

The role of the remote ocean on tropical cyclone activity associated with different types of El Niños

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Introduction

Tropical cyclones can cause substantial loss of life and can impact Financial markets. There is a great deal of interest in landfalling tropical cyclones associated with different types of El Niños, defined as whether maximum warming occurs in the Eastern Pacific (EP Niño) or Central Pacific (CP Niño) (see Kim *et al*, 2011). Key research questions:

- What is the role of remote SSTs on tropical cyclone activity associated with different types of El Niños
- What are the driving mechanisms of tropical cyclone location?

The ENSO-TC teleconnection

The tropical cyclone location changes between El Niño and La Niña years captured in ERA-Interim (fig 2) match well with Camargo *et al* (2007).

HiGAM captures the shift of tropical cyclones to phase of ENSO in the Pacific and Indian Ocean. In the North Atlantic variability is confined to the Caribbean due to biases in the mean state climatology. The variability is over pronounced in the Western Pacific.

HiGEM is able to broadly capture the shift of tropical cyclones in the Pacific and Indian Ocean, however the shift is more zonal as opposed to meridional. HiGEM is unable to capture the expected response of tropical cyclone locations changes in the North Atlantic.

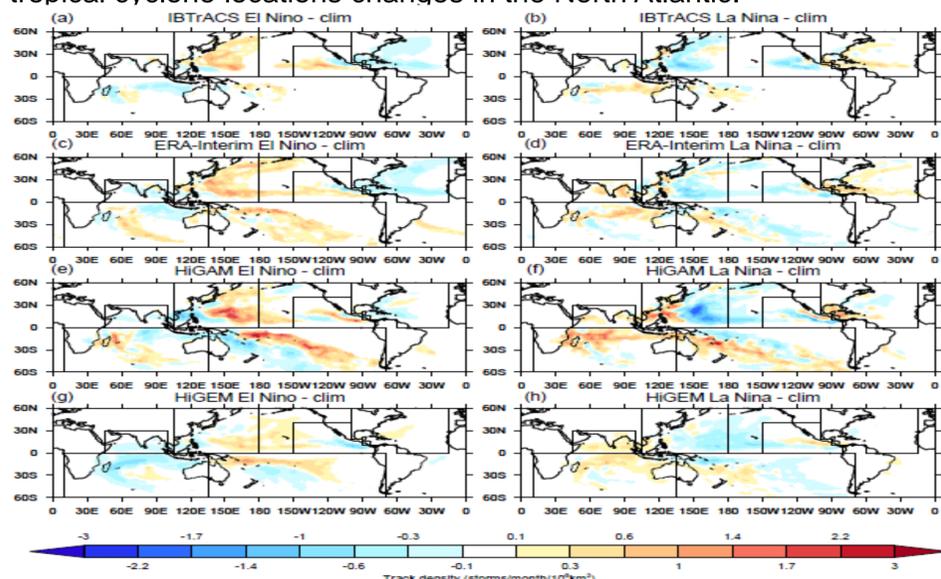


Fig 2. Tropical cyclone track density during May-November in the NH and October to May in the SH for IBTrACS (1979-2010), ERA-Interim (1979-2010), HiGAM AMIP (1979-2002) and HiGEM (150-year present day simulation).

Walker circulation

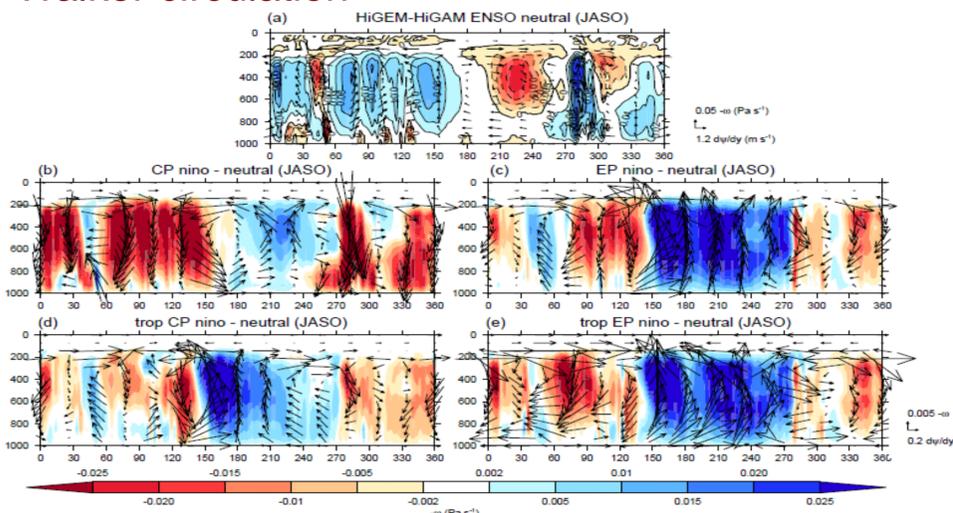


Fig 4. Height longitude cross-section of Walker Circulation 0-10°N, June-October for (a) ENSO neutral, (b) CP Niño minus ENSO neutral, (c) EP Niño minus ENSO neutral, (d) tropical SST CP Niño minus ENSO neutral, (e) tropical SST EP Niño minus ENSO neutral.

The Walker circulation response associated with CP Niños is weaker than EP Niños and doesn't show an increase in ascending motion to the West. Further large-scale environmental parameters will be investigated on the relationship to tropical cyclones in the Western North Pacific.

The model and SST composites

SSTs are taken from the present-day simulation (150 years) of HiGEM, a coupled model which has a resolution of N144 (~ 90 km). Tropical cyclone validation of the model is given in Bell *et al* (2013).

The five strongest ENSO events during August-September-October (ASO) are composited as the focus is on the Northern hemisphere. The two types of El Niño are defined using the methodology of Kug and Ham (2011): EP Niño is defined as normalized NINO3 SST > 1°C and > NINO4 SST; WP Niño is defined as NINO4 SST > 1°C and > NINO3 SST.

Remote SST experiments use the El Niño in the tropical Pacific (160°E -East Pacific coast, 10°S-20°N) with a tukey filtering out to 10° and ENSO neutral SSTs elsewhere (fig 1).

The SSTs are used to force HiGAM (see Strachan *et al*, 2013) with 10 ensemble members.

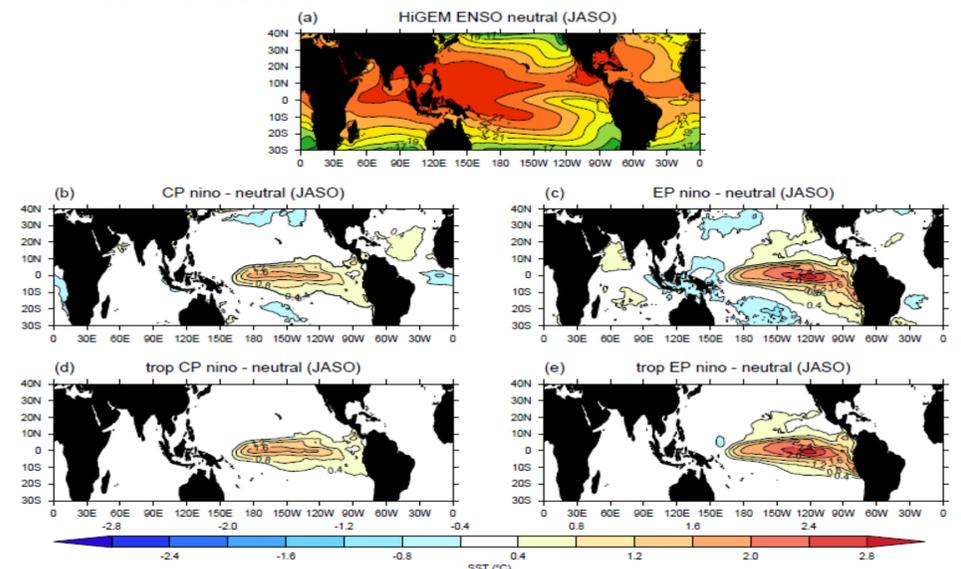


Fig 1. (a) Composites of ENSO neutral SST taken from the 150-year HiGEM present-day simulation. (b) and (c) 5 strongest CP Niño and EP Niño. (d) and (e) Tropical Pacific SST only with neutral SSTs elsewhere.

TC response to the different types of El Niños

During CP Niños more tropical cyclones are steered toward South East Asia compared to EP Niños, similar to other studies. More experiments are needed for the remote SST experiments.

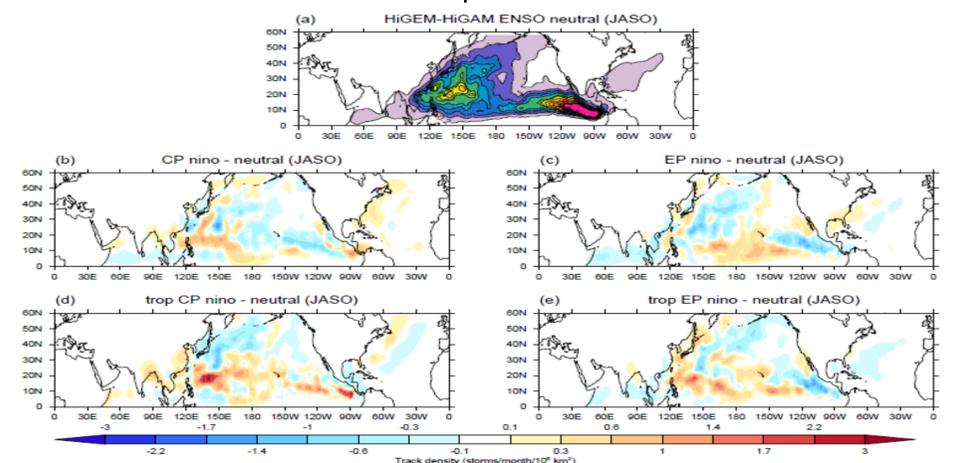


Fig 3. Same as figure 2. (a) ENSO neutral (10 years), (b) CP Niño (10 years), (c) EP Niño (10 years), (d) tropical SST CP Niño (4 years), (e) tropical SST EP Niño (5 years)

Future work

- Further analysis will focus on the Western North Pacific.
- Investigate the role of thermodynamic and dynamics parameters.

References: Bell *et al* (2013) Response of tropical cyclones to idealized climate change experiments in a global high resolution coupled general circulation model *J. Climate*
 Camargo *et al* (2007) Use of a Genesis Potential Index to Diagnose ENSO Effects on Tropical Cyclone Genesis *J. Climate*
 Kug and Ham (2011) Are there two types of La Niña? *GRL*
 Strachan *et al* (2013) Investigating global tropical cyclone activity with a hierarchy of AGCMs: the role of model resolution *J. Climate*.