Plan to make SLIMED Lunar Irradiance calibration widely accessible

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SLIMED: A follow-on to ROLO model, is published:
Multiple-instrument-based spectral irradiance of the Moon.
Jour. Applied Remote Sensing. Vol. 16, Issue 3
https://doi.org/10.1117/1.JRS.16.038502 Open Access

- Developed in IDL, requires a license. Need to convert to a public language.
- e.g., Python or some version of C. IDL recoded so that all files are now NetCDF,
- Development of irradiance model requires the use of effective wavelength.
  Current version of application also does, but need not.
- Model is defined by combinations of photometric angles and wavelength.
  Any revised model using the same scheme can use the same code!
- SLIMED model has architecture close to the 'Framework' concept.
- Related documents: Algo.pdf (algorithm) Framework.pdf

Design Goals

- Allow calibration to be run at any institution.
- Minimize the instrument team effort required.
- Accommodate observatories and aircraft, as well as spacecraft.
- Run 1-to-many observations at one time.
- Keep file sizes small enough for email transfer between institutions.
- Optionally allow separation of information based on its permanence.
- Allow easy update of the reflectance model, without changing other modules.
- Current detailed design based on SLIM and the use fo effective wavelengths
- Any model specified by polynomials of the lunar angle set and 'wave' using standard symbols.
- Accommodate oversampling factor; pre-applied or not.
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- Note: Requires use of the JPL NAIF SPICE system..
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- Note: The SLIM system uses an effective wavelength for each band, which is adequate and efficient
- for narrow bands; and required for model development
- However, the translated system could easily use the original RSRs for each band,
- or RSRs on a common waveset..

Standard Attributes. In all files

NAME	C	TYPE	——— Attributes ——— Packet S: Spectral and Source File _wt
title	d	S	Brief name for what is in this file; e.g.,
summary	d	S	Summary of file, identifying major contents
institution	c	S	Name of organization generating this file
insti_url	d	S	url of the institution
license	d	S	Any legal limits or disclaimers
platform	c	S	Name of spacecraft or observatory
instrument	e	S	Name of instrument. Should not repeat 'platform'
serial	w	S	Serial number within virtually identical instruments. May be null. See note
acronym	c	S	Short word for platform+instrument that is unique within GSICS. Registered upon first submission
data_source	d	S	Source of the data, and any version number or date. Comments allowed.
history	d	S	Processing history: [seperator], date, software and version, email, purpose ... See note
id	d	S	File names(s) that institution would normally associate with these data. Commonly ridgedly formatted and long.
model	c	S	Lunar spectral irradiance system being used
reference	d	S	List of materials describing the instrument, observations or processing
oversamp_stat	c	S	Status of over-sample factor. Valid values are: 'none, 'team', 'calib'. See note
- - -	-	-	- - - End of standard ID set - - - - See note.

Files from teams

+ Launch date

vardesc	c	S	Description of all the variables in this file.
num_band	e	I	[chan] Number of bands (or channels) in the VIS/NIR.
——	–	—-	———— Variables ————
band_id	c	S(M)	[channel_name] Name normally associated with the band, each unique
nom_wav	e	I2(M)	[effective_wavelength] Nominal wavelength in nm, each unique
rsr	e	R1(x,2)	[srf] System-level Relative Spectral Response, bands concatenated. [*,0] is Wavelength in nm. [*,1] is the System-level relative spectral response. See note
nin_band	e	I2(M)	Number of points in each band in 'rsr'
NAME	C	TYPE	———— Attributes ———— Packet G: Geometry File _tv
ditto	"	"	The standard set in Packet S. 'oversamp_stat' is controlling
date_type	e	S	Normally 'UTC'. See $ 1.3
num_date	e	I2	[date] Number of observation times.
vardesc	c	S	Brief description of the variables
——	–	—-	———— Variables ————
date	e	S(N)	Observation time of center of the Moons disk, UTC. See note.
sat_pos	e	R1(N,3)	Viewer location (satellite_position). XYZ of Earth-Centered Inertial position. Required unless 'tele_loc' supplied.
tele_loc	e	R1(3)	Telescope location as Longitude E, latitude, elevation. Only if observatory.
obs_qual	m	R1(N)	Relative uncertainty of the irradiance determination of each observation. Median value of 1.
oversamp_fa	d	R1[N]	Optional. Oversample-factor. Use depends upon 'oversamp_stat'
conditions	o	R1(N,C)	Optional. Any number of columns of condition at each observation time
condes	o	S(C)	Requires if 'conditions' present. Explanation for each columns of 'conditions'
NAME	C	TYPE	———— Attributes ———— Packet I: Irradiance File _ir
ditto	"	"	The standard set in Packet S
vardesc	c	S	Brief description of the variables
——	–	—-	————Variables ————
band_id	c	S(M)	[channel_name] Duplicate of that in _wt file for insurance.
irr_obs	e	R1(N,M)	Measured lunar spectral irradiance. Units: micro-Watt m^{-2} nm^{-1}. See note
obs_unc	m	R1(N,M)	One-sigma uncertainty of the measurement, same units. Independent of 'obs_qual'
modes	w	S[k]	Optional, Names of different modes
nummod	w	I1[k]	Number of observations i each mode, aligned with 'modes'

_wt

_tv

_ir

Output files

NAME	C	TYPE	——— Attributes ——— File _ew: Effective wave; Static
ditto	"	"	The standard set in Packet S.
vardesc	c	S	Brief description of the 2nd dimension of 'eff_wave'
num_band	e	I	[chan] Number of bands (or channels) in the VIS/NIR.
———	–	—-	——— Variables ———
eff_wave	e	R1(M,8)	Effective wavelength array [band,item]

_wt

NAME	C	TYPE	——— Attributes ——— File _pg: Photometric Geometry
ditto	"	"	The standard set in Packet S. 'oversamp_stat' is controlling.
vardesc	c	S	Brief description of the variables, esp. the 2nd dimension of 'pgeom'
num_date	e	I2	[date] Number of observation times.
———	–	—-	——— Variables ———
etsec	e	R2(N)	Observation time of center of the Moon's disk, ephemeris time in seconds. See note.
pgeom	e	R1(N,11)	Photometric geometry, distances and celestial angles
oversamp_fa	d	R1(N)	Optional oversample-factor. See note. dup4conv

_pg

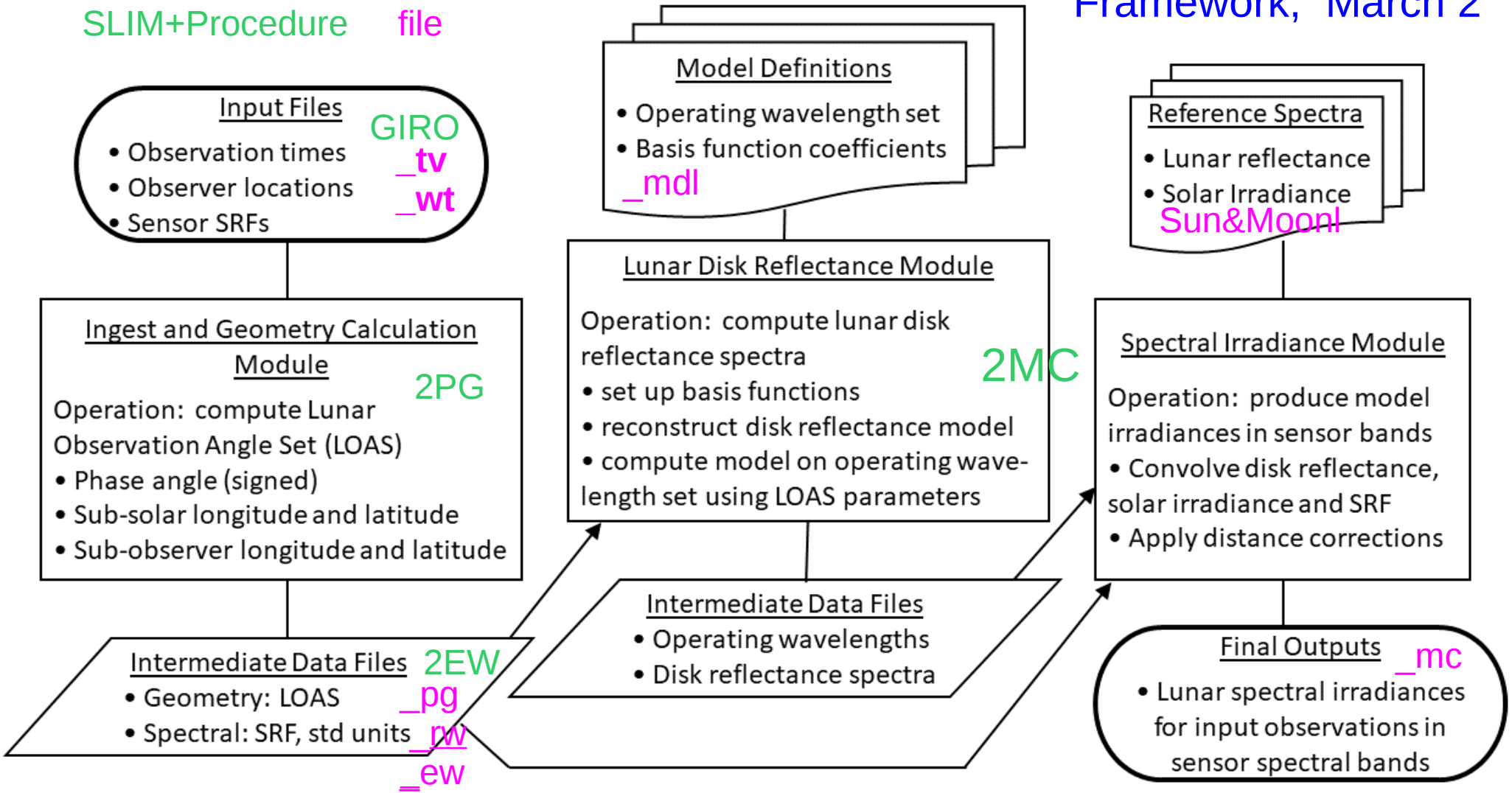
NAME	C	TYPE	——— Attributes ——— File _mc: Model and Calibration
ditto	"	"	The standard set in Packet S
reference_model	e	S	Name of the reference model and its version
vardesc	c	S	Brief description of variables
num_date	e	I2	[date] Number of observation times.
num_band	e	I	[chan] Number of bands (or channels) in the VIS/NIR.
———	–	—-	——— Variables ———
band_id	c	S(M)	Name normally associated with the band. dup4conv
eff_wave	e	R1(M,8)	Effective wavelength array [band,item]. dup4conv
utcd	e	R1(N)	Observation time, center of the Moon's disk, as days from 2000 Jan 01 00:00 UTC
irr_mod	e	R1(N,M)	Model spectral irradiance; micro-Watt m^{-2} nm^{-1}.
calib_ratio	e	R1(N,M)	Calibration ratio: Observed / model irradiance [date,band]. [7,7] is invalid placeholder
modes	w	S[k]	Optional, Names of different modes. See note.
nummod	w	I1[k]	Number of observations in each mode, aligned with 'modes'

_mc

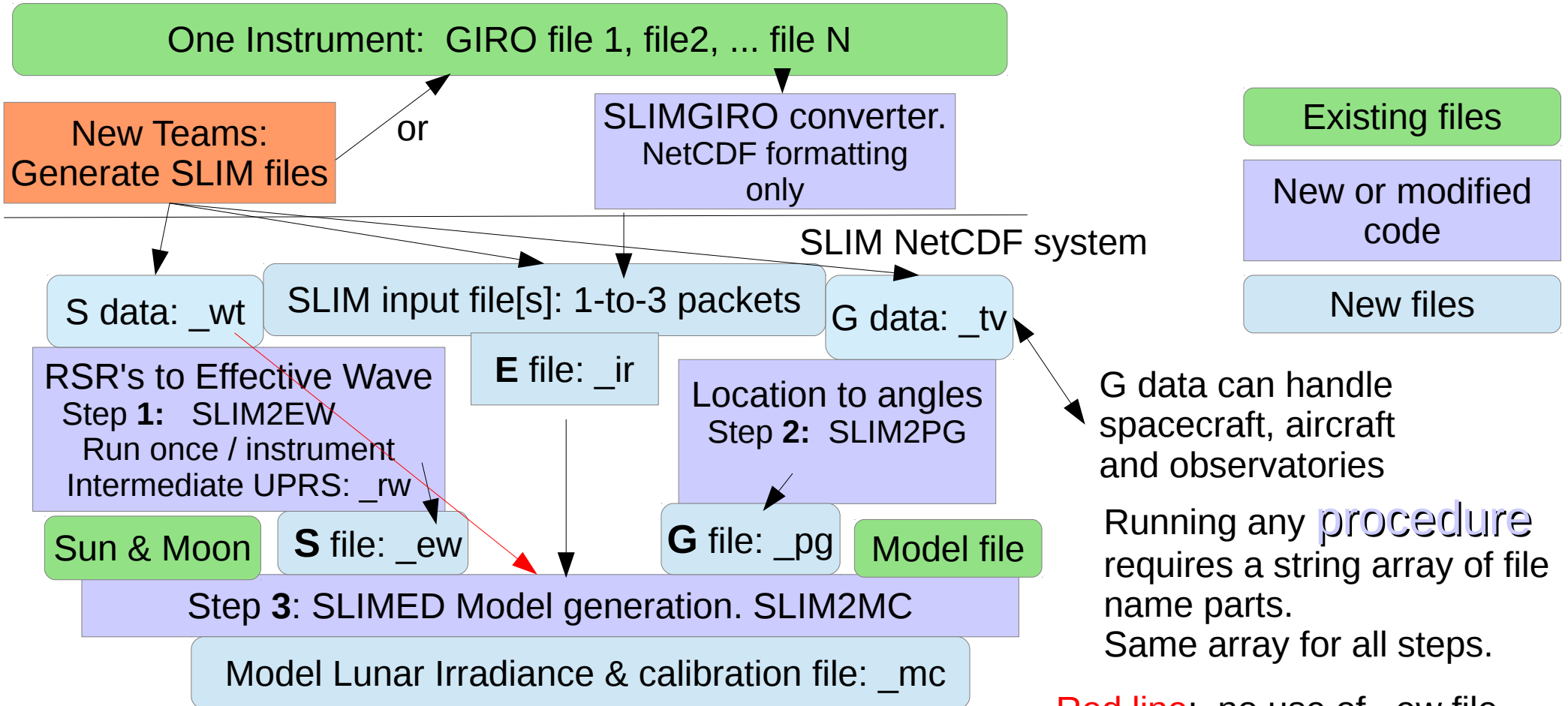
Modules and Files based on SLIM

SLIM+Procedure file

Framework, March 2



Flow: SLIMED in NetCDF



Initial Tasks (today?)

- Agree on lprogramming anguage to be used
- Discuss ensemble of information covered by the set of files. Start with Tables in Algo.pdf
- Standard attributes that go in each file. Next slide
- How information is divided between files. Following 2 slides
- Discuss the architecture to be used.
- Determine who will code what
- If coding translation done in more than one place,
- who might manage the effort.?
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- -------- Other items. ----------
- Note: Hugh's desire to be done before the Lunar Workshop in December
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- Who plans to try the SLIM application now in IDL ?
- Feedback on any problems will be helpful.

Backup

Wavelength Detail Options

- 1) Effective wavelength. Wavelength weighted by RSR and lunar light (reference solar spectrum * reference lunar reflectance). Normally one value per band.

  Most efficient. Can use a few weighted wavelengths for broad bands.

- 2) RSRs interpolated onto a standard wavelength set. E.g ., SLIM uses 2115 points.

  Model all standard points. For each band, multiply by RSR and sum

- 3) RSRs on their original points. Model all points for each band.

  Multiply by RSR scaled to total 1 Could be many thousand points

  E.g., SEVIRI has 471 points. VIIRS has 65,091 points.

Framework, March 2