PO.133

VAISALA

Scan geometry and pulse length effect on turbulence retrieval using a virtual vertically profiling Doppler Wind Lidar and a turbulence box generator

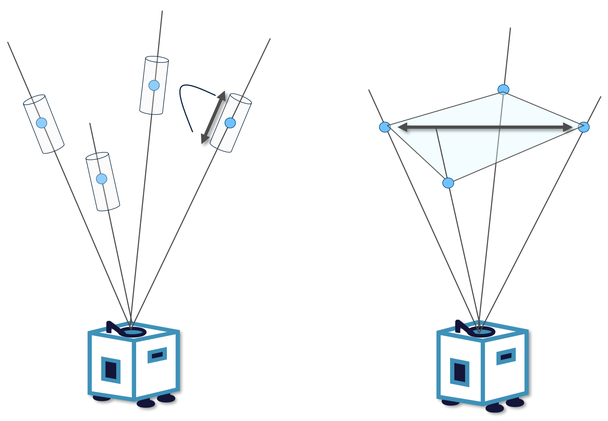
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Inter-beam effects dominate the uncertainties of profiling wind lidars. Proper processing help alleviate them (PO.112)

Doppler Wind Lidars measure the wind across a volume characterized by the **pulse length** or **focus range**, for pulsed and continuous wave systems, respectively. Compared to a point measurement, this can lead to a filtering of the wind speed. This is called the i**ntra-beam** averaging.

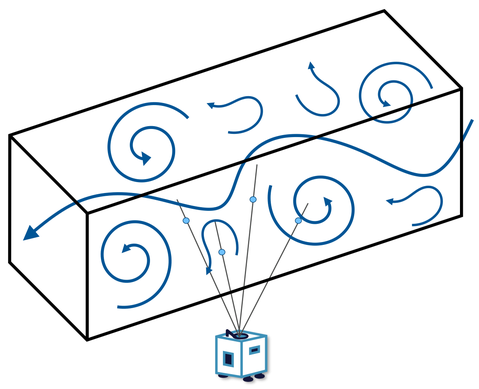
For wind field reconstruction, vertically profiling Doppler Wind Lidars scan the wind sequentially by 4 different beams to create a full DBS scans. **Wind homogeneity** is assumed across the volume and duration of this scan. Errors arise when the wind deviate from homogeneity. This is called the **inter-beams** averaging.

In real life, intra-beam and inter-beam effects are coupled, and it is difficult to dissociate them. We use **numerical simulations** to study the influence of both these effects separately.



We couple a **turbulence box** simulator with a pulsed coherent doppler lidar simulator. A vertical turbulent plane with no vertical shear is generated using Kaimal model and propagated in 3D with Taylor Frozen Hypothesis.

A complete **virtual lidar** is created and its signal is propagated through the turbulence box. We simulate a vertically scanning, noise-less lidar using a DBS reconstruction. The physics of the pulse and the scanning scheme are considered.

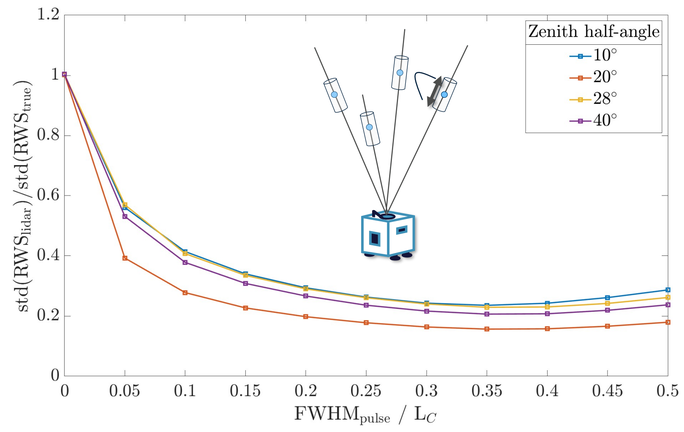


Turbulence box parameters	
U_{mean} (m s^{-1})	10
TI (%)	10
Spatial resolution (m)	2
Temporal resolution (s)	0.5
Integral length scale (m)	100
Simulation duration (h)	24

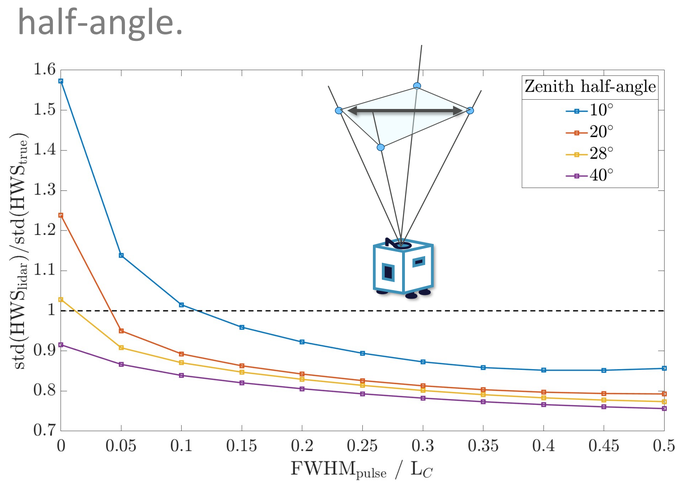
Virtual lidar parameters	
Accumulation time (s)	1
Zenith half-angle (°)	10, 20 28, 40
Pulse FWHM (m)	0m to 50m
Scanning scheme	DBS

Lidar signal is propagated through the turbulence box for **several zenith half-angles** and **pulse size** (characterized by its full-width at half maximum). Intra-beam effects get stronger with increasing pulse size. Inter-beam effects increase with increasing half-angle.

Intra-beam effects are shown by a reduction of LOS wind speed fluctuations with increased pulse size, regardless of the geometry.



Inter-beam effects are shown by a reduction of the fluctuations of the reconstructed wind speed with increased half-angle.



For typical profiling wind lidars, **inter-beam effects dominate** the error on the reconstructed wind speed. Advanced wind reconstruction algorithms can compensate this effect and improve the metrology.

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