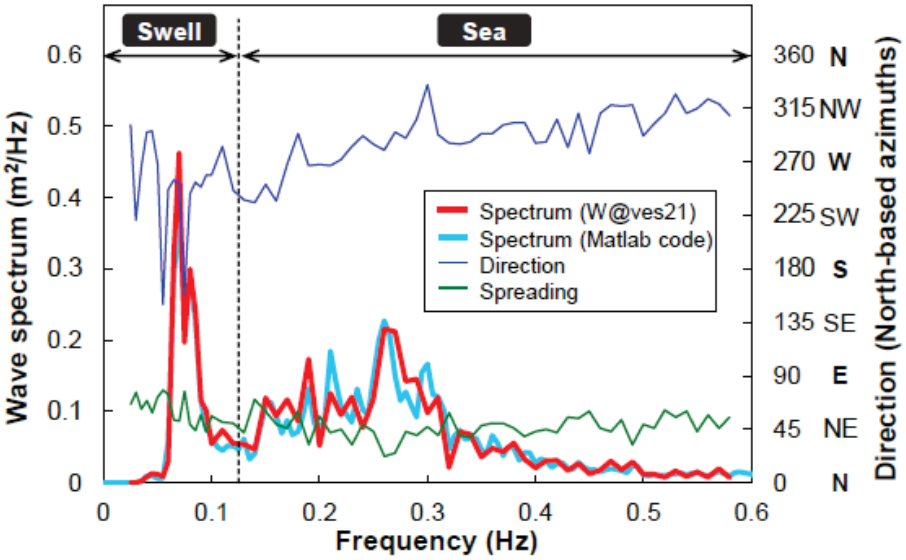
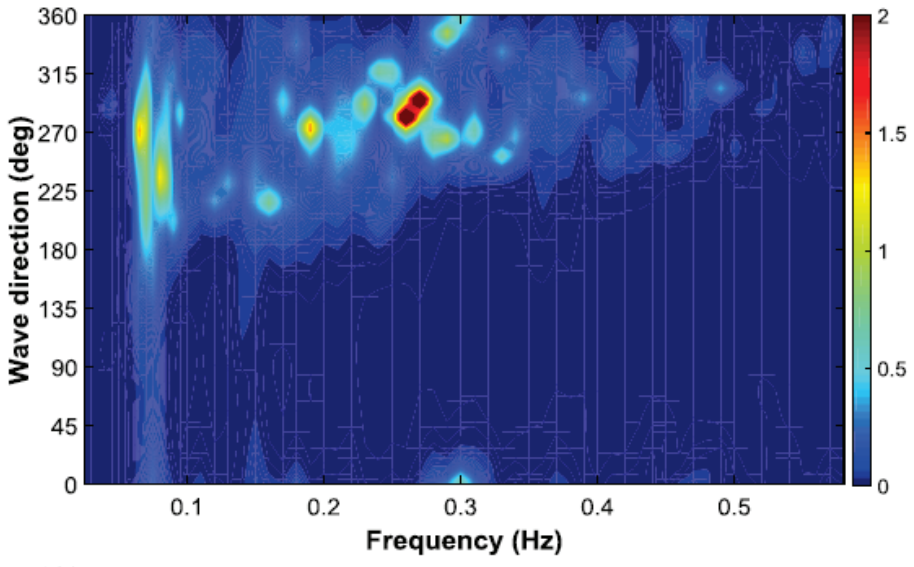
Non-directional and directional wave spectra

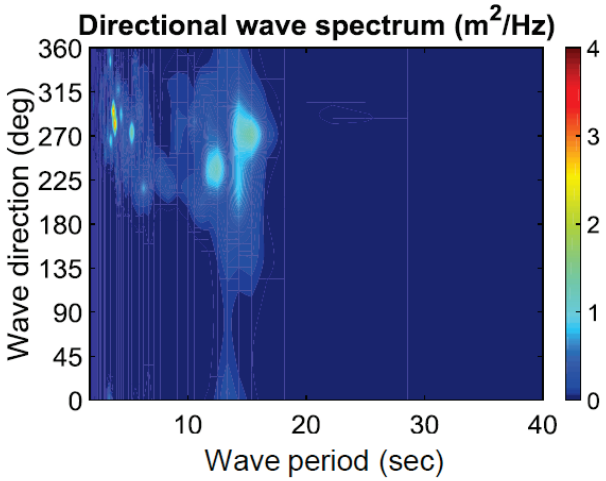


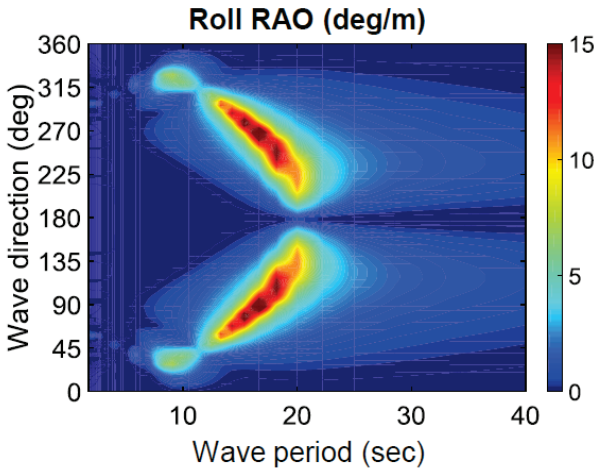


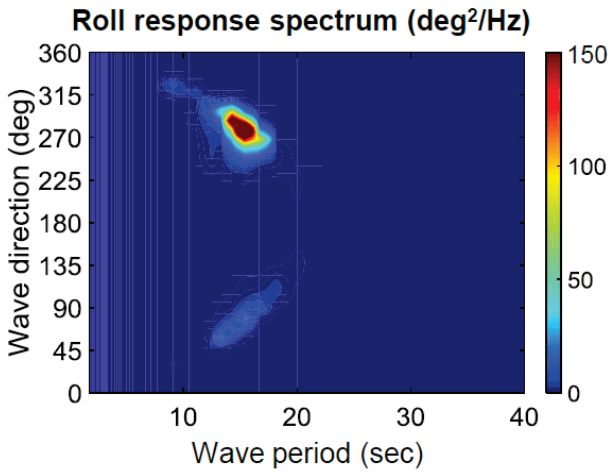
Wave spectrum measured at waverider buoy at time of CMA CGM Wagner passing waverider buoy

(Wave spectrum)*(RAO)^2 = (Response spectrum)

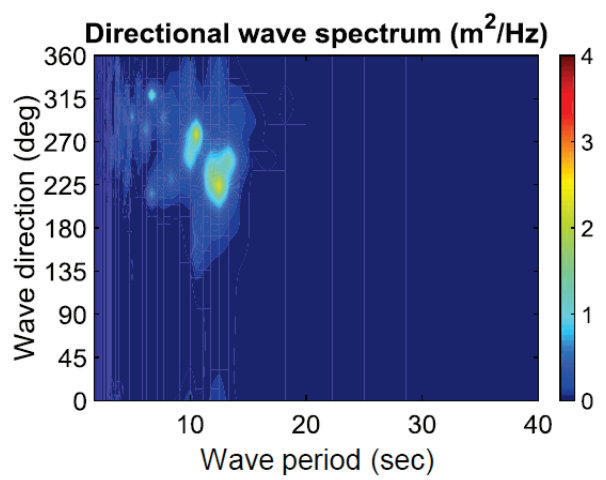
CMA CGM Wagner inbound

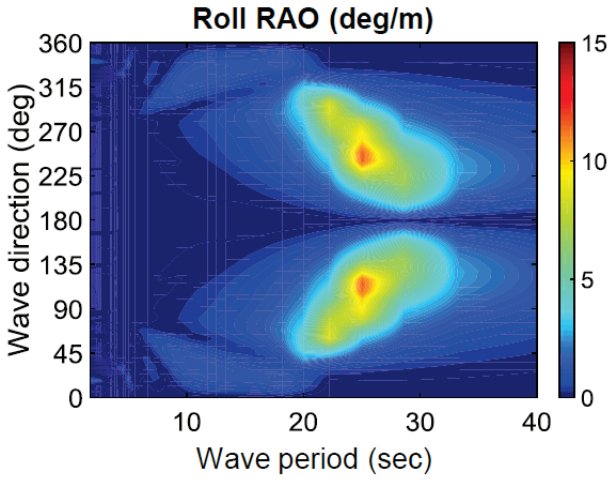


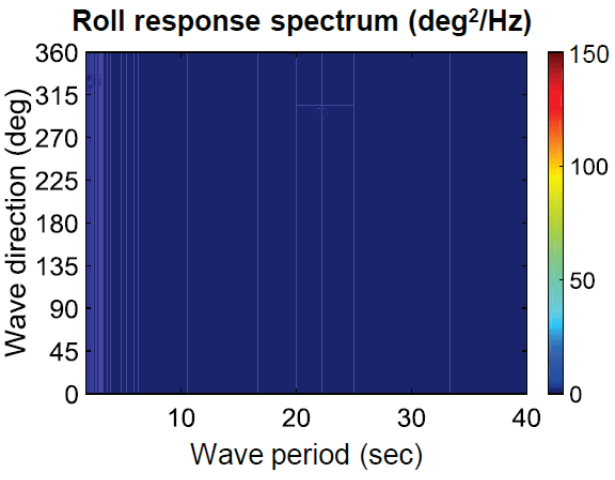




MOL Emissary inbound







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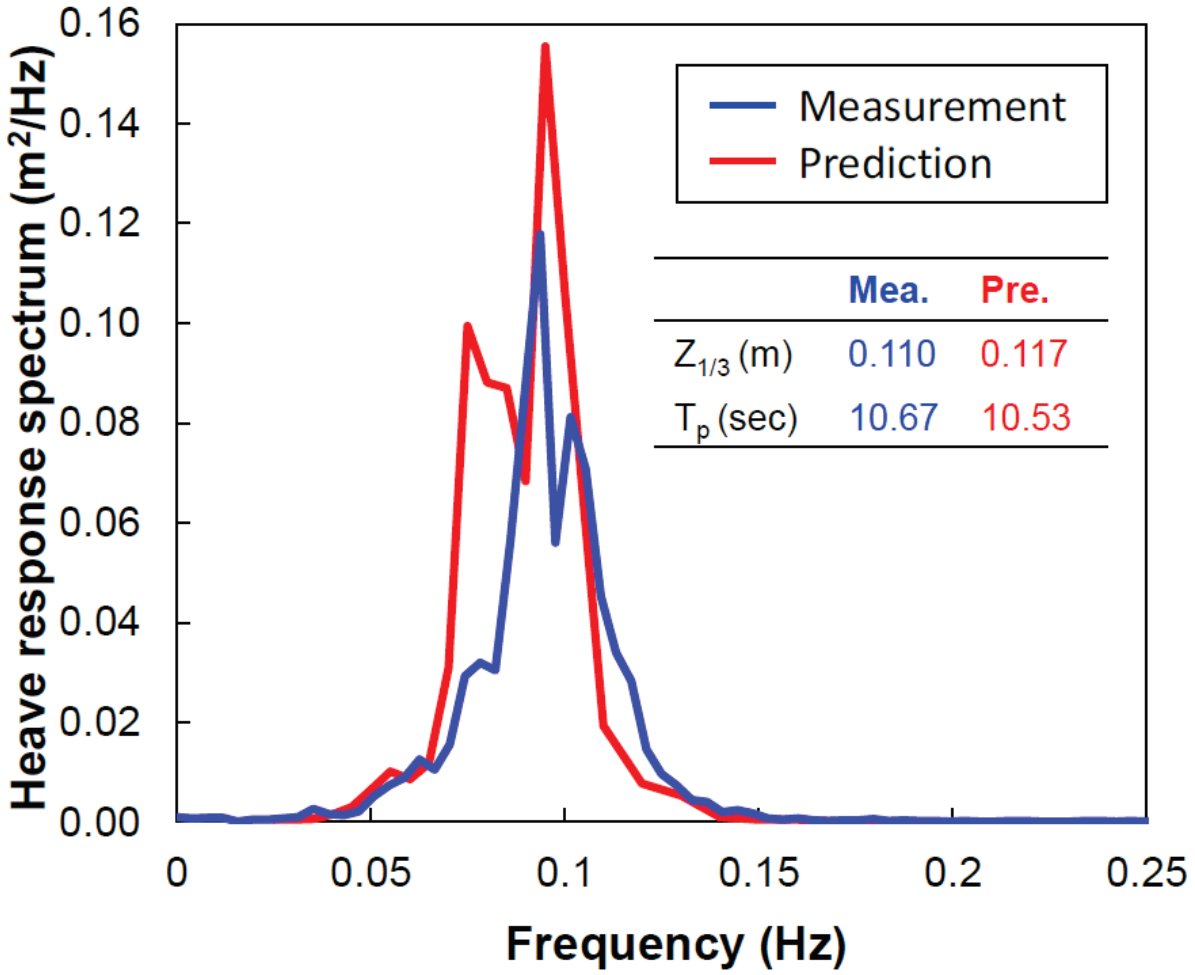
Method validation



MOL Emissary inbound

Recommendations for supplying wave data for ship hydrodynamics

Good: Timeseries of ($H_{S(Swell)}$,$T_{P(Swell)}$), principal swell direction, spreading angle

Better: 2D array, e.g. Excel spreadsheet

- Across = frequency, down = time
- Extra columns of principal swell direction, spreading angle

Best: 3D array, e.g. Matlab or NetCDF file:

- Dim1 = frequency, Dim2 = direction, Dim3 = time

These can be supplied at multiple locations (e.g. along a shipping channel) as required.

Q & A