Landsat Radiometric Processing Enhancements and Updates

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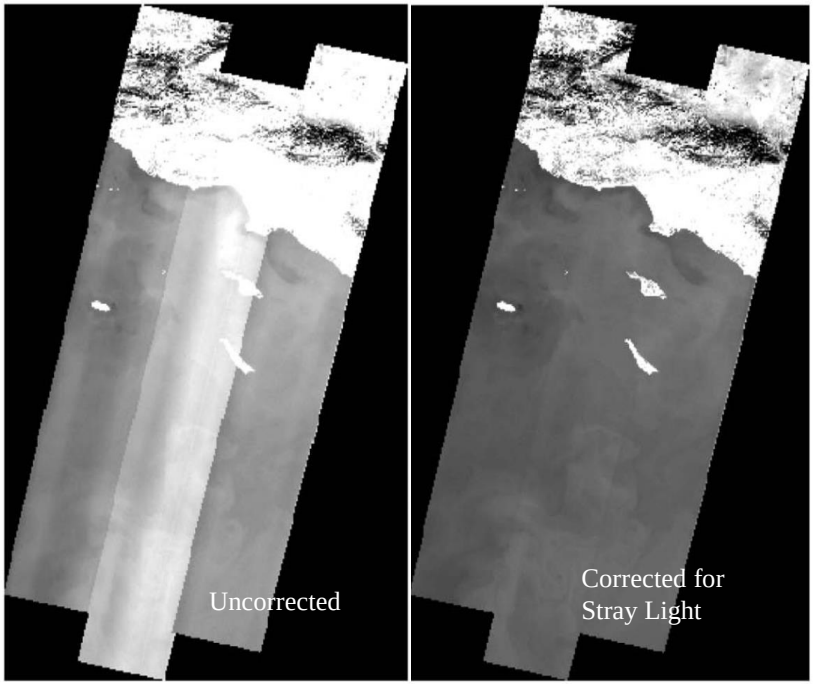

Figure 1

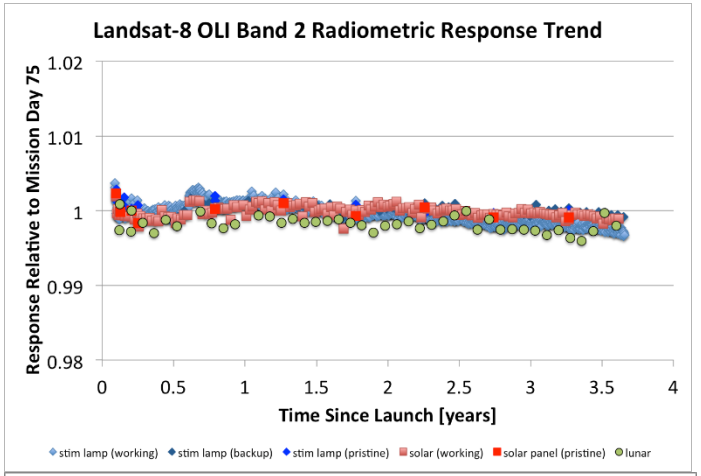

Figure 2

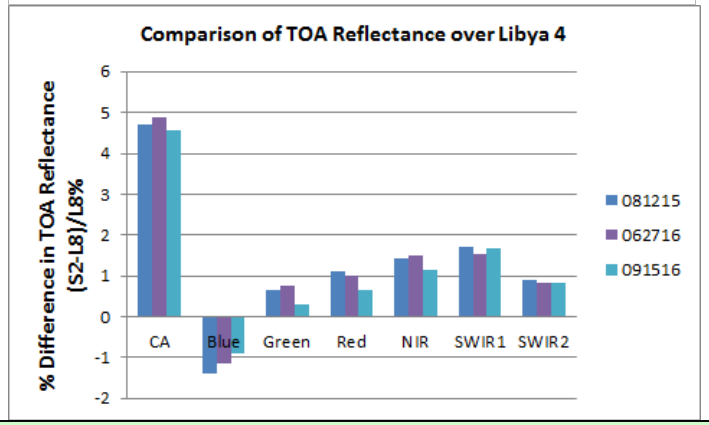

Figure 3

Landsat operational processing will now include correction for Landsat-8 TIRS stray light and provide consistent Landsat-4 TM to Landsat-7 ETM+ radiometric calibration tied to the Landsat-8 OLI reflectance calibration. Landsat-8 OLI is radiometrically stable and consistent with Sentinel-2 MSI.

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References:

2016 Montanaro, M., Gerace, A. (2016) Performance of the proposed stray light correction algorithm for the thermal infrared sensor (TIRS) onboard Landsat 8. *Proc. SPIE 9972, Earth Observing Systems XXI*, 99720F1-7; doi:10.1117/12.2238554.

2016 Micijevic, E., Haque, Md O., Mishra, N. (2016) Radiometric Calibration Updates to the Landsat Collection. *Proc. SPIE 9972, Earth Observing Systems XXI*, 99720D1-12; doi:10.1117/12.2239426.

2015 Markham, B., Barsi, J., Kaita, E., Ong, L., Morfitt, R., Haque, Md O. (2015). Radiometric Calibration and Stability of the Landsat-8 Operational Land Imager(OLI). Proc. SPIE 9607, Earth Observing Systems XX, 96070N-1-7; doi:10.1117/12.2188412.

2015 Montanaro, M., Gerace, A., Rohrbach, S. (2015) Toward an operational stray light correction for the Landsat 8 Thermal Infrared Sensor. *Applied Optics*, 54, 3963-3978.

2015 Czapla-Myers, J., McCorkel, J., Anderson, N., Biggar, S., Helder, D., Aaron, D., Leigh, L., Mishra, N. (2015) The Ground-Based Absolute Radiometric Calibration of Landsat 8 OLI. *Remote Sensing*, 7, 600-626; doi:10.3390/rs70100600.

2014 Markham, B., Barsi, J., Kvaran, G., Ong, L., Kaita, E., Biggar, S., Czapla-Myers, J., Mishra, N., Helder, D. (2014) Landsat-8 Operational Land Imager Radiometric Calibration and Stability. *Remote Sensing*, 6, 12275-12308; doi:10.3390/rs61212275.

Technical Description of Images:

Figure 1. A Landsat-8 TIRS image of the coast of Southern California showing the effect of stray light on the imagery before and after the operational stray light correction to go into effect in November 2016.

Figure 2. The Landsat-8 OLI radiometric response trends to the on-board calibration systems and the moon demonstrating the stability of band 2 of the OLI instrument to the ±0.2% level. Other bands are similar, with only band 1 showing a 1% change over three years; the November 2016 processing update will adjust for this change.

Figure 3. A comparison of the OLI radiometric calibration to the similar bands of the Sentinel-2 MSI instrument. With the exception of band 1 at ~5% difference, the bands are within ~1%.

Scientific significance:

Accuracy within and consistency between data products Is critical for any scientific analysis combining data sources and/or evaluating Earth surface changes. Long term consistency of the Landsat data record has been achieved and consistency between Landsat and Sentinel-2 data will allow combining data from these two platforms to achieve Earth coverage at the 2-3 day interval.

Relevance for future science and relationship to Decadal Survey:

The TIRS stray light has limited the ability to determine absolute temperature of targets– the correction algorithm should reduce TOA uncertainty to ~1K for most scenes. With the consistency within the Landsat data record scientists will be able to assess Earth surface trends across ~35 years (with TM quality or better data) and ~45 years (when MSS data are included). With multiple Landsat and Sentinel-2 sensors operating simultaneously, the data consistency will allow within season phenological studies at moderate (30 meter or better) spatial resolution, not heretofore possible.