

On the structure of the eye of hurricane Isabel.

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Tropical cyclones (TC) belong to the most destructive natural phenomena and represent a danger for almost 50 countries throughout the world. The TC landfalls involve victims among the population and cause significant damage to the economy. At the same time, a TC's making no landfall in the Russian Far East led to prolonged absence of fresh water in the whole region. The forecast of the motion and evolution of TCs strongly depends on gaining insight into the processes that take place in a TC.

Isabel, one of the strongest superhurricanes has been studied. It crossed the Atlantic from September to October 2003 and reached the stage of a hurricane with the pressure 915 hPa and the wind velocity 170 knots. The hurricane proceeded to the state North Carolina, crossed the states Virginia, West Virginia, Pennsylvania and, after turning into an extratropical cyclone, proceeded to the Great Lakes and further to Canada. Its path exceeded 5.500 km.

When observing the motion of TC Isabel, on the photographs taken from the satellite GOES-12 East (G-12) unusual structures were detected in the eye of the hurricane in the microwave range. These structures form near the hurricane eye wall, where huge velocity gradients and strong turbulence take place, and upward and downward fluxes occur. The velocity fluctuations reach here tremendous values.

The eye looked as a circle split into five sectors, with an oval vortex formation in every one, which occupied the largest part of the sector. At the moment of observations the diameter of the eye was 35 - 40 km, the diameters of each of the vortices constituted 10 – 12 km. One observed cyclonic rotation of this system formed of five cyclonic vortices round the TC center. The performed estimation has demonstrated that the mean linear velocity of the relative rotation was about 115 – 140 km/h.

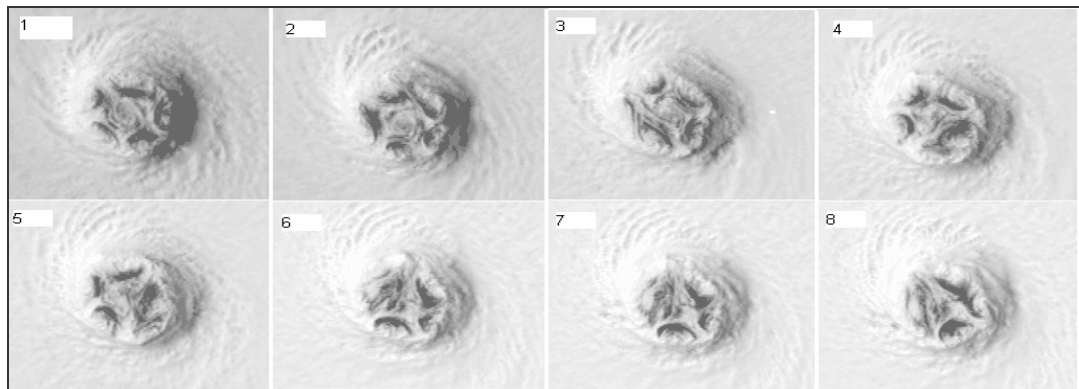
The system of vortices gradually transformed, one of the five vortices began to attract and capture the neighboring left vortex; as a result a system of four vortices rotating round the center formed. Further rather complex deformations of the vortices

took place (pushing apart, contraction, capturing of one vortex by another); the resulting pattern comprised three stretched vortices.

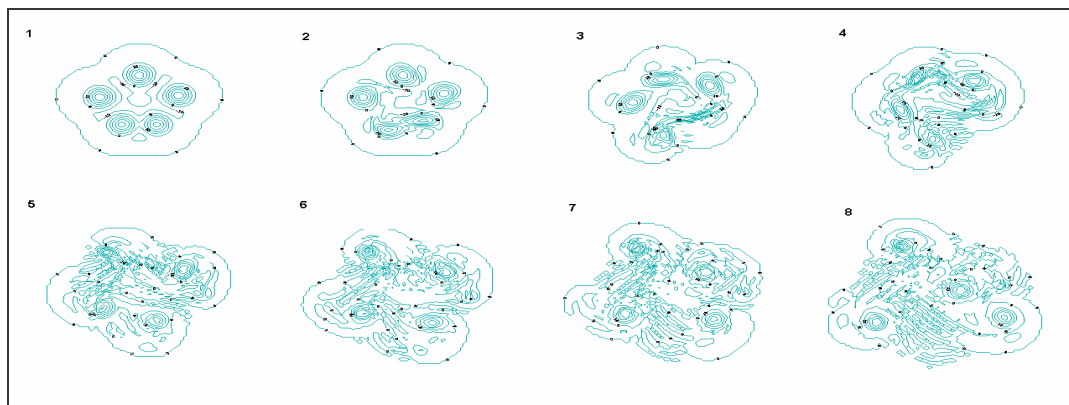
To get insight into the behavior of the vortices in the TC, numerical experiments using a barotropic model /1, 2/ with several interacting perfect vortices were helpful. The comparison of the rotation and transformation of the vortices observed in the eye of hurricane Isabel with the results obtained using the numerical model (Fig.2) demonstrates the identical character of the behavior of the vortices in the eye of the real TC and those simulated by the barotropic model.

References

1. A.E.Pokhil, Some prerequisites for generation of a large vortex and characteristics of vortex interaction. – Meteorology and Hydrology, 1996, no.2, pp. 24 – 32.
2. A.E.Pokhil and I.V.Polyakova, Interaction of cyclonic vortex pair in a barotropic atmospheric model, Meteorology and Hydrology, 1992, no.2, pp. 40 – 50.



Figures 1. Evolution of the vortices in the eye of hurricane Isabel.



Figures 2. Evolution of the vortices simulated using the barotropic model.