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Resolution Dependency of Future Caribbean Sea Level Response

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The current global climate models, which are often used in inter-comparison projects, have a large variety in their spatial resolution. For most climate models, the resolution of the ocean grid does not allow to resolve mesoscale processes such as ocean eddies. Current sea level projections are based on these coarse climate models, but might have biases (either positive or negative) in these projections since mesoscale processes are parameterised.

Here we investigate the differences in future Caribbean sea level rise using a centennial simulation of a high- and low-resolution version of the Community Earth System Model under the same anthropogenic forcing. In the high-resolution version of the model mesoscale processes are resolved. Locally, we find a decrease of 7.2 cm in sea level extremes over a 100-year period in the high-resolution version; this decrease is almost absent in the low-resolution version. This local decrease in sea level extremes is related to ocean eddies, which are not resolved in the low-resolution version, hence explaining the different sea level response between the models. When comparing modelled sea level trends to observed sea level trends over the past 25 years, we find a reasonable agreement between observations and the high-resolution model. However, for the low-resolution model and some of the preliminary CMIP6 model output, there is a substantial mismatch between the observed- and modelled sea level trends.

By analysing model output from two different resolutions of the same climate model, we find that the sea level response in the Caribbean Sea is resolution-dependent. As a result, not resolving mesoscale processes in climate models can locally result in overestimations of future sea level rise projections.