# OMPS J01 SDR Algorithm Implementation

*OMPS-TC-SDR and OMPS-NP-SDR*
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# Outline

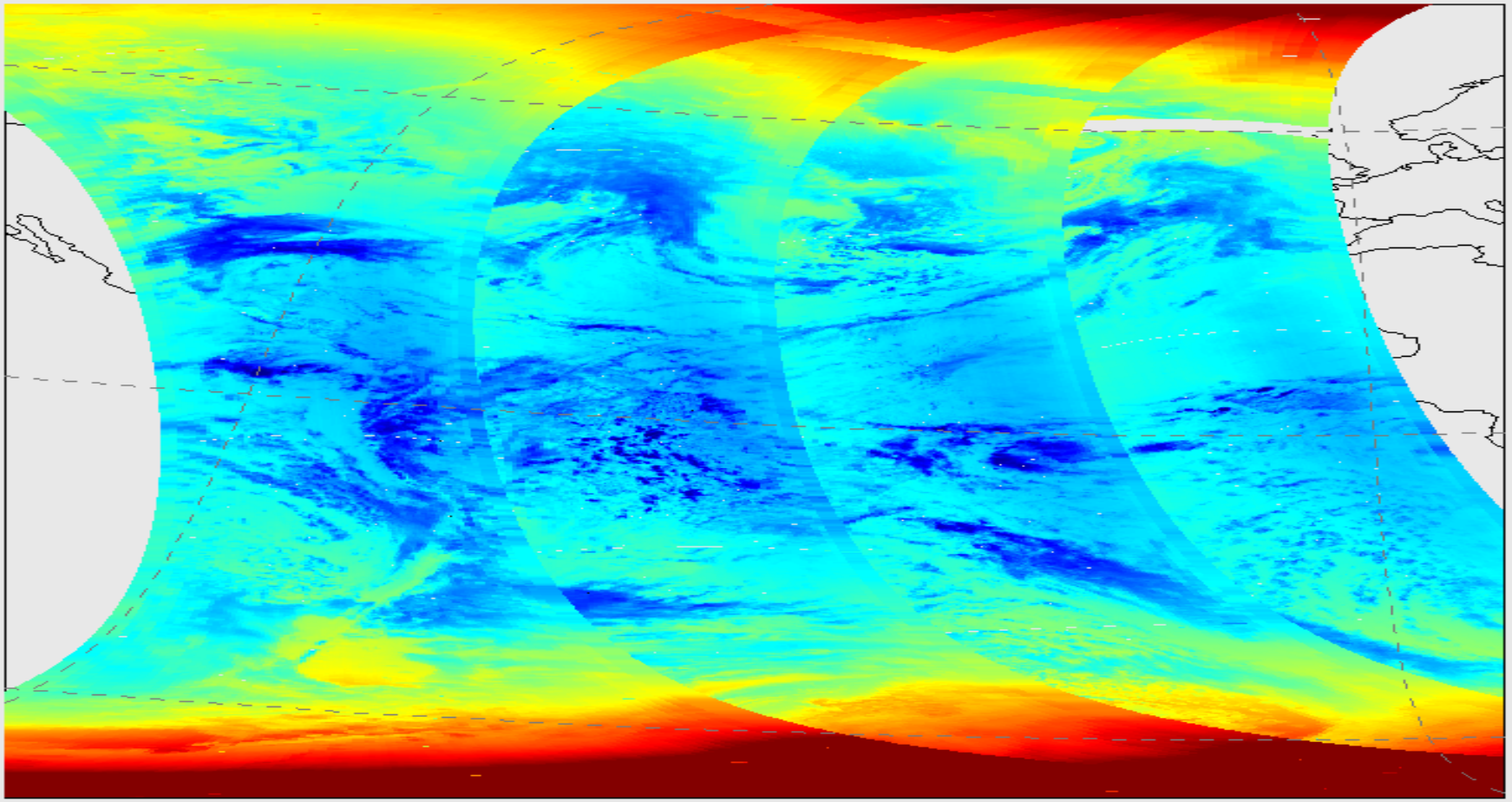
- NOAA STAR responsible to provide updates for IDPS SDR processor to handle JPSS1 OMPS for TC and NP
- JPSS1 OMPS has significant changes in the RDR format, primarily Rice compression of instrument counts.
- Star developed code updates for TC and NP SDR using ADL.
- The SDR processor has been implemented and passed important tests using J01 proxy data and J01 electronics test data.
- Backward compatible with NPP is required: One executable handles both NPP and J01
- This work has three broad components:
  1) Understanding the J01 RDR format and test data
  2) NP SDR Changes: 5x5, new tables, spacecraft ID
  3) TC SDR specific changes: sparse spectral, aggregation, new tables

- Summary of results and methods.

# J01 TC-SDR Updates

- New APID values.
- Updated image/engineering headers for FSW6
- Rice Decompression on instrument counts
- Pixel aggregation, temporal and spatial.
- Updated straylight algorithm to handle sparse spectral
- J01 GroundPi and LUTs ( work in Progress)
- Wavelength table improvement using thermal model.
- 13 orbits medium resolution TC-RDR tested
- 13 orbits high resolution TC-RDR tested.

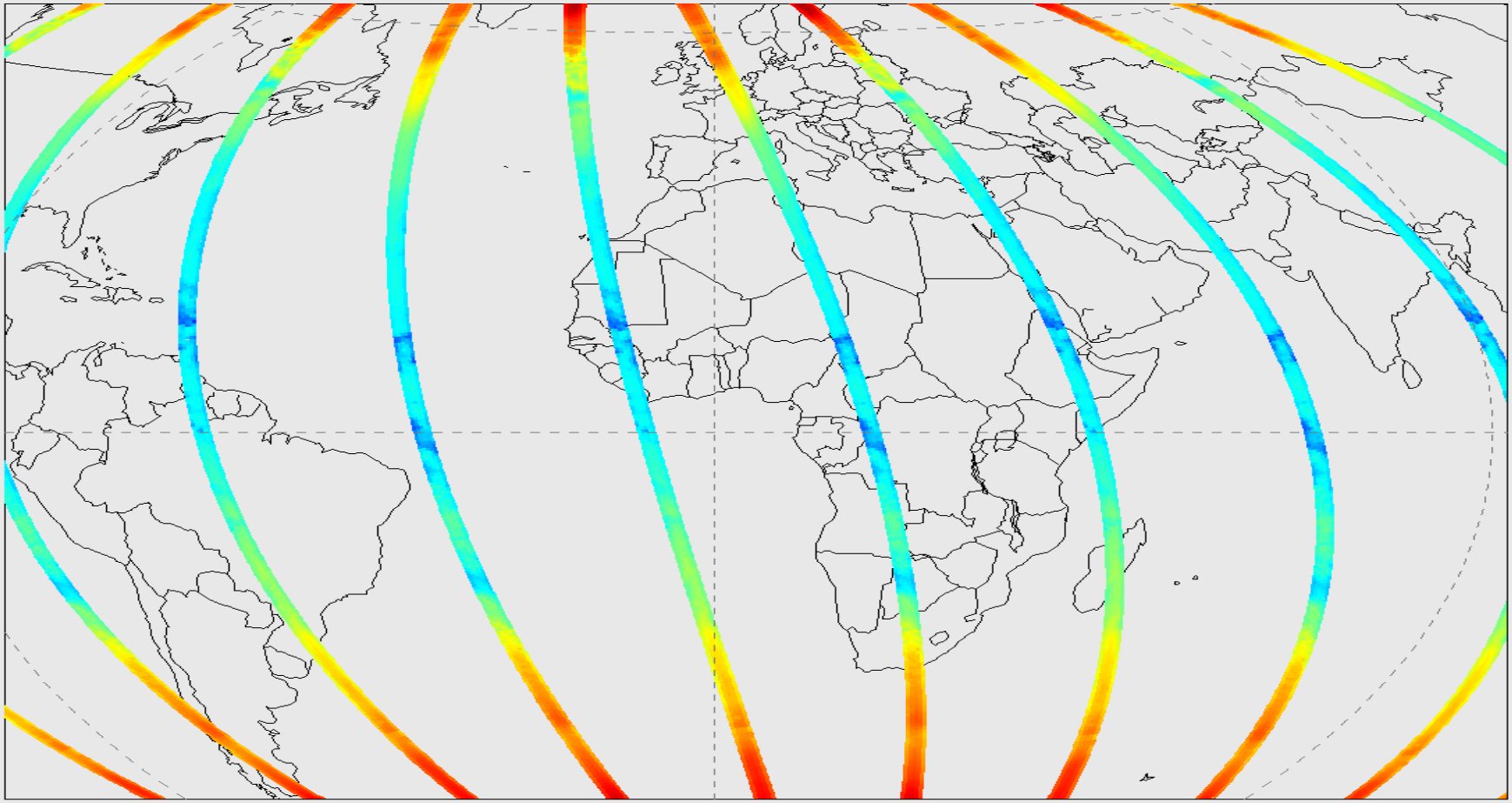
# 103 x 15 TC SDR Radiance



# J01 NP-SDR Updates

- New APID values.
- Updated image/engineering headers for FSW6
- Rice Decompression on instrument counts
- J01 GroundPi and LUTs ( work in Progress)
- 13 orbits medium resolution NP-RDR (NPP Proxy)
- 13 orbits medium resolution NP-RDR (BBMEB)

# NP-SDR 5x5 Radiance



# OMPS RDR Format Change

- J01 OMPS will use FSW6.0( Flight SoftWare 6.0).
- FSW6.0 introduces compressed instrument counts using Rice Compression( SZIP2.1).
- Image/engineering headers very similar but code to parse them needs to be updated.
- FSW6 introduces at least 14 new APIDs,  two existing APID values have a modified format.
- Eight of the new APID will not be implemented in ADL/IDPS.

| Version | APID | J01 | Compression |
|---|---|---|---|
| FSW 3.6 | 560 TC-RDR | | |
| FSW6.0 | 560 TC-RDR | x | NO |
| FSW6.0 | 592 TC-RDR-RF | x | NO |
| FSW6.0 | 608 TC-RDR-RF | x | YES |
| FSW6.0 | 616 TC-RDR | x | YES |

# OMPS RDR Format Change

| Version | APID | J01 | Compression |
|---|---|---|---|
| FSW 3.6 | 561 NP-RDR | | |
| FSW6.0 | 561 NP-RDR | x | NO |
| FSW6.0 | 593 NP-RDR-RF | x | NO |
| FSW6.0 | 609 NP-RDR-RF | x | YES |
| FSW6.0 | 617 NP-RDR | x | YES |

- J01 nominal RDR will be compressed
- Instrument vendor supplied documentation on how the counts were compressed
- The compression algorithm is the same as VIIRS but the implementation is simpler for OMPS, they use different compression parameters.
- Szip compression is part of the CCSDS standard.

# OMPS RDR Test Data

- NASA Test data group created 42 hour test with 26 orbits useful for developing J1 OMPS capability in the IDPS SDR processor.
- First task: create a J1 RDR reader to find out what is in the data.
- High level summary of the test datasets used

| Description | NmacroPixel | Spectral x Spatial | nTimes | Source |
|---|---|---|---|---|
| TC RDR MedRes | 10042 | 61 x 156 | 30 | NPP |
| TC RDR HiRes | 30870 | 147 x 208 | 30 | J1 Electronics |
| NP RDR MedRes | 894 | 147 x 5 | 5 | NPP |
| NP RDR MedRes | 942 | 157 x 5 | 5 | J1 Electronics |

# OMPS-RDR Test dataset Cont'd

- Two source of test data:  NPP measured or BBMEB in lab prototype with J1 electronics
- TC has medium spatial resolution and high spatial resolution.
- Data was supplied in both compressed and uncompressed formats.
- TC data uses a timing pattern of 30 scans per 37 second granule.  Current NPP TC-RDR uses 5 scans per 37 seconds granule.
- NP data uses a timing pattern of 5 scans per 37 second granule.

# TC Med Res/Hi Res in IDPS

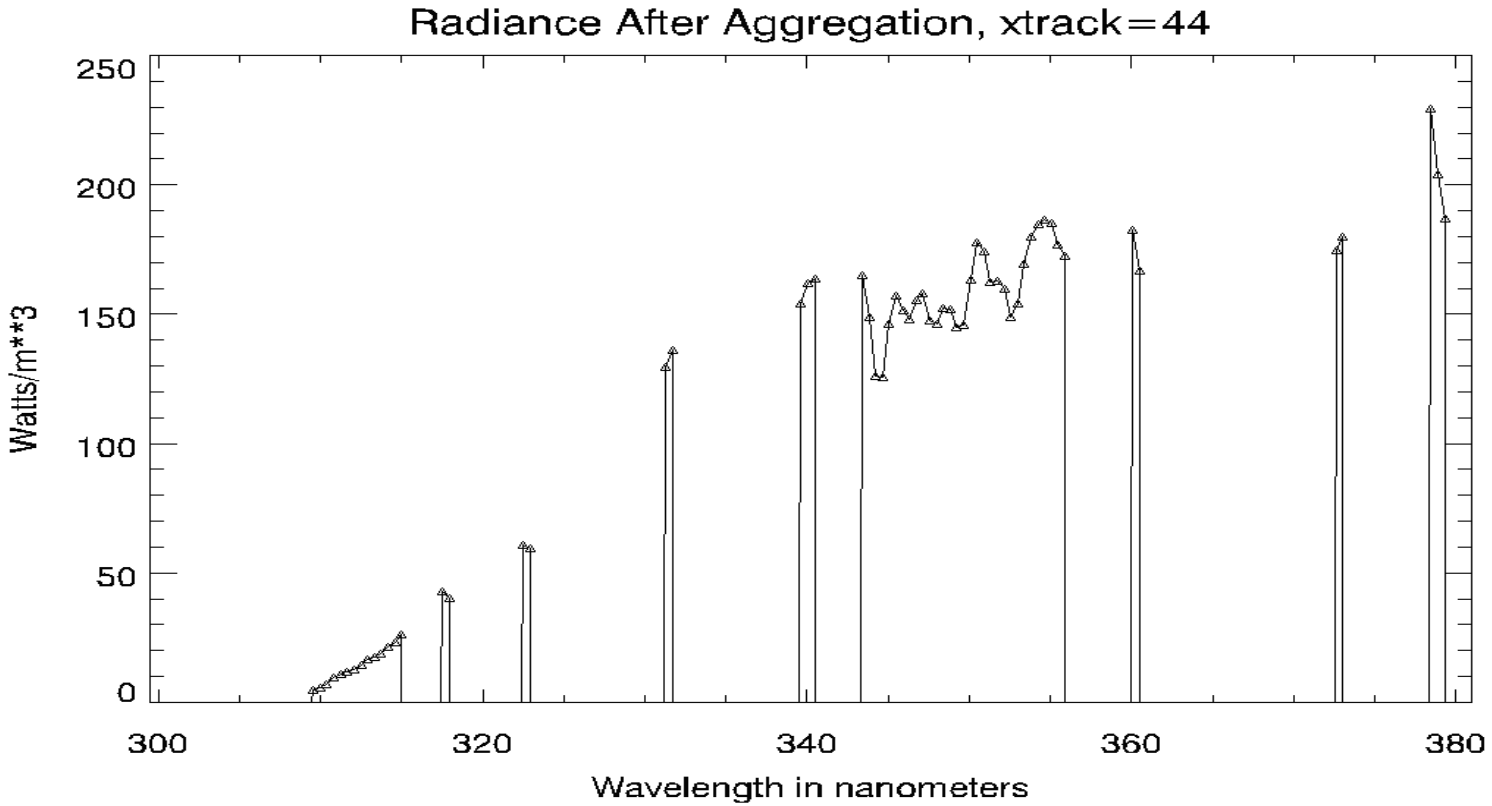
- OMPS TC SDR in IDPS has a size restriction of 260 wavelengths by 15 scans along track by 105 cross track pixels. Both OMPS J01 spatial dimensions are expected to exceed this limit in the nominal earthview mode.
- NASA PEATE proposed a solution using pixel aggregation.
- Along track pixels will be temporally aggregated to reduce spatial resolution.
- Across track pixels will be aggregated to fit within the 105 spatial limit.
- NASA PEATE supplied demonstration code and NOAA STAR implemented and tested it in the ADL/IDPS framework.
- Pixel aggregation is done in units of counts. It occurs as part of the VerifiedRDR creation. Pixels are aggregated and geolocation is established prior to the SDR science code.

# TC Med Res/Hi Res in IDPS

- In the current J01 Block2 SDR implementation the TC-RDR temporal aggregation takes 30 scans per granule and aggregates to 15 scans per granule, it effectively doubles the ground pixel size in the along track dimension.
- The across track dimension is aggregated to 103 spatial pixels. Both high resolution mode and medium resolution TC earthview modes will be aggregated to 103 spatial cross track by 15 along track.
- The NP SDR processor will not have spatial aggregation, it fits within the existing 5 scans by 5 across track size limit defined by the IDPS.

# TC-SDR Sparse Spectral

- A new feature of the J01 TC-SDR is the sparse spectral coverage. There will be groups of measurements that will not be downlinked to ground.
- The straylight algorithm was updated to work with sparse spectral measurements.
- The following image shows the SDR radiance for a sparse spectral case, there are eight spectral gaps.
- Test data has 61 measurement wavelengths.



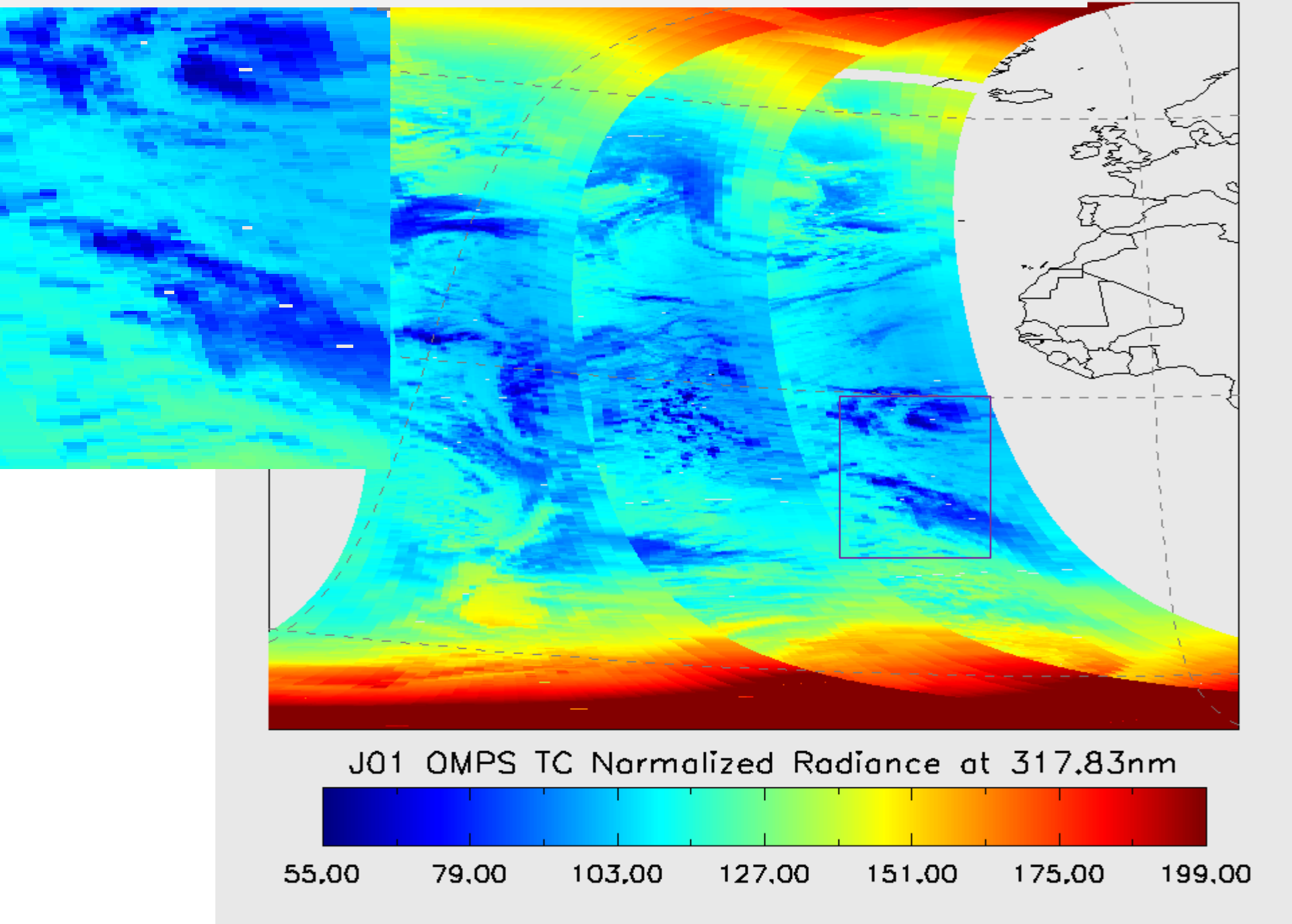
# Sparse Spectral for TC

- Our medium resolution test data has 61 wavelengths. The aggregation maps the 61 values onto the full spectral range of 364 wavelengths.
- This allows the RDR to limit spectral coverage in order to increase spatial resolution.
- Sparse spectral is handled as part of the spatial aggregation algorithm. The sample table and macro tables will double in size relative to the NPP SDR tables. The dual tables have an input component that describes the where the measurements originate on the CCD detector. The output component of the dual table describes where the pixels will map to on the CCD detector.
- At runtime the dual tables control how the pixel aggregation is performed.
- There is a timing pattern dual table that controls how the temporal pixel aggregation.
- In summary there are three dual tables that control pixel aggregation:
  - OMPS-TC-TIMINGPATTERN-GND-PI
  - OMPS-TC-MACROTABLE-GND-PI
  - OMPS-TC-SAMPLETABLE-EV-GND-PI

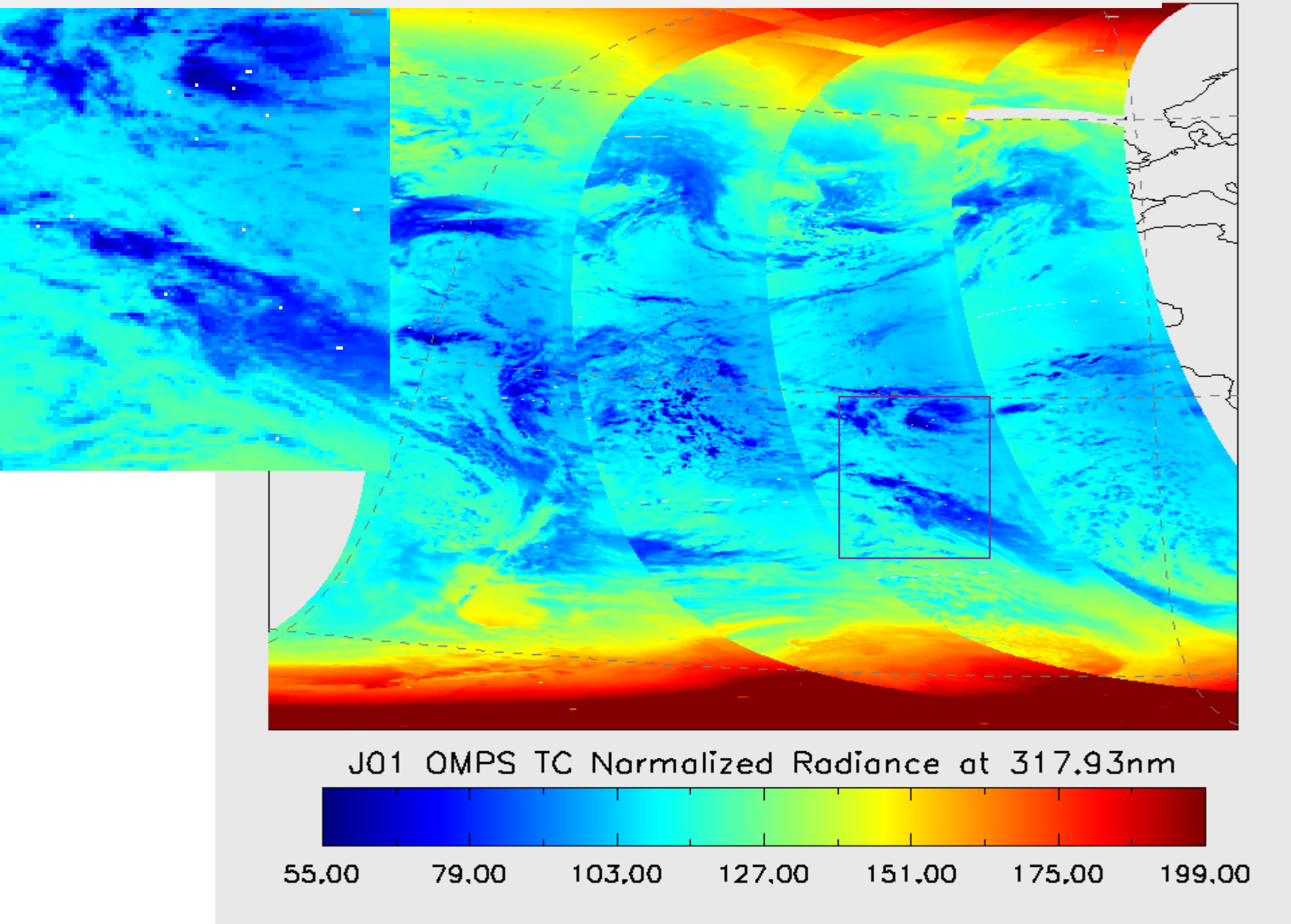
# J1 Ground Pixel Resolution

- NP SDR goes from 1 pixel per granule to 25 pixels per granule
- TC SDR goes from 35x5 ground pixels per granule to 103x15( from 175 ground pixels to 1545 ground pixels per granule)
- Following slides demonstrate qualitative increase in spatial resolution for TC-SDR. In the next slide the TC-SDR has been aggregated to 35 x 5. The subsequent slide is aggregated to 103 x 15.

Three orbits with current low resolution 35 cross-track x 5 along-track FOVs.



Four orbits with current medium resolution 103 cross-track x 15 along-track FOVs.



# Summary

- NOAA STAR worked in collaboration with multiple partners to develop and implement the JPSS1 OMPS TC and NP SDR processor.

- The NASA Peate provided the initial aggregation algorithm. BATC provided us the necessary documentation to understand the format. Raytheon helped implement the changes for ADL/IDPS. Star AIT assisted with testing and code deliveries.

- Algorithm readiness review in September.

- J01 SDR algorithm is ready for both TC and NP
  - Algorithm has been Tested for software validation and a limited amount of geophysical validation
  - Delivered to DPES for further operational testing
  - Currently in block2 integration

Path Forward

- We are working to further test and verify the algorithm lookup tables
- End-to-end RDR to EDR test in progress.