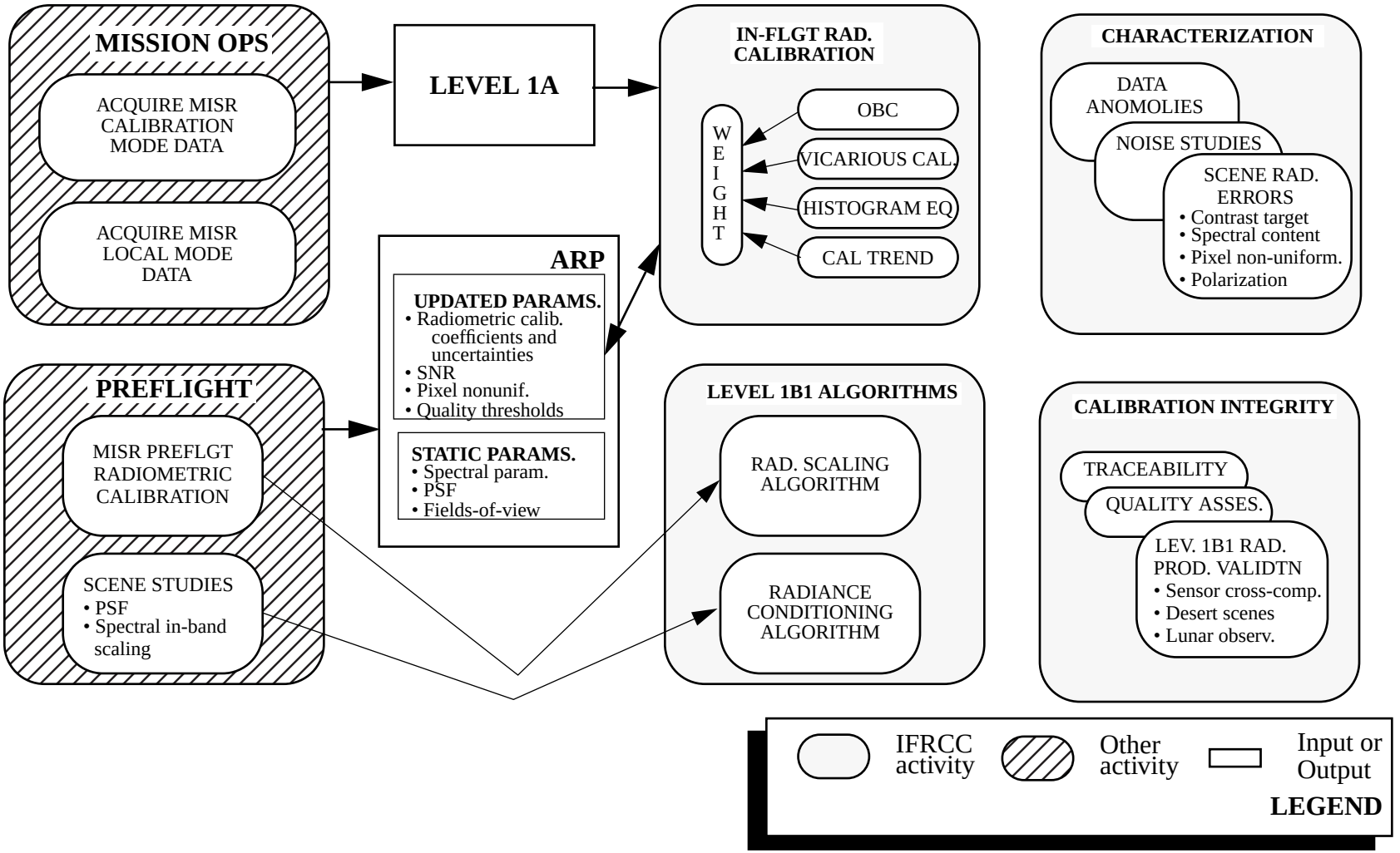
MULTIPLE IN-FLIGHT CALIBRATION METHODOLOGIES

- **MISR will make use of four calibration methodologies, in order to assess calibration uncertainty and reduce systematic errors.**
  - On-Board Calibrator (OBC) hardware are used to establishes an absolute and relative calibration for each pixel. The OBC consists of solar-reflecting diffuse panels (Spectralon), detector standards, and a goniometer to verify there is no degradation in the reflectance shape. Data are acquired monthly.
  - Vicarious calibration (VC) can be one of three types:
    1) High-altitude sensor (e.g. AirMISR) VC
    2) Surface-radiance VC
    3) Surface reflectance VC
  - Histogram equalization statistics are used to provide a relative-calibration of the pixels within an array.
  - Trend analysis are used to fold other calibration data into the coefficient algorithm (e.g. preflight). Retrospective data are weighted less with time.
- **A weighting algorithm will combine the multiple data in order to achieve the most accurate sensor calibration.**

IFRCC PROGRAM ELEMENTS



ARP STRUCTURES

File name	Description
Preflight Characterization Data	• preflight instrument characterization parameters • unlikely to be modified once delivered • measured pixel spectral response functions (7x36), standardized spectral response functions (1 per band), instantaneous fields-of-view
Preflight Calibration Data	• input to DAAC processes • unlikely to be modified once delivered • spectral descriptors relevant to Level 1B1 and Level 2 standard products • band weighted solar irradiances
In-flight Calibration Data	• parameters updated monthly on-orbit • at-launch values are initialized by the preflight calibration data • radiometric calibration coefficients, calibration uncertainties, signal-to-noise ratios, and Detector Data Quality Indicators.
Configuration Parameters	• threshold parameters and process control limits used by DAAC processes

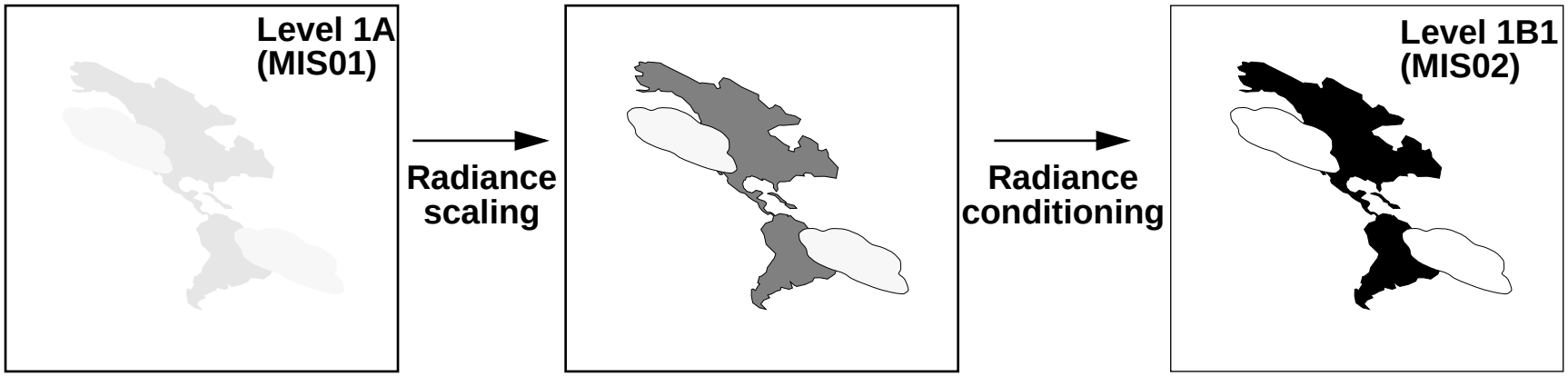
ARPGEN PROCESSING CODE

- **Data conditioning**
  - Resamples photodiode data to CCD data time acquisition
  - Removes corrupt data
- **Regression**
  - Regresses CCD DN data against photodiode measured incident radiances
  - Quadratic fit produces G_0, G_1, and G_2 coefficients for every pixel
  - Data weighted inversely by the DN variances (noisy data weighted less)
  - Process repeated using 3 independent on-board standards (HQE, PIN nadir, PIN at closest view angle to camera being calibrated)
- **Coefficient trending**
  - Uses historical coefficients and present coefficient
  - Performs a quadratic fit to the data
  - Reported coefficient comes from fit. This smooths gain coefficients, in case of noise in the retrieval
- **Coefficient weighting**
  - Final coefficients come from a weighted average of the multiple determinations (vicarious and 3 detector standards)
  - Weighting is inversely proportional to the methodology uncertainty

ARPGEN PROCESSING (CONT.)

- **Performance summary**
  - SNR computed from residuals of CCD DN against photodiode radiances
  - sliding window does local fit of the data, to determine local variances
  - SNR used to update radiometric uncertainty tables
  - CCD element response uniformity updated as part of detector data quality metric

RADIOMETRIC SCALING AND CONDITIONING



LEVEL 1B1 RADIOMETRIC PRODUCT

Parameter name	Units	Horizontal Sampling (Coverage)	Comments
Radiance	$W\ m^{-2}\ \mu m^{-1}\ sr^{-1}$	250 m nadir, 275 m off-nadir, or averages per the camera configuration (Global)	• Radiometrically-scaled data • No geometric resampling • 9 cameras, 4 bands • Uncertainty reported in Ancillary Radiometric Product
Data Qual. Indicator	None	Same as above	• 0 (within spec.); 1 (reduced accuracy), 2 (unusable for science); 3(unusable)

RADIANCE SCALING

- Radiometric calibration coefficients are used to retrieve a band-averaged spectral radiance. Total-band response is included.

RADIANCE CONDITIONING

- PSF deconvolution to sharpen the image, compensating for focal-plane scattering;
- A standardized spectral response function is assumed.

DATA QUALITY INDICATORS (DQI)

- **Data Quality Indicators (DQI) are assigned to each Level 1B pixel. These are assigned the values:**

DQI value	significance	Error component radiance uncertainty contribution	Level 1B2 resample weighting
0	within specification	None	full
1	reduced accuracy	1-3%	half
2	unusable for science	3-50%	none
3	unusable	>50%	none

- **Saturation blooming (Note: in average mode pixel is sat. if sat. in red band)**
  - DQI=0 if no. saturated pixels (nsat)=0
  - else DQI=1 if specific pixel under test has < 0.5% radiometric error
  - else DQI=1 if specific pixel under test has < 3.0% radiometric error; else DQI =2
- **Video offset uncertainty**
  - DQI=0 if line average DN less than threshold (~12,000 DN)
  - else DQI=1 if specific pixel under test has < 0.5% radiometric error
  - else DQI=1 if specific pixel under test has < 0.5% radiometric error; else DQI=2

DATA QUALITY INDICATORS (DQI), CONT.

- **Detector anomaly**
  - Values can be predetermined and stored in ARP
  - SNR used as DQI criteria

SNR	DDQI value
>100	0, else
>90	1, else
> 10	2, else
	3

- Detector response uniformity used as DQI criteria

Uniformity, 4x4 average mode	DDQI value
<10%	0, else
<15%	1, else
<50%	2, else
	3

Uniformity, 2x2 average mode	DDQI value
<10%	0, else
<15%	1, else
<50%	2, else
	3