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Antarctic shelf warming under climate change: Insights from eddying climate models

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Ocean warming around the Antarctic Ice Sheet has important implications for ice sheet mass loss and global sea level rise. Understanding the ocean processes responsible for Antarctic shelf warming is thus critical to improve climate projections. Several recent studies have pointed out the role of ocean mesoscale eddies in bringing heat onto the shelf with a focus on specific regions, such as the Western Antarctic Peninsula. However, we still lack a more general picture of ocean warming over the whole Antarctic shelf region and a detailed analysis of the response of heat transport to climate change.

In this study, we present an analysis of the response of ocean heat transport at the Antarctic shelf break to climate change, and we address the role of mesoscale eddies in this transport. To do so, we use two eddying climate models of different resolutions in the ocean (0.25° and 0.10°) each run under a preindustrial forcing scenario and a climate change forcing scenario. Analyses of the heat transport across the Antarctic Slope Front (ASF) are carried out with a decomposition of the transport into its time-mean and eddy components. Heat budgets over the shelf region are also performed to investigate the role of other processes (e.g. surface fluxes) in shelf warming. Finally, the Antarctic shelf region is divided into several sub-regions to examine geographical variations in the warming. We find that the shelf regions warm under climate change due to a combination of warmer atmospheric temperatures, a large reduction of sea ice coverage, increased heat transport across the ASF or increased freshening at the surface. We discuss the impact of each of these factors on shelf warming in the different regions, as well as the contribution of mesoscale eddies to this warming.