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Recent enhancement and prolonged occurrence of MJO over the Indian Ocean and their impact on Indian summer monsoon rainfall

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The Madden-Julian oscillation (MJO) is one of the leading modes of tropical intra-seasonal variability, which exerts significant impacts on the weather and climate across the globe, particularly in the tropics. MJO affects the Asian monsoon by producing enhanced and suppressed convection during the active and break periods, respectively. In the recent decades, the heat content of Indo-western Pacific Ocean has increased significantly, which strengthened the MJO activity. Previous studies also have shown that the expansion of Indo-western Pacific warm pool led to the warping of MJO life cycle, which decreases its residence time over the Indian Ocean (IO) and increases over the Pacific Ocean. Here we show that in the boreal summer months, MJO amplitude has strengthened during the global warming hiatus or rapid IO warming period (1999–2015) compared to the previous period (1982–1998). In the later period, MJO exhibits a faster regeneration over the western IO, and its residence time has increased in the western hemisphere and western IO but decreased in the eastern IO and eastern Pacific Ocean. The strengthening of MJO and the readjustment in its residence time are due to the local MJO feedback on the IO and the La Nina like sea surface temperature pattern in the Pacific Ocean. The prolonged MJO activity leads to bursts of rainfall over the Indian subcontinent in Phase 3 and Phase 4, influencing the active spells of the Indian summer monsoon and causing heavy rainfall over central India and East Asia.