sentinelSimulator Documentation

Release 0.0.1

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CONTENTS

CHAPTER ONE

CONTENTS:

1.1 sentinelSimulator

This Python package simulates Sentinel 2 data based on output from the JULES land surface model. Here we provide documentation on this package. Below we illustrate a basic explanation of the package in use.

Example of using sentinelSimulator package:

```
import simulator as sim
# Create class instance containing sentinel simulator data
sim.Simulator(year=2012, month=1, days=365)
```

1.1.1 Features

- Simulates sentinel 2 data from JULES output
- Add additional explanation

1.1.2 Source Code

github.com/example_user/sentinelSimulator

1.1.3 Support

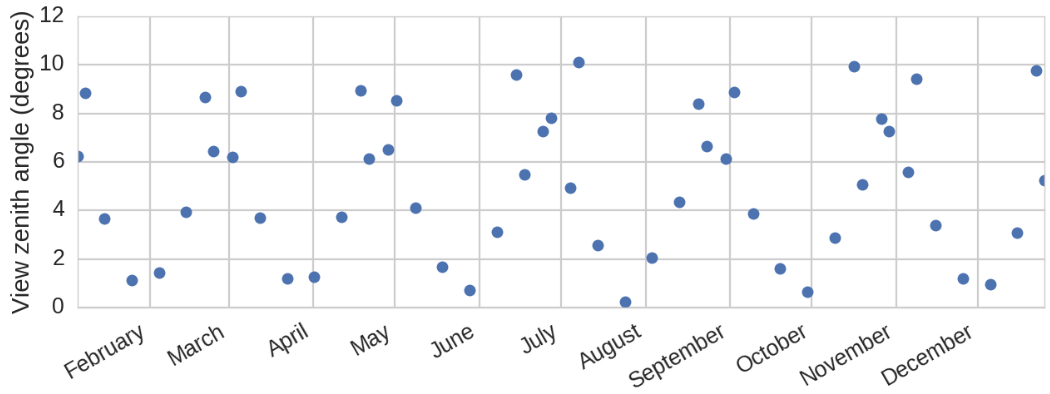
If you are having issues, please let us know. Contact: ewan.pinnington@gmail.com

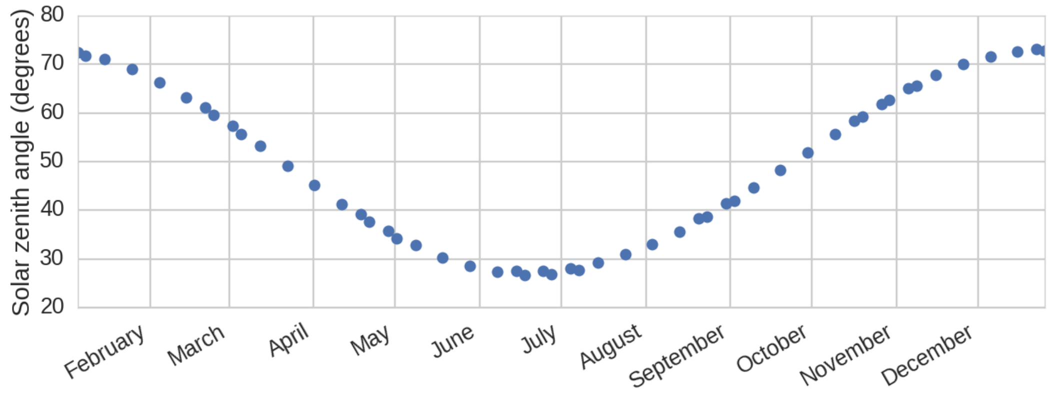
1.1.4 License

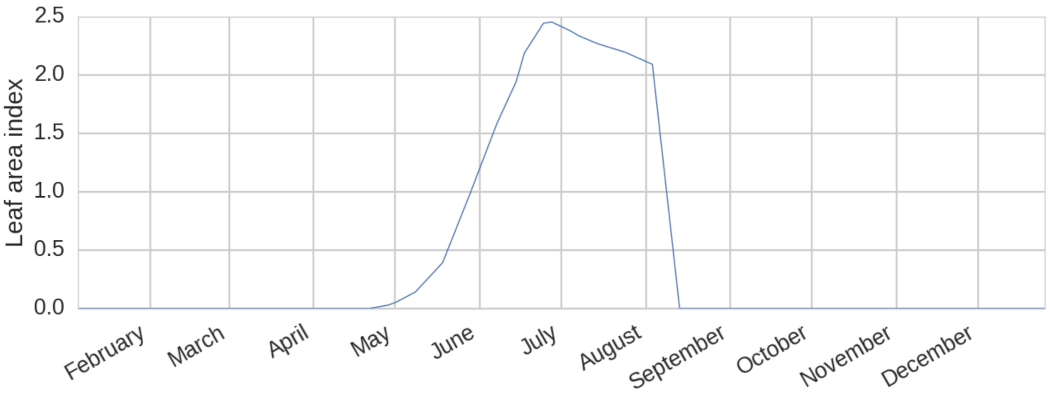
Details of licensing information.

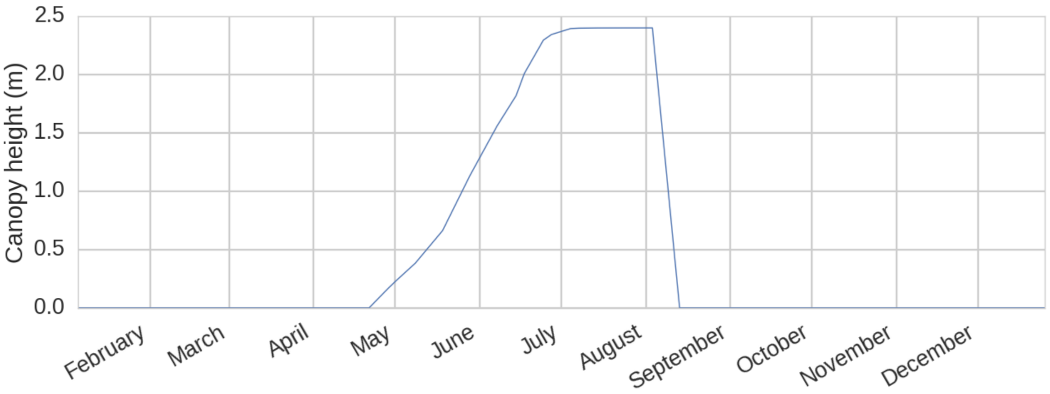
1.2 Example Output

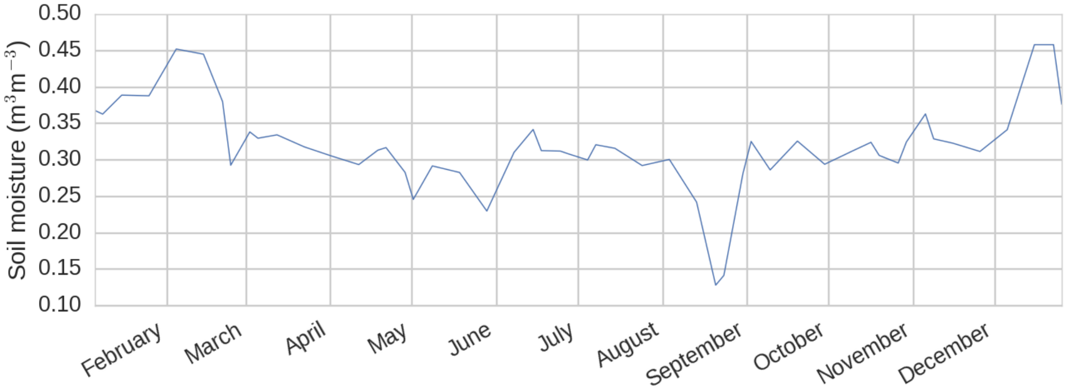
Here we show some example output from the Sentinel simulator.

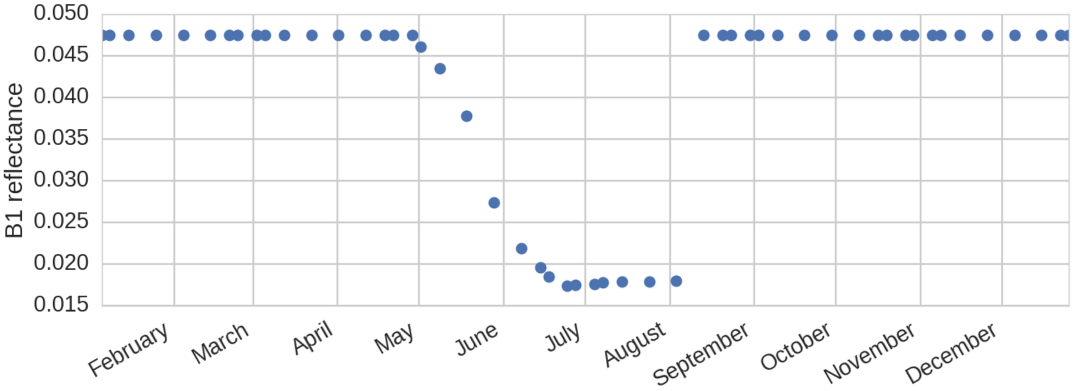

View zenith angle (degrees)
12
10
8
6
4
2
0
February
March
April
May
June
July
August
September
October
November
December

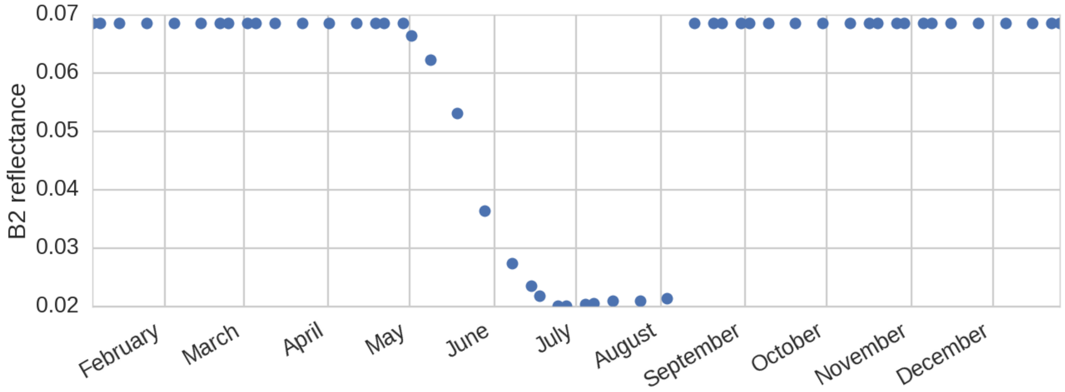

Solar zenith angle (degrees)
80
70
60
50
40
30
20
February
March
April
May
June
July
August
September
October
November
December

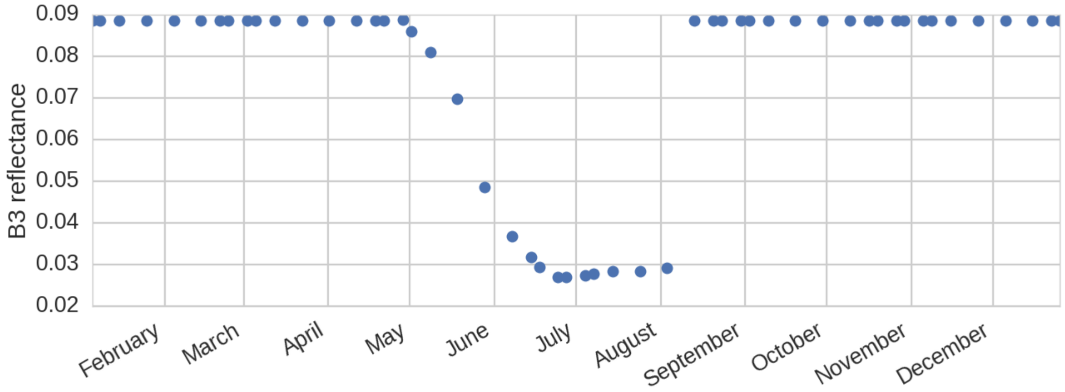

Leaf area index
2.5
2.0
1.5
1.0
0.5
0.0
February
March
April
May
June
July
August
September
October
November
December

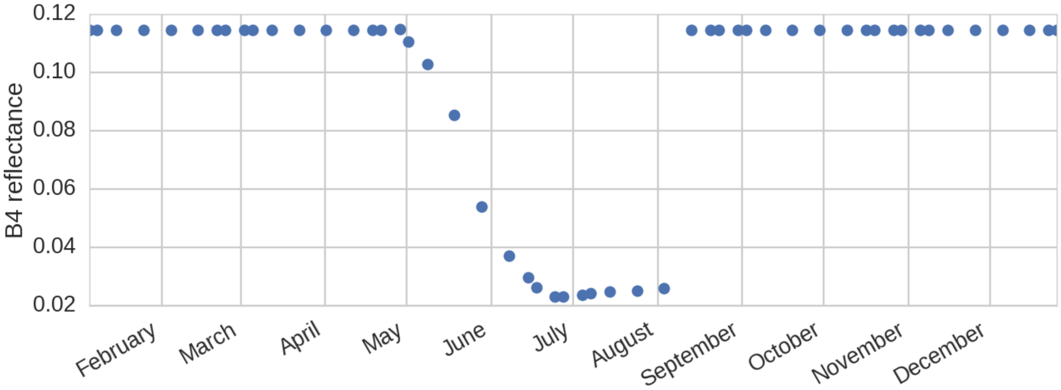

Canopy height (m)
2.5
2.0
1.5
1.0
0.5
0.0
February
March
April
May
June
July
August
September
October
November
December

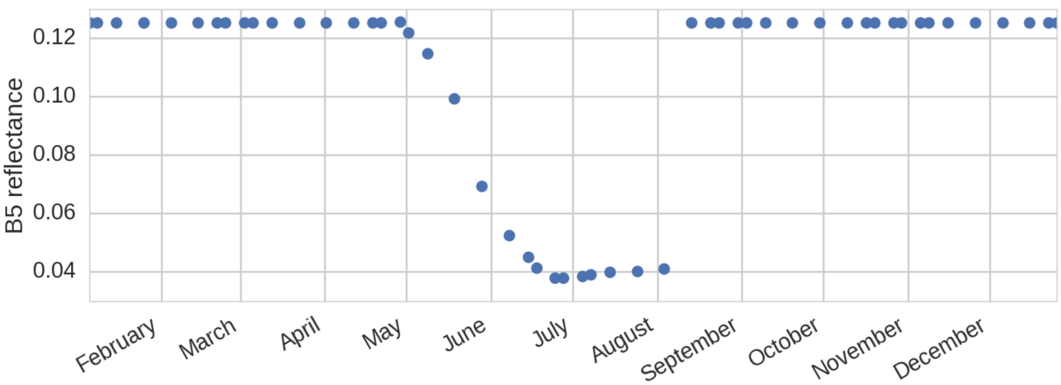

Soil moisture (m^{3}m^{-3})
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
February
March
April
May
June
July
August
September
October
November
December

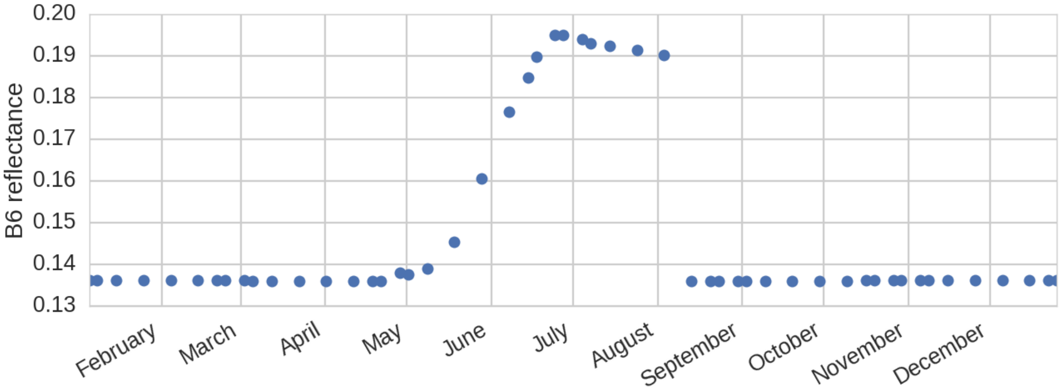

B1 reflectance
0.050
0.045
0.040
0.035
0.030
0.025
0.020
0.015
February
March
April
May
June
July
August
September
October
November
December

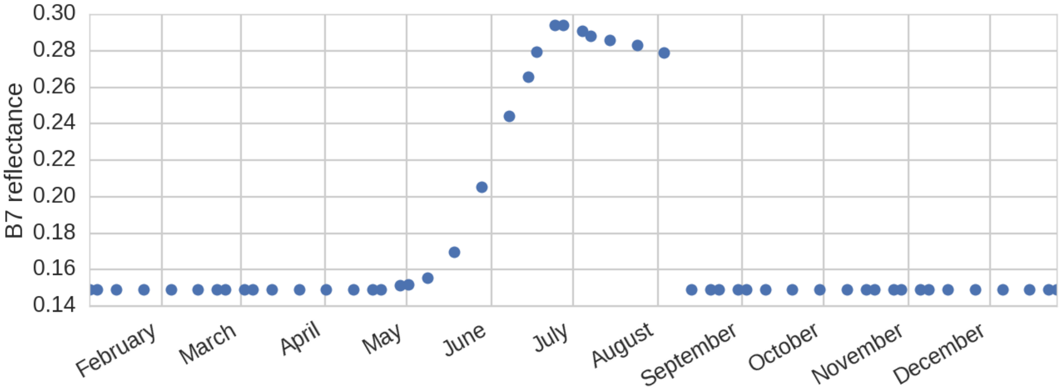

B2 reflectance
0.07
0.06
0.05
0.04
0.03
0.02
February
March
April
May
June
July
August
September
October
November
December

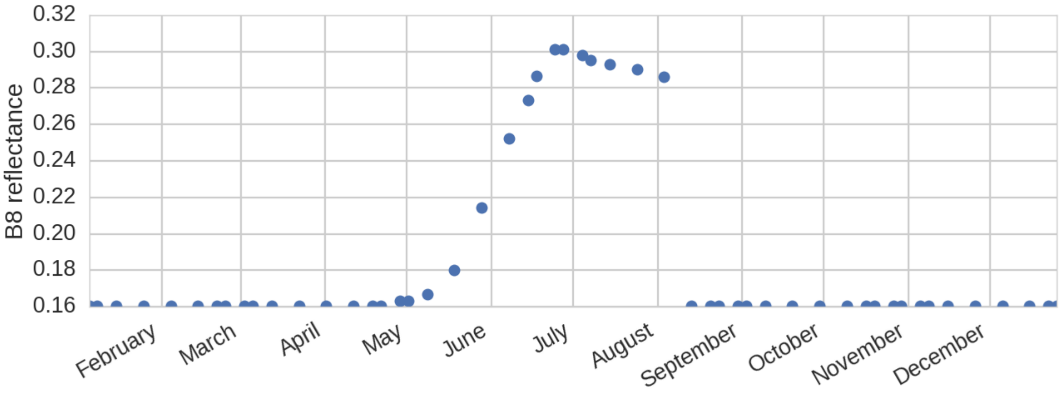

B3 reflectance
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
February
March
April
May
June
July
August
September
October
November
December

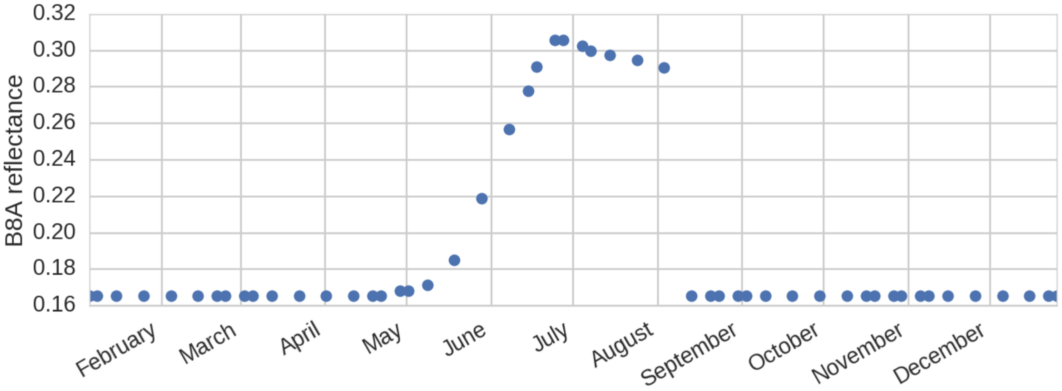

B4 reflectance
0.12
0.10
0.08
0.06
0.04
0.02
February
March
April
May
June
July
August
September
October
November
December

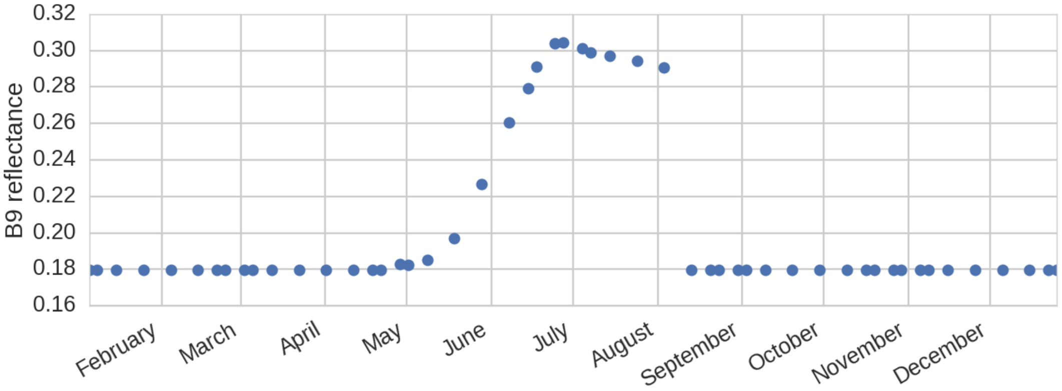

B5 reflectance
0.12
0.10
0.08
0.06
0.04
February
March
April
May
June
July
August
September
October
November
December

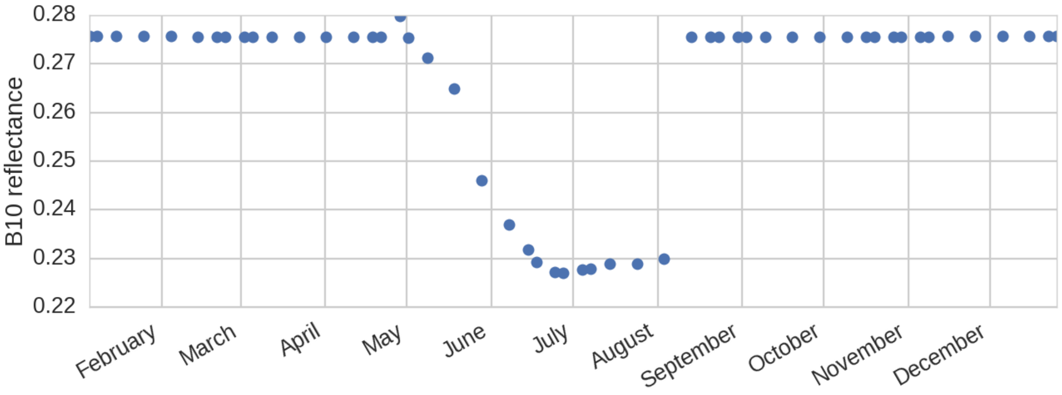

B6 reflectance
0.20
0.19
0.18
0.17
0.16
0.15
0.14
0.13
February
March
April
May
June
July
August
September
October
November
December

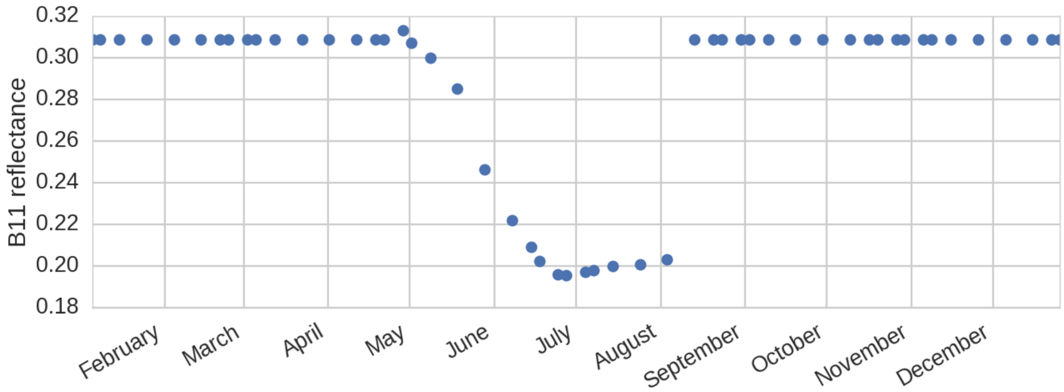

B7 reflectance
0.30
0.28
0.26
0.24
0.22
0.20
0.18
0.16
0.14
February
March
April
May
June
July
August
September
October
November
December

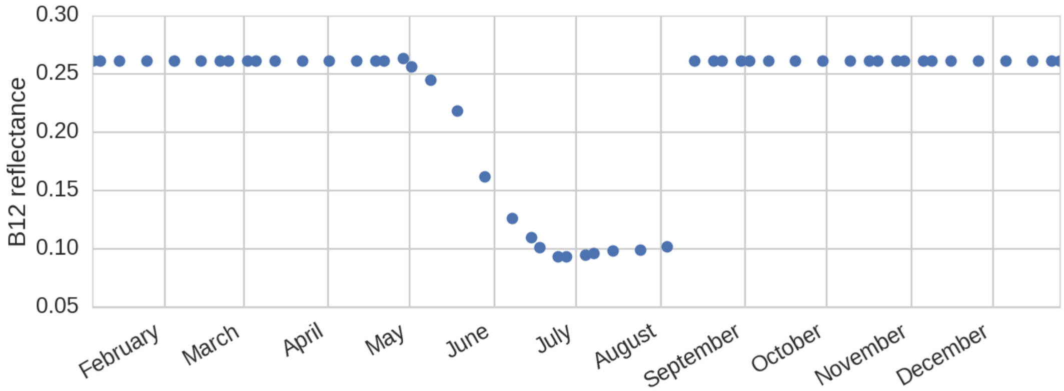

B8 reflectance
0.32
0.30
0.28
0.26
0.24
0.22
0.20
0.18
0.16
February
March
April
May
June
July
August
September
October
November
December


B8A reflectance
0.32
0.30
0.28
0.26
0.24
0.22
0.20
0.18
0.16
February
March
April
May
June
July
August
September
October
November
December


B9 reflectance
0.32
0.30
0.28
0.26
0.24
0.22
0.20
0.18
0.16
February
March
April
May
June
July
August
September
October
November
December


B10 reflectance
0.28
0.27
0.26
0.25
0.24
0.23
0.22
February
March
April
May
June
July
August
September
October
November
December





1.3 sentinel_simulator

1.3.1 sentinel_simulator package

Subpackages

sentinel_simulator.jules package

Submodules

sentinel_simulator.jules.py_importNML module

`sentinel_simulator.jules.py_importNML.`**`importJulesNML`**`(`*nml*`)`

Parse a JULES nml file and write it in the style used for the julesNML class.

Parameters **nml** (*str.*) – JULES NML file name.

Returns None

sentinel_simulator.jules.py_jules module

`sentinel_simulator.jules.py_jules.`**`crop_run`**`(`*sow_date=110*, *b=6.631*, *smwilt=0.1866*, *neff=0.00057*`)`

Function that runs JULES with crop model turned on and given user defined parameters at Wallerfing site. Output is saved in folder and file specified within function.

Parameters

- **sow_date** (*int.*) – Sow date, between 90 and 150.
- **b** (*float.*) – Brooks-Corey exponent factor.
- **smwilt** (*float.*) – Soil moisture wilting point.
- **neff** (*float.*) – Nitrogen use efficiency of crop (Vcmax).

Returns ‘Done’ to notify used JULES run has finished.

Return type str

class `sentinel_simulator.jules.py_jules.`**`jules`**(*jules_exe='/home/if910917/jules/models/jules4.8/build/bin/jules.exe'*)

Bases: `sentinel_simulator.jules.py_jules.julesAllNML`

Class to run JULES.

Parameters **jules_exe** (*str*) – location of JULES executable.

Note: You must have JULES installed on local system with a version of 4.8 or higher.

`runJules`()

Write all NML files to disk. Run JULES in a subprocess. Check output for fatal errors.

Returns stdout and stderr output from JULES model run.

Return type str

class `sentinel_simulator.jules.py_jules.`**`julesAllNML`**

This class is populated by the contents of a module which contains templates of all the required JULES namelist files

`writeNML`()

sentinel_simulator.jules.py_julesNML module This module holds JULES namelist files. It has been automatically generated.

class `sentinel_simulator.jules.py_julesNML.`**`julesNML`**(*template*, *filename*)

This is the base class for storing and writing JULES namelist files

`update`(*template*)

`write`()

Module contents

Submodules

sentinel_simulator.opticalCanopyRT module

`sentinel_simulator.opticalCanopyRT.`**`canopyRTOptical`**(*state*, *geom*, *resln=1.0*)

A python wrapper to the SemiDiscrete optical canopy RT model of Nadine Gobron. Runs the model for the the whole of its valid spectra range at a resolution set by resln.

Parameters

- **state** (*instance*) – Instance of the stateVector class.
- **geom** (*instance*) – Instance of the sensorGeomety class.

- **resln** (*float*) – the spectral resolution in nm [optional].

Returns Instance of the spectra class.

Return type instance

sentinel_simulator.satelliteGeometry module

`sentinel_simulator.satelliteGeometry.`**`getSentinel2Geometry`**(*startDateUTC*, *lengthDays*, *lat*, *lon*, *alt=0.0*, *mission='Sentinel-2a'*, *tleFile='../TLE/norad_resource_tle.txt'*)

Calculate approximate geometry for Sentinel overpasses. Approximate because it assumes maximum satellite elevation is the time at which target is imaged.

Parameters

- **startDateUTC** (*object*) – a datetime object specifying when to start prediction.
- **lengthDays** (*int*) – number of days over which to perform calculations.
- **lat** (*float*) – latitude of target.
- **lon** (*float*) – longitude of target.
- **alt** (*float*) – altitude of target (in km).
- **mission** (*str*) – mission name as in TLE file.
- **tleFile** (*str*) – TLE file.

Returns a python list containing instances of the sensorGeometry class arranged in date order.

Return type list

class `sentinel_simulator.satelliteGeometry.`**`sensorGeometry`**

Class to hold sun-sensor geometry information.

`printGeom`()

Prints currently specified class attributes.

sentinel_simulator.spectra module

exception `sentinel_simulator.spectra.`**`UnknownFileType`**

Bases: `exceptions.Exception`

Exception class for unknown filetypes

`sentinel_simulator.spectra.`**`convolve`**(*s1orig*, *s2orig*, *resln=1.0*, *s2norm=True*)

Convolve one spectra with another, for example to apply a band pass, or a spectral response function.

Parameters

- **s1orig** (*object*) – A spectra object.
- **s2orig** (*float*) – A spectra object.
- **resln** (*float*) – The spectral resolution to use.
- **s2norm** (*bool*) – If True normalise the second spectra (e.g. to apply a spectra response function).

Returns Convolved spectra.

Return type object

`sentinel_simulator.spectra.`**`sentinel2`**(*s*, *mission='a'*)

class `sentinel_simulator.spectra.`**`spectra`**(*fname=None*, *ftype='SVC'*, *wavlCol=0*, *reflCol=1*, *hdrLines=1*)

Bases: `object`

Spectra class for sentinel simulator.

`interpolate`(*resltn=0.1*)

Interpolate spectra to the given resolution. Overwites exisiting data.

Parameters **resltn** (*float*) – resolution of the interpolation.

`loadCSV`(*f*, *wavlCol=0*, *reflCol=1*, *hdrLines=1*)

Read in data from a standard CSV file object.

Parameters

- **f** (*file*) – File object.
- **wavlCol** (*int*) – Column containing wavelengths.
- **reflCol** (*int*) – Column containing reflectance data.
- **hdrLines** (*int*) – Number of lines to skip at start of file.

`loadSVCSig`(*f*)

Read in data from an SVC .sig ascii file.

Parameters **f** (*file*) – File object.

`loadSpectra`(*fname*, *wavlCol=0*, *reflCol=1*, *hdrLines=1*)

Load in the spectra from a given file using a method appropriate to the type of file.

Note: Current supported formats are:

SVC - SCV .sig ascii file

CSV - standard ascii comma seperated values

Parameters

- **fname** (*str*) – Valid filename containing spectra.
- **wavlCol** (*int*) – Column containing wavelengths.
- **reflCol** (*int*) – Column containing reflectance data.
- **hdrLines** (*int*) – Number of lines to skip at start of file.

`trim`(*wlmin*, *wlmax*)

Trim the spectra so it is between two specified wavelengths. Destroys the original data.

Parameters

- **wlmin** (*float*) – The lowest wavelength of the new spectra.
- **wlmax** (*float*) – The highest wavelength of the new spectra.

sentinel_simulator.stateVector module

`sentinel_simulator.stateVector.`**`get_jules_state`**(*date_utc*, *nc_file='jules/output/wallerfing_79_12.3_hourly.nc'*)

Function that returns a stateVector instance for a given time. :param date_utc: datetime object of when to extract JULES output. :type date_utc: object :param nc_file: JULES output file from which to extract data. :type nc_file: str :return: Instance of stateVector class. :rtype: instance

`sentinel_simulator.stateVector.`**`nearest`**(*items*, *pivot*)

`sentinel_simulator.stateVector.`**`read`**(*file_format='jules'*, *file_str=None*, *year=None*)

Reads output data to a dictionary of state vectors indexed by time.

Note: This function requires sub-functions capable of reading specified file format.

Parameters

- **file_format** – format of output to read.
- **file_str** (*str*) – location of file.
- **year** (*int*) – year of data to extract, if equal to None whole time series extracted

Returns state dictionary.

Return type dict

`sentinel_simulator.stateVector.`**`read_jules`**(*nc_file=None*, *year=None*)

Reads jules output from netCDF file and writes it to a dictionary indexed by date.

Parameters

- **nc_file** (*str*) – location of nc_file.
- **year** (*int*) – year of data to extract, if equal to None whole time series extracted.

Returns state dictionary.

Return type dict

class `sentinel_simulator.stateVector.`**`stateVector`**

Class to hold state vector data for optical and microwave canopy RT models.

Module contents

CHAPTER

TWO

INDICES AND TABLES

- *genindex*
- *modindex*
- *search*

PYTHON MODULE INDEX