photobiologyInOut Version 0.2.1
User Guide

Pedro J. Aphalo

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Contents

1 Introduction

```
library(photobiology)
library(photobiologygg)
library(photobiologyInOut)
```

This package defines functions for importing spectral data from different instruments (Table 1) and simulation models (Table 2).

2 Examples

Reading a file geenrated by Ocean Optics' Jaz spectrometer.

```
jaz.spct <- read_oojaz_file(file = "spectrum.JazIrrad")

## Warning in range_check(x, strict.range = strict.range):  Negative spectral energy
irradiance values; minimun s.e.irrad = -1.9
## Warning in range_check(x, strict.range = strict.range):  Negative spectral energy
irradiance values; minimun s.e.irrad = -0.0019
```

R function	Instrument	Program
read_ooss_txt_file()	Ocean Optics spectrometers	SpectraSuite
read_macam_dta_file()	Macam	*instrument*
read_licor_prn_file()	LI-COR LI-1800	PC1800 (MS-DOS program)

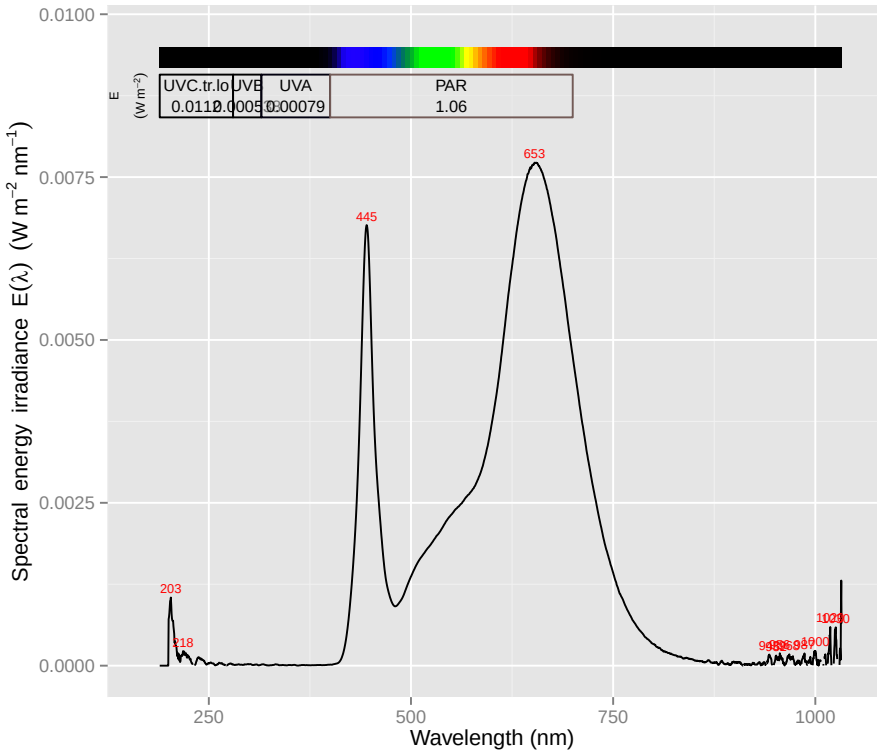
Table 1: Functions for importing measured spectral emission data

R function	Simulation model	version
read_tuv_file()	TUV (Sasha Madronich)	version 5.0 (modified by PJA)
read_tuv_file()	TUV (Sasha Madronich)	edited output from 5.0 (original)

Table 2: Functions for importing simualted spectral data from models

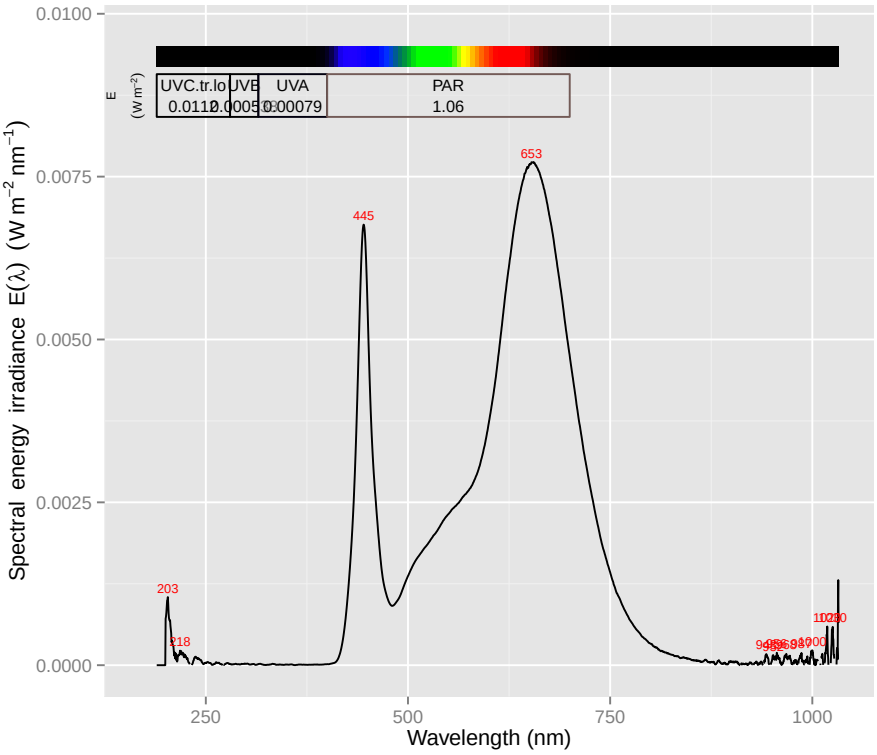
Plotting the spectrum.

```
plot(jaz.spct)

## Warning:  Removed 2 rows containing missing values (geom_path).
```



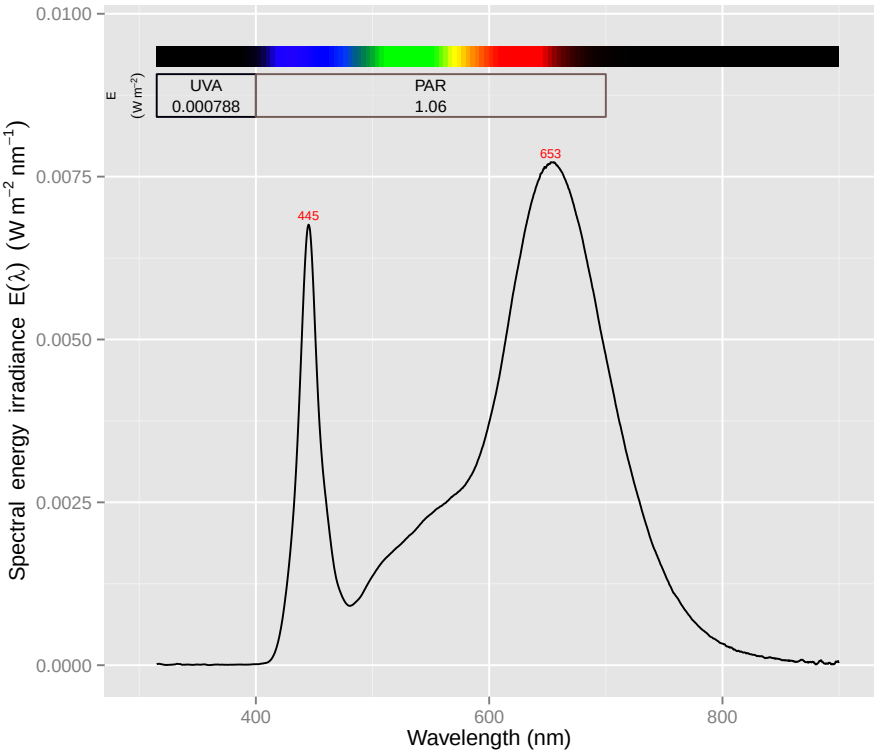
All in one statement.

```
plot(read_oojaz_file(file = "spectrum.JazIrrad"))

## Warning in range_check(x, strict.range = strict.range):  Negative spectral energy
irradiance values; minimun s.e.irrad = -1.9
## Warning in range_check(x, strict.range = strict.range):  Negative spectral energy
irradiance values; minimun s.e.irrad = -0.0019
## Warning:  Removed 2 rows containing missing values (geom_path).
```



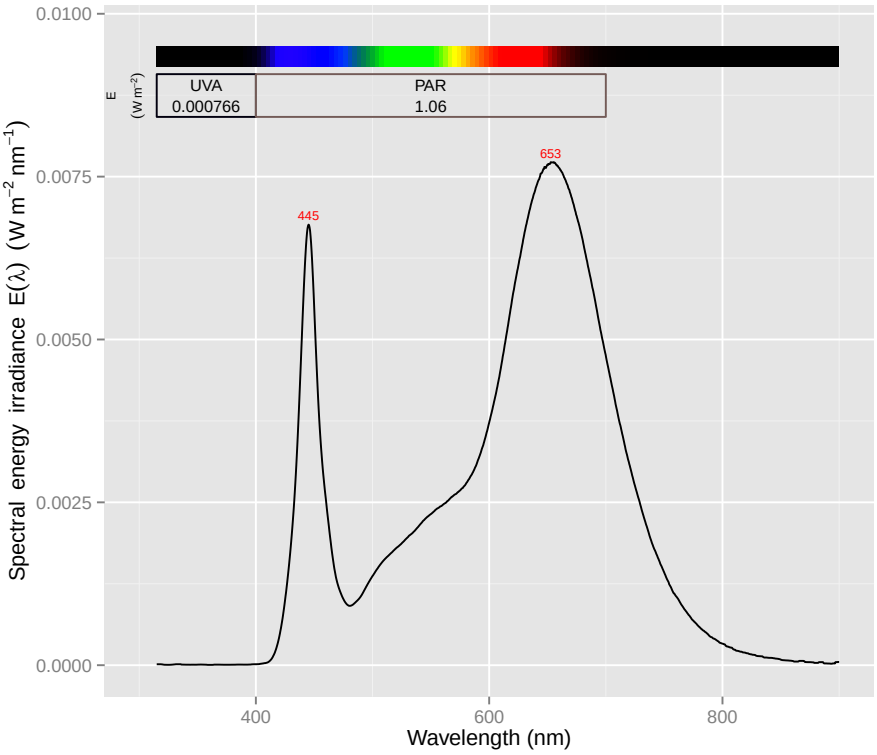
As above but limiting the wavelength range plotted.

```
plot(read_oojaz_file(file = "spectrum.JazIrrad"), range = c(315,900))

## Warning in range_check(x, strict.range = strict.range):  Negative spectral energy
irradiance values; minimun s.e.irrad = -1.9
## Warning in range_check(x, strict.range = strict.range):  Negative spectral energy
irradiance values; minimun s.e.irrad = -0.0019
## Warning in range_check(x, strict.range = strict.range):  Negative spectral energy
irradiance values; minimun s.e.irrad = -0.0019
```



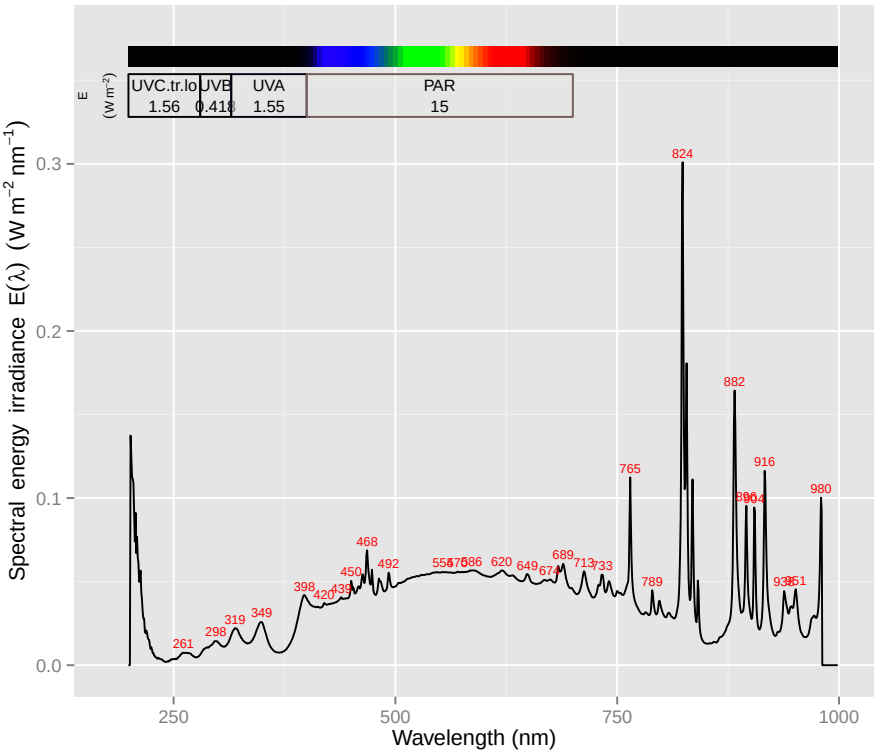
Adding our custom "adaptive" smoothing.

```
plot(smooth_spct(read_oojaz_file(file = "spectrum.JazIrrad")), range = c(315,900))

## Warning in range_check(x, strict.range = strict.range):  Negative spectral energy
irradiance values; minimun s.e.irrad = -1.9
## Warning in range_check(x, strict.range = strict.range):  Negative spectral energy
irradiance values; minimun s.e.irrad = -0.0019
## Warning in smooth_spct.source.spct(read_oojaz_file(file = "spectrum.JazIrrad")):
74 'bad' estimates in spectral irradiance
## Warning in range_check(x, strict.range = strict.range):  Negative spectral energy
irradiance values; minimun s.e.irrad = -0.0011
## Warning in range_check(x, strict.range = strict.range):  Negative spectral energy
irradiance values; minimun s.e.irrad = -0.0011
```



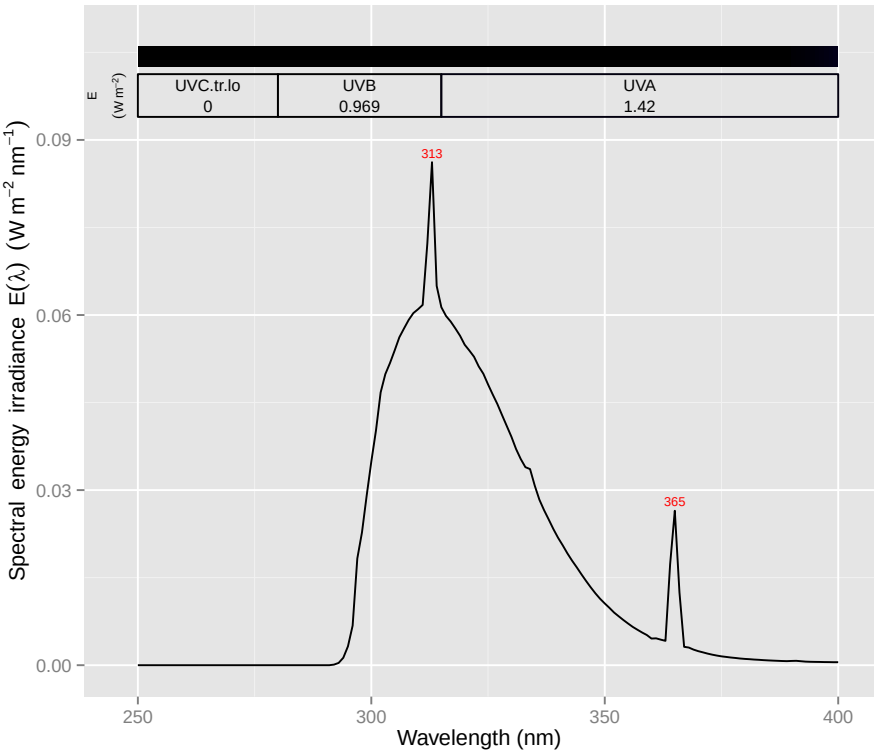
Now a file from an Ocean Optics' Q6500? spectrometer.

```
plot(read_ooss_file(file = "spectrum.SSIrrad"))
```



Macam's single column DTA files can also be imported.

```
plot(read_macam_file(file = "spectrum.DTA"))
```



And a file generated by LI-COR's PC1800 program for the LI-1800 sepctroradiometer.

```
read_licor_file(file = "spectrum.PRN")

##      w.length    s.e.irrad
##   1:      300 6.053193e-05
##   2:      301 1.333399e-04
##   3:      302 8.702762e-05
##   4:      303 1.279194e-04
##   5:      304 1.810952e-04
##  ---
## 597:      896 2.060117e-03
## 598:      897 1.571039e-03
## 599:      898 1.029629e-03
## 600:      899 5.312083e-04
## 601:      900 2.383262e-04
```

In all cases as much information as possible is decoed, and the data file headers are preserved as comments in the source.spct objects.

```
cat(comment(jaz.spct))

## Ocean Optics:
## Jaz Absolute Irradiance File
```

```
## ++++++++++++++++++++++++++++++++++++
## Date: Tue Feb 03 09:36:38 2015
## User: jaz
## Dark Spectrum Present: Yes
## Processed Spectrum Present: Yes
## Spectrometers: JAZA1065
## Integration Time (usec): 658000 (JAZA1065)
## Spectra Averaged: 3 (JAZA1065)
## Boxcar Smoothing: 5 (JAZA1065)
## Correct for Electrical Dark: Yes (JAZA1065)
## Strobe/Lamp Enabled: No (JAZA1065)
## Correct for Detector Non-linearity: Yes (JAZA1065)
## Correct for Stray Light: No (JAZA1065)
## Number of Pixels in Processed Spectrum: 2048
## Fiber (micron): 3900
## Collection Area: 0.119459
## Int. Sphere: No
```

A variable with the user supplied date and time data, or the date read from the header (the text itself) not the file date as the file date may noy reflect the creation date and time.

```
jaz.spct <- read_oojaz_file(file = "spectrum.JazIrrad", date = NULL)

## Warning in range_check(x, strict.range = strict.range):  Negative spectral energy
irradiance values; minimun s.e.irrad = -1.9
## Warning in range_check(x, strict.range = strict.range):  Negative spectral energy
irradiance values; minimun s.e.irrad = -0.0019

jaz.spct

##        w.length    s.e.irrad                date
##    1:  189.2849  0.000000000 2015-02-03 09:36:38
##    2:  189.7444  0.000000000 2015-02-03 09:36:38
##    3:  190.2040  0.000000000 2015-02-03 09:36:38
##    4:  190.6635  0.000000000 2015-02-03 09:36:38
##    5:  191.1229  0.000000000 2015-02-03 09:36:38
##   ---
## 2043: 1031.7194  0.000940100 2015-02-03 09:36:38
## 2044: 1032.0767  0.001306664 2015-02-03 09:36:38
## 2045: 1032.4341  0.000649023 2015-02-03 09:36:38
## 2046: 1032.7911 -0.001947533 2015-02-03 09:36:38
## 2047: 1033.1483 -0.001068803 2015-02-03 09:36:38
```

```
jaz.spct <- read_oojaz_file(file = "spectrum.JazIrrad", date = today())

## Warning in range_check(x, strict.range = strict.range):  Negative spectral energy
irradiance values; minimun s.e.irrad = -1.9
## Warning in range_check(x, strict.range = strict.range):  Negative spectral energy
irradiance values; minimun s.e.irrad = -0.0019

jaz.spct

##        w.length    s.e.irrad       date
##    1:  189.2849  0.000000000 2015-04-09
```

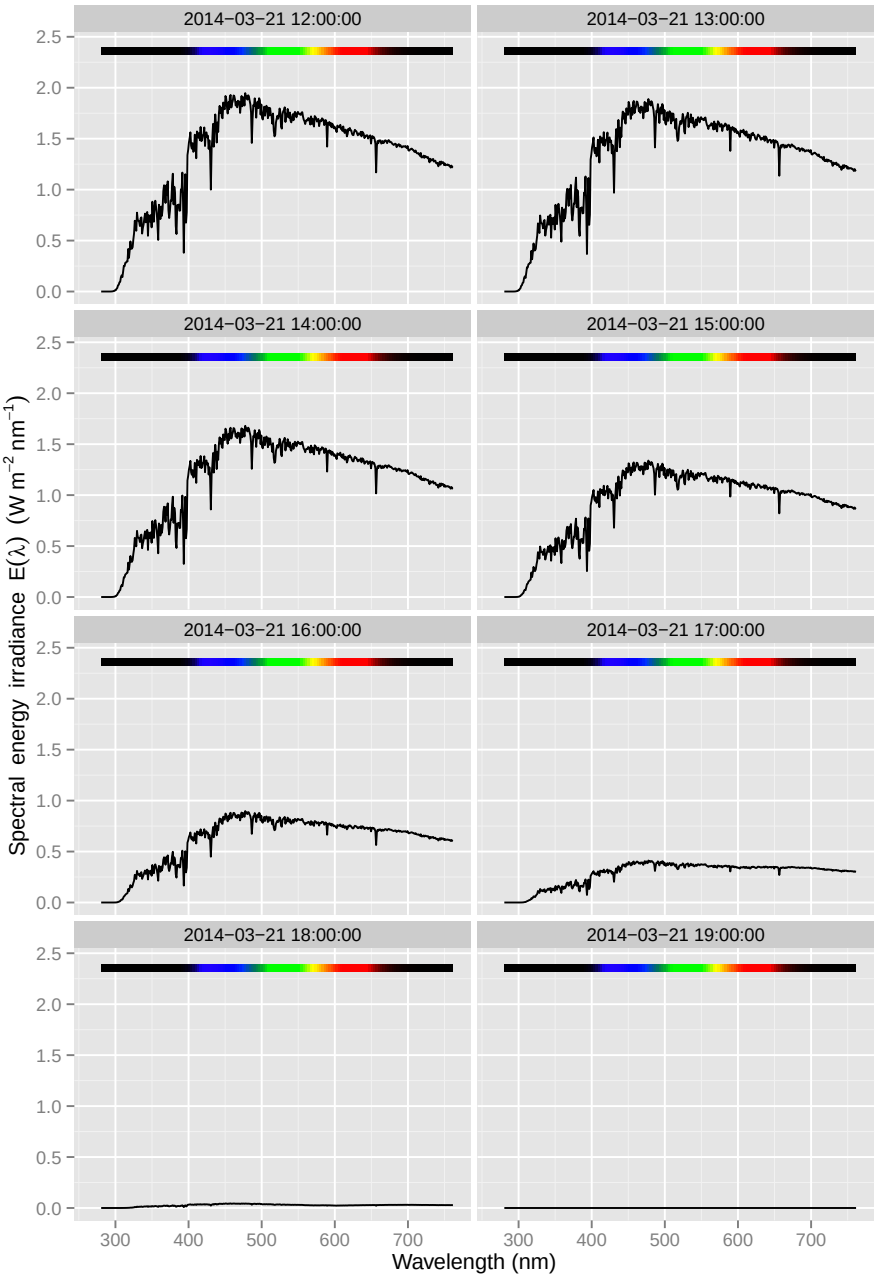
```
##    2:  189.7444  0.000000000 2015-04-09
##    3:  190.2040  0.000000000 2015-04-09
##    4:  190.6635  0.000000000 2015-04-09
##    5:  191.1229  0.000000000 2015-04-09
##   ---
## 2043: 1031.7194  0.000940100 2015-04-09
## 2044: 1032.0767  0.001306664 2015-04-09
## 2045: 1032.4341  0.000649023 2015-04-09
## 2046: 1032.7911 -0.001947533 2015-04-09
## 2047: 1033.1483 -0.001068803 2015-04-09
```

The output from the TUV model can be imported either by editing it before import, or by making a simple edit to the output routine of TUV. This function is known to work with TUV version 5.0 output. The output from TUV can contain a variable number of spectra in "parallel" columns, which are *melted* into a single column, with a factor with letter as levels, a numeric variable with the zenith angle and a POSIXct column with times. A date needs to be always supplied as the output file from TUV has only time of day information.

```
tuv.spct <- read_tuv_file(file = "usrout.txt", date = ymd("2014-03-21"))
summary(subset(tuv.spct, spectrum == "A"))

## wavelength ranges from 280.5 to 761.5 nm
## largest wavelength step size is 1 nm
## spectral irradiance ranges from 3.041e-15 to 1.947 W m-2 nm-1
## energy irradiance is 636.7 W m-2
## photon irradiance is 2928 umol s-1 m-2

tuv.spct

##       w.length spectrum s.e.irrad   angle                date
##    1:    280.5        A 3.041e-15   1.829 2014-03-21 12:00:00
##    2:    281.5        A 1.164e-13   1.829 2014-03-21 12:00:00
##    3:    282.5        A 1.824e-12   1.829 2014-03-21 12:00:00
##    4:    283.5        A 9.874e-12   1.829 2014-03-21 12:00:00
##    5:    284.5        A 1.258e-10   1.829 2014-03-21 12:00:00
##   ---
## 3852:    757.5        H 0.000e+00 103.213 2014-03-21 19:00:00
## 3853:    758.5        H 0.000e+00 103.213 2014-03-21 19:00:00
## 3854:    759.5        H 0.000e+00 103.213 2014-03-21 19:00:00
## 3855:    760.5        H 0.000e+00 103.213 2014-03-21 19:00:00
## 3856:    761.5        H 0.000e+00 103.213 2014-03-21 19:00:00
```

It is possible to extract individual spectra with subset, or as done here plot them in different panels.

```
plot(tuv.spct, annotations = c("colour.guide")) +
  facet_wrap(~date, ncol = 2)
```


2014−03−21 12:00:00
2014−03−21 13:00:00
2014−03−21 14:00:00
2014−03−21 15:00:00
2014−03−21 16:00:00
2014−03−21 17:00:00
2014−03−21 18:00:00
2014−03−21 19:00:00
Spectral energy irradiance E(λ) (W m−2 nm−1)
0.0
0.5
1.0
1.5
2.0
2.5
300
400
500
600
700
Wavelength (nm)