USGS CARD4L self-assessment of Surface Reflectance (Collection 2)

Summary Table: WGCV CARD4L Review Panel evaluation

	Threshold	Target
1. General Metadata		
1.1 Traceability	Not applicable	Not assessed
1.2 Metadata Machine Readability	Verified	Not assessed *
1.3 Data Collection Time	Verified	Verified
1.4 Geographical Area	Verified	Verified
1.5 Coordinate Reference System	Verified	Verified
1.6 Map Projection	Verified	Verified
1.7 Geometric Correction Methods	Not applicable	Verified
1.8 Geometric Accuracy of the Data	Not applicable	Verified
1.9 Instrument	Verified	Verified
1.10 Spectral Bands	Verified	Verified*
1.11 Sensor Calibration	Not applicable	Verified
1.12 Radiometric Accuracy	Not applicable	Verified*
1.13 Algorithms	Verified	Verified
1.14 Ancillary Data	Verified	Verified
1.15 Processing Chain Provenance	Not applicable	Verified
1.16 Data Access	Verified	Not assessed
1.17 Overall Data Quality	Not applicable	Verified*
2. Per-Pixel Metadata		
2.1 Metadata Machine Readability	Verified	Not assessed
2.2 No Data	Verified	Verified
2.3 Incomplete Testing	Verified	Verified
2.4 Saturation	Verified	Verified
2.5 Cloud	Verified	Verified
2.6 Cloud Shadow	Verified	Verified
2.7 Land/Water Mask	Not applicable	Verified
2.8 Snow/Ice Mask	Not applicable	Verified
2.9 Terrain Shadow Mask	Not applicable	Not assessed
2.10 Terrain Occlusion	Not applicable	Verified
2.11 Illumination and Viewing Geometry	Verified*	Not assessed
2.12 Aerosol Optical Depth Parameters	Not applicable	Verified
3. Radiometric and Atmospheric Corrections		
3.1 Measurement	Verified*	Not assessed
3.2 Measurement Uncertainty	Not applicable	Not assessed
3.3 Measurement Normalisation	Not applicable	Verified*
3.4 Directional Atmospheric Scattering	Verified	Verified
3.5 Water Vapour Corrections	Verified	Verified
3.6 Ozone Corrections	Not applicable	Verified
4. Geometric Corrections		
4.1 Geometric Correction	Verified	Verified

*See explanation provided in the notes below

Feedback for consideration:

1.2 Machine Readability: It might be helpful to indicate if there is any plan to move towards the 'Target' requirement and if so timeline or perceived challenges.

1.10 Spectral Bands: If in the spectral viewer a band is selected and the RSR is viewed in the excel spreadsheet, the tables have misleading headers. The relative spectral shape column has at its title, values in units of Watts, but this is not the case and they are simply relative numbers normalised to a peak.

1.12 Radiometric Accuracy: Although the cited and accessible paper provides a good basis for this evidence and indeed a framework for the assessment together with an initial evaluation in (2014), it is not easy to see from the landing page how this is updated on an ongoing basis.

1.17 Overall Data Quality: Target requirement is rather loose and unspecific e.g. if only cloud cover is required then say so, if there are other requirements then these should perhaps be specified.

2.11 Illumination and Viewing Geometry: Lumping terrain shadow mask with illumination and view angles is too simplistic, separation into different requirements would be more reasonable. Suggestion to have a specification related only to the identification of solar incidence and sensor viewing angles for each pixel, with an additional specification related only to terrain correction. This would then lead to the modification of specification 3.3 as well, to avoid confusion. It would be good to separate BRDF correction and terrain correction.

3.1 Measurement: Based on QA4EO principles that were agreed by CEOS agencies, the threshold as stated should require an uncertainty statement, as a 'measurement' value with no indicator of confidence or quality is not very useful.

3.3 Measurement Normalisation: Clarity in the requirement as to whether it is an obligation that measurements are all normalised or that there is the option to have them normalised, is required. BRDF models have to be applied for normalization of reflectance to nadir, both for flat and rough terrain. For a particular viewing angle normalization, a BRDF model of the surface would be required. Terrain correction gives reflectance in viewing direction to the sensor, but can complement BRDF correction to get reflectance normalized to nadir. Requirement could be modified as "Measurements are normalised for illumination and viewing conditions, including nadir view angle and specified solar elevation and azimuth with BRDF correction".

3.6 Ozone Corrections: The ozone is retrieved by an auxiliary file, which is identified in the Landsat metadata, but the Ozone value used for the retrieval in not reported. It would be desirable to have the actual ozone values in the metadata.

CARD4L review outcome:

Threshold level:	**Compliance verified for all applicable items**
Target level:	**Compliance for eight items yet to meet requirements, was not assessed; compliance for the remaining items was verified**

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