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Simultaneous observations of cirrus clouds and frostpoint by lidar and CU -CFH in upper tropical troposphere over Indone

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Cirrus clouds and frostpoint near tropical tropopause were simultaneously observed by ground based lidar and balloon borne CU-CFH (University of Colorado Cryogenic Frostpoint Hygrometer), respectively, over Indonesia as part of SOWER (Soundings of Ozone and Water in the Equatorial Region) campaigns. The observations are made at Bandung (7S, 108E) in December 2003 and 2004, and at Biak (1S, 136E) in January 2006, 2007, 2008 2009 and 2010. Within about two weeks of the campaign in each year, the lidar was operated almost continuously through the campaign, and several CU-CFH were launched by balloons. Although the weather in this season is quite rainy at these Indonesian tropical sites, the lidar could observe tropopause height simultaneously with 17 balloon flights of CU-CFH in the 6 campaigns. In most of the simultaneous observations, super saturation over ice was observed at the height where cirrus clouds were observed. In an extreme case, 190% relative humidity over ice was observed at the height where cirrus clouds were observed just below tropopause. In other cases, a few tens percent of super saturation was observed on average. Higher humidity was observed just below cold point tropopause (CPT). Back ward trajectory analysis shows that almost all of the cirrus clouds observed at the height from 17 km to CPT were in the phase of synoptic scale temperature decrease for a few days before the observation. On the other hand, about half of the lower cirrus clouds from 14 to 17 km were in the phase of temperature increase, suggesting that local deep convections probably affected the formation of the clouds. The cirrus clouds were observed at one of the lidar wavelengths, 532 nm. The ratio of backscattering coefficient of cirrus clouds at the lidar wavelengths at 532 nm and 1064 nm is dependent on radius of cirrus cloud, although the wavelengths are less than one tenth of the cloud particle size. Since the cloud microphysics has crucial information for the dehydration processes, this dependence is going to be used for the retrieving microphysics of the clouds.

Keywords: Tropical upper troposphere, Dehydration, Cirrus Clouds, Super Saturation, Stratosphere Troposphere Exchange, Lidar