SCANNING DOPPLER LIDAR

The 2015 Pan American and Parapan American Games will take place this year in Toronto and surrounding areas from July 10-26 and August 7-15, respectively. The Toronto 2015 Games is the largest multi-sport event Canada has ever hosted, involving 7,600 athletes competing in 51 sports (36 Pan Am and 15 Parapan) in 30 different venues located in the Greater Golden Horseshoe Area. Environment Canada is providing state-of-the art, 24/7 dedicated, venue-specific weather alerting services and environmental emergency support for the Toronto 2015 Games. The TO2015 Games are also a catalyst for enhancing existing weather services through research and demonstration projects that will benefit future generations of Canadians.

What does the technology do?

A Doppler LiDAR system transmits laser beams which are backscattered by aerosols such as dust and other particles in the air, permitting the real-time measurement of the wind field. Conventional wind measurement instruments such as anemometers measure wind speed and direction at one level in the atmosphere (usually at a standard height of 10 m). Doppler LiDAR uses remote sensing technology to provide a vertical profile of atmospheric winds, detecting winds at various elevations above the ground across a broad area.

In contrast to Doppler RADARs, which require a precipitation target to measure the wind field, Doppler LiDARs (Light Detection And Ranging) can take measurements where there is no precipitation.

In essence, the Doppler LiDAR will provide a measurement of wind speed and direction in what we perceive to be clear skies.

What's new about the technology?

Initially the Doppler LiDAR was a costly tool limited to the improvement of aviation safety through monitoring the threat of invisible winds. The LiDARs are used widely at major airports to detect wake vortices allowing for more efficient use of aircraft and runways. The expanded use of the instrument has driven prices down by nearly 90% over a period of a few years.

This new and affordable Doppler LiDAR technology has matured to a technical readiness level appropriate for operational use. Given the

presence of sufficient aerosols, it can detect winds up to a height of about 5 km and a range of 15 km, at about 10 minute resolution. It has a range resolution of 10 m which allows the measurement of fine-scale wind features.

How is the new technology better?

Doppler LiDARs can map the wind in high resolution (10 metre samples), non-precipitating conditions, complementing the Doppler radars which can measure winds in precipitation conditions. LiDARs can also provide vertical air movement information in addition to the horizontal winds, which is important in the forecasting of clouds and precipitation, and the triggering of severe weather. We can therefore use a Doppler LiDAR to continuously monitor high-resolution wind patterns across urban areas, looking for localized patterns such as lake breezes.

What is the legacy for Canadians?

Doppler LiDARs will be specifically used to provide the fine details of a wind field that defines a lake breeze, in particular the vertical motions which create or enhance thunderstorms. With time, this instrument will be used to inform operational weather forecasts and the numerical weather prediction process which will improve the lead times for thunderstorm forecasts.

Doppler LiDARs may also be deployed to monitor wind conditions across remote, difficult to monitor locations such as in the Arctic. Standard instrumentation cannot easily or affordably provide that functionality under arctic conditions.