

Metocean conditions during the Antarctic Circumnavigation Expedition: A comparison with model predictions

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Introduction

Global wave models show considerable biases in integral wave parameters in the Southern Ocean, a remote region of the world that is still poorly explored.

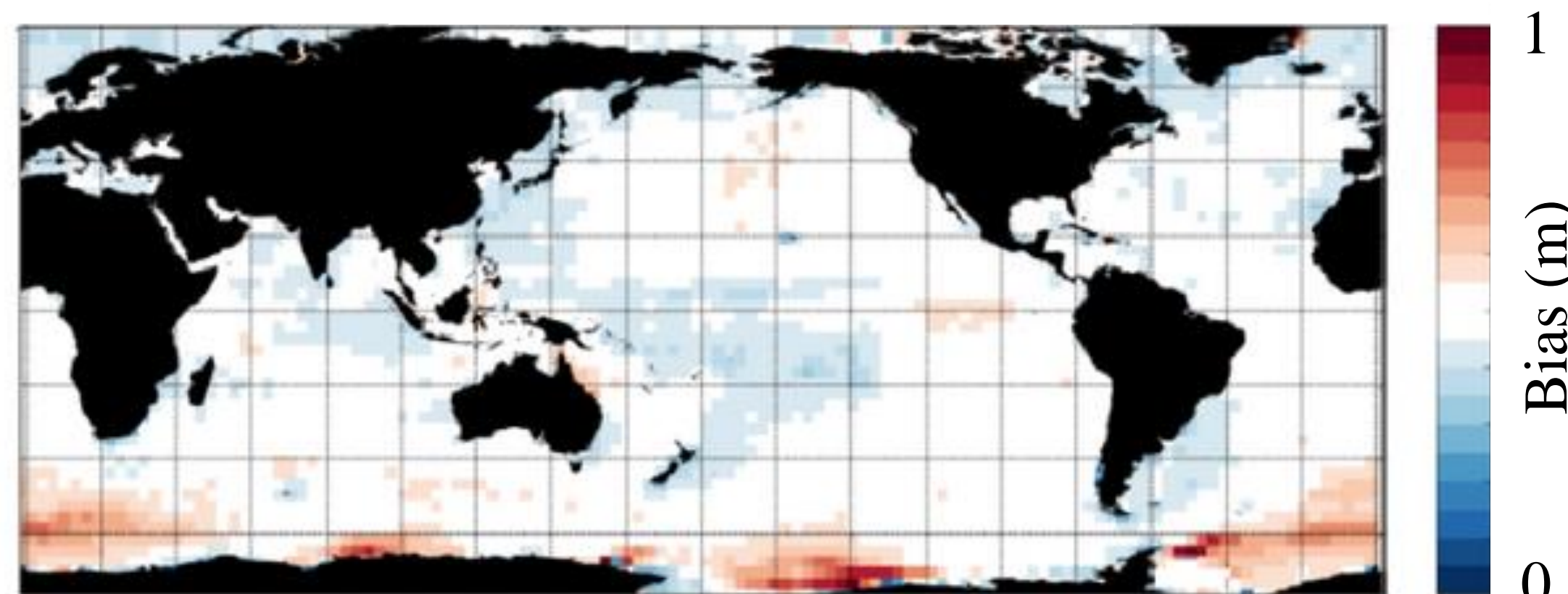


Figure 1. Example model verification of *CAWCR* hindcast for 2005 H_s against altimeter data (see Zieger et al., 2015).

Observations

Here, we present a database of metocean conditions compiled during the Antarctic Circumnavigation Expedition (*ACE*) from December 2016 to March 2017. Observations were gathered using a radar-based wave and surface current monitoring system (*WaMoS-II*) on board of the research vessel Akademik Tryoshnikov.



Figure 2. Antarctic Circumnavigation Expedition (Dec. 2016 – Mar. 2017).

Methods

Observations are calibrated using sea state information reconstructed from the measured ship motions.

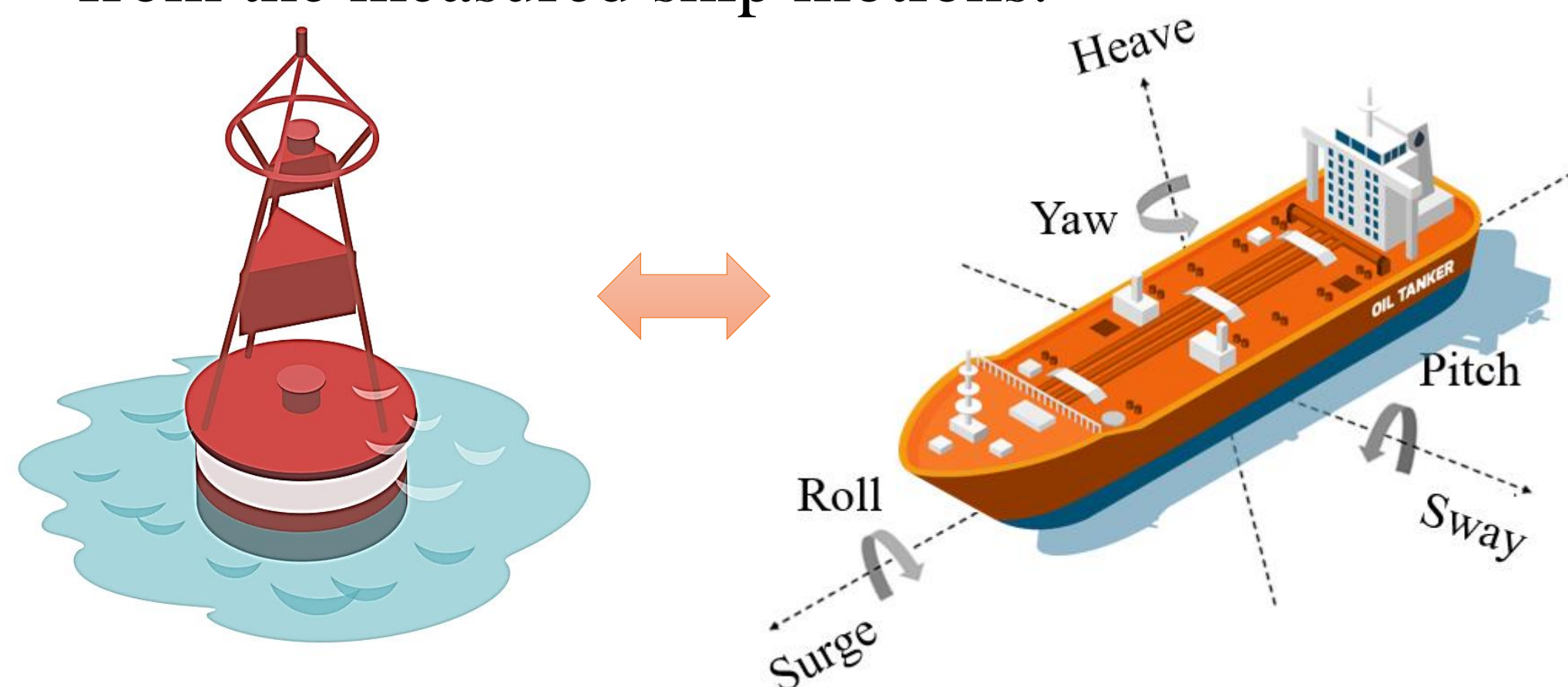
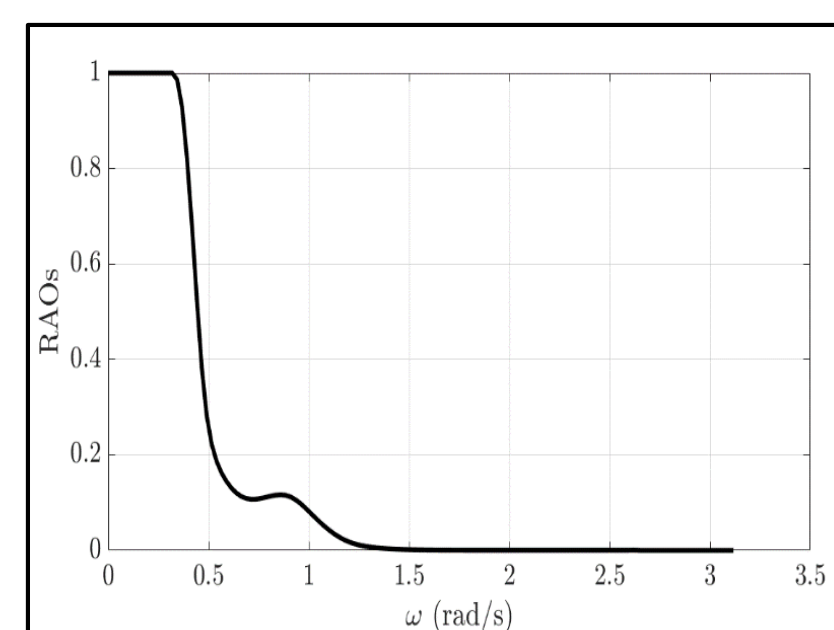
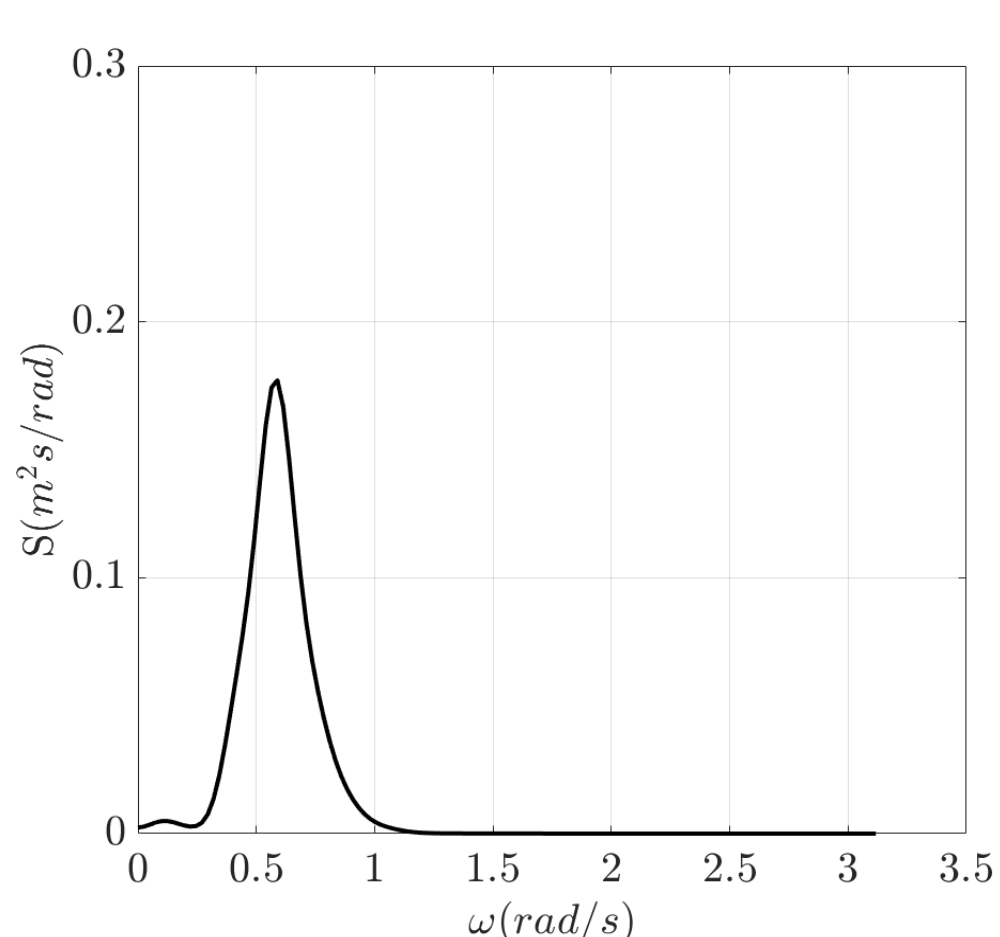


Figure 3. Assuming ship as a big buoy, directional properties of encountered sea state is estimated based on the measured heave motion of the ship.

Measured Response Spectrum



÷ Transfer Function (RAO^2)

Reconstructed Sea State

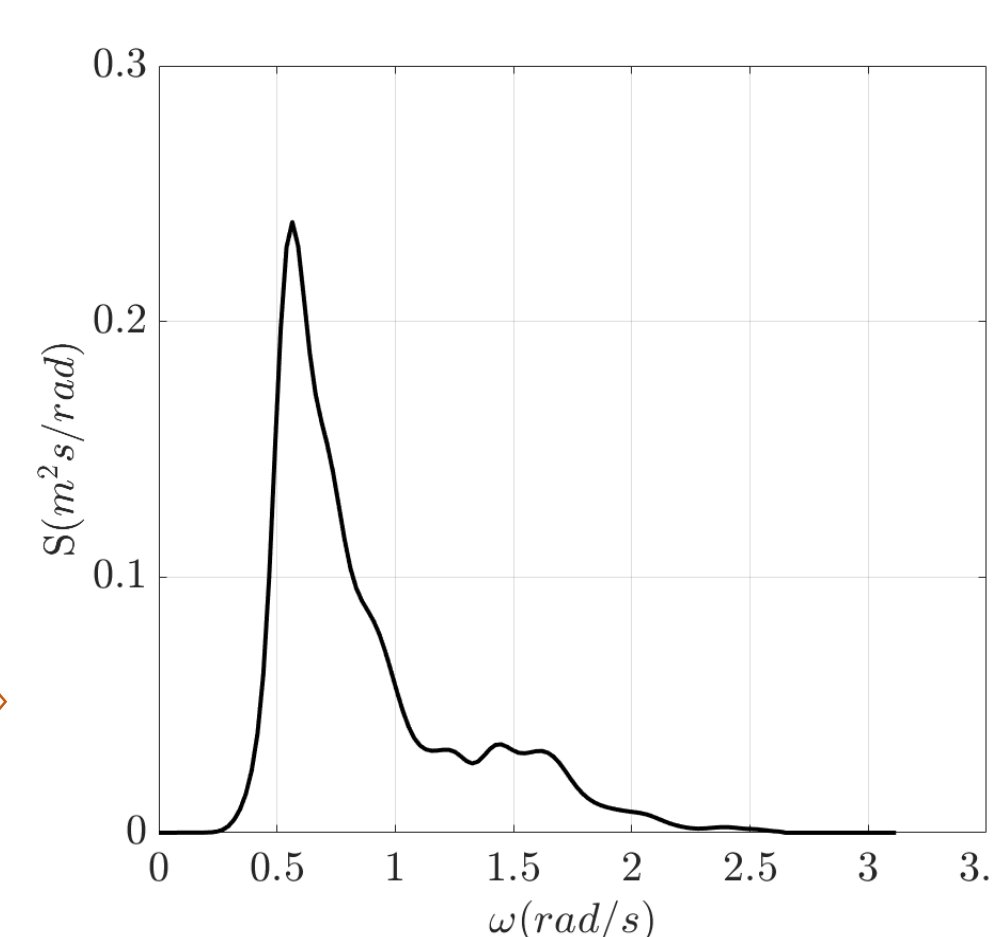


Figure 4. Response Amplitude Operators ($RAOs$) of the ship is modelled using Nemoh, a *BEM* model developed at Ecole Centrale de Nantes. This modelled $RAOs$ is used to reconstructed the sea states based on measured response spectra.

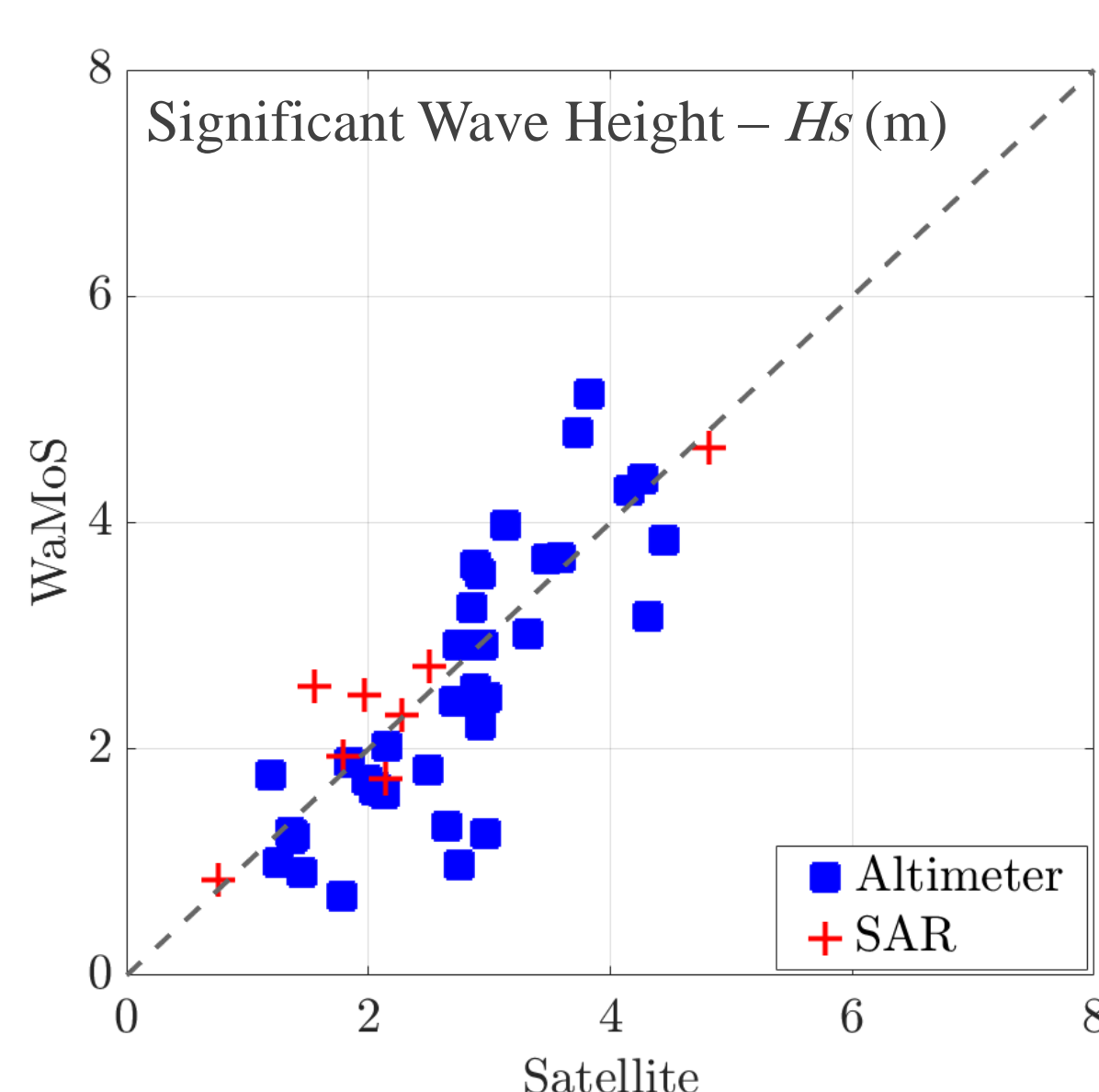


Figure 5. Significant wave height from calibrated observations is evaluated against satellite data-sets obtained from altimeter and Synthetic Aperture Radar (*SAR*).

Results

Calibrated observations are used to discuss the performance of the global wave model, *CAWCR* hindcast, in the Southern Ocean.

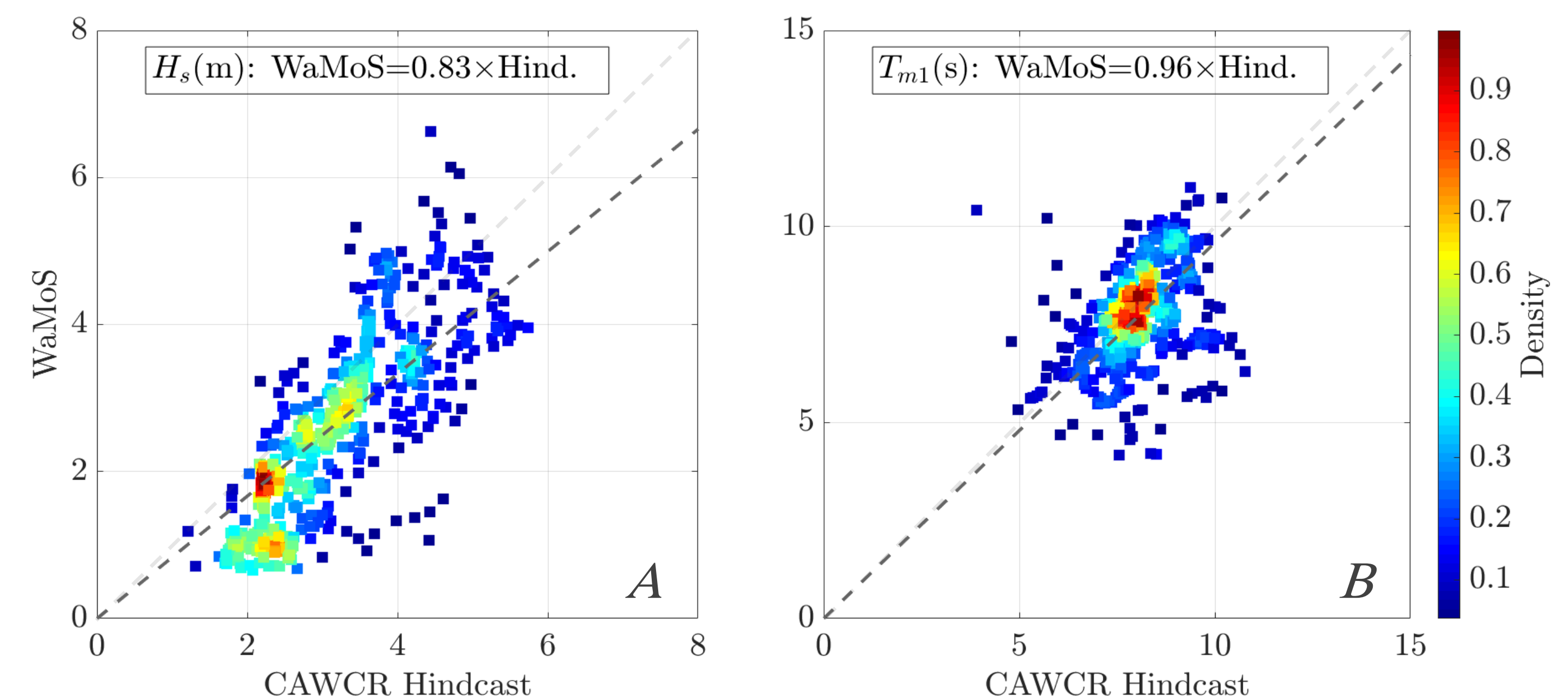


Figure 6. Observed integral wave parameters against *CAWCR* hindcast from *ACE* legs 1, 2, and 3.

A) Significant wave height, B) Mean wave period.

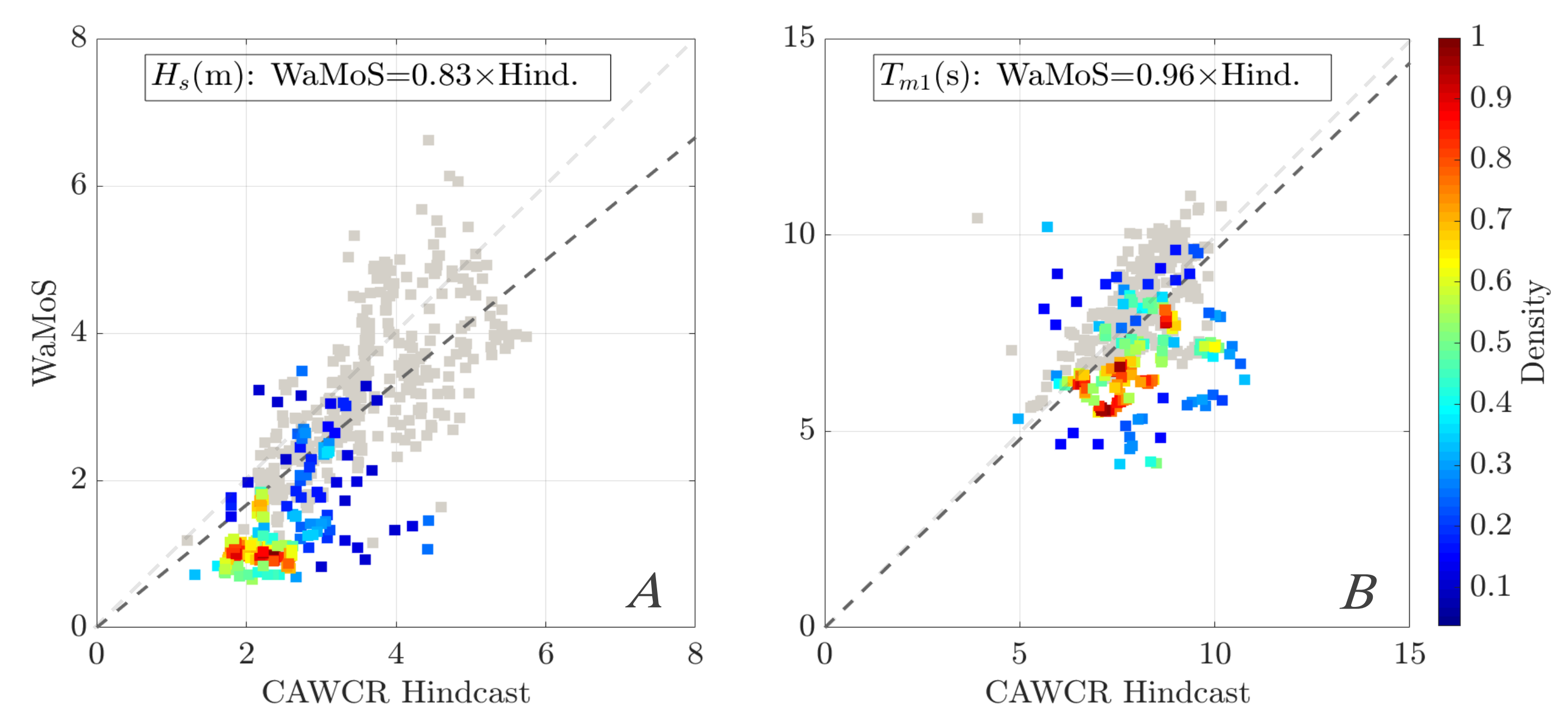


Figure 7. Observed integral wave parameters against *CAWCR* hindcast with highlighted data from 2nd leg in Antarctic Marginal Ice Zone (*MIZ*).

A) Significant wave height, B) Mean wave period.

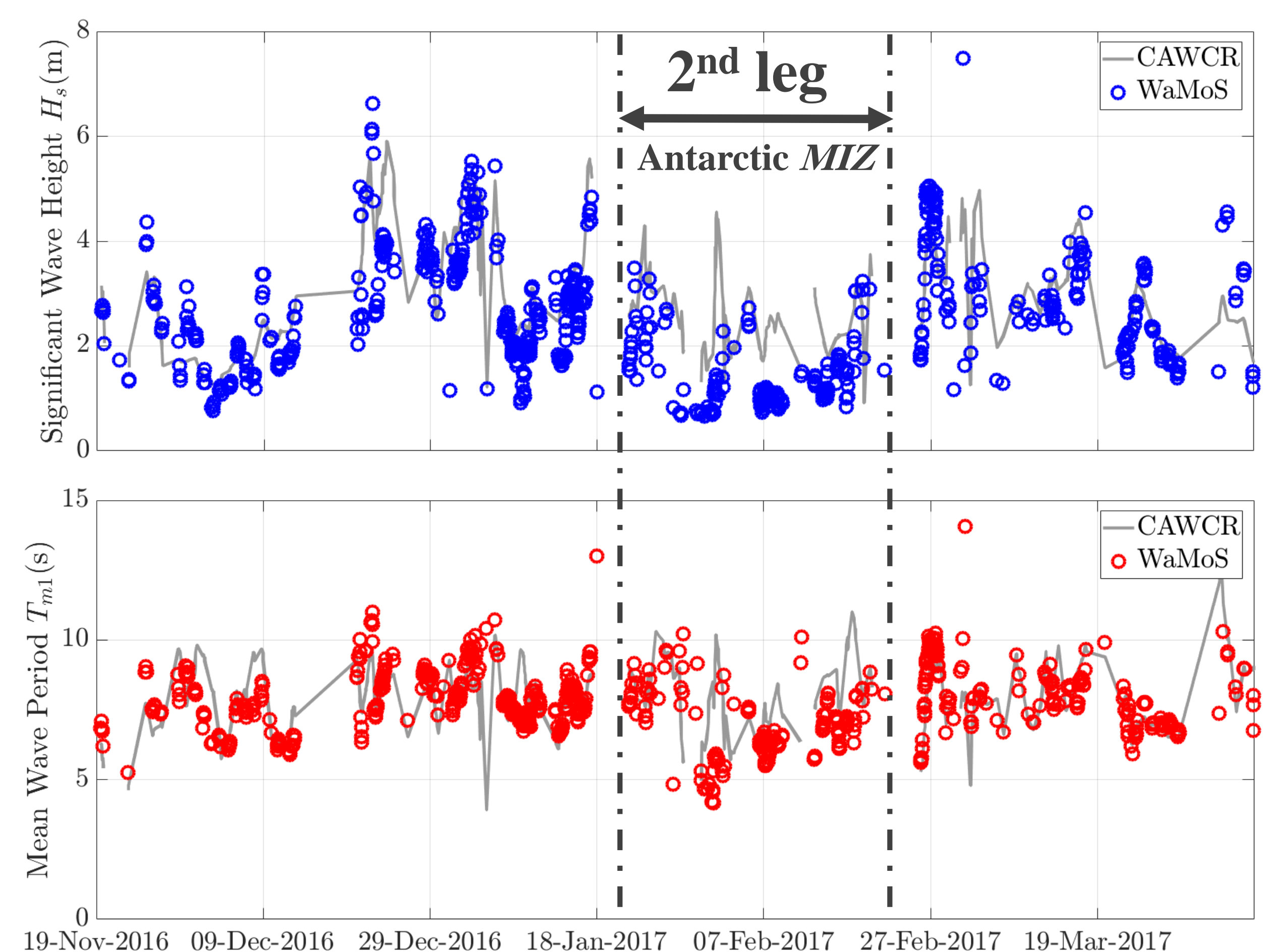


Figure 8. Timeseries of observed integral wave parameters against *CAWCR* hindcast.

Conclusion

CAWCR hindcast generally overestimates the significant wave height. This overestimation is more considerable in the *MIZ* indicating the limited performance of global wave models by improper detection of wave-ice interaction in high latitudes. Nevertheless, observed storms are underestimated by the hindcast.

Acknowledgements

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