Using surface returns to remove residual pointing errors for an airborne Doppler lidar

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Abstract

Obtaining accurate wind observations from an airborne Doppler lidar requires very precise pointing knowledge of the laser beam. A .1 degree pointing knowledge error can result in a .2 m/s velocity error along the line-of-sight. One option is to exercise great care in aligning the laser beam with the aircraft axes and then acquiring precise information from an onboard navigation system for aircraft attitude. A pointing knowledge approach using surface returns developed for a space mission has been adapted to the CIRPAS Twin Otter's Doppler wind lidar and has been demonstrated during a series of field experiments. RMSEs less than .05 m/s have been achieved for the three components of the wind in vertical profiles (50 m resolution) representing a few 100 meters of flight path. This approach negates the need for precise physical alignment and allows for continuous up dating of attitude corrections due to aircraft flexure, air stream loading of the scanner or any drift in the Inertial Navigation System. Examples of soundings and algorithm validation are presented along with applications where the vertical velocity data are evaluated for their realism.