The effect of the ENSO extreme event during 1997 on the moisture transport to Central America

Durán-Quesada Ana María* and Gimeno Luis.

EPhysLab (Environmental Physics Laboratory) Facultade de Ciencias. Campus de Ourense.

Universidad de Vigo. 32004 Ourense. ESPAÑA.

** am.duran@uvigo.es*

1.Introduction

The extreme warm ENSO phase during 1997 affected the region in different aspects; coral bleach in the Pacific, local precipitation and moisture transport were also modified. Part of our current research, has shown how the local moisture trasport within Central America is roled in the low troposphere by low level jet structures in both coasts Caribbean and Pacific. The CLLJ and the CHOCO jet are the identified stuctures acting as moisture conveyors to Central America. The mentioned structures present an important response to SST variations, thus, are highly sensible to the ENSO phases. The CLLJ tends to increase (decrease) its wind magnitude during the warm (cold) ENSO phase while the CHOCO jet presents the opposite response.

2.Precipitation in Central America

Central American climate has two main influences: Caribbean region tends to be moister along the year than the region influenced by the Pacific that presents a drier tendency. The Caribbean side is of special interest for the moisture transported from the Caribbean Sea since the CLLJ is highly sensible to ENSO warm events. In this region; July and December are the rainiest months and the presence of a dry spell during July has been also studied as an important feature of the distribution of precipitation in Central America and is known as MSD. A warm ENSO phase is supossed to reduce the precipitation over the major part of Central America. Which is the mechanism that controls this effect and how does it act? For giving some highligths the 1997 warm ENSO event is presented as example.

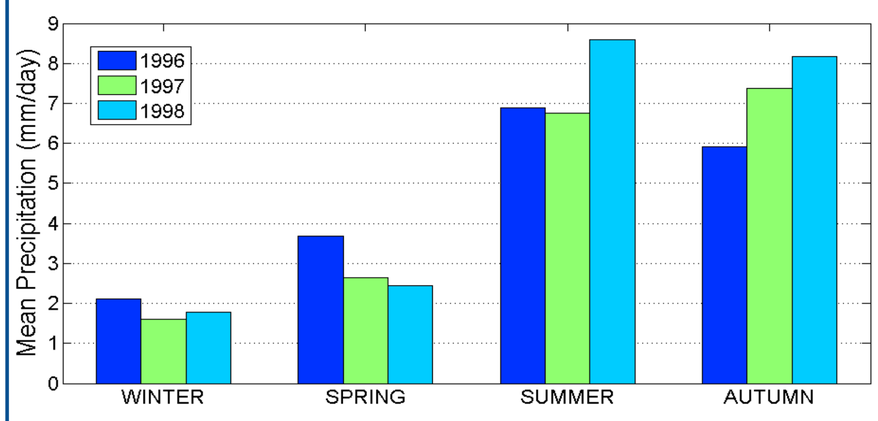

Fig 1 Seasonal average of precipitation for the 1996-1998 period. Data from CPCP

The precipitation patterns show a decrease in intensity during 1997 with respect to 1996 and 1998 except for Autumn.

The amount of rain varies significantly over the continental region, as can be seen from fig 2 the precipitation over ocean is maintained or inclusive higher. Thus, the influence of the ENSO is of particular importance for the continent. The ENSO 97 event onset was May 97 and ended in May 98. *Which is the temporal response of the precipitation pattern?*

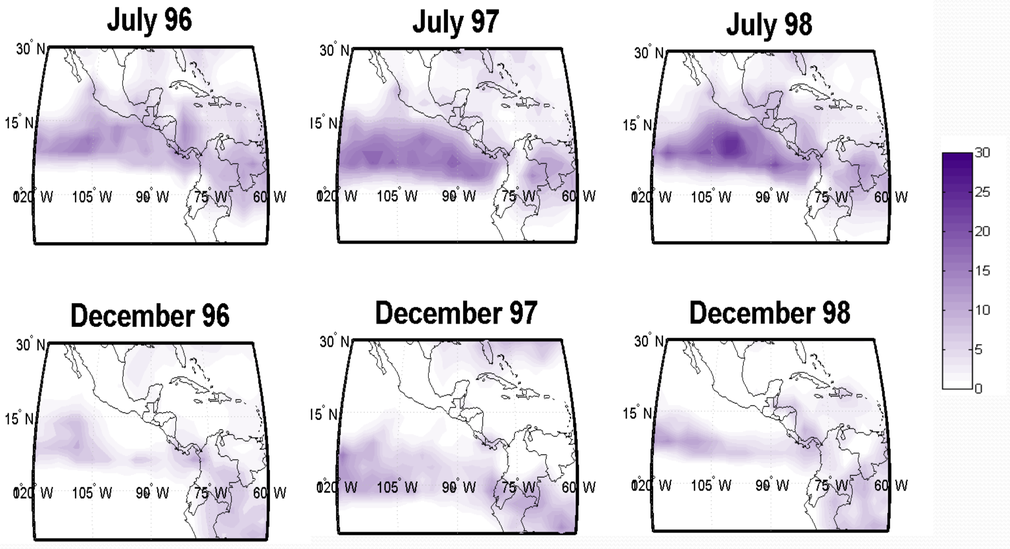

Fig 2 Precipitation pattern for the rainiest months in the Caribbean basin for the 1996-1998 period. Data from CPCP and units in mm

3.Wind fields

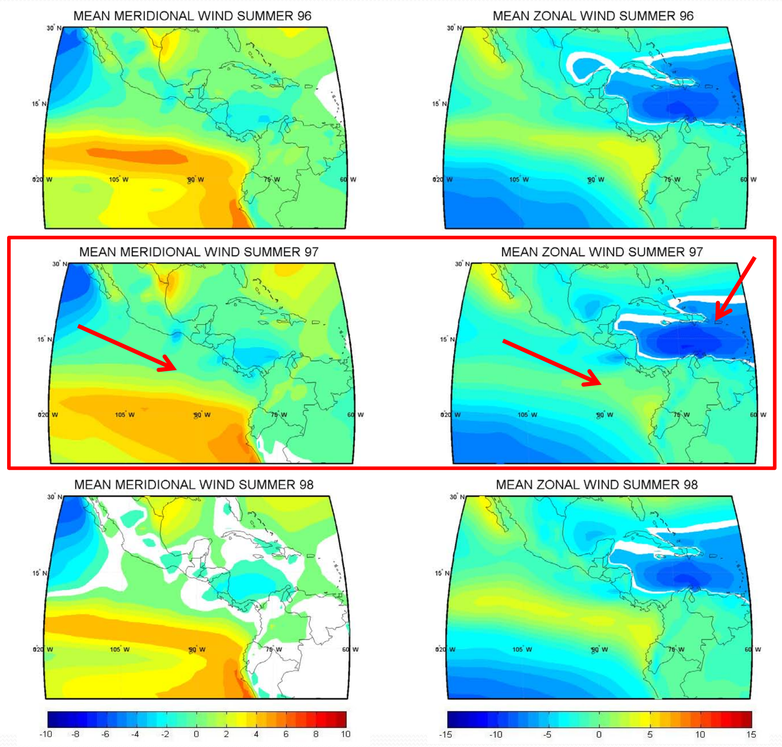

Fig 3 Meridional and Zonal wind contours for the 1996-1998 period.
Data from QuikScat and units in m/s

- **The effect of the ENSO warm phase is an increase/ decrease in the intensity of the CLLJ/CHOCO jet winds. On 1997 a significant increase on the CLLJ is observed while CHOCO jet winds are decreased.**
- **Under these conditions the transport through the CLLJ is supposed to be major and for instance the contribution of moisture from the Caribbean Source has to be reduced.**
- **If the winds of the CHOCO jet are weak, contribution from the Pacific source is potentially reduced since moisture is not able to be transported to the continental area and most of the moisture is lost over the ocean.**

4.Moisture divergence flux

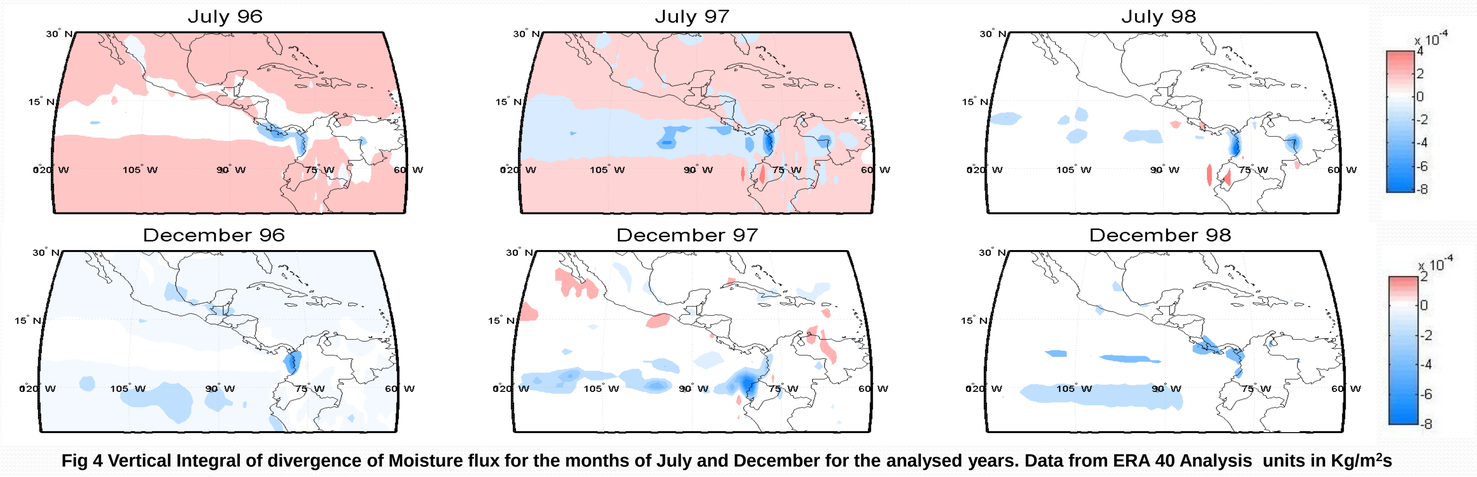

Fig 4 Vertical Integral of divergence of Moisture flux for the months of July and December for the analysed years. Data from ERA 40 Analysis units in Kg/m²s

- **The results showed in fig 4 are in agreement with variations in moisture convergence (negative divergence) over Central America along the ENSO warm phase cycle, the case of July when the ITCZ reaches its northernmost position seems to be the most representative for the analysis case.**

5.The transport of moisture mechanisms?

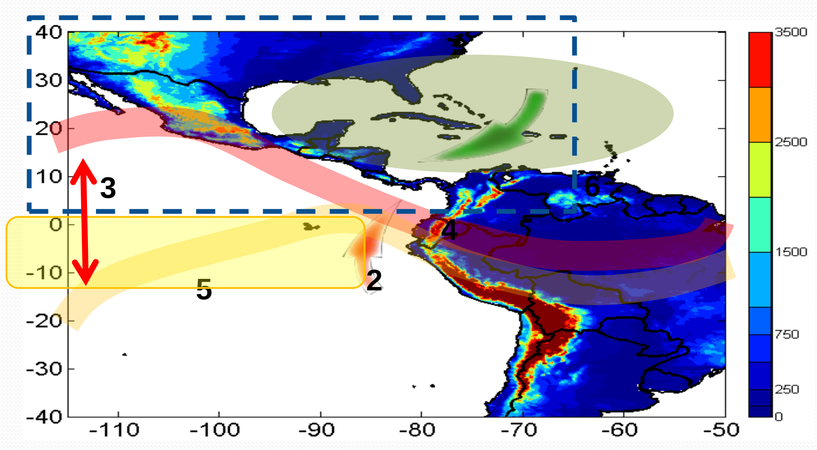

Fig 5 Diagram showing the main structures involved in the process of transport of moisture. Contours show altitude in m

- **1 CLLJ**
- **2 CHOCO jet**
- **3 ITCZ seasonal migration**
- **4 AWP region**
- **5 El NINO 3 region**
- **6 the Warm Pools influence**

- **The low level jets can be indicated as the main direct transport mechanisms, while the rest of indicated structures act in an indirect way, affecting different aspects of the low level jets.**

6.Conclusions

- **As a result of variations in the intensity of the winds, the transport of moisture is also affected. The effect of the ENSO warm phase is a reduction in moisture contribution to the continental area, since most of the moisture is able to reach the eastern Pacific region due to the intensity of the winds. This fact is in turn noticed in the precipitation patterns observed for July 1997 where maxima CLLJ were present.**
- **In the case of December 1997, a good agrement is observed between the moisture flux divergence and the reduction of the CHOCO jet winds intensity. Moisture does not reach the southern Central America, this is also consistent with the precipitation band observed for December 1997, that is placed southerly while compared with December 1996 and 1998.**
- **The direct effect of the ENSO phases over transport of moisture in Central America is exherted through the conveyor mechanisms that are influence by ENSO, in the case of Central America this means that moisture transport response to ENSO is roled by the answer of local low level jets to the ENSO phase itself.**

7.Acknowlegments

• The authors want to acknowledge the cooperation of the ATMOS group of the Norwegian Institute for Air Research (NILU), particularly Dr. Andreas Stohl, Dr. Harald Sodemann and Dr. Sabine Eckhardt for their support during a Short Term Scientific Mission granted by COST through the ES0604 (WAVACS) COST Action. Colaboration of Dr. Raquel Nieto from EPHYSLAB and Dr. Jorge Amador from the Center of Geophysical Research and the School of Physics of the University of Costa Rica has been also fundamental for the current research. Financial support from Fundacion Carolina (Spain) and the University of Costa Rica is also acknowledged. We thank the financial support from the COST 0604 Action provided to attend this Summer School.

Environmental | Physics | Laboratory

EPhysLab

8.References

Amador, J.A., 2008: The Intra-Americas Sea Low-level Jet, Ann. NY Acad. Sci., 1146, 153-188, doi: 10.1196/annals.1446.012

Hastenrath, S.L, 1967: Rainfall distribution and regime in Central America. Arch. Meteor. Geophys. Bioklimatol., 15B, 201–241..

Magaña, V.O., Amador, J.A., Medina, S., 1999: The mid-summer drought over Mexico and Central America. J. Climate 12, 1577–1588.

Muñoz, E., A.J. Busalacchi, S. Nigam A. Ruiz- Barradas. 2008: Winter and summer structure of the Caribbean Low-Level Jet. J. Climate. 21 : 1260–1276

Poveda, G., and O. J. Mesa, 2000:On the Existence of Lloró (the Rainiest Locality on Earth): Enhanced Ocean-Land-Atmosphere Interaction by a Low-Level Jet, Geophys. Res. Lett., 27(11), 1675– 1678.

Wang, C., 2007: Variability of the Caribbean low-level jet and its relations to climate. Clim. Dyn., 29:411-422.

____, S. K. Lee and D.B. Enfield, 2008. Climate Response to Anomalously Large and Small Atlantic Warm Pools During the Summer.Journal of Climate, 21, 2437-2450.