Re-assessing Lifetime Geolocation Performance of CrIS aboard Suomi-NPP with ICVS

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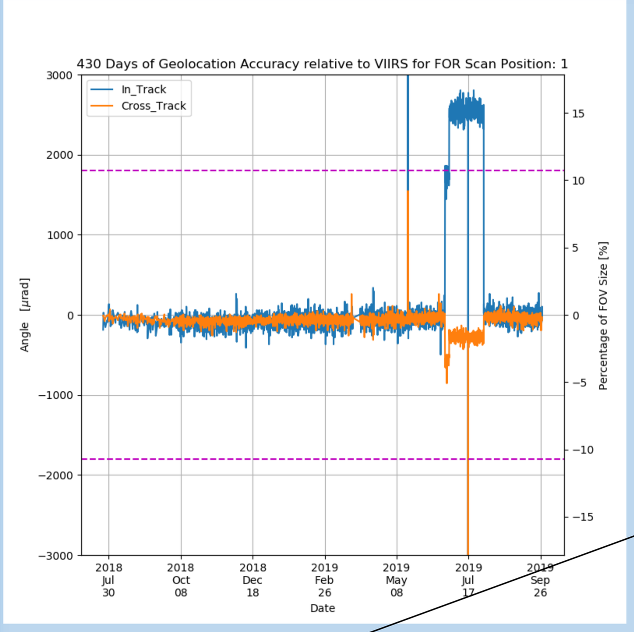
Monitoring CrIS Geolocation Accuracy in Near-Real Time via ICVS

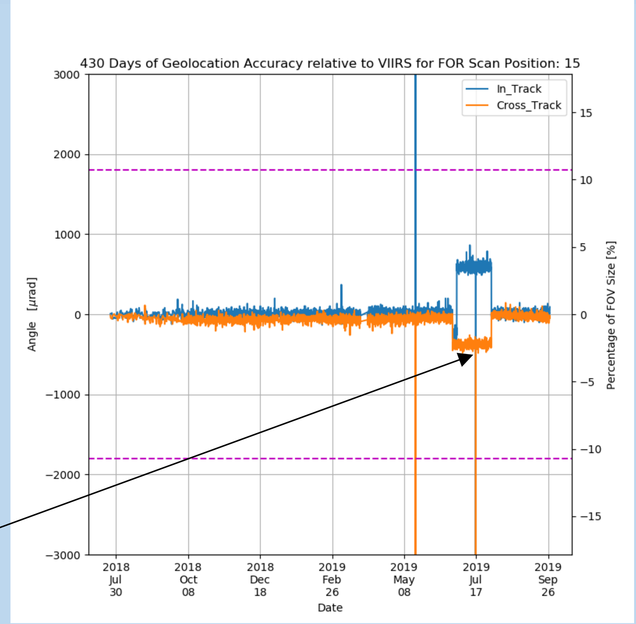
The Cross Track Infrared Sounder (CrIS) provides observations of temperature and moisture vital to many applications such as numerical weather forecasting and climate monitoring. CrIS has flown aboard the Suomi National Polar-orbiting Partnership satellite (S-NPP) since 2011 and aboard NOAA-20 since 2017. Its 1305 spectral channels measure outgoing infrared radiation from 3.92 µm to 15.38 µm. At nadir, CrIS has a spatial resolution of 14 km.

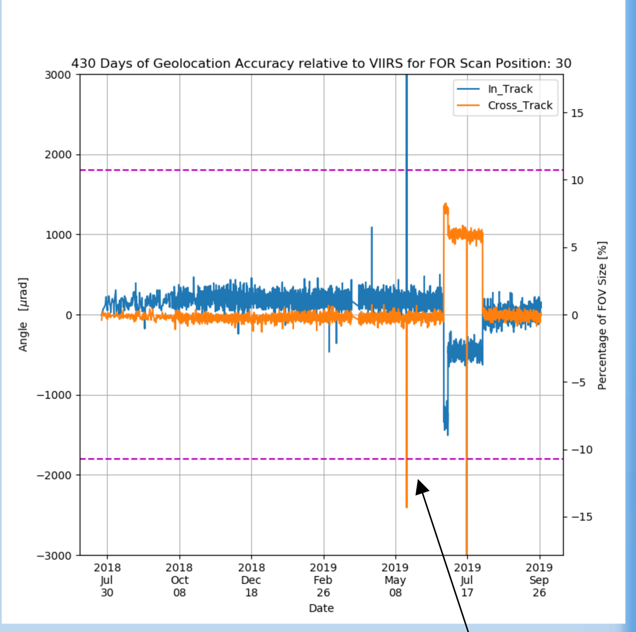
Because accurate geolocation information is an important requirement for any useful application of CrIS observations, Long-term CrIS geolocation accuracy has been consistently monitored by the JPSS/STAR Integrated Calibration and Validation System (ICVS). The accuracy of CrIS geolocation is measured by convolving CrIS observations with those from the Visible Infrared Imaging Radiometer Suite (VIIRS) I5 band and identifying the VIIRS pixel that best matches each CrIS pixel. This technique was originally presented by Likun Wang[1] for S-NPP CrIS, where VIIRS' geolocation information is treated as "truth", which is reasonable given its much greater spatial resolution and frequent geolocation calibration with respect to Landsat, which is in turn calibrated with respect to the ground. In this study, this method is operatized by improving the code efficiency. Examples of improvements include the creation of bash scripts to automatically match contemporaneous CrIS and VIIRS data granules within 20° of the equator and handle. the new code is applied to assess the geolocation performance of the re-operated SNPP CrIS instrument after the MW was switched to side 2 of its electronics board . It is expected that the results in this study can provide an overall picture of SNPP CrIS geolocation accuracy performance for the past 13 months. Future efforts will extend these assessments into the past to verify S-NPP geolocation accuracy performance for its entire lifetime since its launch in 2011.

Over One Full Year of Geolocation Monitoring

For 13 months, the assessed difference in geolocation between CrIS and VIIRS has been small, stable and within specifications

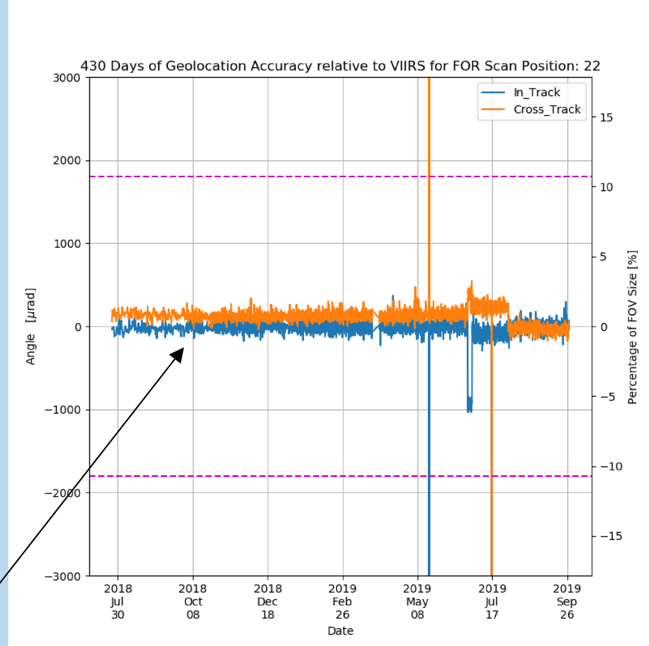


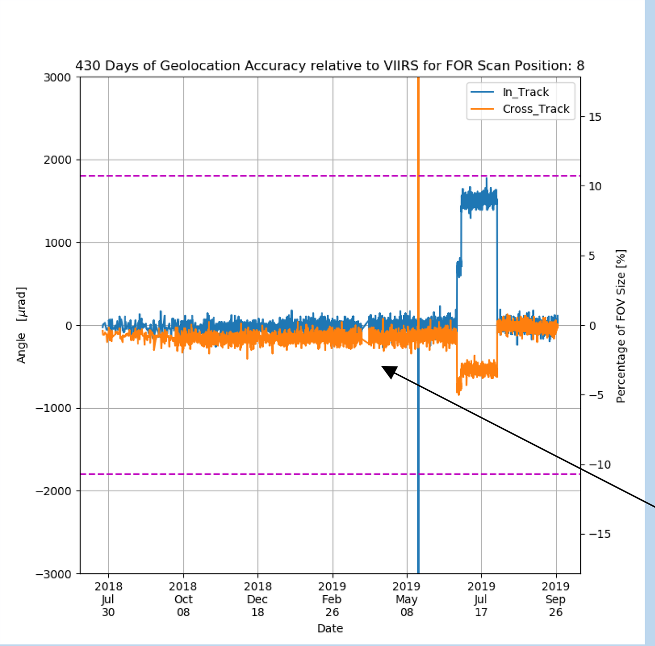




Angular errors were reduced slightly (w.r.t. to before the side switch) after v40 mapping angles were uploaded on Aug 1, 2019

Assessment frequency changed from 2x/day to 13x/day



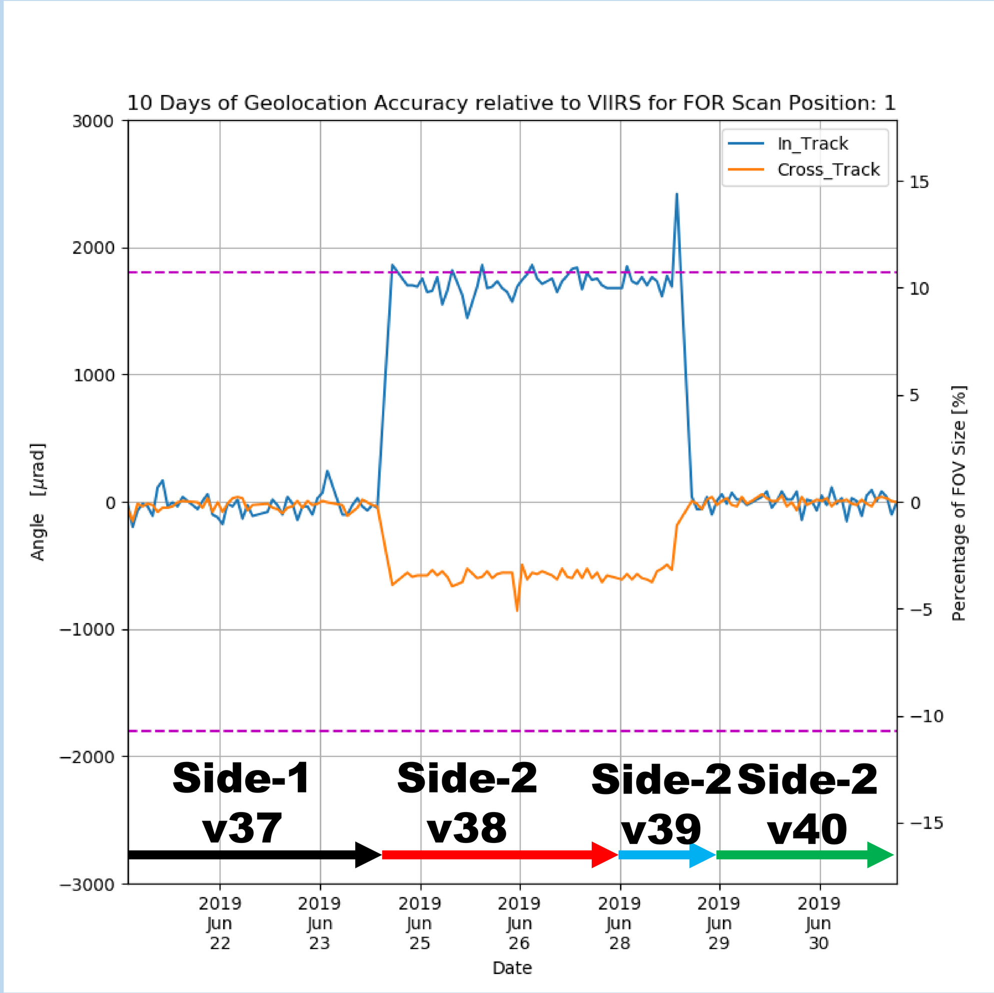


VIIRS Lunar Calibration Maneuver

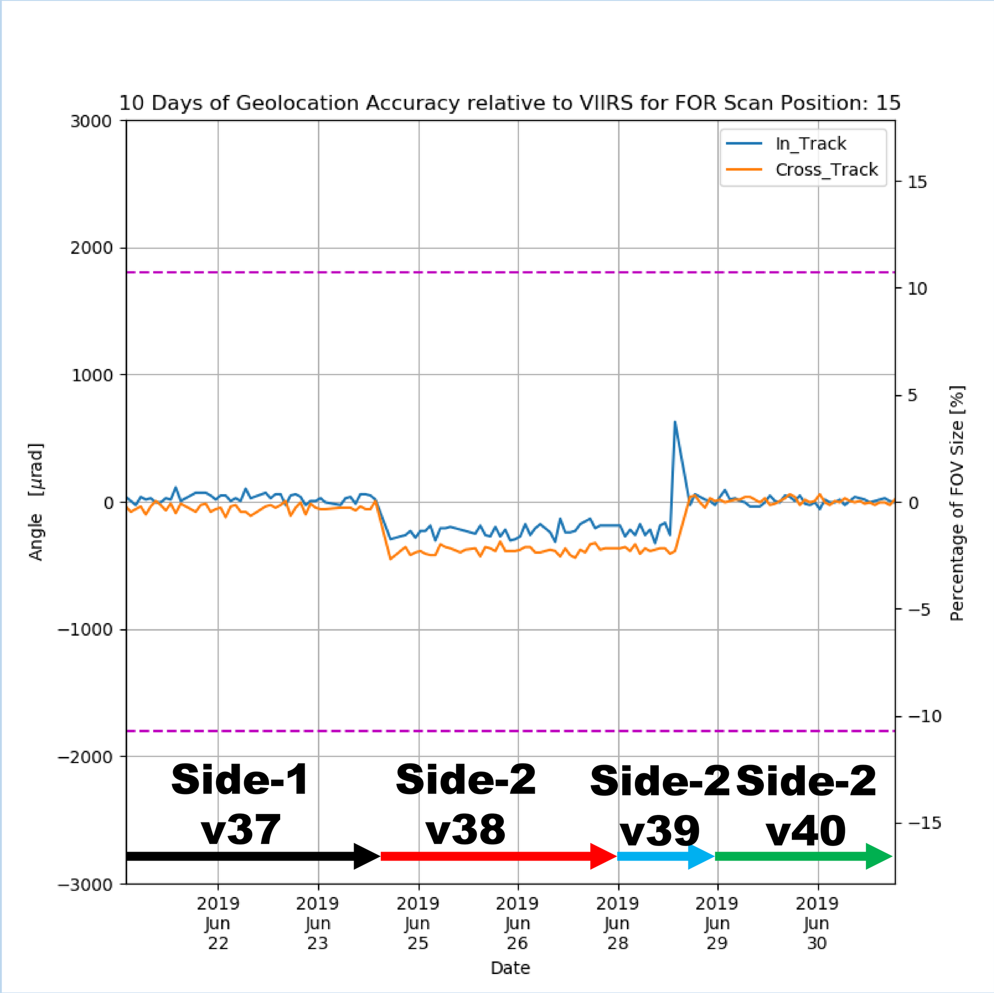
Data gap after midwave circuit board failure at the end of March, 2019

Consequences of Electronics Board Side Switch on board Suomi NPP CrIS

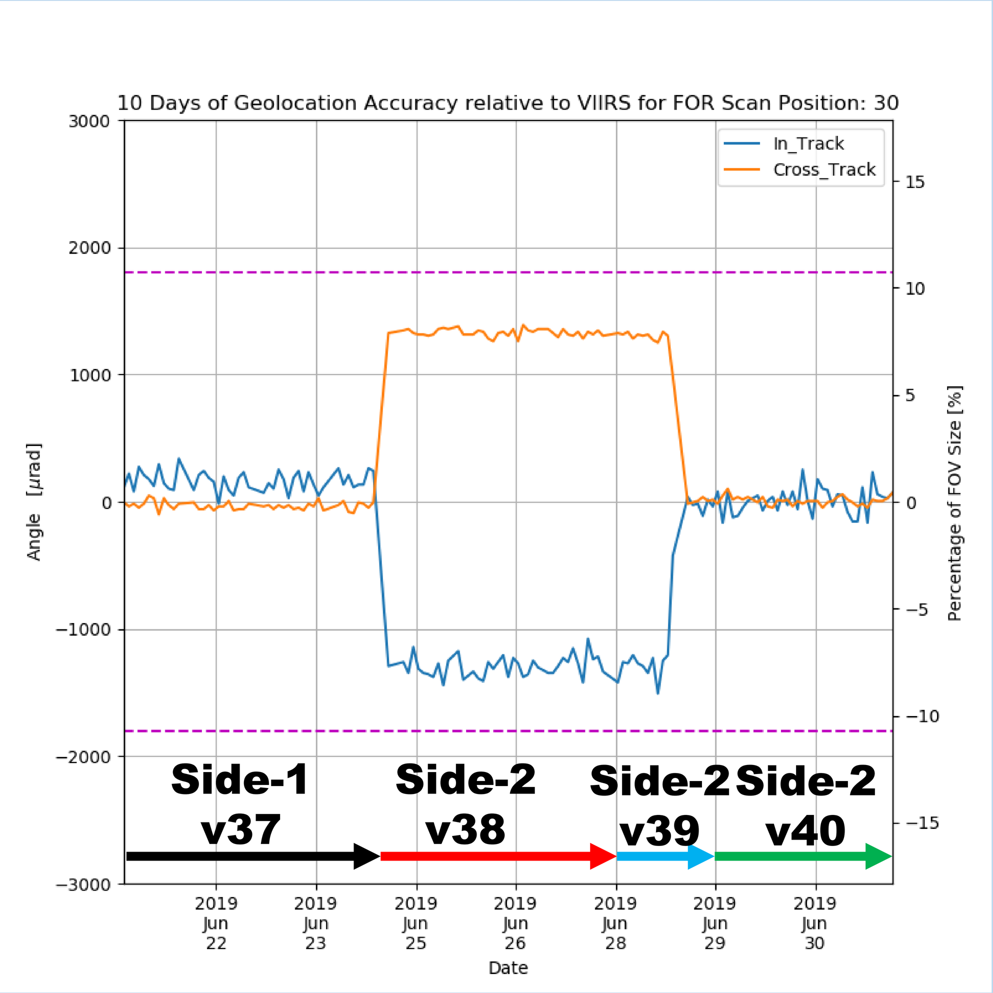
Field of Regard 1



Field of Regard 15

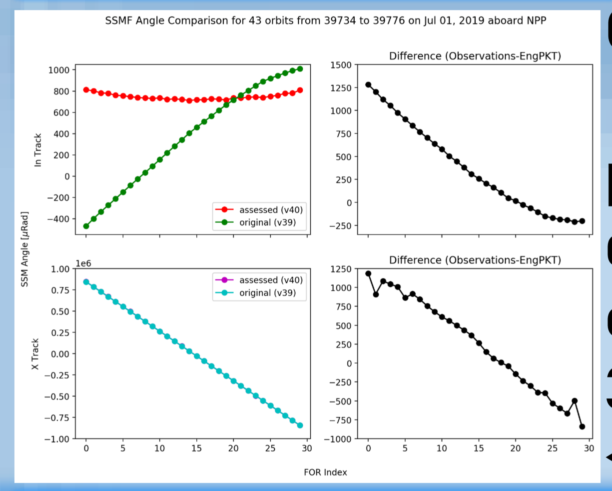


Field of Regard 30



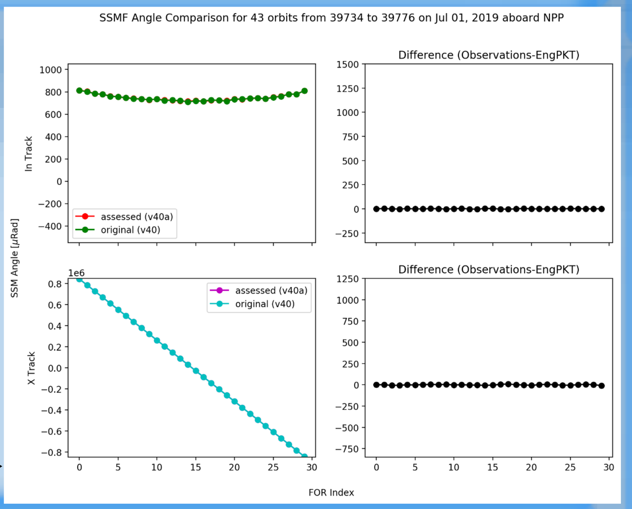
On March 26, 2019, S-NPP CrIS suffered a hardware failure on side 1 of its electronics board that ceased the collection of mid-wave IR data. After a data gap of almost 3 months, the instrument was switched to side 2 of its electronics board on June 24, 2019. Because the geometry of side 2 had never undergone post-launch calibration before, the geolocation worsened considerably after the switch to side 2. Soon thereafter, new calibration parameters were derived by ICVS and uploaded to the instrument, which led to a dramatic improvement of the geolocation accuracy across all FORs. For further information, please visit https://www.star.nesdis.noaa.gov/icvs/status_NPP_CrIS.php

Deriving Mapping Angles for EngPkt v40 after switching electronic board sides



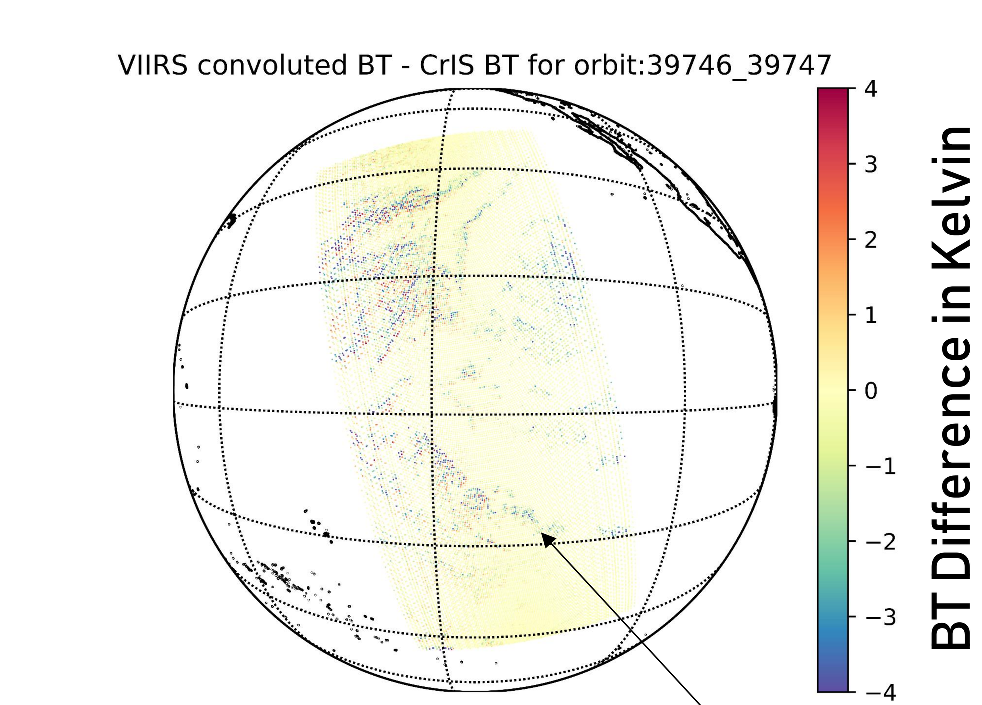
CrIS granules with updated instrument line shape (ILS) parameters were used to derive new mapping angle calibration parameters using 3 days' data after the switch

<---Before (v39) After(v40)--->

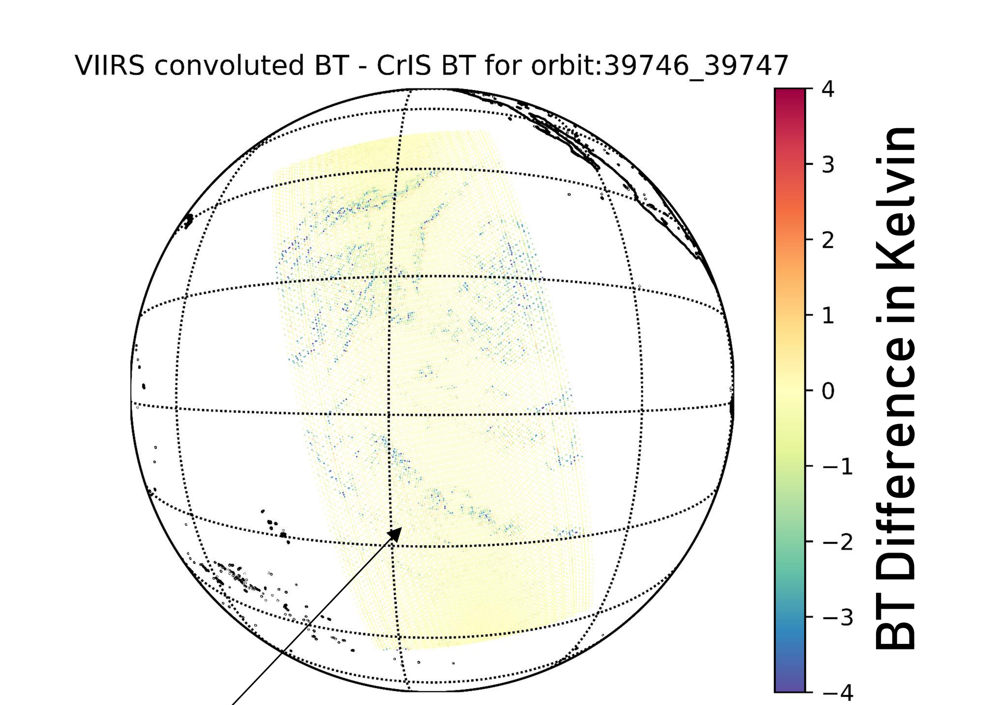


Difference between VIIRS convolution & CrIS observations

Before Deriving New Mapping Parameters (EP v39)



After Deriving New Mapping Parameters (EP v40)



Regions with large BT differences have been greatly reduced. Major differences occur over cloudy areas

Summary and Acknowledgement

1. CrIS Geolocation accuracy is low and stable on board both NOAA-20 and S-NPP
2. Accurate geolocation was reestablished quickly after switching circuit board sides in June 2019

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[1]Wang, L., et al., 2016: Fast and Accurate Collocation of the Visible Infrared Imaging Radiometer Suite Measurements with Cross-Track Infrared Sounder. Remote Sensing, 8, 76, doi:10.3390/rs8010076. http://dx.doi.org/10.3390/rs8010076.

[2]Wang, L., et al., 2013: Geolocation assessment for CrIS sensor data records. Journal of Geophysical Research: Atmospheres, 118, 12,690-12,704, doi:10.1002/2013jd020376. http://dx.doi.org/10.1002/2013JD020376