How Does Intertropical Convergence Zone (ITCZ) Variation Impact on Tropical Cyclone Frequency over the tropical Oceans?

Liping Ma, Ric Williams

(*Earth, Ocean & Ecological Sciences, School of Environmental Sciences, Liverpool University, Liverpool, UK. Email: Liping.Ma@Liverpool.ac.uk)*

Scientific contribution:

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 number of tropical cyclones positively correlates with a strengthening and northward movement of the Intertropical Convergence Zone (ITCZ, defined as positive relative vorticity at 925hPa)

Data: NCEP monthly data and number of tropical cyclones observational data are employed in this research.

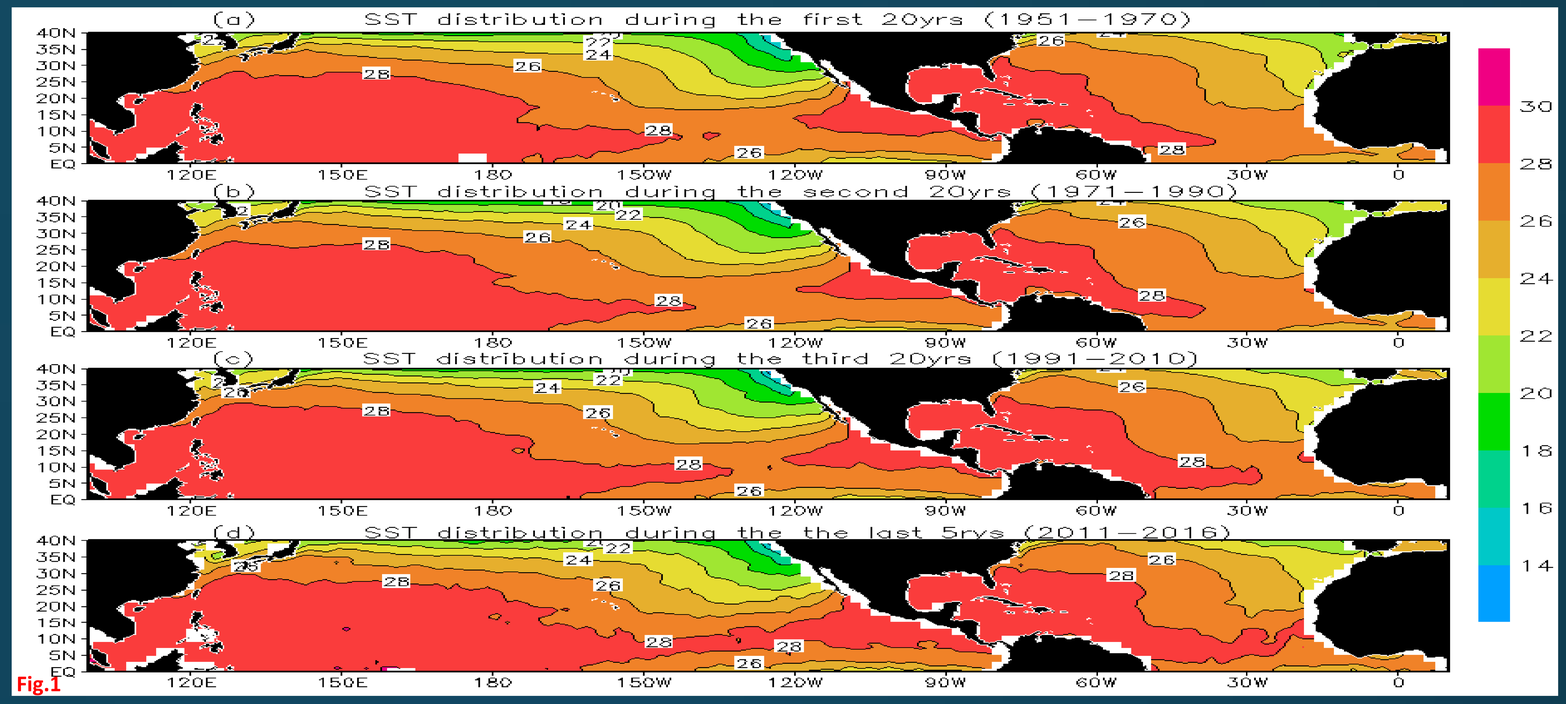


Fig.1

Fig.1 Seasonal mean Sea Surface Temperature (SST in℃) distribution (a)-(c) averaged every 20 years (d) last 5 years (2011-2016) during July to October (JASO) over the subtropical to tropical North Pacific and Atlantic.

Fig.1 showing sea surface temperature warming and its regional characteristics. In the tropical western north Pacific, the warm pool (surrounded by 28°C) is expanding gradually to the east . Comparing (a) to (b) and (c) until (d) last 5 years, the warm pool is connected as one belt from west to east. The SSTs meridional gradient in the west side of tropical ocean is reducing, whereas the east side is increasing, which is the same in the tropical North Atlantic. This might be the reason why the ITCZ has been changing regionally differences over these domains in Fig .2 and Fig 3.

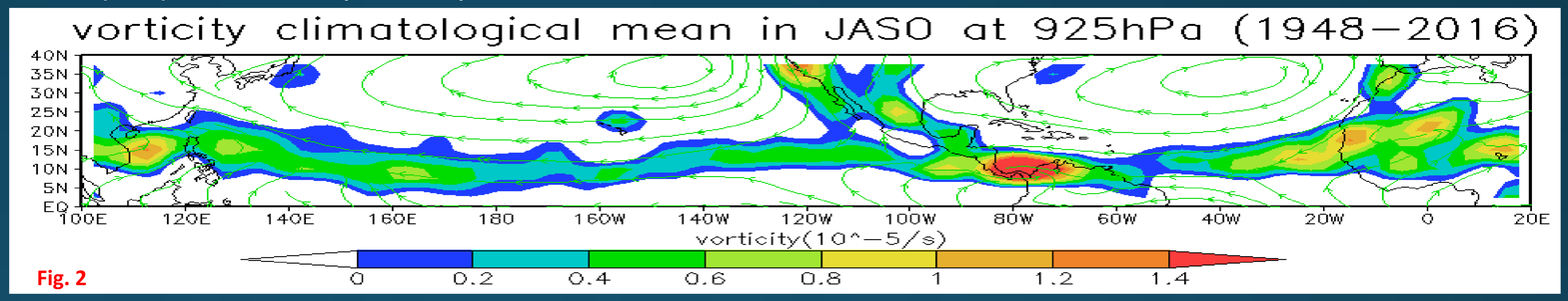


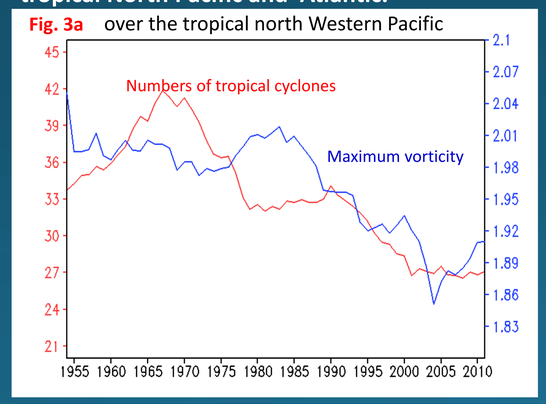
Fig. 2

Fig.2 Seasonal climatology mean wind streamline and positive relative vorticity at 925hPa during JASO from 1948-2016 over the subtropical to tropical North Pacific and Atlantic.

Conclusion:

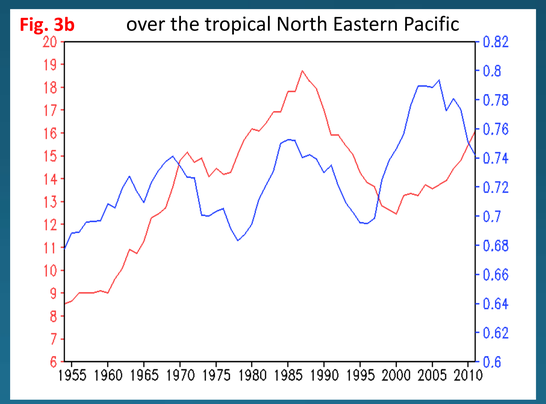
This research reveals that dynamical conditions are important in determining tropical cyclone formation in the tropical oceans as long as the thermal condition is satisfied. If the vorticity linked to the ITCZ is weakening by an equatorward shift, then the low Coriolis parameter there inhibits the formation of tropical cyclones, such as over the North Western Pacific(Fig.3a). However, if the vorticity linked to the ITCZ strengthens by a poleward shift, then the high Coriolis parameter enhances the formation of tropical cyclones , for instance, over the North Eastern Pacific and North Atlantic (Fig.3b and c).

Fig. 3a over the tropical north Western Pacific



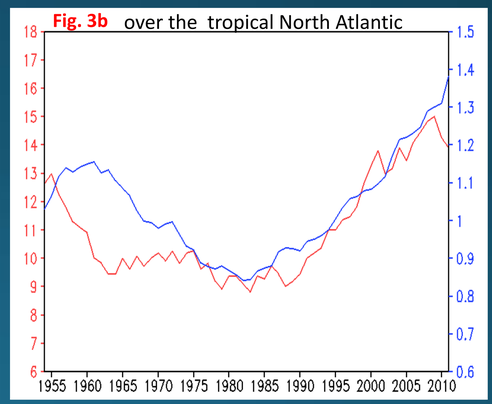
In the tropical North Western Pacific since 1965:
ITCZ : weakening and equatorward
Tropical cyclone numbers: decreasing

Fig. 3b over the tropical North Eastern Pacific



In the tropical North Eastern Pacific since 1948:
ITCZ : strengthening and poleward
Tropical cyclone numbers: increasing

Fig. 3b over the tropical North Atlantic



In the tropical North Atlantic since 1984:
ITCZ : strengthening and poleward
Tropical cyclone numbers: increasing

Support reference: Ma, Liping and Chen, Lianshou 2009 : The relationship between global warming and the variation in tropical cyclone frequency over the western North Pacific.J. Tropical Meteorology, Vol 15, No. 1, pp.38-44.