snowbal1_2.py

Introduction and Purpose

The SNOWBAL module (snowbal1_2.py) is a Python script to determine the representative wavelength for wavelength bands and water vapour, liquid water content and/or ice water content for given conditions, e.g. snow density, impurities, specific surface area, using TARTES and DISORT. The module is further described and its output analyzed in Van Dalum et al. (2019). The script is built in Python2.7, but should also be compatible with Python3.7.

The SNOWBAL module also includes the creation of the required input files for Libradtran using the provided templates, and running Libradtran using the created input files. The wavelengths and fluxes in the Libradtran output are loaded and used as weights. Then the spectral albedo is calculated using TARTES, which has to be installed in the current working directory. The spectral albedo is converted to a broadband albedo using the Libradtran spectral fluxes as weights. The broadband albedo corresponds to a wavelength for which TARTES would produce this albedo, which is called the representative wavelength. Further corrections are applied before the representative wavelengths are saved into a text file for clear-sky direct radiation, clear-sky diffuse radiation, and cloudy diffuse radiation. The fraction of incoming radiation that is direct is also computed. More information about the steps taken is found in the code.

Packages

tartes, including impurities module
os.path
numpy
shutil

Input parameters

Default values of all parameters are found in the code.

Name	Description
savedir	Directory to save the results
libradtran_base	Base directory of Libradtran data
basename	Base name of the input and output files, beyond "=" is the angle to be considered
libradtrantemplate	Libradtran input template name
alb_file_location	Location of the albedo file that is used for DISORT. An example file has been added, which is created with TARTES, but other albedo files can be used as well.
alb_file_name	Base name of the albedo file
iwplist	IWP, ice water path list, multiple values are allowed
lwplist	LWP, liquid water path list, multiple values are allowed
PWlist	PW, precipitable water list, multiple values are allowed
sza	Solar zenith angle
cloudyangle	Angle to use to compute the representative wavelength for cloudy conditions.
spectralintervalsnm	Spectral intervals to consider in nanometers (default 12 spectral intervals)
ssa	Specific surface area of each snow layer
density	Snow density of each snow layer
thickness	Snow layer thickness

impurity_type	Impurity types to consider, for no impurities choose "", for soot: Soot, for hulis: HULIS
impurities	Impurity concentration in g/g in each layer, 0.0 is a valid option.
makingfiles	Switch: 1 if Libradtran input files making is on, 0 if off.
runninglibradtran	Switch: 1 if Libradtran is run with inputfiles produced with makingfiles, 0 if off.
verbose	Switch: 1 to produce an extra Libradtran output file, which includes the cloud optical thickness. This output file is called verbose

Output

Name	Description
table_clearsky_diffuse.txt	Table with representative wavelengths for clear-sky diffuse radiation depending on SZA
band%s_wavelength_direct.txt	Table with representative wavelengths for clear-sky direct radiation depending on PW and SZA for every band (band number filled in at %s)
band%s_wavelength_cloudy.txt	Table with representative wavelengths for cloudy diffuse radiation depending on LWP and IWP for every band (band number filled in at %s)
dirsum_table.txt	Table with direct/total incoming shortwave radiation fraction

time_series.py

Introduction and Purpose

The second script (time_series.py) is a Python script and provides a code to conduct a time series for a grid point on the Greenland ice sheet for a whole year using RACMO2.3p2 output (the data set used in Van Dalum et al. (2019) can be found here: https://doi.org/10.5281/zenodo.1468647). Data are considered at the same moment every day (e.g 15:00 GMT, but other moments can be chosen as well). For these moments, TARTES is run using the conditions provided by RACMO2.3p2, and the representative wavelengths from the lookup tables produced with the SNOWBAL module. The results are then shown in a figure similar to Figure 12 from Van Dalum et al. (2019). The option to use the albedo scheme of Kuipers Munneke et al. (2011) and compare the results with TARTES, is also implemented. Some corrections for cloud thickness and the top snow layer are made. More information about the steps taken are found in the code. The script is built in Python2.7, but should also be compatible with Python3.7.

Packages

tartes
matplotlib
os.path
seaborn
time
numpy
netCDF4
scipy

Input parameters

Default values of all parameters are found in the code.

Name	Description
datalocation	Directory with RACMO data (in netcdf format), all data in this directory will be loaded
lookuptablelocation	Directory with the lookup tables for RACMO
savedir	Directory to save the results
lwpthres	LWP threshold. It is assumed that all radiation is cloudy diffuse beyond this value
iwpthres	IWP threshold. It is assumed that all radiation is cloudy diffuse beyond this value
impcon	Soot concentration in kg/kg (one value if constant, otherwise a value for all layers)
ssabareice	SSA of the bare ice, taken as a constant for all conditions
wlbands	Number of wavelength bands
anglescs	SZA of the look up table for clear sky conditions for Direct/total energy fraction (for example an array from 0 to 90 degrees).
angleswl	SZA of the lookup table for wavelength determination of clear sky conditions for direct and diffuse.
iwplist	Ice water path for the lookup table interpolation
lwplist	Liquid water path for the lookup table interpolation
PW_list	Precipitable water for the lookup table interpolation. Note that in RACMO, PW has the variable name var230.
lw	Linewidth for plots
year	Considered year
timegmt	Time in GMT
latpoint	Latitude element of the considered point (for latpoint = 46: 64.67 N)
lonpoint	Longitude element of the considered point (for lonpoint = 40: 45.05 W)
pkm	Switch: 1 If the albedo according to Kuipers Munneke et al. (2011) is considered
plot	Switch: 1 If plots are made
rhoice	Density of ice (for PKM)
albbareice	Bare ice albedo (for PKM)
monthlist	List of the considered months
monthlistabb	List of the abbreviations of the months
monthselementen	List of the amount days in the considered months
lambdaclouds	Array with representative wavelengths for cloudy conditions
lambdadir	Array with representative wavelengths for clear-sky direct radiation
lambdadif	Array with representative wavelength for clear-sky diffuse radiation
dirsumfrac	Direct/total energy fraction per band and as a function of SZA.

Output

A figure with 8 panels (7 if PKM is turned off) as a function of time for the given year and moment of the day. Panel 1. Surface downward SW radiation including total, UV + visible and IR, 2. Broadband albedo of TARTES, RACMO2, and PKM if PKM is turned on. The horizontal lines on the right indicate the broadband albedo 3. Albedo difference: TARTES – RACMO2, 4. Albedo difference TARTES – PKM if PKM is turned on, 5. SZA, 6. Cloud cover, 7. 2-m Temperature with melt events indicated red, 8. SSA as a function of depth, including a horizontal line at the bottom, indicating the lack of a fresh snow layer.