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The role of the Arctic on the variability of the Bering Strait throughflow using GRACE ocean bottom pressure and in situ mooring observations from 2002 to 2016.

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The oceanic flow through the Bering Strait – the only oceanic connection between the Pacific and the Arctic oceans – plays an important role in Arctic water column stratification and the Arctic's heat and freshwater budgets, and is also a major source of nutrients critical for Arctic ecosystems. Various studies suggest that the Bering Strait throughflow, though mediated by the local wind, is primarily driven by a far-field, 'pressure head' forcing, commonly attributed (without proof) to a sea surface height difference between the Pacific and the Arctic. Using monthly observations of ocean bottom pressure anomalies (OBP) from the Gravity Recovery and Climate Experiment (GRACE) data from 2002 to 2016, combined with in situ ocean velocity data from long-term moorings in the Bering Strait, we now identify the characteristics of the pressure head forcing of the flow. We find that the pressure head variability is predominantly driven from the Arctic, specifically by OBP variations in the East Siberian Sea (ESS). Examined seasonally, we find substantial Arctic-driving of the flow especially during the summer, when the Bering Strait throughflow is generally largest, and to a lesser extent during the winter, when local wind forcing dominates the total flow variability. During the summer, the OBP variations in the ESS explain about two thirds of the total Bering Strait flow variance, and are related to westward winds on the Arctic shelves. We suggest these westward winds drive a northward Ekman flux, lowering sea-level in the ESS, thus increasing the sea surface height difference between the Bering Sea Shelf and the ESS and drawing waters northward through the Bering Strait. During the winter, in addition to this mechanism, variability in the Bering Strait flow is more strongly related to OBP variation over the Bering Sea shelf ($\sim$35% of the total flow variance vs $\sim$6% from ESS OBP only), in turn driven by winds in the north Pacific.