

Laplace's Atmosphere: An Array of Ringing Modes Discovered in Global Reanalysis Data

*Takatoshi Sakazaki¹, Kevin Hamilton²

1. Graduate School of Science, Kyoto University, 2. International Pacific Research Center and Department of Atmospheric Sciences, University of Hawai'i at Manoa

We used newly-available ERA-5 hourly global reanalyses to examine the variations of atmospheric circulation on global scales and high frequencies. The space-time spectra of surface pressure displays a typical red background spectrum but also a striking number of isolated peaks. Some peaks represent astronomically forced tides but we show that most peaks are manifestations of the ringing of randomly excited global scale resonant modes. A few such modes have been tentatively identified in earlier observational investigations, but we demonstrate the existence of the full array of normal mode oscillations with periods as short as 2 hours. This is a powerful and uniquely detailed confirmation of the predictions of the theory of global oscillations that has its roots in the work of Laplace two centuries ago.

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