Modelling the dynamics of the upper ocean in the Panama Basin

Lizdenia Arce-Marenco, Miguel A. Morales Maqueda.

School of Natural and Environmental Sciences, Newcastle University, UK.

Introduction

The El Niño-Southern Oscillation (ENSO) is an world-wide phenomenon that originates in the tropical regions of the Pacific. The ENSO depends on the dynamic coupling between the atmosphere and the ocean[1]. The dynamic processes behind the occurrence, intensity and impact of the ENSO are still topics of study[2]. Although the number of oceanographic studies and observations in the Panama Basin (Eastern Tropical Pacific) has increased in recent years, the existing scientific literature does not provide a clear understanding of vertical processes (mixing and upwelling) in the basin and how the ENSO could affect them.

Objectives

- To determine the location and seasonality of upwelling areas in the Panama Basin.
- To describe the influence of the ENSO in these regions.
- To investigate how vertical mixing and upwelling interact in the region.

Metodology

We have used a three-dimensional ocean modelling framework (NEMO[3], Nucleus for European Modelling of the Ocean) to investigate the impacts of the ENSO on the upper ocean dynamics in the Panama Basin. A global, coarse resolution formulation of NEMO has been integrated for the period 1948 to 2009, using as interannual atmospheric forcing the Coordinated Ocean-ice Reference Experiments (CORE[4]) dataset version 2.

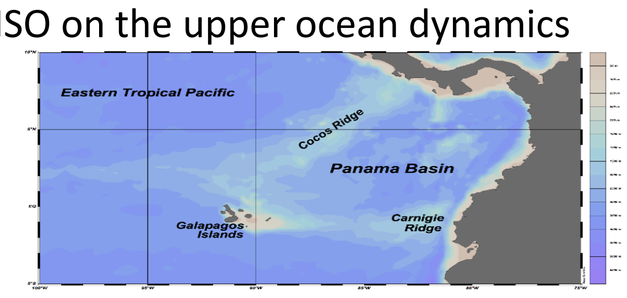


Figure 1. Map of the Panama Basin

Results

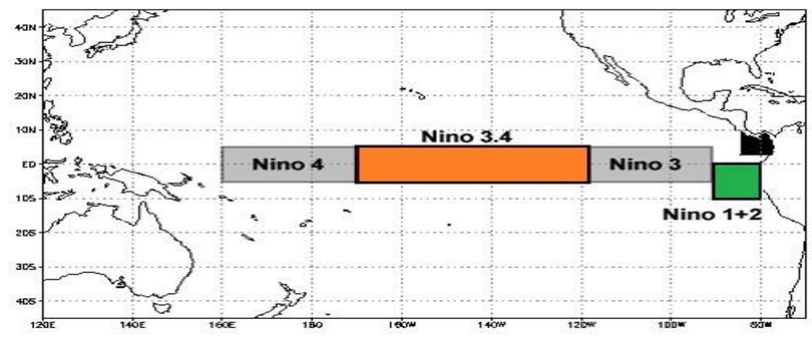
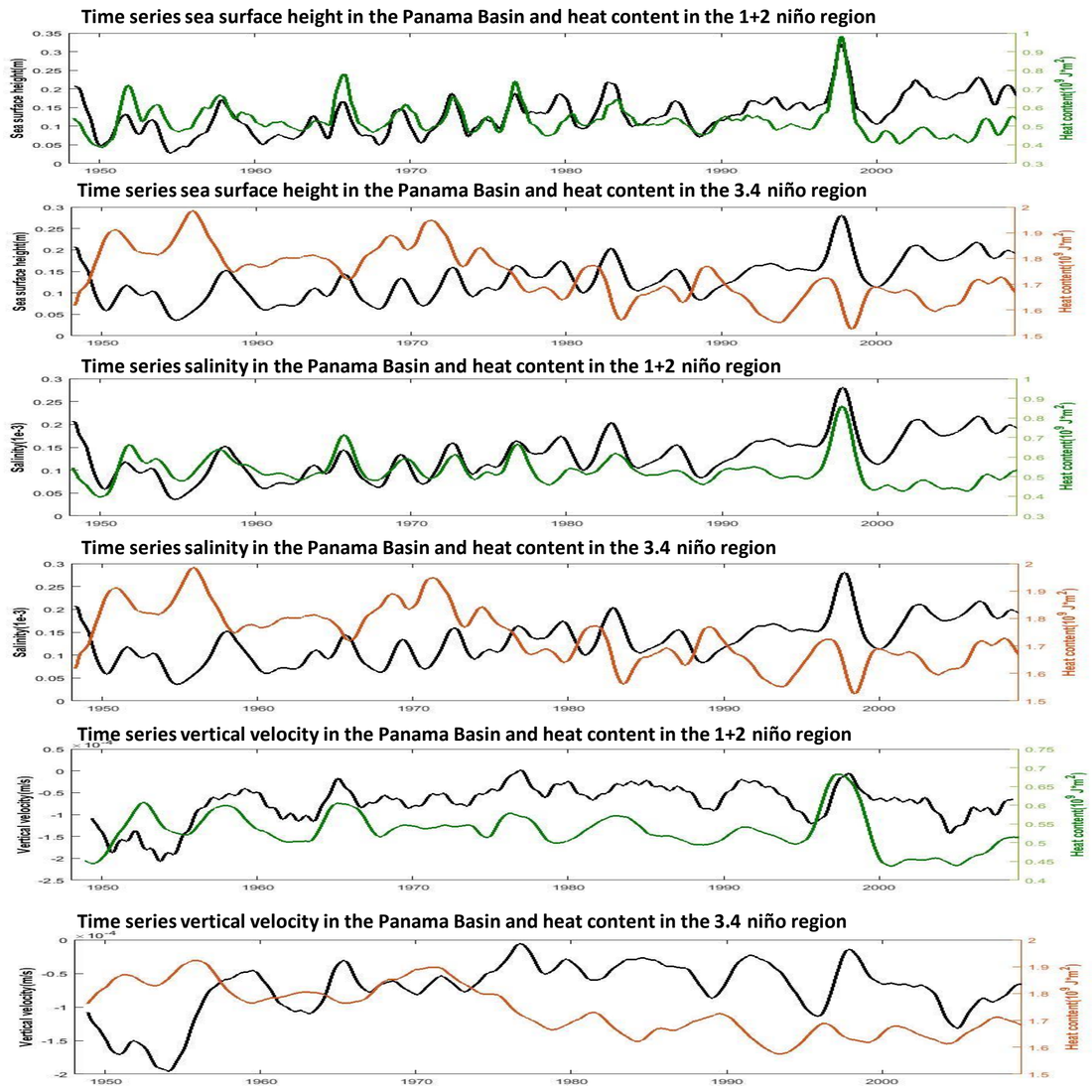


Figure 2. Niño regions. (Source: NOAA's Climate Prediction Center)



Region	Heat content-Sea surface height	Heat content-Salinity	Heat content-Vertical velocity
3.4	-0.699	-0.693	-0.458
1+2	0.357	0.268	0.254

Table 1. Correlations between heat content above the thermocline in ENSO regions 3.4 and 1+2, on the one hand, and oceanographic variables (SSH, S, w) in the Panana Basin.

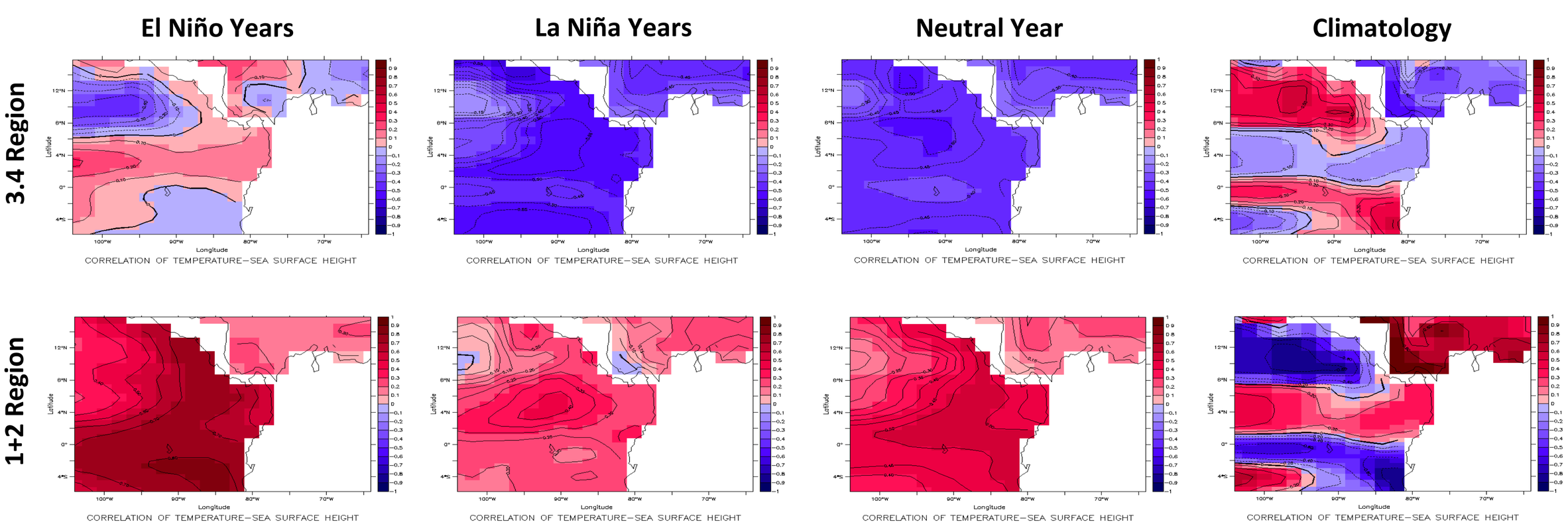
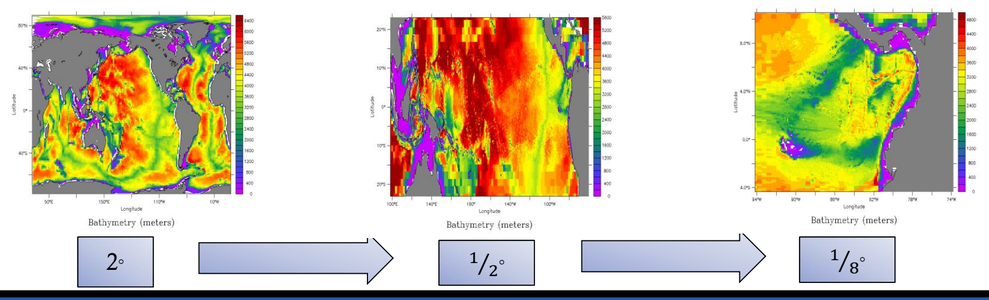


Figure 3. Correlations between sea surface height in the Panama Basin and the heat content in the ENSO regions 3.4 (5S-5N and 170-120W) (upper panel) and 1+2 (0-10S, 90W-80W)(lower panel) during El Niño years, La Niña years, neutral years and climatology.

Next Steps

The Adaptive Grid Refinement In Fortran (AGRIF) algorithm will be used to nest a 1/8° resolution model of the circulation in the Panama Basin and adjacent areas of the Eastern Tropical Pacific into a 1/2° resolution model of the tropical and equatorial Pacific Ocean which, in turn, will be nested into a 2° resolution global model, the ORCA2-LIM2 version of NEMO.



Conclusions

Preliminary results from this model experiment indicate that there are strong negative correlations between upper ocean temperatures in the central tropical Pacific and sea surface height and salinity in the Panama Basin. However, when we calculate these correlation for strong the ENSO years we also find high positive correlations between heat content in the Eastern Pacific and the sea surface height in the Panama Basin.

References

1. Latif, M. and Keenlyside, N.S. (2009) 'El Niño/Southern Oscillation response to global warming', *Proceedings of the National Academy of Sciences, 106(49), pp. 20578-20583.*
2. McPhaden, M.J. (2002) 'El Niño and La Niña: Causes and global consequences.', *Encyclopedia of Global Environment Change*, Anonymous John Wiley and Sons(LTD), pp. 353-370.
3. Madec, G., and the NEMO team, 2008: NEMO ocean engine. *Note du Pôle de modélisation*, Institut Pierre-Simon Laplace (IPSL), France, No 27, ISSN No 1288-1619.
4. Large, W.G. and S.G. Yeager. 2009: The global climatology of an interannually varying air-sea flux data set. Climate Dynamics, 33, 341-364.