



Simultaneous occurrence of polar stratospheric clouds and upper-tropospheric clouds caused by blocking anticyclones in the Southern Hemisphere

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This study statistically examines the simultaneous appearance of polar stratospheric clouds (PSCs) and upper tropospheric clouds (UCs) using the CALIPSO lidar observations for five austral winters of 2007-2011. The occurrence frequency of clouds in the height range of 15-25 km is significantly correlated with that in 9-25 km. From the analyses based on tropopause-relative altitude, the occurrence frequency of clouds at higher than 6 km above the tropopause (i.e. PSCs) is significantly correlated with that around and slightly above the tropopause. The UCs observed simultaneously with PSCs reported in previous case studies are possibly located around and slightly above the tropopause rather than in the troposphere. It is shown that the simultaneous occurrence of PSCs and UCs is frequently associated with blocking highs having large horizontal scales (several thousand kilometers) and tall structure (up to a height of ~ 15 km). The longitudinal variation of blocking high frequency accords well with that of the simultaneous occurrence frequency of PSCs and UCs. This fact suggests that the blocking highs provide a preferable condition for the simultaneous occurrence of PSCs and UCs. Moreover, PSC compositions are investigated as a function of relative-longitude of the anticyclones including blocking highs. It is seen that relatively high proportions of STS (super-cooled ternary solutions), Ice, and Mix2 (mixture of nitric acid trihydrate and STS) types are distributed to windward of, around, and to leeward of the anticyclones in the westerly background flows, respectively.