Simultaneous observations of structure function parameter of refractive index using a high resolution radar and the DataHawk small airborne measurement system

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The SOUSY (SOUnding SYstem) radar was relocated to the Jicamarca Radio Observatory (JRO), near Lima, Peru in 2000, where the radar controller and acquisition system were upgraded with state-of-the-art parts to take full advantage of its potential for high-resolution atmospheric sounding. Due to its broad bandwidth (4 MHz), it is able to characterize clear-air backscattering with high range resolution (37.5 m).

A campaign conducted at JRO in July 2014 aimed to characterize the lower troposphere with a high temporal resolution (8.1 Hz) using the DataHawk (DH) small unmanned aircraft system, which provides in-situ atmospheric measurements at scales as small as 1 m in the lower troposphere, and can be GPS-guided to obtain measurements within the beam of the radar. This was a unique opportunity to make coincident observations by both systems, and to directly compare their in-situ and remotely sensed parameters.

Because SOUSY only points vertically, it is only possible to retrieve vertical radar profiles caused by changes in the refractive index within the resolution volume. Turbulent variations due to scattering are described by the structure function parameter of refractive index C_n^2.

Profiles of C_n^2 from the DH are obtained by combining pressure, temperature, and relative humidity measurements along the helical trajectory and integrated at the same scale as the radar range resolution. Excellent agreement is observed between the C_n^2 estimates obtained from the DH and SOUSY in the overlapping measurement regime from 1200 m up to 4200 m above sea level, and this correspondence provides the first accurate calibration of the SOUSY radar for measuring C_n^2.