Name: _____

ATOC/ASTR 5560   Radiative Processes — Lab 10
November 16, 2001

The purpose of this lab is to learn how to use a general purpose atmospheric radiative transfer model for "real world" type applications. SBDART is a plane-parallel radiative transfer model, built on DISORT, that also includes lookup tables of particle scattering information and molecular absorption data. An introduction to SBDART and a link to "SBDART on the Web" is available at URL `http://www.crseo.ucsb.edu/esrg/pauls_dir/`. If you want SBDART on your own computer, the distribution is available from the Web site or on nit
in `/home/rt/sbdart/sbdart_pkg.tar.gz`.
Log in to nit and copy the following files to your directory:

`/home/rt/sbdart/sbdart`	SBDART executable
`/home/rt/sbdart/rt.doc`	SBDART documentation file
`/home/rt/sbdart/INPUT`	SBDART namelist input file
`/home/rt/sbdart/plotsbdart.pro`	IDL file for plot SBDART spectra

1. This lab will calculate solar flux spectra.

   a) What radiative transfer assumption does SBDART make that results in poor accuracy for radiances? Is this ok for fluxes? Explain. See the Web site introduction.

   b) How is the molecular absorption handled (e.g. line-by-line, band model, k-distribution)? What is the source of absorption information?

2. Look at the SBDART documentation file `rt.doc`. The initial SBDART `INPUT` file for the lab is listed below. You won't need to use any other parameters. For each parameter state the meaning of the particular value. Also give an overall description of the initial run (e.g. longwave broadband flux, for tropical atmosphere with a liquid cloud above the ocean in Hawaii on the solstice).

SBDART INPUT File	
isat=0	user defined wavelength range with no filter function
nf=3	
wlinf=0.25	
wlsup=4.0	
wlinc=-0.01	
sza=0	
iday=316	
time=19	
alat=40	
alon=-105	
isalb=3	
idatm=6	
uw=-1	
uo3=-1	
xco2=360	
zcloud=0.5,-1.0	
lwp=0.0,0.0	
nre=10,0	
jaer=3	
zaer=25	
taerst=0.0	
zout=0,100	
iout=1	
nstr=4	

3. Run SBDART with the initial `INPUT` file. Type

        sbdart >specbase.out

which directs the flux spectra to the desired output file. This will be the "base case".

a) Plot the top of atmosphere and surface upwelling and downwelling fluxes using the `PlotOneCase` section of the IDL file.

b) List the top of atmosphere incident and upwelling flux, and the surface upwelling and downwelling flux. What is the broadband albedo of the surface and atmosphere/surface?

c) Using your extensive knowledge of Radiative Processes, briefly explain the causes of the level and major features of each of the four spectra.

4. Now we will do a long series of sensitivity tests. This involves perturbing one aspect of the atmosphere or surface, running SBDART to compute the fluxes, and comparing the results with the base case.

   For each perturbation, make the appropriate change in the SBDART `INPUT` file, and make sure you start with the original `INPUT` file so you don't mix up perturbations.

   For each case, run SBDART, plot the base case and perturbation spectra using section `PlotTwoCases`, write down the TOA upwelling and surface downwelling broadband fluxes, and *briefly* explain the changes in the spectra.

   a) Change the surface type to vegetation. To see the surface effect, use section `PlotOneCase` instead so the upwelling flux is plotted. Calculate the broadband surface albedo for vegetation.

   b) Increase the vertically integrated water vapor amount by 50% (factor of 1.5).

   c) Decrease the ozone amount by 50 Dobson units.

   d) Double the carbon dioxide concentration.

e) Set the stratospheric aerosol optical depth to 0.3 and fresh volcanic aerosol type.

f) Put in a cloud from 0.5 to 1.0 km height with a liquid water path of $100 \ \mathrm{g/m^2}$ and effective radius of $10 \ \mu$m.

g) Change the cloud height to 1.5 to 2.0 km (LWP of $100 \ \mathrm{g/m^2}$ and r_e of $10 \ \mu$m). Compare the fluxes using section `PlotTwoCases` to the *cloud case* in f.

h) Finally, make a table of the TOA upwelling and surface downwelling fluxes for all perturbations. List the changes from the appropriate base case in $\mathrm{W/m^2}$.