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Numerical modeling and validation of wave heights and directionality in the ice using WAVEWATCH III

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The poorly understood attenuation of waves, the key dynamic effect that defines the width of the Marginal Ice Zone, has been attributed to the combined effect of wave scattering and wave dissipation. Because scattering and dissipation have very different effects on the directional distribution of wave energy, it is possible to better understand the balance between scattering and dissipation by an analysis of the width of the directional wave spectrum. We have thus introduced dissipation and scattering terms in the spectral wave model WAVEWATCH III, and an estimation of the maximum ice floe size. Academic and realistic simulations show that the energy level and directional spreading far into the Arctic pack ice (Wadhams and Doble 2009) can be well explained by dissipative processes without the need for scattering. The same is true of observed swells in the Southern Ocean (Ardhuin et al. 2015). However, the dissipation level required to explain the observed wave height goes from 2 in the southern ocean to 12 times the viscous dissipation under a smooth ice plate. This and other data suggest that broken ice causes less dissipation than a continuous ice cover, possibly due to the dissipation by creep inside the ice when it is not broken and bends. Work is under way to parameterize that effect using the estimated maximum ice floe size.