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How can tropical cyclones survive?

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It is important for understanding the development of tropical cyclones to be able to quantify the exchange of enthalpy and momentum between air and water. Air-sea fluxes are often formulated as drag CD and enthalpy CK exchange coefficients. Emanuel, 1986, derived an expression for potential intensity that depends on local environment parameters and is proportional to the ratio of enthalpy and drag coefficients. This ratio should be larger than 0.75 for a cyclone to develop. There are no direct surface measurements of CK/ CD under hurricane conditions and extrapolation from most open-ocean measurements at 25 m/s gives values of CK/ CD< 0.75 and in that case no cyclone could survive and Emanuel's theory must be wrong.
However there are measurements of CK taken over the Baltic Sea and Lake Ontario showing increasing values of CK up to 2.5 for wind speeds around 12 m/s. If this can be implemented for hurricane conditions the ratio CK/ CD>0.75 is in accordance with Emanuel's prediction. The high CK values are observed during situations when there is a regime shift of the structure of turbulence in the boundary layer. From spectral analysis it was found that as the boundary layer approaches neutral stratification, smaller-scale eddies become increasingly important in the turbulent transport of humidity and sensible heat and thus enhance the exchange coefficient CK. This turbulence regime is called the UVCN regime and require high wind speed, small temperature difference between air and water, sufficiently strong wind gradients and growing sea condition (Smedman et al., 2007, Sahlee et al., 2008).
What is the difference between world oceans and enclosed seas? The answer is the waves. The wave field over the open oceans is swell dominated but in enclosed seas and coastal areas swell is restricted mainly to low wind speed conditions, and swell is short lived because of short distances to the shores. When swell is present the MABL will be dominated by large eddies of zi size creating weak gradients of wind, temperature and humidity and thus small scale eddies cannot be formed leading to reduced CK-values. However, during hurricane condition the waves are expected to be young, stratification is close to neutral and gradients are sufficiently large to generate UVCN condition and thus increased CK values.

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