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Experimental and theoretical investigation of barotropic blocking in quasi-two-dimensional rotating flows

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Experiments on the excitation of zonal flows in a barotropic rotating annulus with conical bottom have been performed [1,2]. The flow was produced by two methods: mechanical pumping and suction - sourse-sink method [1] and MHD method [2]. The velocity fields have been reconstructed by the particle image velocimetry (PIV) method.
Diagrams of regimes are presented in parameters of the dimensionless angular velocity of the zonal flow averaged over the channel width and the dimensionless angular velocity of transport of vortex perturbations of cyclonic and anticyclonic types.
Attention is focused on the results for the regions of the diagram with slow motion of vortices with respect to the rotating coordinate system near the parameters for stationary Rossby waves (blocking of circulation). For some parameters of the flow the system with almost immobile blocked anticyclones in the outer part of the flow and rapidly moving cyclones in the main stream appears. We consider some simple linear estimation of blocking conditions [1,2].
It is obatined the solution of Obukhov-Charney equation admitting a long quasi-stationary stage of evolution in which the meridional wave number and value of the total wave energy (close to the maximum value) remained virtually unchanged over long time [3]. This effect is realized in a dominant contribution of the free surface deformation in the potential vorticity. It was shown that this effect can lead to new scenarios phase and amplitude Rossby wave blocking.
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References

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