TROPICAL CYCLONE ACTIVITY IN A WARMER CLIMATE AS SIMULATED BY A HIGH_RESOLUTION COUPLED GENERAL CIRCULATION MODEL: CHANGES IN FREQUENCY AND AIR-SEA INTERACTION

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This study investigates the possible changes that the greenhouse global warming might generate in the characteristics of the tropical cyclones (TCs) (Gualdi et al. 2008). The analysis has been performed using climate scenario simulations (fig. 3) carried out with a fully coupled high-resolution global general circulation model (INGV-SXG, fig. 1, Gualdi et al. 2008). The capability of the model to reproduce a reasonably realistic TC climatology has been assessed by comparing the model results from a simulation of the XX Century (fig. 2) with observations (NHC, JTW). The TC detection method is based on Bengtsson et al. 1995 and Walsh et al. 1997. The model appears to be able to simulate tropical cyclone-like vortices with many features similar to the observed TCs (fig. 6). The simulated TC activity exhibits realistic geographical distribution (fig. 4), seasonal modulation (fig. 5) and interannual variability, suggesting that the model is able to reproduce the major basic mechanisms that link the TC occurrence with the large scale circulation.

The results from the climate scenarios reveal a substantial general reduction of the TC frequency (fig. 7) and the atmospheric CO₂ concentration is doubled and quadrupled (fig. 3). The reduction appears particularly evident for the tropical north west Pacific (WNP) and north Atlantic (ATL). In the WNP the weaker TC activity seems to be associated with a reduced amount of convective instabilities (fig. 9 and tab. 1). In the ATL the region weaker TC activity seems to be due to both the increased stability of the atmosphere and a stronger vertical wind shear. Despite the generally reduced TC activity (fig. 7), there is evidence of increased rainfall associated with the simulated cyclones (fig. 8). Using the new fully coupled CMCC model (CMCC_MED), with a T159 (~80 Km) atmospheric resolution, we found a significant modulation of the Ocean Heat Transport (OHT) induced by the TC activity.

Conclusions
- General reduction of TCs frequency (fig. 7) when atmospheric CO₂ concentration is doubled (2xCO₂) and quadrupled (4xCO₂) (fig. 3) with respect to preindustrial value (PREIND).
- Reduced amount of convective instabilities (fig. 9, tab. 1) in 2xCO₂ and 4xCO₂ experiments with respect to PREIND.
- CMCC_MED CSRM at 80 Km of atmospheric resolution is capable to detect the tropical cyclone - ocean interaction in terms of induced SST cooling (fig. 11). Model results suggest that TCs affect significantly the Meridional Ocean Heat Transport (fig. 12).