Quantifying the Skill of Sea Ice Simulations in Earth System Models Using a Variational ICESat-2 Emulator

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Abstract

ICESat-2 is scheduled for launch in late 2018 and offers the potential of basin-scale sea ice freeboard measured with unprecedented accuracy. A challenge awaiting Earth System Modelers using data from the Advanced Topographic Laser Altimeter System (ATLAS) aboard ICESat-2 is in quantifying model skill and bias to accurately account for the time, place, snow cover and scale-dependent density of sea ice in models. To achieve this, we have developed a satellite emulator in the Regional Arctic System Model (RASM; Roberts et al., 2015, Hamman et al. 2017, Cassano et al. 2017) to generate run-time skill metrics within CICE Consortium sea ice code. Rather than comparing modeled ice thickness with approximations generated from ATLAS retrievals, the emulator directly compares modeled and measured freeboard, avoiding uncertainties associated with ice density and snow loading in observational freeboard-to-thickness conversions. A virtual version of ICESat-2 flies through the model and samples freeboard at the same place and time as ICESat-2. The most important innovation associated with the emulator lies in determining modeled freeboard with variational ridging. This permits the scale-dependent density of sea ice to be matched to the Gaussian footprint of ICESat-2 laser tracks via a 'Dilation Field' using the principle of virtual work. We focus on this aspect of the ICESat-2 emulator and highlight its computational efficiency and portability, and present RASM results of model bias and skill-scores.

References

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