

Lidar systems for monitoring atmospheric pollution

Resource Center
«Observatory for the Environmental
Safety»
Research Park

St. Petersburg State University



Research Park of Saint-Petersburg State University

Nanotechnology and Materials Science (14 resource centers)

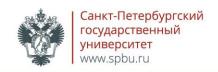
Biomedicine and Human Health (6 resource centers)



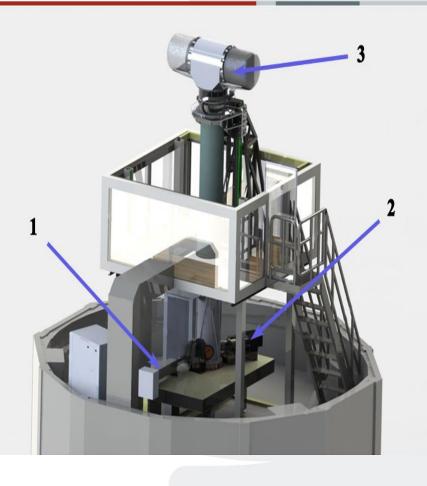
26 Resource Centers

Information Systems and Technology (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



Instruments of the 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

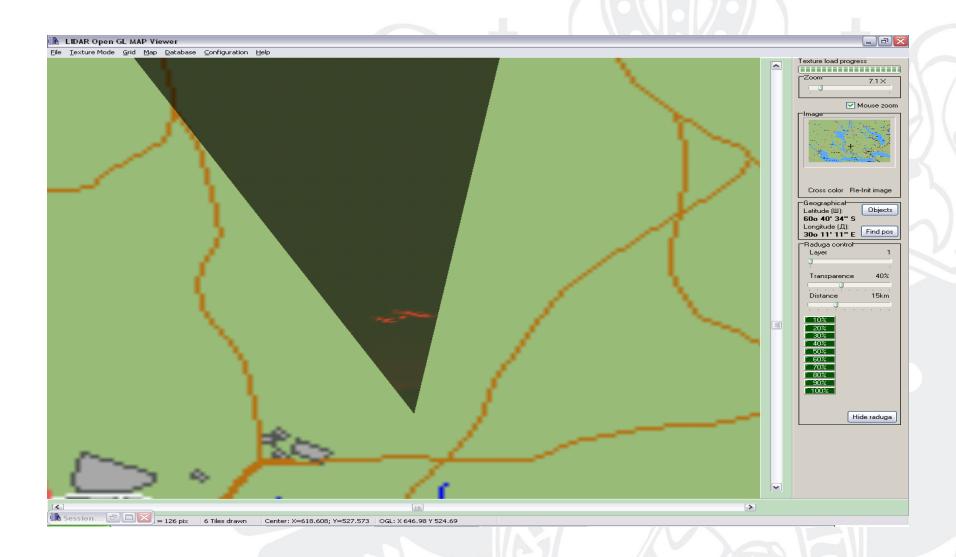
350-480, 230-310 nm

Pulse repetition 10 Hz

Pulse duration 9 nsec



Area relating and mapping of the pollution cloud



Measuremen

ts

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

Investigation

First stage

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

Second stage. Measurements

- 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

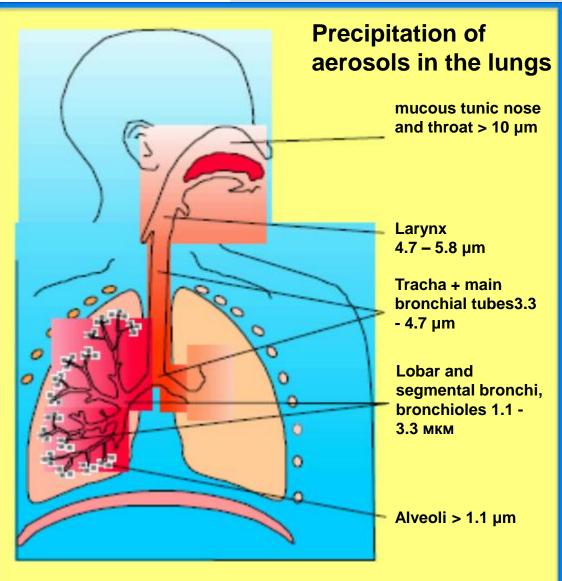


Aerosols harmful to the human health

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



Effects of aerosol on people



Particles more than 10 µm are deposited in the region of the nose and throat

Particles less than 4 µm fall into the larynx and bronchi and reach the lungs

Particles less than 1 µm reach alveoli



Determination wind speed (vertical and

horizontal) and direction - - X Доплеровский гетеродинный лидар 💢 Параметры Круговое сканирование Вертикальный срез Профиль ветра Параметры сканирования 25.03.2016 15:01:01 Вертикальный угол, град. Вертикальная составляющая Горизонтальная составляющая Направление → 45 🖨 ° 0 🖨 ′ 0 🖨 3700-≣ 3600-3600-3600-3500-3500-3500-3400 3400 3400-3300-3300-3300-150 30 3200 3200-3200-3100-3100-3100 3000-3000-3000--180 2900-2900-2900-2800-2800 2800 -30 2700 2700 2700 2600-2600-2600-2500-2500-2500-2400 2400-2400 2300-2300-2300-2200-2200-2200-Σ 2100 Сохранять данные ∑ 2100-2100 Широта: 59 2000 Долгота: 30 Сканировать Высота 1900-**Угол: 20** 1800-Подключение: Fa Открыть Сохранить 1700-Сканер 1600-1600-1600-Горизонталь: 0 1500-1500-1500-Вертикаль: 0 1400 1400 1400-Подключение: False 1300-1300-1300-1200-1200 1200-1100-1100-1100-Статус: False 1000-1000-1000-900-3 900-900-800-800-800-Настройки 700-700-700-3 600-Ē 600-600-Скорос 500-500-500-400-400-400-300-300-300-Количество усреднений: Высота: 1237,5 м. 200-200-200-20000 Тор. сост.: 9,9 м/с. 100-100-100-Вер. сост.: 0,6 м/с Дальность измерения: Направление: 3Ю3 (-123) 5 7,5 10 12,5 15 60 120 180 240 300 360 -2,5 7500 м Соличество точек: 134 Скорость, м/с Направление, град Скорость, м/с Сохранить

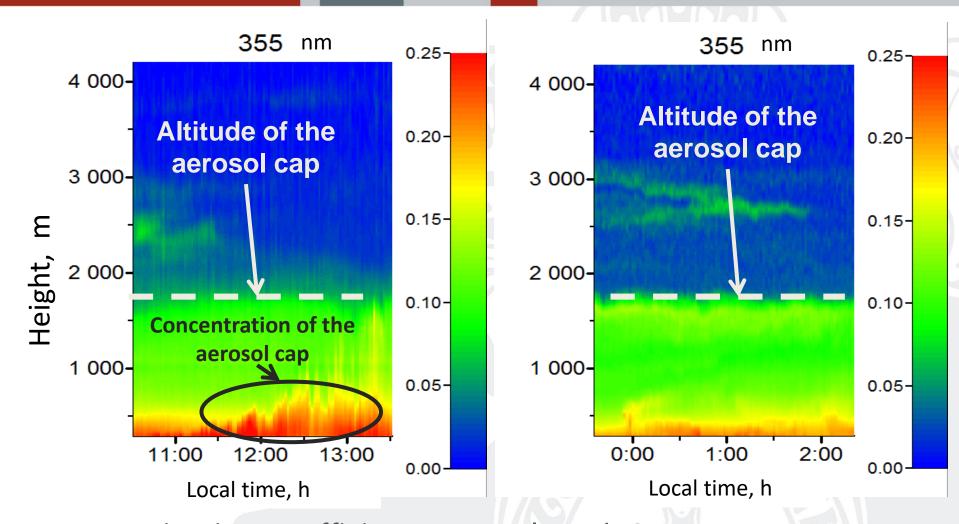
Подключение к серверу выполнено

Calculating the wind speed sinusoid

Determinat ion wind speed (vertical and horizontal) and direction



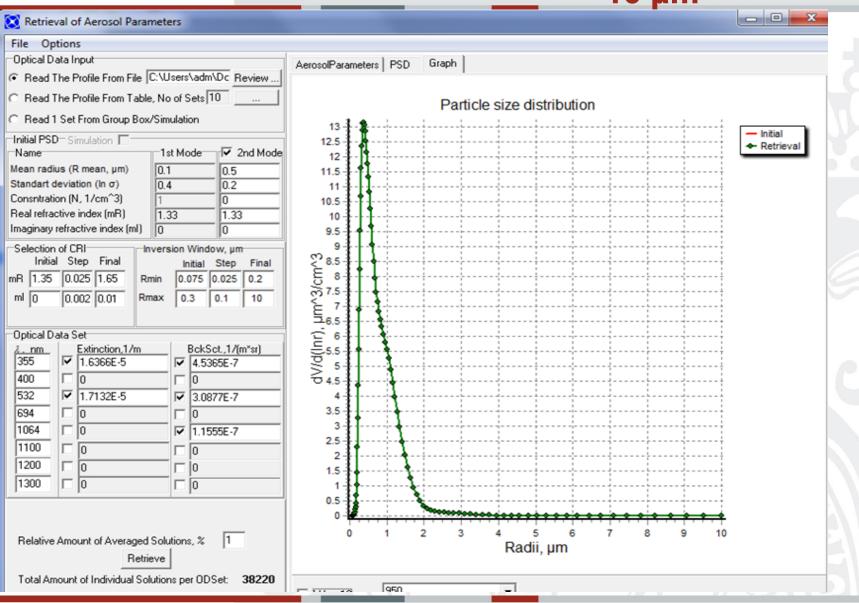
Day variations of the pollution cap above St.Petersburg day-time/night-time



- 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 µm





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
dmitriy.samulenkov@spbu.ru