



# Lidar systems for monitoring atmospheric pollution

*Resource Center  
«Observatory for the Environmental  
Safety»  
Research Park  
St. Petersburg State University*



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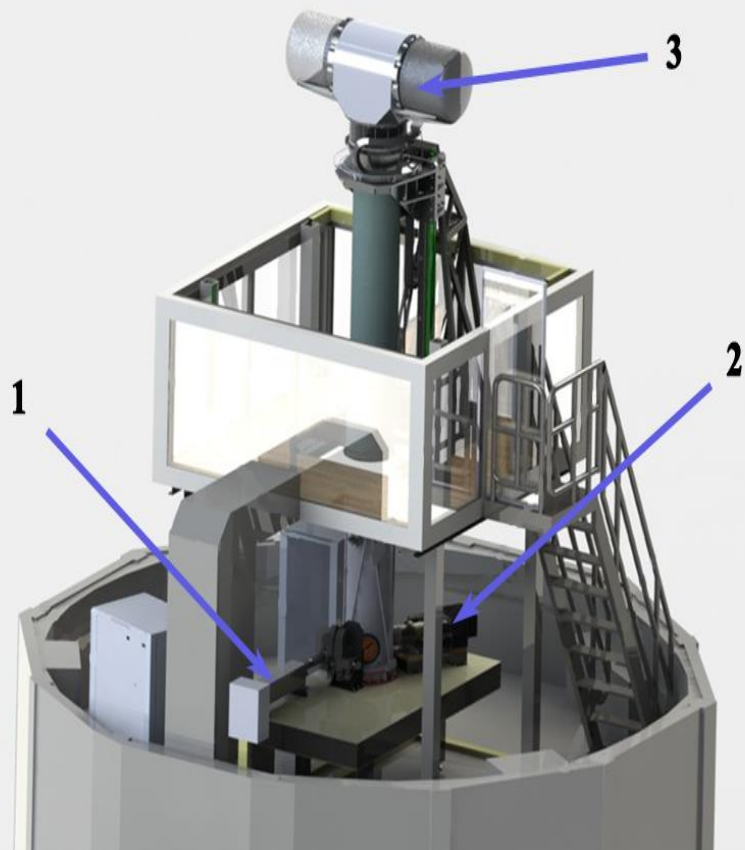


Information Systems  
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(3 *resource centers*)

Ecology and Nature  
Management  
(3 *resource centers*)



# Stationary lidar system



**1 - Aerosol lidar ; 2 - Wind lidar ;  
3 - Scanner**

**Lidar tower**



# Mobile lidar system





- Doppler lidar for measurements of vertical profiles of the wind speed (horizontal and vertical components) and direction
- Aerosol lidar for vertical profiles of atmospheric aerosols parameters observation
- Differential absorption lidar for vertical profiles of atmospheric gases



## **Aerosol lidar**

1064 nm - 400 mJ

532 nm – 160 mJ

355 nm - 100 mJ

Pulse duration 10 nsec

Pulse repetition rate 20 Hz

## **Wind lidar**

Wavelength 1557.2-1557.5nm - Pulse power 110 mJ

Pulse duration 400 nsec

Pulse repetition rate 10kHz

## **Short-wave lidar, Titan-sapphire laser**

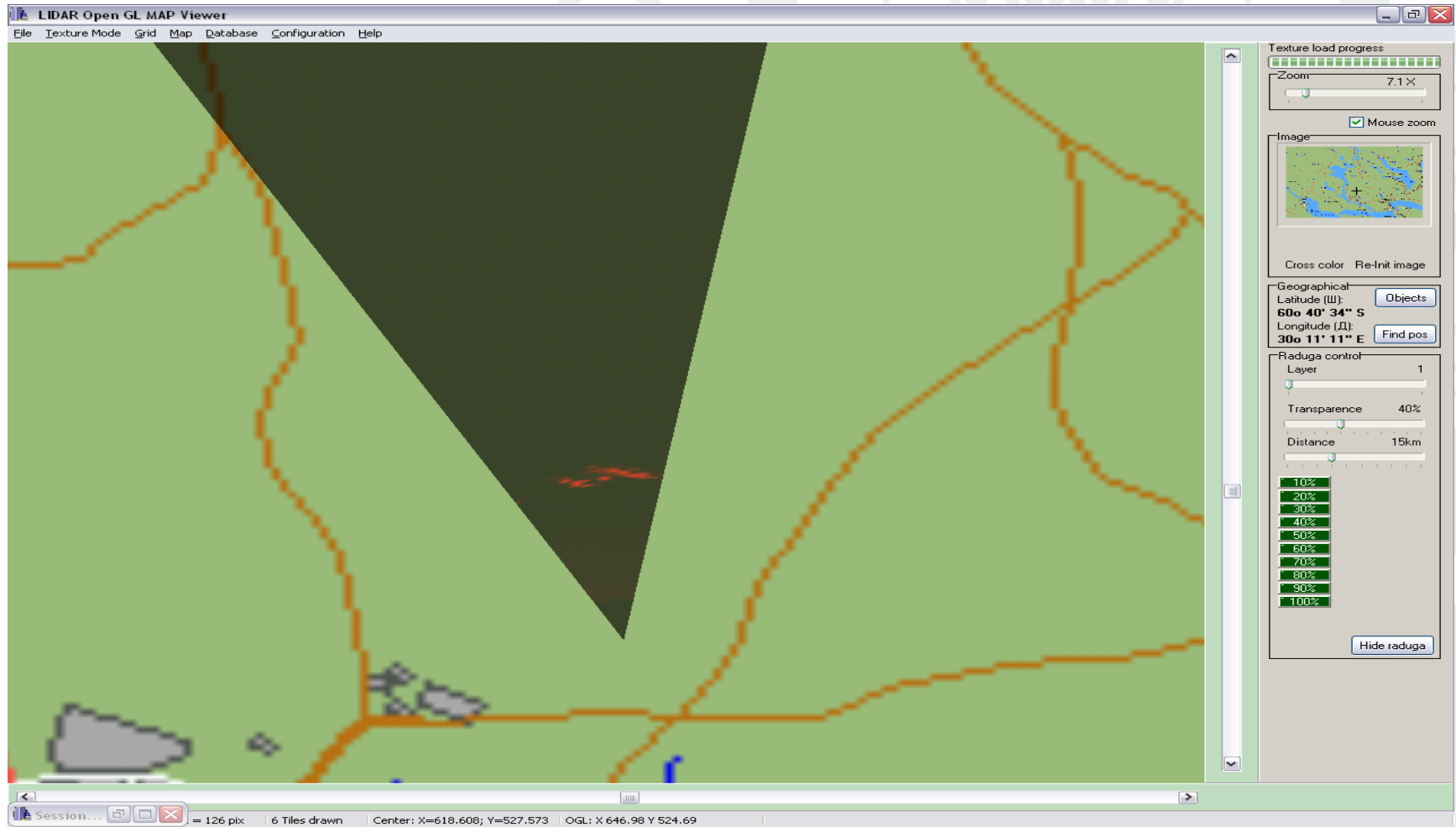
350-480, 230-310 nm

Pulse repetition 10 Hz

Pulse duration 9 nsec



# Area relating and mapping of the pollution cloud





## Measurement plan

- 15.01.2019 – 28.02.2019 • The choice of observation sites on the highway Scandinavia

- Lidar measurements 01.03.2019 - 31.12.2019

First measurements 18.03.2019 - 31.04.2019

Will be chosen the date with favorable weather





## First stage

- a. The choice of observation sites on the highway Scandinavia
- b. Sites inspection for the measuring possibility

## Second stage. Measurements

- a. Determination of optical depth (the effect of aerosol on solar radiation, heating, visibility on the road)
- b. Determination of aerosol microphysical parameters
- c. Determination of small gases, modeling
- d. Determination of the wind speed and direction
- e. Preparing of report

## Third stage. Preparation of the educational course (together with partners)

- a. Acquaintance with modern equipment
- b. Acquaintance with measurement methods
- c. Acquaintance with influence of meteorological factors on spread of pollution
- d. Public health risks associated with road transport pollution



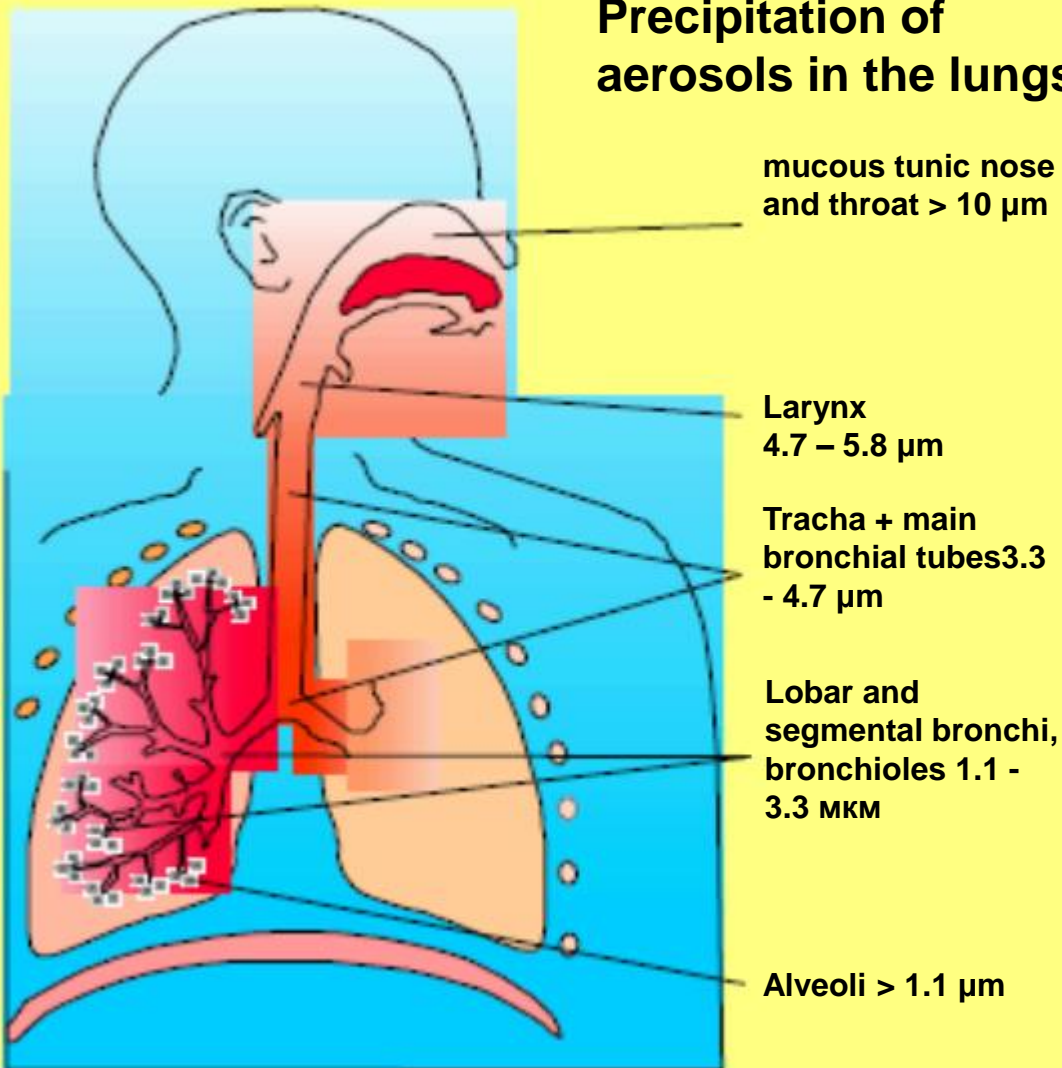
# Aerosols harmful to the human health

- Respiratory illnesses
- Heart – vascular diseases
- Allergies
- Eye diseases



## Effects of aerosol on people

### Precipitation of aerosols in the lungs



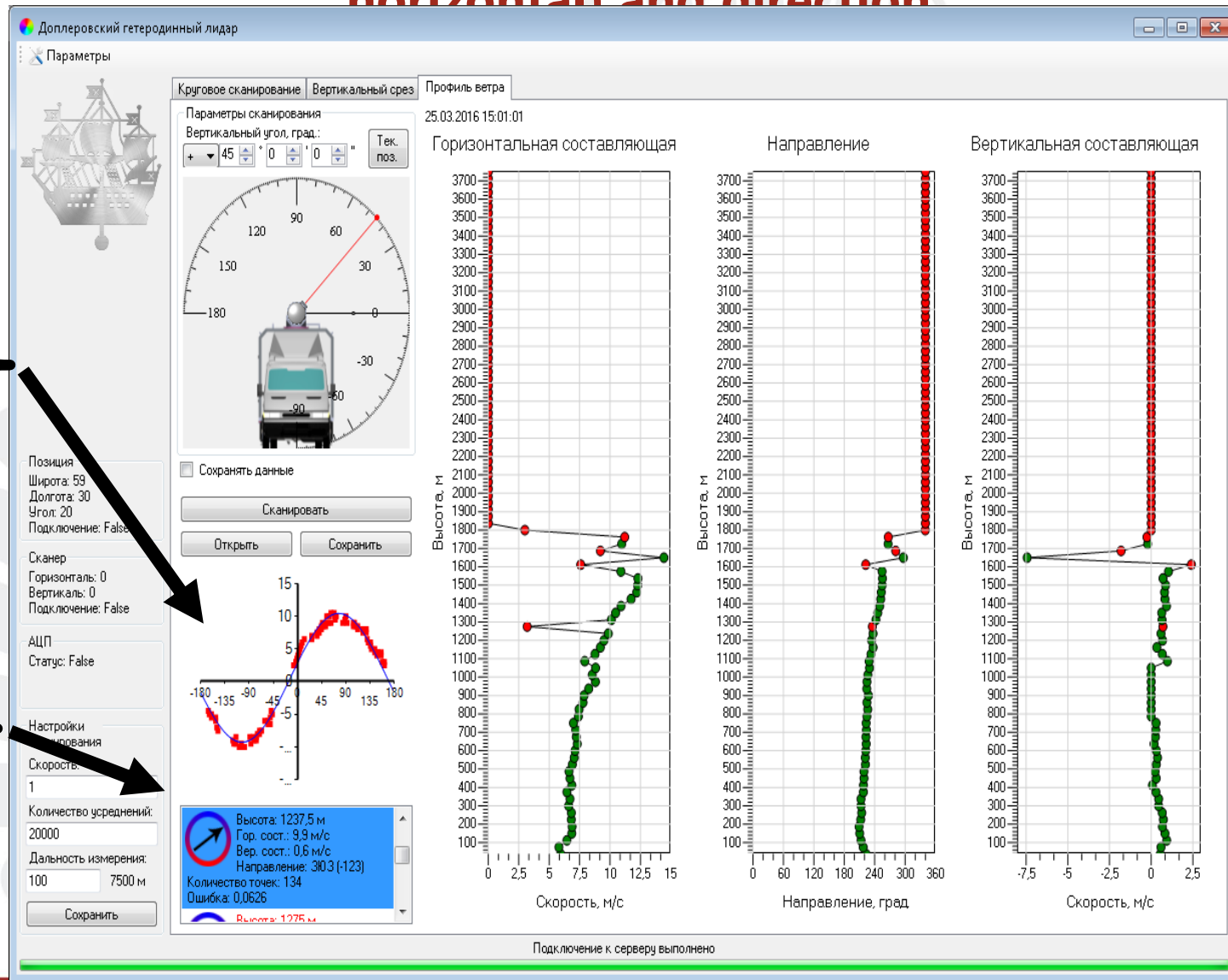
Particles more than  $10 \mu\text{m}$  are deposited in the region of the nose and throat

Particles less than  $4 \mu\text{m}$  fall into the larynx and bronchi and reach the lungs

Particles less than  $1 \mu\text{m}$  reach alveoli



# Determination wind speed (vertical and horizontal) and direction

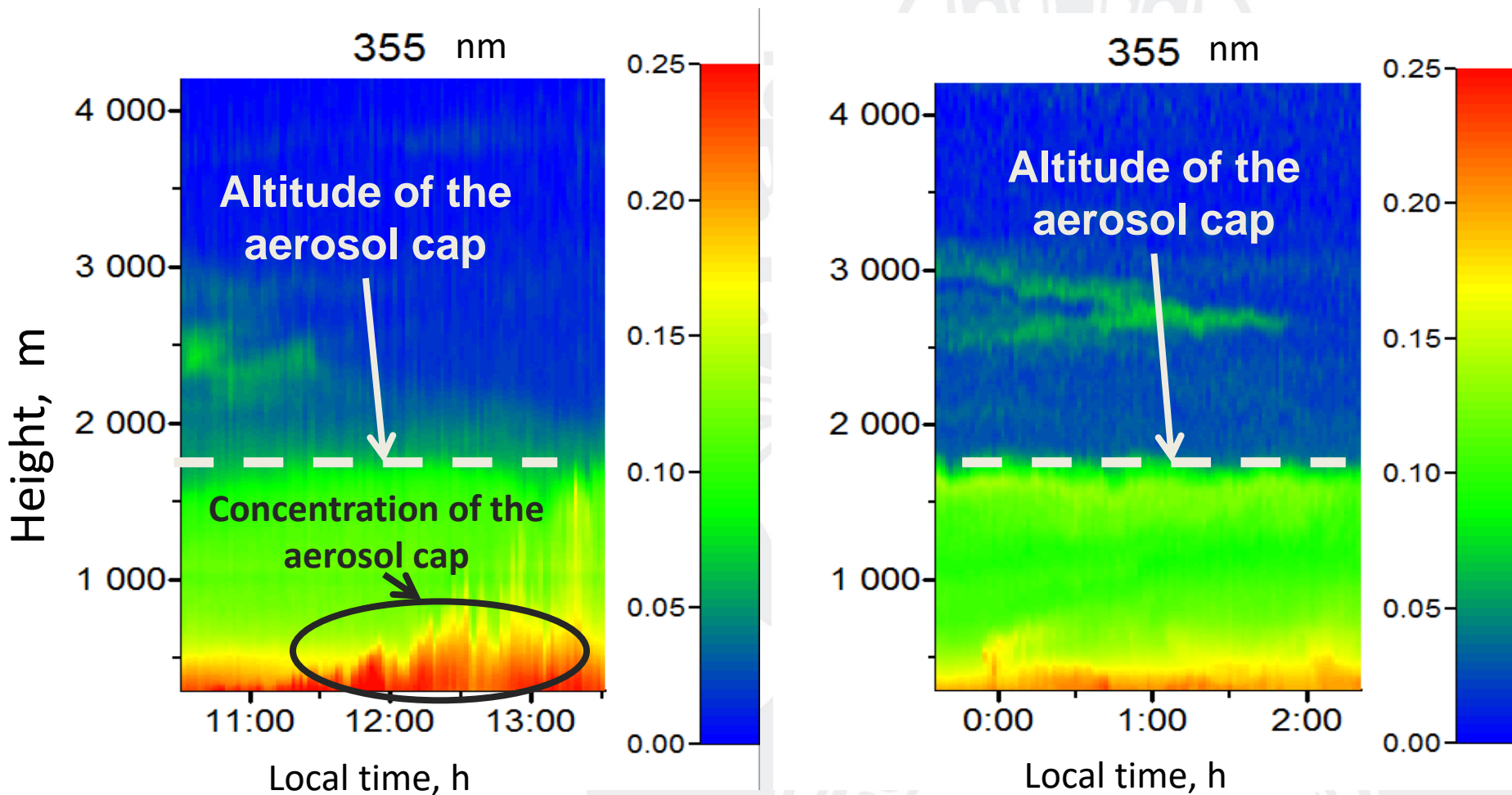


Calculating the  
wind speed  
sinusoid

Determinat  
ion wind  
speed  
(vertical  
and  
horizontal)  
and  
direction



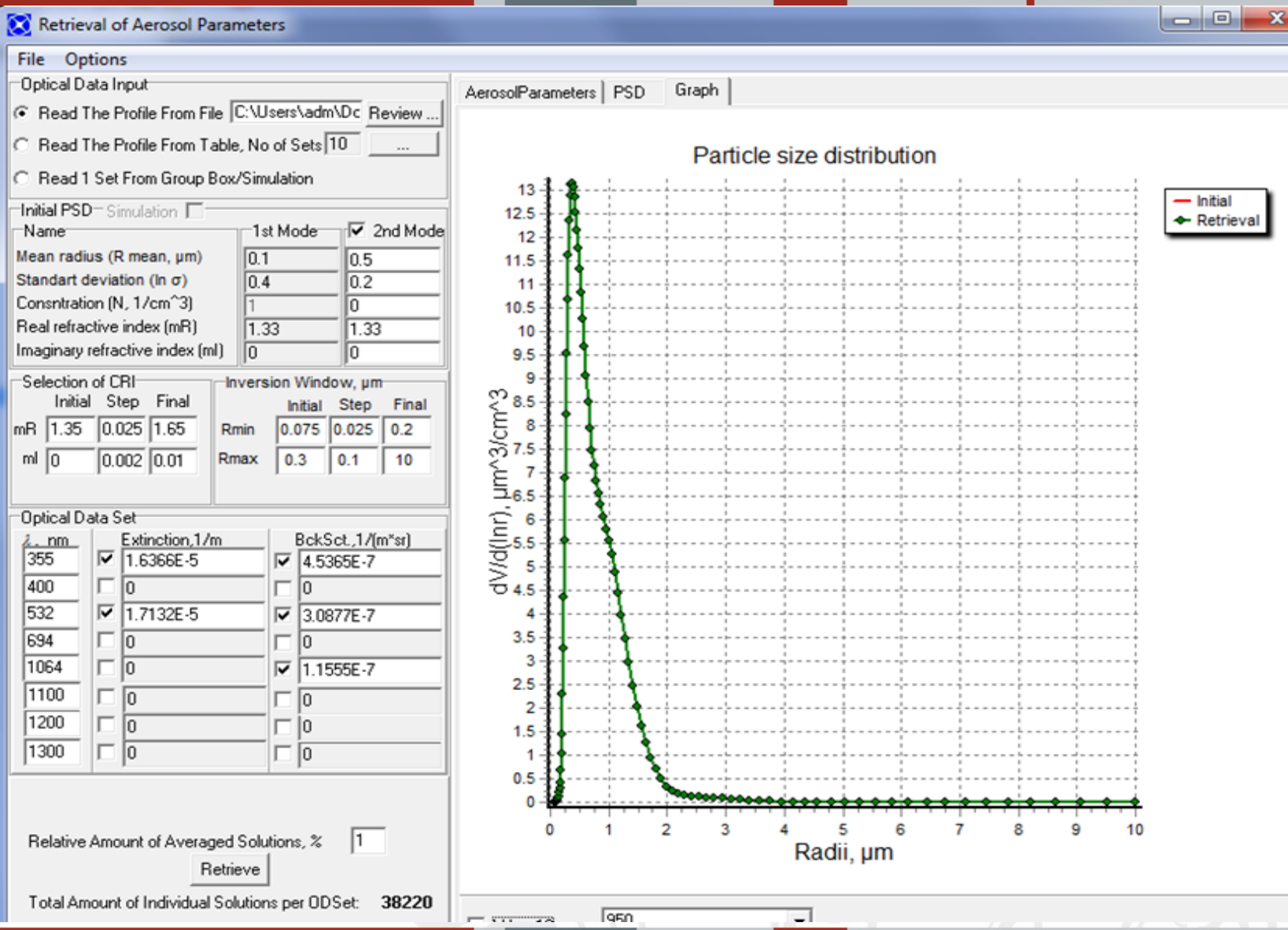
# Day variations of the pollution cap above St.Petersburg day-time/night-time



- Extinction coefficient at wavelength 355 nm
- The day-time density of the cap is higher in 1.7 times



# Particle size is detected in ranges 0.5 – 10 $\mu\text{m}$





# Questions

- We need a contact person from all partners for creating the educational program



**Thanks for your attention !**  
**<http://researchpark.spbu.ru>**  
**[emc.spbu.ru](http://emc.spbu.ru)**  
**[dmitriy.samulenkov@spbu.ru](mailto:dmitriy.samulenkov@spbu.ru)**