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Connection of periodic orbits and variability patterns in a barotropic atmospheric system

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It was shown recently (Gritsun, 2008) that an attractor of barotropic atmospheric system contains many unstable periodic orbits (UPOs). Orbits form a skeleton for the system attractor and approximate statistical characteristics of the system with high accuracy. Consequently, it is reasonable to expect that some of UPOs are somehow connected with most prominent patterns of model variability.

In this study we have investigated the relationship between periodic trajectories of the model and its 25-day mode of variability (Branstator, 1988; Branstator, Selten, 2004). This mode is, in fact, the first complex empirical orthogonal function (or "Hilbert EOF" (H. von Storch, Zwiers, 1999)) for a given system being a dominant rotational component of the system dynamics. It was shown that the mode structure coincides with several least unstable periodic orbits of the system. The phase portrait of the system in the plane of the first complex EOF has a regular shape with maximum of the probability density function in the vicinity of these weakly unstable periodic orbits.