Geophysical Research Abstracts,
Vol. 10, EGU2008-A-01446, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-01446
EGU General Assembly 2008

Anatomizing the ocean role in ENSO changes under global warming

H. Yang (1, 2) and Q. Zhang (2)

(1) Department of Atmospheric Science, School of Physics, Peking University, Beijing, China, (2) Department of Meteorology, Stockholm University, Stockholm, Sweden (hjyang@pku.edu.cn)

A revisit on observations show that the tropical El Nino-Southern Oscillation (ENSO) variability, after removing both the long term trend and decadal variation of the background climate, has been enhanced by as much as 60% during the past 50 years. This is inconsistent with the changes in the equatorial atmosphere which shows a slowdown of the zonal Walker circulation and tends to stabilize the tropical coupling system. The ocean role is then highlighted. The observed enhanced ENSO variability is attributed to the strengthened equatorial thermocline that plays as a destabilizing factor of the tropical coupling system. In order to quantify the dynamic effect of the ocean on the ENSO variability under the global warming, a series of ensemble experiments are performed using a coupled climate model (FOAM), following the "1pctto2x" scenario defined in the IPCC reports. Term balance analyses on the temperature variability equation show that the anomalous upwelling of mean vertical temperature gradient (referred as "local term") in the eastern equatorial Pacific is the most important destabilizing factor to the temperature variabilities. The magnitude of local term and its change are controlled equally by its two components, the mean vertical temperature gradient $\bar{T}_z$and the "virtual vertical heat flux" $-w'T'$. The former can be viewed as the background of the latter and these two components are positively correlated. A stronger $\bar{T}_z$ is usually associated with a bigger upward heat flux $-w'T'$, which implies a bigger impact of the thermocline on the SST. The $\bar{T}_z$ is first enhanced during the transient stage of the global warming with a 1% yr^{-1} increase of CO_2, and then reduced during the equilibrium stage with a fixed doubled CO_2. This turnaround in $\bar{T}_z$

determines the turnaround of ENSO variability in the whole global warming period.