

Working with L1B (radiance) data and creation of "I/F"





Converting Radiance to I/F

 If working with L1b (radiance) data, I/F can be derived in a straightforward manner:

$$IoF = \frac{I\pi d^2}{F}$$

Where:

- I = radiance in W/m²/Sr/µm
- F = solar flux (solar spectrum) in W/m²/µm
- d = Moon-Sun distance in AU



Download M3 Solar Spectrum

http://m3.jpl.nasa.gov/docs/solar_spec_global85.txt http://m3.jpl.nasa.gov/docs/solar_spec_target256.txt



- MODTRAN-based (See Green et al., 2011)
- Global and target resolution version can be downloaded in ASCII format from the above links
- See http:// m3.jpl.nasa.gov/ m3data.html for more



Download M3 Solar Spectrum

http://m3.jpl.nasa...spec_global85.

ENVI ASCII Plot	: File [Mon Nov 2	2 17:44:36 2010]
Column 1: Wavel	length(nm)	
Column 2: M3 SS	3G V3 (W/m^2/um)~	~1
460.989990	2022.662109	
500.920013	1934.504639	
540.840027	1875.621826	
580.765015	1833.137451	
620.689941	1689.644409	
660.609985	1550.267334	
700.537537	1428.238281	
730.479980	1324.721680	
750.440002	1271.074707	
770.400024	1216.917114	
790.364990	1162.946045	
810.330017	1107.837036	
830.290039	1053.718018	
850.250000	985.262878	
870.209961	946.577942	
890.174988	920.729126	
910.140015	879.042053	
030 000076	838 584351	

- File is tabdelimited ASCII text
- 3 lines of header information to be skipped when importing





Steps to convert radiance to I/F in ENVI





Step 1: Import M3 Spectral Library

• Step 1:

실 Ef	실 ENVI 4.5										
File	Basic Tools	Classification	Transform	Filter	Spectral	Мар	Vector	Topographic	Radar	Window	Help
					SPEAR	Tools					
					Spectr	al Libra	ries		S	pectral Libra	ary Viewer
					Spectr	al Slice	s		► S	pectral Libra	ary Resampling
					MNE R	otation	1		, S	pectral Libra	ary Builder
					Pixel P	urity Ir	ndex		•		
					n-Dime	nsiona	l Visualize	er	•		
					Mappin	ng Meth	nods		•		

• Step 2:



(Can also choose "ASCII File...." here but that has more steps)





Step 1: Import M3 Spectral Library



Input ASCII File	<
Input File: C:\Documents and Settings\jeffn\Deskto ▲ Columns: 2, Rows: 85 460.989990 2022.662109 500.920013 1934.504639 540.840027 1875.621826 580.765015 1833.137451 620.689941 1689.644409	
X Axis Column 1	Ī
Y Axis Column 2 🗢	
Wavelength Units Nanometers	
Y Scale Factor 1.000000	
OK Cancel	_





Step 1: Import M3 Spectral Library

Step 3:

🍑 Sp	pectral I	library B	uilder	_	미×
File	Import	Options	Help		
Wav Ban	velength: ds: 85	460.99 to	2976.2 Nano	ometers	
	9	Spectrum N	lame	Color	
1	M3 SSG	i V3 (W/m	^2/um)	White	
	1	7			
S	elect All	Plot	Delete		
Ca	incel				

Click Plot

Done!



(Can save file as spectral library from File menu)





Step 2: Open Files

- Open radiance (RDN) file in ENVI:
 - File > Open Image File
- Open observations (OBS) file also
 - This step can be skipped if you want to use 1.0 AU for the Moon-Sun distance (~2% error)
- Open <u>and plot</u> the M3 solar spectrum if you have not already





Step 3: Get the Moon-Sun Distance

실 A	vailable Bands List	×
File	Options	
	M3G20090203T135512_V01_OBS_subset.IMG To-Sun Azimuth (deg) To-M3 Azimuth (deg) To-M3 Zenith (deg) Phase (deg) To-Sun Path Length (au-0.986049380276) To-M3 Path Length (m) Facet Slope (deg) Facet Aspect (deg) Facet Cos(i) (unitless)	
۰	Gray Scale 🔘 RGB Color	
	Selected Band]
To-	Sun Path Length (au-0.986049380276):M3G20090203T135512_V01_0BS_su	1
		1
Dim	15 304 x 545 (Floating Point) [BIL]	
Lo	pad Band No Display -	

- Get mean distance from list of band names of the OBS file
- Could use perpixel values in the **To-Sun Path** Length Band (band math)





Step 4: Call Spectral Math

🍑 El	\VI 4.5					
File	Basic Tools	Classification	Transform	Filter	Spectral	Ma
	Resize Da Subset D Rotate/Fl Layer Sta	ata (Spatial/Spe ata via ROIs ip Data icking	ctral)			
	Convert (Stretch D	Data (BSQ, BIL, ata	BIP)			
	Statistics Spatial St Change D Measurer	atistics Detection nent Tool	+ + +			
	Band Mat	h				
	Spectral I	Math				
	Segmenta	ation Image				
	Region O Mosaickin Masking	f Interest g)))			
	Preproce	ssing	+			

 Select Spectral Math under Basic Tools menu (also under Spectral menu)





Step 5: Enter the expression

Spectral Math	1			
Previous Spectral Math Expressions:	 Exp 	ression	is:	
	floa	t((s1*!dp)	i*0.98604	93^2)/s2)
Enter an expression: [(s1*!dpi*0.9860493^2)/s2		7 7	\uparrow	\uparrow
Add to List				
		Double		
OK Cancel Help	Radiance	precision π	Moon-Sun	Solar
			distance squared; variable per file	Spectrum





Step 6: Define s1

Click "Map Variable to Input File" and select your radiance (RDN) file

실 Variables to Spectra Pairings	×
Exp: [(\$1*!dpi*0.9860493^2)/\$2	
Variables used in expression:	
S1 - [undefined]	
S2 - [underined]	
Available Spectra list	
M3 SSG V3 (W/m^2/um)	
	- 1
Map Variable to Input File	
Output Result to Same Window	
OK Queue Cancel Help Clear	

Should end up with this:

Variables to Spectra Pairings	×
Exp: [s1*!dpi*0.9860493^2]/s2	
Variables used in expression:	
S1 - [File: M3G20090203T135512_V01_RDN_s	
S2 · fundefined	
Available Spectra list	
M3 SSG V3 (W/m ² /um)	
Map Variable to Input File	
[]	_
Output Besult to 🔍 File . O. Memoru	
OK Queue Cancel Help Clear	





Step 7: Define s2







Step 8: Choose Output File

	실 Variables to Spectra Pairings	X
	Exp: (s1*!dpi*0.9860493^2)/s2	
	Variables used in expression:	
	S2 - M3 SSG V3 (W/m ² /um)	
	Available Spectra list	
	M3 SSG V3 (W/m^2/um)	
	Map Variable to Input File	
Ì		
	Output Result to 💿 File 🗢 Memory	
	Enter Output Filename Choose 🔲 Compress	
		-
	L:\Documents and Settings\jeffn\Desktop\agu\w	a
ľ		
	OK Queue Cancel Help Clear	

• Then click "OK" and ENVI goes to work...

	Spectral Math Processing	<u>_ ×</u>
	Input File : C:\Documents and Settings\jeffn\Desktop\agu\ Output File: C:\Documents and Settings\jeffn\Desktop\agu\	walktł walki
ļ	•	•
	Cancel 29%	0.2%





Last Step: Enjoy!



실 A	실 Available Bands List 📃 🔲 🤉						
File	Optio	ns					
		IIIS IG20090203T135512_V01_IOF_subset.IMG Spec Math (Band 1:M3620090203T135512_V01_RDN_sub Spec Math (Band 2:M3620090203T135512_V01_RDN_sub Spec Math (Band 3:M3620090203T135512_V01_RDN_sub Spec Math (Band 5:M3620090203T135512_V01_RDN_sub Spec Math (Band 6:M3620090203T135512_V01_RDN_sub Spec Math (Band 6:M3620090203T135512_V01_RDN_sub Spec Math (Band 7:M3620090203T135512_V01_RDN_sub Spec Math (Band 8:M3620090203T135512_V01_RDN_sub Spec Math (Band 9:M3620090203T135512_V01_RDN_sub Spec Math (Band 10:M3620090203T135512_V01_RDN_sub Spec Math (Band 10:M3620090203T135512_V01_RDN_sub Spec Math (Band 11:M3620090203T135512_V01_RDN_sub Spec Math (Band 12:M3620090203T135512_V01_RDN_sub Spec Math (Band 14:M3620090203T135512_V01_RDN_sub Spec Math (Band 14:M3620090203T135512_V01_RDN_sub Spec Math (Band 16:M3620090203T135512_V01_RDN_sub Spec Math (Band 16:M3620090203T135512_V01_RDN_subbab d15:M3620090203T135512_V01_RDN_subbab d15:M3620090203T135512_V	sset.IMC sst.IMC sst.I				
	Gray S	icale © RGB Color					
		Selected Band	<u></u>				
Isbe	ec Mati	h (Band 1:M3G200902031135512_V01_RDN_subset.IMG) (4	60.9900j:				
Dim	Dims 304 x 545 (Double Precision) [BIL]						
Lo	oad Ba	nd No Display 🗸					





Check your work!

- Example radiance, observations, and I/ F file posted to M3 website so that you can make sure you get the same answer we do:
- http://m3.jpl.nasa.gov/m3data.html
- Filename: M3_TestSubsetCube_M3G20090203T135512_R4.zip
- Note: radiance cube is in older R4 radiance calibration, not U2 as delivered 9/30/11

