SAND2017-3653C

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Sandia National Laboratories

On the Selection of Sea States in Assessing Extreme Loads on a Wave Energy Converter

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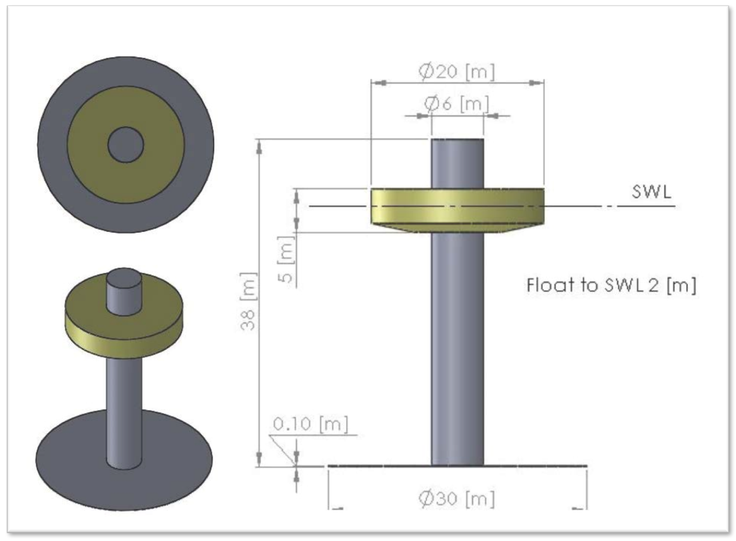
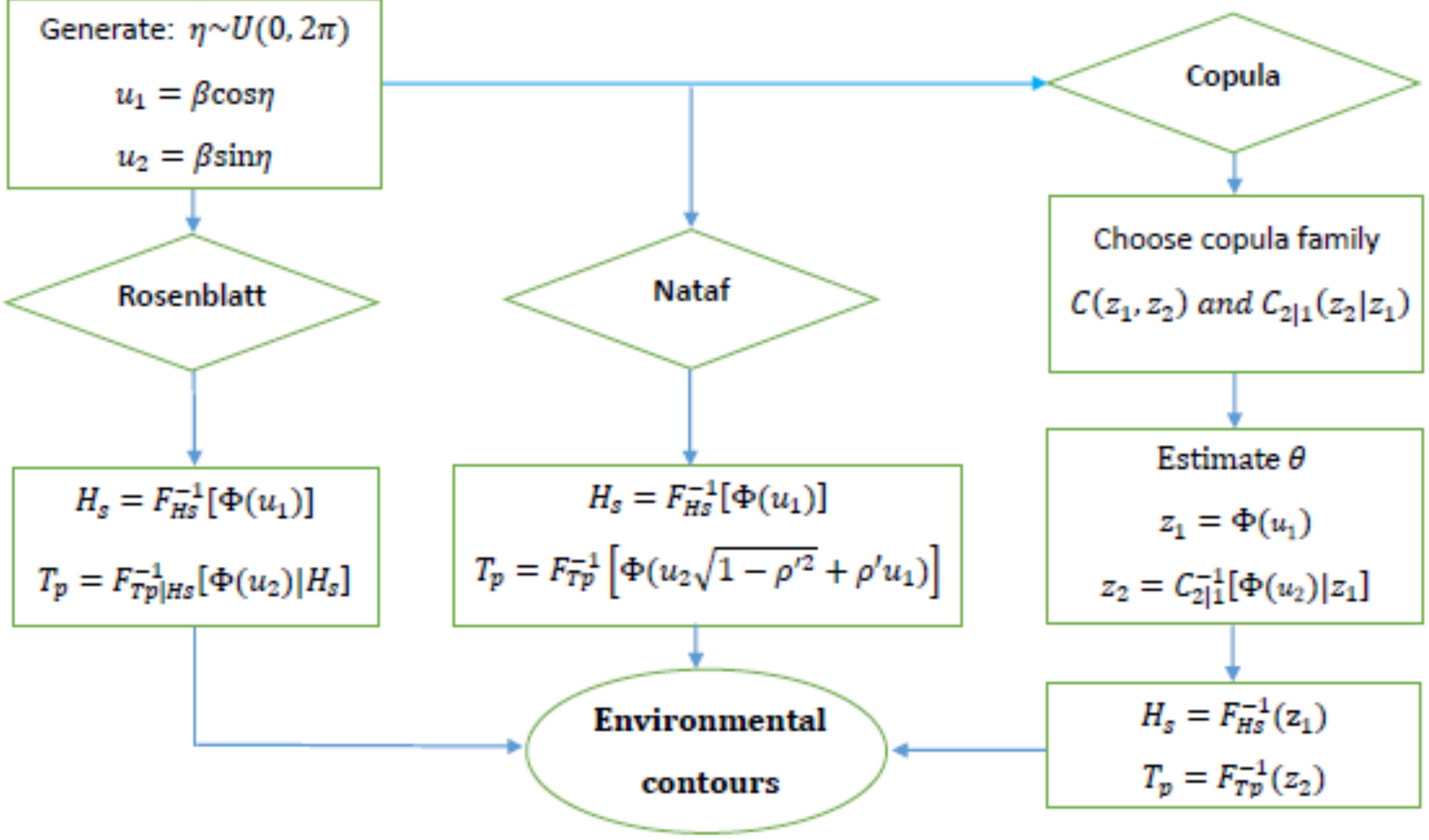
May 1-3, 2017

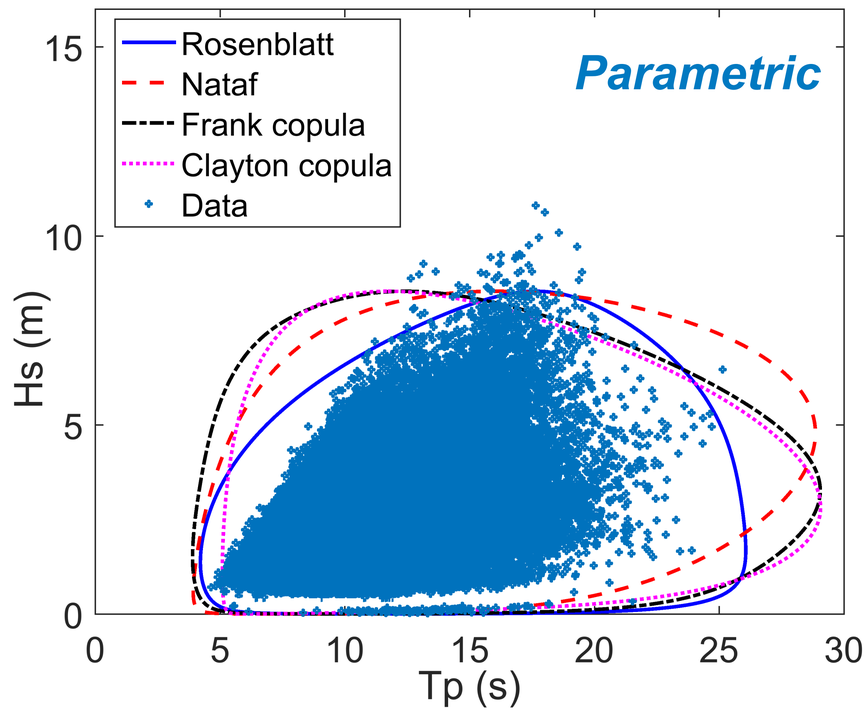
Abstract

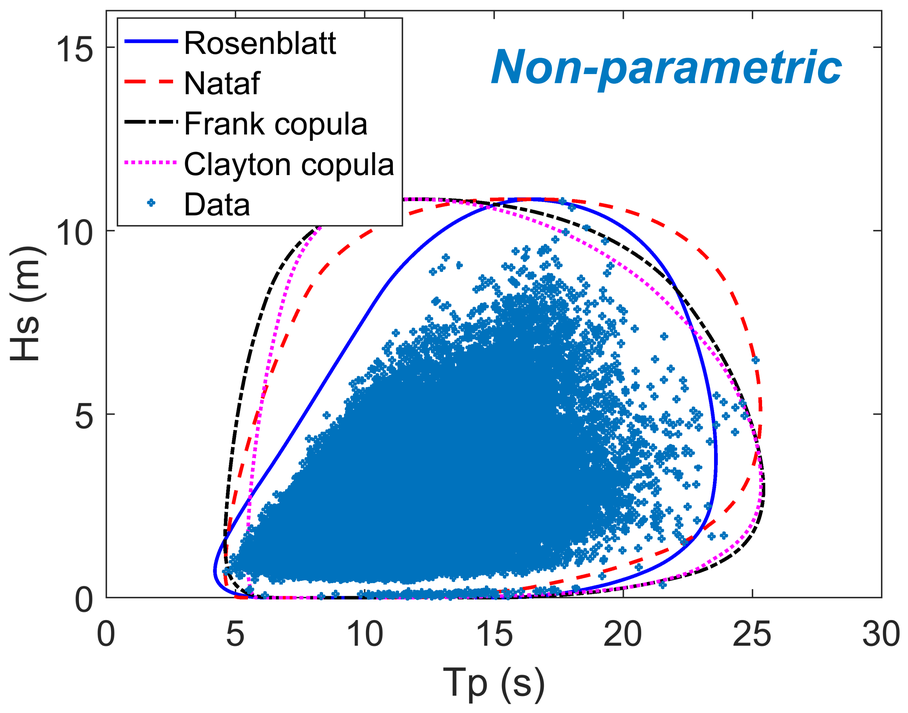
This study is concerned with the extreme response of a two-body wave point absorber (Reference Model 3 or RM3) [1]. This device, which serves as a wave energy converter (WEC), is a simple two-body point absorber consisting of a float and a reaction plate. Power generation results from heave motion induced by waves. We use the open-source simulation tool (Wave Energy Converter Simulator or WEC-Sim) to carry out simulations of the device. We are interested in site-specific design loads associated with a 50-year return period. Accordingly, we use the Inverse FORM approach in this study [2, 3]. The deployment site of interest for this device is near National Data Buoy Center Site 46022. We are most interested in discussing how the availability of metocean data from such sites may be used to define "environmental contours" that help to derive design loads. We show how, given the same metocean data, we can either estimate joint distributions or marginal distributions of the underlying variables together with different correlation measures. These two different approaches, both consistent with the data, lead to somewhat different environmental contours used for design.



Schematic representation of the Reference Model 3 (RM3) point absorber [1].







Conclusions

- When site data are limited, it is often not possible to derive full joint distributions on the metocean variables for evaluating extreme loads on a WEC device.
- With the same data set, we show how environmental contours may be constructed given different dependence assumptions on the metocean variables.
- Distribution-free approaches are presented along with parametric approaches for developing the environmental contours; such approaches have the advantage of not requiring fits to the data.
- Such environmental contours are important in design load definition.
- The approaches presented show how to make use of various summaries of metocean variable statistics – full joint distributions, marginal distributions, correlation coefficients, etc.

ACKNOWLEDGEMENTS

This work was funded by the U.S. Department of Energy's Water Power Technologies Office. Sandia National Laboratories is a multi-mission laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

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