daisea

The **daisea** package utilizes derivative analysis, iterative spectral evaluation and Gaussian decomposition of total non-water absorption spectra to provide an estimate of colored detrital material (CDM) absorption and phytoplankton absorption.

The primary function is **daisea** (**D**erivative **A**nalysis and **I**terative **S**pectral **E**valuation of **A**bsorption) as described in the manuscript *Deriving inherent optical properties from decomposition of hyperspectral non-water absorption* (B.K. Grunert, C.B. Mouw, A.B. Ciochetto). We encourage users to refer to this document for a detailed description of steps along with a flow chart; additional information on function output can be found in this document as well. As the main executable function, **daisea** utilizes a variety of custom sub-functions as well as the following Matlab Toolboxes: **Curve Fitting Toolbox** and **Signal Processing Toolbox**. Input spectra should be hyperspectral, ideally at a wavelength range of ≤ 5 nm. Spectral range should extend to approximately 350 nm and up to 690 nm or greater. All function files include a detailed description of required input variables.

Sub-functions:

build_daisea_model
Function utilizes an estimated single exponential model and pre-defined number of estimated Gaussian curves to fit total non-water absorption using a least squares approach.

build_phy_model
Function optimizes a pre-defined number of estimated Gaussian curves for a given signal using a least squares approach.

cdom_model_lam0_noK
Function models a colored dissolved organic matter (CDOM), non-algal particulate (NAP), or CDM absorption spectra with a single exponential following a defined initial wavelength, absorption at that wavelength, and no offset value (K value).

spectral_slope_nogauss_noK
Function estimates spectral slope (S) for a CDOM, NAP or CDM absorption spectra assuming the spectra can be fit with a single exponential model, no Gaussian components and K value.

cdom_model_0gaussian_noK
Function models an absorption spectra best approximated with a single exponential and no Gaussian components with no K value.

cdom_model_1gaussian_noK
Function models an absorption spectra best approximated with a single exponential and one Gaussian component with no K value.

cdom_model_2gaussian_noK
Function models an absorption spectra best approximated with a single exponential and two Gaussian components with no K value.
cdom_model_3gaussian_noK
Function models an absorption spectra best approximated with a single exponential and three Gaussian components with no K value.

cdom_model_4gaussian_noK
Function models an absorption spectra best approximated with a single exponential and four Gaussian components with no K value.

cdom_model_5gaussian_noK
Function models an absorption spectra best approximated with a single exponential and five Gaussian components with no K value.

cdom_model_6gaussian_noK
Function models an absorption spectra best approximated with a single exponential and six Gaussian components with no K value.

cdom_model_7gaussian_noK
Function models an absorption spectra best approximated with a single exponential and seven Gaussian components with no K value.

cdom_model_8gaussian_noK
Function models an absorption spectra best approximated with a single exponential and eight Gaussian components with no K value.

cdom_model_9gaussian_noK
Function models an absorption spectra best approximated with a single exponential and nine Gaussian components with no K value.

cdom_model_10gaussian_noK
Function models an absorption spectra best approximated with a single exponential and ten Gaussian components with no K value.

cdom_model_11gaussian_noK
Function models an absorption spectra best approximated with a single exponential and eleven Gaussian components with no K value.

cdom_model_12gaussian_noK
Function models an absorption spectra best approximated with a single exponential and twelve Gaussian components with no K value.

cdom_model_13gaussian_noK

Function models an absorption spectra best approximated with a single exponential and thirteen Gaussian components with no K value.

cdom_model_14gaussian_noK
Function models an absorption spectra best approximated with a single exponential and fourteen Gaussian components with no K value.

cdom_model_15gaussian_noK
Function models an absorption spectra best approximated with a single exponential and fifteen Gaussian components with no K value.

cdom_model_16gaussian_noK
Function models an absorption spectra best approximated with a single exponential and sixteen Gaussian components with no K value.

gauss
Function models a single Gaussian curve.

gauss1
Function models a single Gaussian curve.

gauss2
Function models two Gaussian curves.

gauss3
Function models three Gaussian curves.

gauss4
Function models four Gaussian curves.

gauss5
Function models five Gaussian curves.

gauss6
Function models six Gaussian curves.

gauss7
Function models seven Gaussian curves.

gauss8
Function models eight Gaussian curves.

gauss9
Function models nine Gaussian curves.

gauss10
Function models ten Gaussian curves.
gauss11
Function models eleven Gaussian curves.

gauss12
Function models twelve Gaussian curves.

gauss13
Function models thirteen Gaussian curves.

gauss14
Function models fourteen Gaussian curves.

gauss15
Function models fifteen Gaussian curves.

gauss16
Function models sixteen Gaussian curves.

How to use example spectra

```
for ii=1:length(example_spectra)
       output(ii)=daisea(example_spectra(ii).at_nw,example_spectra(ii).wavelength,350,700);
end
```

How to plot results

```
for ii=1:length(output)
       figure;
       plot(output(ii).lam,output(ii).at_nw,'--k')
       hold on;
       plot(output(ii).lam,output(ii).agd_final_estimate,'-','color',[140 81 10]/255)
       plot(output(ii).lam, output(ii).agd_final_estimate+output(ii).aphy_final_estimate,'-
       ','color',[35 139 69]/255)
end
```

How to cite this package
This algorithm/package was released with an accompanying publication, *Deriving inherent optical properties from decomposition of hyperspectral non-water absorption* (B.K. Grunert, C.B. Mouw, A.B. Ciochetto). This ReadMe file will be updated upon publication. If used prior to publication, please contact B.K. Grunert for citation information.