



ISTITUTO NAZIONALE di
GEOFISICA e VULCANOLOGIA

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

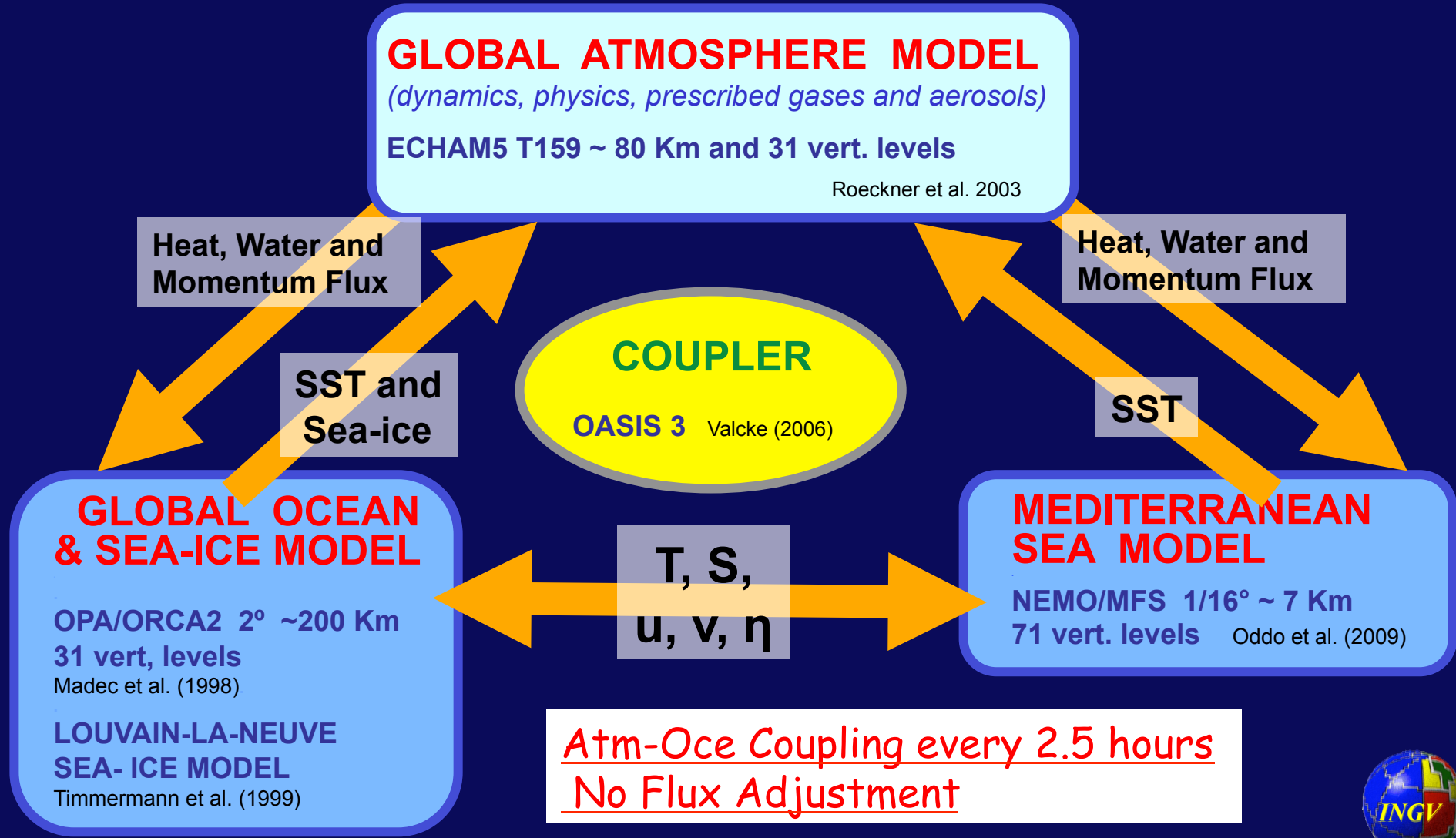
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29th Conference on Hurricanes and Tropical Meteorology

E. Scoccimarro, S. Gualdi, A. Bellucci, A. Sanna, P. Oddo, A. Navarra - Tucson, Arizona May 10-14 2010

In this study the effect of TCs on NH Ocean Heat Transport (OHT) is investigated with a "Hurricane Resolving" High-Resolution Coupled General Circulation Model (CMCC_MED evolution of INGV-SXG [Gualdi et al. 2008]) that will be also used for CMCC CMIP5 IPCC scenario exps



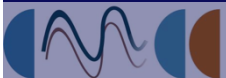
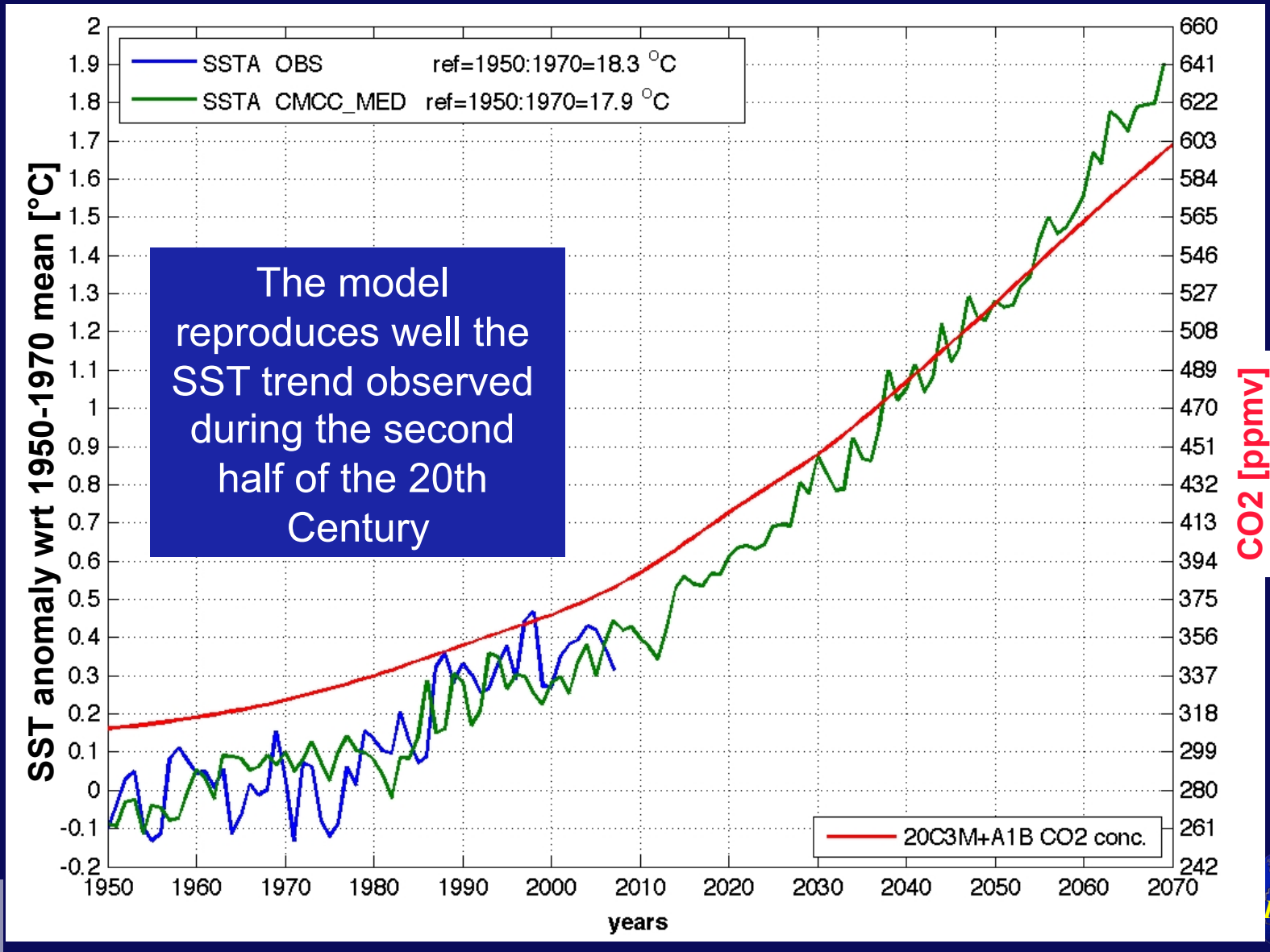
OUTLINE

1. The CMCC Climate Simulations used in this study
2. How the model represent Tropical Cyclones (TCs): comparison with the climatology of observed TCs
3. How simulated TCs affect the Northern Hemisphere Ocean Heat Transport (OHT)
4. TCs activity under the 21st century (A1B scenario)



The CMCC climate simulation : 20C3M and A1B scenario

Evolution of the global mean SST Anomaly from 1950 to 2069: observation vs. model

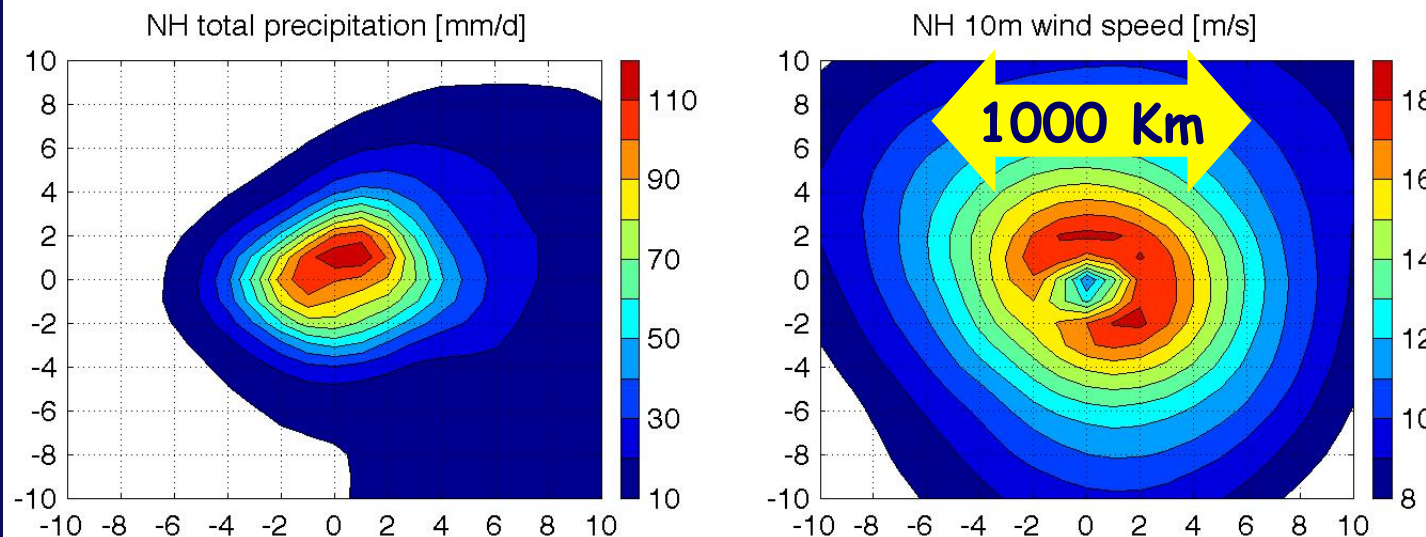


How the model represent Tropical Cyclones

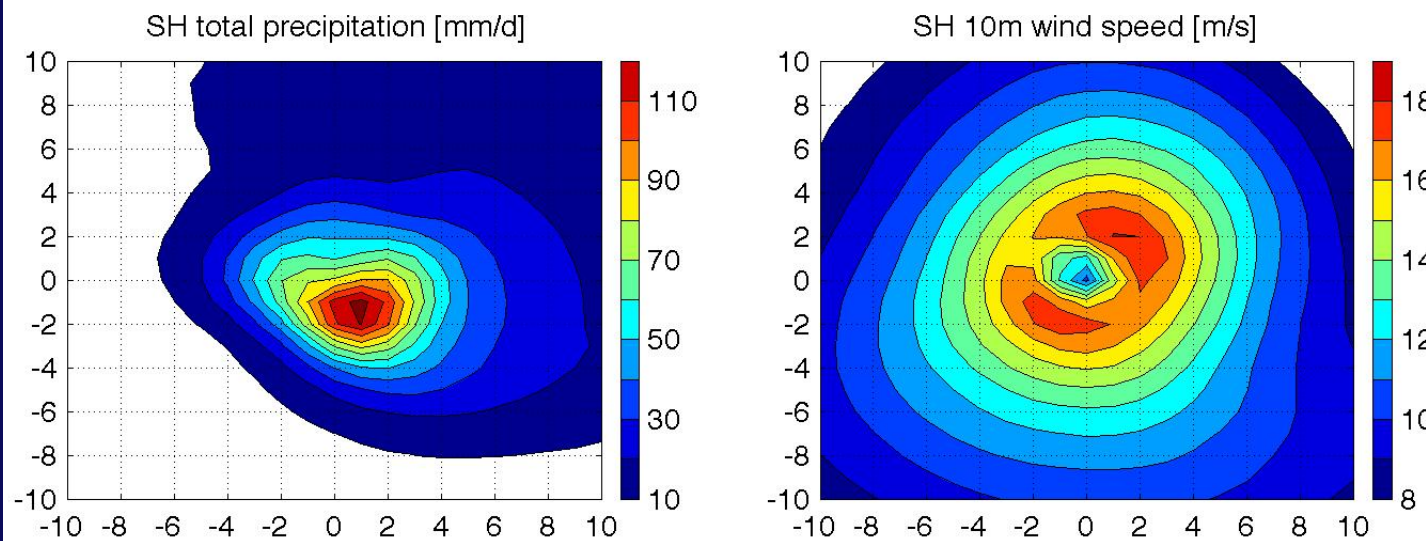
Composite of 100 hemispheric most intense simulated TCs

[TC-MIP CSIRO TCs detection method http://www.earthsci.unimelb.edu.au/~kwalsh/tcmip_index.html]

NH



SH



PRECIPITATION

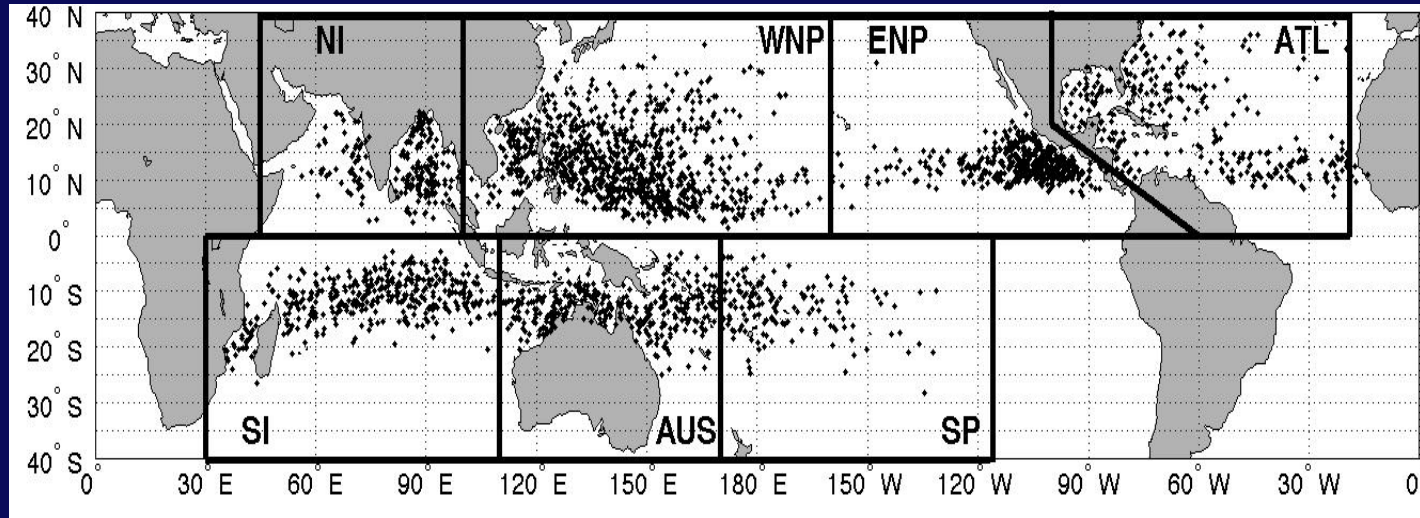
10m WIND SPEED



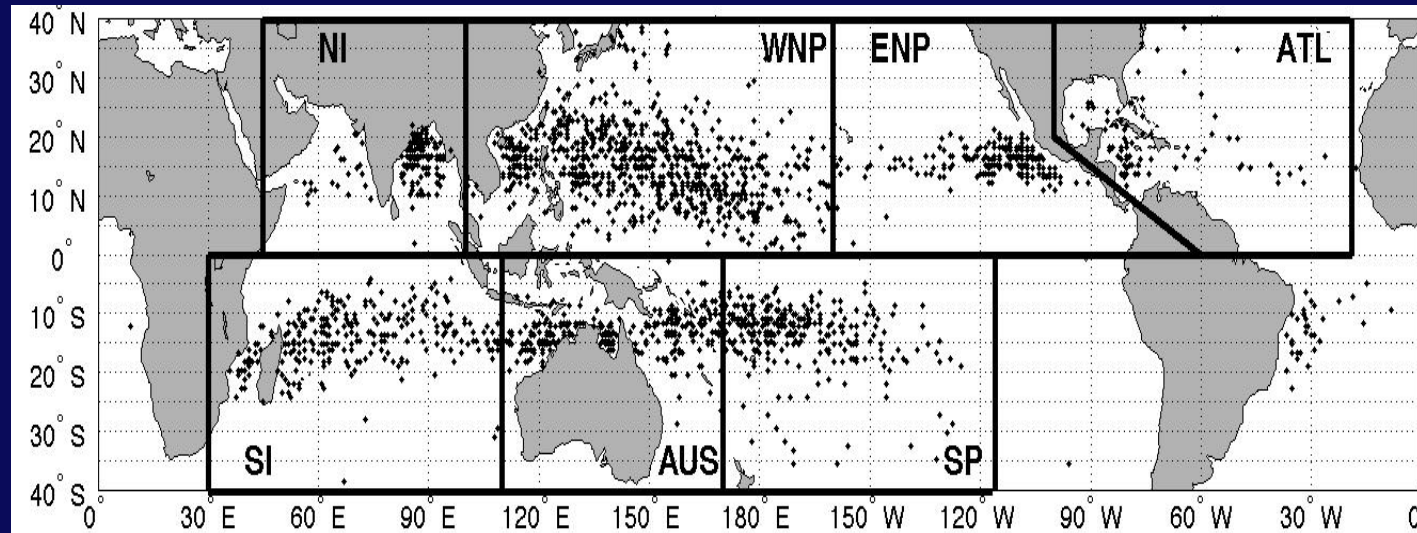
How the model represent Tropical Cyclones

TCs track starting points during 1970:1999

OBS

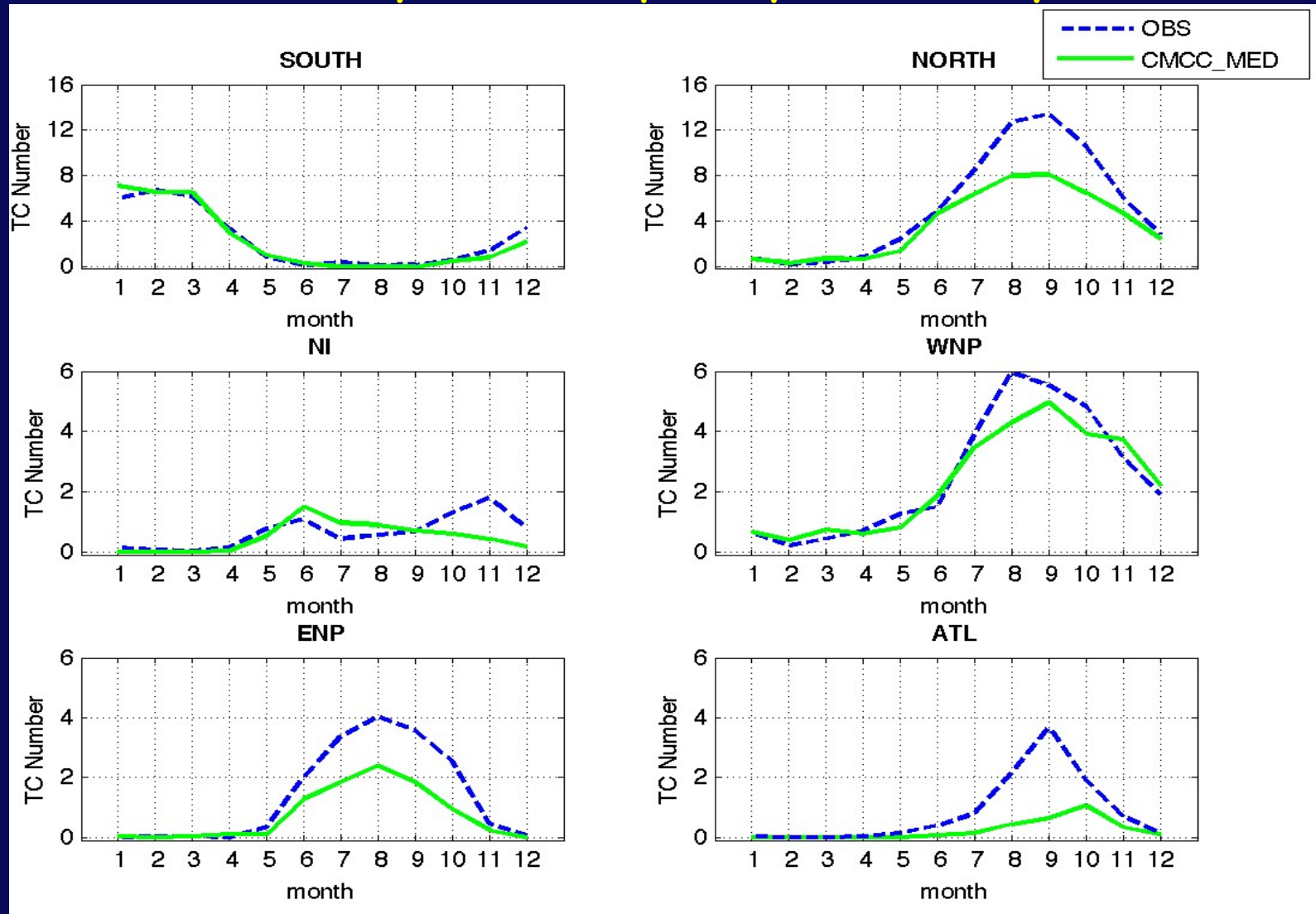


MODEL

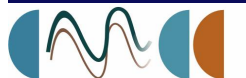


How the model represent Tropical Cyclones

Seasonality of the Tropical Cyclone Activity

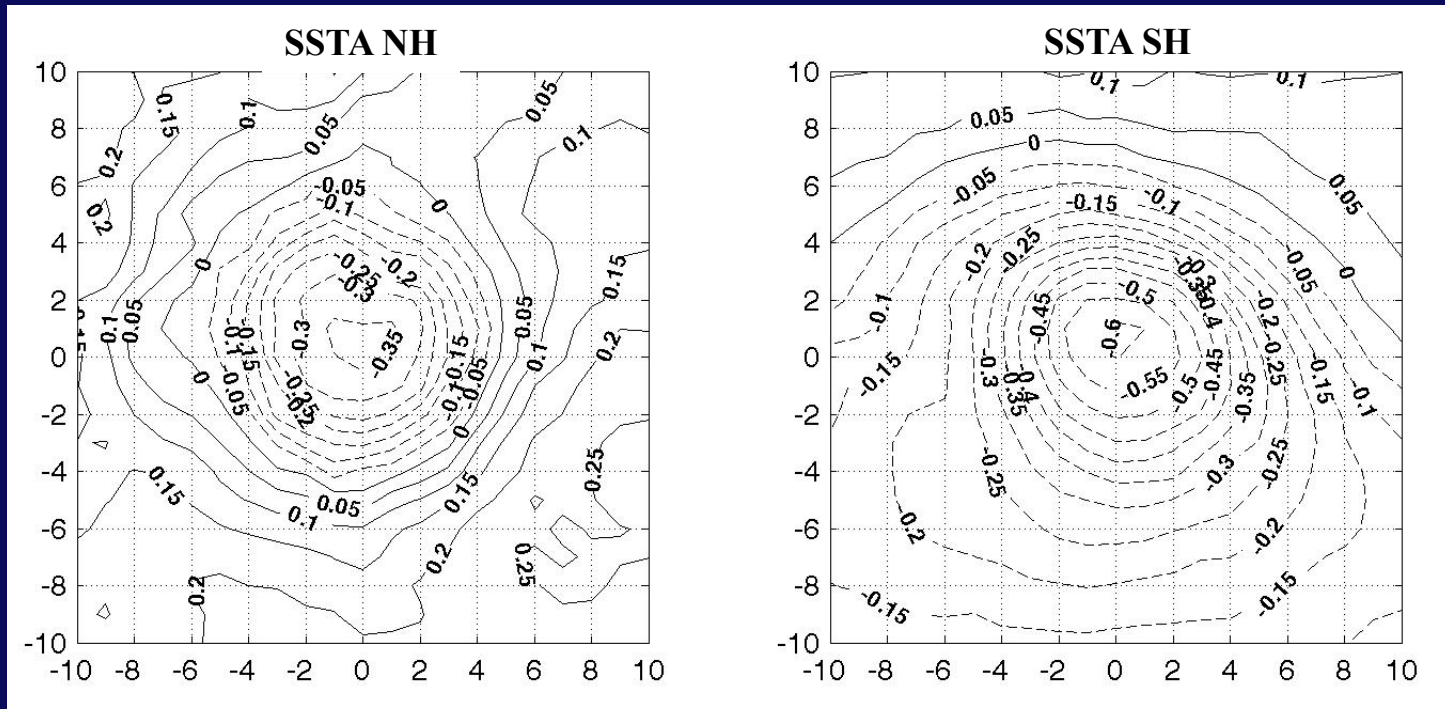


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How the model represent Tropical Cyclones

Sea Surface Cooling induced by TCs: TC induced SSTA [°C] composite



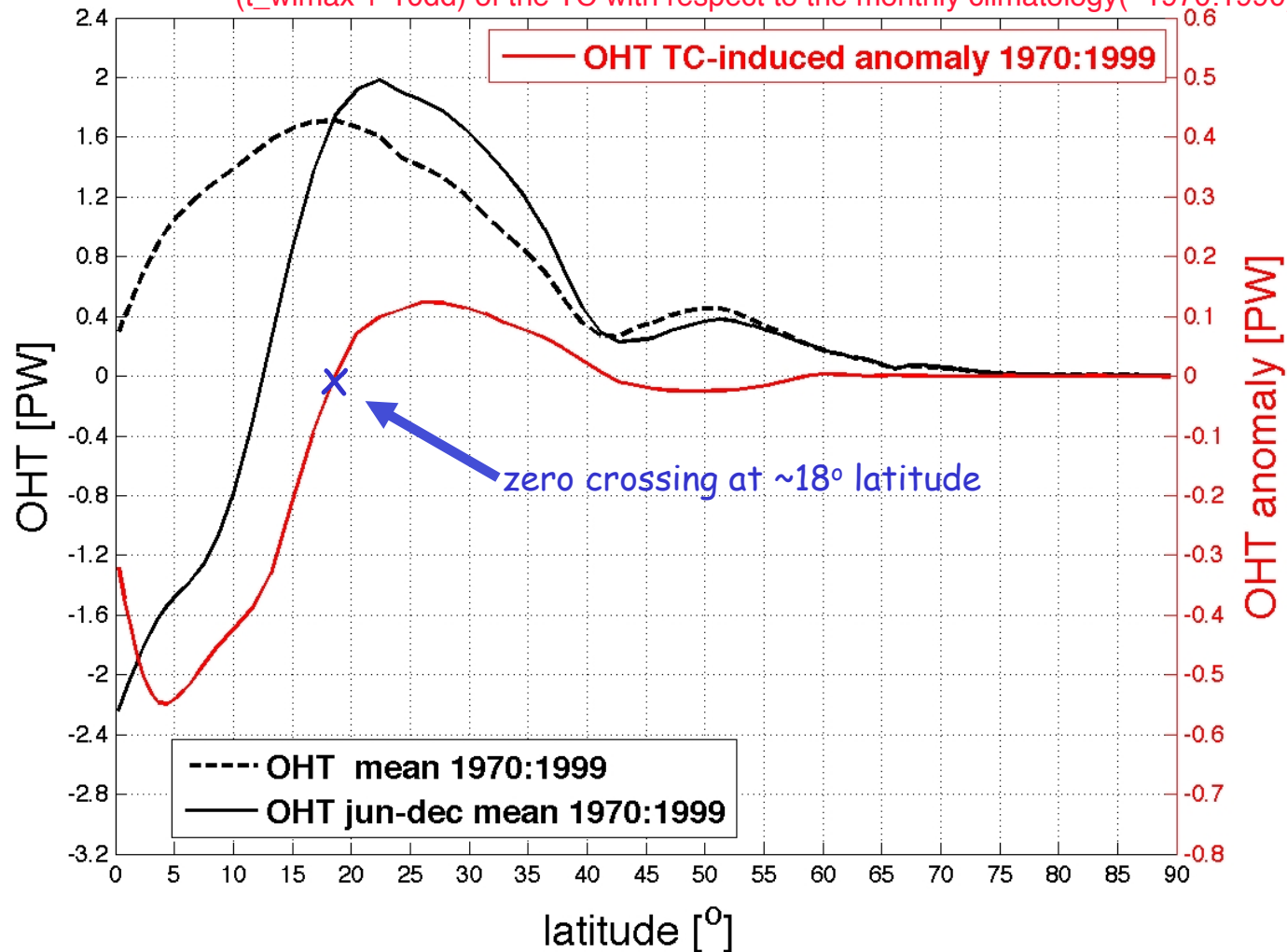
Composite Sea Surface Temperature Anomaly (SSTA) over the TC eye region computed as the difference between the SST at $T_2 = T_WIMAX + 2\text{days}$ and $T_1 = T_WIMAX - 6\text{h}$. T_WIMAX is the time at which maximum wind speed is reached.

The anomaly is then averaged over the **100 most intense TCs** of the NH (left panel) and SH (right panel) during 1970:1999.

How TCs affect the Ocean Heat Transport

OHT as simulated by the model and TC induced OHT (TCiOHT) Anomaly

The anomalies have been computed (and averaged) for 20 days around the day of maximum intensity ($t_{wimax} \pm 10dd$) of the TC with respect to the monthly climatology (1970:1999)



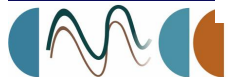
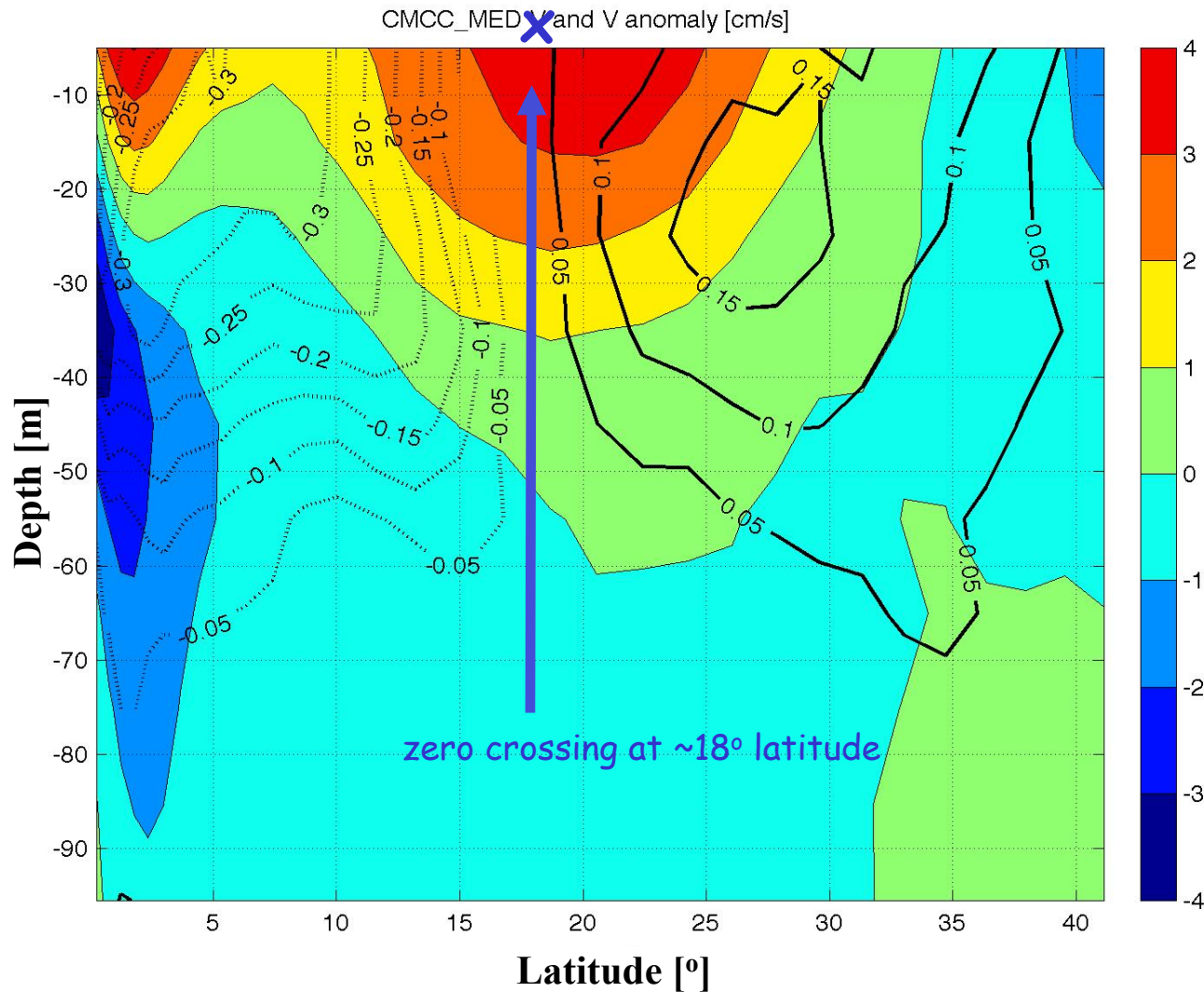
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How TCs affect the Ocean Heat Transport

Meridional Velocity anomaly induced by TCs:

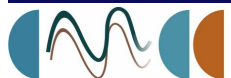
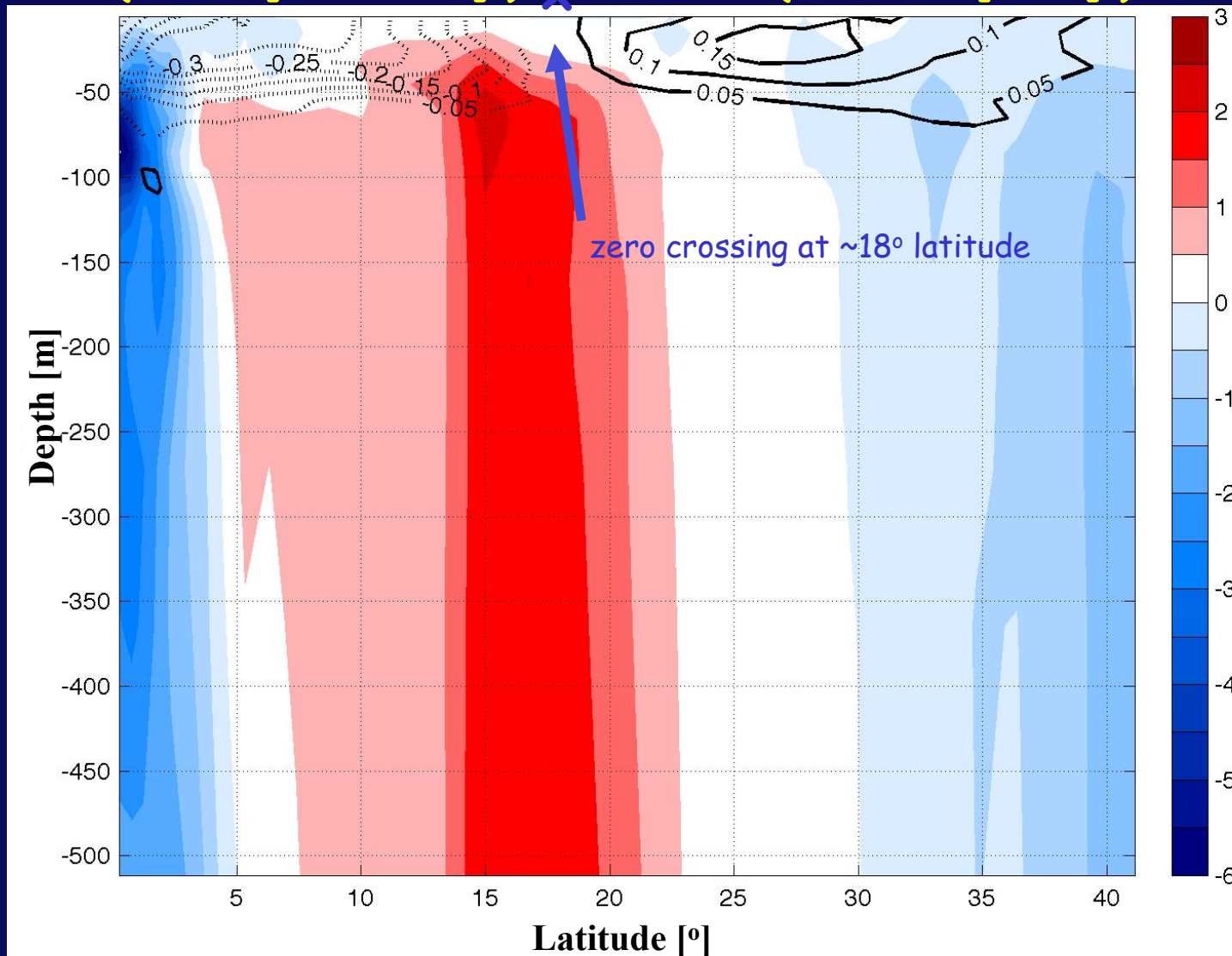
$V_{\text{jun-dec mean}}$ (colors [cm/s]) and V_{anomaly} (contours [cm/s])



How TCs affect the Ocean Heat Transport

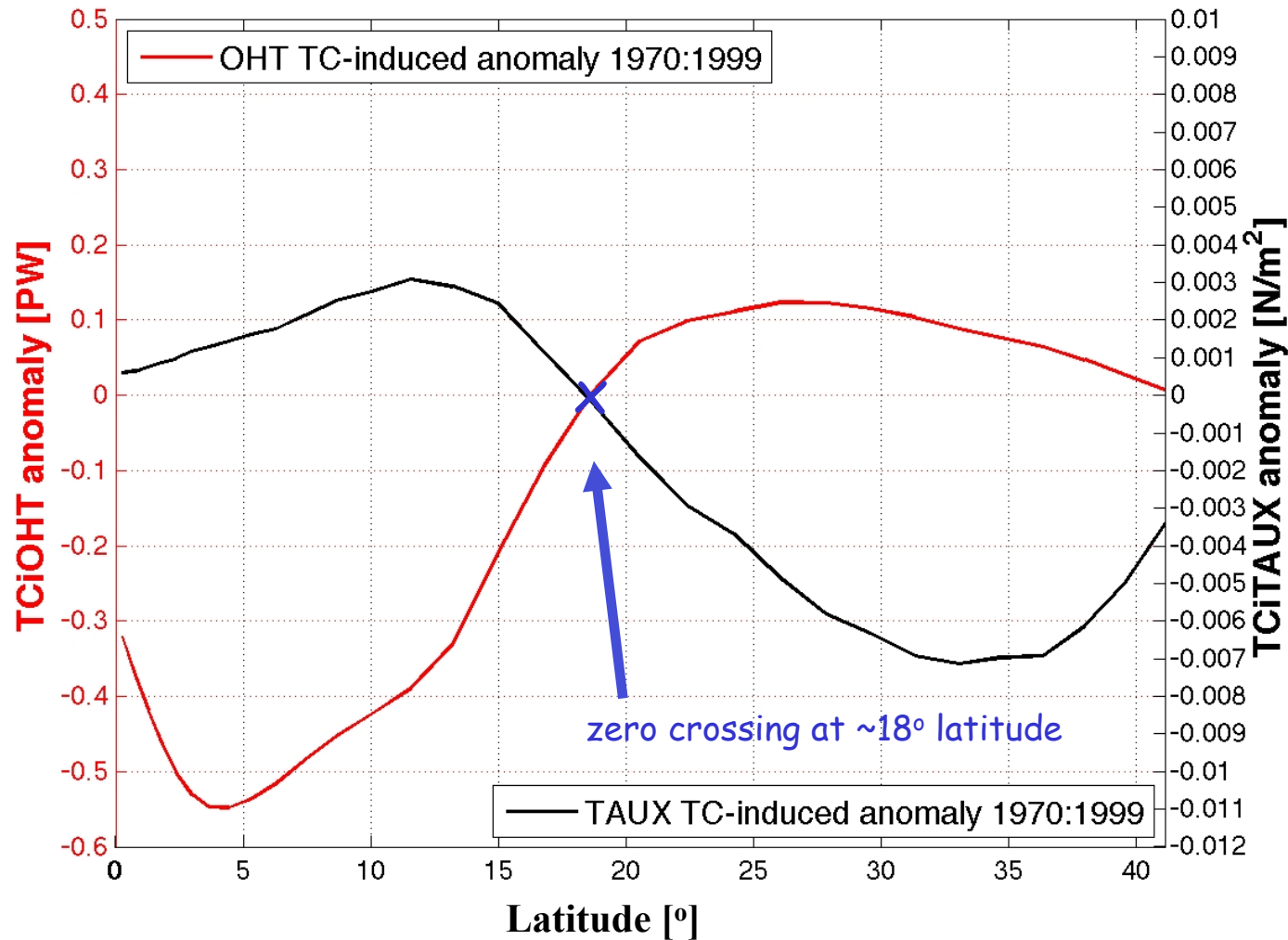
Ocean Velocity Anomalies induced by TCs:

W (colors [$1e-5\text{cm/s}$]) \times and V (contours [cm/s])

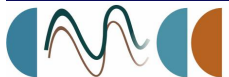


How TCs affect the Ocean Heat Transport

TC induced OHT (TCiOHT) and TAUX (TCiTAUX) Anomalies

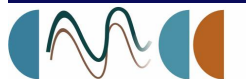
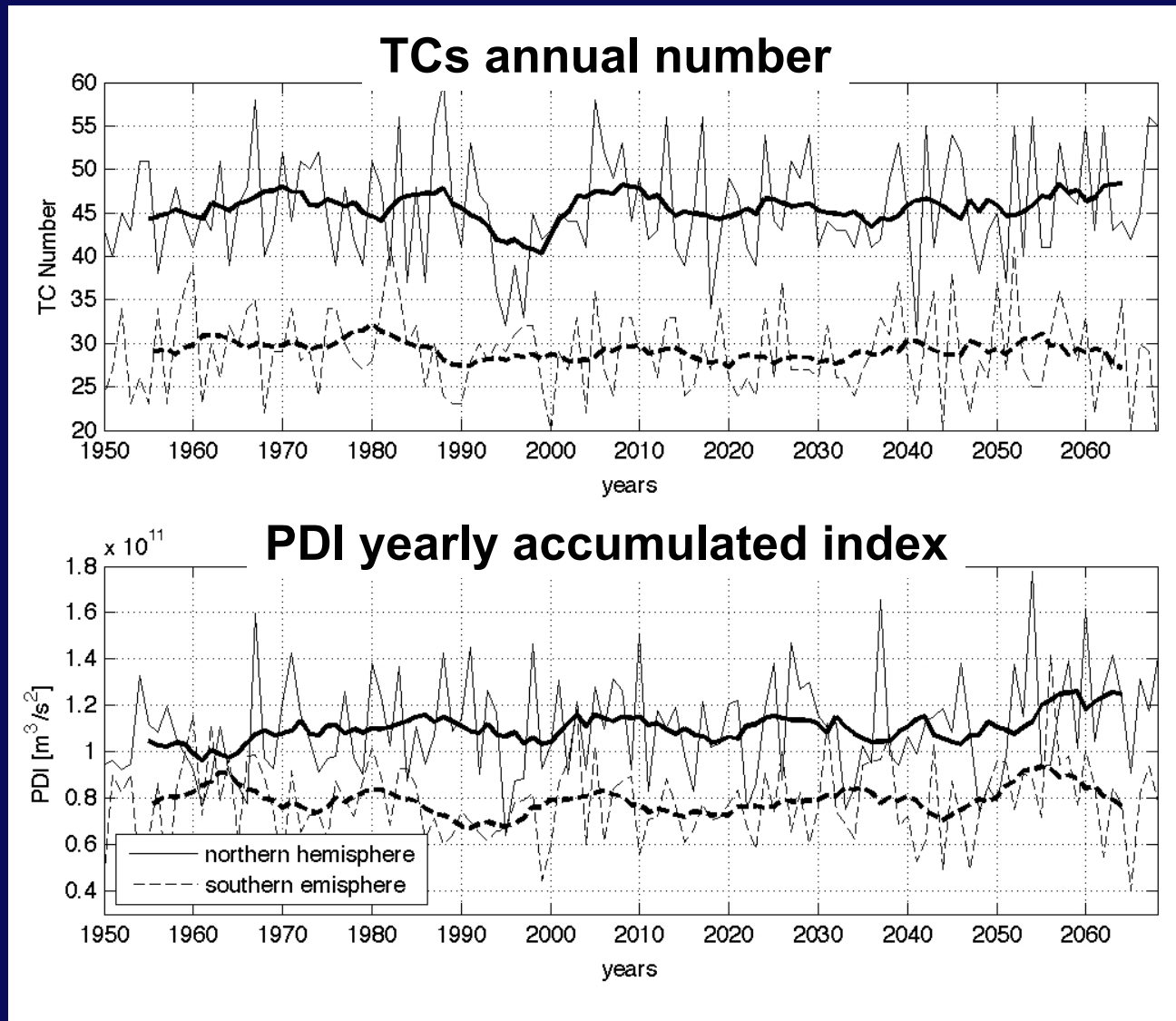


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TCs activity under the 21st century (A1B scenario)

TCs number and Intensity (PDI)





EFFECTS OF TROPICAL CYCLONES ON OCEAN HEAT TRANSPORT



CONCLUSIONS

The CMCC_MED (atmosphere resolution = 80Km) coupled GCM appears to simulate Tropical Cyclones (TCs) with realistic features.

TCs act reinforcing trade winds at high tropical latitudes (18° - 30° N) and weaken them at low latitudes (5° - 18° N).

The induced overturning cells in the ocean velocity cause a TC induced Ocean Heat Transport (TciOHT) anomaly:

The *Poleward OHT out of the tropics* increases (*) but also increases the OHT *into the deep tropics* (**).

During the simulated period (1950:2069) (20C3M+A1B) TCs activity and TciOHT anomaly are not significantly changed.

(*) [Emanuel, 2001] (**) [Jansen & Ferrari, 2009]

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EFFECTS OF TROPICAL CYCLONES ON OCEAN HEAT TRANSPORT

as simulated by a High Resolution
Coupled General Circulation Model

THANK YOU !

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