



REMOTE SENSING OF AEROSOLS IN THE EARTH ATMOSPHERE

ATMOSPHERIC AEROSOLS



Tropospheric aerosols have a strong impact on the environment and climate

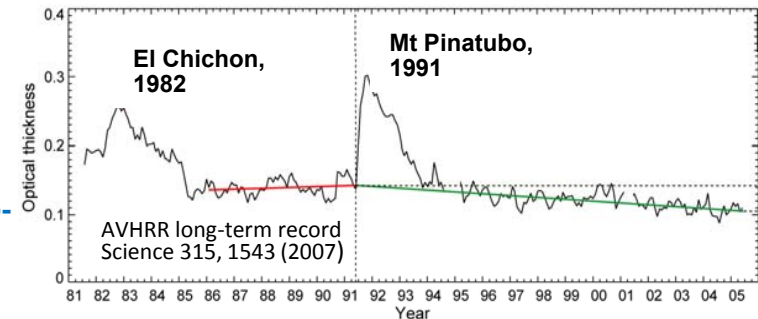
Aerosols are microscopic liquid and solid particles suspended in the atmosphere. There are many types of natural and anthropogenic aerosols.



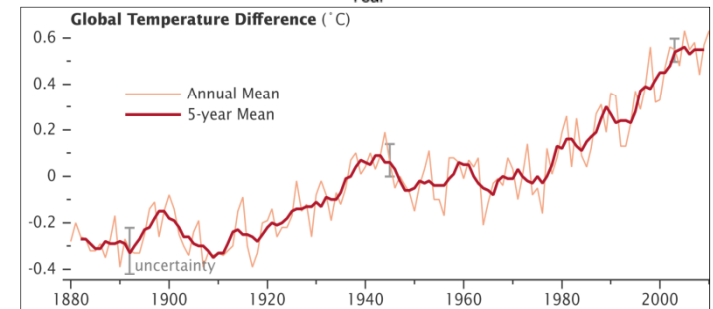
Volcanic eruptions increase the concentration of stratospheric aerosols and may temporarily increase their effect on climate quite significantly.

Optical thickness τ decreased by 0.04 for 20 years.

τ decrease by 0.01 results in an increase of the total flux of electromagnetic energy at the Earth surface at 0.25 W/m².



Temperature increased by $\sim 0.4^\circ$ for 20 years.

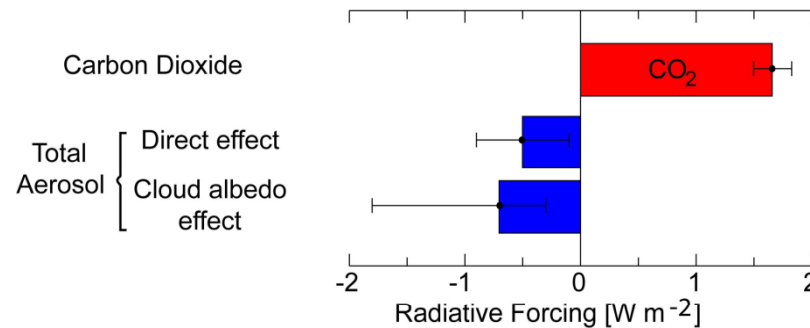
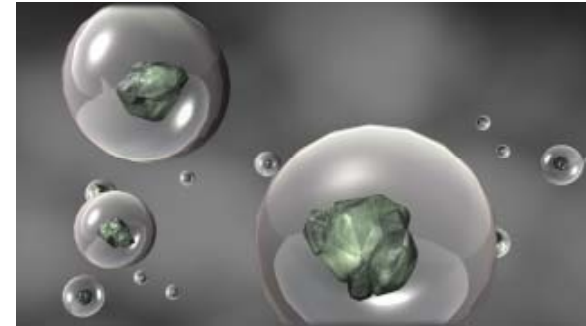


Long-term changes in the composition of the atmosphere can cause global climate change and thereby affect local weather and the quality of human life.

ATMOSPHERIC AEROSOL AND CLIMATE

Atmospheric aerosols affect climate directly by absorbing (black carbon aerosols) and reflecting (sulfates and other nonabsorbing aerosols) the incident sunlight, thereby heating or cooling the atmosphere. This is a direct climate effect.

Aerosols also cause an indirect cooling effect by modulating cloud properties: increased numbers of aerosols (serving as cloud condensation nuclei) lead to larger numbers of smaller cloud droplets, thereby suppressing rainfall and increasing cloud lifetime.



Climate effects of aerosols are believed to be nearly comparable to those of the greenhouse gases, but they remain poorly quantified and represent the largest uncertainty regarding climate change .

There are no reliable quantitative estimates of the direct and, especially, the indirect aerosol effects and their anthropogenic components.

THE MAIN OBJECTIVE

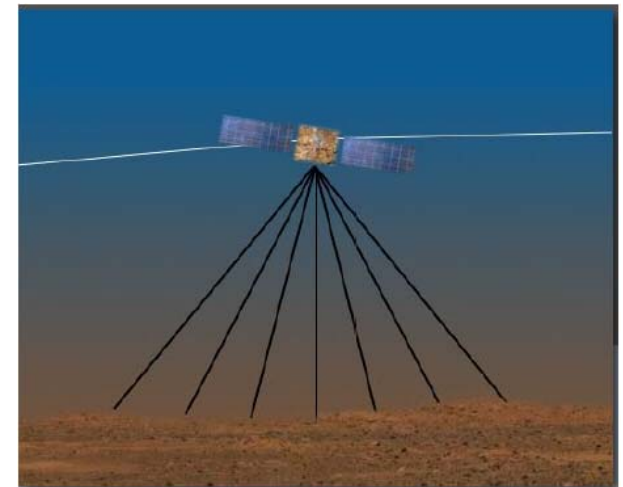


To enable accurate quantification of the role of aerosols as natural and anthropogenic agents of climate change by utilization of a high-precision multispectral scanning polarimeter installed on-board of the satellite.

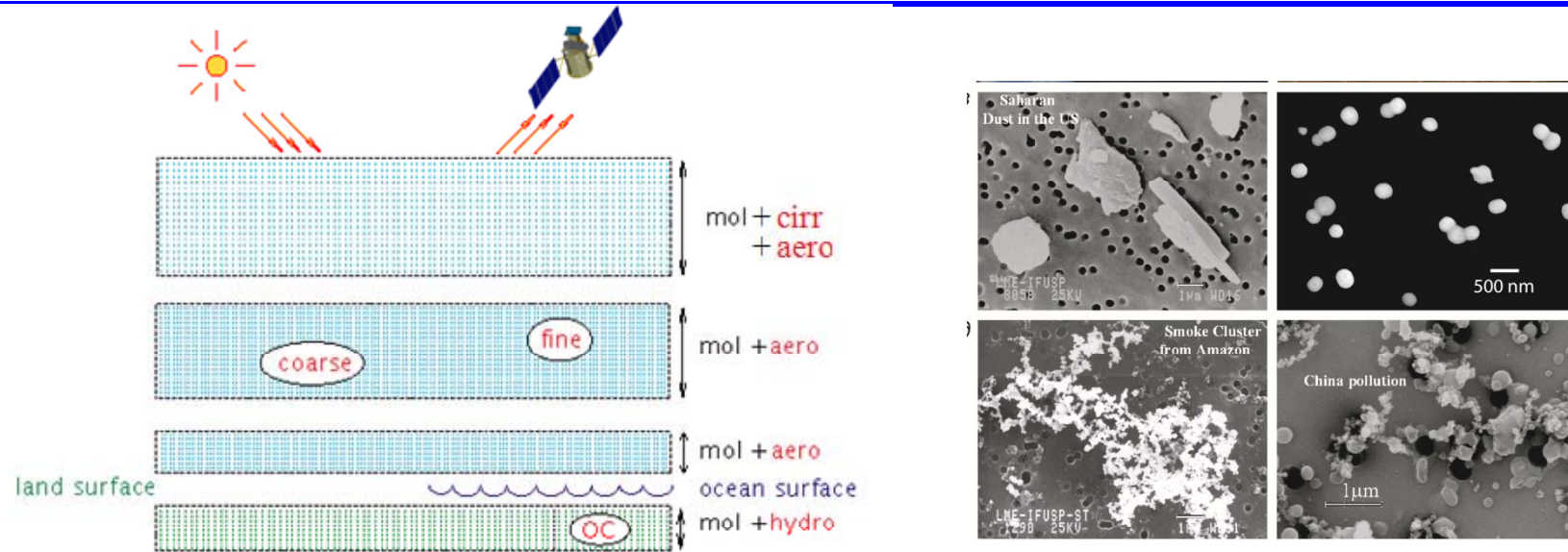
The main function of a satellite aerosol climatology:

to provide an accurate, reliable, and comprehensive constraint on models in terms of long-term global distributions of aerosol

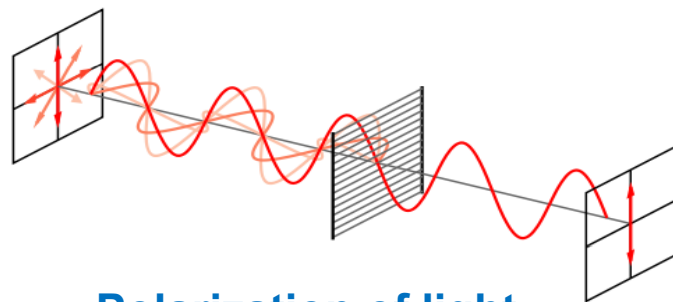
- optical thickness
- size distribution
- chemical composition (via refractive index)
- single-scattering albedo



COMPLEXITY OF AEROSOL RETRIEVALS FROM SPACE



The complexity, heterogeneity, and strong variability of the global distribution make tropospheric aerosols a very difficult object for studying.



Polarization of light

Why polarization?

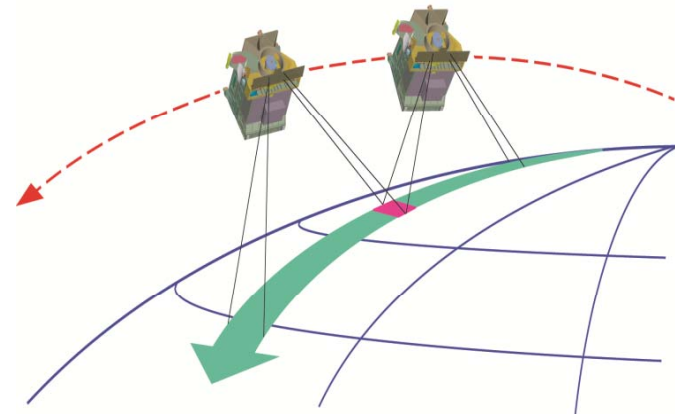
- Polarization is a relative measurement that can be made extremely accurately.
- Polarimetric measurements can be accurately and stably calibrated on orbit.
- The variation of polarization with scattering angle and wavelength allows aerosol particle size, refractive index and shape to be determined.
- Appropriate theoretical analysis tools are available.

THE PROPOSED SOLUTIONS

National Academy of Sciences of Ukraine proposes to initiate research-scientific Project aimed at studying the aforesaid subject within the International Academy of Astronautics which will allow to consolidate efforts of international experts in space and other related areas of science with the purpose of finding solution to a number of key aspects of the Project.

For implementation of main objectives in frames of IAA research-scientific Project it is proposed to pay special attention to finding solutions of the following Project tasks:

- Identification of possible social-economic aspects of different aerosol types effect on the energy balance of the Earth atmosphere.
- Determination of climate models critical parameters connected with aerosols.
- Framing of scientific-technical challenges of the continuous and global monitoring of aerosols and determination of their parameters.



THE PROPOSED SOLUTIONS

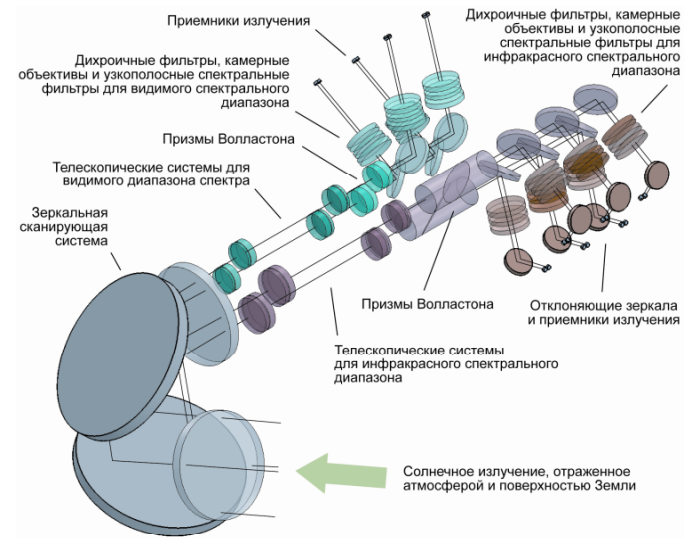
- Implementation of comparative analysis of the satellite monitoring methods which can be applied to aerosol problem with special attention to polarimetry as one of the most precise and informative remote sensing methods.

- Determination of optimal measurement strategy of optical, microphysical and chemical properties of aerosols and clouds in the Earth atmosphere as well as their spatial-time distribution.



- Selection of perspective satellite system configuration options and correspondent measurement instrumentation for aerosols monitoring.

- Identification of optimal modality of international cooperation for implementation of proposed scientific methodology and technical solutions.



Principal scheme of the polarimeter ScanPol