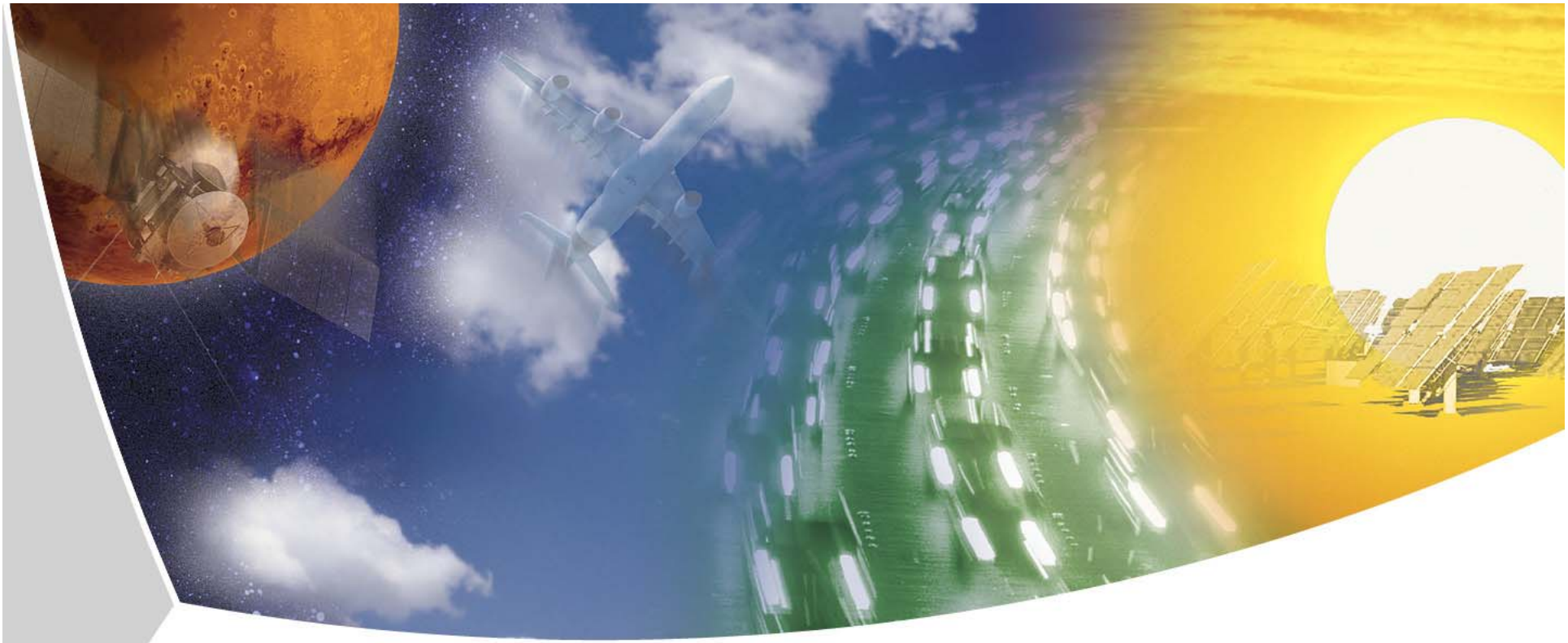

Falcon Instrumentation for COPS

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Institut für Physik der Atmosphäre

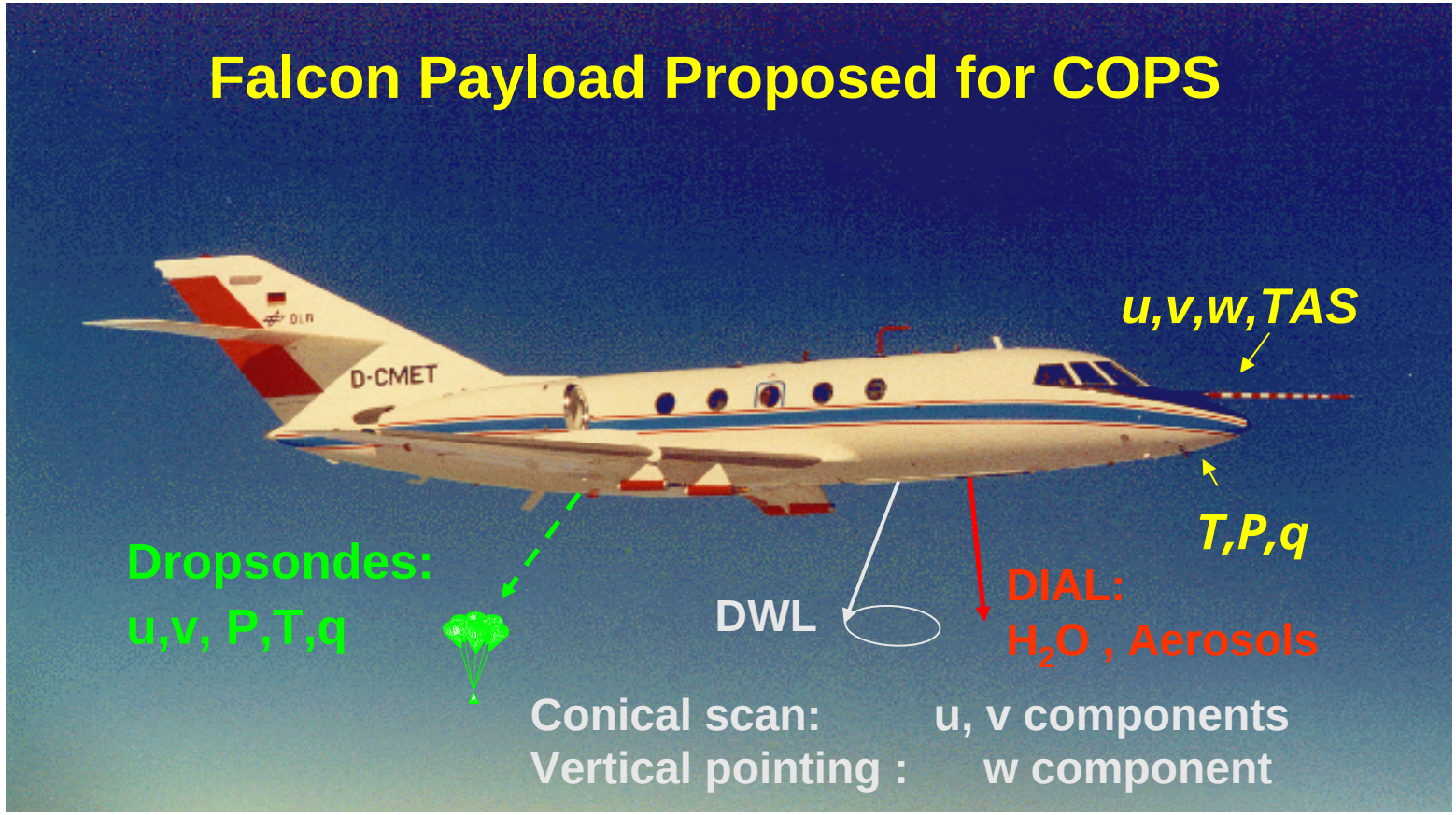
DLR Falcon Objectives for COPS

1. Investigate the connection between tropospheric wind and water vapour structures (PV and moisture streamers, dry layers) and the location and timing of convection and precipitation.

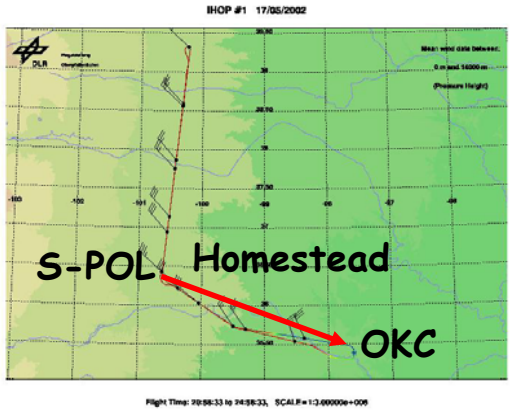
2. Characterise the initial and boundary conditions of convection with high resolution wind and water vapour fields. Investigate the spatial variability of humidity, wind and latent heat fluxes.

3. Perform targeted upstream measurements for the quantification of humidity advection to the COPS area and for near real-time assimilation of humidity into a NWP model.

Falcon Payload Proposed for COPS



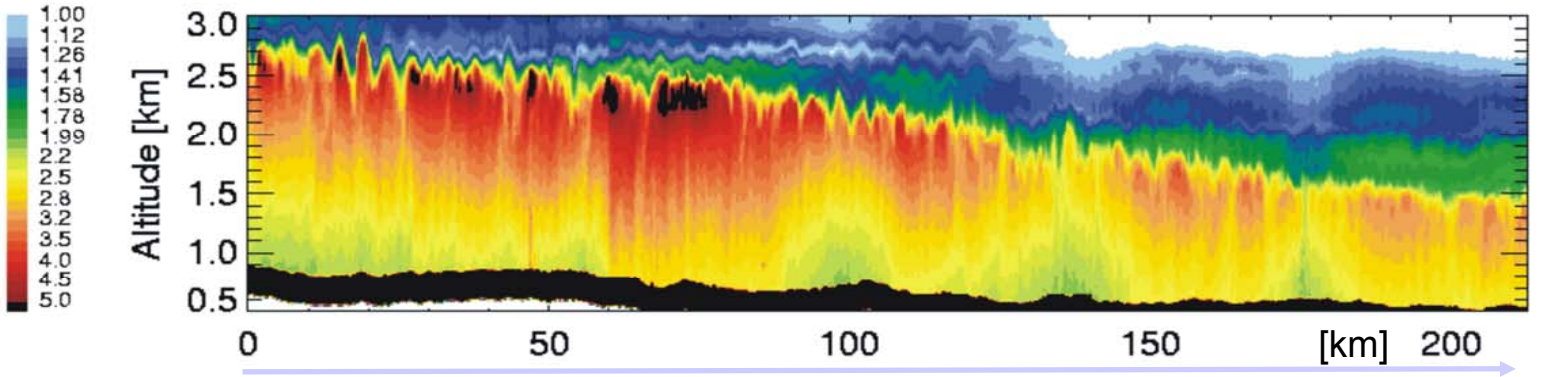
Flight Altitude [m]	3000	6000	9500	12500
max. Range [km]	2100	2800	3200	3700
max. Endurance	04:10	04:15	04:45	05:00



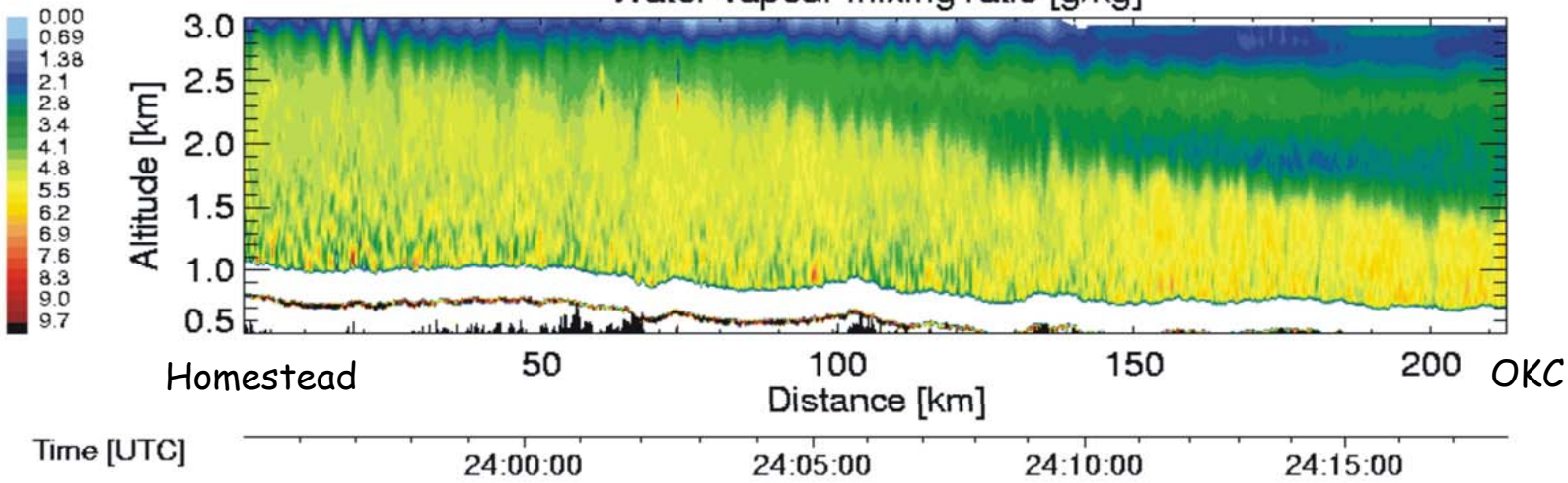
Boundary Layer Heterogeneity during IHOP

IHOP 17. May 2002 1. Flight (Part 3)

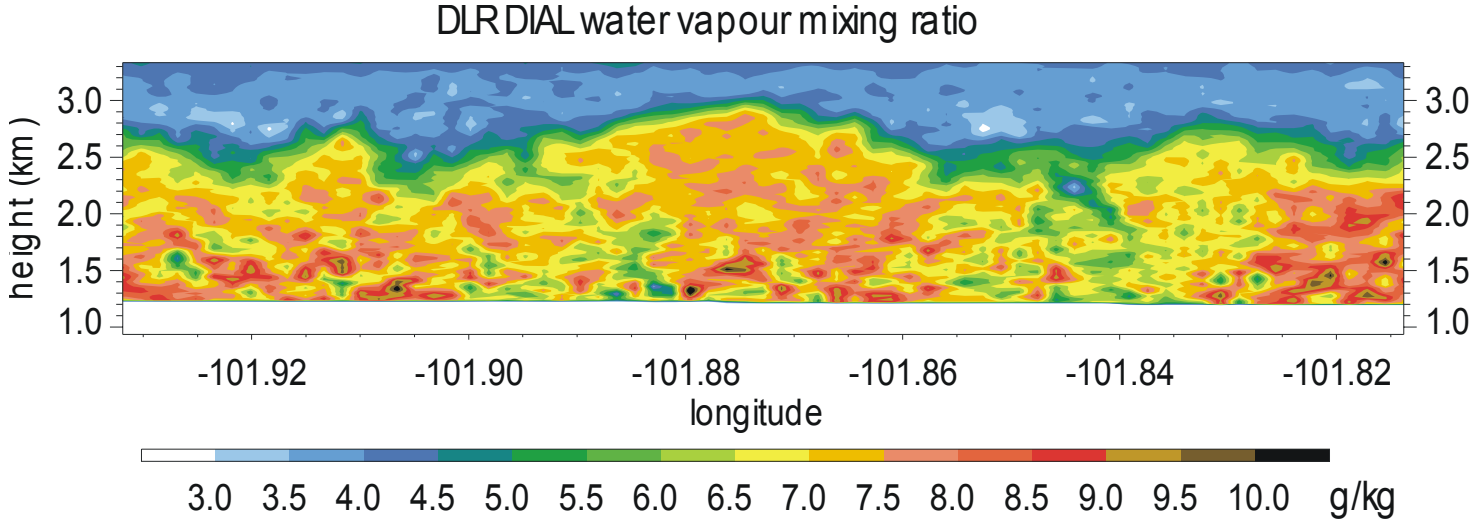
Backscatter Ratio at 925 nm



Water vapour mixing ratio [g/kg]



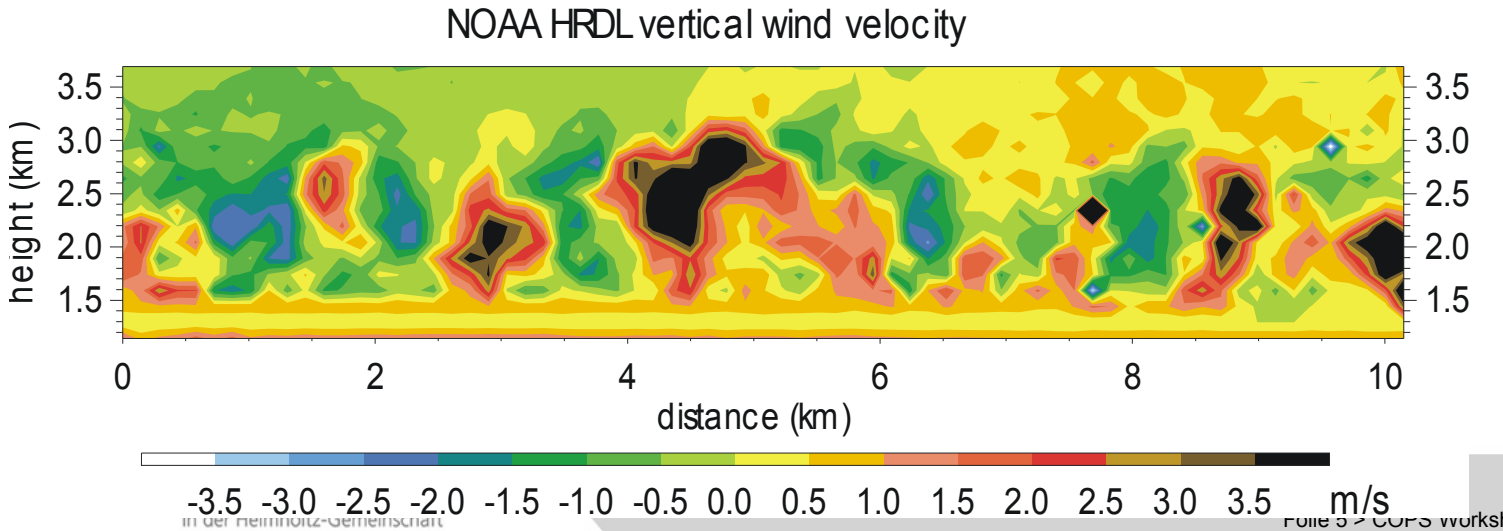
2-d Cross Sections of Water Vapour and Vertical Wind Component during IHOP



DLR-DIAL:

Δx = 150 m

Δz = 150 m

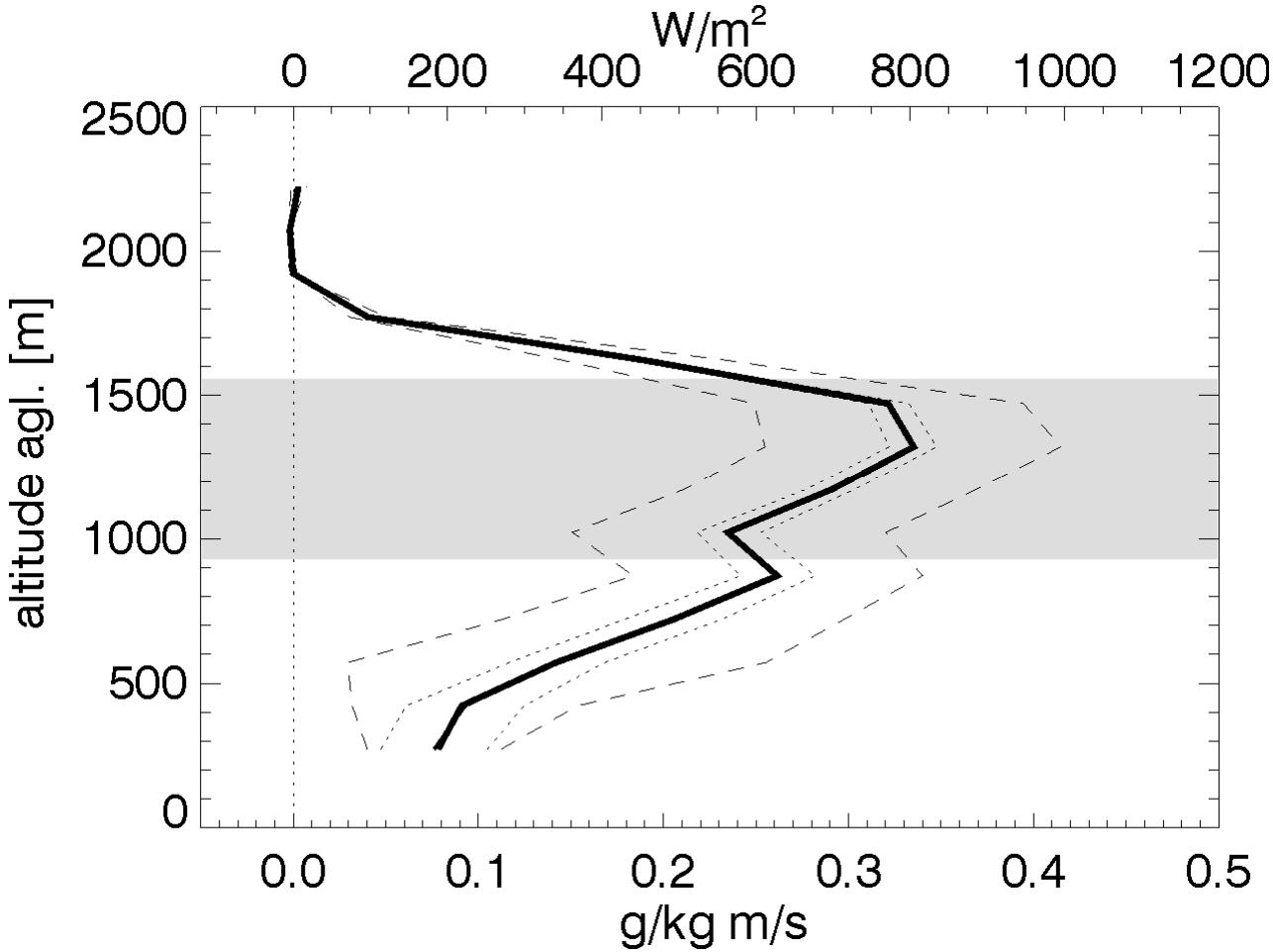


NOAA-HRDL:

Δx = 150 m

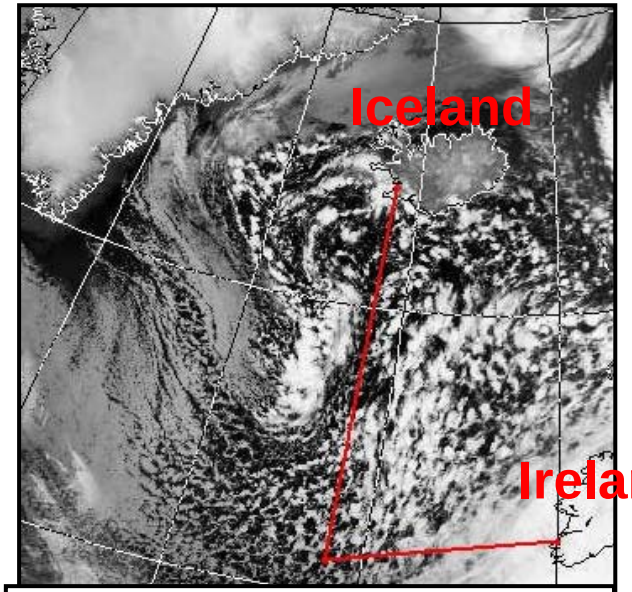
Δz = 150 m

Profile of Latent Heat Flux from Airborne Doppler Wind and Water Vapour Lidars during IHOP

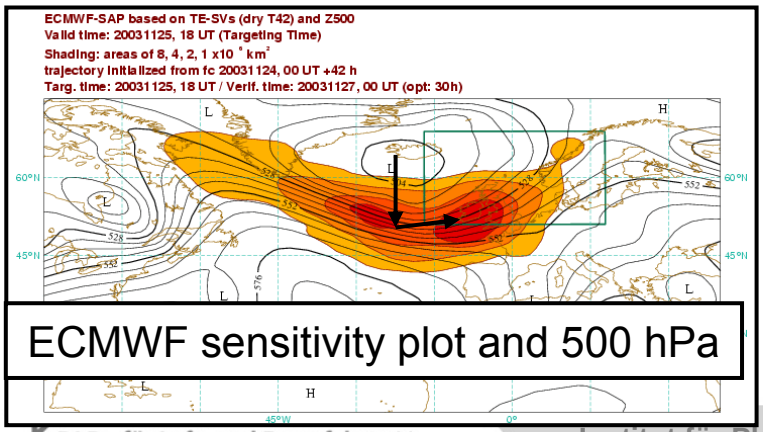


Kiemle, et al., 2006

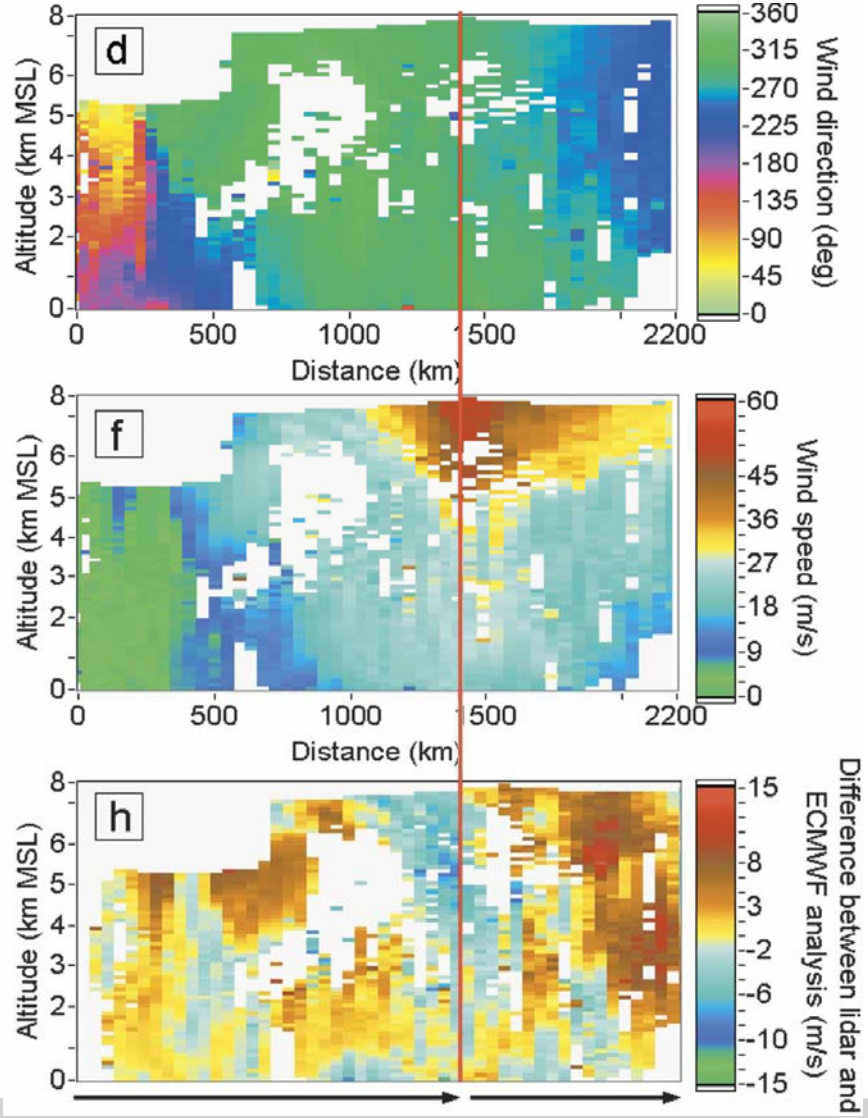
Airborne DWL- Measurements during Targeted Observations in the North Atlantic Region



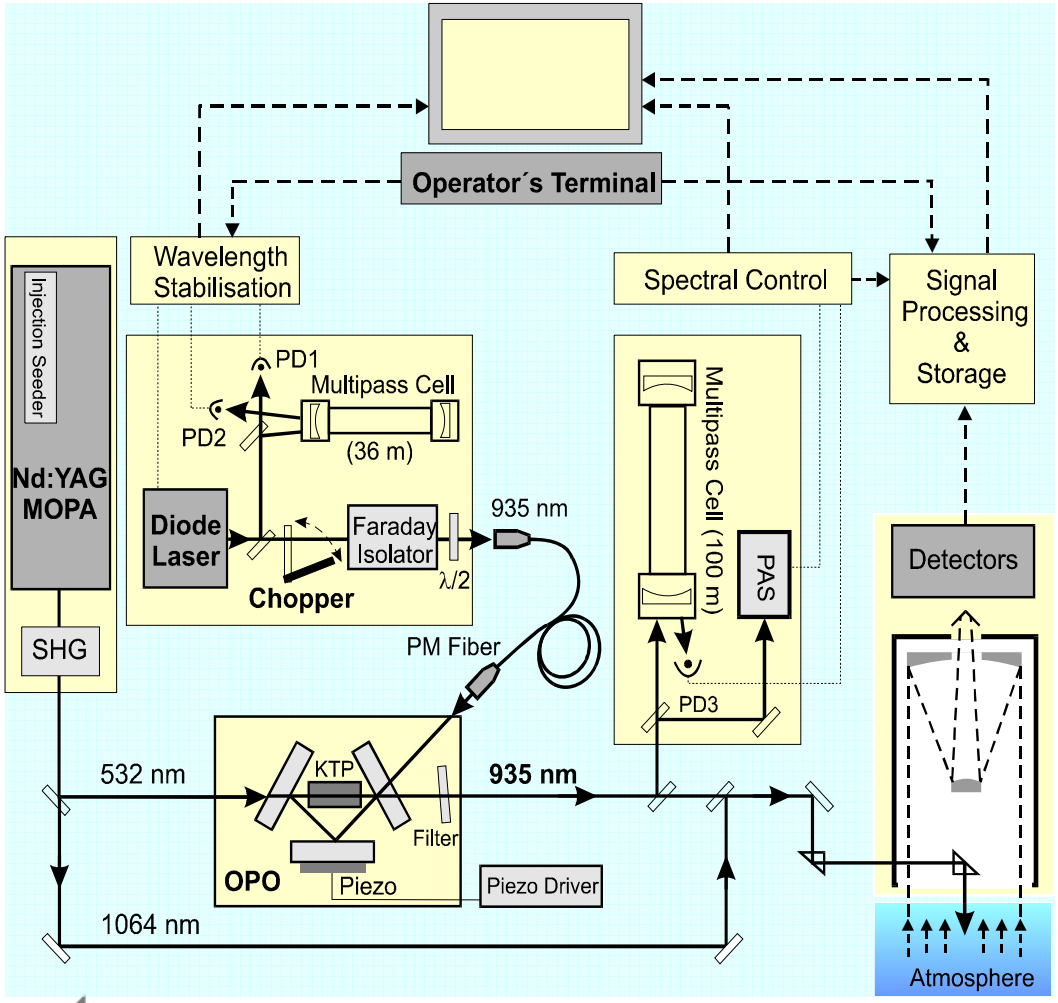
http://www.sat.dundee.ac.uk/

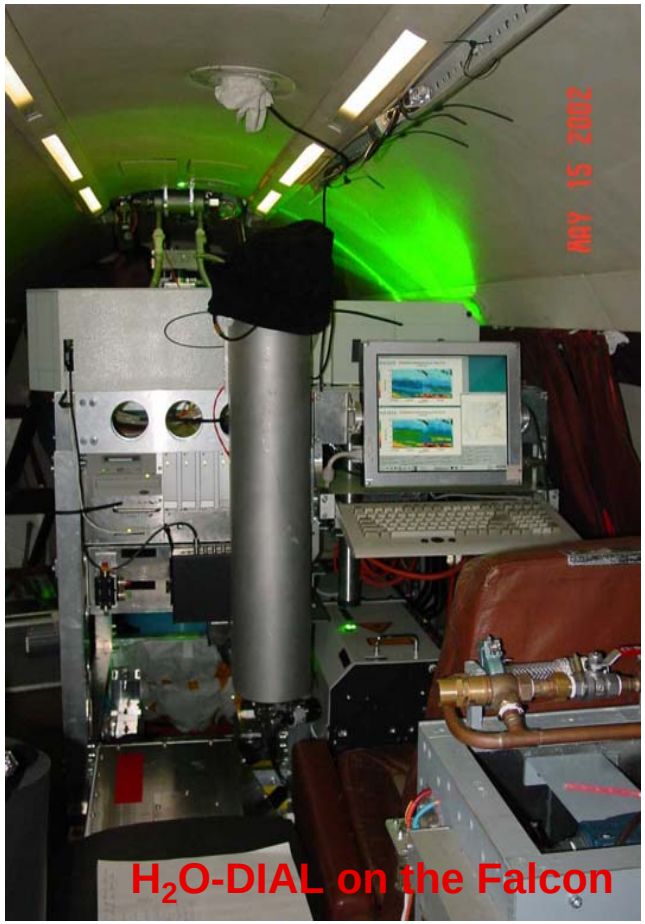


ECMWF sensitivity plot and 500 hPa



H_2O-DIAL: Experimental Setup on the Falcon

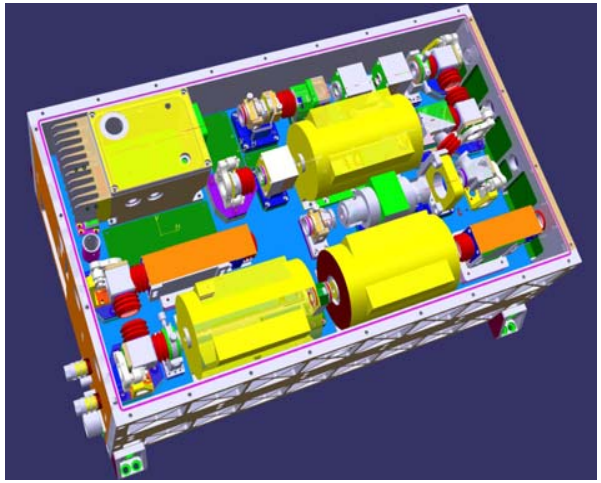


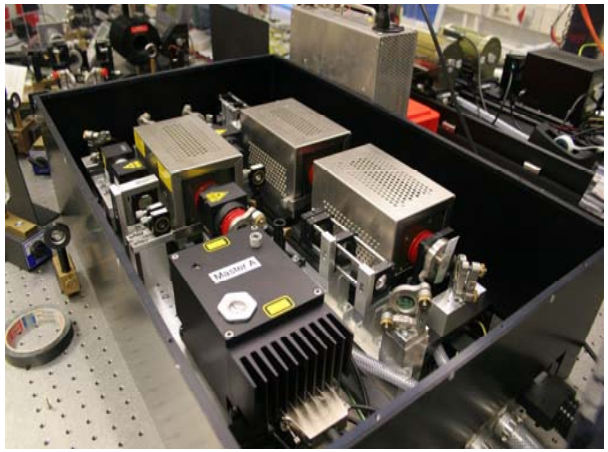


New Transmitter Concept for Improvement of DIAL-Performance and Instrument Robustness

Major Innovation

- New four-wavelength H_2O- DIAL operating at 935 nm for humidity profiling from ground up to the low stratosphere
- High wall-plug efficiency by use of an Optical Parametric Oscillator (OPO) for efficient generation of radiation in the 935 nm spectral region.
- High overall mechanical stiffness by implementation of short resonator concepts





Airborne Multi-Wavelength H_2O DIAL:

Transmitter Specifications

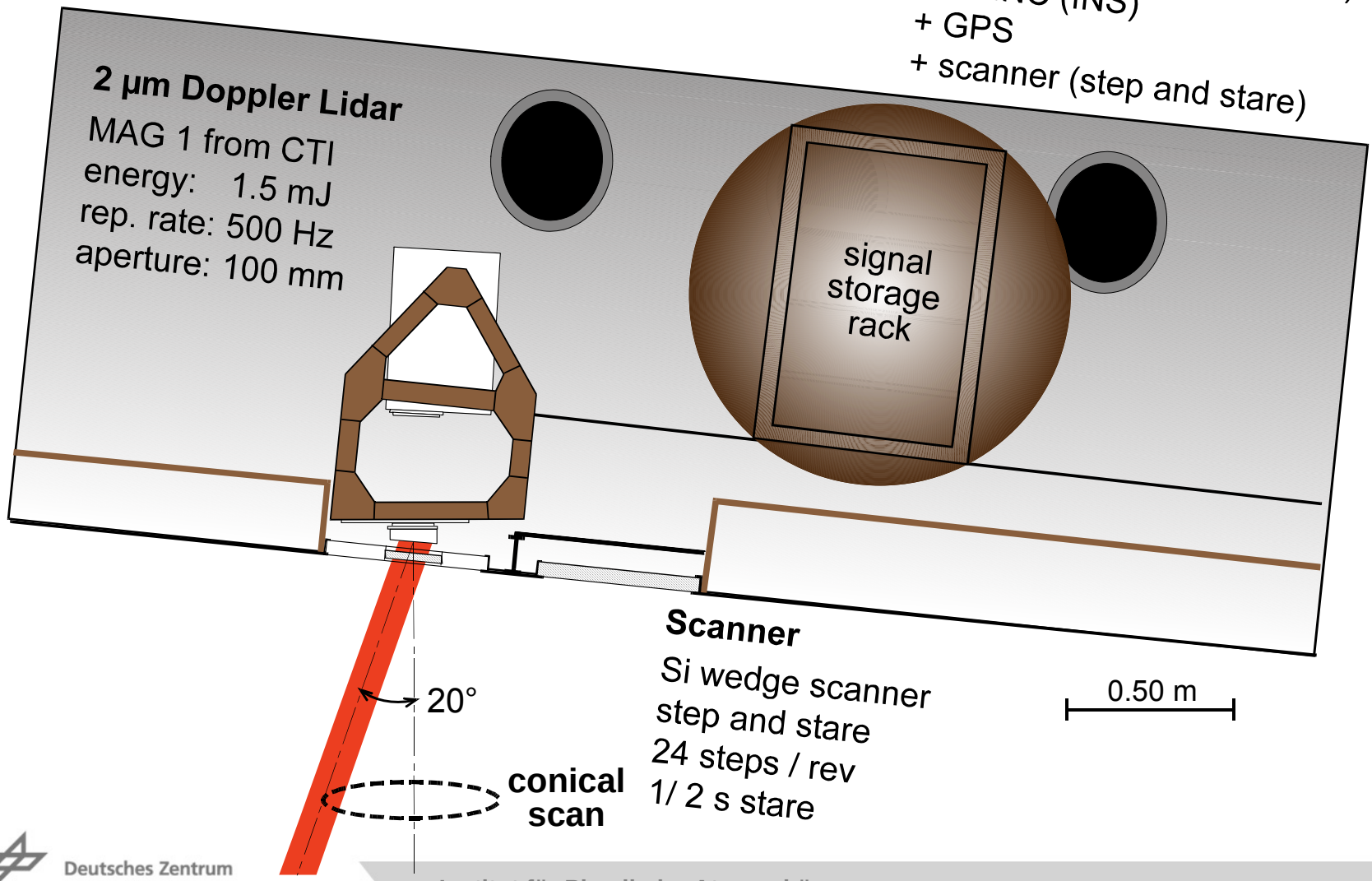
Improvement of power/volume ratio by a factor of six,

Improvement of electro-optical conversion efficiency by a factor of three

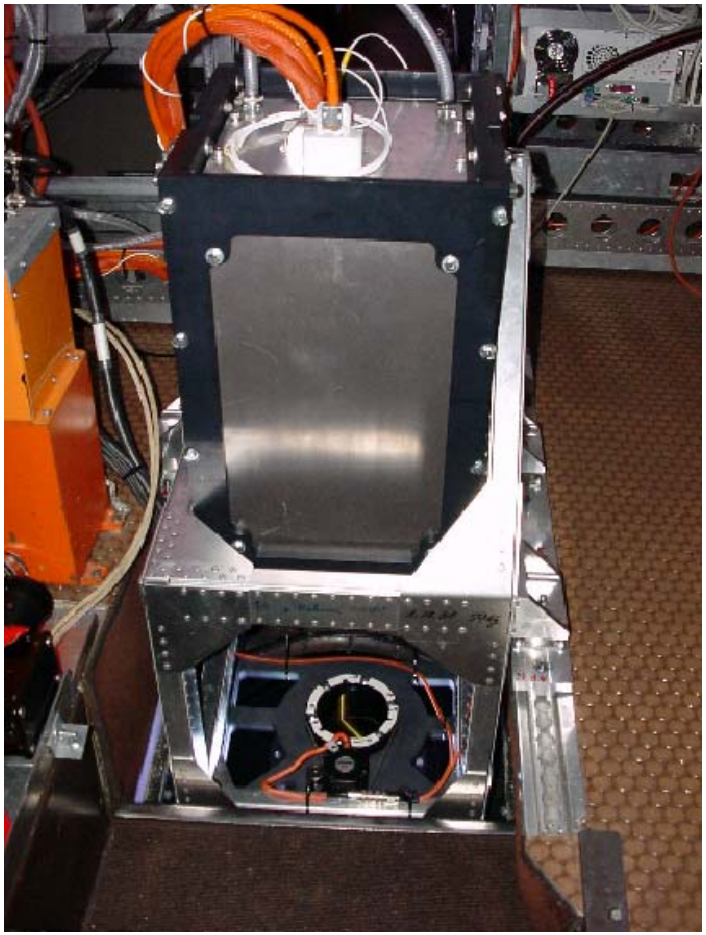
	Current system	New System
Output Power		
Laser Output @ 1064nm	220 mJ	380 mJ
Laser Output @ 532nm	110 mJ	185 mJ
OPO Output @ 935nm	13 mJ	38 mJ
Repetition rate (on-/off-line)	50 Hz	50 Hz
Number of wavelengths	2	4
Spatial Beam Quality		
OPO Beam Diameter (2nd M)	6 mm	4,5 mm
OPO Beam Divergence	~ 2.5 mrad	2.0 mrad
Beam Quality M^2	n.a.	7.6
Boresight Stability	n.a.	TBD
Spectral Beam Quality		
Pulse Linewidth	200 MHz	TBD
Frequency Stability	60 MHz	TBD
Spectral Purity	99.6 %	> 99.9 %

Airborne Doppler Wind Lidar

Signal Storage (DLR)
single shots,
early digitizing (1 GByte/min)
+ ARINC (INS)
+ GPS
+ scanner (step and stare)

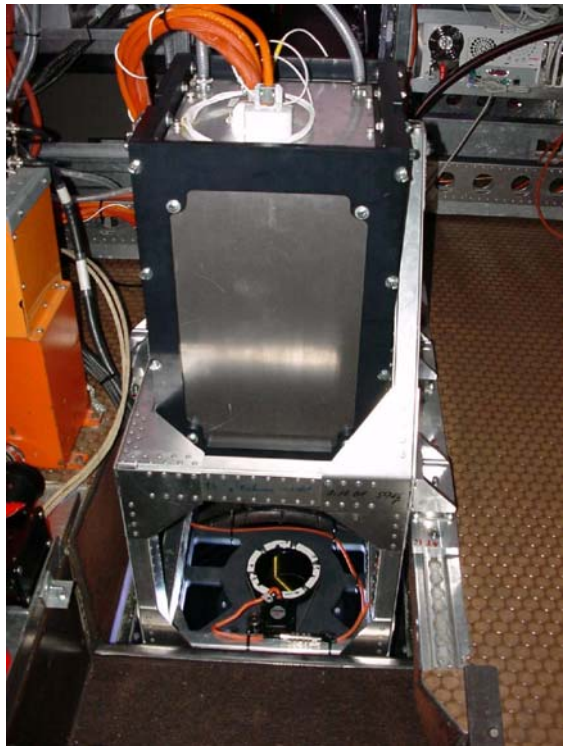


2 μm Doppler Wind Lidar on the Falcon

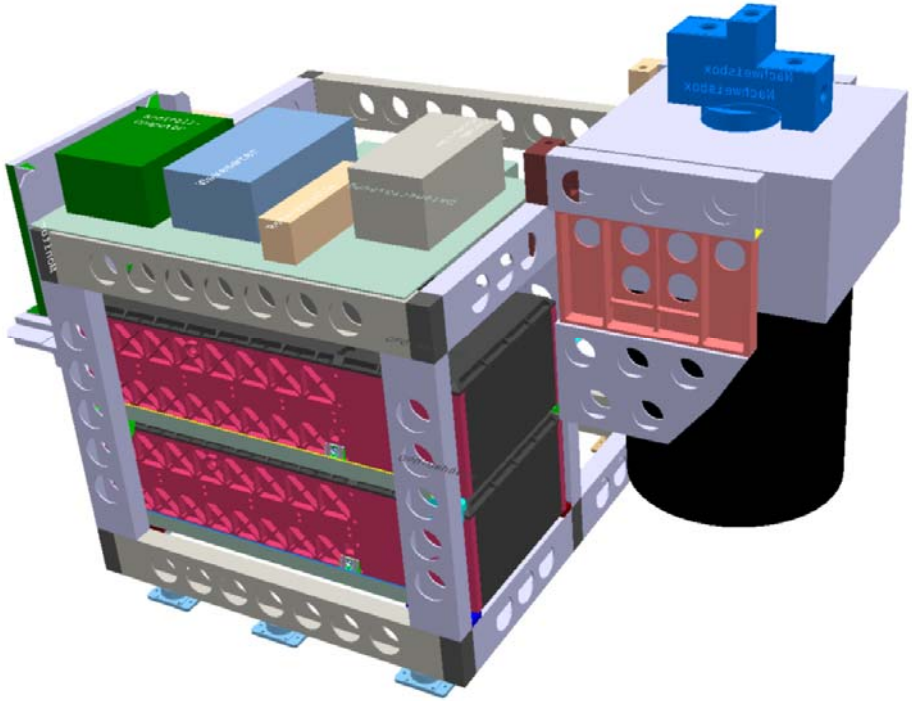


Quicklook on board of the Falcon aircraft

Common Integration of Multi-Wavelength H_2O DIAL and 2µm DWL System on the Falcon Aircraft

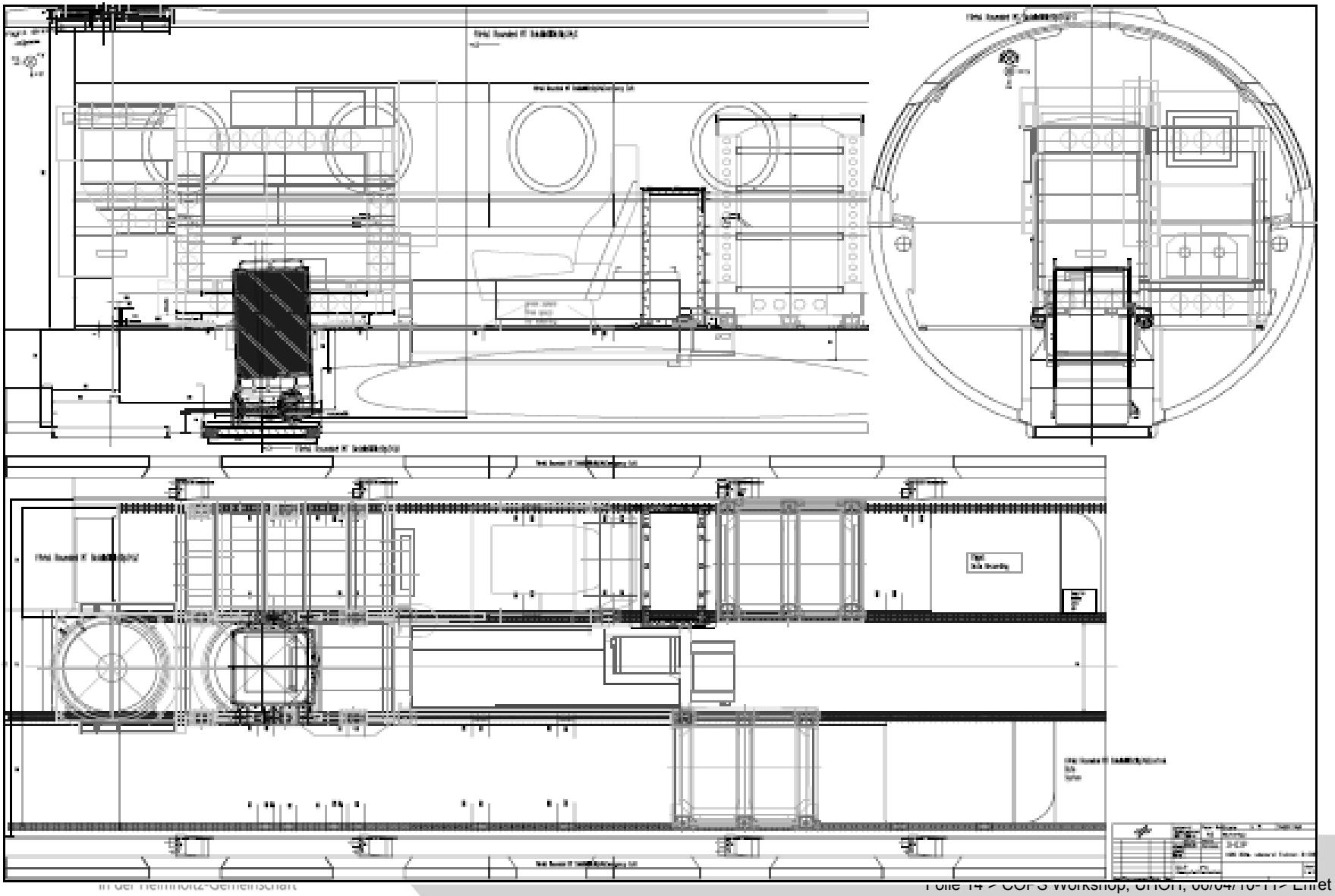


2µm-DWL



Multi-wavelength H_2O-DIAL

Installation Plan for the Falcon Aircraft



Schedule, Milestones

June 2006: laser sub-systems of 4λ-DIAL tested

October 2006: ground-based tests of 4λ-DIAL

November 2006: airworthiness of 4λ-DIAL on Falcon completed

November 2006: first airborne test of 4λ-DIAL

May 2007: first airborne campaign with 4λ-DIAL

May 2007: airworthiness of Falcon payload for COPS completed

June 2007: Falcon integration of 4λ-DIAL and 2µm DWL for COPS