**Absorption modeling part.**

Mathematical model for absorption

The coccolith core absorption term is given by

(62)

where is the number of coccospheres and is the result of an integral over the size distribution of the cores:

(63)

We note that if we neglect the backscatter loss from the front surfaces which we can do to first order, the absorption by the cores is independent of whether they are coated or not. We can thus write:

(64)

where is the proportion of naked cores and is the fraction of naked cores that remain in the surface after their liths have been shed (=number of surviving naked cores /). The first term represents the absorption from the naked cores left in the surface layer after lith shedding, while the second term represents the absorption from the coated cores in the bloom.

Commented Code from Mathematica source:

Function: read in imaginary index of refraction from file.

(\* read coccolithophore absorption from Aimme Neely and smooth data\*)

filename="coccolithophore-imaginary-index-smoothed-v2.txt";

datatable=Import[filename,"Table"];

colx=1;

coly=2;

wavemicron=datatable[[All,colx]];

kccraw=datatable[[All,coly]];

Function: smooth imaginary index data to lower resolution of 10 nm and produce an interpolation for any wavelength. (I have made my own function for a sliding average but I am sure there are equivalent program built in to Matlab)

(\* smooth to a resolution 10.0 nm \*)

kccsmooth=smoothcentered[kccraw,25];

kccwave=Transpose[{wavemicron,kccsmooth}];

(\* coccolithophore core absorption index wavelenght in micron \*)

(\* compute mean coccolithophore cross-section in meters squared \*)

kabscc[wave\_]:=Interpolation[kccwave,InterpolationOrder->1][wave]

Function: Produce the absorption efficiency for a single spherical core using the anomalous diffraction approximation, rc is the radius in microns, wave is the wavelength in microns.

del[wave\_]:=4 kabscc[wave] 2 Pi/wave

qabs[rc\_,wave\_]:=2((1/2)+(Exp[-del[wave]rc]/(del[wave]rc))+((Exp[-del[wave]rc]-1)/(del[wave]rc)^2))

Function: general form of m=2,nu=2 gamma distribution. UnitStep[r-rmin] is the Heavyside step function

psize22norm[beta\_,rmin\_,r\_]:=UnitStep[r-rmin](4beta^(3/2)/Sqrt[Pi]) (r-rmin)^2Exp[-beta(r-rmin)^2]

Function: compute beta from the standard deviation of the size distribution sig in microns

betamusig22[sig\_]:=(3 Pi-8)/(2 Pi sig^2)

Function: compute rmin from the standard deviation(microns) and the mean(microns) of the size distribution

rminmusig22[mu\_,sig\_]:=mu-sig/Sqrt[(3Pi-8)/8]

(\* compute mean coccolithophore cross-section in meters squared and add frcore parameter to account for actual fraction of cores left near the surface note: corrected for the amount of partially coated cores\*)

Function: Integrate over 2 2 gamma distribution to obtain mean specific absorption per particle which is equal to the cross-section (i.e. the total absorption will be a =m2 Number of particles/m3)

(\* do integral over m=2,nu=2 gamma distribution \*)

acocco[frcore\_,flith\_,r\_,sig\_,mu\_,wave\_]:=1 10^(-12)(frcore flith +(1-flith))NIntegrate[qabs[2Sqrt[ao^2/r],wave]Pi (4ao^2/r)psize22norm[betamusig22[sig],rminmusig22[mu,sig],ao],{ao,0,Infinity}]