Evaluation of the performance of the range imaging technique using small UAVs as hard targets during ShUREX campaigns (2015-2016)

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During the ShUREX (Shigaraki UAV Radar Experiment) campaigns carried out in 2015 and 2016 (Kantha *et al*., 2017, this issue), small GPS controlled UAVs (~1.5 m wingspan) equipped with multiple sensors were flown in the immediate vicinity of the MU radar (Shigaraki observatory, Japan) for measuring atmospheric parameters in the boundary layer and in the lower troposphere (~4-5 km). The MU radar was simultaneously and continuously operated in range imaging mode using five equally-spaced frequencies between 46.0 and 47.0 MHz and provided observations from vertical and oblique (10° off zenith) beams. Because of its close proximity, UAV echoes were detected by the radar but this shortcoming, often overcome by Doppler frequency sorting, was also an opportunity for taking stock of the range imaging (FII) technique and for altitude calibration of the MU radar. During ShUREX 2015, UAV 12 was programmed to fly along circular paths at a constant distance from the center of the radar antenna array so that the UAV could be regarded as a nearly discrete target. It was found that the range imaging technique with the Capon and MUSIC processing methods detected the UAV positions and displacements with excellent accuracy (better than ~10-20 m) *without any ghost echoes*. This gives extra credence to the thin echo layers and their vertical displacements often observed in the atmospheric column when using the range imaging technique with the Capon method. Based on GPS measurements made on board the UAV, it was also possible to precisely calibrate the MU radar in altitude. Other UAV flights carried out in 2015 and 2016 confirmed the altitude calibration performed using UAV 12 data.

References

Kantha et al 2017, this issue.