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Synoptic Eddy and Low-frequency Flow (SELF) Interaction and the Self-organization of Low-frequency Modes

F.-F. Jin

Department of Meteorology, Florida State University, USA (jff@met.sfu.edu / fax 1-850-644-9642)

The two-way interaction between synoptic eddy and low-frequency flow (SELF), which we will refer to as the SELF-feedback, has long been recognized to play an important role in the low-frequency variability of the atmospheric circulation. A linear framework for studying the dynamics of the SELF-feedback in proposed in this study. In this framework, we examine the formation of low-frequency modes by considering the ensemble-mean linear dynamics with a stochastic basic flow that includes climatological mean state and a stochastic component representing the synoptic eddy activity. The SELF-feedback is well captured by the first-order closure of the ensemble-mean dynamics of the linear system. Using this framework, we show that leading low-frequency modes, such as NAO, emerge in a stormy background flow by organizing the synoptic eddies to gain reinforcement through a positive scale selective SELF-feedback.