

HO_x Radical Measurements in the Lower Troposphere Using an Airborne Laser-Induced Fluorescence Instrument on a Zeppelin NT

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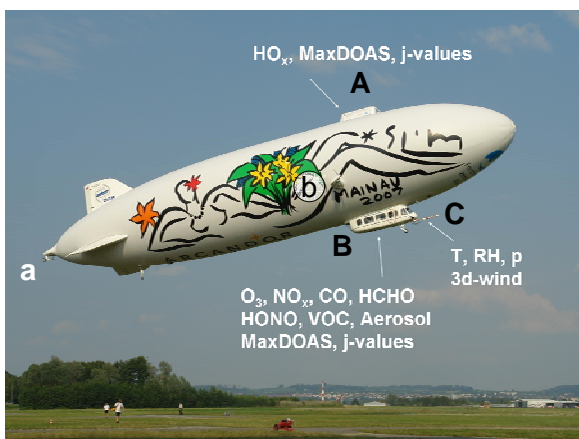
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Zeppelin NT for Atmospheric Research

Instrumentation

Parameter	Technique	Group*
OH, HO ₂	Laser-induced fluorescence	FZJ
O ₃	UV photometry	FZJ
CO	UV fluorescence	FZJ
NO, NO ₂	Chemiluminescence	FZJ
NO ₂ columns	MaxDOAS	IUP-H
HONO	LOPAP	FZJ
HCHO	Hantzsch fluorimetry	FZJ
VOCs	Online GC & Canisters	FZJ, BUW
Aerosol	SMPS, CPC	FZJ
j-values	Actinic spectroradiometry	FZJ
H ₂ O, T	Humicap sensor	FZJ
Wind, pressure	Turbulence probe	ZLT
Altitude	Radar altimeter	ZLT
Position	GPS	FZJ

* FZJ Forschungszentrum Jülich, IUP Umweltphysik Univ. Heidelberg, BUW Bergische Univ. Wuppertal, ZLT Zeppelin Luftschifftechnik



Technical Data

Length	75 m
Diameter	~ 19 m
Scientific payload *	~ 1000 kg
Flight speed	0 - 115 km/h
Operating altitude	20 - 3000 m
Horizontal reach	up to 1100 km
Max. endurance	20 hrs
Mission power	8.4 kW, 28VDC

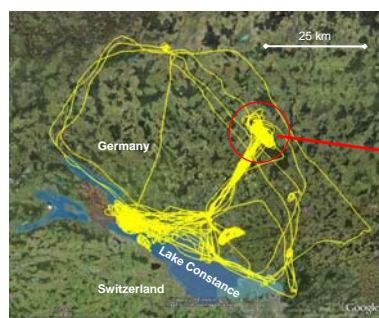
* Instruments + operators



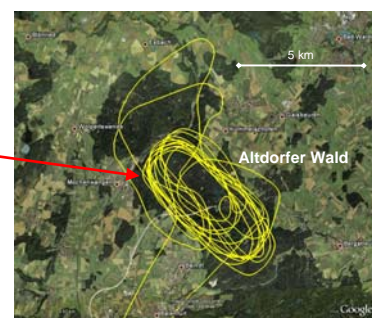
Zeppelin during takeoff, driven by one rear (a) and two lateral (b) propulsion engines. The rigid-frame airship is equipped with a top platform (A) carrying the complete laser-induced fluorescence instrument for HO_x measurement, a gondola with 10 m² of available space (B) and a meteorological boom (C). Instruments are rack mounted (D).

ZEPTER 2008 Field Campaign

- Investigation of the HO_x chemistry in the lower troposphere up to 1000 m height above different land surfaces at Lake Constance in Southern Germany, Oct. / Nov. 2008.
- Application of a modified Zeppelin NT as an airborne research platform for atmospheric measurements and a mobile van for groundbased measurement of trace gases.
- Vertical profiles of free radicals (HO_x) and trace gases were measured with high spatial resolution (~ 20 m) in and above the atmospheric boundary layer (ABL).
- A clear distinction between ABL and the free troposphere was observed in terms of temperature and chemical composition.



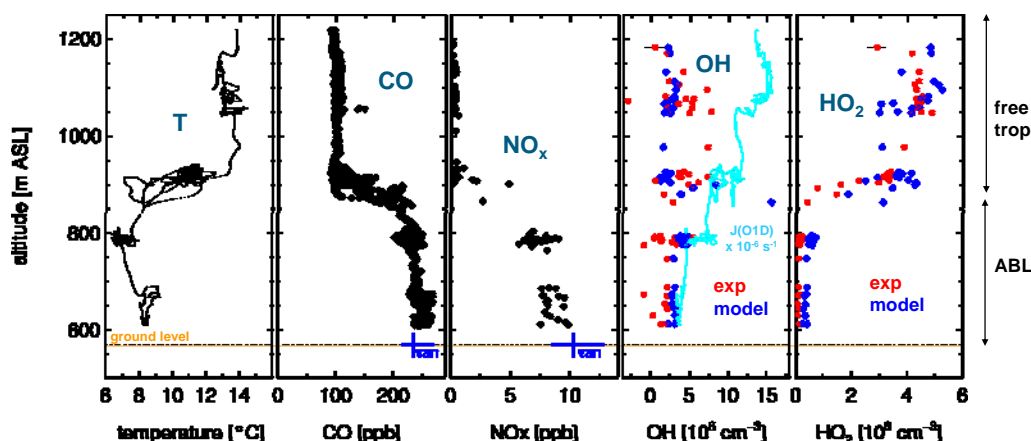
Flight tracks (yellow) of 25 flights from 17 Oct to 8 Nov at Lake Constance (395 m asl).



Flight track (yellow) of flight No 10 on 26 Oct above Altdorfer Wald (forest, 570 m asl).

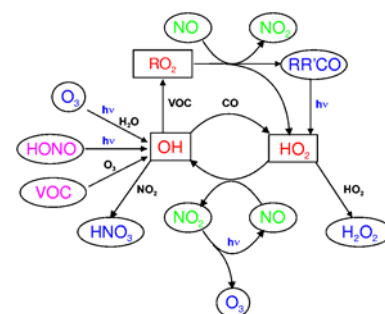
Flight No 10 - Altdorfer Wald on 26 October 2008

All data are preliminary !



Example: Vertical profiles of radicals and trace gases measured on 26 Oct during the airship descent from 13:52 to 15:15 local time above Altdorfer Wald. Ground level is at 570 m (asl). The blue crosses (CO, NO_x) represent groundbased measurements below the Zeppelin (vertical bar: median value, horizontal bar: total range). All data are preliminary. HCHO was between 0.5 ppb (free trop.) and 1.5 ppb (ABL), and the total OH reactivity between 4 s⁻¹ (free trop.) and 10 s⁻¹ (ABL).

Photochemistry



Simplified scheme of tropospheric photochemistry.

HO_x concentrations were modelled using the RACM2 (Stockwell et al., JGR 1997) with modified isoprene mechanism (Karl et al, JAC 2006). Measured trace gases and photolysis frequencies were used as model input.

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