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# A Review on Variation of Cloud Temperature, Correlation with Carnot Cycle with the help of Mechanism Involved for Genesis of Cyclone

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**ABSTRACT:** Tropical cyclone (TC) implicit intensity (PI) hypothesis has a well-known form, conformable with a Carnot cycle interpretation of TC energetics, which relates PI to mean environmental conditions the difference between face and TC gush temperatures and the air – ocean enthalpy disequilibrium

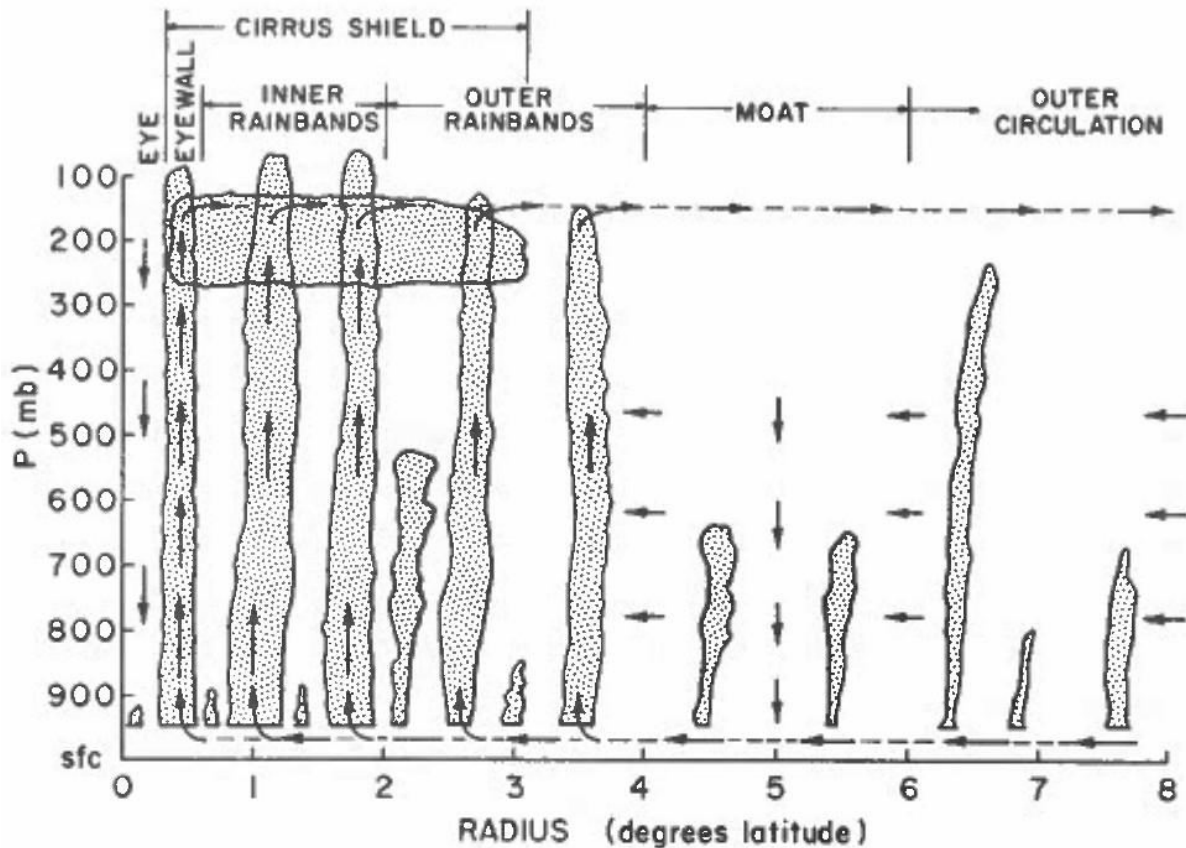
PI has also been defined as a difference in convective available implicit energy (CAPE) between two parcels, and quantitative assessments of unborn changes make use of a numerical algorithm hung on this description. Then, an analysis shows the conditions under which these Carnot and CAPE- predicated PI descriptions are new. There are multiple conditions, not preliminarily enumerated, which in particular reveal a part for unrecoverable entropy product from face evaporation. This fine analysis is vindicated by numerical computations of PI's perceptivity to large changes in face- air relative moisture. Numerical and theoretical models of tropical cyclones indicate that the maximum wind speed in mature storms is sensitive to the rate of the enthalpy and instigation face exchange portions and that the spin up time of tropical cyclones varies equally with the magnitude of these portions. At the same time, the Carnot cycle model developed by the author predicts that the central pressure of mature cyclones is independent of the magnitude of the exchange portions.

Due to the well- mixed supposition, the net impact of the dissipative heating turns out to be negligible, performing in the same MPI estimation as in Emanuel's 1986 composition. Within the atmospheric face subcaste, the dissipative heating comes at the expenditure of reduced internal kinetic energy in the boundary subcaste, which isn't seen in Bister and Emanuel's expression due to their supposition of constant wind speed within the atmospheric face subcaste.

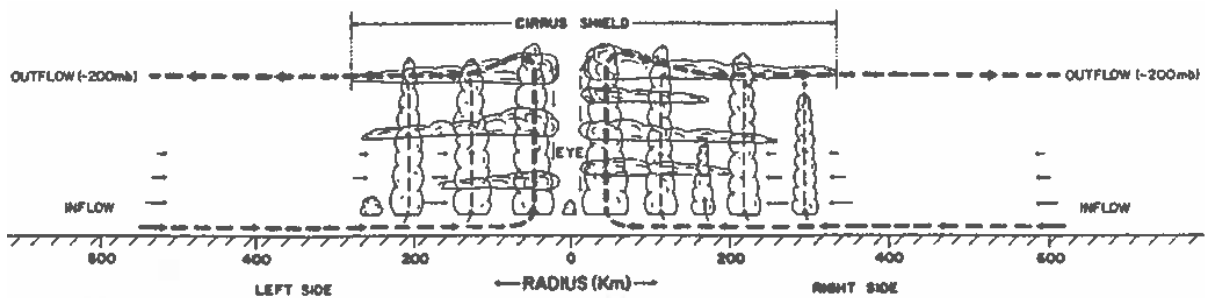
**KEYWORDS:** Tropical cyclone; Cloud; diurnal variation;

## I. INTRODUCTION

Tropical cyclone (TC) maximum potential intensity (MPI) plays an important role in understanding the TC intensity limit and relationship between the TC climatology and global changes (Emanuel, 1986, 2003; Holland, 1997). In an early model for steady TCs, Emanuel (1986, hereinafter E86) presented a formulation in which MPI is linked to the difference between the sea-surface temperature (SST) and the temperature of the outflow layer near the tropopause. E86's model was based on the moist slantwise condition under the gradient wind balance without explicit inclusion of the dissipative heating in the planetary boundary layer (PBL). The model was later extended by Bister and Emanuel (1998, hereinafter BE98) in which the entire dissipative heating is assumed to be recycled as an extra heat source at the ocean warm surface and directly contributes to the total energy input of TCs. This hypothesis leads to an increase of MPI by a factor  $T_s/T_o$  where  $T_s$  is SST and  $T_o$  is the outflow temperature, and results in roughly 20% increase in MPI as reported in a number of subsequent studies (e.g. Zhang and Altshuler, 1999; Jin et al., 2007).



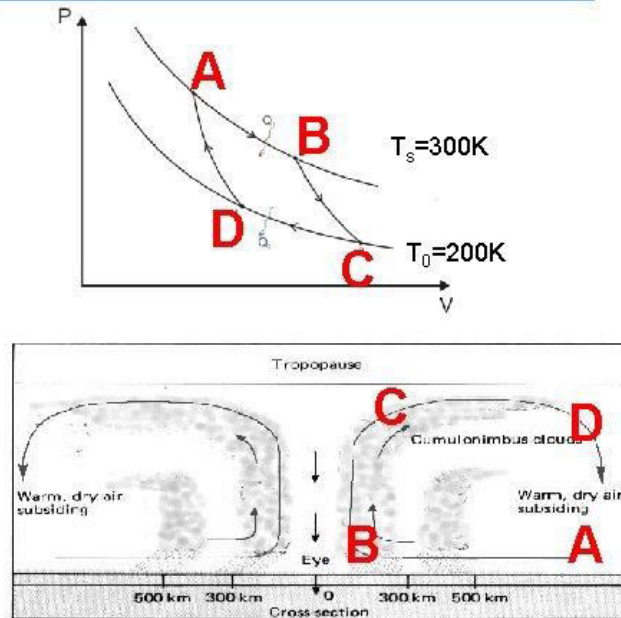
**Figure 1:** Vertical cross-section of the circulation associated with a TC over ocean, only one sided from the TC Centre.



**Figure 2:** Vertical cross-section of the circulation associated with a TC over ocean in both sides from the TC Centre

Tropical cyclone (TC) maximum implicit intensity (MPI) plays an important part in understanding the TC intensity limit and relationship between the TC climatology and global changes (Emanuel, 1986, 2003; Holland, 1997). In an early model for steady TCs, Emanuel (1986, hereinafter E86) presented an expression in which MPI is linked to the difference between the ocean-face temperature (SST) and the temperature of the exodus subsurface near the tropopause. E86's model was grounded on the wettest slantwise condition under the gradient wind balance without unequivocal addition of the dissipative heating in the planetary boundary subsurface (PBL). The model was later extended by Bister and Emanuel (1998, hereinafter BE98) in which the entire dissipative heating is assumed to be reclaimed as a redundant heat source at the ocean warm face and directly contributes to the total energy input of TCs. This thesis leads to an increase of MPI by a factor  $T_s / T_o$  where  $T_s$  is SST and  $T_o$  is the exodus temperature, and results in roughly 20% increase in MPI as reported in a number of posterior studies (e.g. Zhang and Altshuler, 1999; Jin et al., 2007).

**PV-Diagram of the hurricane Carnot engine**



- Sufficient ocean Thermal energy (SST > 26.5 C)
- Enhanced mid-troposphere (700 hpa) relative humidity
- Conditional Instability
- Enhanced lower troposphere relative Vorticity
- Weak Vertical shear of the horizontal winds at the genesis site.
- Displacement by at least 5-degree latitude away from the equator

A to B: Air undergoes Isothermal expansion as it flows toward the lower pressure of the storm center while in contact with the surface of the ocean (Heat bath @  $T_s = 300K$ ).

B to C: Adiabatic (very fast) ascent of the air

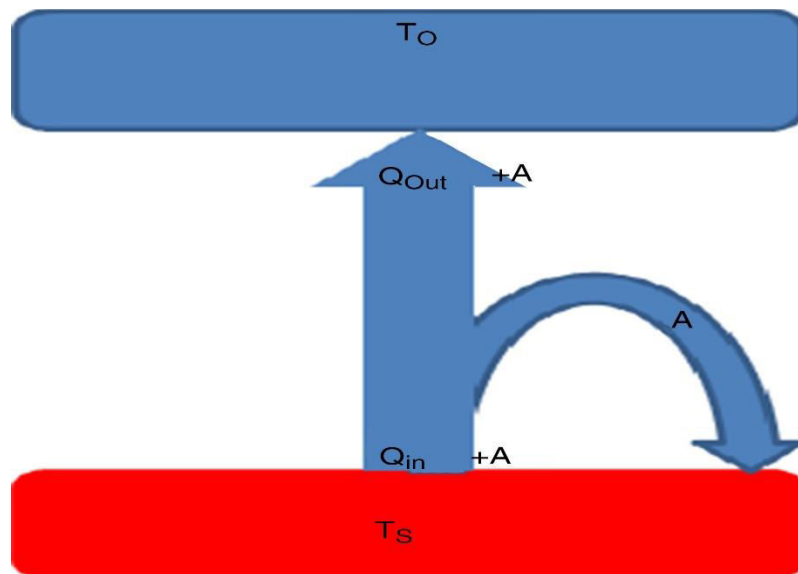
C to D: Air flows out at the top of its trajectory and is incorporated from the extreme low-pressure region into other weather systems via an Isothermal compression (Heat bath @  $T_o = 200K$ )

D to A: Air undergoes an adiabatic compression when losing altitude fast

**II. FUTURE OF SCOPE**

One of the more neglected components of post storm analysis of tropical cyclone (TC) is the routine preparation of best tracks and detailed forecast performance statistics at the end of each season when more raw data and complete history of TC are available. Whilst this is a time-consuming task, which uses valuable resources, it provides the best possible storm archive, together with invaluable information on overall forecast performance and the relative performance of individual techniques. Such information is essential for

1. Developing new forecasting techniques and monitoring forecast improvements resulting from new algorithms, techniques and observing systems; Evaluation of value addition by forecasters to guidance received from the objective aids;
2. Providing a basis for objectively estimating forecast uncertainty, which is used in deciding the timing and extent of warnings and watches, especially for critical regions;
3. Providing feedback on the relative accuracy of available forecast techniques, perhaps including stratification into different synoptic, latitudinal, or seasonal types (e.g., Neumann and Pelissier 1981).
4. Cyclone Tracking using Machine Learning
5. Enthalpy calculation using Thermodynamics



**Figure3:** Illustration of the no-work-to-environment Carnot cycle proposed by Bister et al. (2011) with the dissipative heating acting as a heat input at the warm source.  $T_s$  denotes the sea surface temperature,  $T_o$  denotes the cold temperature at the outflow layer, and  $A$  denotes the work done by atmosphere due to friction at the top of the atmospheric surface layer.

An unexpected consequence of BE98's dissipative heating hypothesis is, however, a notion of a cycle by which the atmosphere produces no work to environment (hereinafter referred to as the NWTE cycle), i.e. the entire frictional work is converted into dissipative heating within the atmospheric surface layer (ASL), which then acts as an external heat input at the ocean surface temperature (Emanuel, 2003; Bister et al., 2011). This hypothesis allows TCs to reuse all of their frictional work such that there is no net loss of the frictional work to the ambient environment (Figure 3). This NWTE cycle is difficult to understand because, after all, TCs do produce work against friction at the ocean-atmosphere interface, and it is not clear how the dissipative heating associated with the atmospheric turbulent kinetic energy (TKE) can be converted completely into heating at the same sea-surface temperature. Bister et al.'s hypothetical TC system consisting of turbines and heaters to demonstrate the NWTE cycle is questionable as well, given the fact that the heaters have to be made from a very special material to convert the exact amount of frictional work into heat at the exact temperature  $T_s$ . This contradicts the second law of thermodynamics, which depends only on the temperatures of the warm and cold reservoirs, not on the material of the sources or sinks.

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