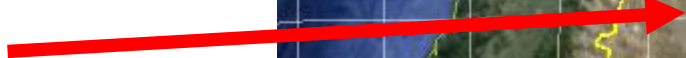


CALBUCCO VOLCANO and AUGER Raman lidar

V. Rizi for CRLF people and AUGER collaboration.
vincenzo.rizi@aquila.infn.it

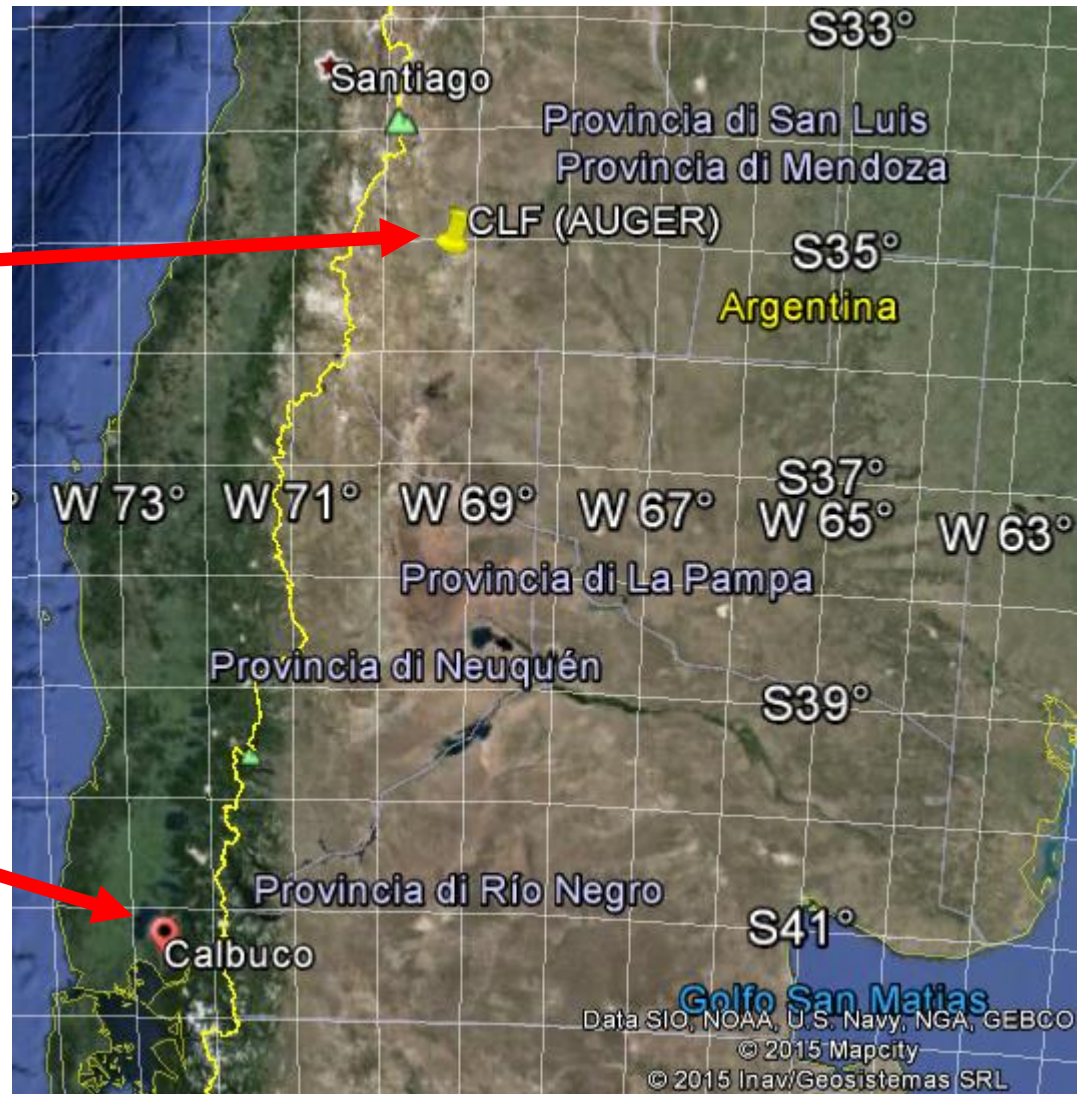
UPDATE
April 29, 2015.

Raman lidar



CALBUCO VOLCANO
41°19'48"S 72°37'06"W

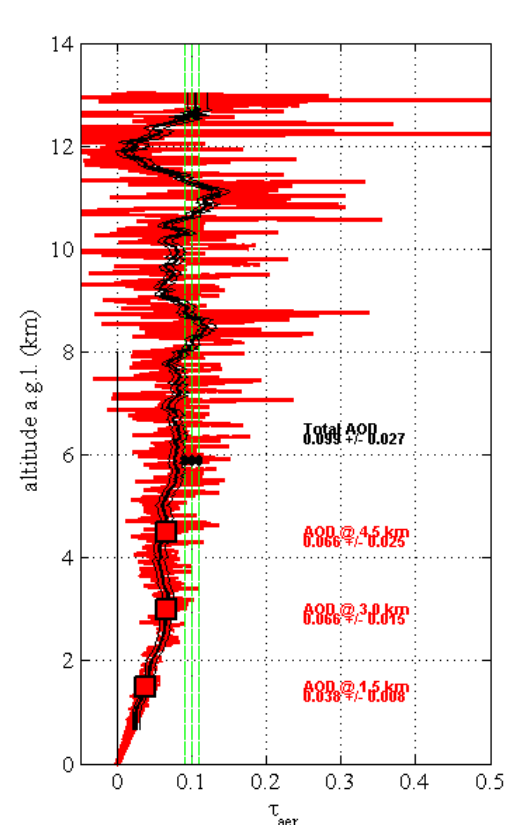
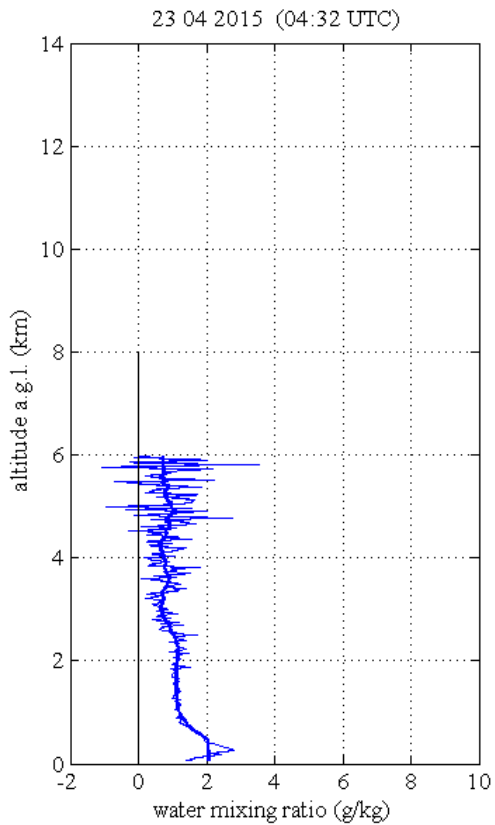
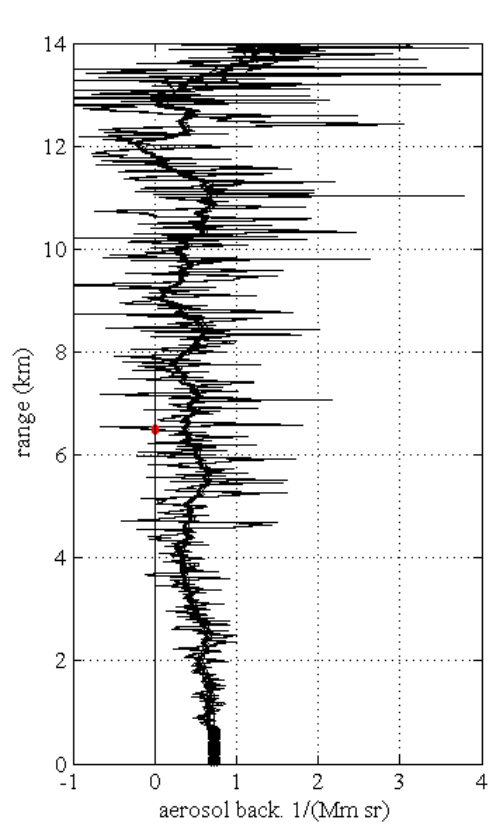
Main eruptions:
April 22, 2015 18:00 LT 21:00 UTC
April 23, 2015 01:00 LT 04:00 UTC

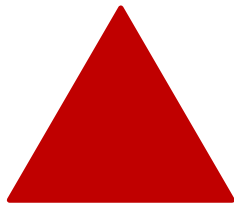


**Available Raman lidar measurements at CRLF (35°16'50.65" S 69°20'12.26" W)
after Calbuco eruptions.**

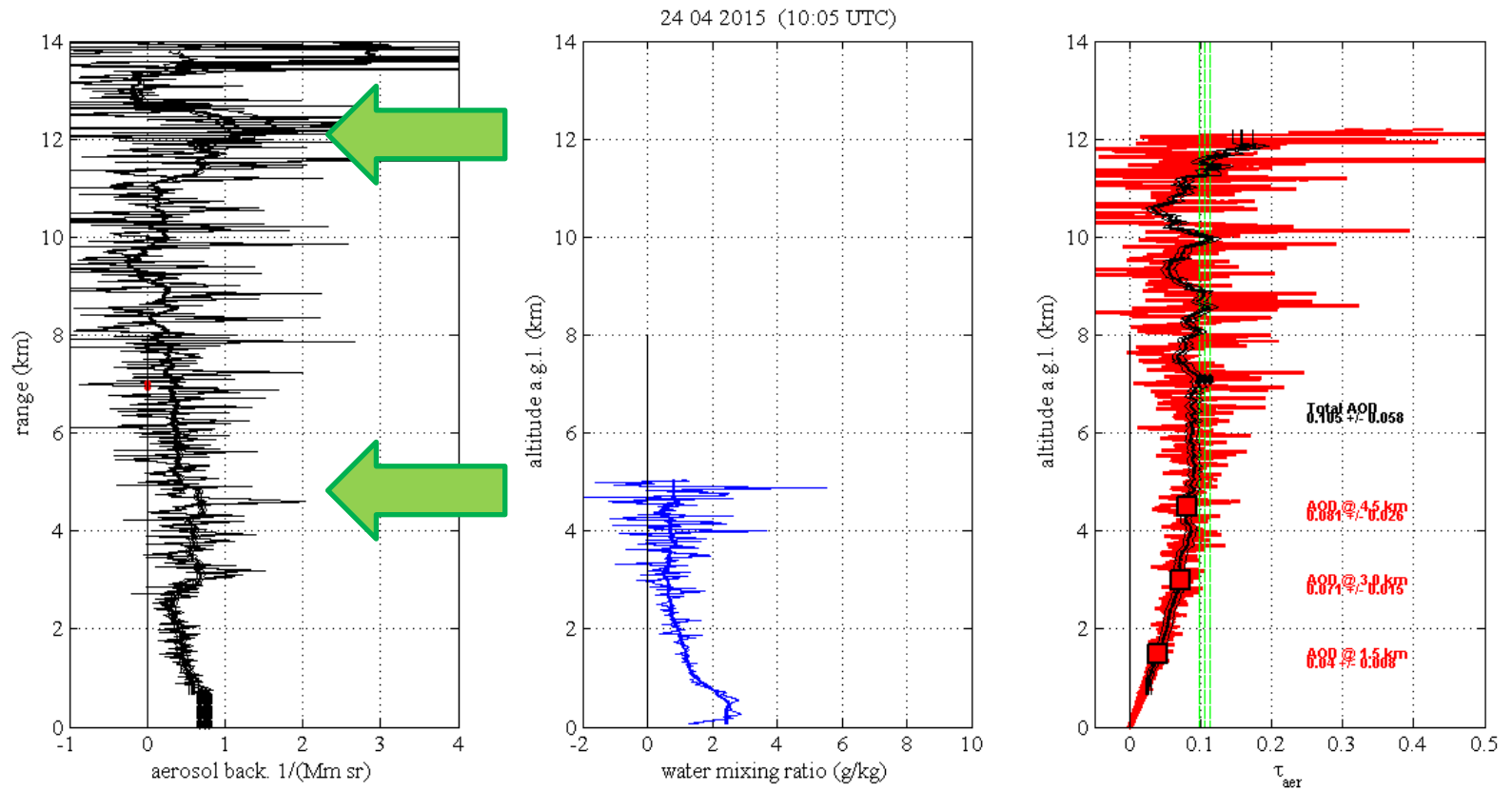
day	month	year	hh:mm UTC	acquisition	
23	04	2015	04:32	12 min	background
24	04	2015	10:05	12 min	possible ash layers (3-8 and 12 km agl)
24	04	2015	22:34	12 min	cloud/ash layers (4 km agl)
25	04	2015	04:32	12 min	cloud/ ash layers (4 km agl)
25	04	2015	10:05	12 min	ash layers (5-6 km agl)
25	04	2015	22:34	12 min	ash layers (5 and 9 km agl)
26	04	2015	04:32	12 min	background
26	04	2015	10:05	12 min	background
26	04	2015	22:34	12 min	cloud/ ash layers (8 km agl)
27	04	2015	04:32	12 min	cloudy
27	04	2015	10:05	12 min	cloudy
28	04	2015	01:03	48 min	cloudy

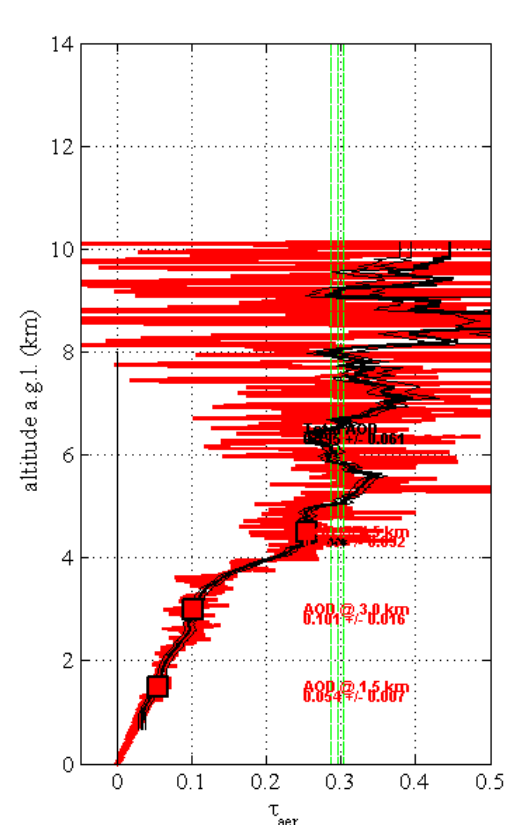
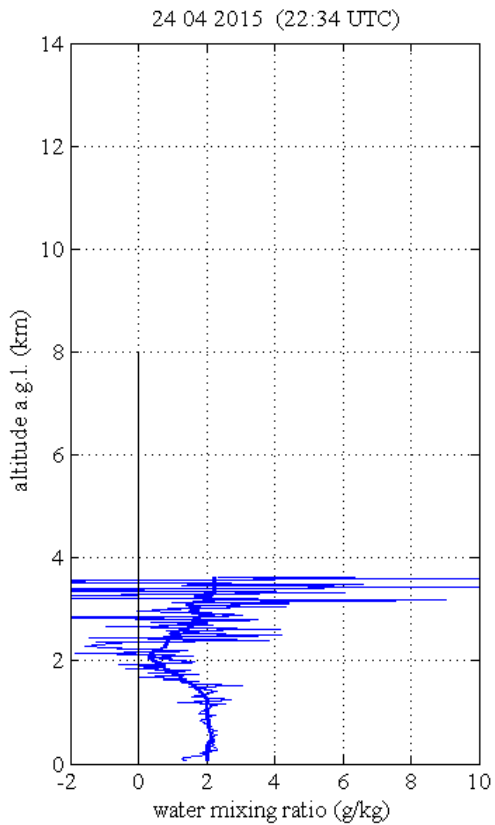
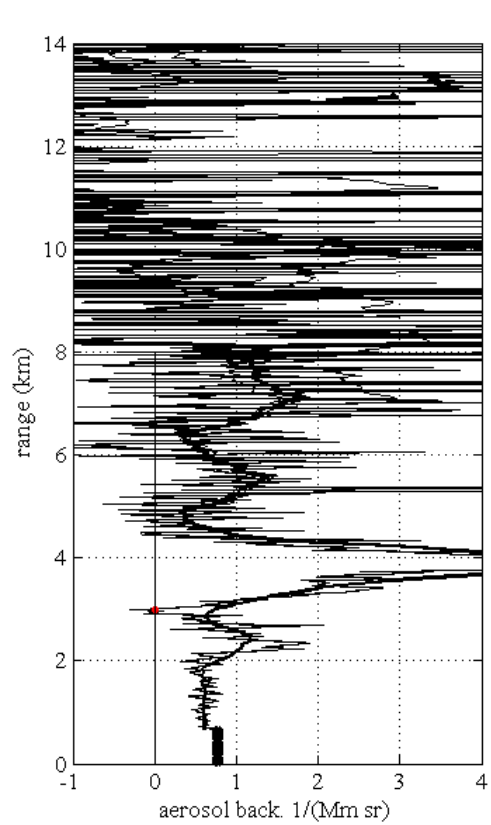
Vertical profiles of aerosol backscatter coefficient, water vapour and aerosol optical depth in the following plots.

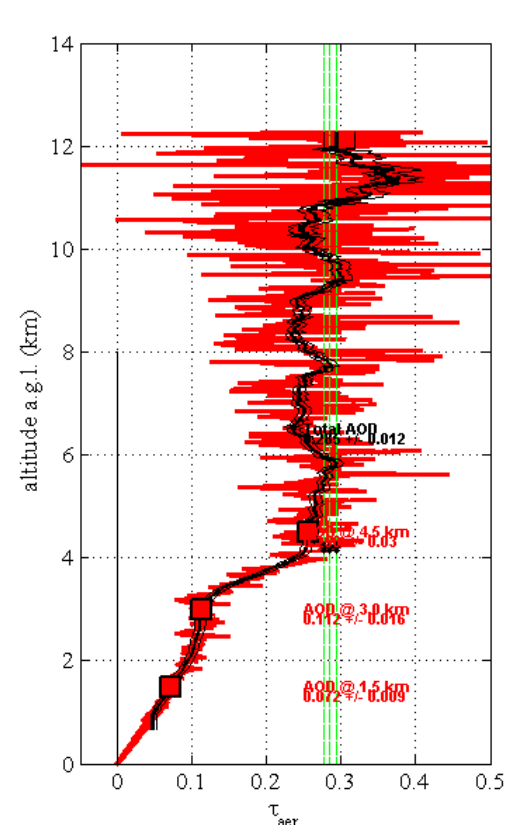
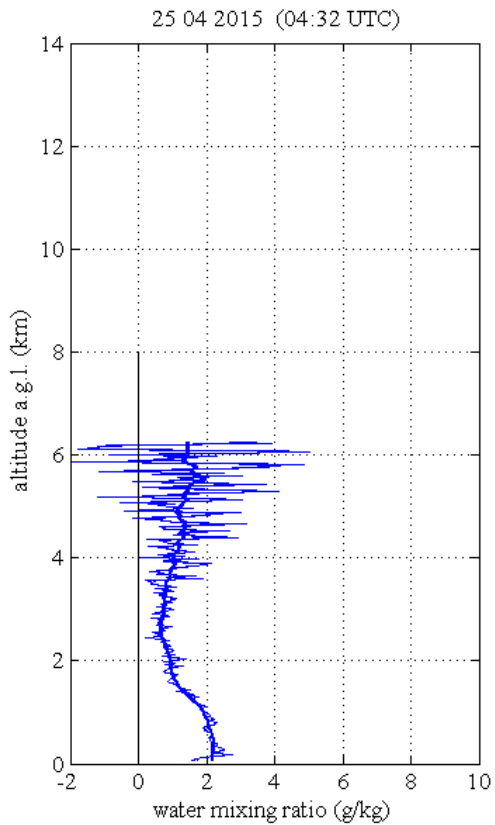
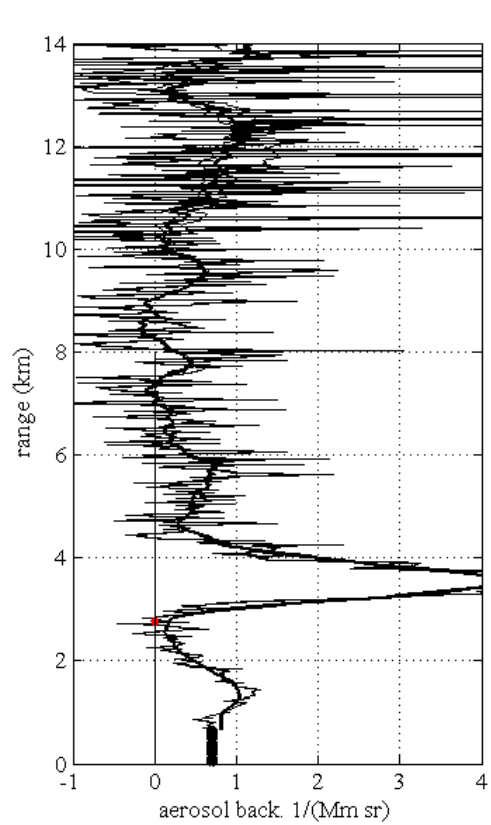


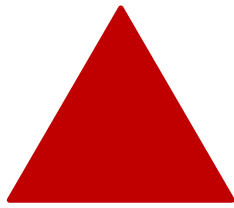


possible ash layers (3-8 and 12 km agl)

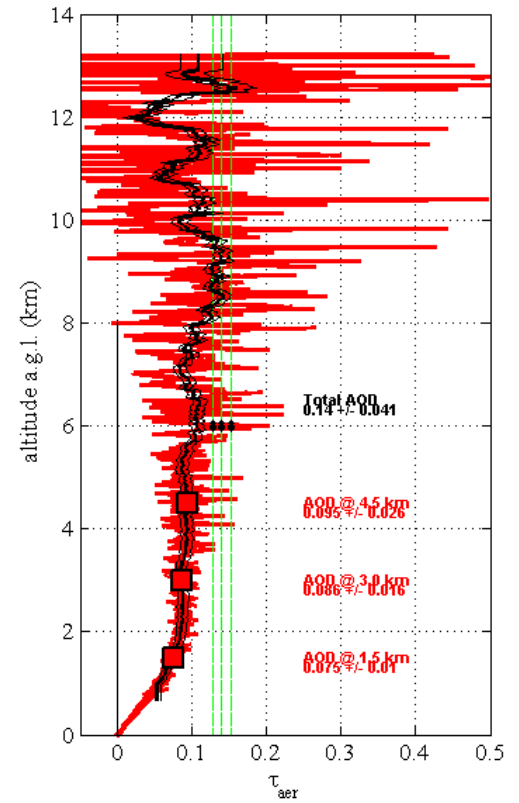
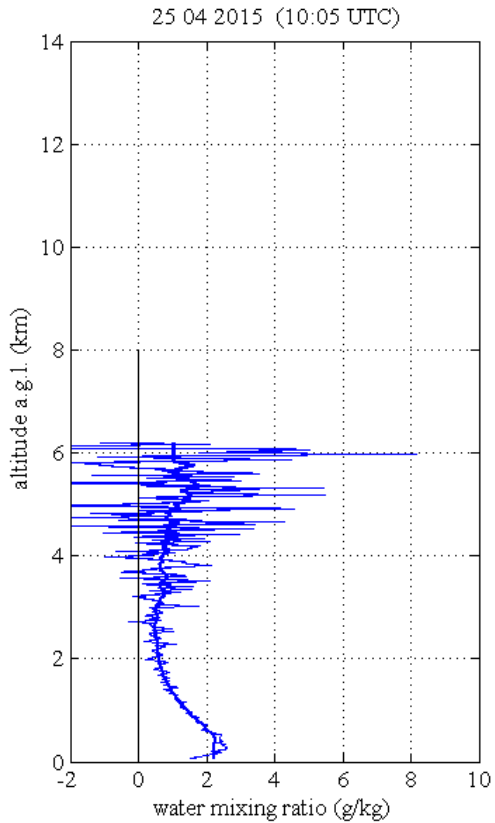
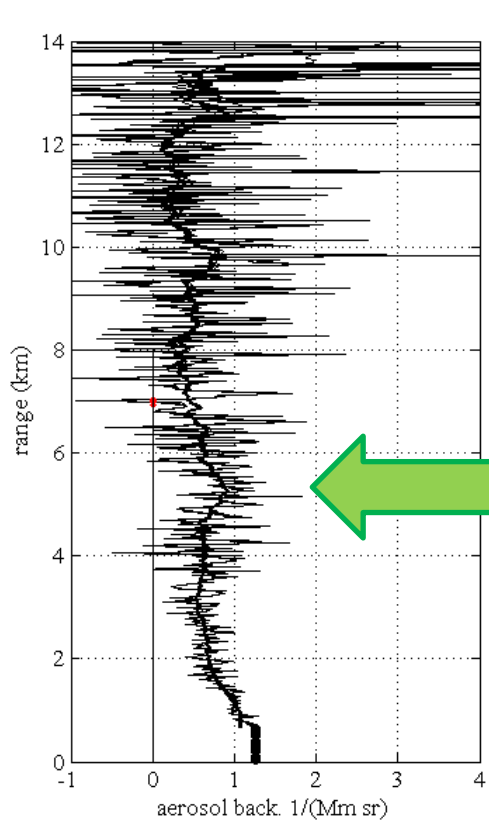


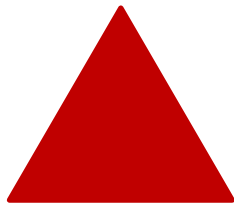




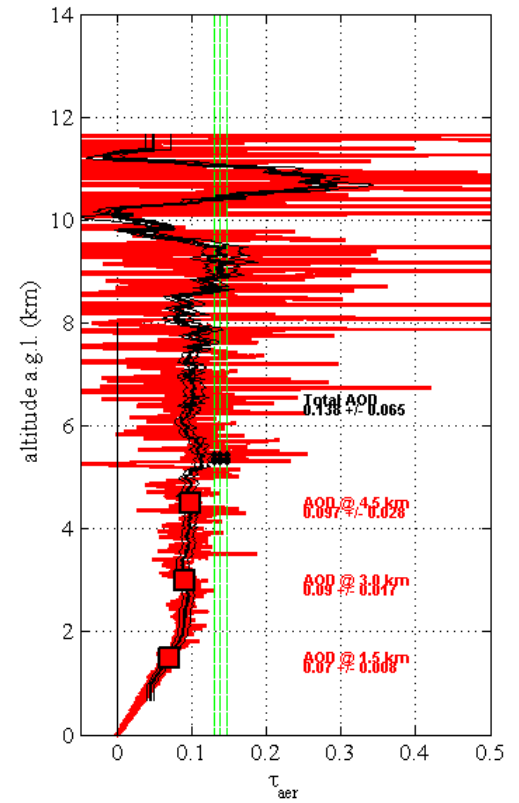
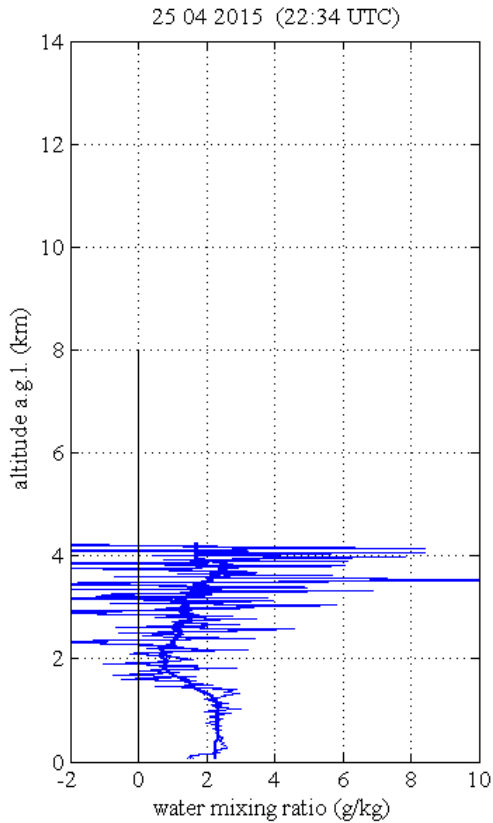
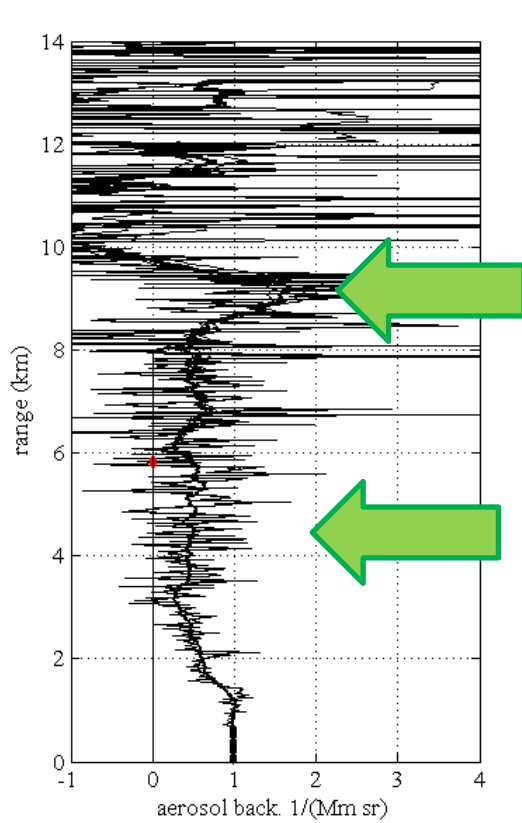


ash layers (5-6 km agl)

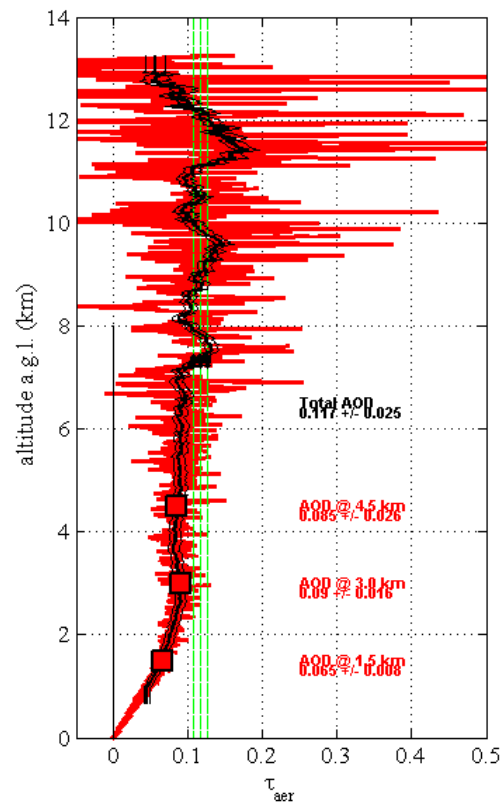
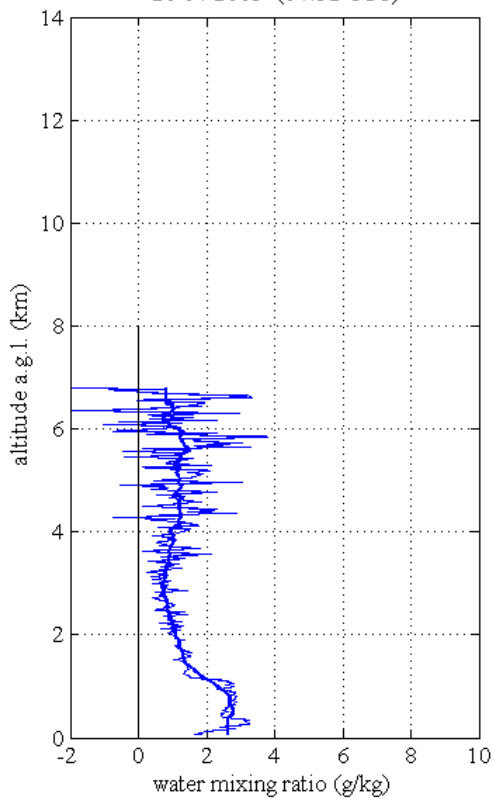
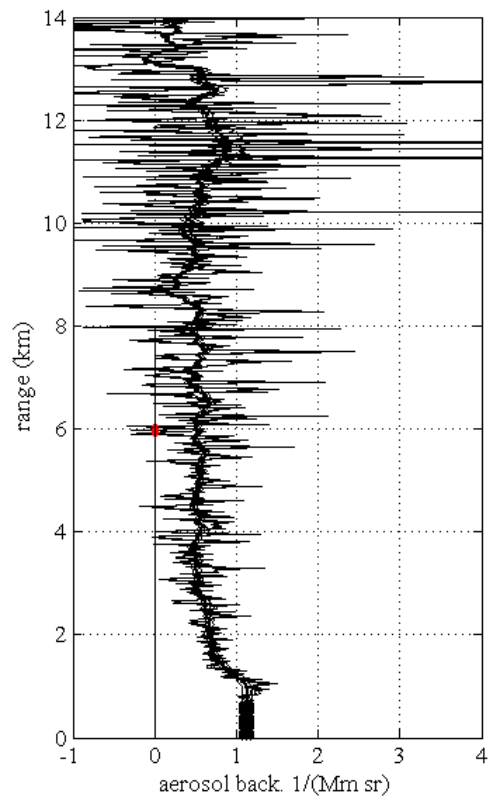


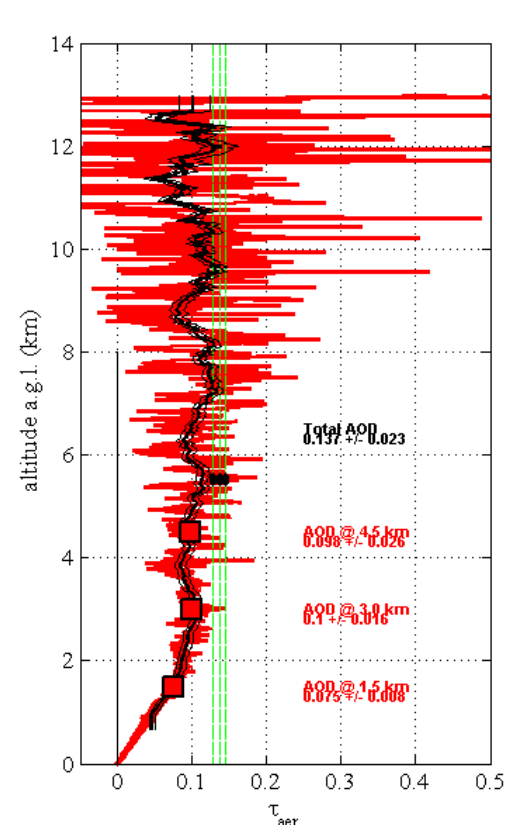
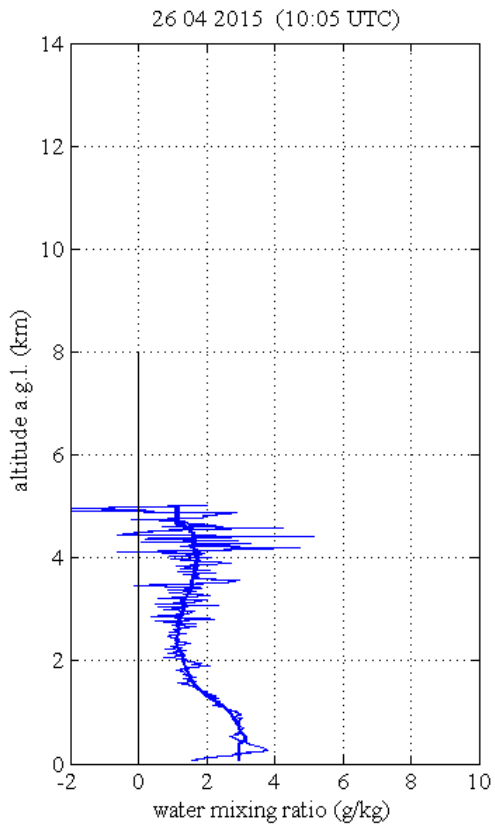
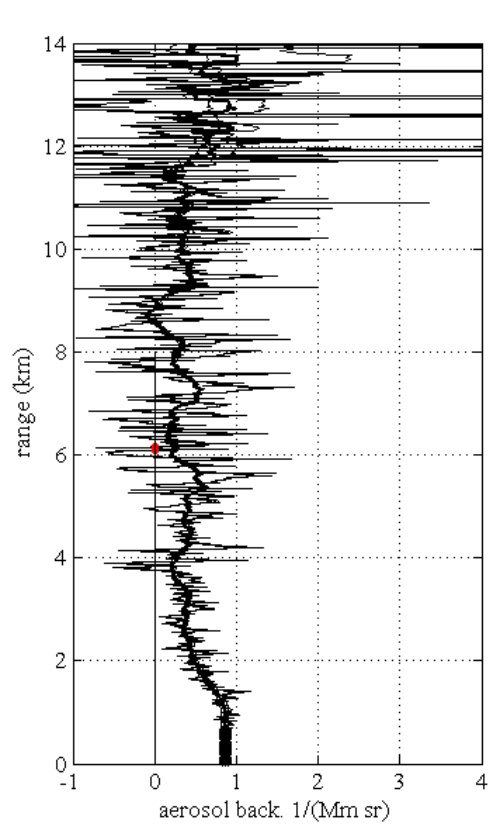


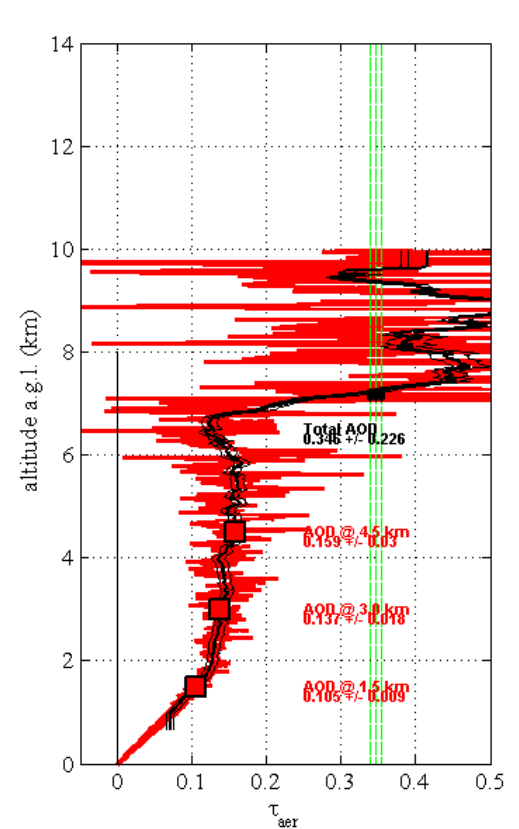
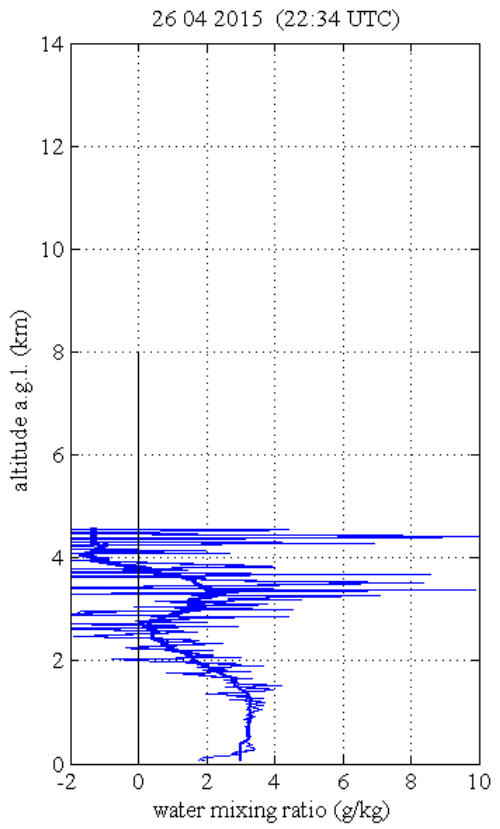
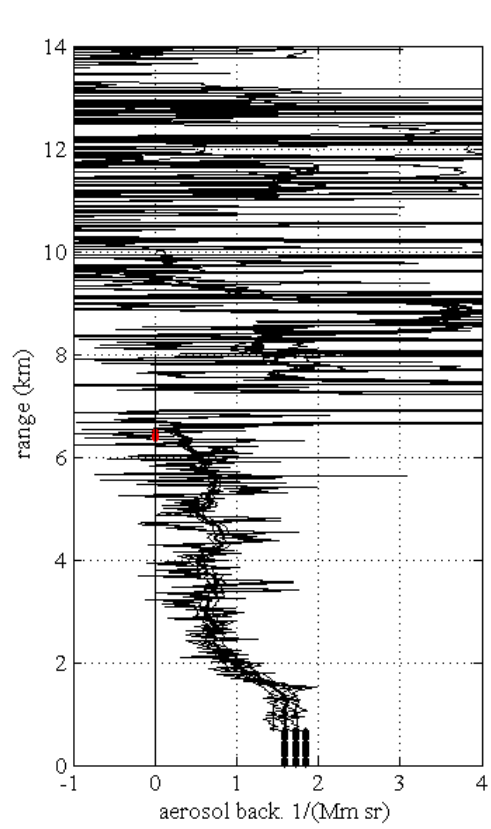
ash layers (5 and 9 km agl)



26 04 2015 (04:32 UTC)





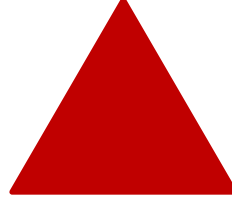
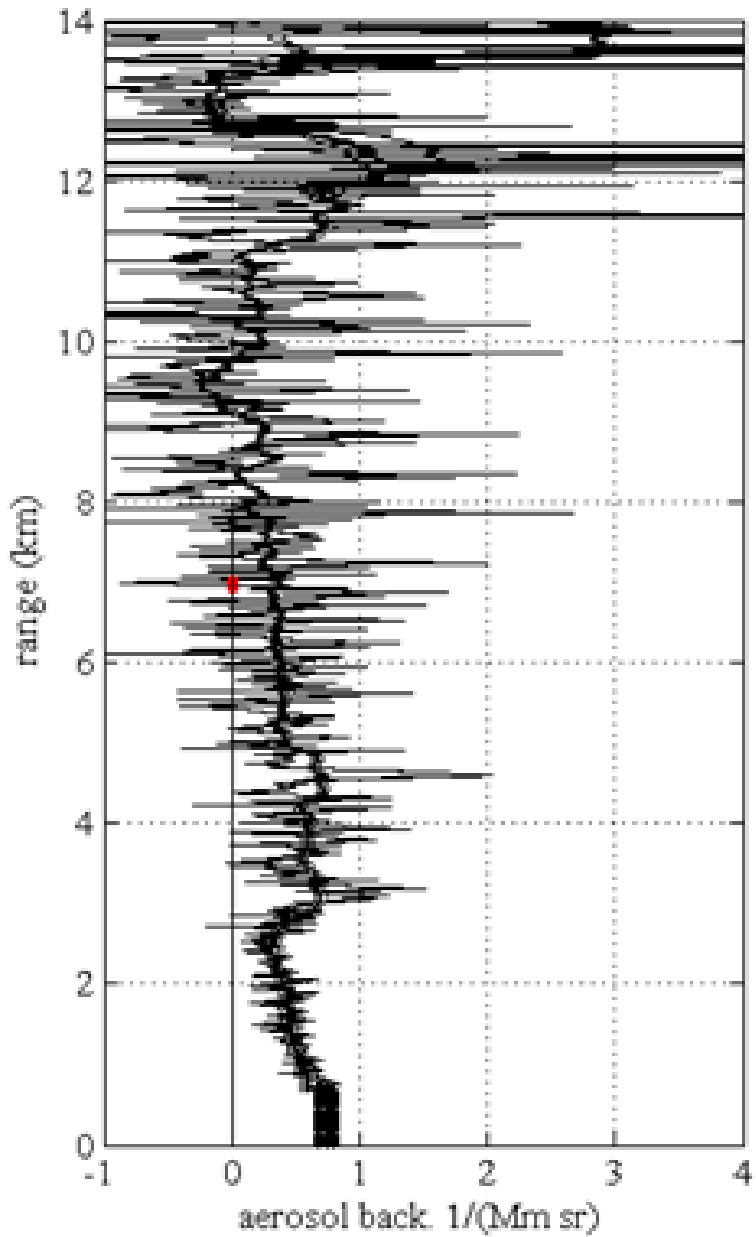


MORE DETAILS

about the (possible) observations of volcanic ash layers.

- vertical profiles of aerosol backscatter coefficient;
 - analysis (also aerosol extinction and lidar ratio profiles, + vertical resolution)
 - backward trajectories of the airmasses sampled by the Raman lidar
- in the following plots.

24/04/2015 10:05 UTC

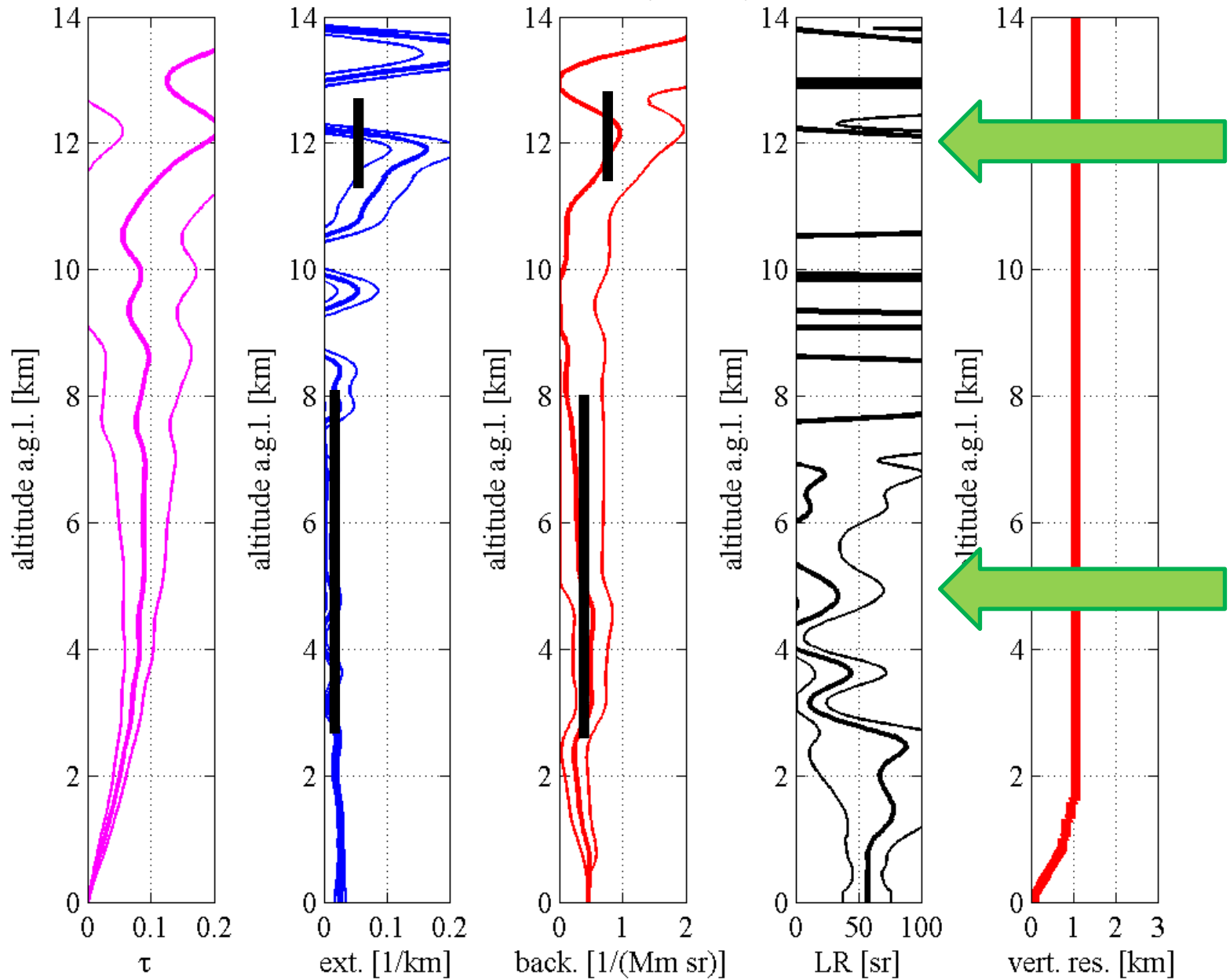


possible ash layers (3-8 and 12 km agl)



ANALYSIS

24 04 2015 (10 UTC)



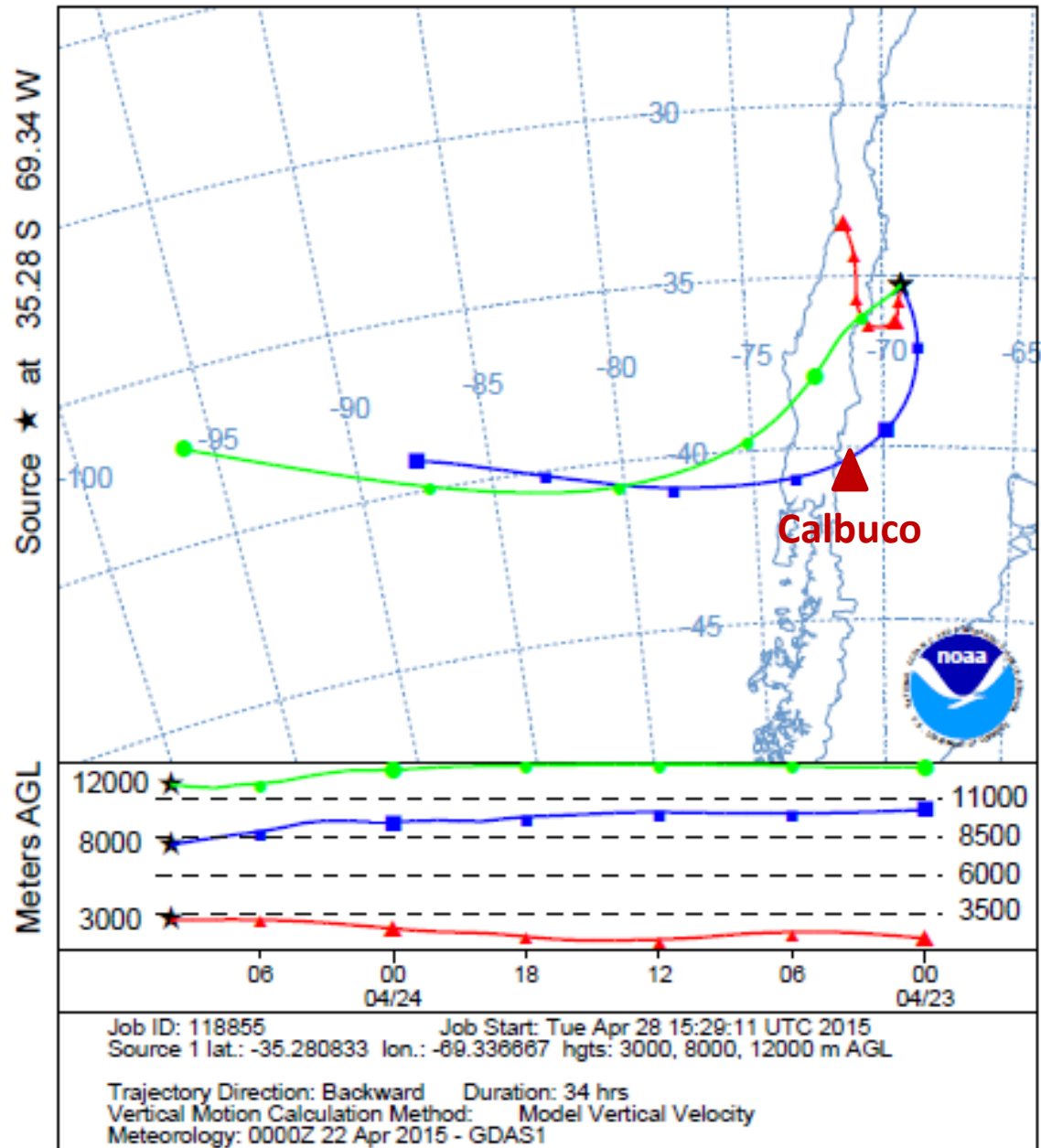
BACK-TRAJECTORIES

The air masses sampled by the Raman lidar at about 8 km agl have passed over the Calbuco area (at about 10 km agl) 18 hours after the main eruptions.

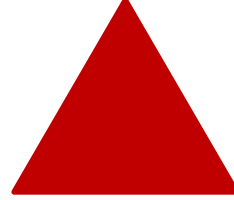
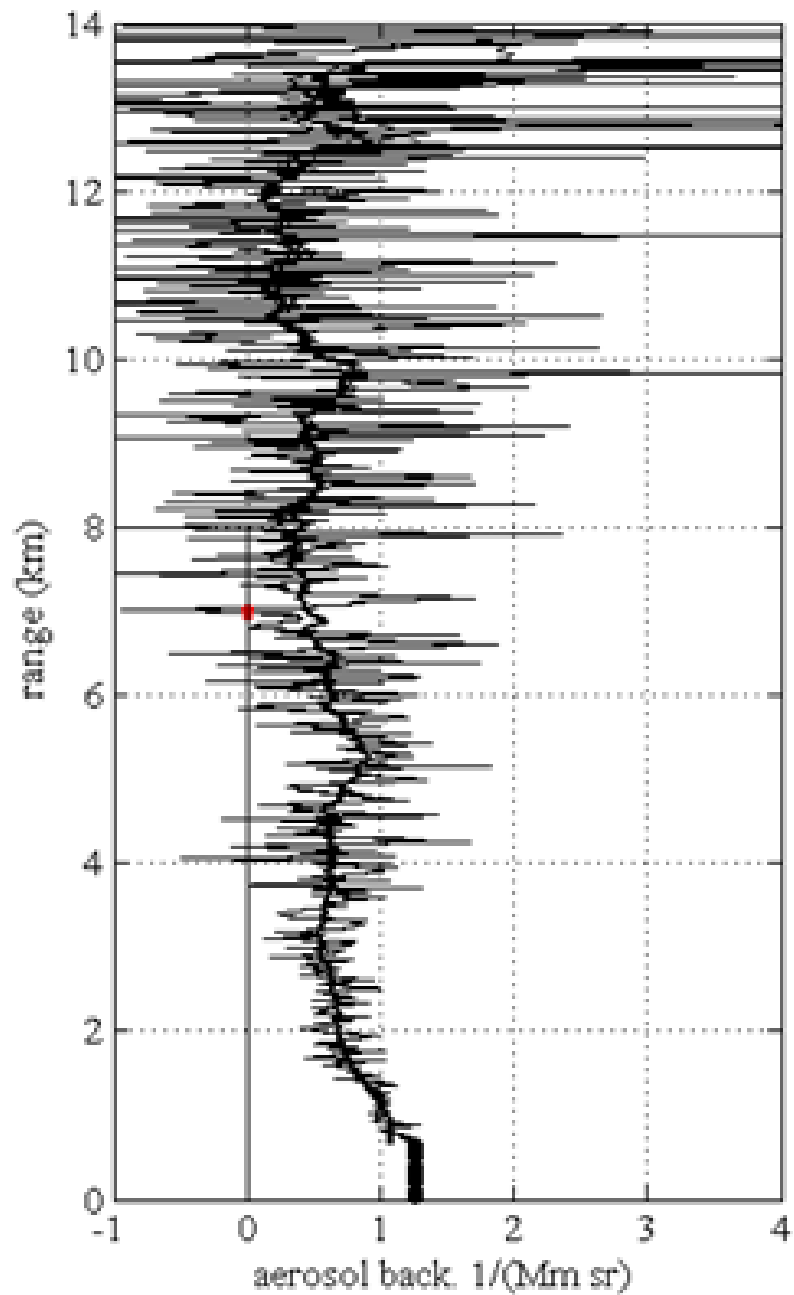
It is possible that they contain volcanic aerosols!

No information from lidar ratio estimations because of large errors.

NOAA HYSPLIT MODEL
Backward trajectories ending at 1000 UTC 24 Apr 15
GDAS Meteorological Data



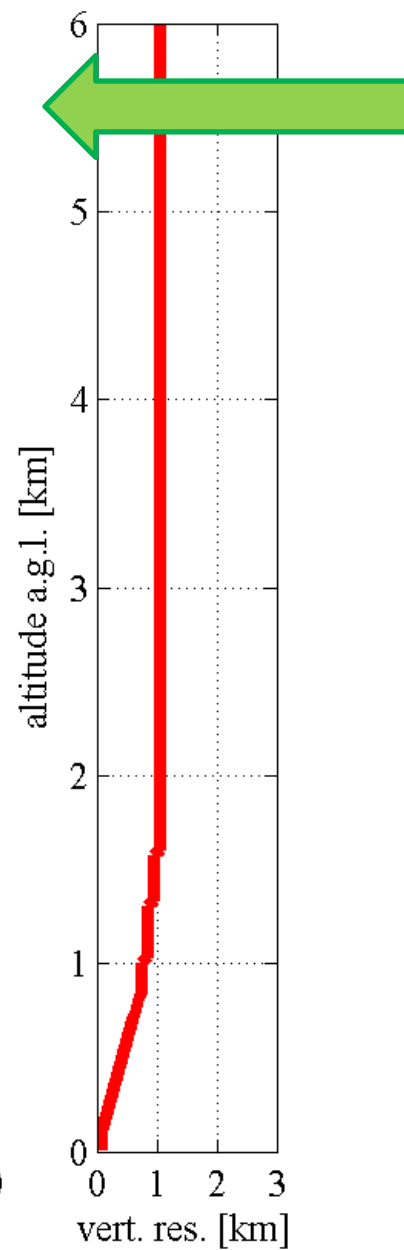
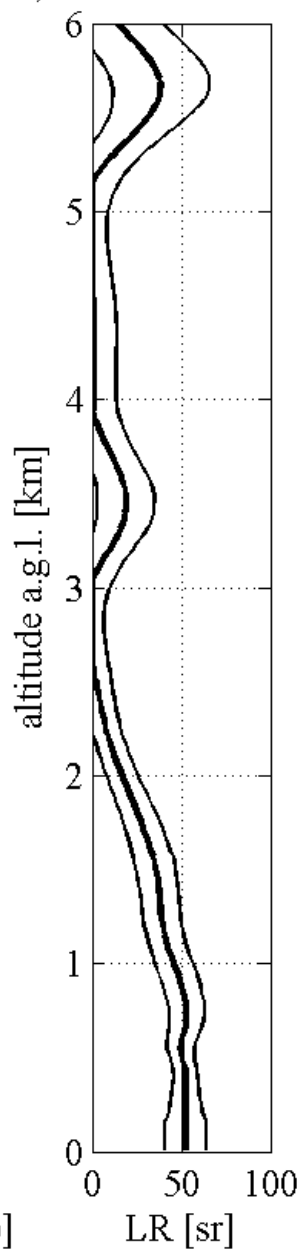
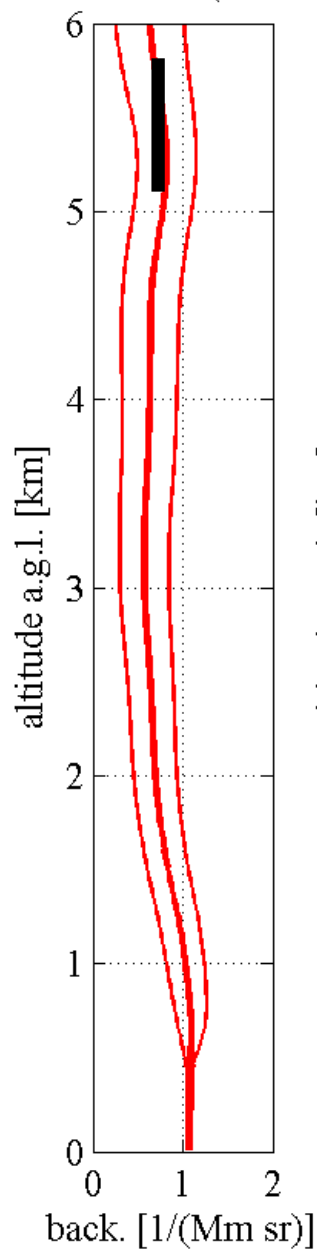
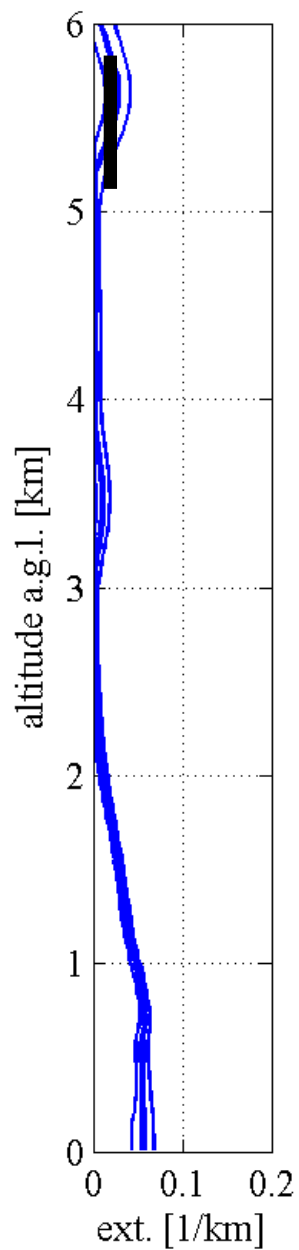
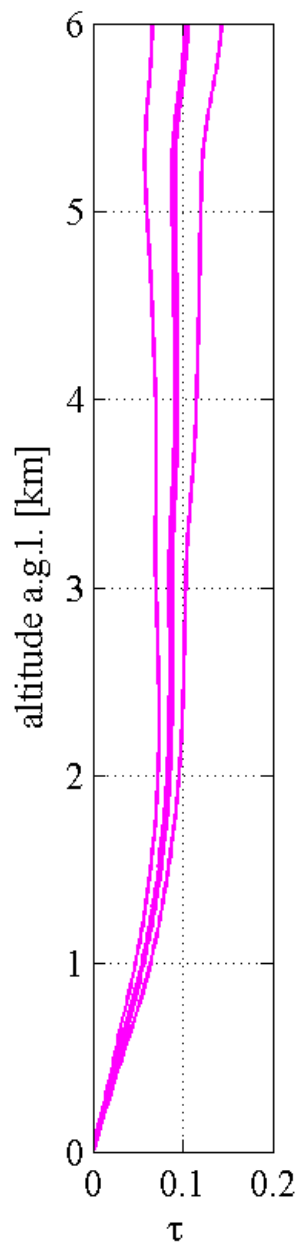
25/04/2015 10:05 UTC



ash layers (5-6 km agl)



25 04 2015 (10 UTC)



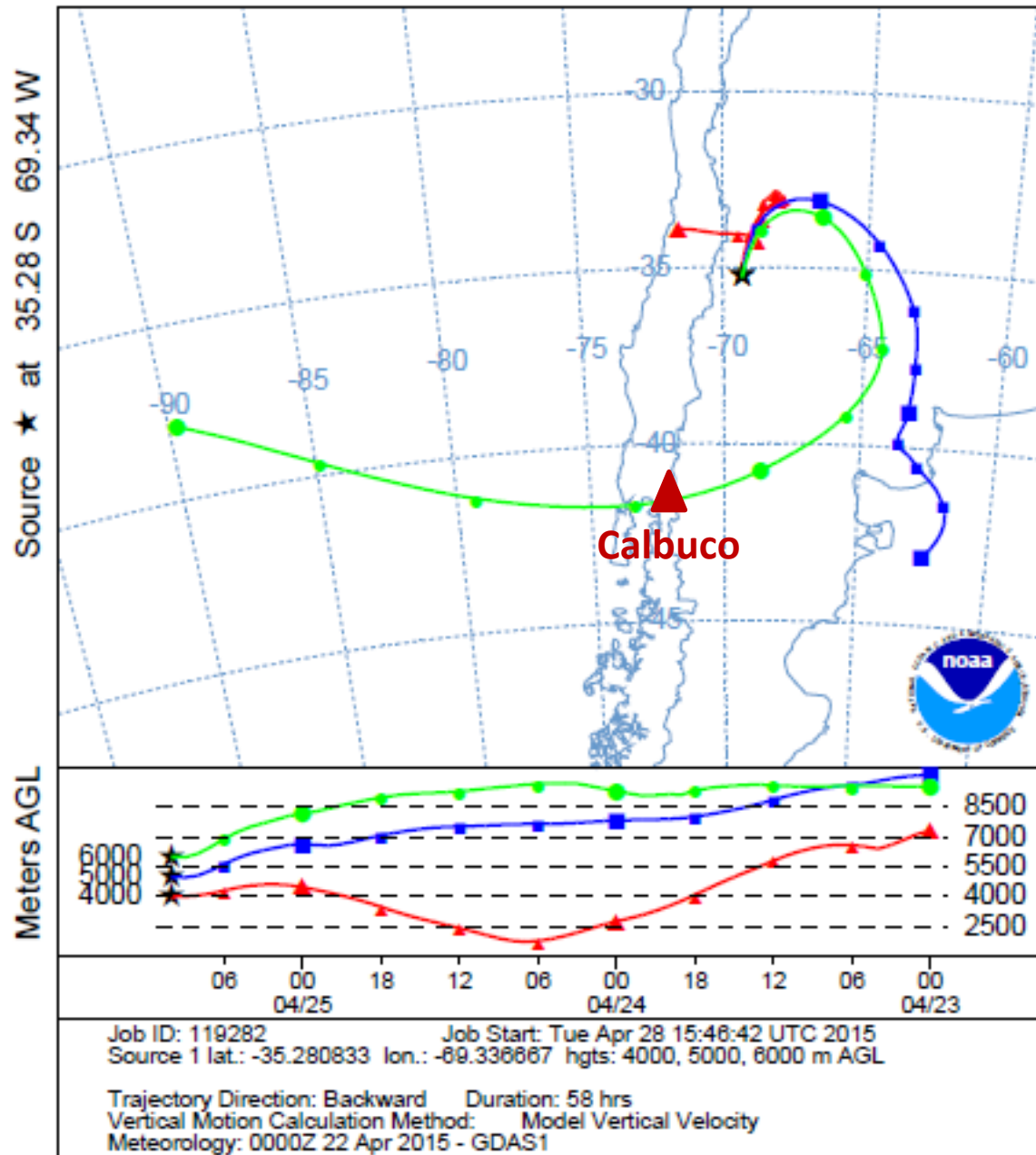
BACK-TRAJECTORIES

The air masses sampled by the Raman lidar at about 6 km agl have passed over the Calbuco area (at about 9 km agl) 18 hours after the main eruptions.

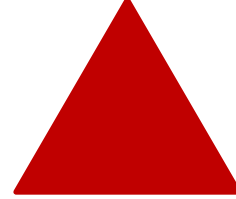
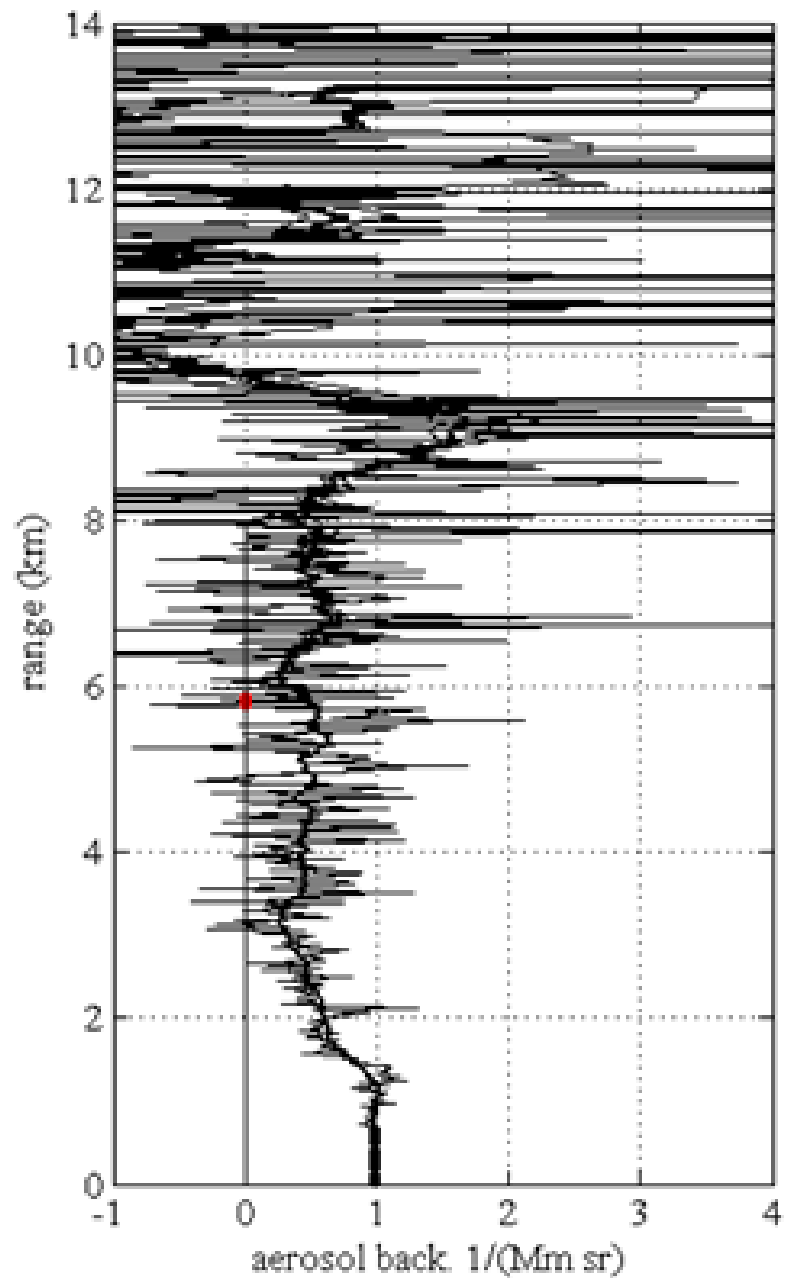
It is possible that the Raman lidar has observed a layer containing volcanic aerosols.

The lidar ratio of these aerosol particles is about 40 +/- 20 sr (relatively fresh volcanic ash).

NOAA HYSPLIT MODEL
Backward trajectories ending at 1000 UTC 25 Apr 15
GDAS Meteorological Data



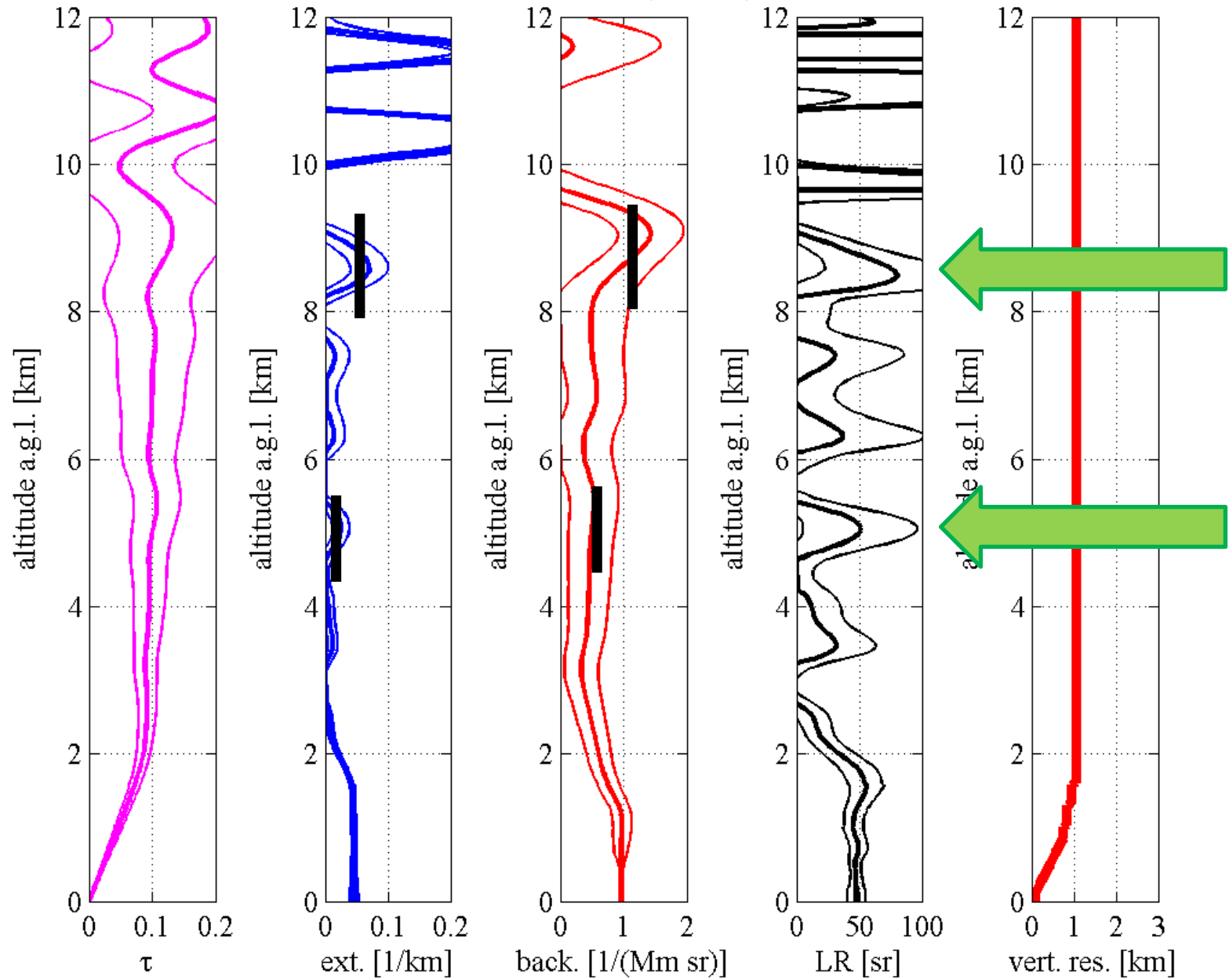
25/04/2015 22:34 UTC



ash layers (5 and 9 km agl)



25 04 2015 (22 UTC)



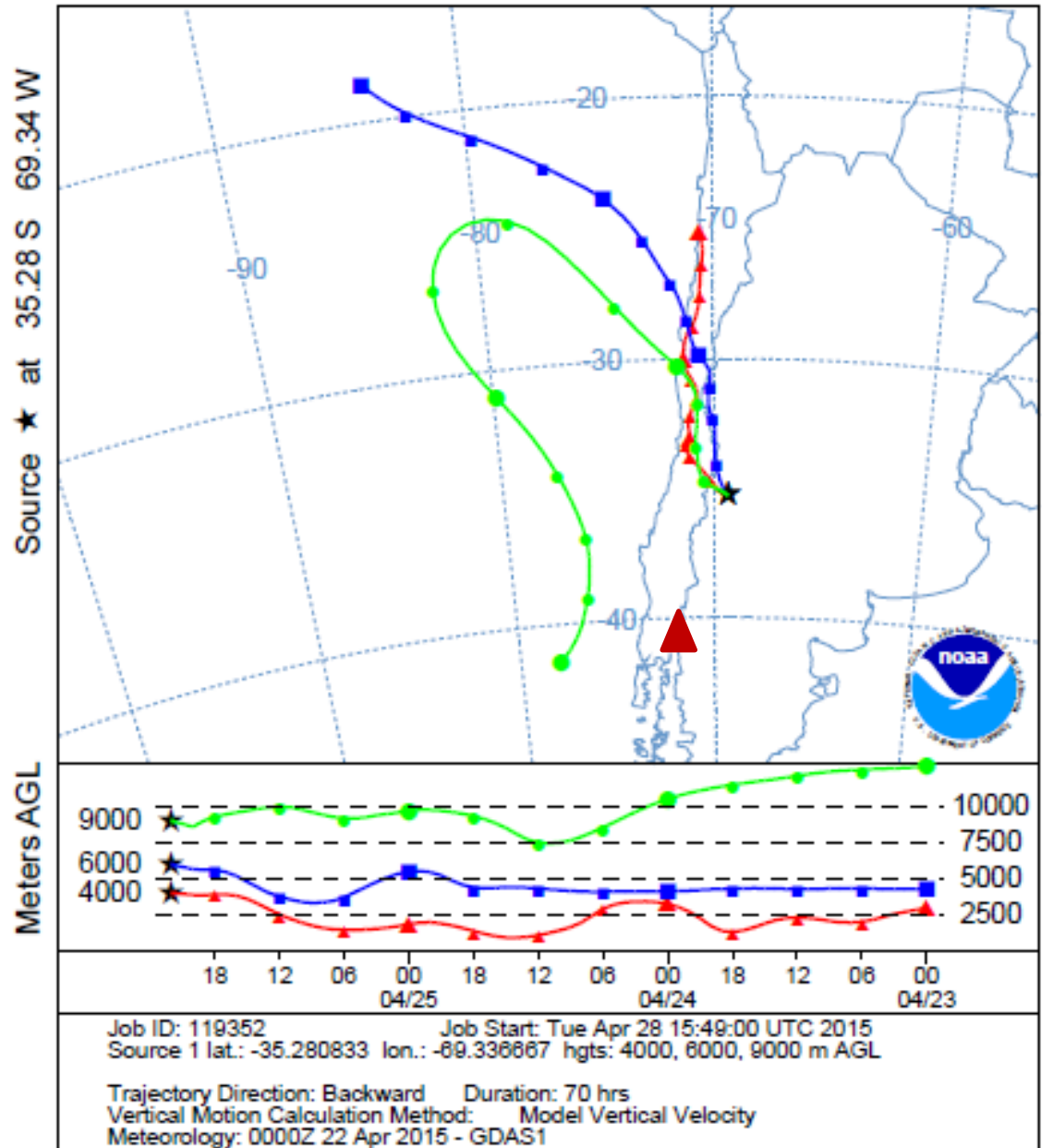
BACK-TRAJECTORIES

The air masses sampled by the Raman lidar are originated from regions far from Calbuco, maybe the one arriving over the Raman lidar at 9 km agl was close to the Calbuco area in the periods of the main eruptions.

The Raman lidar has sampled volcanic aerosol at 9 km agl?

The lidar ratio of the aerosol particles in this layer is about 70 +/- 30 sr (aged volcanic ash?).

NOAA HYSPLIT MODEL
Backward trajectories ending at 2200 UTC 25 Apr 15
GDAS Meteorological Data



Some conclusions.

The Raman lidar of the P. Auger Observatory, that it is automatically run along the data taking periods of the Observatory, has observed in 3 occasions aerosol layers that can contain particles originated by the Calbuco main eruptions.

The backward airmass trajectories confirm such interpretations.

The Raman lidar has taken measurements for short time periods (to not interfere with Observatory) and the estimations of the lidar ratio of the detected volcanic ash are affected by large errors.

The Auger Raman lidar is now taking measurement in «atmospheric mode», i.e. longer data taking periods.

April 29, 2015