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Shearing Wind Helicity and its application

RONGSHENG WU[1], JUAN FANG[1], YING HAN[1], LMSM[1] and MOE[1]
[1]*Department of Atmospheric Sciences, Nanjing University*

Helicity is defined as $H = \vec{V} \cdot \vec{\omega}$ where $\vec{V}, \vec{\omega}$ are the velocity and vorticity vectors respectively. It has been widely studied by many scientists since last eighties to study the properties of weather systems such as tornado, squall line and some other severe weather systems. Since helicity, as definition, is the scale multiply of velocity and vorticity vectors, it may be positive or negative according to these vectors features. For example, cyclonic rotation of the flow with upward vertical motion, the helicity is positive while with downward motion, it is negative. The direct relationship of the helicity to the weather system is not quite clear and obvious.
However, as we generalize the conception of helicity as shearing wind helicity, H_s that is

$$H_s = \frac{\partial \vec{V}}{\partial z} \cdot \vec{\omega}$$

Then the situation will change. The relationship of the shearing wind vector helicity with weather system becomes clearer; we can obtain the following relation after some manipulations

$$\frac{\partial \bar{\zeta}}{\partial t} \approx \bar{H}_s$$

Where $\bar{\zeta}, \bar{H}_s$ are the average vorticity and shearing wind helicity with respect to the whole volume of the system, after neglecting some other small terms. This means that average shearing wind helicity is directly relating to the increasing of average cyclonic rotation of the weather system dynamically. We also point out that the shearing wind helicity as matter of fact is the twist terms in the vorticity equation physically. A case study on the development of tropical cyclone is presented to demonstrate that the shearing wind helicity is effective for diagnosing the development of the weather system.