

# VHF BOUNDARY LAYER RADAR AND RASS

By

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# Abstract

This thesis describes the refinements, modifications and additions to a prototype Very High Frequency (VHF) Boundary Layer (BL) Spaced Antenna (SA) radar initially installed at the University of Adelaide's Buckland Park field site in 1997.

Previous radar observations of the lowest few kilometres of the atmosphere, in particular the Atmospheric Boundary Layer, have used Ultra-High Frequency (UHF) radars. Unlike VHF radars, UHF radars are extremely sensitive to hydro-meteors and have difficulty in distinguishing clear-air echoes from precipitation returns. The advantages and requirements of using a VHF radar to observe the lowest heights is discussed in conjunction with some of the limitations.

The successful operation of the system over long periods has enabled in-depth investigation of the performance of the system in a variety of conditions and locations. Observations were made from as low as 300m and as high as 8 km, dependent upon conditions. Comparisons between the radar and alternative wind measuring devices were carried out and examined.

The antenna system of the radar is a critical component which was analysed in depth and subsequently re-designed. Through the use of numerical models and measurements, evaluation of different designs was accomplished. Further calibration of the remaining components of the full system has enabled estimations of the absolute received power. Additional parameters which can be derived with a calibrated radar were compared with values obtained by other authors, giving favourable results.

Full Correlation Analysis (FCA) is the predominant technique used in this work. A brief discussion of the background theory and parameters which can be measured

is described. A simple one-dimensional model was developed and combined with a “radar backscatter model” to investigate potential sources of errors in the parameters determined using FCA with the VHF Boundary Layer Radar. In particular, underestimations in the wind velocity were examined.

The integration of a Radio Acoustic Sounding System (RASS) to obtain temperature profiles is discussed. The theory of RASS measurements including the limitations and considerations which are required for the VHF BL radar are given. The difficulties encountered trying to implement such a system and the subsequent success using a Stratospheric Tropospheric (ST) Profiler in place of the BL radar is presented.

Taken as a whole this thesis shows the success of the VHF BL to obtain measurements from as low as 300m. The validation of this prototype radar provides an alternative and, in certain situations, a superior device with which to study the lower troposphere.

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