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Inter annual variability of dry air in tropical free troposphere

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As a dominant greenhouse gas, water vapor plays a key role in Earth's climate. Particularly in the low concentration regions, were sensitivity of outgoing long wave radiation is more important than in the moist regions like the in the mid troposphere. Thus, it is important to document and understand the water vapor spatiotemporal variability in the dry regions of the intertropical belt. In these regions the distribution of water vapor is controlled by large-scale dynamics that mixes air originating from the mid-latitude and from the Tropics. While the mechanism have been identified from theoretical studies, its role in explaining the variability at inter annual scale is still unclear.

In the dry subtropical regions, the distribution of water vapor departs from Gaussian statistics. So, the arithmetical average is unsuitable to characterize the humidity field and its variability. In order to better apprehend this, the dry air occurrences is computed, using Relative Humidity at 500 hPa from NCEP reanalysis (RH500), to focus on the dry tail distribution of water vapor. We examined the inter annual variability of this dry air index during boreal summer (June-August) and winter (December-February) of the period 1978-2007. Then the study is focused on the subtropical dry air behaviour during the well know tropical inter annual mode of variability El Nino Southern Oscillation (ENSO). Indeed, the first mode of an Empirical Orthogonal Function on the dry occurrences of humidity in the tropical belt, which describes approximately 15 % of the inter annual variance, shows a strong ENSO pattern with important response in Pacific area.

The relative role of temperature and moisture in shaping the variability and the changes in the dry occurrences of relative humidity is investigated. Relative Humidity is computed fixing interannual temperature constant and equal to the climatological mean (RH"500) and compared to the original distribution. The results show insignificant differences between the two variables, suggesting an important role of the water vapor content variability in explaining the variability of RH and a limited contribution of the temperature. This is further analyzed by using outputs from an advection-condensation model based on back trajectories computed from the NCEP wind field. The origin of dry air in regions of interest during ENSO events is then revealed. Some features of the last saturations regions are shown to be robust to the El Nino or La Nina phase. Beyond the Pacific Ocean region, signature of ENSO are weak and other atmospheric variability modes (e.g., NAO) are investigated to explain the inter annual variability there and will be presented at the conference.