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EFFECTS OF TROPICAL CYCLONES ON OCEAN HEAT TRANSPORT AS SIMULATED BY A HIGH RESOLUTION COUPLED GENERAL CIRCULATION MODEL

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ABSTRACT (ID 944502)

In this study the **interplay between Tropical Cyclones** (TCs) **and the Northern hemispheric Ocean Heat Transport** (OHT) **is investigated**. In particular, results from a numerical simulation of the 20th and 21st Century climate, following the Intergovernmental Panel for Climate Change (IPCC) **20C3M and A1B scenario protocols** respectively have been analyzed. The numerical simulations have been performed **using a state-of-the-art global atmosphere-ocean-sea-ice coupled general circulation model - CGCM** (CMCC-MED, Gualdi et al. 2010, Scoccimarro et al. 2010) with relatively high-resolution (**T159**) in the atmosphere. The model is an evolution of the INGV-SXG (Gualdi et al. 2008, Bellucci et al. 2008) and the ECHAM-OPA-LIM (Fogli et al. 2009, Vichi et al. 2010) models. The simulated TCs exhibit realistic structure, geographical distribution (Fig.2) and interannual variability, indicating that the model is able to capture the basic mechanisms linking the TC activity with the large scale circulation. The cooling of the surface ocean observed in correspondence of the TCs is well simulated by the model (Fig.3). **TC activity is shown to significantly affect the poleward OHT out of the tropics, and the heat transport into the deep tropics** (Fig.4). **This effect**, investigated by looking at the 100 most intense Northern Hemisphere TCs, **is strongly correlated with the TC-induced momentum flux at the ocean surface** (Fig.7). TCs frequency and intensity appear to be substantially stationary through the whole 1950-2069 simulated period as well as the effect of the TCs on the meridional OHT.

Simulation of Tropical Cyclones in CMCC-MED

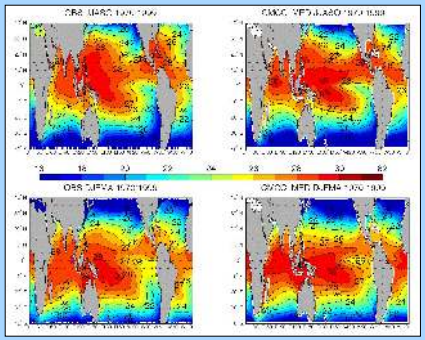

Fig. 1 Observed (left) and simulated (right) 1970-1999 Sea Surface Temperature during northern (upper panels) and southern (lower panels) summer.

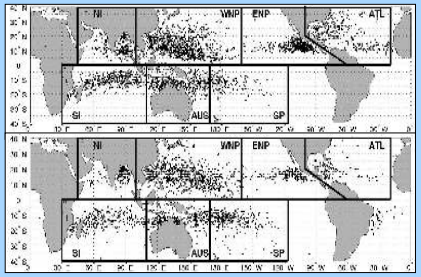

Fig. 2 Observed (upper panel) and simulated (lower panel) TC Tracks starting point during 1970-1999 period.

Tropical Cyclone-Ocean Interaction (as obtained averaging the anomalies computed over the 100 most intense simulated Northern Hemispheric TCs)

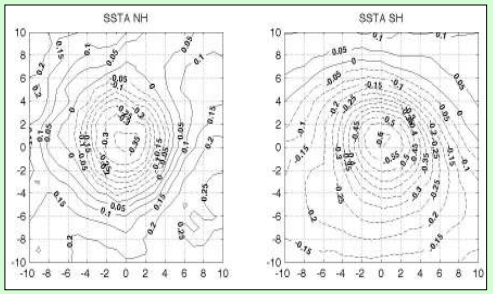

Fig. 3 Composite Sea Surface Temperature Anomaly (SSTA) over the TC eye region computed as the difference between the SST at T2=T_WIMAX+2days and T1=T_WIMAX.

T_WIMAX is the time at which maximum wind speed is reached.

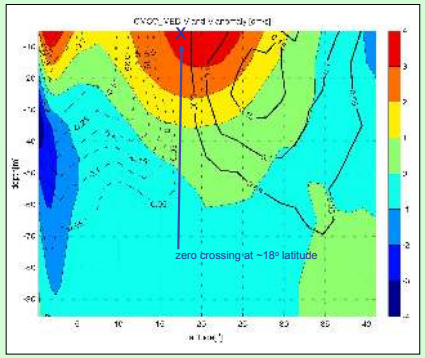

Fig. 5 Zonally averaged ocean meridional velocity (V) mean computed over the period June-December 1970-1999 (color) and TC induced meridional velocity anomalies. Anomalies have been computed as in Figure 4.

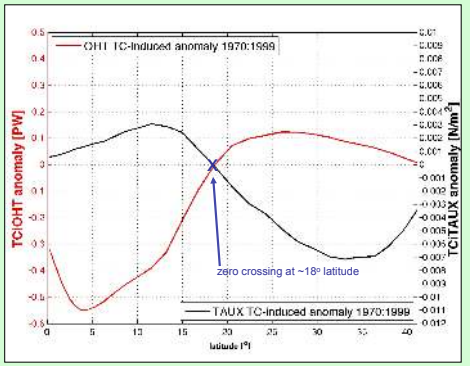

Fig. 7 Zonally averaged TC induced Ocean Heat Transport (TCiOHT) (red, same as figure 4) and surface zonal TC induced momentum flux (TCiTAUX).

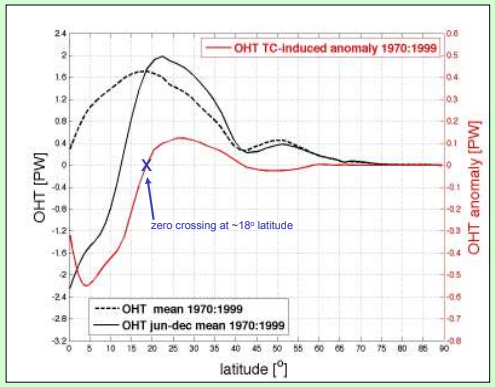

Fig. 4 Ocean Heat Transport (OHT, black) and OHT anomaly (red) induced by TCs. The anomalies have been computed (and averaged) for 20 days around the day of maximum intensity (T_WIMAX +-10dd) of the TC with respect to the monthly climatology(1970:1999)

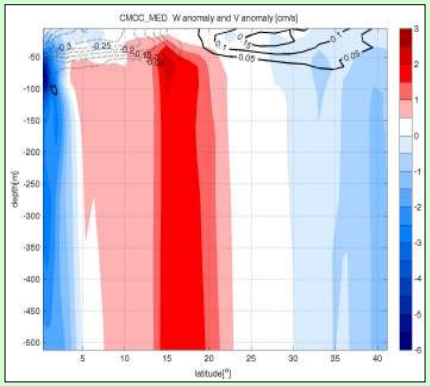

Fig. 6 Zonally averaged TC induced vertical velocity (W) anomaly computed over the period June-December 1970-1999, scaled by a factor of 10^5 (color). Contours are the TC induced meridional velocity (V) anomalies (as Fig 5).

Conclusions

- State of the art CGCMs (CMCC-MED in this study) have a sufficient horizontal resolution to investigate air-sea interaction during TCs events.
- The winds associated with **the TCs significantly weaken (strengthen) the Trade Winds in the 5-18°N (18-30°N) latitude belt.**
- **The induced overturning cells in the ocean velocity (Fig.5,6) cause a TC induced Ocean Heat Transport (TciOHT) anomaly (Fig.4)**: The **Poleward OHT out of the tropics increases** (Emanuel, 2001) **but also increases the OHT into the deep tropics** (Jansen & Ferrari 2009).

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