



LONG-TERM LOAD RESPONSE OF A TWO-BODY POINT ABSORBER IN EXTREME SEAS

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Underwater, Risk Reduction: Towards more reliability
Gare Maritime Transatlantiquem, Auditorium 2
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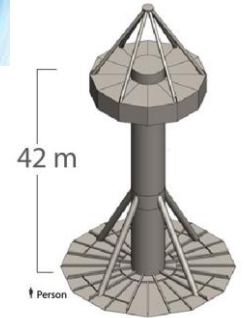
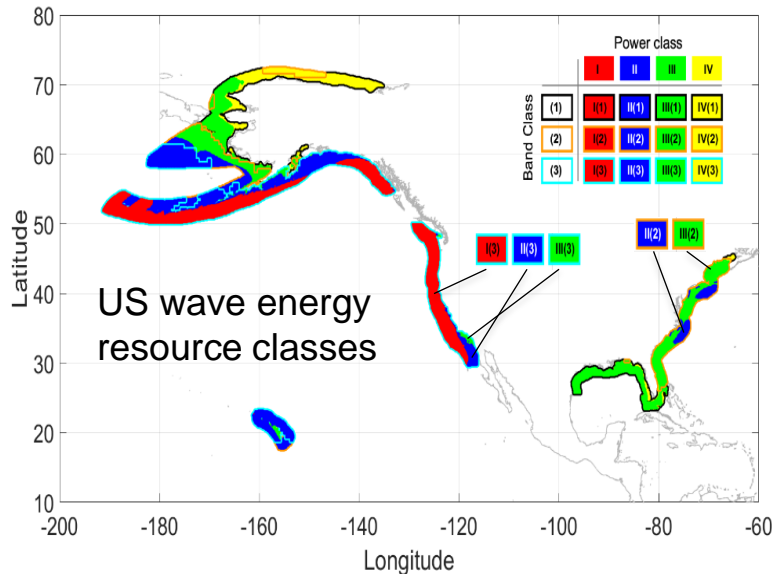
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MOTIVATION/GOAL

- Feasible to design standard WEC device class that can be deployed over broad geographic region?
- What is magnitude and distribution of extreme loads within wave energy resource classes?

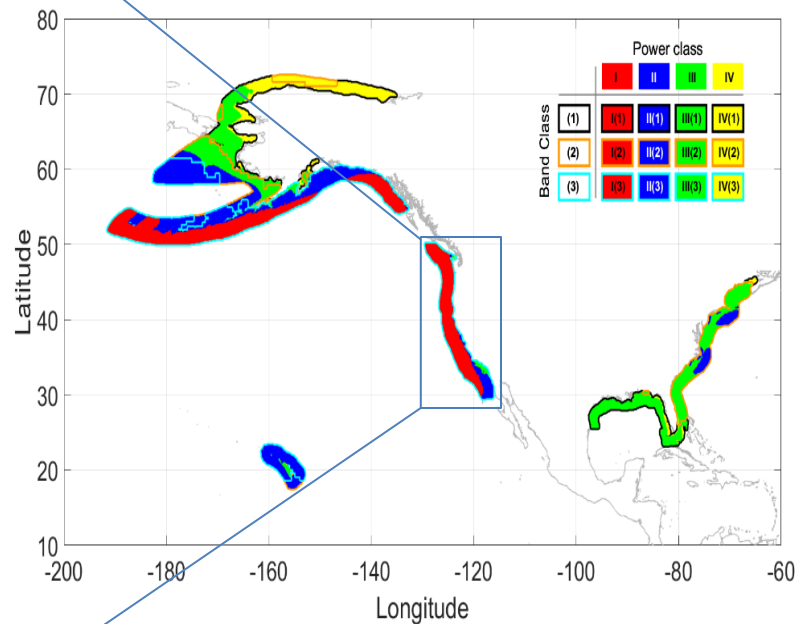
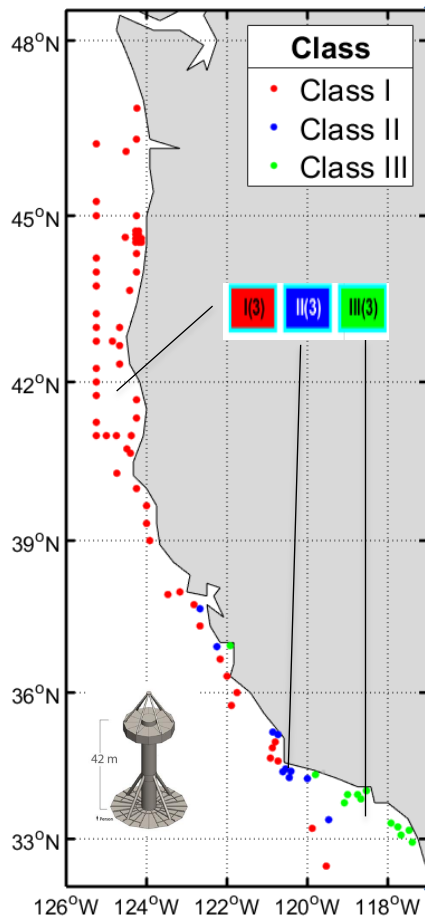
**WEC Extreme Condition
Modeling Workshop**
May 13-14, 2014
Albuquerque, NM, USA



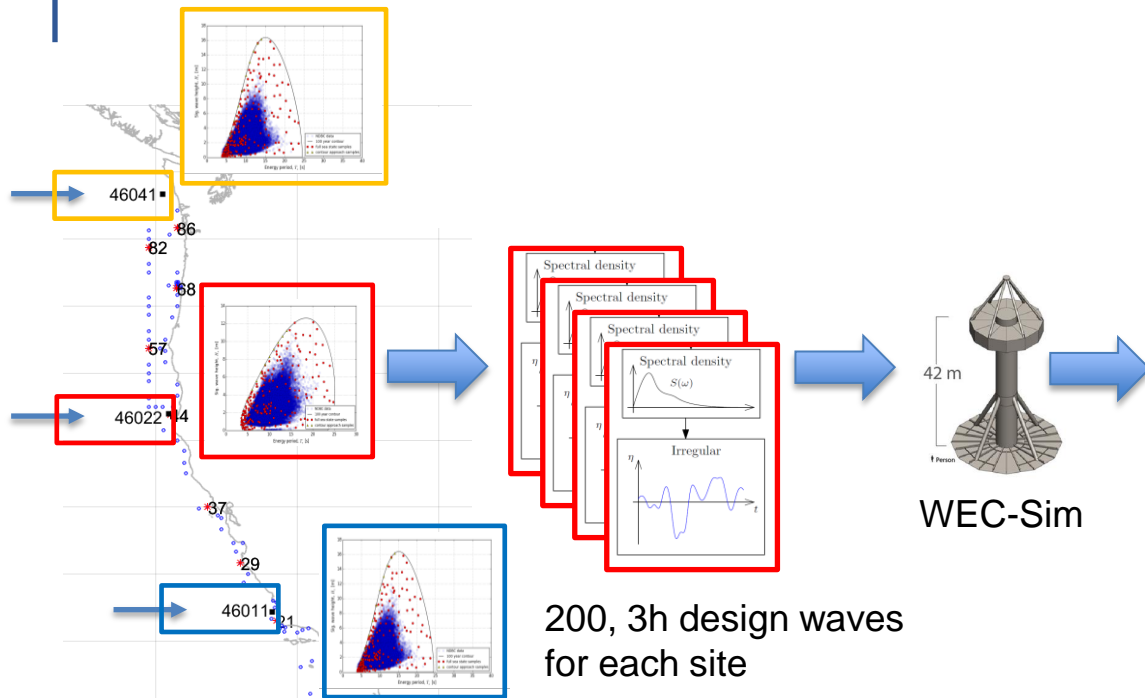
Reference Model (RM3)

STUDY OBJECTIVES

- Simulate extreme loads on reference model 3 (RM3) point absorber in locked survival mode
- Three different resource classes along the US West Coast:
Predominantly Class I(3) and II(3) sites

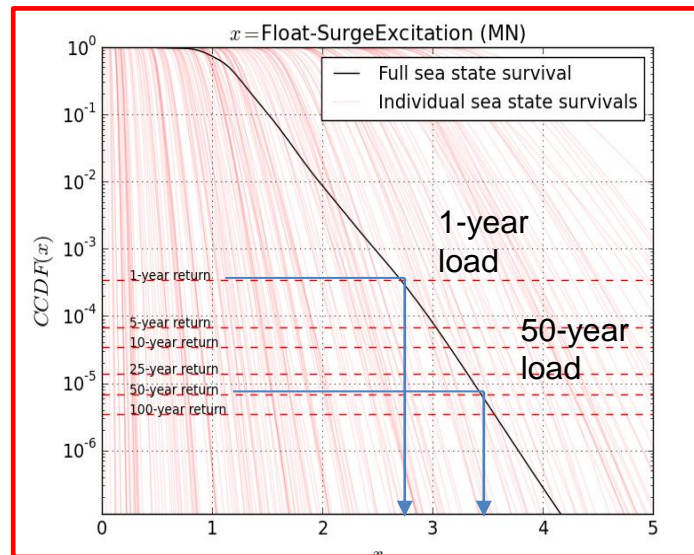


METHODS



200, 3h design waves
for each site

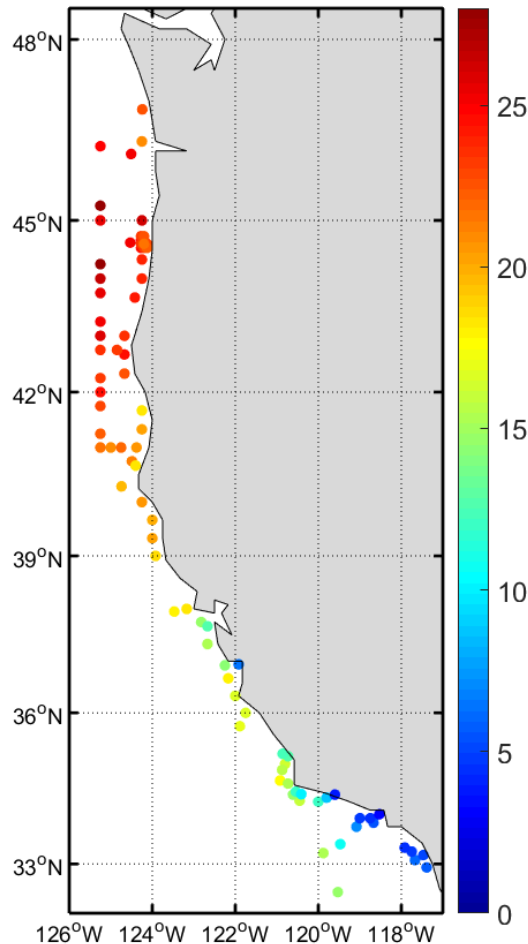
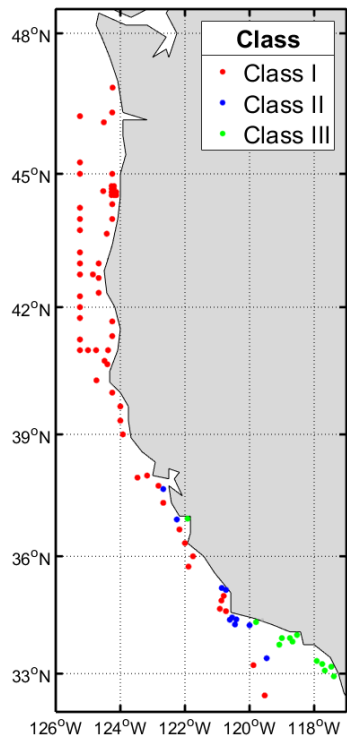
Environmental contours for
79 sites with 200 selected sea states



200 short term response distributions
and combine to one long term distribution
Extreme loads (Heave, Surge, etc.)

RESULTS

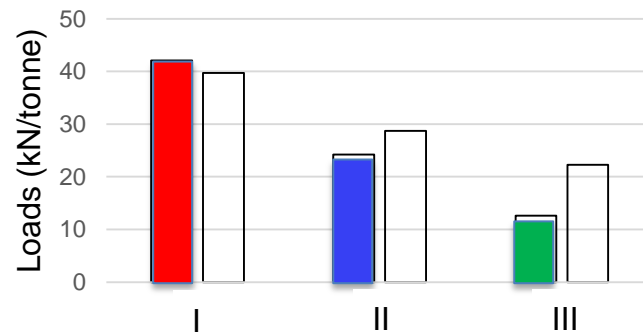
Linear Heave (50-year)



RM3 Heave Excitation Loads, 50-year

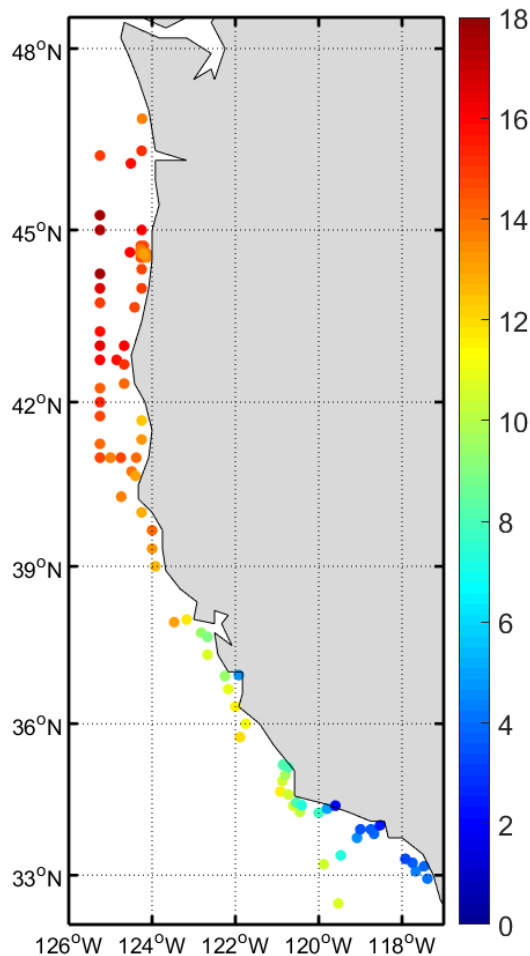
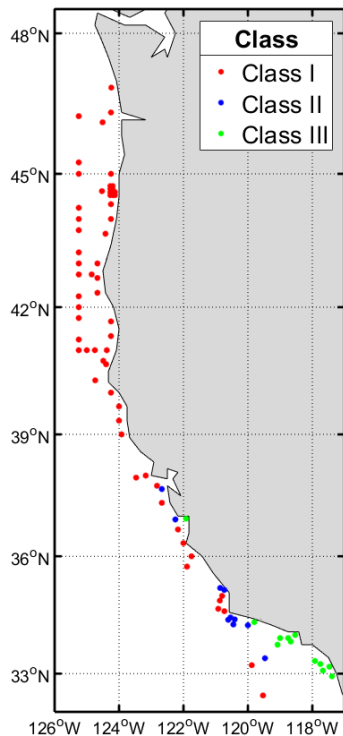
Class	I	II	III
Average (MN)	21.5	12.8	5.6
Std. Dev. (MN)	3.5	1.8	1.5
98 th P (MN)	28.6	16.4	8.6
98 th P (kN/tonne)	42.1	24.2	12.6

Compare with normalized rotor thrust loads (50-y)
NREL reference wind turbine (kN/tonne)



RESULTS

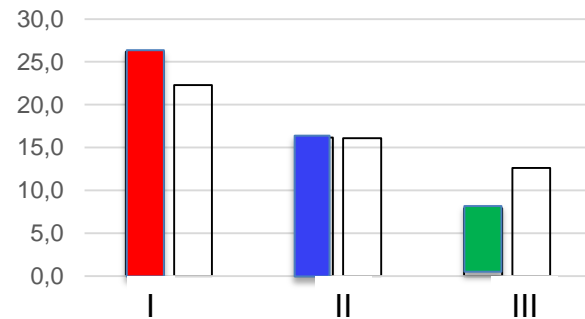
Linear Heave (1-year)



RM3 Heave Excitation Loads, 1-year

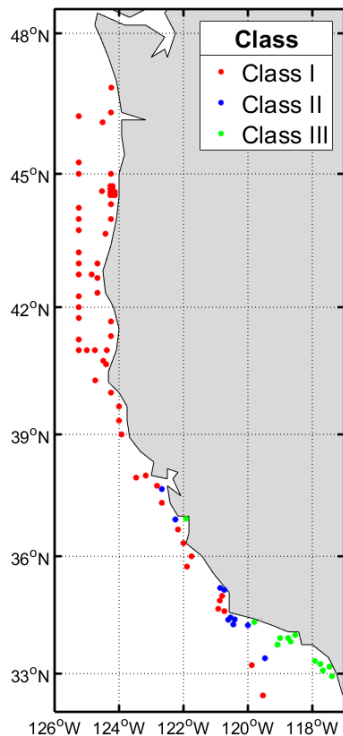
Class	I	II	III
Average (MN)	13.9	8.6	3.9
Std. Dev. (MN)	2.0	1.2	0.7
98 th P (MN)	17.8	11.0	5.4
98 th P (kN/tonne)	26.2	16.2	7.9

Compare with normalized rotor thrust loads (1-y)
NREL reference wind turbine (kN/tonne)



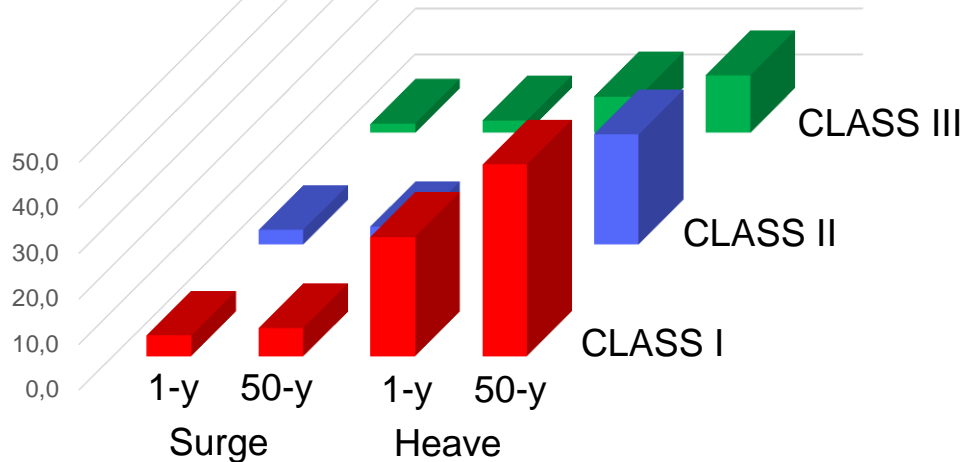
RESULTS

98th Percentile Heave and Surge Loads



RM3 98th Percentile Excitation Loads (kN/tonne)

CLASS	I	II	III
Surge 1	4.5	3.2	2.0
Surge 50	6.2	4.0	2.7
Heave 1	26.2	16.2	7.9
Heave 50	42.1	24.2	12.6



CONCLUSIONS

- Magnitude and distribution of dominant extreme load (heave) similar to maximum rotor thrust loads on NREL reference wind turbine for IEC Class I, II and III conditions – similar classification systems for WECs feasible
- Method can be applied to evaluate extreme load response and classification system for any WEC archetype
- Future studies
 - Increase population of sites for improved statistics
 - Expand design load cases and types of extreme load responses



Long-term load response of a two-body point absorber in extreme seas

THANK YOU

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