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Eddy-driven and Subtropically-influenced Jet Variability Structures in the Observed Three-dimensional Zonal Wind Field

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This study investigates the three-dimensional structure of extratropical tropospheric zonal wind variability in the ERA-40 reanalysis using a variety of horizontal, vertical and three-dimensional EOF-based analyses. Leading PCs of zonal wind and near-surface geopotential height are linked, but the correspondence is not one-to-one and the relationship is both height- and sector-dependent. The height-dependence has one of two characteristic shapes consistent with either eddy-driven or subtropically-influenced jet variability. The leading three-dimensional EOFs of the zonal wind field have a clearer relationship with eddy-driven or subtropically-influenced jet variability and explain more zonal wind variance than alternative indices.

The relative importance of annular variability in the Northern Hemisphere is concentrated at low frequencies, suggesting different dynamics are important on different time scales and that much of the month-to-month variability occurs in sectors. Sector-based analyses in the Northern Hemisphere are also generally more statistically robust and dynamically intuitive than hemisphere-based analyses.

The results suggest the generic co-existence of eddy-driven and subtropically-influenced jet variability, and that the relative dominance of one over the other is governed by the different jet configurations that exist in the various hemispheres and / or sectors: (1) North Atlantic variability is predominantly eddy-driven, (2) North Pacific variability is predominantly subtropically-influenced, and (3) Southern Hemisphere variability is predominantly eddy-driven, except in the South Pacific, where evidence of subtropically-influenced variability also exists.