**MEMORANDUM FOR:** The Record

**FROM:**  Dr. Thomas Kopp, VIIRS Imagery Validation Lead

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**SUBJECT:** NPP VIIRS NCC Imagery EDR beta status

**DATE:**  10/3/2012

The successful launch of the Suomi National Polar-orbiting Partnership (SNPP) Spacecraft on 28 October 2011 with the Visible Infrared Imaging Radiometer Suite (VIIRS) ushered in a new generation of capabilities for operational environmental remote sensing for weather, climate, ocean, and other environmental applications. VIIRS succeeds the NOAA AVHRR and NASA EOS MODIS with 22 spectral bands covering wavelengths from 0.41 to 12.5 m, providing data for the production of 22 Environmental Data Records (EDRs) with its calibrated and geolocated Sensor Data Record (SDRs). The Imagery EDR comprises use of all 5 I-bands, 6 of the 16 M-bands, and the Day Night Band (DNB). The DNB is a special case, where the Imagery produced is referred to as Near Constant Contrast (NCC). NCC Imagery contains additional processing and therefore is considered independent of the other Imagery products. All non-NCC Imagery was declared beta back in May 2012, but the NCC Imagery required further investigation. The status of the NCC Imagery is now well understood, and has achieved beta status as well.

NCC Imagery is a special case for two reasons: 1) There is additional processing beyond that of placing appropriate pixels on the Ground Track Mercator (GTM) projection and 2) the DNB does not operate like a typical visual channel. The production of NCC Imagery includes additional processing to minimize the impact of solar and lunar angles across the scan. The NCC algorithm uses Look-Up Tables (LUTs) to reduce these contrasts, hence making it easier for a human viewer to discriminate actual atmospheric or ground features. This is especially important in the vicinity of the terminator. The DNB also uses three gains, such that the sensor is more sensitive when little reflectance is available, as is the case under moonlight. These gain shifts must be accounted for in the LUTs for NCC Imagery to work properly.

Imagery is heavily dependent on the upstream SDRs, in this case the DNB SDR. As calibration of the DNB SDRs improves, so does the quality of the Imagery. Radiometric accuracy and sufficient geolocation, covered by the VIIRS SDR team, are prerequisites for any Imagery to attain the next stage. The VIIRS SDRs, including the DNB, formally achieved beta status in mid-May 2012.

The Imagery team shortly after launch set up a website to post and track examples of all Imagery, including NCC, both from the actual EDR and others built from the original DNB SDRs. Interested parties may go to <http://rammb.cira.colostate.edu/projects/npp/> to see the examples posted there. NCC Imagery has been analyzed by subject matter experts at the University of Wisconsin, CIRA, NOAA/STAR, NRL-Monterey, Northrop Grumman, and Aerospace.

NCC Imagery products under daytime conditions received positive feedback immediately after launch. However many issues were observed in the terminator or under lunar illumination. Areas of fill in the shape of triangles were noted in approximately 8% of the NCC products. Although it was expected that NCC Imagery would be useful down to half moon illumination, it was useful only with 2-3 days either side of the full moon phase. Stray light was noted on the dark side of the terminator, when the sun was just below the horizon. Excessive fill was also noted in very dark pixels and in granules where the solar angle crossed the 105 solar angle, the point where the algorithm assumes no solar illumination exists. Each of these has a documented Discrepancy Report.

Two of the items above are not related to the NCC algorithm. The cause of the triangles was missing adjacent granules, and has been significantly mitigated by improvements in the ground system. As of October 2012 the percentage of cases is below 0.5%. Stray light has been tied to the instrument; however a software correction is in development for a potential 2013 implementation. The other issues above are being addressed via changes in the LUTs, through the stray light correction, or modifications to the NCC algorithm itself. However the user should be aware all of these issues will be observed in the NCC Imagery through 2012.

The definition of achieving beta includes that following considerations: initial calibration has been applied, it is minimally validated but may contain significant errors, users may gain familiarity with it, and it is not yet ready for formal publications or quantitative analysis. The NCC Imagery EDR has achieved all of these. The DNB SDR team has already reached beta with regard to calibration. Qualitative evaluation has been accomplished for all types of scenes and granules. Users are already familiar with the format. The NCC Imagery has been used in a few public presentations, and the DNB has been shown in even more. From a technical point-of-view, NCC Imagery attained beta status on July 18, 2012, when the related LUTs were updated based on VIIRS DNB in-flight characteristics.

The move to provisional status depends on three factors: 1) the advancement of VIIRS DNB SDRs to provisional, 2) improvement in the nighttime NCC Imagery, and 3) more quantitative analyses from the Imagery Cal/Val team. The correction of stray light is not mandatory to achieve the provisional stage, since its’ root cause is not in the NCC algorithm, but our objective is to correct it by the time provisional is reached. The definition of provisional includes that the product may “not be optimal” but it is ready for “operational assessment”. This will be achieved once we remove some of the causes of fill (dark pixels, 105 angle issue) from the nighttime NCC Imagery EDR.

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