Sara Brennan

ENSO Summary Paper

There is a lot of research in regards to ENSO and its effects on the world’s climate, particularly on precipitation levels. There are also a lot of questions as to whether the relationships between precipitation and ENSO are changing with global warming, as an anthropogenic forcing, or if it is all within the realm of natural variation. This is a difficult topic due to the lack of reliable data since there has been little observation of the central pacific where classic El Niño characteristics are found up until the mid 1900’s.

Dai and Wigley (2000) looked at satellite estimates of oceanic precipitation as well as historical rain-gauge records to try to tease out the relationship between world-wide precipitation and El Niño patterns. Changes in the Walker circulation result in changes in precipitation in the tropics in the east-west direction. During warm periods, the Walker circulation weakens and the ITCZ moves towards the equator, resulting in a reduction in precipitation where the normal, northern boundary of the ITCZ is in the eastern Pacific. During El Niños, the Southern Pacific Convergence Zone also shifts creating a weakened east-Asian monsoon and increases precipitation below the equator in the central Pacific Ocean. ENSO appears to be related to other large scale anomalies such as the precipitation anomalies over Canada, but few of these can be physically linked; there is strong indication that the Hadley cell is affected in such a way as to create these extratropical anomalies.

Li and Ting focused on the Asian-monsoons relationship to ENSO to determine how much variability can be attributed to anthropogenic warming and how much is simply natural variation. Recent research has suggested that global warming is creating warmer ENSO periods which cause a break-down in monsoon patterns, but there is also contradictory research suggesting that the warming ENSO and changes in monsoon behavior are the result of natural variability. Li and Tang used 34 models with grid boxes that had a high number of observations to try to determine what kind of forcing had a significant effect on ENSO and thus Asian-monsoons. Overall, they found that there was a huge amount of decadal variability when correlations between India rainfall and Niño 3.4 SST relationships were analyzed. When only natural components were included, there was almost no difference between maps of observed, CMIP5 historical, and RCP8.5, suggesting that radiative forcing has little effect on the ENSO-monsoon relationship. When anthropogenic forcing was added, there was still little correlation seen, but there was a slight weakening in the RCP8.5 suggesting that natural variability is the main contributor to the ENSO-monsoon relationship, but SST warming due to anthropogenic climate change may contribute to a weakening ENSO-monsoon relationship in the future.

Based on the results of these two studies, it is clear that more research needs to be done with more data to get any clear answers. Both studies agree that changes in ENSO behavior and its relationships to precipitation world-wide are, at least in part, due to natural variability. In short, scientists do not have enough historical data to know how important the recent shifts we have seen in the ENSO patterns are to climate change. It is likely that warmer sea surface temperatures will cause a shift in ENSO, this shift will likely lead to weaker monsoons and wetter tropics. Due to ENSO’s interactions with the Hadley cell, there will also be changes in precipitation worldwide, although total amount will not change very much according to Dai and Wigley since ENSO mostly causes rain belts to shift places rather than changing the quantity of precipitation. There are many more things to investigate in regards to ENSO and these studies have just begun to scratch the surface of answering them.