WHAT LIMITS TYPHOON INTENSITY?

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A substantial amount of recent work, mainly by ourselves and Kerry Emanuel, has shown that the maximum achievable intensity of tropical cyclones can be accurately estimated using thermodynamic principles. This maximum potential intensity is derived by assuming that the tropical cyclone is able to utilise all of the available thermodynamic energy, both initially in the atmosphere and that becomes available as a result of the interaction between the cyclone and the underlying ocean.

However, whilst the thermodynamic estimates based on long - term mean conditions provided an excellent upper bound on the tropical cyclone intensity, it is also well known that most tropical cyclones do not reach this upper bound. This leads naturally to the question of what other processes can limit the cyclone intensity in individual cases. Our investigations have identified a number of candidate processes. Perhaps the best known are the influence of strong vertical windshear, movement over land, and the effects of ocean cooling (especially for slowly moving tropical cyclones). Other processes that will be discussed include: the non-linear relationship between the dynamical time-scale required for tropical cyclone intensification to proceed and the thermodynamic energy that is available the influence of surrounding systems (many of which are at the mesoscale and difficult to resolve with the current observing systems) and the potential for vortex breakdown, in which the eye and radius of maximum winds region rapidly mix to a halt the intensification process. We are also have evidence that the process of forming a tropical cyclone, especially in a monsoon environment, inherently leads to a reduction in the thermodynamic capacity for tropical cyclone intensification.

These processes will be discussed using the for observations and a series of specially designed numerical experimentations.