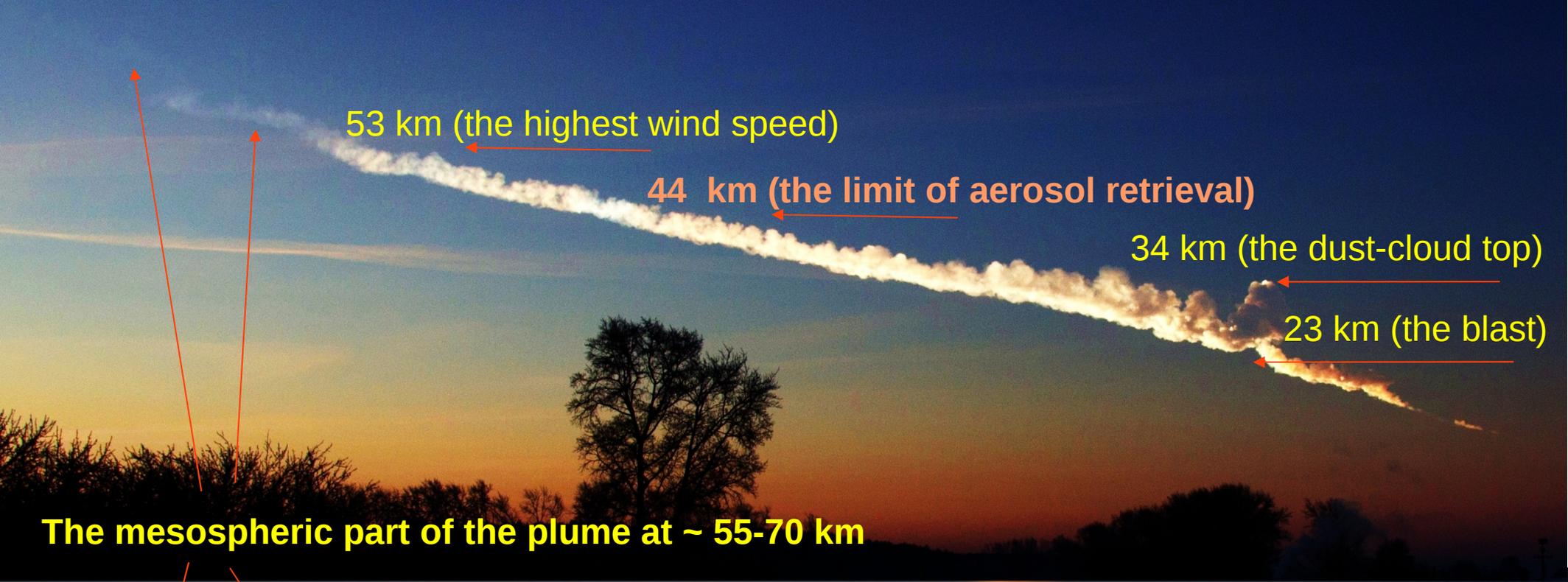


Spectral variations of the limb radiances due to bolides

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Motivation: extending the altitudinal sensitivity limit for aerosol detection and providing relevant info about spectral variability

- We clearly see the Chelyabinsk bolide plume as a **peak of radiances** at different wavelengths, or as a **peak of spectral ratio** (red/blue, e.g., 654nm/346nm).
- This spectral ratio allows to detect similar events at altitudes up to **~70 km**, while the aerosol retrieval algorithms are limited to **39 km** in the operational version and **44 km** in the research version.
- We can detect **bolides ~ 40-50 times smaller** than Chelyabinsk bolide



53 km (the highest wind speed)

44 km (the limit of aerosol retrieval)

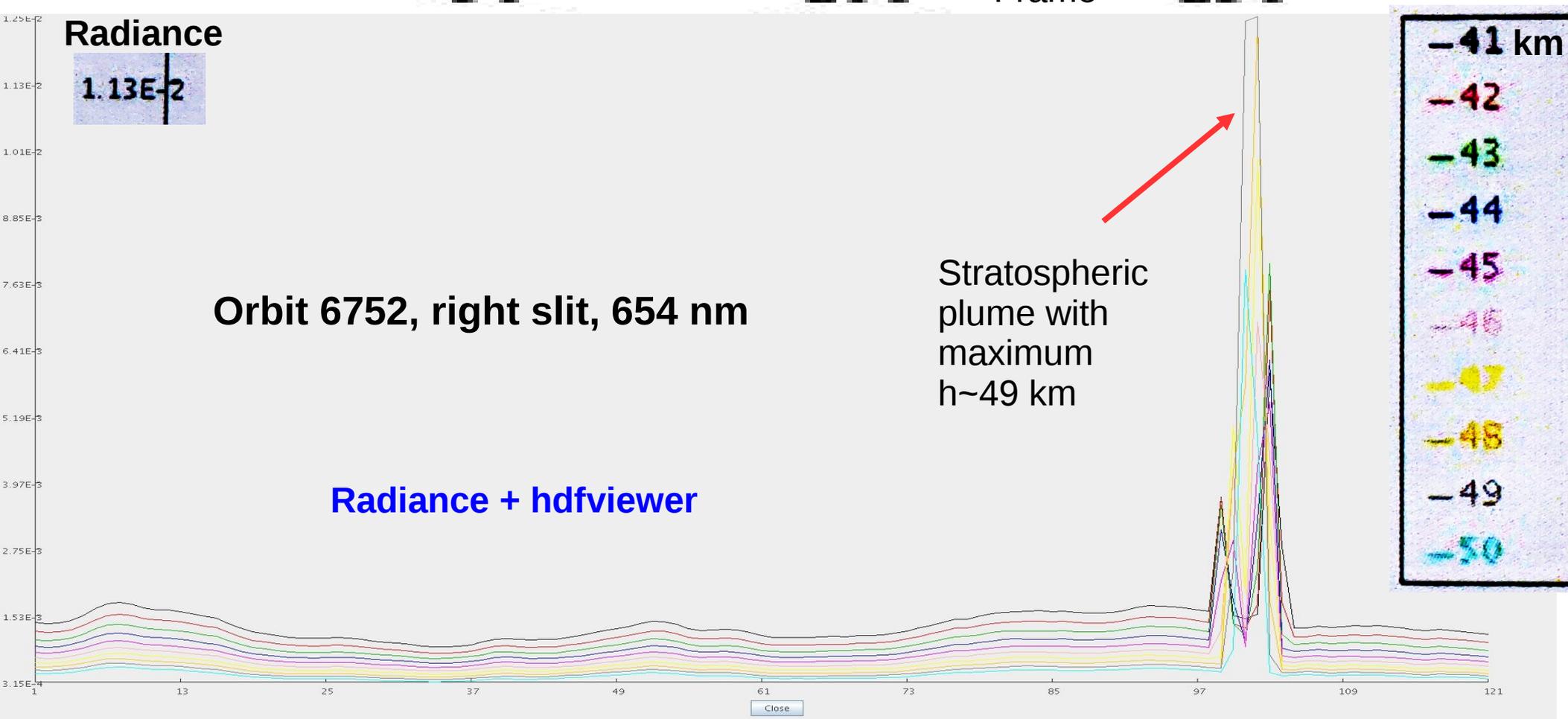
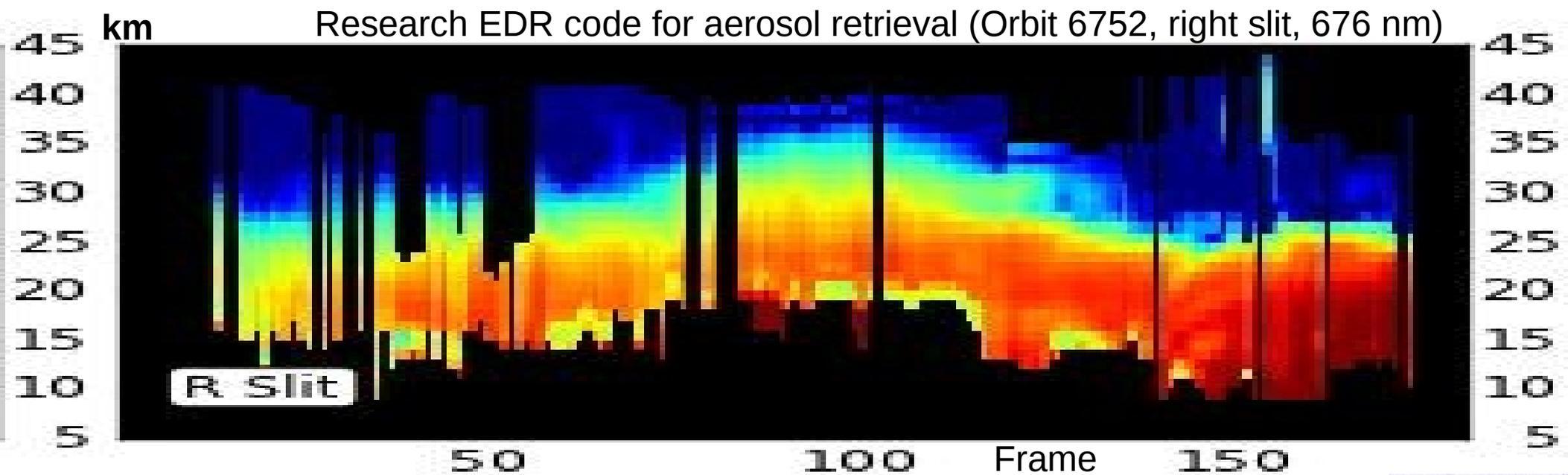
34 km (the dust-cloud top)

23 km (the blast)

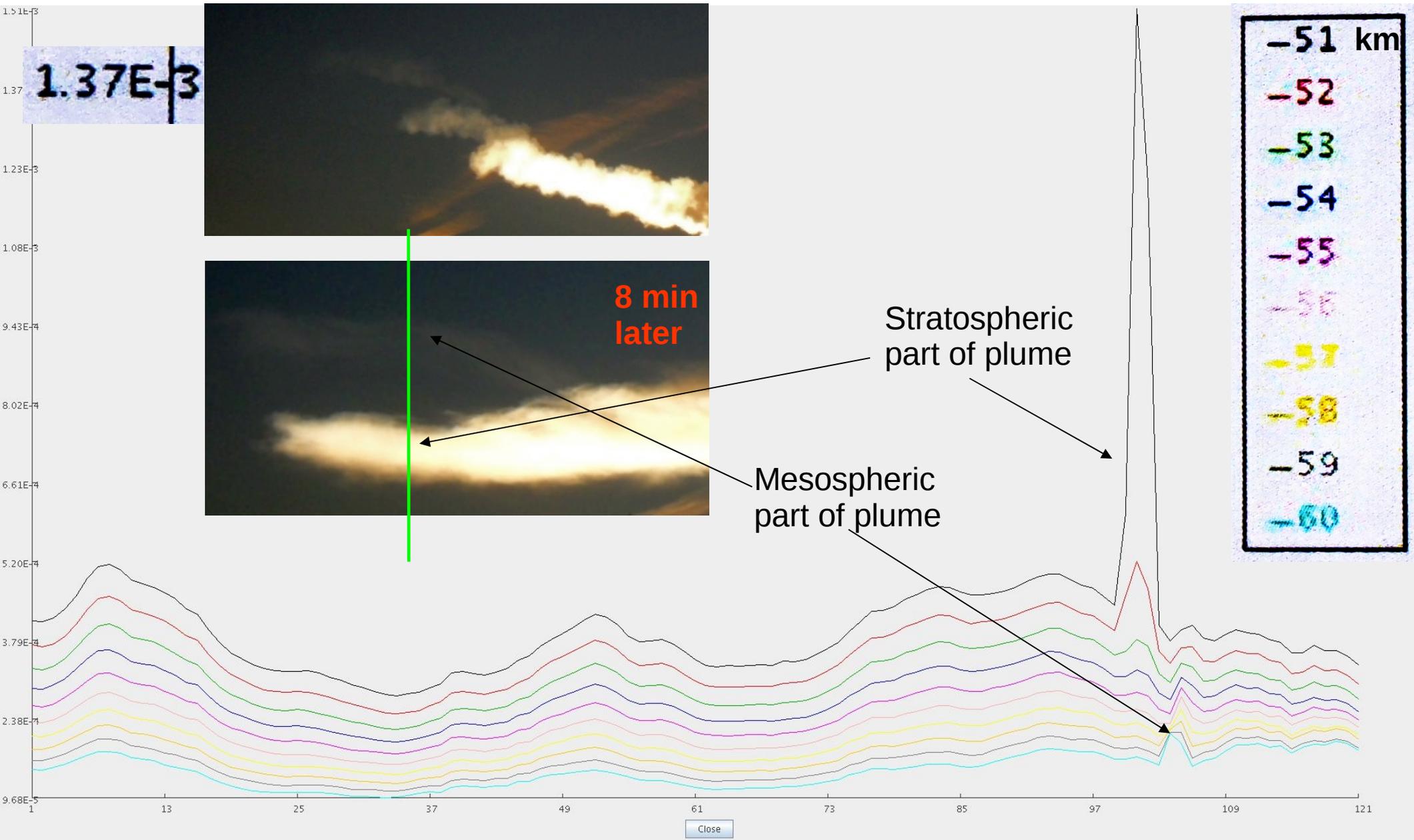
The mesospheric part of the plume at ~ 55-70 km



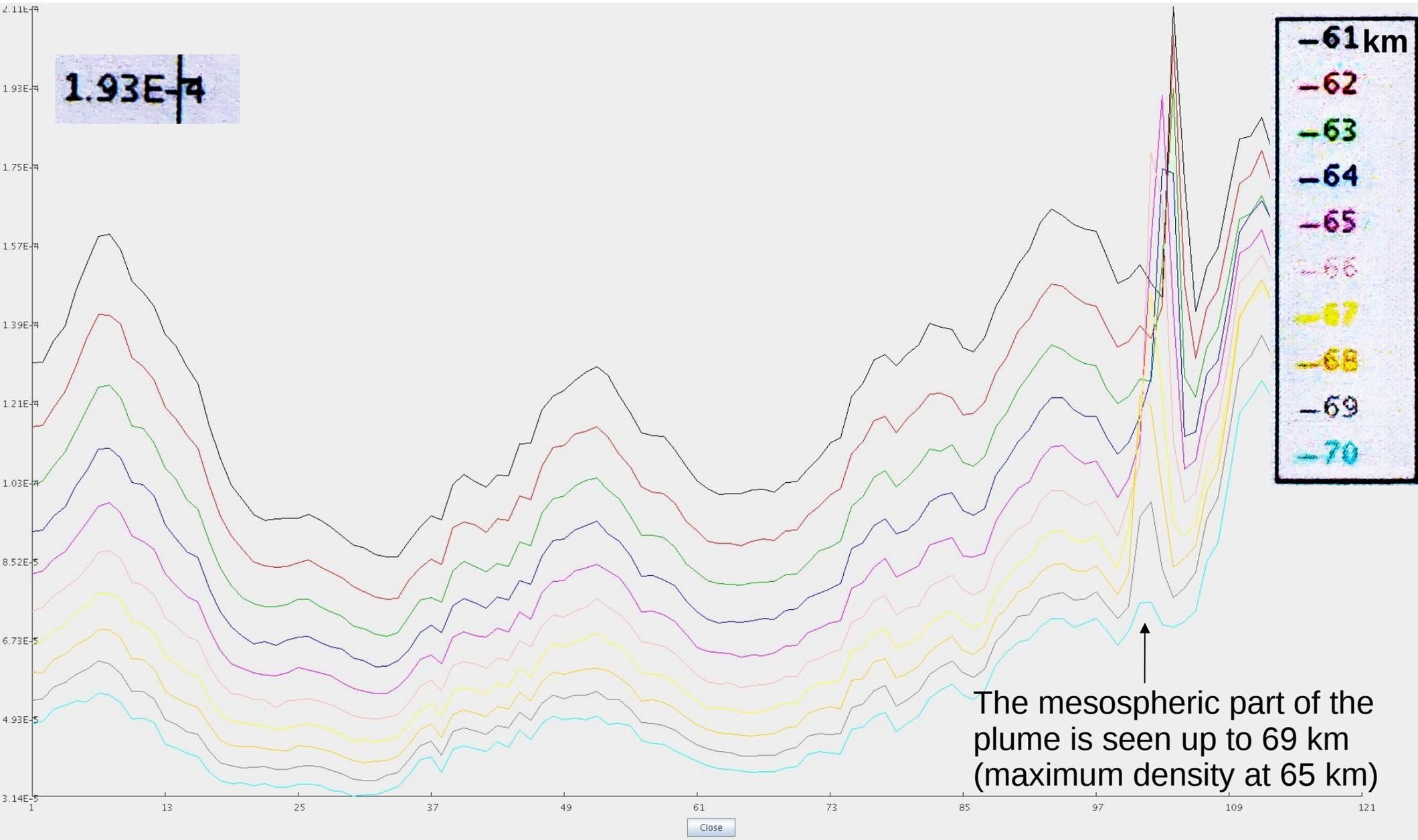
Research EDR code for aerosol retrieval (Orbit 6752, right slit, 676 nm)



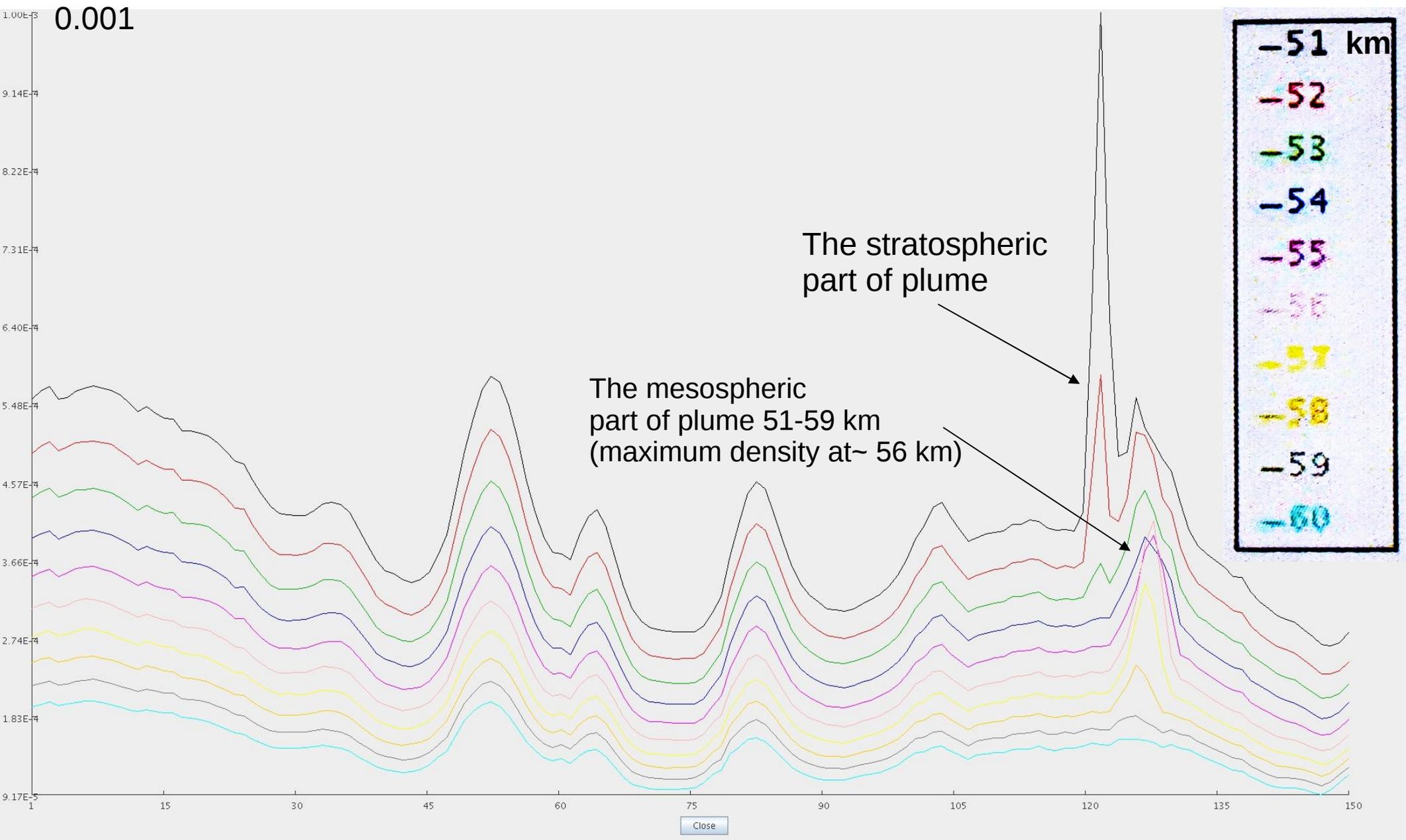
Orbit 6752 (right slit), 654 nm



Orbit 6752 (right slit), 654 nm



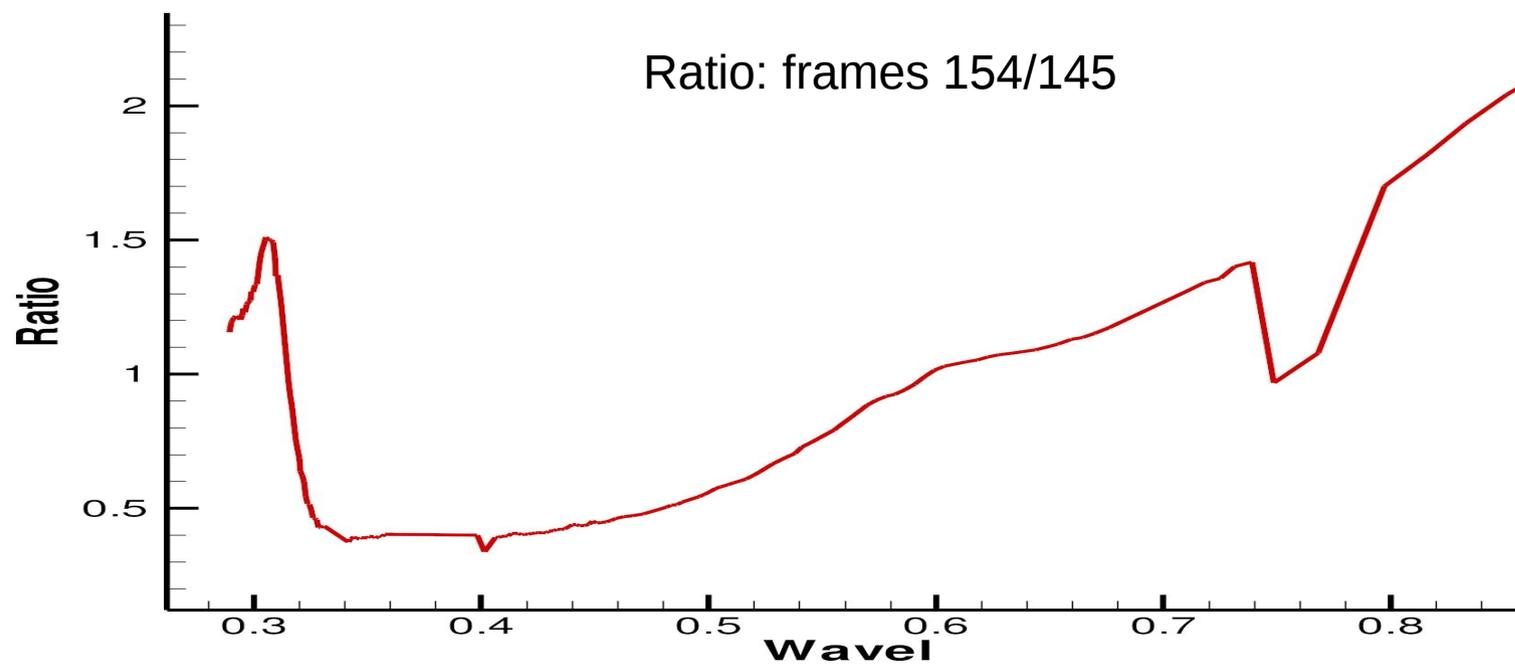
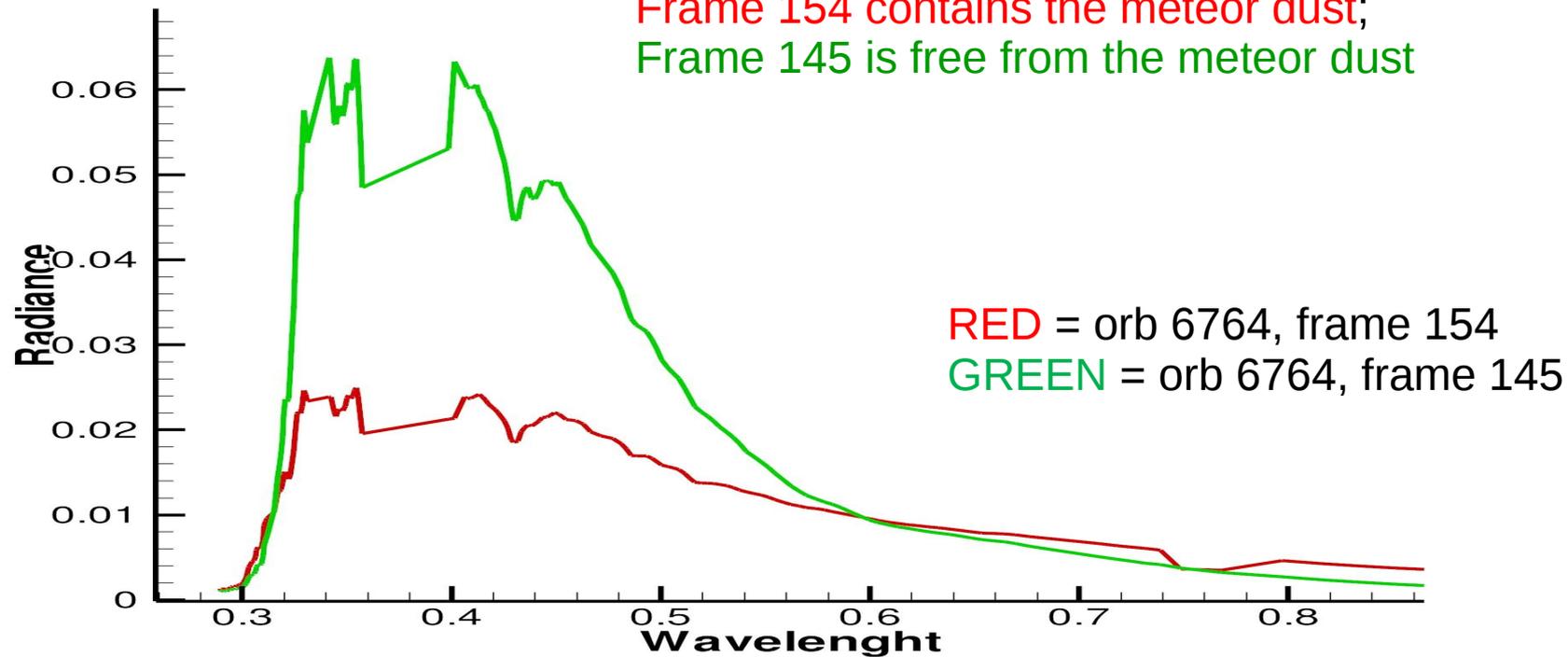
Next day: Feb 16. Plume over Sibiria. Orbit 6763, central slit, 654 nm



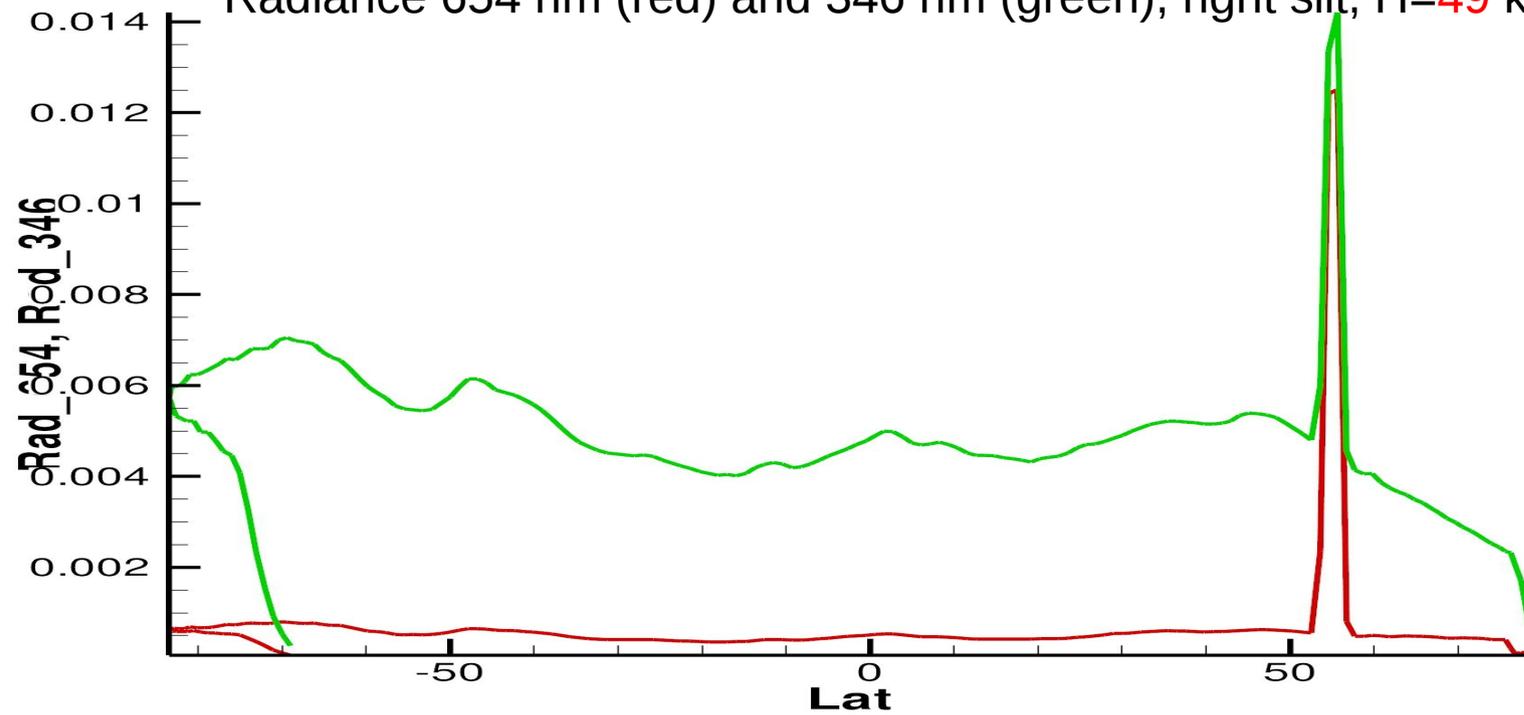
16 Feb. 2013

Frame 154 contains the meteor dust;

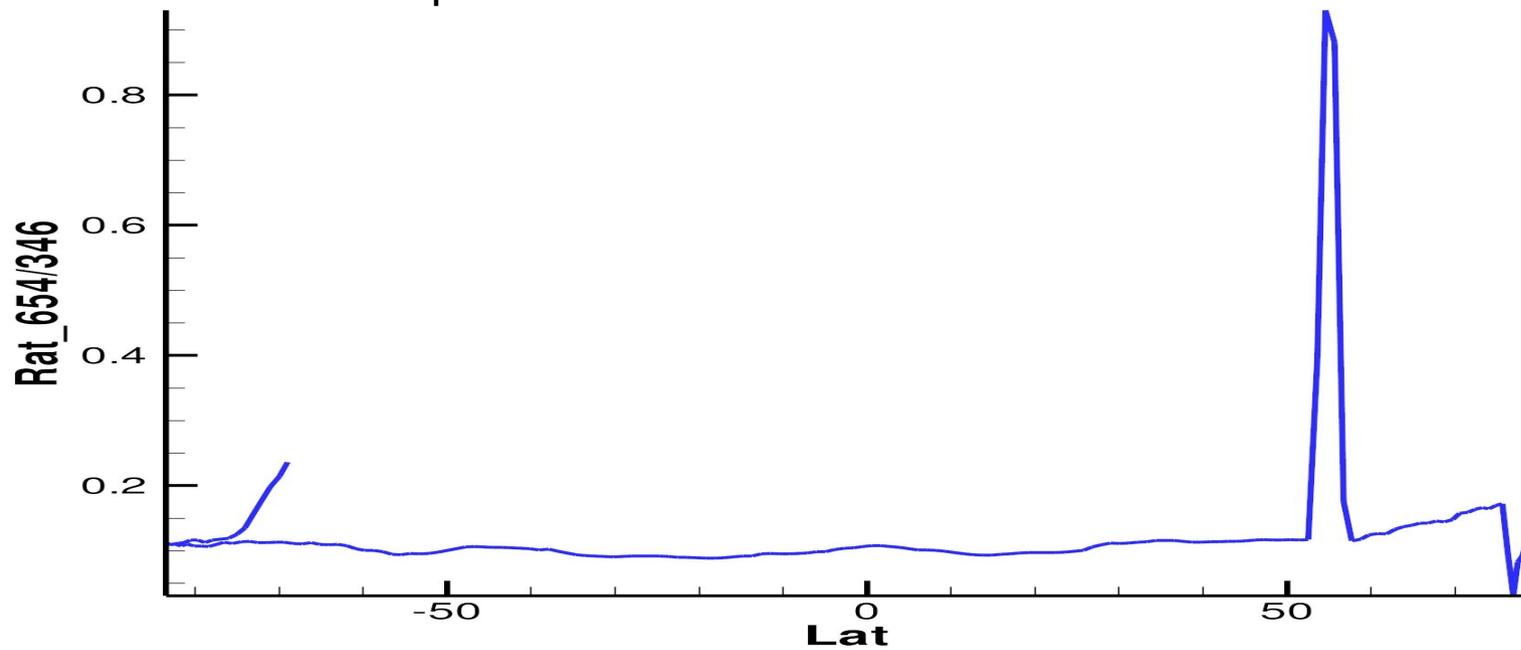
Frame 145 is free from the meteor dust



15 Feb. 2013, Orbit 6752 (first observation, near Novosibirsk)
Radiance 654 nm (red) and 346 nm (green), right slit, H=49 km

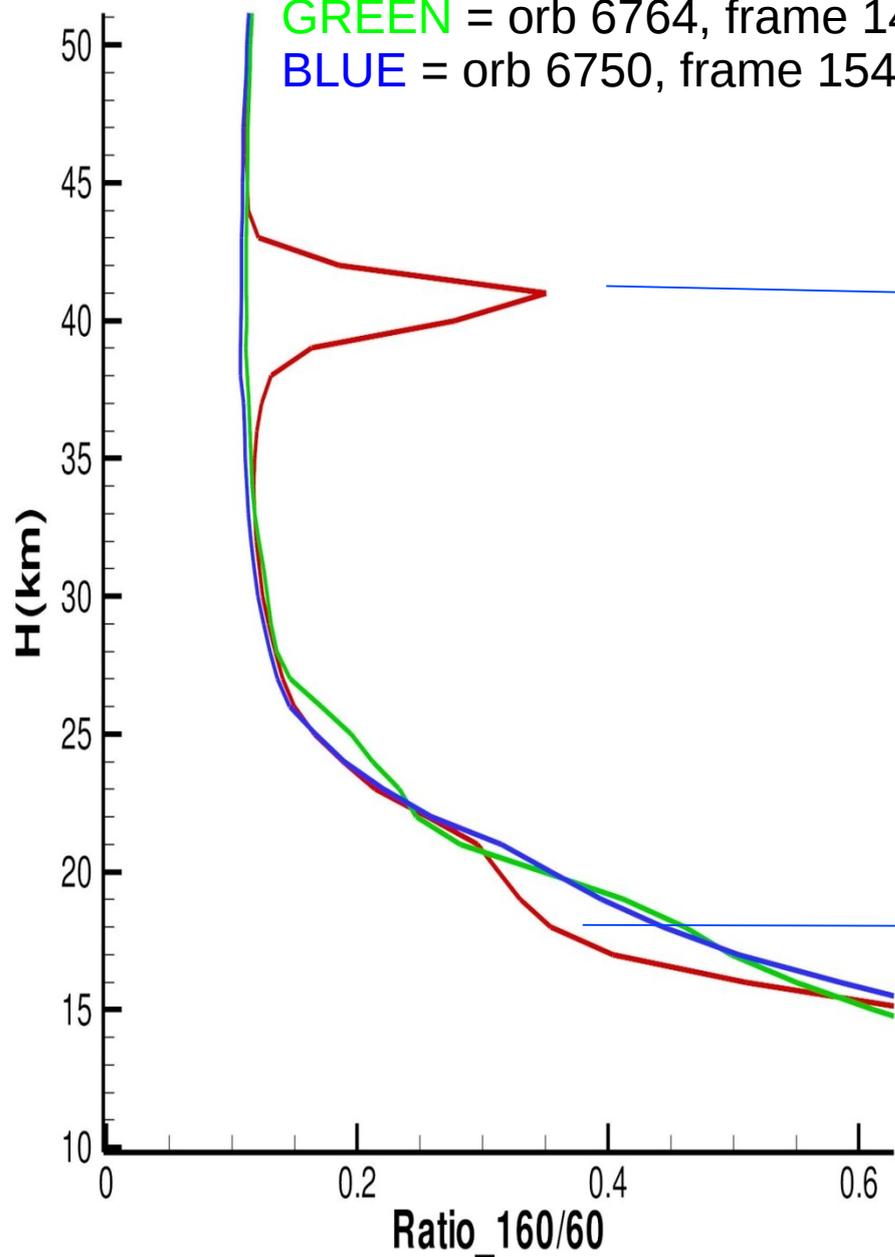


Spectral ratio: 654 nm/346 nm for H=49 km

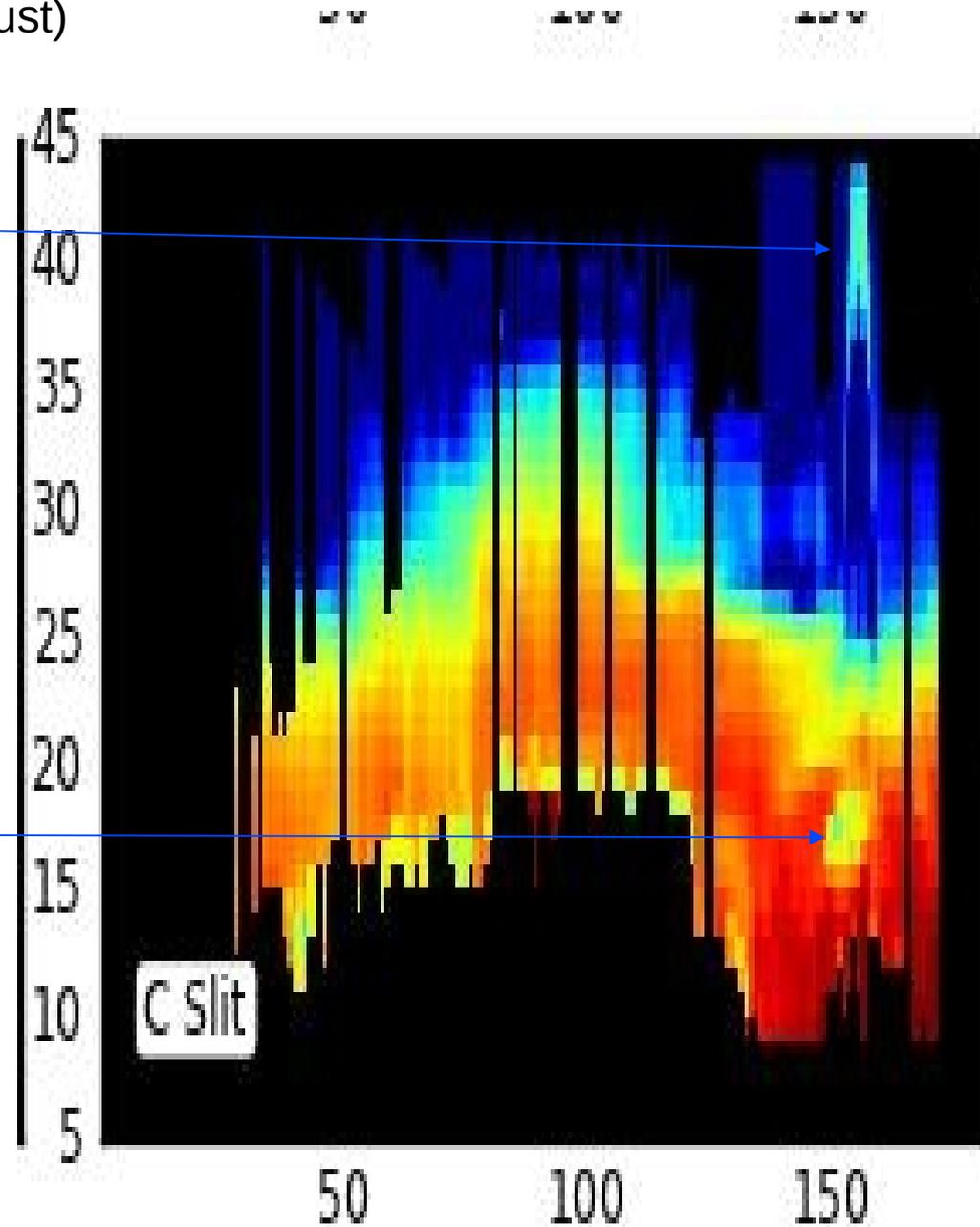


Ratio: Radiance(654nm)/Radiance(346nm)

RED = orb 6764, frame 154 (dust)
GREEN = orb 6764, frame 145 (no dust)
BLUE = orb 6750, frame 154 (no dust)



Aerosol extinction:
EDR research code



Discovering Atlantic bolide in OMPS/LP data

Bolide list from NASA <http://neo.jpl.nasa.gov/fireballs/>

Note that data are not provided in real-time and not all fireballs are reported.

Date/Time - Peak Brightness (UT)	Latitude (Deg)	Longitude (Deg)	Altitude (km)	Velocity (km/s)	Velocity Components (km/s)			Total Radiated Energy (J)	Calculated Total Impact Energy (kt)
					vx	vy	vz		
2013-04-30 08:40:38	35.5N	30.7W	21.2	not reported	1	9	-8	511E10	10
2013-04-21 06:23:12	28.1S	64.6W	40.7	not reported	5	14	1	106.6E10	2.5
2013-02-20 13:13:07	23.0S	38.8W	not reported	not reported	-11	-8	-1	3.2E10	0.1
2013-02-15 03:20:33	54.8N	61.1E	233	18.6	+12.8	-13.3	-2.4	3.75E+14	440

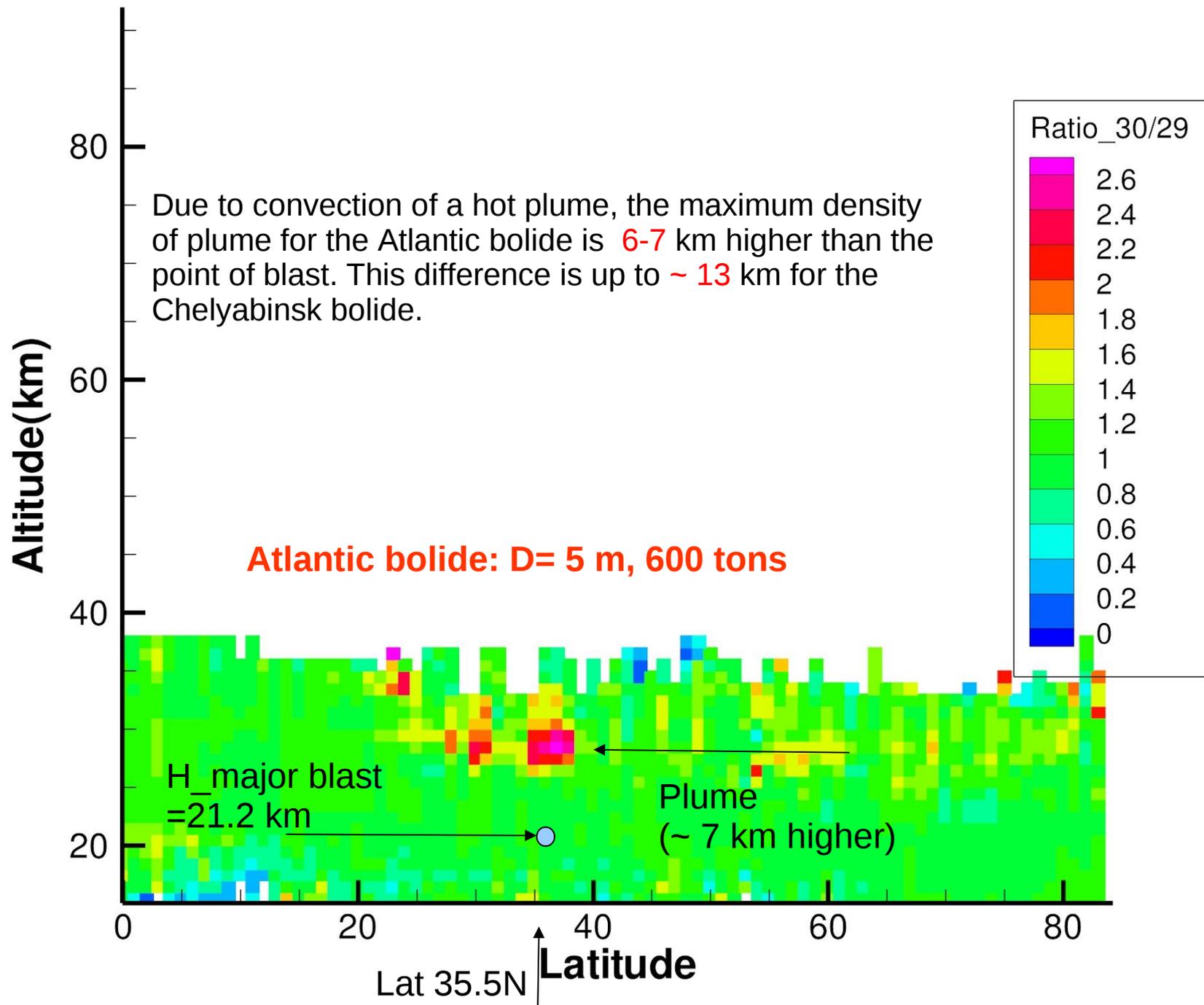
“Atlantic Bolide”,
D=5 m →

“Russian Bolide”,
D=18 m →

→ Bolides at the altitude above the current operational aerosol limit (potentially detectable via spectral variations).

Daily zonal mean for longitudes from -90W to 30E (+- 60 deg from the event)

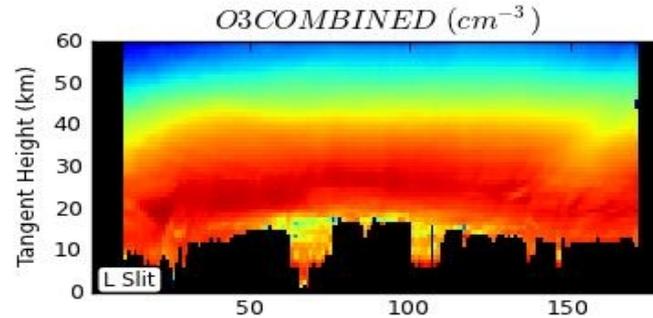
Ratio of Extinction Coefficients for Apr30/Apr29



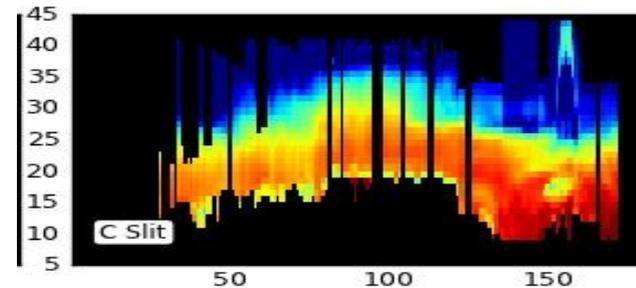
OMPS/LP provides 3 basic products for each orbit and slit

Visualization by curtains

2D Ozone [Altitude (60), Latitude(180)]



2D Aerosol Extinction [Alt(45), Lat(180)]



3D Radiance (Altitude (80), Latitude(180), Wavelength(270)) - cannot be visualized as a curtain

For a user it is not easy to quickly assess the radiances (1 orbit ~ 1 Gig) without efficient visualization of the content.

For **Release 3**, we can convert **270 wavelengths** -> **one parameter**, e.g., **Ratio 654/354 nm** and develop a set of 2D supporting products for visualization of 3D **Radiance** by 2D curtains. These files and curtains can be tuned to show different **spectral events** in stratosphere and **mesosphere (up to ~80km)**: bolides, PMC, PSC, pyrocumulonimbus clouds, “aerosol bubbles”, etc.

Summary:

1. We clearly see **spectral variations** caused by the Chelyabinsk bolide plume as a **peak in the limb radiances** at different wavelengths (tests were done for 346, 445, 654 nm) or the **peak of spectral ratio** (red/blue: wavelengths 654nm/346nm, or spectral pixels 160/60).
2. This spectral ratio shows a **signature of the Chelyabinsk bolide plume for altitudes up to 68-69 km**, thus being less restricted by altitude than the aerosol retrieval algorithms (39 km in operational version, 44 km in research version).
3. The stratosphere and mesosphere have different **local aerosol events**: bolides, PMC, PSC, pyrocumulonimbus clouds, “aerosol bubbles”, etc. These events may show up as distinctive peaks in the red/blue spectral ratio in the OMPS/LP radiances.
4. Basic information about spectral variability can be provided as a **new OMPS/LP radiance-related 2D product**.

We can detect and, possibly, follow the bolide events ~40-50 times smaller than the Chelyabinsk bolide.