



Makarov, V.G., M.A. Sokolovskiy & Z. Kizner (2012). Doubly symmetric finite-core heton equilibria. *Journal of Fluid Mechanics*, 708: 397-417. DOI: 10.1017/jfm.2012.316

Doubly symmetric finite-core heton equilibria

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A finite-core heton is a baroclinic f -plane modon of a special type: it is composed of two patches of uniform quasi-geostrophic potential vorticity (PV) residing in different layers of a two-layer rotating fluid. This paper focuses on numerical construction of steadily translating, doubly symmetric, finite-core hetons and testing their stability. Such a heton, which possesses symmetry about the translation axis and the transverse axis, is a stationary solution to the equations of PV conservation in each of the layers when considered in a comoving frame of reference. When constructing the heton solutions and examining their bifurcations, we identify a heton by a pair of independent non-dimensional parameters, the half-length (in the translation direction) of a PV patch and the distance of the front point of the upper patch from the translation axis. The advantage of this method over other tried approaches is that it allows one to obtain solutions of new, previously unknown types. The results of testing the heton stability are presented on the plane made by a mean radius of a PV patch and the (horizontal) separation between the centroids of the patches. Two kinds of stability are tested separately, the stability to arbitrary perturbations that do not preserve the symmetry of the initial state and the stability to so-called symmetric perturbations that do not violate the initial symmetry. The hetons comparable in size with the Rossby radius, and smaller, are always stable in both senses. However, when some critical size is exceeded, the heton stability becomes dependent on the separation, and the larger the heton, the higher the separation required for stability. The separation guaranteeing the stability to symmetric perturbations is smaller than that required for the stability to arbitrary perturbations. Interrelations between instabilities and bifurcations are briefly discussed.

Palabras clave: contour dynamics, vortex instability, rotating flows

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