RAYLEIGH-MIE-RAMAN LIDAR ACTIVITIES FOR THE STUDY OF THE ATMOSPHERE AT ISAC-CNR

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http://lidar.ifa.rm.cnr.it/

• INSTRUMENT DESCRIPTION
• DATA DESCRIPTION
• GEOPHYSICAL PRODUCTS
• APPLICATIONS
• CRITICAL ISSUES
• OTHER POSSIBLE CONTRIBUTIONS
Rayleigh-Mie-Raman (RMR) multi-channel lidar of Rome - Tor Vergata

**TRANSMITTER**
Laser Nd:YAG Continuum Powerlite 8010
- 2 beams: 532 nm, 355 nm
- Energy: 200 mJ, 400 mJ
- Pulse repetition rate: 10 Hz
- Pulse duration: 7 ns
- Beam diameter: 45 mm
- Beam divergence: 0.1 mrad

**RECEIVER**

<table>
<thead>
<tr>
<th>Collector 1</th>
<th>Collector 2</th>
<th>Collector 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>newtonian array</td>
<td>single newtonian</td>
<td>single newtonian</td>
</tr>
<tr>
<td>Diameter: 9*500 mm</td>
<td>Diameter: 300 mm</td>
<td>Diameter: 150 mm</td>
</tr>
<tr>
<td>F-number: F3</td>
<td>F-number: F3</td>
<td>F-number: F3</td>
</tr>
<tr>
<td>FOV: 0.6 mrad</td>
<td>FOV: 0.9 mrad</td>
<td>FOV: 1.8 mrad</td>
</tr>
</tbody>
</table>

**DATA ACQUISITION**

<table>
<thead>
<tr>
<th>Raman UT</th>
<th>Raman LT</th>
</tr>
</thead>
<tbody>
<tr>
<td>channels:</td>
<td>channels:</td>
</tr>
<tr>
<td>387 nm</td>
<td>387 nm</td>
</tr>
<tr>
<td>407 nm</td>
<td>407 nm</td>
</tr>
<tr>
<td>Elastic (T):</td>
<td>Elastic (UTLS):</td>
</tr>
<tr>
<td>355 nm</td>
<td>532 nm</td>
</tr>
<tr>
<td>532 nm</td>
<td>(PBL, LT)</td>
</tr>
</tbody>
</table>

For each photo-detection channel
- Photon-counting: 200 MHz Bandwidth
- ADC: 12 bit, 20 Msample/s
- 500 ns max. resolution
Rayleigh-Mie-Raman Lidar: example of measurement session (Level 0)

8x2 Channels (4 wavelengths, 3 telescopes)
Total Range: ~70 m÷150 km
Δt: Standard 1’ (600 profiles)
Δz: Standard 75 m (7.5 m ANALOG ONLY)
REAL PRODUCT S RESOLUTION:
- Geophysical variable: channels used, algorithm, distribution.
- Signal integration: Threshold SNR, algorithm

ORIGINAL 1'-75m

‘CLASSIC’ A-PRIORI FIXED BOX

SCENE DEPENDENT DYNAMIC INTEGRATION

WVMR [g/kg]  SNR
**RAYLEIGH-MIE-RAMAN LIDAR**

- **RMR geophysical products**
  - Water vapor mixing ratio profile
  - Cloud base detection and optical thickness
  - Aerosol properties
  - Temperature profile (15-80 km)

- **RMR scientific applications**
  - Satellite Validation
  - WV PDF – small scale variability
  - Atmospheric dry layers characterization
  - Interaction WV-clouds-aerosol
  - Cirrus detection and characterizations
  - PBL Height estimation
  - UT-LS exchange (gravity waves??)

- **YMC’s scientific issues**
  - Predictions
  - Diurnal cycle
  - Aerosols-clouds, interaction
  - UTLS interactions
  - MJO

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The diagram illustrates the integration of various scientific applications and issues related to RMR geophysical products. It highlights the interconnection between different aspects such as satellite validation, atmospheric dry layers, and interactions between water vapor, clouds, and aerosols, as well as the influence of UTLS exchanges.
RAYLEIGH-MIE-RAMAN (RMR) LIDAR
Institute of Atmospheric Science and Climate (ISAC-CNR)
Rome-Tor Vergata 41.8°N 12.6°E 106 aslm

CRITICAL ISSUES
FUNDINGS
PERSONNEL
LOGISTICS: TRANSPORT, CONCRETE BASE, WATER & POWER SUPPLY

WV MIXING RATIO CALIBRATION (NEARBY RADIOSONDE AVAILABILITY, GPS)
DAYTIME REDUCED SOUNDING RANGE
OPTICALLY THICK CLOUDS (NO WV, TEMPERATURE and AEROSOLS PROFILES ABOVE THE CLOUD BASE)
PRECIPITATION (NO OBS)
ADDITIONAL CONTRIBUTIONS

PBL SOUNDING (THEETHERED BALLOON/KITES)
NUMERICAL MODELING
LINK WITH STRATOCLIM ACTIVITIES
Thank you!

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http://lidar.ifa.rm.cnr.it/
What would be the best (science & logistics) site?

- Size of the instrument: 6.5x2.5xH6.5 m (ISO 20)
- Area required to locate the instrument: 50 m²
- Access: must be guaranteed to an air-ride trailer incorporating a crane
- Security/site surveillance: required throughout the entire campaign period because of the presence of expensive instrumentation
- Infrastructures/storage areas needed:
  - Rest-rooms,
  - Storage areas (3x2)m²
- Power supply (freq., voltage, power) –autonomy – necessary infrastructure (water, oil, etc...): 
  - Power supply (freq.): 50 Hz
  - Power supply (voltage): 220 Volt
  - Power supply (power): min 6 kW (i.e. 2 kW for laser source and 4 kW for receiver/data acquisition system/AC) peak 10 kW
- Running water: 5-7 l/min