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How do different wind forcing products impact the zonal current variability in the tropical Atlantic?

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The upper wind-driven circulation in the tropical Atlantic plays a key role in the basin wide distribution of water mass properties and affects the transport of heat, freshwater, and biogeochemical components like oxygen or nutrients. It is an important component of the Atlantic climate system and the marine ecosystems. Hence, it is crucial to improve our understanding of its long-term variability which largely relies on model simulations due to sparse observational data coverage in earlier periods. In this study the impact of two different wind forcing products on the tropical Atlantic zonal current field is studied in a high-resolution ocean general circulation model. The first forcing product is the Coordinated Ocean-Ice Reference Experiments (CORE) v2 dataset covering the period 1948 to 2009 (Griffies et al., 2009). It has a horizontal resolution of 2°x2° and temporal resolution of 6-hours. The second forcing product is the new JRA55-do surface dataset (Tsujino et al., 2018). This dataset stands out due to its high horizontal (~55 km) and temporal resolution (3 h) which now covers the entire observational period (1958 to present).

While CORE simulations had difficulties to realistically simulate off-equatorial zonal currents in the tropical Atlantic, in model simulations forced with JRA55-do preliminary results show a clearly improved structure of the equatorial current system. In this study, the used CORE simulation tends to overestimate the strength and vertical extend of the zonal currents especially north of the equator compared to the here used JRA55-do simulation and observations. This might be due to the low resolution of the CORE forcing which cannot resolve smaller scale wind stress and wind stress curl structures.

Furthermore, the CORE wind forcing exhibit suspicious multidecadal wind variability (He et al., 2016) which presumable impacts the multidecadal variability of the simulated wind-driven circulation in the tropical Atlantic. Here, largest differences of zonal wind stress anomalies (up to ~0.03 N m^{-2}) between both forcing products occur north of the equator between 30°-10°W before 1990. CORE shows stronger eastward wind stress anomalies between 1958 and 1970 and stronger westward wind stress anomalies between 1970 and 1990. How this impacts the variability of the equatorial current system is investigated in this study.