Loss of Significance and Multidecadal Variability of the Madden-Julian Oscillation

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Change in significance and multidecadal variability of northern hemispheric winter MJO during 1948-2006 is examined using NCEP/NCAR reanalysis data. Variation of MJO power relative to the red background is estimated by isolating the MJO signal through frequency-wavenumber spectral analysis using a 10-year sliding window. It is shown that during the periods, the rate of increase of background power has been larger than the rate of increase of MJO power leading to a decreasing trend of significant MJO power. It is also found that a multidecadal variation rides on the decreasing trend of significant power of the MJO. Another finding is that the zonal mean component of zonal wind at 200 hPa on MJO time scale has a significant increasing trend. Both the above trends are statistically significant at 95% confidence level.

Energetics calculation in wavenumber domain has been carried out to understand why the significant MJO power is not increasing as fast as the red background. It is shown that the long waves (wavenumber 1-3, ie the MJO scale) lose energy to the zonal mean flow and the rate of kinetic energy gain by zonal mean flow from the long waves has a linear increasing trend. Thus, while MJO is also being energized by the warming ocean, it is losing increasingly more energy to zonal mean flow making the zonal mean more energetic while losing its own significance at the same time. It is found that the observed multidecadal variability of the significant MJO power has no relationship with other well known multidecadal variability. However, we find that the multidecadal variability of MJO and the rate of kinetic energy exchange between zonal mean flow and long waves are closely linked, indicating that the observed multidecadal variability of MJO is internally driven.