Mid-term exam.

How to prepare for the Exam

- Organize your lecture notes and lab, you may use them during the exam.
- No any textbooks will be allowed during the exam
- There will be a lecture dedicated to review the materials for the Exam
- The list of topics and equation numbers for the review will be posted at class website
- Tasks will be focused on testing your understanding of the major concepts that covered in the class
- Examples of the exam tasks will be provided in the lectures and labs

Examples of Exam Problems

- For each wavelength listed below name one atmospheric species that can significantly affect electromagnetic radiation and identify the process of interaction.
- 0.3 μm wavelength

- 0.5 μm wavelength

Examples of Exam Problems

- For each wavelength listed below name one atmospheric species that can significantly affect electromagnetic radiation and identify the process of interaction.
- 0.3 μm wavelength:
  ozone, absorption
- 0.5 μm wavelength:
  aerosol, scattering

Example of Problems

- Satellite has two passive channels: one is centered at 0.5 μm and another one is at 10 μm. Which of these channels can take measurements only during daylight? Which of these channels can measure during nights?

Answer

- The channel that operates at 0.5 μm requires the presence of the Sun, where as the 10 μm channels measure the thermal radiation in the IR spectrum. Thus, the first channel can operate during the day only, where as the second can operate during the night.

Example of Problems

- Why many passive sensors which working in visible spectrum region have a channel centered around 500 nm?

Answer

- 500 nm is in the visible part of the solar spectrum, it has a lot of solar energy and atmospheric gases almost do not absorb at this wavelength.

Example of Problems

Calculate attenuation of the direct solar radiation propagating at the wavelength of 0.5 μm through a layer filled with smoke aerosol. Consider that the layer has the 1 km depth and the extinction coefficient of smoke at this wavelength is 0.5 $km^{-1.}$

Then compute the visibility through this layer and single scattering albedo, assuming that there is no light absorption at this wavelength.

Answer

First, you need to compute the optical depth of the smoke layer

$$\tau = k_{ext} * \text{depth}$$

Then, attenuation of the direct solar radiation is found as

$$I/I_0 = \exp(-\tau)$$

Using the values given in this problem, we have $\tau = 0.5$ thus attenuation is

$$\exp(-0.5) = 0.607$$

The horizontal visibility is defined as VIS = $3.9/k_{sc}$, assuming that no absorption at this wavelength

$$k_{sc} = k_{ext}, \text{ thus VIS} = 3.9/0.5 = 7.8 \text{ km}$$

To be continued …

- More tasks will be provided at the end of each lecture