Assignment 10 FYS4630/FYS9630

Tuesday November 7, 2017

Download the uvspec program (based on DISORT) from the webpage. Unzip the zip-file.

Compile and link with the command:

f95 spect-assignment8.f nspher-f95.f –o prog

The file 'solar.inp' contains top-of-the-atmosphere solar spectral irradiances, absorption cross sections for ozone and molecular oxygen. Do not edit this file.

The file 'subarcticwinterN.atm': The file contains a model atmospheric profile (pressure, temperature and ozone). The model atmosphere is divided into 80 layers each 1 km thick. The ozone amount in each layer is found in the second table in the file. Column 1: Bottom layer height. Column 2: top of layer height. Column 3: Ozone amount in DU in each layer.

1) Compute the downward total spectral irradiance (direct + diffuse) 290 -800 nm at the bottom of the atmosphere for surface albedo A_g= 0.05 and 0.80. Assume clear-sky conditions, solar zenith angle 40° and total ozone column amount 300 DU. Plot the ratio of the two spectra, i.e. $F^-(A_g = 0.80)/F^-(A_g=0.05)$. Explain why the ratio is > 1 and why a maximum is found around 320 nm. Hint: Wavelength dependent Rayleigh scattering cross sections and wavelength dependent ozone absorption cross section. The wavelength dependent ozone absorption cross sections are also found in the textbook on page 123.

2) Compute the total spectral downward irradiance (direct + diffuse) for 290 – 800 nm at the bottom of the atmosphere for surface albedo 0.05 for a) total ozone column amount 300 DU and b) for an atmosphere without any ozone (0 DU). Plot both spectra and comment the result. Assume clear-sky condition and that the solar zenith angle is 40°.

3) Compute the downward **diffuse** irradiance at the ground for 305 nm. The surface albedo is 0.05, the solar zenith angle is 40°, the sky is clear and the total ozone column amount is 300 DU. Repeat the calculation but now with a slightly different ozone profile: Move 10 DU from the layer between 14 and 15 km to the bottom layer (0-1 km), so that the total ozone column amount is unchanged. (You need to edit the file 'subarcticwinterN.atm' in order to do this.). How does this redistribution of ozone affect the calculated downward diffuse irradiance? What is the explanation for the difference in downward diffuse irradiance? Hint: absorption and multiple scattering.

   Repeat the computation above but now for a solar zenith angle of 80°.