Major changes in Level-1 products derived from the SNPP VIIRS Collection-2 (C2) and JPSS-1 VIIRS Collection-2.1 (C2.1) reprocessing cycles (August 13, 2021)

The following sections highlight the major improvements and updates for both incarnations of Suomi National Polar-orbiting Partnership (SNPP) Visible Infrared Imaging Radiometer Suite (VIIRS) and the first Joint Polar Satellite System (JPSS-1) VIIRS reprocessing-derived Level-1 (L1) products. Most geolocation-specific changes are applicable to both the SNPP VIIRS and JPSS-1 VIIRS L1 products, and hence, they are both described under the SNPP VIIRS section, and the exceptions are identified.

SNPP VIIRS Level-1 C1 to C2

The SNPP VIIRS L1 C2 reprocessing cycle will benefit through its use of the NASA Land SIPS-produced L1 inputs along with calibration and geolocation Look-up Tables (LUT) generated by the VIIRS Characterization Support Team and Geolocation team, respectively. Both the calibration and geolocation sets of LUTs are based on data derived from the entire SNPP VIIRS mission period that started in January 2012.

Calibration-specific changes

SNPP VIIRS reflective solar band (RSB) updates include the following:

- After careful reevaluation of the onboard solar diffuser calibration trends compared to the lunar observations, the F-factor trends have been updated for all VIS/NIR bands. The long-term band-average reflectance differences compared to Collection 1 are generally within 0.5%.
- The largest change to RSB in C2 is a detector-dependent correction applied to account for spatially dependent degradation of the solar diffuser. The result is reduced striping in C2 for most VIS/NIR bands, most significantly for moderate-resolution bands M1 and M2 where the improvement is more than 1%.
- Collection 2 also uses consistent c_0, c_1, and c_2 temperature-dependent gain coefficients over the mission for both F-factor calculation and for calculation of per-pixel reflectance in the L1B code. In C1, an update to these LUTs was made mid-mission. The consistent processing for C2 may lead to some minor radiance-dependent differences between C1 and C2 in the first few years of the mission.

SNPP VIIRS day-night band (DNB) updates include the following:

- Improved the DNB's Low Gain Stage (LGS) gain and gain ratios with updated H-factor.
- Fixed the DNB's contaminated straylight correction tables that were affected by aurora light.

Geolocation-specific changes

VIIRS Instrument Geometric Model Update (VIGMU): The VIIRS instrument's geometric model was updated to correct a previous incorrect parameter in the geolocation LUT; this correction eliminates wobble in the L1 product, both for the SNPP VIIRS and JPSS-1 VIIRS L1 outputs.

Time-dependent attitude corrections to the inst2sc (time-dependent instrument-to-spacecraft) rotation matrix: This improvement provides observation-based corrections to the mounting matrix that are especially useful during the reprocessing cycle. For SNPP VIIRS, it helps to minimize the impact due to a switch of the other scan-control electronics (SCE) side, and also helps correct geolocation errors of ~800 meters for about 7 hours due to an error in on-orbit operations. Given the unique nature and behavior of each satellite system, these corrections are not systemic, and they are relevant to both the SNPP VIIRS and JPSS-1 VIIRS instruments' outputs.

Improved flagging of ephemeris and attitude data gaps (eaGaps) within the input data:
The eaGap flagging helps improve downstream handling of data issues for both SNPP VIIRS and JPSS-1 VIIRS cases. The existing 2-bits of the scan quality flag-field are used to implement the eaGap flagging mechanism. Previously, the flagging, which did not work can now flag during cases when the data has *no* gaps, *small* gaps, *medium* gaps, and *large* gaps. The sizes are defined and determined as follows:

- No gap: 0 < gap <= 1.5 sec (interpolation)
- Small gap: 1.5 sec < gap <= 9 sec (interpolation)
- Medium gap: 1.5 sec < edge of granule gap <= 9 sec (extrapolation)
- Large gap: 9 sec < gap (no geolocation is produced)

Control Points:
A new set of chip files is implemented, and a bug was resolved that caused it to populate certain data-fields with all 0 values. These improvements are relevant to both SNPP VIIRS and JPSS-1 VIIRS outputs.

Kalman Filter:

A Kalman filter module is implemented only in the SNPP VIIRS L1A to improve attitude accuracy that contributes to geolocation accuracy.

EFL Update:

The Effective Focal Length (EFL) in the SNPP VIIRS Geolocation LUT was updated. This update would result, for example, in an increase in the scan width in the along-track direction for the DNB from about 12,000 m to 12,060 m.

Fractional Land-Water Mask:

A new 750-m fractional land-water mask (LWM) referred to as *water_present* is introduced within both the SNPP VIIRS VNP03MOD and JPSS-1 VIIRS VJ103MOD geolocation data products. This field indicates the amount of the moderate-resolution pixels that contain water (according to the imagery-resolution pixels). The field corresponds to double the number of imagery-resolution pixels that are "ocean." The reason for the doubling is based on historical precedent having a range from 0 – 8.

JPSS-1 VIIRS Level-1 C2 to C2.1

The JPSS-1 VIIRS L1 C2.1 reprocessing cycle will use the NASA Land SIPS-produced L1 inputs along with calibration and geolocation LUTs generated by the VIIRS Characterization Support Team and Geolocation team, respectively. Both the calibration and geolocation sets of LUTs are based on data from the entire JPSS-1 VIIRS mission period that started in January 2018.

Calibration-specific changes

Revised VIIRS HAM Response Versus Scan angle function (RVS LUT) to correct an error in the pre-launch angle of incidence (AOI) mapping for all bands. The major impact of the change in radiance retrieval is in the Thermal Emissive Bands (TEB) for less than 1% in M14, 0.6% in M15, 0.4% in I5 and 0.3% in M16. For RSB, the impact is very small – less than 0.1%. For DNB, the impact is negligible. The impact is mainly at the beginning of the scan.

Geolocation-specific changes

Most all improvements and updates described for the SNPP VIIRS L1 geolocation are applicable to the JPSS-1 VIIRS L1 geolocation as well. Exceptions are identified.