ADVANCES IN WIND PROFILER RADAR

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ABSTRACT

Wind profiler radars are being deployed increasingly world-wide, furnishing critical information on changing wind fields. These instruments continuously monitor wind fields above with a high temporal / spatial resolution. The measurements do not depend on the presence of precipitation.
The quality of available data has improved significantly over the past few years. Because of advances in hardware / software, measurements below 100 m are common. In addition to mean wind profiles, wind profiler radars also furnish in real time wind variability, atmospheric turbulence, wind shear information, rainfall rates, boundary layer height. We present examples of various information available from wind profiler radar data.

INTRODUCTION

Initialy, wind profiler radar outputs were limited to mean wind information and signal to noise from the vertical beam. Output products were produced for a single end user. The quality control was limited to a rudimentary comparison with neighboring wind estimates.
Today, the radar's output include detailed system parameters in order to determine precise reflectivity information which can be related directly to atmospheric reflectivity or rainfall rate. A multitude of products can be generated simultaneously and independently for a variety of end users (for local applications: pollution or airport applications and synoptic applications). The statictics (mean, standard deviation, skewness) for each beam of all velocity, spectral width and Signal to Noise estimates are available for each product. This additional information is invaluable for statistical quality control and for the elaboration of end user products complementing simple wind profiles.

Wind Profilers today

Wind profilers are being used increasingly by people that are not always specialists in meteorology. Consequently new ways of displaying the information are being developed. Quality control of the products is becoming increasingly sophisticated.

These instruments are providing valuable data for a wide variety of applications.

Airport Applications:
In most airport applications wind shear and turbulence is of primary interest. The wind field itself is of secondary importance. The final end user requires simple/efficient displays. In such cases simple "pop up" windows indicating in real time wind shear warnings are used along with simple tabular displays of current wind condition at specific altitudes / headings. The information is available in real time via simple ASCII text files, or coded into the METAR or PILOT messages.

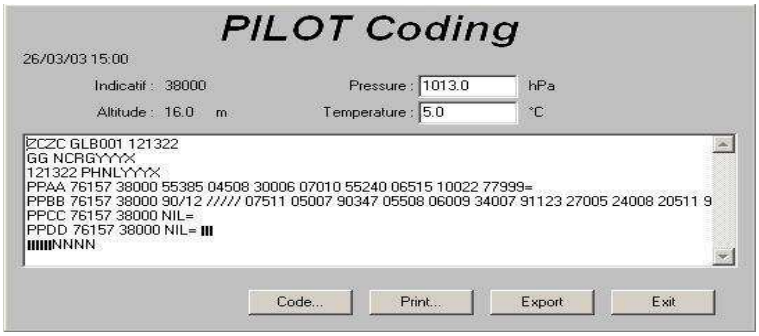

Figure 1 Pilot message

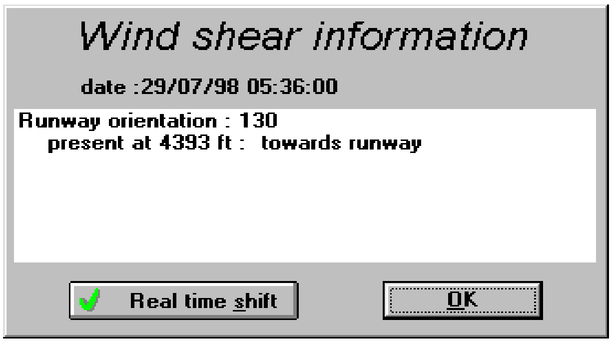

Figure 2 Wind shear message

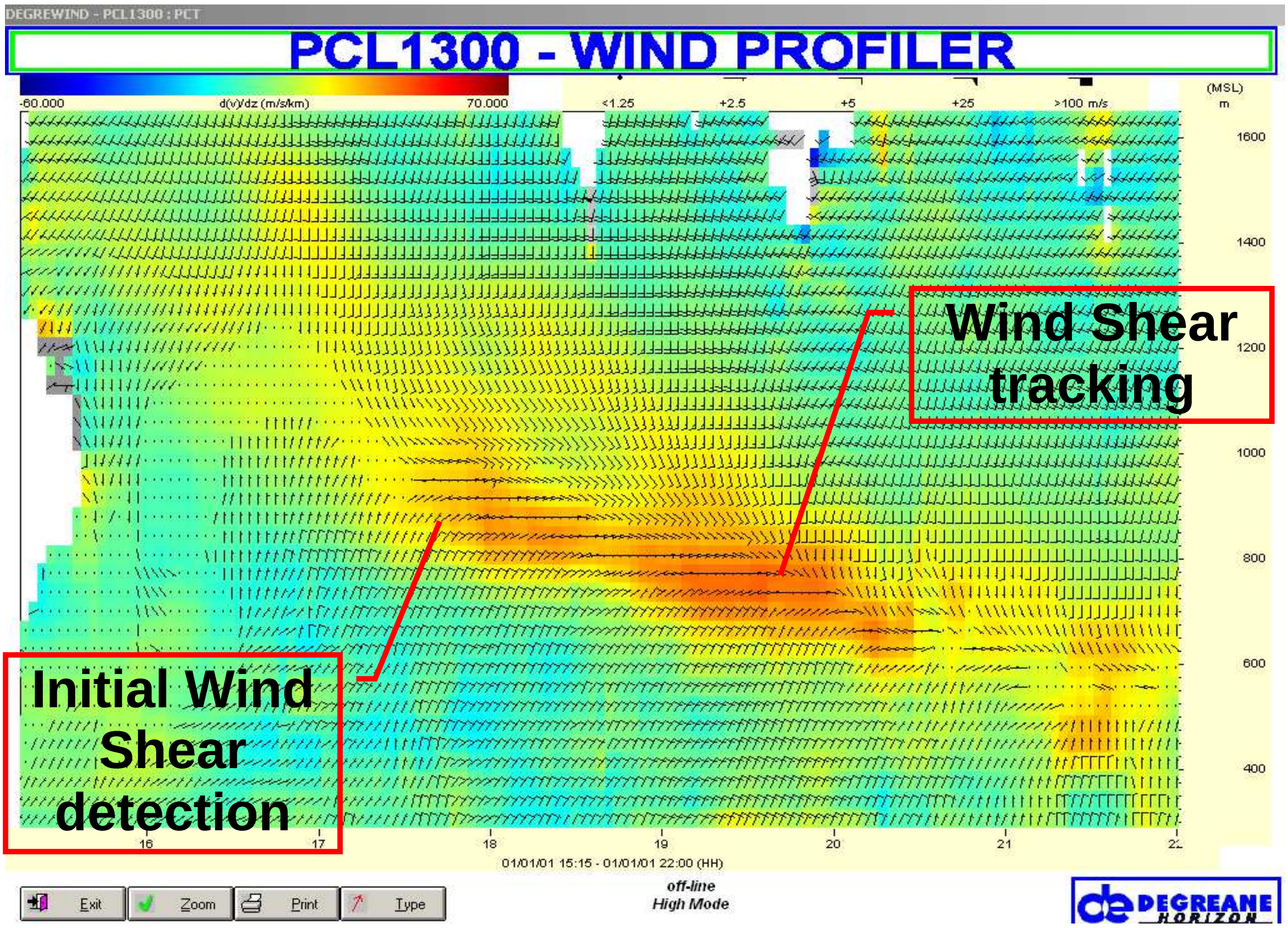

Figure 3 Example of a horizontal wind + wind shear display

<u>Air Monitoring Applications:</u>

The wind profiler, in addition to the wind fields, provides estimates of the boundary layer height, turbulent kenetic energy dissipation rate. The information is available in real time via simple ASCII text files.

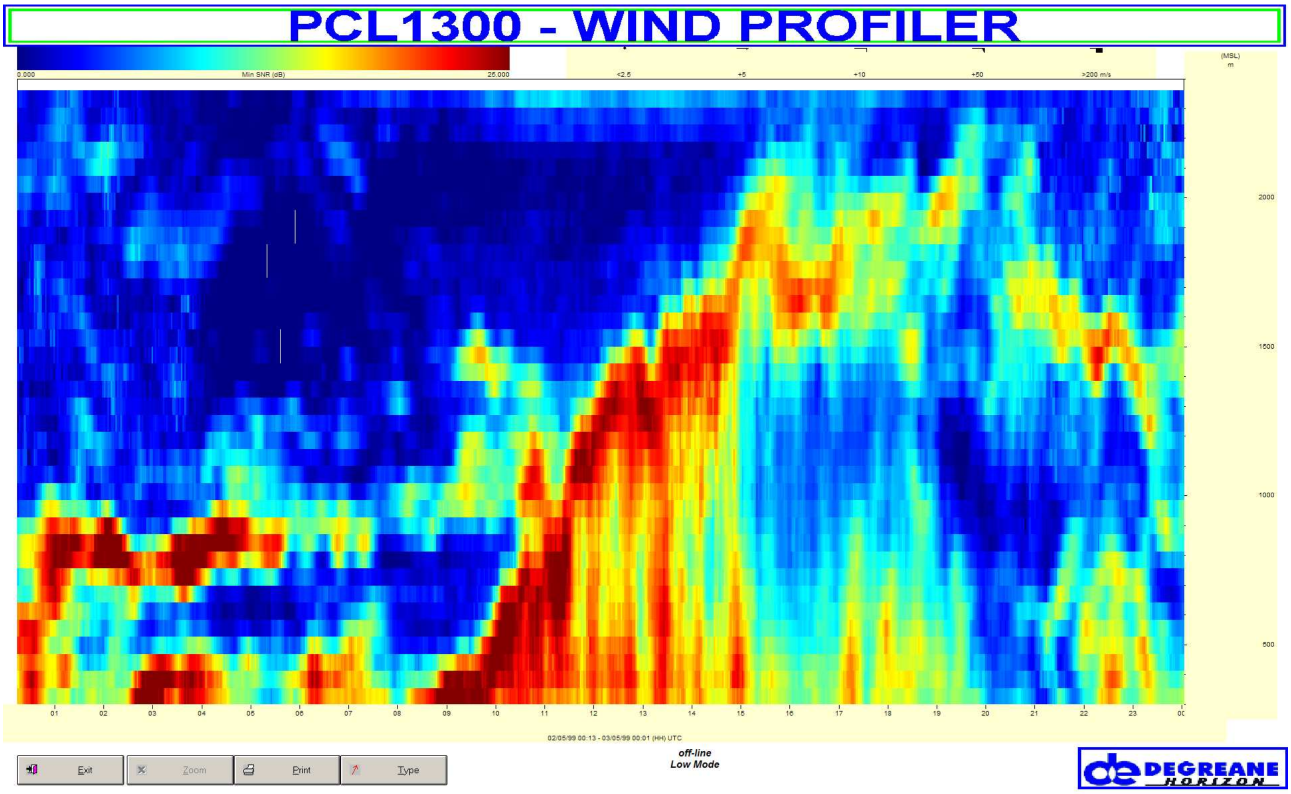

Figure 4 Example of a Convective boundary layer development (SNR)

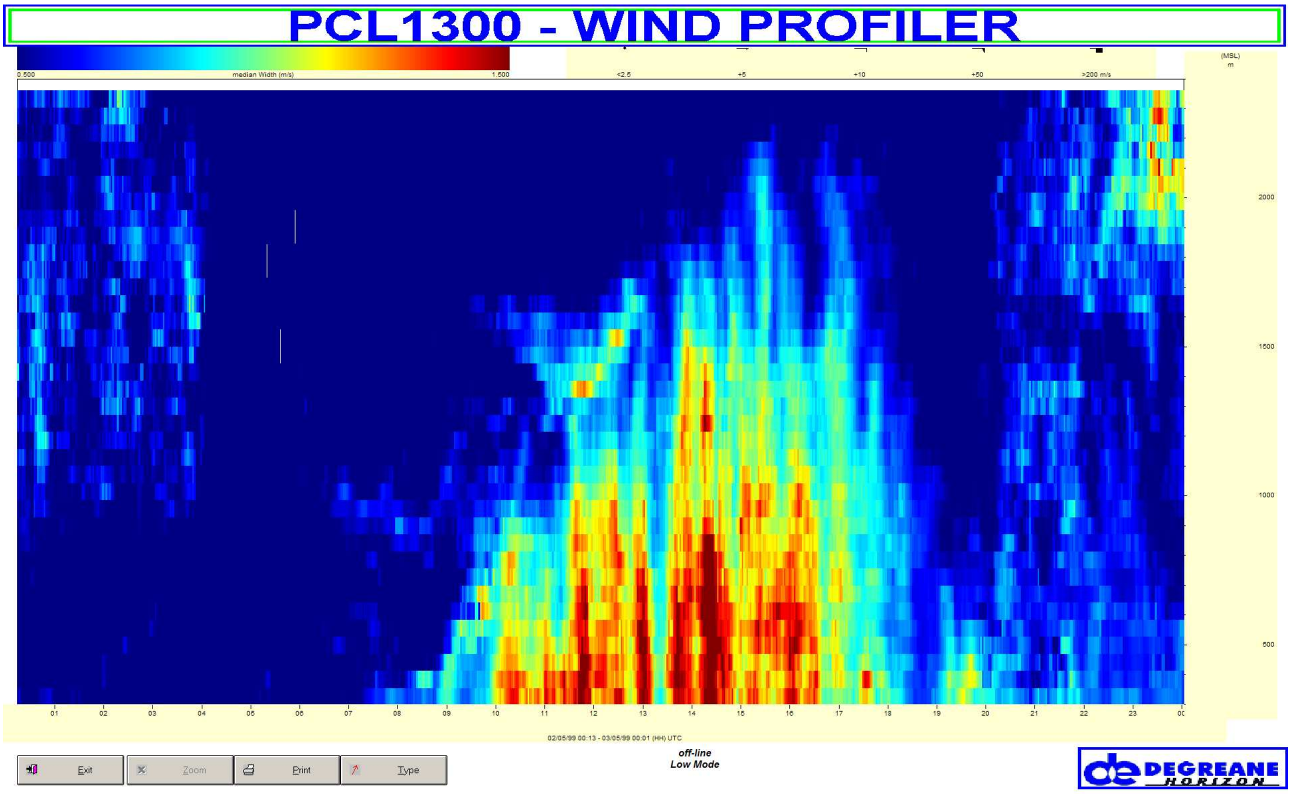

Figure 5 Boundary layer development using median spectral width

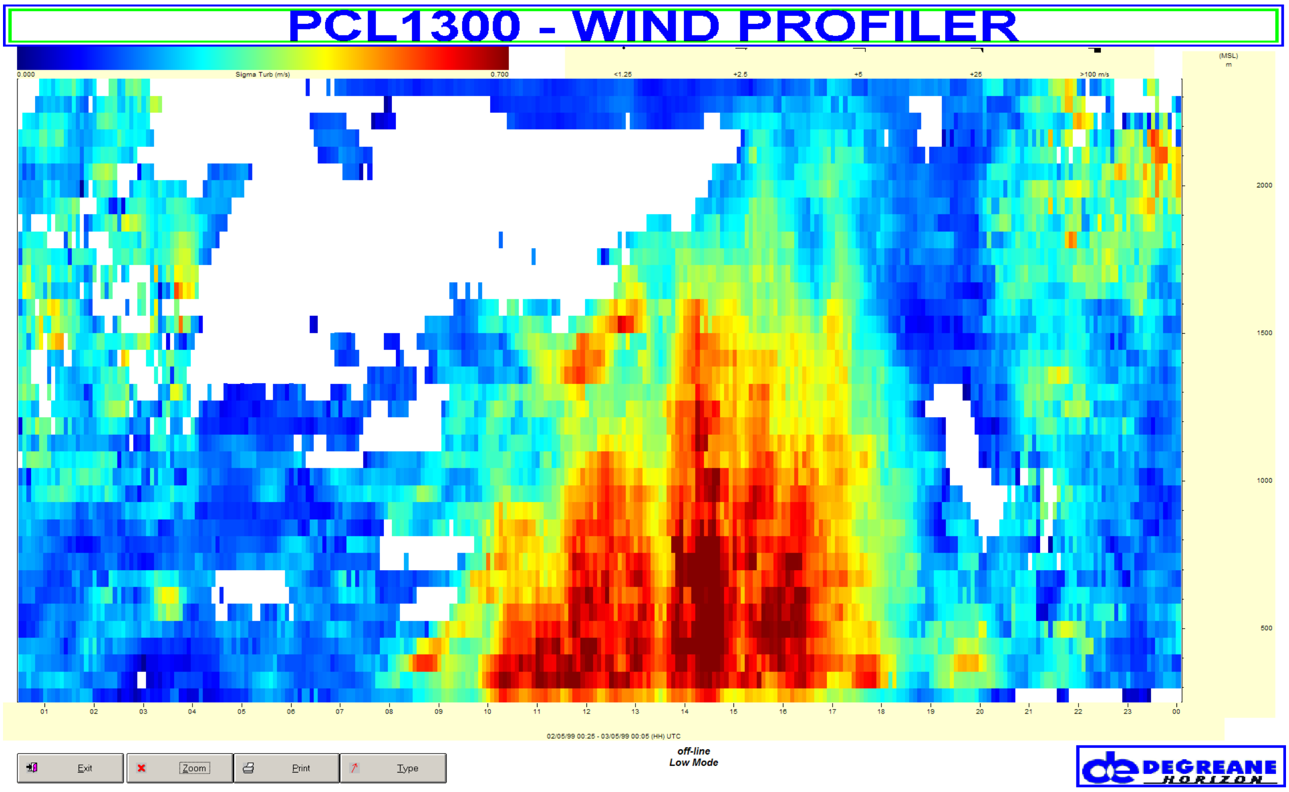

Figure 6 Boundary layer development identified by turbulenced induced beam broadening

Synoptic applications:

In synoptic applications, the wind profile is available in real time via BUFR coded messages. Secondary products such as rainfall rate or atmospheric reflectivity, turbulence, shear, turbulent kenetic energy dissipation rate, virtual temperature profiles are also available in real time. Often, in such applications, wind profilers are networked together: US (33, 400 MHz), Japan (25, 1 GHz), Korea (10, 1 GHz), UK (2, 50MHz; 3, 1 GHz), Germany (4, 400 MHz).

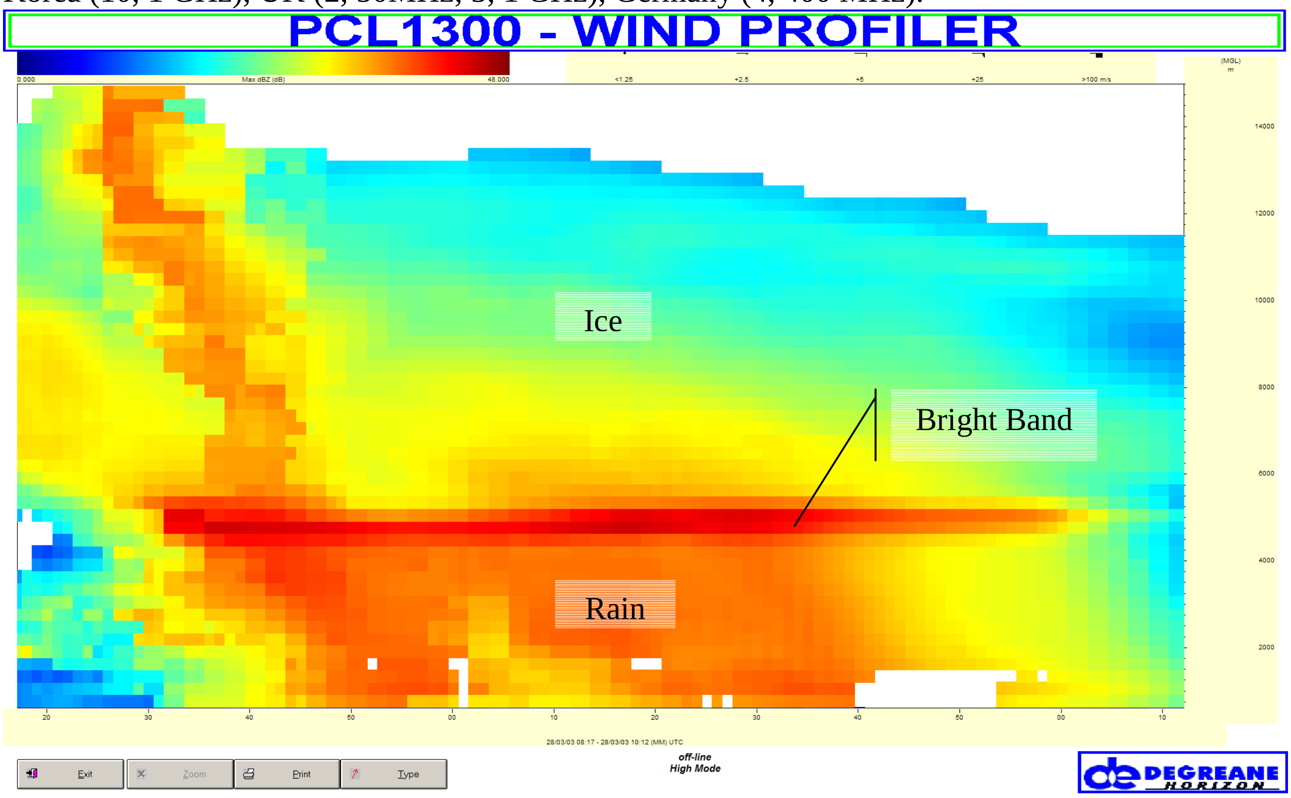

Figure 7 dBZe display

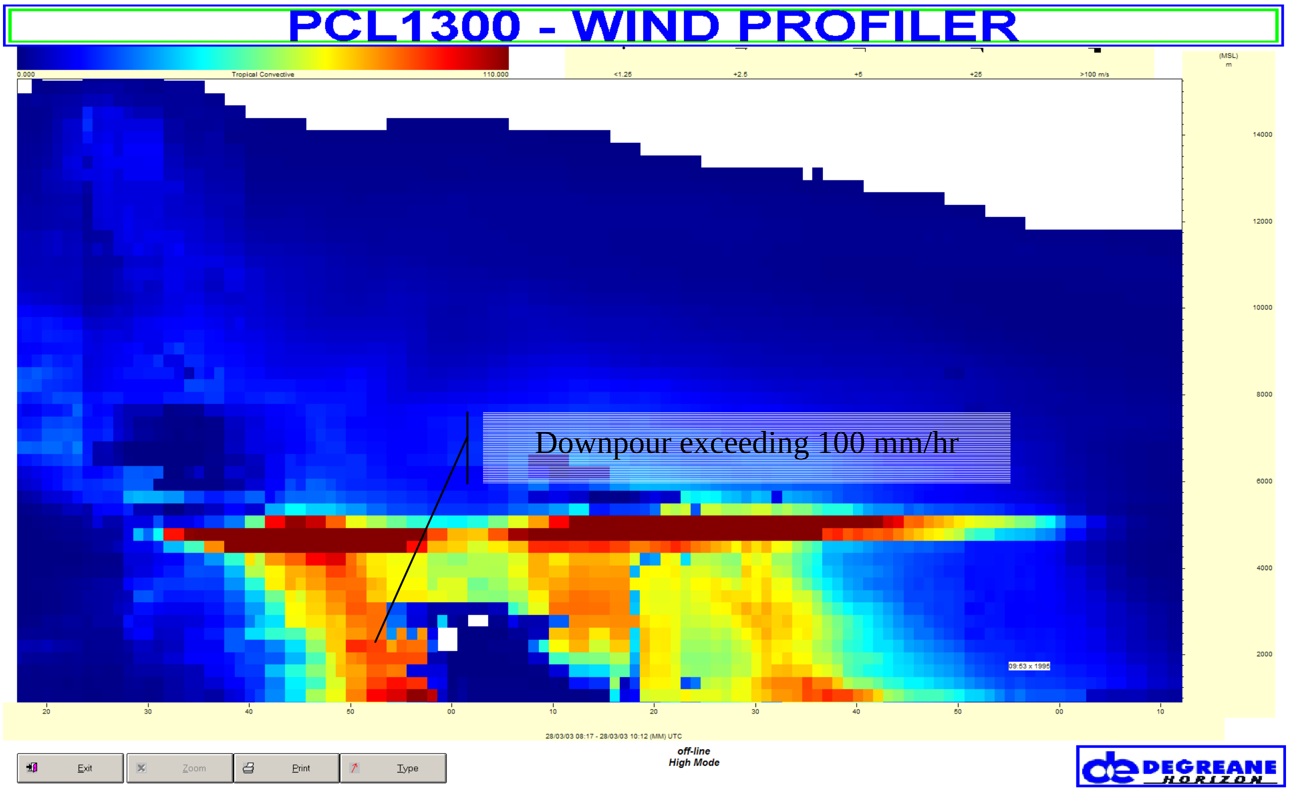

Figure 8 Rainfall Rate display

<u>Current developments:</u>

The integration of 2 wind profilers (1 GHz), airport sensors, and automatic weather stations with a microscale urban climate model is currently underway.

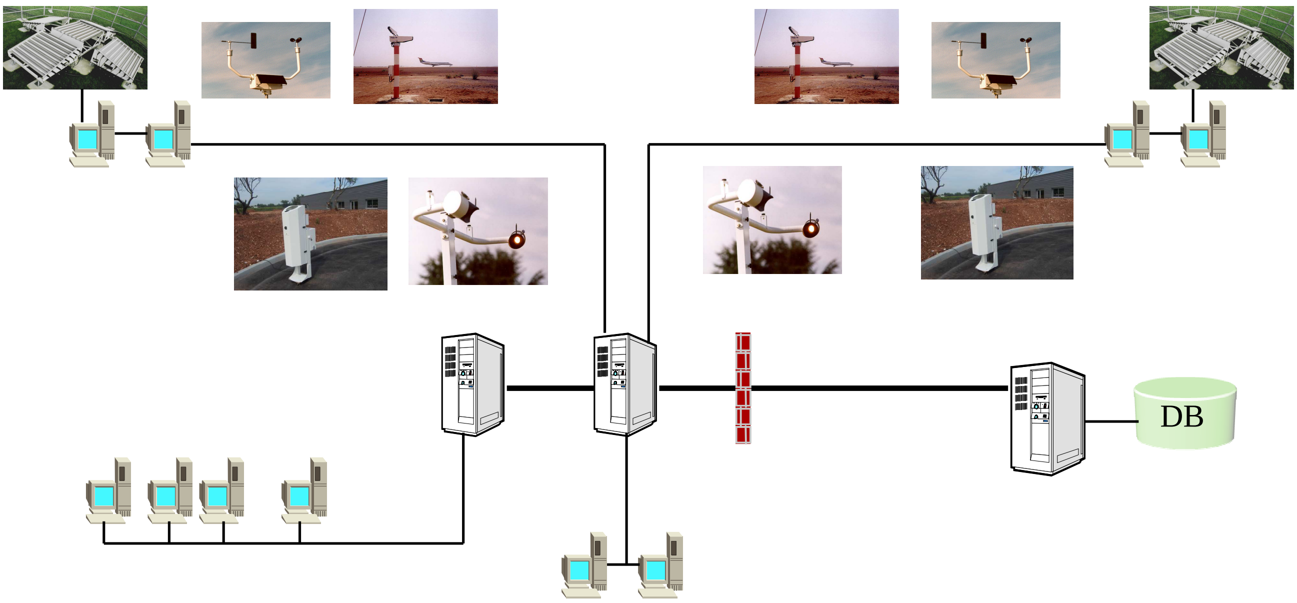

Figure 9 Wind profiler, AWOS, model integration

The development of a mechanically tilting profiler antenna is currently underway (1 GHz) . This will allow to increase significantly system sensitivity. For research application, the radar will also be able to scan in two orthogonal vertical planes. One such application is the study of land/sea breeze interaction within the boundary layer.

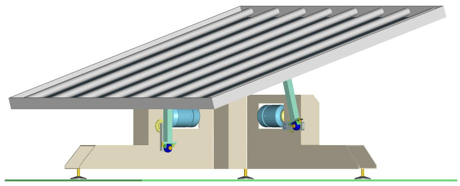

Figure 10 Mechanical tilting antenna

Conclusions

Wind profilers are being used increasingly world wide. However, in many applications new types of displays are being developed and others still need to be found. The new generation of wind profilers allow the instrument to be used simultaneously for several different applications / end users. This dissemination of information is an opportunity to create links between different end users which can lead to an exchange of expertise/knowledge increasing the quality of the end products being generated.

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