

EGU2020-6285

<https://doi.org/10.5194/egusphere-egu2020-6285>

EGU General Assembly 2020

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Equatorial atmospheric zonal circulation changes over India Ocean during recent decades

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The equatorial zonal asymmetric (Walker) circulation causes changes in the tropical rainfall pattern which induces devastation flood and drought that considerably impact the lives of millions of people. However, understanding of changes in zonal circulation is not yet certain. Here we examine the robustness of changes in Indian Walker Circulation (IWC) characteristics using different reanalysis and observation datasets in terms of the linear trends of IWC. The meridional (5°S:5°N) averaged vertical velocity using different datasets are used to precisely locate the ascending (94°E:104°E, eastern) and descending (35°E:45°E, western) branch of IWC. We analyzed the zonal sea level pressure (SLP) gradient, velocity potential (VP) at 850 and 200 hPa, surface zonal wind (SZW) and zonal mass stream function (ZMSF) anomalies over the period of 1980–2017. We found that the magnitude of ZMSF representing anticlockwise circulation has an increasing trend in all the datasets. This kind of change is physically in agreement with the changes of SLP and SZW (an increasing trend in westerlies over the central IO) while the VP shows the decreasing trend which is in agreement with the strengthening of IWC during the recent decades. JRA55 is the most reliable which shows the significant and highest trend among all other datasets. The change point detection using the Pettitt method is applied to the normalized mean of all datasets which determines that in the post-1997-98 there is a significant strengthening of IWC as compared to the pre-1997-98 which demonstrates that IWC is highly sensitive by super El-Nino. The attribution of this strengthening can be examined using the CMIP5/6 datasets to determine the relative contribution of anthropogenic warming and natural variability.