Status and initial science results based on use of
the VIIRS+CrIS fusion radiance product

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CERES Science Team Meeting
September 16, 2020
Remote Sensing Special Issue

Title: Analysis of Decadal-Scale Continuous Data Products from Weather Satellite Platforms

Goals:
- clearly document, at a minimum, Terra/Aqua/S-NPP+ continuity products
- summarize key findings, algorithms, uncertainties, etc.
- currently 8 papers published (4 from CERES); 2 more in review

Guest editors: Bryan Baum; Ping Yang; Hartwig Deneke

Relevant details:
- New papers accepted until end of 2020
- No page limit
- Papers will be published as soon as they complete the review process
- Review process moves very quickly; be prepared for this
- Cost is 1800 Swiss francs (about $1850 USD)

https://www.mdpi.com/journal/remotesensing/special_issues/weather_satellite
Fusion Provides MODIS-like IR Channels for VIIRS

CrIS Radiances \((W \text{ m}^{-2} \text{ str}^{-1} \mu \text{m}^{-1})\)

Fusion Radiances \((W \text{ m}^{-2} \text{ str}^{-1} \mu \text{m}^{-1})\)

6.7-\(\mu\)m
MODIS Band 27

Fusion is provided for full VIIRS swath at M-band resolution (750m)

13.3-\(\mu\)m
MODIS Band 33
Fusion products (V1) are now operational for both S-NPP and NOAA-20:
Search for “VIIRS CrIS data fusion”

The relevant Aqua MODIS-like IR radiance channels (MODIS channels 23, 24, 25, 27, 28, 30, 31, 32, 33, 34, 35, 36) are provided in a VIIRS Level 2 granule (NetCDF4).

Additionally, VIIRS (measured – fusion) brightness temperature differences are included for VIIRS M15 and M16 → Necessary for Optimal Estimation methods.

**The VIIRS+CrIS Fusion product page (overview/documentation):**

**Direct access to the S-NPP VIIRS+CrIS fusion product archive:**
https://ladsweb.modaps.eosdis.nasa.gov/archive/allData/5110/FSNRAD_L2_VIIRS_CRIS_SNPP

**Direct access to the NOAA-20 VIIRS+CrIS fusion product archive:**
https://ladsweb.modaps.eosdis.nasa.gov/archive/allData/5110/FSNRAD_L2_VIIRS_CRIS_NOAA20
Suomi-NPP ACHA – CALIPSO comparisons for ice cloud heights

No fusion: 8.5, 11, 12 µm. With fusion: 8.5, 11, 12 & 13.3 µm

Zonal averages of S-NPP CTH differences (VIIRS-CALIOP) for ice clouds

No fusion: 8.5, 11, 12 µm. With fusion: 8.5, 11, 12 & 13.3 µm

Figure from Li et al. (2020)
Figure from Borbas, Weisz, Moeller, Menzel, and Baum: Improvement in tropospheric moisture retrievals from VIIRS through the use of infrared absorption bands constructed from VIIRS and CrIS data fusion. In review, Atmos. Meas. Tech. Disc., https://doi.org/10.5194/amt-2020-248.

TPW from fusion is in line with Aqua MODIS product.
VIIRS+CrIS Product Availability

1. VIIRS Warm-Up, Cool-Down calibration periods present the greatest loss of fusion product (more to follow on this)

2. Otherwise, loss of fusion product appears to be due to the unavailability of VIIRS granules that were not present in the Atmosphere SIPS archive at the time of production. We are looking into backfilling the gaps.

3. Missing CrIS granules are not an issue but note the loss of the MWIR data (water vapor bands) on S-NPP between March 26 at 18:27 UTC – June 6, 2019. We were able to construct the other MODIS-like channels during this period (MODIS bands 23-25, 30, 33-36).
Fusion Product Latency
Product generation to confirmed delivery at LAADS

Snapshot for June, July, August 2020

<table>
<thead>
<tr>
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<th>Production Latency (Hrs)</th>
<th>Uploaded Delivery Latency (Hrs)</th>
<th>Confirmed Delivery (Hrs)</th>
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<tbody>
<tr>
<td></td>
<td>SNPP</td>
<td>NOAA-20</td>
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Delivery to LAADS occurs right after production

~ 20 minutes after the SIPS creates a granule, LAADS has it

~ 20 minutes after LAADS has a granule, it’s available in CMR (common metadata repository)

Delivery times are fairly consistent from month to month
### NOAA-20 Fusion Production Stats

For NOAA-20: the failure rate is \(\sim 0.1\%\).

Appears to be a WUCD period in March 2018; maybe another in February 2018 after VIIRS just became operational.

We are investigating the occasional loss of fusion granules in the record.

Just learned that the A-SIPS periodically checks with the Land SIPS to fill in gaps.
### S-NPP Fusion Production Stats

For Suomi-NPP: the failure rate is < 2% since 2012.

Primary cause of missing fusion granules corresponds with periodic VIIRS Warm-Up, Cool-Down (WUCD) calibration maneuver.
Primary cause of missing fusion granules corresponds with periodic VIIRS Warm-Up, Cool-Down (WUCD) calibration maneuver.

Current focus for testing is on June 2016, the worst month of coverage in the S-NPP record.
Quicklook Granule Viewer: S-NPP VIIRS true color
Atmosphere SIPS (https://sips.ssec.wisc.edu/) → Products → Quicklooks
Quicklook Granule Viewer: NOAA-20 VIIRS 6.7-µm Fusion Channel Daytime

September 1, 2020
Worldview: Compare Fusion to Aqua MODIS
September 9, 2020; Band 27 (6.7 µm); Night
Summary

The full records of the fusion product S-NPP and NOAA-20 are now available at the NASA LAADS DAAC:

The relevant Aqua MODIS-like IR radiance channels (MODIS channels 23-25, 27, 28, 30–36) are provided in a VIIRS Level 2 granule (NetCDF4).

Also provide brightness temperature differences (VIIRS – VIIRS fusion) for M-bands 15 and 16 (split window); useful for uncertainty estimates

The VIIRS L2 granule is 6 minutes; very similar format to Level-1B

Now working on Version 2:
- latest VIIRS & CrIS calibration
- filling in data gaps as much as possible
- improving methodology