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On statistics of the free-troposphere synoptic component: An evaluation of the contribution from the third-order moments to the synoptic-scale dynamics and fluxes of heat and humidity

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Based on the ERA40 data for 1976-2002 we calculated skewnesses and mixed third-order statistical moments (TOMs) for the synoptic variations (with (2-6)day timescale) of horizontal winds, temperature, vertical velocity and specific humidity, in Eulerian coordinates. All these variables show skewnesses which markedly deviate from zero, mostly at the entries and the outlets of the mid-latitude storm tracks. In these regions, high values of skewness for vertical velocity, temperature and specific humidity are revealed throughout the entire free troposphere, while the marked skewnesses for horizontal winds are traced in the lower free troposphere. We found a noticeable deviation of the synoptic-component statistics from the Gaussian statistics. We also make an estimate of the contribution from TOMs to the prognostic equations for the synoptic-scale kinetic energy and the meridional fluxes of sensible and latent heat, which appears to be nonnegligile, mainly in the storm tracks in winter. Our analysis attests that the most pronounced contribution of TOMs to these equations comes from the self-advection by the horizontal synoptic-scale motions, while the TOMs induced by the metric terms in the original equations, and specifically the TOMs associated with the vertical self-advection by the synoptic-scale motions, are much less important.