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Influence of horizontal resolution and complexity of aerosol-cloud interactions on marine stratocumulus and stratocumulus-to-cumulus transition in HadGEM-GC31

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We evaluate the impact of horizontal model resolution (~135, 60 and 25 km, respectively) and different levels of complexity of the aerosol-cloud interaction parameterization (interactive versus non-interactive) on springtime subtropical marine stratocumulus properties and stratocumulus-to-cumulus transition (SCT) using the atmosphere-only version of HadGEM-GC31. Higher resolution and non-interactive aerosols resulted in small, but significantly higher, liquid water contents and lower precipitation rates, in particular over the southern hemisphere. Higher resolution also resulted in a significantly stronger shortwave (SW) cloud radiative effect (CRE). Over the southern hemisphere, non-interactive aerosols also resulted in a stronger SW CRE, but over the northern hemisphere non-significant changes or a weaker SW CRE was obtained compared to the simulation using interactive aerosols. In general, no significant changes in the all-sky SW radiation was obtained. Only the model version with lowest resolution showed a weak tendency of a faster SCT than the other model versions. We conclude that a change in the complexity of the aerosol-cloud parameterization may significantly affect the SW CRE of marine stratocumuli, at least regionally, but the sign and magnitude of the impact will be dependent on the background level as well as the relative change in liquid water and the absolute change in cloud droplet number concentration of the specific model version.