

Seasonal and regional variations and long-term trends in upper tropospheric jets from reanalyses

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Upper tropospheric jet streams are a key component of the atmospheric circulation, linked with weather and climate phenomena. Long-term changes in upper-tropospheric jet latitude, altitude, and strength are assessed for 1980–2014 using five modern reanalyses: MERRA, MERRA-2, ERA-Interim, JRA-55, and NCEP CFSR. Changes are computed from jet locations evaluated daily at each longitude to analyze regional and seasonal variations. The changes in subtropical and polar (eddy driven) jets are evaluated separately. Good agreement among the reanalyses in many regions and seasons provides confidence in the robustness of the diagnosed trends. Jet shifts show strong regional and seasonal variations, resulting in changes that are not robust in zonal or annual means. Robust changes in the subtropical jet indicate tropical widening over Africa except during Northern Hemisphere (NH) spring, and tropical narrowing over the eastern Pacific in NH winter. The Southern Hemisphere (SH) polar jet shows a robust poleward shift, while the NH polar jet shifts equatorward in most regions/seasons. The Asian monsoon has increased in area and appears to have shifted westward toward Africa. Interannual variability in the subtropical jets is strongly correlated with El Nino/Southern Oscillation (ENSO), and some of the long term changes in jet locations are consistent with the predominant phase of ENSO in the earlier versus later years of the record, especially in NH winter. The results presented highlight the importance of understanding regional and seasonal variations when quantifying long-term changes in jet locations, the mechanisms for those changes, and their potential human impacts. They also demonstrate the value of comparing multiple reanalyses in assessing the robustness of those changes.

Key words: upper tropospheric jets, climate variability and trends, reanalyses intercomparison, SPARC SRIP, tropical widening