

Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

The Walker circulation, diabatic heating, and outgoing longwave radiation¹ REED OGROSKY, SAMUEL STECHMANN, University of Wisconsin-Madison — The Matsuno-Gill model, derived from the forced shallow-water equations in the tropics, has been widely used to describe the large-scale overturning circulation in the tropical atmosphere. This model contains damping terms in the form of Rayleigh friction and Newtonian cooling. Here, using new data analysis techniques, evidence suggests that damping is actually negligible. Specifically, near the equator, the east–west overturning circulation is in agreement with the undamped wave response to atmospheric heating. To estimate the heating, satellite observations of outgoing longwave radiation (OLR) are used. Frequently OLR is used as a heuristic indicator of cloudiness. Here, the results further suggest that OLR variations are actually proportional to total diabatic heating variations, with a proportionality constant of $18 \text{ W m}^{-2}(\text{K day}^{-1})^{-1}$. While the agreement holds best over long time averages of years or decades, it also holds over shorter periods of one season or one month. Consequently, it is suggested that the strength of the Walker circulation—and its evolution in time—could be estimated using satellite data.

¹We gratefully acknowledge support from ONR N00014-12-1-0744 and ONR N00014-12-1-0912.

Reed Ogrosky
University of Wisconsin-Madison

Date submitted: 01 Aug 2014

Electronic form version 1.4