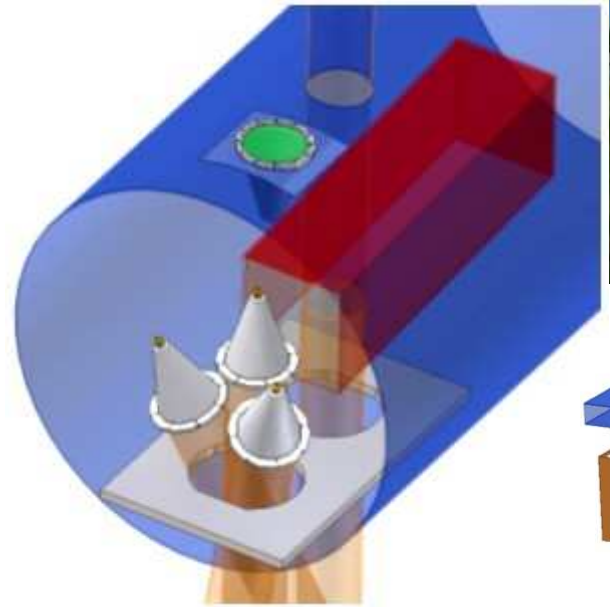
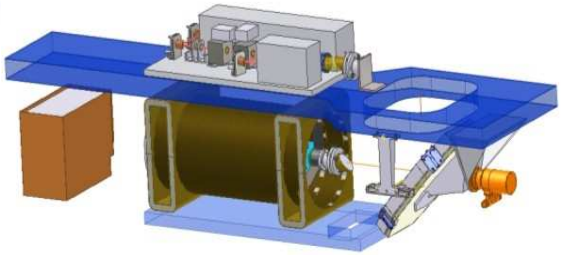
CNRS instrumentation for COPS

Cyrille Flamant
Institut Pierre-Simon Laplace, CNRS, Paris, France





New CNRS/INSU aircraft

ATR 42

Scientific payload: 2500 kg
Max. range: 6 h (3200 km)
Practical ceiling: 25000 ft
Min. altitude: 150 m
Max. cruise speed: 134 m/s
Seat: 2 experiment operators
and 7 scientists

Falcon 20

Scientific payload: 1000 kg
Max. range: 5 h (4100 km)
Practical ceiling: 42000 ft
Min. altitude: 150 m
Max. cruise speed: 240 m/s
Seat: 2 experiment operators
and 2 scientists

Airborne Instrumentation

- **Lidars: HRS backscatter, H_2O DIAL, Doppler wind, O_3 DIAL**
- **Radar/lidar: 94 GHz radar + HSR backscatter lidar**
- Dropsondes
- ENVISCOPE small aerosol sampling line: PCASP, 3λ nephelometer
- Cloud microphysics: Fast FSSP, Netzorov IC/WC, polar nephelometer, CN chamber
- Chemistry: O_3, NO, NO_2, NOy, HNO_3, PAN, VOC's, CO and mass spectrometer (OH/HO_2)
- In situ mean and turbulent meteorological variables

⑤ Aircraft are currently undergoing important modifications

⑤ Certifications for the above scientific payloads to be obtained by the end of 2005 in preparation for the AMMA/SOP (2006)

Airborne H_2O DIAL LEANDRE 2

ACE-2'97, FETCH'98, MAP'99, IHOP_2002, AMMA'06

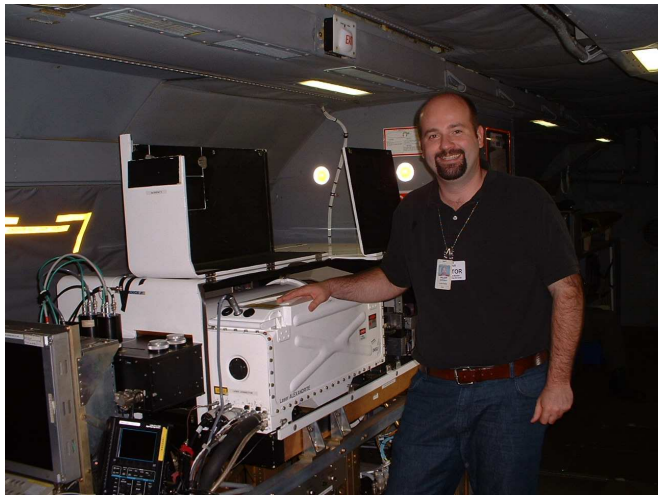
• Tunable spectral range enables measurements in various humidity conditions, e.g. for IWVC ranging from 5 to 50 kg m^{-2}
• 7 absorption lines that can be selected and changed in-flight

Emitter:	Spectral range	727 nm - 770 nm
	Pulse energy	2×50 mJ $\pm$ 10 %
(Double pulse	Repetition rate	10 Hz
dual wavelength	Temporal pulse width	225 ns
flash-pumped	Double pulse temporal separation	50 μs
Alexandrite laser)	Double pulse spectral separation	442 pm
Receiver:	Telescope diameter	30 cm
	Field of view	1.5 mrd - 8 mrd
	Photomultiplier efficiency	4 %
	Filter: Max trans / bandwidth	57 % / 1 nm
	Digitizer	12 bits / 10 MHz

Need for accurate, high resolution measurements of water vapor distribution in lower troposphere to improve current understanding:

- PBL dynamics, including the entrainment process,
- surface-atmosphere moisture exchanges,
- cloud formation,
- aerosol-cloud-radiation interactions,
- convective initiation and maintenance,
- cyclogenesis and severe storm formation.

Standard processing:
100 shots (10 sec.)
1 km horizontal res
300 m vertical res
Precision: < 0.4 g kg^{-1}
Accuracy : 0.15 g kg^{-1}

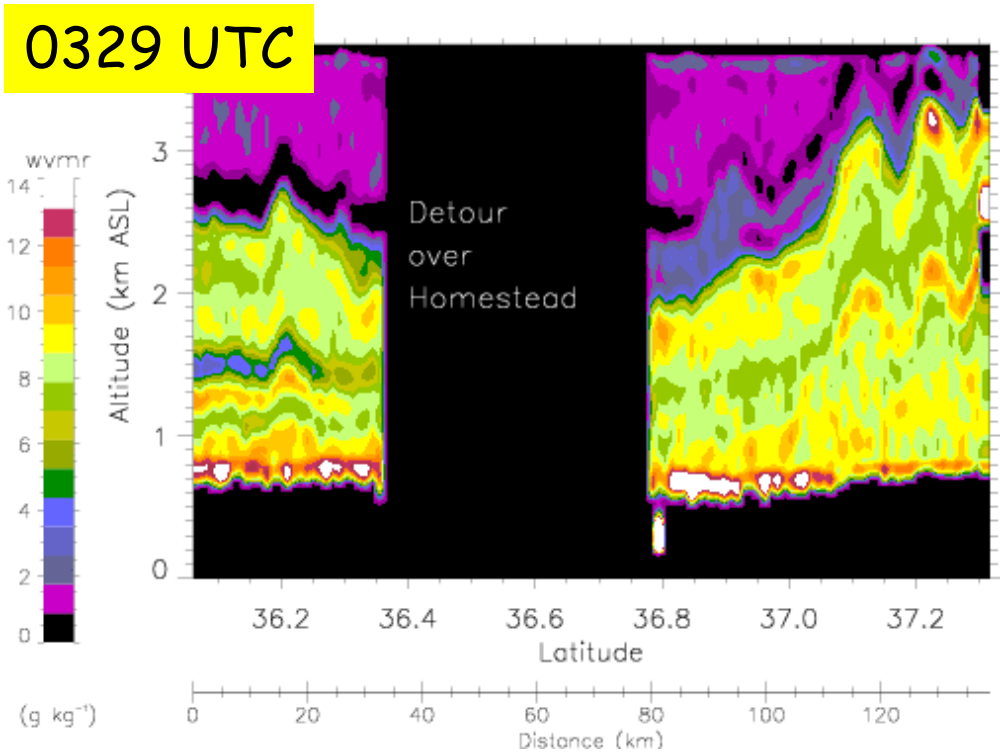


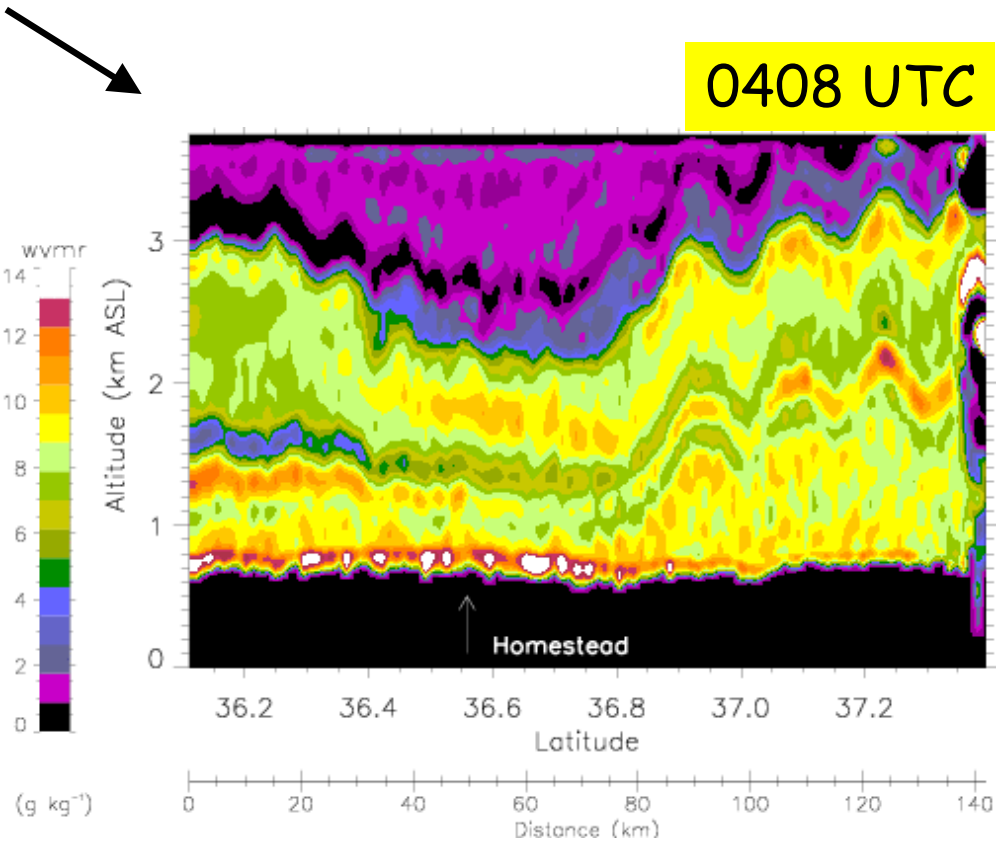
LEANDRE 2 in the NRL P-3

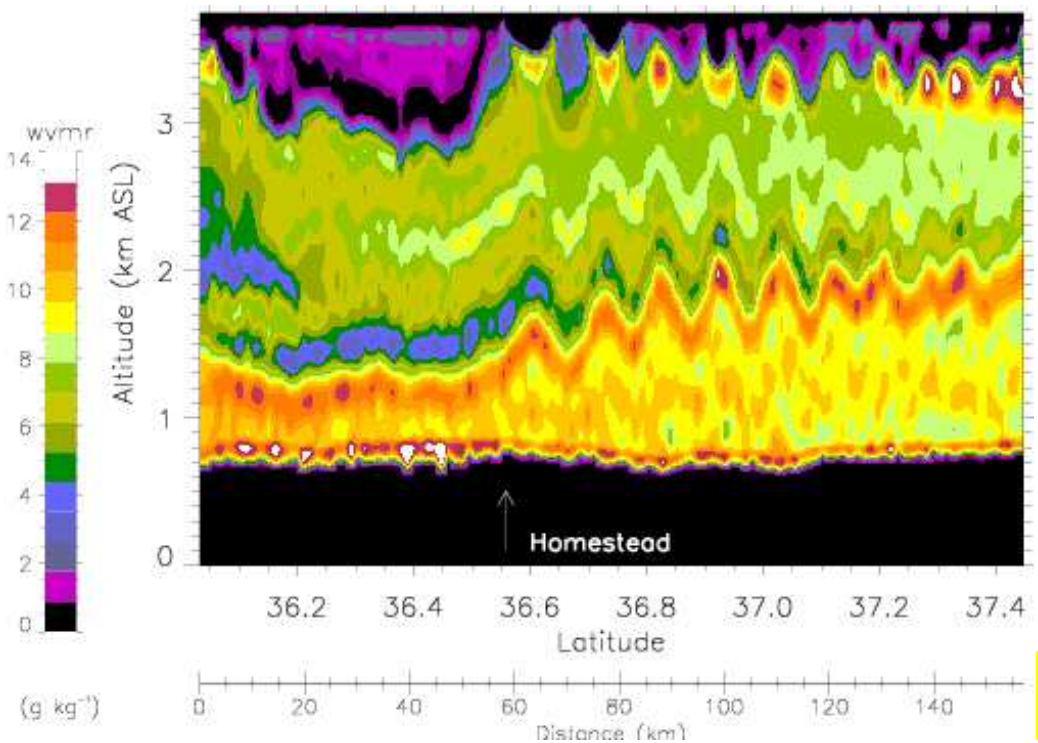
- Sideway pointing in the ABL
- Vertical pointing (nadir or zenith)
- coupling with ELDORA clear air measurements

International H_2O Project
IHOP_2002

LEANDRE-2: temporal evolution of a bore event over the SGP

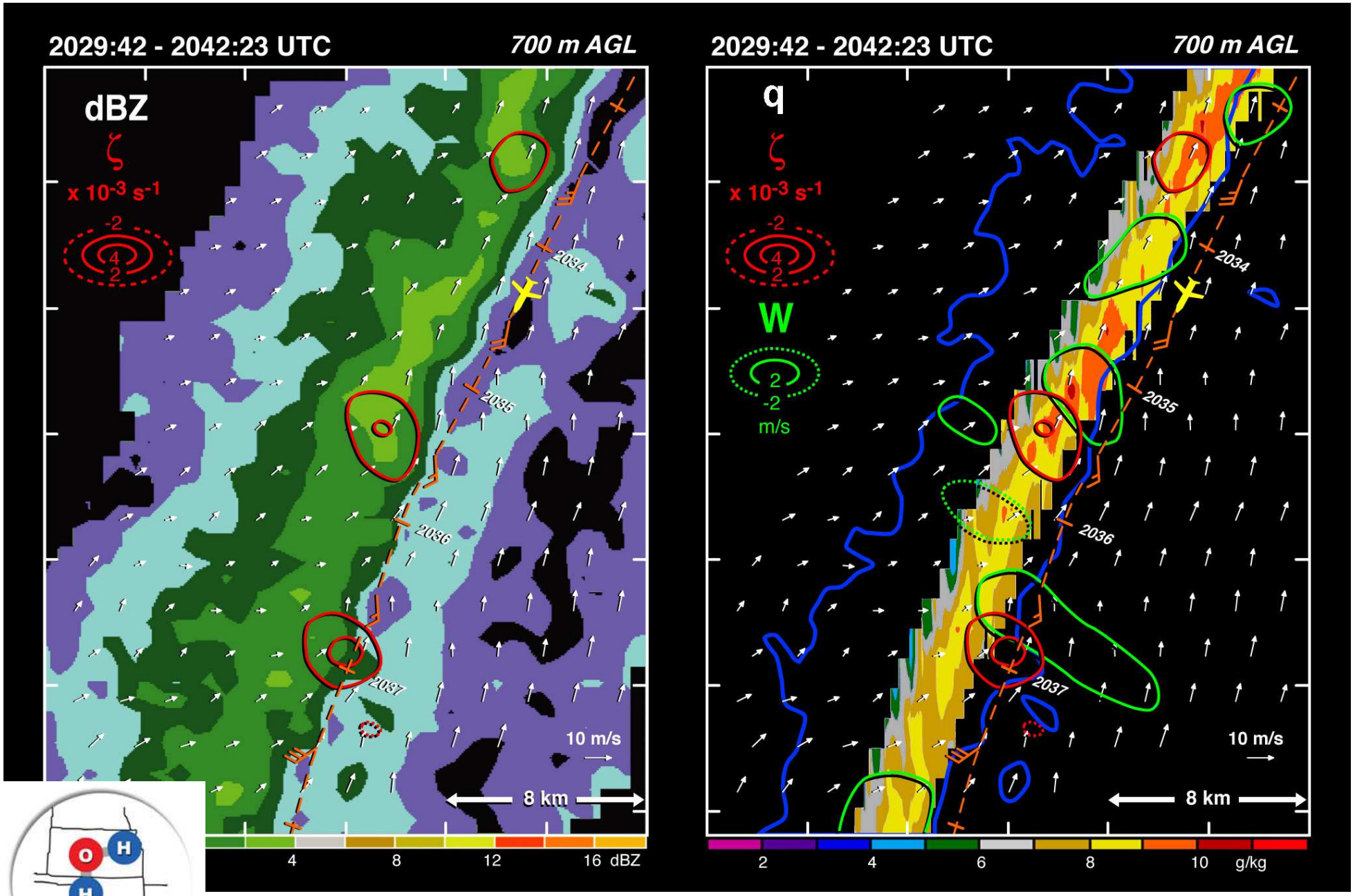






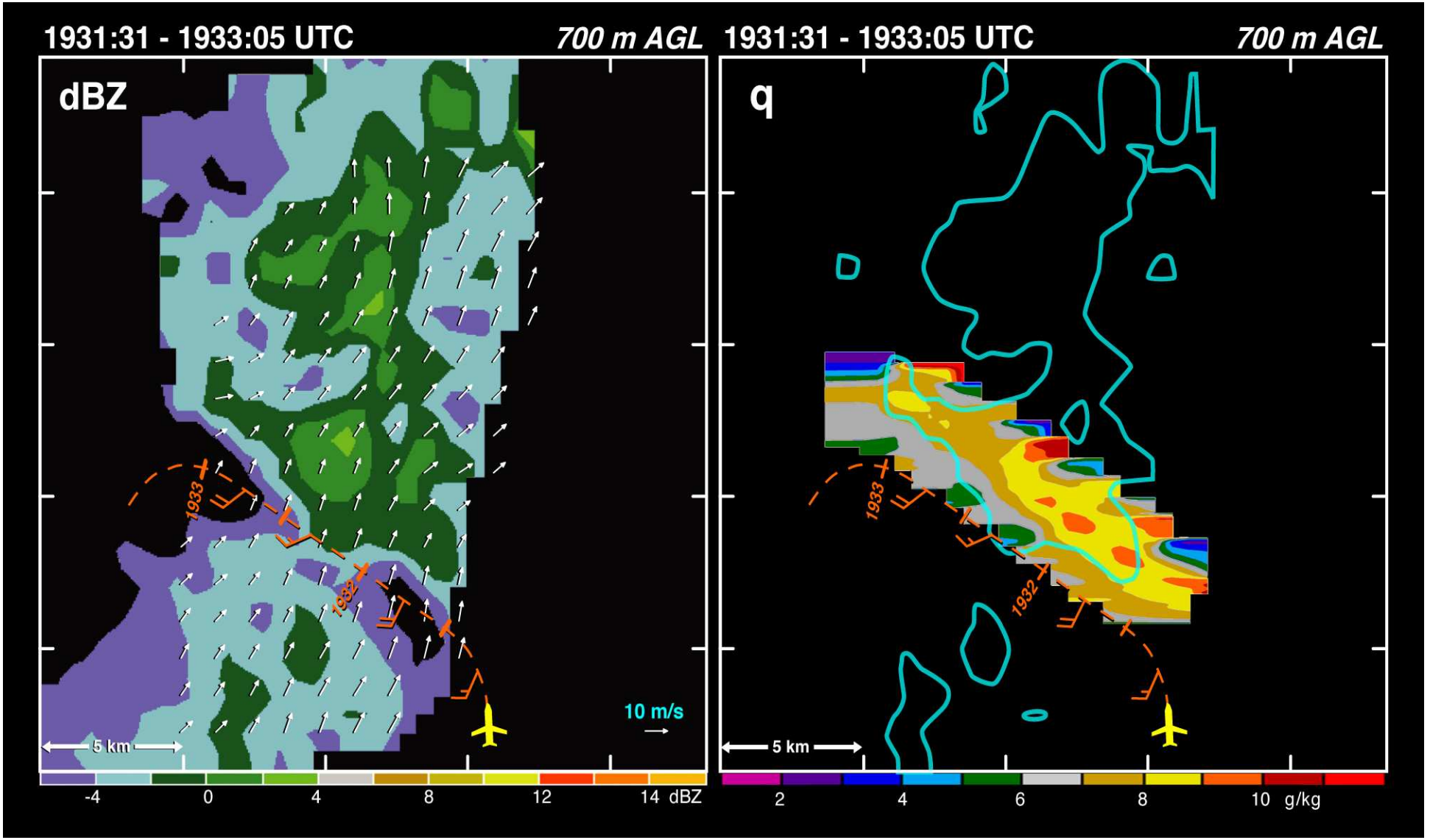
0555 UTC

International H_2O Project
IHOP_2002



International H_2O Project

IHOP_2002



International H_2O Project
IHOP_2002

ELDORA

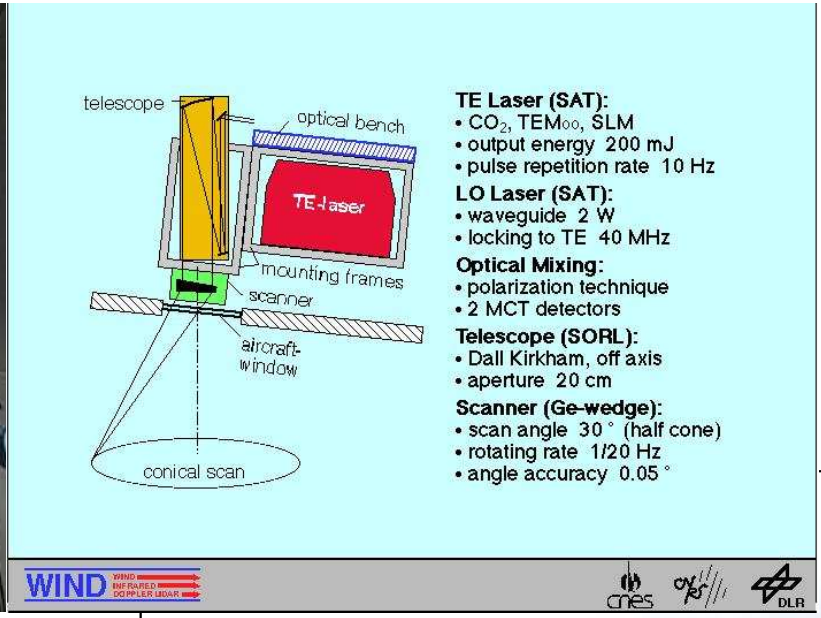
LEANDRE II

Airborne Doppler lidar WIND

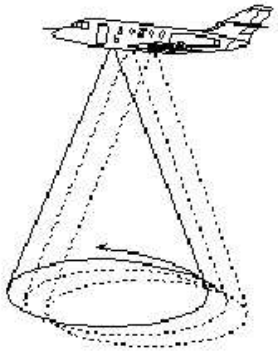
(DLR-CNRS-CNES collaboration)

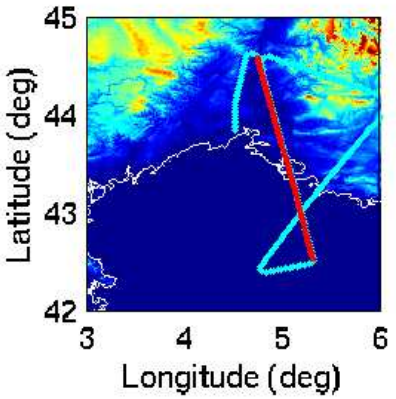
MAP'99, ESCOMPTE'01, VERTIKATOR'02, AMMA'06

The motivation of WIND is (i) to conduct basic research in meteorology and atmospheric dynamics, and (ii) to support preparatory activities for future space-based wind lidars.



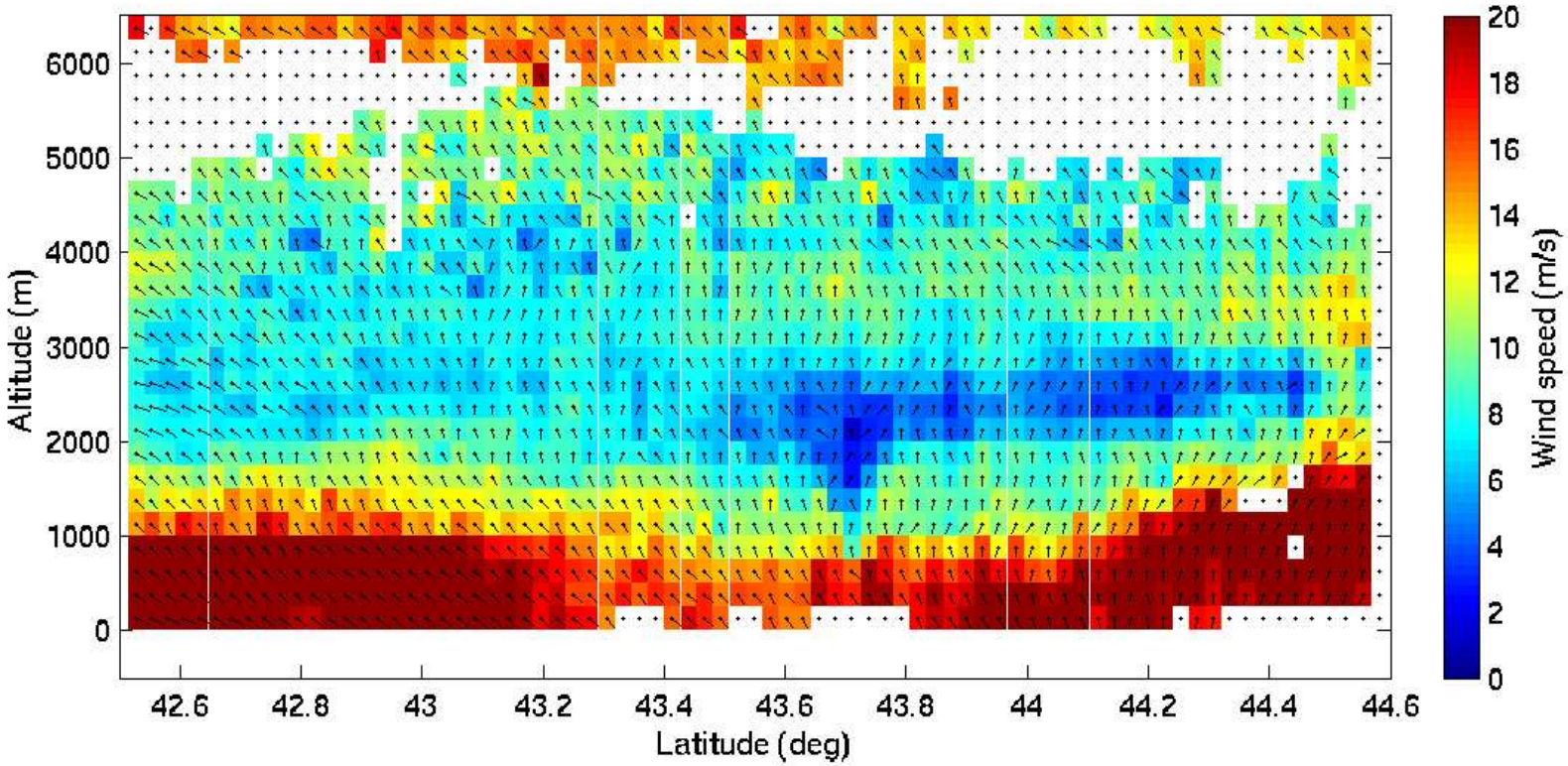
WIND:
Horizontal resolution: 4-10 km
Vertical resolution: 250 m
Precision: 1-3 m/s

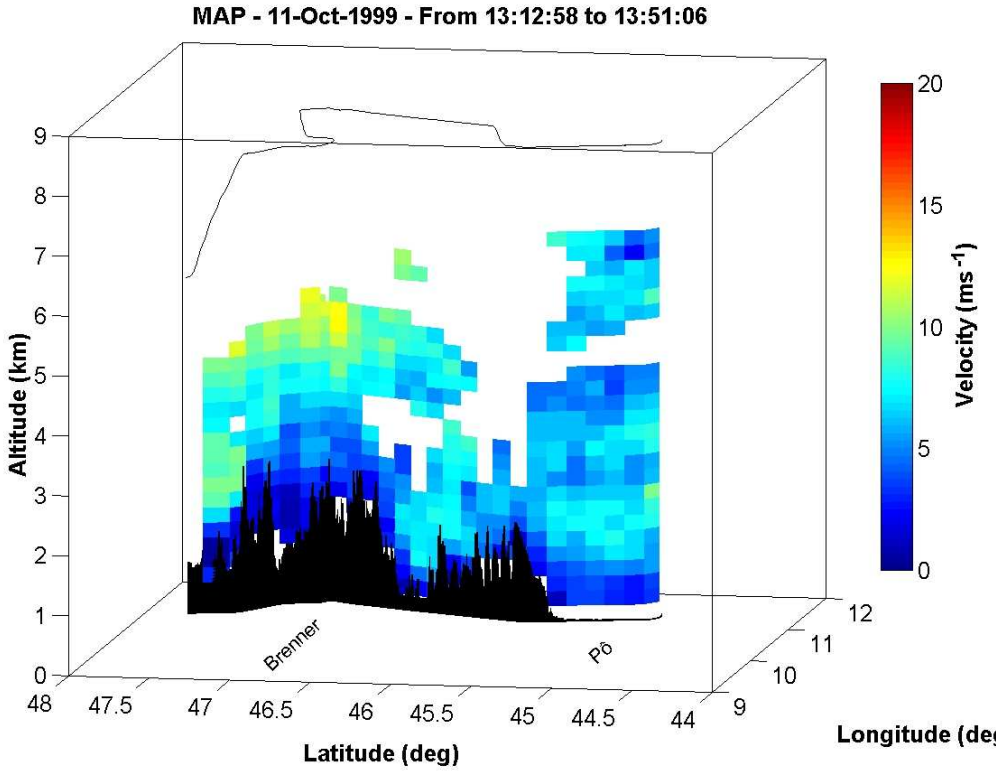




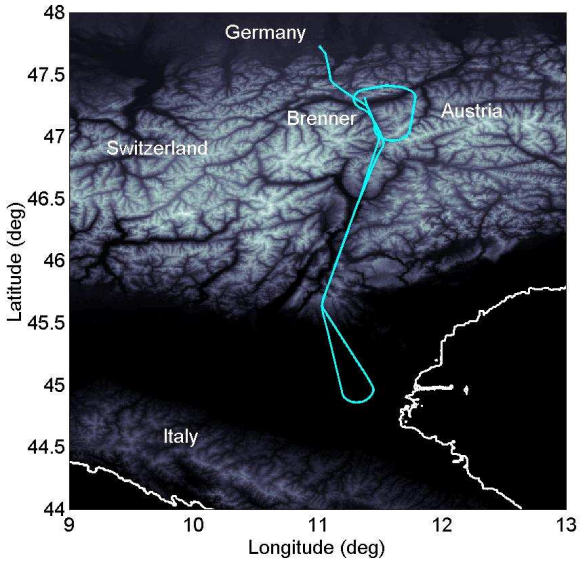
ESCOMPTE
28–Jun–2001 10:16:13 to 10:42:16

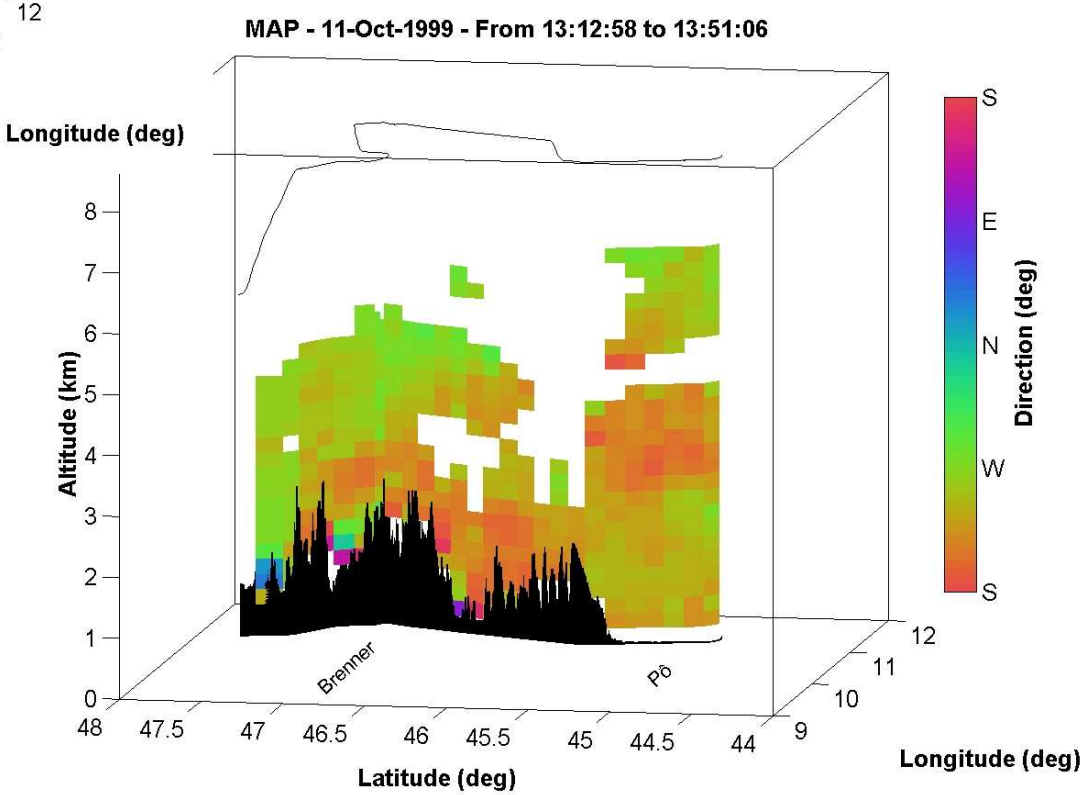
Mistral event in southern France





Wind measurements in the Wipp and Adige valleys during MAP

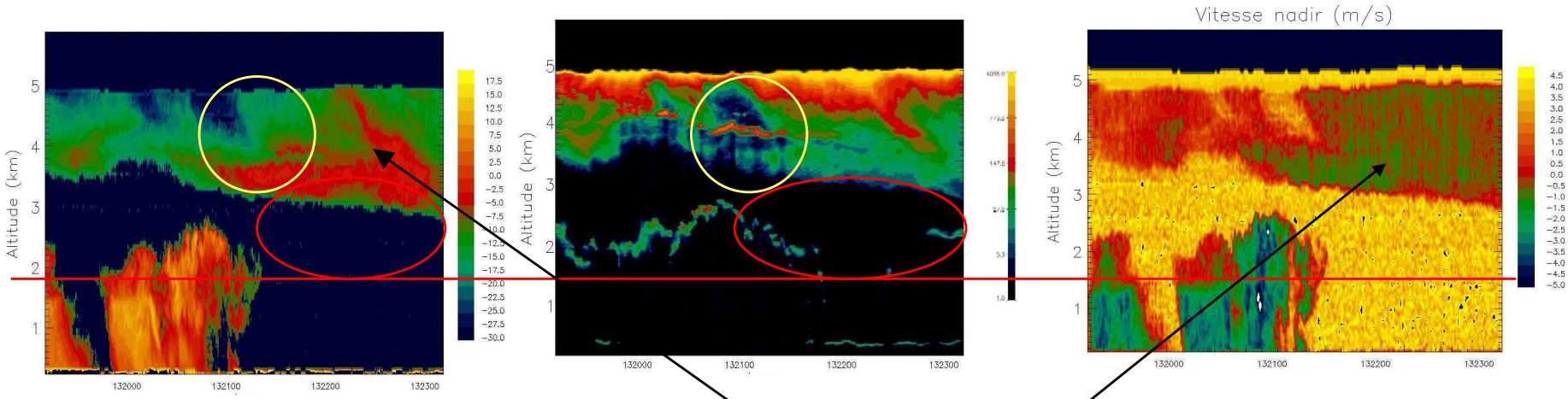




Airborne Radar/Lidar System RALI

AMMA'06

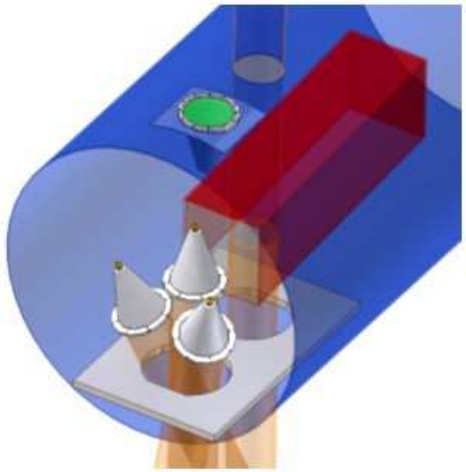
Microphysical, radiative, and dynamical properties of non and weakly precipitating clouds



Radar reflectivity

Lidar Backscattering

Radar vertical velocity



Large particles precipitating

Supercoooled water and clouds not detected by radar

Bright band altitude (precipitations)

In cloud parameters : IWC, De, Phase, Wd

Airborne chemistry equipement for AMMA SOP-2

- O_3 (Absorption UV)
- NO, NO_2, NOy, HNO_3, PAN (Chimiluminescence luminol)
- COV (C4-C10) onboard and post-flight (CPG – SM)
- CO (Absorption IR)
- JNO_2

ATR 42

- O_3 (Absorption UV)
- OH, HO_2 (**SAMU**)
- NO, NO_2, NOy, HNO_3, PAN (Chimiluminescence O_3 **MONA**)
- COV (C4-C10) onboard and post-flight (CPG – SM)
- COVO (carbonyls) onboard and post-flight (HPLC)
- CO (Absorption IR)
- H_2O_2 + ROOH (Fluorescence UV)
- JNO_2

Falcon 20

Transportable ground-based remote sensing equipement

Instrument	Range (V: vertical; S: scan)	Area of use	Instrument PI (Institute)
Doppler Infrared Lidar (10.6 mm) TWL	0.3 -10 km (S*)	Dynamics	P. Drobinski (SA/LMD)
5 GHz Doppler Radar RONSARD	0.5 – 100 km (S)	Precipitation	G. Scialom (CETP)
Raman Lidar (355 nm)	0.1 – 7 km (S*)	Water vapor	O. Bock (SA/IGN)
95 GHz doppler radar RASTA	0.1 – 15 km (V)	Clouds properties	A. Protat (CETP)