

Detection of the dry intrusions from the mid-latitudes to the Equator and their association with MJO

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Dry intrusion is a large-scale intrusion phenomenon of extremely dry air into tropics and it influences on the cumulus convection. However, their large-scale features and statistics have not been revealed yet. The purposes of this study are detecting the dry intrusions using a long-term reanalysis data (the ERA-Interim, 0.75° grid) and clarifying relationship between the appearance of the dry intrusions and the Madden-Julian Oscillation (MJO) activity.

First, we drew daily map of precipitable water (PW) from the ERA-interim for the year from 1998 to 2016 (total 10593 days), and we counted the appearance at every 20° longitudes according to the following conditions; 1) the dry intrusion arrives at 10°S-10°N and is maintained for 2-10 days, 2) It forms a crescent shape with an area that PW of less than 40 mm, 3) It includes areas with a PW of less than 30 mm and 4) The entire dry intrusion fits into an area of roughly 2000 km².

Among the 10593 days, we detected 1118 cases in all so the dry intrusions appear about 40 times a year in average, and appearance in the Northern Hemisphere are less (388 cases), and more in the Southern Hemisphere (730 cases). About 90% of the dry intrusions were detected in an area from the Indian Ocean to the western tropical Pacific in both hemispheres. The appearance of the dry intrusions has seasonal dependence; a lot of the dry intrusions are in winter and few are in summer in both hemispheres.

Sometimes the dry intrusions by above definitions were appeared in association with the strong tropical cyclones, and they reach 8% of the total number of appearances of the dry intrusions.

We composited 700 hPa and 850 hPa zonal wind when the dry intrusions were appeared around the Indian Ocean, the Maritime Continent and the western tropical Pacific, respectively. As a result, a strong westerly wind blew around an area where dry intrusions were appeared in the Indian Ocean and the western tropical Pacific. In the Maritime Continent, a strong westerly wind blew on the west side of the Maritime Continent. Such wind fields occurred also at the MJO activity and it is called the Westerly wind burst (WWB). The WWB blew over the western tropical Pacific when the dry intrusions occurred in the Maritime Continent and the western tropical Pacific. Therefore, it may be had an association between a convection activity by the MJO and dry air intrusion. Over an entire period, 25.2% of all the dry intrusions detected in the western tropical Pacific occurred when the MJO was active in there and 14.8% occurred in the same area but the MJO was not active. The remaining 60.0% occurred when the MJO was active or non-active in other areas. This percentage has become lower in cases of the dry intrusions occurred in the Indian Ocean and the Maritime Continent.