Geophysical Research Abstracts
Vol. 21, EGU2019-4275, 2019
EGU General Assembly 2019

Climatic Forcing of Ice-Shelf Melting in the Amundsen Sea: Anthropogenic Trends and Internal Variability

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Recent ice loss from the West Antarctic Ice Sheet has been caused by ocean melting of ice shelves in the Amundsen Sea. Eastward wind anomalies at the shelf break enhance the import of warm Circumpolar Deep Water into the Amundsen Sea, creating transient ice-shelf melting anomalies with an approximately decadal period. However, no anthropogenic influence on this process has been established. We use climate model simulations to infer that increased greenhouse-gas forcing caused shelf-break winds to transition from mean easterlies in the 1920s to the near-zero mean zonal winds of the present day. Strong internal climate variability, primarily linked to the tropical Pacific, is superimposed upon this anthropogenic trend. This indicates that the Amundsen Sea experienced decadal ocean anomalies throughout the twentieth century, with warm anomalies gradually becoming more prevalent. This offers a credible explanation for the ongoing ice loss. Model projections show that strong future greenhouse-gas forcing creates persistent mean westerly shelf-break winds by 2100, suggesting a further enhancement of warm ocean anomalies. These wind changes do not occur under a scenario in which greenhouse gases are stabilised.