

## Vaisala LAP<sup>®</sup>-3000 Lower Atmosphere Profiler in Torino Monitoring and Forecasting Air Quality

Since 1987 the region of Piedmont (Piemonte) in north-western Italy has benefited from an extensive real-time hydro-meteorological network. Operated by the Regional Directorate, the "Direzione Servizi Tecnici di Prevenzione" (DSTP), the network comprises state-of-the-art technologies ranging from surface weather stations to weather radar and upper-air automatic systems. Environmental problems have received increasing attention during the last decade, due to their severe impacts on society. Consequently, DSTP instigated a regional forecasting service, providing information on the atmospheric conditions critical to air pollution monitoring.



Torino's landmark, the Mole Antonelliana, is located in downtown Torino.

PHOTO COURTESY: CITY OF TORINO

At the beginning of March 2003, the Direzione Servizi Tecnici di Prevenzione DSTP merged into ARPA Piemonte (The Regional Office for the Protection of the Environment), with Dr. Vincenzo Coccolo as the newly appointed chief executive. Both the tasks and staff of the former DSTP have now been transferred to ARPA Piemonte, which will focus on all issues related to natural and environmental risk.

ARPA Piemonte has recently ordered a Vaisala LAP<sup>®</sup>-3000 Lower Atmosphere Profiler to aid in monitoring and forecasting air quality in Torino, the main city of Regione Piemonte with 1 million inhabitants. Observations performed of the boundary layer with the wind profiler are combined with other monitoring systems and mathematical models. Accurate measurements are needed to predict air pollution conditions and movement.

The LAP<sup>®</sup>-3000, ordered by ARPA Piemonte, will consist of a four-panel antenna and a shelter, housing electronics and a control

PC. The system will be installed on the roof of a building in downtown Torino, a location selected after a site survey. Installation will be carried out in the summer of 2003. The Wind Profiler data will be transmitted via LAN to the ARPA forecasting center SSRN (Sala Situazione Rischi Naturali). To complete the environmental monitoring system, ARPA Piemonte will also install an additional instrument, which is not part of the LAP<sup>®</sup>-3000, for temperature profile measurements up to 1000 m above the ground. The instrument will be installed at the same site in Torino.

### Accurate lower atmosphere profiles

The Vaisala LAP<sup>®</sup>-3000 Lower Atmosphere Profiler was jointly developed under a Co-operative Research and Development Agreement (CRADA) between the National Oceanic and Atmospheric Administration (NOAA), Sonoma Technology Inc and Vaisala. The LAP<sup>®</sup>-3000 offers a measurement range of approximately 3000 meters, depending

on the conditions. It is used for a broad range of applications, including atmospheric boundary layer research, air pollution research, aviation operations, mesoscale meteorological forecasting and urban airshed modeling. More than one hundred and thirty LAP<sup>®</sup>-3000 systems have been deployed and are operating worldwide.

The LAP<sup>®</sup>-3000 is a remote sensing clear air Doppler radar that reliably provides continuous and real-time vertical profiles of horizontal and vertical wind speed and direction. It calculates the wind components using the Doppler beam swinging (DBS) method. The return signal is scattered back from eddies and turbulence in the atmos-

phere. The vertical wind profile is provided at the selected resolution steps (called range gates) for the user. The LAP<sup>®</sup>-3000 operates unattended and can be networked to another location.

The operating system is Vaisala LAP-XM<sup>®</sup> software running on a Radar Processor PC. LAP-XM<sup>®</sup> provides the tools for data processing, as well as for data display. The user-friendly graphical application software is Graph-XM. Graph-XM allows site-specific optimization of system performance, including variable temporal and range resolution. The user may choose signal processing parameters, quality control features and data formats.

### Broad installation base

The Vaisala LAP<sup>®</sup>-3000 Lower Atmosphere Profiler is already being used extensively in air quality management programs in the USA. The co-operative working agreement between Vaisala, NOAA and air quality management districts is continuously leading to useful findings. One example is the discovery of bird contamination in wind profiler measurements and the relevant development of advanced signal processing algorithms to minimize the adverse effects of these clutter targets. This enhancement is part of a broader scope of development carried out on LAP<sup>®</sup>-3000 signal processing in recent years. As a result of these developments, new algorithms have been incorporated into LAP-XM<sup>®</sup> signal processing software (wavelet clutter reduction, multiple peak picking, and running averages of wind consensus values). ●

Visit to the Catania airport wind profiler demo site. From left, Pauli Niska-Pudas (Vaisala), Dr. Roberto Cremonini, Dr. Stefano Bovo, Dr. Renata Pelosini, Dr. Vincenzo Coccolo (ARPA Piemonte), Alessandro Marchini (I&SI), Maria Rita Leccese (Eurelettronica Icas Srl).

