Helicity as an indicator of tropical cyclone's intensity

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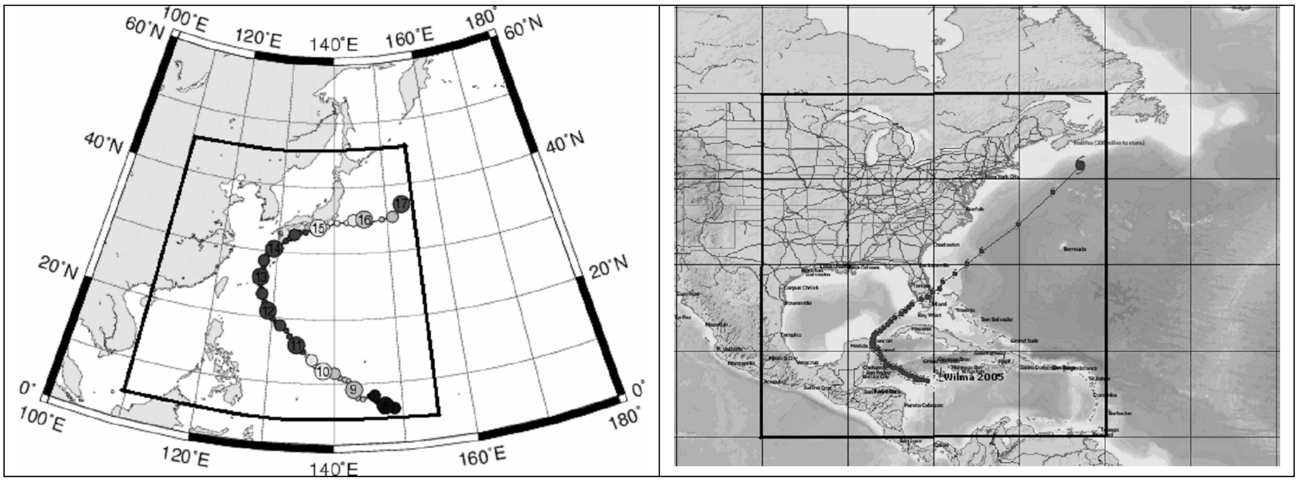
Tropical cyclones belong to the group of the most dangerous forces of nature. Their impact on the human life and infrastructure is due not only to the strong winds causing destruction but also to the abundance of consequences that may follow after their passage. It seems that tropical cyclones have already been completely investigated but in fact their behavior often remains obscure and even nowadays we can't give a perfect prediction of their formation and development.

One of the topical questions concerning tropical cyclones consider reasons of development or dissipation of tropical depressions. It can be useful for tropical cyclone prediction and for an active influence on typhoons at the stage of tropical depression.
It's obvious that one can face plenty of difficulties while receiving observational data corresponding to the distribution of meteorological values in tropical cyclones (TC). That is why simulation of these severe storms turns out to be the only instrument of the exploration of their detailed structure.

In the aims of hurricanes' development simulation and calculation of several parameters of its intensity the mesoscale numerical model ETA was adapted to North-West Pacific and the Caribbean Sea (Mesinger, 1988, Black, 1994). ETA has 45 vertical levels and its horizontal grid's space is about 20 km. NCEP's analyse data with resolution 1° was used as initial and boundary conditions.



TC possess specific structure: a spiral circulation of air in it which is created by tangential and vertical circulation in the storm. The tangential circulation provokes great wind speed and the vertical is very important for heat and moisture exchange between the sea surface and the cyclone.

According to Kurgansky and Montgomery (2007), the downward flux of kinematic helicity across the top level of a turbulent viscous boundary layer can serve as an index of intensity and potential impact of atmospheric vortices such as tropical cyclone on the infrastructure:

$$SI = (8\pi / 3) \int_0^{\infty} V^3 dr \, . \qquad (1)$$

Where; *r – radius, m; V(r) – azimuthal wind, m/s²; SI – downward flux of helicity, m³/s⁴*

We've calculated this value during the periods of tropical cyclones' development**.** The graphics for Man-Yi (2007, Pacific) and Wilma (2005, Atlantic) show that at the moment of intensifying of the cyclone, the index increases rapidly. The decrease is observed when a cyclone reaches the land and weakens or when it attaints higher latitudes. One can also notice the daily variation of helicity flux: at daytime it increases and at night the decrease is observed.

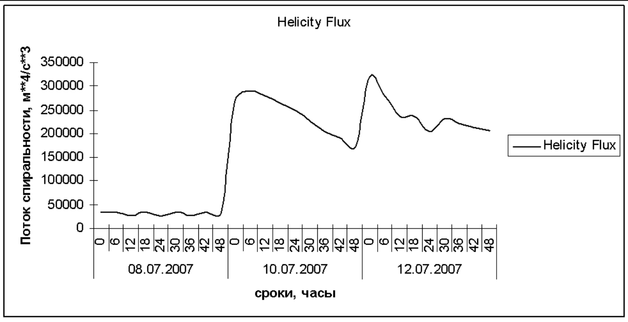
Davies-Johnes (1999) proposed to use relative helicity to estimate the force of the storm and reckon the storm motion in.

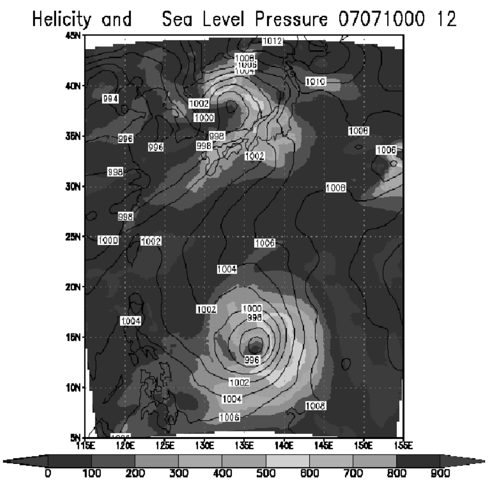
$$H = (V - Vmean)\frac{\partial u}{\partial z} + (U - Umean)\frac{\partial v}{\partial z}$$

Where V and U – meridional and zonal wind, m/s²; Vmean and Umean – meridional and zonal components of storm motion, m/s²; H – relative helicity, m/s².

As TC develops, relative helicity increases and its maximum is observed at the south-west part of the storm.

Man-Yi





Wilma