**Coccolith contribution to radiance signal program**

Note: I have separated the background signal and coccolith signal part to simplify the programming. The coccolith part is handled by producing tables of values of mean cross-sections as a function of various parameters that can then be interpolated to obtain the coccolith contribution to Rrs. This is done because in Mathematica it is very time consuming to evaluate the mean cross-sections repeatedly. )

(\* produce components required for coccolith contribution to Rrs signal \*)

(\* produce table for interpolation over desired parameters \*)

(\* set other required fixed parameters \*)

delrsrchoffman=1/5

ftzhai=1/4

ratioaxis=1.2

gapshape=0.01

layers=4

The code produces a three dimensional table to use for interpolation

(\* produce table for interpolation over combinations of {flith,ao,wave} \*)

coccodat=Flatten[Table[{flith,ao,wave,bloomstategen[flith,0.15,ao,layers,delrsrchoffman,ftsqryoung,

ftzhai,1.2,gapshape,34,0.666,wwao,wrao,aobo,wave/1.333]},{flith,0,1,.2},{ao,1,2,.2},{wave,.3,.9,.01}],2];

Export["coccolith-interpolation-table",coccodat,"Table"]

(\* produce the coccolith terms for Rrs evaluation from interpolation if the cross-section table\*)

(\* read coccolithophore cross-sections interpolation table from file and modify to meters squared \*)

(\* current file derived with 4 layers initial coccolithophore coating, sigma 0.15, r=1.2 \*)

coccores=Import["coccolith-interpolation-table","Table"];

interpcocco=Interpolation[coccores,InterpolationOrder->1];

The backscattering cross-section for coccoliths is produced by interpolation

bcocco[flith\_,mean\_,wave\_]:=1.0 10^(-12) interpcocco[flith,mean,wave]

(\* compute mean coccolithophore absorption 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\*)

acocco[frcore\_,flith\_,r\_,sig\_,mu\_,wave\_]:=1.0 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}]

(\* note that ncc0 is the number of initial coccolithophore cores per meter cube \*)

(\* produce total absorption for background sea and coccolith \*)

atot[frcore\_,flith\_,nclbgrd\_,ncd\_,ncc0\_,r\_,sigma\_,mean\_,wave\_]:=abckbrg[nclbgrd,ncd,wave]+

ncc0 acocco[frcore,flith,r,sigma,mean,wave]

bbtot[cnap\_,nclbgrd\_,flith\_,mean\_,ncc0\_,wave\_]:=bbbckgrd[cnap,nclbgrd,wave]+

ncc0 bcocco[flith,mean,wave]

xtot[frcore\_,cnap\_,nclbgrd\_,ncd\_,flith\_,ncc0\_,r\_,sigma\_,mean\_,wave\_]:=

bbtot[cnap,nclbgrd,flith,mean,ncc0,wave]/(atot[frcore,flith,nclbgrd,ncd,ncc0,r,sigma,mean,wave]+

bbtot[cnap,nclbgrd,flith,mean,ncc0,wave])

(\* compute full version of below surface water reflectance using albert-Mobley model \*)

rrsdtot[thsair\_,thvair\_,u\_,frcore\_,nclbgrd\_,cnap\_,flith\_,ncd\_,ncc0\_,r\_,sigma\_,mean\_,wave\_]:=

p1d xtot[frcore,cnap,nclbgrd,ncd,flith,ncc0,r,sigma,mean,wave]

(1+p2d xtot[frcore,cnap,nclbgrd,ncd,flith,ncc0,r,sigma,mean,wave]+

p3d xtot[frcore,cnap,nclbgrd,ncd,flith,ncc0,r,sigma,mean,wave]^2+

p4d xtot[frcore,cnap,nclbgrd,ncd,flith,ncc0,r,sigma,mean,wave]^3)

(1+p5d/Cos[thsw[thsair]])(1+p6d u)(1+p7d/Cos[thvw[thvair])

(\* correct for water interface using Lee in type 2 because of possible large below surface rrs in bloom \*)

rrsdplus[thsair\_,thvair\_,u\_,frcore\_,nclbgrd\_,cnap\_,flith\_,ncd\_,ncc0\_,r\_,sigma\_,mean\_,wave\_]:=

0.518 rrsdtot[ths,thv,u,frcore,nclbgrd,cnap,flith,ncd,ncc0,r,sigma,mean,wave]/

(1.0-1.562 rrsdtot[ths,thv,u,frcore,nclbgrd,cnap,flith,ncd,ncc0,r,sigma,mean,wave])