Our understanding of the limitations of the Global Meridional Overturning Circulation (GMOC) is constrained by long-term averaged global hydrographic data, a model known as Robust Diagnostic Simulation (DIAG). The zonally averaged overturning streamfunctions in the Atlantic and Southern Oceans (Figure 2) and Indo-Pacific and Southern Oceans (Figure 3) are derived from DIAG. By tracing the streamfunction contours one can follow the water mass pathways of the GMOC circuit. The derived GMOC patterns are summarized in a new schematic (Figure 5), which highlights two important pathways that have been highlighted in the recent decades based on observations and models (e.g., Ganachaud & Wunsch, 2000; Sloyan & Rintoul, 2001; Danabasoglu et al., 2014, 2016). Due to these limitations (Figure 1a), it is questionable whether the current state-of-the-art GCMs are up to the task of bridging gaps in the observational data (MODEL, DIAG).