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Interactive comment on "Investigating the relationship between volume transport and sea surface height in a numerical ocean model" *by* Estee Vermeulen et al.

Estee Vermeulen et al.

esteever01@gmail.com

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The Agulhas Current System plays a vital role in global-climate circulation, being the strongest western boundary current in the Southern Hemisphere. Several climate models have proposed that western boundary currents, such as the Agulhas Current, are becoming stronger due to the intensifying global wind systems and anthropogenic climate change. To validate such model predictions requires accurate long-term observational evidence. There is evidently a trade-off between spatial and temporal monitoring. In situ observations may accurately measure the dynamics of the Agulhas Current throughout the water column but are costly and spatially coarse. Whereas, satellite

observations can provide high-temporal and spatial data of the surface ocean but lacks detailed information below the surface. Numerous studies aiming to monitor long-term changes in global current systems have adopted methods to combine various sampling tools, including the development of the Agulhas transport proxy.

The Agulhas transport proxy developed by Beal and Elipot (2016) was built based on the physical principle of geostrophy, where along-track sea surface slope measured by an altimeter can be interpreted as a measure of the volume transport across a portion of the current, assuming the current depicts an equivalent barotropic structure with depth. This modelling study aimed to recreate the Agulhas transport proxy within a regional HYCOM of the Agulhas Current System, attempting to test the validity of the underlying assumptions on which the satellite-altimeter proxy was based. The 34-year regional-hindcast simulation from HYCOM provided the tools to test the sensitivity of the transport proxy to vertical changes in the current and the length scale of observations used to build a strong, constant linear relationship between volume transport and SSH slope.

This study motivates the need to improve long-term monitoring methods, where such improvements include advances in model development, combined with adequate validation studies, to help plan future experiments intending to monitor long-term changes in ocean circulation.

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