The image is a composite. The left side shows a satellite view of Earth, with a prominent red and orange landmass (likely Africa) and surrounding green and blue areas. The right side shows a blue sky with a green laser beam originating from a yellow circular object at the bottom right. The text is overlaid on the top half of the image.

Cloud top height estimation from satellite imagery and LIDAR measurements

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Why?

- Lidar measurements



- Forecast



SYSTEMS

EUMETCAST

- 24 hours a day, 365 days a year.
- The satellite observes the full disk of the Earth with a repeated cycle of 15 minutes in 12 spectral wavelength regions or channels.
- Spectral Range is between 0.6 – 13.4 μ m
 - 4 visible and NIR channels, 0.6 – 1.6 μ m
 - 8 IR channels 3.9 – 13.4 μ m

LIDAR

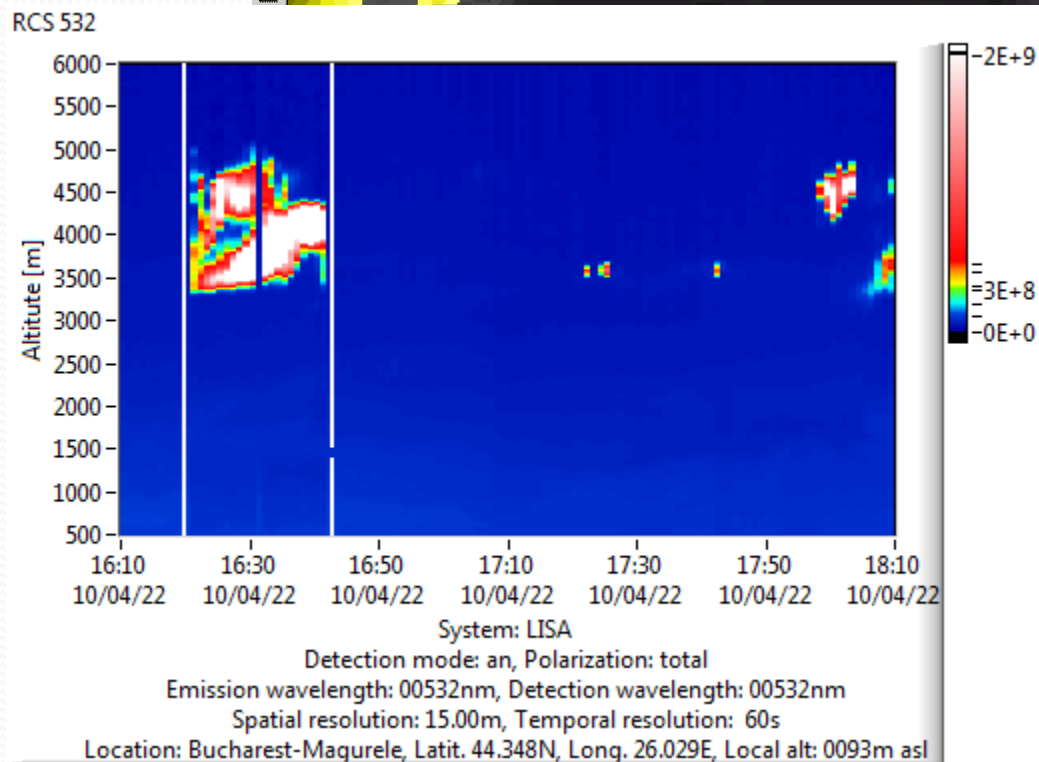
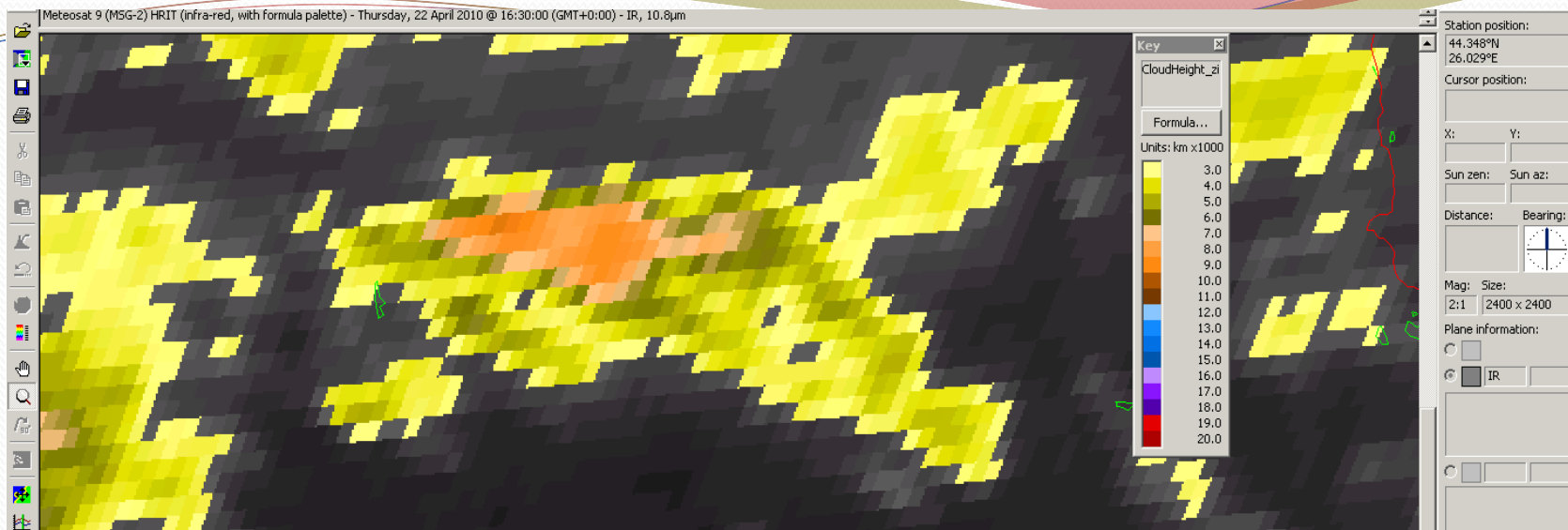
- Use pulsed or continuous lasers to sound high altitudes in the atmosphere.
- RALI
 - 15-20 km maximum range;
 - 3,75m range resolution;
 - 4 elastic channels (1064, 532p, 532c, 355nm), 2 Nitrogen vibrational Raman channels (607, 387nm) and water vapor channel (408nm).
- LISA
 - 10 km maximum range;
 - 15 m range resolution;
 - two elastic channels (1064nm and 532nm).

Methodology

- Satellite retrieval
 - 10,8μm brightness temperature (BT);
 - Standard atmospheric model
- LIDAR retrieval
 - Range Corrected Signal (RCS)
 - First derivate of RCS (LiSA method)

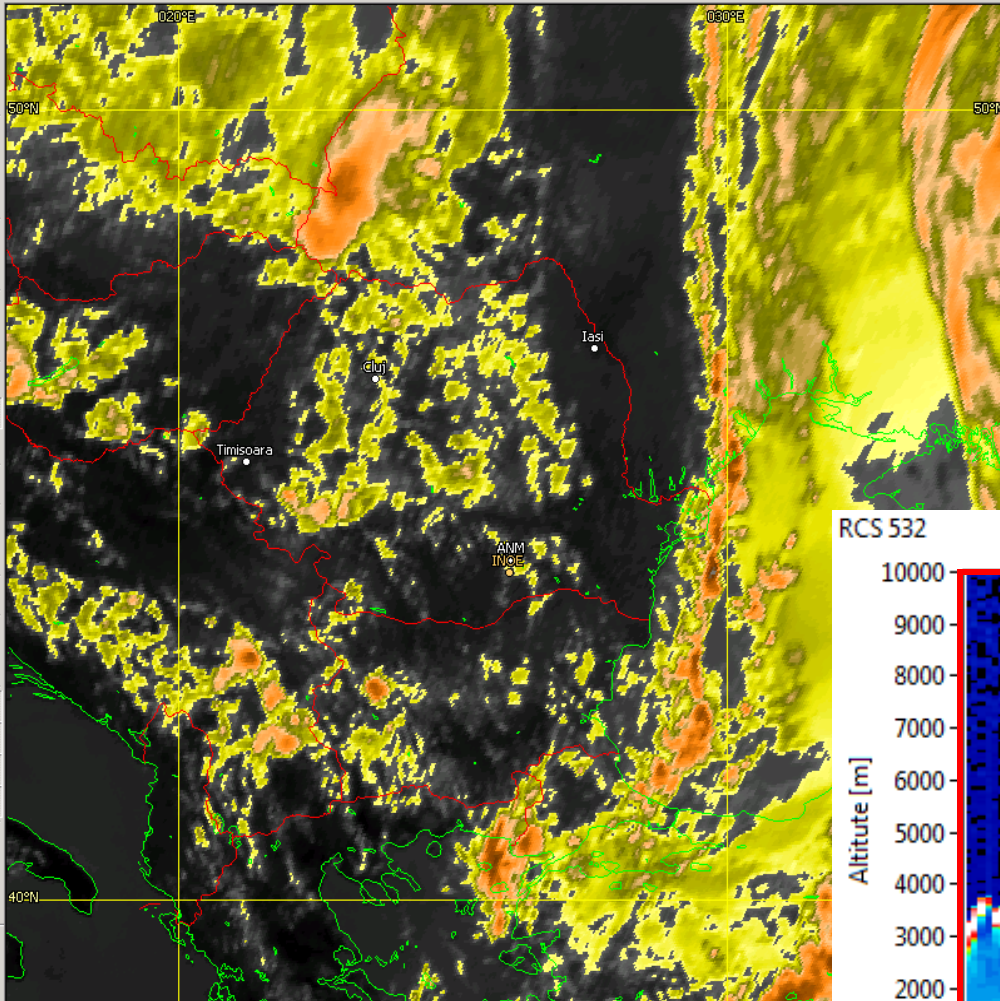
$$h_{\min} = \min\left(\frac{\partial RCS}{\partial z}\right); h_{\max} = \max\left(\frac{\partial RCS}{\partial z}\right)$$

Selection of case studies

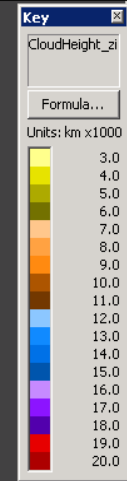


Results and discussion

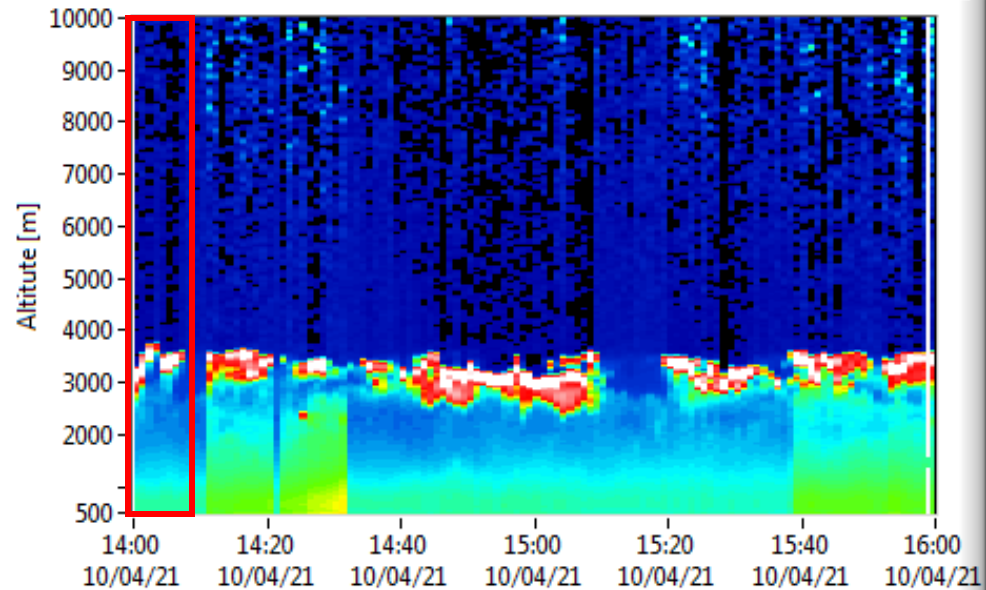
Low clouds



INOE cloud top height = 3.1 Km



RCS 532



System: LISA

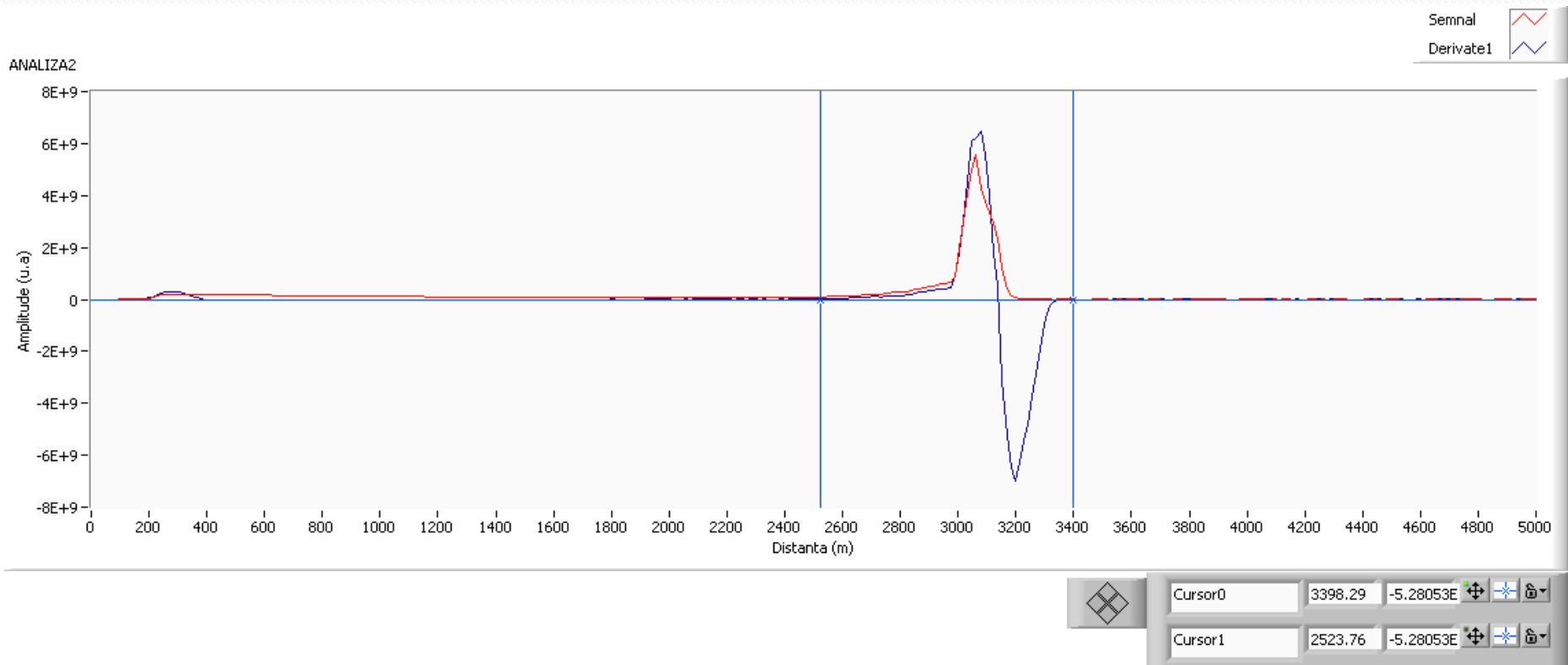
Detection mode: an, Polarization: total

Emission wavelength: 00532nm, Detection wavelength: 00532nm

Spatial resolution: 15.00m, Temporal resolution: 60s

Location: Bucharest-Magurele, Latit. 44.348N, Long. 26.029E, Local alt: 0093m asl

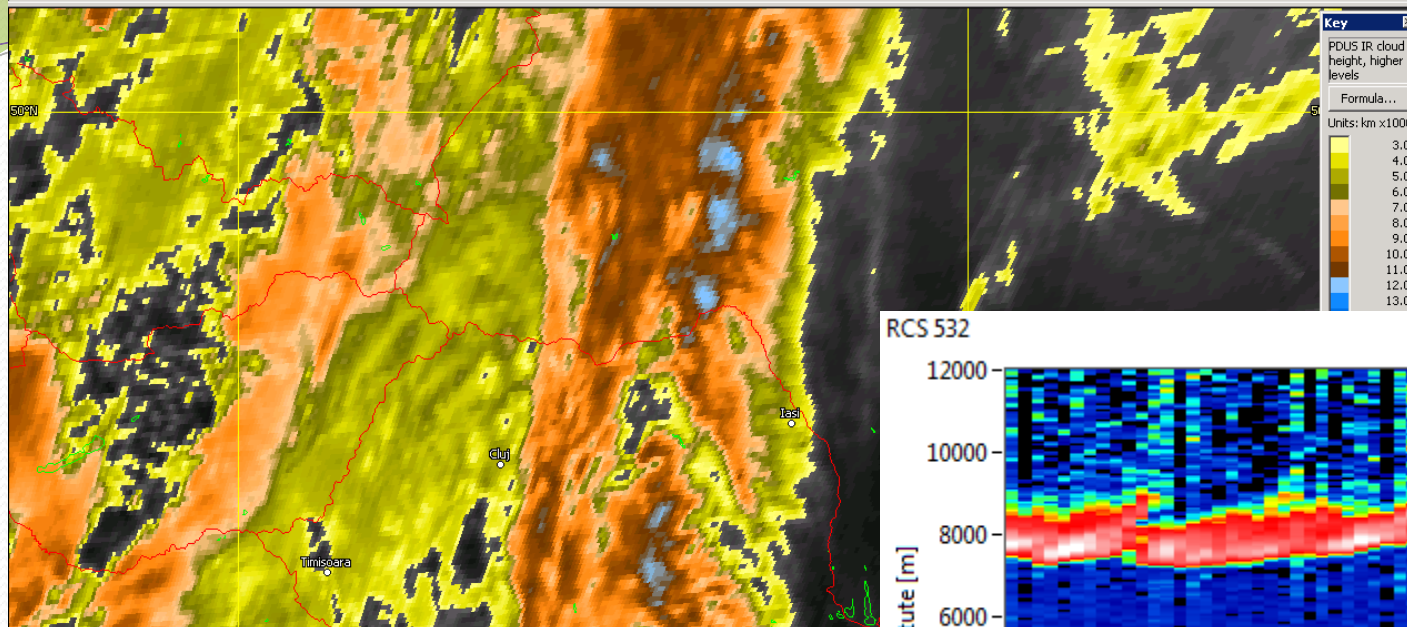
Low clouds



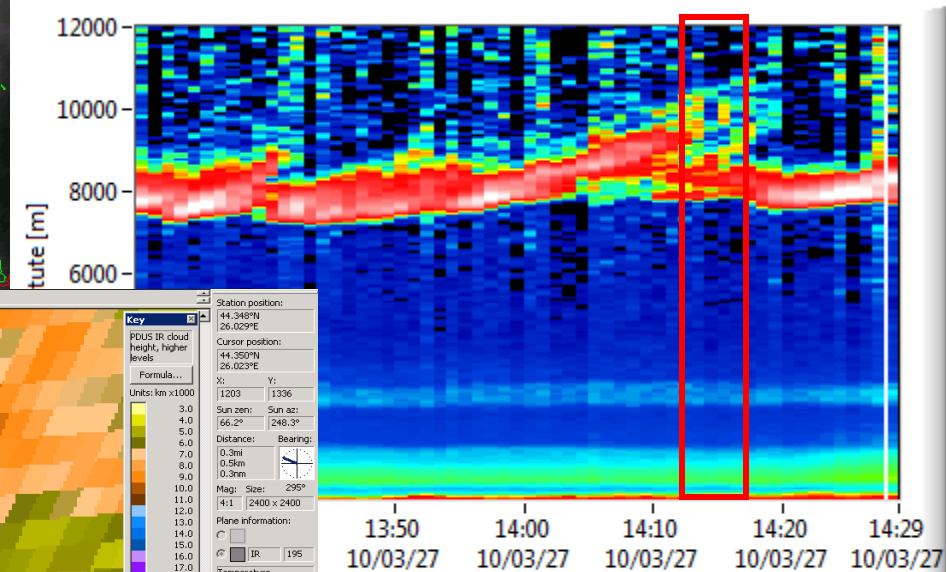
High clouds

INOE cloud top height = 9.5 Km

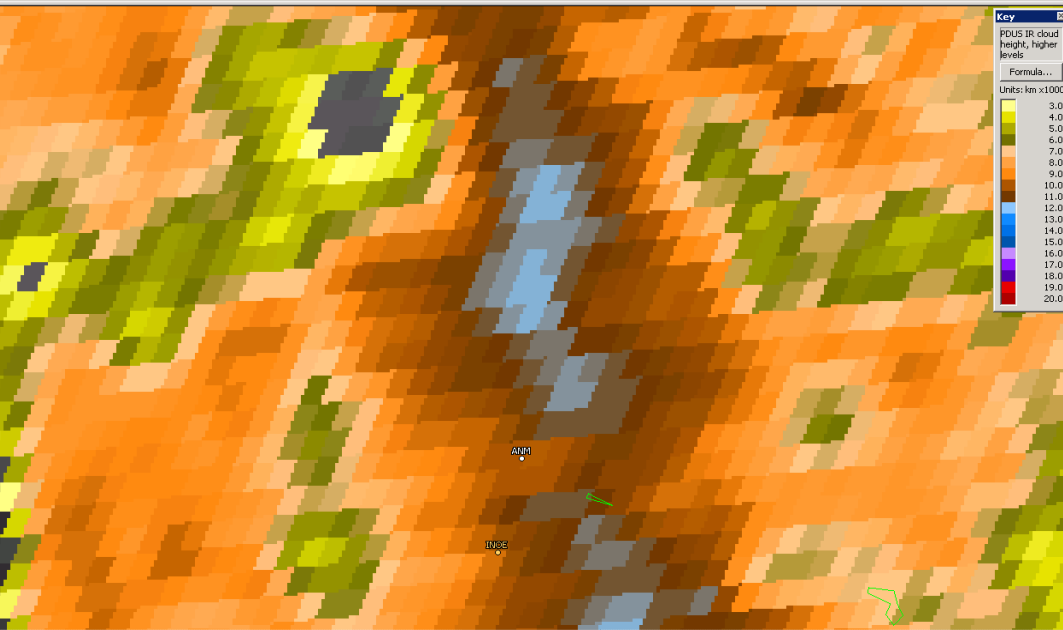
Meteosat 9 (MSG-2) HRIT (infra-red, with formula palette) - Saturday, 27 March 2010 @ 14:15:00 (GMT+0:00) - IR, 10.8µm



RCS 532



Meteosat 9 (MSG-2) HRIT (infra-red, with formula palette) - Saturday, 27 March 2010 @ 14:15:00 (GMT+0:00) - IR, 10.8µm



Station position:
44.348°N
26.029°E

Cursor position:
44.350°N
26.032°E

X: 1203 Y: 1336

Sun zen: 66.2° Sun az: 248.3°

Distance: 0.3mi 0.5km 0.3nm

Mag: Size: 295°

Plane information:
IR 195

Temperature: -41.9°C (-43.4°F)

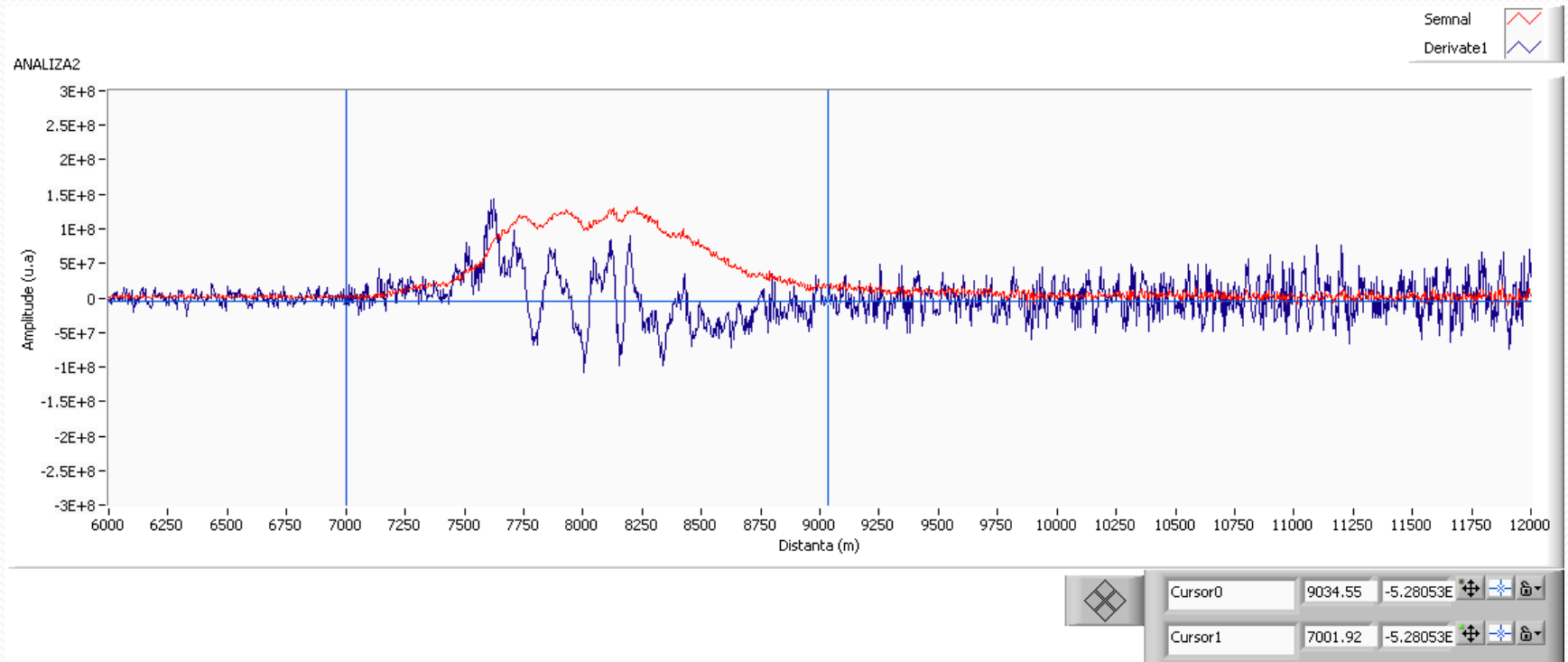
Product classification

Product:
PDU5 IR cloud height, higher levels
9.5 km x 1000

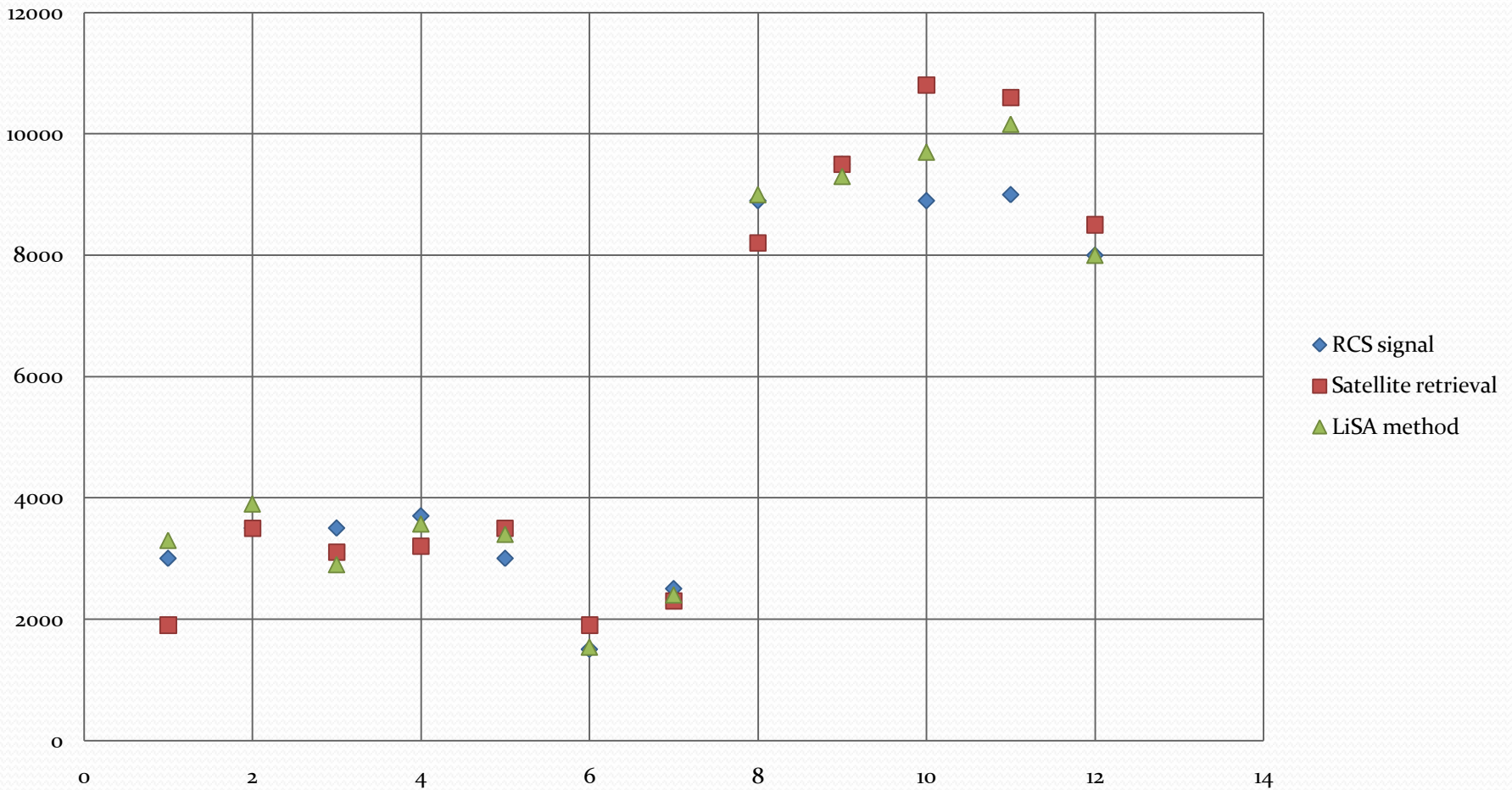
System: LISA

Detection mode: an, Polarization: total
length: 00532nm, Detection wavelength: 00532nm
resolution: 15.00m, Temporal resolution: 60s
Magurele, Latit. 44.348N, Long. 26.029E, Local alt: 0093m asl

High clouds



Comparison between lidar and satellite data



Differences between derivate of RCS signal (LiSA method) and satellite retrieval

$\mu=497,5$ m

SD= 405.64 m

Conclusions

- These preliminary analyses underline that both techniques passive and active can estimate cloud top height within a 0.65 km differences.
- Combining these techniques with LiSA model we can improve the accuracy of cloud top height estimation at ± 0.49 Km.
- The accuracy of heights obtained from satellite imagery is limited by the accuracy of the vertical atmospheric temperature profile and surface temperature.
- The study will be continued using several satellite channels to estimate cloud top height and more cases in order to overcome systems limitations and to improve the satellite cloud estimation.