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How Does Intertropical Convergence Zone Variation Impact on Tropical Cyclone in the Northern Hemisphere?

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Enhanced sea surface temperature is expected to be favourable for more tropical cyclone formation. However, a surprising result emerges from the analysis of the frequency of tropical cyclones in the global tropical oceans in the northern hemisphere. The frequency of tropical cyclones positively correlates with a strengthening and northward movement of the Intertropical Convergence Zone (ITCZ hereafter).

There is a different regional character for the tropical cyclones activity: in the Western North Pacific, the number of tropical cyclones has been decreasing since 1960s, whereas in the Eastern North Pacific and North Atlantic, the number of tropical cyclones has been increasing since 1949 and 1984 respectively. Most of the tropical cyclones in the tropical oceans are generated within the ITCZ (called the monsoon trough in the Western North Pacific, and the easterly wave in the Eastern North Pacific and North Atlantic).

At the same time, there are changes in the strength and position of the ITCZ. In the Western North Pacific, ITCZ strength has been weakening and its position has been moving equatorward since the 1960s when the tropical cyclones frequency decreased. In the Eastern North Pacific, the ITCZ has been strengthening and moving northward where the tropical cyclone frequency has been increasing since 1949. In North Atlantic, since the mid-1980s, the ITCZ has been strengthening and moving northward and the tropical cyclone numbers have been increasing uniformly since then.

To understand the differing regional response, the ITCZ may be viewed as a planetary wave undulating around the planet along the tropics. The trough phase is correlated with where the tropical cyclone numbers reduce, such as in the Western North Pacific since 1960s; conversely, its peak phase in the tropical oceans is where the frequency of tropical cyclones increases, such as in the tropical Eastern North Pacific since 1949 and North Atlantic since 1984

In conclusion, this research reveals that dynamical conditions are important in determining tropical cyclone formation in the tropical oceans as long as the thermal condition is satisfied. If the vorticity linked to the ITCZ is weakening by an equatorward shift, then the low Coriolis parameter there inhibits the formation of tropical cyclones. However, if the vorticity linked to the ITCZ strengthens by a poleward shift, then the high Coriolis parameter enhances the formation of tropical cyclones.