

# Assessing the accuracy of boundary element method codes for wave energy converter simulation

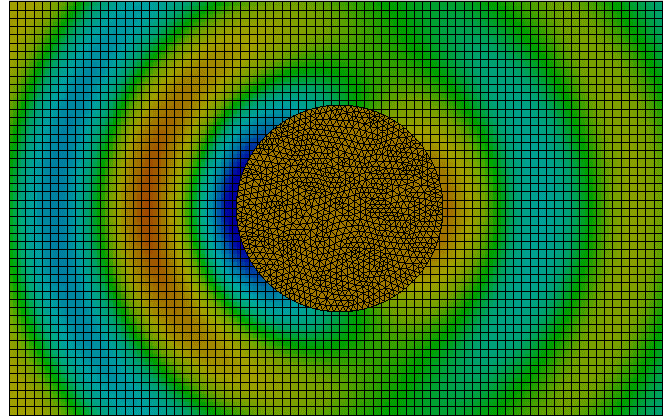
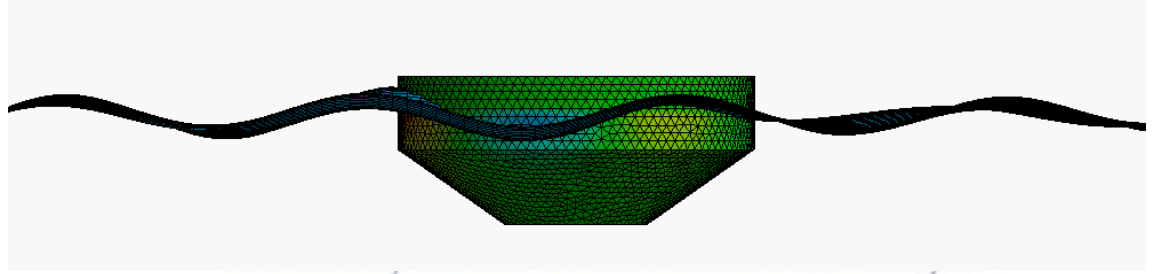
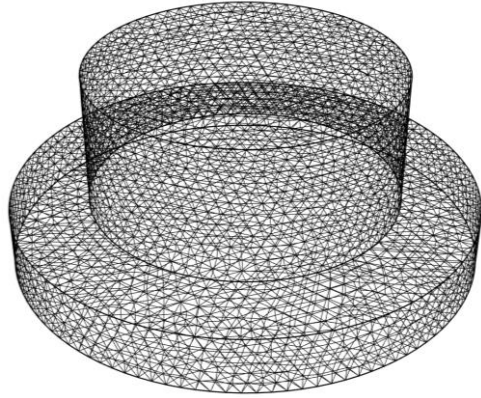
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Polagye, and Curtis Rusch



# Boundary Element Methods

$$\nabla^2 \phi = 0$$



Images:  
<https://www.wamit.com/>  
<https://capytaine.github.io/stable/#>

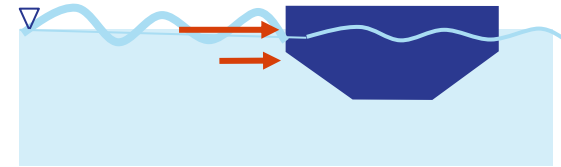
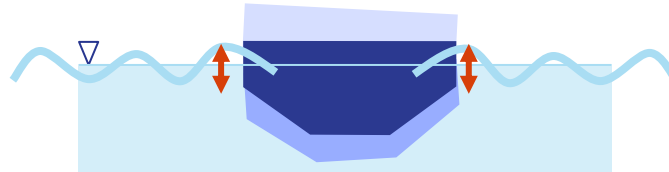
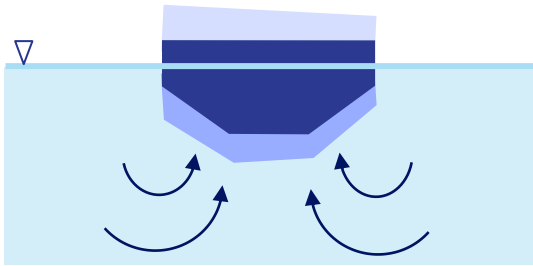
# WEC Hydrodynamics

$$(-\omega^2(M + A(\omega)) + i\omega B(\omega) + K)\hat{X} = \hat{F}_{exc}(\omega)$$

Added Mass [kg]  
~ acceleration

Radiation Damping  
[N-s/m] ~ velocity

Excitation Force [N/m]




# Goals

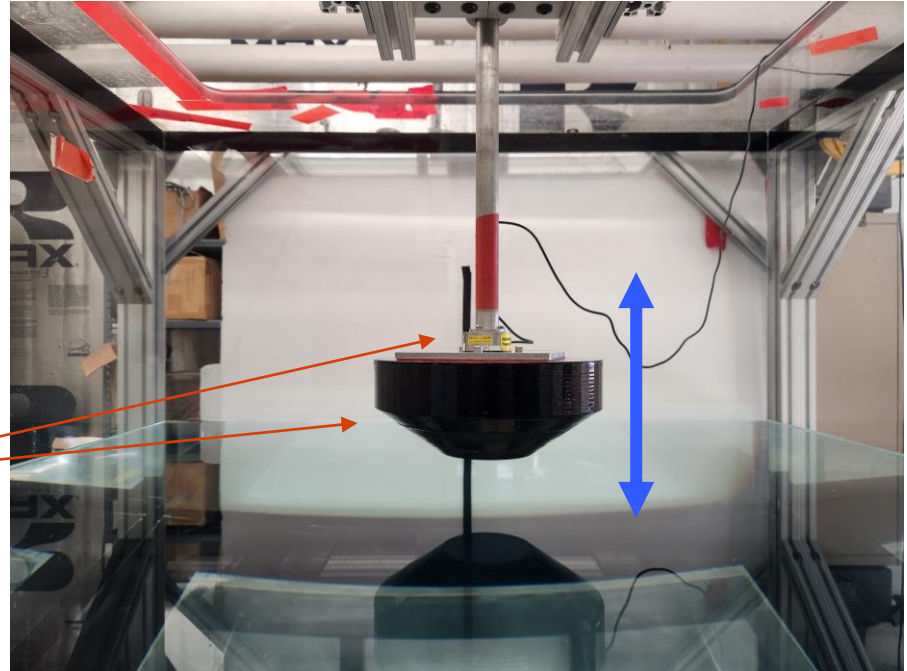
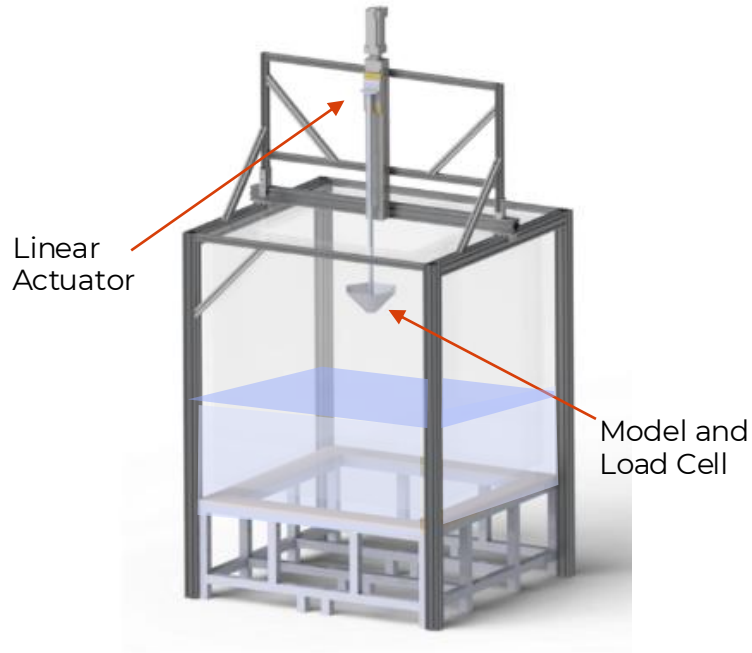
Characterize the hydrodynamic coefficients from BEM for various WEC floats and assess the impact of geometric variation across BEM codes and against experimental results.

- Evaluate changes in hydrodynamics between BEM codes for each geometry
- **Compare BEM with experimental results to estimate potential inaccuracy**

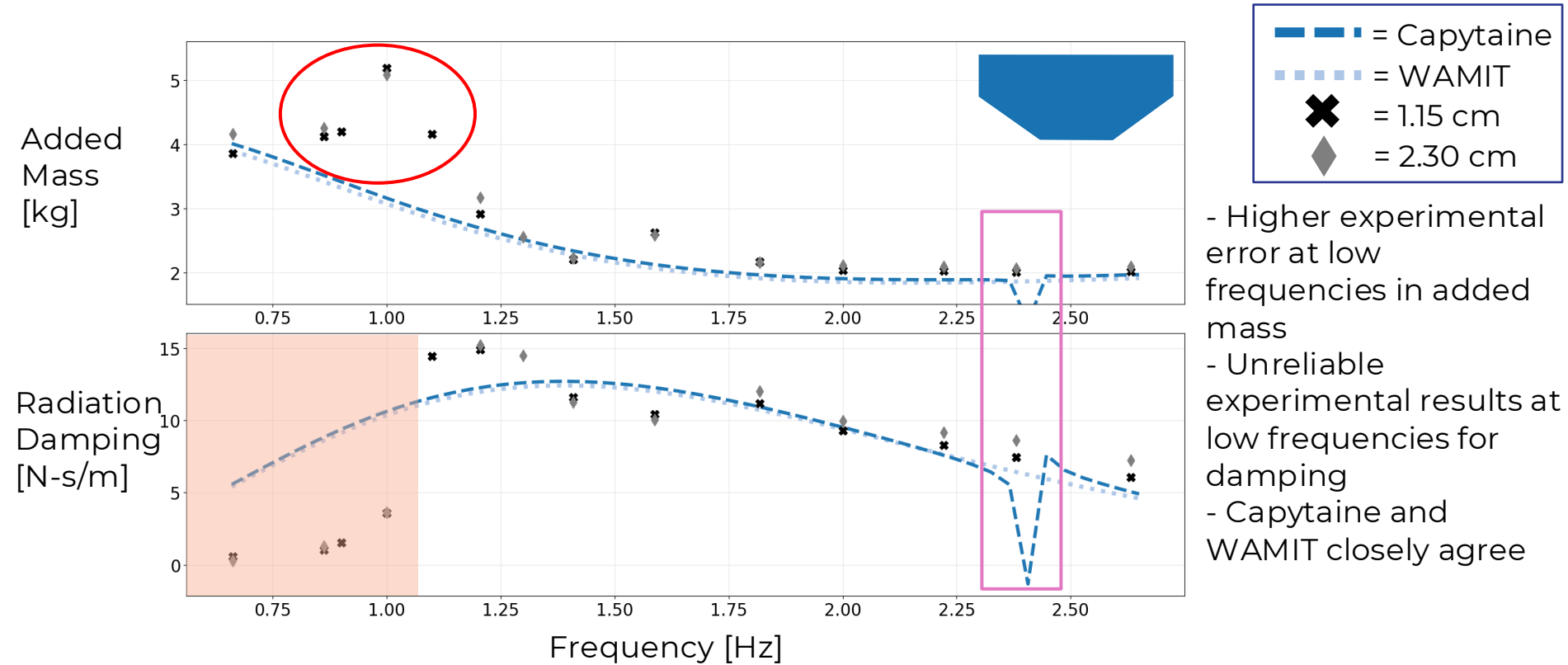
# Float Geometries

Shape	Description
<p>WaveBot</p>  A blue trapezoidal cross-section of a float. A white horizontal line represents the water surface. A vertical double-headed arrow indicates the draft, which is the submerged depth of the float.	<p>Benchmark case: 1/7th scale of Sandia National Labs WaveBot experiments</p>

# Experimental Methods

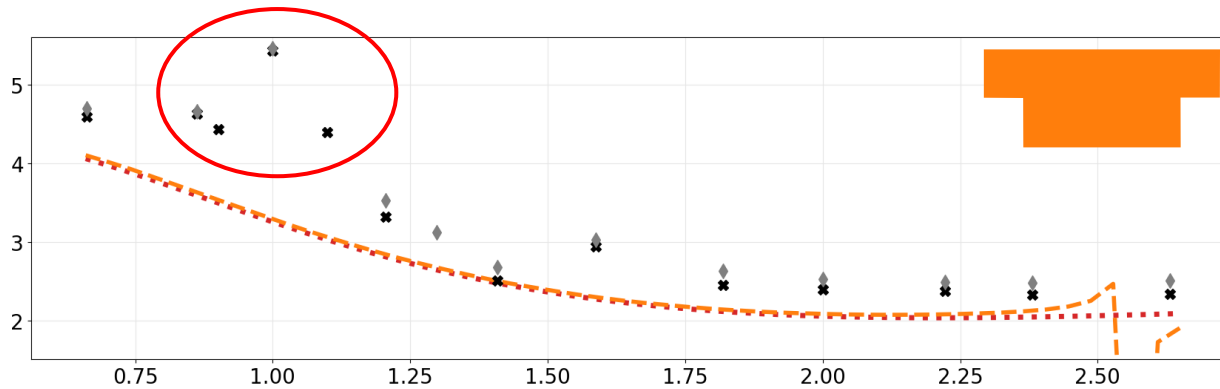


# WaveBot BEM vs. Experiments



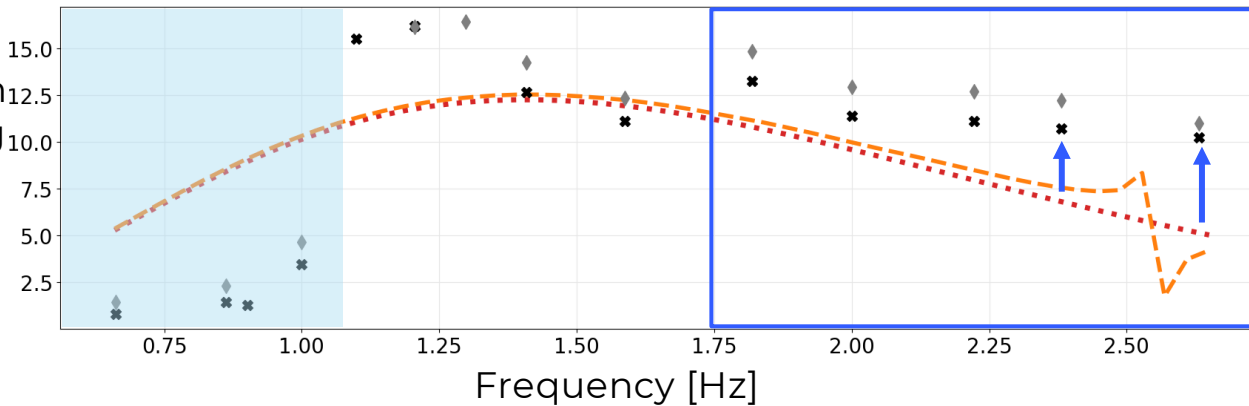
# “T” BEM vs. Experiments

Added Mass  
[kg]



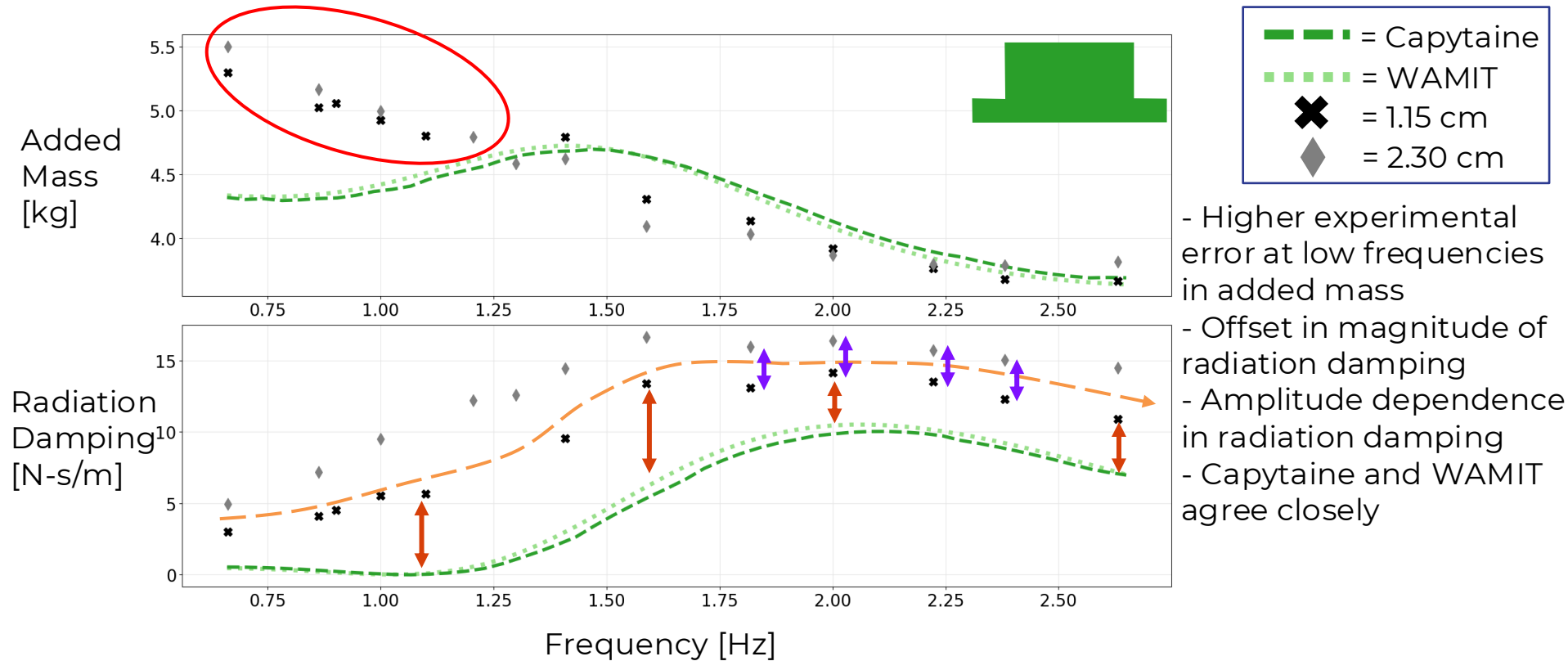
- Higher experimental error at low frequencies in added mass
- Unreliable experimental results at low frequencies for damping
- Experiments diverge from BEM at higher frequencies
- Capytaine and WAMIT closely agree

Radiation Damping  
[N-s/m]

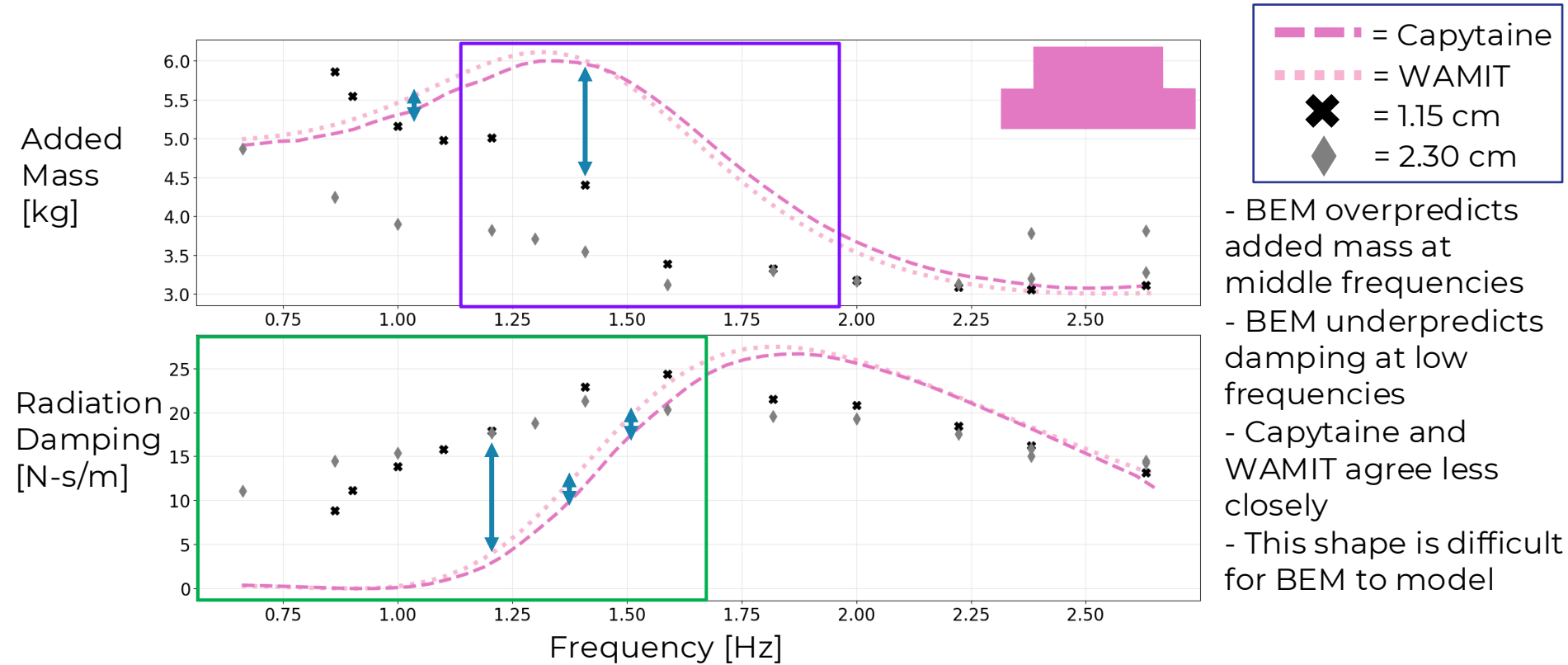




# Thin Hat BEM vs. Experiments



# Thick Hat BEM vs. Experiments





# Conclusions

- There is limited variation in BEM results from Capytaine and WAMIT for most geometries, especially **non-brimmed** geometries
- BEM and experiments agree in both magnitude and behavior for most frequencies for **non-brimmed** geometries
- BEM struggles to predict the hydrodynamics of a geometry with **a brim near the free-surface**

# Questions?

Funding provided by:

