MEMO

Suomi NPP VIIRS Geolocation Products Degradation
Late November to Early December 2012

by

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Geometric Calibration Group

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Summary

Suomi NPP VIIRS entered petulant mode on Nov. 22, 2012 (data-day 327) at 16:32z. When the power was restored starting the same day at 22:07z, the Scan control Electronics (SCE) was switched from Side B to A. At that time, geolocation lookup tables (LUTs) containing incorrect parameters for SCE Side-A introduced a nadir geolocation bias of ~325 m in the scan direction, about one I-band pixel size or half an M-band pixel size. Corrected LUTs were applied starting Dec. 11, 2012 (data-day 346) at 19:18z, and the geolocation products accuracy returned to normal.

Background

The VIIRS instrument onboard the NOAA/NASA JPSS Program Suomi NPP (SNPP) satellite uses a scan control electronics (SCE) assembly to control the rotating telescope assembly (RTA) and half angle mirror (HAM) motors through encoders. There are two SCE assemblies called Side A and Side B. The SCE maintains fairly constant speeds of the RTA and HAM. It also synchronizes the HAM to the RTA so that when the VIIRS views various sectors the incoming rays are directed to the sensor (detectors) in an appropriate time for digitization, storage and transmission to the ground. Prior to SNPP launch on October 28, 2011, it was decided to use SCE Side B as the primary side. After the SNPP launch, it was found that the SCE occasionally failed to synchronize the RTA and HAM (termed “sync loss”) about once every two weeks (for about 100 seconds per event). During sync loss, the science data from VIIRS is not useful for generating Sensor Data Records (SDRs) and Environmental Data Records (EDRs). In early 2012, JPSS Program launched an intensive investigation on the matter with the instrument vendor, who recommended a switch to Side A to narrow down the most probable root cause(s).

The VIIRS instrument communicates data through a bus to SNPP spacecraft for transmission to the ground. That bus occasionally locks up about once every two months. This communication loss is termed “petulant mode”. To restore the data communication, the power supply from the spacecraft to the VIIRS is turned off and VIIRS is restarted.

Since early in the mission, VIIRS geolocation errors have been tracked by the NASA JPSS VIIRS VCST Geo and corrected through SDR geolocation parameter look-up tables (SDR/GEO LUTs) to sub-pixel accuracy. The geolocation accuracy based on a set of global ground control points was better than 80 m

root mean square errors (RMSEs) in the along-scan and along-track directions. In anticipation of the SCE side switch to Side A, a different set of SDR/GEO LUTs was generated according to the results of pre-launch test data analysis. The only SCE side dependent coefficient was the RTA encoder start position of the earth view "start-of-scan".

VIIRS SCE Side Switch, Ensuing Issue and Resolution

The JPSS Program followed the recommendation from the VIIRS vendor and took the "opportunity" of a petulant mode event on November 22, 2012 (data-day 237) at 16:32z to switch the VIIRS SCE from Side B to A. When the power was restored starting the same day at 22:07z, the Scan control Electronics (SCE) Side A was selected. VIIRS science data started to flow to the spacecraft and to be transmitted to the ground for the production of SDRs and EDRs.

At that time, the LUTs containing SCE Side A value were found to be incorrect due to an unexpected change in HAM start-of-scan encoder value after the SCE side switch. Based on ground control point matchups, a nadir bias of ~ 325 m was found in the scan direction (Figure 1). Subsequently, with help from other teams, the VCST Geo generated and tested a new set of LUTs to correct the A-side RTA encoder start position parameter. These updated LUTs were loaded into the NESDIS IDPS on Dec. 11, 2012 (data-day 346) and started being applied at 19:18z. Post-update, the geolocation errors on the SCE Side A returned to nominal (Figure 1).

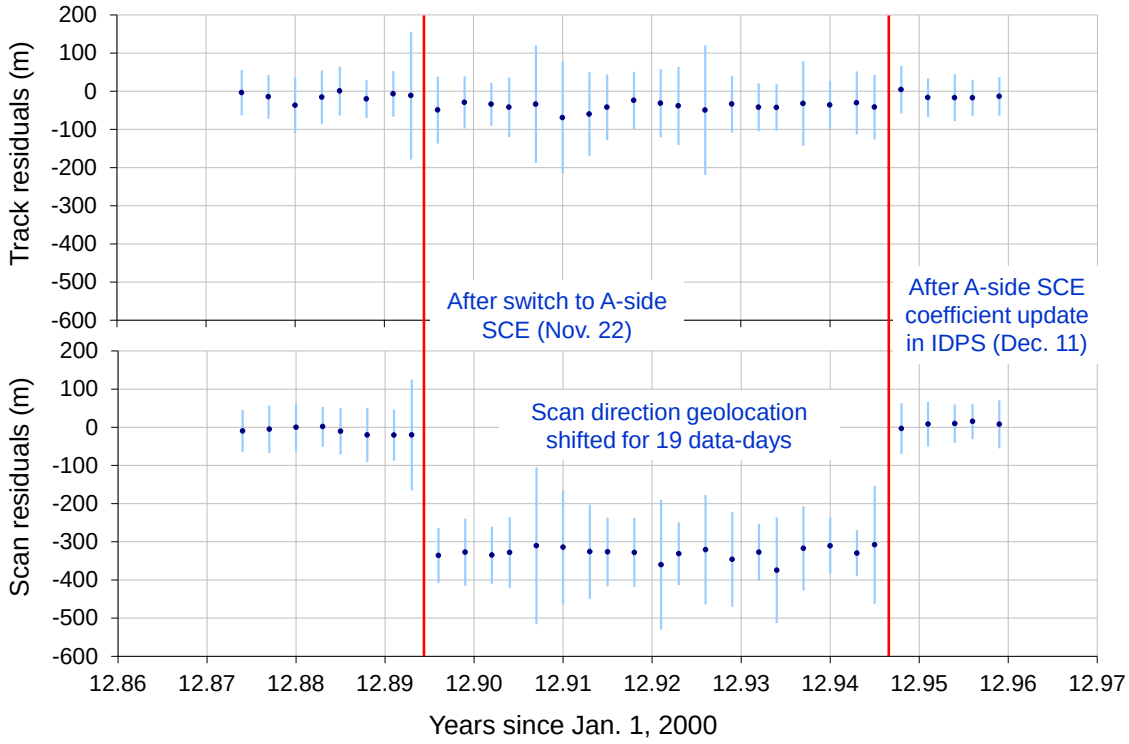

Figure 1. IDPS daily control point residuals before the SCE switch, after the switch but before correction and after the geolocation error correction. Shown are the daily average nadir equivalent residuals (blue dots) and daily standard deviation (light blue vertical lines).

Concluding Remarks

S-NPP VIIRS geolocation products were degraded for about three weeks starting when the SCE was switch from Side B to A on November 22, 2012 due to an incorrect parameter in the SDR/GEO LUTs. Beginning December 11, 2012, corrected LUTs successfully removed geolocation nadir bias of ~325 m in the scan direction.

However, a number of additional actions are still needed:

1) A better understanding is needed of how the encoders and the RTA and HAM scan synchronization control logic works.
2) An additional pre-launch dynamic pointing test may be needed to nail down A to B side offset (and nominal encoder values) before launch (of VIIRS Flight Unit 2 (F2) on JPSS-1 (J1), etc.).
3) HAM and RTA encoder values (per SCE side) should be in the SDR/GEO LUTs since they may vary on a per-instrument basis (F2 on J1, etc.).