Lidar and radiosonde measurement campaign in Potenza for the validation of ENVISAT atmospheric products

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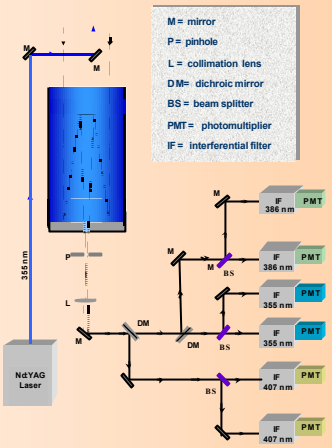
In the frame of the validation program of ENVISAT, an intensive water vapour lidar measurement campaign, started on July 2002, is in progress at IMAA-CNR in Tito Scalo (PZ) (Southern Italy, 40°36'N, 15°44'E, 820 m above sea level). Systematic measurements will be performed for a period of 12 months. Two measurements per week have been performed for the first six months of the validation campaign, while one measurement per week is scheduled for the last six months. At the moment, we have collected more than 240 hours of measurements. Lidar observations are complemented with radiosonde launches.

The Raman Lidar system is based on a Nd:YAG laser equipped with third harmonic generator (355 nm) with a repetition rate up to 100 Hz. The third harmonic is transmitted into the atmosphere in a coaxial mode. The receiver consists of a vertically pointing telescope in Cassegrain configuration with a 0.5 m diameter primary mirror and a combined focal length of 5 m. The collected radiation is split into three channels by means of dichroic mirrors. Interferential filters are used to select the elastic backscattered radiation at 355 nm, the N_2 Raman shifted radiation at 386.6 nm and the water vapour Raman shifted radiation at 407 nm. Each wavelength is then split into 2 different channels for both low and high range signals. Photomultiplier tubes are used as detectors. Both low and height range signals are acquired in photon counting mode by using a Multi Channel Scaler (MCS) with a dwell time of 100 ns. The overall characteristics of the Raman lidar are reported in the table.

Raman lidar measurements allow the determination of water vapour vertical profile by the simultaneous detection of the backscattered radiation in the Raman vibrational bands of water vapour and nitrogen. Water vapour Raman lidar measurements are expressed in terms of *mixing ratio*, that is the ratio between the mass of water vapour and the mass of dry air in a given volume.



LASER: Nd:YAG laser (Coherent – Infinity)

Max. Pulse Energy	@ 355nm 170mJ
Maximum repetition rate	100Hz
Beam divergence	<0.3 mrad
Pulse duration	3 ÷ 4 ns

RECEIVING SYSTEM: Cassegrain telescope

Primary mirror diameter	0.5 m
Combined focal length	5 m
Field of view	0.2 ÷ 2 mrad

SPECTRAL SELECTION: interferential filter

Wavelengths (nm)	386, 407	355
Out of band rejection	$<10^{-10}$	$<10^{-8}$
Bandwidth (nm)	<1.0	<1.0
Trasmission efficiency	~ 60%	~ 33%

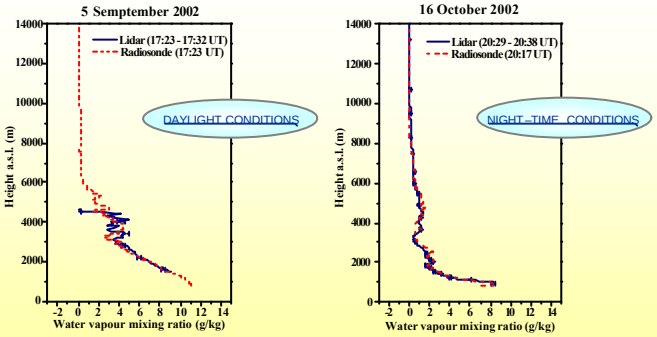
DETECTORS: photomultiplier

THORN EMI 9202 QB 355, 386, 407 nm

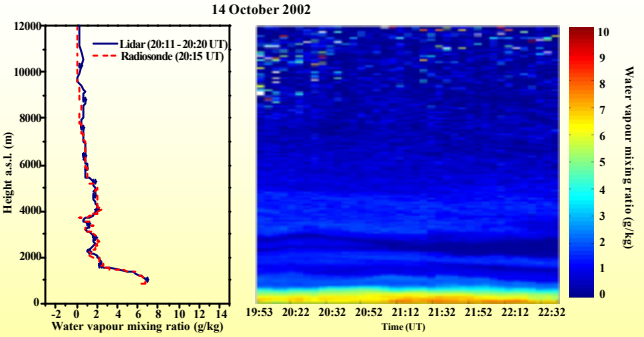
ACQUISITION: photon counting mode

EG&G MCS - PCI	
Minimum dwell time	100 ns
Bandwidth	150 MHz
PHILLIPS SCIENT. Fast discriminator	
Bandwidth	300 MHz

WATER VAPOUR RAMAN LIDAR MEASUREMENTS

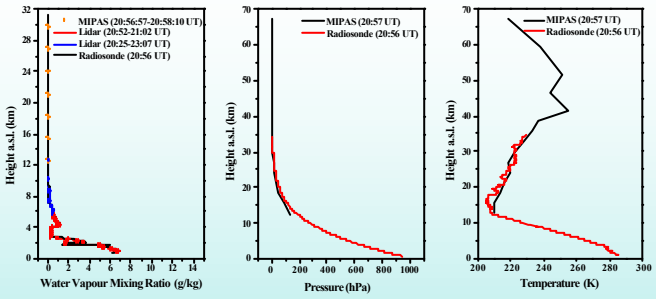


Raman lidar measurements are reported with a vertical resolution variable between 60 m and 300 m, and with an integration time of 10 minutes for both daylight and night-time conditions. In the first case, the maximum height value is around 4500 m while in the second case we can retrieve water vapour profile up to 14000 m. Statistical errors for lidar water vapour measurements are within 10% up to about 4000 m of height for daylight conditions, and within 10% up to 7000 m and 25% up to 14000 m of height for night-time conditions.



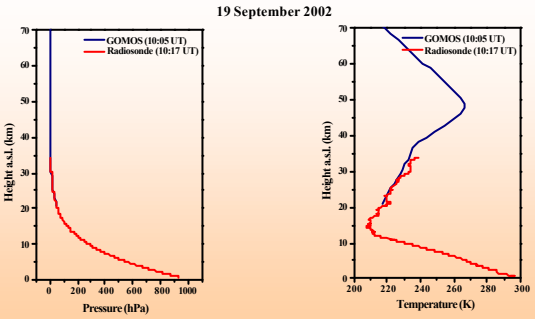
The false colour map shows the time evolution and vertical variability of water vapour mixing ratio for 14 October 2002. Each profile corresponds to an integration time of 5 minutes and a vertical resolution of 60 m. The map shows the presence of two distinct water vapour layers that extend from the top of lidar station to about 2000 m and from 4000 m to 5500 m respectively, and that remain stable during all the acquisition time. These layers are well evident in the reported single vertical profile obtained by integrating lidar signals in the time interval 20:11–20:20 UT, in agreement also with the simultaneous radiosonde profile.

MIPAS COMPARISON



A preliminary analysis of the comparison between MIPAS, radiosonde and lidar for water vapour mixing ratio measurements has been performed. Water vapour lidar data can be used only for altitudes below 14 km and for this height region MIPAS data seem to indicate an understimation of the water vapour mixing ratio, while at higher height the agreement with radiosonde data is quite good. Improvement in the retrieval algorithm of water vapour MIPAS profiles is in progress. The goal is to obtain water vapour MIPAS profiles that extend down to about 5 km of height a.s.l. and thus to realize comparisons between MIPAS, radiosonde and lidar water vapour profiles over an extended range of height.
Comparisons between MIPAS and radiosonde for temperature and pressure have been also performed. Differences between MIPAS and radiosonde data are within 2% for both temperature and pressure profiles.

GOMOS COMPARISON



Preliminary comparisons between GOMOS and radiosonde measurements show a good agreement for both pressure and temperature profiles. However, at this stage of the validation campaign, with a small available dataset, it is difficult to draw some final conclusions; the measurement campaign at IMAA is still in progress and we'll have more data available for comparisons in the next future.

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