Package 'Rprospect'

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Type Package

Title R functions for running PROSPECT family of leaf radiative transfer models

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Author Shawn P. Serbin

Maintainer Shawn P. Serbin <serbin@wisc.edu>

Description A package containing R functions for running the PROSPECT family of leaf radiative transfer models (RTMs). This package also includes functions for inverting the PROSPECT models with measured reflectance and transmittance spectra (using the DEoptim algorithm) to obtain estimates of leaf parameters (e.g. Chlorophyll, leaf mass per area).

Depends gsl, DEoptim,

Suggests testthat, snowfall, doSNOW

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LazyLoad yes

Collate 'tav.R' 'prospect4.R' 'prospect5.R' 'prospect5B.R''invprospect.R' 'merit.R' 'diagnostics.R'

R topics documented:

`invprospect` *Invert the PROSPECT family (PROSPECT-4,PROSPECT-5,PROSPECT-5B) of leaf radiative transfer models*

Description

Invert the PROSPECT family (PROSPECT-4,PROSPECT-5,PROSPECT-5B) of leaf radiative transfer models

Usage

```
invprospect(refl, tran, model, method, strategy,
  threshold, cpus, type)
```

Arguments

`refl`	observed leaf reflectance data
`tran`	observed leaf transmittance data
`model`	version of PROSPECT model to invert. Options: 4,5,5B. Default = 4
`method`	algorithm for finding the minimum of cost function between observed and modeled spectra (i.e. optimize the model parameters). Current options: DEoptim
`strategy`	DEoptim strategy (see DEoptim)
`threshold`	minimum threshold of the difference between observed and modeled spectra during optimization. Default = 0.0001
`cpus`	the number of cpus to use in parallel inversion of PROSPECT (optional)
`type`	the type of cluster to run the parallel inversion. Options: 'SOCK','MPI'. Default: 'SOCK'. Also see ?snowfall

Details

Function to invert the PROSPECT family (PROSPECT-4,PROSPECT-5,PROSPECT-5B) of leaf radiative transfer models (RTMs) on measured reflectance and transmittance data. This function is used for single spectra inversions.

Value

output optimum set of leaf parameters (N,Cab,Car,Cbrown,Cw,Cm), rmse of the inversion, and associated modeled reflectance and transmittance

Author(s)

Shawn P. Serbin

merit.p4 — *Merit function for inverting PROSPECT-4 on observed leaf reflectance and transmittance data*

Description

Merit function for inverting PROSPECT-4 on observed leaf reflectance and transmittance data

Usage

```
merit.p4(x)
```

Author(s)

Shawn Serbin

merit.p5 — *Merit function for inverting PROSPECT-5 on observed leaf reflectance and transmittance data*

Description

Merit function for inverting PROSPECT-5 on observed leaf reflectance and transmittance data

Usage

```
merit.p5(x)
```

Author(s)

Shawn Serbin

plot.prospect.inv — *Diagnostic plots displaying the results of the PROSPECT model inversion*

Description

Diagnostic plots displaying the results of the PROSPECT model inversion

Usage

```
plot.prospect.inv(inv.output, outdir, file)
```

Arguments

inv.output	output from the PROSPECT inversion
outdir	output directory for diagnostic plots
file	file name for diagnostic plots

Value

plot diagnostic plots of model inversion

Author(s)

Shawn Serbin

`prospect4` *PROSPECT-4 leaf radiative transfer model*

Description

Plant leaf reflectance and transmittance are calculated from 400 nm to 2500 nm (1 nm step) with the following parameters:

Usage

```
prospect4(N, Cab, Cw, Cm)
```

Arguments

`N`	leaf structure parameter. Number of elementary layers
`Cab`	leaf chlorophyll a+b content in ug/cm2
`Cw`	leaf equivalent water thickness (EWT) in g/cm2 or cm-1
`Cm`	leaf dry matter content in g/cm2 (alias leaf mass per area [LMA])

Author(s)

Shawn P. Serbin

References

Stokes G.G. (1862), On the intensity of the light reflected from or transmitted through a pile of plates, Proc. Roy. Soc. Lond., 11:545-556.

Allen W.A., Gausman H.W., Richardson A.J., Thomas J.R. (1969), Interaction of isotropic ligth with a compact plant leaf, J. Opt. Soc. Am., 59(10):1376-1379.

Jacquemoud S., Ustin S.L., Verdebout J., Schmuck G., Andreoli G., Hosgood B. (1996), Estimating leaf biochemistry using the PROSPECT leaf optical properties model, Remote Sens. Environ., 56:194-202.

Jacquemoud S., Baret F. (1990), PROSPECT: a model of leaf optical properties spectra, Remote Sens. Environ., 34:75-91.

Feret et al. (2008), PROSPECT-4 and 5: Advances in the Leaf Optical Properties Model Separating Photosynthetic Pigments, Remote Sensing of Environment

Feret et al. (2008). http://teledetection.ipgp.jussieu.fr/prosail/

Examples

```
LRT <- prospect4(2,65,0.004,0.002)
```

prospect5 *PROSPECT-5 leaf radiative transfer model*

Description

Plant leaf reflectance and transmittance are calculated from 400 nm to 2500 nm (1 nm step) with the following parameters:

Usage

```
prospect5(N, Cab, Car, Cw, Cm)
```

Arguments

N	leaf structure parameter. Number of elementary layers
Cab	leaf chlorophyll a+b content in ug/cm2
Car	leaf carotenoid content ug/cm2
Cw	leaf equivalent water thickness (EWT) in g/cm2 or cm-1
Cm	leaf dry matter content in g/cm2 (alias leaf mass per area [LMA])

Author(s)

Shawn P. Serbin

References

Stokes G.G. (1862), On the intensity of the light reflected from or transmitted through a pile of plates, Proc. Roy. Soc. Lond., 11:545-556.

Allen W.A., Gausman H.W., Richardson A.J., Thomas J.R. (1969), Interaction of isotropic ligth with a compact plant leaf, J. Opt. Soc. Am., 59(10):1376-1379.

Jacquemoud S., Ustin S.L., Verdebout J., Schmuck G., Andreoli G., Hosgood B. (1996), Estimating leaf biochemistry using the PROSPECT leaf optical properties model, Remote Sens. Environ., 56:194-202.

Jacquemoud S., Baret F. (1990), PROSPECT: a model of leaf optical properties spectra, Remote Sens. Environ., 34:75-91.

Feret et al. (2008), PROSPECT-4 and 5: Advances in the Leaf Optical Properties Model Separating Photosynthetic Pigments, Remote Sensing of Environment

Feret et al. (2008). http://teledetection.ipgp.jussieu.fr/prosail/

Examples

```
LRT <- prospect5(2,65,30,0.004,0.002)
```

prospect5B *PROSPECT-5B leaf radiative transfer model*

Description

Plant leaf reflectance and transmittance are calculated from 400 nm to 2500 nm (1 nm step) with the following parameters:

Usage

```
prospect5B(N, Cab, Car, Cbrown, Cw, Cm)
```

Arguments

N	leaf structure parameter. Number of elementary layers
Cab	leaf chlorophyll a+b content in ug/cm2
Car	leaf carotenoid content ug/cm2
Cbrown	brown pigments content in arbitrary units
Cw	leaf equivalent water thickness (EWT) in g/cm2 or cm-1
Cm	leaf dry matter content in g/cm2 (alias leaf mass per area [LMA])

Author(s)

Shawn P. Serbin

References

Stokes G.G. (1862), On the intensity of the light reflected from or transmitted through a pile of plates, Proc. Roy. Soc. Lond., 11:545-556.

Allen W.A., Gausman H.W., Richardson A.J., Thomas J.R. (1969), Interaction of isotropic ligth with a compact plant leaf, J. Opt. Soc. Am., 59(10):1376-1379.

Jacquemoud S., Ustin S.L., Verdebout J., Schmuck G., Andreoli G., Hosgood B. (1996), Estimating leaf biochemistry using the PROSPECT leaf optical properties model, Remote Sens. Environ., 56:194-202.

Jacquemoud S., Baret F. (1990), PROSPECT: a model of leaf optical properties spectra, Remote Sens. Environ., 34:75-91.

Feret et al. (2008), PROSPECT-4 and 5: Advances in the Leaf Optical Properties Model Separating Photosynthetic Pigments, Remote Sensing of Environment

The specific absorption coefficient corresponding to brown pigment is provided by Frederic Baret and used with his autorization.

Feret et al. (2008). http://teledetection.ipgp.jussieu.fr/prosail/

Examples

```
LRT <- prospect5B(2,65,30,0.3,0.004,0.002)
```

tav *Transmission of radiation through elementary layers within PROSPECT*

Description

Transmission of isotropic radiation across an interface between two dielectrics. The computation of the transmittivity at the leaf surface for a given incidence solid angle within PROSPECT

Usage

```
tav(teta, ref)
```

Arguments

teta	angle
ref	refractive index value by wavelength

Author(s)

Shawn P. Serbin

References

Stern F. (1964), Transmission of isotropic radiation across an interface between two dielectrics, Appl. Opt., 3(1):111-113.

Allen W.A. (1973), Transmission of isotropic light across a dielectric surface in two and three dimensions, J. Opt. Soc. Am., 63(6):664-666.

Feret et al. (2008), PROSPECT-4 and 5: Advances in the Leaf Optical Properties Model Separating Photosynthetic Pigments, Remote Sensing of Environment

Feret et al. (2008). http://teledetection.ipgp.jussieu.fr/prosail/

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