Geophysical Research Abstracts
Vol. 14, EGU2012-1874, 2012
EGU General Assembly 2012

Effect of Ocean Barrier Layers on Tropical Cyclone Intensification

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Improving tropical cyclone forecasts and mitigating its destructive potential require the knowledge of various environmental factors that influence the cyclone's path and intensity. While information of upper ocean thermal structure has been shown to augment the intensity forecast, the idea that upper ocean salinity can also play a role has been hitherto untested at a global scale. Here, using a variety of observations and model simulations, we systematically demonstrate that tropical cyclone intensification is significantly affected by salinity-induced Barrier Layers, which are 'quasi-permanent' features in the upper tropical oceans. When tropical cyclones pass over regions with Barrier Layers, the increased stratification and stability within the layer reduces the storm induced vertical mixing and sea surface temperature cooling. This causes an increase in enthalpy heat flux from the ocean to the atmosphere and consequently an intensification of tropical cyclones. On average, tropical cyclone intensification rate is nearly five times higher over regions with Barrier Layers, as compared to regions without. Our finding underscores the importance of observing not only the upper ocean thermal but also the salinity structure in the regions of deep tropical Barrier Layers, in order to improve ocean state estimates and modeling of Barrier Layer processes, which may prove to be important keys to more skillful prediction of tropical cyclone intensities. As the hydrological cycle may change under global warming, associated Barrier Layer changes need to be considered in projecting future tropical cyclone activity.