Project 0 – SBDART

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1. If you need to perform radiative transfer calculations to test some ideas for your research, SBDART is a simple, good model to start with. Read and use **rt.pdf** – it is a very informative and well-written document, and it tells you every input parameter you need to know for a radiative transfer model.

2. Note that unfortunately, SBDART is no longer maintained or updated by anyone or any group. Therefore, caution must be exercised if you plan to use results for any publication in peer-review journals.

3. Download the source code (sbdart.tar.gz) and compile it (using Makefile) in your machine.

4. Run the model (the executable file is "**sbdart**") by typing

```
test_runs
```

which is a unix script that has included five examples for you. You will get five sets of output. Use the Python code for plotting.

5.1. Example 1 includes the following input parameters into a file called "INPUT"

Parameter	Parameter value	Remark
idatm	4	sub-arctic summer
isat	0	Filter function (page 3)
wlinf	0.25	lower wavelength limit (in microns)
wlsup	1.0	upper wavelength limit (in microns)
wlinc	0.005	spectral resolution
iout	1	one output record for each wavelength

Exercise:

- Change **idatm** to see how downwelling radiation changes.
- Change **wlsup** to 2.5 microns to know more about near-infrared radiation.

5.2. Example 2 investigates how radiation varies with cloud optical thickness and surface albedo at the top of the atmosphere (TOA) and at the surface.
Exercise:

- At a given surface albedo, check how surface radiation changes with cloud optical depth.
- Compare and contrast upwelling radiation at the TOA at various surface albedos.

5.3. Example 3 shows spectral longwave radiation.
Exercise:
- Examine which of the following has the biggest impact on downwelling surface longwave radiation: 1) increase cloud optical thickness to 20, 50 (meaning add more liquid water into the atmosphere); 2) lower cloud height from 8 km to 2 km (think why this matters!); 3) change atmospheric profile to tropical.

5.4. Example 4 shows how to construct the famous Nakajima-King diagram that influences the cloud retrieval community since 1990!
Exercise:
- Understand the physical meanings of this diagram.
- Change one of wavelength to 1.6 microns, and see what changes.
- Change **isalb** to **1** and see if the diagram remains useful for retrieving clouds.

5.5. Read the Appendix of the reference to understand Example 5 (it is really cool!).