A wind, temperature, H2O and CO2 scanning lidar mobile observatory for a 3D thermodynamic view of the atmosphere

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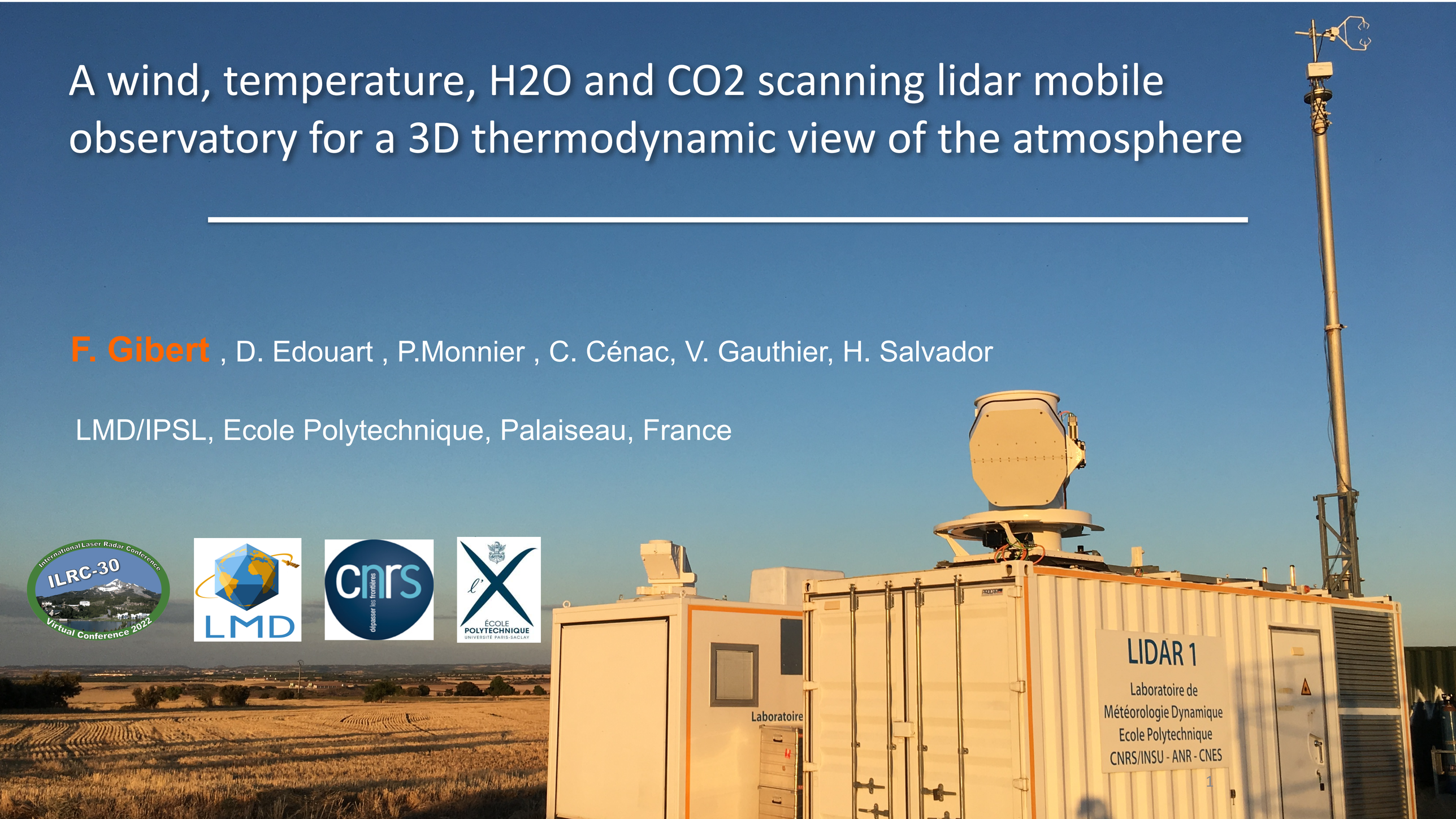
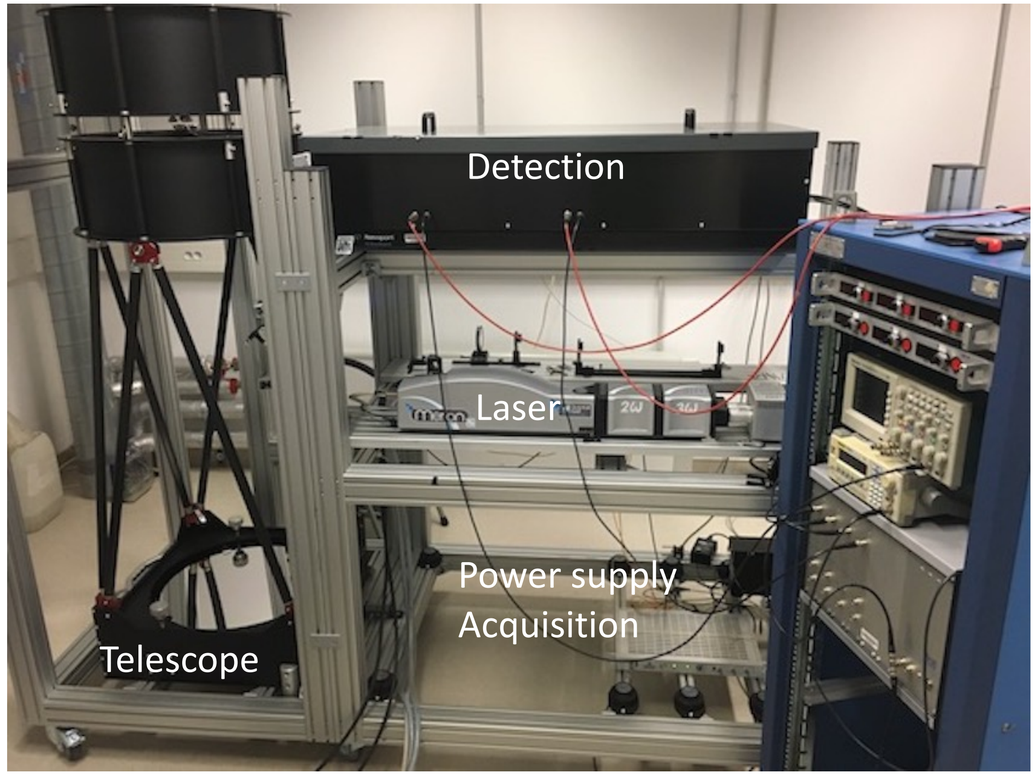
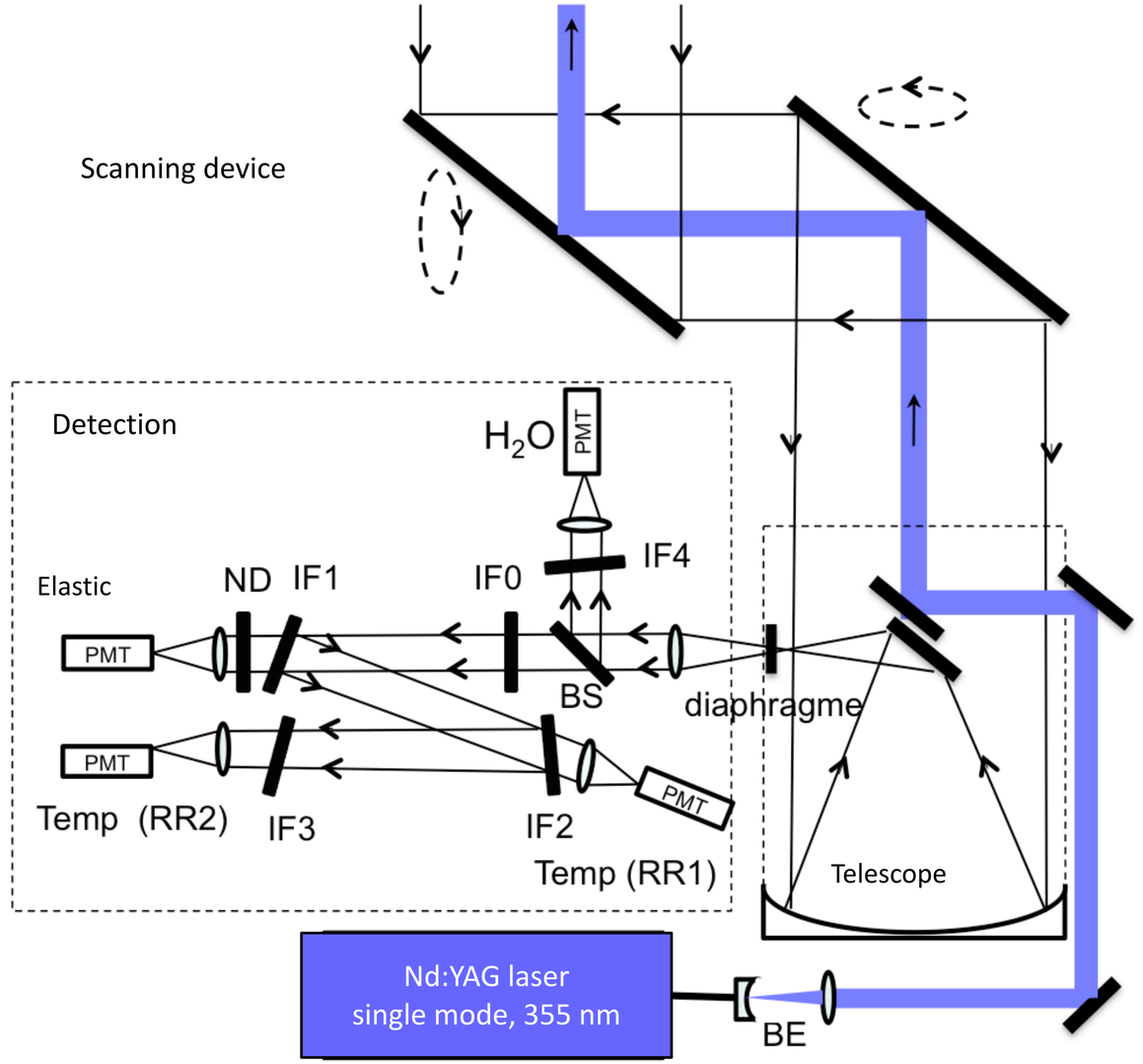


Instrumentation (1/2)

TERA: temperature, H_2O raman lidar 355 nm



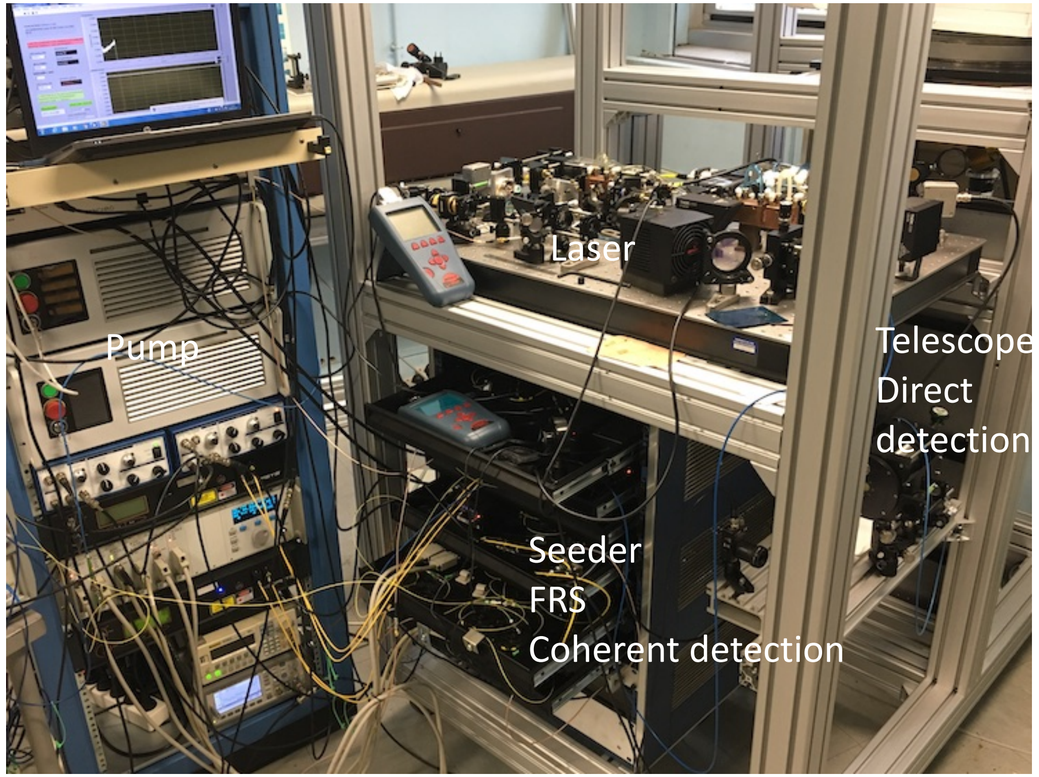
Laser Nd:YAG Power E /PRF/ Δt	DPSS MERION 20W 200 mJ/ 100 Hz / 10 ns
Wavelength, single mode	354.8 nm
Interference filter/ Bandwidth IF1 Aerosols, clouds IF2 Temperature IF3 Temperature IF4 H2O	 354.8 / 0.3 nm 354.15 / 0.3 nm 353.3 / 0.5 nm 407.7 / 0.3 nm
Telescope	Newton ø 50 cm
Detectors	PMT
Acquisition, analogic and photocounting	LICEL TR40-12-bit
Power supply	< 5 kW



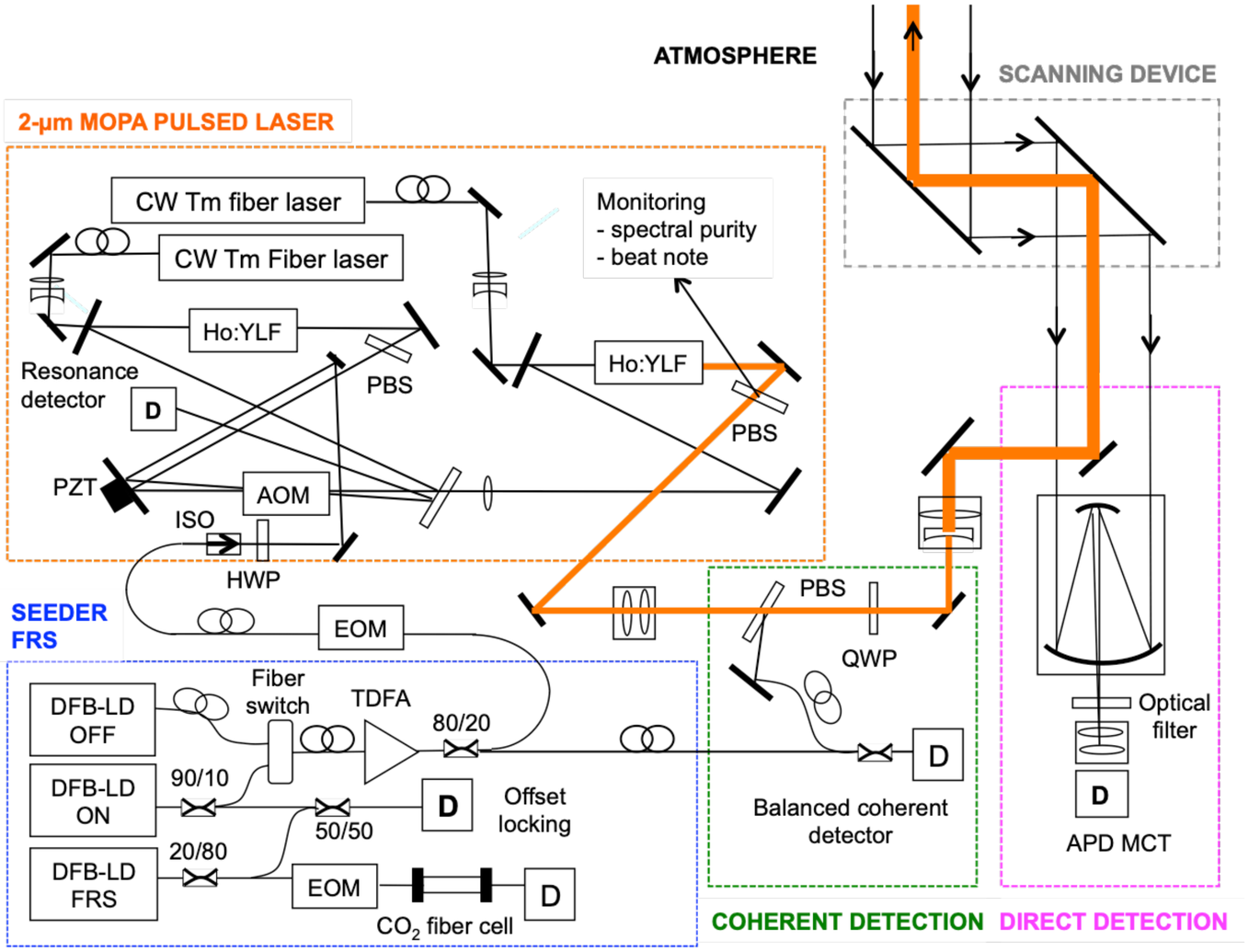
Instrumentation (2/2)

COWI: CO_2 and wind

DIAL and Doppler lidar - 2051 nm

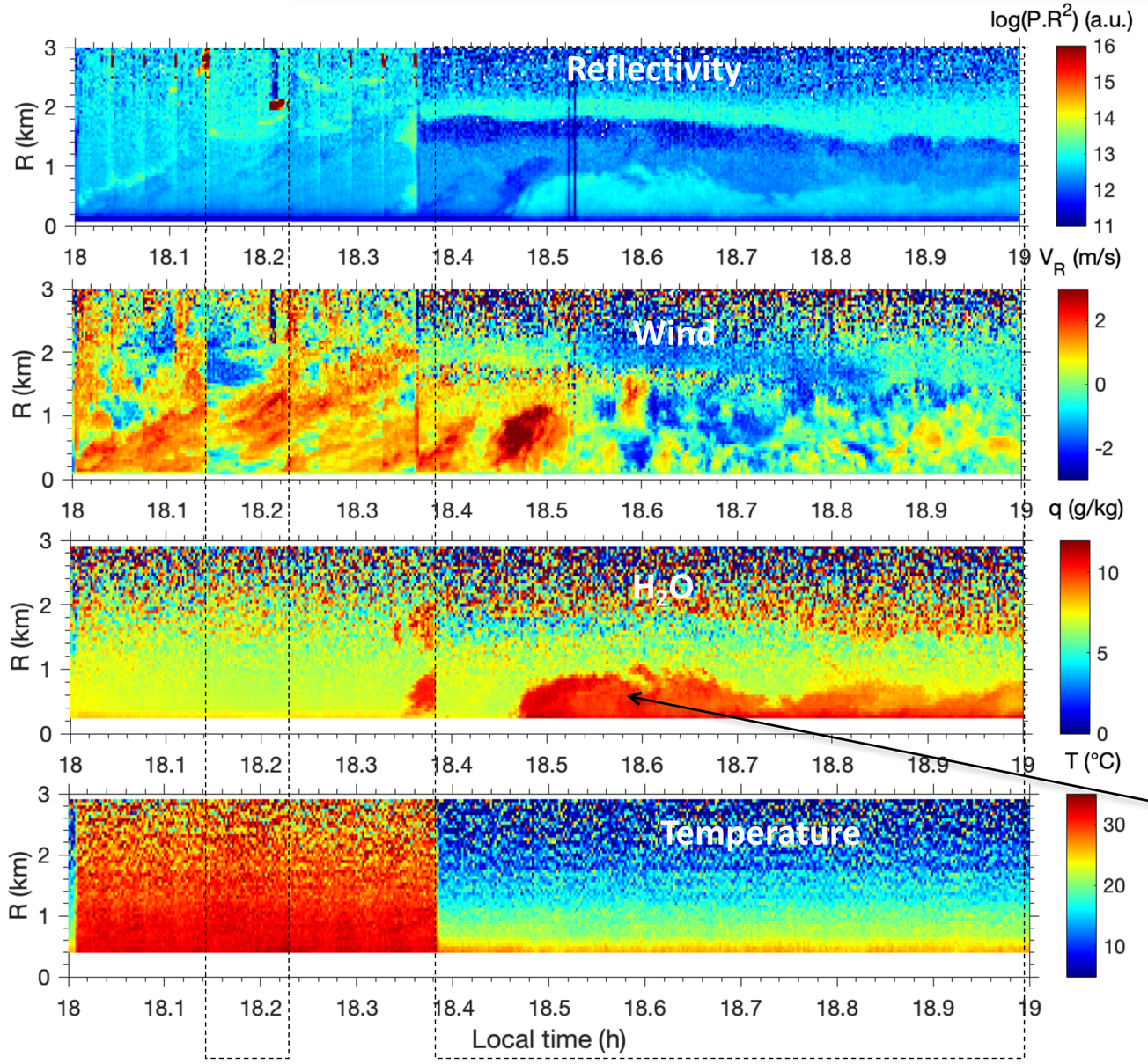


Laser Ho:YLF Power E /PRF/ Δt	 < 20W 10 mJ/ 2 kHz / 200 ns
Wavelengths	2051.04 /2051.25 nm
Frequency stability with FRS	< 150 kHz @ 10s
Spectral purity	> 99.96 %
Coherent detection	PIN InGaAs Lens ø 50 mm
Direct detection	APD HgCdTe Télescope ø 200 mm
Acquisition	FPGA 16 bit – 400 MHz
Power supply	< 2 kW



(Gibert, AO, 2018; Dumas, AO, 2017)

Example of 1h of measurements



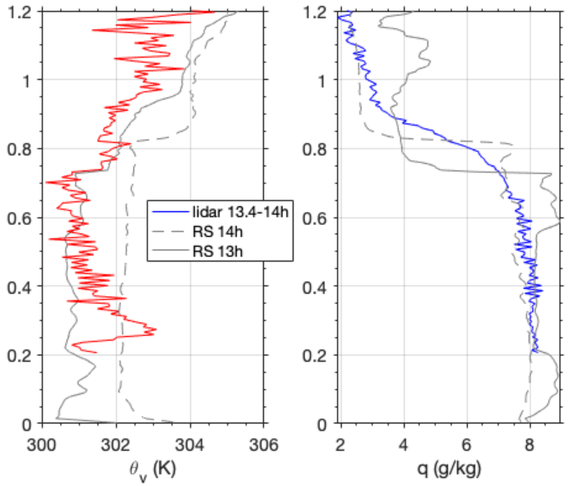
Time resolution: 8 s
Space resolution: 50 m

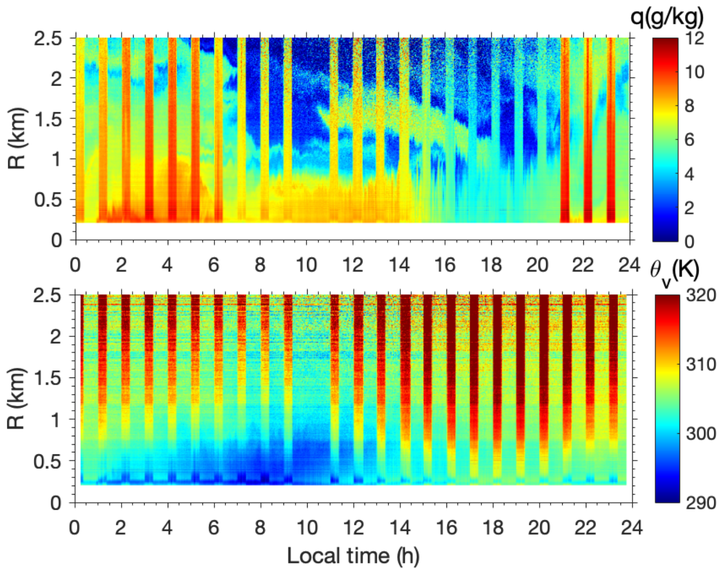
RHI: fixed azimut – vertical cross-section of the atmosphere 0-6° at 0.05°/s

PPI: fixed elevation - horizontal cross-section of the atmosphere 30° at 0.1°/s

sea breeze event
cold and humid layer
that propagates close
to the ground

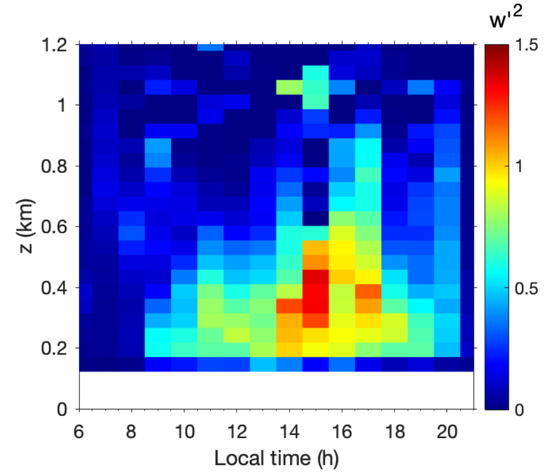
Vertical profiling: flux, moments, integral scales



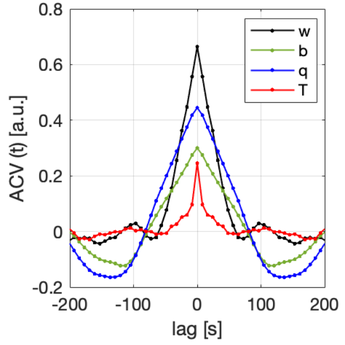


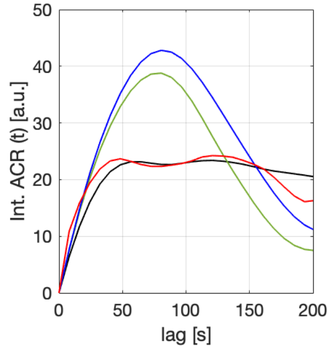
Profiles

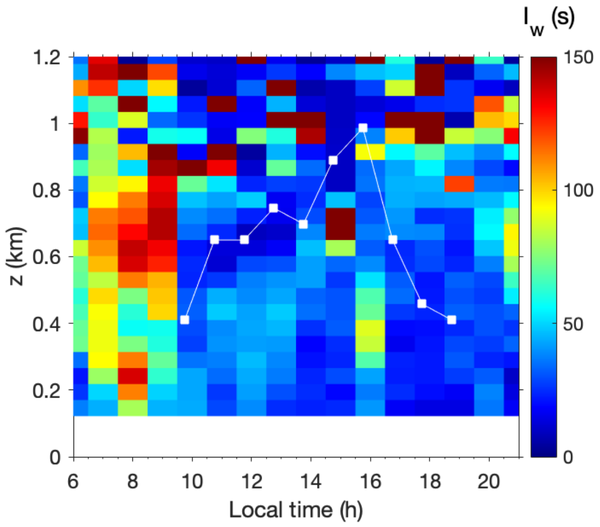
Variances & higher order moments



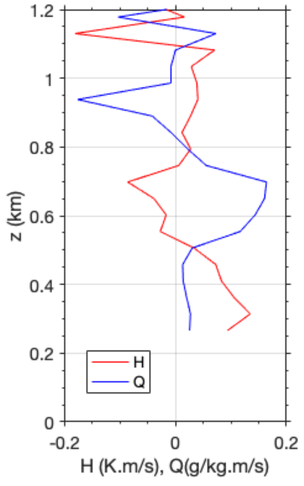
Spectra & Integral scales

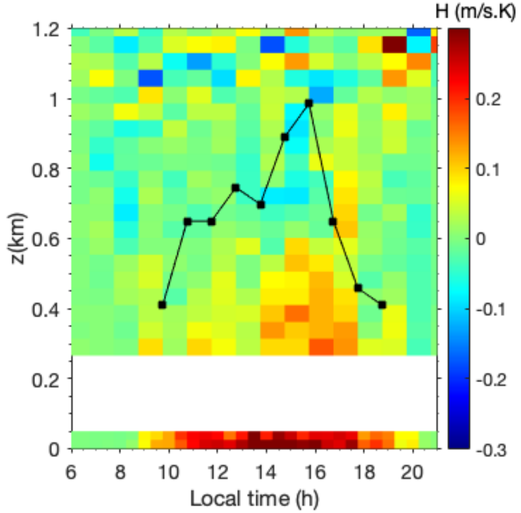


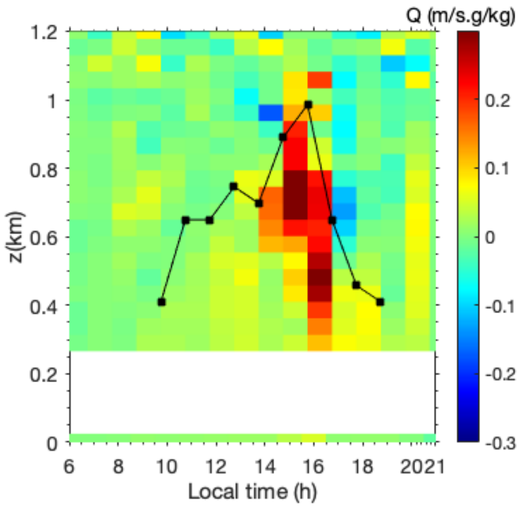




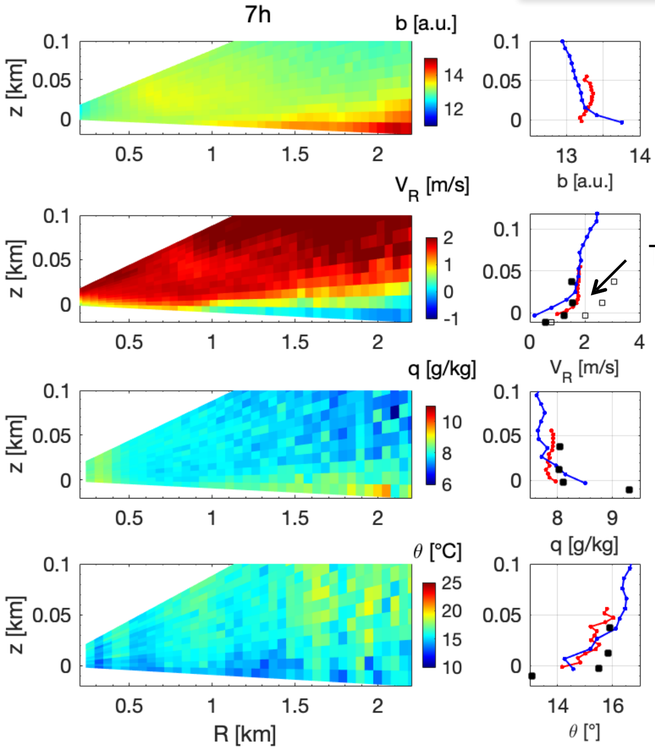
Turbulent Flux







Scanning ability in the surface layer

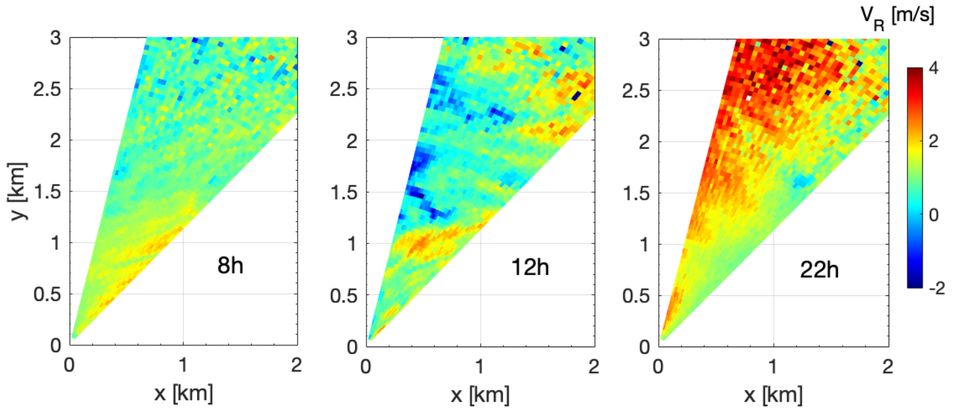


Lidar R=0.5 km
dry area

Lidar R=1.5 km
irrigated area

Tower

Vertical cross-section of the atmosphere (RHI):
- wind and scalar profiles in the surface layer
- surface flux estimate using Monin-Obukhov similarity theory



Horizontal cross-section of the atmosphere (PPI):
- scalar field heterogeneity
- 2D map of wind speed and direction
- friction velocity and Monin-Obukhov length from integral scales of turbulence