Observational study on westerly wind burst over Sumatra, Indonesia by the Equatorial Atmosphere Radar

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This study focuses on features of vertical wind and cloud distributions in Sumatra during the initial phase of a westerly wind burst (WWB) associated with a synoptic-scale super cloud cluster (SCC), by mainly using radar, radiosonde, and lidar data from 5 to 9 May 2004. The convective envelope of the SCC reached Sumatra from the Indian Ocean on 5 May, passing over Sumatra on 7 May. Intensification of the westerly wind occurred over Sumatra below 5.5 - 6.0 km as the SCC passed over it. On 7 May, the 2.5 - 4.0 km westerly wind at Kototabang (KT; 0.2degS, 100.32degE, 865 m MSL) was identified as a WWB. Precipitating clouds around KT were suppressed after 7 May, as drier air (lower than 60 % relative humidity) was transported from the Indian Ocean over Sumatra at 2.5 - 6.0 km. Non-precipitation clouds were observed at 5 – 8 km by the lidar after 7 May.

After 7 May, the vertical wind at 2.5 - 5.5 km showed the oscillatory motion with a timescale of about 12 hours. Similar oscillatory motion was found in the 1.5 - 2.5 km zonal wind. Contrary to the radiosonde-derived downward wind with a horizontal scale of several hundred km, daily-averaged vertical wind at KT showed upward motion of 0.07 - 0.08 m/s on 7 and 8 May, when westerly winds larger than 10 m/s prevailed at 2.5 - 4.0 km. These facts imply that the topography around KT, which has steep mountains to the west, modulates the behaviors of the vertical wind.

The vertical wind oscillation was suppressed above 3.0 - 5.5 km, where the Richardson number (Ri) was smaller than 0.45 and westerly wind changed to easterly wind. The small Ri was brought about by strong vertical wind shear (larger than 10 m/s/km) and/or weak vertical gradient of potential temperature (smaller than 3 K/km). Both regions appeared at the upper part of the westerly wind region. This fact implies that shear instability and horizontal wind change inhibit upward propagation of vertical wind oscillations.