NOTES AND CORRESPONDENCE

Comments on "A Preliminary Study of Severe Wind-Producing MCSs in Environments of Limited Moisture"

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Corfidi et al. (2006) recently discussed the occurrence of mesoscale convective systems (MCSs) in environments characterized by low dewpoints. Within this otherwise interesting and informative presentation, they stated (on p. 717), "Wind compositing in all cases was accomplished by calculating arithmetic means of direction and speed (Schaefer and Doswell 1979)."

The Schaefer and Doswell (1979; hereafter SD79) reference discusses the differences between using wind speed/direction versus the Cartesian (u, v) components to interpolate winds between points, noting (on p. 459) that, "interpolation of components does not necessarily yield the same results as interpolation of magnitude and direction." Although the concern in SD79 was with interpolation, the same issue arises when averaging the winds. That is, an average of wind speeds and directions yields a different answer, in general, than averaging the Cartesian vector component velocities.

As a simple example of the problem, if we were to average two winds of equal speed, one from the north (360° or 0°) and one from the south (180°), the average using wind speed/direction is a wind from either 270° or 90°, depending on whether the north wind is represented by 360° or 0°, with the same speed as the original winds. The discontinuity in wind direction at 360°/0° complicates the issue, but it should be evident that the true average of wind components is a calm wind—in this case, markedly different from that obtained by averaging wind speed/direction arithmetically. As an example of the discontinuity problem, consider averaging two winds of equal speed, one from 330° and the other from 30°. The average of directions would be from 180°, whereas the true average would be from 360°/0°. The average of speeds would be whatever the original wind speed was, whereas the proper vector average would be the original value times 0.866 = sin 30°.

There is nothing in SD79 that can be cited to justify not using the proper vector u and v wind components for compositing. In Doswell and Caracena (1988), the issue is reconsidered at some length. They conclude (in their section 2) that, "The choice between representations, . . . , is clearly that of u and v components." The transformation between Cartesian vector components and wind speed/direction is nonlinear, and the 360°/0° singularity makes any use of wind speed/direction problematic for such operations as interpolation or averaging (as in compositing wind fields).

However, in the case of Corfidi et al. (2006), the method they have used minimizes the impact of this problem. The rotation of the wind fields by aligning the storm motion vector with the x axis means that the singularity in wind direction is not much of an issue in their actual data. The authors graciously have shared with me the results of a recalculation using the components instead of the wind speed/direction—the difference between the published and recalculated results turns out to be rather small. Given the precautions they took with their methodology, the error incurred by averaging speed/direction was minimized in their study.

My main reason for concern is their statement (above) about the compositing of the wind values using the speed/direction method. A casual reader might believe that averaging wind speed/direction is the appropriate way to average wind vectors, which it is not.

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Although the errors incurred by using the incorrect method made little difference in the composites done by Corfidi et al. (2006), this would not generally be the case. Large errors in compositing can result from using wind speed/direction averaging, especially when individual winds in the data are on both sides of the singularity at 360°/0°. Doing operations such as averaging or interpolation properly on vector quantities requires the use of the vector components, rather than wind speed/direction.

REFERENCES

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