



## Seasonal cycle and ENSO changes induced by ice-sheet and obliquity in Early Holocene

yihua luan (1,2,3), Pascale Braconnot (1), and Yongqiang Yu (2)

(1) Laboratoire des Sciences du Climat et de l'Environnement (LSCE/IPSL), Unité mixte CEA-CNRS-UVSQ, 91191 Gif sur Yvette, France (yihua.luan@lsce.ipsl.fr), (2) State Key Laboratory of Numerical Modeling for Atmospheric Sciences and Geophysical Fluid Dynamics (LASG), Institute of Atmospheric Physics (IAP), Beijing, 100029 China , (3) Graduate University of Chinese Academy of Sciences, Beijing, 100049 China

ENSO was present throughout the Holocene but underwent a steady increase from the Early-mid-Holocene to the present. Using the IPSL-CM4 coupled ocean-atmosphere model we have performed simulations of the early and mid-Holocene to analyze the response of the seasonal and interannual variations to the insolation forcing. We also considered in addition the possible role of a fresh water flux in the North Atlantic. These results show that the insolation forcing damps both the seasonal cycle in the Niño3 box and the interannual variability while the fresh water flux damps the seasonal cycle but enhances the interannual variability (Braconnot et al. submitted, Luan et al. in preparation). In this presentation we'll go one step further in the analysis of the ENSO changes during the Holocene by comparing the impact of the early Holocene remnant ice-sheet in Northern Hemisphere to that of the fresh water fluxes. Indeed the Intertropical Convergence Zone (ITCZ) is also shifted southward when an early Holocene ice-sheet is considered in addition to the insolation forcing. The resulting pattern in the east Pacific shares similarities with the impact of the fresh water flux and this has certainly contributed to alter ENSO characteristics in the early Holocene. Also, to better understand the role of the change in the mean seasonality we'll isolate the impact of precession and obliquity from sensitivity experiments. For all these experiments we analyze the changes in seasonality and interannual variability by comparing El-Niño and La-Niña composites. The comparison of the different results will help us better understand the relationship between the seasonal cycle and the development of El-Niño and La-Niña events. The relative impact of the different forcing on the changes in precipitation, temperature and thermocline depth in the tropical Pacific will be discussed.

### References

P.Braconnot, Y.Luan, Simon Brewer and W.Zheng, 2010: Impact of Earth's orbit and fresh water fluxes on Holocene climate mean seasonal cycle and ENSO characteristics. (submitted)  
Y. Luan, P. Braconnot, Y. Yu and W. Zheng: Early to Middle Holocene climate seasonal cycle and interannual variability induced by Insolation changes. (in preparation)