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On the best locations for ground-based PSC observations

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Spaceborne observations of Polar Stratospheric Clouds (PSCs) with the Cloud-Aerosol Lidar with Orthogonal Polarization (CALIOP) aboard the Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO) satellite provide a comprehensive picture of the occurrence of Arctic and Antarctic PSCs as well as their microphysical properties. However, advances in understanding PSC microphysics also require measurements with ground-based instruments, which are often superior to CALIOP in terms of, e.g. time resolution, measured parameters, and signal-to-noise ratio. This advantage is balanced by the location of ground-based PSC observations and their dependence on tropospheric cloudiness. CALIPSO observations during the boreal winters from December 2006 to February 2018 and the austral winters 2012 and 2015 are used to assess the effect of tropospheric cloudiness and other measurement-inhibiting factors on the representativeness of ground-based PSC observations with lidar in the Arctic and Antarctic, respectively. Information on tropospheric and stratospheric clouds from the CALIPSO Cloud Profile product (05kmCPro version 4.10) and the PSC mask version 2, respectively, is combined on a profile-by-profile basis to identify conditions under which a ground-based lidar is likely to perform useful measurements for the analysis of PSC occurrence. It is found that the location of a ground-based measurement together with the related tropospheric cloudiness can have a profound impact on the derived PSC statistics and that these findings are rarely in agreement with polar-wide results from CALIOP observations. Considering the current polar research infrastructure, it is concluded that the most suitable sites for the expansion of capabilities for ground-based lidar observations of PSCs are Summit and Villum in the Arctic and Mawson, Troll, and Vostok in the Antarctic.