**R for Photobiology**

New chapter structure (version 2020-05-24)

1. Preface (to be included in full in book proposal)
   1. Scope of the book. What it includes, and what it does not include)
   2. Expected readership
   3. Why is a book like this needed/useful?
2. Introduction
   1. Photobiology (definition)
   2. R and R packages
3. Astronomy and atmosphere
   1. Solar time, local time, time zones and universal time coordinates
   2. Solar angles
   3. Day length/night length
   4. Aire mass (length of path of solar beam through the atmosphere
   5. Water-vapour in air
4. Radiation and radiation sources
   1. Radiation emission physics. Black body emission. Plank’s law. Energy of a photon.
   2. Irradiance, radiance, fluence rate, etc. and their units.
   3. Collimated vs. diffuse radiation. Point sources.
   4. Spectra.
   5. Computing summaries from spectra
   6. Measurement of radiation
   7. Sunlight, skylight and radiation transfer modelling
   8. Lamps (incandescent, discharge, LEDs).
5. Radiation interactions with “large objects”
   1. Large vs. small “particles”. Reflection, absorption, transmission. Refractive index, Fresnel’s laws. Light scattering.
   2. Reflectance (specular and total), transmittance (internal and total), absorptance and absorbance.
   3. Beer-Lambert’s law, attenuation vs. path length in homogeneous and heterogenous media.
   4. Spectra
   5. Computing summaries from spectra
   6. Measuring optical properties
   7. Optical filters and windows
   8. Plants’ and animals’ optical properties
   9. Light in plant canopies
   10. Light in water bodies
   11. Light in the soil (?)
6. Radiation interactions with molecules and its role in organisms
   1. Absorption of photons. Single photon and multi-photon phenomena
   2. Photochemical reactions
   3. Fluorescence and phosphorescence
   4. Action and response spectra
   5. Photosynthesis
   6. DNA damage
   7. Erythema
7. Photoreceptor proteins
   1. Radiation as a source of information for organisms
   2. What are photoreceptors?
   3. Absorption spectra and action spectra
   4. Photoreceptors of microorganisms
   5. Photoreceptors of plants
   6. Photoreceptors of animals and humans
   7. Photomorphogenesis, photoperiodism and phototropism
8. Colour perception and vision
   1. Colours from wavelengths
   2. “Perceptual distance” among colours
   3. “colour spaces” and colour reproduction
9. Operations on spectral data
   1. Removing “noise”, despiking and smoothing
   2. Rescaling, normalization and other single-spectrum transformations
   3. Conversion among units and bases of expression
   4. Feature extraction: Peaks, valleys and spikes
   5. Feature extraction: NDVI and other indexes
   6. Convolution and deconvolution of spectra
   7. Combining spectra to predict radiation spectra of source plus filter combinations
   8. Data acquisition
   9. Data exchange within R and with other software
   10. Accessing and depositing spectral data in public repositories
10. Operations on data collections
    1. Time series of data summaries
       1. Broad-band sensors
       2. Importing data from loggers
       3. Adding metadata
       4. Plotting
    2. Time series of spectra
       1. Spectrometers
       2. Acquisition and/or import
       3. Computing summaries
       4. Adding metadata
       5. Plotting
    3. Spectral images
       1. Spectral cameras
       2. Data dimensions
       3. Spatial features
11. Data acquisition and instrument calibrations (**on-line only**)
    1. Cosine response errors and their consequences
    2. Wavelength calibration errors and their consequences
    3. Irradiance calibration
    4. Etc.