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Exploring the Effect of Aerosol on Marine Cloud Cover Using a Counterfactual Approach

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Aerosol–cloud interactions in marine stratocumulus clouds (Sc) are among the most challenging frontiers in cloud–climate research. In particular, the cloud cover susceptibility to droplet concentration remained under-represented in the literature. We developed methodologies to estimate what would have been the cloud cover and the associated radiative effect of currently observed Sc, but in a hypothetical cleaner world. The first methodology uses a realistic Lagrangian large eddy simulation coupled with satellite observations and provides a process-oriented analysis. The other uses a simple model and provides a global estimate of the radiative impact. We found that overcast Sc decks would have broken up sooner had they not been influenced by anthropogenic aerosol, thereby causing a significant effective radiative forcing.