

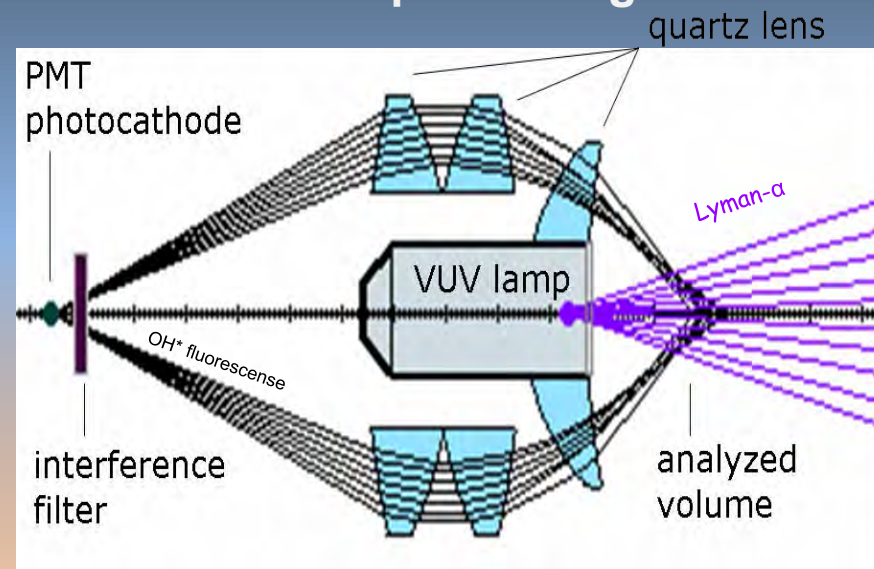
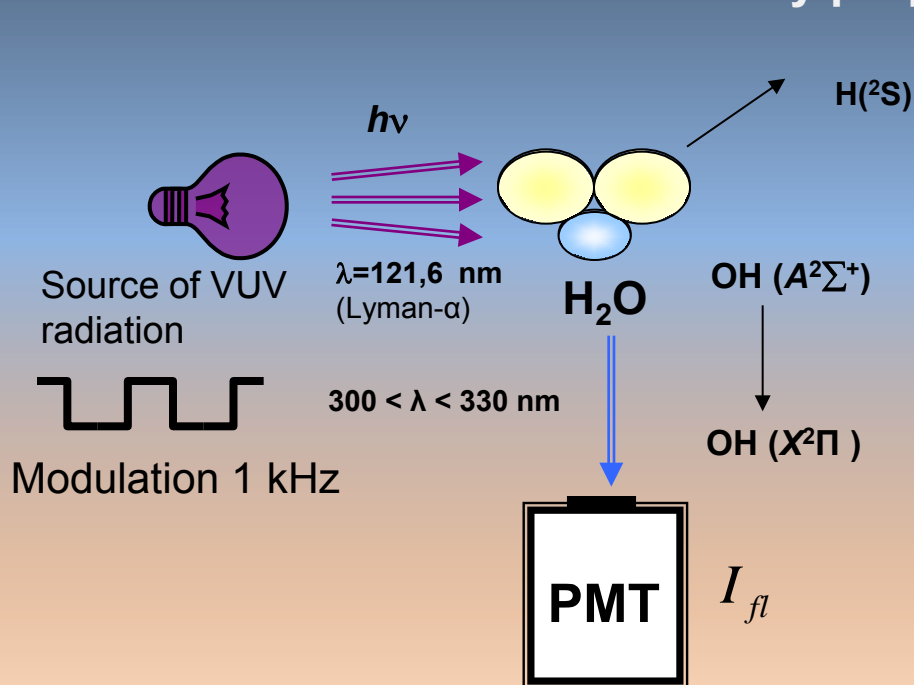
FLUORESCENCE LYMAN-ALPHA STRATOSPHERIC HYGROMETER (FLASH): APPLICATION ON METEOROLOGICAL BALLOONS, LONG DURATION BALLOONS AND AIRCRAFT

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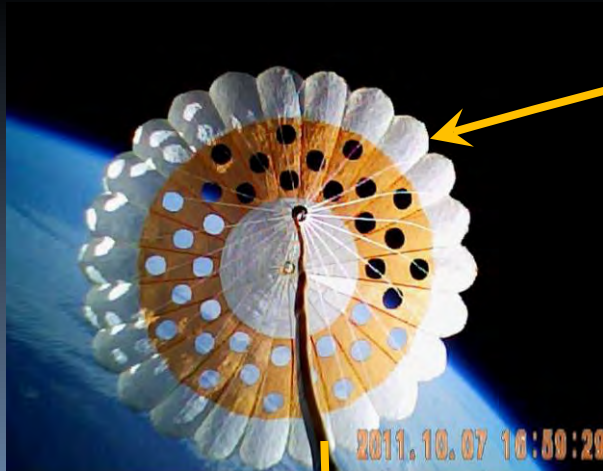
Fluorescent method of measure

Stratospheric hygrometer *FLASH* (FLuorescent Airborne Stratospheric Hygrometer) uses a fluorescent technique based on the reaction of water molecule dissociation when exposed to radiation of wavelength $\lambda = 121.6$ nm (L_{α} is hydrogen emission) with the formation of excited OH radicals and subsequent reemission in a wavelength range between 306 and 325 nm. For measurements in the upper troposphere and lower stratosphere the intensity of fluorescent emission is directly proportional to water vapor mixing ratio.



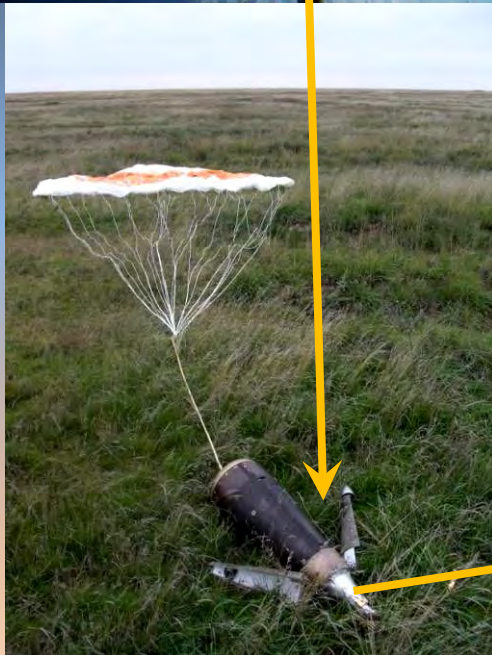
Optical layout of the fluorescent hygrometer
(FLASH) for balloon

Rocket application of FLASH:



In 1970 – 80 was flying to the 60-80 km by rockets. Descent by parachute from the top of trajectory. The weight of FLASH was 5 kg. Sealed housing special designed for rocket application.

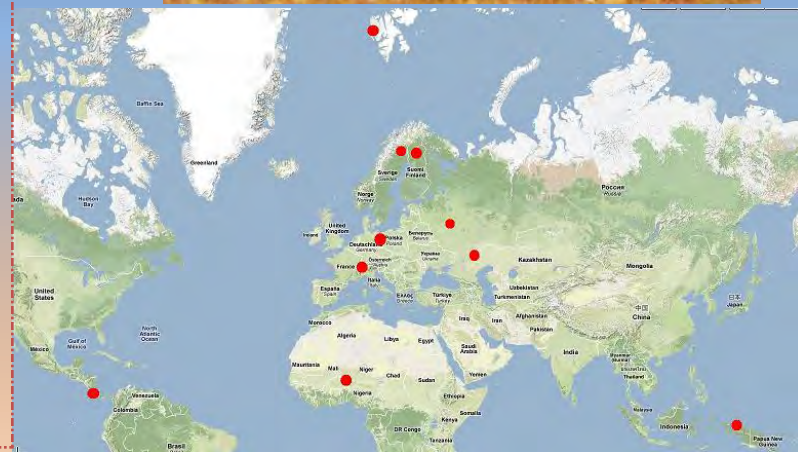
Last campaign Hygrosonde-2 on 16/12/2001 (Khaplanov M.)



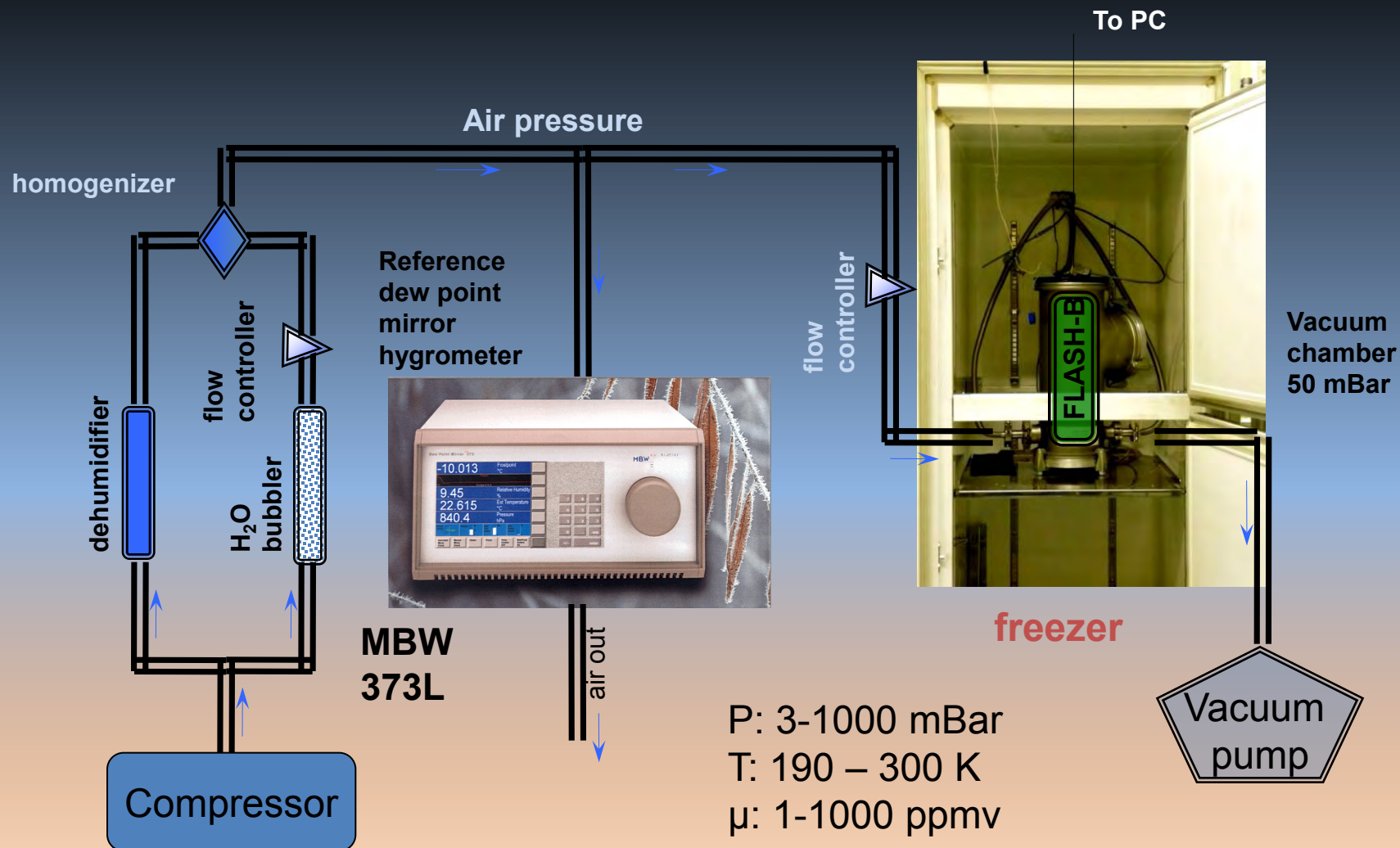
Meteo balloon application of FLASH-B:



Measurement range	<i>0.5...1000 ppmv</i>
Detection limit	<i>0.1 ppmv</i>
Measurement cycle length	<i>1 sec</i>
Integration time	<i>1 - 4 sec</i>
Vertical resolution	<i>~ 50 m (descent in UTLS)</i>
Total uncertainty	<i><10 % (1σ)</i>
Power consumption	<i>0.5 – 1 W</i>
Height range	<i>350... 5 mBar</i>
Weight	<i>0.5 kg</i>

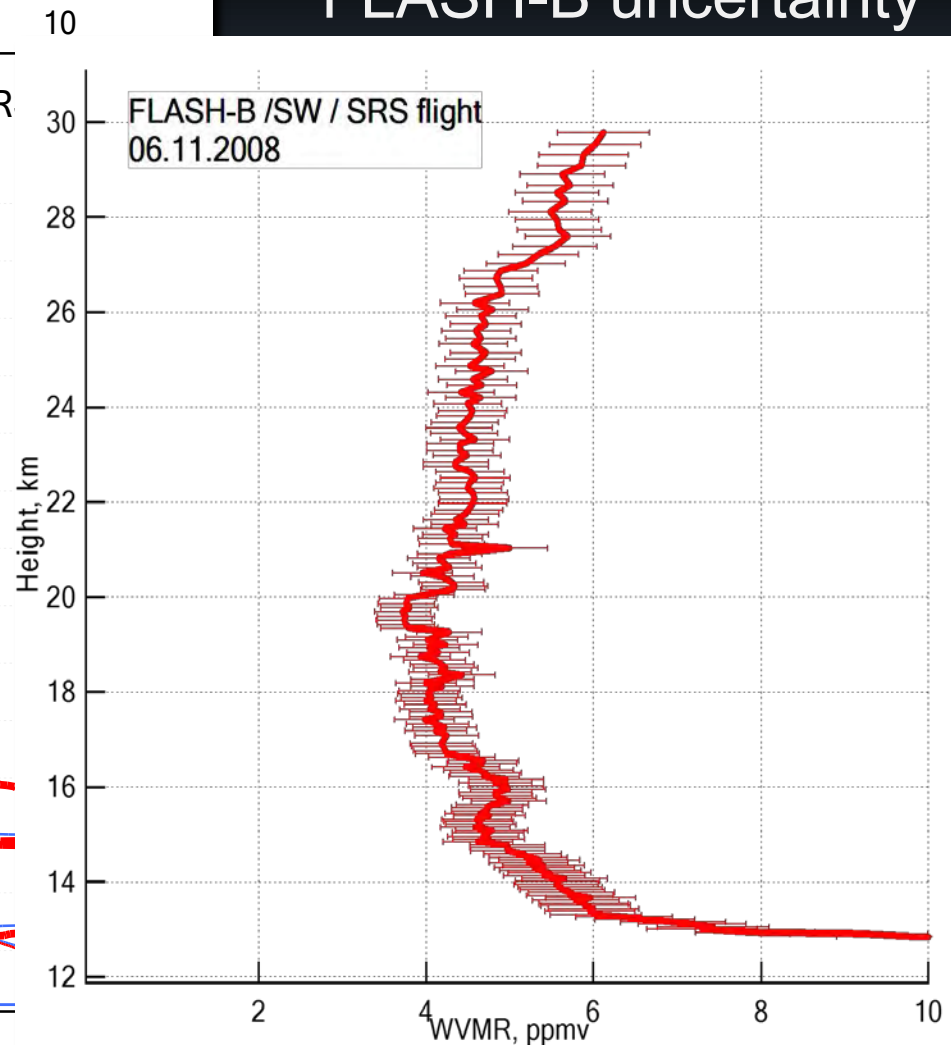
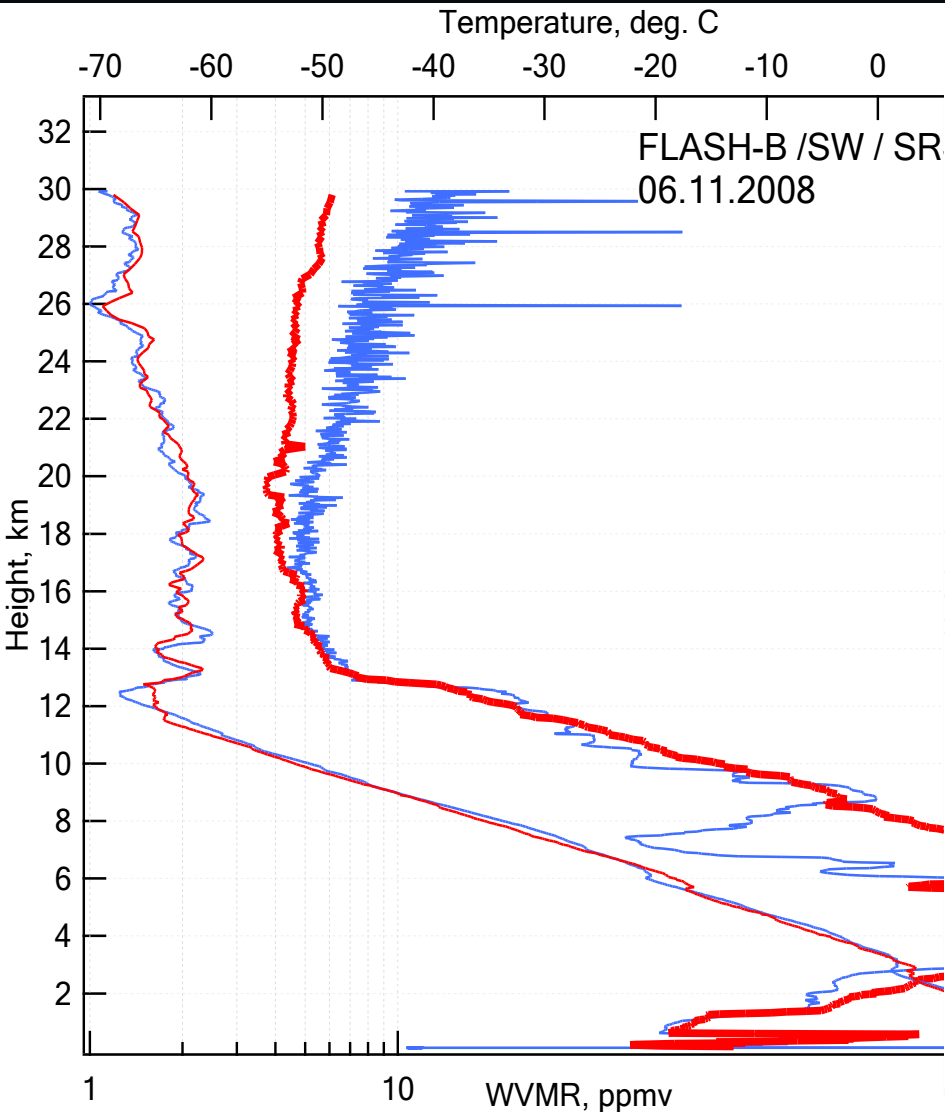


Calibration facility

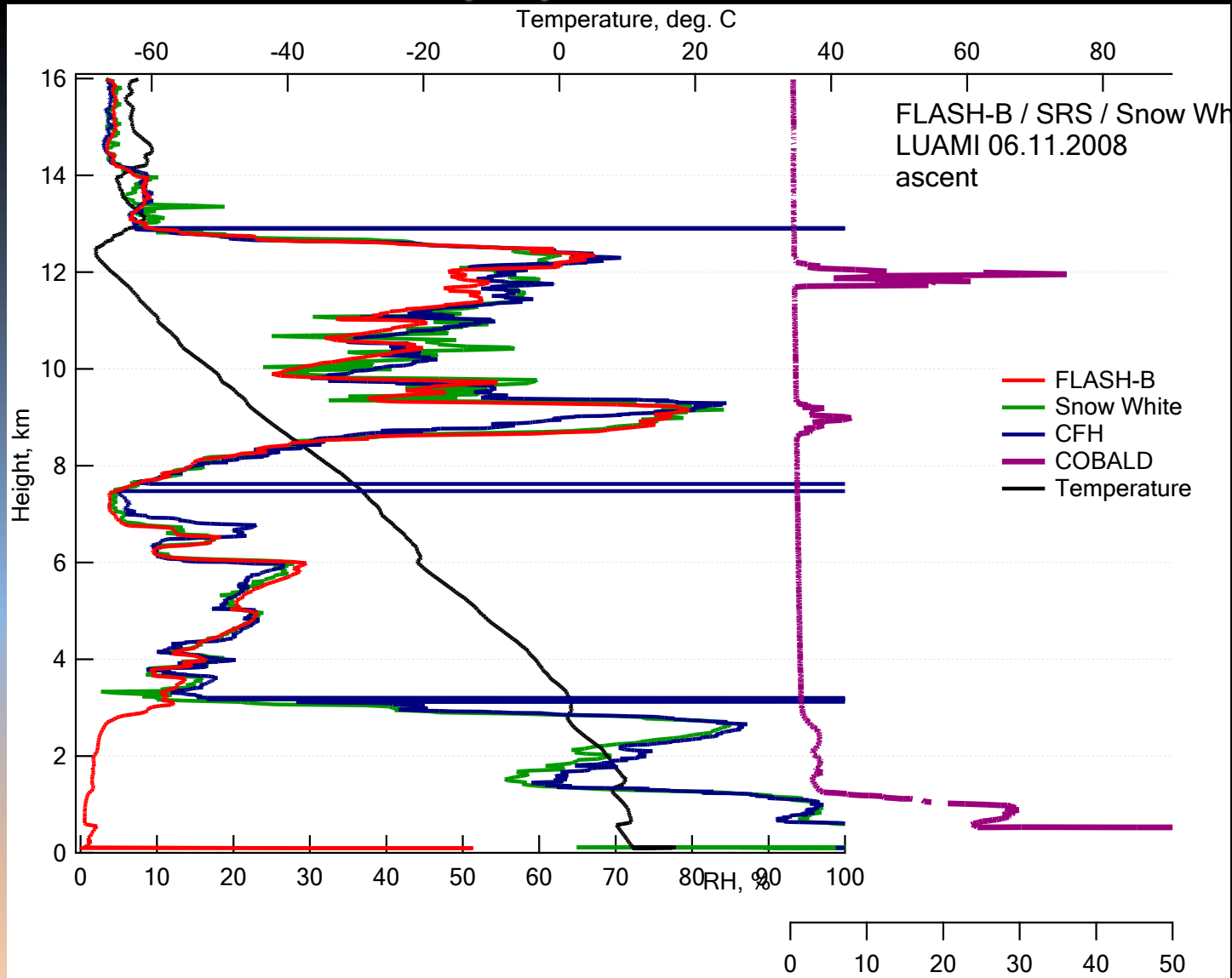


Results of flights:

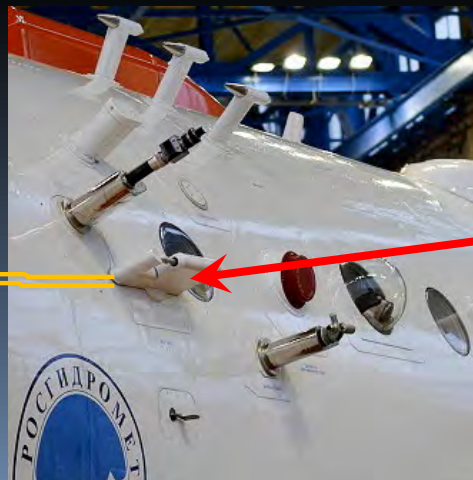
FLASH-B uncertainty



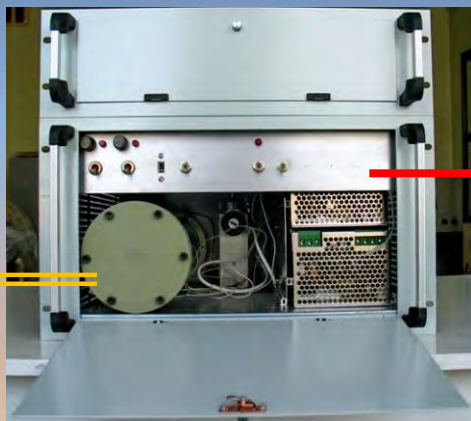
Multipayload results



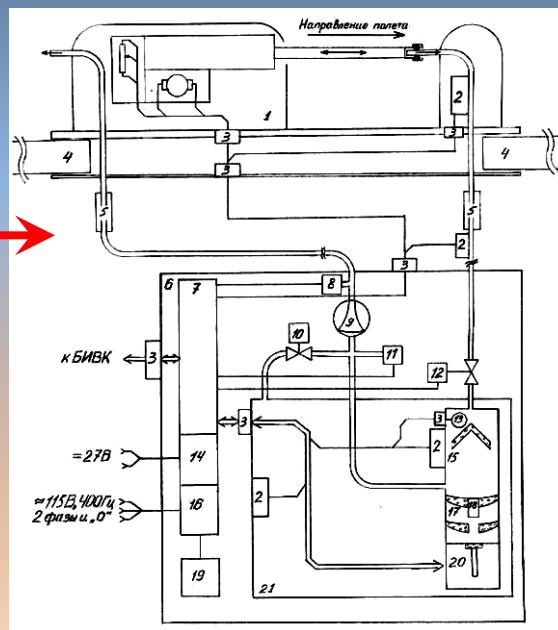
Tropospheric YAK42-Roshydromet application:



The Yak-42D plane
laboratory "Roshydromet"
made in 2013 year
Max.Speed: 810 km/h
Range: 4,000 km
Service ceiling: 9,600 m



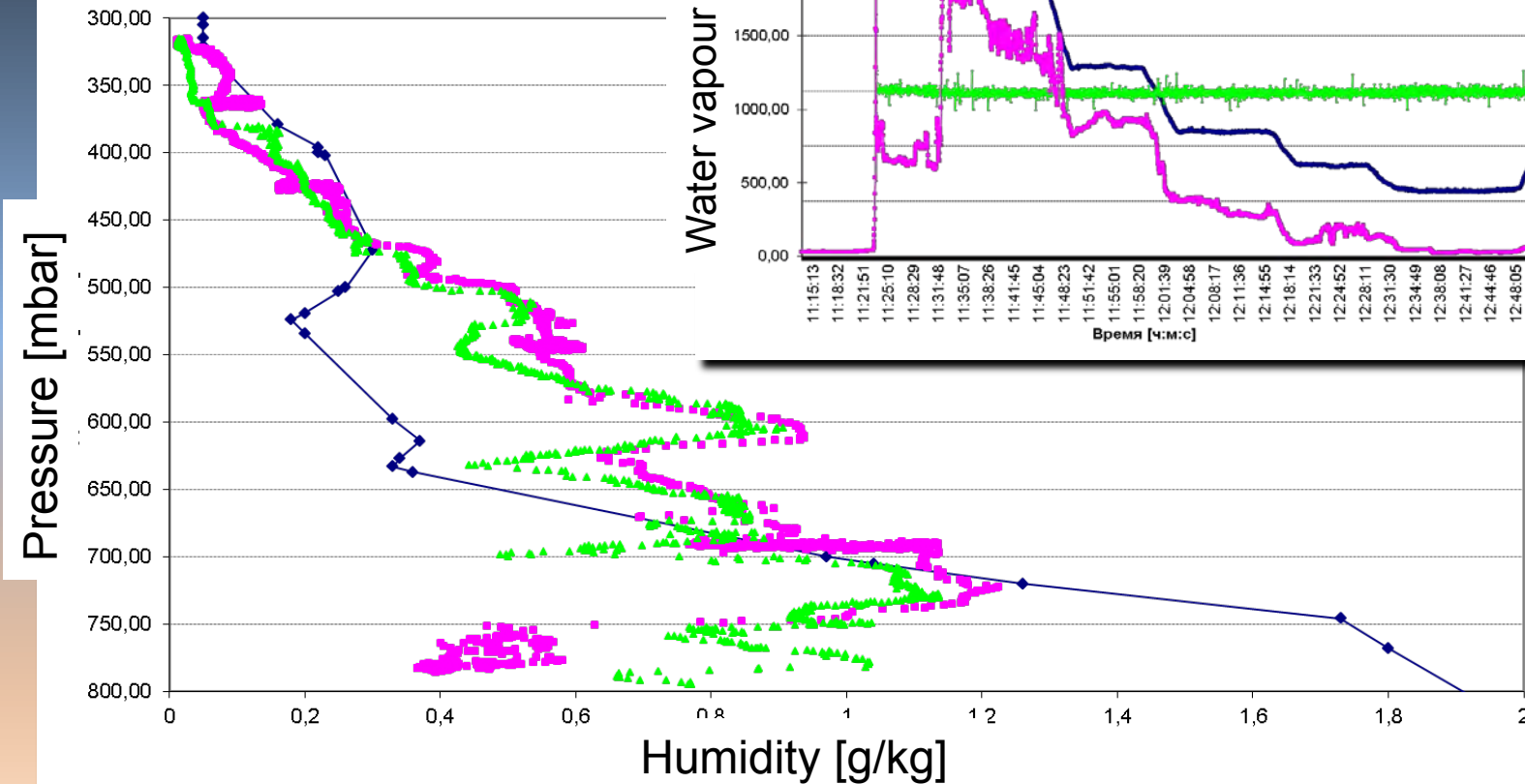
FLASH hygrometer onboard



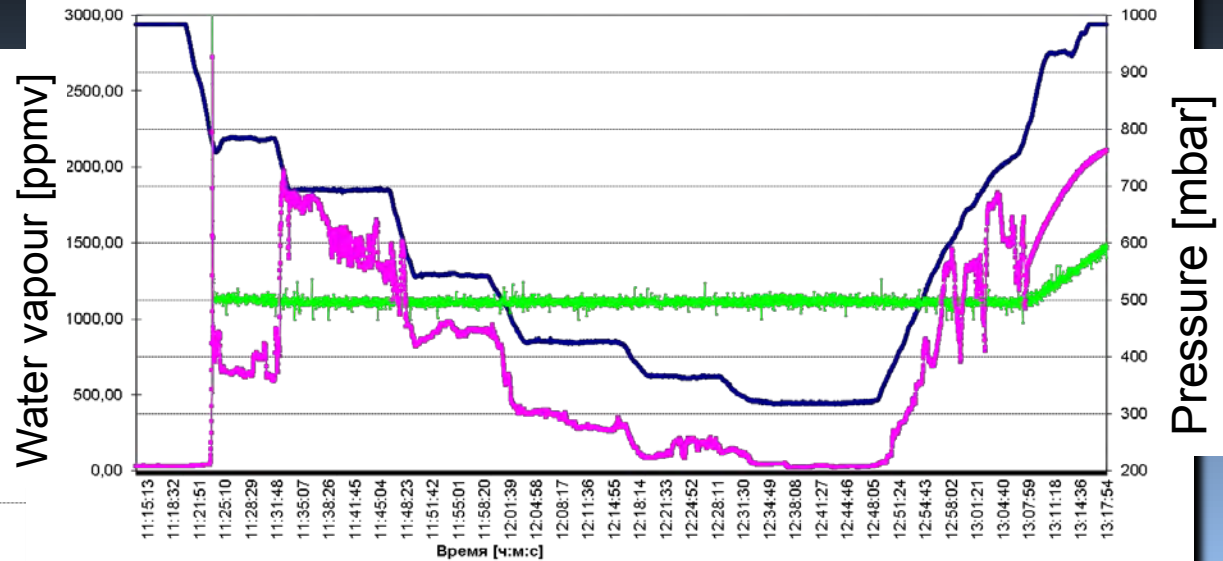
- 1 – closing inlet;
- 2 – heaters; 3 – connectors;
- 4 – airplane wall;
- 7- control unit;
- 8,11 – pressure sensor;
- 9- vacuum pump;
- 12 – flow controller;
- 13 – temperature sensor;
- 14,16 – power supply;
- 15 – chamber; 17 - optics;
- 18 – UV lamp;
- 20 – FLASH;

Tropospheric YAK42-Roshydromet FLASH data:

Comparison vs radiosonde at
12.11.2013



Water vapour and pressure during flight 12.11.2013



Stratospheric M55-Geophysica aircraft application:

Flash-M55:

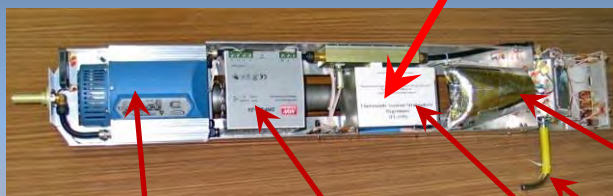
Weight 25 kg

1200mm x D30mm

Power 100 W

Automatic Data

logging 3 days



chamber

inlet

FLASH

Power
supply

Vacuum
Pump

Max speed: 332 km/h at 5,000 m

743 km/h at 20,000 m

Range: 4,965 km

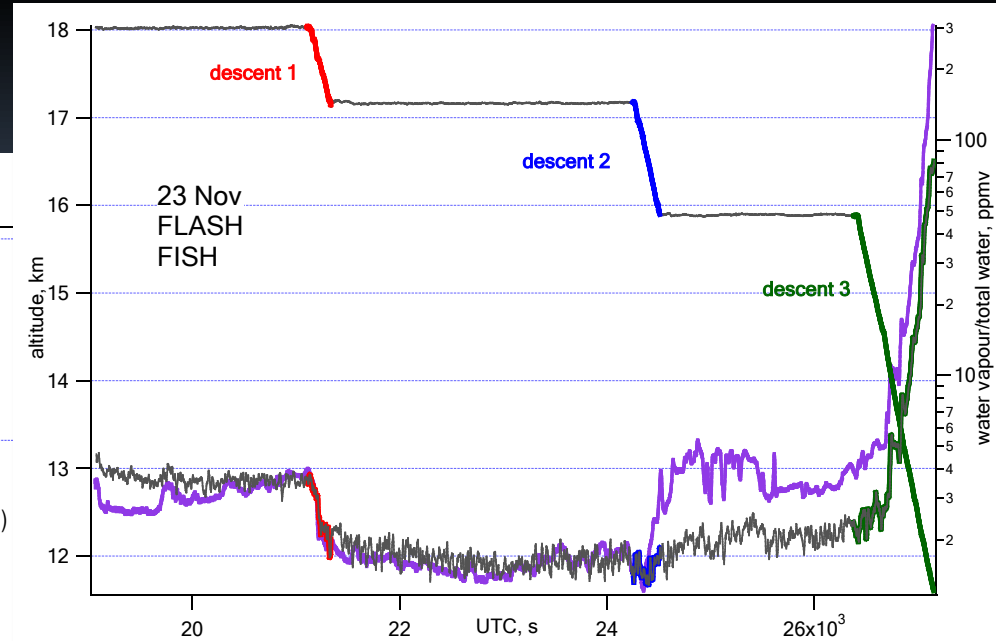
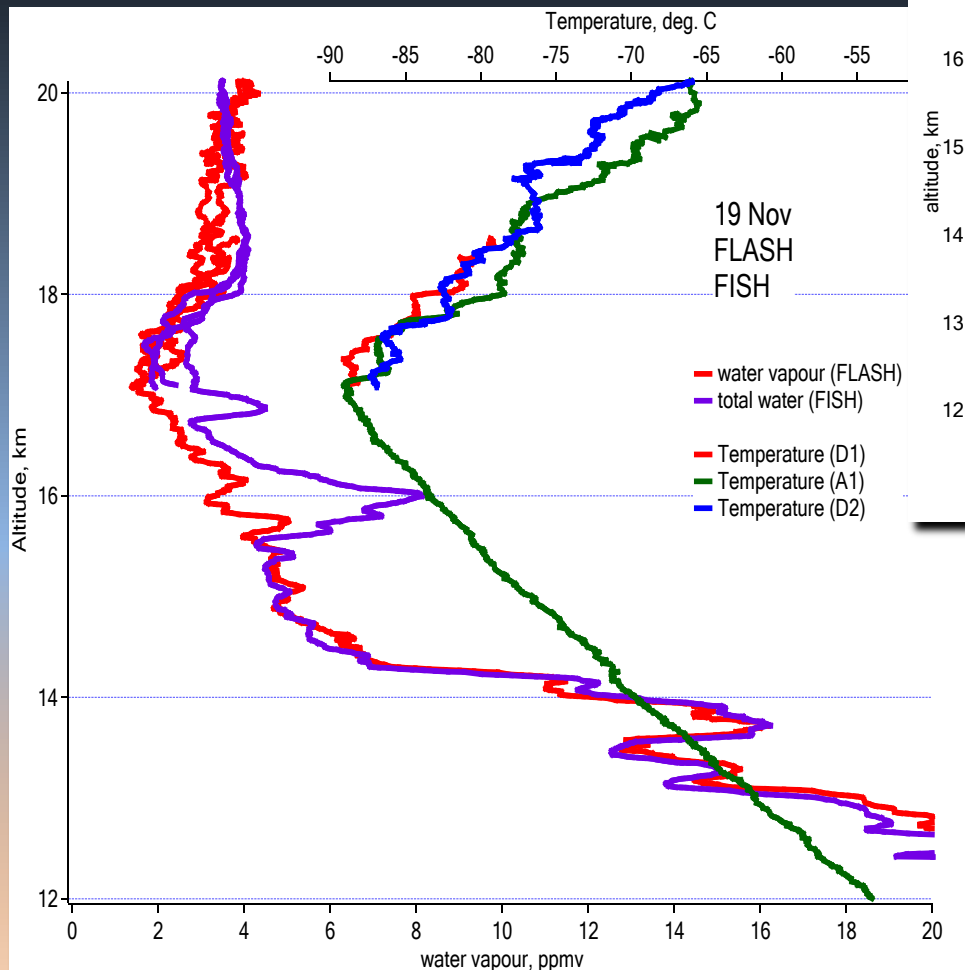
Endurance: 6.5 hours at
17,000 m

Service ceiling: 21,500 m

Time to altitude: 21,000 m in 35
minutes

M55-Geophysica aircraft FLASH data:

Vertical water vapour profile

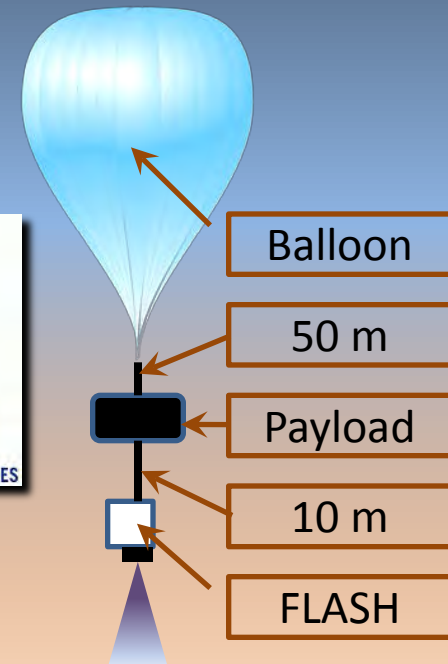
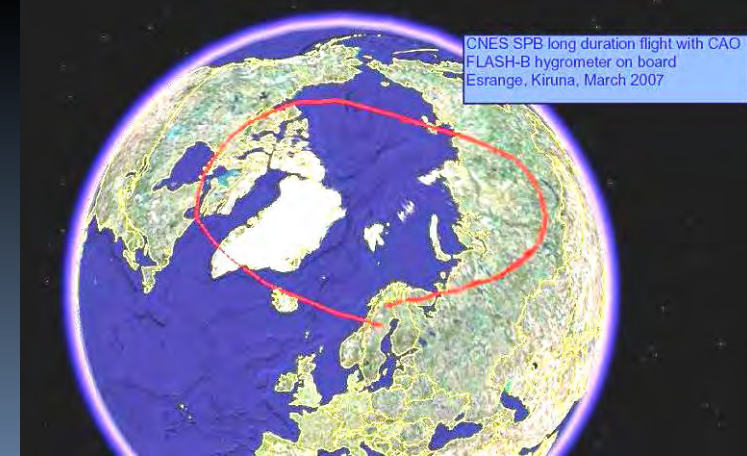
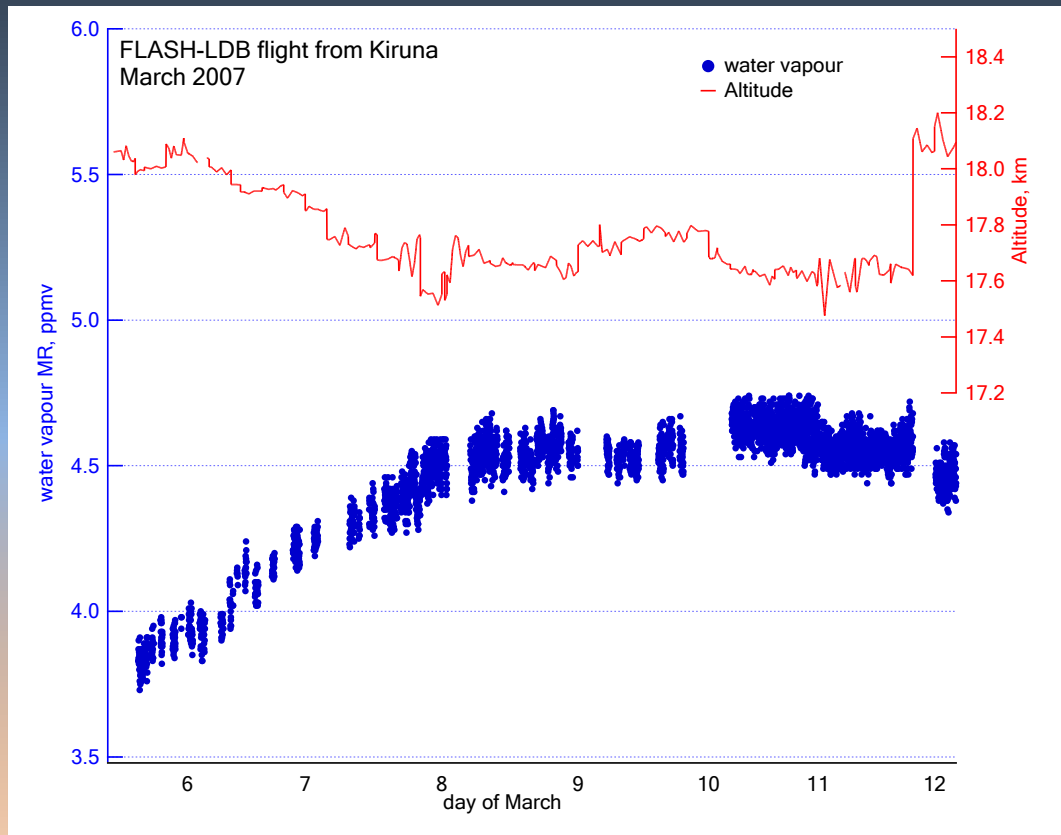


Time data set water vapour

Participation in:
SCOUT 2005
RECONCILE 2011
STRATOCCLIM 2015

Long Duration CNES balloon and FLASH:

Balloon was flown 2 weeks at altitude 17-18 km
FLASH works at night time only, 15 min per hour

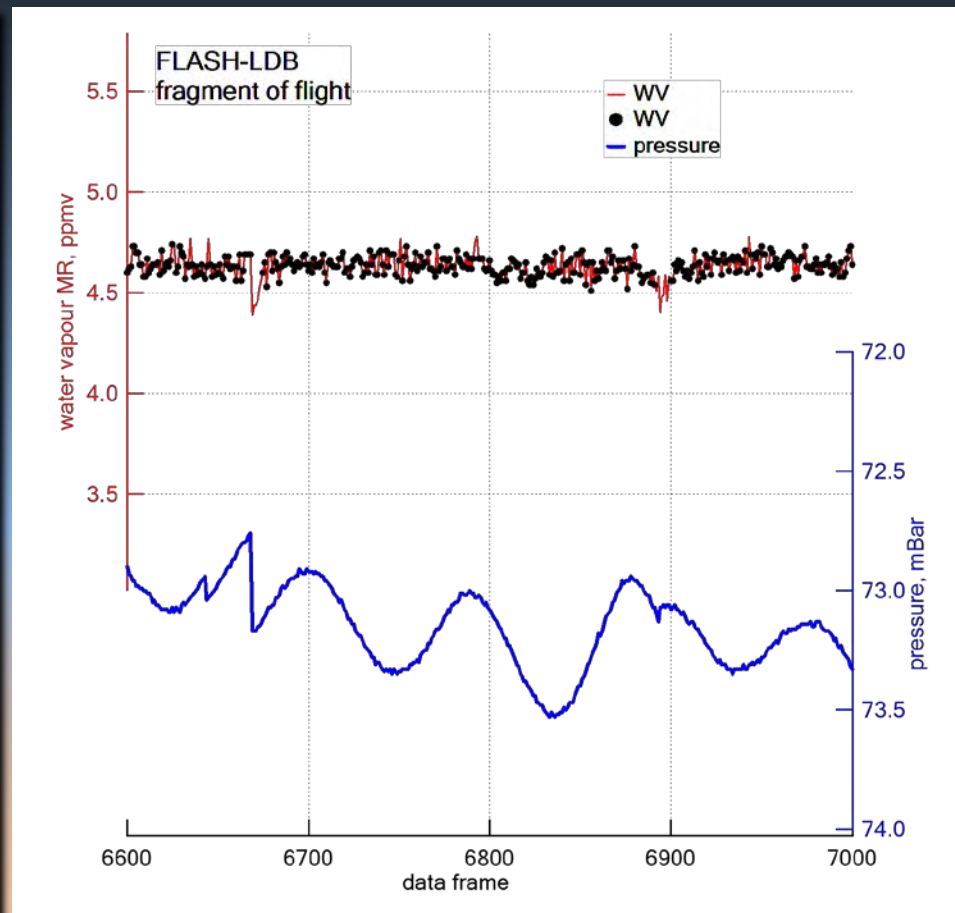
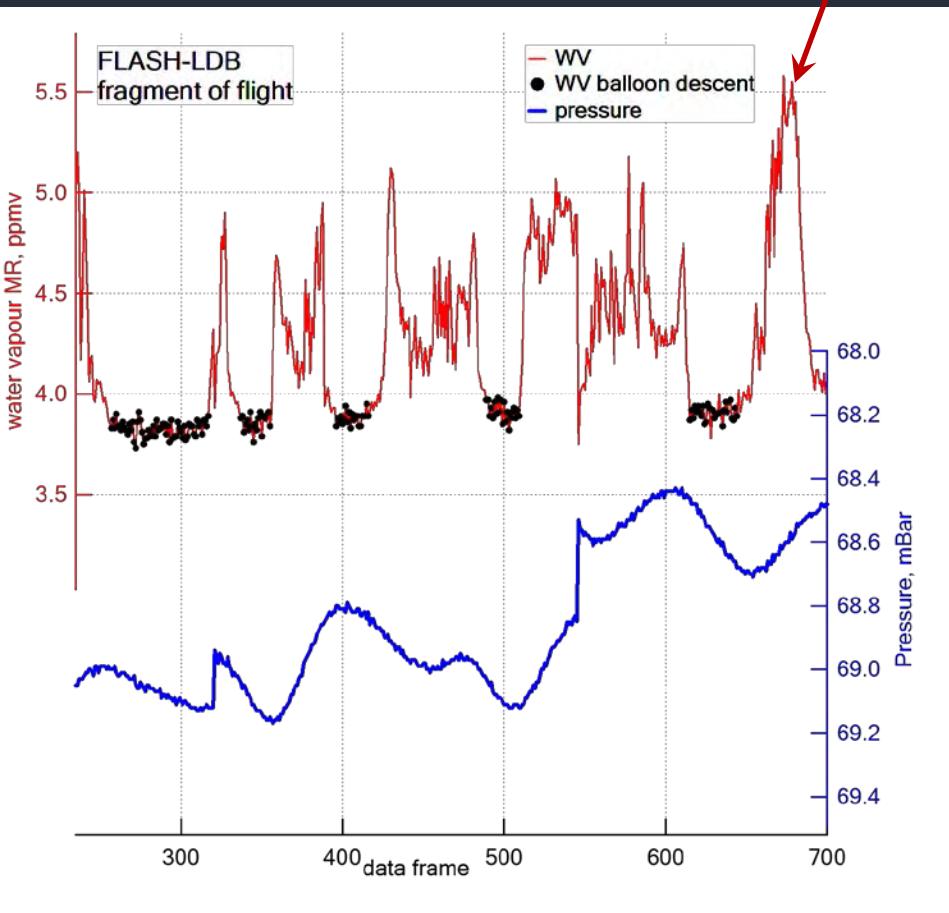


Long Duration CNES balloon FLASH data:

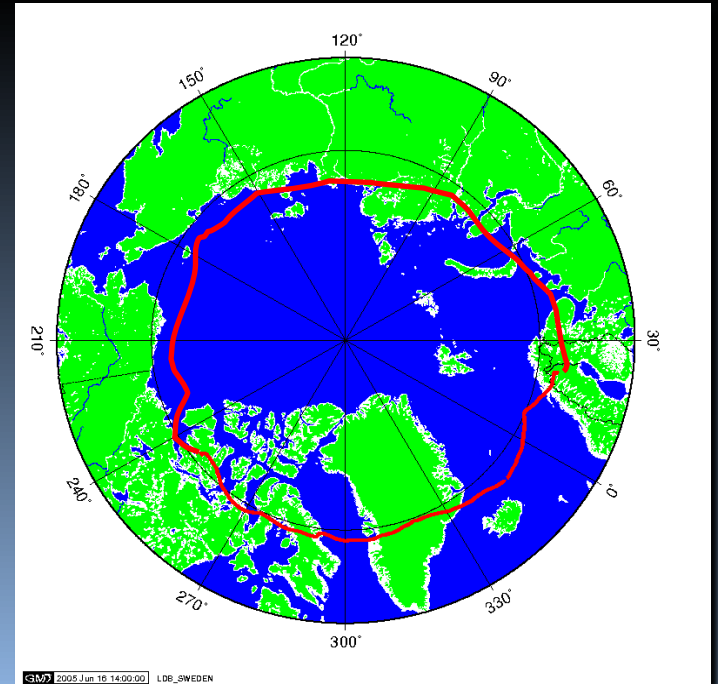
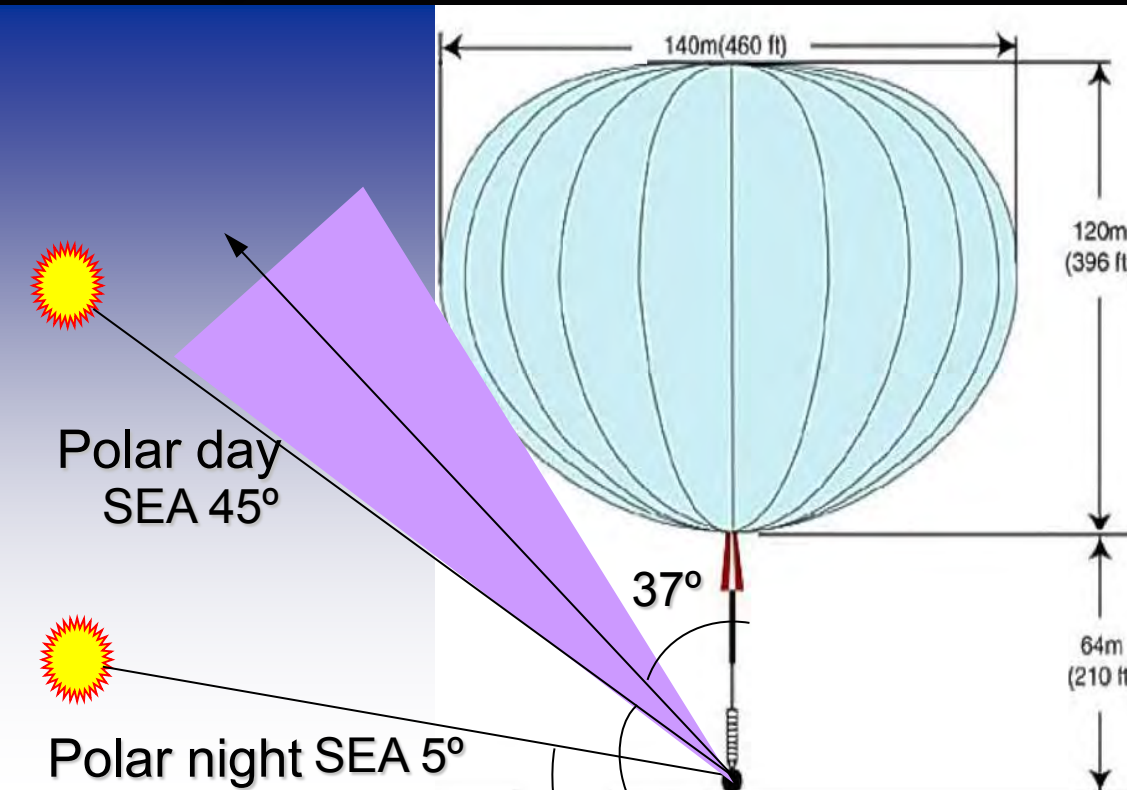
1-st day of flight

contamination

5-th day of flight



Long Duration PoGoLite balloon and FLASH:



FLASH FOW is 40 deg must be placed between maximum Solar Elevation Angle (SEA) and balloon in order to avoid over exposure reflected light.

Launch site:	Esrang Space Center
Launch date:	July 2013
Mass/kg:	~2 tons
Balloon size:	1,2 Mm ³
Height:	~39 km
Duration:	~15 days
Targets:	the Crab (nebula and pulsar) and Cygnus X-1

Long Duration PoGoLite balloon FLASH set up:

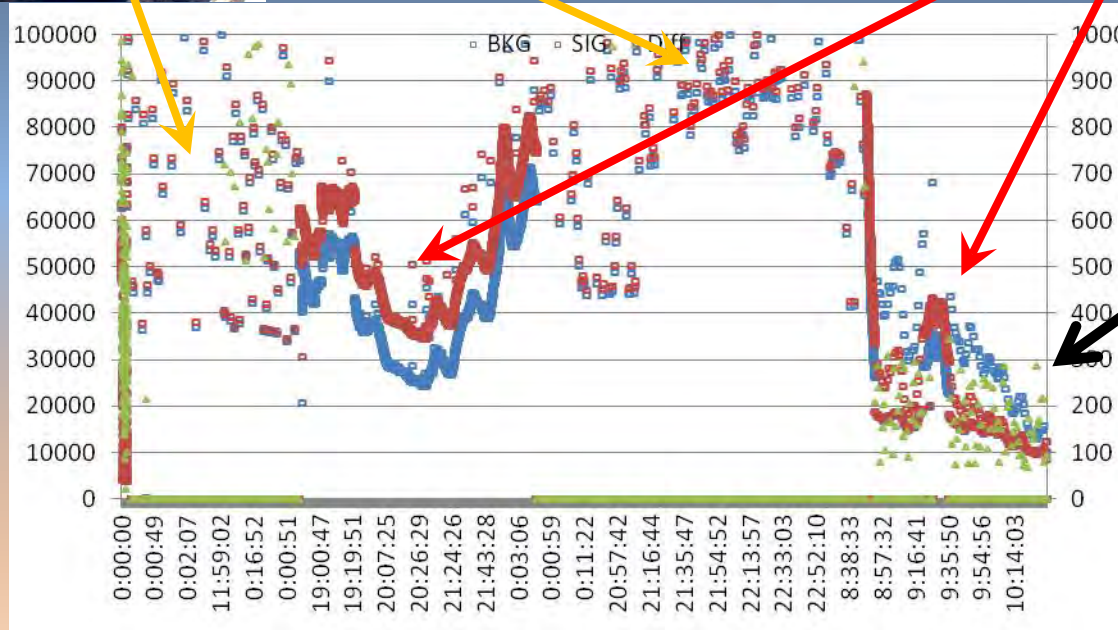
At daytime the FLASH looks to the Sun direction, as a Polarimeter. There is over exposure condition.
At night time they turn back. There measuring cond.



PoGoLite FLASH data:

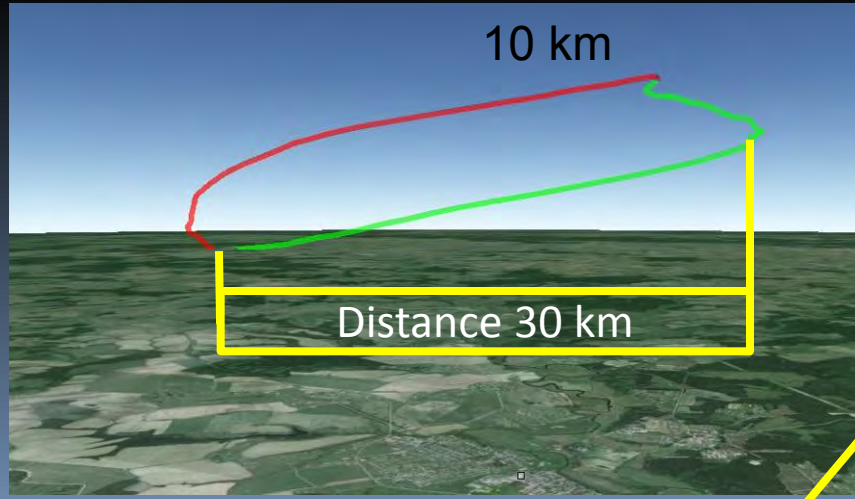


“Daytime” data
is over
exposure.

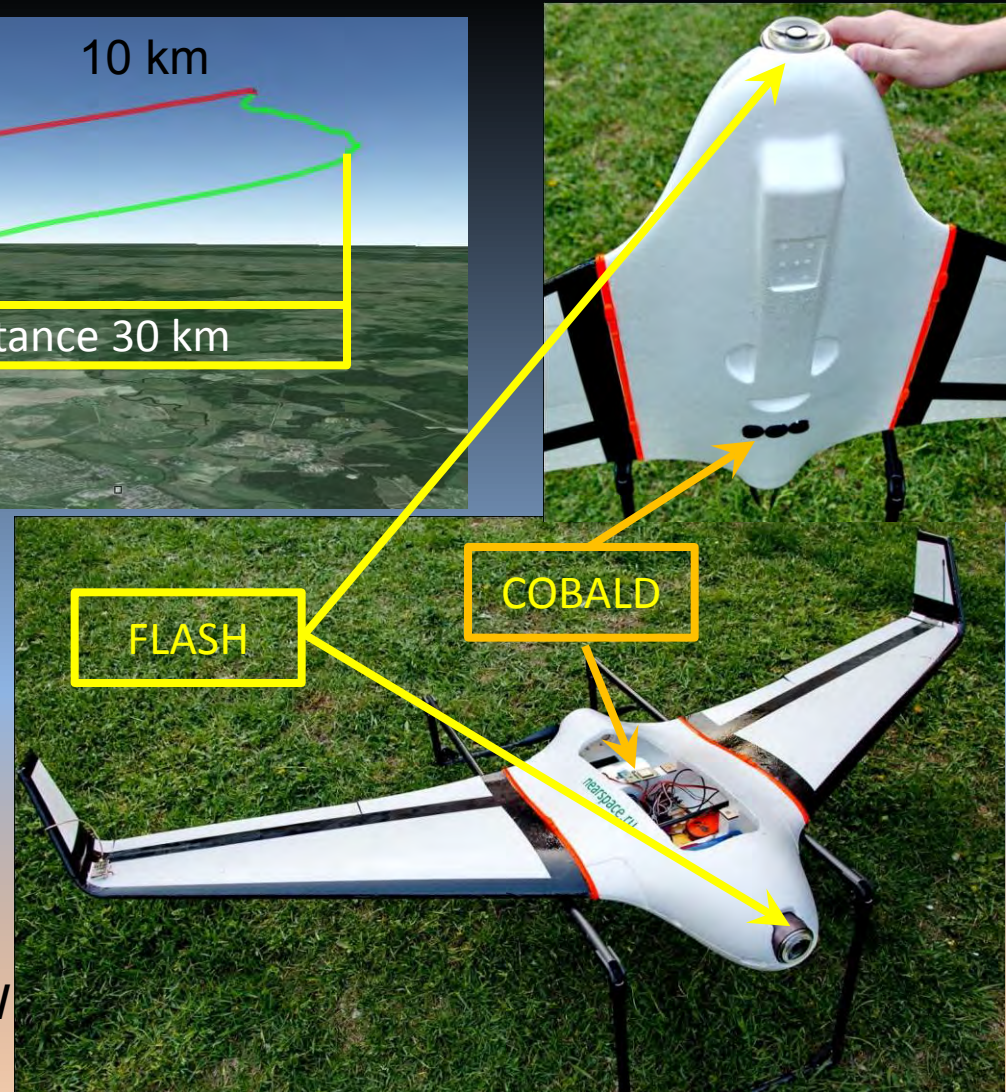


“Night time”
data
5 ppmv
Noise
3 ppmv

Unmanned Aerial Vehicles (UAV) application:



Skywalker X-8 FPV
Wingspan: **2,12 m**
Cruise speeds
80-90 kph.
Max weight: **4 kg**
Payload: **1,5 kg**
Range: **50 km**
Flight video:
[http://nearspace.ru/
?page_id=258](http://nearspace.ru/?page_id=258)



Summary:

Is born for missile applications, FLASH hygrometer has been modified for a variety of platforms:

- Very light weight version for rubber meteo balloons for night flights;
- Small gondola for stratosphere aircraft M55 fixing under wing;
- Big rack module for tropospheric airborne laboratory YAK42-Roshydromet;
- He has been modied for stratospheric long-duration CNES and SSC Esrange balloons;
- FLASH was adapted for use onboard Unmanned Aerial Vehicles (UAV);

Nearest future:

- FLASH adapting for use with LDB Strateole III with with the reeldown instrument hosting FLASH and COBALD