Estimation of Bering Strait throughflow using local wind, sea-level gradient and pressure-head forcing

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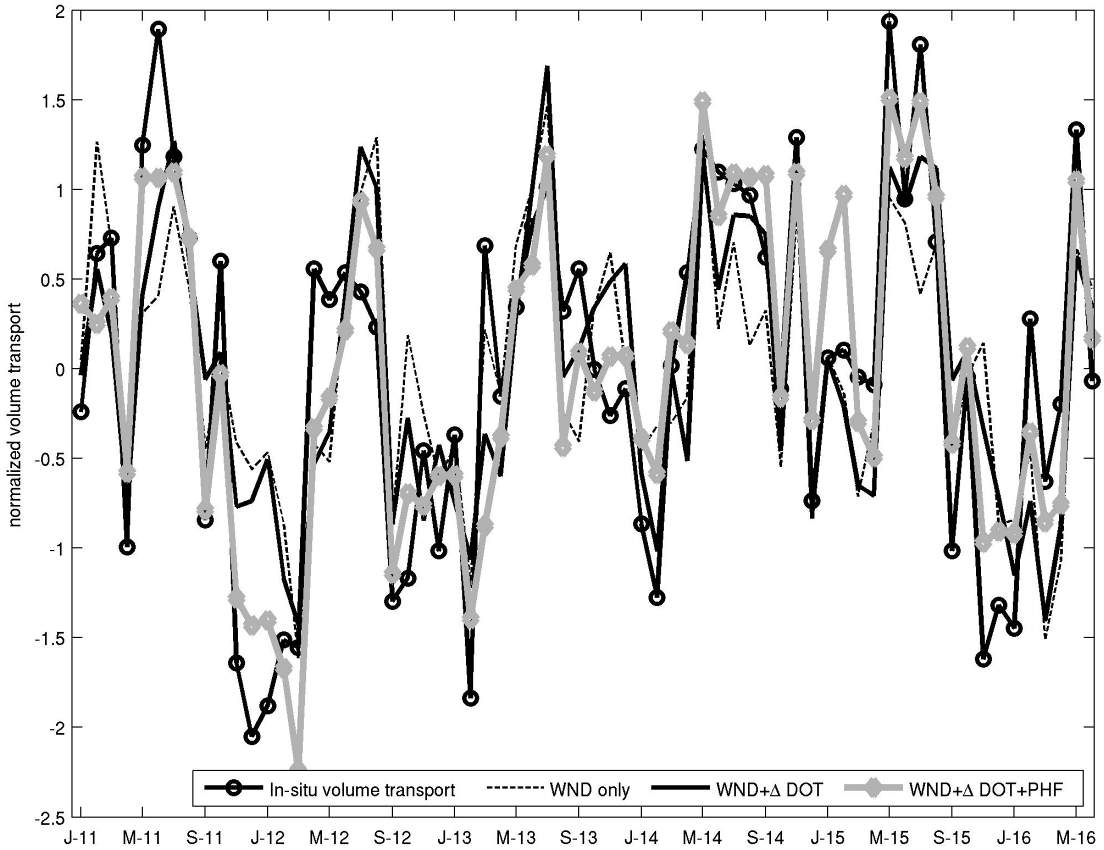
The volume transport of the Bering Strait is one of the important parameters for understanding the poleward heat/freshwater/nutrient flux into the Pacific sector of the Arctic Ocean. It has been pointed out that the Bering Strait throughflow is driven by local wind and the pressure-head forcing related to the difference of sea surface height between the Pacific and Arctic. However, this pressure-head forcing has not been well defined. In this study, we attempted to build the regression models to reproduce the volume transport of the Bering Strait (Woodgate et al. 2015), using two gridded datasets; ERA5 monthly averaged 10m U- and V-components of wind, and monthly Dynamic Ocean Topography (DOT) derived from the measurements of satellite radar altimeters from January 2011 to December 2018. DOT dataset in the ice-covered area was constructed from the measurements from the SAR/Interferometric Radar Altimeter mounted on the CryoSat-2. Predictor variables are 330 degree wind component derived from ERA5 data, sea level gradient across the strait, and the difference of DOT between the Bering Sea (or the Pacific Ocean) and the Arctic Ocean. At first, we revisited the linear regression model using wind only, and the multiple linear regression model using wind and sea level gradient. Our results show that the linear regression model resulted in the correlation coefficient 0.7, while the multiple linear regression model shows 0.78. Then, we established another multiple linear regression model using wind, sea level gradient and the DOT difference as the proxy of the Pressure-head forcing. In this study, we selected Eastern Siberian Sea and the Bering Sea shelf for calculating the difference of DOT. This model well reproduced the volume transport of the Bering Strait (R=0.88). When the calculation area of mean DOT in the Bering Sea is reduced, the correlation coefficient slightly decreased, but there is no significant difference. Recent relatively high DOT distribution in the Bering Sea shelf implies oceanic warming (or less cold bottom water) but the timeseries of DOT suggests us that the pressure-head forcing is primarily controlled by the DOT in the east Siberian Sea.

Keywords: Bering Strait throughflow, Pressure-head forcing, Dynamic ocean topography


normalized volume transport
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
J-11
M-11
S-11
J-12
M-12
S-12
J-13
M-13
S-13
J-14
M-14
S-14
J-15
M-15
S-15
J-16
M-16
In-situ volume transport
WND only
WND+Δ DOT
WND+Δ DOT+PHF