Spatial structure of RASS signals observed by a UHF Volume Imaging Radar

Paco López Dekker and Stephen J. Frasier

An implementation of a Radio Acoustic Sounding System (RASS) using the Turbulent Eddy Profiler (TEP), a UHF volume imaging radar, is presented. TEP makes use of digital beamforming techniques to generate a number of simultaneous beams within its field of view, providing 3-D clear-air radar data of a portion of the atmospheric boundary layer. In RASS mode, TEP can be used to retrieve virtual temperature fields. High resolution time series of vertical profiles of virtual potential temperature are used, in combination with clear-air radar reflectivity images, to validate and interpret the temperature measurements. Here, the system is used to study the spatial structure of the RASS echo by observing the diffraction pattern on the antenna array, or by studying beamformed intensity images of the RASS echo. In low-wind conditions, the time-averaged intensity of the diffraction pattern of the RASS echo shows a well defined structure, which implies that this pattern has a persistent morphology. It is appealing to interpret this structure as the focused spot. In general, the observed structures have scales of one meter, matching the aperture size of the acoustic source. Examples of the volumetric images of the RASS echo are shown, displayed as a stack of horizontal slices of the reflectivity field. While the acoustic beam embedded in the radar field of view can be recognized, these images also suggest more complex patterns like split regions of high reflectivity (see figure). These patterns have been predicted in the literature, and can be related to vertical gradients of temperature and wind velocity.

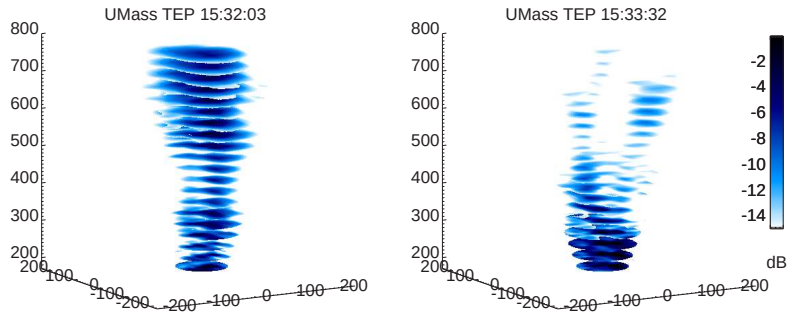

Figure 1: Spatial signature of RASS signal. The images show stacks of horizontal slices showing the radar-reflectivity at each range gate.