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Singular vortices as building blocks of atmospheric low-frequency variability

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General circulation of the atmosphere is characterized by multi-scale flows with a vigorous eddy field of intense cyclones and anticyclones (synoptic eddies) that control the day-to-day weather variations, but also exhibit a pronounced low-frequency variability. Recent studies showed that the latter variability can be thought of in terms of the low-frequency redistribution of the atmospheric storm tracks, which is insensitive to the detailed spatial structure of the individual synoptic eddies. This observation suggests an idea of tackling the problem of multi-scale mid-latitude atmospheric variability by considering the systems of interacting singular vortices; in such systems, the singular eddy field is clearly isolated from the regular field, thereby allowing unambiguous identification of the various dynamical components of the eddy–mean-flow interaction. In this work, we develop a numerical finite-difference model describing the evolution of a singular monopole on a beta-plane and show that it provides a reasonable approximation of the continuous equations by comparing its numerical and (approximate) analytical solutions and considering the invariants of motion. These results lay a foundation for numerical consideration of systems of multiple singular vortices, which could provide further insights in our fundamental understanding of the processes underlying the multi-scale atmospheric variability. This study was supported by the Russian Ministry of Education and Science (project 14.616.21.0075).