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Vertically homogeneous stationary tornado-type vortex

P.B. Rutkevich (1) and P.P. Rutkevych (2)

(1) Space Research Institute RAN, Dep 056, Moscow, Russian Federation (pbrutkevich@gmail.com), (2) Institute of High Performance Computing, A*STAR, Singapore

Tornado is regarded as one of the most dangerous atmosphere phenomena. The tornado phenomenon has been intensively studied so far, however, there is still no established and accepted theory of how tornadoes form, an uncertainty still exists concerning extreme winds and pressure drops in tornadoes. It is commonly accepted that it is possible to describe tornado from the set of nonlinear hydrodynamical equations, however, it is still unclear which non-linear processes are responsible for its formation. Nonlinear terms in the system are associated with either centrifugal force, or entropy transport, or transport of humidity. It appears that the amount and spatial distribution of precipitation with the convection are important indicators of the weather phenomena associated with a particular storm. The low-precipitation supercells that produce relatively little precipitation and yet show clear visual signs of rotation. Low-precipitation supercells occur most often near the surface dryline and, owing to the sparse precipitation and relatively dry environments with little cloudiness. Low-precipitation storms are frequently non-tornadic and many are non-severe despite exhibiting persistent rotation. On the other hand, the so-called high-precipitation storms are characterized by substantial precipitation within their mesocyclonic circulations. When high-precipitation storms have a recognizable hook radar echo, reflectivity in the hook is comparable to those in the precipitation core. High-precipitation supercells are probably the most common form of supercell and produce severe weather of all types including tornadoes. Therefore, in this work we consider a hydrodynamic system with only one nonlinear term associated with atmosphere humidity, which yields energy to the system. The tornado vortex is usually to a good approximation cylindrical so we use cylindrical geometry and homogeneity in vertical direction. In this case the problem reduces to a system of ordinary differential equations. Rotation in the vortex is associated with compressibility so we also take into account the compressibility of the gas. Under certain approximations the problem reduces to a single high-order nonlinear equation. Numerical solution of the obtained high-order equation describes all three velocity components and all thermodynamic parameters in the system. The system exhibits high rotation and strong vertical air flow in the middle part of the vortex.