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Response of atmosphere circulation on global and regional scales to the two El Niño flavors

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El Niño - Southern Oscillation (ENSO) is one of the most striking anomalies in the climate system of our planet. Recently it has been established [Ashok et al., 2007; Kug et al., 2009] that El Niño appears in two different flavors: the canonical El Niño, which is characterized by the maximum SST anomalies in the eastern Pacific, and El Niño Modoki with maximum anomalies localized in the center of the Pacific Ocean, near the date line. Recent studies demonstrated [Ashok et al., 2007; Weng et al., 2009; Mo, 2010 et al.] that the remote response to the two types of El Niño is drastically different, being opposite in some areas. Based on the regression analysis the air temperature and precipitation anomalies observed during canonical and Modoki El Niño were defined. However, the structure and mechanisms of this response are fairly understood. A comprehensive analysis of the atmospheric circulation anomalies resulted from two types of El Niño may emerge the causes of different remote response associated to the two types of El Niño.

The large-scale zonal atmospheric circulation response to El Niño is characterized by the poleward propagation of the signal from the equatorial and tropical latitudes. El Niño is associated with the intensification of western currents in mid latitudes and equatorial belt in the low troposphere and decreasing of the easterlies in tropics. The global circulation response is more intensive during El Niño Modoki as compare to the canonical El Niño. However, the spatial structure of the response is similar for the both types of El Niño.

El Niño induces drastic anomalies in vertical circulation. It is shown that Hadley and Walker circulation anomalies associated to the Canonical and Modoki El Niño have different space localization and timing. Canonical El Niño is characterized by anomalous ascending motion in central and eastern Pacific localized near the equator and in the equatorial regions of the Southern Hemisphere. Over Indonesia, south to the equator prevails air descent. During El Niño Modoki anomalous air rising occurs over the central equatorial Pacific, while descending motion develop to the east (mainly in the equatorial regions of the Southern Hemisphere) and to the west (in the Northern Hemisphere). The structure of the anomalies of vertical cells outside the Pacific region differ over the Western Indian Ocean and East Africa, South America and the Caribbean.

The analysis of regional circulation response to the El Niño revealed that in the Northern Hemisphere the intensity of the response is comparable for two types of El Niño, while in the Southern Hemisphere the circulation anomalies are more pronounced during the El Niño Modoki. All atmosphere centers of actions under investigation were divided into four groups according to the character of circulation response to the two types of El Niño: 1 - centers of action with similar response to both types of El Niño; 2 – centers of action with different response to canonical and Modoki El Niño; 3 - centers of action, having significant correlations with only one type of El Niño; 4 - centers of action with no significant relationships with two types of El Niño.

It is suggested that the difference in weather anomalies observed during the two types of El Niño are mostly associated to the circulation anomalies in the centers of action and in the vertical cells which differs between canonical and Modoki El Niño.

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