

WIND POWER



WEATHER & CLIMATE



AVIATION WEATHER



AIR QUALITY &
INDUSTRIAL RISK



LEOSPHERE
A VAISALA COMPANY

Wind Observations in Urban Environments

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UAS Weather Forum, April 29, 2019





Agenda

1. Corporate introduction, Doppler Lidar technology & Windcube portfolio
2. Mapping wind hazardous areas with a scanning Doppler Lidar
3. Open discussion



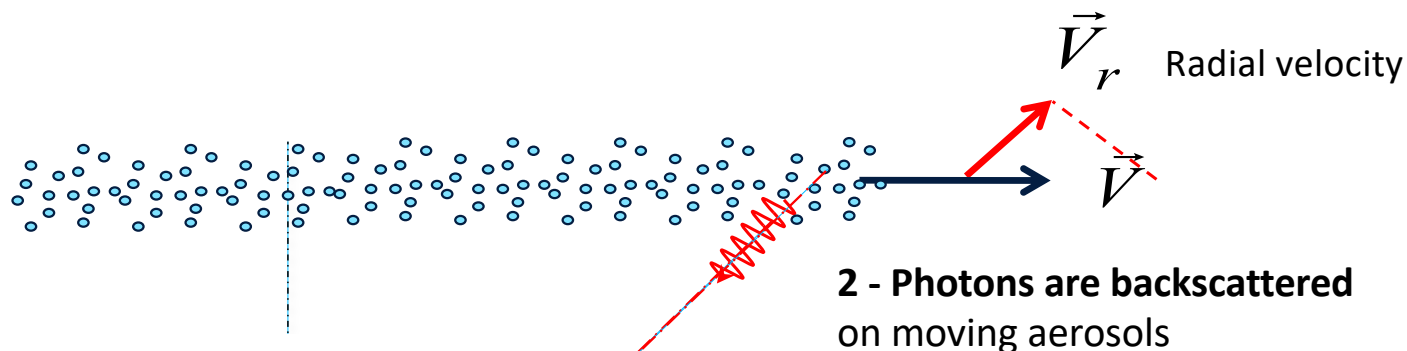
LEOSPHERE : WORLD LEADING LIDAR SOLUTIONS MANUFACTURER

Leosphere, founded in 2004 is world leader in ground-based and nacelle-mounted Lidar for atmospheric observation. The company designs, develops, manufactures, sells and services turnkey remote-sensing instruments enabling wind measurement and aerosol characterization.

The company has been **fully owned by Vaisala** since October 2018.



Pulsed heterodyne Doppler LIDAR principle



- The moving aerosols induce an optical frequency change of the backscattered laser light due to the Doppler effect.
- The Doppler shift is proportional to the radial wind velocity.
- Simultaneous measurements of **wind and aerosol backscatter**



Heterodyne Pulsed Doppler LIDAR standardization by ISO

WMO has requested ISO to prepare and published an International Standard :

-> **ISO/DIS 28902-2**: « Air Quality – Environmental meteorology, part 2: **Ground-based remote sensing of wind by heterodyne pulsed Doppler Lidar** »

- Defines terms and definitions of LIDAR characteristics
- Describes the Fundamentals of operation principles
- Defines a Figure of Merit and make the link between instrument characteristics and performances
- Defines guidelines for instruments' testing

published: 2017/07

http://www.iso.org/iso/catalogue_detail.htm?csnumber=59210





A complete range of Lidar systems for all applications

WINDCUBE

Vertical Profiler Lidar



- Ranges: 40 to 200+ meters
- 12 user defined range gates
- Speed Accuracy : 0,1 m/s
- Buoy version

WINDCUBE

360° Long Range Scanning Lidar



- Ranges: 3km / 6km / 10km
- Up to 320 range gates
- Configurable scanning patterns

WIND IRIS

Turbine-mounted Lidar



- Range: 50 to 450+ meters
- 10 user defined range gates
- Speed Accuracy : 0,1 m/s
- Hub Height measurement

WIND IRIS

Feed Forward Turbine Control Lidar



- Range: 50 to 200+ meters
- 10 user defined range gates
- Integrated to turbine control system

GROUND BASED

NACELLE MOUNTED



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Lidar technology at the crossroads of atmospheric environmental applications



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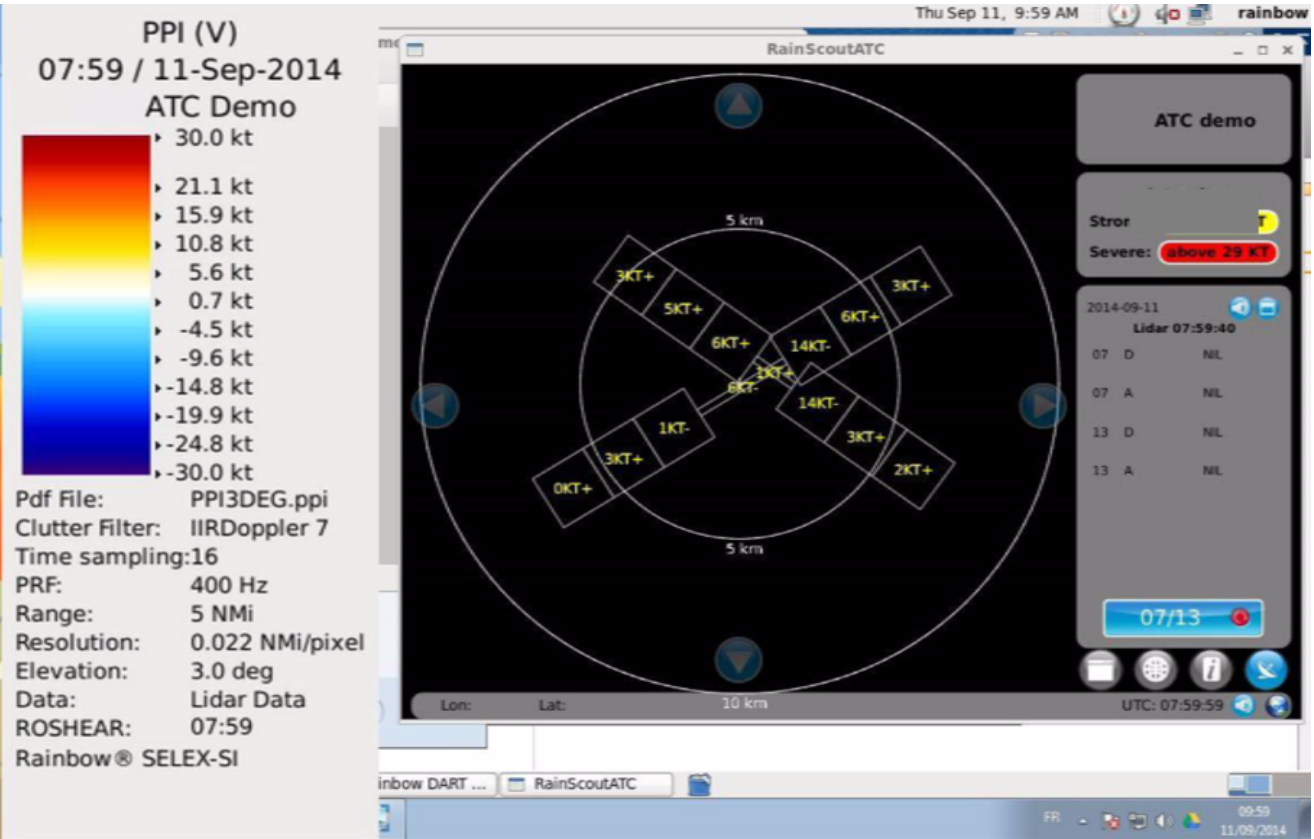
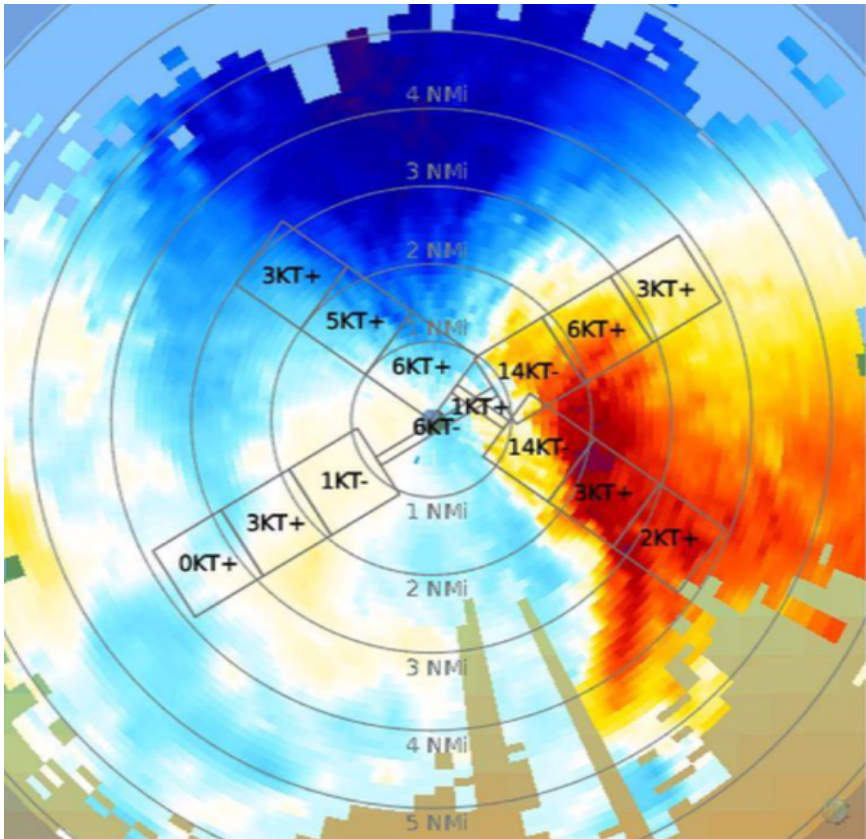


AVIATION WEATHER



More than 1400 Doppler Lidars in the field

Example of Lidar based automated wind shear alerts at airport





Microscale wind impacts UAVs : Control , Stability & Endurance



■ Wind phenomena affecting Control & Stability of a UAV

- Wind shear, micro bursts, high wind speed
- Building induced wind inhomogeneities
- Gusts and other wind anomalies at landing and takeoff sites

■ Wind phenomena affecting flight endurance

- Wind speed and direction varying with altitude
- Spatial horizontal distribution of the wind vectors

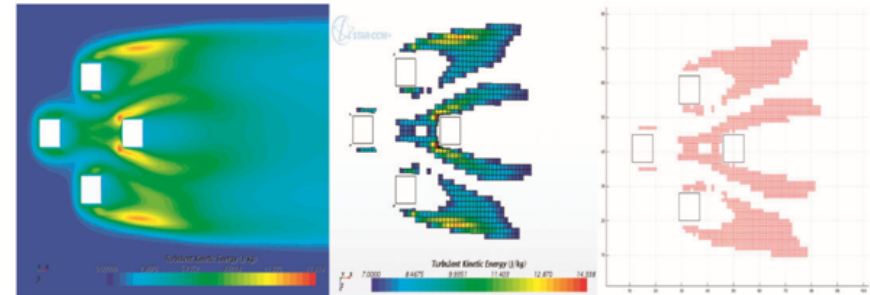
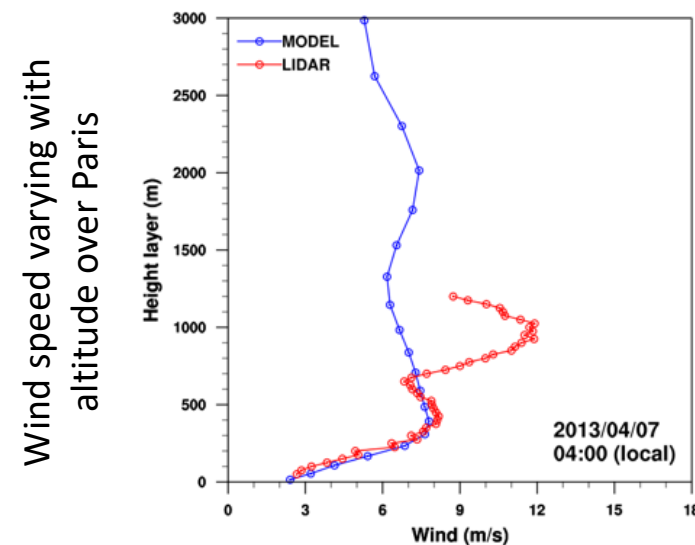


Figure 7. Spatial variation of TKE for the 'Plus' configuration.

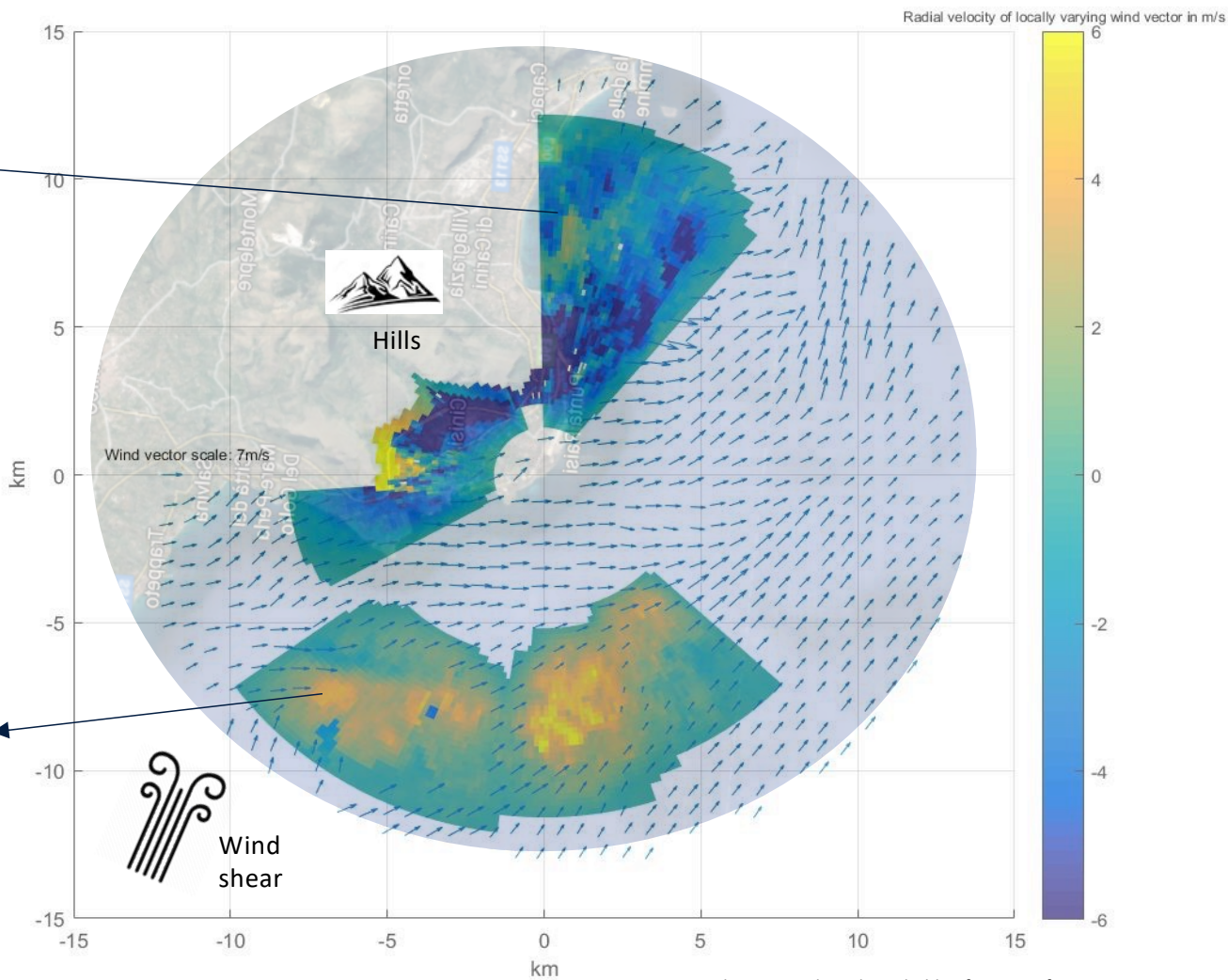
Turbulence induced by buildings





Scanning Doppler Lidar help mapping hazardous wind areas

Turbulent wind wake due to the hills

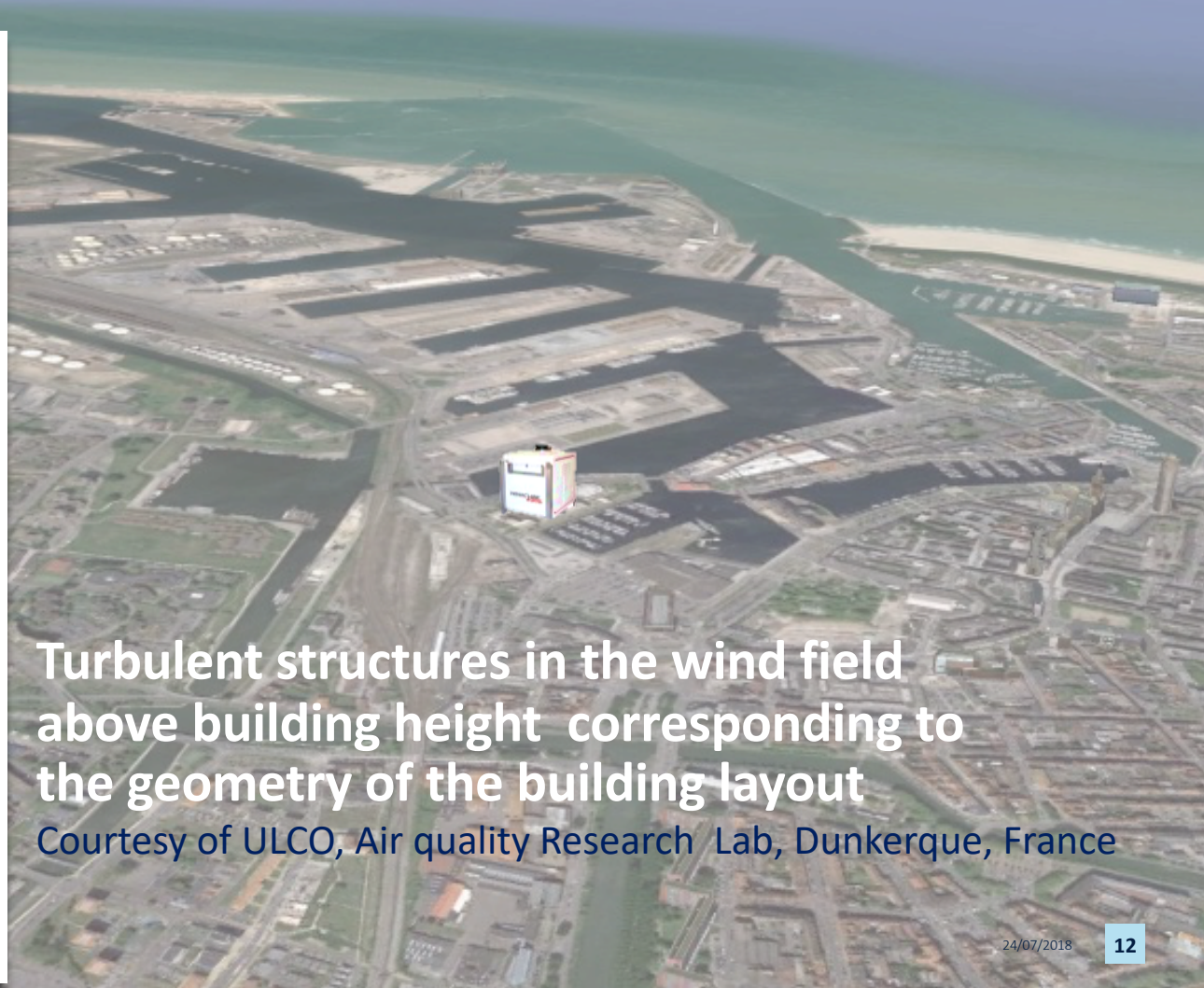
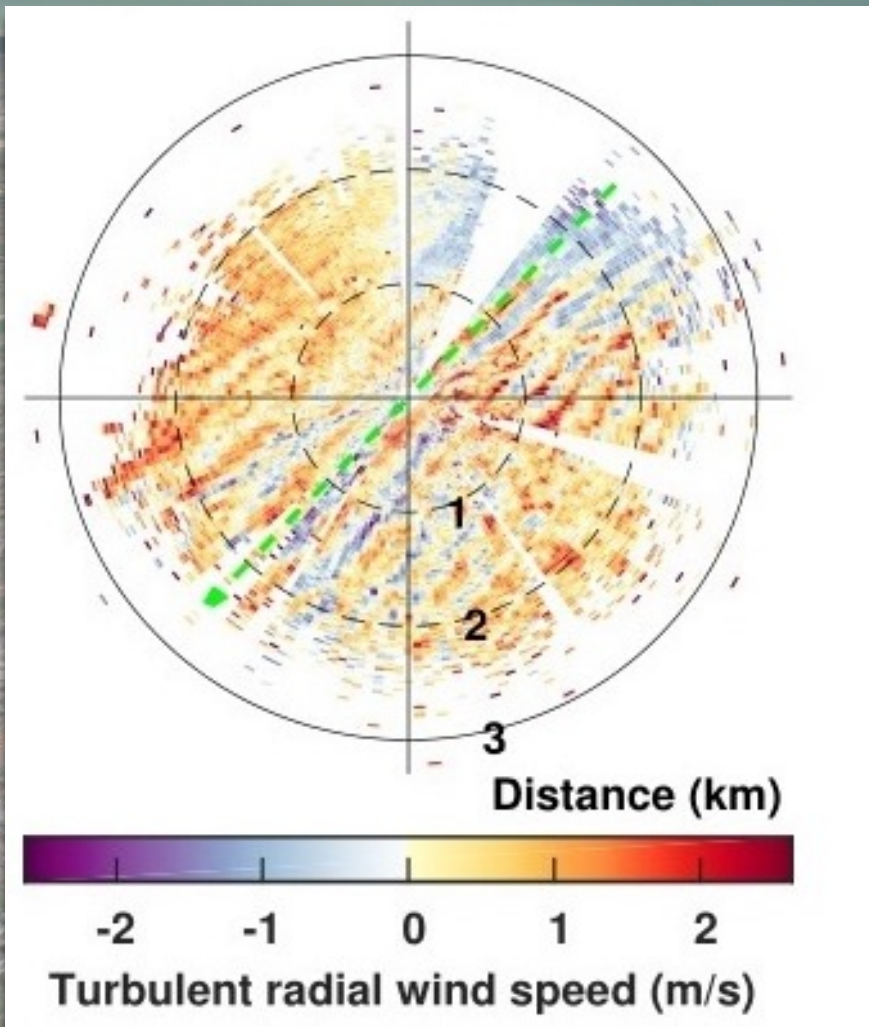


Inhomogeneous winds due to wind shear

Certain shear zones have been hidden for ease of view



Real time monitoring of atmospheric hazards around cities, factories, nuclear plants

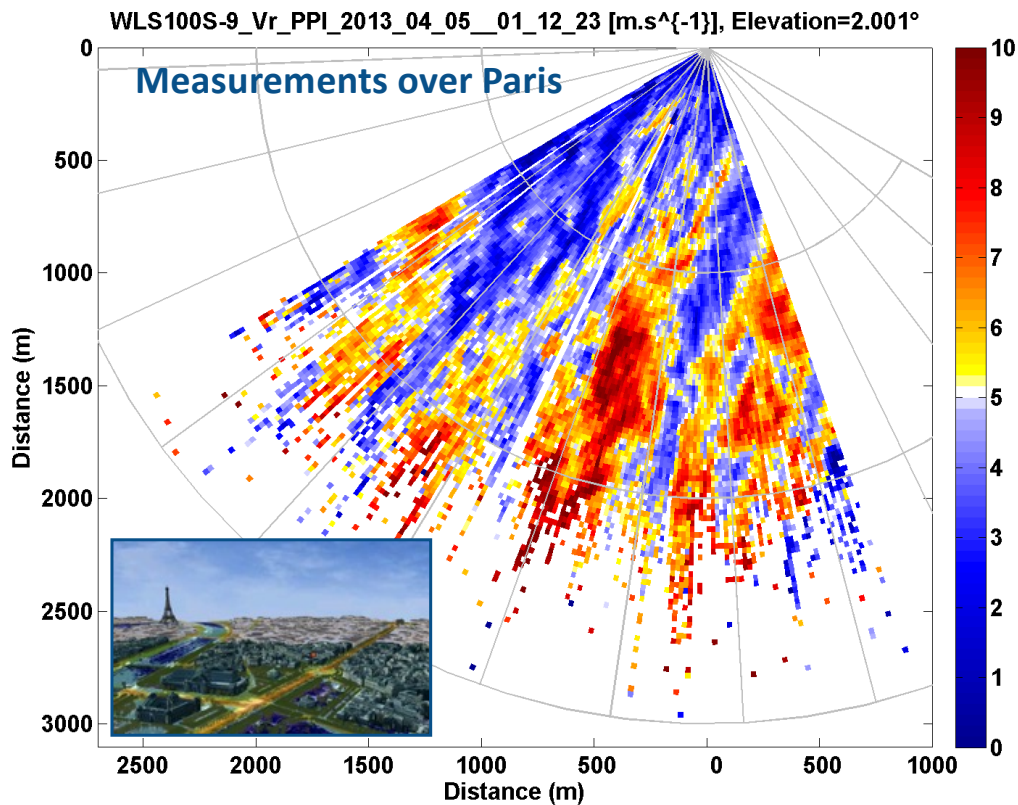


Turbulent structures in the wind field above building height corresponding to the geometry of the building layout

Courtesy of ULCO, Air quality Research Lab, Dunkerque, France



Capabilities and ongoing development for urban environment



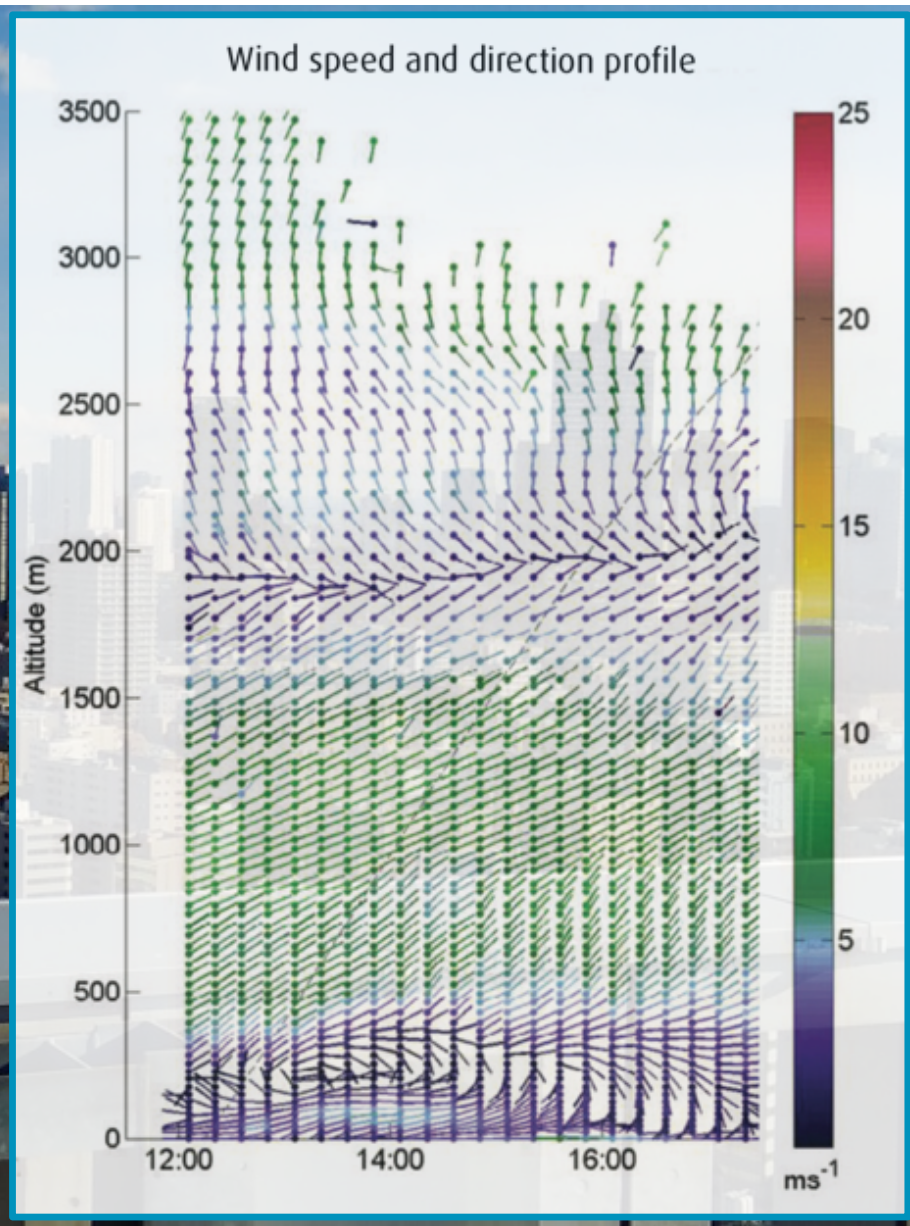
■ Doppler Lidar can identify complex wind patterns:

- Wakes induced by buildings
- Turbulence profile
- Winds aloft

■ We are developing data products to evaluate the impact of real world winds on UAVs such as:

- Assess UAVS capabilities required to fly through real world winds
- Wind dependence on UAVs' flight endurance
- Wind related airworthiness standards to ensure safe flight
- Flight planning potential based on high resolution wind profile measurement and forecasts

Thank you
Kiitos
Merci





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INNOVATION BUSINESS
LIDARS AIR QUALITY EXPERT
ATMOSPHERE WORLDWIDE NETWORKS
TECHNOLOGY SCIENCES
PERFORMANCE DATA ANALYSIS
GROUP WORLD LEADER
LASER WIND POWER