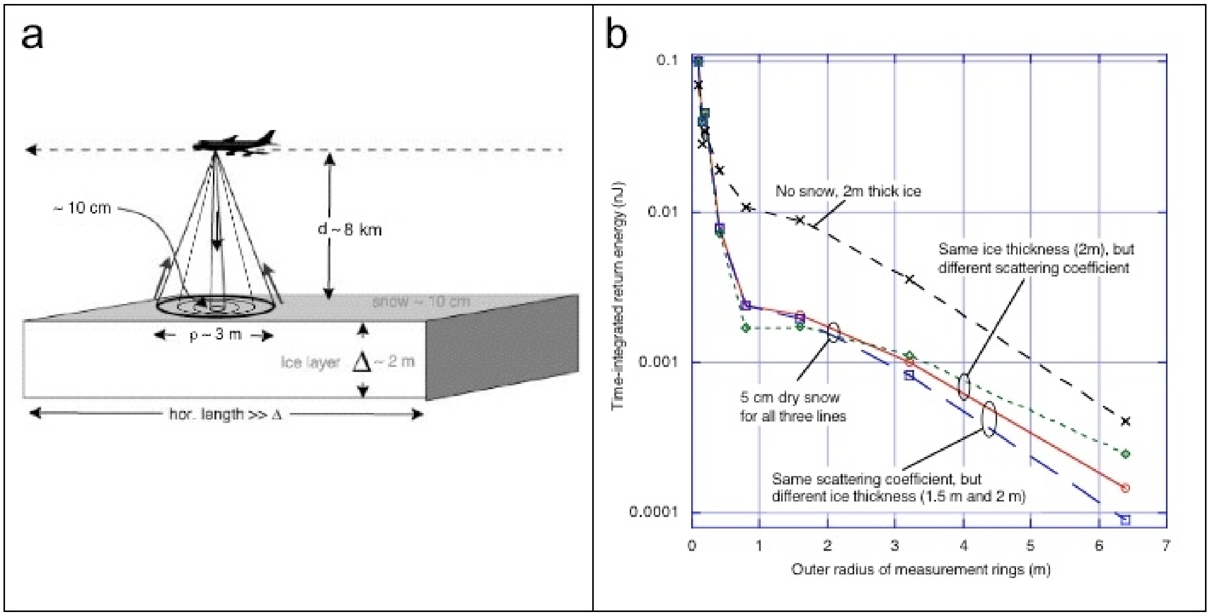
Concept of new lidar measurements of snow and sea ice thickness



The left panel (a) shows the typical setup of proposed snow and sea ice thickness measurements: An airborne lidar illuminates the surface with a tightly focused laser beam and measures the light returning from increasingly wide concentric rings, thus observing the way light spreads inside snow and ice. A comparison of the red and blue curves in the right panel (b) reveals that snow and ice thickness affect the return energy measured at each ring: The bright halo around the illuminated spot extends farther out in thicker layers, because photons can travel longer without escaping through the bottom. The figure also shows that snow and sea ice measurements pose different challenges. While sea ice is usually much thicker, snow contains a much higher concentration of scatterers (there are more crystals in snow than bubbles in ice). As a consequence, sea ice halos are larger but snow halos are brighter. Simulation results suggest that airborne sea ice measurements are possible at night and that snow measurements are possible during both night and day. For moderate snow and sea ice thicknesses (around 30-50 cm for snow and 3 m for ice), limitations in instrument performance are expected to cause measurement uncertainties on the order of 10%. These results indicate that instruments using the new approach have the potential to become an important component of future snow and sea ice observing systems. Such measurements can help better understand snow and sea ice processes, and can also contribute to the validation of satellite measurements. For more information, see Várnai, T., and R. F. Cahalan, 2007: Potential for airborne offbeam lidar measurements of snow and sea ice thickness. J. Geophys. Res.

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