Contribution of Ageostrophic Wind Components in Coupled Upper-Level Jet Streaks
Scott M. Rochette¹, Chad M. Gravelle², and Patrick S. Market³

¹Department of the Earth Sciences, The College at Brockport, State University of New York
²Cooperative Institute for Precipitation Systems, Department of Earth and Atmospheric Sciences, Saint Louis University
³Department of Soil, Environmental and Atmospheric Sciences, University of Missouri-Columbia

Introduction

- Cold-season coupled upper-level jet streak complexes associated with weak synoptic-scale-shear (see Rochette et al. 2008) were examined with respect to the jet-
  related ageostrophic wind component.
- This ageostrophic wind was decomposed into its isallobaric, inertial-advective, and inertial-convective subcomponents to determine the relative significance of each one.
- The subcomponents were then summed to recreate an ageostrophic wind vector, which was then compared qualitatively to the traditionally diagnosed ageostrophic wind component (Vag).
- The purpose of the project is to evaluate the relative significance of the ageostrophic wind and its components during significant cold-season precipitation episodes associated with synoptic-scale-shear systems.

Methodology

- Examination of the US flow regime using the General Meteorological Package (GEMPAK) with the North American Regional Reanalysis (NARR) dataset revealed 39 coupled jet streak cases. These were then subdivided into weak dynamic (n=20) and strong dynamic (n=19) scenarios. The weak dynamic cases (covered in this presentation) were characterized by modest surface circulations and open mid-tropospheric waves.
- The decomposition of the ageostrophic wind is as follows:

\[
\begin{align*}
\vec{\nabla} \cdot \left( \vec{V} - \vec{V}_g \right) = & \vec{V}_a \\
\vec{V}_a = & \vec{V}_i - \vec{V}_c \\
\end{align*}
\]

- The isallobaric component becomes more focused at the time of coupling, and the inertial-convective component is quite distinct at coupling time.
- The inertial-advective component is the dominant term of the three, and it is quite distinct at the time of coupling, which is consistent with the traditional formulation of the ageostrophic wind (Vag).
- Isallobaric component becomes more focused at the time of coupling, and it is consistent with the traditional formulation of the ageostrophic wind (Vag).

Conclusions

- Isallobaric component, while the weakest term, exhibits excellent position over coupling region at t = 0 h.
- Isallobaric component becomes more distinct at the time of coupling.
- Significant inverted trough development at surface (w/o significant cyclone in vicinity) are less apparent in the summed-component V field.
- Time differences needed in the \(V - V_g\) calculation as signatures becoming stronger/better defined at time of coupling; these are less apparent in the summed-component \(V_{ag}\).

References

- Uccellini, L. W., and J. M. Kocin, 1987: Signatures of a warm conveyor belt associated with the northern jet streak’s DTC becomes quite distinct at coupling time.

Images:

- 250-hPa isotachs (shaded m s⁻¹), 250-hPa heights (brown, m), and 250-hPa ageostrophic wind vectors at 0000 UTC 8 March 2002 (left) and 0900 UTC 8 March 2002 (right).
- 250-hPa isotachs (shaded m s⁻¹), 250-hPa heights (brown, m), and 250-hPa ageostrophic wind vectors at t = -12 h (left) and t = 0 h (right).
- 250-hPa sum of the ageostrophic wind components (brown, m s⁻¹) at t = -12 h (left) and t = 0 h (right).