WAMSI Conference 2011

Node 1

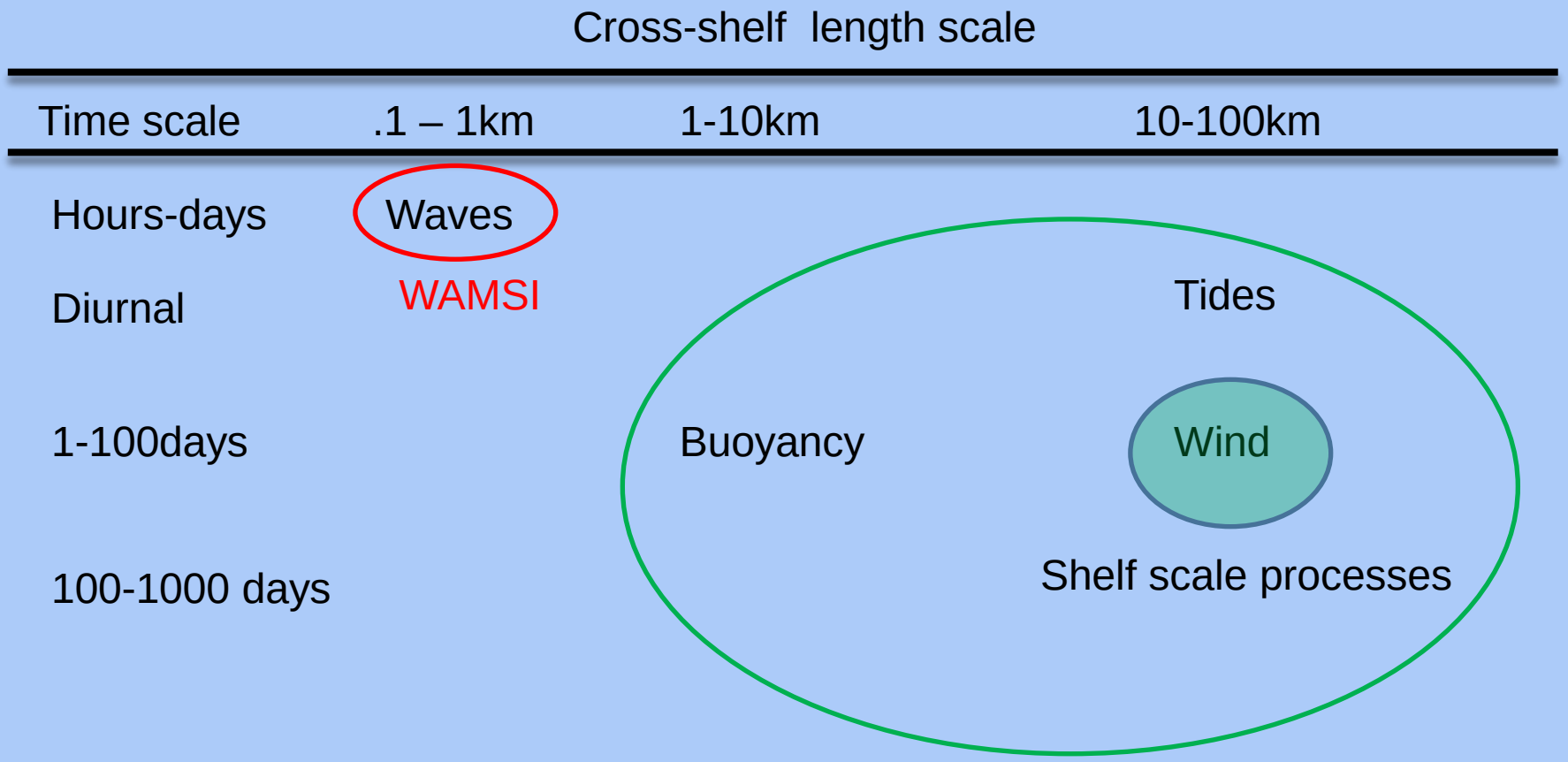
Marmion Lagoon Hydrodynamics

Graham Symonds, Liejun Zhong, Nick Mortimer

National Research FLAGSHIPS Wealth from Oceans CSIRO

western australian marine science institution

Primary physical drivers of coastal currents

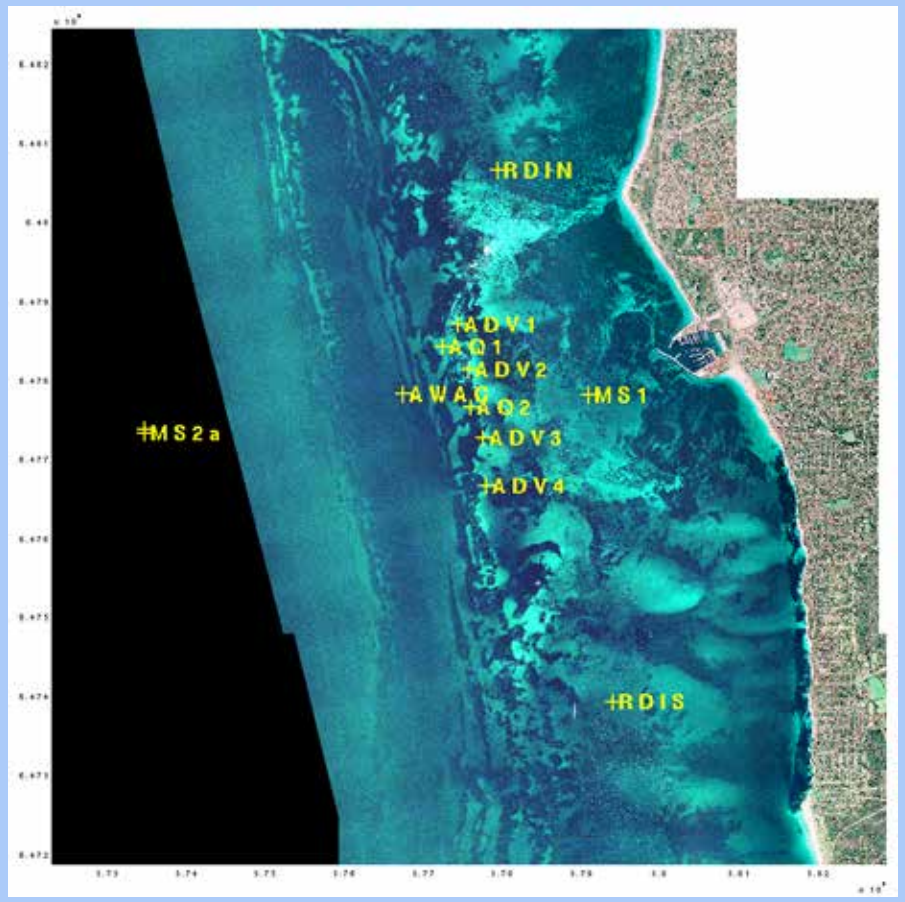


Perth Coastal Waters Study, SRFME

National Research FLAGSHIPS Wealth from Oceans CSIRO

western australian marine science institution

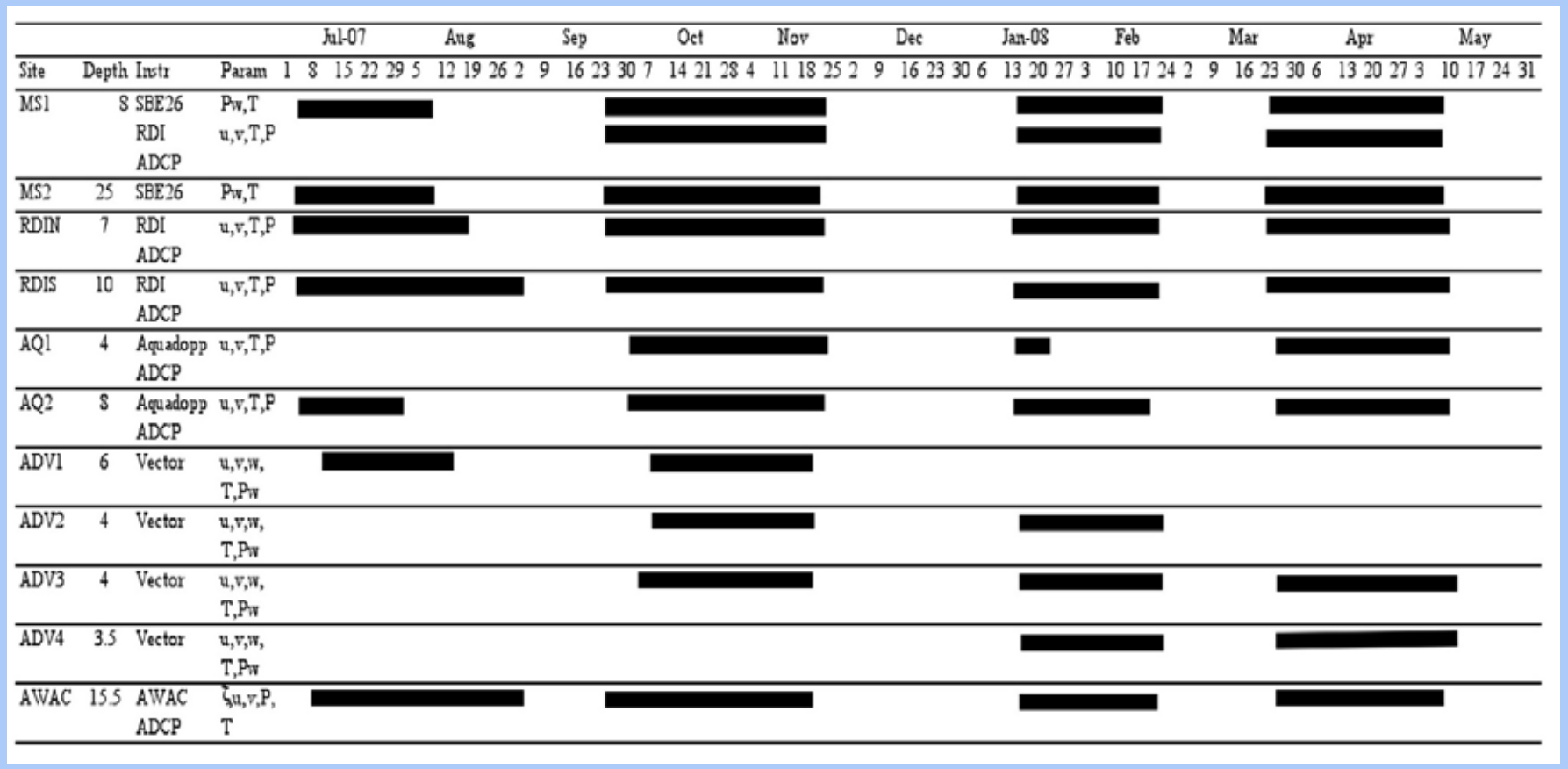
Marmion Lagoon Measurement Program
July 2007 – May 2008



National Research FLAGSHIPS Wealth from Oceans CSIRO

western australian marine science institution

Sampling schedule



National Research FLAGSHIPS Wealth from Oceans CSIRO

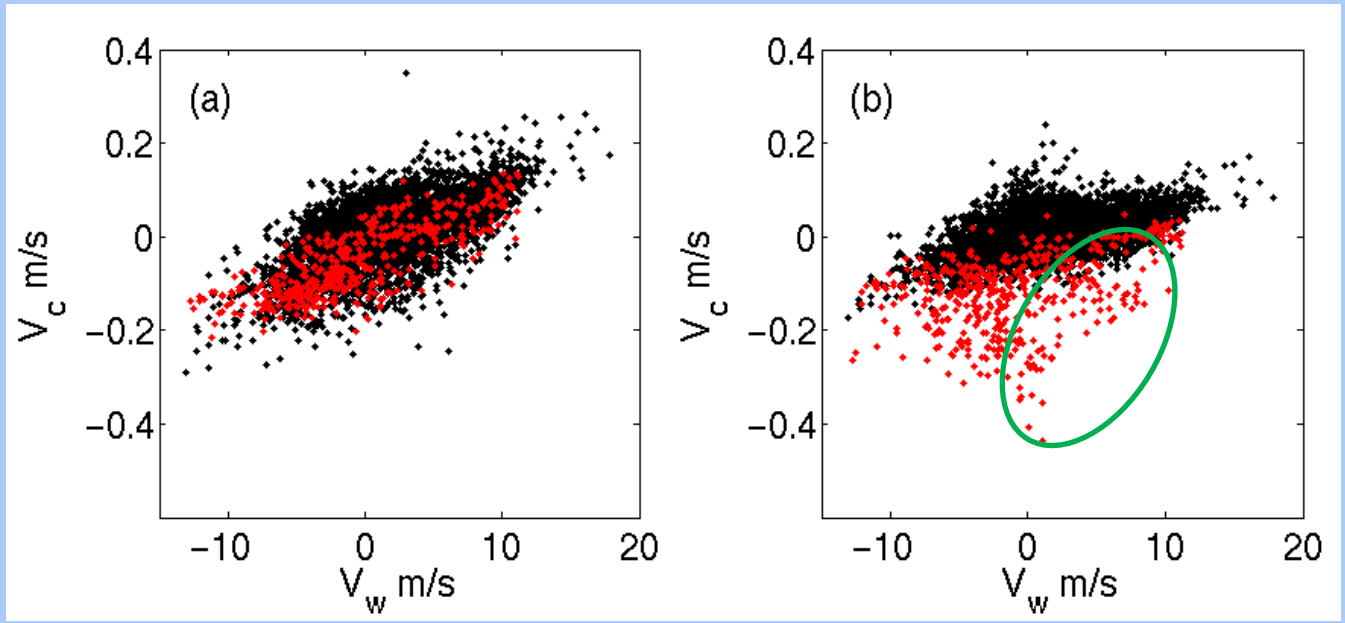
western australian marine science institution

Alongshore current (V_c) vs alongshore wind (V_w)

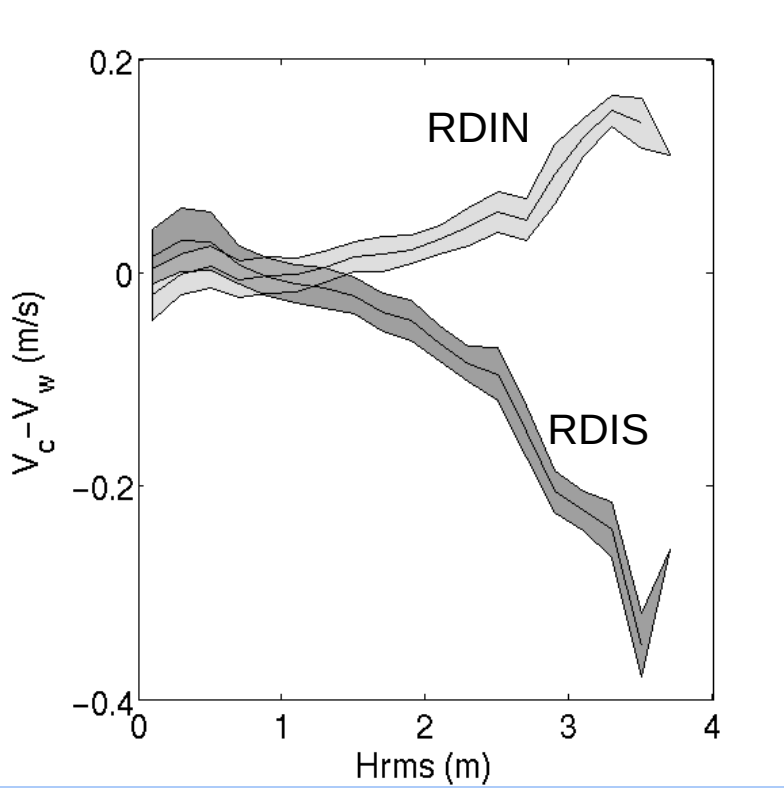
- Hrms < 1.5m
- Hrms>1.5m

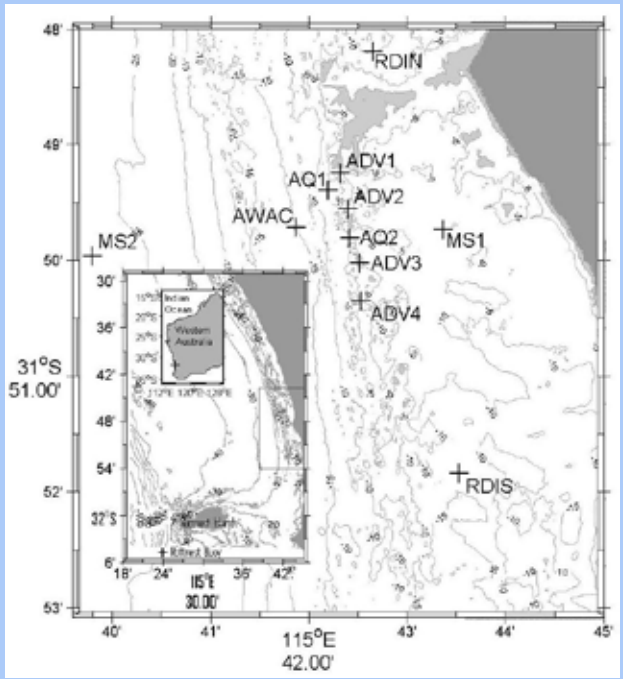
Outside lagoon (AWAC)

Inside lagoon (RDIS)



Alongshore Currents

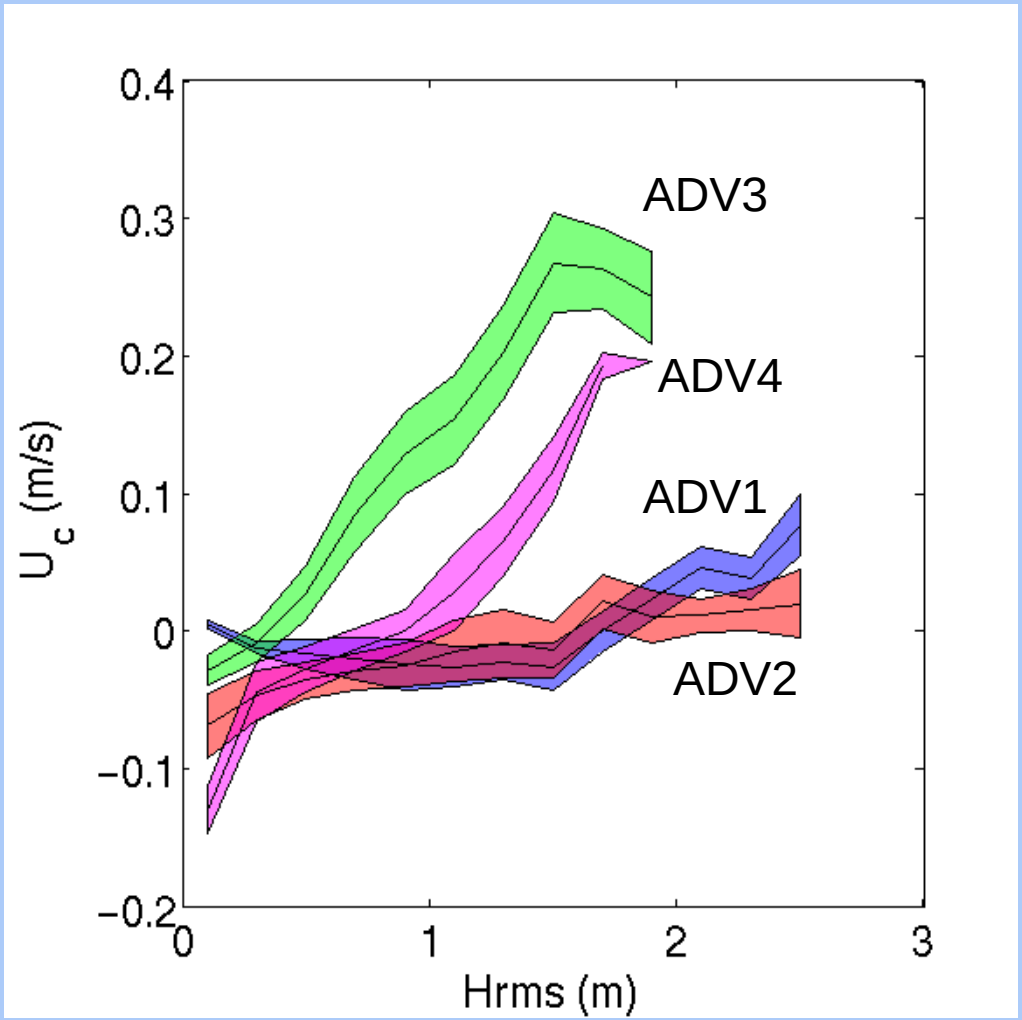


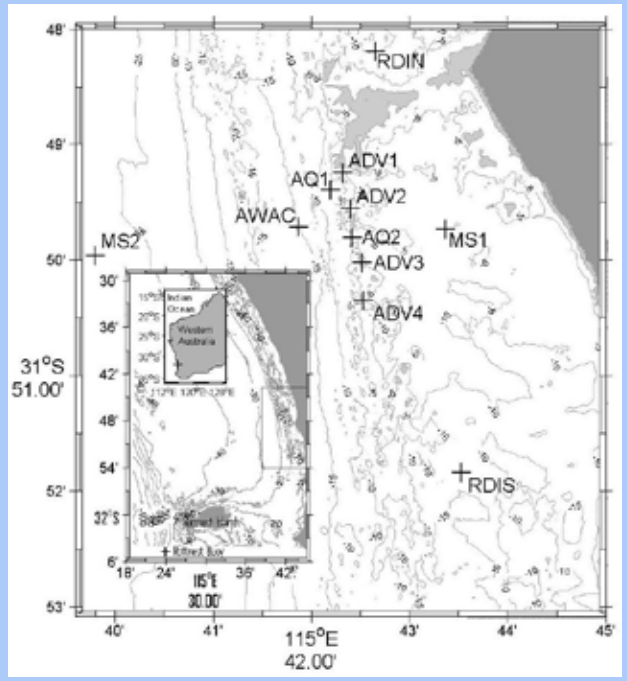


National Research FLAGSHIPS Wealth from Oceans CSIRO

western australian marine science institution

Cross-reef currents

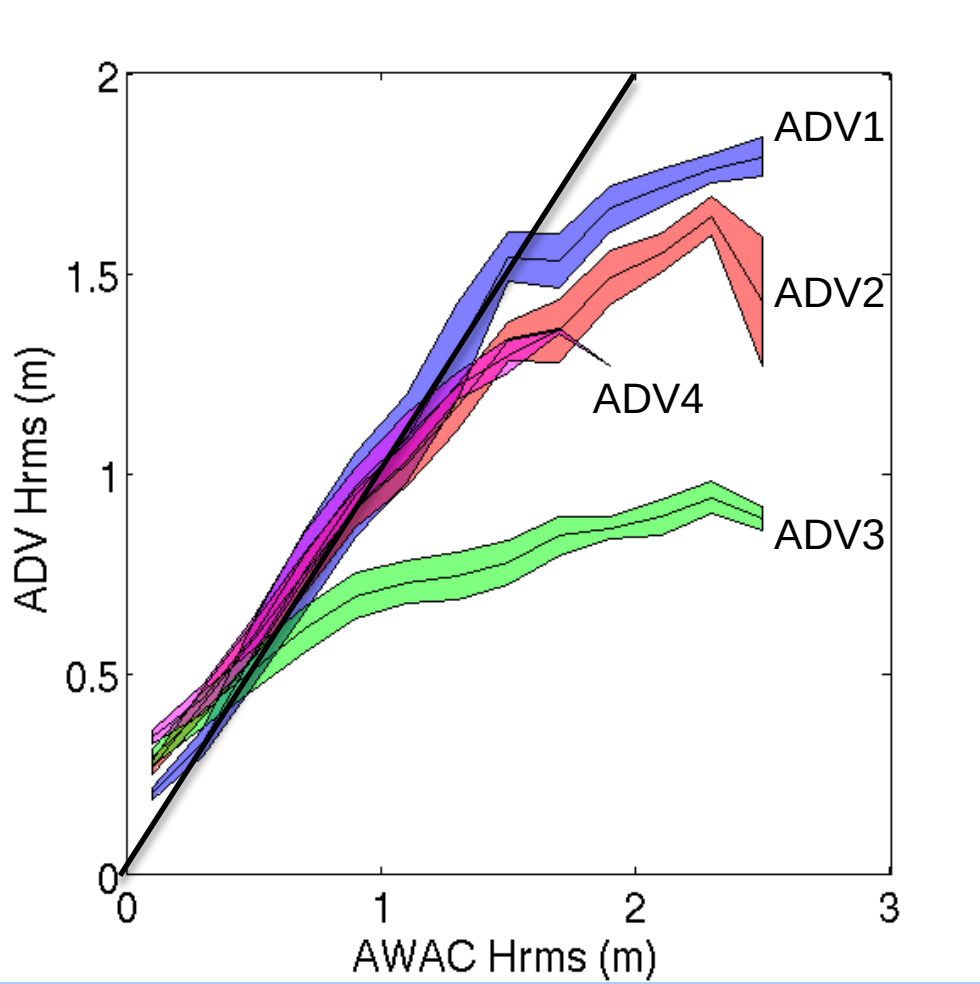


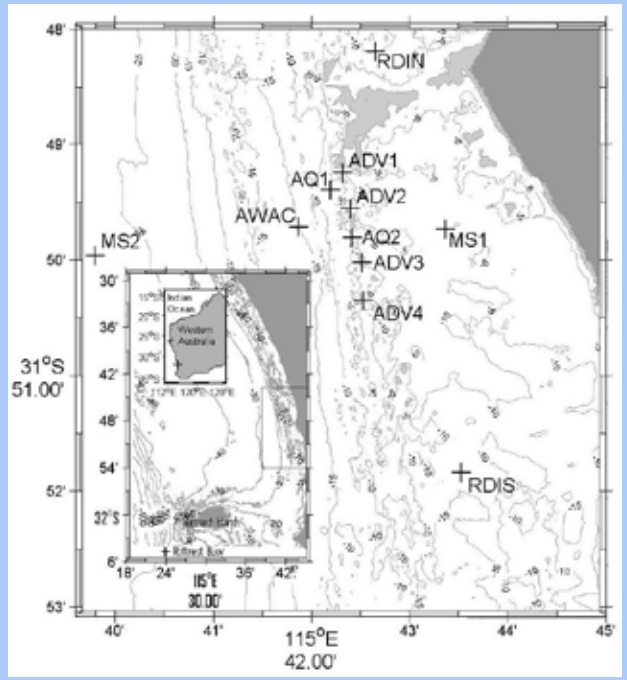


National Research FLAGSHIPS Wealth from Oceans CSIRO

western australian marine science institution

Depth induced wave breaking





National Research FLAGSHIPS Wealth from Oceans CSIRO

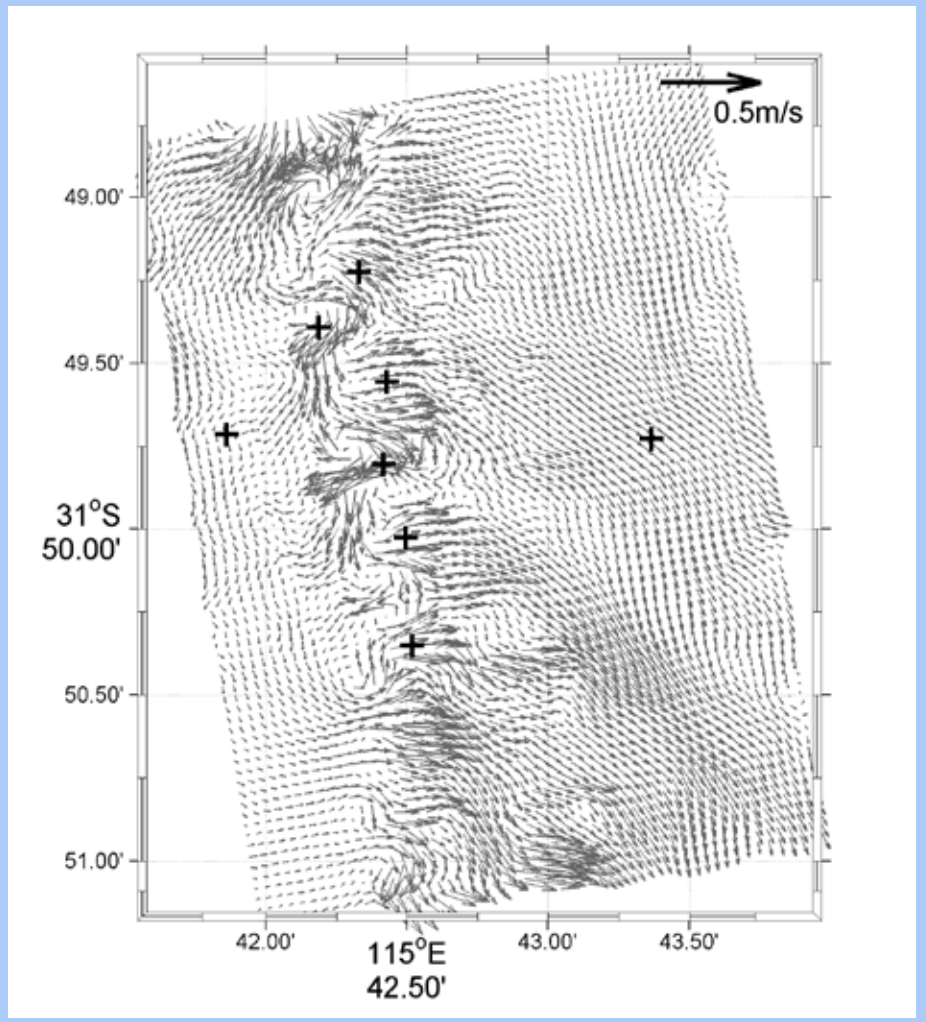
western australian marine science institution

Numerical model – XBeach

Wave forcing
Over the reef crests breaking waves drive currents into the lagoon

Hrms=2.2m, T=14s, Dir=266^0

\+ instrument locations



$$skill = 1 - \frac{\sum \left| X_{model} - X_{obs} \right|^2}{\sum \left(\left| X_{model} - \overline{X_{obs}} \right| + \left| X_{obs} - \overline{X_{obs}} \right| \right)^2}$$

Deployment	Site	variable	r^2	p-value	skill
1	AWAC	Hrms	.92	0	1
1	MS1	Hrms	.64	.0003	.59
1	RDIN	V	.05	.43	.17
1	RDIS	V	.69	0	.77
1	AQ2	U	.5	.0033	.66
2	AWAC	Hrms	1	0	1
2	MS1	Hrms	.79	0	.59
2	ADV1	U	0	.83	.25
2	ADV2	U	.62	.0008	.4
2	ADV3	U	.85	0	.89
2	AQ1	U	.11	.25	.47

National Research FLAGSHIPS Wealth from Oceans CSIRO

western australian marine science institution

Conclusions

- During high wave events, wave forcing dominates over wind in driving circulation across Marmion lagoon.
- High spatial variability in the currents in the vicinity of the reefs.
- Across the reefs, flow into the lagoon is forced by gradients in wave momentum due to depth induced breaking.
- In the lagoon the flow is governed by a balance between the pressure gradient and bottom friction.

Thank-you

Graham Symonds, Liejun Zhong, and Nick A. Mortimer
Effects of wave exposure on circulation in a temperate reef environment, *J. Geophys. Res*. 116, C09010, doi:10.1029/2010JC006658, 2011.

National Research FLAGSHIPS Wealth from Oceans CSIRO

western australian marine science institution