A Description of Hydrometeor Layer Occurrence Statistics Derived from the First Year of Merged CloudSat and CALIPSO Data

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The occurrence statistics of hydrometeor layers covering the earth's surface is described using the first year of millimeter radar data collected by CloudSat merged with lidar data collected by CALIPSO (July 2006-June 2007). These satellites are flown in a tight orbital configuration so that they probe nearly the same volumes of the atmosphere within 10-15 seconds of each other. This configuration combined with the capacity for millimeter radar to penetrate optically thick hydrometeor layers and the ability of the lidar to detect optically thin clouds, has allowed us to characterize the vertical and horizontal structure of hydrometeor layers with unprecedented precision. We find that the global hydrometeor coverage demonstrates a fairly smooth annual cycle with a range of 3% peaking in October 2006 and reaching a minimum in March 2007. The geographic distribution of hydrometeor layers defined in terms of layer base and layer thickness is described. The predominance of geometrically thin boundary layer clouds is illustrated as is the spatial distribution of upper tropospheric ice clouds in the tropics. The co-occurrence of multiple layers is shown to be a strong function of latitude and geography with co-occurring middle level (3km< layer base<6 km) and high level (base > 6km) layers being predominant over the continents. Cloud layer overlap is also examined and a bias due to an assumption of maximum fractional overlap in coarse resolution models is quantified and shown to be on the order -5 to -7% globally maximizing over the high latitude continents of the Northern Hemisphere.