Discrepancies between ADL and IDPS processed SDRs

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When assessing the accuracy of F-ratio approach MSL12 processing of VIIRS data, discrepancies were found when using IDPS SDR as basis. The comparison was made between MSL12 L2 products generated with F-ratio approach with IDPS SDR as basis, and those generated directly from ADL-reprocessed SDR with desired F-factors. The error found in TOA radiance was larger than that reported in our earlier study (Sun et al., 2014, doi:10.1109/LGRS.2014.2317553). The granule date is 2014/05/15 before which the C0=0 has already been implemented (on 2014/05/01) by IDPS.

To investigate the source of this discrepancy, SDRs were processed from RDR using IDPS F LUTs, and the results were expected to be identical to official IDPS SDRs, which was not the case. It was found that although sensor radiance values were consistent between IDPS official SDR and reprocessed SDR based on IDPS F-LUTs, the reflectance values were not. Since MSL12 package reads in reflectance from the beginning, this inconsistency in reflectance resulted in inconsistency in L2 products.

To find out the reason for this inconsistency only in reflectance but not in radiance, the LUTs used by ADL and those used by IDPS were compared, and it was found the following LUTs have difference versions and have the potential to cause discrepancy with respect to M-bands between ADL and IDPS:

VIIRS-SDR-RADIOMETRIC-PARAM-LUT
VIIRS-SDR-RSR-LUT (VIIRS-SDR-RELATIVE-SPECTRAL-RESPONSE-LUT)
VIIRS-SDR-GEO-MOD-PARAM-LUT
VIIRS-SDR-DG-ANOMALY-DN-LIMITS-LUT

The reflectance is only different from radiance by a factor of PI over solar irradiance and cosine of solar zenith angle, and the radiance is same, which means the differences can only come from solar irradiance and solar zenith angle. Indeed, both were found to contribute to the difference. The major factor is the different RSR LUTs which resulted in different band-averaged

solar irradiance (~0.2% error), and the minor factor is the different solar zenith angle caused by different GEO PARAM LUTs (~0.02% error).

The RSR LUT used by ADL is an older version than what IDPS used on 2014/05/15, but it is the last version before the LUT changed its name from VIIRS-SDR-RSR-LUT to VIIRS-SDR-RELATIVE-SPECTRAL-RESPONSE-LUT. The name change was forced because of the addition of DNB RSR to the LUT which changed the file size. However, when IDPS added DNB RSR to the LUT and changed its name on 2013/11/14, an older version RSR LUT was used as the basis by mistake. This error was not fixed until 2014/10/01 when IDPS updated the version of the VIIRS-SDR-RELATIVE-SPECTRAL-RESPONSE-LUT. It is also the current RSR LUT being used, and is consistent with the one used by ADL.

The GEO LUT used by ADL is an earlier version than what IDPS used on 2014/05/15. After update the GEO LUT to the most recent version, the solar zenith angles were consistent between ADL and IDPS.

As for the IDPS SDRs, we noted that the RSR LUT used were incorrect, and therefore the reflectance had error from 2013/11/14~2014/10/01. Besides, there is solar vector and lunar angle error (~0.02%) before 2014/11/21. This requires our reprocessed SDR time span to be extended to end of Nov.2014 from end of May, 2014, another six months, to fix both RSR LUT error and solar vector and lunar angle error.

Before end of May, 2014, older version of GEO LUT was used during ADL reprocessing. But the error is acceptable (~0.02%). For the Jun~Nov, 2014 reprocessing, new GEO LUT will be used.

After Nov, 2014, ADL should be able to reproduce SDRs identical to official IDPS SDRs, and the F-ratio approach should be applicable by MSL12 over IDPS SDR since then. However, on 2015/03/06, IDPS updated the DELTA-C LUT to include temperature correction, which caused noticeable discrepancy only in M6 (~0.1%). To reproduce SDRs identical to official IDSP SDR, ADL need to use the updated DELTA-C table. This may also have some effect on our VIIRS sensor calibration activity.

Appendix – Change of relevant IDPS LUTs (excluding F-LUTs)

VIIRS-SDR-RSR-LUT(VIIRS-SDR-RELATIVE-SPECTRAL-RESPONSE-LUT) Change:

```
d20120524_t1338:
Version Change:        1-D-NPP-3 (prelaunch)
               ->      1-O-CCR-12-408-JPSS-DPA-002
d20130405_t0042:
Version Change         1-O-CCR-12-408-JPSS-DPA-002
               ->      1-O-CCR-13-888-JPSS-DPA-003 (ADL)
d20131114_t1842:
Name Change            VIIRS-SDR-RSR-LUT
               ->      VIIRS-SDR-RELATIVE-SPECTRAL-RESPONSE-LUT
Version Change         1-O-CCR-13-888-JPSS-DPA-003
               ->      1-O-CCR-13-876-JPSS-DPA-001
d20141001_t2013:
Version Change         1-O-CCR-13-876-JPSS-DPA-001
               ->      1-O-CCR-14-1965-JPSS-DPA-002 (current)
```

VIIRS-SDR-GEO-MOD-PARAM-LUT Change:

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d20120223_t1525:       1-N-CCR-11-203-NASA-001-sideB
               ->      1-O-CCR-12-324-NASA-002-sideB

d20121211_t1918:       1-O-CCR-12-324-NASA-002-sideB
               ->      1-O-CCR-12-766-JPSS-DPA-005-SCE-AB

d20130418_t2102:       1-O-CCR-12-766-JPSS-DPA-005-SCE-AB
               ->      1-O-CCR-13-0957-JPSS-DPA-008 (ADL)

d20130822_t1950:       1-O-CCR-13-0957-JPSS-DPA-008
               ->      1-O-CCR-13-1171-JPSS-DPA-009 (current)
```

VIIRS-SDR-DELTA-C-LUT Change:

```
d20111209_t1736:       1-D-NPP-3 (prelaunch)
               ->      1-N-CCR-11-117-JPSS-DPA-001

d20120229_t1802:       1-N-CCR-11-117-JPSS-DPA-001
               ->      1-N-CCR-12-000-JPSS-DPA-002

d20140501_t2121:       1-N-CCR-12-330-JPSS-DPA-002
               ->      1-0-CCR-14-1698-JPSS-DPA-003 (ADL)

d20150306_t2113:       1-0-CCR-14-1698-JPSS-DPA-003
               ->      1-O-CCR-15-2253-temp-corrected-JPSS-DPA-004 (current)
```