An investigation of the Theory on the Maximum Potential Intensity for Hurricanes

Chun-Chieh Wu Miao-Ling Lu

Department of Atmospheric Sciences
National Taiwan University

ABSTRACT

Emanuel(1986) proposed an air-sea interaction theory for hurricanes. By regarding hurricanes as a Carnot heat engine, Emanuel derived a theoretical formula that estimates the maximum potential intensity for hurricanes. In this work high-resolution EC/ADVANCED data were used to verify the above theory and to understand the characteristics of some meteorological parameters from real-case Western-Pacific typhoons in 1990. Our analyses indicate that among those typhoons examined the outflow temperature ($\overline{T}_o$) and the water vapor mixing ratio (q) are highly variable, but the sea surface temperature (T_s) and environmental pressure (P_a) are less variable. The variability of the above parameters can affect each storm's minimum pressure (P_c) obtained from the Carnot cycle theory. In addition, the sensitivity tests indicate that errors from some parameters, especially $\overline{T}_o$ and RH, can lead to large variation in the estimation of the theoretical minimum pressure. This study shows that there is great difficulty in applying the Carnot cycle theory to real typhoons.

Key words: Air-sea interaction theory for hurricanes, Carnot heat engine, maximum potential intensity for hurricanes.