# The same three tests were repeated for four cases. In the first two cases, software packages were reporting values for the statistical min, max, mean, std\_dev while the metadata within the file were reporting missing values. In the third case, the statistical min resulted in different values when calculated versus when reported from the metadata within the file. Finally, a good match between the statistical and metadata stats were compared with the same tests applied to verify that the methods which diagnosed the bad data don’t alter the results.

# In cases one, two, and three the calculated and metadata values only matched well after a DQF mask was applied. In case four, the DQF did not significantly alter data that was already matching fairly well.

# Conclusion: The user cannot rely on metadata alone to screen for bad pixels, the DQF must be used in combination with knowledge from the metadata.

# Summary of Row 832 in Excel File, corresponding CMI\_C04 in

# OR\_ABI-L2-MCMIPM2-M3\_G16\_s20170610635274\_e20170610635337\_c20170610635421.nc

The inconsistent statistical results between the metadata and other software packages are due to the fact that all DQF values indicate the data is bad. However, there are pixels within the data which are within a valid range. Every software package must use a DQF mask in addition to the metadata attributes to determine valid pixels before display or calculation.

## First Check

Row 832:

McIDAS-V derived Stats C04

2017-03-02T06:35:27.4Z

mean: 1.42E-06

min: 0

max: 0.016605601

std\_dev: 4.83E-05

Meta Data Reported Stats C04

mean: ‘nan’

min: ‘nan’

max: ‘nan’

std\_dev: ‘nan’

The presence of ‘nan’ values in the metadata were verified by ncdump and toolsUI.

## Second Check

The file was run in glance and the McIDAS-V values were verified.

## Third Check

Is it possible that all values fall outside of the valid range?

The valid range was calculated from the meta data

short CMI\_**C04**(y, x) ;

 CMI\_**C04**:\_FillValue = -1s ;

 CMI\_**C04**:long\_name = "ABI Cloud and Moisture Imagery reflectance factor" ;

 CMI\_**C04**:standard\_name = "toa\_lambertian\_equivalent\_albedo\_multiplied\_by\_cosine\_solar\_zenith\_angle" ;

 CMI\_**C04**:\_Unsigned = "true" ;

 CMI\_**C04**:sensor\_band\_bit\_depth = 11b ;

 CMI\_**C04**:valid\_range = 0s, 4095s ;

 CMI\_**C04**:scale\_factor = 0.0002442f ;

 CMI\_**C04**:add\_offset = 0.f ;

 CMI\_**C04**:units = "1" ;

 CMI\_**C04**:resolution = "y: 0.000056 rad x: 0.000056 rad" ;

 CMI\_**C04**:coordinates = "band\_id\_**C04** band\_wavelength\_**C04** t y x" ;

 CMI\_**C04**:grid\_mapping = "goes\_imager\_projection" ;

 CMI\_**C04**:cell\_methods = "t: point area: point" ;

 CMI\_**C04**:ancillary\_variables = "DQF\_**C04**" ;

# calculate valid\_range with valid\_range = (valid\_range \* scale\_factor) + add\_offset

* valid\_range\_min = (0 \* 0.0002442) + 0
* valid\_range\_max = (4095 \* 0.0002442) + 0
* print valid\_range\_min,valid\_range\_max

 Returns: 0.0 0.999999

# Does the data fall outside that range?

thisDataInRange=maskWithinRange(thisData,valid\_range\_min, valid\_range\_max, 1)\*thisData

# Get Statistics of new Field

print describe(thisDataInRange)

Min       :  7.326000e-04 Max       :  0.01661 Range     :  0.01587 Q1        :  7.326000e-04 Q2        :  7.326000e-04 Q3        :  7.326000e-04 IQR       :  0.00 Mean      :  7.975000e-04 Mode      :  7.326000e-04 Kurtosis  :  310.70 Skewness  :  16.85 Std Dev   :  8.248765e-04 Variance  :  6.804212e-07

# How Many good points?

stats2=Statistics(thisDataInRange)

stats2.getNumGoodPoints()

Result: 444

## Fourth Check

# What are the DQF values?

dqf=loadGrid(field='DQF\_C04', \*\*parms)

Length    :  250000 Min       :  2.000 Max       :  2.000 Range     :  0.00 Q1        :  2.000 Q2        :  2.000 Q3        :  2.000 IQR       :  0.00 Mean      :  2.000 Mode      :  2.000 Kurtosis  :  NaN Skewness  :  NaN Std Dev   :  0.00 Variance  :  0.00

# the DQF values are uniformly 2. For complete conviction, mask the values which are not good (keep the values which are good…when good points are flagged by 0).

dqf\_mask=mask(dqf, '==', 0, 1)

# Verify that when CMI is masked by dqf, all values are missing.

print describe(dqf\_mask\*thisData)

Min       :  NaN Max       :  NaN Range     :  NaN Q1        :  NaN Q2        :  NaN Q3        :  NaN IQR       :  NaN Mean      :  NaN Mode      :   Kurtosis  :  NaN Skewness  :  NaN Std Dev   :  NaN Variance  :  NaN

# Summary of Row 1080 in Excel File, corresponding to field CMI\_C05 in

# OR\_ABI-L2-MCMIPM2-M3\_G16\_s20170610635274\_e20170610635337\_c20170610635421.nc

The case is the same as for file CMI\_C04

# Summary of Row 1493 in Excel File, corresponding to field CMI\_C07 in

# OR\_ABI-L2-MCMIPM2-M3\_G16\_s20170610740274\_e20170610740331\_c20170610740413.nc

In this case, the statistics between the software and the metadata are very close, except in the case of the min value, where the difference is greater than 25 degrees K. Upon further inspection, 6 pixel values lie outside the valid range identified in the metadata. If the DQF mask is applied, the software statistics match the metadata statistics.

McIDAS-V derived Stats C07

2017-03-02T07:40:27.4Z

mean: 279.3804519

min: 173.1499939

max: 298.102356

std\_dev: 20.63277315

Meta Data Reported Stats C07

mean: 279.4759216

min: 197.3052826

max: 298.0997314

std\_dev: 20.47908783

with DQF applied…

Length    :  250000 Min       :  197.30 Max       :  298.10 Range     :  100.80 Q1        :  267.36 Q2        :  288.92 Q3        :  294.81 IQR       :  27.44 Mean      :  279.48 Mode      :  295.90 Kurtosis  :  1.586 Skewness  :  -1.481 Std Dev   :  20.48 Variance  :  419.40

# Summary of Row 1164 in Excel File, corresponding to field CMI\_C05 in

This case represents a case where the metadata and calculated values were consistent. This case checks to see if the DQF undesirably alters the match. While the mean produces a slightly larger difference, it is a small increase.

# OR\_ABI-L2-MCMIPM2-M3\_G16\_s20170612252274\_e20170612252343\_c20170612252554.nc

McIDAS-V derived Stats C05

2017-03-02T22:52:27.4Z

mean: 0.038645477

min: 0

max: 0.32747221

std\_dev: 0.022830068

Meta Data Reported Stats C05

mean: 0.0386547

min: 7.55E-05

max: 0.332327694

std\_dev: 0.022794301

After DQF mask is applied

Min       :  0.00 Max       :  0.32747 Range     :  0.32747 Q1        :  0.02295 Q2        :  0.03394 Q3        :  0.04835 IQR       :  0.02540 Mean      :  0.03868 Mode      :  0.02784 Kurtosis  :  5.255 Skewness  :  1.631 Std Dev   :  0.02281 Variance  :  5.204644e-04